VISHAY INTERTECHNOLOGY, INC.

INTERACTIVE data book

INFRARED EMITTERS AND DETECTORS

VISHAY SEMICONDUCTORS

VSE-DB0103-0810

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One of the World's Largest Manufacturers of
Discrete Semiconductors and Passive Components

VISHAY INTERTECHNOLOGY, INC.

INFRARED EMITTERS AND DETECTORS

VISHAY SEMICONDUCTORS

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SEMICONDUCTORS

RECTIFIERS

Schottky (single, dual)
Standard, Fast, and Ultra-Fast Recovery (single, dual)
Bridge
Superectifier®
Sinterglass Avalanche Diodes

HIGH-POWER DIODES AND THYRISTORS

High-Power Fast-Recovery Diodes
Phase-Control Thyristors
Fast Thyristors

SMALL-SIGNAL DIODES

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Tuner/Capacitance (single, dual)
Bandswitching
PIN

ZENER AND SUPPRESSOR DIODES

Zener (single, dual)
TVS (TransZorb®, Automotive, ESD, Arrays)

FETs

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High-Voltage TrenchFET® Power MOSFETs
High-Voltage Planar MOSFETs
JFETs

OPTOELECTRONICS

IR Emitters and Detectors, and IR Receiver Modules
Optocouplers and Solid-State Relays
Optical Sensors
LEDs and 7-Segment Displays
Infrared Data Transceiver Modules
Custom Products

ICs

Power ICs
Analog Switches
RF Transmitter and Receiver Modules
ICs for Optoelectronics

MODULES

Power Modules (contain power diodes, thyristors, MOSFETs, IGBTs)
DC/DC Converters

PASSIVE COMPONENTS

RESISTIVE PRODUCTS

- Foil Resistors
- Film Resistors
  - Metal Film Resistors
  - Thin Film Resistors
  - Thick Film Resistors
  - Metal Oxide Film Resistors
  - Carbon Film Resistors
- Wirewound Resistors
- Power Metal Strip® Resistors
- Chip Fuses
- Variable Resistors
  - Cermet Variable Resistors
  - Wirewound Variable Resistors
  - Conductive Plastic Variable Resistors
- Networks/Arrays
- Non-linear Resistors
  - NTC Thermistors
  - PTC Thermistors
  - Varistors

MAGNETICS

Inductors
Transformers

CAPACITORS

- Tantalum Capacitors
  - Molded Chip Tantalum Capacitors
  - Coated Chip Tantalum Capacitors
  - Solid Through-Hole Tantalum Capacitors
  - Wet Tantalum Capacitors
- Ceramic Capacitors
  - Multilayer Chip Capacitors
  - Disc Capacitors
- Film Capacitors
- Power Capacitors
- Heavy-Current Capacitors
- Aluminum Capacitors
- Silicon RF Capacitors

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Infrared Emitters and Detectors Data Book

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OZONE DEPLETING SUBSTANCES POLICY STATEMENT

It is the policy of Vishay Semiconductor GmbH to

1. Meet all present and future national and international statutory requirements.
2. Regularly and continuously improve the performance of our products, processes, distribution and operating systems with respect to their impact on the health and safety of our employees and the public, as well as their impact on the environment.

It is particular concern to control or eliminate releases of those substances into the atmosphere which are known as ozone depleting substances (ODSs).

The Montreal Protocol (1987) and its London Amendments (1990) intend to severely restrict the use of ODSs and forbid their use within the next ten years. Various national and international initiatives are pressing for an earlier ban on these substances.

Vishay Semiconductor GmbH has been able to use its policy of continuous improvements to eliminate the use of ODSs listed in the following documents.

1. Annex A, B and list of transitional substances of the Montreal Protocol and the London Amendments respectively
2. Class I and II ozone depleting substances in the Clean Air Act Amendments of 1990 by the Environmental Protection Agency (EPA) in the USA
3. Council Decision 88/540/EEC and 91/690/EEC Annex A, B and C (transitional substances) respectively.

Vishay Semiconductor GmbH can certify that our semiconductors are not manufactured with ozone depleting substances and do not contain such substances.

Infrared Emitters and Detectors

DATASHEETS PHOTO DETECTORS

GLOSSARY

Selector Guide

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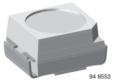
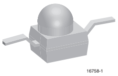
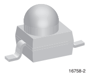
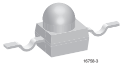
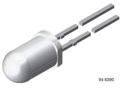
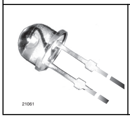
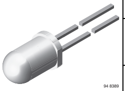
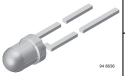
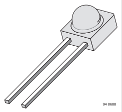
Selector Guide

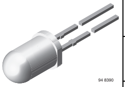
HIGH SPEED INFRARED EMITTERS, 830 nm TO 950 nm, GaAlAs DOUBLE HETERO

	PART NUMBER	ANGLE ± φ (°)	RADIANT INTENSITY I_e (mW/sr)	FORWARD VOLTAGE V_F (V)	TEST CONDITION at I_F (mA)	RISE TIME t_r (ns)	REMARKS	PAGE
SMD, PLCC-2								
	VSMF3710	60	6 to 22	1.4 (< 1.6)	100	30	890 nm, SMD, clear epoxy	292
	VSMF4710	60	6 to 22	1.5 (< 1.8)	100	15	870 nm, SMD, clear epoxy	297
	VSMF4720	60	10 to 30	1.45 (< 1.6)	100	15	870 nm, SMD, clear epoxy	302
	VSMG2700	60	6 to 22	1.5 (< 1.8)	100	20	830 nm, SMD, clear epoxy, for CMOS camera illumination	307
	VSMG3700	60	6 to 22	1.5 (< 1.8)	100	20	850 nm, SMD, clear epoxy, for CMOS camera illumination	312
SMD, dome, clear epoxy								
	TSMF1000	17	5	1.3 (< 1.5)	20	30	890 nm, SMD, clear mold compound	224
	TSMF1020	17	5	1.3 (< 1.5)	20	30	890 nm, SMD, clear mold compound	224
	TSMF1030	17	5	1.3 (< 1.5)	20	30	890 nm, SMD, clear mold compound	224
5 mm, T-1¾, leads with stand-off, clear epoxy								
	TSFF5210	10	120 to 360	1.5 (< 1.8)	100	15	870 nm, stand-off, clear epoxy	131
	TSFF5410	22	45 to 135	1.5 (< 1.8)	100	15	870 nm, stand-off, clear epoxy	135
	TSHF5210	10	120 to 360	1.4 (< 1.6)	100	30	890 nm, stand-off, clear epoxy	175
	TSHF5410	22	45 to 135	1.4 (< 1.6)	100	30	890 nm, stand-off, clear epoxy	179
	TSHG5210	10	140 to 420	1.5 (< 1.8)	100	20	850 nm, stand-off, clear epoxy	191
	TSHG5410	18	45 to 135	1.5 (< 1.8)	100	20	850 nm, stand-off, clear epoxy	195
5 mm, T-1¾, leads with stand-off, clear epoxy								
	TSFF5510	38	16 to 48	1.3 to 1.7	100	15	870 nm, stand-off, clear epoxy	139

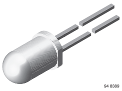
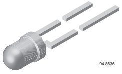
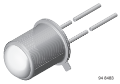
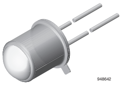
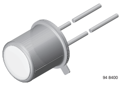
HIGH SPEED INFRARED EMITTERS, 830 nm TO 950 nm, GaAlAs DOUBLE HETERO

	PART NUMBER	ANGLE ± φ (°)	RADIANT INTENSITY I_e (mW/sr)	FORWARD VOLTAGE V_F (V)	TEST CONDITION at I_F (mA)	RISE TIME t_r (ns)	REMARKS	PAGE
5 mm, T-1¾, leads without stand-off, clear epoxy								
	TSFF6210	10	90 to 450	1.5 (< 1.8)	100	15	870 nm, clear epoxy	143
	TSHF6210	10	120 to 360	1.4 (< 1.6)	100	30	890 nm, clear epoxy	183
	TSHF6410	22	45 to 135	1.4 (< 1.6)	100	30	890 nm, clear epoxy	187
	TSHG6210	10	140 to 420	1.5 (< 1.8)	100	20	850 nm, clear epoxy	199
	TSHG6410	18	45 to 135	1.5 (< 1.8)	100	20	850 nm, clear epoxy	203
	TSHG8200	10	120 to 360	1.5 (< 1.8)	100	20	830 nm, clear epoxy	207
	TSHG8400	22	45 to 135	1.5 (< 1.8)	100	20	830 nm, clear epoxy	211
3 mm, T-1, clear epoxy								
	TSHF4410	22	40	1.5 (< 1.8)	100	30	890 nm, clear epoxy	171
	VSLB3940	22	65 (> 32)	1.35 (< 1.6)	100	15	950 nm, clear epoxy	288
Side view, 5 mm								
	TSSF4500	22	20 (> 10)	1.35 (< 1.6)	100	30	890 nm, clear epoxy	240

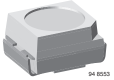
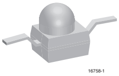
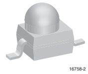
INFRARED EMITTERS, 875 nm, GaAlAs

	PART NUMBER	ANGLE ± φ (°)	RADIANT INTENSITY I_e (mW/sr)	FORWARD VOLTAGE V_F (V)	TEST CONDITION at I_F (mA)	RISE TIME t_r (ns)	REMARKS	PAGE
5 mm, T-1¾, leads with stand-off, clear epoxy								
	TSHA5200	12	40 (> 25)	1.5 (< 1.8)	100	600	Stand off, clear epoxy	151
	TSHA5201	12	50 (> 30)	1.5 (< 1.8)	100	600	Stand off, clear epoxy	151
	TSHA5202	12	60 (> 36)	1.5 (< 1.8)	100	600	Stand off, clear epoxy	151
	TSHA5203	12	65 (> 50)	1.5 (< 1.8)	100	600	Stand off, clear epoxy	151
	TSHA5500	24	20 (> 12)	1.5 (< 1.8)	100	600	Stand off, clear epoxy	156
	TSHA5501	24	25 (> 16)	1.5 (< 1.8)	100	600	Stand off, clear epoxy	156
	TSHA5502	24	30 (> 20)	1.5 (< 1.8)	100	600	Stand off, clear epoxy	156
	TSHA5503	24	35 (> 24)	1.5 (< 1.8)	100	600	Stand off, clear epoxy	156

INFRARED EMITTERS, 875 nm, GaAlAs

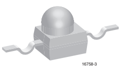
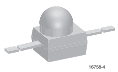
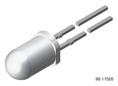
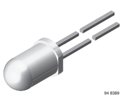
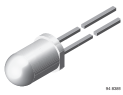
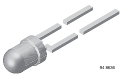
	PART NUMBER	ANGLE ± φ (°)	RADIANT INTENSITY I_e (mW/sr)	FORWARD VOLTAGE V_F (V)	TEST CONDITION at I_F (mA)	RISE TIME t_r (ns)	REMARKS	PAGE
5 mm, T-1¾, leads without stand-off, clear epoxy								
	TSHA6200	12	40 (> 25)	1.5 (< 1.8)	100	600	Clear epoxy	161
	TSHA6201	12	50 (> 30)	1.5 (< 1.8)	100	600	Clear epoxy	161
	TSHA6202	12	60 (> 36)	1.5 (< 1.8)	100	600	Clear epoxy	161
	TSHA6203	12	65 (> 50)	1.5 (< 1.8)	100	600	Clear epoxy	161
	TSHA6500	24	20 (> 12)	1.5 (< 1.8)	100	600	Clear epoxy	166
	TSHA6501	24	25 (> 16)	1.5 (< 1.8)	100	600	Clear epoxy	166
	TSHA6502	24	30 (> 20)	1.5 (< 1.8)	100	600	Clear epoxy	166
	TSHA6503	24	35 (> 24)	1.5 (< 1.8)	100	600	Clear epoxy	166
3 mm, T-1, clear epoxy								
	TSHA4400	20	20 (> 12)	1.5 (< 1.8)	100	600	Clear epoxy	147
	TSHA4401	20	30 (> 16)	1.5 (< 1.8)	100	600	Clear epoxy	147
Metal can, TO-18								
	TSTA7100	5	50 (> 20)	1.4 (< 1.8)	100	600	Hermetically sealed	248
	TSTA7300	12	20 (> 10)	1.4 (< 1.8)	100	600	Hermetically sealed	252
	TSTA7500	30	6 (> 3.5)	1.4 (< 1.8)	100	600	Hermetically sealed	256

HIGH POWER INFRARED EMITTERS, 940 nm, GaAlAs/GaAs

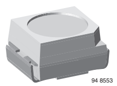
	PART NUMBER	ANGLE ± φ (°)	RADIANT INTENSITY I_e (mW/sr)	FORWARD VOLTAGE V_F (V)	TEST CONDITION at I_F (mA)	RISE TIME t_r (ns)	REMARKS	PAGE
SMD, PLCC-2								
	VSML3710	60	8 (> 4)	1.35 (< 1.6)	100	800	SMD, clear epoxy	317
SMD, dome, clear epoxy								
	TSML1000	12	7 (> 3)	1.2 (< 1.5)	20	800	SMD, clear mold compound	232
	TSML1020	12	7 (> 3)	1.2 (< 1.5)	20	800	SMD, clear mold compound	232

For technical questions concerning IR emitters, contact: emittertechsupport@vishay.com
For technical questions concerning detectors, contact: detectortechsupport@vishay.com

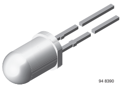
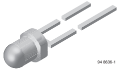
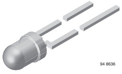
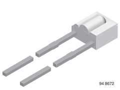
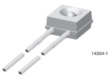
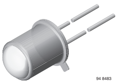
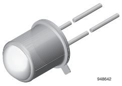
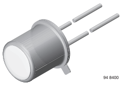
HIGH POWER INFRARED EMITTERS, 940 nm, GaAlAs/GaAs

	PART NUMBER	ANGLE ± φ (°)	RADIANT INTENSITY I_e (mW/sr)	FORWARD VOLTAGE V_F (V)	TEST CONDITION at I_F (mA)	RISE TIME t_r (ns)	REMARKS	PAGE
SMD, dome, clear epoxy								
	TSML1030	12	7 (> 3)	1.2 (< 1.5)	20	800	SMD, clear mold compound	232
	TSML1040	12	7 (> 3)	1.2 (< 1.5)	20	800	SMD, clear mold compound	232
5 mm, T-1¾, leads with stand-off, blue-gray epoxy								
	TSAL5100	10	130 (> 80)	1.35 (< 1.6)	100	800	Stand-off, blue-gray epoxy	90
	TSAL5300	22	45 (> 30)	1.35 (< 1.6)	100	800	Stand-off, blue-gray epoxy	94
5 mm, T-1¾, leads without stand-off, blue-gray epoxy								
	TSAL6100	10	130 (> 80)	1.35 (< 1.6)	100	800	Blue-gray epoxy	99
	TSAL6100X01	10	130 (> 80)	1.35 (< 1.6)	100	800	Blue-gray epoxy	103
	TSAL6200	17	60 (> 40)	1.35 (< 1.6)	100	800	Blue-gray epoxy	107
	TSAL6400	25	40 (> 25)	1.35 (< 1.6)	100	800	Blue-gray epoxy	111
5 mm, T-1¾, leads without stand-off, clear epoxy								
	TSAL7200	17	60 (> 40)	1.35 (< 1.6)	100	800	Clear epoxy	115
	TSAL7300	22	45 (> 30)	1.35 (< 1.6)	100	800	Clear epoxy	119
	TSAL7400	25	40 (> 25)	1.35 (< 1.6)	100	800	Clear epoxy	123
	TSAL7600	30	25 (> 15)	1.35 (< 1.6)	100	800	Clear epoxy	127
3 mm, T-1, blue-gray epoxy								
	TSAL4400	25	30 (> 16)	1.35 (< 1.6)	100	800	Clear epoxy	86

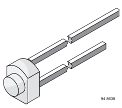
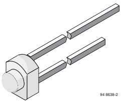
INFRARED EMITTERS, 950 nm, GaAs

	PART NUMBER	ANGLE ± φ (°)	RADIANT INTENSITY I_e (mW/sr)	FORWARD VOLTAGE V_F (V)	TEST CONDITION at I_F (mA)	RISE TIME t_r (ns)	REMARKS	PAGE
SMD, PLCC-2								
	VSMS3700	60	1.6 to 8	1.3 (< 1.7)	100	800	SMD, clear epoxy	322

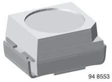
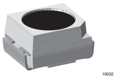
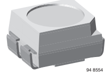
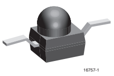
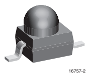
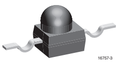
INFRARED EMITTERS, 950 nm, GaAs

	PART NUMBER	ANGLE ± φ (°)	RADIANT INTENSITY I_e (mW/sr)	FORWARD VOLTAGE V_F (V)	TEST CONDITION at I_F (mA)	RISE TIME t_r (ns)	REMARKS	PAGE
5 mm, T-1¾, leads with stand-off, blue epoxy								
	TSUS5200	15	20 (> 10)	1.3 (< 1.7)	100	800	Stand-off, blue epoxy	280
	TSUS5201	15	25 (> 15)	1.3 (< 1.7)	100	800	Stand-off, blue epoxy	280
	TSUS5202	15	30 (> 20)	1.3 (< 1.7)	100	800	Stand-off, blue epoxy	280
	TSUS5400	22	14 (> 7)	1.3 (< 1.7)	100	800	Stand-off, blue epoxy	284
	TSUS5401	22	17 (> 10)	1.3 (< 1.7)	100	800	Stand-off, blue epoxy	284
	TSUS5402	22	20 (> 15)	1.3 (< 1.7)	100	800	Stand-off, blue epoxy	284
3 mm, T-1, blue epoxy								
	TSUS4300	16	18 (> 7)	1.3 (< 1.7)	100	800	Emerged rim, blue epoxy	272
	TSUS4400	18	15 (> 7)	1.3 (< 1.7)	100	800	Small rim, blue epoxy	276
Side view, clear epoxy								
	TSSS2600	25	2.5 (> 1.0)	1.2 (< 1.6)	50	800	Clear epoxy	244
	TSKS5400S	30	2 to 7	1.3 (< 1.7)	100	800	Clear mold compound, Short leads	219
	TSKS5400	30	2 to 7	1.3 (< 1.7)	100	800	Clear mold compound, long leads	215
Metal can, TO-18								
	TSTS7100	5	> 10	1.3 (< 1.7)	100	800	Hermetically sealed	260
	TSTS7300	12	6.3 (> 4)	1.3 (< 1.7)	100	800	Hermetically sealed	264
	TSTS7500	30	1.6 (> 1.25)	1.3 (< 1.7)	100	800	Hermetically sealed	268

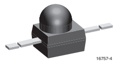
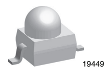
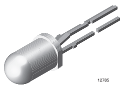
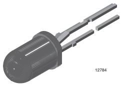
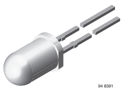
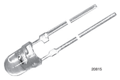
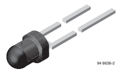
INFRARED EMITTERS, 950 nm, GaAs

	PART NUMBER	ANGLE ± φ (°)	RADIANT INTENSITY I_e (mW/sr)	FORWARD VOLTAGE V_F (V)	TEST CONDITION at I_F (mA)	RISE TIME t_r (ns)	REMARKS	PAGE
1.8 mm, T-¾, blue epoxy								
	CQY36N	55	1.5 (> 0.7)	1.3 (< 1.6)	50	800	Flat top, blue epoxy	78
	CQY37N	12	5 (> 2.2)	1.3 (< 1.6)	50	800	Lens, blue epoxy	82

SILICON NPN PHOTOTRANSISTORS

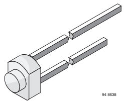
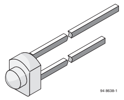
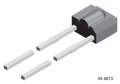
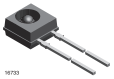
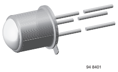
	PART NUMBER	BANDWIDTH		ANGLE ± φ (°)	COLLECTOR LIGHT CURRENT I_{ca} (mA)	RISE TIME t_r (µs)	REMARKS	PAGE
		$\lambda_{0.1}$ (nm)	$\lambda_{0.5}$ (nm)					
SMD, PLCC-2								
	VEMT3700	450 to 1080		60	0.5 (> 0.25)	2	Clear epoxy, detector for visible or IR radiation	521
	VEMT3700F		860 to 1050	60	0.5 (> 0.25)	2	Black epoxy, filter matched with 950 nm IR emitters	526
SMD, PLCC-3								
	VEMT4700	450 to 1080		60	0.5 (> 0.25)	2	Clear epoxy, detector for visible or IR radiation	531
SMD, dome								
	TEMT1000		730 to 980	15	7 (> 2)	2	Black mold compound, filter matched with 950 nm IR emitters	476
	TEMT1020		730 to 980	15	7 (> 2)	2	Black mold compound, filter matched with 950 nm IR emitter	476
	TEMT1030		730 to 980	15	7 (> 2)	2	Black mold compound, filter matched with 950 nm IR emitter	476

SILICON NPN PHOTOTRANSISTORS

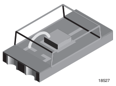
	PART NUMBER	BANDWIDTH		ANGLE ± φ (°)	COLLECTOR LIGHT CURRENT I_{ca} (mA)	RISE TIME t_r (µs)	REMARKS	PAGE
		$\lambda_{0.1}$ (nm)	$\lambda_{0.5}$ (nm)					
SMD, dome								
	TEMT1040		730 to 980	15	7 (> 2)	2	Black mold compound, filter matched with 950 nm IR emitter	476
	TEMT1520	450 to 1080		15	2 to 8	2	Clear mold, detector for visible or IR radiation	484
5 mm, T-1¾								
	BPV11	450 to 1080		15	10 (> 3)	6	Leads with stand-off, clear epoxy, detector for visible or IR radiation, base terminal	342
	BPV11F		900 to 980	15	9 (> 3)	6	Leads with stand-off, black epoxy, filter matched with 950 nm GaAs IR emitters, base terminal	346
	BPW96B	450 to 1080		20	2.5 to 7.5	2.3	Leads with stand-off, clear epoxy, detector for visible or IR radiation	419
	BPW96C	450 to 1080		20	4.5 to 15	2.3	Leads with stand-off, clear epoxy, detector for visible or IR radiation	419
3 mm, T-1								
	BPW85A	450 to 1080		25	0.8 to 2.5	2.3	Clear epoxy, detector for visible or IR radiation	414
	BPW85B	450 to 1080		25	1.5 to 4.0	2.3	Clear epoxy, detector for visible or IR radiation	414
	BPW85C	450 to 1080		25	3.8 to 8.0	2.3	Clear epoxy, detector for visible or IR radiation	414
	TEFT4300		870 to 1050	30	3.2 (> 0.8)	2.3	Black epoxy, filter matched with 950 nm IR emitters	423

For technical questions concerning IR emitters, contact: emittertechsupport@vishay.com
For technical questions concerning detectors, contact: detectortechsupport@vishay.com

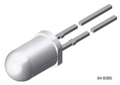
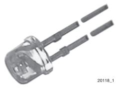
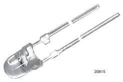
SILICON NPN PHOTOTRANSISTORS

	PART NUMBER	BANDWIDTH		ANGLE ± φ (°)	COLLECTOR LIGHT CURRENT I_{ca} (mA)	RISE TIME t_r (μs)	REMARKS	PAGE
		$\lambda_{0.1}$ (nm)	$\lambda_{0.5}$ (nm)					
1.8 mm, T-¾								
	BPW16N	450 to 1040		40	0.14 (> 0.07)	5	Flat top, clear epoxy, detector for visible or IR radiation	366
	BPW17N	450 to 1040		12	1.0 (> 0.5)	5	Lens, clear epoxy, detector for visible or IR radiation	370
Side view								
	TEST2600		850 to 980	30/60	2.5 (> 1.0)	6	Black epoxy, filter matched with 950 nm IR emitters	517
	TEKT5400S		850 to 980	37	4 (> 2.0)	6	Black epoxy, filter matched with 950 nm IR emitters	431
Metal can, TO-18								
	BPW76A	450 to 1080		40	0.4 to 0.8	6	Hermetically sealed	398
	BPW76B	450 to 1080		40	1.2 (> 0.6)	6	Hermetically sealed	398
	BPW77NA	450 to 1080		10	7.5 to 15	6	Hermetically sealed	402
	BPW77NB	450 to 1080		10	20 (> 10)	6	Hermetically sealed	402

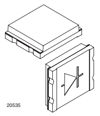
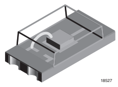
AMBIENT LIGHT SENSOR, SILICON NPN - PHOTOTRANSISTORS

	PART NUMBER	λ_P (nm)	BANDWIDTH $\lambda_{0.5}$ (nm)	ANGLE ± φ (°)	COLLECTOR LIGHT CURRENT I_{PCE} (μA)	PAGE
SMD, 1206						
	TEMT6000X01	570	440 to 800	60	50 (> 17.5)	489
SMD, 0805						
	TEMT6200FX01	550	450 to 610	60	7.5 to 39	494

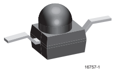
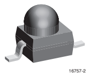
AMBIENT LIGHT SENSOR, SILICON NPN - PHOTOTRANSISTORS

	PART NUMBER	**λ_P (nm)**	**BANDWIDTH $\lambda_{0.5}$ (nm)**	**ANGLE ± φ (°)**	**COLLECTOR LIGHT CURRENT I_{PCE} (µA)**	**PAGE**
5 mm, T-1¾, leads with stand-off						
	TEPT5600	570	440 to 800	20	350 (> 125)	505
	TEPT5700	570	440 to 800	50	75 (> 26)	509
3 mm, T-1						
	TEPT4400	570	440 to 800	30	200 (> 75)	501

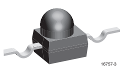
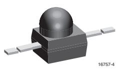
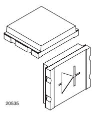
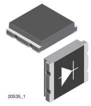
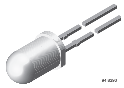
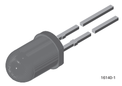
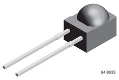
AMBIENT LIGHT DETECTORS, PHOTODIODES

	PART NUMBER	**λ_P (nm)**	**BANDWIDTH $\lambda_{0.5}$ (nm)**	**ANGLE ± φ (°)**	**REVERSE LIGHT CURRENT I_{ra} (µA)**	**PAGE**
SMD, top view						
	TEMD5510FX01	540	430 to 610	65	1 (> 0.8)	467
SMD, 1206						
	TEMD6010FX01	540	430 to 610	60	0.04 (> 0.03)	472

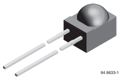
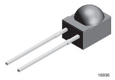
SILICON PIN PHOTODIODES

	PART NUMBER	**BANDWIDTH**		**ANGLE ± φ (°)**	**SENSITIVITY I_{ra} (µA)**	**RISE TIME t_r (µs)**	**REMARKS**	**PAGE**
		$\lambda_{0.1}$ (nm)	**$\lambda_{0.5}$ (nm)**					
SMD, dome								
	TEMD1000		790 to 1050	15	12 (> 5)	0.004	Black mold compound, filter matched with 870 nm to 950 nm IR emitters	436
	TEMD1020		790 to 1050	15	12 (> 5)	0.004	Black mold compound, filter matched with 870 nm to 950 nm IR emitters	436

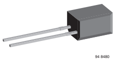
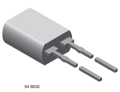
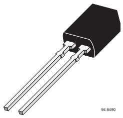
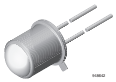
SILICON PIN PHOTODIODES

	PART NUMBER	BANDWIDTH		ANGLE ± φ (°)	SENSITIVITY I_{ra} (μA)	RISE TIME t_r (μs)	REMARKS	PAGE
		$\lambda_{0.1}$ (nm)	$\lambda_{0.5}$ (nm)					
SMD, dome								
	TEMD1030		790 to 1050	15	12 (> 5)	0.004	Black mold compound, filter matched with 870 nm to 950 nm IR emitters	436
	TEMD1040		790 to1050	15	12 (> 5)	0.004	Black mold compound, filter matched with 870 nm to 950 nm IR emitters	436
SMD, top view								
	TEMD5010X01	430 to 1100		65	55 (> 45)	100	Clear epoxy, detector for visible or IR radiation	443
	TEMD5020X01	430 to 1100		65	35 (> 25)	100	Clear epoxy, detector for visible or IR radiation	449
	TEMD5110X01		790 to 1050	65	55 (> 45)	100	Black mold compound, filter matched with 870 nm to 950 nm IR emitters	455
	TEMD5120X01		790 to 1050	65	35 (> 25)	100	Black mold compound, filter matched with 870 nm to 950 nm IR emitters	461
5 mm, T-1¾, leads with stand-off								
	BPV10	380 to 1100		20	70 (> 38)	0.0025	Leads with stand-off, clear epoxy, detector for visible or IR radiation	334
	BPV10NF		790 to 1050	20	60 (> 30)	0.0025	Leads with stand-off, black epoxy, filter matched with 870 nm to 950 nm IR emitters	338
Side view, 4.5 mm lens								
	BPV22F		870 to 1050	60	80 (> 55)	0.1	Black epoxy, filter matched with 950 nm IR emitters	350
	BPV22NF		790 to 1050	60	85 (> 55)	0.1	Black epoxy, filter matched with 870 nm to 950 nm IR emitters	354
	BPV23F		870 to 1050	60	63 (> 45)	0.07	Black epoxy, filter matched with 950 nm IR emitters	358
	BPV23NF		790 to 1050	60	65 (> 45)	0.07	Black epoxy, filter matched with 870 nm to 950 nm IR emitters	362

SILICON PIN PHOTODIODES

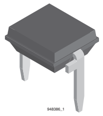
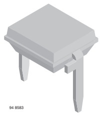
	PART NUMBER	BANDWIDTH		ANGLE ± φ (°)	SENSITIVITY I_{ra} (μA)	RISE TIME t_r (μs)	REMARKS	PAGE
		$\lambda_{0.1}$ (nm)	$\lambda_{0.5}$ (nm)					
Side view, 4.5 mm lens								
	BPV22NFL		790 to 1050	60	85 (> 55)	0.1	Black epoxy, filter matched with 870 nm to 950 nm IR emitters	354
	BPV23FL		870 to 1050	60	63 (> 45)	0.07	Black epoxy, filter matched with 950 nm IR emitters	358
	BPV23NFL		790 to 1050	60	65 (> 45)	0.07	Black epoxy, filter matched with 870 nm to 950 nm IR emitters	362
	TESP5700		790 to 980	60	25 (> 16)	0.01	Black epoxy, filter matched with 870 nm to 950 nm IR emitters	513

SILICON PIN PHOTODIODES

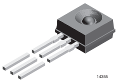
	PART NUMBER	BANDWIDTH		ANGLE ± φ (°)	SENSITIVITY I_{ra} (μA)	RISE TIME t_r (μs)	REMARKS	PAGE
		$\lambda_{0.1}$ (nm)	$\lambda_{0.5}$ (nm)					
Side view								
	BPW41N		870 to 1050	65	45 (> 43)	0.1	Black epoxy, filter matched with 950 nm IR emitters	390
	BPW82		790 to 1050	65	45 (> 43)	0.1	Black epoxy, filter matched with 870 nm to 950 nm IR emitters	406
	BPW46	430 to 1100		65	50 (> 40)	0.1	Flat top, clear epoxy, detector for visible or IR radiation	394
	BPW83		790 to 1050	65	45 (> 43)	0.1	Black epoxy, filter matched with 870 nm to 950 nm IR emitters	410
Metal can, TO-18								
	BPW24R		600 to 1050	12	60 (> 45)	0.007	Lens, hermetically sealed	382

For technical questions concerning IR emitters, contact: emittertechsupport@vishay.com
For technical questions concerning detectors, contact: detectortechsupport@vishay.com

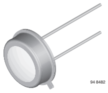
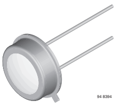
SILICON PIN PHOTODIODES

	PART NUMBER	BANDWIDTH		ANGLE ± φ (°)	SENSITIVITY I_{ra} (µA)	RISE TIME t_r (µs)	REMARKS	PAGE
		$\lambda_{0.1}$ (nm)	$\lambda_{0.5}$ (nm)					
Top view								
	BP104		870 to 1050	65	45 (> 40)	0.1	Black mold compound, filter matched with 950 nm IR emitters	330
	BPW104S		870 to 1050	65	45 (> 40)	0.1	Packed in tubes, black mold compound, filter matched to 950 nm IR emitters	330
	BPW34	430 to 1100		65	50 (> 40)	0.1	Clear mold compound, detector for visible or IR radiation	386
	BPW34S	430 to 1100		65	50 (> 40)	0.1	Packed in tubes, clear mold compound, detectorfor visible or IR radiation	386

SILICON PHOTO SCHMITT TRIGGER

	PART NUMBER	BANDWIDTH $\lambda_{0.5}$ (nm)	ANGLE ± φ (°)	SENSITIVITY E_{on} (µW/cm^2)	REMARKS	PAGE
Side view lens						
	TEKS5400	600 to 1020	30	50 (< 85)	Black mold compound, filter matched with 950 nm IR emitters, digital output, open collector	427

SILICON PHOTODIODE

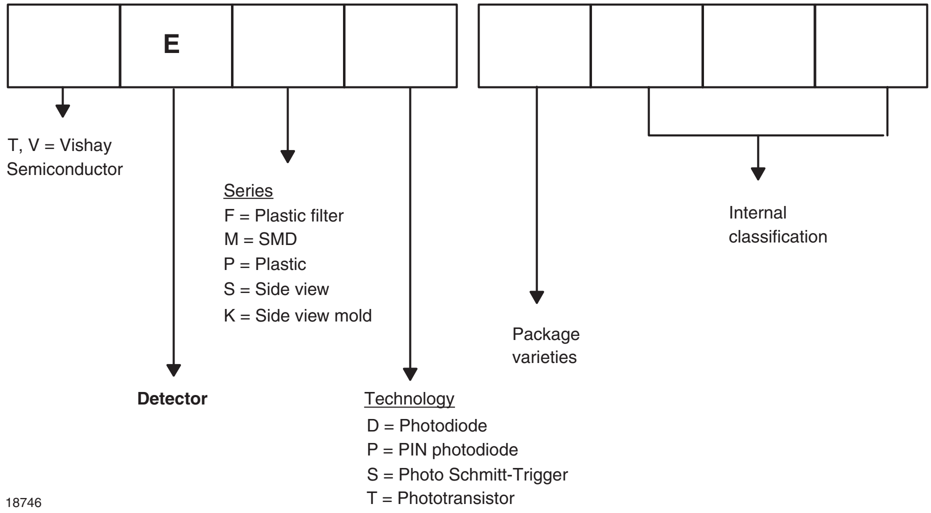
	PART NUMBER	BANDWIDTH $\lambda_{0.5}$ (nm)	ANGLE ± φ (°)	SENSITIVITY I_K (µA)	RISE TIME t_r (µs)	REMARKS	PAGE
Metal can, TO-5							
	BPW20RF	550 to 1040	50	60 (> 20)	3.5	Hermetically sealed, detector for visible or IR radiation	374
	BPW21R	420 to 675	50	9 (> 4.5)	3.5	Hermetically sealed, filter matched with human eye spectrum	378

General Information

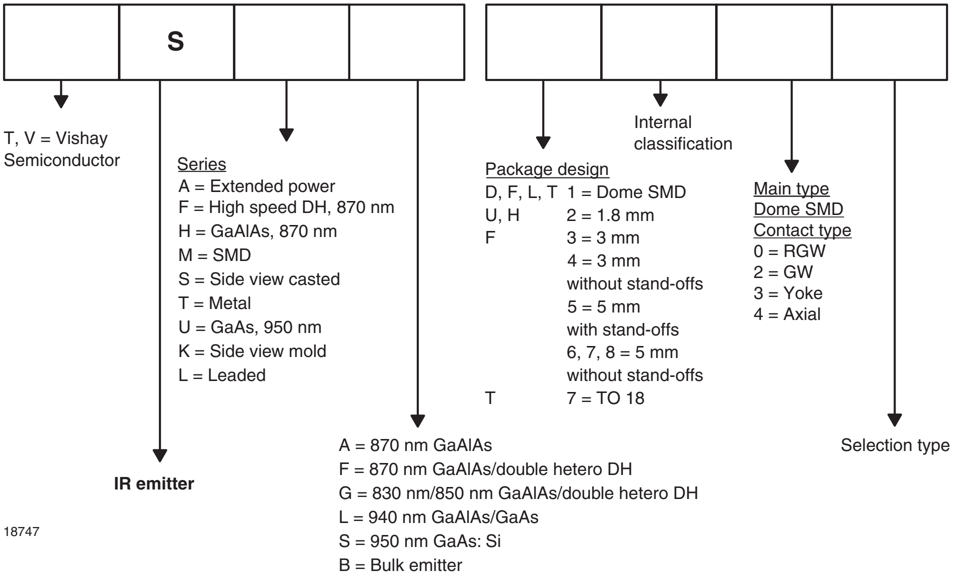
Contents

Type Designation Code

DETECTORS



IR EMITTERS



Physics and Technology

EMITTERS

Materials

Infrared emitting diodes (IREDs) can be produced from a range of different III-V compounds. Unlike the elemental semiconductor silicon, compound III-V semiconductors consist of two or more different elements of group three (e.g., Al, Ga, In) and five (e.g., P, As) of periodic table. The bandgap energies of these compounds vary between 0.18 eV and 3.4 eV. However, the IREDs considered here emit in the near infrared spectral range between 800 nm and 1000 nm, and, therefore, the selection of materials is limited to GaAs and mixed crystal $Ga_{1-X}Al_XAs$, $0 \le X \le 0.8$, made from pure compounds GaAs and AlAs.

Infrared radiation is produced by the radiative recombination of electrons and holes from the conduction and valence bands. Emitted photon energy, therefore, corresponds closely to bandgap energy E_g. The emission wavelength can be calculated according to the formula λ (µm) = 1.240/Eg (eV). Internal efficiency depends on band structure, doping material and doping level. Direct bandgap materials offer high efficiencies, because no phonons are needed for recombination of electrons and holes. GaAs is a direct gap material and $G_{a1-X}Al_XAs$ is direct up to X = 0.44. Doping species Si provides the best efficiencies and the shifts emission wavelength below the bandgap energy into the infrared spectral range by about 50 nm typically. Charge carriers are injected into the material via pn junctions. Junctions of high injection efficiency are readily formed in GaAs and $Ga_{1-X}Al_XAs$. P-type conductivity can be obtained with metals of valency two, such as Zn and Mg, and n-type conductivity with elements of valency six, such as S, Se and Te. However, silicon of valency four can occupy sites of III-valence and V-valence atoms, and, therefore, acts as donor and as acceptor. Conductivity type depends primarily on material growth temperature. By employing exact temperature control, pn junctions can be grown with the same doping species Si on both sides of the junction. Ge, on the other hand, also has a valency of four, but occupies group V sites at high temperatures i.e., p-type.

Only mono crystalline material is used for IRED production. In the mixed crystal system $Ga_{1-X}Al_XAs$, $0 \le X \le 0.8$, lattice constant varies only by about 1.5 x 10^{-3}. Therefore, mono crystalline layered structures of different $G_{a1-X}Al_XAs$ compositions can be produced with extremely high structural quality. These structures are useful because the bandgap can be shifted from 1.40 eV (GaAs) to values beyond 2.1 eV which enables transparent windows and heterogeneous structures to be fabricated. Transparent windows are another suitable means to increase efficiency, and heterogeneous structures can provide shorter switching times and higher efficiency. Such structures are termed single hetero (SH) or double hetero structures (DH). DH structures consist normally of two layers that confine a layer with a much smaller bandgap.

The best production method for all materials needed is liquid phase epitaxy (LPE). This method uses Ga-solutions containing As, possibly Al, and a doping substance. The solution is saturated at a high temperature, typically 900 °C, and GaAs substrates are dipped into the liquid. The solubility of As and Al decreases with decreasing temperature. In this way epitaxial layers can be grown by slow cooling of the solution. Several layers differing in composition may be obtained using different solutions one after another, as needed e.g. for DHs.

In liquid phase epitaxial reactors, production quantities of up to 50 wafers, depending on type of structure required, can be handled.

IRED CHIPS AND CHARACTERISTICS

At present, the most popular IRED chip is made only from GaAs. The structure of the chip is displayed in figure 1.

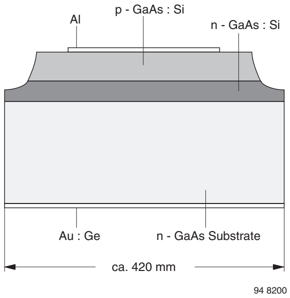


Fig. 1

On an n-type substrate, two Si-doped layers are grown by liquid phase epitaxy from the same solution producing an emission wavelegth of 950 nm. Growth starts as n-type at high temperature and becomes p-type below about 820 °C. A structured Al-contact on p-side and a large area Au:Ge contact on back side provide a very low series resistance.

The angular distribution of emitted radiation is displayed in figure 2.

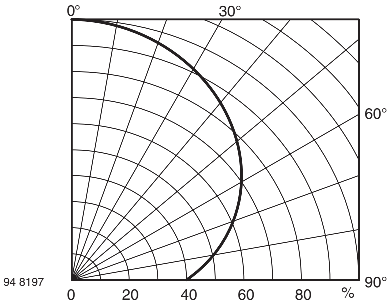


Fig. 2

The package of the chip has to provide good collection efficiency of radiation emitted sideways, and has to diminish the refractive index step between the chip (n = 3.6) and the air (n = 1.0) with an epoxy of refractive index of 1.55. In this way, the output power of chip is increased by a factor of 3.5 for the assembled device.

The chip described is the most cost-efficient one. Its forward voltage at I_F = 1.5 A has the lowest possible value. Total series resistance is typically only 0.60 Ω; output power and linearity (defined as optical output power increase, divided by current increase between 0.1 A and 1.5 A) are high. Relevant data on chip and a typical assembled device are given in table 1.

The technology used for a chip emitting at 880 nm eliminates the absorbing substrate and uses only a thick epitaxial layer. The chip is shown in figure 3.

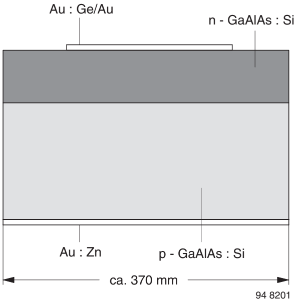


Fig. 3

Originally, the GaAs substrate was adjacent to the n-side. Growth of $Ga_{0.7}Al_{0.3}As$ started as n-type and became p-type - as in the first case - through the specific properties of the doping material Si. A characteristic feature of the Ga-Al-As phase system causes the Al-content of growing epitaxial layer to decrease. This causes the Al-concentration at the junction to drop to 8 % ($Ga_{0.92}Al_{0.08}As$), producing an emission wavelength of 880 nm. During further growth the Al-content approaches zero. The gradient of the Al-content and correlated gradient of bandgap energy produce an emission band of a relatively large half width. The transparency of the large bandgap material results in a high external efficiency on this type of chip.

The chip is mounted n-side up, and the front side metallization is Au:Ge/Au, whereas the reverse side metallization is Au:Zn.

The angular distribution of the emitted radiation is displayed in figure 4.

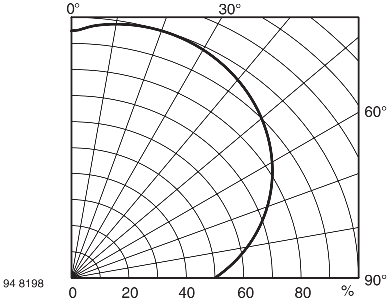


Fig. 4

Due to its shorter wavelength, $Ga_{1-X}Al_XAs$ chip described above offers specific advantages in combination with a Si detector. Integrated opto ICs, like amplifiers or Schmitt Triggers, have higher sensitivities at shorter wavelengths. Similarly, phototransistors are also more sensitive. Finally, the frequency bandwidth of pin diodes is higher at shorter wavelengths. This chip also has the advantage of having high linearity up to and beyond 1.5 A. The forward voltage, however, is higher than the voltage of a GaAs chip. Table 2 (see “Symbols and Terminology”) provides more data on the chip.

A technology combining some of the advantages of the two technologies described above is summarized in figure 5.

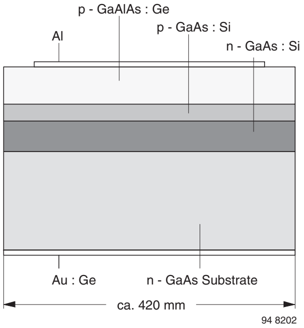


Fig. 5

Starting an with n-type substrate, n- and p-type GaAs layers are grown in a similar way to the epitaxy of a standard GaAs:Si diode. After this, a highly transparent window layer of $Ga_{1-X}Al_XAs$, doped p-type is grown. The upper contact to the p-side is made of Al and the rear side contact is Au:Ge. The angular distribution of emitted radiation is shown in figure 6.

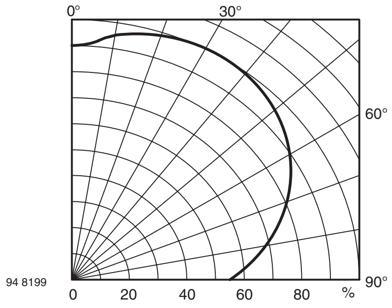


Fig. 6

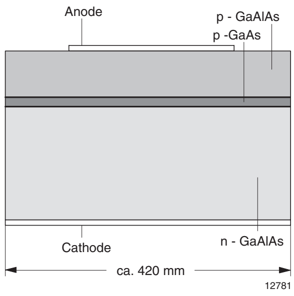


Fig. 7

This chip type combines a relatively low forward voltage with a high electro-optical efficiency, offering an optimized combination of the advantageous characteristics of the two other chips. Refer again to table 2 (see “Symbols and Terminology”) for more details.

As mentioned in the previous section, double heterostructures (DH) provide even higher efficiencies and faster switching times. A schematic representation of such a chip is shown in figure 7.

The active layer is depicted as the thin layer between the p- and n- type $Ga_{1-X}Al_XAs$ confinement layers.

The contacts are dependent on the polarity of the chip. If p is up, then the p-side contact is Al and the back side Au:Ge; if n is up, then this side has an Au:Ge contact and the back side Au:Zn.Two such chips that are also very suitable for IrDA applications are given in table 1.

TABLE 1: CHARACTERISTICS DATA OF IRED CHIPS

TECHNOLOGY	TYPICAL CHIP DATA				TYPICAL DEVICE	TYPICAL DEVICE DATA				
	Φ_e at 0.1 A (mW)	λ_p (nm)	$\Delta\lambda$ (nm)	POLARITY		Φ_e at 0.1 A (mW)	Φ_e at 1.5 A (mW)	V_F at 0.1 A (V)	V_F at 1.0 A (V)	t_r at 0.1 A (ns)
GaAs	7.7	950	50	p up	TSUS540.	20	140	1.3	2.1	800
GaAlAs	6.7	875	80	n up	TSHA550.	27	350	1.5	3.4	600
GaAlAs/GaAs	16	940	50	p up	TSAL6200	35	300	1.35	2.4	800
GaAlAs/GaAlAs	16	890	40	p up	TSHF5410	45		1.5		30
GaAlAs/GaAlAs	17	870	40	p up	TSFF5410	50		1.5		15

UV, VISIBLE, AND NEAR IR SILICON PHOTODETECTORS

(adapted from ”Sensors, Vol 6, Optical Sensors, Chapt. 8, VCH - Verlag, Weinheim 1991”)

Silicon Photodiodes (PN and PIN Diodes)

The physics of silicon detector diodes

Absorption of radiation is caused by the interaction of photons and charge carriers inside a material. The different energy levels allowed and the band structure determine the likelihood of interaction and, therefore, the absorption characteristics of the semiconductors. The long wavelength cutoff of the absorption is given by the bandgap energy. The slope of the absorption curve depends on the physics of interaction and is much weaker for silicon than for most other semiconducting materials. This results in a strong wavelength-dependent penetration depth which is shown in figure 8. (The penetration depth is defined as that depth where 1/e of the incident radiation is absorbed.)

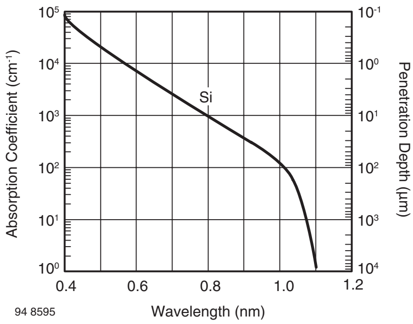


Fig. 8 - Absorption and Penetration Depth of Optical Radiation in Silicon

Depending on the wavelength, the penetration depth varies from tenths of a micron at 400 nm (blue) to more than 100 µm at 1 µm (IR). For detectors to be effective, an interaction length of at least twice the penetration depth should be realized (equivalent to $1/e^2$ = 86 % absorbed radiation). In the pn diode, generated carriers are collected by the electrical field of the pn junction. Effects in the vicinity of a pn junction are shown in figure 9 for various types and operating modes of the pn diode. Incident radiation generates mobile minority carriers - electrons on the p-side, holes on the n-side. In the short circuit mode shown in figure 9 (top), the carriers drift under the field of the built-in potential of the pn junction. Other carriers diffuse inside the field-free semiconductor along a concentration gradient, which results in an electrical current through the applied load, or without load, in an external voltage, open circuit voltage, V_{OC}, at contact terminals. Bending of the energy bands near the surface is caused by surface states. An equilibrium is established between generation, recombination of carriers, and current flow through the load.

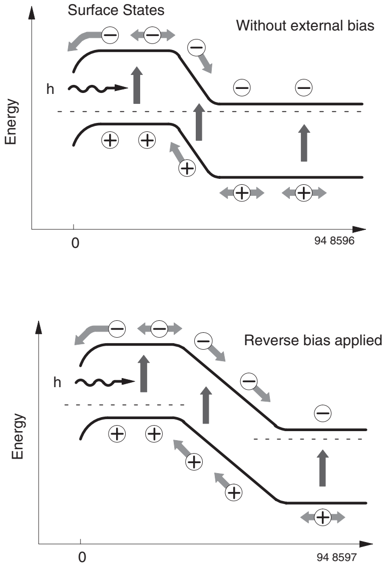


Fig. 9 - Generation-Recombination Effects in the Vicinity of a PN Junction
Top: Short Circuit Mode, Bottom: Reverse Biased

Recombination takes place inside the bulk material with technology- and process-dependent time constants which are very small near the contacts and surfaces of the device. For short wavelengths with very small penetration depths, carrier recombination is the efficiency limiting process. To achieve high efficiencies, as many carriers as possible should be separated by the electrical field inside the space charge region. This is a very fast process, much faster than typical recombination times (for data, see chapter 'Operating modes and circuits'). The width, W, of the space charge is a function of doping the concentration N_B and applied voltage V:

$$W = \sqrt{\frac{2 \times \varepsilon_S \times \varepsilon_o \times (V_{bi} + V)}{q \times N_B}} \tag{1}$$

(for a one-sided abrupt junction), where V_{bi} is built-in voltage, ε_s dielectric constant of Si, ε_o vacuum dielectric constant and q is electronic charge. The diode's capacitance (which can be speed limiting) is also a function of the space charge width and applied voltage. It is given by

$$C = \frac{\varepsilon_S \times \varepsilon_o \times A}{W} \tag{2}$$

where A is the area of the diode. An externally applied bias will increase the space charge width (see figure 8) with the result that a larger number of carriers are generated inside this zone which can be flushed out very fast with high efficiency under the applied field. From equation (1), it is evident that the space charge width is a function of the doping concentration N_B. Diodes with a so-called pin structure show according to equation (1) a wide space charge width where i stands for intrinsic, low doped. This zone is also sometimes nominated as n or p rather than low doped n, n- or p, p-zone indicating the very low doping. Per equation (2), the junction capacitance C, is low due to the large space charge region of PIN photodiodes. These photodiodes are mostly used in applications requiring high speed.

Figure 10 shows a cross section of PIN photodiodes and PN diodes. The space charge width of the PIN photodiodes (bottom) with a doping level (n = N_B) as low as N_B = 5 x 1011 cm^{-3} is about 80 µm wide for a 2.5 V bias in comparison with a pn diode with a doping (n) of N_B = 5 x 1015 cm^{-3} with only 0.8 mm.

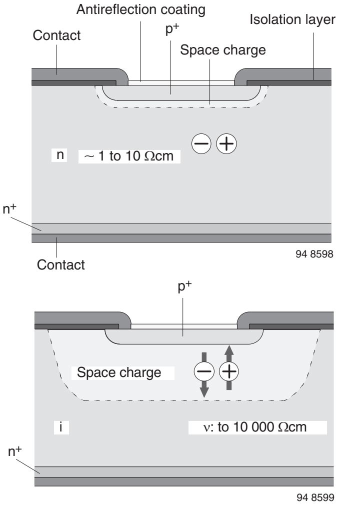


Fig. 10 - Comparison of PN Diode (Top) and PIN Photodiode (Bottom)

PROPERTIES OF SILICON PHOTODIODES

I-V Characteristics of illuminated pn junction

The cross section and I-V-characteristics of a photodiode are shown in figure 11 and 12. The characteristic of the illuminated diode is identical to the characteristic of a standard rectifier diode. The relationship between current, I, and voltage, V, is given by

$$I = I_S \times (\exp V / V_T - 1) \tag{3}$$

with $V_T = kT/q$

$k = 1.38 \times 10^{-23}$ JK^{-1}, Boltzmann constant

$q = 1.6 \times 10^{-19}$ As, electronic charge.

I_S, the dark-reverse saturation current, is a material- and technology-dependent quantity. The value is influenced by the doping concentrations at pn junction, by carrier lifetime, and especially by temperature. It shows a strongly exponential temperature dependence and doubles every 8 °C.

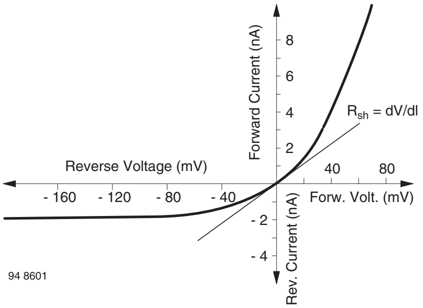


Fig. 11 - Measured I-V-Characteristics of an Si Photodiode in the Vicinity of the Origin

The typical dark currents of Si photodiodes are dependent on size and technology and range from less than picoamps up to tens of nanoamps at room temperature conditions. As noise generators, dark current I_{r0} and the resistance R_{sh} (defined and measured at a voltage of 10 mV forward or reverse, or peak-to-peak) are limiting quantities when detecting very small signals.

The photodiode exposed to optical radiation generates a photocurrent I_r exactly proportional to incident radiant power Φ_e.

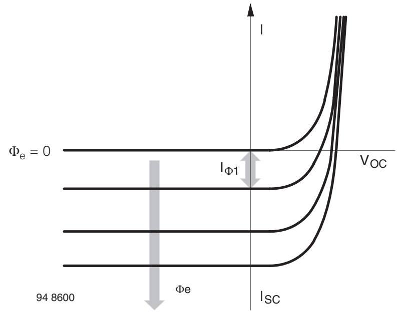


Fig. 12 - I-V-Charachteristics of an Si Photodiode under Illumination. Parameter: Incident Radiant Flux

The quotient of both is spectral responsibility s(λ),

$$s(\lambda) = I_r / \phi_e [A/W] \tag{4}$$

The characteristic of the irradiated photodiode is then given by

$$I = I_S \times (\exp V / V_T - 1) - s(\lambda) \times \phi_e \tag{5}$$

and in case V ≈ 0, zero or reverse bias we find,

$$I = -I_S - s(\lambda) \times \phi_e \tag{6}$$

Dependent on load resistance, R_L, and applied bias, different operating modes can be distinguished. An unbiased diode operates in photovoltaic mode. Under short circuit conditions (load $R_L = 0\ \Omega$), short circuit current, I_{SC} flows into the load. When R_L increases to infinity, the output voltage of the diode rises to the open circuit voltage, V_{OC}, given by

$$V_{OC} = V_T \times \ln(s(\lambda) \times \phi_e / I_S + 1) \tag{7}$$

Because of this logarithmic behavior, the open circuit voltage is sometimes used for optical light meters in photographic applications. The open circuit voltage shows a strong temperature dependence with a negative temperature coefficient. The reason for this is the exponential temperature coefficient of the dark reverse saturation current I_S. For precise light measurement, a temperature control of the photodiode is employed. Precise linear optical power measurements require small voltages at the load, typically smaller than about 5 % of the corresponding open circuit voltage. For less precise measurements, an output voltage of half the open circuit voltage can be allowed. The most important disadvantage of operating in photovoltaic mode is the relatively large response time. For faster response, it is necessary to implement an additional voltage source reverse-biasing the photodiode. This mode of operation is termed photoconductive mode. In this mode, the lowest detectable power is limited by the shot noise of the dark current, I_S, while in photovoltaic mode, the thermal (Johnson) noise of shunt resistance, R_{sh}, is the limiting quantity.

SPECTRAL RESPONSIVITY

Efficiency of Si photodiodes:

The spectral responsivity, s_λ, is given as the number of generated charge carriers (η x N) per incident photons N of energy h x ν (η is percent efficiency, h is the Plancks constant, and ν is the radiation frequency). Each photon will generate one charge carrier at the most. The photocurrent I_{re} is then given as

$$I_{re} = \eta \times N \times q \qquad (8)$$

$$s_\lambda = I_{re}/\phi_e \qquad (9)$$

$$= \eta \times N \times q/(h \times \nu \times N) = \eta \times q/(h \times \nu)$$

$$s_\lambda = \frac{\lambda(\mu m)}{1.24}[A/W]$$

At fixed efficiency, a linear relationship between wavelength and spectral responsivity is valid.

Figure 8 shows that the semiconductors absorb radiation similar to a cut-off filter. At wavelengths smaller than the cut-off wavelength, the incident radiation is absorbed. At larger wavelengths the radiation passes through the material without interaction. The cut-off wavelength corresponds to the bandgap of the material. As long as the energy of the photon is larger than the bandgap, carriers can be generated by absorption of photons, provided that the material is thick enough to propagate photon-carrier interaction. Bearing in mind that the energy of photons decreases with increasing wavelength, we can see, that the curve of the spectral responsivity vs. wavelength in ideal case (100 % efficiency) will have a triangular shape (see figure 13). For silicon photodetectors, the cut-off wavelength is near 1100 nm.

In most applications, it is not necessary to detect radiation with wavelengths larger than 1000 nm. Therefore, designers use a typical chip thickness of 200 µm to 300 µm, which results in reduced sensitivity at wavelengths larger than 950 nm. With a typical chip thickness of 250 µm, an efficiency of about 35 % at 1060 nm is achieved. At shorter wavelengths (blue-near UV, 500 nm to 300 nm) sensitivity is limited by recombination effects near the surface of the semiconductor. A reduction in efficiency starts near 500 nm and increases as the wavelength decreases. Standard detectors designed for visible and near IR radiation may have poor UV/blue sensitivity and poor UV stability. Well designed sensors for wavelengths of 300 nm to 400 nm can operate with fairly high efficiencies. At shorter wavelengths (< 300 nm), efficiency decreases strongly.

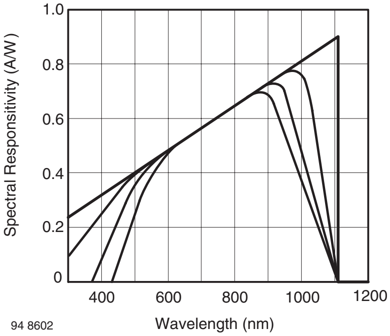


Fig. 13 - Spectral Responsivity as a Function of Wavelength of a Si Photodetector Diode, Ideal and Typical Values

Temperature dependence of spectral responsivity

The efficiency of carrier generation by absorption and the loss of carriers by recombination are the factors which influence spectral responsivity. The absorption coefficient increases with temperature. The radiation of the long wavelength is therefore more efficiently absorbed inside the bulk and results in increased response. For shorter wavelengths (< 600 nm), reduced efficiency is observed with increasing temperature because of increased recombination rates near the surface. These effects are strongly dependent on technological parameters and therefore cannot be generalized to the behavior at longer wavelengths.

Uniformity of spectral responsivity

Inside the technologically defined active area of photodiodes, spectral responsivity shows a variation of sensitivity on the order of < 1 %. Outside the defined active area, and especially at lateral edges of the chips, local spectral response is sensitive to applied reverse voltage. Additionally, this effect depends on wavelength. Therefore, the relation between power (W) related spectral responsivity, s_λ (A/W), and power density (W/cm^2) related spectral responsivity, s_λ [A/(W/cm^2)] is not a constant. Rather, this relation is a function of wavelength and reverse bias

Stability of spectral responsivity

Si detectors for wavelengths between 500 nm and 800 nm appear to be stable over very long periods of time. In the literature concerned here, remarks can be found on instabilities of detectors in blue, UV, and near IR under certain conditions. Thermal cycling reversed the degradation effects.

Surface effects and contamination are possible causes but are technologically well controlled.

Angular dependence of responsivity

The angular response of Si photodiodes is given by the optical laws of reflection. The angular response of a detector is shown in figure 14.

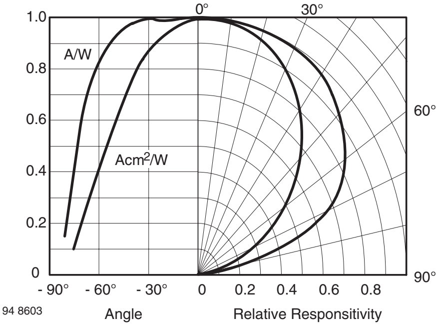


Fig. 14 - Responsivity of Si Photodiodes as a Function of the Angle of Incidence

Semiconductor surfaces are covered with quarter wavelength anti-reflection coatings. Encapsulation is performed with uncoated glass or sapphire windows.

The bare silicon response can be altered by optical imaging devices such as lenses. In this way, nearly every arbitrary angular response can be achieved.

Dynamic Properties of Si Photodiodes

Si photodiodes are available in many different variations. The design of diodes can be tailored to meet special needs. Si photodiodes may be designed for maximum efficiency at given wavelengths, for very low leakage currents, or for high speed. The design of a photodiode is nearly always a compromise between various aspects of a specification.

Inside the absorbing material of the diode, photons can be absorbed in different regions. For example at the top of a p^+n^--diode there is a highly doped layer of p^+ - Si. Radiation of shorter wavelengths will be effectively absorbed, but for larger wavelengths only a small amount is absorbed. In the vicinity of the pn junction, there is the space charge region, where most of the photons should generate carriers. An electric field accelerates the generated carrier in this part of the detector to a high drift velocity. Carriers which are not absorbed in these regions penetrate into field-free region where the motion of the generated carriers fluctuates by a slow diffusion process.

The dynamic response of the detector is composed of different processes which transport carriers to contacts. The dynamic response of photodiodes is influenced by three fundamental effects:

- Drift of carriers in an electric field
- Diffusion of carriers
- Capacitance x load resistance

Carrier drift in the space charge region occurs rapidly with very small time constants. Typically, transit times in an electric field of 0.6 V/µm are on the order of 16 ps/µm and 50 ps/µm for electrons and holes, respectively. At (maximum) saturation velocity, the transit time is on the order of 10 ps/µm for electrons in p-material. With a 10 µm drift region, travelling times of 100 ps can be expected. Response time is a function of the distribution of the generated carriers and is therefore dependent on wavelength.

The diffusion of the carriers is a very slow process. Time constants are on the order of some ms. The typical pulse response of the detectors is dominated by these two processes. Obviously, carriers should be absorbed in large space charge regions with high internal electrical fields. This requires material with an adequate low doping level.

Furthermore, a reverse bias of rather large voltage is useful. Radiation of shorter wavelength is absorbed in smaller penetration depths. At wavelengths shorter than 600 nm, decreasing wavelength leads to an absorption in the diffused top layer. The movement of carriers in this region is also diffusion limited. Because of the small carrier lifetimes, the time constants are not as large as in homogeneous substrate material.

Finally, capacitive loading of output in combination with load resistance limits frequency response.

PROPERTIES OF SILICON PHOTOTRANSISTORS

The phototransistor is equivalent to a photodiode in conjunction with a bipolar transistor amplifier (figure 15). Typically, the current amplification, B, is between 100 and 1000 depending on type and application. The active area of phototransistor is usually about 0.5 x 0.5 mm².

The data of spectral responsivity are equivalent to those of photodiodes, but must be multiplied by the factor current amplification, B.

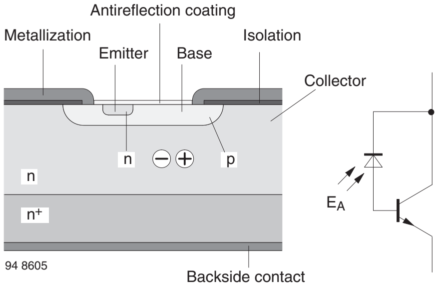


Fig. 15 - Phototransistor, Cross Section and Equivalent Circuit

The switching times of phototransistors are dependent on current amplification and load resistance and are between 30 ms and 1 ms. The resulting cut-off frequencies are a few hundred kHz.

The transit times, t_r and t_f, are given by

$$t_{r,\,f} = \sqrt{\left(1/2f_t^{\,2}\right)^2 + b\left(RC_BV\right)^2} \tag{10}$$

f_t: Transit frequency

R: Load resistance, 1.6

C_B: Base-collector capacitance, b= 4 to 5

V: Amplification

Phototransistors are most frequently applied in transmissive and reflective optical sensors.

Measurement Techniques

INTRODUCTION

The characteristics of optoelectronics devices given in datasheets are verified either by 100 % production tests followed by statistic evaluation or by sample tests on typical specimens. These tests can be divided into following categories:

- Dark measurements
- Light measurements
- Measurements of switching characteristics, cut-off frequency and capacitance
- Angular distribution measurements
- Spectral distribution measurements
- Thermal measurements

Dark and light measurements limits are 100 % measurements. All other values are typical. The basic circuits used for these measurements are shown in the following sections. The circuits may be modified slightly to accommodate special measurement requirements.

Most of the test circuits may be simplified by use of a source measure unit (SMU), which allows either to source voltage and measure current or to source current and measure voltage.

DARK AND LIGHT MEASUREMENTS

EMITTER DEVICES

IR Diodes (GaAs)

Forward voltage, V_F, is measured either on a curve tracer or statically using the circuit shown in figure 1. A specified forward current (from a constant current source) is passed through the device and the voltage developed across it is measured on a high-impedance voltmeter.

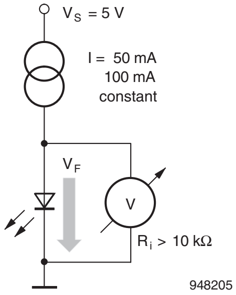


Fig. 1

To measure reverse voltage, V_R, a 10 µA or 100 µA reverse current from a constant current source is impressed through the diode (figure 2) and the voltage developed across is measured on a voltmeter of high input impedance (≥ 10 MΩ).

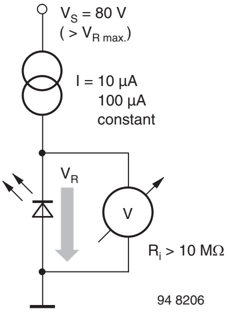


Fig. 2

For most devices, V_R is specified at 10 µA reverse current. In this case either a high impedance voltmeter has to be used, or current consumption of DVM has to be calculated and added to the specified current. A second measurement step will then give correct readings.

In case of GaAs IR diodes, total radiant output power, Φ_e, is usually measured. This is done with a calibrated large-area photovoltaic cell fitted in a conical reflector with a bore which accepts the test item - see figure 3. An alternative test set uses a silicon photodiode attached to an integrating sphere. A constant DC or pulsating forward current of specified magnitude is passed through the IR diode. The advantage of pulse-current measurements at room temperature (25 °C) is that results can be reproduced exactly.

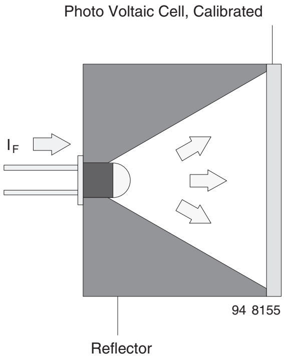


Fig. 3

If, for reasons of measurement economy, only DC measurements (figure 4) are to be made, then the energizing time should be kept short (below 1 s) and of uniform duration, to minimize any fall-off in light output due to internal heating.

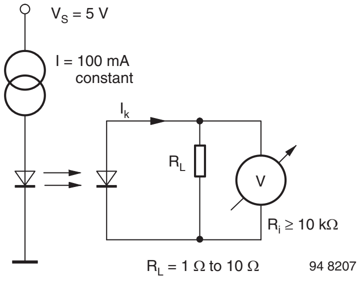


Fig. 4

To ensure that the relationship between irradiance and photocurrent is linear, the photodiode should operate near the short-circuit configuration. This can be achieved by using a low resistance load (≤ 10 Ω) of such a value that the voltage dropped across is very much lower than the open circuit voltage produced under identical illumination conditions ($R_{meas} << R_i$). The voltage across the load should be measured with a sensitive DVM.

A knowledge of radiant intensity, I_e, produced by an IR emitter enables customers to assess the range of IR light barriers. The measurement procedure for this is more or less the same as the one used for measuring radiant power. The only difference is that in this case the photodiode is used without a reflector and is mounted at a specified distance from, and on the optical axis of, the IR diode (figure 5). This way, only the radiant power of a narrow axial beam is considered.

The radiant power within a solid angle of Ω = 0.01 steradian (sr) is measured at a distance of 100 mm. Radiant intensity is then obtained by using this measured value for calculating the radiant intensity for a solid angle of Ω = 1 sr.

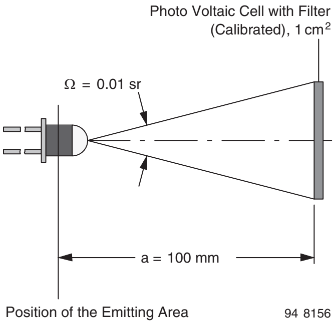


Fig. 5

DETECTOR DEVICES

Photovoltaic cells, photodiodes

- Dark measurements

The reverse voltage characteristic, V_R, is measured either on a curve tracer or statically using the circuit shown in figure 6. A high-impedance voltmeter, which draws only an insignificant fraction of device's reverse current, must be used.

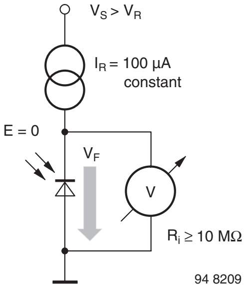


Fig. 6

Dark reverse current measurements, I_{ro}, must be carried out in complete darkness - reverse currents of silicon photodiodes are in the range of nanoamperes only, and an illumination of a few lx is quite sufficient to falsify the test result. If a highly sensitive DVM is to be used, then a current sampling resistor of such a value that voltage dropped across it is small in comparison with supply voltage must be connected in series with the test item (figure 7). Under these conditions, any reverse voltage variations of the test samples can be ignored. Shunt resistance (dark resistance) is determined by applying a very slight voltage to the photodiode and then measuring dark current. In case of 10 mV or less, forward and reverse polarity will result in similar readings.

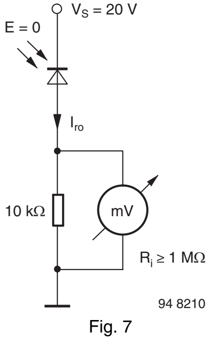


Fig. 7

- Light measurements

The same circuit as used in dark measurement can be used to carry out light reverse current, I_{ra}, measurements on photodiodes. The only difference is the diode is now irradiated and a current sampling resistor of lower value must be used (figure 8), because of the higher currents involved.

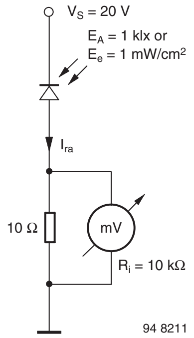


Fig. 8

The open circuit voltage, V_O, and short circuit current, I_k, of photovoltaic cells and photodiodes are measured by means of the test circuit shown in figure 9. The value of the load resistor used for the I_k measurement should be chosen so that the voltage dropped across it is low in comparison with the open circuit voltage produced under conditions of identical irradiation.

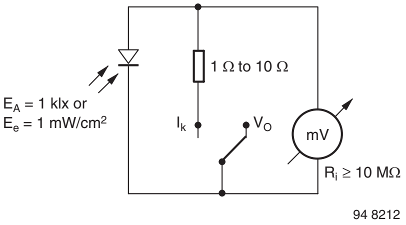


Fig. 9

The light source used for the light measurements is a calibrated incandescent tungsten lamp with no filters.

The filament current is adjusted for a color temperature of 2856 K (standard illuminant A to DIN 5033 sheet 7). A specified illumination, E_v, (usually 100 lx or 1000 lx) is produced by adjusting the distance, a, between the lamp and a detector on an optical bench. E_v can be measured on a V(λ)-corrected luxmeter, or, if luminous intensity, I_v, of the lamp is known, E_v can be calculated using the formula: $E_v = I_v/a^2$.

It should be noted that this inverse square law is only strictly accurate for point light sources, that is for sources where the dimensions of the source (the filament) are small ($\leq$ 10 %) in comparison with the distance between the source and detector.

Since lux is a measure for visible light only, near-infrared radiation (800 nm to 1100 nm) where silicon detectors have their peak sensitivity is not taken into account. Unfortunately, the near-infrared emission of filament lamps of various construction varies widely. As a result, light current measurements carried out with different lamps (but the same lux and color temperature calibration) may result in readings that differ up to 20 %.

The simplest way to overcome this problem is to calibrate (measure the light current) some items of a photodetector type with a standard lamp (OSRAM WI 41/G) and then use these devices for adjustment of the lamp used for field measurements.

An IR diode is used as a radiation source (instead of a Tungsten incandescent lamp), to measure detector devices being used mainly in IR transmission systems together with IR emitters (e.g., IR remote control, IR headphone). Operation is possible both with DC or pulsed current.

The adjustment of irradiance, E_e, is similar to the above mentioned adjustment of illuminance, E_v. To achieve a high stability similar to filament lamps, consideration should be given to the following two points:

- The IR emitter should be connected to a good heat sink to provide sufficient temperature stability.
- DC or pulse-current levels as well as pulse duration have great influence on self-heating of IR diodes and should be chosen carefully.
- The radiant intensity, I_e, of the device is permanently controlled by a calibrated detector.

Phototransistors

The collector emitter voltage, V_{CEO}, is measured either on a transistor curve tracer or statically using the circuit shown in figure 10. Normal bench illumination does not change the measured result.

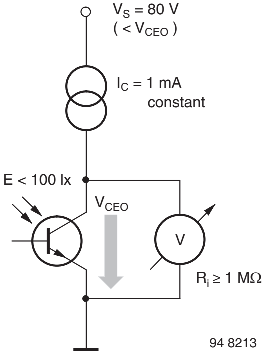


Fig. 10

In contrast, however, the collector dark current, I_{CEO} or I_{CO}, must be measured in complete darkness (figure 11). Even ordinary daylight illumination of the wire fed-through glass seals would falsify the measurement result.

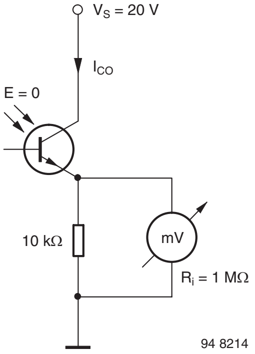


Fig. 11

The same circuit is used for collector light current, I_{ca}, measurements (figure 12). The optical axis of the device is aligned to an incandescent tungsten lamp with no filters, producing a CIE illuminance A of 100 lx or 1000 lx with a color temperature of T_f = 2856 K. Alternatively an IR irradiance by a GaAs diode can be used (refer to the photovoltaic cells and photodiodes section). Note that a lower sampling resistor is used, in keeping with the higher current involved.

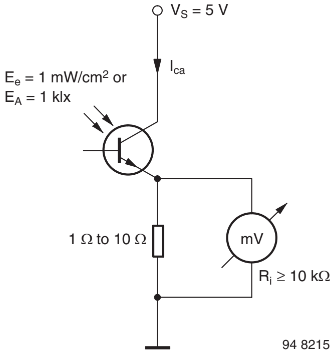


Fig. 12

To measure collector emitter saturation voltage, V_{CEsat}, the device is illuminated and a constant collector current is passed through. The magnitude of this current is adjusted below the level of the minimum light current, $I_{ca\ min}$, for the same illuminance (figure 13). The saturation voltage of the phototransistor (approximately 100 mV) is then measured on a high impedance voltmeter.

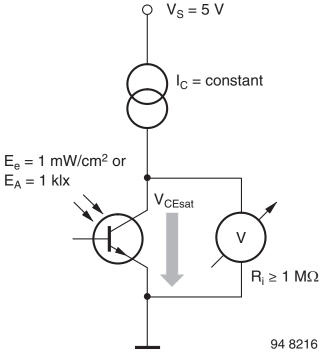


Fig. 13

SWITCHING CHARACTERISTICS

Definition

Each electronic device generates a certain delay between input and output signals as well as a certain amount of amplitude distortion. A simplified circuit (figure 14) shows how input and output signals of optoelectronic devices can be displayed on a dual-trace oscilloscope.

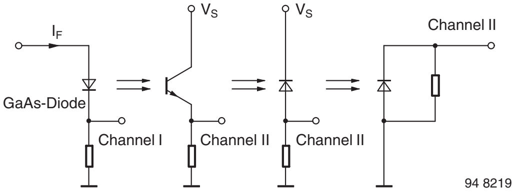


Fig. 14

The switching characteristics can be determined by comparing the timing of output current waveform with the input current waveform (figure 15).

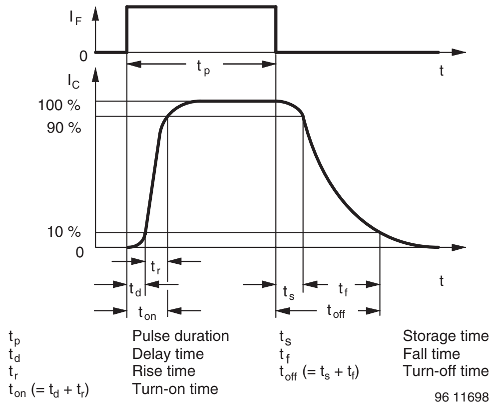


Fig. 15

These time parameters also include the delay existing in a luminescence diode between forward current (I_F) and radiant power Φ_e).

Notes Concerning the Test Set-up

Circuits used for testing IR emitting, emitting sensitive and optically coupled isolator devices are basically the same (figure 14). The only difference is the way in which test device is connected to the circuit.

It is assumed that rise and fall times associated with the signal source (pulse generator) and dual trace oscilloscope are insignificant, and that the switching characteristics of any radiant sensitive device used in set-up are considerably shorter than those of the test item. The switching characteristics of IR emitters, for example ($t_r \approx$ 10 ns to 1000 ns), are measured with aid of a PIN Photodiode detector ($t_r \approx$ 1 ns).

Photo- and darlington transistors and photo- and solar cells ($t_r \approx$ 0.5 µs to 50 µs) are, as a rule, measured by use of fast IR diodes ($t_r <$ 30 ns) as emitters.

Red light-emitting diodes are used as light sources only for devices which cannot be measured with IR diodes because of their spectral sensitivity (e.g. BPW21R). These diodes emit only 1/10 of radiant power of IR diodes and consequently generate only very low signal levels.

Switching Characteristic Improvements on Phototransistors and Darlington Phototransistors

As in any ordinary transistor, switching times are reduced if drive signal level, and hence collector current, is increased. Another time reduction (especially in fall time t_f) can be achieved by use of a suitable base resistor, assuming there is an external base connection, although this can only be done at the expense of sensitivity.

TECHNICAL DESCRIPTION - ASSEMBLY

Emitter

Emitters are manufactured using the most modern liquid phase epitaxy (LPE) process. By using this technology, the number of undesirable flaws in the crystal is reduced. This results in a higher quantum efficiency and thus higher radiation power. Distortions in the crystal are prevented by using mesa technology which leads to lower degradation. A further advantage of the mesa technology is that each individual chip can be tested optically and electrically, even on the wafer.

DETECTOR

Vishay Semiconductor detectors have been developed to match perfectly to emitters. They have low capacitance, high photosensitivity, and extremely low saturation voltage.

Silicon nitride passivation protects surface against possible impurities.

Assembly

Components are fitted onto lead frames by fully automatic equipment using conductive epoxy adhesive. Contacts are established automatically with digital pattern recognition using well-proven thermosonic techniques. All component are measured according to the parameter limits given in the datasheet.

Applications

Silicon photodetectors are used in manifold applications, such as sensors for radiation from near UV over visible to near infrared. There are numerous applications in measurement of light, such as dosimetry in UV, photometry, and radiometry. A well known application is shutter control in cameras.

Another large application area for detector diodes, and especially phototransistors, is position sensing.

Examples are differential diodes, optical sensors, and reflex sensors.

Other types of silicon detectors are built-in as parts of optocouplers.

One of the largest application areas is remote control of TV sets and other home entertainment appliances.

Different applications require specialized detectors and also special circuits to enable optimized functioning.

Equivalent circuit

Photodetector diodes can be described by the electrical equivalent circuit shown in figure 16.

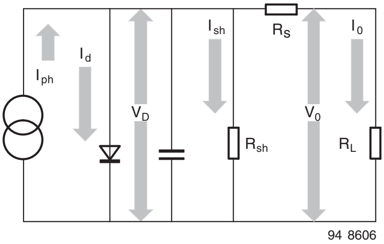


Fig. 16

$$I_O = I_{ph} - I_D - I_{sh} \quad (1)$$

$$I_O = I_{ph} - I_s\left(\exp\frac{qV_D}{kT} - 1\right) - I_{sh}$$

$$V_{OC} = V_T \times \ln\left(\frac{s(\lambda) \times \phi_e - I_{sh}}{I_s} + 1\right) \quad (2)$$

As described in the chapter “I-V Characteristics of illuminated pn junction”, the incident radiation generates a photocurrent loaded by a diode characteristic and load resistor, R_L. Other parts of the equivalent circuit (parallel capacitance, C, combined from junction, C_j, and stray capacitances, serial resistance, R_S, and shunt resistance, R_{sh}, representing an additional leakage) can be neglected in most standard applications, and are not expressed in equations 5 and 7 (see “Physics and Technology”). However, in applications with high frequencies or extreme irradiation levels, these parts must be regarded as limiting elements.

Searching for the right detector diode type

The BPW 20 RF photodiode is based on rather highly doped n-silicon, while BPW34 is a PIN photodiode based on very lightly doped n-silicon. Both diodes have the same active area and spectral response as a function of wavelength is very similar. These diodes differ in their junction capacitance and shunt resistance. Both can influence the performance of an application.

Detecting very small signals is the domain of photodiodes with their very small dark currents and dark/shunt resistances.

With a specialized detector technology, these parameters are very well controlled in all Vishay photodetectors.

The very small leakage currents of photodiodes are offset by higher capacitances and smaller bandwidths in comparison to PIN photodiodes.

Photodiodes are often operated in photovoltaic mode, especially in light meters. This is depicted in figure 17, where a strong logarithmic dependence of the open circuit voltage on the input signal is used.

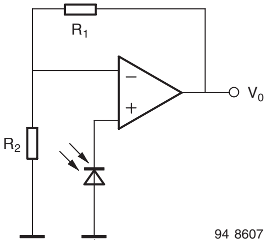


Fig. 17 - Photodiode in the Photovoltaic Mode Operating with a Voltage Amplifier

$$V_O \approx V_{OC} \times [1 + R_1/R_2] \text{ with} \quad (3)$$

$$V_{OC} = V_T \times \ln(s(\lambda) \times \phi_e/I_s + 1) \quad (2)$$

It should be noted that extremely high shunt/dark resistance (more than 15 GΩ) combined with a high-impedance operational amplifier input and a junction capacitance of about 1 nF can result in slow switch-off time constants of some seconds. Some instruments therefore have a reset button for shortening the diode before starting a measurement.

The photovoltaic mode of operation for precise measurements should be limited to the range of low ambient temperatures, or a temperature control of the diode (e.g., using a Peltier cooler) should be applied. At high temperatures, dark current is increased (see figure 18) leading to a non-logarithmic and temperature dependent output characteristic (see figure 19). The curves shown in figure 18 represent typical behavior of these diodes. Guaranteed leakage (dark reverse current) is specified with I_{ro} = 30 nA for standard types. This value is far from that one which is typically measured. Tighter customer specifications are available on request. The curve shown in figure 19 show the open circuit voltage as a function of irradiance with dark reverse current, I_S, as a parameter (in a first approximation increasing I_S and I_{sh} have the same effect). The parameter shown covers the possible spread of dark current. In combination with figure 18 one can project the extreme dependence of the open circuit voltage at high temperatures (figure 20).

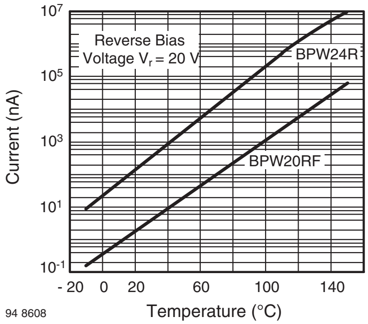


Fig. 18 - Reverse Dark Current vs. Temperature

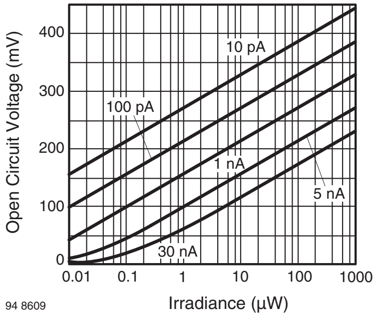


Fig. 19 - Open Circuit Voltage vs. Irradiance, Parameter: Dark Reverse Current, BPW20RF

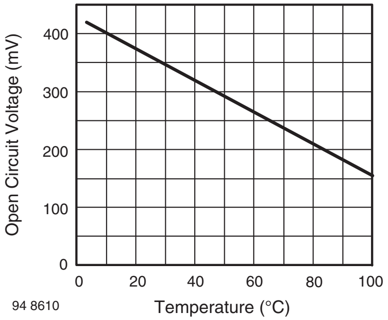


Fig. 20 - Open Circuit Voltage vs. Temperature, BPW46

Operating modes and circuits

The advantages and disadvantages of operating a photodiode in open circuit mode have been discussed.

For operation in short circuit mode (see figure 21) or photoconductive mode (see figure 22), current-to-voltage converters are typically used. In comparison with photovoltaic mode, the temperature dependence of the output signal is much lower. Generally, the temperature coefficient of the light reverse current is positive for irradiation with wavelengths > 900 nm, rising with increasing wavelength. For wavelengths < 600 nm, a negative temperature coefficient is found, likewise with increasing absolute value to shorter wavelengths.

Between these wavelength boundaries the output is almost independent of temperature. By using this mode of operation, the reverse biased or unbiased (short circuit conditions), output voltage, V_O, will be directly proportional to incident radiation, ϕ_e (see equation in figure 21).

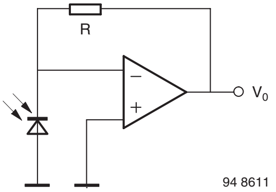


Fig. 21 - Transimpedance Amplifier, Current to Voltage Converter, Short Circuit Mode

$$V_O = -R \times \Phi_e \times s(\lambda) \tag{4}$$

$$V_O = -I_{sc} \times R \tag{5}$$

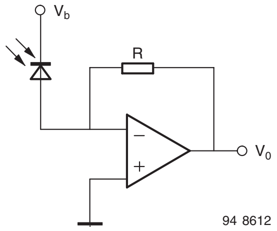


Fig. 22 - Transimpedance Amplifier, Current to Voltage Converter, Reverse Biased Photodiode

The circuit in figure 21 minimizes the effect of reverse dark current while the circuit in figure 22 improves the speed of the detector diode due to a wider space charge region with decreased junction capacitance and field increased velocity of the charge carrier transport.

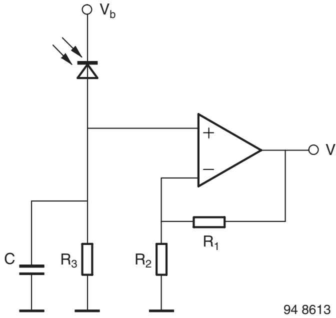


Fig. 23 - RC-Loaded Photodiode with Voltage Amplifier

Figure 23 shows photocurrent flowing into an RC load, where C represents junction and stray capacity while R_3 can be a real or complex load, such as a resonant circuit for the operating frequency.

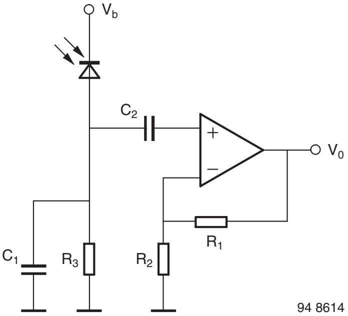


Fig. 24 - AC-Coupled Amplifier Circuit

$$V_O \approx \phi_e \times s(\lambda) \times R_3 \times [1 + R_1 / R_2] \qquad (6)$$

The circuit in figure 24 is equivalent to figure 23 with a change to AC coupling. In this case, the influence of background illumination can be separated from a modulated signal. The relation between input signal (irradiation, ϕ_e) and output voltage is given by the equation in figure 24.

Frequency response

The limitations of switching times in photodiodes are determined by carrier lifetime. Due to the absorption properties of silicon, especially in photodiodes, most of incident radiation at longer wavelengths is absorbed outside the space charge region. Therefore, a strong wavelength dependence of the switching times can be observed (figure 25).

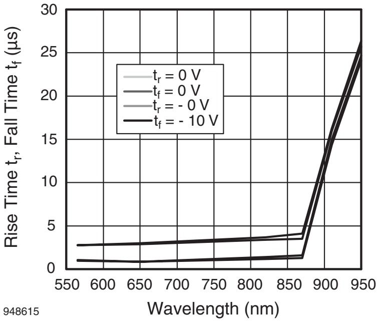


Fig. 25 - Switching Times vs. Wavelength for Photodiode BPW20RF

A drastic increase in rise and fall times is observed at wavelengths > 850 nm. Differences between unbiased and biased operation result from the widening of the space charge region.

However, for PIN photodiodes (BPW34/TEMD5000 family) similar results with shifted time scales are found. An example of such behavior, in this case in the frequency domain, is presented in figure 26 for a wavelength of 820 nm and figure 27 for 950 nm.

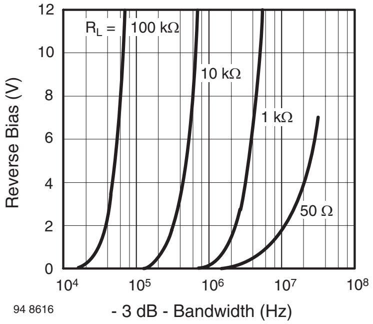


Fig. 26 - BPW34, TEMD5010X01, Bandwidth vs.
Reverse Bias Voltage, Parameter: Load Resistance, λ = 820 nm

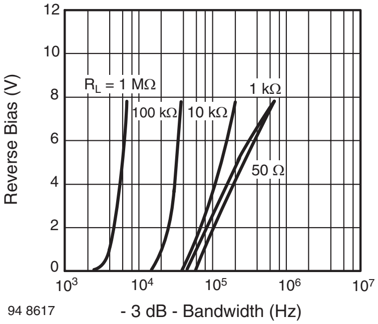


Fig. 27 - BPW41, TEMD5110X01, Bandwidth vs. Reverse Bias Voltage, Parameter: Load Resistance λ = 950 nm

Below about 870 nm, only slight wavelength dependence can be recognized, while a steep change of cut-off frequency takes place from 870 nm to 950 nm (different time scales in figure 26 and figure 27). Additionally, the influence of load resistances and reverse bias voltages can be taken from these diagrams.

For cut-off frequencies greater than 10 MHz to 20 MHz, depending on the supply voltage available for biasing the detector diode, PIN photodiodes are also used. However, for this frequency range, and especially when operating with low bias voltages, thin epitaxially grown intrinsic (i) layers are incorporated into PIN photodiodes.

As a result, these diodes (e.g., Vishay's TESP5700) can operate with low bias voltages (3 V to 4 V) with cut-off frequencies of 300 MHz at a wavelength of 790 nm. With application-specific optimized designs, PIN photodiodes with cut-off frequencies up to 1 GHz at only a 3 V bias voltage with only an insignificant loss of responsivity can be generated.

The main applications for these photodiodes are found in optical local area networks operating in the first optical window at wavelengths of 770 nm to 880 nm.

WHICH TYPE FOR WHICH APPLICATION?

In table 1, selected diode types are assigned to different applications. For more precise selection according to chip sizes and packages, refer to the tables in introductory pages of this data book.

TABLE 1 - PHOTODIODE REFERENCE TABLE

DETECTOR APPLICATION	PIN PHOTODIODE	PHOTODIODE	EPI PIN PHOTODIODE
Photometry, light meter		BPW21R	
Radiometry	TEMD5010X01, BPW34, BPW24R, ...	BPW20RF	
Light barriers	BPV10NF, BPW24R		
Remote control, IR filter included, λ > 900 nm	BPV20F, BPV23F, BPW41N, S186P, TEMD5100X01		
IR Data Transmission fc < 10 MHz IR filter included, λ > 820 nm	BPV23NF, BPW82, BPW83, BPV10NF, TEMD1020, TEMD5110X01		
IR Data Transmission, fc > 10 MHz, no IR filter	BPW34, BPW46, BPV10, TEMD5010X01		TESP5700
Densitometry	BPW34, BPV10, TEMD5010X01	BPW20RF, BPW21R	
Smoke detector	BPV22NF, BPW34, TEMD5010X01		

PHOTOTRANSISTOR CIRCUITS

A phototransistor typically operates in a circuit shown in figure 28. Resistor R_B can be omitted in most applications. In some phototransistors, the base terminal is not connected. R_B can be used to suppress background radiation by setting a threshold level (see equation 7 and 8)

$$V_O = V_S - B \times \phi_e \times s(\lambda) \times R_L \quad (7)$$

$$V_O \approx V_S - (B \times \phi_e \times s(\lambda) - 0.6/R_B) \times R_L \quad (8)$$

For the dependence of rise and fall times on load resistance and collector-base capacitance, see the chapter "Properties of Silicon Phototransistors".

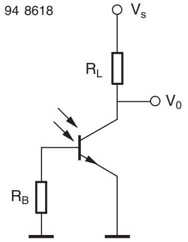
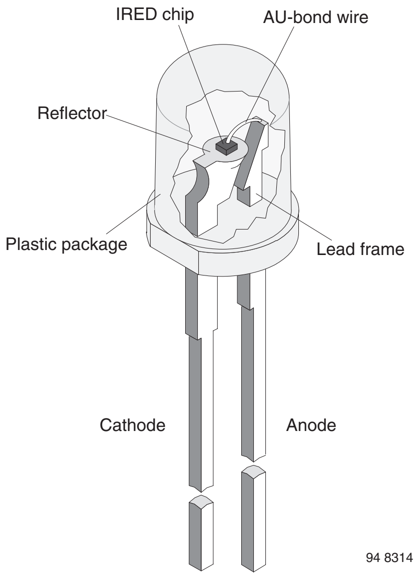
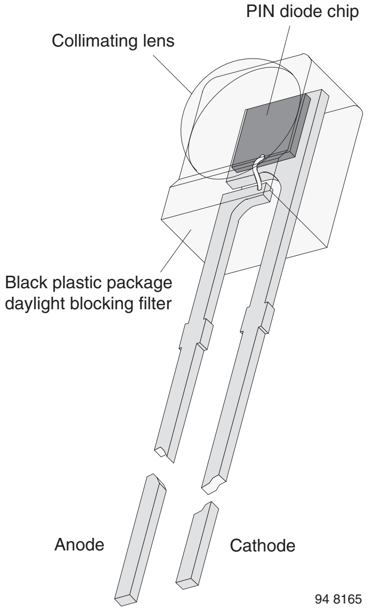


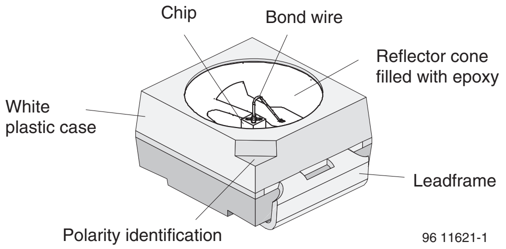
Fig. 28 - Phototransistor with Load Resistor and Optional Base Resistor

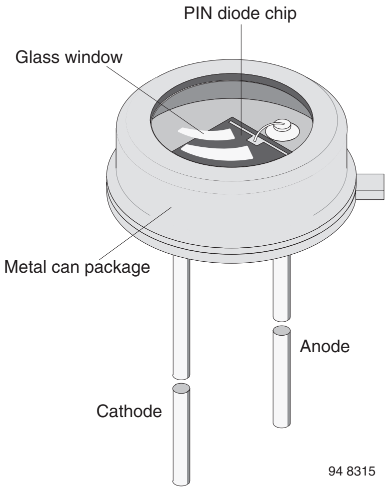
Component Construction

Photodetector and infrared emitter components are available in plastic or metal packages.
Plastic devices mostly include a lens to improve radiant sensitivity or radiant intensity. Detector chips are mounted on flat leadframe surfaces while leadframes for emitters have a silver plated reflector performing higher radiant intensity.
Devices in metal packages are hermetically sealed, are released for extended operating temperature range and have small optical and mechanical tolerances.









Packaging and Order Information

PACKAGING SURVEY

TABLE 1 - PACKAGING OPTIONS OF DETECTOR AND EMITTER DEVICES

PACKAGE FORM	SERIES	PACKAGING OPTION			
		BULK	TAPE	BLISTER TAPE	TUBE
Metal can	BPW./TS.	X			
Side view lens	TEKS5400.		X		
	TEKS5400S TEKT5400S TSKS5400S	X	X		
	TSKS542.X01		X		
SMD	TEM./TSM./ VEM./VSM.			X	
Top view mold	BP104 BPW34	X			
	BP104S BPW34S				X
Other leaded packages	BP./TE./TS.	X	X		

MOISTURE PROOF PACKAGING

The reel is packed in a moisture proof aluminum bag to protect devices from absorbing moisture during transportation and storage.

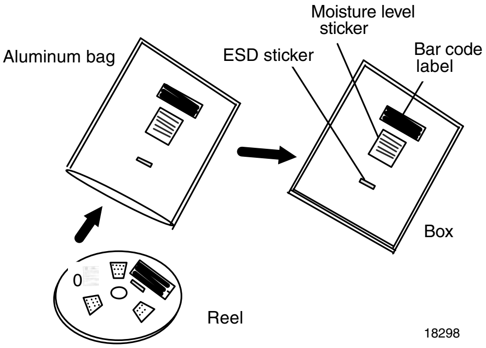


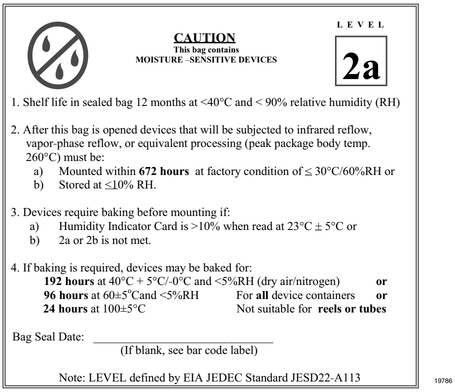
Fig. 1 - Moisture Proof Packaging

RECOMMENDED METHOD OF STORAGE

Dry box storage is recommended as soon as the dry bag has been opened to prevent moisture absorption.
The following conditions should be observed if dry boxes are not available:

- Storage temperature 10 °C to 30 °C
- Storage humidity ≤ 60 % RH max.

After storage longer than the specified floor life (see table 2), moisture content will be too high for reflow soldering. In case of moisture absorption, the devices will recover to their former condition by drying using conditions according to the individual moisture sensitivity level (MSL) specified on a sticker affixed to the dry bags (e.g. figure 2, MSL 2a).



LEVEL

2a

CAUTION

This bag contains
MOISTURE –SENSITIVE DEVICES

1. Shelf life in sealed bag 12 months at <40°C and < 90% relative humidity (RH)

2. After this bag is opened devices that will be subjected to infrared reflow, vapor-phase reflow, or equivalent processing (peak package body temp. 260°C) must be:
   a) Mounted within **672 hours** at factory condition of ≤ 30°C/60%RH or
   b) Stored at ≤10% RH.

3. Devices require baking before mounting if:
   a) Humidity Indicator Card is >10% when read at 23°C ± 5°C or
   b) 2a or 2b is not met.

4. If baking is required, devices may be baked for:
   192 hours at 40°C + 5°C/-0°C and <5%RH (dry air/nitrogen) **or**
   96 hours at 60±5°Cand <5%RH For **all** device containers **or**
   24 hours at 100±5°C Not suitable for **reels or tubes**

Bag Seal Date: ______________________________
(If blank, see bar code label)

Note: LEVEL defined by EIA JEDEC Standard JESD22-A113

Fig. 2 - Example of MSL Sticker

TABLE 2 - MOISTURE SENSITIVITY LEVEL, FLOOR LIFE AND FLOOR CONDITIONS

MSL	FLOOR LIFE	CONDITIONS
1	No limit	≤ 30 °C/90 % RH
2	1 year	≤ 30 °C/60 % RH
2a	672 h	
3	168 h	
4	72 h	
5	24h/48 h	
6	6 h	

ESD PRECAUTION

Proper storage and handling procedures should be followed to prevent ESD damage to the devices, especially when they are removed from the antistatic shielding bag.

BAR CODE LABELS

Vishay Semiconductor standard bar code labels are printed on the final package. Labels containing Vishay Semiconductor specific data are affixed to each package unit.

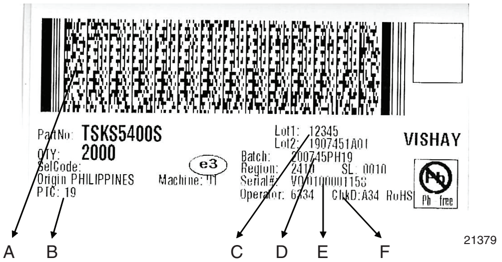


Fig. 3 - Bar code design and information

A) PDF417 bardoce including 325 char

B) Plant code according TQD9021
http://intra.hn.vishay.com/quality/docs/tqd/tqd_9021.htm

C) Lot1 and Lot2 reflects the lot numbers. Lot2 is a combination of 19 (PTC), 0745 (YYWW), 1 (production day MO=1, TU=2), A (Shift A,B,C) and 01 as production equipment

D) Batch contains the datecode 200745 (YYYYWW), origin (PH=Philippines), 19 (PTC)

E) Unique label serial number: VO production location (ISO), 01=label station ID, 00001158 (serial number)

F) Check digit: counting number starting at A00 up to Z99 to give e.g. a manufactured reel a serial number (track and trace information)

TAPING OF SMD

Vishay SMD IR emitters and detectors are packed in antistatic blister tapes (in accordance with DIN IEC 40 (CO) 564) for automatic component insertion. The blister tapes are plastic strips with impressed component cavities, which are covered by a glued top tape.

Missing Devices

A maximum of 0.5 % of the total number of components per reel may be missing, excluding missing components at the beginning and at the end of reel. A maximum of three consecutive components may be missing. This gap is followed by ≥ 6 consecutive components (minimum).

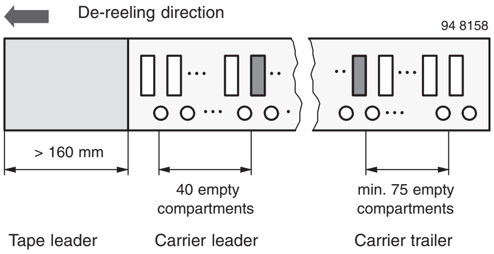


Fig. 4 - Beginning and End of Reel

TAPING SMD PLCC-2 PACKAGE

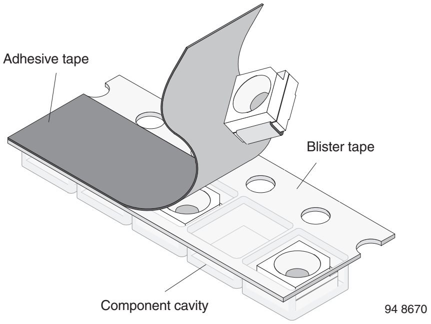


Fig. 5 - Blister Tape

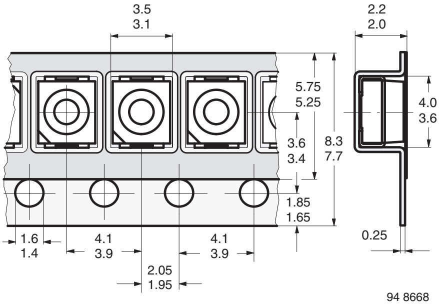


Fig. 6 - Tape Dimensions in mm for PLCC-2

TAPING STANDARDS GS08 AND GS18

GS08: 1500 pcs/reel

GS18: 8000 pcs/reel

The tape leader is at least 160 mm and is followed by a carrier tape leader with at least 40 empty compartments (figure 3). The tape leader may include carrier tape as long as the cover tape is not connected to carrier tape.

The last component is followed by a carrier tape trailer with at least 75 empty compartments, sealed with cover tape.

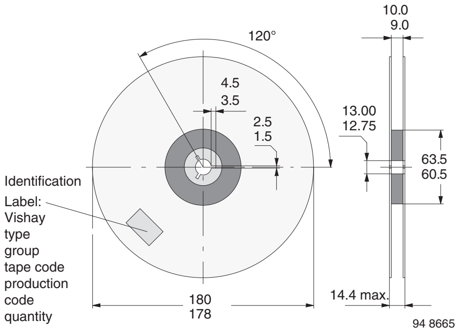


Fig. 7 - Reel Dimensions: GS08

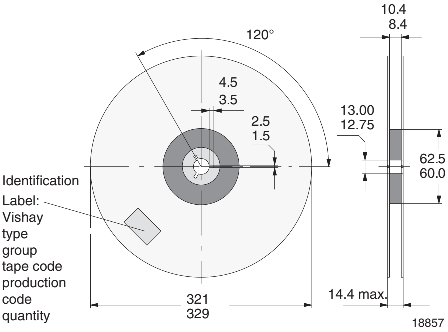


Fig. 8 - Reel Dimensions: GS18

COVER TAPE REMOVAL FORCE

The removal force may vary in strength between 0.1 N and 1.0 N at a removal speed of 5 mm/s.

In order to prevent components from popping out of blisters, the cover tape must be pulled off at an angle of 180° relative to the feed direction.

TAPING SMD WITH PCB OR DOME PACKAGE

Dimensions in millimeters

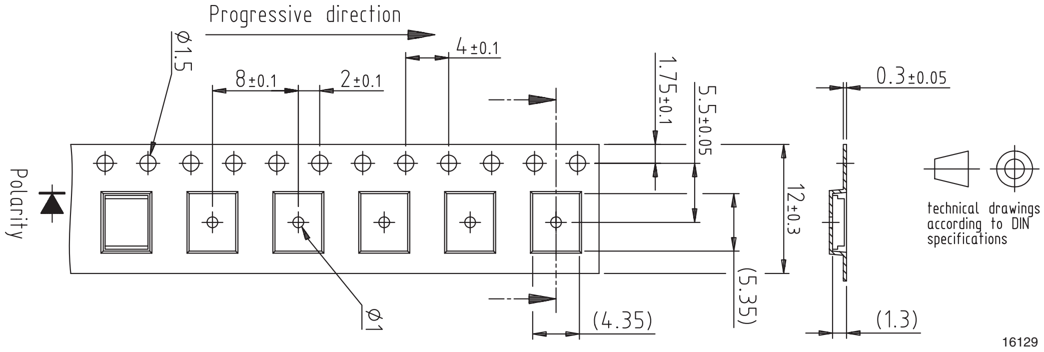


Fig. 9 - Blister Tape of TEMD5000 and TEMD5100

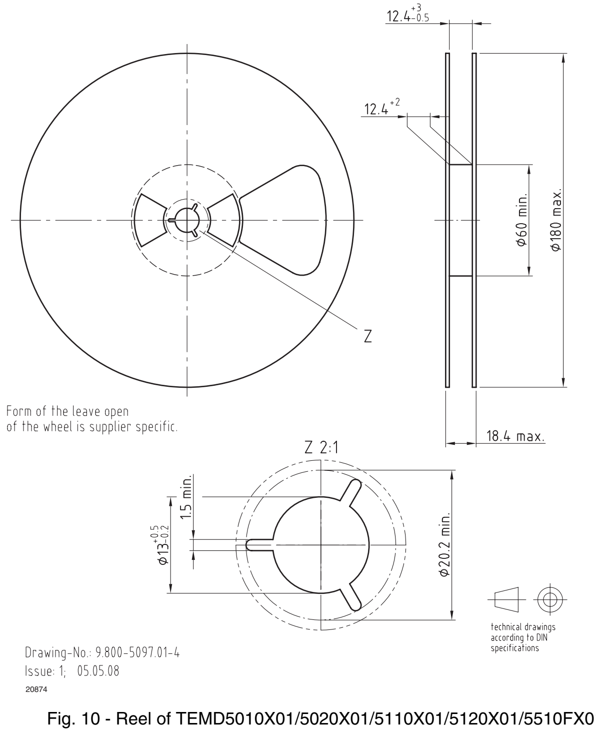


Fig. 10 - Reel of TEMD5010X01/5020X01/5110X01/5120X01/5510FX01

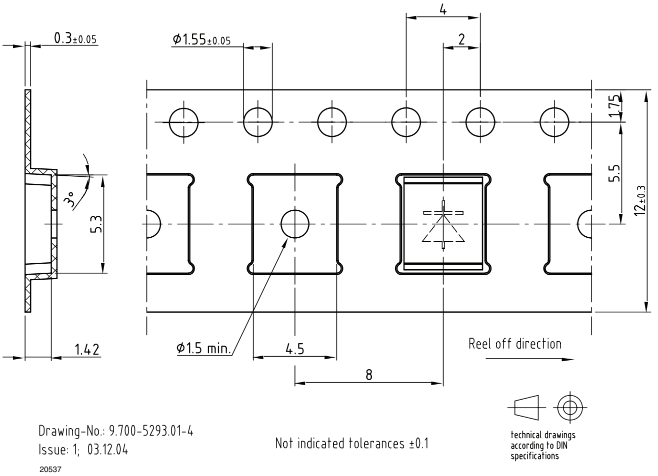


Fig. 11 - Blister Tape of TEMD5010X01/5020X01/5110X01/5120X01/5510FX01

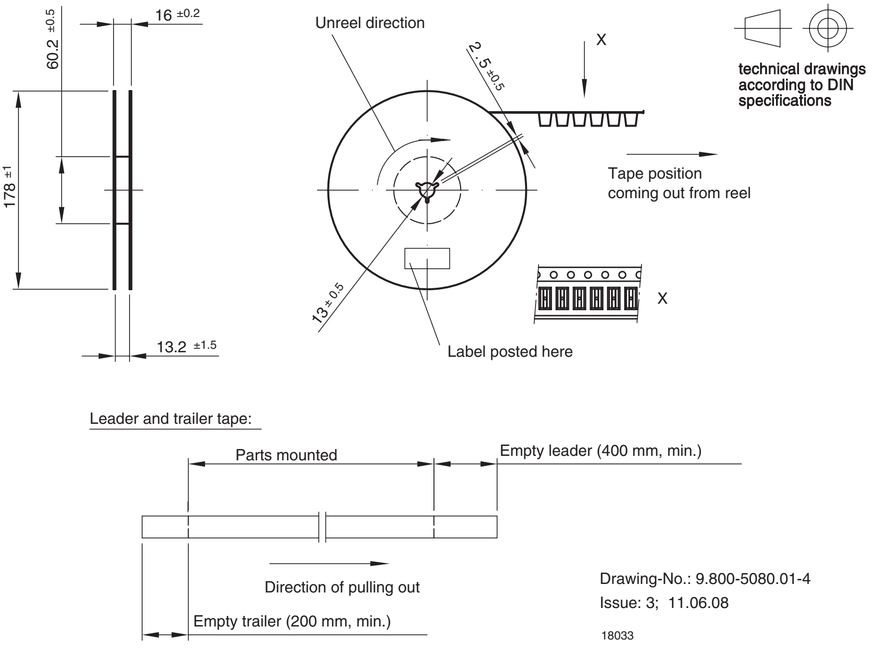


Fig. 12 - Reel of TEMx1000 Series and TSMx1000 Series
Quantity per Reel: 1000 pcs

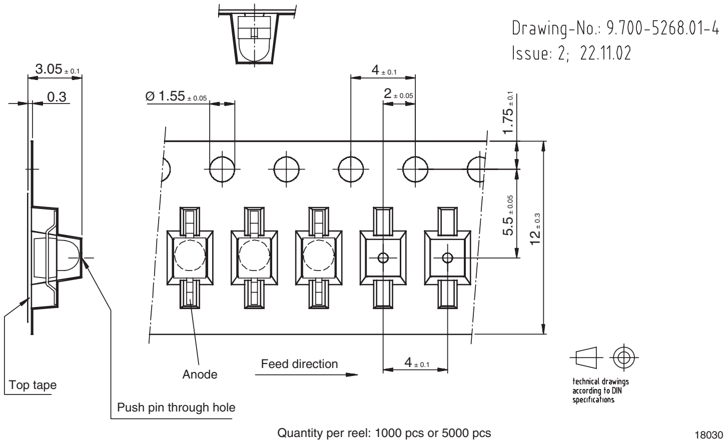


Fig. 13 - Blister Tape of TSMF1000, TSML1000, and TEMD1000

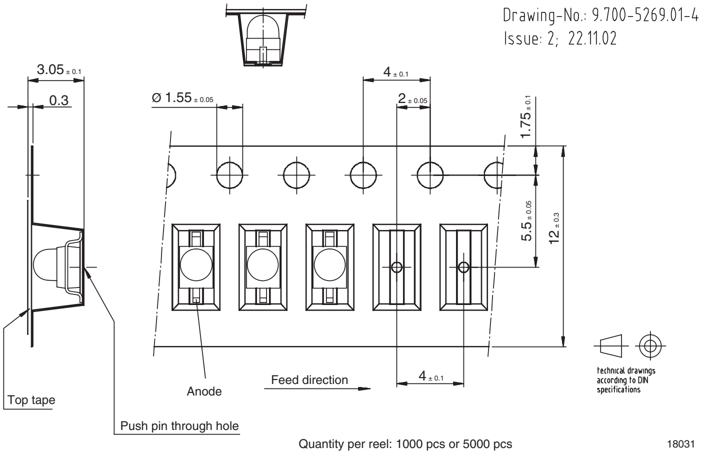


Fig. 14 - Blister Tape of TSMF1020, TSML1020, and TEMD1020

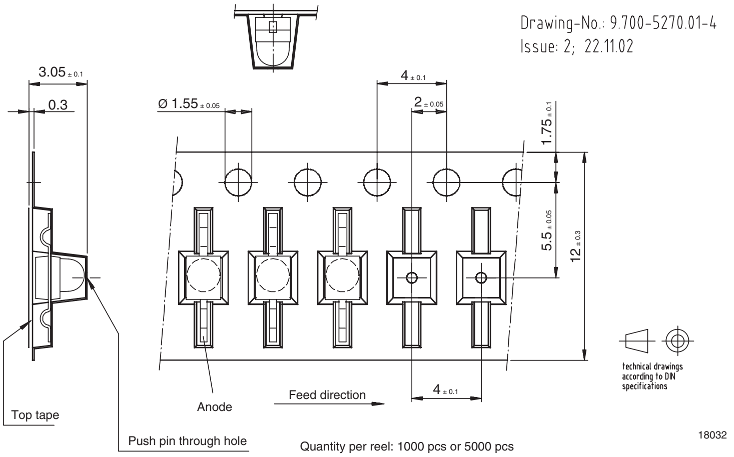


Fig. 15 - Blister Tape of TSMF1030, TSML1030, and TEMD1030

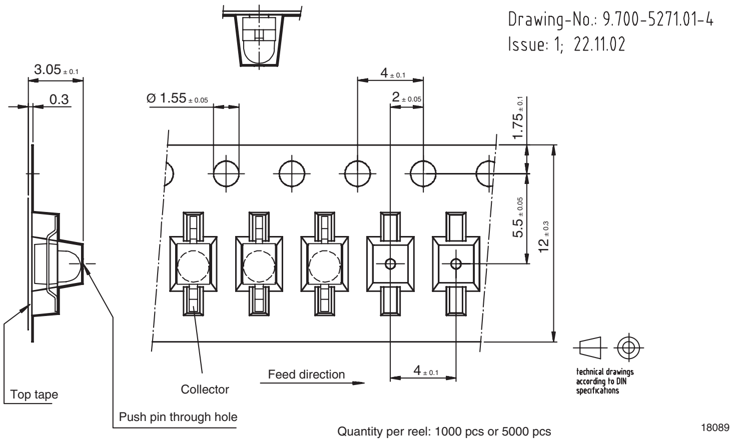
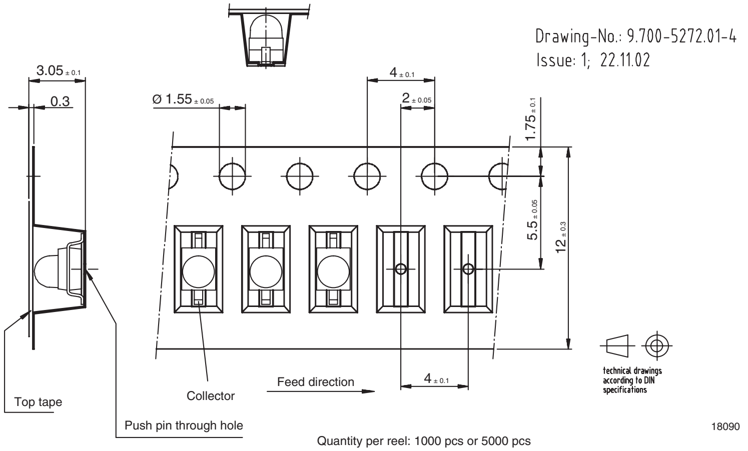
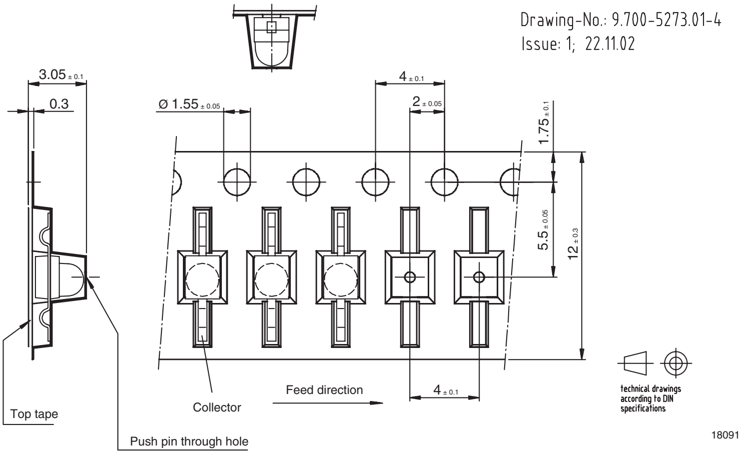


Fig. 16 - Blister Tape of TEMT1000



Quantity per reel: 1000 pcs or 5000 pcs

Fig. 17 - Blister Tape of TEMT1020 and TEMT1520



Quantity per reel: 1000 pcs or 5000 pcs

Fig. 18 - Blister Tape of TEMT1030

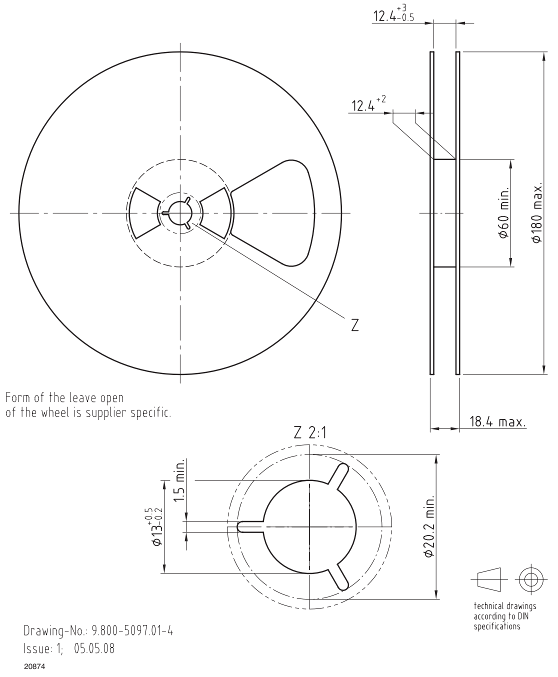


Fig. 19 - Reel of TEMx6000 Series
Quantity per Reel: 3000 pcs

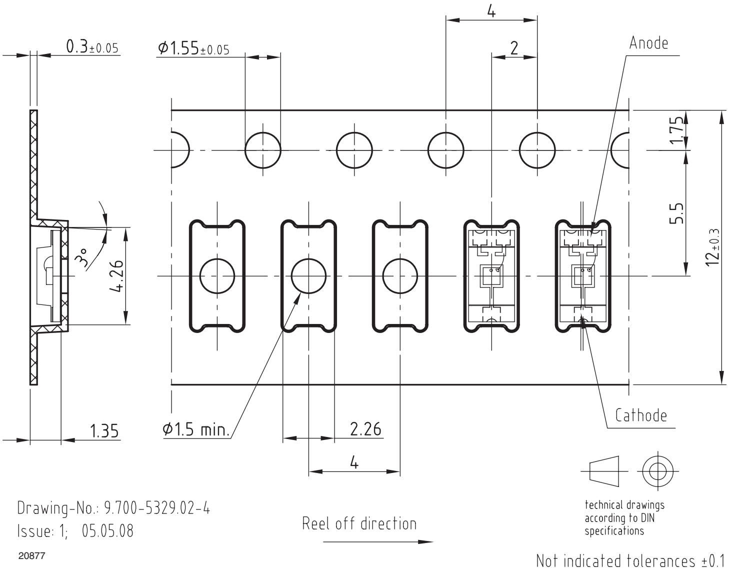


Fig. 20 - Blister Tape of TEMD6010FX01

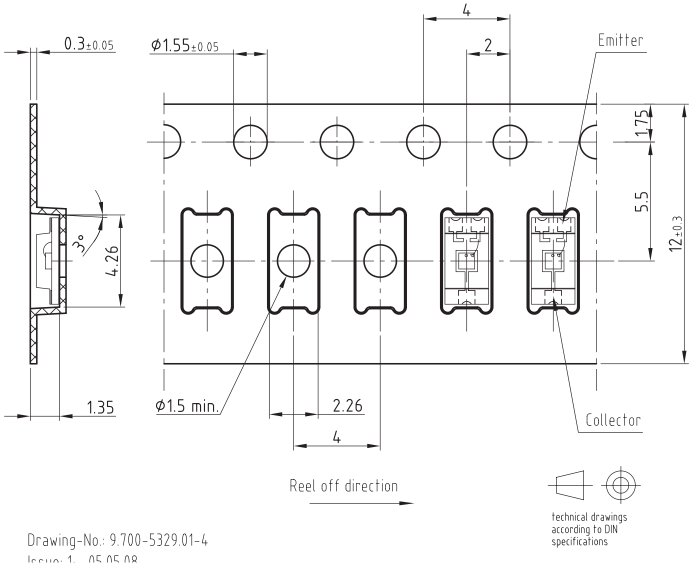


Fig. 21 - Blister Tape of TEMT6000X01

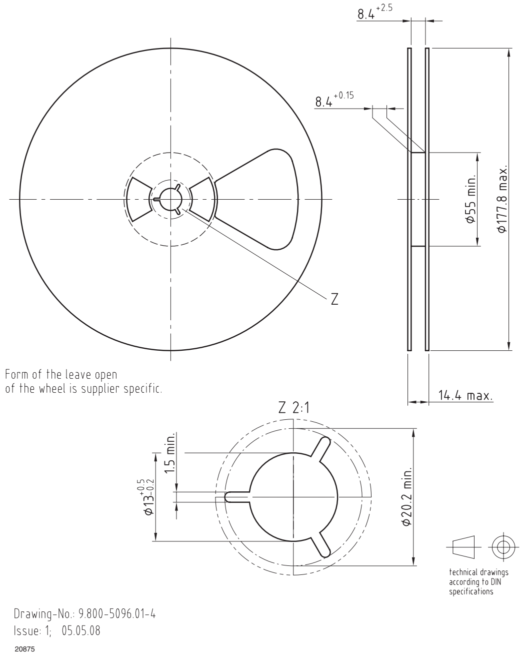


Fig. 22 - Reel of TEMx6200X01 Series
Quantity per reel: 3000 pcs

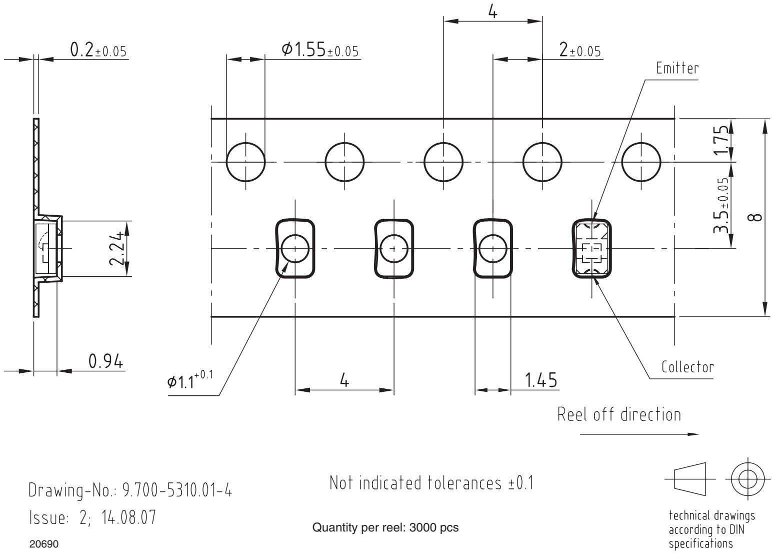


Fig. 23 - Blister Tape of TEMT6200FX01

TAPING OF T-1 (3 mm) AND T-1 3/4 (5 mm) DEVICES

The taping specification is based on IEC publication 286, taking into account industrial requirements for automatic insertion.

Absolute maximum ratings, mechanical dimensions, optical and electrical characteristics for taped devices are identical to basic catalog types and can be found in specifications for untaped devices.

Note that the lead wires of taped components may be shorted or bent in accordance to the IEC standard.

PACKAGING

The tapes of components are available on reels or in Ammopack. Each reel and each box is marked with label containing the following information:

- Vishay
- Type
- Group
- Tape code (see figure 24)
- Productions code
- Quantity

CODE FOR TAPED DEVICES

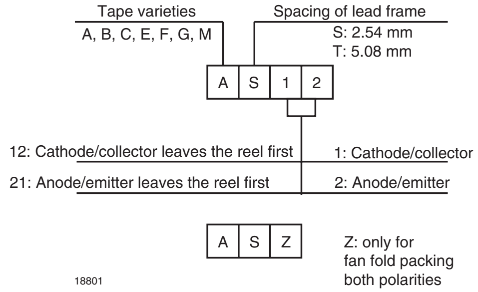


Fig. 24 - Taping Code

Number of Packed Components

T-1 (3 mm): 2000 pcs

T-1 3/4 (5 mm): 1000 pcs

MISSING COMPONENTS

Up to 3 consecutive components may be missing but the gap is followed by at least 6 components. A maximum of 0.5 % of components per reel quantity may be missing. At least 5 empty positions are present at the start and the end of the tape to enable tape insertion.

Tensile strength of the tape: ≥ 15 N

Pulling force in plane of the tape, at right angles to reel: ≥ 5 N

Note: Shipment in fan-fold packages is standard for radial taped devices.

Shipment in reel packing is only possible if the customer guarantees removal of empty reels.

According to what is stated in a German packaging decree (Verpackungsverordnung) we are not able to accept return of reels.

ORDERING CODE

Type designations are extended by a code for the taping standard.

Example:

TSAL6200-AS12 (reel packing)
TSAL6200-ASZ (fan-fold packing)
BPW85-AS12 (reel packing)

TABLE 3: TAPING SURVEY OF LEADED COMPONENTS

CODE FOR TAPING STANDARD	"H" - HIGH OF TAPING IN mm (TOLERANCES ± 0.5 mm)			PREFERENCES	REMARKS
	3 mm	5 mm	SIDEVIEW'S		
AS12	17.3	17.3	16.0	Standard	Reel, cathode/collector leaves first
AS21					Reel, anode/emitter leaves first
ASZ					Ammopack
CS12	22.0	22.0	-		Reel, cathode/collector leaves first
CS21					Reel, anode/emitter leaves first
CSZ					Ammopack
ES12	-	24.0	24.0	Standard	Reel, cathode/collector leaves first
ES21					Reel, anode/emitter leaves first
ESZ					Ammopack
EGZ	-	-	24.0		Ammopack 2 mm pin distance lead to lead
MS12	25.5	25.5	-		Reel, cathode/collector leaves first
MS21					Reel, anode/emitter leaves first
MSZ					Ammopack
GSZ	-	-	29.0		Ammopack 2 mm pin distance lead to lead
FSZ	-	-	27.0	Standard	Ammopack
FGZ	-	-	27.0		Ammopack 2 mm pin distance lead to lead

REEL DIMENSIONS in millimeters

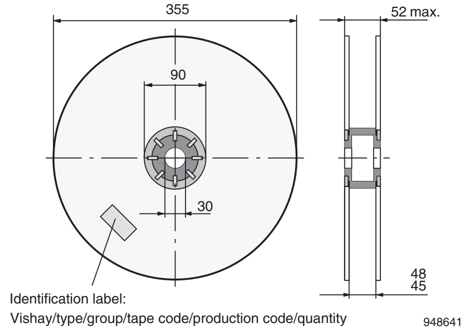


Fig. 25 - Dimensions of the Reel

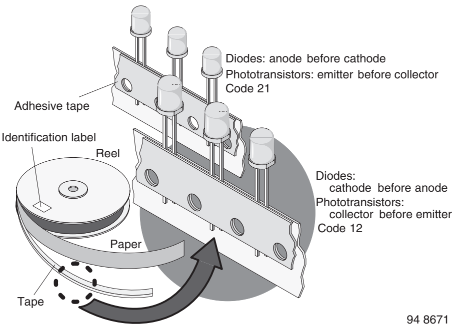


Fig. 26 - Components on Tape and Reel

AMMOPACK

The tape is folded in a concertina arrangement and laid in a cardboard box.

If components are required to have the cathode or collector leave the box first (figure 27), then open the box at the side marked with the "-" symbol. If anode or emitter sould leave the box first, then open at the side marked with the "+" symbol.

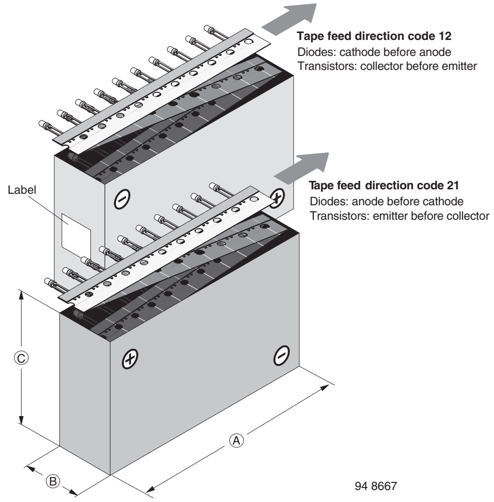


Fig. 27 - Tape Feed Direction

TABLE 4 - INNER DIMENSIONS OF AMMOPACK

A mm	B mm	C mm	COMPONENTS
340	46	125	T-1 3/4 (5 mm)
340	34	140	T-1 (3 mm) AS-taping
340	41	140	T-1 (3 mm) other than AS-taping
348	43	125	FSZ side view lens
348	46	125	GSZ side view lens

TAPING OF T-1 (3 mm) PACKAGES

Polarity options: Z, 12, 21

TABLE 5 - POSITION OF T-1 (3 mm) COMPONENTS IN TAPE

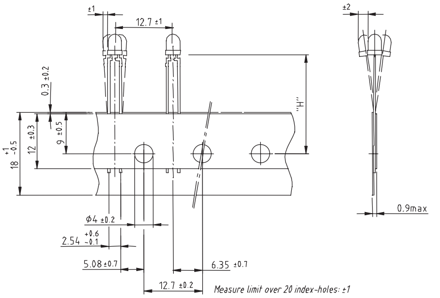
OPTION	H	PREFERENCE
AS	17.3 ± 0.5 mm	recommended
MS	25.5 ± 0.5 mm	recommended
CS	22.0 ± 0.5 mm	

TAPING OF T-1 3/4 (5 mm) PACKAGES

Polarity options: Z, 12, 21

TABLE 6 - POSITION OF T-1 3/4 (5 mm) COMPONENTS IN TAPE

OPTION	H	PREFERENCE
AS	17.3 ± 0.5 mm	recommended
MS	25.5 ± 0.5 mm	recommended
CS	22.0 ± 0.5 mm	
ES	24.0 ± 0.5 mm	

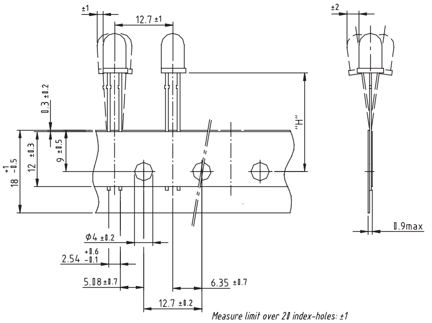


Measure limit over 20 index-holes: ±1

Quantity per:	Reel (Mat. - No. 1764)
	2000

94 8171

Fig. 28 - Taping of T-1 (3 mm) Devices

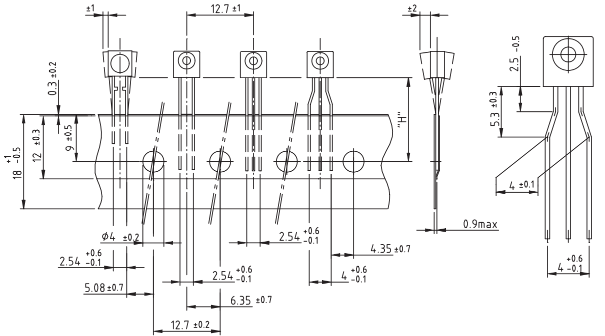


Measure limit over 20 index-holes: ±1

Quantity per:	Reel (Mat. - No. 1764)
	1000

94 8172

Fig. 29 - Taping of T-1 3/4 (5 mm) Devices



Measure limit over 20 index-holes: ±1

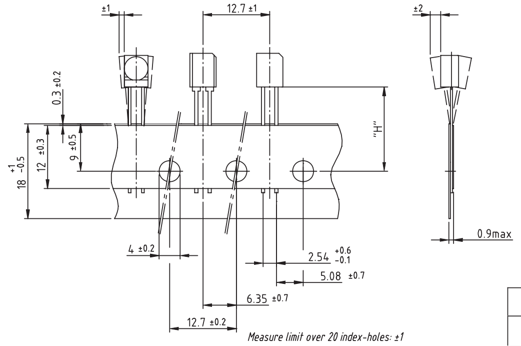
Bend leads:
Lead standard xG
Straight leads:
Lead standard xS

Option	H
AS	16 ± 0.5 mm
ES	24 ± 0.5 mm
FS	27 ± 0.5 mm
GS	29 $^{+0.2}_{-0.5}$ mm
EG	24 ± 0.5 mm
FG	27 ± 0.5 mm

Quantity per:	Ammopack (Mat. - No. 1763)
	2000

18886

Fig. 30 - Taping of Side View Lens Packages



Option	H
AS	16 ± 0.5 mm
ES	24 ± 0.5 mm
MS	25.5 ± 0.5 mm

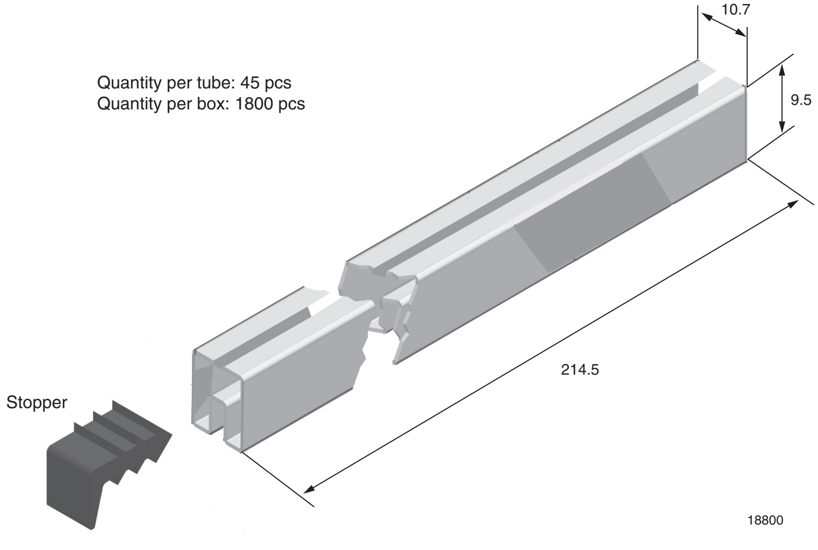
Quantity per:	Reel (Mat. - No. 1764)
	1000

18887

Fig. 31 - Taping of Side View PIN Photodiodes

TUBE PACKAGING OF TOP VIEW PIN PHOTODIODES BP104S AND BPW34S

Dimensions in millimeters



Quantity per tube: 45 pcs
Quantity per box: 1800 pcs

Fig. 32 - Drawing Proportions Not Scaled

Assembly Instructions

GENERAL

Optoelectronic semiconductor devices can be mounted in any position. Connection wires may be bent provided the bend is not less than 1.5 mm from bottom of case. During bending, no forces must be transmitted from pins to case (e.g., by spreading the pins).
If the device is to be mounted near heat generating components, the resultant increase in ambient temperature should be taken into account.

SOLDERING INSTRUCTIONS

Protection against overheating is essential when a device is being soldered. It is recommended, therefore, that the connection wires be left in place as long as possible. The maximum permissible device junction temperature should be exceeded for as little time as possible, and for no longer than specified in the solder profiles, during the soldering process.
In case of plastic encapsulated devices, the maximum permissible soldering temperature is governed by the maximum permissible heat that may be applied to encapsulants rather than by the maximum permissible junction temperature.
Maximum soldering iron (or solder bath) temperatures are given in table 1. During soldering, no forces must be transmitted from pins to case (e.g., by spreading pins).

SOLDERING METHODS

There are several methods in use to solder devices onto the substrate. Some of them are listed in the following sections.

Vapor Phase Soldering

Soldering in saturated vapor is also known as condensation soldering. This soldering process is used as a batch system (dual vapor system) or as a continuous single vapor system. Both systems may also include preheating of the assemblies to prevent high-temperature shock and other undesired effects.

Infrared soldering

With infrared (IR) reflow soldering the heating is contact-free and the energy for heating the assembly is derived from direct infrared radiation and from convection (Refer to CECC00802).
The heating rate in an IR furnace depends on the absorption coefficients of the material surfaces and on the ratio of component’s mass to its irradiated surface.
The temperature of components in an IR furnace, with a mixture of radiation and convection, cannot be determined in advance. Temperature measurement may be performed by measuring the temperature of a certain component while it is being transported through furnace.
The temperatures of small components, soldered together with larger ones, may rise up to 280 °C.
The following parameters influence the internal temperature of a component:

- Time and power
- Mass of component
- Size of component
- Size of printed circuit board
- Absorption coefficient of surfaces
- Packaging density
- Wavelength spectrum of radiation source
- Ratio of radiated and convected energy

Temperature-time profiles of the entire process and the above parameters are given in figures 1 and 2.

TABLE 1- MAXIMUM SOLDERING TEMPERATURES

	IRON SOLDERING			WAVE SOLDERING		
	IRON TEMPERATURE	DISTANCE OF THE SOLDERING POSITION FROM THE LOWER EDGE OF THE CASE	MAXIMUM ALLOWABLE SOLDERING TIME	SOLDERING TEMPERATURE SEE TEMPERATURE TIME PROFILES	DISTANCE OF THE SOLDERING POSITION FROM THE LOWER EDGE OF THE CASE	MAXIMUM ALLOWABLE SOLDERING TIME
Devices in metal case	≤ 245 °C	≥ 1.5 mm	5 s	245 °C	≥ 1.5 mm	5 s
	≤ 245 °C	≥ 5.0 mm	10 s			
	≤ 350 °C	≥ 5.0 mm	5 s	300 °C	≥ 5.0 mm	3 s
Devices in plastic case > 3 mm	≤ 260 °C	≥ 2.0 mm	5 s	235 °C	≥ 2.0 mm	8 s
	≤ 300 °C	≥ 5.0 mm	3 s	260 °C	≥ 2.0 mm	5 s
Devices in plastic case ≤ 3 mm	≤ 300 °C	≥ 5.0 mm	3 s	260 °C	≥ 2.0 mm	3 s

Wave soldering

In wave soldering, one or more continuously replenished waves of molten solder are generated, while the substrates to be soldered are moved in one direction across the wave’s crest.

Temperature-time profiles of the entire process are given in figure 3.

Iron soldering

This process cannot be carried out in a controlled way.

It should not be considered for use in applications where reliability is important. There is no SMD classification for this process.

Laser soldering

This is an excess heating soldering method. The energy absorbed may heat device to a much higher temperature than desired. There is no SMD classification for this process at the moment.

Resistance soldering

This is a soldering method which uses temperature controlled tools (thermodes) for making solder joints. There is no SMD classification for this process at the moment.

WARNING

Surface-mount devices are sensitive to moisture release if they are subjected to infrared reflow or a similar soldering process (e.g. wave soldering). After opening the bag, they must be:

1. stored at ambient of < 20 % relative humidity (RH)
2. mounted within floor life specified on MSL sticker under factory conditions of T_{amb} < 30 °C/RH < 60 %

Devices require baking before mounting if 1. or 2. is not met and the humidity indicator card is > 20 % at 23 ± 5 °C. If baking is required, devices may be baked for 192 h at 40 °C + 5 °C - 0 °C and < 5 % RH.

TEMPERATURE-TIME PROFILES

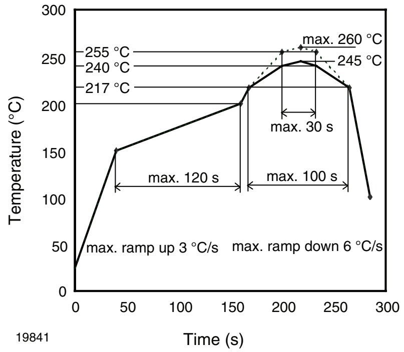


Fig. 1 - Lead (Pb)-free (Sn) Infrared Reflow Solder Profile acc. J-STD020D for Surface-Mount Components

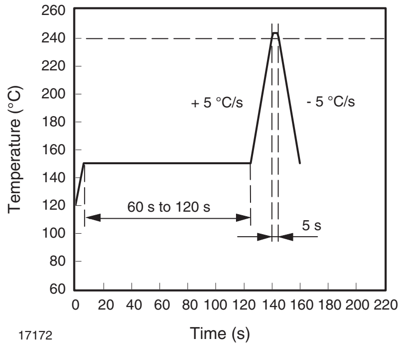


Fig. 2 - Infrared Reflow SnPb Solder Profile for Surface-Mount Components like TEMx1xxx and TSMx1xxx

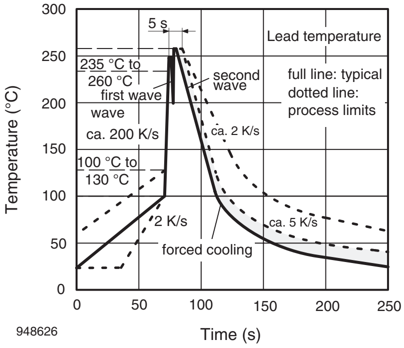


Fig. 3 - Double Wave Solder Profile for Leaded Components

HEAT REMOVAL

To maintain thermal equilibrium, the heat generated in the semiconductor junction(s) must be removed to keep the junction temperature below specified maximum.

In case of low-power devices, the natural heat conductive path between the case and surrounding air is usually adequate for this purpose. The heat generated in the junction is conveyed to the case or the header by conduction rather than convection. A measure of the effectiveness of heat conduction is the inner thermal resistance or the junction-to-case thermal resistance, R_{thJC}, which is governed by the device construction.

Any heat transfer from the case to the surrounding air involves radiation convection and conduction, the effectiveness of transfer being expressed in terms of an R_{thCA} value, i.e., external or case ambient thermal resistance. The total junction-to-ambient thermal resistance is consequently:

$R_{thJA} = R_{thJC} + R_{thCA}$

The total maximum power dissipation, $P_{totmax.}$ of a semiconductor device can be expressed as follows:

$$P_{totmax.} = \frac{T_{jmax.} - T_{amb}}{R_{thJA}} = \frac{T_{jmax.} - T_{amb}}{R_{thJC} + R_{thCA}}$$

where:

$T_{jmax.}$	the maximum allowable junction temperature
T_{amb}	the highest ambient temperature likely to be reached under the most unfavorable conditions
R_{thJC}	junction-to-case thermal resistance
R_{thJA}	the junction-to-ambient thermal resistance, is specified for the components. The following diagram shows how the different installation conditions effect the thermal resistance
R_{thCA}	the case-to-ambient thermal resistance, R_{thCA}, depends on cooling conditions. If a heat dissipator or sink is used, R_{thCA} depends on the thermal contact between the case and heat sink, upon the heat propagation conditions in the sink, and upon the rate at which heat is transferred to the surrounding air

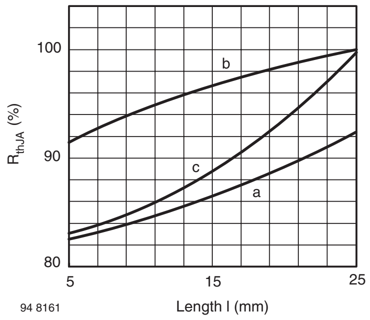


Fig. 4 - Junction-to-Ambient Thermal Resistance vs.

Lead Length at Different Assembly

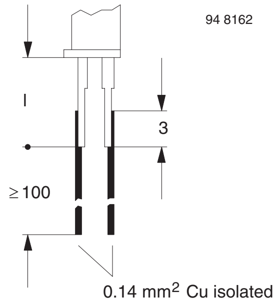


Fig. 5 - In Case of Wire Contacts (Curve B, Figure 4)

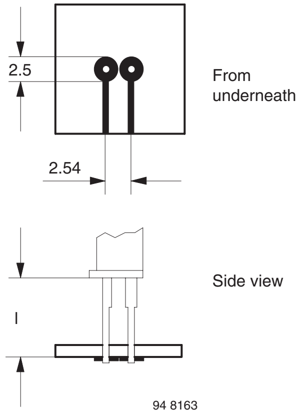


Fig. 6 - In Case of Assembly on PC Board, no Heatsink (Curve C, Figure 4)

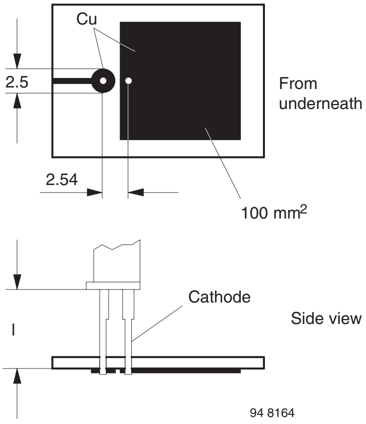


Fig. 7 - In Case of Assembly on PC Board, with Heatsink (Curve A, Figure 4)

Quality Information

Corporate Quality Policy

Our goal is to exceed the quality expectations of our customers. This commitment starts with top management and extends through the entire organization. It is achieved through innovation, technical excellence and continuous improvement.

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Fig. 1 - Vishay Quality Policy

VISHAY INTERTECHNOLOGY, INC.

ENVIRONMENTAL, HEALTH AND SAFETY POLICY

VISHAY INTERTECHNOLOGY, INC. is committed to conducting its worldwide operations in a socially responsible and ethical manner to protect the environment, and ensure the safety and health of our employees, to conduct their daily activities in an environmentally responsible manner.

Protection of the Environment: Conduct our business operation in a manner that protects the environmental quality of the communities in which our facilities are located. Reduce risks involved with storage and use of hazardous materials. The company is also committed to continual improvement of its environmental performance.

Compliance with Environmental, Health and Safety Laws and Regulations:
Comply with all relevant environmental, health and safety laws and regulations in every location. Maintain a system that provides timely updates of regulatory change. Cooperate fully with governmental agencies in meeting applicable requirements.

Energy, Resource Conservation and Pollution Control: Strive to minimize energy and material consumption in the design of products and processes, and in the operation of our facilities. Promote the recycling of materials, including hazardous wastes, whenever possible. Minimize the generation of hazardous and non-hazardous wastes at our facilities to prevent or eliminate pollution. Manage and dispose of wastes safely and responsibly.

Fig. 2 - Vishay Quality Road Map

QUALITY SYSTEM

QUALITY PROGRAM

At the heart of the quality process is the Vishay worldwide quality program. This program, which has been in place since the early 90's, is specifically designed to meet rapidly increasing customer quality demands now and in the future.
Vishay Corporate Quality implements the Quality Policy and translates its requirements for use throughout the worldwide organization.
Vishay Quality has defined a roadmap with specific targets along the way. The major target is to achieve world-class excellence throughout Vishay worldwide.

VISHAY CORPORATE QUALITY

Vishay Corporate Quality defines and implements the Vishay quality policy at a corporate level. It acts to harmonize the quality systems of the constituent divisions and to implement Total Quality Management throughout the company worldwide.

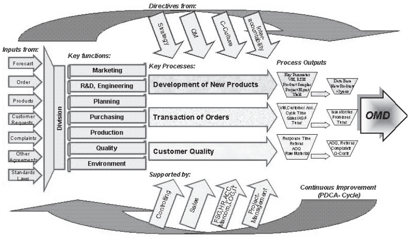
Vishay Zero Defect Program

- Exceeding quality expectations of our customers
- Commitment from top management through entire organization
- Newest and most effective procedures and tools
  - design, manufacturing and testing
  - management procedures (e.g. SPC, TQM)
- Continuous decreasing numbers for AOQ and failure rate
- Detailed failure analysis using 8D methodology
- Continuous improvement of quality performance of parts and technology

QUALITY GOALS AND METHODS

The goals are straightforward: Customer satisfaction through continuous improvement towards zero defects in every area of our operation. We are committed to meet our customers' requirements in terms of quality and service. In order to achieve this, we build excellence into our products from concept to delivery and beyond.

- **Design-in Quality**
  Quality must be designed into products. Vishay uses optimized design rules based on statistical information. This is refined using electrical, thermal, and mechanical simulation together with techniques such as FMEA, QFD and DOE.
- **Built-in Quality**
  Quality is built into all Vishay products by using qualified materials, suppliers, and processes. Fundamental to this is the use of SPC techniques by both Vishay and its suppliers. The use of these techniques, as well as tracking critical processes, reduces variability, optimizing the process with respect to the specification. The target is defect prevention and continuous improvement.
- **Qualification**
  All new products are qualified before release by submitting them to a series of mechanical, electrical, and environmental tests. The same procedure is used for new or changed processes or packages.
- **Monitoring**
  A selection of the same or similar tests used for qualification is also used to monitor the short- and long-term reliability of the product.
- **SPC (Statistical Process Control)**
  SPC is an essential part of all Vishay process control. It has been established for many years and is used as a tool for the continuous improvement of processes by measuring, controlling, and reducing variability.
- **Vishay Quality System**
  All Vishay's facilities worldwide are approved to ISO 9000. In addition, depending on their activities, some Vishay companies are approved to recognized international and industry standards such as ISO/TS 16949.
  Each subsidiary goal is to fulfill the particular requirements of customers. The Opto Divisions of Vishay Semiconductor GmbH are certified according to ISO/TS 16949.



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The procedures used are based upon these standards and laid down in an approved and controlled Quality Manual.

BUSINESS EXCELLENCE

Total Quality Management is a management system combining the resources of all employees, customers, and suppliers in order to achieve total customer satisfaction. The fundamental elements of this system are:

- Management commitment
- EFQM assessment methodology
- Employee Involvement Teams (EITs)
- Supplier development and partnership
- Quality tools
- Training
- Quality system
- Six sigma
- Automotive excellence program (AEP)
- Zero defect

All Vishay employees from the senior management downwards are trained in understanding and use of TQM. Every employee plays its own part in the continuous improvement process which is fundamental to TQM and our corporate commitment to exceed customers' expectations in all areas including design, technology, manufacturing, human resources, marketing, and finance. Everyone is involved in fulfilling this goal. Vishay management believes that this can only be achieved by employee empowerment.

The Vishay corporate core values

- Leadership by example
- Employee empowerment
- Continuous improvement
- Total customer satisfaction

are the very essence of the Vishay Quality Movement process.

- **Training**

Vishay maintains that it can only realize its aims if the employees are well trained. It therefore invests heavily in courses to provide all employees with the knowledge they need to facilitate continuous improvement. A training profile has been established for all employees with emphasis being placed on total quality leadership. Our long-term aim is to continuously improve our training so as to keep ahead of projected changes in business and technology.

- **EFQM Assessment Methodology**

From 1995, VISHAY has started to introduce the EFQM (European Foundation for Quality Management) methodology for structuring its Total Quality Management approach. This methodology, similar to the Malcolm Baldrige process, consists in self-assessing the various VISHAY divisions and facilities according to nine business criteria:

- Leadership
- People
- Policy and strategy
- Partnership and resources
- Processes
- People results
- Customer results
- Society results
- Key performance results (see figure 3)

The assessments are conducted on a yearly basis by trained and empowered, internal Vishay assessors.

This permits the identification of key-priority improvement projects and the measurement of the progress accomplished.

The EFQM methodology helps Vishay to achieve world-class business excellence.

- **Employee Involvement Teams**

At Vishay we believe that every person in the company has a contribution to make in meeting our target of customer satisfaction. Management therefore involves employees to higher and higher levels of motivation, thus achieving higher levels of effectiveness and productivity. Employee involvement teams, which are both functional and cross functional, combine the varied talents from across the breadth of the company. By taking part in training, these teams are continually searching for ways to improve their jobs, achieving satisfaction for themselves, the company and most important of all the customer.

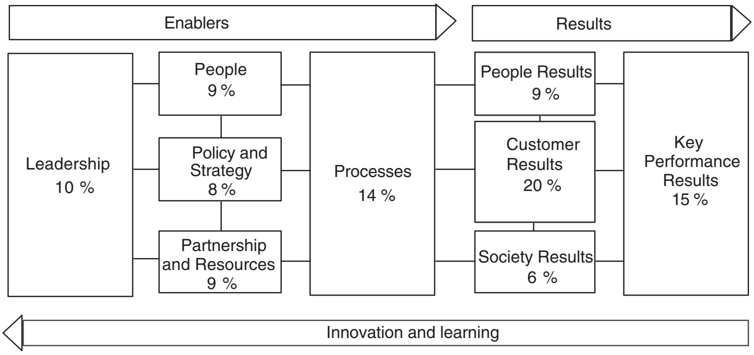

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Fig. 3 - EFQM Criteria for Self-Assessment

TQM TOOLS

As part of its search for excellence, Vishay employs many different techniques and tools. The most important of them are:

- **Auditing**

As well as third party auditing employed for approval by ISO 9000 and customers, Vishay carries out its own internal and external auditing. There is a common auditing procedure for suppliers and sub-contractors between the Vishay entities. This procedure is also used for inter-company auditing between the facilities within Vishay. It is based on the “Continuous Improvement” concept with heavy emphasis on the use of SPC and other statistical tools for the control and reduction of variability.

Internal audits are carried out on a routine basis. They include audits of satellite facilities (e.g., sales offices, warehousing etc.). Audits are also used widely to determine attitudes and expectations both within and outside the company.

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- **Failure Mode and Effect Analysis (FMEA)**

FMEA is a technique for analyzing the possible methods of failure and their effect upon the performance/reliability of the product/process. Process FMEAs are performed for all processes. In addition, product FMEAs are performed on all critical or customer products.

- **Design of Experiments (DOE)**

There is a series of tools that may be used for the statistical design of experiments. It consists of a formalized procedure for optimizing and analyzing experiments in a controlled manner. Taguchi and factorial experiment design are included in this. They provide a major advantage in determining the most important input parameters, making the experiment more efficient and promoting common understanding among team members of the methods and principles used.

- **Gauge Repeatability and Reproducibility (GR and R)**

This technique is used to determine equipment's suitability for purpose. It is used to make certain that all equipment is capable of functioning to the required accuracy and repeatability. All new equipment is approved before use by this technique.

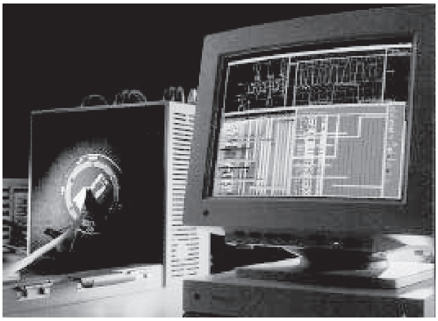
- **Quality Function Deployment (QFD)**

QFD is a method for translating customer requirements into recognizable requirements for Vishay's marketing, design, research, manufacturing and sales (including after-sales). QFD is a process, which brings together the life cycle of a product from its conception, through design, manufacture, distribution, and use until it has served its expected life.

QUALITY SERVICE

VISHAY believes that quality of service is equally as important as the technical ability of its products to meet their required performance and reliability. Our objectives therefore include:

- On-time delivery
- Short response time to customers' requests
- Rapid and informed technical support
- Fast handling of complaints
- A partnership with our customers



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- **Customer Quality**

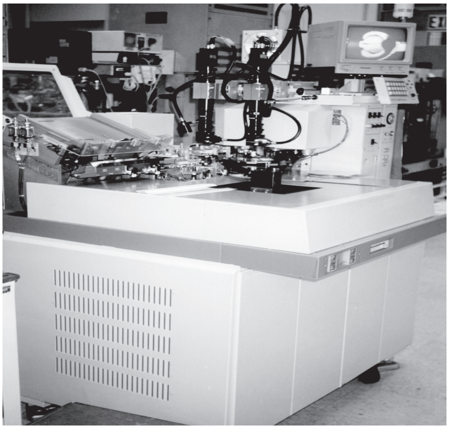
Complaints fall mainly into two categories:

- Logistical
- Technical

Vishay has a procedure detailing the handling of complaints.

Initially complaints are forwarded to the appropriate sales office where in-depth information describing the problem, using the Vishay **P**roduct **A**nalysis **R**equest and **R**eturn **F**orm (**PARRF**), is of considerable help in giving a fast and accurate response. If it is necessary to send back the product for logistical reasons, the Sales Office issues a Returned Material Authorization (RMA) number.

On receipt of the goods in good condition, credit is automatically issued.



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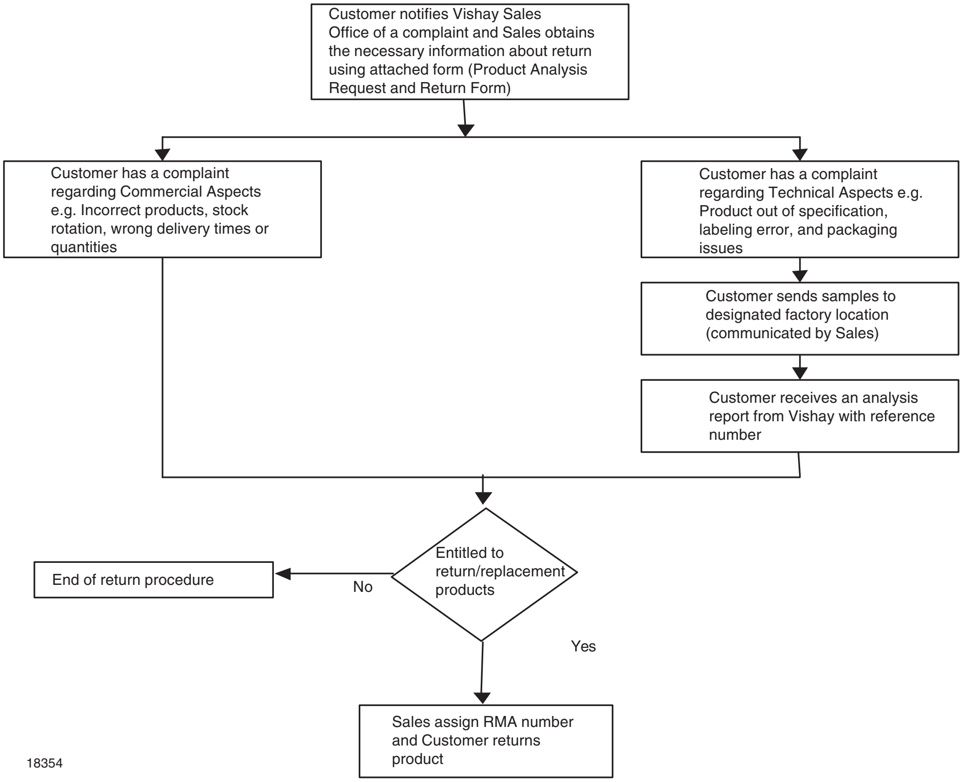
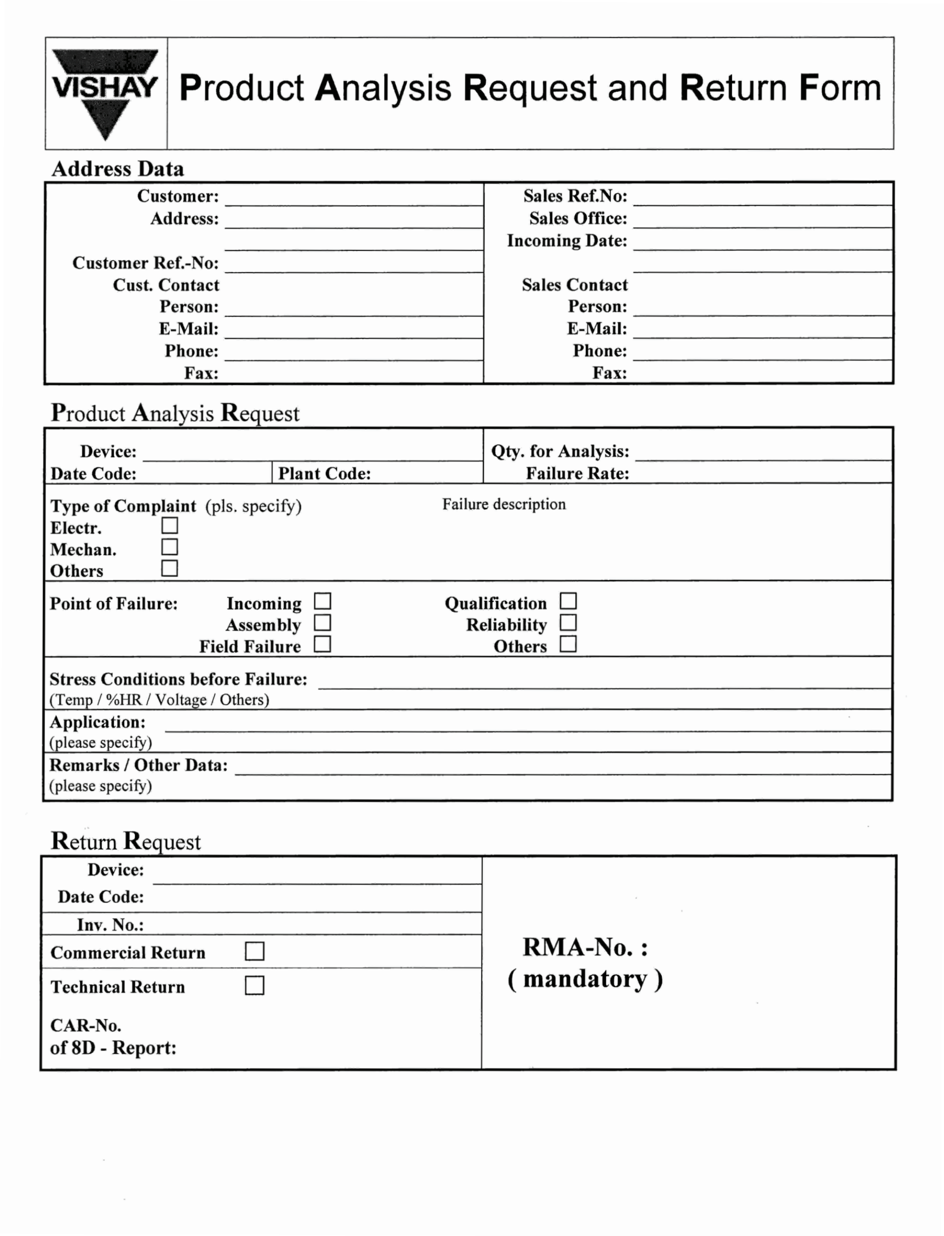
If there is a technical reason for complaint, a sample together with the **PARRF** is sent to the Sales Office for forwarding to the Failure Analysis Department of the supplying facility. The device's receipt will be acknowledged and a report issued on completion of the analysis. The cycle time for this analysis has set targets and is constantly monitored to improve response time. Failure analysis normally consists of electrical testing, functional testing, mechanical analysis (including X-ray), decapsulation, visual analysis and electrical probing. Other specialized techniques (e.g. LCD, thermal imaging, SEM, acoustic microscopy) may be used if necessary.

If the analysis uncovers a quality problem, a Corrective Action Report (CAR) in 8D format will be issued. Any subsequent returns are handled with the RMA procedure.

Quality Information



Complaint and Return Procedure



Product Analysis Request and Return Form

Address Data

Customer:	**Sales Ref.No:**
Address:	**Sales Office:**
	Incoming Date:
Customer Ref.-No:	
Cust. Contact Person:	**Sales Contact Person:**
E-Mail:	**E-Mail:**
Phone:	**Phone:**
Fax:	**Fax:**

Product Analysis Request

Device:		**Qty. for Analysis:**
Date Code:	**Plant Code:**	**Failure Rate:**

Type of Complaint (pls. specify)
Electr. ☐
Mechan. ☐
Others ☐

Failure description

Point of Failure:

Incoming ☐	**Qualification** ☐
Assembly ☐	**Reliability** ☐
Field Failure ☐	**Others** ☐

Stress Conditions before Failure:
(Temp / %HR / Voltage / Others)

Application:
(please specify)

Remarks / Other Data:
(please specify)

Return Request

Device:	**RMA-No. :** **(mandatory)**
Date Code:	
Inv. No.:	
Commercial Return ☐	
Technical Return ☐	
CAR-No. of 8D - Report:	

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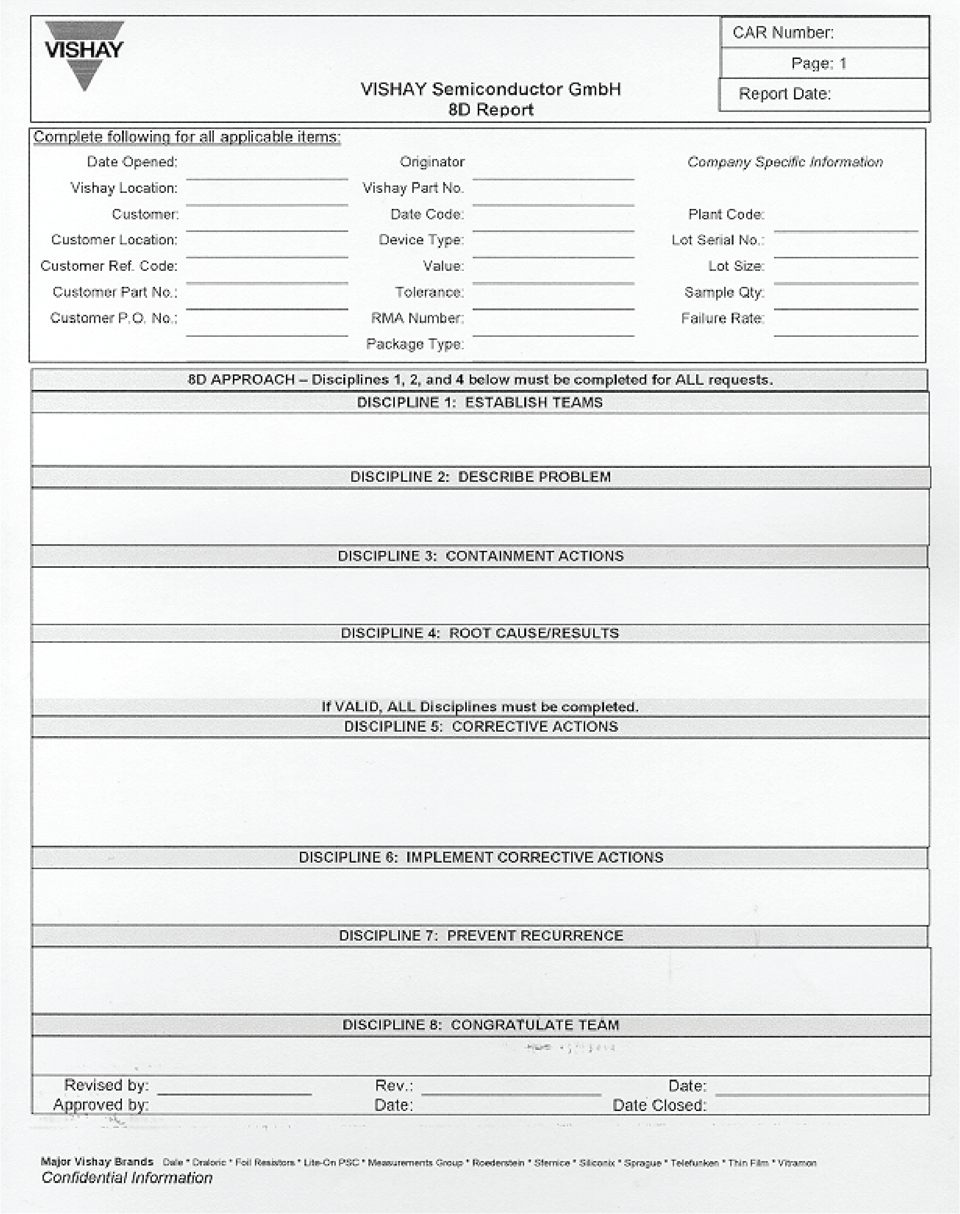
Product **A**nalysis **R**equest and **R**eturn **F**orm (PARRF)



CAR Number:
Page: 1
Report Date:

VISHAY Semiconductor GmbH
8D Report

Complete following for all applicable items:

Date Opened:
Vishay Location:
Customer:
Customer Location:
Customer Ref. Code:
Customer Part No.:
Customer P.O. No.:

Originator
Vishay Part No.
Date Code:
Device Type:
Value:
Tolerance:
RMA Number:
Package Type:

Company Specific Information
Plant Code:
Lot Serial No.:
Lot Size:
Sample Qty:
Failure Rate:

8D APPROACH – Disciplines 1, 2, and 4 below must be completed for ALL requests.

DISCIPLINE 1: ESTABLISH TEAMS

DISCIPLINE 2: DESCRIBE PROBLEM

DISCIPLINE 3: CONTAINMENT ACTIONS

DISCIPLINE 4: ROOT CAUSE/RESULTS

If VALID, ALL Disciplines must be completed.

DISCIPLINE 5: CORRECTIVE ACTIONS

DISCIPLINE 6: IMPLEMENT CORRECTIVE ACTIONS

DISCIPLINE 7: PREVENT RECURRENCE

DISCIPLINE 8: CONGRATULATE TEAM

Revised by: ____ Rev.: ____ Date: ____
Approved by: Date: Date Closed:

Major Vishay Brands Dale * Draloric * Foil Resistors * Lite-On PSC * Measurements Group * Roederstein * Sfernice * Siliconix * Sprague * Telefunken * Thin Film * Vitramon
Confidential Information

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Vishay 8D Form

- **Change Notification**

All product and process changes are controlled and released via ECN (Engineering Change Notification). This requires the approval of the relevant departments. In the case of a major change, the change is forwarded to customers via Sales/ Marketing before implementation. Where specific agreements are in place, the change will not be implemented unless approved by the customer.

QUALITY AND RELIABILITY

ASSURANCE PROGRAM

Though both quality and reliability are designed into all Vishay products, three basic programs must assure them:

- Average Outgoing Quality (AOQ) - 100 % testing is followed by sample testing to measure the defect level of the shipped product. This defect level (AOQ) is measured in ppm (parts per million)
- Reliability qualification program - to assure that the design, process or change is reliable
- Reliability monitoring program - to measure and assure that there is no decrease in the reliability of the product


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AOQ PROGRAM

Before leaving the factory, all products are sampled after 100 % testing to ensure that they meet a minimum quality level and to measure the level of defects. The results are accumulated and expressed in ppm (parts per million). They are the measure of the average number of potentially failed parts in deliveries over a period of time. The sample size used is determined by AQL or LTPD tables depending upon the product. No rejects are allowed in the sample.

The AOQ value is calculated monthly using the method defined in standard JEDEC 16:

$$\mathrm{AOQ} = p \cdot \mathrm{LAR} \cdot 10^{6} (\mathrm{ppm})$$

where:

$$p = \frac{\text{number of devices rejected}}{\text{total number of devices tested}}$$

LAR = lot acceptance rate:

$$\mathrm{LAR} = 1 - \frac{\text{number of lots rejected}}{\text{total number of lots tested}}$$

The AOQ values are recorded separately with regard to electrical and mechanical (visual) rejects by product type and package.

RELIABILITY AND QUALIFICATION

Qualification is used as a means of verifying that a new product or process meets specified reliability requirements. This is also used to verify and release changes to products or processes including new materials, packages, and manufacturing locations. At the same time it provides a means to obtain information on the performance and reliability of new products and technologies.

There are three types of qualification and release:

- Wafer process/technology qualification
- Package qualification
- Product/device qualification

The actual qualification procedure depends on which of these (or combinations of these) are to be qualified. Normally there are three categories of qualification in order of degree of qualification and testing required.

For the qualification there are two different standards. For Commodity and Industrial products the Vishay internal standard is used. For Automotive grade parts, the qualification is done according to AEC-Q101.

Accelerated testing is normally used in order to produce results fast. The stress level employed depends upon the failure mode investigated. The stress test is set so that the level used gives the maximum acceleration without introducing any new or untypical failure mode.

The tests used consist of a set of the following:

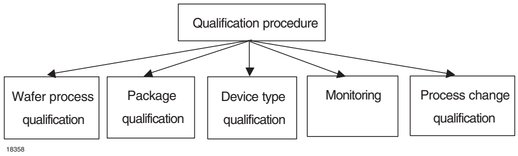
- High temperature life test (static)
- High temperature life test (dynamic)
- HTRB (high temperature reverse bias)
- Humidity 85/85 (with or without bias)
- Temperature cycling
- High-temperature storage
- Low-temperature storage
- Marking permanency
- Lead integrity
- Solderability
- Resistance to solder heat
- Mechanical shock (not plastic packages)
- Vibration (not plastic packages)
- ESD characterization

SMD devices only are subjected to preconditioning to simulate board assembly techniques using the methods defined in standard J-STD-020C before being subjected to stresses.

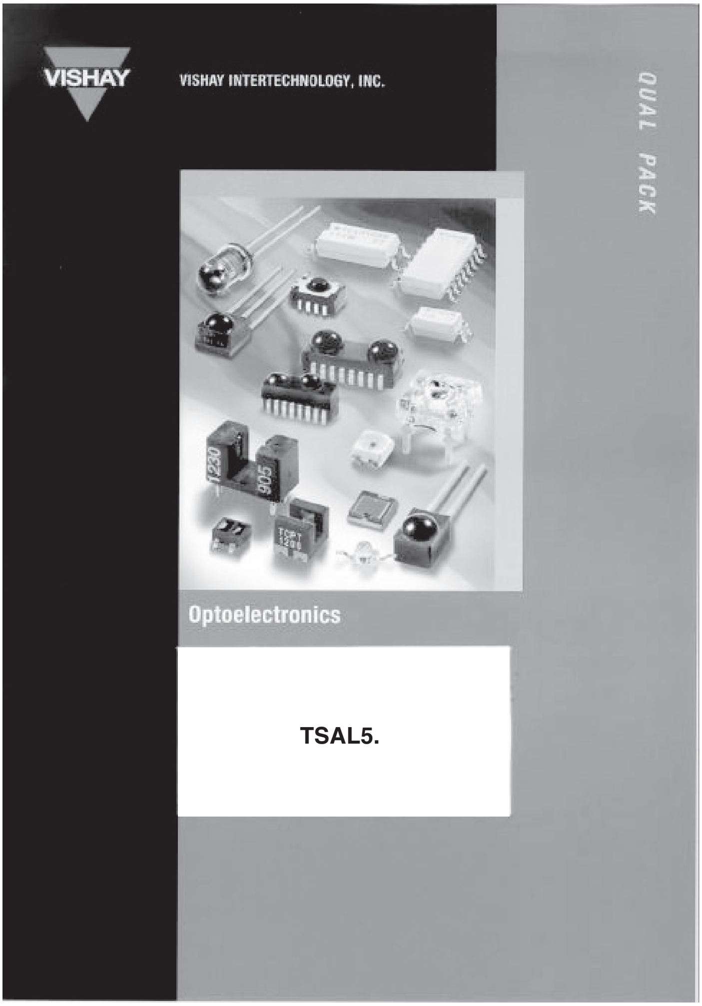
Normally, the endpoint tests are related to the datasheet or to specified parameters. Additionally, they may include:

- Destructive physical analysis
- X-ray
- Delamination testing using scanning acoustic microscope
- Thermal imaging
- Thermal and electrical resistance analysis

A summary of the reliability test results combined with process flows and technological data will be prepared when the device has passed the Vishay qualification tests. The summary is named QualPack.



For Automotive grade devices also additional information according to the PPAP requirements will be provided on request.


VISHAY INTERTECHNOLOGY, INC.

QUAL PACK

Optoelectronics

TSAL5.

Example of the QualPack

RELIABILITY MONITORING AND WEAR OUT

The monitoring program consists of short-term monitoring to provide fast feedback on a regular basis in case of a reduction in reliability and to measure the Early-life Failure Rate (EFR). At the same time, Long-term monitoring is used to determinate the Long-term steady-state Failure Rate (LFR). The tests used are a subset from those used for qualification and consist of:

- Life tests
- Humidity tests
- Temperature-cycling tests

The actual tests used depend on the product tested.
Depending on the assembly volume a yearly monitoring and wear-out test plan is created.
Wear-out data is particularly important for optoelectronic devices.

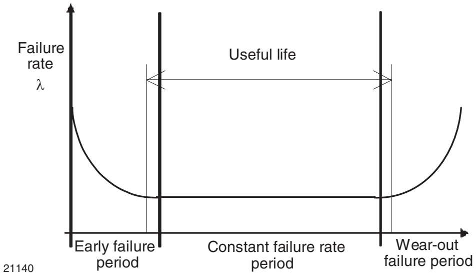


Fig. 4 - Bathtub Curve

The lifetime distribution curve is shown on figure 4. This curve is also known as the 'bath-tub curve' because of its shape. There are three basic sections:

- Early-life failures (infant mortality)
- Operating-life failures (random failures)
- Wear-out failures

Out of that data degradation curves can be made. These curves show the long time behavior of the different devices. Some typical curves are attached in this report.

RELIABILITY PRINCIPLES

Reliability is the probability that a part works operated, under specific conditions, performs properly for a given period of time.

$F(t) + R(t) = 1$ or $R(t) = 1 - F(t)$

where:

$R(t)$ = probability of survival

$F(t)$ = probability of failure

$F(t) = 1 - e^{-\lambda t}$
where

λ = instantaneous failure rate

t = time

thus,

$R(t) = e^{-\lambda t}$

MTTF, MTBF

MTTF (mean time to failure) applies to parts that will be thrown away on failing. MTBF (mean time between failures) applies to parts or equipment that is going to be repaired. MTTF is the inverse failure rate.

$$\mathrm{MTTF} = \frac{1}{\lambda}$$

So R(t) becomes to:

$$R_{(t)} = e^{-\lambda t} = e^{-\frac{t}{\mathrm{MTTF}}}$$

After a certain time, t will be equal to MTTF, R(t) becomes:

$$R_{(t)} = e^{-1} = 0.37$$

If a large number of units are considered, only 37 % of their operation times will be longer than MTTF figure.

The failure rate (λ) during the constant (random) failure period is determined from life-test data. The failure rate is calculated from the formula:

$$\lambda = \frac{r}{\Sigma(fi \cdot ti) + (N \cdot t)} = \frac{r}{C}$$

where

λ = failure rate (h^{-1})

r = number of observed failures

f_i = failure number

t_i = time to defect

N = good sample size

t = entire operating time

C = number of components X h

The result is expressed in either

a) % per 1000 component hours by multiplying by 10^5

or in

b) FITs by multiplying by 10^9 (1 FIT = $10^{-9}\ h^{-1}$)

Example 1: Determination of failure rate λ
500 devices were operated over a period of 2000 h (t) with:
1 failure (f1) after 1000 h (t1)
The failure rate of the given example can be calculated as follows:

$$\lambda = \frac{1}{(1 \cdot 1000\ h) + 499 \cdot 2000\ h}$$

$$\lambda = 2 \cdot 10^{-6} h^{-1}$$

That means that this sample has an average failure rate of **0.1 %/1000 h or 1001 FIT**

Observed failure rates as measured above are for the specific lot of devices tested. If the predicted failure rate for the total population is required, statistical confidence factors have to be applied.

The confidence factors can be obtained from “chi square” (χ^2) charts. Normally, these charts show the value of ($\chi^2/2$) rather than χ^2. The failure rate is calculated by dividing the $\chi^2/2$ factor by the number of component hours.

$$\lambda_{pop} = \frac{(\chi^2/2)}{C}$$

The values for $\chi^2/2$ are given in table 1

TABLE 1 - $\chi^2/2$ CHART

NUMBER OF FAILURES	CONFIDENCE LEVEL	
	60 %	90 %
0	0.92	2.31
1	2.02	3.89
2	3.08	5.30
3	4.17	6.70
4	5.24	8.00
5	6.25	9.25
6	7.27	10.55

Example 2: The failure rate of the population
Using example 1 with a failure rate of 1001 FIT and 1 failure: $\chi^2/2$ at 60 % confidence is 2.02

$$\lambda_{pop} = \frac{2.02}{9.99 \cdot 10^5} = 2022 \text{ FIT}$$

This means that the failure rate of the population will not exceed 2022 FIT with a probability of 60 %.

- **Accelerated Stress Testing**

In order to be able to assure long operating life with a reasonable confidence, Vishay carries out accelerated testing on all its products. The normal accelerating factor is the temperature of operation. Most failure mechanisms of semiconductors are dependent upon temperature. This temperature dependence is best described by the Arrhenius equation.

$$\lambda_{T2} = \lambda_{T1} \times e^{\left[\frac{E_A}{k} \times \left(\frac{1}{T1} - \frac{1}{T2}\right)\right]}$$

where

k = Boltzmann's constant 8.63 x 10^{-5} eV/K
E_A = activation energy (eV)
T_1 = operation temperature (K)
T_2 = stress temperature (K)
λ_{T1} = operation failure rate
λ_{T2} = stress-test failure rate

Using this equation, it is possible from the stress test results to predict what would happen in use at the normal temperature of operation.

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ACTIVATION ENERGY

Provided the stress testing does not introduce a failure mode, which would not occur in practice, this method gives an acceptable method for predicting reliability using short test periods compared to the life of the device. It is necessary to know the activation energy of the failure mode occurring during the accelerated testing. This can be determined by experiment. In practice, it is unusual to find a failure or if there is, it is a random failure mode. For this reason an average activation energy is normally used for this calculation. Though activation energies can vary between 0.3 eV and 2.2 eV, under the conditions of use, activation energies of between 0.6 eV and 0.9 eV are used depending upon the technology.

