$5.00

TRW

OPTRON PRODUCTS

OPTOELECTRONICS DATA BOOK

1982

OPTOELECTRONICS DIVISION
OPTOELECTRONICS DATA BOOK

OPTRON PRODUCTS

SAME PEOPLE . . . . . DIFFERENT NAME

You used to know us as. . . . .

OPTRON, INC.

Then we were. . . . .

TRW OPTRON

Now we are. . . . .

TRW

Optoelectronics Division
TRW Electronic Components Group

TRW

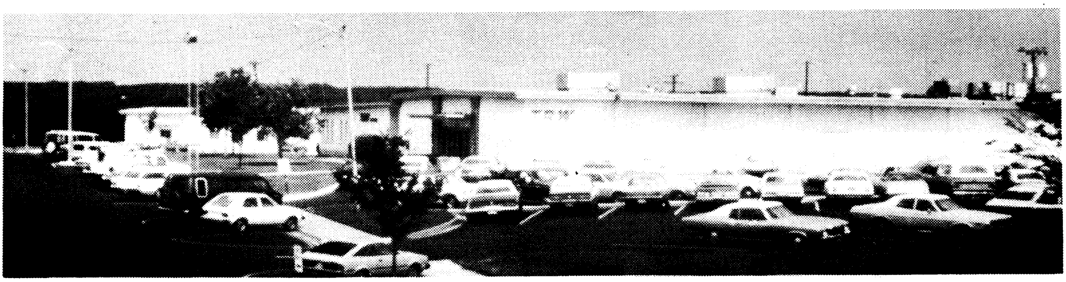
OPTOELECTRONICS DATA BOOK

1982

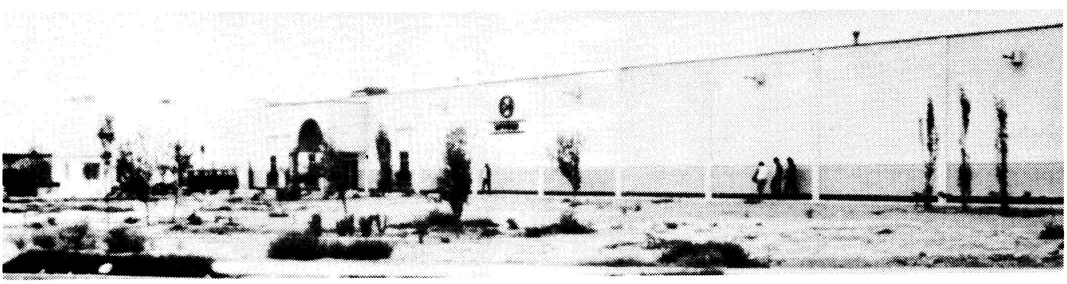
TRW OPTRON, A DIVISION OF TRW INC., 1201 TAPPAN CIRCLE, CARROLLTON, TEXAS, 75006 (214) 323-2200, TWX-910-860-5958

COMPANY HISTORY

Headquarters, Carrollton, Texas



Mineral Wells, Texas



Juarez, Mexico

TRW Optron, an electronic components division of TRW Inc. since January, 1979, is headquartered in Carrollton, Texas, a rapidly growing suburb of North Dallas. Optron was founded in October of 1968 with four employees and initially occupied a small portion of the far left end of the current headquarters building shown above.

Since then Optron has enjoyed an exceptional growth rate. The product line includes emitter and sensor chips, emitter and sensor discretes, reflective and interrupter assemblies, custom assemblies, opto-isolators, triac drivers, Photologic™ devices, fiber optic devices and opto hybrids. "Firsts" for Optron include the bidirectional fiber optic transceiver, the Photologic™ family of logic compatible integrated circuit photosensors, and the discrete lateral side looking plastic package.

Total employment now exceeds 1200 people. The Carrollton facilities consist of four buildings totaling approximately 155,000 square feet. Additionally, Optron owns plants in Mineral Wells, Texas and Juarez, Mexico with 57,000 and 23,000 square feet, respectively, and also has a contract manufacturing operation in Manila, Philippines.

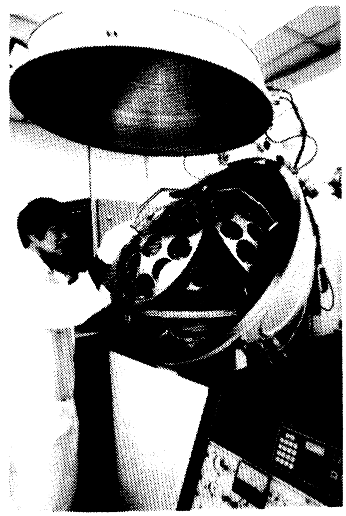
TRW Optron has emerged as the market leader in recent years as a result of innovative plastic packaging techniques and a broad based quality product line. Our philosophy is that quality products and quality service are the most important ingredients in customer satisfaction. That is why our goal is to manufacture the finest optoelectronic devices available, backed by quality and customer service second to none.

CAPABILITIES

Optron has complete facilities for the manufacture of optoelectronic devices. We make our own chips, our own printed circuit boards and our own plastic housings. We even make much of our own automated test equipment. This way we have complete start-to-finish control over the building of our devices, which means better overall quality control and faster delivery times to our customers since we are not so dependent on outside vendors.

Material Preparation Department

Silicon slices are visually checked before being loaded into state-of-the art diffusion furnaces for formation of PN junctions.



Slices being loaded into an electron gun metalizer which evaporates aluminum on the slices to provide electrical contact points.

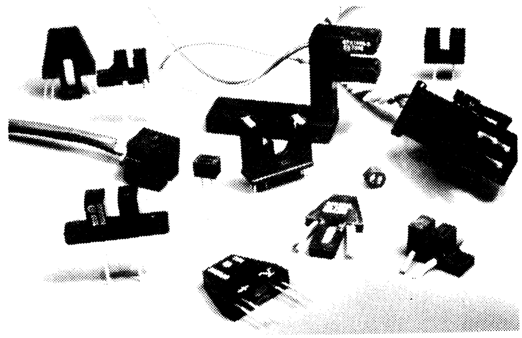
Printed Circuit Board Department

Double sided plated thru-hole boards being removed from plating tanks. Our printed circuit board department ships over 125,000 PC boards per month to satisfy our in-house requirements as well as several outside customers.

The plating area showing thru-hole plating tanks, reflow soldering, etching, and board washing equipment.

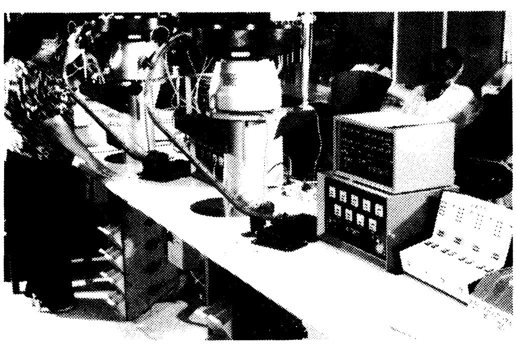
Plastics Department

An inspector checks injection molded parts for flashing or broken pins.

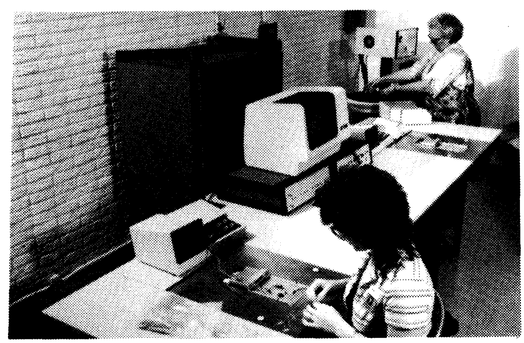


A few of the wide variety of optoelectronic housings. Our plastics department ships over 3 million plastic housings per month plus a small number of unrelated plastic parts to outside customers.

Optron Built Computer Controlled Test Equipment



A high volume test set for testing lateral "side looking" emitters and sensors simultaneously.



Test fixtures interfaced with Teradyne computer system allows a wide variety of high speed testing programs.

NEW PRODUCTS

The products mentioned in this section are all new and have not been released yet. Though some are already being sampled to customers, final characterization has not been completed. All products will be released sometime between the printing of the 1982 Data Book and the printing of the 1983 Data Book.

The following "first look" and brief description will give you a good idea of what new products to expect from TRW Optron over the next few months.

Gallium Aluminum Arsenide, T-1¾, Infrared Emitting Diodes

OP290 —This GaAlAs LED has an included emission angle of 50° measured at the half power points and is intended for pulse operation at up to 5.0 amps in applications involving remote control open air communication at communication rates to 1 MHz.

OP291 —An identical product to the OP290 except that it is characterized at $I_F = 100$ mA. It should be considered as a potential low cost plastic replacement for TO-46 windowed infrared emitters since it has more consistent beam pattern, improved reliability, and three times the power output.

OP295 —This GaAlAs LED has an included emission angle of 20° measured at the half power points and is intended for pulse operation at up to 5.0 amps in applications requiring high on-axis radiant intensity such as surveillance and industrial controls.

OP296 —An identical product to the OP295 except that it is characterized at $I_F = 100$ mA. It should be considered as a low cost plastic replacement for TO-46 lensed infrared emitters since it has more consistent beam pattern, improved reliability and three times the power output.

P_O—Radiant Power Output (Typical)

OP290	240 mW	$I_F = 1.5$ A, pw $= 25\mu s$
OP291	16 mW	$I_F = 100$ mA, pw $= 25\mu s$

$E_{e(APT)}$—Apertured Radiant Incidence (Typical)

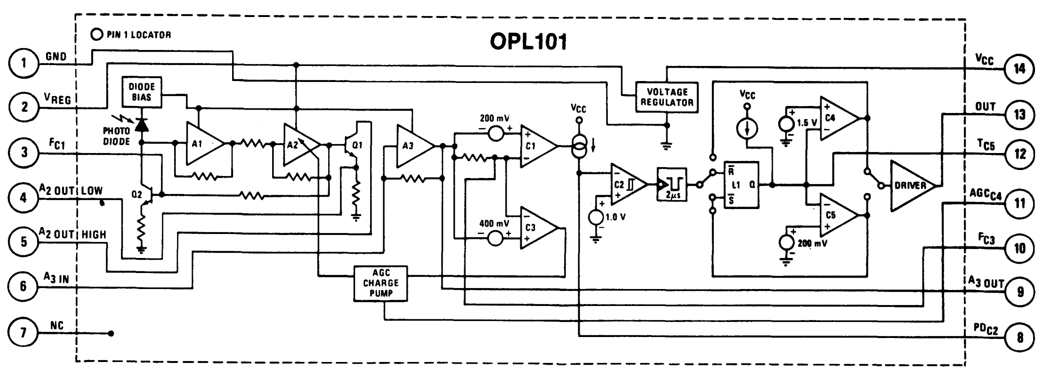
OP295	66 mW/cm²	$I_F = 1.5$ A, pw $= 25\ \mu s$, see note
OP296	3.8 mW/cm²	$I_F = 100$ mA, pw $= 25\ \mu s$, see note

NOTE: Measurement is made 1.429 inches (36.3mm) from device tip through 0.25 inches (6.35mm) diameter aperture.

Opto-Integrated Circuits

Photologic™ II —This series is similar in function to the current Photologic series in that a photodiode drives a linear amplifier which in turn drives a Schmitt trigger connected to various output configurations. The Photologic II features an on-board voltage regulator allowing it to be used with power supplies ranging from 4.5 V to 24 V making it compatible with most logic families. The Photologic II will be offered in all existing Photologic package styles.

OPL101 —This opto-IC contains a high gain amplifier with a photodiode integrated on a single silicon chip. It is mounted in a standard 14 pin P-DIP and is intended for application in remote communications. The OPL101 is spectrally matched to the OP290/295 series of GaAlAs infrared emitting diodes. It is currently the most complex opto-IC in the marketplace. The schematic is shown below.



OPL102 —The OPL102 is a metal mask variation of the OPL101. It is designed to detect a missing pulse or string of pulses and is intended for use in beam interrupt systems in industrial controls and surveillance. It is also mounted in a 14 pin P-DIP.

NEW PRODUCTS (continued)

Optically Coupled Isolators—Standard 6 Pin P-DIP

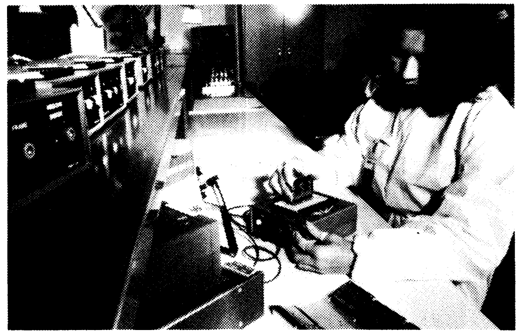
OPI3030, 3031 3032, 3033	—This opto-isolator series features triac driver output with zero voltage crossing. It is intended for applications where peak blocking voltage does not exceed 250 VAC. There are four different LED drive current ranges, necessary to cause output latching, 30 mA, 15 mA, 10 mA and 5 mA.
OPI3040, 3041 3042, 3043	—An identical series except that peak blocking voltage must not exceed 400 VAC.
6N134	—This is a dual channel 16 pin hermetic isolator with open collector logic level output. It is intended for speeds below 10 M baud in such applications as line receivers and high speed logic ground isolation. It is directly interchangeable with the Hewlett-Packard 6N134.
6N135/136	—These are dual channel 8 pin P-DIP isolators with transistor output. They are intended for speeds below 1 M baud in such applications as TTL/LSTTL and TTL/CMOS ground isolation, analog circuits and line receivers. They are directly interchangeable with the Hewlett-Packard 6N135/136.
6N137	—This is an 8 pin P-DIP isolator with open collector logic level output. It is intended for speeds below 10 M baud in such applications as line receivers and high speed logic ground isolation. It is directly interchangeable with the Hewlett-Packard 6N137.
6N138/139	—These are 8 pin P-DIP isolators with darlington output. They are intended for applications requiring speeds below 300 K baud but higher gain. This includes the applications for the 6N135/136 plus low current ground isolation. These devices are directly interchangeable with the Hewlett-Packard 6N138/139.

HIGH RELIABILITY

High reliability at TRW Optron is more than a group, an area, or a line. It is a complete, full capability department with its own engineering and manufacturing people dedicated completely to the design and production of high reliability products.

TRW Optron has emerged as the market leader with the broadest product line of infrared optoelectronic components in the industry. The company provides high quality products, strong technical backup, superior service, and specialization in custom work. Leading edge technology products include the Automatic Brightness Controller, the integrated infrared Pulse Receiver, and optohybrid devices.

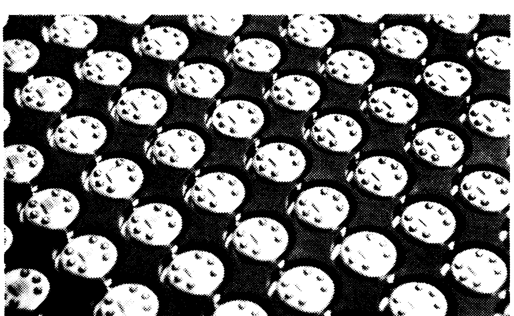
High reliability assembly modules from temperature cycling ready for additional testing.



Each module is tested in each of the test fixtures shown on the test bench shelf. Fixtures are made by Optron with duplicate fixtures sent to the customer for use in his incoming inspection.

Dedication to performance produces an end product that conforms to military specifications with operating characteristics that meet the most critical specifications. This capability is enhanced by the special treatment given to products by the people at Optron and is exemplified by additional hours and inspection steps that assure excellence, not merely conformance.

Significant on-going process improvements are continually carried forward to assure product conformance and reliability. Every step of TRW Optron's assembly procedure is constantly analyzed to develop improved process yields. This philosophy led to the development of an in-house brazing technique for joining the ceramic chip substrate to a TO-5 header. To date, this and other process improvements have resulted in the company's ability to test more than 300,000 TO-5 hermetic couplers on monitored temperature cycle without a failure.



Ceramic substrates are brazed to TO-5 headers. LED and sensor chips are mounted to the substrates.

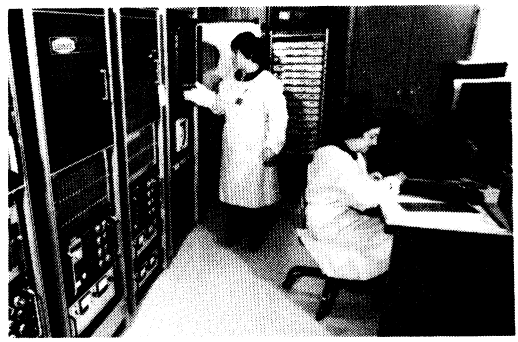
Bond operators are bonding gold wires to the chips to provide electrical contact to the header.

TRW Optron offers the industry's broadest line of Hi-Rel optoelectronic products including JAN, JANTX and JANTXV couplers. The company's product line of standard devices is complemented by Optron's ability to produce custom parts to required specifications, some exceeding military requirements. All Hi-Rel engineering, manufacturing, processing and quality control facilities are located in the United States. This, of course, allows much more direct and immediate control over the product and faster response time to customer needs.

TRW Optron is a QPL supplier, approved by DESC and qualified to MIL-S-19500 revision F. The company's calibration system complies with the requirements of MIL-S-45662 which incorporates MIL-Q-9858 and MIL-I-45208.

State-of-the-art equipment is a must at Optron. It is faster, more accurate, and produces products of higher conformity. Specially designed burn-in racks that incorporate recording devices provide the means to monitor burn-in temperature over a seven day period.

Devices are monitored for temperature characteristics in accordance with specification requirements.



Devices being loaded into TRW Optron designed burn-in racks.

Computerized testing with data log capability facilitates complete lot traceability. Specific lots can be tracked back to the slice diffusion run. Computer printouts can be supplied to customers for a complete history of all test results.

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TRW OPTRON

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INFRARED EMITTING DIODES

Part No.	Package Style	Min. Power Output at Rated IF	Beam Angle Between Half Power Points	Page No.
OP123	Pill	0.4 mW @ 50 mA	35°	2-3
OP124	Pill	1.5 mW @ 50 mA	35°	2-3
OP130	TO-46, Lensed	1.0 mW @ 100 mA	18°	4-5
OP131	TO-46, Lensed	3.0 mW @ 100 mA	18°	4-5
OP132	TO-46, Lensed	4.0 mW @ 100 mA	18°	4-5
OP133	TO-46, Lensed	5.0 mW @ 100 mA	18°	4-5
OP130W	TO-46, Window	1.0 mW @ 100 mA	50°	4-5
OP131W	TO-46, Window	3.0 mW @ 100 mA	50°	4-5
OP132W	TO-46, Window	4.0 mW @ 100 mA	50°	4-5
OP133W	TO-46, Window	5.0 mW @ 100 mA	50°	4-5
OP135	TO-46, Lensed	15 mW @ 1 A, pulsed	18°	6-7
OP136	TO-46, Lensed	27 mW @ 1 A, pulsed	18°	6-7
OP135W	TO-46, Window	15 mW @ 1 A, pulsed	64°	6-7
OP136W	TO-46, Window	27 mW @ 1 A, pulsed	64°	6-7
OP140	Plastic, Side Looking	0.5 mW @ 40 mA	36°	8-9
OP140SL	Plastic, Side Looking	$E_{e(APT)}$ = 0.02 mW @ 20 mA	36°	8-9
OP140SLD	Plastic, Side Looking	$E_{e(APT)}$ = 0.10 mW @ 20 mA	36°	8-9
OP140SLC	Plastic, Side Looking	$E_{e(APT)}$ = 0.20 mW @ 20 mA	36°	8-9
OP140SLB	Plastic, Side Looking	$E_{e(APT)}$ = 0.30 mW @ 20 mA	36°	8-9
OP140SLA	Plastic, Side Looking	$E_{e(APT)}$ = 0.40 mW @ 20 mA	36°	8-9
OP160	T-1, Lensed, 50 Mil Lead Spacing	0.5 mW @ 20 mA	16°	10-11
OP160SL	T-1, Lensed, 50 Mil Lead Spacing	$E_{e(APT)}$ = 0.05 mW @ 20 mA	16°	10-11
OP160SLD	T-1, Lensed, 50 Mil Lead Spacing	$E_{e(APT)}$ = 0.28 mW @ 20 mA	16°	10-11
OP160SLC	T-1, Lensed, 50 Mil Lead Spacing	$E_{e(APT)}$ = 0.85 mW @ 20 mA	16°	10-11
OP160SLB	T-1, Lensed, 50 Mil Lead Spacing	$E_{e(APT)}$ = 1.4 mW @ 20 mA	16°	10-11
OP160SLA	T-1, Lensed, 50 Mil Lead Spacing	$E_{e(APT)}$ = 1.95 mW @ 20 mA	16°	10-11
OP160W	T-1, Flat Lens, 50 Mil Lead Spacing	0.5 mW @ 20 mA	85°	12-13
OP161	T-1, Lensed, 100 Mil Lead Spacing	0.5 mW @ 20 mA	16°	14-15
OP161SL	T-1, Lensed, 100 Mil Lead Spacing	$E_{e(APT)}$ = 0.05 mW @ 20 mA	16°	14-15
OP161SLD	T-1, Lensed, 100 Mil Lead Spacing	$E_{e(APT)}$ = 0.28 mW @ 20 mA	16°	14-15
OP161SLC	T-1, Lensed, 100 Mil Lead Spacing	$E_{e(APT)}$ = 0.85 mW @ 20 mA	16°	14-15
OP161SLB	T-1, Lensed, 100 Mil Lead Spacing	$E_{e(APT)}$ = 1.4 mW @ 20 mA	16°	14-15
OP161SLA	T-1, Lensed, 100 Mil Lead Spacing	$E_{e(APT)}$ = 1.95 mW @ 20 mA	16°	14-15
OP168F	Black Plastic, End Looking	0.25 mW @ 20 mA	104°	16-17
OP169	Plastic, End Looking	0.2 mW @ 20 mA	46°	18-19
OP169SL	Plastic, End Looking	$E_{e(APT)}$ = 0.02 mW @ 20 mA	46°	18-19
OP169SLD	Plastic, End Looking	$E_{e(APT)}$ = 0.116 mW @ 20 mA	46°	18-19
OP169SLC	Plastic, End Looking	$E_{e(APT)}$ = 0.195 mW @ 20 mA	46°	18-19
OP223	Pill	0.8 mW @ 50 mA	35°	20-21
OP224	Pill	3.0 mW @ 50 mA	35°	20-21
OP230	TO-46, Lensed	6.0 mW @ 100 mA	18°	22-23
OP231	TO-46, Lensed	8.0 mW @ 100 mA	18°	22-23
OP232	TO-46, Lensed	10 mW @ 100 mA	18°	22-23
OP233	TO-46, Lensed	12 mW @ 100 mA	18°	22-23
OP230W	TO-46, Window	6.0 mW @ 100 mA	50°	22-23
OP231W	TO-46, Window	8.0 mW @ 100 mA	50°	22-23
OP232W	TO-46, Window	10 mW @ 100 mA	50°	22-23
OP233W	TO-46, Window	12 mW @ 100 mA	50°	22-23
OP240	Plastic, Side Looking	1.0 mW @ 40 mA	36°	24-25
OP240SLC	Plastic, Side Looking	$E_{e(APT)}$ = 0.20 mW @ 20 mA	36°	24-25
OP240SLB	Plastic, Side Looking	$E_{e(APT)}$ = 0.40 mW @ 20 mA	36°	24-25
OP240SLA	Plastic, Side Looking	$E_{e(APT)}$ = 0.60 mW @ 20 mA	36°	24-25
OP260	T-1, Lensed, 50 Mil Lead Spacing	1.0 mW @ 20 mA	16°	26-27
OP260SLC	T-1, Lensed, 50 Mil Lead Spacing	$E_{e(APT)}$ = 0.5 mW @ 20 mA	16°	26-27
OP260SLB	T-1, Lensed, 50 Mil Lead Spacing	$E_{e(APT)}$ = 2.5 mW @ 20 mA	16°	26-27
OP260SLA	T-1, Lensed, 50 Mil Lead Spacing	$E_{e(APT)}$ = 4.0 mW @ 20 mA	16°	26-27

PHOTOSENSORS

Part No.	Package Style	Function	Min. Output CT = 2870°	Page No.
OP300	Pill	Photodarlington	$I_{C(ON)}$ = 0.8 mA, V_{CE} = 5 V, E_e = 1 mW/cm^2	30-31
OP301	Pill	Photodarlington	$I_{C(ON)}$ = 0.8 mA, V_{CE} = 5 V, E_e = 1 mW/cm^2	30-31
OP302	Pill	Photodarlington	$I_{C(ON)}$ = 1.8 mA, V_{CE} = 5 V, E_e = 1 mW/cm^2	30-31
OP303	Pill	Photodarlington	$I_{C(ON)}$ = 3.6 mA, V_{CE} = 5 V, E_e = 1 mW/cm^2	30-31
OP304	Pill	Photodarlington	$I_{C(ON)}$ = 7.0 mA, V_{CE} = 5 V, E_e = 1 mW/cm^2	30-31
OP305	Pill	Photodarlington	$I_{C(ON)}$ = 14 mA, V_{CE} = 5 V, E_e = 1 mW/cm^2	30-31
OP500	T-1, Lensed, 50 Mil Lead Spacing	Phototransistor	$I_{C(ON)}$ = 4.0 mA, V_{CE} = 5 V, E_e = 20 mW/cm^2	32-33
OP500SLD	T-1, Lensed, 50 Mil Lead Spacing	Phototransistor	$I_{C(ON)}$ = 10 mA, V_{CE} = 5 V, E_e = 20 mW/cm^2	32-33
OP500SLC	T-1, Lensed, 50 Mil Lead Spacing	Phototransistor	$I_{C(ON)}$ = 17 mA, V_{CE} = 5 V, E_e = 20 mW/cm^2	32-33
OP500SLB	T-1, Lensed, 50 Mil Lead Spacing	Phototransistor	$I_{C(ON)}$ = 25 mA, V_{CE} = 5 V, E_e = 20 mW/cm^2	32-33
OP500SLA	T-1, Lensed, 50 Mil Lead Spacing	Phototransistor	$I_{C(ON)}$ = 40 mA, V_{CE} = 5 V, E_e = 20 mW/cm^2	32-33
OP500W	T-1, Flat Lens, 50 Mil Lead Spacing	Phototransistor	$I_{C(ON)}$ = 0.5 mA, V_{CE} = 5 V, E_e = 20 mW/cm^2	34-35
OP501	T-1, Lensed, 100 Mil Lead Spacing	Phototransistor	$I_{C(ON)}$ = 4.0 mA, V_{CE} = 5 V, E_e = 20 mW/cm^2	36-37
OP501SLD	T-1, Lensed, 100 Mil Lead Spacing	Phototransistor	$I_{C(ON)}$ = 10 mA, V_{CE} = 5 V, E_e = 20 mW/cm^2	36-37
OP501SLC	T-1, Lensed, 100 Mil Lead Spacing	Phototransistor	$I_{C(ON)}$ = 17 mA, V_{CE} = 5 V, E_e = 20 mW/cm^2	36-37
OP501SLB	T-1, Lensed, 100 Mil Lead Spacing	Phototransistor	$I_{C(ON)}$ = 25 mA, V_{CE} = 5 V, E_e = 20 mW/cm^2	36-37
OP501SLA	T-1, Lensed, 100 Mil Lead Spacing	Phototransistor	$I_{C(ON)}$ = 40 mA, V_{CE} = 5 V, E_e = 20 mW/cm^2	36-37
OP502	T-1, Lensed, 100 Mil Lead Spacing	Phototransistor	$I_{C(ON)}$ = 0.8 mA, V_{CE} = 5 V, E_e = 5 mW/cm^2	38-39
OP502B	T-1, Lensed, 100 Mil Lead Spacing	Phototransistor	$I_{C(ON)}$ = 1.0 mA, V_{CE} = 5 V, E_e = 5 mW/cm^2	38-39
OP502A	T-1, Lensed, 100 Mil Lead Spacing	Phototransistor	$I_{C(ON)}$ = 2.5 mA, V_{CE} = 5 V, E_e = 5 mW/cm^2	38-39

TRW OPTRON, A DIVISION OF TRW INC., 1201 TAPPAN CIRCLE, CARROLLTON, TEXAS, 75006 (214) 323-2200, TWX-910-860-5958

PHOTOSENSORS (continued)

Part No.	Package Style	Function	Min. Output CT = 2870°	Page No.
OP508F	Black Plastic, End Looking	Phototransistor	$I_{C(ON)}$ = 0.5 mA, V_{CE} = 5 V, E_e = 20 mW/cm^2	40-41
OP509	Black Plastic, End Looking	Phototransistor	$I_{C(ON)}$ = 0.05 mA, V_{CE} = 5 V, E_e = 1 mW/cm^2	42-43
OP509SLD	Black Plastic, End Looking	Phototransistor	$I_{C(ON)}$ = 0.17 mA, V_{CE} = 5 V, E_e = 1 mW/cm^2	42-43
OP509SLC	Black Plastic, End Looking	Phototransistor	$I_{C(ON)}$ = 0.3 mA, V_{CE} = 5 V, E_e = 1 mW/cm^2	42-43
OP530	T-1, Lensed, 50 Mil Lead Spacing	Photodarlington	$I_{C(ON)}$ = 5.0 mA, V_{CE} = 5 V, E_e = 0.5 mW/cm^2	44-45
OP538F	Black Plastic, End Looking	Photodarlington	$I_{C(ON)}$ = 1.0 mA, V_{CE} = 5 V, E_e = 1 mW/cm^2	46-47
OP550	Plastic, Side Looking	Phototransistor	$I_{C(ON)}$ = 0.5 mA, V_{CE} = 5 V, E_e = 20 mW/cm^2	48-49
OP550SLD	Plastic, Side Looking	Phototransistor	$I_{C(ON)}$ = 4.5 mA, V_{CE} = 5 V, E_e = 20 mW/cm^2	48-49
OP550SLC	Plastic, Side Looking	Phototransistor	$I_{C(ON)}$ = 12 mA, V_{CE} = 5 V, E_e = 20 mW/cm^2	48-49
OP550SLB	Plastic, Side Looking	Phototransistor	$I_{C(ON)}$ = 15 mA, V_{CE} = 5 V, E_e = 20 mW/cm^2	48-49
OP550SLA	Plastic, Side Looking	Phototransistor	$I_{C(ON)}$ = 22 mA, V_{CE} = 5 V, E_e = 20 mW/cm^2	48-49
OP560	Plastic, Side Looking	Photodarlington	$I_{C(ON)}$ = 0.5 mA, V_{CE} = 2 V, E_e = 1 mW/cm^2	50-51
OPL550	Plastic, Side Looking	Photologic	Buffer, Totem-Pole	52-55
OPL550-OC	Plastic, Side Looking	Photologic	Buffer, Open Collector	52-55
OPL551	Plastic, Side Looking	Photologic	Inverter, Totem-Pole	52-55
OPL551-OC	Plastic, Side Looking	Photologic	Inverter, Open Collector	52-55
OP600	Pill	Phototransistor	$I_{C(ON)}$ = 0.8 mA, V_{CE} = 5 V, E_e = 20 mW/cm^2	56-57
OP601	Pill	Phototransistor	$I_{C(ON)}$ = 0.5 mA, V_{CE} = 5 V, E_e = 20 mW/cm^2	56-57
OP602	Pill	Phototransistor	$I_{C(ON)}$ = 2.0 mA, V_{CE} = 5 V, E_e = 20 mW/cm^2	56-57
OP603	Pill	Phototransistor	$I_{C(ON)}$ = 4.0 mA, V_{CE} = 5 V, E_e = 20 mW/cm^2	56-57
OP604	Pill	Phototransistor	$I_{C(ON)}$ = 7.0 mA, V_{CE} = 5 V, E_e = 20 mW/cm^2	56-57
OP640	Pill	Phototransistor	$I_{C(ON)}$ = 0.8 mA, V_{CE} = 5 V, E_e = 20 mW/cm^2	56-57
OP641	Pill	Phototransistor	$I_{C(ON)}$ = 0.5 mA, V_{CE} = 5 V, E_e = 20 mW/cm^2	56-57
OP642	Pill	Phototransistor	$I_{C(ON)}$ = 2.0 mA, V_{CE} = 5 V, E_e = 20 mW/cm^2	56-57
OP643	Pill	Phototransistor	$I_{C(ON)}$ = 4.0 mA, V_{CE} = 5 V, E_e = 20 mW/cm^2	56-57
OP644	Pill	Phototransistor	$I_{C(ON)}$ = 7.0 mA, V_{CE} = 5 V, E_e = 20 mW/cm^2	56-57
OP700	Coaxial	Phototransistor	$I_{C(ON)}$ = 0.8 mA, V_{CE} = 5 V, E_e = 20 mW/cm^2	58-59
OP701	Coaxial	Phototransistor	$I_{C(ON)}$ = 1.5 mA, V_{CE} = 5 V, E_e = 20 mW/cm^2	58-59
OP702	Coaxial	Phototransistor	$I_{C(ON)}$ = 3.0 mA, V_{CE} = 5 V, E_e = 20 mW/cm^2	58-59
OP703	Coaxial	Phototransistor	$I_{C(ON)}$ = 6.0 mA, V_{CE} = 5 V, E_e = 20 mW/cm^2	58-59
OP790	Coaxial	Photodiode	I_L = 12 μA, V_R = 10 V, E_e = 20 mW/cm^2	60-61
OP800	TO-18, Lensed	Phototransistor	$I_{C(ON)}$ = 0.8 mA, V_{CE} = 5 V, E_e = 5 mW/cm^2	62-63
OP801	TO-18, Lensed	Phototransistor	$I_{C(ON)}$ = 0.5 mA, V_{CE} = 5 V, E_e = 5 mW/cm^2	62-63
OP802	TO-18, Lensed	Phototransistor	$I_{C(ON)}$ = 2.0 mA, V_{CE} = 5 V, E_e = 5 mW/cm^2	62-63
OP803	TO-18, Lensed	Phototransistor	$I_{C(ON)}$ = 4.0 mA, V_{CE} = 5 V, E_e = 5 mW/cm^2	62-63
OP804	TO-18, Lensed	Phototransistor	$I_{C(ON)}$ = 7.0 mA, V_{CE} = 5 V, E_e = 5 mW/cm^2	62-63
OP805	TO-18, Lensed	Phototransistor	$I_{C(ON)}$ = 15 mA, V_{CE} = 5 V, E_e = 5 mW/cm^2	62-63
OP800W	TO-18, Window	Phototransistor	$I_{C(ON)}$ = 0.3 mA, V_{CE} = 5 V, E_e = 5 mW/cm^2	64-65
OP801W	TO-18, Window	Phototransistor	$I_{C(ON)}$ = 0.5 mA, V_{CE} = 5 V, E_e = 5 mW/cm^2	64-65
OP802W	TO-18, Window	Phototransistor	$I_{C(ON)}$ = 2.5 mA, V_{CE} = 5 V, E_e = 5 mW/cm^2	64-65
OP830	TO-18, Lensed	Photodarlington	$I_{C(ON)}$ = 15 mA, V_{CE} = 5 V, E_e = 0.5 mW/cm^2	66-67
OP830W	TO-18, Window	Photodarlington	$I_{C(ON)}$ = 4.0 mA, V_{CE} = 5 V, E_e = 5 mW/cm^2	68-69
OP841	TO-18, Lensed	Phototransistor	$I_{C(ON)}$ = 0.5 mA, V_{CE} = 5 V, E_e = 5 mW/cm^2	70-71
OP842	TO-18, Lensed	Phototransistor	$I_{C(ON)}$ = 2.0 mA, V_{CE} = 5 V, E_e = 5 mW/cm^2	70-71
OP843	TO-18, Lensed	Phototransistor	$I_{C(ON)}$ = 5.0 mA, V_{CE} = 5 V, E_e = 5 mW/cm^2	70-71
OP844	TO-18, Lensed	Phototransistor	$I_{C(ON)}$ = 7.0 mA, V_{CE} = 5 V, E_e = 5 mW/cm^2	70-71
OP845	TO-18, Lensed	Phototransistor	$I_{C(ON)}$ = 15 mA, V_{CE} = 5 V, E_e = 5 mW/cm^2	70-71
OP841W	TO-18, Window	Phototransistor	$I_{C(ON)}$ = 0.3 mA, V_{CE} = 5 V, E_e = 5 mW/cm^2	72-73
OP842W	TO-18, Window	Phototransistor	$I_{C(ON)}$ = 1.0 mA, V_{CE} = 5 V, E_e = 5 mW/cm^2	72-73
OP843W	TO-18, Window	Phototransistor	$I_{C(ON)}$ = 1.5 mA, V_{CE} = 5 V, E_e = 5 mW/cm^2	72-73
OP844W	TO-18, Window	Phototransistor	$I_{C(ON)}$ = 2.0 mA, V_{CE} = 5 V, E_e = 5 mW/cm^2	72-73
OP845W	TO-18, Window	Phototransistor	$I_{C(ON)}$ = 2.5 mA, V_{CE} = 5 V, E_e = 5 mW/cm^2	72-73
OPL800	TO-18, Lensed	Photologic	Buffer, Totem-Pole	74-77
OPL800-OC	TO-18, Lensed	Photologic	Buffer, Open Collector	74-77
OPL801	TO-18, Lensed	Photologic	Inverter, Totem-Pole	74-77
OPL801-OC	TO-18, Lensed	Photologic	Inverter, Open Collector	74-77
OP900	Pill	Photodiode	I_L = 8 μA, V_R = 50 V, E_e = 20 mW/cm^2	78-79
OP903	TO-5, Lensed	Photodiode	I_L = 200 μA, V_R = 10 V, E_e = 5 mW/cm^2	80-81
OP903W	TO-5, Window	Photodiode	I_L = 50 μA, V_R = 10 V, E_e = 5 mW/cm^2	82-83
OP913	TO-5, Lensed	Photodiode	I_L = 240 μA, V_R = 10 V, E_e = 5 mW/cm^2	80-81
OP913W	TO-5, Window	Photodiode	I_L = 55 μA, V_R = 10 V, E_e = 5 mW/cm^2	82-83
OP905	2 Lead, Clear Pl[illegible]	[illegible]	I_L = [illegible]5 μA, V_R = 5 V, E_e = 5 mW/cm^2	84-85
OP905F	2 Lead, Black P[illegible]	[illegible]	[illegible] μA, V_R = 5 V, E_e = 5 mW/cm^2	86-87
OP915	2 Lead, Clear Pl[illegible]	[illegible]	[illegible] μA, V_R = 5 V, E_e = 5 mW/cm^2	84-85
OP915F	2 Lead, Black P[illegible]	[illegible]	I_L = [illegible] μA, V_R = 5 V, E_e = 5 mW/cm^2	86-87

DISCONTINUED

OPTICALLY COUPLED ISOLATORS

Part No.	Package Style	Function	Min. CTR	Isolation Voltage	Page No.
CNY/I	6 Pin DIP	Phototransistor	40 @ V_{CE} = 5 V, I_F = 10 mA	4000 VDC	90-93
CNY/II	6 Pin DIP	Phototransistor	63 @ V_{CE} = 5 V, I_F = 10 mA	4000 VDC	90-93
CNY/III	6 Pin DIP	Phototransistor	100 @ V_{CE} = 5 V, I_F = 10 mA	4000 VDC	90-93
CNY/IV	6 Pin DIP	Phototransistor	160 @ V_{CE} = 5 V, I_F = 10 mA	4000 VDC	90-93
OPI102	TO-5	Phototransistor	25 @ V_{CE} = 5 V, I_F = 10 mA	1000 VDC	94-95
OPI103	TO-5	Phototransistor	100 @ V_{CE} = 5 V, I_F = 10 mA	1000 VDC	94-95
OPI110	Black Plastic Housing	Phototransistor	12.5 @ V_{CE} = 5 V, I_F = 16 mA	10 kVDC	96-97
OPI113	Black Plastic Housing	Photodarlington	50 @ V_{CE} = 5 V, I_F = 16 mA	10 kVDC	96-97
OPI120	Black Plastic Housing	Phototransistor	20 @ V_{CE} = 5 V, I_F = 10 mA	15 KVDC	98-99
OPI123	Black Plastic Housing	Phototransistor	50 @ V_{CE} = 5 V, I_F = 10 mA	15 kVDC	98-99

OPTICALLY COUPLED ISOLATORS (continued)

Part No.	Package Style	Function	Min. CTR	Isolation Voltage	Page No.
OPI125	Black Plastic Housing	Photologic	Buffer, Totem-Pole	15 kVDC	100-103
OPI126	Black Plastic Housing	Photologic	Buffer, Open Collector	15 kVDC	100-103
OPI127	Black Plastic Housing	Photologic	Inverter, Totem-Pole	15 kVDC	100-103
OPI128	Black Plastic Housing	Photologic	Inverter, Open Collector	15 kVDC	100-103
OPI1264A	Black Plastic Housing	Phototransistor	25 @ $V_{CE}=5$ V, $I_F=10$ mA	10 kVDC	104-105
OPI1264B	Black Plastic Housing	Phototransistor	50 @ $V_{CE}=5$ V, $I_F=10$ mA	10 kVDC	104-105
OPI1264C	Black Plastic Housing	Phototransistor	100 @ $V_{CE}=5$ V, $I_F=10$ mA	10 kVDC	104-105
OPI130	TO-5	Photodarlington	100 @ $V_{CE}=2$ V, $I_F=10$ mA	1000 VDC	106-107
OPI140	TO-72	Phototransistor	15 @ $V_{CE}=10$ V, $I_F=10$ mA	1000 VDC	108-109
OPI150	Black Plastic Housing	Phototransistor	10 @ $V_{CE}=10$ V, $I_F=10$ mA	50 kVDC	110-111
OPI153	Black Plastic Housing	Photodarlington	25 @ $V_{CE}=10$ V, $I_F=20$ mA	50 kVDC	110-111
OPI2100	6 Pin DIP	Phototransistor	150 @ $V_{CE}=5$ V, $I_F=10$ mA	4000 VDC	112-113
OPI2150	6 Pin DIP	Phototransistor	2 @ $V_{CE}=5$ V, $I_F=10$ mA	1500 VDC	114-115
OPI2250	6 Pin DIP	Phototransistor	2 @ $V_{CE}=5$ V, $I_F=10$ mA	2500 VDC	114-115
OPI2151	6 Pin DIP	Phototransistor	10 @ $V_{CE}=5$ V, $I_F=10$ mA	1500 VDC	116-117
OP2251	6 Pin DIP	Phototransistor	10 @ $V_{CE}=5$ V, $I_F=10$ mA	2500 VDC	116-117
OPI2152	6 Pin DIP	Phototransistor	20 @ $V_{CE}=5$ V, $I_F=10$ mA	1500 VDC	118-119
OPI2252	6 Pin DIP	Phototransistor	20 @ $V_{CE}=5$ V, $I_F=10$ mA	2500 VDC	118-119
OPI2153	6 Pin DIP	Phototransistor	50 @ $V_{CE}=5$ V, $I_F=10$ mA	1500 VDC	120-121
OPI2253	6 Pin DIP	Phototransistor	50 @ $V_{CE}=5$ V, $I_F=10$ mA	2500 VDC	120-121
OPI2154	6 Pin DIP	Phototransistor	10 @ $V_{CE}=0.5$ V, $I_F=0.5$ mA	1500 VDC	122-123
OPI2155	6 Pin DIP	Phototransistor	20 @ $V_{CE}=0.5$ V, $I_F=0.5$ mA	1500 VDC	122-123
OPI2254	6 Pin DIP	Phototransistor	10 @ $V_{CE}=0.5$ V, $I_F=0.5$ mA	2500 VDC	122-123
OPI2255	6 Pin DIP	Phototransistor	20 @ $V_{CE}=0.5$ V, $I_F=0.5$ mA	4000 VDC	122-123
OPI2500	6 Pin DIP	Phototransistor	12.5@ $V_{CE}=0.4$ V, $I_F=\pm 16$ mA	1500 VDC	124-125
OPI3009	6 Pin DIP	Triac Driver	$I_{FT}=30$ mA	2500 VDC	126-127
OPI3010	6 Pin DIP	Triac Driver	$I_{FT}=15$ mA	2500 VDC	126-127
OPI3011	6 Pin DIP	Triac Driver	$I_{FT}=10$ mA	2500 VDC	126-127
OPI3012	6 Pin DIP	Triac Driver	$I_{FT}=5$ mA	2500 VDC	126-127
OPI3020	6 Pin DIP	Triac Driver	$I_{FT}=30$ mA	2500 VDC	128-129
OPI3021	6 Pin DIP	Triac Driver	$I_{FT}=15$ mA	2500 VDC	128-129
OPI3022	6 Pin DIP	Triac Driver	$I_{FT}=10$ mA	2500 VDC	128-129
OPI3023	6 Pin DIP	Triac Driver	$I_{FT}=5$ mA	2500 VDC	128-129
OPI3150	6 Pin DIP	Photodarlington	300 @ $V_{CE}=2$ V, $I_F=10$ mA	1500 VDC	130-131
OPI3250	6 Pin DIP	Photodarlington	300 @ $V_{CE}=2$ V, $I_F=10$ mA	2500 VDC	130-131
OPI3151	6 Pin DIP	Photodarlington	300 @ $V_{CE}=1$ V, $I_F=10$ mA	1500 VDC	132-133
OPI3251	6 Pin DIP	Photodarlington	300 @ $V_{CE}=1$ V, $I_F=10$ mA	2500 VDC	132-133
OPI3152	6 Pin DIP	Photodarlington	300 @ $V_{CE}=5$ V, $I_F=10$ mA	1500 VDC	134-135
OPI3252	6 Pin DIP	Photodarlington	300 @ $V_{CE}=5$ V, $I_F=10$ mA	2500 VDC	134-135
OPI3153	6 Pin DIP	Photodarlington	500 @ $V_{CE}=5$ V, $I_F=1$ mA	1500 VDC	136-137
OPI3253	6 Pin DIP	Photodarlington	500 @ $V_{CE}=5$ V, $I_F=1$ mA	2500 VDC	136-137
OPI6000	6 Pin DIP	Phototransistor	20 @ $V_{CE}=5$ V, $I_F=10$ mA	2500 VDC	138-139
OPI6100	6 Pin DIP	Phototransistor	10 @ $V_{CE}=5$ V, $I_F=10$ mA	2500 VDC	138-139
OPI7002	Black Plastic Housing	Phototransistor	20 @ $V_{CE}=10$ V, $I_F=5$ mA	6000 VDC	140-141
OPI7010	Black Plastic Housing	Phototransistor	100 @ $V_{CE}=10$ V, $I_F=5$ mA	6000 VDC	140-141
OPI7320	Black Plastic Housing	Photodarlington	200 @ $V_{CE}=5$ V, $I_F=5$ mA	6000 VDC	140-141
OPI7340	Black Plastic Housing	Photodarlington	400 @ $V_{CE}=5$ V, $I_F=5$ mA	6000 VDC	140-141
OPI8012	6 Pin DIP	Photologic	Buffer, Totem-Pole	1500 VDC	142-145
OPI8013	6 Pin DIP	Photologic	Buffer, Open Collector	1500 VDC	142-145
OPI8014	6 Pin DIP	Photologic	Inverter, Totem-Pole	1500 VDC	142-145
OPI8015	6 Pin DIP	Photologic	Inverter, Open Collector	1500 VDC	142-145
3N243, R	TO-72	Phototransistor	15 @ $V_{CE}=10$ V, $I_F=10$ mA	1000 VDC	146-149
3N244, R	TO-72	Phototransistor	30 @ $V_{CE}=10$ V, $I_F=10$ mA	1000 VDC	146-149
3N245, R	TO-72	Phototransistor	60 @ $V_{CE}=10$ V, $I_F=10$ mA	1000 VDC	146-149
4N22A	TO-5	Phototransistor	25 @ $V_{CE}=5$ V, $I_F=10$ mA	1000 VDC	150-151
4N23A	TO-5	Phototransistor	60 @ $V_{CE}=5$ V, $I_F=10$ mA	1000 VDC	150-151
4N24A	TO-5	Phototransistor	100 @ $V_{CE}=5$ V, $I_F=10$ mA	1000 VDC	150-151
JAN, JANTX, JANTXV 4N22A	TO-5	Phototransistor	25 @ $V_{CE}=5$ V, $I_F=10$ mA	1000 VDC	152-155
JAN, JANTX, JANTXV 4N23A	TO-5	Phototransistor	60 @ $V_{CE}=5$ V, $I_F=10$ mA	1000 VDC	152-155
JAN, JANTX, JANTXV 4N24A	TO-5	Phototransistor	100 @ $V_{CE}=5$ V, $I_F=10$ mA	1000 VDC	152-155
4N25	6 Pin DIP	Phototransistor	20 @ $V_{CE}=10$ V, $I_F=10$ mA	2500 VDC	156-157
4N26	6 Pin DIP	Phototransistor	20 @ $V_{CE}=10$ V, $I_F=10$ mA	1500 VDC	156-157
4N27	6 Pin DIP	Phototransistor	10 @ $V_{CE}=10$ V, $I_F=10$ mA	500 VDC	156-157
4N28	6 Pin DIP	Phototransistor	10 @ $V_{CE}=10$ V, $I_F=10$ mA		156-157
4N29	6 Pin DIP	Photodarlington	100 @ $V_{CE}=10$ V, $I_F=10$ mA	2500 VDC	158-159
4N30	6 Pin DIP	Phototransistor	100 @ $V_{CE}=10$ V, $I_F=10$ mA	1500 VDC	158-159
4N31	6 Pin DIP	Phototransistor	50 @ $V_{CE}=10$ V, $I_F=10$ mA	1500 VDC	158-159
4N32	6 Pin DIP	Photodarlington	500 @ $V_{CE}=5$ V, $I_F=10$ mA	2500 VDC	158-159
4N33	6 Pin DIP	Photodarlington	500 @ $V_{CE}=5$ V, $I_F=10$ mA	1500 VDC	158-159
4N35	6 Pin DIP	Phototransistor	100 @ $V_{CE}=10$ V, $I_F=10$ mA	3500 VDC	160-161
4N36	6 Pin DIP	Phototransistor	100 @ $V_{CE}=10$ V, $I_F=10$ mA	2500 VDC	160-161
4N37	6 Pin DIP	Phototransistor	100 @ $V_{CE}=10$ V, $I_F=10$ mA	1500 VDC	160-161
4N38	6 Pin DIP	Phototransistor	20 @ $V_{CE}=1$ V, $I_F=20$ mA	1500 VDC	162-163
4N38A	6 Pin DIP	Phototransistor	20 @ $V_{CE}=1$ V, $I_F=20$ mA	2500 VDC, 1775 VAC	162-163

TRW OPTRON

EMITTER AND PHOTOSENSOR CHIPS

Part No.	Function	Chip Size - Inches (Millimeters)	Min. Output CT = 2870°	Page No.
OPC116	Infrared Emitter	0.016 (0.406) Square	$P_O = 4$ mW, $I_F = 100$ mA	166
OPC123	Infrared Emitter	0.010 (0.254) × 0.012 (0.305)	$P_O = 2$ mW, $I_F = 50$ mA	167
OPC124	Infrared Emitter	0.016 (0.406) Square	$P_O = 15$ mW, $I_F = 1$ A pulsed	168
OPC300	Photodarlington	0.030 (0.762) Square	$I_L = 0.8$ mA, $V_{CE} = 5$ V, $E_e = 1$ mW/cm^2	169
OPC300M	Photodarlington	0.030 (0.762) Square	$I_L = 0.8$ mA, $V_{CE} = 5$ V, $E_e = 1$ mW/cm^2	170
OPC60X	Phototransistor	0.04 (1.016) Square	$I_L = 0.8$ mA, $V_{CE} = 5$ V, $E_e = 5$ mW/cm^2	171
OPC60Y	Photodiode	0.035 (0.889) Square	$I_L = 10$ μA, $V_R = 5$ V, $E_e = 20$ mW/cm^2	172
OPC600L	Phototransistor	0.025 (0.635) Square	$I_L = 0.8$ mA, $V_{CE} = 5$ V, $E_e = 20$ mW/cm^2	173
OPC8012	Photologic	0.072 (1.83) × 0.047 (1.19)	Buffer, Totem-Pole	174-175
OPC8013	Photologic	0.072 (1.83) × 0.047 (1.19)	Buffer, Open Collector	174-175
OPC8014	Photologic	0.072 (1.83) × 0.047 (1.19)	Inverter, Totem-Pole	174-175
OPC8015	Photologic	0.072 (1.83) × 0.047 (1.19)	Inverter, Open Collector	174-175
OPC903	Photodiode	0.120 (3.05) Square	$I_L = 40$ μA, $V_R = 5$ V, $E_e = 1$ mW/cm^2, $\lambda = 935$ nm	176
OPC913	Pin Photodiode	0.120 (3.05) Square	$I_L = 40$ μA, $V_R = 5$ V, $E_e = 1$ mW/cm^2, $\lambda = 935$ nm	177

LED AND PHOTOSENSOR ARRAYS

Part No.	Function	No. of Channels	Distance Between Channels Inches (Millimeters)	Page No.
OPA508	Phototransistor	9	0.10 (2.54)	180-181
OPB508	LED-Phototransistor	9	0.10 (2.54)	182-183
OPA512A	Phototransistor	12	0.25 (6.35)	184-185
OPB512A	LED-Phototransistor	12	0.25 (6.35)	186-187

REFLECTIVE ASSEMBLIES

Part No.	Function	Hermetic/Plastic	Focused/Unfocused	Min. $I_{C(ON)}$ (2)	Page No.
OPB125A	Photodarlington	Hermetic	Focused	2 mA, $V_{CE} = 5$ V, $I_F = 40$ mA, d = 0.20 in. (5.08 mm)	190-191
OPB253A	Phototransistor	Hermetic	Focused	25μA, $V_{CE} = 5$ V, $I_F = 40$ mA, d = 0.20 in. (5.08mm)	192-193
OPB703A	Phototransistor	Plastic	Focused	200μA, $V_{CE} = 5$ V, $I_F = 40$ mA, d = 0.20 in. (5.08mm)	194-195
OPB706A	Phototransistor	Plastic	Unfocused	500μA, $V_{CE} = 5$ V, $I_F = 20$ mA, d = 0.05 in. (1.27mm)	196-199
OPB706B	Phototransistor	Plastic	Unfocused	350μA, $V_{CE} = 5$ V, $I_F = 20$ mA, d = 0.05 in. (1.27mm)	196-199
OPB706C	Phototransistor	Plastic	Unfocused	200μA, $V_{CE} = 5$ V, $I_F = 20$ mA, d = 0.05 in. (1.27mm)	196-199
OPB707A	Photodarlington	Plastic	Unfocused	25 mA, $V_{CE} = 5$ V, $I_F = 20$ mA, d = 0.05 in. (1.27mm)	196-199
OPB707B	Photodarlington	Plastic	Unfocused	17 mA, $V_{CE} = 5$ V, $I_F = 20$ mA, d = 0.05 in. (1.27mm)	196-199
OPB707C	Photodarlington	Plastic	Unfocused	10 mA, $V_{CE} = 5$ V, $I_F = 20$ mA, d = 0.05 in. (1.27mm)	196-199
OPB708	Phototransistor	Plastic	Focused	10 μA, $V_{CE} = 5$ V, $I_F = 40$ mA, d = 0.15 in. (3.81mm)	200-203
OPB709	Photodarlington	Plastic	Focused	1 mA, $V_{CE} = 5$ V, $I_F = 40$ mA, d = 0.15 in. (3.81mm)	200-203
OPB710	Phototransistor	Plastic	Unfocused	150μA, $V_{CE} = 5$ V, $I_F = 50$ mA, d = 0.25 in. (6.35mm)	204-207
OPB730	Photodarlington	Plastic	Unfocused	1 mA, $V_{CE} = 5$ V, $I_F = 50$ mA, d = 0.25 in. (6.35 mm)	204-207
OPB711	Phototransistor	Plastic	Focused	350μA, $V_{CE} = 5$ V, $I_F = 50$ mA, d = 0.08 in. (2.03mm)	208-211
OPB712	Photodarlington	Plastic	Focused	20mA, $V_{CE} = 5$ V, $I_F = 20$ mA, d = 0.08 in. (2.03mm)	208-211

Note 1: Measured using an Eastman Kodak neutral white paper with 90% diffuse reflectance at a distance "d" from the assembly head.

SLOTTED OPTICAL SWITCHES

Part No.	Function	Slot Width Inches (Millimeters)	Sensor Aperture Inches (Millimeters)	Min. $I_{C(ON)}$	Page No.
CNY36	Phototransistor	0.120 (3.05)		200μA, $V_{CE} = 10$ V, $I_F = 20$ mA	214-215
OPB804	Phototransistor	0.155 (3.94)		500μA, $V_{CE} = 10$ V, $I_F = 20$ mA	216-217
OPB806	Phototransistor	0.125 (3.18)		400μA, $V_{CE} = 0.5$ V, $I_F = 15$ mA	218-219
OPB813	Phototransistor	0.125 (3.18)		500μA, $V_{CE} = 10$ V, $I_F = 20$ mA	220-221
OPB814	Phototransistor	0.125 (3.18)		1mA, $V_{CE} = 5$ V, $I_F = 10$ mA	220-221
OPB815	Phototransistor	0.125 (3.18)		1.8mA, $V_{CE} = 0.6$ V, $I_F = 20$ mA	220-221
OPB813S10	Phototransistor	0.125 (3.18)	0.01 (0.254) × 0.04 (1.02)	500μA, $V_{CE} = 10$ V, $I_F = 20$ mA	222-223
OPB813S7	Phototransistor	0.125 (3.18)	0.007 (0.178) × 0.04 (1.02)	350μA, $V_{CE} = 10$ V, $I_F = 20$ mA	222-223
OPB813S5	Phototransistor	0.125 (3.18)	0.005 (0.127) × 0.04 (1.02)	250μA, $V_{CE} = 10$ V, $I_F = 20$ mA	222-223
OPB813S3	Phototransistor	0.125 (3.18)	0.003 (0.076) × 0.04 (1.02)	75 μA, $V_{CE} = 10$ V, $I_F = 20$ mA	222-223
OPB816	Phototransistor	0.125 (3.18)		500μA, $V_{CE} = 10$ V, $I_F = 20$ mA	224-225
OPB817	Phototransistor	0.125 (3.18)		1 mA, $V_{CE} = 5$ V, $I_F = 10$ mA	224-225
OPB818	Phototransistor	0.200 (5.08)		100μA, $V_{CE} = 5$ V, $I_F = 20$ mA	226-227
OPB819S20	Phototransistor	0.125 (3.18)	0.01 (0.254) × 0.06 (1.52)	200μA, $V_{CE} = 10$ V, $I_F = 20$ mA	228-229
OPB820	Phototransistor	0.08 (2.03)		500μA, $V_{CE} = 5$ V, $I_F = 20$ mA	230-231
OPB820S12	Phototransistor	0.08 (2.03)	0.012 (0.305) × 0.04 (1.02)	400μA, $V_{CE} = 5$ V, $I_F = 20$ mA	230-231
OPB820S7	Phototransistor	0.08 (2.03)	0.007 (0.178) × 0.04 (1.02)	300μA, $V_{CE} = 5$ V, $I_F = 20$ mA	230-231
OPB820S5	Phototransistor	0.08 (2.03)	0.005 (0.127) × 0.04 (1.02)	170μA, $V_{CE} = 5$ V, $I_F = 20$ mA	230-231
OPB821	Phototransistor	0.08 (2.03)		500μA, $V_{CE} = 5$ V, $I_F = 20$ mA	232-233
OPB821S12	Phototransistor	0.08 (2.03)	0.012 (0.254) × 0.04 (1.02)	400μA, $V_{CE} = 5$ V, $I_F = 20$ mA	232-233
OPB821S7	Phototransistor	0.08 (2.03)	0.007 (0.178) × 0.04 (1.02)	300μA, $V_{CE} = 5$ V, $I_F = 20$ mA	232-233
OPB821S5	Phototransistor	0.08 (2.03)	0.005 (0.127) × 0.04 (1.02)	170μA, $V_{CE} = 5$ V, $I_F = 20$ mA	232-233
OPB822S	Phototransistor	0.10 (2.54)	2)0.01 (0.254) × 0.08 (2.03)	250μA, $V_{CE} = 10$ V, $I_F = 20$ mA	234-235
OPB822SD	Phototransistor	0.10 (2.54)	2E 2S) 0.01 (0.254) × 0.08 (2.03)	100μA, $V_{CE} = 10$ V, $I_F = 20$ mA	234-235
OPB823A	Phototransistor	0.125 (3.18)		200μA, $V_{CE} = 10$ V, $I_F = 20$ mA	236-237
OPB824A	Phototransistor	0.125 (3.18)		500μA, $V_{CE} = 10$ V, $I_F = 20$ mA	236-237
OPB825,-A,-B.	Phototransistor	0.160 (4.06)		500μA, $V_{CE} = 0.5$ V, $I_F = 20$ mA	238-239

SLOTTED OPTICAL SWITCHES (continued)

Part No.	Function	Slot Width Inches (Millimeters)	Sensor Aperture Inches (Millimeters)	Min. $I_{C(ON)}$	Page No.
OPB826S	Phototransistor	0.10 (2.54)	2) 0.01 (0.254) × 0.04 (1.02)	250μA, V_{CE} = 10 V, I_F = 20 mA	240-241
OPB826SD	Phototransistor	0.10 (2.54)	2E 2S) 0.01 (0.254) × 0.04 (1.02	100μA, V_{CE} = 10 V, I_F = 20 mA	240-241
OPB831S20	Phototransistor	0.20 (5.08)	2) 0.02 (0.508) × 0.06 (1.52)	400μA, V_{CE} = 5 V, I_F = 25 mA	242-243
OPB835	Phototransistor	0.15 (3.81)		1.5 mA, V_{CE} = 0.4 V, I_F = 25 mA	244-245
OPB836	Phototransistor	0.20 (5.08)		1 mA, V_{CE} = 5 V, I_F = 20 mA	246-247
OPB840	Digital Output	0.05 (1.27)	13 Channel	V_{CC} = 5.25 V, I_{CC} = 450 mA	248-249
OPB841	Digital Output	0.05 (1.27)	12 Channel	V_{CC} = 5.25 V, I_{CC} = 410 mA	248-249
OPB842	Digital Output	0.05 (1.27)	12 Channel	V_{CC} = 5.25 V, I_{CC} = 410 mA	248-249
OPB847	Digital Output	0.10 (2.54)		4 mA, V_{CE} = 5 V, I_F = 20 mA	250-251
OPB848	Digital Output	0.10 (2.54)		1 mA, V_{CE} = 5 V, I_F = 20 mA	250-251
OPB860/870	Phototransistor	0.125 (3.18)	E S) 0.05 (1.27) × 0.06 (1.52)	500μA, V_{CE} = 10 V, I_F = 20 mA	252-255
OPB861/871	Phototransistor	0.125 (3.18)	E S) 0.05 (1.27) × 0.06 (1.52)	1 mA, V_{CE} = 5 V, I_F = 10 mA	252-255
OPB862/872	Phototransistor	0.125 (3.18)	E S) 0.05 (1.27) × 0.06 (1.52)	1.8 mA, V_{CE} = 0.6 V, I_F = 20 mA	252-255
OPB913S10	Photologic	0.125 (3.18)	0.01 (0.254) × 0.04 (1.02)	Buffer, Totem-Pole	256-259
OPB914S10	Photologic	0.125 (3.18)	0.01 (0.254) × 0.04 (1.02)	Buffer, Open Collector	256-259
OPB915S10	Photologic	0.125 (3.18)	0.01 (0.254) × 0.04 (1.02)	Inverter, Totem-Pole	256-259
OPB916S10	Photologic	0.125 (3.18)	0.01 (0.254) × 0.04 (1.02)	Inverter, Open Collector	256-259
OPB947	Photologic	0.10 (2.54)		Buffer, Totem-Pole	260-263
OPB948	Photologic	0.10 (2.54)		Buffer, Open Collector	260-263
OPB960	Photologic	0.125 (3.18)	E S) 0.05 (1.27) × 0.06 (1.52)	Buffer, Totem-Pole	264-268
OPB961/970	Photologic	0.125 (3.18)	E S) 0.05 (1.27) × 0.06 (1.52)	Buffer, Open Collector	264-268
OPB962/972	Photologic	0.125 (3.18)	E S) 0.05 (1.27) × 0.06 (1.52)	Inverter, Totem-Pole	264-268
OPB963/973	Photologic	0.125 (3.18)	E S) 0.05 (1.27) × 0.06 (1.52)	Inverter, Open Collector	264-268

LED AND PHOTOSENSOR MATCHED PAIRS

Part No.	Function	Package Style	Min. $I_{C(ON)}$	Page No.
OPS660	Phototransistor	T-1, Lensed, 50 Mil Lead Spacing	500μA, (1) V_{CE} = 5 V, I_F = 20 mA	270-271
OPS690	Transistor	Plastic, Side Looking	100 μA, (2) V_{CE} = 10 V, I_F = 20 mA	272-273
OPS691	Phototransistor	Plastic, Side Looking	500 μA, (2) V_{CE} = 10 V, I_F = 20 mA	272-273
OPS692	Phototransistor	Plastic, Side Looking	1 μA, (2) V_{CE} = 10 V, I_F = 20 mA	272-273
OPS693	Phototransistor	Plastic, Side Looking	2 μA, (2) V_{CE} = 10 V, I_F = 20 mA	272-273

Note 1: Distance from lens tip to lens tip is 0.25 inches (6.35mm)
Note 2: Distance from lens tip to lens tip is 0.125 inches (3.18mm)

FIBER OPTIC DATA LINKS

Part No.	Function	Package Style	Distance Between Transceivers, CM.	Min. I_L	Page No.
OPB950-100	Photodiode	Black Plastic Housing	100	400 nA, V_R = I_F = 50 mA	276-277
OPB950-300	Photodiode	Black Plastic Housing	300	200 nA, V_R = I_F = 50 mA	276-277
OPB950-700	Photodiode	Black Plastic Housing	700	100 nA, V_R = I_F = 50 mA	276-277
OPB950-1000	Photodiode	Black Plastic Housing	1000	50 nA, V_R = I_F = 50 mA	276-277

Complex Photologic Devices

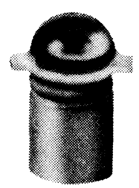
AUTOMATIC BRIGHTNESS CONTROLLER

Part No.	Function	Package Style	Max. V_{CC}, I_{CC}	Source/Sink Current	Page No.
OPL100C	Linear and Digital	8 Pin DIP	24 V, 18.8 mA	−50/20 mA	280-281
OPL100I	Linear and Digital	8 Pin DIP	24 V, 12.5 mA	−50/20 mA	280-281

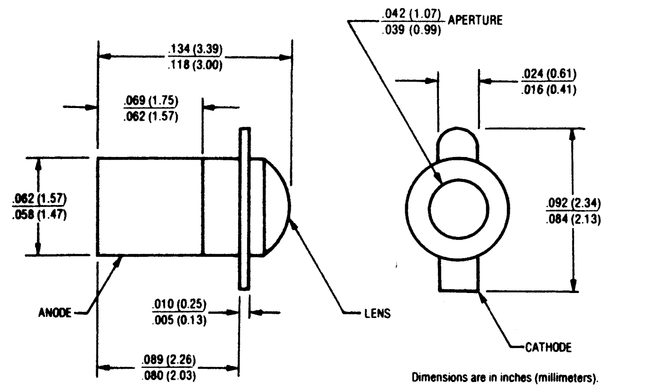
Infrared Emitting Diodes

GaAs Hermetic Infrared Emitting Diodes

Types OP123, OP124



FIVE TIMES ACTUAL SIZE



Dimensions are in inches (millimeters).

Features

- MINIATURE HERMETICALLY SEALED "PILL" PACKAGE
- IDEAL FOR DIRECT MOUNTING TO PC BOARDS(1)
- HIGH POWER OUTPUT
- MECHANICALLY AND SPECTRALLY MATCHED TO THE OP600 PHOTOTRANSISTOR AND THE OP300 PHOTODARLINGTON

Description

The OP123 and OP124 series are high intensity gallium arsenide infrared emitting diodes mounted in miniature "pill" type hermetically sealed packages. This package style is intended for direct mounting into PC boards.

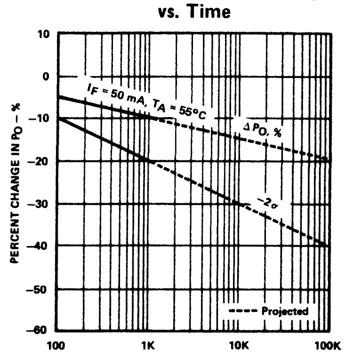
All electrical parameters are 100% tested by manufacturing. Specifications are guaranteed to a .65% AQL.

absolute maximum ratings (25°C unless otherwise noted)

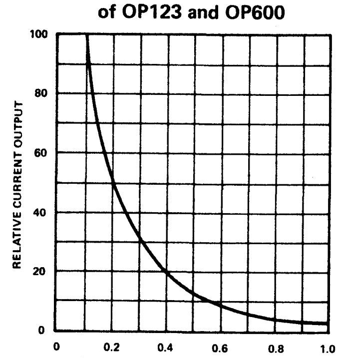
Reverse Voltage . . . . 2 V
Continuous Forward Current . . . . 100 mA
Storage Temperature Range . . . . −65°C to +150°C
Operating Temperature Range . . . . −65°C to +125°C
Soldering Temperature (for 3 sec. w/soldering iron(2)) . . . . 240°C
Power Dissipation . . . . 150 mW(3)

Notes: (1) Refer to Application Bulletin 111 which discusses proper techniques for soldering pill-type devices into PC boards.
(2) RMA flux is recommended. Duration can be extended to 10 seconds max. when flow soldering.
(3) Derate linearly 1.0 mW/°C above 25°C.

Percent Changes in Power Output vs. Time



Coupling Characteristics of OP123 and OP600



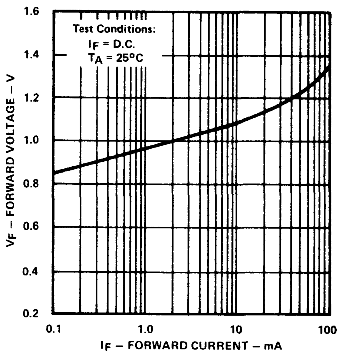
Types OP123, OP124

electrical characteristics (25°C unless otherwise noted)

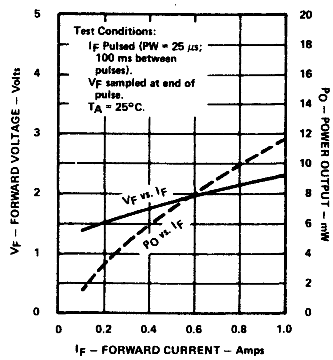
SYMBOL	PARAMETER		MIN	TYP	MAX	UNITS	TEST CONDITIONS
P_O	Radiant Power Output	OP123 OP124	0.4 1.0			mW	I_F = 50 mA
V_F	Forward Voltage				1.5	V	I_F = 50 mA
I_R	Reverse Current				100	μA	V_R = 2 V
λp	Wavelength at Peak Emission			935		nm	I_F = 50 mA
B	Spectral Bandwidth Between Half Power Points			50		nm	I_F = 50 mA
$\Delta\lambda p/\Delta T$	Spectral Shift with Temperature			+0.2		nm/°C	I_F = Constant
θ_{HP}	Emission Angle at Half Power Points			35		Deg.	I_F = 50 mA
t_r	Output Rise Time			1200		ns	$I_{F(PK)}$ = 50 mA, PW = 10 μs, D.C. = 10%
t_f	Output Fall Time			550		ns	

Typical Performance Curves

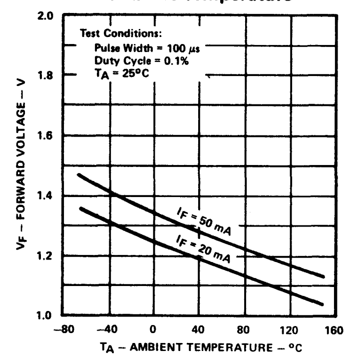
Forward Voltage vs. Forward Current



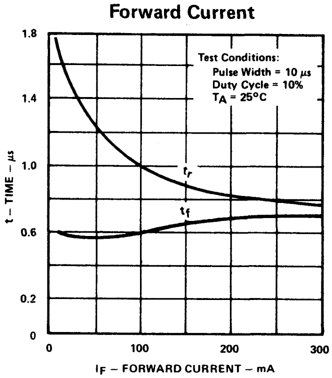
Forward Voltage and Power Output vs. Forward Current



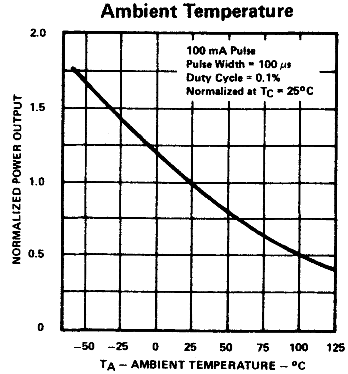
Forward Voltage vs. Ambient Temperature



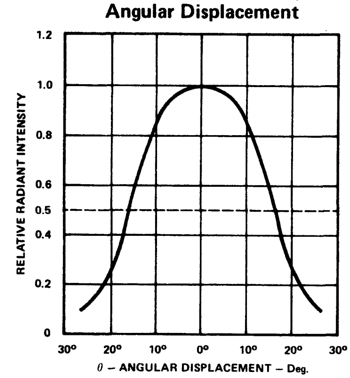
Rise Time and Fall Time vs. Forward Current



Normalized Power Output vs. Ambient Temperature



Relative Radiant Intensity vs. Angular Displacement



TRW Optron reserves the right to make changes at any time in order to improve design and to supply the best product possible.

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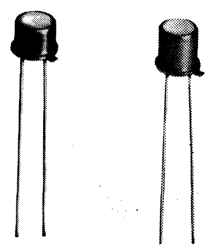
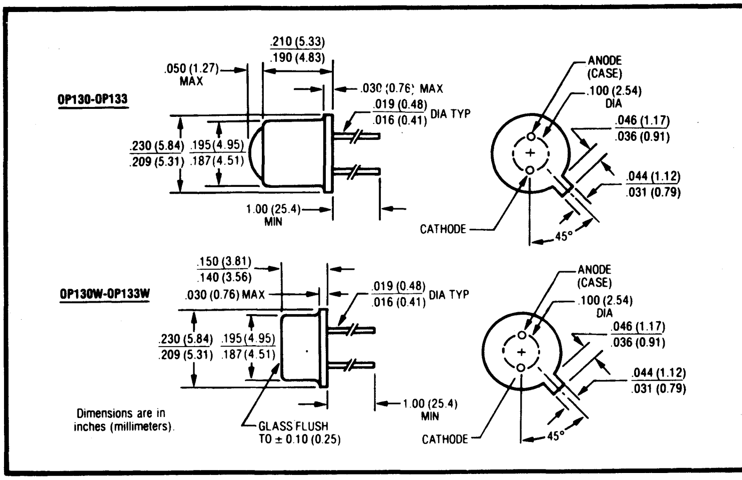
Printed in U.S.A.

GaAs Hermetic Infrared Emitting Diodes

Types OP130-OP133, OP130W-OP133W



ACTUAL SIZE



Features

- TO-46 HERMETICALLY SEALED PACKAGES
- AVAILABLE IN SEVERAL P_O RANGES
- MECHANICALLY AND SPECTRALLY MATCHED TO OP800 AND OP800W PHOTOTRANSISTORS OR OP830 AND OP830W PHOTODARLINGTONS

Description

The OP130 through OP133 and OP130W through OP133W are high intensity gallium arsenide infrared emitting diodes mounted in hermetic TO-46 housings. The OP130 series have lensed cans providing a relatively narrow beam angle. The OP130W series have flat window cans providing a relatively wide beam angle.

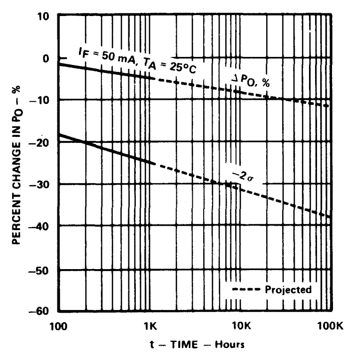
All electrical parameters are 100% tested by manufacturing. Specifications are guaranteed to a .65% AQL.

absolute maximum ratings (25° C unless otherwise noted)

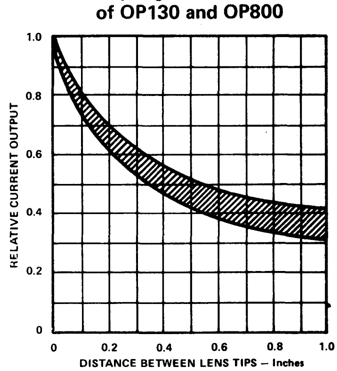
Reverse Voltage . . . . 2 V
Continuous Forward Current . . . . 100 mA
Peak Forward Current (Pulse Width = 2 μsec., 0.1% Duty Ccyle . . . . 10 A
Storage and Operating Temperature Range . . . . –65°C to +150°C
Lead Soldering Temperature (1/16 Inch [1.6 mm] from Case for
5 sec. with soldering iron(1)) . . . . 240°C
Power Dissipation . . . . 200 mW(2)

Notes: (1) RMA flux is recommended. Duration can be extended to 10 seconds max. when flow soldering.
(2) Derate linearly 1.6 mW/°C above 25°C.

Percent Changes in Power Output vs. Time



Coupling Characteristics of OP130 and OP800



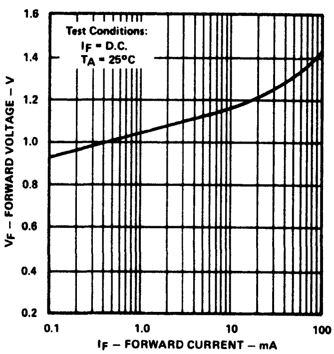
Types OP130-OP133, OP130W-OP133W

electrical characteristics (25° C unless otherwise noted)

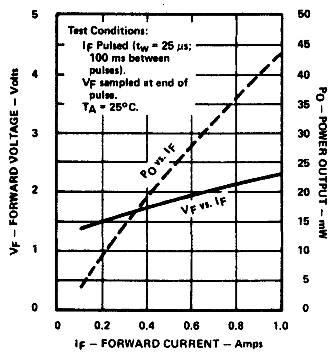
SYMBOL	PARAMETER	MIN	TYP	MAX	UNITS	TEST CONDITIONS
P_O	Radiant Power Output OP130, OP130W	1.0	2.0		mW	I_F = 100 mA
	OP131, OP131W	3.0	3.5		mW	I_F = 100 mA
	OP132, OP132W	4.0	4.5		mW	I_F = 100 mA
	OP133, OP133W	5.0	6.0		mW	I_F = 100 mA
V_F	Forward Voltage		1.5	1.75	V	I_F = 100 mA
I_R	Reverse Current			100	μA	V_R = 2 V
λp	Wavelength at Peak Emission		935		nm	I_F = 100 mA
B	Spectral Bandwidth Between Half Power Points		50		nm	I_F = 100 mA
$\Delta\lambda_p/\Delta T$	Spectral Shift with Temperature		+0.2		nm/°C	I_F = Constant
θ_{HP}	Emission Angle at Half Power Points					
	OP130–OP133		18		Deg.	I_F = 100 mA
	OP130W–OP133W		50		Deg.	I_F = 100 mA
t_r	Output Rise Time		1000		ns	$I_{F(PK)}$ = 100 mA, PW = 10 μs D.C. = 10%
t_f	Output Fall Time		600		ns	

Typical Performance Curves

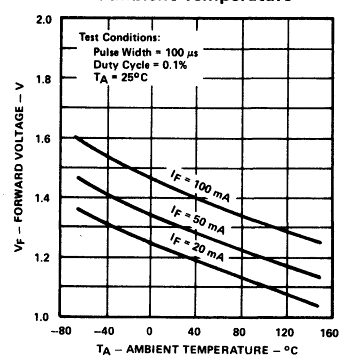
Forward Voltage vs. Forward Current



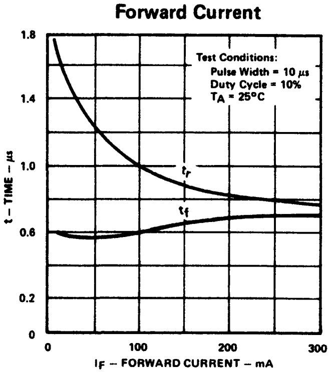
Forward Voltage and Power Output vs. Forward Current



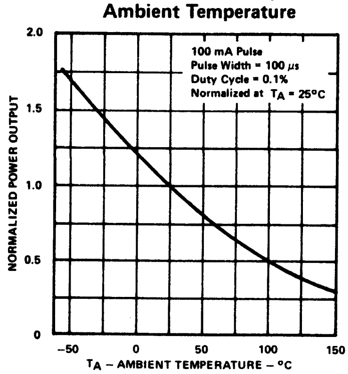
Forward Voltage vs. Ambient Temperature



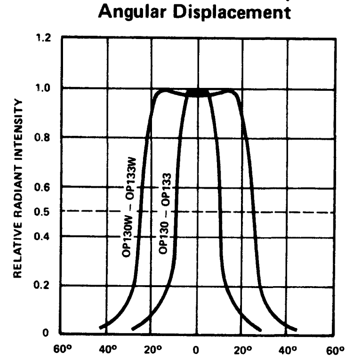
Rise Time and Fall Time vs. Forward Current



Normalized Power Output vs. Ambient Temperature



Relative Radiant Intensity vs. Angular Displacement



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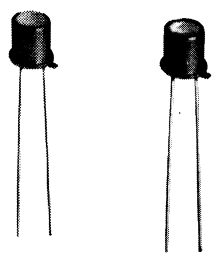
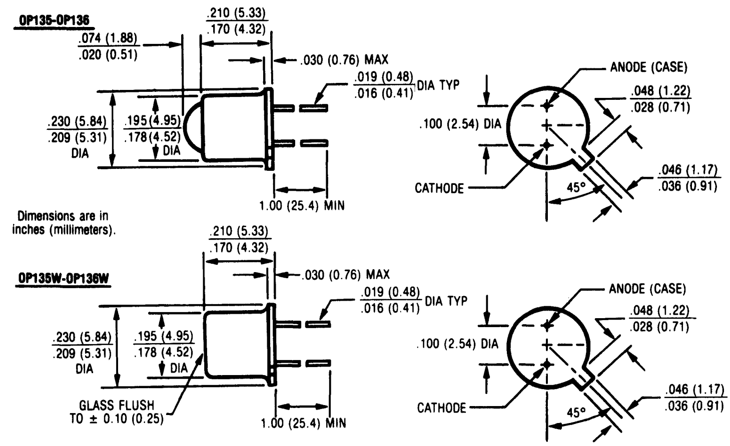
Printed in U.S.A.

GaAs Hermetic Infrared Emitting Diodes

Types OP135, OP136, OP135W, OP136W



OP135 OP135W
OP136 OP136W
ACTUAL SIZE



Features

- VERY LOW DEGRADATION
- DESIGNED FOR PULSE OPERATION
- MECHANICALLY AND SPECTRALLY MATCHED TO THE OP800 PHOTOTRANSISTOR SERIES AND THE OP830 PHOTODARLINGTON
- U. L. RECOGNIZED, FILE NO. S2047

Description

The OP135, OP136, OP135W, and OP136W are gallium arsenide infrared emitting diodes each containing a 256 square mil chip designed for high average current levels especially in pulse applications. The OP135 and OP136 feature a lensed can for narrow radiation angle and the OP135W and OP136W feature a flat window can for wide radiation angle.

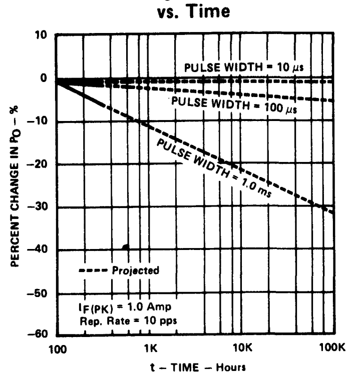
All electrical parameters are 100% tested by manufacturing. Specifications are guaranteed to a .65% AQL.

absolute maximum ratings (25° C unless otherwise noted)

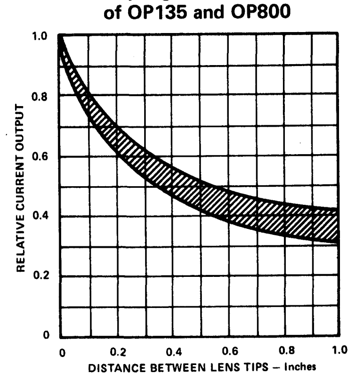
Continuous Forward Current	100 mA
Peak Forward Current (50 μs pulse, D.C. = 0.1%)	5 A
Reverse Voltage	2 V
Storage and Operating Temperature Range	−55°C to +150°C
Lead Soldering Temperature (1/16 Inch [1.6 mm] from Case for 5 sec. with soldering iron(1))	240°C
Power Dissipation	200 mW(2)

Notes: (1) RMA flux is recommended. Duration can be extended to 10 seconds max. when flow soldering.
(2) Derate linearly 1.6 mW/°C above 25°C.
(3) Measurement taken on leading edge of light pulse.

Percent Changes in Power Output vs. Time



Coupling Characteristics of OP135 and OP800



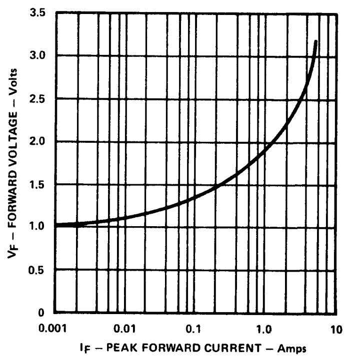
Types OP135, OP136, OP135W, OP136W

electrical characteristics (25° C unless otherwise noted)

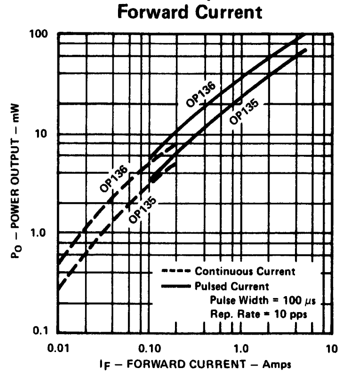
SYMBOL	PARAMETER		MIN	TYP	MAX	UNITS	TEST CONDITIONS
P_O	Radiant Power Output (Pulsed)	OP135, OP135W OP136, OP136W	15 27			mW mW	$I_{F(PK)}$ = 1.0 A, PW = 100 μs, D.C. = 0.1%(3)
P_O	Radiant Power Output (D.C.)	OP135, OP135W OP136, OP136W		3 5		mW mW	I_F = 100 mA, D.C.
V_F	Forward Voltage				2.5	V	$I_{F(PK)}$ = 1.0 A, PW = 100 μs, D.C. = 0.1%
I_R	Reverse Leakage Current				100	μA	V_R = 2.0 V
λp	Wavelength at Peak Emission			940		nm	$I_{F(PK)}$ = 1.0 A, PW = 100 μs, D.C. = 0.1%
B	Spectral Bandwidth Between Half Power Points			60		nm	$I_{F(PK)}$ = 1.0 A, PW = 100 μs, D.C. = 0.1%
Δλp/ΔT	Spectral Shift with Temperature			+0.2		nm/°C	I_F = Constant
θ_{HP}	Emission Angle at Half Power Points	OP135, OP136 OP135W, OP136W		18 64		Deg. Deg.	$I_{F(PK)}$ = 1.0 A, PW = 100 μs, D.C. = 0.1%
t_r	Output Rise Time			400		ns	$I_{F(PK)}$ = 1.0 A, PW = 2.0 μs, D.C. = 0.1%
t_f	Output Fall Time			350		ns	

Typical Performance Curves

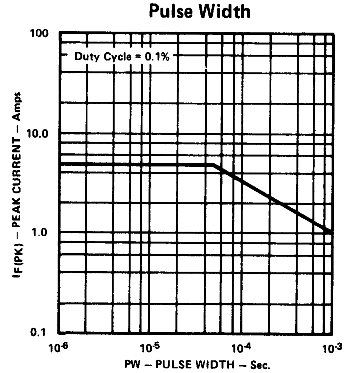
Forward Voltage vs. Peak Forward Current



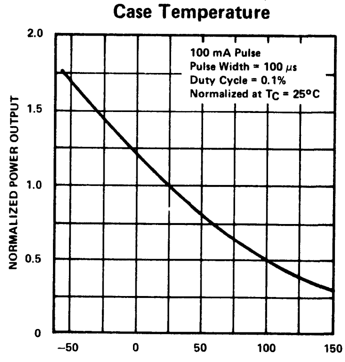
Power Output vs. Forward Current



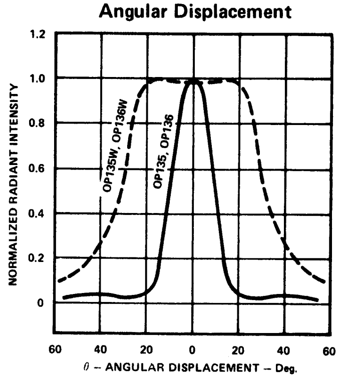
Peak Current vs. Pulse Width



Normalized Power Output vs. Case Temperature



Normalized Radiant Intensity vs. Angular Displacement



TRW Optron reserves the right to make changes at any time in order to improve design and to supply the best product possible.

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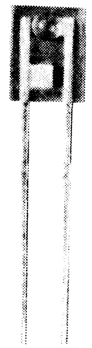
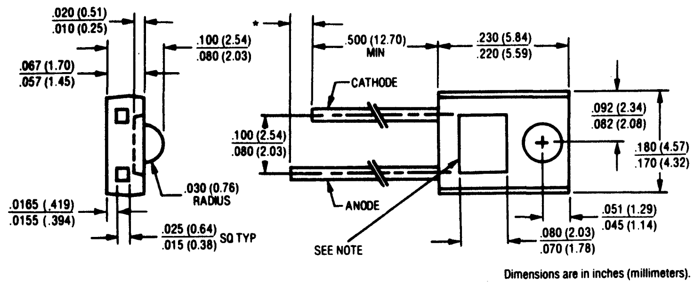
Printed in U.S.A.

GaAs Plastic Infrared Emitting Diodes

Types OP140, OP140SL-OP140SLD



TWICE ACTUAL SIZE



NOTE: This is a mold mark and is being phased out in new production.

* For identification purposes, anode lead is .06 (1.52) nom. longer than cathode lead.

Features

- SELECTED TO SPECIFIC ON-LINE INTENSITY AND RADIANT INTENSITY RANGES
- LOW COST, MINIATURE PLASTIC SIDE LOOKING PACKAGE
- MECHANICALLY AND SPECTRALLY MATCHED TO THE OP550–OP550SL SERIES OF PHOTOTRANSISTORS AND THE OP560 PHOTODARLINGTON

Description

The OP140 and OP140SL series are high intensity gallium arsenide infrared emitting diodes mounted in clear plastic side looking packages. The OP140 SL series provides a broad range of intensity selection.

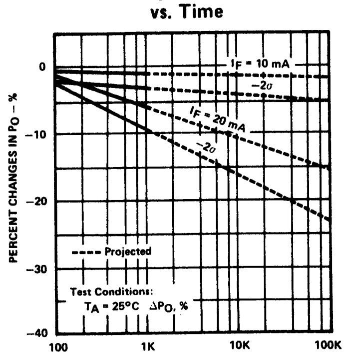
All electrical parameters are 100% tested by manufacturing. The specifications are guaranteed to a cumulative .65% AQL except for the OP140SL series $E_{e(APT)}$ and I_e limits which are guaranteed to a 2.5% AQL.

absolute maximum ratings (25° C unless otherwise noted)

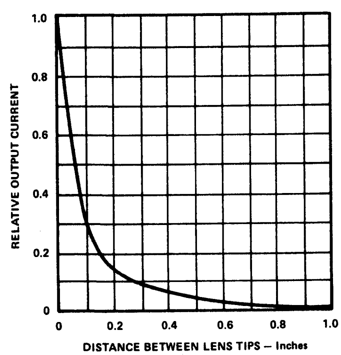
Reverse Voltage	2 V
Continuous Forward Current	50 mA
Peak Forward Current (Pulse Width = 1 µsec., 300 pps)	3 A
Storage and Operating Temperature Range	−40°C to +100°C
Lead Soldering Temperature (1/16 inch [1.6 mm] from Case for 5 sec. with soldering iron[1])	240°C
Power Dissipation	100 mW[2]

Notes: (1) RMA flux is recommended. Duration can be extended to 10 seconds max. when flow soldering.
(2) Derate linearly 1.33 mW/°C above 25°C.
(3) $E_{e(APT)}$ is a measurement of the average apertured radiant incidance upon a sensing area 0.081 inches (2.06 mm) in diameter perpendicular to and centered on the mechanical axis of the lens, and 0.400 inches (10.16 mm) from the lens tip. I_e is a measurement of the average radiant intensity within the cone formed by the above conditions. $E_{e(APT)}$ and I_e are not necessarily uniform within the measured area.

Percent Changes in Power Output vs. Time



Coupling Characteristics of OP140 and OP550



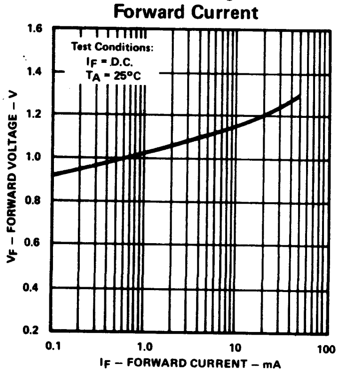
Types OP140, OP140SL-OP140SLD

electrical characteristics (25° C unless otherwise noted)

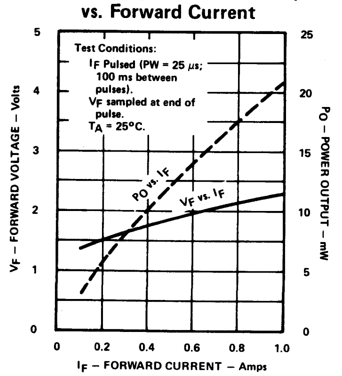
SYMBOL	PARAMETER		MIN	TYP	MAX	UNITS	TEST CONDITIONS
P_O	Radiant Power Output	OP140	0.5			mW	I_F = 40 mA
$E_{e(APT)}$ (3)	Apertured Radiant Incidance	OP140SL	0.02			mW/cm²	I_F = 20 mA
		OP140SLD	0.10		0.30	mW/cm²	I_F = 20 mA
		OP140SLC	0.20		0.40	mW/cm²	I_F = 20 mA
		OP140SLB	0.30		0.55	mW/cm²	I_F = 20 mA
		OP140SLA	0.40			mW/cm²	I_F = 20 mA
I_e (3)	Radiant Intensity	OP140SL	0.05			mW/sr	I_F = 20 mA
		OP140SLD	0.28		0.83	mW/sr	I_F = 20 mA
		OP140SLC	0.55		1.11	mW/sr	I_F = 20 mA
		OP140SLB	0.83		1.53	mW/sr	I_F = 20 mA
		OP140SLA	1.11			mW/sr	I_F = 20 mA
V_F	Forward Voltage				1.6	V	I_F = 20 mA
I_R	Reverse Current				100	μA	V_R = 2 V
λp	Wavelength at Peak Emission			935		nm	I_F = 20 mA
B	Spectral Bandwidth Between Half Power Points			50		nm	I_F = 20 mA
Δλp/ΔT	Spectral Shift with Temperature			+0.2		nm/°C	I_F = Constant
θ_{HP}	Emission Angle at Half Power Points			40		Deg.	I_F = 20 mA
t_r	Output Rise Time			1550		ns	$I_{F(PK)}$ = 20 mA, PW = 10 μs DC = 10 %
t_f	Output Fall Time			550		ns	

Typical Performance Curves

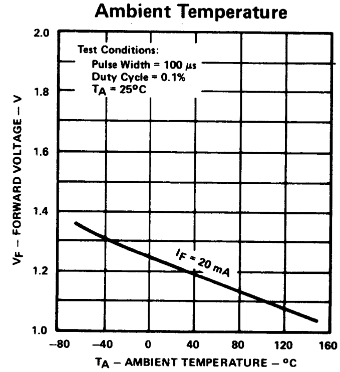
Forward Voltage vs. Forward Current



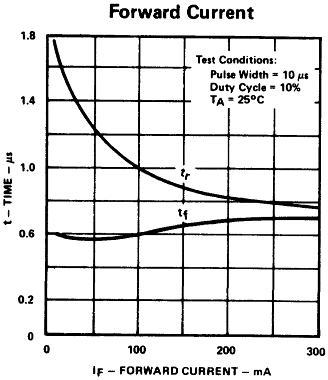
Forward Voltage and Power Output vs. Forward Current



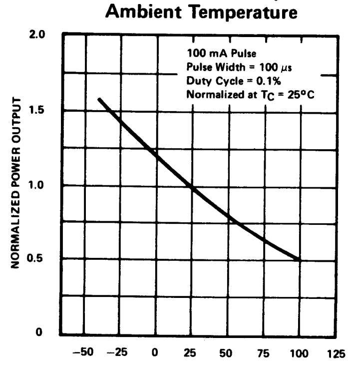
Forward Voltage vs. Ambient Temperature



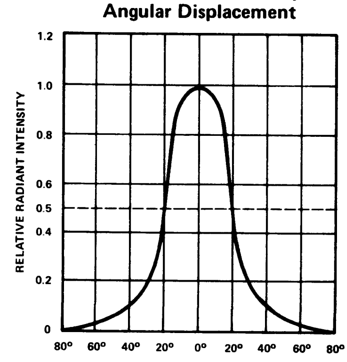
Rise Time and Fall Time vs. Forward Current



Normalized Power Output vs. Ambient Temperature



Relative Radiant Intensity vs. Angular Displacement



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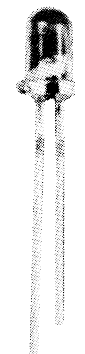
Printed in U.S.A.

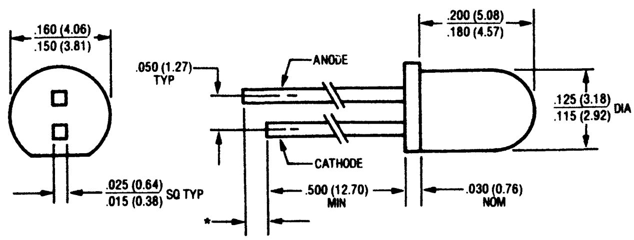
GaAs Plastic Infrared Emitting Diodes

Types OP160, OP160SL-OP160SLD



TWICE ACTUAL SIZE

Dimensions are in inches (millimeters).



* For identification purposes, anode lead is .06 (1.52) nom. longer than cathode lead.

Features

- SELECTED TO SPECIFIC ON-LINE INTENSITY AND RADIANT INTENSITY RANGES
- LOW COST, MINIATURE, PLASTIC END-LOOKING PACKAGE
- MECHANICALLY AND SPECTRALLY MATCHED TO THE OP500–OP500SL SERIES PHOTOTRANSISTORS AND THE OP530 PHOTODARLINGTON

Description

The OP160 and OP160SL series are gallium arsenide infrared emitting diodes mounted in clear plastic end-looking packages. The OP160SL series allows a broad range of intensity selection.

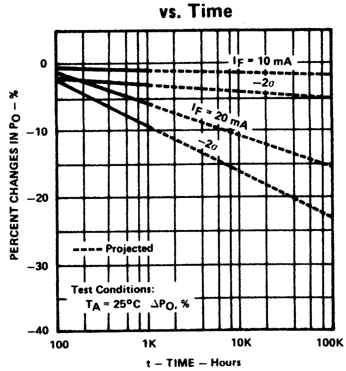
All electrical parameters are 100% tested by manufacturing. The specifications are guaranteed to a cumulative .65% AQL except for the OP160SLA through OP160SLD series $E_{e(APT)}$ and I_e limits which are guaranteed to a 2.5 AQL.

absolute maximum ratings (25° C unless otherwise noted)

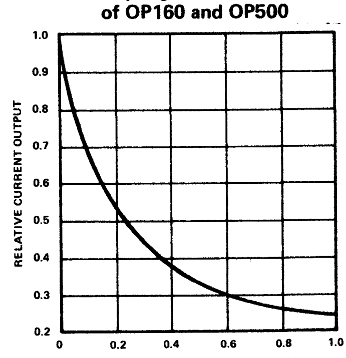
Reverse Voltage . . . . 2 V
Continuous Forward Current . . . . 50 mA
Peak Forward Current (Pulse Width = 1 μsec., 300 pps) . . . . 3 A
Storage and Operating Temperature Range . . . . −40°C to +100°C
Lead Soldering Temperature (1/16 Inch [1.6 mm] from Case for 5 sec. with soldering iron(1)) . . . . 240°C
Power Dissipation . . . . 100 mW(2)

Notes: (1) RMA flux is recommended. Duration can be extended to 10 seconds max. when flow soldering.
(2) Derate linearly 1.33 mW/°C above 25°C.
(3) $E_{e(APT)}$ is a measurement of the average apertured radiant incidance upon a sensing area 0.180 inches (4.57 mm) in diameter perpendicular to and centered on the mechanical axis of the lens, and 0.653 inches (16.59 mm) from the lens tip. I_e is a measurement of the average radiant intensity within the cone formed by the above conditions. $E_{e(APT)}$ and I_e are not necessarily uniform within the measured area.

Percent Changes in Power Output vs. Time



Coupling Characteristics of OP160 and OP500



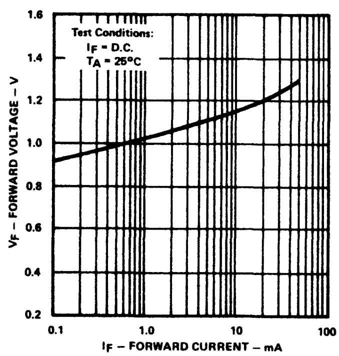
Types OP160, OP160SL-OP160SLD

electrical characteristics (25° C unless otherwise noted)

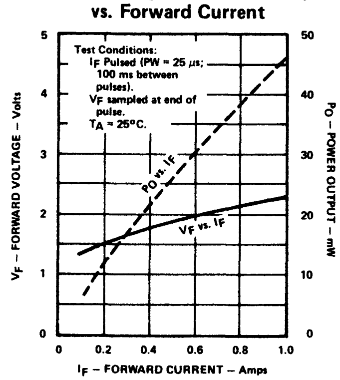
SYMBOL	PARAMETER		MIN	TYP	MAX	UNITS	TEST CONDITIONS
P_O	Radiant Power Output	OP160	0.5			mW	I_F = 20 mA
$E_{e(APT)}$ (3)	Apertured Radiant Incidance	OP160SL	0.05			mW/cm²	I_F = 20 mA
		OP160SLD	0.28		0.95	mW/cm²	I_F = 20 mA
		OP160SLC	0.85		1.60	mW/cm²	I_F = 20 mA
		OP160SLB	1.40		2.20	mW/cm²	I_F = 20 mA
		OP160SLA	1.95			mW/cm²	I_F = 20 mA
I_e (3)	Radiant Intensity	OP160SL	0.052			mW/sr	I_F = 20 mA
		OP160SLD	0.29		0.99	mW/sr	I_F = 20 mA
		OP160SLC	0.88		1.66	mW/sr	I_F = 20 mA
		OP160SLB	1.46		2.29	mW/sr	I_F = 20 mA
		OP160SLA	2.03			mW/sr	I_F = 20 mA
V_F	Forward Voltage				1.6	V	I_F = 20 mA
I_R	Reverse Current				100	μA	V_R = 2 V
λp	Wavelength at Peak Emission			935		nm	I_F = 20 mA
B	Spectral Bandwidth Between Half Power Points			50		nm	I_F = 20 mA
Δλp/ΔT	Spectral Shift with Temperature			+0.2		nm/°C	I_F = Constant
θ_{HP}	Emission Angle at Half Power Points			16		Deg.	I_F = 20 mA
t_r	Output Rise Time			1550		ns	$I_{F(PK)}$ = 20 mA, PW = 10 μs DC = 10%
t_f	Output Fall Time			580		ns	

Typical Performance Curves

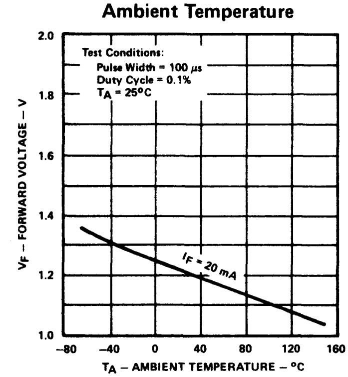
Forward Voltage vs. Forward Current



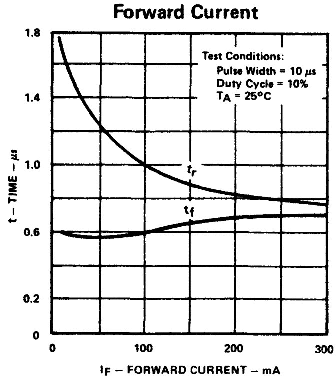
Forward Voltage and Power Output vs. Forward Current



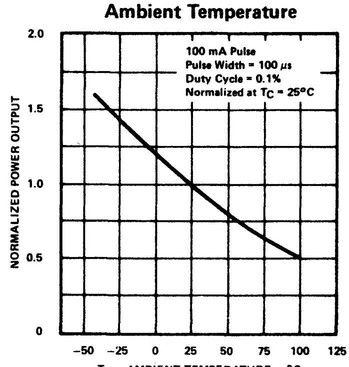
Forward Voltage vs. Ambient Temperature



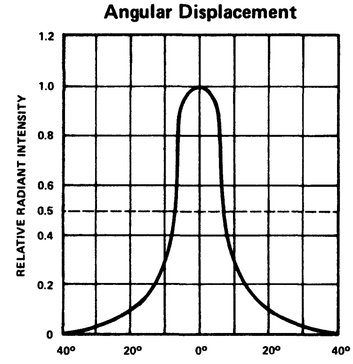
Rise Time and Fall Time vs. Forward Current



Normalized Power Output vs. Ambient Temperature



Relative Radiant Intensity vs. Angular Displacement



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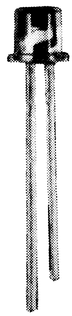
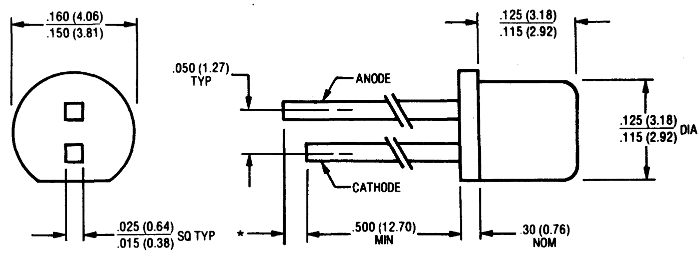
GaAs Plastic Infrared Emitting Diodes

Type OP160W



TWICE ACTUAL SIZE



Dimensions are in inches (millimeters).

*For identification purposes, anode lead is .06 (1.52) nom. longer than cathode lead.

Features;

- FLAT LENSED FOR WIDE RADIATION ANGLE
- LOW COST, MINIATURE, PLASTIC END-LOOKING PACKAGE
- MECHANICALLY AND SPECTRALLY MATCHED TO THE OP500W PHOTOTRANSISTOR

Description

The OP160W is a gallium arsenide infrared emitting diode molded in a clear plastic, flat lensed, mini-axial package. The flat lens allows a radiation half angle of 40° measured from the optical axis to the half power point. The OP160W is mechanically and spectrally matched to the OP500W phototransistor.

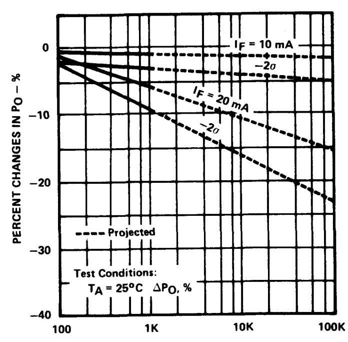
All electrical parameters are 100% tested by manufacturing. Specifications are guaranteed to a .65% AQL.

absolute maximum ratings (25° C unless otherwise noted)

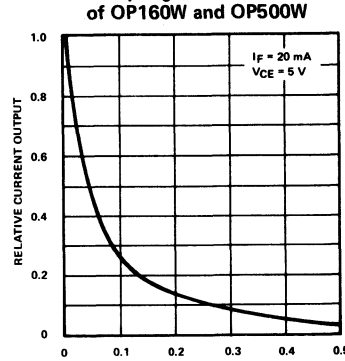
Continuous Forward Current . . . . 50 mA
Peak Forward Current (Pulse Width = 1 μsec, 300 pps) . . . . 3 A
Forward Voltage . . . . 2 V
Storage and Operating Temperature Range . . . . −40°C to +100°C
Lead Soldering Temperature Range (1/16 Inch [1.6 mm] from Case for 5 sec. with soldering iron(1)) . . . . 240°C
Power Dissipation . . . . 100 mW(2)

Notes: (1) RMA flux is recommended. Duration can be extended to 10 seconds max. when flow soldering.
(2) Derate linearly 1.33 mW/°C above 25°C.

Percent Changes in Power Output vs. Time



Coupling Characteristics of OP160W and OP500W



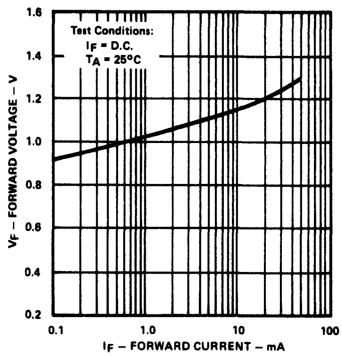
Type OP160W

electrical characteristics (25° C unless otherwise noted)

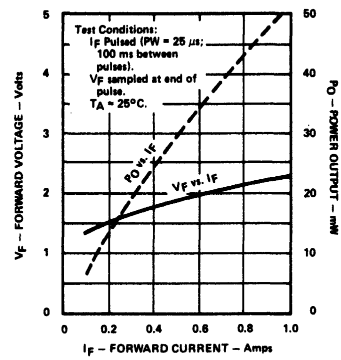
SYMBOL	PARAMETER	MIN	TYP	MAX	UNITS	TEST CONDITIONS
P_O	Radiant Power Output	0.5			mW	I_F = 20 mA
V_F	Forward Voltage			1.6	V	I_F = 20 mA
I_R	Reverse Current			100	μA	V_R = 2 V
λp	Wavelength at Peak Emission		935		nm	I_F = 20 mA
B	Spectral Bandwidth Between Half Power Points		50		nm	I_F = 20 mA
Δλp/ΔT	Spectral Shift with Temperature		+0.2		nm/°C	I_F = Constant
θ_{HP}	Emission Angle at Half Power Points		85		Deg.	I_F = 20 mA
t_r	Output Rise Time		1550		ns	$I_{F(PK)}$ = 20 mA, PW = 10 μs, D.C. = 10%
t_f	Output Fall Time		580		ns	$I_{F(PK)}$ = 20 mA, PW = 10 μs, D.C. = 10%

Typical Performance Curves

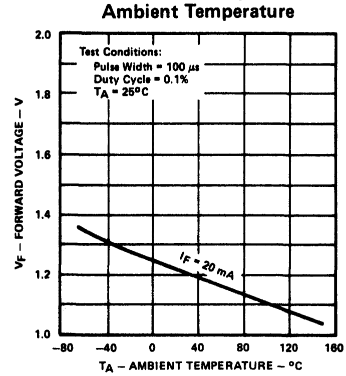
Forward Voltage vs. Forward Current



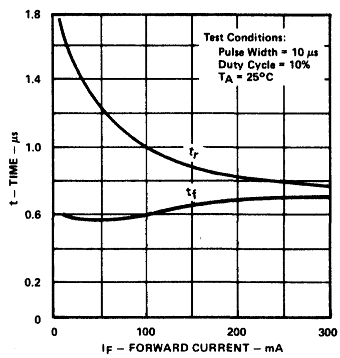
Forward Voltage and Power Output vs. Forward Current



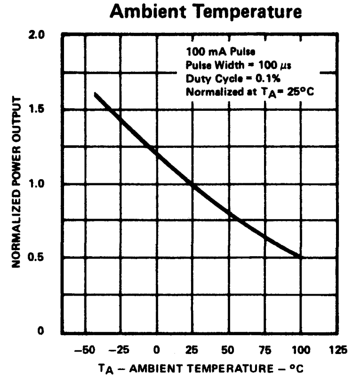
Forward Voltage vs. Ambient Temperature



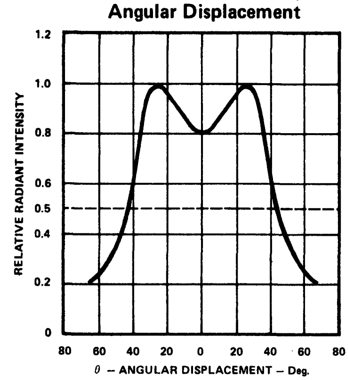
Rise Time and Fall Time vs. Forward Current



Normalized Power Output vs. Ambient Temperature



Relative Radiant Intensity vs. Angular Displacement



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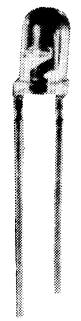
TRW OPTRON

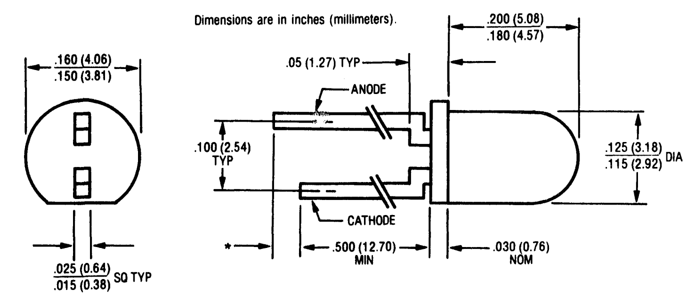
PRODUCT BULLETIN 3006
May 1982

GaAs Plastic Infrared Emitting Diodes

Types OP161, OP161SL-OP161SLA



TWICE ACTUAL SIZE



* For identification purposes, anode lead is .06 (1.52) nom. longer than cathode lead.

Features

- 0.100 INCH (2.54 mm) LEAD SPACING FOR STANDARD SOCKET MOUNTING
- LOW COST, PLASTIC END-LOOKING PACKAGE
- MECHANICALLY AND SPECTRALLY MATCHED TO THE OP501SL PHOTOTRANSISTOR SERIES

Description

The OP161 and OP161SL series are gallium arsenide infrared emitting diodes molded in clear plastic, mini-axial packages. The lensing effect of the package allows a radiation half angle of 8° measured from the optical axis to the half power point. Lead spacing is 0.100 (2.54 mm) to allow mounting in standard sockets. These devices are mechanically and spectrally matched to the OP501 and OP501SL series of phototransistors.

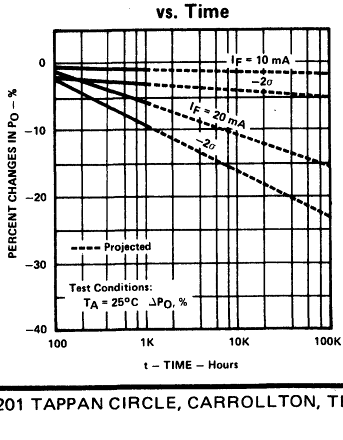
All electrical parameters are 100% tested by manufacturing. Specifications are guaranteed to a .65% AQL except for the OP161SL through OP161SLD series $E_{e(APT)}$ and I_e limits which are guaranteed to a 2.5% AQL.

absolute maximum ratings (25° C unless otherwise noted)

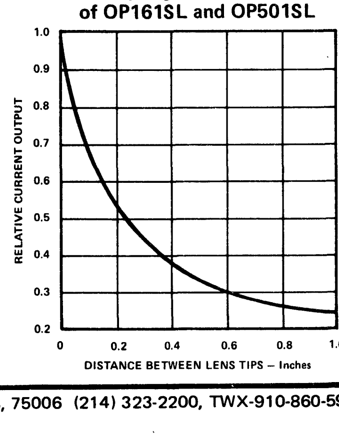
Continuous Forward Current . . . . 50 mA
Peak Forward Current (Pulse Width = 1 μsec, 300 pps) . . . . 3 A
Forward Voltage . . . . 2 V
Storage and Operating Temperature Range . . . . −40°C to +100°C
Lead Soldering Temperature Range (1/16 Inch [1.6 mm] from Case for
3 sec. with soldering iron(1)) . . . . 240°C
Power Dissipation . . . . 100 mW(2)

Notes: (1) RMA flux is recommended. Duration can be extended to 10 seconds max. when flow soldering.
(2) Derate linearly 1.33 mW/°C above 25°C.
(3) $E_{e(APT)}$ is a measurement of the average apertured radiant incidance upon a sensing area 0.180 inches (4.57 mm) in diameter perpendicular to and centered on the mechanical axis of the lens, and 0.653 inches (16.59 mm) from the lens tip. I_e is a measurement of the average radiant intensity within the cone formed by the above conditions. $E_{e(APT)}$ and I_e are not necessarily uniform within the measured area.

Percent Changes in Power Output vs. Time



Coupling Characteristics of OP161SL and OP501SL



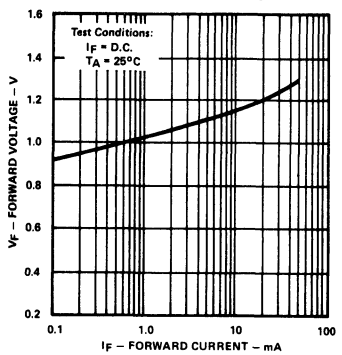
Types OP161, OP161SL-OP161SLA

electrical characteristics (25° C unless otherwise noted)

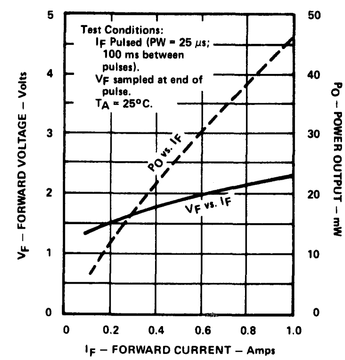
SYMBOL	PARAMETER		MIN	TYP	MAX	UNITS	TEST CONDITIONS
P_O	Radiant Power Output	OP161	0.5			mW	I_F = 20 mA
$E_{e(APT)}$ (3)	Apertured Radiant Incidance	OP161SL	0.05			mW/cm²	I_F = 20 mA
		OP161SLD	0.28		0.95	mW/cm²	I_F = 20 mA
		OP161SLC	0.85		1.60	mW/cm²	I_F = 20 mA
		OP161SLB	1.40		2.20	mW/cm²	I_F = 20 mA
		OP161SLA	1.95			mW/cm²	I_F = 20 mA
I_e (3)	Radiant Intensity	OP161SL	0.052			mW/sr	I_F = 20 mA
		OP161SLD	0.29		0.99	mW/sr	I_F = 20 mA
		OP161SLC	0.88		1.66	mW/sr	I_F = 20 mA
		OP161SLB	1.46		2.29	mW/sr	I_F = 20 mA
		OP161SLA	2.03			mW/sr	I_F = 20 mA
V_F	Forward Voltage				1.6	V	I_F = 20 mA
I_R	Reverse Current				100	μA	V_R = 2 V
λp	Wavelength at Peak Emission			935		nm	I_F = 20 mA
B	Spectral Bandwidth Between Half Power Points			50		nm	I_F = 20 mA
Δλp/ΔT	Spectral Shift with Temperature			+0.2		nm/°C	I_F = Constant
θ_{HP}	Emission Angle at Half Power Points			16		Deg.	I_F = 20 mA
t_r	Output Rise Time			1550		ns	$I_{F(PK)}$ = 20 mA, PW = 10 μs DC = 10%
t_f	Output Fall Time			580		ns	

Typical Performance Curves

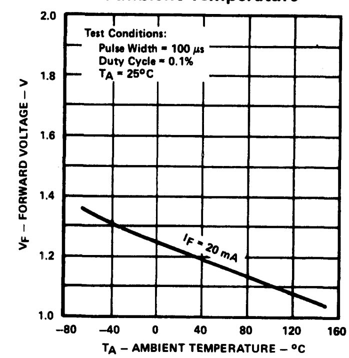
Forward Voltage vs. Forward Current



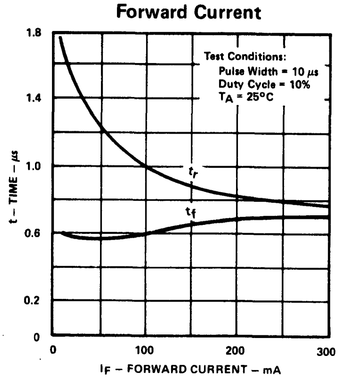
Forward Voltage and Power Output vs. Forward Current



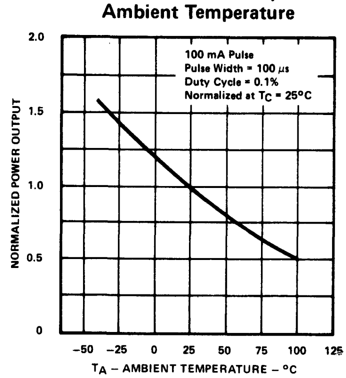
Forward Voltage vs. Ambient Temperature



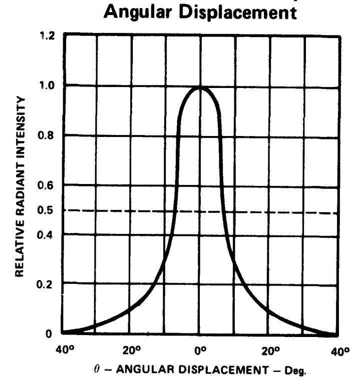
Rise Time and Fall Time vs. Forward Current



Normalized Power Output vs. Ambient Temperature



Relative Radiant Intensity vs. Angular Displacement



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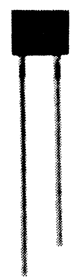
Printed in U.S.A.

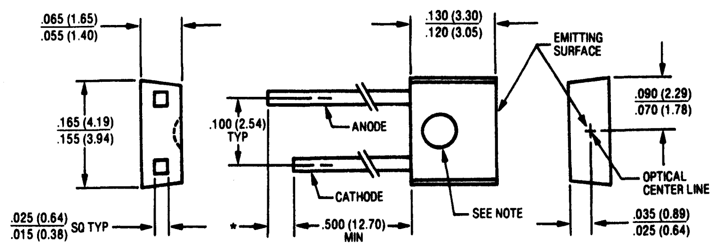
GaAs Plastic Infrared Emitting Diodes

Type OP168F



TWICE ACTUAL SIZE

Dimensions are in inches (millimeters).



NOTE: This is a mold mark and is being phased out in new production.

*For identification purposes, anode lead is .06 (1.52) nom. longer than cathode lead.

Features

- FLAT LENSED FOR WIDE RADIATION ANGLE
- EASILY STACKABLE ON 0.100 INCH (2.54 mm) HOLE CENTERS
- MECHANICALLY AND SPECTRALLY MATCHED TO THE OP508F PHOTOTRANSISTOR AND THE OP538F PHOTODARLINGTON

Description

The OP168F is a gallium arsenide infrared emitting diode molded in a "end emitting" miniature black plastic package. This device has a wide radiation angle due to its flat emitting surface. Small size and 0.100 (2.54 mm) lead spacing allow considerable design flexibility. The OP168F is mechanically and spectrally matched to the OP508F phototransistor and the OP538F photodarlington.

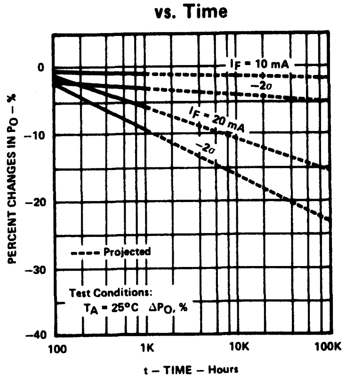
All electrical parameters are 100% tested by manufacturing. Specifications are guaranteed to a .65% AQL.

absolute maximum ratings (25° C unless otherwise noted)

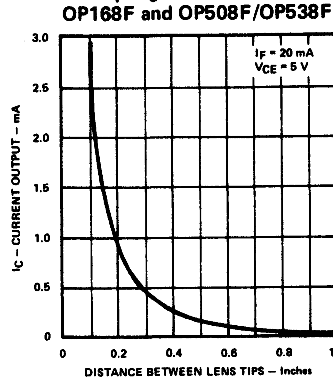
Continuous Forward Current . . . . 50 mA
Peak Forward Current (Pulse Width = 1 μsec, 300 pps) . . . . 3 A
Forward Voltage . . . . 2 V
Storage and Operating Temperature Range . . . . −40°C to +100°C
Lead Soldering Temperature Range (1/16 Inch [1.6 mm] from Case for
5 sec. with soldering iron(1)) . . . . 240°C
Power Dissipation . . . . 100 mW(2)

Notes: (1) RMA flux is recommended. Duration can be extended to 10 seconds max. when flow soldering.
(2) Derate linearly 1.33 mW/°C above 25°C.

Percent Changes in Power Output vs. Time



Coupling Characteristics of OP168F and OP508F/OP538F



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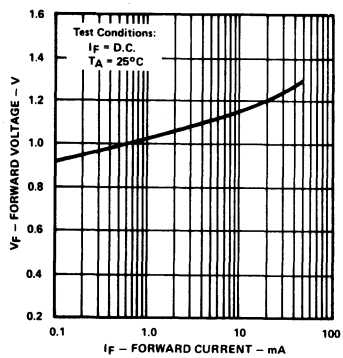
Type OP168F

electrical characteristics (25° C unless otherwise noted)

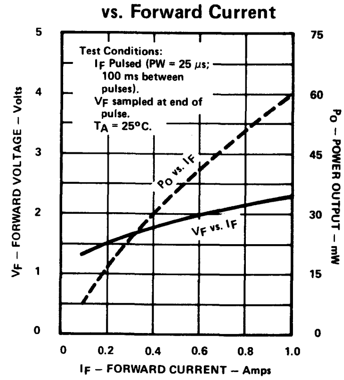
SYMBOL	PARAMETER	MIN	TYP	MAX	UNITS	TEST CONDITIONS
P_O	Radiant Power Output	0.25			mW	I_F = 20 mA
V_F	Forward Voltage			1.6	V	I_F = 20 mA
I_R	Reverse Current			100	μA	V_R = 2 V
λp	Wavelength at Peak Emission		935		nm	I_F = 20 mA
B	Spectral Bandwidth Between Half Power Points		50		nm	I_F = 20 mA
$\Delta\lambda p/\Delta T$	Spectral Shift with Temperature		+0.2		nm/°C	I_F = Constant
θ_{HP}	Emission Angle at Half Power Points		104		Deg.	I_F = 20 mA
t_r	Output Rise Time		1550		ns	$I_{F(PK)}$ = 20 mA, PW = 10 μs, D.C. = 10%
t_f	Output Fall Time		580		ns	$I_{F(PK)}$ = 20 mA, PW = 10 μs, D.C. = 10%

Typical Performance Curves

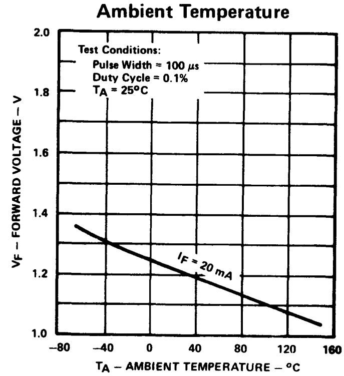
Forward Voltage vs. Forward Current



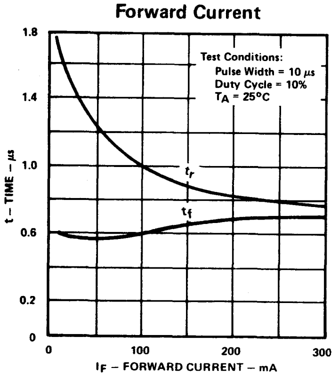
Forward Voltage and Power Output vs. Forward Current



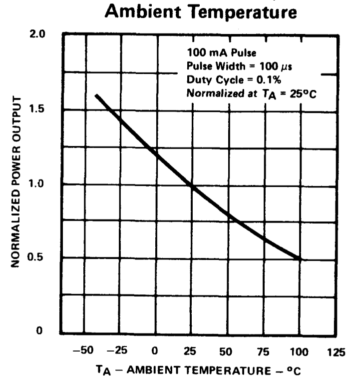
Forward Voltage vs. Ambient Temperature



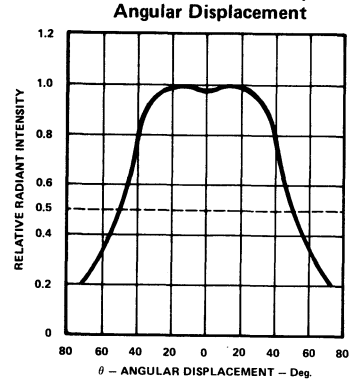
Rise Time and Fall Time vs. Forward Current



Normalized Power Output vs. Ambient Temperature



Relative Radiant Intensity vs. Angular Displacement



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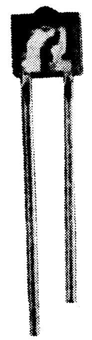
Printed in U.S.A.

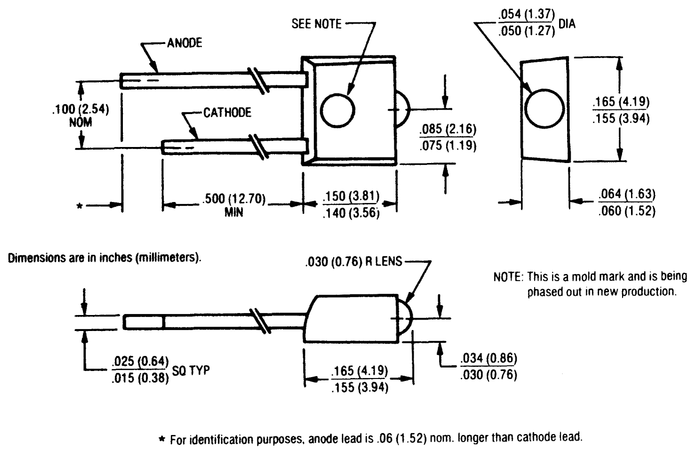
TRW OPTRON

PRODUCT BULLETIN 3008
June 1982

GaAs Plastic Infrared Emitting Diodes
Types OP169, OP169SL - OP169SLC



TWICE ACTUAL SIZE



Features

- INTEGRAL LENS FOR NARROW BEAM ANGLE
- EASILY STACKABLE ON 0.100 INCH (2.54 mm) HOLE CENTERS
- MECHANICALLY AND SPECTRALLY MATCHED TO THE OP509SL PHOTOTRANSISTOR SERIES

Description

The OP169 and OP169SL series are gallium arsenide infrared emitting diodes molded in "end-emitting" miniature clear packages. The molded lens insures improved uniformity of lens magnification from unit to unit. The OP169SL series provides a broad range of on-line and radiant intensities and has considerable design flexibility due to its small size. These devices are mechanically and spectrally matched to the OP509 and OP509SL phototransistor series.

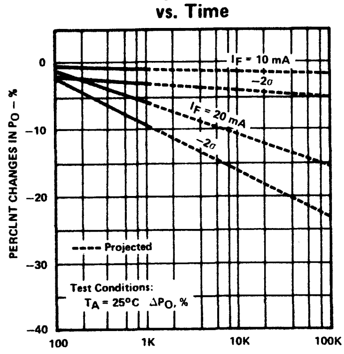
All electrical parameters are 100% tested by manufacturing. Specifications are guaranteed to a .65% AQL except for OP169SLC and OP169SLD $E_{e(APT)}$ and I_e limits which are guaranteed to a 2.5% AQL.

absolute maximum ratings (25° C unless otherwise noted)

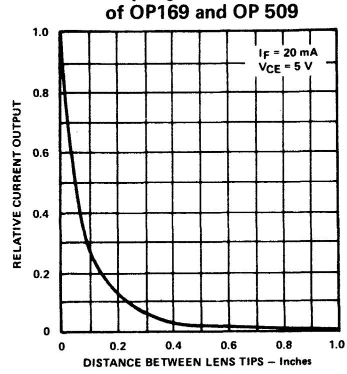
Continuous Forward Current . . . . 50 mA
Peak Forward Current (Pulse Width = 1 µsec, 300 pps) . . . . 3 A
Forward Voltage . . . . 2 V
Storage and Operating Temperature Range . . . . −40°C to +100°C
Lead Soldering Temperature Range (1/16 Inch [1.6 mm] from Case for
5 sec. with soldering iron[1]) . . . . 240°C
Power Dissipation . . . . 100 mW[2]

Notes: (1) RMA flux is recommended. Duration can be extended to 10 seconds max. when flow soldering.
(2) Derate linearly 1.33 mW/°C above 25°C.
(3) $E_{e(APT)}$ is a measurement of the average apertured radiant incidance upon a sensing area 0.180 inches (4.57 mm) in diameter perpendicular to and centered on the mechanical axis of the lens, and 0.653 inches (16.59 mm) from the lens tip. I_e is a measurement of the average radiant intensity within the cone formed by the above conditions. $E_{e(APT)}$ and I_e are not necessarily uniform within the measured area.

Percent Changes in Power Output vs. Time



Coupling Characteristics of OP169 and OP 509



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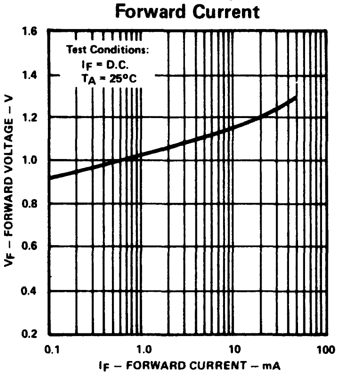
Types OP169, OP169SL - OP169SLC

electrical characteristics (25° C unless otherwise noted)

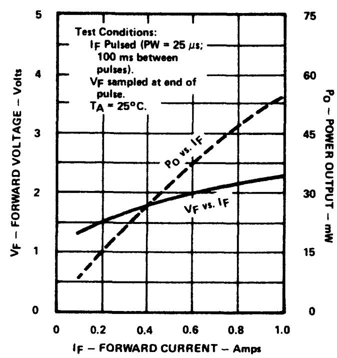
SYMBOL	PARAMETER		MIN	TYP	MAX	UNITS	TEST CONDITIONS
P_O	Radiant Power Output	OP169	0.2			mW	I_F = 20 mA
$E_{e(APT)}$ (3)	Apertured Radiant Incidance	OP169SL OP169SLD OP169SLC	0.02 0.116 0.195		 0.244	mW/cm^2 mW/cm^2 mW/cm^2	I_F = 20 mA I_F = 20 mA I_F = 20 mA
I_e (3)	Radiant Intensity	OP169SL OP169SLD OP169SLC	0.056 0.324 0.544		 0.681	mW/sr mW/sr mW/sr	I_F = 20 mA I_F = 20 mA I_F = 20 mA
V_F	Forward Voltage				1.6	V	I_F = 20 mA
I_R	Reverse Current				100	μA	V_R = 2 V
λp	Wavelength at Peak Emission			935		nm	I_F = 20 mA
B	Spectral Bandwidth Between Half Power Points			50		nm	I_F = 20 mA
Δλp/ΔT	Spectral Shift with Temperature			+0.2		nm/°C	I_F = Constant
θ_{HP}	Emission Angle at Half Power Points			46		Deg.	I_F = 20 mA
t_r	Output Rise Time			1550		ns	$I_{F(PK)}$ = 20 mA, PW = 10 μs DC = 10 %
t_f	Output Fall Time			580		ns	

Typical Performance Curves

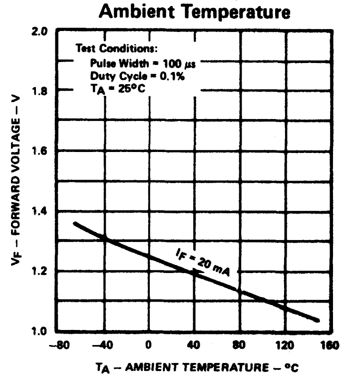
Forward Voltage vs. Forward Current



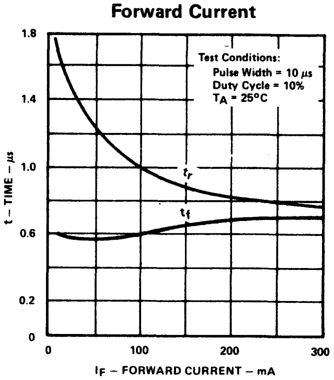
Forward Voltage and Power Output vs. Forward Current



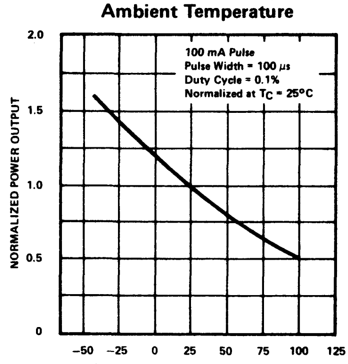
Forward Voltage vs. Ambient Temperature



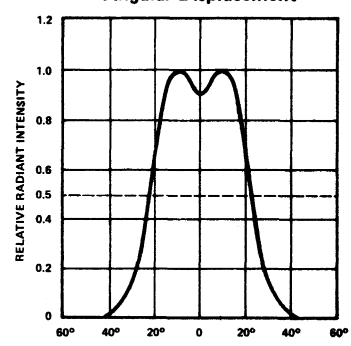
Rise Time and Fall Time vs. Forward Current



Normalized Power Output vs. Ambient Temperature

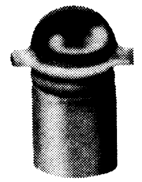


Relative Radiant Intensity vs. Angular Displacement

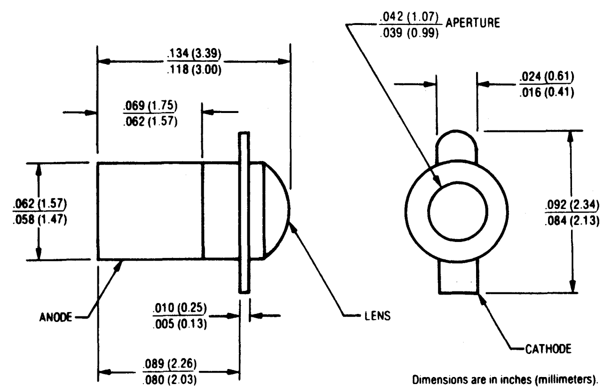


GaAlAs Hermetic Infrared Emitting Diodes

Types OP223, OP224



FIVE TIMES ACTUAL SIZE



Features

- TWICE THE POWER OUTPUT OF GaAs AT THE SAME DRIVE CURRENT
- MINIATURE HERMETICALLY SEALED "PILL" PACKAGE
- IDEAL FOR DIRECT MOUNTING TO PC BOARDS(1)
- MECHANICALLY AND SPECTRALLY MATCHED TO THE OP600 PHOTOTRANSISTOR AND THE OP300 PHOTODARLINGTON

Description

The OP223 and OP224 are gallium aluminum arsenide infrared emitting diodes mounted in miniature "pill" type hermetically sealed packages. This package style is intended for direct mounting into PC boards. Gallium aluminum arsenide features twice the radiated output of gallium arsenide at the same forward current. Also with a wavelength centered at 880 nanometers, it more closely matches the spectral response of silicon phototransistors.

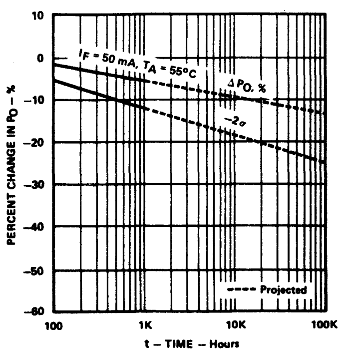
All electrical parameters are 100% tested by manufacturing. Specifications are guaranteed to a cumulative .65% AQL.

absolute maximum ratings (25° C unless otherwise noted)

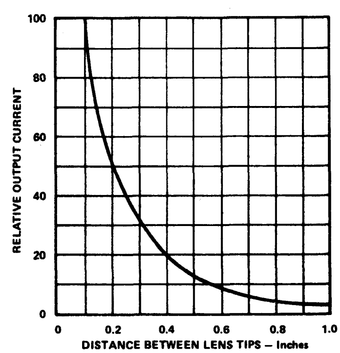
Reverse Voltage	2 V
Continuous Forward Current	50 mA
Storage Temperature Range	−65°C to +150°C
Operating Temperature Range	−65°C to +125°C
Soldering Temperature (for 5 sec. w/soldering iron(2))	240°C
Power Dissipation	125 mW (3)

Notes: (1) Refer to Application Bulletin 111 which discusses proper techniques for soldering pill-type devices into PC boards.
(2) RMA flux is recommended. Duration can be extended to 10 seconds max. when flow soldering.
(3) Derate linearly 1.25 mW/°C above 25°C.
(4) $E_{e(APT)}$ and I_e are measured using a 0.031 inch (0.787 mm) diameter apertured sensor placed 0.50 inches (12.7 mm) from the mounting plane. This corresponds to an included cone angle of 0.003 sr.

Percent Changes in Power Output vs. Time



Coupling Characteristics of OP223 and OP600



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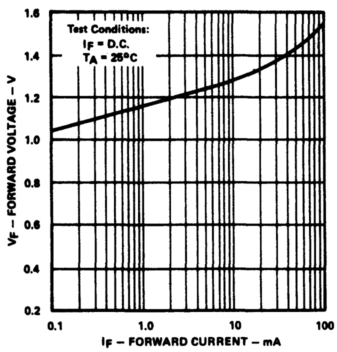
Types OP223, OP224

electrical characteristics (25° C unless otherwise noted)

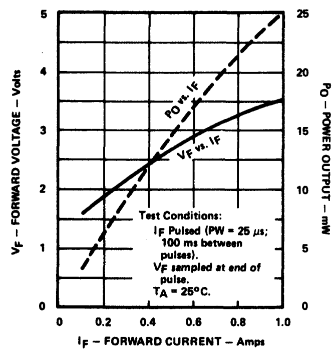
SYMBOL	PARAMETER		MIN	TYP	MAX	UNITS	TEST CONDITIONS
P_O	Radiant Power Output	OP223 OP224		0.8 3.0		mW mW	I_F = 50 mA I_F = 50 mA
$E_e(APT)^{(4)}$	Apertured Radiant Incidance	OP223 OP224	1.0 3.5			mW/cm² mW/cm²	I_F = 50 mA I_F = 50 mA
$I_e^{(4)}$	Radiant Intensity	OP223 OP224	1.62 5.64			mW/sr mW/sr	I_F = 50 mA I_F = 50 mA
V_F	Forward Voltage				1.7	V	I_F = 50 mA
I_R	Reverse Current				100	μA	V_R = 2 V
λp	Wavelength at Peak Emission			880		nm	I_F = 50 mA
B	Spectral Bandwidth Between Half Power Points			50		nm	I_F = 50 mA
$\Delta\lambda p/\Delta T$	Spectral Shift with Temperature			+0.2		nm/°C	I_F = Constant
θ_{HP}	Emission Angle at Half Power Points			36		Deg.	I_F = 50 mA
t_r	Output Rise Time			475		ns	$I_{F(PK)}$ = 50 mA, PW = 10 μs DC = 10%
t_f	Output Fall Time			250		ns	

Typical Performance Curves

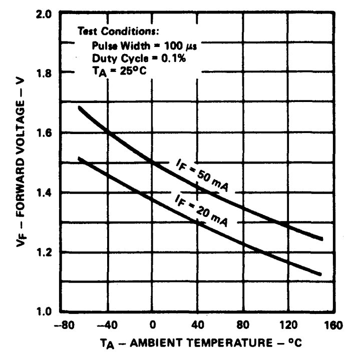
Forward Voltage vs. Forward Current



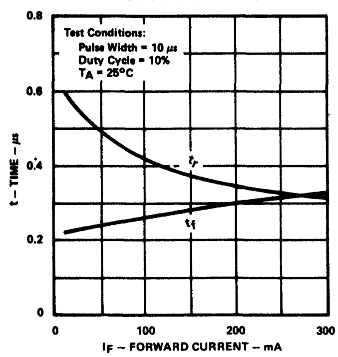
Forward Voltage and Power Output vs. Forward Current



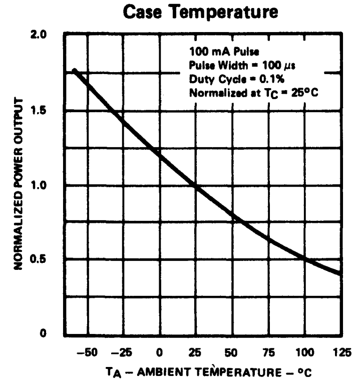
Forward Voltage vs. Ambient Temperature



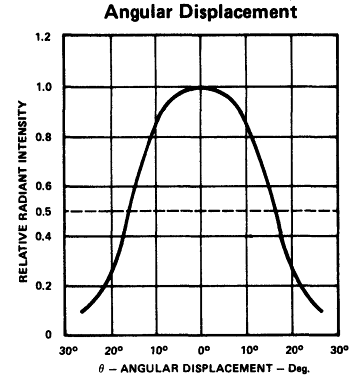
Rise Time and Fall Time vs. Forward Current



Normalized Power Output vs. Case Temperature



Relative Radiant Intensity vs. Angular Displacement



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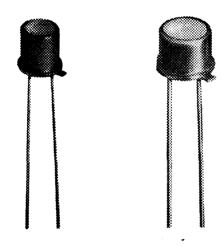
TRW *OPTRON*

PRODUCT BULLETIN 3010
March 1982

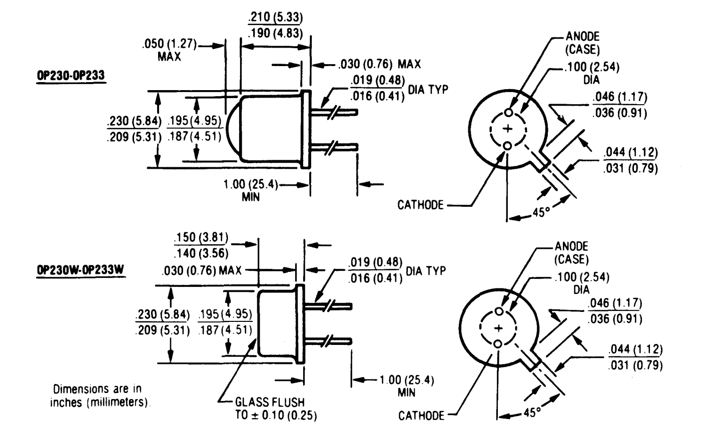
GaAlAs Hermetic Infrared Emitting Diodes

Types OP230-OP233, OP230W-OP233W



OP230 OP230W

ACTUAL SIZE



Features

- TWICE THE POWER OUTPUT OF GaAs AT THE SAME DRIVE CURRENT
- TO-46 HERMETICALLY SEALED PACKAGE
- MECHANICALLY AND SPECTRALLY MATCHED TO OP800 AND OP800W PHOTOTRANSISTORS OR OP830 AND OP830W PHOTODARLINGTONS

Description

The OP230—OP233 and OP230W—OP233W series are gallium aluminum arsenide infrared emitting diodes mounted in hermetic TO-46 housings. Gallium aluminum arsenide features twice the radiated output of gallium arsenide at the same forward current. Also with a wavelength centered at 880 nanometers, it more closely matches the spectral response of silicon phototransistors. The OP230 series have lensed cans providing a narrow beam angle, the OP230W series have flat window cans providing a wide beam angle.

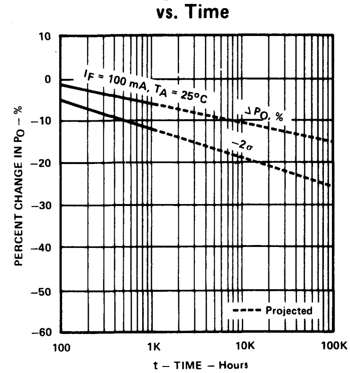
All electrical parameters are 100% tested by manufacturing. Specifications are guaranteed to a cumulative .65% AQL.

absolute maximum ratings (25° C unless otherwise noted)

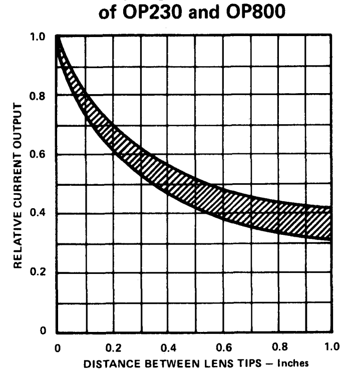
Reverse Voltage . . . . 2 V
Continuous Forward Current . . . . 100 mA
Peak Forward Current (Pulse Width = 1 μsec., 0.1% Duty Cycle) . . . . 10 A
Storage and Operating Temperature Range . . . . −65°C to +150°C
Lead Soldering Temperature (1/16 inch [1.6 mm] from Case for
5 sec. w/soldering iron[1]) . . . . 240°C
Power Dissipation . . . . 200 mW[2]

Notes: (1) RMA flux is recommended. Duration can be extended to 10 seconds max. when flow soldering.
(2) Derate linearly 1.6 mW/°C above 25°C.

Percent Changes in Power Output vs. Time



Coupling Characteristics of OP230 and OP800



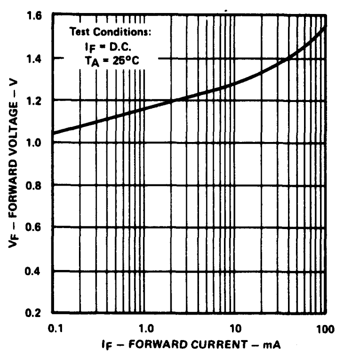
Types OP230-OP233, OP230W-OP233W

electrical characteristics (25° C unless otherwise noted)

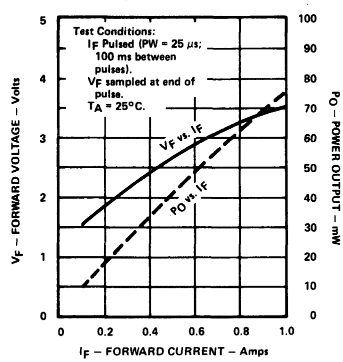
SYMBOL	PARAMETER	MIN	TYP	MAX	UNITS	TEST CONDITIONS
P_O	Radiant Power Output OP230, OP230W OP231, OP231W OP232, OP232W OP233, OP233W	6.0 8.0 10.0 12.0			mW mW mW mW	I_F = 100 mA I_F = 100 mA I_F = 100 mA I_F = 100 mA
V_F	Forward Voltage			2.0	V	I_F = 100 mA
I_R	Reverse Current			100	µA	V_R = 2 V
λp	Wavelength at Peak Emission		880		nm	I_F = 100 mA
B	Spectral Bandwidth Between Half Power Points		50		nm	I_F = 100 mA
$\Delta\lambda_p/\Delta T$	Spectral Shift with Temperature		+0.2		nm/°C	I_F = Constant
θ_{HP}	Emission Angle at Half Power Points OP230–OP233 OP230W–OP233W		 18 50		 Deg. Deg.	 I_F = 100 mA I_F = 100 mA
t_r	Output Rise Time		450		ns	$I_{F(PK)}$ = 100 mA, PW = 10 µs D.C. = 10%
t_f	Output Fall Time		250		ns	

Typical Performance Curves

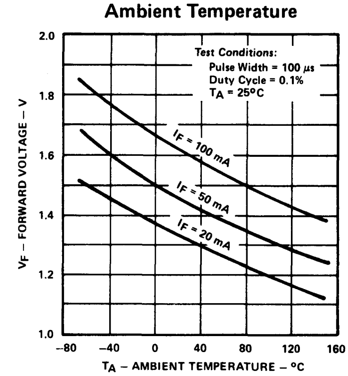
Forward Voltage vs. Forward Current



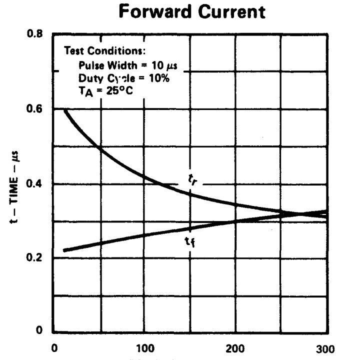
Forward Voltage and Power Output vs. Forward Current



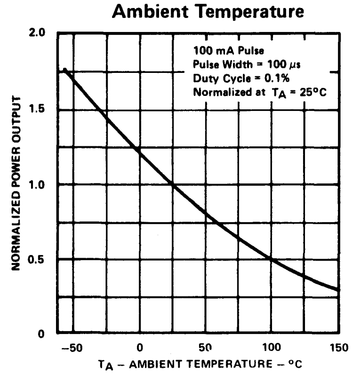
Forward Voltage vs. Ambient Temperature



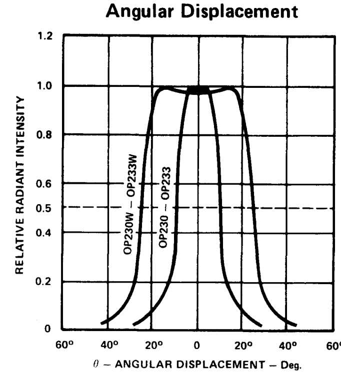
Rise Time and Fall Time vs. Forward Current



Normalized Power Output vs. Ambient Temperature



Relative Radiant Intensity vs. Angular Displacement



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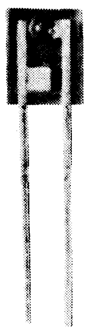
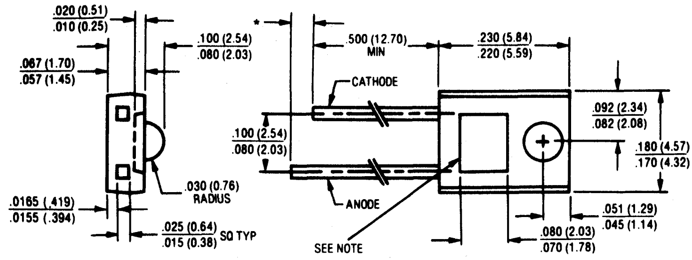
GaAlAs Plastic Infrared Emitting Diodes

Types OP240, OP240SLA-OP240SLC



TWICE ACTUAL SIZE



Dimensions are in inches (millimeters).

NOTE: This is a mold mark and is being phased out in new production.

* For identification purposes, anode lead is .06 (1.52) nom. longer than cathode lead.

Features

- TWICE THE POWER OUTPUT OF GaAs AT THE SAME DRIVE CURRENT
- SELECTED TO SPECIFIC ON-LINE INTENSITY AND RADIANT INTENSITY RANGES
- MECHANICALLY AND SPECTRALLY MATCHED TO THE OP550–OP550SL SERIES OF PHOTOTRANSISTORS AND THE OP560 PHOTODARLINGTON

Description

The OP240 and OP240SL series are gallium aluminum arsenide infrared emitting diodes mounted in low cost, clear plastic end-looking packages. Gallium aluminum arsenide features twice the radiated output of gallium arsenide at the same forward current. Also with a wavelength centered at 880 nanometers, it more closely matches the spectral response of silicon phototransistors.

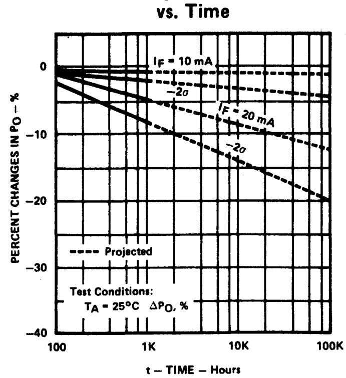
All electrical parameters are 100% tested by manufacturing. The specifications are guaranteed to a cumulative .65% AQL except for OP240SLA through OP240SLC $E_{e(APT)}$ and I_e limits which are guaranteed to a 2.5% AQL.

absolute maximum ratings (25° C unless otherwise noted)

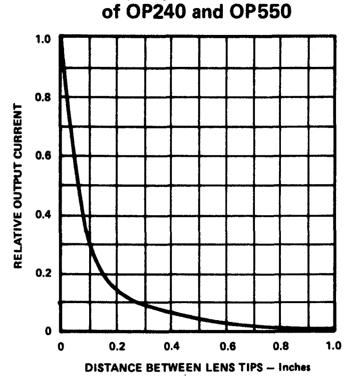
Reverse Voltage . . . . 2 V
Continuous Forward Current . . . . 50 mA
Peak Forward Current (Pulse Width = 1 μsec., 300 pps) . . . . 3 A
Storage and Operating Temperature Range . . . . −40°C to +100°C
Lead Soldering Temperature (1/16 inch [1.6 mm] from Case for
5 sec. w/soldering iron (1)) . . . . 240°C
Power Dissipation . . . . 100 mW(2)

Notes: (1) RMA flux is recommended. Duration can be extended to 10 seconds max. when flow soldering.
(2) Derate linearly 1.33 mW/°C above 25°C.
(3) $E_{e(APT)}$ is a measurement of the average apertured radiant incidance upon a sensing area 0.081 inches (2.06 mm) in diameter perpendicular to and centered on the mechanical axis of the lens, and 0.400 inches (10.16 mm) from the lens tip. I_e is a measurement of the average radiant intensity within the cone formed by the above conditions. $E_{e(APT)}$ and I_e are not necessarily uniform within the measured area.

Percent Changes in Power Output vs. Time



Coupling Characteristics of OP240 and OP550



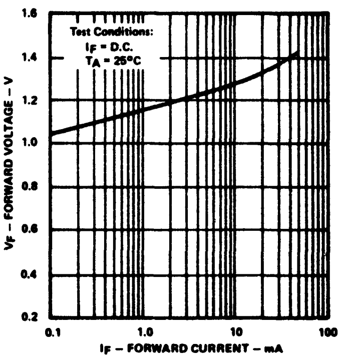
Types OP240, OP240SLA-OP240SLC

electrical characteristics (25° C unless otherwise noted)

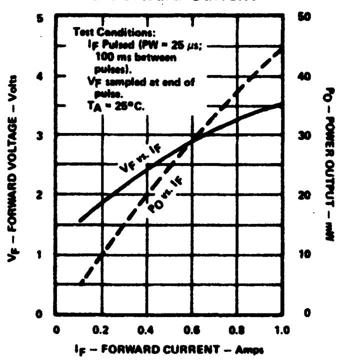
SYMBOL	PARAMETER		MIN	TYP	MAX	UNITS	TEST CONDITIONS
P_O	Radiant Power Output	OP240		1.0		mW	I_F = 40 mA
$E_{e(APT)}$ (3)	Apertured Radiant Incidance	OP240	0.05			mW/cm²	I_F = 20 mA
		OP240SLC	0.20		0.86	mW/cm²	I_F = 20 mA
		OP240SLB	0.40		1.20	mW/cm²	I_F = 20 mA
		OP240SLA	0.60			mW/cm²	I_F = 20 mA
I_e (3)	Radiant Intensity	OP240	0.14			mW/sr	I_F = 20 mA
		OP240SLC	0.56		2.4	mW/sr	I_F = 20 mA
		OP240SLB	1.12		3.35	mW/sr	I_F = 20 mA
		OP240SLA	1.67			mW/sr	I_F = 20 mA
V_F	Forward Voltage				1.8	V	I_F = 20 mA
I_R	Reverse Current				100	µA	V_R = 2 V
λp	Wavelength at Peak Emission			880		nm	I_F = 20 mA
B	Spectral Bandwidth Between Half Power Points			50		nm	I_F = 20 mA
$\Delta\lambda p/\Delta T$	Spectral Shift with Temperature			+0.2		nm/°C	I_F = Constant
θ_{HP}	Emission Angle at Half Power Points			40		Deg.	I_F = 20 mA
t_r	Output Rise Time			550		ns	$I_{F(PK)}$ = 20 mA, PW = 10 µs DC = 10%
t_f	Output Fall Time			225		ns	$I_{F(PK)}$ = 20 mA, PW = 10 µs DC = 10%

Typical Performance Curves

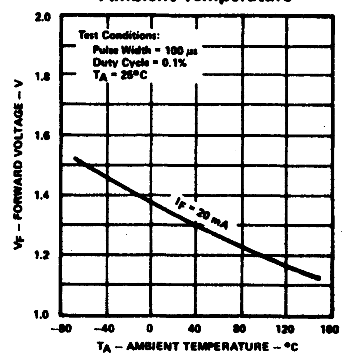
Forward Voltage vs. Forward Current



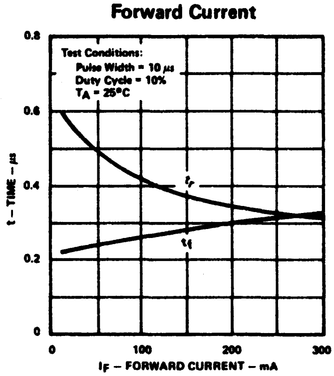
Forward Voltage and Power Output vs. Forward Current



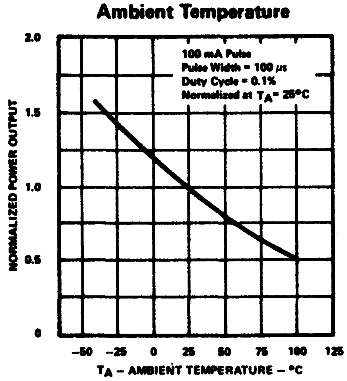
Forward Voltage vs. Ambient Temperature



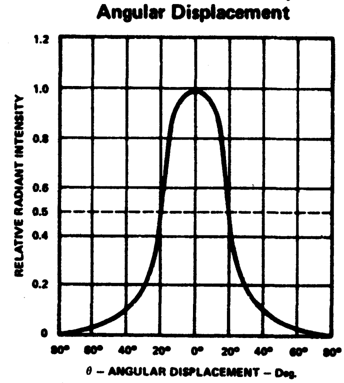
Rise Time and Fall Time vs. Forward Current



Normalized Power Output vs. Ambient Temperature



Relative Radiant Intensity vs. Angular Displacement



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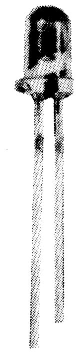
Printed in U.S.A.

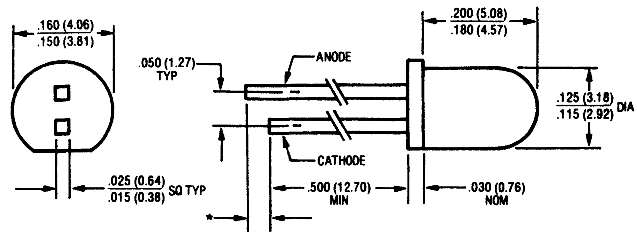
GaAlAs Plastic Infrared Emitting Diodes

Types OP260, OP260SLA-OP260SLC



TWICE ACTUAL SIZE

Dimensions are in inches (millimeters).



* For identification purposes, anode lead is .06 (1.52) nom. longer than cathode lead.

Features

- TWICE THE POWER OUTPUT OF GaAs AT THE SAME DRIVE CURRENT
- SELECTED TO SPECIFIC ON-LINE INTENSITY AND RADIANT INTENSITY RANGES
- MECHANICALLY AND SPECTRALLY MATCHED TO THE OP500—OP500SL SERIES OF PHOTOTRANSISTORS AND THE OP530 PHOTODARLINGTON

Description

The OP260 and OP260SL series are gallium aluminum arsenide infrared emitting diodes mounted in low cost, clear plastic end-looking packages. Gallium aluminum arsenide features twice the radiated output of gallium arsenide at the same forward current. Also with a wavelength centered at 880 nanometers, it more closely matches the spectral response of silicon phototransistors.

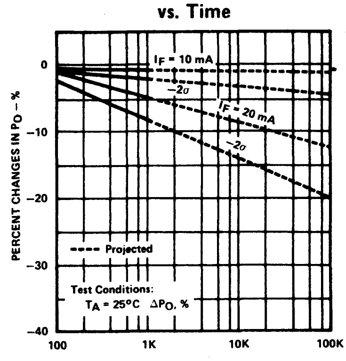
All electrical parameters are 100% tested by manufacturing. The specifications are guaranteed to a cumulative .65% AQL except for OP260SLA through OP260SLC $E_{e(APT)}$ and I_e limits which are guaranteed to a 2.5% AQL.

absolute maximum ratings (25° C unless otherwise noted)

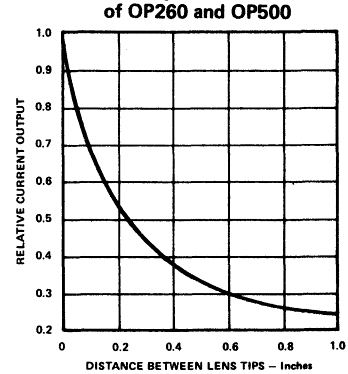
Reverse Voltage	2 V
Continuous Forward Current	50 mA
Peak Forward Current (Pulse Width = 1 μsec., 300 pps)	3 A
Storage and Operating Temperature Range	−40°C to +100°C
Lead Soldering Temperature (1/16 inch [1.6 mm] from Case for 5 sec. w/soldering iron(1))	240°C
Power Dissipation	100 mW(2)

Notes: (1) RMA flux is recommended. Duration can be extended to 10 seconds max. when flow soldering.
(2) Derate linearly 1.33 mW/°C above 25°C.
(3) $E_{e(APT)}$ is a measurement of the average apertured radiant incidance upon a sensing area 0.180 inches (4.57 mm) in diameter perpendicular to and centered on the mechanical axis of the lens, and 0.653 inches (16.59 mm) from the lens tip. I_e is a measurement of the average radiant intensity within the cone formed by the above conditions. $E_{e(APT)}$ and I_e are not necessarily uniform within the measured area.

Percent Changes in Power Output vs. Time



Coupling Characteristics of OP260 and OP500



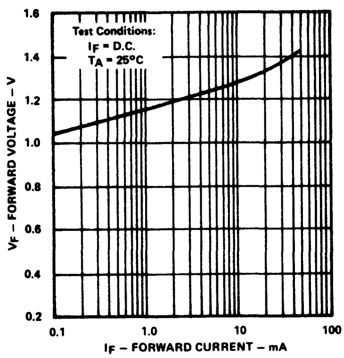
Types OP260, OP260SLA-OP260SLC

electrical characteristics (25° C unless otherwise noted)

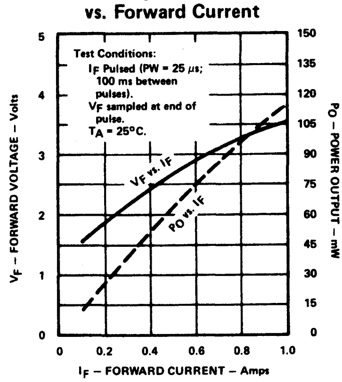
SYMBOL	PARAMETER		MIN	TYP	MAX	UNITS	TEST CONDITIONS
P_O	Radiant Power Output	OP260		1.0		mW	I_F = 20 mA
$E_e(APT)$ (3)	Apertured Radiant Incidance	OP260	0.10			mW/cm²	I_F = 20 mA
		OP260SLC	0.50		3.5	mW/cm²	I_F = 20 mA
		OP260SLB	2.5		6.0	mW/cm²	I_F = 20 mA
		OP260SLA	4.0			mW/cm²	I_F = 20 mA
I_e (3)	Radiant Intensity	OP260	0.104			mW/sr	I_F = 20 mA
		OP260SLC	0.52		3.64	mW/sr	I_F = 20 mA
		OP260SLB	2.6		6.24	mW/sr	I_F = 20 mA
		OP260SLA	4.16			mW/sr	I_F = 20 mA
V_F	Forward Voltage				1.8	V	I_F = 20 mA
I_R	Reverse Current				100	μA	V_R = 2 V
λp	Wavelength at Peak Emission			880		nm	I_F = 20 mA
B	Spectral Bandwidth Between Half Power Points			50		nm	I_F = 20 mA
$\Delta\lambda p/\Delta T$	Spectral Shift with Temperature			+0.2		nm/°C	I_F = Constant
θ_{HP}	Emission Angle at Half Power Points			16		Deg.	I_F = 20 mA
t_r	Output Rise Time			575		ns	$I_{F(PK)}$ = 20 mA, PW = 10 μs DC = 10 %
t_f	Output Fall Time			225		ns	

Typical Performance Curves

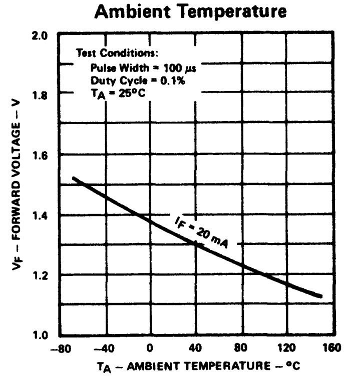
Forward Voltage vs. Forward Current



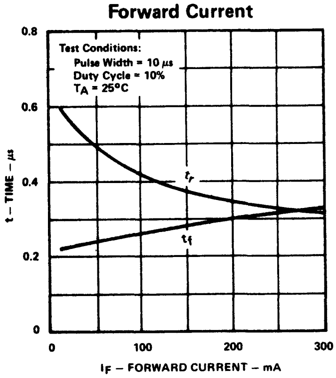
Forward Voltage and Power Output vs. Forward Current



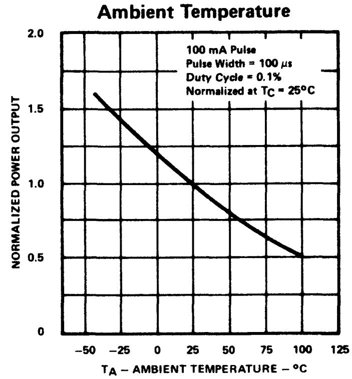
Forward Voltage vs. Ambient Temperature



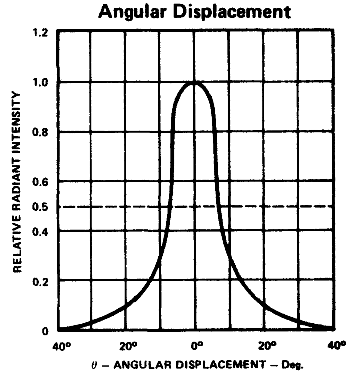
Rise Time and Fall Time vs. Forward Current



Normalized Power Output vs. Ambient Temperature



Relative Radiant Intensity vs. Angular Displacement



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Printed in U.S.A.

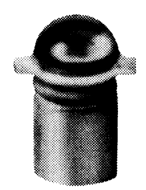
Photosensors

TRW OPTRON

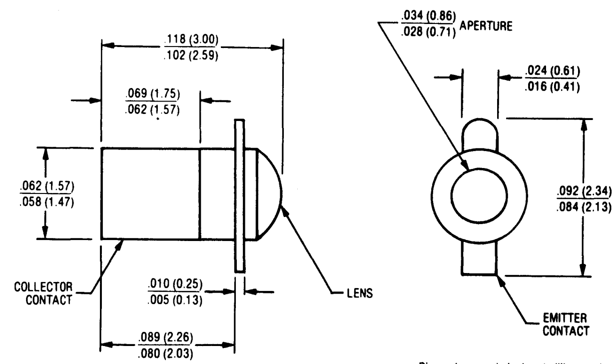
PRODUCT BULLETIN 3014
February 1982

NPN Silicon Photodarlingtons

Types OP300, OP301, OP302, OP303, OP304, OP305



5 TIMES ACTUAL SIZE



Dimensions are in inches (millimeters).

Features

- MINIATURE HERMETICALLY SEALED PACKAGE
- HIGH CURRENT GAIN
- IDEAL FOR DIRECT MOUNTING IN PC BOARDS(1)

Description

The OP300 through OP305 each consist of an NPN silicon photodarlington mounted in a miniature glass lensed, hermetically sealed, "Pill" package. The lensing effect allows an acceptance half angle of 15° measured from the optical axis to the half power point. Photodarlingtons are normally used in applications where light signal levels are low and more current gain is needed than is possible with phototransistors. This series is mechanically and spectrally matched to the OP123/124 and OP223/224 series of infrared emitting diodes.

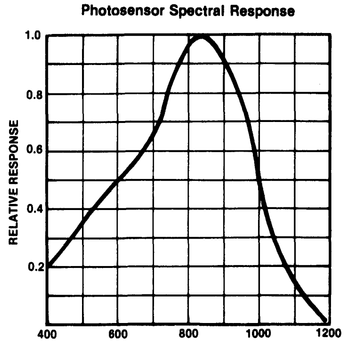
All electrical parameters are 100% tested by manufacturing. Specifications are guaranteed to a cumulative .65% AQL.

absolute maximum rating (25°C unless otherwise noted)

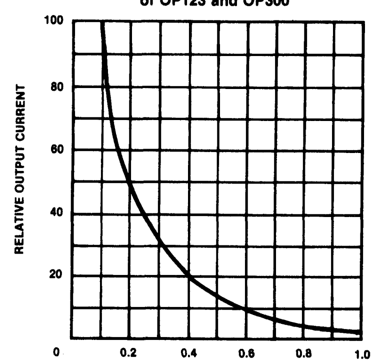
Collector-Emitter Voltage .... 15 V
Emitter-Collector Voltage .... 5 V
Storage Temperature Range .... −65°C to +150°C
Operating Temperature Range .... −65°C to +85°C
Lead Soldering Temperature (1/16 inch - 1.6 mm from case for 5 sec. with soldering iron)(2) .... 240°C
Power Dissipation .... 60 mW(3)

Notes: (1) Refer to Application Bulletin 111 which discusses proper techniques for soldering Pill type devices into PC boards.
(2) RMA flux is recommended. Duration can be extended to 10 sec. max. when wave soldering.
(3) Derate Linearly 1.0 mW/°C above 25°C.
(4) Junction temperature maintained at 25°C.
(5) Light source is an unfiltered tungsten bulb operating at CT = 2870°K.

Photosensor Spectral Response



Coupling Characteristics of OP123 and OP300



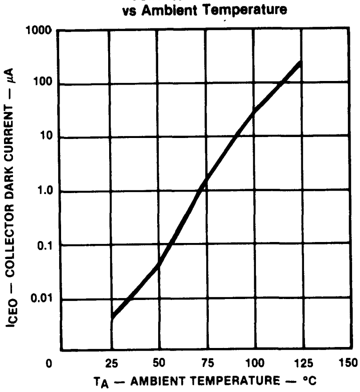
Types OP300, OP301, OP302, OP303, OP304, OP305

electrical characteristics (− 40 °C to + 70 °C unless otherwise noted)

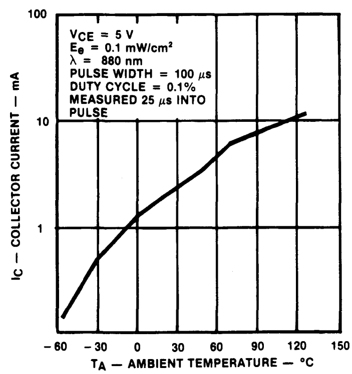
SYMBOL	PARAMETER		MIN	TYP	MAX	UNITS	TEST CONDITIONS
$I_{C(ON)}$ (4)	On-State Collector Current	OP300	0.8			mA	V_{CE} = 5 V, E_e = 1 mW/cm² (5)
		OP301	0.8		2.4	mA	V_{CE} = 5 V, E_e = 1 mW/cm² (5)
		OP302	1.8		5.4	mA	V_{CE} = 5 V, E_e = 1 mW/cm² (5)
		OP303	3.6		12.0	mA	V_{CE} = 5 V, E_e = 1 mW/cm² (5)
		OP304	7.0		21.0	mA	V_{CE} = 5 V, E_e = 1 mW/cm² (5)
		OP305	14.0		43.0	mA	V_{CE} = 5 V, E_e = 1 mW/cm² (5)
I_{CEO}	Collector Dark Current	OP300, 303, 304, 305			1.0	μA	V_{CE} = 10 V, E_e = 0
		OP301, 302			0.25	μA	V_{CE} = 10 V, E_e = 0
$V_{(BR)CEO}$	Collector-Emitter Breakdown Voltage		15.0			V	I_C = 100 μA
$V_{(BR)ECO}$	Emitter-Collector Breakdown Voltage		5.0			V	I_E = 100 μA
$V_{CE(SAT)}$ (4)	Collector-Emitter Saturation Voltage	OP300, 301			1.1	V	I_C = 0.4 mA, E_e = 1 mW/cm² (5)
		OP302, 303, 304, 305			1.1	V	I_C = 1.0 mA, E_e = 1 mW/cm² (5)

Typical Performance Curves

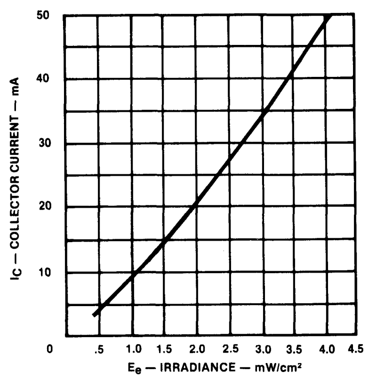
Collector Dark Current vs Ambient Temperature



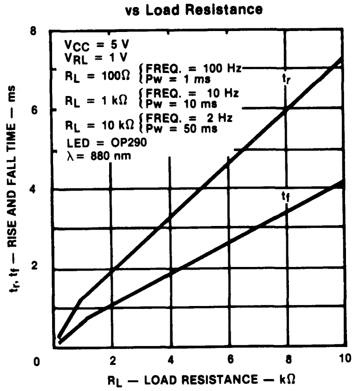
Collector Current vs Ambient Temperature



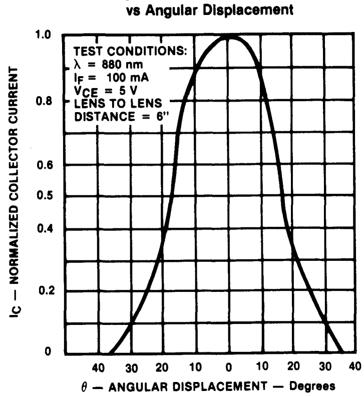
Collector Current vs Irradiance



Rise and Fall Time vs Load Resistance



Normalized Collector Current vs Angular Displacement



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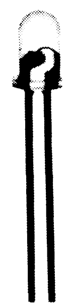
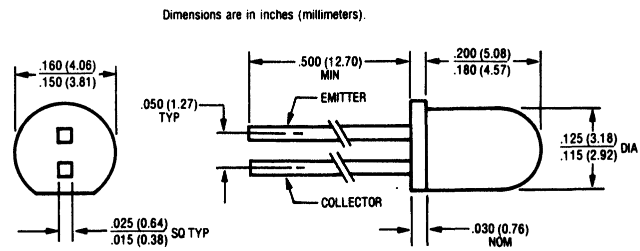
NPN Silicon Phototransistors

Types OP500, OP500SLD, OP500SLC, OP500SLB, OP500SLA



TWICE ACTUAL SIZE



Features

- WIDE RANGE OF COLLECTOR CURRENTS
- LENSED FOR HIGH SENSITIVITY
- LOW COST PLASTIC PACKAGE

Description

The OP500 and OP500SLD through SLA each consist of an NPN silicon phototransistor mounted in a lensed, clear plastic, end looking package. The lensing effect of the package allows an acceptance half angle of 8° measured from the optical axis to the half power point. This series is mechanically and spectrally matched to the OP160 and OP260 series of infrared emitting diodes.

All electrical parameters are 100% tested by manufacturing. Specifications are guaranteed to a cumulative .65% AQL.

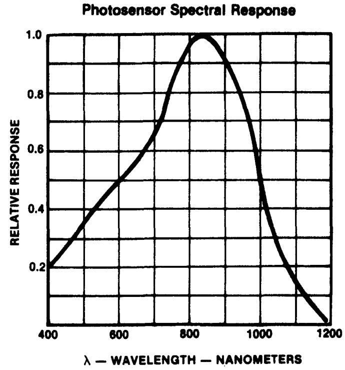
Collector current ranges on the OP500SLD through SLA are guaranteed to a 2.5% AQL.

absolute maximum rating (25°C unless otherwise noted)

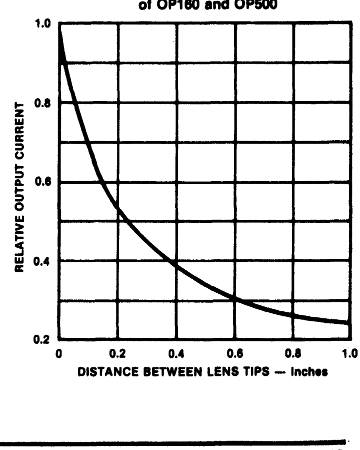
Collector-Emitter Voltage .... 30 V
Emitter-Collector Voltage .... 5 V
Storage and Operating Temperature Range .... −40°C to +100°C
Lead Soldering Temperature (1/16 inch - 1.6 mm from case for 5 sec. with soldering iron)(1) .... 240°C
Power Dissipation .... 100 mW(2)

Notes: (1) RMA flux is recommended. Duration can be extended to 10 sec. max. when wave soldering.
(2) Derate Linearly 1.33 mW/°C above 25°C.
(3) Junction temperature maintained at 25°C.
(4) Light source is an unfiltered tungsten bulb operating at CT = 2870°K.

Photosensor Spectral Response



Coupling Characteristics of OP160 and OP500



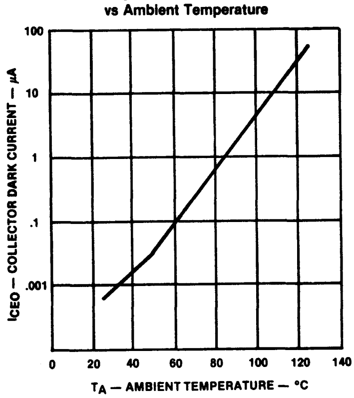
Types OP500, OP500SLD, OP500SLC, OP500SLB, OP500SLA

electrical characteristics (25 °C unless otherwise noted)

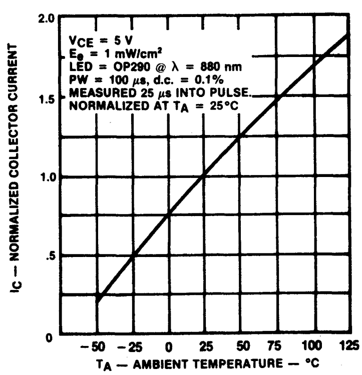
SYMBOL	PARAMETER		MIN	TYP	MAX	UNITS	TEST CONDITIONS
$I_{C(ON)}$ (3)	On-State Collector Current	OP500	4			mA	V_{CE} = 5 V, E_e = 20 mW/cm² (4)
		OP500SLD	10		24	mA	V_{CE} = 5 V, E_e = 20 mW/cm² (4)
		OP500SLC	17		35	mA	V_{CE} = 5 V, E_e = 20 mW/cm² (4)
		OP500SLB	25		50	mA	V_{CE} = 5 V, E_e = 20 mW/cm² (4)
		OP500SLA	40			mA	V_{CE} = 5 V, E_e = 20 mW/cm² (4)
I_{CEO}	Collector Dark Current			1		μA	V_{CE} = 10 V, T_A = 80°C, E_e = 0
					100	nA	V_{CE} = 10 V, E_e = 0
$V_{(BR)CEO}$	Collector-Emitter Breakdown Voltage		30			V	I_C = 1 mA
$V_{(BR)ECO}$	Emitter-Collector Breakdown Voltage		5			V	I_E = 100 μA
$V_{CE(SAT)}$ (3)	Collector-Emitter Saturation Voltage				0.4	V	I_C = 0.5 mA, E_e = 20 mW/cm² (4)
t_r	Rise Time			5		μs	V_{CC} = 30 V, I_C = 800 μA
t_f	Fall Time			5		μs	R_L = 1 kΩ,

Typical Performance Curves

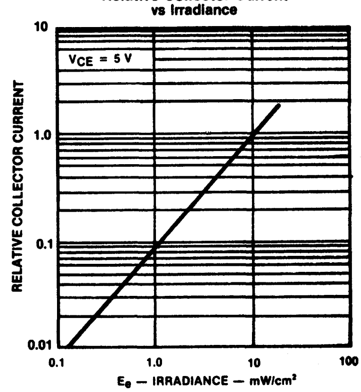
Collector Dark Current vs Ambient Temperature



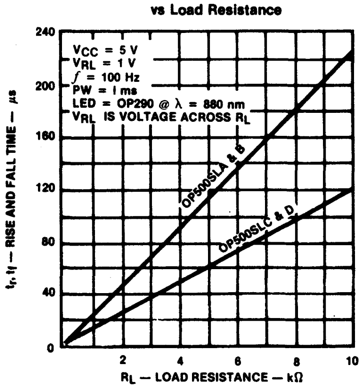
Normalized Collector Current vs Ambient Temperature



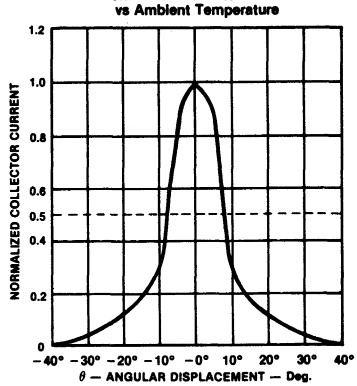
Relative Collector Current vs Irradiance



Rise and Fall Time vs Load Resistance



Normalized Collector Current vs Ambient Temperature



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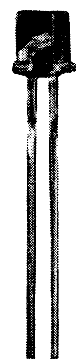
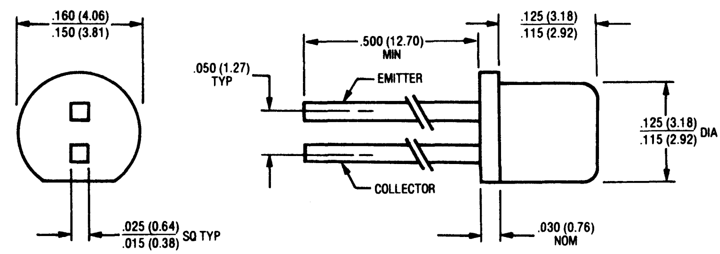
Printed in U.S.A.

NPN Silicon Phototransistor
Type OP500W



TWICE ACTUAL SIZE



Dimensions are in inches (millimeters).

Features

- FLAT LENSED FOR WIDE ACCEPTANCE ANGLE
- LOW COST PLASTIC PACKAGE

Description

The OP500W consists of an NPN silicon phototransistor mounted in a flat lensed, clear plastic, end-looking package. The flat lens allows an acceptance half angle of 45° measured from the optical axis to the half power point. The OP500W is mechanically and spectrally matched to the OP160W infrared emitting diode.

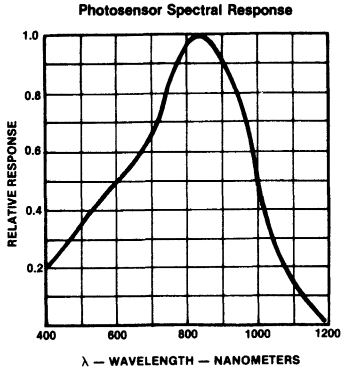
All electrical parameters are 100% tested by manufacturing. Specifications are guaranteed to a cumulative .65% AQL.

absolute maximum rating (25°C unless otherwise noted)

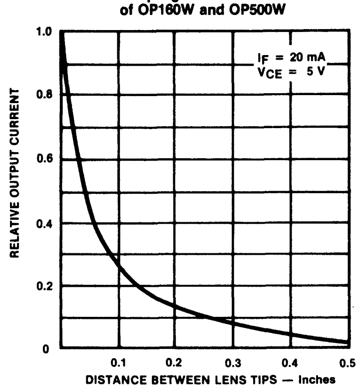
Collector-Emitter Voltage .... 30 V
Emitter-Collector Voltage .... 5 V
Storage and Operating Temperature Range .... −40°C to +100°C
Lead Soldering Temperature (1/16 inch - 1.6 mm from case for 5 sec. with soldering iron)(1) .... 240°C
Power Dissipation .... 100 mW(2)

Notes: (1) RMA flux is recommended. Duration can be extended to 10 sec. max. when wave soldering.
(2) Derate Linearly 1.33 mW/°C above 25°C.
(3) Junction temperature maintained at 25°C.
(4) Light source is an unfiltered tungsten bulb operating at CT = 2870°K.

Photosensor Spectral Response



Coupling Characteristics of OP160W and OP500W



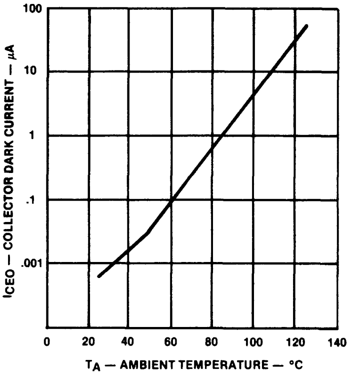
Type OP500W

electrical characteristics (25 °C unless otherwise noted)

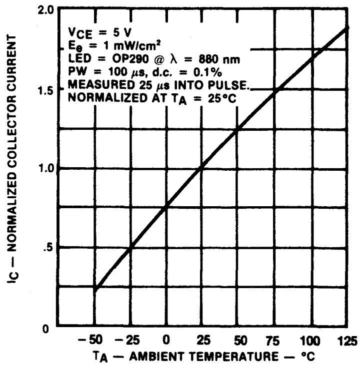
SYMBOL	PARAMETER	MIN	TYP	MAX	UNITS	TEST CONDITIONS
$I_{C(ON)}$ (3)	On-State Collector Current	0.5			mA	V_{CE} = 5 V, E_e = 20 mW/cm² (2)(4)
I_{CEO}	Collector Dark Current			100	nA	V_{CE} = 10 V, E_e = 0
$V_{(BR)CEO}$	Collector-Emitter Breakdown Voltage	30			V	I_C = 1 mA
$V_{(BR)ECO}$	Emitter-Collector Breakdown Voltage	5			V	I_E = 100 μA
$V_{CE(SAT)}$ (3)	Collector-Emitter Saturation Voltage			.4	V	I_C = 250 μA, E_e = 20 mW/cm² (2)(4)

Typical Performance Curves

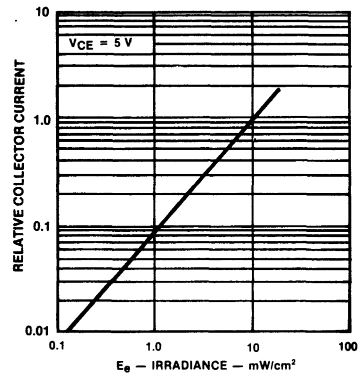
Collector Dark Current vs Ambient Temperature



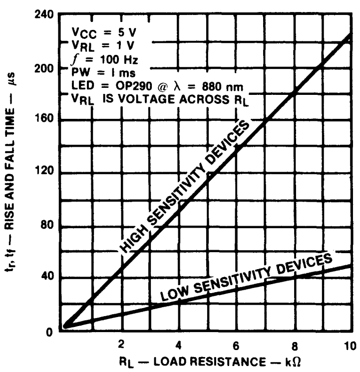
Normalized Collector Current vs Ambient Temperature



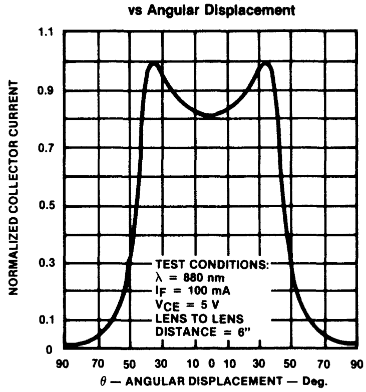
Relative Collector Current vs Irradiance



Rise and Fall Time vs Load Resistance



Normalized Collector Current vs Angular Displacement



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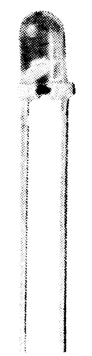
Printed in U.S.A.

TRW OPTRON

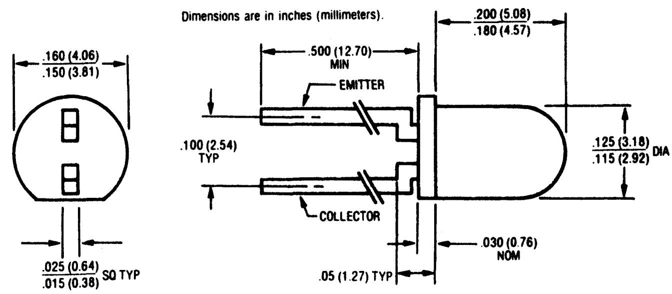
PRODUCT BULLETIN 3017
February 1982

NPN Silicon Phototransistors

Types OP501, OP501SLD, OP501SLC, OP501SLB, OP501SLA



TWICE ACTUAL SIZE



Features

- .10" (2.54mm) LEAD SPACING
- WIDE RANGE OF COLLECTOR CURRENTS
- LENSED FOR HIGH SENSITIVITY

Description

The OP501 and OP501SLD through SLA each consist of an NPN silicon phototransistor mounted in a lensed, clear plastic, end looking package. The lensing effect of the package allows an acceptance half angle of 8 ° measured from the optical axis to the half power point. This series is identical to the OP500 except for lead spacing. It is mechanically and spectrally matched to the OP160 and OP260 series of infrared emitting diodes.

All electrical parameters are 100% tested by manufacturing. Specifications are guaranteed to a cumulative .65% AQL.

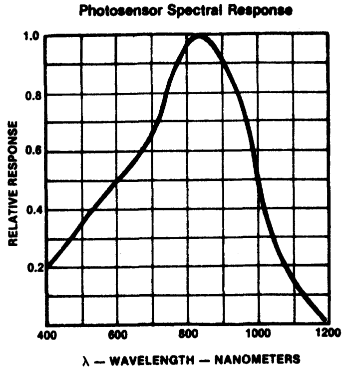
Collector current ranges on the OP501SLD through SLA are guaranteed to a 2.5% AQL.

absolute maximum rating (25 °C unless otherwise noted)

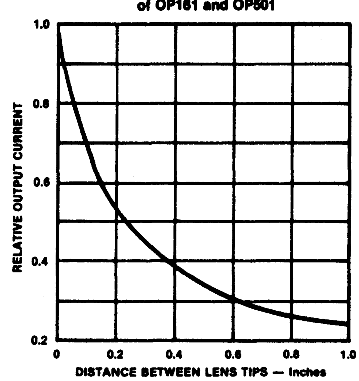
Collector-Emitter Voltage . . . . . . 30 V
Emitter-Collector Voltage . . . . . . 5 V
Storage and Operating Temperature Range . . . . . . − 40 °C to + 100 °C
Lead Soldering Temperature (1/16 inch - 1.6 mm from case for 5 sec. with soldering iron)[1] . . . . . . 240 °C
Power Dissipation . . . . . . 100 mW[2]

Notes: (1) RMA flux is recommended. Duration can be extended to 10 sec. max. when wave soldering.
(2) Derate Linearly 1.33 mW/ °C above 25 °C.
(3) Junction temperature maintained at 25 °C.
(4) Light source is an unfiltered tungsten bulb operating at CT = 2870 °K.

Photosensor Spectral Response



Coupling Characteristics of OP161 and OP501



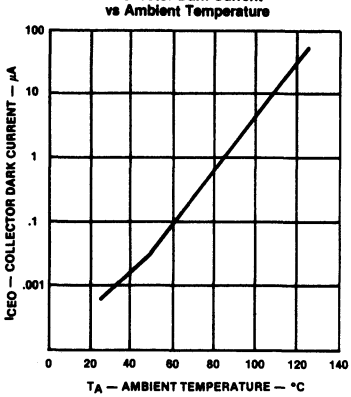
Types OP501, OP501SLD, OP501SLC, OP501SLB, OP501SLA

electrical characteristics (25 °C unless otherwise noted)

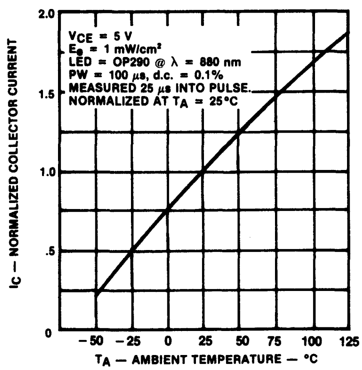
SYMBOL	PARAMETER		MIN	TYP	MAX	UNITS	TEST CONDITIONS
$I_{C(ON)}$ [3]	On-State Collector Current	OP501	4			mA	$V_{CE} = 5$ V, $E_e = 20$ mW/cm^2 [4]
		OP501SLD	10		24	mA	$V_{CE} = 5$ V, $E_e = 20$ mW/cm^2 [4]
		OP501SLC	17		35	mA	$V_{CE} = 5$ V, $E_e = 20$ mW/cm^2 [4]
		OP501SLB	25		50	mA	$V_{CE} = 5$ V, $E_e = 20$ mW/cm^2 [4]
		OP501SLA	40			mA	$V_{CE} = 5$ V, $E_e = 20$ mW/cm^2 [4]
I_{CEO}	Collector Dark Current				100	nA	$V_{CE} = 10$ V, $E_e = 0$
$V_{(BR)CEO}$	Collector-Emitter Breakdown Voltage		30			V	$I_C = 1$ mA
$V_{(BR)ECO}$	Emitter-Collector Breakdown Voltage		5			V	$I_E = 100\ \mu A$
$V_{CE(SAT)}$ [3]	Collector-Emitter Saturation Voltage				.4	V	$I_C = 500\ \mu A$, $E_e = 20$ mW/cm^2 [4]

Typical Performance Curves

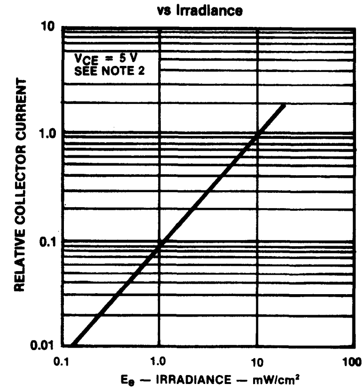
Collector Dark Current vs Ambient Temperature



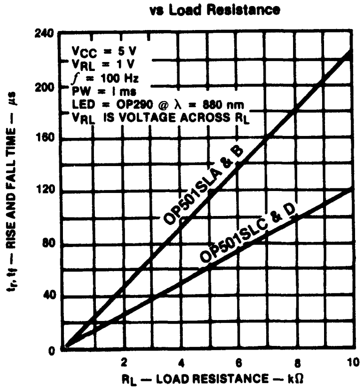
Normalized Collector Current vs Ambient Temperature



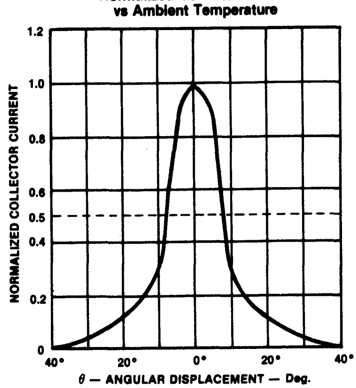
Relative Collector Current vs Irradiance



Rise and Fall Time vs Load Resistance



Normalized Collector Current vs Ambient Temperature



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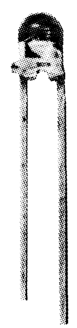
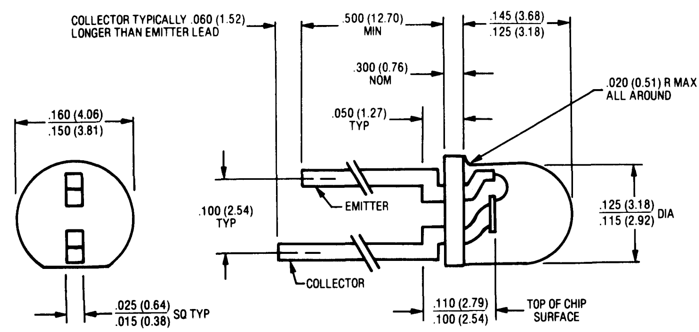
NPN Silicon Phototransistors

Types OP502, OP502A, OP502B



TWICE ACTUAL SIZE



Dimensions are in inches (millimeters).

If application requires mounting unit in a hole or sleeve, allow for .02 (.51) radius between unit body and flange.

Features

- .10" (2.54mm) LEAD SPACING
- THREE RANGES OF COLLECTOR CURRENT
- LENSED FOR HIGH SENSITIVITY

Description

The OP502, OP502A, and OP502B each consist of an NPN silicon phototransistor mounted in a lensed, clear plastic, end looking package. The lensing effect of the package allows an acceptance half angle of 40° measured from the optical axis to the half power point. This series provides a good trade off between wide acceptance angle and optical gain. It is spectrally matched to the OP160 and OP260 series of infrared emitting diodes.

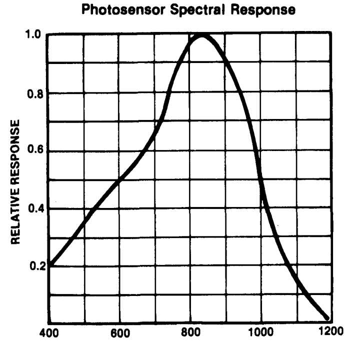
All electrical paramaters are 100% tested by manufacturing. Specifications are guaranteed to a cumulative .65% AQL.

absolute maximum rating (25°C unless otherwise noted)

Collector-Emitter Voltage . . . . 20 V
Emitter-Collector Voltage . . . . 5 V
Storage and Operating Temperature Range . . . . −40°C to +100°C
Lead Soldering Temperature (1/16 inch - 1.6 mm from case for 5 sec. with soldering iron)(1) . . . . 240°C
Power Dissipation . . . . 100 mW(2)

Notes: (1) RMA flux is recommended. Duration can be extended to 10 sec. max. when wave soldering.
(2) Derate Linearly 1.33 mW/°C above 25°C.
(3) Junction temperature maintained at 25°C.
(4) Light source is an unfiltered tungsten bulb operating at CT = 2870°K.

Photosensor Spectral Response



Types OP502, OP502A, OP502B

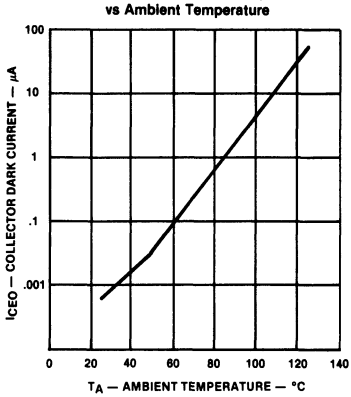
PRODUCT BULLETIN 3018
February 1982

electrical characteristics (25 °C unless otherwise noted)

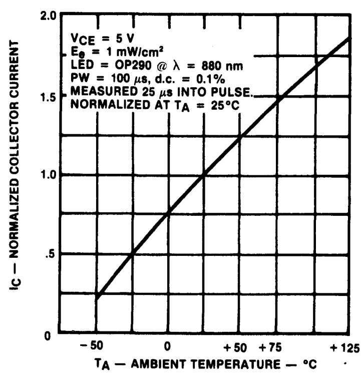
SYMBOL	PARAMETER		MIN	TYP	MAX	UNITS	TEST CONDITIONS
$I_{C(ON)}$[3]	On-State Collector Current	OP502	0.8			mA	V_{CE} = 5 V, E_e = 5 mW/cm²[4]
		OP502B	1.0		4.0	mA	V_{CE} = 5 V, E_e = 5 mW/cm²[4]
		OP502A	2.5		10.0	mA	V_{CE} = 5 V, E_e = 5 mW/cm²[4]
I_{CEO}	Collector Dark Current			1		μA	V_{CE} = 15 V, T_A = 80 °C E_e = 0
					100	nA	V_{CE} = 10 V, E_e = 0
$V_{(BR)CEO}$	Collector-Emitter Breakdown Voltage		20			V	I_C = 1 mA
$V_{(BR)ECO}$	Emitter-Collector Breakdown Voltage		5			V	I_E = 100 μA
$V_{CE(SAT)}$[3]	Collector-Emitter Saturation Voltage				0.4	V	I_C = 0.5 mA, E_e = 5 mW/cm²[4]
t_r	Rise Time			5		μs	V_{CC} = 10 V, I_C = 1 mA
t_f	Fall Time			5		μs	R_L = 100Ω

Typical Performance Curves

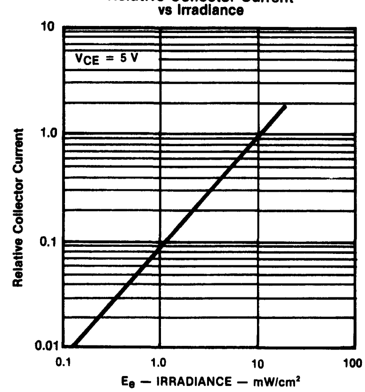
Collector Dark Current vs Ambient Temperature



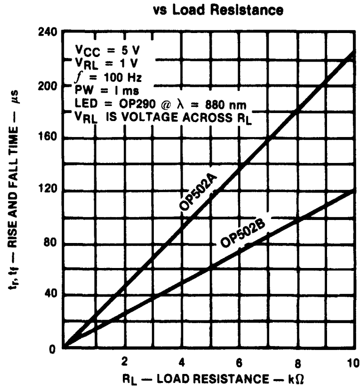
Normalized Collector Current vs Ambient Temperature



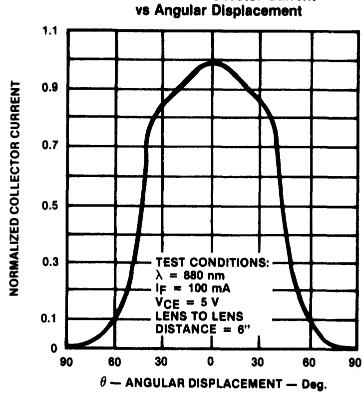
Relative Collector Current vs Irradiance



Rise and Fall Time vs Load Resistance



Normalized Collector Current vs Angular Displacement



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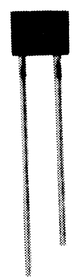
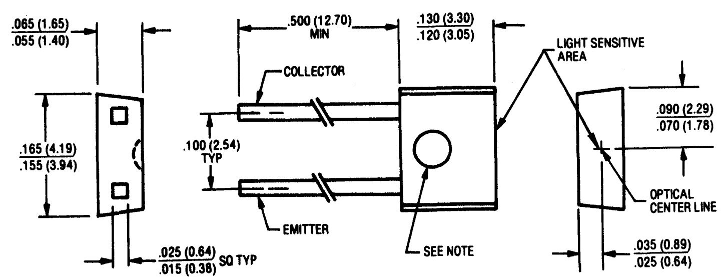
Printed in U.S.A.

NPN Silicon Phototransistor
Type OP508F



TWICE ACTUAL SIZE



NOTE: This is a mold mark and is being phased out in new production.

Dimensions are in inches (millimeters).

Features

- FLAT LENSED FOR WIDE ACCEPTANCE ANGLE
- CAN BE MOUNTED ON .10" (2.54mm) HOLE CENTERS
- LOW COST PLASTIC PACKAGE

Description

The OP508F consists of an NPN silicon phototransistor mounted in a flat lensed, black plastic, end looking package. The flat lens allows an acceptance half angle of 60° measured from the optical axis to the half power point. The black plastic package significantly reduces ambient light noise. This device can be mounted on .10" (2.54mm) hole centers making it an ideal low cost alternate to hermetic pill discretes. It is mechanically and spectrally matched to the OP168F infrared emitting diode.

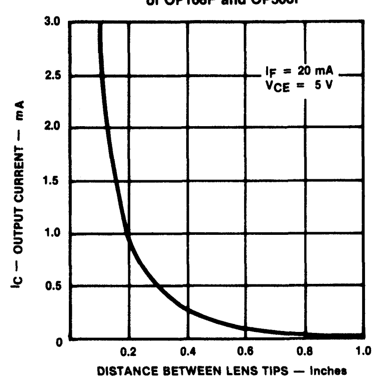
All electrical paramaters are 100% tested by manufacturing. Specifications are guaranteed to a cumulative .65% AQL.

absolute maximum rating (25°C unless otherwise noted)

Collector-Emitter Voltage . . . . 30 V
Emitter-Collector Voltage . . . . 5 V
Storage and Operating Temperature Range . . . . −40°C to +100°C
Lead Soldering Temperature (1/16 inch - 1.6 mm from case for 5 sec. with soldering iron)[1] . . . . 240°C
Power Dissipation . . . . 100 mW[2]

Notes: (1) RMA flux is recommended. Duration can be extended to 10 sec. max. when wave soldering.
(2) Derate Linearly 1.33 mW/°C above 25°C.
(3) Junction temperature maintained at 25°C.
(4) Light source is an unfiltered tungsten bulb operating at CT = 2870°K.

Coupling Characteristics of OP168F and OP508F



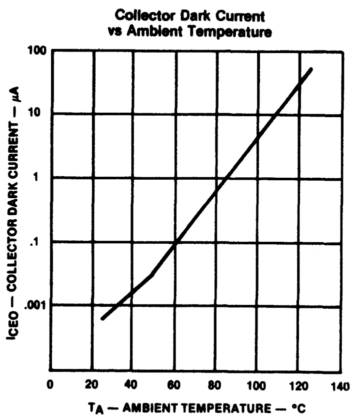
Type OP508F

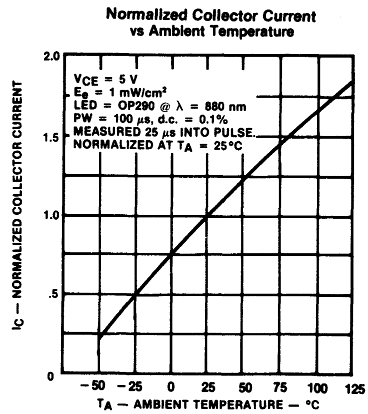
PRODUCT BULLETIN 3019
February 1982

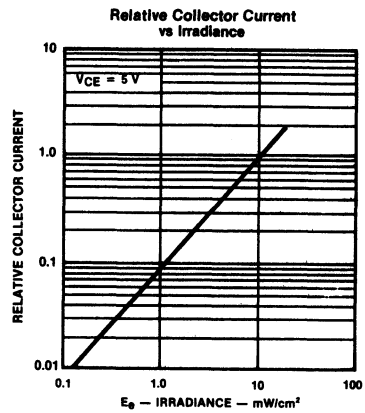
electrical characteristics (25 °C unless otherwise noted)

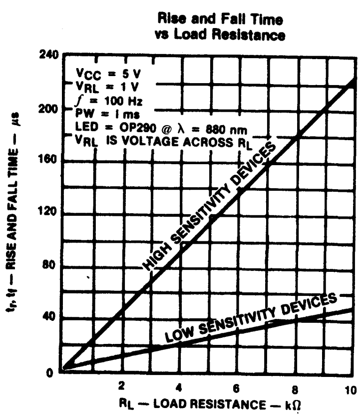
SYMBOL	PARAMETER	MIN	TYP	MAX	UNITS	TEST CONDITIONS
$I_{C(ON)}$ (3)	On-State Collector Current	0.5			mA	V_{CE} = 5 V, E_e = 20 mW/cm² (4)
I_{CEO}	Collector Dark Current			100	nA	V_{CE} = 10 V, E_e = 0
$V_{(BR)CEO}$	Collector-Emitter Breakdown Voltage	30			V	I_C = 1 mA
$V_{(BR)ECO}$	Emitter-Collector Breakdown Voltage	5			V	I_E = 100 μA
$V_{CE(SAT)}$ (3)	Collector-Emitter Saturation Voltage			.4	V	I_C = 250 μA, E_e = 20 mW/cm² (4)

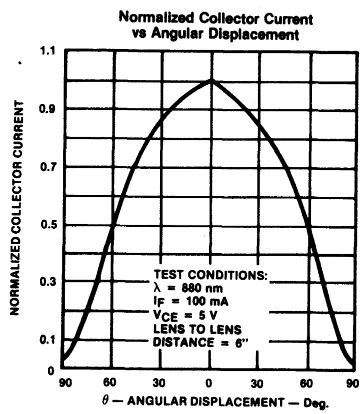
Typical Performance Curves











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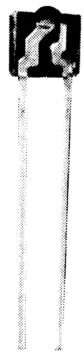
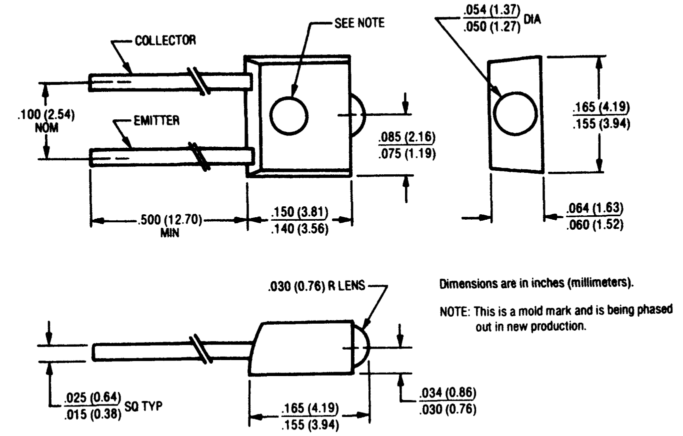
NPN Silicon Phototransistors

Types OP509, OP509SLD, OP509SLC, OP509SLB, OP509SLA



TWICE ACTUAL SIZE



Features

- LENSED FOR HIGH SENSITIVITY
- CAN BE MOUNTED ON .10" (2.54 mm) HOLE CENTERS
- LOW COST PLASTIC PACKAGE

Description

The OP509 and OP509SLD through SLA each consist of an NPN silicon phototransistor mounted in a lensed, clear plastic, end looking package. The lensing effect of the package allows an acceptance half angle of 50° measured from the optical axis to the half power point. This series is mechanically and spectrally matched to the OP169 series of infrared emitting diodes.

All electrical parameters are 100% tested by manufacturing. Specifications are guaranteed to a cumulative .65% AQL.

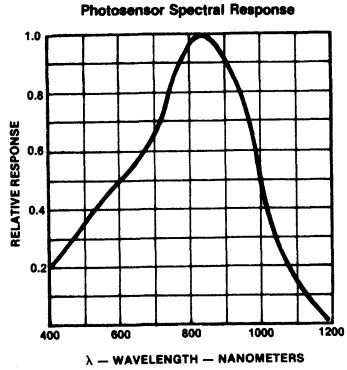
Collector current ranges on the OP509SLD through SLA are guaranteed to a 2.5% AQL.

absolute maximum rating (25 °C unless otherwise noted)

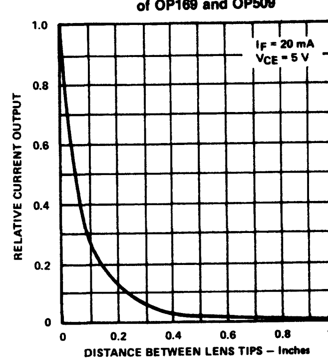
Collector-Emitter Voltage . . . . 30 V
Emitter-Collector Voltage . . . . 5 V
Storage and Operating Temperature Range . . . . −40 °C to +100 °C
Lead Soldering Temperature (1/16 inch - 1.6 mm from case for 5 sec. with soldering iron)(1) . . . . 240 °C
Power Dissipation . . . . 100 mW(2)

Notes: (1) RMA flux is recommended. Duration can be extended to 10 sec. max. when wave soldering.
(2) Derate Linearly 1.33 mW/ °C above 25 °C.
(3) Junction temperature maintained at 25 °C.
(4) Light source is an unfiltered tungsten bulb operating at CT = 2870 °K.

Photosensor Spectral Response



Coupling Characteristics of OP169 and OP509



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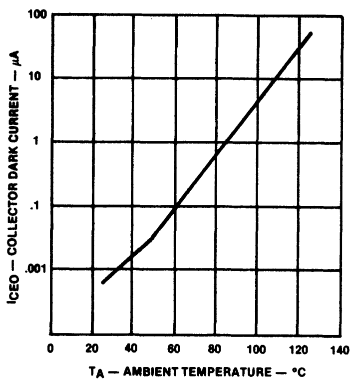
Types OP509, OP509SLD, OP509SLC, OP509SLB, OP509SLA

electrical characteristics (25 °C unless otherwise noted)

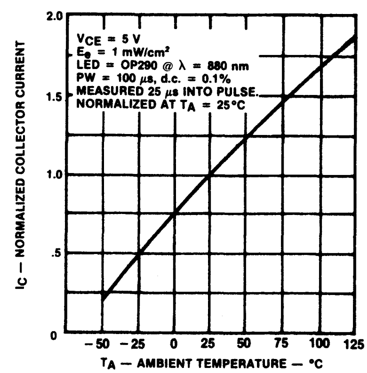
SYMBOL	PARAMETER		MIN	TYP	MAX	UNITS	TEST CONDITIONS
$I_{C(ON)}$ (3)	On-State Collector Current	OP509	0.5			mA	V_{CE} = 5 V, E_e = 1 mW/cm² (4)
		OP509SLD	.17			mA	V_{CE} = 5 V, E_e = 1 mW/cm² (4)
		OP509SLC	.3		.5	mA	V_{CE} = 5 V, E_e = 1 mW/cm² (4)
		OP509SLB	.7		.9	mA	V_{CE} = 5 V, E_e = 1 mW/cm² (4)
		OP509SLA	1.2		1.5	mA	V_{CE} = 5 V, E_e = 1 mW/cm² (4)
I_{CEO}	Collector-Emitter Dark Current				100	nA	V_{CE} = 10 V, E_e = 0
$V_{(BR)CEO}$	Collector-Emitter Breakdown Voltage		30			V	I_C = 1 mA
$V_{(BR)ECO}$	Emitter-Collector Breakdown Voltage		5			V	I_E = 100 μA
$V_{CE(SAT)}$ (3)	Collector-Emitter Saturation Voltage				.4	V	I_C = 250 μA, E_e = 5 mW/cm² (4)

Typical Performance Curves

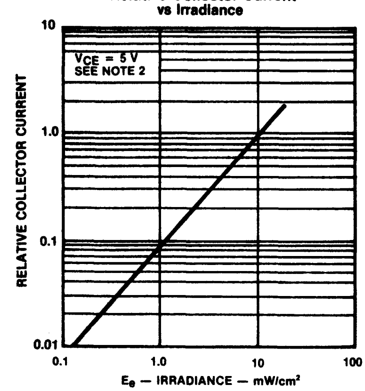
Collector Dark Current vs Ambient Temperature



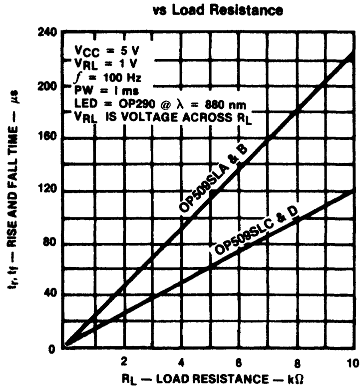
Normalized Collector Current vs Ambient Temperature



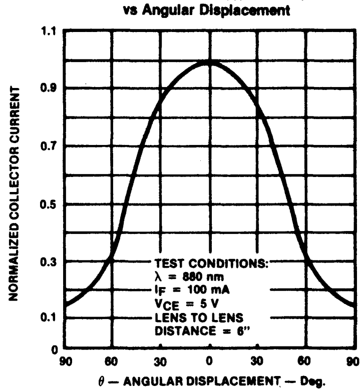
Relative Collector Current vs Irradiance



Rise and Fall Time vs Load Resistance



Normalized Collector Current vs Angular Displacement



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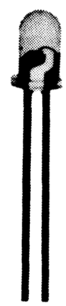
Printed in U.S.A.

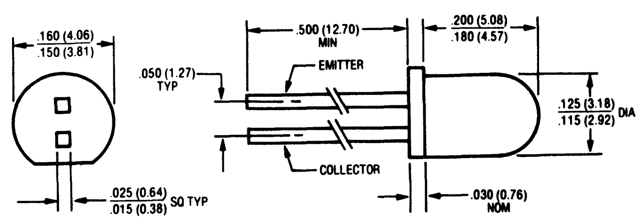
NPN Silicon Photodarlington

Type OP530



TWICE ACTUAL SIZE

Dimensions are in inches (millimeters).



Features

- LENSED FOR HIGH SENSITIVITY
- HIGH CURRENT GAIN
- LOW COST PLASTIC PACKAGE

Description

The OP530 consists of an NPN silicon photodarlington mounted in a lensed, clear plastic, end looking package. The lensing effect allows an acceptance half angle of 8° measured from the optical axis to the half power point. Photodarlington devices are normally used in applications where light signal levels are low and more current gain is needed than is possible with phototransistors. The OP530 is mechanically and spectrally matched to the OP160 and OP260 series of infrared emitting diodes.

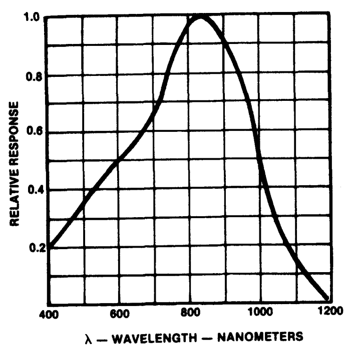
All electrical paramaters are 100% tested by manufacturing. Specifications are guaranteed to a cumulative .65% AQL.

absolute maximum rating (25 °C unless otherwise noted)

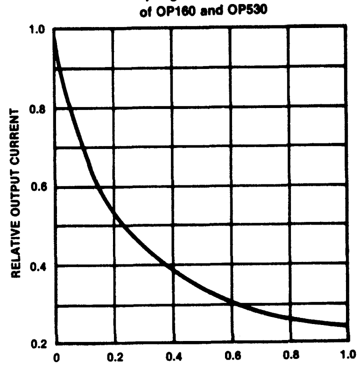
Collector-Emitter Voltage . . . . 15 V
Emitter-Collector Voltage . . . . 5 V
Storage and Operating Temperature Range . . . . −40 °C to +100 °C
Lead Soldering Temperature (1/16 inch - 1.6 mm from case for 5 sec. with soldering iron)[1] . . . . 240 °C
Power Dissipation . . . . 100 mW[2]

Notes: (1) RMA flux is recommended. Duration can be extended to 10 sec. max. when wave soldering.
(2) Derate Linearly 1.33 mW/°C above 25 °C.
(3) Junction temperature maintained at 25 °C.
(4) Light source is an unfiltered tungsten bulb operating at CT = 2870 °K.

Photosensor Spectral Response



Coupling Characteristics of OP160 and OP530



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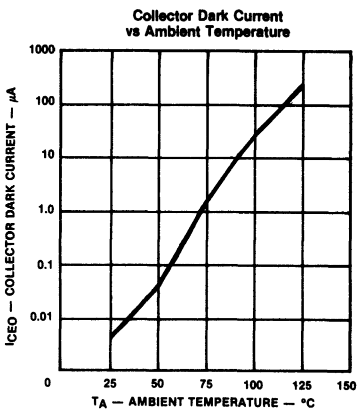
Type OP530

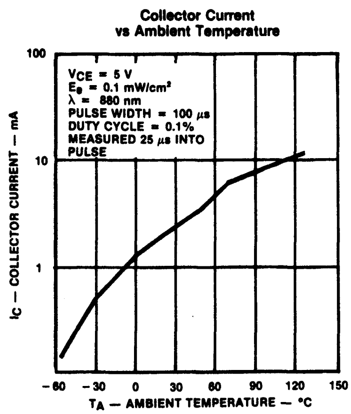
PRODUCT BULLETIN 3021
February 1982

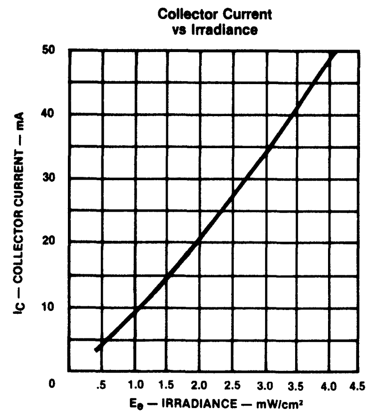
electrical characteristics (25°C unless otherwise noted)

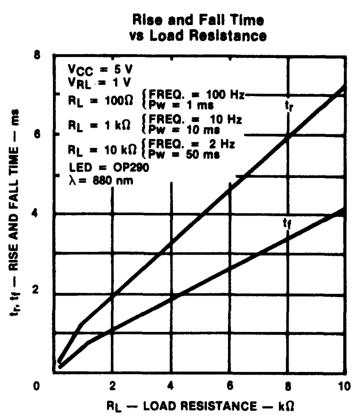
SYMBOL	PARAMETER	MIN	TYP	MAX	UNITS	TEST CONDITIONS
$I_{C(ON)}$ (3)	On-State Collector Current	5			mA	V_{CE} = 5 V, E_e = 0.5 mW/cm² (4)
I_{CEO}	Collector Dark Current			100	nA	V_{CE} = 10 V, E_e = 0
$V_{(BR)CEO}$	Collector-Emitter Breakdown Voltage	15			V	I_C = 1 mA
$V_{(BR)ECO}$	Emitter-Collector Breakdown Voltage	5			V	I_E = 100 μA
$V_{CE(SAT)}$ (3)	Collector-Emitter Saturation Voltage			1.1	V	I_C = 2.5 mA, E_e = 0.5 mW/cm² (4)

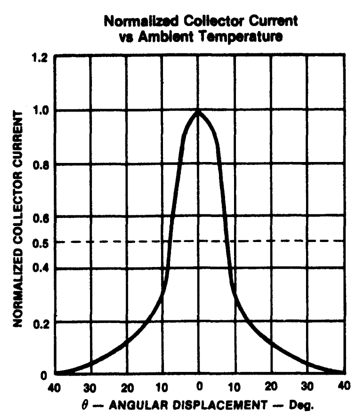
Typical Performance Curves











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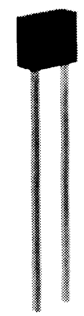
TRW OPTRON

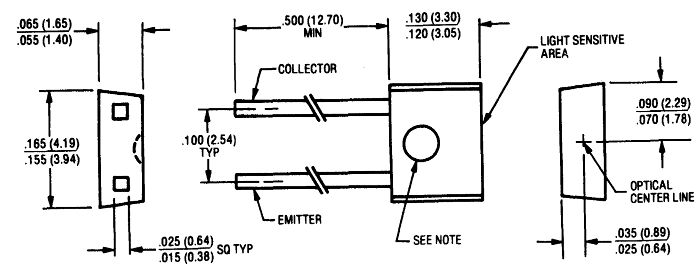
PRODUCT BULLETIN 3024
February 1982

NPN Silicon Photodarlington

Type OP538F



TWICE ACTUAL SIZE



NOTE: This is a mold mark and is being phased out in new production.

Dimensions are in inches (millimeters).

Features

- FLAT LENSED FOR WIDE ACCEPTANCE ANGLE
- CAN BE MOUNTED ON .10" (2.54mm) HOLE CENTERS
- LOW COST PLASTIC PACKAGE

Description

The OP538F consists of an NPN silicon photodarlington mounted in a flat lensed, black plastic, end looking package. The flat lens allows an acceptance half angle of 65° measured from the optical axis to the half power point. The black plastic package significantly reduces ambient light noise. This device can be mounted on .10" (2.54mm) hole centers making it an ideal low cost alternative to hermetic pill discretes. It is mechanically and spectrally matched to the OP168F infrared emitting diode.

All electrical parameters are 100% tested by manufacturing. Specifications are guaranteed to a cumulative .65% AQL.

absolute maximum rating (25 °C unless otherwise noted)

Collector-Emitter Voltage .... 15 V
Emitter-Collector Voltage .... 5 V
Storage and Operating Temperature Range .... − 40 °C to + 100 °C
Lead Soldering Temperature (1/16 inch - 1.6 mm from case for 5 sec. with soldering iron)[1] .... 240 °C
Power Dissipation .... 100 mW[2]

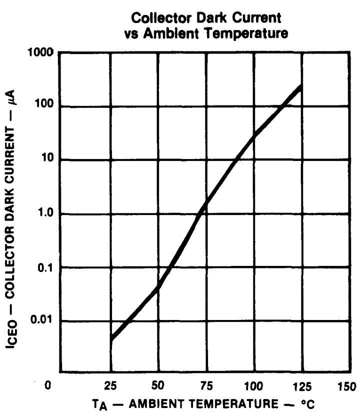
Notes: (1) RMA flux is recommended. Duration can be extended to 10 sec. max. when wave soldering.
(2) Derate Linearly 1.33 mW/ °C above 25 °C.
(3) Junction temperature maintained at 25 °C.
(4) Light source is an unfiltered tungsten bulb operating at CT = 2870 °K.

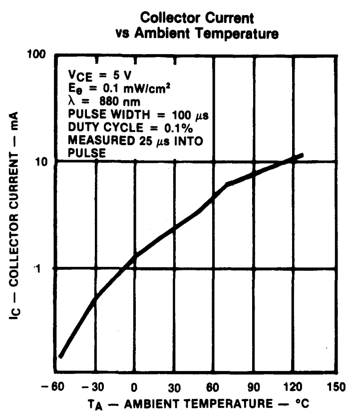
Type OP538F

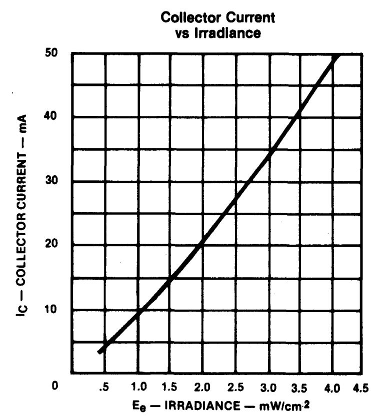
electrical characteristics (25 °C unless otherwise noted)

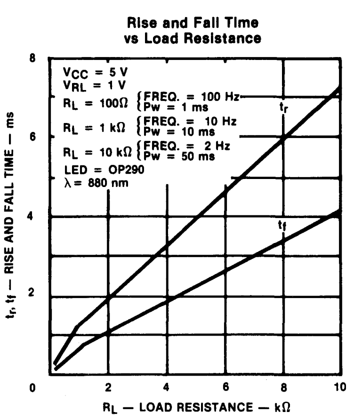
SYMBOL	PARAMETER	MIN	TYP	MAX	UNITS	TEST CONDITIONS
$I_{C(ON)}$ (3)	On-State Collector Current	1			mA	V_{CE} = 5 V, E_e = 1 mW/cm^2 (4)
I_{CEO}	Collector Dark Current			225	nA	V_{CE} = 10 V, E_e = 0
$V_{(BR)CEO}$	Collector-Emitter Breakdown Voltage	15			V	I_C = 1 mA
$V_{(BR)ECO}$	Emitter-Collector Breakdown Voltage	5			V	I_E = 100 μA
$V_{CE(SAT)}$ (3)	Collector-Emitter Saturation Voltage			1	V	I_C = 0.5 mA, E_e = 1 mW/cm^2 (4)

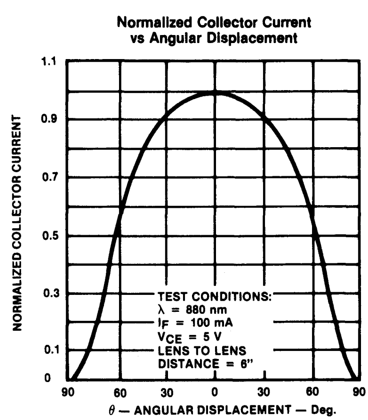
Typical Performance Curves











TRW OPTRON reserves the right to make changes at any time in order to improve design and to supply the best product possible.

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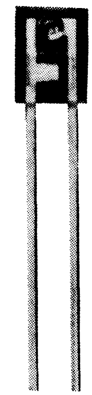
Printed in U.S.A.

TRW OPTRON

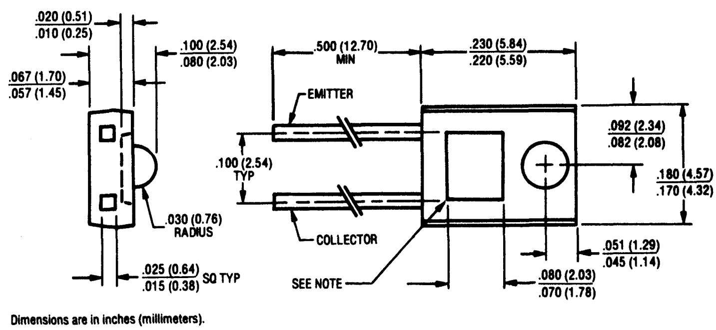
PRODUCT BULLETIN 3025
February 1982

NPN Silicon Phototransistors

Types OP550, OP550SLD, OP550SLC, OP550SLB, OP550SLA



TWICE ACTUAL SIZE



Dimensions are in inches (millimeters).

NOTE: This is a mold mark and is being phased out in new production.

Features

- WIDE RANGE OF COLLECTOR CURRENTS
- LENSED FOR HIGH SENSITIVITY
- LOW COST PLASTIC PACKAGE

Description

The OP550 and OP550SLD through SLA each consist of an NPN silicon phototransistor mounted in a lensed, clear plastic, side looking package. The lensing effect of the package allows an acceptance half angle of 28° measured from the optical axis to the half power point. This series is mechanically and spectrally matched to the OP140 and OP240 series of infrared emitting diodes.

All electrical parameters are 100% tested by manufacturing. Specifications are guaranteed to a cumulative .65% AQL.

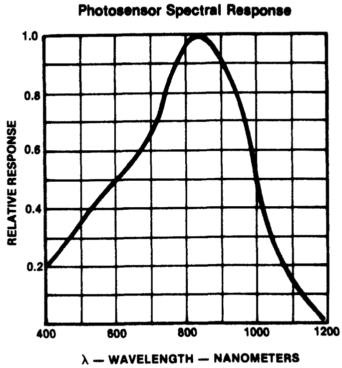
Collector current ranges on the OP550SLD through SLA are guaranteed to a 2.5% AQL.

absolute maximum rating (25°C unless otherwise noted)

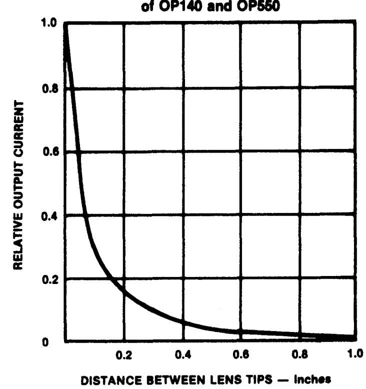
Collector-Emitter Voltage . . . . 30 V
Emitter-Collector Voltage . . . . 5 V
Storage and Operating Temperature Range . . . . −40°C to +100°C
Lead Soldering Temperature (1/16 inch - 1.6 mm from case for 5 sec. with soldering iron)(1) . . . . 240°C
Power Dissipation . . . . 100 mW(2)

Notes: (1) RMA flux is recommended. Duration can be extended to 10 sec. max. when wave soldering.
(2) Derate Linearly 1.33 mW/°C above 25°C.
(3) Junction temperature maintained at 25°C.
(4) Light source is an unfiltered tungsten bulb operating at CT = 2870°K.

Photosensor Spectral Response



Coupling Characteristics of OP140 and OP550



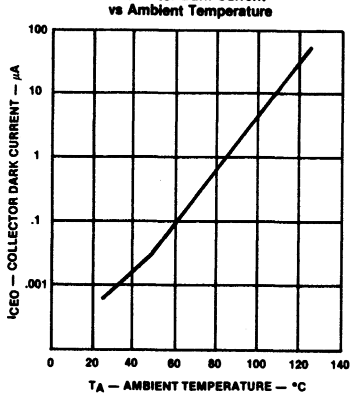
Types OP550, OP550SLD, OP550SLC, OP550SLB, OP550SLA

electrical characteristics (25 °C unless otherwise noted)

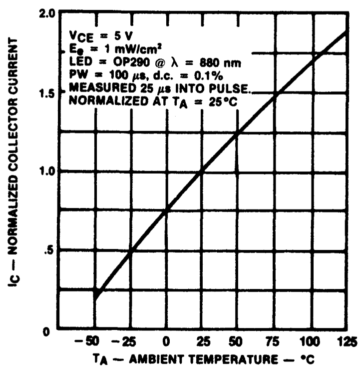
SYMBOL	PARAMETER		MIN	TYP	MAX	UNITS	TEST CONDITIONS
$I_{C(ON)}$ (3)	On-State Collector Current	OP550	0.5			mA	V_{CE} = 5 V, E_e = 20 mW/cm² (4)
		OP550SLD	4.5		14.5	mA	V_{CE} = 5 V, E_e = 20 mW/cm² (4)
		OP550SLC	12.0		19.0	mA	V_{CE} = 5 V, E_e = 20 mW/cm² (4)
		OP550SLB	15.0		27.5	mA	V_{CE} = 5 V, E_e = 20 mW/cm² (4)
		OP550SLA	22.0			mA	V_{CE} = 5 V, E_e = 20 mW/cm² (4)
I_{CEO}	Collector Dark Current				100	nA	V_{CE} = 10 V, E_e = 0
$V_{(BR)CEO}$	Collector-Emitter Breakdown Voltage		30.0			V	I_C = 1 mA
$V_{(BR)ECO}$	Emitter-Collector Breakdown Voltage		5.0			V	I_E = 100 μA
$V_{CE(SAT)}$ (3)	Collector-Emitter Saturation Voltage				0.4	V	I_C = 250 μA, E_e = 20 mW/cm² (4)

Typical Performance Curves

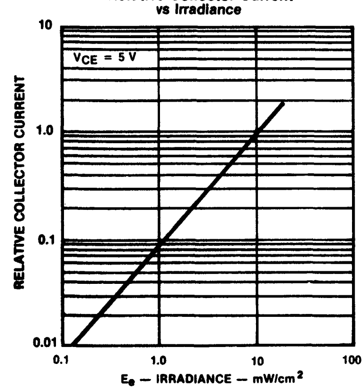
Collector Dark Current vs Ambient Temperature



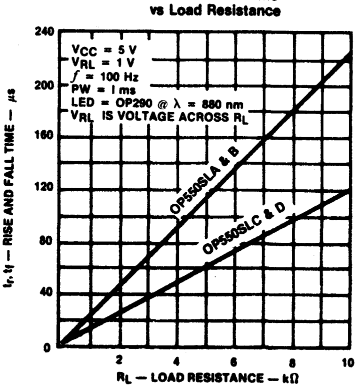
Normalized Collector Current vs Ambient Temperature



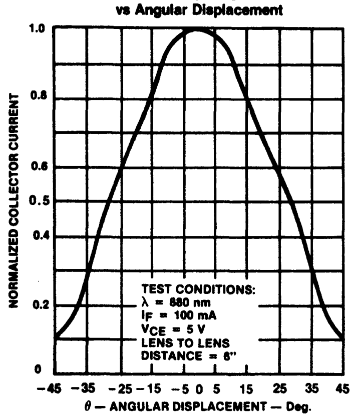
Relative Collector Current vs Irradiance



Rise and Fall Time vs Load Resistance



Normalized Collector Current vs Angular Displacement



TRW OPTRON reserves the right to make changes at any time in order to improve design and to supply the best product possible.

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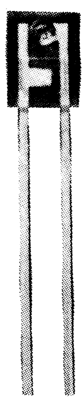
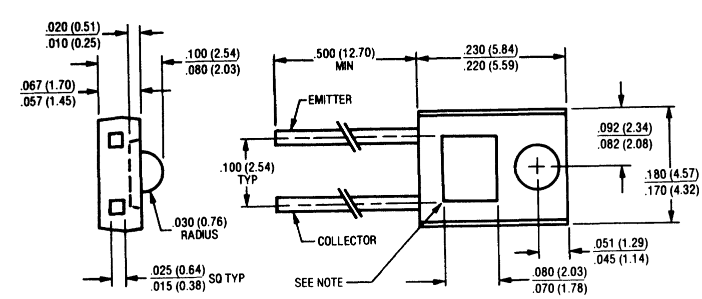
 Printed in U.S.A.

NPN Silicon Photodarlington

Type OP560



TWICE ACTUAL SIZE



Dimensions are in inches (millimeters).

NOTE: This is a mold mark and is being phased out in new production.

Features

- LENSED FOR HIGH SENSITIVITY
- HIGH CURRENT GAIN
- LOW COST PLASTIC PACKAGE

Description

The OP560 consists of an NPN silicon photodarlington mounted in a lensed, clear plastic, side looking package. The lensing effect allows an acceptance half angle of 28° measured from the optical axis to the half power point. Photodarlington devices are normally used in applications where light signal levels are low and more current gain is needed than is possible with phototransistors. The OP560 is mechanically and spectrally matched to the OP140 and OP240 series of infrared emitting diodes.

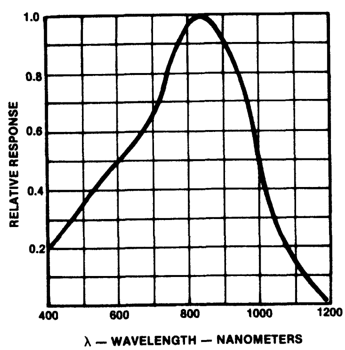
All electrical parameters are 100% tested by manufacturing. Specifications are guaranteed to a cumulative .65% AQL.

absolute maximum rating (25 °C unless otherwise noted)

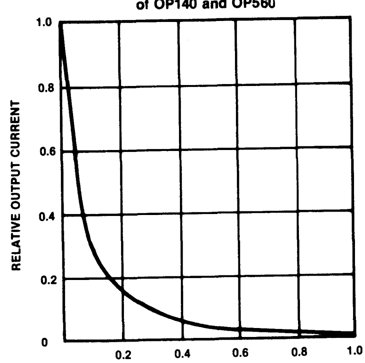
Collector-Emitter Voltage . . . . 30 V
Emitter-Collector Voltage . . . . 5 V
Storage and Operating Temperature Range . . . . − 40 °C to + 100 °C
Lead Soldering Temperature (1/16 inch - 1.6 mm from case for 5 sec. with soldering iron)(1) . . . . 240 °C
Power Dissipation . . . . 100 mW(2)

Notes: (1) RMA flux is recommended. Duration can be extended to 10 sec. max. when wave soldering.
(2) Derate Linearly 1.33 mW/ °C above 25 °C.
(3) Junction temperature maintained at 25 °C.
(4) Light source is an unfiltered tungsten bulb operating at CT = 2870 °K.

Photosensor Spectral Response



Coupling Characteristics of OP140 and OP560

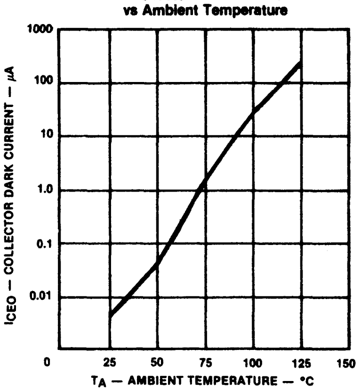


electrical characteristics (25 °C unless otherwise noted)

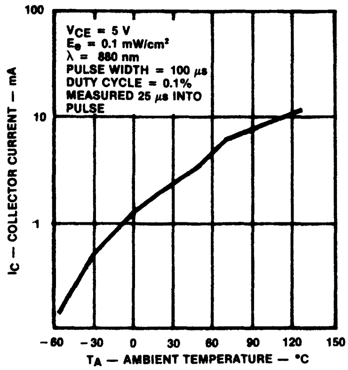
SYMBOL	PARAMETER	MIN	TYP	MAX	UNITS	TEST CONDITIONS
$I_{C(ON)}$ (3)	On-State Collector Current	.5			mA	V_{CE} = 2 V, E_e = 1 mW/cm² (4) R_L = 50Ω
I_{CEO}	Collector Dark Current			100	nA	V_{CE} = 10 V, E_e = 0
$V_{(BR)CEO}$	Collector-Emitter Breakdown Voltage	30			V	I_C = 1 mA
$V_{(BR)ECO}$	Emitter-Collector Breakdown Voltage	5			V	I_E = 100 μA
$V_{CE(SAT)}$ (3)	Collector-Emitter Saturation Voltage			1.1	V	I_C = 0.4 mA, E_e = 1 mW/cm² (4)

Typical Performance Curves

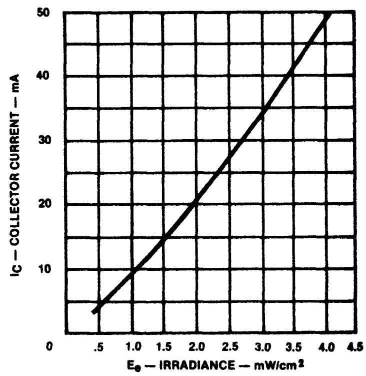
Collector Dark Current vs Ambient Temperature



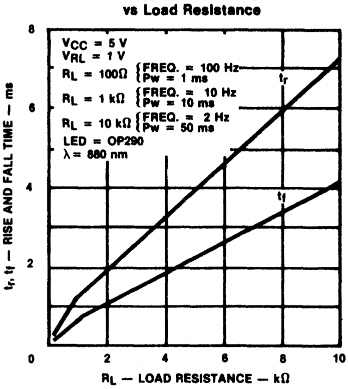
Collector Current vs Ambient Temperature



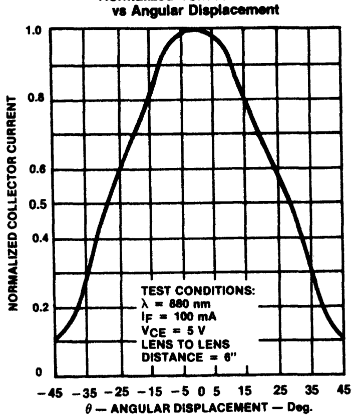
Collector Current vs Irradiance



Rise and Fall Time vs Load Resistance



Normalized Collector Current vs Angular Displacement



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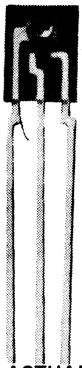
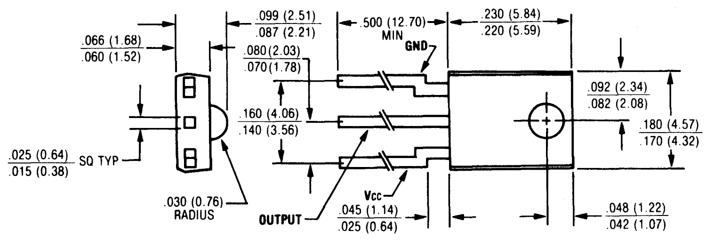
Photologic™ Plastic Sensors
Types OPL550, OPL550-OC, OPL551, OPL551-OC



TWICE ACTUAL SIZE



Dimensions are in inches (millimeters).