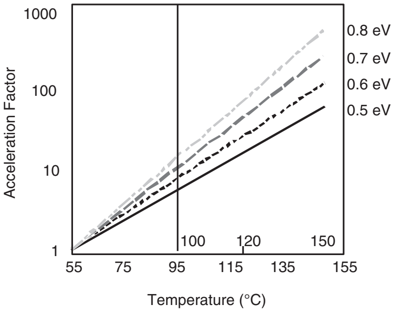

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Fig. 5 - Acceleration Factor for different Activation Energies Normalized to T = 55 °C

ACTIVATION ENERGIES FOR COMMON FAILURE MECHANISMS

The activation energies for some of the major semiconductor failure mechanisms are given in the table below. These are estimates taken from published literature.

TABLE 2 - ACTIVATION ENERGIES FOR COMMON FAILURE MECHANISM

FAILURE MECHANISM	ACTIVATION ENERGY
Mechanical wire shorts	0.3 to 0.4
Diffusion and bulk defects	0.3 to 0.4
Oxide defects	0.3 to 0.4
Top-to-bottom metal short	0.5
Electro migration	0.4 to 1.2
Electrolytic corrosion	0.8 to 1.0
Gold-aluminum intermetallics	0.8 to 2.0
Gold-aluminum bond degradation	1.0 to 2.2
Ionic contamination	1.02
Alloy pitting	1.77

Failure rates are quoted at an operating temperature of 55 °C and 60 % confidence using an activation energy (E_A) of 0.8 eV for optoelectronic devices.

Example 3: Conversion to 55 °C

In Example 2, the life test was out at 125 °C so to transform to an operating temperature of 55 °C.

T1 = 273 + 55 = 328K

T1 = 273 + 125 = 398K

Acceleration factor =

$$\frac{\lambda_{(T2)}}{\lambda_{(T1)}} = \frac{\lambda_{(423K)}}{\lambda_{(328K)}} = 144$$

thus

$$\lambda_{(328K)} = \frac{\lambda_{(423K)}}{144} = \frac{2022}{144}$$

= 14 **FIT**

(at 55 °C with a confidence of 60 %)

This figure can be re-calculated for any operating/junction temperature using this method.

- **EFR (Early Life Failure Rate)**

This is defined as the proportion of failures that will occur during the warranty period of the system for which they were designed. To standardize this period, Vishay uses 1000 operation hours as the reference period. This is the figure also used by the automotive industry; it equates to one year in the life of an automobile. In order to estimate this figure, Vishay normally operates a sample of devices for 48 h or 168 h under the accelerated conditions detailed above. The Arrhenius law is then used as before to calculate the failure rate at 55 °C with a confidence level of 60 %. This figure is multiplied by 1000 to give the failures in 1000 h and by 10^6 to give a failure in ppm. All EFR figures are quoted in ppm (parts per million).

The value of EFR and LFR is also depending on the amount of new products brought to market in the period. If a lot of new products are released the EFR and the LFR value can also be increased in that period due to increased rejects.

- **Climatic Tests Models**

Temperature cycling failure rate

The inverse power law is used to model fatigue failures of materials that are subjected to thermal cycling. For the purpose of accelerated testing, this model relationship is called Coffin-Manson relationship, and can be expressed as follows:

$$A_F = \left(\frac{\Delta T_{stress}}{\Delta T_{use}}\right)^M$$

where:

A_F = acceleration factor
ΔT_{use} = temp. range under normal operation
ΔT_{stress} = temp. range under stress operation
M = constant characteristic of the failure mechanism.

TABLE 3 - COFFIN - MANSON EXPONENT

FAILURE MECHANISM	M
Al wire bond failure	3.5
Intermetallic bond fracture	4.0
Au wire bond heel crack	5.1
Chip-out bond failure	7.1

For instance:

ΔT_{use} = 15 °C/60 °C = 45 °C
ΔT_{stress} = - 25 °C/100 °C = 125 °C

$$A_F = \left(\frac{125\ °C}{45\ °C}\right)^3 \approx 21$$

Relative Humidity failure rate

Moisture effect modeling is based upon the Howard-Pecht-Peck model using the acceleration factor of the equation shown below:

$$A_F = \left(\frac{RH_{stress}}{RH_{use}}\right)^C \cdot e^{\left[\frac{E_A}{k}\left(\frac{1}{T_{use}} - \frac{1}{T_{stress}}\right)\right]}$$

where:

RH_{stress} = relative humidity during test
RH_{use} = relative humidity during operation
T_{stress} = temperature during test
T_{use} = temperature during operation
E_A = activation energy
k = Boltzmann constant
C = material constant

For instance:

RH_{stress} = 85 %, RH_{use} = 92 %
T_{stress} = 85 °C, T_{use} = 40 °C

$$A_F = \left(\frac{85\ \%\ RH}{92\ \%\ RH}\right)^3 \times e^{\left[\frac{0.8}{8.617 \times 10^{-5}}\left(\frac{1}{313} - \frac{1}{358}\right)\right]}$$

$$A_F \approx 33$$

This example shows how to transform test conditions into environmental or into another test conditions. This equation is applicable for devices subjected to temperature humidity bias (THB) testing.

Using these acceleration factors the useful lifetime can be calculated. Applying the acceleration factor once more, useful lifetime for the moisture effect model for parts subjected to THB can be estimated by the following equation:

$$\text{Useful life}_{\text{Years}} = \frac{A_F \cdot \text{test hours}}{\text{hours per year}}$$

with:

test hours = 1000

hours per year = 8760

$A_F \approx 118$ (40 °C/60 % RH)

$$\text{Useful life}_{\text{Years}} = \frac{118 \cdot 1000}{8760} \approx 13.5 \text{ years}$$

This means that operation in 40 °C/60 % RH environment is good for around 13 years, calculated out of the 85 °C/85 % RH 1000 h humidity stress test.

- **Soldering**

All products are tested to ascertain their ability to withstand the industry standard soldering conditions after storage. In general, these conditions are as follows

- Wave soldering: double-wave soldering according to CECC 00802 s
- Reflow soldering: According to JEDEC STD 20C

Note: certain components may have limitations due to their construction

- **Dry pack**

When being stored, certain types of device packages can absorb moisture, which is released during the soldering operations, thus causing damage to the device. The so-called “popcorn” effect is such an example. To prevent this, Surface Mount Devices (SMD) are evaluated during qualification, using a test consisting of moisture followed by soldering simulation (pre-conditioning) and then subjected to various stress tests. In table 4 - Moisture Sensitivity Levels - the six different levels, the floor life conditions as well as the soak requirements belonging to these levels are described. Any device which is found to deteriorate under these conditions is packaged in “dry pack”.

The dry-packed devices are packed generally according to IPC JEDEC STD 33 “Handling, Packing, Shipping and use of Moisture/Reflow sensitive Surface Mount Devices”, IPC-SM-786 “Recommended Procedures for Handling of Moisture Sensitive Plastic IC Packages”.

Following some general recommend dations:

- Shelf life in the packaging at < 40 °C and 90 % RH is 12 months
- After opening, the devices should be handled according to the specifications mentioned on the dry-pack label
- If the exposure or storage time is exceeded, the devices should be baked:
  - Low-temperature baking - 192 h at 40 °C and 5 % RH
  - High-temperature baking - 24 h at 125 °C

TABLE 4 - MOISTURE SENSITIVITY LEVELS

	FLOOR LIFE		SOAK REQUIREMENTS			
LEVEL	CONDITIONS	TIME	TIME (h)			CONDITIONS
1	≤ 30 °C/90 % RH	Unlimited	168			85 °C/85% RH
2	≤ 30 °C/60 % RH	1 year	168			85 °C/60% RH
2a	≤ 30 °C/60 % RH	4 weeks	696			30 °C/60% RH
			X	Y	Z	
3	≤ 30 °C/60 % RH	168 h	24	168	192	30 °C/60% RH
4	≤ 30 °C/60 % RH	72 h	24	72	96	30 °C/60% RH
5	≤ 30 °C/60 % RH	48 h	24	48	72	30 °C/60% RH
5a	≤ 30 °C/60 % RH	24 h	24	24	48	30 °C/60% RH
6	≤ 30 °C/60 % RH	6 h	0	6	6	30 °C/60% RH

X = Default value of semiconductor manufacturer’s exposure time (MET) between bake and bag plus the maximum time allowed out of the bag at the distributor’s facility. The actual times may be used rather than the default times, but they must be used if they exceed the default times.

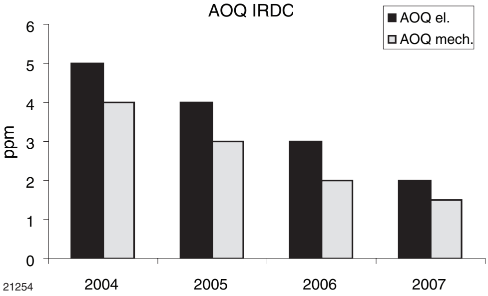
Y = Floor life of package after it is removed from dry pack bag.

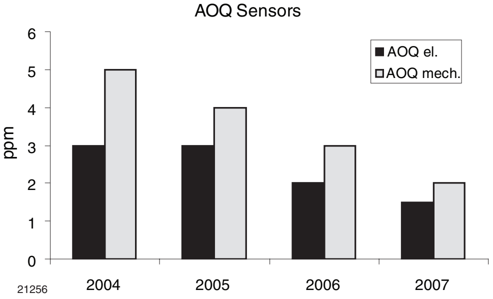
Z = Total soak time for evaluation (X + Y).

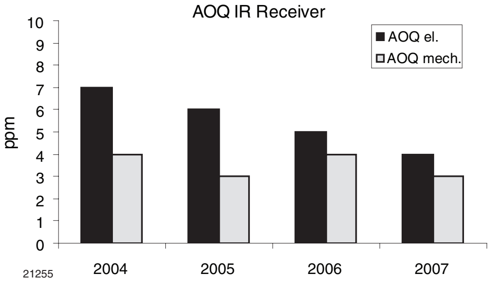
Note: There are two possible floor lives and soak times in level 5. The correct floor life will be determined by the manufacturer and will be noted on the dry pack bag label per JEP 113. “Symbol and Labels for Moisture Sensitive Devices”.

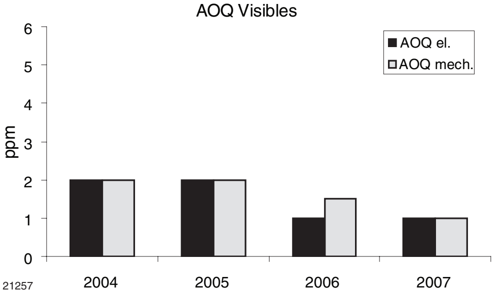
QUALITIY AND RELIABILITY DATA

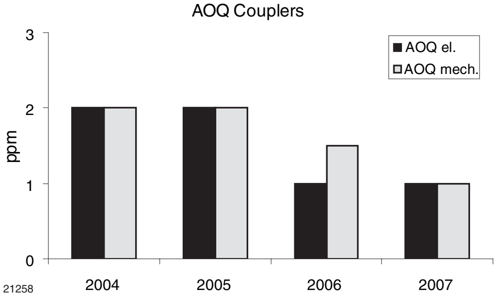
Average Outgoing Quality (AOQ)



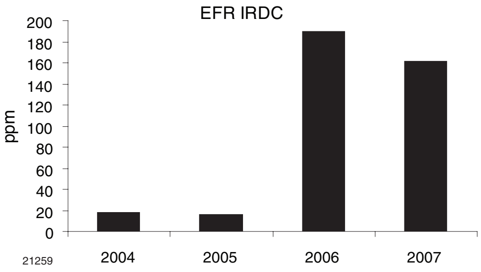




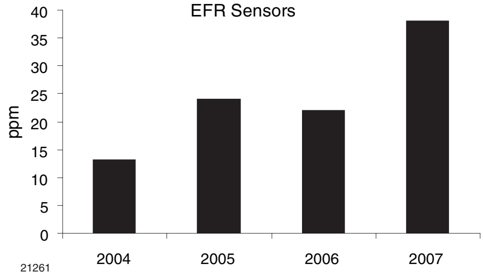




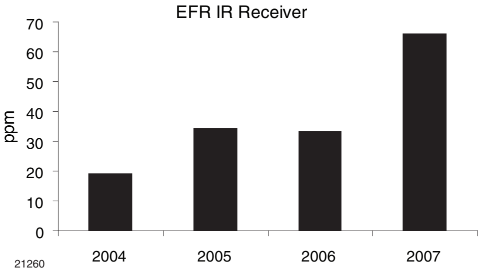
Early Failure Rate (EFR)



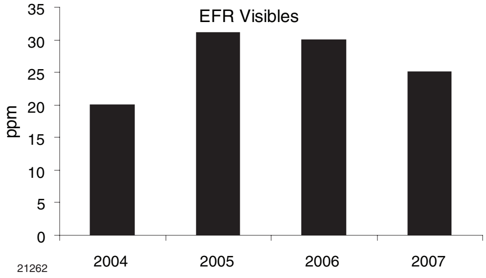
Increase of EFR due to functional rejects in 2006 due to ramp up of new products

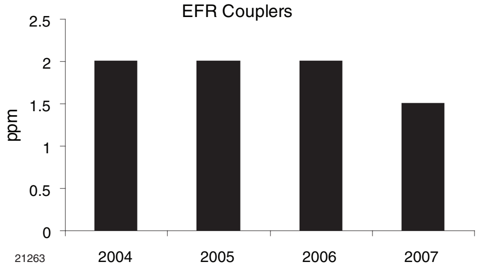


Increase of EFR only due to lower amount of samples, old results were cutted off. No additional rejects in 2007

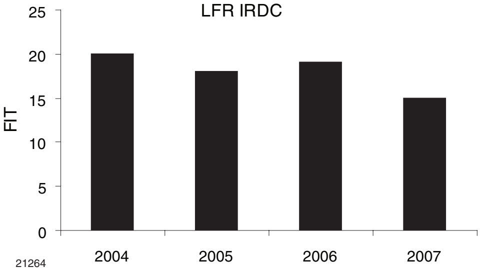


Increase of EFR only due to lower amount of samples, old results were cutted off. No additional rejects in 2007





Latent Failure Rate (LFR)



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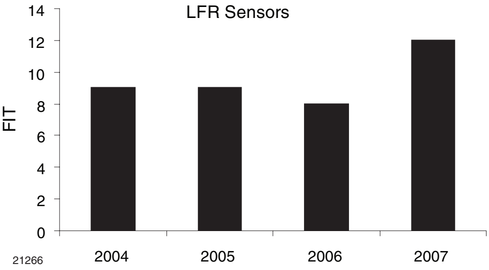

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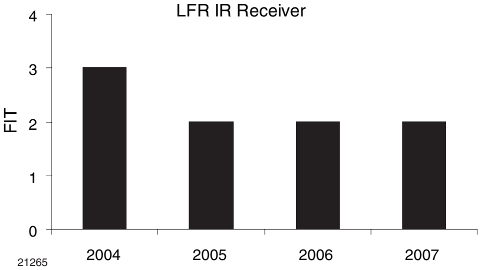

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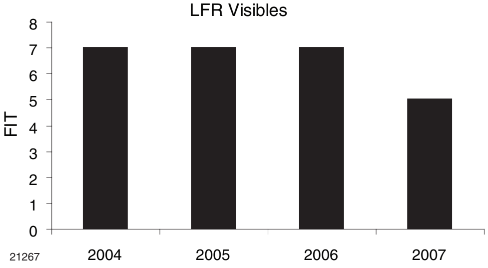

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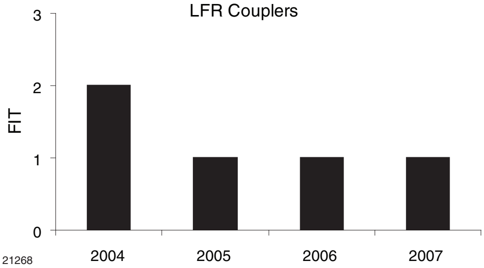

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Eye Safety Risk Assessment of Light or Infrared Emitting Diodes

INTRODUCTION

Product safety legislation (e.g. general product safety laws as in Europe the “low voltage- or machinery directives”) requires conformity with "essential requirements", for instance, protection of health and safety that goods must meet when placed on the market. In this context, compliance with product safety standards for optical sources, such as the standards IEC 60825-1 and IEC 62471, should provide presumption of conformity with these “essential requirements”. The compliance is guaranteed when the goods are classified according the standards as safe, expressed as with e.g. “class 1” or “exempt”.

Therefore the operating conditions and the optical and mechanical construction of the final goods define the risk. The risk assessment of LED (1) applications is not directly related to the LED component.

The risk assessment and classification is to be done with the final product, not with the built-in component. In IEC/EN60825-1 that is expressed by “Laser products that are sold to other manufacturers for use as components of any system for subsequent sale are not subject to IEC 60825-1, since the final product will itself be subject to this standard”. IEC 62471 demands a risk assessment of the lamp (LED) itself. This may be not sufficient for the application, especially when LED arrays are used.

RISK ASSESSMENT FOR LED - APPLICATIONS

Optical sources and optical radiation are covered by different regulative standards. After the latest changes in 2007 the eye safety standards compiled in the following table are applicable for LEDs.

Note

(1) We are useing sometimes in our documentation the abbreviation LED and the word light emitting diode also for infrared emitting diodes (IRED). Whenever the term LED is used, IREDs are included when not otherwise noted. That is common usage but not in agreement with IEC 60050-845.

EXAMPLE OF APPLICATIONS COVERED BY DIFFERENT OPTICAL RADIATION SAFETY STANDARDS

	IEC/EN 60825-1 (1) (2007-03)	IEC 62471 (2006) CIE S009:2002 (2)	DIRECTIVE 2006/25/EC (3)
Fiber optical components	IEC 60825-2	x	w
Free air communication IR - remote control (TV, audio, video) IR - communication (IrDA®, home)	IEC 60825-12 removal expected	x	w
Lighting (visible und IR), lamps	-	x	w
IR - photo flash (traffic enforcement)	-	x	w
IR - light barriers	-	x	w
LED indicators	-	x	w
UV - lamps	-	x	w

Notes

w: for workers environment only

(1) **IEC/EN 60825-1 (2007-03), DIN EN 60825-1 (2008-05)**
“SAFETY OF LASER PRODUCTS - Part 1: Equipment classification and requirements”

(2) **IEC 62471 (2006), CIE S009 (2002)**
“Photobiological Safety of Lamps and Lamp Systems”

(3) **DIRECTIVE 2006/25/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL**
of 5 April 2006
on the minimum health and safety requirements regarding the exposure of workers to risks arising from physical agents (artificial optical radiation) (19th individual directive within the meaning of article 16(1) of directive 89/391/EEC)

Eye Safety Risk Assessment of Light or Infrared Emitting Diodes

THE DIFFERENT EYE SAFETY STANDARDS FOR LEDS

The standard **IEC (EN DIN) 60825-1** "SAFETY OF LASER PRODUCTS - Part 1: equipment classification and requirements", is applicable to safety of laser products emitting laser radiation in the wavelength range 180 nm to 1 mm. In previous editions, LEDs were included in the scope of IEC 60825-1, and they may be still included in other parts of the IEC 60825 series, as e.g. in IEC 60825 - Part 12, "Safety of free space optical communication systems used for transmission of information".

With the development of lamp safety standards, optical radiation safety of LEDs in general can be more appropriately addressed by lamp safety standards. The removal of LEDs from the scope of the Part 1 of IEC 60825 does not preclude other standards from including LEDs whenever they refer to lasers. CIE S009 or IEC 62471 may be applied to determine the risk group of an LED or product incorporating one or more LEDs.

IEC 60825-1 does not cover the LEDs emitting radiation for indication, illumination or lighting anymore.

A general standard for the safety of incoherent sources is **CIE S009** ("Photobiological Safety of Lamps and Lamp Systems"), which is published as a new common ISO/IEC standard **IEC 62471**. This is equivalent but not in all items identical with the **European Directive 2006/25/E** with the long title already mentioned above.

IEC 62471 failed to be converted and edited as EN 62471. A new edition of EN 62471-1 is under preparation. Until that is released IEC 62471 can be used representing the state of the art.

LEDs used for free air data communication (including e.g. short range applications as Remote Control or IrDA® links) are still covered by all three standards.

IEC 62471 (CIE S009) according the title "Photobiological Safety of Lamps and Lamp Systems" lets assume not only to cover the final product as IEC 60825-1 but especially the lamp. The original text, chapter 6 of IEC 62471 says it requires in first order the classification of the lamp: "This clause is concerned with lamp classification. However a similar classification system could be applicable to luminaires or other systems containing operating lamps".

While in case of e.g. incandescent lamps where e.g. in most cases just one single conventional lamp (bulb) is used for a luminaire the risk assessment can refer to the lamp. In case of LEDs with many LEDs e.g. combined in one luminaire this may be different.

LED manufacturers usually do not know the future application and would have to apply any limit set. Thus, since the risk group allocation bases in any case on the most restrictive limits, the result might be inappropriate for the future application or overly restrictive. As the laser safety standard IEC 60825-1 also IEC 62471 is to be interpreted like "The final product will itself be subject to this standard". Only this is strictly in agreement with general product safety laws (e.g. in Europe the "low voltage- or machinery directives").

For instance, the EU product safety legislation requires conformity with "essential requirements", e.g., protection of health and safety that goods must meet when they are placed on the common market. In this context, compliance with product safety standards, such as the standards IEC 60825-1 and IEC 62471, should provide presumption of conformity with these "essential requirements".

CLASSIFICATION

IREDs

Most IREDs are emitting in the 800 nm to 960 nm range. Radiation within these wavelengths causes a thermal retina hazard and thermal injury risk of the cornea and possible delayed effects on the lens of the eye (cataractogenesis). In general the IEC 60825-1 is more restrictive in case of the thermal retinal hazard; the cornea/lens limits are only in IEC 62471 and in the European Directive 2006/25/EC.

Most of the IREDs can be classified by the simplified method according IEC 60825-1 comparing the maximum intensity emitted under absolute maximum rating conditions. When the intensity is above that limit, the source size has to be taken into account. With that none of the currently available (July/2008) Vishay IREDs violate the class 1 limit. In case of IEC 62471 and in the European Directive 2006/25/EC all Vishay IREDs are inside the exempt conditions. Only with arrays care must be taken not to violate the cornea/lens limits.

LEDs

Diode emitters in the visible spectrum cover the wavelength range from 400 nm to 780 nm including also wide band white LEDs. LEDs in the visible spectrum are used for lighting, signaling, or as indicators. Therefore the risk assessment is according IEC 62471 and in the European Directive 2006/25/EC.

Here the blue light hazard with the wavelength depending function B (λ) is the limiting factor still on the red side of the spectrum. It has to be taken into account up to a wavelength of 700 nm.

The intensity specification of visible LEDs is done in terms of photometric units as Candela (cd). Due to the strong variation of the ratio to the radiometric units used for defining the limits this is more complicated or even confusing for the normal electrical engineer.

Nearly all LEDs are far below the Exempt limits. However, care should be taken on the short wavelength side of the spectrum. Therefore a general statement as for IREDs cannot be given.

Vishay supplies all necessary data for the risk assessment in the data sheet and on request, in case it is not published there. Either via the sales channel or simply the technical support box on the website this data will be available on request.

Eye Safety Risk Assessment of Infrared Emitting Diodes According IEC (EN DIN) 60825-1

LEDs are removed from IEC 60825-1 but are still covered by the **free air communication** safety standard **IEC 60825-12**. Therefore LEDs for free air communication are still to be assessed according IEC 60825-1. All other LEDs for lighting, illumination, light barriers, and so on are moved to the eye safety standard for artificial non coherent sources IEC 62471 (identical with CIE S009).

COMPILATION OF INTENSITY/WAVELENGTH DATA FOR CLASS 1 ASSESSMENT ACCORDING IEC 60825-1

PART NUMBER	VIRTUAL SOURCE SIZE d (mm)	WAVELENGTH/MAXIMUM INTENSITY AT ABSOLUTE MAX. RATINGS HANDLED BY THE SIMPLIFIED METHOD	WAVELENGTH/MAXIMUM INTENSITY WHERE APPARENT SOURCE IS TO BE TAKEN INTO ACCOUNT; FOR CLASS 1 LIMIT REFER TO DIAGRAM
CQY36N	1.2	950 nm/7.5 mW/sr	
CQY37N	1.2	950 nm/11 mW/sr	
TSAL4400	1,9	940 nm/80 mW/sr	
TSAL5100	3.7	940 nm/80 mW/sr	
TSAL5300	2.3		940 nm/400 mW/sr
TSAL6100	3.7		940 nm/400 mW/sr
TSAL6100X01	3.7		940 nm/400 mW/sr
TSAL6200	2.4		940 nm/200 mW/sr
TSAL6400	2.2	940 nm/125 mW/sr	
TSAL7200	2.4		940 nm/200 mW/sr
TSAL7300	2.3	940 nm/150 mW/sr	
TSAL7400	2.2	940 nm/125 mW/sr	
TSAL7600	1.8	940 nm/75 mW/sr	
TSFF5210	2.7		870 nm/360 mW/sr
TSFF5410	2.2		870 nm/135 mW/sr
TSHA4400	1.8	875 nm/80 mW/sr	
TSHA4401	1.8	875 nm/80 mW/sr	
TSHA5200	3.7		875 nm/125 mW/sr
TSHA5201	3.7		875 nm/125 mW/sr
TSHA5202	3.7		875 nm/125 mW/sr
TSHA5203	3.7		875 nm/125 mW/sr
TSHA5500	2.2		875 nm/60 mW/sr
TSHA5501	2.2		875 nm/60 mW/sr
TSHA5502	2.2		875 nm/60 mW/sr
TSHA5503	2.2		875 nm/60 mW/sr
TSHA6200	3.7		875 nm/125 mW/sr
TSHA6201	3.7		875 nm/125 mW/sr
TSHA6202	3.7		875 nm/125 mW/sr
TSHA6203	3.7		875 nm/125 mW/sr
TSHA6500	2.2	875 nm/60 mW/sr	
TSHA6501	2.2	875 nm/60 mW/sr	
TSHA6502	2.2	875 nm/60 mW/sr	
TSHA6503	2.2	875 nm/60 mW/sr	
TSHF4410	1.8		880 nm/120 mW/sr
TSHF5210	3.7		880 nm/360 mW/sr
TSHF5410	2.1		880 nm/135 mW/sr
TSHF6210	2.1		880 nm/360 mW/sr
TSHF6410	2.1		880 nm/135 mW/sr
TSHG5210	3.7		850 nm/420 mW/sr
TSHG5410	2.1		850 nm/135 mW/sr
TSHG6210	3.7		850 nm/420 mW/sr

Eye Safety Risk Assessment of Infrared Emitting Diodes According IEC (EN DIN) 60825-1

COMPILATION OF INTENSITY/WAVELENGTH DATA FOR CLASS 1 ASSESSMENT ACCORDING IEC 60825-1

PART NUMBER	VIRTUAL SOURCE SIZE d (mm)	WAVELENGTH/MAXIMUM INTENSITY AT ABSOLUTE MAX. RATINGS HANDLED BY THE SIMPLIFIED METHOD	WAVELENGTH/MAXIMUM INTENSITY WHERE APPARENT SOURCE IS TO BE TAKEN INTO ACCOUNT; FOR CLASS 1 LIMIT REFER TO DIAGRAM
TSHG6410	2.1		850 nm/135 mW/sr
TSHG8200	3.7		830 nm/360 mW/sr
TSHG8400	2.1		830 nm/135 mW/sr
TSKS5400	1.2	950 nm/7 mW/sr	
TSKS5400S	1.2	950 nm/7 mW/sr	
TSMF1000	1.2	890 nm/13 mW/sr	
TSMF1020	1.2	890 nm/13 mW/sr	
TSMF1030	1.2	890 nm/13 mW/sr	
TSML1000	1.2	940 nm/15 mW/sr	
TSML1000	1.2	940 nm/120 mW/sr	
TSML1020	1.2	940 nm/15 mW/sr	
TSML1020	1.2	940 nm/120 mW/sr	
TSML1030	1.2	940 nm/15 mW/sr	
TSML1030	1.2	940 nm/120 mW/sr	
TSML1040	1.2	940 nm/15 mW/sr	
TSML1040	1.2	940 nm/120 mW/sr	
TSML3700	0.5	940 nm/15 mW/sr	
TSPF5400	2.2		870 nm/150 mW/sr
TSSF4500	2.4	870 nm/50 mW/sr	
TSSS2600	2	950 nm/3 mW/sr	
TSTA7100	1.5	875 nm/100 mW/sr	
TSTA7300	1	875 nm/50 mW/sr	
TSTA7500	0.5	875 nm/16 mW/sr	
TSTS7100	1.5	950 nm/50 mW/sr	
TSTS7300	1	950 nm/20 mW/sr	
TSTS7500	0.5	950 nm/6.5 mW/sr	
TSUS4300	2.1	950 nm/35 mW/sr	
TSUS4400	2.1	950 nm/35 mW/sr	
TSUS5200	3.8	950 nm/50 mW/sr	
TSUS5201	3.8	950 nm/50 mW/sr	
TSUS5202	3.8	950 nm/50 mW/sr	
TSUS5400	2.9	950 nm/35 mW/sr	
TSUS5401	2.9	950 nm/35 mW/sr	
TSUS5402	2.9	950 nm/35 mW/sr	
VSLB3940X01	-	950 nm/110 mW/sr	
VSMB1940X01	-	950 nm/8 mW/sr	
VSMB2000X01	-	950 nm/12 mW/sr	
VSMB2020X01	-	950 nm/12 mW/sr	
VSMB3940X01	-	950 nm/11 mW/sr	
VSMF3710	-	870 nm/22 mW/sr	
VSMF4710	-	870 nm/22 mW/sr	
VSMF4720	-	870 nm/30 mW/sr	
VSMG2700	-	830 nm/22 mW/sr	
VSMG3700	-	830 nm/22 mW/sr	
VSML3710	0.36	940 nm/15 mW/sr	
VSMS3700	-	950 nm/8 mW/sr	

Note

All listed diode emitters are inside IEC 60825-1, class 1

Eye Safety Risk Assessment of Infrared Emitting Diodes According IEC (EN DIN) 60825-1

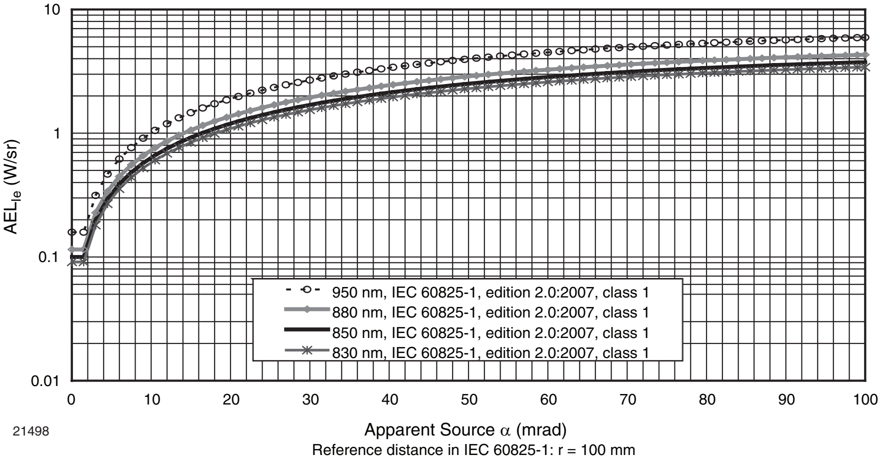


Fig. 1 - Accessible Emission Levels (AELs) vs. Apparent Source Size
(α = d/r, 1 mm source diameter is equivalent to an angular subtense of 10 mrad)

For the simplified method the apparent source size is not taken into account, the values for $\alpha = 0$ of this diagram are relevant.

IEC 62471 and EU DIRECTIVE 2006/25/EC

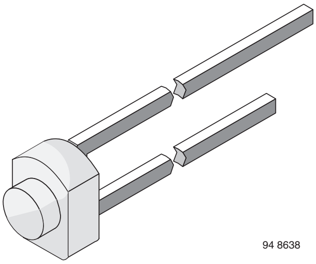
For all other **applications beside free air communications** (covered by IEC EN DIN 60825-12) the standard IEC 62471 is applicable.
This standard for incoherent sources replaces for LEDs the laser standard IEC DIN EN 60825-1.
In case of IR - Emitters the dominating limit is the cornea/lens risk in the wavelength range from 780 nm to 3000 nm. This limits the irradiance to E_e = 100 W/m^2 which is expressed as intensity a value of **I_e = 4 W/sr** with the measurement condition of that standard with 0.2 m distance in mind ($I_e = E_e \times r^2$).
Evaluating the other limiting conditions as the thermal retinal risk and blue light hazard result in not limiting higher values for wavelengths $\lambda > 850$ nm and therefore are not to be taken into account. Only for $\lambda = 830$ nm a little reduction to **I_e = 3.77 W/sr** is given by the thermal risk.
This is still far above of the emitted intensities of IREDs covered by the Vishay datasheets.

Datasheets
Infrared
Emitters

Contents

For full listing please see Table of Contents
on pages 1 and 2.

Infrared Emitting Diode, RoHS Compliant, 950 nm, GaAs



DESCRIPTION

CQY36N is an infrared, 950 nm emitting diode in GaAs technology molded in a miniature, clear plastic package without lens.

FEATURES

- Package type: leaded
- Package form: T-¾
- Dimensions (in mm): ∅ 1.8
- Peak wavelength: λ_p = 950 nm
- High reliability
- Angle of half intensity: φ = ± 55°
- Low forward voltage
- Suitable for high pulse current operation
- Good spectral matching with Si photodetectors
- Package matches with detector BPW16N
- Lead (Pb)-free component in accordance with RoHS 2002/95/EC and WEEE 2002/96/EC

Pb-free

e4

RoHS
COMPLIANT

APPLICATIONS

- Radiation source in near infrared range

PRODUCT SUMMARY				
COMPONENT	**I_e (mW/sr)**	**φ (deg)**	**λ_P (nm)**	**t_r (ns)**
CQY36N	1.5	± 55	950	400

Note

Test conditions see table "Basic Characteristics"

ORDERING INFORMATION			
ORDERING CODE	**PACKAGING**	**REMARKS**	**PACKAGE FORM**
CQY36N	Bulk	MOQ: 5000 pcs, 5000 pcs/bulk	T-¾

Note

MOQ: minimum order quantity

ABSOLUTE MAXIMUM RATINGS				
PARAMETER	**TEST CONDITION**	**SYMBOL**	**VALUE**	**UNIT**
Reverse voltage		V_R	5	V
Forward current		I_F	100	mA
Surge forward current	$t_p \leq 100$ µs	I_{FSM}	2	A
Power dissipation		P_V	160	mW
Junction temperature		T_j	100	°C
Operating temperature range		T_{amb}	- 25 to + 85	°C
Storage temperature range		T_{stg}	- 25 to + 100	°C
Soldering temperature	t ≤ 3 s	T_{sd}	245	°C
Thermal resistance junction/ambient	leads not soldered	R_{thJA}	450	K/W

Note

T_{amb} = 25 °C, unless otherwise specified

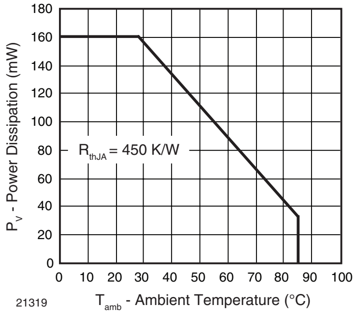


Fig. 1 - Power Dissipation Limit vs. Ambient Temperature

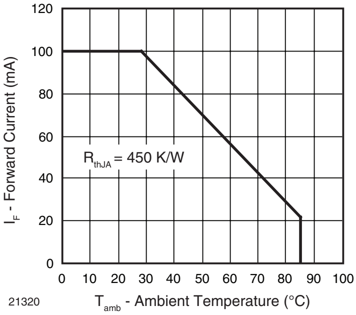


Fig. 2 - Forward Current Limit vs. Ambient Temperature

BASIC CHARACTERISTICS

PARAMETER	TEST CONDITION	SYMBOL	MIN.	TYP.	MAX.	UNIT
Forward voltage	$I_F = 50$ mA, $t_p \leq 20$ ms	V_F		1.3	1.6	V
Temperature coefficient of V_F	$I_F = 100$ mA	TK_{VF}		- 1.3		mV/K
Breakdown voltage	$I_R = 100$ µA	$V_{(BR)}$	5			µA
Junction capacitance	$V_R = 0$ V, f = 1 MHz, E = 0	C_j		50		pF
Radiant intensity	$I_F = 50$ mA, $t_p \leq 20$ ms	I_e	0.7	1.5	7.5	mW/sr
Radiant power	$I_F = 50$ mA, $t_p \leq 20$ ms	ϕ_e		10		mW
Temperature coefficient of ϕ_e	$I_F = 50$ mA	$TK\phi_e$		- 0.8		%/K
Angle of half intensity		φ		± 55		deg
Peak wavelength	$I_F = 50$ mA	λ_p		950		nm
Spectral bandwidth	$I_F = 50$ mA	$\Delta\lambda$		50		nm
Rise time	$I_F = 1.5$ A, $t_p/T = 0.01$, $t_p \leq 10$ µs	t_r		400		ns
Fall time	$I_F = 1.5$ A, $t_p/T = 0.01$, $t_p \leq 10$ µs	t_f		450		ns
Virtual source diameter		d		1.2		mm

Note

$T_{amb} = 25$ °C, unless otherwise specified

BASIC CHARACTERISTICS

$T_{amb} = 25$ °C, unless otherwise specified

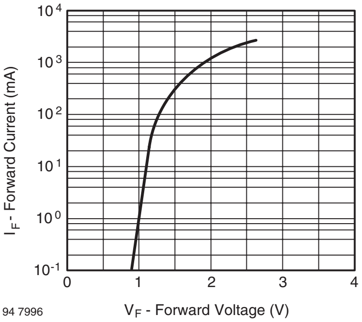


Fig. 3 - Forward Current vs. Forward Voltage

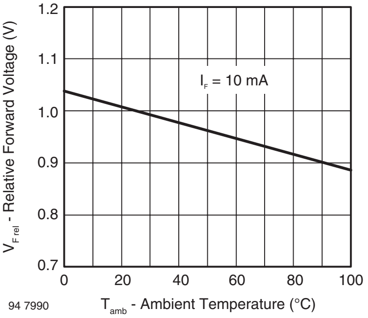


Fig. 4 - Relative Forward Voltage vs. Ambient Temperature

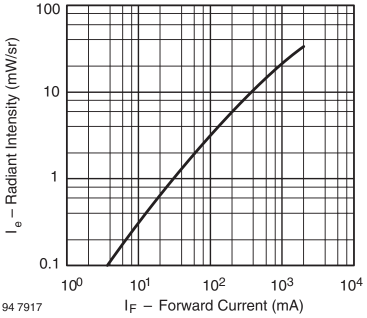


Fig. 5 - Radiant Intensity vs. Forward Current

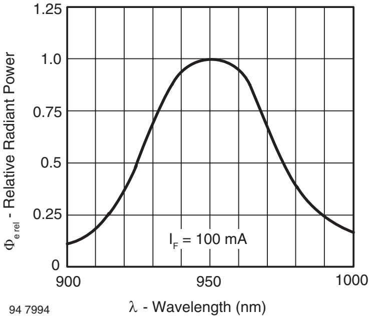


Fig. 8 - Relative Radiant Power vs. Wavelength

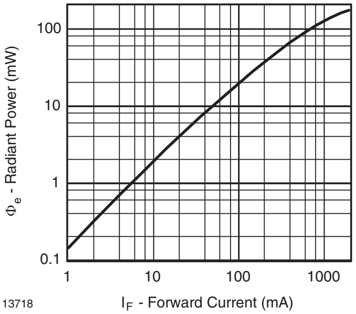


Fig. 6 - Radiant Power vs. Forward Current

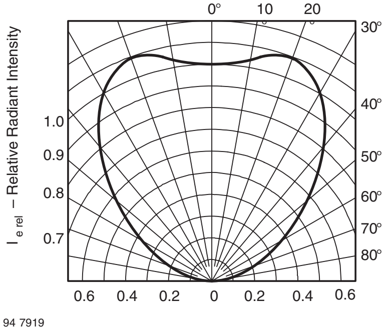


Fig. 9 - Relative Radiant Intensity vs. Angular Displacement

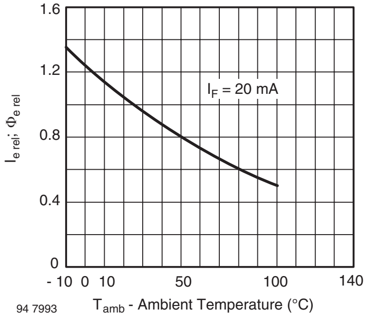
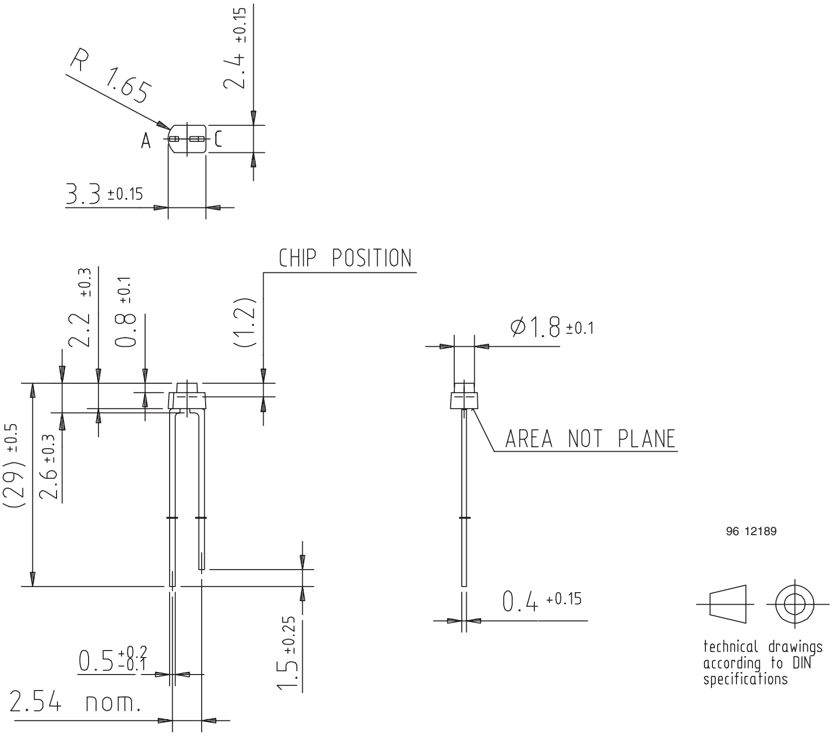
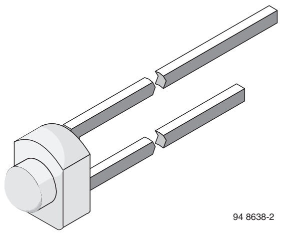


Fig. 7 - Relative Radiant Intensity/Power vs. Ambient Temperature

PACKAGE DIMENSIONS in millimeters



Infrared Emitting Diode, RoHS Compliant, 950 nm, GaAs



FEATURES

- Package type: leaded
- Package form: T-¾
- Dimensions (in mm): ∅ 1.8
- Peak wavelength: λ_p = 950 nm
- High reliability
- Angle of half intensity: $\varphi = \pm 12°$
- Low forward voltage
- Suitable for high pulse current operation
- Good spectral matching with Si photodetectors
- Package matches with detector BPW17N
- Lead (Pb)-free component in accordance with RoHS 2002/95/EC and WEEE 2002/96/EC

DESCRIPTION

CQY37N is an infrared, 950 nm emitting diode in GaAs technology molded in a miniature, clear plastic package with lens.

APPLICATIONS

- Radiation source in near infrared range

PRODUCT SUMMARY

COMPONENT	I_e (mW/sr)	φ (deg)	λ_P (nm)	t_r (ns)
CQY37N	5	± 12	950	400

Note
Test conditions see table “Basic Characteristics“

ORDERING INFORMATION

ORDERING CODE	PACKAGING	REMARKS	PACKAGE FORM
CQY37N	Bulk	MOQ: 5000 pcs, 5000 pcs/bulk	T-¾

Note
MOQ: minimum order quantity

ABSOLUTE MAXIMUM RATINGS

PARAMETER	TEST CONDITION	SYMBOL	VALUE	UNIT
Reverse voltage		V_R	5	V
Forward current		I_F	100	mA
Surge forward current	$t_p \leq 100$ µs	I_{FSM}	2	A
Power dissipation		P_V	160	mW
Junction temperature		T_j	100	°C
Operating temperature range		T_{amb}	- 25 to + 85	°C
Storage temperature range		T_{stg}	- 25 to + 100	°C
Soldering temperature	$t \leq 3$ s	T_{sd}	245	°C
Thermal resistance junction/ambient	leads not soldered	R_{thJA}	450	K/W

Note
T_{amb} = 25 °C, unless otherwise specified

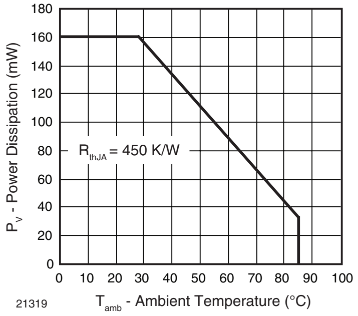


Fig. 1 - Power Dissipation Limit vs. Ambient Temperature

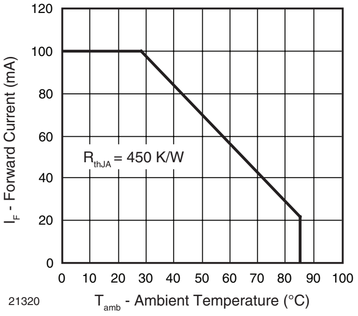


Fig. 2 - Forward Current Limit vs. Ambient Temperature

BASIC CHARACTERISTICS

PARAMETER	TEST CONDITION	SYMBOL	MIN.	TYP.	MAX.	UNIT
Forward voltage	I_F = 50 mA, $t_p \le$ 20 ms	V_F		1.3	1.6	V
Temperature coefficient of V_F	I_F = 100 mA	TK_{VF}		- 1.3		mV/K
Breakdown voltage	I_R = 100 µA	$V_{(BR)}$	5			µA
Junction capacitance	V_R = 0 V, f = 1 MHz, E = 0	C_j		50		pF
Radiant intensity	I_F = 50 mA, $t_p \le$ 20 ms	I_e	2.2	5	11	mW/sr
Radiant power	I_F = 50 mA, $t_p \le$ 20 ms	ϕ_e		10		mW
Temperature coefficient of ϕ_e	I_F = 50 mA	$TK\phi_e$		- 0.8		%/K
Angle of half intensity		φ		± 12		deg
Peak wavelength	I_F = 50 mA	λ_p		950		nm
Spectral bandwidth	I_F = 50 mA	$\Delta\lambda$		50		nm
Rise time	I_F = 1.5 A, t_p/T = 0.01, $t_p \le$ 10 µs	t_r		400		ns
Fall time	I_F = 1.5 A, t_p/T = 0.01, $t_p \le$ 10 µs	t_f		450		ns
Virtual source diameter		d		1.2		mm

Note

T_{amb} = 25 °C, unless otherwise specified

BASIC CHARACTERISTICS

T_{amb} = 25 °C, unless otherwise specified

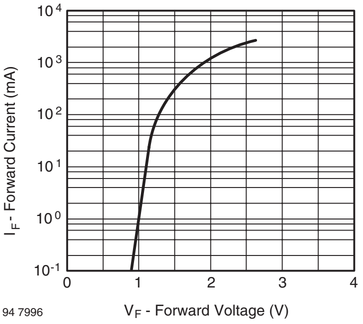


Fig. 3 - Forward Current vs. Forward Voltage

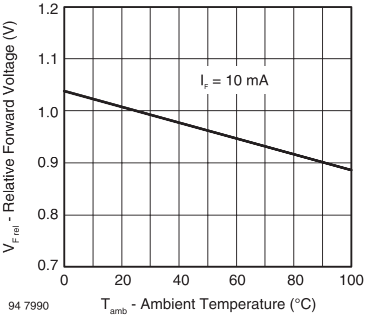


Fig. 4 - Relative Forward Voltage vs. Ambient Temperature

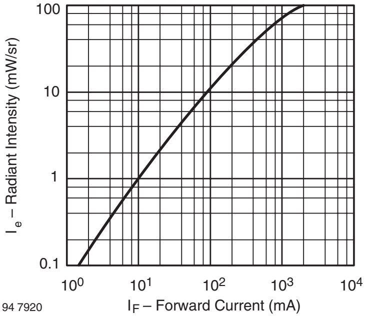


Fig. 5 - Radiant Intensity vs. Forward Current

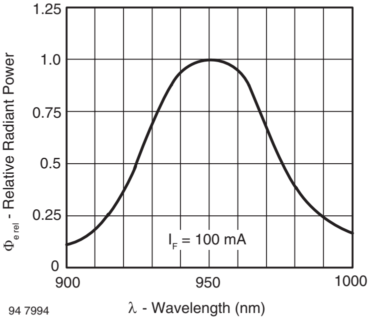


Fig. 8 - Relative Radiant Power vs. Wavelength

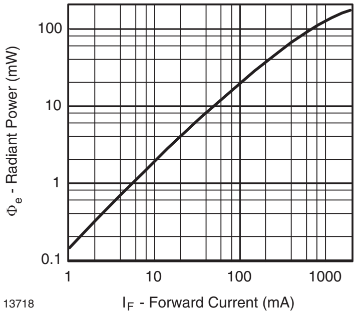


Fig. 6 - Radiant Power vs. Forward Current

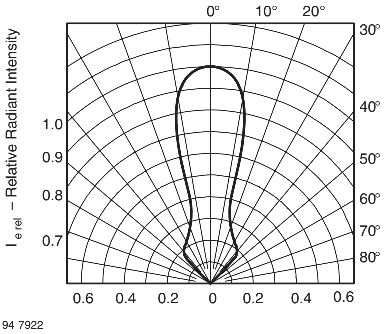


Fig. 9 - Relative Radiant Intensity vs. Angular Displacement

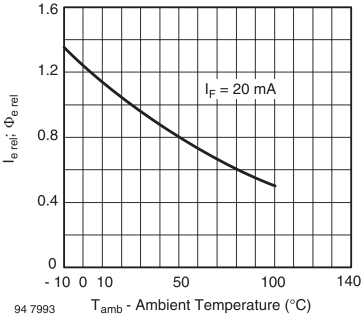
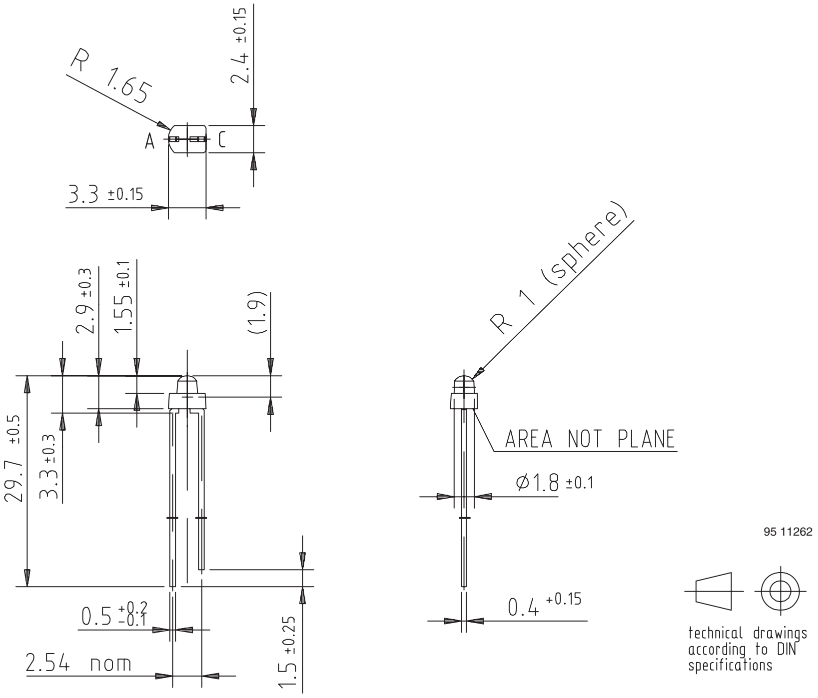
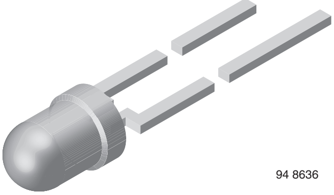


Fig. 7 - Relative Radiant Intensity/Power vs. Ambient Temperature

PACKAGE DIMENSIONS in millimeters



High Power Infrared Emitting Diode, RoHS Compliant, 940 nm, GaAlAs/GaAs



DESCRIPTION

TSAL4400 is an infrared, 940 nm emitting diode in GaAlAs/GaAs technology with high radiant power molded in a blue-gray plastic package.

FEATURES

- Package type: leaded
- Package form: T-1
- Dimensions (in mm): ∅ 3
- Peak wavelength: λ_p = 940 nm
- High reliability
- High radiant power
- High radiant intensity
- Angle of half intensity: φ = ± 25°
- Low forward voltage
- Suitable for high pulse current operation
- Good spectral matching with Si photodetectors
- Package matches with detector TEFT4300
- Lead (Pb)-free component in accordance with RoHS 2002/95/EC and WEEE 2002/96/EC

Pb Pb-free

e2

RoHS COMPLIANT

APPLICATIONS

- Infrared remote control units
- Free air transmission systems
- Infrared source for optical counters and card readers

PRODUCT SUMMARY

COMPONENT	I_e (mW/sr)	φ (deg)	λ_P (nm)	t_r (ns)
TSAL4400	30	± 25	940	800

Note
Test conditions see table “Basic Characteristics“

ORDERING INFORMATION

ORDERING CODE	PACKAGING	REMARKS	PACKAGE FORM
TSAL4400	Bulk	MOQ: 5000 pcs, 5000 pcs/bulk	T-1

Note
MOQ: minimum order quantity

ABSOLUTE MAXIMUM RATINGS

PARAMETER	TEST CONDITION	SYMBOL	VALUE	UNIT
Reverse voltage		V_R	5	V
Forward current		I_F	100	mA
Peak forward current	$t_p/T = 0.5$, t_p = 100 µs	I_{FM}	200	mA
Surge forward current	t_p = 100 µs	I_{FSM}	1.5	A
Power dissipation		P_V	160	mW
Junction temperature		T_j	100	°C
Operating temperature range		T_{amb}	- 40 to + 85	°C
Storage temperature range		T_{stg}	- 40 to + 100	°C
Soldering temperature	$t \leq 5$ s, 2 mm from case	T_{sd}	260	°C
Thermal resistance junction/ambient	J-STD-051, leads 7 mm, soldered on PCB	R_{thJA}	300	K/W

Note
T_{amb} = 25 °C, unless otherwise specified

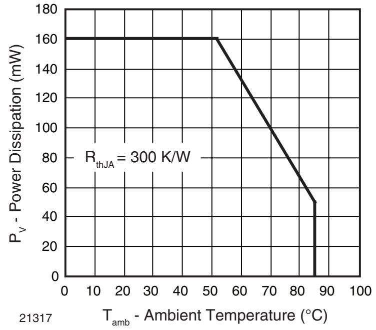


Fig. 1 - Power Dissipation Limit vs. Ambient Temperature

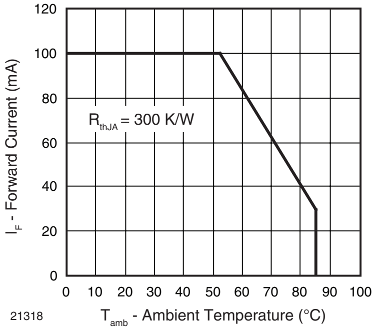


Fig. 2 - Forward Current Limit vs. Ambient Temperature

BASIC CHARACTERISTICS

PARAMETER	TEST CONDITION	SYMBOL	MIN.	TYP.	MAX.	UNIT
Forward voltage	I_F = 100 mA, t_p = 20 ms	V_F		1.35	1.6	V
	I_F = 1 A, t_p = 100 µs	V_F		2.6	3	V
Temperature coefficient of V_F	I_F = 1 mA	TK_{VF}		- 1.8		mV/K
Reverse current	V_R = 5 V	I_R			10	µA
Junction capacitance	V_R = 0 V, f = 1 MHz, E = 0	C_j		25		pF
Radiant intensity	I_F = 100 mA, t_p = 20 ms	I_e	16	30	80	mW/sr
	I_F = 1 A, t_p = 100 µs	I_e	135	240		mW/sr
Radiant power	I_F = 100 mA, t_p = 20 ms	ϕ_e		35		mW
Temperature coefficient of ϕ_e	I_F = 20 mA	$TK\phi_e$		- 0.6		%/K
Angle of half intensity		φ		± 25		deg
Peak wavelength	I_F = 100 mA	λ_p		940		nm
Spectral bandwidth	I_F = 100 mA	$\Delta\lambda$		50		nm
Temperature coefficient of λ_p	I_F = 100 mA	$TK\lambda_p$		0.2		nm/K
Rise time	I_F = 100 mA	t_r		800		ns
Fall time	I_F = 100 mA	t_f		800		ns
Virtual source diameter	Method: 63 % encircled energy	d		1.9		mm

Note

T_{amb} = 25 °C, unless otherwise specified

BASIC CHARACTERISTICS

T_{amb} = 25 °C, unless otherwise specified

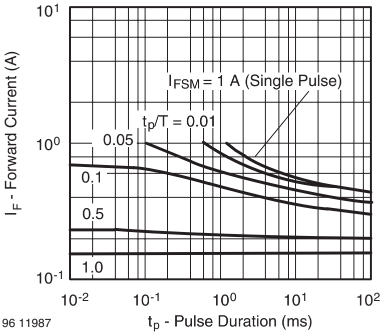


Fig. 3 - Pulse Forward Current vs. Pulse Duration

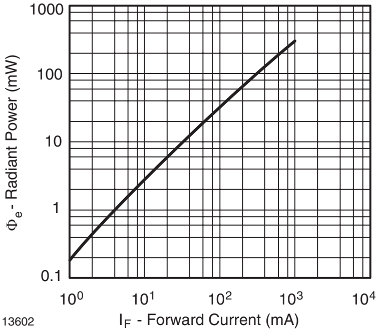


Fig. 6 - Radiant Power vs. Forward Current

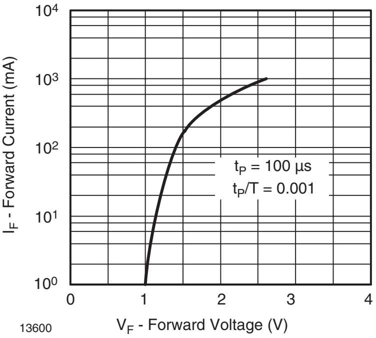


Fig. 4 - Forward Current vs. Forward Voltage

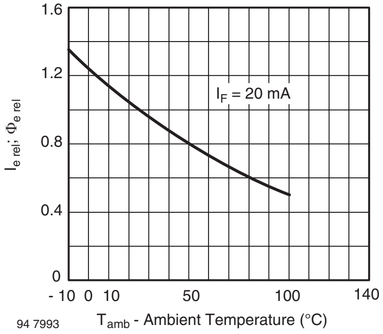


Fig. 7 - Rel. Radiant Intensity/Power vs. Ambient Temperature

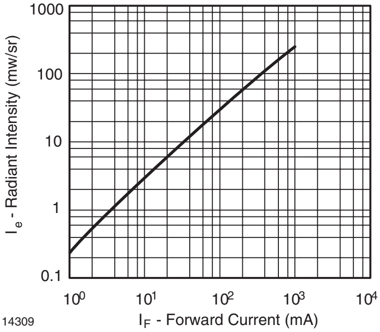


Fig. 5 - Radiant Intensity vs. Forward Current

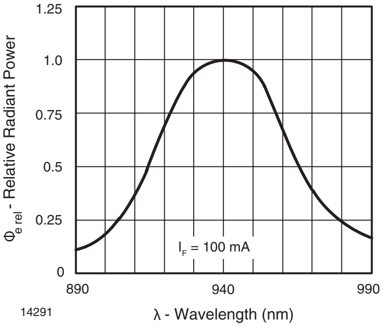


Fig. 8 - Relative Radiant Power vs. Wavelength

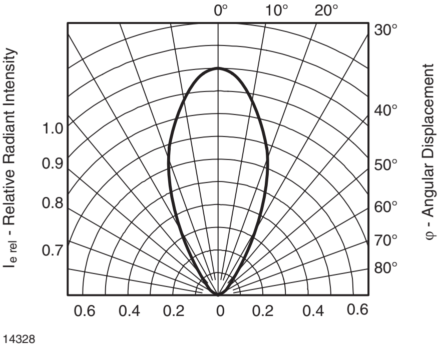
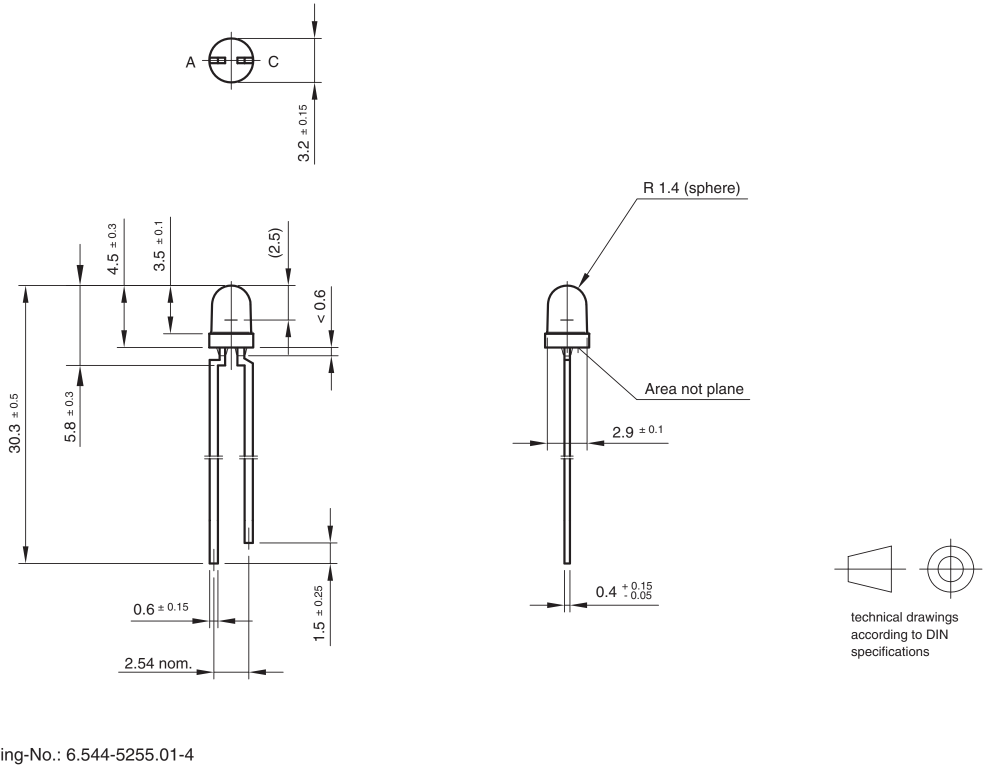


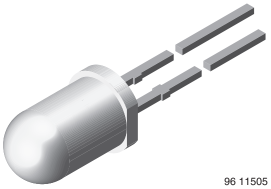
Fig. 9 - Relative Radiant Intensity vs. Angular Displacement

PACKAGE DIMENSIONS in millimeters



Drawing-No.: 6.544-5255.01-4
Issue: 6; 24.07.08
95 10913

High Power Infrared Emitting Diode, RoHS Compliant, 940 nm, GaAlAs/GaAs



DESCRIPTION

TSAL5100 is an infrared, 940 nm emitting diode in GaAlAs/GaAs technology with high radiant power, molded in a blue-gray plastic package.

FEATURES

- Package type: leaded
- Package form: T-1¾
- Dimensions (in mm): ∅ 5
- Leads with stand-off
- Peak wavelength: λ_p = 940 nm
- High reliability
- High radiant power
- High radiant intensity
- Angle of half intensity: φ = ± 10°
- Low forward voltage
- Suitable for high pulse current operation
- Good spectral matching with Si photodetectors
- Lead (Pb)-free component in accordance with RoHS 2002/95/EC and WEEE 2002/96/EC

Pb-free
e2
RoHS
COMPLIANT

APPLICATIONS

- Infrared remote control units with high power reqirements
- Free air transmission systems
- Infrared source for optical counters and card readers
- IR source for smoke detectors
- Smoke-automatic fire detectors

PRODUCT SUMMARY

COMPONENT	I_e (mW/sr)	φ (deg)	λ_P (nm)	t_r (ns)
TSAL5100	130	± 10	940	800

Note
Test conditions see table “Basic Characteristics“

ORDERING INFORMATION

ORDERING CODE	PACKAGING	REMARKS	PACKAGE FORM
TSAL5100	Bulk	MOQ: 4000 pcs, 4000 pcs/bulk	T-1¾

Note
MOQ: minimum order quantity

ABSOLUTE MAXIMUM RATINGS

PARAMETER	TEST CONDITION	SYMBOL	VALUE	UNIT
Reverse voltage		V_R	5	V
Forward current		I_F	100	mA
Peak forward current	$t_p/T = 0.5$, $t_p = 100\ \mu s$	I_{FM}	200	mA
Surge forward current	$t_p = 100\ \mu s$	I_{FSM}	1.5	A
Power dissipation		P_V	160	mW
Junction temperature		T_j	100	°C
Operating temperature range		T_{amb}	- 40 to + 85	°C
Storage temperature range		T_{stg}	- 40 to + 100	°C
Soldering temperature	$t \leq 5$ s, 2 mm from case	T_{sd}	260	°C
Thermal resistance junction/ambient	J-STD-051, leads 7 mm soldered on PCB	R_{thJA}	230	K/W

Note
T_{amb} = 25 °C, unless otherwise specified

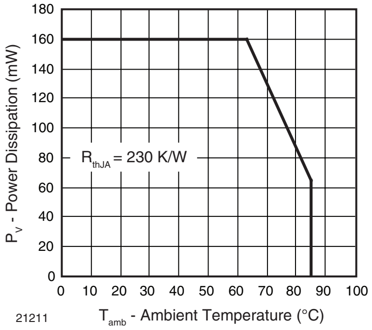


Fig. 1 - Power Dissipation Limit vs. Ambient Temperature

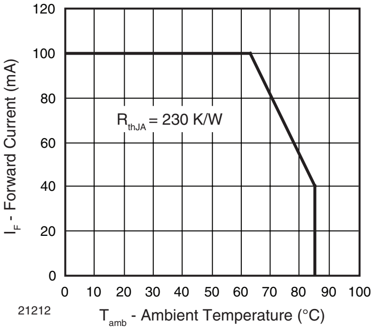


Fig. 2 - Forward Current Limit vs. Ambient Temperature

BASIC CHARACTERISTICS

PARAMETER	TEST CONDITION	SYMBOL	MIN.	TYP.	MAX.	UNIT
Forward voltage	I_F = 100 mA, t_p = 20 ms	V_F		1.35	1.6	V
	I_F = 1 A, t_p = 100 µs	V_F		2.6	3	V
Temperature coefficient of V_F	I_F = 1 mA	TK_{VF}		- 1.8		mV/K
Reverse current	V_R = 5 V	I_R			10	µA
Junction capacitance	V_R = 0 V, f = 1 MHz, E = 0	C_j		25		pF
Radiant intensity	I_F = 100 mA, t_p = 20 ms	I_e	80	130	400	mW/sr
	I_F = 1 A, t_p = 100 µs	I_e	650	1000		mW/sr
Radiant power	I_F = 100 mA, t_p = 20 ms	ϕ_e		35		mW
Temperature coefficient of ϕ_e	I_F = 20 mA	$TK\phi_e$		- 0.6		%/K
Angle of half intensity		φ		± 10		deg
Peak wavelength	I_F = 100 mA	λ_p		940		nm
Spectral bandwidth	I_F = 100 mA	$\Delta\lambda$		50		nm
Temperature coefficient of λ_p	I_F = 100 mA	$TK\lambda_p$		0.2		nm/K
Rise time	I_F = 100 mA	t_r		800		ns
Fall time	I_F = 100 mA	t_f		800		ns
Virtual source diameter	method: 63 % encircled energy	d		3.7		mm

Note

T_{amb} = 25 °C, unless otherwise specified

BASIC CHARACTERISTICS

T_{amb} = 25 °C, unless otherwise specified

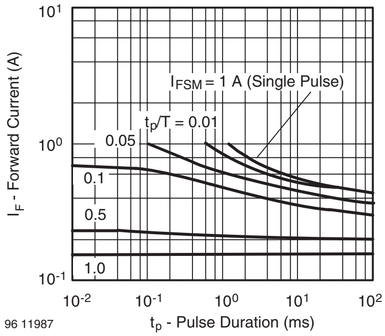


Fig. 3 - Pulse Forward Current vs. Pulse Duration

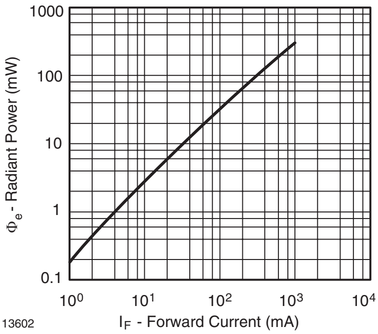


Fig. 6 - Radiant Power vs. Forward Current

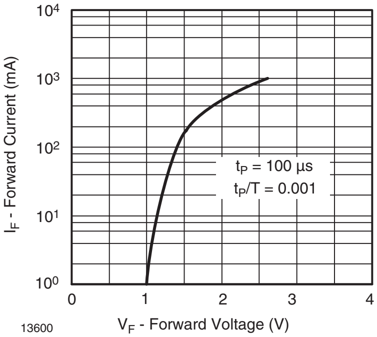


Fig. 4 - Forward Current vs. Forward Voltage

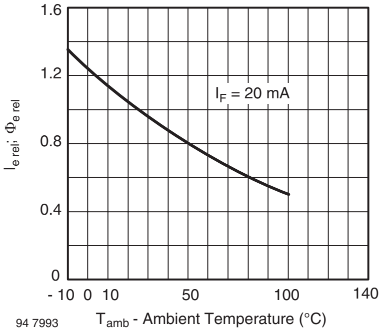


Fig. 7 - Rel. Radiant Intensity/Power vs. Ambient Temperature

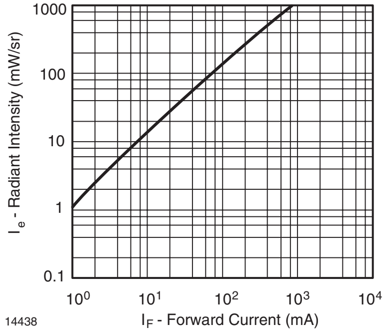


Fig. 5 - Radiant Intensity vs. Forward Current

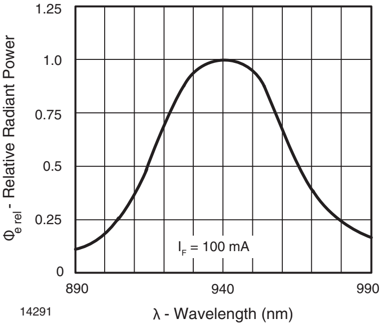


Fig. 8 - Relative Radiant Power vs. Wavelength

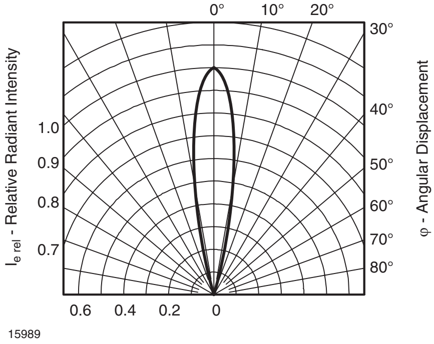
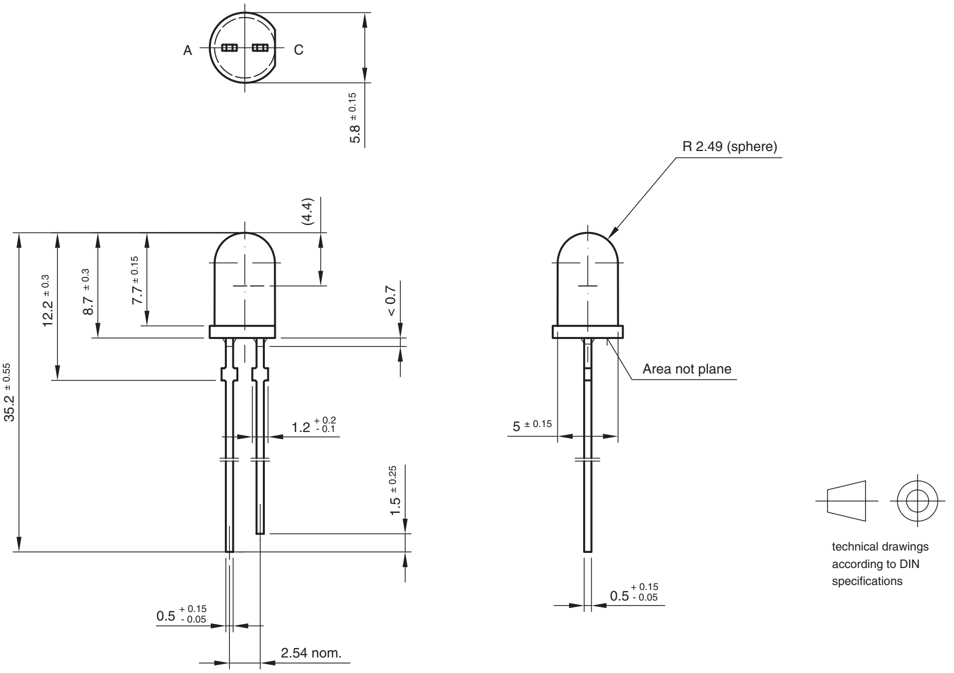


Fig. 9 - Relative Radiant Intensity vs. Angular Displacement

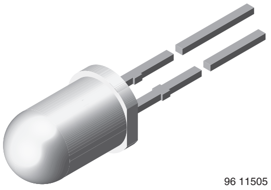
PACKAGE DIMENSIONS in millimeters



technical drawings according to DIN specifications

6.544-5258.08-4
Issue: 3; 08.11.99
14435

High Power Infrared Emitting Diode, RoHS Compliant, 940 nm, GaAlAs/GaAs



DESCRIPTION

TSAL5300 is an infrared, 940 nm emitting diode in GaAlAs/GaAs technology with high radiant power molded in a blue-gray plastic package.

FEATURES

- Package type: leaded
- Package form: T-1¾
- Dimensions (in mm): ∅ 5
- Leads with stand-off
- Peak wavelength: λ_p = 940 nm
- High reliability
- High radiant power
- High radiant intensity
- Angle of half intensity: $\varphi = \pm 22°$
- Low forward voltage
- Suitable for high pulse current operation
- Good spectral matching with Si photodetectors
- Lead (Pb)-free component in accordance with RoHS 2002/95/EC and WEEE 2002/96/EC

APPLICATIONS

- Infrared remote control units with high power requirements
- Free air transmission systems
- Infrared source for optical counters and card readers

PRODUCT SUMMARY

COMPONENT	I_e (mW/sr)	φ (deg)	λ_P (nm)	t_r (ns)
TSAL5300	45	± 22	940	800

Note
Test conditions see table “Basic Characteristics“

ORDERING INFORMATION

ORDERING CODE	PACKAGING	REMARKS	PACKAGE FORM
TSAL5300	Bulk	MOQ: 4000 pcs, 4000 pcs/bulk	T-1¾
TSAL5300-MSZ	Ammopack	MOQ: 5000 pcs, 1000 pcs/ammopack	T-1¾

Note
MOQ: minimum order quantity

ABSOLUTE MAXIMUM RATINGS

PARAMETER	TEST CONDITION	SYMBOL	VALUE	UNIT
Reverse voltage		V_R	5	V
Forward current		I_F	100	mA
Peak forward current	$t_p/T = 0.5$, $t_p = 100$ µs	I_{FM}	200	mA
Surge forward current	$t_p = 100$ µs	I_{FSM}	1.5	A
Power dissipation		P_V	160	mW
Junction temperature		T_j	100	°C
Operating temperature range		T_{amb}	- 40 to + 85	°C
Storage temperature range		T_{stg}	- 40 to + 100	°C
Soldering temperature	$t \leq 5$ s, 2 mm from case	T_{sd}	260	°C
Thermal resistance junction/ambient	J-STD-051, leads 7 mm soldered on PCB	R_{thJA}	230	K/W

Note
T_{amb} = 25 °C, unless otherwise specified

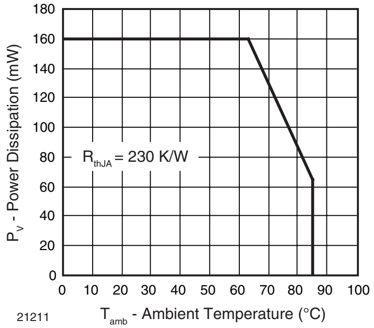


Fig. 1 - Power Dissipation Limit vs. Ambient Temperature

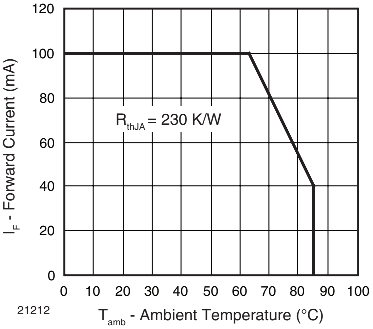


Fig. 2 - Forward Current Limit vs. Ambient Temperature

BASIC CHARACTERISTICS

PARAMETER	TEST CONDITION	SYMBOL	MIN.	TYP.	MAX.	UNIT
Forward voltage	I_F = 100 mA, t_p = 20 ms	V_F		1.35	1.6	V
	I_F = 1 A, t_p = 100 µs	V_F		2.6	3	V
Temperature coefficient of V_F	I_F = 1 mA	TK_{VF}		- 1.8		mV/K
Reverse current	V_R = 5 V	I_R			10	µA
Junction capacitance	V_R = 0 V, f = 1 MHz, E = 0	C_j		25		pF
Radiant intensity	I_F = 100 mA, t_p = 20 ms	I_e	30	45	150	mW/sr
	I_F = 1 A, t_p = 100 µs	I_e	260	350		mW/sr
Radiant power	I_F = 100 mA, t_p = 20 ms	ϕ_e		35		mW
Temperature coefficient of ϕ_e	I_F = 20 mA	$TK\phi_e$		- 0.6		%/K
Angle of half intensity		φ		± 22		deg
Peak wavelength	I_F = 100 mA	λ_p		940		nm
Spectral bandwidth	I_F = 100 mA	$\Delta\lambda$		50		nm
Temperature coefficient of λ_p	I_F = 100 mA	$TK\lambda_p$		0.2		nm/K
Rise time	I_F = 100 mA	t_r		800		ns
	I_F = 1 A	t_r		500		ns
Fall time	I_F = 100 mA	t_f		800		ns
	I_F = 1 A	t_f		500		ns
Virtual source diameter	Method: 63 % encircled energy	d		2.3		mm

Note

T_{amb} = 25 °C, unless otherwise specified

BASIC CHARACTERISTICS

T_{amb} = 25 °C, unless otherwise specified

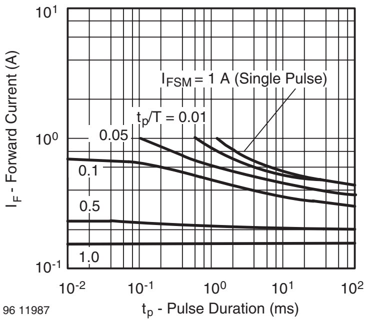


Fig. 3 - Pulse Forward Current vs. Pulse Duration

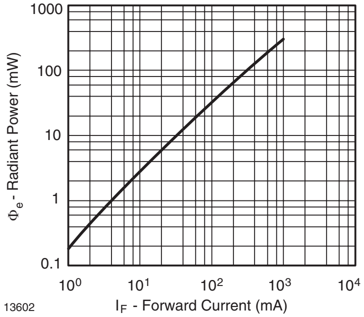


Fig. 6 - Radiant Power vs. Forward Current

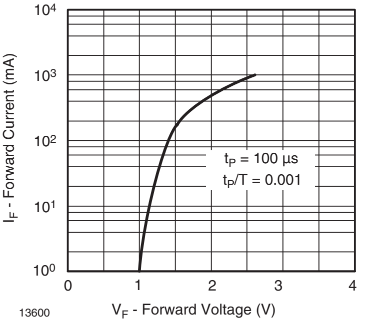


Fig. 4 - Forward Current vs. Forward Voltage

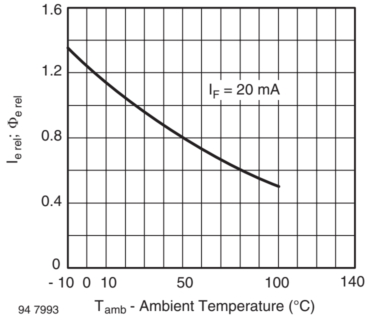


Fig. 7 - Relative Radiant Intensity/Power vs. Ambient Temperature

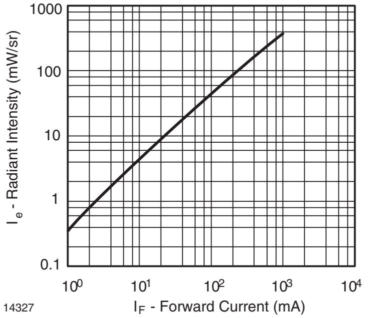


Fig. 5 - Radiant Intensity vs. Forward Current

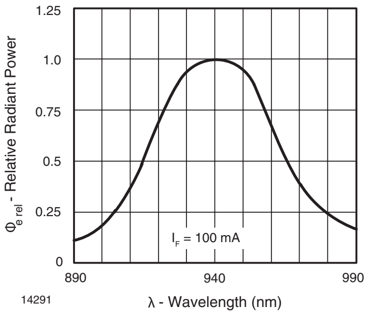


Fig. 8 - Relative Radiant Power vs. Wavelength

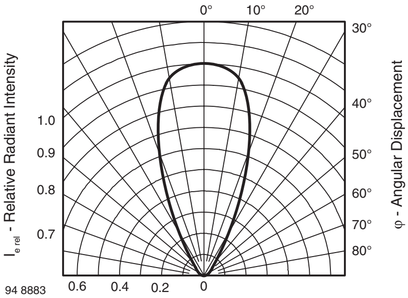
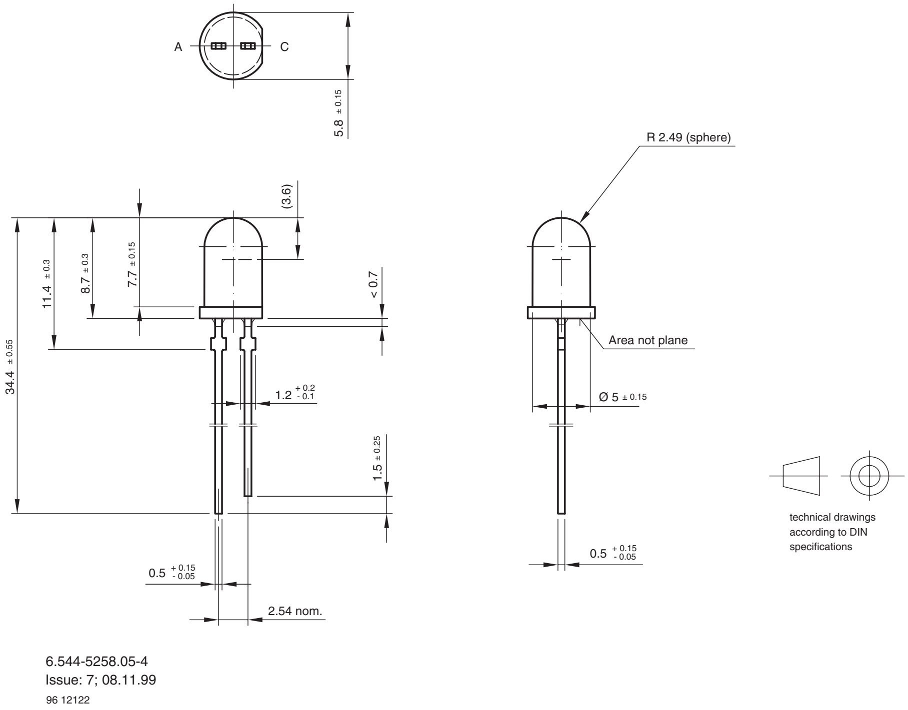


Fig. 9 - Relative Radiant Intensity vs. Angular Displacement

PACKAGE DIMENSIONS in millimeters



TAPE DIMENSIONS TSAL5300		
OPTION	H ± 0.5 mm	QUANTITY/BOX
CS21Z	22	1000
FSZ	27	1000
GSZ	29	1000
MSZ	25.5	1000

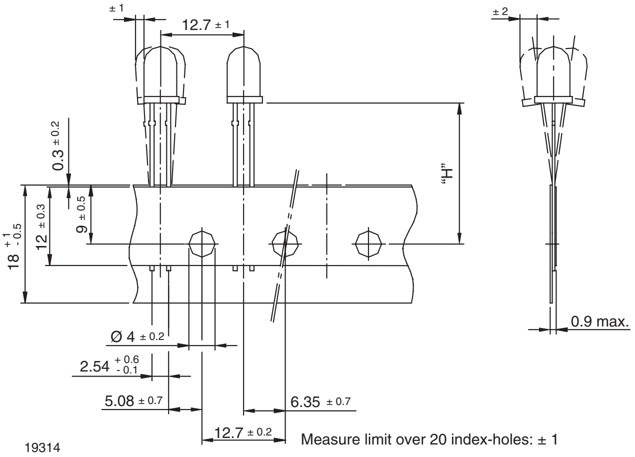


Fig. 10 - ∅ 5 mm Devices on Tape

AMMOPACK

The tape is folded in a concertina arrangement and laid in cardboard box.

If components are required with cathode before the anode (figure 12), then start of tape should be taken from the side of the box marked "-". If components are required with anode before cathode, then tape should be taken from the side of the box marked "+".

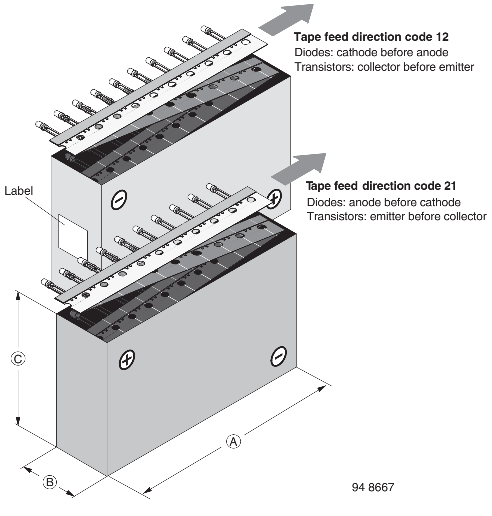
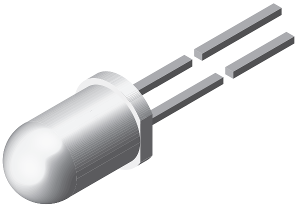


Fig. 11 - Tape Direction

High Power Infrared Emitting Diode, RoHS Compliant, 940 nm, GaAlAs/GaAs



FEATURES

- Package type: leaded
- Package form: T-1¾
- Dimensions (in mm): ∅ 5
- Peak wavelength: λ_p = 940 nm
- High reliability
- High radiant power
- High radiant intensity
- Angle of half intensity: $\varphi = \pm 10°$
- Low forward voltage
- Suitable for high pulse current operation
- Good spectral matching with Si photodetectors
- Lead (Pb)-free component in accordance with RoHS 2002/95/EC and WEEE 2002/96/EC

Pb-free
e2
RoHS
COMPLIANT

DESCRIPTION

TSAL6100 is an infrared, 940 nm emitting diode in GaAlAs/GaAs technology with high radiant power molded in a blue-gray plastic package.

APPLICATIONS

- Infrared remote control units with high power reqirements
- Free air transmission systems
- Infrared source for optical counters and card readers
- IR source for smoke detectors

PRODUCT SUMMARY

COMPONENT	I_e (mW/sr)	φ (deg)	λ_P (nm)	t_r (ns)
TSAL6100	130	± 10	940	800

Note
Test conditions see table “Basic Characteristics”

ORDERING INFORMATION

ORDERING CODE	PACKAGING	REMARKS	PACKAGE FORM
TSAL6100	Bulk	MOQ: 4000 pcs, 4000 pcs/bulk	T-1¾

Note
MOQ: minimum order quantity

ABSOLUTE MAXIMUM RATINGS

PARAMETER	TEST CONDITION	SYMBOL	VALUE	UNIT
Reverse voltage		V_R	5	V
Forward current		I_F	100	mA
Peak forward current	$t_p/T = 0.5$, $t_p = 100$ µs	I_{FM}	200	mA
Surge forward current	$t_p = 100$ µs	I_{FSM}	1.5	A
Power dissipation		P_V	160	mW
Junction temperature		T_j	100	°C
Operating temperature range		T_{amb}	- 40 to + 85	°C
Storage temperature range		T_{stg}	- 40 to + 100	°C
Soldering temperature	$t \leq 5$ s, 2 mm from case	T_{sd}	260	°C
Thermal resistance junction/ambient	J-STD-051, leads 7 mm soldered on PCB	R_{thJA}	230	K/W

Note
T_{amb} = 25 °C, unless otherwise specified

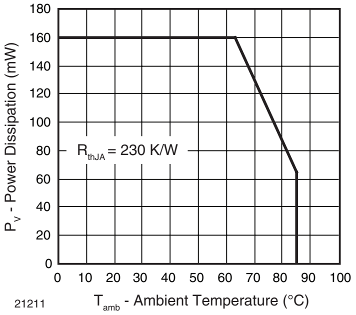


Fig. 1 - Power Dissipation Limit vs. Ambient Temperature

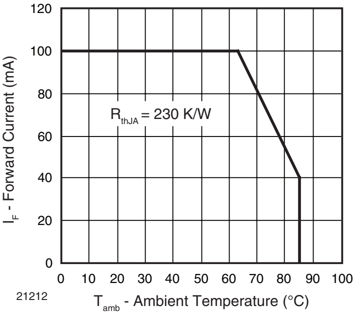


Fig. 2 - Forward Current Limit vs. Ambient Temperature

BASIC CHARACTERISTICS

PARAMETER	TEST CONDITION	SYMBOL	MIN.	TYP.	MAX.	UNIT
Forward voltage	I_F = 100 mA, t_p = 20 ms	V_F		1.35	1.6	V
	I_F = 1 A, t_p = 100 µs	V_F		2.6	3	V
Temperature coefficient of V_F	I_F = 1 mA	TK_{VF}		- 1.8		mV/K
Reverse current	V_R = 5 V	I_R			10	µA
Junction capacitance	V_R = 0 V, f = 1 MHz, E = 0	C_j		25		pF
Radiant intensity	I_F = 100 mA, t_p = 20 ms	I_e	80	130	400	mW/sr
	I_F = 1 A, t_p = 100 µs	I_e	650	1000		mW/sr
Radiant power	I_F = 100 mA, t_p = 20 ms	ϕ_e		35		mW
Temperature coefficient of ϕ_e	I_F = 20 mA	$TK\phi_e$		- 0.6		%/K
Angle of half intensity		φ		± 10		deg
Peak wavelength	I_F = 100 mA	λ_p		940		nm
Spectral bandwidth	I_F = 100 mA	$\Delta\lambda$		50		nm
Temperature coefficient of λ_p	I_F = 100 mA	$TK\lambda_p$		0.2		nm/K
Rise time	I_F = 100 mA	t_r		800		ns
Fall time	I_F = 100 mA	t_f		800		ns
Virtual source diameter	method: 63 % encircled energy	d		3.7		mm

Note

T_{amb} = 25 °C, unless otherwise specified

BASIC CHARACTERISTICS

T_{amb} = 25 °C, unless otherwise specified

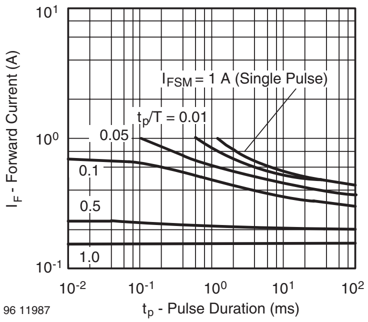


Fig. 3 - Pulse Forward Current vs. Pulse Duration

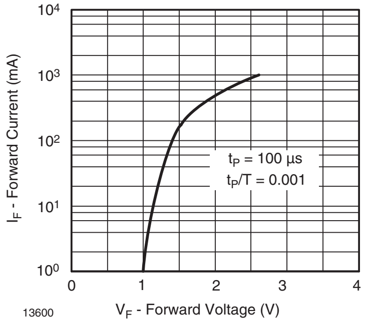


Fig. 4 - Forward Current vs. Forward Voltage

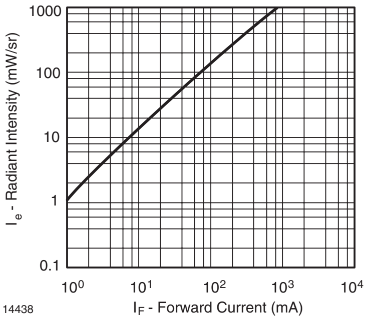


Fig. 5 - Radiant Intensity vs. Forward Current

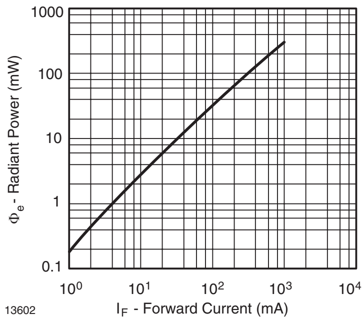


Fig. 6 - Radiant Power vs. Forward Current

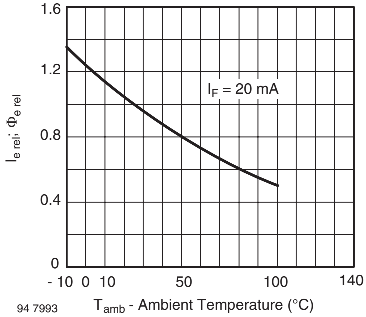


Fig. 7 - Rel. Radiant Intensity/Power vs. Ambient Temperature

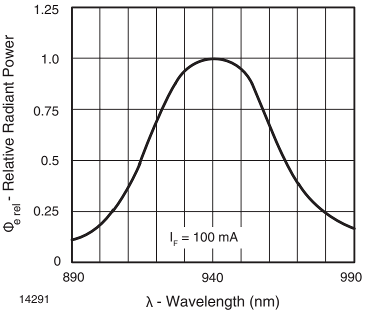


Fig. 8 - Relative Radiant Power vs. Wavelength

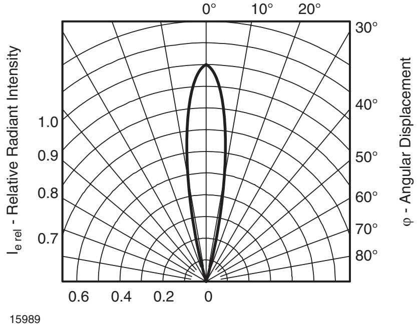
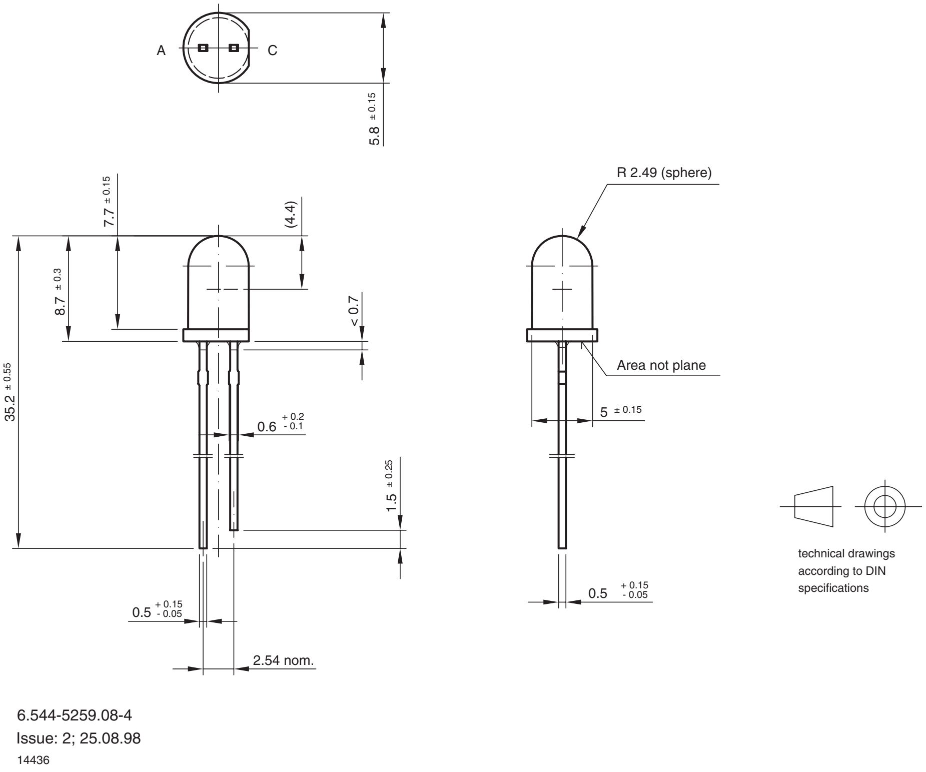
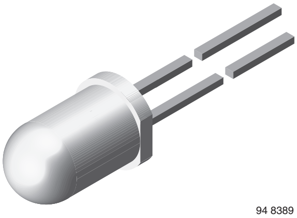


Fig. 9 - Relative Radiant Intensity vs. Angular Displacement

PACKAGE DIMENSIONS in millimeters



High Power Infrared Emitting Diode, RoHS Compliant, 940 nm, GaAlAs/GaAs



FEATURES

- Package type: leaded
- Package form: T-1¾
- Dimensions (in mm): ∅ 5
- Peak wavelength: λ_p = 940 nm
- High reliability
- High radiant power
- High radiant intensity
- Angle of half intensity: φ = ± 10°
- Low forward voltage
- Suitable for high pulse current operation
- Good spectral matching with Si photodetectors
- Lead (Pb)-free component in accordance with RoHS 2002/95/EC and WEEE 2002/96/EC

DESCRIPTION

TSAL6100X01 is an infrared, 940 nm emitting diode in GaAlAs/GaAs technology with high radiant power molded in a blue-gray plastic package.

TSAL6100X01 is released to smoke-automatic fire detector application by the UL.

APPLICATIONS

- Infrared remote control units with high power reqirements
- Free air transmission systems
- Infrared source for optical counters and card readers
- Smoke-automatic fire detectors

PRODUCT SUMMARY

COMPONENT	I_e (mW/sr)	φ (deg)	λ_P (nm)	t_r (ns)
TSAL6100X01	130	± 10	940	800

Note

Test conditions see table “Basic Characteristics”

ORDERING INFORMATION

ORDERING CODE	PACKAGING	REMARKS	PACKAGE FORM
TSAL6100X01	Bulk	MOQ: 4000 pcs, 4000 pcs/bulk	T-1¾

Note

MOQ: minimum order quantity

ABSOLUTE MAXIMUM RATINGS

PARAMETER	TEST CONDITION	SYMBOL	VALUE	UNIT
Reverse voltage		V_R	5	V
Forward current		I_F	100	mA
Peak forward current	$t_p/T = 0.5$, t_p = 100 µs	I_{FM}	200	mA
Surge forward current	t_p = 100 µs	I_{FSM}	1.5	A
Power dissipation		P_V	160	mW
Junction temperature		T_j	100	°C
Operating temperature range		T_{amb}	- 40 to + 85	°C
Storage temperature range		T_{stg}	- 40 to + 100	°C
Soldering temperature	t ≤ 5 s, 2 mm from case	T_{sd}	260	°C
Thermal resistance junction/ambient	J-STD-051, leads 7 mm soldered on PCB	R_{thJA}	230	K/W

Note

T_{amb} = 25 °C, unless otherwise specified

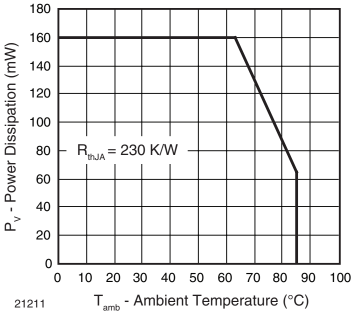


Fig. 1 - Power Dissipation Limit vs. Ambient Temperature

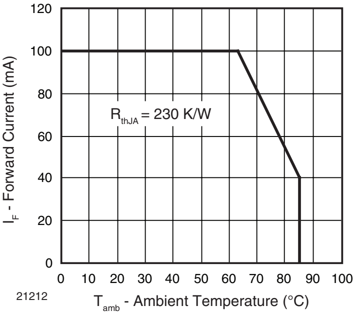


Fig. 2 - Forward Current Limit vs. Ambient Temperature

BASIC CHARACTERISTICS

PARAMETER	TEST CONDITION	SYMBOL	MIN.	TYP.	MAX.	UNIT
Forward voltage	I_F = 100 mA, t_p = 20 ms	V_F		1.35	1.6	V
	I_F = 1 A, t_p = 100 µs	V_F		2.6	3	V
Temperature coefficient of V_F	I_F = 1 mA	TK_{VF}		- 1.8		mV/K
Reverse current	V_R = 5 V	I_R			10	µA
Junction capacitance	V_R = 0 V, f = 1 MHz, E = 0	C_j		25		pF
Radiant intensity	I_F = 100 mA, t_p = 20 ms	I_e	80	130	400	mW/sr
	I_F = 1 A, t_p = 100 µs	I_e	650	1000		mW/sr
Radiant power	I_F = 100 mA, t_p = 20 ms	ϕ_e		35		mW
Temperature coefficient of ϕ_e	I_F = 20 mA	$TK\phi_e$		- 0.6		%/K
Angle of half intensity		φ		± 10		deg
Peak wavelength	I_F = 100 mA	λ_p		940		nm
Spectral bandwidth	I_F = 100 mA	$\Delta\lambda$		50		nm
Temperature coefficient of λ_p	I_F = 100 mA	$TK\lambda_p$		0.2		nm/K
Rise time	I_F = 100 mA	t_r		800		ns
Fall time	I_F = 100 mA	t_f		800		ns
Virtual source diameter	method: 63 % encircled energy	d		3.7		mm

Note

T_{amb} = 25 °C, unless otherwise specified

BASIC CHARACTERISTICS

T_{amb} = 25 °C, unless otherwise specified

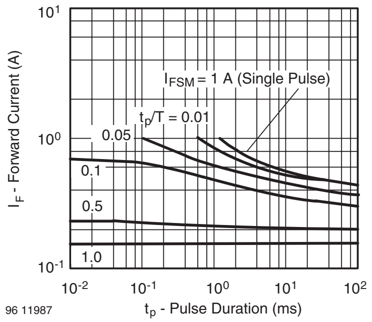


Fig. 3 - Pulse Forward Current vs. Pulse Duration

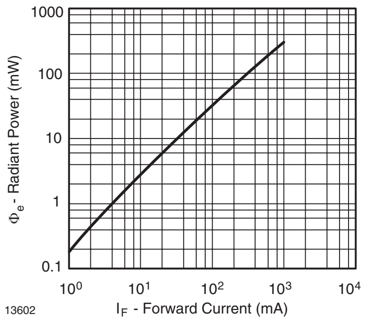


Fig. 6 - Radiant Power vs. Forward Current

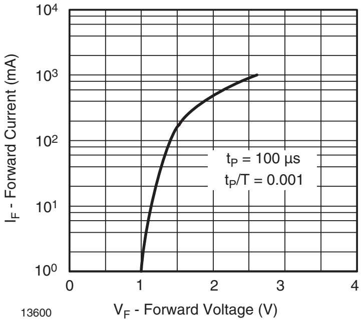


Fig. 4 - Forward Current vs. Forward Voltage

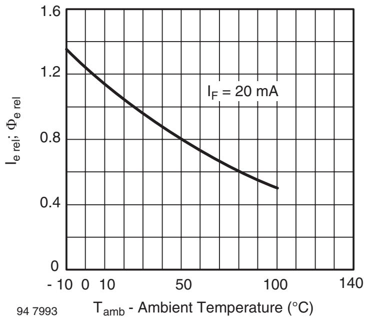


Fig. 7 - Rel. Radiant Intensity/Power vs. Ambient Temperature

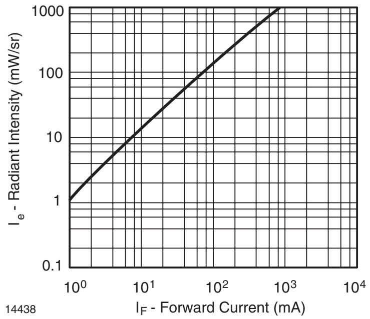


Fig. 5 - Radiant Intensity vs. Forward Current

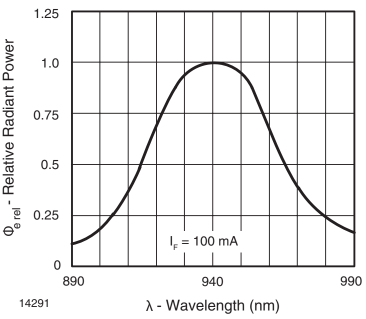


Fig. 8 - Relative Radiant Power vs. Wavelength

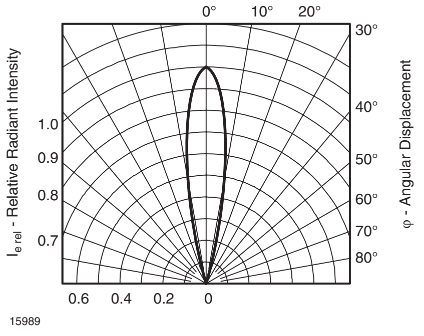
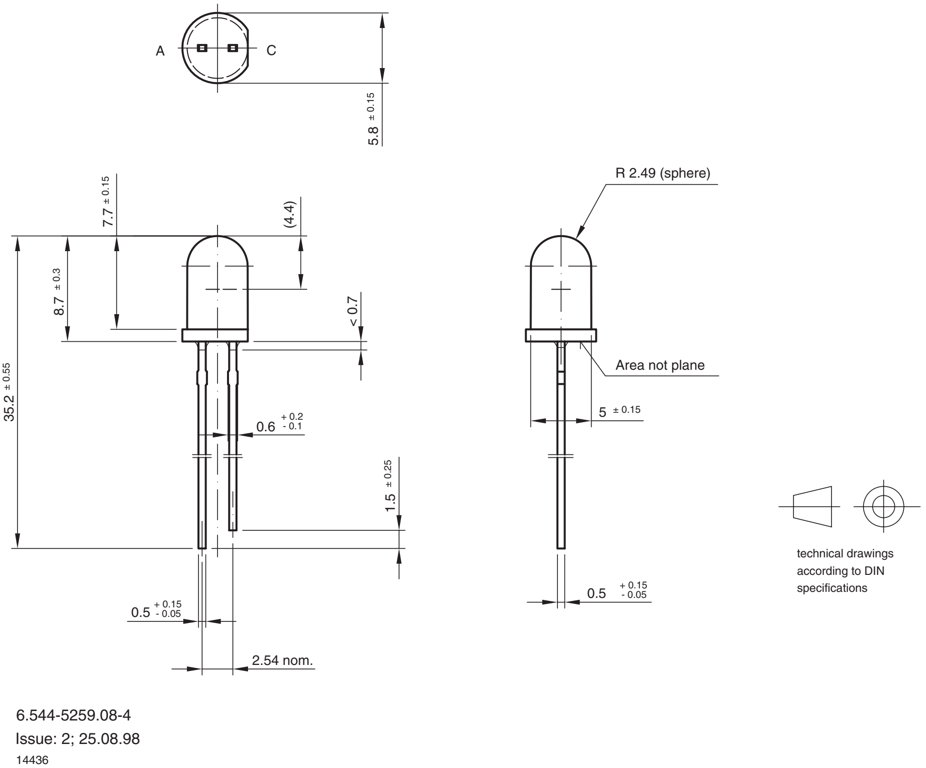
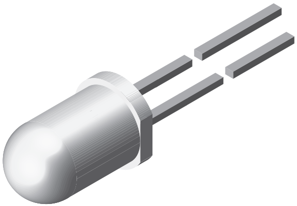


Fig. 9 - Relative Radiant Intensity vs. Angular Displacement

PACKAGE DIMENSIONS in millimeters



High Power Infrared Emitting Diode, RoHS Compliant, 940 nm, GaAlAs/GaAs



DESCRIPTION

TSAL6200 is an infrared, 940 nm emitting diode in GaAlAs/GaAs technology with high radiant power molded in a blue-gray plastic package.

FEATURES

- Package type: leaded
- Package form: T-1¾
- Dimensions (in mm): ∅ 5
- Peak wavelength: λ_p = 940 nm
- High reliability
- High radiant power
- High radiant intensity
- Angle of half intensity: φ = ± 17°
- Low forward voltage
- Suitable for high pulse current operation
- Good spectral matching with Si photodetectors
- Lead (Pb)-free component in accordance with RoHS 2002/95/EC and WEEE 2002/96/EC

Pb-free
e2
RoHS
COMPLIANT

APPLICATIONS

- Infrared remote control units with high power requirements
- Free air transmission systems
- Infrared source for optical counters and card readers

PRODUCT SUMMARY

COMPONENT	I_e (mW/sr)	φ (deg)	λ_P (nm)	t_r (ns)
TSAL6200	60	± 17	940	800

Note
Test conditions see table "Basic Characteristics"

ORDERING INFORMATION

ORDERING CODE	PACKAGING	REMARKS	PACKAGE FORM
TSAL6200	Bulk	MOQ: 4000 pcs, 4000 pcs/bulk	T-1¾

Note
MOQ: minimum order quantity

ABSOLUTE MAXIMUM RATINGS

PARAMETER	TEST CONDITION	SYMBOL	VALUE	UNIT
Reverse voltage		V_R	5	V
Forward current		I_F	100	mA
Peak forward current	t_p/T = 0.5, t_p = 100 µs	I_{FM}	200	mA
Surge forward current	t_p = 100 µs	I_{FSM}	1.5	A
Power dissipation		P_V	160	mW
Junction temperature		T_j	100	°C
Operating temperature range		T_{amb}	- 40 to + 85	°C
Storage temperature range		T_{stg}	- 40 to + 100	°C
Soldering temperature	t ≤ 5 s, 2 mm from case	T_{sd}	260	°C
Thermal resistance junction/ambient	J-STD-051, leads 7 mm soldered on PCB	R_{thJA}	230	K/W

Note
T_{amb} = 25 °C, unless otherwise specified

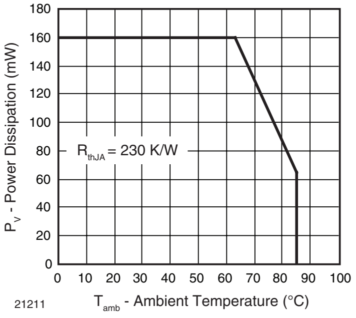


Fig. 1 - Power Dissipation Limit vs. Ambient Temperature

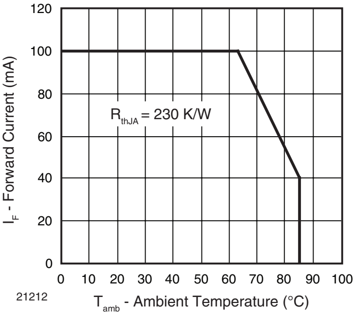


Fig. 2 - Forward Current Limit vs. Ambient Temperature

BASIC CHARACTERISTICS

PARAMETER	TEST CONDITION	SYMBOL	MIN.	TYP.	MAX.	UNIT
Forward voltage	I_F = 100 mA, t_p = 20 ms	V_F		1.35	1.6	V
	I_F = 1 A, t_p = 100 µs	V_F		2.6	3	V
Temperature coefficient of V_F	I_F = 1 mA	TK_{VF}		- 1.8		mV/K
Reverse current	V_R = 5 V	I_R			10	µA
Junction capacitance	V_R = 0 V, f = 1 MHz, E = 0	C_j		25		pF
Radiant intensity	I_F = 100 mA, t_p = 20 ms	I_e	40	60	200	mW/sr
	I_F = 1 A, t_p = 100 µs	I_e	340	500		mW/sr
Radiant power	I_F = 100 mA, t_p = 20 ms	ϕ_e		35		mW
Temperature coefficient of ϕ_e	I_F = 20 mA	$TK\phi_e$		- 0.6		%/K
Angle of half intensity		φ		± 17		deg
Peak wavelength	I_F = 100 mA	λ_p		940		nm
Spectral bandwidth	I_F = 100 mA	$\Delta\lambda$		50		nm
Temperature coefficient of λ_p	I_F = 100 mA	$TK\lambda_p$		0.2		nm/K
Rise time	I_F = 100 mA	t_r		800		ns
Fall time	I_F = 100 mA	t_f		800		ns
Virtual source diameter	method: 63 % encircled energy	d		2.4		mm

Note

T_{amb} = 25 °C, unless otherwise specified

BASIC CHARACTERISTICS

T_{amb} = 25 °C, unless otherwise specified

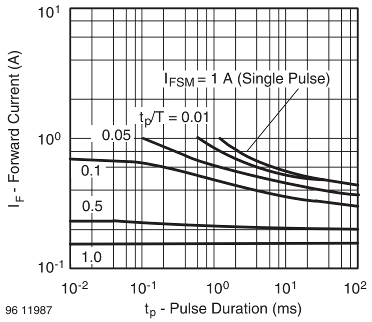


Fig. 3 - Pulse Forward Current vs. Pulse Duration

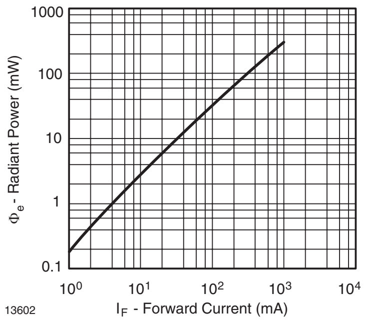


Fig. 6 - Radiant Power vs. Forward Current

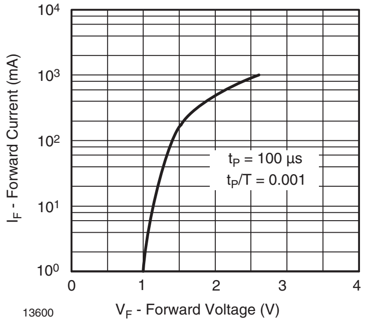


Fig. 4 - Forward Current vs. Forward Voltage

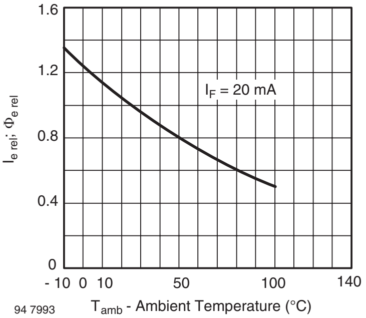


Fig. 7 - Relative Radiant Intensity/Power vs. Ambient Temperature

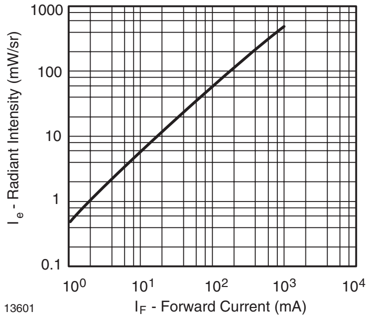


Fig. 5 - Radiant Intensity vs. Forward Current

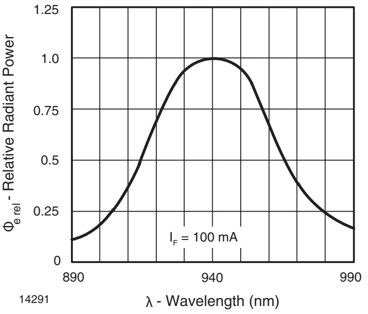


Fig. 8 - Relative Radiant Power vs. Wavelength

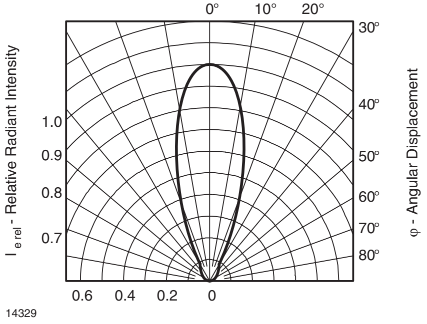
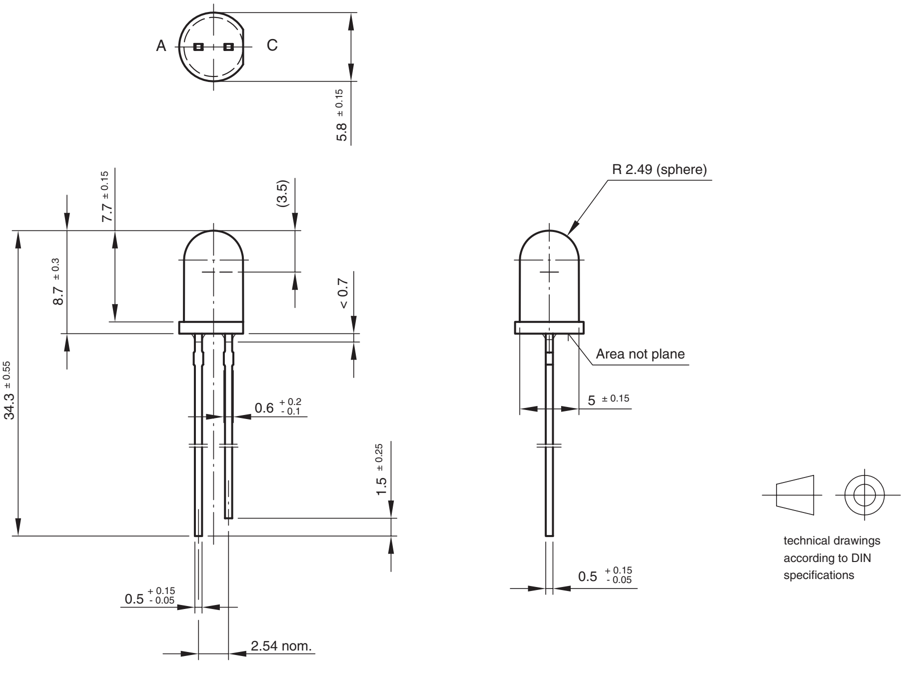


Fig. 9 - Relative Radiant Intensity vs. Angular Displacement

PACKAGE DIMENSIONS in millimeters



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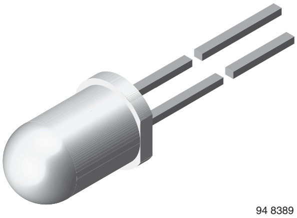
High Power Infrared Emitting Diode, RoHS Compliant, 940 nm, GaAlAs/GaAs



DESCRIPTION

TSAL6400 is an infrared, 940 nm emitting diode in GaAlAs/GaAs technology with high radiant power molded in a blue-gray plastic package.

FEATURES

- Package type: leaded
- Package form: T-1¾
- Dimensions (in mm): ∅ 5
- Peak wavelength: λ_p = 940 nm
- High reliability
- High radiant power
- High radiant intensity
- Angle of half intensity: φ = ± 25°
- Low forward voltage
- Suitable for high pulse current operation
- Good spectral matching with Si photodetectors
- Lead (Pb)-free component in accordance with RoHS 2002/95/EC and WEEE 2002/96/EC

Pb-free

e2

RoHS
COMPLIANT

APPLICATIONS

- Infrared remote control units with high power requirements
- Free air transmission systems
- Infrared source for optical counters and card readers

PRODUCT SUMMARY

COMPONENT	I_e (mW/sr)	φ (deg)	λ_P (nm)	t_r (ns)
TSAL6400	40	± 25	940	800

Note

Test conditions see table "Basic Characteristics"

ORDERING INFORMATION

ORDERING CODE	PACKAGING	REMARKS	PACKAGE FORM
TSAL6400	Bulk	MOQ: 4000 pcs, 4000 pcs/bulk	T-1¾

Note

MOQ: minimum order quantity

ABSOLUTE MAXIMUM RATINGS

PARAMETER	TEST CONDITION	SYMBOL	VALUE	UNIT
Reverse voltage		V_R	5	V
Forward current		I_F	100	mA
Peak forward current	$t_p/T = 0.5$, t_p = 100 µs	I_{FM}	200	mA
Surge forward current	t_p = 100 µs	I_{FSM}	1.5	A
Power dissipation		P_V	160	mW
Junction temperature		T_j	100	°C
Operating temperature range		T_{amb}	- 40 to + 85	°C
Storage temperature range		T_{stg}	- 40 to + 100	°C
Soldering temperature	t ≤ 5 s, 2 mm from case	T_{sd}	260	°C
Thermal resistance junction/ambient	J-STD-051, leads 7 mm soldered on PCB	R_{thJA}	230	K/W

Note

T_{amb} = 25 °C, unless otherwise specified

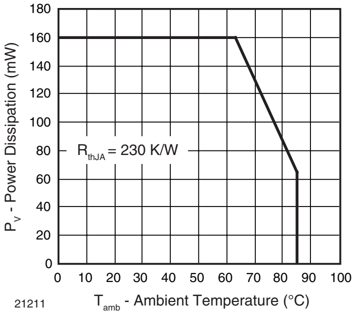


Fig. 1 - Power Dissipation Limit vs. Ambient Temperature

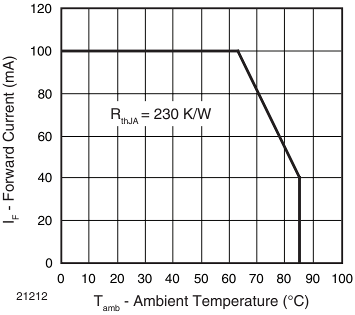


Fig. 2 - Forward Current Limit vs. Ambient Temperature

BASIC CHARACTERISTICS

PARAMETER	TEST CONDITION	SYMBOL	MIN.	TYP.	MAX.	UNIT
Forward voltage	I_F = 100 mA, t_p = 20 ms	V_F		1.35	1.6	V
	I_F = 1 A, t_p = 100 µs	V_F		2.6	3	V
Temperature coefficient of V_F	I_F = 1 mA	TK_{VF}		- 1.8		mV/K
Reverse current	V_R = 5 V	I_R			10	µA
Junction capacitance	V_R = 0 V, f = 1 MHz, E = 0	C_j		25		pF
Radiant intensity	I_F = 100 mA, t_p = 20 ms	I_e	25	40	125	mW/sr
	I_F = 1 A, t_p = 100 µs	I_e	220	310		mW/sr
Radiant power	I_F = 100 mA, t_p = 20 ms	ϕ_e		35		mW
Temperature coefficient of ϕ_e	I_F = 20 mA	$TK\phi_e$		- 0.6		%/K
Angle of half intensity		φ		± 25		deg
Peak wavelength	I_F = 100 mA	λ_p		940		nm
Spectral bandwidth	I_F = 100 mA	$\Delta\lambda$		50		nm
Temperature coefficient of λ_p	I_F = 100 mA	$TK\lambda_p$		0.2		nm/K
Rise time	I_F = 100 mA	t_r		800		ns
Fall time	I_F = 100 mA	t_f		800		ns
Virtual source diameter	method: 63 % encircled energy	d		2.2		mm

Note

T_{amb} = 25 °C, unless otherwise specified

BASIC CHARACTERISTICS

T_{amb} = 25 °C, unless otherwise specified

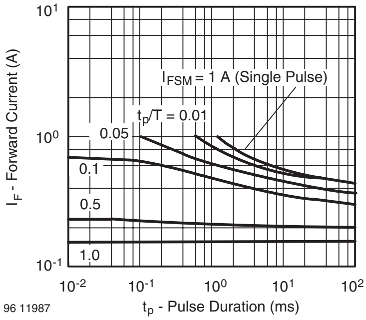


Fig. 3 - Pulse Forward Current vs. Pulse Duration

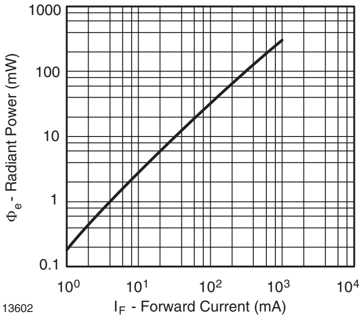


Fig. 6 - Radiant Power vs. Forward Current

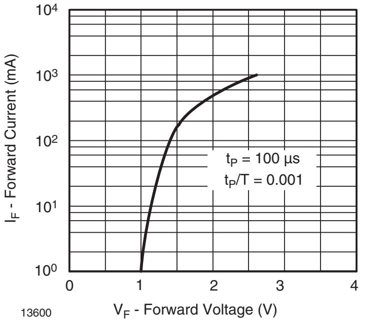


Fig. 4 - Forward Current vs. Forward Voltage

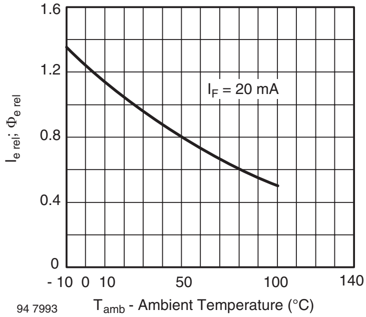


Fig. 7 - Relative Radiant Intensity/Power vs. Ambient Temperature

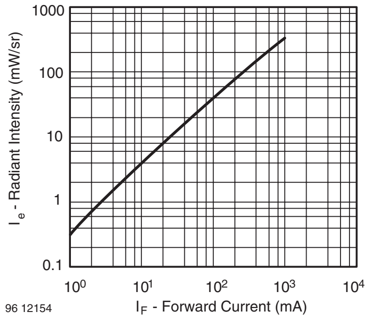


Fig. 5 - Radiant Intensity vs. Forward Current

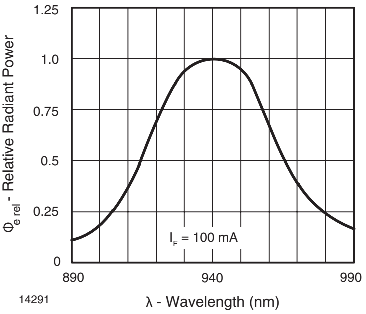


Fig. 8 - Relative Radiant Power vs. Wavelength

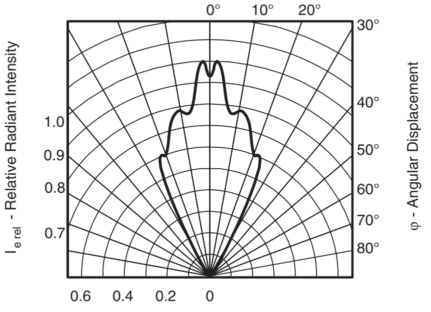


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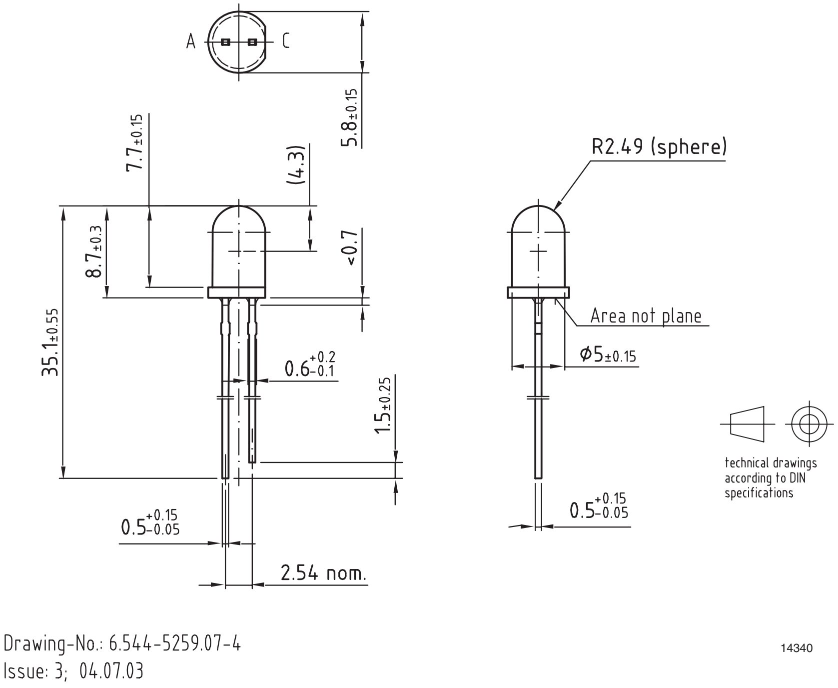
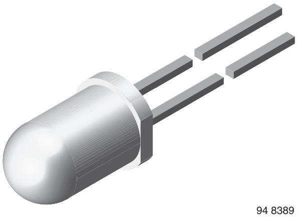
Fig. 9 - Relative Radiant Intensity vs. Angular Displacement

PACKAGE DIMENSIONS in millimeters



14340

High Power Infrared Emitting Diode, RoHS Compliant, 940 nm, GaAlAs/GaAs



FEATURES

Pb-free

e2

RoHS COMPLIANT

- Package type: leaded
- Package form: T-1¾
- Dimensions (in mm): ∅ 5
- Peak wavelength: λ_p = 940 nm
- High reliability
- High radiant power
- High radiant intensity
- Angle of half intensity: φ = ± 17°
- Low forward voltage
- Suitable for high pulse current operation
- Good spectral matching with Si photodetectors
- Lead (Pb)-free component in accordance with RoHS 2002/95/EC and WEEE 2002/96/EC

DESCRIPTION

TSAL7200 is an infrared, 940 nm emitting diode in GaAlAs/GaAs technology with high radiant power molded in a clear, untinted plastic package.

APPLICATIONS

- Infrared remote control units with high power requirements
- Free air transmission systems
- Infrared source for optical counters and card readers

PRODUCT SUMMARY

COMPONENT	I_e (mW/sr)	φ (deg)	λ_P (nm)	t_r (ns)
TSAL7200	60	± 17	940	800

Note

Test conditions see table "Basic Characteristics"

ORDERING INFORMATION

ORDERING CODE	PACKAGING	REMARKS	PACKAGE FORM
TSAL7200	Bulk	MOQ: 4000 pcs, 4000 pcs/bulk	T-1¾

Note

MOQ: minimum order quantity

ABSOLUTE MAXIMUM RATINGS

PARAMETER	TEST CONDITION	SYMBOL	VALUE	UNIT
Reverse voltage		V_R	5	V
Forward current		I_F	100	mA
Peak forward current	$t_p/T = 0.5$, t_p = 100 µs	I_{FM}	200	mA
Surge forward current	t_p = 100 µs	I_{FSM}	1.5	A
Power dissipation		P_V	160	mW
Junction temperature		T_j	100	°C
Operating temperature range		T_{amb}	- 40 to + 85	°C
Storage temperature range		T_{stg}	- 40 to + 100	°C
Soldering temperature	t ≤ 5 s, 2 mm from case	T_{sd}	260	°C
Thermal resistance junction/ambient	J-STD-051, leads 7 mm soldered on PCB	R_{thJA}	230	K/W

Note

T_{amb} = 25 °C, unless otherwise specified

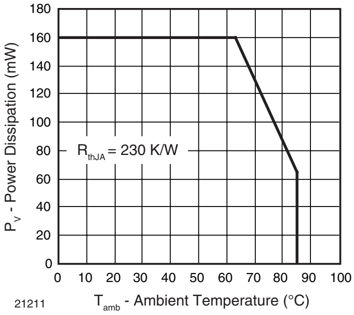


Fig. 1 - Power Dissipation Limit vs. Ambient Temperature

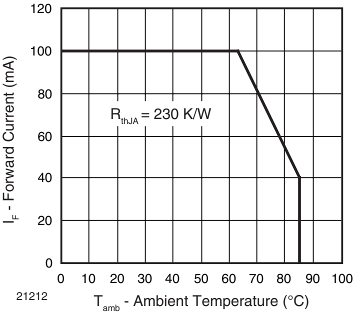


Fig. 2 - Forward Current Limit vs. Ambient Temperature

BASIC CHARACTERISTICS

PARAMETER	TEST CONDITION	SYMBOL	MIN.	TYP.	MAX.	UNIT
Forward voltage	I_F = 100 mA, t_p = 20 ms	V_F		1.35	1.6	V
	I_F = 1 A, t_p = 100 µs	V_F		2.6	3	V
Temperature coefficient of V_F	I_F = 1 mA	TK_{VF}		- 1.8		mV/K
Reverse current	V_R = 5 V	I_R			10	µA
Junction capacitance	V_R = 0 V, f = 1 MHz, E = 0	C_j		25		pF
Radiant intensity	I_F = 100 mA, t_p = 20 ms	I_e	40	60	200	mW/sr
	I_F = 1 A, t_p = 100 µs	I_e	340	500		mW/sr
Radiant power	I_F = 100 mA, t_p = 20 ms	ϕ_e		35		mW
Temperature coefficient of ϕ_e	I_F = 20 mA	$TK\phi_e$		- 0.6		%/K
Angle of half intensity		φ		± 17		deg
Peak wavelength	I_F = 100 mA	λ_p		940		nm
Spectral bandwidth	I_F = 100 mA	$\Delta\lambda$		50		nm
Temperature coefficient of λ_p	I_F = 100 mA	$TK\lambda_p$		0.2		nm/K
Rise time	I_F = 100 mA	t_r		800		ns
Fall time	I_F = 100 mA	t_f		800		ns
Virtual source diameter	Method: 63 % encircled energy	d		2.4		mm

Note

T_{amb} = 25 °C, unless otherwise specified

BASIC CHARACTERISTICS

T_{amb} = 25 °C, unless otherwise specified

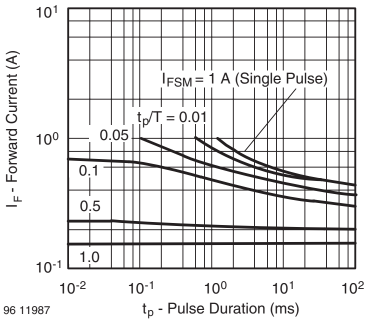


Fig. 3 - Pulse Forward Current vs. Pulse Duration

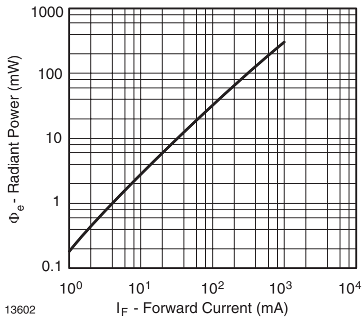


Fig. 6 - Radiant Power vs. Forward Current

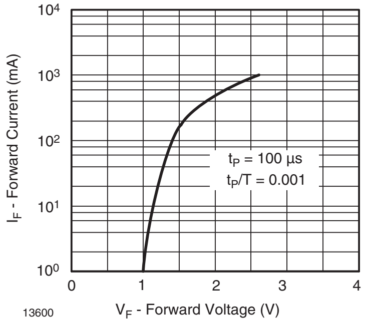


Fig. 4 - Forward Current vs. Forward Voltage

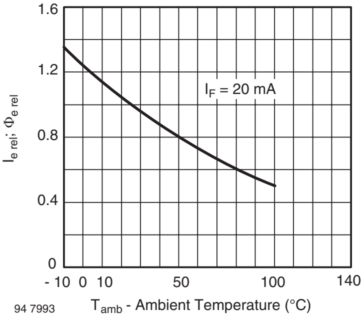


Fig. 7 - Relative Radiant Intensity/Power vs. Ambient Temperature

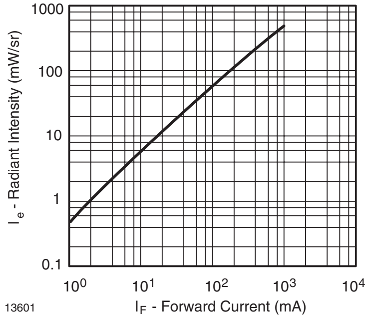


Fig. 5 - Radiant Intensity vs. Forward Current

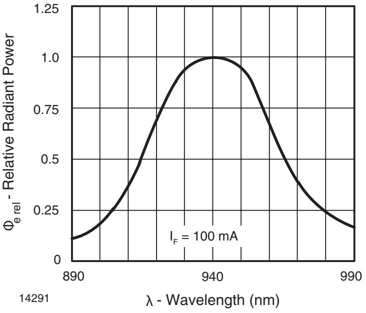


Fig. 8 - Relative Radiant Power vs. Wavelength

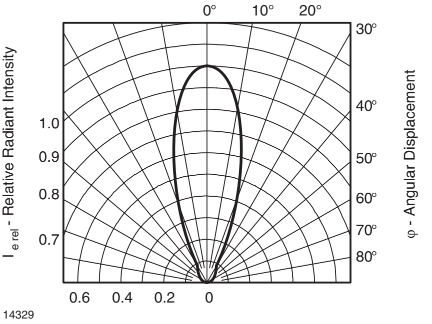
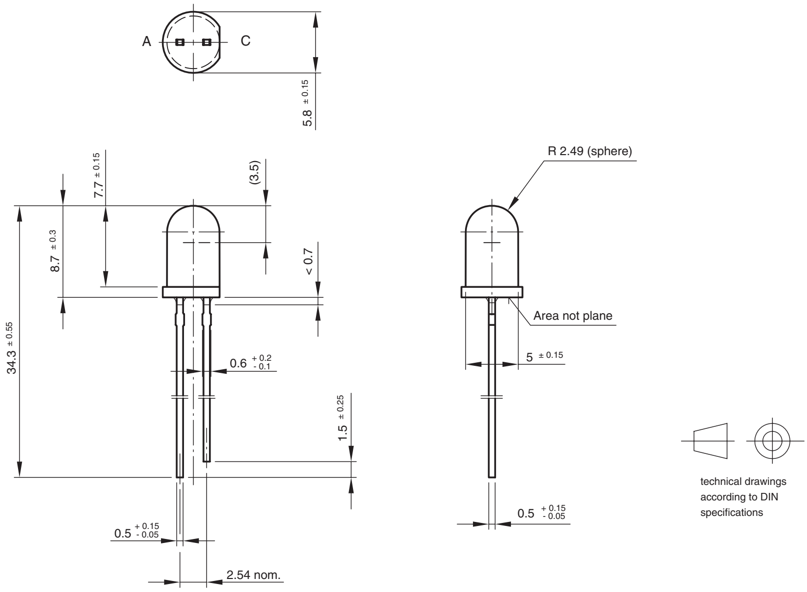


Fig. 9 - Relative Radiant Intensity vs. Angular Displacement

PACKAGE DIMENSIONS in millimeters



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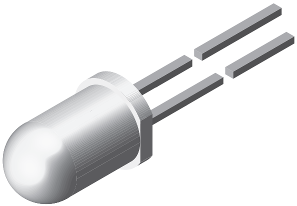
High Power Infrared Emitting Diode, RoHS Compliant, 940 nm, GaAlAs/GaAs


94 8389

FEATURES

Pb-free
e2
RoHS COMPLIANT

- Package type: leaded
- Package form: T-1¾
- Dimensions (in mm): ∅ 5
- Peak wavelength: λ_p = 940 nm
- High reliability
- High radiant power
- High radiant intensity
- Angle of half intensity: $\varphi = \pm 22°$
- Low forward voltage
- Suitable for high pulse current operation
- Good spectral matching with Si photodetectors
- Lead (Pb)-free component in accordance with RoHS 2002/95/EC and WEEE 2002/96/EC

DESCRIPTION

TSAL7300 is an infrared, 940 nm emitting diode in GaAlAs/GaAs technology with high radiant power molded in a clear, untinted plastic package.

APPLICATIONS

- Infrared remote control units with high power requirements
- Free air transmission systems
- Infrared source for optical counters and card readers

PRODUCT SUMMARY

COMPONENT	I_e (mW/sr)	φ (deg)	λ_P (nm)	t_r (ns)
TSAL7300	45	± 22	940	800

Note

Test conditions see table “Basic Characteristics”

ORDERING INFORMATION

ORDERING CODE	PACKAGING	REMARKS	PACKAGE FORM
TSAL7300	Bulk	MOQ: 4000 pcs, 4000 pcs/bulk	T-1¾

Note

MOQ: minimum order quantity

ABSOLUTE MAXIMUM RATINGS

PARAMETER	TEST CONDITION	SYMBOL	VALUE	UNIT
Reverse voltage		V_R	5	V
Forward current		I_F	100	mA
Peak forward current	$t_p/T = 0.5$, $t_p = 100\ \mu s$	I_{FM}	200	mA
Surge forward current	$t_p = 100\ \mu s$	I_{FSM}	1.5	A
Power dissipation		P_V	160	mW
Junction temperature		T_j	100	°C
Operating temperature range		T_{amb}	- 40 to + 85	°C
Storage temperature range		T_{stg}	- 40 to + 100	°C
Soldering temperature	$t \leq 5$ s, 2 mm from case	T_{sd}	260	°C
Thermal resistance junction/ambient	J-STD-051, leads 7 mm soldered on PCB	R_{thJA}	230	K/W

Note

T_{amb} = 25 °C, unless otherwise specified

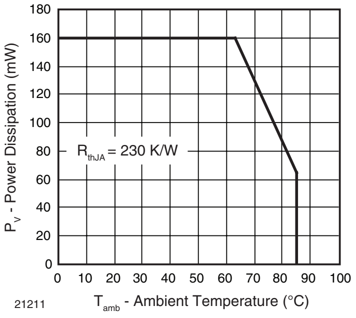


Fig. 1 - Power Dissipation Limit vs. Ambient Temperature

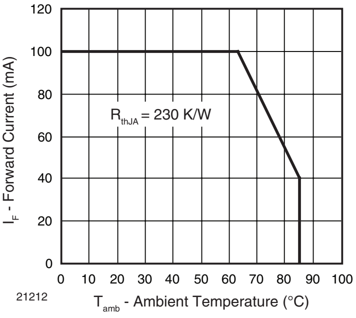


Fig. 2 - Forward Current Limit vs. Ambient Temperature

BASIC CHARACTERISTICS

PARAMETER	TEST CONDITION	SYMBOL	MIN.	TYP.	MAX.	UNIT
Forward voltage	I_F = 100 mA, t_p = 20 ms	V_F		1.35	1.6	V
	I_F = 1 A, t_p = 100 µs	V_F		2.6	3	V
Temperature coefficient of V_F	I_F = 1 mA	TK_{VF}		- 1.8		mV/K
Reverse current	V_R = 5 V	I_R			10	µA
Junction capacitance	V_R = 0 V, f = 1 MHz, E = 0	C_j		25		pF
Radiant intensity	I_F = 100 mA, t_p = 20 ms	I_e	30	45	150	mW/sr
	I_F = 1 A, t_p = 100 µs	I_e	260	350		mW/sr
Radiant power	I_F = 100 mA, t_p = 20 ms	ϕ_e		35		mW
Temperature coefficient of ϕ_e	I_F = 20 mA	$TK\phi_e$		- 0.6		%/K
Angle of half intensity		φ		± 22		deg
Peak wavelength	I_F = 100 mA	λ_p		940		nm
Spectral bandwidth	I_F = 100 mA	$\Delta\lambda$		50		nm
Temperature coefficient of λ_p	I_F = 100 mA	$TK\lambda_p$		0.2		nm/K
Rise time	I_F = 100 mA	t_r		800		ns
	I_F = 1 A	t_r		500		ns
Fall time	I_F = 100 mA	t_f		800		ns
	I_F = 1 A	t_f		500		ns
Virtual source diameter	Method: 63 % encircled energy	d		2.3		mm

Note

T_{amb} = 25 °C, unless otherwise specified

BASIC CHARACTERISTICS

T_{amb} = 25 °C, unless otherwise specified

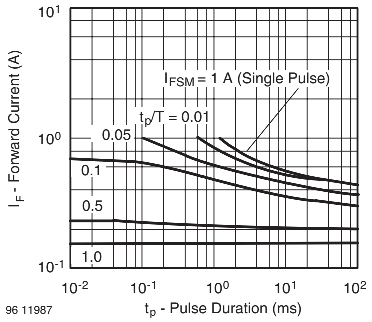


Fig. 3 - Pulse Forward Current vs. Pulse Duration

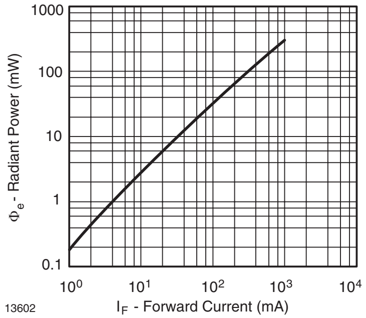


Fig. 6 - Radiant Power vs. Forward Current

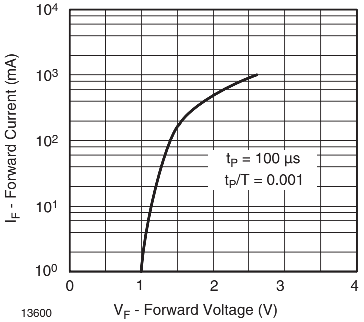


Fig. 4 - Forward Current vs. Forward Voltage

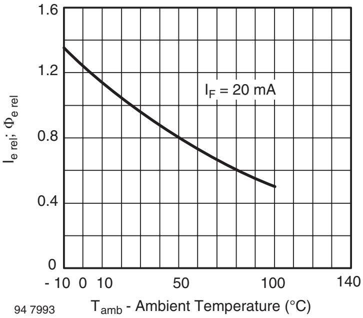


Fig. 7 - Relative Radiant Intensity/Power vs. Ambient Temperature

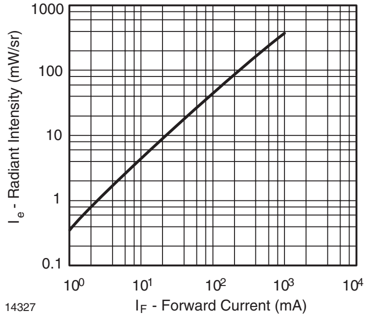


Fig. 5 - Radiant Intensity vs. Forward Current

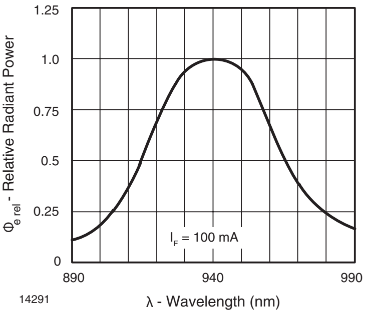


Fig. 8 - Relative Radiant Power vs. Wavelength

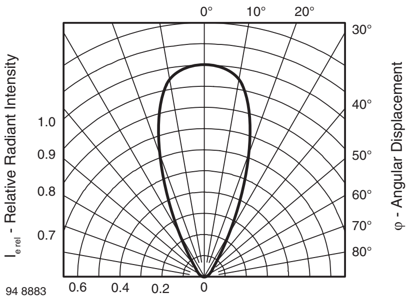
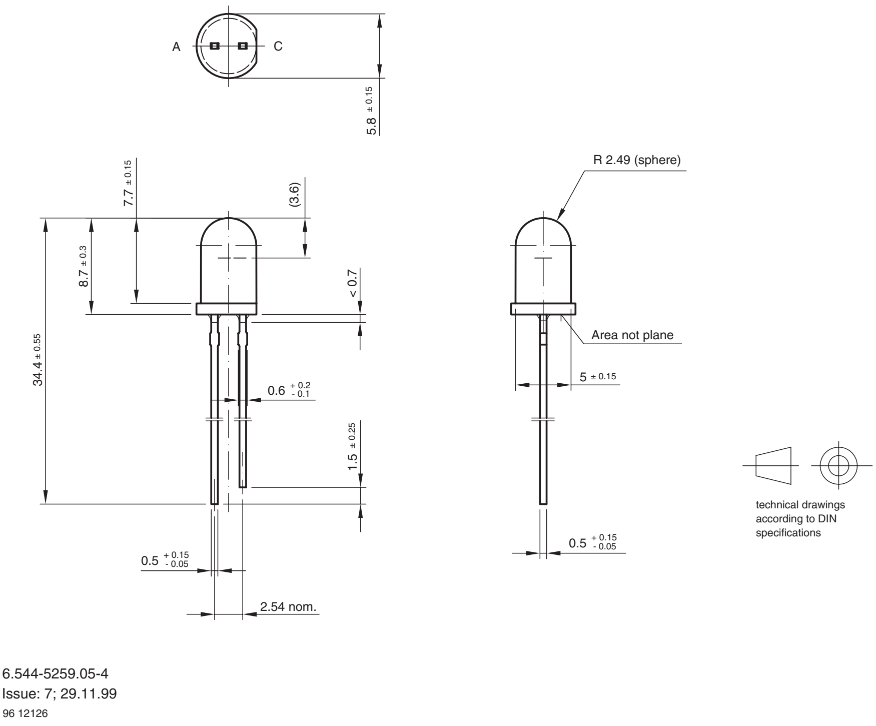
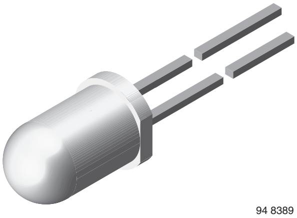


Fig. 9 - Relative Radiant Intensity vs. Angular Displacement

PACKAGE DIMENSIONS in millimeters



High Power Infrared Emitting Diode, RoHS Compliant, 940 nm, GaAlAs/GaAs


94 8389

DESCRIPTION

TSAL7400 is an infrared, 940 nm emitting diode in GaAlAs/GaAs technology with high radiant power molded in a clear, untinted plastic package.

FEATURES

- Package type: leaded
- Package form: T-1¾
- Dimensions (in mm): ∅ 5
- Peak wavelength: λ_p = 940 nm
- High reliability
- High radiant power
- High radiant intensity
- Angle of half intensity: φ = ± 25°
- Low forward voltage
- Suitable for high pulse current operation
- Good spectral matching with Si photodetectors
- Lead (Pb)-free component in accordance with RoHS 2002/95/EC and WEEE 2002/96/EC

Pb-free

e2

RoHS
COMPLIANT

APPLICATIONS

- Infrared remote control units with high power requirements
- Free air transmission systems
- Infrared source for optical counters and card readers

PRODUCT SUMMARY

COMPONENT	I_e (mW/sr)	φ (deg)	λ_P (nm)	t_r (ns)
TSAL7400	40	± 25	940	800

Note
Test conditions see table “Basic Characteristics”

ORDERING INFORMATION

ORDERING CODE	PACKAGING	REMARKS	PACKAGE FORM
TSAL7400	Bulk	MOQ: 4000 pcs, 4000 pcs/bulk	T-1¾

Note
MOQ: minimum order quantity

ABSOLUTE MAXIMUM RATINGS

PARAMETER	TEST CONDITION	SYMBOL	VALUE	UNIT
Reverse voltage		V_R	5	V
Forward current		I_F	100	mA
Peak forward current	$t_p/T = 0.5$, $t_p = 100$ µs	I_{FM}	200	mA
Surge forward current	$t_p = 100$ µs	I_{FSM}	1.5	A
Power dissipation		P_V	160	mW
Junction temperature		T_j	100	°C
Operating temperature range		T_{amb}	- 40 to + 85	°C
Storage temperature range		T_{stg}	- 40 to + 100	°C
Soldering temperature	$t \leq 5$ s, 2 mm from case	T_{sd}	260	°C
Thermal resistance junction/ambient	J-STD-051, leads 7 mm soldered on PCB	R_{thJA}	230	K/W

Note
T_{amb} = 25 °C, unless otherwise specified

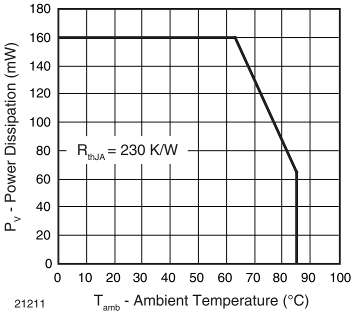


Fig. 1 - Power Dissipation Limit vs. Ambient Temperature

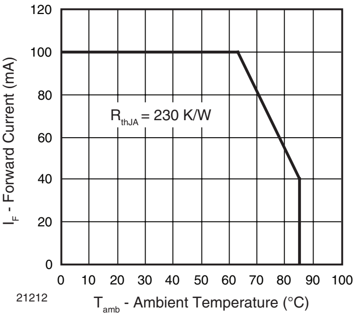


Fig. 2 - Forward Current Limit vs. Ambient Temperature

BASIC CHARACTERISTICS

PARAMETER	TEST CONDITION	SYMBOL	MIN.	TYP.	MAX.	UNIT
Forward voltage	I_F = 100 mA, t_p = 20 ms	V_F		1.35	1.6	V
	I_F = 1 A, t_p = 100 µs	V_F		2.6	3	V
Temperature coefficient of V_F	I_F = 1 mA	TK_{VF}		- 1.8		mV/K
Reverse current	V_R = 5 V	I_R			10	µA
Junction capacitance	V_R = 0 V, f = 1 MHz, E = 0	C_j		25		pF
Radiant intensity	I_F = 100 mA, t_p = 20 ms	I_e	25	40	125	mW/sr
	I_F = 1 A, t_p = 100 µs	I_e	220	310		mW/sr
Radiant power	I_F = 100 mA, t_p = 20 ms	ϕ_e		35		mW
Temperature coefficient of ϕ_e	I_F = 20 mA	$TK\phi_e$		- 0.6		%/K
Angle of half intensity		φ		± 25		deg
Peak wavelength	I_F = 100 mA	λ_p		940		nm
Spectral bandwidth	I_F = 100 mA	$\Delta\lambda$		50		nm
Temperature coefficient of λ_p	I_F = 100 mA	$TK\lambda_p$		0.2		nm/K
Rise time	I_F = 100 mA	t_r		800		ns
Fall time	I_F = 100 mA	t_f		800		ns
Virtual source diameter		d		2.2		mm

Note

T_{amb} = 25 °C, unless otherwise specified

BASIC CHARACTERISTICS

T_{amb} = 25 °C, unless otherwise specified

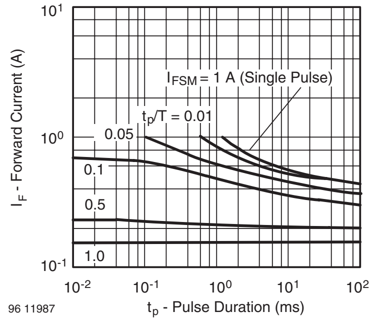


Fig. 3 - Pulse Forward Current vs. Pulse Duration

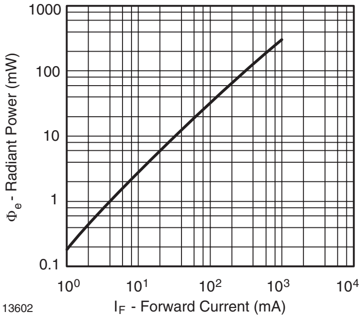


Fig. 6 - Radiant Power vs. Forward Current

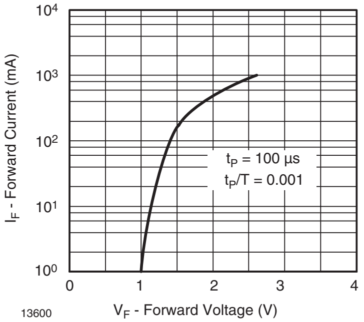


Fig. 4 - Forward Current vs. Forward Voltage

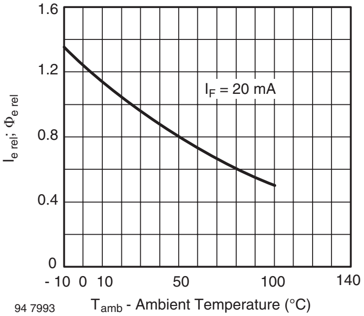


Fig. 7 - Relative Radiant Intensity/Power vs. Ambient Temperature

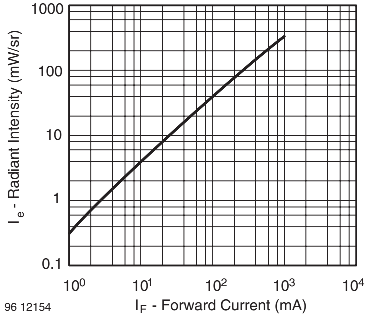


Fig. 5 - Radiant Intensity vs. Forward Current

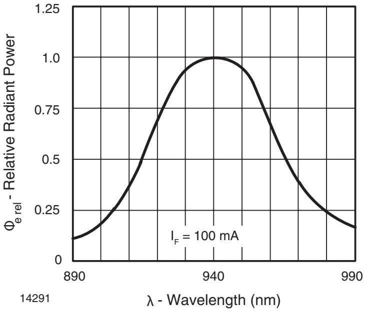


Fig. 8 - Relative Radiant Power vs. Wavelength

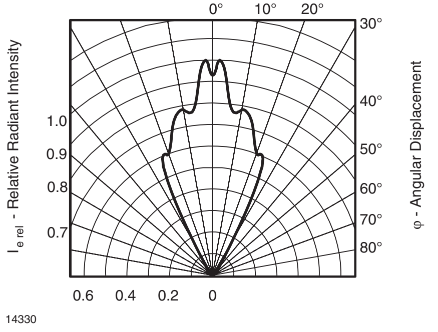
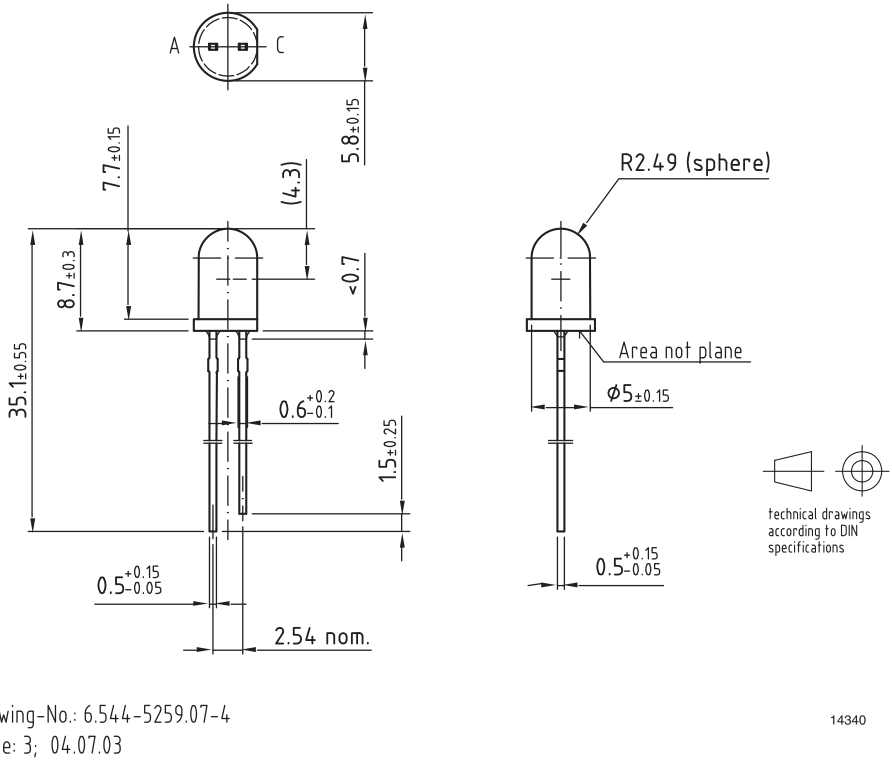
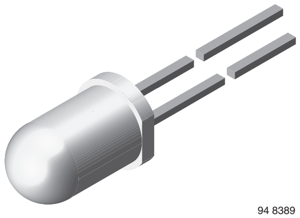


Fig. 9 - Relative Radiant Intensity vs. Angular Displacement

PACKAGE DIMENSIONS in millimeters



High Power Infrared Emitting Diode, RoHS Compliant, 940 nm, GaAlAs/GaAs


94 8389

FEATURES

- Package type: leaded
- Package form: T-1¾
- Dimensions (in mm): ∅ 5
- Peak wavelength: λ_p = 940 nm
- High reliability
- High radiant power
- High radiant intensity
- Angle of half intensity: $\varphi = \pm 30°$
- Low forward voltage
- Suitable for high pulse current operation
- Good spectral matching with Si photodetectors
- Lead (Pb)-free component in accordance with RoHS 2002/95/EC and WEEE 2002/96/EC

Pb-free
e2
RoHS
COMPLIANT

DESCRIPTION

TSAL7600 is an infrared, 940 nm emitting diode in GaAlAs/GaAs technology with high radiant power molded in a clear, untinted plastic package.

APPLICATIONS

- Infrared remote control units with high power requirements
- Free air transmission systems
- Infrared source for optical counters and card readers

PRODUCT SUMMARY

COMPONENT	I_e (mW/sr)	φ (deg)	λ_P (nm)	t_r (ns)
TSAL7600	25	± 30	940	800

Note
Test conditions see table "Basic Characteristics"

ORDERING INFORMATION

ORDERING CODE	PACKAGING	REMARKS	PACKAGE FORM
TSAL7600	Bulk	MOQ: 4000 pcs, 4000 pcs/bulk	T-1¾

Note
MOQ: minimum order quantity

ABSOLUTE MAXIMUM RATINGS

PARAMETER	TEST CONDITION	SYMBOL	VALUE	UNIT
Reverse voltage		V_R	5	V
Forward current		I_F	100	mA
Peak forward current	$t_p/T = 0.5$, $t_p = 100\ \mu s$	I_{FM}	200	mA
Surge forward current	$t_p = 100\ \mu s$	I_{FSM}	1.5	A
Power dissipation		P_V	160	mW
Junction temperature		T_j	100	°C
Operating temperature range		T_{amb}	- 40 to + 85	°C
Storage temperature range		T_{stg}	- 40 to + 100	°C
Soldering temperature	$t \leq 5$ s, 2 mm from case	T_{sd}	260	°C
Thermal resistance junction/ambient	J-STD-051, leads 7 mm soldered on PCB	R_{thJA}	230	K/W

Note
T_{amb} = 25 °C, unless otherwise specified

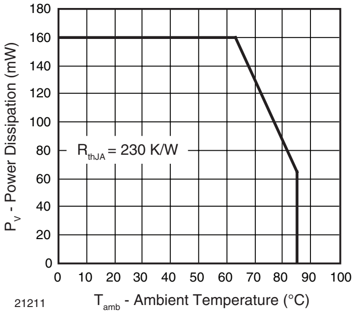


Fig. 1 - Power Dissipation Limit vs. Ambient Temperature

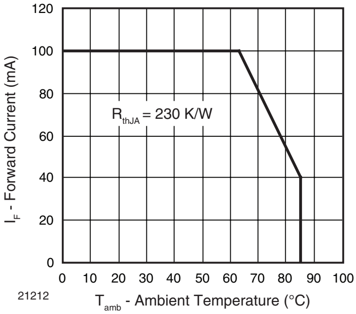


Fig. 2 - Forward Current Limit vs. Ambient Temperature

BASIC CHARACTERISTICS

PARAMETER	TEST CONDITION	SYMBOL	MIN.	TYP.	MAX.	UNIT
Forward voltage	I_F = 100 mA, t_p = 20 ms	V_F		1.35	1.6	V
	I_F = 1 A, t_p = 100 µs	V_F		2.6	3	V
Temperature coefficient of V_F	I_F = 1 mA	TK_{VF}		- 1.8		mV/K
Reverse current	V_R = 5 V	I_R			10	µA
Junction capacitance	V_R = 0 V, f = 1 MHz, E = 0	C_j		25		pF
Radiant intensity	I_F = 100 mA, t_p = 20 ms	I_e	15	25	75	mW/sr
	I_F = 1 A, t_p = 100 µs	I_e	120	200		mW/sr
Radiant power	I_F = 100 mA, t_p = 20 ms	ϕ_e		35		mW
Temperature coefficient of ϕ_e	I_F = 20 mA	$TK\phi_e$		- 0.6		%/K
Angle of half intensity		φ		± 30		deg
Peak wavelength	I_F = 100 mA	λ_p		940		nm
Spectral bandwidth	I_F = 100 mA	$\Delta\lambda$		50		nm
Temperature coefficient of λ_p	I_F = 100 mA	$TK\lambda_p$		0.2		nm/K
Rise time	I_F = 100 mA	t_r		800		ns
Fall time	I_F = 100 mA	t_f		800		ns
Virtual source diameter		d		1.8		mm

Note

T_{amb} = 25 °C, unless otherwise specified

BASIC CHARACTERISTICS

T_{amb} = 25 °C, unless otherwise specified

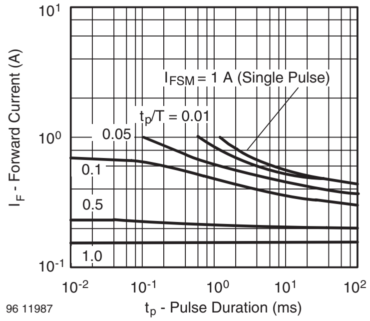


Fig. 3 - Pulse Forward Current vs. Pulse Duration

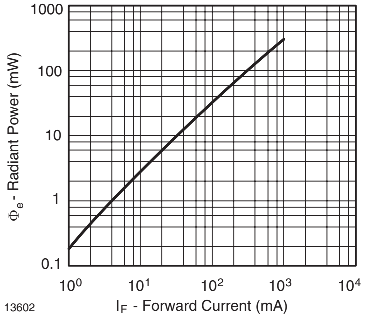


Fig. 6 - Radiant Power vs. Forward Current

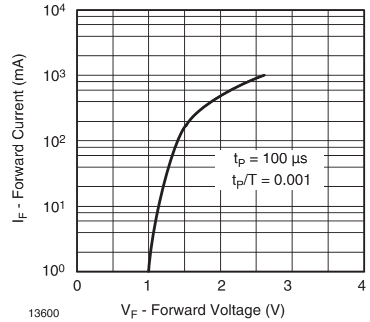


Fig. 4 - Forward Current vs. Forward Voltage

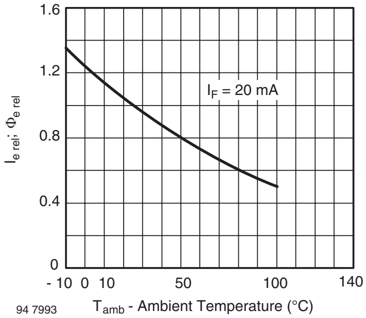


Fig. 7 - Relative Radiant Intensity/Power vs. Ambient Temperature

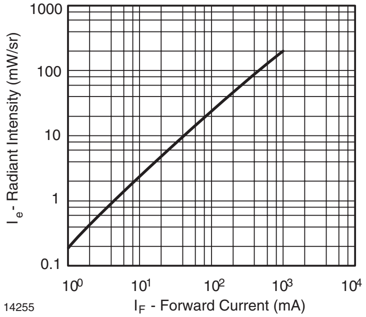


Fig. 5 - Radiant Intensity vs. Forward Current

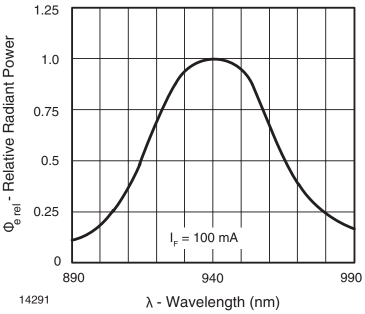


Fig. 8 - Relative Radiant Power vs. Wavelength

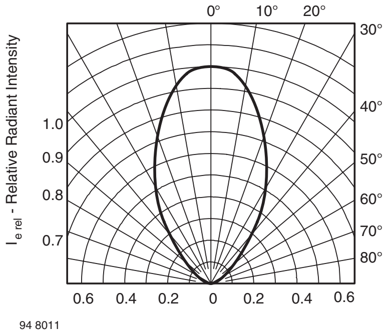
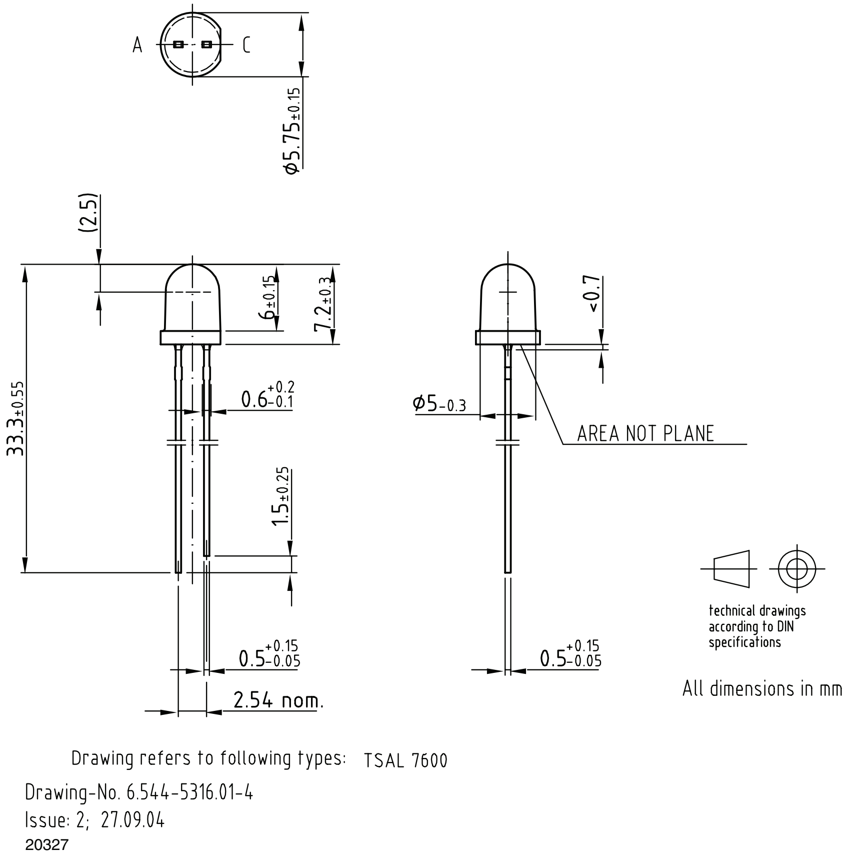
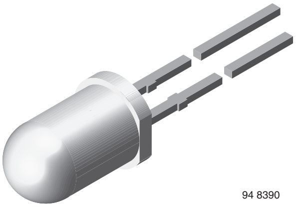


Fig. 9 - Relative Radiant Intensity vs. Angular Displacement

PACKAGE DIMENSIONS in millimeters



High Speed Infrared Emitting Diode, RoHS Compliant, 870 nm, GaAlAs Double Hetero



FEATURES

- Package type: leaded
- Package form: T-1 3/4
- Dimensions (in mm): ∅ 5
- Leads with stand-off
- Peak wavelength: λ_p = 870 nm
- High reliability
- High radiant power
- High radiant intensity
- Angle of half intensity: φ = ± 10°
- Low forward voltage
- Suitable for high pulse current operation
- High modulation bandwidth: f_c = 24 MHz
- Good spectral matching with Si photodetectors
- Lead (Pb)-free component in accordance with RoHS 2002/95/EC and WEEE 2002/96/EC

Pb-free

e2

RoHS COMPLIANT

DESCRIPTION

TSFF5210 is an infrared, 870 nm emitting diode in GaAlAs double hetero (DH) technology with high radiant power and high speed, molded in a clear, untinted plastic package.

APPLICATIONS

- Infrared video data transmission between camcorder and TV set
- Free air data transmission systems with high modulation frequencies or high data transmission rate requirements
- Smoke-automatic fire detectors

PRODUCT SUMMARY

COMPONENT	I_e (mW/sr)	φ (deg)	λ_P (nm)	t_r (ns)
TSFF5210	180	± 10	870	15

Note

Test conditions see table “Basic Characteristics”

ORDERING INFORMATION

ORDERING CODE	PACKAGING	REMARKS	PACKAGE FORM
TSFF5210	Bulk	MOQ: 4000 pcs, 4000 pcs/bulk	T-1¾

Note

MOQ: minimum order quantity

ABSOLUTE MAXIMUM RATINGS

PARAMETER	TEST CONDITION	SYMBOL	VALUE	UNIT
Reverse voltage		V_R	5	V
Forward current		I_F	100	mA
Peak forward current	$t_p/T = 0.5$, $t_p = 100\ \mu s$	I_{FM}	200	mA
Surge forward current	$t_p = 100\ \mu s$	I_{FSM}	1	A
Power dissipation		P_V	180	mW

ABSOLUTE MAXIMUM RATINGS

PARAMETER	TEST CONDITION	SYMBOL	VALUE	UNIT
Junction temperature		T_j	100	°C
Operating temperature range		T_{amb}	- 40 to + 85	°C
Storage temperature range		T_{stg}	- 40 to + 100	°C
Soldering temperature	t ≤ 5 s, 2 mm from case	T_{sd}	260	°C
Thermal resistance junction/ambient	J-STD-051, leads 7 mm, soldered on PCB	R_{thJA}	230	K/W

Note

T_{amb} = 25 °C, unless otherwise specified

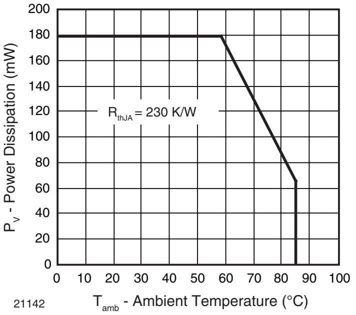


Fig. 1 - Power Dissipation Limit vs. Ambient Temperature

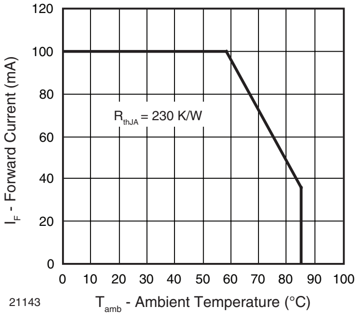


Fig. 2 - Forward Current Limit vs. Ambient Temperature

BASIC CHARACTERISTICS

PARAMETER	TEST CONDITION	SYMBOL	MIN.	TYP.	MAX.	UNIT
Forward voltage	I_F = 100 mA, t_p = 20 ms	V_F		1.5	1.8	V
	I_F = 1 A, t_p = 100 µs	V_F		2.3	3.0	V
Temperature coefficient of V_F	I_F = 1 mA	TK_{VF}		- 1.8		mV/K
Reverse current	V_R = 5 V	I_R			10	µA
Junction capacitance	V_R = 0 V, f = 1 MHz, E = 0	C_j		125		pF
Radiant intensity	I_F = 100 mA, t_p = 20 ms	I_e	120	180	360	mW/sr
	I_F = 1 A, t_p = 100 µs	I_e		1800		mW/sr
Radiant power	I_F = 100 mA, t_p = 20 ms	ϕ_e		50		mW
Temperature coefficient of ϕ_e	I_F = 100 mA	$TK\phi_e$		- 0.35		%/K
Angle of half intensity		φ		± 10		deg
Peak wavelength	I_F = 100 mA	λ_p		870		nm
Spectral bandwidth	I_F = 100 mA	$\Delta\lambda$		40		nm
Temperature coefficient of λ_p	I_F = 100 mA	$TK\lambda_p$		0.25		nm/K
Rise time	I_F = 100 mA	t_r		15		ns
Fall time	I_F = 100 mA	t_f		15		ns
Cut-off frequency	I_{DC} = 70 mA, I_{AC} = 30 mA pp	f_c		24		MHz
Virtual source diameter		d		3.7		mm

Note

T_{amb} = 25 °C, unless otherwise specified

BASIC CHARACTERISTICS

T_{amb} = 25 °C, unless otherwise specified

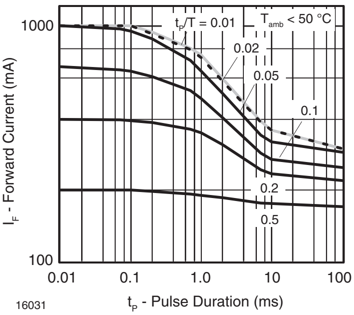


Fig. 3 - Pulse Forward Current vs. Pulse Duration

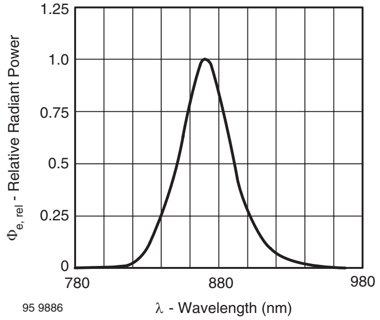


Fig. 6 - Relative Radiant Power vs. Wavelength

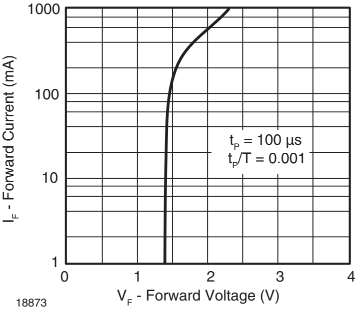


Fig. 4 - Forward Current vs. Forward Voltage

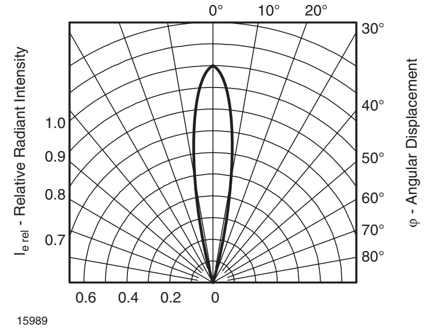


Fig. 7 - Relative Radiant Intensity vs. Angular Displacement

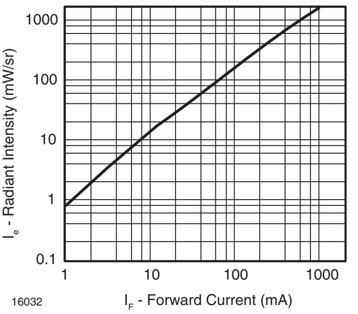


Fig. 5 - Radiant Intensity vs. Forward Current

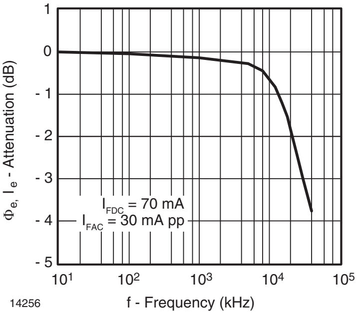
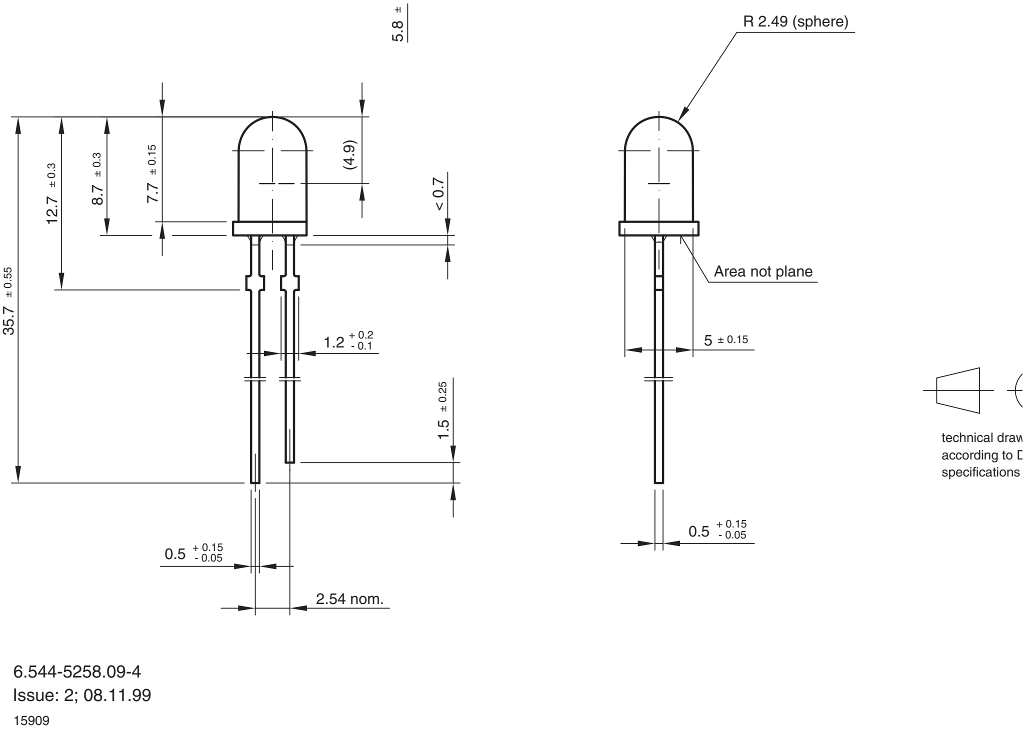
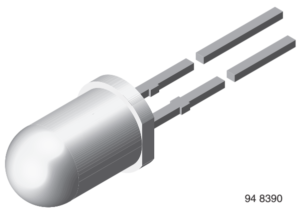


Fig. 8 - Attenuation vs. Frequency

PACKAGE DIMENSIONS in millimeters



High Speed Infrared Emitting Diode, RoHS Compliant, 870 nm, GaAlAs Double Hetero



FEATURES

- Package type: leaded
- Package form: T-1¾
- Dimensions (in mm): ∅ 5
- Leads with stand-off
- Peak wavelength: λ_p = 870 nm
- High reliability
- High radiant power
- High radiant intensity
- Angle of half intensity: φ = ± 22°
- Low forward voltage
- Suitable for high pulse current operation
- High modulation bandwidth: f_c = 24 MHz
- Good spectral matching to Si photodetectors
- Lead (Pb)-free component in accordance with RoHS 2002/95/EC and WEEE 2002/96/EC

DESCRIPTION

TSFF5410 is an infrared, 870 nm emitting diode in GaAlAs double hetero (DH) technology with high radiant power and high speed, molded in a clear, untinted plastic package.