Features

- FOUR OUTPUT OPTIONS
- HIGH NOISE IMMUNITY
- DIRECT TTL/LSTTL INTERFACE
- LOW COST PLASTIC SIDE LOOKING PACKAGE
- MECHANICALLY AND SPECTRALLY MATCHED TO OP140 LED
- DATA RATES TO 250 KBAUD

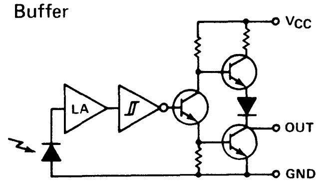
Description

The OPL500, OPL500-OC, OPL551, and OPL551-OC contain a monolithic integrated circuit which incorporates a photodiode, a linear amplifier, and a Schmitt trigger on a single silicon chip. The devices feature TTL/LSTTL compatible logic level output which can drive up to 8 TTL loads without additional circuitry. Also featured are medium speed data rates to 250 KBAUD with typical output rise and fall times of 25 nsec. The Schmitt trigger's hysteresis characteristics provide high immunity to noise on input and V_{CC}. The Photologic chip is encapsulated in a molded plastic package which has an integral lens for enhanced optical coupling. These devices are mechanically and spectrally matched to the OP140 and OP240 infrared emitting diodes.

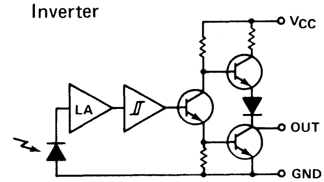
TM Trademark TRW INC.

Schematics

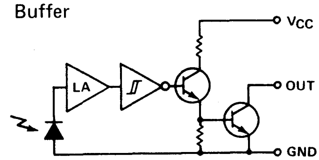
OPL550 (Totem-Pole Output)
Buffer



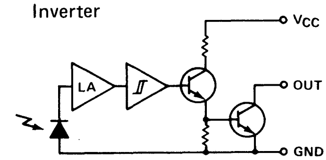
OPL551 (Totem-Pole Output)
Inverter



OPL550-OC (Open Collector Output)
Buffer



OPL551-OC (Open Collector Output)
Inverter



absolute maximum ratings (25° C unless otherwise noted)

Supply Voltage, V_{CC} (not to exceed 3 seconds)	+10 V
Storage Temperature Range	−40°C to +85°C
Operating Temperature Range	−40°C to +70°C
Lead Soldering Temperature (1/16 Inch [1.6 mm] from Case for 5 sec. w/soldering iron(1))	240°C
Power Dissipation	200 mW(2)
Duration of Output Short to V_{CC} or Ground (OPL550, OPL551)	1 sec.
Duration of Output Short to V_{CC} (OPL550-OC, OPL551-OC)	1 sec.
Voltage at Output Lead (OPL550-OC, OPL551-OC)	35 V

Notes: (1) RMA flux is recommended. Duration can be extended to 10 seconds max. when flow soldering.
(2) Derate linearly 2.67 mW/°C above 25°C.

Types OPL550, OPL550-OC, OPL551, OPL551-OC

electrical characteristics (−40° C to +70° C unless otherwise noted)

SYMBOL	PARAMETER	MIN	TYP	MAX	UNITS	TEST CONDITIONS (1)
V_{CC}	Operating Supply Voltage	4.75		5.25	V	
	Peak-to-Peak V_{CC} Ripple Necessary to Cause False Triggering of Output		2		V	V_{CC} = 5 VDC f = DC to 50 MHz
$E_{eT(+)}$	Positive-Going Threshold Irradiance		0.5	3	mW/cm^2	V_{CC} = 5 V
$E_{eT(-)}$	Negative-Going Threshold Irradiance		0.25		mW/cm^2	
$E_{eT(+)}/E_{eT(-)}$	Hysteresis Ratio		2			
I_{CC}	Supply Current			15	mA	V_{CC} = 5.25 V, E_e = 0 or 3 mW/cm^2

OPL550 (Buffer, Totem-Pole)

V_{OH}	High Level Output Voltage	2.4			V	V_{CC} = 4.75 V, I_{OH} = −800 μA E_e = 3 mW/cm^2
V_{OL}	Low Level Output Voltage			0.4	V	V_{CC} = 4.75 V, I_{OL} = 12.8 mA, E_e = 0
I_{OS}	Short Circuit Output Current	−30		−100	mA	V_{CC} = 5.25 V, E_e = 3 mW/cm^2 Output = GND

OPL550-OC (Buffer, Open Collector)

I_{OH}	High Level Output Current			100	μA	V_{CC} = 4.75 V, V_{OH} = 30 V E_e = 3 mW/cm^2
V_{OL}	Low Level Output Voltage			0.4	V	V_{CC} = 4.75 V, I_{OL} = 12.8 mA, E_e = 0

OPL551 (Inverter, Totem-Pole)

V_{OH}	High Level Output Voltage	2.4			V	V_{CC} = 4.75 V, I_{OH} = − 800 μA E_e = 0
V_{OL}	Low Level Output Voltage			0.4	V	V_{CC} = 4.75 V, I_{OL} = 12.8 mA E_e = 3 mW/cm^2
I_{OS}	Short Circuit Output Current	−30		−100	mA	V_{CC} = 5.25 V, E_e = 0 Output = GND

OPL551-OC (Inverter, Open Collector)

I_{OH}	High Level Output Current			100	μA	V_{CC} = 4.75 V, V_{OH} = 30 E_e = 0
V_{OL}	Low Level Output Voltage			0.4	V	V_{CC} = 4.75 V, I_{OL} = 12.8 mA E_e = 3 mW/cm^2

OPL550, OPL551

t_r, t_f	Output Rise Time, Output Fall Time			70	ns	V_{CC} = 5 V, T_A = 25°C E_e = 0 or 3 mW/cm^2
t_{PLH}, t_{PHL}	Propagation Delay, Low-High, High-Low			5	μs	f = 10 kHz, D.C. = 50% R_L = 8 TTL Loads

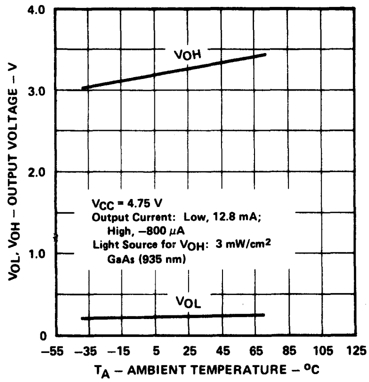
OPL550-OC, OPL551-OC

t_r, t_f	Output Rise Time, Output Fall Time			70	ns	V_{CC} = 5 V, T_A = 25°C E_e = 0 or 3 mW/cm^2
t_{PLH}, t_{PHL}	Propagation Delay, Low-High, High-Low			5	μs	f = 10 kHz, D.C. = 50% R_L = 360 Ω

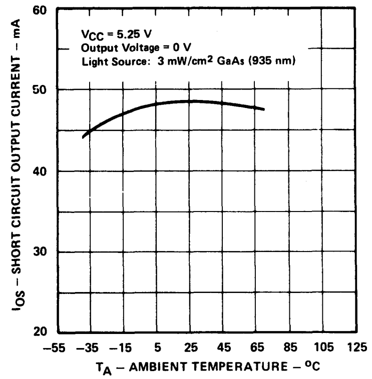
Note: (1) Light measurements are made with λ_i = 935 nm.

OPL550, OPL551

Output Voltage vs. Ambient Temperature

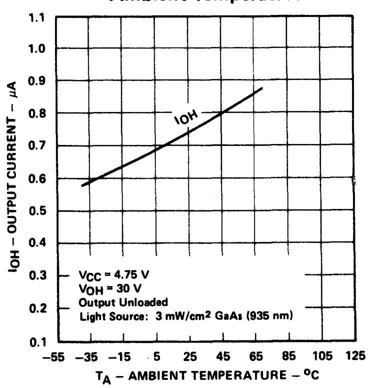


Short Circuit Output Current vs. Ambient Temperature

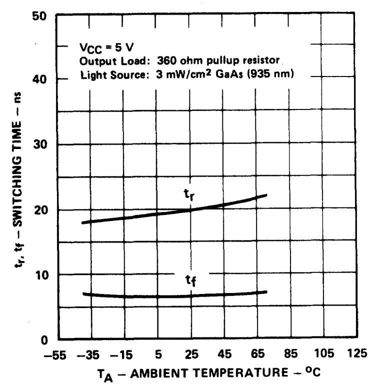


OPL550-OC, OPL551-OC

Output Current (High) vs. Ambient Temperature

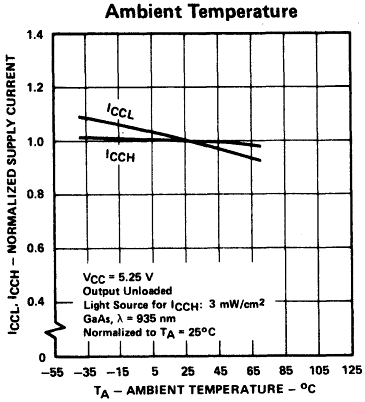


Rise Time and Fall Time vs. Ambient Temperature



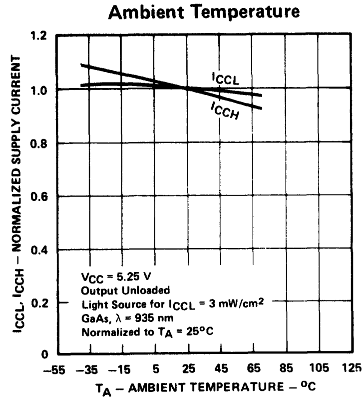
OPL550, OPL550-OC

Normalized Supply Current vs. Ambient Temperature

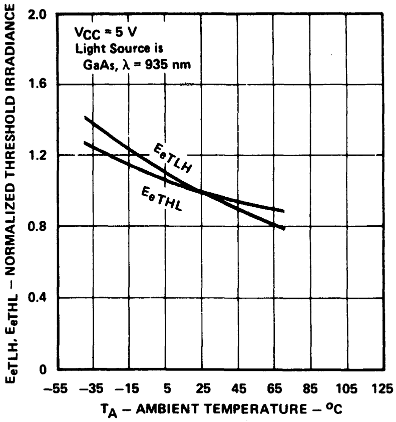


OPL551, OPL551-OC

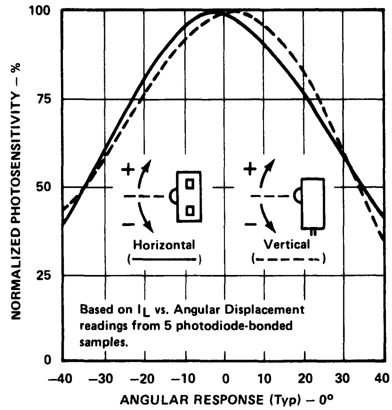
Normalized Supply Current vs. Ambient Temperature



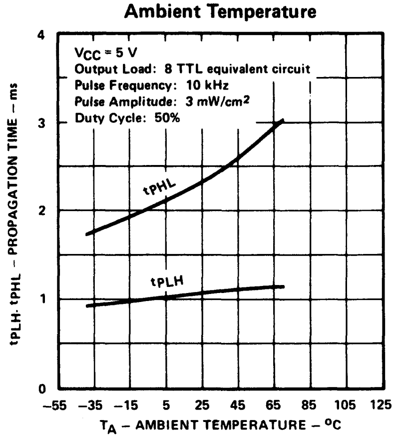
Normalized Threshold Irradiance vs. Ambient Temperature



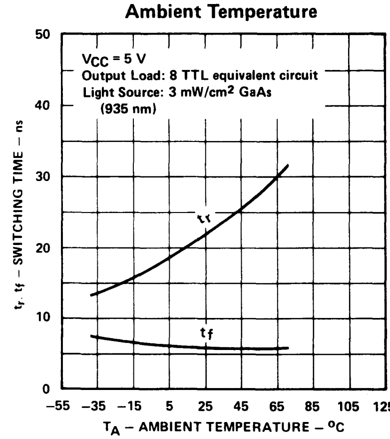
Angular Displacement from Package Mechanical Axis



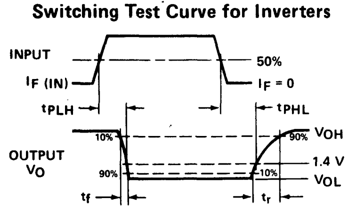
Propagation Time vs. Ambient Temperature



Rise Time and Fall Time vs. Ambient Temperature

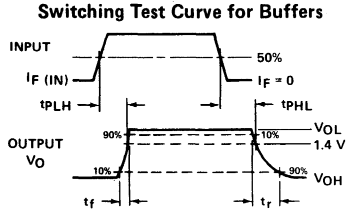


Switching Test Curve for Inverters



LED: f = 1 kHz, D.C. = 50%

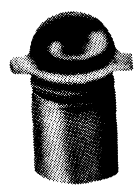
Switching Test Curve for Buffers



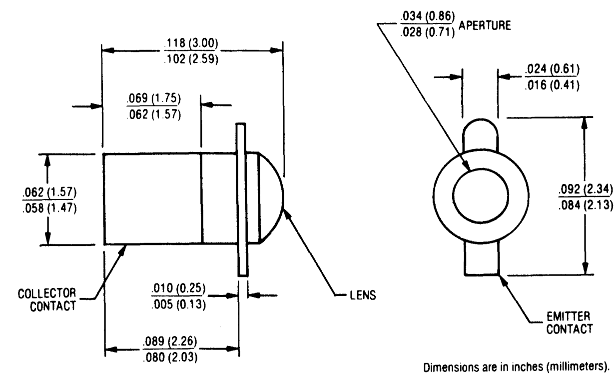
LED: f = 1 kHz, D.C. = 50%

NPN Silicon Phototransistors

Types OP600—OP604, OP640—OP644



5 TIMES ACTUAL SIZE



Dimensions are in inches (millimeters).

Features

- MINIATURE HERMETICALLY SEALED PACKAGE
- WIDE RANGE OF COLLECTOR CURRENTS
- IDEAL FOR DIRECT MOUNTING IN PC BOARDS(1)

Description

The OP600 through OP604 and OP640 through OP644 each consist of an NPN silicon phototransistor mounted in a miniature glass lensed, hermetically sealed, "Pill" package. The lensing effect allows an acceptance half angle of 15° measured from the optical axis to the half power point. Except for breakdown voltages and leakage the OP600 series and OP640 series are identical. They are also mechanically and spectrally matched to the OP123 and OP223 series of infrared emitting diodes.

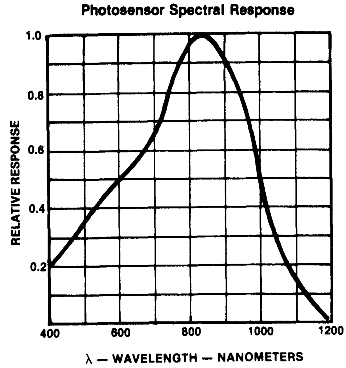
All electrical parameters are 100% tested by manufacturing. Specifications are guaranteed to a cumulative .65% AQL.

absolute maximum rating (25 °C unless otherwise noted)

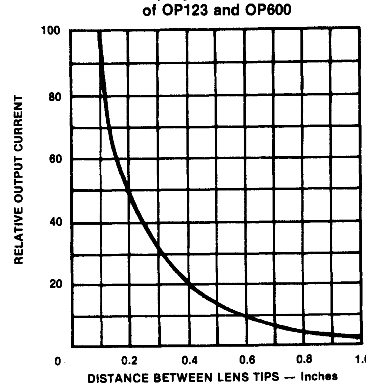
Collector-Emitter Voltage, OP600—OP604	50 V
OP640—OP641	25 V
Emitter-Collector Voltage, OP600—OP604	7 V
OP640—OP641	5 V
Storage Temperature Range	−65 °C to +150 °C
Operating Temperature Range	−65 °C to +125 °C
Soldering Temperature (for 5 seconds with soldering iron)(2)	240 °C
Power Dissipation	50 mW(3)

Notes: (1) Refer to Application Bulletin 111 which discusses proper techniques for soldering Pill type devices to PC boards.
(2) RMA flux is recommended. Duration can be extended to 10 sec. max. when wave soldering.
(3) Derate Linearly 0.5 mW/°C above 25 °C.
(4) Junction temperature maintained at 25 °C.
(5) Light source is an unfiltered tungsten bulb operating at CT = 2870 °K.

Photosensor Spectral Response



Coupling Characteristics of OP123 and OP600



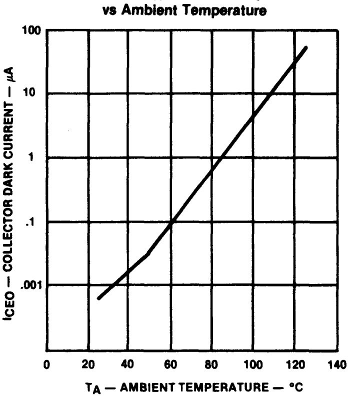
Types OP600—OP604, OP640—OP644

electrical characteristics (25 °C unless otherwise noted)

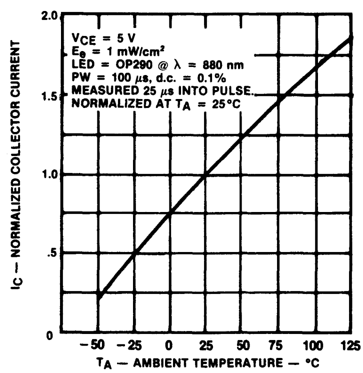
SYMBOL	PARAMETER		MIN	TYP	MAX	UNITS	TEST CONDITIONS
$I_{C(ON)}$ (4)	On-State Collector Current	OP600—OP640	0.8			mA	V_{CE} = 5 V, E_e = 20 mW/cm² (5)
		OP601—OP641	0.5		3.0	mA	V_{CE} = 5 V, E_e = 20 mW/cm² (5)
		OP602—OP642	2		5	mA	V_{CE} = 5 V, E_e = 20 mW/cm² (5)
		OP603—OP643	4		8	mA	V_{CE} = 5 V, E_e = 20 mW/cm² (5)
		OP604—OP644	7		22	mA	V_{CE} = 5 V, E_e = 20 mW/cm² (5)
I_{CEO}	Collector Dark Current	OP600—OP604				nA	V_{CE} = 10 V, E_e = 0
		OP640—OP644				nA	V_{CE} = 10 V, E_e = 0
$V_{(BR)CEO}$	Collector-Emitter Breakdown Voltage	OP600—OP604	50			V	I_C = 100 μA
		OP640—OP644	25			V	I_C = 100 μA
$V_{(BR)ECO}$	Emitter-Collector Breakdown Voltage	OP600—OP604	7			V	I_E = 100 μA
		OP640—OP644	5			V	I_E = 100 μA
$V_{CE(SAT)}$ (4)	Collector-Emitter Saturation Voltage				0.4	V	I_C = 0.4 mA, E_e = 20 mW/cm² (5)
t_r	Rise Time			2.5		μs	V_{CC} = 5 V, I_C = 0.8 mA
t_f	Fall Time			2.5		μs	R_L = 1 kΩ, See Test Circuit

Typical Performance Curves

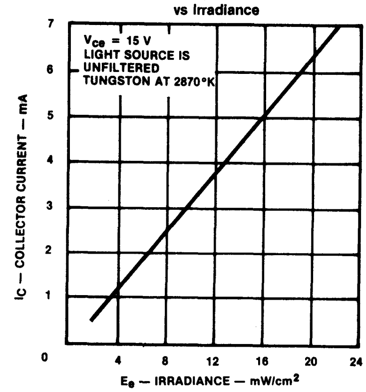
Collector Dark Current vs Ambient Temperature



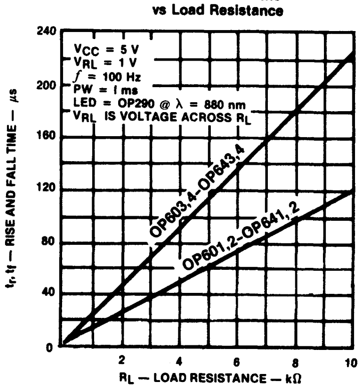
Normalized Collector Current vs Ambient Temperature



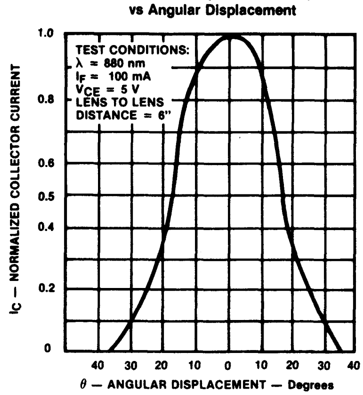
Collector Current vs Irradiance



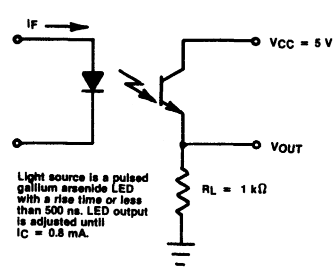
Rise and Fall Time vs Load Resistance



Normalized Collector Current vs Angular Displacement



Switching Time Test Circuit



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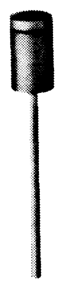
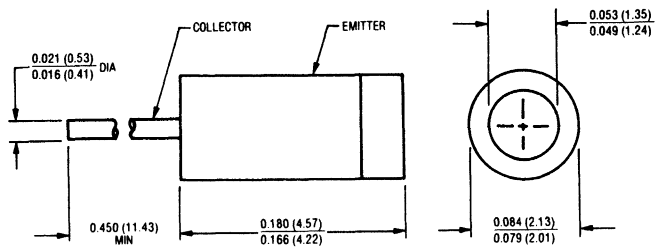
NPN Silicon Phototransistors

Types OP700, OP701, OP702, OP703



TWICE ACTUAL SIZE



Dimensions are in inches (millimeters).

Features

- COAXIAL HERMETICALLY SEALED PACKAGE
- WIDE RANGE OF COLLECTOR CURRENTS
- IDEAL FOR DIRECT MOUNTING IN PC BOARDS

Description

The OP700, OP701, OP702, and OP703 each consist of an NPN silicon phototransistor mounted in a flat lensed, coaxial, hermetically sealed package. The flat lens allows an acceptance half angle of 30° measured from the optical axis to the half power point. The coaxial package features a collector lead extending from the bottom making it possible to insert the unit into a PC board with the flat lens flush to one side so that both contacts can be soldered to the other side. This is particularly suitable in paper tape readers.

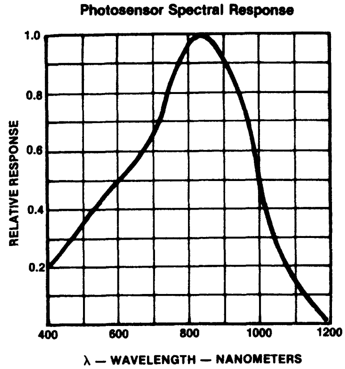
All electrical paramaters are 100% tested by manufacturing. Specifications are guaranteed to a cumulative .65% AQL.

absolute maximum rating (25 °C unless otherwise noted)

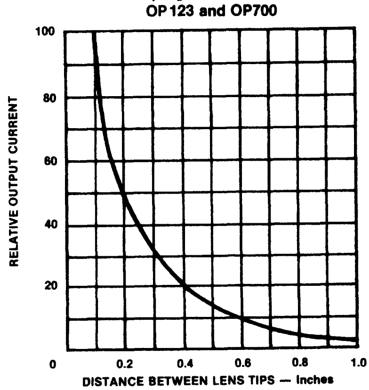
Collector-Emitter Voltage	25 V
Emitter-Collector Voltage	5 V
Storage Temperature Range	− 65 °C to + 150 °C
Operating Temperature Range	− 55 °C to + 125 °C
Lead Soldering Temperature (1/16 inch - 1.6 mm from case for 5 sec. with soldering iron)(1)	240 °C
Power Dissipation	50 mW(2)

Notes: (1) RMA flux is recommended. Duration can be extended to 10 sec. max. when wave soldering.
(2) Derate Linearly 0.5 mW/ °C above 25 °C.
(3) Junction temperature maintained at 25 °C.
(4) Light source is an unfiltered tungsten bulb operating at CT = 2870 °K.

Photosensor Spectral Response



Coupling Characteristics OP 123 and OP700



PRODUCT BULLETIN 3030
February 1982

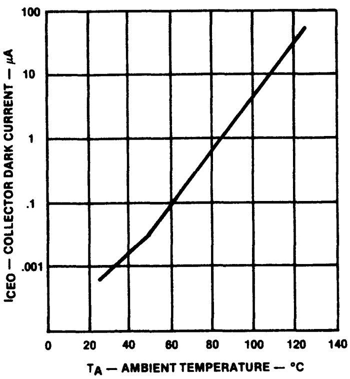
Types OP700, OP701, OP702, OP703

electrical characteristics (25 °C unless otherwise noted)

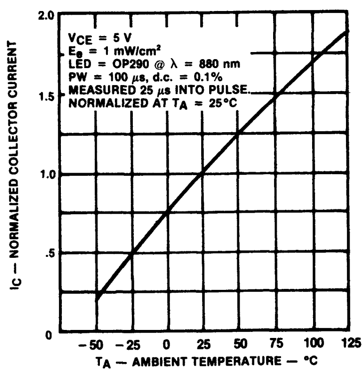
SYMBOL	PARAMETER		MIN	TYP	MAX	UNITS	TEST CONDITIONS
$I_{C(ON)}$ (3)	On-State Collector Current	OP700	0.8				V_{CE} = 5 V, E_e = 20 mW/cm² (4)
		OP701	1.5				V_{CE} = 5 V, E_e = 20 mW/cm² (4)
		OP702	3				V_{CE} = 5 V, E_e = 20 mW/cm² (4)
		OP703	6				V_{CE} = 5 V, E_e = 20 mW/cm² (4)
I_{CEO}	Collector Dark Current			100		nA	V_{CE} = 10 V, E_e = 0
$V_{(BR)CEO}$	Collector-Emitter Breakdown Voltage		25			V	I_C = 100 μA
$V_{(BR)ECO}$	Emitter-Collector Breakdown Voltage		5			V	I_E = 100 μA
$V_{CE(SAT)}$ (3)	Collector-Emitter Saturation Voltage			0.4		V	I_C = 0.4 mA, E_e = 20 mW/cm² (4)

Typical Performance Curves

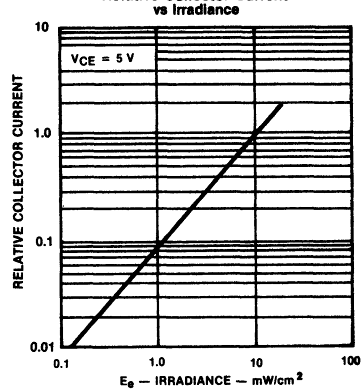
Collector Dark Current vs Ambient Temperature



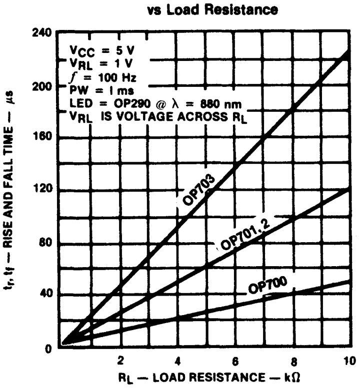
Normalized Collector Current vs Ambient Temperature



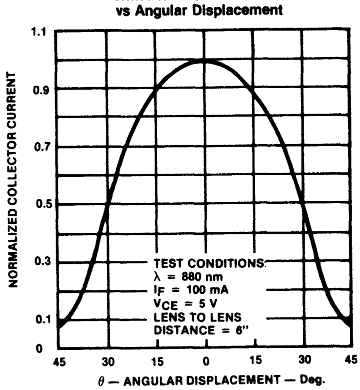
Relative Collector Current vs Irradiance



Rise and Fall Time vs Load Resistance



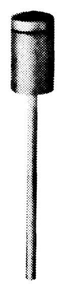
Normalized Collector Current vs Angular Displacement



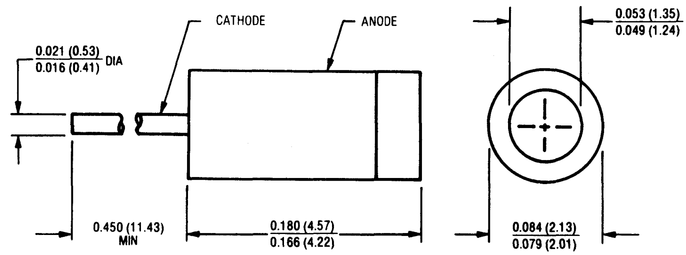
TRW OPTRON, A DIVISION OF TRW INC., 1201 TAPPAN CIRCLE, CARROLLTON, TEXAS, 75006 (214) 323-2200, TWX-910-860-5958

PN Junction Silicon Photodiode

Type OP790



TWICE ACTUAL SIZE



Dimensions are in inches (millimeters).

Features

- COAXIAL HERMETICALLY SEALED PACKAGE
- FAST SWITCHING SPEED
- IDEAL FOR DIRECT MOUNTING TO PC BOARDS

Description

The OP790 consists of a PN junction silicon photodiode mounted in a flat lensed, coaxial, hermetically sealed package. The flat lens allows an acceptance half angle of 30° measured from the optical axis to the half power point. The coaxial package features a cathode lead extending from the bottom making it possible to insert the unit into a PC board with the flat lens flush to one side so that both contacts can be soldered to the other side. This is particularly suitable in paper tape readers. This device can also be used in a photovoltaic mode.

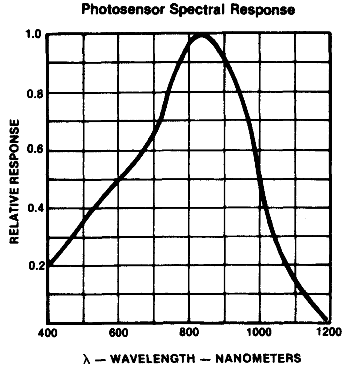
All electrical parameters are 100% tested by manufacturing. Specifications are guaranteed to a cumulative .65% AQL.

absolute maximum rating (25 °C unless otherwise noted)

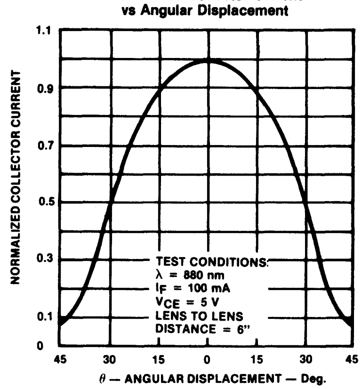
Reverse Voltage .... 100 V
Storage Temperature Range .... −65 °C to +150 °C
Operating Temperature Range .... −55 °C to +125 °C
Lead Soldering Temperature (1/16 inch [1.6 mm] from case for 5 sec. with soldering iron)[1] .... 240 °C
Power Dissipation .... 50 mW[2]

Notes: (1) RMA flux is recommended. Duration can be extended to 10 sec. max. when wave soldering.
(2) Derate Linearly 0.5 mW/°C above 25°C.
(3) Junction temperature maintained at 25°C.
(4) Light source is an unfiltered tungsten bulb operating at CT = 2870°K.

Photosensor Spectral Response



Normalized Collector Current vs Angular Displacement



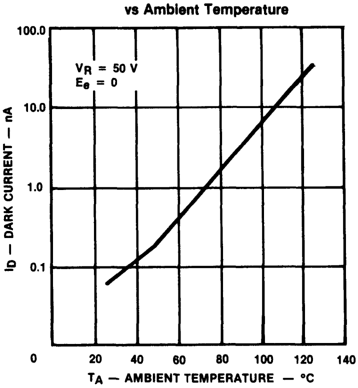
Type OP790

electrical characteristics (25 °C unless otherwise noted)

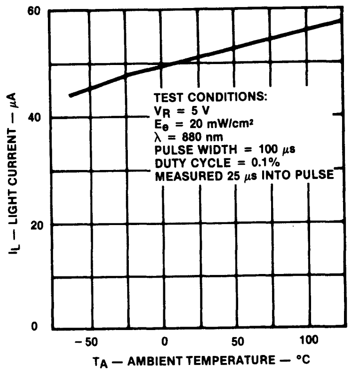
SYMBOL	PARAMETER	MIN	TYP	MAX	UNITS	TEST CONDITIONS
I_L (3)	Light Current	13			μA	V_R = 10 V, E_e = 20 mW/cm^2 (4)
I_D (3)	Dark Current			10	nA	V_R = 10 V
$V_{(BR)R}$	Reverse Breakdown Voltage	100			V	I_R = 100 μA
t_r t_f	Rise Time Fall Time		600 600		ns ns	V_R = 50 V, R_L = 1 KΩ See Test Circuit

Typical Performance Curves

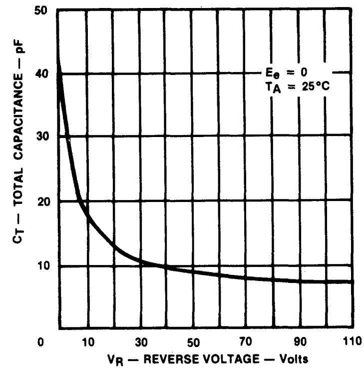
Dark Current vs Ambient Temperature



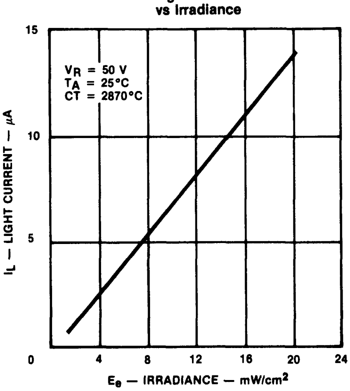
Light Current vs Ambient Temperature



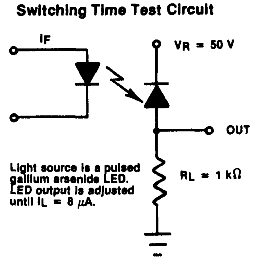
Total Capacitance vs Reverse Voltage



Light Current vs Irradiance



Switching Time Test Circuit



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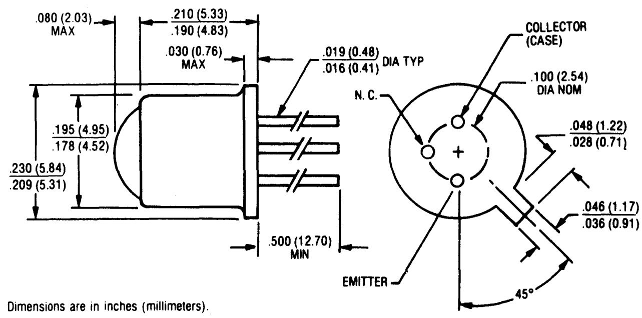
Printed in U.S.A.

NPN Silicon Phototransistors

Types OP800 through OP805

ACTUAL SIZE



Dimensions are in inches (millimeters).

Features

- LENSED FOR HIGH SENSITIVITY
- WIDE RANGE OF COLLECTOR CURRENTS
- TO-18 HERMETICALLY SEALED PACKAGE

Description

The OP800 through OP805 each consist of an NPN silicon phototransistor mounted in a lensed, hermetically sealed, TO-18 package. TO-18 packages offer high power dissipation, and superior hostile environment operation. The lensing effect allows an acceptance half angle of 10° measured from the optical axis to the half power point. The base lead is bonded to enable conventional transistor biasing. This series is mechanically and spectrally matched to the OP130 and OP230 series of infrared emitting diodes.

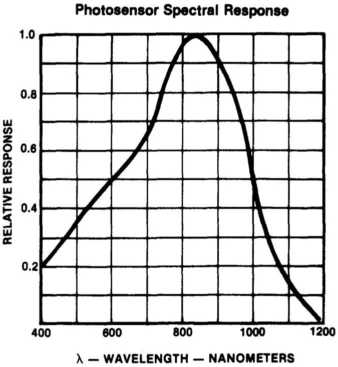
All electrical paramaters are 100% tested by manufacturing. Specifications are guaranteed to a cumulative .65% AQL.

absolute maximum rating (25 °C unless otherwise noted)

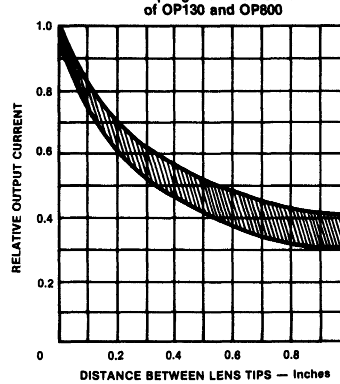
Collector-Base Voltage	50 V
Collector-Emitter Voltage	30 V
Emitter-Base Voltage	7 V
Emitter-Collector Voltage	7 V
Continuous Collector Current	50 mA
Storage Temperature Range	−65 °C to +150 °C
Operating Temperature Range	−65 °C to +125 °C
Lead Soldering Temperature (1/16 inch [1.6mm] from case for 5 sec. with soldering iron)(1)	240 °C
Power Dissipation	250 mW(2)

Notes: (1) RMA flux is recommended. Duration can be extended to 10 sec. max. when wave soldering.
(2) Derate Linearly 2.5 mW/ °C above 25 °C.
(3) Junction temperature maintained at 25 °C.
(4) Light source is an unfiltered tungsten bulb operating at CT = 2870 °K.

Photosensor Spectral Response



Coupling Characteristics of OP130 and OP800



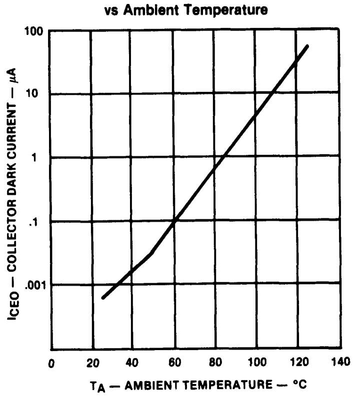
Types OP800 through OP805

electrical characteristics (25°C unless otherwise noted)

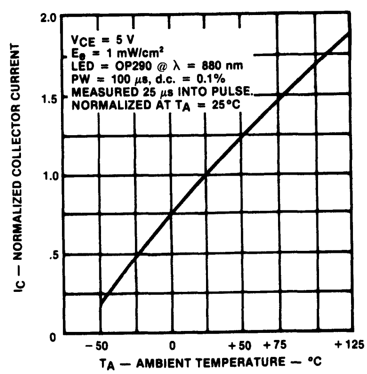
SYMBOL	PARAMETER		MIN	TYP	MAX	UNITS	TEST CONDITIONS
$I_{C(ON)}$ (3)	On-State Collector Current	OP800	0.8			mA	V_{CE} = 5 V, E_e = 5 mW/cm² (4)
		OP801	0.5		3	mA	V_{CE} = 5 V, E_e = 5 mW/cm² (4)
		OP802	2		5	mA	V_{CE} = 5 V, E_e = 5 mW/cm² (4)
		OP803	4		8	mA	V_{CE} = 5 V, E_e = 5 mW/cm² (4)
		OP804	7		22	mA	V_{CE} = 5 V, E_e = 5 mW/cm² (4)
		OP805	15			mA	V_{CE} = 5 V, E_e = 5 mW/cm² (4)
I_{CEO}	Collector Dark Current				100	nA	V_{CE} = 10 V, E_e = 0
$V_{(BR)CEO}$	Collector-Emitter Breakdown Voltage		30			V	I_C = 100 µA
$V_{(BR)ECO}$	Emitter-Collector Breakdown Voltage		7			V	I_E = 100 µA
$V_{CE(SAT)}$ (3)	Collector-Emitter Saturation Voltage				0.4	V	I_C = 0.4 mA, E_e = 5 mW/cm² (4)
t_r	Rise Time			2		µs	V_{CC} = 5 V, I_C = 0.8 mA
t_f	Fall Time			2		µs	R_L = 100Ω, See Test Circuit

Typical Performance Curves

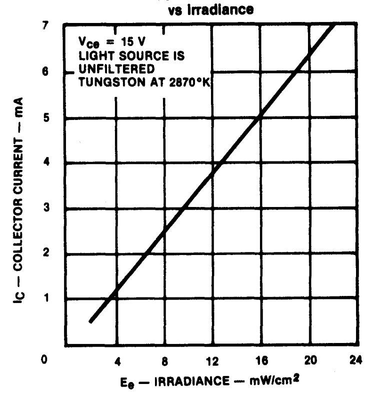
Collector Dark Current vs Ambient Temperature



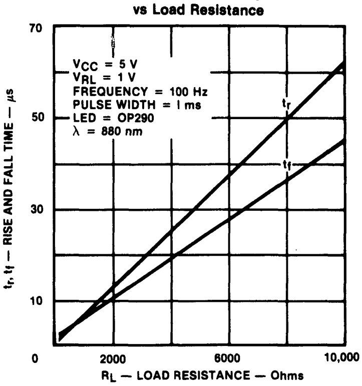
Normalized Collector Current vs Ambient Temperature



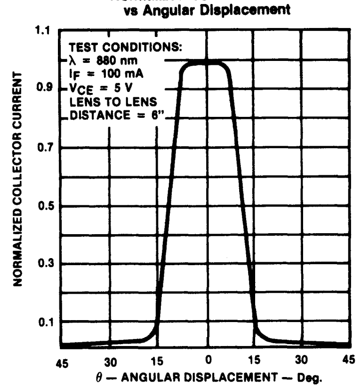
Collector Current vs Irradiance



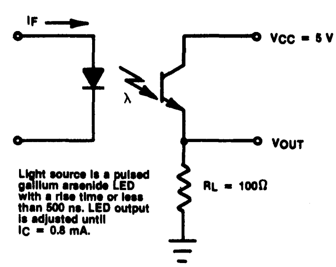
Rise and Fall Time vs Load Resistance



Normalized Collector Current vs Angular Displacement



Switching Time Test Circuit



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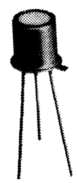
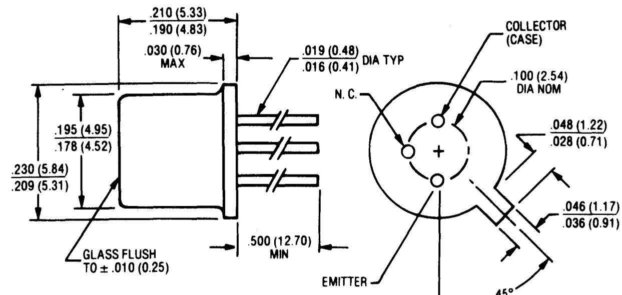
 Printed in U.S.A.

NPN Silicon Phototransistors
Types OP800W, OP801W, OP802W



ACTUAL SIZE



Dimensions are in inches (millimeters).

Features

- FLAT LENSED FOR WIDE ACCEPTANCE ANGLE
- THREE COLLECTOR CURRENT RANGES
- TO-18 HERMETICALLY SEALED PACKAGE

Description

The OP800W, OP801W,and OP802W each consist of an NPN silicon phototransistor mounted in a flat lensed, hermetically sealed TO-18 package. TO-18 packages offer high power dissipation and superior hostile environment operation.The flat lens allows an acceptance half angle of 35° measured from the optical axis to the half power point. The base lead is bonded to enable conventional transistor biasing.This series is mechanically and spectrally matched to the OP130W and OP230W series of infrared emitting diodes.

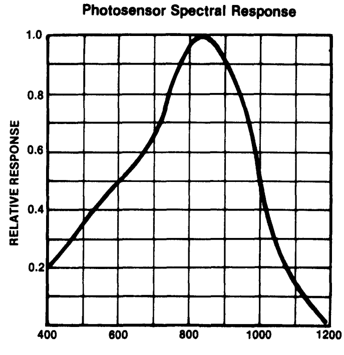
All electrical parameters are 100% tested by manufacturing. Specifications are guaranteed to a cumulative .65% AQL.

absolute maximum rating (25°C unless otherwise noted)

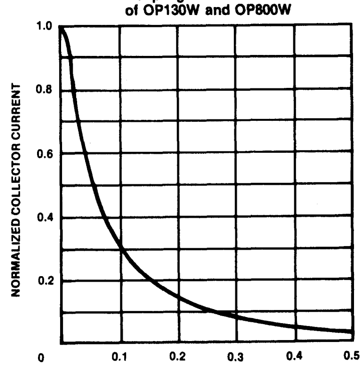
Collector-Emitter Voltage . . . . . 30 V
Emitter-Collector Voltage . . . . . 7 V
Storage Temperature Range . . . . . −65°C to +150°C
Operating Temperature Range . . . . . −55°C to +125°C
Lead Soldering Temperature (1/16 inch - 1.6 mm from case for 5 sec. with soldering iron)[1] . . . . . 240°C
Power Dissipation . . . . . 250 mW[2]

Notes: (1) RMA flux is recommended. Duration can be extended to 10 sec. max. when wave soldering.
(2) Derate Linearly 2.5 mW/°C above 25°C.
(3) Junction temperature maintained at 25°C.
(4) Light source is an unfiltered tungsten bulb operating at CT = 2870°K.

Photosensor Spectral Response



Coupling Characteristics of OP130W and OP800W



Types OP800W, OP801W, OP802W

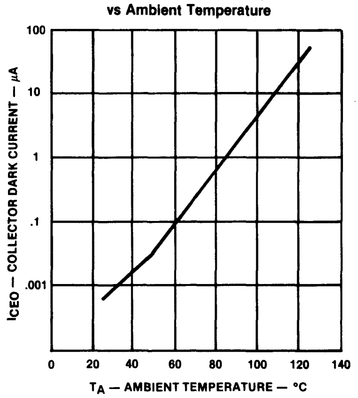
PRODUCT BULLETIN 3022
February 1982

electrical characteristics (25°C unless otherwise noted)

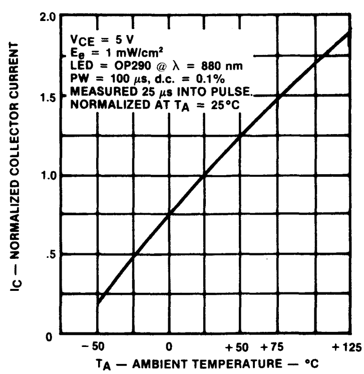
SYMBOL	PARAMETER		MIN	TYP	MAX	UNITS	TEST CONDITIONS
$I_{C(ON)}$ (3)	Light Current	OP800W OP801W OP802W	0.3 0.5 2.5		 3 	mA mA mA	V_{CE} = 5 V, E_e = 5 mW/cm^2 (4) V_{CE} = 5 V, E_e = 5 mW/cm^2 (4) V_{CE} = 5 V, E_e = 5 mW/cm^2 (4)
I_{CEO}	Dark Current				100	nA	V_{CE} = 10 V, E_e = 0
$V_{(BR)CEO}$	Collector-Emitter Breakdown Voltage		30			V	I_C = 100 μA
$V_{(BR)ECO}$	Emitter-Collector Breakdown Voltage		7			V	I_E = 100 μA
$V_{CE(SAT)}$ (3)	Saturation Voltage				0.4	V	I_C = 0.4 mA, E_e = 5 mW/cm^2 (4)
t_r t_f	Rise Time Fall Time			2 2		μs μs	V_{CC} = 5 V, I_C = 0.8 mA R_L = 100Ω, See Test Circuit

Typical Performance Curves

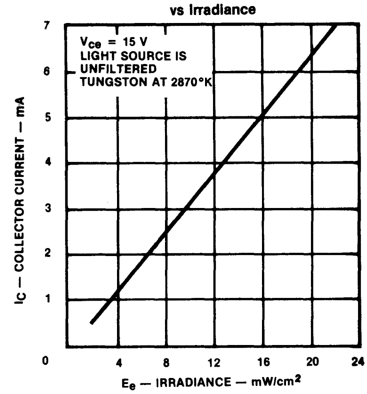
Collector Dark Current vs Ambient Temperature



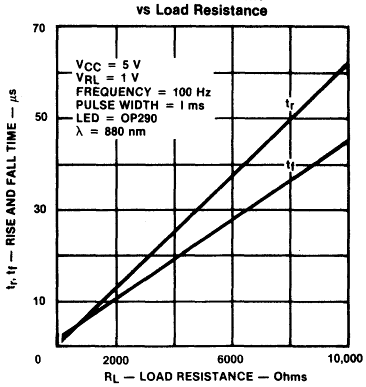
Normalized Collector Current vs Ambient Temperature



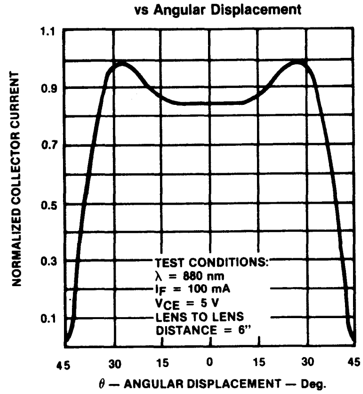
Collector Current vs Irradiance



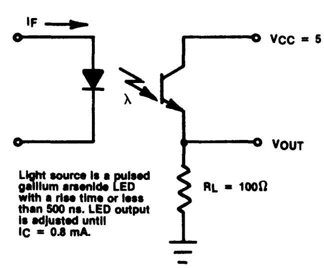
Rise and Fall Time vs Load Resistance



Normalized Collector Current vs Angular Displacement



Switching Time Test Circuit



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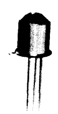
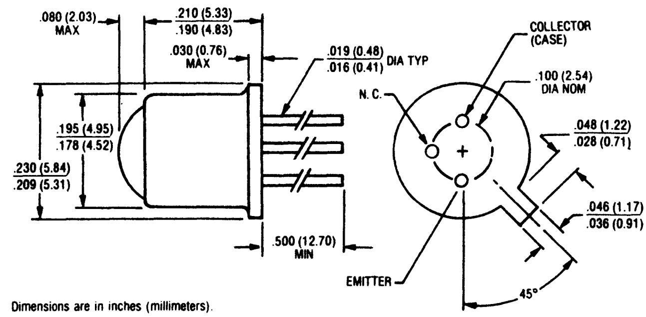
TRW OPTRON

PRODUCT BULLETIN 3033
February 1982

NPN Silicon Photodarlington
Type OP830



ACTUAL SIZE



Dimensions are in inches (millimeters).

Features

- LENSED FOR HIGH SENSITIVITY
- HIGH CURRENT GAIN
- TO-18 HERMETICALLY SEALED PACKAGE

Description

The OP830 consists of an NPN silicon photodarlington mounted in a lensed, hermetically sealed, TO-18 package. The lensing effect allows an acceptance half angle of 10° measured from the optical axis to the half power point. Photodarlington devices are normally used in applications where light signal levels are low and more current gain is needed than is possible with phototransistors. The OP830 is mechanically and spectrally matched to the OP130 and OP230 series of infrared emitting diodes.

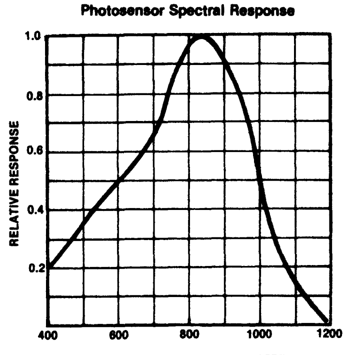
All electrical parameters are 100% tested by manufacturing. Specifications are guaranteed to a cumulative .65% AQL.

absolute maximum rating (25 °C unless otherwise noted)

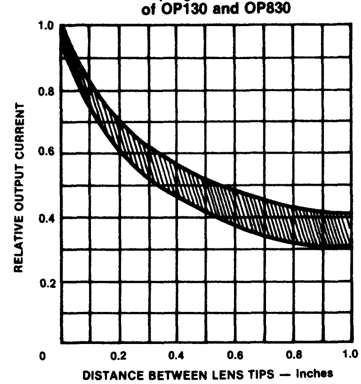
Collector-Emitter Voltage .... 15 V
Emitter-Collector Voltage .... 5 V
Storage Temperature Range .... −65 °C to +150 °C
Operating Temperature Range .... −55 °C to +125 °C
Lead Soldering Temperature (1/16 inch - 1.6 mm from case for 5 sec. with soldering iron)(1) .... 240 °C
Power Dissipation .... 50 mW(2)

Notes: (1) RMA flux is recommended. Duration can be extended to 10 sec. max. when wave soldering.
(2) Derate Linearly 2.0 mW/°C above 25 °C.
(3) Junction temperature maintained at 25 °C.
(4) Light source is an unfiltered tungsten bulb operating at CT = 2870 °K.

Photosensor Spectral Response



Coupling Characteristics of OP130 and OP830



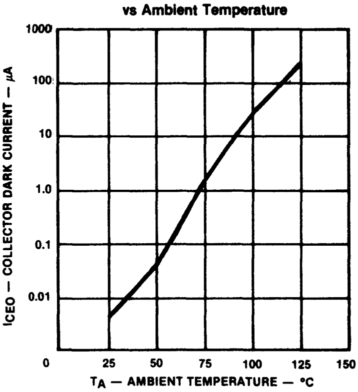
Type OP830

electrical characteristics (25°C unless otherwise noted)

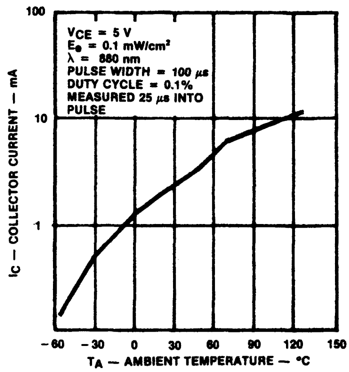
SYMBOL	PARAMETER	MIN	TYP	MAX	UNITS	TEST CONDITIONS
$I_{C(ON)}$ [(3)]	On-State Collector Current	15			mA	V_{CE} = 5 V, E_e = 0.5 mW/cm²[(4)]
I_{CEO}	Collector Dark Current			1	μA	V_{CE} = 10 V
$V_{(BR)CEO}$	Collector-Emitter Breakdown Voltage	15			V	I_C = 100 μA
$V_{(BR)ECO}$	Emitter-Collector Breakdown Voltage	5			V	I_E = 100 μA
$V_{CE(SAT)}$ [(3)]	Collector-Emitter Saturation Voltage			1.2	V	I_C = 1 mA, E_e = 0.5 mW/cm²[(4)]

Typical Performance Curves

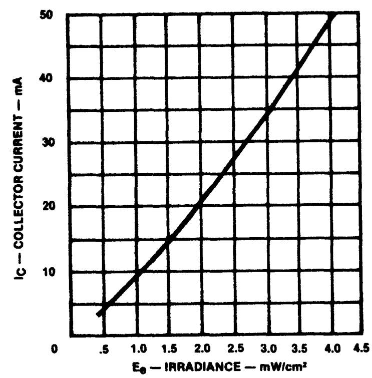
Collector Dark Current vs Ambient Temperature



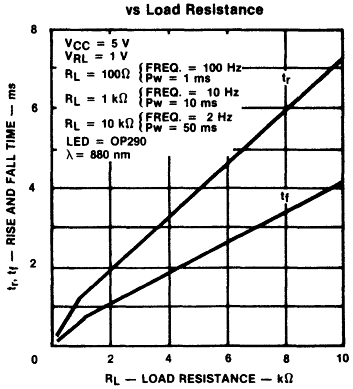
Collector Current vs Ambient Temperature



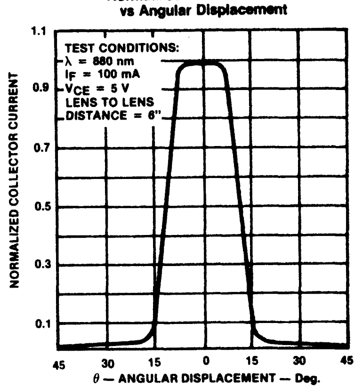
Collector Current vs Irradiance



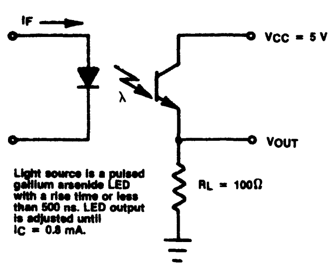
Rise and Fall Time vs Load Resistance



Normalized Collector Current vs Angular Displacement



Switching Time Test Circuit



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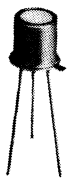
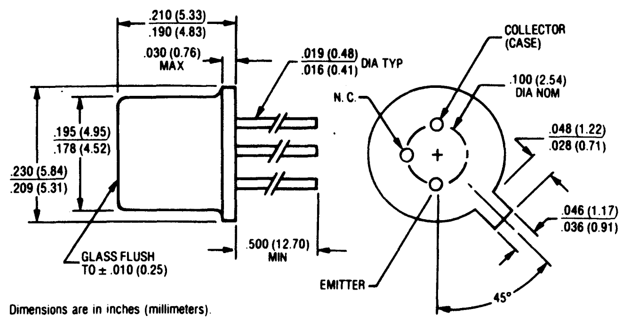
TRW OPTRON

PRODUCT BULLETIN 3034
February 1982

NPN Silicon Photodarlington
Type OP830W



ACTUAL SIZE



Dimensions are in inches (millimeters).

Features

- FLAT LENSED FOR WIDE ACCEPTANCE ANGLE
- HIGH CURRENT GAIN
- TO-18 HERMETICALLY SEALED PACKAGE

Description

The OP830W consists of an NPN silicon photodarlington mounted in a flat lensed, hermetically sealed, TO-18 package. The flat lens allows an acceptance half angle of 40° measured from the optical axis to the half power point. Photodarlington devices are normally used in applications where light signal levels are low and more current gain is needed than is possible with phototransistors. The OP830W is mechanically and spectrally matched to the OP130W and OP230W series of infrared emitting diodes.

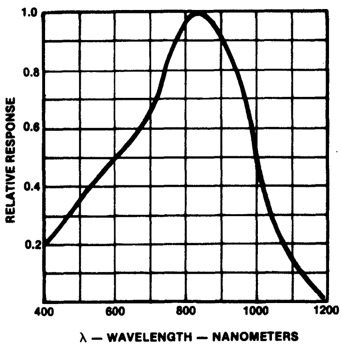
All electrical parameters are 100% tested by manufacturing. Specifications are guaranteed to a cumulative .65% AQL.

absolute maximum rating (25 °C unless otherwise noted)

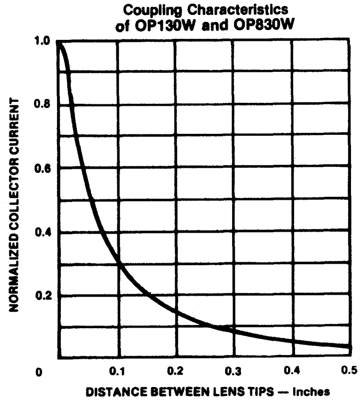
Collector-Emitter Voltage .... 15 V
Emitter-Collector Voltage .... 5 V
Storage Temperature Range .... −65 °C to +150 °C
Operating Temperature Range .... −55 °C to +125 °C
Lead Soldering Temperature (1/16 inch - 1.6 mm from case for 5 sec. with soldering iron)[1] .... 240 °C
Power Dissipation .... 50 mW[2]

Notes: (1) RMA flux is recommended. Duration can be extended to 10 sec. max. when wave soldering.
(2) Derate Linearly 2.0 mW/°C above 25 °C.
(3) Junction temperature maintained at 25 °C.
(4) Light source is an unfiltered tungsten bulb operating at CT = 2870 °K.

Photosensor Spectral Response



Coupling Characteristics of OP130W and OP830W



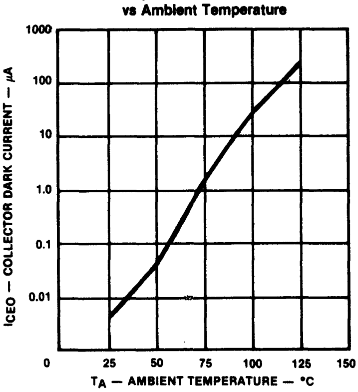
Type OP830W

electrical characteristics (25 °C unless otherwise noted)

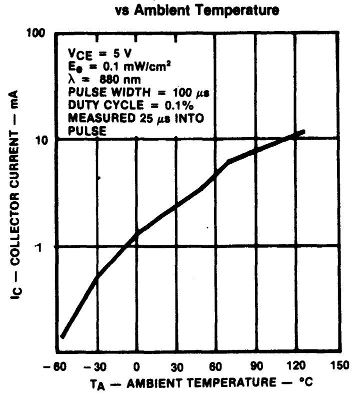
SYMBOL	PARAMETER	MIN	TYP	MAX	UNITS	TEST CONDITIONS
$I_{C(ON)}$ (3)	On-State Collector Current	4			mA	V_{CE} = 5 V, E_e = 0.5 mW/cm² (2)(4)
I_{CEO}	Collector Dark Current			1	μA	V_{CE} = 10 V
$V_{(BR)CEO}$	Collector-Emitter Breakdown Voltage	15			V	I_C = 100 μA
$V_{(BR)ECO}$	Emitter-Collector Breakdown Voltage	5			V	I_E = 100 μA
$V_{CE(SAT)}$ (3)	Collector-Emitter Saturation Voltage			1.2	V	I_C = 1 mA, E_e = 0.5 mW/cm² (2)(4)

Typical Performance Curves

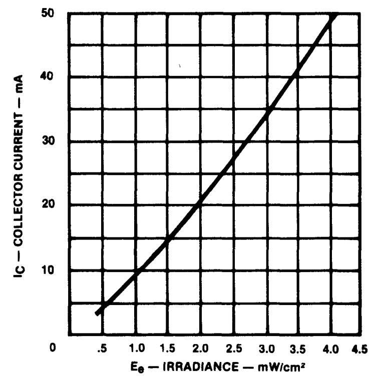
Collector Dark Current vs Ambient Temperature



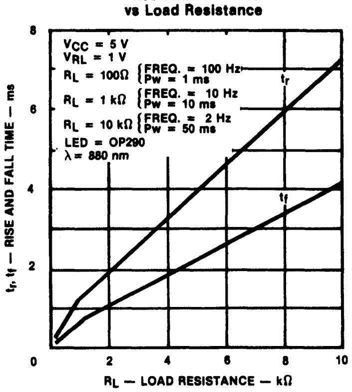
Collector Current vs Ambient Temperature



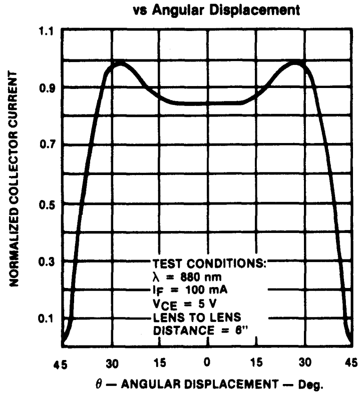
Collector Current vs Irradiance



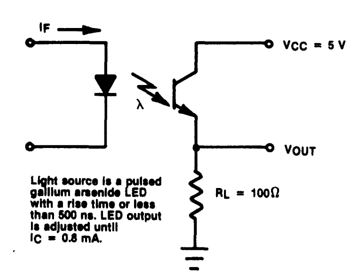
Rise and Fall Time vs Load Resistance



Normalized Collector Current vs Angular Displacement



Switching Time Test Circuit



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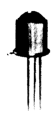
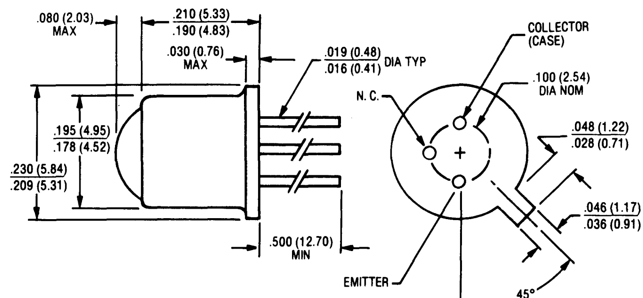
Printed in U.S.A.

NPN Silicon Phototransistor
Types OP841 through OP845



ACTUAL SIZE



Dimensions are in inches (millimeters).

Features

- COLLECTOR CURRENTS ARE BINNED TO MINIMUMS ONLY
- LENSED FOR HIGH SENSITIVITY
- TO-18 HERMETICALLY SEALED PACKAGE

Description

The OP841 through OP845 each consist of an NPN silicon phototransistor mounted in a lensed, hermetically sealed, TO-18 package. The lensing effect allows an acceptance half angle of 10° measured from the optical axis to the half power point. The base lead is bonded to enable conventional transistor biasing. Except for minor differences in collector current ranges and minimum range binning only, this series is identical to the OP800 series and is mechanically and spectrally matched to the OP130 and OP230 series of infrared emitting diodes.

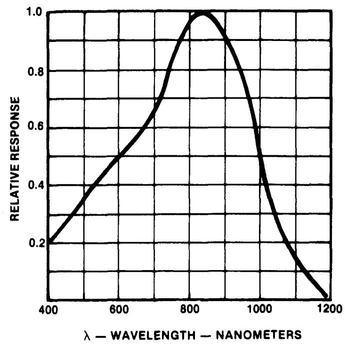
All electrical parameters are 100% tested by manufacturing. Specifications are guaranteed to a cumulative .65% AQL.

absolute maximum rating (25 °C unless otherwise noted)

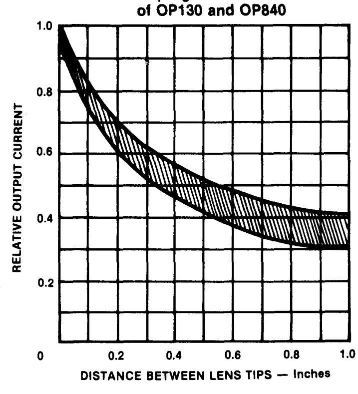
Collector-Base Voltage	50 V
Collector-Emitter Voltage	30 V
Emitter-Base Voltage	5 V
Emitter-Collector Voltage	5 V
Continuous Collector Current	50 mA
Storage Temperature Range	−65 °C to +150 °C
Operating Temperature Range	−65 °C to +125 °C
Lead Soldering Temperature (1/16 inch - 1.6 mm from case for 5 sec. with soldering iron)(1)	240 °C
Power Dissipation	250 mW(2)

Notes: (1) RMA flux is recommended. Duration can be extended to 10 sec. max. when wave soldering.
(2) Derate Linearly 2.5 mW/ °C above 25 °C.
(3) Junction temperature maintained at 25 °C.
(4) Light source is an unfiltered tungsten bulb operating at CT = 2870 °K.

Photosensor Spectral Response



Coupling Characteristics of OP130 and OP840



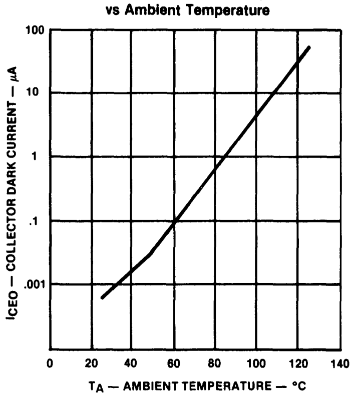
Types OP841 through OP845

electrical characteristics (25°C unless otherwise noted)

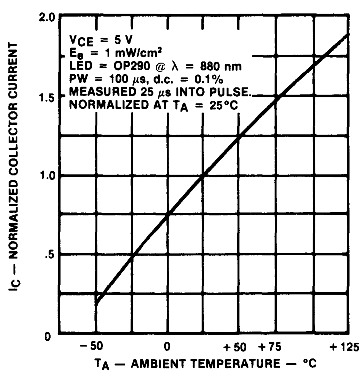
SYMBOL	PARAMETER	MIN	TYP	MAX	UNITS	TEST CONDITIONS
$I_{C(ON)}$ [3]	On-State Collector Current OP841	0.5			mA	V_{CE} = 5 V, E_e = 5 mW/cm² [4]
	OP842	2			mA	V_{CE} = 5 V, E_e = 5 mW/cm² [4]
	OP843	5			mA	V_{CE} = 5 V, E_e = 5 mW/cm² [4]
	OP844	7			mA	V_{CE} = 5 V, E_e = 5 mW/cm² [4]
	OP845	15			mA	V_{CE} = 5 V, E_e = 5 mW/cm² [4]
I_{CEO}	Collector Dark Current			100	nA	V_{CE} = 10 V, E_e = 0
$V_{(BR)CEO}$	Collector-Emitter Breakdown Voltage	30			V	I_C = 100 μA
$V_{(BR)ECO}$	Emitter-Collector Breakdown Voltage	5			V	I_E = 100 μA
$V_{CE(SAT)}$ [3]	Collector-Emitter Saturation Voltage			0.4	V	I_C = 0.4 mA, E_e = 5 mW/cm² [4]
t_r	Rise Time		2		μs	V_{CC} = 5 V, I_C = 0.8 mA
t_f	Fall Time		2		μs	R_L = 100Ω, See Test Circuit

Typical Performance Curves

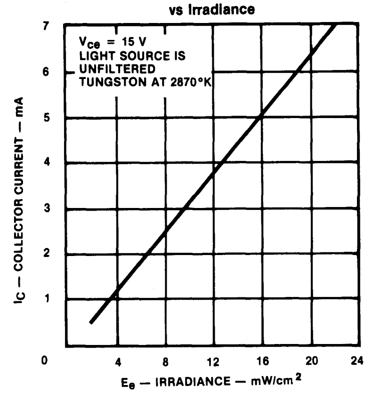
Collector Dark Current vs Ambient Temperature



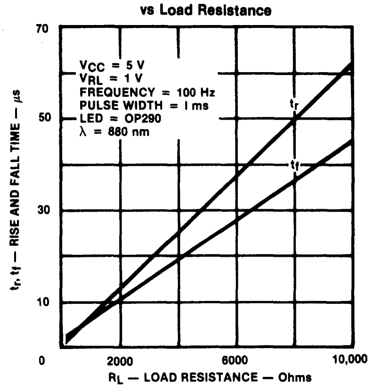
Normalized Collector Current vs Ambient Temperature



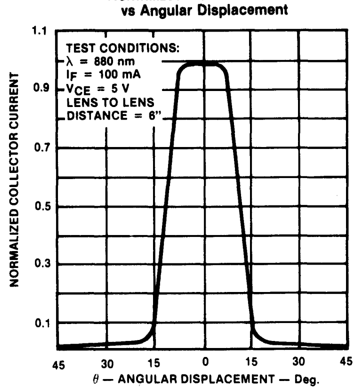
Collector Current vs Irradiance



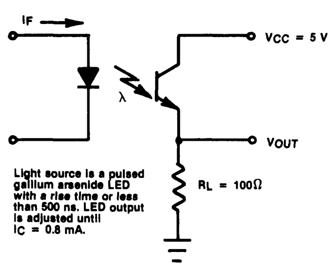
Rise and Fall Time vs Load Resistance



Normalized Collector Current vs Angular Displacement



Switching Time Test Circuit



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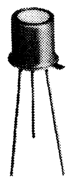
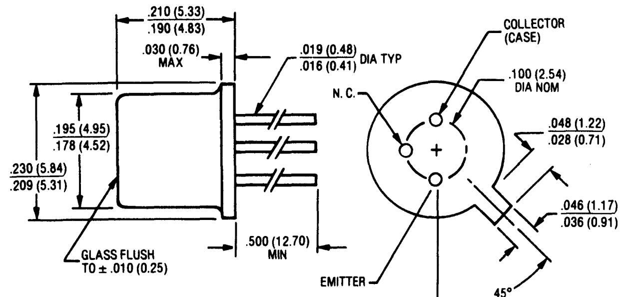
Printed in U.S.A.

NPN Silicon Phototransistors

Types OP841W through OP845W



ACTUAL SIZE



Dimensions are in inches (millimeters).

Features

- COLLECTOR CURRENTS ARE BINNED TO MINIMUMS ONLY
- FLAT LENSED FOR WIDE ACCEPTANCE ANGLE
- TO-18 HERMETICALLY SEALED PACKAGE

Description

The OP841W through OP845W each consist of an NPN silicon phototransistor mounted in a flat lensed, hermetically sealed, TO-18 package. The flat lens allows an acceptance half angle of 40° measured from the optical axis to the half power point. The base lead is bonded to enable conventional transistor biasing. Except for minor differences in collector current ranges and minimum range binning only, this series is identical to the OP800W series and is mechanically and spectrally matched to the OP130W and OP230W series of infrared emitting diodes.

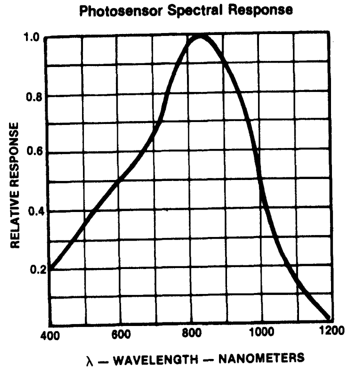
All electrical parameters are 100% tested by manufacturing. Specifications are guaranteed to a cumulative .65% AQL.

absolute maximum rating (25 °C unless otherwise noted)

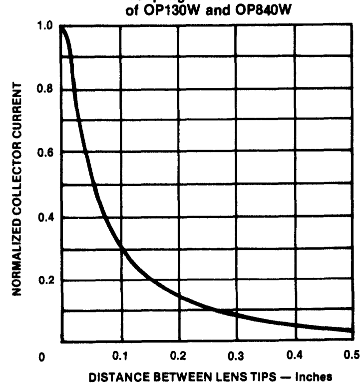
Collector-Base Voltage	50 V
Collector-Emitter Voltage	30 V
Emitter-Base Voltage	5 V
Emitter-Collector Voltage	5 V
Continuous Collector Current	50 mA
Storage Temperature Range	− 65 °C to + 150 °C
Operating Temperature Range	− 65 °C to + 125 °C
Lead Soldering Temperature (1/16 inch - 1.6 mm from case for 5 sec. with soldering iron)(1)	240 °C
Power Dissipation	250 mW(2)

Notes: (1) RMA flux is recommended. Duration can be extended to 10 sec. max. when wave soldering.
(2) Derate Linearly 2.5 mW/ °C above 25 °C.
(3) Junction temperature maintained at 25 °C.
(4) Light source is an unfiltered tungsten bulb operating at CT = 2870 °K.

Photosensor Spectral Response



Coupling Characteristics of OP130W and OP840W



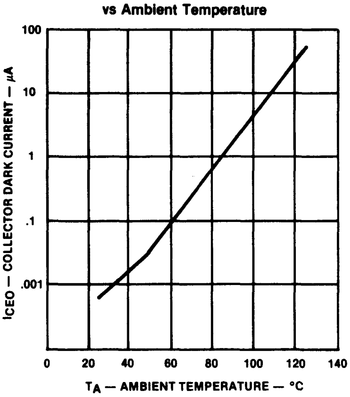
Types OP841W through OP845W

electrical characteristics (25°C unless otherwise noted)

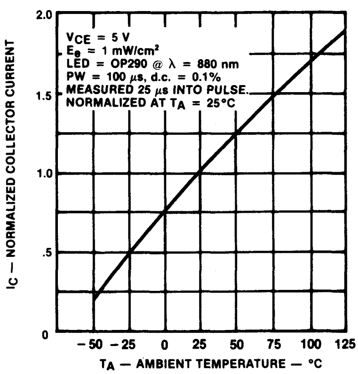
SYMBOL	PARAMETER		MIN	TYP	MAX	UNITS	TEST CONDITIONS
$I_{C(ON)}$[3]	On-State Collector Current	OP841W	0.3			mA	V_{CE} = 5 V, E_e = 5 mW/cm²[4]
		OP842W	1			mA	V_{CE} = 5 V, E_e = 5 mW/cm²[4]
		OP843W	1.5			mA	V_{CE} = 5 V, E_e = 5 mW/cm²[4]
		OP844W	2			mA	V_{CE} = 5 V, E_e = 5 mW/cm²[4]
		OP845W	2.5			mA	V_{CE} = 5 V, E_e = 5 mW/cm²[4]
I_{CEO}	Collector Dark Current				100	nA	V_{CE} = 10 V, E_e = 0
$V_{(BR)CEO}$	Collector-Emitter Breakdown Voltage		30			V	I_C = 100 μA
$V_{(BR)ECO}$	Emitter-Collector Breakdown Voltage		5			V	I_E = 100 μA
$V_{CE(SAT)}$[3]	Collector-Emitter Saturation Voltage				0.4	V	I_C = 0.4 mA, E_e = 5 mW/cm²[4]
t_r	Rise Time			2		μs	V_{CC} = 5 V, I_C = 0.8 mA
t_f	Fall Time			2		μs	R_L = 100Ω, See Test Circuit

Typical Performance Curves

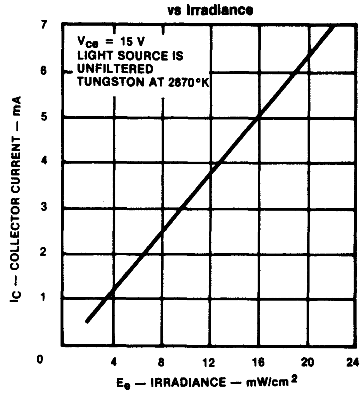
Collector Dark Current vs Ambient Temperature



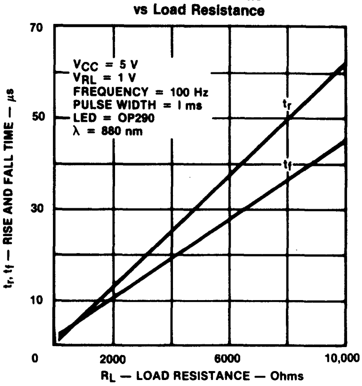
Normalized Collector Current vs Ambient Temperature



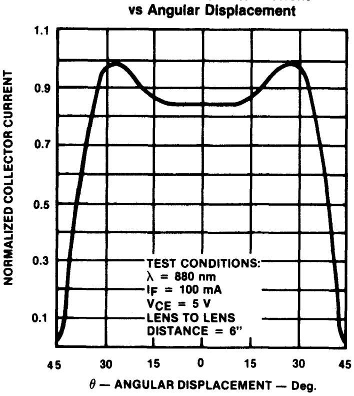
Collector Current vs Irradiance



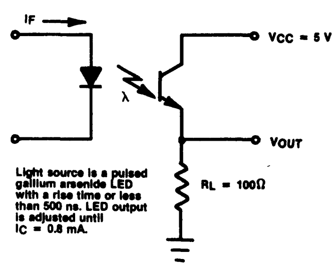
Rise and Fall Time vs Load Resistance



Normalized Collector Current vs Angular Displacement



Switching Time Test Circuit

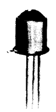


TRW OPTRON reserves the right to make changes at any time in order to improve design and to supply the best product possible.

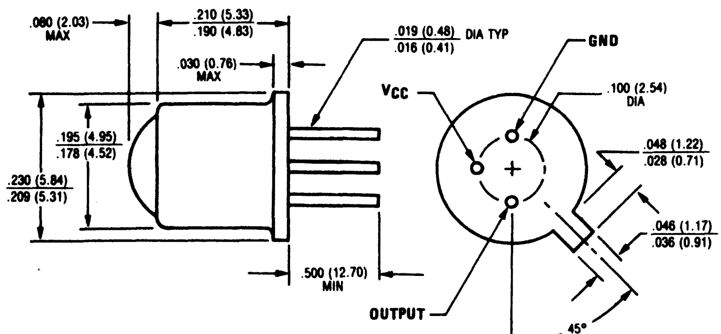
TRW OPTRON, A DIVISION OF TRW INC., 1201 TAPPAN CIRCLE, CARROLLTON, TEXAS, 75006 (214) 323-2200, TWX-910-860-5958

Printed in U.S.A

Photologic™ Hermetic Sensors
Types OPL800, OPL800-OC, OPL801, OPL801-OC



ACTUAL SIZE



Dimensions are in inches (millimeters).

Features

- FOUR OUTPUT OPTIONS
- HIGH NOISE IMMUNITY
- DIRECT TTL/LSTTL INTERFACE
- TO-18 HERMETIC PACKAGE
- MECHANICALLY AND SPECTRALLY MATCHED TO OP130 LED
- DATA RATES TO 250 KBAUD

Description

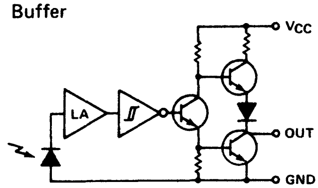
The OPL800, OPL800-OC, OPL801, and OPL801-OC each incorporate a photodiode, a linear amplifier, and a Schmitt trigger on a single silicon chip. The devices feature TTL/LSTTL compatible logic level output which can drive up to 8 TTL loads without additional interface circuitry. Also featured are medium speed data rates to 250 KBAUD with typical rise and fall times of 25 nsec. The Schmitt trigger's hysteresis characteristics provide high immunity to noise on input and V_{CC}. The Photologic chip is mounted on a standard TO-18 header which is hermetically sealed in a lensed metal can. These devices are mechanically and spectrally matched to the OP130 and OP230 infrared emitting diodes.

All electrical parameters are 100% tested by manufacturing. Specifications are guaranteed to a .65% AQL.

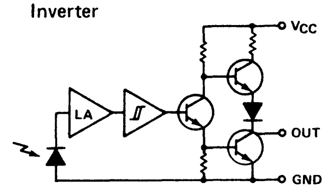
TM Trademark TRW INC.

Schematics

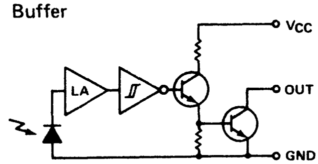
OPL800 (Totem-Pole Output)
Buffer



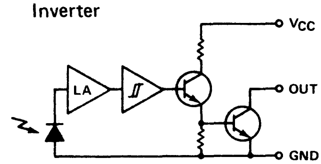
OPL801 (Totem-Pole Output)
Inverter



OPL800-OC (Open Collector Output)
Buffer



OPL801-OC (Open Collector Output)
Inverter



absolute maximum ratings (25° C unless otherwise noted)

Supply Voltage, V_{CC} (not to exceed 3 seconds)	+10 V
Storage Temperature Range	−65°C to +150°C
Operating Temperature Range	−55°C to +110°C
Lead Soldering Temperature (1/16 Inch [1.6 mm] from Case for 5 sec. w/soldering iron(1))	240°C
Power Dissipation	250 mW(2)
Duration of Output Short to V_{CC} or Ground (OPL800, OPL801)	1 sec.
Duration of Output Short to V_{CC} (OPL800-OC, OPL801-OC)	1 sec.
Voltage at Output Lead (OPL800-OC, OPL801-OC)	35 V

Notes: (1) RMA flux is recommended. Duration can be extended to 10 seconds max. when flow soldering.
(2) Derate linearly 2.0 mW/°C above 25°C.

Types OPL800, OPL800-OC, OPL801, OPL801-OC

electrical characteristics (−40° C to +70° C unless otherwise noted)

SYMBOL	PARAMETER	MIN	TYP	MAX	UNITS	TEST CONDITIONS (1)
V_{CC}	Operating Supply Voltage	4.75		5.25	V	
	Peak-to-Peak V_{CC} Ripple Necessary to Cause False Triggering of Output		2		V	V_{CC} = 5 VDC f = DC to 50 MHz
$E_{eT(+)}$	Positive-Going Threshold Irradiance		0.5	3	mW/cm2	V_{CC} = 5 V
$E_{eT(-)}$	Negative-Going Threshold Irradiance		0.25		mW/cm2	
$E_{eT(+)}/E_{eT(-)}$	Hysteresis Ratio		2			
I_{CC}	Supply Current			15	mA	V_{CC} = 5.25 V, E_e = 0 or 1 mW/cm2

OPL800 (Buffer, Totem-Pole)

SYMBOL	PARAMETER	MIN	TYP	MAX	UNITS	TEST CONDITIONS
V_{OH}	High Level Output Voltage	2.4			V	V_{CC} = 4.75 V, I_{OH} = −800 μA E_e = 1 mW/cm2
V_{OL}	Low Level Output Voltage			0.4	V	V_{CC} = 4.75 V, I_{OL} = 12.8 mA, E_e = 0
I_{OS}	Short Circuit Output Current	−30		−100	mA	V_{CC} = 5.25 V, E_e = 1 mW/cm2 Output = GND

OPL800-OC (Buffer, Open Collector)

SYMBOL	PARAMETER	MIN	TYP	MAX	UNITS	TEST CONDITIONS
I_{OH}	High Level Output Current			100	μA	V_{CC} = 4.75 V, V_{OH} = 30 V E_e = 1 mW/cm2
V_{OL}	Low Level Output Voltage			0.4	V	V_{CC} = 4.75 V, I_{OL} = 12.8 mA, E_e = 0

OPL801 (Inverter, Totem-Pole)

SYMBOL	PARAMETER	MIN	TYP	MAX	UNITS	TEST CONDITIONS
V_{OH}	High Level Output Voltage	2.4			V	V_{CC} = 4.75 V, I_{OH} = − 800 μA E_e = 0
V_{OL}	Low Level Output Voltage			0.4	V	V_{CC} = 4.75 V, I_{OL} = 12.8 mA E_e = 1 mW/cm2
I_{OS}	Short Circuit Output Current	−30		−100	mA	V_{CC} = 5.25 V, E_e = 0 Output = GND

OPL801-OC (Inverter, Open Collector)

SYMBOL	PARAMETER	MIN	TYP	MAX	UNITS	TEST CONDITIONS
I_{OH}	High Level Output Current			100	μA	V_{CC} = 4.75 V, V_{OH} = 30 E_e = 0
V_{OL}	Low Level Output Voltage			0.4	V	V_{CC} = 4.75 V, I_{OL} = 12.8 mA E_e = 1 mW/cm2

OPL800, OPL801

SYMBOL	PARAMETER	MIN	TYP	MAX	UNITS	TEST CONDITIONS
t_r, t_f	Output Rise Time, Output Fall Time			70	ns	V_{CC} = 5 V, T_A = 25°C E_e = 0 or 1 mW/cm2
t_{PLH}, t_{PHL}	Propagation Delay, Low-High, High-Low			5	μs	f = 10 kHz, D.C. = 50% R_L = 8 TTL Loads

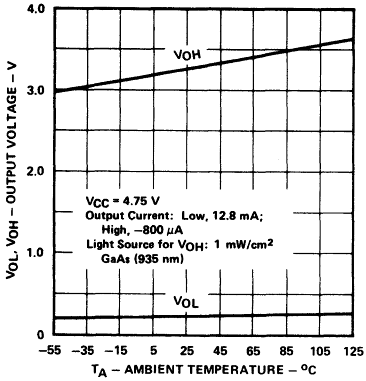
OPL800-OC, OPL801-OC

SYMBOL	PARAMETER	MIN	TYP	MAX	UNITS	TEST CONDITIONS
t_r, t_f	Output Rise Time, Output Fall Time			70	ns	V_{CC} = 5 V, T_A = 25°C E_e = 0 or 1 mW/cm2
t_{PLH}, t_{PHL}	Propagation Delay, Low-High, High-Low			5	μs	f = 10 kHz, D.C. = 50% R_L = 360 Ω

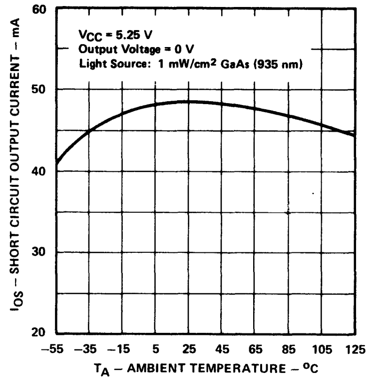
Note: (1) Light measurements are made with λ_i = 935 nm.

OPL800, OPL801

Output Voltage vs. Ambient Temperature

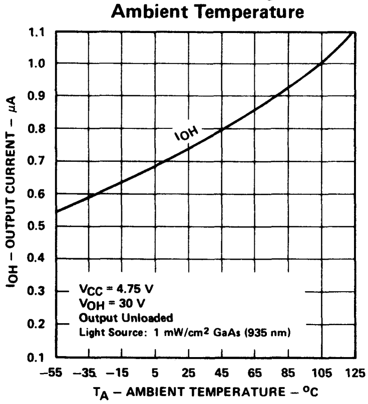


Short Circuit Output Current vs. Ambient Temperature

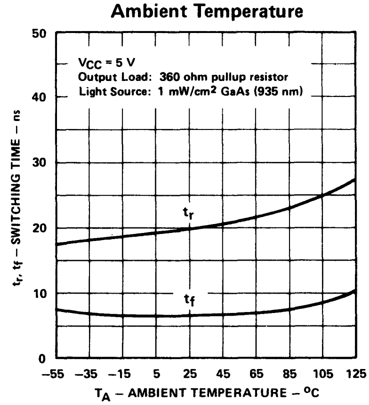


OPL800-OC, OPL801-OC

Output Current (High) vs. Ambient Temperature

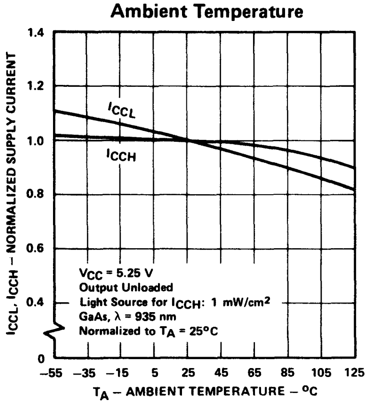


Rise Time and Fall Time vs. Ambient Temperature



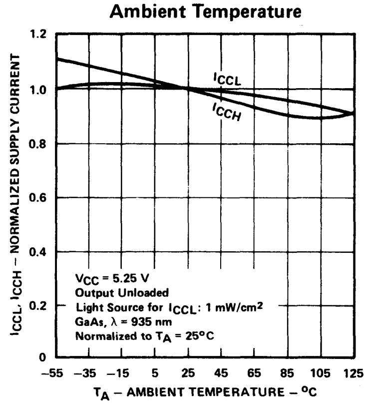
OPL800, OPL800-OC

Normalized Supply Current vs. Ambient Temperature

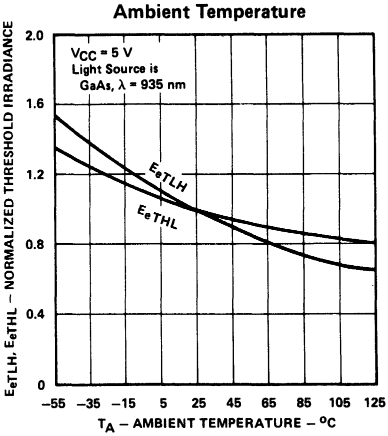


OPL801, OPL801-OC

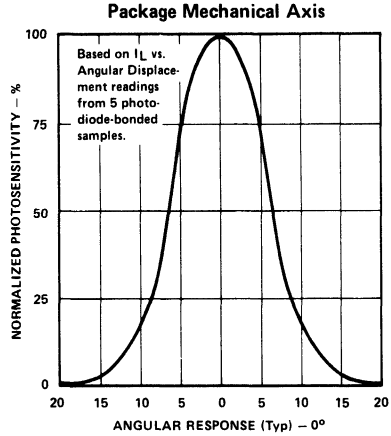
Normalized Supply Current vs. Ambient Temperature



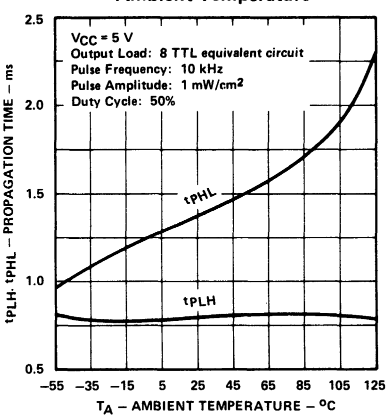
Normalized Threshold Irradiance vs. Ambient Temperature



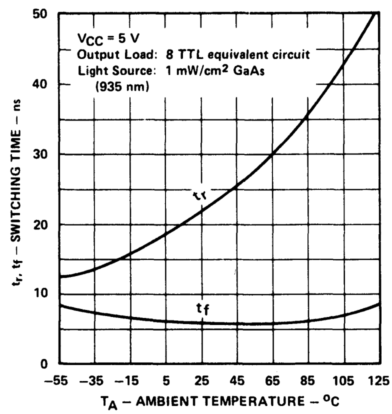
Angular Displacement from Package Mechanical Axis



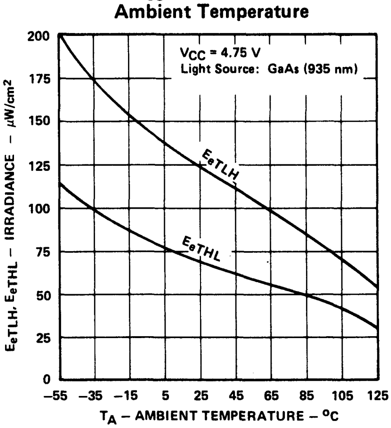
Propagation Time vs. Ambient Temperature



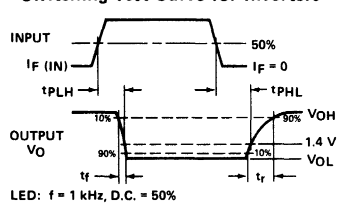
Rise Time and Fall Time vs. Ambient Temperature



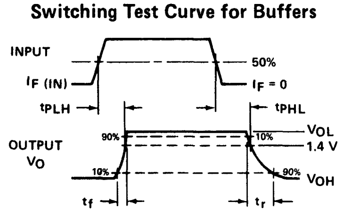
Trigger Irradiance vs. Ambient Temperature



Switching Test Curve for Inverters



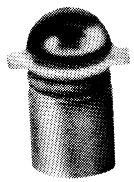
Switching Test Curve for Buffers



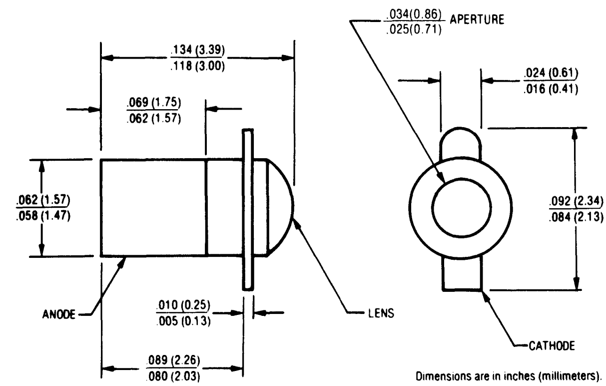
TRW OPTRON

PRODUCT BULLETIN 3037
February 1982

PN Junction Silicon Photodiode
Type OP900



5 TIMES ACTUAL SIZE



Dimensions are in inches (millimeters).

Features

- MINIATURE HERMETICALLY SEALED PACKAGE
- FAST SWITCHING SPEED
- IDEAL FOR DIRECT MOUNTING TO PC BOARDS

Description

The OP900 consists of a PN junction silicon photodiode mounted in a miniature, glass lensed hermetically sealed "Pill" package. The lensing effect allows an acceptance half angle of 35° measured from the optical axis to the half power point. This device can also be used in a photovoltaic mode.

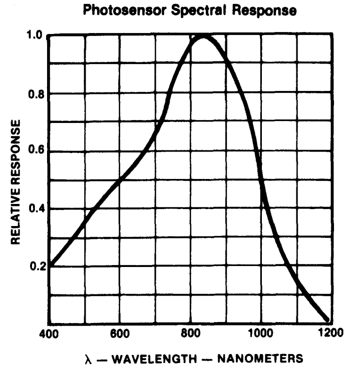
All electrical parameters are 100% tested by manufacturing. Specifications are guaranteed to a cumulative .65% AQL.

absolute maximum rating (25 °C unless otherwise noted)

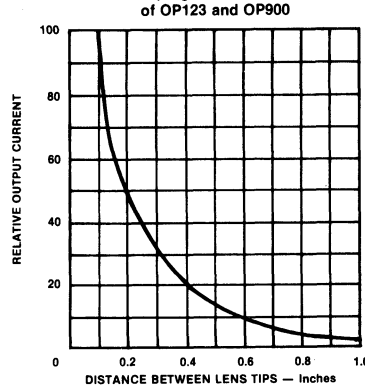
Reverse Voltage . . . . 100 V
Storage Temperature Range . . . . −65 °C to +150 °C
Operating Temperature Range . . . . −65 °C to +125 °C
Lead Soldering Temperature (1/16 inch - 1.6 mm from case for 5 sec. with soldering iron)(1) . . . . 240 °C
Power Dissipation . . . . 50 mW(2)

Notes: (1) RMA flux is recommended. Duration can be extended to 10 sec. max. when wave soldering.
(2) Derate Linearly 0.5 mW/cm2 above 25 °C.
(3) Junction temperature maintained at 25 °C.
(4) Light source is an unfiltered tungsten bulb operating at CT = 2870 °K.

Photosensor Spectral Response



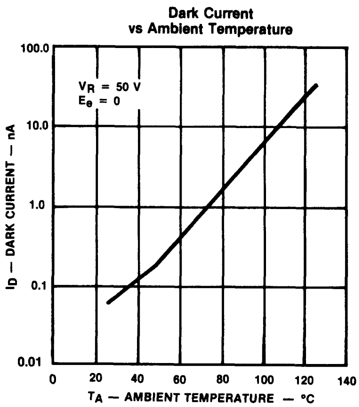
Coupling Characteristics of OP123 and OP900

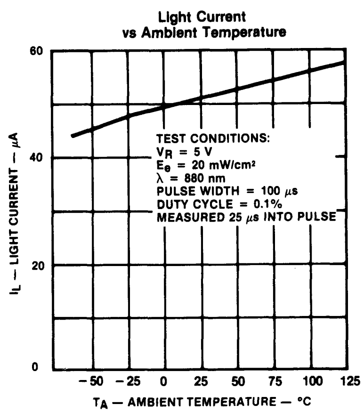


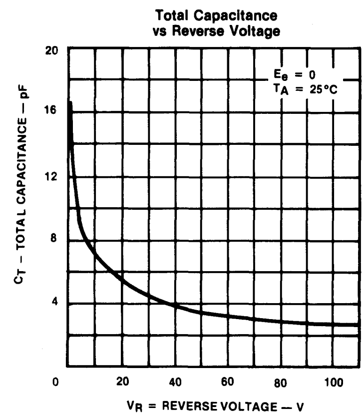
electrical characteristics (25°C unless otherwise noted)

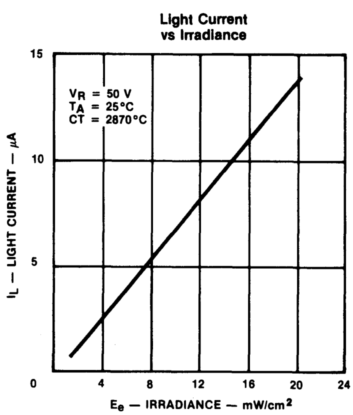
SYMBOL	PARAMETER	MIN	TYP	MAX	UNITS	TEST CONDITIONS
I_L [3]	Light Current	8	14		μA	V_R = 10 V, E_e = 20 mW/cm²[4]
I_D [3]	Dark Current			10	nA	V_R = 50 V, E_e = 0
I_D	Dark Current		1		μA	V_R = 50 V, E_e = 0 T_A = 100°C
$V_{(BR)R}$	Reverse Voltage Breakdown	100	150		V	I_R = 100 μA
t_r	Rise Time		100		ns	V_R = 50 V, I_L = 8 μA R_L = 1kΩ
t_f	Fall Time		100		ns	See Test Circuit

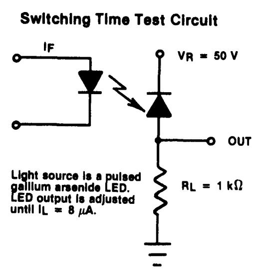
Typical Performance Curves





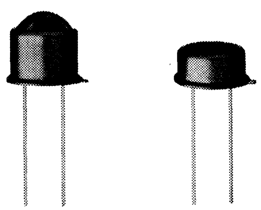




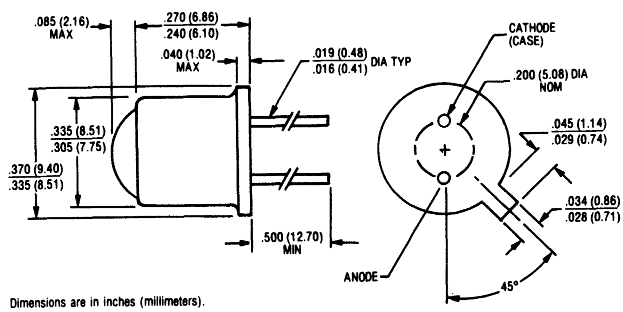


TRW OPTRON reserves the right to make changes at any time in order to improve design and to supply the best product possible.

PIN Silicon Photodiodes
Types OP903, OP913



ACTUAL SIZE



Dimensions are in inches (millimeters).

Features

- LARGE ACTIVE AREA CHIP
- FAST SWITCHING TIME
- LENSED FOR HIGH SENSITIVITY
- TO-5 HERMETICALLY SEALED PACKAGE

Description

The OP903 AND OP913 each consist of a PIN silicon photodiode mounted in a flat lensed, two leaded, TO-5 hermetically sealed package. The lensing effect allows an acceptance angle of 10° measured from the optical axis to the half power point. The large active area chip makes very low light level detection possible. Both devices can be used in the photovoltaic mode.

All electrical parameters are 100% tested by manufacturing. Specifications are guaranteed to a cumulative .65% AQL.

absolute maximum rating (25°C unless otherwise noted)

Reverse Voltage . . . . 32 V
Storage Temperature Range . . . . −65°C to +150°C
Operating Temperature Range . . . . −55°C to +125°C
Lead Soldering Temperature (1/16 inch - 1.6 mm from case for 5 sec. with soldering iron)[1] . . . . 240°C
Power Dissipation . . . . 150 mW[2]

Notes: (1) RMA flux is recommended. Duration can be extended to 10 sec. max. when flow soldering.
(2) Derate Linearly 1.5 mW/°C above 25°C.
(3) Junction temperature maintained at 25°C.
(4) Light source is an unfiltered tungsten bulb operating at CT = 2870°K.
(5) At any particular wavelength, the flux responsivity, $R_\varnothing$, is the ratio of the diode photocurrent to the radiant flux producing it. $R_\varnothing$ is related to quantum efficiency by:

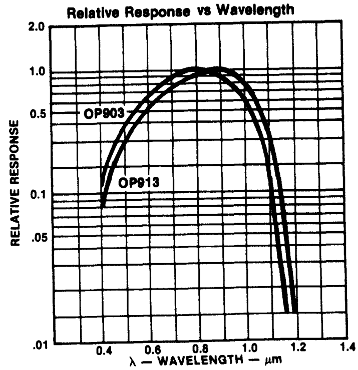
$$R_\varnothing = \eta q \left(\frac{\lambda}{1240} \right)$$

Where ηq is the quantum efficiency in electrons per photon and λ is the wavelength in nanometers. Thus, at 900 nm, 0.6 A/W corresponds to a quantum efficiency of 83%.
(6) NEP is the radiant flux, at a specified wavelength, required for unity signal to noise ratio normalized for bandwidth.

$$NEP = \frac{I_N/\sqrt{\Delta f}}{R_\varnothing}$$ where $I_N/\sqrt{\Delta f}$ is the bandwidth normalized shot noise.

NEP calculation is made using responsivity at peak sensitivity wavelength, with spot noise measurement at 1000 Hz in a noise bandwidth of 6 Hz. (λ, f, Δf) = (λp, 1000 Hz, 6 Hz).

Relative Response vs Wavelength



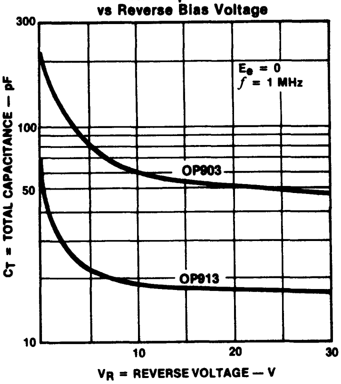
Types OP903, OP913

electrical characteristics (25 °C unless otherwise noted)

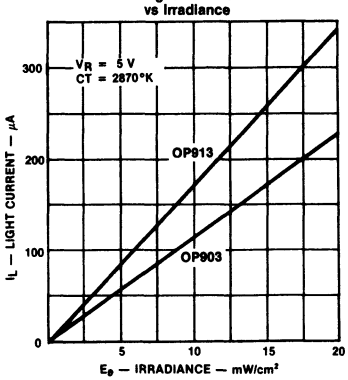
SYMBOL	PARAMETER		MIN	TYP	MAX	UNITS	TEST CONDITIONS
$I_{L(R)}$ (3)	Reverse Light Current	OP903 OP913	100 120	200 240		μA μA	V_{CE} = 5 V, E_e = 5 mW/cm² (4) V_{CE} = 5 V, E_e = 5 mW/cm² (4)
$I_{D(R)}$ (3)	Reverse Dark Current				25	nA	V_R = 10 V, E_e = 0 (4)
V_{OC}	Open Circuit Voltage	OP903 OP913		425 400		mV mV	E_e = 5 mW/cm² (4) E_e = 5 mW/cm² (4)
I_{SC}	Short Circuit Current	OP903 OP913	100 120			μA μA	E_e = 5 mW/cm² (4) E_e = 5 mW/cm² (4)
$V_{(BR)R}$	Reverse Breakdown Voltage		32			V	I_R = 100 μA
C_T	Total Capacitance	OP903 OP913		150 150		pF pF	V_R = 0, E_e = 0, f = 1 mHz V_R = 0, E_e = 0, f = 1 mHz
t_{on}, t_{off}	Turn-on Time, Turn-off Time	OP903 OP913		200 50		ns ns	V_R = 10 V, R_L = 1KΩ V_R = 10 V, R_L = 1KΩ

Typical Performance Curves

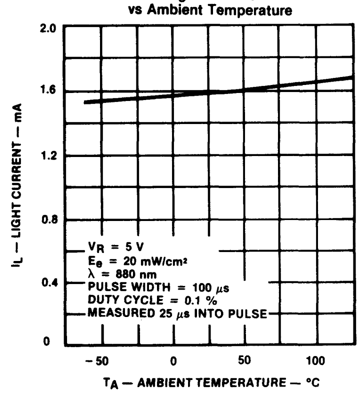
Total Capacitance vs Reverse Bias Voltage



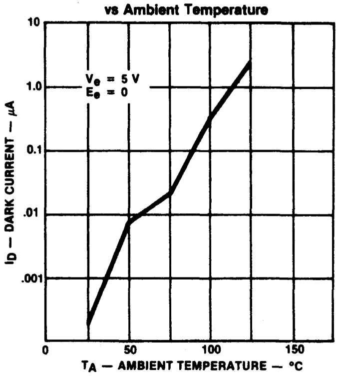
Light Current vs Irradiance



Light Current vs Ambient Temperature



Dark Current vs Ambient Temperature



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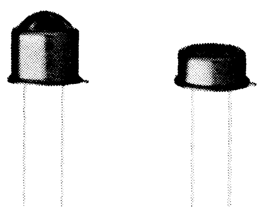
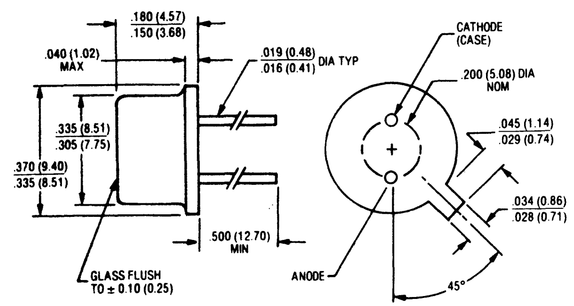
PIN Silicon Photodiodes

Types OP903W, OP913W



ACTUAL SIZE



Dimensions are in inches (millimeters)

Features

- LARGE ACTIVE AREA CHIP
- FAST SWITCHING TIMES
- FLAT LENSED FOR WIDE ACCEPTANCE ANGLE
- TO-5 HERMETICALLY SEALED PACKAGE

Description

The OP903W AND OP913W each consist of a PIN silicon photodiode mounted in a flat lensed, two leaded, TO-5 hermetically sealed package. The flat lens allows an acceptance half angle of 30° measured from the optical axis to the half power point. The large active area chip makes very low light level detection possible. Both devices can be used in the photovoltaic mode.

All electrical parameters are 100% tested by manufacturing. Specifications are guaranteed to a cumulative .65% AQL.

absolute maximum rating (25°C unless otherwise noted)

Reverse Voltage	32 V
Storage Temperature Range	−65°C to +150°C
Operating Temperature Range	−55°C to +125°C
Lead Soldering Temperature (1/16 inch - 1.6 mm from case for 5 sec. with soldering iron)[1]	240°C
Power Dissipation	150 mW[2]

Notes: (1) RMA flux is recommended. Duration can be extended to 10 sec. max. when flow soldering.
(2) Derate Linearly 1.5 mW/°C above 25°C.
(3) Junction temperature maintained at 25°C.
(4) Light source is an unfiltered tungsten bulb operating at CT = 2870°K.
(5) At any particular wavelength, the flux responsivity, $R_\varnothing$, is the ratio of the diode photocurrent to the radiant flux producing it. $R_\varnothing$ is related to quantum efficiency by:

$$R_\varnothing = \eta q \left(\frac{\lambda}{1240}\right)$$

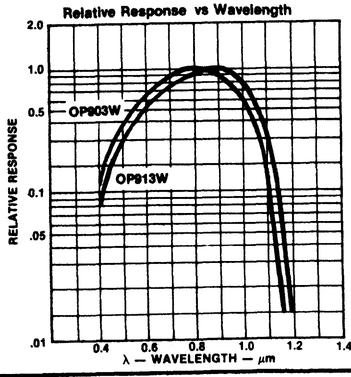
Where ηq is the quantum efficiency in electrons per photon and λ is the wavelength in nanometers. Thus, at 900 nm, 0.6 A/W corresponds to a quantum efficiency of 83%.
(6) NEP is the radiant flux, at a specified wavelength, required for unity signal to noise ratio normalized for bandwidth.

$$NEP = \frac{I_N/\sqrt{\Delta f}}{R_\varnothing}$$

where $I_N/\sqrt{\Delta f}$ is the bandwidth normalized shot noise.

NEP calculation is made using responsivity at peak sensitivity wavelength, with spot noise measurement at 1000 Hz in a noise bandwidth of 6 Hz. (λ, f, Δf) = (λp, 1000 Hz, 6 Hz).

Relative Response vs Wavelength



Types OP903W, OP913W

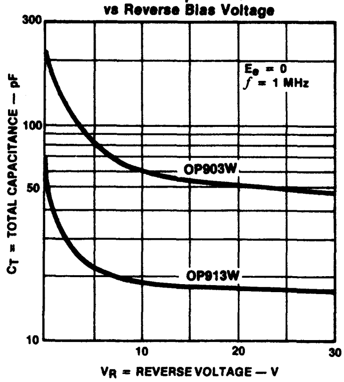
PRODUCT BULLETIN 3039
February 1982

electrical characteristics (25 °C unless otherwise noted)

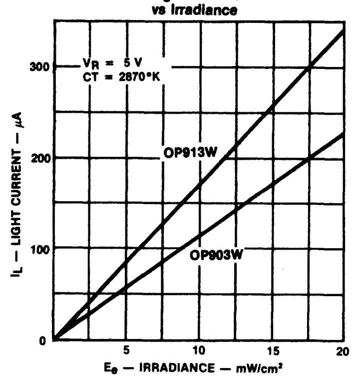
SYMBOL	PARAMETER		MIN	TYP	MAX	UNITS	TEST CONDITIONS
$I_{L(R)}$ [3]	Reverse Light Current	OP903W OP913W		50 55		μA μA	V_{CE} = 5 V, E_e = 5 mW/cm^2 [4] V_{CE} = 5 V, E_e = 5 mW/cm^2 [4]
$I_{D(R)}$ [3]	Reverse Dark Current				25	nA	V_R = 10 V, E_e = 0
V_{OC}	Open Circuit Voltage	OP903W OP913W		375 300		mV mV	E_e = 5 mW/cm^2 [4] E_e = 5 mW/cm^2 [4]
I_{SC}	Short Circuit Current	OP903W OP913W	35 40			μA μA	E_e = 5 mW/cm^2 [4] E_e = 5 mW/cm^2 [4]
$V_{(BR)R}$	Reverse Breakdown Voltage		32			V	I_R = 100 μA
C_T	Total Capacitance	OP903W OP913W		270 70		pF pF	V_R = 0, E_e = 0, f = 1 mHz
t_{on}, t_{off}	Turn-on Time, Turn-off Time	OP903W OP913W		200 50		ns ns	V_R = 10 V, R_L = 1 KΩ V_R = 10 V, R_L = 1 KΩ

Typical Performance Curves

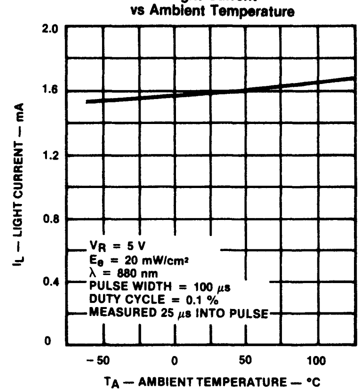
Total Capacitance vs Reverse Bias Voltage



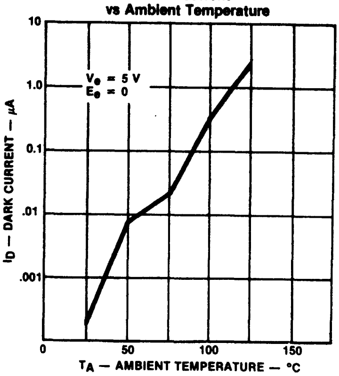
Light Current vs Irradiance



Light Current vs Ambient Temperature



Dark Current vs Ambient Temperature



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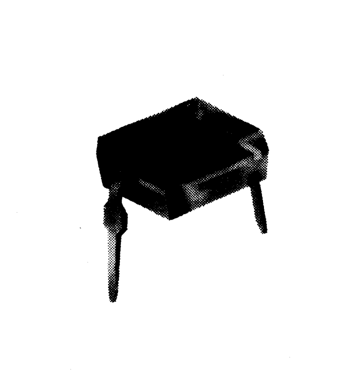
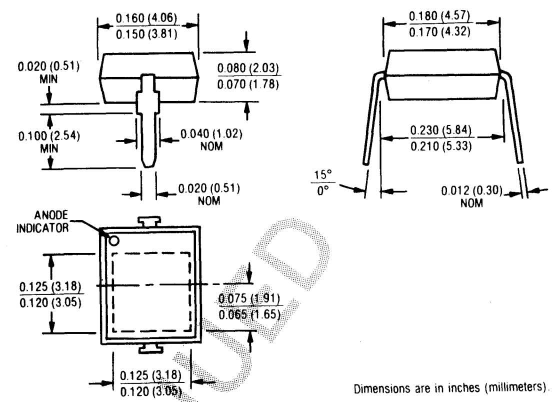
TRW OPTRON

PRODUCT BULLETIN 3040
February 1982

PIN Silicon Photodiodes
Types OP905, OP915



3 TIMES ACTUAL SIZE



Dimensions are in inches (millimeters).

Features
- LARGE ACTIVE AREA CHIP
- FAST SWITCHING TIMES
- LOW COST BLACK PLASTIC PACKAGE

Description
The OP905 and OP915 each consist of a PIN silicon photodiode mounted in a miniature clear plastic package. The large active area chip makes very low light level detection possible. Both devices can be used in the photovoltaic mode.

All electrical parameters are 100% tested by manufacturing. Specifications are guaranteed to a cumulative .65% AQL.

absolute maximum rating (25 °C unless otherwise noted)

Reverse Voltage .... 33 V
Storage and Operating Temperature Range .... −40 °C to +100 °C
Soldering Temperature (1/16 inch - 1.6 mm from case for 5 sec. with soldering iron)[1] .... 240 °C
Power Dissipation .... 150 mW[2]

Notes: (1) RMA flux is recommended. Duration can be extended to 10 sec. max. when flow soldering.
(2) Derate Linearly 2.0 mW/°C above 25 °C.
(3) Junction temperature maintained at 25 °C.
(4) Light source is an unfiltered tungsten bulb operating at CT = 2870 °K.
(5) At any particular wavelength, the flux responsivity, $R_\varnothing$, is the ratio of the diode photocurrent to the radiant flux producing it. $R_\varnothing$ is related to quantum efficiency by:

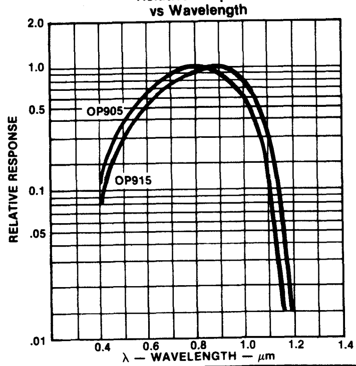
$$R_\varnothing = \eta q \left(\frac{\lambda}{1240} \right)$$

Where ηq is the quantum efficiency in electrons per photon and λ is the wavelength in nanometers. Thus, at 900 nm, 0.6 A/W corresponds to a quantum efficiency of 83%.
(6) NEP is the radiant flux, at a specified wavelength, required for unity signal to noise ratio normalized for bandwidth.

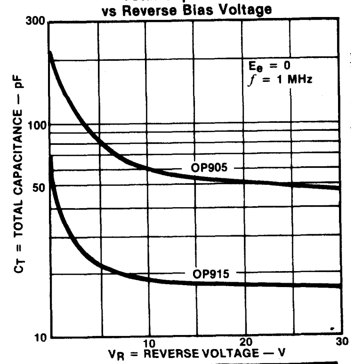
$$NEP = \frac{I_N/\sqrt{\Delta f}}{R_\varnothing}$$ where $I_N/\sqrt{\Delta f}$ is the bandwidth normalized shot noise.

NEP calculation is made using responsivity at peak sensitivity wavelength, with spot noise measurement at 1000 Hz in a noise bandwidth of 6 Hz. (λ, f, Δf) = (λp, 1000 Hz, 6 Hz).

Relative Response vs Wavelength



Total Capacitance vs Reverse Bias Voltage



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Types OP905, OP915

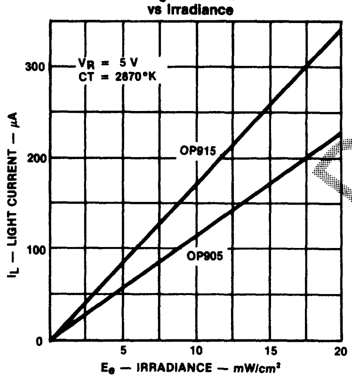
PRODUCT BULLETIN 3040
February 1982

electrical characteristics (25 °C unless otherwise noted)

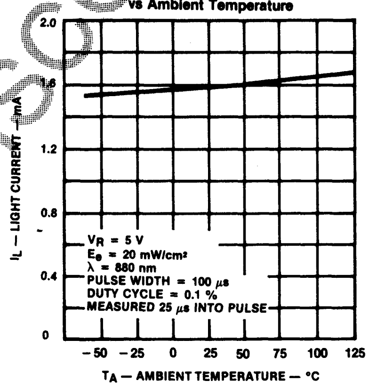
SYMBOL	PARAMETER	OP905 MIN	OP905 TYP	OP905 MAX	OP915 MIN	OP915 TYP	OP915 MAX	UNITS	TEST CONDITIONS
Photovoltaic Mode									
V_{OC}	Open Circuit Voltage		400			350		mV	E_e = 5 mW/cm²[(4)]
I_{SC}	Short Circuit Current	35	55		50	75		μA	E_e = 5 mW/cm²[(4)]
$R_{\varnothing}$	Responsivity[(5)]		0.43			0.55		A/Watt	V_R = 0 V, λ = Peak Wavelength
C_T	Total Capacitance		270			70		pF	V_R = 0 V, E_e = 0, f = 1 MHz
Photodiode Mode									
$I_{L(R)}$	Reverse Light Current	35	57		50	80		μA	V_R = 5 V, E_e = 5 mW/cm²[(4)]
$I_{D(R)}$	Reverse Dark Current		1	30		5	30	nA	V_R = 10 V, E_e = 0
$R_{\varnothing}$	Responsivity[(5)]		0.49			0.60		A/Watt	V_R = 38 V, λ = Peak Wavelength
$V_{(BR)R}$	Reverse Breakdown Voltage	33	170		33	170		V	I_R = 100 μA, E_e = 0
NEP	Noise Equivalent Power[(6)]		4.0 X10^{-14}			7.0 X10^{-14}		W Hz$^{-1/2}$	
C_T	Total Capacitance		110	150		25	30	pF	V_R = 3 V, E_e = 0, f = 1 mHz
t_{on}	Turn-on Time		200			50		nSec	V_R = 10 V, R_L = 1 KΩ
t_{off}	Turn-off Time		200			50		nSec	V_R = 10 V, R_L = 1 KΩ

Typical Performance Curves

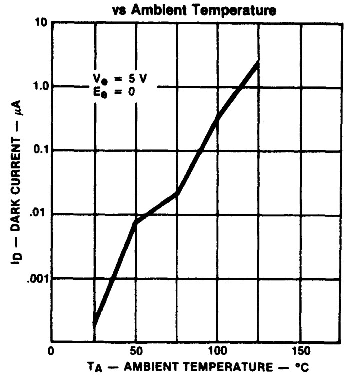
Light Current vs Irradiance



Light Current vs Ambient Temperature



Dark Current vs Ambient Temperature



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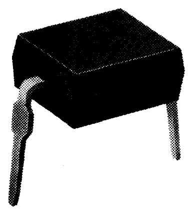
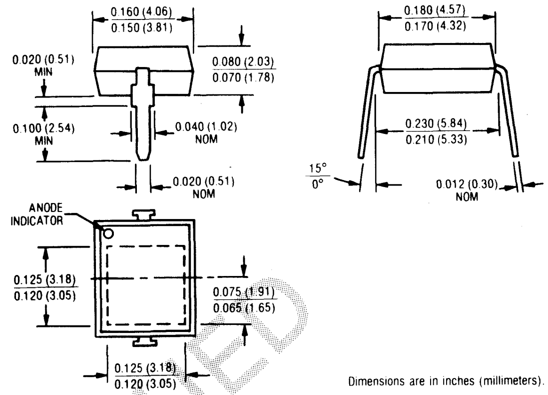
PIN Silicon Photodiodes
Types OP905F, OP915F



3 TIMES ACTUAL SIZE



Features

- LARGE ACTIVE AREA CHIP
- FAST SWITCHING TIMES
- LOW COST BLACK PLASTIC PACKAGE

Description

The OP905F and OP915F each consist of a PIN silicon photodiode mounted in a miniature black plastic package. The black plastic package helps to reduce ambient light noise. The large active area chip makes very low light level detection possible. Both devices can be used in the photovoltaic mode.