APPLICATIONS

- Infrared video data transmission between camcorder and TV set
- Free air data transmission systems with high modulation frequencies or high data transmission rate requirements

PRODUCT SUMMARY

COMPONENT	I_e (mW/sr)	φ (deg)	λ_P (nm)	t_r (ns)
TSFF5410	70	± 22	870	15

Note
Test conditions see table “Basic Characteristics”

ORDERING INFORMATION

ORDERING CODE	PACKAGING	REMARKS	PACKAGE FORM
TSFF5410	Bulk	MOQ: 4000 pcs, 4000 pcs/bulk	T-1¾

Note
MOQ: minimum order quantity

ABSOLUTE MAXIMUM RATINGS

PARAMETER	TEST CONDITION	SYMBOL	VALUE	UNIT
Reverse voltage		V_R	5	V
Forward current		I_F	100	mA
Peak forward current	t_p/T = 0.5, t_p = 100 µs	I_{FM}	200	mA
Surge forward current	t_p = 100 µs	I_{FSM}	1	A
Power dissipation		P_V	180	mW

ABSOLUTE MAXIMUM RATINGS

PARAMETER	TEST CONDITION	SYMBOL	VALUE	UNIT
Junction temperature		T_j	100	°C
Operating temperature range		T_{amb}	- 40 to + 85	°C
Storage temperature range		T_{stg}	- 40 to + 100	°C
Soldering temperature	$t \leq 5$ s, 2 mm from case	T_{sd}	260	°C
Thermal resistance junction/ambient	J-STD-051, leads 7 mm, soldered on PCB	R_{thJA}	230	K/W

Note

T_{amb} = 25 °C, unless otherwise specified

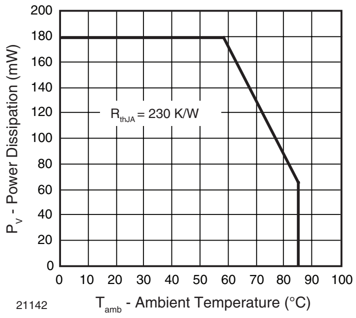


Fig. 1 - Power Dissipation Limit vs. Ambient Temperature

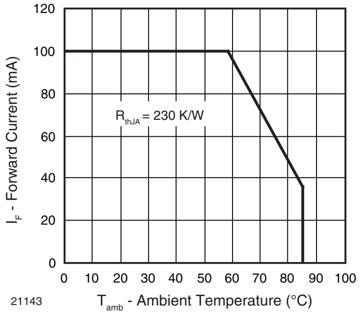


Fig. 2 - Forward Current Limit vs. Ambient Temperature

BASIC CHARACTERISTICS

PARAMETER	TEST CONDITION	SYMBOL	MIN.	TYP.	MAX.	UNIT
Forward voltage	I_F = 100 mA, t_p = 20 ms	V_F		1.5	1.8	V
	I_F = 1 A, t_p = 100 µs	V_F		2.3	3.0	V
Temperature coefficient of V_F	I_F = 1 mA	TK_{VF}		- 1.8		mV/K
Reverse current	V_R = 5 V	I_R			10	µA
Junction capacitance	V_R = 0 V, f = 1 MHz, E = 0	C_j		125		pF
Radiant intensity	I_F = 100 mA, t_p = 20 ms	I_e	45	70	135	mW/sr
	I_F = 1 A, t_p = 100 µs	I_e		700		mW/sr
Radiant power	I_F = 100 mA, t_p = 20 ms	ϕ_e		50		mW
Temperature coefficient of ϕ_e	I_F = 100 mA	$TK\phi_e$		- 0.35		%/K
Angle of half intensity		φ		± 22		deg
Peak wavelength	I_F = 100 mA	λ_p		870		nm
Spectral bandwidth	I_F = 100 mA	$\Delta\lambda$		40		nm
Temperature coefficient of λ_p	I_F = 100 mA	$TK\lambda_p$		0.25		nm/K
Rise time	I_F = 100 mA	t_r		15		ns
Fall time	I_F = 100 mA	t_f		15		ns
Cut-off frequency	I_{DC} = 70 mA, I_{AC} = 30 mA pp	f_c		24		MHz
Virtual source diameter		d		2.1		mm

Note

T_{amb} = 25 °C, unless otherwise specified

BASIC CHARACTERISTICS

T_{amb} = 25 °C, unless otherwise specified

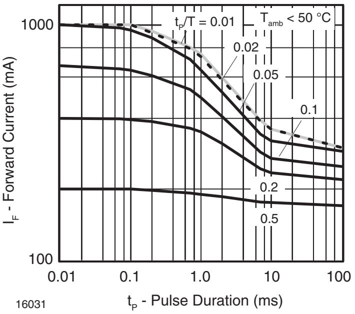


Fig. 3 - Pulse Forward Current vs. Pulse Duration

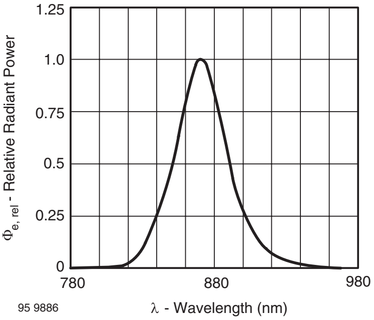


Fig. 6 - Relative Radiant Power vs. Wavelength

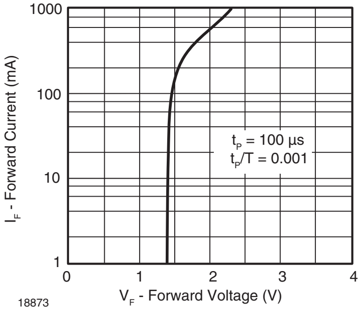


Fig. 4 - Forward Current vs. Forward Voltage

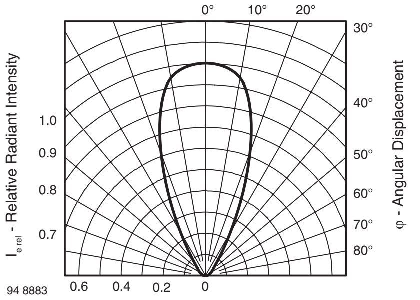


Fig. 7 - Relative Radiant Intensity vs. Angular Displacement

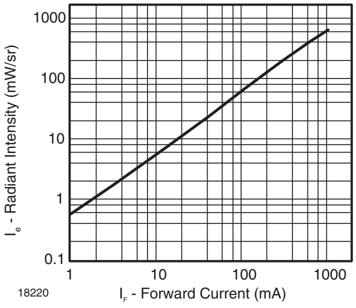


Fig. 5 - Radiant Intensity vs. Forward Current

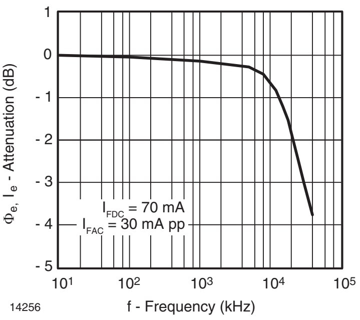
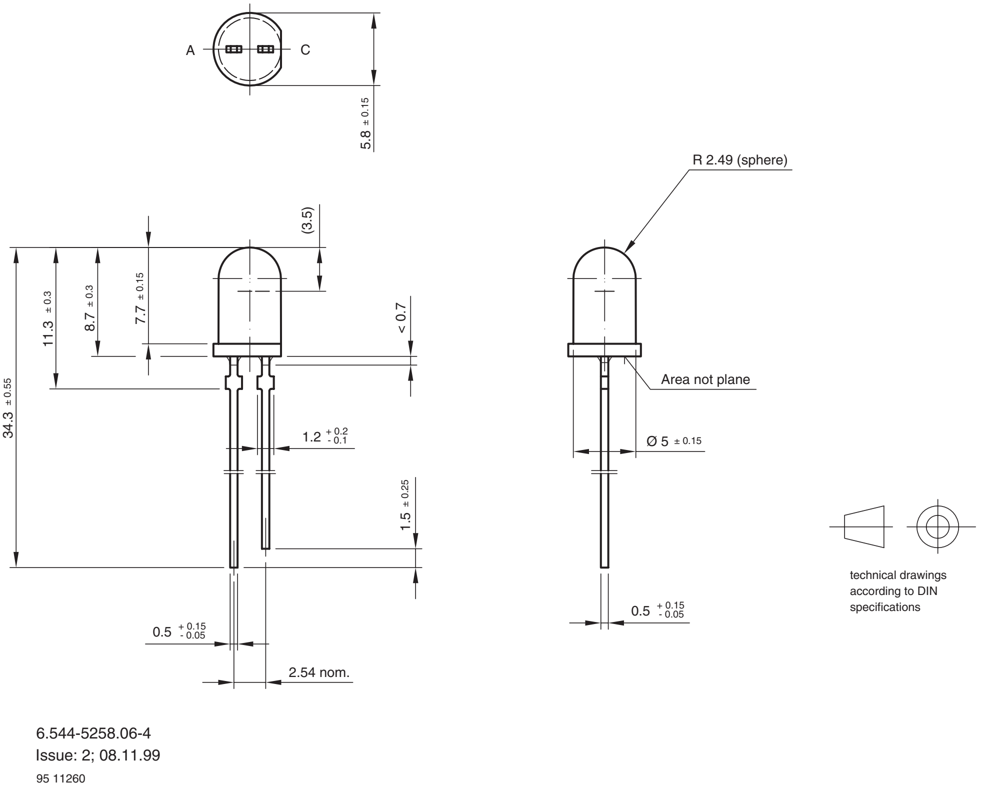
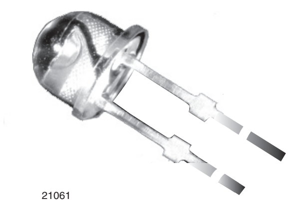


Fig. 8 - Attenuation vs. Frequency

PACKAGE DIMENSIONS in millimeters



High Speed Infrared Emitting Diode, RoHS Compliant, 870 nm, GaAlAs Double Hetero



DESCRIPTION

TSFF5510 is an infrared, 870 nm emitting diode in GaAlAs double hetero (DH) technology with high radiant power and high speed, molded in a clear, untinted plastic package.

FEATURES

- Package type: leaded
- Package form: T-1¾
- Dimensions (in mm): ∅ 5
- Leads with stand-off
- Peak wavelength: λ_p = 870 nm
- High reliability
- High radiant power
- High radiant intensity
- Angle of half intensity: φ = ± 38°
- Low forward voltage
- Suitable for high pulse current operation
- High modulation bandwidth: f_c = 24 MHz
- Good spectral matching with Si photodetectors
- Lead (Pb)-free component in accordance with RoHS 2002/95/EC and WEEE 2002/96/EC

Pb-free
e2
RoHS
COMPLIANT

APPLICATIONS

- Infrared video data transmission between camcorder and TV set
- Free air data transmission systems with high data transmission rates

PRODUCT SUMMARY				
COMPONENT	**I_e (mW/sr)**	**φ (deg)**	**λ_p (nm)**	**t_r (ns)**
TSFF5510	32	± 38	870	15

Note
Test conditions see table “Basic Characteristics”

ORDERING INFORMATION			
ORDERING CODE	**PACKAGING**	**REMARKS**	**PACKAGE FORM**
TSFF5510	Bulk	MOQ: 4000 pcs, 4000 pcs/bulk	T-1¾

Note
MOQ: minimum order quantity

ABSOLUTE MAXIMUM RATINGS				
PARAMETER	**TEST CONDITION**	**SYMBOL**	**VALUE**	**UNIT**
Reverse voltage		V_R	5	V
Forward current		I_F	100	mA
Peak forward current	t_p/T = 0.5, t_p = 100 µs	I_{FM}	200	mA
Surge forward current	t_p = 100 µs	I_{FSM}	1	A
Power dissipation		P_V	180	mW
Junction temperature		T_j	100	°C
Operating temperature range		T_{amb}	- 40 to + 85	°C
Storage temperature range		T_{stg}	- 40 to + 100	°C
Soldering temperature	$t \leq 5$ s, 2 mm from case	T_{sd}	260	°C
Thermal resistance junction/ambient	J-STD-051, leads 7 mm soldered on PCB	R_{thJA}	230	K/W

Note
T_{amb} = 25 °C, unless otherwise specified

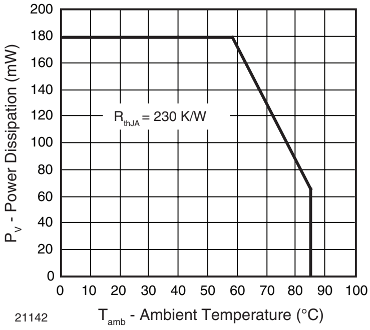


Fig. 1 - Power Dissipation Limit vs. Ambient Temperature

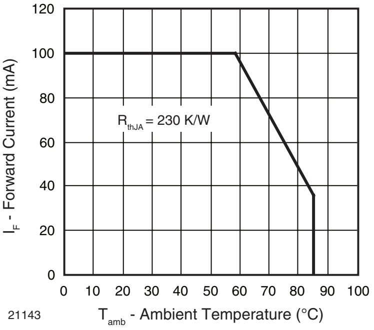


Fig. 2 - Forward Current Limit vs. Ambient Temperature

BASIC CHARACTERISTICS

PARAMETER	TEST CONDITION	SYMBOL	MIN.	TYP.	MAX.	UNIT
Forward voltage	I_F = 100 mA, t_p = 20 ms	V_F	1.3	1.45	1.7	V
	I_F = 450 mA, t_p = 100 µs	V_F	1.5	1.75	2.1	V
	I_F = 1 A, t_p = 100 µs	V_F		2.1		V
Temperature coefficient of V_F	I_F = 1 mA	TK_{VF}		- 1.8		mV/K
Reverse current	V_R = 5 V	I_R			10	µA
Junction capacitance	V_R = 0 V, f = 1 MHz, E = 0	C_j		110		pF
Radiant intensity	I_F = 100 mA, t_p = 20 ms	I_e	16	32	48	mW/sr
Radiant power	I_F = 100 mA, t_p = 20 ms	ϕ_e		55		mW
Temperature coefficient of ϕ_e	I_F = 100 mA	$TK\phi_e$		- 0.35		%/K
Angle of half intensity		φ		± 38		deg
Peak wavelength	I_F = 100 mA	λ_p		870		nm
Spectral bandwidth	I_F = 100 mA	$\Delta\lambda$		55		nm
Temperature coefficient of λ_p	I_F = 100 mA	$TK\lambda_p$		0.25		nm/K
Rise time	I_F = 100 mA	t_r		15		ns
Fall time	I_F = 100 mA	t_f		15		ns
Cut-off frequency	I_{DC} = 70 mA, I_{AC} = 30 mA pp	f_c		24		MHz

Note

T_{amb} = 25 °C, unless otherwise specified

BASIC CHARACTERISTICS

T_{amb} = 25 °C, unless otherwise specified

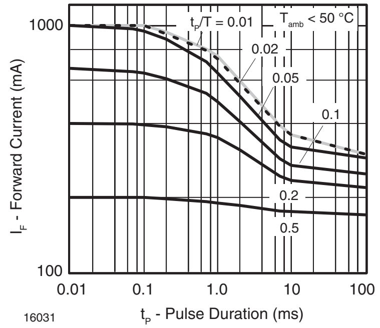


Fig. 3 - Pulse Forward Current vs. Pulse Duration

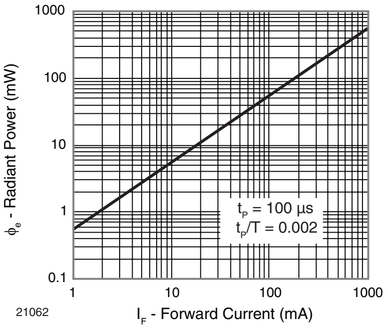


Fig. 6 - Radiant Power vs. Forward Current

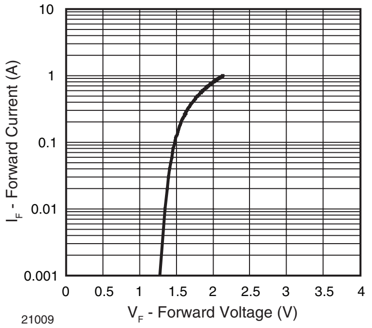


Fig. 4 - Forward Current vs. Forward Voltage

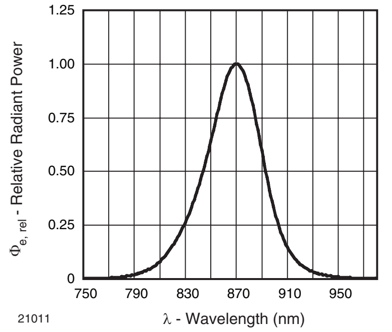


Fig. 7 - Relative Radiant Power vs. Wavelength

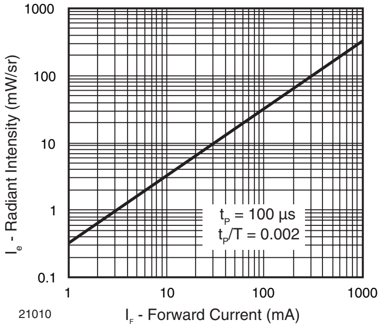


Fig. 5 - Radiant Intensity vs. Forward Current

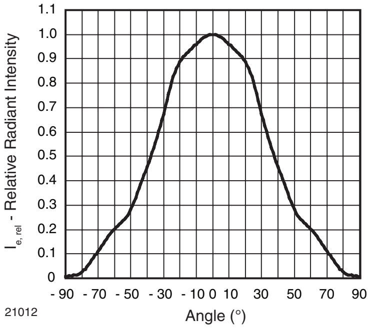
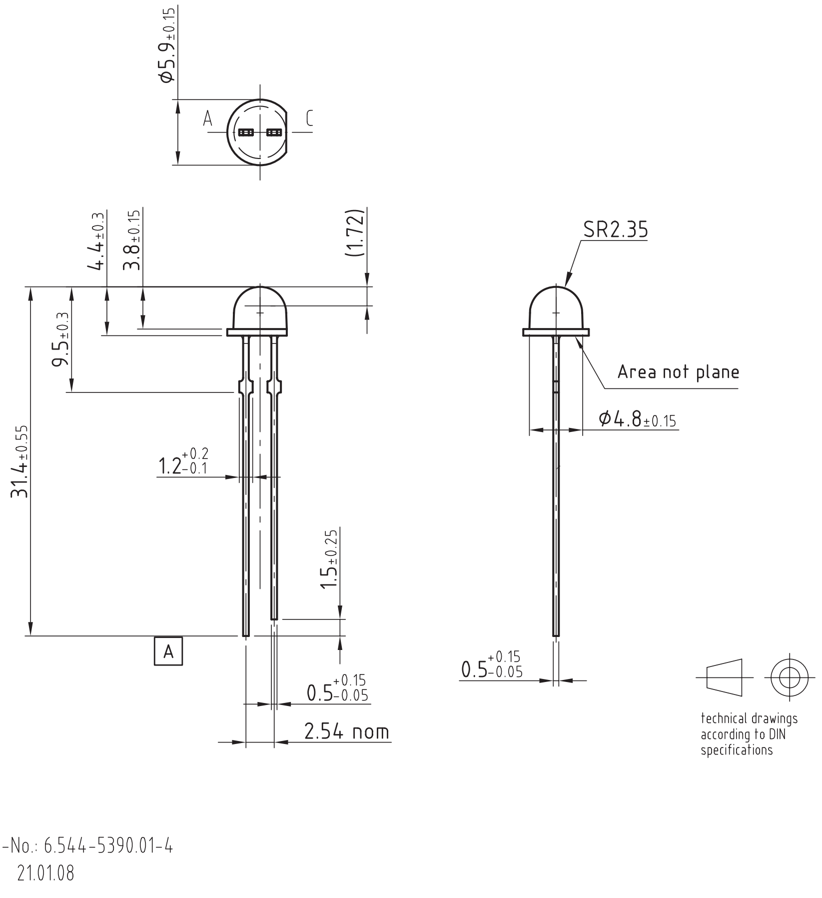
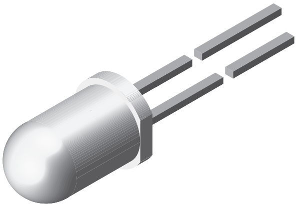


Fig. 8 - Relative Radiant Intensity vs. Angular Displacement

PACKAGE DIMENSIONS in millimeters



High Speed Infrared Emitting Diode, RoHS Compliant, 870 nm, GaAlAs Double Hetero



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FEATURES

- Package type: leaded
- Package form: T-1¾
- Dimensions (in mm): ∅ 5
- Peak wavelength: λ_p = 870 nm
- High reliability
- High radiant power
- High radiant intensity
- Angle of half intensity: φ = ± 10°
- Low forward voltage
- Suitable for high pulse current operation
- High modulation bandwidth: f_c = 24 MHz
- Good spectral matching with Si photodetectors
- Lead (Pb)-free component in accordance with RoHS 2002/95/EC and WEEE 2002/96/EC

Pb-free

e2

RoHS
COMPLIANT

DESCRIPTION

TSFF6210 is an infrared, 870 nm emitting diode in GaAlAs double hetero (DH) technology with high radiant power and high speed, molded in a clear, untinted plastic package.

APPLICATIONS

- Infrared video data transmission between Camcorder and TV set
- Free air data transmission systems with high modulation frequencies or high data transmission rate requirements
- Smoke-automatic fire detectors

PRODUCT SUMMARY

COMPONENT	I_e (mW/sr)	φ (deg)	λ_P (nm)	t_r (ns)
TSFF6210	180	± 10	870	15

Note

Test conditions see table "Basic Characteristics"

ORDERING INFORMATION

ORDERING CODE	PACKAGING	REMARKS	PACKAGE FORM
TSFF6210	Bulk	MOQ: 4000 pcs, 4000 pcs/bulk	T-1¾

Note

MOQ: minimum order quantity

ABSOLUTE MAXIMUM RATINGS

PARAMETER	TEST CONDITION	SYMBOL	VALUE	UNIT
Reverse voltage		V_R	5	V
Forward current		I_F	100	mA
Peak forward current	$t_p/T = 0.5$, $t_p = 100\ \mu s$	I_{FM}	200	mA
Surge forward current	$t_p = 100\ \mu s$	I_{FSM}	1	A
Power dissipation		P_V	180	mW

ABSOLUTE MAXIMUM RATINGS				
PARAMETER	**TEST CONDITION**	**SYMBOL**	**VALUE**	**UNIT**
Junction temperature		T_j	100	°C
Operating temperature range		T_{amb}	- 40 to + 85	°C
Storage temperature range		T_{stg}	- 40 to + 100	°C
Soldering temperature	t ≤ 5 s, 2 mm from case	T_{sd}	260	°C
Thermal resistance junction/ambient	J-STD-051, leads 7 mm, soldered on PCB	R_{thJA}	230	K/W

Note

T_{amb} = 25 °C, unless otherwise specified

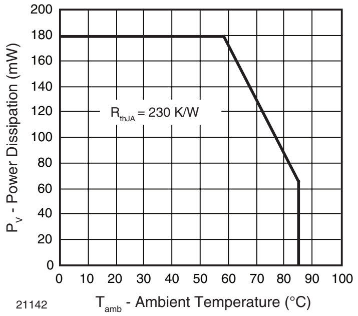


Fig. 1 - Power Dissipation Limit vs. Ambient Temperature

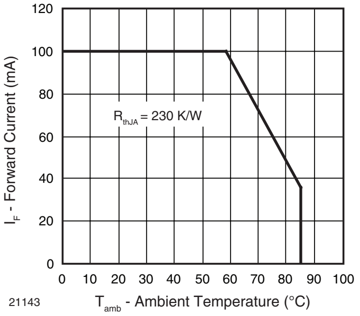


Fig. 2 - Forward Current Limit vs. Ambient Temperature

BASIC CHARACTERISTICS						
PARAMETER	**TEST CONDITION**	**SYMBOL**	**MIN.**	**TYP.**	**MAX.**	**UNIT**
Forward voltage	I_F = 100 mA, t_p = 20 ms	V_F		1.5	1.8	V
	I_F = 1 A, t_p = 100 µs	V_F		2.3	3.0	V
Temperature coefficient of V_F	I_F = 1 mA	TK_{VF}		- 1.8		mV/K
Reverse current	V_R = 5 V	I_R			10	µA
Junction capacitance	V_R = 0 V, f = 1 MHz, E = 0	C_j		125		pF
Radiant intensity	I_F = 100 mA, t_p = 20 ms	I_e	90	180	450	mW/sr
	I_F = 1 A, t_p = 100 µs	I_e		1800		mW/sr
Radiant power	I_F = 100 mA, t_p = 20 ms	ϕ_e		50		mW
Temperature coefficient of ϕ_e	I_F = 100 mA	$TK\phi_e$		- 0.35		%/K
Angle of half intensity		φ		± 10		deg
Peak wavelength	I_F = 100 mA	λ_p		870		nm
Spectral bandwidth	I_F = 100 mA	$\Delta\lambda$		40		nm
Temperature coefficient of λ_p	I_F = 100 mA	$TK\lambda_p$		0.25		nm/K
Rise time	I_F = 100 mA	t_r		15		ns
Fall time	I_F = 100 mA	t_f		15		ns
Cut-off frequency	I_{DC} = 70 mA, I_{AC} = 30 mA pp	f_c		24		MHz
Virtual source diameter		d		3.7		mm

Note

T_{amb} = 25 °C, unless otherwise specified

BASIC CHARACTERISTICS

T_{amb} = 25 °C, unless otherwise specified

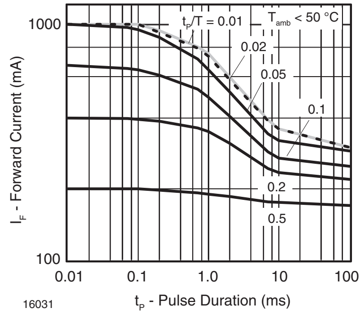


Fig. 3 - Pulse Forward Current vs. Pulse Duration

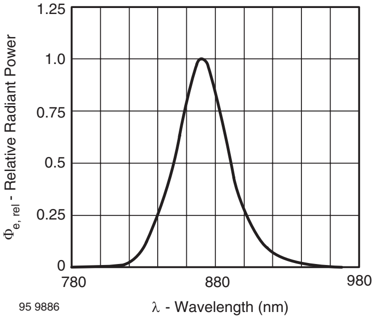


Fig. 6 - Relative Radiant Power vs. Wavelength

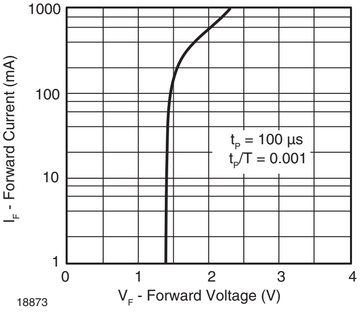


Fig. 4 - Forward Current vs. Forward Voltage

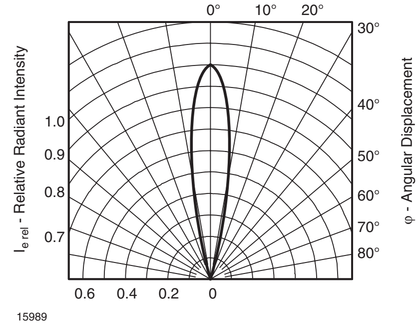


Fig. 7 - Relative Radiant Intensity vs. Angular Displacement

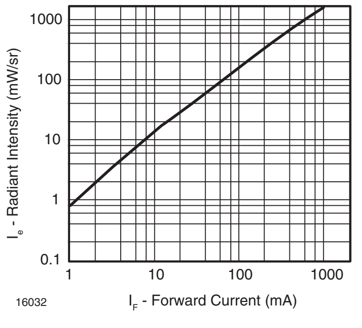


Fig. 5 - Radiant Intensity vs. Forward Current

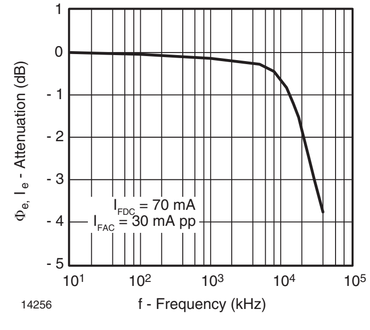
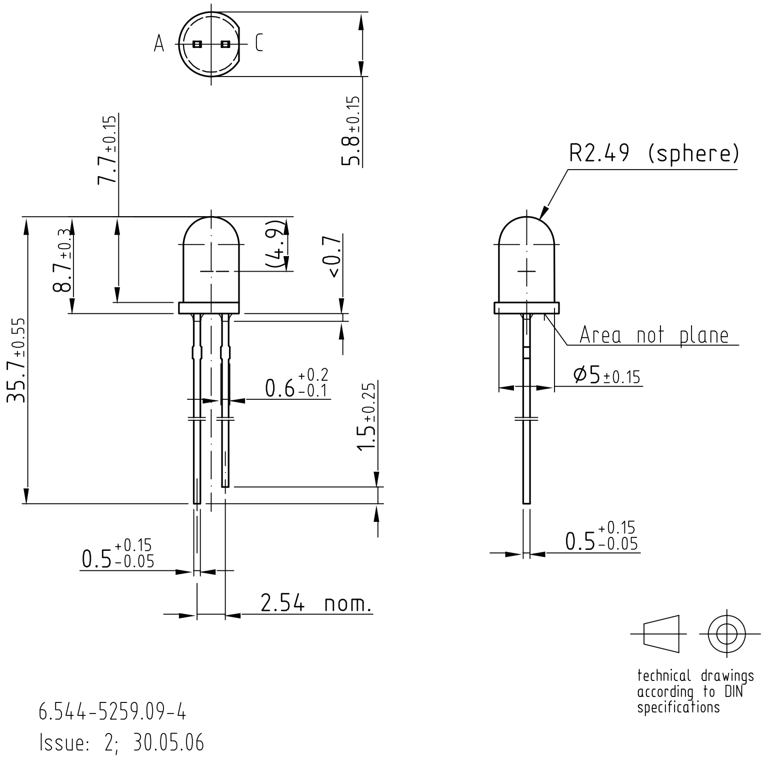


Fig. 8 - Attenuation vs. Frequency

PACKAGE DIMENSIONS in millimeters



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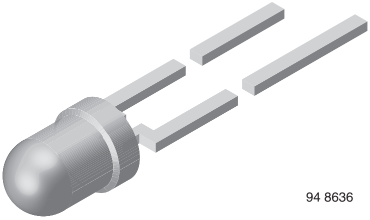
Infrared Emitting Diode, RoHS Compliant, 875 nm, GaAlAs



DESCRIPTION

The TSHA440. series are infrared, 875 nm emitting diodes in GaAlAs technology, molded in a clear, untinted plastic package.

FEATURES

- Package type: leaded
- Package form: T-1
- Dimensions (in mm): Ø 3
- Peak wavelength: λ_p = 875 nm
- High reliability
- Angle of half intensity: $\varphi = \pm 20°$
- Low forward voltage
- Suitable for high pulse current operation
- Good spectral matching with Si photodetectors
- Lead (Pb)-free component in accordance with RoHS 2002/95/EC and WEEE 2002/96/EC

Pb-free
e2
RoHS
COMPLIANT

APPLICATIONS

- Infrared remote control and free air data transmission systems with comfortable radiation angle
- This emitter series is dedicated to systems with panes in transmission space between emitter and detector, because of the low absorbtion of 875 nm radiation in glass

PRODUCT SUMMARY

COMPONENT	I_e (mW/sr)	φ (deg)	λ_P (nm)	t_r (ns)
TSHA4400	20	± 20	875	600
TSHA4401	30	± 20	875	600

Note

Test conditions see table "Basic Characteristics"

ORDERING INFORMATION

ORDERING CODE	PACKAGING	REMARKS	PACKAGE FORM
TSHA4400	Bulk	MOQ: 5000 pcs, 5000 pcs/bulk	T-1
TSHA4401	Bulk	MOQ: 5000 pcs, 5000 pcs/bulk	T-1

Note

MOQ: minimum order quantity

ABSOLUTE MAXIMUM RATINGS

PARAMETER	TEST CONDITION	SYMBOL	VALUE	UNIT
Reverse voltage		V_R	5	V
Forward current		I_F	100	mA
Peak forward current	$t_p/T = 0.5$, $t_p = 100\ \mu s$	I_{FM}	200	mA
Surge forward current	$t_p = 100\ \mu s$	I_{FSM}	2	A
Power dissipation		P_V	180	mW
Junction temperature		T_j	100	°C
Operating temperature range		T_{amb}	- 40 to + 85	°C
Storage temperature range		T_{stg}	- 40 to + 100	°C
Soldering temperature	$t \le 5$ s, 2 mm from case	T_{sd}	260	°C
Thermal resistance junction/ambient	J-STD-051, leads 7 mm, soldered on PCB	R_{thJA}	300	K/W

Note

T_{amb} = 25 °C, unless otherwise specified

Infrared Emitting Diode, RoHS Compliant, 875 nm, GaAlAs

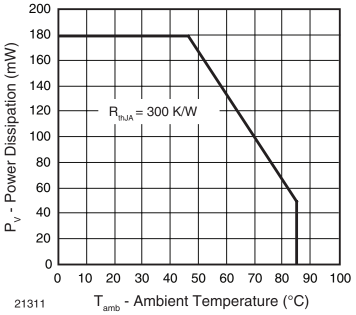


Fig. 1 - Power Dissipation Limit vs. Ambient Temperature

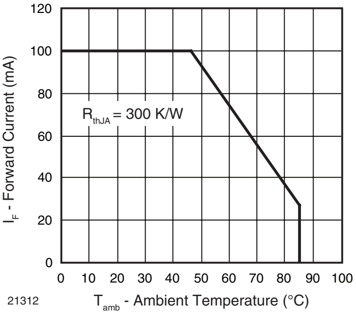


Fig. 2 - Forward Current Limit vs. Ambient Temperature

BASIC CHARACTERISTICS

PARAMETER	TEST CONDITION	SYMBOL	MIN.	TYP.	MAX.	UNIT
Forward voltage	I_F = 100 mA, t_p = 20 ms	V_F		1.5	1.8	V
	I_F = 1.5 A, t_p = 100 µs	V_F		3.2	4.9	V
Temperature coefficient of V_F	I_F = 100 mA	TK_{VF}		- 1.6		mV/K
Reverse current	V_R = 5 V	I_R			100	µA
Junction capacitance	V_R = 0 V, f = 1 MHz, E = 0	C_j		20		pF
Temperature coefficient of ϕ_e	I_F = 100 mA	$TK\phi_e$		- 0.7		%/K
Angle of half intensity		φ		± 20		deg
Peak wavelength	I_F = 100 mA	λ_p		875		nm
Spectral bandwidth	I_F = 100 mA	$\Delta\lambda$		80		nm
Temperature coefficient of λ_p	I_F = 100 mA	$TK\lambda_p$		0.2		nm/K
Rise time	I_F = 100 mA	t_r		600		ns
	I_F = 1.5 A	t_r		300		ns
Fall time	I_F = 100 mA	t_f		600		ns
	I_F = 1.5 A	t_f		300		ns
Virtual source diameter		d		1.8		mm

Note

T_{amb} = 25 °C, unless otherwise specified

TYPE DEDICATED CHARACTERISTICS

PARAMETER	TEST CONDITION	PART	SYMBOL	MIN.	TYP.	MAX.	UNIT
Radiant intensity	I_F = 100 mA, t_p = 20 ms	TSHA4400	I_e	12	20	60	mW/sr
		TSHA4401	I_e	16	30	60	mW/sr
	I_F = 1.5 mA, t_p = 100 µs	TSHA4400	I_e	140	240		mW/sr
		TSHA4401	I_e	190	360		mW/sr
Radiant power	I_F = 100 mA, t_p = 20 ms	TSHA4400	ϕ_e		20		mW
		TSHA4401	ϕ_e		24		mW

Note

T_{amb} = 25 °C, unless otherwise specified

BASIC CHARACTERISTICS

T_{amb} = 25 °C, unless otherwise specified

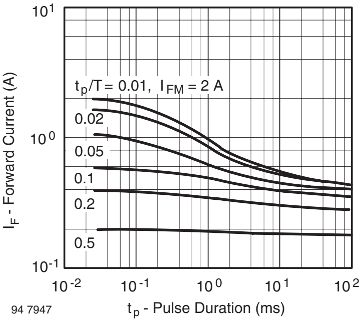


Fig. 3 - Pulse Forward Current vs. Pulse Duration

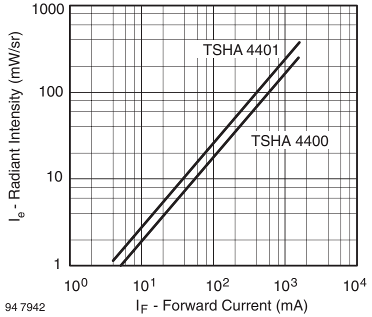


Fig. 6 - Radiant Intensity vs. Forward Current

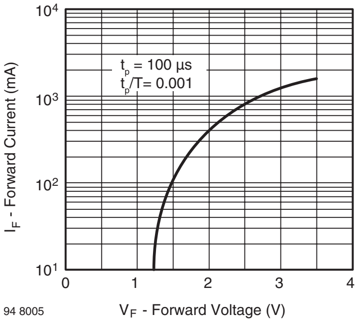


Fig. 4 - Forward Current vs. Forward Voltage

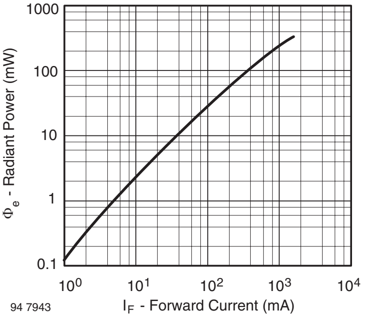


Fig. 7 - Radiant Power vs. Forward Current

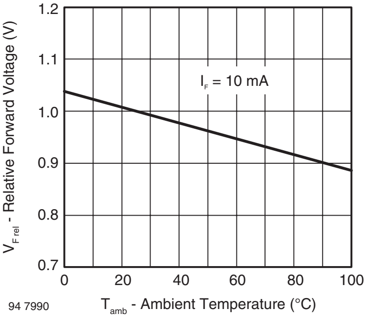


Fig. 5 - Relative Forward Voltage vs. Ambient Temperature

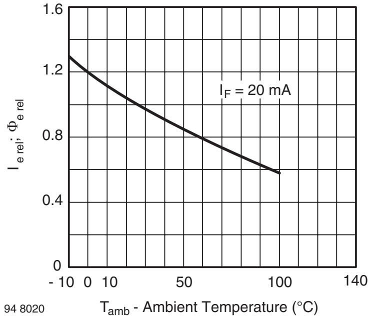


Fig. 8 - Relative Radiant Intensity/Power vs. Ambient Temperature

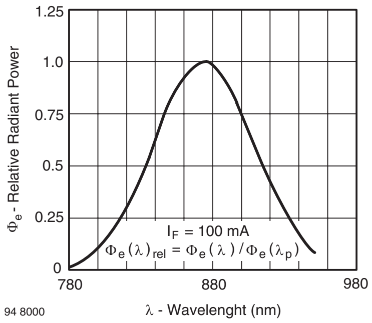


Fig. 9 - Relative Radiant Power vs. Wavelength

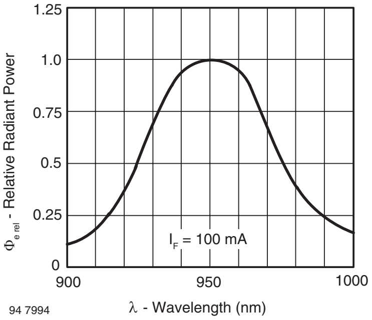
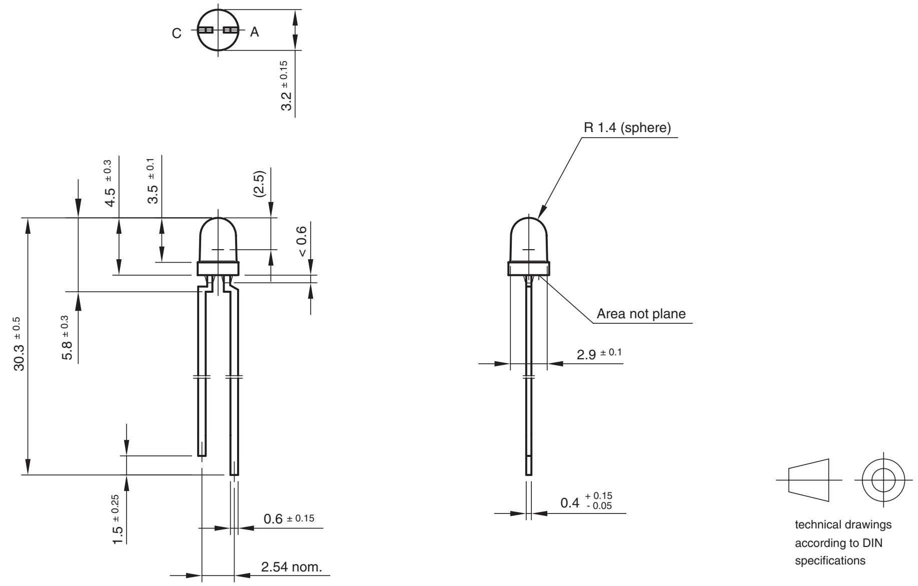


Fig. 10 - Relative Radiant Intensity vs. Angular Displacement

PACKAGE DIMENSIONS in millimeters



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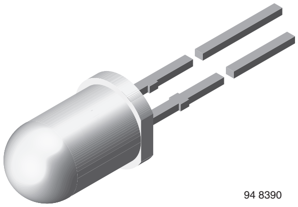
Infrared Emitting Diode, RoHS Compliant, 875 nm, GaAlAs



FEATURES

- Package type: leaded
- Package form: T-1¾
- Dimensions (in mm): Ø 5
- Leads with stand-off
- Peak wavelength: λ_p = 875 nm
- High reliability
- Angle of half intensity: $\varphi = \pm 12°$
- Low forward voltage
- Suitable for high pulse current operation
- Lead (Pb)-free component in accordance with RoHS 2002/95/EC and WEEE 2002/96/EC

Pb Pb-free

e2

RoHS COMPLIANT

DESCRIPTION

The TSHA520. series are infrared, 875 nm emitting diodes in GaAlAs technology, molded in a clear, untinted plastic package.

APPLICATIONS

- Infrared remote control and free air data transmission systems
- This emitter series is dedicated to systems with panes in transmission space between emitter and detector, because of the low absorbtion of 875 nm radiation in glass

PRODUCT SUMMARY

COMPONENT	I_e (mW/sr)	φ (deg)	λ_P (nm)	t_r (ns)
TSHA5200	40	± 12	875	600
TSHA5201	50	± 12	875	600
TSHA5202	60	± 12	875	600
TSHA5203	65	± 12	875	600

Note

Test conditions see table “Basic Characteristics”

ORDERING INFORMATION

ORDERING CODE	PACKAGING	REMARKS	PACKAGE FORM
TSHA5200	Bulk	MOQ: 4000 pcs, 4000 pcs/bulk	T-1¾
TSHA5201	Bulk	MOQ: 4000 pcs, 4000 pcs/bulk	T-1¾
TSHA5202	Bulk	MOQ: 4000 pcs, 4000 pcs/bulk	T-1¾
TSHA5203	Bulk	MOQ: 4000 pcs, 4000 pcs/bulk	T-1¾

Note

MOQ: minimum order quantity

ABSOLUTE MAXIMUM RATINGS

PARAMETER	TEST CONDITION	SYMBOL	VALUE	UNIT
Reverse voltage		V_R	5	V
Forward current		I_F	100	mA
Peak forward current	$t_p/T = 0.5$, $t_p = 100$ µs	I_{FM}	200	mA
Surge forward current	$t_p = 100$ µs	I_{FSM}	2.5	A
Power dissipation		P_V	180	mW

ABSOLUTE MAXIMUM RATINGS

PARAMETER	TEST CONDITION	SYMBOL	VALUE	UNIT
Junction temperature		T_j	100	°C
Operating temperature range		T_{amb}	- 40 to + 85	°C
Storage temperature range		T_{stg}	- 40 to + 100	°C
Soldering temperature	t ≤ 5 s, 2 mm from case	T_{sd}	260	°C
Thermal resistance junction/ambient	J-STD-051, leads 7 mm, soldered on PCB	R_{thJA}	230	K/W

Note

T_{amb} = 25 °C, unless otherwise specified

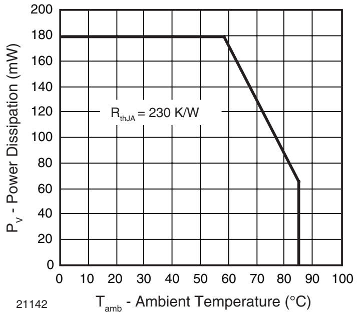


Fig. 1 - Power Dissipation Limit vs. Ambient Temperature

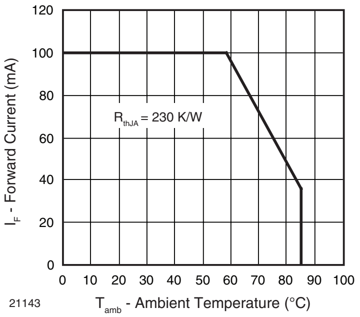


Fig. 2 - Forward Current Limit vs. Ambient Temperature

BASIC CHARACTERISTICS

PARAMETER	TEST CONDITION	SYMBOL	MIN.	TYP.	MAX.	UNIT
Forward voltage	I_F = 100 mA, t_p = 20 ms	V_F		1.5	1.8	V
Temperature coefficient of V_F	I_F = 100 mA	TK_{VF}		- 1.6		mV/K
Reverse current	V_R = 5 V	I_R			100	µA
Junction capacitance	V_R = 0 V, f = 1 MHz, E = 0	C_j		20		pF
Temperature coefficient of ϕ_e	I_F = 20 mA	$TK\phi_e$		- 0.7		%/K
Angle of half intensity		φ		± 12		deg
Peak wavelength	I_F = 100 mA	λ_p		875		nm
Spectral bandwidth	I_F = 100 mA	$\Delta\lambda$		80		nm
Temperature coefficient of λ_p	I_F = 100 mA	$TK\lambda_p$		0.2		nm/K
Rise time	I_F = 100 mA	t_r		600		ns
	I_F = 1.5 A	t_r		300		ns
Fall time	I_F = 100 mA	t_f		600		ns
	I_F = 1.5 A	t_f		300		ns
Virtual source diameter		d		3.7		mm

Note

T_{amb} = 25 °C, unless otherwise specified

TYPE DEDICATED CHARACTERISTICS

PARAMETER	TEST CONDITION	PART	SYMBOL	MIN.	TYP.	MAX.	UNIT
Forward voltage	I_F = 1.5 A, t_p = 100 µs	TSHA5200	V_F		3.2	4.9	V
		TSHA5201	V_F		3.2	4.9	V
		TSHA5202	V_F		3.2	4.5	V
		TSHA5203	V_F		3.2	4.5	V
Radiant intensity	I_F = 100 mA, t_p = 20 µs	TSHA5200	I_e	25	40	125	mW/sr
		TSHA5201	I_e	30	50	125	mW/sr
		TSHA5202	I_e	36	60	125	mW/sr
		TSHA5203	I_e	50	65	125	mW/sr
	I_F = 1.5 A, t_p = 100 µs	TSHA5200	I_e	300	500		mW/sr
		TSHA5201	I_e	400	600		mW/sr
		TSHA5202	I_e	500	700		mW/sr
		TSHA5203	I_e	600	800		mW/sr
Radiant power	I_F = 100 mA, t_p = 20 µs	TSHA5200	ϕ_e		22		mW
		TSHA5201	ϕ_e		23		mW
		TSHA5202	ϕ_e		24		mW
		TSHA5203	ϕ_e		25		mW

Note
T_{amb} = 25 °C, unless otherwise specified

BASIC CHARACTERISTICS

T_{amb} = 25 °C, unless otherwise specified

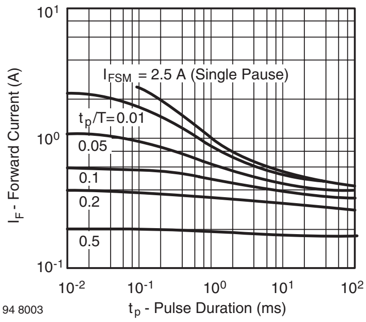


Fig. 3 - Pulse Forward Current vs. Pulse Duration

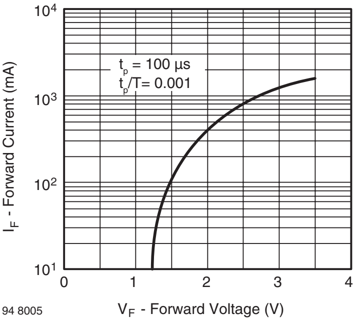


Fig. 4 - Forward Current vs. Forward Voltage

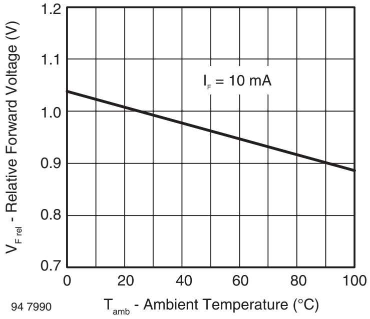


Fig. 5 - Relative Forward Voltage vs. Ambient Temperature

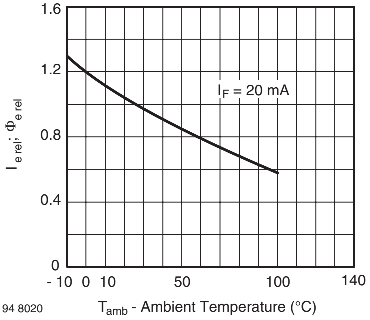


Fig. 8 - Relative Radiant Intensity/Power vs. Ambient Temperature

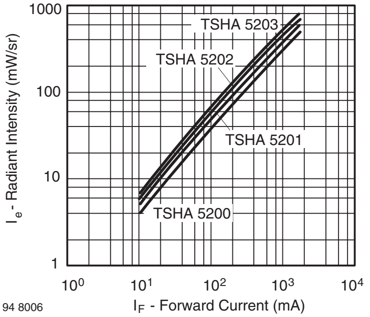


Fig. 6 - Radiant Intensity vs. Forward Current

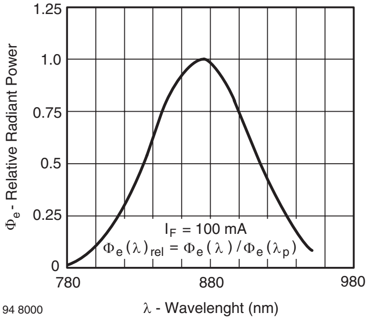


Fig. 9 - Relative Radiant Power vs. Wavelength

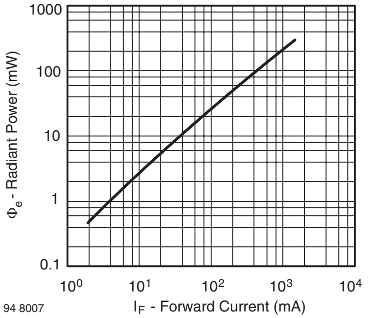


Fig. 7 - Radiant Power vs. Forward Current

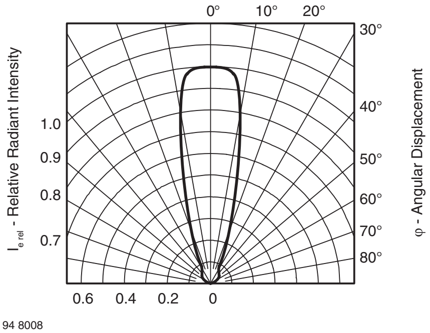
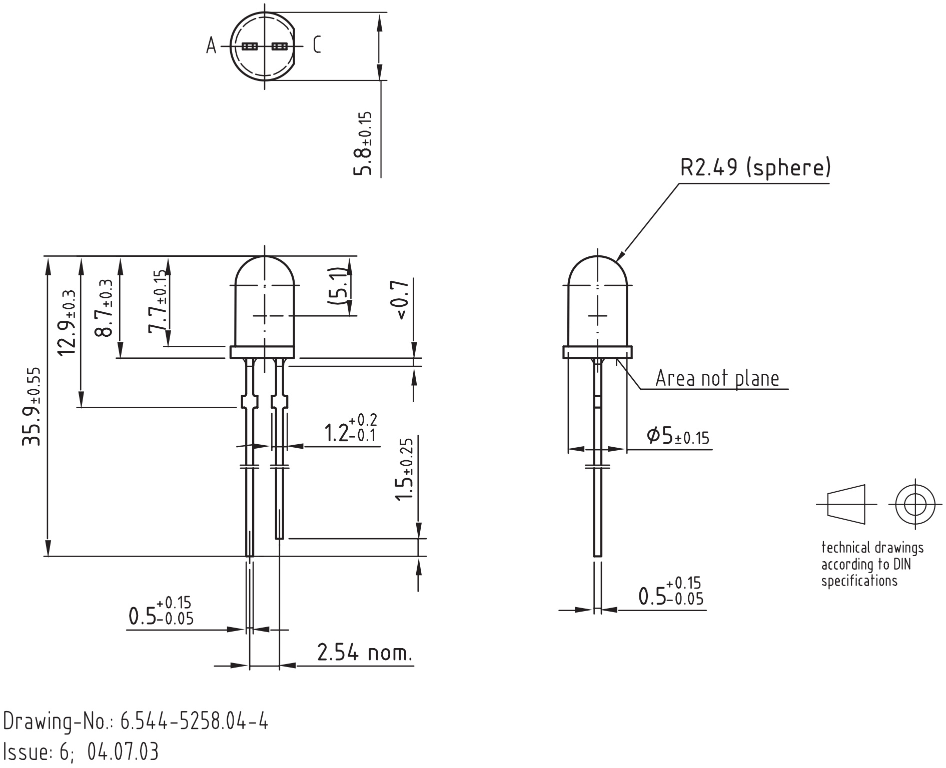


Fig. 10 - Relative Radiant Intensity vs. Angular Displacement

PACKAGE DIMENSIONS in millimeters



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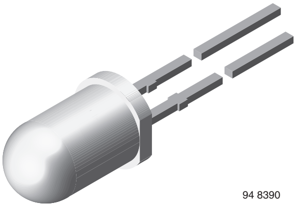
Infrared Emitting Diode, RoHS Compliant, 875 nm, GaAlAs



FEATURES

- Package type: leaded
- Package form: T-1¾
- Dimensions (in mm): Ø 5
- Leads with stand-off
- Peak wavelength: λ_p = 875 nm
- High reliability
- Angle of half intensity: φ = ± 24°
- Low forward voltage
- Suitable for high pulse current operation
- Good spectral matching with Si photodetectors
- Lead (Pb)-free component in accordance with RoHS 2002/95/EC and WEEE 2002/96/EC

Pb-free
e2
RoHS
COMPLIANT

DESCRIPTION

The TSHA550. series are infrared, 875 nm emitting diodes in GaAlAs on GaAlAs technology, molded in a clear, untinted plastic package.

APPLICATIONS

- Infrared remote control and free air data transmission systems with comfortable radiation angle
- This emitter series is dedicated to systems with panes in transmission space between emitter and detector, because of the low absorbtion of 875 nm radiation in glass

PRODUCT SUMMARY

COMPONENT	I_e (mW/sr)	φ (deg)	λ_P (nm)	t_r (ns)
TSHA5500	20	± 24	875	600
TSHA5501	25	± 24	875	600
TSHA5502	30	± 24	875	600
TSHA5503	35	± 24	875	600

Note
Test conditions see table “Basic Characteristics”

ORDERING INFORMATION

ORDERING CODE	PACKAGING	REMARKS	PACKAGE FORM
TSHA5500	Bulk	MOQ: 4000 pcs, 4000 pcs/bulk	T-1¾
TSHA5501	Bulk	MOQ: 4000 pcs, 4000 pcs/bulk	T-1¾
TSHA5502	Bulk	MOQ: 4000 pcs, 4000 pcs/bulk	T-1¾
TSHA5503	Bulk	MOQ: 4000 pcs, 4000 pcs/bulk	T-1¾

Note
MOQ: minimum order quantity

ABSOLUTE MAXIMUM RATINGS

PARAMETER	TEST CONDITION	SYMBOL	VALUE	UNIT
Reverse voltage		V_R	5	V
Forward current		I_F	100	mA
Peak forward current	$t_p/T = 0.5$, t_p = 100 µs	I_{FM}	200	mA
Surge forward current	t_p = 100 µs	I_{FSM}	2.5	A
Power dissipation		P_V	180	mW

ABSOLUTE MAXIMUM RATINGS

PARAMETER	TEST CONDITION	SYMBOL	VALUE	UNIT
Junction temperature		T_j	100	°C
Operating temperature range		T_{amb}	- 40 to + 85	°C
Storage temperature range		T_{stg}	- 40 to + 100	°C
Soldering temperature	t ≤ 5 s, 2 mm from case	T_{sd}	260	°C
Thermal resistance junction/ambient	J-STD-051, leads 7 mm, soldered on PCB	R_{thJA}	230	K/W

Note

T_{amb} = 25 °C, unless otherwise specified

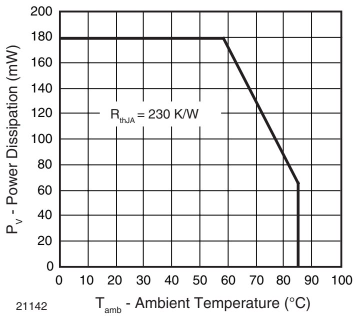


Fig. 1 - Power Dissipation Limit vs. Ambient Temperature

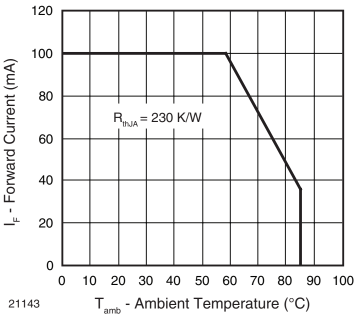


Fig. 2 - Forward Current Limit vs. Ambient Temperature

BASIC CHARACTERISTICS

PARAMETER	TEST CONDITION	SYMBOL	MIN.	TYP.	MAX.	UNIT
Forward voltage	I_F = 100 mA, t_p = 20 ms	V_F		1.5	1.8	V
Temperature coefficient of V_F	I_F = 100 mA	TK_{VF}		- 1.6		mV/K
Reverse current	V_R = 5 V	I_R			100	µA
Junction capacitance	V_R = 0 V, f = 1 MHz, E = 0	C_j		20		pF
Temperature coefficient of ϕ_e	I_F = 20 mA	$TK\phi_e$		- 0.7		%/K
Angle of half intensity		φ		± 24		deg
Peak wavelength	I_F = 100 mA	λ_p		875		nm
Spectral bandwidth	I_F = 100 mA	$\Delta\lambda$		80		nm
Temperature coefficient of λ_p	I_F = 100 mA	$TK\lambda_p$		0.2		nm/K
Rise time	I_F = 100 mA	t_r		600		ns
	I_F = 1.5 A	t_r		300		ns
Fall time	I_F = 100 mA	t_f		600		ns
	I_F = 1.5 A	t_f		300		ns
Virtual source diameter		d		2.2		mm

Note

T_{amb} = 25 °C, unless otherwise specified

TYPE DEDICATED CHARACTERISTICS

PARAMETER	TEST CONDITION	PART	SYMBOL	MIN.	TYP.	MAX.	UNIT
Forward voltage	I_F = 1.5 A, t_p = 100 µs	TSHA5500	V_F		3.2	4.9	V
		TSHA5501	V_F		3.2	4.9	V
		TSHA5502	V_F		3.2	4.5	V
		TSHA5203	V_F		3.2	4.5	V
Radiant intensity	I_F = 100 mA, t_p = 20 ms	TSHA5500	I_e	12	20	60	mW/sr
		TSHA5501	I_e	16	25	60	mW/sr
		TSHA5502	I_e	20	30	60	mW/sr
		TSHA5503	I_e	24	35	60	mW/sr
	I_F = 1.5 A, t_p = 100 µs	TSHA5500	I_e	150	240		mW/sr
		TSHA5501	I_e	200	300		mW/sr
		TSHA5502	I_e	250	360		mW/sr
		TSHA5503	I_e	300	420		mW/sr
Radiant power	I_F = 100 mA, t_p = 20 ms	TSHA5500	ϕ_e		22		mW
		TSHA5501	ϕ_e		23		mW
		TSHA5502	ϕ_e		24		mW
		TSHA5503	ϕ_e		25		mW

Note

T_{amb} = 25 °C, unless otherwise specified

BASIC CHARACTERISTICS

T_{amb} = 25 °C, unless otherwise specified

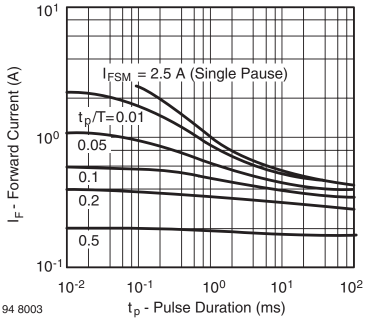


Fig. 3 - Pulse Forward Current vs. Pulse Duration

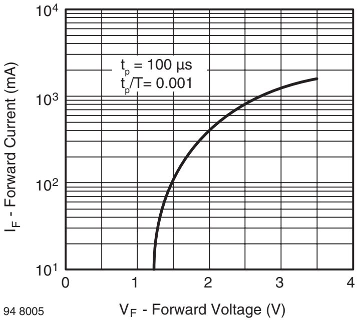


Fig. 4 - Forward Current vs. Forward Voltage

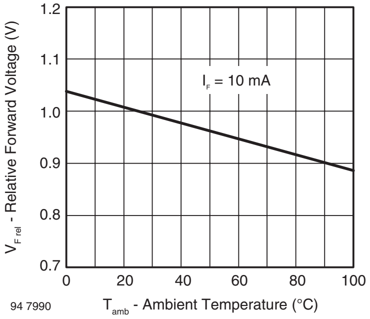


Fig. 5 - Relative Forward Voltage vs. Ambient Temperature

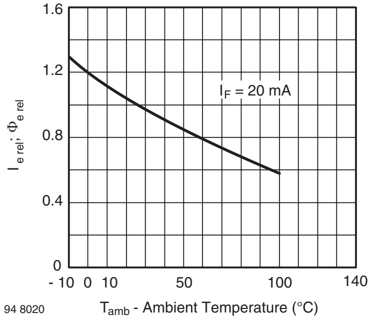


Fig. 8 - Relative Radiant Intensity/Power vs. Ambient Temperature

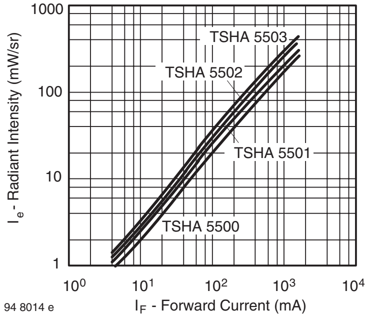


Fig. 6 - Radiant Intensity vs. Forward Current

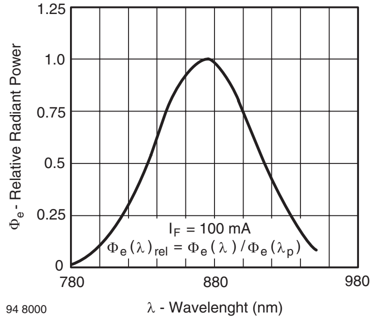


Fig. 9 - Relative Radiant Power vs. Wavelength

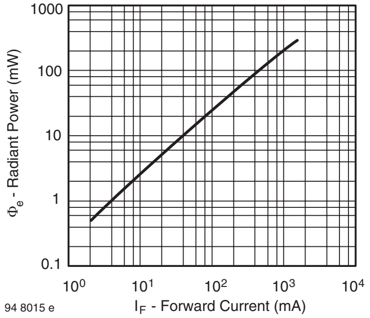


Fig. 7 - Radiant Power vs. Forward Current

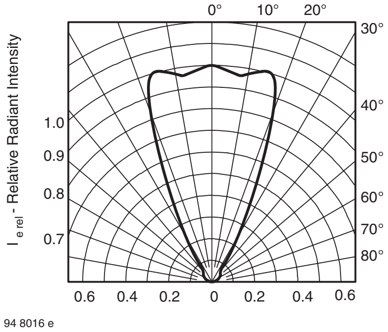
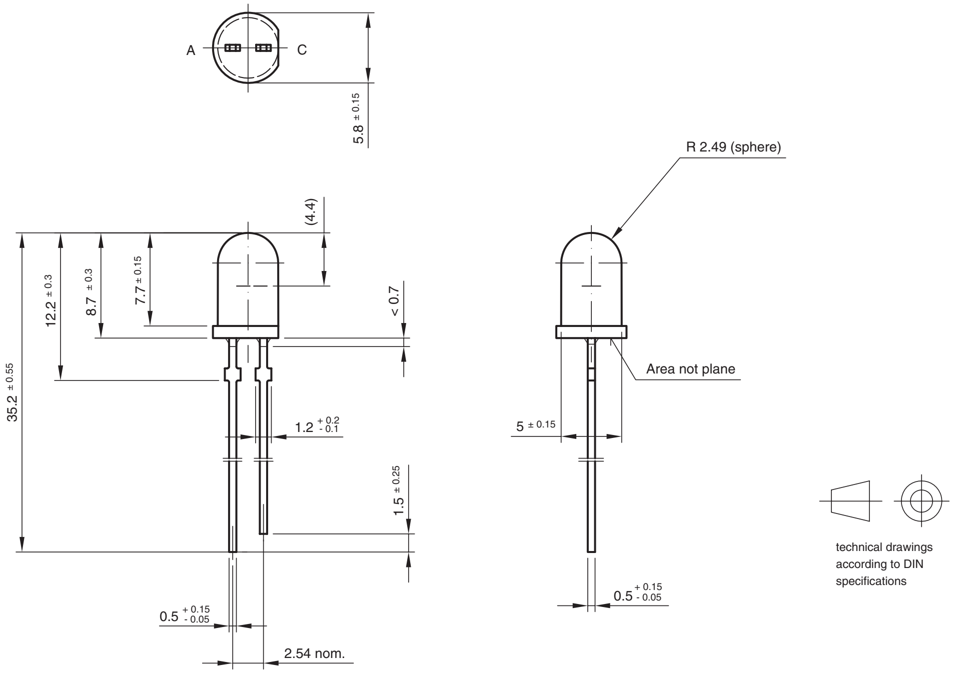


Fig. 10 - Relative Radiant Intensity vs. Angular Displacement

PACKAGE DIMENSIONS in millimeters



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Issue: 3; 08.11.99
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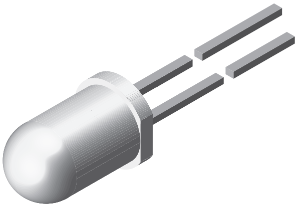
Infrared Emitting Diode, RoHS Compliant, 875 nm, GaAlAs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FEATURES

- Package type: leaded
- Package form: T-1¾
- Dimensions (in mm): Ø 5
- Peak wavelength: λ_p = 875 nm
- High reliability
- Angle of half intensity: $\varphi = \pm 12°$
- Low forward voltage
- Suitable for high pulse current operation
- Good spectral matching with Si photodetectors
- Lead (Pb)-free component in accordance with RoHS 2002/95/EC and WEEE 2002/96/EC

Pb-free
e2
RoHS
COMPLIANT

DESCRIPTION

The TSHA620. series are infrared, 875 nm emitting diodes in GaAlAs technology, molded in a clear, untinted plastic package.

APPLICATIONS

- Infrared remote control and free air data transmission systems
- This emitter series is dedicated to systems with panes in transmission space between emitter and detector, because of the low absorbtion of 875 nm radiation in glass

PRODUCT SUMMARY

COMPONENT	I_e (mW/sr)	φ (deg)	λ_P (nm)	t_r (ns)
TSHA6200	40	± 12	875	600
TSHA6201	50	± 12	875	600
TSHA6202	60	± 12	875	600
TSHA6203	65	± 12	875	600

Note
Test conditions see table “Basic Characteristics“

ORDERING INFORMATION

ORDERING CODE	PACKAGING	REMARKS	PACKAGE FORM
TSHA6200	Bulk	MOQ: 4000 pcs, 4000 pcs/bulk	T-1¾
TSHA6201	Bulk	MOQ: 4000 pcs, 4000 pcs/bulk	T-1¾
TSHA6202	Bulk	MOQ: 4000 pcs, 4000 pcs/bulk	T-1¾
TSHA6203	Bulk	MOQ: 4000 pcs, 4000 pcs/bulk	T-1¾

Note
MOQ: minimum order quantity

ABSOLUTE MAXIMUM RATINGS

PARAMETER	TEST CONDITION	SYMBOL	VALUE	UNIT
Reverse voltage		V_R	5	V
Forward current		I_F	100	mA
Peak forward current	$t_p/T = 0.5$, $t_p = 100\ \mu s$	I_{FM}	200	mA
Surge forward current	$t_p = 100\ \mu s$	I_{FSM}	2.5	A
Power dissipation		P_V	180	mW

Infrared Emitting Diode, RoHS Compliant, 875 nm, GaAlAs

ABSOLUTE MAXIMUM RATINGS

PARAMETER	TEST CONDITION	SYMBOL	VALUE	UNIT
Junction temperature		T_j	100	°C
Operating temperature range		T_{amb}	- 40 to + 85	°C
Storage temperature range		T_{stg}	- 40 to + 100	°C
Soldering temperature	t ≤ 5 s, 2 mm from case	T_{sd}	260	°C
Thermal resistance junction/ambient	J-STD-051, leads 7 mm, soldered on PCB	R_{thJA}	230	K/W

Note

T_{amb} = 25 °C, unless otherwise specified

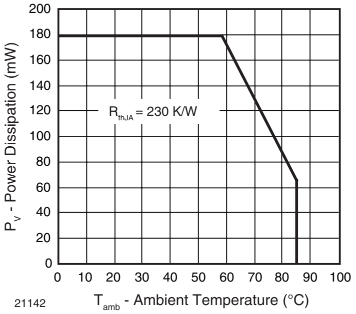


Fig. 1 - Power Dissipation Limit vs. Ambient Temperature

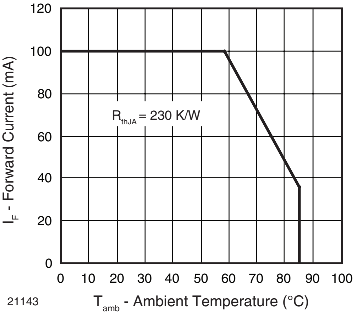


Fig. 2 - Forward Current Limit vs. Ambient Temperature

BASIC CHARACTERISTICS

PARAMETER	TEST CONDITION	SYMBOL	MIN.	TYP.	MAX.	UNIT
Forward voltage	I_F = 100 mA, t_p = 20 ms	V_F		1.5	1.8	V
Temperature coefficient of V_F	I_F = 100 mA	TK_{VF}		- 1.6		mV/K
Reverse current	V_R = 5 V	I_R			100	µA
Junction capacitance	V_R = 0 V, f = 1 MHz, E = 0	C_j		20		pF
Temperature coefficient of ϕ_e	I_F = 20 mA	$TK\phi_e$		- 0.7		%/K
Angle of half intensity		φ		± 12		deg
Peak wavelength	I_F = 100 mA	λ_p		875		nm
Spectral bandwidth	I_F = 100 mA	$\Delta\lambda$		80		nm
Temperature coefficient of λ_p	I_F = 100 mA	$TK\lambda_p$		0.2		nm/K
Rise time	I_F = 100 mA	t_r		600		ns
	I_F = 1.5 A	t_r		300		ns
Fall time	I_F = 100 mA	t_f		600		ns
	I_F = 1.5 A	t_f		300		ns
Virtual source diameter		d		3.7		mm

Note

T_{amb} = 25 °C, unless otherwise specified

TYPE DEDICATED CHARACTERISTICS							
PARAMETER	**TEST CONDITION**	**PART**	**SYMBOL**	**MIN.**	**TYP.**	**MAX.**	**UNIT**
Forward voltage	I_F = 1.5 A, t_p = 100 µs	TSHA6200	V_F		3.2	4.9	V
		TSHA6201	V_F		3.2	4.9	V
		TSHA6202	V_F		3.2	4.5	V
		TSHA6203	V_F		3.2	4.5	V
Radiant intensity	I_F = 100 mA, t_p = 20 ms	TSHA6200	I_e	25	40	125	mW/sr
		TSHA6201	I_e	30	50	125	mW/sr
		TSHA6202	I_e	36	60	125	mW/sr
		TSHA6203	I_e	50	65	125	mW/sr
	I_F = 1.5 A, t_p = 100 µs	TSHA6200	I_e	300	500		mW/sr
		TSHA6201	I_e	400	600		mW/sr
		TSHA6202	I_e	500	700		mW/sr
		TSHA6203	I_e	600	800		mW/sr
Radiant power	I_F = 100 mA, t_p = 20 ms	TSHA6200	ϕ_e		22		mW
		TSHA6201	ϕ_e		23		mW
		TSHA6202	ϕ_e		24		mW
		TSHA6203	ϕ_e		25		mW

Note

T_{amb} = 25 °C, unless otherwise specified

BASIC CHARACTERISTICS

T_{amb} = 25 °C, unless otherwise specified

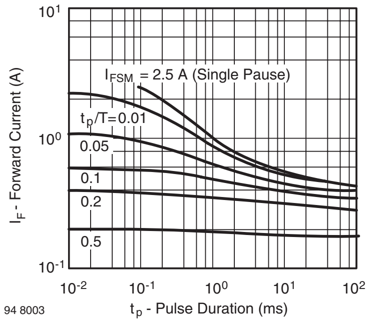


Fig. 3 - Pulse Forward Current vs. Pulse Duration

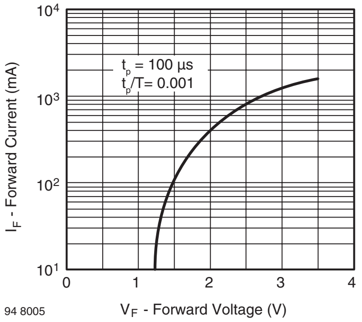


Fig. 4 - Forward Current vs. Forward Voltage

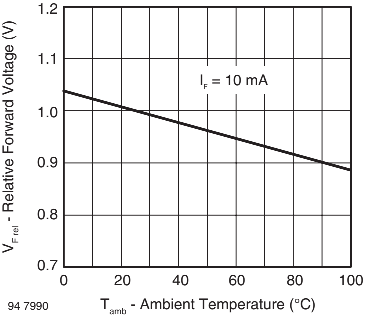


Fig. 5 - Relative Forward Voltage vs. Ambient Temperature

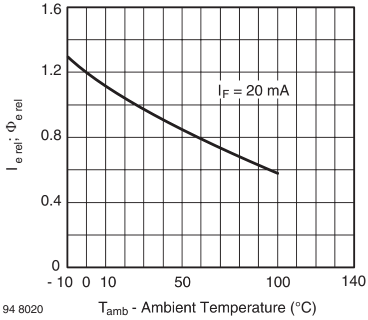


Fig. 8 - Relative Radiant Intensity/Power vs. Ambient Temperature

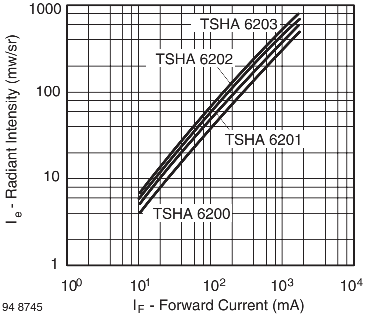


Fig. 6 - Radiant Intensity vs. Forward Current

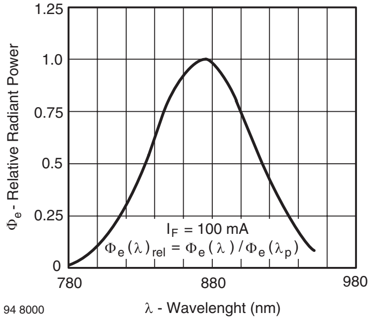


Fig. 9 - Relative Radiant Power vs. Wavelength

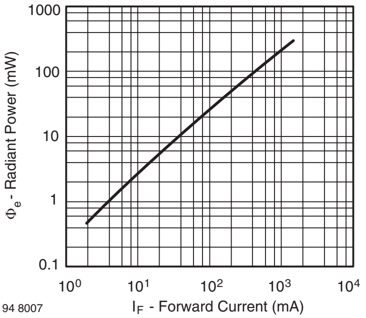


Fig. 7 - Radiant Power vs. Forward Current

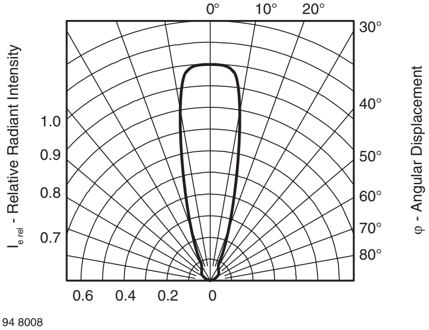
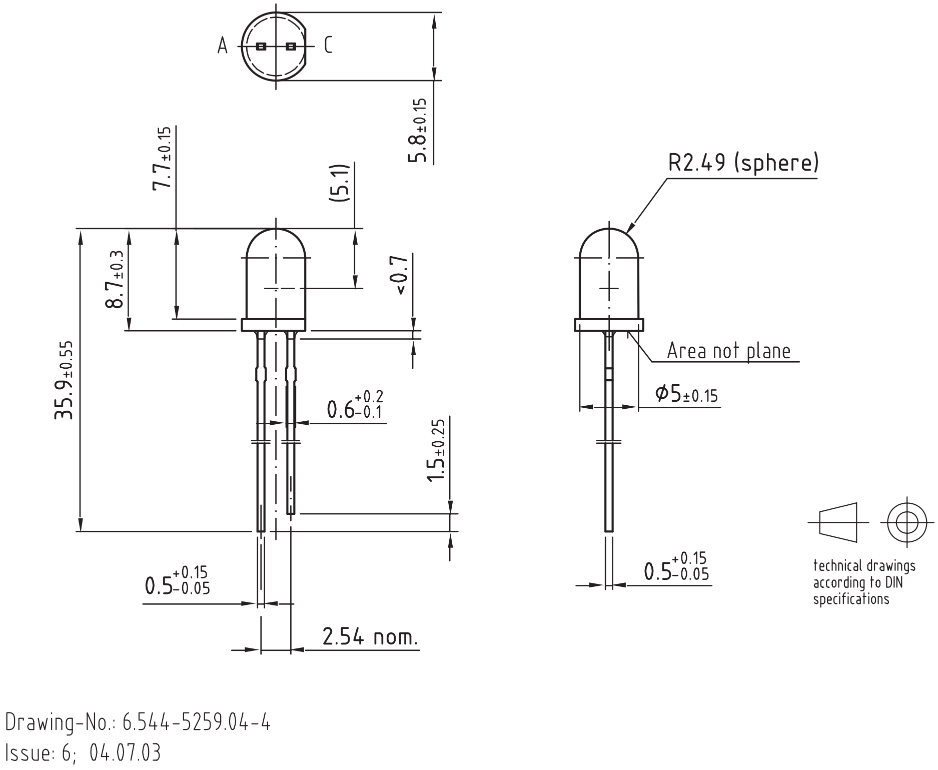


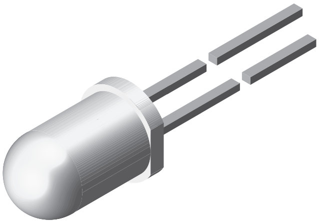
Fig. 10 - Relative Radiant Intensity vs. Angular Displacement

PACKAGE DIMENSIONS in millimeters



96 12125

Infrared Emitting Diode, RoHS Compliant, 875 nm, GaAlAs


94 8389

DESCRIPTION

The TSHA650. series are infrared, 875 nm emitting diodes in GaAlAs technology, molded in a clear, untinted plastic package.

FEATURES

- Package type: leaded
- Package form: T-1¾
- Dimensions (in mm): Ø 5
- Peak wavelength: λ_p = 875 nm
- High reliability
- Angle of half intensity: φ = ± 24°
- Low forward voltage
- Suitable for high pulse current operation
- Good spectral matching with Si photodetectors
- Lead (Pb)-free component in accordance with RoHS 2002/95/EC and WEEE 2002/96/EC

Pb-free
e2
RoHS
COMPLIANT

APPLICATIONS

- Infrared remote control and free air data transmission systems with comfortable radiation angle
- This emitter series is dedicated to systems with panes in transmission space between emitter and detector, because of the low absorbtion of 875 nm radiation in glass

PRODUCT SUMMARY

COMPONENT	I_e (mW/sr)	φ (deg)	λ_P (nm)	t_r (ns)
TSHA6500	20	± 24	875	600
TSHA6501	25	± 24	875	600
TSHA6502	30	± 24	875	600
TSHA6503	35	± 24	875	600

Note
Test conditions see table “Basic Characteristics”

ORDERING INFORMATION

ORDERING CODE	PACKAGING	REMARKS	PACKAGE FORM
TSHA6500	Bulk	MOQ: 4000 pcs, 4000 pcs/bulk	T-1¾
TSHA6501	Bulk	MOQ: 4000 pcs, 4000 pcs/bulk	T-1¾
TSHA6502	Bulk	MOQ: 4000 pcs, 4000 pcs/bulk	T-1¾
TSHA6503	Bulk	MOQ: 4000 pcs, 4000 pcs/bulk	T-1¾

Note
MOQ: minimum order quantity

ABSOLUTE MAXIMUM RATINGS

PARAMETER	TEST CONDITION	SYMBOL	VALUE	UNIT
Reverse voltage		V_R	5	V
Forward current		I_F	100	mA
Peak forward current	$t_p/T = 0.5$, $t_p = 100$ µs	I_{FM}	200	mA
Surge forward current	$t_p = 100$ µs	I_{FSM}	2.5	A
Power dissipation		P_V	180	mW

ABSOLUTE MAXIMUM RATINGS

PARAMETER	TEST CONDITION	SYMBOL	VALUE	UNIT
Junction temperature		T_j	100	°C
Operating temperature range		T_{amb}	- 40 to + 85	°C
Storage temperature range		T_{stg}	- 40 to + 100	°C
Soldering temperature	t ≤ 5 s, 2 mm from case	T_{sd}	260	°C
Thermal resistance junction/ambient	J-STD-051, leads 7 mm, soldered on PCB	R_{thJA}	230	K/W

Note

T_{amb} = 25 °C, unless otherwise specified

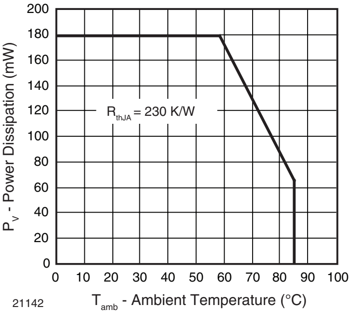


Fig. 1 - Power Dissipation Limit vs. Ambient Temperature

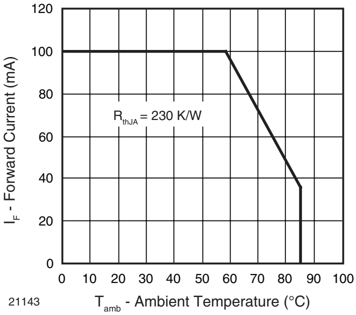


Fig. 2 - Forward Current Limit vs. Ambient Temperature

BASIC CHARACTERISTICS

PARAMETER	TEST CONDITION	SYMBOL	MIN.	TYP.	MAX.	UNIT
Forward voltage	I_F = 100 mA, t_p = 20 ms	V_F		1.5	1.8	V
Temperature coefficient of V_F	I_F = 100 mA	TK_{VF}		- 1.6		mV/K
Reverse current	V_R = 5 V	I_R			100	µA
Junction capacitance	V_R = 0 V, f = 1 MHz, E = 0	C_j		20		pF
Temperature coefficient of ϕ_e	I_F = 20 mA	$TK\phi_e$		- 0.7		%/K
Angle of half intensity		φ		± 24		deg
Peak wavelength	I_F = 100 mA	λ_p		875		nm
Spectral bandwidth	I_F = 100 mA	$\Delta\lambda$		80		nm
Temperature coefficient of λ_p	I_F = 100 mA	$TK\lambda_p$		0.2		nm/K
Rise time	I_F = 100 mA	t_r		600		ns
	I_F = 1.5 A	t_r		300		ns
Fall time	I_F = 100 mA	t_f		600		ns
	I_F = 1.5 A	t_f		300		ns
Virtual source diameter		d		2.2		mm

Note

T_{amb} = 25 °C, unless otherwise specified

TYPE DEDICATED CHARACTERISTICS

PARAMETER	TEST CONDITION	PART	SYMBOL	MIN.	TYP.	MAX.	UNIT
Forward voltage	I_F = 1.5 A, t_p = 100 µs	TSHA6500	V_F		3.2	4.9	V
		TSHA6501	V_F		3.2	4.9	V
		TSHA6502	V_F		3.2	4.5	V
		TSHA6503	V_F		3.2	4.5	V
Radiant intensity	I_F = 100 mA, t_p = 20 ms	TSHA6500	I_e	12	20	60	mW/sr
		TSHA6501	I_e	16	25	60	mW/sr
		TSHA6502	I_e	20	30	60	mW/sr
		TSHA6503	I_e	24	35	60	mW/sr
	I_F = 1.5 A, t_p = 100 µs	TSHA6500	I_e	150	240		mW/sr
		TSHA6501	I_e	200	300		mW/sr
		TSHA6502	I_e	250	360		mW/sr
		TSHA6503	I_e	300	420		mW/sr
Radiant power	I_F = 100 mA, t_p = 20 ms	TSHA6500	ϕ_e		22		mW
		TSHA6501	ϕ_e		23		mW
		TSHA6502	ϕ_e		24		mW
		TSHA6503	ϕ_e		25		mW

Note

T_{amb} = 25 °C, unless otherwise specified

BASIC CHARACTERISTICS

T_{amb} = 25 °C, unless otherwise specified

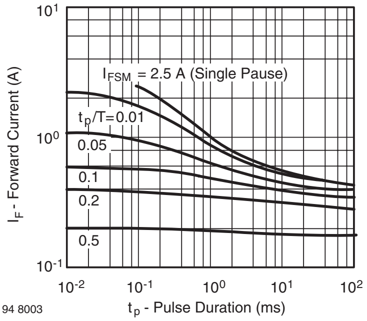


Fig. 3 - Pulse Forward Current vs. Pulse Duration

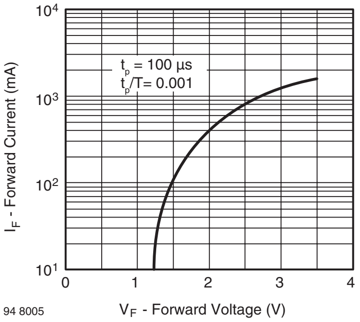


Fig. 4 - Forward Current vs. Forward Voltage

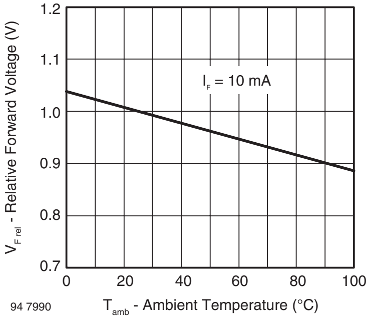


Fig. 5 - Relative Forward Voltage vs. Ambient Temperature

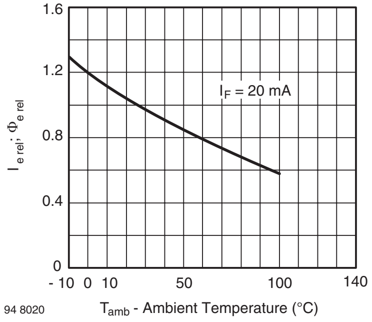


Fig. 8 - Relative Radiant Intensity/Power vs. Ambient Temperature

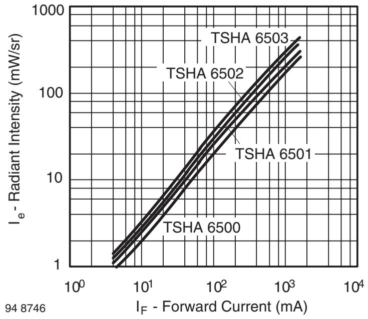


Fig. 6 - Radiant Intensity vs. Forward Current

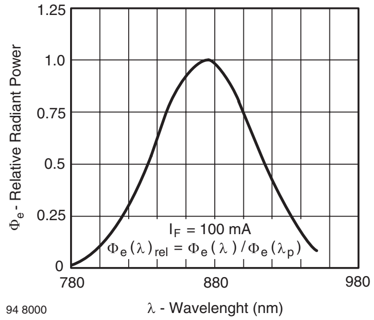


Fig. 9 - Relative Radiant Power vs. Wavelength

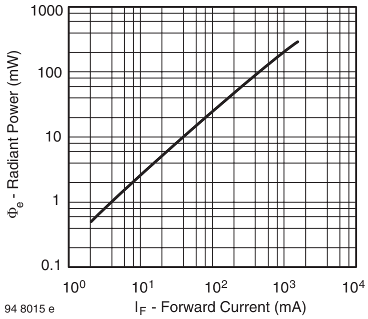


Fig. 7 - Radiant Power vs. Forward Current

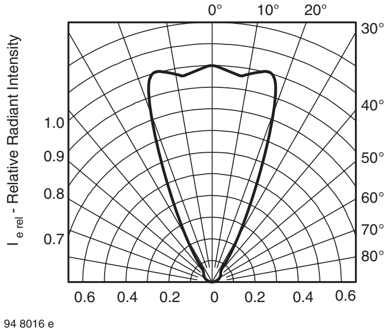
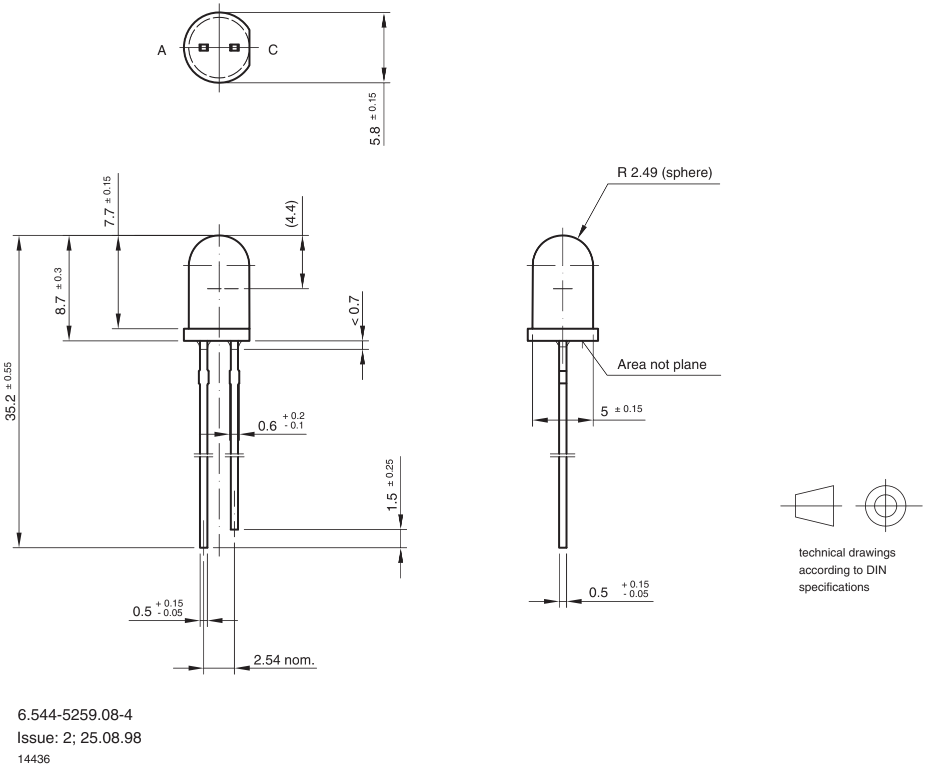
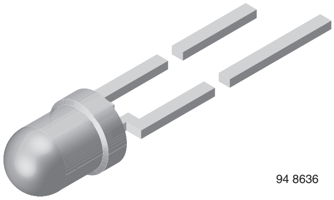


Fig. 10 - Relative Radiant Intensity vs. Angular Displacement

PACKAGE DIMENSIONS in millimeters



High Speed Infrared Emitting Diode, RoHS Compliant, 890 nm, GaAlAs Double Hetero



FEATURES

- Package type: leaded
- Package form: T-1
- Dimensions (in mm): ∅ 3
- Peak wavelength: λ_p = 890 nm
- High reliability
- High radiant power
- High radiant intensity
- Angle of half intensity: φ = ± 22°
- Low forward voltage
- Suitable for high pulse current operation
- High modulation bandwidth: f_c = 12 MHz
- Good spectral matching with Si photodetectors
- Lead (Pb)-free component in accordance with RoHS 2002/95/EC and WEEE 2002/96/EC

Pb-free
e2
RoHS
COMPLIANT

DESCRIPTION

TSHF4410 is an infrared, 890 nm emitting diode in GaAlAs double hetero (DH) technology with high radiant power and high speed, molded in a clear, untinted plastic package.

APPLICATIONS

- Infrared high speed remote control and free air data transmission systems with high modulation frequencies or high data transmission rate requirements
- Transmission systems according to IrDA requirements and for carrier frequency based systems (e.g. ASK/FSK - coded, 450 kHz or 1.3 MHz)
- Smoke-automatic fire detectors

PRODUCT SUMMARY

COMPONENT	I_e (mW/sr)	φ (deg)	λ_P (nm)	t_r (ns)
TSHF4410	40	± 22	890	30

Note
Test conditions see table “Basic Characteristics”

ORDERING INFORMATION

ORDERING CODE	PACKAGING	REMARKS	PACKAGE FORM
TSHF4410	Bulk	MOQ: 5000 pcs, 5000 pcs/bulk	T-1

Note
MOQ: minimum order quantity

ABSOLUTE MAXIMUM RATINGS

PARAMETER	TEST CONDITION	SYMBOL	VALUE	UNIT
Reverse voltage		V_R	5	V
Forward current		I_F	100	mA
Peak forward current	t_p/T = 0.5, t_p = 100 µs	I_{FM}	200	mA
Surge forward current	t_p = 100 µs	I_{FSM}	1.5	A
Power dissipation		P_V	180	mW
Junction temperature		T_j	100	°C

ABSOLUTE MAXIMUM RATINGS

PARAMETER	TEST CONDITION	SYMBOL	VALUE	UNIT
Operating temperature range		T_{amb}	- 40 to + 85	°C
Storage temperature range		T_{stg}	- 40 to + 100	°C
Soldering temperature	t ≤ 5 s, 2 mm from case	T_{sd}	260	°C
Thermal resistance junction/ambient	J-STD-051, leads 7 mm, soldered on PCB	R_{thJA}	300	K/W

Note

T_{amb} = 25 °C, unless otherwise specified

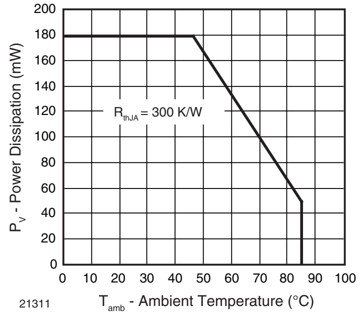


Fig. 1 - Power Dissipation Limit vs. Ambient Temperature

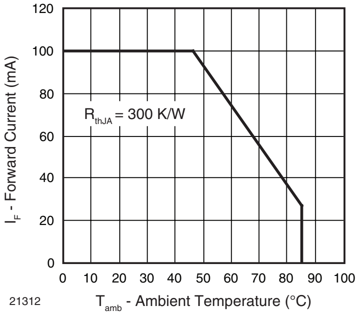


Fig. 2 - Forward Current Limit vs. Ambient Temperature

BASIC CHARACTERISTICS

PARAMETER	TEST CONDITION	SYMBOL	MIN.	TYP.	MAX.	UNIT
Forward voltage	I_F = 100 mA, t_p = 20 ms	V_F		1.5	1.8	V
	I_F = 1 A, t_p = 100 µs	V_F		2.4	3.0	V
Temperature coefficient of V_F	I_F = 1 mA	TK_{VF}		- 1.8		mV/K
Reverse current	V_R = 5 V	I_R			10	µA
Junction capacitance	V_R = 0 V, f = 1 MHz, E = 0	C_j		125		pF
Radiant intensity	I_F = 100 mA, t_p = 20 ms	I_e		40		mW/sr
	I_F = 1 A, t_p = 100 µs	I_e		400		mW/sr
Radiant power	I_F = 100 mA, t_p = 20 ms	ϕ_e		40		mW
Temperature coefficient of ϕ_e	I_F = 100 mA	$TK\phi_e$		- 0.35		%/K
Angle of half intensity		φ		± 22		deg
Peak wavelength	I_F = 100 mA	λ_p		890		nm
Spectral bandwidth	I_F = 100 mA	$\Delta\lambda$		44		nm
Temperature coefficient of λ_p	I_F = 100 mA	$TK\lambda_p$		0.25		nm/K
Rise time	I_F = 100 mA	t_r		30		ns
Fall time	I_F = 100 mA	t_f		30		ns
Cut-off frequency	I_{DC} = 70 mA, I_{AC} = 30 mA pp	f_c		12		MHz
Virtual source diameter	Method: 63 % encircled energy	d		1.9		mm

Note

T_{amb} = 25 °C, unless otherwise specified

BASIC CHARACTERISTICS

T_{amb} = 25 °C, unless otherwise specified

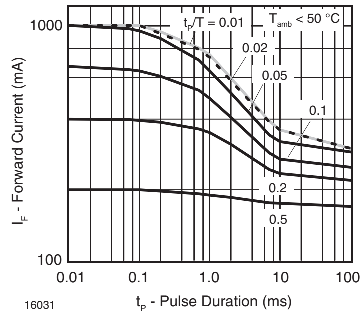


Fig. 3 - Pulse Forward Current vs. Pulse Duration

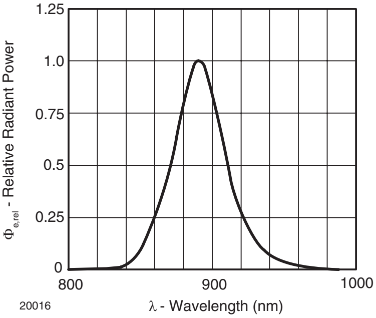


Fig. 6 - Relative Radiant Power vs. Wavelength

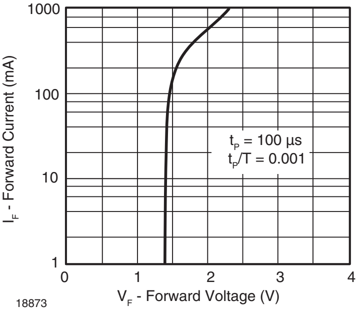


Fig. 4 - Forward Current vs. Forward Voltage

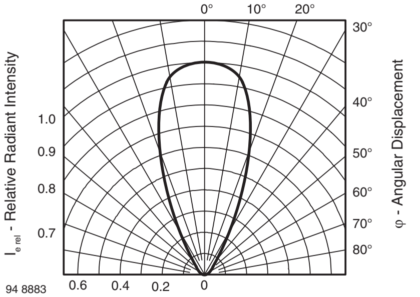


Fig. 7 - Relative Radiant Intensity vs. Angular Displacement

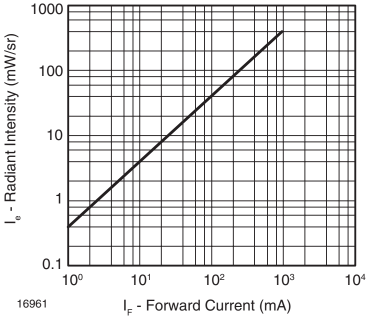
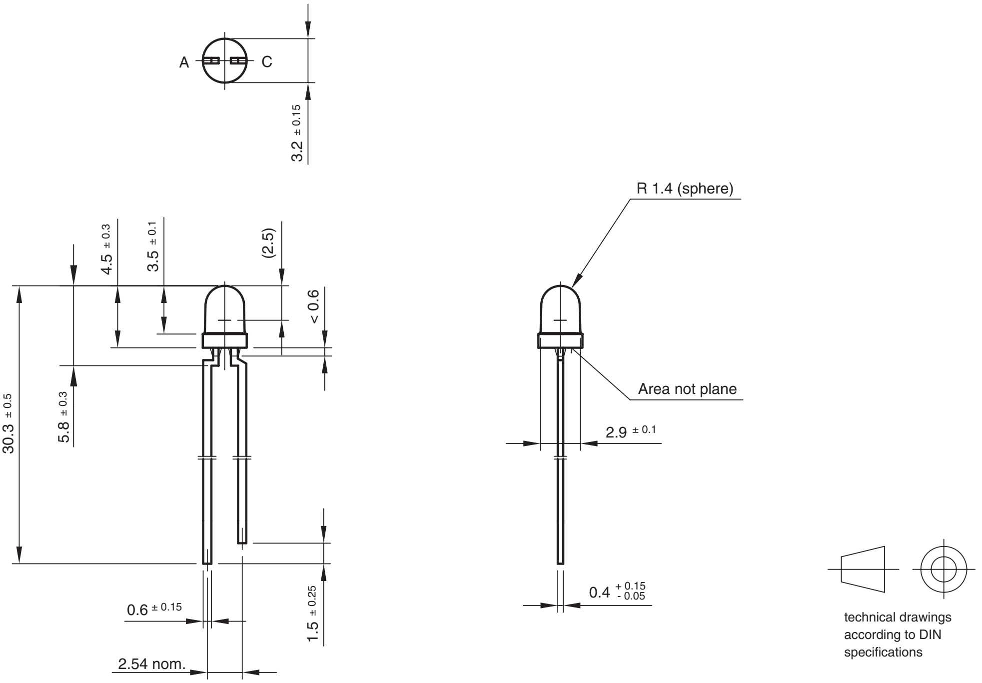


Fig. 5 - Radiant Intensity vs. Forward Current

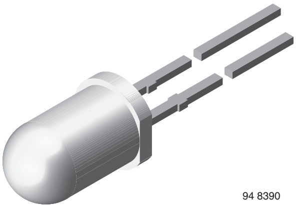
PACKAGE DIMENSIONS in millimeters



technical drawings according to DIN specifications

Drawing-No.: 6.544-5255.01-4
Issue: 6; 24.07.08
95 10913

High Speed Infrared Emitting Diode, RoHS Compliant, 890 nm, GaAlAs Double Hetero



DESCRIPTION

TSHF5210 is an infrared, 890 nm emitting diode in GaAlAs double hetero (DH) technology with high radiant power and high speed, molded in a clear, untinted plastic package.

FEATURES

- Package type: leaded
- Package form: T-1¾
- Dimensions (in mm): ∅ 5
- Leads with stand-off
- Peak wavelength: λ_p = 890 nm
- High reliability
- High radiant power
- High radiant intensity
- Angle of half intensity: $\varphi = \pm 10°$
- Low forward voltage
- Suitable for high pulse current operation
- High modulation bandwidth: f_c = 12 MHz
- Good spectral matching with Si photodetectors
- Lead (Pb)-free component in accordance with RoHS 2002/95/EC and WEEE 2002/96/EC

Pb-free
e2
RoHS
COMPLIANT

APPLICATIONS

- Infrared high speed remote control and free air data transmission systems with high modulation frequencies or high data transmission rate requirements
- Transmission systems according to IrDA requirements and for carrier frequency based systems (e.g. ASK/FSK - coded, 450 kHz or 1.3 MHz)
- Smoke-automatic fire detectors

PRODUCT SUMMARY

COMPONENT	I_e (mW/sr)	φ (deg)	λ_P (nm)	t_r (ns)
TSHF5210	180	± 10	890	30

Note
Test conditions see table “Basic Characteristics“

ORDERING INFORMATION

ORDERING CODE	PACKAGING	REMARKS	PACKAGE FORM
TSHF5210	Bulk	MOQ: 4000 pcs, 4000 pcs/bulk	T-1¾

Note
MOQ: minimum order quantity

ABSOLUTE MAXIMUM RATINGS

PARAMETER	TEST CONDITION	SYMBOL	VALUE	UNIT
Reverse voltage		V_R	5	V
Forward current		I_F	100	mA
Peak forward current	$t_p/T = 0.5$, t_p = 100 µs	I_{FM}	200	mA
Surge forward current	t_p = 100 µs	I_{FSM}	1.5	A
Power dissipation		P_V	160	mW

ABSOLUTE MAXIMUM RATINGS

PARAMETER	TEST CONDITION	SYMBOL	VALUE	UNIT
Junction temperature		T_j	100	°C
Operating temperature range		T_{amb}	- 40 to + 85	°C
Storage temperature range		T_{stg}	- 40 to + 100	°C
Soldering temperature	$t \leq 5$ s, 2 mm from case	T_{sd}	260	°C
Thermal resistance junction/ambient	J-STD-051, leads 7 mm, soldered on PCB	R_{thJA}	230	K/W

Note

T_{amb} = 25 °C, unless otherwise specified

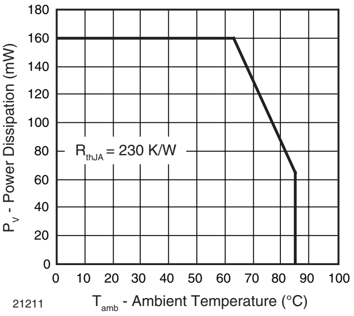


Fig. 1 - Power Dissipation Limit vs. Ambient Temperature

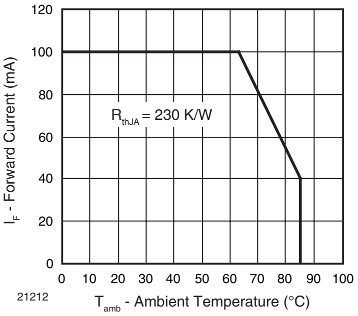


Fig. 2 - Forward Current Limit vs. Ambient Temperature

BASIC CHARACTERISTICS

PARAMETER	TEST CONDITION	SYMBOL	MIN.	TYP.	MAX.	UNIT
Forward voltage	I_F = 100 mA, t_p = 20 ms	V_F		1.4	1.6	V
	I_F = 1 A, t_p = 100 µs	V_F		2.3		V
Temperature coefficient of V_F	I_F = 1 mA	TK_{VF}		- 1.8		mV/K
Reverse current	V_R = 5 V	I_R			10	µA
Junction capacitance	V_R = 0 V, f = 1 MHz, E = 0	C_j		125		pF
Radiant intensity	I_F = 100 mA, t_p = 20 ms	I_e	120	180	360	mW/sr
	I_F = 1 A, t_p = 100 µs	I_e		1800		mW/sr
Radiant power	I_F = 100 mA, t_p = 20 ms	ϕ_e		50		mW
Temperature coefficient of ϕ_e	I_F = 100 mA	$TK\phi_e$		- 0.35		%/K
Angle of half intensity		φ		± 10		deg
Peak wavelength	I_F = 100 mA	λ_p		890		nm
Spectral bandwidth	I_F = 100 mA	$\Delta\lambda$		40		nm
Temperature coefficient of λ_p	I_F = 100 mA	$TK\lambda_p$		0.25		nm/K
Rise time	I_F = 100 mA	t_r		30		ns
Fall time	I_F = 100 mA	t_f		30		ns
Cut-off frequency	I_{DC} = 70 mA, I_{AC} = 30 mA pp	f_c		12		MHz
Virtual source diameter		d		3.7		mm

Note

T_{amb} = 25 °C, unless otherwise specified

BASIC CHARACTERISTICS

T_{amb} = 25 °C, unless otherwise specified

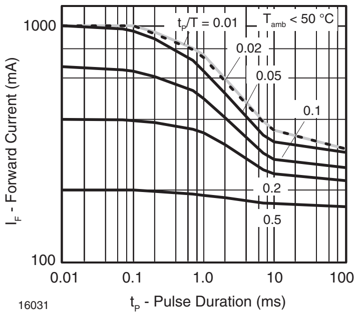


Fig. 3 - Pulse Forward Current vs. Pulse Duration

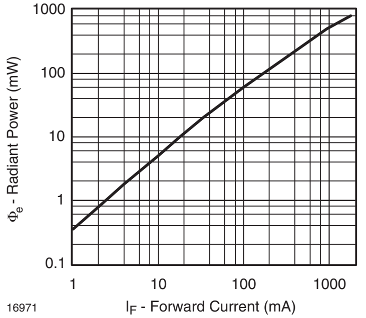


Fig. 6 - Radiant Power vs. Forward Current

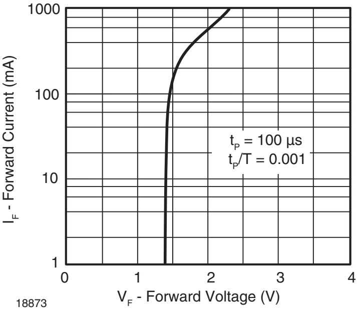


Fig. 4 - Forward Current vs. Forward Voltage

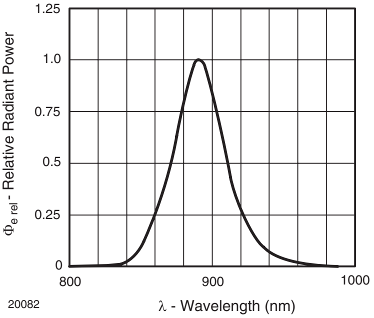


Fig. 7 - Relative Radiant Power vs. Wavelength

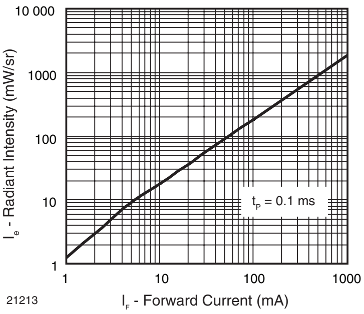


Fig. 5 - Radiant Intensity vs. Forward Current

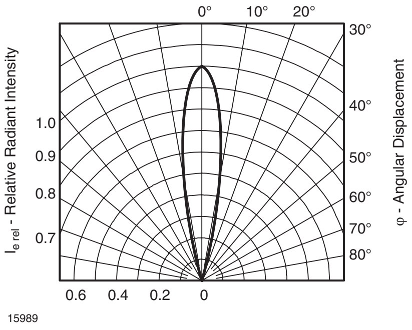
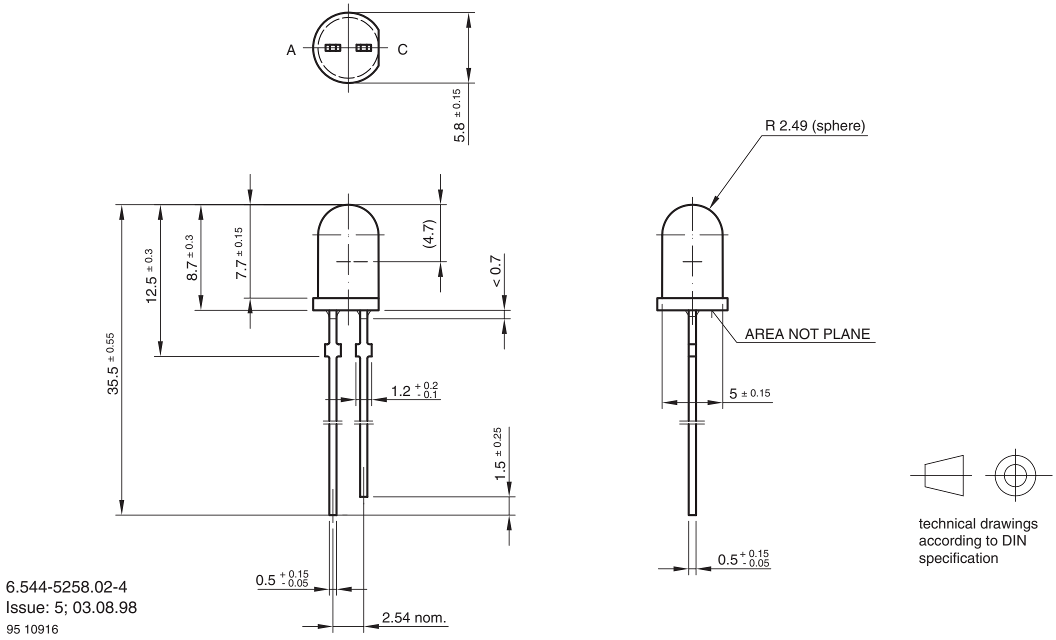
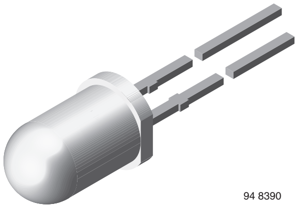


Fig. 8 - Relative Radiant Intensity vs. Angular Displacement

PACKAGE DIMENSIONS in millimeters



High Speed Infrared Emitting Diode, RoHS Compliant, 890 nm, GaAlAs Double Hetero



94 8390

DESCRIPTION

TSHF5410 is an infrared, 890 nm emitting diode in GaAlAs double hetero (DH) technology with high radiant power and high speed, molded in a clear, untinted plastic package.

FEATURES

Pb-free

e2

RoHS
COMPLIANT

- Package type: leaded
- Package form: T-1¾
- Dimensions (in mm): ∅ 5
- Leads with stand-off
- Peak wavelength: λ_p = 890 nm
- High reliability
- High radiant power
- High radiant intensity
- Angle of half intensity: φ = ± 22°
- Low forward voltage
- Suitable for high pulse current operation
- High modulation bandwidth: f_c = 12 MHz
- Good spectral matching with Si photodetectors
- Lead (Pb)-free component in accordance with RoHS 2002/95/EC and WEEE 2002/96/EC

APPLICATIONS

- Infrared high speed remote control and free air data transmission systems with high modulation frequencies or high data transmission rate requirements
- Transmission systems according to IrDA requirements and for carrier frequency based systems (e.g. ASK/FSK - coded, 450 kHz or 1.3 MHz)

PRODUCT SUMMARY				
COMPONENT	**I_e (mW/sr)**	**φ (deg)**	**λ_P (nm)**	**t_r (ns)**
TSHF5410	70	± 22	890	30

Note
Test conditions see table "Basic Characteristics"

ORDERING INFORMATION			
ORDERING CODE	**PACKAGING**	**REMARKS**	**PACKAGE FORM**
TSHF5410	Bulk	MOQ: 4000 pcs, 4000 pcs/bulk	T-1¾

Note
MOQ: minimum order quantity

ABSOLUTE MAXIMUM RATINGS				
PARAMETER	**TEST CONDITION**	**SYMBOL**	**VALUE**	**UNIT**
Reverse voltage		V_R	5	V
Forward current		I_F	100	mA
Peak forward current	t_p/T = 0.5, t_p = 100 µs	I_{FM}	200	mA
Surge forward current	t_p = 100 µs	I_{FSM}	1.5	A
Power dissipation		P_V	160	mW

High Speed Infrared Emitting Diode, RoHS Compliant, 890 nm, GaAlAs Double Hetero

ABSOLUTE MAXIMUM RATINGS

PARAMETER	TEST CONDITION	SYMBOL	VALUE	UNIT
Junction temperature		T_j	100	°C
Operating temperature range		T_{amb}	- 40 to + 85	°C
Storage temperature range		T_{stg}	- 40 to + 100	°C
Soldering temperature	t ≤ 5 s, 2 mm from case	T_{sd}	260	°C
Thermal resistance junction/ambient	J-STD-051, leads 7 mm, soldered on PCB	R_{thJA}	230	K/W

Note

T_{amb} = 25 °C, unless otherwise specified

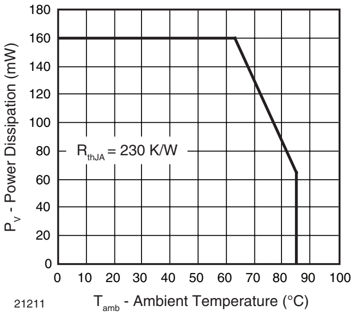


Fig. 1 - Power Dissipation Limit vs. Ambient Temperature

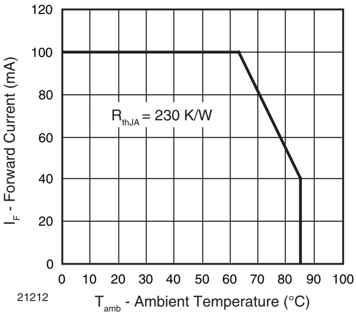


Fig. 2 - Forward Current Limit vs. Ambient Temperature

BASIC CHARACTERISTICS

PARAMETER	TEST CONDITION	SYMBOL	MIN.	TYP.	MAX.	UNIT
Forward voltage	I_F = 100 mA, t_p = 20 ms	V_F		1.4	1.6	V
	I_F = 1 A, t_p = 100 µs	V_F		2.3		V
Temperature coefficient of V_F	I_F = 1 mA	TK_{VF}		- 1.8		mV/K
Reverse current	V_R = 5 V	I_R			10	µA
Junction capacitance	V_R = 0 V, f = 1 MHz, E = 0	C_j		125		pF
Radiant intensity	I_F = 100 mA, t_p = 20 ms	I_e	45	70	135	mW/sr
	I_F = 1 A, t_p = 100 µs	I_e		700		mW/sr
Radiant power	I_F = 100 mA, t_p = 20 ms	ϕ_e		50		mW
Temperature coefficient of ϕ_e	I_F = 100 mA	$TK\phi_e$		- 0.35		%/K
Angle of half intensity		φ		± 22		deg
Peak wavelength	I_F = 100 mA	λ_p		890		nm
Spectral bandwidth	I_F = 100 mA	$\Delta\lambda$		40		nm
Temperature coefficient of λ_p	I_F = 100 mA	$TK\lambda_p$		0.25		nm/K
Rise time	I_F = 100 mA	t_r		30		ns
Fall time	I_F = 100 mA	t_f		30		ns
Cut-off frequency	I_{DC} = 70 mA, I_{AC} = 30 mA pp	f_c		12		MHz
Virtual source diameter		d		2.1		mm

Note

T_{amb} = 25 °C, unless otherwise specified

BASIC CHARACTERISTICS

T_{amb} = 25 °C, unless otherwise specified

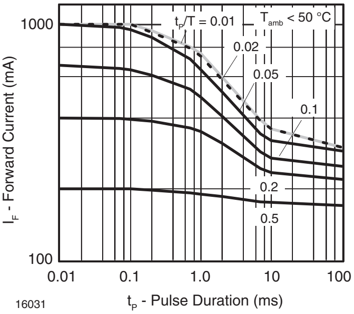


Fig. 3 - Pulse Forward Current vs. Pulse Duration

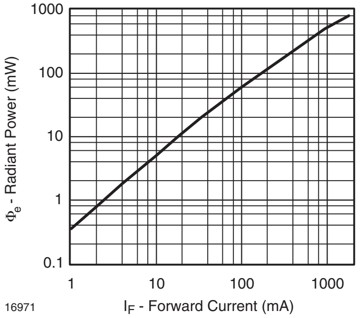


Fig. 6 - Radiant Power vs. Forward Current

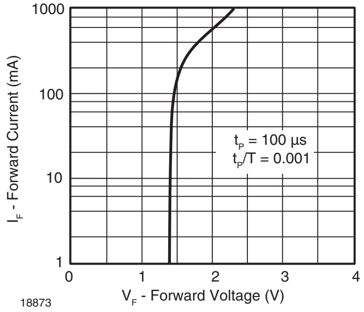


Fig. 4 - Forward Current vs. Forward Voltage

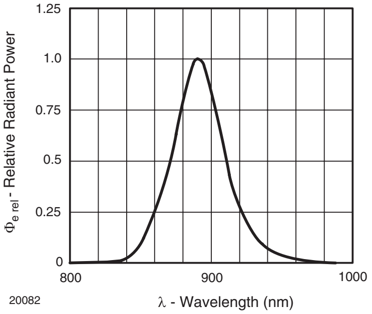


Fig. 7 - Relative Radiant Power vs. Wavelength

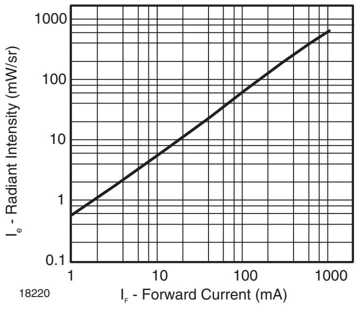


Fig. 5 - Radiant Intensity vs. Forward Current

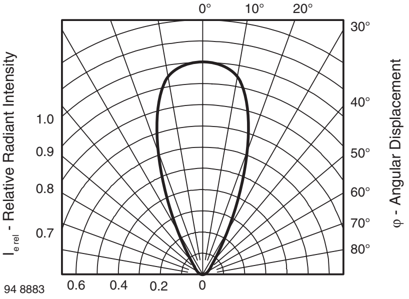
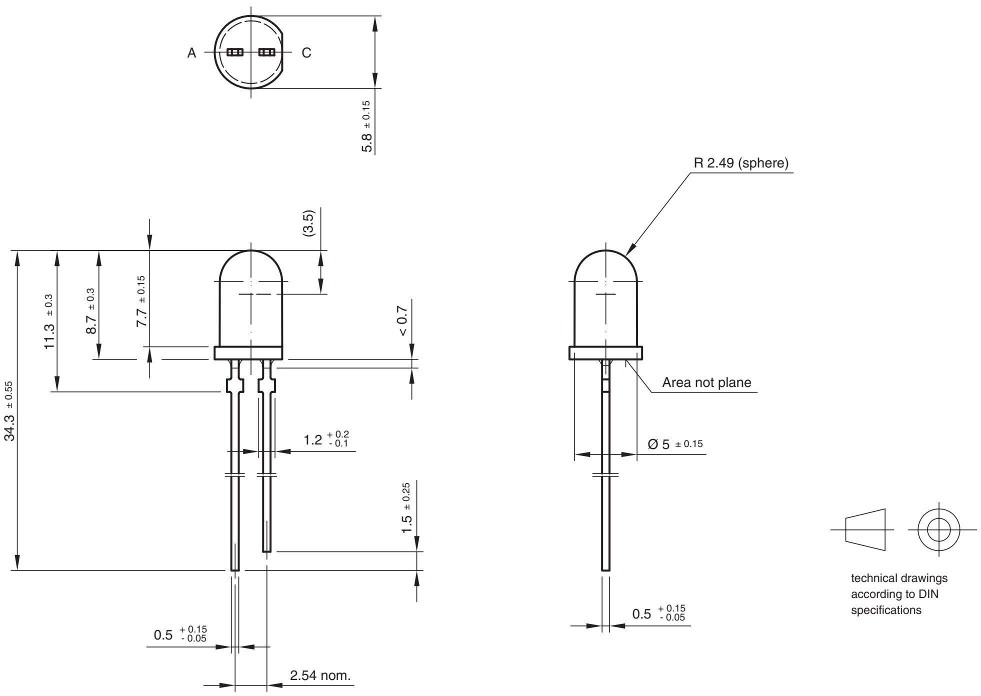


Fig. 8 - Relative Radiant Intensity vs. Angular Displacement

PACKAGE DIMENSIONS in millimeters



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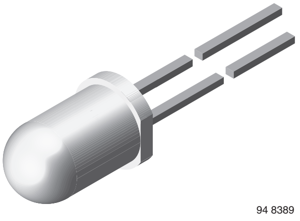
High Speed Infrared Emitting Diode, RoHS Compliant, 890 nm, GaAlAs Double Hetero



DESCRIPTION

TSHF6210 is an infrared, 890 nm emitting diode in GaAlAs double hetero (DH) technology with high radiant power and high speed, molded in a clear, untinted plastic package.

FEATURES

- Package type: leaded
- Package form: T-1¾
- Dimensions (in mm): ∅ 5
- Peak wavelength: λ_p = 890 nm
- High reliability
- High radiant power
- High radiant intensity
- Angle of half intensity: φ = ± 10°
- Low forward voltage
- Suitable for high pulse current operation
- High modulation bandwidth: f_c = 12 MHz
- Good spectral matching with Si photodetectors
- Lead (Pb)-free component in accordance with RoHS 2002/95/EC and WEEE 2002/96/EC

Pb-free
e2
RoHS
COMPLIANT

APPLICATIONS

- Infrared high speed remote control and free air data transmission systems with high modulation frequencies or high data transmission rate requirements
- Transmission systems according to IrDA requirements and for carrier frequency based systems (e.g. ASK/FSK - coded, 450 kHz or 1.3 MHz)
- Smoke-automatic fire detectors

PRODUCT SUMMARY

COMPONENT	I_e (mW/sr)	φ (deg)	λ_P (nm)	t_r (ns)
TSHF6210	180	± 10	890	30

Note
Test conditions see table “Basic Characteristics”

ORDERING INFORMATION

ORDERING CODE	PACKAGING	REMARKS	PACKAGE FORM
TSHF6210	Bulk	MOQ: 4000 pcs, 4000 pcs/bulk	T-1¾

Note
MOQ: minimum order quantity

ABSOLUTE MAXIMUM RATINGS

PARAMETER	TEST CONDITION	SYMBOL	VALUE	UNIT
Reverse voltage		V_R	5	V
Forward current		I_F	100	mA
Peak forward current	t_p/T = 0.5, t_p = 100 µs	I_{FM}	200	mA
Surge forward current	t_p = 100 µs	I_{FSM}	1.5	A
Power dissipation		P_V	160	mW

ABSOLUTE MAXIMUM RATINGS

PARAMETER	TEST CONDITION	SYMBOL	VALUE	UNIT
Junction temperature		T_j	100	°C
Operating temperature range		T_{amb}	- 40 to + 85	°C
Storage temperature range		T_{stg}	- 40 to + 100	°C
Soldering temperature	t ≤ 5 s, 2 mm from case	T_{sd}	260	°C
Thermal resistance junction/ambient	J-STD-051, leads 7 mm soldered on PCB	R_{thJA}	230	K/W

Note

T_{amb} = 25 °C, unless otherwise specified

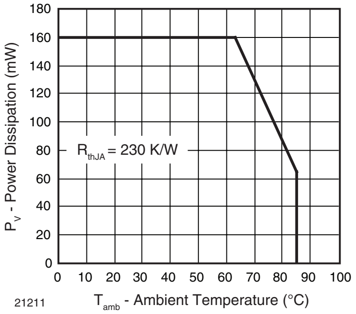


Fig. 1 - Power Dissipation Limit vs. Ambient Temperature

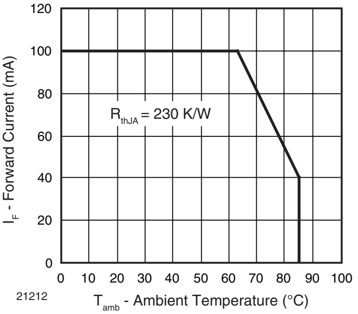


Fig. 2 - Forward Current Limit vs. Ambient Temperature

BASIC CHARACTERISTICS

PARAMETER	TEST CONDITION	SYMBOL	MIN.	TYP.	MAX.	UNIT
Forward voltage	I_F = 100 mA, t_p = 20 ms	V_F		1.4	1.6	V
	I_F = 1 A, t_p = 100 µs	V_F		2.3		V
Temperature coefficient of V_F	I_F = 1 mA	TK_{VF}		- 1.8		mV/K
Reverse current	V_R = 5 V	I_R			10	µA
Junction capacitance	V_R = 0 V, f = 1 MHz, E = 0	C_j		125		pF
Radiant intensity	I_F = 100 mA, t_p = 20 ms	I_e	120	180	360	mW/sr
	I_F = 1 A, t_p = 100 µs	I_e		1800		mW/sr
Radiant power	I_F = 100 mA, t_p = 20 ms	ϕ_e		50		mW
Temperature coefficient of ϕ_e	I_F = 100 mA	$TK\phi_e$		- 0.35		%/K
Angle of half intensity		φ		± 10		deg
Peak wavelength	I_F = 100 mA	λ_p		890		nm
Spectral bandwidth	I_F = 100 mA	$\Delta\lambda$		40		nm
Temperature coefficient of λ_p	I_F = 100 mA	$TK\lambda_p$		0.25		nm/K
Rise time	I_F = 100 mA	t_r		30		ns
Fall time	I_F = 100 mA	t_f		30		ns
Cut-off frequency	I_{DC} = 70 mA, I_{AC} = 30 mA pp	f_c		12		MHz
Virtual source diameter		d		3.7		mm

Note

T_{amb} = 25 °C, unless otherwise specified

BASIC CHARACTERISTICS

T_{amb} = 25 °C, unless otherwise specified

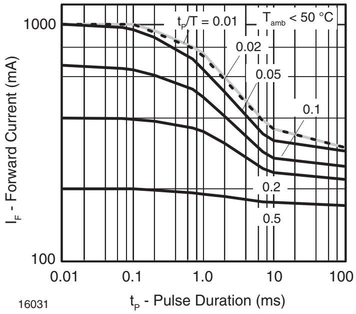


Fig. 3 - Pulse Forward Current vs. Pulse Duration

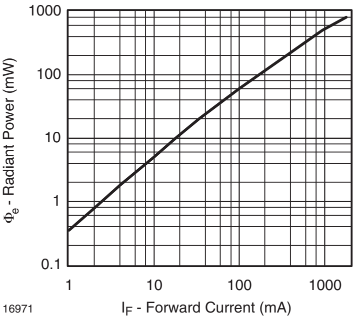


Fig. 6 - Radiant Power vs. Forward Current

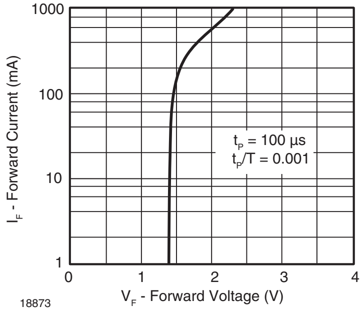


Fig. 4 - Forward Current vs. Forward Voltage

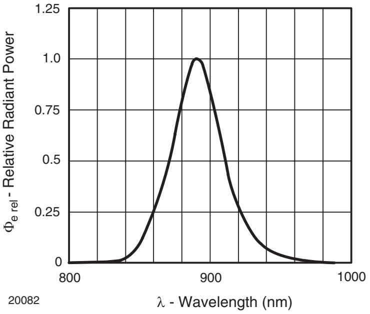


Fig. 7 - Relative Radiant Power vs. Wavelength

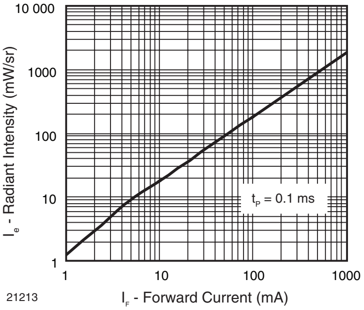


Fig. 5 - Radiant Intensity vs. Forward Current

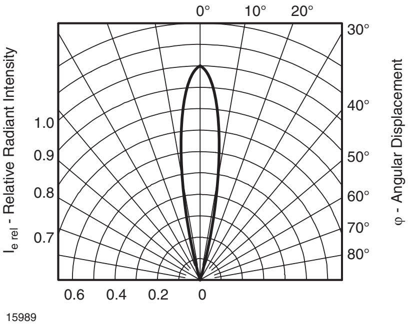
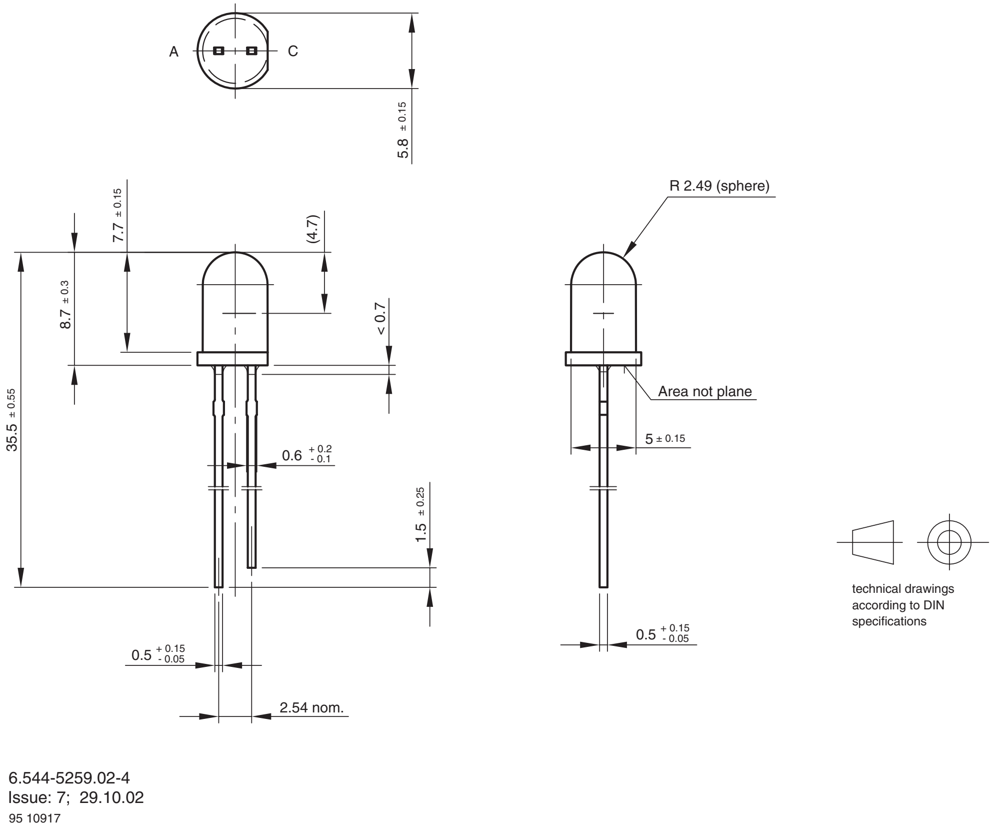
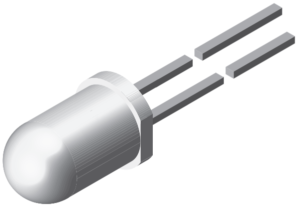


Fig. 8 - Relative Radiant Intensity vs. Angular Displacement

PACKAGE DIMENSIONS in millimeters



High Speed Infrared Emitting Diode, RoHS Compliant, 890 nm, GaAlAs Double Hetero


94 8389

FEATURES

- Package type: leaded
- Package form: T-1¾
- Dimensions (in mm): ∅ 5
- Peak wavelength: λ_p = 890 nm
- High reliability
- High radiant power
- High radiant intensity
- Angle of half intensity: $\varphi = \pm 22°$
- Low forward voltage
- Suitable for high pulse current operation
- High modulation bandwidth: f_c = 12 MHz
- Good spectral matching with Si photodetectors
- Lead (Pb)-free component in accordance with RoHS 2002/95/EC and WEEE 2002/96/EC

Pb-free
e2
RoHS
COMPLIANT

DESCRIPTION

TSHF6410 is an infrared, 890 nm emitting diode in GaAlAs double hetero (DH) technology with high radiant power and high speed, molded in a clear, untinted plastic package.

APPLICATIONS

- Infrared high speed remote control and free air data transmission systems with high modulation frequencies or high data transmission rate requirements
- Transmission systems according to IrDA requirements and for carrier frequency based systems (e.g. ASK/FSK - coded, 450 kHz or 1.3 MHz)

PRODUCT SUMMARY

COMPONENT	I_e (mW/sr)	φ (deg)	λ_P (nm)	t_r (ns)
TSHF6410	70	± 22	890	30

Note
Test conditions see table “Basic Characteristics”

ORDERING INFORMATION

ORDERING CODE	PACKAGING	REMARKS	PACKAGE FORM
TSHF6410	Bulk	MOQ: 4000 pcs, 4000 pcs/bulk	T-1¾

Note
MOQ: minimum order quantity

ABSOLUTE MAXIMUM RATINGS

PARAMETER	TEST CONDITION	SYMBOL	VALUE	UNIT
Reverse voltage		V_R	5	V
Forward current		I_F	100	mA
Peak forward current	$t_p/T = 0.5$, $t_p = 100\ \mu s$	I_{FM}	200	mA
Surge forward current	$t_p = 100\ \mu s$	I_{FSM}	1.5	A
Power dissipation		P_V	160	mW

ABSOLUTE MAXIMUM RATINGS

PARAMETER	TEST CONDITION	SYMBOL	VALUE	UNIT
Junction temperature		T_j	100	°C
Operating temperature range		T_{amb}	- 40 to + 85	°C
Storage temperature range		T_{stg}	- 40 to + 100	°C
Soldering temperature	$t \leq 5$ s, 2 mm from case	T_{sd}	260	°C
Thermal resistance junction/ambient	J-STD-051, leads 7 mm soldered on PCB	R_{thJA}	230	K/W

Note

T_{amb} = 25 °C, unless otherwise specified

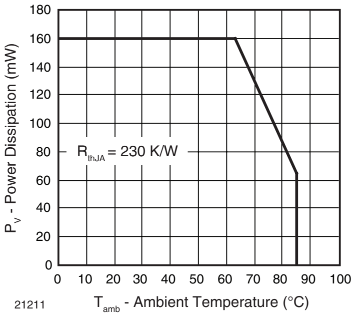


Fig. 1 - Power Dissipation Limit vs. Ambient Temperature

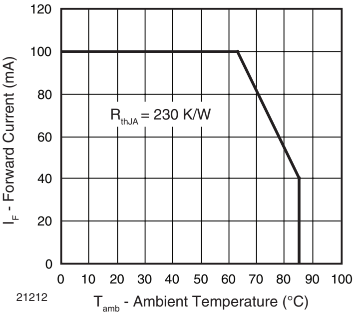


Fig. 2 - Forward Current Limit vs. Ambient Temperature

BASIC CHARACTERISTICS

PARAMETER	TEST CONDITION	SYMBOL	MIN.	TYP.	MAX.	UNIT
Forward voltage	I_F = 100 mA, t_p = 20 ms	V_F		1.4	1.6	V
	I_F = 1 A, t_p = 100 µs	V_F		2.3		V
Temperature coefficient of V_F	I_F = 1 mA	TK_{VF}		- 1.8		mV/K
Reverse current	V_R = 5 V	I_R			10	µA
Junction capacitance	V_R = 0 V, f = 1 MHz, E = 0	C_j		125		pF
Radiant intensity	I_F = 100 mA, t_p = 20 ms	I_e	45	70	135	mW/sr
	I_F = 1 A, t_p = 100 µs	I_e		700		mW/sr
Radiant power	I_F = 100 mA, t_p = 20 ms	ϕ_e		50		mW
Temperature coefficient of ϕ_e	I_F = 100 mA	$TK\phi_e$		- 0.35		%/K
Angle of half intensity		φ		± 22		deg
Peak wavelength	I_F = 100 mA	λ_p		890		nm
Spectral bandwidth	I_F = 100 mA	$\Delta\lambda$		40		nm
Temperature coefficient of λ_p	I_F = 100 mA	$TK\lambda_p$		0.25		nm/K
Rise time	I_F = 100 mA	t_r		30		ns
Fall time	I_F = 100 mA	t_f		30		ns
Cut-off frequency	I_{DC} = 70 mA, I_{AC} = 30 mA pp	f_c		12		MHz
Virtual source diameter		d		2.1		mm

Note

T_{amb} = 25 °C, unless otherwise specified

BASIC CHARACTERISTICS

T_{amb} = 25 °C, unless otherwise specified

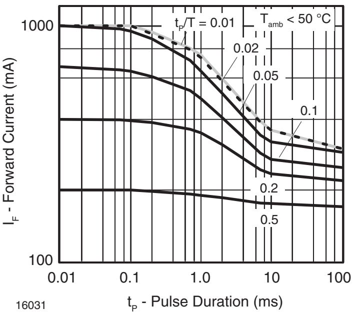


Fig. 3 - Pulse Forward Current vs. Pulse Duration

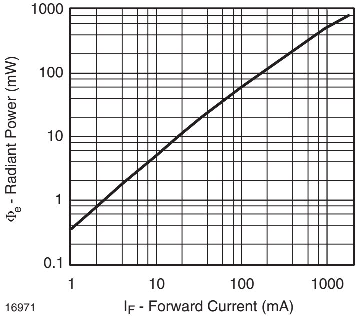


Fig. 6 - Radiant Power vs. Forward Current

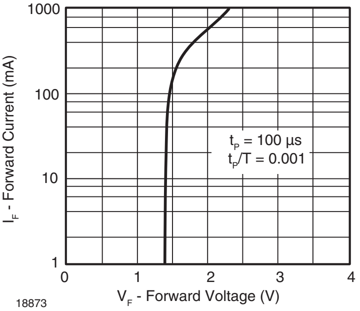


Fig. 4 - Forward Current vs. Forward Voltage

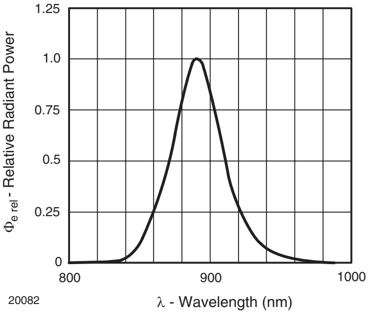


Fig. 7 - Relative Radiant Power vs. Wavelength

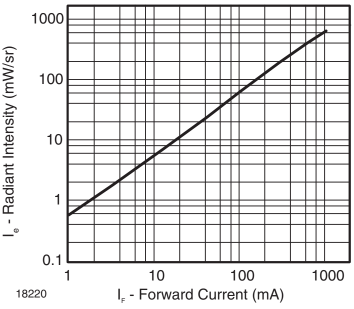


Fig. 5 - Radiant Intensity vs. Forward Current

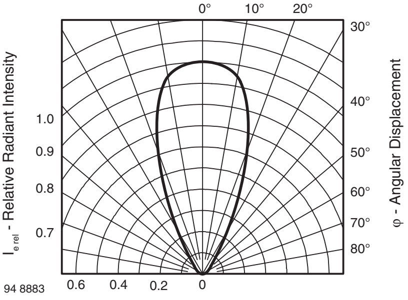
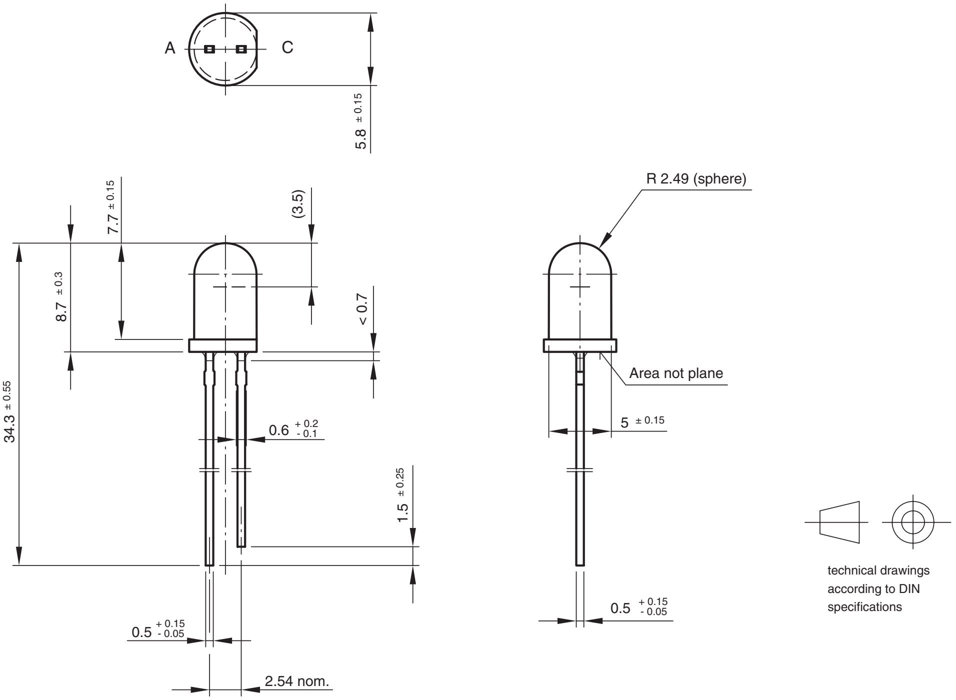


Fig. 8 - Relative Radiant Intensity vs. Angular Displacement

PACKAGE DIMENSIONS in millimeters



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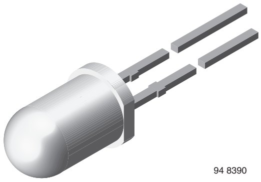
High Speed Infrared Emitting Diode, RoHS Compliant, 850 nm, GaAlAs Double Hetero



DESCRIPTION

TSHG5210 is an infrared, 850 nm emitting diode in GaAlAs double hetero (DH) technology with high radiant power and high speed, molded in a clear, untinted plastic package.

FEATURES

- Package type: leaded
- Package form: T-1¾
- Dimensions (in mm): ∅ 5
- Leads with stand-off
- Peak wavelength: λ_p = 850 nm
- High reliability
- High radiant power
- High radiant intensity
- Angle of half intensity: φ = ± 10°
- Low forward voltage
- Suitable for high pulse current operation
- High modulation bandwidth: f_c = 18 MHz
- Good spectral matching with CMOS cameras
- Lead (Pb)-free component in accordance with RoHS 2002/95/EC and WEEE 2002/96/EC

Pb-free

e2

RoHS
COMPLIANT

APPLICATIONS

- Infrared radiation source for operation with CMOS cameras
- High speed IR data transmission
- Smoke-automatic fire detectors

PRODUCT SUMMARY

COMPONENT	I_e (mW/sr)	φ (deg)	λ_p (nm)	t_r (ns)
TSHG5210	230	± 10	850	20

Note

Test conditions see table “Basic Characteristics”

ORDERING INFORMATION

ORDERING CODE	PACKAGING	REMARKS	PACKAGE FORM
TSHG5210	Bulk	MOQ: 4000 pcs, 4000 pcs/bulk	T-1¾

Note

MOQ: minimum order quantity

ABSOLUTE MAXIMUM RATINGS

PARAMETER	TEST CONDITION	SYMBOL	VALUE	UNIT
Reverse voltage		V_R	5	V
Forward current		I_F	100	mA
Peak forward current	$t_p/T = 0.5$, t_p = 100 µs	I_{FM}	200	mA
Surge forward current	t_p = 100 µs	I_{FSM}	1	A
Power dissipation		P_V	180	mW
Junction temperature		T_j	100	°C
Operating temperature range		T_{amb}	- 40 to + 85	°C
Storage temperature range		T_{stg}	- 40 to + 100	°C
Soldering temperature	$t \leq 5$ s, 2 mm from case	T_{sd}	260	°C
Thermal resistance junction/ambient	J-STD-051, leads 7 mm, soldered on PCB	R_{thJA}	230	K/W

Note

T_{amb} = 25 °C, unless otherwise specified

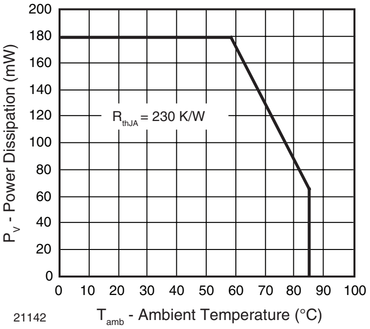


Fig. 1 - Power Dissipation Limit vs. Ambient Temperature

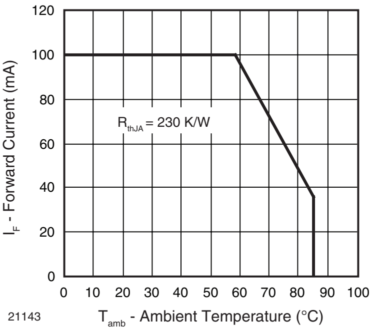


Fig. 2 - Forward Current Limit vs. Ambient Temperature

BASIC CHARACTERISTICS

PARAMETER	TEST CONDITION	SYMBOL	MIN.	TYP.	MAX.	UNIT
Forward voltage	I_F = 100 mA, t_p = 20 ms	V_F		1.5	1.8	V
	I_F = 1 A, t_p = 100 µs	V_F		2.3		V
Temperature coefficient of V_F	I_F = 1 mA	TK_{VF}		- 1.8		mV/K
Reverse current	V_R = 5 V	I_R			10	µA
Junction capacitance	V_R = 0 V, f = 1 MHz, E = 0	C_j		125		pF
Radiant intensity	I_F = 100 mA, t_p = 20 ms	I_e	140	230	420	mW/sr
	I_F = 1 A, t_p = 100 µs	I_e		2300		mW/sr
Radiant power	I_F = 100 mA, t_p = 20 ms	ϕ_e		55		mW
Temperature coefficient of ϕ_e	I_F = 100 mA	$TK\phi_e$		- 0.35		%/K
Angle of half intensity		φ		± 10		deg
Peak wavelength	I_F = 100 mA	λ_p	820	850	880	nm
Spectral bandwidth	I_F = 100 mA	$\Delta\lambda$		40		nm
Temperature coefficient of λ_p	I_F = 100 mA	$TK\lambda_p$		0.25		nm/K
Rise time	I_F = 100 mA	t_r		20		ns
Fall time	I_F = 100 mA	t_f		13		ns
Cut-off frequency	I_{DC} = 70 mA, I_{AC} = 30 mA pp	f_c		18		MHz
Virtual source diameter		d		3.7		mm

Note

T_{amb} = 25 °C, unless otherwise specified

BASIC CHARACTERISTICS

T_{amb} = 25 °C, unless otherwise specified

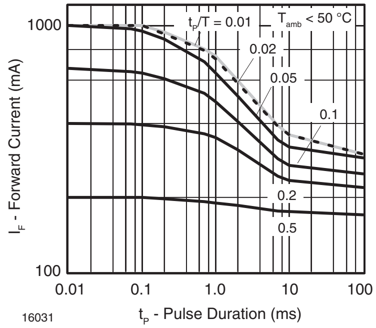


Fig. 3 - Pulse Forward Current vs. Pulse Duration

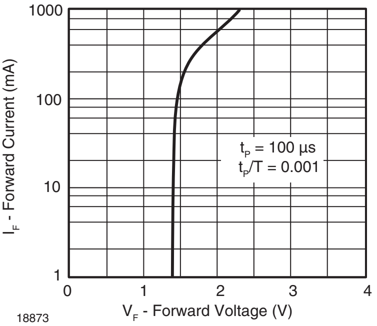


Fig. 4 - Forward Current vs. Forward Voltage

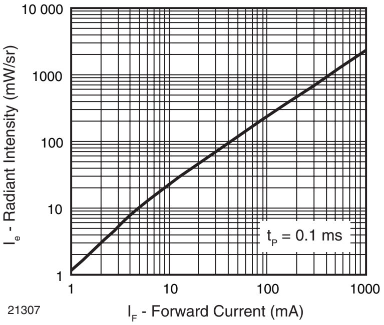


Fig. 5 - Radiant Intensity vs. Forward Current

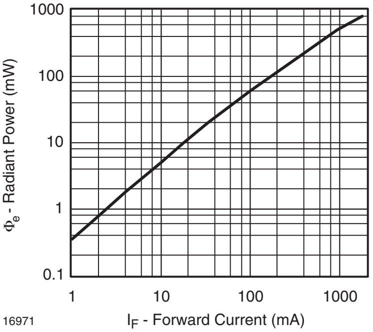


Fig. 6 - Radiant Power vs. Forward Current

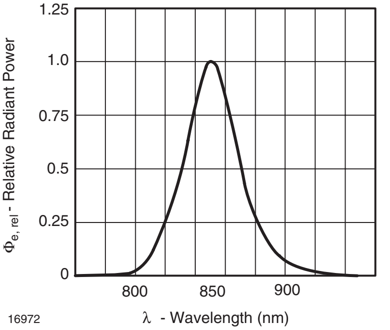


Fig. 7 - Relative Radiant Power vs. Wavelength

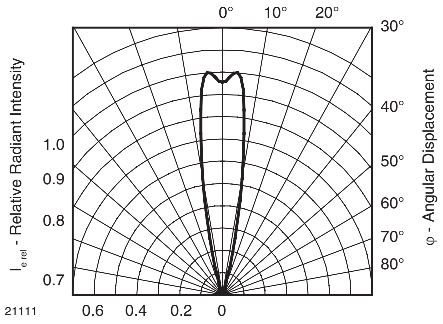
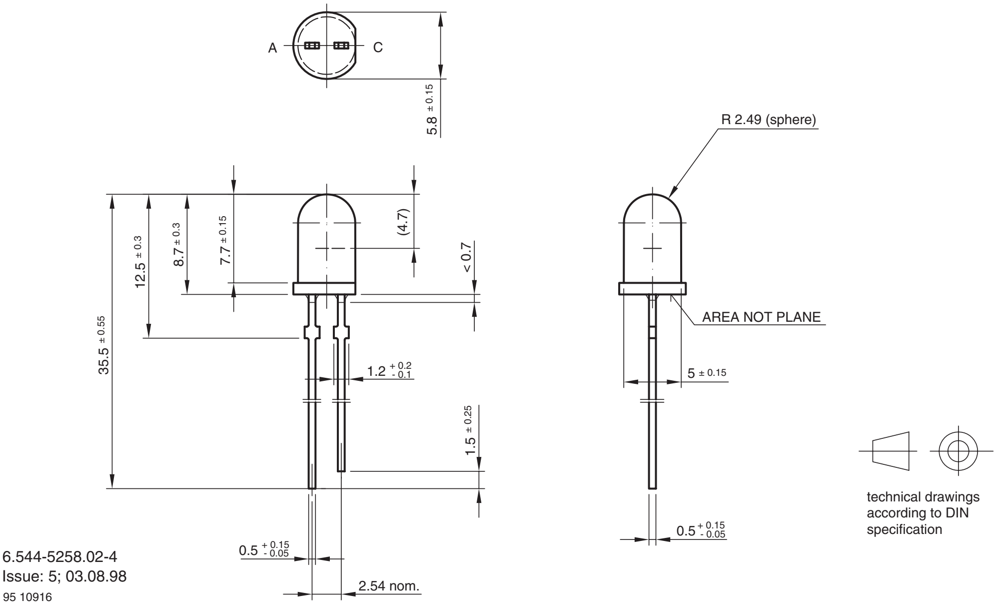
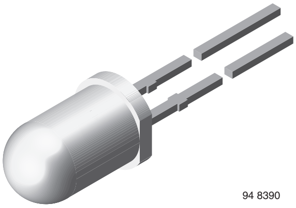


Fig. 8 - Relative Radiant Intensity vs. Angular Displacement

PACKAGE DIMENSIONS in millimeters



High Speed Infrared Emitting Diode, RoHS Compliant, 850 nm, GaAlAs Double Hetero



DESCRIPTION

TSHG5410 is an infrared, 850 nm emitting diode in GaAlAs double hetero (DH) technology with high radiant power and high speed, molded in a clear, untinted plastic package.

FEATURES

- Package type: leaded
- Package form: T-1¾
- Dimensions (in mm): ∅ 5
- Leads with stand-off
- Peak wavelength: λ_p = 850 nm
- High reliability
- High radiant power
- High radiant intensity
- Angle of half intensity: $\varphi = \pm 18°$
- Low forward voltage
- Suitable for high pulse current operation
- High modulation bandwidth: f_c = 18 MHz
- Good spectral matching with CMOS cameras
- Lead (Pb)-free component in accordance with RoHS 2002/95/EC and WEEE 2002/96/EC

Pb Pb-free
e2
RoHS COMPLIANT

APPLICATIONS

- Infrared radiation source for operation with CMOS cameras
- High speed IR data transmission

PRODUCT SUMMARY

COMPONENT	I_e (mW/sr)	φ (deg)	λ_p (nm)	t_r (ns)
TSHG5410	90	± 18	850	20

Note
Test conditions see table “Basic Characteristics”

ORDERING INFORMATION

ORDERING CODE	PACKAGING	REMARKS	PACKAGE FORM
TSHG5410	Bulk	MOQ: 4000 pcs, 4000 pcs/bulk	T-1¾

Note
MOQ: minimum order quantity

ABSOLUTE MAXIMUM RATINGS

PARAMETER	TEST CONDITION	SYMBOL	VALUE	UNIT
Reverse voltage		V_R	5	V
Forward current		I_F	100	mA
Peak forward current	$t_p/T = 0.5$, t_p = 100 µs	I_{FM}	200	mA
Surge forward current	t_p = 100 µs	I_{FSM}	1	A
Power dissipation		P_V	180	mW
Junction temperature		T_j	100	°C
Operating temperature range		T_{amb}	- 40 to + 85	°C
Storage temperature range		T_{stg}	- 40 to + 100	°C
Soldering temperature	$t \leq 5$ s, 2 mm from case	T_{sd}	260	°C
Thermal resistance junction/ambient	J-STD-051, leads 7 mm, soldered on PCB	R_{thJA}	230	K/W

Note
T_{amb} = 25 °C, unless otherwise specified

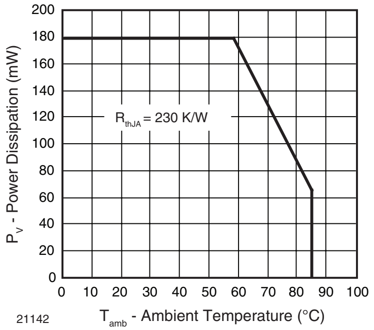


Fig. 1 - Power Dissipation Limit vs. Ambient Temperature

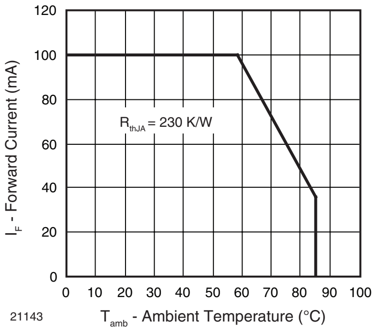


Fig. 2 - Forward Current Limit vs. Ambient Temperature

BASIC CHARACTERISTICS

PARAMETER	TEST CONDITION	SYMBOL	MIN.	TYP.	MAX.	UNIT
Forward voltage	I_F = 100 mA, t_p = 20 ms	V_F		1.5	1.8	V
	I_F = 1 A, t_p = 100 µs	V_F		2.3		V
Temperature coefficient of V_F	I_F = 1 mA	TK_{VF}		- 1.8		mV/K
Reverse current	V_R = 5 V	I_R			10	µA
Junction capacitance	V_R = 0 V, f = 1 MHz, E = 0	C_j		125		pF
Radiant intensity	I_F = 100 mA, t_p = 20 ms	I_e	45	90	135	mW/sr
	I_F = 1 A, t_p = 100 µs	I_e		900		mW/sr
Radiant power	I_F = 100 mA, t_p = 20 ms	ϕ_e		55		mW
Temperature coefficient of ϕ_e	I_F = 100 mA	$TK\phi_e$		- 0.35		%/K
Angle of half intensity		φ		± 18		deg
Peak wavelength	I_F = 100 mA	λ_p	820	850	880	nm
Spectral bandwidth	I_F = 100 mA	$\Delta\lambda$		40		nm
Temperature coefficient of λ_p	I_F = 100 mA	$TK\lambda_p$		0.25		nm/K
Rise time	I_F = 100 mA	t_r		20		ns
Fall time	I_F = 100 mA	t_f		13		ns
Cut-off frequency	I_{DC} = 70 mA, I_{AC} = 30 mA pp	f_c		18		MHz
Virtual source diameter		d		2.1		mm

Note

T_{amb} = 25 °C, unless otherwise specified

BASIC CHARACTERISTICS

T_{amb} = 25 °C, unless otherwise specified

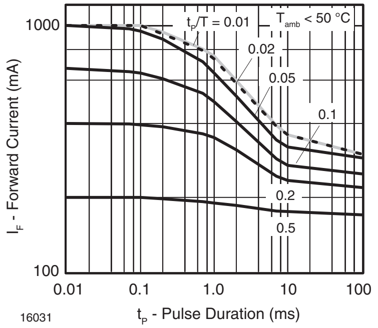


Fig. 3 - Pulse Forward Current vs. Pulse Duration

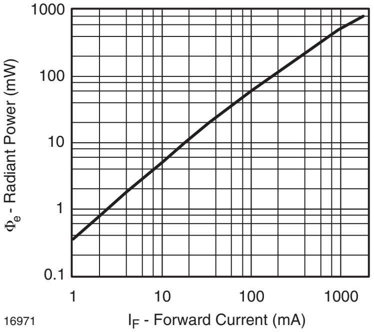


Fig. 6 - Radiant Power vs. Forward Current

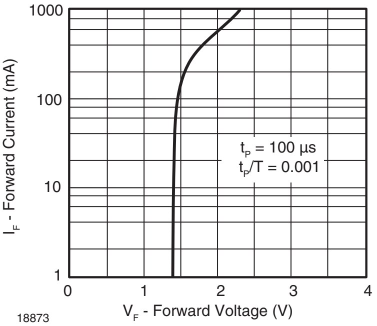


Fig. 4 - Forward Current vs. Forward Voltage

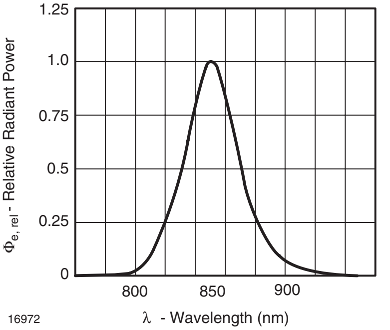


Fig. 7 - Relative Radiant Power vs. Wavelength

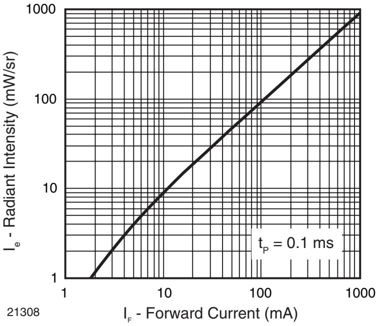


Fig. 5 - Radiant Intensity vs. Forward Current

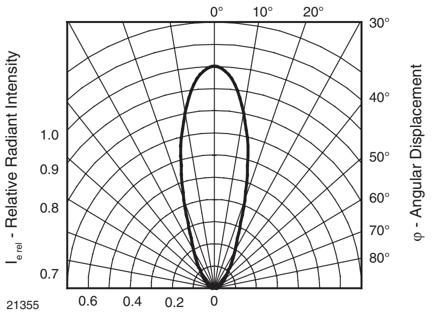
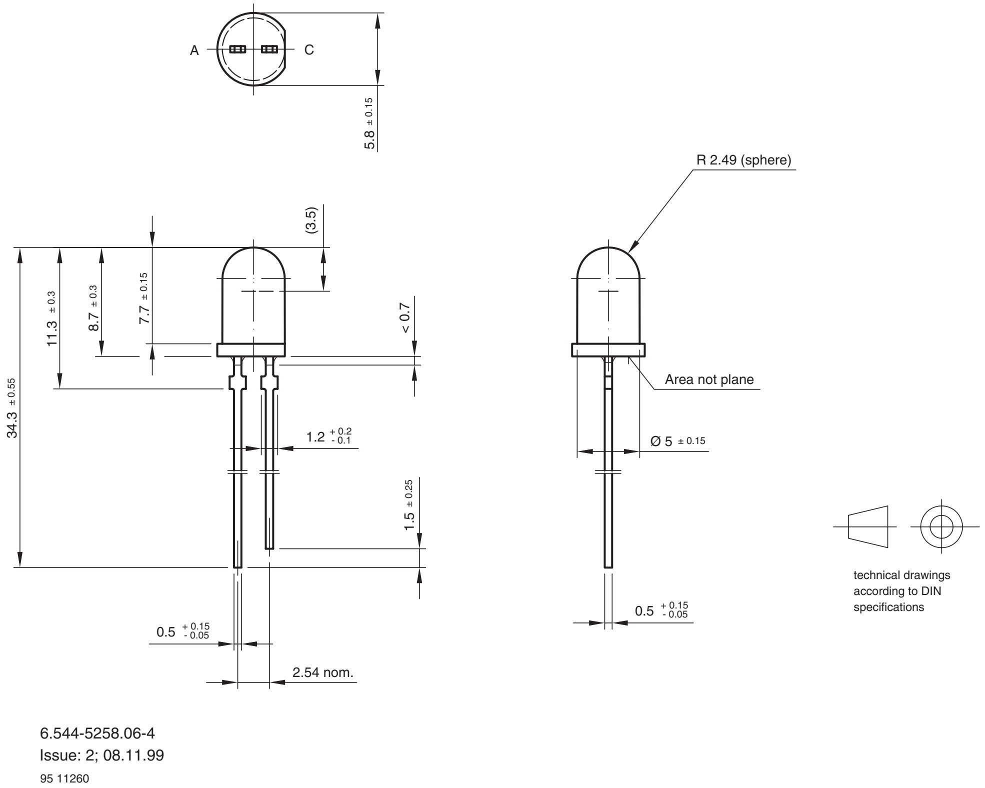
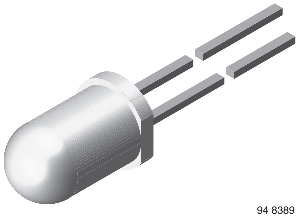


Fig. 8 - Relative Radiant Intensity vs. Angular Displacement

PACKAGE DIMENSIONS in millimeters



High Speed Infrared Emitting Diode, RoHS Compliant, 850 nm, GaAlAs Double Hetero



FEATURES

Pb-free

e2

RoHS COMPLIANT

- Package type: leaded
- Package form: T-1¾
- Dimensions (in mm): ∅ 5
- Peak wavelength: λ_p = 850 nm
- High reliability
- High radiant power
- High radiant intensity
- Angle of half intensity: φ = ± 10°
- Low forward voltage
- Suitable for high pulse current operation
- High modulation bandwidth: f_c = 18 MHz
- Good spectral matching with CMOS cameras
- Lead (Pb)-free component in accordance with RoHS 2002/95/EC and WEEE 2002/96/EC

DESCRIPTION

TSHG6210 is an infrared, 850 nm emitting diode in GaAlAs double hetero (DH) technology with high radiant power and high speed, molded in a clear, untinted plastic package.

APPLICATIONS

- Infrared radiation source for operation with CMOS cameras
- High speed IR data transmission
- Smoke-automatic fire detectors

PRODUCT SUMMARY

COMPONENT	I_e (mW/sr)	φ (deg)	λ_p (nm)	t_r (ns)
TSHG6210	230	± 10	850	20

Note

Test conditions see table “Basic Characteristics”

ORDERING INFORMATION

ORDERING CODE	PACKAGING	REMARKS	PACKAGE FORM
TSHG6210	Bulk	MOQ: 4000 pcs, 4000 pcs/bulk	T-1¾

Note

MOQ: minimum order quantity

ABSOLUTE MAXIMUM RATINGS

PARAMETER	TEST CONDITION	SYMBOL	VALUE	UNIT
Reverse voltage		V_R	5	V
Forward current		I_F	100	mA
Peak forward current	t_p/T = 0.5, t_p = 100 µs	I_{FM}	200	mA
Surge forward current	t_p = 100 µs	I_{FSM}	1	A
Power dissipation		P_V	180	mW
Junction temperature		T_j	100	°C
Operating temperature range		T_{amb}	- 40 to + 85	°C
Storage temperature range		T_{stg}	- 40 to + 100	°C
Soldering temperature	$t \leq 5$ s, 2 mm from case	T_{sd}	260	°C
Thermal resistance junction/ambient	J-STD-051, leads 7 mm, soldered on PCB	R_{thJA}	230	K/W

Note

T_{amb} = 25 °C, unless otherwise specified

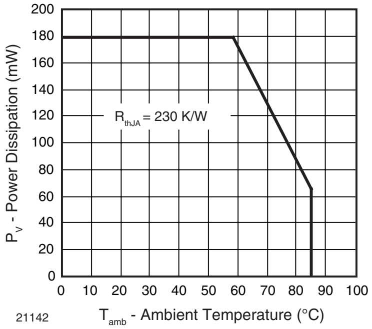


Fig. 1 - Power Dissipation Limit vs. Ambient Temperature

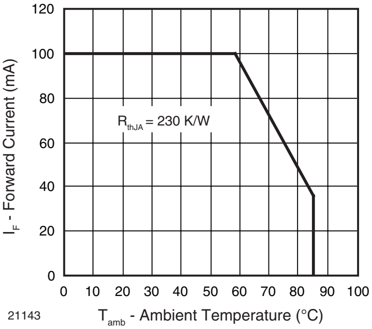


Fig. 2 - Forward Current Limit vs. Ambient Temperature

BASIC CHARACTERISTICS

PARAMETER	TEST CONDITION	SYMBOL	MIN.	TYP.	MAX.	UNIT
Forward voltage	I_F = 100 mA, t_p = 20 ms	V_F		1.5	1.8	V
	I_F = 1 A, t_p = 100 µs	V_F		2.3		V
Temperature coefficient of V_F	I_F = 1 mA	TK_{VF}		- 1.8		mV/K
Reverse current	V_R = 5 V	I_R			10	µA
Junction capacitance	V_R = 0 V, f = 1 MHz, E = 0	C_j		125		pF
Radiant intensity	I_F = 100 mA, t_p = 20 ms	I_e	140	230	420	mW/sr
	I_F = 1 A, t_p = 100 µs	I_e		2300		mW/sr
Radiant power	I_F = 100 mA, t_p = 20 ms	ϕ_e		55		mW
Temperature coefficient of ϕ_e	I_F = 100 mA	$TK\phi_e$		- 0.35		%/K
Angle of half intensity		φ		± 10		deg
Peak wavelength	I_F = 100 mA	λ_p	820	850	880	nm
Spectral bandwidth	I_F = 100 mA	$\Delta\lambda$		40		nm
Temperature coefficient of λ_p	I_F = 100 mA	$TK\lambda_p$		0.25		nm/K
Rise time	I_F = 100 mA	t_r		20		ns
Fall time	I_F = 100 mA	t_f		13		ns
Cut-off frequency	I_{DC} = 70 mA, I_{AC} = 30 mA pp	f_c		18		MHz
Virtual source diameter		d		3.7		mm

Note

T_{amb} = 25 °C, unless otherwise specified

BASIC CHARACTERISTICS

T_{amb} = 25 °C, unless otherwise specified

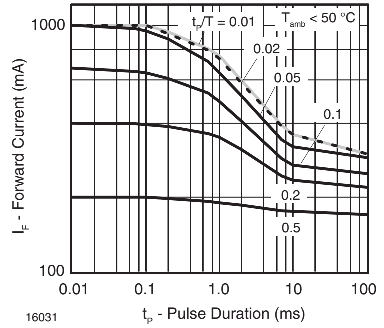


Fig. 3 - Pulse Forward Current vs. Pulse Duration

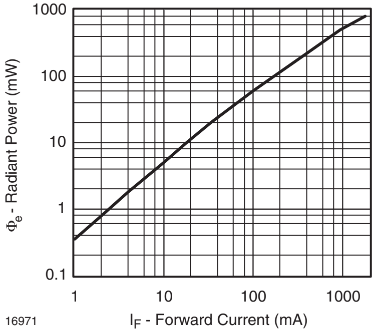


Fig. 6 - Radiant Power vs. Forward Current

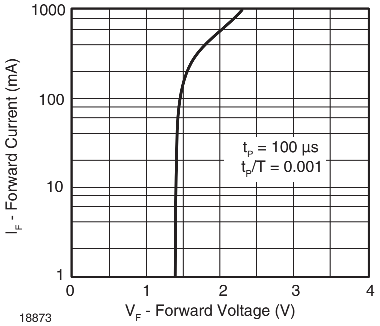


Fig. 4 - Forward Current vs. Forward Voltage

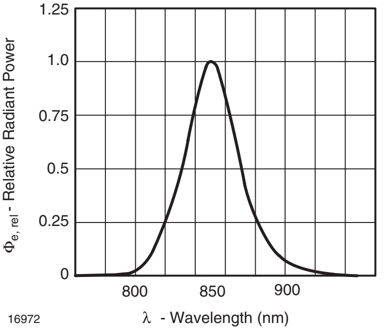


Fig. 7 - Relative Radiant Power vs. Wavelength

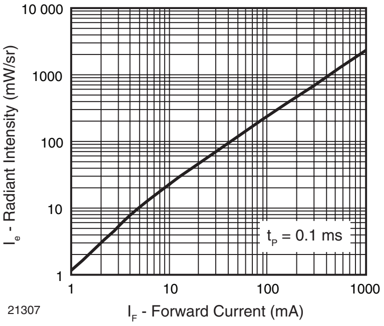


Fig. 5 - Radiant Intensity vs. Forward Current

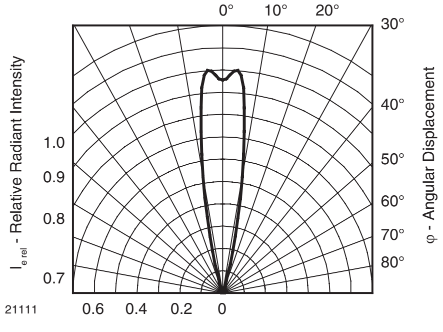
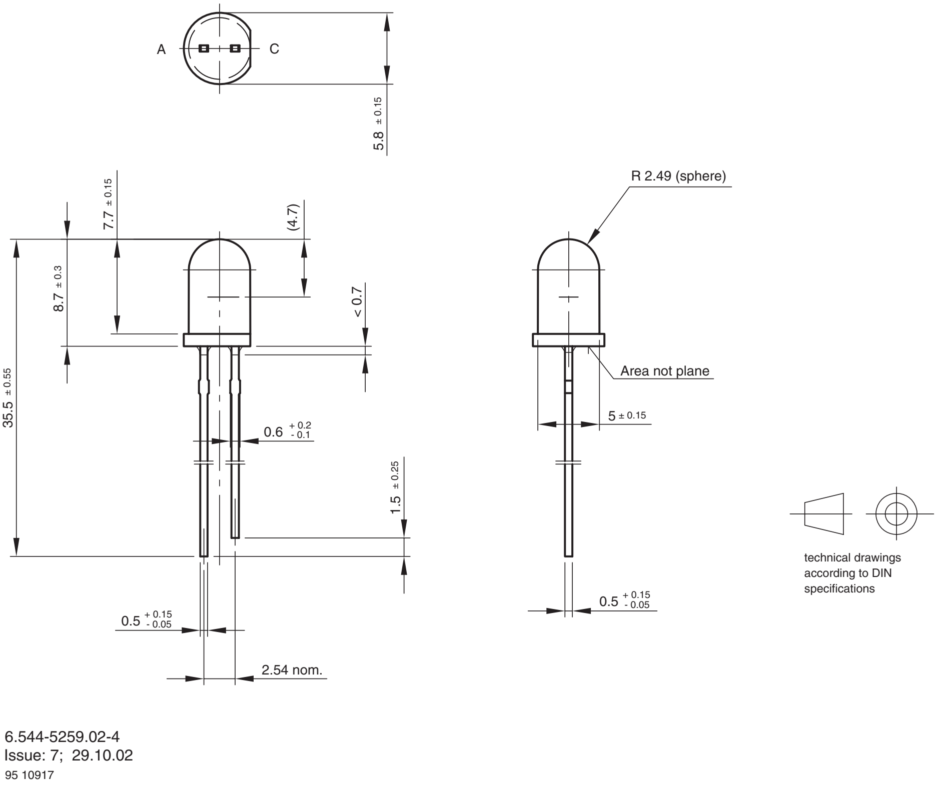
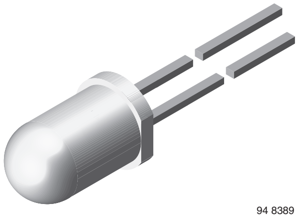


Fig. 8 - Relative Radiant Intensity vs. Angular Displacement

PACKAGE DIMENSIONS in millimeters



High Speed Infrared Emitting Diode, RoHS Compliant, 850 nm, GaAlAs Double Hetero



FEATURES

- Package type: leaded
- Package form: T-1¾
- Dimensions (in mm): ∅ 5
- Peak wavelength: λ_p = 850 nm
- High reliability
- High radiant power
- High radiant intensity
- Angle of half intensity: φ = ± 18°
- Low forward voltage
- Suitable for high pulse current operation
- High modulation bandwidth: f_c = 18 MHz
- Good spectral matching with CMOS cameras
- Lead (Pb)-free component in accordance with RoHS 2002/95/EC and WEEE 2002/96/EC

Pb-free
e2
RoHS
COMPLIANT

DESCRIPTION

TSHG6410 is an infrared, 850 nm emitting diode in GaAlAs double hetero (DH) technology with high radiant power and high speed, molded in a clear, untinted plastic package.

APPLICATIONS

- Infrared radiation source for operation with CMOS cameras
- High speed IR data transmission

PRODUCT SUMMARY

COMPONENT	I_e (mW/sr)	φ (deg)	λ_p (nm)	t_r (ns)
TSHG6410	90	± 18	850	20

Note
Test conditions see table "Basic Characteristics"

ORDERING INFORMATION

ORDERING CODE	PACKAGING	REMARKS	PACKAGE FORM
TSHG6410	Bulk	MOQ: 4000 pcs, 4000 pcs/bulk	T-1¾

Note
MOQ: minimum order quantity

ABSOLUTE MAXIMUM RATINGS

PARAMETER	TEST CONDITION	SYMBOL	VALUE	UNIT
Reverse voltage		V_R	5	V
Forward current		I_F	100	mA
Peak forward current	$t_p/T = 0.5$, t_p = 100 µs	I_{FM}	200	mA
Surge forward current	t_p = 100 µs	I_{FSM}	1	A
Power dissipation		P_V	180	mW
Junction temperature		T_j	100	°C
Operating temperature range		T_{amb}	- 40 to + 85	°C
Storage temperature range		T_{stg}	- 40 to + 100	°C
Soldering temperature	$t \leq 5$ s, 2 mm from case	T_{sd}	260	°C
Thermal resistance junction/ambient	J-STD-051, leads 7 mm, soldered on PCB	R_{thJA}	230	K/W

Note
T_{amb} = 25 °C, unless otherwise specified

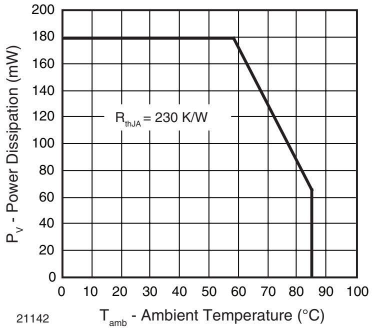


Fig. 1 - Power Dissipation Limit vs. Ambient Temperature

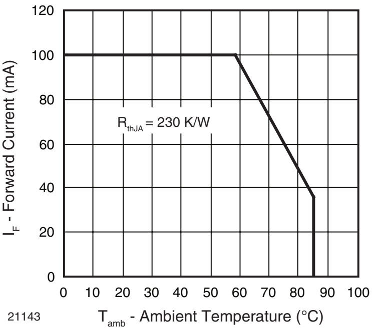


Fig. 2 - Forward Current Limit vs. Ambient Temperature

BASIC CHARACTERISTICS

PARAMETER	TEST CONDITION	SYMBOL	MIN.	TYP.	MAX.	UNIT
Forward voltage	I_F = 100 mA, t_p = 20 ms	V_F		1.5	1.8	V
	I_F = 1 A, t_p = 100 µs	V_F		2.3		V
Temperature coefficient of V_F	I_F = 1 mA	TK_{VF}		- 1.8		mV/K
Reverse current	V_R = 5 V	I_R			10	µA
Junction capacitance	V_R = 0 V, f = 1 MHz, E = 0	C_j		125		pF
Radiant intensity	I_F = 100 mA, t_p = 20 ms	I_e	45	90	135	mW/sr
	I_F = 1 A, t_p = 100 µs	I_e		900		mW/sr
Radiant power	I_F = 100 mA, t_p = 20 ms	ϕ_e		55		mW
Temperature coefficient of ϕ_e	I_F = 100 mA	$TK\phi_e$		- 0.35		%/K
Angle of half intensity		φ		± 18		deg
Peak wavelength	I_F = 100 mA	λ_p	820	850	880	nm
Spectral bandwidth	I_F = 100 mA	$\Delta\lambda$		40		nm
Temperature coefficient of λ_p	I_F = 100 mA	$TK\lambda_p$		0.25		nm/K
Rise time	I_F = 100 mA	t_r		20		ns
Fall time	I_F = 100 mA	t_f		13		ns
Cut-off frequency	I_{DC} = 70 mA, I_{AC} = 30 mA pp	f_c		18		MHz
Virtual source diameter		d		2.1		mm

Note

T_{amb} = 25 °C, unless otherwise specified

BASIC CHARACTERISTICS

T_{amb} = 25 °C, unless otherwise specified

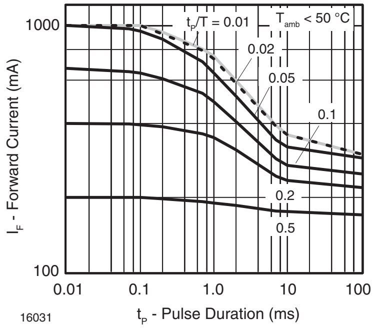


Fig. 3 - Pulse Forward Current vs. Pulse Duration

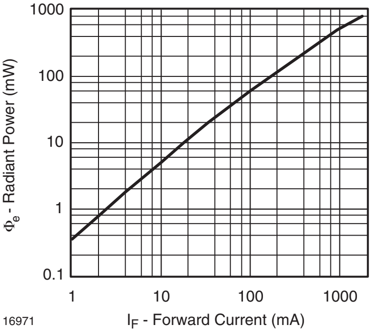


Fig. 6 - Radiant Power vs. Forward Current

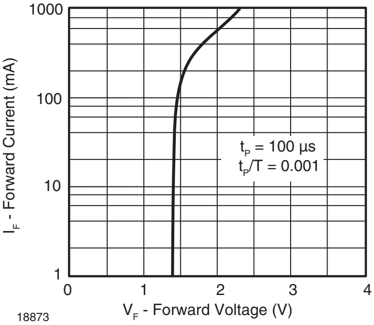


Fig. 4 - Forward Current vs. Forward Voltage

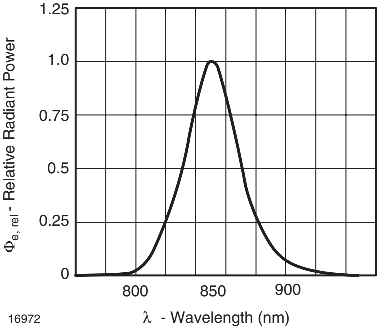


Fig. 7 - Relative Radiant Power vs. Wavelength

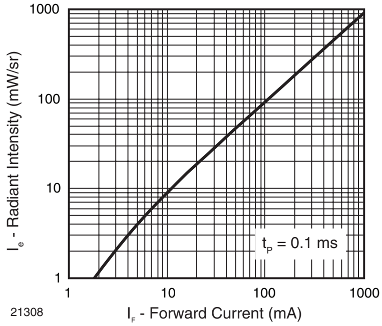


Fig. 5 - Radiant Intensity vs. Forward Current

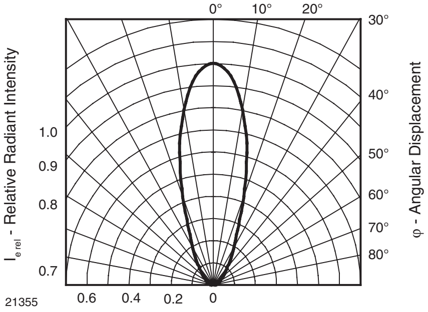
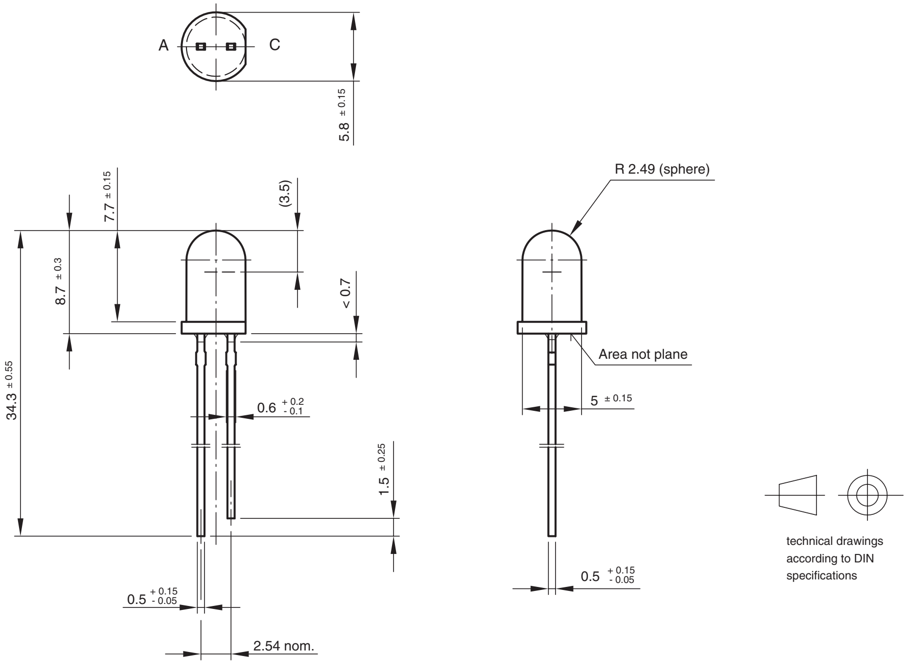


Fig. 8 - Relative Radiant Intensity vs. Angular Displacement

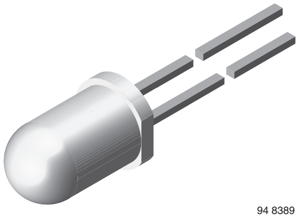
PACKAGE DIMENSIONS in millimeters



technical drawings according to DIN specifications

6.544-5259.06-4
Issue: 5; 27.09.05
19257

High Speed Infrared Emitting Diode, RoHS Compliant, 830 nm, GaAlAs Double Hetero



94 8389

DESCRIPTION

TSHG8200 is an infrared, 830 nm emitting diode in GaAlAs double hetero (DH) technology with high radiant power and high speed, molded in a clear, untinted plastic package.

FEATURES

- Package type: leaded
- Package form: T-1¾
- Dimensions (in mm): ∅ 5
- Peak wavelength: λ_p = 830 nm
- High reliability
- High radiant power
- High radiant intensity
- Angle of half intensity: φ = ± 10°
- Low forward voltage
- Suitable for high pulse current operation
- High modulation bandwidth: f_c = 18 MHz
- Good spectral matching with CMOS cameras
- Lead (Pb)-free component in accordance with RoHS 2002/95/EC and WEEE 2002/96/EC

Pb-free

e2

RoHS
COMPLIANT

APPLICATIONS

- Infrared radiation source for operation with CMOS cameras (illumination)
- High speed IR data transmission
- Smoke-automatic fire detectors

PRODUCT SUMMARY

COMPONENT	I_e (mW/sr)	φ (deg)	λ_P (nm)	t_r (ns)
TSHG8200	180	± 10	830	20

Note

Test conditions see table "Basic Characteristics"

ORDERING INFORMATION

ORDERING CODE	PACKAGING	REMARKS	PACKAGE FORM
TSHG8200	Bulk	MOQ: 4000 pcs, 4000 pcs/bulk	T-1¾

Note

MOQ: minimum order quantity

ABSOLUTE MAXIMUM RATINGS

PARAMETER	TEST CONDITION	SYMBOL	VALUE	UNIT
Reverse voltage		V_R	5	V
Forward current		I_F	100	mA
Peak forward current	$t_p/T = 0.5$, t_p = 100 µs	I_{FM}	200	mA
Surge forward current	t_p = 100 µs	I_{FSM}	1	A
Power dissipation		P_V	180	mW
Junction temperature		T_j	100	°C
Operating temperature range		T_{amb}	- 40 to + 85	°C
Storage temperature range		T_{stg}	- 40 to + 100	°C
Soldering temperature	$t \leq 5$ s, 2 mm from case	T_{sd}	260	°C
Thermal resistance junction/ambient	J-STD-051, leads 7 mm soldered on PCB	R_{thJA}	230	K/W

Note

T_{amb} = 25 °C, unless otherwise specified

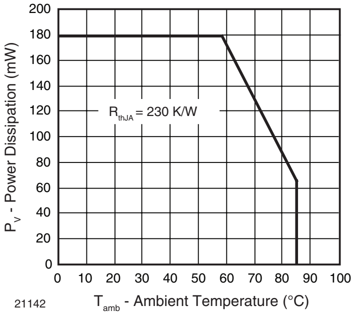


Fig. 1 - Power Dissipation Limit vs. Ambient Temperature

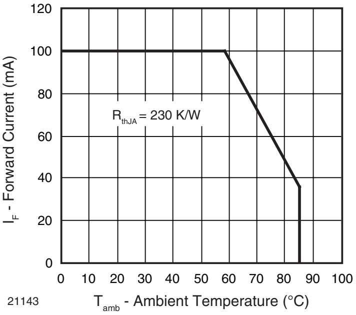


Fig. 2 - Forward Current Limit vs. Ambient Temperature

BASIC CHARACTERISTICS

PARAMETER	TEST CONDITION	SYMBOL	MIN.	TYP.	MAX.	UNIT
Forward voltage	I_F = 100 mA, t_p = 20 ms	V_F		1.5	1.8	V
	I_F = 1 A, t_p = 100 µs	V_F		2.3		V
Temperature coefficient of V_F	I_F = 1 mA	TK_{VF}		- 1.8		mV/K
Reverse current	V_R = 5 V	I_R			10	µA
Junction capacitance	V_R = 0 V, f = 1 MHz, E = 0	C_j		125		pF
Radiant intensity	I_F = 100 mA, t_p = 20 ms	I_e	120	180	360	mW/sr
	I_F = 1 A, t_p = 100 µs	I_e		1600		mW/sr
Radiant power	I_F = 100 mA, t_p = 20 ms	ϕ_e		50		mW
Temperature coefficient of ϕ_e	I_F = 100 mA	$TK\phi_e$		- 0.35		%/K
Angle of half intensity		φ		± 10		deg
Peak wavelength	I_F = 100 mA	λ_p		830		nm
Spectral bandwidth	I_F = 100 mA	$\Delta\lambda$		40		nm
Temperature coefficient of λ_p	I_F = 100 mA	$TK\lambda_p$		0.25		nm/K
Rise time	I_F = 100 mA	t_r		20		ns
Fall time	I_F = 100 mA	t_f		13		ns
Cut-off frequency	I_{DC} = 70 mA, I_{AC} = 30 mA pp	f_c		18		MHz
Virtual source diameter		d		3.7		mm

Note

T_{amb} = 25 °C, unless otherwise specified

BASIC CHARACTERISTICS

T_{amb} = 25 °C, unless otherwise specified

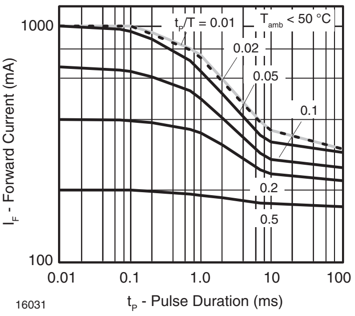


Fig. 3 - Pulse Forward Current vs. Pulse Duration

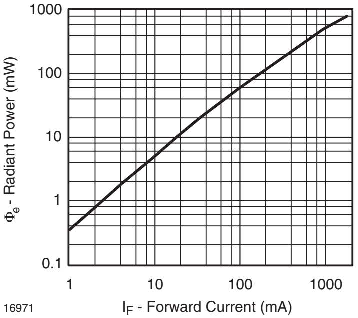


Fig. 6 - Radiant Power vs. Forward Current

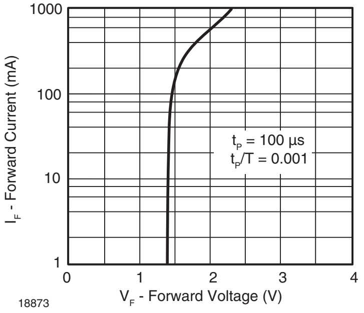


Fig. 4 - Forward Current vs. Forward Voltage

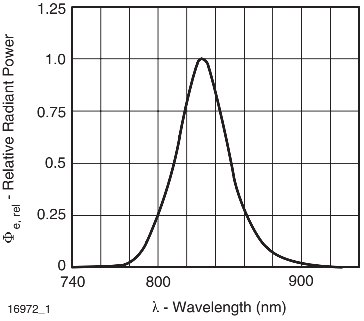


Fig. 7 - Relative Radiant Power vs. Wavelength

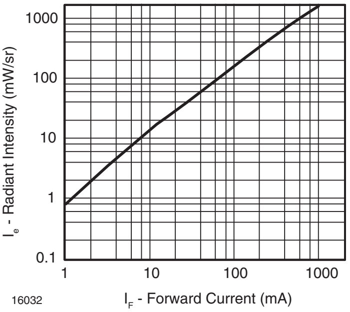


Fig. 5 - Radiant Intensity vs. Forward Current

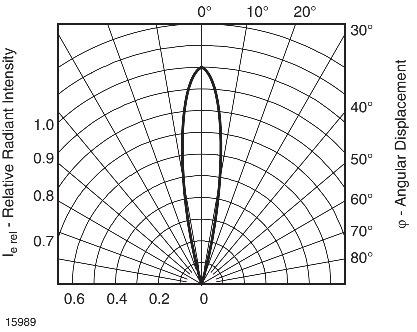
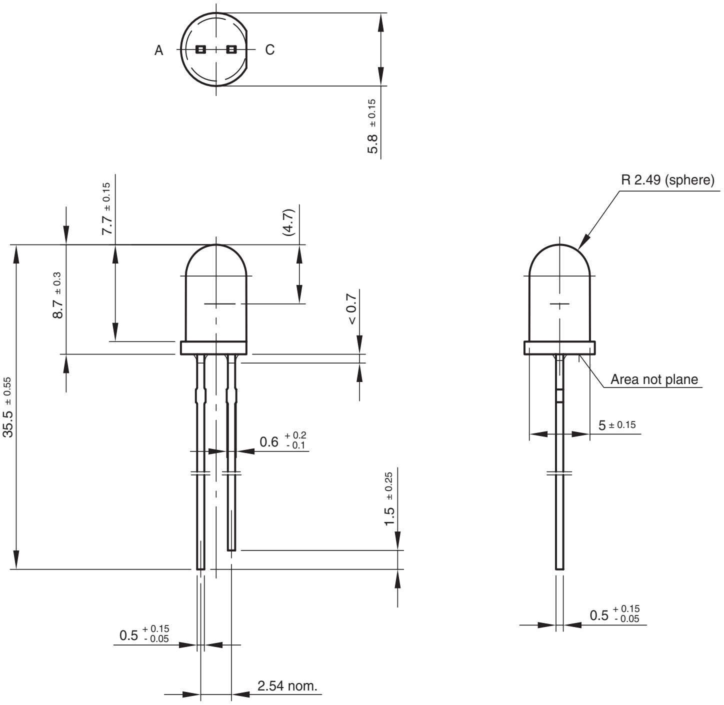
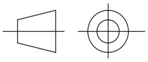


Fig. 8 - Relative Radiant Intensity vs. Angular Displacement

PACKAGE DIMENSIONS in millimeters

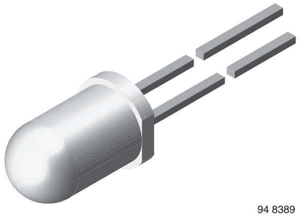




technical drawings
according to DIN
specifications

6.544-5259.02-4
Issue: 7; 29.10.02
95 10917

High Speed Infrared Emitting Diode, RoHS Compliant, 830 nm, GaAlAs Double Hetero



DESCRIPTION

TSHG8400 is an infrared, 830 nm emitting diode in GaAlAs double hetero (DH) technology with high radiant power and high speed, molded in a clear, untinted plastic package.

FEATURES

- Package type: leaded
- Package form: T-1¾
- Dimensions (in mm): ∅ 5
- Peak wavelength: λ_p = 830 nm
- High reliability
- High radiant power
- High radiant intensity
- Angle of half intensity: φ = ± 22°
- Low forward voltage
- Suitable for high pulse current operation
- High modulation bandwidth: f_c = 18 MHz
- Good spectral matching with CMOS cameras
- Lead (Pb)-free component in accordance with RoHS 2002/95/EC and WEEE 2002/96/EC

Pb-free
e2
RoHS
COMPLIANT

APPLICATIONS

- Infrared radiation source for operation with CMOS cameras (illumination)
- High speed IR data transmission

PRODUCT SUMMARY

COMPONENT	I_e (mW/sr)	φ (deg)	λ_P (nm)	t_r (ns)
TSHG8400	70	± 22	830	20

Note
Test conditions see table “Basic Characteristics”

ORDERING INFORMATION

ORDERING CODE	PACKAGING	REMARKS	PACKAGE FORM
TSHG8400	Bulk	MOQ: 4000 pcs, 4000 pcs/bulk	T-1¾

Note
MOQ: minimum order quantity

ABSOLUTE MAXIMUM RATINGS

PARAMETER	TEST CONDITION	SYMBOL	VALUE	UNIT
Reverse voltage		V_R	5	V
Forward current		I_F	100	mA
Peak forward current	$t_p/T = 0.5$, t_p = 100 µs	I_{FM}	200	mA
Surge forward current	t_p = 100 µs	I_{FSM}	1	A
Power dissipation		P_V	180	mW
Junction temperature		T_j	100	°C
Operating temperature range		T_{amb}	- 40 to + 85	°C
Storage temperature range		T_{stg}	- 40 to + 100	°C
Soldering temperature	$t \leq 5$ s, 2 mm from case	T_{sd}	260	°C
Thermal resistance junction/ambient	J-STD-051, leads 7 mm soldered on PCB	R_{thJA}	230	K/W

Note
T_{amb} = 25 °C, unless otherwise specified

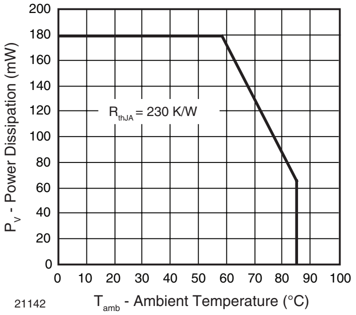


Fig. 1 - Power Dissipation Limit vs. Ambient Temperature

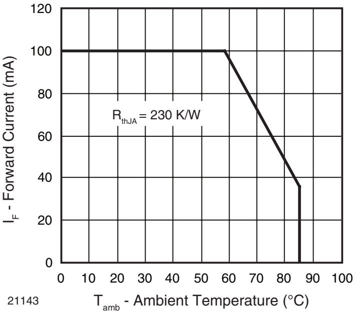


Fig. 2 - Forward Current Limit vs. Ambient Temperature

BASIC CHARACTERISTICS

PARAMETER	TEST CONDITION	SYMBOL	MIN.	TYP.	MAX.	UNIT
Forward voltage	I_F = 100 mA, t_p = 20 ms	V_F		1.5	1.8	V
	I_F = 1 A, t_p = 100 µs	V_F		2.3		V
Temperature coefficient of V_F	I_F = 1 mA	TK_{VF}		- 1.8		mV/K
Reverse current	V_R = 5 V	I_R			10	µA
Junction capacitance	V_R = 0 V, f = 1 MHz, E = 0	C_j		125		pF
Radiant intensity	I_F = 100 mA, t_p = 20 ms	I_e	45	70	135	mW/sr
	I_F = 1 A, t_p = 100 µs	I_e		700		mW/sr
Radiant power	I_F = 100 mA, t_p = 20 ms	ϕ_e		50		mW
Temperature coefficient of ϕ_e	I_F = 100 mA	$TK\phi_e$		- 0.35		%/K
Angle of half intensity		φ		± 22		deg
Peak wavelength	I_F = 100 mA	λ_p		830		nm
Spectral bandwidth	I_F = 100 mA	$\Delta\lambda$		40		nm
Temperature coefficient of λ_p	I_F = 100 mA	$TK\lambda_p$		0.25		nm/K
Rise time	I_F = 100 mA	t_r		20		ns
Fall time	I_F = 100 mA	t_f		13		ns
Cut-off frequency	I_{DC} = 70 mA, I_{AC} = 30 mA pp	f_c		18		MHz
Virtual source diameter		d		3.7		mm

Note

T_{amb} = 25 °C, unless otherwise specified

BASIC CHARACTERISTICS

T_{amb} = 25 °C, unless otherwise specified

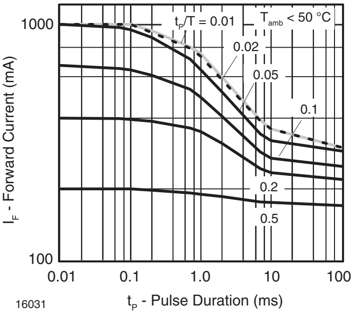


Fig. 3 - Pulse Forward Current vs. Pulse Duration

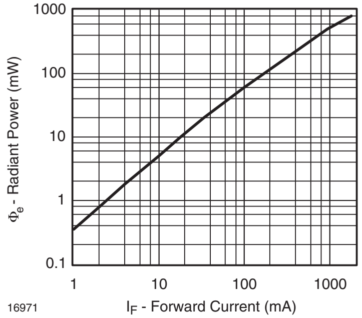


Fig. 6 - Radiant Power vs. Forward Current

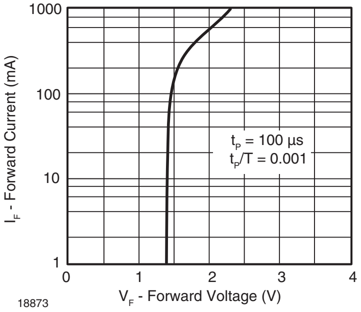


Fig. 4 - Forward Current vs. Forward Voltage

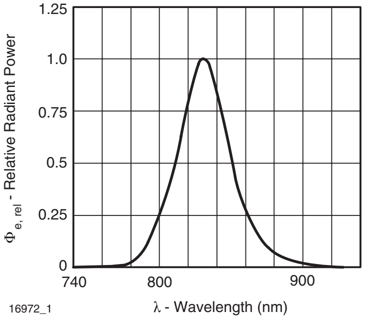


Fig. 7 - Relative Radiant Power vs. Wavelength

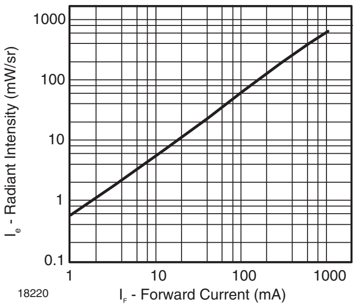


Fig. 5 - Radiant Intensity vs. Forward Current

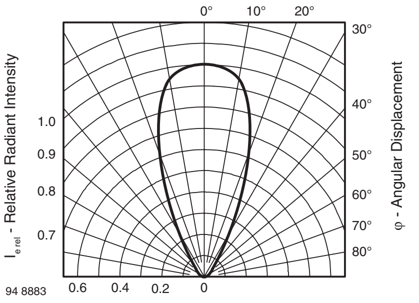
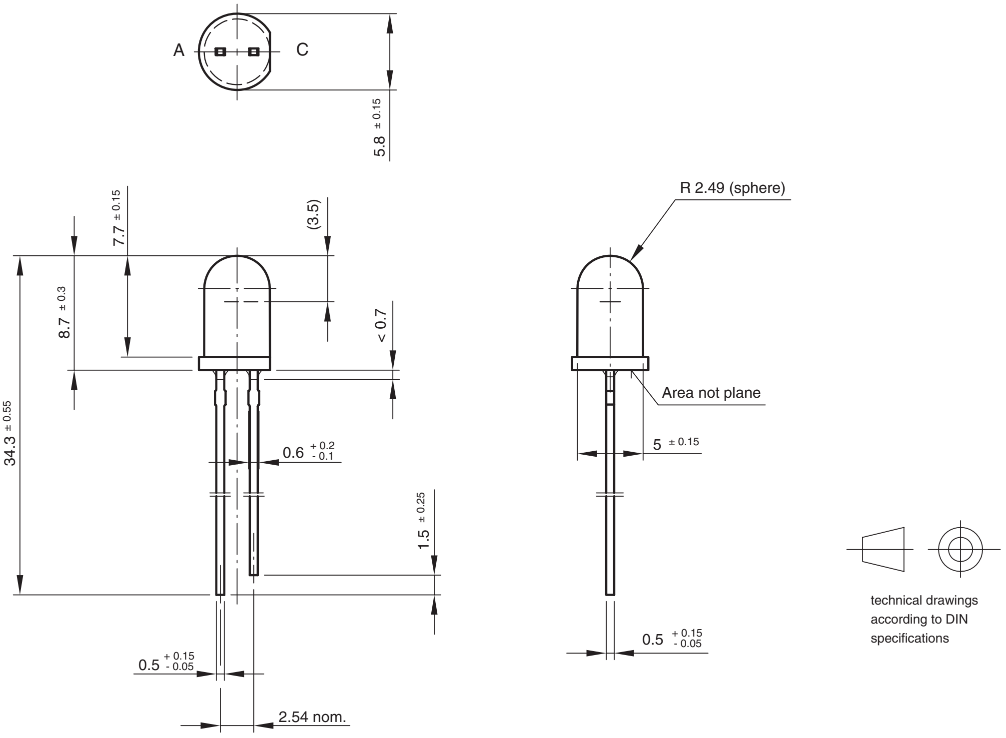


Fig. 8 - Relative Radiant Intensity vs. Angular Displacement

PACKAGE DIMENSIONS in millimeters



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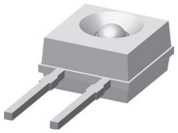
Issue: 5; 27.09.05
19257

Infrared Emitting Diode, RoHS Compliant, 950 nm, GaAs



DESCRIPTION

The TSKS5400-FSZ is an infrared, 950 nm emitting diode in GaAs technology with high radiant power, molded in a clear plastic package.

FEATURES

- Package type: leaded
- Package form: side view lens
- Dimensions (L x W x H in mm): 5 x 2.65 x 5
- Peak wavelength: λ_p = 950 nm
- High reliability
- High radiant power
- High radiant intensity
- Angle of half intensity: φ = ± 30°
- Low forward voltage
- Suitable for high pulse current operation
- Good spectral matching with Si photodetectors
- Package matched with detector TEKS5400
- Lead (Pb)-free component in accordance with RoHS 2002/95/EC and WEEE 2002/96/EC

Pb-free
e3
RoHS
COMPLIANT

APPLICATIONS

- Photointerrupters
- Transmissive sensors, gap sensors
- Reflective sensors

PRODUCT SUMMARY

COMPONENT	I_e (mW/sr)	φ (deg)	λ_P (nm)	t_r (ns)
TSKS5400-FSZ	4.5	± 30	950	400

Note
Test conditions see table “Basic Characteristics”

ORDERING INFORMATION

ORDERING CODE	PACKAGING	REMARKS	PACKAGE FORM
TSKS5400-FSZ	Tape and ammopack	MOQ: 2000 pcs, 2000 pcs/ammopack	Side view lens

Note
MOQ: minimum order quantity

ABSOLUTE MAXIMUM RATINGS

PARAMETER	TEST CONDITION	SYMBOL	VALUE	UNIT
Reverse voltage		V_R	6	V
Forward current		I_F	100	mA
Surge forward current	$t_p \leq 100$ µs	I_{FSM}	2	A
Power dissipation		P_V	170	mW
Junction temperature		T_j	100	°C
Operating temperature range		T_{amb}	- 25 to + 85	°C
Storage temperature range		T_{stg}	- 40 to + 100	°C
Soldering temperature	$t \leq 5$ s, 2 mm from case	T_{sd}	260	°C
Thermal resistance junction/ambient	J-STD-051, leads 7 mm, soldered on PCB	R_{thJA}	270	K/W

Note
T_{amb} = 25 °C, unless otherwise specified

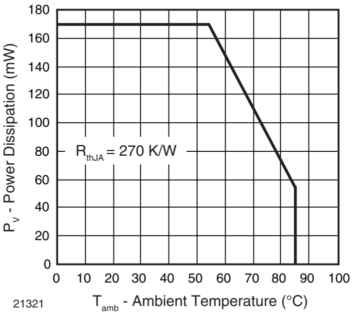


Fig. 1 - Power Dissipation Limit vs. Ambient Temperature

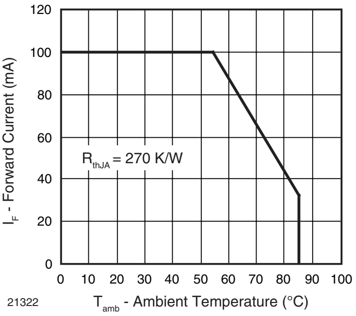


Fig. 2 - Forward Current Limit vs. Ambient Temperature

BASIC CHARACTERISTICS						
PARAMETER	**TEST CONDITION**	**SYMBOL**	**MIN.**	**TYP.**	**MAX.**	**UNIT**
Forward voltage	$I_F = 100$ mA, $t_p \leq 20$ ms	V_F		1.3	1.7	V
Reverse voltage	$I_R = 10$ µA	V_R	6			V
Temperature coefficient of V_F	$I_F = 100$ mA	TK_{VF}		- 1.3		mV/K
Junction capacitance	$V_R = 0$ V, f = 1 MHz, E = 0	C_j		30		pF
Radiant intensity	$I_F = 100$ mA, $t_p \leq 20$ ms	I_e		4.5		mW/sr
Radiant power	$I_F = 50$ mA, $t_p \leq 20$ ms	ϕ_e		10		mW
Temperature coefficient of ϕ_e	$I_F = 50$ mA	$TK\phi_e$		- 0.8		%/K
Angle of half sensitivity		φ		± 30		deg
Peak wavelength	$I_F = 50$ mA	λ_p		950		nm
Spectral bandwidth	$I_F = 50$ mA	$\Delta\lambda$		50		nm
Rise time	$I_F = 1$ A, $t_p/T = 0.01$, $t_p \leq 10$ µs	t_r		400		ns
Fall time	$I_F = 1$ A, $t_p/T = 0.01$, $t_p \leq 10$ µs	t_f		450		ns

Note

$T_{amb} = 25$ °C, unless otherwise specified

BASIC CHARACTERISTICS

$T_{amb} = 25$ °C, unless otherwise specified

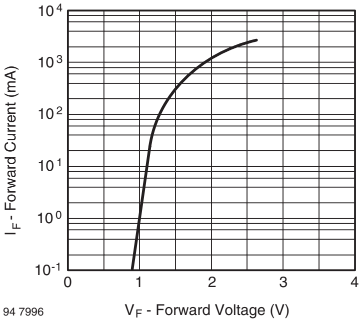


Fig. 3 - Pulse Forward Current vs. Forward Voltage

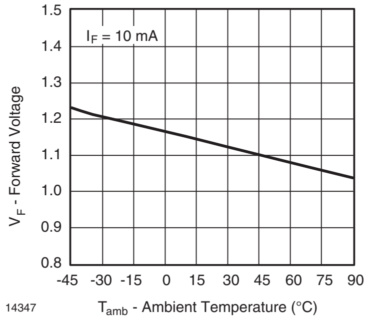


Fig. 4 - Forward Voltage vs. Ambient Temperature

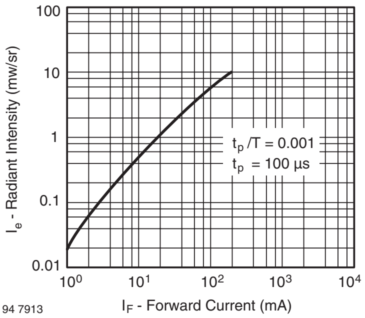


Fig. 5 - Radiant Intensity vs. Forward Current

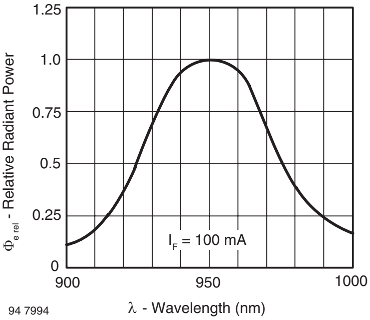


Fig. 8 - Relative Radiant Power vs. Wavelength

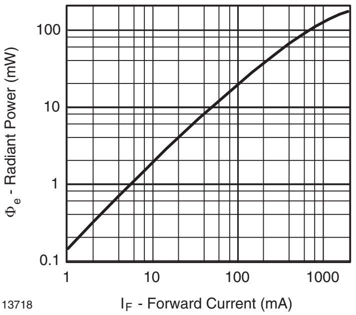


Fig. 6 - Radiant Power vs. Forward Current

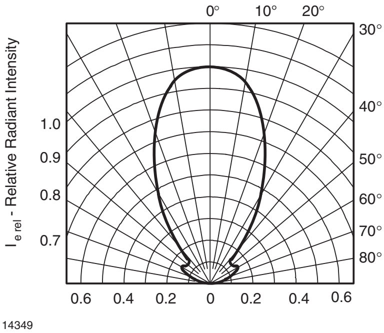


Fig. 9 - Relative Radiant Intensity vs. Angular Displacement

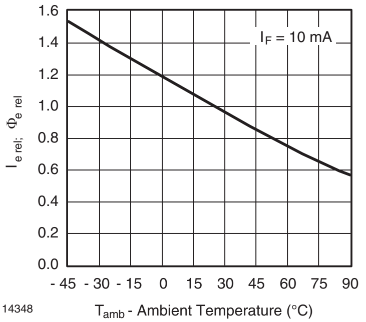
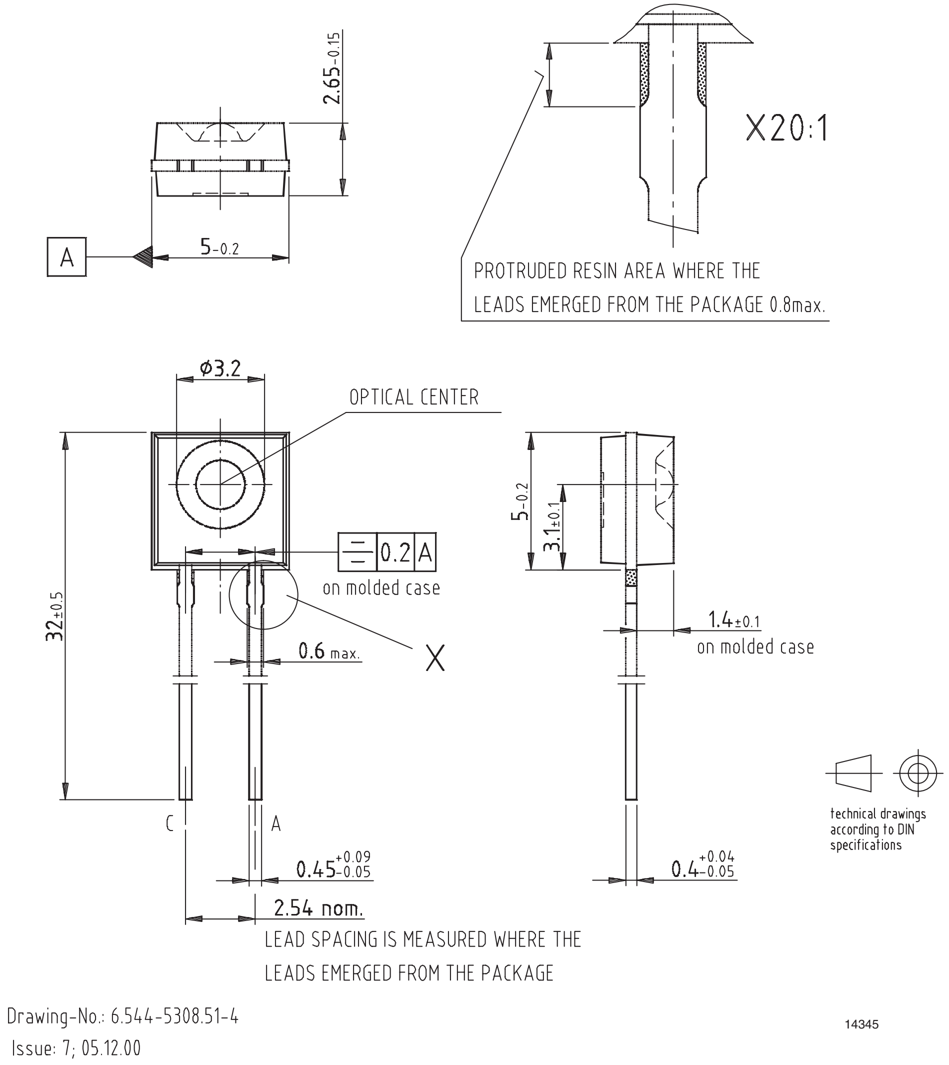


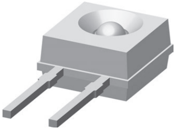
Fig. 7 - Relative Radiant Intensity vs. Ambient Temperature

PACKAGE DIMENSIONS in millimeters



14345

Infrared Emitting Diode, RoHS Compliant, 950 nm, GaAs



DESCRIPTION

The TSKS5400S is an infrared, 950 nm emitting diode in GaAs technology with high radiant power, molded in a clear plastic package.

FEATURES

- Package type: leaded
- Package form: side view lens
- Dimensions (L x W x H in mm): 5 x 2.65 x 5
- Peak wavelength: λ_p = 950 nm
- High reliability
- High radiant power
- High radiant intensity
- Angle of half intensity: φ = ± 30°
- Low forward voltage
- Suitable for high pulse current operation
- Good spectral matching with Si photodetectors
- Package matched with detector TEKS5400
- Lead (Pb)-free component in accordance with RoHS 2002/95/EC and WEEE 2002/96/EC

Pb Pb-free

e3

RoHS COMPLIANT

APPLICATIONS

- Photointerrupters
- Transmissive sensors, gap sensors
- Reflective sensors

PRODUCT SUMMARY

COMPONENT	I_e (mW/sr)	φ (deg)	λ_P (nm)	t_r (ns)
TSKS5400S	4.5	± 30	950	400

Note

Test conditions see table “Basic Characteristics”

ORDERING INFORMATION

ORDERING CODE	PACKAGING	REMARKS	PACKAGE FORM
TSKS5400S	Bulk	MOQ: 2000 pcs, 2000 pcs/bulk	Side view lens

Note

MOQ: minimum order quantity

ABSOLUTE MAXIMUM RATINGS

PARAMETER	TEST CONDITION	SYMBOL	VALUE	UNIT
Reverse voltage		V_R	6	V
Forward current		I_F	100	mA
Surge forward current	$t_p \leq 100\ \mu s$	I_{FSM}	2	A
Power dissipation		P_V	170	mW
Junction temperature		T_j	100	°C
Operating temperature range		T_{amb}	- 25 to + 85	°C
Storage temperature range		T_{stg}	- 40 to + 100	°C
Soldering temperature	t ≤ 5 s, 2 mm from case	T_{sd}	260	°C
Thermal resistance junction/ambient	J-STD-051, leads 7 mm, soldered on PCB	R_{thJA}	270	K/W

Note

T_{amb} = 25 °C, unless otherwise specified

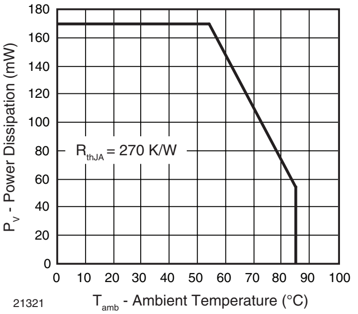


Fig. 1 - Power Dissipation Limit vs. Ambient Temperature

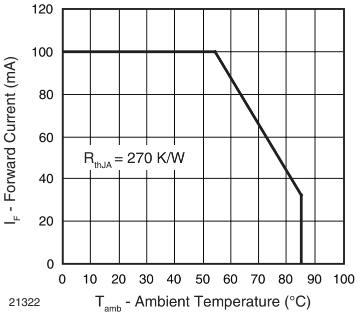


Fig. 2 - Forward Current Limit vs. Ambient Temperature

BASIC CHARACTERISTICS						
PARAMETER	TEST CONDITION	SYMBOL	MIN.	TYP.	MAX.	UNIT
Forward voltage	I_F = 100 mA, $t_p \leq$ 20 ms	V_F		1.3	1.7	V
Reverse voltage	I_R = 10 µA	V_R	6			V
Temperature coefficient of V_F	I_F = 100 mA	TK_{VF}		- 1.3		mV/K
Junction capacitance	V_R = 0 V, f = 1 MHz, E = 0	C_j		50		pF
Radiant intensity	I_F = 100 mA, $t_p \leq$ 20 ms	I_e		4.5		mW/sr
Radiant power	I_F = 50 mA, $t_p \leq$ 20 ms	ϕ_e		10		mW
Temperature coefficient of ϕ_e	I_F = 50 mA	$TK\phi_e$		- 1.0		%/K
Angle of half sensitivity		φ		± 30		deg
Peak wavelength	I_F = 50 mA	λ_p		950		nm
Spectral bandwidth	I_F = 50 mA	$\Delta\lambda$		50		nm
Rise time	I_F = 1 A, t_p/T = 0.01, $t_p \leq$ 10 µs	t_r		400		ns
Fall time	I_F = 1 A, t_p/T = 0.01, $t_p \leq$ 10 µs	t_f		450		ns

Note

T_{amb} = 25 °C, unless otherwise specified

BASIC CHARACTERISTICS

T_{amb} = 25 °C, unless otherwise specified

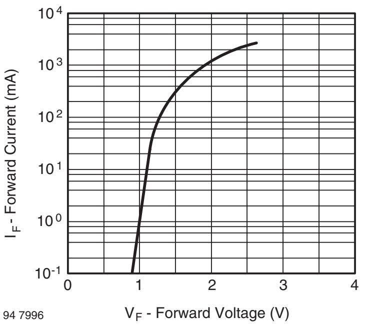


Fig. 3 - Pulse Forward Current vs. Forward Voltage

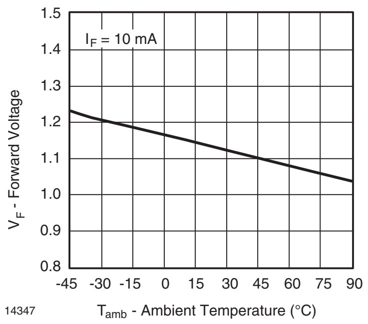


Fig. 4 - Forward Voltage vs. Ambient Temperature

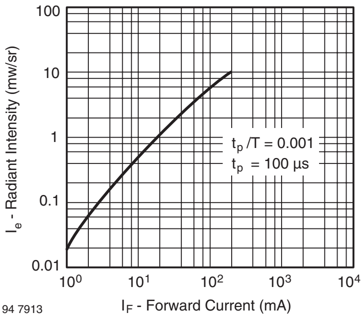


Fig. 5 - Radiant Intensity vs. Forward Current

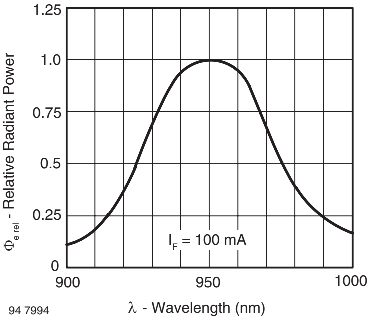


Fig. 8 - Relative Radiant Power vs. Wavelength

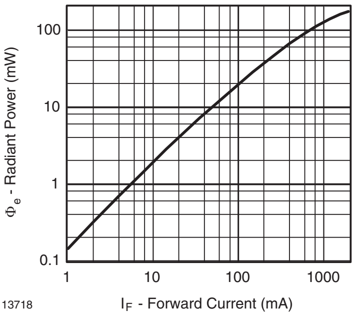


Fig. 6 - Radiant Power vs. Forward Current

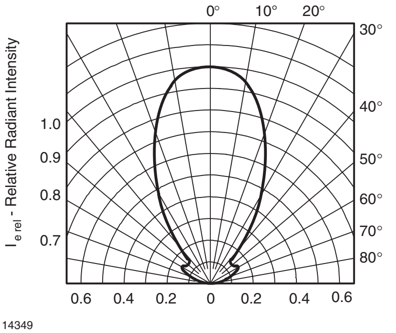


Fig. 9 - Relative Radiant Intensity vs. Angular Displacement

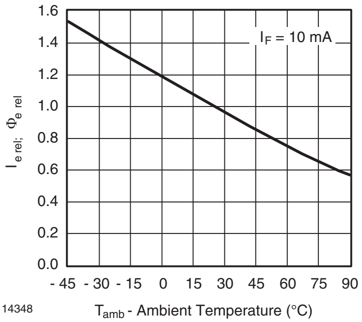
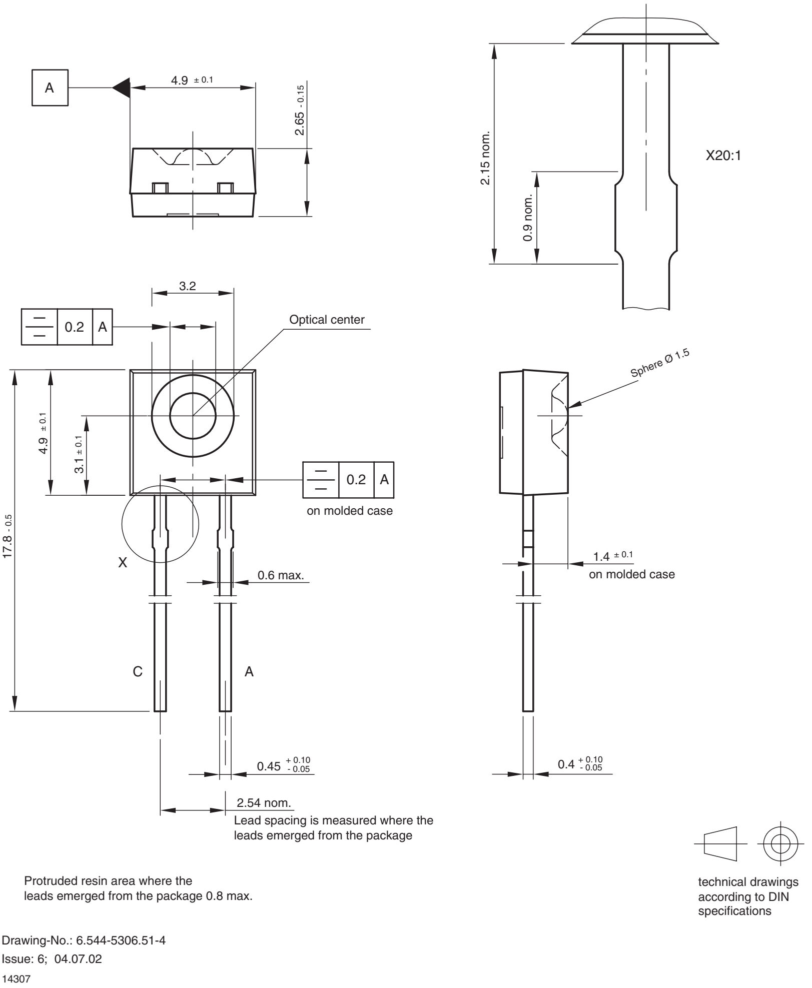
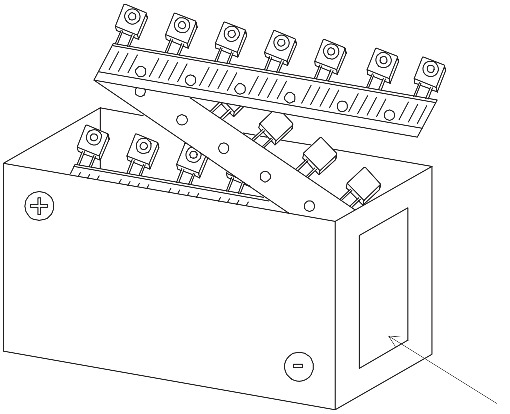


Fig. 7 - Relative Radiant Intensity vs. Ambient Temperature

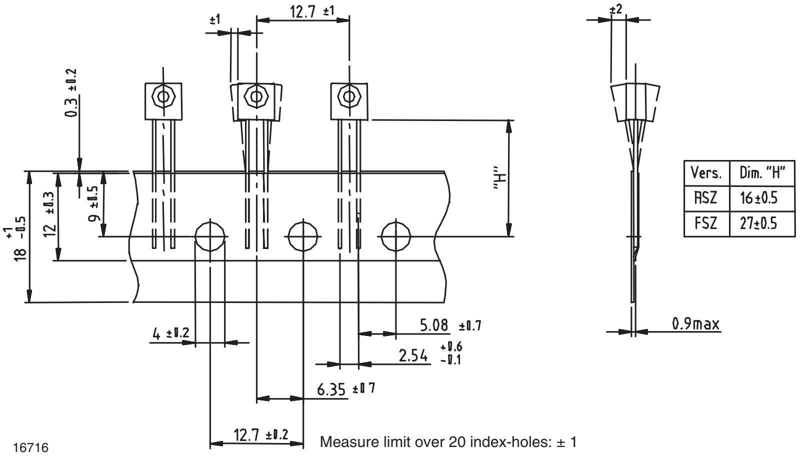
PACKAGE DIMENSIONS in millimeters



TAPE AND AMMOPACK STANDARDS Dimensions in millimeters



Labeling: barcode-label see 5.6.4

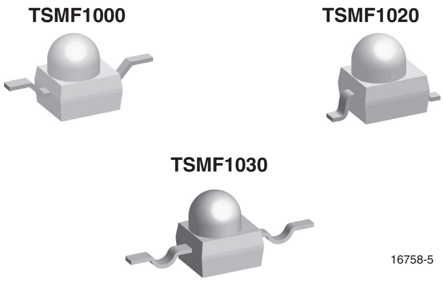


Vers.	Dim. "H"
ASZ	16±0.5
FSZ	27±0.5

Measure limit over 20 index-holes: ± 1

16716

High Speed Infrared Emitting Diode, RoHS Compliant, 890 nm, GaAlAs Double Hetero



DESCRIPTION

TSMF1000 series are infrared, 890 nm emitting diodes in GaAlAs double hetero (DH) technology with high radiant power and high speed, molded in clear, untinted plastic packages (with lens) for surface mounting (SMD).

FEATURES

- Package type: surface mount
- Package form: GW, RGW, yoke, axial
- Dimensions (L x W x H in mm): 2.5 x 2 x 2.7
- Peak wavelength: λ_p = 890 nm
- High radiant power
- Angle of half intensity: φ = ± 17°
- Low forward voltage
- Suitable for high pulse current operation
- Versatile terminal configurations
- Package matches with detector TEMD1000
- Floor life: 168 h, MSL 3, acc. J-STD-020
- Lead (Pb)-free component in accordance with RoHS 2002/95/EC and WEEE 2002/96/EC

APPLICATIONS

- IrDA compatible data transmission
- Miniature light barrier
- Photointerrupters
- Optical switch
- Control and drive circuits
- Shaft encoders

PRODUCT SUMMARY

COMPONENT	I_e (mW/sr)	φ (deg)	λ_P (nm)	t_r (ns)
TSMF1000	5	± 17	890	30
TSMF1020	5	± 17	890	30
TSMF1030	5	± 17	890	30

Note
Test conditions see table “Basic Characteristics”

ORDERING INFORMATION

ORDERING CODE	PACKAGING	REMARKS	PACKAGE FORM
TSMF1000	Tape and reel	MOQ: 1000 pcs, 1000 pcs/reel	Reverse gullwing
TSMF1020	Tape and reel	MOQ: 1000 pcs, 1000 pcs/reel	Gullwing
TSMF1030	Tape and reel	MOQ: 1000 pcs, 1000 pcs/reel	Yoke

Note
MOQ: minimum order quantity

ABSOLUTE MAXIMUM RATINGS

PARAMETER	TEST CONDITION	SYMBOL	VALUE	UNIT
Reverse voltage		V_R	5	V
Forward current		I_F	100	mA
Peak forward current	$t_p/T = 0.5$, $t_p = 100$ µs	I_{FM}	200	mA
Surge forward current	$t_p = 100$ µs	I_{FSM}	0.8	A
Power dissipation		P_V	180	mW

ABSOLUTE MAXIMUM RATINGS

PARAMETER	TEST CONDITION	SYMBOL	VALUE	UNIT
Junction temperature		T_j	100	°C
Operating temperature range		T_{amb}	- 40 to + 85	°C
Storage temperature range		T_{stg}	- 40 to + 100	°C
Soldering temperature	$t \leq 5$ s	T_{sd}	260	°C
Thermal resistance junction/ambient	Soldered on PCB, pad dimensions: 4 mm x 4 mm	R_{thJA}	400	K/W

Note

T_{amb} = 25 °C, unless otherwise specified

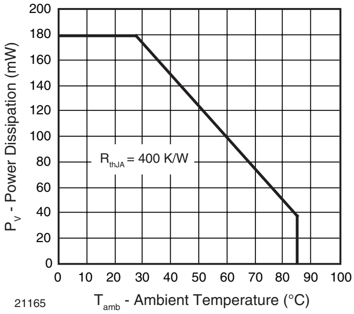


Fig. 1 - Power Dissipation Limit vs. Ambient Temperature

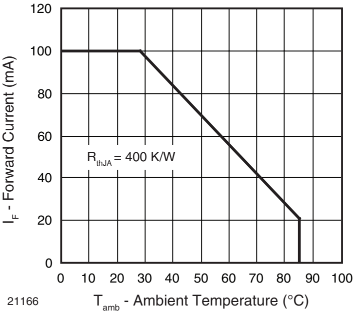


Fig. 2 - Forward Current Limit vs. Ambient Temperature

BASIC CHARACTERISTICS

PARAMETER	TEST CONDITION	SYMBOL	MIN.	TYP.	MAX.	UNIT
Forward voltage	I_F = 20 mA	V_F		1.3	1.5	V
	I_F = 1 A, t_p = 100 µs	V_F		2.4		V
Temperature coefficient of V_F	I_F = 1 mA	TK_{VF}		- 1.8		mV/K
Reverse current	V_R = 5 V	I_R			10	µA
Junction capacitance	V_R = 0 V, f = 1 MHz, E = 0	C_j		160		pF
Radiant intensity	I_F = 20 mA	I_e	2.5	5	13	mW/sr
	I_F = 100 mA, t_p = 100 µs	I_e		25		mW/sr
Radiant power	I_F = 100 mA, t_p = 20 ms	ϕ_e		35		mW
Temperature coefficient of ϕ_e	I_F = 20 mA	$TK\phi_e$		- 0.6		%/K
Angle of half intensity		φ		± 17		deg
Peak wavelength	I_F = 20 mA	λ_p		890		nm
Spectral bandwidth	I_F = 20 mA	$\Delta\lambda$		40		nm
Temperature coefficient of λ_p	I_F = 20 mA	$TK\lambda_p$		0.2		nm/K
Rise time	I_F = 20 mA	t_r		30		ns
Fall time	I_F = 20 mA	t_f		30		ns
Cut-off frequency	I_{DC} = 70 mA, I_{AC} = 30 mA pp	f_c		12		MHz
Virtual source diameter		d		1.2		mm

Note

T_{amb} = 25 °C, unless otherwise specified

BASIC CHARACTERISTICS

T_{amb} = 25 °C, unless otherwise specified

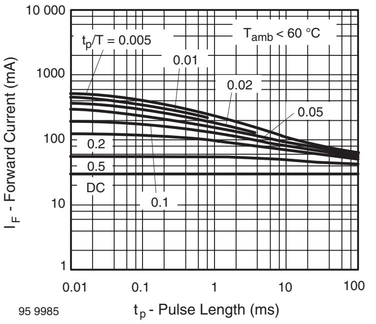


Fig. 3 - Pulse Forward Current vs. Pulse Duration

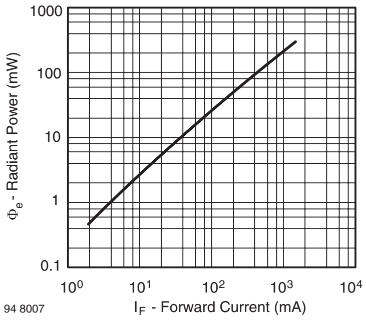


Fig. 6 - Radiant Power vs. Forward Current

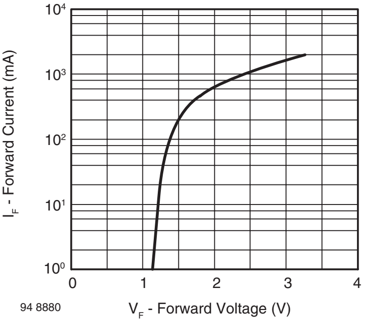


Fig. 4 - Forward Current vs. Forward Voltage

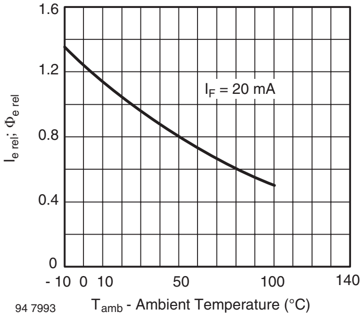


Fig. 7 - Rel. Radiant Intensity/Power vs. Ambient Temperature

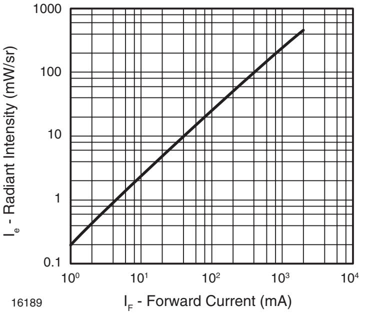


Fig. 5 - Radiant Intensity vs. Forward Current

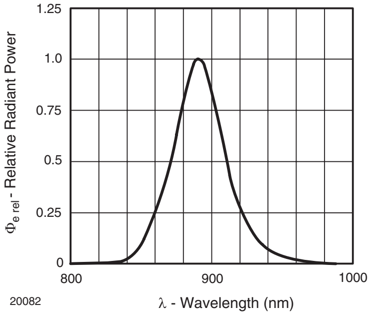


Fig. 8 - Relative Radiant Power vs. Wavelength

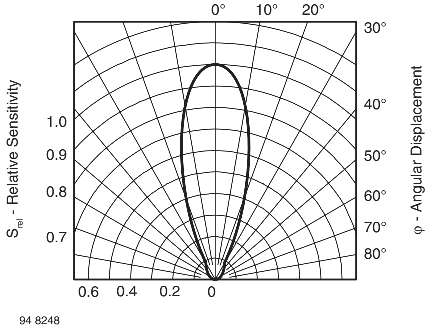


Fig. 9 - Relative Radiant Intensity vs. Angular Displacement

REFLOW SOLDER PROFILE

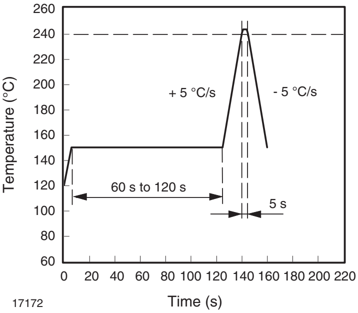


Fig. 10 - Lead Tin (SnPb) Reflow Solder Profile

PRECAUTIONS FOR USE

1. Over-current-proof

Customer must apply resistors for protection, otherwise slight voltage shift will cause big current change (burn out will happen).

2. Storage

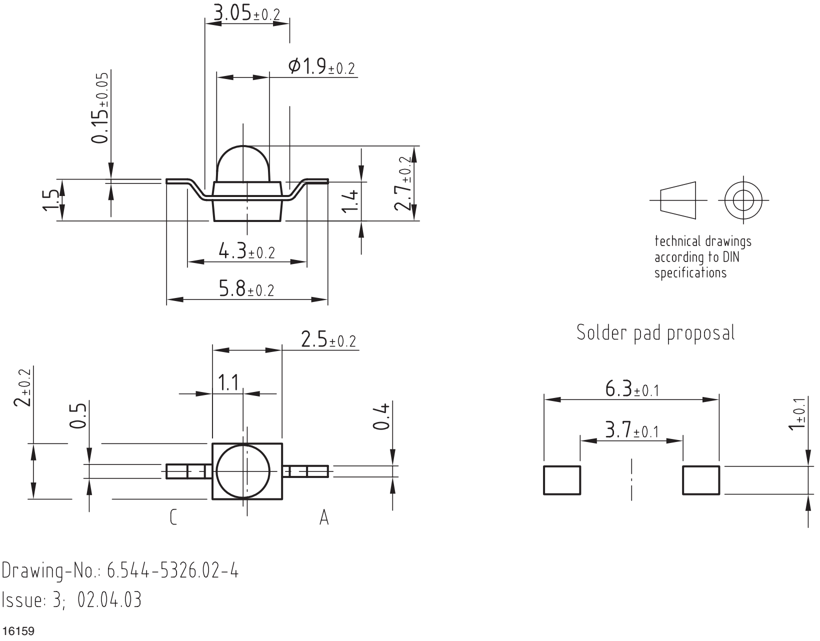
2.1 Storage temperature and rel. humidity conditions are: 5 °C to 35 °C, R.H. 60 %.

2.2 Floor life must not exceed 168 h, acc. to JEDEC level 3, J-STD-020.
Once the package is opened, the products should be used within a week. Otherwise, they should be kept in a damp proof box with desiccant.
Considering tape life, we suggest to use products within one year from production date.

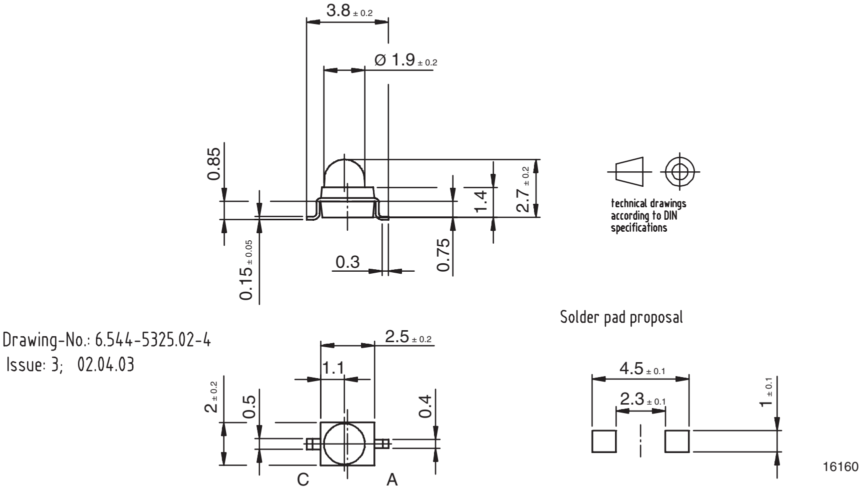
2.3 If opened more than one week in an atmosphere 5 °C to 35 °C, R.H. 60 %, devices should be treated at 60 °C ± 5 °C for 15 h.

2.4 If humidity indicator in the package shows pink color (normal blue), then devices should be treated with the same conditions as 2.3.

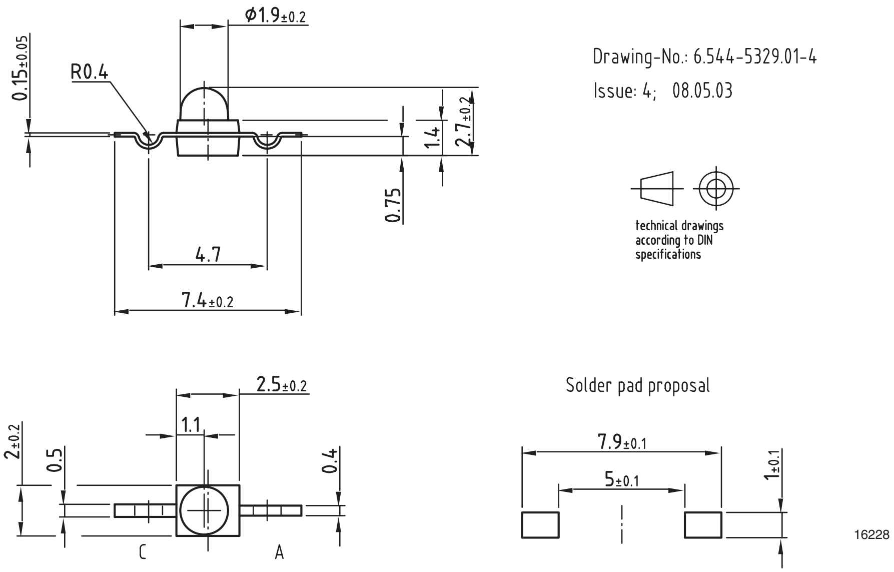
PACKAGE DIMENSIONS in millimeters: **TSMF1000**



PACKAGE DIMENSIONS in millimeters: **TSMF1020**

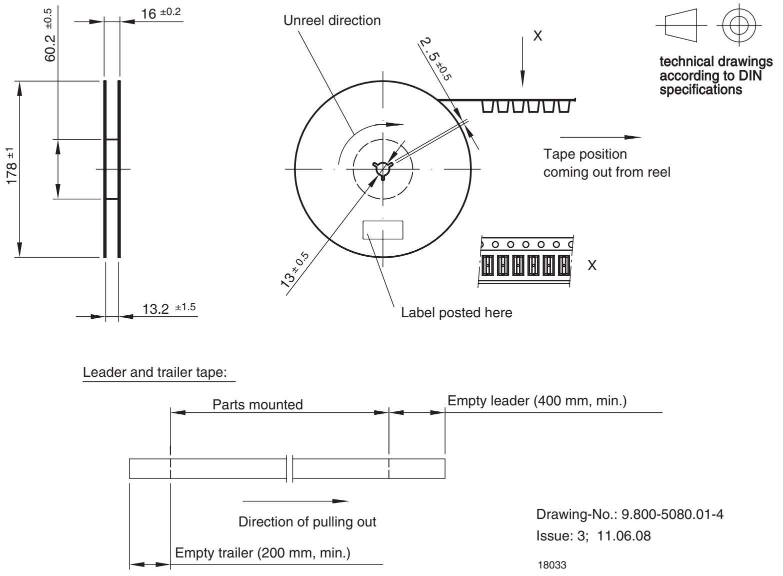


PACKAGE DIMENSIONS in millimeters: **TSMF1030**



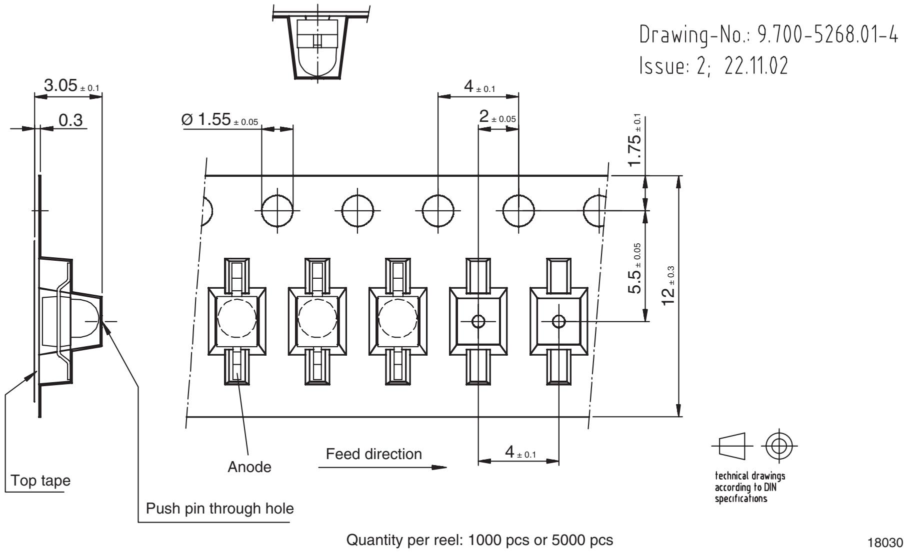
Drawing-No.: 6.544-5329.01-4
Issue: 4; 08.05.03

REEL DIMENSIONS in millimeters



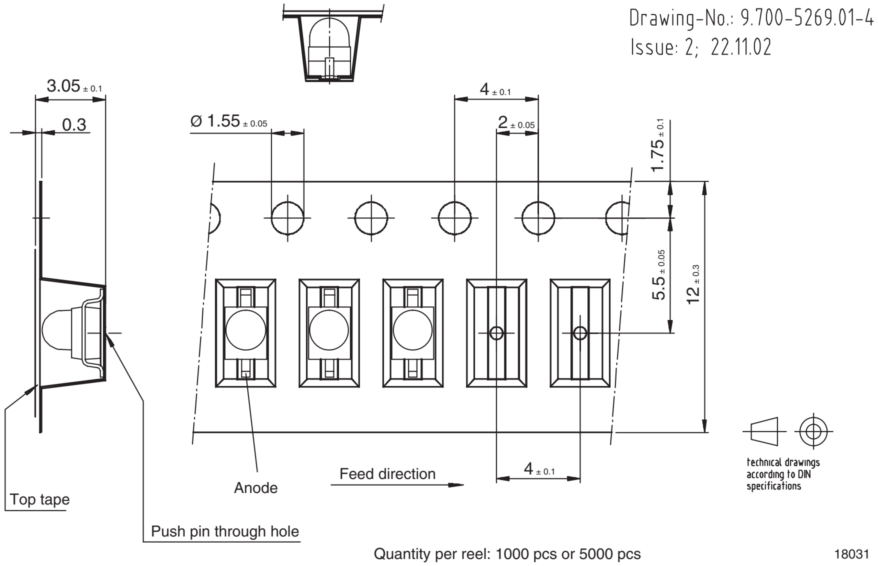
Drawing-No.: 9.800-5080.01-4
Issue: 3; 11.06.08

TAPING DIMENSIONS in millimeters: **TSMF1000**



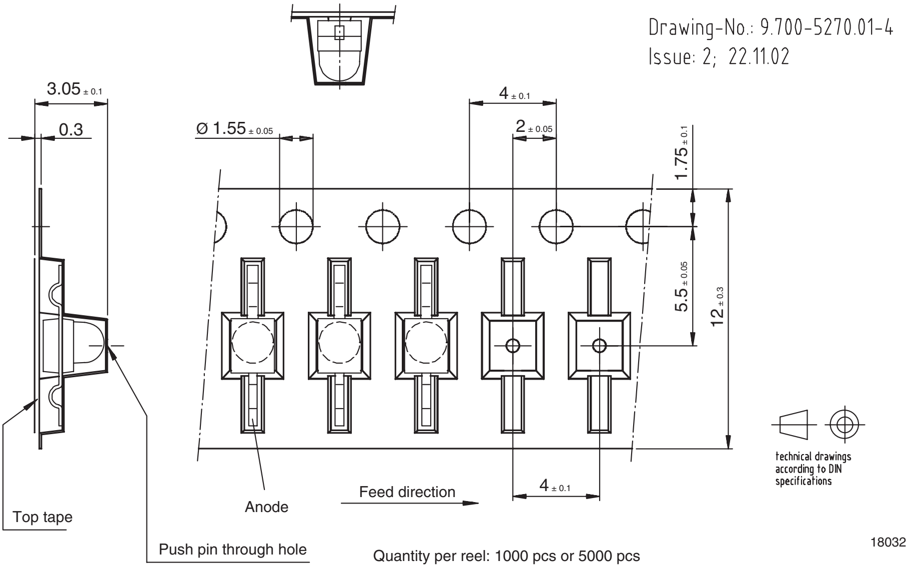
Quantity per reel: 1000 pcs or 5000 pcs

TAPING DIMENSIONS in millimeters: **TSMF1020**



Quantity per reel: 1000 pcs or 5000 pcs

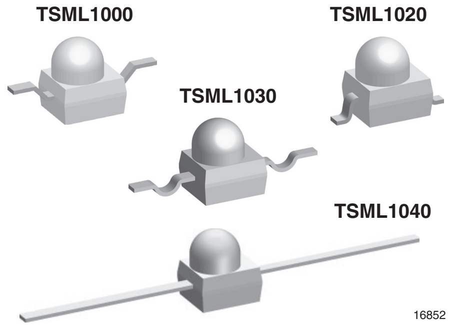
TAPING DIMENSIONS in millimeters: **TSMF1030**



TSML1000, TSML1020, TSML1030, TSML1040

Vishay Semiconductors

High Power Infrared Emitting Diode, RoHS Compliant, 940 nm, GaAlAs/GaAs



DESCRIPTION

TSML1000 is an infrared, 940 nm emitting diode in GaAlAs/GaAs with high radiant power molded in a clear, untinted plastic package (with lens) for surface mounting (SMD).

FEATURES

- Package type: surface mount
- Package form: GW, RGW, yoke, axial
- Dimensions (L x W x H in mm): 2.5 x 2 x 2.7
- Peak wavelength: λ_p = 940 nm
- High radiant power
- High radiant intensity
- Angle of half intensity: φ = ± 12°
- Low forward voltage
- Suitable for high pulse current operation
- Good spectral matching with Si photodetectors
- Versatile terminal configurations
- Package matches with detector TEMT1000
- Floor life: 168 h, MSL 3, acc. J-STD-020
- Lead (Pb)-free component in accordance with RoHS 2002/95/EC and WEEE 2002/96/EC

APPLICATIONS

- For remote control
- Punched tape readers
- Encoder
- Photointerrupters

PRODUCT SUMMARY				
COMPONENT	**I_e (mW/sr)**	**φ (deg)**	**λ_P (nm)**	**t_r (ns)**
TSML1000	7	± 12	940	800
TSML1020	7	± 12	940	800
TSML1030	7	± 12	940	800
TSML1040	7	± 12	940	800

Note
Test conditions see table “Basic Characteristics”

ORDERING INFORMATION			
ORDERING CODE	**PACKAGING**	**REMARKS**	**PACKAGE FORM**
TSML1000	Tape and reel	MOQ: 1000 pcs, 1000 pcs/reel	Reverse gullwing
TSML1020	Tape and reel	MOQ: 1000 pcs, 1000 pcs/reel	Gullwing
TSML1030	Tape and reel	MOQ: 1000 pcs, 1000 pcs/reel	Yoke
TSML1040	Bulk	MOQ: 1000 pcs, 1000 pcs/bulk	Axial leads

Note
MOQ: minimum order quantity

ABSOLUTE MAXIMUM RATINGS				
PARAMETER	**TEST CONDITION**	**SYMBOL**	**VALUE**	**UNIT**
Reverse voltage		V_R	5	V
Forward current		I_F	100	mA
Peak forward current	t_p/T = 0.5, t_p = 100 µs	I_{FM}	200	mA
Surge forward current	t_p = 100 µs	I_{FSM}	1.0	A

ABSOLUTE MAXIMUM RATINGS

PARAMETER	TEST CONDITION	SYMBOL	VALUE	UNIT
Power dissipation		P_V	190	mW
Junction temperature		T_j	100	°C
Operating temperature range		T_{amb}	- 40 to + 85	°C
Storage temperature range		T_{stg}	- 40 to + 100	°C
Soldering temperature	$t \leq 5$ s	T_{sd}	< 260	°C
Thermal resistance junction/ambient	Soldered on PCB, pad dimensions: 4 mm x 4 mm	R_{thJA}	400	°C

Note

T_{amb} = 25 °C, unless otherwise specified

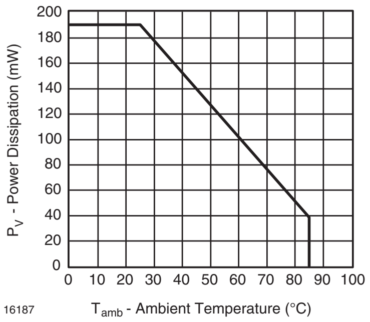


Fig. 1 - Power Dissipation Limit vs. Ambient Temperature

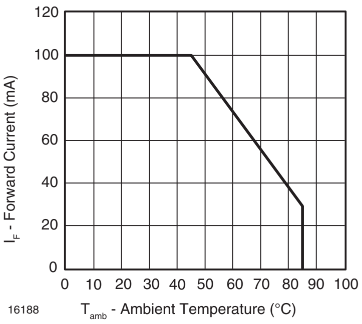


Fig. 2 - Forward Current vs. Ambient Temperature

BASIC CHARACTERISTICS

PARAMETER	TEST CONDITION	SYMBOL	MIN.	TYP.	MAX.	UNIT
Forward voltage	I_F = 20 mA, t_p = 20 ms	V_F		1.2	1.5	V
	I_F = 1 A, t_p = 100 µs	V_F		2.6		V
Temperature coefficient of V_F	I_F = 1 mA	TK_{VF}		- 1.8		mV/K
Reverse current	V_R = 5 V	I_R			10	µA
Junction capacitance	V_R = 0 V, f = 1 MHz, E = 0	C_j		25		pF
Radiant intensity	I_F = 20 mA, t_p = 20 ms	I_e	3	7	15	mW/sr
Radiant power	I_F = 100 mA, t_p = 20 ms	ϕ_e		35		mW
Temperature coefficient of ϕ_e	I_F = 20 mA	$TK\phi_e$		- 0.6		%/K
Angle of half intensity		φ		± 12		deg
Peak wavelength	I_F = 100 mA	λ_p		940		nm
Spectral bandwidth	I_F = 100 mA	$\Delta\lambda$		50		nm
Temperature coefficient of λ_p	I_F = 100 mA	$TK\lambda_p$		0.2		nm/K
Rise time	I_F = 100 mA	t_r		800		ns
Fall time	I_F = 100 mA	t_f		800		ns
Virtual source diameter		d		1.2		mm

Note

T_{amb} = 25 °C, unless otherwise specified

BASIC CHARACTERISTICS

T_{amb} = 25 °C, unless otherwise specified

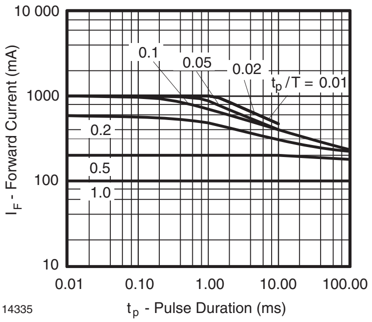


Fig. 3 - Pulse Forward Current vs. Pulse Duration

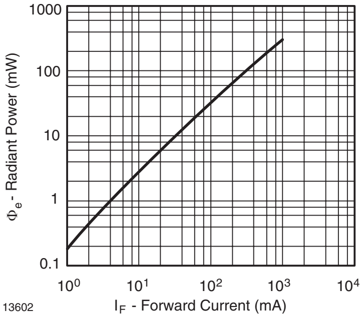


Fig. 6 - Radiant Power vs. Forward Current

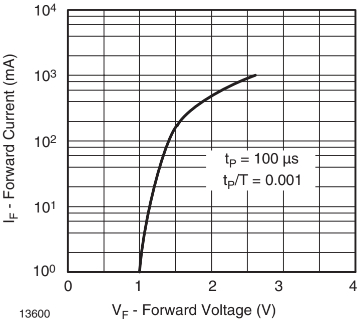


Fig. 4 - Forward Current vs. Forward Voltage

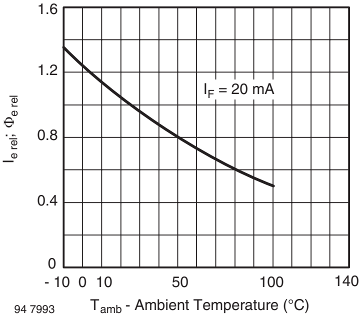


Fig. 7 - Relative Radiant Intensity/Power vs. Ambient Temperature

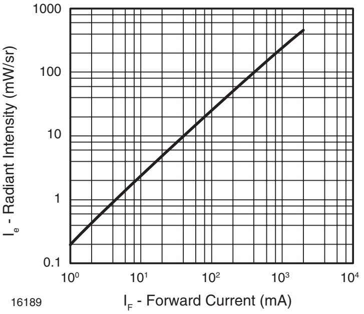


Fig. 5 - Radiant Intensity vs. Forward Current

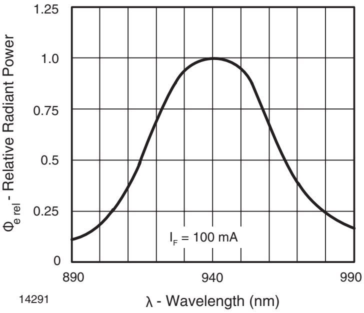


Fig. 8 - Relative Radiant Power vs. Wavelength

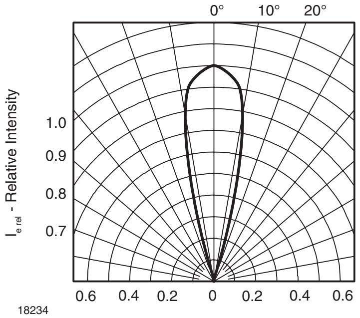


Fig. 9 - Relative Radiant Intensity vs. Angular Displacement

PRECAUTIONS FOR USE

1. Over-current-proof

Customer must apply resistors for protection, otherwise slight voltage shift will cause big current change (burn out will happen).

2. Storage

2.1 Storage temperature and rel. humidity conditions are: 5 °C to 35 °C, R.H. 60 %.

2.2 Floor life must not exceed 168 h, acc. to JEDEC level 3, J-STD-020.
Once the package is opened, the products should be used within a week. Otherwise, they should be kept in a damp proof box with desiccant.
Considering tape life, we suggest to use products within one year from production date.

2.3 If opened more than one week in an atmosphere 5 °C to 35 °C, R.H. 60 %, devices should be treated at 60 °C ± 5 °C for 15 h.

2.4 If humidity indicator in the package shows pink color (normal blue), then devices should be treated with the same conditions as 2.3.

REFLOW SOLDER PROFILE

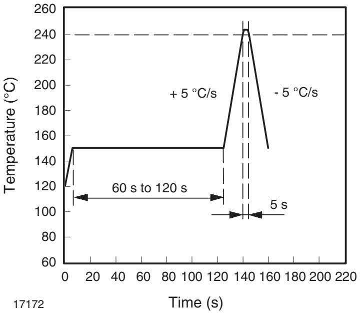
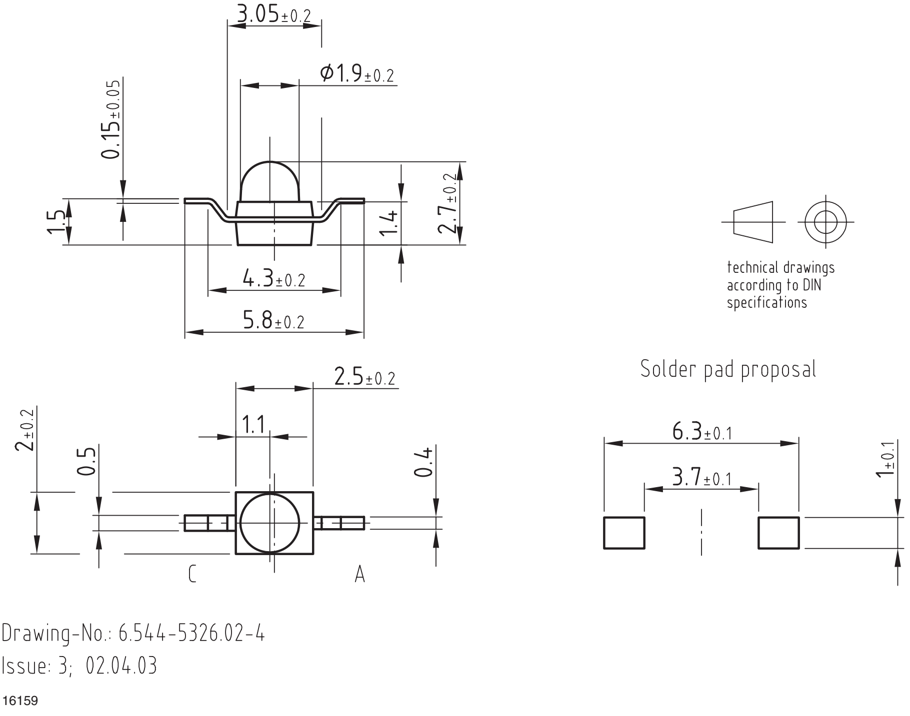
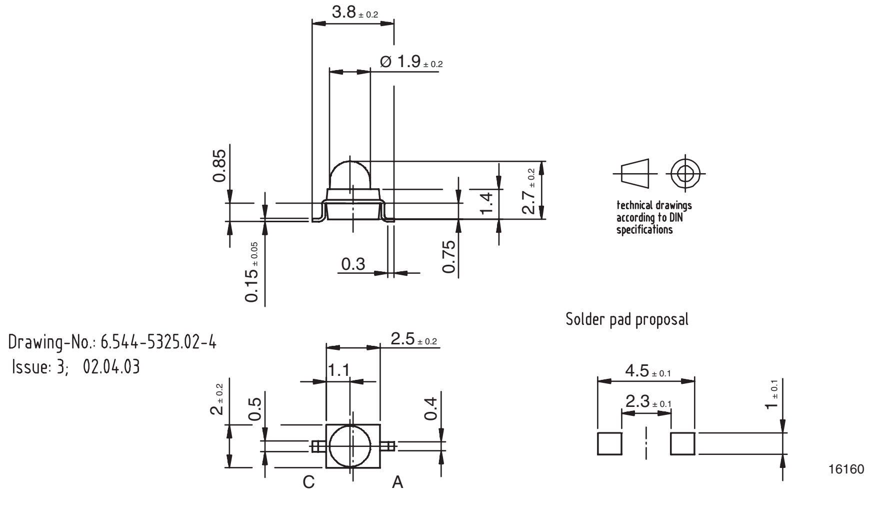


Fig. 10 - Lead Tin (SnPb) Reflow Solder Profile

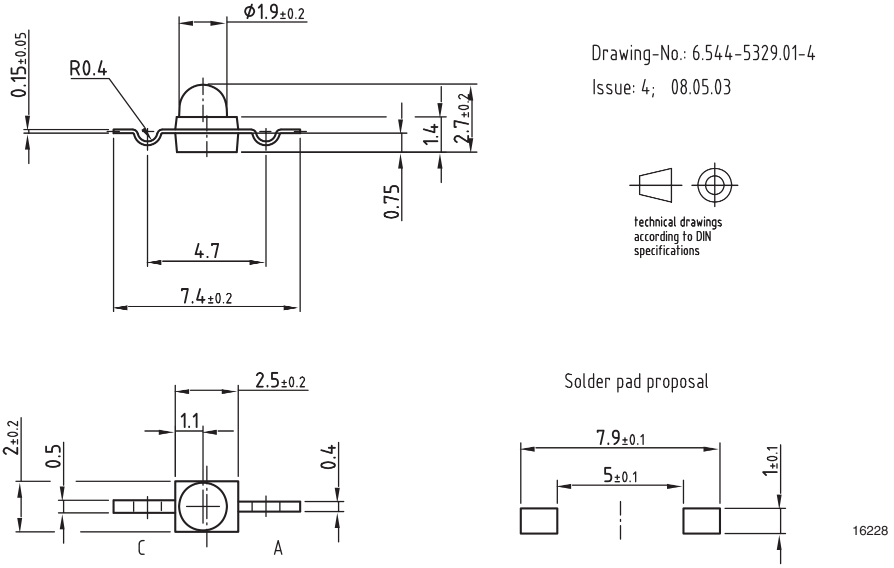
PACKAGE DIMENSIONS in millimeters: **TSML1000**



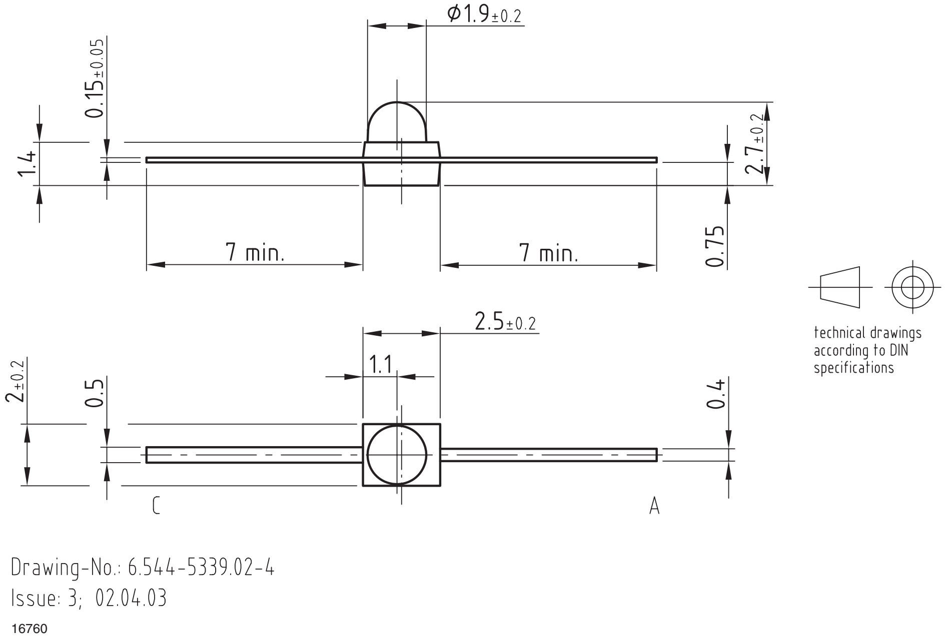
PACKAGE DIMENSIONS in millimeters: **TSML1020**



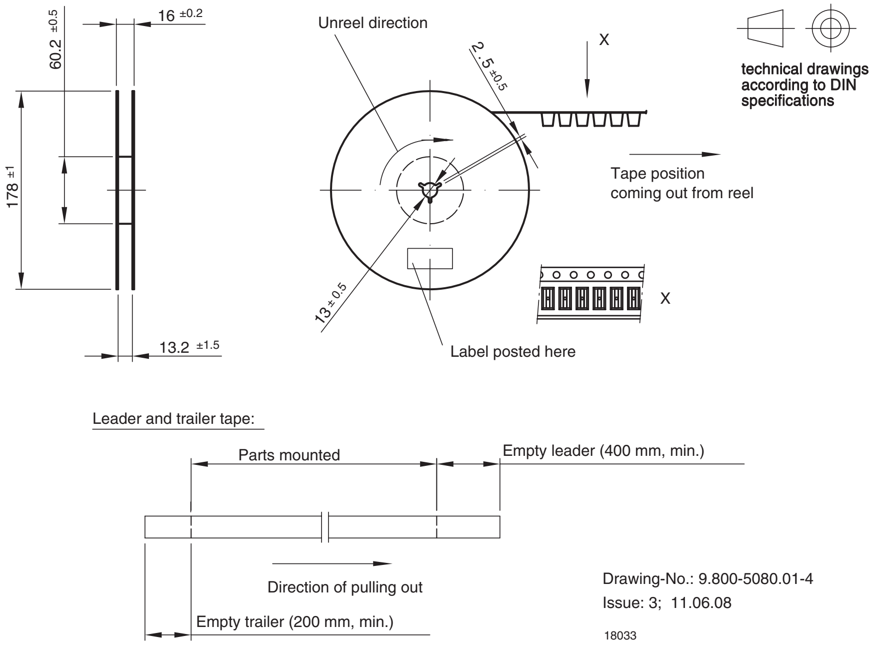
PACKAGE DIMENSIONS in millimeters: **TSML1030**



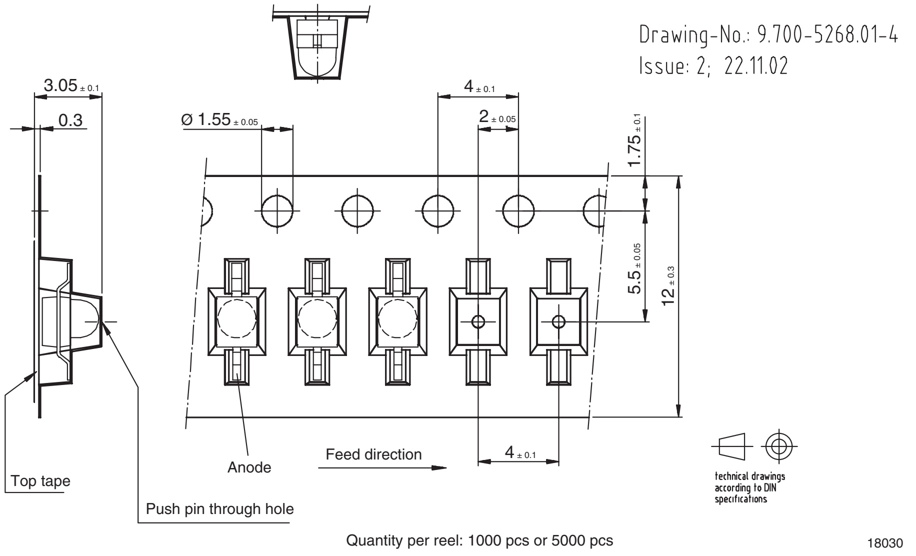
PACKAGE DIMENSIONS in millimeters: **TSML1040**



REEL DIMENSIONS in millimeters



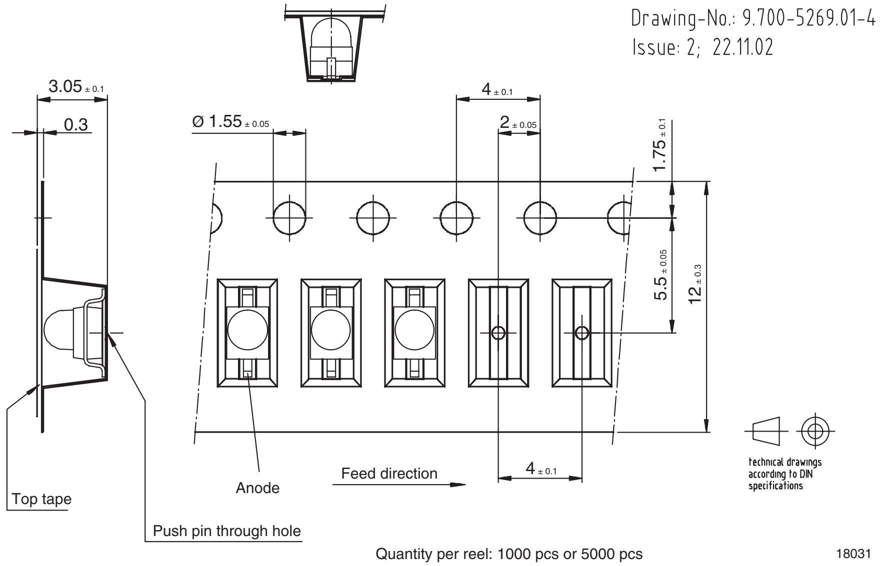
TAPING DIMENSIONS in millimeters: **TSML1000**



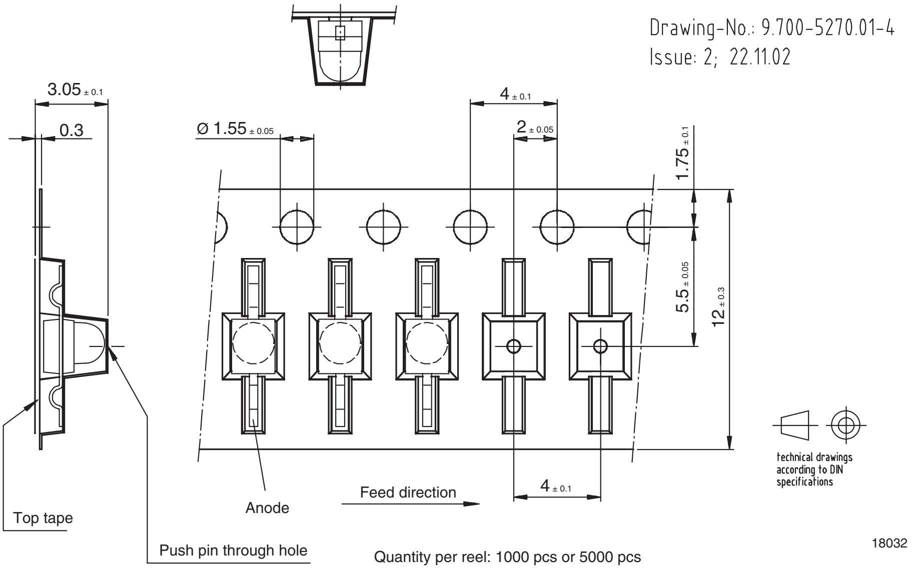
Quantity per reel: 1000 pcs or 5000 pcs

18030

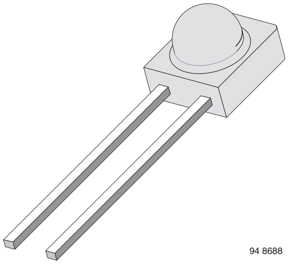
TAPING DIMENSIONS in millimeters: **TSML1020**



TAPING DIMENSIONS in millimeters: **TSML1030**



High Speed Infrared Emitting Diode, RoHS Compliant, 890 nm, GaAlAs Double Hetero



DESCRIPTION

TSSF4500 is an infrared, 890 nm emitting diode in GaAlAs double hetero (DH) technology with high radiant power and high speed, molded in a clear, untinted plastic package.

FEATURES

- Package type: leaded
- Package form: side view
- Dimensions (L x W x H in mm): 4.5 x 4 x 4.8
- Peak wavelength: λ_p = 890 nm
- High reliability
- High radiant power
- High radiant intensity
- Angle of half intensity: φ = ± 22°
- Low forward voltage
- Suitable for high pulse current operation
- High modulation bandwidth: f_c = 12 MHz
- Good spectral matching with Si photodetectors
- Lead (Pb)-free component in accordance with RoHS 2002/95/EC and WEEE 2002/96/EC

Pb-free

e4

RoHS
COMPLIANT

APPLICATIONS

- Infrared high speed remote control and free air data transmission systems with high modulation frequencies or high data transmission rate requirements
- TSSF4500 is ideal for the design of transmission systems according to IrDA requirements and for carrier frequency based systems (e.g. ASK/FSK - coded, 450 kHz or 1.3 MHz)

PRODUCT SUMMARY

COMPONENT	I_e (mW/sr)	φ (deg)	λ_p (nm)	t_r (ns)
TSSF4500	20	± 22	890	30

Note

Test conditions see table “Basic Characteristics”

ORDERING INFORMATION

ORDERING CODE	PACKAGING	REMARKS	PACKAGE FORM
TSSF4500	Bulk	MOQ: 4000 pcs, 4000 pcs/bulk	Side view

Note

MOQ: minimum order quantity

ABSOLUTE MAXIMUM RATINGS

PARAMETER	TEST CONDITION	SYMBOL	VALUE	UNIT
Reverse voltage		V_R	5	V
Forward current		I_F	100	mA
Peak forward current	$t_p/T = 0.5$, t_p = 100 µs	I_{FM}	200	mA
Surge forward current	t_p = 100 µs	I_{FSM}	1.5	A
Power dissipation		P_V	160	mW

ABSOLUTE MAXIMUM RATINGS

PARAMETER	TEST CONDITION	SYMBOL	VALUE	UNIT
Junction temperature		T_j	100	°C
Operating temperature range		T_{amb}	- 40 to + 100	°C
Storage temperature range		T_{stg}	- 40 to + 100	°C
Soldering temperature	$t \leq 5$ s, 2 mm from case	T_{sd}	260	°C
Thermal resistance junction/ambient	Leads not soldered	R_{thJA}	450	K/W

Note

T_{amb} = 25 °C, unless otherwise specified

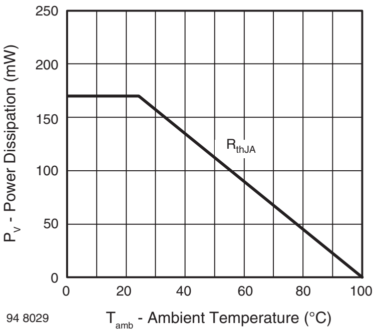


Fig. 1 - Power Dissipation Limit vs. Ambient Temperature

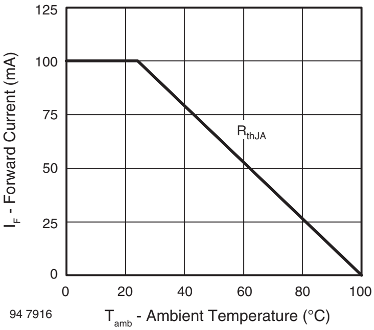


Fig. 2 - Forward Current Limit vs. Ambient Temperature

BASIC CHARACTERISTICS

PARAMETER	TEST CONDITION	SYMBOL	MIN.	TYP.	MAX.	UNIT
Forward voltage	I_F = 100 mA, t_p = 20 ms	V_F		1.35	1.6	V
	I_F = 1.5 A, t_p = 100 µs	V_F		2.4		V
Temperature coefficient of V_F	I_F = 1 mA	TK_{VF}		- 1.8		mV/K
Reverse current	V_R = 5 V	I_R			10	µA
Junction capacitance	V_R = 0 V, f = 1 MHz, E = 0	C_j		160		pF
Radiant intensity	I_F = 100 mA, t_p = 20 ms	I_e	10	20	50	mW/sr
	I_F = 1 A, t_p = 100 µs	I_e		200		mW/sr
Radiant power	I_F = 100 mA, t_p = 20 ms	ϕ_e		35		mW
Temperature coefficient of ϕ_e	I_F = 100 mA	$TK\phi_e$		- 0.7		%/K
Angle of half intensity		φ		± 22		deg
Peak wavelength	I_F = 100 mA	λ_p		890		nm
Spectral bandwidth	I_F = 100 mA	$\Delta\lambda$		40		nm
Temperature coefficient of λ_p	I_F = 100 mA	$TK\lambda_p$		0.2		nm/K
Rise time	I_F = 100 mA	t_r		30		ns
Fall time	I_F = 100 mA	t_f		30		ns
Cut-off frequency	I_{DC} = 70 mA, I_{AC} = 30 mA pp	f_c		12		MHz
Virtual source diameter		d		2.1		mm

Note

T_{amb} = 25 °C, unless otherwise specified

BASIC CHARACTERISTICS

T_{amb} = 25 °C, unless otherwise specified

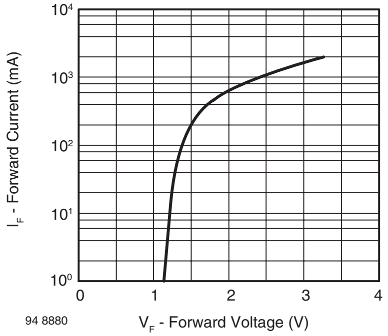


Fig. 3 - Forward Current vs. Forward Voltage

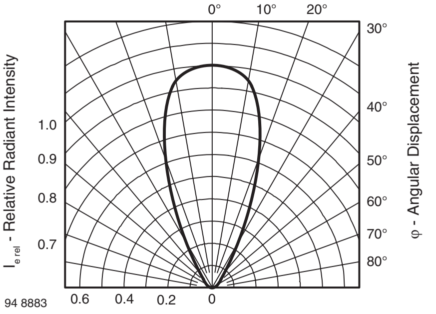


Fig. 6 - Relative Radiant Intensity vs. Angular Displacement

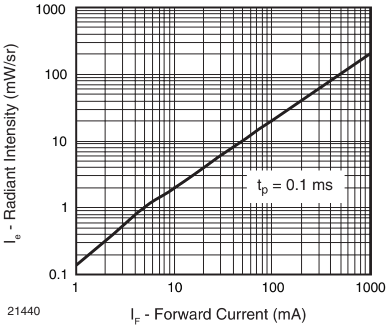


Fig. 4 - Radiant Intensity vs. Forward Current

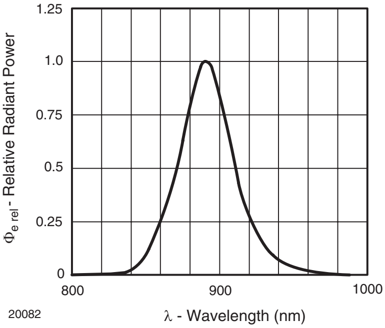
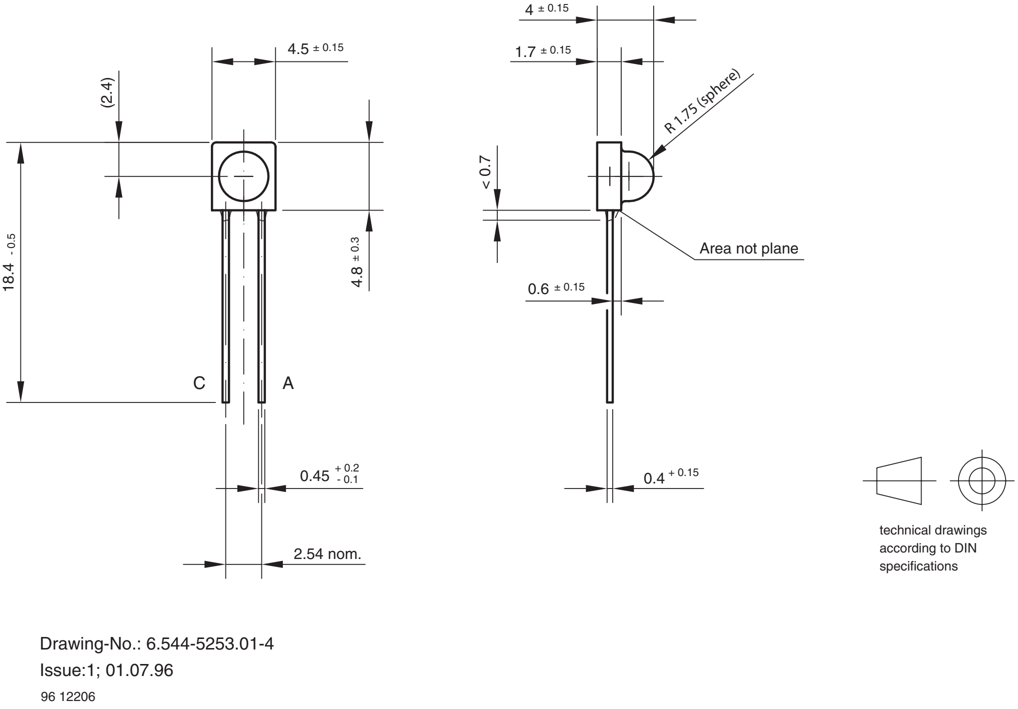
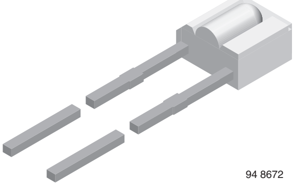


Fig. 5 - Relative Radiant Power vs. Wavelength

PACKAGE DIMENSIONS in millimeters



Infrared Emitting Diode, RoHS Compliant, 950 nm, GaAs



DESCRIPTION

TSSS2600 is an infrared, 950 nm emitting diode in GaAs technology, molded in a miniature, clear plastic package with side view lens.

FEATURES

- Package type: leaded
- Package form: side view
- Dimensions (L x W x H in mm): 3.6 x 2.2 x 5
- Peak wavelength: λ_p = 950 nm
- High reliability
- High radiant power
- High radiant intensity
- Angle of half intensity: φ = ± 25°, horizontal
- Low forward voltage
- Suitable for high pulse current operation
- Good spectral matching with Si photodetectors
- Package matched with detector TEST2600
- Lead (Pb)-free component in accordance with RoHS 2002/95/EC and WEEE 2002/96/EC

Pb-free

e2

RoHS
COMPLIANT

APPLICATIONS

- Infrared source in miniature light barriers or reflective sensor systems with short transmission distances and low forward voltage requirements. Matching with silicon PIN photodiodes or phototransistors (e.g. TEST2600)

PRODUCT SUMMARY

COMPONENT	I_e (mW/sr)	φ (deg)	λ_p (nm)	t_r (ns)
TSSS2600	2.6	± 25	950	800

Note

Test conditions see table “Basic Characteristics”

ORDERING INFORMATION

ORDERING CODE	PACKAGING	REMARKS	PACKAGE FORM
TSSS2600	Bulk	MOQ: 5000 pcs, 5000 pcs/bulk	Side view

Note

MOQ: minimum order quantity

ABSOLUTE MAXIMUM RATINGS

PARAMETER	TEST CONDITION	SYMBOL	VALUE	UNIT
Reverse voltage		V_R	5	V
Forward current		I_F	100	mA
Peak forward current	$t_p/T = 0.5$, $t_p = 100\ \mu s$	I_{FM}	200	mA
Surge forward current	$t_p = 100\ \mu s$	I_{FSM}	2.0	A
Power dissipation		P_V	170	mW
Junction temperature		T_j	100	°C
Operating temperature range		T_{amb}	- 40 to + 100	°C
Storage temperature range		T_{stg}	- 40 to + 100	°C
Soldering temperature	$t \leq 5$ s, 2 mm from case	T_{sd}	260	°C
Thermal resistance junction/ambient	Leads not soldered	R_{thJA}	450	K/W

Note

T_{amb} = 25 °C, unless otherwise specified

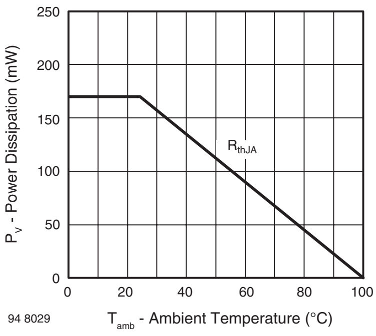


Fig. 1 - Power Dissipation Limit vs. Ambient Temperature

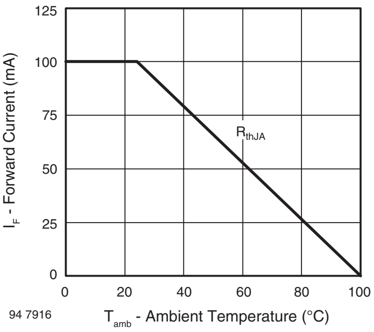


Fig. 2 - Forward Current Limit vs. Ambient Temperature

BASIC CHARACTERISTICS

PARAMETER	TEST CONDITION	SYMBOL	MIN.	TYP.	MAX.	UNIT
Forward voltage	I_F = 100 mA, t_p = 20 ms	V_F		1.25	1.6	V
	I_F = 1.5 A, t_p = 100 µs	V_F		2.2		V
Temperature coefficient of V_F	I_F = 100 mA	TK_{VF}		- 1.3		mV/K
Reverse current	V_R = 5 V	I_R			100	µA
Junction capacitance	V_R = 0 V, f = 1 MHz, E = 0	C_j		30		pF
Radiant intensity	I_F = 100 mA, t_p = 20 ms	I_e	1	2.6	3	mW/sr
	I_F = 1.5 A, t_p = 100 µs	I_e		25		mW/sr
Radiant power	I_F = 100 mA, t_p = 20 ms	ϕ_e		20		mW
Temperature coefficient of ϕ_e	I_F = 100 mA	$TK\phi_e$		- 0.8		%/K
Angle of half intensity	horizontal	φ_1		± 25		deg
	vertical	φ_2		± 60		deg
Peak wavelength	I_F = 100 mA	λ_p		950		nm
Spectral bandwidth	I_F = 100 mA	$\Delta\lambda$		50		nm
Temperature coefficient of λ_p	I_F = 100 mA	$TK\lambda_p$		0.2		nm/K
Rise time	I_F = 100 mA	t_r		800		ns
	I_F = 1.5 A	t_r		400		ns
Fall time	I_F = 100 mA	t_f		800		ns
	I_F = 1.5 A	t_f		400		ns
Virtual source diameter		d		2		mm

Note

T_{amb} = 25 °C, unless otherwise specified

BASIC CHARACTERISTICS

T_{amb} = 25 °C, unless otherwise specified

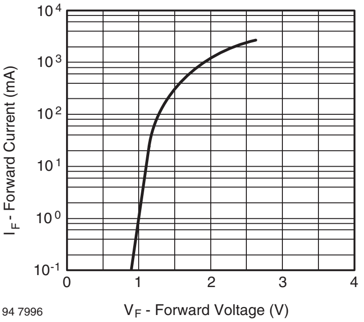


Fig. 3 - Pulse Forward Current vs. Forward Voltage

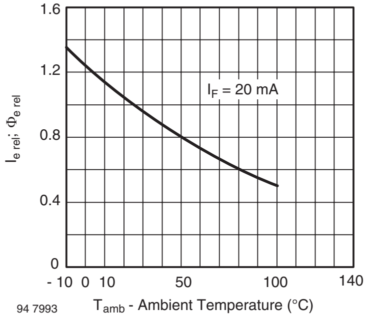


Fig. 6 - Relative Radiant Intensity/Power vs. Ambient Temperature

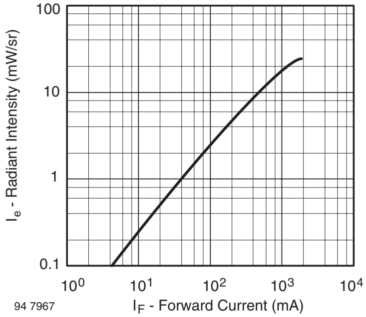


Fig. 4 - Radiant Intensity vs. Forward Current

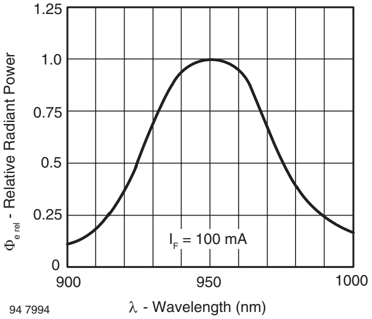


Fig. 7 - Relative Radiant Power vs. Wavelength

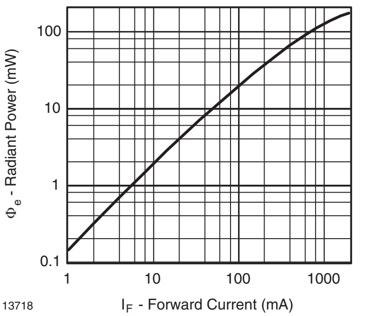


Fig. 5 - Radiant Power vs. Forward Current

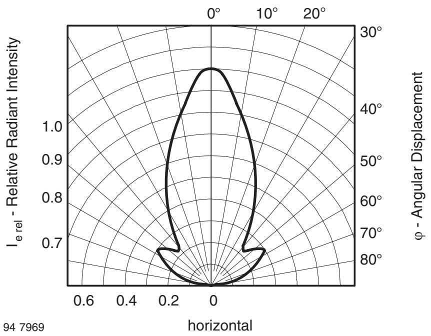


Fig. 8 - Relative Radiant Intensity vs. Angular Displacement

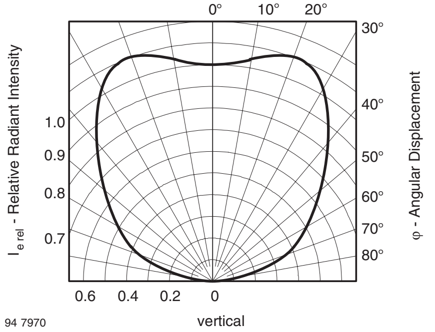
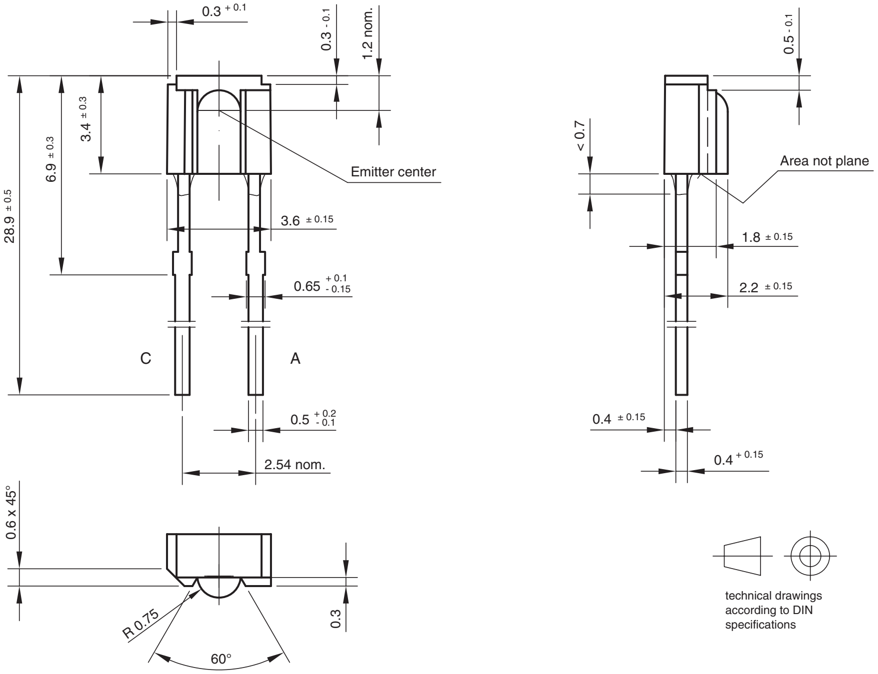


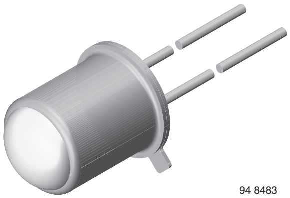
Fig. 9 - Relative Radiant Intensity vs. Angular Displacement

PACKAGE DIMENSIONS in millimeters



Drawing-No.: 6.544-5241.01-4
Issue: 3; 18.04.96
95 11488

Infrared Emitting Diode, RoHS Compliant, 875 nm, GaAlAs



DESCRIPTION

TSTA7100 is an infrared, 875 nm emitting diode in GaAlAs technology in a hermetically sealed TO-18 package with lens.

FEATURES

- Package type: leaded
- Package form: TO-18
- Dimensions (in mm): ∅ 4.7
- Peak wavelength: λ_p = 875 nm
- High reliability
- High radiant power
- High radiant intensity
- Angle of half intensity: φ = ± 5°
- Low forward voltage
- Suitable for high pulse current operation
- Good spectral matching with Si photodetectors
- Lead (Pb)-free component in accordance with RoHS 2002/95/EC and WEEE 2002/96/EC

Pb-free

e4

RoHS
COMPLIANT

APPLICATIONS

- Radiation source near infrared range

PRODUCT SUMMARY

COMPONENT	I_e (mW/sr)	φ (deg)	λ_P (nm)	t_r (ns)
TSTA7100	50	± 5	875	300

Note

Test conditions see table “Basic Characteristics”

ORDERING INFORMATION

ORDERING CODE	PACKAGING	REMARKS	PACKAGE FORM
TSTA7100	Bulk	MOQ: 1000 pcs, 1000 pcs/bulk	TO-18

Note

MOQ: minimum order quantity

ABSOLUTE MAXIMUM RATINGS

PARAMETER	TEST CONDITION	SYMBOL	VALUE	UNIT
Reverse voltage		V_R	5	V
Forward current		I_F	100	mA
Peak forward current	$t_p/T = 0.5$, $t_p \leq 100$ µs	I_{FM}	200	mA
Surge forward current	$t_p \leq 100$ µs	I_{FSM}	2.5	A
Power dissipation		P_V	180	mW
	$T_{case} \leq 25$ °C	P_V	500	mW
Junction temperature		T_j	100	°C
Storage temperature range		T_{stg}	- 55 to + 100	°C
Thermal resistance junction/ambient	leads not soldered	R_{thJA}	450	K/W
Thermal resistance junction/case	leads not soldered	R_{thJC}	150	K/W

Note

T_{amb} = 25 °C, unless otherwise specified

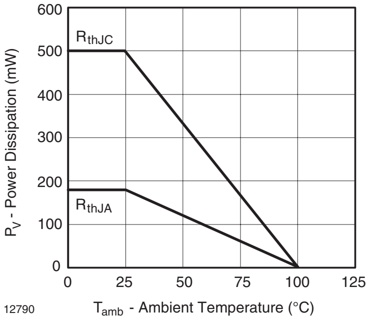


Fig. 1 - Power Dissipation Limit vs. Ambient Temperature

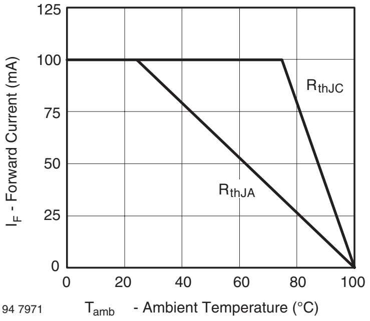


Fig. 2 - Forward Current Limit vs. Ambient Temperature

BASIC CHARACTERISTICS

PARAMETER	TEST CONDITION	SYMBOL	MIN.	TYP.	MAX.	UNIT
Forward voltage	$I_F = 100$ mA, $t_p \leq 20$ ms	V_F		1.4	1.8	V
Breakdown voltage	$I_R = 100$ µA	$V_{(BR)}$	5			V
Junction capacitance	$V_R = 0$ V, f = 1 MHz, E = 0	C_j		20		pF
Radiant intensity	$I_F = 100$ mA, $t_p \leq 20$ ms	I_e	20	50	100	mW/sr
Radiant power	$I_F = 100$ mA, $t_p \leq 20$ ms	ϕ_e		10		mW
Temperature coefficient of ϕ_e	$I_F = 100$ mA	$TK\phi_e$		- 0.7		%/K
Angle of half intensity		φ		± 5		deg
Peak wavelength	$I_F = 100$ mA	λ_p		875		nm
Spectral bandwidth	$I_F = 100$ mA	$\Delta\lambda$		80		nm
Rise time	$I_F = 1.5$ A, $t_p/T = 0.01$, $t_p \leq 10$ µs	t_r		300		ns
Fall time	$I_F = 1.5$ A, $t_p/T = 0.01$, $t_p \leq 10$ µs	t_f		300		ns
Virtual source diameter		d		1.5		mm

Note

$T_{amb} = 25$ °C, unless otherwise specified

BASIC CHARACTERISTICS

$T_{amb} = 25$ °C, unless otherwise specified

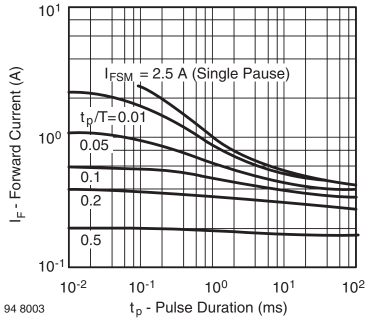


Fig. 3 - Pulse Forward Current vs. Pulse Duration

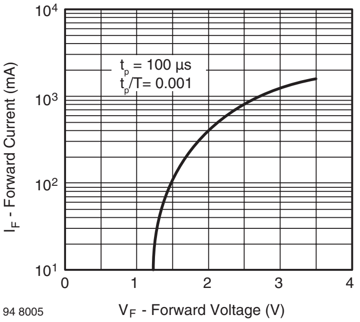


Fig. 4 - Forward Current vs. Forward Voltage

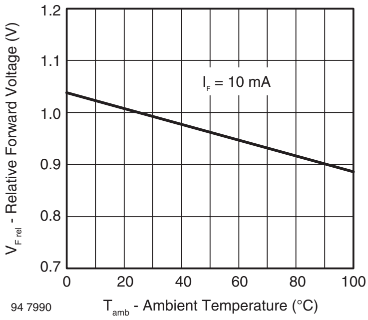


Fig. 5 - Relative Forward Voltage vs. Ambient Temperature

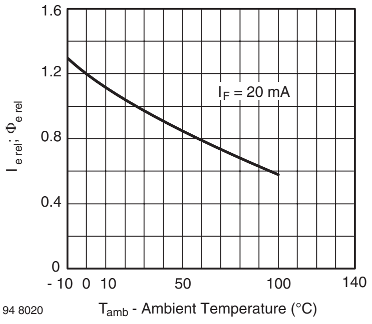


Fig. 8 - Rel. Radiant Intensity/Power vs. Ambient Temperature

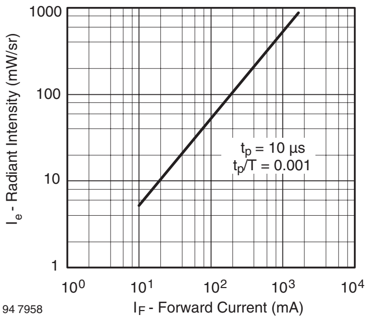


Fig. 6 - Radiant Intensity vs. Forward Current

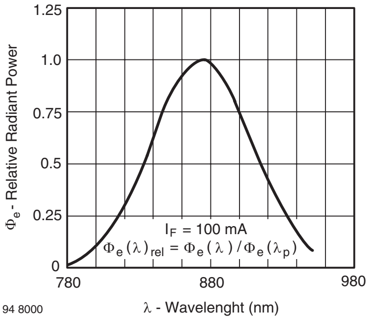


Fig. 9 - Relative Radiant Power vs. Wavelength

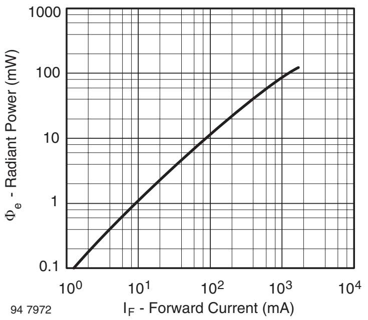


Fig. 7 - Radiant Power vs. Forward Current

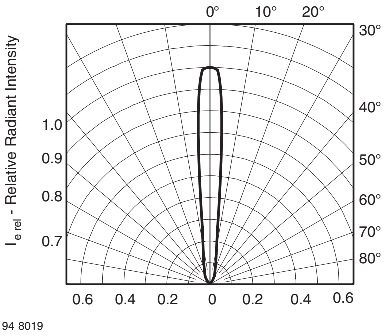
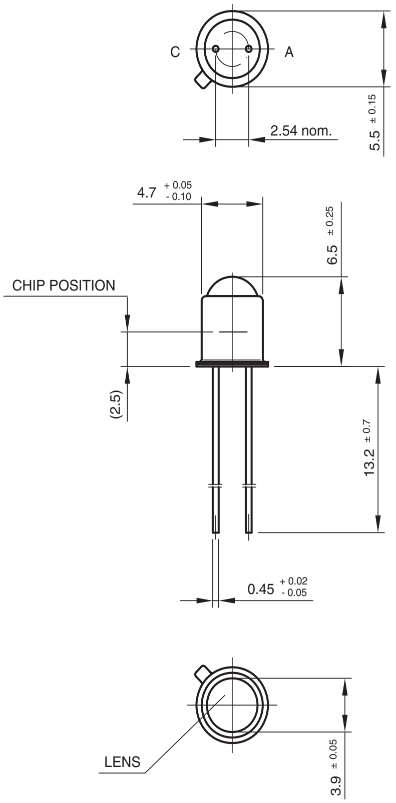
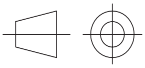


Fig. 10 - Relative Radiant Intensity vs. Angular Displacement

PACKAGE DIMENSIONS in millimeters

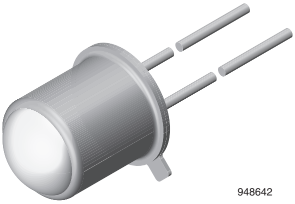




technical drawings
according to DIN
specifications

Drawing-No.: 6.503-5002.01-4
Issue: 2; 24.08.98
96 12174

Infrared Emitting Diode, RoHS Compliant, 875 nm, GaAlAs



DESCRIPTION

TSTA7300 is an infrared, 875 nm emitting diode in GaAlAs technology in a hermetically sealed TO-18 package with lens.

FEATURES

- Package type: leaded
- Package form: TO-18
- Dimensions (in mm): ∅ 4.7
- Peak wavelength: λ_p = 875 nm
- High reliability
- High radiant power
- High radiant intensity
- Angle of half intensity: φ = ± 12°
- Low forward voltage
- Suitable for high pulse current operation
- Good spectral matching with Si photodetectors
- Lead (Pb)-free component in accordance with RoHS 2002/95/EC and WEEE 2002/96/EC

Pb-free

e4

RoHS
COMPLIANT

APPLICATIONS

- Radiation source near infrared range

PRODUCT SUMMARY

COMPONENT	I_e (mW/sr)	φ (deg)	λ_P (nm)	t_r (ns)
TSTA7300	20	± 12	875	300

Note

Test conditions see table “Basic Characteristics”

ORDERING INFORMATION

ORDERING CODE	PACKAGING	REMARKS	PACKAGE FORM
TSTA7300	Bulk	MOQ: 1000 pcs, 1000 pcs/bulk	TO-18

Note

MOQ: minimum order quantity

ABSOLUTE MAXIMUM RATINGS

PARAMETER	TEST CONDITION	SYMBOL	VALUE	UNIT
Reverse voltage		V_R	5	V
Forward current		I_F	100	mA
Peak forward current	$t_p/T = 0.5$, $t_p \leq 100$ µs	I_{FM}	200	mA
Surge forward current	$t_p \leq 100$ µs	I_{FSM}	2.5	A
Power dissipation		P_V	180	mW
	$T_{case} \leq 25$ °C	P_V	500	mW
Junction temperature		T_j	100	°C
Storage temperature range		T_{stg}	- 55 to + 100	°C
Thermal resistance junction/ambient	leads not soldered	R_{thJA}	450	K/W
Thermal resistance junction/case	leads not soldered	R_{thJC}	150	K/W

Note

T_{amb} = 25 °C, unless otherwise specified

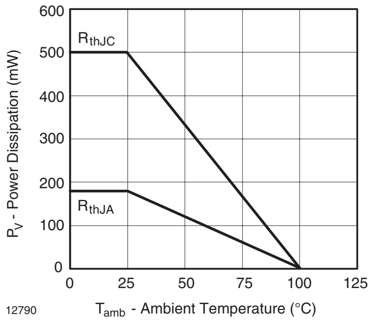


Fig. 1 - Power Dissipation Limit vs. Ambient Temperature

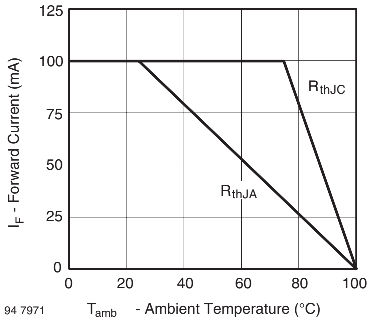


Fig. 2 - Forward Current Limit vs. Ambient Temperature

BASIC CHARACTERISTICS						
PARAMETER	**TEST CONDITION**	**SYMBOL**	**MIN.**	**TYP.**	**MAX.**	**UNIT**
Forward voltage	$I_F = 100$ mA, $t_p \leq 20$ ms	V_F		1.4	1.8	V
Breakdown voltage	$I_R = 100$ µA	$V_{(BR)}$	5			V
Junction capacitance	$V_R = 0$ V, f = 1 MHz, E = 0	C_j		20		pF
Radiant intensity	$I_F = 100$ mA, $t_p \leq 20$ ms	I_e	10	20	50	mW/sr
Radiant power	$I_F = 100$ mA, $t_p \leq 20$ ms	ϕ_e		10		mW
Temperature coefficient of ϕ_e	$I_F = 100$ mA	$TK\phi_e$		- 0.7		%/K
Angle of half intensity		φ		± 12		deg
Peak wavelength	$I_F = 100$ mA	λ_p		875		nm
Spectral bandwidth	$I_F = 100$ mA	$\Delta\lambda$		80		nm
Rise time	$I_F = 1.5$ A, $t_p/T = 0.01$, $t_p \leq 10$ µs	t_r		300		ns
Fall time	$I_F = 1.5$ A, $t_p/T = 0.01$, $t_p \leq 10$ µs	t_f		300		ns
Virtual source diameter		d		1		mm

Note

$T_{amb} = 25$ °C, unless otherwise specified

BASIC CHARACTERISTICS

$T_{amb} = 25$ °C, unless otherwise specified

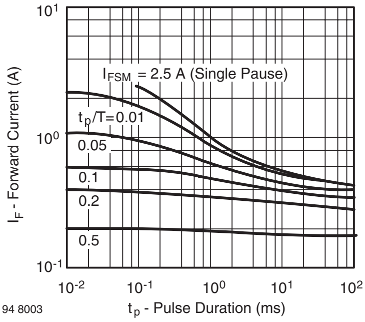


Fig. 3 - Pulse Forward Current vs. Pulse Duration

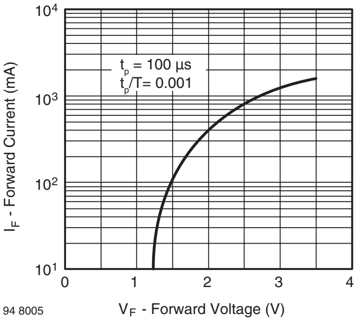


Fig. 4 - Forward Current vs. Forward Voltage

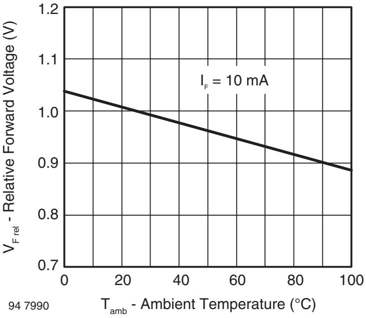


Fig. 5 - Relative Forward Voltage vs. Ambient Temperature

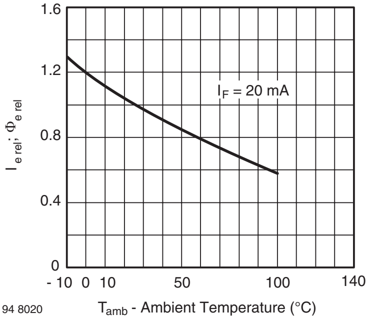


Fig. 8 - Rel. Radiant Intensity/Power vs. Ambient Temperature

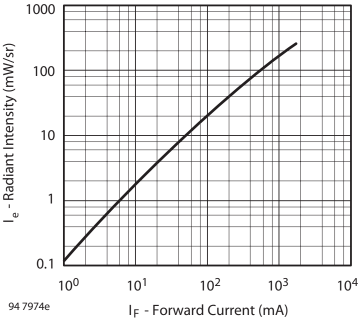


Fig. 6 - Radiant Intensity vs. Forward Current

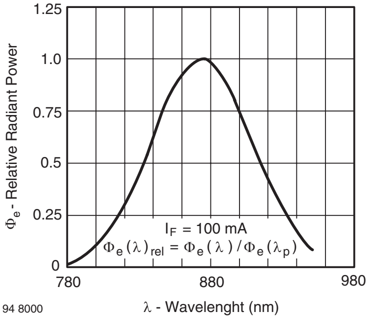


Fig. 9 - Relative Radiant Power vs. Wavelength

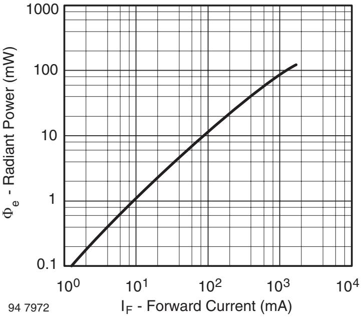


Fig. 7 - Radiant Power vs. Forward Current

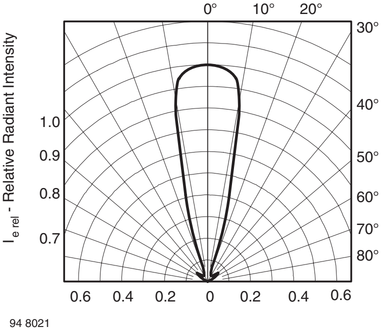
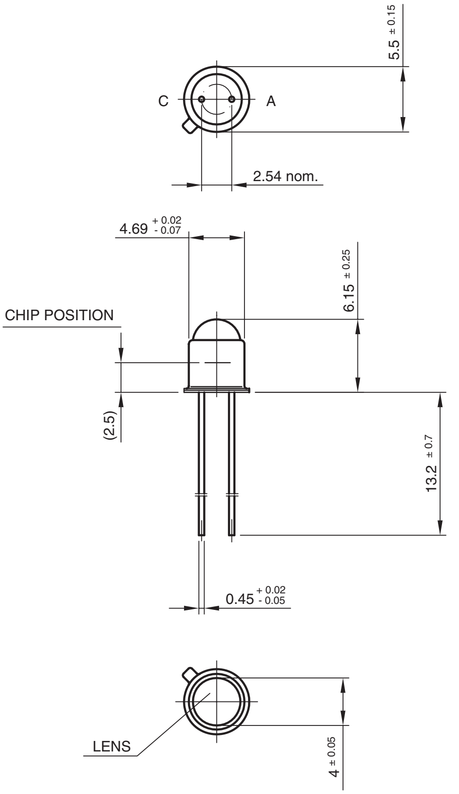
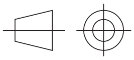


Fig. 10 - Relative Radiant Intensity vs. Angular Displacement

PACKAGE DIMENSIONS in millimeters

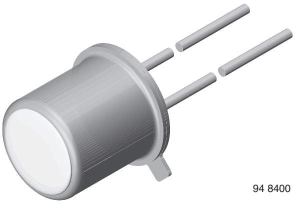




technical drawings
according to DIN
specifications

Drawing-No.: 6.503-5022.01-4
Issue: 2; 24.08.98
96 12179

Infrared Emitting Diode, RoHS Compliant, 875 nm, GaAlAs



FEATURES

- Package type: leaded
- Package form: TO-18
- Dimensions (in mm): ∅ 4.7
- Peak wavelength: λ_p = 875 nm
- High reliability
- High radiant power
- High radiant intensity
- Angle of half intensity: φ = ± 30°
- Low forward voltage
- Suitable for high pulse current operation
- Good spectral matching with Si photodetectors
- Lead (Pb)-free component in accordance with RoHS 2002/95/EC and WEEE 2002/96/EC

Pb-free

e4

RoHS COMPLIANT

DESCRIPTION

TSTA7500 is an infrared, 875 nm emitting diode in GaAlAs technology in a hermetically sealed TO-18 package with flat glass window.

APPLICATIONS

- Radiation source near infrared range

PRODUCT SUMMARY

COMPONENT	I_e (mW/sr)	φ (deg)	λ_P (nm)	t_r (ns)
TSTA7500	6	± 30	875	300

Note

Test conditions see table “Basic Characteristics”

ORDERING INFORMATION

ORDERING CODE	PACKAGING	REMARKS	PACKAGE FORM
TSTA7500	Bulk	MOQ: 1000 pcs, 1000 pcs/bulk	TO-18

Note

MOQ: minimum order quantity

ABSOLUTE MAXIMUM RATINGS

PARAMETER	TEST CONDITION	SYMBOL	VALUE	UNIT
Reverse voltage		V_R	5	V
Forward current		I_F	100	mA
Peak forward current	$t_p/T = 0.5$, $t_p \leq 100$ µs	I_{FM}	200	mA
Surge forward current	$t_p \leq 100$ µs	I_{FSM}	2.5	A
Power dissipation		P_V	180	mW
	$T_{case} \leq 25$ °C	P_V	500	mW
Junction temperature		T_j	100	°C
Storage temperature range		T_{stg}	- 55 to + 100	°C
Thermal resistance junction/ambient	leads not soldered	R_{thJA}	450	K/W
Thermal resistance junction/case	leads not soldered	R_{thJC}	150	K/W

Note

T_{amb} = 25 °C, unless otherwise specified

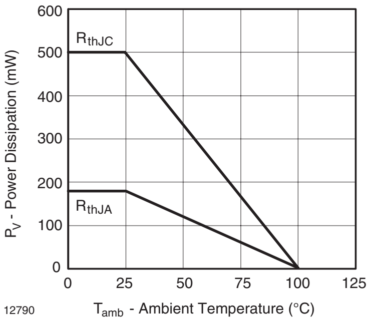


Fig. 1 - Power Dissipation Limit vs. Ambient Temperature

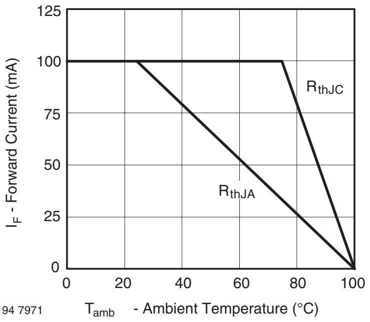


Fig. 2 - Forward Current Limit vs. Ambient Temperature

BASIC CHARACTERISTICS						
PARAMETER	**TEST CONDITION**	**SYMBOL**	**MIN.**	**TYP.**	**MAX.**	**UNIT**
Forward voltage	$I_F = 100$ mA, $t_p \leq 20$ ms	V_F		1.4	1.8	V
Breakdown voltage	$I_R = 100$ µA	$V_{(BR)}$	5			V
Junction capacitance	$V_R = 0$ V, f = 1 MHz, E = 0	C_j		20		pF
Radiant intensity	$I_F = 100$ mA, $t_p \leq 20$ ms	I_e	3.5	6	16	mW/sr
Radiant power	$I_F = 100$ mA, $t_p \leq 20$ ms	ϕ_e		10		mW
Temperature coefficient of ϕ_e	$I_F = 100$ mA	$TK\phi_e$		- 0.7		%/K
Angle of half intensity		φ		± 30		deg
Peak wavelength	$I_F = 100$ mA	λ_p		875		nm
Spectral bandwidth	$I_F = 100$ mA	$\Delta\lambda$		80		nm
Rise time	$I_F = 1.5$ A, $t_p/T = 0.01$, $t_p \leq 10$ µs	t_r		300		ns
Fall time	$I_F = 1.5$ A, $t_p/T = 0.01$, $t_p \leq 10$ µs	t_f		300		ns
Virtual source diameter		d		0.5		mm

Note

$T_{amb} = 25$ °C, unless otherwise specified

BASIC CHARACTERISTICS

$T_{amb} = 25$ °C, unless otherwise specified

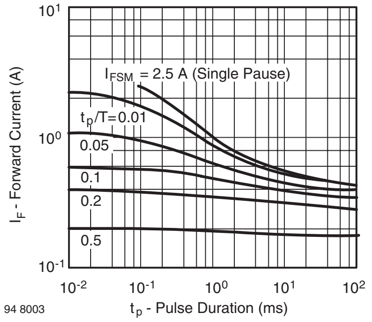


Fig. 3 - Pulse Forward Current vs. Pulse Duration

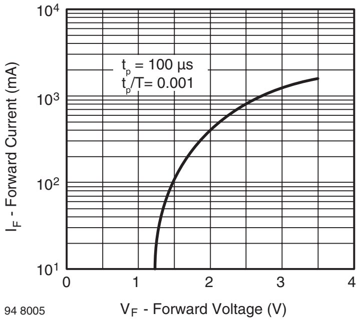


Fig. 4 - Forward Current vs. Forward Voltage

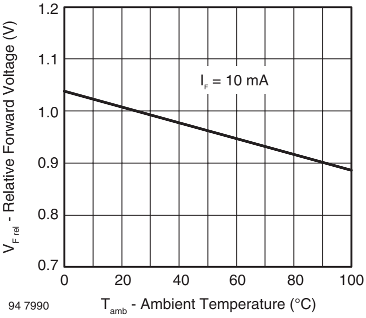


Fig. 5 - Relative Forward Voltage vs. Ambient Temperature

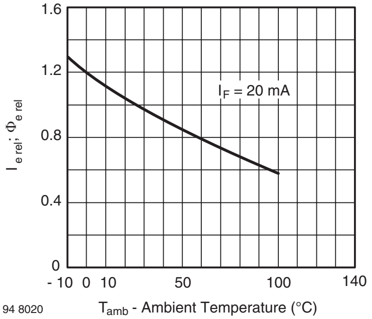


Fig. 8 - Rel. Radiant Intensity/Power vs. Ambient Temperature

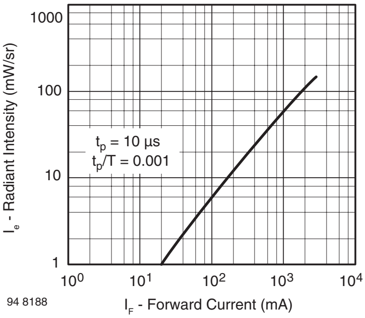


Fig. 6 - Radiant Intensity vs. Forward Current

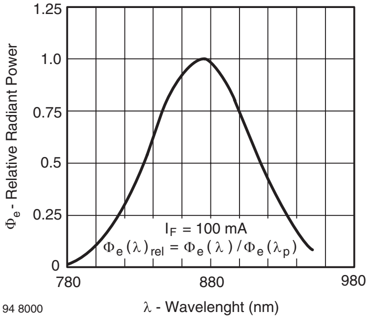


Fig. 9 - Relative Radiant Power vs. Wavelength

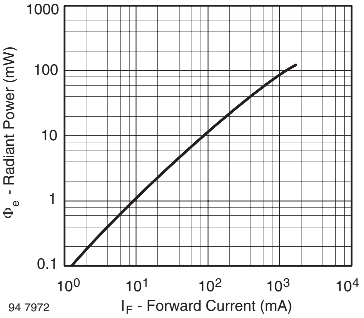


Fig. 7 - Radiant Power vs. Forward Current

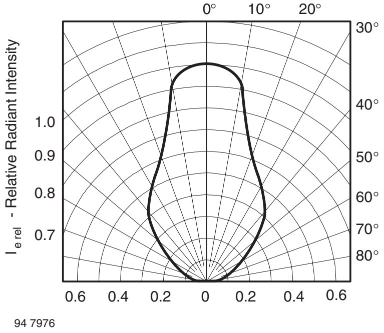
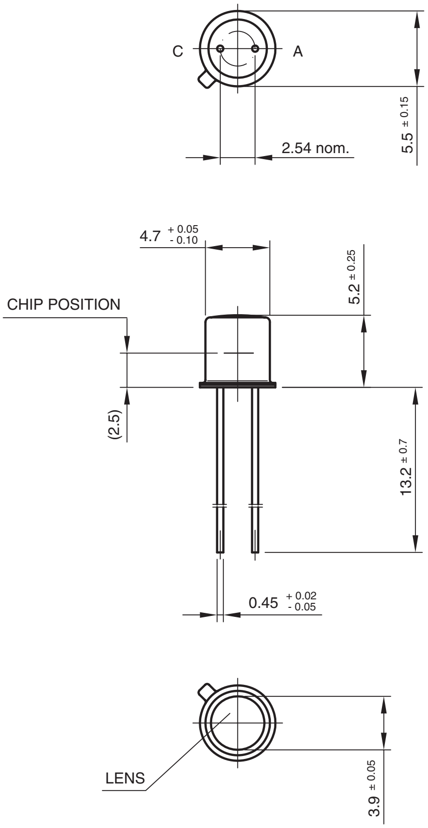
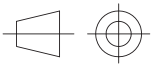


Fig. 10 - Relative Radiant Intensity vs. Angular Displacement

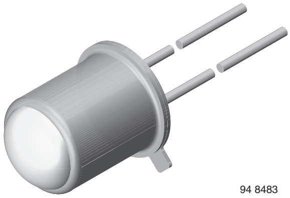
PACKAGE DIMENSIONS in millimeters





Drawing-No.: 6.503-5001.01-4
Issue: 2; 24.08.98
96 12173

Infrared Emitting Diode, RoHS Compliant, 950 nm, GaAs



DESCRIPTION

TSTS7100 is an infrared, 950 nm emitting diode in GaAs technology in a hermetically sealed TO-18 package with lens.

FEATURES

- Package type: leaded
- Package form: TO-18
- Dimensions (in mm): ∅ 4.7
- Peak wavelength: λ_p = 950 nm
- High reliability
- High radiant power
- High radiant intensity
- Angle of half intensity: φ = ± 5°
- Low forward voltage
- Suitable for high pulse current operation
- Good spectral matching with Si photodetectors
- Lead (Pb)-free component in accordance with RoHS 2002/95/EC and WEEE 2002/96/EC

Pb-free
e4
RoHS COMPLIANT

APPLICATIONS

- Radiation source in near infrared range

PRODUCT SUMMARY

COMPONENT	I_e (mW/sr)	φ (deg)	λ_P (nm)	t_r (ns)
TSTS7100	> 10	± 5	950	400

Note
Test conditions see table "Basic Characteristics"

ORDERING INFORMATION

ORDERING CODE	PACKAGING	REMARKS	PACKAGE FORM
TSTS7100	Bulk	MOQ: 1000 pcs, 1000 pcs/bulk	TO-18

Note
MOQ: minimum order quantity

ABSOLUTE MAXIMUM RATINGS

PARAMETER	TEST CONDITION	SYMBOL	VALUE	UNIT
Reverse voltage		V_R	5	V
Forward current	$T_{case} \leq 25$ °C	I_F	250	mA
Peak forward current	$t_p/T = 0.5$, $t_p \leq 100$ µs, $T_{case} \leq 25$ °C	I_{FM}	500	mA
Surge forward current	$t_p \leq 100$ µs	I_{FSM}	2.5	A
Power dissipation		P_V	170	mW
	$T_{case} \leq 25$ °C	P_V	500	mW
Junction temperature		T_j	100	°C
Storage temperature range		T_{stg}	- 55 to + 100	°C
Thermal resistance junction/ambient	leads not soldered	R_{thJA}	450	K/W
Thermal resistance junction/case	leads not soldered	R_{thJC}	150	K/W

Note
T_{amb} = 25 °C, unless otherwise specified

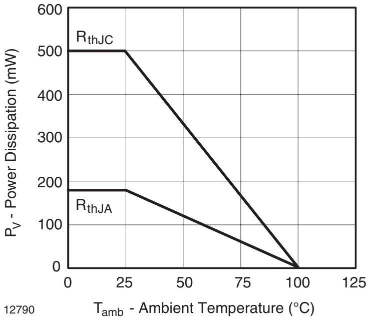


Fig. 1 - Power Dissipation Limit vs. Ambient Temperature

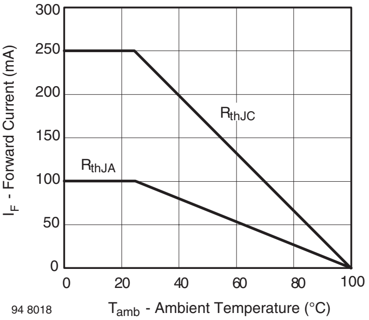


Fig. 2 - Forward Current Limit vs. Ambient Temperature

BASIC CHARACTERISTICS						
PARAMETER	**TEST CONDITION**	**SYMBOL**	**MIN.**	**TYP.**	**MAX.**	**UNIT**
Forward voltage	I_F = 100 mA, $t_p \le$ 20 ms	V_F		1.3	1.7	V
Temperature coefficient of V_F	I_F = 100 mA	TK_{VF}		- 1.3		mV/K
Breakdown voltage	I_R = 100 µA	$V_{(BR)}$	5			V
Junction capacitance	V_R = 0 V, f = 1 MHz, E = 0	C_j		30		pF
Radiant intensity	I_F = 100 mA, t_p = 20 ms	I_e	10		50	mW/sr
Radiant power	I_F = 100 mA, $t_p \le$ 20 ms	ϕ_e		7		mW
Temperature coefficient of ϕ_e	I_F = 100 mA	$TK\phi_e$		- 0.8		%/K
Angle of half intensity		φ		± 5		deg
Peak wavelength	I_F = 100 mA	λ_p		950		nm
Spectral bandwidth	I_F = 100 mA	$\Delta\lambda$		50		nm
Rise time	I_F = 1.5 A, t_p/T = 0.01, $t_p \le$ 10 µs	t_r		400		ns
Fall time	I_F = 1.5 A, t_p/T = 0.01, $t_p \le$ 10 µs	t_f		400		ns
Virtual source diameter		d		1.5		mm

Note

T_{amb} = 25 °C, unless otherwise specified

BASIC CHARACTERISTICS

T_{amb} = 25 °C, unless otherwise specified

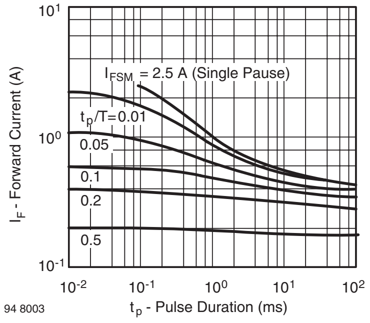


Fig. 3 - Pulse Forward Current vs. Pulse Duration

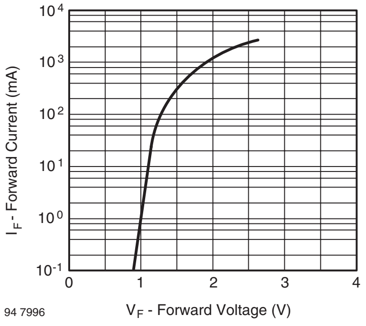


Fig. 4 - Forward Current vs. Forward Voltage

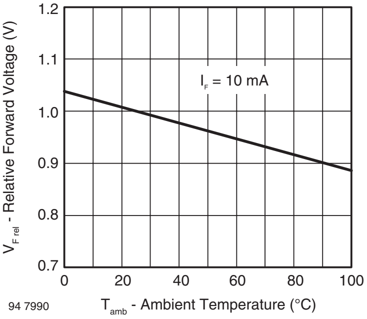


Fig. 5 - Relative Forward Voltage vs. Ambient Temperature

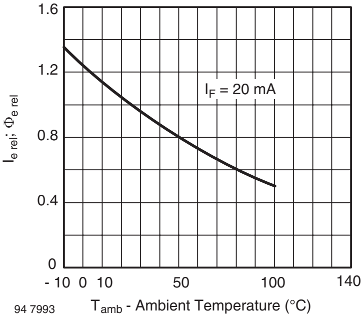


Fig. 8 - Rel. Radiant Intensity/Power vs. Ambient Temperature

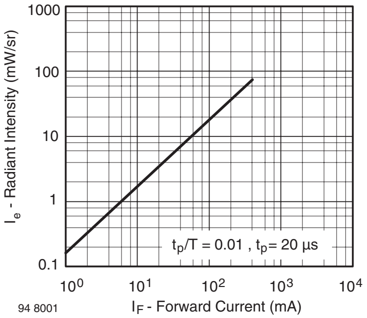


Fig. 6 - Radiant Intensity vs. Forward Current

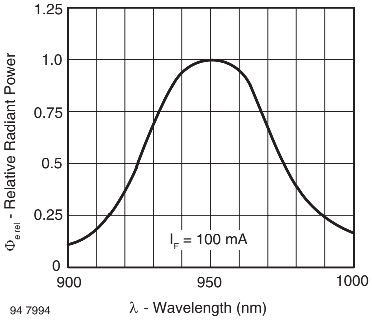


Fig. 9 - Relative Radiant Power vs. Wavelength

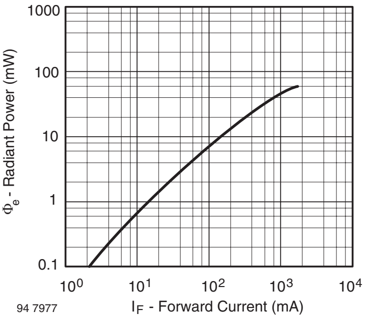


Fig. 7 - Radiant Power vs. Forward Current

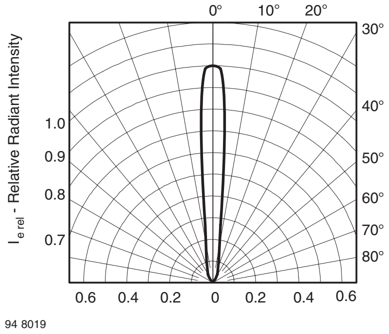
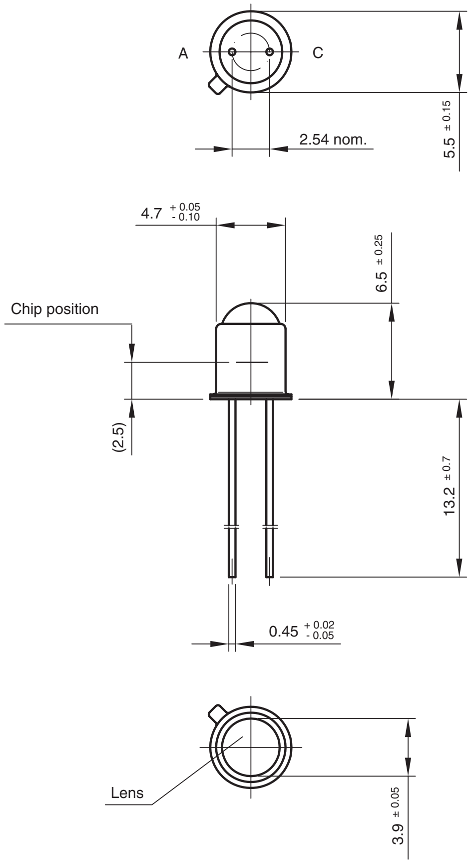
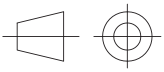


Fig. 10 - Relative Radiant Intensity vs. Angular Displacement

PACKAGE DIMENSIONS in millimeters

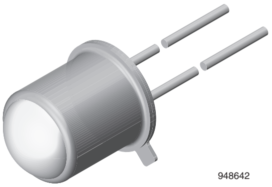




technical drawings
according to DIN
specifications

Drawing-No.: 6.503-5002.02-4
Issue: 1; 24.08.98
14486

Infrared Emitting Diode, RoHS Compliant, 950 nm, GaAs



DESCRIPTION

TSTS7300 is an infrared, 950 nm emitting diode in GaAs technology in a hermetically sealed TO-18 package with lens.

FEATURES

- Package type: leaded
- Package form: TO-18
- Dimensions (in mm): ∅ 4.7
- Peak wavelength: λ_p = 950 nm
- High reliability
- High radiant power
- High radiant intensity
- Angle of half intensity: φ = ± 12°
- Low forward voltage
- Suitable for high pulse current operation
- Good spectral matching with Si photodetectors
- Lead (Pb)-free component in accordance with RoHS 2002/95/EC and WEEE 2002/96/EC

Pb-free

e4

RoHS
COMPLIANT

APPLICATIONS

- Radiation source in near infrared range

PRODUCT SUMMARY

COMPONENT	I_e (mW/sr)	φ (deg)	λ_P (nm)	t_r (ns)
TSTS7300	6.3	± 12	950	400

Note

Test conditions see table “Basic Characteristics”

ORDERING INFORMATION

ORDERING CODE	PACKAGING	REMARKS	PACKAGE FORM
TSTS7300	Bulk	MOQ: 1000 pcs, 1000 pcs/bulk	TO-18

Note

MOQ: minimum order quantity

ABSOLUTE MAXIMUM RATINGS

PARAMETER	TEST CONDITION	SYMBOL	VALUE	UNIT
Reverse voltage		V_R	5	V
Forward current	$T_{case} \leq 25$ °C	I_F	250	mA
Peak forward current	$t_p/T = 0.5$, $t_p \leq 100$ µs, $T_{case} \leq 25$ °C	I_{FM}	500	mA
Surge forward current	$t_p \leq 100$ µs	I_{FSM}	2.5	A
Power dissipation		P_V	170	mW
	$T_{case} \leq 25$ °C	P_V	500	mW
Junction temperature		T_j	100	°C
Storage temperature range		T_{stg}	- 55 to + 100	°C
Thermal resistance junction/ambient	leads not soldered	R_{thJA}	450	K/W
Thermal resistance junction/case	leads not soldered	R_{thJC}	150	K/W

Note

T_{amb} = 25 °C, unless otherwise specified

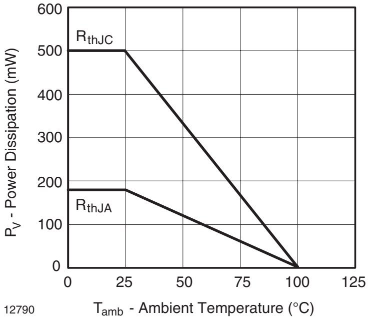


Fig. 1 - Power Dissipation Limit vs. Ambient Temperature

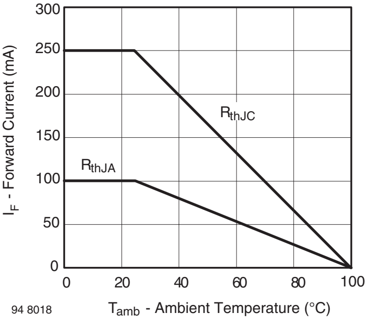


Fig. 2 - Forward Current Limit vs. Ambient Temperature

BASIC CHARACTERISTICS						
PARAMETER	**TEST CONDITION**	**SYMBOL**	**MIN.**	**TYP.**	**MAX.**	**UNIT**
Forward voltage	I_F = 100 mA, $t_p \le$ 20 ms	V_F		1.3	1.7	V
Temperature coefficient of V_F	I_F = 100 mA	TK_{VF}		- 1.3		mV/K
Breakdown voltage	I_R = 100 µA	$V_{(BR)}$	5			V
Junction capacitance	V_R = 0 V, f = 1 MHz, E = 0	C_j		30		pF
Radiant intensity	I_F = 100 mA, t_p = 20 ms	I_e	4	6.3	32	mW/sr
Radiant power	I_F = 100 mA, $t_p \le$ 20 ms	ϕ_e		7		mW
Temperature coefficient of ϕ_e	I_F = 100 mA	$TK\phi_e$		- 0.8		%/K
Angle of half intensity		φ		± 12		deg
Peak wavelength	I_F = 100 mA	λ_p		950		nm
Spectral bandwidth	I_F = 100 mA	$\Delta\lambda$		50		nm
Rise time	I_F = 1.5 A, t_p/T = 0.01, $t_p \le$ 10 µs	t_r		400		ns
Fall time	I_F = 1.5 A, t_p/T = 0.01, $t_p \le$ 10 µs	t_f		400		ns
Virtual source diameter		d		1		mm

Note

T_{amb} = 25 °C, unless otherwise specified

BASIC CHARACTERISTICS

T_{amb} = 25 °C, unless otherwise specified

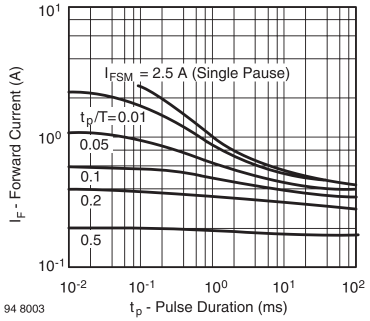


Fig. 3 - Pulse Forward Current vs. Pulse Duration

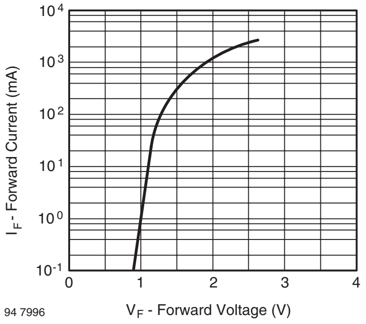


Fig. 4 - Forward Current vs. Forward Voltage

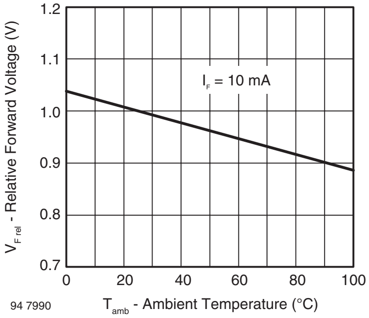


Fig. 5 - Relative Forward Voltage vs. Ambient Temperature

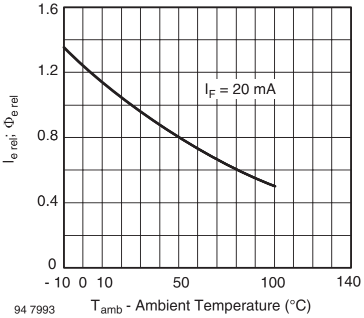


Fig. 8 - Relative Radiant Intensity/Power vs. Ambient Temperature

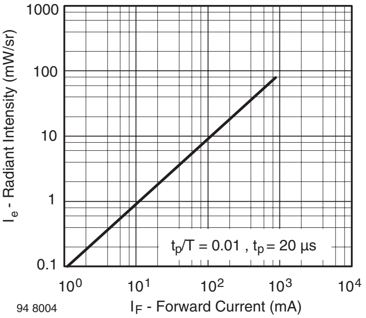


Fig. 6 - Radiant Intensity vs. Forward Current

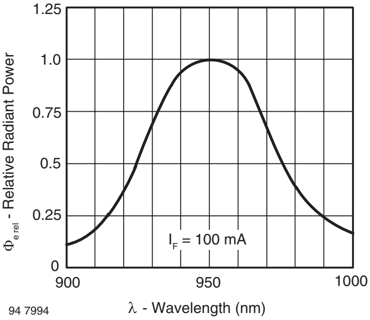


Fig. 9 - Relative Radiant Power vs. Wavelength

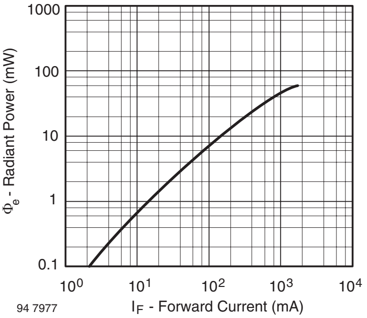


Fig. 7 - Radiant Power vs. Forward Current

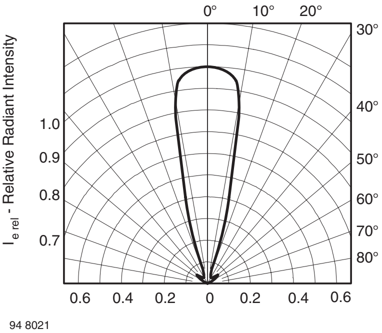
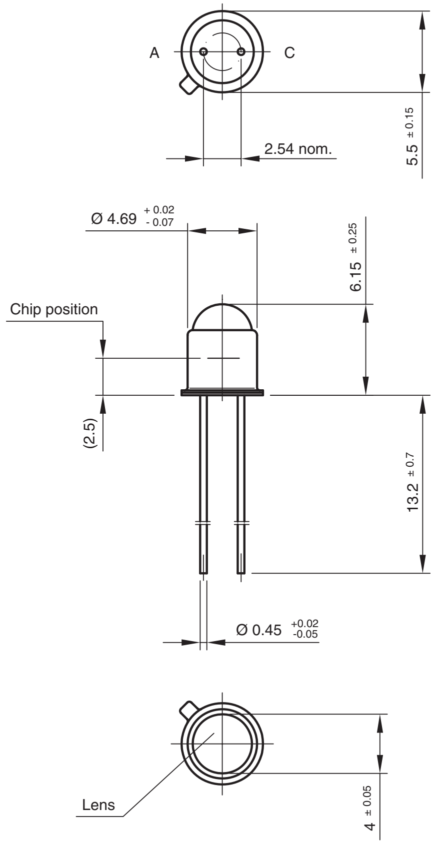
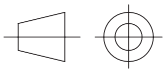


Fig. 10 - Relative Radiant Intensity vs. Angular Displacement

PACKAGE DIMENSIONS in millimeters





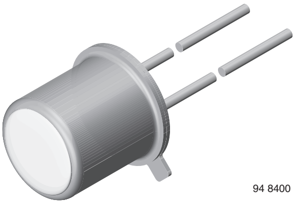
technical drawings
according to DIN
specifications

Drawing-No.: 6.503-5022.02-4

Issue: 1; 24.08.98

14487

Infrared Emitting Diode, RoHS Compliant, 950 nm, GaAs



DESCRIPTION

TSTS7500 is an infrared, 950 nm emitting diode in GaAs technology in a hermetically sealed TO-18 package with flat glass window.

FEATURES

- Package type: leaded
- Package form: TO-18
- Dimensions (in mm): ∅ 4.7
- Peak wavelength: λ_p = 950 nm
- High reliability
- High radiant power
- High radiant intensity
- Angle of half intensity: $\varphi = \pm 30°$
- Low forward voltage
- Suitable for high pulse current operation
- Good spectral matching with Si photodetectors
- Lead (Pb)-free component in accordance with RoHS 2002/95/EC and WEEE 2002/96/EC

Pb-free

e4

RoHS
COMPLIANT

APPLICATIONS

- Radiation source in near infrared range

PRODUCT SUMMARY

COMPONENT	I_e (mW/sr)	φ (deg)	λ_P (nm)	t_r (ns)
TSTS7500	1.6	± 30	950	400

Note

Test conditions see table "Basic Characteristics"

ORDERING INFORMATION

ORDERING CODE	PACKAGING	REMARKS	PACKAGE FORM
TSTS7500	Bulk	MOQ: 1000 pcs, 1000 pcs/bulk	TO-18

Note

MOQ: minimum order quantity

ABSOLUTE MAXIMUM RATINGS

PARAMETER	TEST CONDITION	SYMBOL	VALUE	UNIT
Reverse voltage		V_R	5	V
Forward current	$T_{case} \leq 25$ °C	I_F	250	mA
Peak forward current	$t_p/T = 0.5$, $t_p \leq 100$ µs, $T_{case} \leq 25$ °C	I_{FM}	500	mA
Surge forward current	$t_p \leq 100$ µs	I_{FSM}	2.5	A
Power dissipation		P_V	170	mW
	$T_{case} \leq 25$ °C	P_V	500	mW
Junction temperature		T_j	100	°C
Storage temperature range		T_{stg}	- 55 to + 100	°C
Thermal resistance junction/ambient	leads not soldered	R_{thJA}	450	K/W
Thermal resistance junction/case	leads not soldered	R_{thJC}	150	K/W

Note

T_{amb} = 25 °C, unless otherwise specified

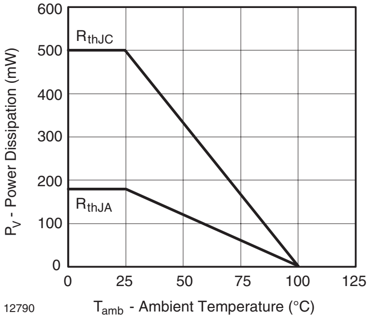


Fig. 1 - Power Dissipation Limit vs. Ambient Temperature

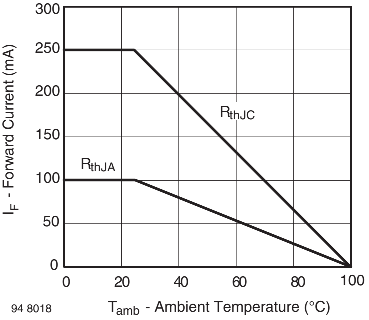


Fig. 2 - Forward Current Limit vs. Ambient Temperature

BASIC CHARACTERISTICS

PARAMETER	TEST CONDITION	SYMBOL	MIN.	TYP.	MAX.	UNIT
Forward voltage	I_F = 100 mA, $t_p \leq 20$ ms	V_F		1.3	1.7	V
Temperature coefficient of V_F	I_F = 100 mA	TK_{VF}		- 1.3		mV/K
Breakdown voltage	I_R = 100 µA	$V_{(BR)}$	5			V
Junction capacitance	V_R = 0 V, f = 1 MHz, E = 0	C_j		30		pF
Radiant intensity	I_F = 100 mA, t_p = 20 ms	I_e	1.25	1.6	8	mW/sr
Radiant power	I_F = 100 mA, $t_p \leq 20$ ms	ϕ_e		7		mW
Temperature coefficient of ϕ_e	I_F = 100 mA	$TK\phi_e$		- 0.8		%/K
Angle of half intensity		φ		± 30		deg
Peak wavelength	I_F = 100 mA	λ_p		950		nm
Spectral bandwidth	I_F = 100 mA	$\Delta\lambda$		50		nm
Rise time	I_F = 1.5 A, t_p/T = 0.01, $t_p \leq 10$ µs	t_r		400		ns
Fall time	I_F = 1.5 A, t_p/T = 0.01, $t_p \leq 10$ µs	t_f		400		ns
Virtual source diameter		d		0.5		mm

Note

T_{amb} = 25 °C, unless otherwise specified

BASIC CHARACTERISTICS

T_{amb} = 25 °C, unless otherwise specified

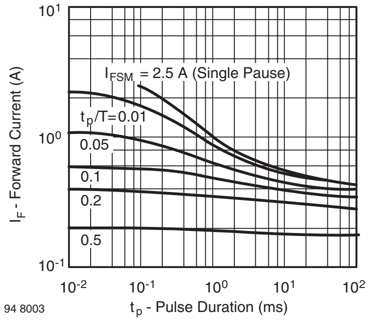


Fig. 3 - Pulse Forward Current vs. Pulse Duration

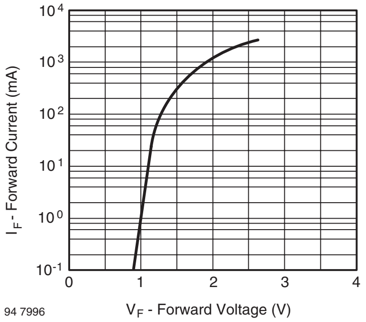


Fig. 4 - Forward Current vs. Forward Voltage

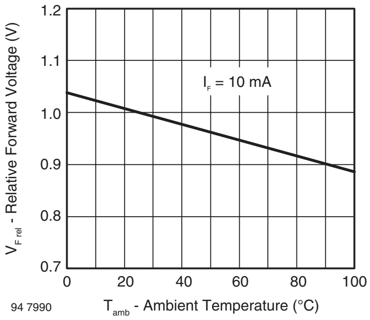


Fig. 5 - Relative Forward Voltage vs. Ambient Temperature

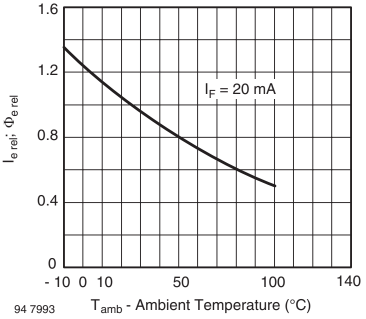


Fig. 8 - Relative Radiant Intensity/Power vs. Ambient Temperature

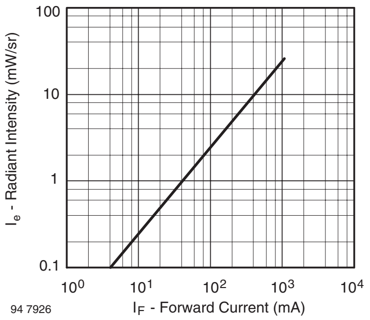


Fig. 6 - Radiant Intensity vs. Forward Current

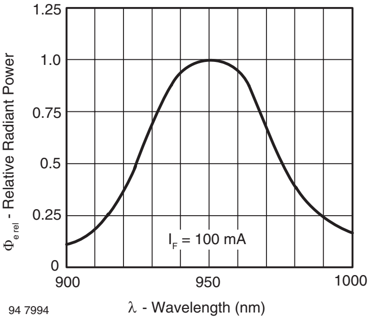


Fig. 9 - Relative Radiant Power vs. Wavelength

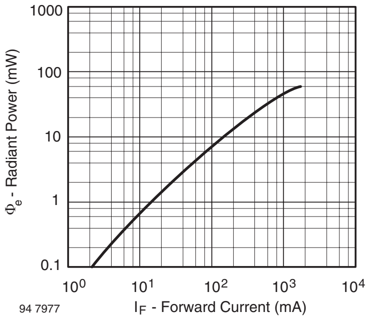


Fig. 7 - Radiant Power vs. Forward Current

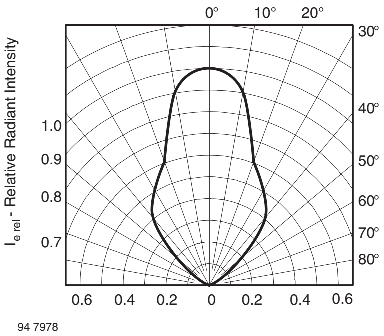
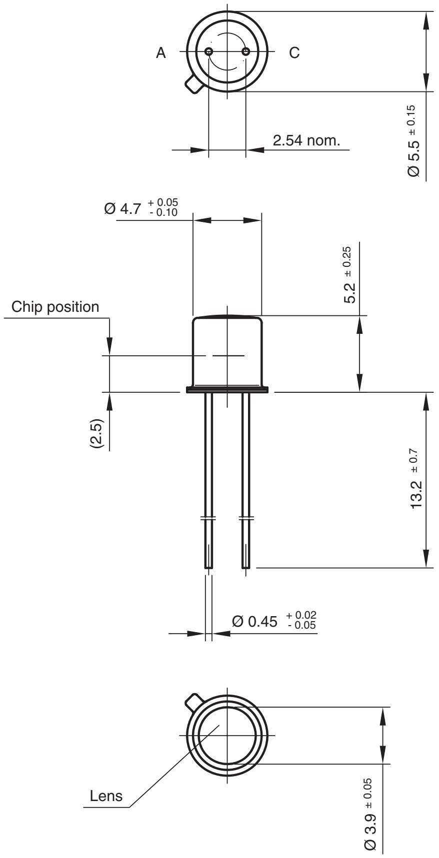
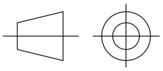


Fig. 10 - Relative Radiant Intensity vs. Angular Displacement

PACKAGE DIMENSIONS in millimeters

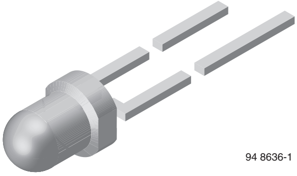




technical drawings
according to DIN
specifications

Drawing-No.: 6.503-5001.02-4
Issue: 1; 24.08.98
14485

Infrared Emitting Diode, RoHS Compliant, 950 nm, GaAs


94 8636-1

DESCRIPTION

TSUS4300 is an infrared, 950 nm emitting diode in GaAs technology molded in a blue tinted plastic package.

FEATURES

- Package type: leaded
- Package form: T-1
- Dimensions (in mm): ∅ 3
- Peak wavelength: λ_p = 950 nm
- High reliability
- Angle of half intensity: φ = ± 16°
- Low forward voltage
- Suitable for high pulse current operation
- Good spectral matching with Si photodetectors
- Package matches with detector TEFT4300
- Lead (Pb)-free component in accordance with RoHS 2002/95/EC and WEEE 2002/96/EC

APPLICATIONS

- Infrared remote control and free air transmission systems with low forward voltage and small package requirements
- Emitter in transmissive sensors
- Emitter in reflective sensors

PRODUCT SUMMARY

COMPONENT	I_e (mW/sr)	φ (deg)	λ_P (nm)	t_r (ns)
TSUS4300	18	± 16	950	800

Note
Test conditions see table “Basic Characteristics”

ORDERING INFORMATION

ORDERING CODE	PACKAGING	REMARKS	PACKAGE FORM
TSUS4300	Bulk	MOQ: 5000 pcs, 5000 pcs/bulk	T-1

Note
MOQ: minimum order quantity

ABSOLUTE MAXIMUM RATINGS

PARAMETER	TEST CONDITION	SYMBOL	VALUE	UNIT
Reverse voltage		V_R	5	V
Forward current		I_F	100	mA
Peak forward current	t_p/T = 0.5, t_p = 100 µs	I_{FM}	200	mA
Surge forward current	t_p = 100 µs	I_{FSM}	2	A
Power dissipation		P_V	170	mW
Junction temperature		T_j	100	°C
Operating temperature range		T_{amb}	- 40 to + 85	°C
Storage temperature range		T_{stg}	- 40 to + 100	°C
Soldering temperature	t ≤ 5 s, 2 mm from case	T_{sd}	260	°C
Thermal resistance junction/ambient	J-STD-051, leads 7 mm, soldered on PCB	R_{thJA}	300	K/W

Note
T_{amb} = 25 °C, unless otherwise specified

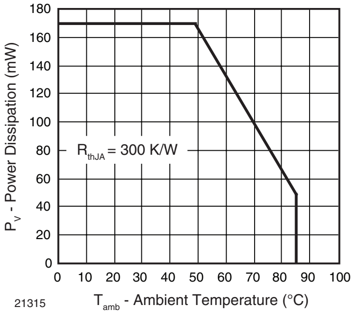


Fig. 1 - Power Dissipation Limit vs. Ambient Temperature

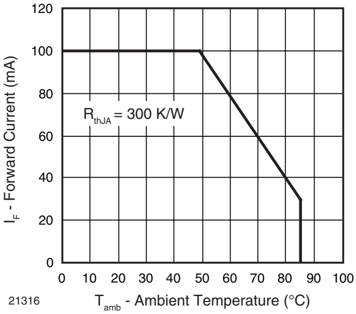


Fig. 2 - Forward Current Limit vs. Ambient Temperature

BASIC CHARACTERISTICS

PARAMETER	TEST CONDITION	SYMBOL	MIN.	TYP.	MAX.	UNIT
Forward voltage	I_F = 100 mA, t_p = 20 ms	V_F		1.3	1.7	V
	I_F = 1.5 A, t_p = 100 µs	V_F		2.2		V
Temperature coefficient of V_F	I_F = 100 mA	TK_{VF}		- 1.3		mV/K
Reverse current	V_R = 5 V	I_R			100	µA
Breakdown voltage	I_R = 100 µA	$V_{(BR)}$	5	40		
Junction capacitance	V_R = 0 V, f = 1 MHz, E = 0	C_j		30		pF
Radiant intensity	I_F = 100 mA, t_p = 20 ms	I_e	7	18	35	mW/sr
	I_F = 1.5 A, t_p = 100 µs	I_e		160		mW/sr
Radiant power	I_F = 100 mA, t_p = 20 ms	ϕ_e		20		mW
Temperature coefficient of ϕ_e	I_F = 20 mA	$TK\phi_e$		- 0.8		%/K
Angle of half intensity		φ		± 16		deg
Peak wavelength	I_F = 100 mA	λ_p		950		nm
Spectral bandwidth	I_F = 100 mA	$\Delta\lambda$		50		nm
Temperature coefficient of λ_p	I_F = 100 mA	$TK\lambda_p$		0.2		nm/K
Rise time	I_F = 100 mA	t_r		800		ns
	I_F = 1.5 A	t_r		400		ns
Fall time	I_F = 100 mA	t_f		800		ns
	I_F = 1.5 A	t_f		400		ns
Virtual source diameter		d		2.1		mm

Note

T_{amb} = 25 °C, unless otherwise specified

BASIC CHARACTERISTICS

T_{amb} = 25 °C, unless otherwise specified

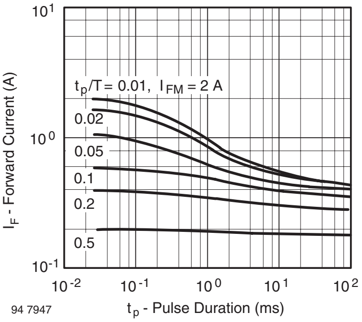


Fig. 3 - Pulse Forward Current vs. Pulse Duration

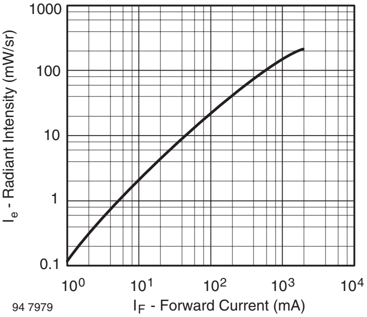


Fig. 6 - Radiant Intensity vs. Forward Current

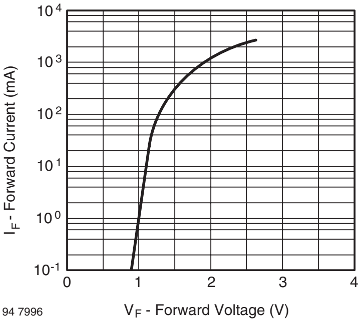


Fig. 4 - Forward Current vs. Forward Voltage

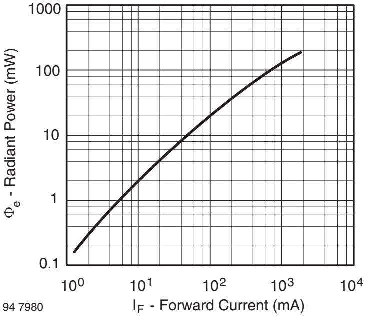


Fig. 7 - Radiant Power vs. Forward Current

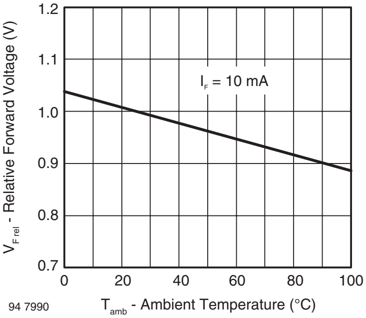


Fig. 5 - Relative Forward Voltage vs. Ambient Temperature

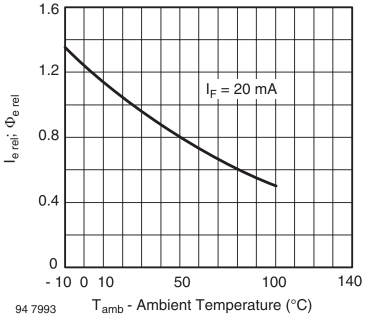


Fig. 8 - Relative Radiant Intensity/Power vs. Ambient Temperature

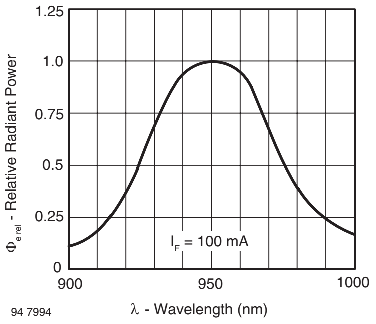


Fig. 9 - Relative Radiant Power vs. Wavelength

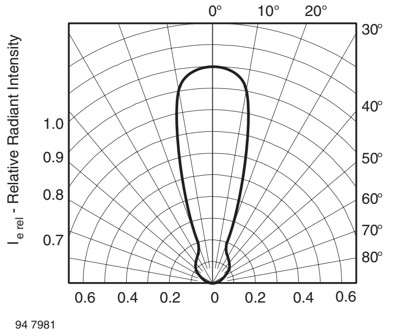
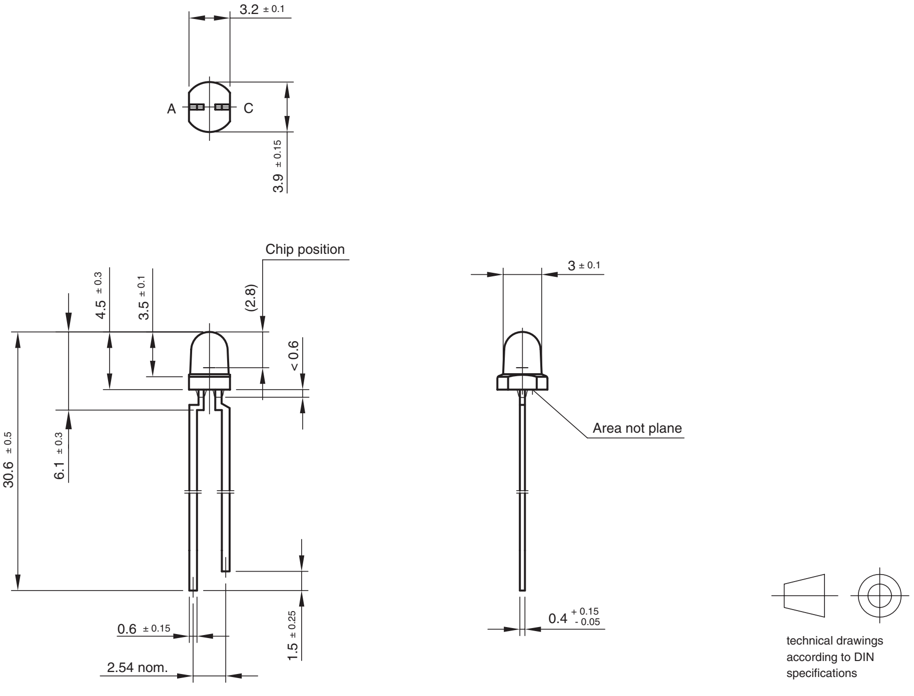


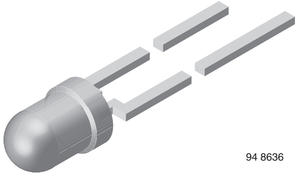
Fig. 10 - Relative Radiant Intensity vs. Angular Displacement

PACKAGE DIMENSIONS in millimeters



Drawing-No.: 6.544-5269.02-4
Issue: 3; 23.04.98
96 12208

Infrared Emitting Diode, RoHS Compliant, 950 nm, GaAs



FEATURES

- Package type: leaded
- Package form: T-1
- Dimensions (in mm): ∅ 3
- Peak wavelength: λ_p = 950 nm
- High reliability
- Angle of half intensity: $\varphi = \pm 18°$
- Low forward voltage
- Suitable for high pulse current operation
- Good spectral matching with Si photodetectors
- Lead (Pb)-free component in accordance with RoHS 2002/95/EC and WEEE 2002/96/EC

DESCRIPTION

TSUS4400 is an infrared, 950 nm emitting diode in GaAs technology molded in a blue tinted plastic package.