All electrical parameters are 100% tested by manufacturing. Specifications are guaranteed to a cumulative .65% AQL.

absolute maximum rating (25 °C unless otherwise noted)

Reverse Voltage . . . . 33 V
Storage and Operating Temperature Range . . . . −40 °C to +100 °C
Soldering Temperature (1/16 inch - 1.6 mm from case for 5 sec. with soldering iron)(1) . . . . 240 °C
Power Dissipation . . . . 150 mW(2)

Notes: (1) RMA flux is recommended. Duration can be extended to 10 sec. max. when flow soldering.
(2) Derate Linearly 2.0 mW/ °C above 25 °C.
(3) Junction temperature maintained at 25 °C.
(4) Light source is an unfiltered tungsten bulb operating at CT = 2870 °K.
(5) At any particular wavelength, the flux responsivity, $R_\varnothing$, is the ratio of the diode photocurrent to the radiant flux producing it. $R_\varnothing$ is related to quantum efficiency by:

$$R_\varnothing = \eta q \left(\frac{\lambda}{1240} \right)$$

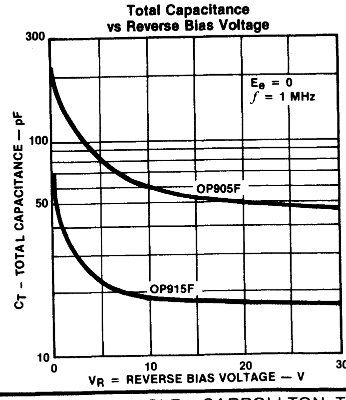
Where ηq is the quantum efficiency in electrons per photon and λ is the wavelength in nanometers. Thus, at 900 nm, 0.6 A/W corresponds to a quantum efficiency of 83%.
(6) NEP is the radiant flux, at a specified wavelength, required for unity signal to noise ratio normalized for bandwidth.

$$NEP = \frac{I_N/\sqrt{\Delta f}}{R_\varnothing}$$

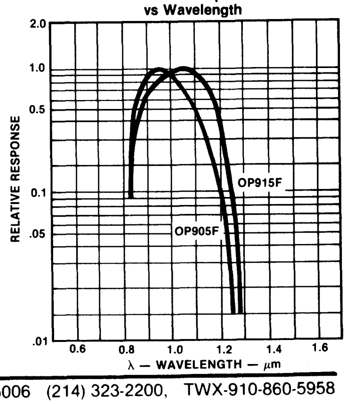
where $I_N/\sqrt{\Delta f}$ is the bandwidth normalized shot noise.

NEP calculation is made using responsivity at peak sensitivity wavelength, with spot noise measurement at 1000 Hz in a noise bandwidth of 6 Hz. (λ, f, Δf) = (λp, 1000 Hz, 6 Hz).

Total Capacitance vs Reverse Bias Voltage



Relative Response vs Wavelength

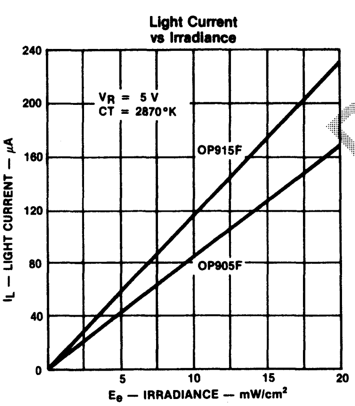


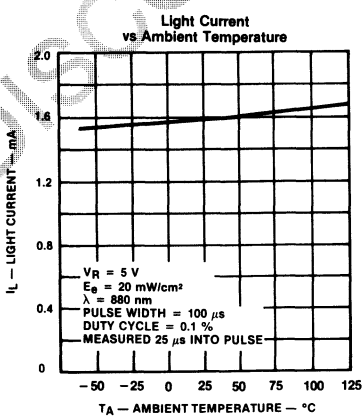
Types OP905F, OP915F

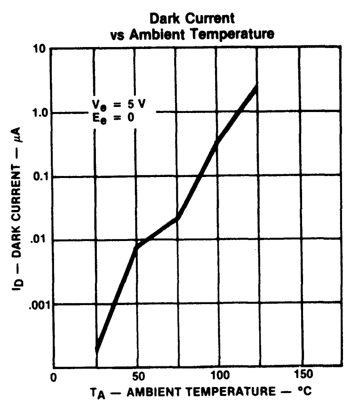
electrical characteristics (25 °C unless otherwise noted)

SYMBOL	PARAMETER	OP905F MIN	OP905F TYP	OP905F MAX	OP915F MIN	OP915F TYP	OP915F MAX	UNITS	TEST CONDITIONS
Photovoltaic Mode									
V_{OC}	Open Circuit Voltage		380			340		mV	E_e = 5 mW/cm²(4)
I_{SC}	Short Circuit Current	20	40		35	55		μA	E_e = 5 mW/cm²(4)
$R_\varnothing$	Responsivity(5)		0.31			0.53		A/Watt	V_R = 0 V, λ = Peak Wavelength
C_T	Total Capacitance		270			70		pF	V_R = 0 V, E_e = 0, f = 1 MHz
Photodiode Mode									
$I_{L(R)}$	Reverse Light Current	20	42		35	57		μA	V_R = 5 V, E_e = 5 mW/cm²(4)
$I_{D(R)}$	Reverse Dark Current		1	30		5	30	nA	V_R = 10 V, E_e = 0
$R_\varnothing$	Responsivity(5)		0.37			0.58		A/Watt	V_R = 38 V, λ = Peak Wavelength
$V_{(BR)R}$	Reverse Breakdown Voltage	33	170		33	170		V	I_R = 100 μA, E_e = 0
NEP	Noise Equivalent Power(6)		5.0 X10^{-14}			7.0 X10^{-14}		WHz$^{-1/2}$	
C_T	Total Capacitance		110	150		25	30	pF	V_R = 3 V, E_e = 0, f = 1 mHz
t_{on}	Turn-on Time		200			50		nSec	V_R = 10 V, R_L = 1KΩ
t_{off}	Turn-off Time		200			50		nSec	V_R = 10 V, R_L = 1KΩ

Typical Performance Curves







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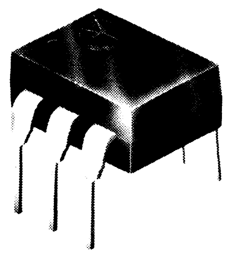
Printed in U.S.A.

Optically Coupled Isolators

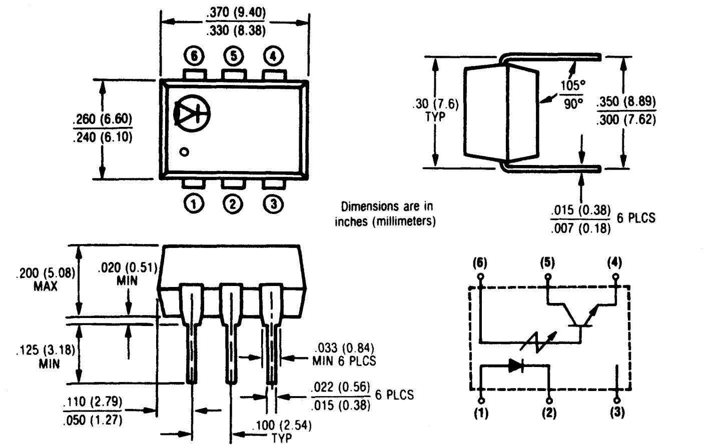
TRW OPTRON

PRODUCT BULLETIN 3044
FEBRUARY 1982

Optically Coupled Isolators
Types CNY 17/I thru CNY 17/IV



TWICE ACTUAL SIZE



Features

- 4000 VDC ISOLATION VOLTAGE
- TIGHTLY CONTROLLED MIN-MAX CTR LIMITS
- LOW COST PLASTIC PACKAGE
- UL RECOGNIZED, FILE NO. E58730
- FAST SWITCHING SPEED

Description

The CNY 17/I, CNY 17/II, CNY 17/III, and CNY 17/IV are optically coupled isolators consisting of an infrared emitting diode coupled to an NPN silicon phototransistor and mounted in a standard six pin dual in-line package.

absolute maximum rating (25 °C unless otherwise noted)

Input-to-Output Isolation Voltage . . . . . 4000 VDC(1)
Operating Temperature Range . . . . . −55 °C to +100 °C
Storage Temperature Range . . . . . −55 °C to +150 °C
Lead Soldering Temperature (1/16 inch - 1.6 mm from case for 5 sec. with soldering iron(2).) . . . . . 260 °C

Input Diode

Reverse DC Voltage . . . . . 3 V
Peak Forward Current (1 μsec pulse width, 330 pps) . . . . . 3 A
Continuous Forward Current . . . . . 60 mA
Power Dissipation . . . . . 100 mW(3)

Output Sensor

Collector-Emitter Voltage . . . . . 70 V
Emitter-Collector Voltage . . . . . 7 V
Power Dissipation . . . . . 150 mW(4)

Notes

1. Measured with input leads shorted together and output leads shorted together
2. RMA flux is recommended. Duration can be extended to 10 sec. max. when flow soldering.
3. Derate linearly 1.33 mW/°C above 25 °C
4. Derate linearly 2.0 mW/°C above 25 °C

electrical characteristics (25°C unless otherwise noted)

SYMBOL	PARAMETER	MIN	MAX	UNITS	TEST CONDITIONS
Input Diode					
V_F	Forward Voltage		1.65	V	I_F = 60 mA
I_R	Reverse Current		10	µA	V_R = 3V
Phototransistor					
$V_{(BR)CEO}$	Collector-Emitter Breakdown Voltage	70		V	I_C = 1 mA
$V_{(BR)CBO}$	Collector-Base Breakdown Voltage	70		V	I_C = 100µA
$V_{(BR)EBO}$	Emitter-Base Breakdown Voltage	7		V	I_E = 100µA
I_{CEO}	Dark Current CNY 17/I, CNY 17/II		50	nA	V_{CE} = 10V
	CNY 17/III, CNY 17/IV		100	nA	V_{CE} = 10V
Coupled					
CTR	Current Transfer Ratio CNY 17/I	40	80	%	I_F = 10mA, V_{CE} = 5V, See Fig. 1, 2, 3
	CNY 17/II	63	125	%	I_F = 10mA, V_{CE} = 5V,
	CNY 17/III	100	200	%	I_F = 10mA, V_{CE} = 5V,
	CNY 17/IV	160	320	%	I_F = 10mA, V_{CE} = 5V,
$V_{CE(SAT)}$	Saturation Voltage		0.4	V	I_F = 10mA, I_C = 2.5 mA, See Fig. 1
V_{ISO}	Isolation Voltage	4000		VDC	See Note 1, Front Page

Thermal Behavior Data

RTHJA - Thermal resistance, junction to ambient air
RTHJX - Thermal resistance, junction to some mounting surface
τTH - Thermal time constant
K - Thermal rating factor

RTHJA or x °C/W	τTH 10^{-2} sec	k	Condition
750	1.7	.008	Free air
500	1.7	.008	Mounted in standard DIP socket.
450	1.7	.008	Mounted in 1/16" - 1.6 mm thick double sided PC board.

See Application Note 105 for proper use of thermal characteristics when device is used in a pulsed mode.

See Application Note 111 for information on proper soldering technique.

Typical Characteristics

Figure 1
On-State Collector Current vs Collector-Emitter Voltage

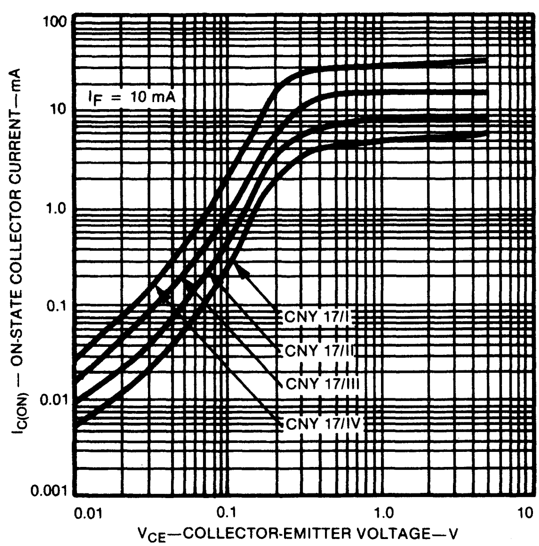


Figure 2
Relative Output Current vs Ambient Temperature

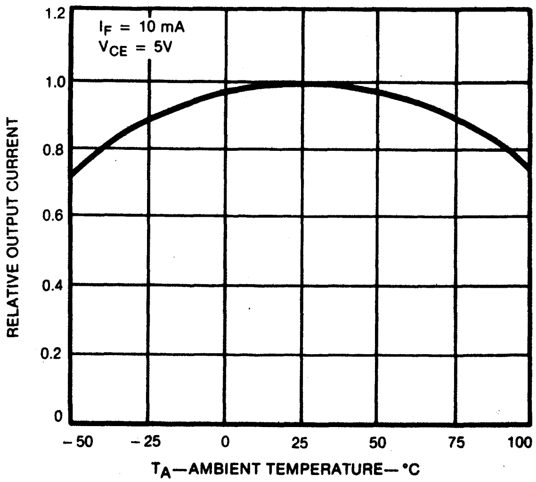


Figure 3
Relative Output Current vs Diode Forward Current

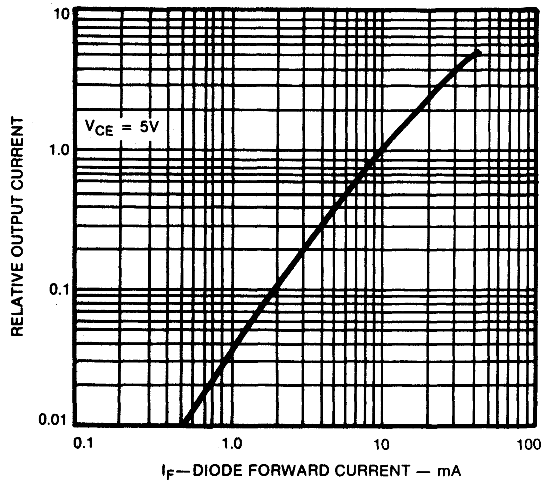


Figure 4
Diode Forward Current vs Diode Forward Voltage

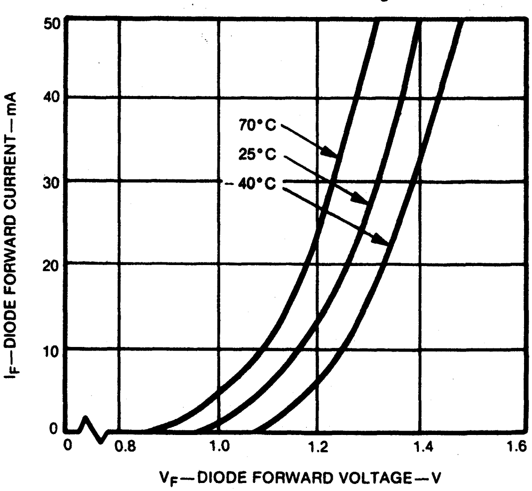
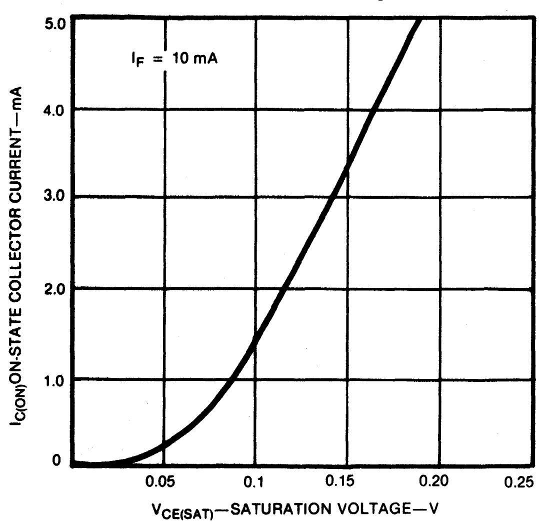


Figure 5
On-State Collector Current vs Saturation Voltage



Types CNY 17/I thru CNY 17/IV

Figure 6
Frequency vs
Phototransistor Output

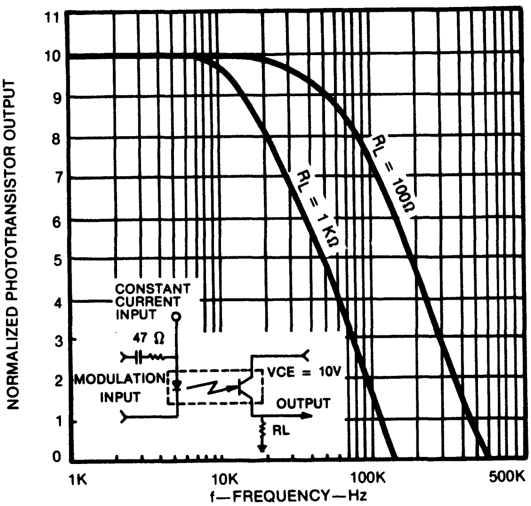


Figure 7
Rise and Fall Time vs
Load Resistance

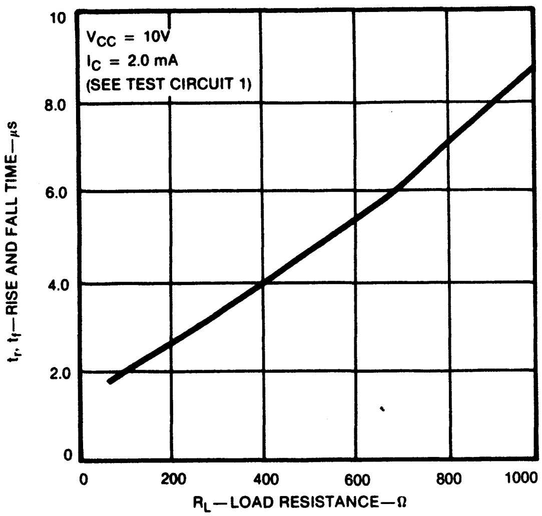


Figure 8
Delay, Rise, and Fall Time vs
Base Resistance

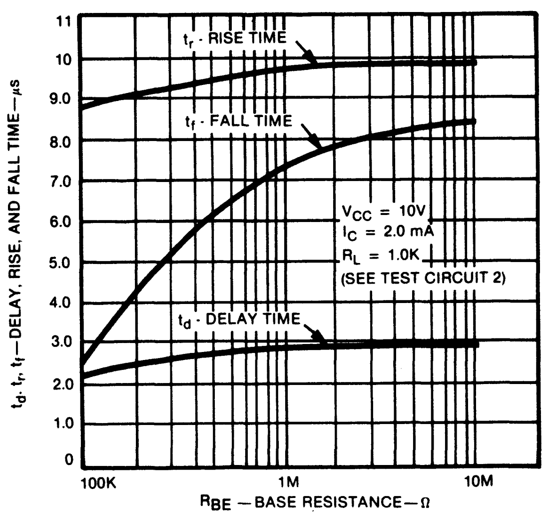
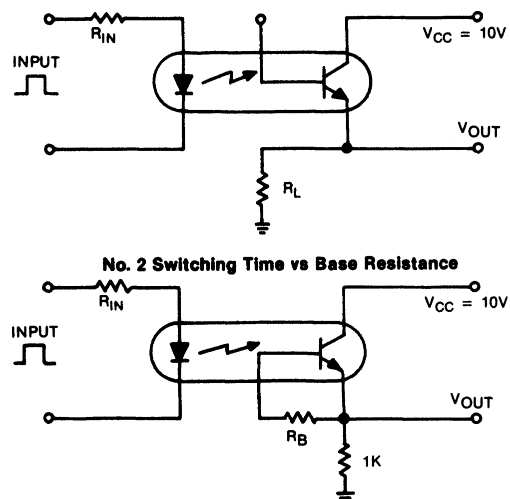


Figure 9
Switching Time Test Circuits
No. 1 Switching Time vs Load Resistance



NOTE: Rise Time (t_r) is time required for collector current to increase from 10% to 90% of its final value. Fall Time (t_f) is time required for the collector current to decrease from 90% to 10% of its initial value. Delay Time (t_d) is the time from input pulse leading edge to point where collector current reaches 10% of its final value.

TRW OPTRON reserves the right to make changes at any time in order to improve design and to supply the best product possible.

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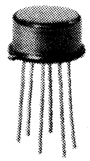
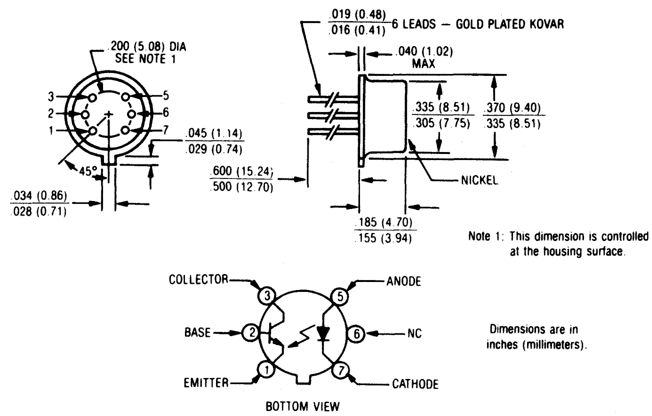
Printed in U.S.A.

Optically Coupled Isolators
Types OPI 102, OPI 103



ACTUAL SIZE



Features

- HIGH DC CURRENT TRANSFER RATIO
- TO-5 HERMETICALLY SEALED PACKAGE
- 1000 VOLT ISOLATION
- BASE CONTACT IS BONDED FOR CONVENTIONAL TRANSISTOR BIASING

Description

The OPI 102 and OPI 103 are optically coupled isolators consisting of a gallium arsenide infrared emitting diode and an NPN silicon phototransistor mounted in a hermetically sealed TO-5 package. TO-5 packages offer high power dissipation, ease of heat sinking and superior hostile environment operation. All electrical parameters are 100% tested by manufacturing. Specifications are guaranteed to a cumulative .65% AQL.

absolute maximum ratings (25 °C unless otherwise noted)

Input-to-Output Isolation Voltage . . . . ± 1000 VDC[1]
Storage and Operating Temperature Range . . . . – 55 °C to + 125 °C
Lead Soldering Temperature (1/16 inch [1.6 mm] from case for 5 sec. with soldering iron)[2] . . . . 240 °C

Input Diode

Forward DC Current (65 °C or below) . . . . 40 mA[3]
Reverse Voltage . . . . 2 V

Output Sensor

Continuous Collector Current . . . . 50 mA
Collector-Emitter Voltage . . . . 35 V
Collector-Base Voltage . . . . 35 V
Emitter-Base Voltage . . . . 4 V
Power Dissipation . . . . 300 mW[4]

Notes

(1) Measured with input leads shorted together and output leads shorted together
(2) RMA flux is recommended. Duration can be extended to 10 sec. max. when flow soldering.
(3) Derate linearly 0.67 mA/ °C above 65 °C
(4) Derate linearly 3.0 mW/ °C above 25 °C

Types OPI 102, OPI 103

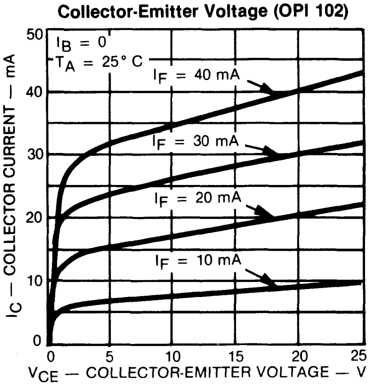
electrical characteristics (25°C unless otherwise noted)

SYMBOL	PARAMETER		MIN	TYP	MAX	UNITS	TEST CONDITIONS
Input Diode							
V_F	Forward Voltage				1.3	V	$I_F = 10$ mA
I_R	Reverse Current				100	μA	$V_R = 2V$
Output Sensor							
$V_{(BR)CEO}$	Collector-Emitter Breakdown Voltage		35			V	$I_C = 1.0$ mA, $I_B = 0$, $I_F = 0$
$V_{(BR)CBO}$	Collector-Base Breakdown Voltage		35			V	$I_C = 100$ μA, $I_B = 0$, $I_F = 0$
$V_{(BR)EBO}$	Emitter-Base Breakdown Voltage		4			V	$I_E = 100$ μA, $I_B = 0$, $I_F = 0$
$I_{C(OFF)}$	Collector-Emitter Dark Current				100	nA	$V_{CE} = 20V$, $I_B = 0$, $I_F = 0$
h_{FE}	Forward Current Gain	OPI 102 OPI 103		300 500			$V_{CE} = 5$ V, $I_C = 10$ mA, $I_F = 0$ $V_{CE} = 5$ V, $I_C = 10$ mA, $I_F = 0$
Coupled							
$I_{C(ON)}$	On State Collector Current	OPI 102 OPI 103	2.5 10			mA mA	$V_{CE} = 5$ V, $I_F = 10$ mA, $I_B = 0$ $V_{CE} = 5$ V, $I_F = 10$ mA, $I_B = 0$
$V_{CE(SAT)}$	Collector-Emitter Saturation Voltage	OPI 102 OPI 103			0.3 0.3	V V	$I_C = 2.5$ mA, $I_F = 20$ mA $I_C = 10$ mA, $I_F = 20$ mA
R_{IO}	Input-to-Output Resistance		10^{11}			Ω	$V_{IO} = \pm 1.0$ kV (See Note)
C_{IO}	Input-to-Output Capacitance			2.5		pF	$V_{IO} = 0$, f = 1 MHz (See Note)
t_r t_f	Output Rise Time Output Fall Time			5 5		μs μs	$V_{CC} = 10$ V, $I_F = 10$ mA $R_L = 100$ Ω (See Test Circuit)

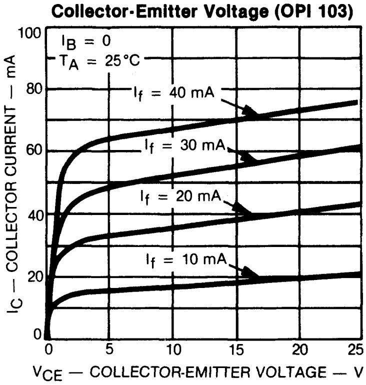
NOTE: Measured with input leads shorted together and output leads shorted together.

Typical Characteristics

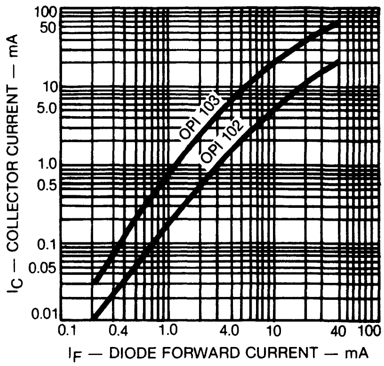
Collector Current vs Collector-Emitter Voltage (OPI 102)



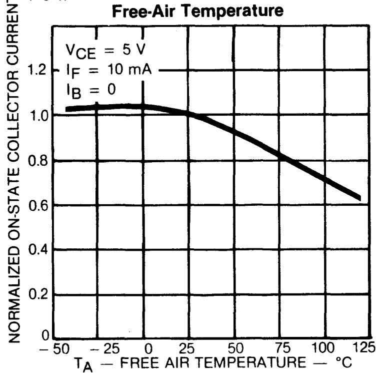
Collector Current vs Collector-Emitter Voltage (OPI 103)



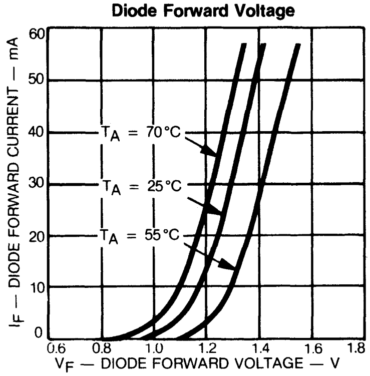
Collector Current vs Diode Forward Current



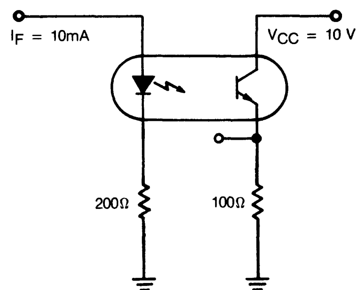
Normalized On-State Collector Current vs Free-Air Temperature



Diode Forward Current vs Diode Forward Voltage



Test Circuit



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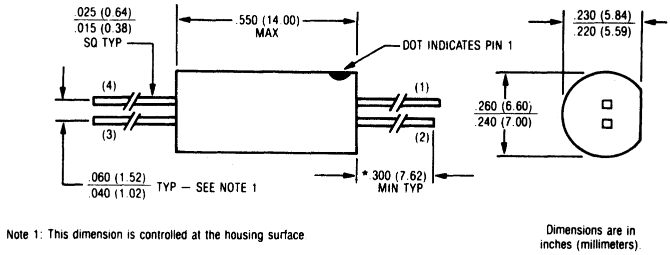
Printed in U.S.A.

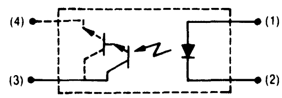
TRW OPTRON

PRODUCT BULLETIN 3046
February 1982

Optically Coupled Isolators
Types OPI110, OPI113

ACTUAL SIZE





*Cathode lead. Other leads are .06 (1.52) nom. longer.

Features

- 10 kV ELECTRICAL ISOLATION
- PHOTOTRANSISTOR OR PHOTODARLINGTON OUTPUT OPTION
- LOW COST PLASTIC HOUSING
- VDE APPROVED
- UL RECOGNIZED FILE NUMBER E58730 (6)

Description

The OPI110 and OPI113 are optically coupled isolators each containing a gallium arsenide infrared emitting diode and an NPN silicon phototransistor (OPI110) or photodarlington (OPI113) sealed in a precast opaque epoxy housing. This series is designed for applications requiring high voltage isolation between input and output.

All electrical parameters are 100% tested by manufacturing. Specifications are guaranteed to a cumulative .65% AQL.

absolute maximum ratings (25°C unless otherwise noted)

Input-to-Output Isolation Voltage .... ±10 kVDC(1)
Storage Temperature Range .... −40°C to +85°C
Operating Temperature Range .... −40°C to +80°C
Lead Soldering Temperature (1/16 inch [1.6 mm] from case for 5 sec. with soldering iron)(2) .... 240°C

Input Diode

Forward DC Current .... 40 mA(3)
Reverse DC Voltage .... 3 V
Power Dissipation .... 50 mW(4)

Output Photosensor

Collector-Emitter Voltage (OPI110) .... 30 V
(OPI113) .... 25 V
Emitter-Collector Voltage .... 5 V
Power Dissipation .... 100 mW(5)

Notes: (1) Measured with input diode leads shorted together and output leads shorted together
(2) RMA flux is recommended. Duration can be extended to 10 sec. max. when flow soldering.
(3) Derate linearly 0.73 mA/°C above 25°C
(4) Derate linearly 0.91 mW/°C above 25°C
(5) Derate linearly 1.82 mW/°C above 25°C
(6) UL recognition is for 3500 VAC, 1 minute only.

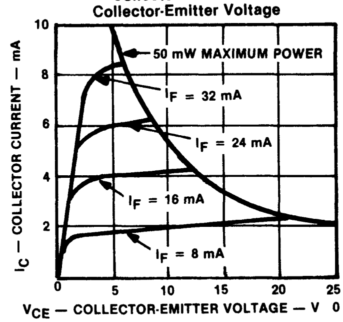
Types OPI110, OPI113

electrical characteristics (25°C unless otherwise noted)

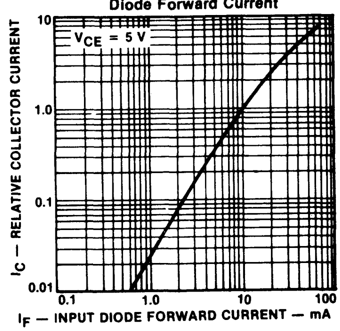
SYMBOL	PARAMETER		MIN	TYP	MAX	UNITS	TEST CONDITIONS
Input Diode							
V_F	Forward Voltage	OPI110 OPI113			1.5 1.5	V V	I_F = 20 mA I_F = 10 mA
I_R	Reverse Current				100	μA	V_R = 3 V
Output Photosensor							
$V_{(BR)CEO}$	Collector-Emitter Breakdown Voltage	OPI110 OPI113	30 25			V V	I_C = 1 mA, I_F = 0 I_C = 1 mA, I_F = 0
$V_{(BR)ECO}$	Emitter-Collector Breakdown Voltage	OPI110 OPI113	5 5			V V	I_E = 10 μA, I_F = 0 I_E = 100 μA, I_F = 0
I_{CEO}	Collector-Emitter Dark Current				100	nA	V_{CE} = 10 V, I_F = 0
Coupled							
I_C/I_F	DC Current Transfer Ratio	OPI110 OPI113	12.5 50	25		% %	I_F = 16 mA, V_{CE} = 5 V I_F = 16 mA, V_{CE} = 2 V
$V_{CE(SAT)}$	Collector Saturation Voltage	OPI110 OPI113			0.4 1.2	V V	I_F = 16 mA, I_C = 1.8 mA I_F = 16 mA, I_C = 5 mA
V_{ISO}	Isolation Voltage		10			kVDC	See Note 1
t_r t_f	Output Rise Time Output Fall Time	OPI110		2 2		μs μs	V_{CC} = 10 V, I_C = 2 mA R_L = 100Ω, See Test Circuit
t_r t_f	Output Rise Time Output Fall Time	OPI113		40 40		μs μs	V_{CC} = 10 V, I_C = 1 mA R_L = 100Ω, See Test Circuit

Typical Performance Curves (OPI110 Only)

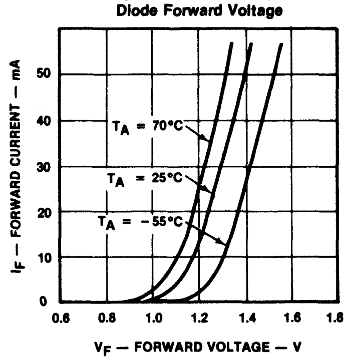
Collector Current vs Collector-Emitter Voltage



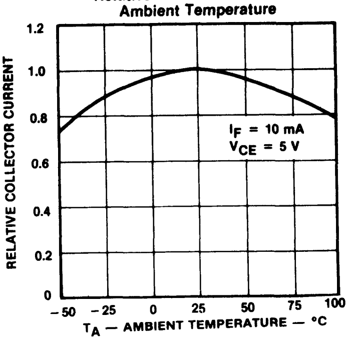
Relative Collector Current vs Diode Forward Current



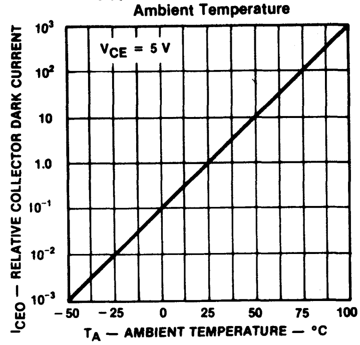
Diode Forward Current vs Diode Forward Voltage



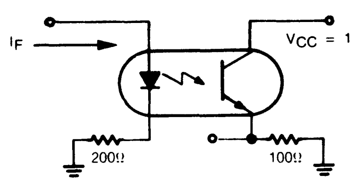
Relative Collector Current vs Ambient Temperature



Relative Collector Dark Current vs Ambient Temperature



Test Circuit



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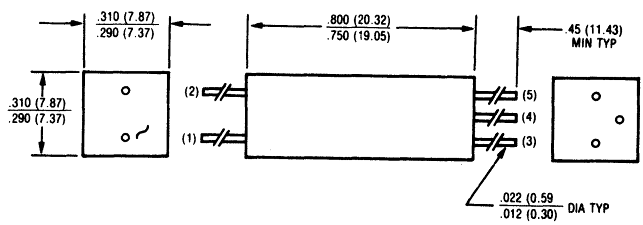
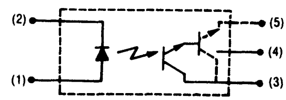
Optically Coupled Isolators
Types OPI120, OPI123

ONE HALF ACTUAL SIZE





Dimensions are in inches (millimeters).

Features

- 15 kV ELECTRICAL ISOLATION
- PHOTOTRANSISTOR OR PHOTODARLINGTON OUTPUT OPTION
- HERMETICALLY SEALED LED AND PHOTOSENSOR
- BASE CONTACT IS BONDED FOR CONVENTIONAL TRANSISTOR BIASING

Description

The OPI120 and OPI123 are optically coupled isolators each containing a gallium arsenide infrared emitting diode and an NPN silicon phototransistor (OPI120) or photodarlington (OPI123) sealed in a high dielectric plastic housing. LED and sensors are in hermetically sealed packages. This series is designed for applications requiring high voltage isolation between input and output.

All electrical parameters are 100% tested by manufacturing. Specifications are guaranteed to a cumulative .65% AQL.

absolute maximum rating (25 °C unless otherwise noted)

Input-to-Output Isolation Voltage . . . . ± 15 kVDC(1)
Storage Temperature Range . . . . −55 °C to +125 °C
Operating Temperature Range . . . . −55 °C to +100 °C
Lead Soldering Temperature (1/16 inch [1.6 mm] from case for 5 sec. with soldering iron)(2) . . . . 240 °C

Input Diode

Forward DC Current . . . . 150 mA(3)
Reverse DC Voltage . . . . 3 V
Power Dissipation . . . . 200 mW(4)

Output Photosensor

Collector-Emitter Voltage (OPI120) . . . . 25 V
(OPI123) . . . . 20 V
Emitter-Collector Voltage . . . . 5 V
Collector-Base Voltage (OPI120) . . . . 25 V
(OPI123) . . . . 30 V
Power Dissipation . . . . 250 mW(5)

Notes: (1) Measured with input leads shorted together and output leads shorted together in air with a maximum relative humidity of 50%. If suitably encapsulated or oil immersed, the isolation voltage is increased to at least 25 kV.
(2) RMA flux is recommended. Duration can be extended to 10 sec. max. when flow soldering.
(3) Derate linearly 2.0 mA/ °C above 25 °C
(4) Derate linearly 2.67 mW/ °C above 25 °C
(5) Derate linearly 3.33 mW/ °C above 25 °C

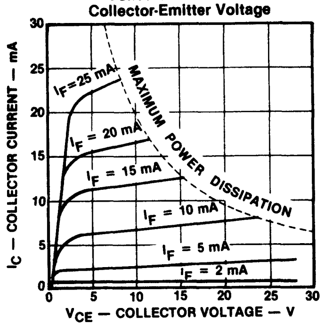
Types OPI120, OPI123

electrical characteristics (25 °C unless otherwise noted)

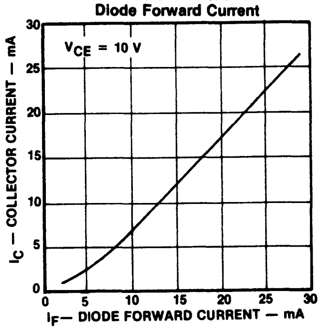
SYMBOL	PARAMETER		MIN	TYP	MAX	UNITS	TEST CONDITIONS
Input Diode							
V_F	Forward Voltage	OPI120 OPI123			1.5 1.5	V V	I_F = 30 mA I_F = 10 mA
I_R	Reverse Current	OPI120 OPI123			100 10	μA μA	V_R = 3 V V_R = 3 V
Output Photosensor							
$V_{(BR)CEO}$	Collector-Emitter Breakdown Voltage	OPI120 OPI123	25 20			V V	I_C = 1 mA I_C = 1 mA
$V_{(BR)ECO}$	Emitter-Collector Breakdown Voltage		5			V	I_E = 100 μA
$V_{(BR)CBO}$	Collector-Base Breakdown Voltage	OPI120 OPI123	30 25			V V	I_C = 100 μA I_C = 100 μA
I_{CEO}	Collector-Emitter Dark Current				100	nA	V_{CE} = 10 V
Coupled							
I_C/I_F	DC Current Transfer Ratio	OPI120 OPI123	20 50	70		% %	I_F = 10 mA, V_{CE} = 5 V I_F = 10 mA, V_{CE} = 2 V
$V_{CE(SAT)}$	Saturation Voltage	OPI120 OPI123	0.5 1.2			V V	I_F = 30 mA, I_C = 1 mA I_F = 5 mA, I_C = 1 mA
V_{ISO}	Isolation Voltage		15			kV	See Note 1
t_r t_f	Output Rise Time Output Fall Time	OPI120		2 2		μs μs	V_{CC} = 10 V, I_C = 2 mA R_L = 100 Ω, See Test Circuit
t_r t_f	Output Rise Time Output Fall Time	OPI123		40 40		μs μs	V_{CC} = 10 V, I_C = 1 mA R_L = 100Ω, See Test Circuit

Typical Performance Curves (OPI120 Only)

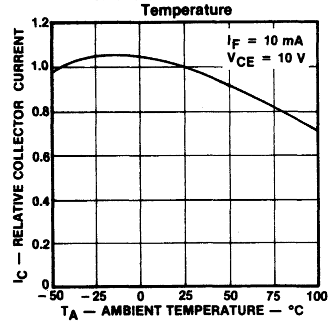
Collector Current vs Collector-Emitter Voltage



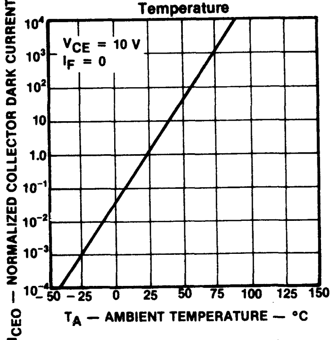
Collector Current vs Diode Forward Current



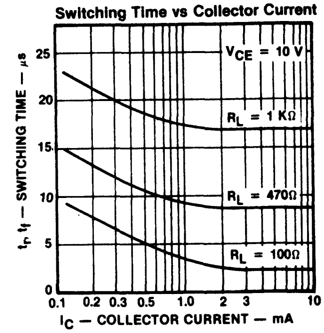
Relative Collector Current vs Temperature



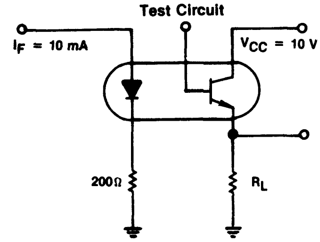
Normalized Collector Dark Current vs Temperature



Switching Time vs Collector Current



Test Circuit



THE INPUT WAVEFORM IS SUPPLIED BY A GENERATOR WITH THE FOLLOWING CHARACTERISTICS: Z_{OUT} = 50Ω, t_r ≤ 15 ns, DUTY CYCLE ≈ 1%, PULSE WIDTH ≈ 100 μs

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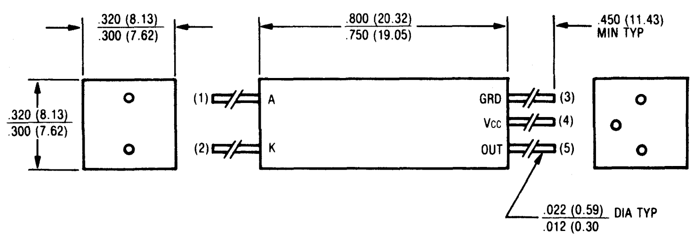
TRW OPTRON

PRODUCT BULLETIN 3048
January 1982

Photologic™ Optically Coupled Isolators

Types OPI125, OPI126, OPI127, OPI128

1/2 ACTUAL SIZE



Dimensions are in inches (millimeters).

Features

- FOUR OUTPUT OPTIONS
- 15 kV INPUT-TO-OUTPUT ISOLATION VOLTAGE
- DIRECT TTL/LSTTL INTERFACE
- HIGH NOISE IMMUNITY
- DATA RATES TO 250 KBAUD
- HERMETICALLY SEALED

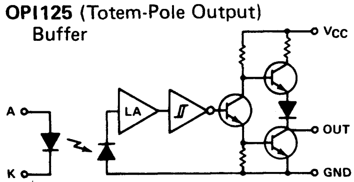
Description

The OPI125, OPI126, OPI127 and OPI128 each contain a gallium arsenide infrared emitting diode coupled to a monolithic integrated circuit which incorporates a photodiode, a linear amplifier, and a Schmitt trigger on a single silicon chip. The devices feature TTL/LSTTL compatible logic level output which can drive up to 8 TTL loads directly without additional circuitry. Also featured are medium speed data rates to 250 KBAUD with typical rise and fall times of 25 nsec. Both the infrared emitting diode and the Photologic sensor are in hermetically sealed packages for maximum long term stability and are mounted in a high dielectric plastic housing.

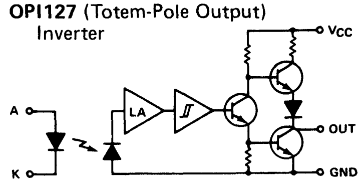
All electrical parameters are 100% tested by manufacturing. Specifications are guaranteed to a .65% AQL.

Schematics

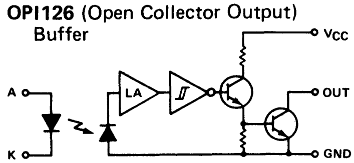
OPI125 (Totem-Pole Output)
Buffer



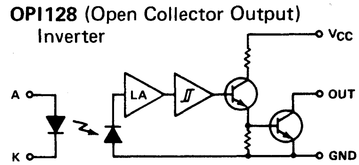
OPI127 (Totem-Pole Output)
Inverter



OPI126 (Open Collector Output)
Buffer



OPI128 (Open Collector Output)
Inverter



absolute maximum ratings (25° C unless otherwise noted)

Input-to-Output Isolation Voltage . . . . ±15,000 VDC(1)
Supply Voltage, V_{CC} (not to exceed 3 seconds) . . . . +10 V
Storage Temperature Range. . . . . −55°C to +100°C
Operating Temperature Range . . . . −55°C to +100°C
Lead Soldering Temperature Range (1/16 inch [1.6 mm] from Case for
5 sec. w/soldering iron(2)) . . . . 240°C
Total Device Power Dissipation . . . . 400 mW(3)
Input Diode Power Dissipation. . . . . 250 mW(4)
Output Photologic Power Dissipation . . . . 200 mW(5)
Duration of Output Short to V_{CC} or Ground (OPI125, OPI127) . . . . 1 sec.
Duration of Output Short to V_{CC} (OPI126, OPI128). . . . . 1 sec.
Voltage at Output Lead (OPI126, OPI128). . . . . 35 V
Diode Input { Forward D.C. Current . . . . 25 mA
Diode Input { Reverse D.C. Voltage . . . . 2 V

Notes: (1) Measured with input leads shorted together and output leads shorted together.
(2) RMA flux is recommended. Duration can be extended to 10 seconds max. when flow soldering.
(3) Derate linearly 5.33 mW/cm^2 above 25°C.
(4) Derate linearly 3.33 mW/cm^2 above 25°C.
(5) Derate linearly 2.67 mW/°C above 25°C.

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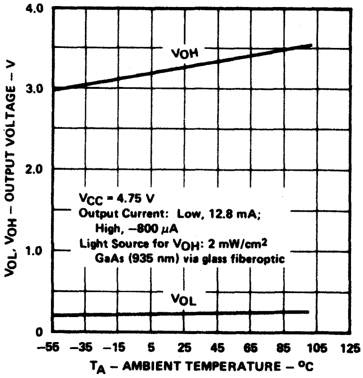
Types OPI125, OPI126, OPI127, OPI128

electrical characteristics (−40° C to +70° C unless otherwise noted)

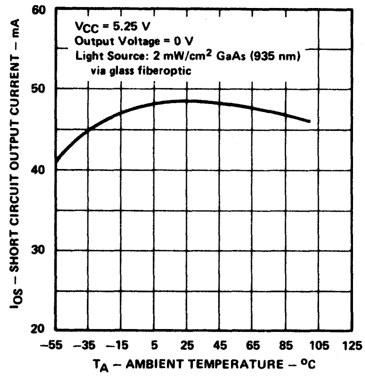
SYMBOL	PARAMETER	MIN	TYP	MAX	UNITS	TEST CONDITIONS
DIODE INPUT						
V_F	Forward Voltage			1.5	V	I_F = 10 mA, T_A = 25°
I_R	Reverse Current			100	µA	V_R = 2 V, T_A = 25°C
$I_{F(+)}$	LED Positive-Going Threshold Current			10	mA	V_{CC} = 5 V
$I_{F(+)}/I_{F(-)}$	Hysteresis Ratio		2			
PHOTOLOGIC OUTPUT						
V_{CC}	Operating Supply Voltage	4.75		5.25	V	
I_{CC}	Supply Current			15	mA	V_{CC} = 5.25 V, I_F = 0 or 10 mA
OPI125 (Buffer, Totem-Pole)						
V_{OL}	Low Level Output Voltage			0.4	V	V_{CC} = 4.75 V, I_{OL} = 12.8 mA I_F = 0 mA
V_{OH}	High Level Output Voltage	2.4			V	V_{CC} = 4.75 V, I_{OH} = −800 µA I_F = 10 mA
I_{OS}	Short Circuit Output Current	−30		−100	mA	V_{CC} = 5.25 V, I_F = 10 mA Output = GND
OPI126 (Buffer, Open Collector)						
V_{OL}	Low Level Output Voltage			0.4	V	V_{CC} = 4.75 V, I_{OL} = 12.8 mA I_F = 0 mA
I_{OH}	High Level Output Current			100	µA	V_{CC} = 4.75 V, V_{OH} = 30 V I_F = 10 mA
OPI127 (Inverter, Totem-Pole)						
V_{OL}	Low Level Output Voltage			0.4	V	V_{CC} = 4.75 V, I_{OL} = 12.8 mA I_F = 10 mA
V_{OH}	High Level Output Voltage	2.4			V	V_{CC} = 4.75 V, I_{OH} = −800 µA I_F = 0 mA
I_{OS}	Short Circuit Output Current	−30		−100	mA	V_{CC} = 5.25 V, I_F = 0 mA Output = GND
OPI128 (Inverter, Open Collector)						
V_{OL}	Low Level Output Voltage			0.4	V	V_{CC} = 4.75 V, I_{OL} = 12.8 mA I_F = 10 mA
I_{OH}	High Level Output Current			100	µA	V_{CC} = 4.75 V, V_{OH} = 30 V I_F = 0 mA
OPI125, OPI127						
t_r, t_f	Output Rise Time, Output Fall Time			70	ns	V_{CC} = 5 V, T_A = 25°C I_F = 0 or 10 mA
t_{PLH}, t_{PHL}	Propagation Delay, Low-High, High-Low			5	µs	f = 10 kHz, D.C. = 50% R_L = 8 TTL Loads
OPI126, OPI128						
t_r, t_f	Output Rise Time, Output Fall Time			70	ns	V_{CC} = 5 V, T_A = 25°C I_F = 0 or 10 mA
t_{PLH}, t_{PHL}	Propagation Delay, Low-High, High-Low			5	µs	f = 10 kHz, D.C. = 50% R_L = 360 Ω

OPI125, OPI127

Output Voltage vs. Ambient Temperature

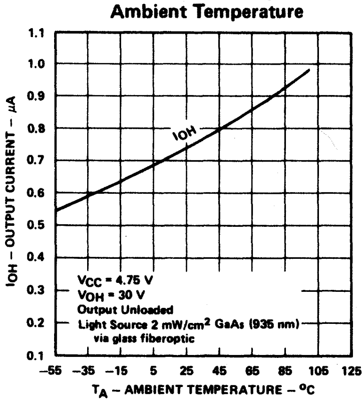


Short Circuit Output Current vs. Ambient Temperature

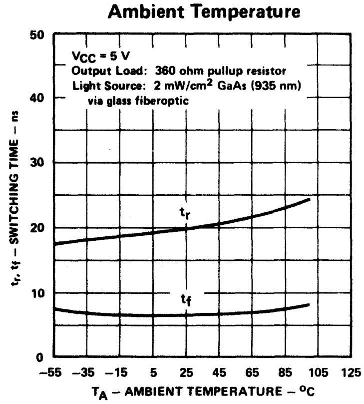


OPI126, OPI128

Output Current (High) vs. Ambient Temperature

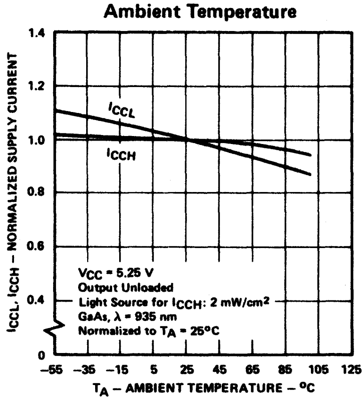


Rise Time and Fall Time vs. Ambient Temperature



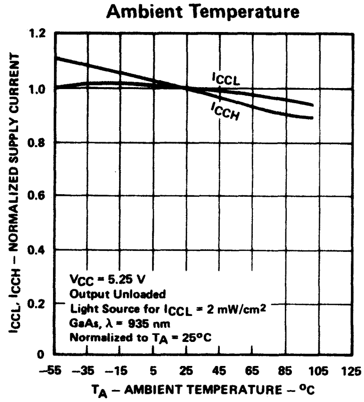
OPI125, OPI126

Normalized Supply Current vs. Ambient Temperature

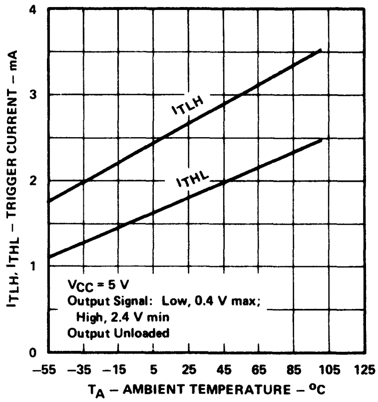


OPI127, OPI128

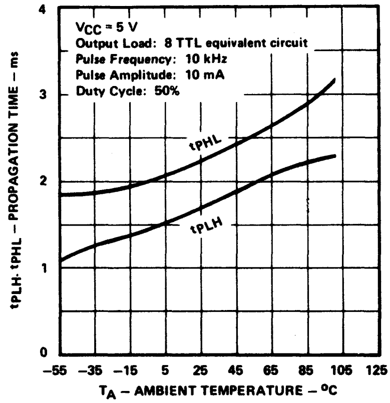
Normalized Supply Current vs. Ambient Temperature



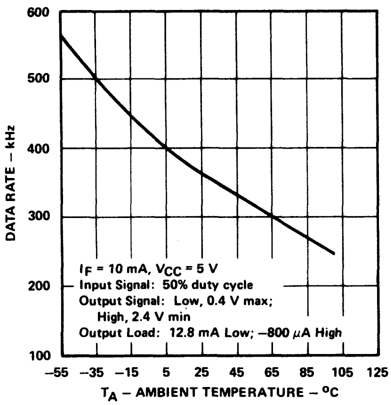
Trigger Current vs. Ambient Temperature



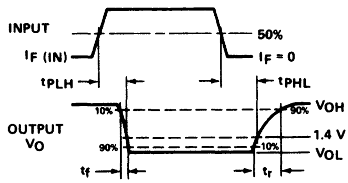
Propagation Time vs. Ambient Temperature



Data Rate vs. Ambient Temperature

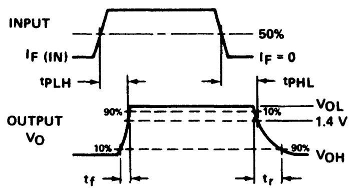


Switching Test Curve for Inverters



LED: f = 1 kHz, D.C. = 50%

Switching Test Curve for Buffers

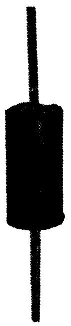


LED: f = 1 kHz, D.C. = 50%

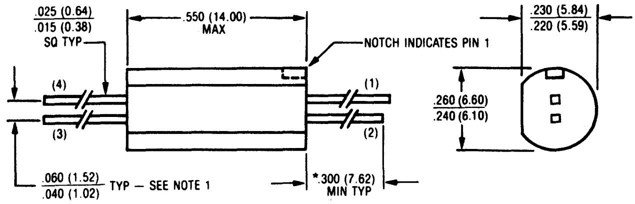
TRW OPTRON

PRODUCT BULLETIN 3052
February 1982

Optically Coupled Isolators
Types OPI1264A, B, C

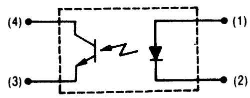


ACTUAL SIZE



Note 1: This dimension is controlled at the housing surface.

Dimensions are in inches (millimeters).



*Cathode lead. Other leads are .06 (1.52) nom. longer.

Features

- 10 kV ELECTRICAL RATING
- HIGH CURRENT TRANSFER RATIO
- LOW COST PLASTIC MODULE
- VDE APPROVED
- UL RECOGNIZED FILE NO. E58730[6]

Description

The OPI1264A, B and C are a family of optically coupled isolators, each consisting of a gallium arsenide, near infrared light emitting diode, coupled to an NPN silicon phototransistor sealed in a precast opaque epoxy housing. This series is designed for applications requiring high voltage isolation between input and output.

All electrical parameters are 100% tested by manufacturing. Specifications are guaranteed to a .65% AQL.

absolute maximum ratings (25 °C unless otherwise noted)

Input-to-Output Isolation Voltage . . . . ± 10 kVDC[1]
Operating Temperature Range . . . . −40 °C to +85 °C
Storage Temperature Range . . . . −40 °C to +80 °C
Lead Soldering Temperature (1/16 inch [1.6 mm] from case for 5 sec. with soldering iron)[2] . . . . 240 °C

Input Diode

Forward DC Current . . . . 40 mA[3]
Reverse DC Voltage . . . . 3 V
Power Dissipation . . . . 50 mW[4]

Output Phototransistor

Collector-Emitter Voltage . . . . 32 V
Emitter-Collector Voltage . . . . 5 V
Power Dissipation . . . . 100 mW[5]

Notes: (1) Measured with input diode leads shorted together and output leads shorted together
(2) RMA flux is recommended. Duration can be extended to 10 sec. max. when flow soldering.
(3) Derate linearly 0.73 mA/ °C above 25 °C
(4) Derate linearly 0.91 mW/ °C above 25 °C
(5) Derate linearly 1.82 mW/°C above 25 °C
(6) UL recognition is for 3500 VAC, 1 minute, only.

Types OPI1264A, B, C

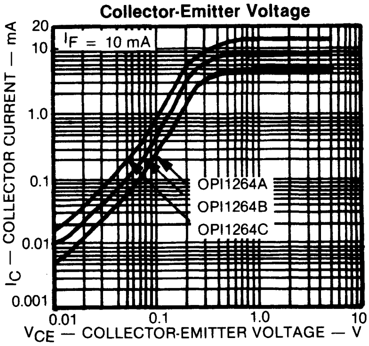
PRODUCT BULLETIN 3052
February 1982

electrical characteristics (25 °C unless otherwise noted)

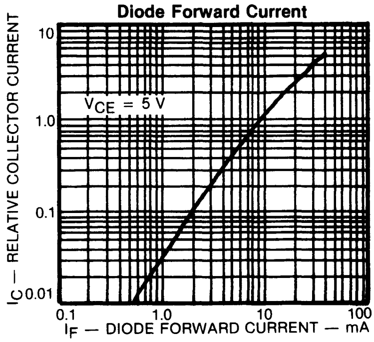
SYMBOL	PARAMETER	MIN	TYP	MAX	UNITS	TEST CONDITIONS
Input Diode						
V_F	Forward Voltage			1.5	V	I_F = 20 mA
I_R	Reverse Current			100	μA	V_R = 3V
Output Phototransistor						
$V_{(BR)CEO}$	Collector-Emitter Breakdown Voltage	32			V	I_C = 1 mA
$V_{(BR)ECO}$	Emitter-Collector Breakdown Voltage	5			V	I_E = 100 μA
I_{CEO}	Collector-Emitter Dark Current			200	nA	V_{CE} = 20 V
I_{CEO}	Collector-Emitter Dark Current OPI1264A			100	μA	V_{CE} = 10 V, T_A = 70 °C
Coupled						
I_C/I_F	DC Current Transfer Ratio					
	OPI1264A	25			%	I_F = 10 mA, V_{CE} = 5 V
	OPI1264B	50			%	I_F = 10 mA, V_{CE} = 5 V
	OPI1264C	100			%	I_F = 10 mA, V_{CE} = 5 V
V_{ISO}	Isolation Voltage	10			kV	See Note 1
$V_{CE(SAT)}$	Collector-Emitter Saturation Voltage			0.4	V	I_F = 10 mA, I_C = 1.6 mA
C_{io}	Input-Output Capacitance		0.06		pF	See Note 1
t_{on}	Turn-On Time OPI1264A		4		μs	I_C = 2 mA, V_{CC} = 10 V, R_L = 100 Ω See Test Circuit
t_{off}	Turn-Off Time OPI1264A		3		μs	I_C = 2 mA, V_{CC} = 10 V, R_L = 100 Ω See Test Circuit

Typical Performance Curves

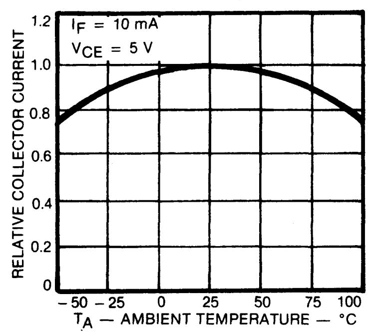
Collector Current vs Collector-Emitter Voltage



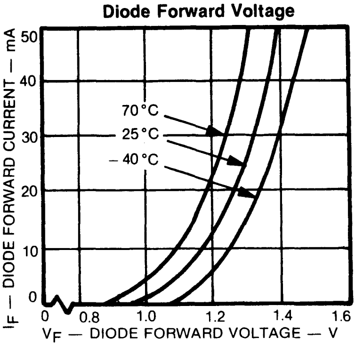
Relative Collector Current vs Diode Forward Current



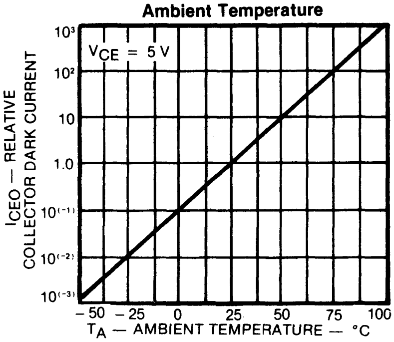
Relative Collector Current vs Ambient Temperature



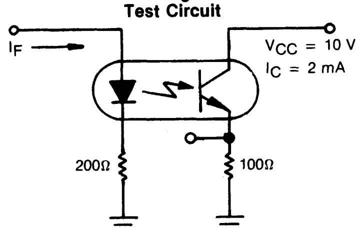
Diode Forward Current vs Diode Forward Voltage



Collector Dark Current vs Ambient Temperature



Switching Time Test Circuit



THE INPUT WAVEFORM IS SUPPLIED BY A GENERATOR WITH THE FOLLOWING CHARACTERISTICS: Z_{OUT} = 50Ω, $t_r \geq$ 15 ns, DUTY CYCLE = 1%, PULSE WIDTH ≈ 100 μs

TRW OPTRON reserves the right to make changes at any time in order to improve design and to supply the best product possible.

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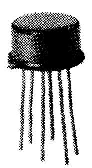
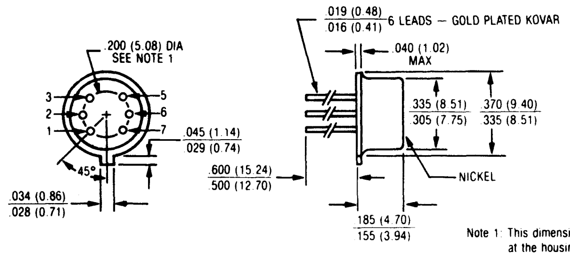
TRW *OPTRON*

PRODUCT BULLETIN 3049
February 1982

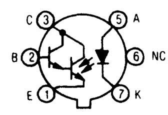
Optically Coupled Isolator
Type OPI130



TWICE ACTUAL SIZE



Note 1: This dimension is controlled at the housing surface.



BOTTOM VIEW

Dimensions are in inches (millimeters).

Features

- PHOTODARLINGTON OUTPUT
- TO-5 HERMETICALLY SEALED PACKAGE
- 1000 VOLT ISOLATION
- BASE LEAD IS BONDED FOR CONVENTIONAL TRANSISTOR BIASING

Description

The OPI130 is an optically coupled isolator consisting of a gallium arsenide infrared emitting diode and an NPN silicon photoDarlington mounted in a hermetically sealed TO-5 package. TO-5 packages offer high power dissipation, ease of heat sinking and superior hostile environment operation.

All electrical parameters are 100% tested by manufacturing. Specifications are guaranteed to a cumulative .65% AQL.

absolute maximum rating (25 °C unless otherwise noted)

Input-to-Output Isolation Voltage . . . . ± 1000 VDC(1)
Storage Temperature Range . . . . – 65 °C to + 150 °C
Operating Temperature Range . . . . – 55 °C to + 125 °C
Lead Soldering Temperature (1/16 inch [1.6 mm] from case for 5 sec. with soldering iron)(2) . . . . 240 °C

Input Diode

Forward DC Current (65 °C or below) . . . . 40 mA
Reverse Voltage . . . . 2 V
Power Dissipation . . . . 60 mW(3)

Output Sensor

Continuous Collector Current . . . . 50 mA
Collector-Emitter Voltage . . . . 25 V
Collector-Base Voltage . . . . 25 V
Emitter-Base Voltage . . . . 5 V
Power Dissipation . . . . 300 mW(4)

Notes:

(1) Measured with input leads shorted together and output leads shorted together
(2) RMA flux is recommended. Duration can be extended to 10 sec. max. when flow soldering.
(3) Derate linearly 0.6 mW/ °C above 25 °C
(4) Derate linearly 3.0 mW/ °C above 25 °C

Type OPI130

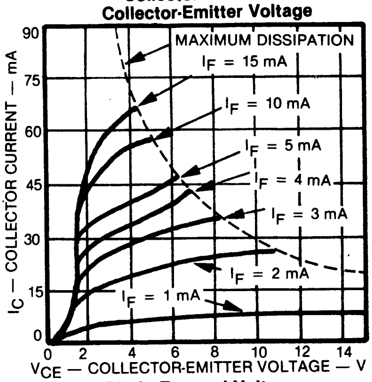
electrical characteristics (25°C unless otherwise noted)

SYMBOL	PARAMETER	MIN	TYP	MAX	UNITS	TEST CONDITIONS
Input Diode						
V_F	Forward Voltage			1.3	V	I_F = 10 mA
I_R	Reverse Current			100	μA	V_R = 2V
Output Photodarlington						
$V_{(BR)CEO}$	Collector-Emitter Breakdown Voltage	25			V	I_C = 1 mA, I_B = 0, I_F = 0
$V_{(BR)CBO}$	Collector-Base Breakdown Voltage	25			V	I_C = 100 μA, I_E = 0, I_F = 0
$V_{(BR)EBO}$	Emitter-Base Breakdown Voltage	5			V	I_E = 100 μA, I_C = 0, I_F = 0
I_{CEO}	Collector-Emitter Dark Current			100	nA	V_{CE} = 10 V, I_B = 0, I_F = 0
			800		μA	V_{CE} = 10 V, I_B = 0, I_F = 0, T_A = 100°C
h_{FE}	DC Current Gain		12000			V_{CE} = 5V, I_C = 10mA, I_F = 0
Coupled						
$I_{C(ON)}$	On-State Collector Current	10			mA	V_{CE} = 2 V, I_F = 5 mA, I_B = 0
$V_{CE(SAT)}$	Collector-Emitter Saturation Voltage			1		I_C = 1 mA, I_F = 5 mA
V_{ISO}	Isolation Voltage	1000			V	V V_{IO} = ± 1 kV (See Note 1)
R_{IO}	Input-to-Output Resistance	10^{11}	10^{12}		Ω	V_{IO} = ± 1 kV (See Note 1)
C_{IO}	Input-to-Output Capacitance		3		pF	V_{IO} = 0, f = 1 MHz (See Note 1)
t_r	Output Rise Time		50		μs	V_{CC} = 20 V, I_F = 5 mA
t_f	Output Fall Time		50		μs	R_L = 100 Ω, (See Test Circuit)

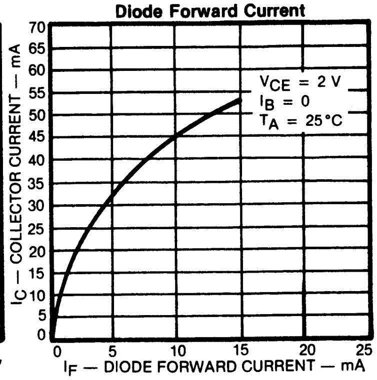
NOTE 1: Derate linearly to 125°C free-air temperature at the rate of 0.67 mA/°C.

Typical Performance Curves

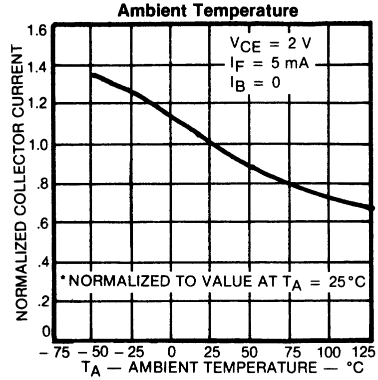
Collector Current vs Collector-Emitter Voltage



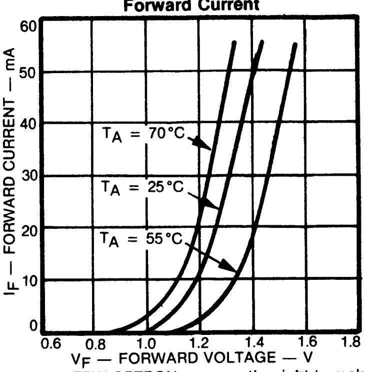
Collector Current vs Diode Forward Current



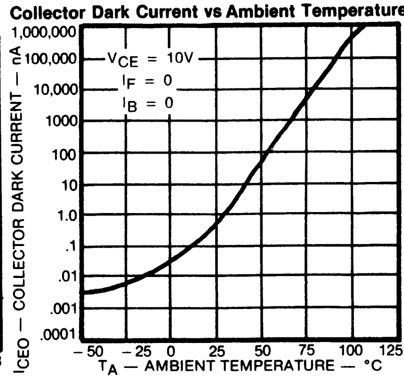
Normalized Collector Current vs Ambient Temperature



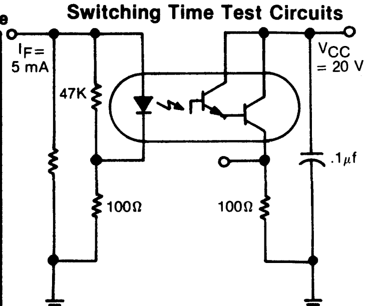
Input Diode Forward Voltage vs Forward Current



Collector Dark Current vs Ambient Temperature



Switching Time Test Circuits



THE INPUT WAVEFORM IS SUPPLIED BY A GENERATOR WITH THE FOLLOWING CHARACTERISTICS: Z_{OUT} = 50Ω, t_r ≤ 15 ns, DUTY CYCLE ≈ 1%, PULSE WIDTH ≈ 100 μs

TRW OPTRON reserves the right to make changes at any time in order to improve design and to supply the best product possible.

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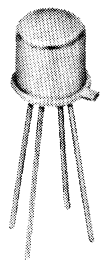
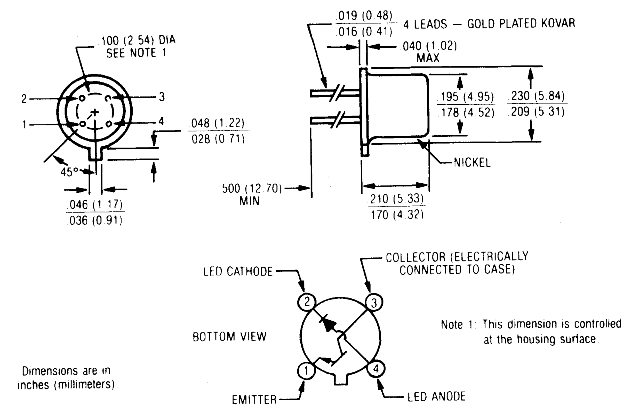
Optically Coupled Isolator

Type OPI140



TWICE ACTUAL SIZE



Note 1: This dimension is controlled at the housing surface.

Dimensions are in inches (millimeters).

Features

- TO-72 HERMETICALLY SEALED PACKAGE
- 1000 VOLT ISOLATION
- WITHSTANDS HTRB AT 125°C, V_{CE} = 20 VOLTS

Description

The OPI140 is an optically coupled isolator consisting of a gallium arsenide infrared emitting diode and an NPN silicon photosensor mounted in a hermetically sealed TO-72 package. TO-72 packages offer high power dissipation, ease of heat sinking and superior hostile environment operation.

All electrical parameters are 100% tested by manufacturing. Specifications are guaranteed to a cumulative .65% AQL.

absolute maximum ratings (25°C unless otherwise noted)

Input-to-Output Isolation Voltage .... ± 1000 VDC(1)
Storage Temperature Range .... −65°C to +150°C
Operating Temperature Range .... −55°C to +125°C
Lead Soldering Temperature (1/16 inch [1.6 mm] from case for 5 sec. with soldering iron)(2) .... 240°C

Input Diode

Forward DC Current .... 40 mA
Reverse DC Voltage .... 3 V
Power Dissipation .... 60 mW(3)

Output Phototransistor

Collector-Emitter Voltage .... 30 V
Emitter-Collector Voltage .... 7 V
Continuous Collector Current .... 30 mA
Power Dissipation .... 200 mW(4)

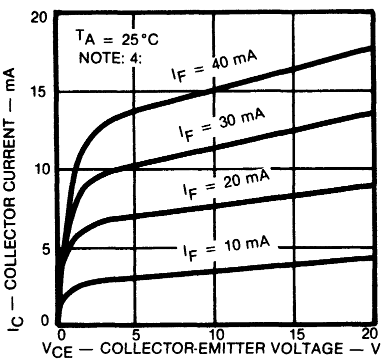
Notes: (1) Measured with input leads shorted together and output leads shorted together
(2) RMA flux is recommended. Duration can be extended to 10 sec. max. when flow soldering.
(3) Derate linearly 0.6 mW/°C above 25°C
(4) Derate linearly 2.0 mW/°C above 25°C

electrical characteristics (25 °C unless otherwise noted)

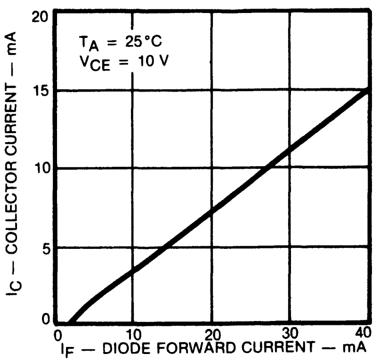
SYMBOL	PARAMETER	MIN	TYP	MAX	UNITS	TEST CONDITIONS
Input Diode						
V_F	Forward Voltage			1.5	V	I_F = 40 mA
I_R	Reverse Current			10	μA	V_R = 3V
Output Phototransistor						
$V_{(BR)CEO}$	Collector-Emitter Breakdown Voltage	30			V	I_C = 1 mA, I_F = 0
$V_{(BR)ECO}$	Emitter-Collector Breakdown Voltage	7			V	I_E = 100 μA, I_F = 0
I_{CEO}	Collector-Emitter Dark Current			50	nA	V_{CE} = 10 V, I_F = 0
Coupled						
$I_{C(ON)}$	On-State Collector Current	1.5			mA	V_{CE} = 10 V, I_F = 10 mA
$V_{CE(SAT)}$	Saturation Voltage			.5	V	I_F = 40 mA, I_C = 1.6mA
V_{ISO}	Isolation Voltage	1000			V	V_{IO} = 1000 V, See Note 1
R_{IO}	Input-to-Output Resistance		10^{11}		Ω	V_{IO} = 500 V, See Note 1
t_r t_f	Output Rise Time Output Fall Time		2 2		μs μs	V_{CC} = 10 V, I_C = 1 mA R_L = 100 Ω, See Test Circuit

Typical Performance Curves

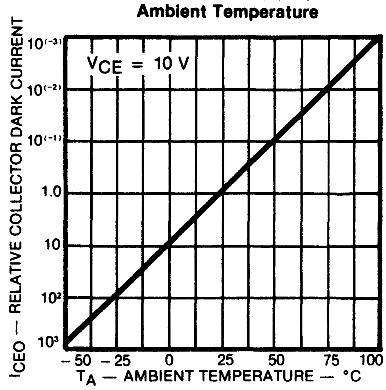
Collector Current vs Collector-Emitter Voltage



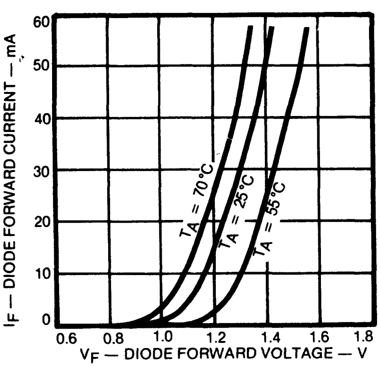
Collector Current vs Diode Forward Current



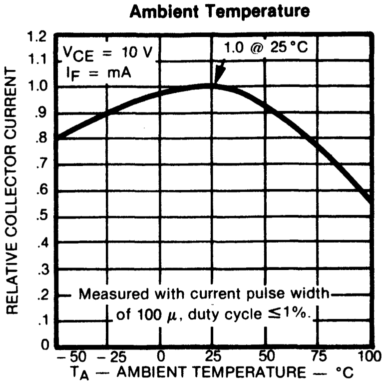
Collector Dark Current vs Ambient Temperature



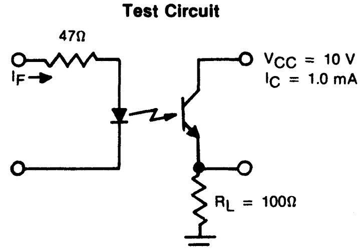
Diode Forward Voltage vs Diode Forward Current



Relative Collector Current vs Ambient Temperature



Test Circuit



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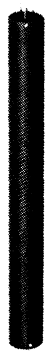
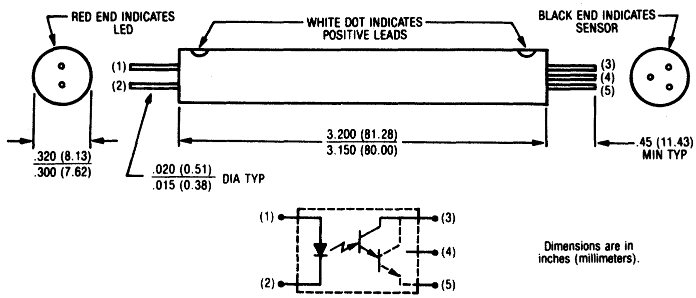
PRODUCT BULLETIN 3051
February 1982

Optically Coupled Isolators
Types OPI150, OPI153



ONE HALF ACTUAL SIZE



Features

- 50 kV ELECTRICAL ISOLATION
- PHOTOTRANSISTOR OR PHOTODARLINGTON OUTPUT OPTION
- HERMETICALLY SEALED LED AND PHOTOSENSOR
- BASE CONTACT IS BONDED FOR CONVENTIONAL TRANSISTOR BIASING

Description

The OPI150 and OPI153 each contain a gallium arsenide infrared emitting diode and an NPN silicon phototransistor (OPI150) or a photodarlington (OPI153) optically coupled by means of a light pipe and mounted in a high dielectric plastic housing. LED and sensors are in hermetically sealed packages. This series is designed for applications requiring very high isolation between input and output.

All electrical parameters are 100% tested by manufacturing. Specifications are guaranteed to a cumulative .65% AQL.

absolute maximum rating (25 °C unless otherwise noted)

Input-to-Output Isolation Voltage	± 50 kV(1)
Storage Temperature Range	− 40 °C to + 85 °C
Operating Temperature Range	− 40 °C to + 85 °C
Lead Soldering Temperature (1/16 inch [1.6 mm] from case for 5 sec. with soldering iron)(2)	240 °C

Input Diode

Reverse Voltage	3 V
Continuous Forward Current	50 mA
Power Dissipation	200 mW(3)

Output Photosensor

Collector-Emitter Voltage	(OPI150)	30 V
	(OPI153)	15 V
Emitter-Collector Voltage	(OPI150)	5 V
	(OPI153)	5 V
Collector-Base Voltage	(OPI150)	30 V
	(OPI153)	20 V
Power Dissipation	(OPI150)	250 mW(4)
	(OPI153)	250 mW(4)

Notes: (1) Measured with input leads shorted together and output leads shorted together.
(2) RMA flux is recommended. Duration can be extended to 10 sec. max. when flow soldering.
(3) Derate linearly 3.33 mW/ °C above 25 °C
(4) Derate linearly 4.17 mW/ °C above 25 °C

Types OPI150, OPI153

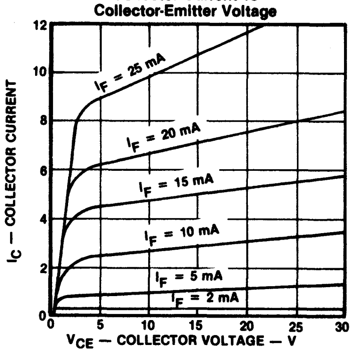
PRODUCT BULLETIN 3051
February 1982

electrical characteristics (25°C unless otherwise noted)

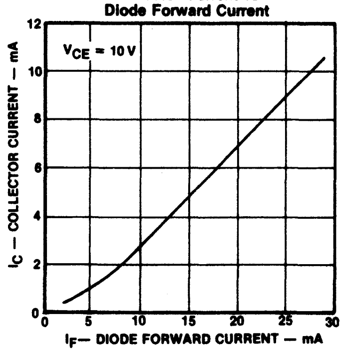
SYMBOL	PARAMETER	MIN	MAX	UNITS	TEST CONDITIONS
Input Diode					
V_F	Forward Voltage		1.5	V	I_F = 50 mA
I_R	Reverse Current		100	μA	V_R = 3 V
Output Photosensor					
$V_{(BR)CEO}$	Collector-Emitter Breakdown Voltage OPI150	30		V	I_C = 1 mA
	OPI153	15		V	I_C = 1 mA
$V_{(BR)ECO}$	Emitter-Collector Breakdown Voltage	5		V	I_F = 100 μA
$V_{(BR)CBO}$	Collector-Base Breakdown Voltage OPI150	30		V	I_C = 100 μA
	OPI153	20		V	I_C = 100 μA
I_{CEO}	Collector-Emitter Dark Current OPI150		100	nA	V_{CE} = 10 V
	OPI153		500	nA	V_{CE} = 10 V
I_{CBO}	Collector-Base Dark Current OPI150		50	nA	V_{CB} = 10 V
Coupled					
I_C/I_F	DC Current Transfer Ratio OPI150	10		%	V_{CE} = 5 V, I_F = 10 mA
	OPI153	25		%	V_{CE} = 5 V, I_F = 20 mA
$I_{CB(ON)}$	On-State Photodiode Current OPI150	10		μA	V_{CB} = 5V, I_F = 20 mA
$V_{CE(SAT)}$	Saturation Voltage OPI150		0.5	V	I_F = 16 mA, I_C = 1 mA
	OPI153		1.2	V	I_F = 30 mA, I_C = 2 mA

Typical Performance Curves (OPI150 Only)

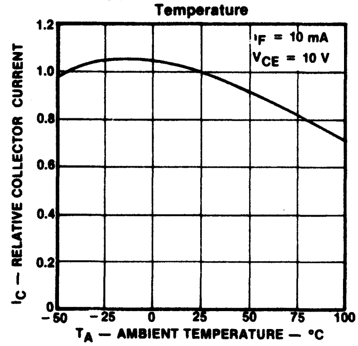
Collector Current vs Collector-Emitter Voltage



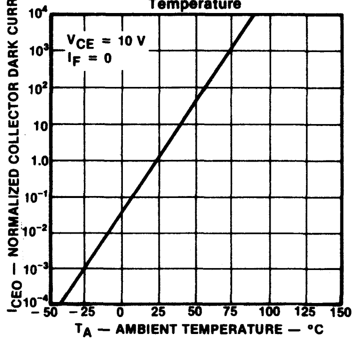
Collector Current vs Diode Forward Current



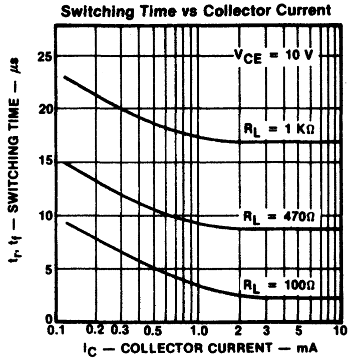
Relative Collector Current vs Temperature



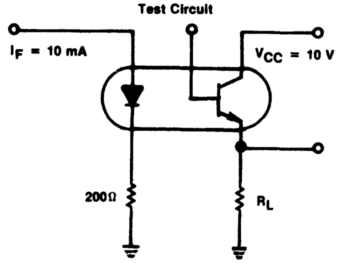
Normalized Collector Dark Current vs Temperature



Switching Time vs Collector Current



Test Circuit



THE INPUT WAVEFORM IS SUPPLIED BY A GENERATOR WITH THE FOLLOWING CHARACTERISTICS: Z_{OUT} = 50Ω, t_r ≤ 15 ns, DUTY CYCLE ≈ 1%, PULSE WIDTH ≈ 100 μs

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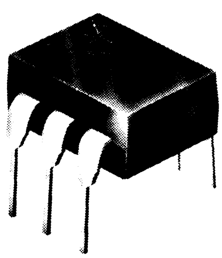
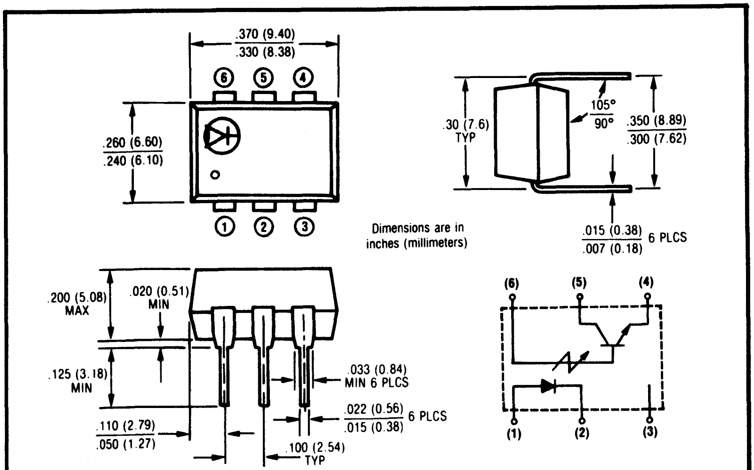
Optically Coupled Isolators
Type OPI2100



TWICE ACTUAL SIZE



Features

- 4 kV ISOLATION
- HIGH CURRENT TRANSFER RATIO
- DIRECT INTERFACE WITH UP TO 10 TTL LOADS
- UL RECOGNIZED FILE NUMBER E58730

Description

The OPI2100 consists of a gallium arsenide infrared emitting diode and an NPN silicon phototransistor mounted in a standard plastic six pin dual-in-line package. This device is designed to directly drive from 1 to 10 TTL loads and has very good output sinking characteristics at low sink current.

All electrical parameters are 100% tested by manufacturing. Specifications are guaranteed to a cumulative .65% AQL.

absolute maximum ratings (25°C unless otherwise noted)

Input-to-Output Isolation Voltage . . . . ± 4000 VDC(1)
Storage Temperature Range . . . . − 55°C to + 150°C
Operating Temperature Range . . . . − 55°C to + 100°C
Lead Soldering Temperature (1/16 inch [1.6 mm] from case for 5 sec. with soldering iron)(2) . . . . 260°C

Input Diode

Forward DC Current . . . . 60 mA
Peak Forward Current (1 μs pulse, 300 pps) . . . . 3 A
Reverse Voltage . . . . 6 V
Power Dissipation . . . . 100 mW(3)

Output Transistor

Collector-Emitter Voltage . . . . 30 V
Collector-Base Voltage . . . . 70 V
Emitter-Collector Voltage . . . . 5 V
Power Dissipation . . . . 150 mW(4)

Notes: (1) Measured with input diode leads shorted together and output leads shorted together
(2) RMA flux is recommended. Duration can be extended to 10 sec. max. when flow soldering.
(3) Derate Linearly 1.33 mW/°C above 25°C
(4) Derate Linearly 2.0 mW/°C above 25°C

Type OPI2100

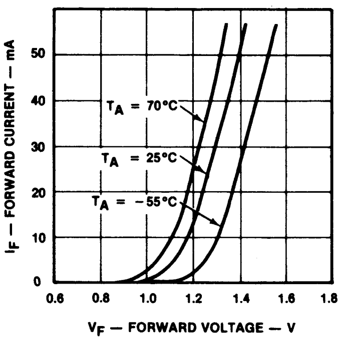
PRODUCT BULLETIN 3054
February 1982

electrical characteristics (25°C unless otherwise noted)

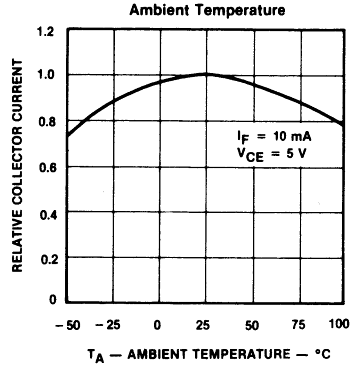
SYMBOL	PARAMETER	MIN	Typ	MAX	UNITS	TEST CONDITIONS
Input Diode						
V_F	Forward Voltage			1.5	V	$I_F = 40$ mA
I_R	Reverse Current			10	μA	$V_R = 6$ V
Output Phototransistor						
$V_{(BR)CEO}$	Colector-Emitter Breakdown Voltage	30			V	$I_C = 1$ mA
$V_{(BR)ECO}$	Emitter-Collector Breakdown Voltage	6			V	$I_E = 100$ μA
$V_{(BR)CBO}$	Collector-Base Breakdown Voltage	70			V	$I_C = 10$ μA
I_{CEO}	Collector-Emitter Dark Current			50	nA	$V_{CE} = 5$ V, $I_F = 0$
h_{FE}	DC Current Gain	100				$V_{CE} = 5$ V, $I_C = 10$ mA
Coupled						
I_C/I_F	DC Current Transfer Ratio	150			%	$V_{CE} = 5$ V, $I_F = 10$ mA
I_C/I_F	DC Current Transfer Ratio	50			%	$V_{CE} = .7$ V, $I_F = 3.2 - 32$ mA
$V_{CE(SAT)}$	Saturation Voltage			.7	V	$I_C = 16$ mA, $I_F = 32$ mA

Typical Performance Curves

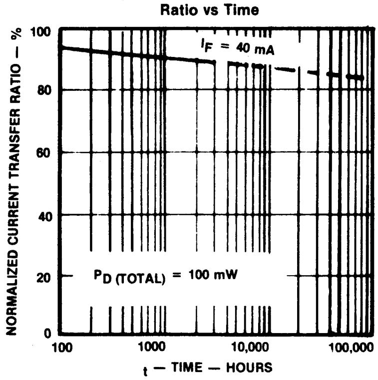
Diode Forward Current vs Diode Forward Voltage



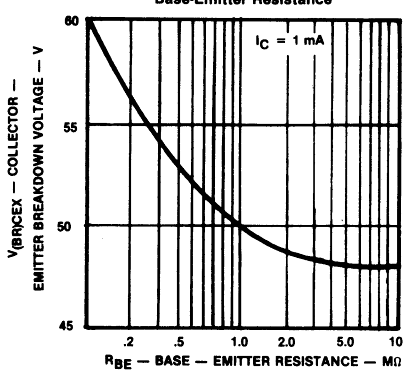
Relative Collector Current vs Ambient Temperature



Normalized Current Transfer Ratio vs Time



Collector-Emitter Breakdown Voltage vs Base-Emitter Resistance



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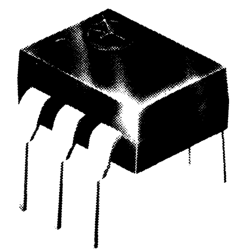
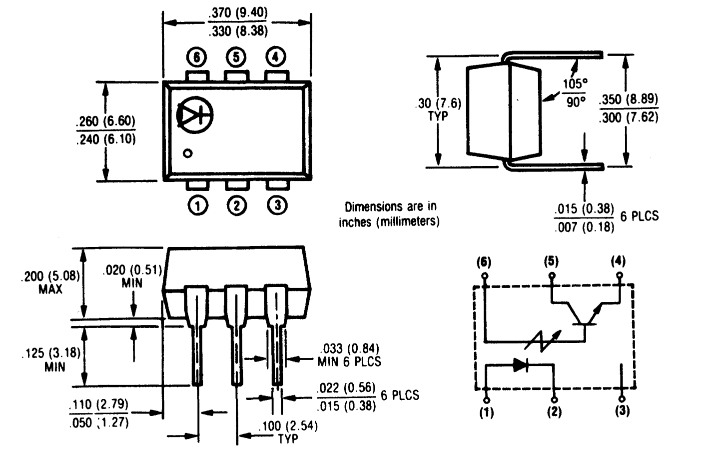
Optically Coupled Isolators
Types OPI2150, OPI2250



TWICE ACTUAL SIZE



Features

- 1500 OR 2500 VOLT ISOLATION
- HIGH CURRENT TRANSFER RATIO
- LOW COST 6 PIN DUAL-IN-LINE PACKAGE
- UL RECOGNIZED FILE NO. E58730

Description

The OPI2150 and OPI2250 each consist of a gallium arsenide infrared light emitting diode coupled to an NPN silicon phototransistor mounted in a six pin dual-in-line package. The OPI2150 and OPI2250 are identical except for input-to-output isolation voltage.

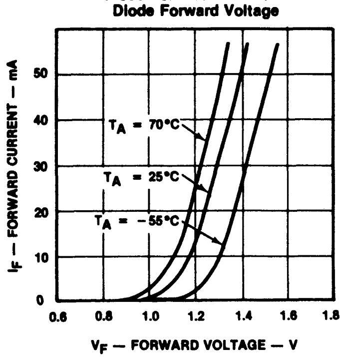
All electrical parameters are 100% tested by manufacturing. Specifications are guaranteed to a cumulative .65% AQL.

absolute maximum ratings (25 °C unless otherwise noted)

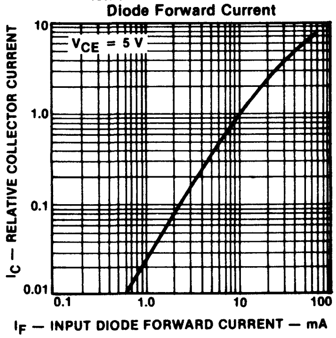
Input-to-Output Isolation Voltage OPI2150	± 1500 V(1)
OPI2250	± 2500 V(1)
Storage Temperature Range	− 55 °C to + 150 °C
Operating Temperature Range	− 55 °C to + 100 °C
Lead Soldering Temperature (1/16 inch [1.6 mm] from case for 5 sec. with soldering iron)(2)	240 °C
Input Diode	
Forward DC Current	60 mA
Peak Forward Current (1 μs pulse width, 300 pps)	3 A
Reverse Voltage	3 V
Power Dissipation (25 °C)	100 mW(3)
Output Transistor	
Power Dissipation	150 mW(4)
$V_{(BR)CEO}$	30 V
$V_{(BR)CBO}$	70 V
$V_{(BR)ECO}$	5 V

Notes: (1) Measured with input diode leads shorted together and output leads shorted together.
(2) RMA flux is recommended. Duration can be extended to 10 sec. max. when flow soldering.
(3) Derate 1.33 mW/°C above 25 °C.
(4) Derate 2.0 mW/°C above 25 °C.

Diode Forward Current vs Diode Forward Voltage



Relative Collector Current vs Diode Forward Current



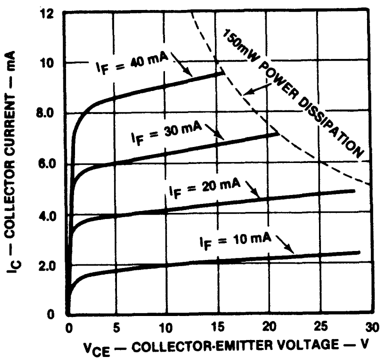
Types OPI2150, OPI2250

electrical characteristics (25 °C unless otherwise noted)

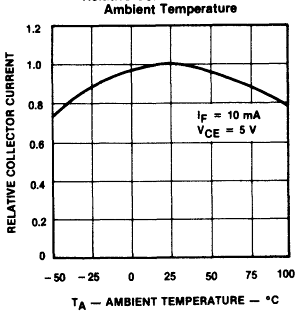
SYMBOL	PARAMETER	MIN	TYP	MAX	UNITS	TEST CONDITIONS
Input Diode						
V_F	Forward Voltage			1.5	V	I_F = 10 mA
$V_{(BR)R}$	Reverse Breakdown Voltage	2			V	I_R = 100 μA
I_R	Reverse Current			100	μA	V_R = 2 V
Output Phototransistor						
$V_{(BR)CEO}$	Collector-to-Emitter Breakdown Voltage	20			V	I_C = 1.0 mA, I_B = 0
$V_{(BR)ECO}$	Emitter-to-Collector Breakdown Voltage	5			V	I_E = 10 μA, I_B = 0
$V_{(BR)CBO}$	Collector-Base Breakdown Voltage	30			V	I_C = 10 μA, I_E = 0
I_{CEO}	Collector-Emitter Dark Current		10	100	nA	V_{CE} = 10 V, I_B = 0
I_{CBO}	Collector-Base Dark Current			50	nA	V_{CB} = 10 V, I_E = 0
C_{CE}	Capacitance Collector-to-Emitter		8.0		pF	V_{CE} = 0
h_{FE}	DC Current Gain		150			V_{CE} = 5.0 V, I_C = 100 μA
Coupled						
I_C/I_F	DC Current Transfer Ratio	2.0	5		%	I_F = 10 mA, V_{CE} = 5 V, I_B = 0
$V_{CE(SAT)}$	Collector-to-Emitter Saturation Voltage			0.5	V	I_F = 50 mA, I_C = 2 mA, I_B = 0
V_{ISO}	Isolation Voltage OPI2150 OPI2250	1500 2500			VDC VDC	See Note 1
R_{IO}	Input-to-Output Resistance	10^{11}			Ω	V_{IO} = 500 V, See Note 1
C_{IO}	Input-to-Output Capacitance		2.0		pF	f = 1 MHz, See Note 1
t_r	Output Rise Time		2.0		μs	V_{CC} = 10 V I_C = 2.0 mA
t_f	Output Fall Time		2.0		μs	R_L = 100Ω

Typical Performance Curves

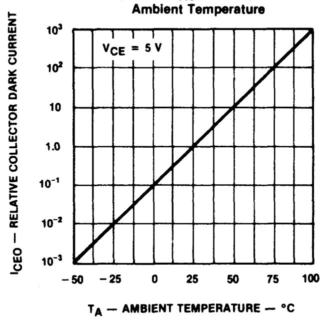
Collector Current vs Collector-Emitter Voltage



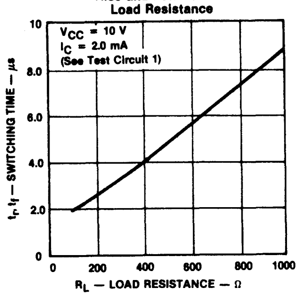
Relative Collector Current vs Ambient Temperature



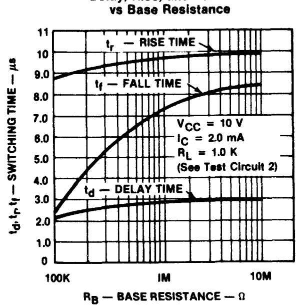
Relative Collector Dark Current vs Ambient Temperature



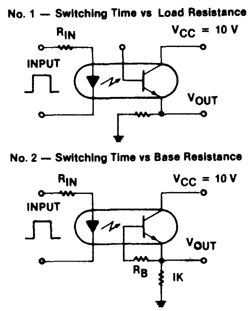
Rise and Fall Time vs Load Resistance



Delay, Rise, and Fall Time vs Base Resistance



Switching Time Test Circuits



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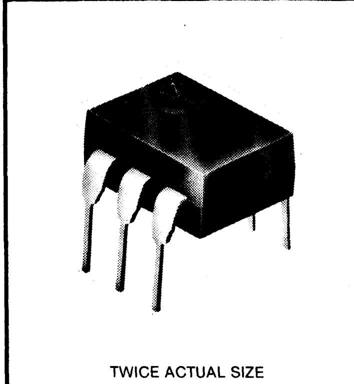
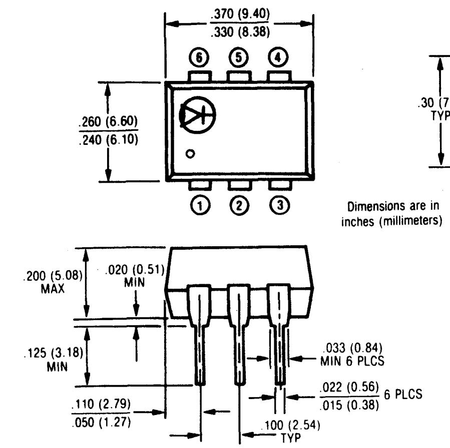
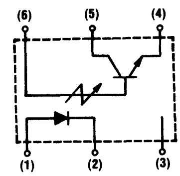
Optically Coupled Isolators
Types OPI2151, OPI2251



TWICE ACTUAL SIZE





Features

- 1500 OR 2500 VOLT ISOLATION
- HIGH CURRENT TRANSFER RATIO
- LOW COST 6 PIN DUAL-IN-LINE PACKAGE
- UL RECOGNIZED FILE NO. E58730

Description

The OPI2151 and OPI2251 each consist of a gallium arsenide infrared light emitting diode coupled to an NPN silicon phototransistor mounted in a six pin dual-in-line package. The OPI2151 and OPI2251 are identical except for input-to-output isolation voltage.

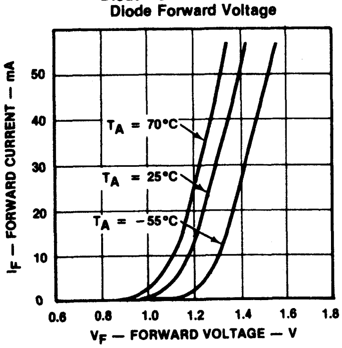
All electrical parameters are 100% tested by manufacturing. Specifications are guaranteed to a cumulative .65% AQL.

absolute maximum ratings (25 °C unless otherwise noted)

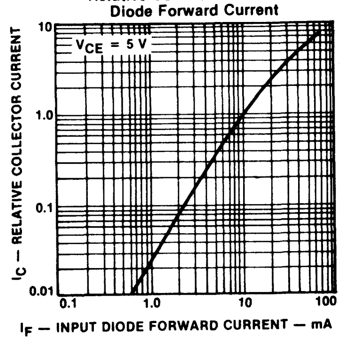
Input-to-Output Isolation Voltage OPI2151	± 1500 V[1]
OPI2251	± 2500 V[1]
Storage Temperature Range	− 55 °C to + 150 °C
Operating Temperature Range	− 55 °C to + 150 °C
Lead Soldering Temperature (1/16 inch [1.6 mm] from case for 5 sec. with soldering iron)[2]	240 °C
Input Diode	
Forward DC Current	60 mA
Peak Forward Current (1 μs pulse width, 300 pps)	3 A
Reverse Voltage	3 V
Power Dissipation (25 °C)	100 mW[3]
Output Transistor	
Power Dissipation	150 mW[4]
$V_{(BR)CEO}$	30 V
$V_{(BR)CBO}$	70 V
$V_{(BR)ECO}$	5 V

Notes: (1) Measured with input leads shorted together and output leads shorted together
(2) RMA rosin flux is recommended. Duration can be extended to 10 sec. max. when flow soldering or using a solder pot.
(3) Derate 1.33 mW/ °C above 25 °C
(4) Derate 2.0 mW/ °C above 25 °C

Diode Forward Current vs Diode Forward Voltage



Relative Collector Current vs Diode Forward Current



Types OPI2151, OPI2251

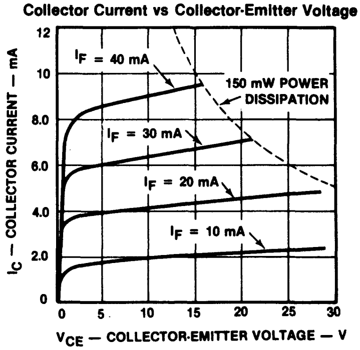
PRODUCT BULLETIN 3056
February 1982

electrical characteristics (25 °C unless otherwise noted)

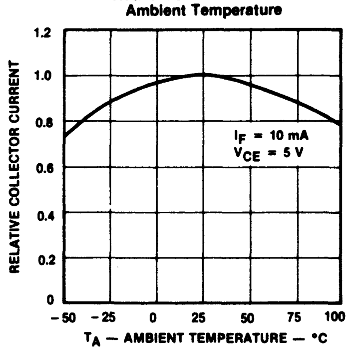
SYMBOL	PARAMETER	MIN	TYP	MAX	UNITS	TEST CONDITIONS
Input Diode						
V_F	Forward Voltage			1.5	V	$I_F = 10$ mA
$V_{(BR)R}$	Reverse Breakdown Voltage	3.0			V	$I_R = 10\ \mu A$
I_R	Reverse Current			10	μA	$V_R = 3.0$ V
Output Phototransistor						
$V_{(BR)CEO}$	Collector-to-Emitter Breakdown Voltage	30			V	$I_C = 1.0$ mA, $I_B = 0$
$V_{(BR)ECO}$	Emitter-to-Collector Breakdown Voltage	5			V	$I_E = 10\ \mu A$, $I_B = 0$
$V_{(BR)CBO}$	Collector-to-Base Breakdown Voltage	30			V	$I_C = 10\ \mu A$, $I_E = 0$
I_{CEO}	Collector-Emitter Dark Current		5.0	100	nA	$V_{CE} = 10$ V, $I_B = 0$
I_{CBO}	Collector-Base Dark Current			20	nA	$V_{CB} = 10$ V, $I_E = 0$
C_{CE}	Capacitance Collector-to-Emitter		8.0		pF	$V_{CE} = 0$
h_{FE}	DC Current Gain		150			$V_{CE} = 5.0$ V, $I_C = 100\ \mu A$
Coupled						
I_C/I_F	DC Current Transfer Ratio	10	20		%	$I_F = 10$ mA, $V_{CE} = 5$ V, $I_B = 0$
$V_{CE(SAT)}$	Collector-to-Emitter Saturation Voltage			0.4	V	$I_F = 10$ mA, $I_C = 250\ \mu A$, $I_B = 0$
V_{ISO}	Isolation Voltage OPI2151 OPI2251	1500 2500			VDC VDC	See Note 1
R_{IO}	Input-to-Output Resistance	10^{11}			Ω	$V_{IO} = 500$ V, See Note 1
C_{IO}	Input-to-Output Capacitance		2.0		pF	f = 1 MHz, See Note 1
t_r	Output Rise Time		2.0		μs	$V_{CC} = 10$ V $I_C = 2.0$ mA $R_L = 100\Omega$
t_f	Output Fall Time		2.0		μs	

Typical Performance Curves

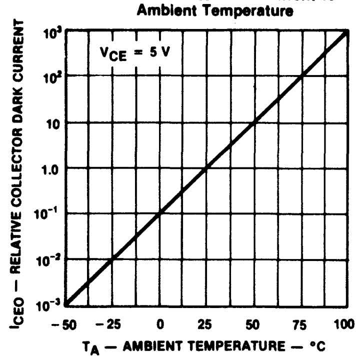
Collector Current vs Collector-Emitter Voltage



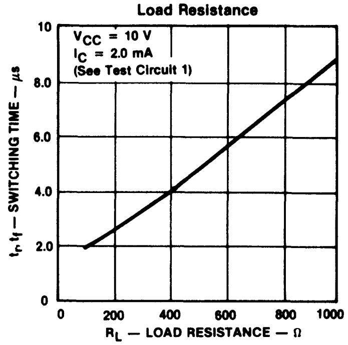
Relative Collector Current vs Ambient Temperature



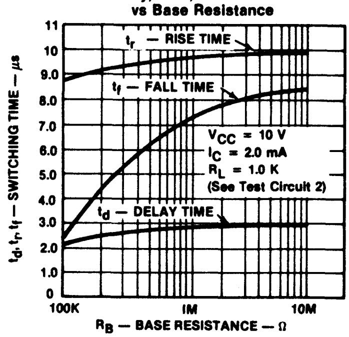
Relative Collector Dark Current vs Ambient Temperature



Rise and Fall Time vs Load Resistance

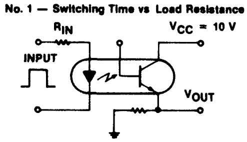


Delay, Rise, and Fall Time vs Base Resistance

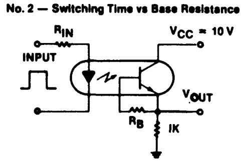


Switching Time Test Circuits

No. 1 — Switching Time vs Load Resistance



No. 2 — Switching Time vs Base Resistance



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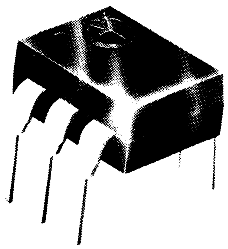
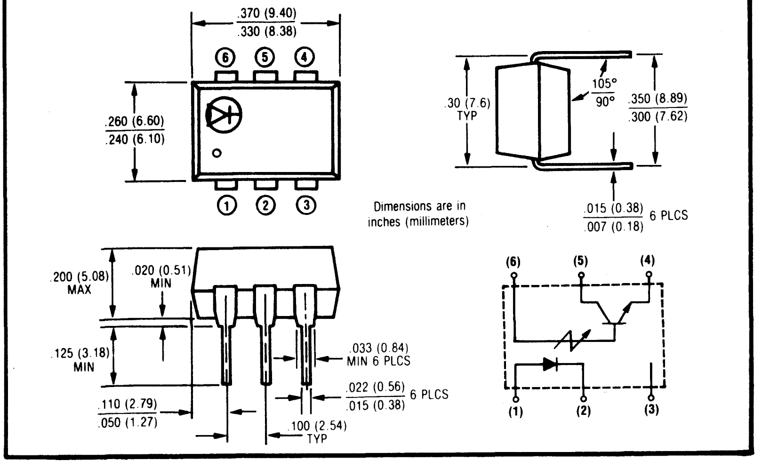
Optically Coupled Isolators
Types OPI2152, OPI2252



TWICE ACTUAL SIZE



Features

- 1500 OR 2500 VOLT ISOLATION
- HIGH CURRENT TRANSFER RATIO
- LOW COST 6 PIN DUAL-IN-LINE PACKAGE
- UL RECOGNIZED FILE NO. E58730

Description

The OPI2152 and OPI2252 each consist of a gallium arsenide infrared light emitting diode coupled to an NPN silicon phototransistor mounted in a six pin dual-in-line package. The OPI2152 and OPI2252 are identical except for input-to-output isolation voltage.

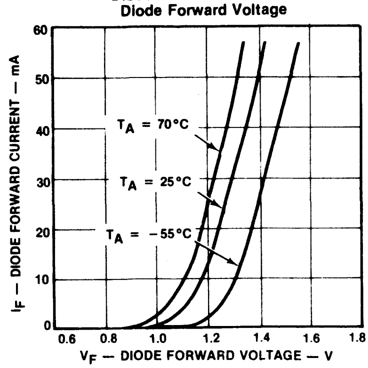
All electrical parameters are 100% tested by manufacturing. Specifications are guaranteed to a cumulative .65% AQL.

absolute maximum ratings (25 °C unless otherwise noted)

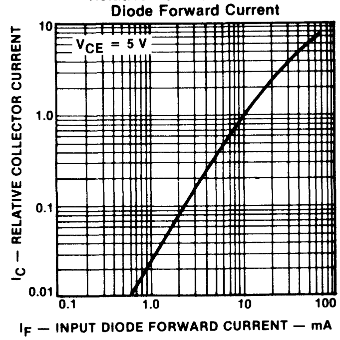
Input-to-Output Isolation Voltage OPI2152	± 1500 V(1)
OPI2252	± 2500 V(1)
Storage Temperature Range	− 55 °C to + 150 °C
Operating Temperature Range	− 55 °C to + 100 °C
Lead Soldering Temperature (1/16 inch [1.6 mm] from case for 5 sec. with soldering iron)(2)	240 °C
Input Diode	
Forward DC Current	60 mA
Peak Forward Current (1 μs pulse width, 300 pps)	3 A
Reverse Voltage	3 V
Power Dissipation (25 °C)	100 mW(3)
Output Transistor	
Power Dissipation	150 mW(4)
$V_{(BR)CEO}$	30 V
$V_{(BR)CBO}$	70 V
$V_{(BR)ECO}$	5 V

Notes: (1) Measured with input diode leads shorted together and output leads shorted together.
(2) RMA flux is recommended. Duration can be extended to 10 sec. max. when flow soldering.
(3) Derate 1.33 mW/°C above 25 °C.
(4) Derate 2.0 mW/°C above 25 °C.

Diode Forward Current vs Diode Forward Voltage



Relative Collector Current vs Diode Forward Current



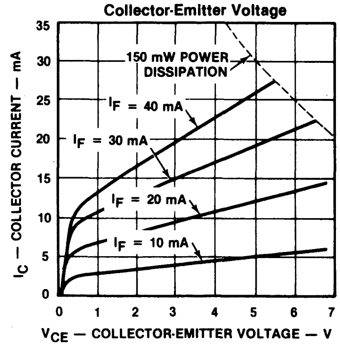
Types OPI2152, OPI2252

electrical characteristics (25 °C unless otherwise noted)

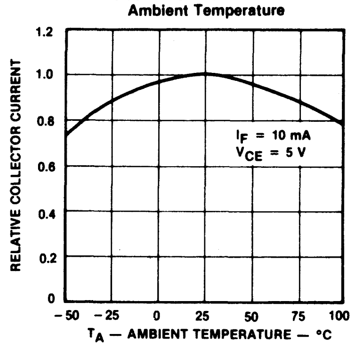
SYMBOL	PARAMETER	MIN	TYP	MAX	UNITS	TEST CONDITIONS
Input Diode						
V_F	Forward Voltage			1.4	V	I_F = 16 mA
$V_{(BR)R}$	Reverse Breakdown Voltage	3.0			V	I_R = 10 μA
I_R	Reverse Leakage Current			10	μA	V_R = 3.0 V
Output Phototransistor						
$V_{(BR)CEO}$	Collector-to-Emitter Breakdown Voltage	30			V	I_C = 1.0 mA, I_B = 0
$V_{(BR)ECO}$	Emitter-to-Collector Breakdown Voltage	5			V	I_E = 10 μA, I_B = 0
$V_{(BR)CBO}$	Collector-to-Base Breakdown Voltage	50			V	I_C = 10 μA, I_E = 0
I_{CEO}	Collector-Emitter Dark Current		5.0	50	nA	V_{CE} = 10 V, I_B = 0
I_{CBO}	Collector-Base Dark Current			20	nA	V_{CB} = 10 V, I_E = 0
C_{CE}	Capacitance Collector-to-Emitter		8.0		pF	V_{CE} = 0
h_{FE}	DC Current Gain		250			V_{CE} = 5.0 V, I_C = 100 μA
Coupled						
I_C/I_F	DC Current Transfer Ratio	20	40		%	I_F = 10 mA, V_{CE} = 5 V, I_B = 0
$V_{CE(SAT)}$	Collector-to-Emitter Saturation Voltage			0.4	V	I_F = 16 mA, I_C = 2 mA, I_B = 0
V_{ISO}	Isolation Voltage OPI2152 OPI2252	1500 2500			VDC VDC	See Note 1
R_{IO}	Input-to-Output Resistance	10^{11}			Ω	V_{IO} = 500 V, See Note 1
C_{IO}	Input-to-Output Capacitance		2.0		pF	f = 1 MHz, See Note 1
t_r	Output Rise Time		2.0		μs	V_{CC} = 10 V, I_C = 2.0 mA, R_L = 100Ω
t_f	Output Fall Time		2.0		μs	

Typical Performance Curves

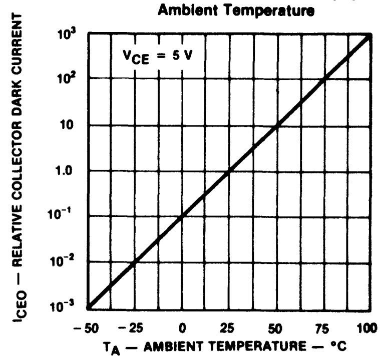
Collector Current vs Collector-Emitter Voltage



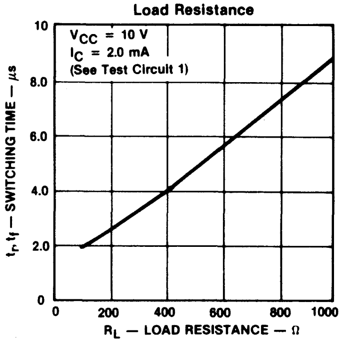
Relative Collector Current vs Ambient Temperature



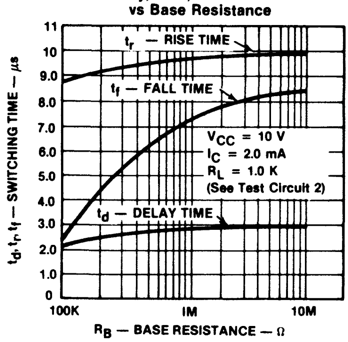
Relative Collector Dark Current vs Ambient Temperature



Rise and Fall Time vs Load Resistance

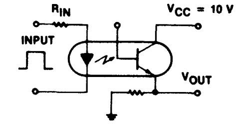


Delay, Rise, and Fall Time vs Base Resistance

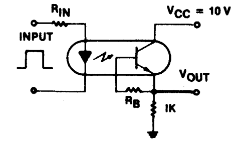


Switching Time Test Circuits

No. 1 — Switching Time vs Load Resistance



No. 2 — Switching Time vs Base Resistance



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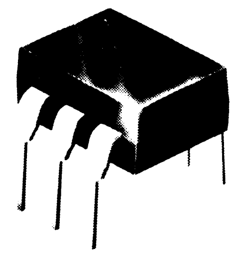
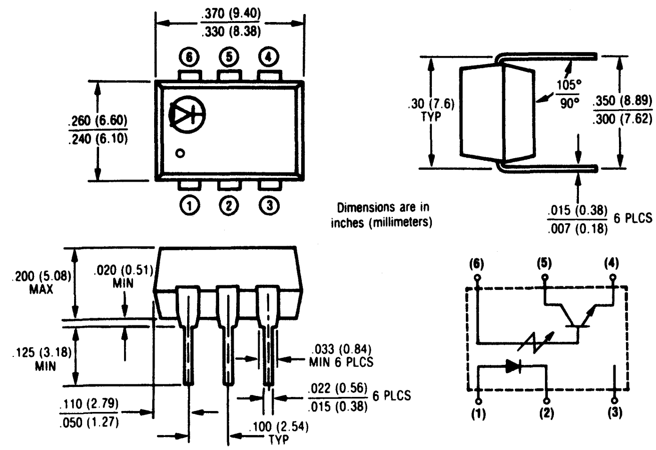
TRW OPTRON

PRODUCT BULLETIN 3058
February 1982

Optically Coupled Isolators
Types OPI2153, OPI2253



TWICE ACTUAL SIZE



Features

- 1500 OR 2500 VOLT ISOLATION
- HIGH CURRENT TRANSFER RATIO
- LOW COST 6 PIN DUAL-IN-LINE PACKAGE
- UL RECOGNIZED FILE NO. E58730

Description

The OPI2153 and OPI2253 each consist of a gallium arsenide infrared light emitting diode coupled to an NPN silicon phototransistor mounted in a six pin dual-in-line package. The OPI2153 and OPI2253 are identical except for input-to-output isolation voltage.

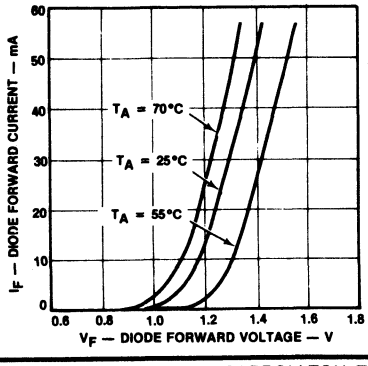
All electrical parameters are 100% tested by manufacturing. Specifications are guaranteed to a cumulative .65% AQL.

absolute maximum ratings (25°C unless otherwise noted)

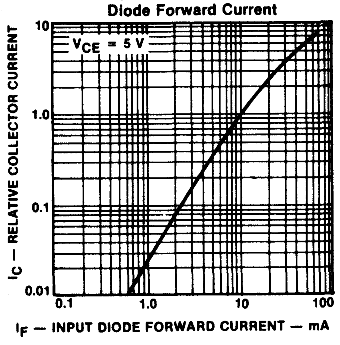
Input-to-Output Isolation Voltage OPI2153	±1500 V(1)
OPI2253	±2500 V(1)
Storage Temperature Range	−55°C to +150°C
Operating Temperature Range	−55°C to +100°C
Lead Soldering Temperature (1/16 inch [1.6 mm] from case for 3 sec. with soldering iron)(2)	240°C
Input Diode	
Forward DC Current	60 mA
Peak Forward Current (1 μs pulse width, 300 pps)	3 A
Reverse Voltage	3 V
Power Dissipation (25°C)	100 mW(3)
Output Transistor	
Power Dissipation	150 mW(4)
$V_{(BR)CEO}$	30 V
$V_{(BR)CBO}$	50 V
$V_{(BR)ECO}$	5 V

Notes: (1) Measured with input leads shorted together and output leads shorted together.
(2) RMA flux is recommended. Duration can be extended to 10 sec. max. when flow soldering.
(3) Derate 1.33 mW/°C above 25°C.
(4) Derate 2.0 mW/°C above 25°C.

Diode Forward Current vs Diode Forward Voltge



Relative Collector Current vs Diode Forward Current



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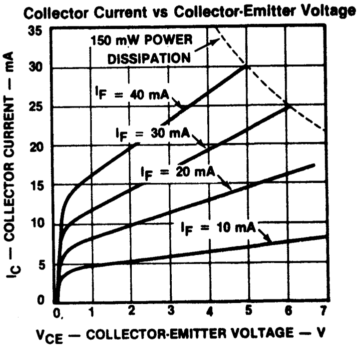
Types OPI2153, OPI2253

electrical characteristics (25 °C unless otherwise noted)

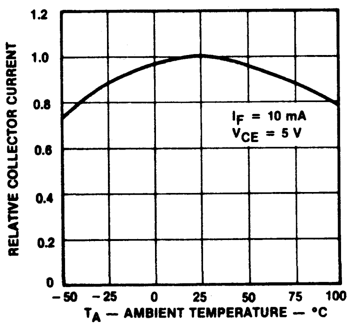
SYMBOL	PARAMETER	MIN	TYP	MAX	UNITS	TEST CONDITIONS
Input Diode						
V_F	Forward Voltage			1.4	V	I_F = 16 mA
$V_{(BR)R}$	Reverse Breakdown Voltage	3.0			V	I_R = 10 μA
I_R	Reverse Leakage Current			10	μA	V_R = 3.0 V
Output Phototransistor						
$V_{(BR)CEO}$	Collector-to-Emitter Breakdown Voltage	30			V	I_C = 1.0 mA, I_B = 0
$V_{(BR)ECO}$	Emitter-to-Collector Breakdown Voltage	5			V	I_E = 10 μA, I_B = 0
$V_{(BR)CBO}$	Collector-to-Base Breakdown Voltage	50			V	I_C = 10 μA, I_E = 0
I_{CEO}	Collector-Emitter Dark Current		5.0	50	nA	V_{CE} = 10 V, I_B = 0
I_{CBO}	Collector-Base Dark Current			20	nA	V_{CB} = 10 V, I_E = 0
C_{CE}	Capacitance Collector-to-Emitter		8.0		pF	V_{CE} = 0
h_{FE}	DC Current Gain		350			V_{CE} = 5.0 V, I_C = 100 μA
Coupled						
I_C/I_F	DC Current Transfer Ratio	50	80		%	I_F = 10 mA, V_{CE} = 5 V, I_B = 0
$V_{CE(SAT)}$	Collector-to-Emitter Saturation Voltage			0.4	V	I_F = 16 mA, I_C = 4 mA, I_B = 0
V_{ISO}	Isolation Voltage OPI2153 OPI2253	1500 2500			VDC VDC	See Note 1
R_{IO}	Input-to-Output Resistance	10^{11}			Ω	V_{IO} = 500 V, See Note 1
C_{IO}	Input-to-Output Capacitance		2.0		pF	f = 1 MHz, See Note 1
t_r	Output Rise Time		2.0		μs	V_{CC} = 10 V I_C = 2.0 mA
t_f	Output Fall Time		2.0		μs	R_L = 100Ω

Typical Performance Curves

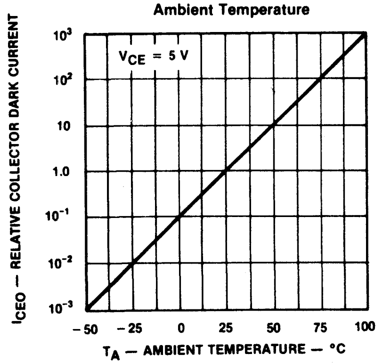
Collector Current vs Collector-Emitter Voltage



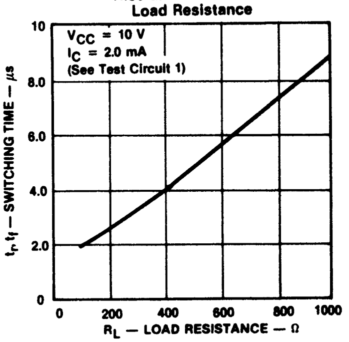
Relative Collector Current vs Ambient Temperature



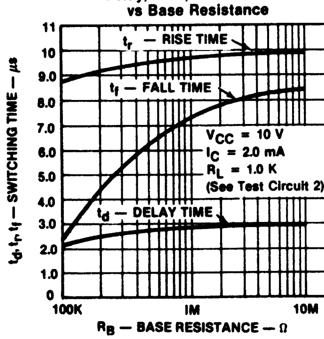
Relative Collector Dark Current vs Ambient Temperature



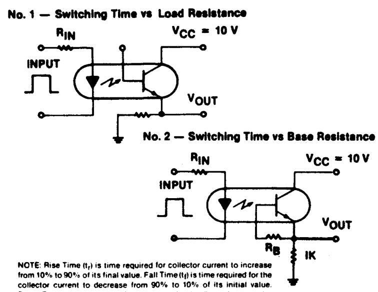
Rise and Fall Time vs Load Resistance



Delay, Rise, and Fall Time vs Base Resistance



Switching Time Test Circuits



NOTE: Rise Time (t_r) is time required for collector current to increase from 10% to 90% of its final value. Fall Time (t_f) is time required for the collector current to decrease from 90% to 10% of its initial value. Delay Time (t_d) is the time from input pulse leading edge to point where collector current reaches 10% of its final value.

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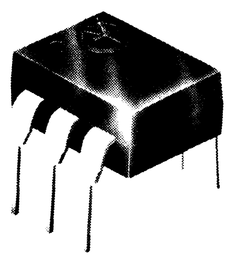
TRW OPTRON

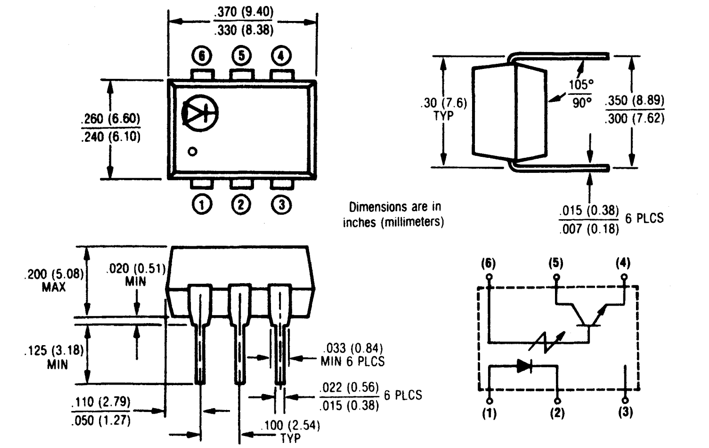
PRODUCT BULLETIN 3059
February 1982

Optically Coupled Isolators

Types OPI2154, OPI2155, OPI2254, OPI2255



TWICE ACTUAL SIZE



Features

- 1500 AND 2500 VOLT ISOLATION
- VERY LOW LED DRIVE CURRENT
- UL RECOGNIZED FILE NUMBER E58730

Description

The OPI2154, OPI2155, OPI2254, and OPI2255 each consist of a gallium arsenide infrared emitting diode and an NPN silicon phototransistor mounted in a standard plastic six pin dual-in-line package. This series is designed to provide electrical isolation at low operating currents.

All electrical parameters are 100% tested by manufacturing. Specifications are guaranteed to a cumulative .65% AQL.

absolute maximum ratings (25 °C unless otherwise noted)

Input-to-Output Isolation Voltage OPI2154, OPI2155 . . . . ± 1500 V(1)
OPI2254, OPI2255 . . . . ± 2500 V(1)
Storage Temperature Range . . . . − 55 °C to + 150 °C
Operating Temperature Range . . . . − 55 °C to + 100 °C
Lead Soldering Temperature (1/16 inch [1.6 mm] from case for . . . . 260 °C
5 sec. with soldering iron)(2)

Input Diode

Forward DC Current . . . . 60 mA
Peak Forward Current (1 μs pulse, 300 pps) . . . . 3 A
Reverse Voltage . . . . 3 V
Power Dissipation . . . . 100 mW(3)

Output Transistor

Collector-Emitter Voltage . . . . 30 V
Collector-Base Voltage . . . . 70 V
Emitter-Collector . . . . 5 V
Power Dissipation . . . . 150 mW(4)

Notes: (1) Measured with input diode leads shorted together and output leads shorted together.
(2) RMA flux is recommended. Duration can be extended to 10 sec. max. when flow soldering.
(3) Derate 1.33 mW/°C above 25 °C.
(4) Derate 2.0 mW/°C above 25 °C.

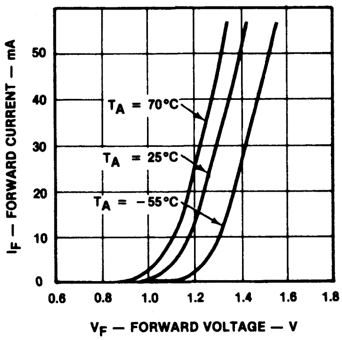
Types OPI2154, OPI2155, OPI2254, OPI2255

electrical characteristics (25°C unless otherwise noted)

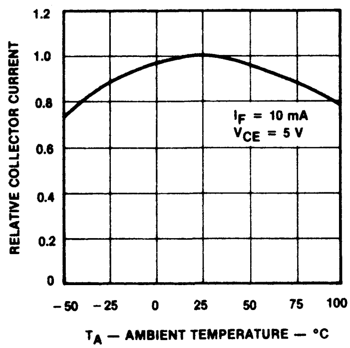
SYMBOL	PARAMETER	MIN	Typ	MAX	UNITS	TEST CONDITIONS
Input Diode						
V_F	Forward Voltage			1.5	V	I_F = 10 mA
I_R	Reverse Current			10	μA	V_R = 3 V
Output Photodiode						
$V_{(BR)CEO}$	Colector-Emitter Breakdown Voltage	30			V	I_C = 1 mA
$V_{(BR)ECO}$	Emitter-Collector Breakdown Voltage	5			V	I_E = 100 μA
$V_{(BR)CBO}$	Collector-Base Breakdown Voltage	30			V	I_C = 100 μA
I_{CEO}	Collector-Emitter Dark Current			50	nA	V_{CE} = 10 V, I_F = 0
C_{CE}	Collector-Emitter Capacitance		8		pF	V_{CE} = 0
h_{FE}	DC Current Gain		500			V_{CE} = 5 V, I_C = 100 μA
Output Phototransistor						
I_C/I_F	DC Current Transfer Ratio OPI2154, OPI2254 OPI2155, OPI2255	 10 20			 % %	 V_{CE} = .5 V, I_F = .5 mA V_{CE} = .5 V, I_F = 1 mA
$V_{CE(SAT)}$	Collector-Emitter Saturation Voltage			.35	V	I_F = 5 mA, I_C = 1 mA

Typical Performance Curves

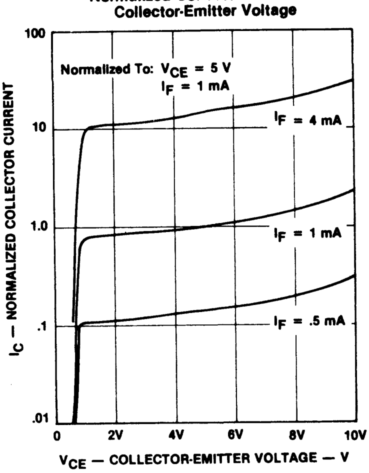
Diode Forward Current vs Diode Forward Voltage



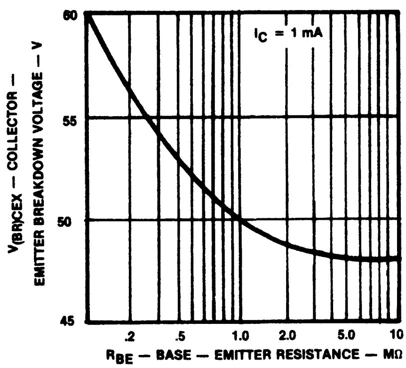
Relative Collector Current vs Ambient Temperature



Normalized Collector Current vs Collector-Emitter Voltage



Collector-Emitter Breakdown Voltage vs Base-Emitter Resistance



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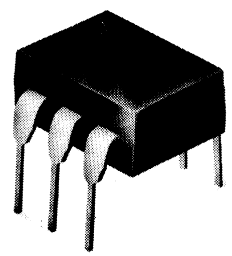
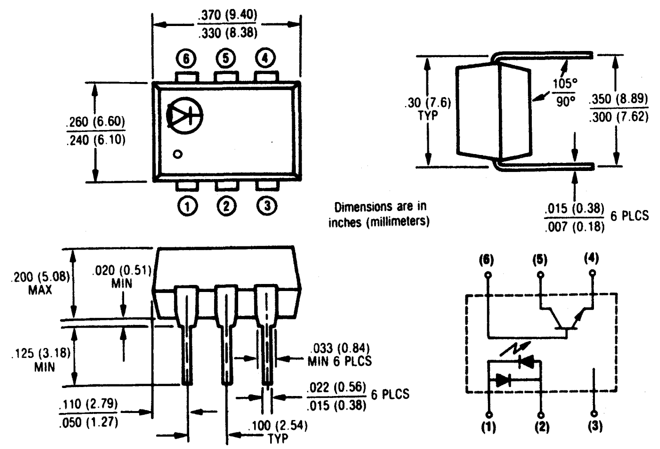
Optically Coupled Isolators
Type OPI2500



TWICE ACTUAL SIZE



Features

- TWO INVERSE PARALLEL LEDs FOR AC TO LOGIC INTERFACING
- LOW COST SIX PIN DUAL-IN-LINE PACKAGE
- UL RECOGNIZED FILE NUMBER E58730

Description

The OPI2500 is an optically coupled isolator consisting of two gallium arsenide infrared emitting diodes connected in inverse parallel and an NPN silicon phototransistor, mounted in a standard plastic six pin dual-in-line package. This device is intended for applications where the input to the LED's is AC.

All electrical parameters are 100% tested by manufacturing. Specifications are guaranteed to a cumulative .65% AQL.

absolute maximum ratings (25 °C unless otherwise noted)

Input-to-Output Isolation Voltage . . . . ± 1500 V[1]
Storage Temperature Range . . . . –55 °C to +150 °C
Operating Temperature Range . . . . –55 °C to +100 °C
Lead Soldering Temperature (1/16 inch [1.6 mm] from case for 5 sec. with soldering iron)[2] . . . . 240 °C

Input Diode

Forward DC Current . . . . ±60 mA
Peak Forward Current (1 μs Pulse Width, 300 pps) . . . . ±3 A
Power Dissipation . . . . 100 mW[3]

Output Phototransistor

$V_{(BR)CEO}$ . . . . 30 V
$V_{(BR)CBO}$ . . . . 70 V
$V_{(BR)ECO}$ . . . . 5 V
Power Dissipation . . . . 150 mW[4]

Notes: (1) Measured with input leads shorted together and output leads shorted together
(2) RMA rosin flux is recommended. Duration can be extended to 10 sec. max. when flow soldering or using a solder pot.
(3) Derate 1.33 mW/ °C above 25 °C
(4) Derate 2.0 mW/ °C above 25 °C

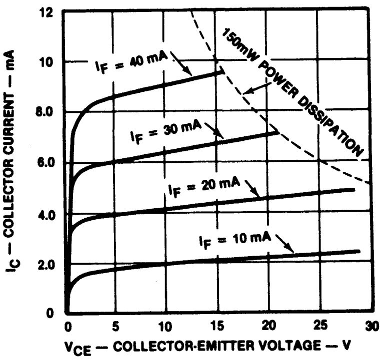
Type OPI2500

electrical characteristics (25 °C unless otherwise noted)

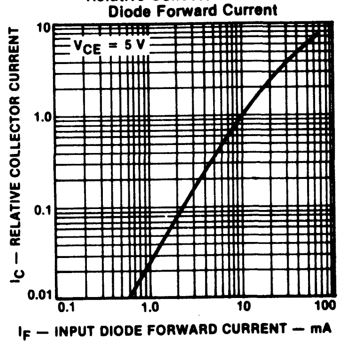
SYMBOL	PARAMETER	MIN	TYP	MAX	UNITS	TEST CONDITIONS
Input Diode						
V_F	Forward Voltage			1.5	V	$I_F = \pm 10$ mA
Output Phototransistor						
$V_{(BR)CEO}$	Collector-to-Emitter Breakdown Voltage	30			V	$I_C = 1.0$ mA, $I_B = 0$
$V_{(BR)ECO}$	Emitter-to-Collector Breakdown Voltage	5			V	$I_E = 10\ \mu A$, $I_B = 0$
$V_{(BR)CBO}$	Collector-to-Base Breakdown Voltage	70			V	$I_C = 10\ \mu A$, $I_E = 0$
I_{CEO}	Collector-Emitter Dark Current		5.0	50	nA	$V_{CE} = 10$ V, $I_B = 0$
I_{CEO}	Collector-Base Dark Current			20	nA	$V_{CB} = 10$ V, $I_E = 0$
	Capacitance Collector-to-Emitter		8.0		pF	$V_{CE} = 0$
	DC Current Gain		250			$V_{CE} = 5.0$ V, $I_C = 100\ \mu A$
Coupled						
I_C/I_F	DC Current Transfer Ratio	12.5	20		%	$I_F = \pm 16$mA, $V_{CE} = 0.4$ V $I_B = 0$
V_{ISO}	Isolation Voltage	1500			V	See Note 1
R_{IO}	Input-to-Output Resistance	10^{11}			Ω	$V_{IO} = 500$ V, See Note 1
C_{IO}	Input-to-Output Capacitance		2.0		pF	f = 1MHz, See Note 1
t_r t_f	Output Rise Time Output Fall Time		2.0 2.0		μs μs	$V_{CC} = 10$ V $I_C = 2.0$ mA $R_L = 100\ \Omega$, See Test Circuit

Typical Performance Curves

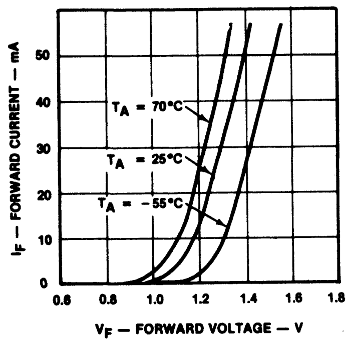
Collector Current vs Collector-Emitter Voltage



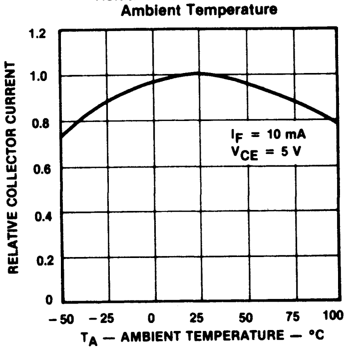
Relative Collector Current vs Diode Forward Current



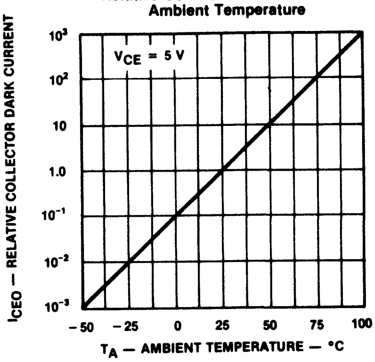
Diode Forward Current vs Diode Forward Voltage



Relative Collector Current vs Ambient Temperature

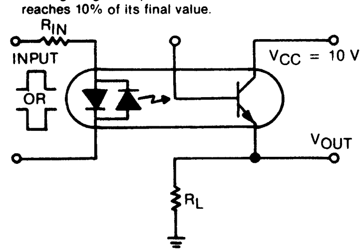


Relative Collector Dark Current vs Ambient Temperature



Switching Time Test Circuit

NOTE: Rise Time (t_r) is time required for collector current to increase from 10% to 90% of its final value. Fall Time (t_f) is time required for the collector current to decrease from 90% to 10% of its initial value. Delay Time (t_d) is the time from input pulse leading edge to point where collector current reaches 10% of its final value.



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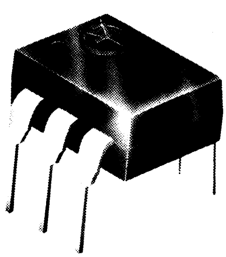
Printed in U.S.A.

TRW *OPTRON*

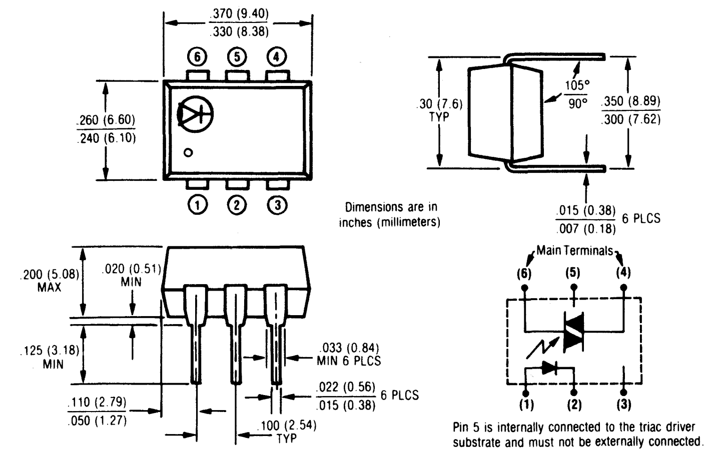
PRODUCT BULLETIN 3061
February 1982

Optically Coupled Triac Drivers

Types OPI3009, OPI3010, OPI3011, OPI3012



TWICE ACTUAL SIZE



Pin 5 is internally connected to the triac driver substrate and must not be externally connected.

Features

- FOR 115 VAC OPERATION
- 2500 VOLT ELECTRICAL ISOLATION
- LOW LED CURRENT DRIVE TO LATCH OUTPUT
- UL RECOGNIZED FILE NO. E58730

Description

The OPI3009, OPI3010, OPI3011, and OPI3012 each consist of a gallium arsenide infrared emitting diode and a monolithic integrated circuit containing a photodiode and a bidirectional switch, mounted in a standard plastic six pin dual-in-line package. This series is intended to interface electric controls with power triacs to control resistive and inductive loads as in motors, solenoids, and appliances.

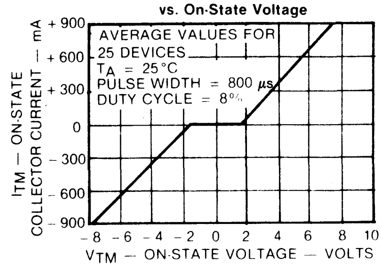
All electrical parameters are 100% tested by manufacturing. Specifications are guaranteed to a cumulative .65% AQL.

absolute maximum ratings (25°C unless otherwise noted)

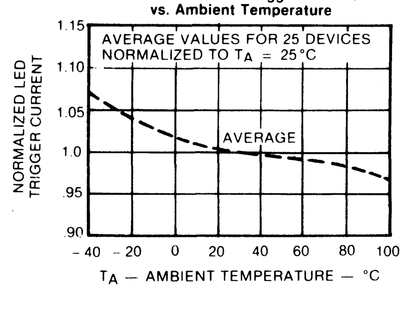
Input-to-Output Isolation Voltage		±2500 V[1]
Storage Temperature Range		−40°C to +150°C
Operating Temperature Range		−40°C to +80°C
Lead Soldering Temperature (1/16 inch [1.6 mm] from case for 5 sec. with soldering iron)[2]		240°C
Total Device Power Dissipation		400 mW[3]
Input Diode		
Forward DC Current	I_F	50 mA
Reverse DC Voltage	V_R	3 V
Power Dissipation	P_D	100 mW[4]
Output Photosensor		
Off-State Terminal Voltage	V_{DRM}	250 V
On-State RMS Current	I_T (RMS)	100 mA
(Full Cycle, 50-60 Hz, T_A = 70°C)		50 mA
Peak Non-Repetitive Surge Current (PW = 10 ms, dc = 10%)	I_{TSM}	1.2 A
Power Dissipation	P_D	350 mW[5]

Notes: (1) Measured with input diode leads shorted together and output leads shorted together
(2) RMA flux is recommended. Duration can be extended to 10 sec. max. when flow soldering.
(3) Derate 7.27 mW/°C above 25°C
(4) Derate 1.82 mW/°C above 25°C
(5) Derate 6.36 mW/°C above 25°C

On-State Collector Current vs. On-State Voltage



Normalized LED Trigger Current vs. Ambient Temperature



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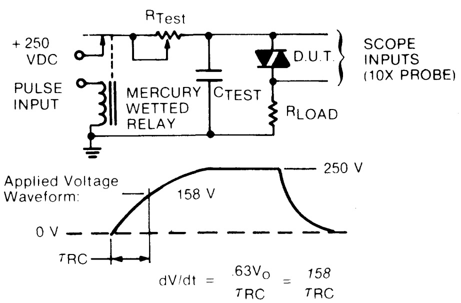
Types OPI3009, OPI3010, OPI3011, OPI3012

electrical characteristics (25 °C unless otherwise noted)

SYMBOL	PARAMETER	MIN	MAX	UNITS	TEST CONDITIONS
Input Diode					
V_F	Forward Voltage		1.5	V	I_F = 10 mA
I_R	Reverse Current		100	μA	V_R = 3 V
Output Photosensor					
I_{DRM}	Peak Blocking Current, Either Direction		100	nA	V_{DRM} =250 V, Must be applied within dV/dt rating
V_{TM}	Peak On-State Voltage, Either Direction		3	V	I_{TM} = 100 mA Peak
dV/dt	Critical Rate of Rise of Off-State-Voltage	15 Typ		V/μs	(See Figures 1 & 3) R_L = 2.5 kΩ
dV/dt	Critical Rate of Rise of Commutating Voltage	.14 Typ		V/μs	(See Figures 2 & 4) R_L = 1 kΩ
Coupled					
I_{FT}	LED Trigger Current Required to Latch Output				Main Terminal Voltage = 3 V
	OPI3009		30	mA	
	OPI3010		15	mA	
	OPI3011		10	mA	
	OPI3012		5	mA	
I_H	Holding Current, Either Direction	100 Typ		μA	

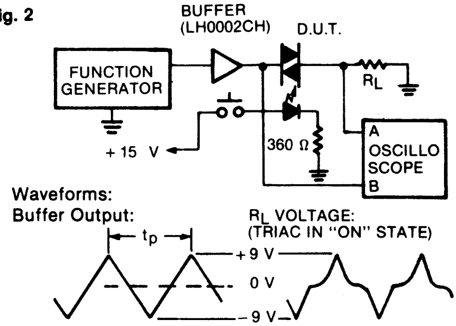
Typical Performance Curves

Fig. 1 Static dV/dt Test Circuit



- The relay provides a high speed repeated pulse to the D.U.T.
- 10X probes are used to allow high speeds and voltages.
- The worse case condition for static dV/dt is established by triggering the D.U.T. with a normal input (LED) current, then removing this current. The variable R_{TEST} allows the dV/dt to be increased until the D.U.T. continues to trigger in response to the applied voltage pulse, even after the LED current has been removed. The dV/dt is then decreased until the D.U.T. stops triggering. T_{RC} is measured at this point and recorded.

Fig. 2 Commutating dV/dt Test Circuit



- 10X probes are used to allow high speeds.
- Frequency is increased until the triac stays "on" after being triggered by pushbutton. Frequency is then decreased until triac turns "off". t_p is measured at this point and recorded.
- Commutating dV/dt = $36/t_p$.

Fig. 3 Static dV/dt vs. Ambient Temperature and Load Resistance

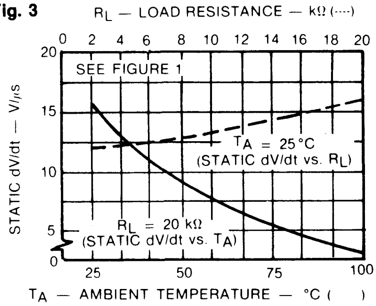
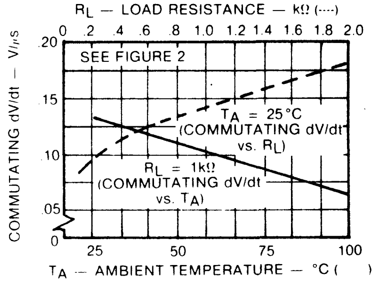


Fig. 4 Commutating dV/dt vs. Ambient Temperature and Load Resistance



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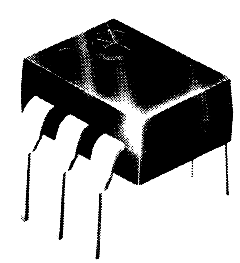
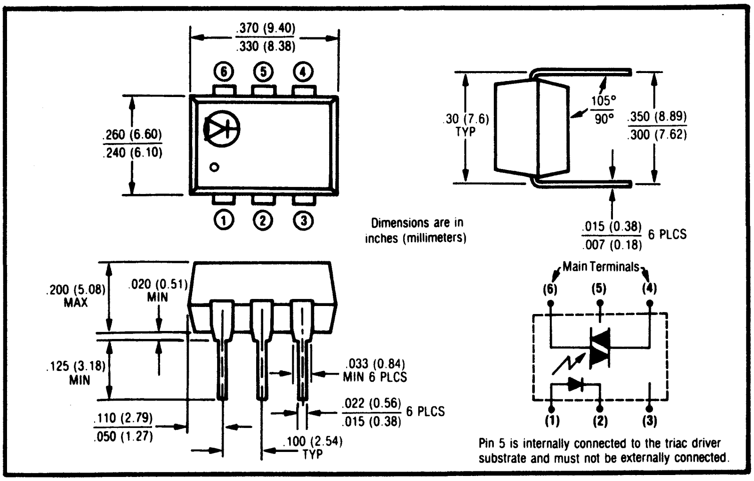
Optically Coupled Triac Drivers

Types OPI3020, OPI3021, OPI3022, OPI3023



TWICE ACTUAL SIZE



Features

- FOR 220 VAC OPERATION
- 2500 VOLT ELECTRICAL ISOLATION
- LOW LED CURRENT DRIVE TO LATCH OUTPUT
- UL RECOGNIZED FILE NO. E58730

Description

The OPI3020, OPI3021, OPI3022, and OPI3023 each consist of a gallium arsenide infrared emitting diode and a monolithic integrated circuit containing a photodiode and a bidirectional switch, mounted in a standard plastic six pin dual-in-line package. This series is intended to interface electric controls with power triacs to control resistive and inductive loads as in motors, solenoids, and appliances.

All electrical parameters are 100% tested by manufacturing. Specifications are guaranteed to a cumulative .65% AQL.

absolute maximum ratings (25°C unless otherwise noted)

Input-to-Output Isolation Voltage . . . . . . ±2500 V[1]
Storage Temperature Range . . . . . . −40°C to +150°C
Operating Temperature Range . . . . . . −40°C to +80°C
Lead Soldering Temperature (1/16 inch [1.6 mm] from case for 5 sec. with soldering iron)[2] 240°C
Total Device Power Dissipation . . . . . . 400 mW[3]

Input Diode

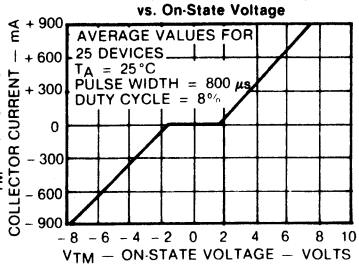
Forward DC Current . . . . . . I_F . . . . . . 50 mA
Reverse DC Voltage . . . . . . V_R . . . . . . 3 V
Power Dissipation . . . . . . P_D . . . 100 mW[4]

Output Photosensor

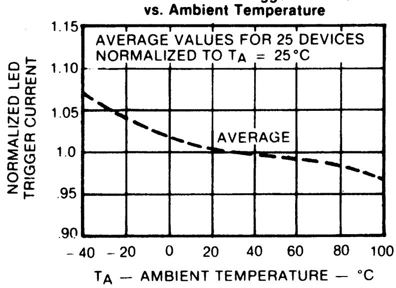
Off-State Terminal Voltage . . . . . . V_{DRM} . . . . . 400 V
On-State RMS Current (Full Cycle, 50-60 Hz, $T_A = 70°C$) . . . . . . $I_T(RMS)$ . . . 100 mA
Peak Non-Repetitive Surge Current (PW = 10 ms, d.c. = 10%) . . . . . . I_{TSM} . . . . . 1.2 A
Power Dissipation . . . . . . P_D . . . 350 mW[5]

Notes: (1) Measured with input diode leads shorted together and output leads shorted together
(2) RMA flux is recommended. Duration can be extended to 10 sec. max. when flow soldering.
(3) Derate 7.27 mW/°C above 25°C
(4) Derate 1.82 mW/°C above 25°C
(5) Derate 6.36 mW/°C above 25°C

On-State Collector Current vs. On-State Voltage



Normalized LED Trigger Current vs. Ambient Temperature



Types OPI3020, OPI3021, OPI3022, OPI3023

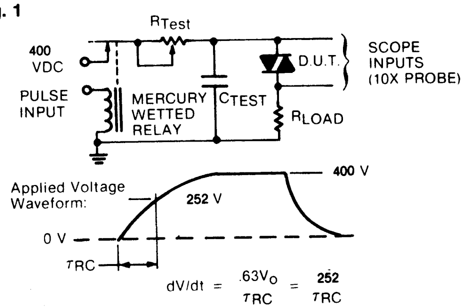
PRODUCT BULLETIN 3062
February 1982

electrical characteristics (25 °C unless otherwise noted)

SYMBOL	PARAMETER	MIN	MAX	UNITS	TEST CONDITIONS
Input Diode					
V_F	Forward Voltage		1.5	V	I_F = 10 mA
I_R	Reverse Current		100	μA	V_R = 3 V
Output Photosensor					
I_{DRM}	Peak Blocking Current, Either Direction		100	nA	V_{DRM} = 400 V, Must be applied within dV/dt rating
V_{TM}	Peak On-State Voltage, Either Direction		3	V	I_{TM} = 100 mA Peak
dV/dt	Critical Rate of Rise of Off-State-Voltage	15 Typ		V/μs	(See Figures 1 & 3) R_L = 4 kΩ
dV/dt	Critical Rate of Rise of Commutating Voltage	.14 Typ		V/μs	(See Figures 2 & 4) R_L = 1 kΩ
Coupled					
I_{FT}	LED Trigger Current Required to Latch Output				Main Terminal Voltage = 3 V
	OPI3020		30	mA	
	OPI3021		15	mA	
	OPI3022		10	mA	
	OPI3023		5	mA	
I_H	Holding Current, Either Direction	100 Typ		μA	

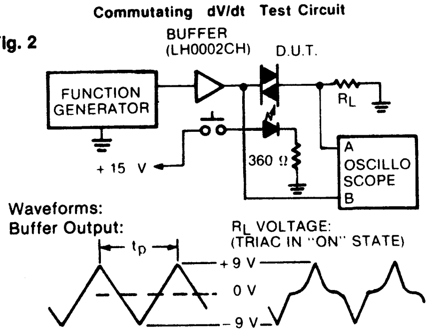
Typical Performance Curves

Fig. 1 Static dV/dt Test Circuit



- The relay provides a high speed repeated pulse to the D.U.T.
- 10X probes are used to allow high speeds and voltages.
- The worse case condition for static dV/dt is established by triggering the D.U.T. with a normal input (LED) current, then removing this current. The variable R_{TEST} allows the dV/dt to be increased until the D.U.T. continues to trigger in response to the applied voltage pulse, even after the LED current has been removed. The dV/dt is then decreased until the D.U.T. stops triggering. T_{RC} is measured at this point and recorded.

Fig. 2 Commutating dV/dt Test Circuit



- 10X probes are used to allow high speeds.
- Frequency is increased until the triac stays "on" after being triggered by pushbutton. Frequency is then decreased until triac turns "off". t_p is measured at this point and recorded.
- Commutating dV/dt = 36/t_p.

Fig. 3 Static dV/dt vs. Ambient Temperature and Load Resistance

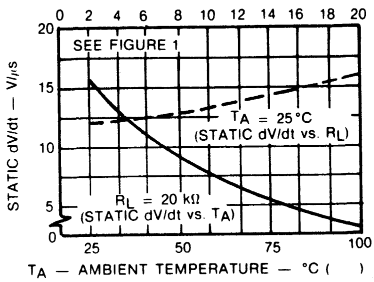
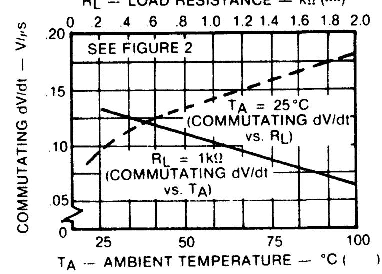


Fig. 4 Commutating dV/dt vs. Ambient Temperature and Load Resistance



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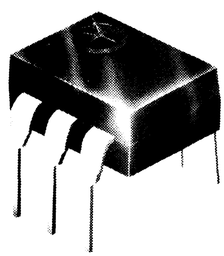
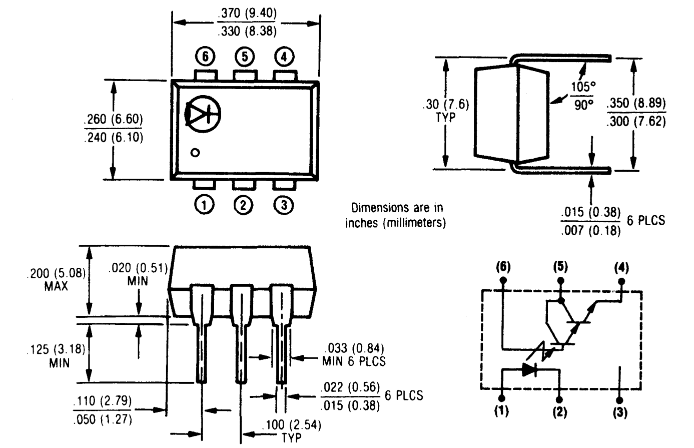
Printed in U.S.A.

Optically Coupled Isolators
Types OPI3150, OPI3250



TWICE ACTUAL SIZE



Features

- PHOTODARLINGTON OUTPUT
- HIGH CURRENT TRANSFER RATIO
- 2500 OR 1500 VOLT ISOLATION RATINGS
- UL RECOGNIZED FILE NO. E58730

Description

The OPI3150 and OPI3250 are optically coupled isolators each consisting of a gallium arsenide infrared emitting diode and an NPN silicon photodarlington mounted in a standard plastic six pin dual-in-line package. Except for isolation voltage, the OPI3150 and OPI3250 are identical.

All electrical parameters are 100% tested by manufacturing. Specifications are guaranteed to a cumulative .65% AQL.

absolute maximum ratings (25 °C unless otherwise noted)

Input-to-Output Isolation Voltage OPI3150 . . . . ± 1500 VDC(1)
OPI3250 . . . . ± 2500 VDC(1)
Storage Temperature Range . . . . − 55 °C to + 150 °C
Operating Temperature Range . . . . − 55 °C to + 100 °C
Lead Soldering Temperature (1/16 inch [1.6 mm] from case for 5 sec. with soldering iron)(2) . . . . 240 °C

Input Diode

Forward DC Current . . . . 60 mA
Peak Forward Current (1 μs pulse width, 330 pps) . . . . 3 A
Reverse DC Voltage . . . . 3 V
Power Dissipation . . . . 100 mW(3)

Output Transistor

Collector-Emitter Voltage . . . . 30 V
Collector-Base Voltage 30V
Emitter-Collector Voltage . . . . 5 V
Power Dissipation . . . . 150 mW(4)

Notes: (1) Measured with input diode leads shorted together and output leads shorted together
(2) RMA flux is recommended. Duration can be extended to 10 sec. max. when flow soldering.
(3) Derate linearly 1.33 mW/ °C above 25 °C
(4) Derate linearly 2.0 mW/ °C above 25 °C

Types OPI3150, OPI3250

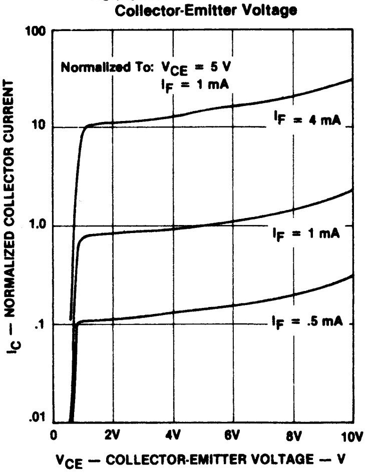
PRODUCT BULLETIN 3065
February 1982

electrical characteristics (25 °C unless otherwise noted)

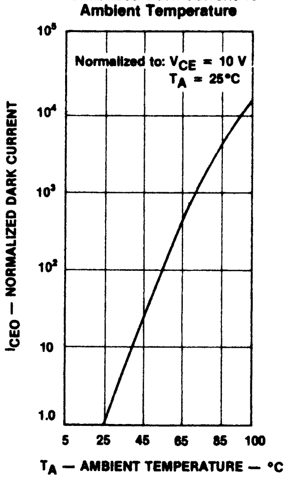
SYMBOL	PARAMETER	MIN	MAX	TYP	UNITS	TEST CONDITIONS
Input Diode						
V_F	Forward Voltage		1.5		V	I_F = 10 mA
I_R	Reverse Current		100		μA	V_R = 3 V
Output Photodarlington						
$V_{(BR)CEO}$	Collector-Emitter Breakdown Voltage	30			V	I_C = 100 μA, I_B = 0
$V_{(BR)CBO}$	Collector-Base Breakdown Voltage	30			V	I_C = 100 μA, I_E = 0
$V_{(BR)ECO}$	Emitter-Collector Breakdown Voltage	5			V	I_E = 100 μA, I_B = 0
I_{CEO}	Collector-Emitter Dark Current		100		nA	V_{CE} = 10 V, I_B = 0
Coupled						
I_C/I_F	DC Current Transfer Ratio	300			%	I_F = 10 mA, V_{CE} = 2 V
$V_{CE(SAT)}$	Collector-Emitter Saturation Voltage		1.0		V	I_F = 10 mA, I_C = 10 mA , I_B = 0
t_r	Output Rise Time			3	μs	V_{CC} = 10 V, I_C = 10 mA
t_f	Output Fall Time			25	μs	R_L = 100Ω

Typical Performance Curves

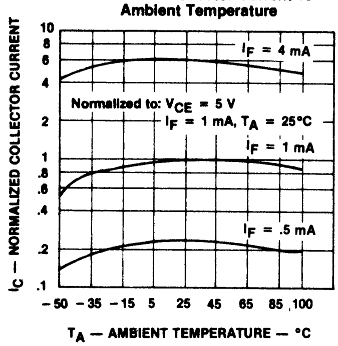
Normalized Collector Current vs Collector-Emitter Voltage



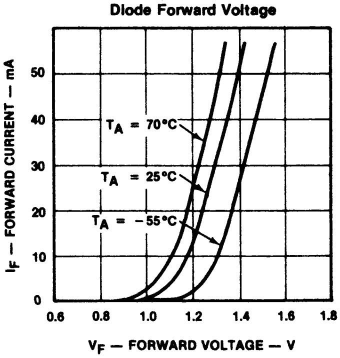
Normalized Dark Current vs Ambient Temperature



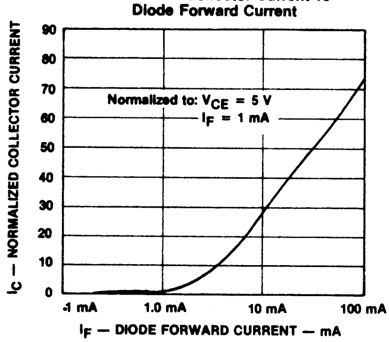
Normalized Collector Current vs Ambient Temperature



Diode Forward Current vs Diode Forward Voltage



Normalized Collector Current vs Diode Forward Current



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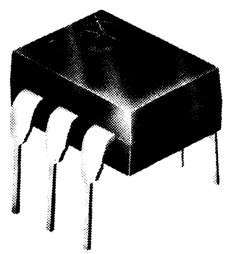
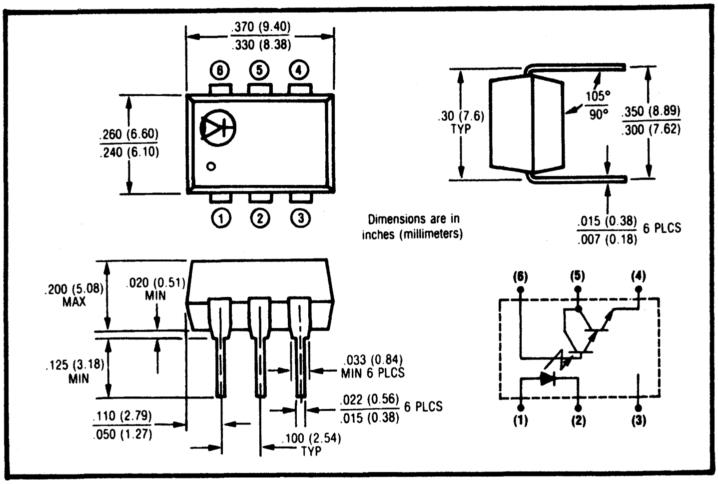
Optically Coupled Isolators
Types OPI3151, OPI3251



TWICE ACTUAL SIZE



Features

- PHOTODARLINGTON OUTPUT
- HIGH CURRENT TRANSFER RATIO
- 2500 OR 1500 VOLT ISOLATION RATINGS
- UL RECOGNIZED FILE NO. E58730

Description

The OPI3151 and OPI3251 are optically coupled isolators each consisting of a gallium arsenide infrared emitting diode and an NPN silicon photodarlington mounted in a standard plastic six pin dual-in-line package. Except for isolation voltage, the OPI3151 and OPI3251 are identical.

All electrical parameters are 100% tested by manufacturing. Specifications are guaranteed to a cumulative .65% AQL.

absolute maximum ratings (25 °C unless otherwise noted)

Input-to-Output Isolation Voltage OPI3151 .... ± 1500 VDC(1)
OPI3251 .... ± 2500 VDC(1)
Storage Temperature Range .... − 55 °C to + 150 °C
Operating Temperature Range .... − 55 °C to + 100 °C
Lead Soldering Temperature (1/16 inch [1.6 mm] from case for 5 sec. with soldering iron)(2) .... 240 °C

Input Diode

Forward DC Current .... 60 mA
Peak Forward Current (1 μs pulse width, 330 pps) .... 3 A
Reverse DC Voltage .... 3 V
Power Dissipation .... 100 mW(3)

Output Transistor

Collector-Emitter Voltage .... 30 V
Collector-Base Voltage 30V
Emitter-Collector Voltage .... 5 V
Power Dissipation .... 150 mW(4)

Notes: (1) Measured with input diode leads shorted together and output leads shorted together
(2) RMA flux is recommended. Duration can be extended to 10 sec. max. when flow soldering.
(3) Derate linearly 1.33 mW/ °C above 25 °C
(4) Derate linearly 2.0 mW/ °C above 25 °C

Types OPI3151, OPI3251

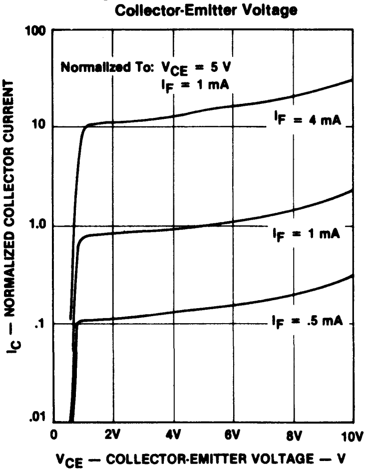
PRODUCT BULLETIN 3066
February 1982

electrical characteristics (25 °C unless otherwise noted)

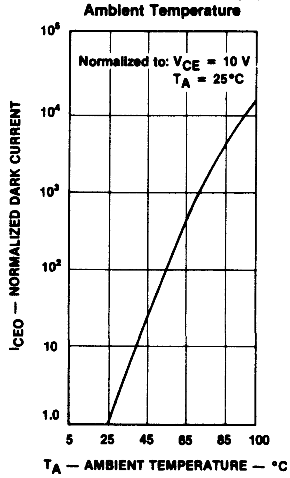
SYMBOL	PARAMETER	MIN	TYP	MAX	UNITS	TEST CONDITIONS
Input Diode						
V_F	Forward Voltage			1.5	V	I_F = 10 mA
I_R	Reverse Current			100	μA	V_R = 3 V
Output Photodarlington						
$V_{(BR)CEO}$	Collector-Emitter Breakdown Voltage	30			V	I_C = 100 μA, I_B = 0
$V_{(BR)CBO}$	Collector-Base Breakdown Voltage	30			V	I_C = 100 μA, I_E = 0
$V_{(BR)ECO}$	Emitter-Collector Breakdown Voltage	5			V	I_E = 100 μA, I_B = 0
I_{CEO}	Collector-Emitter Dark Current			100	nA	V_{CE} = 10 V, I_B = 0
Coupled						
I_C/I_F	DC Current Transfer Ratio	300			%	I_F = 10 mA, V_{CE} = 1 V
$V_{CE(SAT)}$	Collector-Emitter Saturation Voltage			1.0	V	I_F = 50 mA, I_C = 50 mA , I_B = 0
t_r t_f	Output Rise Time Output Fall Time		3 25		μs μs	V_{CC} = 10 V, I_C = 10 mA R_L = 100Ω

Typical Performance Curves

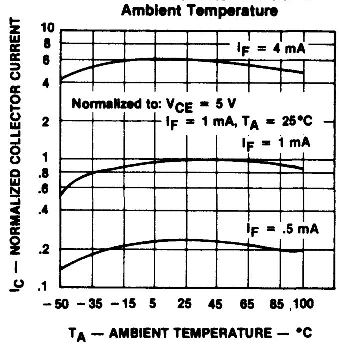
Normalized Collector Current vs Collector-Emitter Voltage



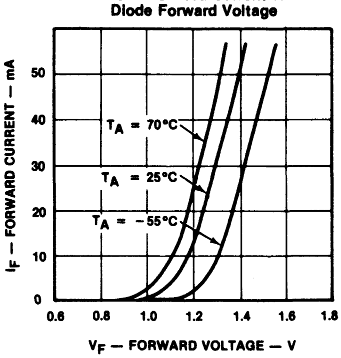
Normalized Dark Current vs Ambient Temperature



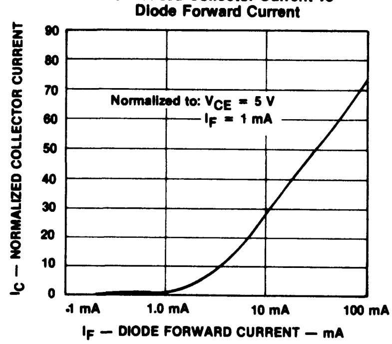
Normalized Collector Current vs Ambient Temperature



Diode Forward Current vs Diode Forward Voltage



Normalized Collector Current vs Diode Forward Current



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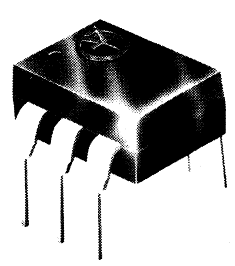
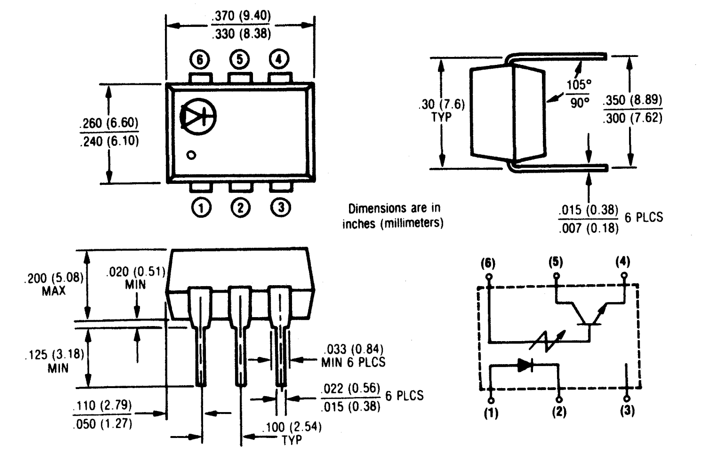
PRODUCT BULLETIN 3067
February 1982

Optically Coupled Isolators
Types OPI3152, OPI3252



TWICE ACTUAL SIZE



Features

- PHOTODARLINGTON OUTPUT
- HIGH CURRENT TRANSFER RATIO
- 2500 OR 1500 VOLT ISOLATION RATINGS
- UL RECOGNIZED FILE NO. E58730

Description

The OPI3152 and OPI3252 are optically coupled isolators each consisting of a gallium arsenide infrared emitting diode and an NPN silicon photodarlington mounted in a standard plastic six pin dual-in-line package. Except for isolation voltage, the OPI3152 and OPI3252 are identical.

All electrical parameters are 100% tested by manufacturing. Specifications are guaranteed to a cumulative .65% AQL.

absolute maximum ratings (25 °C unless otherwise noted)

Input-to-Output Isolation Voltage OPI3152 . . . . ± 1500 VDC(1)
OPI3252 . . . . ± 2500 VDC(1)
Storage Temperature Range . . . . −55 °C to +150 °C
Operating Temperature Range . . . . −55 °C to +100 °C
Lead Soldering Temperature (1/16 inch [1.6 mm] from case for 5 sec. with soldering iron)(2) . . . . 240 °C

Input Diode

Forward DC Current . . . . 60 mA
Peak Forward Current (1 μs pulse width, 330 pps) . . . . 3 A
Reverse DC Voltage . . . . 3 V
Power Dissipation . . . . 100 mW(3)

Output Transistor

Collector-Emitter Voltage . . . . 30 V
Collector-Base Voltage 30V
Emitter-Collector Voltage . . . . 5 V
Power Dissipation . . . . 150 mW(4)

Notes: (1) Measured with input diode leads shorted together and output leads shorted together
(2) RMA flux is recommended. Duration can be extended to 10 sec. max. when flow soldering.
(3) Derate linearly 1.33 mW/ °C above 25 °C
(4) Derate linearly 2.0 mW/ °C above 25 °C

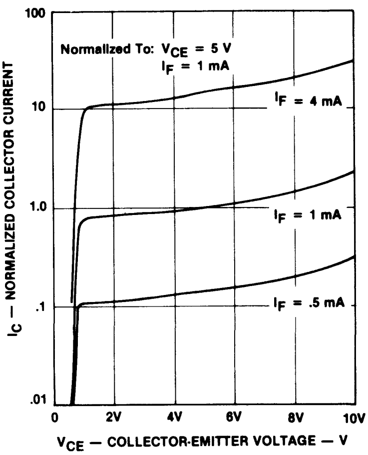
Types OPI3152, OPI3252

electrical characteristics (25 °C unless otherwise noted)

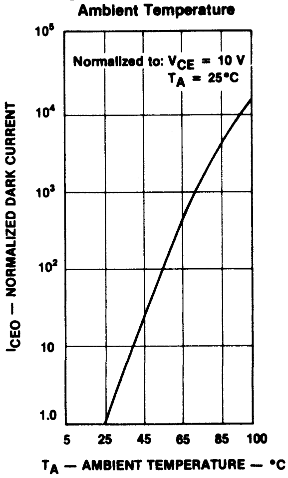
SYMBOL	PARAMETER	MIN	TYP	MAX	UNITS	TEST CONDITIONS
Input Diode						
V_F	Forward Voltage			1.5	V	I_F = 10 mA
I_R	Reverse Current			100	μA	V_R = 3 V
Output Photodarlington						
$V_{(BR)CEO}$	Collector-Emitter Breakdown Voltage	55			V	I_C = 100 μA, I_B = 0
$V_{(BR)CBO}$	Collector-Base Breakdown Voltage	55			V	I_C = 100 μA, I_E = 0
$V_{(BR)ECO}$	Emitter-Collector Breakdown Voltage	5			V	I_E = 100 μA, I_B = 0
I_{CEO}	Collector-Emitter Dark Current			100	nA	V_{CE} = 10 V, I_B = 0
Coupled						
I_C/I_F	DC Current Transfer Ratio	300			%	I_F = 10 mA, V_{CE} = 5 V
$V_{CE(SAT)}$	Collector-Emitter Saturation Voltage			1.0	V	I_F = 50 mA, I_C = 50 mA, I_B = 0
t_r t_f	Output Rise Time Output Fall Time		3 25		μs μs	V_{CC} = 10 V, I_C = 10 mA R_L = 100Ω

Typical Performance Curves

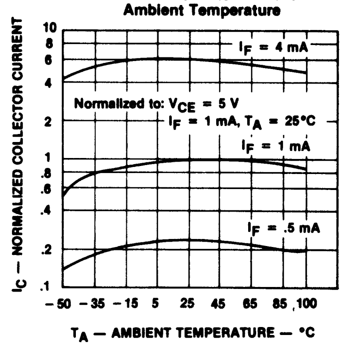
Normalized Collector Current vs Collector-Emitter Voltage



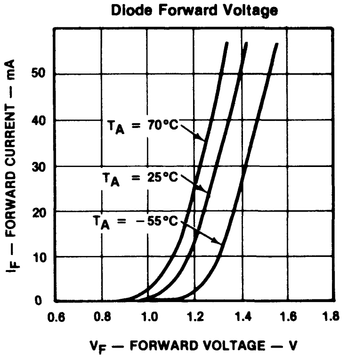
Normalized Dark Current vs Ambient Temperature



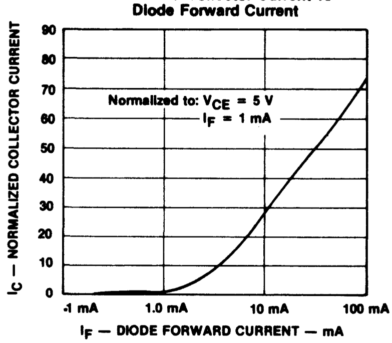
Normalized Collector Current vs Ambient Temperature



Diode Forward Current vs Diode Forward Voltage



Normalized Collector Current vs Diode Forward Current



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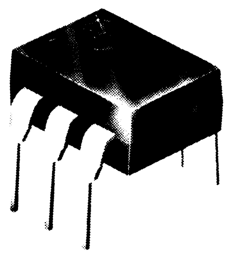
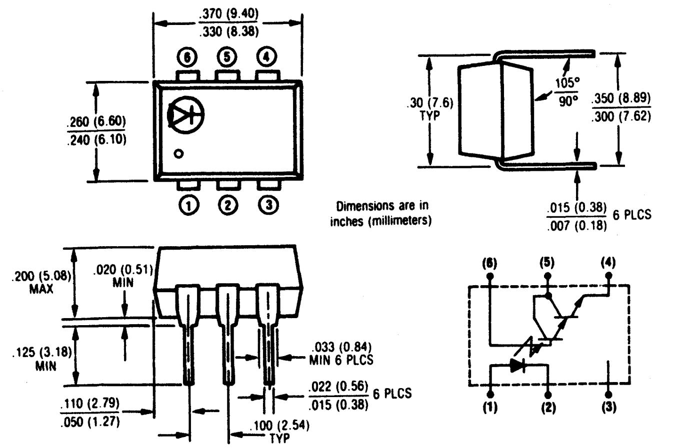
Optically Coupled Isolators
Types OPI3153, OPI3253



TWICE ACTUAL SIZE



Features

- PHOTODARLINGTON OUTPUT
- HIGH CURRENT TRANSFER RATIO
- 2500 OR 1500 VOLT ISOLATION RATINGS
- UL RECOGNIZED FILE NO. E58730

Description

The OPI3153 and OPI3253 are optically coupled isolators each consisting of a gallium arsenide infrared emitting diode and an NPN silicon photodarlington mounted in a standard plastic six pin dual-in-line package. Except for isolation voltage, the OPI3153 and OPI3253 are identical.

All electrical parameters are 100% tested by manufacturing. Specifications are guaranteed to a cumulative .65% AQL.

absolute maximum ratings (25 °C unless otherwise noted)

Input-to-Output Isolation Voltage OPI3153 . . . . ± 1500 VDC(1)
OPI3253 . . . . ± 2500 VDC(1)
Storage Temperature Range . . . . −55 °C to +150 °C
Operating Temperature Range . . . . −55 °C to +100 °C
Lead Soldering Temperature (1/16 inch [1.6 mm] from case for 5 sec. with soldering iron)(2) . . . . 240 °C

Input Diode

Forward DC Current . . . . 60 mA
Peak Forward Current (1 μs pulse width, 330 pps) . . . . 3 A
Reverse DC Voltage . . . . 3 V
Power Dissipation . . . . 100 mW(3)

Output Transistor

Collector-Emitter Voltage . . . . 30 V
Collector-Base Voltage 30V
Emitter-Collector Voltage . . . . 5 V
Power Dissipation . . . . 150 mW(4)

Notes: (1) Measured with input diode leads shorted together and output leads shorted together
(2) RMA flux is recommended. Duration can be extended to 10 sec. max. when flow soldering.
(3) Derate linearly 1.33 mW/°C above 25°C
(4) Derate linearly 2.0 mW/°C above 25°C

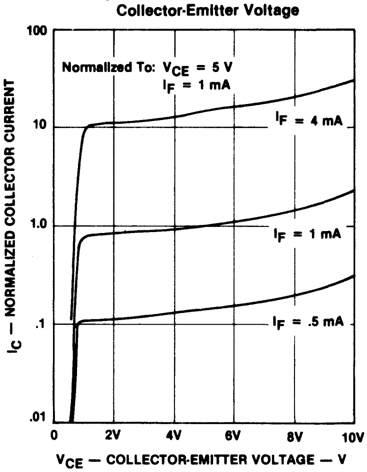
Types OPI3153, OPI3253

electrical characteristics (25 °C unless otherwise noted)

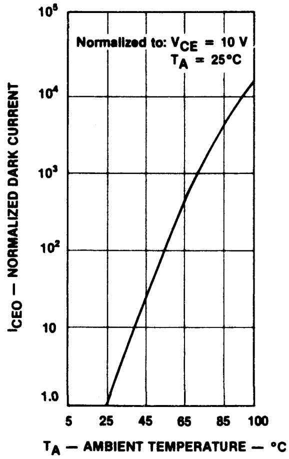
SYMBOL	PARAMETER	MIN	TYP	MAX	UNITS	TEST CONDITIONS
Input Diode						
V_F	Forward Voltage			1.5	V	$I_F = 10$ mA
I_R	Reverse Current			100	μA	$V_R = 3$ V
Output Photosensor						
$V_{(BR)CEO}$	Collector-Emitter Breakdown Voltage	30			V	$I_C = 1$ mA, $I_B = 0$
$V_{(BR)CBO}$	Collector-Base Breakdown Voltage	30			V	$I_C = 100$ μA, $I_E = 0$
$V_{(BR)ECO}$	Emitter-Collector Breakdown Voltage	5			V	$I_E = 100$ μA, $I_B = 0$
I_{CEO}	Collector-Emitter Dark Current			100	nA	$V_{CE} = 10$ V, $I_B = 0$
Coupled						
I_C/I_F	DC Current Transfer Ratio	500			%	$I_F = 1$ mA, $V_{CE} = 5$ V
$V_{CE(SAT)}$	Collector-Emitter Saturation Voltage			1.0	V	$I_F = 1$ mA, $I_C = 1$ mA, $I_B = 0$
t_r	Output Rise Time		3		μs	$V_{CC} = 10$ V, $I_C = 10$ mA
t_f	Output Fall Time		25		μs	$R_L = 100\Omega$

Typical Performance Curves

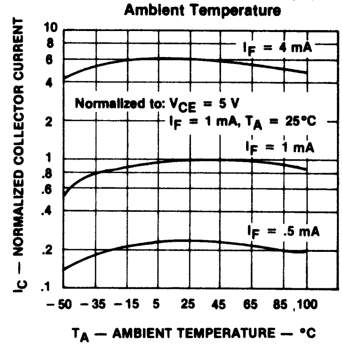
Normalized Collector Current vs Collector-Emitter Voltage



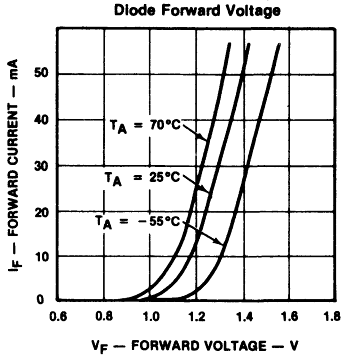
Normalized Dark Current vs Ambient Temperature



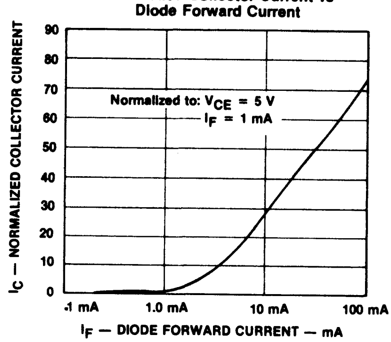
Normalized Collector Current vs Ambient Temperature



Diode Forward Current vs Diode Forward Voltage



Normalized Collector Current vs Diode Forward Current



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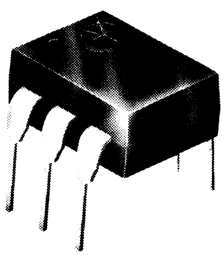
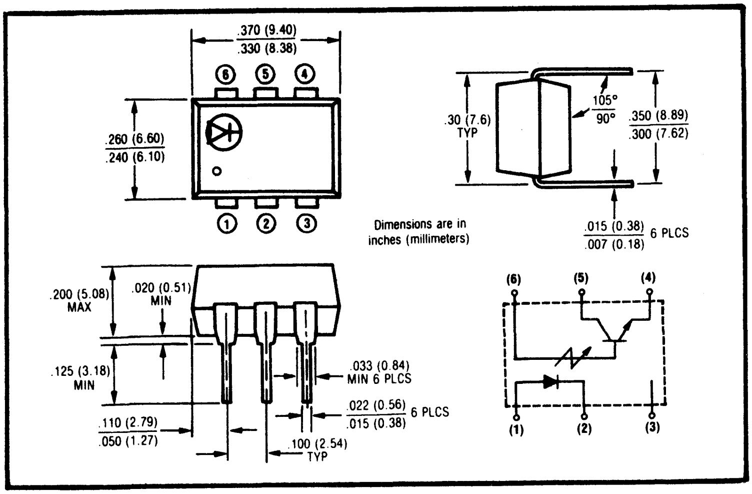
PRODUCT BULLETIN 3069
February 1982

Optically Coupled Isolators, High $V_{(BR)CEO}$
Types OPI6000, OPI6100



TWICE ACTUAL SIZE



Features

- 300 V COLLECTOR — EMITTER BREAKDOWN VOLTAGE
- LOW COST 6 PIN DUAL-IN-LINE PACKAGE
- UL RECOGNIZED FILE NO. E58730

Description

The OPI6000 and OPI6100 are optically coupled isolators each consisting of a gallium arsenide infrared emitting diode and an NPN silicon phototransistor mounted in a standard plastic six pin dual-in-line package. This series is intended for applications where high collector-emitter breakdown voltages are required.

All electrical parameters are 100% tested by manufacturing. Specifications are guaranteed to a cumulative .65% AQL.

absolute maximum ratings (25 °C unless otherwise noted)

Input-to-Output Isolation Voltage . . . . ± 1500 VDC(1)
Storage Temperature Range . . . . −55 °C to 150 °C
Operating Temperature Range . . . . −55 °C to 100 °C
Lead Soldering Temperature (1/16 inch [1.6 mm] from case for 5 sec. with soldering iron)(2) . . . . 240 °C

Input Diode
Forward DC Current . . . . 60 mA
Peak Forward Current (1 μs pulse width, 300 pps) . . . . 3 A
Reverse Voltage . . . . 3 V
Power Dissipation . . . . 100 mW(3)

Output Phototransistor
$V_{(BR)CEO}$ . . . . OPI6000 . . . . 300 V
OPI6100 . . . . 200 V
$V_{(BR)CBO}$ . . . . OPI6000 . . . . 300 V
OPI6100 . . . . 200 V
$V_{(BR)ECO}$ . . . . 7 V
Power Dissipation . . . . 300 mW(4)

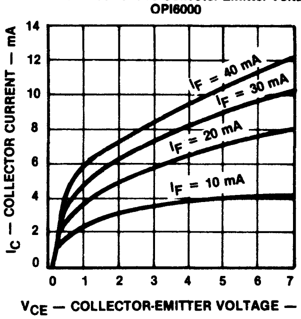
Notes: (1) Measured with input leads shorted together and output leads shorted together
(2) RMA flux is recommended. Duration can be extended to 10 sec. max. when flow soldering.
(3) Derate 1.33 mW/ °C above 25 °C
(4) Derate 4.0 mW/ °C above 25 °C

electrical characteristics (25 °C unless otherwise noted)

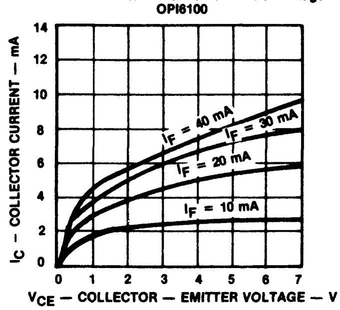
SYMBOL	PARAMETER	MIN	TYP	MAX	UNITS	TEST CONDITIONS
Input Diode						
V_F	Forward Voltage			1.5	V	I_F = 10 mA
I_R	Reverse Current			10	μA	V_R = 3.0 V
Output Phototransistor						
$V_{(BR)CEO}$	Collector-Emitter Breakdown Voltage (See Note 1) OPI6000 OPI6100	300 200			V	I_C = 1.0 mA, I_F = 0
$V_{(BR)ECO}$	Emitter-Collector Breakdown Voltage	7			V	I_E = 10 μA, I_F = 0
$V_{(BR)CBO}$	Collector-Base Breakdown Voltage OPI6000 OPI6100	300 200			V	I_C = 100 μA, I_F = 0
I_{CEO}	Collector Dark Current OPI6000			100	nA	V_{CE} = 200 V, I_F = 0, R_{BE} = 1 MΩ
I_{CEO}	Collector Dark Current OPI6100			100	nA	V_{CE} = 100 V, I_F = 0, R_{BE} = 1 MΩ
Coupled						
I_C/I_F	DC Current Transfer Ratio OPI6000 OPI6100	20 10			% %	I_F = 10 mA, V_{CE} = 5 V I_F = 10 mA, V_{CE} = 5 V
$V_{CE(SAT)}$	Collector-Emitter Saturation Voltage			0.4	V	I_F = 10 mA, I_C = 0.5 mA
V_{ISO}	Isolation Voltage	1500			VDC	See Note 1
R_{IO}	Input-to-Output Resistance	10^{11}			Ω	V_{IO} = 500 V, See Note 1
C_{IO}	Input-to-Output Capacitance		2.0		pF	f = 1.0 MHz, See Note 1
t_{on} t_{off}	Turn On Time Turn Off Time		4.0 2.5		μs μs	V_{CC} = 10 V, R_L = 100 Ω I_F = 2 mA, See Test Circuit

Typical Performance Curves

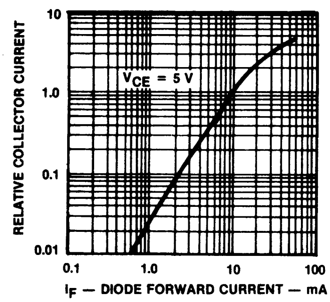
Collector Current vs Collector-Emitter Voltage OPI6000



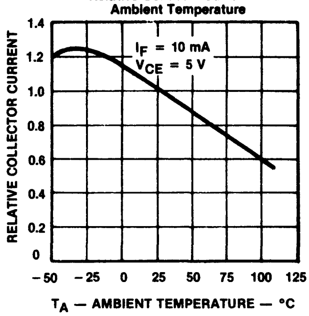
Collector Current vs Collector-Emitter Voltage OPI6100



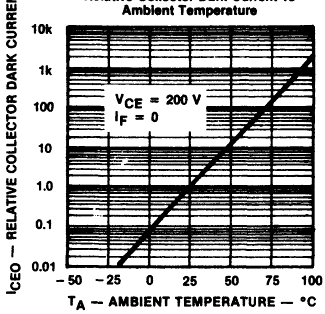
Relative Collector Current vs Diode Forward Current



Relative Collector Current vs Ambient Temperature

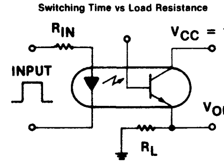


Relative Collector Dark Current vs Ambient Temperature



Switching Time Test Circuit

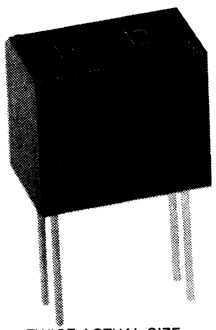
Switching Time vs Load Resistance



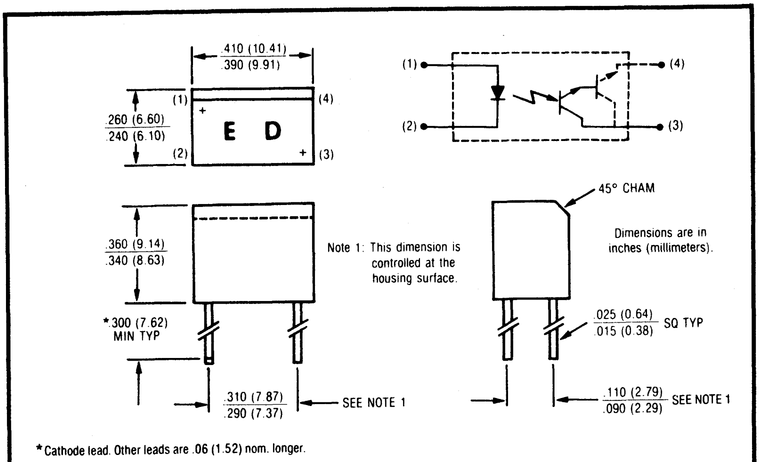
NOTE: Rise Time (t_r) is time required for collector current to increase from 10% to 90% of its final value. Fall Time (t_f) is time required for the collector current to decrease from 90% to 10% of its initial value. Delay Time (t_d) is the time from input pulse leading edge to point where collector current reaches 10% of its final value.

TRW OPTRON

Optically Coupled Isolators
Types OPI7002, OPI7010, OPI7320, OPI7340



TWICE ACTUAL SIZE



Features

- 6 kV ELECTRICAL ISOLATION
- LOW-COST PLASTIC HOUSING
- U.L. RECOGNIZED FILE NUMBER E58370

Description

The OPI7002, OPI7010, OPI7320, and OPI7340 each consist of a gallium arsenide infrared emitting diode coupled to an NPN silicon phototransistor (OPI7002, OPI7010) or photodarlington (OPI7320, OPI7340). The LED and sensor are encased in a black low-cost plastic housing. Pin spacing is compatible with standard dual-in-line packages.

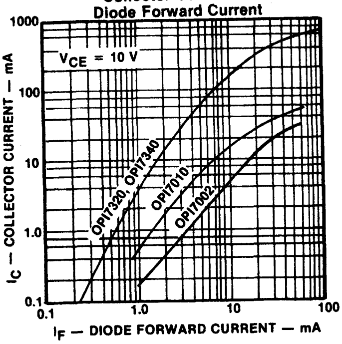
All electrical parameters are 100% tested by manufacturing. Specifications are guaranteed to a cumulative .65% AQL.

absolute maximum rating (25°C unless otherwise noted)

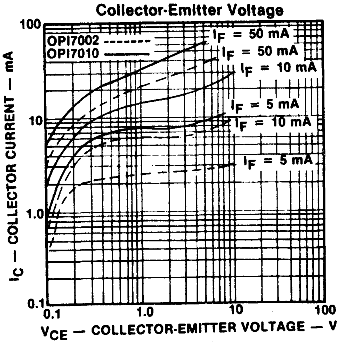
Input-to-Output Isolation Rating	±6 kVDC(1)
Storage Temperature Range	−55°C to +85°C
Operating Temperature Range	−55°C to +85°C
Lead Soldering Temperature (1/16 inch [1.6 mm] from case for 5 sec. with soldering iron)(2)	240°C
Input Diode	
Forward DC Current	60 mA
Peak Forward Current (1 μsec pulse width, 300 pps)	3 A
Reverse Voltage	3 V
Power Dissipation	100 mW(3)
Output Photosensor	
Collector-Emitter Voltage	30 V
Emitter-Collector Voltage	5 V
Power Dissipation	150 mW(4)

Notes: (1) Measured with input leads shorted together and output leads shorted together.
(2) RMA flux is recommended. Duration can be extended to 10 sec. max. when flow soldering.
(3) Derate 1.67 mW/°C above 25°C.
(4) Derate 2.5 mW/°C above 25°C.

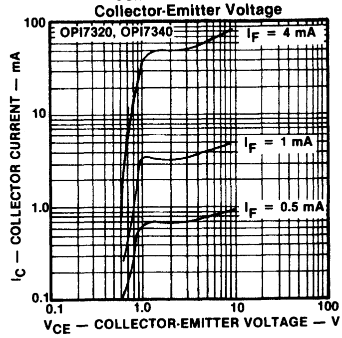
Collector Current vs Diode Forward Current



Collector Current vs Collector-Emitter Voltage



Collector Current vs Collector-Emitter Voltage



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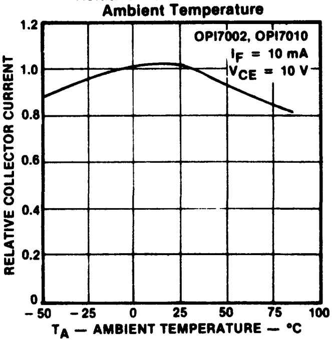
Types OPI7002, OPI7010, OPI7320, OPI7340

electrical characteristics (25°C unless otherwise noted)

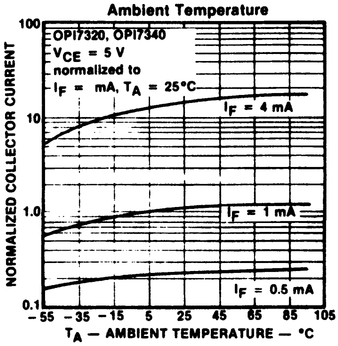
SYMBOL	PARAMETER	MIN	TYP	MAX	UNIT	TEST CONDITIONS
Input Diode						
V_F	Forward Voltage		1.1	1.7	V	I_F = 10 mA
I_R	Reverse Current			10	μA	V_R = 3 V
Output Sensor						
$V_{(BR)CEO}$	Collector-Emitter Breakdown Voltage	30			V	I_C = 1 mA, I_F = 0
$V_{(BR)ECO}$	Emitter-Collector Breakdown Voltage	5			V	I_E = 100 μA, I_F = 0
I_{CEO}	Collector Dark Current		5	100	μA	V_{CE} = 10 V, I_F = 0
Coupled						
I_C/I_F	DC Current Transfer Ratio OPI7002 OPI7010 OPI7320 OPI7340	20 100 200 400			% % % %	V_{CE} = 10 V, I_F = 5 mA V_{CE} = 5 V, I_F = 5 mA
$V_{CE(SAT)}$	Collector-Emitter Saturation Voltage OPI7002, OPI7010 OPI7320, OPI7340			0.4 1.0	V V	I_F = 10 mA, I_C = 0.5 mA I_F = 5 mA, I_C = 2 mA
V_{ISO}	Isolation Voltage	6000			VDC	See Note 1
t_{on}	Turn-On Time OPI7002, OPI7010 OPI7320, OPI7340		4 150		μs μs	V_{CE} = 10 V, I_{CE} = 10 mA, R_L = 100Ω
t_{off}	Turn-Off Time OPI7002, OPI7010 OPI7320, OPI7340		3 125		μs μs	V_{CE} = 10 V, I_{CE} = 10 mA, R_L = 100Ω
C_{IO}	Capacitance Input-to-Output		0.2		pF	V_{IO} = 0, f = 1 MHz, See Note 1

Typical Performance Curves

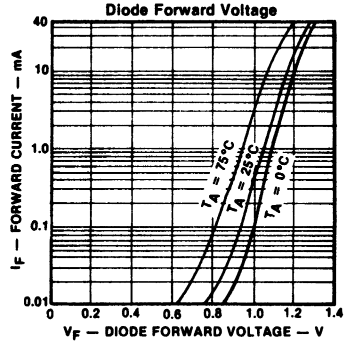
Relative Collector Current vs Ambient Temperature



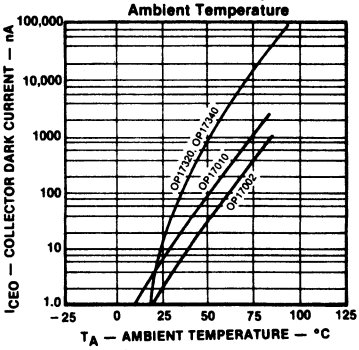
Normalized Collector Current vs Ambient Temperature



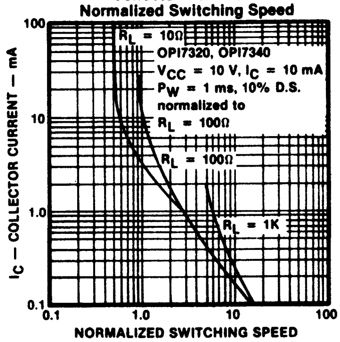
Diode Forward Current vs Diode Forward Voltage



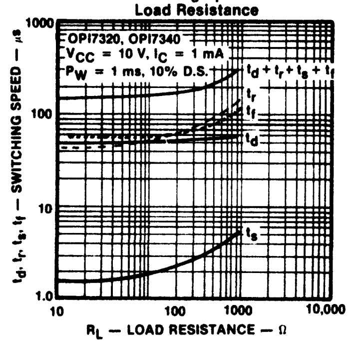
Collector Dark Current vs Ambient Temperature



Collector Current vs Normalized Switching Speed



Switching Speed vs Load Resistance



TRW OPTRON reserves the right to make changes at any time in order to improve design and to supply the best product possible.

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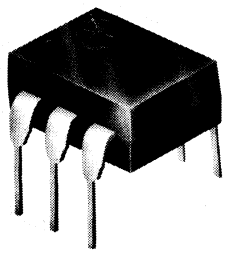
Printed in U.S.A.

TRW OPTRON

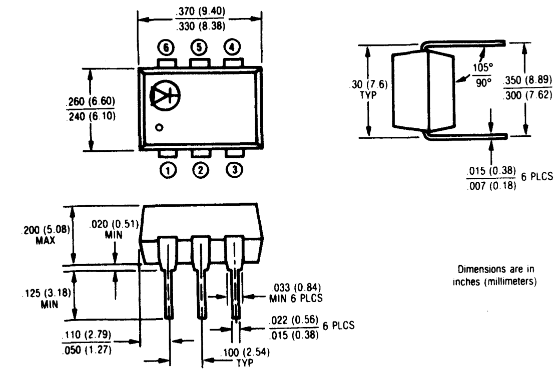
PRODUCT BULLETIN 3079
January 1982

Photologic™ Optically Coupled Isolators

Types OPI8012, OPI8013, OPI8014, OPI8015



TWICE ACTUAL SIZE



Features

- FOUR OUTPUT OPTIONS
- LOW COST P-DIP PACKAGE
- DIRECT TTL/LSTTL INTERFACE
- HIGH NOISE IMMUNITY
- DATA RATES TO 250 KBAUD
- U. L. RECOGNIZED FILE NO. E58730

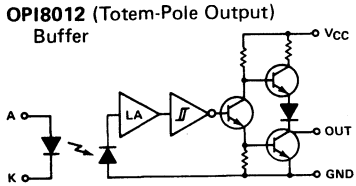
Description

The OPI8012, OPI8013, OPI8014 and OPI8015 each contain a gallium arsenide infrared emitting diode coupled to a monolithic integrated circuit which incorporates a photodiode, a linear amplifier and a Schmitt trigger on a single silicon chip. The devices feature TTL/LSTTL compatible logic level output which can drive up to 8 TTL loads directly without additional circuitry. Also featured are medium speed data rates to 250 KBAUD and typical rise and fall times of 25 nsec. The devices are designed for industrial environments and have built-in hysterisis for high immunity to noise on input and V_{CC}.

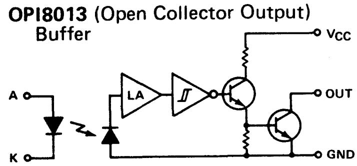
All electrical parameters are 100% tested by manufacturing. Specifications are guaranteed to a .65% AQL.

Schematics

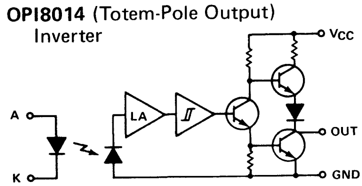
OPI8012 (Totem-Pole Output)
Buffer



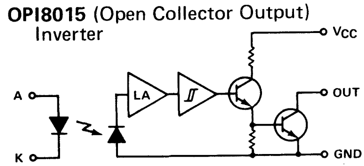
OPI8013 (Open Collector Output)
Buffer



OPI8014 (Totem-Pole Output)
Inverter



OPI8015 (Open Collector Output)
Inverter



absolute maximum ratings (25° C unless otherwise noted)

Input-to-Output Isolation Voltage . . . . 1500 V Peak(1)
Supply Voltage, V_{CC} . . . . +10 V
Storage Temperature Range. . . . . −55°C to +150°C
Operating Temperature Range . . . . −55°C to +100°C
Lead Soldering Temperature (1/16 inch [1.6 mm] from Case for 5 sec. w/soldering iron(2)) . . . . 240°C
Total Device Power Dissipation . . . . 250 mW(3)
Input Diode Power Dissipation. . . . . 100 mW(4)
Output Photologic Power Dissipation . . . . 200 mW(5)
Duration of Output Short to V_{CC} or Ground (OPI8012, OPI8014). . . . . 1 sec.
Duration of Output Short to V_{CC} (OPI8013, OPI8015) . . . . 1 sec.
Voltage at Output Lead (OPI8013, OPI8015). . . . . 35 V
Diode Input { Forward D.C. Current . . . . 25 mA
Diode Input { Reverse D.C. Voltage . . . . 3 V

Notes: (1) Measured with input leads shorted together and output leads shorted together.
(2) RMA flux is recommended. Duration can be extended to 10 seconds max. when flow soldering.
(3) Derate linearly 3.33 mW/cm^2 above 25°C.
(4) Derate linearly 1.33 mW/cm^2 above 25°C.
(5) Derate linearly 2.67 mW/cm^2 above 25°C.

TM Trademark TRW INC.

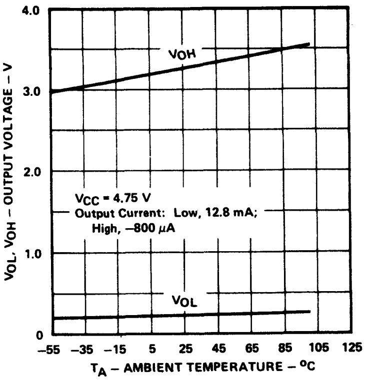
Types OPI8012, OPI8013, OPI8014, OPI8015

electrical characteristics (−40° C to +70° C unless otherwise noted)

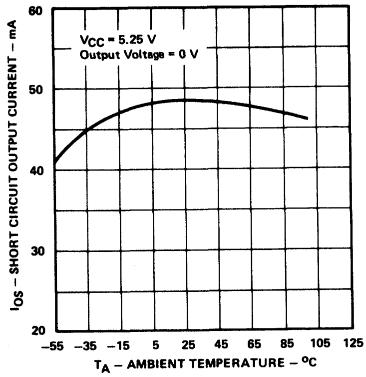
SYMBOL	PARAMETER	MIN	TYP	MAX	UNITS	TEST CONDITIONS
DIODE INPUT						
V_F	Forward Voltage			1.5	V	I_F = 10 mA, T_A = 25°
I_R	Reverse Current			100	μA	V_R = 3 V, T_A = 25°C
$I_{F(+)}$	LED Positive-Going Threshold Current			10	mA	V_{CC} = 5 V
$I_{F(+)}/I_{F(-)}$	Hysteresis Ratio		2			
PHOTOLOGIC OUTPUT						
V_{CC}	Operating Supply Voltage	4.75		5.25	V	
I_{CC}	Supply Current			15	mA	V_{CC} = 5.25 V, I_F = 0 or 10 mA
OPI8012 (Buffer, Totem-Pole)						
V_{OL}	Low Level Output Voltage			0.4	V	V_{CC} = 4.75 V, I_{OL} = 12.8 mA I_F = 0 mA
V_{OH}	High Level Output Voltage	2.4			V	V_{CC} = 4.75 V, I_{OH} = −800 μA I_F = 10 mA
I_{OS}	Short Circuit Output Current	−30		−100	mA	V_{CC} = 5.25 V, I_F = 10 mA Output = GND
OPI8013 (Buffer, Open Collector)						
V_{OL}	Low Level Output Voltage			0.4	V	V_{CC} = 4.75 V, I_{OL} = 12.8 mA I_F = 0 mA
I_{OH}	High Level Output Current			100	μA	V_{CC} = 4.75 V, V_{OH} = 30 V I_F = 10 mA
OPI8014 (Inverter, Totem Pole)						
V_{OL}	Low Level Output Voltage			0.4	V	V_{CC} = 4.75 V, I_{OL} = 12.8 mA I_F = 10 mA
V_{OH}	High Level Output Voltage	2.4			V	V_{CC} = 4.75 V, I_{OH} = −800 μA I_F = 0 mA
I_{OS}	Short Circuit Output Current	−30		−100	mA	V_{CC} = 5.25 V, I_F = 0 mA Output = GND
OPI8015 (Inverter, Open Collector)						
V_{OL}	Low Level Output Voltage			0.4	V	V_{CC} = 4.75 V, I_{OL} = 12.8 mA I_F = 10 mA
I_{OH}	High Level Output Current			100	μA	V_{CC} = 4.75 V, V_{OH} = 30 V I_F = 0 mA
OPI8012, OPI8014						
t_r, t_f	Output Rise Time, Output Fall Time			70	ns	V_{CC} = 5 V, T_A = 25°C I_F = 10 mA, Square Wave f = 10 kHz, D.C. = 50% R_L = 8 TTL Loads
t_{PLH}, t_{PHL}	Propagation Delay, Low-High, High-Low			5	μs	
OPI8013, OPI8015						
t_r, t_f	Output Rise Time, Output Fall Time			70	ns	V_{CC} = 5 V, T_A = 25°C I_F = 10 mA, Square Wave f = 10 kHz, D.C. = 50% R_L = 360 Ω
t_{PLH}, t_{PHL}	Propagation Delay, Low-High, High-Low			5	μs	

OPI8012, OPI8014

Output Voltage vs. Ambient Temperature

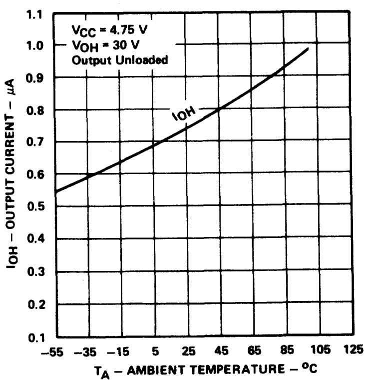


Short Circuit Output Current vs. Ambient Temperature

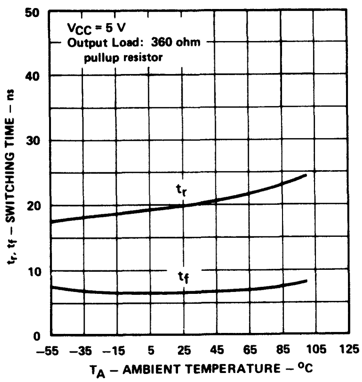


OPI8013, OPI8015

Output Current (High) vs. Ambient Temperature

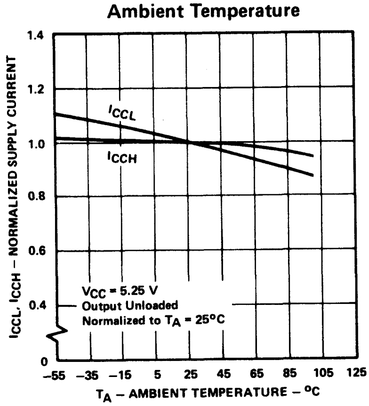


Rise Time and Fall Time vs. Ambient Temperature



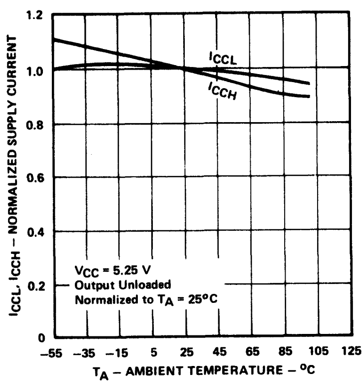
OPI8012, OPI8013

Normalized Supply Current vs. Ambient Temperature



OPI8014, OPI8015

Normalized Supply Current vs. Ambient Temperature



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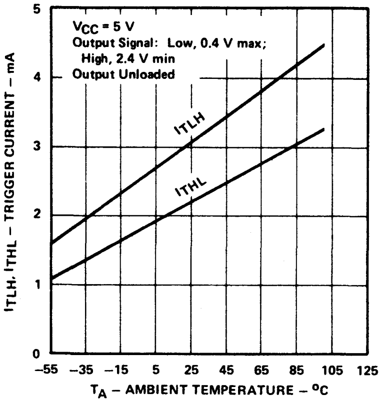
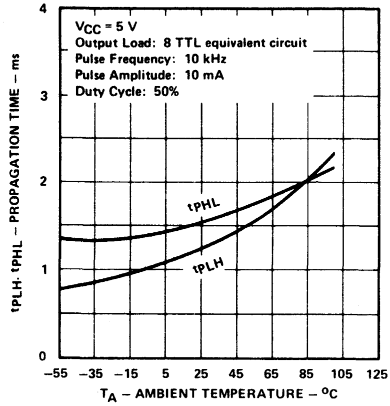
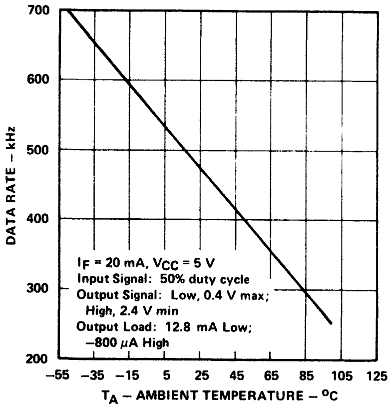
Trigger Current vs. Ambient Temperature



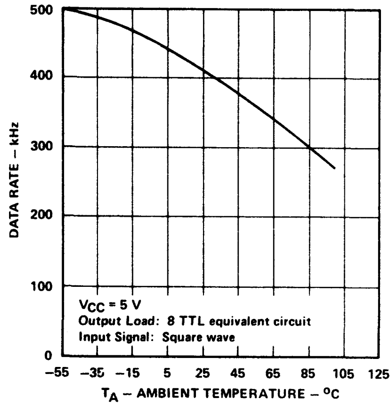
Propagation Time vs. Ambient Temperature



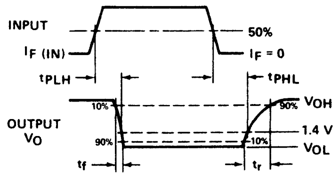
Data Rate vs. Ambient Temperature



Data Rate vs. Ambient Temperature

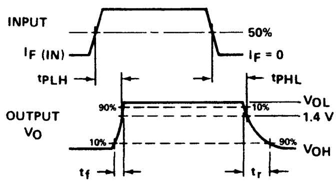


Switching Test Curve for Inverters



LED: f = 1 kHz, D.C. = 50%

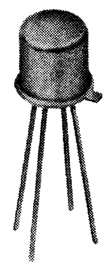
Switching Test Curve for Buffers



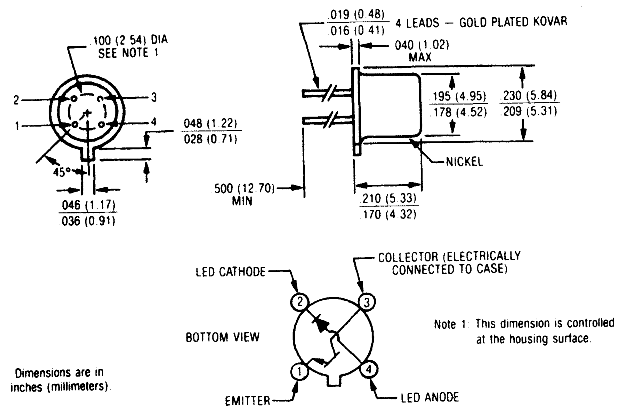
LED: f = 1 kHz, D.C. = 50%

Optically Coupled Isolators

Types 3N243, 3N244, 3N245, 3N243R, 3N244R, 3N245R



TWICE ACTUAL SIZE



Dimensions are in inches (millimeters).

Features

- "R" SERIES PROCESSED TO MIL-S-19500/486A
- TO-72 HERMETICALLY SEALED PACKAGE
- 1 kVDC ELECTRICAL ISOLATION

Description

The 3N243, 3N244, and 3N245 are JEDEC registered optically coupled isolators each consisting of a gallium arsenide infrared emitting diode and an NPN silicon phototransistor mounted in a hermetically sealed TO-72 package. The 3N243R, 3N244R and 3N245R are identical except that they are additionally processed in accordance with Table I. They are then Group A tested by QC. (See Table II).

All electrical parameters are 100% tested by manufacturing. Specifications are guaranteed to a cumulative .65% AQL.

absolute maximum ratings (25 °C unless otherwise noted)

Input-to-Output Isolation Voltage	± 1 kVDC(1)
Storage Temperature Range	– 55 °C to + 150 °C
Operating Temperature Range	– 55 °C to + 125 °C
Lead Soldering Temperature (1/16 inch [1.6 mm] from case for 5 sec. with soldering iron)(2)	240 °C

Input Diode

Forward DC Current	40 mA
Reverse Voltage	2 V
Power Dissipation	60 mW(3)

Output Phototransistor

Continuous Collector Current	30 mA
Collector-Emitter Voltage	30 V
Emitter-Collector Voltage	5 V
Power Dissipation	200 mW(4)

Notes: (1) Measured with input leads shorted together and output leads shorted together.
(2) RMA flux is recommended. Duration can be extended to 10 sec. max. when flow soldering.
(3) Derate 0.6 mW/°C above 25 °C.
(4) Derate 2.0 mW/°C above 25 °C.

Types 3N243, 3N244, 3N245, 3N243R, 3N244R, 3N245R

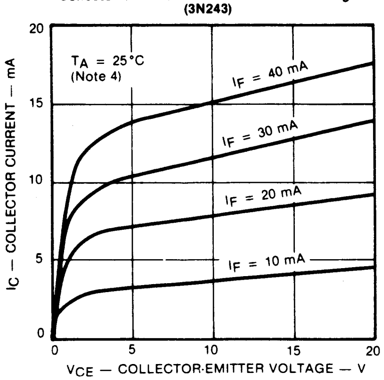
PRODUCT BULLETIN 3081
February 1982

electrical characteristics (25°C unless otherwise noted)

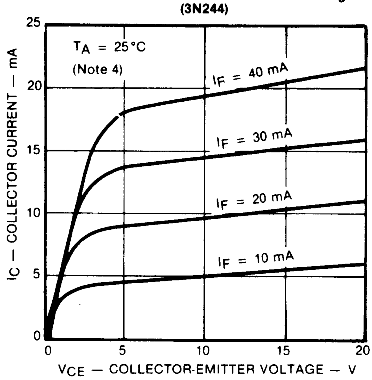
SYMBOL	PARAMETER	3N243, 3N243R MIN	3N243, 3N243R TYP	3N243, 3N243R MAX	3N244, 3N244R MIN	3N244, 3N244R TYP	3N244, 3N244R MAX	3N245, 3N245R MIN	3N245, 3N245R TYP	3N245, 3N245R MAX	UNITS	TEST CONDITIONS
Input Diode												
V_F	Forward Voltage	0.8		1.3	0.8		1.3	0.8		1.3	V	I_F = 10 mA
V_F	Forward Voltage	1.0		1.5	1.0		1.5	1.0		1.5	V	I_F = 10 mA, T_A = 55°C
V_F	Forward Voltage	0.7		1.2	0.7		1.2	0.7		1.2	V	I_F = 10 mA, T_A = 100°C
I_R	Reverse Current			100			100			100	μA	V_R = 2 V
Output Phototransistor												
$V_{(BR)CEO}$	Collector-Emitter Breakdown Voltage	30			30			30			V	I_C = 1 mA
$V_{(BR)ECO}$	Emitter-Collector Breakdown Voltage	5			5			5			V	I_E = 100 μA
I_{CEO}	Collector Dark Current			100			100			100	nA	V_{CE} = 10 V
I_{CEO}	Collector Dark Current			100			100			100	μA	V_{CE} = 10 V, T_A = 100°C
Coupled												
$I_{C(ON)}$	On-State Collector Current	1.5			3.0			6.0			mA	I_F = 10 mA, V_{CE} = 10 V
	On-State Collector Current	0.3			0.8			1.5			mA	I_F = 3 mA, V_{CE} = 10 V
	On-State Collector Current	0.5			1.0			1.5			mA	I_F = 10 mA, V_{CE} = 10 V, T_A = −55°C
	On-State Collector Current	0.5			1.0			1.5			mA	I_F = 10 mA, V_{CE} = 10 V, T_A = 100°C
$V_{CE(SAT)}$	Collector-Emitter Saturation Voltage			0.3							V	I_F = 20 mA, I_C = 1.5 mA
	Collector-Emitter Saturation Voltage						0.3				V	I_F = 20 mA, I_C = 3 mA
	Collector-Emitter Saturation Voltage									0.3	V	I_F = 20 mA, I_C = 6 mA
I_{IO}	Leakage, Input-to-Output			100			100			100	nA	V_{IO} = ±1 kVDC, See Note 1
C_{IO}	Capacitance, Input-to-Output			5			5			5	pF	V_{IO} = OV, f = 1 MHz, See Note 1
t_r	Output Rise Time			10			10			15	μs	V_{CC} = 10 V, I_F = 10 mA
t_f	Output Fall Time			10			10			15	μs	R_L = 100Ω, See Test Circuit

Typical Performance Curves

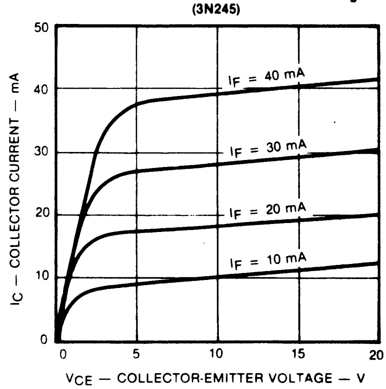
Collector Current vs Collector-Emitter Voltage (3N243)



Collector Current vs Collector-Emitter Voltage (3N244)



Collector Current vs Collector-Emitter Voltage (3N245)



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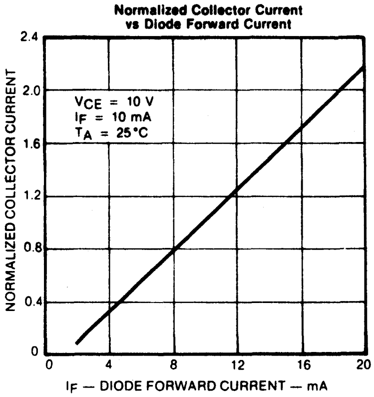
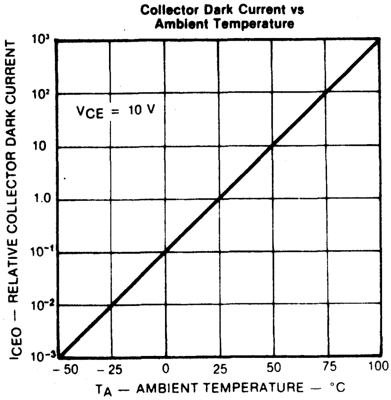
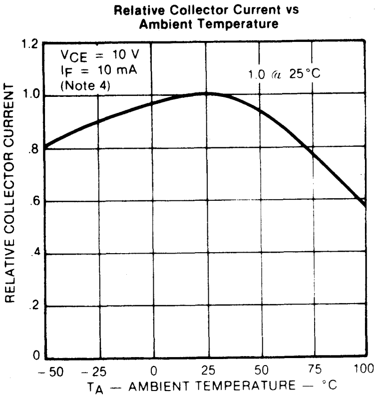
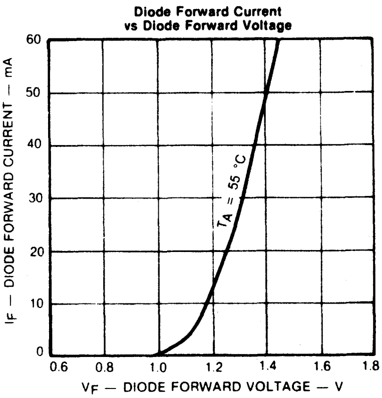
Printed in U.S.A.

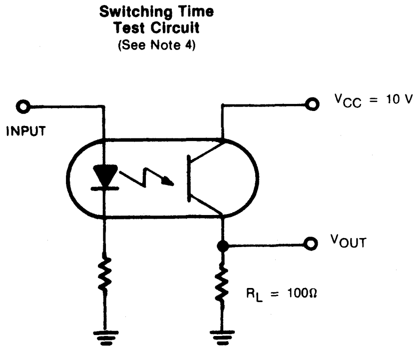
Typical Performance Curves











NOTES:

1. Derate linearly to 125°C free-air temperature at 0.4 mA/°C.
2. Derate linearly to 125°C free-air temperature at 2 mW/°C.
3. These parameters are measured between all the input leads shorted together and all the phototransistor leads shorted together.
4. The input waveform is supplied by a generator with the following characteristics: $Z_{OUT} = 50\Omega$, $t_r \leq 15$ ns, duty cycle ≈ 1%, pulse width ≈ 100 μs.

Types 3N243, 3N244, 3N245, 3N243R, 3N244R, 3N245R

HIGH RELIABILITY PROCESSING

TRW Optron manufactures several types of metal can couplers which are processed to Military Specification 19500/486A and Military Standard 750. Once units complete this rigorous testing, they are referred to as "high reliability" processed. The purpose of high reliability processing is to weed out the potentially weak or early failure unit which might go undetected in regular processing. High reliability processing also makes it possible to guarantee certain levels of performance under harsh environmental and electrical conditions.

TRW Optron's metal can couplers, because of their advanced design, have compiled impressive results during high reliability testing. As of this printing, over 1,650,000 device-hours have been completed on Operating Life test without a failure, and over 90,000 devices have completed Monitored Temperature Cycle without a catastrophic failure.

The following is a summary of TRW Optron's high reliability testing sequence.

100% Processing
Table I

Test Required	Test Method (MIL-STD-750)	3N243R 3N244R 3N245R
Pre-Cap Visual Inspection	2072	TRW Optron Pre-Cap Visual
Initial Electrical Testing		X
High Temperature Storage, T_A = 125°C, t = 72 hrs.		T_A = 150°C t = 48 hrs
Temperature Cycle, 10 cycles, 15 min. each extreme	1051, Condition B	X
Constant Acceleration, Non Operating, 20,000 G, Y only	2006	X
Hermetic Seal, fine and gross	1071, Condition G or H, C or D	X
Electrical Testing		X
Power Burn-in, V_{CE} = 10 V, P_t = 275 mW ± 25 mW, I_F = 40 mA, T_A = 25°C, t = 168 hrs.	1039 Condition A	P_t = 175-200 mW
Electrical Testing		X
Radiographic Inspection	2076	When Specified

Quality and Reliability Lot Acceptance Testing
Table II

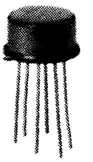
Sub Group	Test Required	MIL-STD-750 Test Method	Sample 3N—
Electrical Testing			
A1	Visual & Mechanical	2071	.65 AQL
A2	Electrical — LED	—	.65 AQL
A3	Electrical — Transistor	—	.65 AQL
A4	Electrical — Combination	—	.65 AQL
A5	Electrical — High Temp.	—	.65 AQL
A6	Electrical — Low Temp.	—	.65 AQL

PRODUCT BULLETIN 3082
February 1982

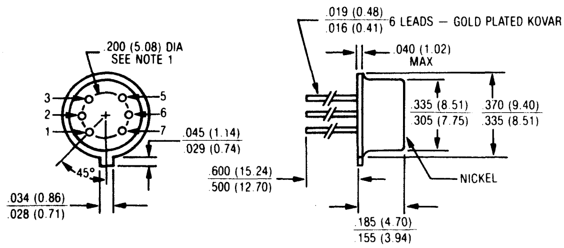
TRW *OPTRON*

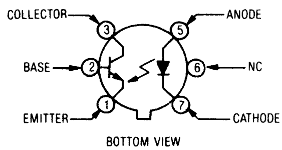
Optically Coupled Isolators

Types 4N22A, 4N23A, 4N24A



ACTUAL SIZE





Dimensions are in inches (millimeters).

Note 1: This dimension is controlled at the housing surface.

Features

- HIGH DC CURRENT TRANSFER RATIO
- TO-5 HERMETICALLY SEALED PACKAGE
- 1 kV ELECTRICAL ISOLATION
- BASE CONTACT IS BONDED FOR CONVENTIONAL TRANSISTOR BIASING

Description

The 4N22A, 4N23A, and 4N24A are JEDEC registered optically coupled isolators each consisting of a gallium arsenide infrared emitting diode and an NPN silicon phototransistor mounted in a hermetically sealed TO-5 package. TO-5 packages offer high power dissipation, ease of heat sinking and superior hostile environment operation. The suffix "A" denotes that the collector is electrically isolated from the can.

All electrical parameters are 100% tested by manufacturing. Specifications are guaranteed to a cumulative .65% AQL.

absolute maximum ratings (25 °C unless otherwise noted)

Input-to-Output Isolation Voltage . . . . ±1 kVDC[1]
Storage and Opera'ing Temperature Range . . . . −55 °C to +125 °C
Lead Soldering Temperature (1/16 inch [1.6 mm] from case for . . . . 240 °C
5 sec. with soldering iron)[2]

Input Diode
Forward DC Current (65 °C or Below) . . . . 40 mA
Reverse Voltage . . . . 2 V
Power Dissipation . . . . 60 mW[3]

Output Phototransistor
Continuous Collector Current . . . . 50 mA
Collector-Emitter Voltage . . . . 35 V
Collector-Base Voltage . . . . 35 V
Emitter-Base Voltage . . . . 4 V
Power Dissipation . . . . 300 mW[4]

Notes: (1) Measured with input leads shorted together and output leads shorted together
(2) RMA flux is recommended. Duration can be extended to 10 sec. max. when flow soldering.
(3) Derate Linearly 0.67 mW/°C above 25°C
(4) Derate Linearly 3.0 mW/°C above 25°C

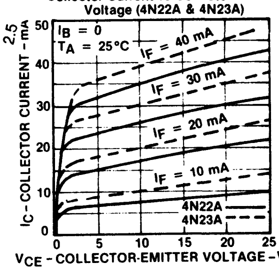
Types 4N22A, 4N23A, 4N24A

electrical characteristics (25 °C unless otherwise noted)

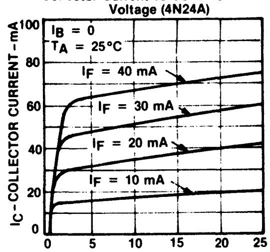
SYMBOL	PARAMETER	4N22A MIN	4N22A TYP	4N22A MAX	4N23A MIN	4N23A TYP	4N23A MAX	4N24A MIN	4N24A TYP	4N24A MAX	UNITS	TEST CONDITIONS
Input Diode												
V_F	Forward Voltage	1 0.8 0.7		1.5 1.3 1.2	1 0.8 0.7		1.5 1.3 1.2	1 0.8 0.7		1.5 1.3 1.2	V	I_F = 10 mA, T_A = −55 °C I_F = 10 mA I_F = 10 mA, T_A = 100 °C
I_R	Reverse Current			100			100			100	μA	V_R = 2 V
Output Phototransistor												
$V_{(BR)CEO}$	Collector-Emitter Breakdown Voltage	35			35			35			V	I_C = 1 mA, I_B = 0, I_F = 0
$V_{(BR)CBO}$	Collector-Base Breakdown Voltage	35			35			35			V	I_C = 100 μA, I_E = 0, I_F = 0
$V_{(BR)EBO}$	Emitter-Base Breakdown Voltage	4			4			4			V	I_E = 100 μA, I_C = 0, I_F = 0
I_{CEO}	Collector-Emitter Dark Current			100 100			100 100			100 100	nA μA	V_{CE} = 20 V, I_B = 0, I_F = 0 V_{CE} = 20 V, I_B = 0, I_F = 0 T_A = 100 °C
Coupled												
$I_{C(ON)}$	On-State Collector Current	0.15 1 2.5 1	 6		0.2 2.5 6 2.5	 9		0.4 4 10 4	 15	0.3	mA	V_{CE} = 5 V, I_F = 2 mA V_{CE} = 5 V, I_F = 10 mA T_A = −55 °C V_{CE} = 5 V, I_F = 10 mA V_{CE} = 5 V, I_F = 10 mA T_A = 100 °C
$V_{CE(SAT)}$	Collector-Emitter Saturation Voltage			0.3			0.3			0.3	V	I_C = 2.5 mA, I_F = 20 mA I_C = 5 mA, I_F = 20 mA I_C = 10 mA, I_F = 20 mA
R_{IO}	Resistance, Input-to-Output	10^{11}			10^{11}			10^{11}			Ω	V_{IO} = ±1 kV, See Note 1
C_{IO}	Capacitance, Input-to-Output			5			5			5	pF	V_{IO} = 0, f = 1 MHz, See Note 1
t_r	Output Rise Time			15			15			20	μs	V_{CC} = 10 V, I_F = 10 mA,
t_f	Output Fall Time			15			15			20	μs	R_L = 100Ω, See Test Circuit

Typical Performance Curves

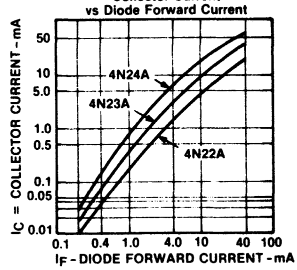
Collector Current vs Collector-Emitter Voltage (4N22A & 4N23A)



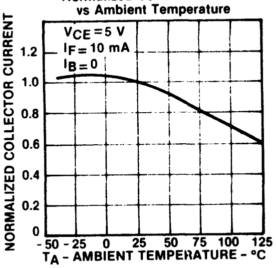
Collector Current vs Collector-Emitter Voltage (4N24A)



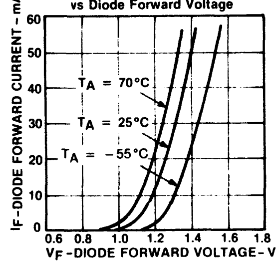
Collector Current vs Diode Forward Current



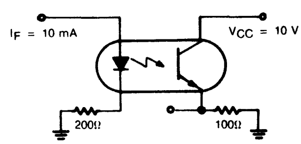
Normalized Collector Current vs Ambient Temperature



Diode Forward Current vs Diode Forward Voltage



Test Circuit

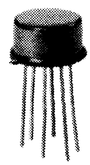


THE INPUT WAVEFORM IS SUPPLIED BY A GENERATOR WITH THE FOLLOWING CHARACTERISTICS: Z_{OUT} = 50Ω, t_r ≤ 15 ns, DUTY CYCLE ≈ 1%, PULSE WIDTH ≈ 100 μs

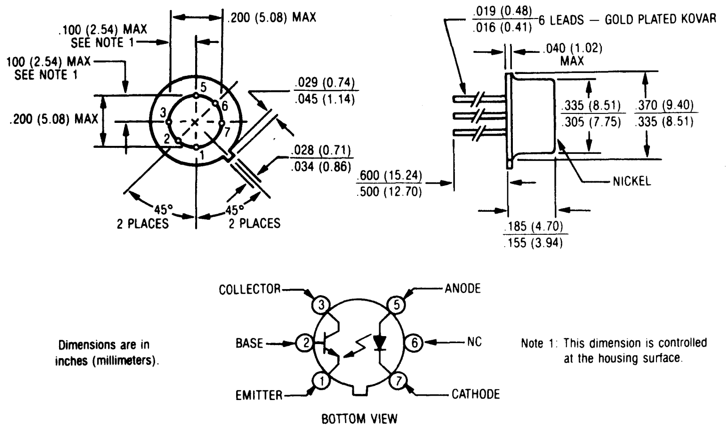
TRW OPTRON reserves the right to make changes at any time in order to improve design and to supply the best product possible.

Optically Coupled Isolators

Types JAN, JANTX, JANTXV-4N22A, 4N23A, 4N24A



TWICE ACTUAL SIZE



Dimensions are in inches (millimeters).

Note 1: This dimension is controlled at the housing surface.

Features

- HIGH RELIABILITY PROCESSED TO MIL-S-19500/486A
- 1 kV ELECTRICAL ISOLATION
- BASE CONTACT IS BONDED FOR CONVENTIONAL TRANSISTOR BIASING

Description

The JAN, JANTX, and JANTXV series of 4N22A, 4N23A, and 4N24A are JEDEC registered optically coupled isolators each consisting of a gallium arsenide infrared emitting diode and an NPN silicon phototransistor mounted in a hermetically sealed TO-5 package. The suffix letter "A" denotes that the collector is electrically isolated from the can. JANTX and JANTXV parts are 100% manufacturing processed to MIL-S-19500/486A. All parts are quality and reliability lot acceptance tested to the same specifications.

absolute maximum ratings (25 °C unless otherwise noted)

Input-to-Output Isolation Voltage .... ± 1kVDC(1)
Storage and Operating Temperature Range .... – 65 °C to + 125 °C
Lead Soldering Temperature (1/16 inch [1.6 mm] from case for 5 sec. with soldering iron)(2) .... 240 °C

Input Diode

Forward DC Current (65 °C or Below) .... 40 mA(3)
Reverse Voltage .... 2 V
Peak Forward Current (1 μs Pulse Width, 300 PPS) .... 1 A

Output Photosensor

Continuous Collector Current .... 50 mA
Collector-Emitter Voltage .... 35 V
Collector-Base Voltage .... 35 V
Emitter-Base Voltage .... 4 V
Power Dissipation .... 300 mW(4)

Notes: (1) Measured with input diode leads shorted together and output leads shorted together
(2) RMA flux is recommended. Duration can be extended to 10 sec. max. when flow soldering.
(3) Derate Linearly 0.67 mA/ °C above 65 °C
(4) Derate Linearly 3.0 mW/ °C above 25 °C
(5) Manufacturing is not required to 100% test

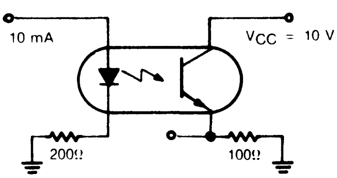
Types JAN, JANTX, JANTXV-4N22A, 4N23A, 4N24A

PRODUCT BULLETIN 3083
February 1982

electrical characteristics (25°C unless otherwise noted)

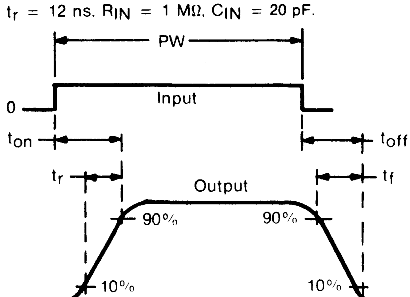
SYMBOL	PARAMETER	JAN, JANTX, JANTXV 4N22A MIN	MAX	JAN, JANTX, JANTXV 4N23A MIN	MAX	JAN, JANTX, JANTXV 4N24A MIN	MAX	UNITS	TEST CONDITIONS
Input Diode									
V_F	Forward Voltage	0.8	1.3	0.8	1.3	0.8	1.3	V	I_F = 10 mA
		1	1.5	1	1.5	1	1.5	V	I_F = 10 mA, T_A = −55°C (5)
		0.7	1.2	0.7	1.2	0.7	1.2	V	I_F = 10 mA, T_A = 100°C (5)
I_R	Reverse Current		100		100		100	μA	V_R = 2 V
Output Photosensor									
$V_{(BR)CEO}$	Collector-Emitter Breakdown Voltage	35		35		35		V	I_C = 1 mA
$V_{(BR)CBO}$	Collector-Base Breakdown Voltage	35		35		35		V	I_C = 100 μA
$V_{(BR)EBO}$	Emitter-Base Breakdown Voltage	4		4		4		V	I_E = 100 μA
I_{CEO}	Collector-Emitter Dark Current		100		100		100	nA	V_{CE} = 20 V
			100		100		100	μA	V_{CE} = 20 V, T_A = 100°C (5)
Coupled									
$I_{C(ON)}$	On-State Collector Current	2.5		6		10		mA	V_{CE} = 5 V, I_F = 10 mA
		1		2.5		4		mA	V_{CE} = 5 V, I_F = 10 mA, T_A = −55°C (5)
		1		2.5		4		mA	V_{CE} = 5 V, I_F = 10 mA, T_A = 100°C (5)
		0.15		0.2		0.4		mA	V_{CE} = 5 V, I_F = 2 mA
$V_{CE(SAT)}$	Collector-Emitter Saturation Voltage		0.3					V	I_C = 2.5 mA, I_F = 20 mA
					0.3			V	I_C = 5 mA, I_F = 20 mA
							0.3	V	I_C = 10 mA, I_F = 20 mA
h_{FE}	DC Current Gain	200		300		400			V_{CE} = 5 V, I_C = 10 mA
R_{IO}	Resistance, Input-to-Output	10^{11}		10^{11}		10^{11}		Ω	V_{IO} = 1 kVDC, (1)
I_{IO}	Leakage, Input-to-Output		10		10		10	nA	V_{IO} = 1 kVDC, (1)
C_{IO}	Capacitance, Input-to-Output		5		5		5	pF	V_{IO} = 0V, f = 1 MHz, (1)
t_r	Output Rise Time		15		15		20	μs	V_{CC} = 10 V, I_F = 10 mA
t_f	Output Fall Time		15		15		20	μs	R_L = 100Ω, See Test Circuit

Test Circuit



THE INPUT WAVEFORM IS SUPPLIED BY A GENERATOR WITH THE FOLLOWING CHARACTERISTICS: Z_{OUT} = 50Ω, $t_r \leq$ 15 ns, DUTY CYCLE ≈ 1%, PULSE WIDTH ≈ 100 μs

THE OUTPUT WAVEFORM IS MONITORED ON AN OSCILLOSCOPE WITH THE FOLLOWING CHARACTERISTICS:
t_r = 12 ns. R_{IN} = 1 MΩ. C_{IN} = 20 pF.



Voltage Waveforms

TRW OPTRON reserves the right to make changes at any time in order to improve design and to supply the best product possible.