APPLICATIONS

- Infrared remote control and free air transmission systems with low forward voltage and small package requirements
- Emitter in transmissive sensors
- Emitter in reflective sensors

PRODUCT SUMMARY

COMPONENT	I_e (mW/sr)	φ (deg)	λ_P (nm)	t_r (ns)
TSUS4400	15	± 18	950	800

Note

Test conditions see table “Basic Characteristics”

ORDERING INFORMATION

ORDERING CODE	PACKAGING	REMARKS	PACKAGE FORM
TSUS4400	Bulk	MOQ: 5000 pcs, 5000 pcs/bulk	T-1

Note

MOQ: minimum order quantity

ABSOLUTE MAXIMUM RATINGS

PARAMETER	TEST CONDITION	SYMBOL	VALUE	UNIT
Reverse voltage		V_R	5	V
Forward current		I_F	100	mA
Peak forward current	$t_p/T = 0.5$, $t_p = 100$ µs	I_{FM}	200	mA
Surge forward current	$t_p = 100$ µs	I_{FSM}	2	A
Power dissipation		P_V	170	mW
Junction temperature		T_j	100	°C
Operating temperature range		T_{amb}	- 40 to + 85	°C
Storage temperature range		T_{stg}	- 40 to + 100	°C
Soldering temperature	$t \leq 5$ s, 2 mm from case	T_{sd}	260	°C
Thermal resistance junction/ambient	J-STD-051, leads 7 mm, soldered on PCB	R_{thJA}	300	K/W

Note

T_{amb} = 25 °C, unless otherwise specified

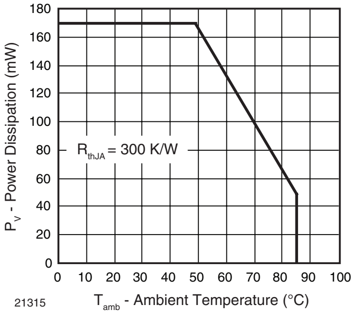


Fig. 1 - Power Dissipation Limit vs. Ambient Temperature

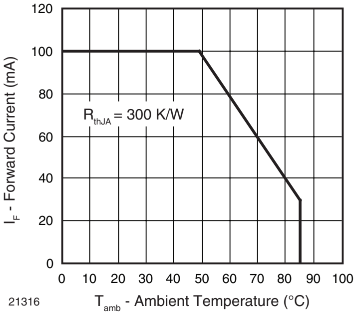


Fig. 2 - Forward Current Limit vs. Ambient Temperature

BASIC CHARACTERISTICS

PARAMETER	TEST CONDITION	SYMBOL	MIN.	TYP.	MAX.	UNIT
Forward voltage	I_F = 100 mA, t_p = 20 ms	V_F		1.3	1.7	V
	I_F = 1.5 A, t_p = 100 µs	V_F		2.2		V
Temperature coefficient of V_F	I_F = 100 mA	TK_{VF}		- 1.3		mV/K
Reverse current	V_R = 5 V	I_R			100	µA
Breakdown voltage	I_R = 100 µA	$V_{(BR)}$	5	40		µA
Junction capacitance	V_R = 0 V, f = 1 MHz, E = 0	C_j		30		pF
Radiant intensity	I_F = 100 mA, t_p = 20 ms	I_e	7	15	35	mW/sr
	I_F = 1.5 A, t_p = 100 µs	I_e		140		mW/sr
Radiant power	I_F = 100 mA, t_p = 20 ms	ϕ_e		20		mW
Temperature coefficient of ϕ_e	I_F = 20 mA	$TK\phi_e$		- 0.8		%/K
Angle of half intensity		φ		± 18		deg
Peak wavelength	I_F = 100 mA	λ_p		950		nm
Spectral bandwidth	I_F = 100 mA	$\Delta\lambda$		50		nm
Temperature coefficient of λ_p	I_F = 100 mA	$TK\lambda_p$		0.2		nm/K
Rise time	I_F = 100 mA	t_r		800		ns
	I_F = 1.5 A	t_r		400		ns
Fall time	I_F = 100 mA	t_f		800		ns
	I_F = 1.5 A	t_f		400		ns
Virtual source diameter		d		2.1		mm

Note

T_{amb} = 25 °C, unless otherwise specified

BASIC CHARACTERISTICS

T_{amb} = 25 °C, unless otherwise specified

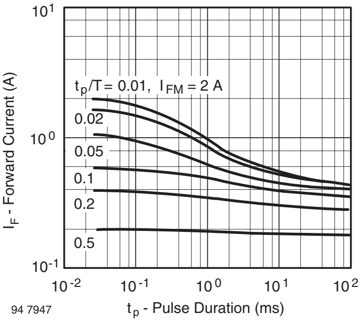


Fig. 3 - Pulse Forward Current vs. Pulse Duration

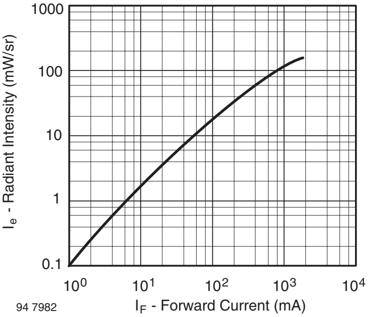


Fig. 6 - Radiant Intensity vs. Forward Current

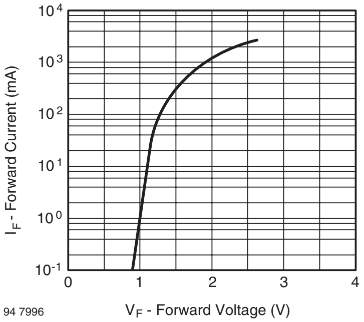


Fig. 4 - Forward Current vs. Forward Voltage

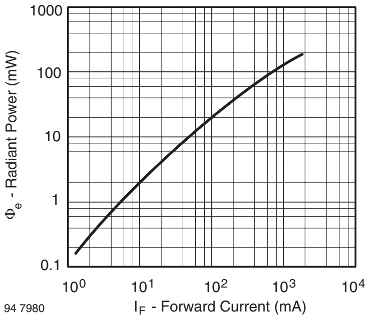


Fig. 7 - Radiant Power vs. Forward Current

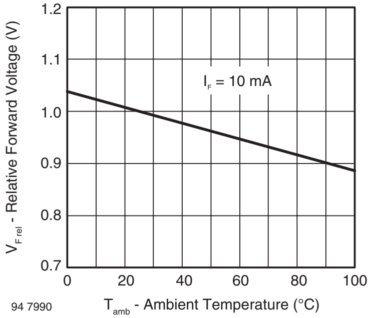


Fig. 5 - Relative Forward Voltage vs. Ambient Temperature

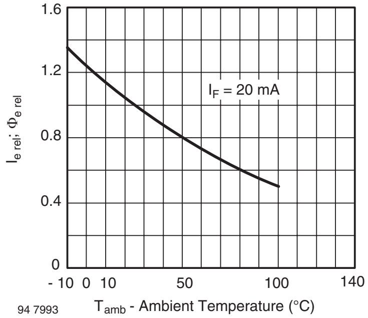


Fig. 8 - Relative Radiant Intensity/Power vs. Ambient Temperature

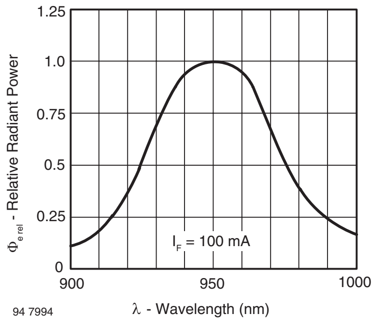


Fig. 9 - Relative Radiant Power vs. Wavelength

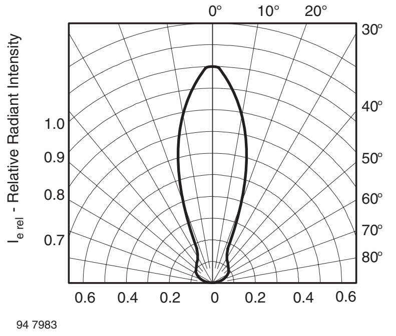
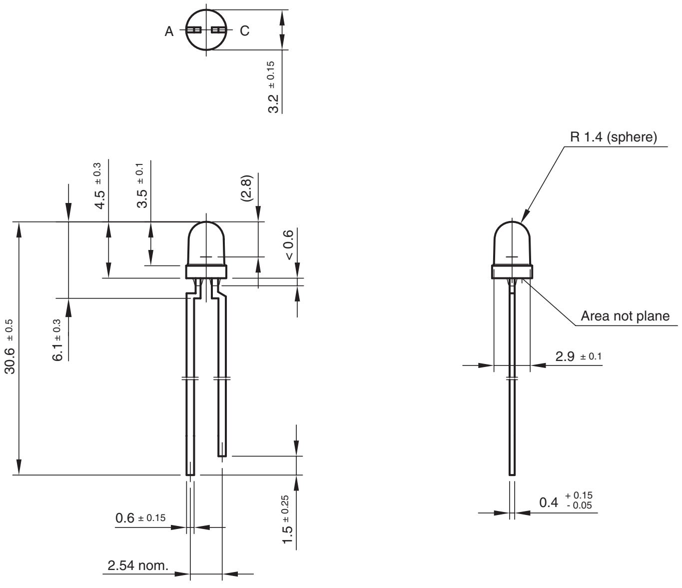
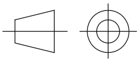


Fig. 10 - Relative Radiant Intensity vs. Angular Displacement

PACKAGE DIMENSIONS in millimeters

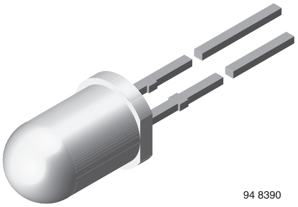




technical drawings
according to DIN
specifications

Drawing-No.: 6.544-5255.02-4
Issue: 3; 23.04.98
95 10914

Infrared Emitting Diode, RoHS Compliant, 950 nm, GaAs



DESCRIPTION

TSUS5200 is an infrared, 950 nm emitting diode in GaAs technology molded in a blue-gray tinted plastic package.

FEATURES

- Package type: leaded
- Package form: T-1¾
- Dimensions (in mm): Ø 5
- Leads with stand-off
- Peak wavelength: λ_p = 950 nm
- High reliability
- Angle of half intensity: φ = ± 15°
- Low forward voltage
- Suitable for high pulse current operation
- Good spectral matching with Si photodetectors
- Lead (Pb)-free component in accordance with RoHS 2002/95/EC and WEEE 2002/96/EC

Pb-free
e2
RoHS
COMPLIANT

APPLICATIONS

- Infrared remote control and free air transmission systems with low forward voltage and small package requirements
- Emitter in transmissive sensors
- Emitter in reflective sensors

PRODUCT SUMMARY

COMPONENT	I_e (mW/sr)	φ (deg)	λ_P (nm)	t_r (ns)
TSUS5200	20	± 15	950	800
TSUS5201	25	± 15	950	800
TSUS5202	30	± 15	950	800

Note
Test conditions see table "Basic Characteristics"

ORDERING INFORMATION

ORDERING CODE	PACKAGING	REMARKS	PACKAGE FORM
TSUS5200	Bulk	MOQ: 4000 pcs, 4000 pcs/bulk	T-1¾
TSUS5201	Bulk	MOQ: 4000 pcs, 4000 pcs/bulk	T-1¾
TSUS5202	Bulk	MOQ: 4000 pcs, 4000 pcs/bulk	T-1¾

Note
MOQ: minimum order quantity

ABSOLUTE MAXIMUM RATINGS

PARAMETER	TEST CONDITION	SYMBOL	VALUE	UNIT
Reverse voltage		V_R	5	V
Forward current		I_F	150	mA
Peak forward current	$t_p/T = 0.5$, t_p = 100 µs	I_{FM}	300	mA
Surge forward current	t_p = 100 µs	I_{FSM}	2.5	A
Power dissipation		P_V	170	mW
Junction temperature		T_j	100	°C
Operating temperature range		T_{amb}	- 40 to + 85	°C
Storage temperature range		T_{stg}	- 40 to + 100	°C
Soldering temperature	$t \leq 5$ s, 2 mm from case	T_{sd}	260	°C
Thermal resistance junction/ambient	J-STD-051, leads 7 mm, soldered on PCB	R_{thJA}	230	K/W

Note
T_{amb} = 25 °C, unless otherwise specified

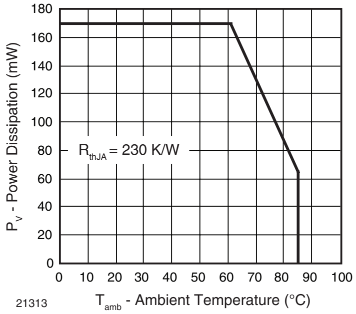


Fig. 1 - Power Dissipation Limit vs. Ambient Temperature

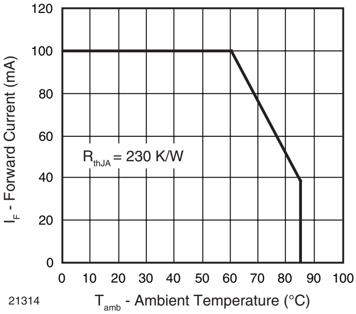


Fig. 2 - Forward Current Limit vs. Ambient Temperature

BASIC CHARACTERISTICS

PARAMETER	TEST CONDITION	SYMBOL	MIN.	TYP.	MAX.	UNIT
Forward voltage	I_F = 100 mA, t_p = 20 ms	V_F		1.3	1.7	V
Temperature coefficient of V_F	I_F = 100 mA	TK_{VF}		- 1.3		mV/K
Reverse current	V_R = 5 V	I_R			100	µA
Junction capacitance	V_R = 0 V, f = 1 MHz, E = 0	C_j		30		pF
Temperature coefficient of ϕ_e	I_F = 20 mA	$TK\phi_e$		- 0.8		%/K
Angle of half intensity		φ		± 15		deg
Peak wavelength	I_F = 100 mA	λ_p		950		nm
Spectral bandwidth	I_F = 100 mA	$\Delta\lambda$		50		nm
Temperature coefficient of λ_p	I_F = 100 mA	$TK\lambda_p$		0.2		nm/K
Rise time	I_F = 100 mA	t_r		800		ns
	I_F = 1.5 A	t_r		400		ns
Fall time	I_F = 100 mA	t_f		800		ns
	I_F = 1.5 A	t_f		400		ns
Virtual source diameter		d		3.8		mm

Note

T_{amb} = 25 °C, unless otherwise specified

TYPE DEDICATED CHARACTERISTICS

PARAMETER	TEST CONDITION	PART	SYMBOL	MIN.	TYP.	MAX.	UNIT
Forward voltage	I_F = 1.5 A, t_p = 100 µs	TSUS5200	V_F		2.2	3.4	V
		TSUS5201	V_F		2.2	3.4	V
		TSUS5202	V_F		2.2	2.7	V
Radiant intensity	I_F = 100 mA, t_p = 20 ms	TSUS5200	I_e	10	20	50	mW/sr
		TSUS5201	I_e	15	25	50	mW/sr
		TSUS5202	I_e	20	30	50	mW/sr
	I_F = 1.5 A, t_p = 100 µs	TSUS5200	I_e	95	180		mW/sr
		TSUS5201	I_e	120	230		mW/sr
		TSUS5202	I_e	170	280		mW/sr
Radiant power	I_F = 100 mA, t_p = 20 ms	TSUS5200	ϕ_e		13		mW
		TSUS5201	ϕ_e		14		mW
		TSUS5202	ϕ_e		15		mW

Note

T_{amb} = 25 °C, unless otherwise specified

BASIC CHARACTERISTICS

T_{amb} = 25 °C, unless otherwise specified

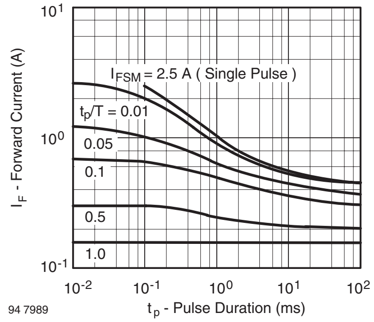


Fig. 3 - Pulse Forward Current vs. Pulse Duration

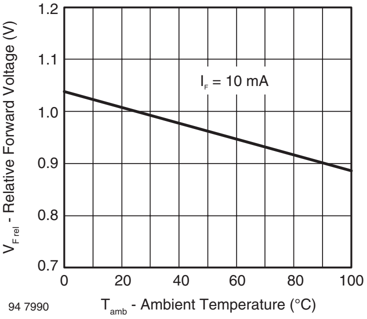


Fig. 5 - Relative Forward Voltage vs. Ambient Temperature

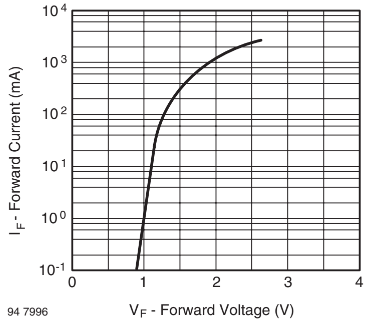


Fig. 4 - Forward Current vs. Forward Voltage

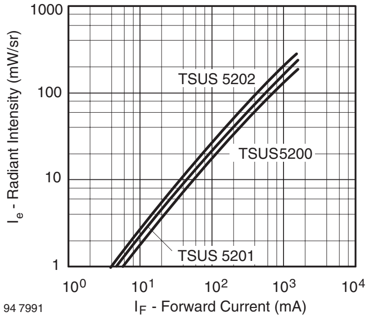


Fig. 6 - Radiant Intensity vs. Forward Current

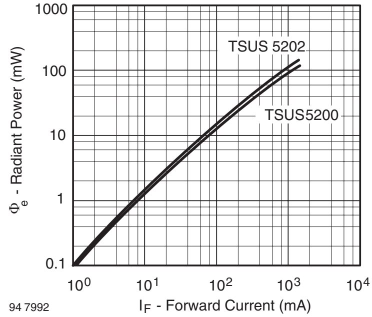


Fig. 7 - Radiant Power vs. Forward Current

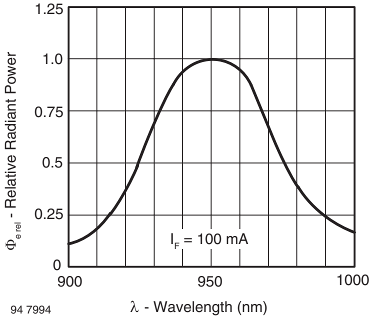


Fig. 9 - Relative Radiant Power vs. Wavelength

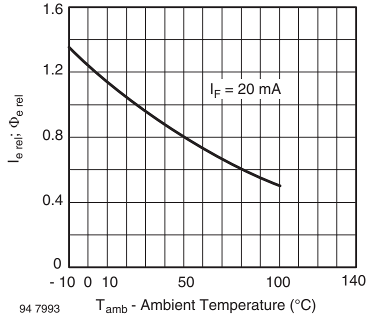


Fig. 8 - Relative Radiant Intensity/Power vs. Ambient Temperature

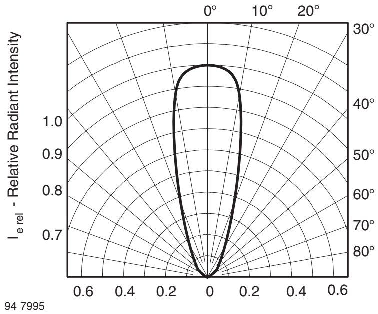
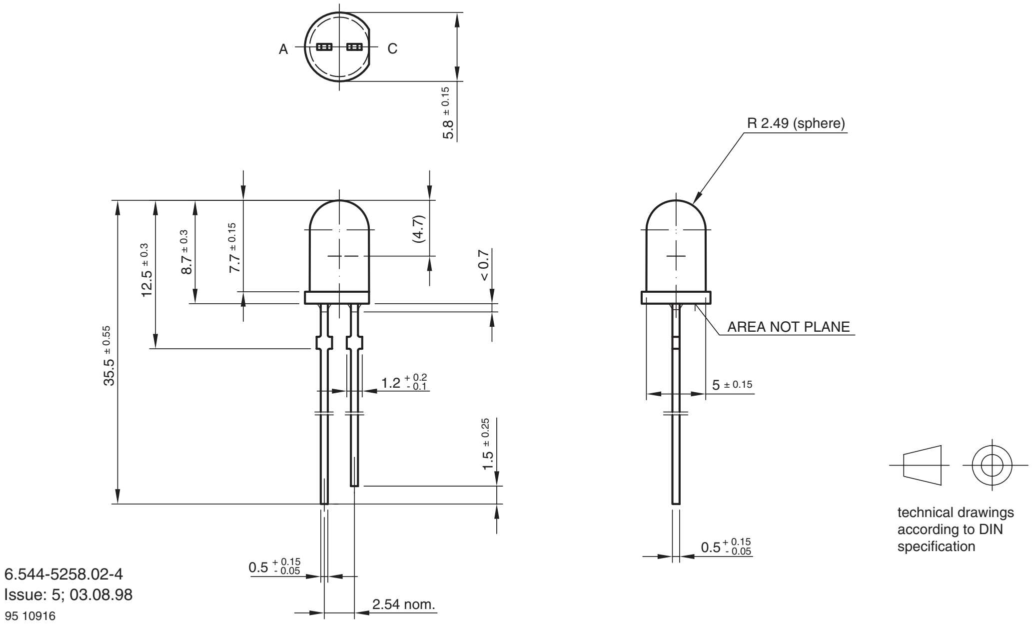
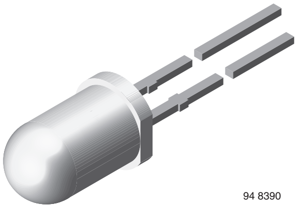


Fig. 10 - Relative Radiant Intensity vs. Angular Displacement

PACKAGE DIMENSIONS in millimeters



Infrared Emitting Diode, RoHS Compliant, 950 nm, GaAs



DESCRIPTION

TSUS5400 is an infrared, 950 nm emitting diode in GaAs technology molded in a blue-gray tinted plastic package.

FEATURES

- Package type: leaded
- Package form: T-1¾
- Dimensions (in mm): Ø 5
- Leads with stand-off
- Peak wavelength: λ_p = 950 nm
- High reliability
- Angle of half intensity: $\varphi = \pm 22°$
- Low forward voltage
- Suitable for high pulse current operation
- Good spectral matching with Si photodetectors
- Lead (Pb)-free component in accordance with RoHS 2002/95/EC and WEEE 2002/96/EC

Pb-free

e2

RoHS COMPLIANT

APPLICATIONS

- Infrared remote control and free air transmission systems with low forward voltage and small package requirements
- Emitter in transmissive sensors
- Emitter in reflective sensors

PRODUCT SUMMARY

COMPONENT	I_e (mW/sr)	φ (deg)	λ_P (nm)	t_r (ns)
TSUS5400	14	± 22	950	800
TSUS5401	17	± 22	950	800
TSUS5402	20	± 22	950	800

Note

Test conditions see table “Basic Characteristics”

ORDERING INFORMATION

ORDERING CODE	PACKAGING	REMARKS	PACKAGE FORM
TSUS5400	Bulk	MOQ: 4000 pcs, 4000 pcs/bulk	T-1¾
TSUS5401	Bulk	MOQ: 4000 pcs, 4000 pcs/bulk	T-1¾
TSUS5402	Bulk	MOQ: 4000 pcs, 4000 pcs/bulk	T-1¾

Note

MOQ: minimum order quantity

ABSOLUTE MAXIMUM RATINGS

PARAMETER	TEST CONDITION	SYMBOL	VALUE	UNIT
Reverse voltage		V_R	5	V
Forward current		I_F	150	mA
Peak forward current	$t_p/T = 0.5$, $t_p = 100$ µs	I_{FM}	300	mA
Surge forward current	$t_p = 100$ µs	I_{FSM}	2.5	A
Power dissipation		P_V	170	mW
Junction temperature		T_j	100	°C
Operating temperature range		T_{amb}	- 40 to + 85	°C
Storage temperature range		T_{stg}	- 40 to + 100	°C
Soldering temperature	$t \leq 5$ s, 2 mm from case	T_{sd}	260	°C
Thermal resistance junction/ambient	J-STD-051, leads 7 mm, soldered on PCB	R_{thJA}	230	K/W

Note

T_{amb} = 25 °C, unless otherwise specified

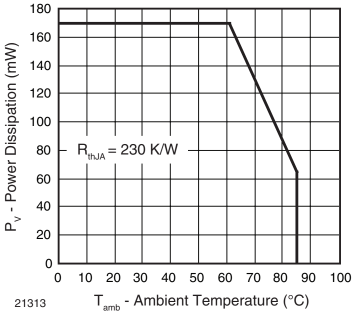


Fig. 1 - Power Dissipation Limit vs. Ambient Temperature

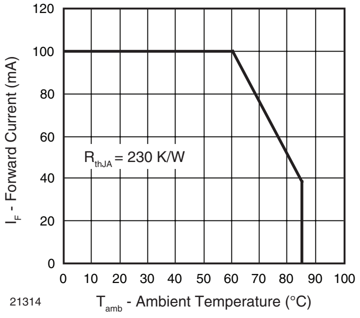


Fig. 2 - Forward Current Limit vs. Ambient Temperature

BASIC CHARACTERISTICS

PARAMETER	TEST CONDITION	SYMBOL	MIN.	TYP.	MAX.	UNIT
Forward voltage	I_F = 100 mA, t_p = 20 ms	V_F		1.3	1.7	V
Temperature coefficient of V_F	I_F = 100 mA	TK_{VF}		- 1.3		mV/K
Reverse current	V_R = 5 V	I_R			100	µA
Junction capacitance	V_R = 0 V, f = 1 MHz, E = 0	C_j		30		pF
Temperature coefficient of ϕ_e	I_F = 20 mA	$TK\phi_e$		- 0.8		%/K
Angle of half intensity		φ		± 22		deg
Peak wavelength	I_F = 100 mA	λ_p		950		nm
Spectral bandwidth	I_F = 100 mA	$\Delta\lambda$		50		nm
Temperature coefficient of λ_p	I_F = 100 mA	$TK\lambda_p$		0.2		nm/K
Rise time	I_F = 100 mA	t_r		800		ns
	I_F = 1.5 A	t_r		400		ns
Fall time	I_F = 100 mA	t_f		800		ns
	I_F = 1.5 A	t_f		400		ns
Virtual source diameter		d		2.9		mm

Note

T_{amb} = 25 °C, unless otherwise specified

TYPE DEDICATED CHARACTERISTICS

PARAMETER	TEST CONDITION	PART	SYMBOL	MIN.	TYP.	MAX.	UNIT
Forward voltage	I_F = 1.5 A, t_p = 100 µs	TSUS5400	V_F		2.2	3.4	V
		TSUS5401	V_F		2.2	3.4	V
		TSUS5402	V_F		2.2	2.7	V
Radiant intensity	I_F = 100 mA, t_p = 20 ms	TSUS5400	I_e	7	14	35	mW/sr
		TSUS5401	I_e	10	17	35	mW/sr
		TSUS5402	I_e	15	20	35	mW/sr
	I_F = 1.5 A, t_p = 100 µs	TSUS5400	I_e	60	140		mW/sr
		TSUS5401	I_e	85	160		mW/sr
		TSUS5402	I_e	120	190		mW/sr
Radiant power	I_F = 100 mA, t_p = 20 ms	TSUS5400	ϕ_e		13		mW
		TSUS5401	ϕ_e		14		mW
		TSUS5402	ϕ_e		15		mW

Note

T_{amb} = 25 °C, unless otherwise specified

BASIC CHARACTERISTICS

T_{amb} = 25 °C, unless otherwise specified

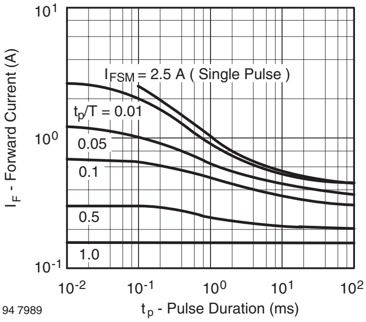


Fig. 3 - Pulse Forward Current vs. Pulse Duration

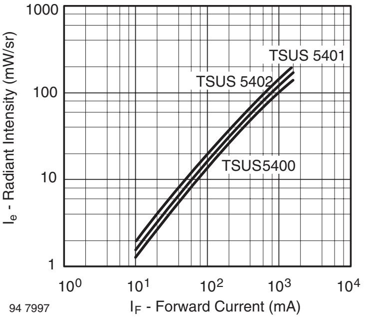


Fig. 6 - Radiant Intensity vs. Forward Current

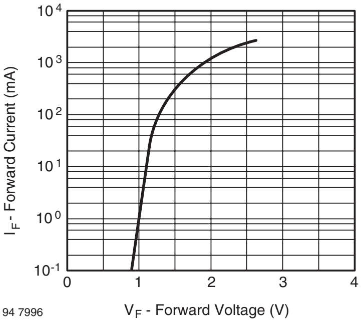


Fig. 4 - Forward Current vs. Forward Voltage

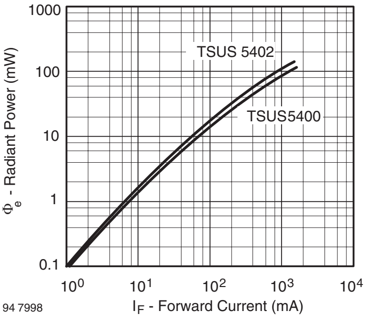


Fig. 7 - Radiant Power vs. Forward Current

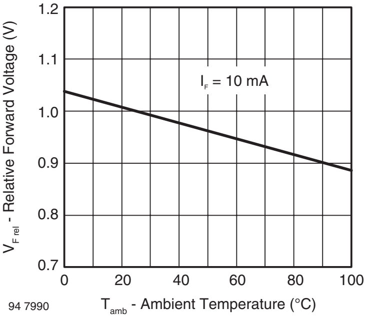


Fig. 5 - Relative Forward Voltage vs. Ambient Temperature

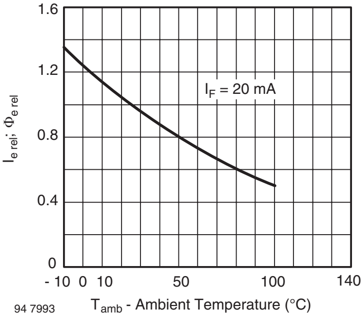


Fig. 8 - Relative Radiant Intensity/Power vs. Ambient Temperature

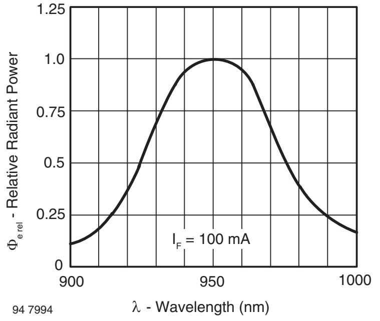


Fig. 9 - Relative Radiant Power vs. Wavelength

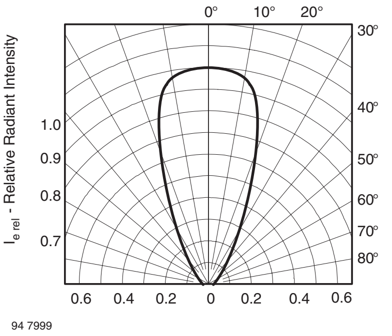
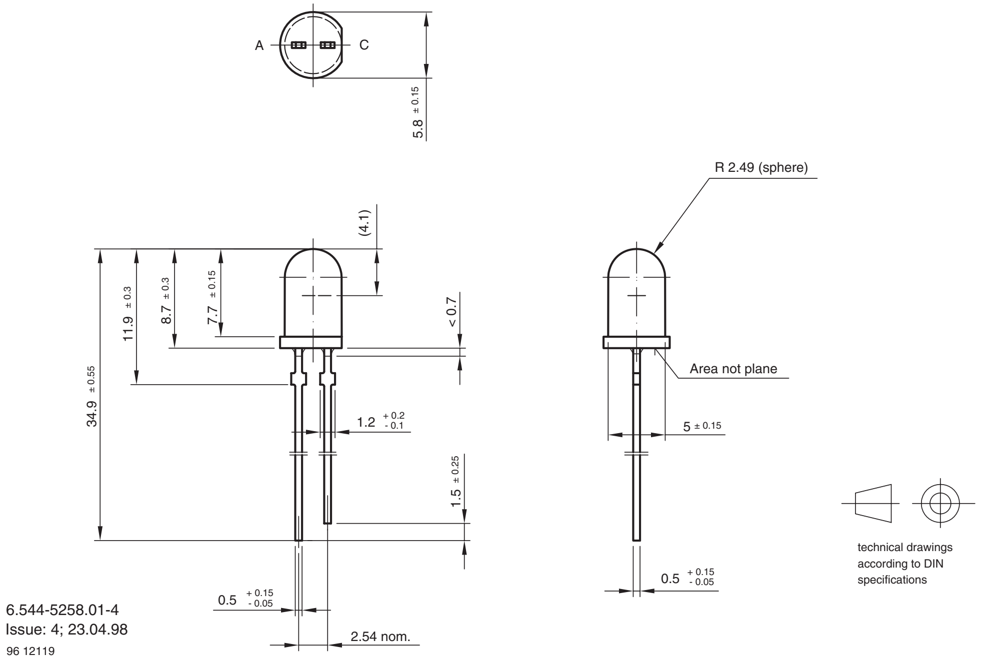


Fig. 10 - Relative Radiant Intensity vs. Angular Displacement

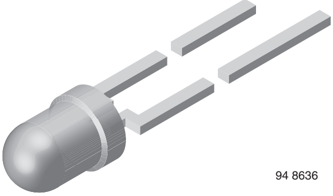
PACKAGE DIMENSIONS in millimeters



VSLB3940

Vishay Semiconductors

High Speed Infrared Emitting Diode, RoHS Compliant, 940 nm, GaAlAs, DDH



FEATURES

- Package type: leaded
- Package form: T-1, clear epoxy
- Dimensions: Ø 3 mm
- Peak wavelength: λ_p = 940 nm
- High speed
- High radiant power
- High radiant intensity
- Angle of half intensity: $\varphi = \pm 22°$
- Low forward voltage
- Suitable for high pulse current operation
- Good spectral matching to Si photodetectors
- Lead (Pb)-free component
- Lead (Pb)-free component in accordance with RoHS 2002/95/EC and WEEE 2002/96/EC

Pb-free

e2

RoHS
COMPLIANT

DESCRIPTION

VSLB3940 is a high speed infrared emitting diode in GaAlAs, DDH technology, molded in a clear plastic package.

APPLICATIONS

- Infrared remote control units

PRODUCT SUMMARY

COMPONENT	I_e (mW/sr)	φ (deg)	λ_p (nm)	t_r (ns)
VSLB3940	65	± 22	940	15

Note
Test conditions see table "Basic Characteristics"

ORDERING INFORMATION

ORDERING CODE	PACKAGING	REMARKS	PACKAGE FORM
VSLB3940	Bulk	MOQ: 5000 pcs, 5000 pcs/bulk	T-1

Note
MOQ: minimum order quantity

ABSOLUTE MAXIMUM RATINGS

PARAMETER	TEST CONDITION	SYMBOL	VALUE	UNIT
Reverse voltage		V_R	5	V
Forward current		I_F	100	mA
Peak forward current	$t_p/T = 0.1$, t_p = 100 µs	I_{FM}	1.0	A
Surge forward current	t_p = 100 µs	I_{FSM}	1.5	A
Power dissipation		P_V	160	mW
Junction temperature		T_j	100	°C
Operating temperature range		T_{amb}	- 25 to + 85	°C
Storage temperature range		T_{stg}	- 40 to + 100	°C
Soldering temperature	$t \leq 5$ s, 2 mm from case	T_{sd}	260	°C
Thermal resistance junction/ambient	J-STD-051, leads 7 mm, soldered on PCB	R_{thJA}	300	K/W

Note
T_{amb} = 25 °C, unless otherwise specified

High Speed Infrared Emitting Diode,
RoHS Compliant, 940 nm, GaAlAs, DDH

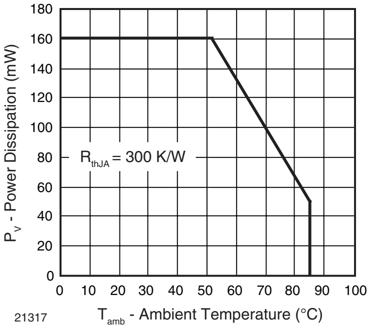


Fig. 1 - Power Dissipation Limit vs. Ambient Temperature

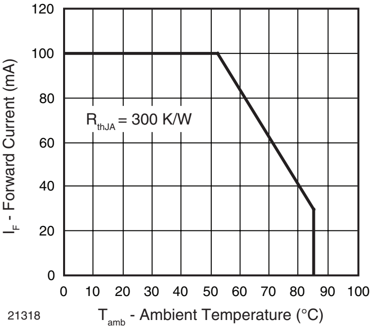


Fig. 2 - Forward Current Limit vs. Ambient Temperature

BASIC CHARACTERISTICS

PARAMETER	TEST CONDITION	SYMBOL	MIN.	TYP.	MAX.	UNIT
Forward voltage	I_F = 100 mA, t_p = 20 ms	V_F	1.15	1.35	1.6	V
	I_F = 1 A, t_p = 100 µs	V_F		2.2		V
Temperature coefficient of V_F	I_F = 1 mA	TK_{VF}		- 1.5		mV/K
	I_F = 100 mA	TK_{VF}		- 1.1		mV/K
Reverse current	V_R = 5 V	I_R			10	µA
Junction capacitance	V_R = 0 V, f = 1 MHz, E = 0 mW/cm^2	C_J		70		pF
Radiant intensity	I_F = 100 mA, t_p = 20 ms	I_e	32	65	110	mW/sr
Radiant power	I_F = 100 mA, t_p = 20 ms	ϕe		40		mW
Temperature coefficient of radiant power	I_F = 1 mA	$TK_{\varphi e}$		- 1.1		%/K
	I_F = 100 mA	$TK_{\varphi e}$		- 0.51		%/K
Angle of half intensity		φ		± 22		deg
Peak wavelength	I_F = 30 mA	λ_p		940		nm
Spectral bandwidth	I_F = 30 mA	$\Delta\lambda$		25		nm
Temperature coefficient of λ_p	I_F = 30 mA	$TK_{\lambda p}$		0.25		nm
Rise time	I_F = 100 mA, 20 % to 80 %	t_r		15		ns
Fall time	I_F = 100 mA, 20 % to 80 %	t_f		15		ns
Virtual source diameter		d		2		mm

Note

T_{amb} = 25 °C, unless otherwise specified

BASIC CHARACTERISTICS

T_{amb} = 25 °C, unless otherwise specified

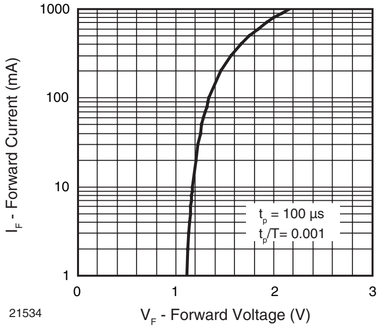


Fig. 3 - Forward Current vs. Forward Voltage

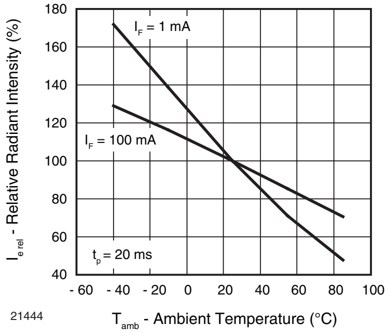


Fig. 6 - Relative Radiant Intensity vs. Ambient Temperature

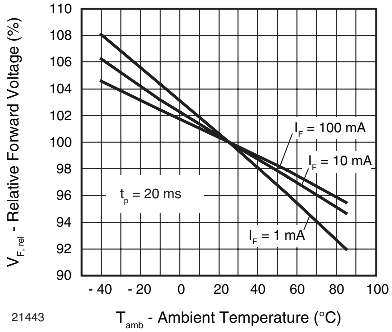


Fig. 4 - Relative Forward Voltage vs. Ambient Temperature

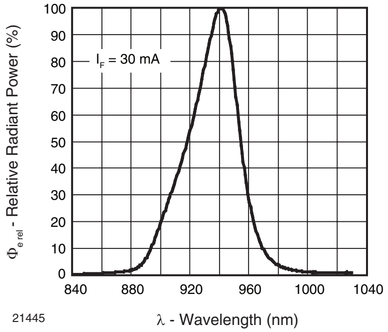


Fig. 7 - Relative Radiant Power vs. Wavelength

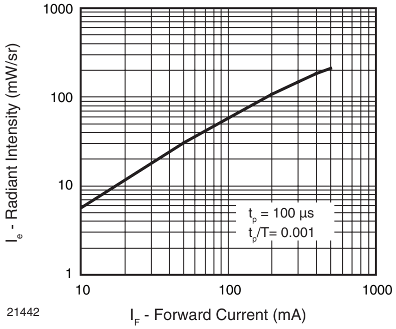


Fig. 5 - Radiant Intensity vs. Forward Current

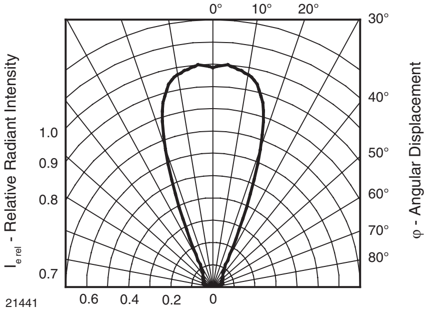
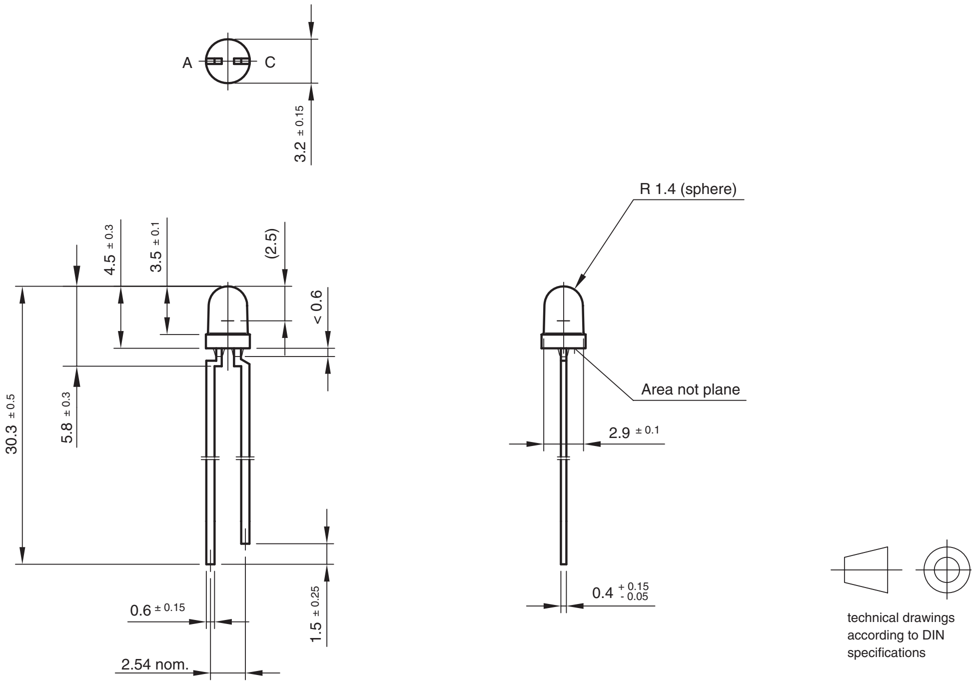


Fig. 8 - Relative Radiant Intensity vs. Angular Displacement

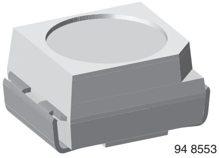
PACKAGE DIMENSIONS in millimeters



technical drawings
according to DIN
specifications

Drawing-No.: 6.544-5255.01-4
Issue: 6; 24.07.08
95 10913

High Speed Infrared Emitting Diode, RoHS Compliant, 890 nm, GaAlAs Double Hetero



DESCRIPTION

VSMF3710 is an infrared, 890 nm emitting diode in GaAlAs double hetero (DH) technology with high radiant power and high speed, molded in a PLCC-2 package for surface mounting (SMD).

FEATURES

- Package type: surface mount
- Package form: PLCC-2
- Dimensions (L x W x H in mm): 3.5 x 2.8 x 1.75
- Peak wavelength: λ_p = 890 nm
- High reliability
- High radiant power
- High radiant intensity
- Angle of half intensity: φ = ± 60°
- Low forward voltage
- Suitable for high pulse current operation
- High modulation band width: f_c = 12 MHz
- Good spectral matching with Si photodetectors
- Floor life: 4 weeks, MSL 2a, acc. J-STD-020
- Lead (Pb)-free reflow soldering
- Lead (Pb)-free component in accordance with RoHS 2002/95/EC and WEEE 2002/96/EC

APPLICATIONS

- High speed IR data transmission
- High power emitter for low space applications
- High performance transmissive or reflective sensors

PRODUCT SUMMARY

COMPONENT	I_e (mW/sr)	φ (deg)	λ_P (nm)	t_r (ns)
VSMF3710	10	± 60	890	30

Note

Test conditions see table "Basic Characteristics"

ORDERING INFORMATION

ORDERING CODE	PACKAGING	REMARKS	PACKAGE FORM
VSMF3710-GS08	Tape and reel	MOQ: 7500 pcs, 1500 pcs/reel	PLCC-2
VSMF3710-GS18	Tape and reel	MOQ: 8000 pcs, 8000 pcs/reel	PLCC-2

Note

MOQ: minimum order quantity

ABSOLUTE MAXIMUM RATINGS

PARAMETER	TEST CONDITION	SYMBOL	VALUE	UNIT
Reverse voltage		V_R	5	V
Forward current		I_F	100	mA
Peak forward current	$t_p/T = 0.5$, $t_p = 100\ \mu s$	I_{FM}	200	mA
Surge forward current	$t_p = 100\ \mu s$	I_{FSM}	1	A
Power dissipation		P_V	160	mW

ABSOLUTE MAXIMUM RATINGS				
PARAMETER	**TEST CONDITION**	**SYMBOL**	**VALUE**	**UNIT**
Junction temperature		T_j	100	°C
Operating temperature range		T_{amb}	- 40 to + 85	°C
Storage temperature range		T_{stg}	- 40 to + 100	°C
Soldering temperature	acc. figure 8, J-STD-020	T_{sd}	260	°C
Thermal resistance junction/ambient	J-STD-051, soldered on PCB	R_{thJA}	250	K/W

Note

T_{amb} = 25 °C, unless otherwise specified

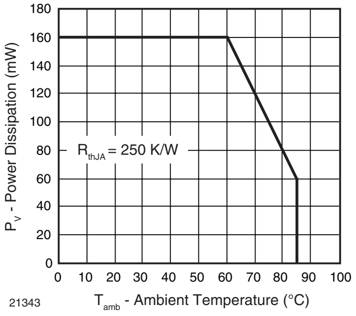


Fig. 1 - Power Dissipation Limit vs. Ambient Temperature

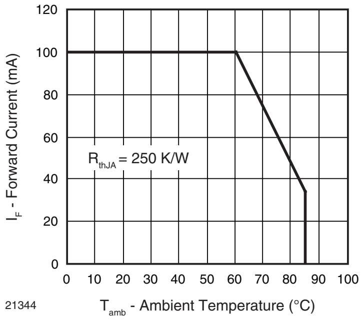


Fig. 2 - Forward Current Limit vs. Ambient Temperature

BASIC CHARACTERISTICS						
PARAMETER	**TEST CONDITION**	**SYMBOL**	**MIN.**	**TYP.**	**MAX.**	**UNIT**
Forward voltage	I_F = 100 mA, t_p = 20 ms	V_F		1.4	1.6	V
	I_F = 1 A, t_p = 100 µs	V_F		2.3		V
Temperature coefficient of V_F	I_F = 1 mA	TK_{VF}		- 1.8		mV/K
Reverse current	V_R = 5 V	I_R			10	µA
Junction capacitance	V_R = 0 V, f = 1 MHz, E = 0	C_j		125		pF
Radiant intensity	I_F = 100 mA, t_p = 20 ms	I_e	6	10	22	mW/sr
	I_F = 1 A, t_p = 100 µs	I_e		100		mW/sr
Radiant power	I_F = 100 mA, t_p = 20 ms	ϕ_e		40		mW
Temperature coefficient of ϕ_e	I_F = 100 mA	$TK\phi_e$		- 0.35		%/K
Angle of half intensity		φ		± 60		deg
Peak wavelength	I_F = 100 mA	λ_p		890		nm
Spectral bandwidth	I_F = 100 mA	$\Delta\lambda$		40		nm
Temperature coefficient of λ_p	I_F = 100 mA	$TK\lambda_p$		0.25		nm/K
Rise time	I_F = 100 mA	t_r		30		ns
Fall time	I_F = 100 mA	t_f		30		ns
Cut-off frequency	I_{DC} = 70 mA, I_{AC} = 30 mA pp	f_c		12		MHz
Virtual source diameter		d		0.44		mm

Note

T_{amb} = 25 °C, unless otherwise specified

BASIC CHARACTERISTICS

T_{amb} = 25 °C, unless otherwise specified

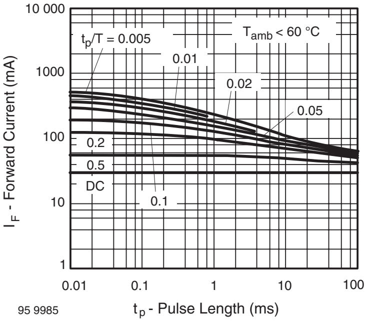


Fig. 3 - Pulse Forward Current vs. Pulse Duration

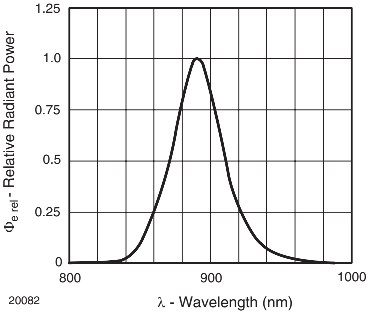


Fig. 6 - Relative Radiant Power vs. Wavelength

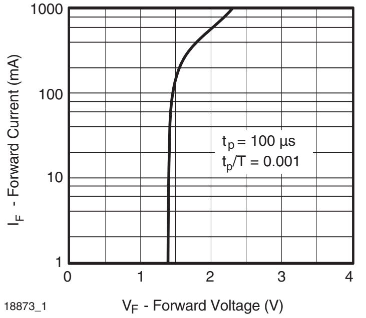


Fig. 4 - Forward Current vs. Forward Voltage

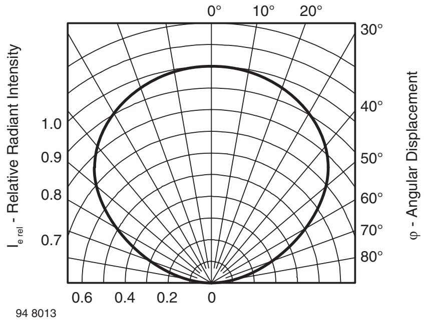


Fig. 7 - Relative Radiant Intensity vs. Angular Displacement

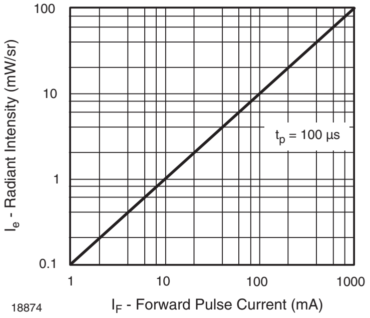
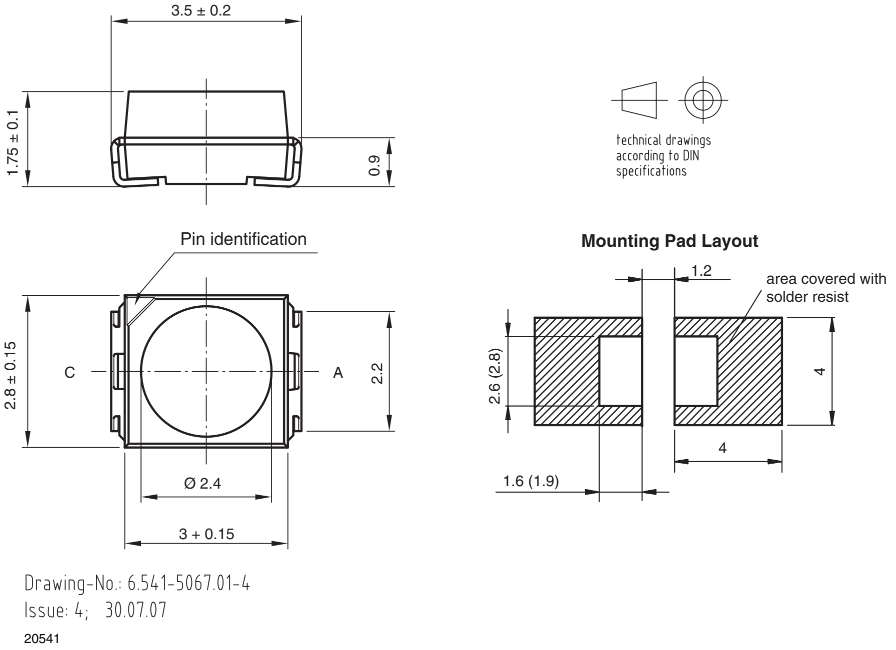


Fig. 5 - Radiant Intensity vs. Forward Current

PACKAGE DIMENSIONS in millimeters



SOLDER PROFILE

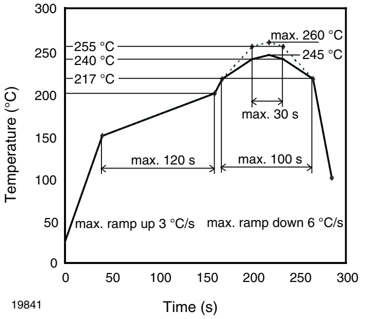


Fig. 8 - Lead (Pb)-free Reflow Solder Profile acc. J-STD-020D

DRYPACK

Devices are packed in moisture barrier bags (MBB) to prevent the products from moisture absorption during transportation and storage. Each bag contains a desiccant.

FLOOR LIFE

Floor life (time between soldering and removing from MBB) must not exceed the time indicated on MBB label:
Floor life: 4 weeks
Conditions: T_{amb} < 30 °C, RH < 60 %
Moisture sensitivity level 2a, acc. to J-STD-020.

DRYING

In case of moisture absorption devices should be baked before soldering. Conditions see J-STD-020 or label. Devices taped on reel dry using recommended conditions 192 h at 40 °C (+ 5 °C), RH < 5 %.

TAPE AND REEL

PLCC-2 components are packed in antistatic blister tape (DIN IEC (CO) 564) for automatic component insertion. Cavities of blister tape are covered with adhesive tape.

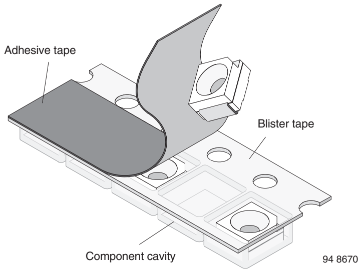


Fig. 9 - Blister Tape

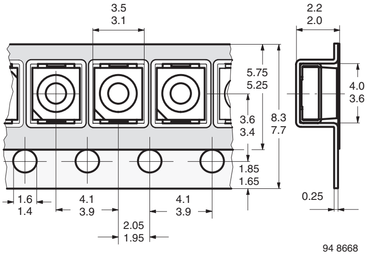


Fig. 10 - Tape Dimensions in mm for PLCC-2

MISSING DEVICES

A maximum of 0.5 % of the total number of components per reel may be missing, exclusively missing components at the beginning and at the end of the reel. A maximum of three consecutive components may be missing, provided this gap is followed by six consecutive components.

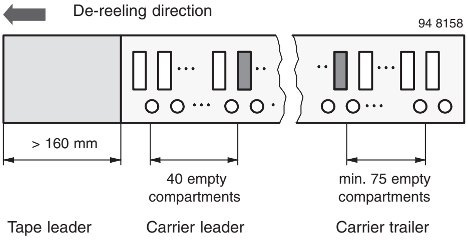


Fig. 11 - Beginning and End of Reel

The tape leader is at least 160 mm and is followed by a carrier tape leader with at least 40 empty compartments. The tape leader may include the carrier tape as long as the cover tape is not connected to the carrier tape. The least component is followed by a carrier tape trailer with a least 75 empty compartments and sealed with cover tape.

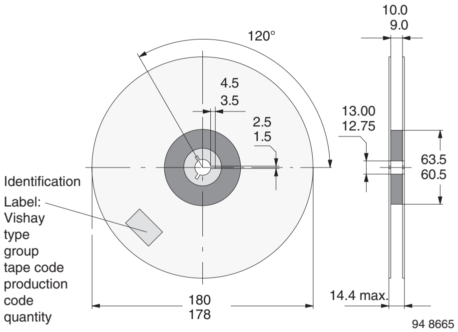


Fig. 12 - Dimensions of Reel-GS08

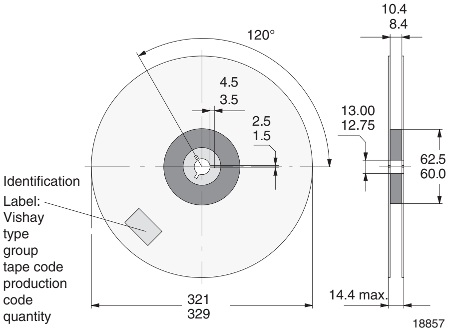
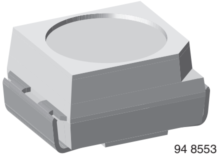


Fig. 13 - Dimensions of Reel-GS18

COVER TAPE REMOVAL FORCE

The removal force lies between 0.1 N and 1.0 N at a removal speed of 5 mm/s. In order to prevent components from popping out of the blisters, the cover tape must be pulled off at an angle of 180° with regard to the feed direction.

High Speed Infrared Emitting Diode, RoHS Compliant, 870 nm, GaAlAs Double Hetero



DESCRIPTION

VSMF4710 is an infrared, 870 nm emitting diode in GaAlAs double hetero (DH) technology with high radiant power and high speed, molded in a PLCC-2 package for surface mounting (SMD).

FEATURES

- Package type: surface mount
- Package form: PLCC-2
- Dimensions (L x W x H in mm): 3.5 x 2.8 x 1.75
- Peak wavelength: λ_p = 870 nm
- High reliability
- High radiant power
- High radiant intensity
- Angle of half intensity: φ = ± 60°
- Low forward voltage
- Suitable for high pulse current operation
- High modulation band width: f_c = 24 MHz
- Good spectral matching with Si photodetectors
- Floor life: 4 weeks, MSL 2a, acc. J-STD-020
- Lead (Pb)-free reflow soldering
- Lead (Pb)-free component in accordance with RoHS 2002/95/EC and WEEE 2002/96/EC

Pb-free
e3
RoHS
COMPLIANT

APPLICATIONS

- High speed IR data transmission
- High power emitter for low space applications
- High performance transmissive or reflective sensors

PRODUCT SUMMARY

COMPONENT	I_e (mW/sr)	φ (deg)	λ_P (nm)	t_r (ns)
VSMF4710	10	± 60	870	15

Note
Test conditions see table “Basic Characteristics”

ORDERING INFORMATION

ORDERING CODE	PACKAGING	REMARKS	PACKAGE FORM
VSMF4710-GS08	Tape and reel	MOQ: 7500 pcs, 1500 pcs/reel	PLCC-2
VSMF4710-GS18	Tape and reel	MOQ: 8000 pcs, 8000 pcs/reel	PLCC-2

Note
MOQ: minimum order quantity

ABSOLUTE MAXIMUM RATINGS

PARAMETER	TEST CONDITION	SYMBOL	VALUE	UNIT
Reverse voltage		V_R	5	V
Forward current		I_F	100	mA
Peak forward current	t_p/T = 0.5, t_p = 100 µs	I_{FM}	200	mA
Surge forward current	t_p = 100 µs	I_{FSM}	1	A
Power dissipation		P_V	160	mW

High Speed Infrared Emitting Diode, RoHS Compliant, 870 nm, GaAlAs Double Hetero

ABSOLUTE MAXIMUM RATINGS

PARAMETER	TEST CONDITION	SYMBOL	VALUE	UNIT
Junction temperature		T_j	100	°C
Operating temperature range		T_{amb}	- 40 to + 85	°C
Storage temperature range		T_{stg}	- 40 to + 100	°C
Soldering temperature	acc. figure 8, J-STD-020	T_{sd}	260	°C
Thermal resistance junction/ambient	J-STD-051, soldered on PCB	R_{thJA}	250	K/W

Note

T_{amb} = 25 °C, unless otherwise specified

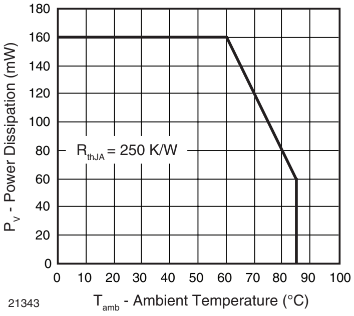


Fig. 1 - Power Dissipation Limit vs. Ambient Temperature

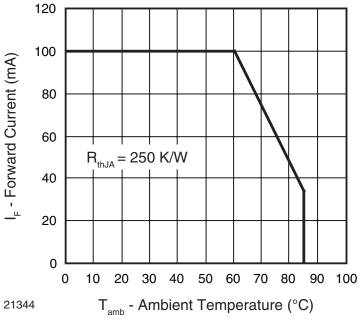


Fig. 2 - Forward Current Limit vs. Ambient Temperature

BASIC CHARACTERISTICS

PARAMETER	TEST CONDITION	SYMBOL	MIN.	TYP.	MAX.	UNIT
Forward voltage	I_F = 100 mA, t_p = 20 ms	V_F		1.5	1.8	V
	I_F = 1 A, t_p = 100 µs	V_F		2.3		V
Temperature coefficient of V_F	I_F = 1 mA	TK_{VF}		- 1.8		mV/K
Reverse current	V_R = 5 V	I_R			10	µA
Junction capacitance	V_R = 0 V, f = 1 MHz, E = 0	C_j		125		pF
Radiant intensity	I_F = 100 mA, t_p = 20 ms	I_e	6	10	22	mW/sr
	I_F = 1 A, t_p = 100 µs	I_e		100		mW/sr
Radiant power	I_F = 100 mA, t_p = 20 ms	ϕ_e		40		mW
Temperature coefficient of ϕ_e	I_F = 100 mA	$TK\phi_e$		- 0.35		%/K
Angle of half intensity		φ		± 60		deg
Peak wavelength	I_F = 100 mA	λ_p		870		nm
Spectral bandwidth	I_F = 100 mA	$\Delta\lambda$		40		nm
Temperature coefficient of λ_p	I_F = 100 mA	$TK\lambda_p$		0.25		nm/K
Rise time	I_F = 100 mA	t_r		15		ns
Fall time	I_F = 100 mA	t_f		15		ns
Cut-off frequency	I_{DC} = 70 mA, I_{AC} = 30 mA pp	f_c		24		MHz
Virtual source diameter		d		0.44		mm

Note

T_{amb} = 25 °C, unless otherwise specified

BASIC CHARACTERISTICS

T_{amb} = 25 °C, unless otherwise specified

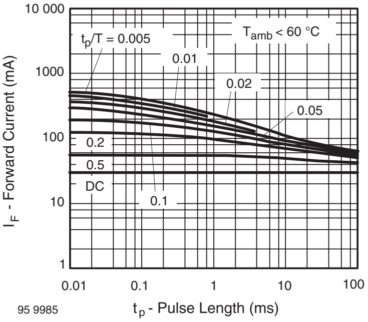


Fig. 3 - Pulse Forward Current vs. Pulse Duration

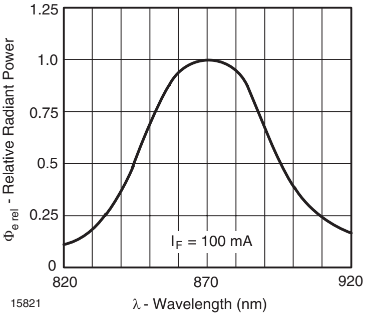


Fig. 6 - Relative Radiant Power vs. Wavelength

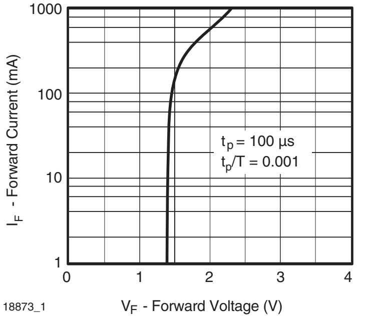


Fig. 4 - Forward Current vs. Forward Voltage

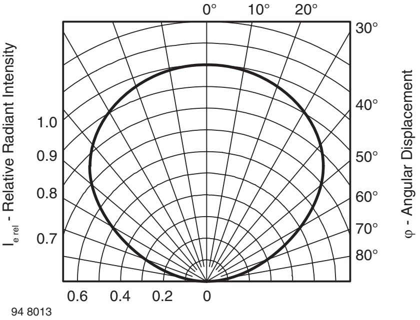


Fig. 7 - Relative Radiant Intensity vs. Angular Displacement

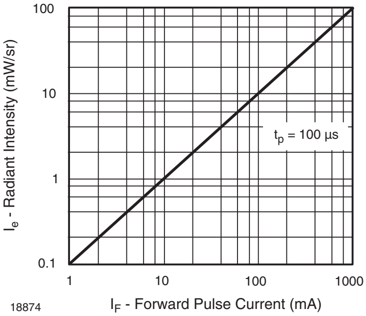
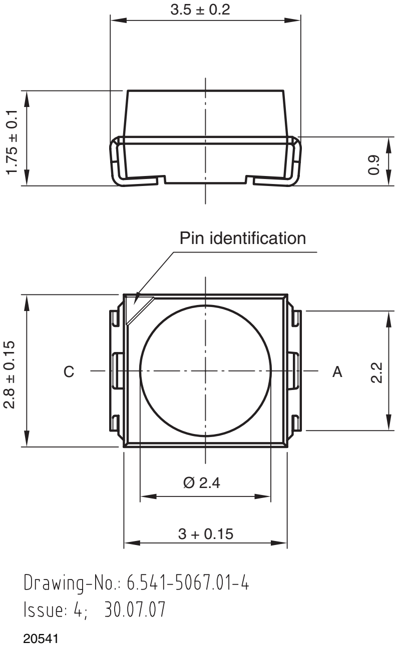
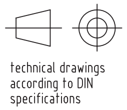


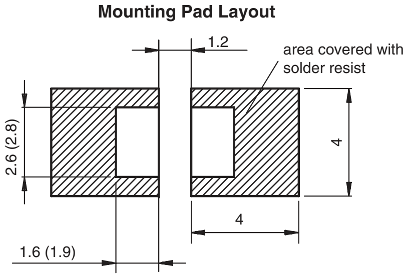
Fig. 5 - Radiant Intensity vs. Forward Current

High Speed Infrared Emitting Diode, RoHS Compliant, 870 nm, GaAlAs Double Hetero

PACKAGE DIMENSIONS in millimeters







SOLDER PROFILE

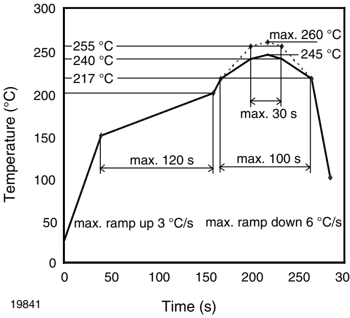


Fig. 8 - Lead (Pb)-free Reflow Solder Profile acc. J-STD-020D

DRYPACK

Devices are packed in moisture barrier bags (MBB) to prevent the products from moisture absorption during transportation and storage. Each bag contains a desiccant.

FLOOR LIFE

Floor life (time between soldering and removing from MBB) must not exceed the time indicated on MBB label:
Floor life: 4 weeks
Conditions: T_{amb} < 30 °C, RH < 60 %
Moisture sensitivity level 2a, acc. to J-STD-020.

DRYING

In case of moisture absorption devices should be baked before soldering. Conditions see J-STD-020 or label. Devices taped on reel dry using recommended conditions 192 h at 40 °C (+ 5 °C), RH < 5 %.

TAPE AND REEL

PLCC-2 components are packed in antistatic blister tape (DIN IEC (CO) 564) for automatic component insertion. Cavities of blister tape are covered with adhesive tape.

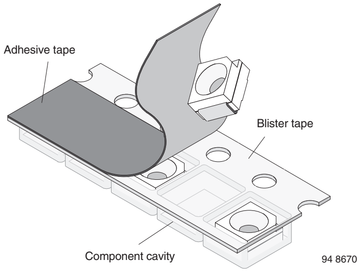


Fig. 9 - Blister Tape

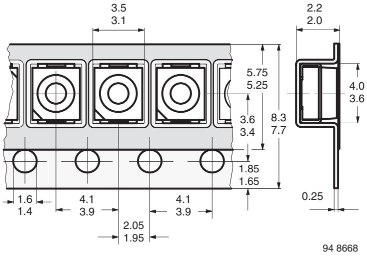


Fig. 10 - Tape Dimensions in mm for PLCC-2

MISSING DEVICES

A maximum of 0.5 % of the total number of components per reel may be missing, exclusively missing components at the beginning and at the end of the reel. A maximum of three consecutive components may be missing, provided this gap is followed by six consecutive components.

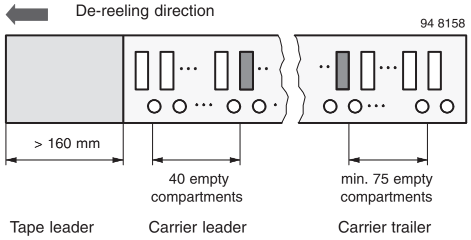


Fig. 11 - Beginning and End of Reel

The tape leader is at least 160 mm and is followed by a carrier tape leader with at least 40 empty compartments. The tape leader may include the carrier tape as long as the cover tape is not connected to the carrier tape. The least component is followed by a carrier tape trailer with a least 75 empty compartments and sealed with cover tape.

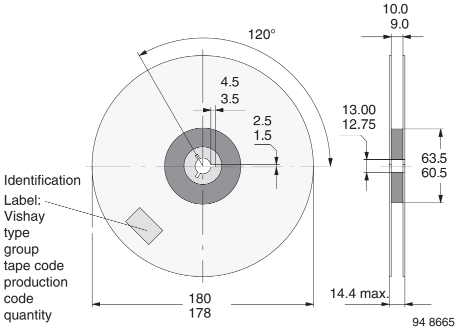


Fig. 12 - Dimensions of Reel-GS08

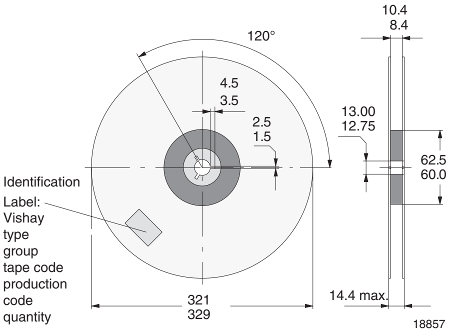
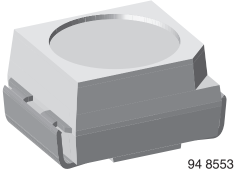


Fig. 13 - Dimensions of Reel-GS18

COVER TAPE REMOVAL FORCE

The removal force lies between 0.1 N and 1.0 N at a removal speed of 5 mm/s. In order to prevent components from popping out of the blisters, the cover tape must be pulled off at an angle of 180° with regard to the feed direction.

High Speed Infrared Emitting Diode, RoHS Compliant, 870 nm, GaAlAs Double Hetero


94 8553

DESCRIPTION

VSMF4720 is an infrared, 870 nm emitting diode in GaAlAs double hetero (DH) technology with high radiant power and high speed, molded in a PLCC-2 package for surface mounting (SMD). A 19" chip provides outstanding low forward voltage and radiant intensity even at 1 A pulse current.

FEATURES

- Package type: surface mount
- Package form: PLCC-2
- Dimensions (L x W x H in mm): 3.5 x 2.8 x 1.75
- Peak wavelength: λ_p = 870 nm
- High reliability
- High radiant power
- High radiant intensity
- Angle of half intensity: φ = ± 60°
- Low forward voltage
- Suitable for high pulse current operation
- High modulation band width: f_c = 24 MHz
- Good spectral matching with Si photodetectors
- Floor life: 4 weeks, MSL 2a, acc. J-STD-020
- Lead (Pb)-free reflow soldering
- Lead (Pb)-free component in accordance with RoHS 2002/95/EC and WEEE 2002/96/EC

Pb-free

e3

RoHS
COMPLIANT

APPLICATIONS

- High speed IR data transmission
- High power emitter for low space applications
- High performance transmissive or reflective sensors

PRODUCT SUMMARY

COMPONENT	I_e (mW/sr)	φ (deg)	λ_P (nm)	t_r (ns)
VSMF4720	16	± 60	870	15

Note
Test conditions see table “Basic Characteristics”

ORDERING INFORMATION

ORDERING CODE	PACKAGING	REMARKS	PACKAGE FORM
VSMF4720-GS08	Tape and reel	MOQ: 7500 pcs, 1500 pcs/reel	PLCC-2
VSMF4720-GS18	Tape and reel	MOQ: 8000 pcs, 8000 pcs/reel	PLCC-2

Note
MOQ: minimum order quantity

ABSOLUTE MAXIMUM RATINGS

PARAMETER	TEST CONDITION	SYMBOL	VALUE	UNIT
Reverse voltage		V_R	5	V
Forward current		I_F	100	mA
Peak forward current	$t_p/T = 0.5$, t_p = 100 µs	I_{FM}	200	mA
Surge forward current	t_p = 100 µs	I_{FSM}	1	A
Power dissipation		P_V	160	mW
Junction temperature		T_j	100	°C
Operating temperature range		T_{amb}	- 40 to + 85	°C
Storage temperature range		T_{stg}	- 40 to + 100	°C
Soldering temperature	Acc. figure 8, J-STD-020B	T_{sd}	260	°C
Thermal resistance junction/ambient	J-STD-051, soldered on PCB	R_{thJA}	250	K/W

Note
T_{amb} = 25 °C, unless otherwise specified

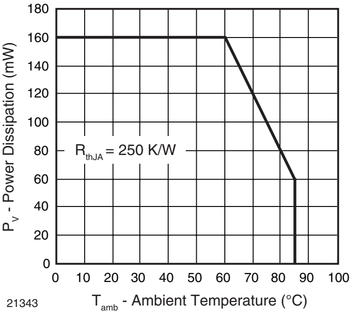


Fig. 1 - Power Dissipation Limit vs. Ambient Temperature

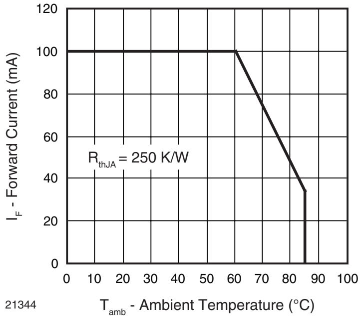


Fig. 2 - Forward Current Limit vs. Ambient Temperature

BASIC CHARACTERISTICS

PARAMETER	TEST CONDITION	SYMBOL	MIN.	TYP.	MAX.	UNIT
Forward voltage	I_F = 100 mA, t_p = 20 ms	V_F		1.45	1.6	V
	I_F = 1 A, t_p = 100 µs	V_F		2.1		V
Temperature coefficient of V_F	I_F = 1 mA	TK_{VF}		- 1.8		mV/K
Reverse current	V_R = 5 V	I_R			10	µA
Junction capacitance	V_R = 0 V, f = 1 MHz, E = 0	C_j		125		pF
Radiant intensity	I_F = 100 mA, t_p = 20 ms	I_e	10	16	30	mW/sr
	I_F = 1 A, t_p = 100 µs	I_e		150		mW/sr
Radiant power	I_F = 100 mA, t_p = 20 ms	ϕ_e		50		mW
Temperature coefficient of ϕ_e	I_F = 100 mA	$TK\phi_e$		- 0.35		%/K
Angle of half intensity		φ		± 60		deg
Peak wavelength	I_F = 100 mA	λ_p		870		nm
Spectral bandwidth	I_F = 100 mA	$\Delta\lambda$		40		nm
Temperature coefficient of λ_p	I_F = 100 mA	$TK\lambda_p$		0.25		nm/K
Rise time	I_F = 100 mA	t_r		15		ns
Fall time	I_F = 100 mA	t_f		15		ns
Cut-off frequency	I_{DC} = 70 mA, I_{AC} = 30 mA pp	f_c		24		MHz
Virtual source diameter		d		0.67		mm

Note

T_{amb} = 25 °C, unless otherwise specified

BASIC CHARACTERISTICS

T_{amb} = 25 °C, unless otherwise specified

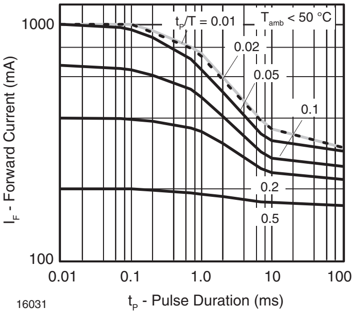


Fig. 3 - Pulse Forward Current vs. Pulse Duration

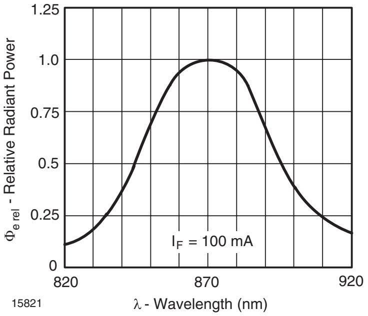


Fig. 6 - Relative Radiant Power vs. Wavelength

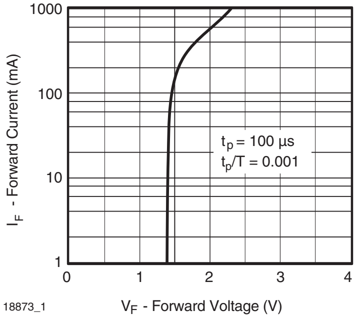


Fig. 4 - Forward Current vs. Forward Voltage

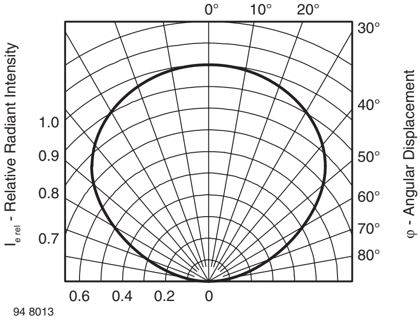


Fig. 7 - Relative Radiant Intensity vs. Angular Displacement

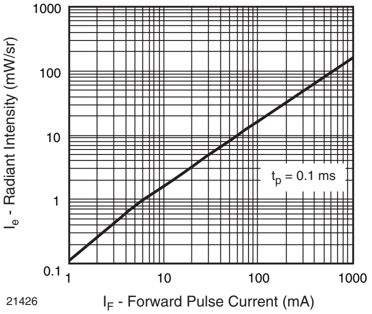
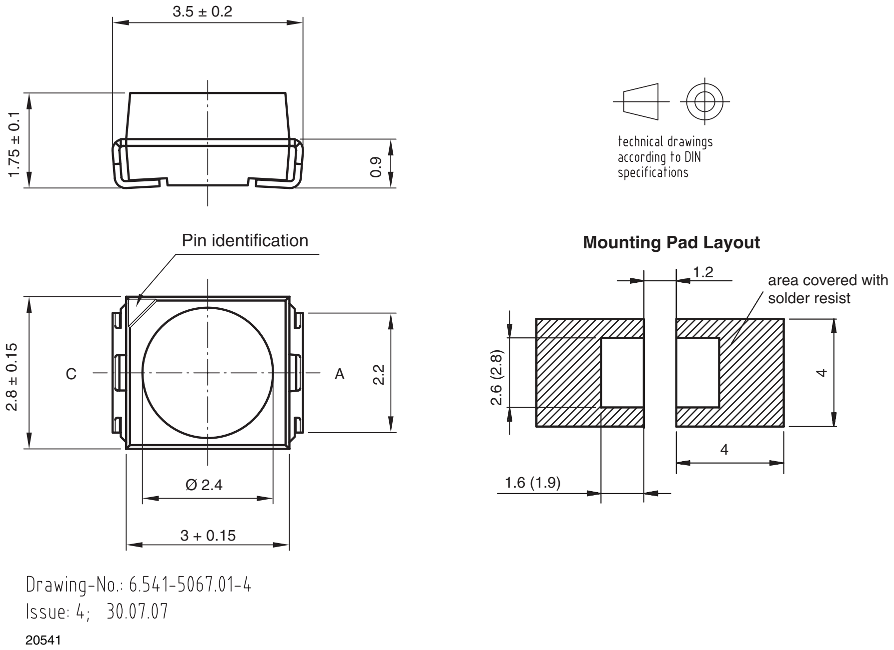


Fig. 5 - Radiant Intensity vs. Forward Current

PACKAGE DIMENSIONS in millimeters



SOLDER PROFILE

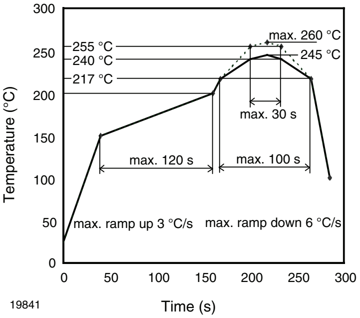


Fig. 8 - Lead (Pb)-free Reflow Solder Profile acc. J-STD-020B for Preconditioning acc. to JEDEC, Level 2a

DRYPACK

Devices are packed in moisture barrier bags (MBB) to prevent the products from moisture absorption during transportation and storage. Each bag contains a desiccant.

FLOOR LIFE

Floor life (time between soldering and removing from MBB) must not exceed the time indicated on MBB label:
Floor life: 4 weeks
Conditions: T_{amb} < 30 °C, RH < 60 %
Moisture sensitivity level 2a, acc. to J-STD-020B.

DRYING

In case of moisture absorption devices should be baked before soldering. Conditions see J-STD-020 or label. Devices taped on reel dry using recommended conditions 192 h at 40 °C (+ 5 °C), RH < 5 %.

TAPE AND REEL

PLCC-2 components are packed in antistatic blister tape (DIN IEC (CO) 564) for automatic component insertion. Cavities of blister tape are covered with adhesive tape.

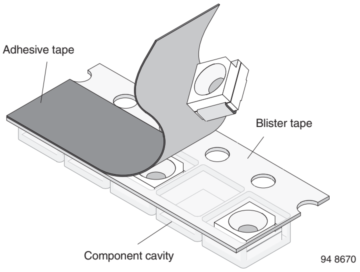


Fig. 9 - Blister Tape

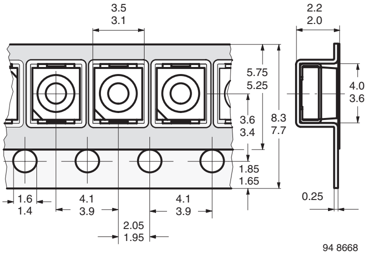


Fig. 10 - Tape Dimensions in mm for PLCC-2

MISSING DEVICES

A maximum of 0.5 % of the total number of components per reel may be missing, exclusively missing components at the beginning and at the end of the reel. A maximum of three consecutive components may be missing, provided this gap is followed by six consecutive components.

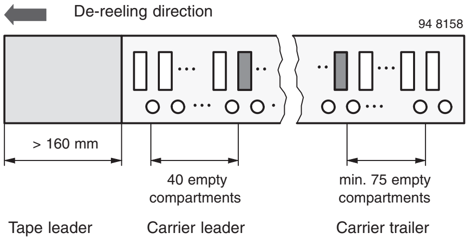


Fig. 11 - Beginning and End of Reel

The tape leader is at least 160 mm and is followed by a carrier tape leader with at least 40 empty compartements. The tape leader may include the carrier tape as long as the cover tape is not connected to the carrier tape. The least component is followed by a carrier tape trailer with a least 75 empty compartements and sealed with cover tape.

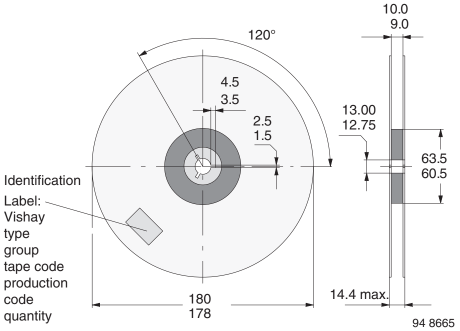


Fig. 12 - Dimensions of Reel-GS08

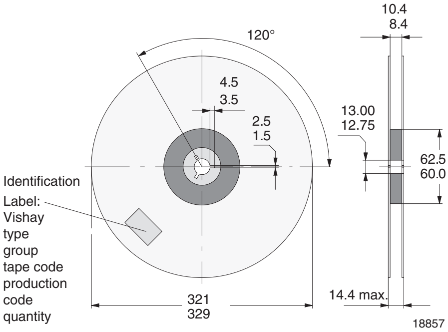
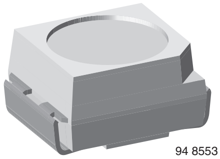


Fig. 13 - Dimensions of Reel-GS18

COVER TAPE REMOVAL FORCE

The removal force lies between 0.1 N and 1.0 N at a removal speed of 5 mm/s. In order to prevent components from popping out of the blisters, the cover tape must be pulled off at an angle of 180° with regard to the feed direction.

High Speed Infrared Emitting Diode, RoHS Compliant, 830 nm, GaAlAs Double Hetero



94 8553

DESCRIPTION

VSMG2700 is an infrared, 830 nm emitting diode in GaAlAs double hetero (DH) technology with high radiant power and high speed, molded in a PLCC-2 package for surface mounting (SMD).

FEATURES

- Package type: surface mount
- Package form: PLCC-2
- Dimensions (L x W x H in mm): 3.5 x 2.8 x 1.75
- Peak wavelength: λ_p = 830 nm
- High reliability
- High radiant power
- High radiant intensity
- Angle of half intensity: $\varphi = \pm 60°$
- Low forward voltage
- Suitable for high pulse current operation
- High modulation band width: f_c = 18 MHz
- Good spectral matching with Si photodetectors
- Floor life: 4 weeks, MSL 2a, acc. J-STD-020
- Lead (Pb)-free reflow soldering
- Lead (Pb)-free component in accordance with RoHS 2002/95/EC and WEEE 2002/96/EC

Pb-free
e3
RoHS
COMPLIANT

APPLICATIONS

- Infrared radiation source for operation with CMOS cameras (illumination)
- High speed IR data transmission

PRODUCT SUMMARY

COMPONENT	I_e (mW/sr)	φ (deg)	λ_P (nm)	t_r (ns)
VSMG2700	10	± 60	830	25

Note
Test conditions see table “Basic Characteristics”

ORDERING INFORMATION

ORDERING CODE	PACKAGING	REMARKS	PACKAGE FORM
VSMG2700-GS08	Tape and reel	MOQ: 7500 pcs, 1500 pcs/reel	PLCC-2
VSMG2700-GS18	Tape and reel	MOQ: 8000 pcs, 8000 pcs/reel	PLCC-2

Note
MOQ: minimum order quantity

ABSOLUTE MAXIMUM RATINGS

PARAMETER	TEST CONDITION	SYMBOL	VALUE	UNIT
Reverse voltage		V_R	5	V
Forward current		I_F	100	mA
Peak forward current	$t_p/T = 0.5$, t_p = 100 µs	I_{FM}	200	mA
Surge forward current	t_p = 100 µs	I_{FSM}	1	A
Power dissipation		P_V	180	mW

ABSOLUTE MAXIMUM RATINGS				
PARAMETER	**TEST CONDITION**	**SYMBOL**	**VALUE**	**UNIT**
Junction temperature		T_j	100	°C
Operating temperature range		T_{amb}	- 40 to + 85	°C
Storage temperature range		T_{stg}	- 40 to + 100	°C
Soldering temperature	acc. figure 8, J-STD-020	T_{sd}	260	°C
Thermal resistance junction/ambient	J-STD-051, soldered on PCB	R_{thJA}	250	K/W

Note

T_{amb} = 25 °C, unless otherwise specified

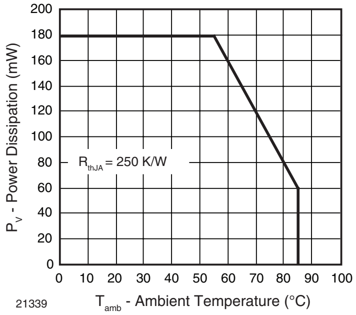


Fig. 1 - Power Dissipation Limit vs. Ambient Temperature

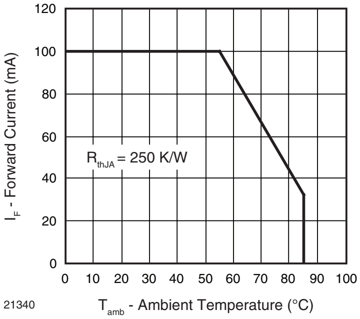


Fig. 2 - Forward Current Limit vs. Ambient Temperature

BASIC CHARACTERISTICS						
PARAMETER	**TEST CONDITION**	**SYMBOL**	**MIN.**	**TYP.**	**MAX.**	**UNIT**
Forward voltage	I_F = 100 mA, t_p = 20 ms	V_F		1.5	1.8	V
	I_F = 1 A, t_p = 100 µs	V_F		2.3		V
Temperature coefficient of V_F	I_F = 1 mA	TK_{VF}		- 1.8		mV/K
Reverse current	V_R = 5 V	I_R			10	µA
Junction capacitance	V_R = 0 V, f = 1 MHz, E = 0	C_j		125		pF
Radiant intensity	I_F = 100 mA, t_p = 20 ms	I_e	6	10	22	mW/sr
	I_F = 1 A, t_p = 100 µs	I_e		100		mW/sr
Radiant power	I_F = 100 mA, t_p = 20 ms	ϕ_e		40		mW
Temperature coefficient of ϕ_e	I_F = 100 mA	$TK\phi_e$		- 0.35		%/K
Angle of half intensity		φ		± 60		deg
Peak wavelength	I_F = 100 mA	λ_p		830		nm
Spectral bandwidth	I_F = 100 mA	$\Delta\lambda$		40		nm
Temperature coefficient of λ_p	I_F = 100 mA	$TK\lambda_p$		0.25		nm/K
Rise time	I_F = 100 mA	t_r		25		ns
Fall time	I_F = 100 mA	t_f		25		ns
Cut-off frequency	I_{DC} = 70 mA, I_{AC} = 30 mA pp	f_c		18		MHz
Virtual source diameter		d		0.44		mm

Note

T_{amb} = 25 °C, unless otherwise specified

BASIC CHARACTERISTICS

T_{amb} = 25 °C, unless otherwise specified

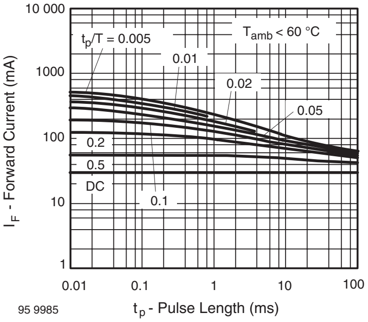


Fig. 3 - Pulse Forward Current vs. Pulse Duration

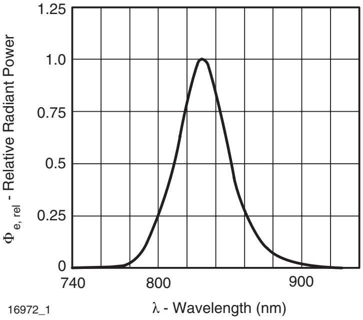


Fig. 6 - Relative Radiant Power vs. Wavelength

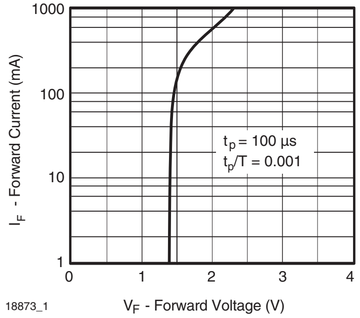


Fig. 4 - Forward Current vs. Forward Voltage

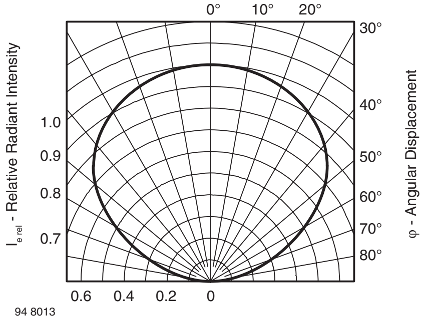


Fig. 7 - Relative Radiant Intensity vs. Angular Displacement

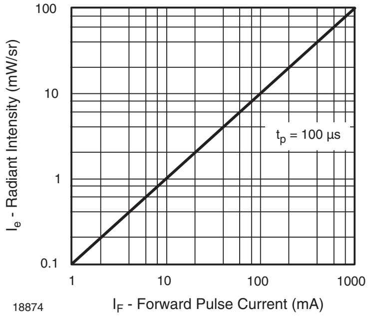
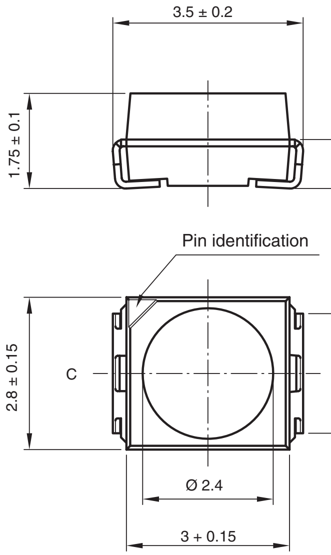
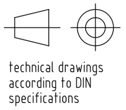


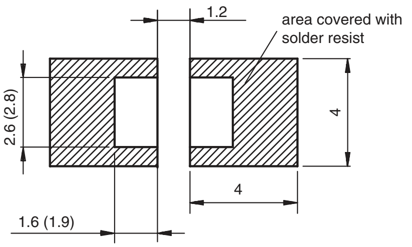
Fig. 5 - Radiant Intensity vs. Forward Current

PACKAGE DIMENSIONS in millimeters





Mounting Pad Layout



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SOLDER PROFILE

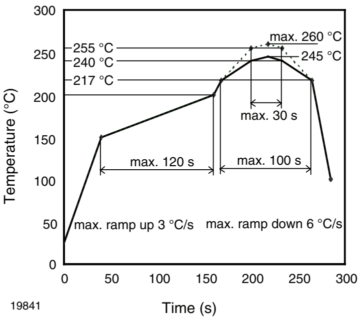


Fig. 8 - Lead (Pb)-free Reflow Solder Profile acc. J-STD-020D

DRYPACK

Devices are packed in moisture barrier bags (MBB) to prevent the products from moisture absorption during transportation and storage. Each bag contains a desiccant.

FLOOR LIFE

Floor life (time between soldering and removing from MBB) must not exceed the time indicated on MBB label:
Floor life: 4 weeks
Conditions: T_{amb} < 30 °C, RH < 60 %
Moisture sensitivity level 2a, acc. to J-STD-020.

DRYING

In case of moisture absorption devices should be baked before soldering. Conditions see J-STD-020 or label. Devices taped on reel dry using recommended conditions 192 h at 40 °C (+ 5 °C), RH < 5 %.

TAPE AND REEL

PLCC-2 components are packed in antistatic blister tape (DIN IEC (CO) 564) for automatic component insertion. Cavities of blister tape are covered with adhesive tape.

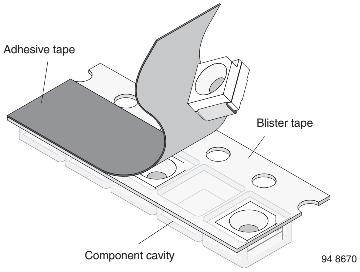


Fig. 9 - Blister Tape

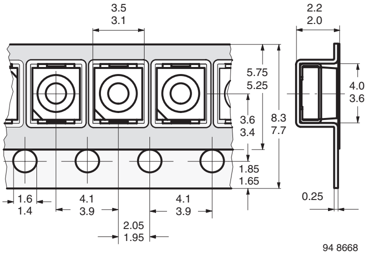


Fig. 10 - Tape Dimensions in mm for PLCC-2

MISSING DEVICES

A maximum of 0.5 % of the total number of components per reel may be missing, exclusively missing components at the beginning and at the end of the reel. A maximum of three consecutive components may be missing, provided this gap is followed by six consecutive components.

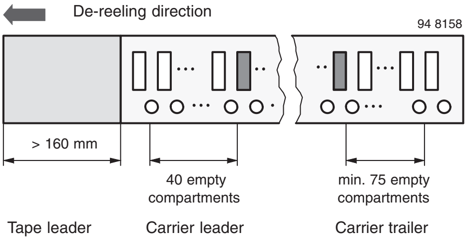


Fig. 11 - Beginning and End of Reel

The tape leader is at least 160 mm and is followed by a carrier tape leader with at least 40 empty compartments. The tape leader may include the carrier tape as long as the cover tape is not connected to the carrier tape. The least component is followed by a carrier tape trailer with a least 75 empty compartments and sealed with cover tape.

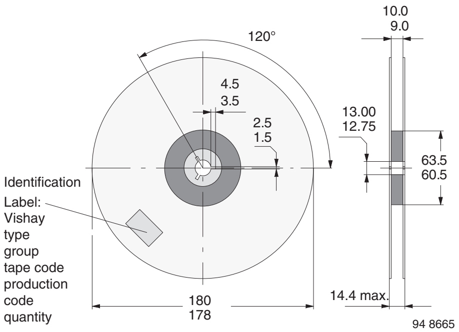


Fig. 12 - Dimensions of Reel-GS08

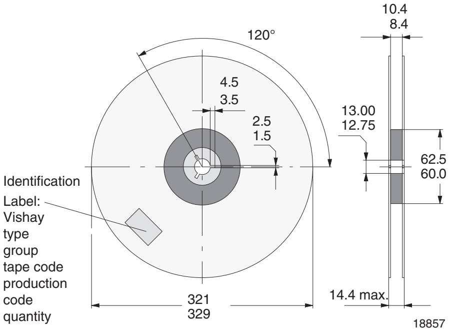
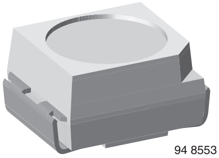


Fig. 13 - Dimensions of Reel-GS18

COVER TAPE REMOVAL FORCE

The removal force lies between 0.1 N and 1.0 N at a removal speed of 5 mm/s. In order to prevent components from popping out of the blisters, the cover tape must be pulled off at an angle of 180° with regard to the feed direction.

High Speed Infrared Emitting Diode, RoHS Compliant, 850 nm, GaAlAs Double Hetero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FEATURES

- Package type: surface mount
- Package form: PLCC-2
- Dimensions (L x W x H in mm): 3.5 x 2.8 x 1.75
- Peak wavelength: λ_p = 850 nm
- High reliability
- High radiant power
- High radiant intensity
- Angle of half intensity: $\varphi = \pm 60°$
- Low forward voltage
- Suitable for high pulse current operation
- High modulation band width: f_c = 18 MHz
- Good spectral matching with Si photodetectors
- Floor life: 4 weeks, MSL 2a, acc. J-STD-020
- Lead (Pb)-free reflow soldering
- Lead (Pb)-free component in accordance with RoHS 2002/95/EC and WEEE 2002/96/EC

Pb-free

e3

RoHS
COMPLIANT

DESCRIPTION

VSMG3700 is an infrared, 850 nm emitting diode in GaAlAs double hetero (DH) technology with high radiant power and high speed, molded in a PLCC-2 package for surface mounting (SMD).

APPLICATIONS

- Infrared radiation source for operation with CMOS cameras (illumination)
- High speed IR data transmission

PRODUCT SUMMARY

COMPONENT	I_e (mW/sr)	φ (deg)	λ_P (nm)	t_r (ns)
VSMG3700	10	± 60	850	20

Note

Test conditions see table “Basic Characteristics”

ORDERING INFORMATION

ORDERING CODE	PACKAGING	REMARKS	PACKAGE FORM
VSMG3700-GS08	Tape and reel	MOQ: 7500 pcs, 1500 pcs/reel	PLCC-2
VSMG3700-GS18	Tape and reel	MOQ: 8000 pcs, 8000 pcs/reel	PLCC-2

Note

MOQ: minimum order quantity

ABSOLUTE MAXIMUM RATINGS

PARAMETER	TEST CONDITION	SYMBOL	VALUE	UNIT
Reverse voltage		V_R	5	V
Forward current		I_F	100	mA
Peak forward current	$t_p/T = 0.5$, $t_p = 100\ \mu s$	I_{FM}	200	mA
Surge forward current	$t_p = 100\ \mu s$	I_{FSM}	1	A
Power dissipation		P_V	180	mW

ABSOLUTE MAXIMUM RATINGS

PARAMETER	TEST CONDITION	SYMBOL	VALUE	UNIT
Junction temperature		T_j	100	°C
Operating temperature range		T_{amb}	- 40 to + 85	°C
Storage temperature range		T_{stg}	- 40 to + 100	°C
Soldering temperature	acc. figure 8, J-STD-020	T_{sd}	260	°C
Thermal resistance junction/ambient	J-STD-051, soldered on PCB	R_{thJA}	250	K/W

Note

T_{amb} = 25 °C, unless otherwise specified

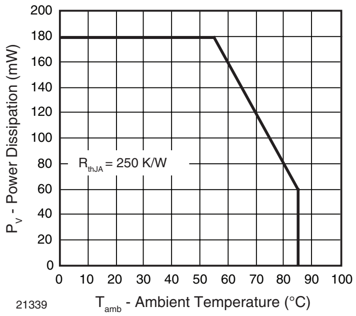


Fig. 1 - Power Dissipation Limit vs. Ambient Temperature

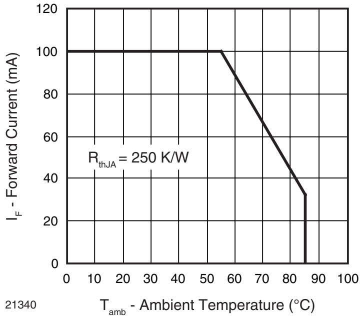


Fig. 2 - Forward Current Limit vs. Ambient Temperature

BASIC CHARACTERISTICS

PARAMETER	TEST CONDITION	SYMBOL	MIN.	TYP.	MAX.	UNIT
Forward voltage	I_F = 100 mA, t_p = 20 ms	V_F		1.5	1.8	V
	I_F = 1 A, t_p = 100 µs	V_F		2.3		V
Temperature coefficient of V_F	I_F = 1 mA	TK_{VF}		- 1.8		mV/K
Reverse current	V_R = 5 V	I_R			10	µA
Junction capacitance	V_R = 0 V, f = 1 MHz, E = 0	C_j		125		pF
Radiant intensity	I_F = 100 mA, t_p = 20 ms	I_e	6	10	22	mW/sr
	I_F = 1 A, t_p = 100 µs	I_e		100		mW/sr
Radiant power	I_F = 100 mA, t_p = 20 ms	ϕ_e		40		mW
Temperature coefficient of ϕ_e	I_F = 100 mA	$TK\phi_e$		- 0.35		%/K
Angle of half intensity		φ		± 60		deg
Peak wavelength	I_F = 100 mA	λ_p		850		nm
Spectral bandwidth	I_F = 100 mA	$\Delta\lambda$		40		nm
Temperature coefficient of λ_p	I_F = 100 mA	$TK\lambda_p$		0.25		nm/K
Rise time	I_F = 100 mA	t_r		20		ns
Fall time	I_F = 100 mA	t_f		13		ns
Cut-off frequency	I_{DC} = 70 mA, I_{AC} = 30 mA pp	f_c		18		MHz
Virtual source diameter		d		0.44		mm

Note

T_{amb} = 25 °C, unless otherwise specified

BASIC CHARACTERISTICS

T_{amb} = 25 °C, unless otherwise specified

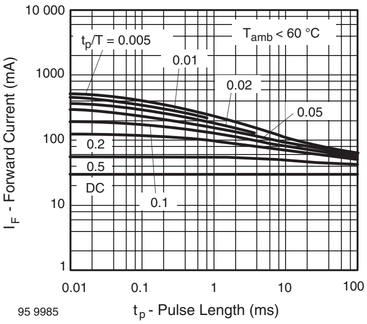


Fig. 3 - Pulse Forward Current vs. Pulse Duration

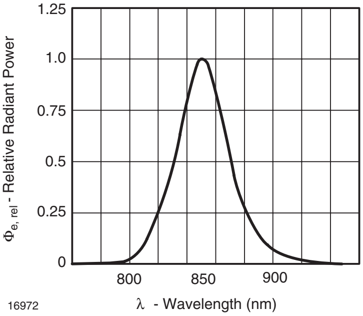


Fig. 6 - Relative Radiant Power vs. Wavelength

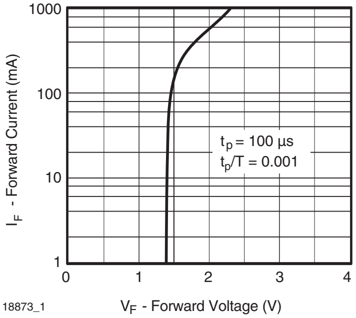


Fig. 4 - Forward Current vs. Forward Voltage

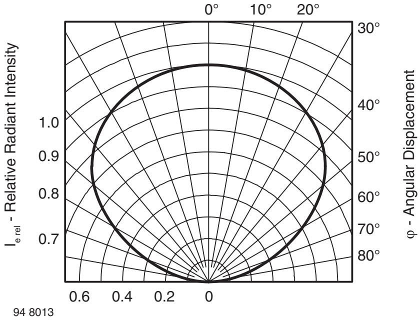


Fig. 7 - Relative Radiant Intensity vs. Angular Displacement

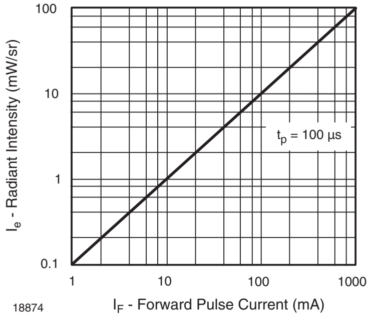
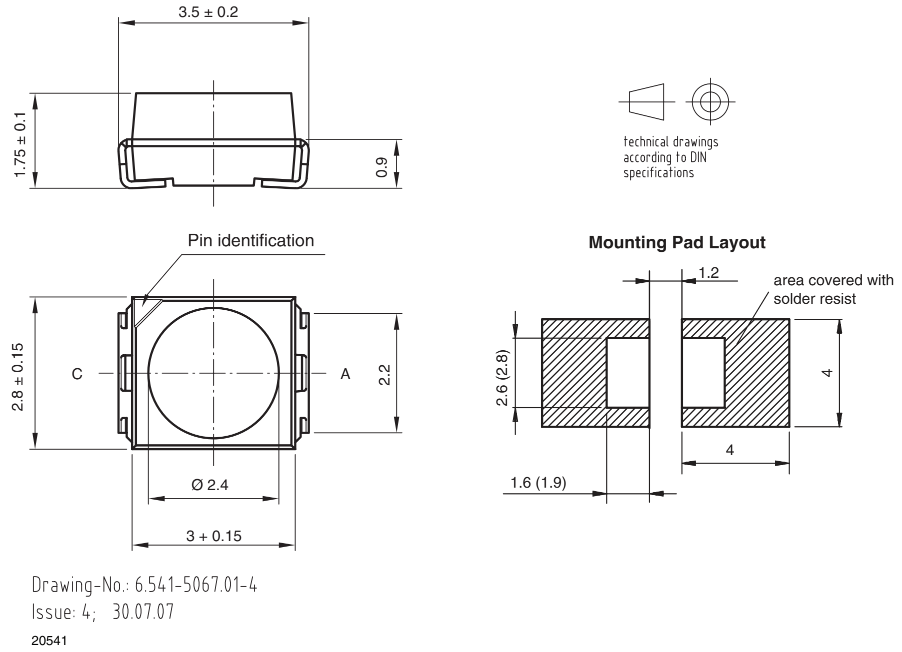


Fig. 5 - Radiant Intensity vs. Forward Current

PACKAGE DIMENSIONS in millimeters



SOLDER PROFILE

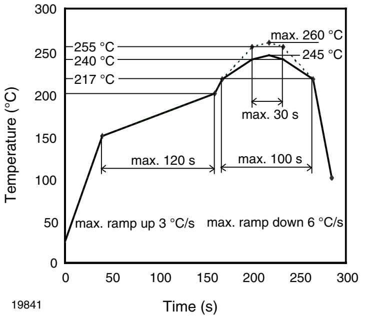


Fig. 8 - Lead (Pb)-free Reflow Solder Profile acc. J-STD-020D

DRYPACK

Devices are packed in moisture barrier bags (MBB) to prevent the products from moisture absorption during transportation and storage. Each bag contains a desiccant.

FLOOR LIFE

Floor life (time between soldering and removing from MBB) must not exceed the time indicated on MBB label:
Floor life: 4 weeks
Conditions: T_{amb} < 30 °C, RH < 60 %
Moisture sensitivity level 2a, acc. to J-STD-020.

DRYING

In case of moisture absorption devices should be baked before soldering. Conditions see J-STD-020 or label. Devices taped on reel dry using recommended conditions 192 h at 40 °C (+ 5 °C), RH < 5 %.

TAPE AND REEL

PLCC-2 components are packed in antistatic blister tape (DIN IEC (CO) 564) for automatic component insertion. Cavities of blister tape are covered with adhesive tape.

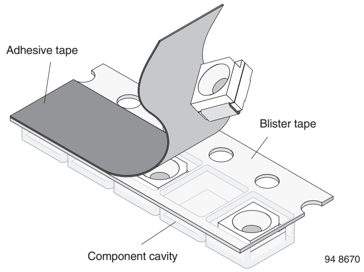


Fig. 9 - Blister Tape

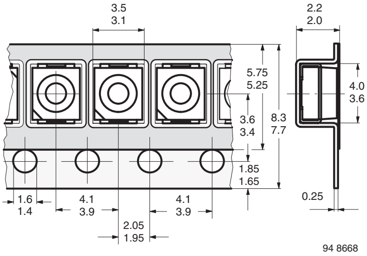


Fig. 10 - Tape Dimensions in mm for PLCC-2

MISSING DEVICES

A maximum of 0.5 % of the total number of components per reel may be missing, exclusively missing components at the beginning and at the end of the reel. A maximum of three consecutive components may be missing, provided this gap is followed by six consecutive components.

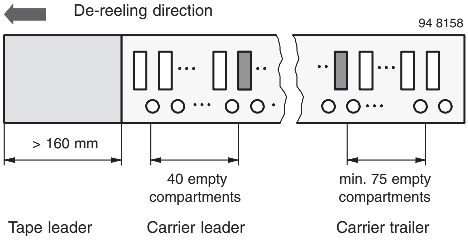


Fig. 11 - Beginning and End of Reel

The tape leader is at least 160 mm and is followed by a carrier tape leader with at least 40 empty compartments. The tape leader may include the carrier tape as long as the cover tape is not connected to the carrier tape. The least component is followed by a carrier tape trailer with a least 75 empty compartments and sealed with cover tape.

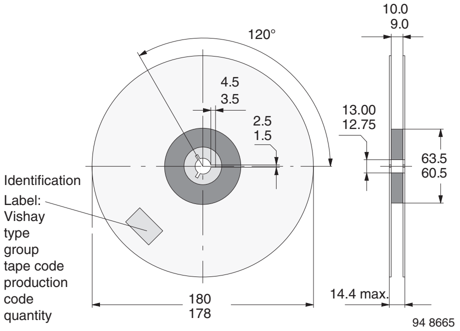


Fig. 12 - Dimensions of Reel-GS08

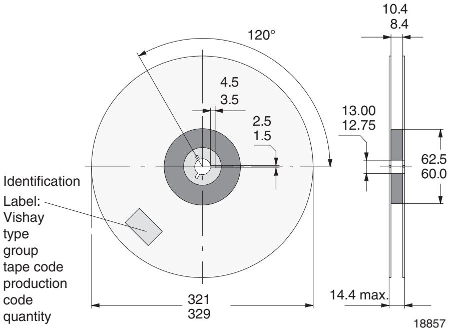
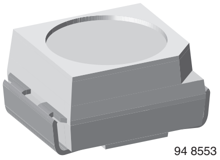


Fig. 13 - Dimensions of Reel-GS18

COVER TAPE REMOVAL FORCE

The removal force lies between 0.1 N and 1.0 N at a removal speed of 5 mm/s. In order to prevent components from popping out of the blisters, the cover tape must be pulled off at an angle of 180° with regard to the feed direction.

High Power Infrared Emitting Diode, RoHS Compliant, 940 nm, GaAlAs/GaAs



DESCRIPTION

VSML3710 is an infrared, 940 nm emitting diode in GaAlAs/GaAs technology with high radiant power, molded in a PLCC-2 package for surface mounting (SMD).

FEATURES

- Package type: surface mount
- Package form: PLCC-2
- Dimensions (L x W x H in mm): 3.5 x 2.8 x 1.75
- Peak wavelength: λ_p = 940 nm
- High reliability
- High radiant power
- High radiant intensity
- Angle of half intensity: $\varphi = \pm 60°$
- Low forward voltage
- Suitable for high pulse current operation
- Good spectral matching with Si photodetectors
- Package matched with IR emitter series VEMT3700
- Floor life: 4 weeks, MSL 2a, acc. J-STD-020
- Lead (Pb)-free reflow soldering
- Lead (Pb)-free component in accordance with RoHS 2002/95/EC and WEEE 2002/96/EC

APPLICATIONS

- IR emitter in photointerrupters, sensors and reflective sensors
- IR emitter in low space applications
- Household appliance
- Tactile keyboards

PRODUCT SUMMARY

COMPONENT	I_e (mW/sr)	φ (deg)	λ_P (nm)	t_r (ns)
VSML3710	8	± 60	940	800

Note
Test conditions see table "Basic Characteristics"

ORDERING INFORMATION

ORDERING CODE	PACKAGING	REMARKS	PACKAGE FORM
VSML3710-GS08	Tape and reel	MOQ: 7500 pcs, 1500 pcs/reel	PLCC-2
VSML3710-GS18	Tape and reel	MOQ: 8000 pcs, 8000 pcs/reel	PLCC-2

Note
MOQ: minimum order quantity

ABSOLUTE MAXIMUM RATINGS

PARAMETER	TEST CONDITION	SYMBOL	VALUE	UNIT
Reverse voltage		V_R	5	V
Forward current		I_F	100	mA
Peak forward current	$t_p/T = 0.5$, $t_p = 100$ µs	I_{FM}	200	mA
Surge forward current	$t_p = 100$ µs	I_{FSM}	1	A
Power dissipation		P_V	160	mW

ABSOLUTE MAXIMUM RATINGS				
PARAMETER	**TEST CONDITION**	**SYMBOL**	**VALUE**	**UNIT**
Junction temperature		T_j	100	°C
Operating temperature range		T_{amb}	- 40 to + 85	°C
Storage temperature range		T_{stg}	- 40 to + 100	°C
Soldering temperature	acc. figure 11, J-STD-020	T_{sd}	260	°C
Thermal resistance junction/ambient	J-STD-051, soldered on PCB	R_{thJA}	250	K/W

Note

T_{amb} = 25 °C, unless otherwise specified

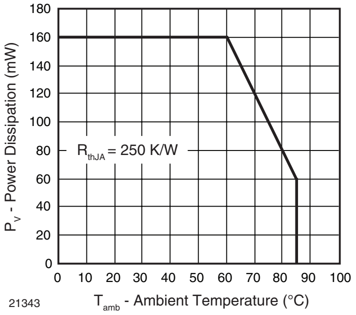


Fig. 1 - Power Dissipation Limit vs. Ambient Temperature

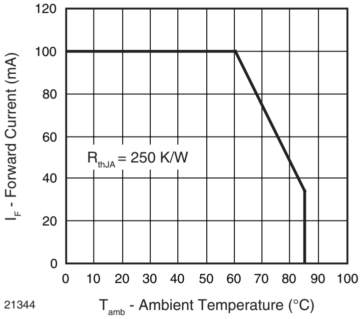


Fig. 2 - Forward Current Limit vs. Ambient Temperature

BASIC CHARACTERISTICS						
PARAMETER	**TEST CONDITION**	**SYMBOL**	**MIN.**	**TYP.**	**MAX.**	**UNIT**
Forward voltage	I_F = 100 mA, t_p = 20 ms	V_F		1.35	1.6	V
	I_F = 1 A, t_p = 100 µs	V_F		2.6	3.0	V
Temperature coefficient of V_F	I_F = 1 mA	TK_{VF}		- 1.8		mV/K
Reverse current	V_R = 5 V	I_R			100	µA
Junction capacitance	V_R = 0 V, f = 1 MHz, E = 0	C_j		25		pF
Radiant intensity	I_F = 100 mA, t_p = 20 ms	I_e	4	8	20	mW/sr
	I_F = 1 A, t_p = 100 µs	I_e		60		mW/sr
Radiant power	I_F = 100 mA, t_p = 20 ms	ϕ_e		35		mW
Temperature coefficient of ϕ_e	I_F = 100 mA	$TK\phi_e$		- 0.6		%/K
Angle of half intensity		φ		± 60		deg
Peak wavelength	I_F = 100 mA	λ_p		940		nm
Spectral bandwidth	I_F = 100 mA	$\Delta\lambda$		50		nm
Temperature coefficient of λ_p	I_F = 100 mA	$TK\lambda_p$		0.2		nm/K
Rise time	I_F = 20 mA	t_r		800		ns
	I_F = 1 A	t_r		500		ns
Fall time	I_F = 20 mA	t_f		800		ns
	I_F = 1 A	t_f		500		ns
Virtual source diameter		d		0.44		mm

Note

T_{amb} = 25 °C, unless otherwise specified

BASIC CHARACTERISTICS

T_{amb} = 25 °C, unless otherwise specified

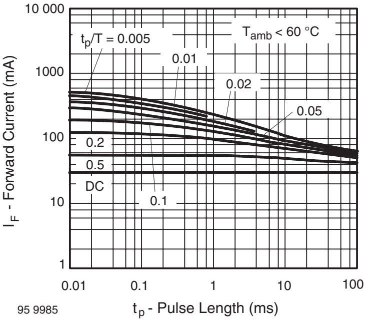


Fig. 3 - Pulse Forward Current vs. Pulse Duration

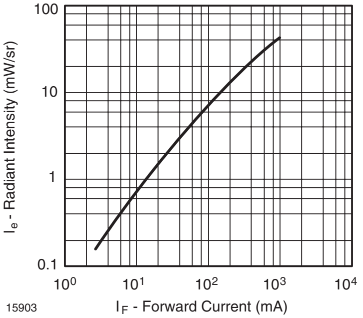


Fig. 6 - Radiant Intensity vs. Forward Current

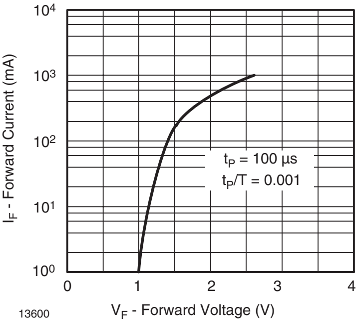


Fig. 4 - Forward Current vs. Forward Voltage

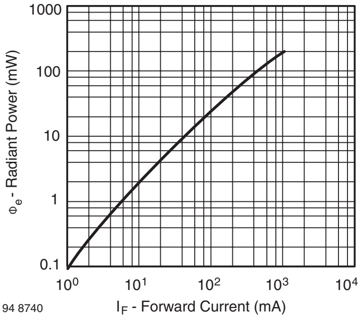


Fig. 7 - Radiant Power vs. Forward Current

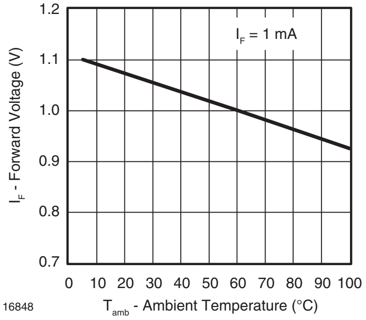


Fig. 5 - Forward Voltage vs. Ambient Temperature

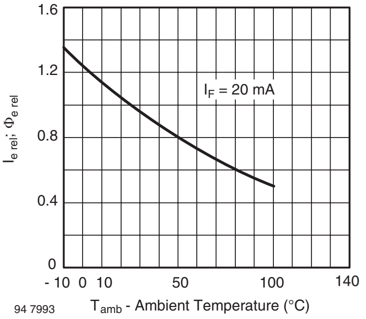


Fig. 8 - Relative Radiant Intensity/Power vs. Ambient Temperature

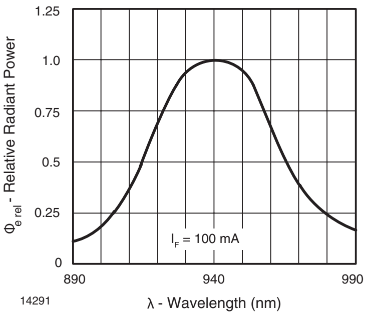


Fig. 9 - Relative Radiant Power vs. Wavelength

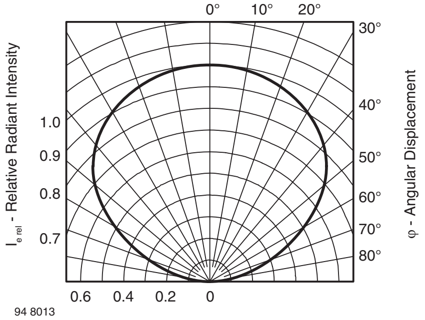
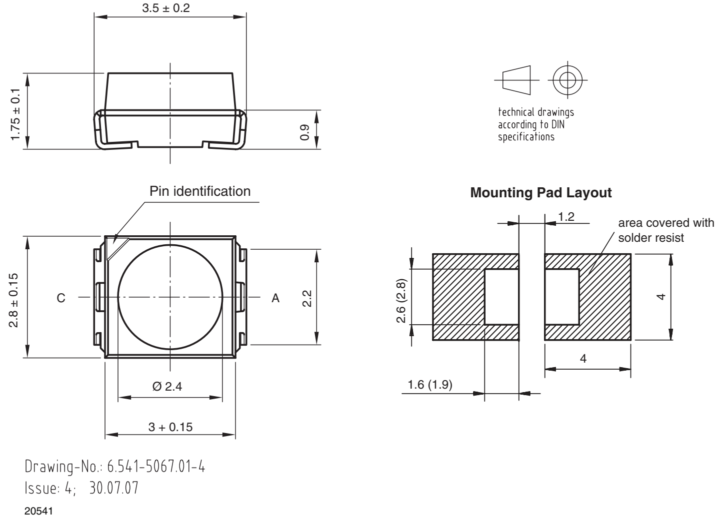


Fig. 10 - Relative Radiant Intensity vs. Angular Displacement

PACKAGE DIMENSIONS in millimeters



SOLDER PROFILE

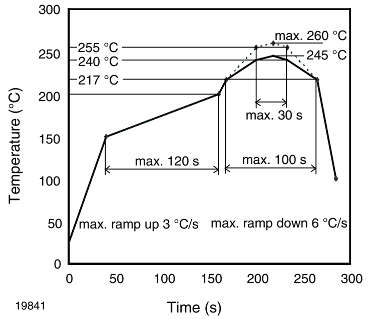


Fig. 11 - Lead (Pb)-free Reflow Solder Profile acc. J-STD-020D

DRYPACK

Devices are packed in moisture barrier bags (MBB) to prevent the products from moisture absorption during transportation and storage. Each bag contains a desiccant.

FLOOR LIFE

Floor life (time between soldering and removing from MBB) must not exceed the time indicated on MBB label:
Floor life: 4 weeks
Conditions: T_{amb} < 30 °C, RH < 60 %
Moisture sensitivity level 2a, acc. to J-STD-020.

DRYING

In case of moisture absorption devices should be baked before soldering. Conditions see J-STD-020 or label. Devices taped on reel dry using recommended conditions 192 h at 40 °C (+ 5 °C), RH < 5 %.

TAPE AND REEL

PLCC-2 components are packed in antistatic blister tape (DIN IEC (CO) 564) for automatic component insertion. Cavities of blister tape are covered with adhesive tape.

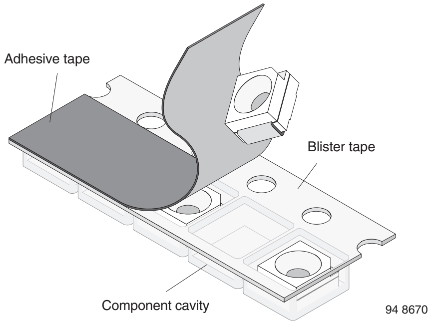


Fig. 12 - Blister Tape

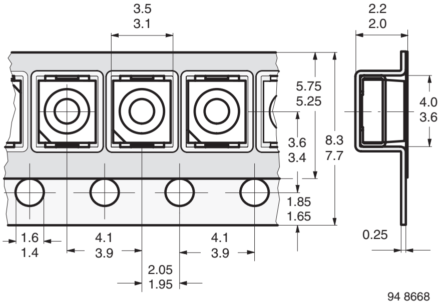


Fig. 13 - Tape Dimensions in mm for PLCC-2

MISSING DEVICES

A maximum of 0.5 % of the total number of components per reel may be missing, exclusively missing components at the beginning and at the end of the reel. A maximum of three consecutive components may be missing, provided this gap is followed by six consecutive components.

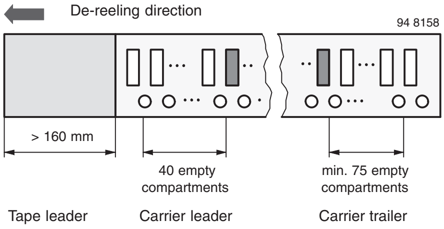


Fig. 14 - Beginning and End of Reel

The tape leader is at least 160 mm and is followed by a carrier tape leader with at least 40 empty compartments. The tape leader may include the carrier tape as long as the cover tape is not connected to the carrier tape. The least component is followed by a carrier tape trailer with a least 75 empty compartments and sealed with cover tape.

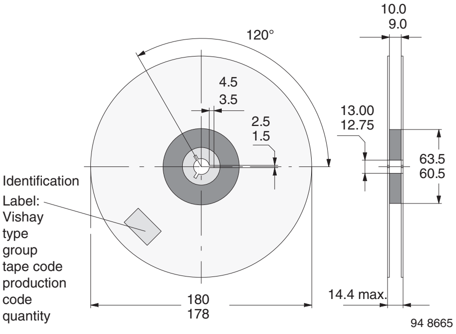


Fig. 15 - Dimensions of Reel-GS08

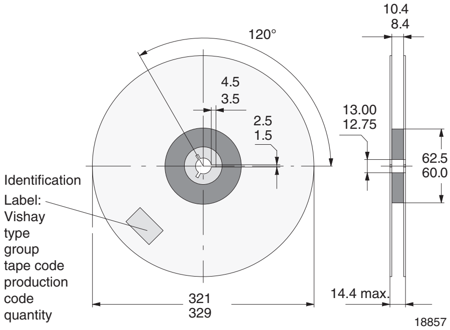
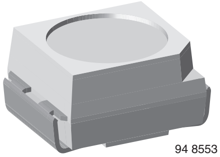


Fig. 16 - Dimensions of Reel-GS18

COVER TAPE REMOVAL FORCE

The removal force lies between 0.1 N and 1.0 N at a removal speed of 5 mm/s. In order to prevent components from popping out of the blisters, the cover tape must be pulled off at an angle of 180° with regard to the feed direction.

Infrared Emitting Diode, RoHS Compliant, 950 nm, GaAs



FEATURES

- Package type: surface mount
- Package form: PLCC-2
- Dimensions (L x W x H in mm): 3.5 x 2.8 x 1.75
- Peak wavelength: λ_p = 950 nm
- High reliability
- Angle of half intensity: φ = ± 60°
- Low forward voltage
- Suitable for high pulse current operation
- Good spectral matching with Si photodetectors
- Package matched with IR emitter series VEMT3700
- Floor life: 4 weeks, MSL 2a, acc. J-STD-020
- Lead (Pb)-free reflow soldering
- Lead (Pb)-free component in accordance with RoHS 2002/95/EC and WEEE 2002/96/EC

Pb
Pb-free
e3
RoHS
COMPLIANT

DESCRIPTION

VSMS3700 is an infrared, 950 nm emitting diode in GaAs technology, molded in a PLCC-2 package for surface mounting (SMD).

APPLICATIONS

- Infrared source in tactile keyboards
- IR diode in low space applications
- PCB mounted infrared sensors
- Emitter in miniature photo-interrupters

PRODUCT SUMMARY

COMPONENT	I_e (mW/sr)	φ (deg)	λ_P (nm)	t_r (ns)
VSMS3700	4.5	± 60	950	800

Note
Test conditions see table "Basic Characteristics"

ORDERING INFORMATION

ORDERING CODE	PACKAGING	REMARKS	PACKAGE FORM
VSMS3700-GS08	Tape and reel	MOQ: 7500 pcs, 1500 pcs/reel	PLCC-2
VSMS3700-GS18	Tape and reel	MOQ: 8000 pcs, 8000 pcs/reel	PLCC-2

Note
MOQ: minimum order quantity

ABSOLUTE MAXIMUM RATINGS

PARAMETER	TEST CONDITION	SYMBOL	VALUE	UNIT
Reverse voltage		V_R	5	V
Forward current		I_F	100	mA
Peak forward current	$t_p/T = 0.5$, t_p = 100 µs	I_{FM}	200	mA
Surge forward current	t_p = 100 µs	I_{FSM}	1.5	A
Power dissipation		P_V	170	mW
Junction temperature		T_j	100	°C
Operating temperature range		T_{amb}	- 40 to + 85	°C
Storage temperature range		T_{stg}	- 40 to + 100	°C
Soldering temperature	acc. figure 11, J-STD-020	T_{sd}	260	°C
Thermal resistance junction/ambient	J-STD-051, soldered on PCB	R_{thJA}	250	K/W

Note
T_{amb} = 25 °C, unless otherwise specified

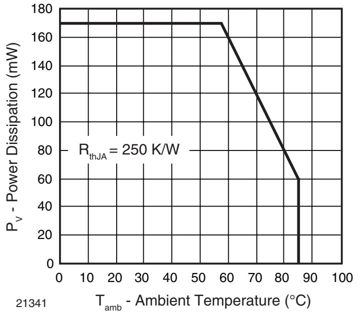


Fig. 1 - Power Dissipation Limit vs. Ambient Temperature

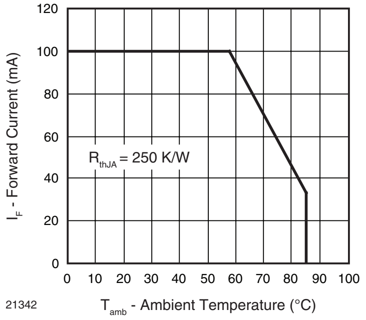


Fig. 2 - Forward Current Limit vs. Ambient Temperature

BASIC CHARACTERISTICS						
PARAMETER	**TEST CONDITION**	**SYMBOL**	**MIN.**	**TYP.**	**MAX.**	**UNIT**
Forward voltage	$I_F = 100$ mA, $t_p = 20$ ms	V_F		1.3	1.7	V
	$I_F = 1$ A, $t_p = 100$ µs	V_F		1.8		V
Temperature coefficient of V_F	$I_F = 100$ mA	TK_{VF}		- 1.3		mV/K
Reverse current	$V_R = 5$ V	I_R			100	µA
Junction capacitance	$V_R = 0$ V, f = 1 MHz, E = 0	C_j		30		pF
Radiant intensity	$I_F = 100$ mA, $t_p = 20$ ms	I_e	1.6	4.5	8.0	mW/sr
	$I_F = 1.5$ A, $t_p = 100$ µs	I_e		35		mW/sr
Radiant power	$I_F = 100$ mA, $t_p = 20$ ms	ϕ_e		15		mW
Temperature coefficient of ϕ_e	$I_F = 100$ mA	$TK\phi_e$		- 0.8		%/K
Angle of half intensity		φ		± 60		deg
Peak wavelength	$I_F = 100$ mA	λ_p		950		nm
Spectral bandwidth	$I_F = 100$ mA	$\Delta\lambda$		50		nm
Temperature coefficient of λ_p	$I_F = 100$ mA	$TK\lambda_p$		0.2		nm/K
Rise time	$I_F = 20$ mA	t_r		800		ns
	$I_F = 1$ A	t_r		400		ns
Fall time	$I_F = 20$ mA	t_f		800		ns
	$I_F = 1$ A	t_f		400		ns
Virtual source diameter	EN 60825-1	d		0.5		mm

Note

$T_{amb} = 25$ °C, unless otherwise specified

BASIC CHARACTERISTICS

T_{amb} = 25 °C, unless otherwise specified

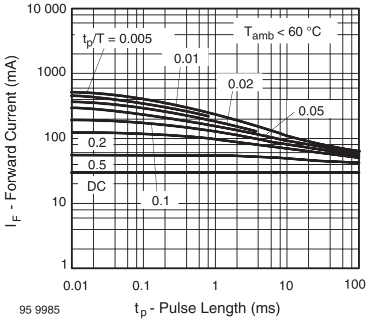


Fig. 3 - Pulse Forward Current vs. Pulse Duration

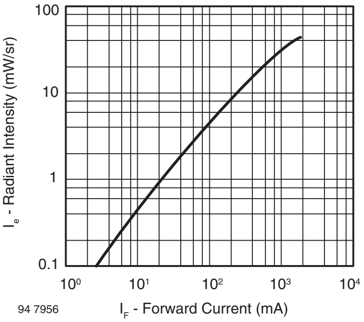


Fig. 6 - Radiant Intensity vs. Forward Current

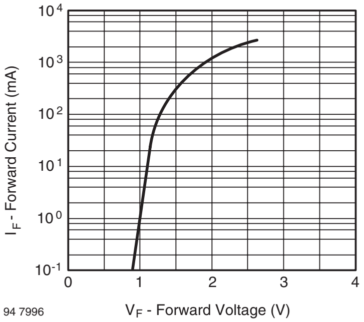


Fig. 4 - Forward Current vs. Forward Voltage

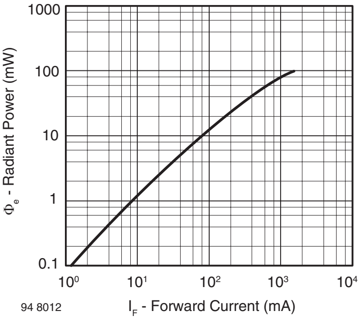


Fig. 7 - Radiant Power vs. Forward Current

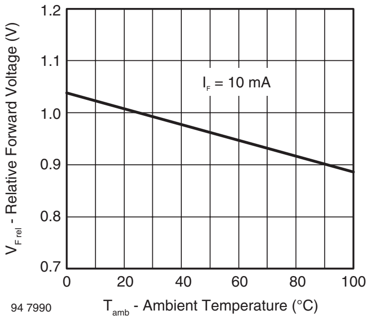


Fig. 5 - Relative Forward Voltage vs. Ambient Temperature

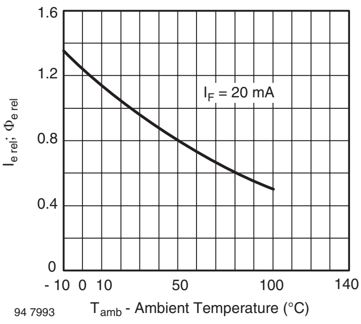


Fig. 8 - Relative Radiant Intensity/Power vs. Ambient Temperature

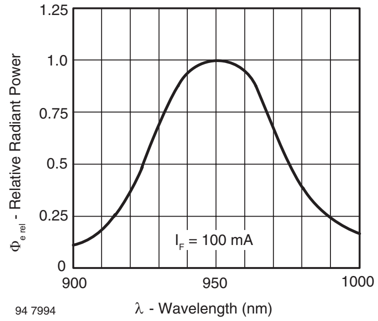


Fig. 9 - Relative Radiant Power vs. Wavelength

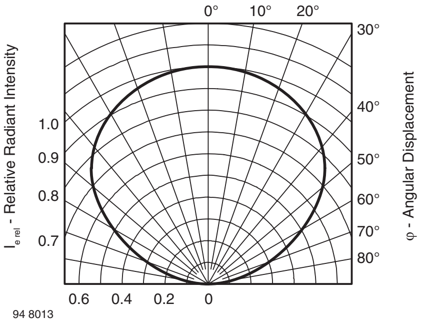
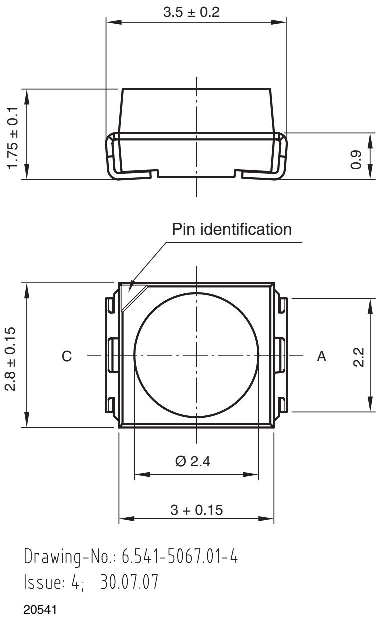
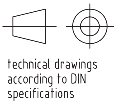


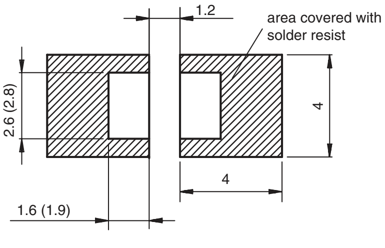
Fig. 10 - Relative Radiant Intensity vs. Angular Displacement

PACKAGE DIMENSIONS in millimeters





Mounting Pad Layout



Die Position (for reference only)

X = +/- 0.2 mm centrical

Y = +/- 0.2 mm centrical

Z = 1.13 mm +/- 0.25 mm, from top of die bottom of component

SOLDER PROFILE

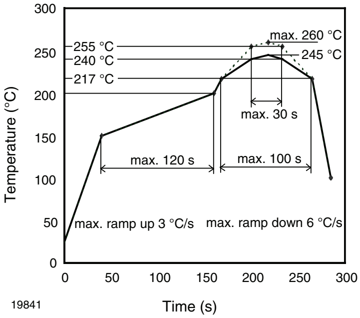


Fig. 11 - Lead (Pb)-free Reflow Solder Profile acc. J-STD-020D

DRYPACK

Devices are packed in moisture barrier bags (MBB) to prevent the products from moisture absorption during transportation and storage. Each bag contains a desiccant.

FLOOR LIFE

Floor life (time between soldering and removing from MBB) must not exceed the time indicated on MBB label:
Floor life: 4 weeks
Conditions: T_{amb} < 30 °C, RH < 60 %
Moisture sensitivity level 2a, acc. to J-STD-020.

DRYING

In case of moisture absorption devices should be baked before soldering. Conditions see J-STD-020 or label. Devices taped on reel dry using recommended conditions 192 h at 40 °C (+ 5 °C), RH < 5 %.

TAPE AND REEL

PLCC-2 components are packed in antistatic blister tape (DIN IEC (CO) 564) for automatic component insertion. Cavities of blister tape are covered with adhesive tape.

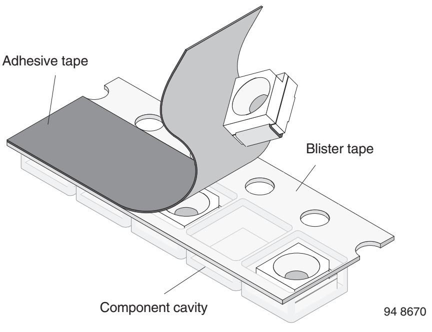


Fig. 12 - Blister Tape

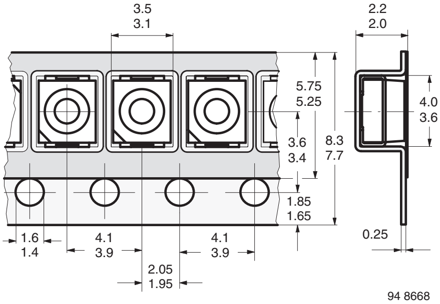


Fig. 13 - Tape Dimensions in mm for PLCC-2

MISSING DEVICES

A maximum of 0.5 % of the total number of components per reel may be missing, exclusively missing components at the beginning and at the end of the reel. A maximum of three consecutive components may be missing, provided this gap is followed by six consecutive components.

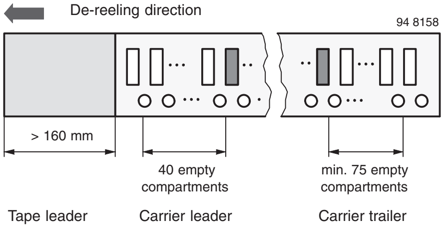


Fig. 14 - Beginning and End of Reel

The tape leader is at least 160 mm and is followed by a carrier tape leader with at least 40 empty compartments. The tape leader may include the carrier tape as long as the cover tape is not connected to the carrier tape. The least component is followed by a carrier tape trailer with a least 75 empty compartments and sealed with cover tape.

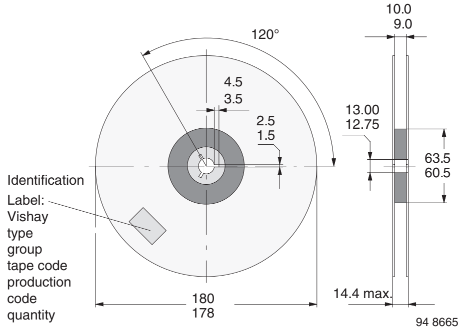


Fig. 15 - Dimensions of Reel-GS08

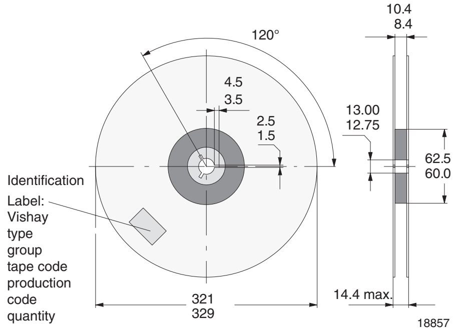


Fig. 16 - Dimensions of Reel-GS18

COVER TAPE REMOVAL FORCE

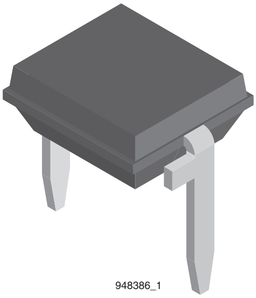
The removal force lies between 0.1 N and 1.0 N at a removal speed of 5 mm/s. In order to prevent components from popping out of the blisters, the cover tape must be pulled off at an angle of 180° with regard to the feed direction.

Datasheets
Photo
Detectors

Contents

For full listing please see Table of Contents
on page 2.

Silicon PIN Photodiode, RoHS Compliant



FEATURES

- Package type: leaded
- Package form: top view
- Dimensions (in mm): 5.4 x 4.3 x 3.2
- Radiant sensitive area (in mm^2): 7.5
- High radiant sensitivity
- Daylight blocking filter matched with 940 nm emitters
- Fast response times
- Angle of half sensitivity: $\varphi = \pm 65°$
- Lead (Pb)-free component in accordance with RoHS 2002/95/EC and WEEE 2002/96/EC

Pb-free

e3

RoHS
COMPLIANT

DESCRIPTION

BP104 is a PIN photodiode with high speed and high radiant sensitivity in miniature, flat, top view plastic package with daylight blocking filter. Filter bandwidth is matched with 900 nm to 950 nm IR emitters.
BP104S is packed in tubes, specifications like BP104.

APPLICATIONS

- High speed detector for infrared radiation
- Infrared remote control and free air data transmission systems, e.g. in combination with TSALxxxx series IR emitters

PRODUCT SUMMARY

COMPONENT	I_{ra} (μA)	φ (deg)	$\lambda_{0.5}$ (nm)
BP104	45	± 65	870 to 1050
BP104S	45	± 65	870 to 1050

Note
Test condition see table “Basic Characteristics”

ORDERING INFORMATION

ORDERING CODE	PACKAGING	REMARKS	PACKAGE FORM
BP104	Bulk	MOQ: 3000 pcs, 3000 pcs/bulk	Top view
BP104S	Tube	MOQ: 1800 pcs, 45 pcs/tube	Top view

Note
MOQ: minimum order quantity

ABSOLUTE MAXIMUM RATINGS

PARAMETER	TEST CONDITION	SYMBOL	VALUE	UNIT
Reverse voltage		V_R	60	V
Power dissipation	$T_{amb} \leq 25$ °C	P_V	215	mW
Junction temperature		T_j	100	°C
Operating temperature range		T_{amb}	- 40 to + 100	°C
Storage temperature range		T_{stg}	- 40 to + 100	°C
Soldering temperature	$t \leq 3$ s	T_{sd}	260	°C
Thermal resistance junction/ambient	Connected with Cu wire, 0.14 mm^2	R_{thJA}	350	K/W

Note
$T_{amb} = 25$ °C, unless otherwise specified

BASIC CHARACTERISTICS						
PARAMETER	**TEST CONDITION**	**SYMBOL**	**MIN.**	**TYP.**	**MAX.**	**UNIT**
Breakdown voltage	I_R = 100 µA, E = 0	$V_{(BR)}$	60			V
Reverse dark current	V_R = 10 V, E = 0	I_{ro}		2	30	nA
Diode capacitance	V_R= 0 V, f = 1 MHz, E = 0	C_D		70		pF
	V_R= 3 V, f = 1 MHz, E = 0	C_D		25	40	pF
Open circuit Voltage	E_e = 1 mW/cm^2, λ = 950 nm	V_o		350		mV
Short circuit current	E_e = 1 mW/cm^2, λ = 950 nm	I_k		38		µA
Reverse light current	E_e = 1 mW/cm^2, λ = 950 nm, V_R = 5 V	I_{ra}	40	45		µA
Angle of half sensitivity		φ		± 65		deg
Wavelength of peak sensitivity		λ_p		950		nm
Range of spectral bandwidth		$\lambda_{0.5}$		870 to 1050		nm
Noise equivalent power	V_R = 10 V, λ = 950 nm	NEP		4×10^{-14}		W/√ Hz
Rise time	V_R = 10 V, R_L = 1 kΩ, λ = 820 nm	t_r		100		ns
Fall time	V_R = 10 V, R_L = 1 kΩ, λ = 820 nm	t_f		100		ns

Note

T_{amb} = 25 °C, unless otherwise specified

BASIC CHARACTERISTICS

T_{amb} = 25 °C, unless otherwise specified

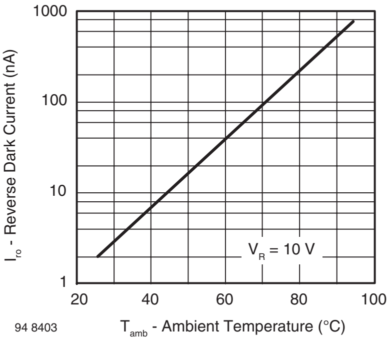


Fig. 1 - Reverse Dark Current vs. Ambient Temperature

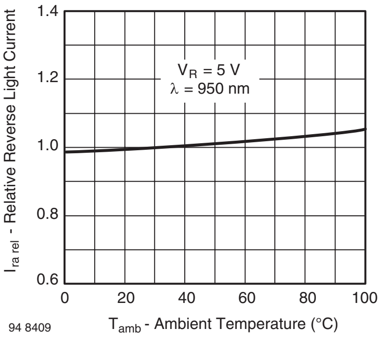


Fig. 2 - Relative Reverse Light Current vs. Ambient Temperature

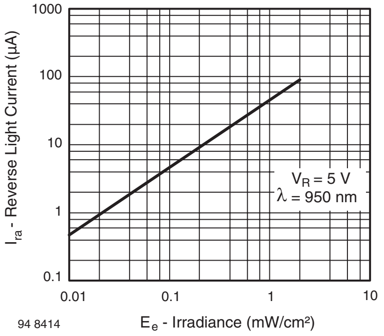


Fig. 3 - Reverse Light Current vs. Irradiance

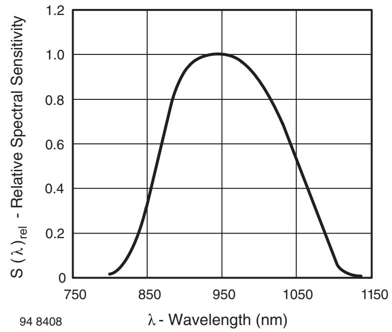


Fig. 6 - Relative Spectral Sensitivity vs. Wavelength

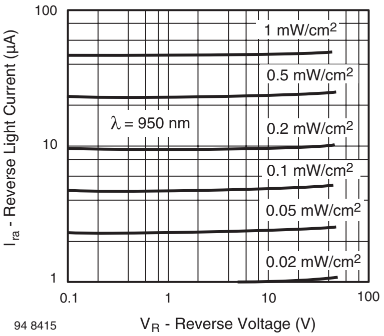


Fig. 4 - Reverse Light Current vs. Reverse Voltage

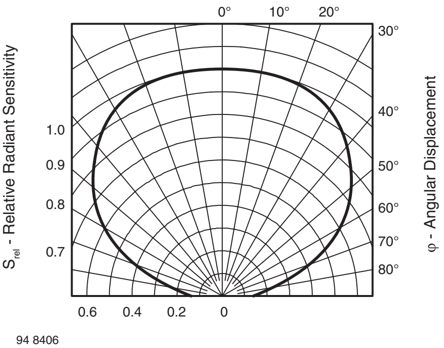


Fig. 7 - Relative Radiant Sensitivity vs. Angular Displacement

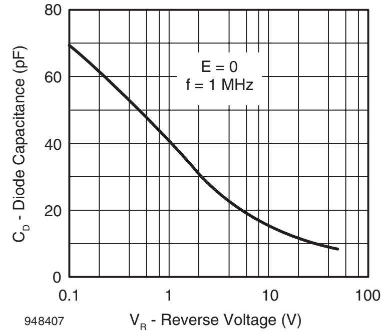
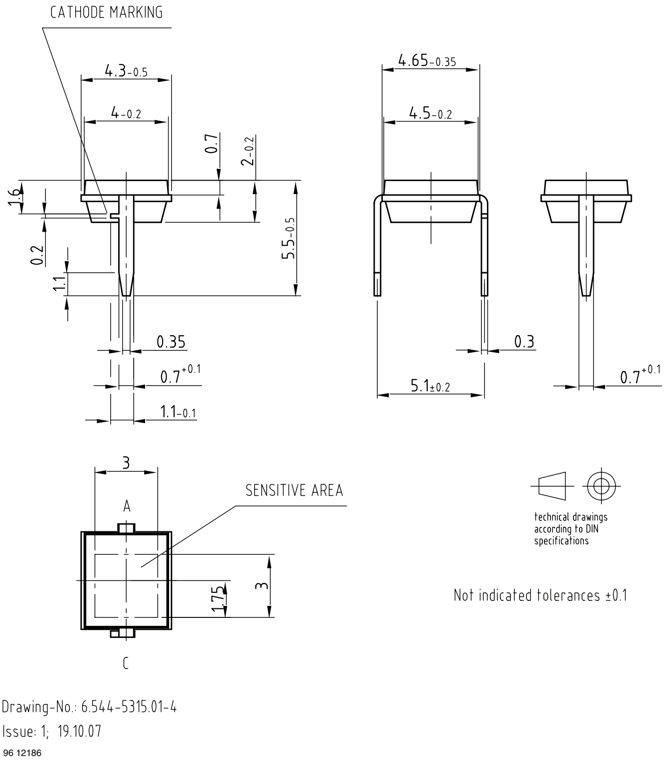


Fig. 5 - Diode Capacitance vs. Reverse Voltage

PACKAGE DIMENSIONS in millimeters



TUBE PACKAGING DIMENSIONS in millimeters

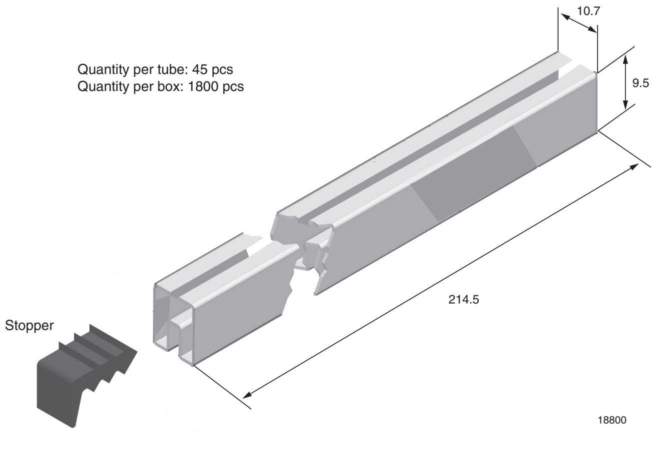
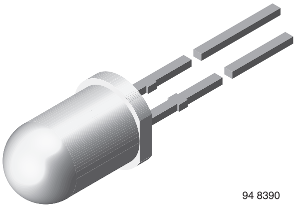


Fig. 8 - Drawing Proportions not scaled

Silicon PIN Photodiode, RoHS Compliant



DESCRIPTION

BPV10 is a PIN photodiode with high speed and high radiant sensitivity in clear, T-1¾ plastic package. It is sensitive to visible and near infrared radiation.

FEATURES

- Package type: leaded
- Package form: T-1¾
- Dimensions (in mm): Ø 5
- Leads with stand-off
- Radiant sensitive area (in mm^2): 0.78
- High photo sensitivity
- High radiant sensitivity
- Suitable for visible and near infrared radiation
- High bandwidth: 250 MHz at V_R = 12 V
- Fast response times
- Angle of half sensitivity: $\varphi = \pm 20°$
- Lead (Pb)-free component in accordance with RoHS 2002/95/EC and WEEE 2002/96/EC

Pb-free
e4
RoHS
COMPLIANT

APPLICATIONS

- High speed photo detector

PRODUCT SUMMARY

COMPONENT	I_{ra} (mA)	φ (deg)	$\lambda_{0.1}$ (nm)
BPV10	70	± 20	380 to 1100

Note
Test condition see table "Basic Characteristics"

ORDERING INFORMATION

ORDERING CODE	PACKAGING	REMARKS	PACKAGE FORM
BPV10	Bulk	MOQ: 4000 pcs, 4000 pcs/bulk	T-1¾

Note
MOQ: minimum order quantity

ABSOLUTE MAXIMUM RATINGS

PARAMETER	TEST CONDITION	SYMBOL	VALUE	UNIT
Reverse voltage		V_R	10	V
Power dissipation	$T_{amb} \leq 25$ °C	P_V	215	mW
Junction temperature		T_j	100	°C
Operating temperature range		T_{amb}	- 40 to + 100	°C
Storage temperature range		T_{stg}	- 40 to + 100	°C
Soldering temperature	$t \leq 5$ s, 2 mm from body	T_{sd}	260	°C
Thermal resistance junction/ambient	Connected with Cu wire, 0.14 mm^2	R_{thJA}	350	K/W

Note
T_{amb} = 25 °C, unless otherwise specified

BASIC CHARACTERISTICS

PARAMETER	TEST CONDITION	SYMBOL	MIN.	TYP.	MAX.	UNIT
Forward voltage	I_F = 50 mA	V_F		1.0	1.3	V
Breakdown voltage	I_R = 100 µA, E = 0	$V_{(BR)}$	60			V
Reverse dark current	V_R = 20 V, E = 0	I_{ro}		1	5	nA
Diode capacitance	V_R = 0 V, f = 1 MHz, E = 0	C_D		11		pF
	V_R = 5 V, f = 1 MHz, E = 0	C_D		3.8		pF
Open circuit voltage	E_A = 1 klx	V_O		480		mV
	E_e = 1 mW/cm², λ = 950 nm	V_O		450		mV
Short circuit current	E_A = 1 klx	I_K		80		µA
	E_e = 1 mW/cm², λ = 950 nm	I_K		65		µA
Reverse light current	E_A = 1 klx, V_R = 5 V	I_{ra}		85		µA
	E_e = 1 mW/cm², λ = 950 nm, V_R = 5 V	I_{ra}	38	70		µA
Absolute spectral sensitivity	V_R = 5 V, λ = 950 nm	s(λ)		0.55		A/W
Angle of half sensitivity		φ		± 20		deg
Wavelength of peak sensitivity		λ_p		920		nm
Range of spectral bandwidth		$\lambda_{0.1}$		380 to 1100		nm
Quantum efficiency	λ = 950 nm	η		72		%
Noise equivalent power	V_R = 20 V, λ = 950 nm	NEP		3×10^{-14}		W/√Hz
Detectivity	V_R = 20 V, λ = 950 nm	D		3×10^{12}		cm√Hz/W
Rise time	V_R = 50 V, R_L = 50 Ω, λ = 820 nm	t_r		2.5		ns
Fall time	V_R = 50 V, R_L = 50 Ω, λ = 820 nm	t_f		2.5		ns

Note

T_{amb} = 25 °C, unless otherwise specified

BASIC CHARACTERISTICS

T_{amb} = 25 °C, unless otherwise specified

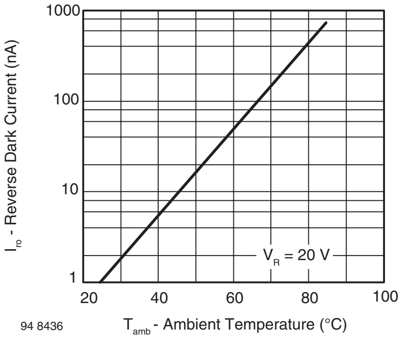


Fig. 1 - Reverse Dark Current vs. Ambient Temperature

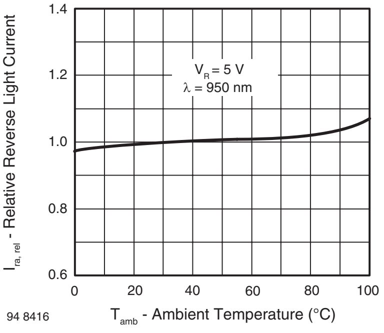


Fig. 2 - Relative Reverse Light Current vs. Ambient Temperature

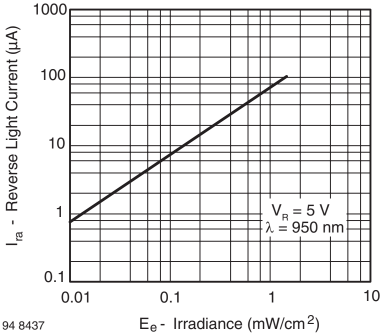


Fig. 3 - Reverse Light Current vs. Irradiance

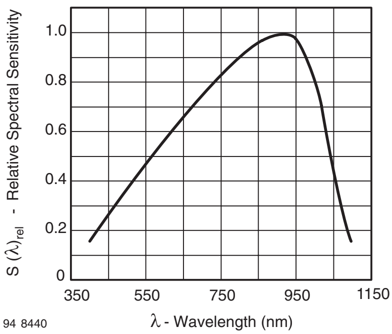


Fig. 6 - Relative Spectral Sensitivity vs. Wavelength

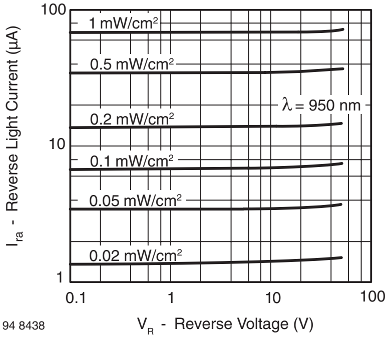


Fig. 4 - Reverse Light Current vs. Reverse Voltage

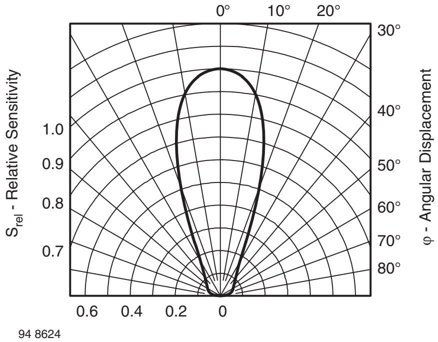


Fig. 7 - Relative Radiant Sensitivity vs. Angular Displacement

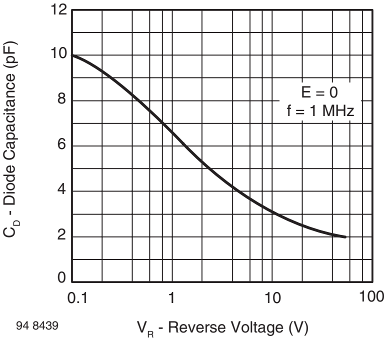
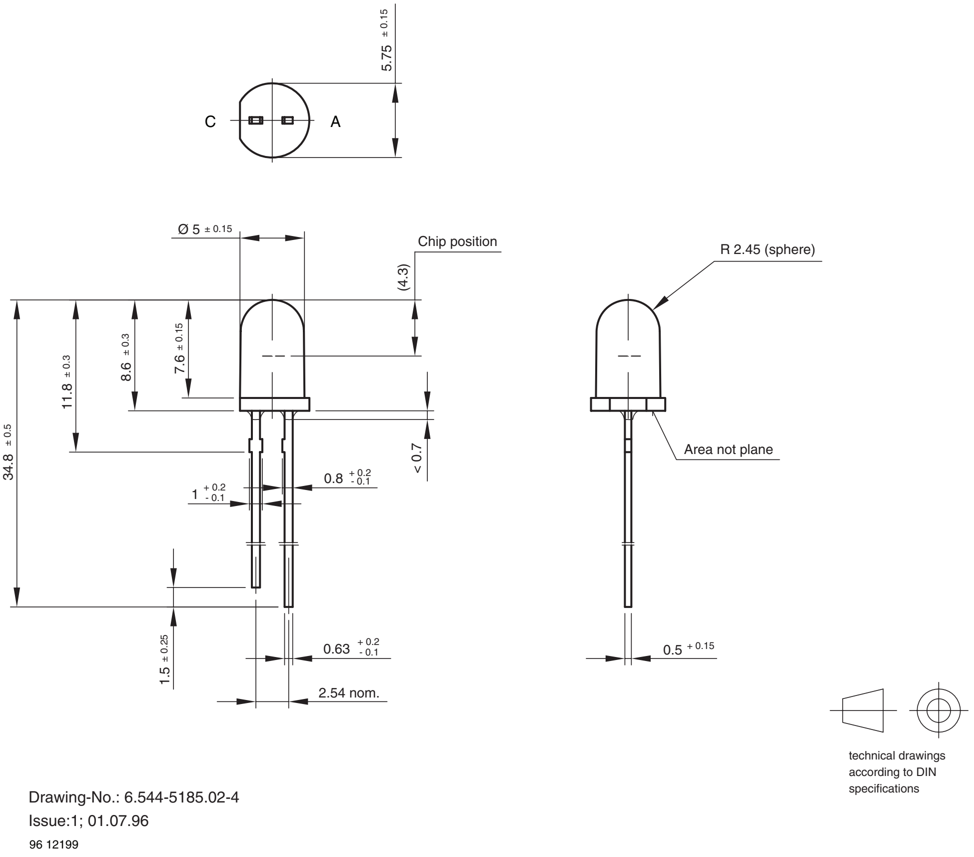
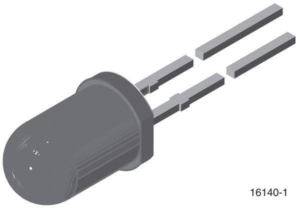


Fig. 5 - Diode Capacitance vs. Reverse Voltage

PACKAGE DIMENSIONS in millimeters



Silicon PIN Photodiode, RoHS Compliant



DESCRIPTION

BPV10NF is a PIN photodiode with high speed and high radiant sensitivity in black, T-1¾ plastic package with daylight blocking filter. Filter bandwidth is matched with 870 nm to 950 nm IR emitters.

FEATURES

- Package type: leaded
- Package form: T-1¾
- Dimensions (in mm): Ø 5
- Leads with stand-off
- Radiant sensitive area (in mm^2): 0.78
- High radiant sensitivity
- Daylight blocking filter matched with 870 nm to 950 nm emitters
- High bandwidth: > 100 MHz at V_R = 12 V
- Fast response times
- Angle of half sensitivity: $\varphi = \pm 20°$
- Lead (Pb)-free component in accordance with RoHS 2002/95/EC and WEEE 2002/96/EC

Pb-free

e4

RoHS
COMPLIANT

APPLICATIONS

- High speed detector for infrared radiation
- Infrared remote control and free air data transmission systems, e.g. in combination with TSFFxxxx series IR emitters

PRODUCT SUMMARY

COMPONENT	I_{ra} (mA)	φ (deg)	$\lambda_{0.5}$ (nm)
BPV10NF	60	± 20	790 to 1050

Note

Test condition see table “Basic Characteristics”

ORDERING INFORMATION

ORDERING CODE	PACKAGING	REMARKS	PACKAGE FORM
BPV10NF	Bulk	MOQ: 4000 pcs, 4000 pcs/bulk	T-1¾

Note

MOQ: minimum order quantity

ABSOLUTE MAXIMUM RATINGS

PARAMETER	TEST CONDITION	SYMBOL	VALUE	UNIT
Reverse voltage		V_R	60	V
Power dissipation	$T_{amb} \le 25$ °C	P_V	215	mW
Junction temperature		T_j	100	°C
Operating temperature range		T_{amb}	- 40 to + 100	°C
Storage temperature range		T_{stg}	- 40 to + 100	°C
Soldering temperature	$t \le 5$ s, 2 mm from body	T_{sd}	260	°C
Thermal resistance junction/ambient	Connected with Cu wire, 0.14 mm^2	R_{thJA}	350	K/W

Note

T_{amb} = 25 °C, unless otherwise specified

BASIC CHARACTERISTICS						
PARAMETER	**TEST CONDITION**	**SYMBOL**	**MIN.**	**TYP.**	**MAX.**	**UNIT**
Forward voltage	I_F = 50 mA	V_F		1.0	1.3	V
Breakdown voltage	I_R = 100 µA, E = 0	$V_{(BR)}$	60			V
Reverse dark current	V_R = 20 V, E = 0	I_{ro}		1	5	nA
Diode capacitance	V_R = 0 V, f = 1 MHz, E = 0	C_D		11		pF
Open circuit voltage	E_e = 1 mW/cm^2, λ = 870 nm	V_O		450		mV
Short circuit current	E_e = 1 mW/cm^2, λ = 870 nm	I_K		50		µA
Reverse light current	E_e = 1 mW/cm^2, λ = 870 nm, V_R = 5 V	I_{ra}		55		µA
	E_e = 1 mW/cm^2, λ = 950 nm, V_R = 5 V	I_{ra}	30	60		µA
Temperature coefficient of I_{ra}	E_e = 1 mW/cm^2, λ = 870 nm, V_R = 5 V	TK_{Ira}		- 0.1		%/K
Absolute spectral sensitivity	V_R = 5 V, λ = 870 nm	s(λ)		0.55		A/W
Angle of half sensitivity		φ		± 20		deg
Wavelength of peak sensitivity		λ_p		940		nm
Range of spectral bandwidth		$\lambda_{0.5}$		790 to 1050		nm
Quantum efficiency	λ = 950 nm	η		70		%
Noise equivalent power	V_R = 20 V, λ = 950 nm	NEP		3 x 10^{-14}		W/√Hz
Detectivity	V_R = 20 V, λ = 950 nm	D*		3 x 10^{12}		cm√Hz/W
Rise time	V_R = 50 V, R_L = 50 Ω, λ = 820 nm	t_r		2.5		ns
Fall time	V_R = 50 V, R_L = 50 Ω, λ = 820 nm	t_f		2.5		ns

Note

T_{amb} = 25 °C, unless otherwise specified

BASIC CHARACTERISTICS

T_{amb} = 25 °C, unless otherwise specified

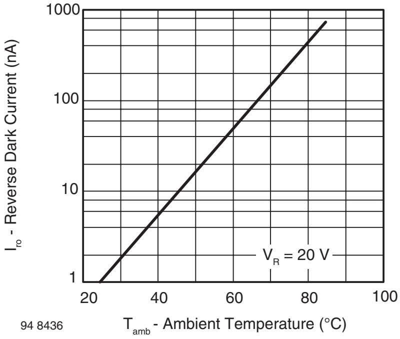


Fig. 1 - Reverse Dark Current vs. Ambient Temperature

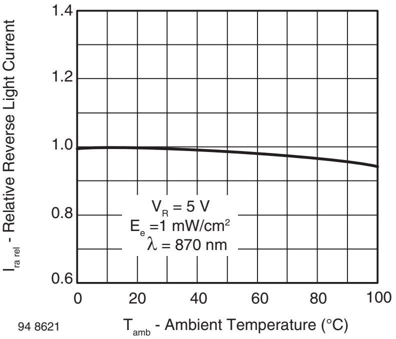


Fig. 2 - Relative Reverse Light Current vs. Ambient Temperature

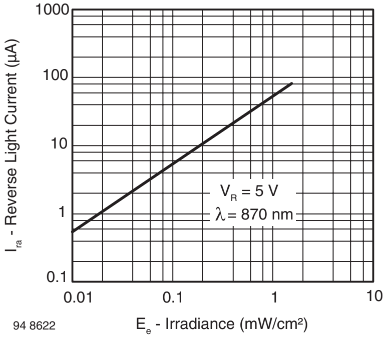


Fig. 3 - Reverse Light Current vs. Irradiance

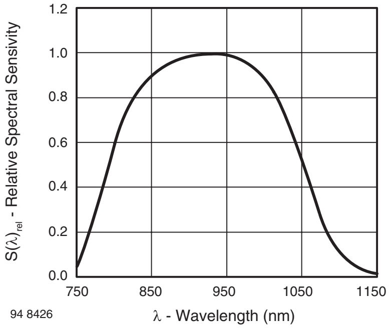


Fig. 6 - Relative Spectral Sensitivity vs. Wavelength

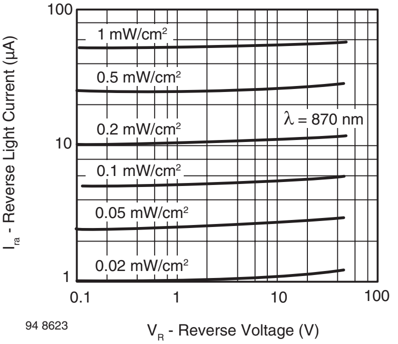


Fig. 4 - Reverse Light Current vs. Reverse Voltage

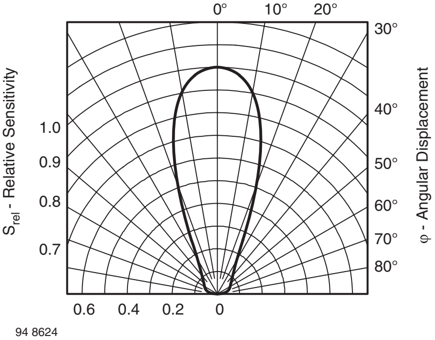


Fig. 7 - Relative Radiant Sensitivity vs. Angular Displacement

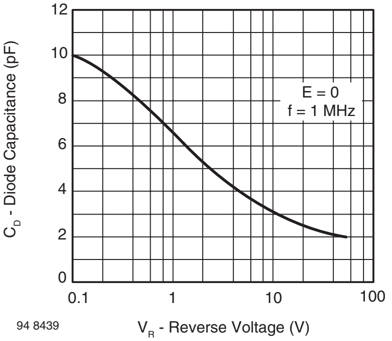
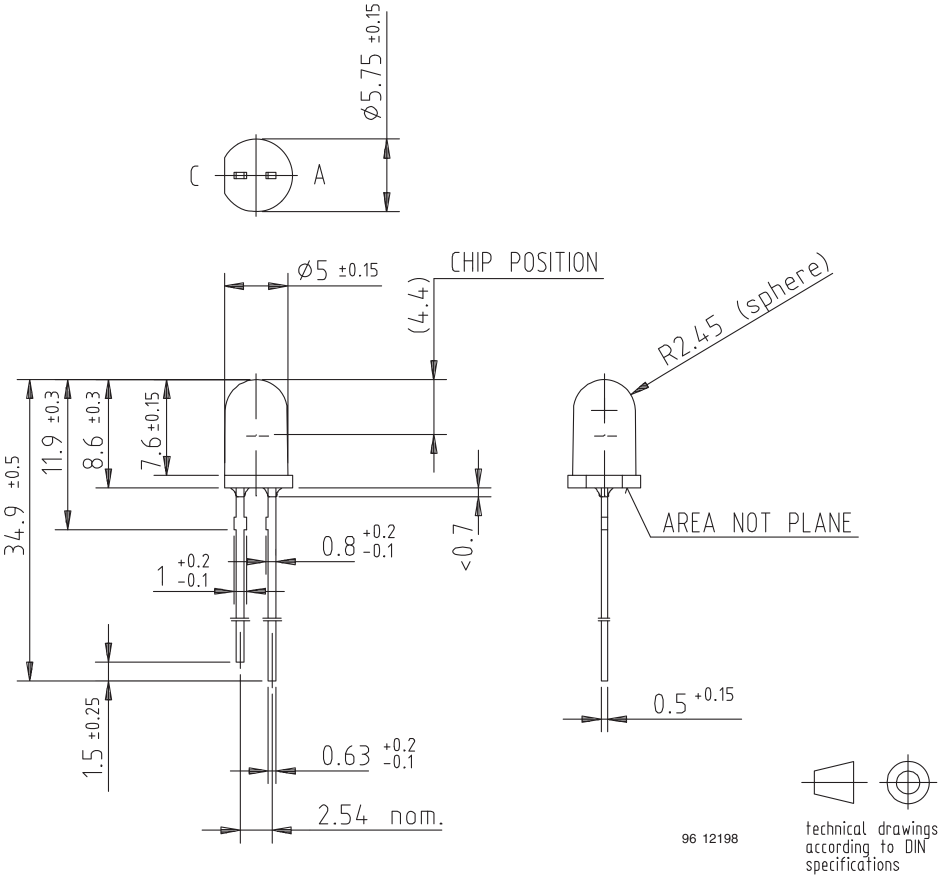
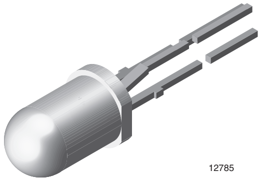


Fig. 5 - Diode Capacitance vs. Reverse Voltage

PACKAGE DIMENSIONS in millimeters



Silicon NPN Phototransistor, RoHS Compliant



DESCRIPTION

BPV11 is a silicon NPN phototransistor with high radiant sensitivity in clear, T-1¾ plastic package with base terminal. It is sensitive to visible and near infrared radiation.

FEATURES

- Package type: leaded
- Package form: T-1¾
- Dimensions (in mm): Ø 5
- High photo sensitivity
- High radiant sensitivity
- Suitable for visible and near infrared radiation
- Fast response times
- Angle of half sensitivity: $\varphi = \pm 15°$
- Base terminal connected
- Lead (Pb)-free component in accordance with RoHS 2002/95/EC and WEEE 2002/96/EC

APPLICATIONS

- Detector for industrial electronic circuitry, measurement and control

PRODUCT SUMMARY

COMPONENT	I_{ca} (mA)	φ (deg)	$\lambda_{0.1}$ (nm)
BPV11	10	± 15	450 to 1080

Note
Test condition see table "Basic Characteristics"

ORDERING INFORMATION

ORDERING CODE	PACKAGING	REMARKS	PACKAGE FORM
BPV11	Bulk	MOQ: 3000 pcs, 3000 pcs/bulk	T-1¾

Note
MOQ: minimum order quantity

ABSOLUTE MAXIMUM RATINGS

PARAMETER	TEST CONDITION	SYMBOL	VALUE	UNIT
Collector base voltage		V_{CBO}	80	V
Collector emitter voltage		V_{CEO}	70	V
Emitter base voltage		V_{EBO}	5	V
Collector current		I_C	50	mA
Collector peak current	$t_p/T = 0.5$, $t_p \leq 10$ ms	I_{CM}	100	mA
Power dissipation	$T_{amb} \leq 47$ °C	P_V	150	mW
Junction temperature		T_j	100	°C
Operating temperature range		T_{amb}	- 40 to + 100	°C
Storage temperature range		T_{stg}	- 40 to + 100	°C
Soldering temperature	$t \leq 5$ s, 2 mm from body	T_{sd}	260	°C
Thermal resistance junction/ambient	Connected with Cu wire, 0.14 mm^2	R_{thJA}	350	K/W

Note
T_{amb} = 25 °C, unless otherwise specified

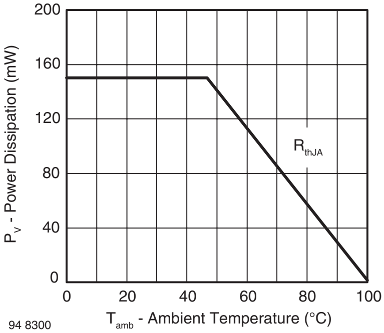


Fig. 1 - Power Dissipation Limit vs. Ambient Temperature

BASIC CHARACTERISTICS

PARAMETER	TEST CONDITION	SYMBOL	MIN.	TYP.	MAX.	UNIT
Collector emitter breakdown voltage	I_C = 1 mA	$V_{(BR)CEO}$	70			V
Collector emitter dark current	V_{CE} = 10 V, E = 0	I_{CEO}		1	50	nA
DC current gain	V_{CE} = 5 V, I_C = 5 mA, E = 0	h_{FE}		450		
Collector emitter capacitance	V_{CE} = 0 V, f = 1 MHz, E = 0	C_{CEO}		15		pF
Collector base capacitance	V_{BE} = 0 V, f = 1 MHz, E = 0	C_{CBO}		19		pF
Collector light current	E_e = 1 mW/cm^2, λ = 950 nm, V_{CE} = 5 V	I_{ca}	3	10		mA
Angle of half sensitivity		φ		± 15		deg
Wavelength of peak sensitivity		λ_p		850		nm
Range of spectral bandwidth		$\lambda_{0.1}$		450 to 1080		nm
Collector emitter saturation voltage	E_e = 1 mW/cm^2, λ = 950 nm, I_C = 1 mA	V_{CEsat}		130	300	mV
Turn-on time	V_S = 5 V, I_C = 5 mA, R_L = 100 Ω	t_{on}		6		µs
Turn-off time	V_S = 5 V, I_C = 5 mA, R_L = 100 Ω	t_{off}		5		µs
Cut-off frequency	V_S = 5 V, I_C = 5 mA, R_L = 100 Ω	f_c		110		kHz

Note

T_{amb} = 25 °C, unless otherwise specified

BASIC CHARACTERISTICS

T_{amb} = 25 °C, unless otherwise specified

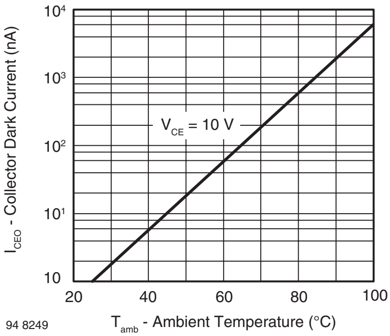


Fig. 2 - Collector Dark Current vs. Ambient Temperature

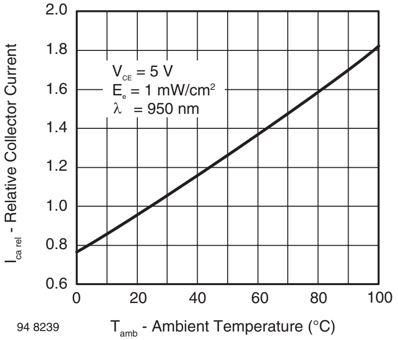


Fig. 3 - Relative Collector Current vs. Ambient Temperature

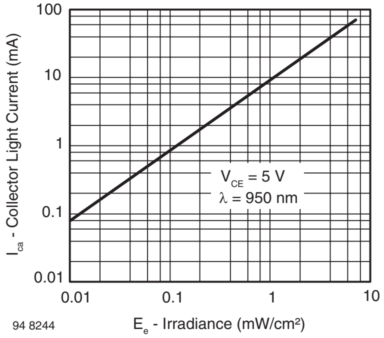


Fig. 4 - Collector Light Current vs. Irradiance

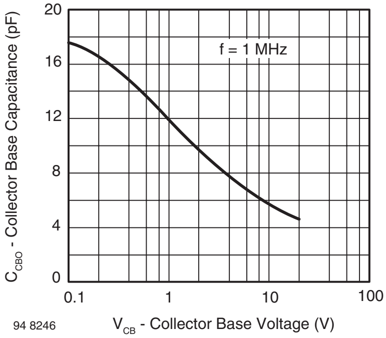


Fig. 7 - Collector Base Capacitance vs. Collector Base Voltage

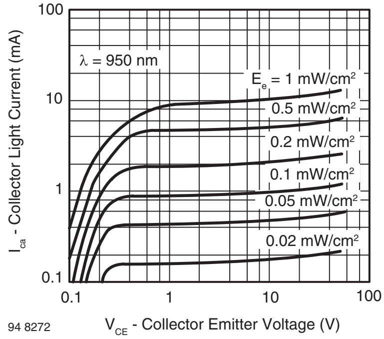


Fig. 5 - Collector Light Current vs. Collector Emitter Voltage

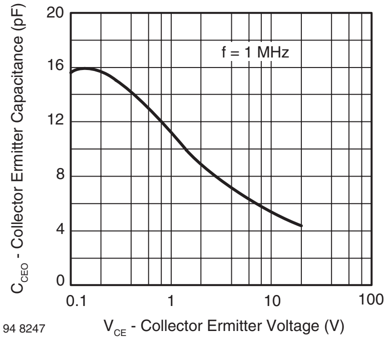


Fig. 8 - Collector Emitter Capacitance vs. Collector Emitter Voltage

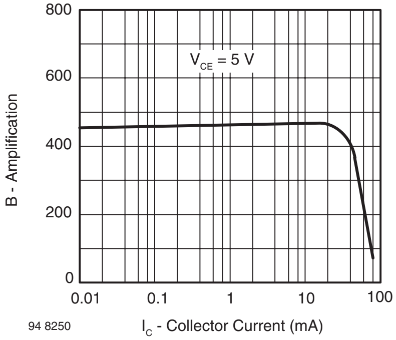


Fig. 6 - Amplification vs. Collector Current

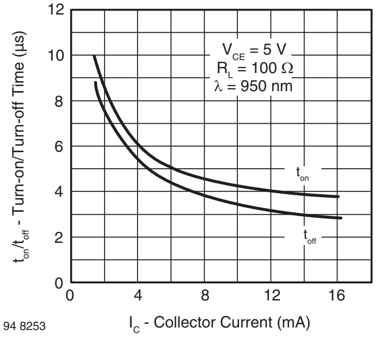


Fig. 9 - Turn-on/Turn-off Time vs. Collector Current

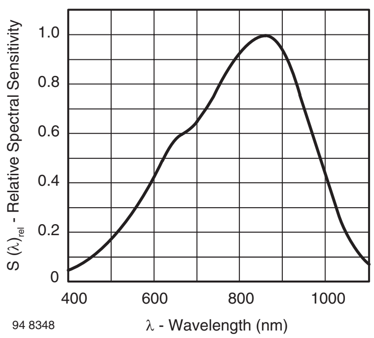


Fig. 10 - Relative Spectral Sensitivity vs. Wavelength

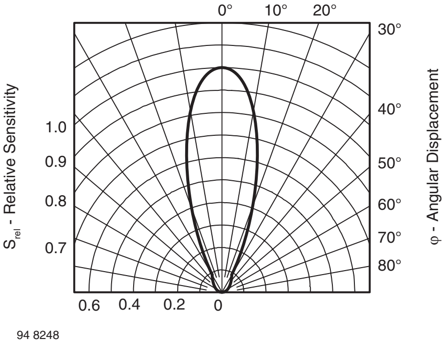
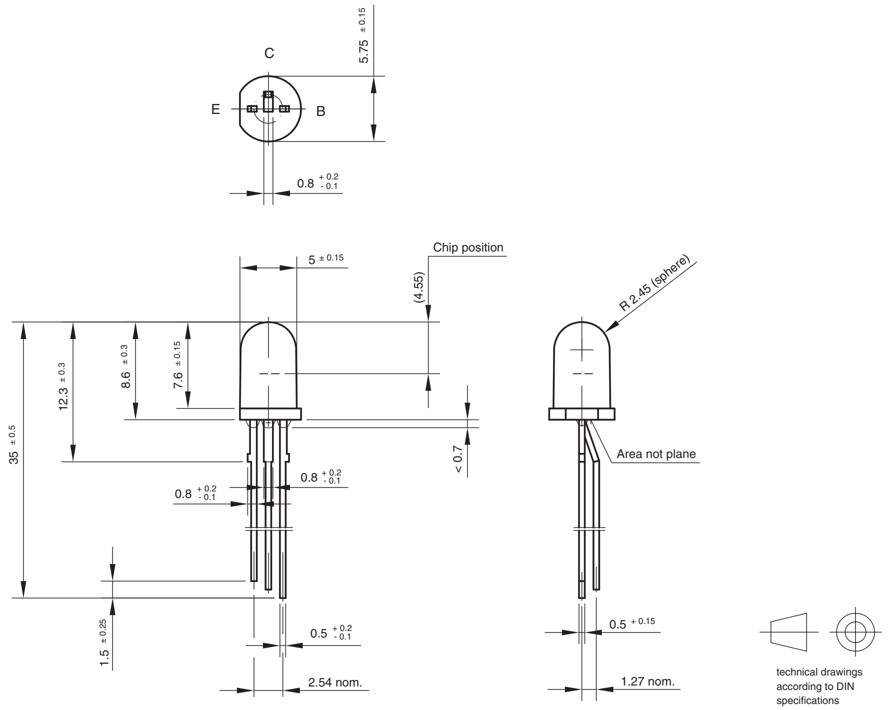


Fig. 11 - Relative Radiant Sensitivity vs. Angular Displacement

PACKAGE DIMENSIONS in millimeters



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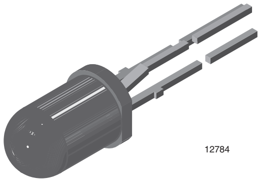
Silicon NPN Phototransistor, RoHS Compliant



DESCRIPTION

BPV11F is a silicon NPN phototransistor with high radiant sensitivity in black, T-1¾ plastic package with base terminal and daylight blocking filter. Filter bandwidth is matched with 900 nm to 950 nm IR emitters.

FEATURES

- Package type: leaded
- Package form: T-1¾
- Dimensions (in mm): Ø 5
- High radiant sensitivity
- Daylight blocking filter matched with 940 nm emitters
- Fast response times
- Angle of half sensitivity: φ = ± 15°
- Base terminal connected
- Lead (Pb)-free component in accordance with RoHS 2002/95/EC and WEEE 2002/96/EC

Pb-free

e4

RoHS
COMPLIANT

APPLICATIONS

- Detector for industrial electronic circuitry, measurement and control

PRODUCT SUMMARY

COMPONENT	I_{ca} (mA)	φ (deg)	$\lambda_{0.5}$ (nm)
BPV11F	9	± 15	900 to 980

Note
Test condition see table "Basic Characteristics"

ORDERING INFORMATION

ORDERING CODE	PACKAGING	REMARKS	PACKAGE FORM
BPV11F	Bulk	MOQ: 3000 pcs, 3000 pcs/bulk	T-1¾

Note
MOQ: minimum order quantity

ABSOLUTE MAXIMUM RATINGS

PARAMETER	TEST CONDITION	SYMBOL	VALUE	UNIT
Collector base voltage		V_{CBO}	80	V
Collector emitter voltage		V_{CEO}	70	V
Emitter base voltage		V_{EBO}	5	V
Collector current		I_C	50	mA
Collector peak current	$t_p/T = 0.5$, $t_p \leq 10$ ms	I_{CM}	100	mA
Power dissipation	$T_{amb} \leq 47$ °C	P_V	150	mW
Junction temperature		T_j	100	°C
Operating temperature range		T_{amb}	- 40 to + 100	°C
Storage temperature range		T_{stg}	- 40 to + 100	°C
Soldering temperature	$t \leq 5$ s, 2 mm from body	T_{sd}	260	°C
Thermal resistance junction/ambient	Connected with Cu wire, 0.14 mm^2	R_{thJA}	350	K/W

Note
T_{amb} = 25 °C, unless otherwise specified

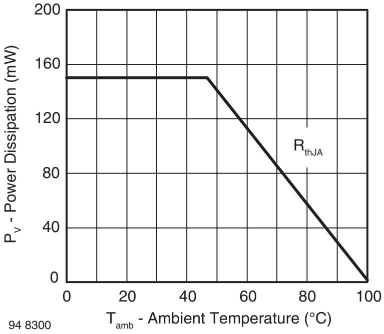


Fig. 1 - Power Dissipation Limit vs. Ambient Temperature

BASIC CHARACTERISTICS

PARAMETER	TEST CONDITION	SYMBOL	MIN.	TYP.	MAX.	UNIT
Collector emitter breakdown voltage	I_C = 1 mA	$V_{(BR)CEO}$	70			V
Collector emitter dark current	V_{CE} = 10 V, E = 0	I_{CEO}		1	50	nA
DC current gain	V_{CE} = 5 V, I_C = 5 mA, E = 0	h_{FE}		450		
Collector emitter capacitance	V_{CE} = 0 V, f = 1 MHz, E = 0	C_{CEO}		15		pF
Collector base capacitance	V_{CE} = 0 V, f = 1 MHz, E = 0	C_{CBO}		19		pF
Collector light current	E_e = 1 mW/cm², λ = 950 nm, V_{CB} = 5 V	I_{ca}	3	9		mA
Angle of half sensitivity		φ		± 15		deg
Wavelength of peak sensitivity		λ_p		930		nm
Range of spectral bandwidth		$\lambda_{0.5}$		900 to 980		nm
Collector emitter saturation voltage	E_e = 1 mW/cm², λ = 950 nm, I_C = 1 mA	V_{CEsat}		130	300	mV
Turn-on time	V_S = 5 V, I_C = 5 mA, R_L = 100 Ω	t_{on}		6		µs
Turn-off time	V_S = 5 V, I_C = 5 mA, R_L = 100 Ω	t_{off}		5		µs
Cut-off frequency	V_S = 5 V, I_C = 5 mA, R_L = 100 Ω	f_c		110		kHz

Note

T_{amb} = 25 °C, unless otherwise specified

BASIC CHARACTERISTICS

T_{amb} = 25 °C, unless otherwise specified

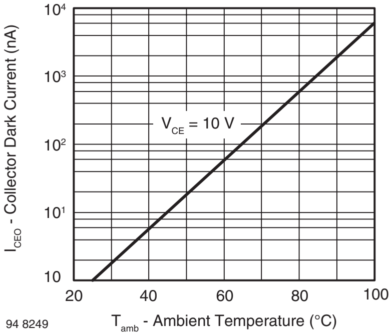


Fig. 2 - Collector Dark Current vs. Ambient Temperature

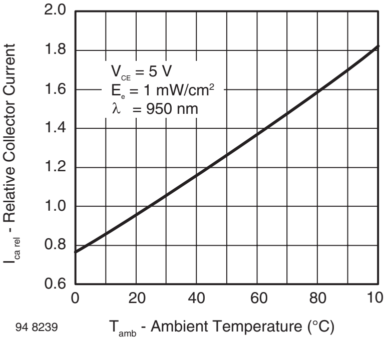


Fig. 3 - Relative Collector Current vs. Ambient Temperature

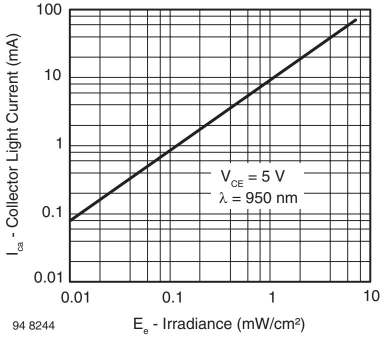


Fig. 4 - Collector Light Current vs. Irradiance

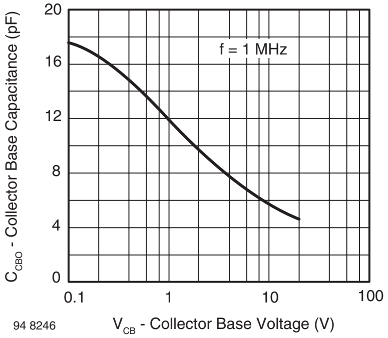


Fig. 7 - Collector Base Capacitance vs. Collector Base Voltage

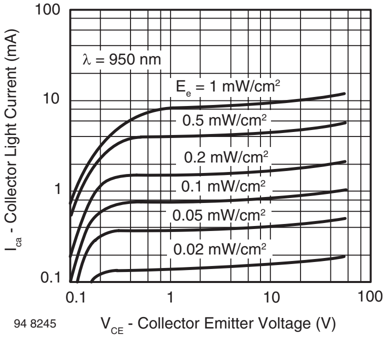


Fig. 5 - Collector Light Current vs. Collector Emitter Voltage

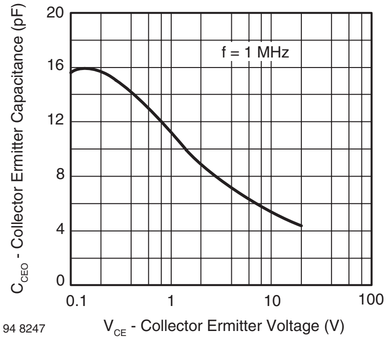


Fig. 8 - Collector Emitter Capacitance vs. Collector Emitter Voltage

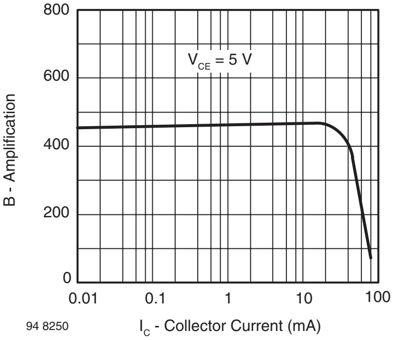


Fig. 6 - Amplification vs. Collector Current

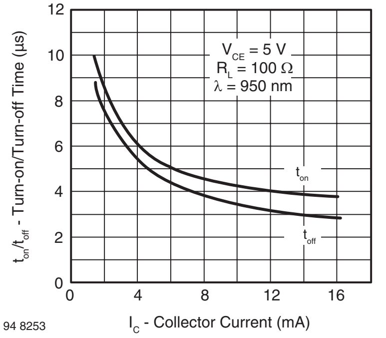


Fig. 9 - Turn-on/Turn-off Time vs. Collector Current

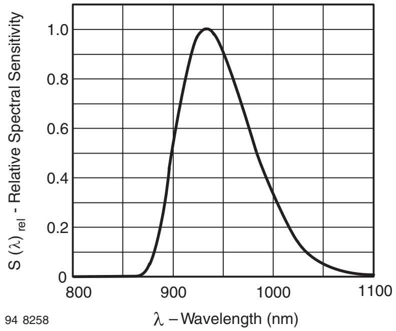


Fig. 10 - Relative Spectral Sensitivity vs. Wavelength

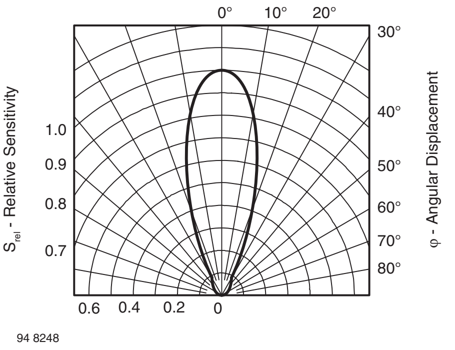
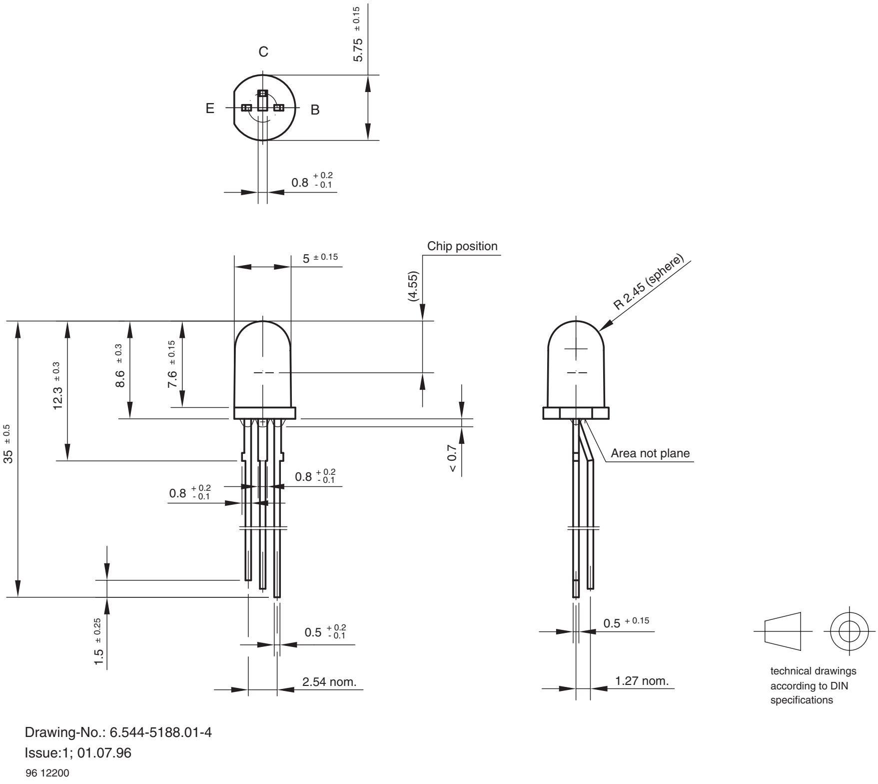
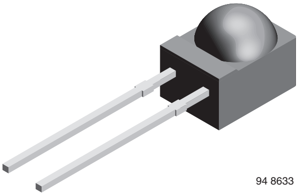


Fig. 11 - Relative Radiant Sensitivity vs. Angular Displacement

PACKAGE DIMENSIONS in millimeters



Silicon PIN Photodiode, RoHS Compliant



FEATURES

- Package type: leaded
- Package form: side view
- Dimensions (in mm): 4.5 x 5 x 6
- Radiant sensitive area (in mm^2): 7.5
- High radiant sensitivity
- Daylight blocking filter matched with 940 nm emitters
- Fast response times
- Angle of half sensitivity: $\varphi = \pm 60°$
- Lead (Pb)-free component in accordance with RoHS 2002/95/EC and WEEE 2002/96/EC

Pb-free

e4

RoHS
COMPLIANT

DESCRIPTION

BPV22F is a PIN photodiode with high speed and high radiant sensitivity in a black, plastic package with side view lens and daylight blocking filter. Filter bandwdith is matched with 900 nm to 950 nm IR emitters. The lens achieves 80 % of sensitivity improvement in comparison with flat package.

APPLICATIONS

- High speed detector for infrared radiation
- Infrared remote control and free air data transmission systems, e.g. in combination with TSALxxxx series IR emitters

PRODUCT SUMMARY

COMPONENT	I_{ra} (μA)	φ (deg)	$\lambda_{0.5}$ (nm)
BPV22F	80	± 60	870 to 1050

Note

Test condition see table “Basic Characteristics”

ORDERING INFORMATION

ORDERING CODE	PACKAGING	REMARKS	PACKAGE FORM
BPV22F	Bulk	MOQ: 4000 pcs, 4000 pcs/bulk	Side view

Note

MOQ: minimum order quantity

ABSOLUTE MAXIMUM RATINGS

PARAMETER	TEST CONDITION	SYMBOL	VALUE	UNIT
Reverse voltage		V_R	60	V
Power dissipation	$T_{amb} \leq 25$ °C	P_V	215	mW
Junction temperature		T_j	100	°C
Operating temperature range		T_{amb}	- 40 to + 100	°C
Storage temperature range		T_{stg}	- 40 to + 100	°C
Soldering temperature	$t \leq 5$ s	T_{sd}	260	°C
Thermal resistance junction/ambient	Connected with Cu wire, 0.14 mm^2	R_{thJA}	350	K/W

Note

T_{amb} = 25 °C, unless otherwise specified

BASIC CHARACTERISTICS						
PARAMETER	**TEST CONDITION**	**SYMBOL**	**MIN.**	**TYP.**	**MAX.**	**UNIT**
Forward voltage	I_F = 50 mA	V_F		1	1.3	V
Breakdown voltage	I_R = 100 µA, E = 0	$V_{(BR)}$	60			V
Reverse dark current	V_R = 10 V, E = 0	I_{ro}		2	30	nA
Diode capacitance	V_R = 0 V, f = 1 MHz, E = 0	C_D		70		pF
Serial resistance	V_R= 12 V, f = 1 MHz	R_S		400		Ω
Open circuit voltage	E_e = 1 mW/cm², λ = 950 nm	V_o		370		mV
Temperature coefficient of V_o	E_e = 1 mW/cm², λ = 950 nm	TK_{Vo}		- 2.6		mV/K
Short circuit current	E_e = 1 mW/cm², λ = 950 nm	I_k		75		µA
Reverse light current	E_e = 1 mW/cm², λ = 950 nm, V_R = 5 V	I_{ra}	55	80		µA
Temperature coefficient of I_{ra}	E_e = 1 mW/cm², λ = 950 nm, V_R = 10 V	TK_{Ira}		0.1		%/K
Absolute spectral sensitivity	V_R = 5 V, λ = 870 nm	s(λ)		0.35		A/W
	V_R = 5 V, λ = 950 nm	s(λ)		0.6		A/W
Angle of half sensitivity		φ		± 60		deg
Wavelength of peak sensitivity		λ_p		950		nm
Range of spectral bandwidth		$\lambda_{0.5}$		870 to 1050		nm
Quantum efficiency	λ = 950 nm	η		90		%
Noise equivalent power	V_R = 10 V, λ = 950 nm	NEP		4×10^{-14}		W/√ Hz
Detectivity	V_R = 10 V, λ = 950 nm	D*		6×10^{12}		cm√Hz/W
Rise time	V_R = 10 V, R_L = 1 kΩ, λ = 820 nm	t_r		100		ns
Fall time	V_R = 10 V, R_L = 1 kΩ, λ = 820 nm	t_f		100		ns
Cut-off frequency	V_R = 12 V, R_L = 1 kΩ, λ = 870 nm	f_c		4		MHz
	V_R = 12 V, R_L = 1 kΩ, λ = 950 nm	f_c		1		MHz

Note

T_{amb} = 25 °C, unless otherwise specified

BASIC CHARACTERISTICS

T_{amb} = 25 °C, unless otherwise specified

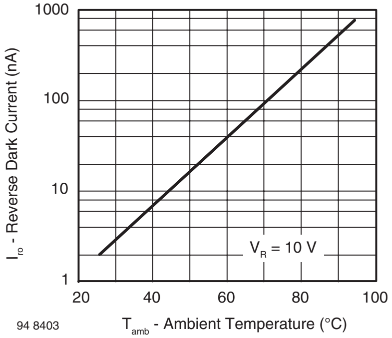


Fig. 1 - Reverse Dark Current vs. Ambient Temperature

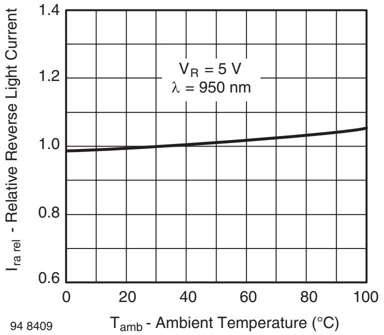


Fig. 2 - Relative Reverse Light Current vs. Ambient Temperature

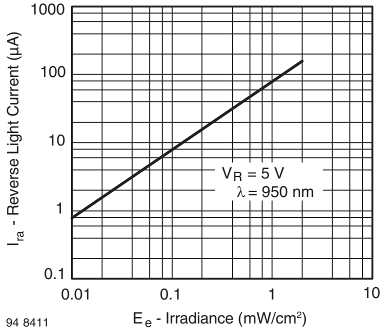


Fig. 3 - Reverse Light Current vs. Irradiance

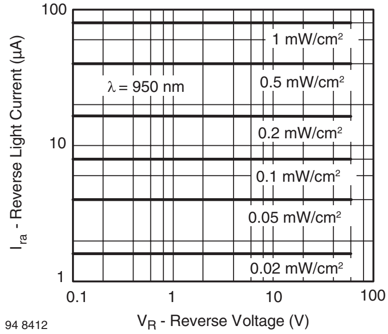


Fig. 4 - Reverse Light Current vs. Reverse Voltage

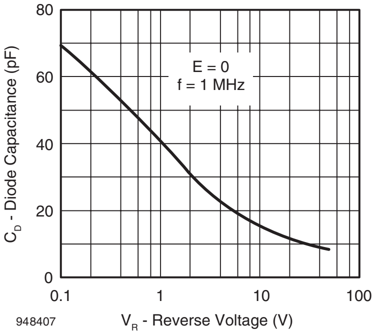


Fig. 5 - Diode Capacitance vs. Reverse Voltage

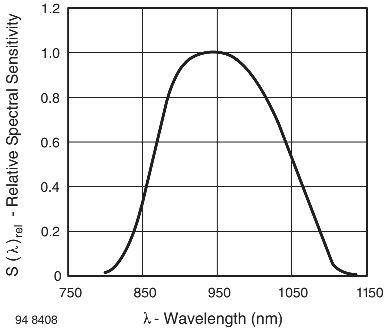


Fig. 6 - Relative Spectral Sensitivity vs. Wavelength

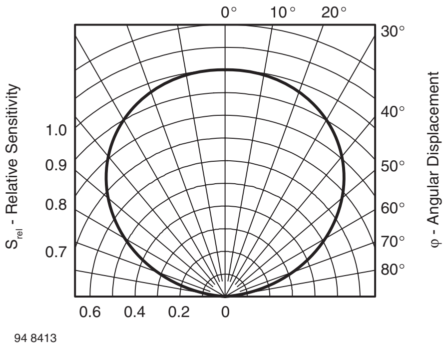
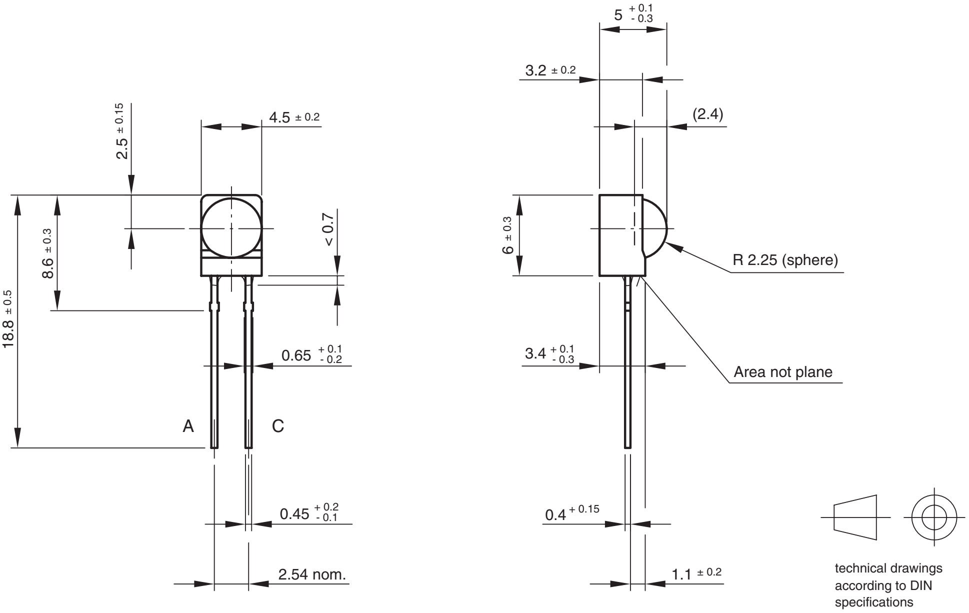


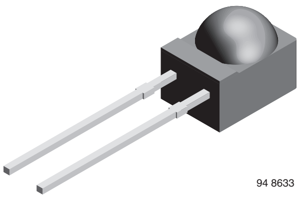
Fig. 7 - Relative Radiant Sensitivity vs. Angular Displacement

PACKAGE DIMENSIONS in millimeters



Drawing-No.: 6.544-5199.01-4
Issue: 2; 19.06.01
95 11475

Silicon PIN Photodiode, RoHS Compliant



FEATURES

- Package type: leaded
- Package form: side view
- Dimensions (in mm): 4.5 x 5 x 6
- Radiant sensitive area (in mm^2): 7.5
- High radiant sensitivity
- Daylight blocking filter matched with 870 nm to 950 nm emitters
- Fast response times
- Angle of half sensitivity: $\varphi = \pm 60°$
- Lead (Pb)-free component in accordance with RoHS 2002/95/EC and WEEE 2002/96/EC

Pb-free
e4
RoHS
COMPLIANT

DESCRIPTION

BPV22NF is a PIN photodiode with high speed and high radiant sensitivity in a black, plastic package with side view lens and daylight blocking filter. Filter bandwidth is matched with 870 nm to 950 nm IR emitters. The lens achieves 80 % of sensitivity improvement in comparison with flat package. BPV22NFL has long leads, other specifications like BPV22NF.

APPLICATIONS

- High speed detector for infrared radiation
- Infrared remote control and free air data transmission systems, e.g. in combination with TSFFxxxx series IR emitters

PRODUCT SUMMARY

COMPONENT	I_{ra} (µA)	φ (deg)	$\lambda_{0.5}$ (nm)
BPV22NF	85	± 60	790 to 1050
BPV22NFL	85	± 60	790 to 1050

Note
Test condition see table “Basic Characteristics”

ORDERING INFORMATION

ORDERING CODE	PACKAGING	REMARKS	PACKAGE FORM
BPV22NF	Bulk	MOQ: 4000 pcs, 4000 pcs/bulk	Side view
BPV22NFL	Bulk	MOQ: 4000 pcs, 4000 pcs/bulk	Side view, long leads

Note
MOQ: minimum order quantity

ABSOLUTE MAXIMUM RATINGS

PARAMETER	TEST CONDITION	SYMBOL	VALUE	UNIT
Reverse voltage		V_R	60	V
Power dissipation	$T_{amb} \leq 25$ °C	P_V	215	mW
Junction temperature		T_j	100	°C
Operating temperature range		T_{amb}	- 40 to + 100	°C
Storage temperature range		T_{stg}	- 40 to + 100	°C
Soldering temperature	$t \leq 5$ s	T_{sd}	260	°C
Thermal resistance junction/ambient	Connected with Cu wire, 0.14 mm^2	R_{thJA}	350	K/W

Note
T_{amb} = 25 °C, unless otherwise specified

BASIC CHARACTERISTICS

PARAMETER	TEST CONDITION	SYMBOL	MIN.	TYP.	MAX.	UNIT
Forward voltage	I_F = 50 mA	V_F		1	1.3	V
Breakdown voltage	I_R = 100 µA, E = 0	$V_{(BR)}$	60			V
Reverse dark current	V_R = 10 V, E = 0	I_{ro}		2	30	nA
Diode capacitance	V_R= 0 V, f = 1 MHz, E = 0	C_D		70		pF
Serial resistance	V_R= 12 V, f = 1 MHz	R_S		400		Ω
Open circuit voltage	E_e = 1 mW/cm², λ = 950 nm	V_o		370		mV
Temperature coefficient of V_o	E_e = 1 mW/cm², λ = 950 nm	TK_{Vo}		- 2.6		mV/K
Short circuit current	E_e = 1 mW/cm², λ = 950 nm	I_k		80		µA
Reverse light current	E_e = 1 mW/cm², λ = 870 nm, V_R = 5 V	I_{ra}	55	85		µA
Temperature coefficient of I_{ra}	E_e = 1 mW/cm², λ = 950 nm, V_R = 10 V	TK_{Ira}		0.1		%/K
Absolute spectral sensitivity	V_R = 5 V, λ = 870 nm	s(λ)		0.57		A/W
	V_R = 5 V, λ = 950 nm	s(λ)		0.6		A/W
Angle of half sensitivity		φ		± 60		deg
Wavelength of peak sensitivity		λ_p		940		nm
Range of spectral bandwidth		$\lambda_{0.5}$		790 to 1050		nm
Quantum efficiency	λ = 950 nm	η		90		%
Noise equivalent power	V_R = 10 V, λ = 950 nm	NEP		4×10^{-14}		W/√ Hz
Detectivity	V_R = 10 V, λ = 950 nm	D*		6×10^{12}		cm√Hz/W
Rise time	V_R = 10 V, R_L = 1 kΩ, λ = 820 nm	t_r		100		ns
Fall time	V_R = 10 V, R_L = 1 kΩ, λ = 820 nm	t_f		100		ns
Cut-off frequency	V_R = 12 V, R_L = 1 kΩ, λ = 870 nm	f_c		4		MHz
	V_R = 12 V, R_L = 1 kΩ, λ = 950 nm	f_c		1		MHz

Note

T_{amb} = 25 °C, unless otherwise specified

BASIC CHARACTERISTICS

T_{amb} = 25 °C, unless otherwise specified

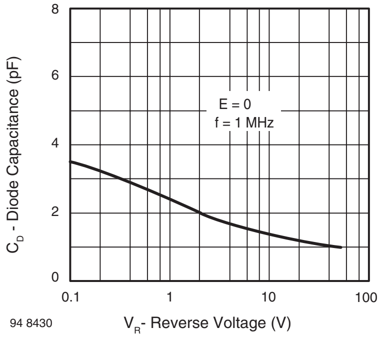


Fig. 1 - Reverse Dark Current vs. Ambient Temperature

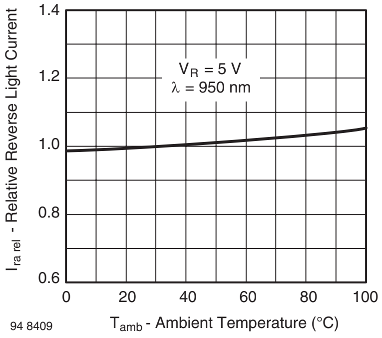


Fig. 2 - Relative Reverse Light Current vs. Ambient Temperature

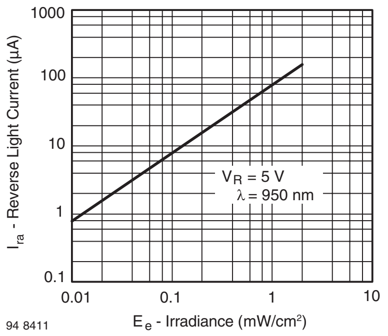


Fig. 3 - Reverse Light Current vs. Irradiance

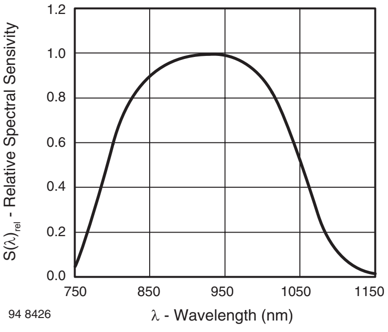


Fig. 6 - Relative Spectral Sensitivity vs. Wavelength

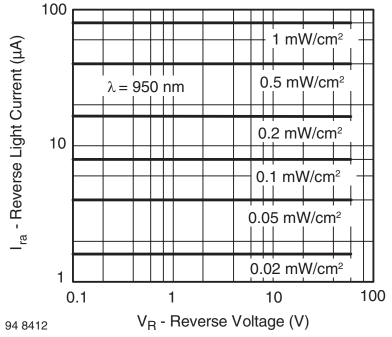


Fig. 4 - Reverse Light Current vs. Reverse Voltage

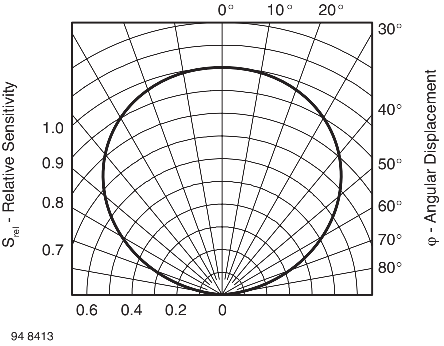


Fig. 7 - Relative Radiant Sensitivity vs. Angular Displacement

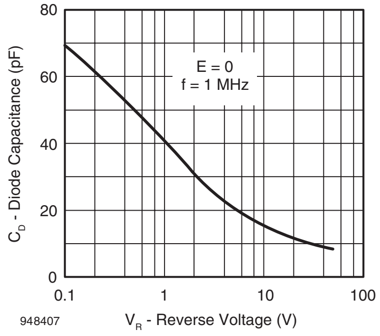
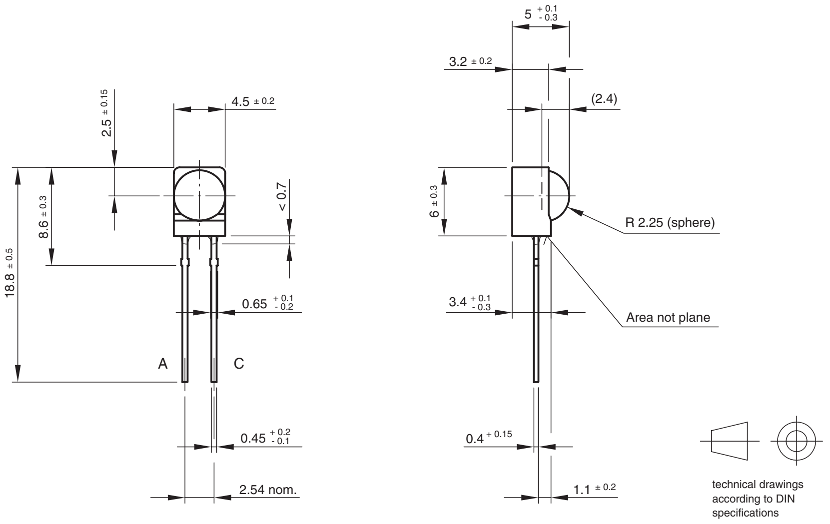


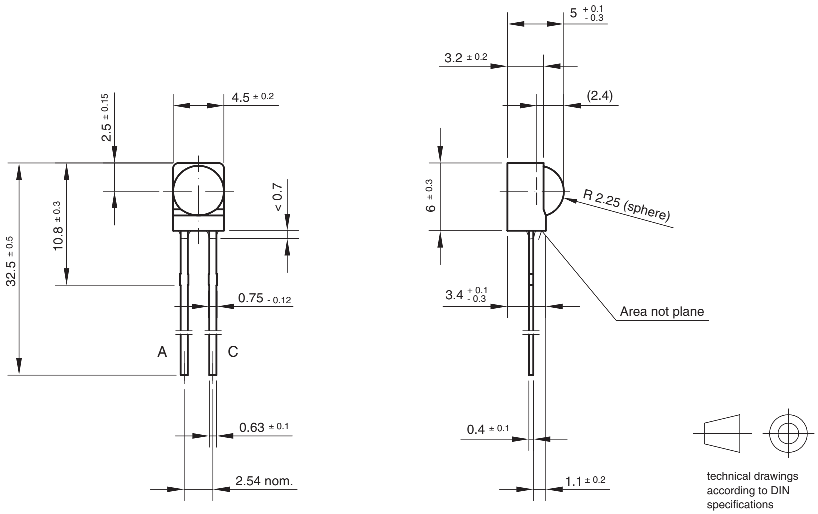
Fig. 5 - Diode Capacitance vs. Reverse Voltage

PACKAGE DIMENSIONS in millimeters: **BPV22NF**



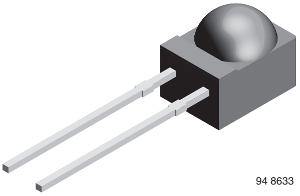
Drawing-No.: 6.544-5199.01-4
Issue: 2; 19.06.01
95 11475

PACKAGE DIMENSIONS in millimeters: **BPV22NFL**



Drawing-No.: 6.544-5236.01-4
Issue: 2; 07.07.97
96 12205

Silicon PIN Photodiode, RoHS Compliant



FEATURES

- Package type: leaded
- Package form: side view
- Dimensions (in mm): 4.5 x 5 x 6
- Radiant sensitive area (in mm^2): 4.4
- High radiant sensitivity
- Daylight blocking filter matched with 940 nm emitters
- Fast response times
- Angle of half sensitivity: $\varphi = \pm 60°$
- Lead (Pb)-free component in accordance with RoHS 2002/95/EC and WEEE 2002/96/EC

Pb-free

e4

RoHS
COMPLIANT

DESCRIPTION

BPV23F is a PIN photodiode with high speed and high radiant sensitivity in a black, plastic package with side view lens and daylight blocking filter. Filter bandwidth is matched with 900 nm to 950 nm IR emitters. The lens achieves 80 % of sensitivity improvement in comparison with flat package. BPV23FL has long leads, other specifications like BPV23F.

APPLICATIONS

- High speed detector for infrared radiation
- Infrared remote control and free air data transmission systems, e.g. in combination with TSALxxxx series IR emitters

PRODUCT SUMMARY

COMPONENT	I_{ra} (µA)	φ (deg)	$\lambda_{0.5}$ (nm)
BPV23F	63	± 60	870 to 1050
BPV23FL	63	± 60	870 to 1050

Note

Test condition see table “Basic Characteristics”

ORDERING INFORMATION

ORDERING CODE	PACKAGING	REMARKS	PACKAGE FORM
BPV23F	Bulk	MOQ: 4000 pcs, 4000 pcs/bulk	Side view
BPV23FL	Bulk	MOQ: 4000 pcs, 4000 pcs/bulk	Side view, long leads

Note

MOQ: minimum order quantity

ABSOLUTE MAXIMUM RATINGS

PARAMETER	TEST CONDITION	SYMBOL	VALUE	UNIT
Reverse voltage		V_R	60	V
Power dissipation	$T_{amb} \leq 25$ °C	P_V	215	mW
Junction temperature		T_j	100	°C
Operating temperature range		T_{amb}	- 40 to + 100	°C
Storage temperature range		T_{stg}	- 40 to + 100	°C
Soldering temperature	$t \leq 5$ s	T_{sd}	260	°C
Thermal resistance junction/ambient	Connected with Cu wire, 0.14 mm^2	R_{thJA}	350	K/W

Note

T_{amb} = 25 °C, unless otherwise specified

BASIC CHARACTERISTICS

PARAMETER	TEST CONDITION	SYMBOL	MIN.	TYP.	MAX.	UNIT
Forward voltage	I_F = 50 mA	V_F		1	1.3	V
Breakdown voltage	I_R = 100 µA, E = 0	$V_{(BR)}$	60			V
Reverse dark current	V_R = 10 V, E = 0	I_{ro}		2	30	nA
Diode capacitance	V_R = 0 V, f = 1 MHz, E = 0	C_D		48		pF
Serial resistance	V_R= 12 V, f = 1 MHz	R_S		900		Ω
Open circuit voltage	E_e = 1 mW/cm², λ = 950 nm	V_o		390		mV
Temperature coefficient of V_o	E_e = 1 mW/cm², λ = 950 nm	TK_{Vo}		- 2.6		mV/K
Short circuit current	E_e = 1 mW/cm², λ = 950 nm	I_k		60		µA
Reverse light current	E_e = 1 mW/cm², λ = 950 nm, V_R = 5 V	I_{ra}	45	63		µA
Temperature coefficient of I_{ra}	E_e = 1 mW/cm², λ = 950 nm, V_R = 10 V	TK_{Ira}		0.2		%/K
Absolute spectral sensitivity	V_R = 5 V, λ = 870 nm	s(λ)		0.35		A/W
	V_R = 5 V, λ = 950 nm	s(λ)		0.6		A/W
Angle of half sensitivity		φ		± 60		deg
Wavelength of peak sensitivity		λ_p		950		nm
Range of spectral bandwidth		$\lambda_{0.5}$		870 to 1050		nm
Quantum efficiency	λ = 950 nm	η		90		%
Noise equivalent power	V_R = 10 V, λ = 950 nm	NEP		4×10^{-14}		W/√ Hz
Detectivity	V_R = 10 V, λ = 950 nm	D*		5×10^{12}		cm√Hz/W
Rise time	V_R = 10 V, R_L = 1 kΩ, λ = 820 nm	t_r		70		ns
Fall time	V_R = 10 V, R_L = 1 kΩ, λ = 820 nm	t_f		70		ns
Cut-off frequency	V_R = 12 V, R_L = 1 kΩ, λ = 870 nm	f_c		4		MHz
	V_R = 12 V, R_L = 1 kΩ, λ = 950 nm	f_c		1		MHz

Note

T_{amb} = 25 °C, unless otherwise specified

BASIC CHARACTERISTICS

T_{amb} = 25 °C, unless otherwise specified

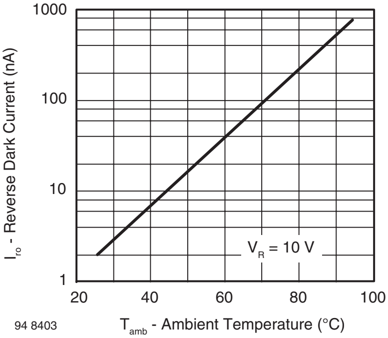


Fig. 1 - Reverse Dark Current vs. Ambient Temperature

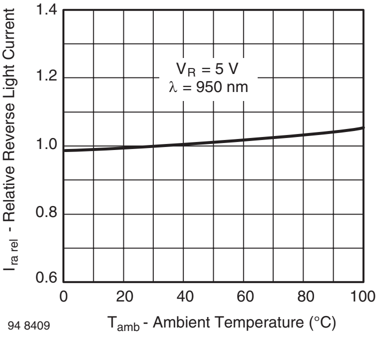


Fig. 2 - Relative Reverse Light Current vs. Ambient Temperature

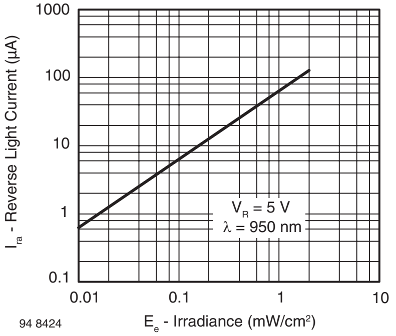


Fig. 3 - Reverse Light Current vs. Irradiance

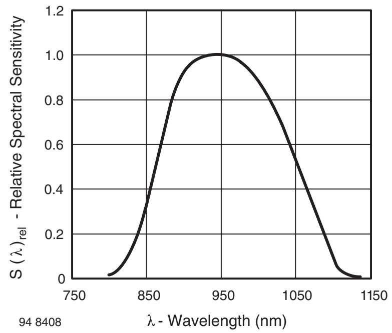


Fig. 6 - Relative Spectral Sensitivity vs. Wavelength

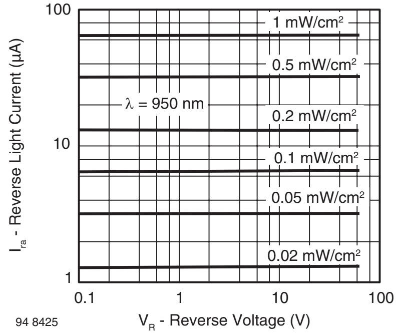


Fig. 4 - Reverse Light Current vs. Reverse Voltage

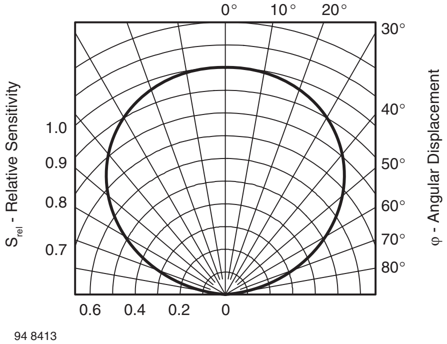


Fig. 7 - Relative Radiant Sensitivity vs. Angular Displacement

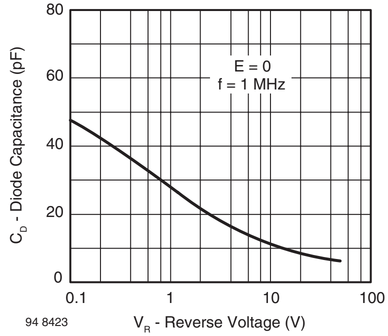
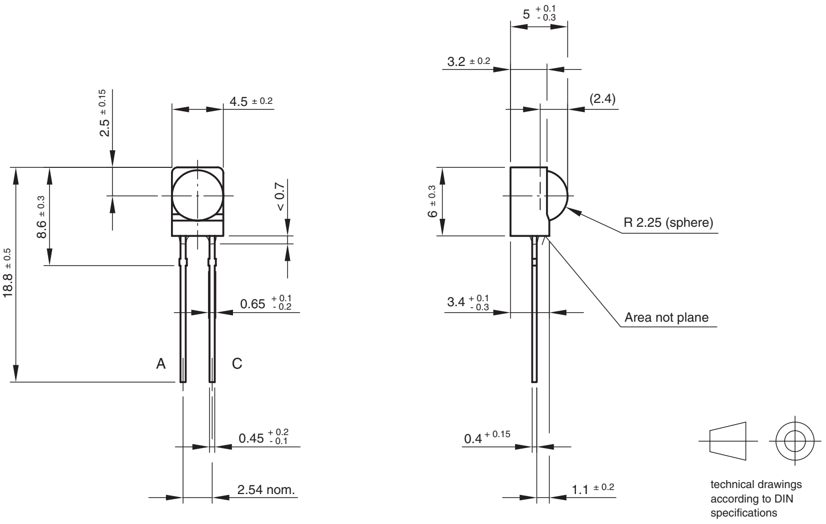


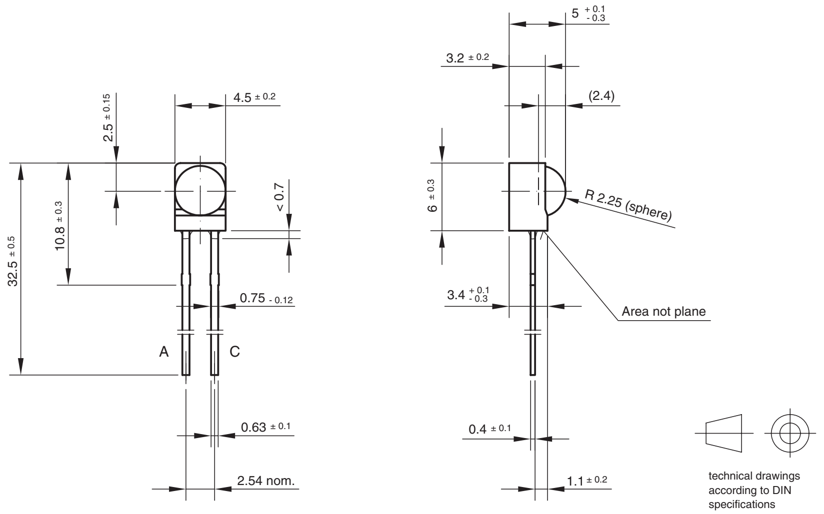
Fig. 5 - Diode Capacitance vs. Reverse Voltage

PACKAGE DIMENSIONS in millimeters: **BPV23F**



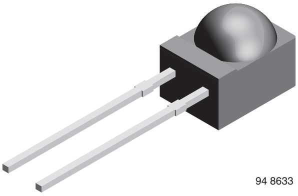
Drawing-No.: 6.544-5199.01-4
Issue: 2; 19.06.01
95 11475

PACKAGE DIMENSIONS in millimeters: **BPV23FL**



Drawing-No.: 6.544-5236.01-4
Issue: 2; 07.07.97
96 12205

Silicon PIN Photodiode, RoHS Compliant



FEATURES

- Package type: leaded
- Package form: side view
- Dimensions (in mm): 4.5 x 5 x 6
- Radiant sensitive area (in mm^2): 4.4
- High radiant sensitivity
- Daylight blocking filter matched with 870 nm to 950 nm emitters
- Fast response times
- Angle of half sensitivity: $\varphi = \pm 60°$
- Lead (Pb)-free component in accordance with RoHS 2002/95/EC and WEEE 2002/96/EC

Pb-free

e4

RoHS
COMPLIANT

DESCRIPTION

BPV23NF is a PIN photodiode with high speed and high radiant sensitivity in a black, plastic package with side view lens and daylight blocking filter. Filter bandwidth is matched with 870 nm to 950 nm IR emitters. The lens achieves 80 % of sensitivity improvement in comparison with flat package. BPV23NFL has long leads, other specifications like BPV23NF.

APPLICATIONS

- High speed detector for infrared radiation
- Infrared remote control and free air data transmission systems, e.g. in combination with TSFFxxxx series IR emitters

PRODUCT SUMMARY

COMPONENT	I_{ra} (μA)	φ (deg)	$\lambda_{0.5}$ (nm)
BPV23NF	65	± 60	790 to 1050
BPV23NFL	65	± 60	790 to 1050

Note
Test condition see table “Basic Characteristics“

ORDERING INFORMATION

ORDERING CODE	PACKAGING	REMARKS	PACKAGE FORM
BPV23NF	Bulk	MOQ: 4000 pcs, 4000 pcs/bulk	Side view
BPV23NFL	Bulk	MOQ: 4000 pcs, 4000 pcs/bulk	Side view, long leads

Note
MOQ: minimum order quantity

ABSOLUTE MAXIMUM RATINGS

PARAMETER	TEST CONDITION	SYMBOL	VALUE	UNIT
Reverse voltage		V_R	60	V
Power dissipation	$T_{amb} \leq 25$ °C	P_V	215	mW
Junction temperature		T_j	100	°C
Operating temperature range		T_{amb}	- 40 to + 100	°C
Storage temperature range		T_{stg}	- 40 to + 100	°C
Soldering temperature	$t \leq 5$ s	T_{sd}	260	°C
Thermal resistance junction/ambient	Connected with Cu wire, 0.14 mm^2	R_{thJA}	350	K/W

Note
T_{amb} = 25 °C, unless otherwise specified

BASIC CHARACTERISTICS

PARAMETER	TEST CONDITION	SYMBOL	MIN.	TYP.	MAX.	UNIT
Forward voltage	I_F = 50 mA	V_F		1	1.3	V
Breakdown voltage	I_R = 100 µA, E = 0	$V_{(BR)}$	60			V
Reverse dark current	V_R = 10 V, E = 0	I_{ro}		2	30	nA
Diode capacitance	V_R = 0 V, f = 1 MHz, E = 0	C_D		48		pF
Serial resistance	V_R= 12 V, f = 1 MHz	R_S		900		Ω
Open circuit voltage	E_e = 1 mW/cm^2, λ = 950 nm	V_o		390		mV
Temperature coefficient of V_o	E_e = 1 mW/cm^2, λ = 950 nm	TK_{Vo}		- 2.6		mV/K
Short circuit current	E_e = 1 mW/cm^2, λ = 950 nm	I_k		65		µA
Reverse light current	E_e = 1 mW/cm^2, λ = 950 nm, V_R = 5 V	I_{ra}	45	65		µA
Temperature coefficient of I_{ra}	E_e = 1 mW/cm^2, λ = 950 nm, V_R = 10 V	TK_{Ira}		0.1		%/K
Absolute spectral sensitivity	V_R = 5 V, λ = 870 nm	s(λ)		0.57		A/W
	V_R = 5 V, λ = 950 nm	s(λ)		0.60		A/W
Angle of half sensitivity		φ		± 60		deg
Wavelength of peak sensitivity		λ_p		940		nm
Range of spectral bandwidth		$\lambda_{0.5}$		790 to 1050		nm
Quantum efficiency	λ = 950 nm	η		90		%
Noise equivalent power	V_R = 10 V, λ = 950 nm	NEP		4 x 10^{-14}		W/√ Hz
Detectivity	V_R = 10 V, λ = 950 nm	D*		5 x 10^{12}		cm√Hz/W
Rise time	V_R = 10 V, R_L = 1 kΩ, λ = 820 nm	t_r		70		ns
Fall time	V_R = 10 V, R_L = 1 kΩ, λ = 820 nm	t_f		70		ns
Cut-off frequency	V_R = 12 V, R_L = 1 kΩ, λ = 870 nm	f_c		4		MHz
	V_R = 12 V, R_L = 1 kΩ, λ = 950 nm	f_c		1		MHz

Note

T_{amb} = 25 °C, unless otherwise specified

BASIC CHARACTERISTICS

T_{amb} = 25 °C, unless otherwise specified

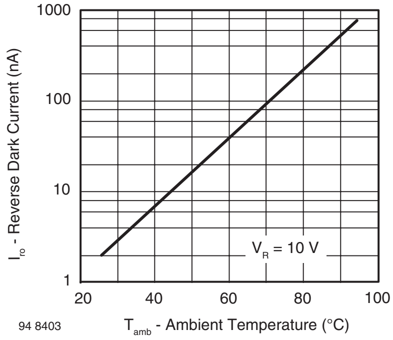


Fig. 1 - Reverse Dark Current vs. Ambient Temperature

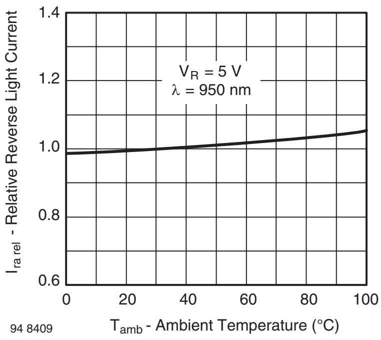


Fig. 2 - Relative Reverse Light Current vs. Ambient Temperature

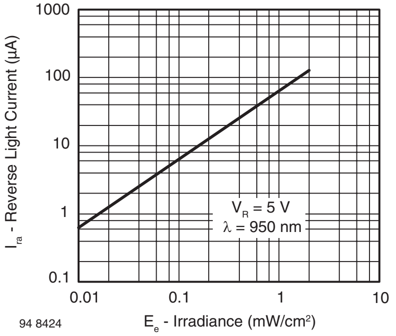


Fig. 3 - Reverse Light Current vs. Irradiance

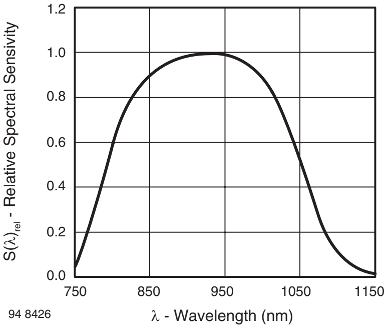


Fig. 6 - Relative Spectral Sensitivity vs. Wavelength

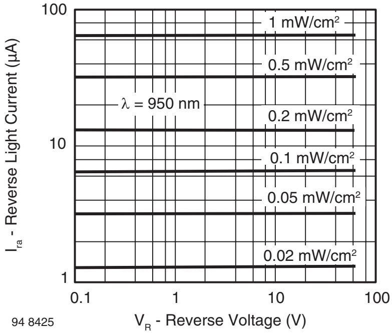


Fig. 4 - Reverse Light Current vs. Reverse Voltage

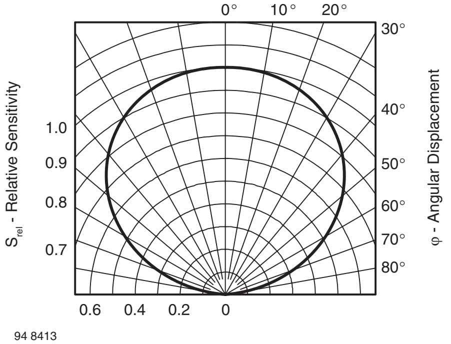


Fig. 7 - Relative Radiant Sensitivity vs. Angular Displacement

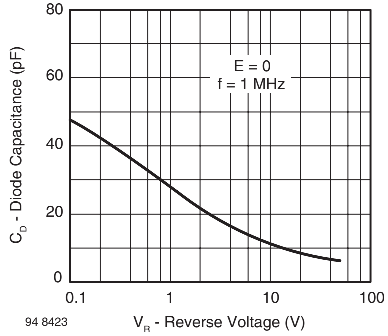
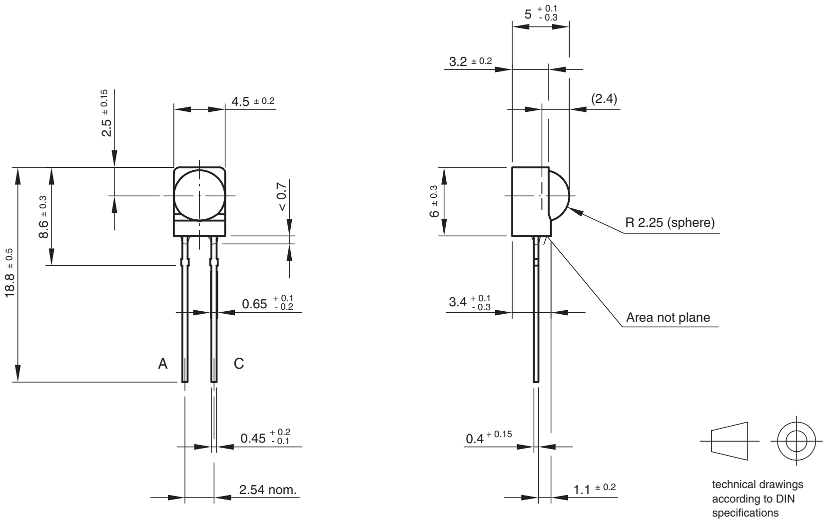


Fig. 5 - Diode Capacitance vs. Reverse Voltage

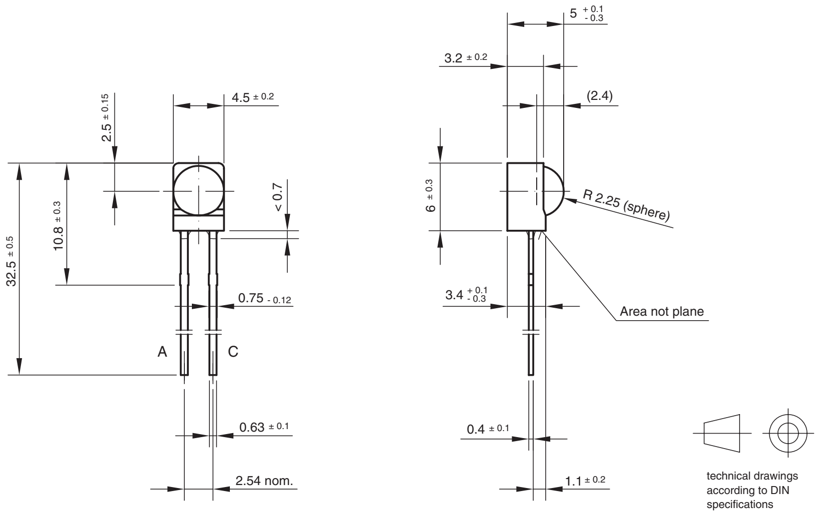
PACKAGE DIMENSIONS in millimeters: BPV23NF



technical drawings
according to DIN
specifications

Drawing-No.: 6.544-5199.01-4
Issue: 2; 19.06.01
95 11475

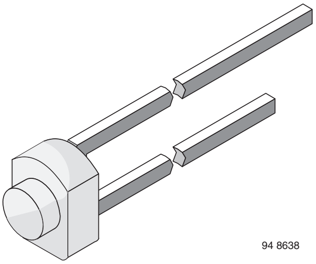
PACKAGE DIMENSIONS in millimeters: BPV23NFL



technical drawings
according to DIN
specifications

Drawing-No.: 6.544-5236.01-4
Issue: 2; 07.07.97
96 12205

Silicon NPN Phototransistor, RoHS Compliant



FEATURES

- Package type: leaded
- Package form: T-¾
- Dimensions (in mm): Ø 1.8
- High photo sensitivity
- High radiant sensitivity
- Suitable for visible and near infrared radiation
- Fast response times
- Angle of half sensitivity: φ = ± 40°
- Lead (Pb)-free component in accordance with RoHS 2002/95/EC and WEEE 2002/96/EC

Pb-free
e4
RoHS COMPLIANT

APPLICATIONS

- Detector in electronic control and drive circuits

DESCRIPTION

BPW16N is a silicon NPN phototransistor with high radiant sensitivity in clear, T-¾ plastic package with flat window. It is sensitive to visible and near infrared radiation. On PCB this package size enables assembly of arrays with 2.54 mm pitch.

PRODUCT SUMMARY

COMPONENT	I_{ca} (mA)	φ (deg)	$\lambda_{0.1}$ (nm)
BPW16N	0.14	± 40	450 to 1040

Note
Test condition see table “Basic Characteristics”

ORDERING INFORMATION

ORDERING CODE	PACKAGING	REMARKS	PACKAGE FORM
BPW16N	Bulk	MOQ: 5000 pcs, 5000 pcs/bulk	T-¾

Note
MOQ: minimum order quantity

ABSOLUTE MAXIMUM RATINGS

PARAMETER	TEST CONDITION	SYMBOL	VALUE	UNIT
Collector emitter voltage		V_{CEO}	32	V
Emitter collector voltage		V_{ECO}	5	V
Collector current		I_C	50	mA
Collector peak current	$t_p/T = 0.5$, $t_p \leq 10$ ms	I_{CM}	100	mA
Power dissipation	$T_{amb} \leq 55$ °C	P_V	100	mW
Junction temperature		T_j	100	°C
Operating temperature range		T_{amb}	- 40 to + 100	°C
Storage temperature range		T_{stg}	- 40 to + 100	°C
Soldering temperature	$t \leq 3$ s	T_{sd}	260	°C
Thermal resistance junction/ambient	Connected with Cu wire, 0.14 mm^2	R_{thJA}	450	K/W

Note
T_{amb} = 25 °C, unless otherwise specified

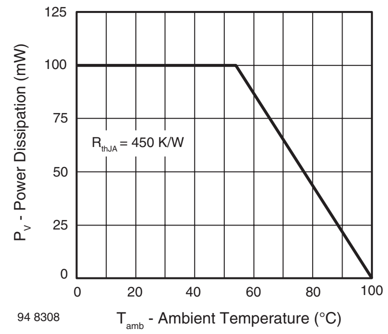


Fig. 1 - Power Dissipation Limit vs. Ambient Temperature

BASIC CHARACTERISTICS						
PARAMETER	**TEST CONDITION**	**SYMBOL**	**MIN.**	**TYP.**	**MAX.**	**UNIT**
Collector emitter breakdown voltage	I_C = 1 mA	$V_{(BR)CEO}$	32			V
Collector emitter dark current	V_{CE} = 20 V, E = 0	I_{CEO}		1	200	nA
Collector emitter capacitance	V_{CE} = 5 V, f = 1 MHz, E = 0	C_{CEO}		8		pF
Collector light current	E_e = 1 mW/cm^2, λ = 950 nm, V_{CE} = 5 V	I_{ca}	0.07	0.14		mA
Angle of half sensitivity		φ		± 40		deg
Wavelength of peak sensitivity		λ_p		825		nm
Range of spectral bandwidth		$\lambda_{0.1}$		450 to 1040		nm
Collector emitter saturation voltage	E_e = 1 mW/cm^2, λ = 950 nm, I_C = 0.01 mA	V_{CEsat}			0.3	V
Turn-on time	V_S = 5 V, I_C = 5 mA, R_L = 100 Ω	t_{on}		4.8		µs
Turn-off time	V_S = 5 V, I_C = 5 mA, R_L = 100 Ω	t_{off}		5.0		µs
Cut-off frequency	V_S = 5 V, I_C = 5 mA, R_L = 100 Ω	f_c		120		kHz

Note

T_{amb} = 25 °C, unless otherwise specified

BASIC CHARACTERISTICS

T_{amb} = 25 °C, unless otherwise specified

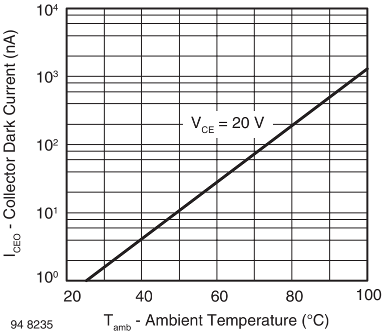


Fig. 2 - Collector Dark Current vs. Ambient Temperature

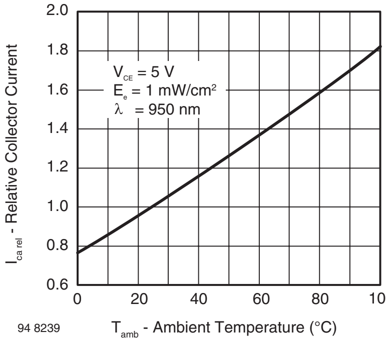


Fig. 3 - Relative Collector Current vs. Ambient Temperature

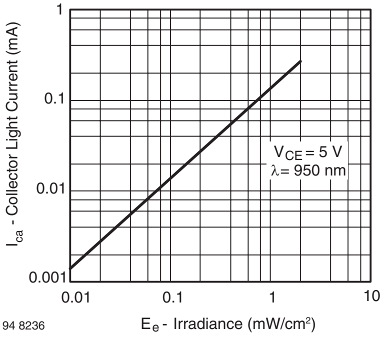


Fig. 4 - Collector Light Current vs. Irradiance

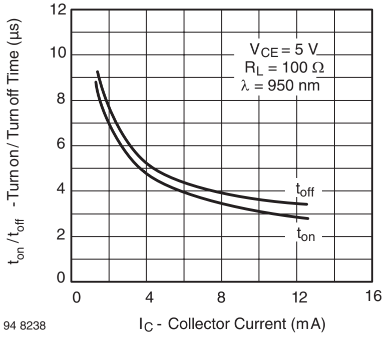


Fig. 7 - Turn-on/Turn-off Time vs. Collector Current

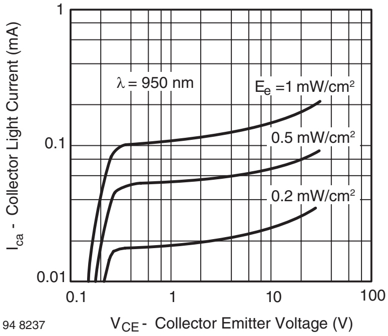


Fig. 5 - Collector Light Current vs. Collector Emitter Voltage

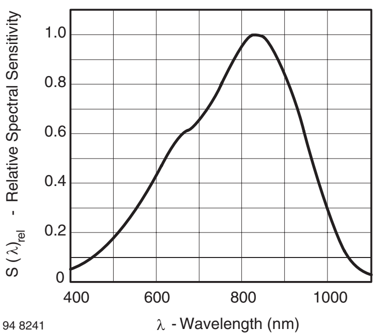


Fig. 8 - Relative Spectral Sensitivity vs. Wavelength

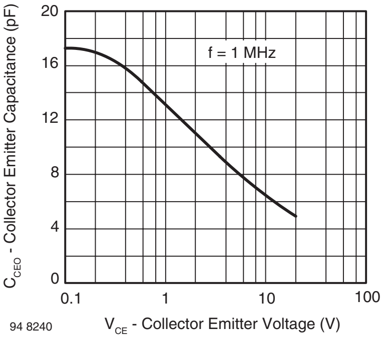


Fig. 6 - Collector Emitter Capacitance vs. Collector Emitter Voltage

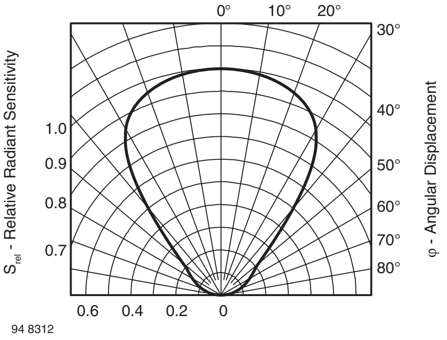
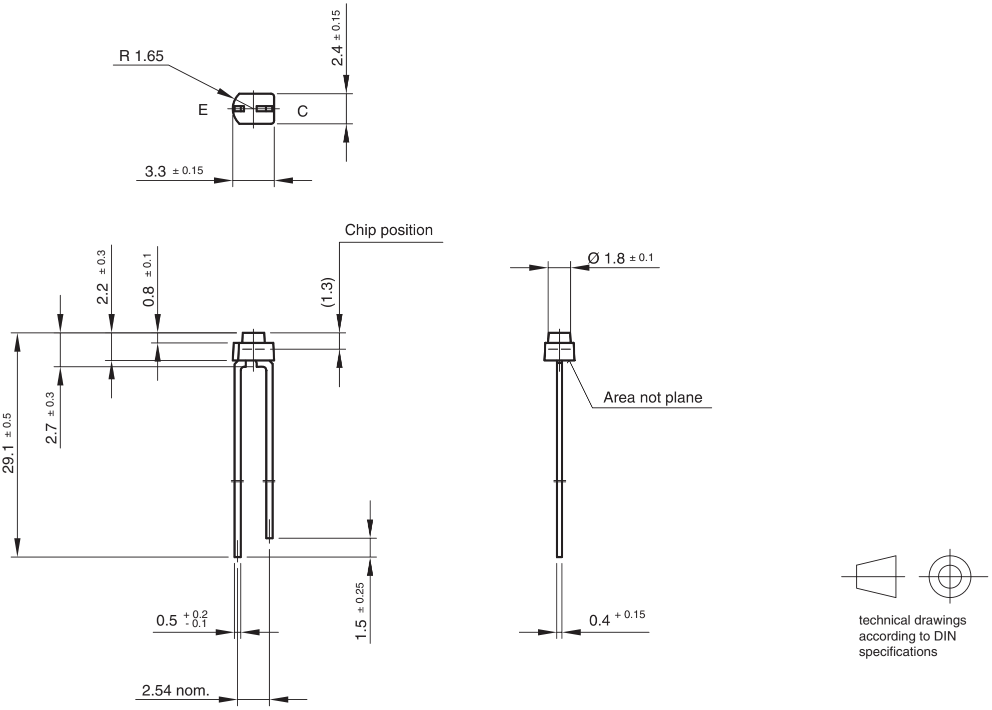


Fig. 9 - Relative Radiant Sensitivity vs. Angular Displacement

PACKAGE DIMENSIONS in millimeters



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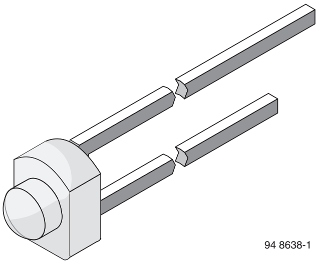
96 12188

Silicon NPN Phototransistor, RoHS Compliant



DESCRIPTION

BPW17N is a silicon NPN phototransistor with high radiant sensitivity in clear, T-3/4 plastic package with lens. It is sensitive to visible and near infrared radiation. On PCB this package size enables assembly of arrays with 2.54 mm pitch.

FEATURES

- Package type: leaded
- Package form: T-¾
- Dimensions (in mm): Ø 1.8
- High photo sensitivity
- High radiant sensitivity
- Suitable for visible and near infrared radiation
- Fast response times
- Angle of half sensitivity: φ = ± 12°
- Lead (Pb)-free component in accordance with RoHS 2002/95/EC and WEEE 2002/96/EC

Pb-free

e4

RoHS COMPLIANT

APPLICATIONS

- Detector in electronic control and drive circuits

PRODUCT SUMMARY

COMPONENT	I_{ca} (mA)	φ (deg)	$\lambda_{0.1}$ (nm)
BPW17N	1.0	± 12	450 to 1040

Note

Test condition see table “Basic Characteristics”

ORDERING INFORMATION

ORDERING CODE	PACKAGING	REMARKS	PACKAGE FORM
BPW17N	Bulk	MOQ: 5000 pcs, 5000 pcs/bulk	T-¾

Note

MOQ: minimum order quantity

ABSOLUTE MAXIMUM RATINGS

PARAMETER	TEST CONDITION	SYMBOL	VALUE	UNIT
Collector emitter voltage		V_{CEO}	32	V
Emitter collector voltage		V_{ECO}	5	V
Collector current		I_C	50	mA
Collector peak current	$t_p/T = 0.5$, $t_p \leq 10$ ms	I_{CM}	100	mA
Power dissipation	$T_{amb} \leq 55$ °C	P_V	100	mW
Junction temperature		T_j	100	°C
Operating temperature range		T_{amb}	- 40 to + 100	°C
Storage temperature range		T_{stg}	- 40 to + 100	°C
Soldering temperature	$t \leq 3$ s	T_{sd}	260	°C
Thermal resistance junction/ambient	Connected with Cu wire, 0.14 mm^2	R_{thJA}	450	K/W

Note

T_{amb} = 25 °C, unless otherwise specified

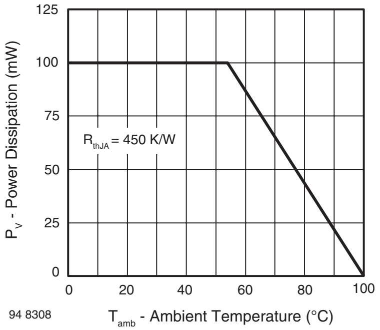


Fig. 1 - Power Dissipation Limit vs. Ambient Temperature

BASIC CHARACTERISTICS						
PARAMETER	**TEST CONDITION**	**SYMBOL**	**MIN.**	**TYP.**	**MAX.**	**UNIT**
Collector emitter breakdown voltage	I_C = 1 mA	$V_{(BR)CEO}$	32			V
Collector emitter dark current	V_{CE} = 20 V, E = 0	I_{CEO}		1	200	nA
Collector emitter capacitance	V_{CE} = 5 V, f = 1 MHz, E = 0	C_{CEO}		8		pF
Collector light current	E_e = 1 mW/cm^2, λ = 950 nm, V_{CE} = 5 V	I_{ca}	0.5	1.0		mA
Angle of half sensitivity		φ		± 12		deg
Wavelength of peak sensitivity		λ_p		825		nm
Range of spectral bandwidth		$\lambda_{0.1}$		450 to 1040		nm
Collector emitter saturation voltage	E_e = 1 mW/cm^2, λ = 950 nm, I_C = 0.1 mA	V_{CEsat}			0.3	V
Turn-on time	V_S = 5 V, I_C = 5 mA, R_L = 100 Ω	t_{on}		4.8		µs
Turn-off time	V_S = 5 V, I_C = 5 mA, R_L = 100 Ω	t_{off}		5.0		µs
Cut-off frequency	V_S = 5 V, I_C = 5 mA, R_L = 100 Ω	f_c		120		kHz

Note

T_{amb} = 25 °C, unless otherwise specified

BASIC CHARACTERISTICS

T_{amb} = 25 °C, unless otherwise specified

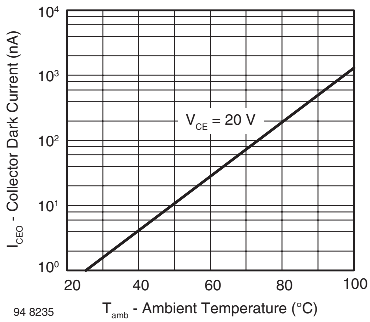


Fig. 2 - Collector Dark Current vs. Ambient Temperature

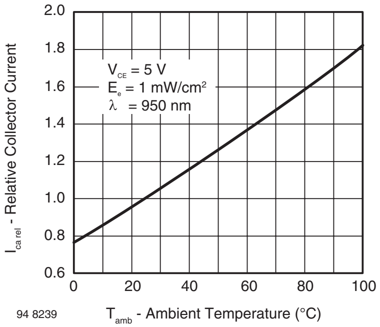


Fig. 3 - Relative Collector Current vs. Ambient Temperature

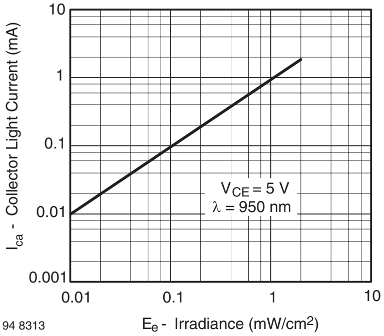


Fig. 4 - Collector Light Current vs. Irradiance

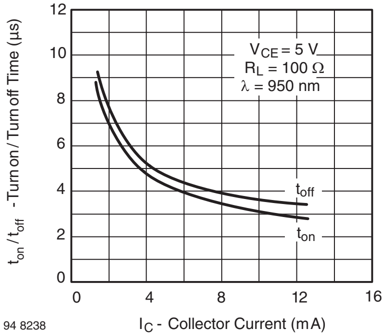


Fig. 7 - Turn-on/Turn-off Time vs. Collector Current

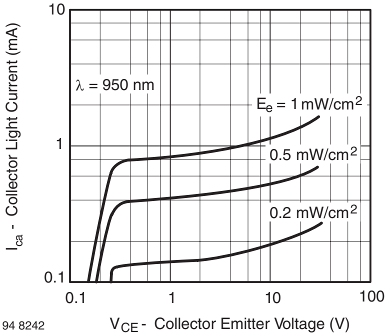


Fig. 5 - Collector Light Current vs. Collector Emitter Voltage

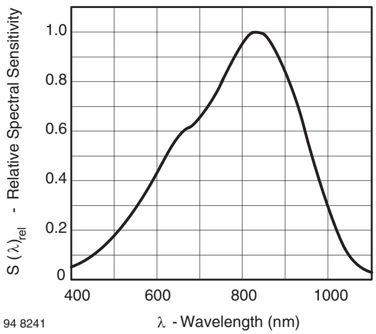


Fig. 8 - Relative Spectral Sensitivity vs. Wavelength

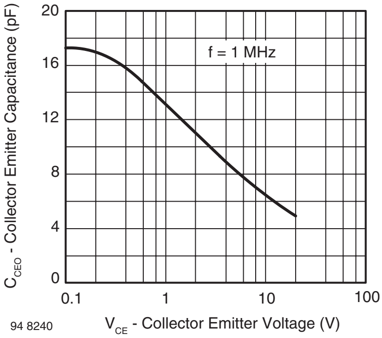


Fig. 6 - Collector Emitter Capacitance vs. Collector Emitter Voltage

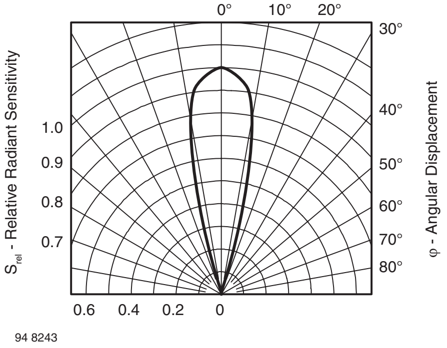
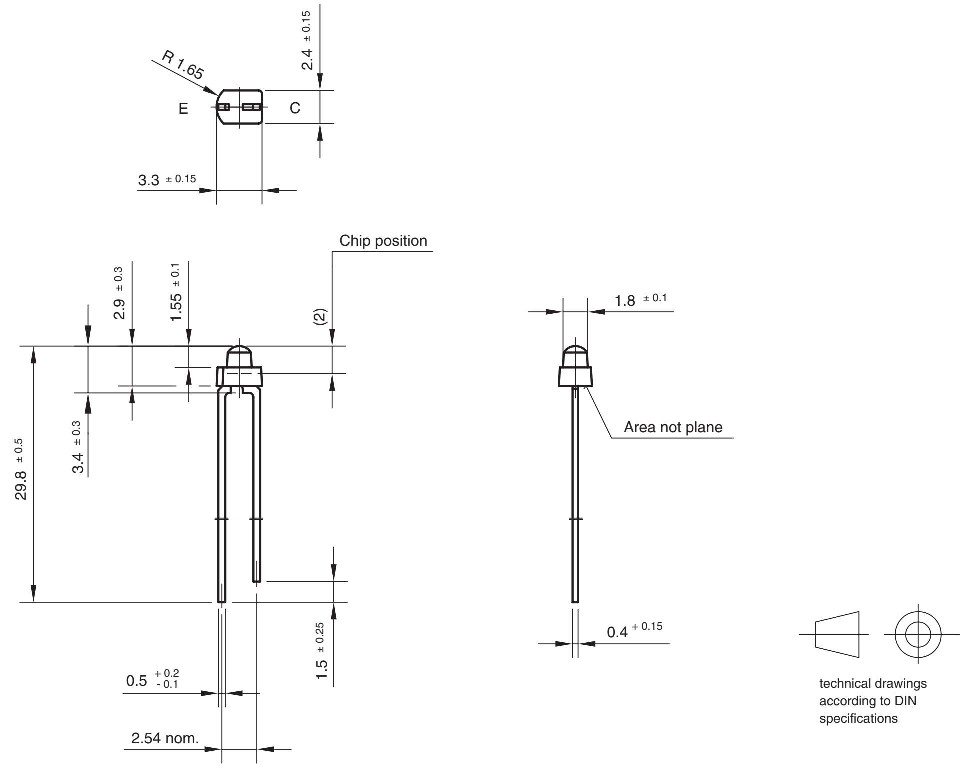


Fig. 9 - Relative Radiant Sensitivity vs. Angular Displacement

PACKAGE DIMENSIONS in millimeters



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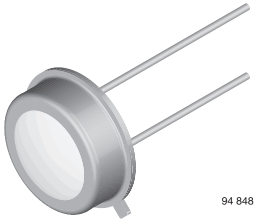
96 12187

Silicon Photodiode, RoHS Compliant



DESCRIPTION

BPW20RF is a planar Silicon PN photodiode in a hermetically sealed short TO-5 case, especially designed for high precision linear applications.

Due to its extremely high dark resistance, the short circuit photocurrent is linear over seven decades of illumination level.

On the other hand, there is a strictly logarithmic correlation between open circuit voltage and illumination over the same range.

Equipped with a clear, flat glass window, the spectral responsitivity reaches from blue to near infrared.

FEATURES

- Package type: leaded
- Package form: TO-5
- Dimensions (in mm): Ø 8.13
- Radiant sensitive area (in mm^2): 7.5
- High photo sensitivity
- High radiant sensitivity
- Suitable for visible and near infrared radiation
- Angle of half sensitivity: $\varphi = \pm 50°$
- Hermetically sealed package
- Cathode connected to package
- Flat glass window
- UV enhanced
- Low dark current
- High shunt resistance
- High linearity
- Lead (Pb)-free component in accordance with RoHS 2002/95/EC and WEEE 2002/96/EC

Pb-free

e4

RoHS COMPLIANT

APPLICATIONS

- Sensor for light measuring techniques in cameras, photometers, color analyzers, exposure meters (e.g. solariums) and other medical and industrial measuring and control applications.

PRODUCT SUMMARY

COMPONENT	I_{ra} (μA)	φ (deg)	$\lambda_{0.5}$ (nm)
BPW20RF	60	± 50	550 to 1040

Note

Test condition see table “Basic Characteristics”

ORDERING INFORMATION

ORDERING CODE	PACKAGING	REMARKS	PACKAGE FORM
BPW20RF	Bulk	MOQ: 500 pcs, 500 pcs/bulk	TO-5

Note

MOQ: minimum order quantity

ABSOLUTE MAXIMUM RATINGS

PARAMETER	TEST CONDITION	SYMBOL	VALUE	UNIT
Reverse voltage		V_R	10	V
Power dissipation	$T_{amb} \leq 50$ °C	P_V	300	mW
Junction temperature		T_j	125	°C
Operating temperature range		T_{amb}	- 40 to + 125	°C
Storage temperature range		T_{stg}	- 40 to + 125	°C
Soldering temperature	$t \leq 5$ s	T_{sd}	260	°C
Thermal resistance junction/ambient	Connected with Cu wire, 0.14 mm^2	R_{thJA}	250	K/W

Note

T_{amb} = 25 °C, unless otherwise specified

BASIC CHARACTERISTICS						
PARAMETER	**TEST CONDITION**	**SYMBOL**	**MIN.**	**TYP.**	**MAX.**	**UNIT**
Forward voltage	I_F = 50 mA	V_F		1.0	1.3	V
Breakdown voltage	I_R = 20 µA, E = 0	$V_{(BR)}$	10			V
Reverse dark current	V_R = 5 V, E = 0	I_{ro}		2	30	nA
Diode capacitance	V_R = 0 V, f = 1 MHz, E = 0	C_D		1.2		nF
	V_R = 5 V, f = 1 MHz, E = 0	C_D		400		pF
Dark resistance	V_R = 10 mV	R_D		38		GΩ
Open circuit voltage	E_A = 1 klx	V_o	330	500		mV
Temperature coefficient of V_o	E_A = 1 klx	TK_{Vo}		- 2		mV/K
Short circuit current	E_A = 1 klx	I_k	20	60		µA
Temperature coefficient of I_k	E_A = 1 klx	TK_{Ik}		0.1		%/K
Reverse light current	E_A = 1 klx, V_R = 5 V	I_{ra}	20	60		µA
	E_e = 1 mW/cm^2, λ = 950 nm, V_R = 5 V	I_{ra}		42		µA
Angle of half sensitivity		φ		± 50		deg
Wavelength of peak sensitivity		λ_p		920		nm
Range of spectral bandwidth		$\lambda_{0.5}$		550 to 1040		nm
Rise time	V_R = 0 V, R_L = 1 kΩ, λ = 820 nm	t_r		3.4		µs
Fall time	V_R = 0 V, R_L = 1 kΩ, λ = 820 nm	t_f		3.7		µs

Note

T_{amb} = 25 °C, unless otherwise specified

BASIC CHARACTERISTICS

T_{amb} = 25 °C, unless otherwise specified

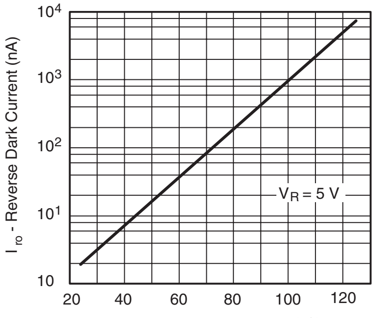


Fig. 1 - Reverse Dark Current vs. Ambient Temperature

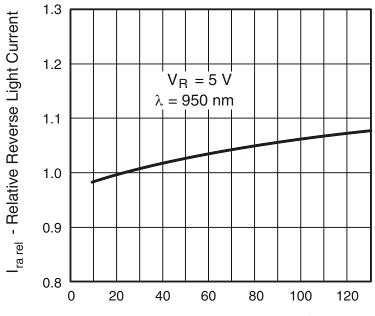


Fig. 2 - Relative Reverse Light Current vs. Ambient Temperature

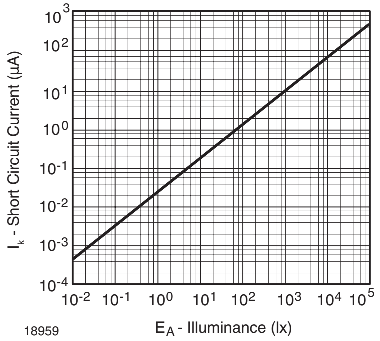


Fig. 3 - Short Circuit Current vs. Illuminance

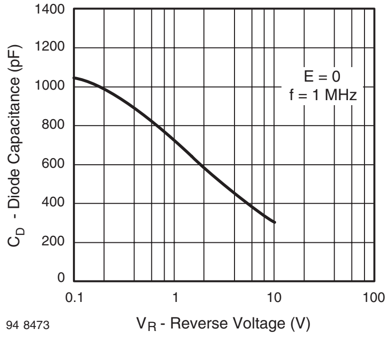


Fig. 6 - Diode Capacitance vs. Reverse Voltage

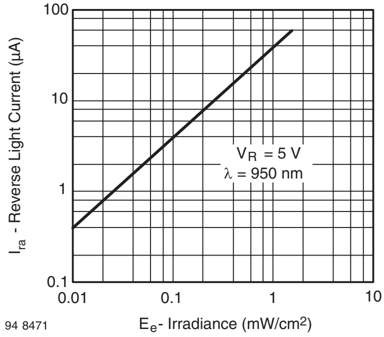


Fig. 4 - Reverse Light Current vs. Irradiance

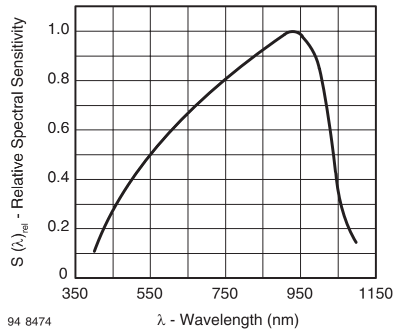


Fig. 7 - Relative Spectral Sensitivity vs. Wavelength

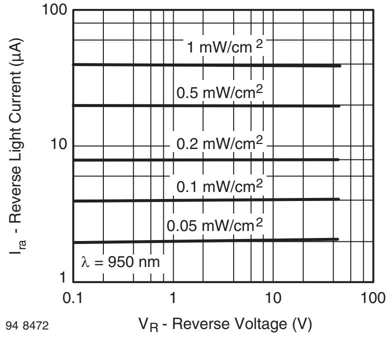


Fig. 5 - Reverse Light Current vs. Reverse Voltage

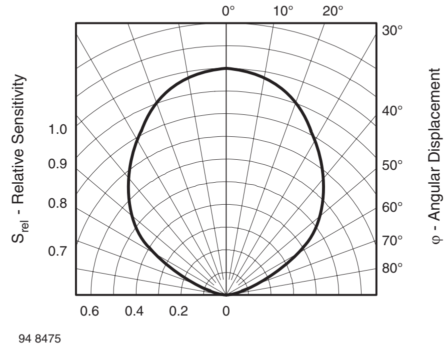
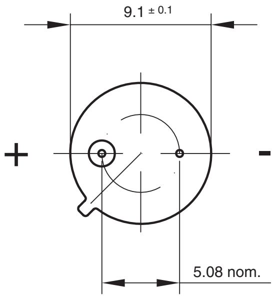
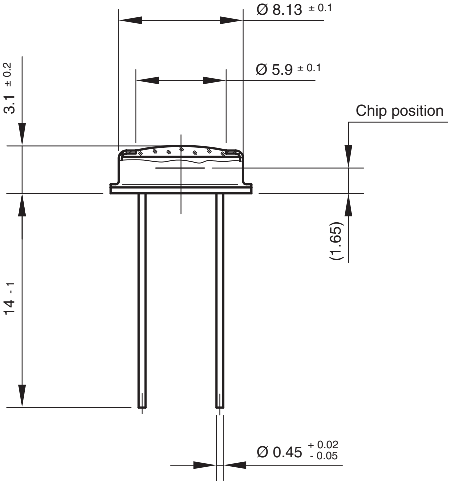
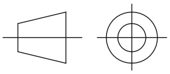


Fig. 8 - Relative Radiant Sensitivity vs. Angular Displacement

PACKAGE DIMENSIONS in millimeters







technical drawings
according to DIN
specifications

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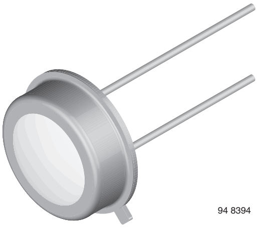
96 12181

Silicon Photodiode, RoHS Compliant



DESCRIPTION

BPW21R is a planar Silicon PN photodiode in a hermetically sealed short TO-5 case, especially designed for high precision linear applications.

Due to its extremely high dark resistance, the short circuit photocurrent is linear over seven decades of illumination level.

On the other hand, there is a strictly logarithmic correlation between open circuit voltage and illumination over the same range.

The device is equipped with a flat glass window with built in color correction filter, giving an approximation to the spectral response of the human eye.

FEATURES

- Package type: leaded
- Package form: TO-5
- Dimensions (in mm): Ø 8.13
- Radiant sensitive area (in mm^2): 7.5
- High photo sensitivity
- Adapted to human eye responsivity
- Angle of half sensitivity: $\varphi = \pm 50°$
- Hermetically sealed package
- Cathode connected to package
- Flat glass window
- Low dark current
- High shunt resistance
- High linearity
- Lead (Pb)-free component in accordance with RoHS 2002/95/EC and WEEE 2002/96/EC

Pb-free

e4

RoHS COMPLIANT

APPLICATIONS

- Sensor in exposure and color measuring purposes

PRODUCT SUMMARY

COMPONENT	I_{ra} (mA)	φ (deg)	$\lambda_{0.5}$ (nm)
BPW21R	9	± 50	420 to 675

Note
Test condition see table "Basic Characteristics"

ORDERING INFORMATION

ORDERING CODE	PACKAGING	REMARKS	PACKAGE FORM
BPW21R	Bulk	MOQ: 500 pcs, 500 pcs/bulk	TO-5

Note
MOQ: minimum order quantity

ABSOLUTE MAXIMUM RATINGS

PARAMETER	TEST CONDITION	SYMBOL	VALUE	UNIT
Reverse voltage		V_R	10	V
Power dissipation	$T_{amb} \leq 50$ °C	P_V	300	mW
Junction temperature		T_j	125	°C
Operating temperature range		T_{amb}	- 40 to + 125	°C
Storage temperature range		T_{stg}	- 40 to + 125	°C
Soldering temperature	$t \leq 5$ s	T_{sd}	260	°C
Thermal resistance junction/ambient	Connected with Cu wire, 0.14 mm^2	R_{thJA}	250	K/W

Note
$T_{amb} = 25$ °C, unless otherwise specified

BASIC CHARACTERISTICS						
PARAMETER	**TEST CONDITION**	**SYMBOL**	**MIN.**	**TYP.**	**MAX.**	**UNIT**
Forward voltage	I_F = 50 mA	V_F		1.0	1.3	V
Breakdown voltage	I_R = 20 µA, E = 0	$V_{(BR)}$	10			V
Reverse dark current	V_R = 5 V, E = 0	I_{ro}		2	30	nA
Diode capacitance	V_R = 0 V, f = 1 MHz, E = 0	C_D		1.2		nF
	V_R = 5 V, f = 1 MHz, E = 0	C_D		400		pF
Dark resistance	V_R = 10 mV	R_D		38		GΩ
Open circuit voltage	E_A = 1 klx	V_o	280	450		mV
Temperature coefficient of V_o	E_A = 1 klx	TK_{Vo}		- 2		mV/K
Short circuit current	E_A = 1 klx	I_k	4.5	9		µA
Temperature coefficient of I_K	E_A = 1 klx	TK_{Ik}		- 0.05		%/K
Reverse light current	E_A = 1 klx, V_R = 5 V	I_{ra}	4.5	9		µA
Sensitivity	V_R = 5 V, E_A = 10^{-2} to 10^5 lx	S		9		nA/lx
Angle of half sensitivity		φ		± 50		deg
Wavelength of peak sensitivity		λ_p		565		nm
Range of spectral bandwidth		$\lambda_{0.5}$		420 to 675		nm
Rise time	V_R = 0 V, R_L = 1 kΩ, λ = 660 nm	t_r		3.1		µs
Fall time	V_R = 0 V, R_L = 1 kΩ, λ = 660 nm	t_f		3.0		µs

Note

T_{amb} = 25 °C, unless otherwise specified

BASIC CHARACTERISTICS

T_{amb} = 25 °C, unless otherwise specified

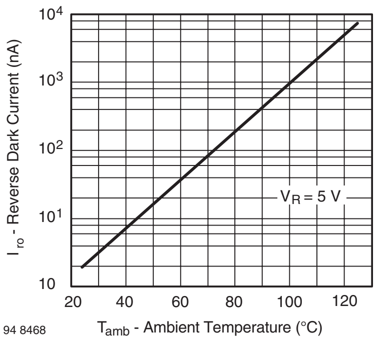


Fig. 1 - Reverse Dark Current vs. Ambient Temperature

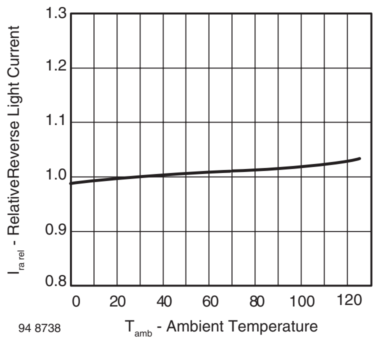


Fig. 2 - Relative Reverse Light Current vs. Ambient Temperature

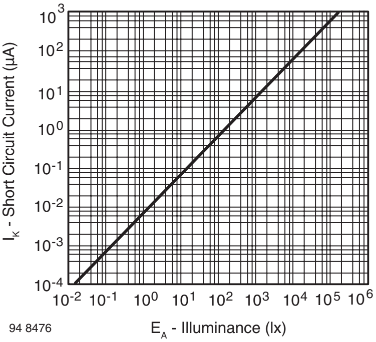


Fig. 3 - Short Circuit Current vs. Illuminance

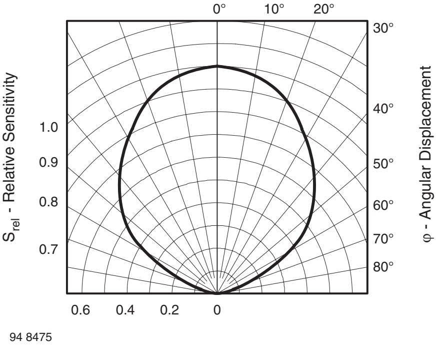


Fig. 6 - Relative Radiant Sensitivity vs. Angular Displacement

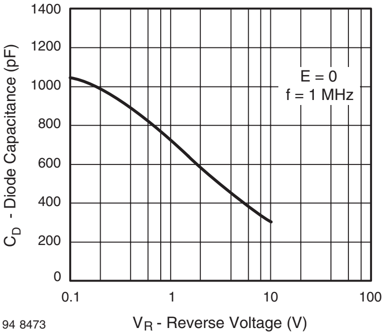


Fig. 4 - Diode Capacitance vs. Reverse Voltage

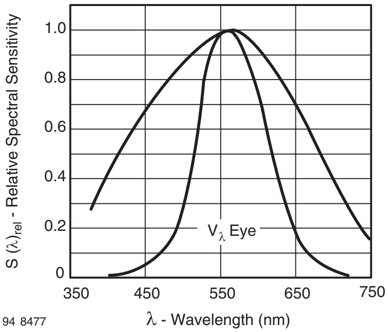
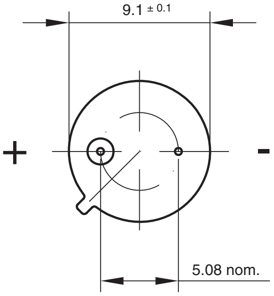
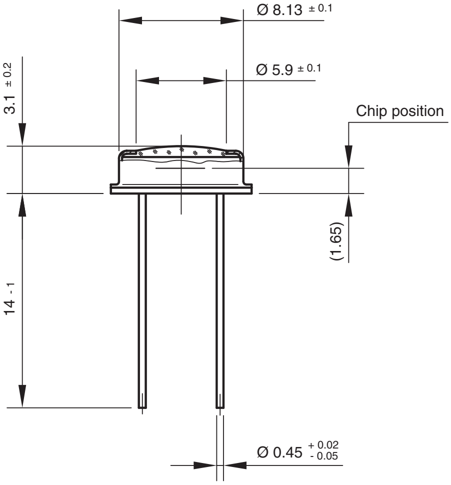
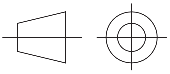


Fig. 5 - Relative Spectral Sensitivity vs. Wavelength

PACKAGE DIMENSIONS in millimeters



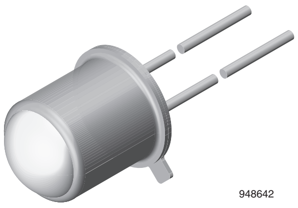




technical drawings
according to DIN
specifications

Drawing-No.: 6.511-5002.01-4
Issue:1; 01.07.96
96 12181

Silicon PIN Photodiode, RoHS Compliant



DESCRIPTION

BPW24R is a high sensitive silicon planar photodiode in a standard TO-18 hermetically sealed metal case with a glass lens.

A precise alignment of the chip gives a good coincidence of mechanical and optical axes. The device features a low capacitance and high speed even at low supply voltages.

FEATURES

- Package type: leaded
- Package form: TO-18
- Dimensions (in mm): Ø 4.7
- Radiant sensitive area (in mm^2): 0.78
- High photo sensitivity
- High radiant sensitivity
- Suitable for visible and near infrared radiation
- Fast response times
- Angle of half sensitivity: $\varphi = \pm 12°$
- Hermetically sealed package
- Cathode connected to package
- Central chip alignment
- Lead (Pb)-free component in accordance with RoHS 2002/95/EC and WEEE 2002/96/EC

Pb-free

e4

RoHS
COMPLIANT

APPLICATIONS

- High speed photo detector

PRODUCT SUMMARY

COMPONENT	I_{ra} (µA)	φ (deg)	$\lambda_{0.5}$ (nm)
BPW24R	60	± 12	600 to 1050

Note

Test condition see table “Basic Characteristics”

ORDERING INFORMATION

ORDERING CODE	PACKAGING	REMARKS	PACKAGE FORM
BPW24R	Bulk	MOQ: 1000 pcs, 1000 pcs/bulk	TO-18

Note

MOQ: minimum order quantity

ABSOLUTE MAXIMUM RATINGS

PARAMETER	TEST CONDITION	SYMBOL	VALUE	UNIT
Reverse voltage		V_R	60	V
Power dissipation	$T_{amb} \leq 25$ °C	P_V	210	mW
Junction temperature		T_j	125	°C
Operating temperature range		T_{amb}	- 40 to + 125	°C
Storage temperature range		T_{stg}	- 40 to + 125	°C
Soldering temperature	$t \leq 5$ s	T_{sd}	260	°C
Thermal resistance junction/ambient	Connected with Cu wire, 0.14 mm^2	R_{thJA}	350	K/W

Note

$T_{amb} = 25$ °C, unless otherwise specified

BASIC CHARACTERISTICS

PARAMETER	TEST CONDITION	SYMBOL	MIN.	TYP.	MAX.	UNIT
Breakdown voltage	I_R = 100 µA, E = 0	$V_{(BR)}$	60	200		V
Reverse dark current	V_R = 50 V, E = 0	I_{ro}		2	10	nA
Diode capacitance	V_R = 0 V, f = 1 MHz, E = 0	C_D		11		pF
	V_R = 5 V, f = 1 MHz, E = 0	C_D		3.8		pF
	V_R = 20 V, f = 1 MHz, E = 0	C_D		2.5		pF
Open circuit voltage	E_e = 1 mW/cm², λ = 950 nm	V_o		450		mV
Temperature coefficient of V_o	E_e = 1 mW/cm², λ = 950 nm	TK_{Vo}		- 2		mV/K
Short circuit current	E_e = 1 mW/cm², λ = 950 nm	I_k		55		µA
Temperature coefficient of I_k	E_A = 1 klx	TK_{Ik}		0.1		%/K
Reverse light current	E_e = 1 mW/cm², λ = 950 nm, V_R = 20 V	I_{ra}	45	60		µA
Absolute Spectral Sensitivity	V_R = 5 V, λ = 870 nm	s(λ)		0.60		A/W
	V_R = 5 V, λ = 900 nm	s(λ)		0.55		A/W
Angle of half sensitivity		φ		± 12		deg
Wavelength of peak sensitivity		λ_p		900		nm
Range of spectral bandwidth		$\lambda_{0.5}$		600 to 1050		nm
Rise time	V_R = 20 V, R_L = 50 Ω, λ = 820 nm	t_r		7		ns
Fall time	V_R = 20 V, R_L = 50 Ω, λ = 820 nm	t_f		7		ns

Note

T_{amb} = 25 °C, unless otherwise specified

BASIC CHARACTERISTICS

T_{amb} = 25 °C, unless otherwise specified

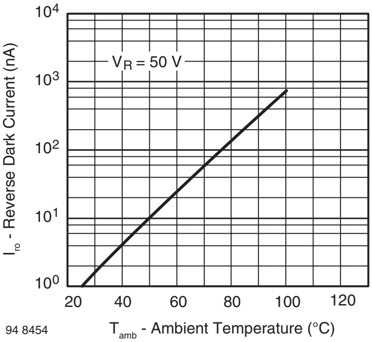


Fig. 1 - Reverse Dark Current vs. Ambient Temperature

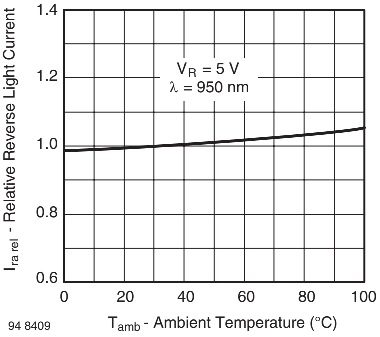


Fig. 2 - Relative Reverse Light Current vs. Ambient Temperature

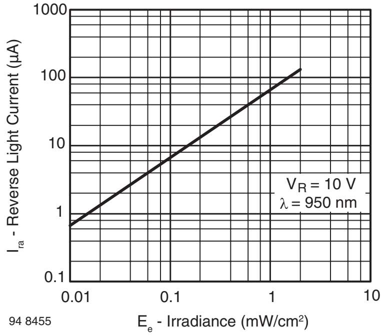


Fig. 3 - Reverse Light Current vs. Irradiance

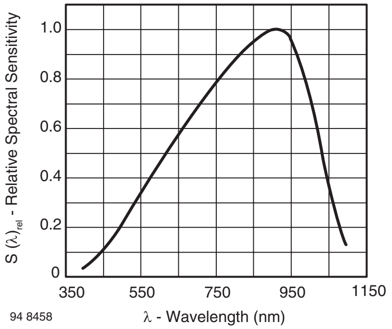


Fig. 6 - Relative Spectral Sensitivity vs. Wavelength

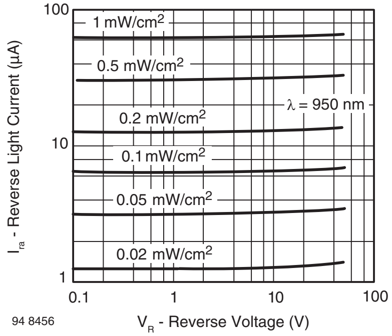


Fig. 4 - Reverse Light Current vs. Reverse Voltage

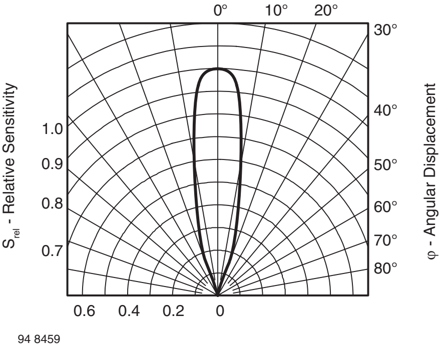


Fig. 7 - Relative Radiant Sensitivity vs. Angular Displacement

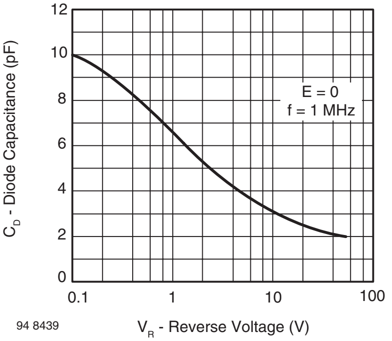
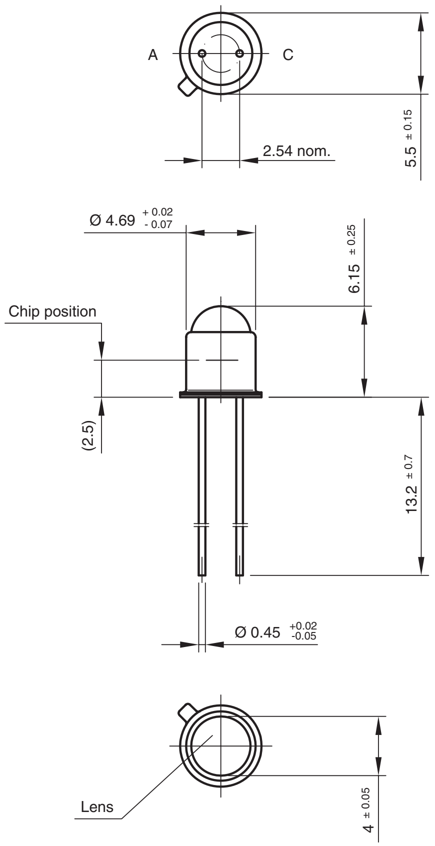
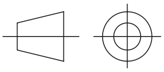


Fig. 5 - Diode Capacitance vs. Reverse Voltage

PACKAGE DIMENSIONS in millimeters





technical drawings
according to DIN
specifications

Drawing-No.: 6.503-5022.02-4
Issue: 1; 24.08.98
14487

Silicon PIN Photodiode, RoHS Compliant

FEATURES

- Package type: leaded
- Package form: top view
- Dimensions (L x W x H in mm): 5.4 x 4.3 x 3.2
- Radiant sensitive area (in mm^2): 7.5
- High photo sensitivity
- High radiant sensitivity
- Suitable for visible and near infrared radiation
- Fast response times
- Angle of half sensitivity: $\varphi = \pm 65°$
- Lead (Pb)-free component in accordance with RoHS 2002/95/EC and WEEE 2002/96/EC

Pb-free

e3

RoHS
COMPLIANT

DESCRIPTION

BPW34 is a PIN photodiode with high speed and high radiant sensitivity in miniature, flat, top view, clear plastic package. It is sensitive to visible and near infrared radiation.
BPW34S is packed in tubes, specifications like BPW34.

APPLICATIONS

- High speed photo detector

PRODUCT SUMMARY

COMPONENT	I_{ra} (µA)	φ (deg)	$\lambda_{0.1}$ (nm)
BPW34	50	± 65	430 to 1100
BPW34S	50	± 65	430 to 1100

Note
Test condition see table “Basic Characteristics”

ORDERING INFORMATION

ORDERING CODE	PACKAGING	REMARKS	PACKAGE FORM
BPW34	Bulk	MOQ: 3000 pcs, 3000 pcs/bulk	Top view
BPW34S	Tube	MOQ: 1800 pcs, 45 pcs/tube	Top view

Note
MOQ: minimum order quantity

ABSOLUTE MAXIMUM RATINGS

PARAMETER	TEST CONDITION	SYMBOL	VALUE	UNIT
Reverse voltage		V_R	60	V
Power dissipation	$T_{amb} \leq 25$ °C	P_V	215	mW
Junction temperature		T_j	100	°C
Operating temperature range		T_{amb}	- 40 to + 100	°C
Storage temperature range		T_{stg}	- 40 to + 100	°C
Soldering temperature	$t \leq 3$ s	T_{sd}	260	°C
Thermal resistance junction/ambient	Connected with Cu wire, 0.14 mm^2	R_{thJA}	350	K/W

Note
T_{amb} = 25 °C, unless otherwise specified

BASIC CHARACTERISTICS

PARAMETER	TEST CONDITION	SYMBOL	MIN.	TYP.	MAX.	UNIT
Breakdown voltage	I_R = 100 µA, E = 0	$V_{(BR)}$	60			V
Reverse dark current	V_R = 10 V, E = 0	I_{ro}		2	30	nA
Diode capacitance	V_R = 0 V, f = 1 MHz, E = 0	C_D		70		pF
	V_R = 3 V, f = 1 MHz, E = 0	C_D		25	40	pF
Open circuit voltage	E_e = 1 mW/cm², λ = 950 nm	V_o		350		mV
Temperature coefficient of V_o	E_e = 1 mW/cm², λ = 950 nm	TK_{Vo}		- 2.6		mV/K
Short circuit current	E_A = 1 klx	I_k		70		µA
	E_e = 1 mW/cm², λ = 950 nm	I_k		47		µA
Temperature coefficient of I_k	E_e = 1 mW/cm², λ = 950 nm	TK_{Ik}		0.1		%/K
Reverse light current	E_A = 1 klx, V_R = 5 V	I_{ra}		75		µA
	E_e = 1 mW/cm², λ = 950 nm, V_R = 5 V	I_{ra}	40	50		µA
Angle of half sensitivity		φ		± 65		deg
Wavelength of peak sensitivity		λ_p		900		nm
Range of spectral bandwidth		$\lambda_{0.1}$		430 to 1100		nm
Noise equivalent power	V_R = 10 V, λ = 950 nm	NEP		4×10^{-14}		W/√Hz
Rise time	V_R = 10 V, R_L = 1 kΩ, λ = 820 nm	t_r		100		ns
Fall time	V_R = 10 V, R_L = 1 kΩ, λ = 820 nm	t_f		100		ns

Note

T_{amb} = 25 °C, unless otherwise specified

BASIC CHARACTERISTICS

T_{amb} = 25 °C, unless otherwise specified

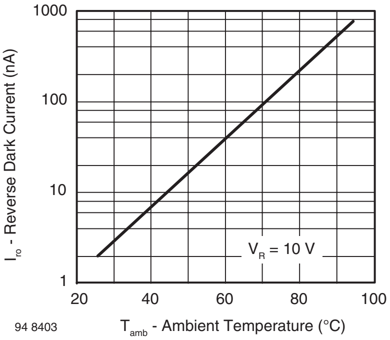


Fig. 1 - Reverse Dark Current vs. Ambient Temperature

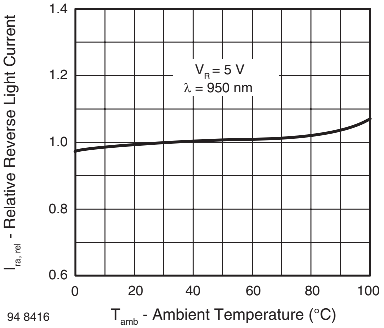


Fig. 2 - Relative Reverse Light Current vs. Ambient Temperature

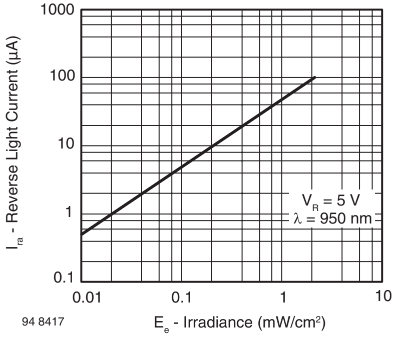


Fig. 3 - Reverse Light Current vs. Irradiance

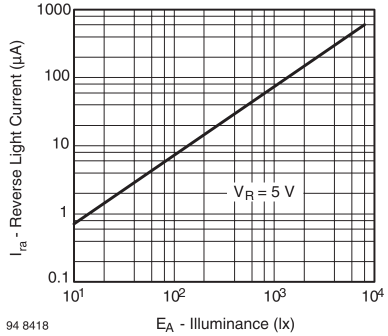


Fig. 4 - Reverse Light Current vs. Illuminance

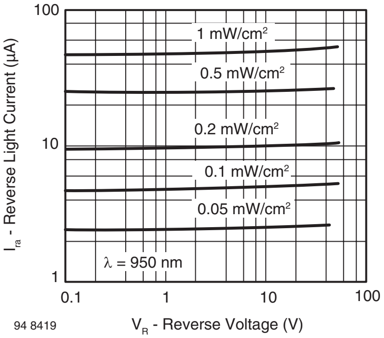


Fig. 5 - Reverse Light Current vs. Reverse Voltage

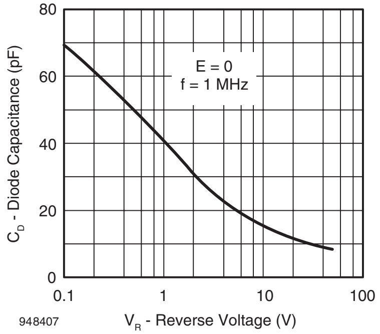


Fig. 6 - Diode Capacitance vs. Reverse Voltage

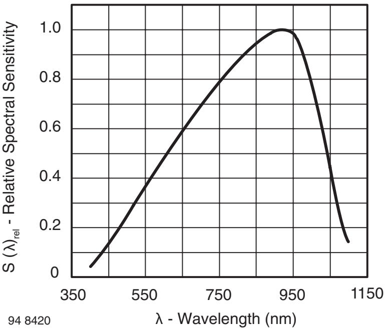


Fig. 7 - Relative Spectral Sensitivity vs. Wavelength

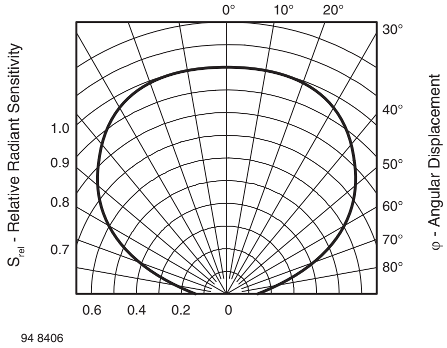
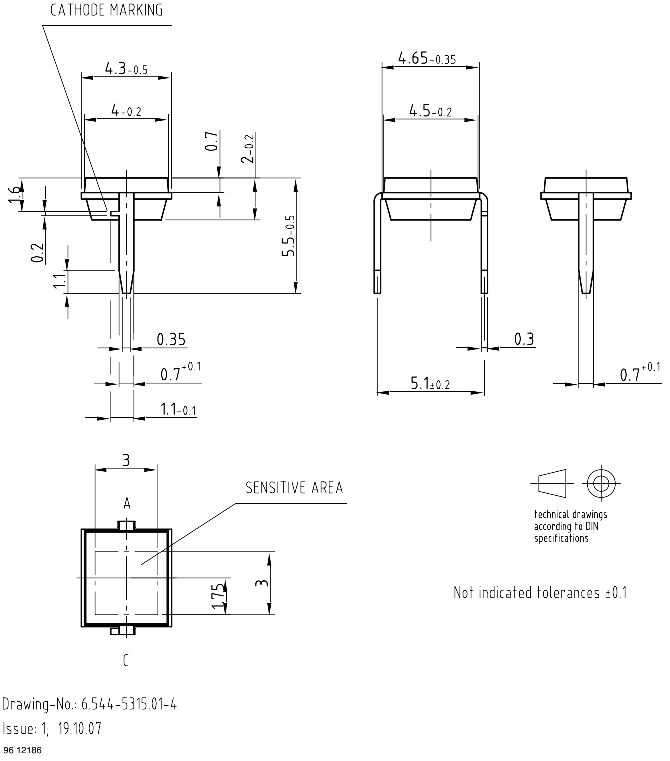


Fig. 8 - Relative Radiant Sensitivity vs. Angular Displacement

PACKAGE DIMENSIONS in millimeters



TUBE PACKAGING DIMENSIONS in millimeters

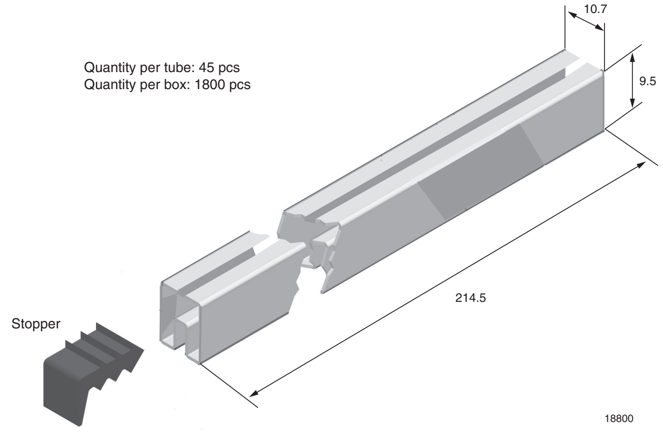
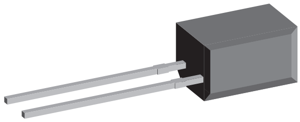


Fig. 9 - Drawing Proportions not scaled

Silicon PIN Photodiode, RoHS Compliant



94 8480

FEATURES

- Package type: leaded
- Package form: side view
- Dimensions (in mm): 5 x 4 x 6.8
- Radiant sensitive area (in mm^2): 7.5
- High radiant sensitivity
- Daylight blocking filter matched with 940 nm emitters
- Fast response times
- Angle of half sensitivity: $\varphi = \pm 65°$
- Lead (Pb)-free component in accordance with RoHS 2002/95/EC and WEEE 2002/96/EC

Pb-free

e4

RoHS
COMPLIANT

DESCRIPTION

BPW41N is a PIN photodiode with high speed and high radiant sensitivity in a black, side view plastic package with daylight blocking filter. Filter bandwidth is matched with 900 nm to 950 nm IR emitters.

APPLICATIONS

- High speed detector for infrared radiation
- Infrared remote control and free air data transmission systems, e.g. in combination with TSALxxxx series IR emitters

PRODUCT SUMMARY

COMPONENT	I_{ra} (µA)	φ (deg)	$\lambda_{0.5}$ (nm)
BPW41N	45	± 65	870 to 1050

Note

Test condition see table “Basic Characteristics”

ORDERING INFORMATION

ORDERING CODE	PACKAGING	REMARKS	PACKAGE FORM
BPW41N	Bulk	MOQ: 4000 pcs, 4000 pcs/bulk	Side view

Note

MOQ: minimum order quantity

ABSOLUTE MAXIMUM RATINGS

PARAMETER	TEST CONDITION	SYMBOL	VALUE	UNIT
Reverse voltage		V_R	60	V
Power dissipation	$T_{amb} \le 25$ °C	P_V	215	mW
Junction temperature		T_j	100	°C
Operating temperature range		T_{amb}	- 40 to + 100	°C
Storage temperature range		T_{stg}	- 40 to + 100	°C
Soldering temperature	$t \le 5$ s	T_{sd}	260	°C
Thermal resistance junction/ambient	Connected with Cu wire, 0.14 mm^2	R_{thJA}	350	K/W

Note

T_{amb} = 25 °C, unless otherwise specified

BASIC CHARACTERISTICS

PARAMETER	TEST CONDITION	SYMBOL	MIN.	TYP.	MAX.	UNIT
Breakdown voltage	I_R = 100 µA, E = 0	$V_{(BR)}$	60			V
Reverse dark current	V_R = 10 V, E = 0	I_{ro}		2	30	nA
Diode capacitance	V_R= 0 V, f = 1 MHz, E = 0	C_D		70		pF
	V_R= 3 V, f = 1 MHz, E = 0	C_D		25	40	pF
Open circuit Voltage	E_e = 1 mW/cm², λ = 950 nm	V_o		350		mV
Temperature coefficient of V_o	E_e = 1 mW/cm², λ = 950 nm	TK_{Vo}		- 2.6		mV/K
Short circuit current	E_e = 1 mW/cm², λ = 950 nm	I_k		38		µA
Temperature coefficient of I_k	E_e = 1 mW/cm², λ = 950 nm	TK_{Ik}		0.1		%/K
Reverse light current	E_e = 1 mW/cm², λ = 950 nm, V_R = 5 V	I_{ra}	43	45		µA
Angle of half sensitivity		φ		± 65		deg
Wavelength of peak sensitivity		λ_p		950		nm
Range of spectral bandwidth		$\lambda_{0.5}$		870 to 1050		nm
Noise equivalent power	V_R = 10 V, λ = 950 nm	NEP		4×10^{-14}		W/√ Hz
Rise time	V_R = 10 V, R_L = 1 kΩ, λ = 820 nm	t_r		100		ns
Fall time	V_R = 10 V, R_L = 1 kΩ, λ = 820 nm	t_f		100		ns

Note

T_{amb} = 25 °C, unless otherwise specified

BASIC CHARACTERISTICS

T_{amb} = 25 °C, unless otherwise specified

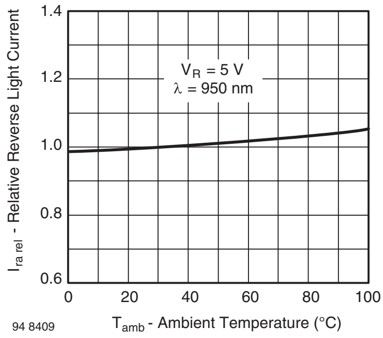


Fig. 1 - Relative Reverse Light Current vs. Ambient Temperature

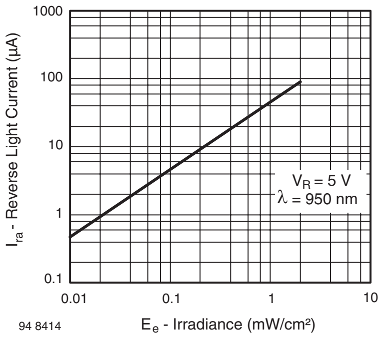


Fig. 2 - Reverse Light Current vs. Irradiance

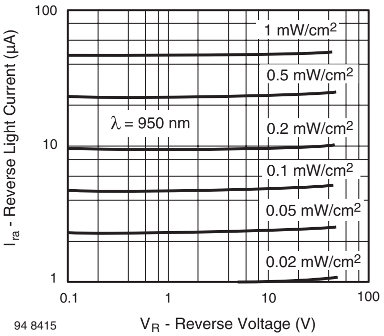


Fig. 3 - Reverse Light Current vs. Reverse Voltage

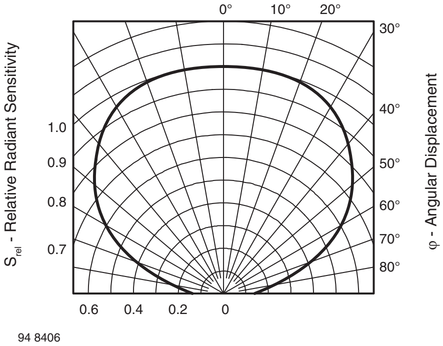


Fig. 6 - Relative Radiant Sensitivity vs. Angular Displacement

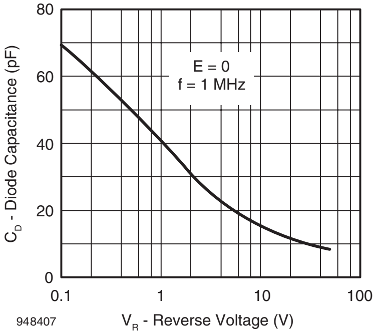


Fig. 4 - Diode Capacitance vs. Reverse Voltage

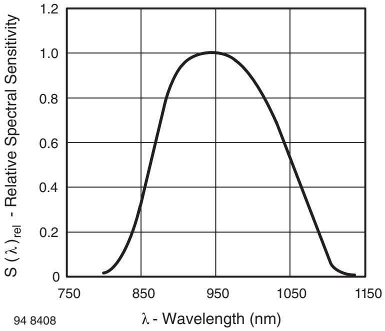
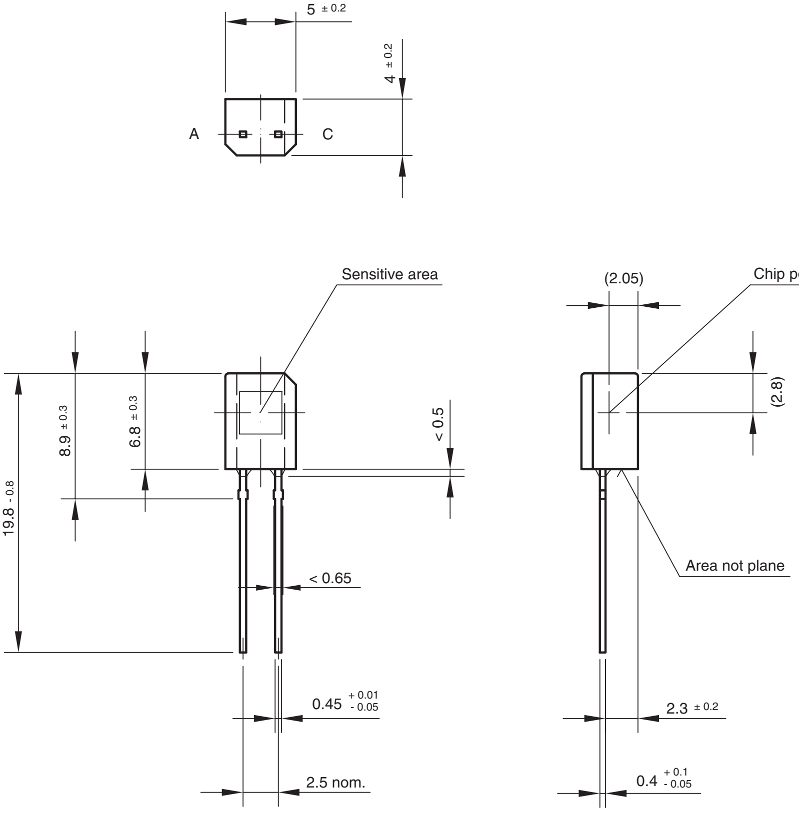
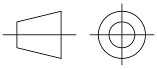


Fig. 5 - Relative Spectral Sensitivity vs. Wavelength

PACKAGE DIMENSIONS in millimeters

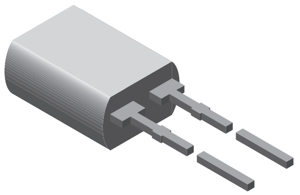




technical drawings
according to DIN
specifications

Drawing-No.: 6.544-5108.01-4
Issue:1; 01.07.96
96 12195

Silicon PIN Photodiode, RoHS Compliant



94 8632

DESCRIPTION

BPW46 is a PIN photodiode with high speed and high radiant sensitivity in a clear, side view plastic package. It is sensitive to visible and near infrared radiation.

FEATURES

- Package type: leaded
- Package form: side view
- Dimensions (L x W x H in mm): 5 x 3 x 6.4
- Radiant sensitive area (in mm^2): 7.5
- High photo sensitivity
- High radiant sensitivity
- Suitable for visible and near infrared radiation
- Fast response times
- Angle of half sensitivity: $\varphi = \pm 65°$
- Lead (Pb)-free component in accordance with RoHS 2002/95/EC and WEEE 2002/96/EC

Pb-free

e4

RoHS
COMPLIANT

APPLICATIONS

- High speed photo detector

PRODUCT SUMMARY

COMPONENT	I_{ra} (mA)	φ (deg)	$\lambda_{0.1}$ (nm)
BPW46	50	± 65	430 to 1100

Note

Test condition see table “Basic Characteristics”

ORDERING INFORMATION

ORDERING CODE	PACKAGING	REMARKS	PACKAGE FORM
BPW46	Bulk	MOQ: 4000 pcs, 4000 pcs/bulk	Side view

Note

MOQ: minimum order quantity

ABSOLUTE MAXIMUM RATINGS

PARAMETER	TEST CONDITION	SYMBOL	VALUE	UNIT
Reverse voltage		V_R	60	V
Power dissipation	$T_{amb} \leq 25$ °C	P_V	215	mW
Junction temperature		T_j	100	°C
Operating temperature range		T_{amb}	- 40 to + 100	°C
Storage temperature range		T_{stg}	- 40 to + 100	°C
Soldering temperature	$t \leq 5$ s	T_{sd}	260	°C
Thermal resistance junction/ambient	Connected with Cu wire, 0.14 mm^2	R_{thJA}	350	K/W

Note

T_{amb} = 25 °C, unless otherwise specified

BASIC CHARACTERISTICS

PARAMETER	TEST CONDITION	SYMBOL	MIN.	TYP.	MAX.	UNIT
Breakdown voltage	I_R = 100 µA, E = 0	$V_{(BR)}$	60			V
Reverse dark current	V_R = 10 V, E = 0	I_{ro}		2	30	nA
Diode capacitance	V_R = 0 V, f = 1 MHz, E = 0	C_D		70		pF
	V_R = 3 V, f = 1 MHz, E = 0	C_D		25	40	pF
Open circuit voltage	E_e = 1 mW/cm^2, λ = 950 nm	V_o		350		mV
Temperature coefficient of V_o	E_e = 1 mW/cm^2, λ = 950 nm	TK_{Vo}		- 2.6		mV/K
Short circuit current	E_A = 1 klx	I_k		70		µA
	E_e = 1 mW/cm^2, λ = 950 nm	I_k		47		µA
Temperature coefficient of V_k	E_e = 1 mW/cm^2, λ = 950 nm	TK_{Vk}		0.1		%/K
Reverse light current	E_A = 1 klx, V_R = 5 V	I_{ra}		75		µA
	E_e = 1 mW/cm^2, λ = 950 nm, V_R = 5 V	I_{ra}	40	50		µA
Angle of half sensitivity		φ		± 65		deg
Wavelength of peak sensitivity		λ_p		900		nm
Range of spectral bandwidth		$\lambda_{0.1}$		430 to 1100		nm
Noise equivalent power	V_R = 10 V, λ = 950 nm	NEP		4 x 10^{-14}		W/√Hz
Rise time	V_R = 10 V, R_L = 1 kΩ, λ = 820 nm	t_r		100		ns
Fall time	V_R = 10 V, R_L = 1 kΩ, λ = 820 nm	t_f		100		ns

Note

T_{amb} = 25 °C, unless otherwise specified

BASIC CHARACTERISTICS

T_{amb} = 25 °C, unless otherwise specified

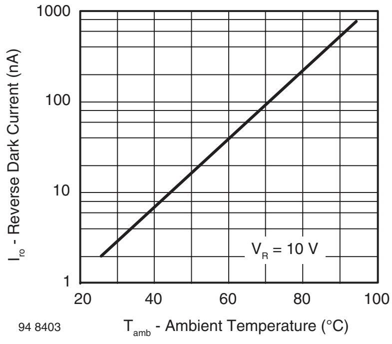


Fig. 1 - Reverse Dark Current vs. Ambient Temperature

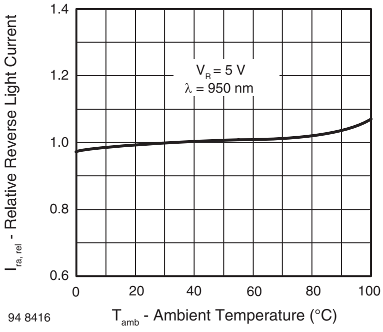


Fig. 2 - Relative Reverse Light Current vs. Ambient Temperature

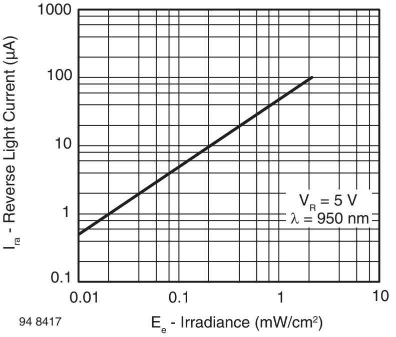


Fig. 3 - Reverse Light Current vs. Irradiance

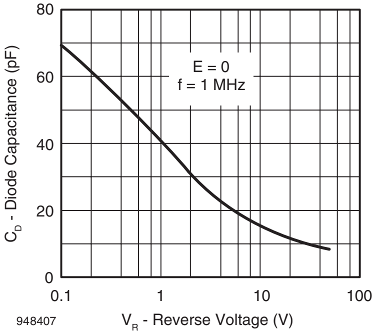


Fig. 6 - Diode Capacitance vs. Reverse Voltage

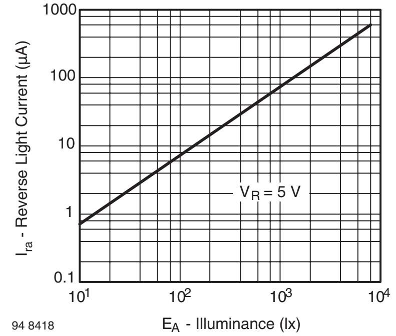


Fig. 4 - Reverse Light Current vs. Illuminance

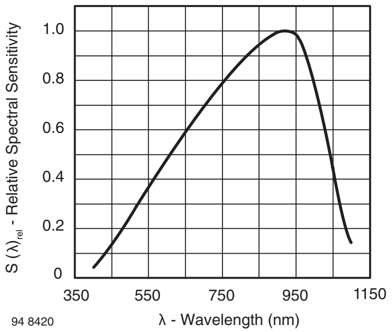


Fig. 7 - Relative Spectral Sensitivity vs. Wavelength

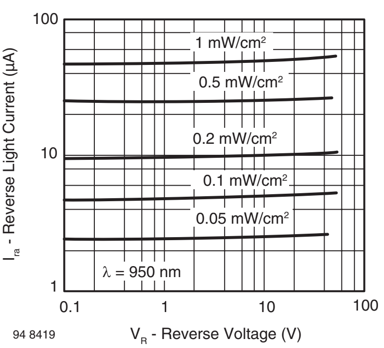


Fig. 5 - Reverse Light Current vs. Reverse Voltage

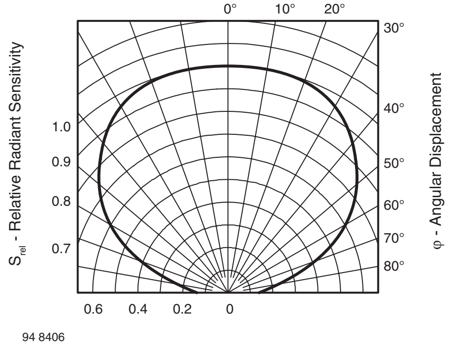
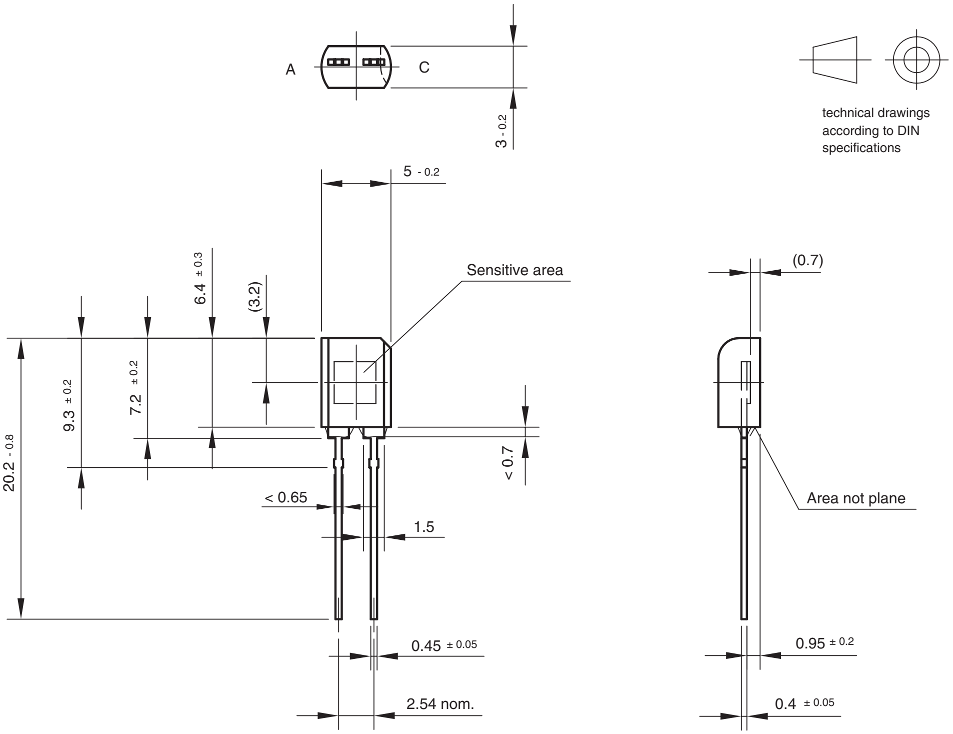


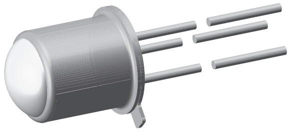
Fig. 8 - Relative Radiant Sensitivity vs. Angular Displacement

PACKAGE DIMENSIONS in millimeters



Drawing-No.: 6.544-5109.01-4
Issue:1; 01.07.96
96 12196

Silicon NPN Phototransistor, RoHS Compliant


94 8401

FEATURES

- Package type: leaded
- Package form: TO-18
- Dimensions (in mm): Ø 4.7
- High photo sensitivity
- High radiant sensitivity
- Suitable for visible and near infrared radiation
- Fast response times
- Angle of half sensitivity: φ = ± 40°
- Base terminal connected
- Hermetically sealed package
- Flat glass window
- Lead (Pb)-free component in accordance with RoHS 2002/95/EC and WEEE 2002/96/EC

Pb-free
e4
RoHS
COMPLIANT

DESCRIPTION

BPW76 is a silicon NPN phototransistor with high radiant sensitivity in hermetically sealed TO-18 package with base terminal and flat glass window. It is sensitive to visible and near infrared radiation.

APPLICATIONS

- Detector in electronic control and drive circuits

PRODUCT SUMMARY

COMPONENT	I_{ca} (mA)	φ (deg)	$\lambda_{0.1}$ (nm)
BPW76A	0.4 to 0.8	± 40	450 to 1080
BPW76B	> 0.6	± 40	450 to 1080

Note
Test condition see table "Basic Characteristics"

ORDERING INFORMATION

ORDERING CODE	PACKAGING	REMARKS	PACKAGE FORM
BPW76A	Bulk	MOQ: 1000 pcs, 1000 pcs/bulk	TO-18
BPW76B	Bulk	MOQ: 1000 pcs, 1000 pcs/bulk	TO-18

Note
MOQ: minimum order quantity

ABSOLUTE MAXIMUM RATINGS

PARAMETER	TEST CONDITION	SYMBOL	VALUE	UNIT
Collector base voltage		V_{CBO}	80	V
Collector emitter voltage		V_{CEO}	70	V
Emitter base voltage		V_{EBO}	5	V
Collector current		I_C	50	mA
Collector peak current	$t_p/T = 0.5$, $t_p \leq 10$ ms	I_{CM}	100	mA
Total power dissipation	$T_{amb} \leq 25$ °C	P_V	250	mW
Junction temperature		T_j	125	°C
Operating temperature range		T_{amb}	- 40 to + 125	°C
Storage temperature range		T_{stg}	- 40 to + 125	°C
Soldering temperature	$t \leq 5$ s	T_{sd}	260	°C
Thermal resistance junction/ambient	Connected with Cu wire, 0.14 mm^2	R_{thJA}	400	K/W
Thermal resistance junction/gase		R_{thJC}	150	K/W

Note
T_{amb} = 25 °C, unless otherwise specified

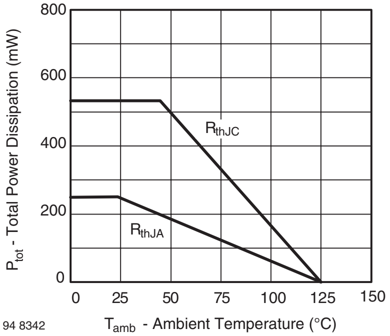


Fig. 1 - Power Dissipation Limit vs. Ambient Temperature

BASIC CHARACTERISTICS

PARAMETER	TEST CONDITION	SYMBOL	MIN.	TYP.	MAX.	UNIT
Collector emitter breakdown voltage	I_C = 1 mA	$V_{(BR)CEO}$	70			V
Collector emitter dark current	V_{CE} = 20 V, E = 0	I_{CEO}		1	100	nA
Collector emitter capacitance	V_{CE} = 5 V, f = 1 MHz, E = 0	C_{CEO}		6		pF
Angle of half sensitivity		φ		± 40		deg
Wavelength of peak sensitivity		λ_p		850		nm
Range of spectral bandwidth		$\lambda_{0.1}$		450 to 1080		nm
Collector emitter saturation voltage	E_e = 1 mW/cm², λ = 950 nm, I_C = 0.1 mA	V_{CEsat}		0.15	0.3	V
Turn-on time	V_S = 5 V, I_C = 5 mA, R_L = 100 Ω	t_{on}		6		µs
Turn-off time	V_S = 5 V, I_C = 5 mA, R_L = 100 Ω	t_{off}		5		µs
Cut-off frequency	V_S = 5 V, I_C = 5 mA, R_L = 100 Ω	f_c		110		kHz

Note

T_{amb} = 25 °C, unless otherwise specified

TYPE DEDICATED CHARACTERISTICS

PARAMETER	TEST CONDITION	PART	SYMBOL	MIN.	TYP.	MAX.	UNIT
Collector light current	E_e = 1 mW/cm², λ = 950 nm, V_{CE} = 5 V	BPW76A	I_{ca}	0.4		0.8	mA
		BPW76B	I_{ca}	0.6			mA

BASIC CHARACTERISTICS

T_{amb} = 25 °C, unless otherwise specified

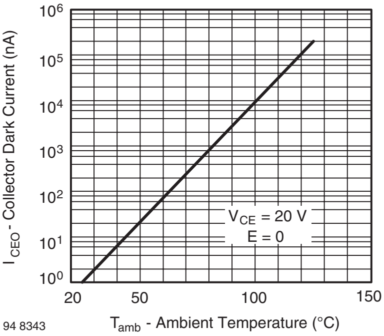


Fig. 2 - Collector Dark Current vs. Ambient Temperature

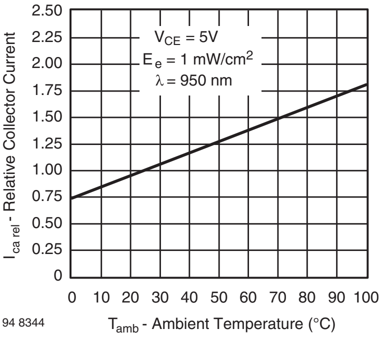


Fig. 3 - Relative Collector Current vs. Ambient Temperature

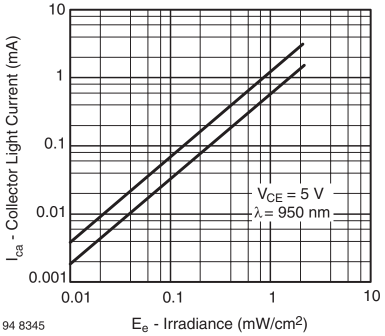


Fig. 4 - Collector Light Current vs. Irradiance

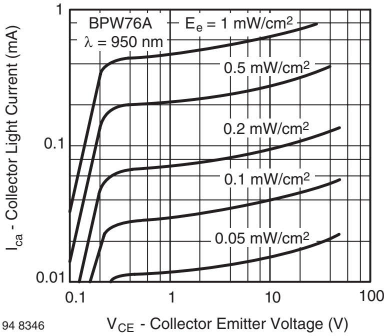


Fig. 5 - Collector Light Current vs. Collector Emitter Voltage

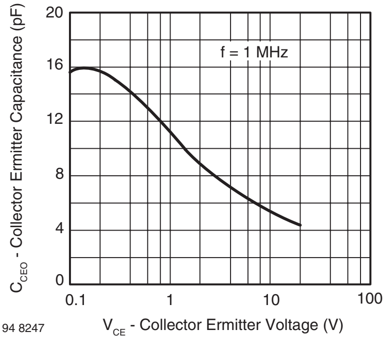


Fig. 6 - Collector Emitter Capacitance vs. Collector Emitter Voltage

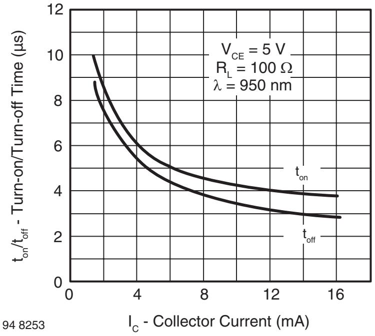


Fig. 7 - Turn-on/Turn-off Time vs. Collector Current

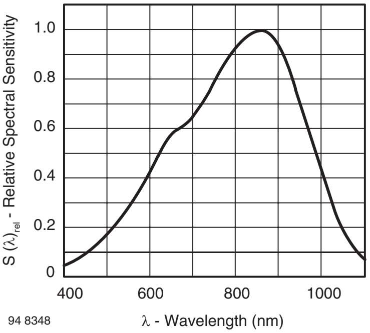


Fig. 8 - Relative Spectral Sensitivity vs. Wavelength

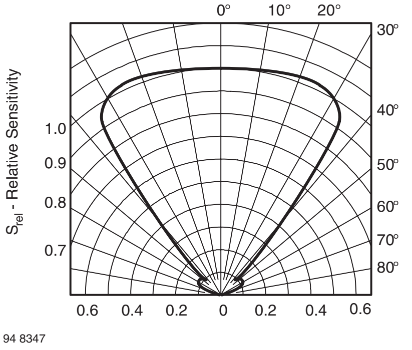
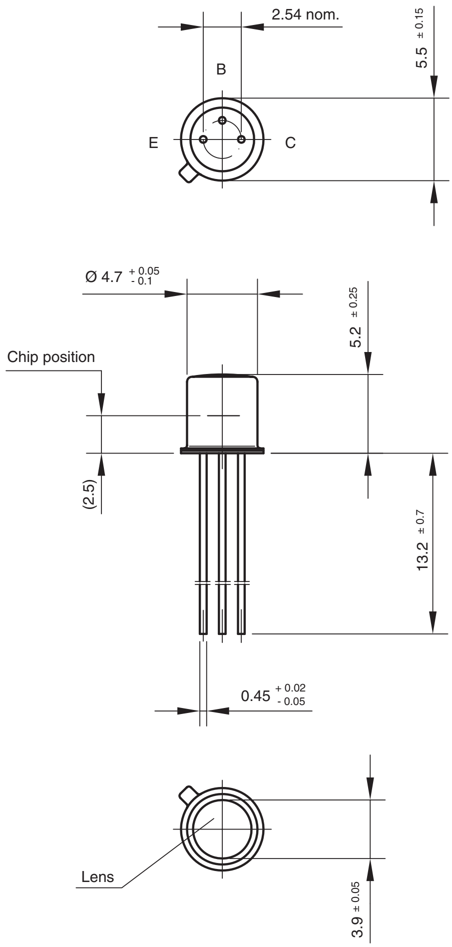
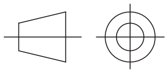


Fig. 9 - Relative Radiant Sensitivity vs. Angular Displacement

PACKAGE DIMENSIONS in millimeters



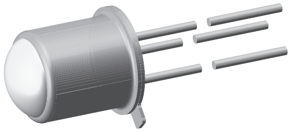


technical drawings
according to DIN
specifications

Drawing-No.: 6.503-5004.01-4
Issue:1; 01.07.96

96 12175

Silicon NPN Phototransistor, RoHS Compliant



DESCRIPTION

BPW77 is a silicon NPN phototransistor with high radiant sensitivity in hermetically sealed TO-18 package with base terminal and glass lens. It is sensitive to visible and near infrared radiation.

FEATURES

- Package type: leaded
- Package form: TO-18
- Dimensions (in mm): Ø 4.7
- High photo sensitivity
- High radiant sensitivity
- Suitable for visible and near infrared radiation
- Fast response times
- Angle of half sensitivity: φ = ± 10°
- Base terminal connected
- Hermetically sealed package
- Lead (Pb)-free component in accordance with RoHS 2002/95/EC and WEEE 2002/96/EC

Pb-free
e4
RoHS
COMPLIANT

APPLICATIONS

- Detector in electronic control and drive circuits

PRODUCT SUMMARY

COMPONENT	I_{ca} (mA)	φ (deg)	$\lambda_{0.1}$ (nm)
BPW77NA	7.5 to 15	± 10	450 to 1080
BPW77NB	> 10	± 10	450 to 1080

Note
Test condition see table “Basic Characteristics”

ORDERING INFORMATION

ORDERING CODE	PACKAGING	REMARKS	PACKAGE FORM
BPW77NA	Bulk	MOQ: 1000 pcs, 1000 pcs/bulk	TO-18
BPW77NB	Bulk	MOQ: 1000 pcs, 1000 pcs/bulk	TO-18

Note
MOQ: minimum order quantity

ABSOLUTE MAXIMUM RATINGS

PARAMETER	TEST CONDITION	SYMBOL	VALUE	UNIT
Collector base voltage		V_{CBO}	80	V
Collector emitter voltage		V_{CEO}	70	V
Emitter base voltage		V_{EBO}	5	V
Collector current		I_C	50	mA
Collector peak current	$t_p/T = 0.5$, $t_p \le 10$ ms	I_{CM}	100	mA
Total power dissipation	$T_{amb} \le 25$ °C	P_V	250	mW
Junction temperature		T_j	125	°C
Operating temperature range		T_{amb}	- 40 to + 125	°C
Storage temperature range		T_{stg}	- 40 to + 125	°C
Soldering temperature	$t \le 5$ s	T_{sd}	260	°C
Thermal resistance junction/ambient	Connected with Cu wire, 0.14 mm^2	R_{thJA}	400	K/W
Thermal resistance junction/gase		R_{thJC}	150	K/W

Note
T_{amb} = 25 °C, unless otherwise specified

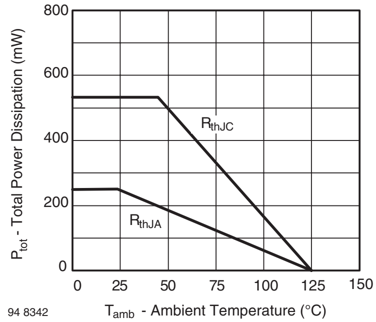


Fig. 1 - Power Dissipation Limit vs. Ambient Temperature

BASIC CHARACTERISTICS

PARAMETER	TEST CONDITION	SYMBOL	MIN.	TYP.	MAX.	UNIT
Collector emitter breakdown voltage	$I_C = 1$ mA	$V_{(BR)CEO}$	70			V
Collector emitter dark current	$V_{CE} = 20$ V, E = 0	I_{CEO}		1	100	nA
Collector emitter capacitance	$V_{CE} = 5$ V, f = 1 MHz, E = 0	C_{CEO}		6		pF
Angle of half sensitivity		φ		± 10		deg
Wavelength of peak sensitivity		λ_p		850		nm
Range of spectral bandwidth		$\lambda_{0.1}$		450 to 1080		nm
Collector emitter saturation voltage	$E_e = 1$ mW/cm^2, $\lambda = 950$ nm, $I_C = 1$ mA	V_{CEsat}		0.15	0.3	V
Turn-on time	$V_S = 5$ V, $I_C = 5$ mA, $R_L = 100\ \Omega$	t_{on}		6		µs
Turn-off time	$V_S = 5$ V, $I_C = 5$ mA, $R_L = 100\ \Omega$	t_{off}		5		µs
Cut-off frequency	$V_S = 5$ V, $I_C = 5$ mA, $R_L = 100\ \Omega$	f_c		110		kHz

Note

$T_{amb} = 25$ °C, unless otherwise specified

TYPE DEDICATED CHARACTERISTICS

PARAMETER	TEST CONDITION	PART	SYMBOL	MIN.	TYP.	MAX.	UNIT
Collector light current	$E_e = 1$ mW/cm^2, $\lambda = 950$ nm, $V_{CE} = 5$ V	BPW77NA	I_{ca}	7.5		15	mA
		BPW77NB	I_{ca}	10			mA

BASIC CHARACTERISTICS

$T_{amb} = 25$ °C, unless otherwise specified

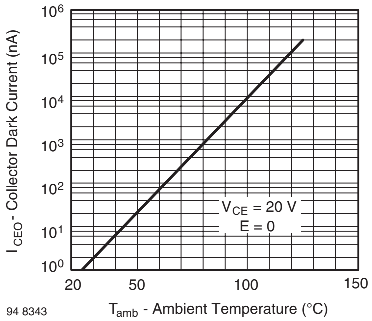


Fig. 2 - Collector Dark Current vs. Ambient Temperature

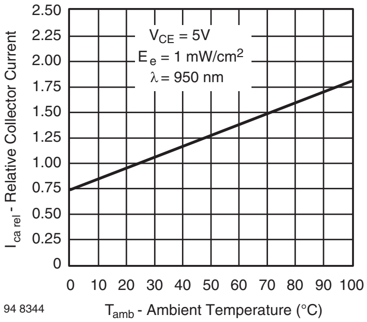


Fig. 3 - Relative Collector Current vs. Ambient Temperature

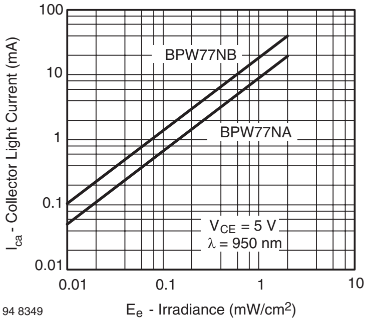


Fig. 4 - Collector Light Current vs. Irradiance

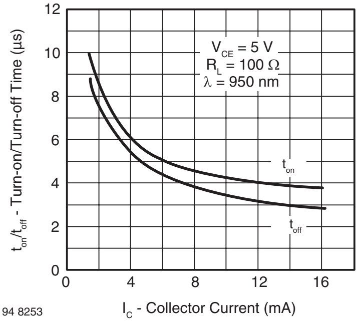


Fig. 7 - Turn-on/Turn-off Time vs. Collector Current

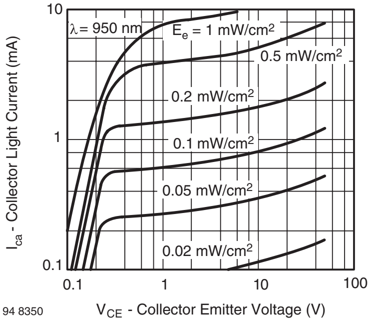


Fig. 5 - Collector Light Current vs. Collector Emitter Voltage

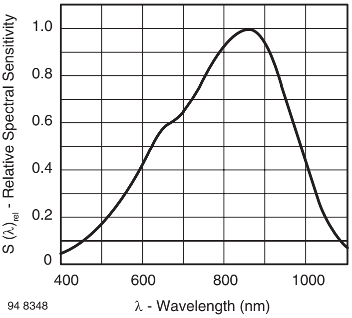


Fig. 8 - Relative Spectral Sensitivity vs. Wavelength

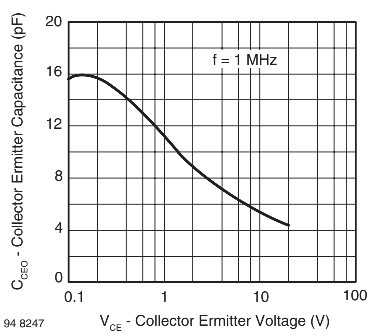


Fig. 6 - Collector Emitter Capacitance vs. Collector Emitter Voltage

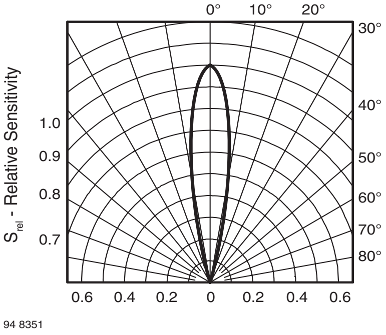
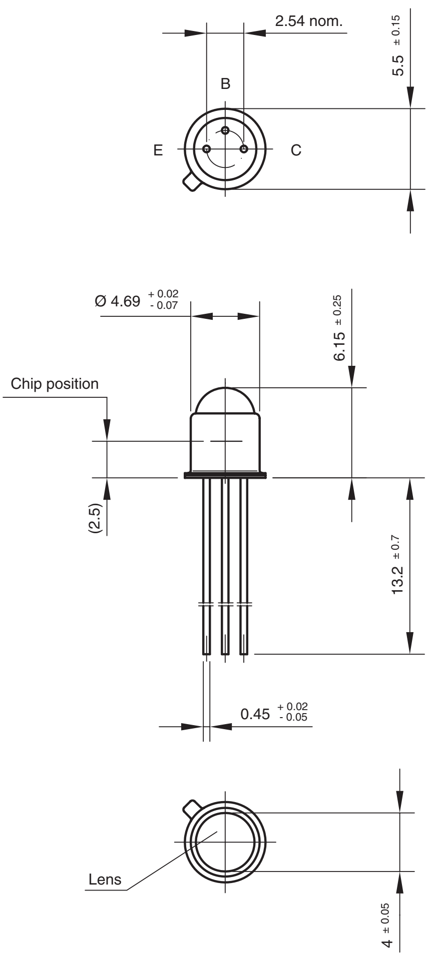
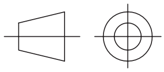


Fig. 9 - Relative Radiant Sensitivity vs. Angular Displacement

PACKAGE DIMENSIONS in millimeters

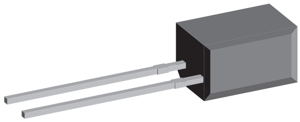




technical drawings
according to DIN
specifications

Drawing-No.: 6.503-5023.01-4
Issue:1; 01.07.96
96 12180

Silicon PIN Photodiode, RoHS Compliant



94 8480

FEATURES

- Package type: leaded
- Package form: side view
- Dimensions (L x W x H in mm): 5 x 4 x 6.8
- Radiant sensitive area (in mm^2): 7.5
- High radiant sensitivity
- Daylight blocking filter matched with 870 nm to 950 nm emitters
- Fast response times
- Angle of half sensitivity: $\varphi = \pm 65°$
- Lead (Pb)-free component in accordance with RoHS 2002/95/EC and WEEE 2002/96/EC

Pb-free

e4

RoHS
COMPLIANT

DESCRIPTION

BPW82 is a PIN photodiode with high speed and high radiant sensitivity in a black, side view plastic package with daylight blocking filter. Filter bandwidth is matched with 870 nm to 950 nm IR emitters.

APPLICATIONS

- High speed detector for infrared radiation
- Infrared remote control and free air data transmission systems, e.g. in combination with TSFFxxxx series IR emitters

PRODUCT SUMMARY

COMPONENT	I_{ra} (µA)	φ (deg)	$\lambda_{0.5}$ (nm)
BPW82	45	± 65	790 to 1050

Note
Test condition see table “Basic Characteristics”

ORDERING INFORMATION

ORDERING CODE	PACKAGING	REMARKS	PACKAGE FORM
BPW82	Bulk	MOQ: 4000 pcs, 4000 pcs/bulk	Side view

Note
MOQ: minimum order quantity

ABSOLUTE MAXIMUM RATINGS

PARAMETER	TEST CONDITION	SYMBOL	VALUE	UNIT
Reverse voltage		V_R	60	V
Power dissipation	$T_{amb} \leq 25$ °C	P_V	215	mW
Junction temperature		T_j	100	°C
Operating temperature range		T_{amb}	- 40 to + 100	°C
Storage temperature range		T_{stg}	- 40 to + 100	°C
Soldering temperature	$t \leq 5$ s	T_{sd}	260	°C
Thermal resistance junction/ambient	Connected with Cu wire, 0.14 mm^2	R_{thJA}	350	K/W

Note
T_{amb} = 25 °C, unless otherwise specified

BASIC CHARACTERISTICS						
PARAMETER	**TEST CONDITION**	**SYMBOL**	**MIN.**	**TYP.**	**MAX.**	**UNIT**
Breakdown voltage	I_R = 100 µA, E = 0	$V_{(BR)}$	60			V
Reverse dark current	V_R = 10 V, E = 0	I_{ro}		2	30	nA
Diode capacitance	V_R = 0 V, f = 1 MHz, E = 0	C_D		70		pF
	V_R = 3 V, f = 1 MHz, E = 0	C_D		25	40	pF
Open circuit voltage	E_e = 1 mW/cm², λ = 870 nm	V_o		350		mV
Short circuit current	E_e = 1 mW/cm², λ = 870 nm	I_k		38		µA
Reverse light current	E_e = 1 mW/cm², λ = 870 nm, V_R = 5 V	I_{ra}	43	45		µA
Angle of half sensitivity		φ		± 65		deg
Wavelength of peak sensitivity		λ_p		950		nm
Range of spectral bandwidth		$\lambda_{0.5}$		790 to 1050		nm
Noise equivalent power	V_R = 10 V, λ = 870 nm	NEP		4×10^{-14}		W/√Hz
Rise time	V_R = 10 V, R_L = 1 kΩ, λ = 820 nm	t_r		100		ns
Fall time	V_R = 10 V, R_L = 1 kΩ, λ = 820 nm	t_f		100		ns

Note

T_{amb} = 25 °C, unless otherwise specified

BASIC CHARACTERISTICS

T_{amb} = 25 °C, unless otherwise specified

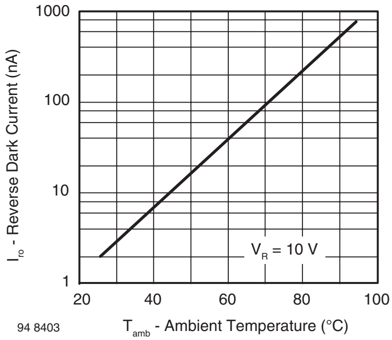


Fig. 1 - Reverse Dark Current vs. Ambient Temperature

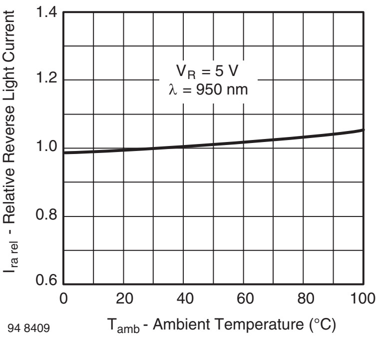


Fig. 2 - Relative Reverse Light Current vs. Ambient Temperature

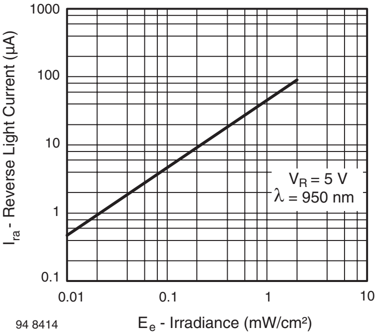


Fig. 3 - Reverse Light Current vs. Irradiance

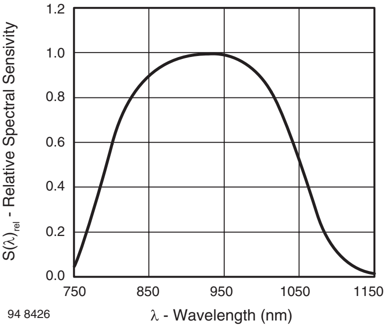


Fig. 6 - Relative Spectral Sensitivity vs. Wavelength

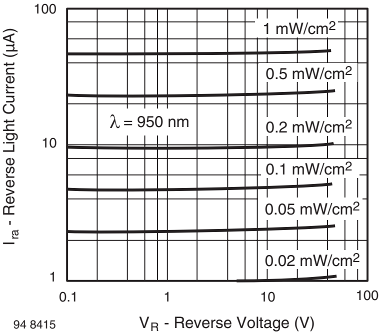


Fig. 4 - Reverse Light Current vs. Reverse Voltage

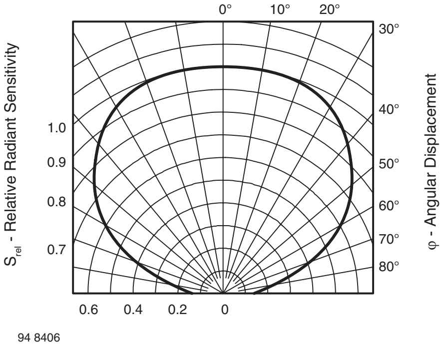


Fig. 7 - Relative Radiant Sensitivity vs. Angular Displacement

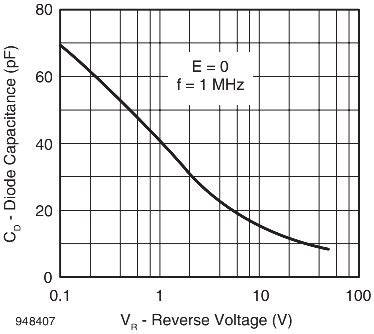
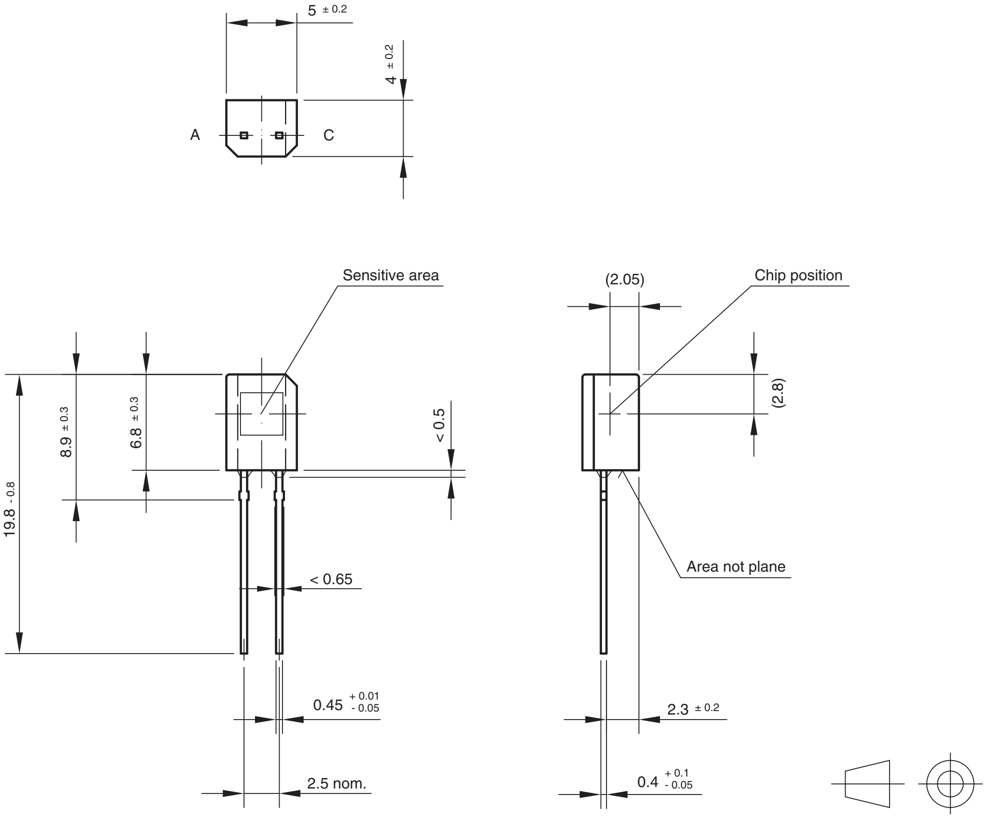


Fig. 5 - Diode Capacitance vs. Reverse Voltage

PACKAGE DIMENSIONS in millimeters



technical drawings
according to DIN
specifications

Drawing-No.: 6.544-5108.01-4
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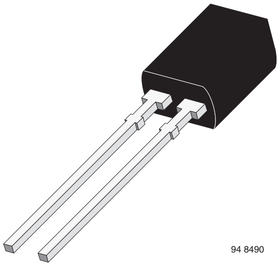
96 12195

Silicon PIN Photodiode, RoHS Compliant



FEATURES

- Package type: leaded
- Package form: side view
- Dimensions (L x W x H in mm): 5 x 3 x 6.4
- Radiant sensitive area (in mm^2): 7.5
- High radiant sensitivity
- Daylight blocking filter matched with 870 nm to 950 nm emitters
- Fast response times
- Angle of half sensitivity: $\varphi = \pm 65°$
- Lead (Pb)-free component in accordance with RoHS 2002/95/EC and WEEE 2002/96/EC

Pb-free

e4

RoHS
COMPLIANT

DESCRIPTION

BPW83 is a PIN photodiode with high speed and high radiant sensitivity in a black, side view plastic package with daylight blocking filter. Filter bandwidth is matched with 870 nm to 950 nm IR emitters.

APPLICATIONS

- High speed detector for infrared radiation
- Infrared remote control and free air data transmission systems, e.g. in combination with TSFFxxxx series IR emitters

PRODUCT SUMMARY

COMPONENT	I_{ra} (µA)	φ (deg)	$\lambda_{0.5}$ (nm)
BPW83	45	± 65	790 to 1050

Note

Test condition see table “Basic Characteristics”

ORDERING INFORMATION

ORDERING CODE	PACKAGING	REMARKS	PACKAGE FORM
BPW83	Bulk	MOQ: 4000 pcs, 4000 pcs/bulk	Side view

Note

MOQ: minimum order quantity

ABSOLUTE MAXIMUM RATINGS

PARAMETER	TEST CONDITION	SYMBOL	VALUE	UNIT
Reverse voltage		V_R	60	V
Power dissipation	$T_{amb} \leq 25$ °C	P_V	215	mW
Junction temperature		T_j	100	°C
Operating temperature range		T_{amb}	- 40 to + 100	°C
Storage temperature range		T_{stg}	- 40 to + 100	°C
Soldering temperature	$t \leq 5$ s	T_{sd}	260	°C
Thermal resistance junction/ambient	Connected with Cu wire, 0.14 mm^2	R_{thJA}	350	K/W

Note

T_{amb} = 25 °C, unless otherwise specified

BASIC CHARACTERISTICS						
PARAMETER	**TEST CONDITION**	**SYMBOL**	**MIN.**	**TYP.**	**MAX.**	**UNIT**
Breakdown voltage	I_R = 100 µA, E = 0	$V_{(BR)}$	60			V
Reverse dark current	V_R = 10 V, E = 0	I_{ro}		2	30	nA
Diode capacitance	V_R = 0 V, f = 1 MHz, E = 0	C_D		70		pF
	V_R = 3 V, f = 1 MHz, E = 0	C_D		25	40	pF
Open circuit voltage	E_e = 1 mW/cm^2, λ = 870 nm	V_o		350		mV
Short circuit current	E_e = 1 mW/cm^2, λ = 870 nm	I_k		38		µA
Reverse light current	E_e = 1 mW/cm^2, λ = 870 nm, V_R = 5 V	I_{ra}	43	45		µA
Angle of half sensitivity		φ		± 65		deg
Wavelength of peak sensitivity		λ_p		950		nm
Range of spectral bandwidth		$\lambda_{0.5}$		790 to 1050		nm
Noise equivalent power	V_R = 10 V, λ = 870 nm	NEP		4 x 10^{-14}		W/√ Hz
Rise time	V_R = 10 V, R_L = 1 kΩ, λ = 820 nm	t_r		100		ns
Fall time	V_R = 10 V, R_L = 1 kΩ, λ = 820 nm	t_f		100		ns

Note

T_{amb} = 25 °C, unless otherwise specified

BASIC CHARACTERISTICS

T_{amb} = 25 °C, unless otherwise specified

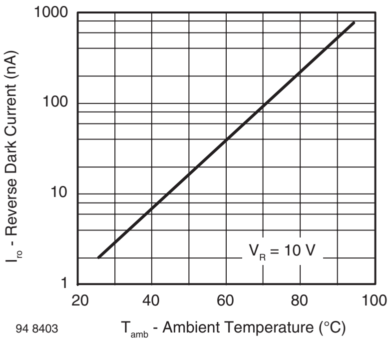


Fig. 1 - Reverse Dark Current vs. Ambient Temperature

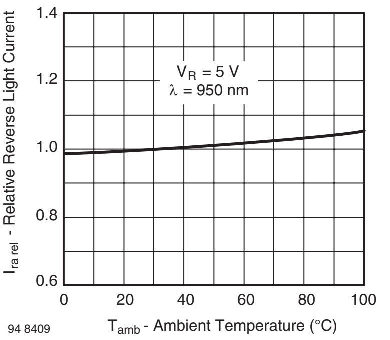


Fig. 2 - Relative Reverse Light Current vs. Ambient Temperature

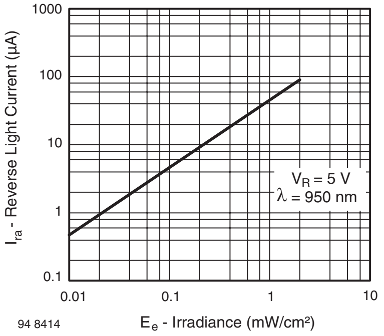


Fig. 3 - Reverse Light Current vs. Irradiance

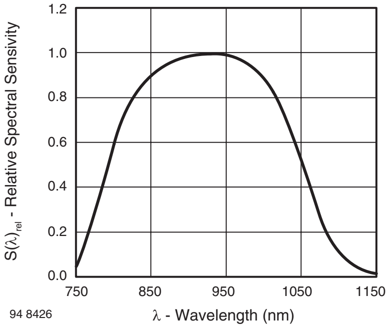


Fig. 6 - Relative Spectral Sensitivity vs. Wavelength

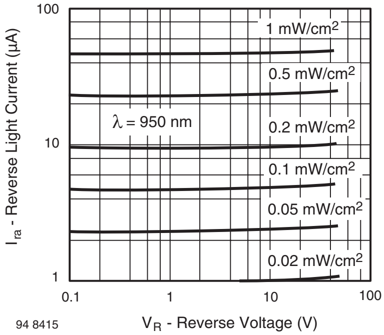


Fig. 4 - Reverse Light Current vs. Reverse Voltage

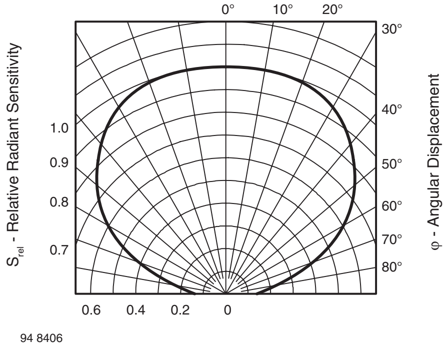


Fig. 7 - Relative Radiant Sensitivity vs. Angular Displacement

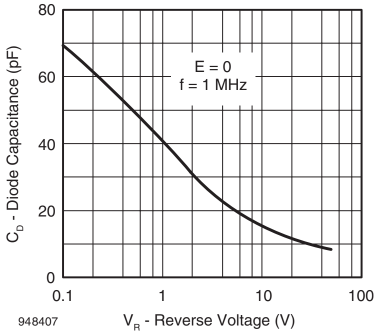
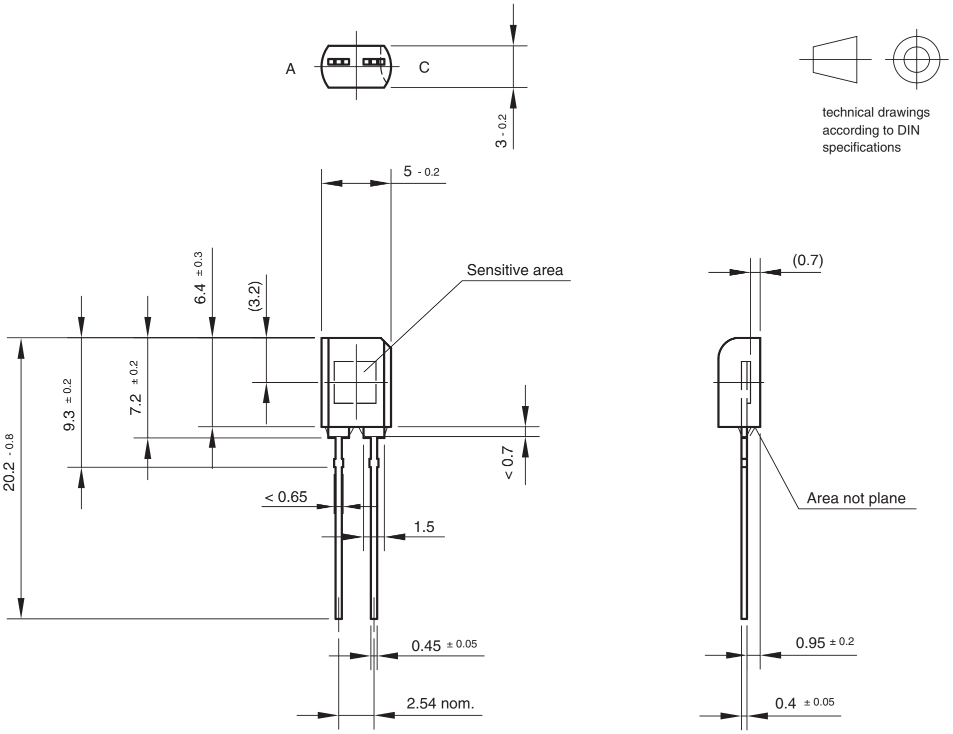


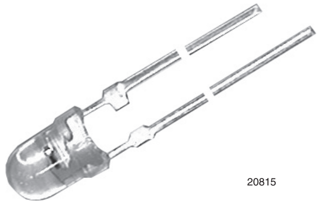
Fig. 5 - Diode Capacitance vs. Reverse Voltage

PACKAGE DIMENSIONS in millimeters



Drawing-No.: 6.544-5109.01-4
Issue:1; 01.07.96
96 12196

Silicon NPN Phototransistor, RoHS Compliant



20815

FEATURES

- Package type: leaded
- Package form: T-1
- Dimensions (in mm): Ø 3
- High photo sensitivity
- High radiant sensitivity
- Suitable for visible and near infrared radiation
- Fast response times
- Angle of half sensitivity: $\varphi = \pm 25°$
- Lead (Pb)-free component in accordance with RoHS 2002/95/EC and WEEE 2002/96/EC

Pb-free

e4

RoHS COMPLIANT

DESCRIPTION

BPW85 is a silicon NPN phototransistor with high radiant sensitivity in clear, T-1 plastic package. It is sensitive to visible and near infrared radiation.

APPLICATIONS

- Detector in electronic control and drive circuits

PRODUCT SUMMARY

COMPONENT	I_{ca} (mA)	φ (deg)	$\lambda_{0.1}$ (nm)
BPW85A	0.8 to 2.5	± 25	450 to 1080
BPW85B	1.5 to 4	± 25	450 to 1080
BPW85C	3 to 8	± 25	450 to 1080

Note

Test condition see table “Basic Characteristics”

ORDERING INFORMATION

ORDERING CODE	PACKAGING	REMARKS	PACKAGE FORM
BPW85A	Bulk	MOQ: 5000 pcs, 5000 pcs/bulk	T-1
BPW85B	Bulk	MOQ: 5000 pcs, 5000 pcs/bulk	T-1
BPW85C	Bulk	MOQ: 5000 pcs, 5000 pcs/bulk	T-1

Note

MOQ: minimum order quantity

ABSOLUTE MAXIMUM RATINGS

PARAMETER	TEST CONDITION	SYMBOL	VALUE	UNIT
Collector emitter voltage		V_{CEO}	70	V
Emitter collector voltage		V_{ECO}	5	V
Collector current		I_C	50	mA
Collector peak current	$t_p/T = 0.5$, $t_p \leq 10$ ms	I_{CM}	100	mA
Power dissipation	$T_{amb} \leq 55$ °C	P_V	100	mW
Junction temperature		T_j	100	°C
Operating temperature range		T_{amb}	- 40 to + 100	°C
Storage temperature range		T_{stg}	- 40 to + 100	°C
Soldering temperature	$t \leq 3$ s, 2 mm from case	T_{sd}	260	°C
Thermal resistance junction/ambient	Connected with Cu wire Ø 0.14 mm^2	R_{thJA}	450	K/W

Note

T_{amb} = 25 °C, unless otherwise specified

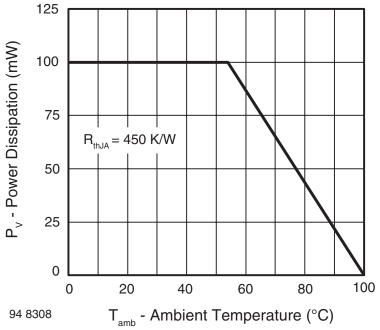


Fig. 1 - Power Dissipation Limit vs. Ambient Temperature

BASIC CHARACTERISTICS

PARAMETER	TEST CONDITION	SYMBOL	MIN.	TYP.	MAX.	UNIT
Collector emitter breakdown voltage	I_C = 1 mA	$V_{(BR)CEO}$	70			V
Collector emitter dark current	V_{CE} = 20 V, E = 0	I_{CEO}		1	200	nA
Collector emitter capacitance	V_{CE} = 5 V, f = 1 MHz, E = 0	C_{CEO}		3		pF
Angle of half sensitivity		φ		± 25		deg
Wavelength of peak sensitivity		λ_p		850		nm
Range of spectral bandwidth		$\lambda_{0.1}$		450 to 1080		nm
Collector emitter saturation voltage	E_e = 1 mW/cm^2, λ = 950 nm, I_C = 0.1 mA	V_{CEsat}			0.3	V
Turn-on time	V_S = 5 V, I_C = 5 mA, R_L = 100 Ω	t_{on}		2.0		µs
Turn-off time	V_S = 5 V, I_C = 5 mA, R_L = 100 Ω	t_{off}		2.3		µs
Cut-off frequency	V_S = 5 V, I_C = 5 mA, R_L = 100 Ω	f_c		180		kHz

Note

T_{amb} = 25 °C, unless otherwise specified

TYPE DEDICATED CHARACTERISTICS

PARAMETER	TEST CONDITION	PART	SYMBOL	MIN.	TYP.	MAX.	UNIT
Collector light current	E_e = 1 mW/cm^2, λ = 950 nm, V_{CE} = 5 V	BPW85A	I_{ca}	0.8		2.5	mA
		BPW85B	I_{ca}	1.5		4.0	mA
		BPW85C	I_{ca}	3.0		8.0	mA

BASIC CHARACTERISTICS

T_{amb} = 25 °C, unless otherwise specified

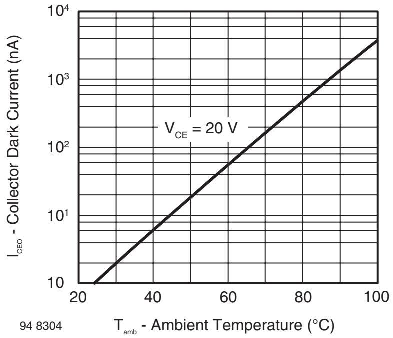


Fig. 2 - Collector Dark Current vs. Ambient Temperature

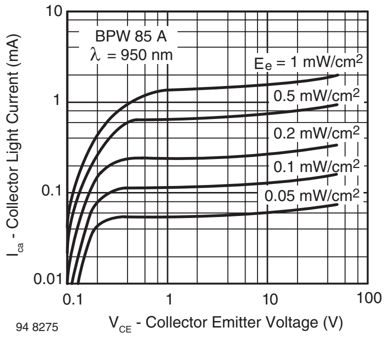


Fig. 5 - Collector Light Current vs. Collector Emitter Voltage

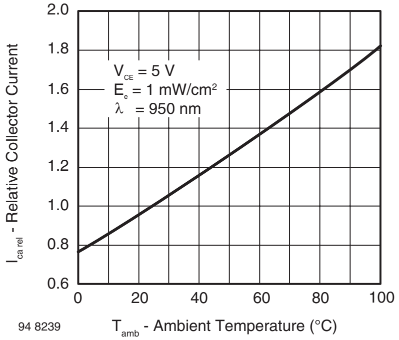


Fig. 3 - Relative Collector Current vs. Ambient Temperature

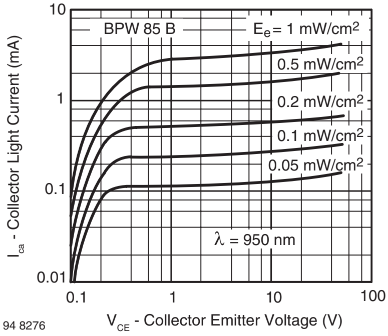


Fig. 6 - Collector Light Current vs. Collector Emitter Voltage

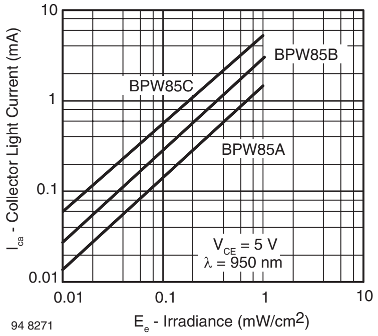


Fig. 4 - Collector Light Current vs. Irradiance

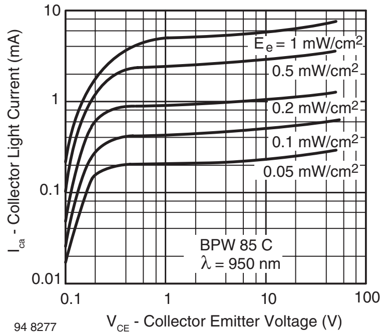


Fig. 7 - Collector Light Current vs. Collector Emitter Voltage

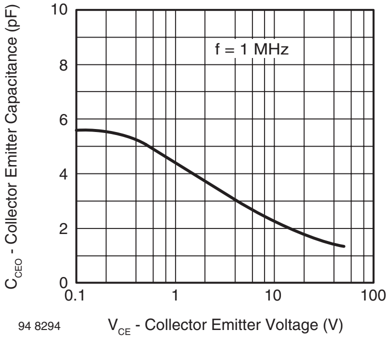


Fig. 8 - Collector Emitter Capacitance vs. Collector Emitter Voltage

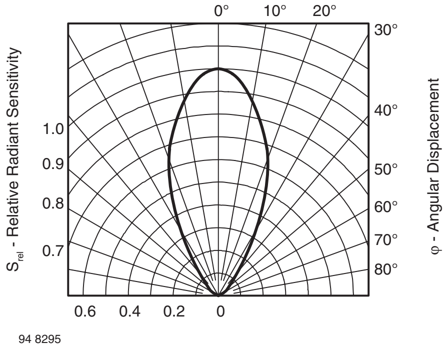


Fig. 11 - Relative Radiant Sensitivity vs. Angular Displacement

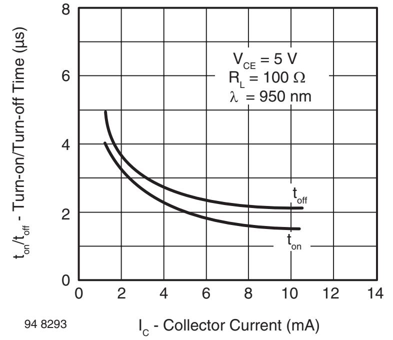


Fig. 9 - Turn-on/Turn-off Time vs. Collector Current

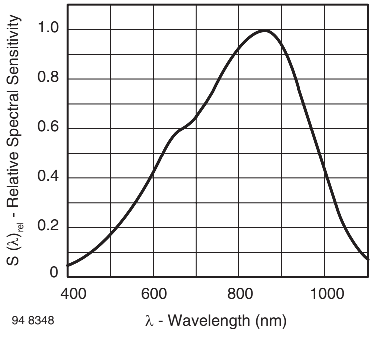
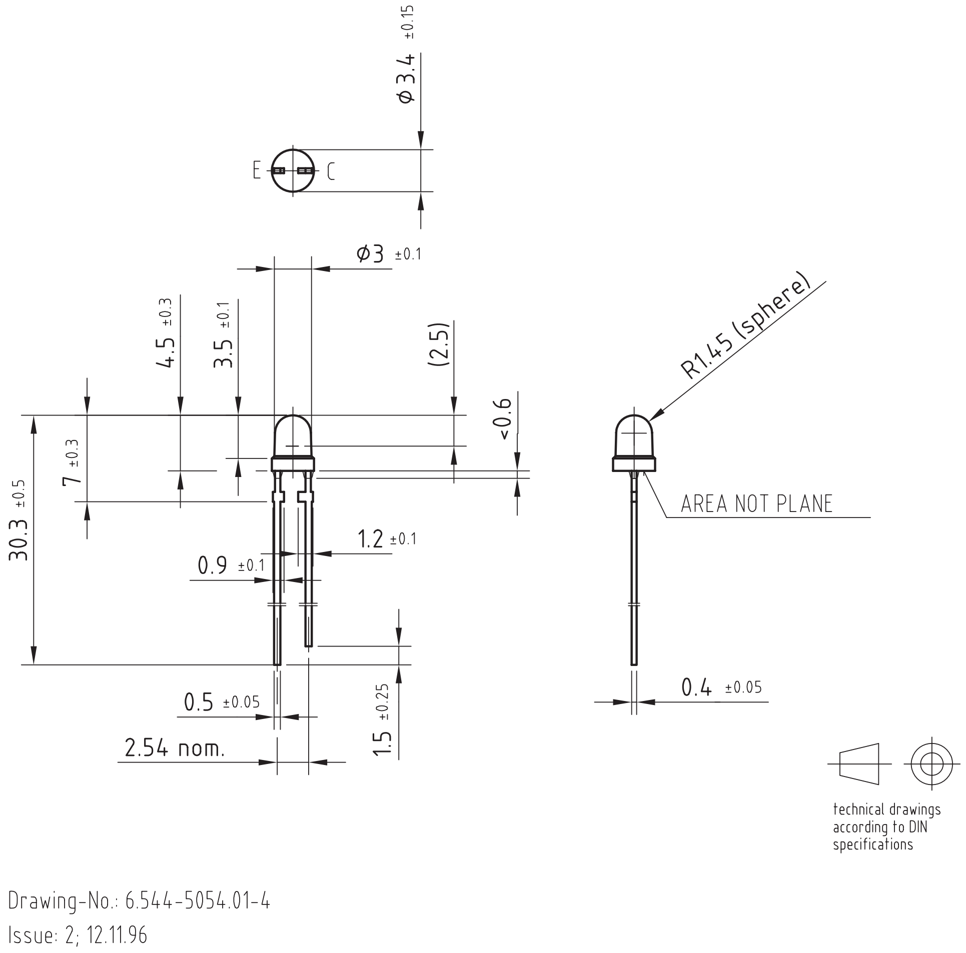


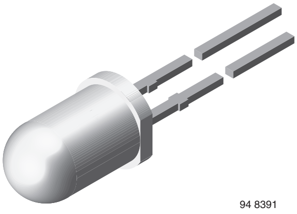
Fig. 10 - Relative Spectral Sensitivity vs. Wavelength

PACKAGE DIMENSIONS in millimeters



96 12190

Silicon NPN Phototransistor, RoHS Compliant



DESCRIPTION

BPW96 is a silicon NPN phototransistor with high radiant sensitivity in clear, T-1¾ plastic package. It is sensitive to visible and near infrared radiation.