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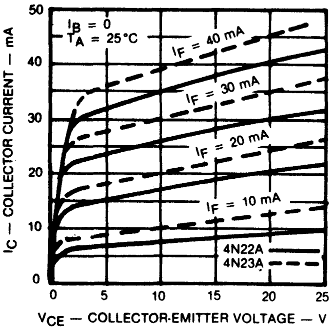
Quality and Reliability Lot Acceptance Testing (continued)

Sub Group	Test Required (MIL-S-19500/486A)	MIL-STD-750 Test Method	Sample Size (Accept on 1 Failure) JAN	JANTX	JANTXV
Environmental Testing (Continued)					
B3	High Temperature Isolation	1016	18	18	18
B3	End Points		18	18	18
C1	Barometric Pressure (reduced)	1001	38	38	38
C2	Physical Dimensions	2066	18	18	18
C3	Resistance to Solvents	MIL-STD-202 Method 215	38	38	38
C4	Terminal Strength	2036, Condition E	38	38	38
C5	Salt Atmosphere (corrosion)	1041	38	38	38
Life Testing					
B4	High Temp. Life (non-operating)	1032	55	77	77
B5	Steady State Operating Life	1027	55	77	77
C6	High Temp. Life (non-operating)	1031	55	77	77
C7	Steady State Operating Life	1026	55	77	77

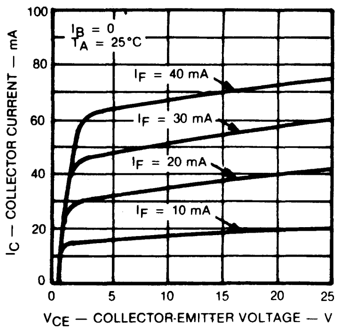
Note: Group C testing is performed once each six months and on one JAN device type.

Typical Performance Curves

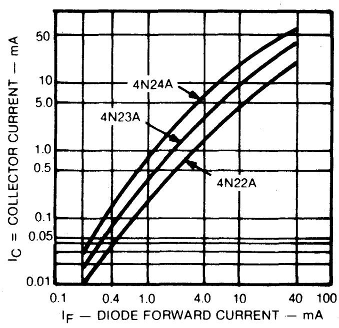
Collector Current vs Collector-Emitter Voltage JAN, JANTX, JANTXV - 4N22A, 4N23A



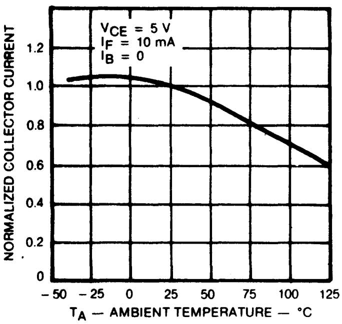
Collector Current vs Collector-Emitter Voltage JAN, JANTX, JANTXV — 4N24A



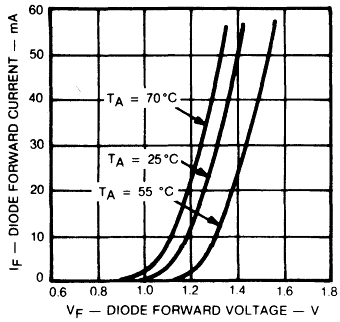
Collector Current vs Diode Forward Current JAN, JANTX, JANTXV



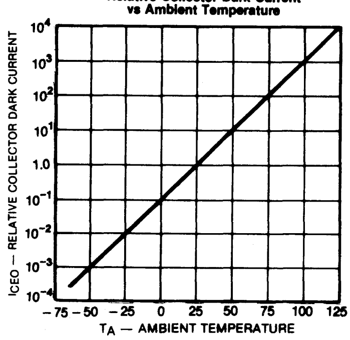
Normalized Collector Current vs Ambient Temperature



Diode Forward Current vs Diode Forward Voltage



Relative Collector Dark Current vs Ambient Temperature



HIGH RELIABILITY PROCESSING

TRW Optron manufactures several types of metal can couplers which are processed to Military Specification 19500/486A. Once units complete this rigorous testing, they are referred to as "high reliability" processed. The purpose of high reliability processing is to weed out the potentially weak or early failure unit which might go undetected in regular processing. High reliability processing also makes it possible to guarantee certain levels of performance under harsh environmental and electrical conditions.

TRW Optron's metal can couplers, because of their advanced design, have compiled impressive results during high reliability testing. As of this printing, over 1,650,000 device-hours have been completed on Operating Life test without a failure, and over 90,000 devices have completed Monitored Temperature Cycle without a catastrophic failure.

The following is a summary of TRW Optron's high reliability testing sequence.

100% Manufacturing Processing

Test Required (MIL-S-19500/486A)	MIL-STD-750 Test Method	JAN 4N22A JAN 4N23A JAN 4N24A	JANTX-4N22A JANTX-4N23A JANTX-4N24A	JANTXV-4N22A JANTXV-4N23A JANTXV-4N24A
Pre-Cap Visual Inspection	2072	—	—	X
Initial Electrical Testing	—	X	X	X
High Temperature Storage, T_A = 125°C, t = 72 hrs.	—	—	X	X
Temperature Cycle, 10 cycles, 15 min. each extreme	1051, Condition B	—	X	X
Constant Acceleration, Non-Operating, 20,000 G, Y,only	2006	—	X	X
Electrical Testing	—	—	X	X
High Temperature Reverse Bias, T_A = 125°C, I_F = O, V_{CB} = 20 V, t = 96 hrs.	1039, Condition A	—	X	X
Electrical Testing		—	X	X
Power Burn-in, V_{CE} = 10 V, P_t = 275 mW ± 25 mW, I_F = 40 mA, T_A = 25°C, t = 168 hrs.	1039, Condition B	—	X	X
Electrical Testing	—	—	X	X
Monitored Temperature Cycle, 1 cycle, 15 min. each extreme	1051, Condition B	—	X	X
Radiographic Inspection	2076	When Specified	When Specified	When Specified
Hermetic Seal, fine and gross	1071, Condition G or H, C or D	X	X	X
External Visual Examination	2071	X	X	X
High Temperature Isolation Voltage, V_{ISO} = 150 V, T_A = 150°C, t = 24 hrs.	1016	—	X	X
Final Electrical Testing	—	X	X	X

Quality and Reliability Lot Acceptance Testing

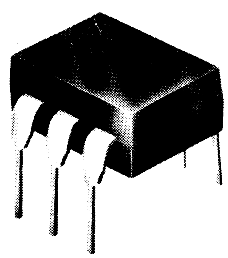
Sub Group	Test Required (MIL-S-19500/486A)	MIL-STD-750 Test Method	Sample Size (Accept on 1 Failure) JAN	JANTX	JANTXV
Electrical Testing					
A1	Visual & Mechanical	2071	38	55	55
A2	Electrical — LED	—	55	77	77
A3	Electrical — Transistor	—	55	77	77
A4	Electrical — Combination	—	55	77	77
A5	Electrical — High Temp.	—	38	55	55
A6	Electrical — Low Temp.	—	38	55	55
Environmental Testing					
B1	Solderability	2026	25	25	25
B1	Thermal Shock (Temp. Cycle)	1051, Condition B	25	25	25
B1	Thermal Shock (Glass Drain)	1056, Condition A	25	25	25
B1	Hermetic Seal	1071, Condition G or H, C or D	25	25	25
B1	Moisture Resistance	1021	25	25	25
B1	End Points		25	25	25
B2	Shock	2016	38	38	38
B2	Vibration, Variable Freq.	2056	38	38	38
B2	Constant Acceleration	2006	38	38	38
B2	End Points		38	38	38

TRW OPTRON reserves the right to make changes at any time in order to improve design and to supply the best product possible.

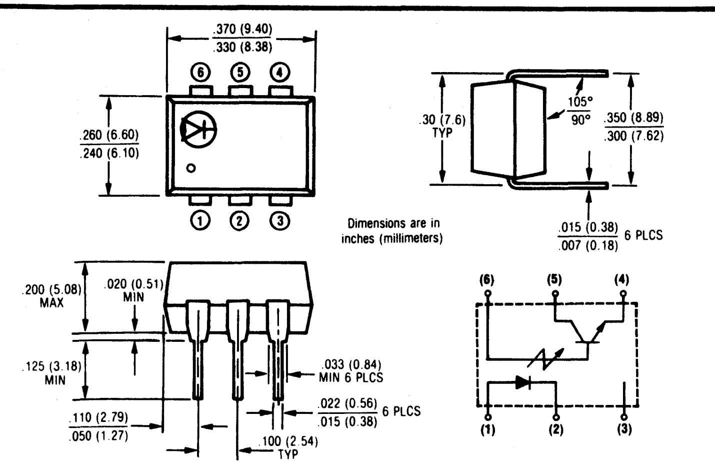
TRW OPTRON

PRODUCT BULLETIN 3070
February 1982

Optically Coupled Isolators
Types 4N25, 4N26, 4N27, 4N28



TWICE ACTUAL SIZE



Features

- 2500, 1500 OR 500 VOLT ISOLATION RATINGS
- LOW COST 6 PIN DUAL-IN-LINE PACKAGE
- UL RECOGNIZED FILE NO. E58730

Description

The 4N25, 4N26, 4N27and 4N28 are JEDEC registered optically coupled isolators each consisting of a gallium arsenide infrared emitting diode and an NPN silicon phototransistor mounted in a standard plastic six pin dual-in-line package.

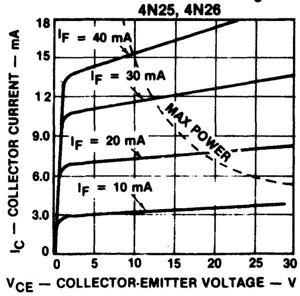
All electrical parameters are 100% tested by manufacturing. Specifications are guaranteed to a cumulative .65% AQL.

absolute maximum ratings (25 °C unless otherwise noted)

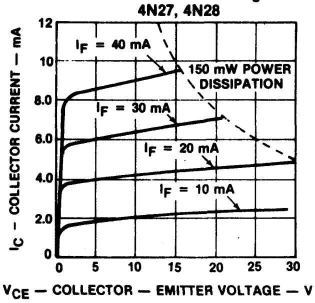
Input-to-Output Isolation Voltage 4N25	± 2500 V(1)
4N26, 4N27	± 1500 V (1)
4N28	500 V (1)
Storage Temperature Range	− 55 °C to + 150 °C
Operating Temperature Range	− 55 °C to + 100 °C
Lead Soldering Temperature (1/16 inch [1.6 mm] from case for 5 sec. with soldering iron)(2)	240 °C
Total Device Power Dissipation	250 mW(3)
Input Diode	
Forward DC Current	60 mA
Peak Forward Current (1 μs pulse width, 300 pps)	3 A
Reverse Voltage	3 V
Power Dissipation	100 mW(4)
Output Phototransistor	
$V_{(BR)CEO}$	30 V
$V_{(BR)CBO}$	70 V
$V_{(BR)ECO}$	7 V
Power Dissipation	150 mW(5)

Notes: (1) Measured with input leads shorted together and output leads shorted together.
(2) RMA flux is recommended. Duration can be extended to 10 sec. max. when flow soldering.
(3) Derate 3.3 mW/°C above 25 °C.
(4) Derate 1.33 mW/°C above 25 °C.
(5) Derate 2.0 mW/°C above 25 °C.

Collector Current vs Collector-Emitter Voltage 4N25, 4N26



Collector Current vs Collector Emitter Voltage 4N27, 4N28

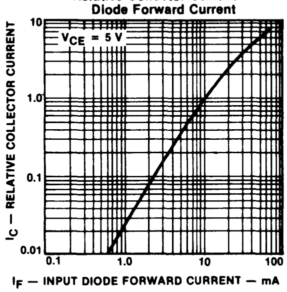


electrical characteristics (25 °C unless otherwise noted)

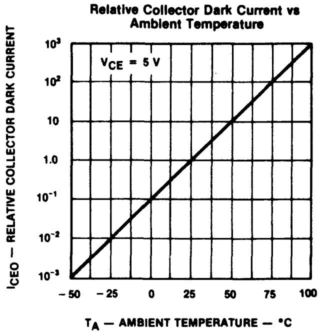
SYMBOL	PARAMETER	MIN	TYP	MAX	UNITS	TEST CONDITIONS
Input Diode						
V_F	Forward Voltage			1.5	V	I_F = 10 mA
$V_{(BR)R}$	Reverse Breakdown Voltage	3.0			V	I_R = 100 μA
I_R	Reverse Current			100	μA	V_R = 3.0 V
Output Phototransistor						
$V_{(BR)CEO}$	Collector-to-Emitter Breakdown Voltage	30			V	I_C = 1.0 mA, I_B = 0
$V_{(BR)ECO}$	Emitter-to-Collector Breakdown Voltage	7			V	I_E = 100 μA, I_B = 0
$V_{(BR)CBO}$	Collector-to-Base Breakdown Voltage	70			V	I_C = 100 μA, I_E = 0
I_{CEO}	Collector-Emitter Dark Current 4N25, 4N26, 4N27 4N28		5.0	50 100	nA nA	V_{CE} = 10 V, I_B = 0
I_{CBO}	Collector-Base Dark Current			20	nA	V_{CB} = 10 V, I_E = 0
C_{CE}	Capacitance, Collector-to-Emitter		8.0		pF	V_{CE} = 0
h_{FE}	DC Current Gain		150			V_{CE} = 5.0 V, I_C = 100 μA
Coupled						
I_C/I_F	DC Current Transfer Ratio 4N25, 4N26 4N27, 4N28	20 10			% %	I_F = 10 mA, V_{CE} = 10 V, I_B = O
V_{ISO}	Isolation Voltage 4N25 4N26, 4N27 4N28	2500 1500 500			VDC VDC VDC	See Note 1
R_{IO}	Input-to-Output Resistance	10^{11}			Ω	V_{IO} = 500 V, See Note 1
$V_{CE(SAT)}$	Collector-Emitter Saturation Voltage			0.5	V	I_F = 50 mA, I_C = 2 mA, I_B = 0
C_{IO}	Input-to-Output Capacitance		2.0		pF	f = 1 MHz, See Note 1
t_r t_f	Output Rise Time Output Fall Time		2.0 2.0		μs μs	V_{CC} = 10 V, I_C = 2 mA R_L = 100 Ω, See Test Circuit

Typical Performance Curves

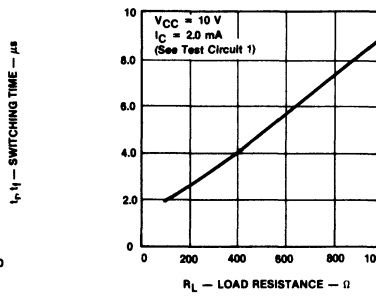
Relative Collector Current vs Diode Forward Current



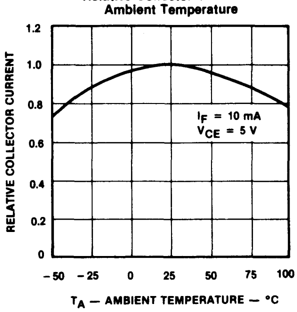
Relative Collector Dark Current vs Ambient Temperature



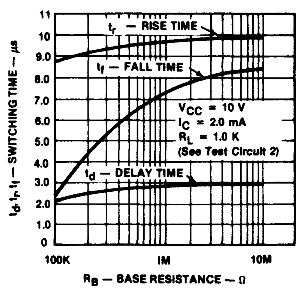
Rise and Fall Time vs Load Resistance



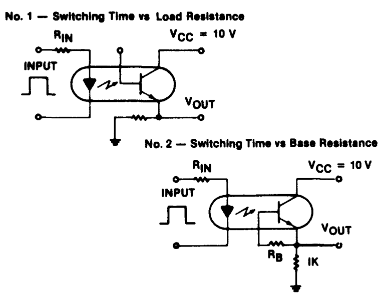
Relative Collector Current vs Ambient Temperature



Delay, Rise, and Fall Time vs Base Resistance



Switching Time Test Circuits



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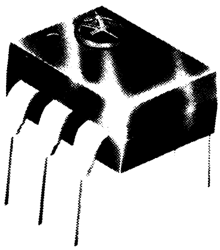
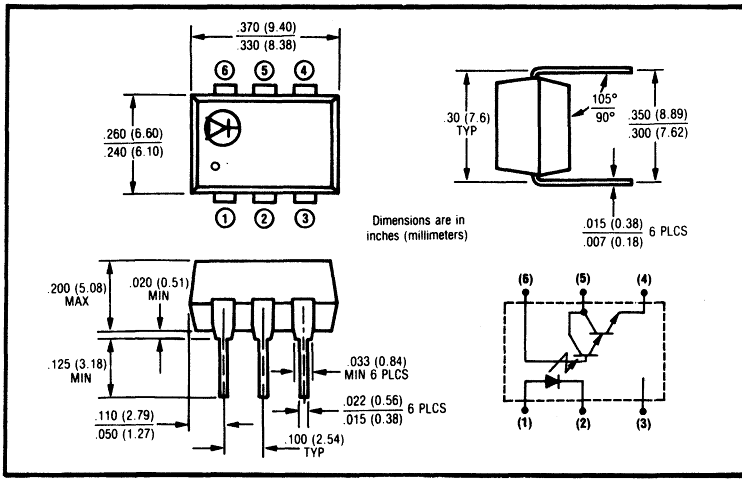
Optically Coupled Isolators
Types 4N29, 4N30, 4N31, 4N32, 4N33



TWICE ACTUAL SIZE



Features

- PHOTODARLINGTON OUTPUT
- HIGH CURRENT TRANSFER RATIO
- 2500 OR 1500 VOLT ISOLATION RATINGS
- UL RECOGNIZED FILE NO. E58730

Description

The 4N29, 4N30, 4N31, 4N32, and 4N33 are JEDEC registered optically coupled isolators each consisting of a gallium arsenide infrared emitting diode and an NPN silicon photodarlington mounted in a standard plastic six pin dual-in-line package.

All electrical parameters are 100% tested by manufacturing. Specifications are guaranteed to a cumulative .65% AQL.

absolute maximum ratings (25 °C unless otherwise noted)

Input-to-Output Isolation Voltage 4N30, 4N31, 4N33	± 1500 VDC(1)
4N29, 4N32	± 2500 VDC(1)
Storage Temperature Range	− 55 °C to + 150 °C
Operating Temperature Range	− 55 °C to + 100 °C
Lead Soldering Temperature (1/16 inch [1.6 mm] from case for 5 sec. with soldering iron)(2)	240 °C

Input Diode

Forward DC Current	60 mA
Peak Forward Current (1 μs pulse width, 330 pps)	3 A
Reverse DC Voltage	3 V
Power Dissipation	100 mW(3)

Output Transistor

Collector-Emitter Voltage	30 V
Collector-Base Voltage	30V
Emitter-Collector Voltage	5 V
Power Dissipation	150 mW(4)

Notes: (1) Measured with input leads shorted together and output leads shorted together
(2) RMA flux is recommended. Duration can be extended to 10 sec. max. when flow soldering.
(3) Derate linearly 1.33 mW/ °C above 25 °C
(4) Derate linearly 2.0 mW/ °C above 25 °C

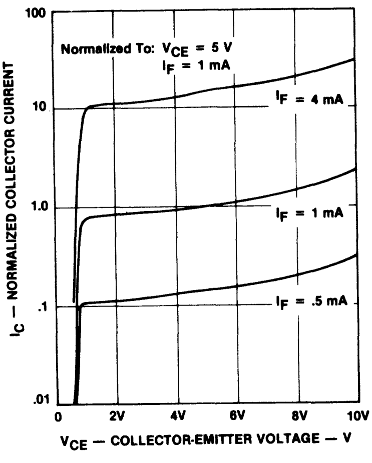
Types 4N29, 4N30, 4N31, 4N32, 4N33

electrical characteristics (25 °C unless otherwise noted)

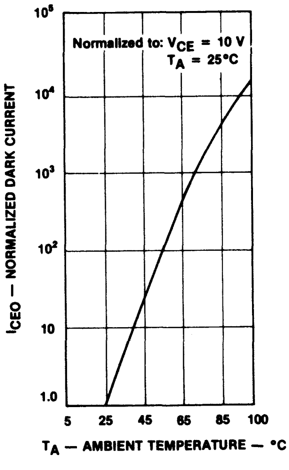
SYMBOL	PARAMETER	MIN	MAX	UNITS	TEST CONDITIONS
Input Diode					
V_F	Forward Voltage		1.5	V	I_F = 10 mA
I_R	Reverse Current		100	μA	V_R = 3 V
Output Photodarlington					
$V_{(BR)CEO}$	Collector-Emitter Breakdown Voltage	30		V	I_C = 100 μA, I_B = 0
$V_{(BR)CBO}$	Collector-Base Breakdown Voltage	30		V	I_C = 100 μA, I_E = 0
$V_{(BR)ECO}$	Emitter-Collector Breakdown Voltage	5		V	I_E = 100 μA, I_B = 0
I_{CEO}	Collector-Emitter Dark Current		100	nA	V_{CE} = 10
Coupled					
I_C/I_F	DC Current Transfer Ratio				I_F = 10 mA, V_{CE} = 10 V
	4N29, 4N30	100		%	
	4N31	50		%	
	4N32, 4N33	500		%	
$V_{CE(SAT)}$	Collector-Emitter Saturation Voltage				I_F = 8 mA, I_C = 2 mA, I_B = 0
	4N29, 4N30, 4N32, 4N33		1	V	
	4N31		1.2	V	
t_{on}	Turn On Time		5	μs	V_{CC} = 10 V, I_C = 50 mA, I_F = 200 mA
t_{off}	Turn Off Time				
	4N29, 4N30, 4N31		40	μs	
	4N32, 4N33		100	μs	

Typical Performance Curves

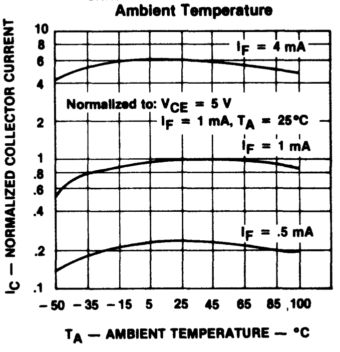
Normalized Collector Current vs Collector-Emitter Voltage



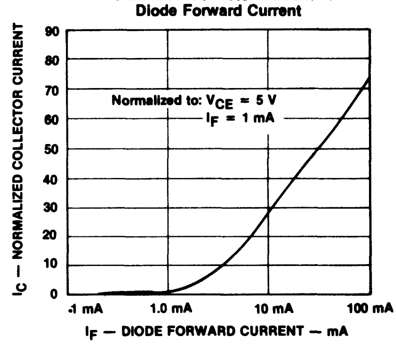
Normalized Dark Current vs Ambient Temperature



Normalized Collector Current vs Ambient Temperature



Normalized Collector Current vs Diode Forward Current



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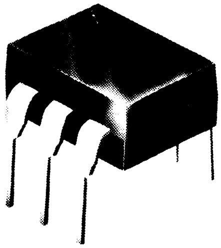
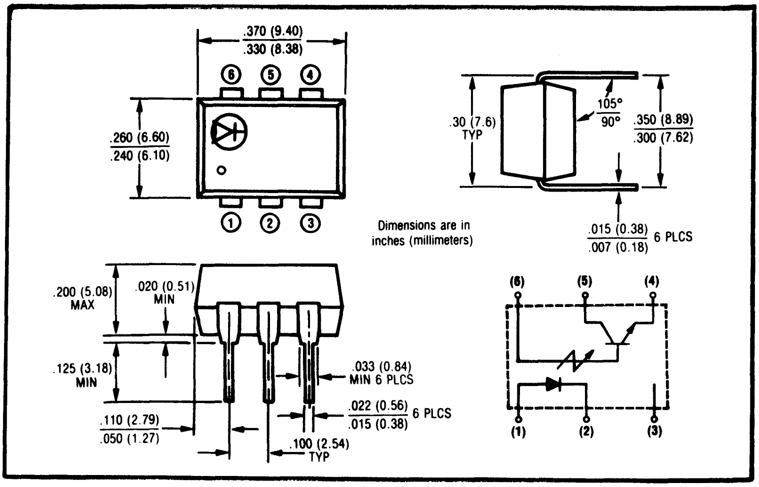
Optically Coupled Isolators

Types 4N35, 4N36, 4N37



TWICE ACTUAL SIZE



Features

- 2500, 1750 OR 1050 V_{RMS} ISOLATION RATINGS
- HIGH CURRENT TRANSFER RATIO
- LOW COST SIX PIN DUAL-IN-LINE PACKAGE
- UL RECOGNIZED FILE NO. E58730

Description

The 4N35, 4N36, and 4N37 are JEDEC registered optically coupled isolators each consisting of a gallium arsenide infrared emitting diode and an NPN silicon phototransistor mounted in a standard plastic sic pin dual-in-line package. Except for isolation voltages, the devices are identical.

All electrical parameters are 100% tested by manufacturing. Specifications are guaranteed to a cumulative .65% AQL.

absolute maximum ratings (25°C unless otherwise noted)

Input-to-Output Isolation Voltage	4N35	2500 V_{RMS}	3500 V_{PEAK} (1)
	4N36	1750 V_{RMS}	2500 V_{PEAK} (1)
	4N37	1050 V_{RMS}	1500 V_{PEAK} (1)

Storage Temperature Range . . . . −55°C to +150°C
Operating Temperature Range . . . . −55°C to +100°C
Lead Soldering Temperature (1/16 inch [1.6 mm] from case for 5 sec. with soldering iron) (2) . . . . 240°C
Total Device Power Dissipation . . . . 400 mW (3)

Input Diode

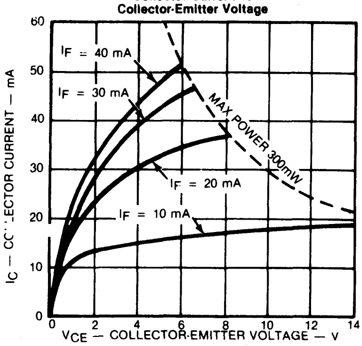
Forward DC Current . . . . 60 mA
Peak Forward Current (1 μs pulse width, 300 pps) . . . . 3 A
Reverse Voltage . . . . 6 V
Power Dissipation . . . . 100 mW (4)

Output Transistor

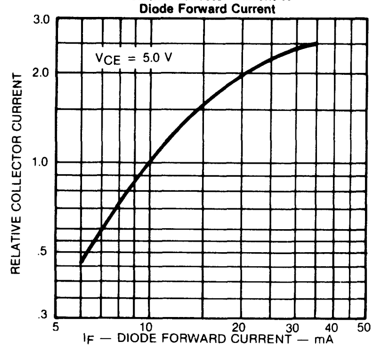
$V_{(BR)CEO}$ . . . . 30 V
$V_{(BR)CBO}$ . . . . 70 V
$V_{(BR)ECO}$ . . . . 7 V
Power Dissipation . . . . 300 mW (5)

Notes: (1) Measured with input leads shorted together and output leads shorted together.
(2) RMA flux is recommended. Duration can be extended to 10 sec. max. when flow soldering.
(3) Derate 4.0 mW/°C above 25°C.
(4) Derate 1.33 mW/°C above 25°C.
(5) Derate 4.0 mW/°C above 25°C.

Collector Current vs Collector-Emitter Voltage



Relative Collector Current vs Diode Forward Current



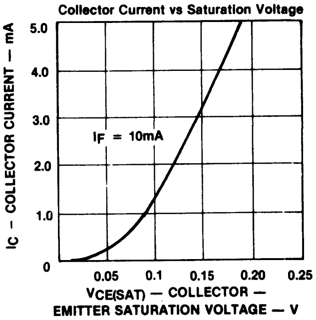
Types 4N35, 4N36, 4N37

electrical characteristics (25°C unless otherwise noted)

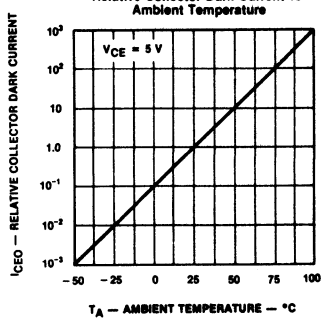
SYMBOL	PARAMETER	MIN	TYP	MAX		TEST CONDITIONS
Input Diode						
V_F	Forward Voltage	0.8 0.9 0.7		1.5 1.7 1.4	V V V	I_F = 10 mA, T_A = 25 C I_F = 10 mA, T_A = −55°C I_F = 10 mA, T_A = 100°C
$V_{(BR)R}$	Reverse Breakdown Voltage	6.0			V	I_R = 10 μA
I_R	Reverse Current			10	μA	V_R = 6.0 V
Output Phototransistor						
$V_{(BR)CEO}$	Collector-to-Emitter Breakdown Voltage	30			V	I_C = 1.0 mA, I_B = 0
$V_{(BR)ECO}$	Emitter-to-Collector Breakdown Voltage	7			V	I_E = 100 μA, I_B = 0
$V_{(BR)CBO}$	Collector-to-Base Breakdown Voltage	70			V	I_C = 100 μA, I_E = 0
I_{CEO}	Collector-Emitter Dark Current		5.0	50 500	nA μA	V_{CE} = 10 V, I_B = 0, T_A = 25°C V_{CE} = 30 V, I_B = 0, T_A = 100°C
I_{CBO}	Collector-Base Dark Current			20	nA	V_{CB} = 10 V, I_E = 0
C_{CE}	Capacitance Collector-to-Emitter	2.0			pF	V_{CE} = 10 V, f = 1 MHz
Coupled						
I_C/I_F	DC Current Transfer Ratio	100 40 40			% % %	T_A = 25°C T_A = 100°C V_{CE} = 10 V T_A = −55°C I_F = 10 mA
$V_{CE(SAT)}$	Collector-Emitter Saturation Voltage				V	I_F = 10 mA, I_C = 0.5 mA, I_B = 0
V_{ISO}	Isolation Voltage 4N35 4N35 4N37	2500 1750 1050			V_{RMS} V_{RMS} V_{RMS}	See Note 1
R_{IO}	Input-to-Output Resistance	10^{11}			Ω	V_{IO} = 500 V, See Note 1
C_{IO}	Input-to-Output Capacitance		2.5		pF	f = 1 MHz, See Note 1
t_r t_f	Output Rise Time Output Fall Time		3.5 3.5	10 10	μs μs	V_{CC} = 10 V, I_C = 2 mA R_L = 100 Ω, See Test Circuit

Typical Performance Curves

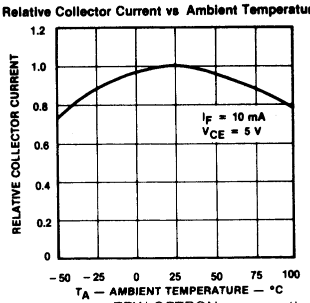
Collector Current vs Saturation Voltage



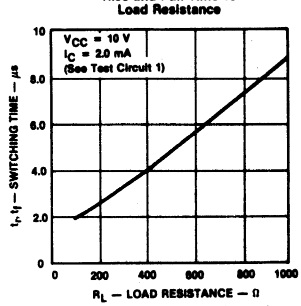
Relative Collector Dark Current vs Ambient Temperature



Relative Collector Current vs Ambient Temperature

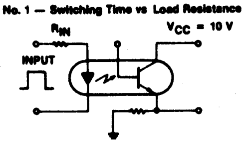


Rise and Fall Time vs Load Resistance



Switching Time Test Circuits

No. 1 — Switching Time vs Load Resistance



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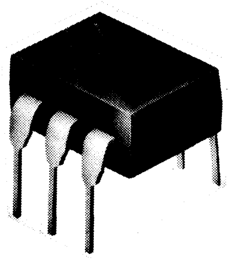
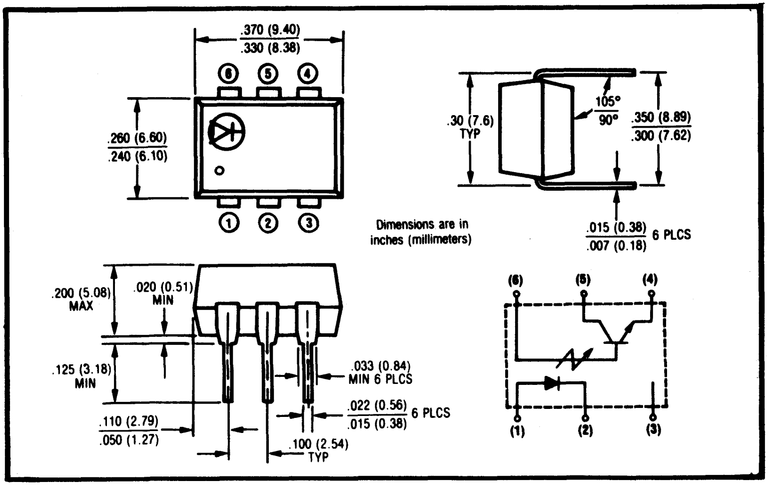
Optically Coupled Isolators

Types 4N38, 4N38A



TWICE ACTUAL SIZE



Features

- 1500 AND 2500 VOLT ISOLATION
- HIGH BREAKDOWN VOLTAGES
- UL RECOGNIZED FILE NUMBER E58730

Description

The 4N38 and 4N38A are JEDEC registered optically coupled isolators each consisting of a gallium arsenide infrared emitting diode and an NPN silicon phototransistor mounted in a standard plastic six pin dual-in-line package. This series is designed with higher than standard breakdown voltages for use in circuitry where increased power supply voltages are used. The 4N38 and 4N38A are identical except for input-to-output isolation voltage.

All electrical parameters are 100% tested by manufacturing. Specifications are guaranteed to a cumulative .65% AQL.

absolute maximum ratings (25°C unless otherwise noted)

Input-to-Output Isolation Voltage 4N38	± 1500 VDC(1)
4N38A	1775 VAC & ± 2500 VDC(1)
Storage Temperature Range	−55°C to +150°C
Operating Temperature Range	−55°C to +100°C
Lead Soldering Temperature (1/16 inch [1.6 mm] from case for 5 sec. with soldering iron)(2)	260°C
Total Device Power Dissipation	250 mW(3)

Input Diode

Forward DC Current	80 mA
Peak Forward Current (1 μs, Pulse, 300 PPS)	3 A
Reverse Voltage	3 V
Power Dissipation	150 mW(4)

Output Phototransistor

Collector-Emitter Voltage	80 V
Collector-Base Voltage	80 V
Emitter-Collector Voltage	7 V
Power Dissipation	150 mW(4)

Notes: (1) Measured with input leads shorted together and output leads shorted together
(2) RMA flux is recommended. Duration can be extended to 10 sec. max. when flow soldering.
(3) Derate 3.33 mW/°C above 25°C
(4) Derate 2.0 mW/°C above 25°C

Types 4N38, 4N38A

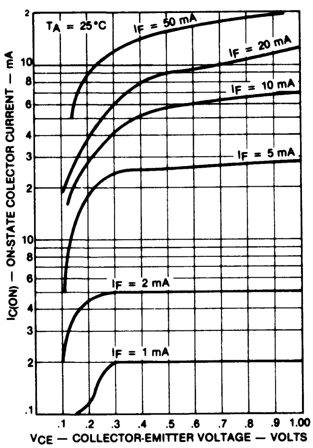
PRODUCT BULLETIN 3073
February 1982

electrical characteristics (25 °C unless otherwise noted)

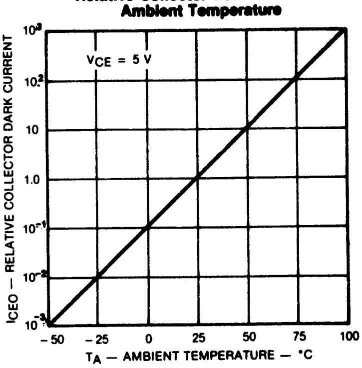
SYMBOL	PARAMETER	MIN	TYP	MAX	UNITS	TEST CONDITIONS
Input Diode						
V_F	Forward Voltage			1.5	V	I_F = 10 mA
I_R	Reverse Current			100	μA	V_R = 3 V
Output Phototransistor						
$V_{(BR)CEO}$	Collector-Emitter Breakdown Voltage	80			V	I_C = 1 mA
$V_{(BR)CBO}$	Collector-Base Breakdown Voltage	80			V	I_C = 1 μA
$V_{(BR)ECO}$	Emitter-Collector Breakdown Voltage	7			V	I_E = 100 μA
I_{CEO}	Collector-Emitter Dark Current			50	nA	V_{CE} = 60 V, I_F = 0
I_{CBO}	Collector-Base Dark Current			20	nA	V_{CB} = 60 V
Coupled						
I_C/I_F	DC Current Transfer Ratio	20			%	V_{CE} = 1 V, I_F = 20 mA
$V_{CE(SAT)}$	Collector-Emitter Saturation Voltage			1.0	V	I_F = 20 mA, I_C = 4 mA
t_{on} t_{off}	Turn-On Time Turn-Off Time		5 5		μs	V_{CC} = 10 V, I_C = 2 mA R_L = 100Ω, See Test Circuit

Typical Performance Curves

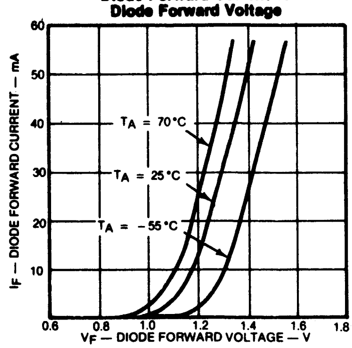
On-State Collector Current vs Collector-Emitter Voltage



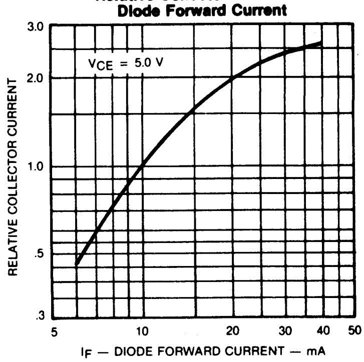
Relative Collector Dark Current vs Ambient Temperature



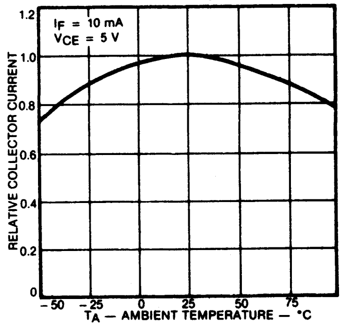
Diode Forward Current vs Diode Forward Voltage



Relative Collector Current vs Diode Forward Current



Relative Collector Current vs Ambient Temperature



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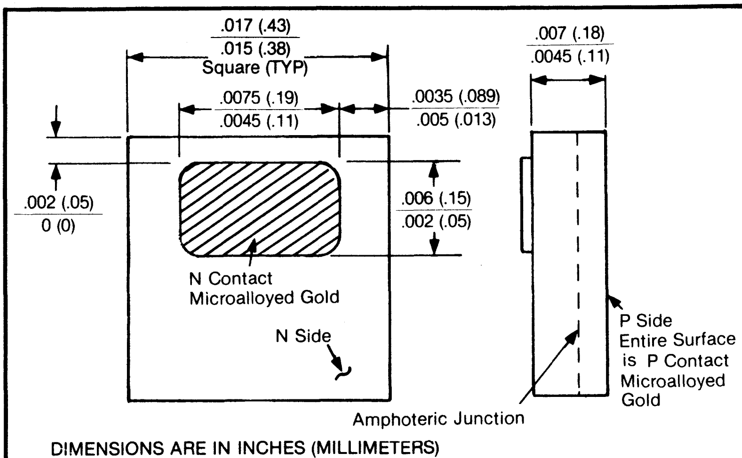
Printed in U.S.A.

Emitter and Photosensor Chips

Gallium Arsenide Infrared Emitter Chip
Type OPC116



Features

- HIGH INFRARED RADIATION OUTPUT
- LOW DEGRADATION
- MICROALLOYED GOLD CONTACTS

Description

TRW Optron's infrared emitting diode chips are fabricated by solution epitaxial techniques which provide high efficiency, long operating life, and minimum degradation. Spectral emission is centered at 935 nanometers.

Since TRW Optron has no control over the techniques the customer may use to alloy and bond chips, TRW Optron cannot be held responsible for damage to the chips resulting from such techniques. Nor can TRW Optron warrant the life or any other parameter after the chips have been bonded.

absolute maximum ratings(1) (25°C unless otherwise noted)

Storage and Operating Temperature Range . . . . −65°C to +150°C
Forward DC Current . . . . 150 mA(2)
Peak Forward Current (1 μs pulse, 300 pps) . . . . 3 A
Power Dissipation . . . . 200 mW

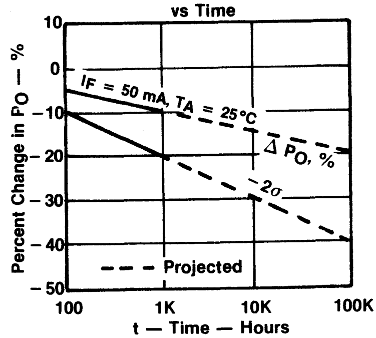
electrical characteristics (25°C unless otherwise noted)

SYMBOL	PARAMETER	MIN	MAX	UNITS	TEST CONDITIONS
V_R	Reverse Voltage	2		V	$I_R = 10\ \mu A$
V_F	Forward Voltage		1.7	V	$I_F = 100$ mA
P_O	Radiant Power Output	4		mW	$I_F = 100$ mA

Notes:

(1) All maximum ratings are determined with the chip mounted on a dimpled TO-46 header using TRW Optron techniques.
(2) Maximum operating current is a function of the package in which the chip is housed and the environment in which the assembled package will be used.
(3) Typical wavelength at peak emission is 935 nm.
(4) Chips will normally be shipped in a glass vial with cotton packing for protection.

Percent Change in Power Output vs Time



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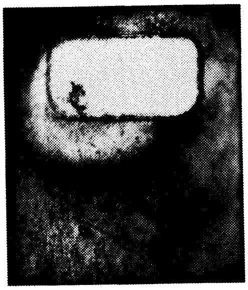
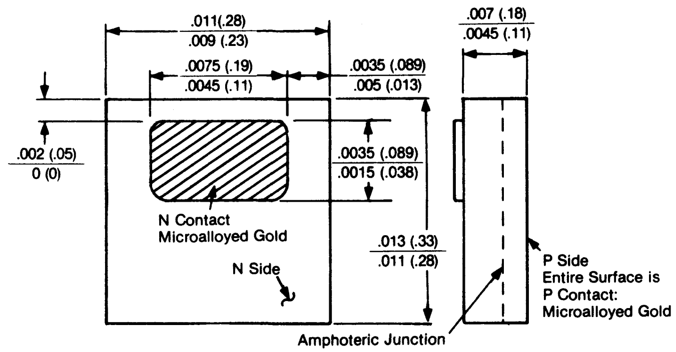
Gallium Arsenide Infrared Emitter Chip

Type OPC123





DIMENSIONS ARE IN INCHES (MILLIMETERS)

Features

- HIGH INFRARED RADIATION OUTPUT
- LOW DEGRADATION
- MICROALLOYED GOLD CONTACTS

Description

TRW Optron's infrared emitting diode chips are fabricated by solution epitaxial techniques which provide high efficiency, long operating life, and minimum degradation. Spectral emission is centered at 935 nanometers.

Since TRW Optron has no control over the techniques the customer may use to alloy and bond chips, TRW Optron cannot be held responsible for damage to the chips resulting from such techniques. Nor can TRW Optron warrant the life or any other parameter after the chips have been bonded.

absolute maximum ratings[1] (25 °C unless otherwise noted)

Storage and Operating Temperature Range .... −65 °C to +150 °C
Forward DC Current .... 100 mA[2]
Peak Forward Current (1 μs pulse, 300 pps) .... 3 A
Power Dissipation .... 200 mW

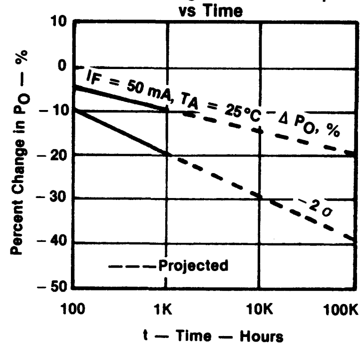
electrical characteristics (25 °C unless otherwise noted)

SYMBOL	PARAMETER	MIN	MAX	UNITS	TEST CONDITIONS
V_R	Reverse Voltage	3		V	I_R = 100 μA
V_F	Forward Voltage		1.75	V	I_F = 50 mA
P_O	Radiant Power Output	2		mW	I_F = 50 mA

Notes:

(1) All maximum ratings are determined with the chip mounted on a dimpled TO-46 header using TRW Optron techniques.
(2) Maximum operating current is a function of the package in which the chip is housed and the environment in which the assembled package will be used.
(3) Typical wavelength at peak emission is 935 nm.
(4) Chips will normally be shipped in a glass vial with cotton packing for protection.

Percent Change in Power Output vs Time



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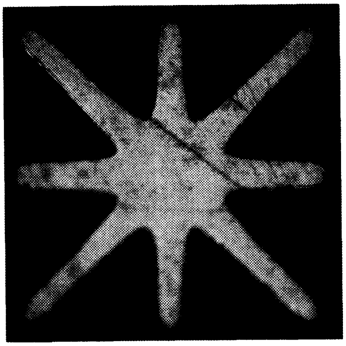
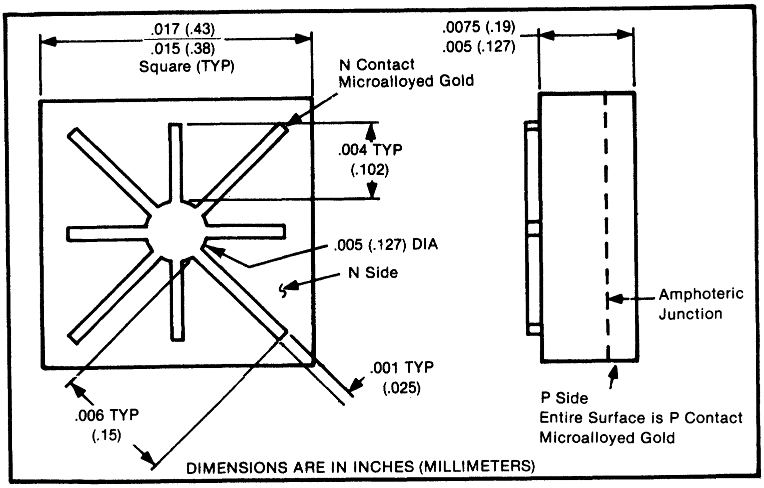
Gallium Arsenide Infrared Emitter Chip

Type OPC124





Features

- DESIGNED FOR PULSE OPERATION
- 16x16 MIL SIZE FOR HIGH POWER DISSIPATION
- MICROALLOYED GOLD CONTACTS

Description

TRW Optron's infrared emitting diode chips are fabricated by solution epitaxial techniques which provide high efficiency, long operating life, and minimum degradation. Spectral emission is centered at 935 nanometers.

Since TRW Optron has no control over the techniques the customer may use to alloy and bond chips, TRW Optron cannot be held responsible for damage to the chips resulting from such techniques. Nor can TRW Optron warrant the life or any other parameter after the chips have been bonded.

absolute maximum ratings[1] (25 °C unless otherwise noted)

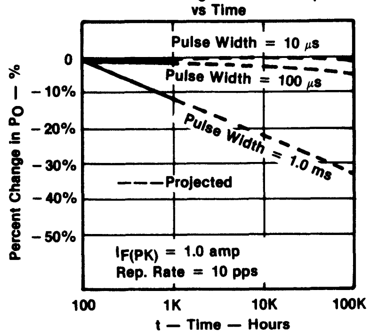
Storage and Operating Temperature Range . . . . −65 °C to +150 °C
Forward DC Current . . . . 1 A[2]
Peak Forward Current (100 μs pulse, 10 pps) . . . . 5 A
Power Dissipation . . . . 200 mW

electrical characteristics (25 °C unless otherwise noted)

SYMBOL	PARAMETER	MIN	MAX	UNITS	TEST CONDITIONS
I_R	Reverse Current		100	μA	V_R = 2 V
V_F	Forward Voltage		2.5	V	I_F = 1 A, pw = 100 μs 10 pps
P_O	Radiant Power Output	15		mW	I_F = 1 A, pw = 100 μs 10 pps

Notes:
(1) All maximum ratings are determined with the chip mounted on a dimpled TO-18 header using TRW Optron techniques.
(2) Maximum power dissipation is a function of the package in which the chip is housed and the environment in which the assembled package will be used.
(3) Chips will normally be shipped in a glass vial with cotton packing for protection.
(4) Light source is an unfiltered tungsten bulb operating at CT = 2870°K.

Percent Change in Power Output vs Time



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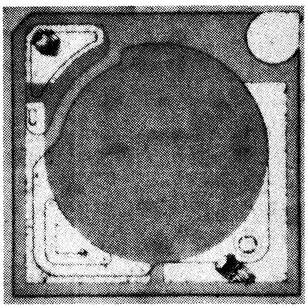
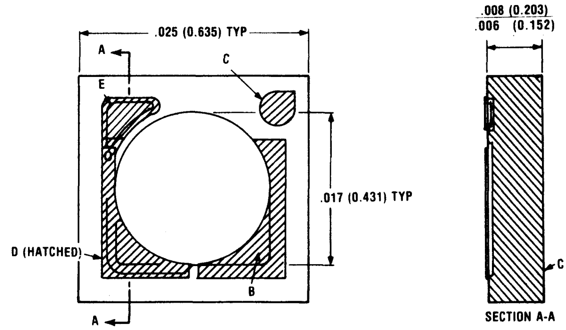
TRW OPTRON

PRODUCT BULLETIN 3090
April 1982

NPN Silicon Photodarlington Chip
Type OPC300





B. Base pad -metallization (aluminum).
C. Collector pad -metallization (aluminum on front side and gold on backside).
D. OP300 metallization (topside) aluminum.
E. Emitter pad -shaded area emitter metallization aluminum.

DIMENSIONS ARE IN INCHES (MILLIMETERS)

Features

- HIGH SENSITIVITY TO LOW LIGHT LEVELS
- LARGE ACTIVE AREA (227 SQUARE MILS)
- SILICON NITRIDE PASSIVATION

Description

TRW Optron's photosensor chips are fabricated using the latest silicon planar diffused technology and are silicon nitride passivated for long term stability. All photosensors have an antireflective coating over the active area to ensure maximum absorption of irradiated light. Chips can be specially probed to satisfy custom requirements.

Since TRW Optron has no control over the techniques the customer may use to alloy and bond chips, TRW Optron cannot be held reponsible for damage to the chips resulting from such techniques.

absolute maximum ratings[1] (25 °C unless otherwise noted)

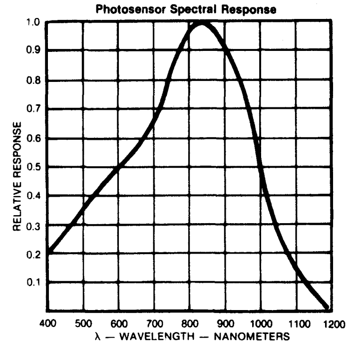
Storage and Operating Temperature Range . . . . −65 °C to +150 °C
Collector-Emitter Voltage . . . . 30 V
Emitter-Collector Voltage . . . . 5 V
Power Dissipation . . . . 50 mW[2]

electrical characteristics (25 °C unless otherwise noted)

SYMBOL	PARAMETER	MIN	TYP	MAX	UNITS	TEST CONDITIONS
$V_{(BR)CEO}$	Collector-Emitter Breakdown Voltage	30			V	I_C = 100 μA
$V_{(BR)ECO}$	Emitter-Collector Breakdown Voltage	5			V	I_E = 100 μA
I_{CEO}	Collector Dark Current			250	nA	V_{CE} = 10 V, E_e = 0
I_L	Light Current	0.8		10	mA	V_{CE} = 5 V, E_e = 1 mW/cm2 [4]
I_{CB}	Collector-Base Current		0.2		μA	V_{CE} = 5 V, E_e = 1 mW/cm2 [4]

Notes:
(1) All maximum ratings are determined with the chip mounted on a TO-18 header using TRW Optron techinques.
(2) Maximum power dissipation is a function of the package in which the chip is housed and the environment in which the assembled package will be used.
(3) Chips will normally be shipped in a glass vial with cotton packing for protection.
(4) Light source is an unfiltered tungsten bulb operating at CT = 2870 °K.

Photosensor Spectral Response



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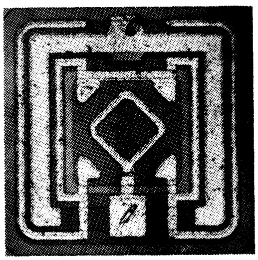
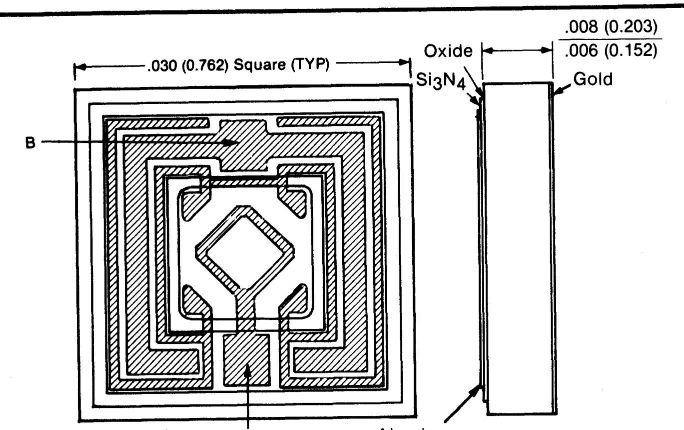
TRW OPTRON

PRODUCT BULLETIN 3091
April 1982

NPN Silicon Photodarlington Chip

Type OPC300M





1. "A" is base contact;
"B" is emitter contact.

DIMENSIONS ARE IN INCHES (MILLIMETERS)

Features

- HIGH COLLECTOR CURRENT
- IMPROVED CURRENT SINKING CHARACTERISTICS
- SILICON NITRIDE PASSIVATION

Description

TRW Optron's photosensor chips are fabricated using the latest silicon planar diffused technology and are silicon nitride passivated for long term stability. All photosensors have an antireflective coating over the active area to ensure maximum absorption of irradiated light. Chips can be specially probed to satisfy custom requirements.

Since TRW Optron has no control over the techniques the customer may use to alloy and bond chips, TRW Optron cannot be held reponsible for damage to the chips resulting from such techniques.

absolute maximum ratings(1) (25 °C unless otherwise noted)

Storage and Operating Temperature Range . . . . −65 °C to +150 °C
Collector-Emitter Voltage . . . . 30 V
Emitter-Collector Voltage . . . . 5 V
Power Dissipation . . . . 50 mW(2)

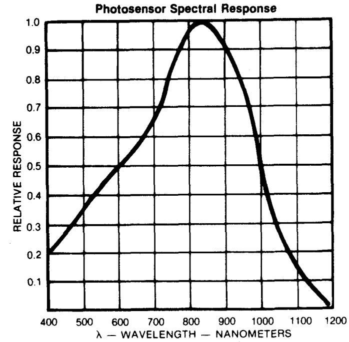
electrical characteristics (25 °C unless otherwise noted)

SYMBOL	PARAMETER	MIN	TYP	MAX	UNITS	TEST CONDITIONS
$V_{(BR)CEO}$	Collector-Emitter Breakdown Voltage	30			V	I_C = 100 μA
$V_{(BR)ECO}$	Emitter-Collector Breakdown Voltage	5			V	I_E = 100 μA
I_{CEO}	Collector Dark Current			250	nA	V_{CE} = 10 V, E_e = 0
I_L	Light Current	0.8		20	mA	V_{CE} = 5 V, E_e = 1 mW/cm² (4)
I_{CB}	Collector-Base Current		0.15		μA	V_{CE} = 5 V, E_e = 1 mW/cm² (4)

Notes:

(1) All maximum ratings are determined with the chip mounted on a TO-18 header using TRW Optron techniques.
(2) Maximum power dissipation is a function of the package in which the chip is housed and the environment in which the assembled package will be used.
(3) Chips will normally be shipped in a glass vial with cotton packing for protection.
(4) Light source is an unfiltered tungsten bulb operating at CT = 2870 °K.

Photosensor Spectral Response



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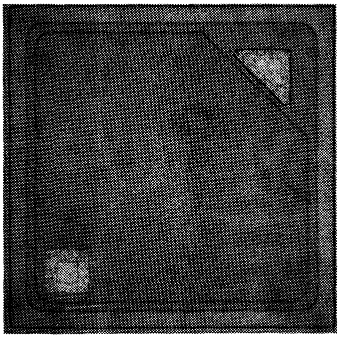
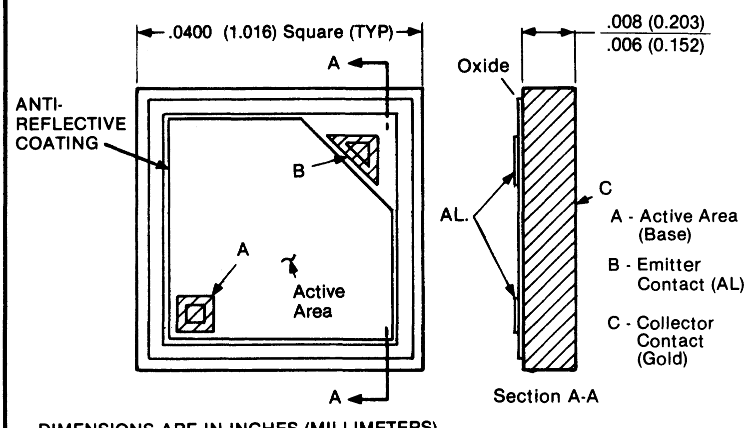
Printed in U.S.A.

NPN Silicon Phototransistor Chip

Type OPC60X





Features

- THREE TIMES THE ACTIVE AREA OF OPC600L
- MORE SENSITIVE AT LOW LIGHT LEVELS
- ACTIVE AREA IS CENTERED ON CHIP

Description

TRW Optron's photosensor chips are fabricated using the latest silicon planar diffused technology and are silicon nitride passivated for long term stability. All photosensors have an antireflective coating over the active area to ensure maximum absorption of irradiated light. Chips can be specially probed to satisfy custom requirements.

Since TRW Optron has no control over the techniques the customer may use to alloy and bond chips, TRW Optron cannot be held reponsible for damage to the chips resulting from such techniques.

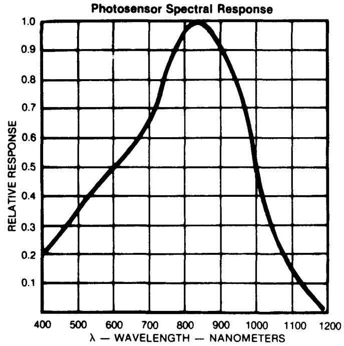
absolute maximum ratings(1) (25 °C unless otherwise noted)

Storage and Operating Temperature Range . . . . −65 °C to +150 °C
Collector-Emitter Voltage . . . . 30 V
Emitter-Collector Voltage . . . . 5 V
Power Dissipation . . . . 50 mW(2)

electrical characteristics (25 °C unless otherwise noted)

SYMBOL	PARAMETER	MIN	TYP	MAX	UNITS	TEST CONDITIONS
$V_{(BR)CEO}$	Collector-Emitter Breakdown Voltage	30			V	$I_C = 100\ \mu A$
$V_{(BR)ECO}$	Emitter-Collector Breakdown Voltage	5			V	$I_E = 100\ \mu A$
I_{CEO}	Collector Dark Current			100	nA	$V_{CE} = 10$ V, $E_e = 0$
I_L	Light Current	0.8		22	mA	$V_{CE} = 5$ V, $E_e = 5$ mW/cm2 (4)
I_{CB}	Collector-Base Current		8.2		μA	$V_{CE} = 5$ V, $E_e = 10$mW/cm2 (4)

Notes:
(1) All maximum ratings are determined with the chip mounted on a dimpled TO-18 header using TRW Optron techniques.
(2) Maximum power dissipation is a function of the package in which the chip is housed and the environment in which the assembled package will be used.
(3) Chips will normally be shipped in a glass vial with cotton packing for protection.
(4) Light source is an unfiltered tungsten bulb operating at CT = 2870 °K.



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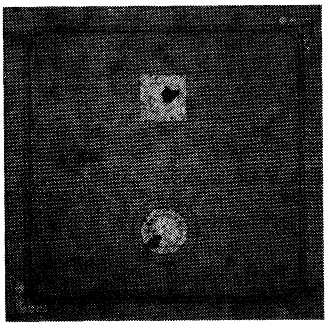
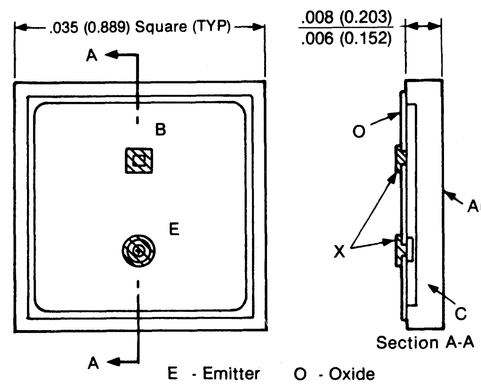
PN Silicon Photodiode Chip

Type OPC60Y





DIMENSIONS ARE IN INCHES (MILLIMETERS)

E - Emitter
B - Base
C - Collector

O - Oxide
X - Al. Contacts
Au - Gold

Features

- 290 SQUARE MIL ACTIVE AREA
- LOW NOISE
- HIGH LINEARITY

Description

Photodiodes are recommended for use in applications requiring fast speed of response. TRW Optron photodiodes may be operated at zero bias (photovoltaic mode) or at any reverse bias up to the diode reverse breakdown voltage. Best linearity is obtained in the reverse bias mode. In the photovoltaic mode, the open circuit voltage varies in a logarithmic manner.

Since TRW Optron has no control over the techniques the customer may use to alloy and bond chips, TRW Optron cannot be held reponsible for damage to the chips resulting from such techniques.

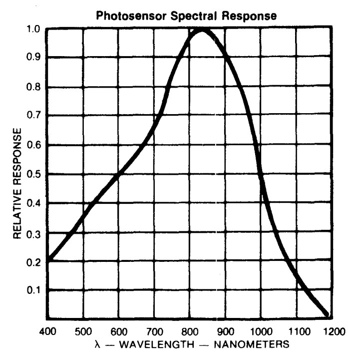
absolute maximum ratings(1) (25 °C unless otherwise noted)

Storage and Operating Temperature Range .... −65 °C to +150 °C
Reverse Breakdown Voltage .... 100 V
Power Dissipation .... 50 mW(2)

electrical characteristics (25 °C unless otherwise noted)

SYMBOL	PARAMETER	MIN	MAX	UNITS	TEST CONDITIONS
$V_{(BR)R}$	Reverse Breakdown Voltage	100		V	I_R = 100 μA
V_F	Forward Voltage		1.5	V	I_F = 10 mA
I_L	Light Current	10⁻		μA	V_R = 5 V, E_e = 20 mW/cm² (4)

Notes:
(1) All maximum ratings are determined with the chip mounted on a dimpled TO-18 header or lead frame package using TRW Optron techniques.
(2) Maximum power dissipation is a function of the package in which the chip is housed and the environment in which the assembled package will be used.
(3) Chips will normally be shipped in a glass vial with cotton packing for protection.
(4) Light source is an unfiltered tungsten bulb operating at CT = 2870 °K.
(5) All photodiodes are nitride passivated with an antireflective coating.



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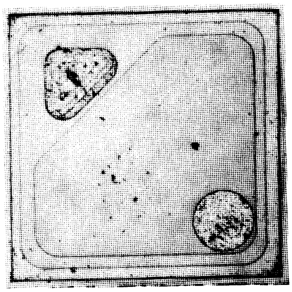
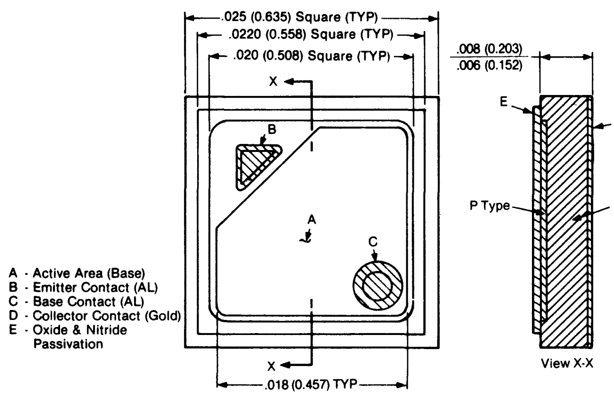
NPN Silicon Phototransistor Chip
Type OPC600L





DIMENSIONS ARE IN INCHES (MILLIMETERS)

Features

- ACTIVE AREA CENTERED ON CHIP
- LOW COST
- SILICON NITRIDE PASSIVATION

Description

TRW Optron's photosensor chips are fabricated using the latest silicon planar diffused technology and are silicon nitride passivated for long term stability. All photosensors have an antireflective coating over the active area to ensure maximum absorption of irradiated light. Chips can be specially probed to satisfy custom requirements.

Since TRW Optron has no control over the techniques the customer may use to alloy and bond chips, TRW Optron cannot be held reponsible for damage to the chips resulting from such techniques.

absolute maximum ratings[1] (25 °C unless otherwise noted)

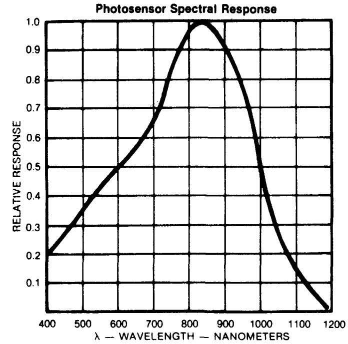
Storage and Operating Temperature Range . . . . −65 °C to +150 °C
Collector-Emitter Voltage . . . . 30 V
Emitter-Collector Voltage . . . . 5 V
Power Dissipation . . . . 50 mW[2]

electrical characteristics (25 °C unless otherwise noted)

SYMBOL	PARAMETER	MIN	TYP	MAX	UNITS	TEST CONDITIONS
$V_{(BR)CEO}$	Collector-Emitter Breakdown Voltage	30			V	I_C = 100 μA
$V_{(BR)ECO}$	Emitter-Collector Breakdown Voltage	5			V	I_E = 100 μA
I_{CEO}	Collector Dark Current	100			nA	V_{CE} = 10 V, E_e = 0
I_L	Light Current	0.8		10	mA	V_{CE} = 5 V, E_e = 20 mW/cm² [4]
I_{CB}	Collector-Base Current		6		μA	V_{CE} = 5 V, E_e = 20 mW/cm² [4]

Notes:
(1) All maximum ratings are determined with the chip mounted on a dimpled TO-18 header using TRW Optron techniques.
(2) Maximum power dissipation is a function of the package in which the chip is housed and the environment in which the assembled package will be used.
(3) Chips will normally be shipped in a glass vial with cotton packing for protection.
(4) Light source is an unfiltered tungsten bulb operating at CT = 2870 °K.

Photosensor Spectral Response

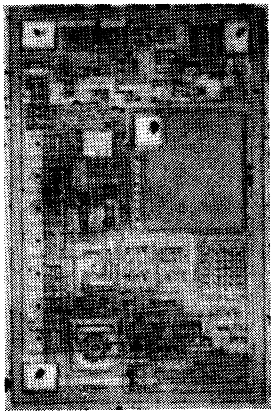


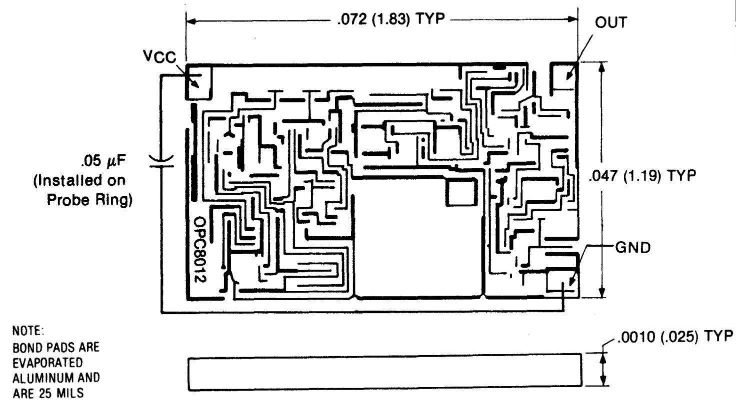
TRW OPTRON reserves the right to make changes at any time in order to improve design and to supply the best product possible.

TRW OPTRON

PRODUCT BULLETIN 3095
April 1982

Photologic™ Chips
Types OPC8012, OPC8013, OPC8014, OPC8015





DIMENSIONS ARE IN INCHES (MILLIMETERS)

Features

- OPEN COLLECTOR OR TOTEM POLE OUTPUT
- DRIVE UP TO 8 TTL LOADS
- DATA RATES TO 250 K BAUD

Description

The OPC8012 family of photologic chips are bipolar monolithic integrated circuits consisting of a photodiode, a linear amplifier, and a Schmitt trigger on a single silicon chip. Four output options are available, buffer-totem pole (OPC8012), buffer-open collector (OPC8013), inverter-totem pole (OPC8015), and inverter-open collector (OPC8014). Featured is logic level output and up to 12.8 mA of sink current for direct driving of up to 8 TTL loads. The Schmitt trigger provides hysteresis for high immunity to noise on the input.

Since TRW Optron has no control over the techniques the customer may use to alloy and bond chips, TRW Optron cannot be held reponsible for damage to the chips resulting from such techniques.

absolute maximum ratings (25 °C unless otherwise noted)

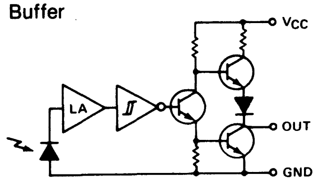
Storage and Operating Temperature Range . . . . −55 °C to +125 °C
Supply Voltage, V_{CC} . . . . 5.25 V
Junction Temperature . . . . 125 °C

Notes:

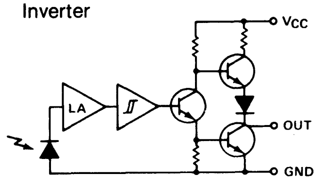
(1) Light level sufficient to cause high level output. (See Typical $E_{eT}+$). Light source is an unfiltered tungsten bulb operating at CT = 2870 °K.
(2) Light level sufficient to cause low level output (see Typical $E_{eT}+$). Light source is an unfiltered tungsten bulb operating at CT = 2870 °K.
(3) Chips will normally be shipped in a glass vial with cotton packing for protection.

Block Diagrams

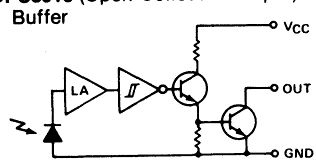
OPC8012 (Totem-Pole Output)
Buffer



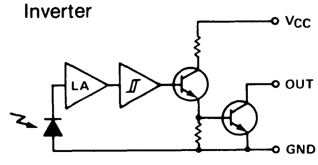
OPC8015 (Totem-Pole Output)
Inverter



OPC8013 (Open Collector Output)
Buffer



OPC8014 (Open Collector Output)
Inverter



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Types OPC8012, OPC8013, OPC8014, OPC8015

electrical characteristics ($-40\,°C$ to $+70\,°C$ unless otherwise noted)

OPC8012 (Buffer-Totem Pole)

SYMBOL	PARAMETER	MIN	TYP	MAX	UNITS	TEST CONDITIONS
I_{CCH}	High Level Supply Current		8	15	mA	V_{CC} = 5.25 V, (See Note 1)
I_{CCL}	Low Level Supply Current		8	15	mA	V_{CC} = 5.25 V, E_e = 0
V_{OH}	High Level Output Voltage	2.4	3.2		V	V_{CC} = 4.75 V, I_{OH} = −800 μA (See Note 1)
V_{OL}	Low Level Output Voltage		0.2	0.4	V	V_{CC} = 4.75 V, I_{OL} = 12.8 mA, E_e = 0
$E_{eT}+$	Trigger Irradiance (Low-High)		1		mW/cm²	V_{CC} = 5 V
$E_{eT}+/E_{eT}-$	Hysteresis		2			V_{CC} = 5 V
I_{OS}	Short Circuit Output Current	−80	−50	−30	μA	V_{CC} = 4.75 V, V_{OUT} = 0, (See Note 1)

OPC8013 (Buffer-Open Collector)

SYMBOL	PARAMETER	MIN	TYP	MAX	UNITS	TEST CONDITIONS
I_{CCH}	High Level Supply Current		8	15	mA	V_{CC} = 5.25 V, (See Note 1)
I_{CCL}	Low Level Supply Current		8	15	mA	V_{CC} = 5.25 V, E_e = 0
I_{OH}	High Level Output Current			80	μA	V_{CC} = 4.75 V, V_{OH} = 35 V, (See Note 1)
V_{OL}	Low Level Output Voltage		0.2	0.4	V	V_{CC} = 4.75 V, I_{OL} = 12.8 mA, E_e = 0
$E_{eT}+$	Trigger Irradiance (Low-High)		1		mW/cm²	V_{CC} = 5 V
$E_{eT}+/E_{eT}-$	Hysteresis		2			V_{CC} = 5 V

OPC8014 (Inverter-Open Collector)

SYMBOL	PARAMETER	MIN	TYP	MAX	UNITS	TEST CONDITIONS
I_{CCH}	High Level Supply Current		8	15	mA	V_{CC} = 5.25 V, E_e = 0
I_{CCL}	Low Level Supply Current		8	15	mA	V_{CC} = 5.25 V, (See Note 2)
I_{OH}	High Level Output Current			80	μA	V_{CC} = 4.75 V, V_{OH} = 35 V, E_e = 0
V_{OL}	Low Level Output Voltage		0.2	0.4	V	V_{CC} = 4.75 V, I_{OL} = 12.8 mA, (See Note 2)
$E_{eT}+$	Trigger Irradiance (High-Low)		1		mW/cm²	V_{CC} = 5 V
$E_{eT}+/E_{eT}-$	Hysteresis		2			V_{CC} = 5 V

OPC8015 (Inverter-Totem Pole)

SYMBOL	PARAMETER	MIN	TYP	MAX	UNITS	TEST CONDITIONS
I_{CCH}	High Level Supply Current		8	15	mA	V_{CC} = 5.25 V, E_e = 0
I_{CCL}	Low Level Supply Current		8	15	mA	V_{CC} = 5.25 V, (See Note 2)
V_{OH}	High Level Output Voltage	2.4	3.2		V	V_{CC} = 4.75 V, I_{OH} = −800 μA, E_e = 0
V_{OL}	Low Level Output Voltage		0.2	0.4	V	V_{CC} = 4.75 V, I_{OH} = 12.8 mA, (See Note 2)
$E_{eT}+$	Trigger Irradiance (High-Low)		1		mW/cm²	V_{CC} = 5 V
$E_{eT}+/E_{eT}-$	Hysteresis		2			V_{CC} = 5 V
I_{OS}	Short Circuit Output Current	−80	−50	−30	μA	V_{CC} = 4.75 V, V_{OUT} = 0, E_e = 0

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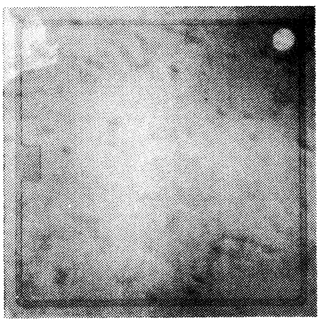
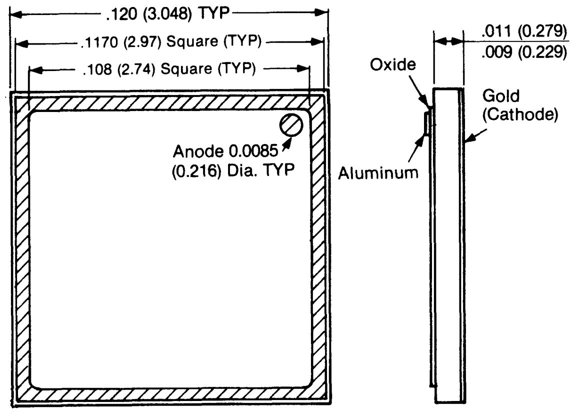
PN Silicon Photodiode Chip

Type OPC903





DIMENSIONS ARE IN INCHES (MILLIMETERS)

Features

- 11,664 SQUARE MIL ACTIVE AREA
- HIGH LINEARITY
- LOW NOISE

Description

Photodiodes are recommended for use in applications requiring fast speed of response. TRW Optron photodiodes may be operated at zero bias (photovoltaic mode) or at any reverse bias up to the diode reverse breakdown voltage. Best linearity is obtained in the reverse bias mode. In the photovoltaic mode, the open circuit voltage varies in a logarithmic manner.

Since TRW Optron has no control over the techniques the customer may use to alloy and bond chips, TRW Optron cannot be held reponsible for damage to the chips resulting from such techniques.

absolute maximum ratings(1) (25 °C unless otherwise noted)

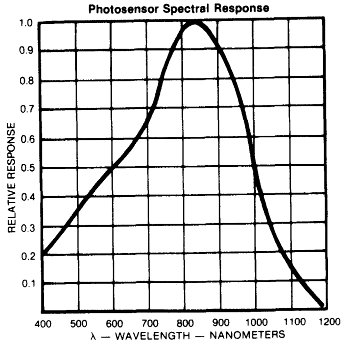
Storage and Operating Temperature Range .... −65 °C to +150 °C
Reverse Breakdown Voltage .... 33 V
Power Dissipation .... 150 mW(2)

electrical characteristics (25 °C unless otherwise noted)

SYMBOL	PARAMETER	MIN	MAX	UNITS	TEST CONDITIONS
$V_{(BR)R}$	Reverse Breakdown Voltage	33		V	$I_R = 100\ \mu A$
V_F	Forward Voltage		1.5	V	$I_F = 10$ mA
I_D	Reverse Dark Current		25	nA	$V_R = 10$ V, $E_e = 0$
I_L	Light Current	40		μA	$V_R = 5$ V, $E_e = 1$ mW/cm²(4) $\lambda = 935$ nm
C_T	Total Capacitance		150	pF	$V_R = 3$ V, $f = 1$ MHz, $E_e = 0$

Notes:
(1) All maximum ratings are determined with the chip mounted on a dimpled TO-5 header or lead frame package using TRW Optron techniques.
(2) Maximum power dissipation is a function of the package in which the chip is housed and the environment in which the assembled package will be used.
(3) Chips will normally be shipped in a glass vial with cotton packing for protection.
(4) Light source is an unfiltered tungsten bulb operating at CT = 2870 °K.
(5) All photodiodes are nitride passivated with an antireflective coating.

Photosensor Spectral Response



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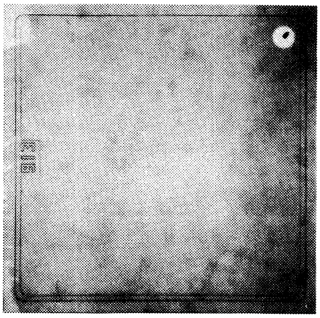
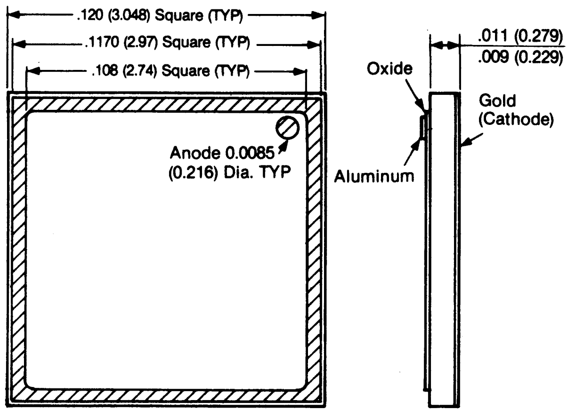
PIN Silicon Photodiode Chip

Type OPC913





DIMENSIONS ARE IN INCHES (MILLIMETERS)

Features

- 11,664 SQUARE MIL ACTIVE AREA
- HIGH SPEED OPERATION
- LOW NOISE

Description

Photodiodes are recommended for use in applications requiring fast speed of response. TRW Optron photodiodes may be operated at zero bias (photovoltaic mode) or at any reverse bias up to the diode reverse breakdown voltage. Best linearity is obtained in the reverse bias mode. In the photovoltaic mode, the open circuit voltage varies in a logarithmic manner.

Since TRW Optron has no control over the techniques the customer may use to alloy and bond chips, TRW Optron cannot be held reponsible for damage to the chips resulting from such techniques.

absolute maximum ratings(1) (25 °C unless otherwise noted)

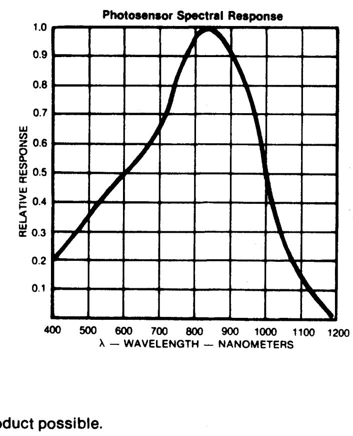
Storage and Operating Temperature Range . . . . −65 °C to +150 °C
Reverse Breakdown Voltage . . . . 33 V
Power Dissipation . . . . 150 mW(2)

electrical characteristics (25 °C unless otherwise noted)

SYMBOL	PARAMETER	MIN	MAX	UNITS	TEST CONDITIONS
$V_{(BR)R}$	Reverse Breakdown Voltage	33		V	$I_R = 100\ \mu A$
V_F	Forward Voltage		1.5	V	$I_F = 10$ mA
I_D	Reverse Dark Current		25	nA	$V_R = 10$ V, $E_e = 0$
I_L	Light Current	40		μA	$V_R = 5$ V, $E_e = 1$ mW/cm2(4) $\lambda = 935$ nm
C_T	Total Capacitance		30	pF	$V_R = 3$ V, $f = 1$ MHz, $E_e = 0$

Notes:

(1) All maximum ratings are determined with the chip mounted on a dimpled TO-5 header or lead frame package using TRW Optron techniques.
(2) Maximum power dissipation is a function of the package in which the chip is housed and the environment in which the assembled package will be used.
(3) Chips will normally be shipped in a glass vial with cotton packing for protection.
(4) Light source is an unfiltered tungsten bulb operating at CT = 2870 °K.
(5) All photodiodes are nitride passivated with an antireflective coating.

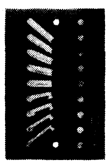


TRW OPTRON reserves the right to make changes at any time in order to improve design and to supply the best product possible.

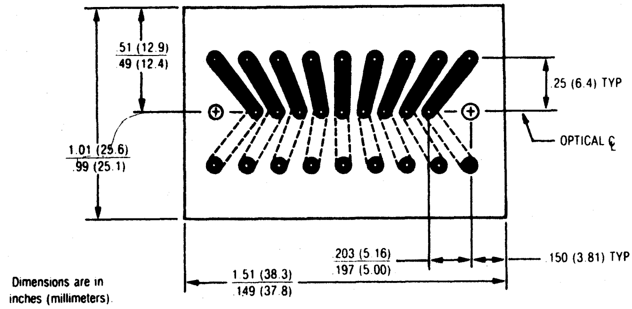
Emitter and Photosensor Arrays

9 Channel Phototransistor Array

Type OPA508



ONE HALF ACTUAL SIZE



Dimensions are in inches (millimeters).

SENSOR SPACING IS $\frac{.103\ (2.62)}{.097\ (2.46)}$ NON-ACCUM. CENTER TO CENTER.

Features

- PHOTOTRANSISTORS ARE MOUNTED ON 0.10 INCH (2.54mm) HOLE CENTERS
- PRINTED CIRCUIT BOARD MOUNTING ENSURES PRECISE ALIGNMENT
- MATCHING PARAMETER TO ENSURE UNIFORM CHANNEL OUTPUT CHARACTERISTICS

Description

The OPA508 consists of nine NPN silicon phototransistors of the OP600 pill type, soldered in a straight line on 0.10 inch (2.54mm) hole centers, into a double sided PC board. The OP600's are matched to ensure uniform output current characteristics. The OPA508 can be used for any application requiring sensing of up to nine channels of information, each separated by 0.10 inches (2.54mm), such as punched tape or cards.

All electrical parameters are 100% tested by manufacturing. Specifications are guaranteed to a cumulative .65% AQL.

absolute maximum ratings (25°C unless otherwise noted)

Collector-Emitter Voltage	25 V
Emitter-Collector Voltage	5 V
Storage Temperature Range	−65°C to +150°C
Operating Temperature Range	−65°C to +125°C
Lead Soldering Temperature (1/16 inch [1.6 mm] from case for 5 sec. with soldering iron)(1)	240°C
Power Dissipation	50 mW(2)

Notes: (1) RMA flux is recommended. Duration can be extended to 10 sec. max. when wave soldering.
(2) Derate linearly 0.5 mW/°C above 25°C.
(3) Light source is an unfiltered tungsten bulb operating at CT = 2870°K

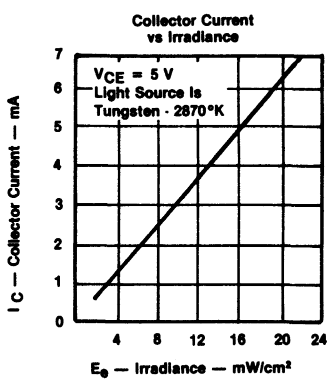
PRODUCT BULLETIN 3098
April 1982

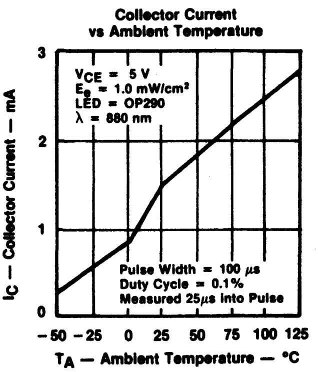
Type OPA508

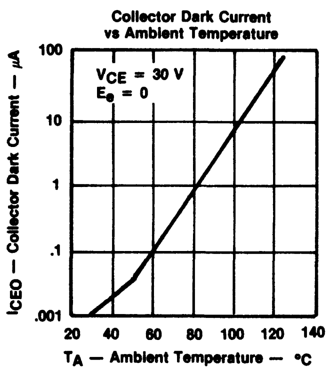
electrical characteristics (25 °C unless otherwise noted)

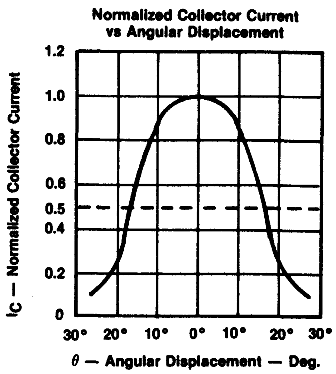
SYMBOL	PARAMETER	MIN	TYP	MAX	UNITS	TEST CONDITIONS
$V_{(BR)CEO}$	Collector-Emitter Breakdown Voltage	25			V	I_C = 100 μA
$V_{(BR)ECO}$	Emitter-Collector Breakdown Voltage	5			V	I_E = 100 μA
I_{CEO}	Collector Dark Current			100	nA	V_{CE} = 10 V, E_e = 0
$I_{C(ON)}$	On-State Collector Current	0.8			mA	V_{CE} = 5 V, E_e = 20 mW/cm², CT = 2870 °K
$\frac{I_{C(ON)}\ MIN.}{I_{C(ON)}\ MAX.}$	Matching Factor	0.5				V_{CE} = 5 V, E_e = 20 mW/cm²
$V_{CE(SAT)}$	Collector-Emitter Saturation Voltage			0.4	V	I_C = 0.4 mA, E_e = 20 mW/cm²

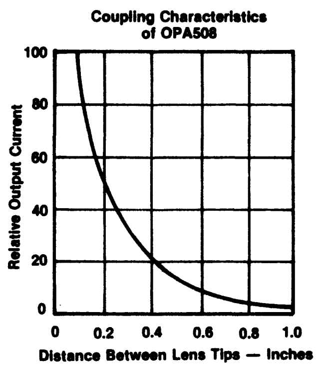
Typical Performance Curves

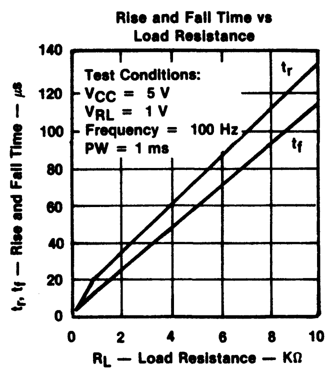












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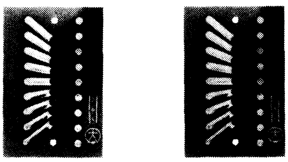
TRW OPTRON

PRODUCT BULLETIN 3099
April 1982

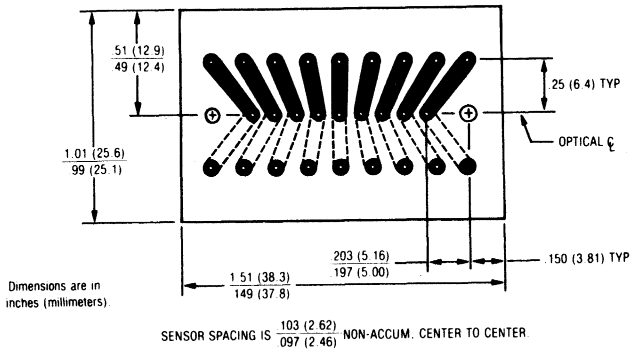
9 Channel LED-Phototransistor Paired Arrays

Type OPB508



EMITTER SENSOR

ONE HALF ACTUAL SIZE



Features

- LEDs AND PHOTOTRANSISTORS ARE MOUNTED ON 0.10 INCH (2.54mm) HOLE CENTERS
- PRINTED CIRCUIT BOARD MOUNTING ENSURES PRECISE ALIGNMENT
- GUARANTEED MIN-MAX $I_{C(ON)}$

Description

The OPB508 consists of an LED board containing nine OP123 pill type gallium arsenide infrared emitting diodes and a photosensor board containing nine OP600 pill type NPN silicon phototransistors. The pills are soldered in straight lines on 0.10 inch (2.54mm) hole centers into double sided PC boards. The OPB508 can be used for any application requiring sensing of up to nine channels of information, each separated by 0.10 (2.54mm), such as punched tape or cards.

All electrical parameters are 100% tested by manufacturing. Specifications are guaranteed to a cumulative .65% AQL.

absolute maximum ratings (25 °C unless otherwise noted)

Storage Temperature Range . . . . −65 °C to +150 °C
Operating Temperature Range . . . . −65 °C to +125 °C
Lead Soldering Temperature (1/16 inch [1.6 mm] from case for 5 sec. with soldering iron)[1] . . . . 240 °C

Input Diode

Forward Current . . . . 100 mA
Reverse Voltage . . . . 2 V
Power Dissipation . . . . 125 mW[2]

Output Phototransistor

Collector-Emitter Voltage . . . . 25 V
Emitter-Collector Voltage . . . . 5 V
Power Dissipation . . . . 50 mW[3]

Notes: (1) RMA flux is recommended. Duration can be extended to 10 sec. max. when wave soldering.
(2) Derate linearly 1.25 mW/°C above 25 °C.
(3) Derate linearly 0.5 mW/°C above 25 °C.
(4) Channel 1 LED illuminating channel 1 phototransistor. Distance from lens tip to lens tip = 0.1 inch (2.54mm)

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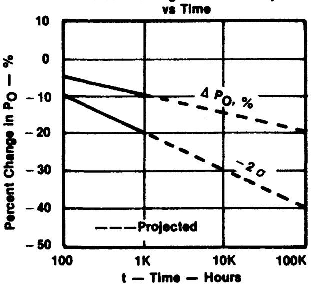
Types OPB508

electrical characteristics (25°C unless otherwise noted)

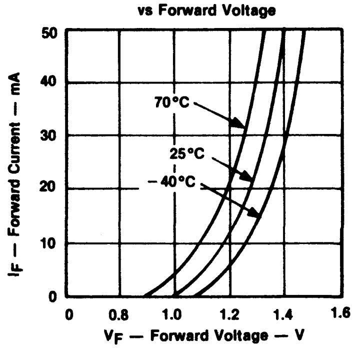
SYMBOL	PARAMETER	MIN	TYP	MAX	UNITS	TEST CONDITIONS
Input Diode						
V_F	Forward Voltage			1.5	V	I_F = 50 mA
$V_{(BR)R}$	Reverse Breakdown Voltage		2		V	I_F = 100 μA
Output Phototransistor						
$V_{(BR)CEO}$	Collector-Emitter Breakdown Voltage	25			V	I_C = 100 μA
$V_{(BR)ECO}$	Emitter-Collector Breakdown Voltage	5			V	I_E = 100 μA
I_{CEO}	Collector Dark Current			100	nA	V_{CE} = 10 V, E_e = 0
Coupled						
$I_{C(ON)}$	On-State Collector Current(4)	1.6		6.4	mA	V_{CE} = 5 V, I_F = 30 mA
$V_{CE(SAT)}$	Collector-Emitter Saturation Voltage			0.4	V	I_C = 0.4 mA, I_F = 30 mA

Typical Performance Curves

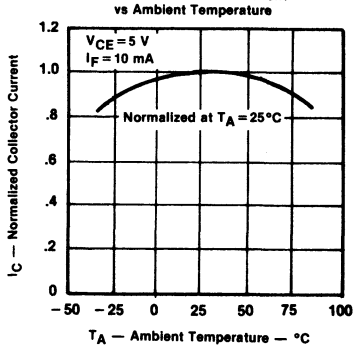
Percent Change in Power Output vs Time



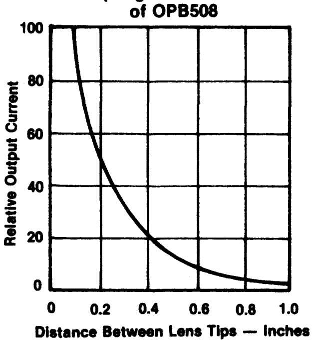
Forward Current vs Forward Voltage



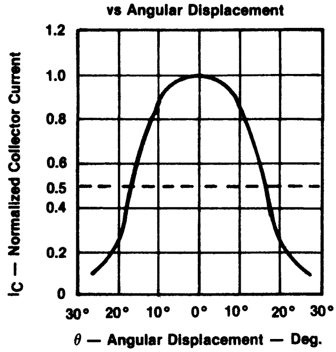
Normalized Collector Current vs Ambient Temperature



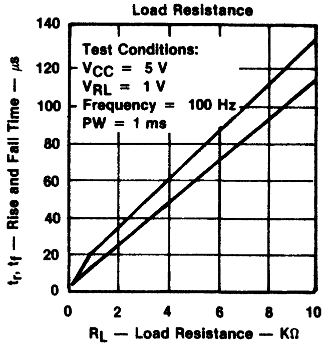
Coupling Characteristics of OPB508



Normalized Collector Current vs Angular Displacement



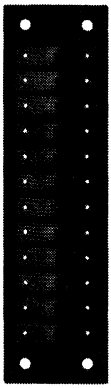
Rise and Fall Time vs Load Resistance



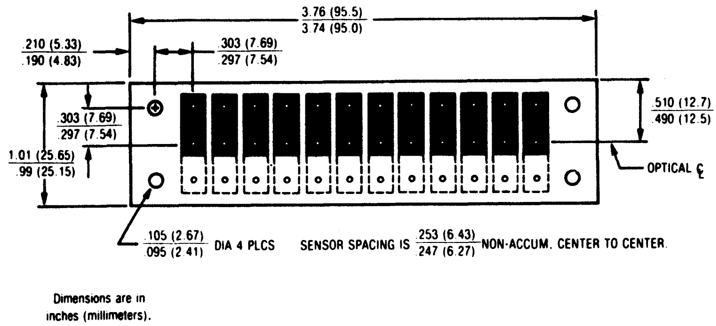
TRW OPTRON reserves the right to make changes at any time in order to improve design and to supply the best product possible.

12 Channel Phototransistor Array

Type OPA512A



ONE HALF ACTUAL SIZE



Features

- PHOTOTRANSISTORS ARE MOUNTED ON 0.25 INCH (6.35mm) HOLE CENTERS
- PRINTED CIRCUIT BOARD MOUNTING ENSURES PRECISE ALIGNMENT
- MATCHING PARAMETER TO ENSURE UNIFORM CHANNEL OUTPUT CHARACTERISTICS

Description

The OPA512A consists of twelve NPN silicon phototransistors of the OP600 pill type, soldered in a straight line on 0.25 inch (6.35mm) hole centers, into a double sided PC board. The OP600's are matched to ensure uniform output current characteristics. The OPA512A can be used for any application requiring sensing of up to twelve channels of information, each separated by 0.25 inches (6.35mm), such as punched cards or tape.

All electrical parameters are 100% tested by manufacturing. Specifications are guaranteed to a cumulative .65% AQL.

absolute maximum ratings (25 °C unless otherwise noted)

Collector-Emitter Voltage	25 V
Emitter-Collector Voltage	5 V
Storage Temperature Range	−65 °C to +150 °C
Operating Temperature Range	−65 °C to +125 °C
Lead Soldering Temperature (1/16 inch [1.6 mm] from case for 5 sec. with soldering iron)[1]	240 °C
Power Dissipation	50 mW[2]

Notes: (1) RMA flux is recommended. Duration can be extended to 10 sec. max. when wave soldering.
(2) Derate linearly 0.5 mW/°C above 25 °C.
(3) Light source is an unfiltered tungsten bulb operating at CT = 2870 °K

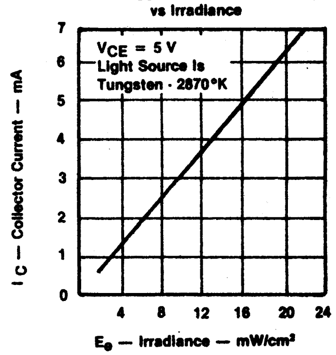
Type OPA512A

electrical characteristics (25 °C unless otherwise noted)

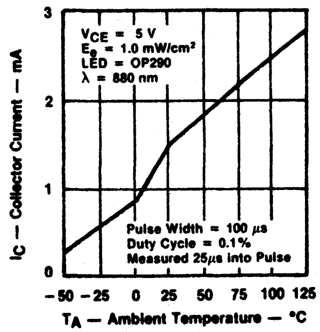
SYMBOL	PARAMETER	MIN	TYP	MAX	UNITS	TEST CONDITIONS
$V_{(BR)CEO}$	Collector-Emitter Breakdown Voltage	25			V	I_C = 100 μA
$V_{(BR)ECO}$	Emitter-Collector Breakdown Voltage	5			V	I_E = 100 μA
I_{CEO}	Collector Dark Current			100	nA	V_{CE} = 10 V, E_e = 0
$I_{C(ON)}$	On-State Collector Current	0.8			mA	V_{CE} = 5 V, E_e = 20 mW/cm² CT = 2870 °K
$\frac{I_{C(ON)}\,MIN.}{I_{C(ON)}\,MAX.}$	Matching Factor	0.5				V_{CE} = 5 V, E_e = 20 mW/cm²
$V_{CE(SAT)}$	Collector-Emitter Saturation Voltage			0.4	V	I_C = 0.4 mA, E_e = 20 mW/cm²

Typical Performance Curves

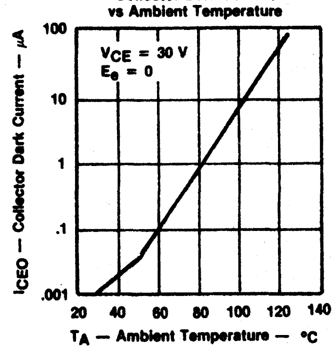
Collector Current vs Irradiance



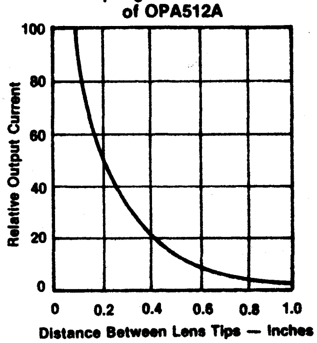
Collector Current vs Ambient Temperature



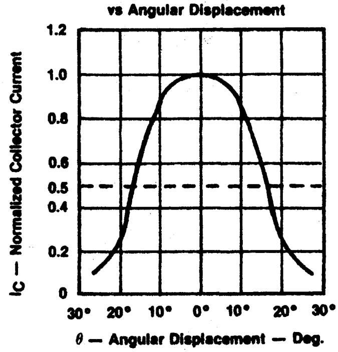
Collector Dark Current vs Ambient Temperature



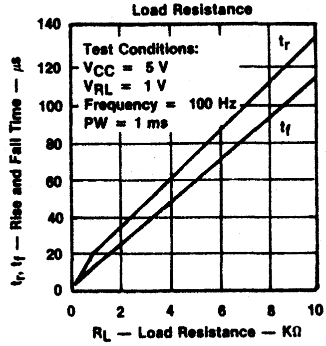
Coupling Characteristics of OPA512A



Normalized Collector Current vs Angular Displacement



Rise and Fall Time vs Load Resistance



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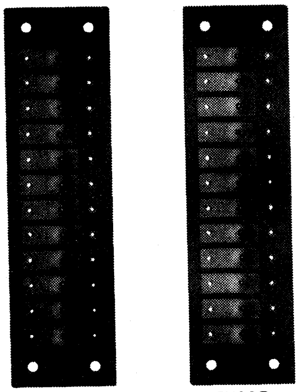
TRW *OPTRON*

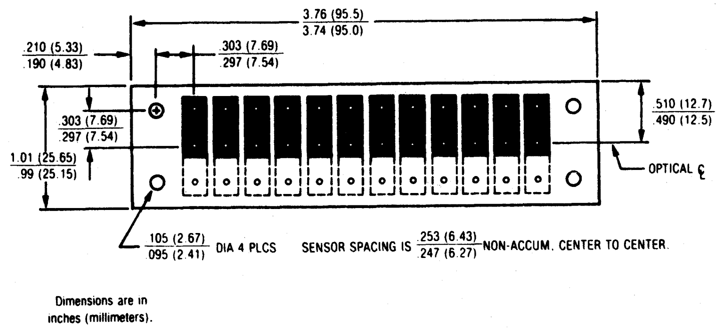
PRODUCT BULLETIN 3101
April 1982

12 Channel LED-Phototransistor Paired Arrays

Type OPB512A



ONE HALF ACTUAL SIZE



Features

- LEDs AND PHOTOTRANSISTORS ARE MOUNTED ON 0.25 INCH (6.35mm) HOLE CENTERS
- PRINTED CIRCUIT BOARD MOUNTING ENSURES PRECISE ALIGNMENT
- GUARANTEED MIN-MAX $I_{C(ON)}$

Description

The OPB512A consists of an LED board containing twelve OP123 pill type gallium arsenide infrared emitting diodes and a photosensor board containing twelve OP600 pill type NPN silicon phototransistors. The pills are soldered in straight lines on 0.25 inch (6.35mm) hole centers into double sided PC boards. The OPB512A can be used for any application requiring sensing of up to twelve channels of information, each separated by 0.25 inches (6.35mm), such as punched cards or tape.

All electrical parameters are 100% tested by manufacturing. Specifications are guaranteed to a cumulative .65% AQL.

absolute maximum ratings (25 °C unless otherwise noted)

Storage Temperature Range . . . . −65 °C to +150 °C
Operating Temperature Range . . . . −65 °C to +125 °C
Lead Soldering Temperature (1/16 inch [1.6 mm] from case for 5 sec. with soldering iron)(1) . . . . 240 °C

Input Diode

Forward Current . . . . 100 mA
Reverse Voltage . . . . 2 V
Power Dissipation . . . . 125 mW(2)

Output Phototransistor

Collector-Emitter Voltage . . . . 25 V
Emitter-Collector Voltage . . . . 5 V
Power Dissipation . . . . 50 mW(3)

Notes: (1) RMA flux is recommended. Duration can be extended to 10 sec. max. when wave soldering.
(2) Derate linearly 1.25 mW/°C above 25 °C.
(3) Derate linearly 0.5 mW/°C above 25 °C.
(4) Channel 1 LED illuminating channel 1 phototransistor. Distance from lens tip to lens tip = 0.1 inch (2.54mm)

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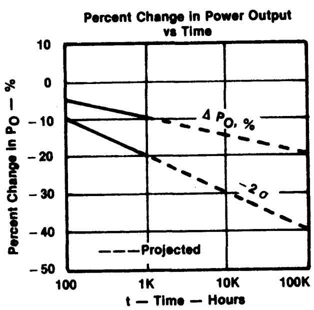
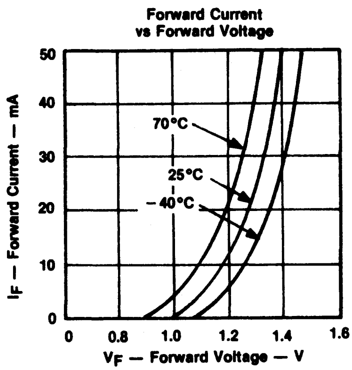
Types OPB512A

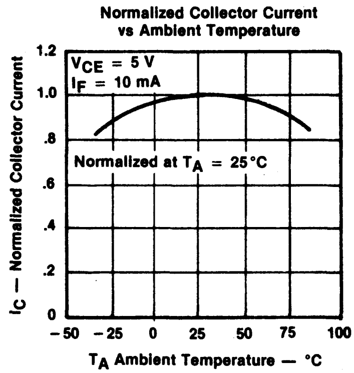
electrical characteristics (25 °C unless otherwise noted)

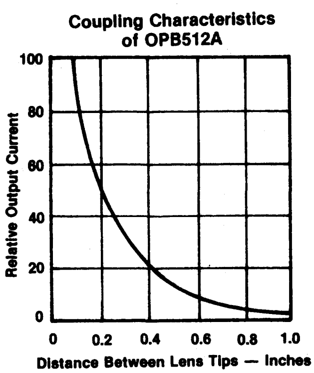
SYMBOL	PARAMETER	MIN	TYP	MAX	UNITS	TEST CONDITIONS
Input Diode						
V_F	Forward Voltage			1.5	V	I_F = 50 mA
$V_{(BR)R}$	Reverse Breakdown Voltage		2		V	I_F = 100 μA
Output Phototransistor						
$V_{(BR)CEO}$	Collector-Emitter Breakdown Voltage	25			V	I_C = 100 μA
$V_{(BR)ECO}$	Emitter-Collector Breakdown Voltage	5			V	I_E = 100 μA
I_{CEO}	Collector Dark Current			100	nA	V_{CE} = 10 V, E_e = 0
Coupled						
$I_{C(ON)}$	On-State Collector Current(4)	1.6		6.4	mA	V_{CE} = 5 V, I_F = 30 mA
$V_{CE(SAT)}$	Collector-Emitter Saturation Voltage			0.4	V	I_C = 0.4 mA, I_F = 30 mA

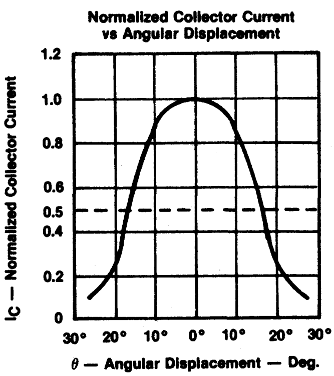
Typical Performance Curves

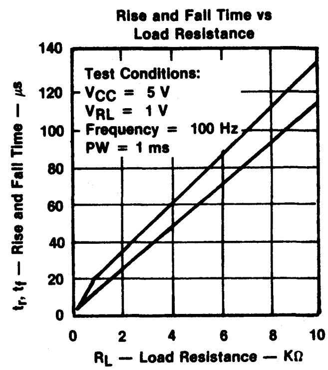












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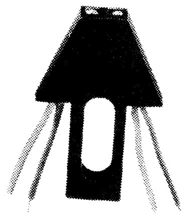
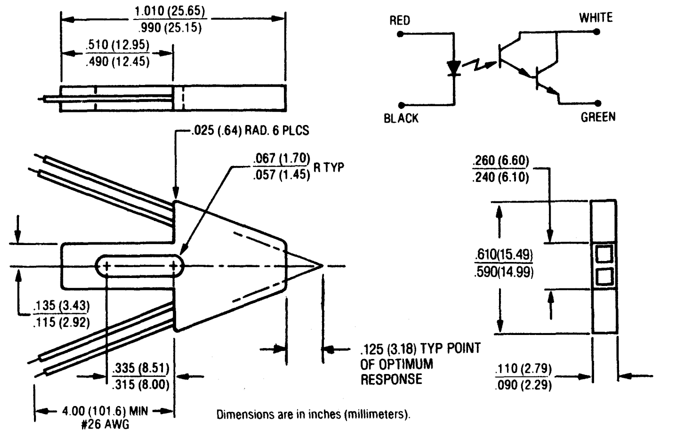
Printed in U.S.A.

Reflective Assemblies

Reflective Object Sensor
Type OPB125A



ACTUAL SIZE



Features

- PHOTODARLINGTON OUTPUT
- LOW PROFILE TO FACILITATE STACKING
- LOW COST PLASTIC HOUSING
- 4.0 INCHES (101.6 mm) MINIMUM LENGTH LEAD WIRE

Description

The OPB125A consists of a gallium arsenide infrared emitting diode and an NPN silicon photodarlington mounted side-by-side on converging optical axes, in a black plastic housing. The photodarlington responds to radiation from the LED only when a reflective object passes within its field of view.

All electrical parameters are 100% tested by manufacturing. Specifications are guaranteed to a cumulative .65% AQL.

absolute maximum ratings (25°C unless otherwise noted)

Storage Temperature Range. . . . . −40°C to 125°C
Operating Temperature Range. . . . . −40°C to 100°C

Input Diode		**Output Photodarlington**	
Forward DC Current	50 mA	Collector-Emitter Voltage	25 V
Reverse DC Voltage	3 V	Emitter-Collector Voltage	5 V
Power Dissipation	80 mW(1)	Power Dissipation	50 mW(2)

Notes: (1) Derate linearly 1.07 mW/°C above 25°C.
(2) Derate linearly 0.67 mW/°C above 25°C.
(3) Measured using an Eastman Kodak neutral white test card having 90% diffuse reflectance as a reflecting surface.
(4) Measured using 3M Tape #476 for a reflecting surface. 3M Tape #476 has a very black dull surface with optical reflectance qualities comparable to a surface coated with carbon black printer's ink.
(5) Crosstalk (I_{CX}) is the collector current measured with the indicated current in the input diode and with no reflecting surface.
(6) Lower curve is based on a calculated worst case condition rather than the conventional -2σ limit.
(7) d is the distance from the assembly head to the reflective surface.

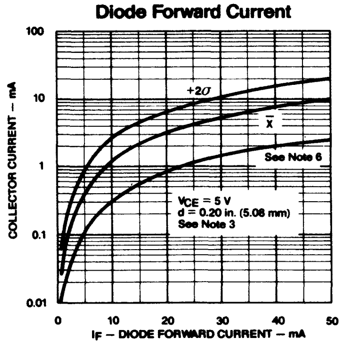
Type OPB125A

electrical characteristics (25°C unless otherwise noted)

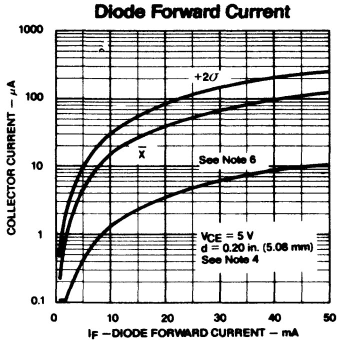
SYMBOL	PARAMETER	MIN	MAX	UNITS	TEST CONDITIONS
INPUT DIODE					
V_F	Forward Voltage		1.7	V	$I_F = 50$ mA
I_R	Reverse Current		100	μA	$V_R = 3$ V
OUTPUT PHOTODARLINGTON					
$V_{(BR)CEO}$	Collector—Emitter Breakdown Voltage	25		V	$I_C = 100$ μA
$V_{(BR)ECO}$	Emitter—Collector Breakdown Voltage	5		V	$I_E = 100$ μA
I_{CEO}	Collector Dark Current		1	μA	$V_{CE} = 10$ V, $I_F = 0$, $E_e \leq 0.1$ μ W/cm^2
COMBINED					
$I_{C(ON)}$	On-State Collector Current	2		mA	$I_F = 40$ mA, $V_{CE} = 5$ V, d = .20 in. (5.08 mm).(7) See Note 3
$I_{C(ON)}$	On-State Collector Current		200	μA	$I_F = 40$ mA, $V_{CE} = 5$ V, d = .20 in. (5.08 mm).(7) See Note 4
I_{CX}	Crosstalk(5)		20	μA	$I_F = 40$ mA, $V_{CE} = 5$ V, No Reflecting Surface

Typical Performance Curves:

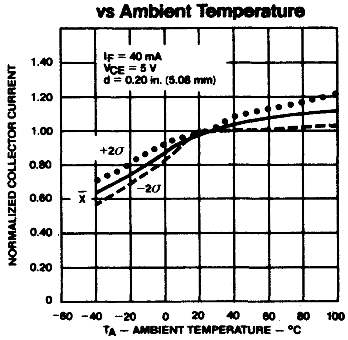
Collector Current vs Diode Forward Current



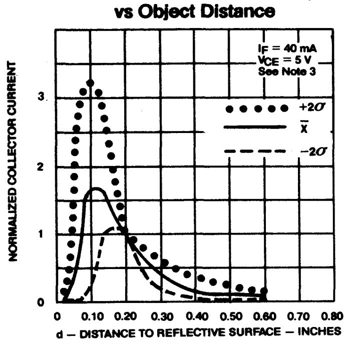
Collector Current vs Diode Forward Current



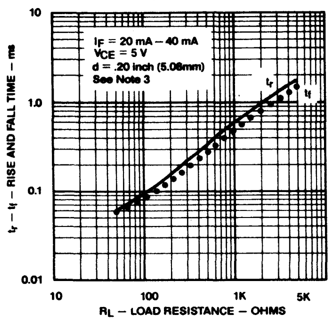
Normalized Collector Current vs Ambient Temperature



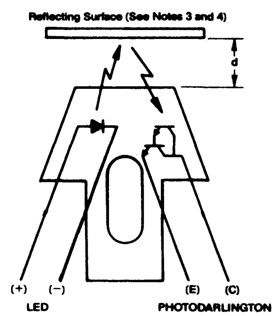
Normalized Collector Current vs Object Distance



Rise and Fall Time vs Load Resistance



TEST CONDITION



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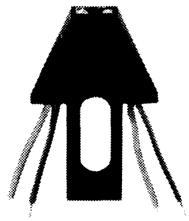
Printed in U.S.A.

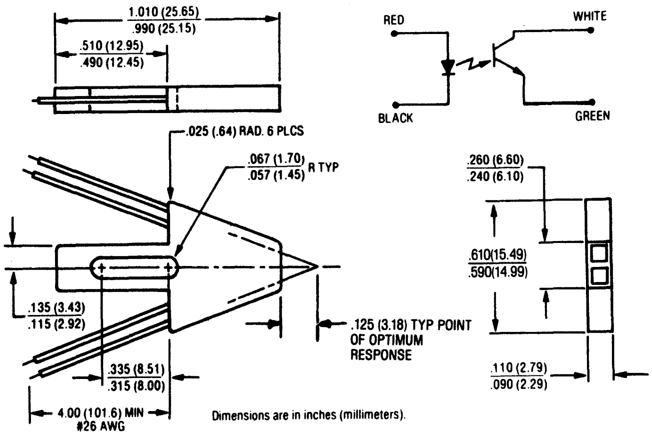
TRW OPTRON

PRODUCT BULLETIN 3094
APRIL 1982

Reflective Object Sensor
Type OPB253A



ACTUAL SIZE



Features
- PHOTOTRANSISTOR OUTPUT
- LOW PROFILE TO FACILITATE STACKING
- LOW COST PLASTIC HOUSING
- 4.0 INCHES (101.6 mm) MINIMUM LENGTH LEAD WIRE

Description
The OPB253A consists of a gallium arsenide infrared emitting diode and an NPN silicon phototransistor mounted side-by-side on converging optical axes, in a black plastic housing. The phototransistor responds to radiation from the LED only when a reflective object passes within its field of view.

All electrical parameters are 100% tested by manufacturing. Specifications are guaranteed to a cumulative .65% AQL.

absolute maximum ratings (25°C unless otherwise noted)
Storage Temperature Range. . . . . −40°C to 125°C
Operating Temperature Range. . . . . −40°C to 100°C

Input Diode		Output Phototransistor	
Forward DC Current	50 mA	Collector-Emitter Voltage	25 V
Reverse DC Voltage	3 V	Emitter-Collector Voltage	5 V
Power Dissipation	80 mW(1)	Power Dissipation	50 mW(2)

Notes: (1) Derate linearly 1.07 mW/°C above 25°C.
(2) Derate linearly 0.67 mW/°C above 25°C.
(3) Measured using an Eastman Kodak neutral white test card having 90% diffuse reflectance as a reflecting surface.
(4) Measured using 3M Tape #476 for a reflecting surface. 3M Tape #476 has a very black dull surface with optical reflectance qualities comparable to a surface coated with carbon black printer's ink.
(5) Crosstalk (I_{CX}) is the collector current measured with the indicated current in the input diode and with no reflecting surface.
(6) Lower curve is based on a calculated worst case condition rather than the conventional -2σ limit.
(7) d is the distance from the assembly head to the reflective surface.

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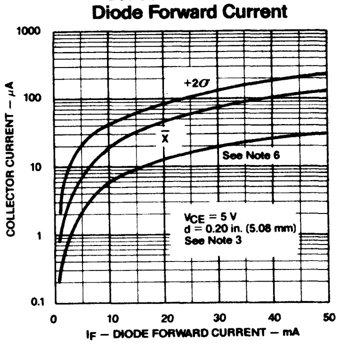
Type OPB253A

electrical characteristics (25°C unless otherwise noted)

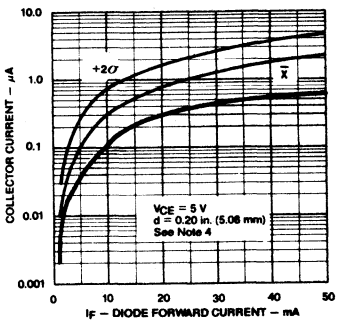
SYMBOL	PARAMETER	MIN	MAX	UNITS	TEST CONDITIONS
INPUT DIODE					
V_F	Forward Voltage		1.7	V	$I_F = 50$ mA
I_R	Reverse Current		100	μA	$V_R = 3$ V
OUTPUT PHOTOTRANSISTOR					
$V_{(BR)CEO}$	Collector—Emitter Breakdown Voltage	25		V	$I_C = 100\ \mu$A
$V_{(BR)ECO}$	Emitter—Collector Breakdown Voltage	5		V	$I_E = 100\ \mu$A
I_{CEO}	Collector Dark Current		100	nA	$V_{CE} = 10$ V, $I_F = 0$, $E_e \leq 0.1\ \mu$ W/cm^2
COMBINED					
$I_{C(ON)}$	On-State Collector Current	25		μA	$I_F = 40$ mA, $V_{CE} = 5$ V, d = .20 in. (5.08 mm).[7] See Note 3
$I_{C(ON)}$	On-State Collector Current		10	μA	$I_F = 40$ mA, $V_{CE} = 5$ V, d = .20 in. (5.08 mm).[7] See Note 4
I_{CX}	Crosstalk[5]		2	μA	$I_F = 40$ mA, $V_{CE} = 5$ V, No Reflecting Surface

Typical Performance Curves:

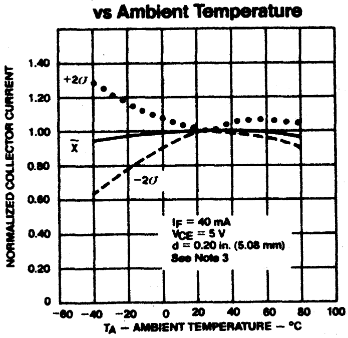
Collector Current vs Diode Forward Current



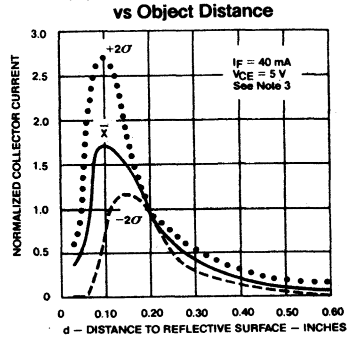
Collector Current vs Diode Forward Current



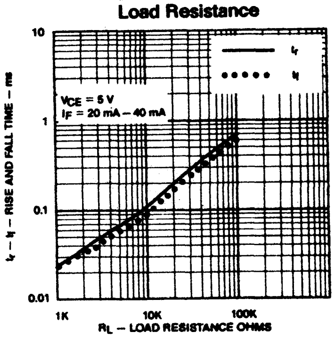
Normalized Collector Current vs Ambient Temperature



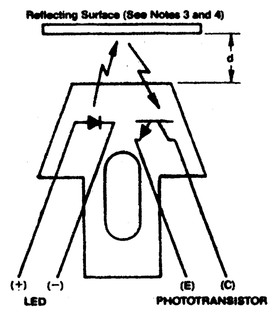
Normalized Collector Current vs Object Distance



Rise and Fall Time vs Load Resistance



TEST CONDITION



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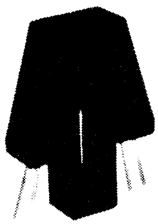
Printed in U.S.A.

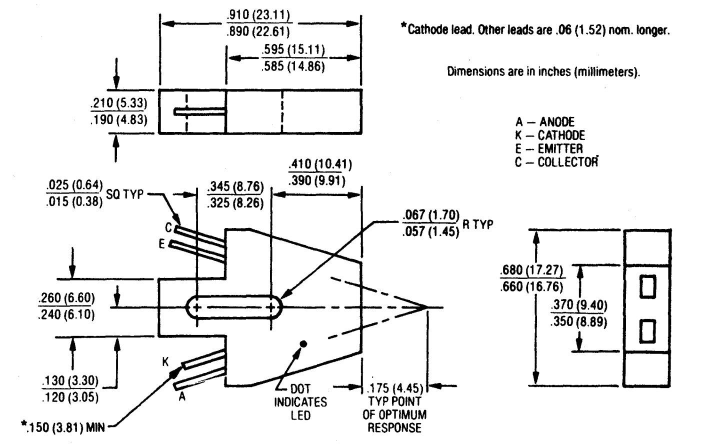
TRW OPTRON

PRODUCT BULLETIN 3103
APRIL 1982

Reflective Object Sensor
Type OPB703A



ACTUAL SIZE



Features

- PHOTOTRANSISTOR OUTPUT
- HIGH SENSITIVITY
- LOW COST PLASTIC HOUSING
- LENSED FOR DUST PROTECTION AND AMBIENT LIGHT FILTRATION

Description

The OPB703A consists of a gallium arsenide infrared emitting diode and an NPN silicon phototransistor mounted side-by-side on converging optical axes, in a black plastic housing. A filtering lens in the face of the housing seals the device from dust and dirt and reduces ambient light noise. The photosensor responds to radiation from the LED only when a reflective object passes within its field of view.