FEATURES

- Package type: leaded
- Package form: T-1¾
- Dimensions (in mm): Ø 5
- Leads with stand-off
- High photo sensitivity
- High radiant sensitivity
- Suitable for visible and near infrared radiation
- Fast response times
- Angle of half sensitivity: $\varphi = \pm 20°$
- Lead (Pb)-free component in accordance with RoHS 2002/95/EC and WEEE 2002/96/EC

APPLICATIONS

- Detector in electronic control and drive circuits

PRODUCT SUMMARY

COMPONENT	I_{ca} (mA)	φ (deg)	$\lambda_{0.1}$ (nm)
BPW96B	2.5 to 7.5	± 20	450 to 1080
BPW96C	4.5 to 15	± 20	450 to 1080

Note
Test condition see table “Basic Characteristics”

ORDERING INFORMATION

ORDERING CODE	PACKAGING	REMARKS	PACKAGE FORM
BPW96B	Bulk	MOQ: 4000 pcs, 4000 pcs/bulk	T-1¾
BPW96C	Bulk	MOQ: 4000 pcs, 4000 pcs/bulk	T-1¾

Note
MOQ: minimum order quantity

ABSOLUTE MAXIMUM RATINGS

PARAMETER	TEST CONDITION	SYMBOL	VALUE	UNIT
Collector emitter voltage		V_{CEO}	70	V
Emitter collector voltage		V_{ECO}	5	V
Collector current		I_C	50	mA
Collector peak current	$t_p/T \leq 0.5$, $t_p \leq 10$ ms	I_{CM}	100	mA
Power dissipation	$T_{amb} \leq 47$ °C	P_V	150	mW
Junction temperature		T_j	100	°C
Operating temperature range		T_{amb}	- 40 to + 100	°C
Storage temperature range		T_{stg}	- 40 to + 100	°C
Soldering temperature	$t \leq 3$ s	T_{sd}	260	°C
Thermal resistance junction/ambient	Connected with Cu wire, 0.14 mm^2	R_{thJA}	350	K/W

Note
T_{amb} = 25 °C, unless otherwise specified

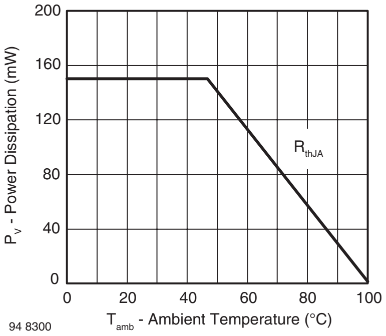


Fig. 1 - Power Dissipation Limit vs. Ambient Temperature

BASIC CHARACTERISTICS						
PARAMETER	**TEST CONDITION**	**SYMBOL**	**MIN.**	**TYP.**	**MAX.**	**UNIT**
Collector emitter breakdown voltage	I_C = 1 mA	$V_{(BR)CEO}$	70			V
Collector emitter dark current	V_{CE} = 20 V, E = 0	I_{CEO}		1	200	nA
Collector emitter capacitance	V_{CE} = 5 V, f = 1 MHz, E = 0	C_{CEO}		3		pF
Angle of half sensitivity		φ		± 20		deg
Wavelength of peak sensitivity		λ_p		850		nm
Range of spectral bandwidth		$\lambda_{0.1}$		450 to 1080		nm
Collector emitter saturation voltage	E_e = 1 mW/cm^2, λ = 950 nm, I_C = 0.1 mA	V_{CEsat}			0.3	V
Turn-on time	V_S = 5 V, I_C = 5 mA, R_L = 100 Ω	t_{on}		2.0		µs
Turn-off time	V_S = 5 V, I_C = 5 mA, R_L = 100 Ω	t_{off}		2.3		µs
Cut-off frequency	V_S = 5 V, I_C = 5 mA, R_L = 100 Ω	f_c		180		kHz

Note

T_{amb} = 25 °C, unless otherwise specified

TYPE DEDICATED CHARACTERISTICS							
PARAMETER	**TEST CONDITION**	**PART**	**SYMBOL**	**MIN.**	**TYP.**	**MAX.**	**UNIT**
Collector light current	E_e = 1 mW/cm^2, λ = 950 nm, V_{CE} = 5 V	BPW96B	I_{ca}	2.5	4.5	7.5	mA
		BPW96C	I_{ca}	4.5	8	15	mA

BASIC CHARACTERISTICS

T_{amb} = 25 °C, unless otherwise specified

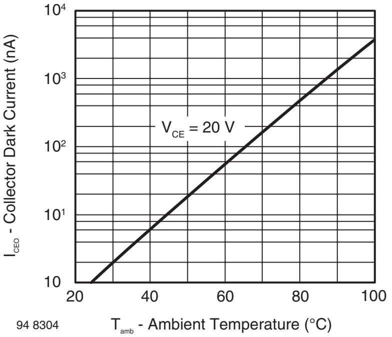


Fig. 2 - Collector Dark Current vs. Ambient Temperature

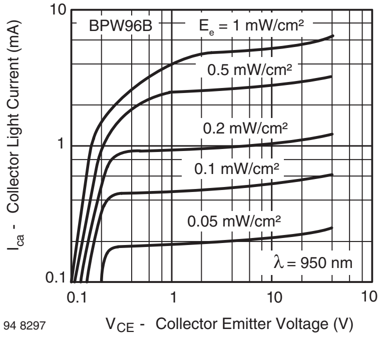


Fig. 5 - Collector Light Current vs. Collector Emitter Voltage

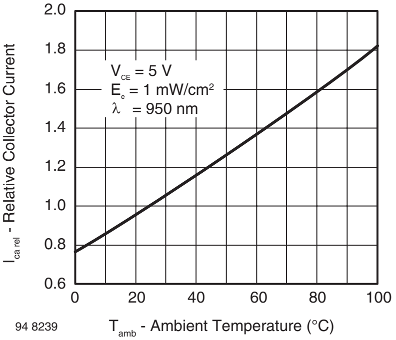


Fig. 3 - Relative Collector Current vs. Ambient Temperature

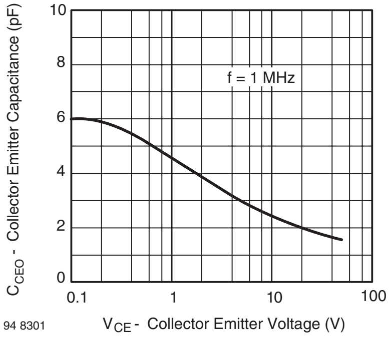


Fig. 6 - Collector Emitter Capacitance vs. Collector Emitter Voltage

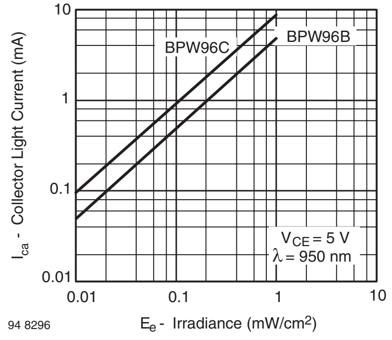


Fig. 4 - Collector Light Current vs. Irradiance

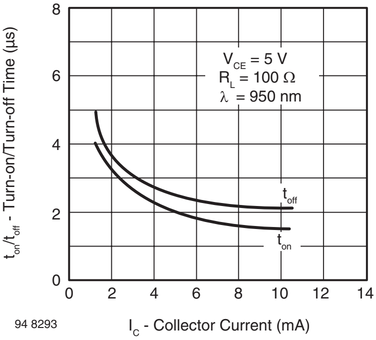


Fig. 7 - Turn-on/Turn-off Time vs. Collector Current

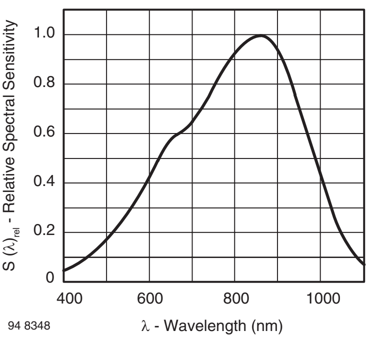


Fig. 8 - Relative Spectral Sensitivity vs. Wavelength

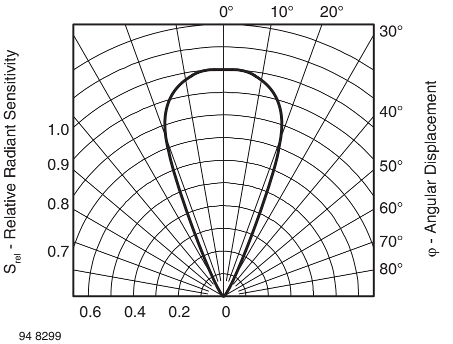
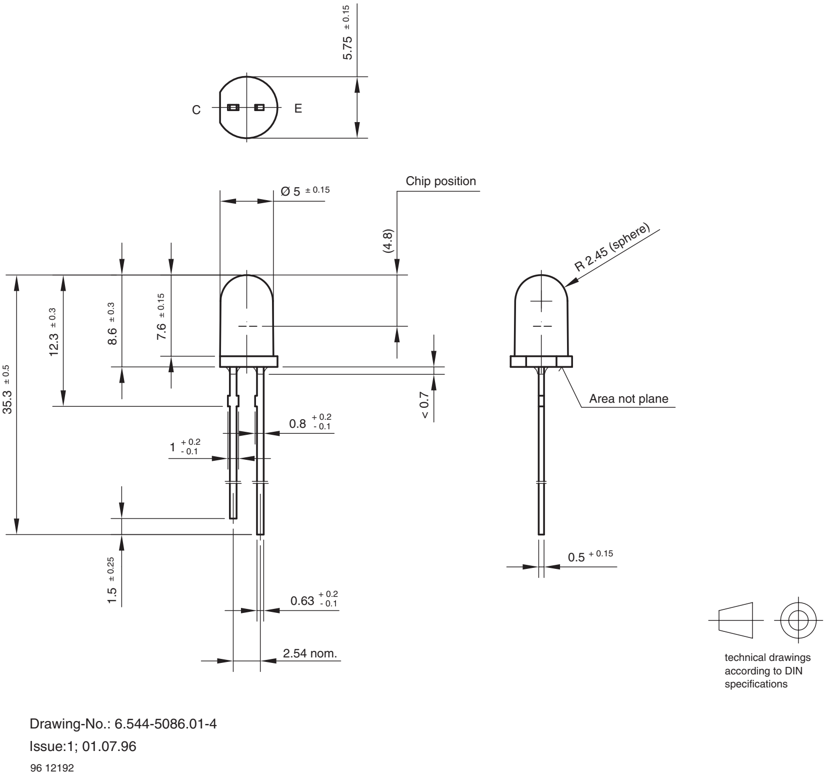
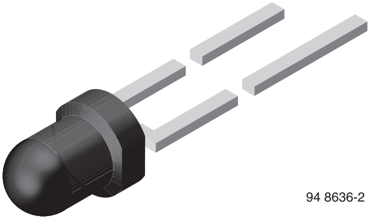


Fig. 9 - Relative Radiant Sensitivity vs. Angular Displacement

PACKAGE DIMENSIONS in millimeters



Silicon NPN Phototransistor, RoHS Compliant


94 8636-2

DESCRIPTION

TEFT4300 is a silicon NPN phototransistor with high radiant sensitivity in black, T-1 plastic package with daylight blocking filter. Filter bandwitdth is matched with 900 nm to 950 nm IR emitters.

FEATURES

- Package type: leaded
- Package form: T-1
- Dimensions (in mm): Ø 3
- High radiant sensitivity
- Daylight blocking filter matched with 940 nm emitters
- Fast response times
- Angle of half sensitivity: φ = ± 30°
- Package matched with IR emitter series TSUS4300 and TSAL4400
- Lead (Pb)-free component in accordance with RoHS 2002/95/EC and WEEE 2002/96/EC

Pb-free

e2

RoHS
COMPLIANT

APPLICATIONS

- Optical switches
- Counters and sorters
- Interrupters
- Encoders
- Position sensors

PRODUCT SUMMARY

COMPONENT	I_{ca} (mA)	φ (deg)	$\lambda_{0.5}$ (nm)
TEFT4300	3.2	± 30	875 to 1000

Note
Test condition see table "Basic Characteristics"

ORDERING INFORMATION

ORDERING CODE	PACKAGING	REMARKS	PACKAGE FORM
TEFT4300	Bulk	MOQ: 5000 pcs, 5000 pcs/bulk	T-1

Note
MOQ: minimum order quantity

ABSOLUTE MAXIMUM RATINGS

PARAMETER	TEST CONDITION	SYMBOL	VALUE	UNIT
Collector emitter voltage		V_{CEO}	70	V
Emitter collector voltage		V_{ECO}	5	V
Collector current		I_C	50	mA
Collector peak current	$t_p/T = 0.5$, $t_p \leq 10$ ms	I_{CM}	100	mA
Power dissipation	$T_{amb} \leq 55$ °C	P_V	100	mW
Junction temperature		T_j	100	°C
Operating temperature range		T_{amb}	- 40 to + 100	°C
Storage temperature range		T_{stg}	- 40 to + 100	°C
Soldering temperature	$t \leq 3$ s, 2 mm from case	T_{sd}	260	°C
Thermal resistance junction/ambient	Connected with Cu wire, 0.14 mm^2	R_{thJA}	450	K/W

Note
T_{amb} = 25 °C, unless otherwise specified

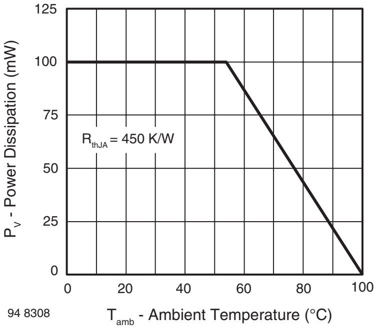


Fig. 1 - Power Dissipation Limit vs. Ambient Temperature

BASIC CHARACTERISTICS

PARAMETER	TEST CONDITION	SYMBOL	MIN.	TYP.	MAX.	UNIT
Collector emitter breakdown voltage	I_C = 1 mA	$V_{(BR)CEO}$	70			V
Collector emitter dark current	V_{CE} = 20 V, E = 0	I_{CEO}		1	200	nA
Collector emitter capacitance	V_{CE} = 5 V, f = 1 MHz, E = 0	C_{CEO}		3		pF
Collector light current	E_e = 1 mW/cm^2, λ = 950 nm, V_{CE} = 5 V	I_{ca}	0.8	3.2		mA
Angle of half sensitivity		φ		± 30		deg
Wavelength of peak sensitivity		λ_p		925		nm
Range of spectral bandwidth		$\lambda_{0.5}$		875 to 1000		nm
Collector emitter saturation voltage	E_e = 1 mW/cm^2, λ = 950 nm, I_C = 0.1 mA	V_{CEsat}			0.3	V
Turn-on time	V_S = 5 V, I_C = 5 mA, R_L = 100 Ω	t_{on}		2.0		µs
Turn-off time	V_S = 5 V, I_C = 5 mA, R_L = 100 Ω	t_{off}		2.3		µs
Cut-off frequency	V_S = 5 V, I_C = 5 mA, R_L = 100 Ω	f_c		180		kHz

Note

T_{amb} = 25 °C, unless otherwise specified

BASIC CHARACTERISTICS

T_{amb} = 25 °C, unless otherwise specified

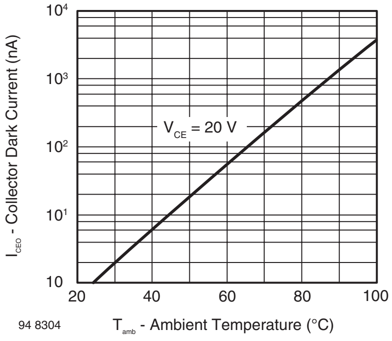


Fig. 2 - Collector Dark Current vs. Ambient Temperature

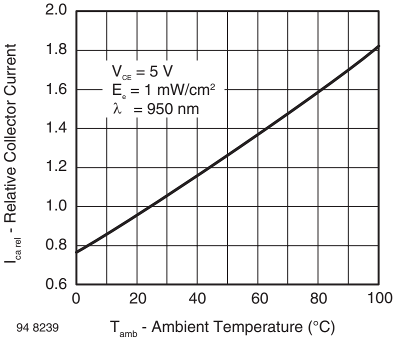


Fig. 3 - Relative Collector Current vs. Ambient Temperature

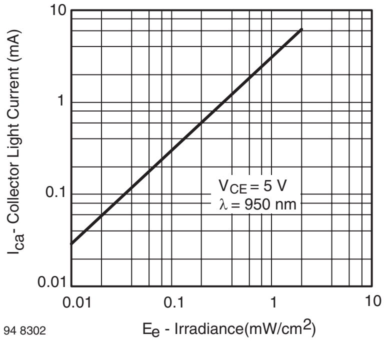


Fig. 4 - Collector Light Current vs. Irradiance

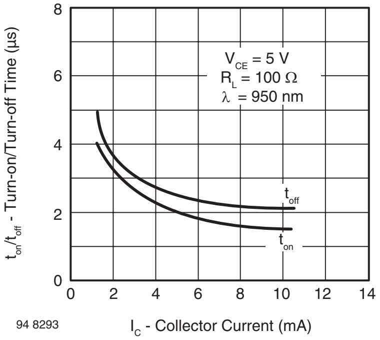


Fig. 7 - Turn-on/Turn-off Time vs. Collector Current

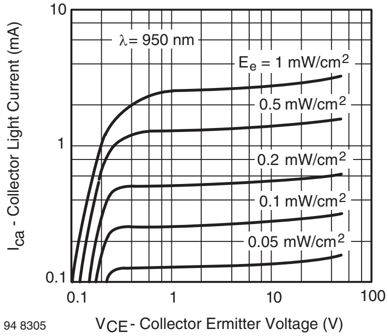


Fig. 5 - Collector Light Current vs. Collector Emitter Voltage

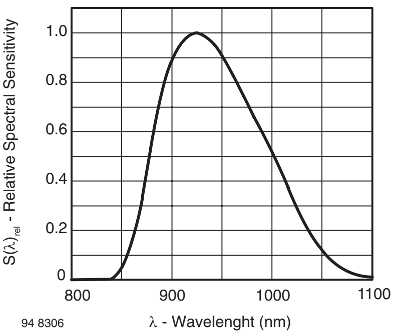


Fig. 8 - Relative Spectral Sensitivity vs. Wavelength

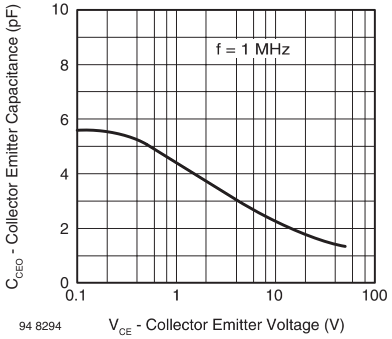


Fig. 6 - Collector Emitter Capacitance vs. Collector Emitter Voltage

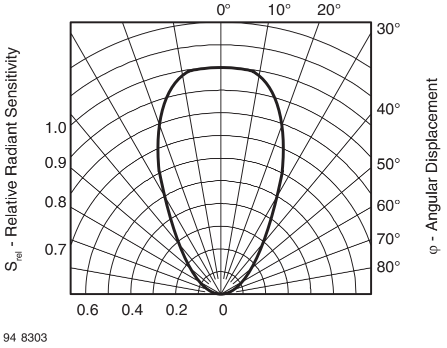
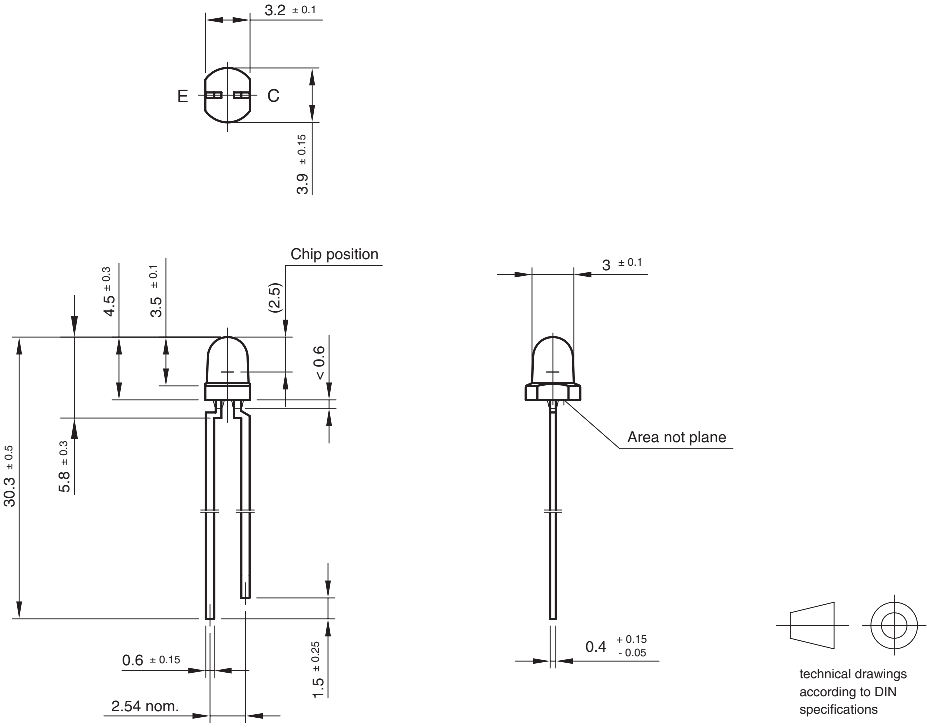


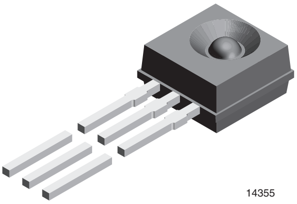
Fig. 9 - Relative Radiant Sensitivity vs. Angular Displacement

PACKAGE DIMENSIONS in millimeters



Drawing-No.: 6.544-5269.01-4
Issue: 4; 01.12.99
96 12172

Silicon Photo Schmitt Trigger with Digital Output, RoHS Compliant



DESCRIPTION

TEKS5400 is a photo Schmitt Trigger with high radiant sensitivity, molded in a plastic package with side view lens and daylight blocking filter. Filter bandwidth is matched with 900 nm to 950 nm IR emitters.

FEATURES

- Package type: leaded
- Package form: side view lens
- Dimensions (L x W x H in mm): 5 x 2.65 x 5
- High radiant sensitivity
- Daylight blocking filter matched with 940 nm IR emitters
- Angle of half sensitivity: $\varphi = \pm 30°$
- Supply voltage range: 4.5 V to 16 V
- Low current consumption: 2 mA
- High EMI protection
- TTL and CMOS compatible
- Open collector output
- Output signal level active “low”
- Package matched with IR emitter series TSKS5400
- Lead (Pb)-free component in accordance with RoHS 2002/95/EC and WEEE 2002/96/EC

Pb-free

e3

RoHS
COMPLIANT

APPLICATIONS

- Shaft encoder
- Transmissive sensor
- Reflective sensor

PRODUCT SUMMARY

COMPONENT	V_{OL} (V)	φ (deg)	$\lambda_{0.5}$ (nm)
TEKS5400-FSZ	0.2	± 30	600 to 1020
TEKS5400-FGZ	0.2	± 30	600 to 1020

Note
Test conditions see table “Basic Characteristics”

ORDERING INFORMATION

ORDERING CODE	PACKAGING	REMARKS	PACKAGE FORM
TEKS5400-FSZ	Tape and ammopack	MOQ: 2000 pcs, 2000 pcs/ammopack, pitch: 1.27 mm	Side view lens
TEKS5400-FGZ	Tape and ammopack	MOQ: 2000 pcs, 2000 pcs/ammopack, pitch: 2.00 mm	Side view lens

Note
MOQ: minimum order quantity

ABSOLUTE MAXIMUM RATINGS

PARAMETER	TEST CONDITION	SYMBOL	VALUE	UNIT
Supply voltage		V_{S1}	18	V
Output current		I_O	20	mA
Power dissipation		P_V	100	mW
Junction temperature		T_j	100	°C
Operating temperature range		T_{amb}	- 25 to + 85	°C
Storage temperature range		T_{stg}	- 40 to + 100	°C
Soldering temperature	$t \leq 5$ s, 2 mm from body	T_{sd}	260	°C
Thermal resistance junction/ambient	J-STD-051, soldered on PCB	R_{thJA}	270	K/W

Note
T_{amb} = 25 °C, unless otherwise specified

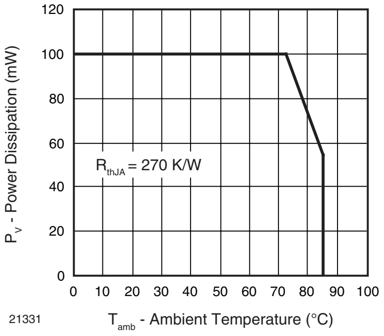


Fig. 1 - Power Dissipation Limit vs. Ambient Temperature

HANDLING PRECAUTIONS

Caution: connect a capacitor C of 100 nF between V_{S1} and ground!

BASIC CHARACTERISTICS

PARAMETER	TEST CONDITION	SYMBOL	MIN.	TYP.	MAX.	UNIT
Supply voltage		V_{S1}/V_{S2}	4.5		16	V
Supply current	V_{S1} = 16 V	I_{S1}		2	5	mA
Irradiance for threshold “on”	λ = 950 nm, V_{S1} = 5 V	E_{eon}	25	50	85	µW/cm²
Hysteresis	V_{S1} = 5 V	E_{eoff}/E_{eon}		80		%
Angle of half sensitivity		φ		± 30		deg
Wavelength of peak sensitivity		λ_p		920		nm
Range of spectral bandwidth		$\lambda_{0.5}$		600 to 1020		nm
Output voltage	I_{OL} = 16 mA, V_{S1} = 5 V, $E_e \geq E_{on}$	V_{OL}		0.2	0.4	V
High level output current	$V_{S1} = V_{S2}$ = 16 V, I_F = 0	I_{OH}			1	µA
Rise time	$V_{S1} = V_{S2}$ = 5 V, R_L = 1 kΩ, E_e = 3 x E_{eon}, λ = 950 nm	t_r		100		ns
Fall time	$V_{S1} = V_{S2}$ = 5 V, R_L = 1 kΩ, E_e = 3 x E_{eon}, λ = 950 nm	t_f		20		ns
Turn-on time	$V_{S1} = V_{S2}$ = 5 V, R_L = 1 kΩ, E_e = 3 x E_{eon}, λ = 950 nm	t_{on}		1.5		µs
Turn-off time	$V_{S1} = V_{S2}$ = 5 V, R_L = 1 kΩ, E_e = 3 x E_{eon}, λ = 950 nm	t_{off}		3		µs
Cut off frequency	$V_{S1} = V_{S2}$ = 5 V, R_L = 1 kΩ, E_e = 3 x E_{eon}, λ = 950 nm	f_c		200		kHz

Note

T_{amb} = 25 °C, unless otherwise specified

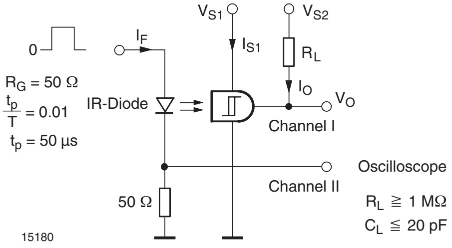


Fig. 2 - Test Circuit

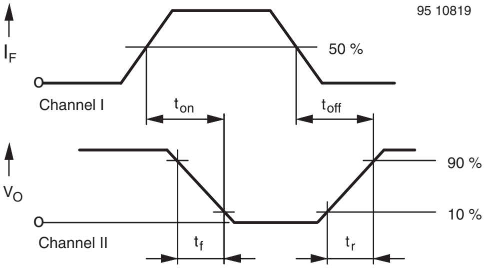


Fig. 3 - Pulse Diagram

BASIC CHARACTERISTICS

T_{amb} = 25 °C, unless otherwise specified

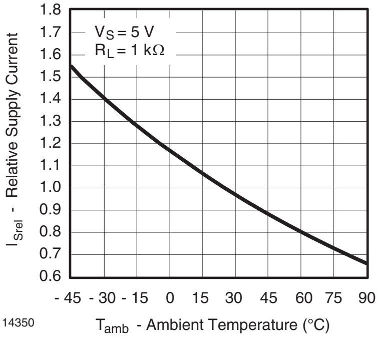


Fig. 4 - Rel. Supply Current vs. Ambient Temperature

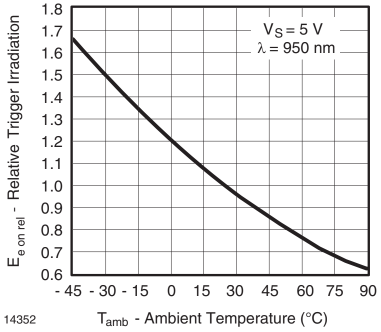


Fig. 6 - Relative Trigger Irradiation vs. Ambient Temperature

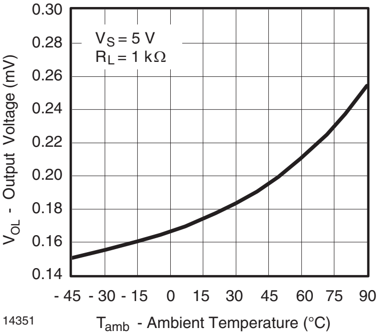


Fig. 5 - Output Voltage vs. Ambient Temperature

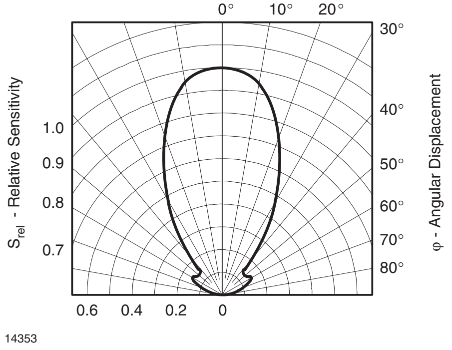
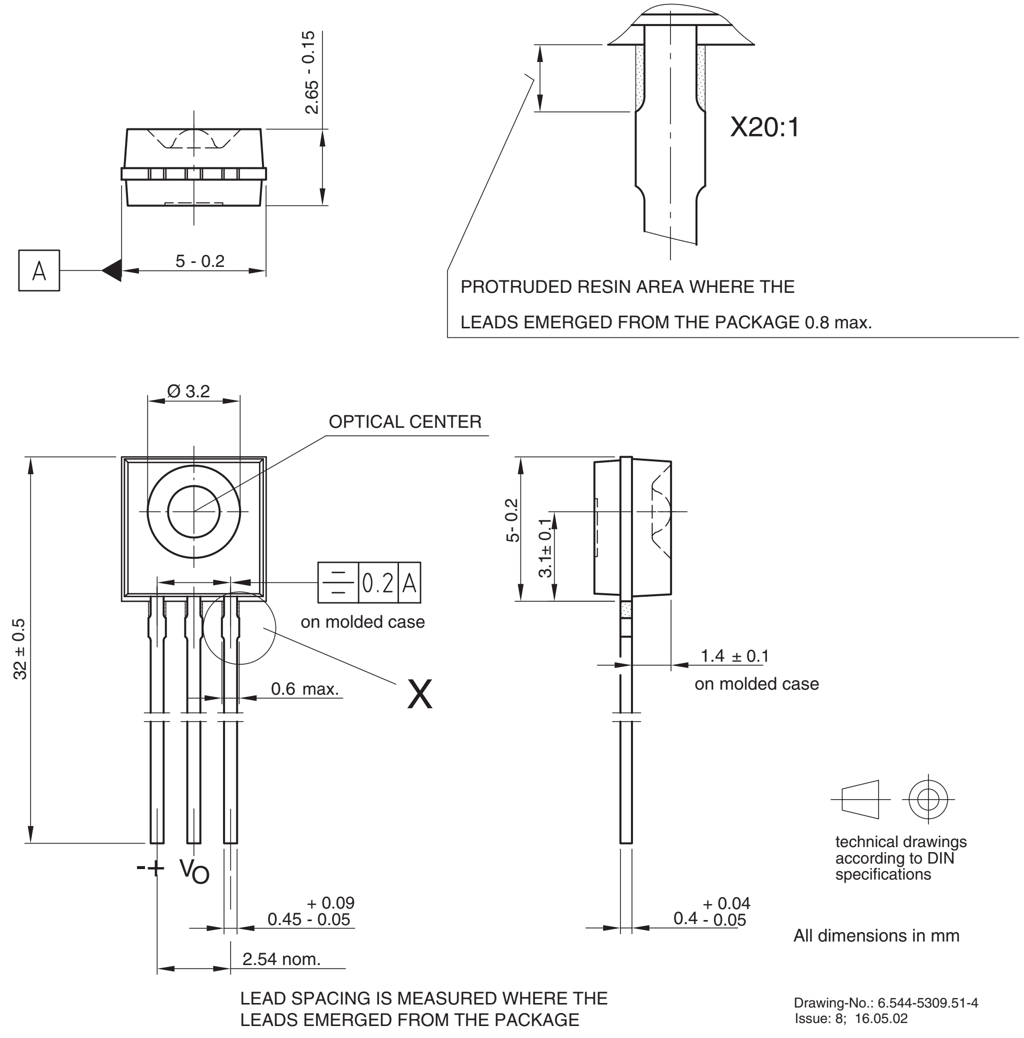


Fig. 7 - Relative Radiant Sensitivity vs. Angular Displacement

PACKAGE DIMENSIONS in millimeters



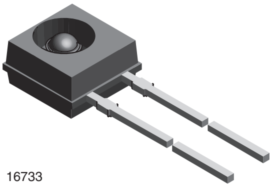
PROTRUDED RESIN AREA WHERE THE LEADS EMERGED FROM THE PACKAGE 0.8 max.

LEAD SPACING IS MEASURED WHERE THE LEADS EMERGED FROM THE PACKAGE

All dimensions in mm

Drawing-No.: 6.544-5309.51-4
Issue: 8; 16.05.02

Silicon NPN Phototransistor, RoHS Compliant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DESCRIPTION

TEKT5400S is a silicon NPN phototransistor with high radiant sensitivity, molded in a plastic package with side view lens and daylight blocking filter. Filter bandwidth is matched with 950 nm IR emitters.

FEATURES

- Package type: leaded
- Package form: side view lens
- Dimensions (L x W x H in mm): 5 x 2.65 x 5
- High radiant sensitivity
- Daylight blocking filter matched with 940 nm emitters
- Fast response times
- Angle of half sensitivity: φ = ± 37°
- Package matched with IR emitter series TSKS5400S
- Lead (Pb)-free component in accordance with RoHS 2002/95/EC and WEEE 2002/96/EC

Pb-free

e3

RoHS
COMPLIANT

APPLICATIONS

- Detector in electronic control and drive circuits

PRODUCT SUMMARY

COMPONENT	I_{ca} (mA)	φ (deg)	$\lambda_{0.5}$ (nm)
TEKT5400S	4	± 37	850 to 980

Note
Test condition see table "Basic Characteristics"

ORDERING INFORMATION

ORDERING CODE	PACKAGING	REMARKS	PACKAGE FORM
TEKT5400S	Bulk	MOQ: 2000 pcs, 2000 pcs/bulk	Side view lens

Note
MOQ: minimum order quantity

ABSOLUTE MAXIMUM RATINGS

PARAMETER	TEST CONDITION	SYMBOL	VALUE	UNIT
Collector emitter voltage		V_{CEO}	70	V
Emitter collector voltage		V_{ECO}	7	V
Collector current		I_C	100	mA
Collector peak current	$t_p/T \leq 0.5$, $t_p \leq 10$ ms	I_{CM}	200	mA
Power dissipation	$T_{amb} \leq 40$ °C	P_V	150	mW
Junction temperature		T_j	100	°C
Operating temperature range		T_{amb}	- 40 to + 85	°C
Storage temperature range		T_{stg}	- 40 to + 100	°C
Soldering temperature	$t \leq 5$ s	T_{sd}	260	°C
Thermal resistance junction/ambient	J-STD-051, soldered on PCB	R_{thJA}	270	K/W

Note
T_{amb} = 25 °C, unless otherwise specified

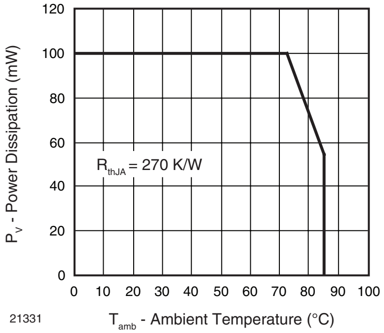


Fig. 1 - Power Dissipation Limit vs. Ambient Temperature

BASIC CHARACTERISTICS						
PARAMETER	**TEST CONDITION**	**SYMBOL**	**MIN.**	**TYP.**	**MAX.**	**UNIT**
Collector emitter voltage	$I_C = 1$ mA	V_{CEO}	70			V
Emitter collector voltage	$I_E = 100$ µA	V_{ECO}	7			V
Collector dark current	$V_{CE} = 20$ V, E = 0	I_{CEO}		1	100	nA
Collector emitter capacitance	$V_{CE} = 5$ V, f = 1 MHz, E = 0	C_{CEO}		6		pF
Collector ligth current	$E_e = 1$ mW/cm^2, $\lambda = 950$ nm, $V_{CE} = 5$ V	I_{ca}	2	4		mA
Angle of half sensitivity		φ		± 37		deg
Wavelength of peak sensitivity		λ_p		920		nm
Range of spectral bandwidth		$\lambda_{0.5}$		850 to 980		nm
Collector emitter saturation voltage	$E_e = 1$ mW/cm^2, $\lambda = 950$ nm, $I_C = 0.1$ mA	V_{CEsat}			0.3	V
Turn-on time	$V_S = 5$ V, $I_C = 5$ mA, $R_L = 100\ \Omega$	t_{on}		6		µs
Turn-off time	$V_S = 5$ V, $I_C = 5$ mA, $R_L = 100\ \Omega$	t_{off}		5		µs
Cut-off frequency	$V_S = 5$ V, $I_C = 5$ mA, $R_L = 100\ \Omega$	f_c		110		kHz

Note

$T_{amb} = 25$ °C, unless otherwise specified

BASIC CHARACTERISTICS

$T_{amb} = 25$ °C, unless otherwise specified

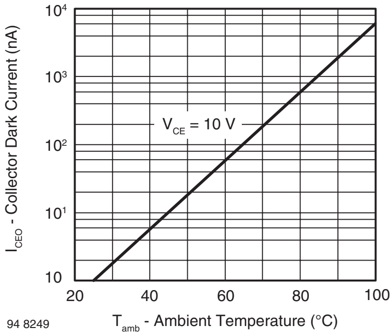


Fig. 2 - Collector Dark Current vs. Ambient Temperature

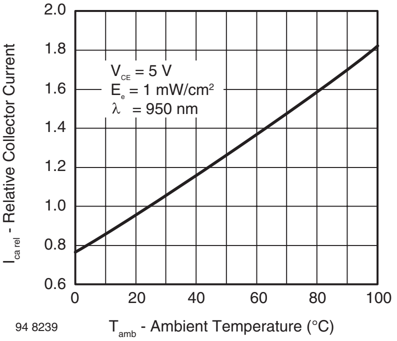


Fig. 3 - Relative Collector Current vs. Ambient Temperature

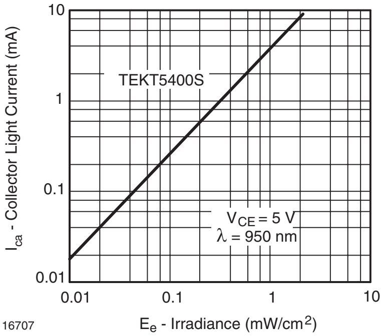


Fig. 4 - Collector Light Current vs. Irradiance

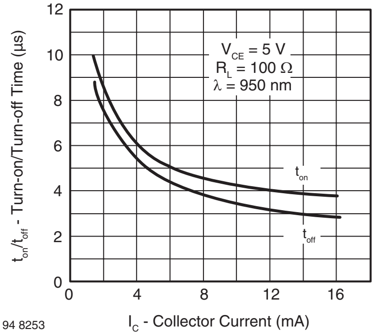


Fig. 7 - Turn-on/Turn-off Time vs. Collector Current

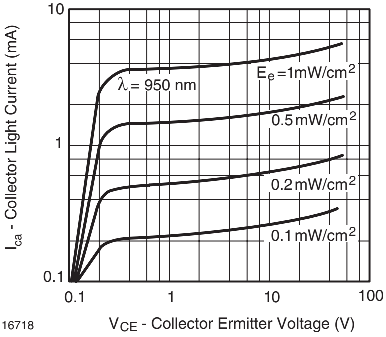


Fig. 5 - Collector Light Current vs. Collector Emitter Voltage

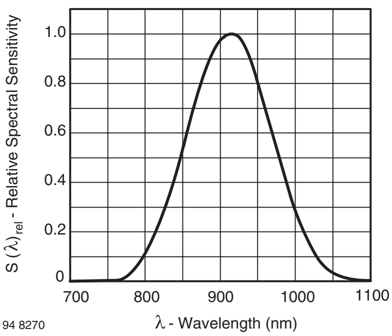


Fig. 8 - Relative Spectral Sensitivity vs. Wavelength

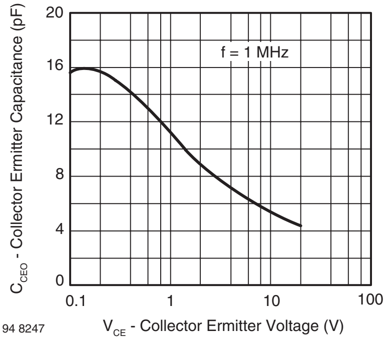


Fig. 6 - Collector Emitter Capacitance vs. Collector Emitter Voltage

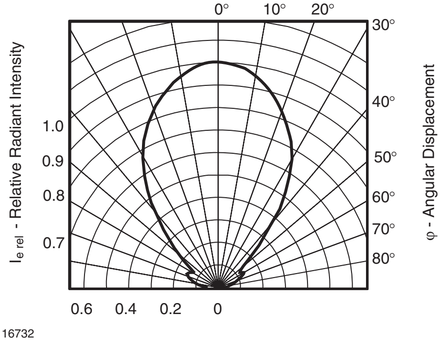
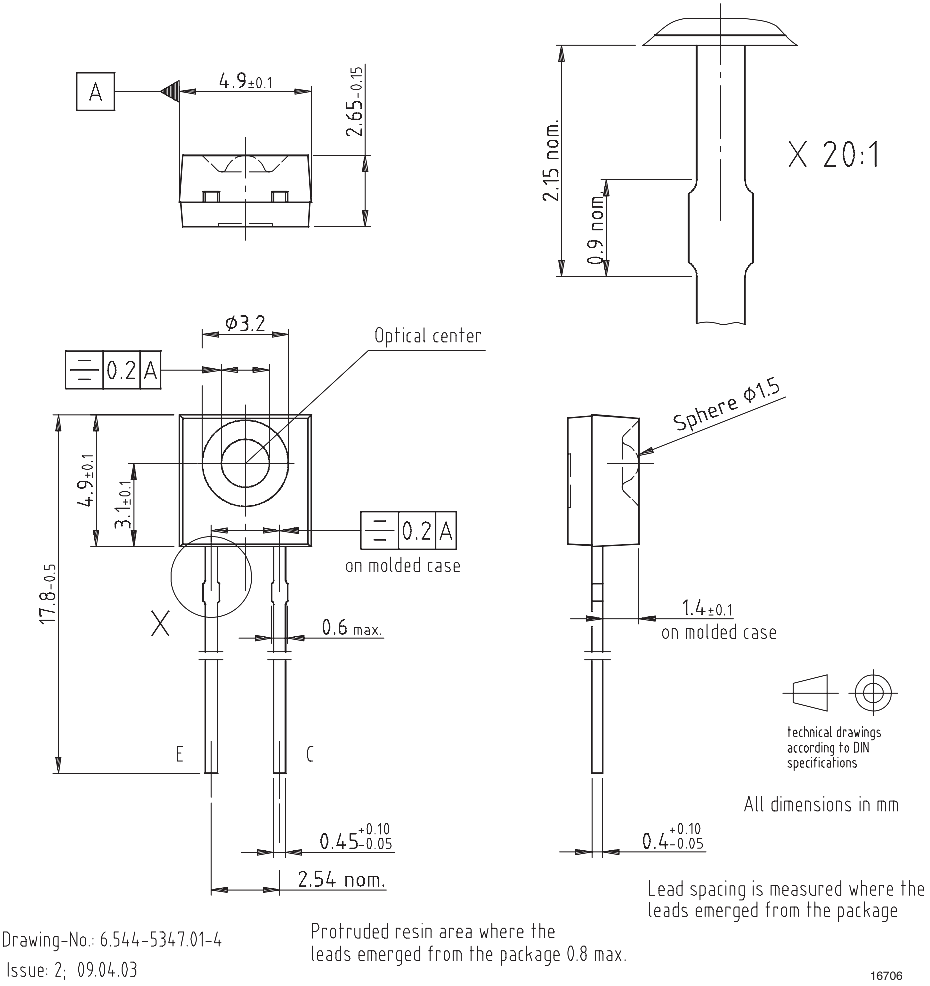


Fig. 9 - Relative Radiant Intensity vs. Angular Displacement

PACKAGE DIMENSIONS in millimeters



All dimensions in mm

Lead spacing is measured where the leads emerged from the package

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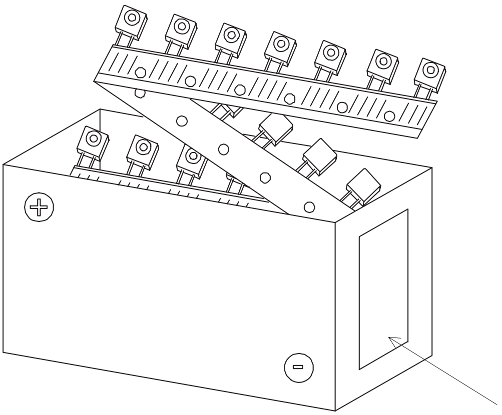
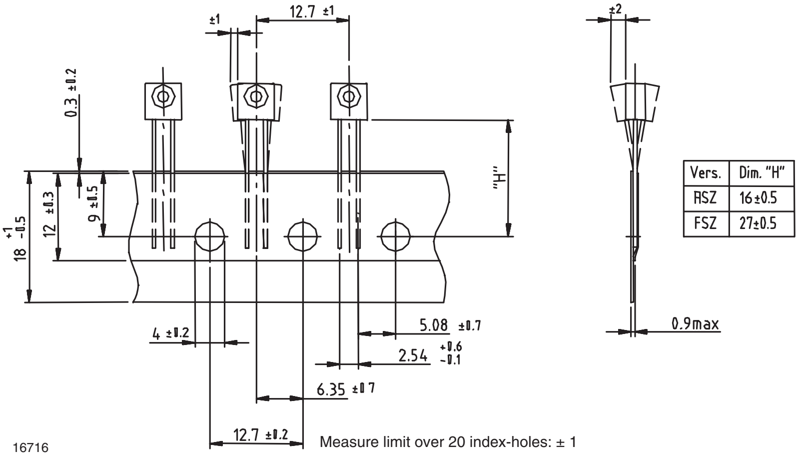
Protruded resin area where the leads emerged from the package 0.8 max.

TAPE AND AMMOPACK STANDARDS Dimensions in millimeters



Labeling: barcode-label see 5.6.4



Vers.	Dim. "H"
ASZ	16±0.5
FSZ	27±0.5

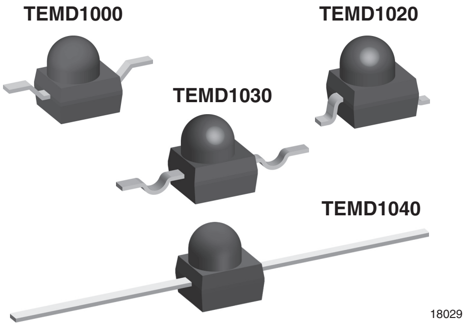
Measure limit over 20 index-holes: ± 1

16716

TEMD1000, TEMD1020, TEMD1030, TEMD1040

Vishay Semiconductors

Silicon PIN Photodiode, RoHS Compliant



DESCRIPTION

TEMD1000 series are PIN photodiodes with high speed and high radiant sensitivity in black, surface mount plastic packages with lens and daylight blocking filter. Filter bandwidth is matched with 870 nm to 950 nm IR emitters.

FEATURES

- Package type: surface mount
- Package form: GW, RGW, yoke, axial
- Dimensions (L x W x H in mm): 2.5 x 2 x 2.7
- Radiant sensitive area (in mm^2): 0.23
- High radiant sensitivity
- Daylight blocking filter matched with 870 nm to 950 nm emitters
- Fast response times
- Angle of half sensitivity: $\varphi = \pm 15°$
- Package matches with IR emitter series TSMF1000
- Floor life: 168 h, MSL 3, acc. J-STD-020
- Lead (Pb)-free component in accordance with RoHS 2002/95/EC and WEEE 2002/96/EC

APPLICATIONS

- High speed detector for infrared radiation
- Infrared remote control and free air data transmissionsystems, e.g. in combination with TSFFxxxx series IR emitters

PRODUCT SUMMARY

COMPONENT	I_{ra} (mA)	φ (deg)	$\lambda_{0.5}$ (nm)
TEMD1000	12	± 15	790 to 1050
TEMD1020	12	± 15	790 to 1050
TEMD1030	12	± 15	790 to 1050
TEMD1040	12	± 15	790 to 1050

Note

Test conditions see table “Basic Characteristics”

ORDERING INFORMATION

ORDERING CODE	PACKAGING	REMARKS	PACKAGE FORM
TEMD1000	Tape and reel	MOQ: 1000 pcs, 1000 pcs/reel	Reverse gullwing
TEMD1020	Tape and reel	MOQ: 1000 pcs, 1000 pcs/reel	Gullwing
TEMD1030	Tape and reel	MOQ: 1000 pcs, 1000 pcs/reel	Yoke
TEMD1040	Bulk	MOQ: 1000 pcs, 1000 pcs/bulk	Axial leads

Note

MOQ: minimum order quantity

ABSOLUTE MAXIMUM RATINGS

PARAMETER	TEST CONDITION	SYMBOL	VALUE	UNIT
Reverse voltage		V_R	60	V
Power dissipation	$T_{amb} \leq 25$ °C	P_V	75	mW
Junction temperature		T_j	100	°C
Operating temperature range		T_{amb}	- 40 to + 85	°C
Storage temperature range		T_{stg}	- 40 to + 100	°C
Soldering temperature	$t \leq 5$ s	T_{sd}	< 260	°C

Note

T_{amb} = 25 °C, unless otherwise specified

BASIC CHARACTERISTICS						
PARAMETER	**TEST CONDITION**	**SYMBOL**	**MIN.**	**TYP.**	**MAX.**	**UNIT**
Forward voltage	I_F = 50 mA	V_F		1	1.3	V
Breakdown voltage	I_R = 100 µA, E = 0	$V_{(BR)}$	60			V
Reverse dark current	V_R = 10 V, E = 0	I_{ro}		1	10	nA
Diode capacitance	V_R = 5 V, f = 1 MHz, E = 0	C_D		1.8		pF
Reverse light current	E_e = 1 mW/cm², λ = 870 nm, V_R = 5 V	I_{ra}		10		µA
	E_e = 1 mW/cm², λ = 950 nm, V_R = 5 V	I_{ra}	5	12		µA
Temperature coefficient of I_{ra}	V_R = 5 V, λ = 870 nm,	TK_{Ira}		0.2		%/K
Absolute spectral sensitivity	V_R = 5 V, λ = 870 nm	s(λ)		0.60		A/W
	V_R = 5 V, λ = 950 nm	s(λ)		0.55		A/W
Angle of half sensitivity		φ		± 15		deg
Wavelength of peak sensitivity		λ_p		940		nm
Range of spectral bandwidth		$\lambda_{0.5}$		790 to 1050		nm
Rise time	V_R = 10 V, R_L = 50 Ω, λ = 820 nm	t_r		4		ns
Fall time	V_R = 10 V, R_L = 50 Ω, λ = 820 nm	t_f		4		ns

Note
T_{amb} = 25 °C, unless otherwise specified

BASIC CHARACTERISTICS

T_{amb} = 25 °C, unless otherwise specified

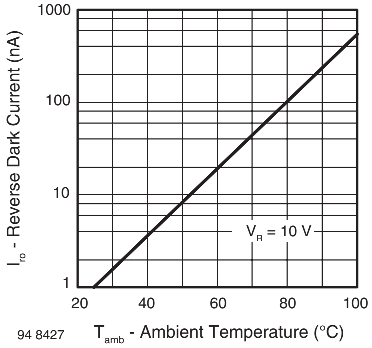


Fig. 1 - Reverse Dark Current vs. Ambient Temperature

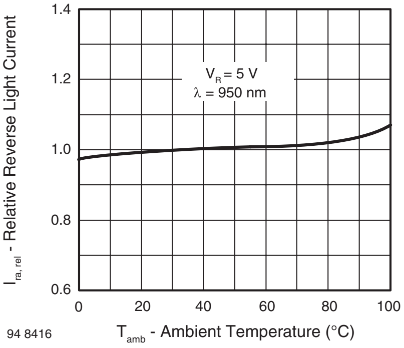


Fig. 2 - Relative Reverse Light Current vs. Ambient Temperature

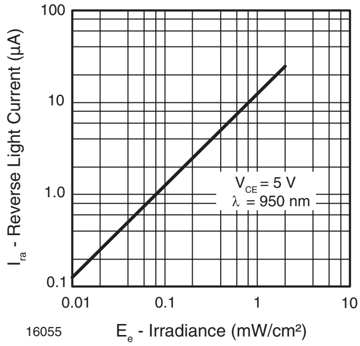


Fig. 3 - Reverse Light Current vs. Irradiance

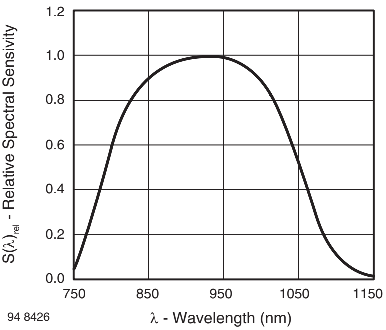


Fig. 5 - Relative Spectral Sensitivity vs. Wavelength

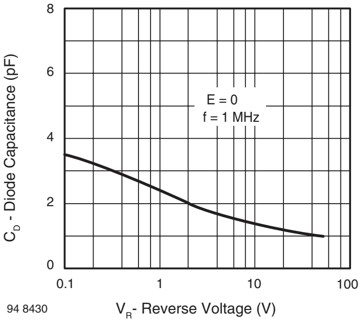


Fig. 4 - Diode Capacitance vs. Reverse Voltage

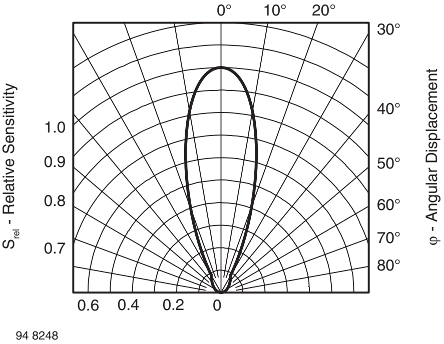


Fig. 6 - Relative Radiant Sensitivity vs. Angular Displacement

PRECAUTIONS FOR USE

1. Over-current-proof

Customer must apply resistors for protection, otherwise slight voltage shift will cause big current change (burn out will happen).

2. Storage

2.1 Storage temperature and rel. humidity conditions are: 5 °C to 35 °C, R.H. 60 %.

2.2 Floor life must not exceed 168 h, acc. to JEDEC level 3, J-STD-020.
Once the package is opened, the products should be used within a week. Otherwise, they should be kept in a damp proof box with desiccant.
Considering tape life, we suggest to use products within one year from production date.

2.3 If opened more than one week in an atmosphere 5 °C to 35 °C, R.H. 60 %, devices should be treated at 60 °C ± 5 °C for 15 h.

2.4 If humidity indicator in the package shows pink color (normal blue), then devices should be treated with the same conditions as 2.3.

REFLOW SOLDER PROFILE

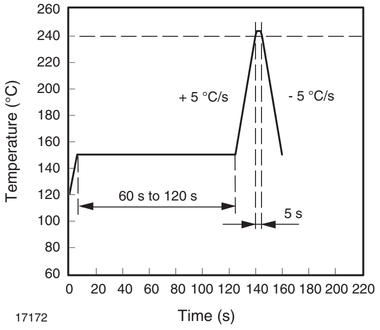
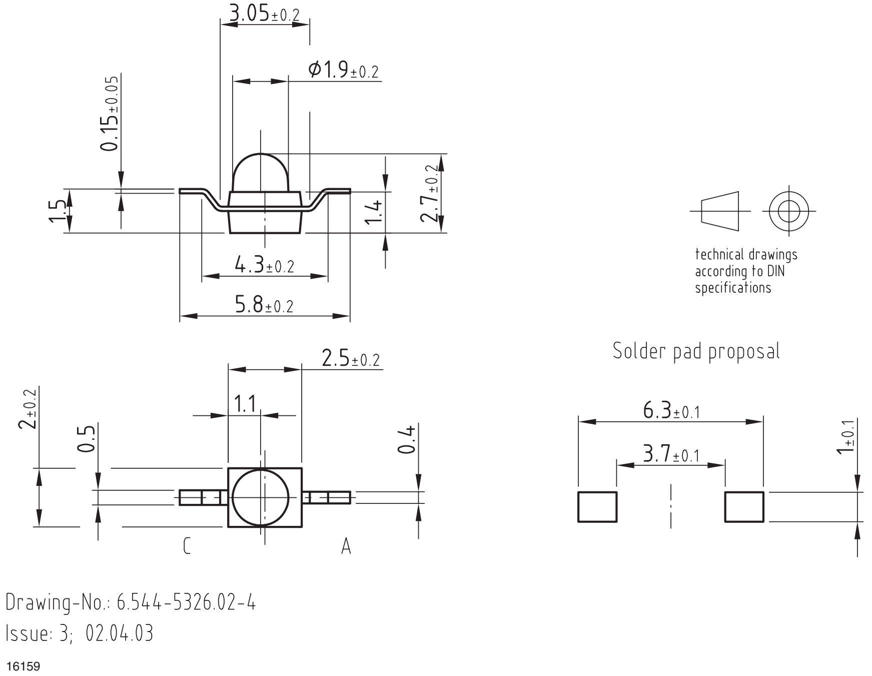
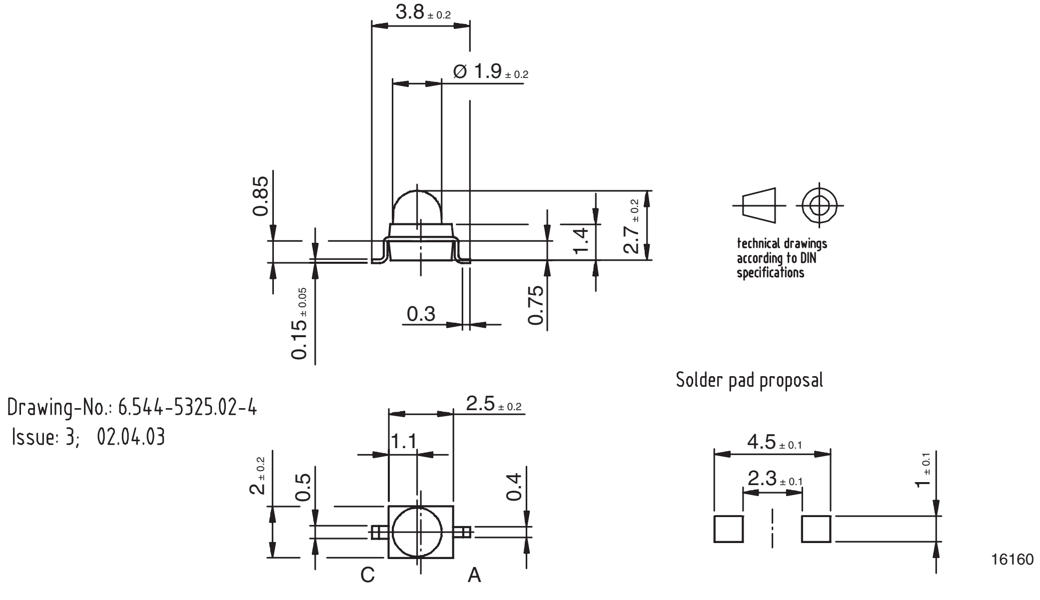


Fig. 7 - Lead Tin (SnPb) Reflow Solder Profile

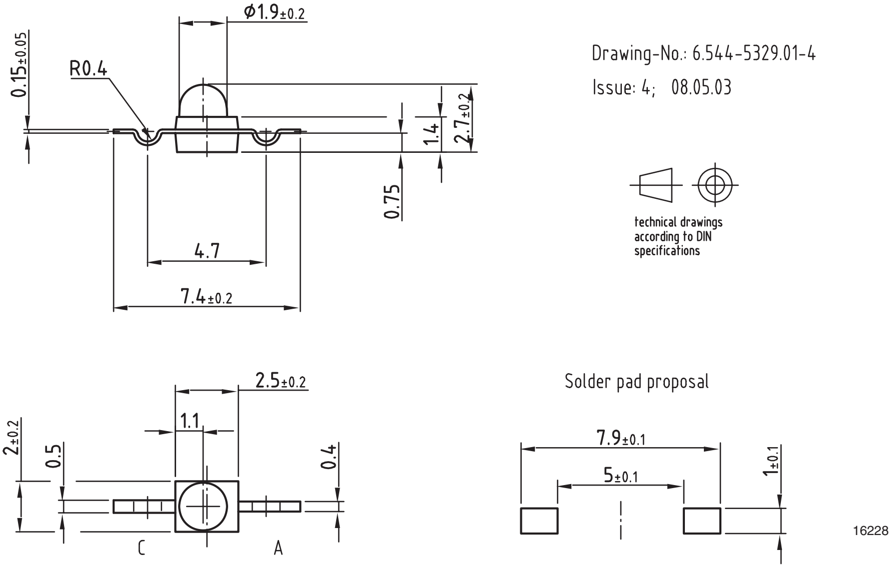
PACKAGE DIMENSIONS in millimeters: **TEMD1000**



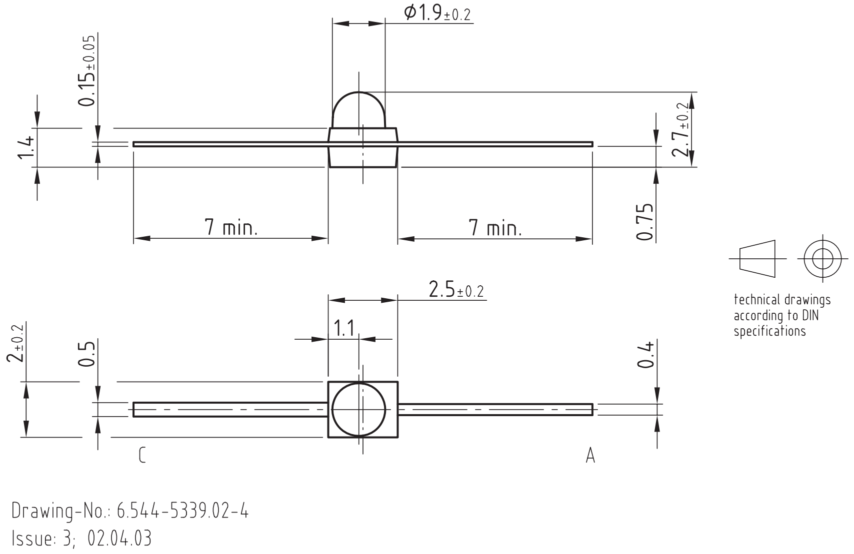
PACKAGE DIMENSIONS in millimeters: **TEMD1020**



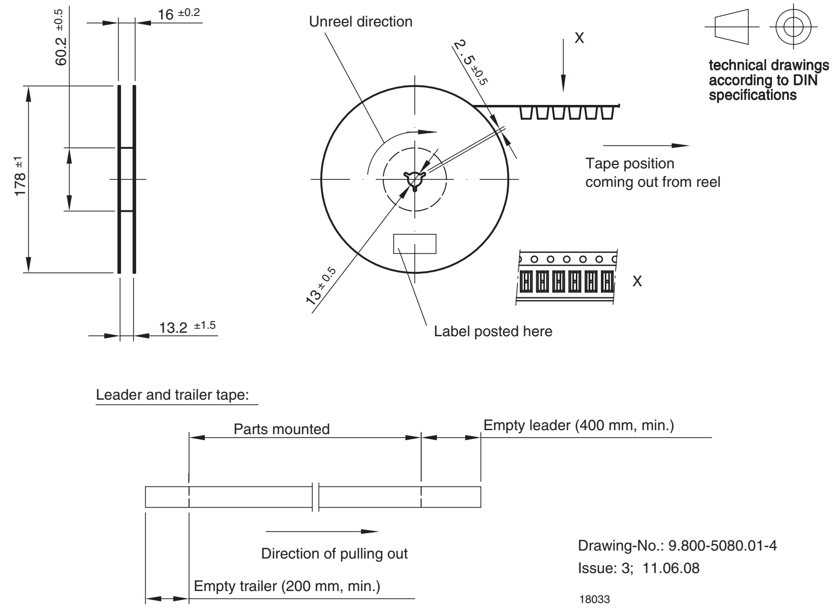
PACKAGE DIMENSIONS in millimeters: **TEMD1030**



PACKAGE DIMENSIONS in millimeters: **TEMD1040**



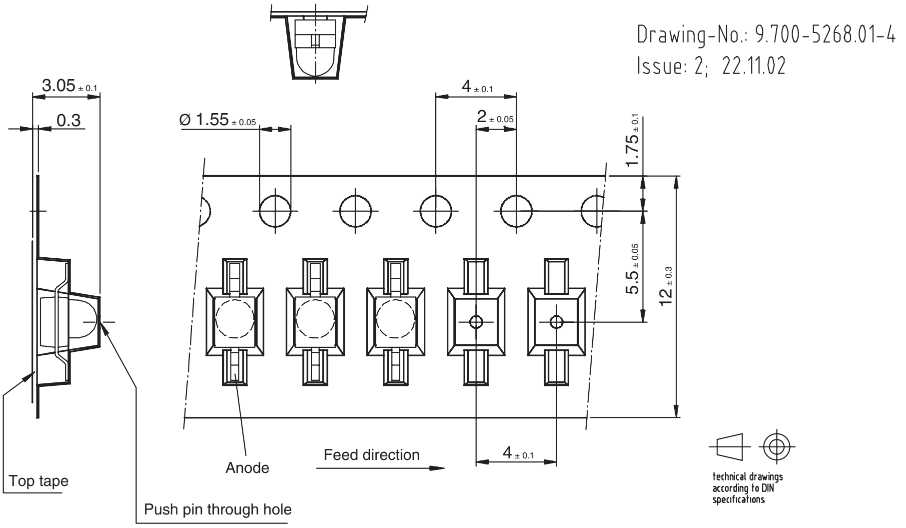
REEL DIMENSIONS in millimeters



Drawing-No.: 9.800-5080.01-4
Issue: 3; 11.06.08

18033

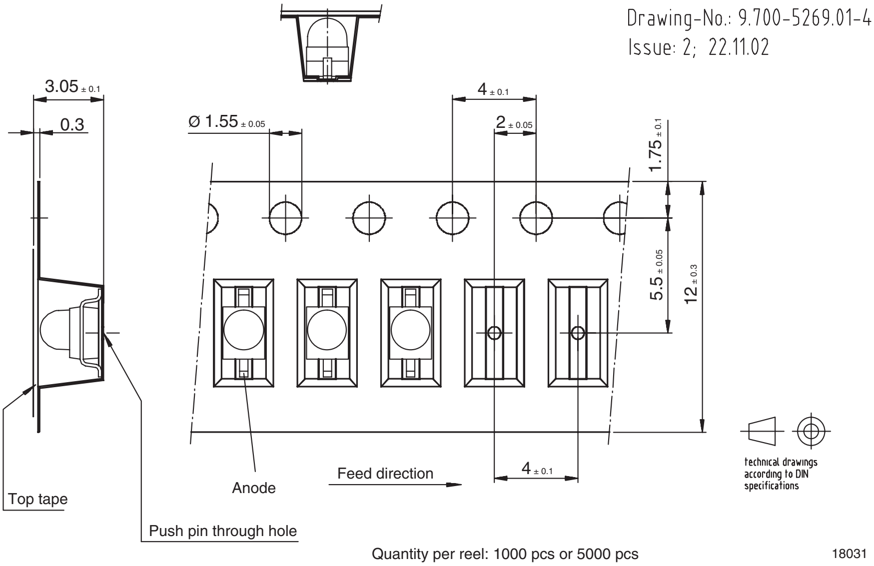
TAPING DIMENSIONS in millimeters: **TEMD1000**



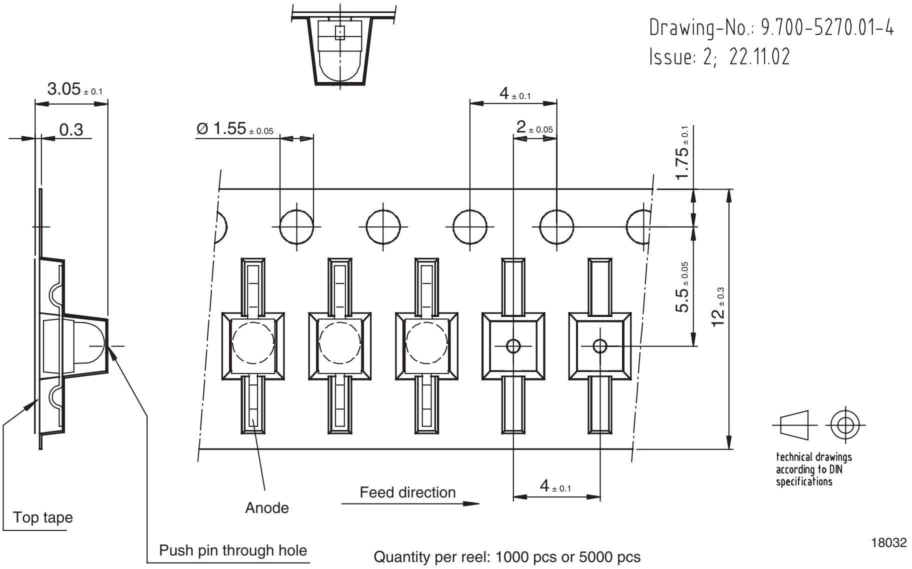
Quantity per reel: 1000 pcs or 5000 pcs

18030

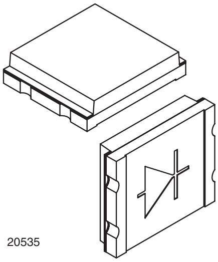
TAPING DIMENSIONS in millimeters: TEMD1020



TAPING DIMENSIONS in millimeters: TEMD1030



Silicon PIN Photodiode, RoHS Compliant, Released for Lead (Pb)-free Reflow Soldering, AEC-Q101 Released



DESCRIPTION

TEMD5010X01 is a high speed and high sensitive PIN photodiode. It is a miniature surface mount device (SMD) including the chip with a 7.5 mm^2 sensitive area detecting visible and near infrared radiation.

FEATURES

- Package type: surface mount
- Package form: top view
- Dimensions (L x W x H in mm): 5 x 4.24 x 1.12
- Radiant sensitive area (in mm^2): 7.5
- Product designed and qualified acc. AEC-Q101 for the automotive market
- High photo sensitivity
- High radiant sensitivity
- Suitable for visible and near infrared radiation
- Fast response times
- Angle of half sensitivity: $\varphi = \pm 65°$
- Floor life: 72 h, MSL 4, acc. J-STD-020
- Lead (Pb)-free reflow soldering
- Lead (Pb)-free component in accordance with RoHS 2002/95/EC and WEEE 2002/96/EC

Pb-free
e4
RoHS
COMPLIANT

APPLICATIONS

- High speed photo detector

PRODUCT SUMMARY

COMPONENT	I_{ra} (µA)	φ (deg)	$\lambda_{0.1}$ (nm)
TEMD5010X01	55	± 65	430 to 1100

Note

Test conditions see table “Basic Characteristics”

ORDERING INFORMATION

ORDERING CODE	PACKAGING	REMARKS	PACKAGE FORM
TEMD5010X01	Tape and reel	MOQ: 1500 pcs, 1500 pcs/reel	Top view

Note

MOQ: minimum order quantity

ABSOLUTE MAXIMUM RATINGS

PARAMETER	TEST CONDITION	SYMBOL	VALUE	UNIT
Reverse voltage		V_R	60	V
Power dissipation	$T_{amb} \leq 25$ °C	P_V	215	mW
Junction temperature		T_j	100	°C
Operating temperature range		T_{amb}	- 40 to + 100	°C
Storage temperature range		T_{stg}	- 40 to + 100	°C
Soldering temperature	Acc. reflow solder profile fig. 8	T_{sd}	260	°C
Thermal resistance junction/ambient		R_{thJA}	350	K/W

Note

T_{amb} = 25 °C, unless otherwise specified

BASIC CHARACTERISTICS						
PARAMETER	**TEST CONDITION**	**SYMBOL**	**MIN.**	**TYP.**	**MAX.**	**UNIT**
Forward voltage	I_F = 50 mA	V_F		1	1.3	V
Breakdown voltage	I_R = 100 µA, E = 0	$V_{(BR)}$	60			V
Reverse dark current	V_R = 10 V, E = 0	I_{ro}		2	30	nA
Diode capacitance	V_R = 0 V, f = 1 MHz, E = 0	C_D		70		pF
	V_R = 3 V, f = 1 MHz, E = 0	C_D		25	40	pF
Open circuit voltage	E_e = 1 mW/cm², λ = 950 nm	V_o		350		mV
Temperature coefficient of V_o	E_e = 1 mW/cm², λ = 950 nm	TK_{Vo}		- 2.6		mV/K
Short circuit current	E_e = 1 mW/cm², λ = 950 nm	I_k		50		µA
Temperature coefficient of I_k	E_e = 1 mW/cm², λ = 950 nm	TK_{Ik}		0.1		%/K
Reverse light current	E_e = 1 mW/cm², λ = 950 nm, V_R = 5 V	I_{ra}	45	55		µA
Angle of half sensitivity		φ		± 65		deg
Wavelength of peak sensitivity		λ_p		940		nm
Range of spectral bandwidth		$\lambda_{0.1}$		430 to 1100		nm
Noise equivalent power	V_R = 10 V, λ = 950 nm	NEP		4×10^{-14}		W/√Hz
Rise time	V_R = 10 V, R_L = 1 kΩ, λ = 820 nm	t_r		100		ns
Fall time	V_R = 10 V, R_L = 1 kΩ, λ = 820 nm	t_f		100		ns

Note

T_{amb} = 25 °C, unless otherwise specified

BASIC CHARACTERISTICS

T_{amb} = 25 °C, unless otherwise specified

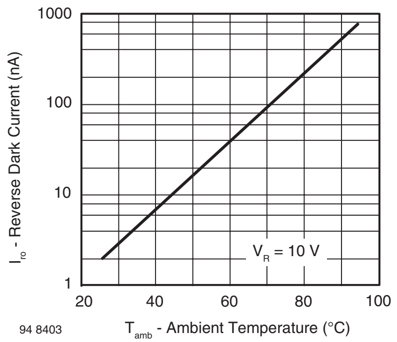


Fig. 1 - Reverse Dark Current vs. Ambient Temperature

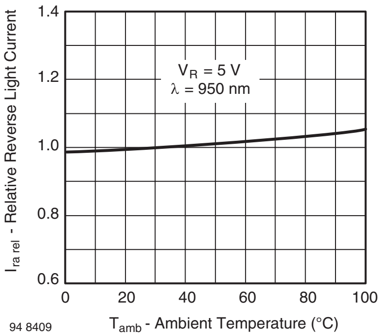


Fig. 2 - Relative Reverse Light Current vs. Ambient Temperature

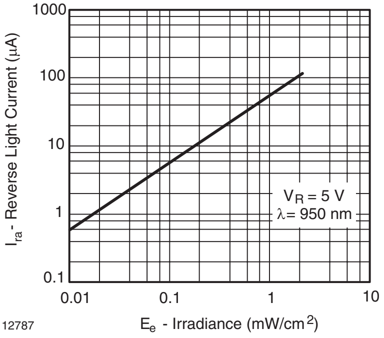


Fig. 3 - Reverse Light Current vs. Irradiance

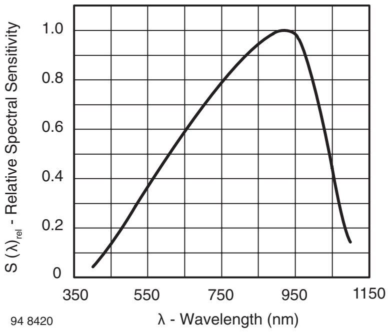


Fig. 6 - Relative Spectral Sensitivity vs. Wavelength

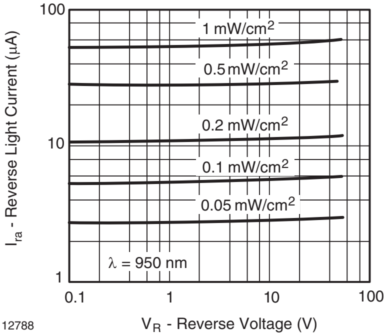


Fig. 4 - Reverse Light Current vs. Reverse Voltage

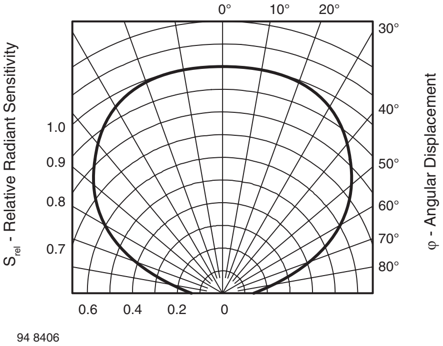


Fig. 7 - Relative Radiant Sensitivity vs. Angular Displacement

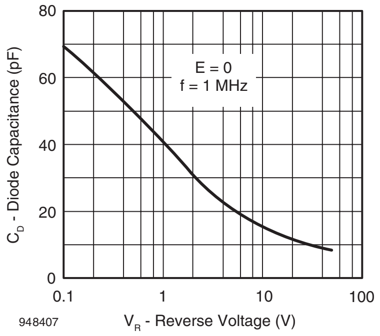
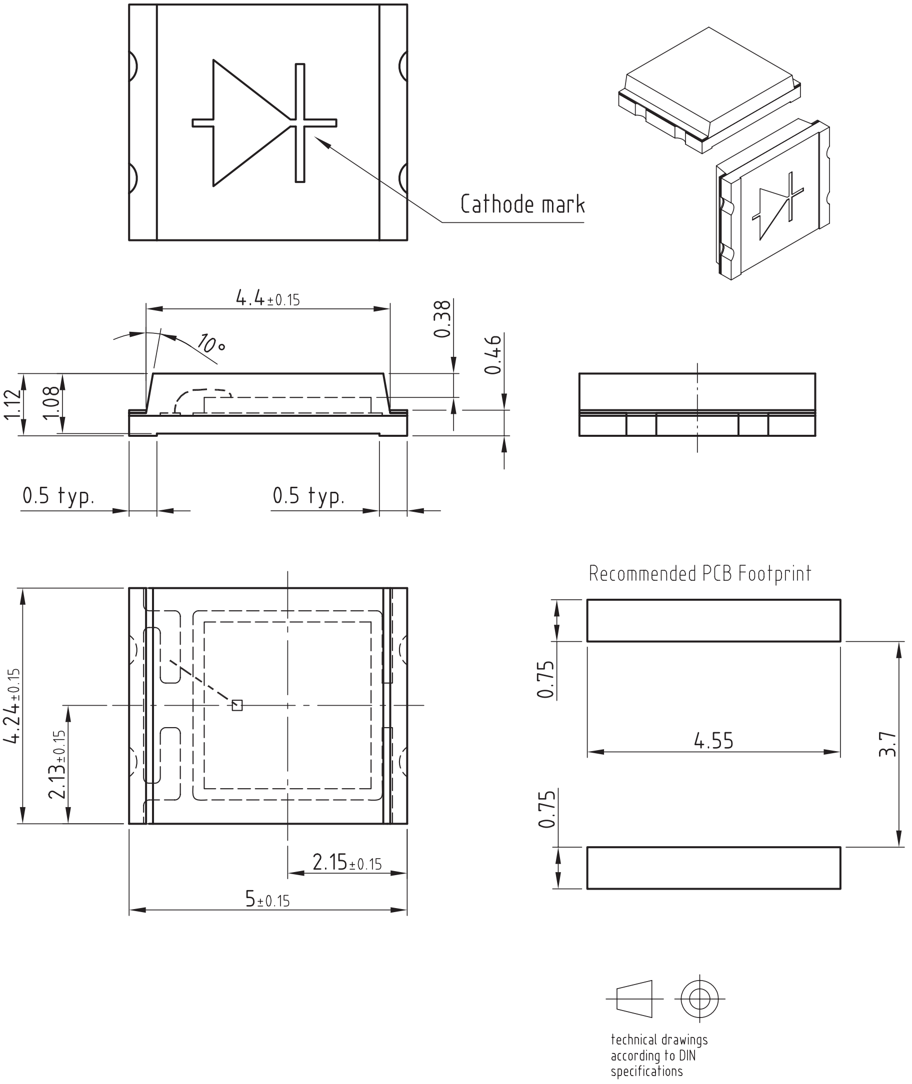


Fig. 5 - Diode Capacitance vs. Reverse Voltage

PACKAGE DIMENSIONS in millimeters



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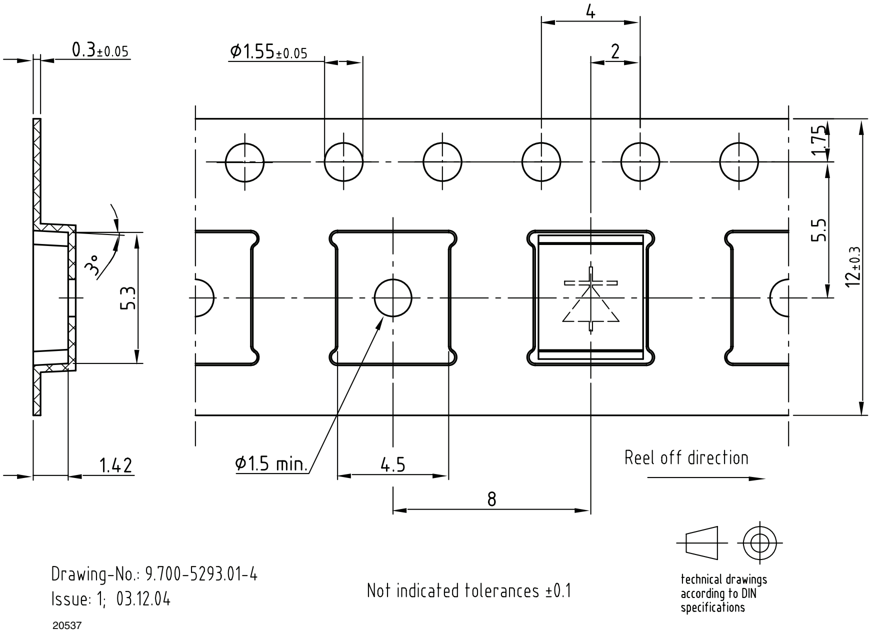
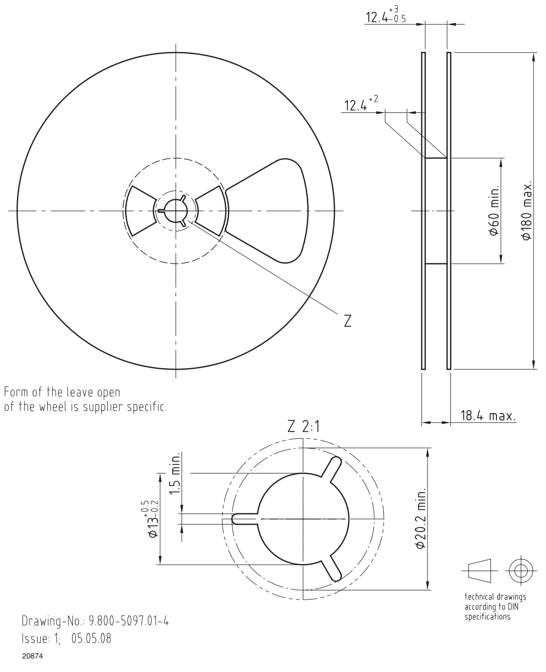
Issue: 3; 05.02.08
20536

Not indicated tolerances ± 0.1

TAPING DIMENSIONS in millimeters



REEL DIMENSIONS in millimeters



SOLDER PROFILE

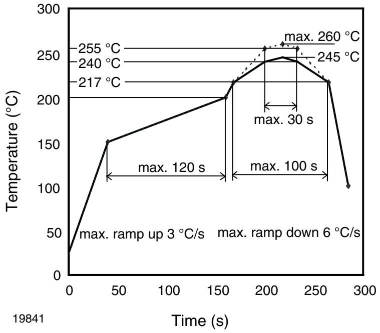


Fig. 8 - Lead (Pb)-free Reflow Solder Profile acc. J-STD-020D

DRYPACK

Devices are packed in moisture barrier bags (MBB) to prevent the products from moisture absorption during transportation and storage. Each bag contains a desiccant.

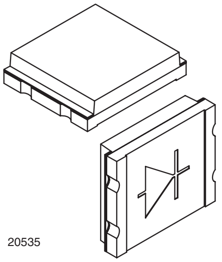
FLOOR LIFE

Time between soldering and removing from MBB must not exceed the time indicated in J-STD-020:
Moisture sensitivity: level 4
Floor life: 72 h
Conditions: T_{amb} < 30 °C, RH < 60 %

DRYING

In case of moisture absorption devices should be baked before soldering. Conditions see J-STD-020 or recommended conditions:
192 h at 40 °C (+ 5 °C), RH < 5 %
or
96 h at 60 °C (+ 5 °C), RH < 5 %.

Silicon PIN Photodiode, RoHS Compliant, Released for Lead (Pb)-free Reflow Soldering, AEC-Q101 Released



FEATURES

- Package type: surface mount
- Package form: top view
- Dimensions (L x W x H in mm): 5 x 4.24 x 1.12
- Radiant sensitive area (in mm^2): 4.4
- Product designed and qualified acc. AEC-Q101 for the automotive market
- High photo sensitivity
- High radiant sensitivity
- Suitable for visible and near infrared radiation
- Fast response times
- Angle of half sensitivity: $\varphi = \pm 65°$
- Floor life: 72 h, MSL 4, acc. J-STD-020
- Lead (Pb)-free reflow soldering
- Lead (Pb)-free component in accordance with RoHS 2002/95/EC and WEEE 2002/96/EC

Pb-free
e4
RoHS
COMPLIANT

DESCRIPTION

TEMD5020X01 is a high speed and high sensitive PIN photodiode. It is a miniature surface mount device (SMD) including the chip with a 4.4 mm^2 sensitive area detecting visible and near infrared radiation.

APPLICATIONS

- High speed photo detectors

PRODUCT SUMMARY

COMPONENT	I_{ra} (µA)	φ (deg)	$\lambda_{0.1}$ (nm)
TEMD5020X01	35	± 65	430 to 1100

Note
Test conditions see table "Basic Characteristics"

ORDERING INFORMATION

ORDERING CODE	PACKAGING	REMARKS	PACKAGE FORM
TEMD5020X01	Tape and reel	MOQ: 1500 pcs, 1500 pcs/reel	Top view

Note
MOQ: minimum order quantity

ABSOLUTE MAXIMUM RATINGS

PARAMETER	TEST CONDITION	SYMBOL	VALUE	UNIT
Reverse voltage		V_R	60	V
Power dissipation	$T_{amb} \leq 25$ °C	P_V	215	mW
Junction temperature		T_j	100	°C
Operating temperature range		T_{amb}	- 40 to + 100	°C
Storage temperature range		T_{stg}	- 40 to + 100	°C
Soldering temperature	Acc. reflow solder profile fig. 8	T_{sd}	260	°C
Thermal resistance junction/ambient	Soldered on PCB with pad dimensions: 4 mm x 4 mm	R_{thJA}	350	K/W

Note
T_{amb} = 25 °C, unless otherwise specified

BASIC CHARACTERISTICS

PARAMETER	TEST CONDITION	SYMBOL	MIN.	TYP.	MAX.	UNIT
Forward voltage	I_F = 50 mA	V_F		1	1.3	V
Breakdown voltage	I_R = 100 µA, E = 0	$V_{(BR)}$	60			V
Reverse dark current	V_R = 10 V, E = 0	I_{ro}		2	30	nA
Diode capacitance	V_R = 0 V, f = 1 MHz, E = 0	C_D		48		pF
	V_R = 3 V, f = 1 MHz, E = 0	C_D		17	40	pF
Open circuit voltage	E_e = 1 mW/cm^2, λ = 950 nm	V_o		350		mV
Temperature coefficient of V_o	E_e = 1 mW/cm^2, λ = 950 nm	TK_{Vo}		- 2.6		mV/K
Short circuit current	E_e = 1 mW/cm^2, λ = 950 nm	I_k		32		µA
Temperature coefficient of I_k	E_e = 1 mW/cm^2, λ = 950 nm	TK_{Ik}		0.1		%/K
Reverse light current	E_e = 1 mW/cm^2, λ = 950 nm, V_R = 5 V	I_{ra}	25	35		µA
Angle of half sensitivity		φ		± 65		deg
Wavelength of peak sensitivity		λ_p		900		nm
Range of spectral bandwidth		$\lambda_{0.1}$		430 to 1100		nm
Noise equivalent power	V_R = 10 V, λ = 950 nm	NEP		4 x 10^{-14}		W/√Hz
Rise time	V_R = 10 V, R_L = 1 kΩ, λ = 820 nm	t_r		100		ns
Fall time	V_R = 10 V, R_L = 1 kΩ, λ = 820 nm	t_f		100		ns

Note

T_{amb} = 25 °C, unless otherwise specified

BASIC CHARACTERISTICS

T_{amb} = 25 °C, unless otherwise specified

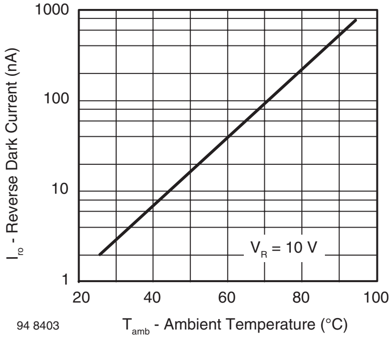


Fig. 1 - Reverse Dark Current vs. Ambient Temperature

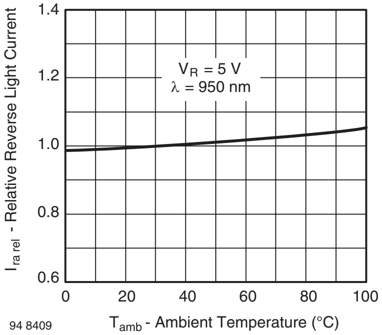


Fig. 2 - Relative Reverse Light Current vs. Ambient Temperature

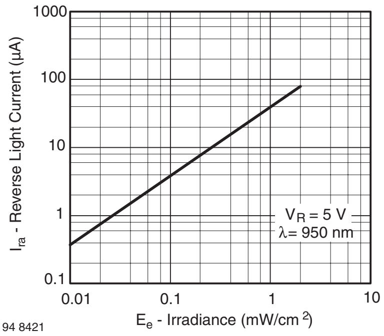


Fig. 3 - Reverse Light Current vs. Irradiance

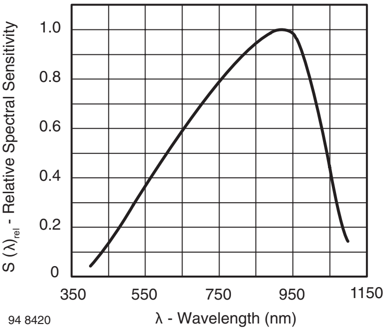


Fig. 6 - Relative Spectral Sensitivity vs. Wavelength

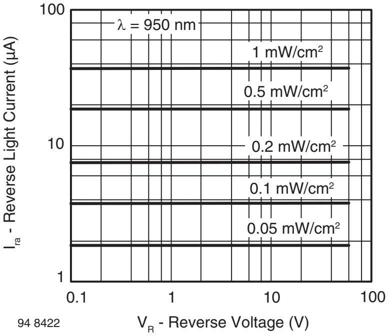


Fig. 4 - Reverse Light Current vs. Reverse Voltage

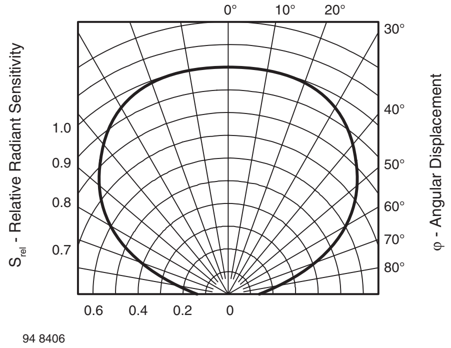


Fig. 7 - Relative Radiant Sensitivity vs. Angular Displacement

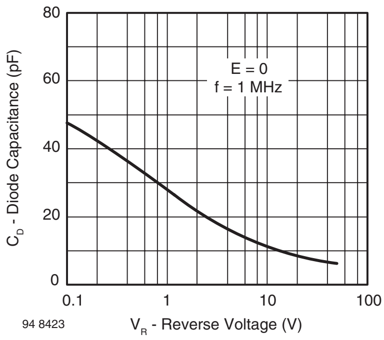
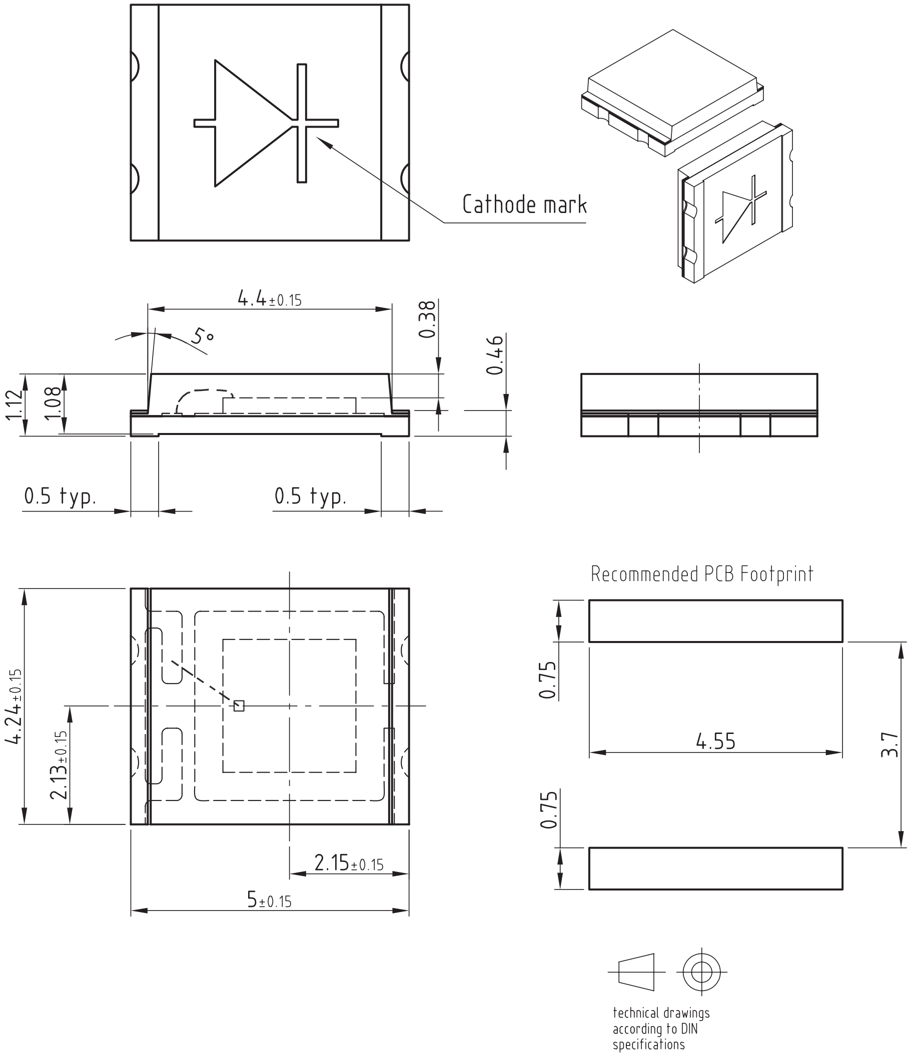


Fig. 5 - Diode Capacitance vs. Reverse Voltage

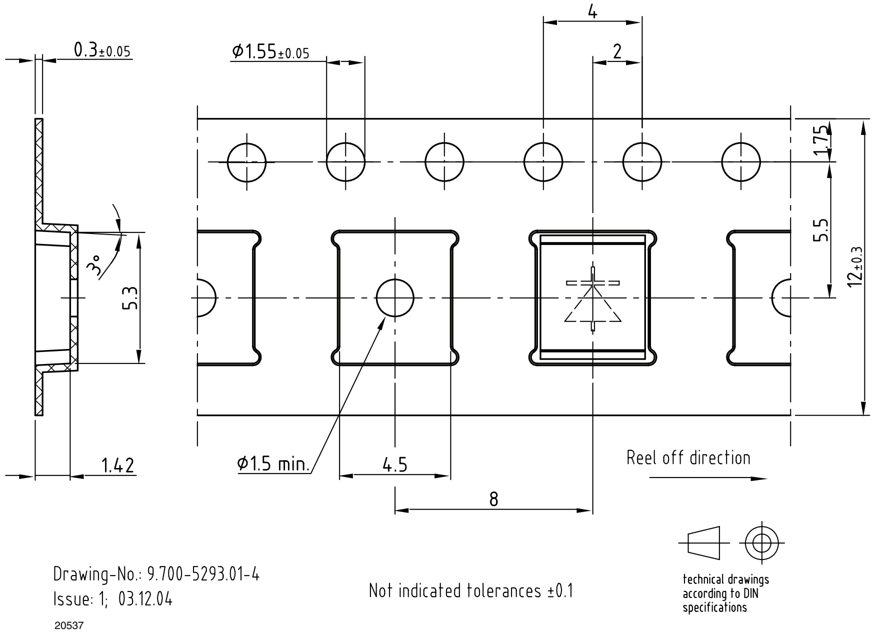
PACKAGE DIMENSIONS in millimeters



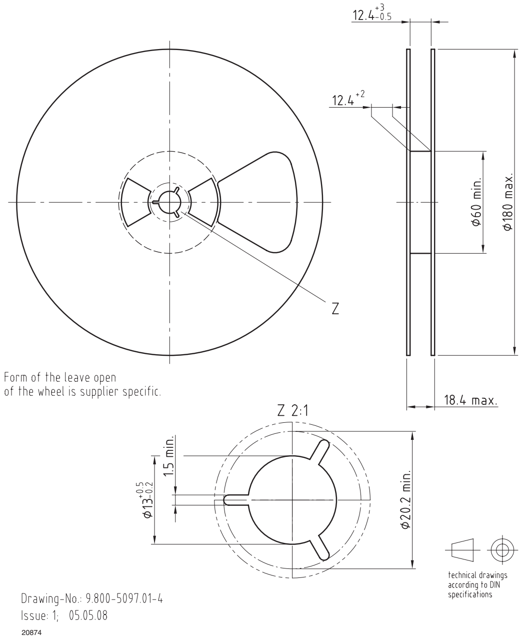
Drawing-No.: 6.541-5059.01-4
Issue: 4; 26.04.07
19280

Not indicated tolerances ± 0.1

TAPING DIMENSIONS in millimeters



REEL DIMENSIONS in millimeters



SOLDER PROFILE

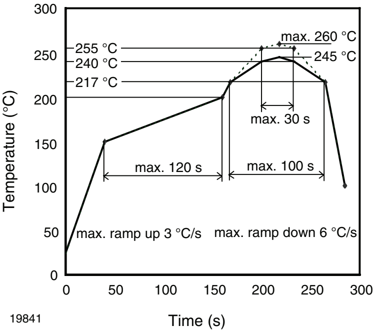


Fig. 8 - Lead (Pb)-free Reflow Solder Profile acc. J-STD-020D

DRYPACK

Devices are packed in moisture barrier bags (MBB) to prevent the products from moisture absorption during transportation and storage. Each bag contains a desiccant.

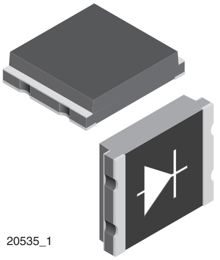
FLOOR LIFE

Time between soldering and removing from MBB must not exceed the time indicated in J-STD-020:
Moisture sensitivity: level 4
Floor life: 72 h
Conditions: T_{amb} < 30 °C, RH < 60 %

DRYING

In case of moisture absorption devices should be baked before soldering. Conditions see J-STD-020 or recommended conditions:
192 h at 40 °C (+ 5 °C), RH < 5 %
or
96 h at 60 °C (+ 5 °C), RH < 5 %.

Silicon PIN Photodiode, RoHS Compliant, Released for Lead (Pb)-free Reflow Soldering, AEC-Q101 Released



FEATURES

- Package type: surface mount
- Package form: top view
- Dimensions (L x W x H in mm): 5 x 4.24 x 1.12
- Radiant sensitive area (in mm^2): 7.5
- Product designed and qualified acc. AEC-Q101 for the automotive market
- High radiant sensitivity
- Daylight blocking filter matched with 870 to 950 nm emitters
- Fast response times
- Angle of half sensitivity: φ = ± 65°
- Floor life: 72 h, MSL 4, acc. J-STD-020
- Lead (Pb)-free reflow soldering
- Lead (Pb)-free component in accordance with RoHS 2002/95/EC and WEEE 2002/96/EC

Pb-free

e4

RoHS
COMPLIANT

DESCRIPTION

TEMD5110X01 is a high speed and high sensitive PIN photodiode. It is a miniature surface mount device (SMD) including the chip with a 7.5 mm^2 sensitive area and a daylight blocking filter matched with IR emitters operating at wavelength 870 nm or 950 nm.

APPLICATIONS

- High speed detector for infrared radiation
- Infrared remote control and free air data transmissionsystems, e.g. in combination with TSFFxxxx series IR emitters

PRODUCT SUMMARY

COMPONENT	I_{ra} (µA)	φ (deg)	$\lambda_{0.5}$ (nm)
TEMD5110X01	55	± 65	790 to 1050

Note
Test conditions see table “Basic Characteristics”

ORDERING INFORMATION

ORDERING CODE	PACKAGING	REMARKS	PACKAGE FORM
TEMD5110X01	Tape and reel	MOQ: 1500 pcs, 1500 pcs/reel	Top view

Note
MOQ: minimum order quantity

ABSOLUTE MAXIMUM RATINGS

PARAMETER	TEST CONDITION	SYMBOL	VALUE	UNIT
Reverse voltage		V_R	60	V
Power dissipation	$T_{amb} \leq 25$ °C	P_V	215	mW
Junction temperature		T_j	100	°C
Operating temperature range		T_{amb}	- 40 to + 100	°C
Storage temperature range		T_{stg}	- 40 to + 100	°C
Soldering temperature	Acc. reflow sloder profile fig. 8	T_{sd}	260	°C
Thermal resistance junction/ambient		R_{thJA}	350	K/W

Note
T_{amb} = 25 °C, unless otherwise specified

BASIC CHARACTERISTICS

PARAMETER	TEST CONDITION	SYMBOL	MIN.	TYP.	MAX.	UNIT
Forward voltage	$I_F = 50$ mA	V_F		1	1.3	V
Breakdown voltage	$I_R = 100$ µA, E = 0	$V_{(BR)}$	60			V
Reverse dark current	$V_R = 10$ V, E = 0	I_{ro}		2	30	nA
Diode capacitance	$V_R = 0$ V, f = 1 MHz, E = 0	C_D		70		pF
	$V_R = 3$ V, f = 1 MHz, E = 0	C_D		25	40	pF
Open circuit voltage	$E_e = 1$ mW/cm², $\lambda = 950$ nm	V_o		350		mV
Temperature coefficient of V_o	$E_e = 1$ mW/cm², $\lambda = 950$ nm	TK_{Vo}		- 2.6		mV/K
Short circuit current	$E_e = 1$ mW/cm², $\lambda = 950$ nm	I_k		50		µA
Temperature coefficient of I_k	$E_e = 1$ mW/cm², $\lambda = 950$ nm	TK_{Ik}		0.1		%/K
Reverse light current	$E_e = 1$ mW/cm², $\lambda = 950$ nm, $V_R = 5$ V	I_{ra}	45	55		µA
Angle of half sensitivity		φ		± 65		deg
Wavelength of peak sensitivity		λ_p		940		nm
Range of spectral bandwidth		$\lambda_{0.5}$		790 to 1050		nm
Noise equivalent power	$V_R = 10$ V, $\lambda = 950$ nm	NEP		4×10^{-14}		W/√Hz
Rise time	$V_R = 10$ V, $R_L = 1$ kΩ, $\lambda = 820$ nm	t_r		100		ns
Fall time	$V_R = 10$ V, $R_L = 1$ kΩ, $\lambda = 820$ nm	t_f		100		ns

Note

$T_{amb} = 25$ °C, unless otherwise specified

BASIC CHARACTERISTICS

$T_{amb} = 25$ °C, unless otherwise specified

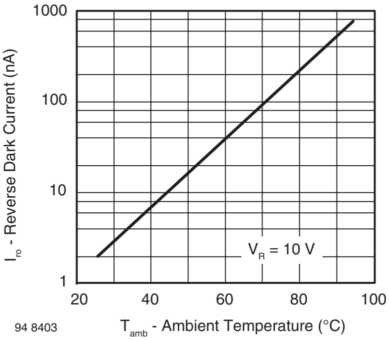


Fig. 1 - Reverse Dark Current vs. Ambient Temperature

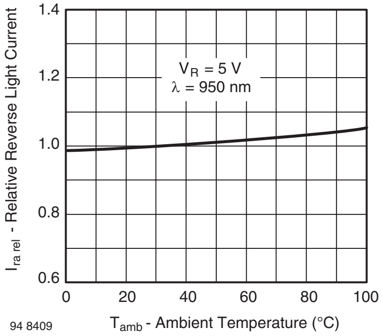


Fig. 2 - Relative Reverse Light Current vs. Ambient Temperature

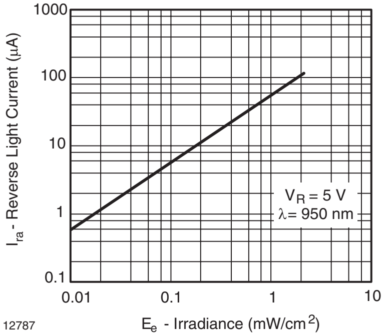


Fig. 3 - Reverse Light Current vs. Irradiance

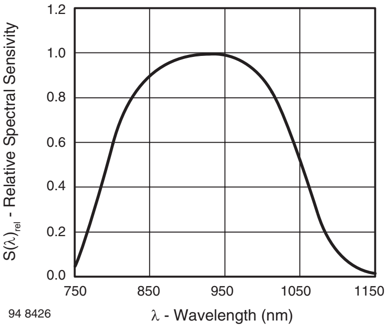


Fig. 6 - Relative Spectral Sensitivity vs. Wavelength

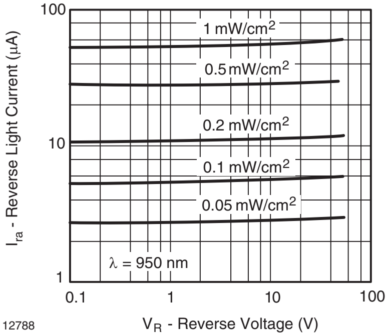


Fig. 4 - Reverse Light Current vs. Reverse Voltage

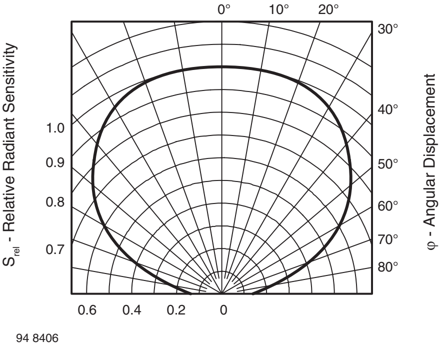


Fig. 7 - Relative Radiant Sensitivity vs. Angular Displacement

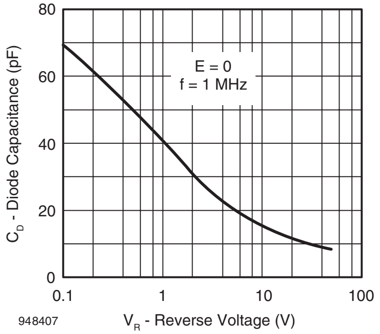
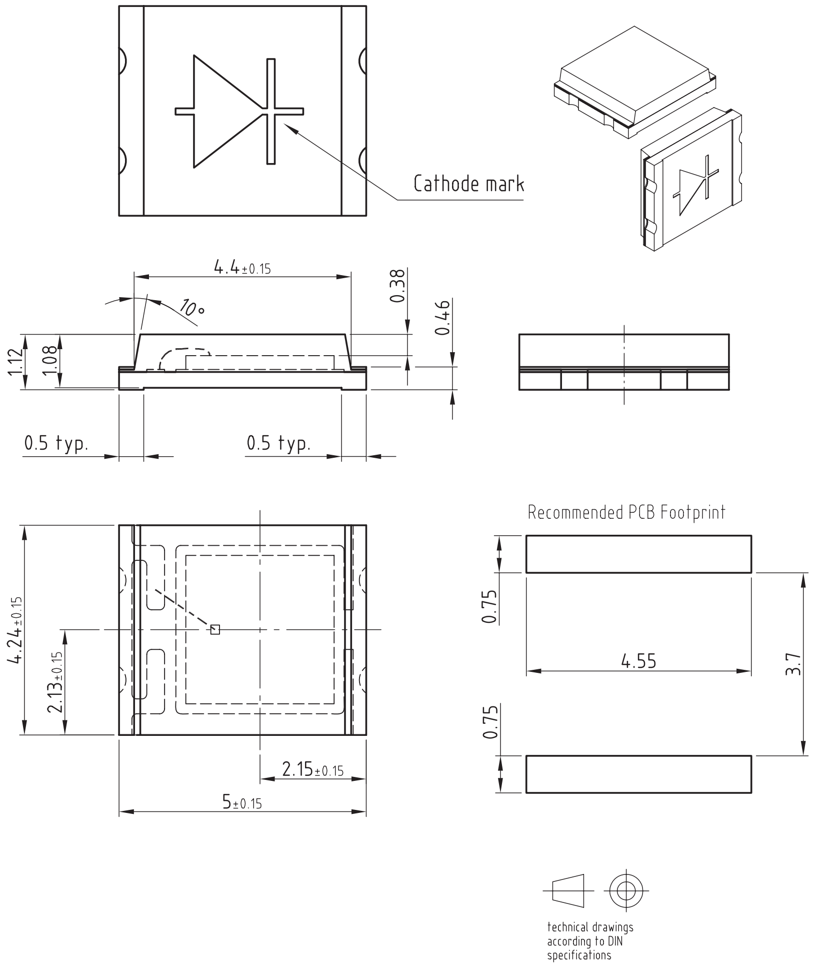


Fig. 5 - Diode Capacitance vs. Reverse Voltage

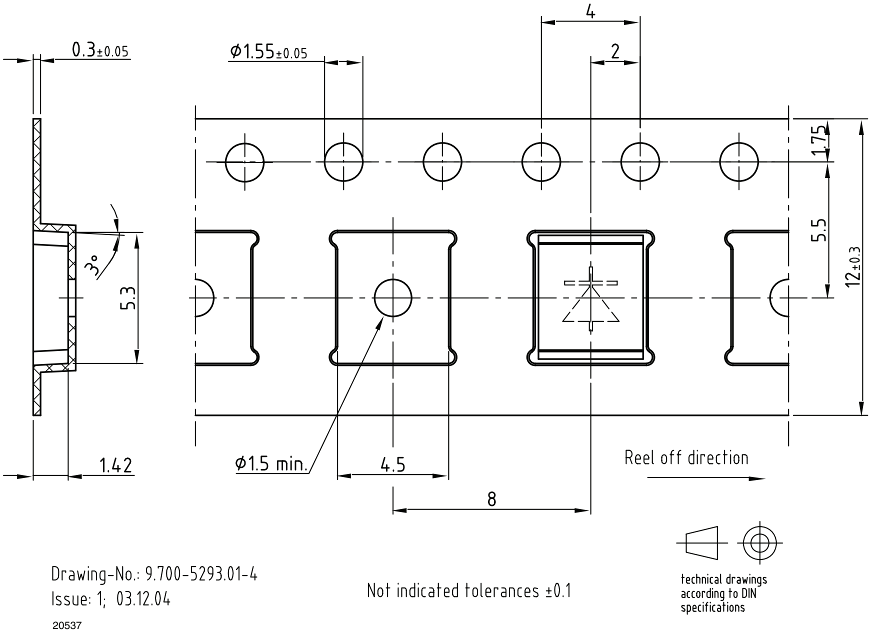
PACKAGE DIMENSIONS in millimeters



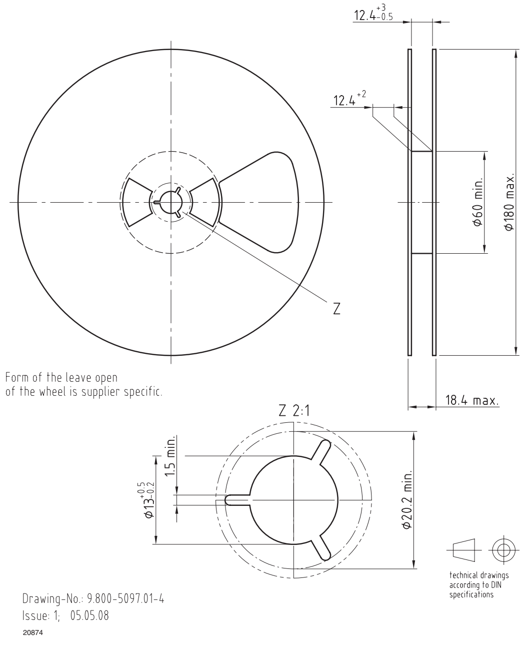
Drawing-No.: 6.541-5060.01-4
Issue: 3; 05.02.08
20536

Not indicated tolerances ± 0.1

TAPING DIMENSIONS in millimeters



REEL DIMENSIONS in millimeters



SOLDER PROFILE

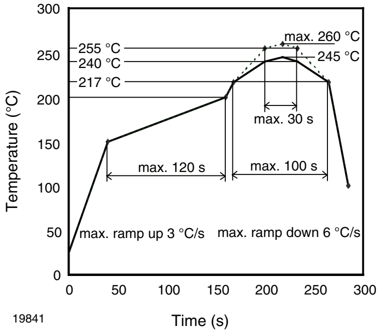


Fig. 8 - Lead (Pb)-free Reflow Solder Profile acc. J-STD-020D

DRYPACK

Devices are packed in moisture barrier bags (MBB) to prevent the products from moisture absorption during transportation and storage. Each bag contains a desiccant.

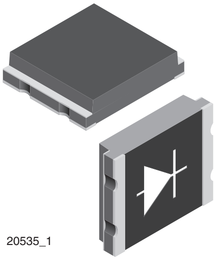
FLOOR LIFE

Time between soldering and removing from MBB must not exceed the time indicated in J-STD-020:
Moisture sensitivity: level 4
Floor life: 72 h
Conditions: T_{amb} < 30 °C, RH < 60 %

DRYING

In case of moisture absorption devices should be baked before soldering. Conditions see J-STD-020 or recommended conditions:
192 h at 40 °C (+ 5 °C), RH < 5 %
or
96 h at 60 °C (+ 5 °C), RH < 5 %.

Silicon PIN Photodiode, RoHS Compliant, Released for Lead (Pb)-free Reflow Soldering, AEC-Q101 Released



DESCRIPTION

TEMD5120X01 is a high speed and high sensitive PIN photodiode. It is a miniature surface mount device (SMD) including the chip with a 4.4 mm^2 sensitive area and a daylight blocking filter matched with IR emitters operating at wavelength 870 nm or 950 nm.

FEATURES

- Package type: surface mount
- Package form: top view
- Dimensions (L x W x H in mm): 5 x 4.24 x 1.12
- Radiant sensitive area (in mm^2): 4.4
- Product designed and qualified acc. AEC-Q101 for the automotive market
- High radiant sensitivity
- Daylight blocking filter matched with 870 nm to 950 nm emitters
- Fast response times
- Angle of half sensitivity: φ = ± 65°
- Floor life: 72 h, MSL 4, acc. J-STD-020
- Lead (Pb)-free reflow soldering
- Lead (Pb)-free component in accordance with RoHS 2002/95/EC and WEEE 2002/96/EC

Pb-free

e4

RoHS
COMPLIANT

APPLICATIONS

- High speed detector for infrared radiation
- Infrared remote control and free air data transmissionsystems, e.g. in combination with TSFFxxxx series IR emitters

PRODUCT SUMMARY

COMPONENT	I_{ra} (µA)	φ (deg)	$\lambda_{0.5}$ (nm)
TEMD5120X01	35	± 65	790 to 1050

Note
Test conditions see table “Basic Characteristics”

ORDERING INFORMATION

ORDERING CODE	PACKAGING	REMARKS	PACKAGE FORM
TEMD5120X01	Tape and reel	MOQ: 1500 pcs, 1500 pcs/reel	Top view

Note
MOQ: minimum order quantity

ABSOLUTE MAXIMUM RATINGS

PARAMETER	TEST CONDITION	SYMBOL	VALUE	UNIT
Reverse voltage		V_R	60	V
Power dissipation	$T_{amb} \leq 25$ °C	P_V	215	mW
Junction temperature		T_j	100	°C
Operating temperature range		T_{amb}	- 40 to + 100	°C
Storage temperature range		T_{stg}	- 40 to + 100	°C
Soldering temperature	Acc. reflow solder profile fig. 8	T_{sd}	260	°C
Thermal resistance junction/ambient		R_{thJA}	350	K/W

Note
T_{amb} = 25 °C, unless otherwise specified

For technical questions, contact: detectortechsupport@vishay.com

BASIC CHARACTERISTICS						
PARAMETER	**TEST CONDITION**	**SYMBOL**	**MIN.**	**TYP.**	**MAX.**	**UNIT**
Forward voltage	I_F = 50 mA	V_F		1	1.3	V
Breakdown voltage	I_R = 100 µA, E = 0	$V_{(BR)}$	60			V
Reverse dark current	V_R = 10 V, E = 0	I_{ro}		2	30	nA
Diode capacitance	V_R = 0 V, f = 1 MHz, E = 0	C_D		48		pF
	V_R = 3 V, f = 1 MHz, E = 0	C_D		17	40	pF
Open circuit voltage	E_e = 1 mW/cm^2, λ = 950 nm	V_o		350		mV
Temperature coefficient of V_o	E_e = 1 mW/cm^2, λ = 950 nm	TK_{Vo}		- 2.6		mV/K
Short circuit current	E_e = 1 mW/cm^2, λ = 950 nm	I_k		32		µA
Temperature coefficient of I_k	E_e = 1 mW/cm^2, λ = 950 nm	TK_{Ik}		0.1		%/K
Reverse light current	E_e = 1 mW/cm^2, λ = 950 nm, V_R = 5 V	I_{ra}	25	35		µA
Angle of half sensitivity		φ		± 65		deg
Wavelength of peak sensitivity		λ_p		940		nm
Range of spectral bandwidth		$\lambda_{0.5}$		790 to 1050		nm
Noise equivalent power	V_R = 10 V, λ = 950 nm	NEP		4 x 10^{-14}		W/√Hz
Rise time	V_R = 10 V, R_L = 1 kΩ, λ = 820 nm	t_r		100		ns
Fall time	V_R = 10 V, R_L = 1 kΩ, λ = 820 nm	t_f		100		ns

Note

T_{amb} = 25 °C, unless otherwise specified

BASIC CHARACTERISTICS

T_{amb} = 25 °C, unless otherwise specified

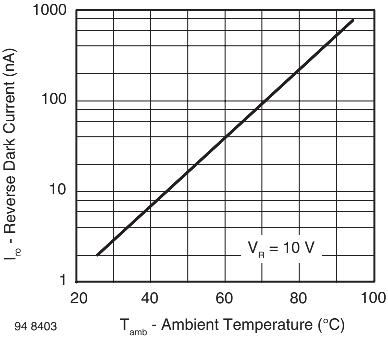


Fig. 1 - Reverse Dark Current vs. Ambient Temperature

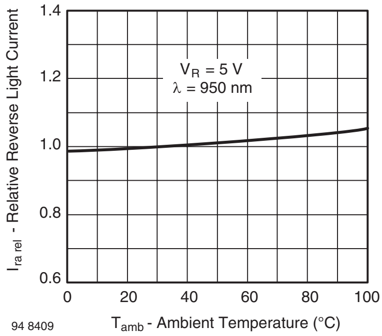


Fig. 2 - Relative Reverse Light Current vs. Ambient Temperature

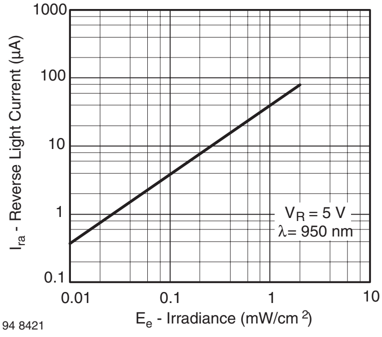


Fig. 3 - Reverse Light Current vs. Irradiance

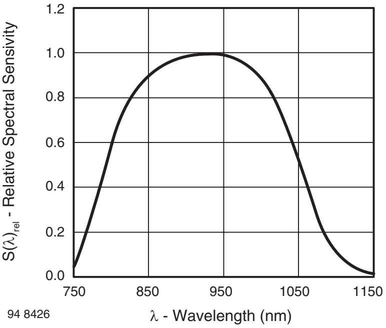


Fig. 6 - Relative Spectral Sensitivity vs. Wavelength

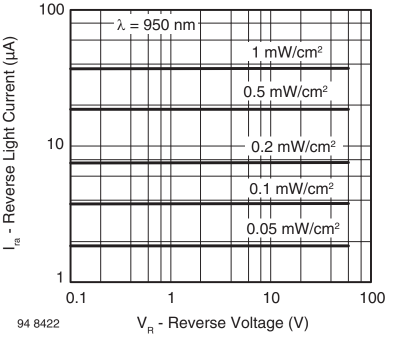


Fig. 4 - Reverse Light Current vs. Reverse Voltage

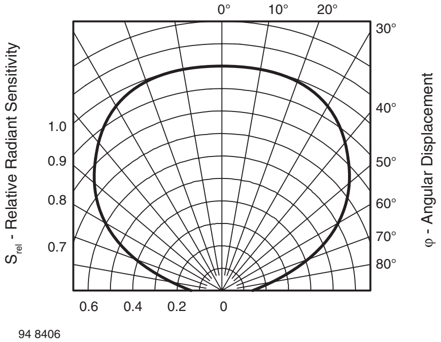


Fig. 7 - Relative Radiant Sensitivity vs. Angular Displacement

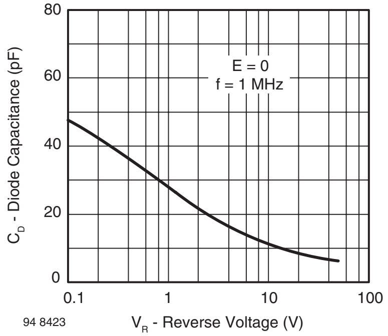
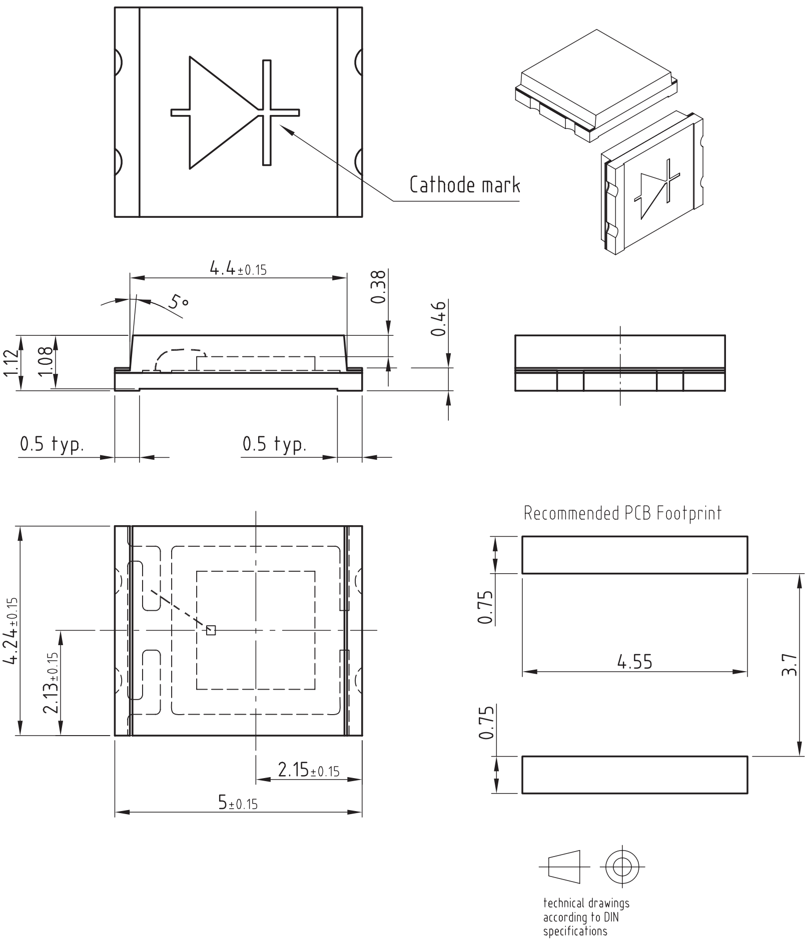


Fig. 5 - Diode Capacitance vs. Reverse Voltage

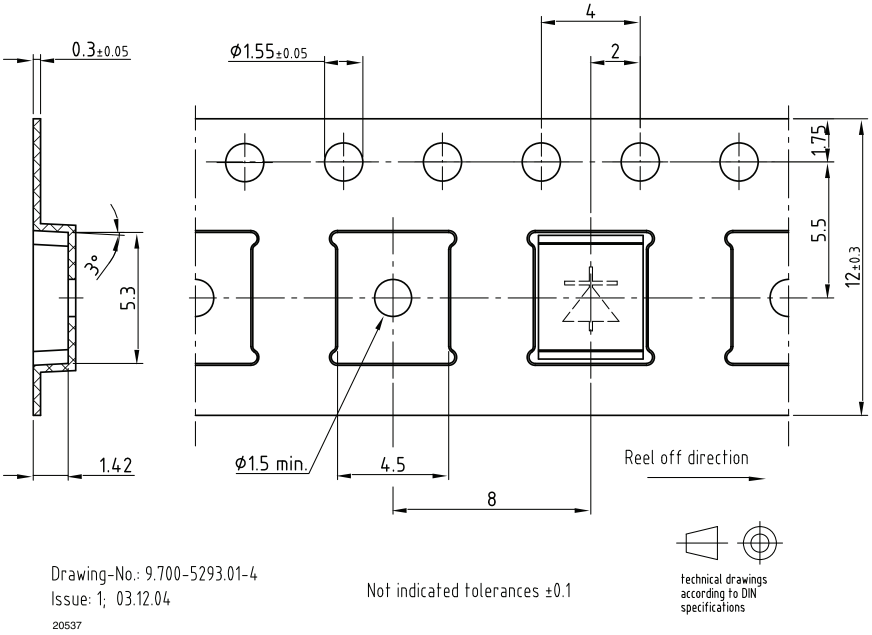
PACKAGE DIMENSIONS in millimeters



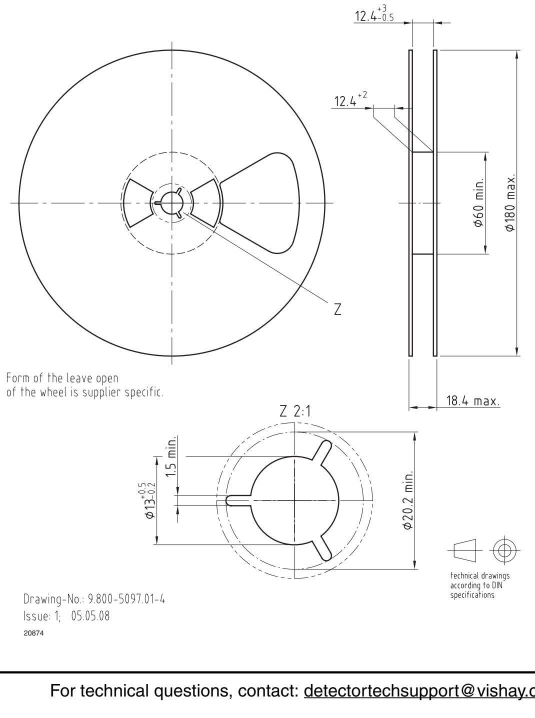
Drawing-No.: 6.541-5059.01-4
Issue: 4; 26.04.07
19280

Not indicated tolerances ± 0.1

TAPING DIMENSIONS in millimeters



REEL DIMENSIONS in millimeters



SOLDER PROFILE

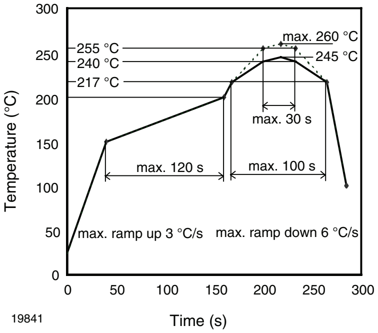


Fig. 8 - Lead (Pb)-free Reflow Solder Profile acc. J-STD-020D

DRYPACK

Devices are packed in moisture barrier bags (MBB) to prevent the products from moisture absorption during transportation and storage. Each bag contains a desiccant.

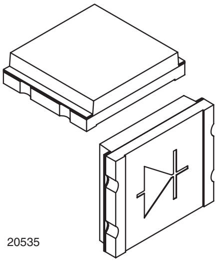
FLOOR LIFE

Time between soldering and removing from MBB must not exceed the time indicated in J-STD-020:
Moisture sensitivity: level 4
Floor life: 72 h
Conditions: T_{amb} < 30 °C, RH < 60 %

DRYING

In case of moisture absorption devices should be baked before soldering. Conditions see J-STD-020 or recommended conditions:
192 h at 40 °C (+ 5 °C), RH < 5 %
or
96 h at 60 °C (+ 5 °C), RH < 5 %.

Ambient Light Sensor, RoHS Compliant, Released for Lead (Pb)-free Reflow Soldering, AEC-Q101 Released



FEATURES

- Package type: surface mount
- Package form: top view
- Dimensions (L x W x H in mm): 5 x 4.24 x 1.12
- Radiant sensitive area (in mm^2): 7.5
- Product designed and qualified acc. AEC-Q101 for the automotive market
- High photo sensitivity
- Adapted to human eye responsivity
- Supression filter for near infrared radiation
- Angle of half sensitivity: $\varphi = \pm 65°$
- Floor life: 72 h, MSL 4, acc. J-STD-020
- Lead (Pb)-free reflow soldering
- Lead (Pb)-free component in accordance with RoHS 2002/95/EC and WEEE 2002/96/EC

Pb-free
e4
RoHS
COMPLIANT

DESCRIPTION

TEMD5510FX01 ambient light sensor is a PIN photodiode with high photo sensitivity in a miniature surface mount device (SMD). The detector chip has 7.5 mm^2 sensitive area. It is sensitive to visible light much like the human eye and has peak sensitivity at 540 nm.

APPLICATIONS

- Automotive sensors
- Ambient light sensors
- Backlight dimmers
- Notebooks
- Computers

PRODUCT SUMMARY

COMPONENT	I_{ra} (µA)	φ (deg)	$\lambda_{0.5}$ (nm)
TEMD5510FX01	26	± 65	430 to 610

Note
Test conditions see table “Basic Characteristics”

ORDERING INFORMATION

ORDERING CODE	PACKAGING	REMARKS	PACKAGE FORM
TEMD5510FX01	Tape and reel	MOQ: 1500 pcs, 1500 pcs/reel	Top view

Note
MOQ: minimum order quantity

ABSOLUTE MAXIMUM RATINGS

PARAMETER	TEST CONDITION	SYMBOL	VALUE	UNIT
Reverse voltage		V_R	16	V
Power dissipation	$T_{amb} \leq 25$ °C	P_V	215	mW
Junction temperature		T_j	100	°C
Operating temperature range		T_{amb}	- 40 to + 100	°C
Storage temperature range		T_{stg}	- 40 to + 100	°C
Soldering temperature	Acc. reflow solder profile fig. 5	T_{sd}	260	°C
Thermal resistance junction/ambient	Soldered on PCB with pad dimensions: 4 mm x 4 mm	R_{thJA}	350	K/W

Note
T_{amb} = 25 °C, unless otherwise specified

BASIC CHARACTERISTICS						
PARAMETER	**TEST CONDITION**	**SYMBOL**	**MIN.**	**TYP.**	**MAX.**	**UNIT**
Breakdown voltage	I_R = 100 µA, E = 0	$V_{(BR)}$	16			V
Reverse dark current	V_R = 10 V, E = 0	I_{ro}		2	30	nA
Diode capacitance	V_R = 0 V, f = 1 MHz, E = 0	C_D		1600		pF
	V_R = 3 V, f = 1 MHz, E = 0	C_D		730	40	pF
Reverse light current	E_e = 1 mW/cm², λ = 550 nm, V_R = 5 V	I_{ra}		26		µA
	E_v = 100 lx, CIE illuminant A, V_R = 5 V	I_{ra}	0.8	1		µA
Angle of half sensitivity		φ		± 65		deg
Wavelength of peak sensitivity		λ_p		540		nm
Range of spectral bandwidth		$\lambda_{0.5}$		430 to 610		nm

Note

T_{amb} = 25 °C, unless otherwise specified

BASIC CHARACTERISTICS

T_{amb} = 25 °C, unless otherwise specified

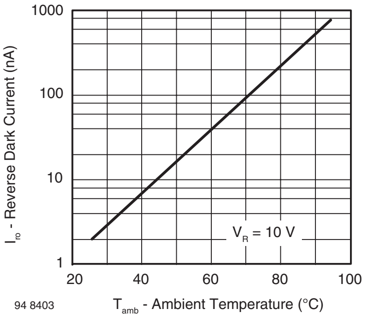


Fig. 1 - Reverse Dark Current vs. Ambient Temperature

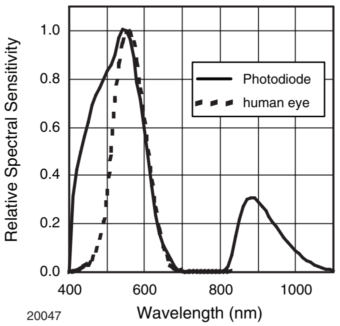


Fig. 3 - Relative Spectral Sensitivity vs. Wavelength

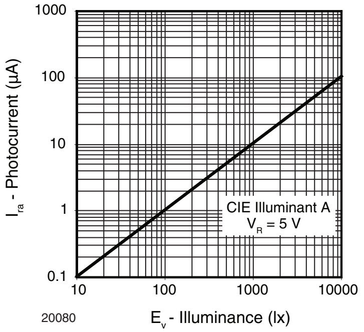


Fig. 2 - Reverse Light Current vs. Irradiance

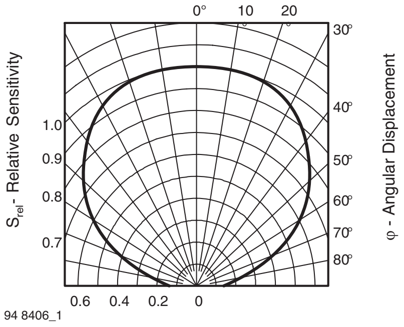
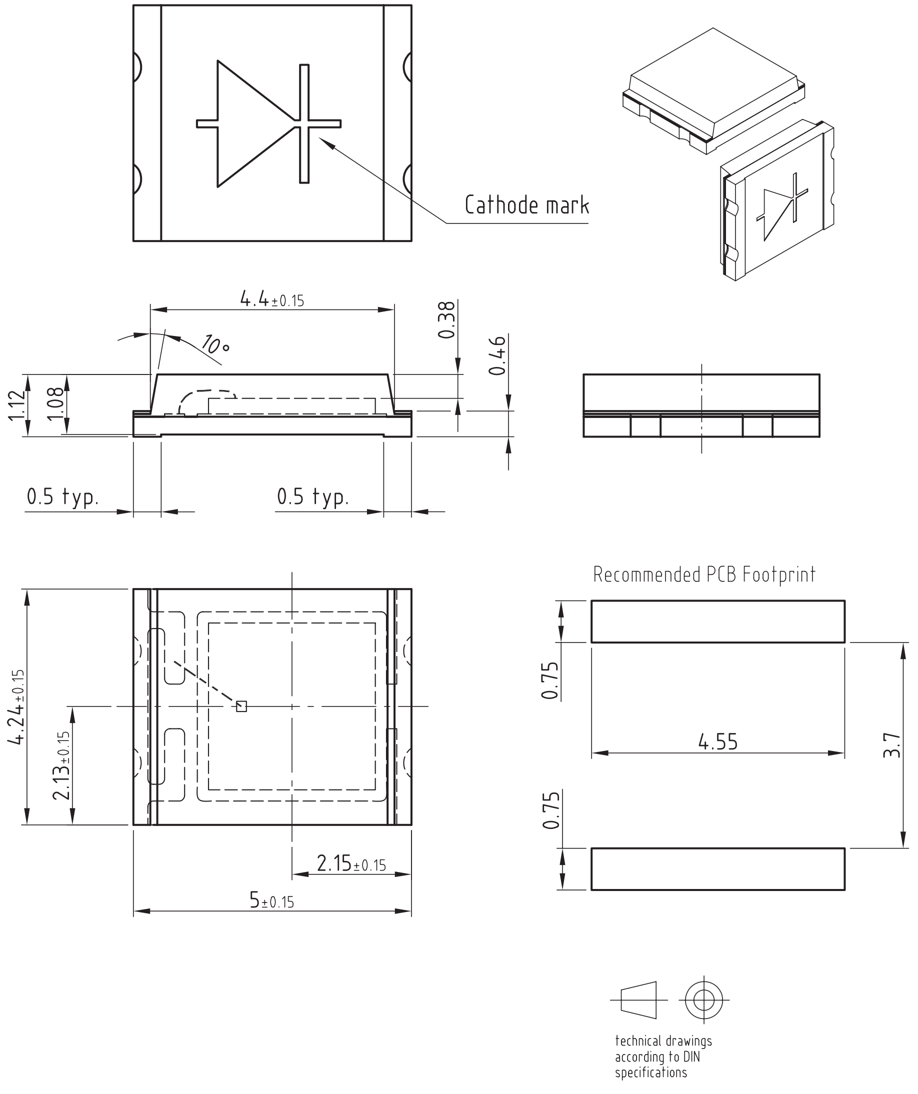


Fig. 4 - Relative Radiant Sensitivity vs. Angular Displacement

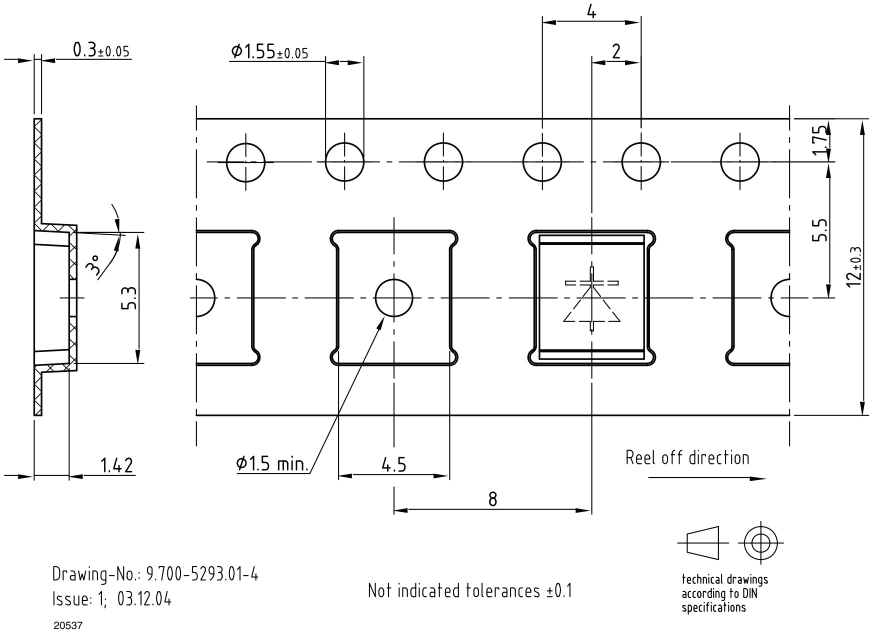
PACKAGE DIMENSIONS in millimeters



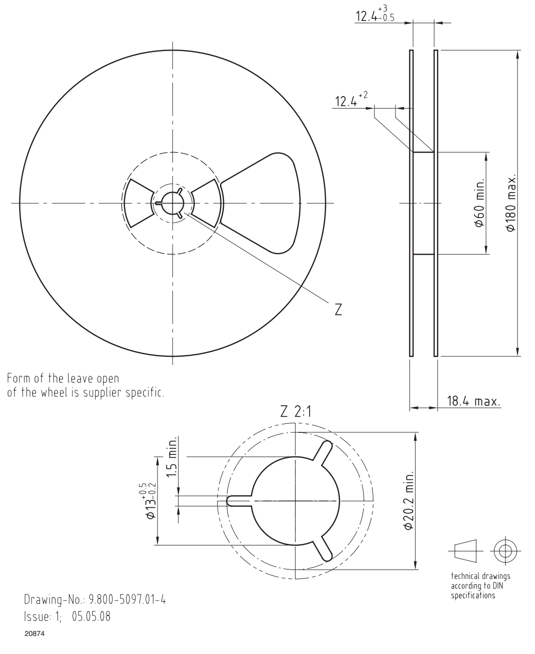
Drawing-No.: 6.541-5060.01-4
Issue: 3; 05.02.08
20536

Not indicated tolerances ± 0.1

TAPING DIMENSIONS in millimeters



REEL DIMENSIONS in millimeters



SOLDER PROFILE

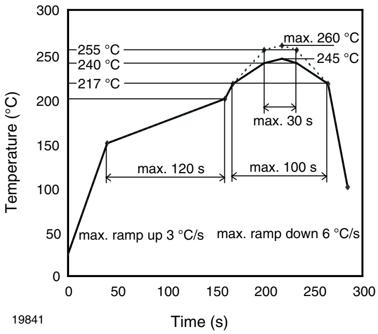


Fig. 5 - Lead (Pb)-free Reflow Solder Profile acc. J-STD-020D

DRYPACK

Devices are packed in moisture barrier bags (MBB) to prevent the products from moisture absorption during transportation and storage. Each bag contains a desiccant.

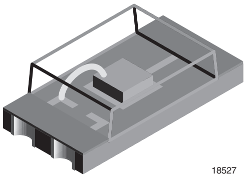
FLOOR LIFE

Time between soldering and removing from MBB must not exceed the time indicated in J-STD-020:
Moisture sensitivity: level 4
Floor life: 72 h
Conditions: T_{amb} < 30 °C, RH < 60 %

DRYING

In case of moisture absorption devices should be baked before soldering. Conditions see J-STD-020 or recommended conditions:
192 h at 40 °C (+ 5 °C), RH < 5 %
or
96 h at 60 °C (+ 5 °C), RH < 5 %.

Ambient Light Sensor, RoHS Compliant, Released for Lead (Pb)-free Reflow Soldering, AEC-Q101 Released



DESCRIPTION

TEMD6010FX01 ambient light sensor is a PIN photodiode with high speed and high photo sensitivity in a clear, surface mount plastic package. The detector chip has 0.23 mm^2 sensitive area. It is sensitive to visible light much like the human eye and has peak sensitivity at 540 nm.

FEATURES

- Package type: surface mount
- Package form: 1206
- Dimensions (L x W x H in mm): 4 x 2 x 1.05
- Radiant sensitive area (in mm^2): 0.23
- Product designed and qualified acc. AEC-Q101 for the automotive market
- High photo sensitivity
- Adapted to human eye responsivity
- Supression filter for near infrared radiation
- Angle of half sensitivity: $\varphi = \pm 60°$
- Floor life: 72 h, MSL 4, acc. J-STD-020
- Lead (Pb)-free reflow soldering
- Lead (Pb)-free component in accordance with RoHS 2002/95/EC and WEEE 2002/96/EC

Pb-free

e4

RoHS
COMPLIANT

APPLICATIONS

- Automotive sensors
- Ambient light sensors
- Backlight dimming
- Mobil phones
- Notebooks
- Computers

PRODUCT SUMMARY

COMPONENT	I_{ra} (µA)	φ (deg)	$\lambda_{0.5}$ (nm)
TEMD6010FX01	1	± 60	430 to 610

Note

Test conditions see table “Basic Characteristics”

ORDERING INFORMATION

ORDERING CODE	PACKAGING	REMARKS	PACKAGE FORM
TEMD6010FX01	Tape and reel	MOQ: 3000 pcs, 3000 pcs/reel	1206

Note

MOQ: minimum order quantity

ABSOLUTE MAXIMUM RATINGS

PARAMETER	TEST CONDITION	SYMBOL	VALUE	UNIT
Reverse voltage		V_R	16	V
Emitter collector voltage		V_{ECO}	1.5	V
Power dissipation		P_V	100	mW
Junction temperature		T_j	100	°C
Operating temperature range		T_{amb}	- 40 to + 100	°C
Storage temperature range		T_{stg}	- 40 to + 100	°C
Soldering temperature	Acc. reflow solder profile fig. 7	T_{sd}	260	°C
Thermal resistance junction/ambient	Soldered on PCB with pad dimensions: 4 mm x 4 mm	R_{thJA}	450	K/W

Note

T_{amb} = 25 °C, unless otherwise specified

BASIC CHARACTERISTICS						
PARAMETER	**TEST CONDITION**	**SYMBOL**	**MIN.**	**TYP.**	**MAX.**	**UNIT**
Breakdown voltage	I_R = 100 µA, E = 0	$V_{(BR)}$	16			V
Reverse dark current	V_{CE} = 5 V, E = 0	I_{ro}		2	30	nA
Diode capacitance	V_R = 0 V, f = 1 MHz, E = 0	C_D		60		pF
	V_R = 5 V, f = 1 MHz, E = 0	C_D		24		pF
Reverse light current	E_e = 1 mW/cm^2, λ = 550 nm, V_R = 5 V	I_{ra}		1		µA
	E_V = 100 lx, CIE illuminant A, V_R = 5 V	I_{ra}	0.03	0.04		µA
Temperature coefficient of I_{ra}	E_V = 100 lx, CIE illuminant A, V_R = 5 V	TK_{Ira}		0.2		%/K
Angle of half sensitivity		φ		± 60		deg
Wavelength of peak sensitivity		$λ_p$		540		nm
Range of spectral bandwidth		$λ_{0.5}$		430 to 610		nm

Note

T_{amb} = 25 °C, unless otherwise specified

BASIC CHARACTERISTICS

T_{amb} = 25 °C, unless otherwise specified

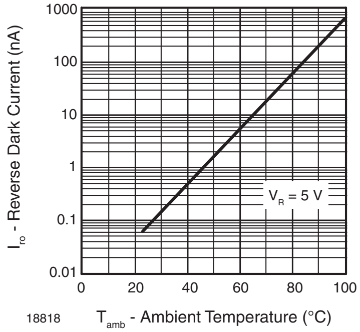


Fig. 1 - Reverse Dark Current vs. Ambient Temperature

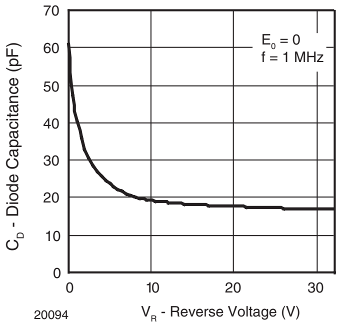


Fig. 3 - Diode Capacitance vs. Reverse Voltage

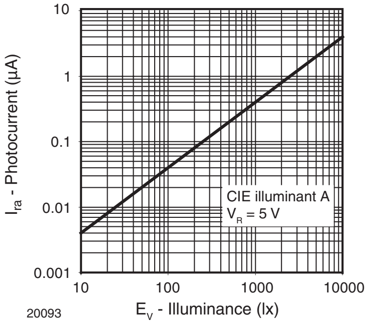


Fig. 2 - Reverse Light Current vs. Illuminance

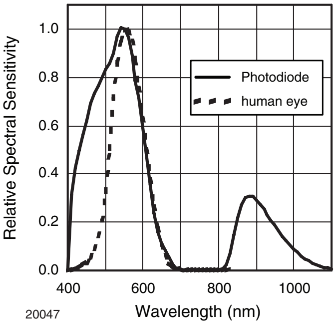


Fig. 4 - Relative Spectral Sensitivity vs. Wavelength

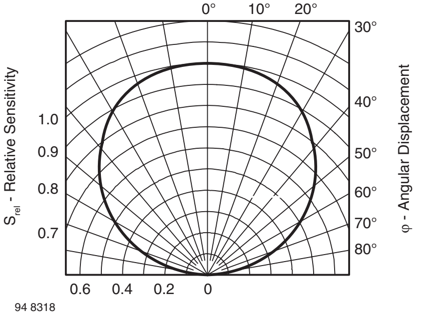


Fig. 5 - Relative Radiant Sensitivity vs. Angular Displacement

REFLOW SOLDER PROFILE

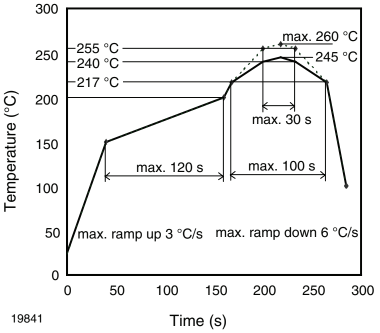


Fig. 6 - Lead (Pb)-free Reflow Solder Profile acc. J-STD-020D

DRYPACK

Devices are packed in moisture barrier bags (MBB) to prevent the products from moisture absorption during transportation and storage. Each bag contains a desiccant.

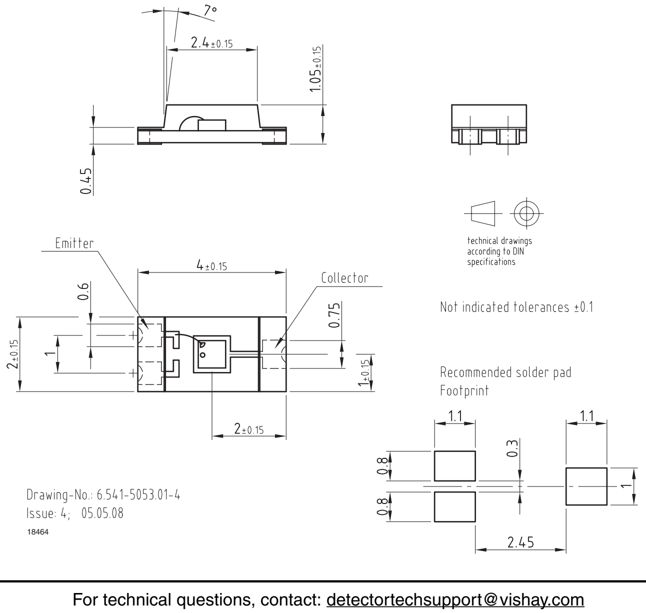
FLOOR LIFE

Time between soldering and removing from MBB must not exceed the time indicated in J-STD-020:
Moisture sensitivity: level 4
Floor life: 72 h
Conditions: T_{amb} < 30 °C, RH < 60 %

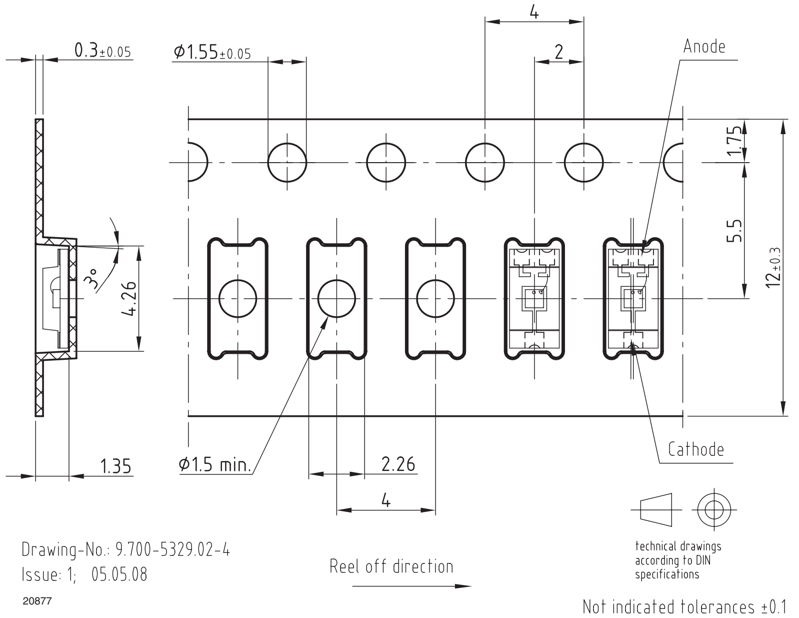
DRYING

In case of moisture absorption devices should be baked before soldering. Conditions see J-STD-020 or recommended conditions:
192 h at 40 °C (+ 5 °C), RH < 5 %
or
96 h at 60 °C (+ 5 °C), RH < 5 %.

PACKAGE DIMENSIONS in millimeters

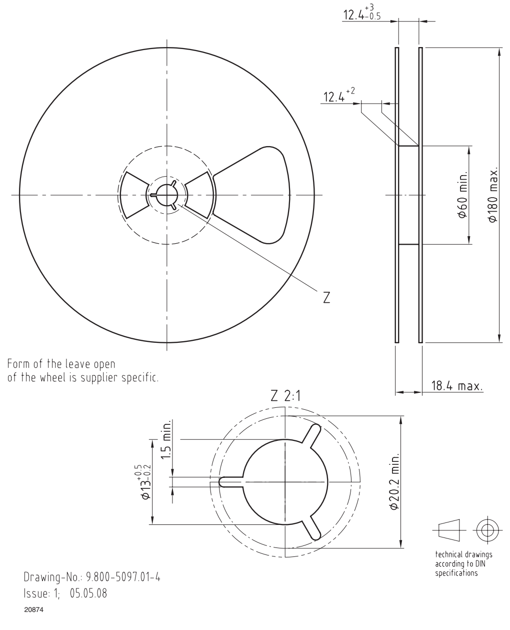


BLISTER TAPE DIMENSIONS in millimeters



REEL DIMENSIONS in millimeters

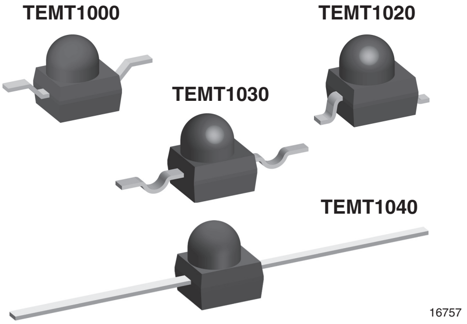
Volume: 3000 pcs/reel



TEMT1000, TEMT1020, TEMT1030, TEMT1040

Vishay Semiconductors

Silicon NPN Phototransistor, RoHS Compliant



FEATURES

- Package type: surface mount
- Package form: GW, RGW, yoke, axial
- Dimensions (L x W x H in mm): 2.5 x 2 x 2.7
- High radiant sensitivity
- Daylight blocking filter matched with 870 nm to 950 nm IR emitters
- Fast response times
- Angle of half sensitivity: φ = ± 15°
- Package matches with IR emitter series TSML1000
- Floor life: 168 h, MSL 3, acc. J-STD-020
- Lead (Pb)-free component in accordance with RoHS 2002/95/EC and WEEE 2002/96/EC

DESCRIPTION

TEMT1000 series are silicon NPN phototransistors with high radiant sensitivity in black, surface mount, plastic packages with lens and daylight blocking filter. Filter bandwidth is matched with 870 nm to 950 nm IR emitters.

APPLICATIONS

- Detector in electronic control and drive circuits
- IR detector for daylight application
- Photo interrupters
- Counter
- Encoder

PRODUCT SUMMARY

COMPONENT	I_{ca} (mA)	φ (deg)	$\lambda_{0.5}$ (nm)
TEMT1000	7	± 15	730 to 1000
TEMT1020	7	± 15	730 to 1000
TEMT1030	7	± 15	730 to 1000
TEMT1040	7	± 15	730 to 1000

Note

Test conditions see table “Basic Characteristics”

ORDERING INFORMATION

ORDERING CODE	PACKAGING	REMARKS	PACKAGE FORM
TEMT1000	Tape and reel	MOQ: 1000 pcs, 1000 pcs/reel	Reverse gullwing
TEMT1020	Tape and reel	MOQ: 1000 pcs, 1000 pcs/reel	Gullwing
TEMT1030	Tape and reel	MOQ: 1000 pcs, 1000 pcs/reel	Yoke
TEMT1040	Bulk	MOQ: 1000 pcs, 1000 pcs/bulk	Axial leads

Note

MOQ: minimum order quantity

ABSOLUTE MAXIMUM RATINGS

PARAMETER	TEST CONDITION	SYMBOL	VALUE	UNIT
Emitter collector voltage		V_{ECO}	5	V
Collector current		I_C	50	mA
Collector peak current	$t_p/T = 0.5$, $t_p \leq 10$ ms	I_{CM}	100	mA
Power dissipation	$T_{amb} \leq 55$ °C	P_V	100	mW
Junction temperature		T_j	100	°C
Operating temperature range		T_{amb}	- 40 to + 85	°C
Storage temperature range		T_{stg}	- 40 to + 100	°C
Soldering temperature	$t \leq 5$ s	T_{sd}	260	°C
Thermal resistance junction/ambient	Soldered on PCB with pad dimensions: 4 mm x 4 mm	R_{thJA}	400	K/W

Note

T_{amb} = 25 °C, unless otherwise specified

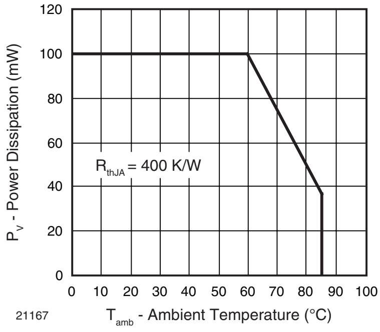


Fig. 1 - Power Dissipation Limit vs. Ambient Temperature

BASIC CHARACTERISTICS						
PARAMETER	**TEST CONDITION**	**SYMBOL**	**MIN.**	**TYP.**	**MAX.**	**UNIT**
Collector emitter voltage	I_C = 1 mA	V_{CEO}	70			V
Collector emitter dark current	V_{CE} = 20 V, E = 0	I_{CEO}		1	200	nA
Collector emitter capacitance	V_{CE} = 5 V, f = 1 MHz, E = 0	C_{CEO}		3		pF
Angle of half sensitivity		φ		± 15		deg
Wavelength of peak sensitivity		λ_p		880		nm
Range of spectral bandwidth		$\lambda_{0.5}$		730 to 1000		nm
Collector emitter saturation voltage	E_e = 1 mW/cm^2, λ = 950 nm, I_C = 0.1 mA	V_{CEsat}			0.3	V
Turn-on time	V_S = 5 V, I_C = 5 mA, R_L = 100 Ω	t_{on}		2.0		µs
Turn-off time	V_S = 5 V, I_C = 5 mA, R_L = 100 Ω	t_{off}		2.3		µs
Cut-off frequency	V_S = 5 V, I_C = 5 mA, R_L = 100 Ω	f_c		180		kHz
Collector light current	E_e = 1 mW/cm^2, λ = 950 nm, V_{CE} = 5 V	I_{ca}	2	7.0		mA

Note

T_{amb} = 25 °C, unless otherwise specified

BASIC CHARACTERISTICS

T_{amb} = 25 °C, unless otherwise specified

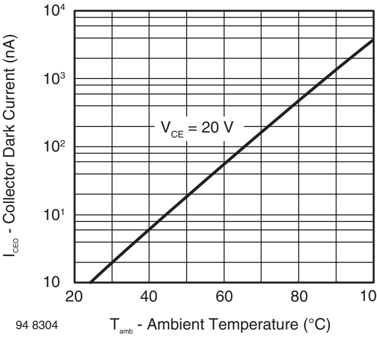


Fig. 2 - Collector Dark Current vs. Ambient Temperature

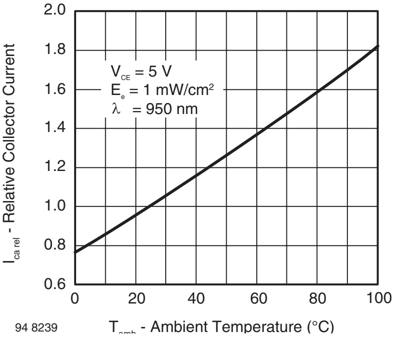


Fig. 3 - Relative Collector Current vs. Ambient Temperature

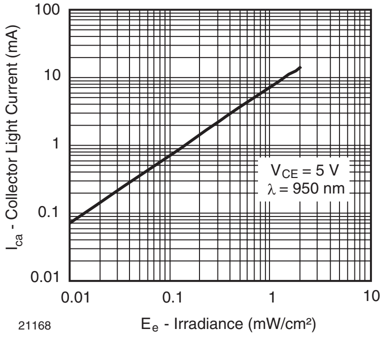


Fig. 4 - Collector Light Current vs. Irradiance

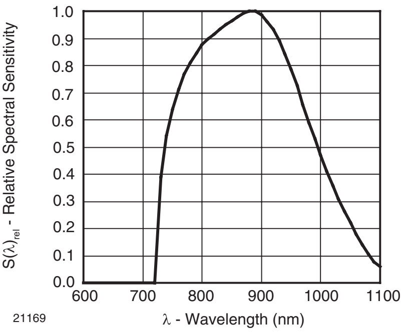


Fig. 7 - Relative Spectral Sensitivity vs. Wavelength

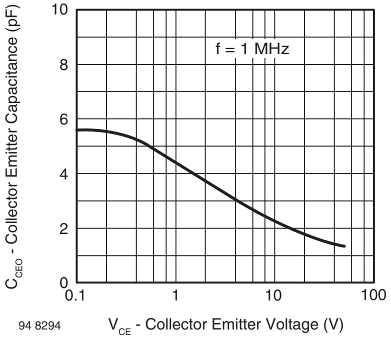


Fig. 5 - Collector Emitter Capacitance vs. Collector Emitter Voltage

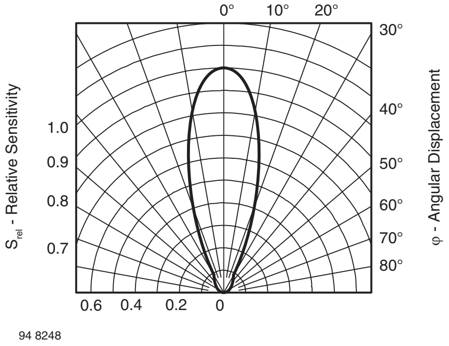


Fig. 8 - Relative Radiant Sensitivity vs. Angular Displacement

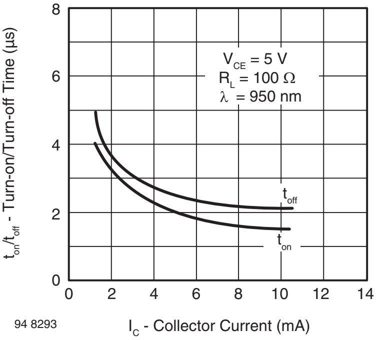


Fig. 6 - Turn-on/Turn-off Time vs. Collector Current

PRECAUTIONS FOR USE

1. Over-current-proof

Customer must apply resistors for protection, otherwise slight voltage shift will cause big current change (burn out will happen).

2. Storage

2.1 Storage temperature and rel. humidity conditions are: 5 °C to 35 °C, R.H. 60 %.

2.2 Floor life must not exceed 168 h, acc. to JEDEC level 3, J-STD-020.
Once the package is opened, the products should be used within a week. Otherwise, they should be kept in a damp proof box with desiccant.
Considering tape life, we suggest to use products within one year from production date.

2.3 If opened more than one week in an atmosphere 5 °C to 35 °C, R.H. 60 %, devices should be treated at 60 °C ± 5 °C for 15 h.

2.4 If humidity indicator in the package shows pink color (normal blue), then devices should be treated with the same conditions as 2.3.

REFLOW SOLDER PROFILE

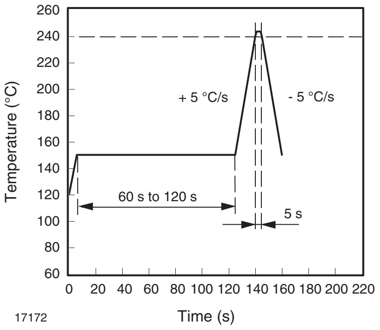
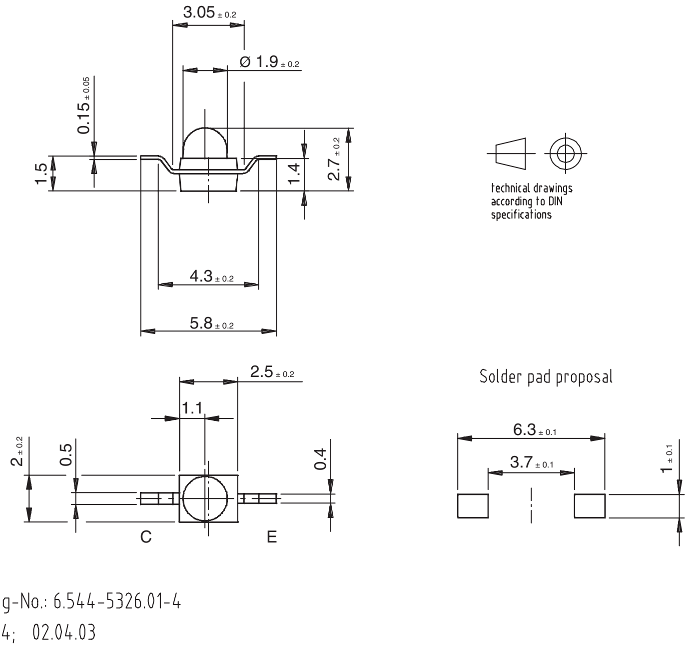
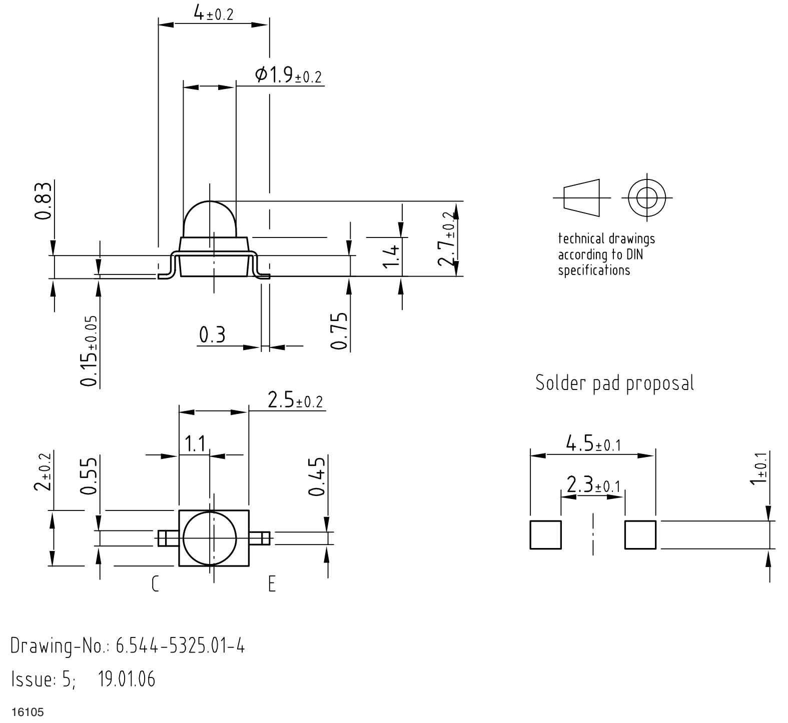


Fig. 9 - Lead Tin (SnPb) Reflow Solder Profile

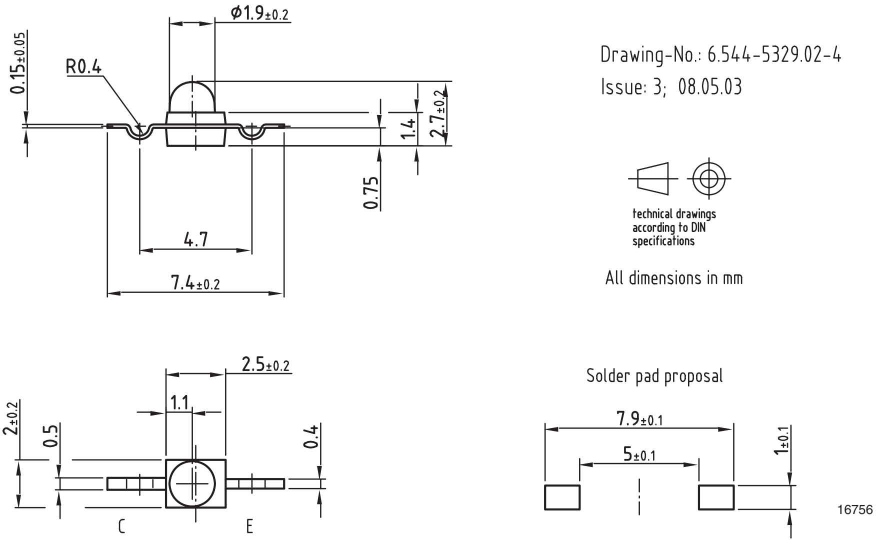
PACKAGE DIMENSIONS in millimeters: TEMT1000



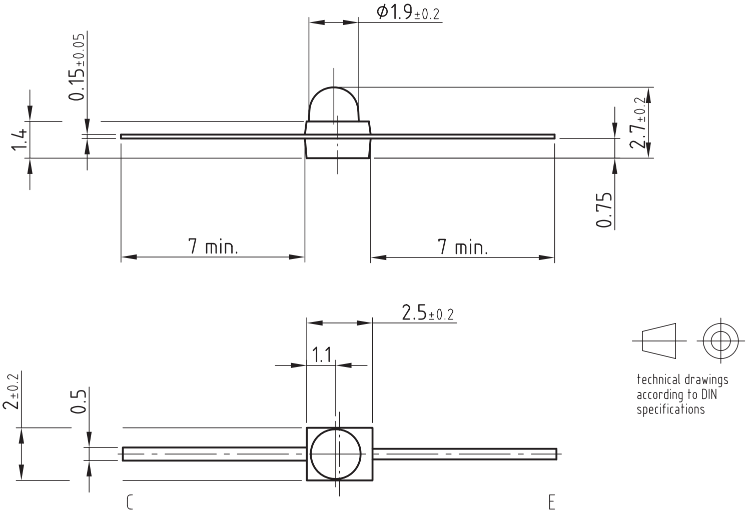
PACKAGE DIMENSIONS in millimeters: **TEMT1020**



PACKAGE DIMENSIONS in millimeters: **TEMT1030**



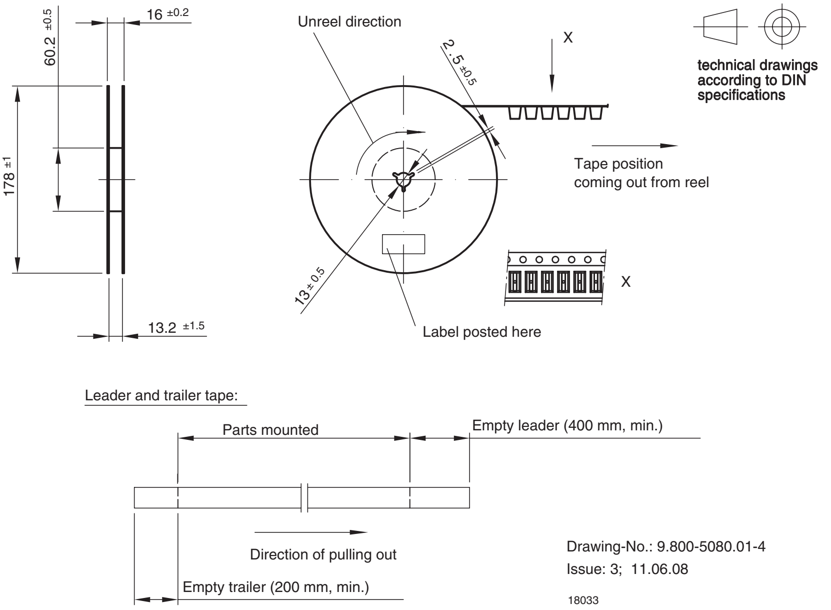
PACKAGE DIMENSIONS in millimeters: **TEMT1040**



Drawing-No.: 6.544-5339.01-4
Issue: 2; 02.04.03

16500

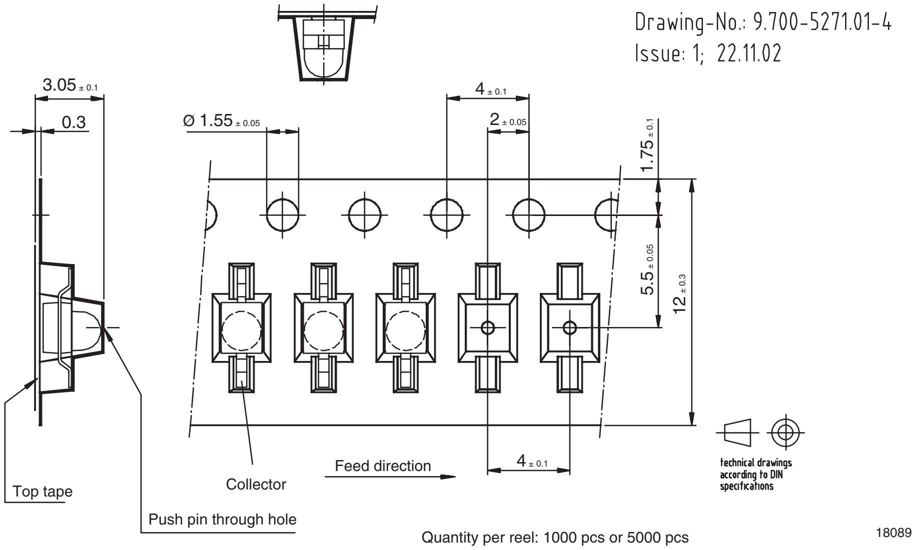
REEL DIMENSIONS in millimeters



Drawing-No.: 9.800-5080.01-4
Issue: 3; 11.06.08

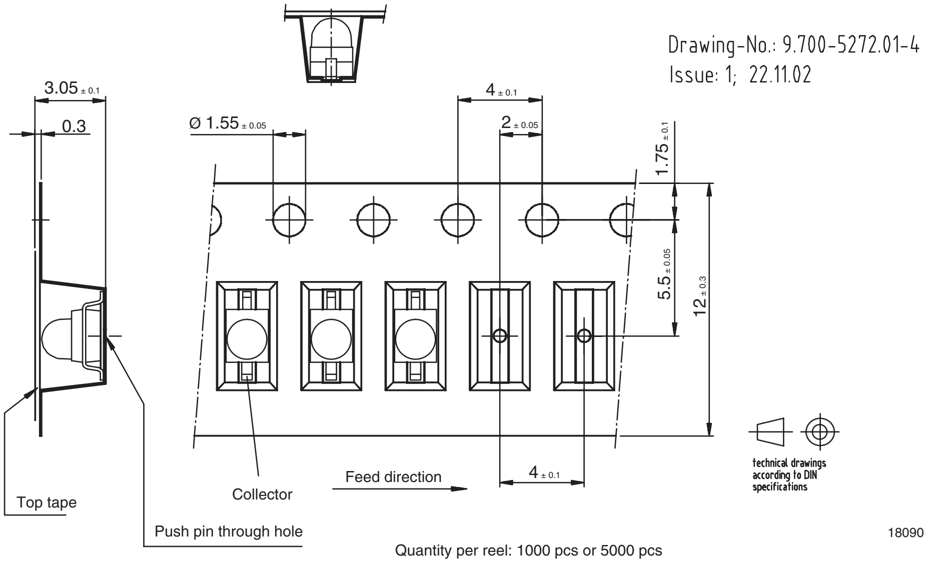
18033

TAPING DIMENSIONS in millimeters: **TEMT1000**



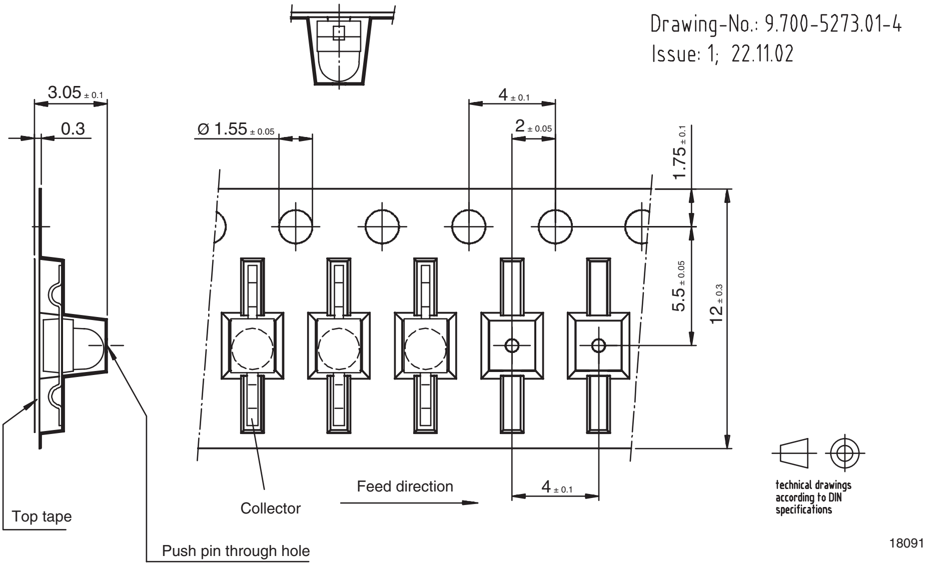
Quantity per reel: 1000 pcs or 5000 pcs

TAPING DIMENSIONS in millimeters: **TEMT1020**



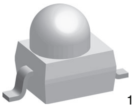
Quantity per reel: 1000 pcs or 5000 pcs

TAPING DIMENSIONS in millimeters: **TEMT1030**



Quantity per reel: 1000 pcs or 5000 pcs

Silicon NPN Phototransistor, RoHS Compliant



FEATURES

- Package type: surface mount
- Package form: gullwing
- Dimensions (L x W x H in mm): 2.5 x 2 x 2.7
- High photo sensitivity
- High radiant sensitivity
- Suitable for visible and near infrared radiation
- Fast response times
- Angle of half sensitivity: φ = ± 15°
- Floor life: 168 h, MSL 3, acc. J-STD-020
- Lead (Pb)-free reflow soldering
- Lead (Pb)-free component in accordance with RoHS 2002/95/EC and WEEE 2002/96/EC

Pb-free

e3

RoHS
COMPLIANT

DESCRIPTION

TEMT1520 is a silicon NPN phototransistor with high radiant sensitivity in a clear, surface mount plastic package with lens. It is sensitive to visible and near infrared radiation.