All electrical parameters are 100% tested by manufacturing. Specifications are guaranteed to a cumulative .65% AQL.

absolute maximum ratings (25°C unless otherwise noted)

Storage Temperature Range. . . . . −40°C to 80°C
Operating Temperature Range. . . . . −40°C to 80°C
Lead Soldering Temperature (1/16 in. [1.6 mm] From Case
for 5 Sec. with Soldering Iron)(1). . . . . 240°C

Input Diode		**Output Photosensor**	
Forward DC Current	40 mA	Collector-Emitter Voltage	30 V
Reverse DC Voltage	3 V	Emitter-Collector Voltage	5 V
Power Dissipation	70 mW(2)	Power Dissipation	50 mW(3)

Notes: (1) RMA flux is recommended. Duration can be extended to 10 sec. max. when flow soldering.
(2) Derate linearly 1.27 mW/°C above 25°C
(3) Derate linearly 0.91 mW/°C above 25°C
(4) d is the distance from the assembly face to the reflective surface.
(5) Measured using an Eastman Kodak neutral white test card having 90% diffuse reflectance as a reflecting surface.
(6) Measured using 3M Tape #476 for a reflecting surface. 3M Tape #476 has a very black dull surface with optical reflectance qualities comparable to a surface coated with carbon black printers ink.
(7) Lower curve is based on a calculated worst case condition rather than the conventional -2σ limit.

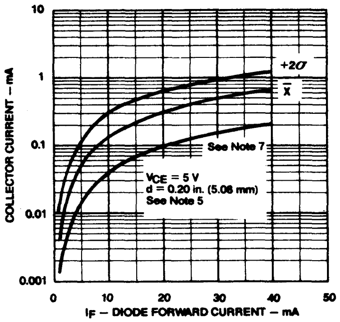
Type OPB703A

electrical characteristics (25°C ambient temperature unless otherwise noted)

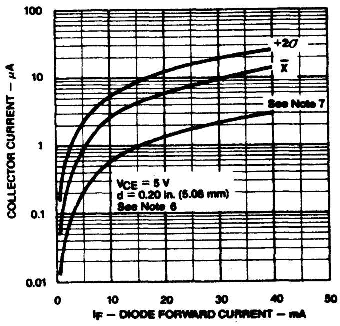
SYMBOL	PARAMETER	MIN	MAX	UNITS	TEST CONDITIONS
INPUT DIODE					
V_F	Forward Voltage		1.7	V	$I_F = 40$ mA
I_R	Reverse Current		100	μA	$V_R = 3$ V
OUTPUT PHOTOTRANSISTOR					
$V_{(BR)CEO}$	Collector—Emitter Breakdown Voltage	30		V	$I_C = 100$ μA
$V_{(BR)ECO}$	Emitter—Collector Breakdown Voltage	5		V	$I_E = 100$ μA
I_{CEO}	Collector Dark Current		100	nA	$V_{CE} = 10$ V, $I_F = 0$, $E_e \leq 0.1$ μ W/cm²
COMBINED					
$I_{C(ON)}$	On-State Collector Current	200		μA	$I_F = 40$ mA, $V_{CE} = 5$ V, d = .20 in. (5.08 mm).[4] See Note 5
$I_{C(ON)}$	On-State Collector Current		35	μA	$I_F = 40$ mA, $V_{CE} = 5$ V, d = .20 in. (5.08 mm).[4] See Note 6

Typical Performance Curves:

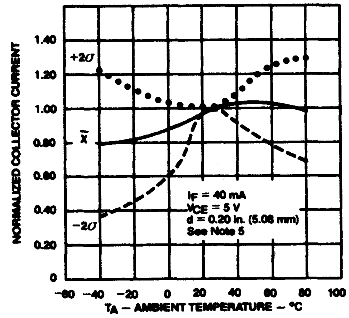
Collector Current vs Diode Forward Current



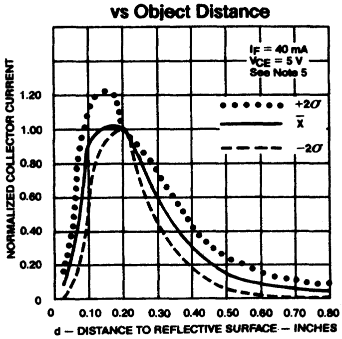
Collector Current vs Diode Forward Current



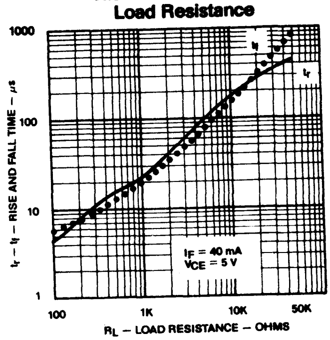
Normalized Collector Current vs Ambient Temperature



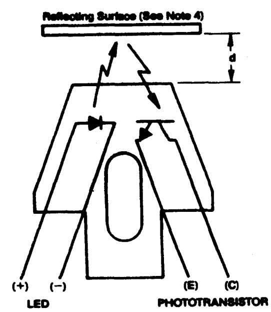
Normalized Collector Current vs Object Distance



Rise and Fall Time vs Load Resistance



TEST CONDITION



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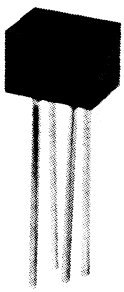
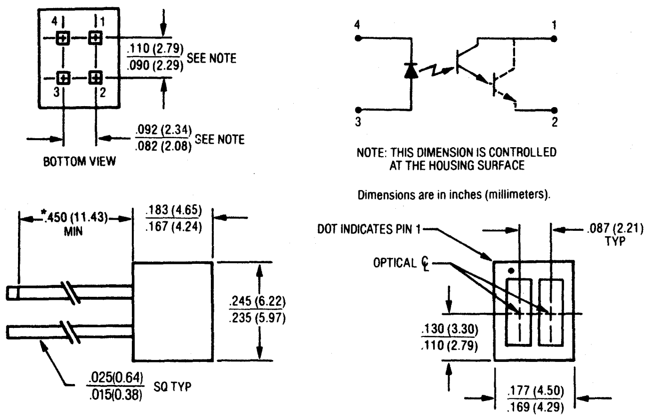
Reflective Object Sensors
Types OPB706, OPB707



TWICE ACTUAL SIZE



*Cathode lead. Other leads are .06 (1.52) nom. longer.

Features

- PHOTOTRANSISTOR (OPB706) OR PHOTODARLINGTON (OPB707) OUTPUT
- UNFOCUSED FOR SENSING DIFFUSE SURFACES
- LOW COST PLASTIC HOUSING

Description

The OPB706 and OPB707 each consist of a gallium arsenide infrared emitting diode and an NPN silicon phototransistor (OPB706) or photodarlington (OPB707) mounted side-by-side on parallel axes in a black plastic housing. Both the emitting diode and photosensor are molded out of black plastic to reduce ambient light noise. The photosensor responds to radiation from the LED only when a reflective object passes within its field of view.

All electrical parameters are 100% tested by manufacturing. Specifications are guaranteed to a cumulative .65% AQL.

absolute maximum ratings (25°C unless otherwise noted)

Operating Temperature Range . . . . −55°C to 80°C
Storage Temperature Range . . . . −55°C to 80°C
Soldering Temperature (1/16 in. [1.6 mm] From Case for 3 Sec.
With Soldering Iron)(1) . . . . 240°C

Input Diode		Output Photosensor	OPB706	OPB707
Forward DC Current	50 mA	Collector-Emitter Voltage	30 V	15 V
Peak Forward Current (Pulse Width = 1 μ sec., 300 pps)	3 A	Emitter-Collector Voltage	5 V	5 V
Reverse DC Voltage	3 V	Collector DC Current	25 mA	125 mA
Power Dissipation	75 mW(2)	Power Dissipation	75 mW(2)	125 mW(3)

Notes: (1) RMA flux is recommended. Duration can be extended to 10 sec. max. when flow soldering.
(2) Derate linearly 1.36 mW/°C above 25°C.
(3) Derate linearly 2.27 mW/°C above 25°C
(4) d is the distance from the assembly face to the reflective surface.
(5) Measured using an Eastman Kodak neutral white test card having 90% diffuse reflectance as a reflecting surface.
(6) Crosstalk (I_{CX}) is the collector current measured with the indicated current in the input diode and with no reflecting surface.
(7) Lower curve is based on a calculated worst case condition rather than the conventional -2σ limit.

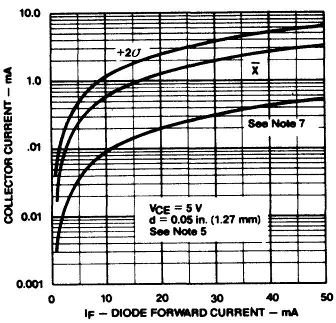
Type OPB706

electrical characteristics (25°C ambient temperature unless otherwise noted)

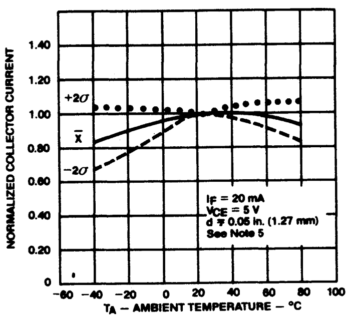
SYMBOL	PARAMETER	MIN	TYP	MAX	UNITS	TEST CONDITIONS
INPUT DIODE						
V_F	Forward Voltage			1.7	V	$I_F = 20$ mA
I_R	Reverse Current			100	μA	$V_R = 3$ V
OUTPUT PHOTOTRANSISTOR						
$V_{(BR)CEO}$	Collector—Emitter Breakdown Voltage	30			V	$I_C = 100\ \mu A$
$V_{(BR)ECO}$	Emitter—Collector Breakdown Voltage	5			V	$I_E = 100\ \mu A$
I_{CEO}	Collector Dark Current			100	nA	$V_{CE} = 5$ V, $I_F = 0$, $E_e \leq 0.1\ \mu$ W/cm^2
COMBINED						
$I_{C(ON)}$	On-State Collector Current OPB706A OPB706B OPB706C	 500 350 200	 1000 700 400		 μA μA μA	$I_F = 20$ mA $V_{CE} = 5$ V d = 0.05 in. (1.27 mm)(4) See Note 5
I_{CX}	Crosstalk(6)			0.20	μA	$I_F = 20$ mA $V_{CE} = 5$ V No Reflecting Surface

Typical Performance Curves:

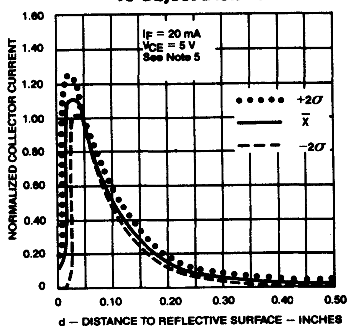
Collector Current vs Diode Forward Current



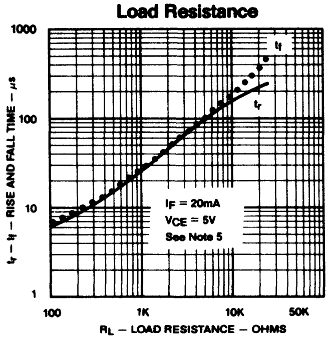
Normalized Collector Current vs Ambient Temperature



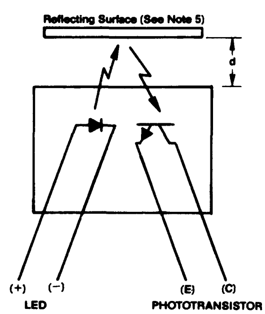
Normalized Collector Current vs Object Distance



Rise and Fall Time vs Load Resistance



TEST CONDITION



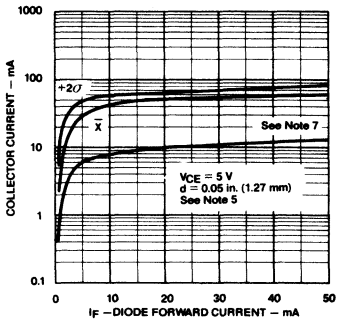
Type OPB707

electrical characteristics (25°C ambient temperature unless otherwise noted)

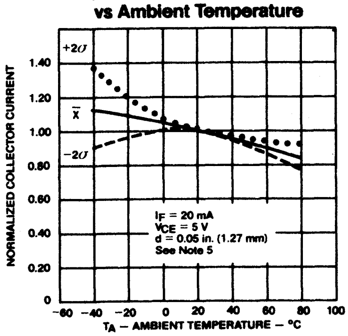
SYMBOL	PARAMETER	MIN	TYP	MAX	UNITS	TEST CONDITIONS
INPUT DIODE						
V_F	Forward Voltage			1.7	V	$I_F = 20$ mA
I_R	Reverse Current			100	μA	$V_R = 3$ V
OUTPUT PHOTODARLINGTON						
$V_{(BR)CEO}$	Collector–Emitter Breakdown Voltage	15			V	$I_C = 100$ μA
$V_{(BR)ECO}$	Emitter–Collector Breakdown Voltage	5			V	$I_E = 100$ μA
I_{CEO}	Collector Dark Current			250	nA	$V_{CE} = 5$ V, $I_F = 0$, $E_e \leq 0.1$ μ W/cm²
COMBINED						
$I_{C(ON)}$	On-State Collector Current OPB707A OPB707B OPB707C	 25 17 10	 50 34 20		 mA mA mA	$I_F = 20$ mA $V_{CE} = 5$ V d = 0.05 in. (1.27 mm)[4] See Note 5
I_{CX}	Crosstalk[6]			10	μA	$I_F = 20$ mA $V_{CE} = 5$ V No Reflecting Surface

Typical Performance Curves:

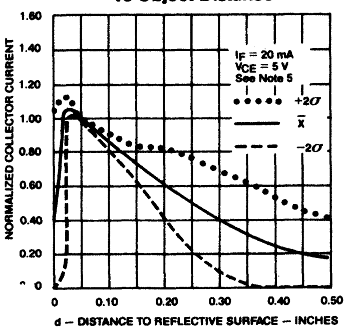
Collector Current vs Diode Forward Current



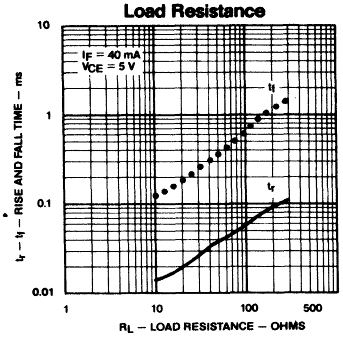
Normalized Collector Current vs Ambient Temperature



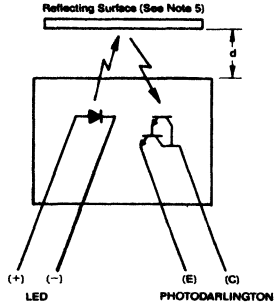
Normalized Collector Current vs Object Distance



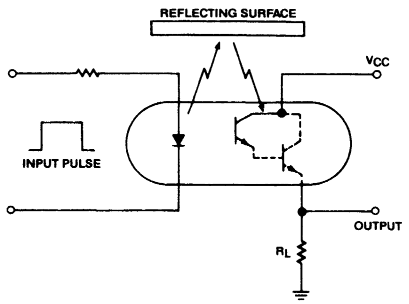
Rise and Fall Time vs Load Resistance



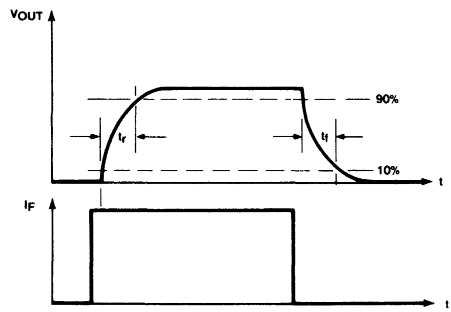
TEST CONDITION



Response Time Test Circuit

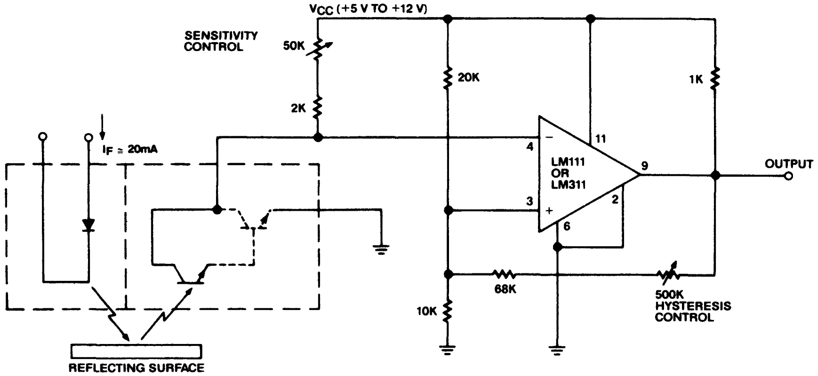


Switching Time Waveforms



Typical Interfacing Circuit

Recommended for applications requiring adjustments on both sensitivity and hysteresis.



(Optron assumes no responsibility for use of any circuits shown and makes no representation that they are free from patent infringement.)

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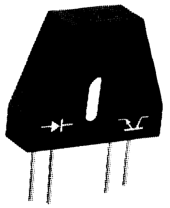
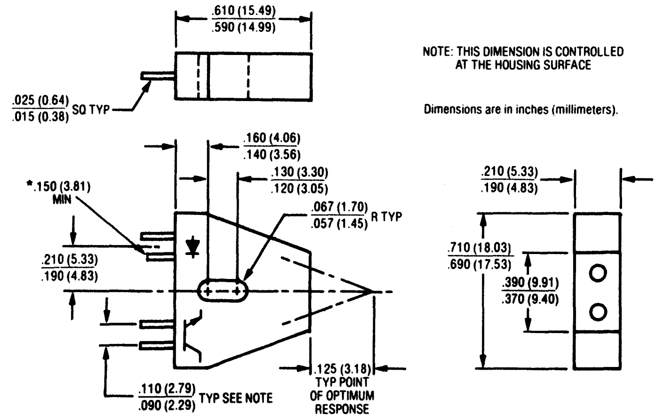
Reflective Object Sensors
Types OPB708, OPB709



ACTUAL SIZE



*Cathode lead. Other leads are .06 (1.52) nom. longer.

Features

- PHOTOTRANSISTOR (OPB708) OR PHOTODARLINGTON (OPB709) OUTPUT
- CROSSTALK DOES NOT EXCEED SPECIFIED I_{CEO}
- LOW COST PLASTIC HOUSING

Description

The OPB708 and OPB709 each consist of a gallium arsenide infrared emitting diode and an NPN silicon phototransistor (OPB708) or photodarlington (OPB709) mounted side-by-side on converging optical axes, in a black plastic housing. Housing material is flame retardant ABS which meets UL 94V-O standards.

The photosensor responds to radiation from the LED only when a reflective object passes within its field of view.

All electrical parameters are 100% tested by manufacturing. Specifications are guaranteed to a cumulative .65% AQL.

absolute maximum ratings (25°C unless otherwise noted)

Storage Temperature Range .... −40°C to 80°C
Operating Temperature Range .... −40°C to 80°C
Lead Soldering Temperature (1/16 in. [1.6 mm] From Case for 5 Sec. With Soldering Iron) .... 240°C(1)

Input Diode		Output Photosensor	OPB708	OPB709
Forward DC Current	40 mA	Collector-Emitter Voltage	30 V	15 V
Reverse DC Voltage	3 V	Emitter-Collector Voltage	5 V	5 V
Power Dissipation	60 mW(2)	Power Dissipation	50 mW(3)	125 mW(4)

Notes:
(1) RMA flux is recommended. Duration can be extended to 10 sec. max. when flow soldering.
(2) Derate linearly 1.09 mW/°C above 25°C.
(3) Derate linearly 0.91 mW/°C above 25°C.
(4) Derate linearly 2.27 mW/°C above 25°C.
(5) d is the distance from the assembly face to the reflective surface.
(6) Reflective surface is Eastman Kodak neutral white test card with 90% diffuse reflectance located 0.15 in. (3.81 mm) from the assembly face.
(7) Reflective surface is magnetic tape placed 0.15 in. (3.81 mm) from assembly face.
(8) Reflective surface is aluminum foil, typical of beginning-of-tape strips on magnetic tape surface. Caution: Do not use a load such that the maximum power rating is exceeded on the OPB709 sensor.
(9) Crosstalk (I_{CX}) is the collector current measured with the indicated current in the input diode and with no reflecting surface.
(10) Lower curve is based on a calculated worst case condition rather than the conventional -2σ limit.

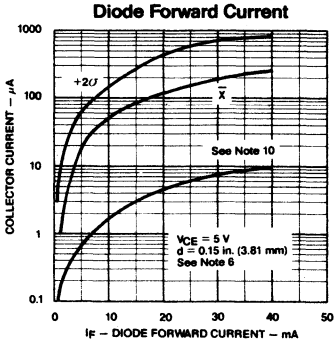
Type OPB708

electrical characteristics (25°C unless otherwise noted)

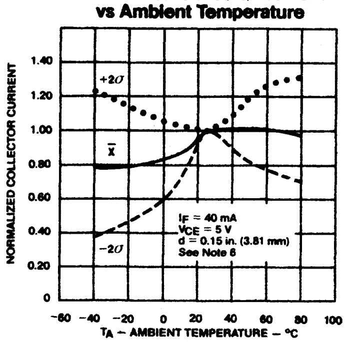
SYMBOL	PARAMETER	MIN	TYP	MAX	UNITS	TEST CONDITIONS
INPUT DIODE						
V_F	Forward Voltage			1.7	V	$I_F = 40$ mA
I_R	Reverse Current			100	μA	$V_R = 3$ V
OUTPUT PHOTOTRANSISTOR						
$V_{(BR)CEO}$	Collector—Emitter Breakdown Voltage	30			V	$I_C = 100\ \mu A$
$V_{(BR)ECO}$	Emitter—Collector Breakdown Voltage	5			V	$I_E = 100\ \mu A$
I_{CEO}	Collector Dark Current			100	nA	$V_{CE} = 15$ V, $I_F = 0$, $E_e \leq 0.1\ \mu W/cm^2$
COMBINED						
$I_{C(ON)}$	On-State Collector Current(6)	10	55		μA	$V_{CE} = 5$ V, $I_F = 40$ mA
$I_{C(ON)}$	On-State Collector Current(7)		65		μA	$V_{CE} = 5$ V, $I_F = 40$ mA
$I_{C(ON)}$	On-State Collector Current(8)		1		mA	$V_{CE} = 5$ V, $I_F = 40$ mA
I_{CX}	Crosstalk(9)			100	nA	$V_{CE} = 5$ V, $I_F = 40$ mA No Reflecting Surface

Typical Performance Curves:

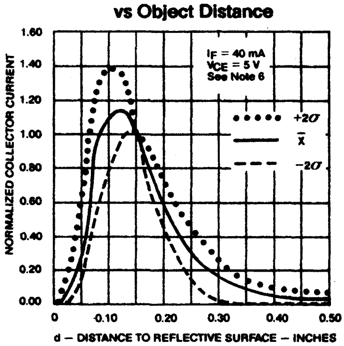
Collector Current vs Diode Forward Current



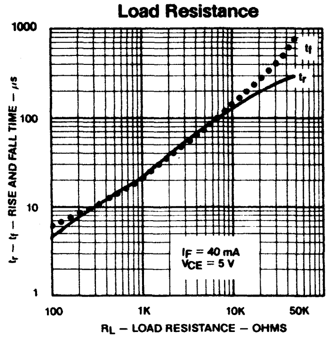
Normalized Collector Current vs Ambient Temperature



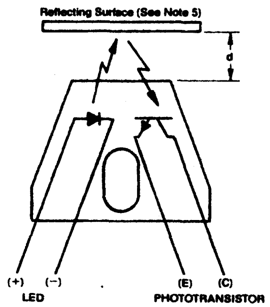
Normalized Collector Current vs Object Distance



Rise and Fall Time vs Load Resistance



TEST CONDITION



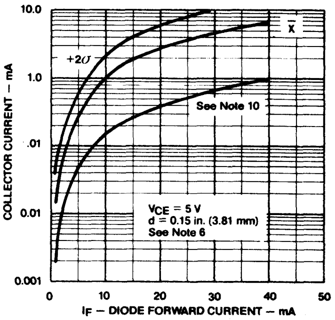
Type OPB709

electrical characteristics (25°C unless otherwise noted)

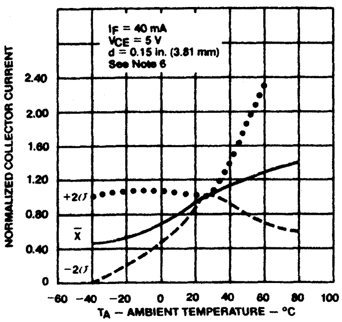
SYMBOL	PARAMETER	MIN	TYP	MAX	UNITS	TEST CONDITIONS
INPUT DIODE						
V_F	Forward Voltage			1.7	V	$I_F = 40$ mA
I_R	Reverse Current			100	μA	$V_R = 3$ V
OUTPUT PHOTODARLINGTON						
$V_{(BR)CEO}$	Collector—Emitter Breakdown Voltage	15			V	$I_C = 100\ \mu A$
$V_{(BR)ECO}$	Emitter—Collector Breakdown Voltage	5			V	$I_E = 100\ \mu A$
I_{CEO}	Collector Dark Current			250	nA	$V_{CE} = 10$ V, $I_F = 0$, $E_e \leq 0.1\ \mu W/cm^2$
COMBINED						
$I_{C(ON)}$	On-State Collector Current(6)	1	8		mA	
$I_{C(ON)}$	On-State Collector Current(7)		9		mA	$V_{CE} = 5$ V, $I_F = 40$ mA
$I_{C(ON)}$	On-State Collector Current(8)		140		mA	
I_{CX}	Crosstalk(9)			250	nA	$V_{CE} = 5$ V, $I_F = 40$ mA No Reflecting Surface

Typical Performance Curves:

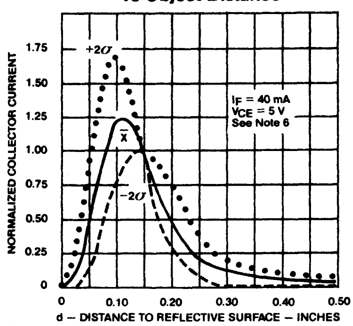
Collector Current vs Diode Forward Current



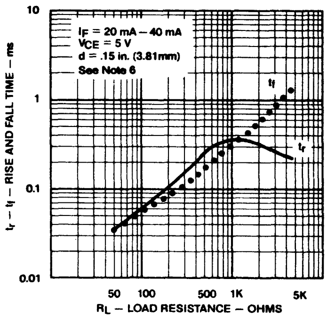
Normalized Collector Current vs Ambient Temperature



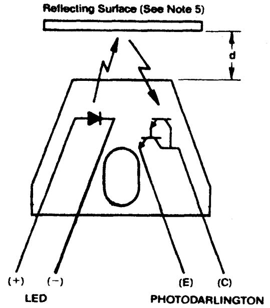
Normalized Collector Current vs Object Distance



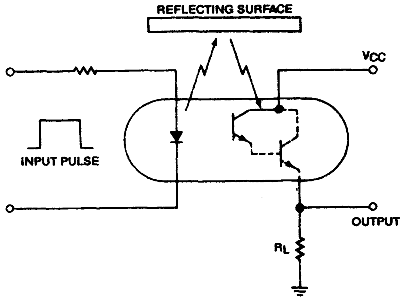
Rise and Fall Time vs Load Resistance



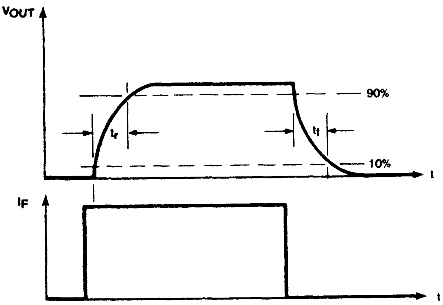
TEST CONDITION



Response Time Test Circuit

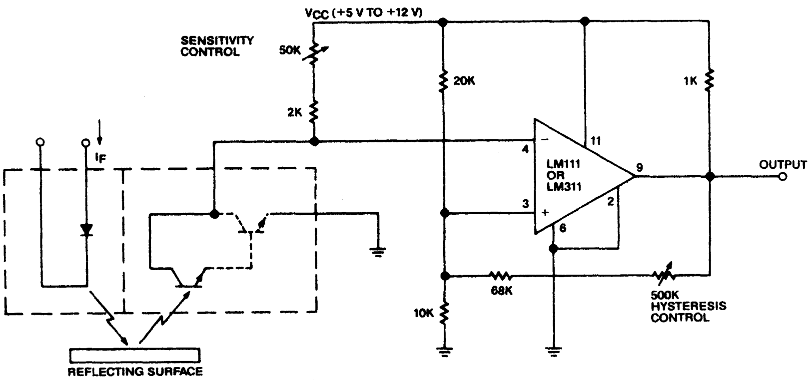


Switching Time Waveforms



Typical Interfacing Circuit

Recommended for applications requiring adjustments on both sensitivity and hysteresis.



(Optron assumes no responsibility for use of any circuits shown and makes no representation that they are free from patent infringement.)

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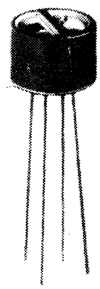
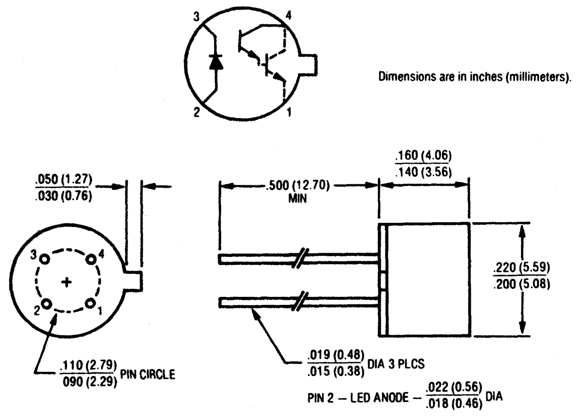
TRW OPTRON

PRODUCT BULLETIN 3106
APRIL 1982

Reflective Object Sensors
Type OPB710, OPB730



TWICE ACTUAL SIZE



Features
- PHOTOTRANSISTOR (OPB710) OR PHOTODARLINGTON (OPB730) OUTPUT
- UNFOCUSED FOR SENSING DIFFUSE SURFACES
- MOUNTED ON STANDARD TO-72 HEADER

Description
The OPB710 and OPB 730 each consist of a gallium arsenide infrared emitting diode and an NPN silicon phototransistor (OPB710) or photodarlington (OPB730) mounted side-by-side on parallel axes, on a standard four lead TO-72 header. The LED and photosensor are covered with clear epoxy and surrounded by a black plastic sleeve. The photosensor responds to radiation from the LED only when a reflective object passes within its field of view.

All electrical parameters are 100% tested by manufacturing. Specifications are guaranteed to a cumulative .65% AQL.

absolute maximum ratings (25°C unless otherwise noted)
Storage Temperature Range. . . . . −20°C to 80°C
Operating Temperature Range. . . . . 0°C to 70°C
Lead Soldering Temperature (1/16 in. [1.6 mm] From Case, For 5 Seconds with Soldering Iron)(1). . . . . 240°C

Input Diode
Forward DC Current. . . . . 50 mA
Peak Forward Current (1 μs Pulse Width, 300 pps). . . . . . . 3 V
Reverse DC Voltage. . . . . 3 V
Power Dissipation. . . . . 75 mW(2)

Output Photosensor
Collector-Emitter Voltage. . . . . 30 V
Emitter-Collector Voltage. . . . . 5 V
Collector DC Current. . . . . 25 mA
Power Dissipation. . . . . 150 mW(3)

Notes: (1) RMA flux is recommended. Duration can be extended to 10 sec. max. when flow soldering.
(2) Derate linearly 1.67 mW/°C above 25°C.
(3) Derate linearly 3.3 mW/°C above 25°C.
(4) d is the distance from the assembly head to the reflective surface.
(5) Measured using as a reflecting surface an Eastman Kodak neutral white test card having 90% diffuse reflectance located 0.25 in. (6.35 mm) from the face of the OPB710/730.
(6) Crosstalk (I_{CX}) is the collector current measured with the indicated current in the input diode and with no reflecting surface.

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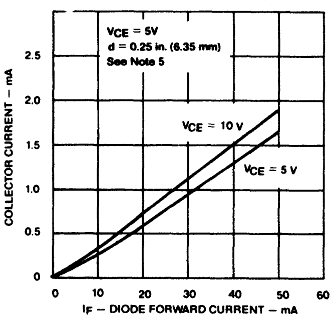
Type OPB710

electrical characteristics (25°C unless otherwise noted)

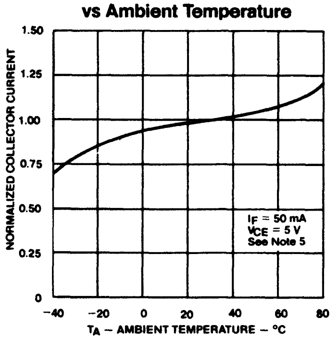
SYMBOL	PARAMETER	MIN	MAX	UNITS	TEST CONDITIONS
INPUT DIODE					
V_F	Forward Voltage		1.5	V	$I_F = 50$ mA
I_R	Reverse Current		100	μA	$V_R = 3$ V
OUTPUT PHOTOTRANSISTOR					
$V_{(BR)CEO}$	Collector—Emitter Breakdown Voltage	20		V	$I_C = 1$ mA
$V_{(BR)ECO}$	Emitter—Collector Breakdown Voltage	5		V	$I_E = 100$ μA
I_{CEO}	Collector Dark Current		100	nA	$V_{CE} = 5$ V, $I_F = 0$, $E_e \leq 0.1$ μ W/cm[2]
COMBINED					
$I_{C(ON)}$	On-State Collector Current	150		μA	$I_F = 50$ mA; $V_{CE} = 5$ V, d = 0.25 in. (6.35 mm).[5] See Test Condition[4]
I_{CX}	Crosstalk[6]		400	nA	$I_F = 50$ mA, $V_{CE} = 5$ V No Reflecting Surface

Typical Performance Curves:

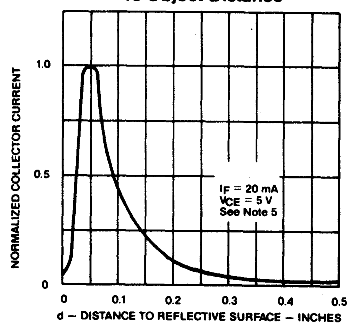
Collector Current vs Diode Forward Current



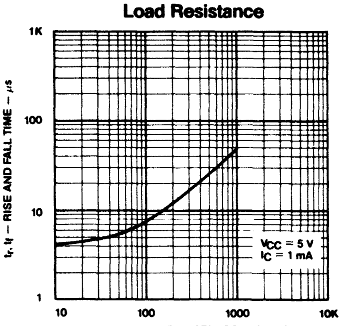
Normalized Collector Current vs Ambient Temperature



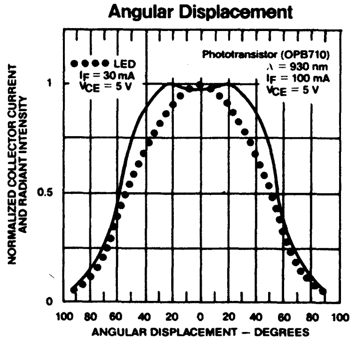
Normalized Collector Current vs Object Distance



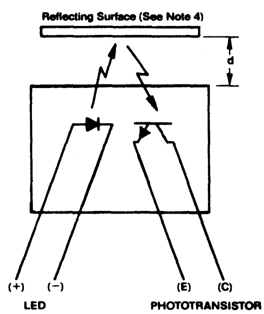
Rise and Fall Time vs Load Resistance



LED and Phototransistor Angular Displacement



TEST CONDITION



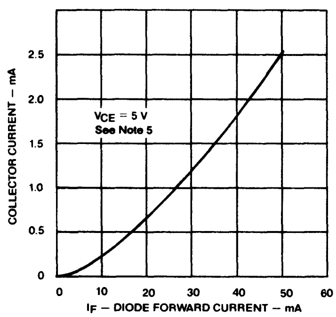
Type OPB730

electrical characteristics (25°C unless otherwise noted)

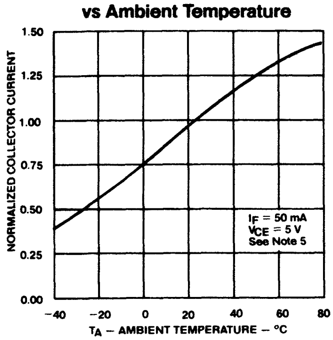
SYMBOL	PARAMETER	MIN	MAX	UNITS	TEST CONDITIONS
INPUT DIODE					
V_F	Forward Voltage		1.5	V	$I_F = 50$ mA
I_R	Reverse Current		100	μA	$V_R = 3$ V
OUTPUT PHOTODARLINGTON					
$V_{(BR)CEO}$	Collector—Emitter Breakdown Voltage	20		V	$I_C = 1$ mA
$V_{(BR)ECO}$	Emitter—Collector Breakdown Voltage	5		V	$I_E = 100\ \mu$A
I_{CEO}	Collector Dark Current		250	nA	$V_{CE} = 5$ V, $I_F = 0$, $E_e \leq 0.1\ \mu$ W/cm^2
COMBINED					
$I_{C(ON)}$	On-State Collector Current	1000		μA	$I_F = 50$ mA, $V_{CE} = 5$ V, d = 0.25 in. (6.35 mm).[5] See Note 4
I_{CX}	Crosstalk[6]		500	nA	$I_F = 50$ mA, $V_{CE} = 5$ V No Reflecting Surface

Typical Performance Curves:

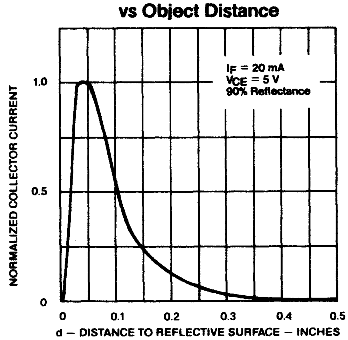
Collector Current vs Diode Forward Current



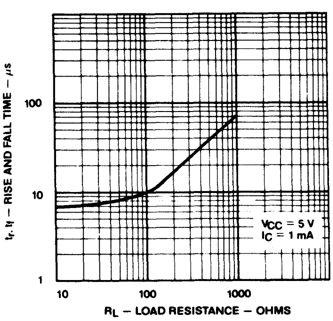
Normalized Collector Current vs Ambient Temperature



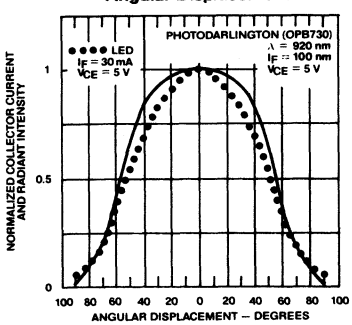
Normalized Collector Current vs Object Distance



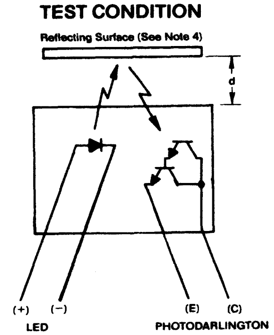
Rise and Fall Time vs Load Resistance



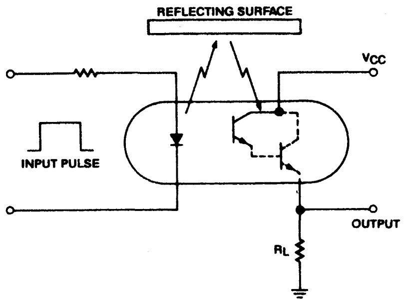
LED and Photodarlington Angular Displacement



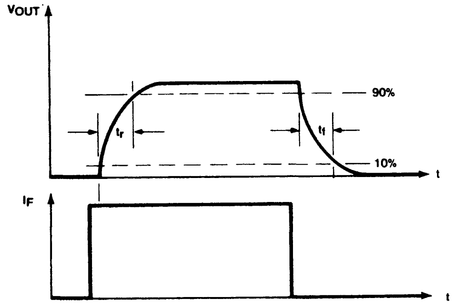
TEST CONDITION



Response Time Test Circuit

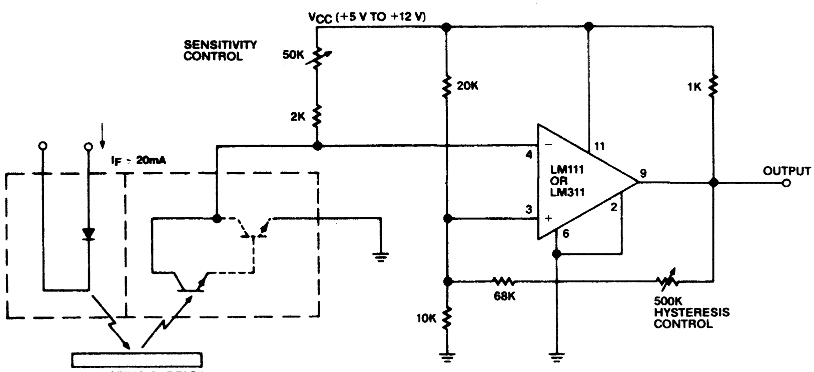


Switching Time Waveforms



Typical Interfacing Circuit

Recommended for applications requiring adjustments on both sensitivity and hysteresis.



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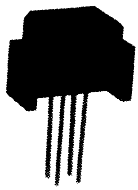
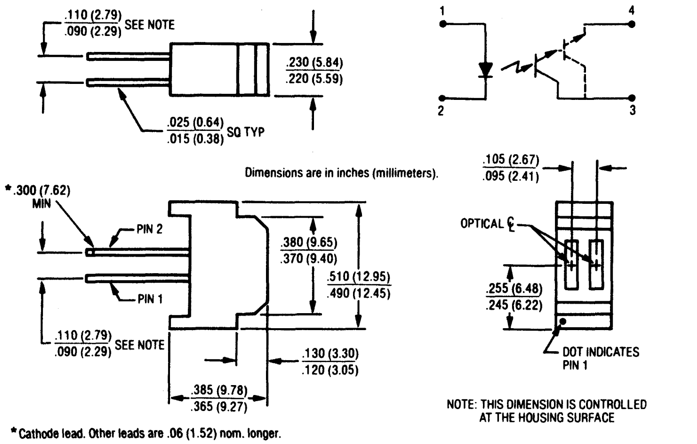
Reflective Object Sensors

Types OPB711, OPB712



ACTUAL SIZE



Features

- PHOTOTRANSISTOR (OPB711) OR PHOTODARLINGTON (OPB712) OUTPUT
- UNFOCUSED FOR SENSING DIFFUSE SURFACES
- LOW COST PLASTIC HOUSING

Description

The OPB711 and OPB712 each consist of a gallium arsenide infrared emitting diode and an NPN silicon phototransistor (OPB711) or photodarlington (OPB712) mounted side-by-side on parallel axes, in a black plastic housing. Both the emitting diode and photosensor are molded out of black plastic to reduce ambient light noise. The photosensor responds to radiation from the LED only when a reflective object passes within its field of view.

All electrical parameters are 100% tested by manufacturing. Specifications are guaranteed to a cumulative .65% AQL.

absolute maximum ratings (25°C unless otherwise noted)

Storage and Operating Temperature Range .... −40°C to 80°C

Lead Soldering Temperature (1/16 in. [1.6 mm] From Case for 5 Sec. With Soldering Iron)(1) .... 240°C

Input Diode		Output Photosensor	OPB711	OPB712
Reverse DC Voltage	3 V	Collector-Emitter Voltage	30 V	15 V
Forward DC Current	50 mA	Emitter-Collector Voltage	5 V	5 V
Peak Forward Current (1 μs pulse width, 300 pps)	3 A	Collector DC Current	25 mA	125 mA
Power Dissipation	80 mW(2)	Power Dissipation	80 mW(2)	125 mW(7)

Notes: (1) RMA flux is recommended. Duration can be extended to 10 sec. max. when flow soldering.

(2) Derate linearly 1.33 mW/°C above 25°C.

(3) d is the distance from the assembly head to the reflective surface.

(4) Measured using an Eastman Kodak neutral white test card with 90% diffuse reflectance as a reflecting surface.

(5) Crosstalk (I_{CX}) is the collector current measured with the indicated current in the input diode and with no reflecting surface.

(6) Lower curve is based on a calculated worst case condition rather than the conventional -2σ limit.

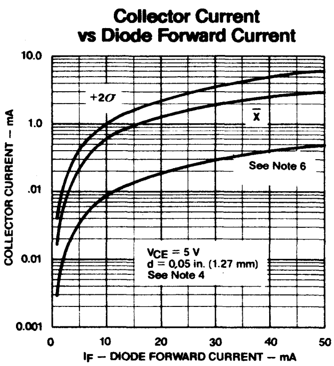
(7) derate linearly 2.27 mW/°C above 25°C.

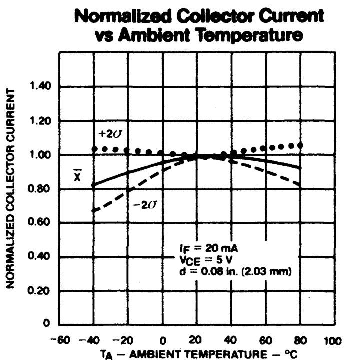
Type OPB711

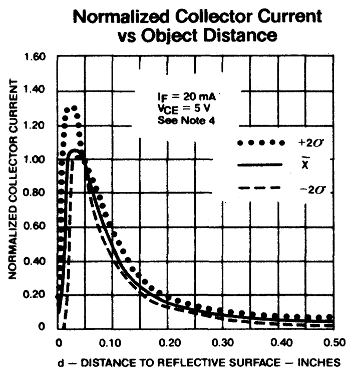
electrical characteristics (25°C unless otherwise noted)

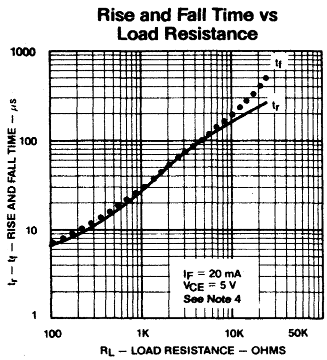
SYMBOL	PARAMETER	MIN	MAX	UNITS	TEST CONDITIONS
INPUT DIODE					
V_F	Forward Voltage		1.7	V	$I_F = 20$ mA
I_R	Reverse Current		100	μA	$V_R = 3$ V
OUTPUT PHOTOTRANSISTOR					
$V_{(BR)CEO}$	Collector—Emitter Breakdown Voltage	30		V	$I_C = 100$ μA
$V_{(BR)ECO}$	Emitter—Collector Breakdown Voltage	5		V	$I_E = 100$ μA
I_{CEO}	Collector Dark Current		100	nA	$V_{CE} = 10$ V, $I_F = 0$, $E_e \leq 0.1$ μ W/cm²
COMBINED					
$I_{C(ON)}$	On-State Collector Current(4)	50		μA	$I_F = 50$ mA, $V_{CE} = 5$ V d = 0.4 in. (10.2 mm)(3)
		350		μA	$I_F = 20$ mA, $V_{CE} = 5$ V d = 0.08 in. (2.03 mm)(3)
I_{CX}	Crosstalk(5)		100	nA	$V_{CE} = 5$ V, $I_F = 20$ mA No Reflecting Surface

Typical Performance Curves:

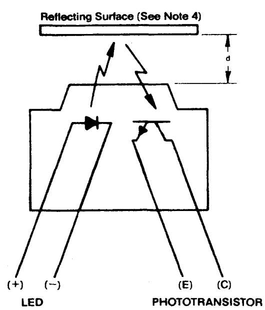








TEST CONDITION

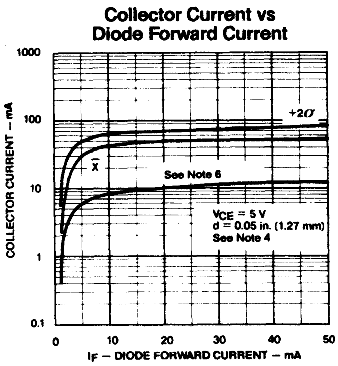


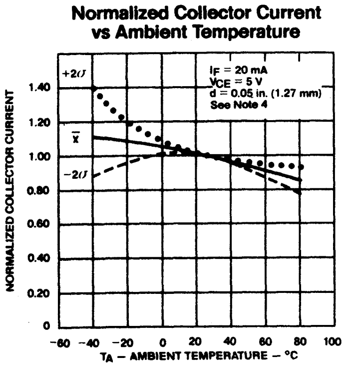
Type OPB712

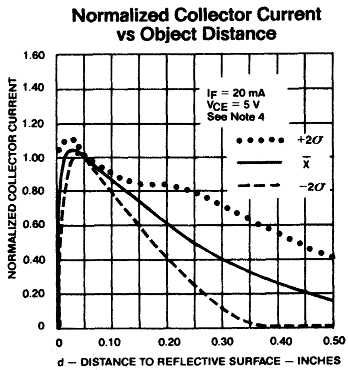
electrical characteristics (25°C unless otherwise noted)

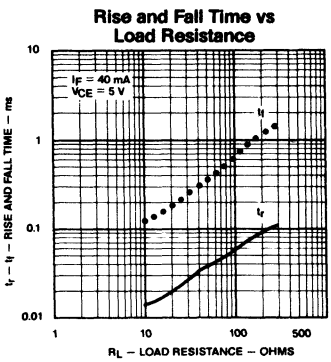
SYMBOL	PARAMETER	MIN	MAX	UNITS	TEST CONDITIONS
INPUT DIODE					
V_F	Forward Voltage		1.7	V	$I_F = 20$ mA
I_R	Reverse Current		100	μA	$V_R = 3$ V
OUTPUT PHOTODARLINGTON					
$V_{(BR)CEO}$	Collector—Emitter Breakdown Voltage	15		V	$I_C = 100$ μA
$V_{(BR)ECO}$	Emitter—Collector Breakdown Voltage	5		V	$I_E = 100$ μA
I_{CEO}	Collector Dark Current		250	nA	$V_{CE} = 10$ V, $I_F = 0$, $E_e \leq 0.1$ μ W/cm^2
COMBINED					
$I_{C(ON)}$	On-State Collector Current	20		mA	$I_F = 20$ mA, $V_{CE} = 5$ V d = 0.08 in. (2.03 mm)(3) See Note 4.
I_{CX}	Crosstalk(5)		250	nA	$V_{CE} = 5$ V, $I_F = 20$ mA No Reflecting Surface

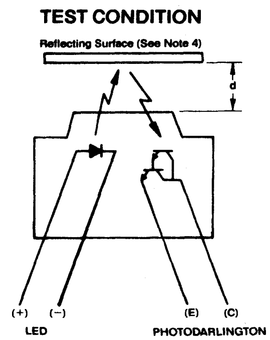
Typical Performance Curves:



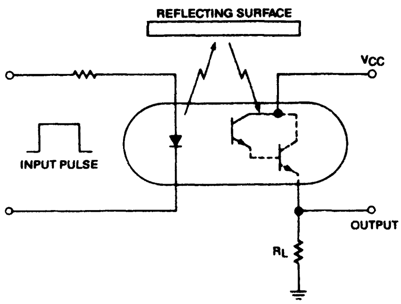




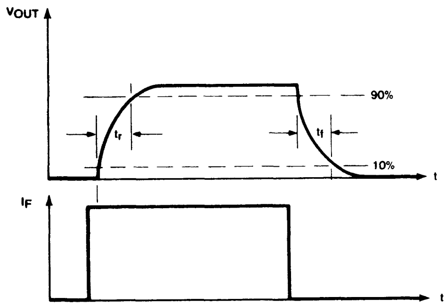




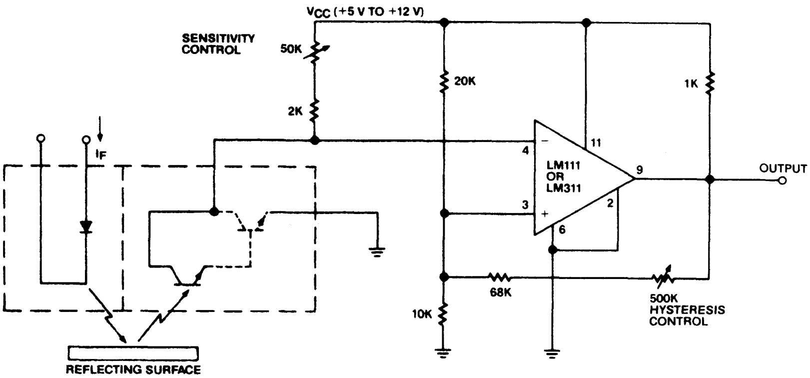
Response Time Test Circuit



Switching Time Waveforms



Typical Interfacing Circuit
Recommended for applications requiring adjustments on both sensitivity and hysteresis.



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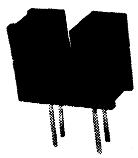
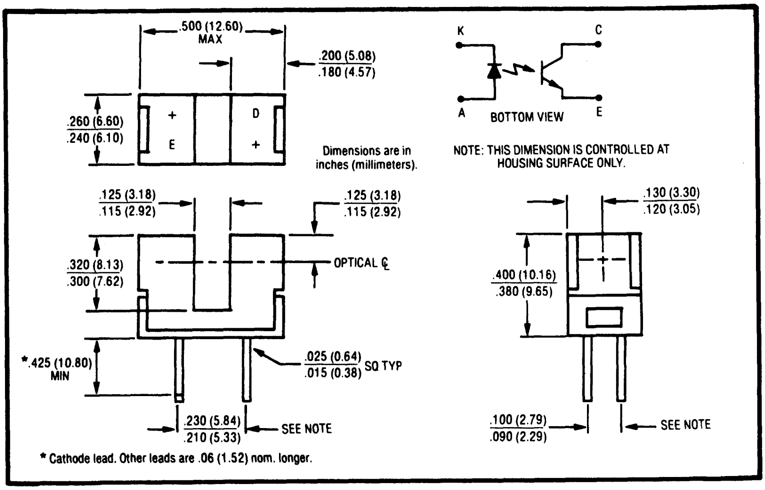
Slotted Optical Switches

Slotted Optical Switch
Type CNY36

NOT RECOMMENDED
FOR NEW DESIGN
SEE OPB860 SERIES



ACTUAL SIZE



Features

- NON-CONTACT SWITCHING
- PRINTED CIRCUIT BOARD MOUNTING
- COMPACT CONSTRUCTION
- FAST SWITCHING SPEED

Description

The CNY36 consists of a gallium arsenide infrared emitting diode and an NPN silicon phototransistor mounted in a low cost plastic housing on opposite sides of a 0.120" (3.05mm) wide slot. Phototransistor switching takes place whenever an opaque object passes through the slot.

All electrical parameters are 100% tested by manufacturing. Specifications are guaranteed to a cumulative .65% AQL.

absolute maximum ratings (25°C unless otherwise noted)

Storage and Operating Temperature Range . . . . −40°C to +100°C
Lead Soldering Temperature (1/16 inch [1.6 mm] from case for 5 sec. with soldering iron)(1) . . . . 240°C

Input Diode

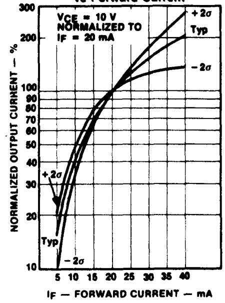
Forward DC Current . . . . 40 mA
Peak Forward Current (1 μs pulse width, 300 pps) . . . . 3 A
Reverse DC Voltage . . . . 5 V
Power Dissipation . . . . 100 mW(2)

Output Phototransistor

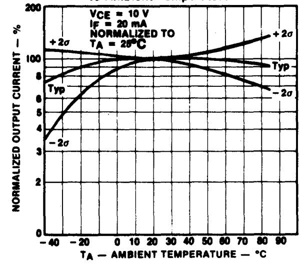
Collector-Emitter Voltage . . . . 32 V
Emitter-Collector Voltage . . . . 5 V
Collector DC Current . . . . 100 mA
Power Dissipation . . . . 100 mW(2)

Notes: (1) RMA flux is recommended. Duration can be extended to 10 sec. max. when wave soldering.
(2) Derate linearly 1.33 mW/°C above 25°C
(3) Junction temperature maintained at 25°C

Normalized Output Current vs Forward Current



Normalized Output Current vs Ambient Temperature



Type CNY36

PRODUCT BULLETIN 3108
February 1982

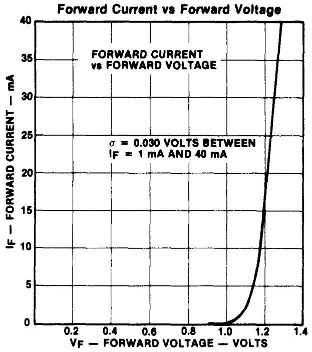
NOT RECOMMENDED
FOR NEW DESIGN
SEE OPB860 SERIES

electrical characteristics (25 °C unless otherwise noted)

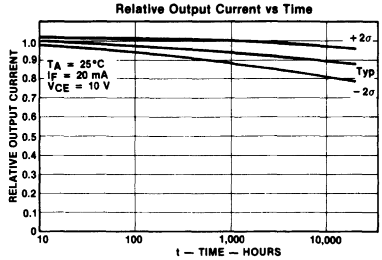
SYMBOL	PARAMETER	MIN	TYP	MAX	UNITS	TEST CONDITIONS
Input Diode						
V_F	Forward Voltage		1.22	1.7	V	I_F = 20 mA
I_R	Reverse Current			100	μA	V_R = 5 V
Output Phototransistor						
$V_{(BR)CEO}$	Collector-Emitter Breakdown Voltage	32			V	I_C = 1 mA
$V_{(BR)ECO}$	Emitter-Collector Breakdown Voltage	5			V	I_E = 100 μA, E_e = O
I_{CEO}	Collector-Emitter Dark Current			100	nA	V_{CE} = 10 V, I_F = O, E_e = O
$V_{CE(SAT)}$	Collector-Emitter Saturation Voltage			0.4	V	I_C = 25 μA, I_F = 20 mA
Coupled						
$I_{C(ON)}$ (3)	Collector Current	0.2	3		mA	V_{CE} = 10 V, I_F = 20 mA
I_D	Collector Dark Current (with closed aperture)		100		nA	V_{CE} = 10 V, I_F = 20 mA E_e = O

Typical Performance Curves

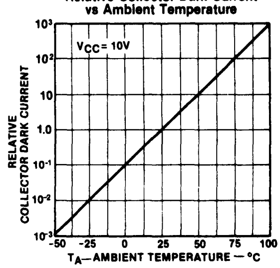
Forward Current vs Forward Voltage



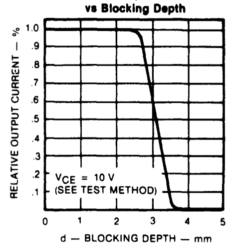
Relative Output Current vs Time



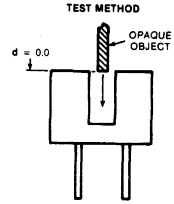
Relative Collector Dark Current vs Ambient Temperature



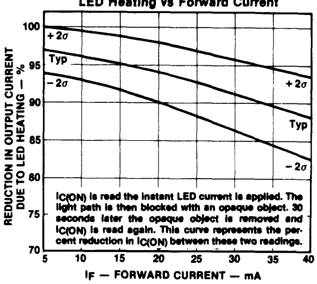
Relative Output Current vs Blocking Depth



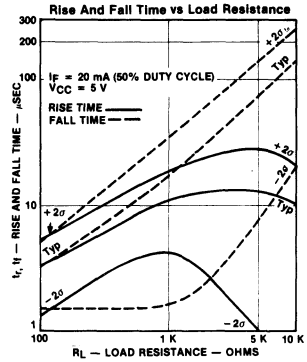
TEST METHOD



Reduction In Output Current Due to LED Heating vs Forward Current



Rise And Fall Time vs Load Resistance



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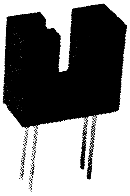
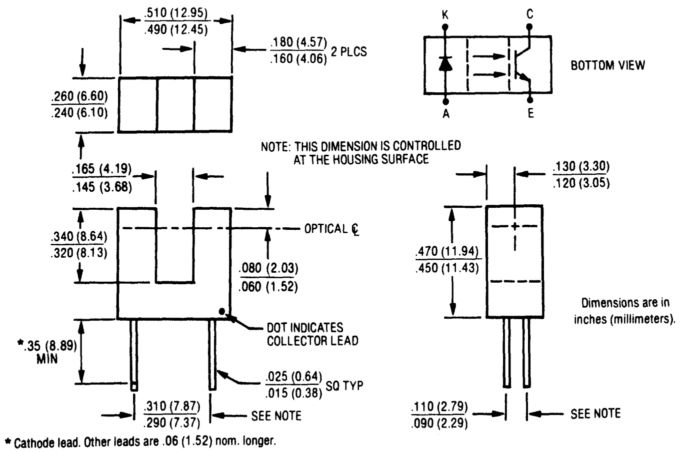
Printed in U.S.A.

Slotted Optical Switch
Type OPB804



ACTUAL SIZE



* Cathode lead. Other leads are .06 (1.52) nom. longer.

Features

- NON-CONTACT SWITCHING
- PRINTED CIRCUIT BOARD MOUNTING
- COMPACT CONSTRUCTION
- FAST SWITCHING SPEED

Description

The OPB804 consists of a gallium arsenide infrared emitting diode and an NPN silicon phototransistor mounted in a low cost plastic housing on opposite sides of a 0.155" (3.94mm) wide slot. Phototransistor switching takes place whenever an opaque object passes through the slot.

All electrical parameters are 100% tested by manufacturing. Specifications are guaranteed to a cumulative .65% AQL.

absolute maximum ratings (25 °C unless otherwise noted)

Storage and Operating Temperature Range . . . . −40 °C to +100 °C
Lead Soldering Temperature (1/16 inch [1.6 mm] from case for 5 sec. with soldering iron)[1] . . . . 240 °C

Input Diode

Forward DC Current . . . . 50 mA
Peak Forward Current (1 μs pulse width, 300 pps) . . . . 3 A
Reverse DC Voltage . . . . 3 V
Power Dissipation . . . . 100 mW[2]

Output Phototransistor

Collector-Emitter Voltage . . . . 30 V
Emitter-Collector Voltage . . . . 5 V
Collector DC Current . . . . 30 mA
Power Dissipation . . . . 100 mW[2]

Notes: (1) RMA flux is recommended. Duration can be extended to 10 sec. max. when wave soldering.
(2) Derate linearly 1.33 mW/°C above 25°C
(3) Junction temperature maintained at 25°C

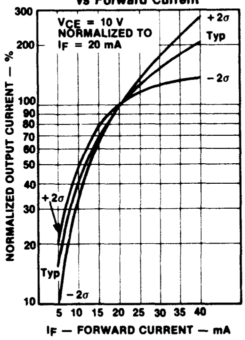
Type OPB804

electrical characteristics (25°C unless otherwise noted)

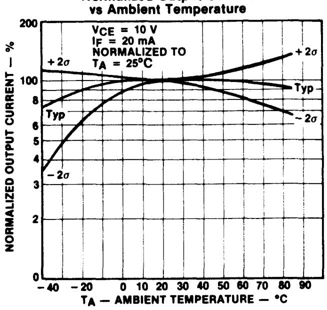
SYMBOL	PARAMETER	MIN	TYP	MAX	UNITS	TEST CONDITIONS
Input Diode						
V_F	Forward Voltage		1.22	1.7	V	$I_F = 20$ mA
I_R	Reverse Current			100	μA	$V_R = 3$ V
Output Phototransistor						
$V_{(BR)CEO}$	Collector-Emitter Breakdown Voltage	30	65		V	$I_C = 1.0$ mA
$V_{(BR)ECO}$	Emitter-Collector Breakdown Voltage	5	9		V	$I_E = 100$ μA
I_{CEO}	Collector Dark Current		5	100	nA	$V_{CE} = 10$ V, $I_F = 0$, $E_e = 0$
Coupled						
$I_{C(ON)}$ (3)	On-State Collector Current	500	1000		μA	$I_F = 20$ mA, $V_{CE} = 10$ V
$V_{CE(SAT)}$	Collector-Emitter Saturation Voltage		0.2	0.4	V	$I_F = 20$ mA, $I_C = 250$ μA

Typical Performance Curves

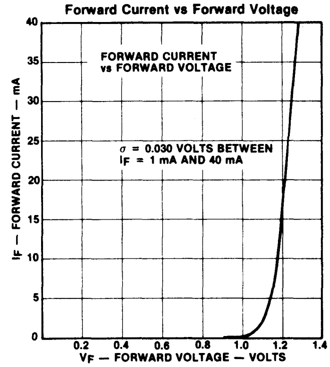
Normalized Output Current vs Forward Current



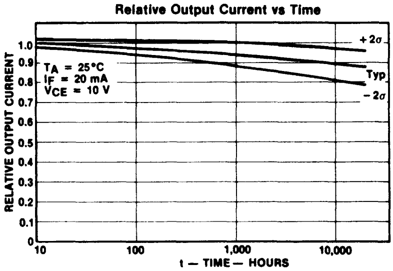
Normalized Output Current vs Ambient Temperature



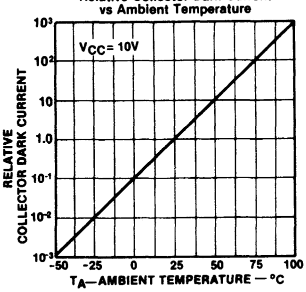
Forward Current vs Forward Voltage



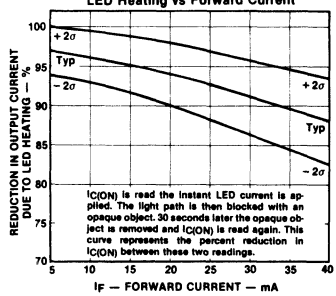
Relative Output Current vs Time



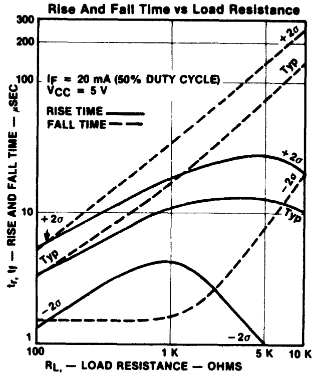
Relative Collector Dark Current vs Ambient Temperature



Reduction In Output Current Due to LED Heating vs Forward Current



Rise And Fall Time vs Load Resistance



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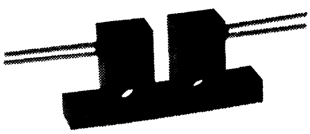
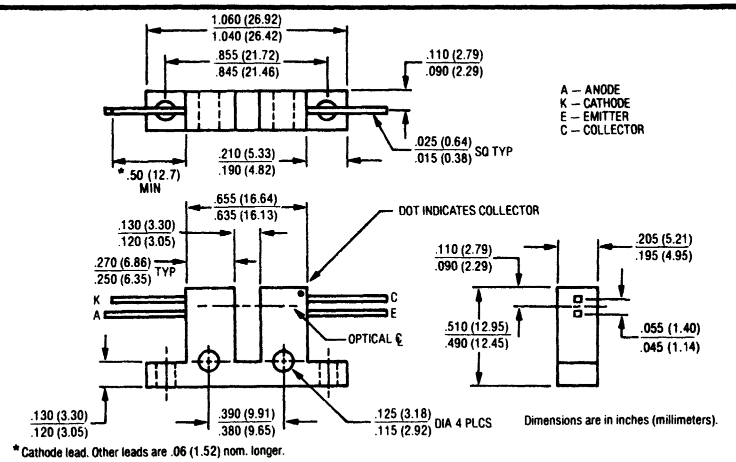
Slotted Optical Switch
Type OPB806



ACTUAL SIZE



Features

- NON-CONTACT SWITCHING
- BASE OR SIDE MOUNTING
- FAST SWITCHING SPEED

Description

The OPB806 consists of a gallium arsenide infrared emitting diode and an NPN silicon phototransistor mounted in a low cost plastic housing on opposite sides of a 0.125" (3.18mm) wide slot. Phototransistor switching takes place whenever an opaque object passes through the slot.

All electrical parameters are 100% tested by manufacturing. Specifications are guaranteed to a cumulative .65% AQL.

absolute maximum ratings (25 °C unless otherwise noted)

Storage and Operating Temperature Range . . . . −40 °C to +100 °C
Lead Soldering Temperature (1/16 inch [1.6 mm] from case for 5 sec. with soldering iron)[1] . . . . 240 °C

Input Diode

Forward DC Current . . . . 40 mA
Peak Forward Current (1 μs pulse width, 300 pps) . . . . 3 A
Reverse DC Voltage . . . . 2 V
Power Dissipation . . . . 100 mW[2]

Output Phototransistor

Collector-Emitter Voltage . . . . 30 V
Emitter-Collector Voltage . . . . 5 V
Collector DC Current . . . . 30 mA
Power Dissipation . . . . 100 mW[2]

Notes: (1) RMA flux is recommended. Duration can be extended to 10 sec. max. when wave soldering.
(2) Derate linearly 1.33 mW/°C above 25 °C
(3) Junction temperature maintained at 25 °C

Type OPB806

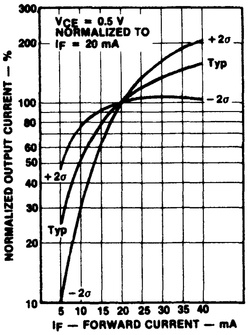
PRODUCT BULLETIN 3110
February 1982

electrical characteristics (25°C unless otherwise noted)

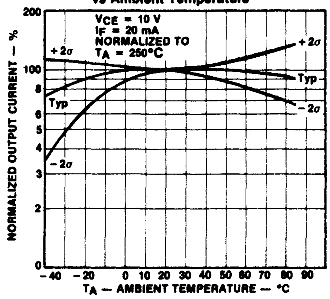
SYMBOL	PARAMETER	MIN	TYP	MAX	UNITS	TEST CONDITIONS
Input Diode						
V_F	Forward Voltage		1.22	1.7	V	$I_F = 20$ mA
I_R	Reverse Current			100	μA	$V_R = 2$ V
Output Phototransistor						
$V_{(BR)CEO}$	Collector-Emitter Breakdown Voltage	30	60		V	$I_C = 100$ μA, H = O
$V_{(BR)ECO}$	Emitter-Collector Breakdown Voltage	5	8		V	$I_E = 100$ μA, H = O
I_{CEO}	Collector-Emitter Dark Current			100	nA	$V_{CE} = 10$ V, $I_F = O$, $E_e = O$
Coupled						
$V_{CE(SAT)}$	Collector-Emitter Saturation Voltage			0.5	V	$I_F = 15$ mA, $I_C = 400$ μA
$I_{C(ON)}$ (3)	On-State Collector Current	0.4 1.6	4.0 8.0		mA mA	$V_{CE} = 0.5$ V, $I_F = 15$ mA $V_{CE} = 0.5$ V, $I_F = 35$ mA

Typical Performance Curves

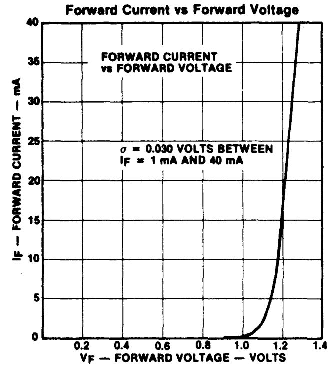
Normalized Output Current vs Forward Current



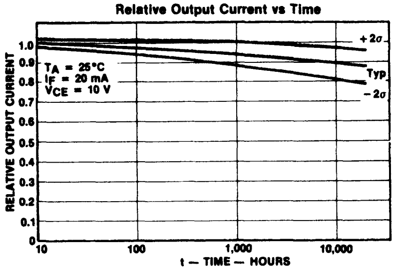
Normalized Output Current vs Ambient Temperature



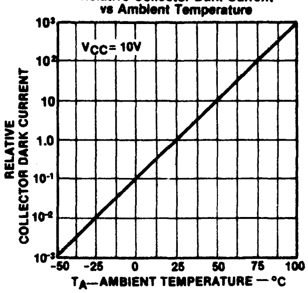
Forward Current vs Forward Voltage



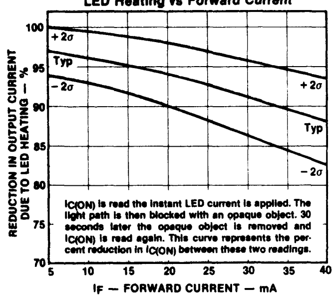
Relative Output Current vs Time



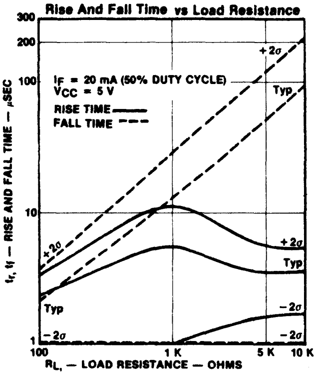
Relative Collector Dark Current vs Ambient Temperature



Reduction In Output Current Due to LED Heating vs Forward Current



Rise And Fall Time vs Load Resistance



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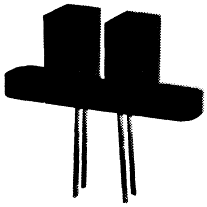
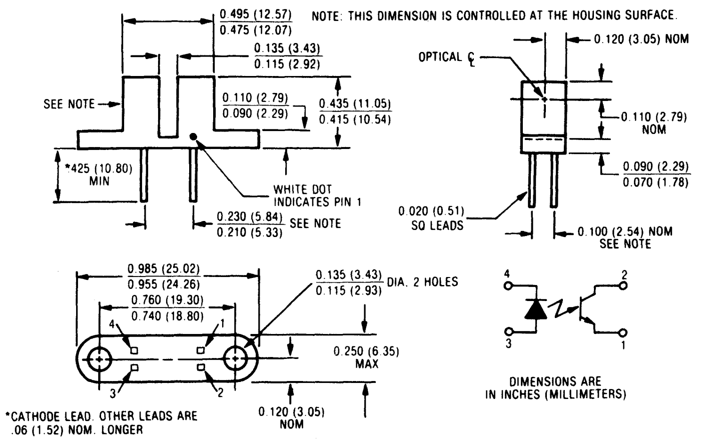
Slotted Optical Switches
Types OPB813, OPB814, OPB815

NOT RECOMMENDED FOR NEW DESIGN
SEE OPB860 SERIES



ACTUAL SIZE



Features

- NON-CONTACT SWITCHING
- COMPLETELY SEALED POLYSULFONE HOUSING
- FAST SWITCHING SPEED

Description

The OPB813, OPB814, and OPB815 each consist of a gallium arsenide infrared emitting diode and an NPN silicon phototransistor mounted on opposite sides of a 0.125" (3.18mm) wide slot. Phototransistor switching takes place whenever an opaque object passes through the slot. The low cost polysulfone housing reduces possible interference from ambient light and provides dirt and dust protection.

All electrical parameters are 100% tested by manufacturing. Specifications are guaranteed to a cumulative .65% AQL.

absolute maximum ratings (25 °C unless otherwise noted)

Storage and Operating Temperature Range .... −40 °C to +100 °C
Lead Soldering Temperature (1/16 inch [1.6 mm] from case for 5 sec. with soldering iron)[1] .... 240 °C

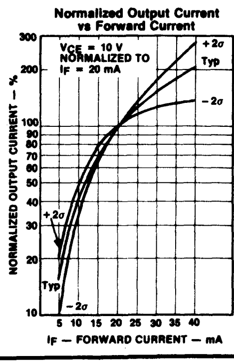
Input Diode

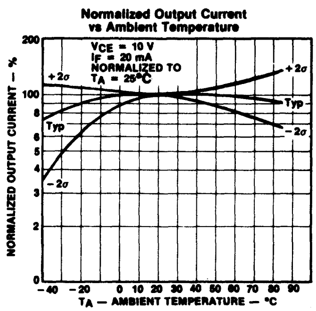
Reverse Voltage .... 3 V
Continuous Forward Current .... 50 mA
Peak Forward Current (1 μs pulse width, 300 pps) .... 3 A
Power Dissipation .... 100 mW[2]

Output Phototransistor

Collector-Emitter Voltage .... 30 V
Emitter-Collector Voltage .... 5 V
Power Dissipation .... 100 mW[2]

Notes:
(1) RMA flux is recommended. Duration can be extended to 10 sec. max. when wave soldering.
(2) Derate linearly 1.33 mW/°C above 25 °C
(3) Junction temperature maintained at 25 °C
(4) Plastic housing is soluble in chlorinated hydrocarbons and ketones. Methanol or isopropanol are recommended as cleaning agents.





Types OPB813, OPB814, OPB815

PRODUCT BULLETIN 3111
February 1982

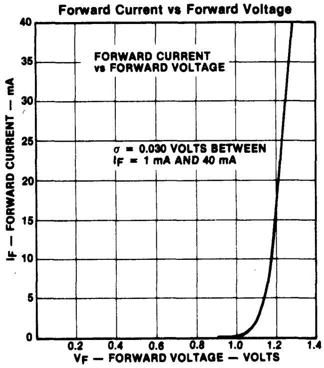
NOT RECOMMENDED
FOR NEW DESIGN
SEE OPB860 SERIES

electrical characteristics (25 °C unless otherwise noted)

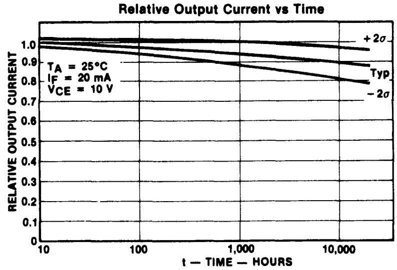
SYMBOL	PARAMETER	MIN	TYP	MAX	UNITS	TEST CONDITIONS
Input Diode						
V_F	Forward Voltage		1.22	1.7	V	I_F = 20 mA
I_R	Reverse Current			100	μA	V_R = 3 V
Output Phototransistor						
$V_{(BR)CEO}$	Collector-Emitter Breakdown Voltage	30	65		V	I_C = 1.0 mA
$V_{(BR)ECO}$	Emitter-Collector Breakdown Voltage	5	9		V	I_E = 100 μA
I_{CEO}	Collector Dark Current		5	100	nA	V_{CE} = 10 V, I_F = 0, E_e = 0
Coupled						
$V_{CE(SAT)}$	Collector-Emitter Saturation Voltage					
	OPB813		0.2	0.4	V	I_F = 20 mA, I_C = 250 μA
	OPB814		0.2	0.4	V	I_F = 10 mA, I_C = 250 μA
	OPB815		0.4	0.6	V	I_F = 20 mA, I_C = 1.8 mA
$I_{C(ON)}$(3)	On-State Collector Current					
	OPB813	500	2000		μA	I_F = 20 mA, V_{CE} = 10 V
	OPB814	1000	3000		μA	I_F = 10 mA, V_{CE} = 5 V
	OPB815	1800	3000		μA	I_F = 20 mA, V_{CE} = 0.6 V

Typical Performance Curves

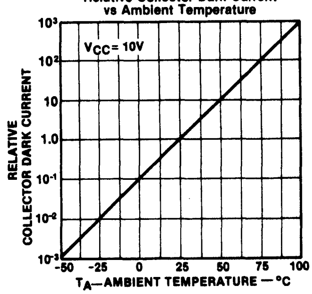
Forward Current vs Forward Voltage



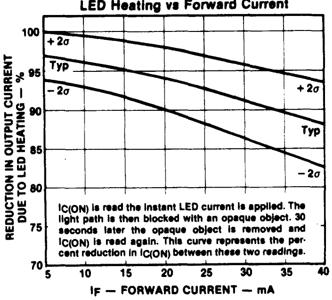
Relative Output Current vs Time



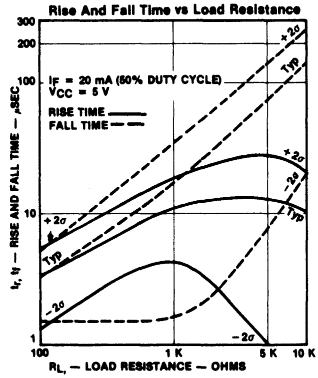
Relative Collector Dark Current vs Ambient Temperature



Reduction In Output Current Due to LED Heating vs Forward Current



Rise And Fall Time vs Load Resistance



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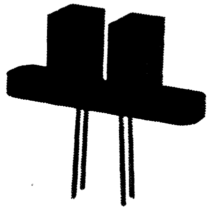
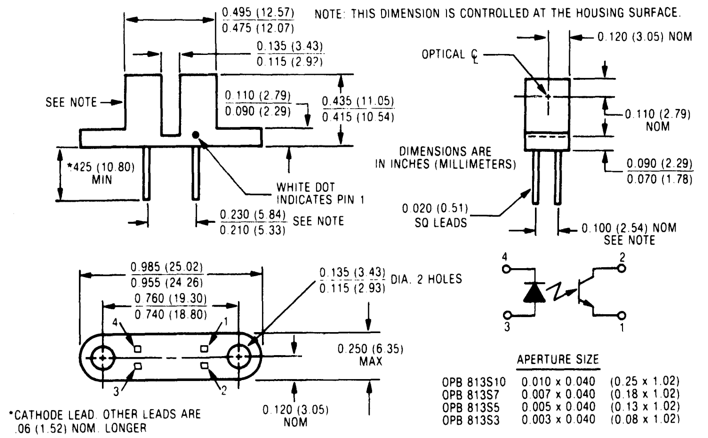
TRW OPTRON

PRODUCT BULLETIN 3023
February 1982

High Resolution Slotted Optical Switches
Types OPB813S10, OPB813S7, OPB813S5, OPB813S3



ACTUAL SIZE



APERTURE SIZE

OPB 813S10	0.010 x 0.040	(0.25 x 1.02)
OPB 813S7	0.007 x 0.040	(0.18 x 1.02)
OPB 813S5	0.005 x 0.040	(0.13 x 1.02)
OPB 813S3	0.003 x 0.040	(0.08 x 1.02)

Features

- NON-CONTACT SWITCHING
- FOUR STANDARD APERTURE SIZES
- COMPLETELY SEALED POLYSULFONE HOUSING
- FAST SWITCHING SPEED

Description

The OPB813S10[5], OPB813S7, OPB813S5 and OPB813S3 each consist of a gallium arsenide infrared emitting diode and an NPN silicon phototransistor mounted on opposite sides of a 0.125" (3.18mm) wide slot. Phototransistor switching takes place whenever an opaque object passes through the slot. The low cost polysulfone housing reduces possible interference from ambient light and provides dirt and dust protection. High resolution position sensing is achieved by using one of four standard aperture sizes.

All electrical parameters are 100% tested by manufacturing. Specifications are guaranteed to a cumulative .65% AQL.

absolute maximum ratings (25 °C unless otherwise noted)

Storage and Operating Temperature Range . . . . −40 °C to +100 °C
Lead Soldering Temperature (1/16 inch [1.6 mm] from case for 5 sec. with soldering iron)[1] . . . . 240 °C

Input Diode

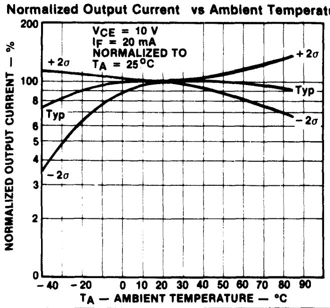
Forward DC Current . . . . 50 mA
Peak Forward Current (1 μs pulse width, 300 pps) . . . . 3 A
Reverse DC Voltage . . . . 3 V
Power Dissipation . . . . 100 mW[2]

Output Phototransistor

Collector-Emitter Voltage . . . . 30 V
Emitter-Collector Voltage . . . . 5 V
Collector DC Current . . . . 30 mA
Power Dissipation . . . . 100 mW[2]

Notes: (1) RMA flux is recommended. Duration can be extended to 10 sec. max. when wave soldering.
(2) Derate linearly 1.33 mW/°C above 25 °C
(3) Junction temperature maintained at 25 °C
(4) Plastic housing is soluble in chlorinated hydrocarbons and ketones. Methanol or isopropanol are recommended as cleaning agents.
(5) The OPB813S10 is not recommended for new design. See OPB860 series.

Normalized Output Current vs Ambient Temperature



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Types OPB813S10, OPB813S7, OPB813S5, OPB813S3

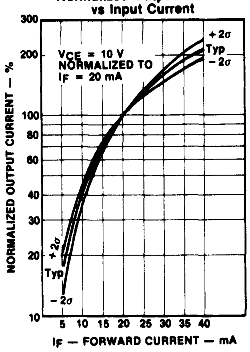
PRODUCT BULLETIN 3023
February 1982

electrical characteristics (25°C unless otherwise noted)

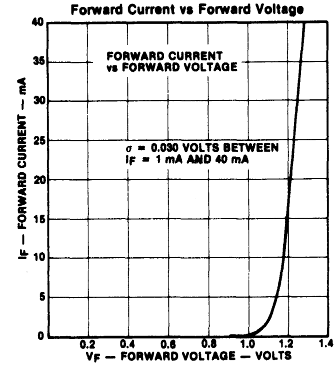
SYMBOL	PARAMETER	MIN	TYP	MAX	UNITS	TEST CONDITIONS
Input Diode						
V_F	Forward Voltage		1.22	1.7	V	I_F = 20 mA
I_R	Reverse Current			100	μA	V_R = 3 V
Output Phototransistor						
$V_{(BR)CEO}$	Collector-Emitter Breakdown Voltage	30	65		V	I_C = 1.0 mA
$V_{(BR)ECO}$	Emitter-Collector Breakdown Voltage	5	9		V	I_E = 100 μA
I_{CEO}	Collector-Emitter Dark Current		5	100	nA	V_{CE} = 10 V, I_F = 0, E_e = 0
Coupled						
$V_{CE(SAT)}$	Collector-Emitter Saturation Voltage OPB813S10 OPB813S7 OPB813S5 OPB813S3			 0.4 0.4 0.4 0.4	 V V V V	 I_F = 20 mA, I_C = 250 μA I_F = 20 mA, I_C = 175 μA I_F = 20 mA, I_C = 125 μA I_F = 20 mA, I_C = 40 μA
$I_{C(ON)}$ (3)	On-State Collector Current OPB813S10 OPB813S7 OPB813S5 OPB813S3	 500 350 250 75			 μA μA μA μA	 I_F = 20 mA, V_{CE} = 10 V I_F = 20 mA, V_{CE} = 10 V I_F = 20 mA, V_{CE} = 10 V I_F = 20 mA., V_{CE} = 10 V

Typical Performance Curves

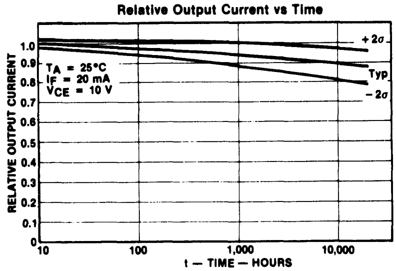
Normalized Output Current vs Input Current



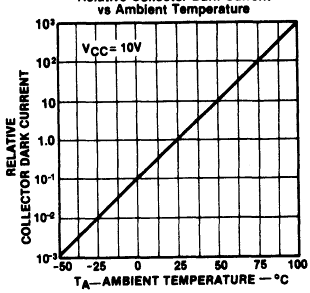
Forward Current vs Forward Voltage



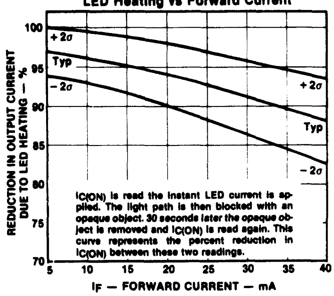
Relative Output Current vs Time



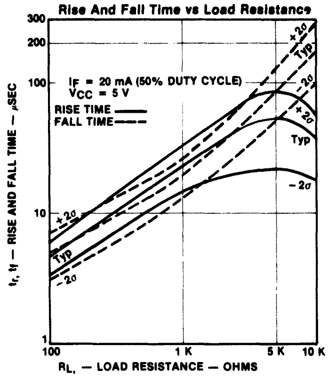
Relative Collector Dark Current vs Ambient Temperature



Reduction In Output Current Due to LED Heating vs Forward Current



Rise And Fall Time vs Load Resistance



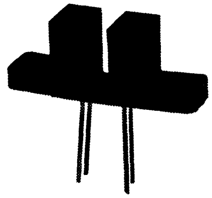
TRW OPTRON, A DIVISION OF TRW INC., 1201 TAPPAN CIRCLE, CARROLLTON, TEXAS, 75006 (214) 323-2200, TWX-910-860-5958

TRW OPTRON

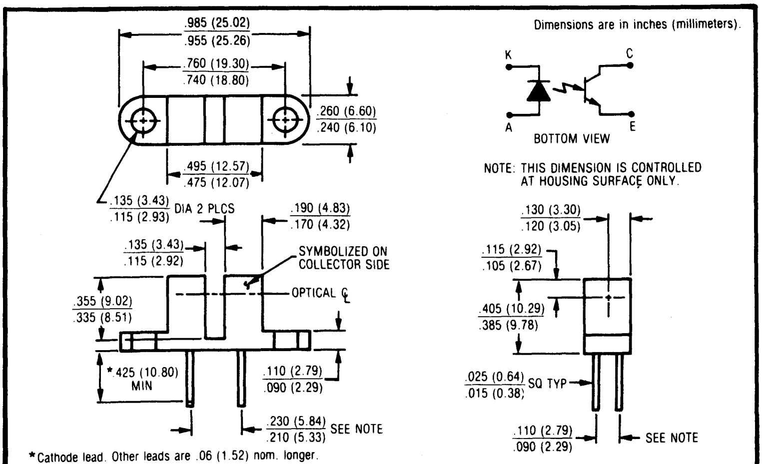
PRODUCT BULLETIN 3112
February 1982

Slotted Optical Switches
Types OPB816, OPB817

NOT RECOMMENDED FOR NEW DESIGN
SEE OPB860 SERIES



ACTUAL SIZE



*Cathode lead. Other leads are .06 (1.52) nom. longer.

Features

- NON-CONTACT SWITCHING
- LOW PROFILE
- FAST SWITCHING SPEED

Description

The OPB816 and OPB817 each consist of a gallium arsenide infrared emitting diode and an NPN silicon phototransistor mounted in a low cost black plastic housing on opposite sides of a 0.125" (3.18mm) wide slot. Phototransistor switching takes place whenever an opaque object passes through the slot.

All electrical parameters are 100% tested by manufacturing. Specifications are guaranteed to a cumulative .65% AQL.

absolute maximum ratings (25 °C unless otherwise noted)

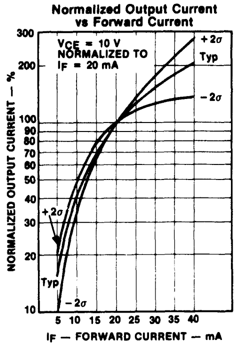
Storage and Operating Temperature Range . . . . −40 °C to +100 °C
Lead Soldering Temperature (1/16 inch [1.6 mm] from case for 5 sec. with soldering iron)[1] . . . . 240 °C

Input Diode
Reverse Voltage . . . . 3 V
Continuous Forward Current . . . . 50 mA
Peak Forward Current (1 μs pulse width, 300 pps) . . . . 3 A
Power Dissipation . . . . 100 mW[2]

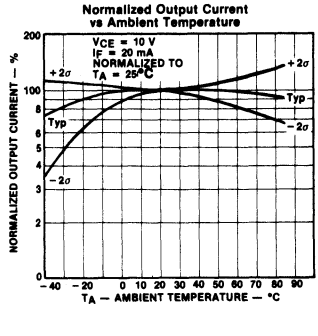
Output Phototransistor
Collector-Emitter Voltage . . . . 30 V
Emitter-Collector Voltage . . . . 5 V
Power Dissipation . . . . 100 mW[2]

Notes: (1) RMA flux is recommended. Duration can be extended to 10 sec. max. when wave soldering.
(2) Derate linearly 1.33 mW/°C above 25 °C
(3) Junction temperature maintained at 25 °C

Normalized Output Current vs Forward Current



Normalized Output Current vs Ambient Temperature



PRODUCT BULLETIN 3112
February 1982

Types OPB816, OPB817

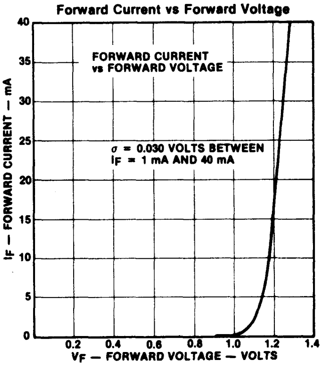
NOT RECOMMENDED
FOR NEW DESIGN
SEE OPB860 SERIES

electrical characteristics (25 °C unless otherwise noted)

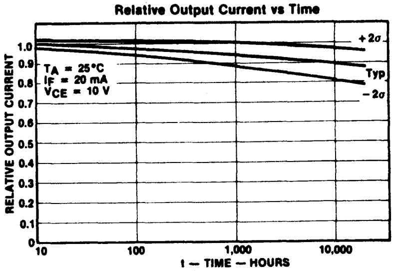
SYMBOL	PARAMETER	MIN	TYP	MAX	UNITS	TEST CONDITIONS
Input Diode						
V_F	Forward Voltage		1.22	1.7	V	I_F = 20 mA
I_R	Reverse Current			100	μA	$V_{(BR)R}$ = 3 V
Output Phototransistor						
$V_{(BR)CEO}$	Collector-Emitter Breakdown Voltage	30	65		V	I_C = 1 mA
$V_{(BR)ECO}$	Emitter-Collector Breakdown Voltage	5	9		V	I_E = 100 μA
I_{CEO}	Collector-Emitter Dark Current		5	100	nA	V_{CE} = 10 V, I_F = O, E_e = O
Coupled						
$V_{CE(SAT)}$	Collector-Emitter Saturation Voltage OPB816 OPB817			0.4 0.4	V V	I_C = 250 μA, I_F = 20 mA I_C = 250 μA, I_F = 10 mA
$I_{C(ON)}$ (3)	On-State Collector Current OPB816 OPB817	500 1000			μA μA	V_{CE} = 10 V, I_F = 20 mA V_{CE} = 5 V, I_F = 10 mA

Typical Performance Curves

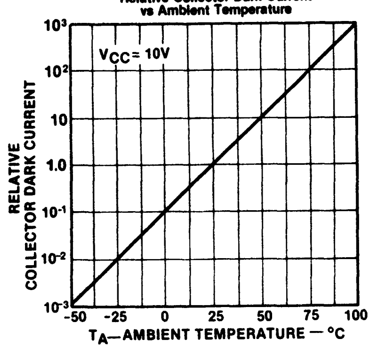
Forward Current vs Forward Voltage



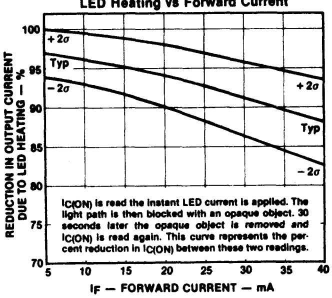
Relative Output Current vs Time



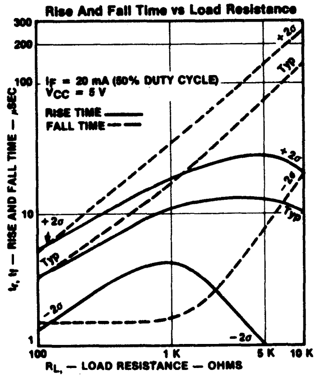
Relative Collector Dark Current vs Ambient Temperature



Reduction In Output Current Due to LED Heating vs Forward Current



Rise And Fall Time vs Load Resistance



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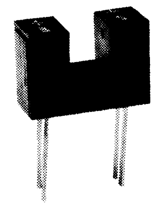
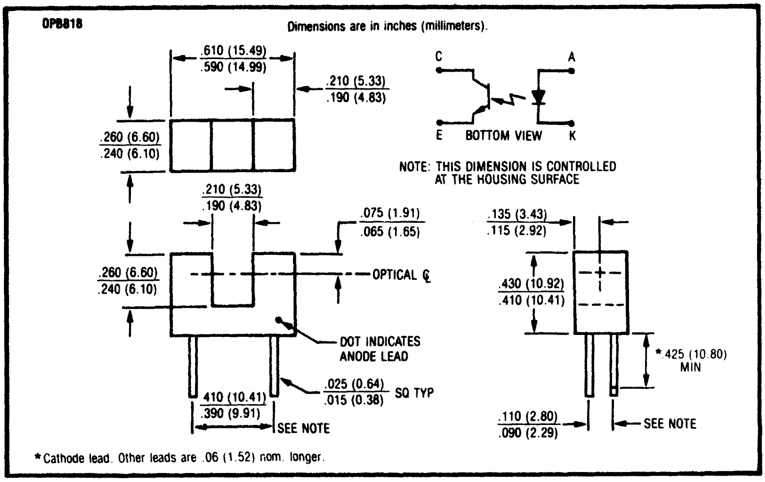
TRW OPTRON

PRODUCT BULLETIN 3113
February 1982

Slotted Optical Switch
Type OPB818



ACTUAL SIZE



Features

- NON-CONTACT SWITCHING
- FOR DIRECT PC BOARD OR DUAL-IN-LINE SOCKET MOUNTING
- FAST SWITCHING SPEED

Description

The OPB818 consists of a gallium arsenide infrared emitting diode and an NPN silicon phototransistor mounted in a low cost black plastic housing on opposite sides of a 0.20" (5.08mm) wide slot. Phototransistor switching takes place whenever an opaque object passes through the slot. The OPB818 is designed for direct soldering into PC boards or mounting in standard dual-in-line sockets.

All electrical parameters are 100% tested by manufacturing. Specifications are guaranteed to a cumulative .65% AQL.

absolute maximum ratings (25 °C unless otherwise noted)

Storage and Operating Temperature Range . . . . −40 °C to +100 °C
Lead Soldering Temperature (1/16 inch [1.6 mm] from case for 5 sec. with soldering iron)(1) . . . . 240 °C

Input Diode

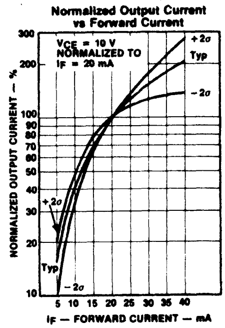
Reverse Voltage . . . . 3 V
Continuous Forward Current . . . . 50 mA
Peak Forward Current (1 μs pulse width, 300 pps) . . . . 3 A
Power Dissipation . . . . 100 mW(2)

Output Phototransistor

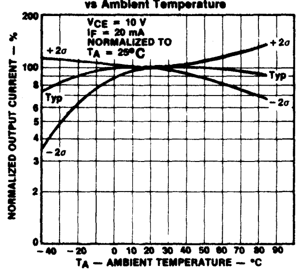
Collector-Emitter Voltage . . . . 30 V
Emitter-Collector Voltage . . . . 5 V
Power Dissipation . . . . 100 mW(2)

Notes: (1) RMA flux is recommended. Duration can be extended to 10 sec. max. when wave soldering.
(2) Derate linearly 1.33 mW/°C above 25°C
(3) Junction temperature maintained at 25 °C

Normalized Output Current vs Forward Current



Normalized Output Current vs Ambient Temperature



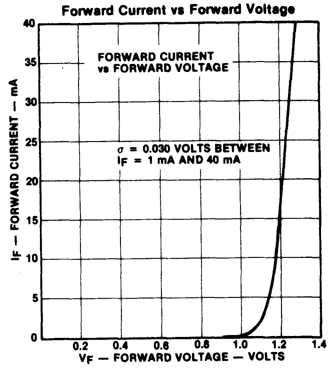
Type OPB818

electrical characteristics (25 °C unless otherwise noted)

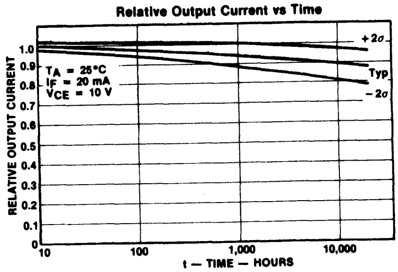
SYMBOL	PARAMETER	MIN	TYP	MAX	UNITS	TEST CONDITIONS
Input Diode						
V_F	Forward Voltage		1.22	1.7	V	$I_F = 20$ mA
I_R	Reverse Current			100	µA	$V_{(BR)R} = 3$ V
Output Phototransistor						
$V_{(BR)CEO}$	Collector-Emitter Breakdown Voltage	30	65		V	$I_C = 1$ mA
$V_{(BR)ECO}$	Emitter-Collector Breakdown Voltage	5	9		V	$I_E = 100$ µA
I_{CEO}	Collector-Emitter Dark Current		5	100	nA	$V_{CE} = 10$ V, $I_F = 0$, $E_e = 0$
Coupled						
$V_{CE(SAT)}$	Collector-Emitter Saturation Voltage			0.4	V	$I_C = 50$ µA, $I_F = 20$ mA
$I_{C(ON)}$ (3)	On-State Collector Current	100			µA	$V_{CE} = 5$ V, $I_F = 20$ mA

Typical Performance Curves

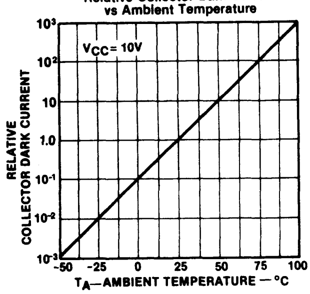
Forward Current vs Forward Voltage



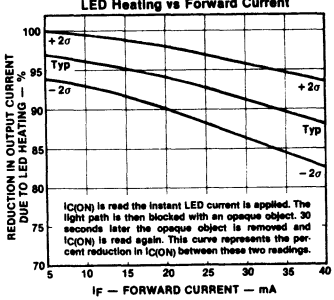
Relative Output Current vs Time



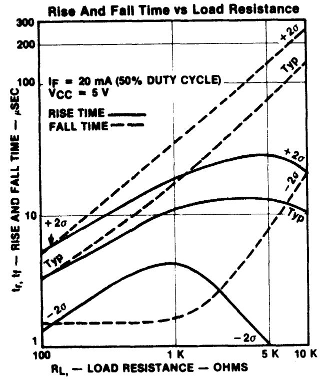
Relative Collector Dark Current vs Ambient Temperature



Reduction In Output Current Due to LED Heating vs Forward Current



Rise And Fall Time vs Load Resistance



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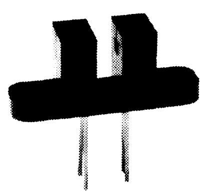
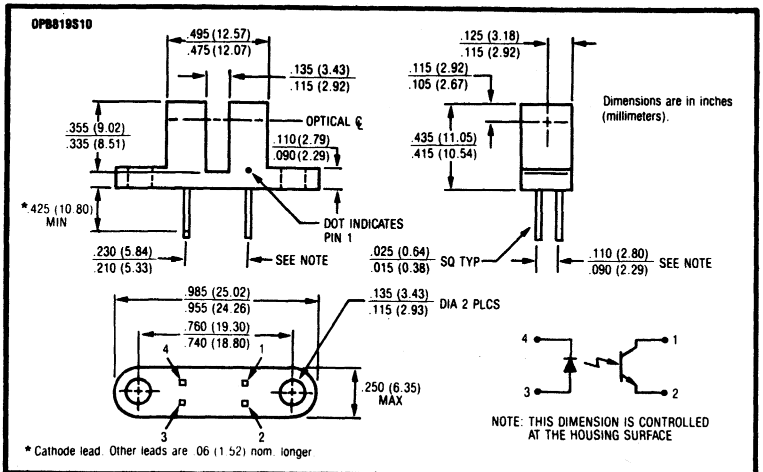
Printed in U.S.A.

Slotted Optical Switch
Type OPB819S10

NOT RECOMMENDED FOR NEW DESIGN SEE OPB860 SERIES



ACTUAL SIZE



Features

- NON-CONTACT SWITCHING
- APERTURE FOR HIGH RESOLUTION
- FAST SWITCHING SPEED

Description

The OPB819S10 consists of a gallium arsenide infrared emitting diode and an NPN silicon phototransistor mounted in a low cost black plastic housing on opposite sides of a 0.125" (3.18mm) wide slot. Phototransistor switching takes place whenever an opaque object passes through the slot. A 0.010" (.25mm) by 0.060" (1.52mm) aperture is mounted in front of the phototransistor for high resolution position sensing.

All electrical parameters are 100% tested by manufacturing. Specifications are guaranteed to a cumulative .65% AQL.

absolute maximum ratings (25 °C unless otherwise noted)

Storage and Operating Temperature Range . . . . −40 °C to +100 °C
Lead Soldering Temperature (1/16 inch [1.6 mm] from case for 5 sec. with soldering iron)(1) . . . . 240 °C

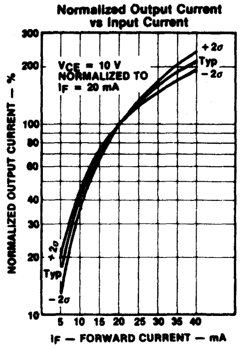
Input Diode

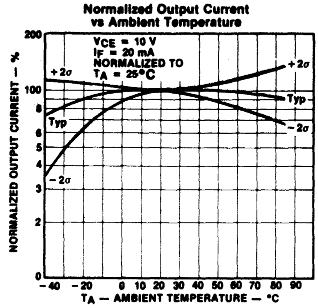
Reverse Voltage . . . . 3 V
Continuous Forward Current . . . . 50 mV
Peak Forward Current (1 μs pulse width, 300 pps) . . . . 3 A
Power Dissipation . . . . 100 mW(2)

Output Phototransistor

Collector-Emitter Voltage . . . . 30 V
Emitter-Collector Voltage . . . . 5 V
Power Dissipation . . . . 100 mW(2)

Notes: (1) RMA flux is recommended. Duration can be extended to 10 sec. max. when wave soldering.
(2) Derate linearly 1.33 mW/°C above 25 °C
(3) Junction temperature maintained at 25 °C





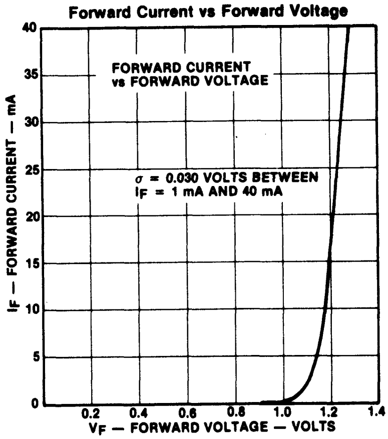
Type OPB819S10

electrical characteristics (25 °C unless otherwise noted)

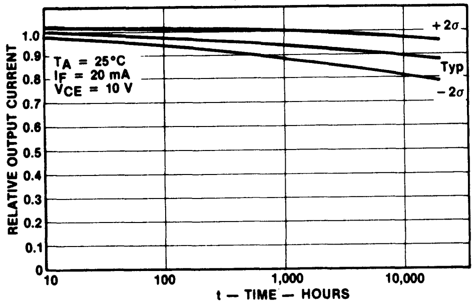
SYMBOL	PARAMETER	MIN	TYP	MAX	UNITS	TEST CONDITIONS
Input Diode						
V_F	Forward Voltage		1.22	1.7	V	I_F = 20 mA
I_R	Reverse Current			100	μA	$V_{(BR)R}$ = 3 V
Output Phototransistor						
$V_{(BR)CEO}$	Collector-Emitter Breakdown Voltage	30	65		V	I_C = 1 mA
$V_{(BR)ECO}$	Emitter-Collector Breakdown Voltage	5	9		V	I_E = 100 μA
I_{CEO}	Collector-Emitter Dark Current		5	100	nA	V_{CE} = 10 V, E_e = 0, I_F = 0
Coupled						
$V_{CE(SAT)}$	Collector-Emitter Saturation Voltage			0.4	V	I_C = 100 μA, I_F = 20 mA
$I_{C(ON)}$ (3)	On-State Collector Current	200			μA	V_{CE} = 10 V, I_F = 20 mA

Typical Performance Curves

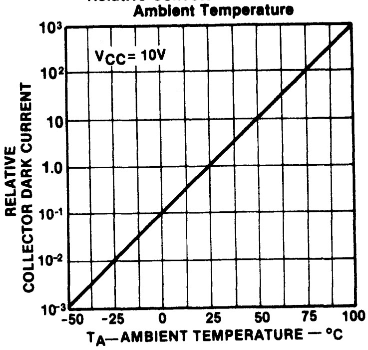
Forward Current vs Forward Voltage



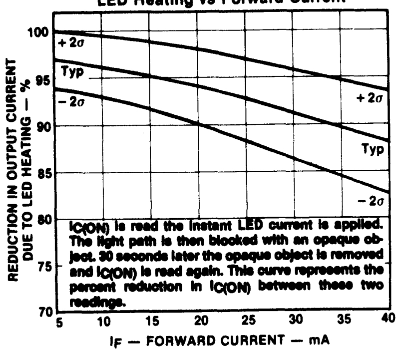
Relative Output Current vs Time



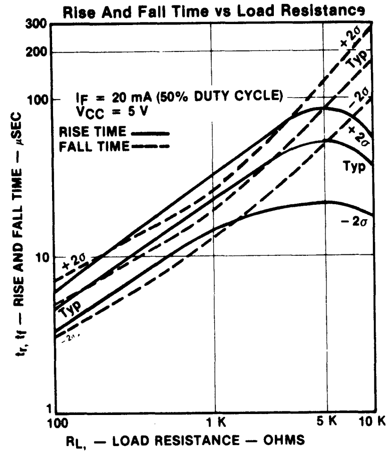
Relative Collector Dark Current vs Ambient Temperature



Reduction In Output Current Due to LED Heating vs Forward Current



Rise And Fall Time vs Load Resistance

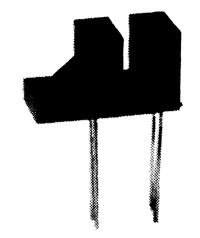


TRW OPTRON reserves the right to make changes at any time in order to improve design and to supply the best product possible.

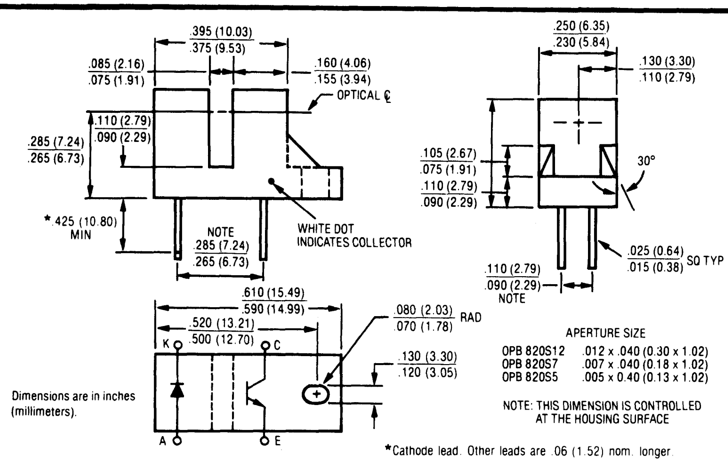
TRW OPTRON

PRODUCT BULLETIN 3115
February 1982

Slotted Optical Switches
Types OPB820, OPB820S12, OPB820S7, OPB820S5



ACTUAL SIZE



Features

- NON-CONTACT SWITCHING
- THREE STANDARD APERTURE SIZES FOR HIGH RESOLUTION
- FAST SWITCHING SPEED

Description

The OPB820, OPB820S12, OPB820S7, and OPB820S5 each consist of a gallium arsenide infrared emitting diode and an NPN silicon phototransistor mounted in a low cost black plastic housing on opposite sides of a 0.080" (2.03mm) wide slot. Phototransistor switching takes place whenever an opaque object passes through the slot. The OPB820 is unapertured. The OPB821S12, OPB821S7, and OPB821S5 each have an aperture in front of the phototransistor for high resolution position sensing.

All electrical parameters are 100% tested by manufacturing. Specifications are guaranteed to a cumulative .65% AQL.

absolute maximum ratings (25 °C unless otherwise noted)

Storage and Operating Temperature Range . . . . −40 °C to +100 °C
Lead Soldering Temperature (1/16 inch [1.6 mm] from case for 5 sec. with soldering iron)[1] . . . . 240 °C

Input Diode

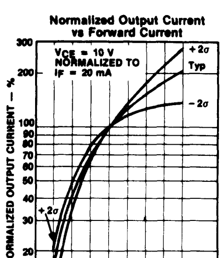
Reverse Voltage . . . . 3 V
Continuous Forward Current . . . . 50 mA
Peak Forward Current (1 μs pulse width, 300 pps) . . . . 3 A
Power Dissipation . . . . 100 mW[2]

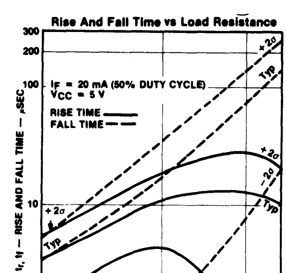
Output Phototransistor

Collector-Emitter Voltage . . . . 30 V
Emitter-Collector Voltage . . . . 5 V
Power Dissipation . . . . 100 mW[2]

Notes: (1) RMA flux is recommended. Duration can be extended to 10 sec. max. when wave soldering.
(2) Derate linearly 1.33 mW/°C above 25 °C
(3) Junction temperature maintained at 25 °C

OPB820





Types OPB820, OPB820S12, OPB820S7, OPB820S5

PRODUCT BULLETIN 3115
February 1982

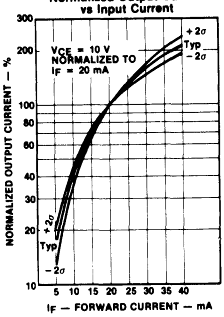
electrical characteristics (25°C unless otherwise noted)

SYMBOL	PARAMETER	MIN	TYP	MAX	UNITS	TEST CONDITIONS
Input Diode						
V_F	Forward Voltage		1.22	1.7	V	$I_F = 20$ mA
I_R	Reverse Current			100	μA	$V_{(BR)R} = 3$ V
Output Phototransistor						
$V_{(BR)CEO}$	Collector-Emitter Breakdown Voltage	30	65		V	$I_C = 1$ mA
$V_{(BR)ECO}$	Emitter-Collector Breakdown Voltage	5	9		V	$I_E = 100$ μA
I_{CEO}	Collector-Emitter Dark Current		5	100	nA	$V_{CE} = 10$ V, $I_F = 0$, $E_e = 0$
Coupled						
$V_{CE(SAT)}$	Collector-Emitter Saturation Voltage					
	OPB820, OPB820S12			0.4	V	$I_C = 250$ μA, $I_F = 20$ mA
	OPB820S7			0.4	V	$I_C = 150$ μA, $I_F = 20$ mA
	OPB820S5			0.4	V	$I_C = 125$ μA, $I_F = 20$ mA
$I_{C(ON)}$(3)	On-State Collector Current					$V_{CE} = 5$ V, $I_F = 20$ mA
	OPB820	500			μA	
	OPB820S12	400			μA	
	OPB820S7	300			μA	
	OPB820S5	170			μA	

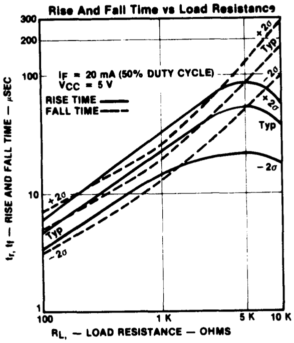
Typical Performance Curves

OPB820S12, OPB820S7, OPB820S5

Normalized Output Current vs Input Current

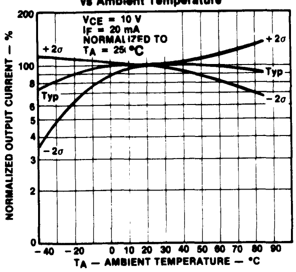


Rise And Fall Time vs Load Resistance

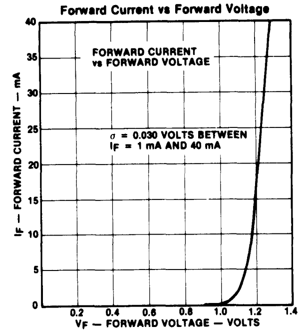


All Assemblies

Normalized Output Current vs Ambient Temperature

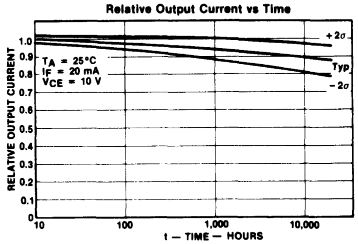


Forward Current vs Forward Voltage

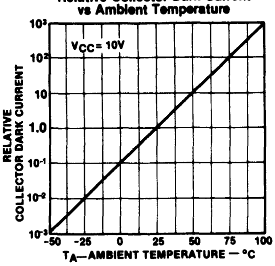


All Assemblies

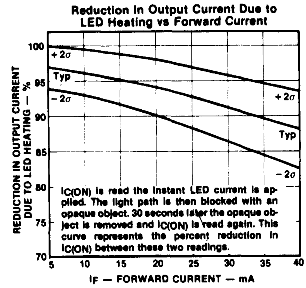
Relative Output Current vs Time



Relative Collector Dark Current vs Ambient Temperature



Reduction In Output Current Due to LED Heating vs Forward Current



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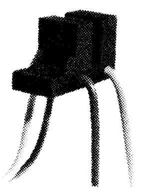
TRW OPTRON

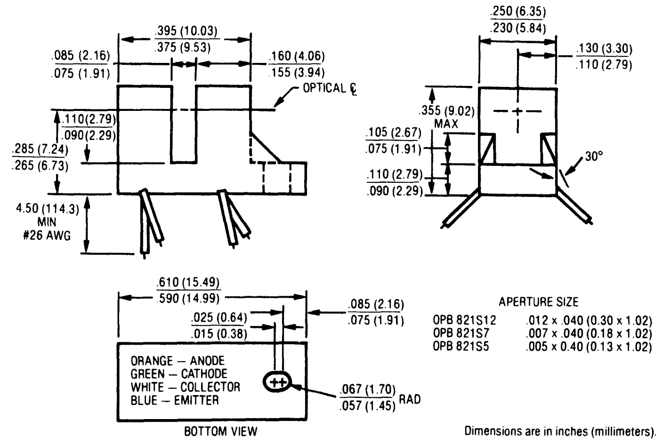
PRODUCT BULLETIN 3116
February 1982

Slotted Optical Switches

Types OPB821, OPB821S12, OPB821S7, OPB821S5



ACTUAL SIZE



Features

- NON-CONTACT SWITCHING
- THREE STANDARD APERTURE SIZES FOR HIGH RESOLUTION
- FAST SWITCHING SPEED

Description

The OPB821, OPB821S12, OPB821S7, and OPB821S5 each consist of a gallium arsenide infrared emitting diode and an NPN silicon phototransistor mounted in a low cost black plastic housing on opposite sides of a 0.080" (2.03mm) wide slot. Phototransistor switching takes place whenever an opaque object passes through the slot. The OPB821 is unapertured. The OPB821S12, OPB821S7, and OPB821S5 each have an aperture in front of the phototransistor for high resolution position sensing. 4.5" (114.3mm) minimum length lead wires ease assembly where PC board mounting is not practical.