APPLICATIONS

- Detector in electronic control and drive circuits
- Detector for light measurement

PRODUCT SUMMARY

COMPONENT	I_{ca} (mA)	φ (deg)	$\lambda_{0.1}$ (nm)
TEMT1520	4.5	± 15	450 to 1080

Note
Test conditions see table "Basic Characteristics"

ORDERING INFORMATION

ORDERING CODE	PACKAGING	REMARKS	PACKAGE FORM
TEMT1520	Tape and reel	MOQ: 1000 pcs, 1000 pcs/reel	Gullwing

Note
MOQ: minimum order quantity

ABSOLUTE MAXIMUM RATINGS

PARAMETER	TEST CONDITION	SYMBOL	VALUE	UNIT
Emitter collector voltage		V_{ECO}	5	V
Collector current		I_C	50	mA
Collector peak current	$t_p/T = 0.5$, $t_p \leq 10$ ms	I_{CM}	100	mA
Power dissipation	$T_{amb} \leq 55$ °C	P_V	100	mW
Junction temperature		T_j	100	°C
Operating temperature range		T_{amb}	- 40 to + 85	°C
Storage temperature range		T_{stg}	- 40 to + 100	°C
Soldering temperature	Acc. reflow solder profile fig. 8	T_{sd}	< 260	°C
Thermal resistance junction/ambient	Soldered on PCB with pad dimensions: 4 mm x 4 mm	R_{thJA}	400	K/W

Note
T_{amb} = 25 °C, unless otherwise specified

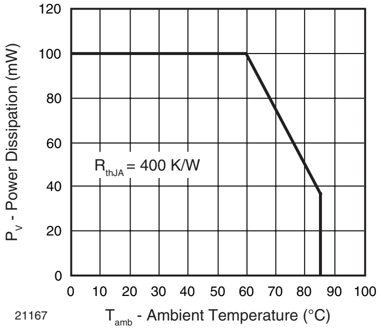


Fig. 1 - Power Dissipation Limit vs. Ambient Temperature

BASIC CHARACTERISTICS						
PARAMETER	**TEST CONDITION**	**SYMBOL**	**MIN.**	**TYP.**	**MAX.**	**UNIT**
Collector emitter voltage	I_C = 1 mA	V_{CEO}	70			V
Collector emitter dark current	V_{CE} = 20 V, E = 0	I_{CEO}		1	200	nA
Collector emitter capacitance	V_{CE} = 5 V, f = 1 MHz, E = 0	C_{CEO}		3		pF
Collector light current	$E_e = 1\ mW/cm^2$, λ = 950 nm, V_{CE} = 5 V	I_{ca}	2	4.5	8	mA
Angle of half sensitivity		φ		± 15		deg
Wavelength of peak sensitivity		λ_p		850		nm
Range of spectral bandwidth		$\lambda_{0.1}$		450 to 1080		nm
Collector emitter saturation voltage	$E_e = 1\ mW/cm^2$, λ = 950 nm, I_C = 0.1 mA	V_{CEsat}			0.3	V
Turn-on time	V_S = 5 V, I_C = 5 mA, R_L = 100 Ω	t_{on}		2.0		µs
Turn-off time	V_S = 5 V, I_C = 5 mA, R_L = 100 Ω	t_{off}		2.3		µs
Cut-off frequency	V_S = 5 V, I_C = 5 mA, R_L = 100 Ω	f_c		180		kHz

Note

T_{amb} = 25 °C, unless otherwise specified

BASIC CHARACTERISTICS

T_{amb} = 25 °C, unless otherwise specified

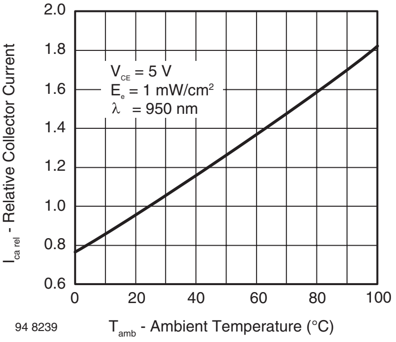


Fig. 2 - Relative Collector Current vs. Ambient Temperature

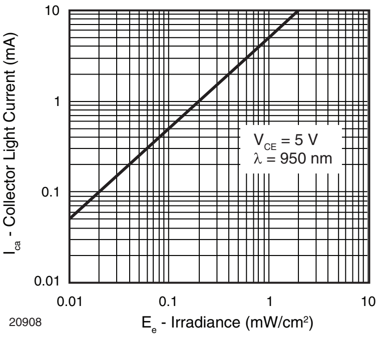


Fig. 3 - Collector Light Current vs. Irradiance

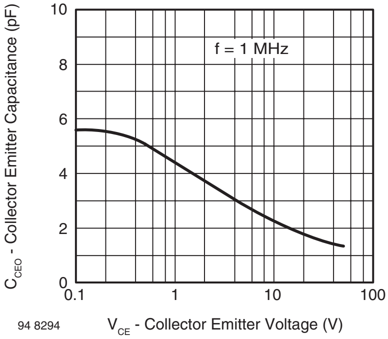


Fig. 4 - Collector Emitter Capacitance vs. Collector Emitter Voltage

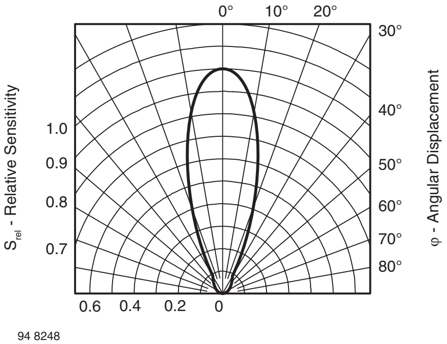


Fig. 7 - Relative Radiant Sensitivity vs. Angular Displacement

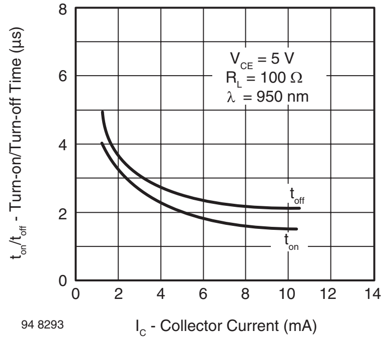


Fig. 5 - Turn-on/Turn-off Time vs. Collector Current

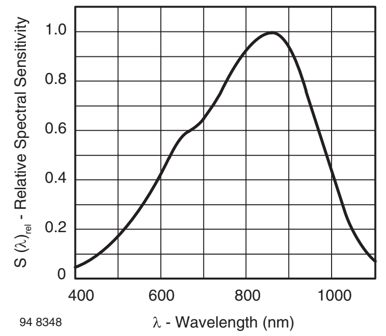


Fig. 6 - Relative Spectral Sensitivity vs. Wavelength

PRECAUTIONS FOR USE

1. Over-current-proof

Customer must apply resistors for protection, otherwise slight voltage shift will cause big current change (burn out will happen).

2. Storage

2.1 Storage temperature and rel. humidity conditions are: 5 °C to 35 °C, R.H. 60 %.

2.2 Floor life must not exceed 168 h, acc. to JEDEC level 3, J-STD-020.
Once the package is opened, the products should be used within a week. Otherwise, they should be kept in a damp proof box with desiccant.
Considering tape life, we suggest to use products within one year from production date.

2.3 If opened more than one week in an atmosphere 5 °C to 35 °C, R.H. 60 %, devices should be treated at 60 °C ± 5 °C for 15 h.

2.4 If humidity indicator in the package shows pink color (normal blue), then devices should be treated with the same conditions as 2.3.

REFLOW SOLDER PROFILE

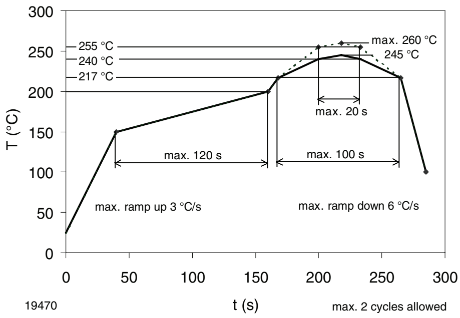
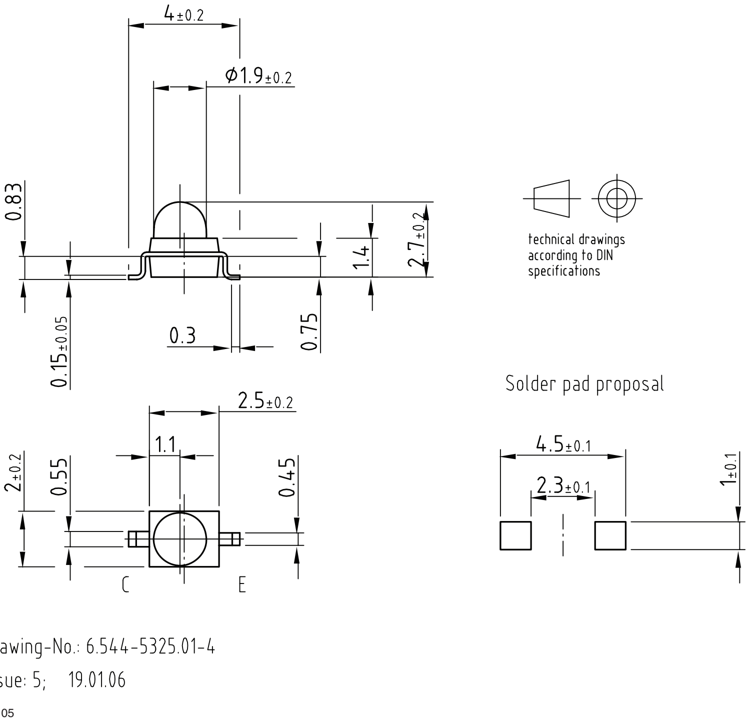
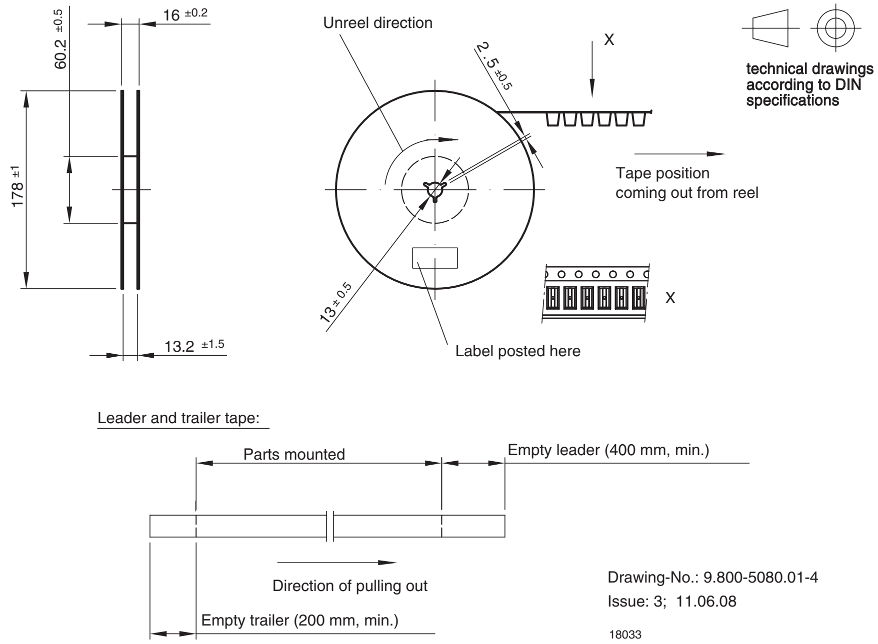


Fig. 8 - Lead (Pb)-free Reflow Solder Profile acc. J-STD-020D

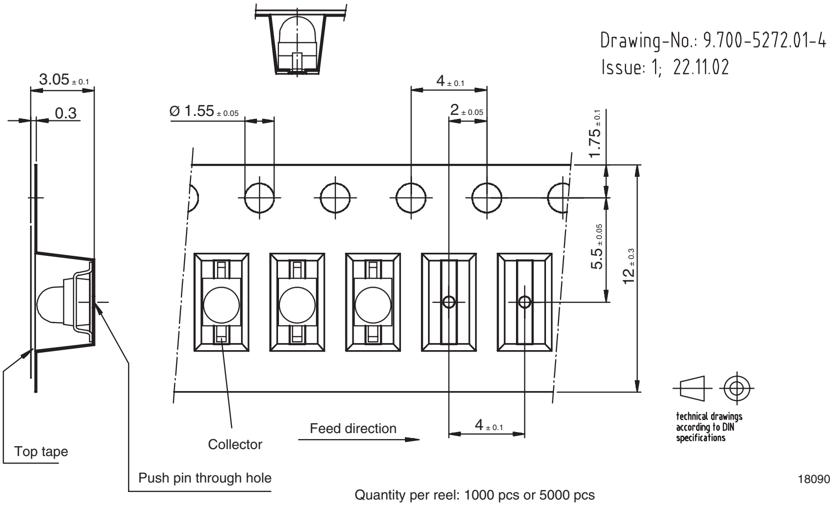
PACKAGE DIMENSIONS in millimeters



REEL DIMENSIONS in millimeters

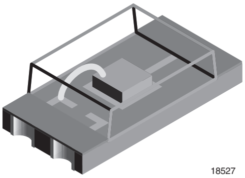


TAPING DIMENSIONS in millimeters



Quantity per reel: 1000 pcs or 5000 pcs

Ambient Light Sensor, RoHS Compliant, Released for Lead (Pb)-free Reflow Soldering, AEC-Q101 Released



DESCRIPTION

TEMT6000X01 ambient light sensor is a silicon NPN epitaxial planar phototransistor in a miniature transparent 1206 package for surface mounting. It is sensitive to visible light much like the human eye and has peak sensitivity at 570 nm.

FEATURES

- Package type: surface mount
- Package form: 1206
- Dimensions (L x W x H in mm): 4 x 2 x 1.05
- Product designed and qualified acc. AEC-Q101 for the automotive market
- High photo sensitivity
- Adapted to human eye responsivity
- Angle of half sensitivity: $\varphi = \pm 60°$
- Floor life: 72 h, MSL 4, acc. J-STD-020
- Lead (Pb)-free reflow soldering
- Lead (Pb)-free component in accordance with RoHS 2002/95/EC and WEEE 2002/96/EC

Pb-free
e3
RoHS
COMPLIANT

APPLICATIONS

Ambient light sensor for control of display backlight dimming in LCD displays and keypad backlighting of mobile devices and in industrial on/off-lighting operation.

- Automotive sensors
- Mobile phones
- Notebook computers
- PDA's
- Cameras
- Dashboards

PRODUCT SUMMARY

COMPONENT	I_{PCE} (µA)	φ (deg)	$\lambda_{0.5}$ (nm)
TEMT6000X01	50	± 60	440 to 800

Note
Test condition see table "Basic Characteristics"

ORDERING INFORMATION

ORDERING CODE	PACKAGING	REMARKS	PACKAGE FORM
TEMT6000X01	Tape and reel	MOQ: 3000 pcs, 3000 pcs/reel	1206

Note
MOQ: minimum order quantity

ABSOLUTE MAXIMUM RATINGS

PARAMETER	TEST CONDITION	SYMBOL	VALUE	UNIT
Collector emitter voltage		V_{CEO}	6	V
Emitter collector voltage		V_{ECO}	1.5	V
Collector current		I_C	20	mA
Power dissipation		P_V	100	mW

Ambient Light Sensor, RoHS Compliant, Released for Lead (Pb)-free Reflow Soldering, AEC-Q101 Released

ABSOLUTE MAXIMUM RATINGS

PARAMETER	TEST CONDITION	SYMBOL	VALUE	UNIT
Junction temperature		T_j	100	°C
Operating temperature range		T_{amb}	- 40 to + 100	°C
Storage temperature range		T_{stg}	- 40 to + 100	°C
Soldering temperature	Acc. reflow solder profile fig. 8	T_{sd}	260	°C
Thermal resistance junction/ambient	Soldered on PCB with pad dimensions: 4 mm x 4 mm	R_{thJA}	450	K/W

Note

T_{amb} = 25 °C, unless otherwise specified

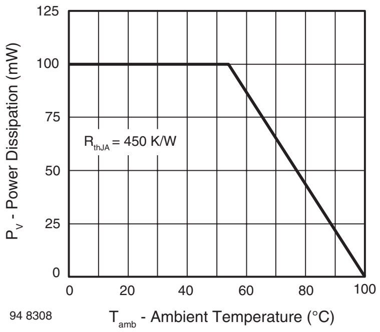


Fig. 1 - Power Dissipation Limit vs. Ambient Temperature

BASIC CHARACTERISTICS

PARAMETER	TEST CONDITION	SYMBOL	MIN.	TYP.	MAX.	UNIT
Collector emitter breakdown voltage	I_C = 0.1 mA	V_{CEO}	6			V
Collector dark current	V_{CE} = 5 V, E = 0	I_{CEO}		3	50	nA
Collector emitter capacitance	V_{CE} = 0 V, f = 1 MHz, E = 0	C_{CEO}		16		pF
Collector light current	E_V = 20 lx, CIE illuminant A, V_{CE} = 5 V	I_{PCE}	3.5	10	16	µA
	E_V = 100 lx, CIE illuminant A, V_{CE} = 5 V	I_{PCE}		50		µA
Temperature coefficient of I_{PCE}	CIE illuminant A	TK_{IPCE}		1.18		%/K
	LED, white	TK_{IPCE}		0.9		%/K
Angle of half sensitivity		φ		± 60		deg
Wavelength of peak sensitivity		λ_p		570		nm
Range of spectral bandwidth		$\lambda_{0.5}$		440 to 800		nm
Collector emitter saturation voltage	E_V = 20 lx, CIE illuminant A, I_{PCE} = 1.2 µA	V_{CEsat}		0.1		V

Note

T_{amb} = 25 °C, unless otherwise specified

BASIC CHARACTERISTICS

T_{amb} = 25 °C, unless otherwise specified

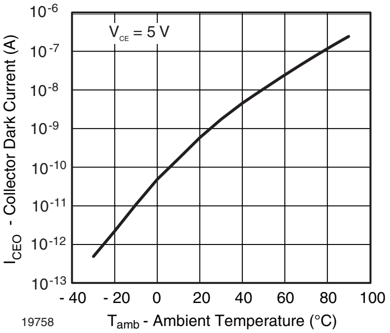


Fig. 2 - Collector Dark Current vs. Ambient Temperature

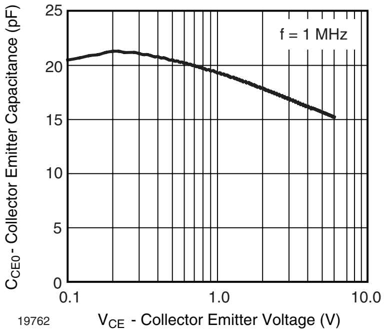


Fig. 5 - Collector Emitter Capacitance vs. Collector Emitter Voltage

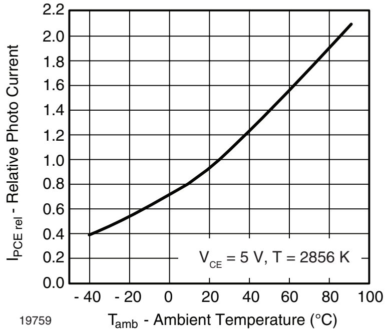


Fig. 3 - Relative Photo Current vs. Ambient Temperature

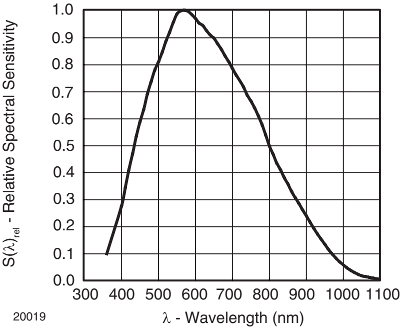


Fig. 6 - Relative Spectral Sensitivity vs. Wavelength

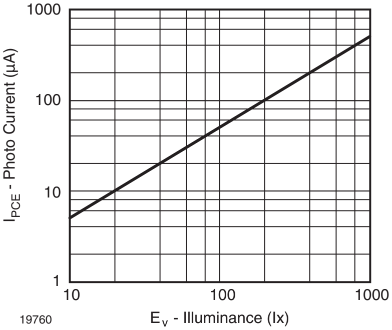


Fig. 4 - Photo Current vs. Illuminance

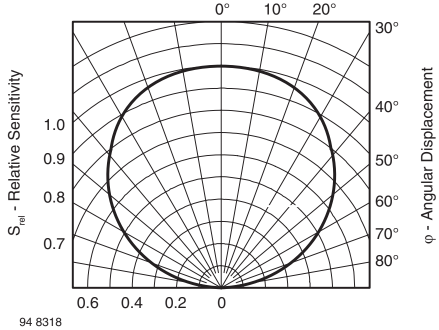


Fig. 7 - Relative Radiant Sensitivity vs. Angular Displacement

REFLOW SOLDER PROFILE

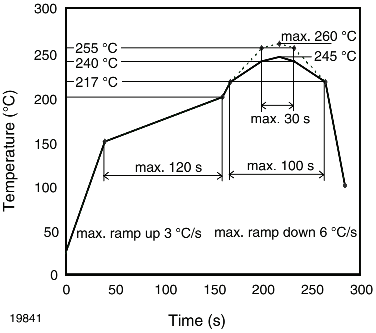


Fig. 8 - Lead (Pb)-free Reflow Solder Profile acc. J-STD-020D

DRYPACK

Devices are packed in moisture barrier bags (MBB) to prevent the products from moisture absorption during transportation and storage. Each bag contains a desiccant.

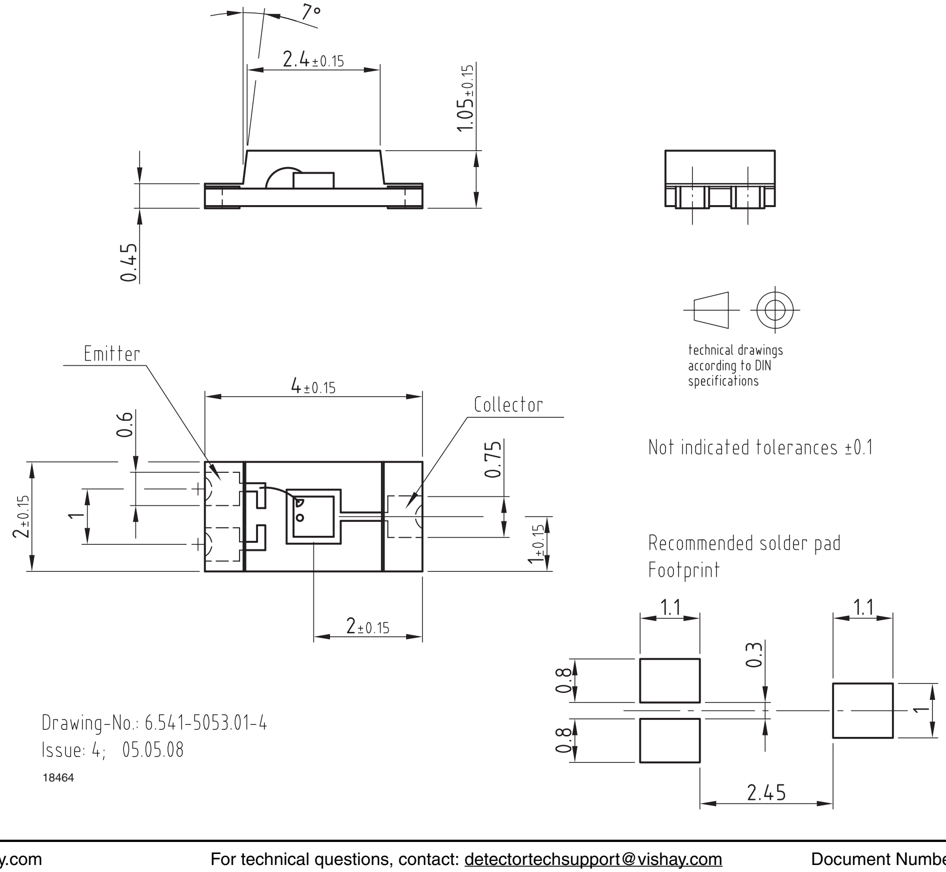
FLOOR LIFE

Time between soldering and removing from MBB must not exceed the time indicated in J-STD-020:
Moisture sensitivity: level 4
Floor life: 72 h
Conditions: T_{amb} < 30 °C, RH < 60 %

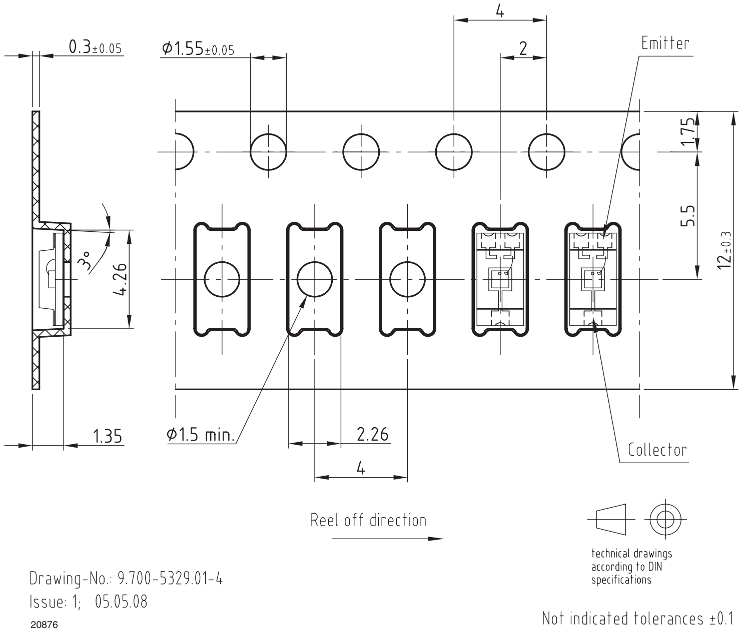
DRYING

In case of moisture absorption devices should be baked before soldering. Conditions see J-STD-020 or recommended conditions:
192 h at 40 °C (+ 5 °C), RH < 5 %
or
96 h at 60 °C (+ 5 °C), RH < 5 %.

PACKAGE DIMENSIONS in millimeters

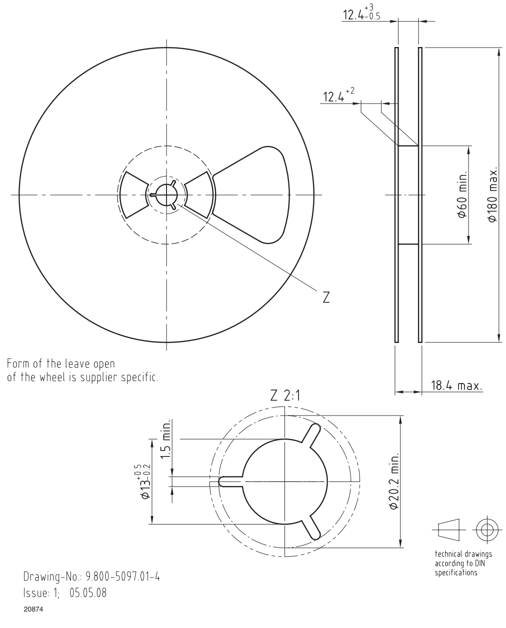


BLISTER TAPE DIMENSIONS in millimeters



REEL DIMENSIONS in millimeters

Volume: 3000 pcs/reel



Ambient Light Sensor in 0805 Package, RoHS Compliant, Released for Lead (Pb)-free Reflow Soldering, AEC-Q101 Released


20043

FEATURES

- Package type: surface mount
- Package form: 0805
- Dimensions (L x W x H in mm): 2 x 1.25 x 0.85
- Product designed and qualified acc. AEC-Q101 for the automotive market
- High photo sensitivity
- Adapted to human eye responsivity
- Supression filter for near infrared radiation
- Angle of half sensitivity: $\varphi = \pm 60°$
- Floor life: 72 h, MSL 4, acc. J-STD-020
- Lead (Pb)-free reflow soldering
- Lead (Pb)-free component in accordance with RoHS 2002/95/EC and WEEE 2002/96/EC

Pb-free
e3
RoHS
COMPLIANT

DESCRIPTION

TEMT6200FX01 ambient light sensor is a silicon NPN epitaxial planar phototransistor in a miniature transparent 0805 package for surface mounting. It is sensitive to visible light much like the human eye and has peak sensitivity at 550 nm.

APPLICATIONS

- Automotive sensors
- Ambient light sensor for display backlight dimming in:
  - Mobile phones
  - Notebook computers
  - PDAs
  - Cameras
  - Dashboards

PRODUCT SUMMARY

COMPONENT	I_{PCE} (μA)	φ (deg)	$\lambda_{0.5}$ (nm)
TEMT6200FX01	7.5 to 39	± 60	450 to 610

Note
Test condition see table “Basic Characteristics”

ORDERING INFORMATION

ORDERING CODE	PACKAGING	REMARKS	PACKAGE FORM
TEMT6200FX01	Tape and reel	MOQ: 3000 pcs, 3000 pcs/reel. Label with I_{PCE} group on each reel. Specifications of group A/B/C see table “Type Dedicated Characteristics”	0805

Note
MOQ: minimum order quantity

ABSOLUTE MAXIMUM RATINGS

PARAMETER	TEST CONDITION	SYMBOL	VALUE	UNIT
Collector emitter voltage		V_{CEO}	6	V
Emitter collector voltage		V_{ECO}	1.5	V
Collector current		I_C	20	mA
Power dissipation		P_V	100	mW
Junction temperature		T_j	100	°C
Operating temperature range		T_{amb}	- 40 to + 100	°C
Storage temperature range		T_{stg}	- 40 to + 100	°C
Soldering temperature	Acc. reflow profile fig. 9	T_{sd}	260	°C
Thermal resistance junction/ambient	Soldered on PCB with pad dimensions: 4 mm x 4 mm	R_{thJA}	450	K/W

Note
T_{amb} = 25 °C, unless otherwise specified

Ambient Light Sensor in 0805 Package, RoHS Compliant, Released for Lead (Pb)-free Reflow Soldering, AEC-Q101 Released

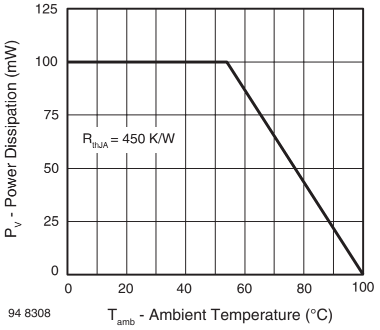


Fig. 1 - Power Dissipation Limit vs. Ambient Temperature

BASIC CHARACTERISTICS

PARAMETER	TEST CONDITION	SYMBOL	MIN.	TYP.	MAX.	UNIT
Collector emitter breakdown voltage	I_C = 0.1 mA	V_{CEO}	6			V
Collector dark current	V_{CE} = 5 V, E = 0	I_{CEO}		3	50	nA
Collector emitter capacitance	V_{CE} = 0 V, f = 1 MHz, E = 0	C_{CEO}		16		pF
Photo current	E_V = 20 lx, CIE illuminant A, V_{CE} = 5 V	I_{PCE}		4.6		µA
	E_V = 100 lx, CIE illuminant A, V_{CE} = 5 V	I_{PCE}	7.5		39	µA
Temperature coefficient of I_{PCE}	CIE illuminant A	TK_{IPCE}		1.18		%/K
	LED, white	TK_{IPCE}		0.9		%/K
Angle of half sensitivity		φ		± 60		deg
Wavelength of peak sensitivity		λ_p		550		nm
Range of spectral bandwidth		$\lambda_{0.5}$		450 to 610		nm
Collector emitter saturation voltage	E_V = 20 lx, 0.45 µA	V_{CEsat}		0.1		V

Note

T_{amb} = 25 °C, unless otherwise specified

TYPE DEDICATED CHARACTERISTICS

PARAMETER	TEST CONDITION	SELECTION TYPE	SYMBOL	MIN.	MAX.	UNIT
Photo current	E_V = 100 lx, CIE illuminant A, V_{CE} = 5 V	TEMT6200FX01A	I_{PCE}	7.5	15	µA
		TEMT6200FX01B	I_{PCE}	12	24	µA
		TEMT6200FX01C	I_{PCE}	19.5	39	µA

Note

T_{amb} = 25 °C, unless otherwise specified

BASIC CHARACTERISTICS

T_{amb} = 25 °C, unless otherwise specified

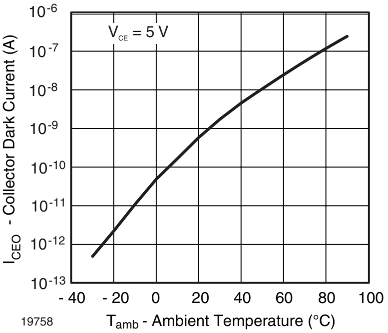


Fig. 2 - Collector Dark Current vs. Ambient Temperature

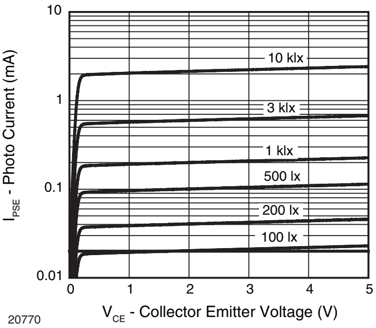


Fig. 5 - Photo Current vs. Collector Emitter Voltage

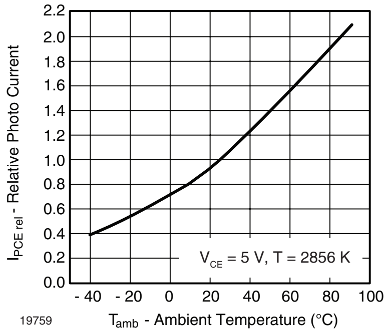


Fig. 3 - Relative Photo Current vs. Ambient Temperature

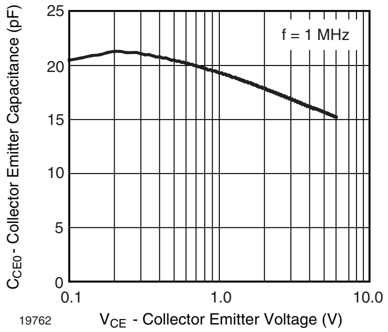


Fig. 6 - Collector Emitter Capacitance vs. Collector Emitter Voltage

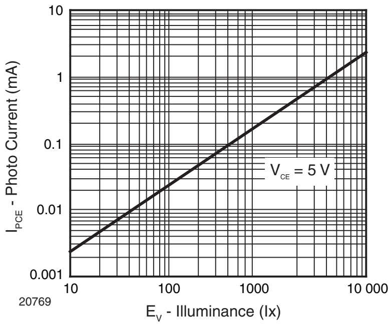


Fig. 4 - Photo Current vs. Illuminance

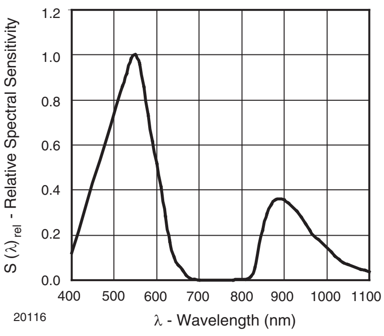


Fig. 7 - Relative Spectral Sensitivity vs. Wavelength

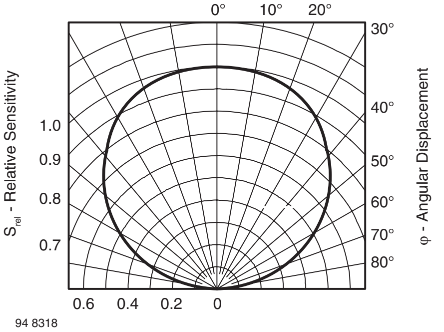


Fig. 8 - Relative Radiant Sensitivity vs. Angular Displacement

REFLOW SOLDER PROFILE

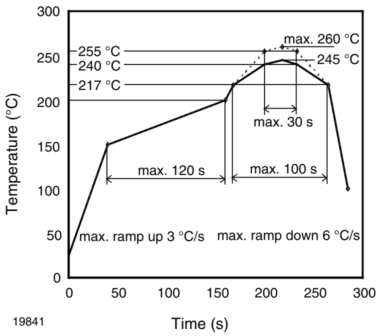


Fig. 9 - Lead (Pb)-free Reflow Solder Profile acc. J-STD-020D

DRYPACK

Devices are packed in moisture barrier bags (MBB) to prevent the products from moisture absorption during transportation and storage. Each bag contains a desiccant.

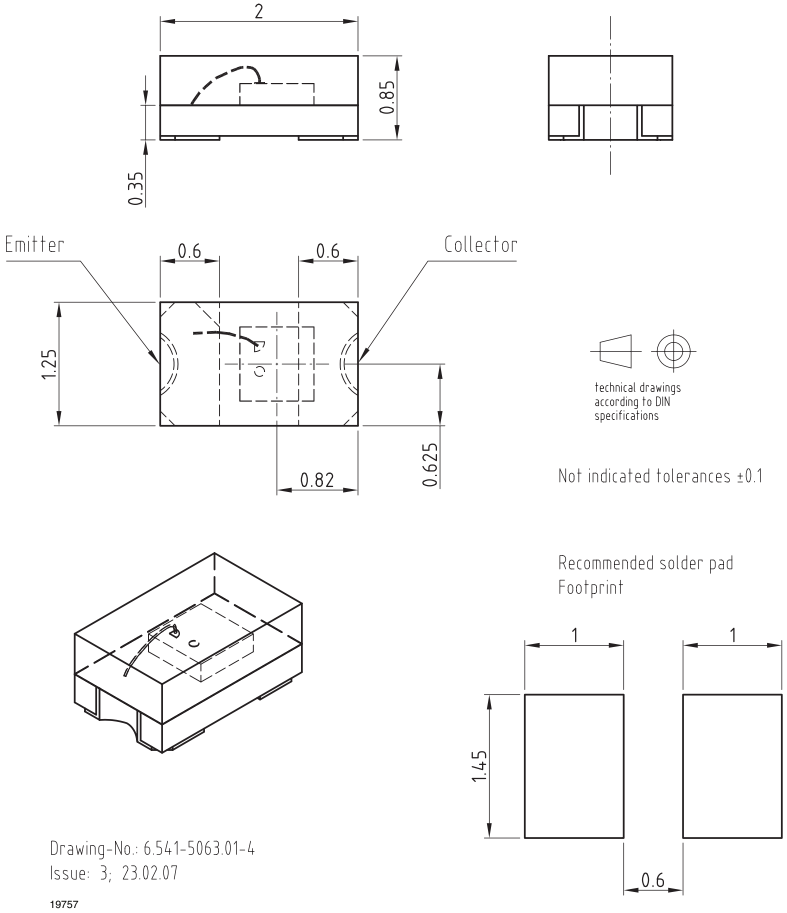
FLOOR LIFE

Floor life (time between soldering and removing from MBB) must not exceed the time indicated on MBB label:
Floor life: 72 h
Conditions: T_{amb} < 30 °C, RH < 60 %
Moisture sensitivity level 4, acc. to J-STD-020.

DRYING

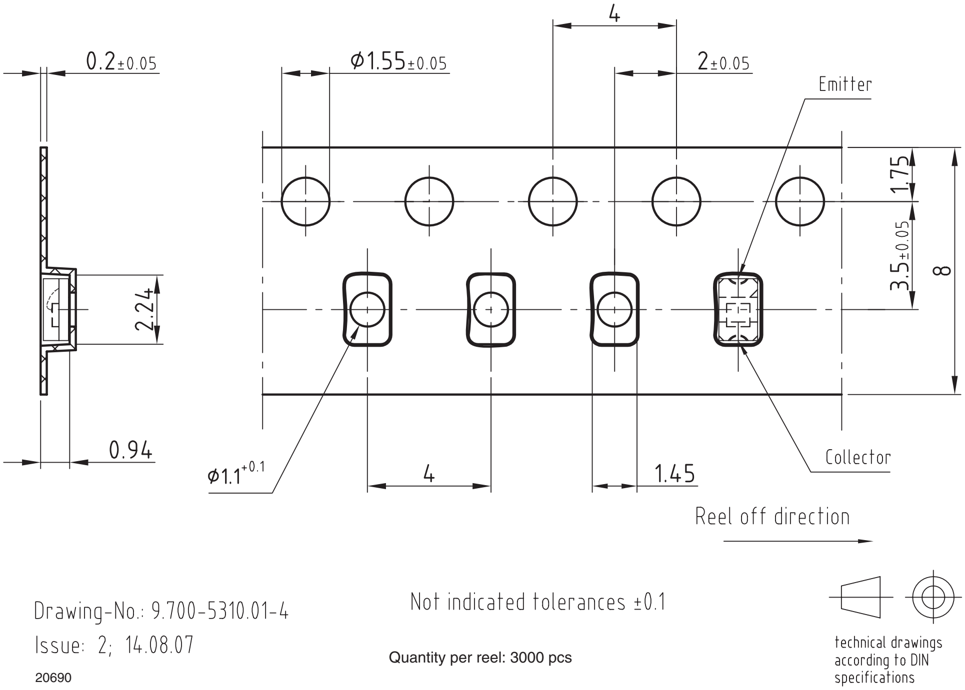
In case of moisture absorption devices should be baked before soldering. Conditions see J-STD-020 or label. Devices taped on reel dry using recommended conditions 192 h at 40 °C (+ 5 °C), RH < 5 %.

PACKAGE DIMENSIONS in millimeters



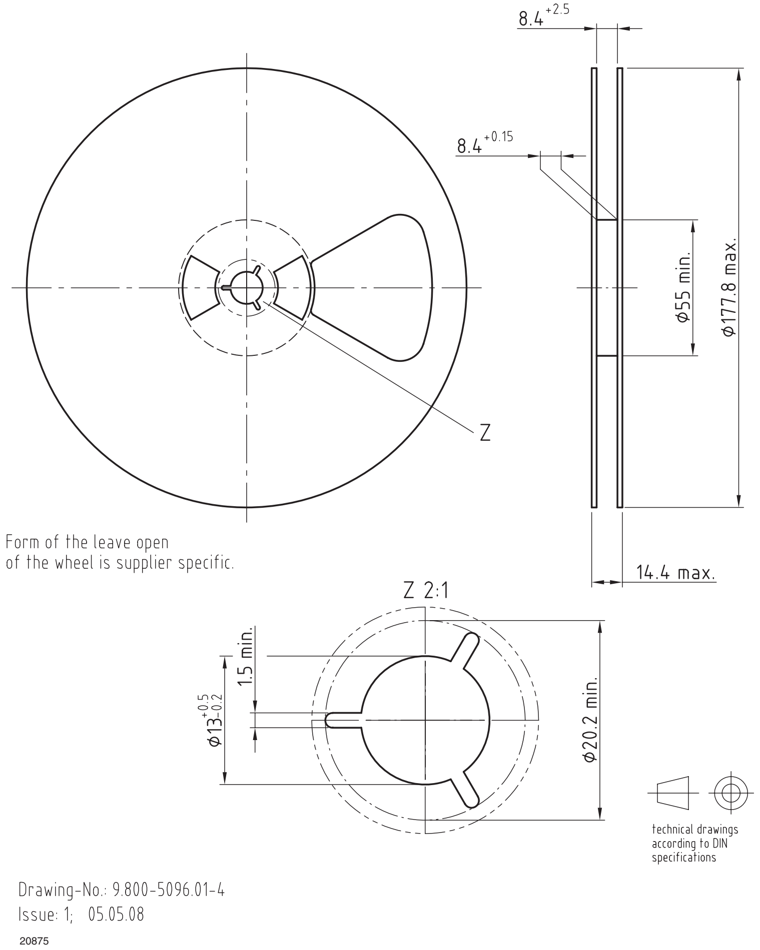
19757

BLISTER TAPE DIMENSIONS in millimeters

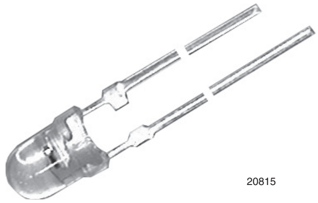


Quantity per reel: 3000 pcs

REEL DIMENSIONS in millimeters



Ambient Light Sensor, RoHS Compliant



DESCRIPTION

TEPT4400 ambient light sensor is a silicon NPN epitaxial planar phototransistor in a T-1 package. It is sensitive to visible light much like the human eye and has peak sensitivity at 570 nm.

FEATURES

- Package type: leaded
- Package form: T-1
- Dimensions (in mm): Ø 3
- High photo sensitivity
- Adapted to human eye responsivity
- Angle of half sensitivity: φ = ± 30°
- Lead (Pb)-free component in accordance with RoHS 2002/95/EC and WEEE 2002/96/EC

Pb-free

e4

RoHS
COMPLIANT

APPLICATIONS

- Ambient light sensor for control of display backlight dimming in LCD displays and keypad backlighting of mobile devices and in industrial on/off-lighting operation
- Replacement of CdS photoresistors

PRODUCT SUMMARY

COMPONENT	I_{PCE} (μA)	φ (deg)	$\lambda_{0.5}$ (nm)
TEPT4400	200	± 30	440 to 800

Note

Test condition see table “Basic Characteristics“

ORDERING INFORMATION

ORDERING CODE	PACKAGING	REMARKS	PACKAGE FORM
TEPT4400	Bulk	MOQ: 5000 pcs, 5000 pcs/bulk	T-1

Note

MOQ: minimum order quantity

ABSOLUTE MAXIMUM RATINGS

PARAMETER	TEST CONDITION	SYMBOL	VALUE	UNIT
Collector emitter voltage		V_{CEO}	6	V
Emitter collector voltage		V_{ECO}	1.5	V
Collector current		I_C	20	mA
Power dissipation	$T_{amb} \leq 55$ °C	P_V	100	mW
Junction temperature		T_j	100	°C
Operating temperature range		T_{amb}	- 40 to + 85	°C
Storage temperature range		T_{stg}	- 40 to + 100	°C
Soldering temperature	$t \leq 3$ s	T_{sd}	260	°C
Thermal resistance junction/ambient	J-STD-051, soldered on PCB	R_{thJA}	300	K/W

Note

T_{amb} = 25 °C, unless otherwise specified

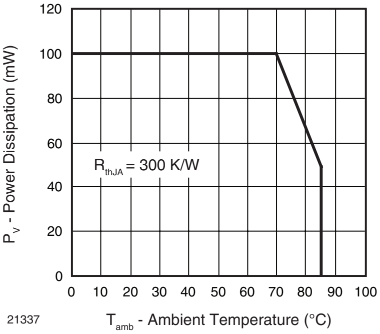


Fig. 1 - Power Dissipation Limit vs. Ambient Temperature

BASIC CHARACTERISTICS						
PARAMETER	**TEST CONDITION**	**SYMBOL**	**MIN.**	**TYP.**	**MAX.**	**UNIT**
Collector emitter breakdown voltage	I_C = 0.1 mA	V_{CEO}	6			V
Collector dark current	V_{CE} = 5 V, E = 0	I_{CEO}		3	50	nA
Collector emitter capacitance	V_{CE} = 0 V, f = 1 MHz, E = 0	C_{CEO}		16		pF
Collector light current	E_v = 20 lx, CIE illuminant A, V_{CE} = 5 V	I_{PCE}	15	40	70	µA
	E_v = 100 lx, CIE illuminant A, V_{CE} = 5 V	I_{PCE}		200		µA
Angle of half sensitivity		φ		± 30		deg
Wavelength of peak sensitivity		λ_p		570		nm
Range of spectral bandwidth		$\lambda_{0.5}$		440 to 800		nm
Collector emitter saturation voltage	E_v = 20 lx, CIE illuminant A, I_{PCE} = 1.2 µA	V_{CEsat}		0.1		V

Note

T_{amb} = 25 °C, unless otherwise specified

BASIC CHARACTERISTICS

T_{amb} = 25 °C, unless otherwise specified

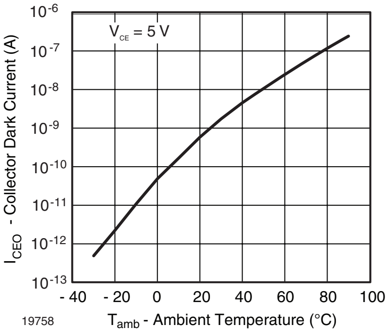


Fig. 2 - Collector Dark Current vs. Ambient Temperature

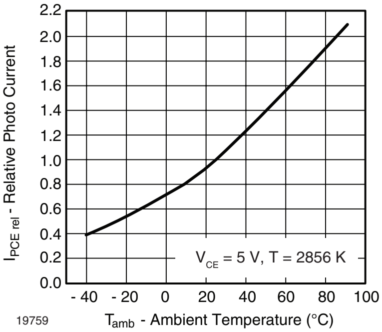


Fig. 3 - Relative Photo Current vs. Ambient Temperature

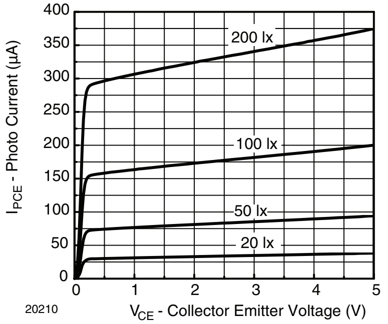


Fig. 4 - Photo Current vs. Collector Emitter Voltage

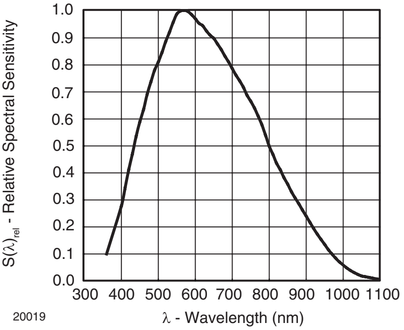


Fig. 7 - Relative Spectral Sensitivity vs. Wavelength

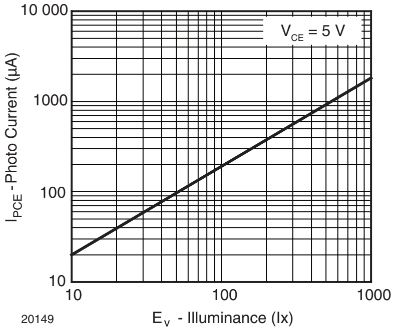


Fig. 5 - Photo Current vs. Illuminance

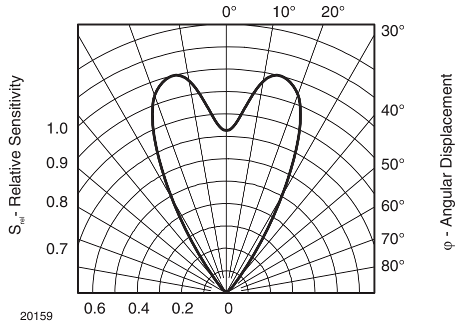


Fig. 8 - Relative Radiant Sensitivity vs. Angular Displacement

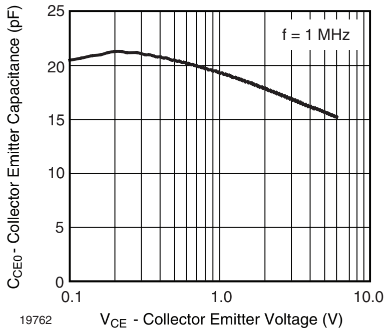
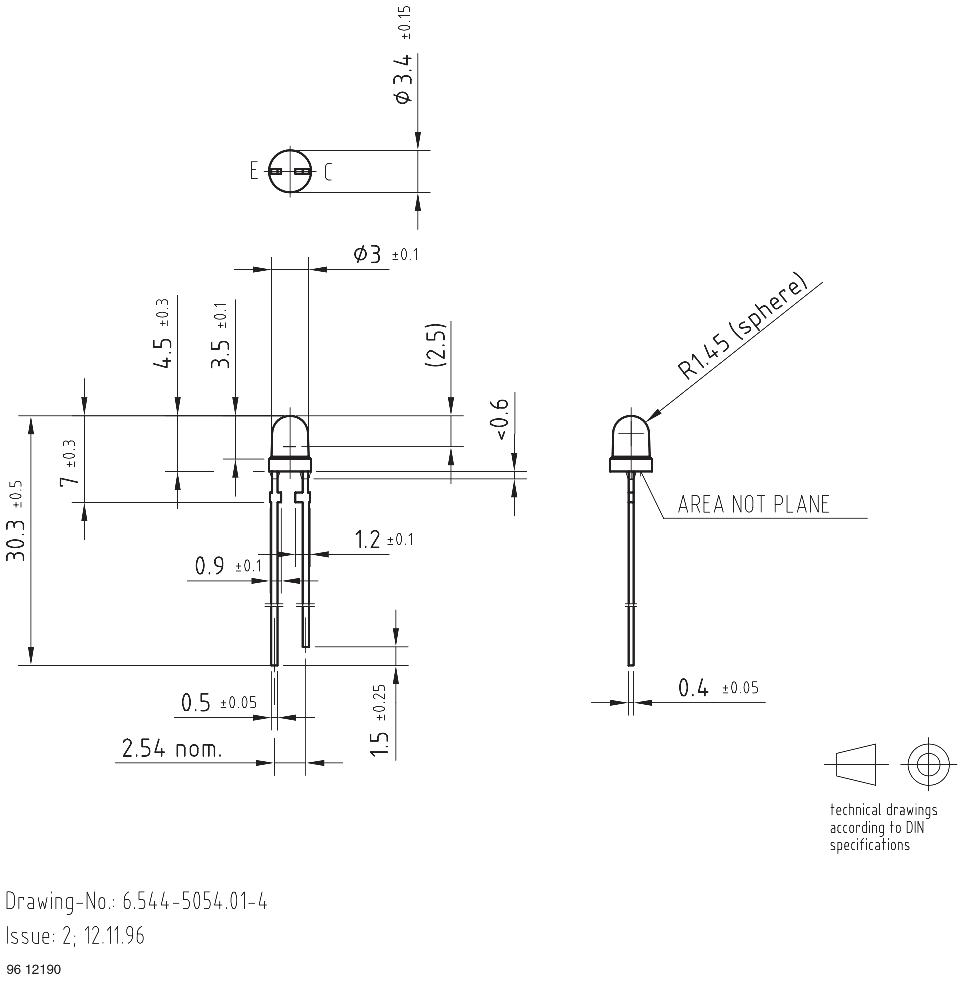
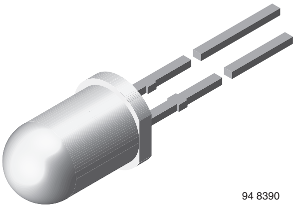


Fig. 6 - Collector Emitter Capacitance vs. Collector Emitter Voltage

PACKAGE DIMENSIONS in millimeters



Ambient Light Sensor, RoHS Compliant


94 8390

DESCRIPTION

TEPT5600 ambient light sensor is a silicon NPN epitaxial planar phototransistor in a T-1¾ package. It is sensitive to visible light much like the human eye and has peak sensitivity at 570 nm.

FEATURES

- Package type: leaded
- Package form: T-1¾
- Dimensions (in mm): Ø 5
- High photo sensitivity
- Adapted to human eye responsivity
- Angle of half sensitivity: φ = ± 20°
- Lead (Pb)-free component in accordance with RoHS 2002/95/EC and WEEE 2002/96/EC

Pb-free
e4
RoHS
COMPLIANT

APPLICATIONS

- Replacement of cadmium sulfide (CdS) photo resistors
- Ambient light sensor

PRODUCT SUMMARY

COMPONENT	I_{PCE} (µA)	φ (deg)	$\lambda_{0.5}$ (nm)
TEPT5600	350	± 20	440 to 800

Note

Test condition see table "Basic Characteristics"

ORDERING INFORMATION

ORDERING CODE	PACKAGING	REMARKS	PACKAGE FORM
TEPT5600	Bulk	MOQ: 4000 pcs, 4000 pcs/bulk	T-1¾

Note

MOQ: minimum order quantity

ABSOLUTE MAXIMUM RATINGS

PARAMETER	TEST CONDITION	SYMBOL	VALUE	UNIT
Collector emitter voltage		V_{CEO}	6	V
Emitter collector voltage		V_{ECO}	1.5	V
Collector current		I_C	20	mA
Power dissipation	$T_{amb} \leq 55$ °C	P_V	100	mW
Junction temperature		T_j	100	°C
Operating temperature range		T_{amb}	- 40 to + 85	°C
Storage temperature range		T_{stg}	- 40 to + 100	°C
Soldering temperature	t ≤ 3 s, 2 mm distance to package	T_{sd}	260	°C
Thermal resistance junction/ambient	J-STD-051, soldered on PCB	R_{thJA}	230	K/W

Note

T_{amb} = 25 °C, unless otherwise specified

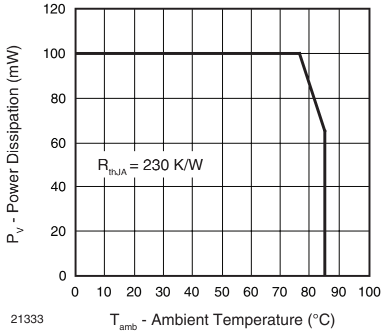


Fig. 1 - Power Dissipation Limit vs. Ambient Temperature

BASIC CHARACTERISTICS

PARAMETER	TEST CONDITION	SYMBOL	MIN.	TYP.	MAX.	UNIT
Collector emitter breakdown voltage	I_C = 0.1 mA	V_{CEO}	6			V
Collector dark current	V_{CE} = 5 V, E = 0	I_{CEO}		3	50	nA
Collector emitter capacitance	V_{CE} = 0 V, f = 1 MHz, E = 0	C_{CEO}		16		pF
Photo current	E_v = 20 lx, CIE illuminant A, V_{CE} = 5 V	I_{PCE}	25	70	140	µA
	E_v = 100 lx, CIE illuminant A, V_{CE} = 5 V	I_{PCE}		350		µA
Angle of half sensitivity		φ		± 20		deg
Wavelength of peak sensitivity		λ_p		570		nm
Range of spectral bandwidth		$\lambda_{0.5}$		440 to 800		nm

Note

T_{amb} = 25 °C, unless otherwise specified

BASIC CHARACTERISTICS

T_{amb} = 25 °C, unless otherwise specified

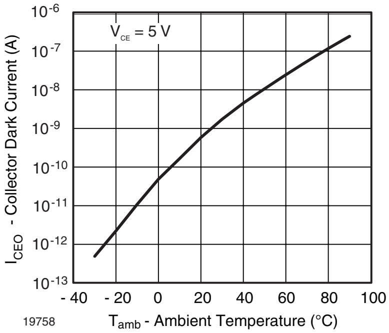


Fig. 2 - Collector Dark Current vs. Ambient Temperature

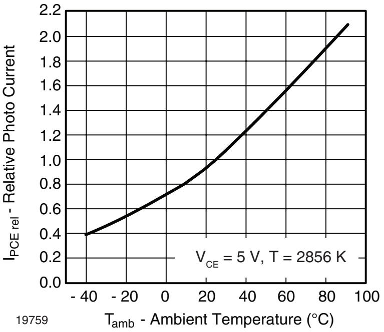


Fig. 3 - Relative Photo Current vs. Ambient Temperature

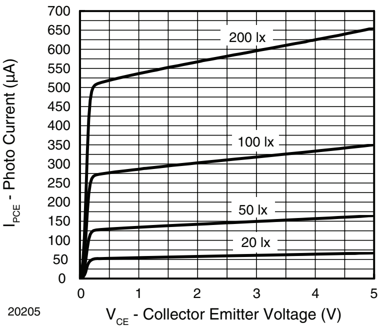


Fig. 4 - Photo Current vs. Collector Emitter Voltage

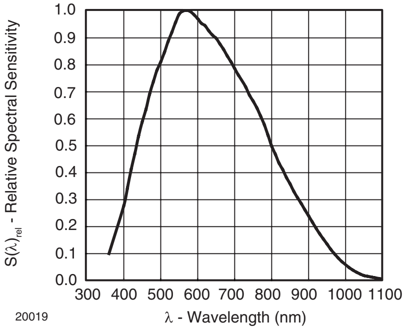


Fig. 7 - Relative Spectral Sensitivity vs. Wavelength

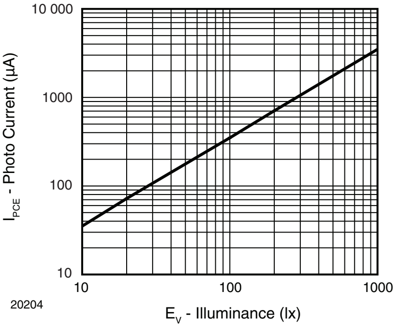


Fig. 5 - Photo Current vs. Illuminance

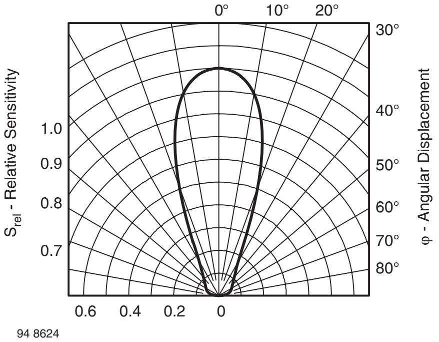


Fig. 8 - Relative Radiant Sensitivity vs. Angular Displacement

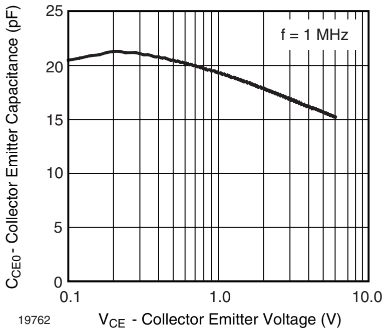
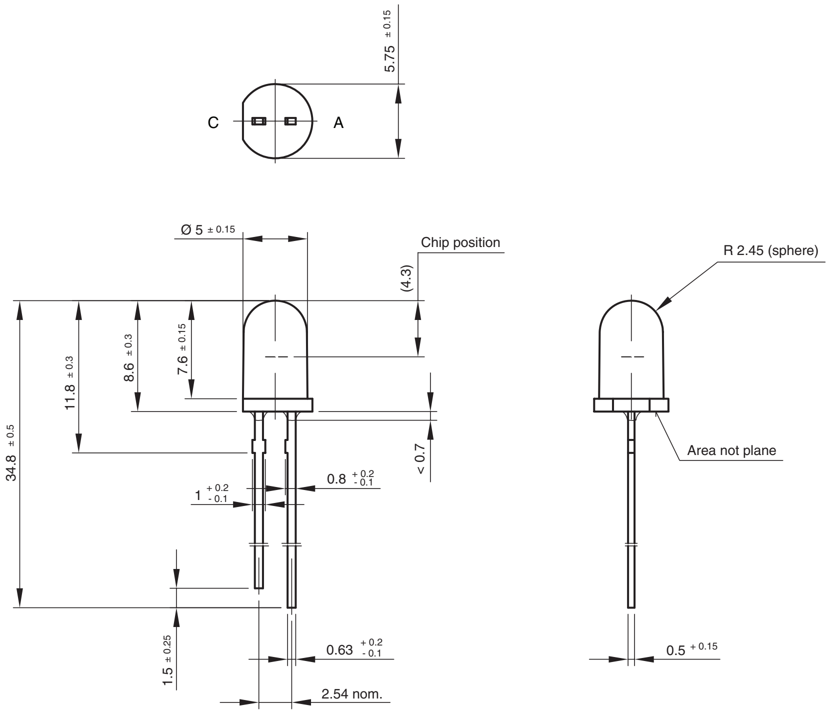
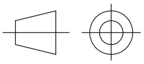


Fig. 6 - Collector Emitter Capacitance vs. Collector Emitter Voltage

PACKAGE DIMENSIONS in millimeters





technical drawings
according to DIN
specifications

Drawing-No.: 6.544-5185.02-4
Issue:1; 01.07.96
96 12199

Ambient Light Sensor, RoHS Compliant

20118

DESCRIPTION

TEPT5700 ambient light sensor is a silicon NPN epitaxial planar phototransistor in a T-1¾ package. It is sensitive to visible light much like the human eye and has peak sensitivity at 570 nm.

FEATURES

- Package type: leaded
- Package form: T-1¾
- Dimensions (in mm): Ø 5
- High photo sensitivity
- Adapted to human eye responsivity
- Angle of half sensitivity: $\varphi = \pm 50°$
- Lead (Pb)-free component in accordance with RoHS 2002/95/EC and WEEE 2002/96/EC

Pb-free

e4

RoHS
COMPLIANT

APPLICATIONS

- Ambient light sensor for control of display backlight dimming in LCD displays and keypad backlighting of mobile devices and in industrial on/off-lighting operation

PRODUCT SUMMARY

COMPONENT	I_{PCE} (mA)	φ (deg)	$\lambda_{0.5}$ (nm)
TEPT5700	75	± 50	440 to 800

Note

Test condition see table “Basic Characteristics”

ORDERING INFORMATION

ORDERING CODE	PACKAGING	REMARKS	PACKAGE FORM
TEPT5700	Bulk	MOQ: 4000 pcs, 4000 pcs/bulk	T-1¾

Note

MOQ: minimum order quantity

ABSOLUTE MAXIMUM RATINGS

PARAMETER	TEST CONDITION	SYMBOL	VALUE	UNIT
Collector emitter voltage		V_{CEO}	6	V
Emitter collector voltage		V_{ECO}	1.5	V
Collector current		I_C	20	mA
Power dissipation	$T_{amb} \leq 55$ °C	P_V	100	mW
Junction temperature		T_j	100	°C
Operating temperature range		T_{amb}	- 40 to + 85	°C
Storage temperature range		T_{stg}	- 40 to + 100	°C
Soldering temperature	$t \leq 5$ s, 2 mm distance to package	T_{sd}	260	°C
Thermal resistance junction/ambient	J-STD-051, soldered on PCB	R_{thJA}	230	K/W

Note

$T_{amb} = 25$ °C, unless otherwise specified

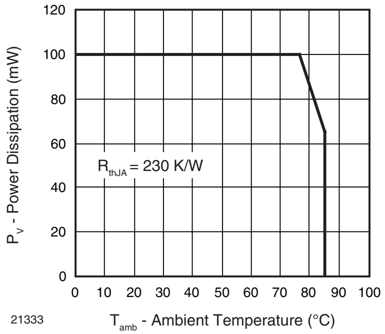


Fig. 1 - Power Dissipation Limit vs. Ambient Temperature

BASIC CHARACTERISTICS						
PARAMETER	**TEST CONDITION**	**SYMBOL**	**MIN.**	**TYP.**	**MAX.**	**UNIT**
Collector emitter breakdown voltage	I_C = 0.1 mA	V_{CEO}	6			V
Collector dark current	V_{CE} = 5 V, E = 0	I_{CEO}		3	50	nA
Collector emitter capacitance	V_{CE} = 0 V, f = 1 MHz, E = 0	C_{CEO}		16		pF
Collector light current	E_v = 20 lx, CIE illuminant A, V_{CE} = 5 V	I_{PCE}	5.2	15	24	µA
	E_v = 100 lx, CIE illuminant A, V_{CE} = 5 V	I_{PCE}		75		µA
Angle of half sensitivity		φ		± 50		deg
Wavelength of peak sensitivity		λ_p		570		nm
Range of spectral bandwidth		$\lambda_{0.5}$		440 to 800		nm
Collector emitter saturation voltage	E_v = 20 lx, CIE illuminant A, I_{PCE} = 1.2 µA	V_{CEsat}		0.1		V

Note
T_{amb} = 25 °C, unless otherwise specified

BASIC CHARACTERISTICS

T_{amb} = 25 °C, unless otherwise specified

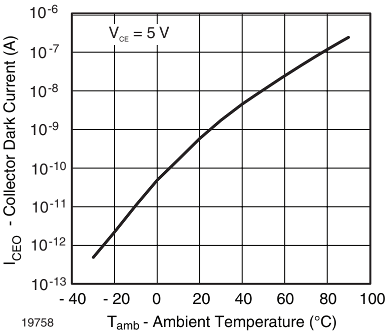


Fig. 2 - Collector Dark Current vs. Ambient Temperature

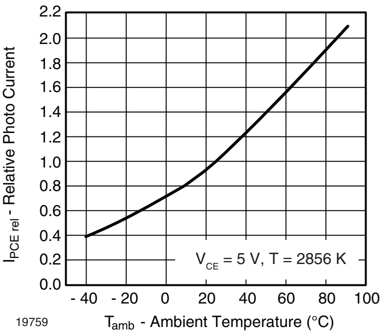


Fig. 3 - Relative Photo Current vs. Ambient Temperature

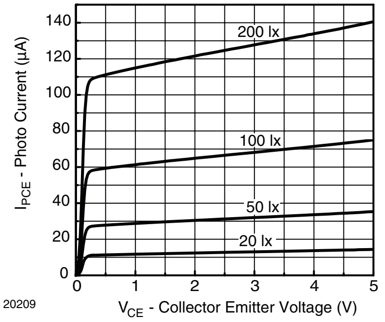


Fig. 4 - Photo Current vs. Collector Emitter Voltage

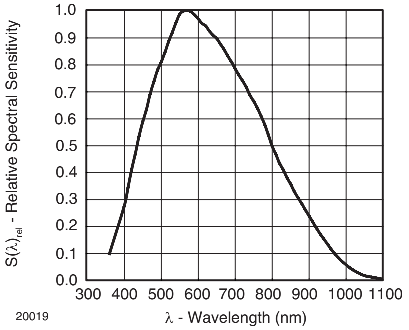


Fig. 7 - Relative Spectral Sensitivity vs. Wavelength

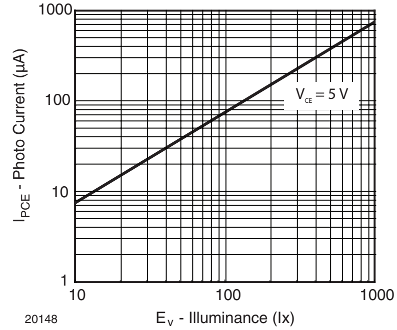


Fig. 5 - Photo Current vs. Illuminance

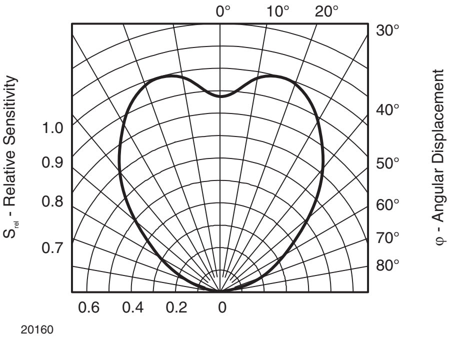


Fig. 8 - Relative Radiant Sensitivity vs. Angular Displacement

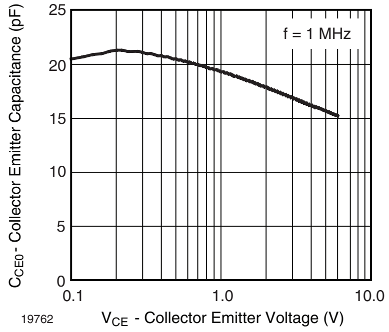
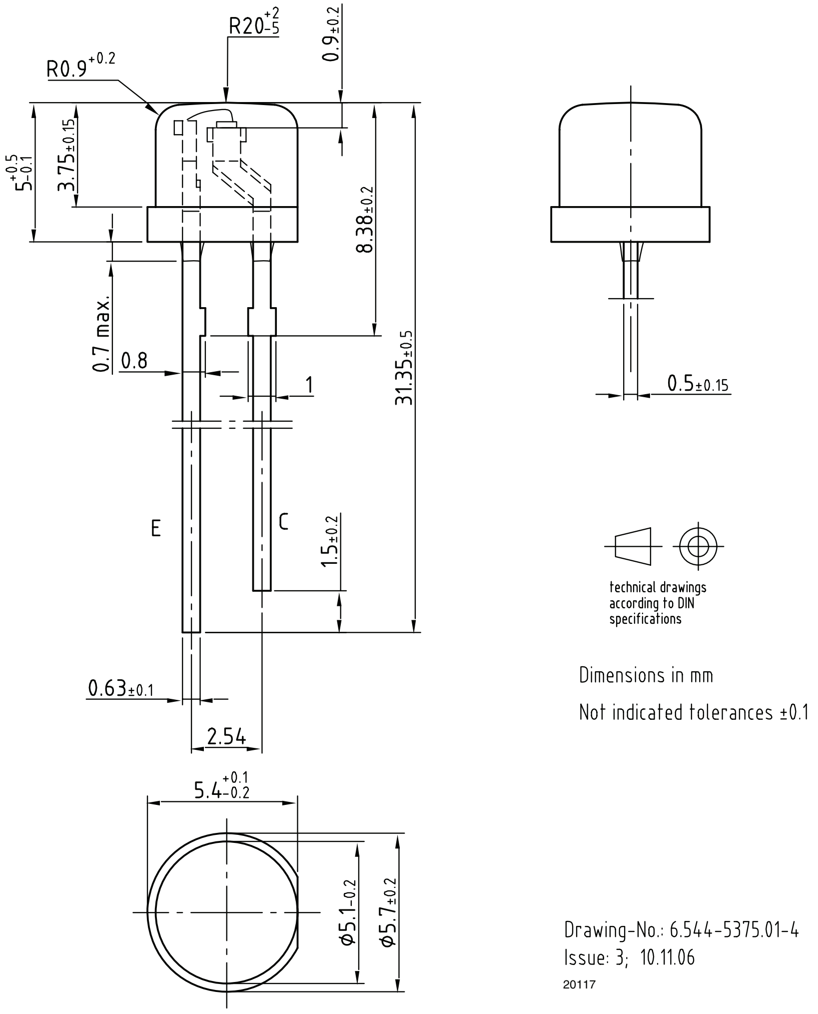
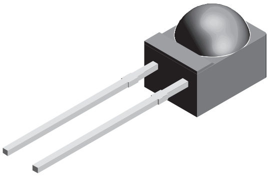


Fig. 6 - Collector Emitter Capacitance vs. Collector Emitter Voltage

PACKAGE DIMENSIONS in millimeters



Silicon PIN Photodiode, RoHS Compliant



16936

FEATURES

- Package type: leaded
- Package form: side view
- Dimensions (L x W x H in mm): 4.5 x 5 x 6
- Radiant sensitive area (in mm^2): 2.2
- High radiant sensitivity
- Daylight blocking filter matched with 870 nm to 950 nm emitters
- High cut-off frequency at V_R = 2 V: 35 MHz
- Angle of half sensitivity: φ = ± 60°
- Lead (Pb)-free component in accordance with RoHS 2002/95/EC and WEEE 2002/96/EC

Pb-free
e4
RoHS
COMPLIANT

DESCRIPTION

TESP5700 PIN photodiode is applicable to high speed data transmission specifically at low reverse voltage. Black epoxy package include side view lens and daylight blocking filter, matched to high speed IR emitters.

APPLICATIONS

- High speed data transmission specifically using low supply voltage
- High speed detector for infrared radiation
- Infrared remote control and free air data transmissionsystems, e.g. in combination with TSFFxxxx series IR emitters

PRODUCT SUMMARY

COMPONENT	I_{ra} (μA)	φ (deg)	$\lambda_{0.5}$ (nm)
TESP5700	25	± 60	790 to 980

Note
Test condition see table “Basic Characteristics”

ORDERING INFORMATION

ORDERING CODE	PACKAGING	REMARKS	PACKAGE FORM
TESP5700	Bulk	MOQ: 4000 pcs, 4000 pcs/bulk	Side view

Note
MOQ: minimum order quantity

ABSOLUTE MAXIMUM RATINGS

PARAMETER	TEST CONDITION	SYMBOL	VALUE	UNIT
Reverse voltage		V_R	60	V
Power dissipation	$T_{amb} \leq 25$ °C	P_V	215	mW
Junction temperature		T_j	100	°C
Operating temperature range		T_{amb}	- 40 to + 100	°C
Storage temperature range		T_{stg}	- 40 to + 100	°C
Soldering temperature	$t \leq 5$ s	T_{sd}	260	°C
Thermal resistance junction/ambient	Connected with Cu wire, 0.14 mm^2	R_{thJA}	350	K/W

Note
T_{amb} = 25 °C, unless otherwise specified

BASIC CHARACTERISTICS						
PARAMETER	**TEST CONDITION**	**SYMBOL**	**MIN.**	**TYP.**	**MAX.**	**UNIT**
Forward voltage	I_F = 50 mA	V_F		0.9	1.3	V
Breakdown voltage	I_R = 100 µA, E = 0	$V_{(BR)}$	60			V
Reverse dark current	V_R = 10 V, E = 0	I_{ro}		1	10	nA
Diode capacitance	V_R = 0 V, f = 1 MHz, E = 0	C_D		17		pF
Serial resistance	V_R = 2 V, f = 1 MHz	R_S		40		Ω
Open circuit voltage	E_e = 1 mW/cm², λ = 870 nm	V_o		430		mV
Temperature coefficient of V_o	E_e = 1 mW/cm², λ = 870 nm	TK_{Vo}		- 2.6		mV/K
Short circuit current	E_e = 1 mW/cm², λ = 870 nm	I_k		23		µA
Reverse light current	E_e = 1 mW/cm², λ = 870 nm, V_R = 2 V	I_{ra}	16	25		µA
Temperature coefficient of I_{ra}	E_e = 1 mW/cm², λ = 870 nm, V_R = 2 V	TK_{Ira}		0.13		%/K
Absolute spectral sensitivity	V_R = 2 V, λ = 870 nm	s(λ)		0.57		A/W
	V_R = 5 V, λ = 950 nm	s(λ)		0.37		A/W
Angle of half sensitivity		φ		± 60		deg
Wavelength of peak sensitivity		λ_p		870		nm
Range of spectral bandwidth		$\lambda_{0.5}$		790 to 980		nm
Rise time	V_R = 2 V, R_L = 50 Ω, λ = 870 nm	t_r		10		ns
Fall time	V_R = 2 V, R_L = 50 Ω, λ = 870 nm	t_f		10		ns
Cut-off frequency	V_R = 2 V, R_L = 50 Ω, λ = 870 nm	f_c		4		MHz

Note

T_{amb} = 25 °C, unless otherwise specified

BASIC CHARACTERISTICS

T_{amb} = 25 °C, unless otherwise specified

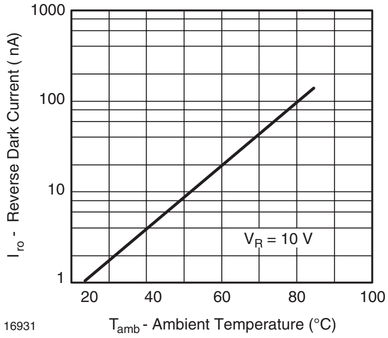


Fig. 1 - Reverse Dark Current vs. Ambient Temperature

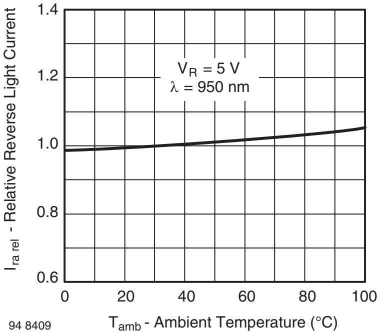


Fig. 2 - Relative Reverse Light Current vs. Ambient Temperature

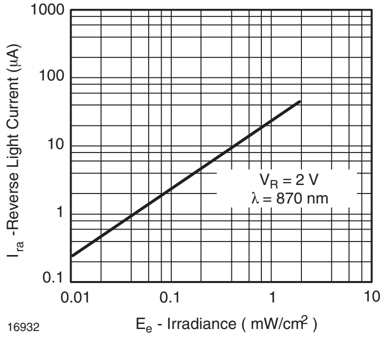


Fig. 3 - Reverse Light Current vs. Irradiance

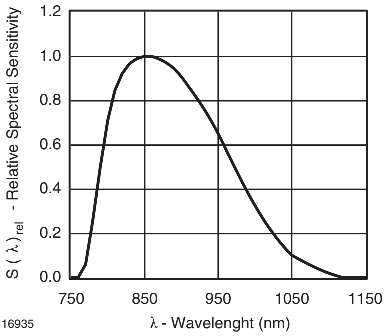


Fig. 6 - Relative Spectral Sensitivity vs. Wavelength

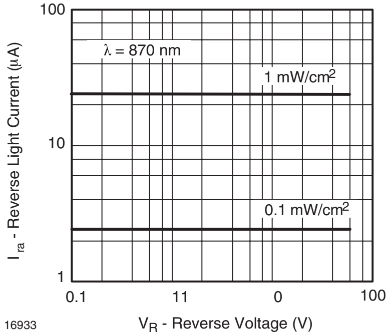


Fig. 4 - Reverse Light Current vs. Reverse Voltage

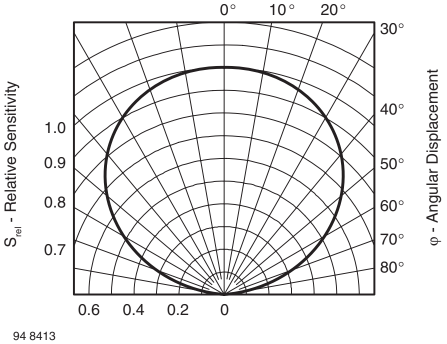


Fig. 7 - Relative Radiant Sensitivity vs. Angular Displacement

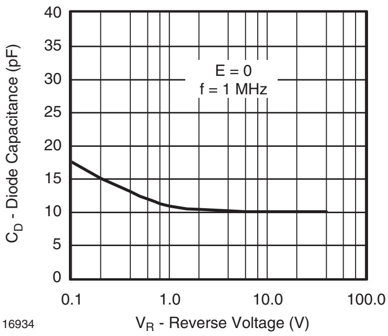
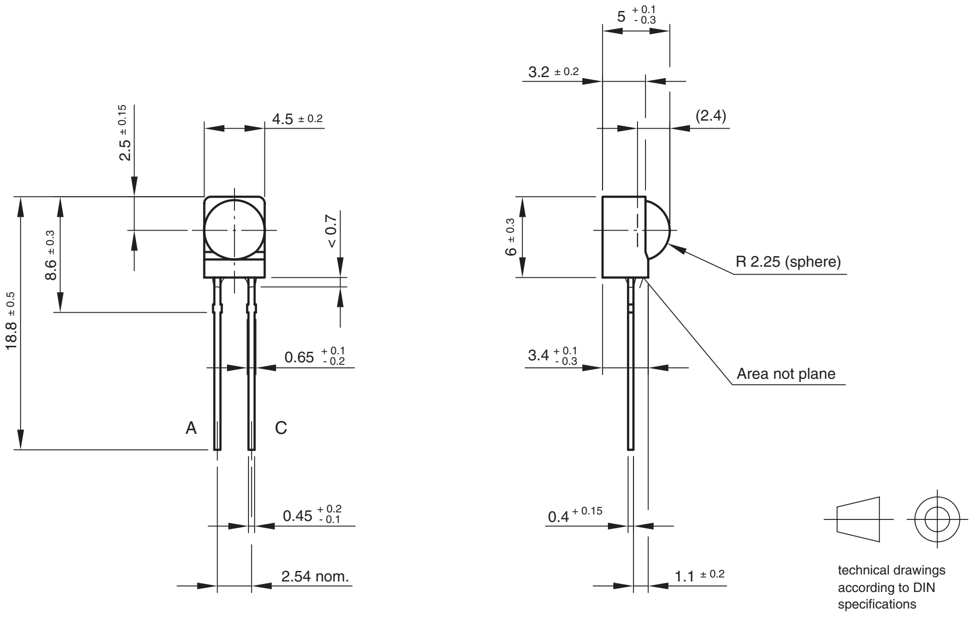


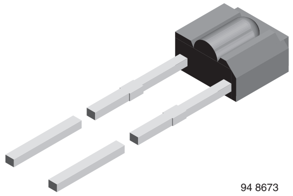
Fig. 5 - Diode Capacitance vs. Reverse Voltage

PACKAGE DIMENSIONS in millimeters



Drawing-No.: 6.544-5199.01-4
Issue: 2; 19.06.01
95 11475

Silicon NPN Phototransistor, RoHS Compliant



DESCRIPTION

TEST2600 is a silicon NPN phototransistor with high radiant sensitivity in black, miniature, side view plastic package with daylight blocking filter. Filter bandwidth is matched with 900 nm to 950 nm IR emitters.

FEATURES

- Package type: leaded
- Package form: side view
- Dimensions (L x W x H in mm): 3.6 x 2.2 x 3.4
- High radiant sensitivity
- Daylight blocking filter matches with 940 nm emitters
- Fast response times
- Angle of half sensitivity: $\varphi_1 = \pm 30°$, horizontal
- Package matches with IR emitter series TSSS2600
- Lead (Pb)-free component in accordance with RoHS 2002/95/EC and WEEE 2002/96/EC

Pb-free
e2
RoHS
COMPLIANT

APPLICATIONS

- Optical switches
- Counters and sorters
- Interrupters
- Tape and card readers
- Encoders
- Position sensors

PRODUCT SUMMARY

COMPONENT	I_{ca} (mA)	φ (deg)	$\lambda_{0.5}$ (nm)
TEST2600	2.5	± 30	850 to 980

Note
Test condition see table "Basic Characteristics"

ORDERING INFORMATION

ORDERING CODE	PACKAGING	REMARKS	PACKAGE FORM
TEST2600	Bulk	MOQ: 5000 pcs, 5000 pcs/bulk	Side view

Note
MOQ: minimum order quantity

ABSOLUTE MAXIMUM RATINGS

PARAMETER	TEST CONDITION	SYMBOL	VALUE	UNIT
Collector emitter voltage		V_{CEO}	70	V
Emitter collector voltage		V_{ECO}	5	V
Collector current		I_C	50	mA
Collector peak current	$t_p/T = 0.5$, $t_p \leq 10$ ms	I_{CM}	100	mA
Total power dissipation	$T_{amb} \leq 55$ °C	P_V	100	mW
Junction temperature		T_j	100	°C
Operating temperature range		T_{amb}	- 40 to + 85	°C
Storage temperature range		T_{stg}	- 40 to + 100	°C
Soldering temperature	$t \leq 3$ s, 2 mm frpm case	T_{sd}	260	°C
Thermal resistance junction/ambient	Connected with Cu wire, 0.14 mm^2	R_{thJA}	450	K/W

Note
T_{amb} = 25 °C, unless otherwise specified

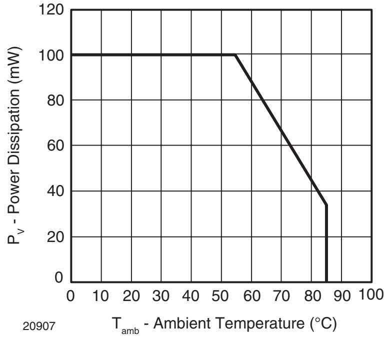


Fig. 1 - Power Dissipation Limit vs. Ambient Temperature

BASIC CHARACTERISTICS						
PARAMETER	**TEST CONDITION**	**SYMBOL**	**MIN.**	**TYP.**	**MAX.**	**UNIT**
Collector emitter breakdown voltage	I_C = 1 mA	$V_{(BR)CEO}$	70			V
Collector emitter dark current	V_{CE} = 20 V, E = 0	I_{CEO}		1	100	nA
Collector emitter capacitance	V_{CE} = 5 V, f = 1 MHz, E = 0	C_{CEO}		6		pF
Collector light current	E_e = 1 mW/cm^2, λ = 950 nm, V_{CE} = 5 V	I_{ca}	1	2.5		mA
Angle of half sensitivity	horizontal	φ_1		± 30		deg
	vertical	φ_2		± 60		deg
Wavelength of peak sensitivity		λ_p		920		nm
Range of spectral bandwidth		$\lambda_{0.5}$		850 to 980		nm
Collector emitter saturation voltage	E_e = 1 mW/cm^2, λ = 950 nm, I_C = 0.1 mA	V_{CEsat}			0.3	V
Turn-on time	V_S = 5 V, I_C = 5 mA, R_L = 100 Ω	t_{on}		6		µs
Turn-off time	V_S = 5 V, I_C = 5 mA, R_L = 100 Ω	t_{off}		5		µs
Cut-off frequency	V_S = 5 V, I_C = 5 mA, R_L = 100 Ω	f_c		110		kHz

Note

T_{amb} = 25 °C, unless otherwise specified

BASIC CHARACTERISTICS

T_{amb} = 25 °C, unless otherwise specified

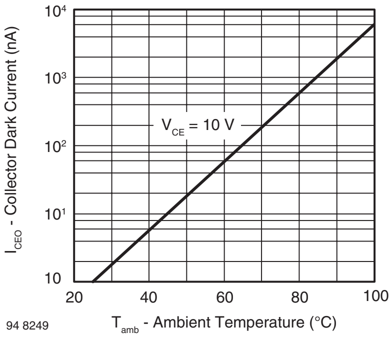


Fig. 2 - Collector Dark Current vs. Ambient Temperature

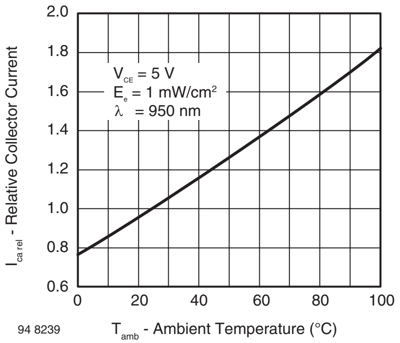


Fig. 3 - Relative Collector Current vs. Ambient Temperature

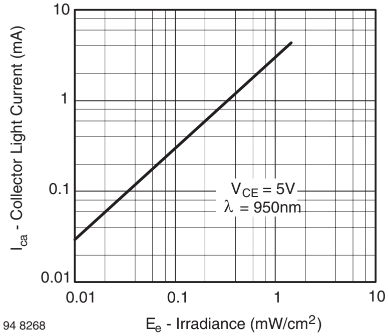


Fig. 4 - Collector Light Current vs. Irradiance

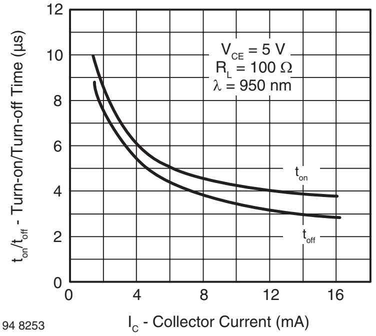


Fig. 7 - Turn-on/Turn-off Time vs. Collector Current

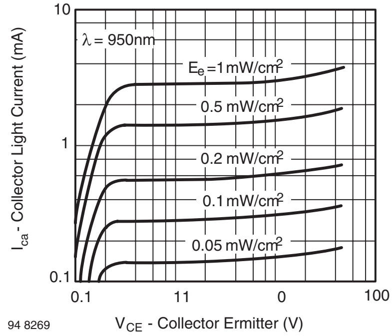


Fig. 5 - Collector Light Current vs. Collector Emitter Voltage

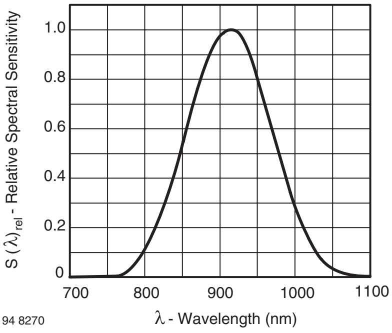


Fig. 8 - Relative Spectral Sensitivity vs. Wavelength

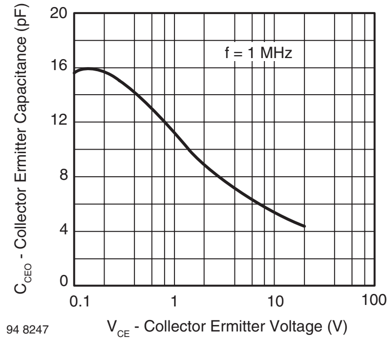


Fig. 6 - Collector Emitter Capacitance vs. Collector Emitter Voltage

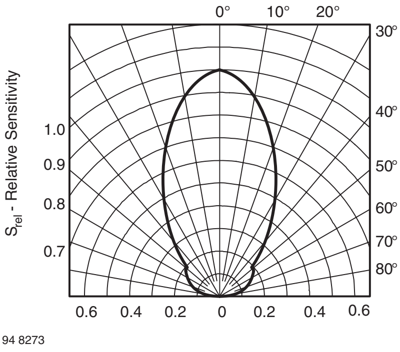


Fig. 9 - Relative Radiant Sensitivity vs. Angular Displacement

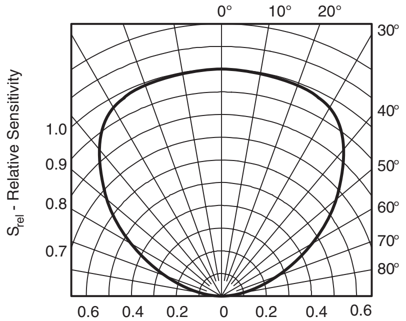


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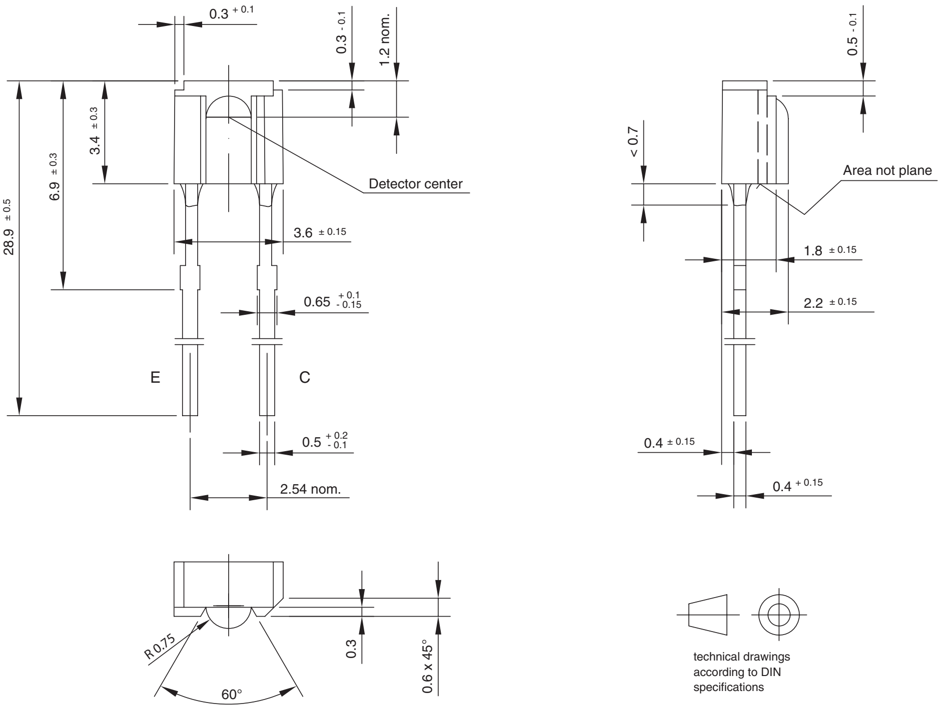
Fig. 10 - Relative Radiant Sensitivity vs. Angular Displacement

PACKAGE DIMENSIONS in millimeters

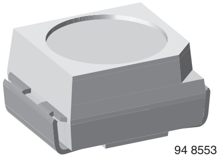


Drawing-No.: 6.544-5242.01-4

Issue: 3; 18.04.96

95 11487

Silicon NPN Phototransistor, RoHS Compliant



FEATURES

- Package type: surface mount
- Package form: PLCC-2
- Dimensions (L x W x H in mm): 3.5 x 2.8 x 1.75
- High photo sensitivity
- High radiant sensitivity
- Suitable for visible and near infrared radiation
- Fast response times
- Angle of half sensitivity: φ = ± 60°
- Package notch indicates collector
- Package matched with IR emitter series VSML3710
- Floor life: 4 weeks, MSL 2a, acc. J-STD-020
- Lead (Pb)-free reflow soldering
- Lead (Pb)-free component in accordance with RoHS 2002/95/EC and WEEE 2002/96/EC

Pb-free
e3
RoHS
COMPLIANT

DESCRIPTION

VEMT3700 is a high speed silicon NPN epitaxial planar phototransistor in a miniature PLCC-2 package for surface mounting on printed boards. The device is sensitive to visible and near infrared radiation.

APPLICATIONS

- Photo interrupters
- Miniature switches
- Counters
- Encoders
- Position sensors
- Ligth sensors

PRODUCT SUMMARY

COMPONENT	I_{ca} (mA)	φ (deg)	$\lambda_{0.1}$ (nm)
VEMT3700	0.5	± 60	450 to 1080

Note

Test conditions see table “Basic Characteristics”

ORDERING INFORMATION

ORDERING CODE	PACKAGING	REMARKS	PACKAGE FORM
VEMT3700-GS08	Tape and reel	MOQ: 7500 pcs, 1500 pcs/reel	PLCC-2
VEMT3700-GS18	Tape and reel	MOQ: 8000 pcs, 8000 pcs/reel	PLCC-2

Note

MOQ: minimum order quantity

ABSOLUTE MAXIMUM RATINGS

PARAMETER	TEST CONDITION	SYMBOL	VALUE	UNIT
Collector emitter voltage		V_{CEO}	70	V
Emitter collector voltage		V_{ECO}	5	V
Collector current		I_C	50	mA
Collector peak current	$t_p/T \leq 0.1$, $t_p \leq 10$ µs	I_{CM}	100	mA
Power dissipation		P_V	100	mW
Junction temperature		T_j	100	°C
Operating temperature range		T_{amb}	- 40 to + 100	°C
Storage temperature range		T_{stg}	- 40 to + 100	°C
Soldering temperature	Acc. reflow solder profile fig. 10	T_{sd}	260	°C
Thermal resistance junction/ambient	Soldered on PCB with pad dimensions: 4 mm x 4 mm	R_{thJA}	400	K/W

Note

T_{amb} = 25 °C, unless otherwise specified

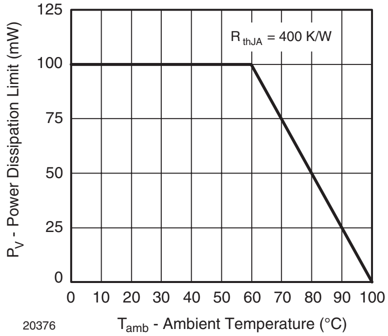


Fig. 1 - Power Dissipation Limit vs. Ambient Temperature

BASIC CHARACTERISTICS						
PARAMETER	**TEST CONDITION**	**SYMBOL**	**MIN.**	**TYP.**	**MAX.**	**UNIT**
Collector emitter breakdown voltage	I_C = 1 mA	$V_{(BR)CEO}$	70			V
Collector emitter dark current	V_{CE} = 20 V, E = 0	I_{CEO}		1	200	nA
Collector emitter capacitance	V_{CE} = 5 V, f = 1 MHz, E = 0	C_{CEO}		3		pF
Collector ligth current	E_e = 1 mW/cm^2, λ = 950 nm, V_{CE} = 5 V	I_{ca}	0.25	0.5		mA
Angle of half sensitivity		φ		± 60		deg
Wavelength of peak sensitivity		λ_p		850		nm
Range of spectral bandwidth		$\lambda_{0.1}$		450 to 1080		nm
Collector emitter saturation voltage	E_e = 1 mW/cm^2, λ = 950 nm, I_C = 0.1 mA	V_{CEsat}		0.15	0.3	V
Rise time, fall time	V_S = 5 V, I_C = 1 mA, λ = 950 nm, R_L = 1 kΩ	t_r/t_f		6		µs
	V_S = 5 V, I_C = 1 mA, λ = 950 nm, R_L = 100 Ω	t_r/t_f		2		µs
Cut-off frequency	V_S = 5 V, I_C = 2 mA, R_L = 100 Ω	f_c		180		kHz

Note
T_{amb} = 25 °C, unless otherwise specified

BASIC CHARACTERISTICS

T_{amb} = 25 °C, unless otherwise specified

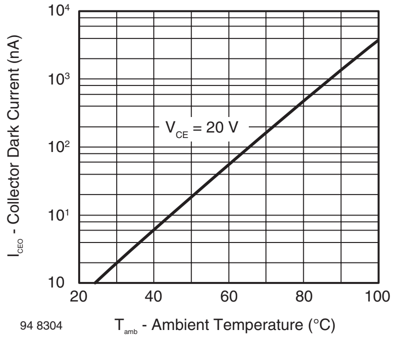


Fig. 2 - Collector Dark Current vs. Ambient Temperature

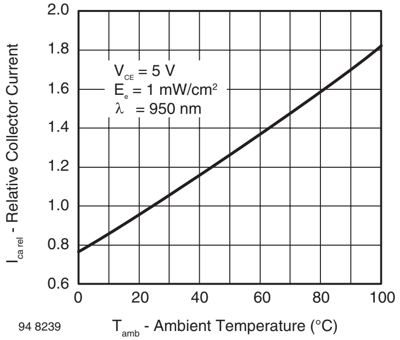


Fig. 3 - Relative Collector Current vs. Ambient Temperature

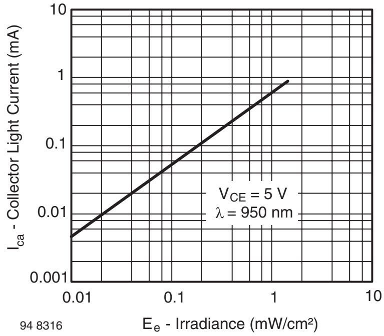


Fig. 4 - Collector Light Current vs. Irradiance

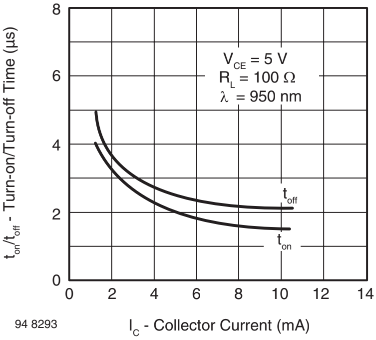


Fig. 7 - Turn-on/Turn-off Time vs. Collector Current

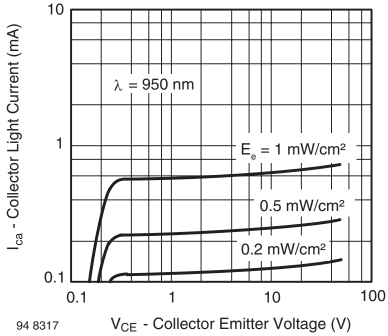


Fig. 5 - Collector Light Current vs. Collector Emitter Voltage

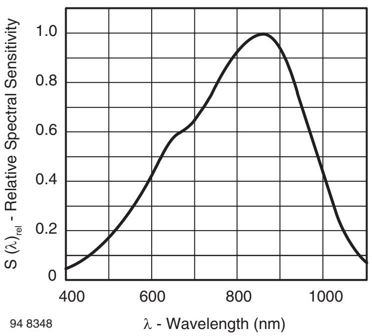


Fig. 8 - Relative Spectral Sensitivity vs. Wavelength

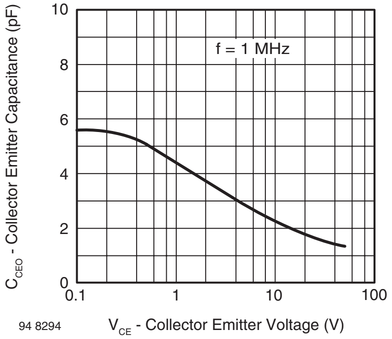


Fig. 6 - Collector Emitter Capacitance vs. Collector Emitter Voltage

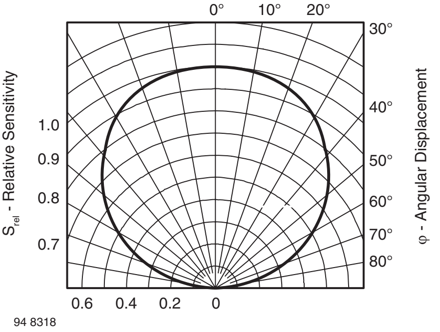
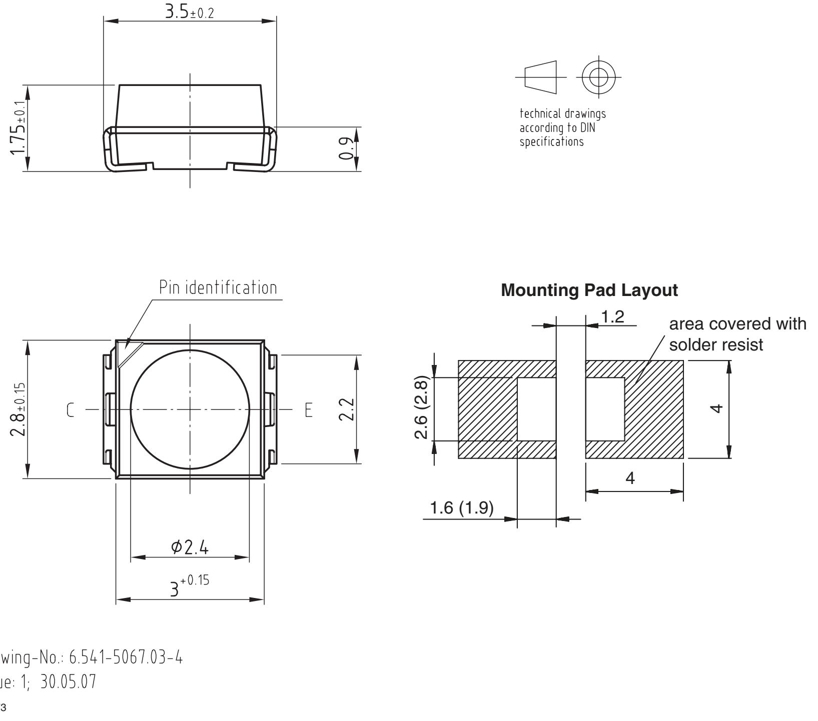


Fig. 9 - Relative Radiant Sensitivity vs. Angular Displacement

PACKAGE DIMENSIONS in millimeters



SOLDER PROFILE

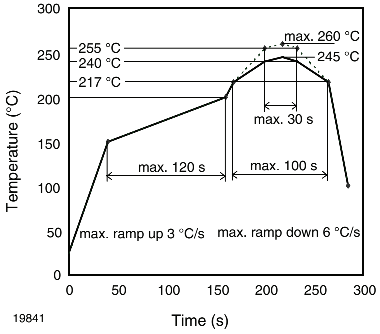


Fig. 10 - Lead (Pb)-free Reflow Solder Profile acc. J-STD-020D

DRYPACK

Devices are packed in moisture barrier bags (MBB) to prevent the products from moisture absorption during transportation and storage. Each bag contains a desiccant.

FLOOR LIFE

Floor life (time between soldering and removing from MBB) must not exceed the time indicated on MBB label:
Floor life: 4 weeks
Conditions: T_{amb} < 30 °C, RH < 60 %
Moisture sensitivity level 2a, acc. to J-STD-020.

DRYING

In case of moisture absorption devices should be baked before soldering. Conditions see J-STD-020 or label. Devices taped on reel dry using recommended conditions 192 h at 40 °C (+ 5 °C), RH < 5 %.

TAPE AND REEL

PLCC-2 components are packed in antistatic blister tape (DIN IEC (CO) 564) for automatic component insertion. Cavities of blister tape are covered with adhesive tape.

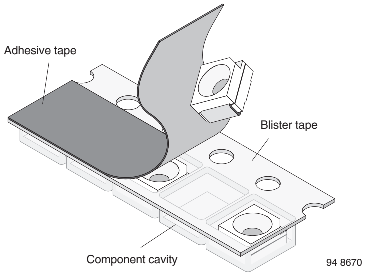


Fig. 11 - Blister Tape

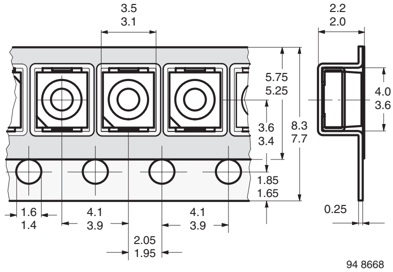


Fig. 12 - Tape Dimensions in mm for PLCC-2

MISSING DEVICES

A maximum of 0.5 % of the total number of components per reel may be missing, exclusively missing components at the beginning and at the end of the reel. A maximum of three consecutive components may be missing, provided this gap is followed by six consecutive components.

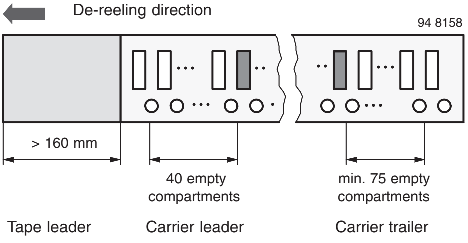


Fig. 13 - Beginning and End of Reel

The tape leader is at least 160 mm and is followed by a carrier tape leader with at least 40 empty compartments. The tape leader may include the carrier tape as long as the cover tape is not connected to the carrier tape. The least component is followed by a carrier tape trailer with a least 75 empty compartments and sealed with cover tape.

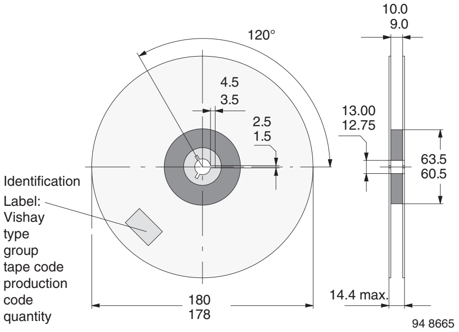


Fig. 14 - Dimensions of Reel-GS08

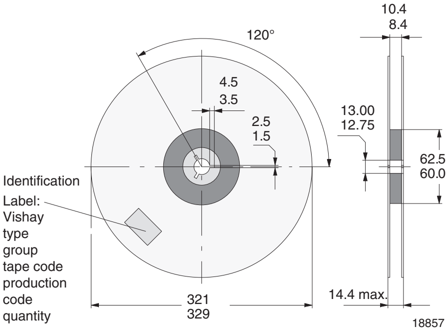
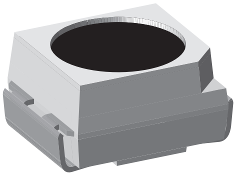


Fig. 15 - Dimensions of Reel-GS18

COVER TAPE REMOVAL FORCE

The removal force lies between 0.1 N and 1.0 N at a removal speed of 5 mm/s. In order to prevent components from popping out of the blisters, the cover tape must be pulled off at an angle of 180° with regard to the feed direction.

Silicon NPN Phototransistor, RoHS Compliant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DESCRIPTION

VEMT3700F is a high speed silicon NPN epitaxial planar phototransistor in a miniature PLCC-2 package. The integrated daylight blocking filter is matched to 950 nm IR emitters.

FEATURES

- Package type: surface mount
- Package form: PLCC-2
- Dimensions (L x W x H in mm): 3.5 x 2.8 x 1.75
- High radiant sensitivity
- Fast response times
- Daylight blocking filter matched with 870 nm to 950 nm emitters
- Angle of half sensitivity: $\varphi = \pm 60°$
- Package notch indicates collector
- Package matched with IR emitter series VSML3710
- Floor life: 4 weeks, MSL 2a, acc. J-STD-020
- Lead (Pb)-free reflow soldering
- Lead (Pb)-free component in accordance with RoHS 2002/95/EC and WEEE 2002/96/EC

APPLICATIONS

- Photo interrupters
- Miniature switches
- Counters
- Encoders
- Position sensors

PRODUCT SUMMARY

COMPONENT	I_{ca} (mA)	φ (deg)	$\lambda_{0.5}$ (nm)
VEMT3700F	0.5	± 60	850 to 1050

Note
Test conditions see table “Basic Characteristics”

ORDERING INFORMATION

ORDERING CODE	PACKAGING	REMARKS	PACKAGE FORM
VEMT3700F-GS08	Tape and reel	MOQ: 7500 pcs, 1500 pcs/reel	PLCC-2
VEMT3700F-GS18	Tape and reel	MOQ: 8000 pcs, 8000 pcs/reel	PLCC-2

Note
MOQ: minimum order quantity

ABSOLUTE MAXIMUM RATINGS

PARAMETER	TEST CONDITION	SYMBOL	VALUE	UNIT
Collector emitter voltage		V_{CEO}	70	V
Emitter collector voltage		V_{ECO}	5	V
Collector current		I_C	50	mA
Collector peak current	$t_p/T \leq 0.1$, $t_p \leq 10$ µs	I_{CM}	100	mA
Power dissipation		P_V	100	mW
Junction temperature		T_j	100	°C
Operating temperature range		T_{amb}	- 40 to + 100	°C
Storage temperature range		T_{stg}	- 40 to + 100	°C
Soldering temperature	Acc. reflow solder profile fig. 10	T_{sd}	260	°C
Thermal resistance junction/ambient	Soldered on PCB with pad dimensions: 4 mm x 4 mm	R_{thJA}	400	K/W

Note
T_{amb} = 25 °C, unless otherwise specified

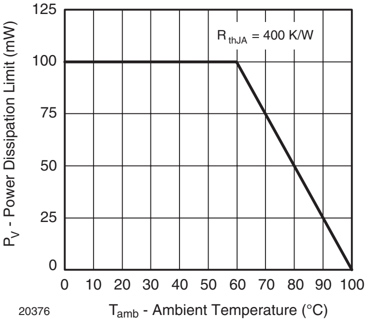


Fig. 1 - Power Dissipation Limit vs. Ambient Temperature

BASIC CHARACTERISTICS

PARAMETER	TEST CONDITION	SYMBOL	MIN.	TYP.	MAX.	UNIT
Collector emitter breakdown voltage	I_C = 1 mA	$V_{(BR)CEO}$	70			V
Collector emitter dark current	V_{CE} = 20 V, E = 0	I_{CEO}		1	200	nA
Collector emitter capacitance	V_{CE} = 5 V, f = 1 MHz, E = 0	C_{CEO}		3		pF
Collector ligth current	E_e = 1 mW/cm², λ = 950 nm, V_{CE} = 5 V	I_{ca}	0.25	0.5		mA
Angle of half sensitivity		φ		± 60		deg
Wavelength of peak sensitivity		λ_p		940		nm
Range of spectral bandwidth		$\lambda_{0.5}$		850 to 1050		nm
Collector emitter saturation voltage	E_e = 1 mW/cm², λ = 950 nm, I_C = 0.1 mA	V_{CEsat}		0.15	0.3	V
Rise time, fall time	V_S = 5 V, I_C = 1 mA, λ = 950 nm, R_L = 1 kΩ	t_r/t_f		6		µs
	V_S = 5 V, I_C = 1 mA, λ = 950 nm, R_L = 100 Ω	t_r/t_f		2		µs
Cut-off frequency	V_S = 5 V, I_C = 2 mA, R_L = 100 Ω	f_c		180		kHz

Note

T_{amb} = 25 °C, unless otherwise specified

BASIC CHARACTERISTICS

T_{amb} = 25 °C, unless otherwise specified

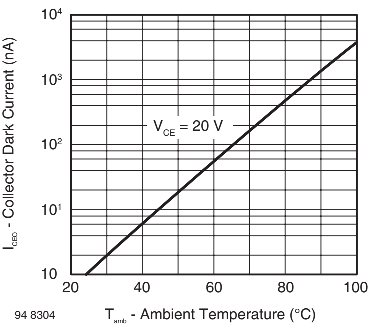


Fig. 2 - Collector Dark Current vs. Ambient Temperature

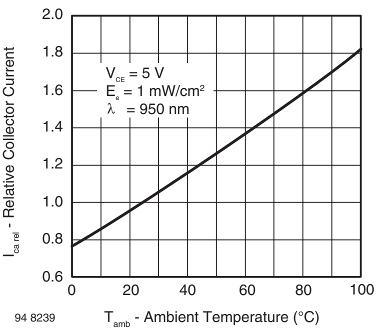


Fig. 3 - Relative Collector Current vs. Ambient Temperature

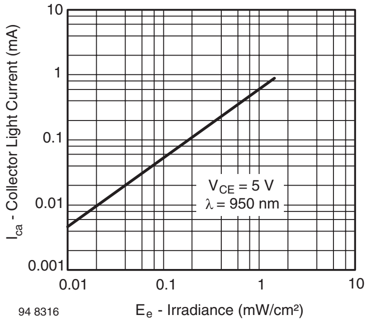


Fig. 4 - Collector Light Current vs. Irradiance

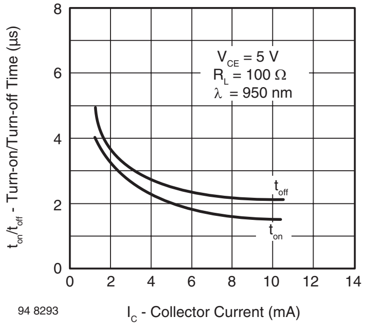


Fig. 7 - Turn-on/Turn-off Time vs. Collector Current

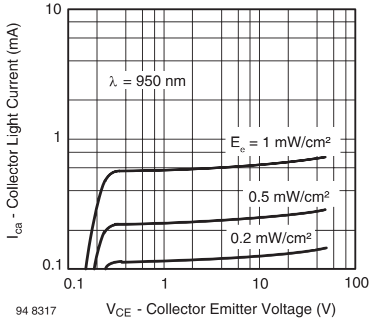


Fig. 5 - Collector Light Current vs. Collector Emitter Voltage

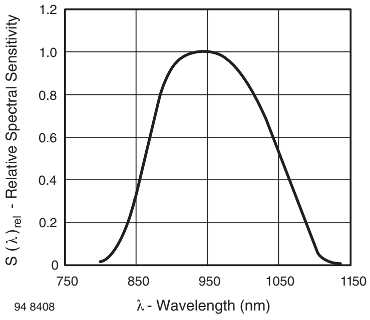


Fig. 8 - Relative Spectral Sensitivity vs. Wavelength

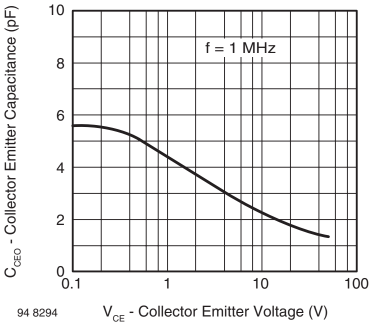


Fig. 6 - Collector Emitter Capacitance vs. Collector Emitter Voltage

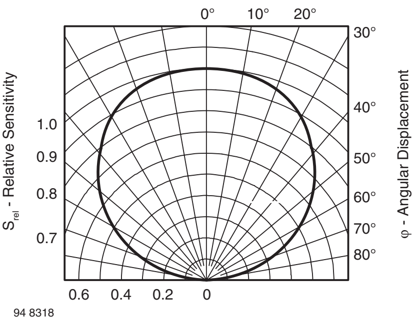
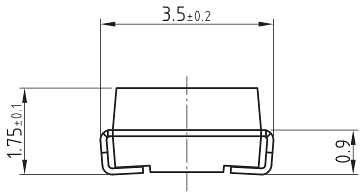
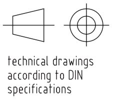
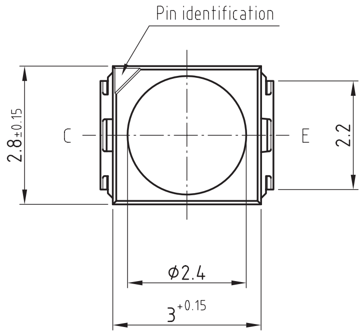


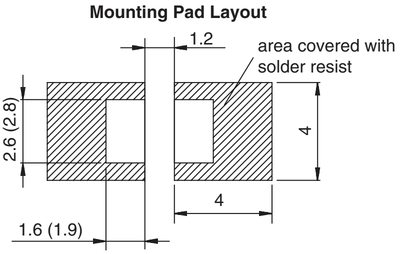
Fig. 9 - Relative Radiant Sensitivity vs. Angular Displacement

PACKAGE DIMENSIONS in millimeters









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SOLDER PROFILE

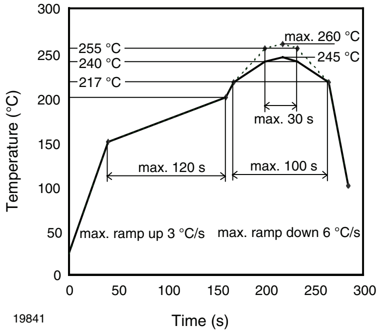


Fig. 10 - Lead (Pb)-free Reflow Solder Profile acc. J-STD-020D

DRYPACK

Devices are packed in moisture barrier bags (MBB) to prevent the products from moisture absorption during transportation and storage. Each bag contains a desiccant.

FLOOR LIFE

Floor life (time between soldering and removing from MBB) must not exceed the time indicated on MBB label:
Floor life: 4 weeks
Conditions: T_{amb} < 30 °C, RH < 60 %
Moisture sensitivity level 2a, acc. to J-STD-020.

DRYING

In case of moisture absorption devices should be baked before soldering. Conditions see J-STD-020 or label. Devices taped on reel dry using recommended conditions 192 h at 40 °C (+ 5 °C), RH < 5 %.

TAPE AND REEL

PLCC-2 components are packed in antistatic blister tape (DIN IEC (CO) 564) for automatic component insertion. Cavities of blister tape are covered with adhesive tape.

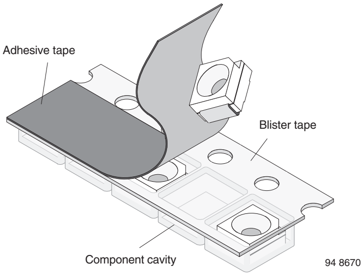


Fig. 11 - Blister Tape

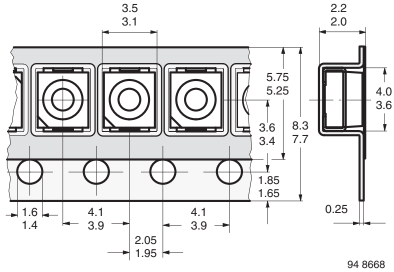


Fig. 12 - Tape Dimensions in mm for PLCC-2

MISSING DEVICES

A maximum of 0.5 % of the total number of components per reel may be missing, exclusively missing components at the beginning and at the end of the reel. A maximum of three consecutive components may be missing, provided this gap is followed by six consecutive components.

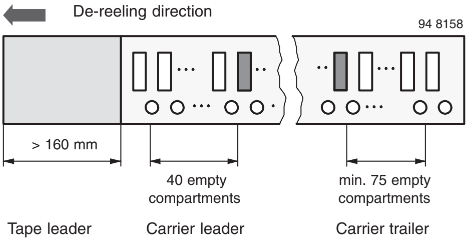


Fig. 13 - Beginning and End of Reel

The tape leader is at least 160 mm and is followed by a carrier tape leader with at least 40 empty compartments. The tape leader may include the carrier tape as long as the cover tape is not connected to the carrier tape. The least component is followed by a carrier tape trailer with a least 75 empty compartments and sealed with cover tape.

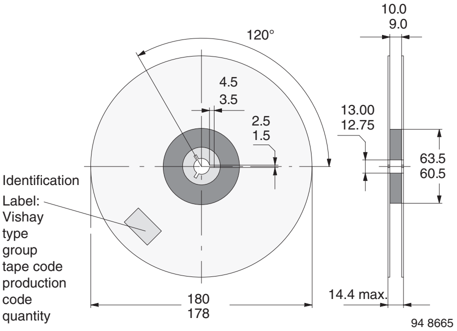


Fig. 14 - Dimensions of Reel-GS08

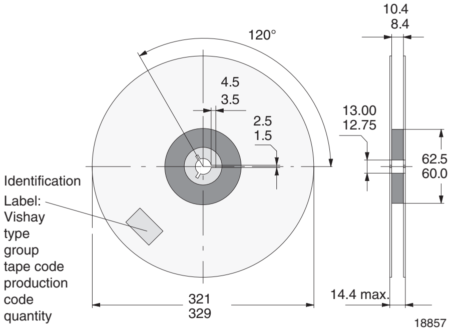
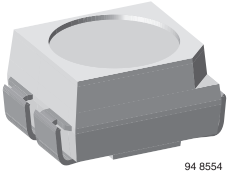


Fig. 15 - Dimensions of Reel-GS18

COVER TAPE REMOVAL FORCE

The removal force lies between 0.1 N and 1.0 N at a removal speed of 5 mm/s. In order to prevent components from popping out of the blisters, the cover tape must be pulled off at an angle of 180° with regard to the feed direction.

Silicon NPN Phototransistor, RoHS Compliant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DESCRIPTION

VEMT4700 is a high speed silicon NPN epitaxial planar phototransistor in a miniature PLCC-3 package for surface mounting on printed boards. The device is sensitive to visible and near infrared radiation.

FEATURES

- Package type: surface mount
- Package form: PLCC-3
- Dimensions (L x W x H in mm): 3.5 x 2.8 x 1.75
- High photo sensitivity
- High radiant sensitivity
- Suitable for visible and near infrared radiation
- Fast response times
- Angle of half sensitivity: $\varphi = \pm 60°$
- Base terminal connected
- Package notch indicates collector
- Package matched with IR emitter series VSML3710
- Floor life: 4 weeks, MSL 2a, acc. J-STD-020
- Lead (Pb)-free reflow soldering
- Lead (Pb)-free component in accordance with RoHS 2002/95/EC and WEEE 2002/96/EC

Pb-free

e3

RoHS COMPLIANT

APPLICATIONS

- Photo interrupters
- Miniature switches
- Counters
- Encoders
- Position sensors
- Light sensors

PRODUCT SUMMARY

COMPONENT	I_{ca} (mA)	φ (deg)	$\lambda_{0.1}$ (nm)
VEMT4700	0.5	± 60	450 to 1080

Note

Test conditions see table “Basic Characteristics”

ORDERING INFORMATION

ORDERING CODE	PACKAGING	REMARKS	PACKAGE FORM
VEMT4700-GS08	Tape and reel	MOQ: 7500 pcs, 1500 pcs/reel	PLCC-3
VEMT4700-GS18	Tape and reel	MOQ: 8000 pcs, 8000 pcs/reel	PLCC-3

Note

MOQ: minimum order quantity

ABSOLUTE MAXIMUM RATINGS

PARAMETER	TEST CONDITION	SYMBOL	VALUE	UNIT
Collector emitter voltage		V_{CEO}	70	V
Emitter collector voltage		V_{ECO}	5	V
Collector current		I_C	50	mA
Collector peak current	$t_p/T \leq 0.1$, $t_p \leq 10$ µs	I_{CM}	100	mA
Power dissipation		P_V	100	mW

ABSOLUTE MAXIMUM RATINGS

PARAMETER	TEST CONDITION	SYMBOL	VALUE	UNIT
Junction temperature		T_j	100	°C
Operating temperature range		T_{amb}	- 40 to + 100	°C
Storage temperature range		T_{stg}	- 40 to + 100	°C
Soldering temperature	Acc. reflow solder profile fig. 10	T_{sd}	260	°C
Thermal resistance junction/ambient	Soldered on PCB with pad dimensions: 4 mm x 4 mm	R_{thJA}	400	K/W

Note

T_{amb} = 25 °C, unless otherwise specified

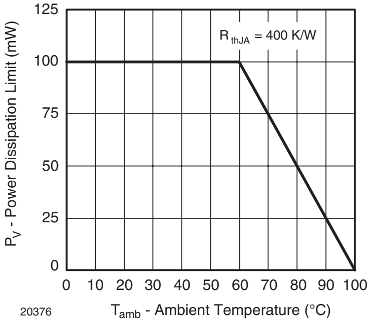


Fig. 1 - Power Dissipation Limit vs. Ambient Temperature

BASIC CHARACTERISTICS

PARAMETER	TEST CONDITION	SYMBOL	MIN.	TYP.	MAX.	UNIT
Collector emitter breakdown voltage	I_C = 1 mA	$V_{(BR)CEO}$	70			V
Collector emitter dark current	V_{CE} = 20 V, E = 0	I_{CEO}		1	200	nA
Collector emitter capacitance	V_{CE} = 5 V, f = 1 MHz, E = 0	C_{CEO}		3		pF
Collector light current	E_e = 1 mW/cm^2, λ = 950 nm, V_{CE} = 5 V	I_{ca}	0.25	0.5		mA
Angle of half sensitivity		φ		± 60		deg
Wavelength of peak sensitivity		λ_p		850		nm
Range of spectral bandwidth		$\lambda_{0.1}$		450 to 1080		nm
Collector emitter saturation voltage	E_e = 1 mW/cm^2, λ = 950 nm, I_C = 0.1 mA	V_{CEsat}		0.15	0.3	V
Rise time, fall time	V_S = 5 V, I_C = 1 mA, λ = 950 nm, R_L = 1 kΩ	t_r/t_f		6		µs
	V_S = 5 V, I_C = 1 mA, λ = 950 nm, R_L = 100 Ω	t_r/t_f		2		µs
Cut-off frequency	V_S = 5 V, I_C = 2 mA, R_L = 100 Ω	f_c		180		kHz

Note

T_{amb} = 25 °C, unless otherwise specified

BASIC CHARACTERISTICS

T_{amb} = 25 °C, unless otherwise specified

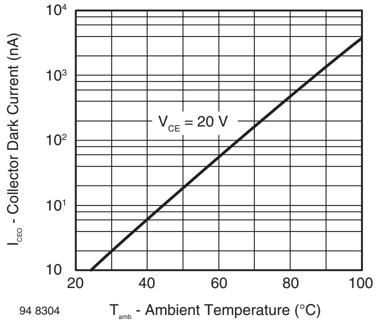


Fig. 2 - Collector Dark Current vs. Ambient Temperature

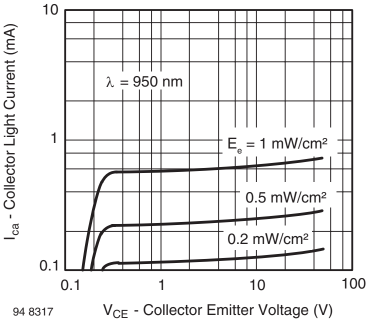


Fig. 5 - Collector Light Current vs. Collector Emitter Voltage

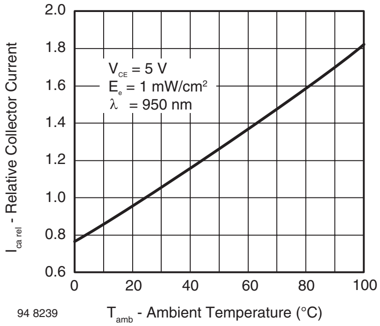


Fig. 3 - Relative Collector Current vs. Ambient Temperature

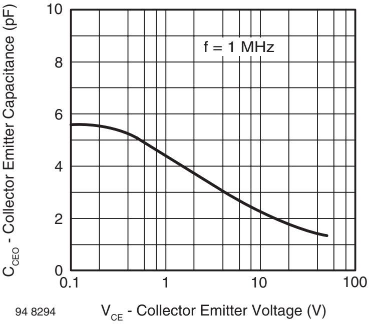


Fig. 6 - Collector Emitter Capacitance vs. Collector Emitter Voltage

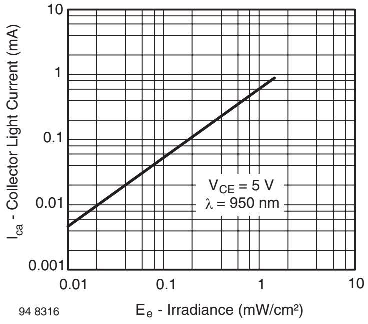


Fig. 4 - Collector Light Current vs. Irradiance

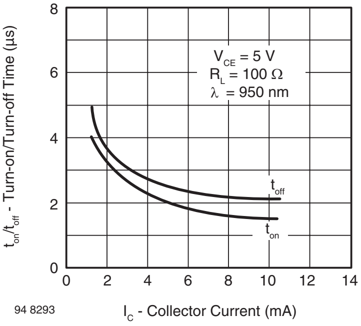


Fig. 7 - Turn-on/Turn-off Time vs. Collector Current

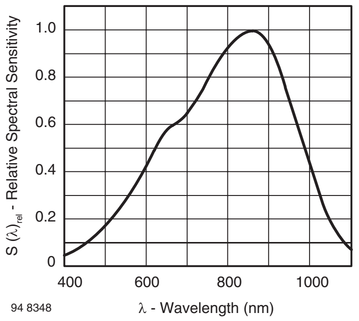


Fig. 8 - Relative Spectral Sensitivity vs. Wavelength

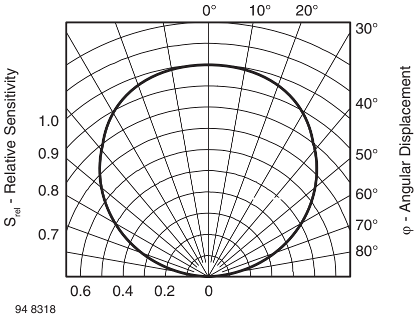
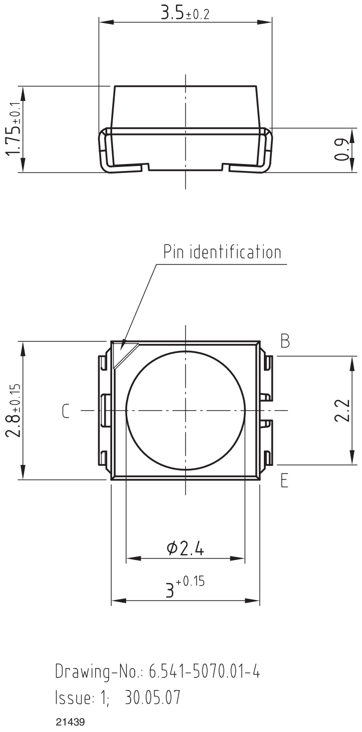
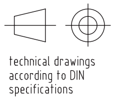


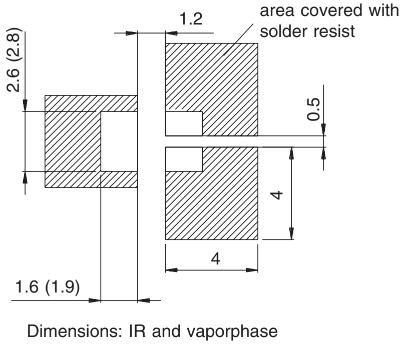
Fig. 9 - Relative Radiant Sensitivity vs. Angular Displacement

PACKAGE DIMENSIONS in millimeters





Mounting Pad Layout



Dimensions: IR and vaporphase
(wave soldering)

SOLDER PROFILE

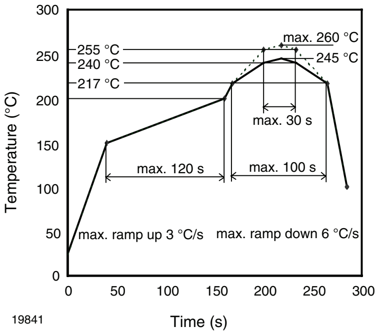


Fig. 10 - Lead (Pb)-free Reflow Solder Profile acc. J-STD-020D

DRYPACK

Devices are packed in moisture barrier bags (MBB) to prevent the products from moisture absorption during transportation and storage. Each bag contains a desiccant.

FLOOR LIFE

Floor life (time between soldering and removing from MBB) must not exceed the time indicated on MBB label:
Floor life: 4 weeks
Conditions: T_{amb} < 30 °C, RH < 60 %
Moisture sensitivity level 2a, acc. to J-STD-020.

DRYING

In case of moisture absorption devices should be baked before soldering. Conditions see J-STD-020 or label. Devices taped on reel dry using recommended conditions 192 h at 40 °C (+ 5 °C), RH < 5 %.

TAPE AND REEL

PLCC-3 components are packed in antistatic blister tape (DIN IEC (CO) 564) for automatic component insertion. Cavities of blister tape are covered with adhesive tape.

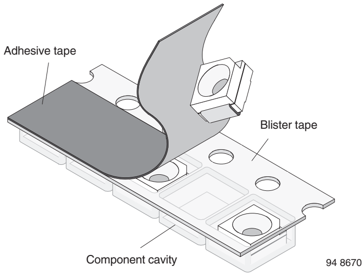


Fig. 11 - Blister Tape

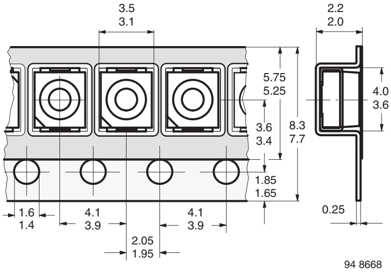


Fig. 12 - Tape Dimensions in mm for PLCC-3

MISSING DEVICES

A maximum of 0.5 % of the total number of components per reel may be missing, exclusively missing components at the beginning and at the end of the reel. A maximum of three consecutive components may be missing, provided this gap is followed by six consecutive components.

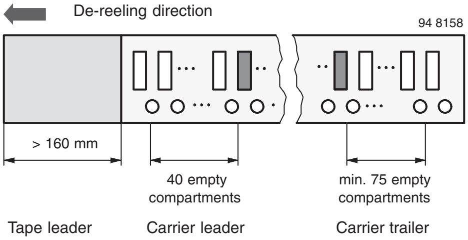


Fig. 13 - Beginning and End of Reel

The tape leader is at least 160 mm and is followed by a carrier tape leader with at least 40 empty compartments. The tape leader may include the carrier tape as long as the cover tape is not connected to the carrier tape. The least component is followed by a carrier tape trailer with a least 75 empty compartments and sealed with cover tape.

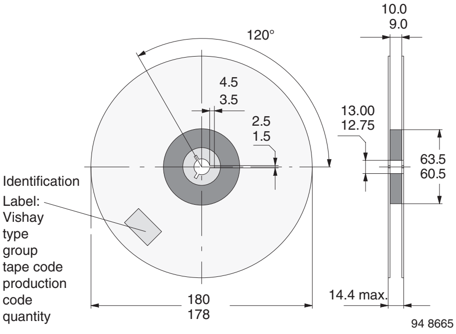


Fig. 14 - Dimensions of Reel-GS08

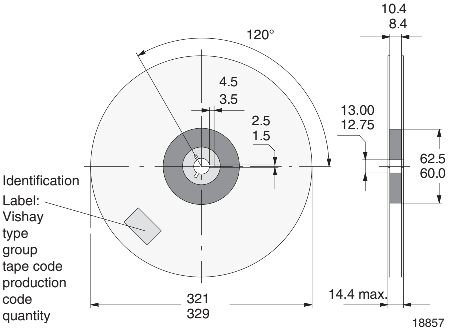


Fig. 15 - Dimensions of Reel-GS18

COVER TAPE REMOVAL FORCE

The removal force lies between 0.1 N and 1.0 N at a removal speed of 5 mm/s. In order to prevent components from popping out of the blisters, the cover tape must be pulled off at an angle of 180° with regard to the feed direction.

Glossary

Contents

Reliability and Statistics Glossary

DEFINITIONS

Accelerated Life Test: A life test under conditions that are more severe than usual operating conditions. It is helpful, but not necessary, that a relationship between test severity and the probability distribution of life be ascertainable.

Acceleration Factor: Notation: f(t) = the time transformation from more severe test conditions to the usual conditions. The acceleration factor is f(t)/t. The differential acceleration factor is df(t)/dt.

Acceptance Number: The largest numbers of defects that can occur in an acceptance sampling plan and still have the lot accepted.

Acceptance Sampling Plant: An accept/reject test the purpose of which is to accept or reject a lot of items or material based on random samples from the lot.

Assessment: A critical appraisal including qualitative judgments about an item, such as importance of analysis results, design criticality, and failure effect.

Attribute (Inspection by): A term used to designate a method of measurement whereby units are examined by noting the presence (or absence) of some characteristic or attribute in each of the units in the group under consideration and by counting how many units do (or do not) possess it. Inspection by attributes can be two kinds: either the unit of product is classified simply as defective or not defective or the number of defects in the unit of product is counted with respect to a given requirement or set of requirements.

Attribute Testing: Testing to evaluate whether or not an item possesses a specified attribute.

Auger Electron Spectrometer: An instrument, that identifies elements on the surface of a sample. It excites the area of interest with an electron beam and observes the resultant emitted Auger electrons.
These electrons have the specific characteristics of the near surface elements. It is usually used to identify very thin films, often surface contaminants.

Availability (Operational Readiness): The probability that at any point in time the system is either operating satisfactorily or ready to be placed in operation on demand when used under stated conditions.

Average Outgoing Quality (AOQ): The average quality of outgoing product after 100 % inspection of a rejected lot, with replacement by good units of all defective units found in inspection.

Bathtub Curve: A plot of the failure rate of an item (whether repairable or not) vs. time. The failure rate initially decreases, then stays reasonably constant, then begins to rise rather rapidly. It has the shape of bathtub. Not all items have this behavior.

Bias:

1. The difference between the s-expected value of an estimator and the value of the true parameter
2. Applied voltage.

Burn-in: The initial operation of an item to stabilize its characteristics and to minimize infant mortality in the field.

Confidence Interval: The interval within which it is asserted that the parameters of a probability distribution lie.

Confidence Level:
Equals 1 - α

where

α = the risk (%).

Corrective Action: A documented design, process, procedure, or materials change to correct the true cause of a failure. Part replacement with a like item does not constitute appropriate corrective action. Rather, the action should make it impossible for that failure to happen again.

Cumulative Distribution Function (CDF): The probability that the random variable takes on any value less than or equal to a value x, e.g.
$F(x) = CDF(x) = Pr(x \le X)$.

Defect: A deviation of an item from some ideal state. The ideal state usually is given in a formal specification.

Degradation: A gradual deterioration in performance as a function of time.

Derating: The intentional reduction of the stress/strength ratio in the application of an item, usually for the purpose of reducing the occurrence of stress-related failures.

Duty Cycle: A specified operating time of an item, followed by a specified time of no operation.

Early Failure Period: That period of life, after final assembly, in which failures occur at an initially high rate because of the presence of defective parts and workmanship. This definition applies to the first part of the bathtub curve for failure rate (infant mortality).

EDX Spectrometer: Generally used with a scanning electron microscope (SEM) to provide elemental analysis of X-rays generated on the region being hit by the primary electron beam.

Effectiveness: The capability of the system or device to perform its function.

EOS - Electrical Overstress: The electrical stressing of electronic components beyond specifications. May be caused by ESD.

ESD - Electrostatic Discharge: The transfer of electrostatic charge between bodies at different electrostatic potentials caused by direct contact or induced by an electrostatic field. Many electronic components are sensitive to ESD and will be degraded or fail.

Expected Value: A statistical term. If x is a random variable and F (x) it its CDF, the E (x) = xdF (x), where the integration is over all x. For continuous variables with a pdf, this reduces to E (x) = $\int$x pfd (x) dx. For discrete random variables with a pfd, this reduces to
E (x) = Σ x_np (x_n) where the sum is over all n.

Exponential Distribution: A 1 parameter distribution ($\lambda > 0$, $t \leq 0$) with: pfd (t) = lexp ($-\lambda$t);
Cdf (t) 0 1 - exp ($-\lambda$t); Sf (t) = exp ($-\lambda$t) ;
failure rate = λ; mean time-to-failure = $1/\lambda$. This is the constant failure-rate-distribution.

Failure: The termination of the ability of an item to perform its required function.

Failure Analysis: The identification of the failure mode, the failure mechanism, and the cause (i.e., defective soldering, design weakness, contamination, assembly techniques, etc.). Often includes physical dissection.

Failure, Catastrophic: A sudden change in the operating characteristics of an item resulting in a complete loss of useful performance of the item.

Failure, Degradation: A failure that occurs as a result of a gradual or partial change in the operating characteristics of an item.

Failure, Initial: The first failure to occur in use.

Failure, Latent: A malfunction that occurs as a result of a previous exposure to a condition that did not result in an immediately detectable failure. Example: Latent ESD failure.

Failure Mechanism: The mechanical, chemical, or other process that results in a failure.

Failure Mode: The effect by which a failure is observed. Generally, describes the way the failure occurs and tells "how" with respect to operation.

Failure Rate: (A) The conditional probability density that the item will fail just after time t, given the item has not failed up to time t; (B) The number of failures of an item per unit measure of life (cycles, time, miles, events, etc.) as applicable for the item.

Failure, Wearout: Any failure for which time of occurrence is governed by rapidly increasing failure rate.

FIT: Failure Unit; (also, Failures In Time) Failures per 109 h.

Functional Failure: A failure whereby a device does not perform its intended function when the inputs or controls are correct.

Gaussian Distribution: A 2 parameter distribution with:

$$\text{pfd (x)} = \frac{1}{\sigma\sqrt{2\pi}} \cdot e^{\frac{1}{2}\left(\frac{x-u}{\sigma}\right)^2}$$

Cdf (x) = guaf (x). SF (x) = gaufc (x). “Mean value of x” u, “standard deviation of x” = σ

Hazard Rate: Instantaneous failure rate.

Hypothesis, Null: A hypothesis stating that there is no difference between some characteristics of the parent populations of several different samples, i.e., that the samples came from similar populations.

Infant Mortality: Premature catastrophic failures occurring at a much greater rate than during the period of useful life prior to the onset of substantial wear out.

Inspection: The examination and testing of supplies and services (including when appropriate, raw materials, components, and intermediate assemblies) to determine whether they conform to specified requirements.

Inspection by Attributes: Inspection whereby either the unit of product or characteristics thereof is classified simply as defective or not defective or the number of defects in the unit of product is counted with respect to a given requirement.

Life Test: A test, usually of several items, made for the purpose of estimating some characteristic(s) of the probability distribution of life.

Lot: A group of units from a particular device type submitted each time for inspection and/or testing is called the lot.

Lot Reject Rate (LRR): The lot reject rate is the percentage of lots rejected form the lots evaluated.

Lot Tolerance Percent Defective (LTPD): The percent defective, which is to be accepted a minimum or arbitrary fraction of the time, or that percent defective whose probability of rejection is designated by **b**.

Mean: (A) The arithmetic mean, the expected value; (B) As specifically modified and defined, e.g., harmonic mean (reciprocals), geometric mean (a product), logarithmic mean (logs).

Mean Life: R(t)dt; where R(t) = the s-reliability of the item; t = the interval over which the mean life is desired, usually the useful life (longevity).

Mean-Life-Between-Failures: The concept is the same as mean life except that it is for repaired items and is the mean up-time of the item. The formula is the same as for mean life except that R(t) is interpreted as the distribution of up-times.

Mean-time-between-failures (MTBF): For a particular interval, the total functioning life of a population of an item divided by the total number of failures within the population during the measurement interval. The definition holds for time, cycles, miles, events, or other measure of life units.

Mean-Time-To-Failure (MTTF): See "Mean Life".

Mean-Time-To-Repair (MTTR): The total corrective maintenance time divided by the total number of corrective maintenance actions during a given period of time.

MTTR: = G(t)dt; where G(t) = CDF of repair time;
T - maximum allowed repair time, i.e., item is treated as no repairable at this echelon and is discarded or sent to a higher echelon for repair.

Operating Characteristic (OC) Curve: A curve showing the relation between the probability of acceptance and either lot quality or process quality, whichever is applicable.

Part Per Million (PPM): PPM is arrived at by multiplying the percentage defective by 10 000.
Example: 0.1 % = 1.000 PPM.

Population: The totality of the set of items, units, measurements, etc., real or conceptual that is under consideration.

Probability Distribution: A mathematical function with specific properties, which describes the probability that a random variable will take on a value or set of values. If the random variable is continuous and well behaved enough, there will be a pdf. If the random variable is discrete, there will be a pmf.

Qualification: The entire process by which products are obtained from manufacturers or distributors, examined and tested, and then identified on a Qualified Product List.

Quality: A property, which refers to the tendency of an item to be made to specific specifications and / or the customer's express needs. See current publications by Juran, Deming, Crosby, et al.

Quality Assurance: A system of activities that provides assurance that the overall quality control job is, in fact, being done effectively. The system involves a continuing evaluation of the adequacy and effectiveness of the overall quality control program with a view to having corrective measures initiated where necessary. For a specific product or service, this involves verifications, audits, and the evaluation of the quality factors that affect the specification, production inspection, and use of the product or service.

Quality Characteristics: Those properties of an item or process, which can be measured, reviewed, or observed and which are identified in the drawings, specifications, or contractual requirements. Reliability becomes a quality characteristic when so defined.

Quality Control (QC): The overall system of activities that provides a quality of product or service, which meets the needs of users; also, the use of such a system.

Random Samples: As commonly used in acceptance sampling theory, the process of selecting sample units in such a manner that all units under consideration have the same probability of being selected.

Reliability: The probability that a device will function without failure over a specified time period or amount of usage at stated conditions.

Reliability Growth: Reliability growth is the effort, and the resource commitment, to improve design, purchasing, production, and inspection procedures to improve the reliability of a design.

Risk: α: The probability of rejecting the null hypothesis falsely.

Scanning Electron Microscope (SEM): An instrument which provides a visual image of the surface features of an item. It scans an electron beam over the surface of a sample while held in a vacuum and collects any of several resultant particles or energies. The SEM provides depth of field and resolution significantly exceeding light microscopy and may be used at magnifications exceeding 50 000 times.

Screening Test: A test or combination of tests intended to remove unsatisfactory items or those likely to exhibit early failures.

Significance: Results that show deviations between hypothesis and the observations used as a test of the hypothesis, greater than can be explained by random variation or chance alone, are called statistically significant.

Significance Level: The probability that, if the hypothesis under test were true, a sample test statistic would be as bad as or worse than the observed test statistic.

SPC: Statistical Process Control.

Storage Life (Shelf Life): The length of time an item can be stored under specified conditions and still meet specified requirements.

Stress: A general and ambiguous term used as an extension of its meaning in mechanics as that which could cause failure. It does not distinguish between those things which cause permanent damage (deterioration) and those things which do not (in the absence of failure).

Variance: The average of the squares of the deviations of individual measurements from their average. It is a measure of dispersion of a random variable or of data.

Wearout: The process of attribution which results in an increase of hazard rate with increasing age (cycles, time, miles, events, etc.) as applicable for the item.

ABBREVIATIONS

AQL	Acceptable quality level
CAR	Corrective action report/request
DIP	Dual in-line package
ECAP	Electronic circuit analysis program
EMC	Electro magnetic compatibility
EMI	Electro magnetic interference
EOS	Electrical overstress
ESD	Electrostatic discharge
FAR	Failure analysis report/request
FIT	(Failure in time) Failure unit; Failures/109 h
FMEA	Failure mode and effects analysis
FTA	Fault tree analysis
h (t)	Hazard rate
LTPD	Lot tolerance percent defective
MOS	Metal oxide semiconductor
MRB	Material review board
MTBF	Mean-time-between-failures
MTTF	Mean-time-to-failure

MTTR	Mean-time-to-repair
PPM	Parts per million
PRST	Probability ratio sequential test
QA	Quality assurance
QC	Quality control
QPL	Qualified products list
RPM	Reliability planning and management
SCA	Sneak circuit analysis
SEM	Scanning electron microscope
TW	Wearout time
Z (t)	Hazard rate
λ	Failure rate (Lambda)

Symbols and Terminology

A	**Anode**, anode terminal
A	**Ampere**, SI unit of electrical current
A	**Radiant sensitive area**, that area which is radiant sensitive for a specified range
a	**Distance**, e.g. between the emitter (source) and the detector
B	**Base**, base terminal
BER	**Bit Error Rate**
bit/s	**Data rate or signaling rate** 1000 bit/s = 1 kbit/s, 10^6 bit/s = 1 Mbit/s
C	**Capacitance,** unit: F (farad) = C/V
C	**Coulomb,** C = s x A
C	**Cathode**, cathode terminal
C	**Collector**, collector terminal
°C	**Degree Celsius,** Celsius temperature, symbol t, and is defined by the quantity equation $t = T - T_0$. The unit of Celsius temperature is the degree Celsius, symbol °C. The numerical value of a Celsius temperature t expressed in degrees Celsius is given by t/°C = T/K - 273.15 It follows from the definition of t that the degree Celsius is equal in magnitude to the Kelvin, which in turn implies that the numerical value of a given temperature difference or temperature interval whose value is expressed in the unit degree Celsius (°C) is equal to the numerical value of the same difference or interval when its value is expressed in the unit Kelvin (K).
C_{CEO}	**Collector emitter capacitance,** Capacitance between the collector and the emitter with open base
cd	**Candela,** SI unit of luminous intensity. The candela is the luminous intensity, in a given direction, of a source that emits monochromatic radiation of frequency 540 Hz x 1012 Hz and that has a radiant intensity in that direction of 1/683 W per steradian. (16th General Conference of Weights and Measures, 1979), 1 cd = 1 lm · sr^{-1}
C_D	**Diode capacitance,** total capacitance effective between the diode terminals due to case, junction and parasitic capacitances
Cj	**Junction capacitance,** capacitance due to a p-n junction of a diode, decreases with increasing reverse voltage
d	**Apparent (of virtual) source size** (of an emitter), the measured diameter of an optical source used to calculate the eye safety laser class of the source. See IEC 60825-1 and EN ISO 11146-1
D*	**Detectivity** $\sqrt{A}/NEP$
E	**Emitter,** Emitter terminal (phototransistor)
E_A	**Illumination at standard illuminant A**, according to DIN 5033 and IEC 306-1, illumination emitted from a tungsten filament lamp with a color temperature T_f = 2855.6 K, which is equivalent to standard illuminant A, unit: lx (Lux) or klx
$E_{A\ amb}$	**Ambient illumination** at standard illuminant A
echo-off	Unprecise term to describe the behavior of the output of IrDA® transceivers during transmission. “Echo-off” means that by blocking the receiver the output RXD is quiet during transmission
echo-on	Unprecise term to describe the behavior of the output of IrDA® transceivers during transmission. “Echo-on” means that the receiver output RXD is active but often undefined during transmission. For correct data reception after transmission the receiver channel must be cleared during the latency period
E_e, E	**Irradiance** (at a point of a surface), quotient of the radiant flux $d\Phi_e$ incident on an element of the surface containing the point, by the area dA of that element. Equivalent definition. Integral, taken over the hemisphere visible from the given point, of the expression $L_e \cdot \cos\theta \cdot d\Omega$, where L_e is the radiance at the given point in the various directions of the incident elementary beams of solid angle $d\Omega$, and θ is the angle between any of these beams and the normal to the surface at the given point $E_e = \frac{d\Phi_e}{dA} = \int_{2\pi sr} (L_e \cdot \cos\theta \cdot d\Omega)$ unit: W · m^{-2}
E_v, E	**Illuminance** (at a point of a surface), quotient of the luminous flux $d\Phi_v$ incident on an element of the surface containing the point, by the area dA of that element. Equivalent definition. Integral, taken over the hemisphere visible from the givenpoint, of the expression $L_v \cdot \cos\theta \cdot d\Omega$, where L_v is the luminance at the given point in the various directions of the incident elementary beams of solid angle $d\Omega$, and θ is the angle between any of these beams and the normal to the surface at the given point $E_v = \frac{d\Phi_v}{dA} = \int_{2\pi sr} (L_v \cdot \cos\theta \cdot d\Omega)$ unit: lx = lm · m^{-2}
F	**Farad,** unit: F = C/V
f	**Frequency,** unit: s^{-1}, Hz (Hertz)
f_c, f_{cd}	**Cut-off frequency** - detector devices, the frequency at which, for constant signal modulation depth of the input radiant power, the demodulated signal power has decreased to ½ of its low frequency value. Example: The incident radiation generates a photocurrent or a photo voltage 0.707 times the value of radiation at f = 1 kHz (3 dB signal drop, other references may occur as e.g. 6 dB or 10 dB)

f_s	**Switching frequency**
FIR	**Fast infrared,** as SIR, data rate 4 Mbit/s
I_a	**Light current,** general: current which flows through a device due to irradiation/illumination
I_B	**Base current**
I_{BM}	**Base peak current**
I_C	**Collector current**
I_{ca}	**Collector light current,** collector current under irradiation. Collector current which flows at a specified illumination/irradiation
I_{CEO}	**Collector dark current, with open base,** collector emitter dark current. For radiant sensitive devices with open base and without illumination/radiation (E = 0)
I_{CM}	**Repetitive peak collector current**
idle	Mode of operation where the device (e.g. a transceiver) is fully operational and expecting to receive a signal for operation e.g in case of a transceiver waiting to receive an optical input or to send an optical output as response to an applied electrical signal.
I_e, I	**Radiant intensity** (of a source, in a given direction), quotient of the radiant flux d Φ_e leaving the source and propagated in the element of solid angle dΩ containing the given direction, by the element of solid angle. $I_e = d\Phi_e/d\Omega$, unit: W · sr $^{-1}$ Note: The radiant intensity I_e of emitters is typically measured with an angle < 0.01 sr on mechanical axis or off-axis in the maximum of the irradiation pattern.
I_F	**Continuous forward current,** the current flowing through a diode in the forward direction
I_{FAV}	**Average (mean) forward current**
I_{FM}	**Peak forward current**
I_{FSM}	**Surge forward current**
I_k	**Short-circuit current,** that value of the current which flows when a photovoltaic cell or a photodiode is short circuited (R_L << R_i) at its terminals
I_o	**DC output current**
I_{ph}	**Photocurrent,** that part of the output current of a photoelectric detector, which is caused by incident radiation.
I_R	**Reverse current, leakage current,** current which flows through a reverse biased semiconductor p-n-junction
IR	**Abbreviation for infrared**
I_{ra}	**Reverse current under irradiation,** reverse light current which flows due to a specified irradiation/illumination in a photoelectric device $I_{ra} = I_{ro} + I_{ph}$
IrDA®	**Infrared Data Association,** no profit organization generating infrared data communication standards
IRED	**Infrared emitting diode,** solid state device embodying a p-n junction, emitting infrared radiation when excited by an electric current. See also LED: solid state device embodying a p-n junction, emitting optical radiation when excited by an electric current.
I_{ro}	**Reverse dark current, dark current,** reverse current flowing through a photoelectric device in the absence of irradiation
IRPHY	Version 1.0, **SIR IrDA®, data communication specification** covering data rates from 2.4 kbit/s to 115.2 kbit/s and a guaranteed operating range more than one meter in a cone of ± 15°
IRPHY	Version 1.1, MIR and FIR were implemented in the IrDA® standard with the version 1.1, replacing version 1.0
IRPHY	Version 1.2, added the SIR low power standard to the IrDA® standard, replacing version 1.1. The SIR low power standard describes a current saving implementation with reduced range (min. 20 cm to other low power devices and min. 30 cm to full range devices).
IRPHY	Version 1.3, extended the low power option to the higher bit rates of MIR and FIR replacing version 1.2.
IRPHY	Version 1.4, VFIR was added, replacing version 1.3
I_{SB}	**Quiescent current**
I_{SD}	**Supply current in dark ambient**
I_{SH}	**Supply current in bright ambient**
I_v, I	**Luminous intensity** (of a source, in a given direction), quotient of the luminous flux dΦ_V leaving the source and propagated in the element of solid angle dΩ containing the given direction, by the element of solid angle. $I_e = d\Phi_V/d\Omega$, unit: cd · sr $^{-1}$ Note: The luminous intensity I_v of emitters is typically measured with an angle < 0.01 sr on mechanical axis or off-axis in the maximum of the irradiation pattern.
K	**luminous efficacy** of radiation, quotient of the luminous flux Φ_V by the corresponding radiant flux Φ_e: $K = \Phi_V / \Phi_e$, unit: lm · W^{-1} Note: When applied to monochromatic radiations, the maximum value of K(λ) is denoted by the symbol K_m. K_m = 683 lm · W^{-1} for $\nu_m = 540 \times 10^{12}$ Hz ($\lambda_m \approx 555$ nm) for photopic vision. K'_m = 1700 lm · W^{-1} for $\lambda'_m \approx 507$ nm for scotopic vision. For other wavelengths : $K(\lambda) = K_m V(\lambda)$ and $K'(\lambda) = K'_m V'(\lambda)$
K	**Kelvin,** SI unit of thermodynamic temperature, is the fraction 1/273.15 of the thermodynamic temperature of the triple point of water (13th CGPM (1967), Resolution 4). The unit Kelvin and its symbol K should be used to express an interval or a difference of temperature. Note: In addition to the thermodynamic

	temperature (symbol T), expressed in Kelvins, use is also made of Celsius temperature (symbol t) defined by the equation $t = T - T_0$, where $T_0 = 273.15$ K by definition. To express Celsius temperature, the unit “degree Celsius”, which is equal to the unit “Kelvin” is used; in this case, “degree Celsius” is a special name used in place of “Kelvin”. An interval or difference of Celsius temperature can, however, be expressed in Kelvins as well as in degrees Celsius.
Latency	**Receiver latency allowance** (in ms or µs) is the maximum time after a node ceases transmitting before the node’s receiving recovers its specified sensitivity
LED and IRED	**L**ight **E**mitting **D**iode, LED: solid state device embodying a p-n junction, emitting optical radiation when excited by an electric current. The term LED is correct only for visible radiation, because light is defined as visible radiation (see Radiation and Light). For infrared emitting diodes the term IRED is the correct term. Nevertheless it is common but not correct to use "LED" also for IREDs.
L_e; L	**Radiance** (in a given direction, at a given point of a real or imaginary surface). Quantity defined by the formula $L_e = \frac{d\Phi_v}{dA \cdot \cos\theta \cdot d\Omega}$, where $d\Phi_e$ is the radiant flux transmitted by an elementary beam passing through the given point and propagating in the solid angle $d\Omega$ containing the given direction; dA is the area of a section of that beam containing the given point; θ is the angle between the normal to that section and the direction of the beam, unit: $W \cdot m^{-2} \cdot sr^{-1}$
lm	**Lumen,** unit for luminous flux
lx	**Lux,** unit for illuminance
m	**Meter,** SI unit of length
M_e; M	**Radiant exitance** (at a point of a surface) - Quotient of the radiant flux $d\Phi_e$ leaving an element of the surface containing the point, by the area dA of that element. Equivalent definition. Integral, taken over the hemisphere visible from the given point, of the expression $L_e \cdot \cos\theta \cdot d\Omega$, where L_e is the radiance at the given point in the various directions of the emitted elementary beams of solid angle $d\Omega$, and θ is the angle between any of these beams and the normal to the surface at the given point. $M_e = \frac{d\Phi_e}{dA} = \int_{2\pi sr} L_e \cdot \cos\theta \cdot d\Omega$ unit: $W \cdot m^{-2}$
MIR	**Medium speed IR,** as SIR, with the data rate 576 kbit/s to 1152 kbit/s
Mode	Electrical input or output port of a transceiver device to set the receiver bandwidth
N.A.	**Numerical Aperture,** N.A. = sin α/2 Term used for the characteristic of sensitivity or intensity angles of fiber optics and objectives
NEP	**Noise equivalent power**
P_{tot}	**Total power dissipation**
P_v	**Power dissipation, general**
Radiation and Light	**Visible radiation,** any optical radiation capable of causing a visual sensation directly. Note: There are no precise limits for the spectral range of visible radiation since they depend upon the amount of radiant power reaching the retina and the responsivity of the observer. The lower limit is generally taken between 360 nm and 400 nm and the upper limit between 760 nm and 830 nm.
Radiation and Light	**Optical radiation,** electromagnetic radiation at wavelengths between the region of transition to X-rays (λ = 1 nm) and the region of transition to radio waves (λ = 1 mm)
Radiation and Light IR	**Infrared radiation,** optical radiation for which the wavelengths are longer than those for visible radiation. Note: For infrared radiation, the range between 780 nm and 1 mm is commonly sub-divided into: IR-A 780 nm to 1400 nm IR-B 1.4 µm to 3 µm IR-C 3 µm to 1 mm
R_D	**Dark resistance**
R_F	**Feedback resistor**
R_i	**Internal resistance**
R_{is}	**Isolation resistance**
R_L	**Load resistance**
R_S	**Serial resistance**
R_{sh}	**Shunt resistance,** the shunt resistance of a detector diode is the dynamic resistance of the diode at zero bias. Typically it is measured at a voltage of 10 mV forward or reverse, or peak-to-peak
R_{thJA}	**Thermal resistance,** junction to ambient
R_{thJC}	**Thermal resistance,** junction to case
RXD	**Electrical data output** port of a transceiver device
s	**Second,** SI-unit of time 1 h = 60 min = 3600 s
S	**Absolute sensitivity** Ratio of the output value Y of a radiant-sensitive device to the input value X of a physical quantity: S = Y/X, units: e.g. A/lx, A/W, $A/(W/m^2)$
s(λ_p)	**Spectral sensitivity** at a wavelength λ_p

$s(\lambda)$	**Absolute spectral sensitivity** at a wavelength λ, the ratio of the output quantity y to the radiant input quantity x in the range of wavelengths λ to λ + Δλ $s(\lambda) = dy(\lambda)/dx(\lambda)$ E.g., the radiant power $\Phi_e(\lambda)$ at a specified wavelength λ falls on the radiationsensitive area of a detector and generates a photocurrent $I_{ph} \cdot s(\lambda)$ is the ratio between the generated photocurrent Iph and the radiant power $\Phi_e(\lambda)$ which falls on the detector. $s(\lambda) = I_{ph} / \Phi_e(\lambda)$, unit: A/W
$s(\lambda)_{rel}$	**Spectral sensitivity, relative,** ratio of the spectral sensitivity s(λ) at any considered wavelength to the spectral sensitivity $s(\lambda_0)$ at a certain wavelength λ_0 taken as a reference $s(\lambda)_{rel} = s(\lambda)/s(\lambda_0)$
$s(\lambda_0)$	**Spectral sensitivity** at a reference wavelength λ_0
SC	Electrical input port of a transceiver device to set the receiver sensitivity
SD	Electrical input port of a transceiver device to shut down the transceiver
Shutdown	Mode of operation where a device is switched to a sleep mode (shut down) by an external signal or after a quiescent period keeping some functions alive to be prepared for a fast transition to operating mode. Might be in some cases identical with “standby”
SIR	**Serial Infrared,** term used by IrDA® to describe infrared data transmission up to and including 115.2 kbit/s. SIR IrDA® data communication covers 2.4 kbit/s to 115.2 kbit/s, equivalent to the basic serial infrared standard introduced with the physical layer version IrPhy version 1.0
Split power supply	Term for using **separated power supplies** for different functions in transceivers. Receiver circuits need well-controlled supply voltages. IRED drivers do not need a controlled supply voltage but need much higher currents. Therefore it safes cost not to control the IRED current supply and have a separated supply. For that some modified design rules have to be taken into account for designing the ASIC. This is used in nearly all Vishay transceivers and is described in US-Patent no. 6,157,476
sr	**Steradian** (sr), SI unit of solid angle Ω. Solid angle that, having its vertex at the centre of a sphere, cuts off an area of the surface of the sphere equal to that of a square with sides of length equal to the radius of the sphere. (ISO, 31/1-2.1, 1978) Example: The unity solid angle, in terms of geometry, is the angle subtended at the center of a sphere by an area on its surface numerically equal to the square of the radius (see figures below). Other than the figures might suggest, the shape of the area does not matter at all. Any shape on the surface of the sphere that holds the same area will define a solid angle of the same size. The unit of the solid angle is the **steradian (sr)**. Mathematically, the solid angle is dimensionless, but for practical reasons, the steradian is assigned.
Standby	Mode of operation where a device is prepared to be quickly switched into an idle or operating mode by an external signal.
T	**Period of time** (duration)
T	**Temperature,** 0 K = - 273.15 °C, unit: K (Kelvin)
t	**Temperature,** °C (degree Celsius). Instead of t sometimes T is used not to mix up temperature T with time t
t	**Time**
T_{amb}	**Ambient temperature,** if self-heating is significant: temperature of the surrounding air below the device, under conditions of thermal equilibrium. If self-heating is insignificant: air temperature in the surroundings of the device
T_{amb}	**Ambient temperature range,** as an absolute maximum rating: the maximum permissible ambient temperature range
T_C	**Temperature coefficient,** the ratio of the relative change of an electrical quantity to the change in temperature (ΔT) which causes it under otherwise constant operating conditions
T_C	**Colour temperature** (BE), the temperature of a Planckian radiator whose radiation has the same chromaticity as that of a given stimulus, unit: K Note: The **reciprocal colour temperature** is also used, unit K^{-1} (BE).
T_{case}	**Case temperature,** the temperature measured at a specified point on the case of a semiconductor device. Unless otherwise stated, this temperature is given as the temperature of the mounting base for devices with metal can
t_d	**Delay time**
t_f	**Fall time,** the time interval between the upper specified value and the lower specified value on the trailing edge of the pulse. Note: It is common to use a 90 % value of the signal for the upper specified value and a 10 % value for the lower specified value.
T_j	**Junction temperature,** the spatial mean value of the temperature during operation. In the case of phototransistors, it is mainly the temperature of the collector junction because its inherent temperature is the maximum.
t_{off}	**Turn-off time,** the time interval between the upper specified value on the trailing edge of the applied input pulse and the lower specified value an the trailing edge of the output pulse. $t_{off} = t_{d(off)} + t_f$

t_{on}	**Turn-on time,** the time interval between the lower specified value on the trailing edge of the applied input pulse and the upper specified value an the trailing edge of the output pulse. $t_{on} = t_{d(on)} + t_f$
t_p	**Pulse duration,** the time interval between the specified value on the leading edge of the pulse and the specified value an the trailing edge of the output pulse. Note: In most cases the specified value is 50 % of the signal
t_{pi}	**Input pulse duration**
t_{po}	**Output pulse duration**
t_r	**Rise time,** the time interval between the lower specified value and the upper specified value on the trailing edge of the pulse. Note: It is common to use a 90 % value of the signal for the upper specified value and a 10 % value for the lower specified value t_s storage time
t_s	**Storage time**
T_{sd}	**Soldering temperature,** maximum allowable temperature for soldering with a specified distance from the case and its duration
T_{stg}	**Storage temperature range,** the temperature range at which the device may be stored or transported without any applied voltage
TXD	Electrical data input port of a transceiver device
V	**Volt**
$V(\lambda)$	**Standard luminous efficiency function** for photopic vision (relative human eye sensitivity)
$V(\lambda)$, $V'(\lambda)$	**Spectral luminous efficiency** (of a monochromatic radiation of wavelength λ); $V(\lambda)$ for photopic vision; $V'(\lambda)$ for scotopic vision). Ratio of the radiant flux at wavelength λ_m to that at wavelength λ such that both radiations produce equally intense luminous sensations under specified photometric conditions and λ_m is chosen so that the maximum value of this ratio is equal to 1
V_{BEO}	**Base emitter voltage, open collector**
$V_{(BR)}$	**Breakdown voltage,** reverse voltage at which a small increase in voltage results in a sharp rise of reverse current. It is given in technical data sheets for a specified current
$V_{(BR)}$	**CEO Collector emitter breakdown voltage, open base**
$V_{(BR)EBO}$	**Emitter base breakdown voltage, open collector**
$V_{(BR)ECO}$	**Emitter collector breakdown voltage, open base**
V_{CBO}	**Collector-base voltage, open emitter,** generally, reverse biasing is carried out by applying a voltage to any of two terminals of a transistor in such a way that one of the junctions operates in reverse direction, whereas the third terminal (second junction) is specified separately.
V_{CC}	**Supply voltage (positive)**
V_{CE}	**Collector emitter voltage**
V_{CEO}	**Collector emitter voltage, open base** ($I_B = 0$)
V_{CEsat}	**Collector emitter saturation voltage,** the saturation voltage is the DC voltage between collector and emitter for specified (saturation) conditions, i.e., I_C and E_V (E_e or I_B), whereas the operating point is within the saturation region.
V_{dd}	**Supply voltage (positive)**
V_{EBO}	**Emitter base voltage, open collector**
V_{ECO}	**Emitter collector voltage, open base**
V_F	**Forward voltage**, the voltage across the diode terminals which results from the flow of current in the forward direction
VFIR	As SIR, data rate 16 Mbit/s
V_{logic}	**Reference voltage** for digital data communication ports
V_{no}	**Signal-to-noise ratio**
V_O	**Output voltage**
ΔV_O	**Output voltage change** (differential output voltage)
V_{OC}	**Open circuit voltage,** the voltage measured between the photovoltaic cell or photodiode terminals at a specified irradiance/illuminance (high impedance voltmeter!)
V_{OH}	**Output voltage high**
V_{OL}	**Output voltage low**
V_{ph}	**Photovoltage,** the voltage generated between the photovoltaic cell or photodiode terminals due to irradiation/ illumination
V_R	**Reverse voltage** (of a junction), applied voltage such that the current flows in the reverse direction
V_R	**Reverse (breakdown) voltage,** the voltage drop which results from the flow of a defined reverse current
V_S	**Supply voltage**
V_{ss}	(Most negative) **supply voltage** (in most cases: ground)
$\pm \varphi_{1/2}$	**Angle of half transmission distance**
η	**Quantum efficiency**
$\theta_{1/2}$; $\pm \varphi = \alpha/2$	**Half-intensity angle,** in a radiation diagram, the angle within which the radiant (or luminous) intensity is greater than or equal to half of the maximum intensity. Note: IEC 60747-5-1 is using $\theta_{1/2}$. In Vishay datasheets mostly $\pm \varphi = \alpha/2$ is used
$\theta_{1/2}$; $\pm \varphi = \alpha/2$	**Half-sensitivity angle,** in a sensitivity diagram, the angle within which the sensitivity is greater than or equal to half of the maximum sensitivity. Note: IEC 60747-5-1 is using $\theta_{1/2}$. In Vishay datasheets mostly $\pm \varphi = \alpha/2$ is used

Ω	**Solid angle,** see sr, steradian for IEC 60050(845)-definition. The space enclosed by rays, which emerge from a single point and lead to all the points of a closed curve. If it is assumed that the apex of the cone formed in this way is the center of a sphere with radius r and that the cone intersects with the surface of the sphere, then the size of the surface area (A) of the sphere subtending the cone is a measure of the solid angle Ω. $\Omega = A/r^2$. The full sphere is equivalent to 4πsr. A cone with an angle of $\alpha/2$ forms a solid angle of $\Omega = 2\,\pi(1 - \cos\alpha/2) = 4\,\pi\,\sin^2\alpha/4$, unit: sr
λ_m	**Wavelength** of the maximum of the spectral luminous efficiency function V(λ)
$\Delta\lambda$	**Range of spectral bandwidth (50 %),** the range of wavelengths where the spectral sensitivity or spectral emission remains within 50 % of the maximum value
Φ_e; Φ; P	**Radiant flux; radiant power,** power emitted, transmitted or received in the form of radiation. unit: W, W = Watt
Φ_v; Φ;	**Luminous flux,** quantity derived from radiant flux Φ_e by evaluating the radiation according to its action upon the CIE standard photometric observer. For photopic vision $\Phi_v = K_m \int_0^\infty \frac{d\Phi_e\lambda}{d\lambda} \cdot V(\lambda)d\lambda,$ where $\frac{d\Phi_e\lambda}{d\lambda}$ is the spectral distribution of the radiant flux and V(λ) is the spectral luminous efficiency, unit : lm, lm: lumen, K_m = 683 lm/W: Note: For the values of K_m (photopic vision) and K'm (scotopic vision), see IEC 60050 (845-01-56).
λ	**Wavelength,** general
λ_c	**Centroid wavelength,** centroid wavelength λ_c of a spectral distribution, which is calculated as "centre of gravity wavelength" according to $\lambda_c = \int_{\lambda_1}^{\lambda_2} \lambda \cdot S_X(\lambda)d\lambda / \int_{\lambda_1}^{\lambda_2} S_X \cdot (\lambda)d\lambda$
λ_D	**Dominant wavelength**
λ_p	**Wavelength** of peak sensitivity or peak emission

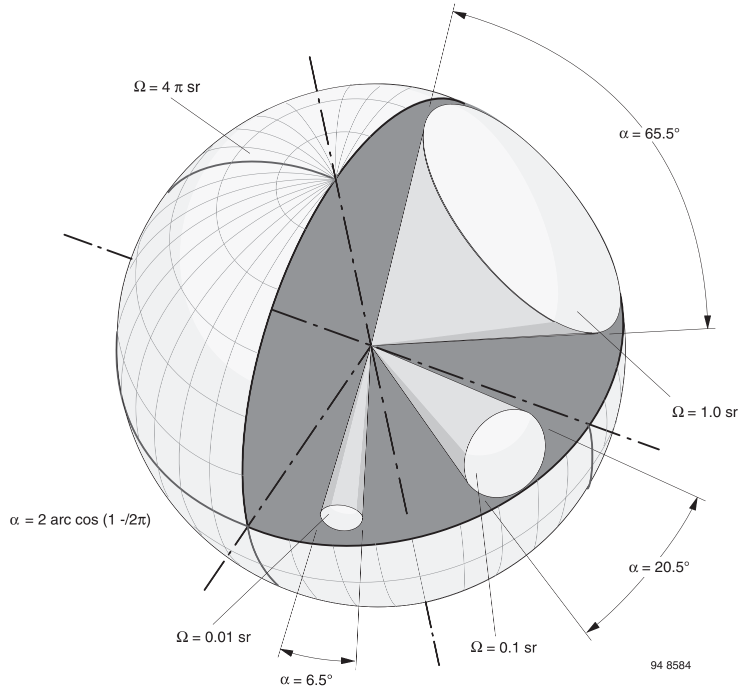


Fig. 1

DEFINITIONS

Databook Nomenclature

The nomenclature, symbols, abbreviations and terms inside the Vishay Semiconductors data book is based on ISO and IEC standards.

The special optoelectronic terms and definitions are referring to the IEC Multilingual Dictionary (Electricity, Electronics and Telecommunications), Fourth edition (2001-01), IEC 50 (Now: IEC 60050). The references are taken from the current editions of IEC 60050 (845), IEC 60747-5-1 and IEC 60747-5-2. Measurement conditions are based on IEC and other international standards and especially guided by IEC 60747-5-3.

Editorial notes: Due to typographical limitations variables cannot be printed in an italics format, which is usually mandatory. Our booklet in general is using American spelling. International standards are written in UK English. Definitions are copied without changes from the original text. Therefore these may contain British spelling.

Radiant and Luminous Quantities and Their Units

These two kinds of quantities have the same basic symbols, identified respectively, where necessary, by the subscript e (energy) or v (visual), e.g. Φ_e, Φ_v. See note.

Note: Photopic and scotopic quantities. Luminous (photometric) quantities are of two kinds, those used for photopic vision and those used for scotopic vision. The wording of the definitions in the two cases being almost identical, a single definition is generally sufficient with the appropriate adjective, photopic or scotopic added where necessary.

The symbols for scotopic quantities are prime (Φ'_v, I'_v, etc), but the units are the same in both cases.

In general, optical radiation is measured in radiometric units. Luminous (photometric) units are used when optical radiation is weighted by the sensitivity of the human eye, correctly spoken, by the CIE standard photometric observer (Ideal observer having a relative spectral responsivity curve that conforms to the V(λ) function for photopic vision or to the V'(λ) function for scotopic vision, and that complies with the summation law implied in the definition of luminous flux).

Note: With a given spectral distribution of a radiometric quantity the equivalent photometric quantity can be evaluated. However, from photometric units without knowing the radiometric spectral distribution in general one cannot recover the radiometric quantities.

Radiometric Terms, Quantities and Units

The radiometric terms are used to describe the quantities of optical radiation.

The relevant radiometric units are:

TABLE 1 - RADIOMETRIC QUANTITIES AND UNITS

RADIOMETRIC TERM	SYMBOL	UNIT	REFERENCE
Radiant power, radiant flux	Φ_e	W	IEC 50 (845-01-24)
Radiant intensity	I_e	W/sr	IEC 50 (845-01-30)
Irradiance	E_e	W/m^2	IEC 50 (845-01-37)
Radiant exitance	M_e	W/m^2	IEC 50 (845-01-47)
Radiance	L_e	W/(sr · m^2)	IEC 50 (845-01-34)

Photometric Terms, Quantities and Units

The photometric terms are used to describe the quantities of optical radiation in the wavelength range of visible radiation (generally assumed as the range from 380 nm to 780 nm). The relevant photometric terms are:

TABLE 2 - PHOTOMETRIC QUANTITIES AND UNITS

PHOTOMETRIC TERM	EQUIVALENT RADIOMETRIC TERM	SYMBOL	UNIT	REFERENCE
Luminous power or luminous flux	Radiant power or radiant flux Φ_e	Φ_v	lm	Φ_v: IEC 50 (845-01-25) lm: IEC 50 (845-01-51)
Luminous intensity	Radiant intensity I_e	I_v	lm/sr = cd	I_v: IEC 50 (845-01-31) cd: IEC 50 (845-01-50)
Illuminance	Irradiance E_e	E_v	lm/m^2 = lx (lux)	E_v: IEC 50 (845-01-38) lx: IEC 50 (845-01-52)
Luminous exitance	Radiant exitance M_e	M_v	lm/m^2	IEC 50 (845-01-48)
Luminance	Radiance L_e	L_v	cd/m^2	IEC 50 (845-01-35)

Photometric units are derived from the radiometric units by weighting them with a wavelength dependent standardized human eye sensitivity V(λ) - function, the so-called CIE-standard photometric observer. There are different functions for photopic vision (V(λ)) and scotopic vision (V'(λ)).

In the following is shown, how the luminous flux is derived from the radiant power and its spectral distribution. The equivalent other photometric terms can be derived from the radiometric terms in the same way.

Relation between distance r, irradiance (illuminance) E_e (E_V) and intensity I_e (I_V)

The relation between intensity of a source and the resulting irradiance in the distance r is given by the basic square root rule law.

An emitted intensity I_e generates in a distance r the irradiance $E_e = I_e/r^2$.

This relationship is not valid under near field conditions and should be used not below a distance d smaller than 5 times the emitter source diameter.

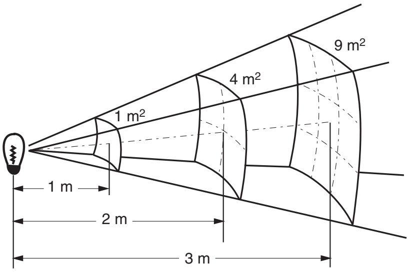


Fig. 2

Using a single radiation point source, one gets the following relation between the parameter E_e, Φ_e, r:

$$E_e = \frac{d\Phi_e}{dA}\left[\frac{W}{m^2}\right]$$

use

$$I_e = \frac{d\Phi}{d\Omega}, \quad \Omega = \frac{A}{r^2} \quad \text{and get}$$

$$E_e = \frac{d\Phi_e}{dA} = I_e\frac{d\Omega}{dA} = \frac{I_e}{r^2}\left[\frac{W}{m^2}\right]$$

Examples

1. Calculate the irradiance with given intensity and distance r: Transceivers with specified intensity of I_e = 100 mW/sr will generate in a distance of 1m an irradiance of $E_e = 100/1^2 = 100$ mW/m². In a distance of 10 m the irradiance would be $E_e = 100/10^2 = 1$ mW/m².
2. Calculate the range of a system with given intensity and irradiance threshold. When the receiver is specified with a sensitivity threshold irradiance E_e = 20 mW/m², the transmitter with an intensity I_e = 120 mW/sr the resulting range can be calculated as

$$r = \sqrt{\frac{I_e}{E_e}} = \sqrt{\frac{120}{20}} = \sqrt{6} = 2.45\text{ m}$$

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