All electrical parameters are 100% tested by manufacturing. Specifications are guaranteed to a cumulative .65% AQL.

absolute maximum ratings (25 °C unless otherwise noted)

Storage and Operating Temperature Range . . . . −40 °C to +100 °C
Lead Soldering Temperature (1/16 inch [1.6 mm] from case for 5 sec. with soldering iron)(1) . . . . 240 °C

Input Diode

Reverse Voltage . . . . 3 V
Continuous Forward Current . . . . 50 mA
Peak Forward Current (1 μs pulse width, 300 pps) . . . . 3 A
Power Dissipation . . . . 100 mW(2)

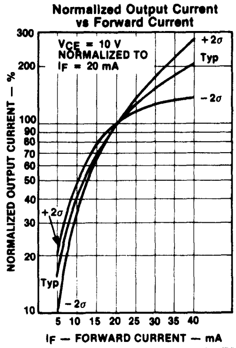
Output Phototransistor

Collector-Emitter Voltage . . . . 30 V
Emitter-Collector Voltage . . . . 5 V
Power Dissipation . . . . 100 mW(2)

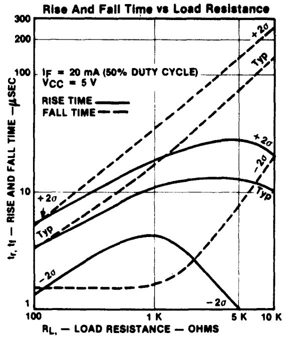
Notes: (1) RMA flux is recommended. Duration can be extended to 10 sec. max. when wave soldering.
(2) Derate linearly 1.33 mW/°C above 25 °C
(3) Junction temperature maintained at 25 °C

OPB821

Normalized Output Current vs Forward Current

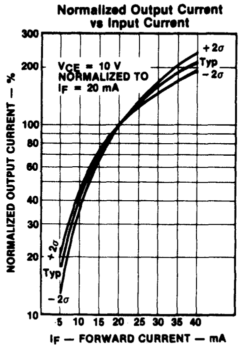


Rise And Fall Time vs Load Resistance



All Assemblies

Normalized Output Current vs Input Current



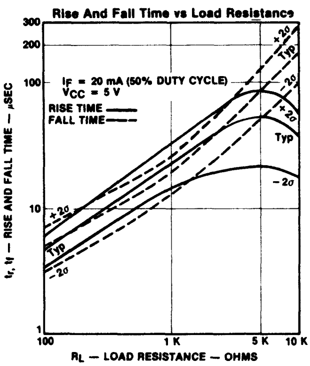
Types OPB821, OPB821S12, OPB821S7, OPB821S5

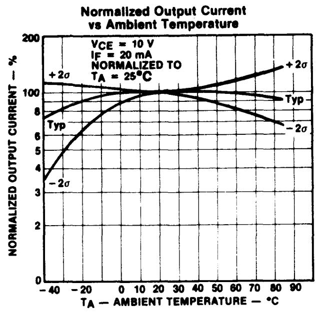
PRODUCT BULLETIN 3116
February 1982

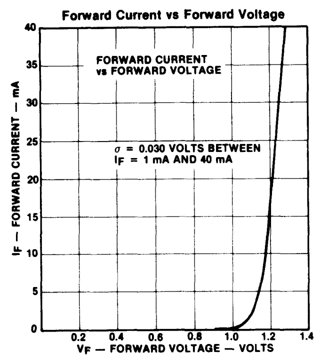
electrical characteristics (25°C unless otherwise noted)

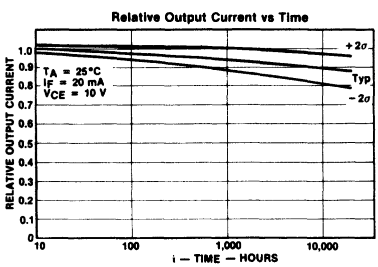
SYMBOL	PARAMETER	MIN	TYP	MAX	UNITS	TEST CONDITIONS
Input Diode						
V_F	Forward Voltage		1.22	1.7	V	I_F = 20 mA
I_R	Reverse Current			100	μA	$V_{(BR)R}$ = 3 V
Output Phototransistor						
$V_{(BR)CEO}$	Collector-Emitter Breakdown Voltage	30	65		V	I_C = 1 mA
$V_{(BR)ECO}$	Emitter-Collector Breakdown Voltage	5	9		V	I_E = 100 μA
I_{CEO}	Collector-Emitter Dark Current		5	100	nA	V_{CE} = 10 V, I_F = 0, E_e = 0
Coupled						
$V_{CE(SAT)}$	Collector-Emitter Saturation Voltage OPB821, OPB821S12 OPB821S7 OPB821S5			 0.4 0.4 0.4	 V V V	 I_C = 250 μA, I_F = 20 mA I_C = 150 μA, I_F = 20 mA I_C = 125 μA, I_F = 20 mA
$I_{C(ON)}$ (3)	On-State Collector Current OPB821 OPB821S12 OPB821S7 OPB821S5	 500 400 300 170			 μA μA μA μA	V_{CE} = 5 V, I_F = 20 mA

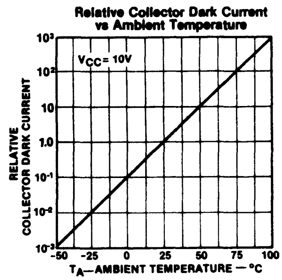
Typical Performance Curves (All Assemblies)

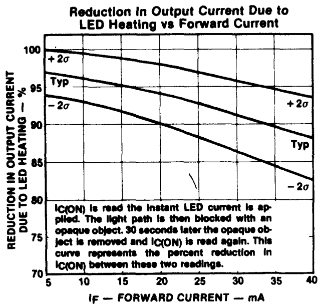












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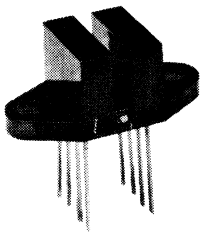
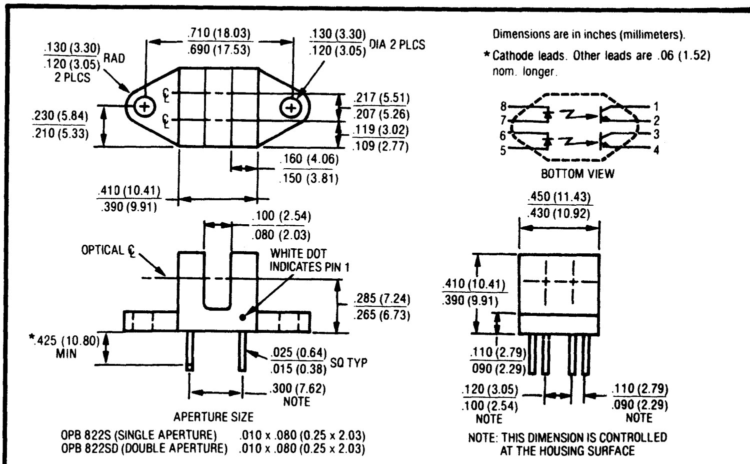
TRW OPTRON

PRODUCT BULLETIN 3117
February 1982

Dual Channel Slotted Optical Switches
Types OPB822S, OPB822SD



ACTUAL SIZE



Features

- NON-CONTACT SWITCHING
- SINGLE OR DOUBLE APERTURES FOR HIGH RESOLUTION
- COMPLETELY SEALED POLYSULFONE HOUSING

Description

The OPB822S and OPB822SD each consist of two gallium arsenide infrared emitting diodes and two NPN silicon phototransistors mounted in a side-by-side configuration on opposite sides of a 0.100" (2.54mm) wide slot. Phototransistor switching takes place whenever an opaque object passes through the device slot. The OPB822S has 0.010" (.025mm) by 0.080" (2.03mm) apertures in front of both phototransistors. The OPB822SD has the same sized apertures in front of both phototransistors and both LED's. Dual channels enable direction of travel sensing. The low cost polysulfone housing reduces possible interference from ambient light and provides dust and dirt protection.

All electrical parameters are 100% tested by manufacturing. Specifications are guaranteed to a cumulative .65% AQL.

absolute maximum ratings (25 °C unless otherwise noted)

Storage and Operating Temperature Range . . . . −40 °C to +100 °C
Lead Soldering Temperature (1/16 inch [1.6 mm] from case for 5 sec. with soldering iron)(1) . . . . 240 °C

Input Diode(s)

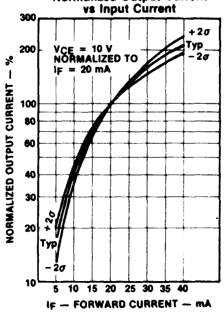
Reverse Voltage . . . . 3 V
Continuous Forward Current . . . . 50 mA
Peak Forward Current (1 μs pulse width, 300 pps) . . . . 3 A
Power Dissipation . . . . 100 mW(2)

Output Phototransistor(s)

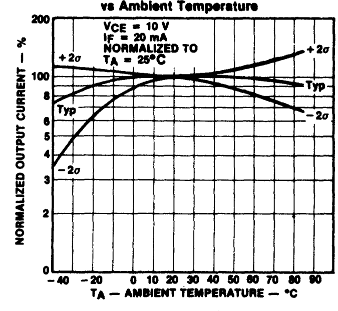
Collector-Emitter Voltage . . . . 30 V
Emitter-Collector Voltage . . . . 5 V
Power Dissipation . . . . 100 mW(2)

Notes: (1) RMA flux is recommended. Duration can be extended to 10 sec. max. when wave soldering.
(2) Derate linearly 1.33 mW/ °C above 25 °C
(3) Junction temperature maintained at 25 °C
(4) Plastic housing is soluble in chlorinated hydrocarbons and ketones. Methanol or isopropanol recommended as cleaning agents.

Normalized Output Current vs Input Current



Normalized Output Current vs Ambient Temperature



Types OPB822S, OPB822SD

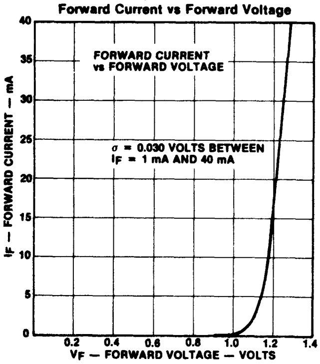
PRODUCT BULLETIN 3117
February 1982

electrical characteristics (25 °C unless otherwise noted)

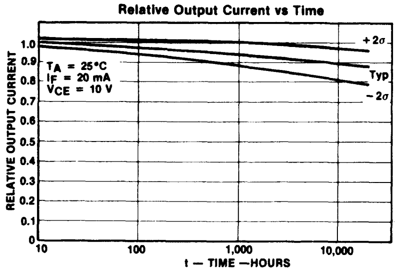
SYMBOL	PARAMETER	MIN	TYP	MAX	UNITS	TEST CONDITIONS
Input Diode						
V_F	Forward Voltage		1.22	1.7	V	I_F = 20 mA
I_R	Reverse Current			100	μA	V_R = 3 V
Output Phototransistor						
$V_{(BR)CEO}$	Collector-Emitter Breakdown Voltage	30	65		V	I_C = 1 mA
$V_{(BR)ECO}$	Emitter-Collector Breakdown Voltage	5	9		V	I_E = 100 μA
I_{CEO}	Collector-Emitter Dark Current		5	100	nA	V_{CE} = 10 V, I_F = 0, E_e = 0
Coupled						
$V_{CE(SAT)}$	Collector-Emitter Saturation Voltage OPB822S OPB822SD			 0.4 0.4	 V V	 I_C = 125 μA, I_F = 20 mA I_C = 50 μA, I_F = 20 mA
$I_{C(ON)}$ (3)	On-State Collector Current OPB822S OPB822SD	 250 100			 μA μA	V_{CE} = 10 V, I_F = 20 mA

Typical Performance Curves

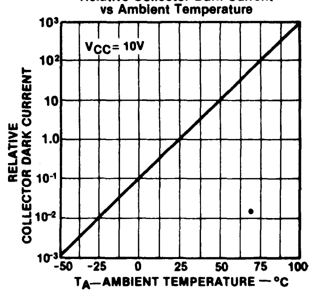
Forward Current vs Forward Voltage



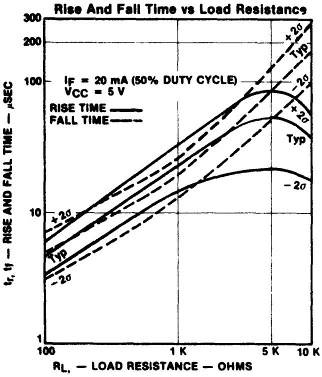
Relative Output Current vs Time



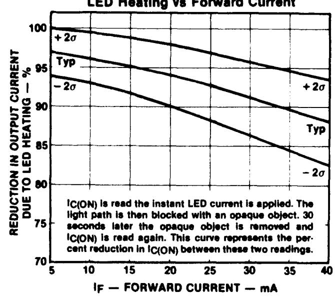
Relative Collector Dark Current vs Ambient Temperature



Rise And Fall Time vs Load Resistance



Reduction In Output Current Due to LED Heating vs Forward Current



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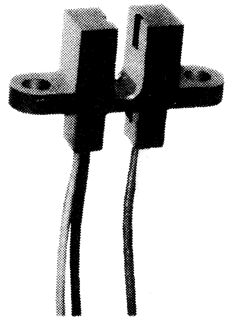
Printed in U.S.A.

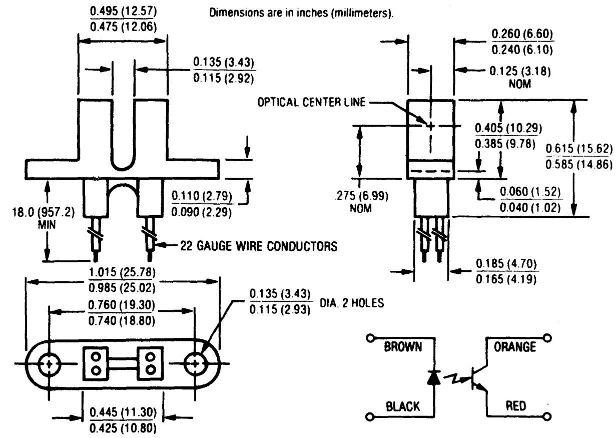
TRW OPTRON

PRODUCT BULLETIN 3118
February 1982

Slotted Optical Switches
Types OPB823A, OPB824A



ACTUAL SIZE



Features

- NON-CONTACT SWITCHING
- LEAD WIRES FOR ELECTRICAL CONNECTION
- FAST SWITCHING SPEED

Description

The OPB823A and OPB824A each consist of a gallium arsenide infrared emitting diode and an NPN silicon phototransistor mounted in a low cost black plastic housing on opposite sides of a 0.125" (3.18mm) wide slot. Phototransistor switching takes place whenever an opaque object passes through the slot. 18" (457.2mm) minimum length lead wires ease assembly where PC board mounting is not practical.

All electrical parameters are 100% tested by manufacturing. Specifications are guaranteed to a cumulative .65% AQL.

absolute maximum ratings (25 °C unless otherwise noted)

Storage and Operating Temperature Range . . . . −40 °C to +80 °C[1]

Input Diode

Forward DC Current . . . . 50 mA
Peak Forward Current (1 μs pulse width, 300 pps) . . . . 3 A
Reverse DC Voltage . . . . 3 V
Power Dissipation . . . . 100 mW[2]

Output Phototransistor

Collector-Emitter Voltage . . . . 30 V
Emitter-Collector Voltage . . . . 5 V
Collector DC Current . . . . 30 mA
Power Dissipation . . . . 100 mW[2]

Notes: (1) Derate linearly 1.82 mW/°C above 25 °C
(2) Junction temperature maintained at 25 °C.
(3) Maximum storage and operating temperature are limited by the temperature rating of the lead wires.

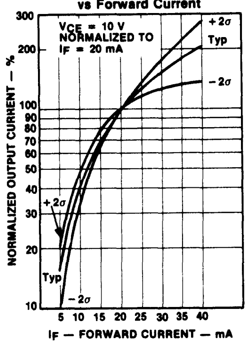
Types OPB823A, OPB824A

electrical characteristics (25 °C unless otherwise noted)

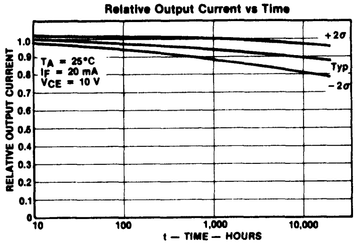
SYMBOL	PARAMETER	MIN	TYP	MAX	UNITS	TEST CONDITIONS
Input Diode						
V_F	Forward Voltage		1.22	1.7	V	I_F = 20 mA
I_R	Reverse Current			100	μA	V_R = 3 V
Output Phototransistor						
$V_{(BR)CEO}$	Collector-Emitter Breakdown Voltage	30	65		V	I_C = 1.0 mA
$V_{(BR)ECO}$	Emitter-Collector Breakdown Voltage	5	9		V	I_E = 100 μA
I_{CEO}	Collector-Emitter Dark Current		5	100	nA	V_{CE} = 10 V, I_F = 0, E_e = 0
Coupled						
$V_{CE(SAT)}$	Collector-Emitter Saturation Voltage OPB823A OPB824A		 0.2 0.2	 0.4 0.4	 V V	 I_F = 20 mA, I_C = 100 μA I_F = 20 mA, I_C = 250 μA
$I_{C(ON)}$ [3]	On-State Collector Current OPB823A OPB824A	 200 500	 500 1000		 μA μA	 I_F = 20 mA, V_{CE} = 10 V I_F = 20 mA, V_{CE} = 10 V

Typical Performance Curves

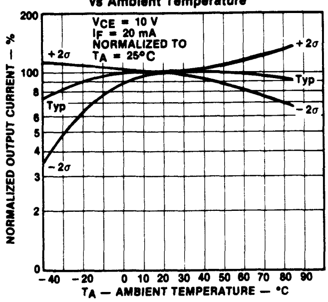
Normalized Output Current vs Forward Current



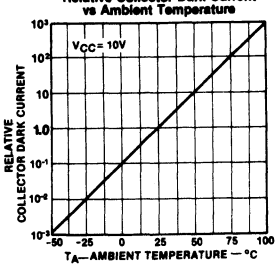
Relative Output Current vs Time



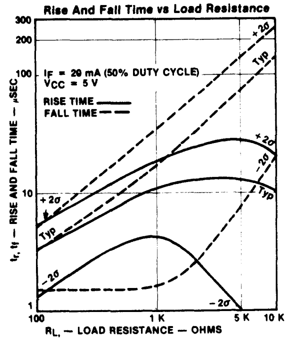
Normalized Output Current vs Ambient Temperature



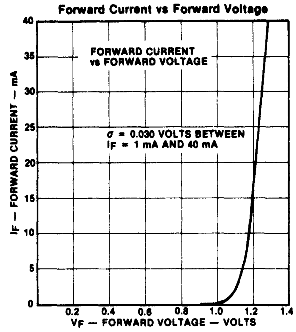
Relative Collector Dark Current vs Ambient Temperature



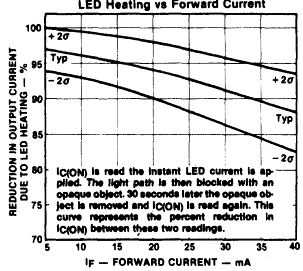
Rise And Fall Time vs Load Resistance



Forward Current vs Forward Voltage



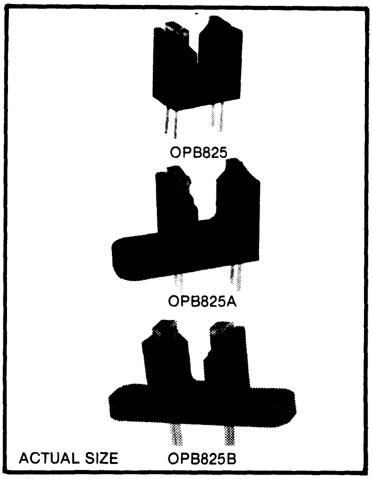
Reduction in Output Current Due to LED Heating vs Forward Current

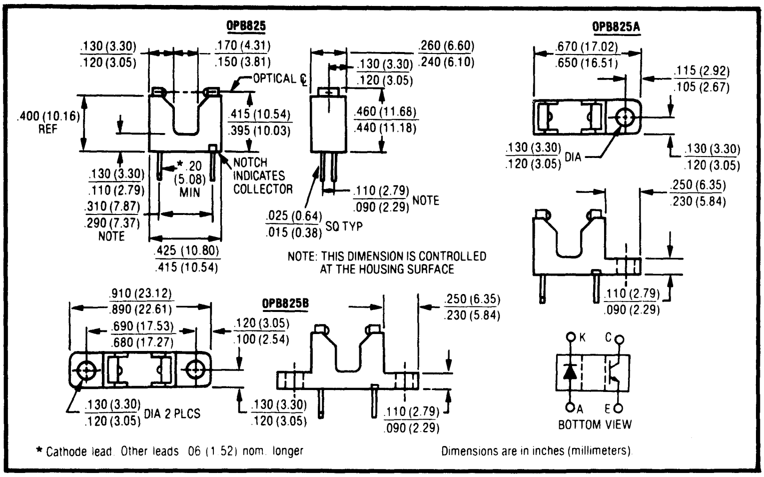


TRW OPTRON reserves the right to make changes at any time in order to improve design and to supply the best product possible.

Slotted Optical Switches
Types OPB825, OPB825A, OPB825B

NOT RECOMMENDED FOR NEW DESIGN
SEE OPB860 SERIES





* Cathode lead. Other leads .06 (1.52) nom. longer

Dimensions are in inches (millimeters)

Features

- NON-CONTACT SWITCHING
- VERSATILE MOUNTING
- SMALL SIZE
- FAST SWITCHING SPEED

Description

The OPB825, OPB825A, and OPB825B each consist of a gallium arsenide infrared emitting diode and an NPN silicon phototransistor mounted in a low cost black plastic housing on opposite sides of a 0.160" (4.06mm) wide slot. Phototransistor switching takes place whenever an opaque object passes through the slot. The OPB825 has no mounting tabs and is intended for direct insertion into PC boards or dual-in-line sockets. The OPB825A has a single mounting tab on the phototransistor side and the OPB825B has mounting tabs on both sides.

All electrical parameters are 100% tested by manufacturing. Specifications are guaranteed to a cumulative .65% AQL.

absolute maximum ratings (25 °C unless otherwise noted)

Storage and Operating Temperature Range . . . . −40 °C to +100 °C
Lead Soldering Temperature (1/16 inch [1.6 mm] from case for 5 sec. with soldering iron)(1) . . . . 240 °C

Input Diode

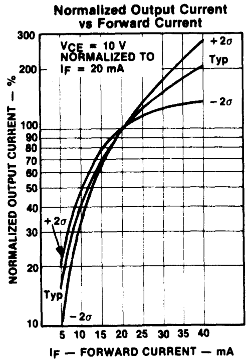
Reverse Voltage . . . . 3 V
Continuous Forward Current . . . . 50 mA
Peak Forward Current (1 μs pulse width, 300 pps) . . . . 3 A
Power Dissipation . . . . 100 mW(2)

Output Phototransistor

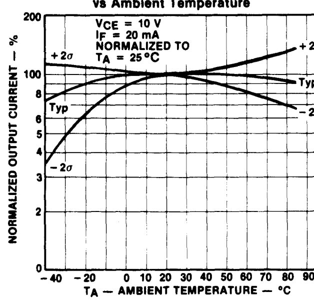
Collector-Emitter Voltage . . . . 30 V
Emitter-Collector Voltage . . . . 5 V
Power Dissipation . . . . 100 mW(2)

Notes: (1) RMA flux is recommended. Duration can be extended to 10 sec. max. when wave soldering.
(2) Derate linearly 1.33 mW/ °C above 25 °C
(3) Junction temperature maintained at 25 °C

Normalized Output Current vs Forward Current



Normalized Output Current vs Ambient Temperature



Types OPB825, OPB825A, OPB825B

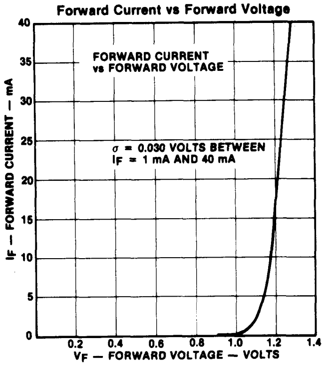
NOT RECOMMENDED FOR NEW DESIGN SEE OPB860 SERIES

electrical characteristics (25 °C unless otherwise noted)

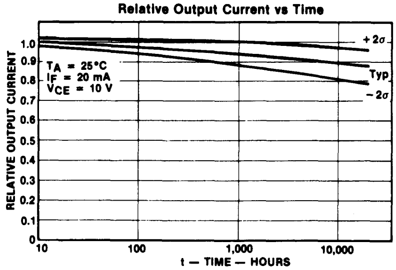
SYMBOL	PARAMETER	MIN	TYP	MAX	UNITS	TEST CONDITIONS
Input Diode						
V_F	Forward Voltage		1.22	1.5	V	I_F = 20 mA
I_R	Reverse Current			100	μA	$V_{(BR)R}$ = 3 V
Output Phototransistor						
$V_{(BR)CEO}$	Collector-Emitter Breakdown Voltage	30	65		V	I_C = 1 mA
$V_{(BR)ECO}$	Emitter-Collector Breakdown Voltage	5	9		V	I_E = 100 μA
I_{CEO}	Collector-Emitter Dark Current		5	100	nA	V_{CE} = 10 V, I_F = 0, E_e = 0
Coupled						
$V_{CE(SAT)}$	Collector-Emitter Saturation Voltage			0.4	V	I_C = 250 μA, I_F = 20 mA
$I_{C(ON)}$ (3)	On-State Collector Current	500			μA	V_{CE} = 0.5 V, I_F = 20 mA

Typical Performance Curves

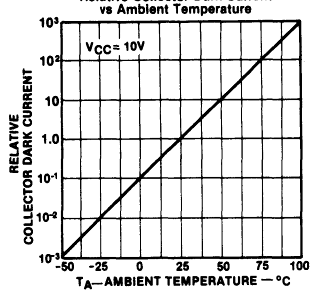
Forward Current vs Forward Voltage



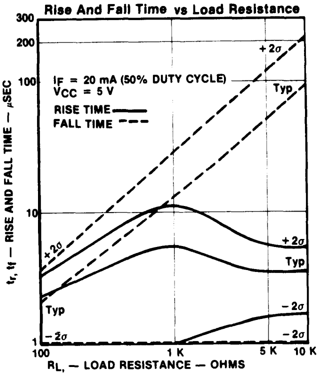
Relative Output Current vs Time



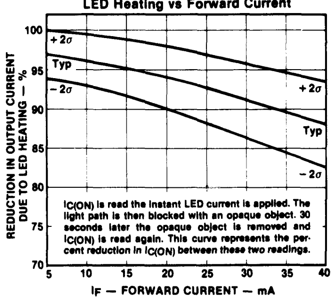
Relative Collector Dark Current vs Ambient Temperature



Rise And Fall Time vs Load Resistance



Reduction In Output Current Due to LED Heating vs Forward Current



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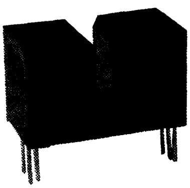
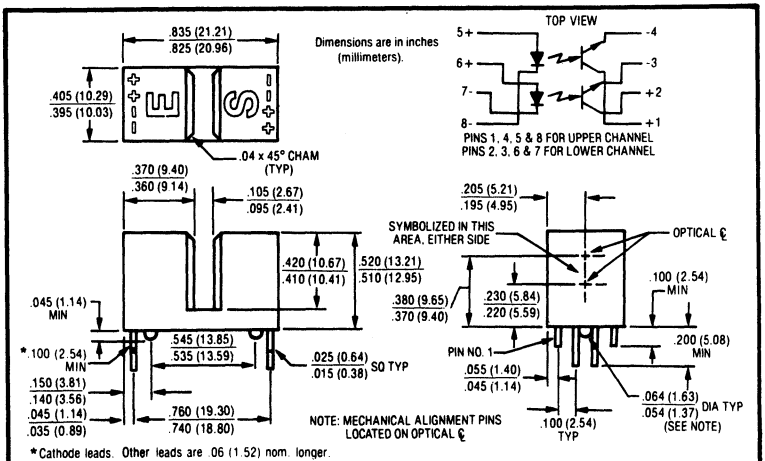
TRW OPTRON, A DIVISION OF TRW INC., 1201 TAPPAN CIRCLE, CARROLLTON, TEXAS, 75006 (214) 323-2200, TWX-910-860-5958

Dual Channel Slotted Optical Switches
Types OPB826S, OPB826SD



ACTUAL SIZE



Features

- NON-CONTACT SWITCHING
- SINGLE OR DOUBLE APERTURES FOR HIGH RESOLUTION
- COMPLETELY SEALED POLYSULFONE HOUSING

Description

The OPB826S and OPB826SD each consist of two gallium arsenide infrared emitting diodes and two NPN silicon phototransistors mounted in an over/under configuration on opposite sides of a 0.100" (2.54mm) wide slot. Phototransistor switching takes place when an opaque object passes through the slot. The OPB826S has 0.010" (0.25mm) by 0.040" (1.02mm) apertures in front of both phototransistors. The OPB826SD has the same sized apertures in front of both phototransistors and both LED's. Dual channels enable direction of travel sensing.

All electrical parameters are 100% tested by manufacturing. Specifications are guaranteed to a cumulative .65% AQL.

absolute maximum ratings (25 °C unless otherwise noted)

Storage and Operating Temperature Range . . . . −40 °C to +100 °C
Lead Soldering Temperature (1/16 inch [1.6mm] from case for 5 sec. with soldering iron)(1) . . . . 240 °C

Input Diode(s)

Reverse Voltage . . . . 3 V
Continuous Forward Current . . . . 40 mA
Peak Forward Current (1 μs pulse width, 300 pps) . . . . 3 A
Power Dissipation . . . . 100 mW(2)

Phototransistor(s)

Collector-Emitter Voltage . . . . 30 V
Emitter-Collector Voltage . . . . 5 V
Power Dissipation . . . . 100 mW(2)

Notes: (1) RMA flux is recommended. Duration can be extended to 10 seconds max. when flow soldering.
(2) Derate linearly 1.33 mW/°C above 25°C.
(3) Junction temperature maintained at 25°C.
(4) Plastic housing is soluble in chlorinated hydrocarbons and ketones. Methanol or isopropanol are recommended as cleaning agents.

PRODUCT BULLETIN 3120
February 1982

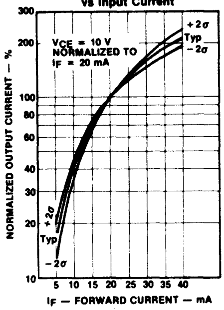
Types OPB826S, OPB826SD

electrical characteristics (25 °C unless otherwise noted)

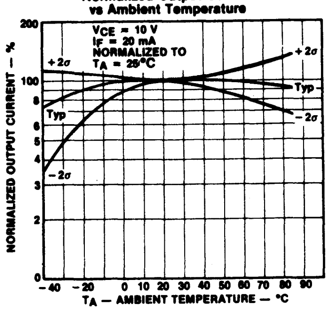
SYMBOL	PARAMETER	MIN	TYP	MAX	UNITS	TEST CONDITIONS
Input Diode						
V_F	Forward Voltage		1.22	1.7	V	I_F = 20 mA
I_R	Reverse Current			100	μA	V_R = 3 V
Output Phototransistor						
$V_{(BR)CEO}$	Collector-Emitter Breakdown Voltage	30	65		V	I_C = 1 mA
$V_{(BR)ECO}$	Emitter-Collector Breakdown Voltage	5	9		V	I_E = 100 μA
I_{CEO}	Collector-Emitter Dark Current		5	100	nA	V_{CE} = 10 V, I_F = 0, E_e = 0
Coupled						
$I_{C(ON)}$ (3)	On-State Collector Current OPB826S OPB826SD	 250 100			 μA μA	V_{CE} = 10 V, I_F = 20 mA
$V_{CE(SAT)}$	Collector-Emitter Saturation Voltage OPB826S OPB826SD			 0.4 0.4	 V V	 I_F = 20 mA, I_C = 125 μA I_F = 20 mA, I_C = 50 μA

Typical Performance Curves

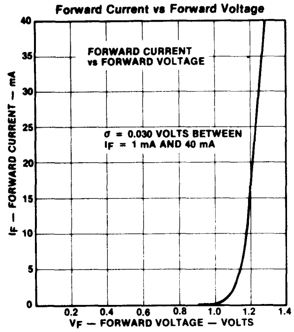
Normalized Output Current vs Input Current



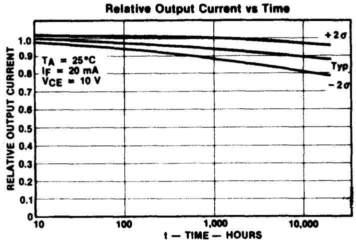
Normalized Output Current vs Ambient Temperature



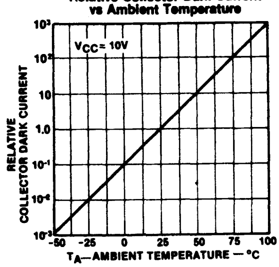
Forward Current vs Forward Voltage



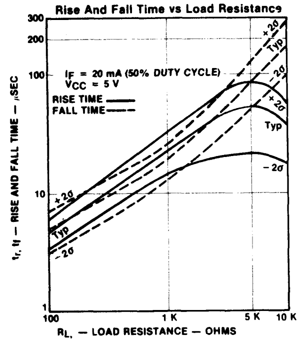
Relative Output Current vs Time



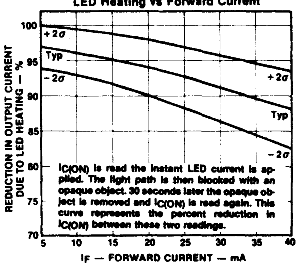
Relative Collector Dark Current vs Ambient Temperature



Rise And Fall Time vs Load Resistance



Reduction In Output Current Due to LED Heating vs Forward Current



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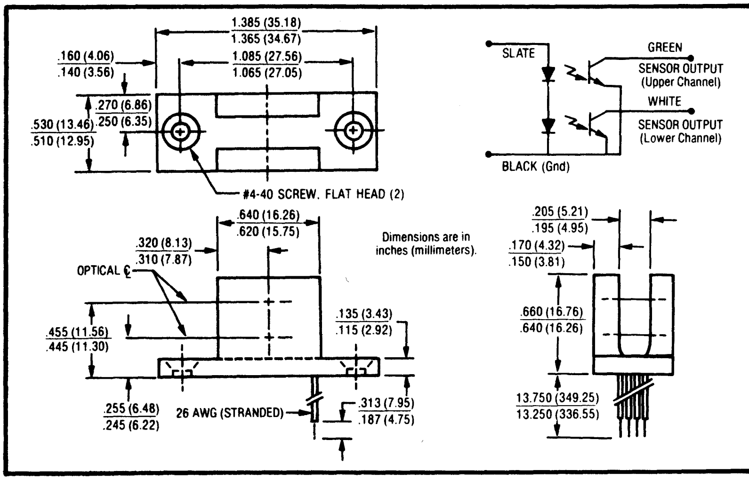
Dual Channel Slotted Optical Switch
Type OPB831S20

ACTUAL SIZE



Features

- NON-CONTACT SWITCHING
- SENSORS APERATURED FOR HIGH RESOLUTION
- COMPLETELY SEALED POLYSULFONE HOUSING

Description

The OPB831S20 consists of two gallium arsenide infrared emitting diodes and two NPN silicon phototransistors mounted in an over/under configuration on opposite sides of a 0.200" (5.08mm) wide slot. Phototransistor switching takes place when an opaque object passes through the slot. A 0.020" (0.508mm) by 0.060" (1.52mm) aperture is mounted in front of each phototransistor for high resolution position sensing. Dual channels enable direction of travel sensing. The low cost polysulfone housing reduces possible interference from ambient light and provides dirt and dust protection.

All electrical parameters are 100% tested by manufacturing. Specifications are guaranteed to a cumulative .65% AQL.

absolute maximum ratings (25 °C unless otherwise noted)

Storage and Operating Temperature Range .... −40 °C to +80 °C(1)

Input Diodes (See Schematic)

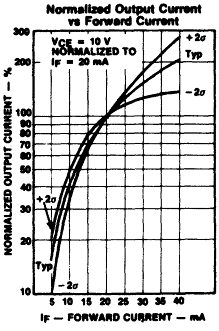
Reverse Voltage	6 V
Continuous Forward Current	40 mA
Peak Forward Current (1 μs pulse width, 300 pps)	3 A
Power Dissipation	200 mW(2)

Output Phototransistor(s)

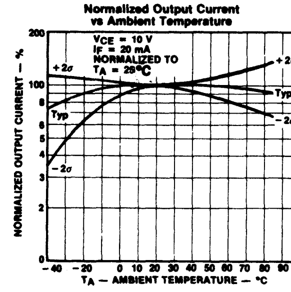
Collector-Emitter Voltage	30 V
Emitter-Collector Voltage	5 V
Power Dissipation	100 mW(3)

Notes: (1) Maximum storage and operating temperature are limited by the temperature rating of the lead wires.
(2) Derate linearly 3.64 mW/°C above 25°C.
(3) Derate linearly 1.82 mW/°C above 25°C.
(4) Junction temperture maintained at 25°C.
(5) Plastic housing is soluble in chlorinated hydrocarbons and ketones. Methanol or isopropanol are recommended as cleaning agents.

Normalized Output Current vs Forward Current



Normalized Output Current vs Ambient Temperature



Type OPB831S20

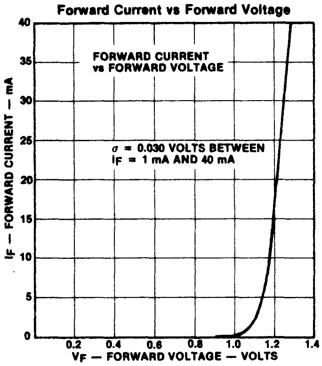
PRODUCT BULLETIN 3121
February 1982

electrical characteristics (25 °C unless otherwise noted)

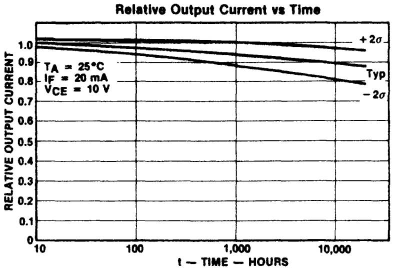
SYMBOL	PARAMETER	MIN	TYP	MAX	UNITS	TEST CONDITIONS
Input Diodes (See Schematic)						
V_F	Forward Voltage		2.44	3.4	V	$I_F = 40$ mA
I_R	Reverse Current			100	μA	$V_R = 6$ V
Output Phototransistor(s)						
$V_{(BR)CEO}$	Collector-Emitter Breakdown Voltage	30	65		V	$I_C = 1$ mA
$V_{(BR)ECO}$	Emitter-Collector Breakdown Voltage	5	9		V	$I_E = 100$ μA
I_{CEO}	Collector-Emitter Dark Current		5	100	nA	$V_{CE} = 10$ V, $I_F = 0$, $E_e = 0$
Coupled						
$V_{CE(SAT)}$	Collector-Emitter Saturation Voltage			0.4	V	$I_C = 200$ μA, $I_F = 25$ mA
$I_{C(ON)}$ (3)	On-State Collector Current	400			μA	$V_{CE} = 5$ V, $I_F = 25$ mA

Typical Performance Curves

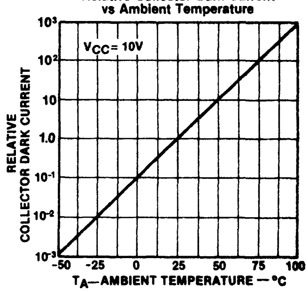
Forward Current vs Forward Voltage



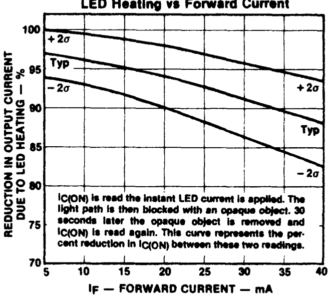
Relative Output Current vs Time



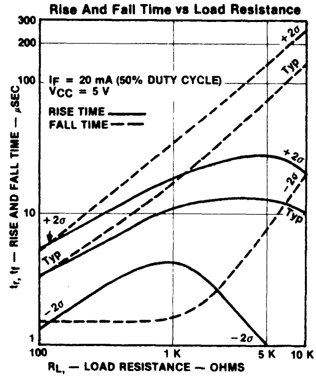
Relative Collector Dark Current vs Ambient Temperature



Reduction In Output Current Due to LED Heating vs Forward Current



Rise And Fall Time vs Load Resistance



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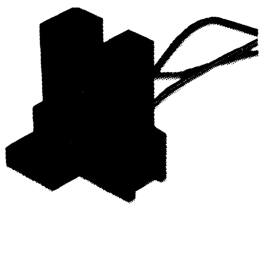
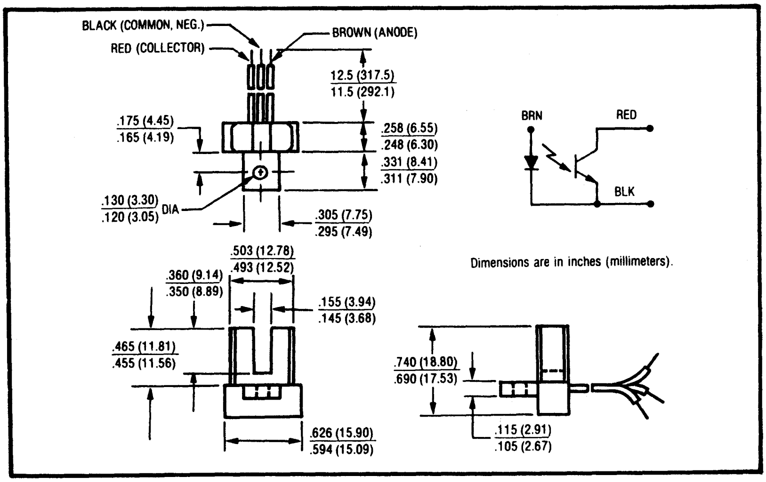
Printed in U.S.A.

Slotted Optical Switch
Type OPB835



ACTUAL SIZE



Features

- NON-CONTACT SWITCHING
- THREE LEAD WIRES FOR ELECTRICAL CONNECTION
- COMPLETELY SEALED POLYSULFONE HOUSING
- FAST SWITCHING SPEED

Description

The OPB835 consists of a gallium arsenide infrared emitting diode and an NPN silicon phototransistor mounted on opposite sides of a 0.15" (3.81mm) wide slot. Phototransistor switching takes place whenever an opaque object passes through the slot. The low cost polysulfone housing reduces possible interference from ambient light and provides dirt and dust protection. 11.5" (292.1mm) minimum length lead wires ease assembly where PC board mounting is not practical.

All electrical parameters are 100% tested by manufacturing. Specifications are guaranteed to a cumulative .65% AQL.

absolute maximum ratings (25 °C unless otherwise noted)

Storage and Operating Temperature Range . . . . −40 °C to +80 °C[1]

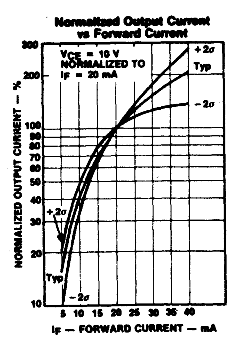
Input Diode

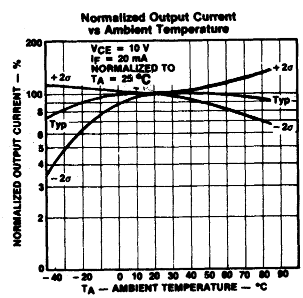
Reverse Voltage . . . . 3 V
Continuous Forward Current . . . . 50 mA
Peak Forward Current (1 μs pulse width, 300 pps) . . . . 3 A
Power Dissipation . . . . 100 mW[2]

Phototransistor

Collector-Emitter Voltage . . . . 30 V
Emitter-Collector Voltage . . . . 5 V
Power Dissipation . . . . 100 mW[2]

Notes: (1) Maximum storage and operating temperature are limited by the temperature rating of the lead wires.
(2) Derate linearly 1.82 mW/°C above 25 °C.
(3) Junction temperture maintained at 25 °C.
(4) Plastic housing is soluble in chlorinated hydrocarbons and ketones. Methanol or isopropanol are recommended as cleaning agents.





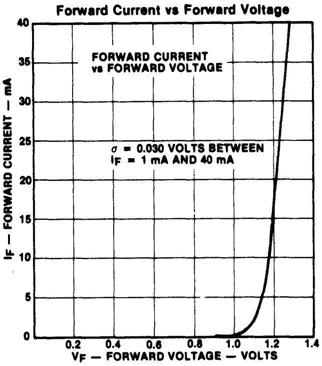
Type OPB835

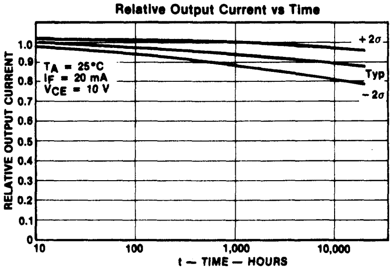
PRODUCT BULLETIN 3122
February 1982

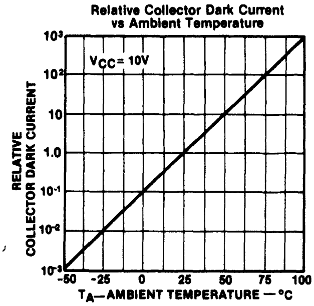
electrical characteristics (25°C unless otherwise noted)

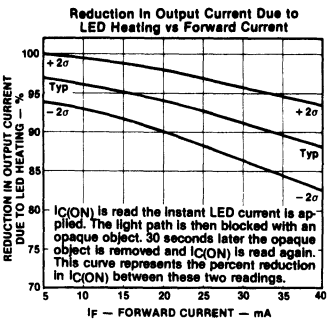
SYMBOL	PARAMETER	MIN	TYP	MAX	UNITS	TEST CONDITIONS
Input Diode						
V_F	Forward Voltage		1.22	1.7	V	I_F = 20 mA
I_R	Reverse Current			100	μA	V_R = 3 V
Output Phototransistor						
$V_{(BR)CEO}$	Collector-Emitter Breakdown Voltage	30	65		V	I_C = 1 mA
$V_{(BR)ECO}$	Emitter-Collector Breakdown Voltage	5	9		V	I_E = 100 μA
I_{CEO}	Collector-Emitter Dark Current		5	100	nA	V_{CE} = 10 V, I_F = 0, E_e = 0
Coupled						
$V_{CE(SAT)}$	Collector-Emitter Saturation Voltage			0.4	V	I_C = 1.5mA, I_F = 26 mA
$I_{C(ON)}$ (3)	On-State Collector Current	1.5			mA	V_{CE} = 0.4 V, I_F = 26 mA

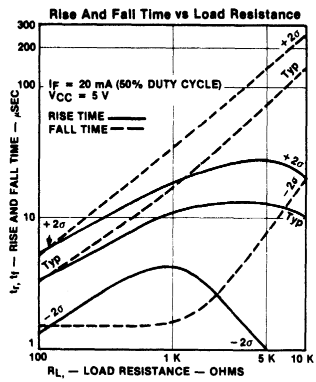
Typical Performance Curves











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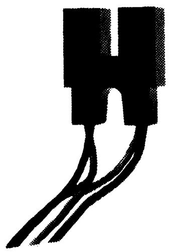
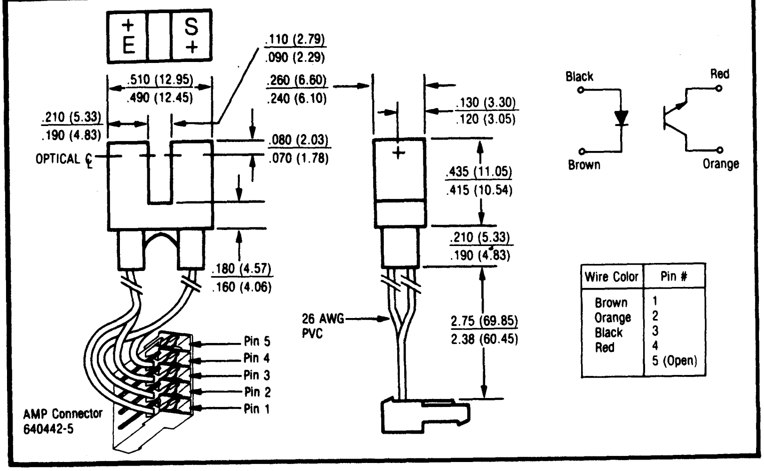
Slotted Optical Switch
Type OPB836



ACTUAL SIZE



Features

- NON-CONTACT SWITCHING
- WIRED TO STANDARD AMP NO. 640442-5 CONNECTOR
- COMPLETELY SEALED POLYSULFONE HOUSING
- FAST SWITCHING SPEED

Description

The OPB836 consists of a gallium arsenide infrared emitting diode and an NPN silicon phototransistor mounted on opposite sides of a 0.100" (2.54mm) wide slot. Phototransistor switching takes place whenever an opaque object passes through the slot. The low cost polysulfone housing reduces possible interference from ambient light and provides dirt and dust protection. A standard Amp No. 640442-5 connector has been attached to the lead wires to ease connection to wire harnesses.

All electrical parameters are 100% tested by manufacturing. Specifications are guaranteed to a cumulative .65% AQL.

absolute maximum ratings (25°C unless otherwise noted)

Storage and Operating Temperature Range . . . . −40°C to +80°C(1)

Input Diode

Reverse Voltage . . . . 3 V
Continuous Forward Current . . . . 50 mA
Peak Forward Current (1 μs pulse width, 300 pps) . . . . 3 A
Power Dissipation . . . . 100 mW(2)

Phototransistor

Collector-Emitter Voltage . . . . 30 V
Emitter-Collector Voltage . . . . 5 V
Power Dissipation . . . . 100 mW(2)

Notes: (1) Maximum storage and operating temperature are limited by the temperature rating of the lead wires.
(2) Derate linearly 1.82 mW/°C above 25°C.
(3) Junction temperture maintained at 25°C.
(4) Plastic housing is soluble in chlorinated hydrocarbons and ketones. Methanol or isopropanol are recommended as cleaning agents.

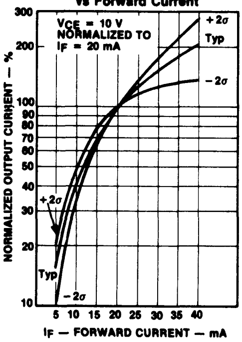
Type OPB836

electrical characteristics (25 °C unless otherwise noted)

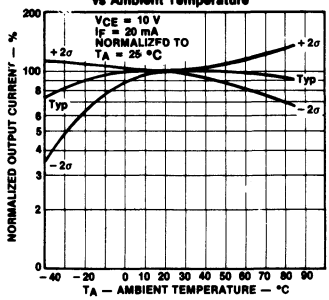
SYMBOL	PARAMETER	MIN	TYP	MAX	UNITS	TEST CONDITIONS
Input Diode						
V_F	Forward Voltage		1.22	1.7	V	$I_F = 20$ mA
I_R	Reverse Current			100	μA	$V_R = 3$ V
Output Phototransistor						
$V_{(BR)CEO}$	Collector-Emitter Breakdown Voltage	30	65		V	$I_C = 1$ mA
$V_{(BR)ECO}$	Emitter-Collector Breakdown Voltage	5	9		V	$I_E = 100$ μA
I_{CEO}	Collector-Emitter Dark Current		5	100	nA	$V_{CE} = 10$ V, $I_F = 0$, $E_e = 0$
Coupled						
$V_{CE(SAT)}$	Collector-Emitter Saturation Voltage			0.4	V	$I_C = 500$ μA, $I_F = 20$ mA
$I_{C(ON)}$(3)	On-State Collector Current	1			mA	$V_{CE} = 5$ V, $I_F = 20$ mA

Typical Performance Curves

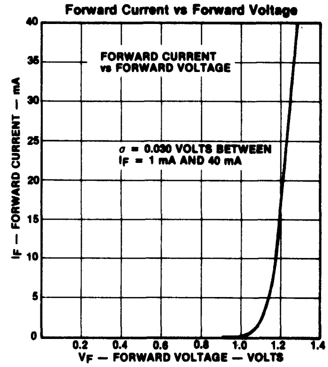
Normalized Output Current vs Forward Current



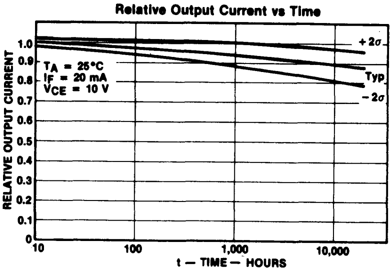
Normalized Output Current vs Ambient Temperature



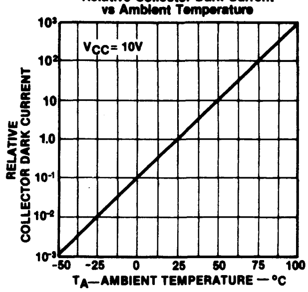
Forward Current vs Forward Voltage



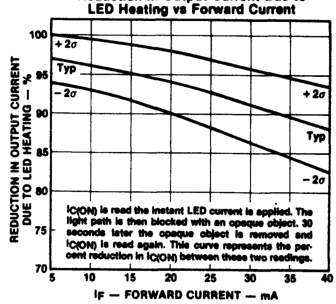
Relative Output Current vs Time



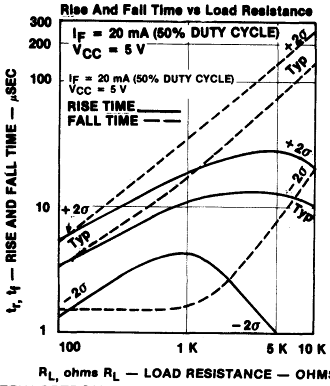
Relative Collector Dark Current vs Ambient Temperature



Reduction In Output Current Due to LED Heating vs Forward Current

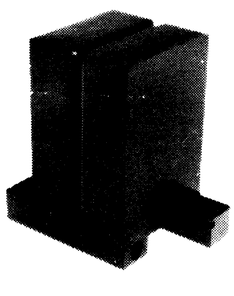


Rise And Fall Time vs Load Resistance

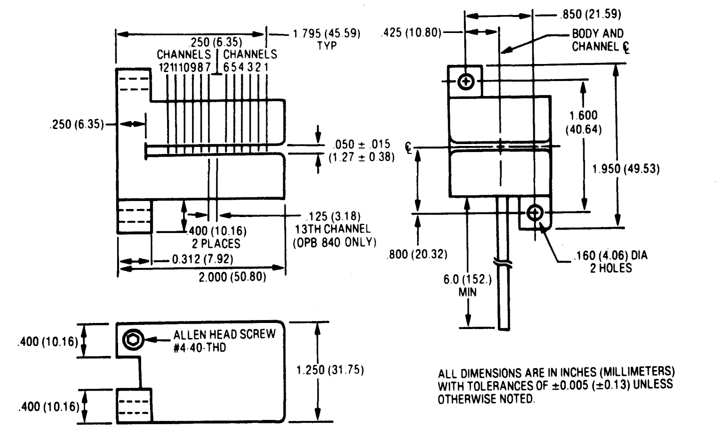


TRW OPTRON reserves the right to make changes at any time in order to improve design and to supply the best product possible.

Integrated Optical Paper Tape Reader
Types OPB840, OPB841, OPB842



ONE HALF ACTUAL SIZE



Features

- 13TH CHANNEL FOR DATA STROBE
- AVAILABLE WITH CONNECTOR TERMINATION
- RUGGED LONG LIFE CONSTRUCTION

Description

The OPB840, OPB841, and OPB842 are multiple channel integrated optical readers for such paper tapes as Burroughs 10020717, IBM 429754 or equivalents. Each device consists of spectrally matched and hermetically sealed gallium arsenide infrared emitting diodes and NPN silicon phototransistors, and two SN7414 hex Schmitt Trigger inverters to allow direct TTL compatibility. The OPB841 and OPB842 are 12 channel readers. The OPB842 is terminated with a 26 pin connector. The OPB840 has a 13th channel which can be used to provide a data strobe by sensing the tape sprocket holes.

absolute maximum ratings (25°C unless otherwise noted)

Supply Voltage Range V_{CC}(1) . . . . −0.5 V to 7 V
Storage Temperature Range . . . . −65°C to +100°C
Operating Temperature Range . . . . 0°C to +70°C

Notes: (1) Both ground terminals connected together.
(2) Not more than one output should be shorted at a time.
(3) Punched holes in tape should have a minimum diameter of .06 inches (1.52mm).

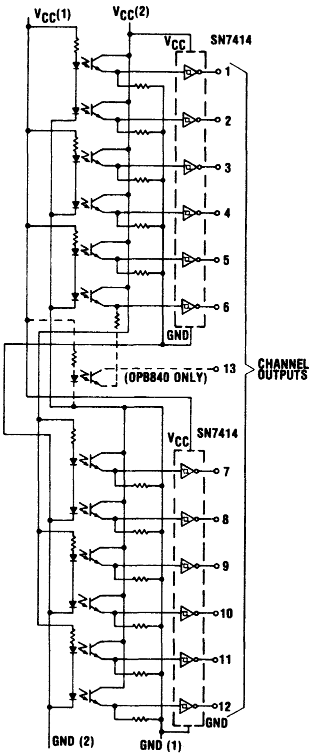
Types OPB840, OPB841, OPB842

PRODUCT BULLETIN 3124
April 1982

electrical characteristics (0°C to +70°C unless otherwise noted)

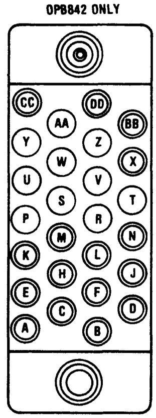
SYMBOL	PARAMETER	MIN	TYP	MAX	UNITS	TEST CONDITIONS
V_{OH}	High Level Output Voltage	2.4			V	V_{CC} = 4.75 V I_{OH} = −800 μA
V_{OL}	Low Level Output Voltage			0.4	V	V_{CC} = 4.75 V I_{OL} = 16 mA
I_{OS}	Short Circuit Output Current(2)	−18		−55	mA	V_{CC} = 5.25 V
I_{CC}	Supply Current OPB840 Total, All Outputs High Total, All Outputs Low OPB841 Total, All Outputs High OPB842 Total, All Outputs Low			320 450 290 410	mA	V_{CC} = 5.25 V
	Average per Channel		25		mA	V_{CC} = 5V, Data Rate ≤ 10 KHz 50% Duty Cycle

INTERNAL WIRING



TYPE	CHANNELS	CONNECTOR
OPB840	13	COLOR CODED WIRES
OPB841	12	COLOR CODED WIRES
OPB842	12	PLUG BODY WINCHESTER ELECTRONICS PART NO. TMARC 26P (OR EQUIVALENT)

OPB842 ONLY



VIEW IS FROM PIN SIDE OF CONNECTOR

FUNCTION	OPB840, OPB841 WIRE COLOR CODE	OPB842 CONNECTOR TERMINAL
CHANNEL 1 OUTPUT	WHITE/BLACK	A
CHANNEL 2 OUTPUT	WHITE/BROWN	B
CHANNEL 3 OUTPUT	WHITE/YELLOW	C
CHANNEL 4 OUTPUT	WHITE/GREEN	D
CHANNEL 5 OUTPUT	WHITE/BLUE	E
CHANNEL 6 OUTPUT	WHITE/VIOLET	F
CHANNEL 7 OUTPUT	WHITE/GRAY	H
CHANNEL 8 OUTPUT	WHITE/BLACK/BROWN	J
CHANNEL 9 OUTPUT	WHITE/BLACK/RED	K
CHANNEL 10 OUTPUT	WHITE/BLACK/ORANGE	L
CHANNEL 11 OUTPUT	WHITE/BLACK/YELLOW	M
CHANNEL 12 OUTPUT	WHITE/BLACK/GREEN	N
CHANNEL 13 OUTPUT	BLUE	—
V_{CC} (1) EMITTERS 1—6, & 13 PHOTOTRANSISTORS 7—12	WHITE/ORANGE	BB
GND (1) EMITTERS 1—6 & 13 PHOTOTRANSISTORS 7—12	BROWN	DD
V_{CC} (2) EMITTERS 7—12 PHOTOTRANSISTORS 1—6 & 13	RED	CC
GND (2) EMITTERS 7—12 PHOTOTRANSISTORS 1—6 & 13	BLACK	X

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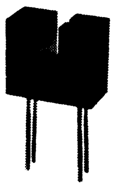
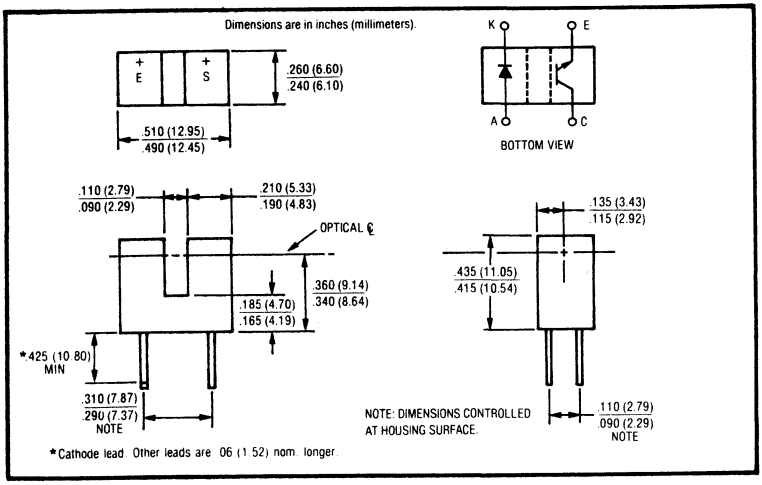
Printed in U.S.A.

Slotted Optical Switches
Types OPB847, OPB848



ACTUAL SIZE



Features

- NON-CONTACT SWITCHING
- APERTURED FOR HIGH RESOLUTION
- FAST SWITCHING SPEED

Description

The OPB847 and OPB848 each consist of a gallium arsenide infrared emitting diode and an NPN silicon phototransistor mounted in a low cost black plastic housing on opposite sides of a 0.100" (2.54mm) wide slot. Phototransistor switching takes place whenever an opaque object passes through the device slot. Both devices have a 0.025" (0.635mm) by 0.06" (1.52 mm) aperture in front of the phototransistor for high resolution position sensing.

All electrical parameters are 100% tested by manufacturing. Specifications are guaranteed to a cumulative .65% AQL.

absolute maximum ratings (25 °C unless otherwise noted)

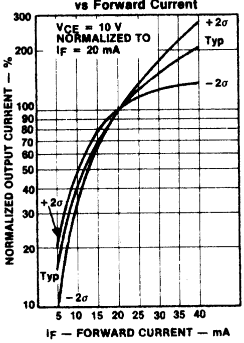
Storage and Operating Temperature Range . . . . −40 °C to +100 °C
Lead Soldering Temperature (1/16 inch [1.6 mm] from case for 5 sec. with soldering iron)[1] . . . . 240 °C

Input Diode
Reverse Voltage . . . . 3 V
Continuous Forward Current . . . . 50 mA
Peak Forward Current (1 µs pulse width, 300 pps) . . . . 3 A
Power Dissipation . . . . 100 mW[2]

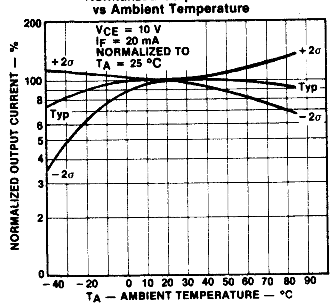
Output Phototransistor
Collector-Emitter Voltage . . . . 30 V
Emitter-Collector Voltage . . . . 5 V
Power Dissipation . . . . 100 mW[2]

Notes: (1) RMA flux is recommended. Duration can be extended to 10 sec. max. when wave soldering.
(2) Derate linearly 1.33 mW/°C above 25 °C
(3) Junction temperature maintained at 25 °C

Normalized Output Current vs Forward Current



Normalized Output Current vs Ambient Temperature



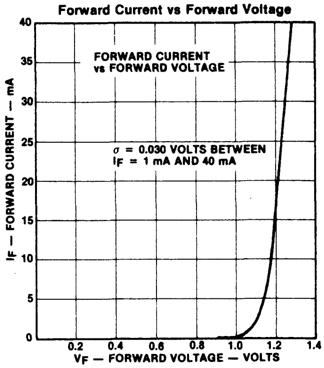
Types OPB847, OPB848

electrical characteristics (25°C unless otherwise noted)

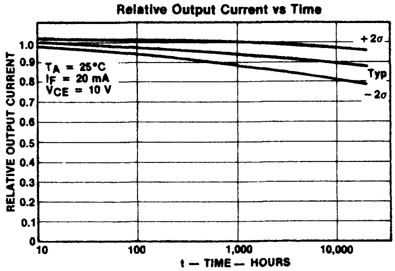
SYMBOL	PARAMETER	MIN	TYP	MAX	UNITS	TEST CONDITIONS
Input Diode						
V_F	Forward Voltage		1.22	1.7	V	I_F = 20 mA
I_R	Reverse Current			100	μA	V_R = 3 V
Output Phototransistor						
$V_{(BR)CEO}$	Collector-Emitter Breakdown Voltage	30	65		V	I_C = 1 mA
$V_{(BR)ECO}$	Emitter-Collector Breakdown Voltage	5	9		V	I_E = 100 μA
I_{CEO}	Collector-Emitter Dark Current		5	100	nA	V_{CE} = 10 V, I_F = 0, E_e = 0
Coupled						
$V_{CE(SAT)}$	Collector-Emitter Saturation Voltage OPB847 OPB848			 0.4 0.4	 V V	 I_C = 2 mA, I_F = 20 mA I_C = 0.5 mA, I_F = 20 mA
$I_{C(ON)}$ (3)	On-State Collector Current OPB847 OPB848	 4 1			 mA mA	V_{CE} = 5 V, I_F = 20 mA

Typical Performance Curves

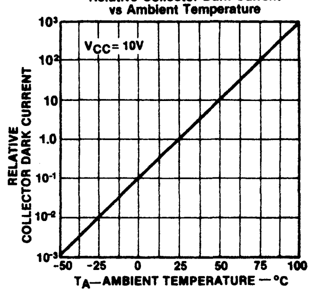
Forward Current vs Forward Voltage



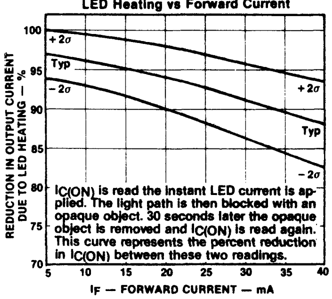
Relative Output Current vs Time



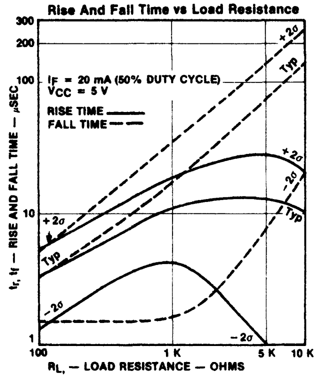
Relative Collector Dark Current vs Ambient Temperature



Reduction In Output Current Due to LED Heating vs Forward Current



Rise And Fall Time vs Load Resistance



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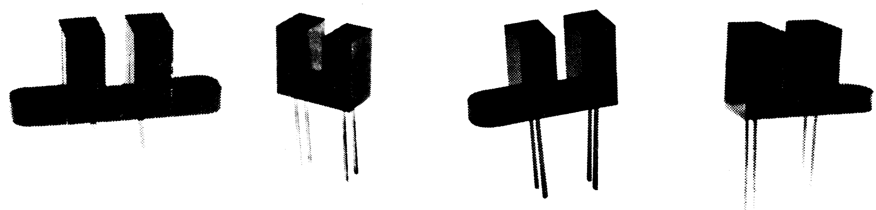
TRW OPTRON

PRODUCT BULLETIN 3126
February 1982

Slotted Optical Switches
Types OPB860 Series, OPB870 Series

RECOMMENDED FOR NEW DESIGN
THE OPB860 SERIES AND OPB870 SERIES ARE RECOMMENDED NEW DESIGN REPLACEMENTS FOR THE FOLLOWING DEVICES:

OPB813 Family	OPB817	OPB825 Family
OPB816	OPB819	CNY36



ACTUAL SIZE — PACKAGE T — PACKAGE N — PACKAGE L — PACKAGE P

Features

- CHOICE OF APERTURE SIZES
- CHOICE OF LEAD SPACING
- CHOICE OF MOUNTING CONFIGURATION
- CHOICE OF MINIMUM $I_{C(ON)}$
- CHOICE OF POLYCARBONATE OR POLYSULFONE HOUSING

Description

The ALL NEW OPB860/OPB870 Series is intended to provide custom design capability in a standard series. Each device consists of a gallium arsenide infrared emitting diode and an NPN silicon phototransistor mounted on opposite sides of a 0.125" (3.18mm) wide slot. Options include sensor aperture widths of 0.050" (1.27mm) or 0.010" (0.25mm); LED aperture width of 0.050" (1.27mm); sensor-led lead spacing of 0.220" (5.59mm) or 0.320" (8.13mm); minimum $I_{C(ON)}$ of 500 μA, 1000 μA, or 1800 μA; and polysulfone (OPB860) housings for dust and dirt protection, or polycarbonate (OPB870) for complete opacity to ambient light.

All electrical parameters are 100% tested by manufacturing. Specifications are guaranteed to a cumulative .65% AQL.

absolute maximum ratings (25°C unless otherwise noted)

Storage and Operating Temperature Range . . . . −40°C to +100°C
Lead Soldering Temperature (1/16 inch [1.6 mm] from case for 5 sec. with soldering iron) (A) . . . . 240°C

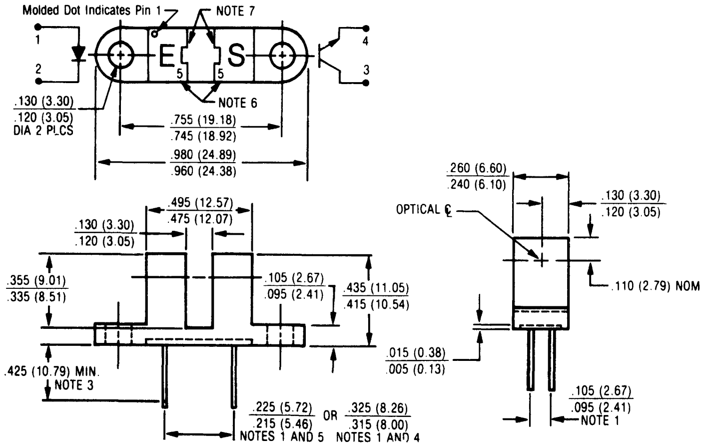
Input Diode
Reverse Voltage . . . . 3 V
Continuous Forward Current . . . . 50 mA
Peak Forward Current (1 μs pulse width, 300 pps) . . . . 3 A
Power Dissipation . . . . 100 mW (B)

Output Phototransistor
Collector-Emitter Voltage . . . . 30 V
Emitter-Collector Voltage . . . . 5 V
Power Dissipation . . . . 100 mW (B)

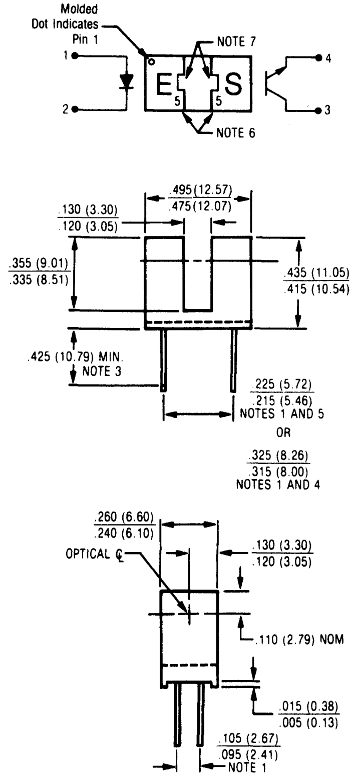
Notes: (A) RMA flux is recommended. Duration can be extended to 10 sec. max. when wave soldering.
(B) Derate linearly 1.33 mW/°C above 25°C
(C) Junction temperature maintained at 25°C

Types OPB860 Series, OPB870 Series

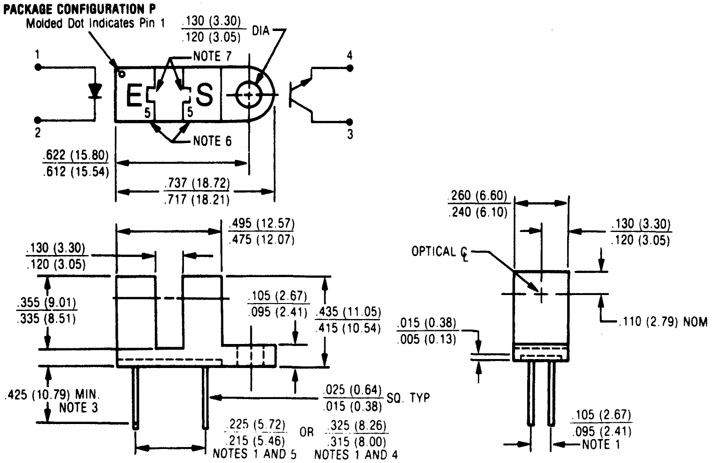
PACKAGE CONFIGURATION T



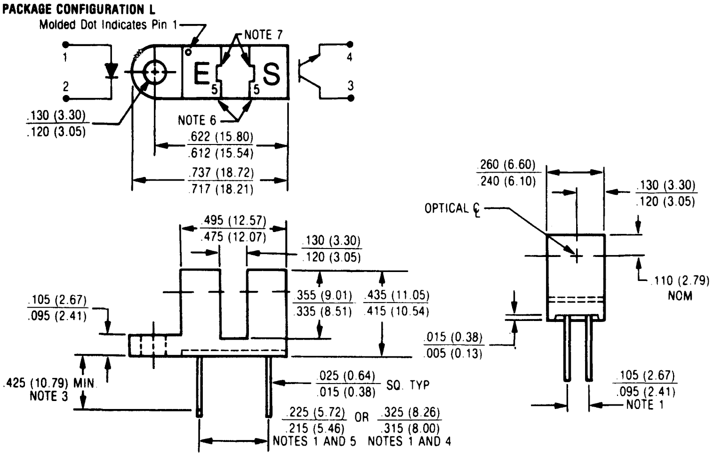
PACKAGE CONFIGURATION N



PACKAGE CONFIGURATION P



PACKAGE CONFIGURATION L



NOTES:
1. Dimension controlled at housing surface only.
2. Housing is soluble in chlorinated hydrocarbons and ketones. Methanol and isopropanol are recommended as cleaning agents.
3. Cathode lead. All other leads are .06 (1.52) nom. longer.
4. OPB860, OPB861, OPB862, OPB870, OPB871, OPB872
5. OPB865, OPB866, OPB867, OPB875, OPB876, OPB877
6. Molded number to identify aperture size. See part number guide.
7. Dimensions of aperture opening dependent on housing material. See part number guide.
8. Housings shown are polycarbonate.

Dimensions are in inches (millimeters).

Types OPB860 Series, OPB870 Series

PRODUCT BULLETIN 3126
February 1982

electrical characteristics (25°C unless otherwise noted)

SYMBOL	PARAMETER	MIN	MAX	UNITS	TEST CONDITIONS
Input Diode					
V_F	Forward Voltage		1.7	V	I_F = 20 mA
I_R	Reverse Current		100	μA	V_R = 3 V
Output Phototransistor					
$V_{(BR)CEO}$	Collector-Emitter Breakdown Voltage	30		V	I_C = 1 mA
$V_{(BR)ECO}$	Emitter-Collector Breakdown Voltage	5		V	I_E = 100 μA
I_{CEO}	Collector-Emitter Dark Current		100	nA	V_{CE} = 10 V
Coupled					
$V_{CE(SAT)}$	Collector-Emitter Saturation Voltage Parameter A - OPB860, OPB865; OPB870, OPB875 Parameter B - OPB861, OPB866; OPB871, OPB876 Parameter C - OPB862, OPB867; OPB872, OPB877		 0.4 0.4 0.6	 V V V	 I_C = 400 μA, I_F = 20 mA I_C = 800 μA, I_F = 10 mA I_C = 1800 μA, I_F = 20 mA
$I_{C(ON)}$(C)	On-State Collector Current Parameter A - OPB860, OPB865; OPB870, OPB875 Parameter B - OPB861, OPB866; OPB871, OPB876 Parameter C - OPB862, OPB867; OPB872, OPB877	 500 1000 1800		 μA μA μA	 V_{CE} = 10 V, I_F = 20 mA V_{CE} = 5 V, I_F = 10 mA V_{CE} = 0.6 V, I_F = 20 mA

PART NUMBER GUIDE

OPB 8XX X XX

- OPB — TRW Optron Assembly
- 8 = Phototransistor Output Family
- Housing Material Designation
  6 = Polysulfone 7 = Polycarbonate
- Mechanical and Electrical Specification Variations
  - 0 = Electrical Parameter A
    Lead Spacing .320" (8.13mm)
  - 1 = Electrical Parameter B
    Lead Spacing .320" (8.13mm)
  - 2 = Electrical Parameter C
    Lead Spacing .320" (8.13mm)
  - 5 = Electrical Parameter A
    Lead Spacing .220" (5.59mm)
  - 6 = Electrical Parameter B
    Lead Spacing .220" (5.59mm)
  - 7 = Electrical Paramater C
    Lead Spacing .220" (5.59mm)
- Mounting Configurations
  - T = Both Mounting Tabs
  - N = No Tabs
  - L = Single Mounting Tab, Emitter Side
  - P = Single Mounting Tab, Sensor Side
- Aperture Width in Front of LED
  5 = .050" (1.27mm)
  Aperture Length is .060" (1.52mm)
- Aperture Width in Front of Sensor
  5 = .050" (1.27mm) *1 = .010" (.25mm)
  Aperture Length is .060" (1.52mm)
  * Available With Electrical Parameter A Only

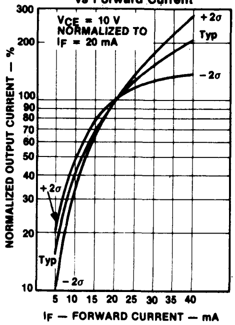
EXAMPLE

OPB875N51

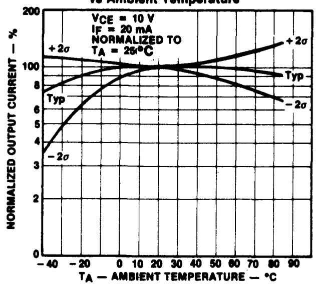
- TRW Optron Assembly
- Phototransistor Output
- Polycarbonate Housing
- Electrical Parameter A
  .220" (5.59mm) Lead Spacing
- Mounting Configuration "N"
- .050" (1.27mm) Width Aperture in Front of LED
- .010" (.25mm) Width Aperture in Front of Sensor

Typical Performance Curves

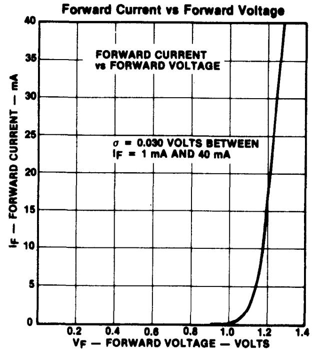
Normalized Output Current vs Forward Current



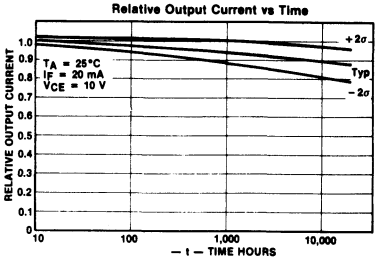
Normalized Output Current vs Ambient Temperature



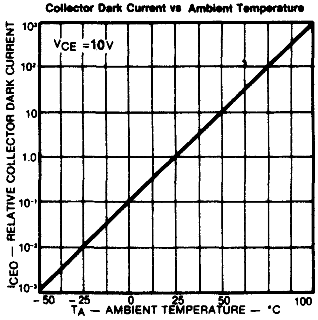
Forward Current vs Forward Voltage



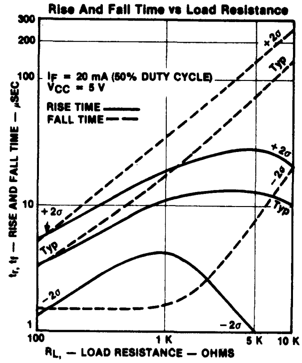
Relative Output Current vs Time



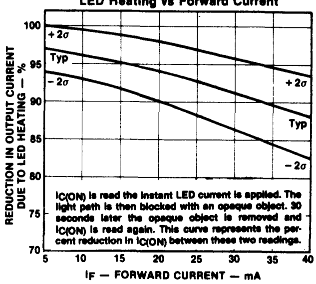
Collector Dark Current vs Ambient Temperature



Rise And Fall Time vs Load Resistance

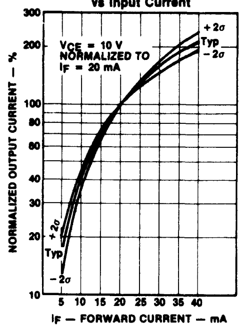


Reduction In Output Current Due to LED Heating vs Forward Current

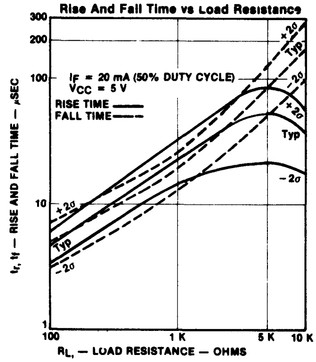


All Part Numbers Ending In "1"

Normalized Output Current vs Input Current

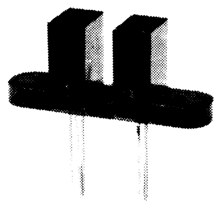


Rise And Fall Time vs Load Resistance

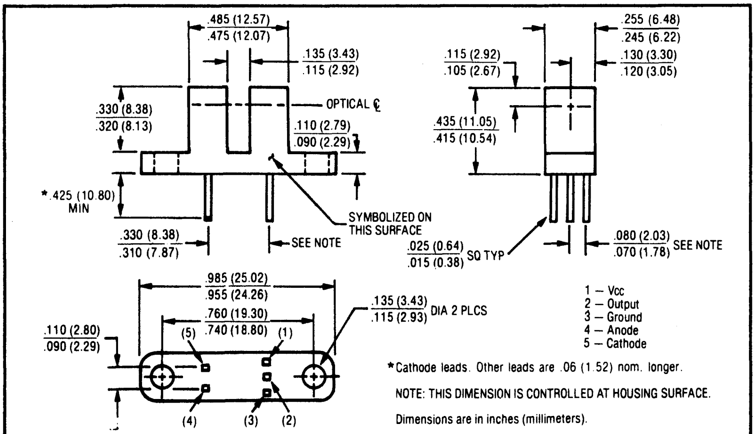


Photologic™ Slotted Switches
Types OPB913S10 - OPB916S10

NOT RECOMMENDED FOR NEW DESIGN. SEE OPB960 SERIES.



ACTUAL SIZE



Features

- FOUR OUTPUT OPTIONS
- APERTURED FOR HIGH RESOLUTION
- LOW COST PLASTIC HOUSING
- DIRECT TTL/LSTTL INTERFACE
- HIGH NOISE IMMUNITY
- DATA RATES TO 250 KBAUD

Description

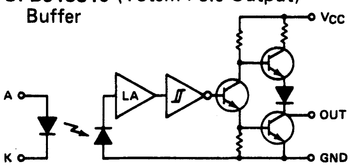
The OPB913S10, OPB914S10, OPB 915S10, and OPB916S10 each contain a gallium arsenide infrared emitting diode coupled to a monolithic integrated circuit which incorporates a photodiode, a linear amplifier, and a Schmitt trigger on a single silicon chip. The devices feature TTL/LSTTL compatible logic level output which can drive up to 8 TTL loads directly without additional circuitry. Also featured are medium speed data rates to 250 KBAUD with typical output rise and fall times of 25 nsec. A 0.010 inch (0.25 mm) molded aperture in front of the Photologic sensor allows high resolution motion sensing. The devices are encased in low cost plastic housings which provide dust protection and reduce ambient light noise.

All electrical parameters are 100% tested by manufacturing. Specifications are guaranteed to a .65% AQL.

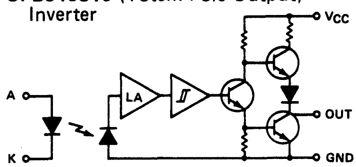
TM Trademark TRW INC.

Schematics

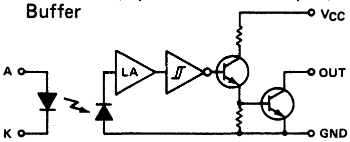
OPB913S10 (Totem-Pole Output)
Buffer



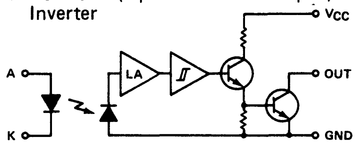
OPB915S10 (Totem-Pole Output)
Inverter



OPB914S10 (Open Collector Output)
Buffer



OPB916S10 (Open Collector Output)
Inverter



absolute maximum ratings (25° C unless otherwise noted)

Supply Voltage, V_{CC} (not to exceed 3 seconds)	+10 V
Storage Temperature Range	−40°C to +100°C
Operating Temperature Range	−40°C to +70°C
Lead Soldering Temperature Range (1/16 inch [1.6 mm] from Case for 5 sec. w/soldering iron(1))	240°C
Total Device Power Dissipation	300 mW(2)
Input Diode Power Dissipation	100 mW(3)
Output Photologic Power Dissipation	200 mW(4)
Duration of Output Short to V_{CC} or Ground (OPB913S10, OPB915S10)	1 sec.
Duration of Output Short to V_{CC} (OPB914S10, OPB916S10)	1 sec.
Voltage at Output Lead (OPB914S10, OPB916S10)	35 V
Diode Input: Forward D.C. Current	40 mA
Diode Input: Reverse D.C. Voltage	3 V

Notes: (1) RMA flux is recommended. Duration can be extended to 10 seconds max. when flow soldering.
(2) Derate linearly 4.0 mW/°C above 25°C.
(3) Derate linearly 1.33 mW/°C above 25°C.
(4) Derate linearly 2.67 mW/°C above 25°C.

Types OPB913S10, OPB914S10, OPB915S10, OPB916S10

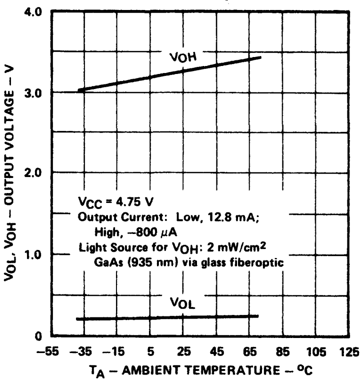
electrical characteristics (−40° C to +70° C unless otherwise noted)

SYMBOL	PARAMETER	MIN	TYP	MAX	UNITS	TEST CONDITIONS
DIODE INPUT						
V_F	Forward Voltage			1.5	V	I_F = 20 mA, T_A = 25°
I_R	Reverse Current			100	μA	V_R = 3 V, T_A = 25°C
$I_{F(+)}$	LED Positive-Going Threshold Current			15	mA	V_{CC} = 5 V
$I_{F(+)}/I_{F(-)}$	Hysteresis Ratio		2			
PHOTOLOGIC OUTPUT						
V_{CC}	Operating Supply Voltage	4.75		5.25	V	
I_{CC}	Supply Current			15	mA	V_{CC} = 5.25 V, I_F = 0(1) or 20 mA
OPB913S10 (Buffer, Totem-Pole)						
V_{OL}	Low Level Output Voltage			0.4	V	V_{CC} = 4.75 V, I_{OL} = 12.8 mA I_F = 0 mA(1)
V_{OH}	High Level Output Voltage	2.4			V	V_{CC} = 4.75 V, I_{OH} = −800 μA I_F = 20 mA
I_{OS}	Short Circuit Output Current	−30		−100	mA	V_{CC} = 5.25 V, I_F = 20 mA Output = GND
OPB914S10 (Buffer, Open Collector)						
V_{OL}	Low Level Output Voltage			0.4	V	V_{CC} = 4.75 V, I_{OL} = 12.8 mA I_F = 0 mA(1)
I_{OH}	High Level Output Current			100	μA	V_{CC} = 4.75 V, V_{OH} = 30 V I_F = 20 mA
OPB915S10 (Inverter, Totem-Pole)						
V_{OL}	Low Level Output Voltage			0.4	V	V_{CC} = 4.75 V, I_{OL} = 12.8 mA I_F = 20 mA
V_{OH}	High Level Output Voltage	2.4			V	V_{CC} = 4.75 V, I_{OH} = −800 μA I_F = 0 mA(1)
I_{OS}	Short Circuit Output Current	−30		−100	mA	V_{CC} = 5.25 V, I_F = 0 mA(1) Output = GND
OPB916S10 (Inverter, Open Collector)						
V_{OL}	Low Level Output Voltage			0.4	V	V_{CC} = 4.75 V, I_{OL} = 12.8 mA I_F = 20 mA
I_{OH}	High Level Output Current			100	μA	V_{CC} = 4.75 V, V_{OH} = 30 V I_F = 0 mA(1)
OPB913S10, OPB915S10						
t_r, t_f	Output Rise Time, Output Fall Time			70	ns	V_{CC} = 5 V, T_A = 25°C I_F = 0(1) or 20 mA f = 10 kHz, D.C. = 50% R_L = 8 TTL Loads
t_{PLH}, t_{PHL}	Propagation Delay, Low-High, High-Low			5	μs	
OPB914S10, OPB916S10						
t_r, t_f	Output Rise Time, Output Fall Time			70	ns	V_{CC} = 5 V, T_A = 25°C I_F = 0(1) or 20 mA f = 10 kHz, D.C. = 50% R_L = 360 Ω
t_{PLH}, t_{PHL}	Propagation Delay, Low-High, High-Low			5	μs	

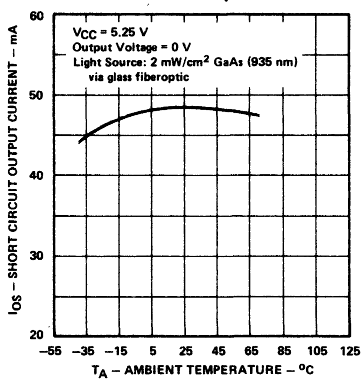
Note: (1) Normal application would be with light source blocked, simulated by I_F = 0.

OPB913S10, OPB915S10

Output Voltage vs. Ambient Temperature

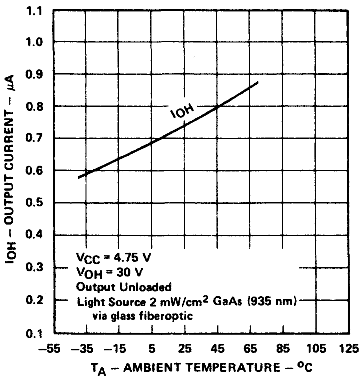


Short Circuit Output Current vs. Ambient Temperature

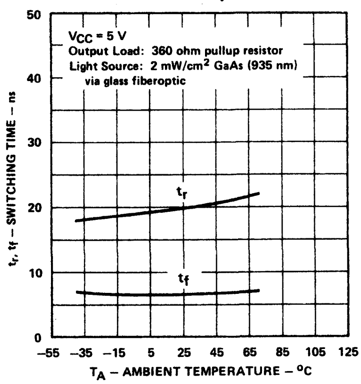


OPB914S10, OPB916S10

Output Current (High) vs. Ambient Temperature

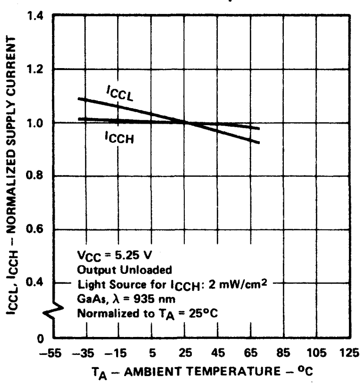


Rise Time and Fall Time vs. Ambient Temperature



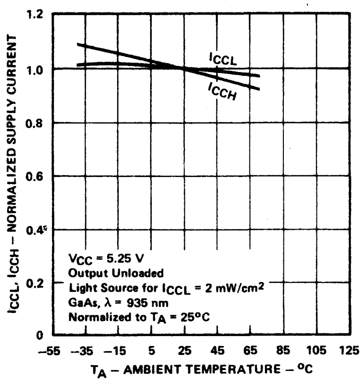
OPB913S10, OPB914S10

Normalized Supply Current vs. Ambient Temperature

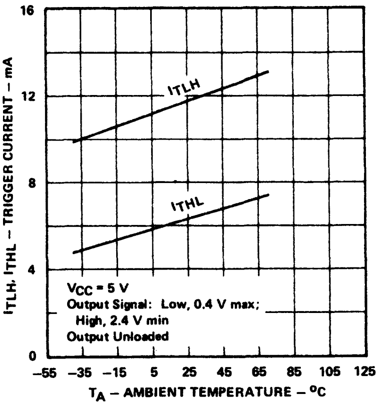


OPB915S10, OPB916S10

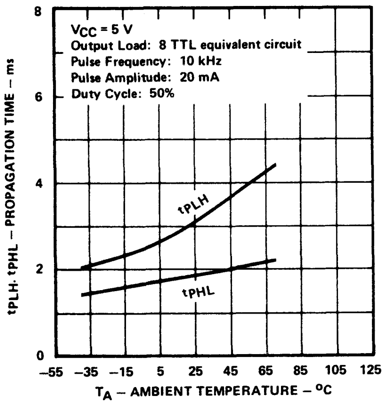
Normalized Supply Current vs. Ambient Temperature



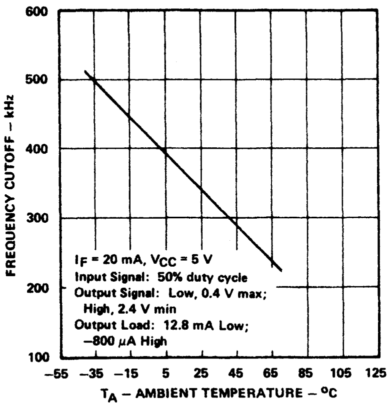
Trigger Current vs. Ambient Temperature



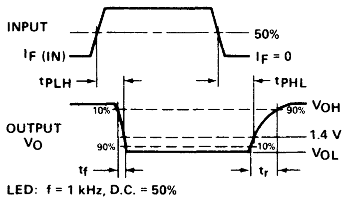
Propagation Time vs. Ambient Temperature



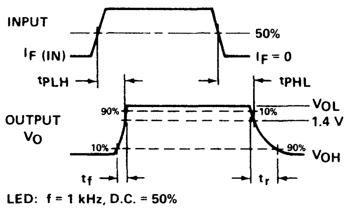
Data Rate vs. Ambient Temperature



Switching Test Curve for Inverters



Switching Test Curve for Buffers

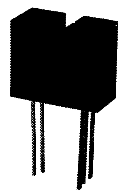


TRW OPTRON

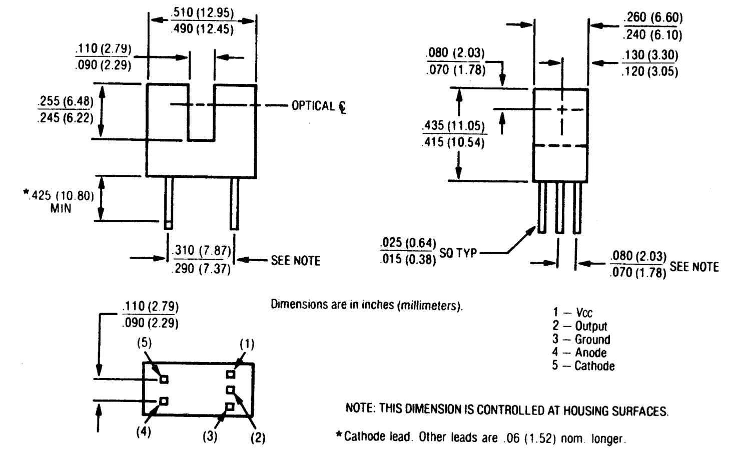
PRODUCT BULLETIN 3128
January 1982

Photologic™ Slotted Switches
Types OPB947, OPB948

NOT RECOMMENDED FOR NEW DESIGN. SEE OPB960 SERIES.



ACTUAL SIZE



Features

- TWO OUTPUT OPTIONS
- LOW COST PLASTIC HOUSING
- DIRECT TTL/LSTTL INTERFACE
- HIGH NOISE IMMUNITY
- DATA RATES TO 250 KBAUD

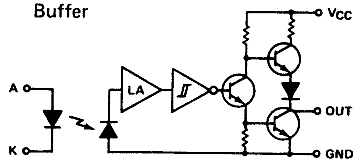
Description

The OPB947 and OPB948 each contain a gallium arsenide infrared emitting diode coupled to a monolithic integrated circuit, which incorporates a photodiode, a linear amplifier and a Schmitt trigger on a single silicon chip. The devices feature TTL/LSTTL compatible logic level output which can drive up to 8 TTL loads directly without additional circuitry. Also featured are medium speed data rates to 250 KBAUD with typical output rise and fall times of 25 nsec. A 0.025 inch (0.635 mm) aperture in front of the sensor and a 0.05 inch (1.27 mm) aperture in front of the LED allows high resolution motion sensing. The devices are encased in low cost plastic housings which provide dust protection, reduce ambient light noise and ease direct soldering to PC boards.

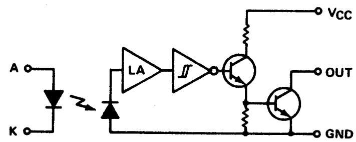
All electrical parameters are 100% tested by manufacturing. Specifications are guaranteed to a .65% AQL.

Schematics

OPB947 (Totem-Pole Output)
Buffer



OPB948 (Open Collector Output)
Buffer



absolute maximum ratings (25° C unless otherwise noted)

Supply Voltage, V_{CC} (not to exceed 3 seconds)	+10 V
Storage Temperature Range	−40°C to +100°C
Operating Temperature Range	−40°C to +70°C
Lead Soldering Temperature Range (1/16 inch [1.6 mm] from Case for 5 sec. w/soldering iron(1))	240°C
Total Device Power Dissipation	300 mW(2)
Input Diode Power Dissipation	100 mW(3)
Output Photologic Power Dissipation	200 mW(4)
Duration of Output Short to V_{CC} or Ground (OPB947)	1 sec.
Duration of Output Short to V_{CC} (OPB948)	1 sec.
Voltage at Output Lead (OPB948)	35 V
Diode Input: Forward D.C. Current	40 mA
Diode Input: Reverse D.C. Voltage	3 V

Notes: (1) RMA flux is recommended. Duration can be extended to 10 seconds max. when flow soldering.
(2) Derate linearly 4.0 mW/°C above 25°C.
(3) Derate linearly 1.33 mW/°C above 25°C.
(4) Derate linearly 2.67 mW/°C above 25°C.

TRW OPTRON, A DIVISION OF TRW INC., 1201 TAPPAN CIRCLE, CARROLLTON, TEXAS, 75006 (214) 323-2200, TWX-910-860-5958

Types OPB947, OPB948

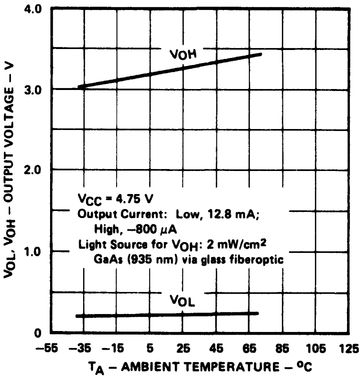
electrical characteristics (−40° C to +70° C unless otherwise noted)

SYMBOL	PARAMETER	MIN	TYP	MAX	UNITS	TEST CONDITIONS
DIODE INPUT						
V_F	Forward Voltage			1.5	V	I_F = 20 mA, T_A = 25°
I_R	Reverse Current			100	μA	V_R = 3 V, T_A = 25°C
$I_{F(+)}$	LED Positive-Going Threshold Current			15	mA	V_{CC} = 5 V
$I_{F(+)}/I_{F(-)}$	Hysteresis Ratio		2			
PHOTOLOGIC OUTPUT						
V_{CC}	Operating Supply Voltage	4.75		5.25	V	
I_{CC}	Supply Current			15	mA	V_{CC} = 5.25 V, I_F = 0(1) or 20 mA
OPB947 (Buffer, Totem-Pole)						
V_{OL}	Low Level Output Voltage			0.4	V	V_{CC} = 4.75 V, I_{OL} = 12.8 mA I_F = 0 mA(1)
V_{OH}	High Level Output Voltage	2.4			V	V_{CC} = 4.75 V, I_{OH} = −800 μA I_F = 20 mA
I_{OS}	Short Circuit Output Current	−30		−100	mA	V_{CC} = 5.25 V, I_F = 20 mA Output = GND
OPB948 (Buffer, Open Collector)						
V_{OL}	Low Level Output Voltage			0.4	V	V_{CC} = 4.75 V, I_{OL} = 12.8 mA I_F = 0 mA(1)
I_{OH}	High Level Output Current			100	μA	V_{CC} = 4.75 V, V_{OH} = 30 V I_F = 20 mA
OPB947						
t_r, t_f	Output Rise Time, Output Fall Time			70	ns	V_{CC} = 5 V, T_A = 25°C I_F = 0(1) or 20 mA
t_{PLH}, t_{PHL}	Propagation Delay, Low-High, High-Low			5	μs	f = 10 kHz, D.C. = 50% R_L = 8 TTL Loads
OPB948						
t_r, t_f	Output Rise Time, Output Fall Time			70	ns	V_{CC} = 5 V, T_A = 25°C I_F = 0(1) or 20 mA
t_{PLH}, t_{PHL}	Propagation Delay, Low-High, High-Low			5	μs	f = 10 kHz, D.C. = 50% R_L = 360 Ω

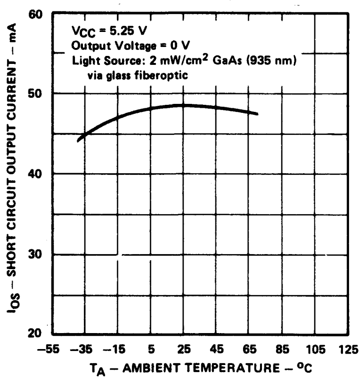
Note: (1) Normal application would be with light source blocked, simulated by I_F = 0.

OPB947

Output Voltage vs. Ambient Temperature

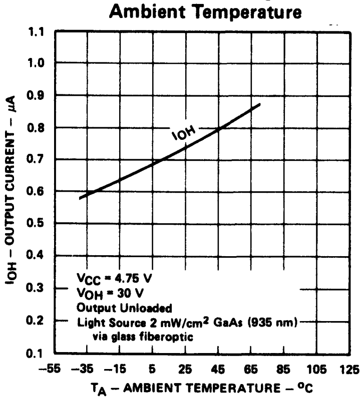


Short Circuit Output Current vs. Ambient Temperature

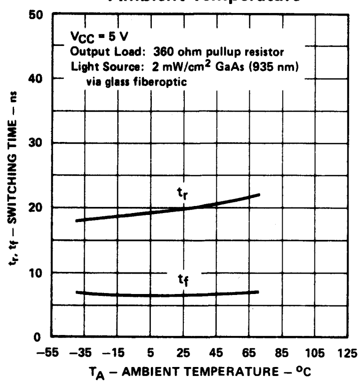


OPB948

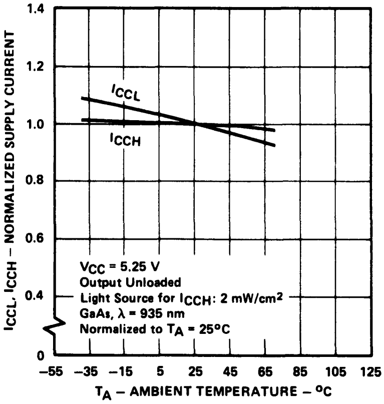
Output Current (High) vs. Ambient Temperature



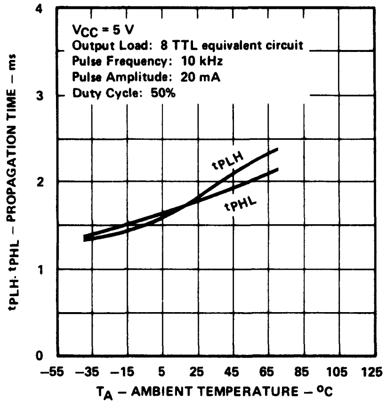
Rise Time and Fall Time vs. Ambient Temperature



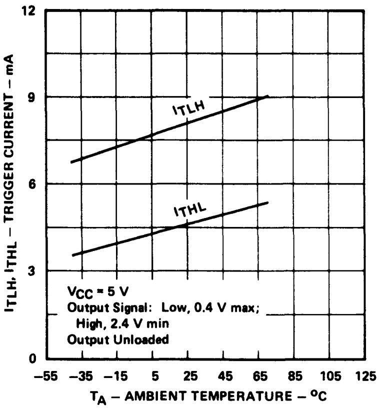
Normalized Supply Current vs. Ambient Temperature



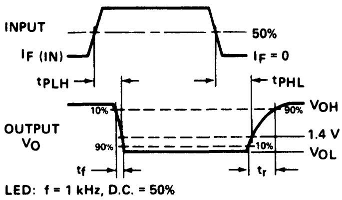
Propagation Time vs. Ambient Temperature



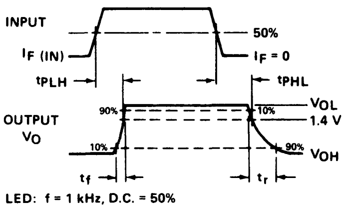
Trigger Current vs. Ambient Temperature



Switching Test Curve for Inverters



Switching Test Curve for Buffers



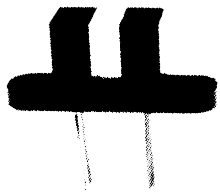
TRW OPTRON

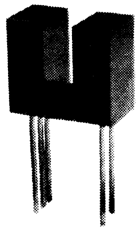
PRODUCT BULLETIN 3130
February 1982

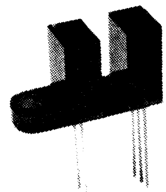
Photologic™ Slotted Optical Switches
Types OPB960 Series, OPB970 Series

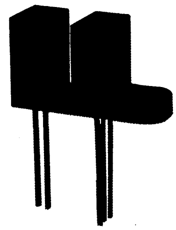
RECOMMENDED FOR NEW DESIGN
THE OPB960 SERIES AND OPB970 SERIES ARE RECOMMENDED NEW DESIGN REPLACEMENTS FOR THE FOLLOWING DEVICES:

OPB913S10	OPB915S10	OPB947
OPB914S10	OPB916S10	OPB948


PACKAGE T


PACKAGE N


PACKAGE L


PACKAGE P

ACTUAL SIZE

Features

- CHOICE OF APERTURE
- CHOICE OF MOUNTING CONFIGURATION
- CHOICE OF OUTPUT CONFIGURATION
- CHOICE OF POLYSULFONE OR POLYCARBONATE HOUSING
- DATA RATES TO 250 K BAUD

Description

The all new OPB960/OPB970 Series is intended to provide custom design capabilities in a standard series. Each device consists of a gallium arsenide infrared emitting diode and a photologic integrated circuit mounted on opposite sides of a 0.125" (3.18mm) wide slot. Options include photologic sensor aperture widths of 0.050" (1.27mm) or 0.010" (0.25mm); four different mounting configurations; buffer-totem pole buffer-open collector, inverter-totem pole, or inverter-open collector output; and polysulfone (OPB960) housing for dirt and dust protection or polycarbonate (OPB970) housing for complete opacity to ambient light.

All electrical parameters are 100% tested by manufacturing. Specifications are guaranteed to a cumulative .65% AQL.

absolute maximum ratings (25 °C unless otherwise noted)

Supply Voltage, V_{CC} (not to exceed 3 seconds) .... + 10V
Storage Temperature Range .... − 40 °C to + 100 °C
Operating Temperature Range .... − 40 °C to + 70 °C
Lead Soldering Temperature (1/16 inch [1.6 mm] from case for 5 sec. with soldering iron)(A) .... 240 °C

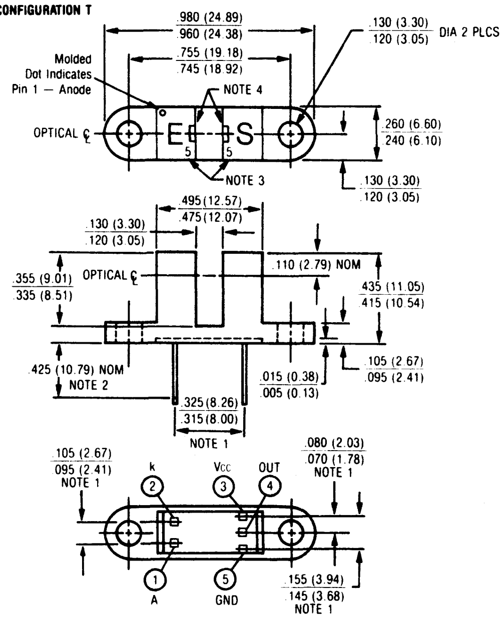
Input Diode Power Dissipation .... 100mW(B)
Output Photologic Power Dissipation .... 200mW(D)
Total Device Power Dissipation .... 300mW(E)
Voltage at Output Lead (Open Collector Output) 35V
Diode { Forward D.C. Current 40mA
Diode { Reverse D.C. Voltage 3V

Notes: (A) RMA flux is recommended. Duration can be extended to 10 sec. max. when wave soldering.
(B) Derate linearly 1.33 mW/°C above 25 °C.
(C) Normal application would be with light source blocked, simulated by $I_F = 0$.
(D) Derate linearly 2.67 mW/°C above 25 °C.
(E) Derate linearly 4.0 mW/°C above 25 °C.

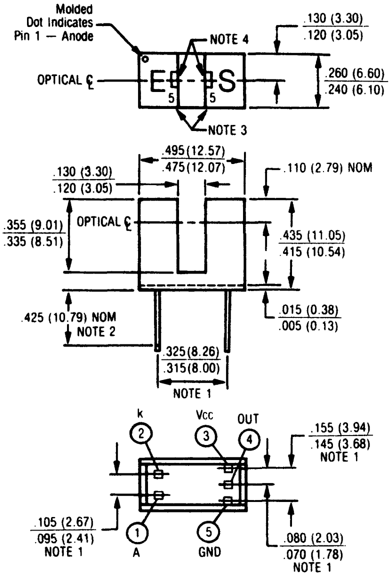
TM Trademark TRW Inc.

Types OPB960 Series, OPB970 Series

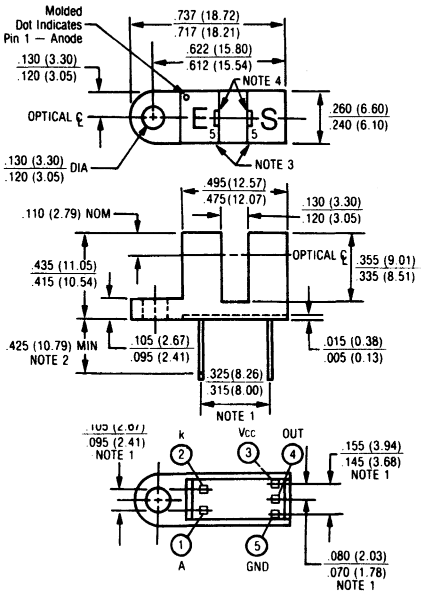
PACKAGE CONFIGURATION T



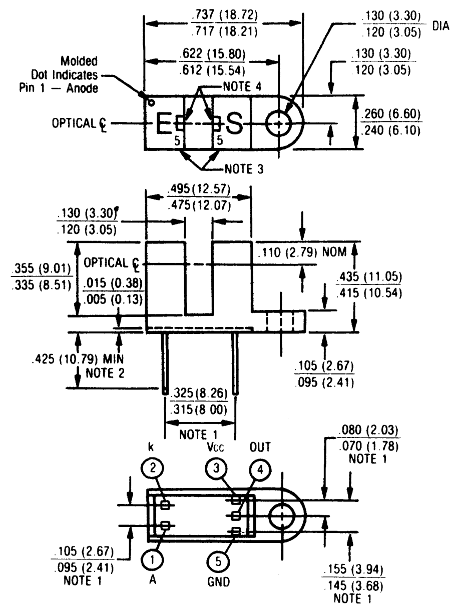
PACKAGE CONFIGURATION N



PACKAGE CONFIGURATION L



PACKAGE CONFIGURATION P



Dimensions are in inches (millimeters).

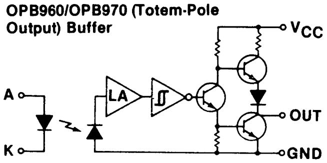
NOTES:
1. This dimension is controlled at housing surface.
2. Cathode lead. All other leads are .06 (1.52) nom. longer.
3. Molded number to identify aperture size. See part number guide.
4. Dimensions of aperture opening dependent on housing material. See part number guide.
5. Housing is soluble in chlorinated hydrocarbons and ketones. Methanol and isopropanol are recommended as cleaning agents.
6. Housings shown are polycarbonate.

electrical characteristics (– 40 °C to + 70 °C unless otherwise noted)

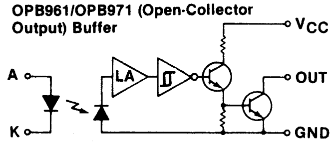
SYMBOL	PARAMETER	MIN	Typ	MAX	UNITS	TEST CONDITIONS
Input Diode						
V_F	Forward Voltage			1.5	V	I_F = 20 mA, T_A = 25 °C
I_R	Reverse Current			100	μA	V_R = 3 V, T_A = 25 °C
Output Photologic						
V_{CC}	Operating Supply Voltage	4.75		5.25	V	
I_{CCL}	Low Level Supply Current:					
	Buffer with Totem-Pole Output			15	mA	V_{CC} = 5.25 V, I_F = 0 mA(C)
	Buffer with Open-Collector			15	mA	V_{CC} = 5.25 V, I_F = 0 mA(C)
	Inverter with Totem-Pole Output			15	mA	V_{CC} = 5.25 V, I_F = 20 mA
	Inverter with Open-Collector			15	mA	V_{CC} = 5.25 V, I_F = 20 mA
I_{CCH}	High Level Supply Current:					
	Buffer with Totem-Pole			15	mA	V_{CC} = 5.25 V, I_F = 20 mA
	Buffer with Open-Collector			15	mA	V_{CC} = 5.25 V, I_F = 20 mA
	Inverter with Totem-Pole			15	mA	V_{CC} = 5.25 V, I_F = 0 mA(C)
	Inverter with Open-Collector			15	mA	V_{CC} = 5.25 V, I_F = 0 mA(C)
V_{OL}	Low Level Output Voltage:					
	Buffer with Totem-Pole			0.4	V	V_{CC} = 4.75 V, I_{OL} = 12.8 mA, I_F = 0 mA(C)
	Buffer with Open-Collector			0.4	V	V_{CC} = 4.75 V, I_{OL} = 12.8 mA, I_F = 0 mA(C)
	Inverter with Totem-Pole			0.4	V	V_{CC} = 4.75 V, I_{OL} = 12.8 mA, I_F = 20 mA
	Inverter with Open-Collector			0.4	V	V_{CC} = 4.75 V, I_{OL} = 12.8 mA, I_F = 20 mA
V_{OH}	High Level Output Voltage:					
	Buffer with Totem-Pole	2.4			V	V_{CC} = 4.75 V, I_{OH} = 800 μA, I_F = 20 mA
	Inverter with Totem-Pole	2.4			V	V_{CC} = 4.75 V, I_{OH} = 800 μA, I_F = 0 mA(C)
I_{OH}	High Level Output Current:					
	Buffer with Open-Collector			100	μA	V_{CC} = 4.75 V, V_{OH} = 30 V, I_F = 0 mA(C)
	Inverter with Open-Collector			100	μA	V_{CC} = 4.75 V, V_{OH} = 30 V, I_F = 20 mA T_A = 25 °C
$I_{F(+)}$	LED Positive-Going Threshold Current			20	mA	V_{CC} = 5 V
$I_{F(+)}/I_{F(-)}$	Hysteresis Ratio		2			V_{CC} = 5 V
I_{OS}	Short Circuit Output Current	– 30		– 100	mA	V_{CC} = 5.25 V, I_F = 20 mA, Output = GND
t_r, t_f	Output Rise Time, Output Fall Time			70	ns	V_{CC} = 5 V, T_A = 25 °C
t_{PLH}, t_{PHL}	Propagation Delay, Low-High & High-Low			5	μs	I_F = 0 or 20 mA, R_L = 8TTL Loads (Totem-Pole), R_L = 360 Ω (Open Collector)

Schematics

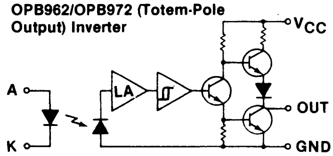
OPB960/OPB970 (Totem-Pole Output) Buffer



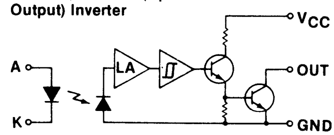
OPB961/OPB971 (Open-Collector Output) Buffer



OPB962/OPB972 (Totem-Pole Output) Inverter



OPB963, OPB973 (Open Collector Output) Inverter



PART NUMBER GUIDE

OPB 9XX X XX

- TRW Optron Assembly
- 9 = Photologic Output Family
- Housing Material Designation
  6 = Polysulfone 7 = Polycarbonate
- Photologic Sensor Output Variations
  0 = Buffer with Totem Pole Output
  1 = Buffer with Open Collector Output
  2 = Inverter with Totem Pole Output
  3 = Inverter with Open Collector Output
- Aperture Width in Front of Sensor
  5 = 0.050" (1.27mm) 1 = 0.010" (0.25mm)
  Aperture Length is 0.060" (1.52mm)
- Aperture Width in Front of LED
  5 = 0.050" (1.27mm)
  Aperture Length is 0.060" (1.52mm)
- Mounting Configurations
  T = Both Mounting Tabs
  N = No Tabs
  L = Single Mounting Tab, Emitter Side
  P = Single Mounting Tab, Sensor Side

EXAMPLE

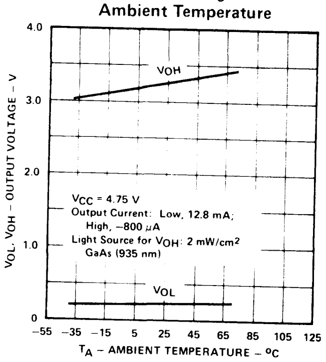
OPB963N51

- TRW Optron Assembly
- Photologic Output
- Polysulfone Housing
- Inverter, Open Collector
- Mounting Tabs on Both Sides
- .050" (1.27mm) Aperture in Front of LED
- .010" (.25mm) Aperture in Front of Sensor

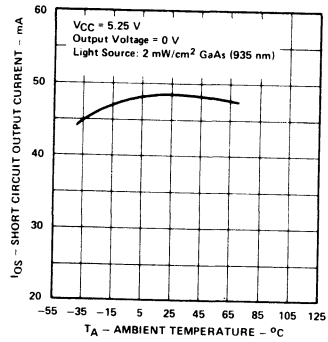
Typical Performance Curves

OPB960, OPB962, OPB970, OPB972

Output Voltage vs. Ambient Temperature



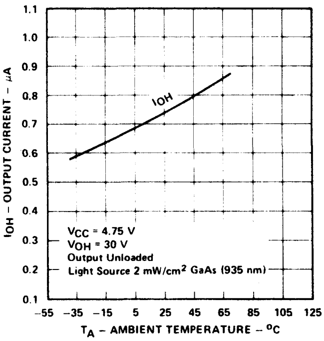
Short Circuit Output Current vs. Ambient Temperature



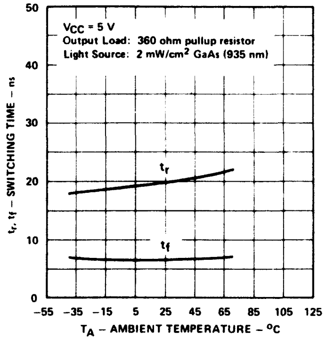
Types OPB960 Series, OPB970 Series

OPB961, OPB963, OPB971, OPB973

Output Current (High) vs. Ambient Temperature

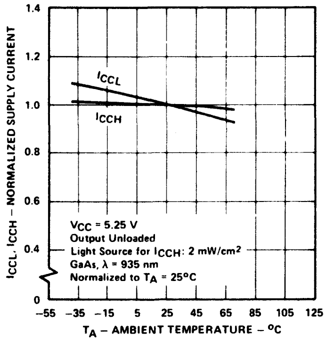


Rise Time and Fall Time vs. Ambient Temperature



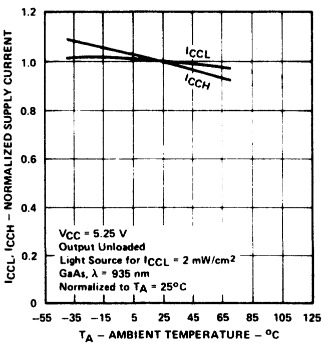
OPB960, OPB961, OPB970, OPB971

Normalized Supply Current vs. Ambient Temperature



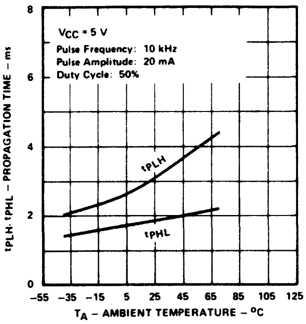
OPB962, OPB963, OPB972, OPB973

Normalized Supply Current vs. Ambient Temperature

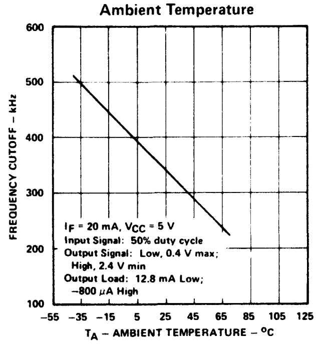


All Assemblies

Propagation Time vs. Ambient Temperature

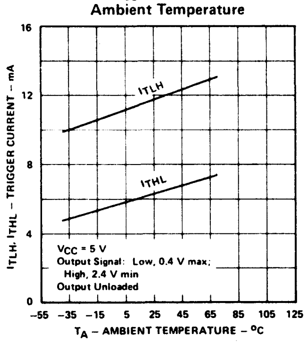


Data Rate vs. Ambient Temperature

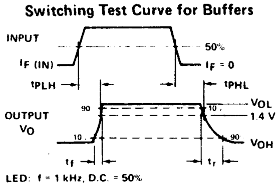


All Assemblies

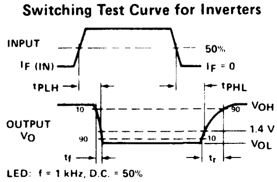
Trigger Current vs. Ambient Temperature



Switching Test Curve for Buffers



Switching Test Curve for Inverters



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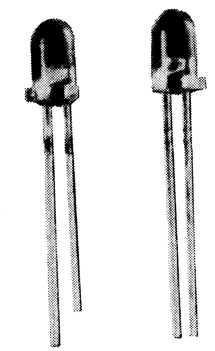
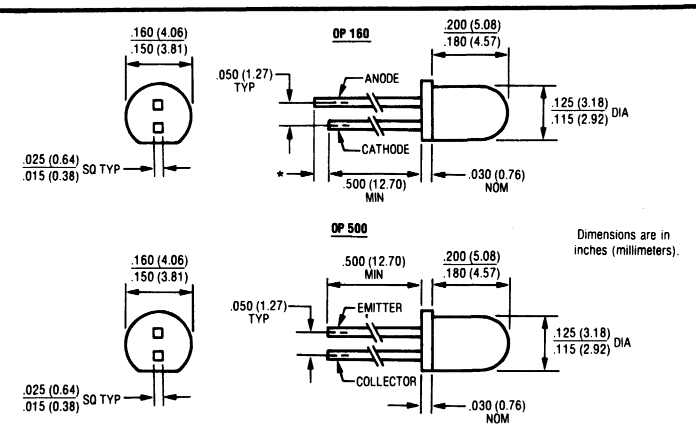
Emitter and Photosensor Matched Pairs

Matched LED and Photosensor Pair

Types OPS660



TWICE ACTUAL SIZE



* For identification purposes, anode lead is .06 (1.52) nom. longer than cathode lead.

Features

- MINI-AXIAL END-LOOKING PLASTIC PACKAGES
- HIGH CURRENT TRANSFER RATIO
- LOW COST PLASTIC PACKAGE

Description

The OPS660 consists of a gallium arsenide infrared emitting diode (OP160) and an NPN silicon phototransistor (OP500) mounted in matched mini-axial end-looking clear plastic packages. Matched pairs are desirable where the application is unique and the quantity required does not justify assembly tooling costs. If separation between the LED and sensor is greater than two times the specified $I_{C(ON)}$ distance, proper alignment becomes critical. Also, it should be remembered that the sensor is sensitive to ambient light.

All electrical parameters are 100% tested by manufacturing. Specifications are guaranteed to a cumulative .65% AQL.

absolute maximum ratings (25 °C unless otherwise noted)

Storage and Operating Temperature Range . . . . −40 °C to +100 °C
Lead Soldering Temperature (1/16 inch [1.6 mm] from case for 5 sec. with soldering iron)(1) . . . . 240 °C

Input Diode

Continuous Forward Current . . . . 50 mA
Peak Forward Current (1 μs pulse width, 300 pps) . . . . 3 A
Reverse Voltage . . . . 2 V
Power Dissipation . . . . 100 mW(2)

Output Phototransistor

Collector-Emitter Voltage . . . . 30 V
Emitter-Collector Voltage . . . . 5 V
Power Dissipation . . . . 100 mW(2)

Notes: (1) RMA flux is recommended. Duration can be extended to 10 sec. max. when wave soldering.
(2) Derate linearly 1.33 mW/°C above 25 °C
(3) Junction temperature maintained at 25 °C.
(4) Distance from lens tip to lens tip is 0.25 inches (6.35mm).

Types OPS660

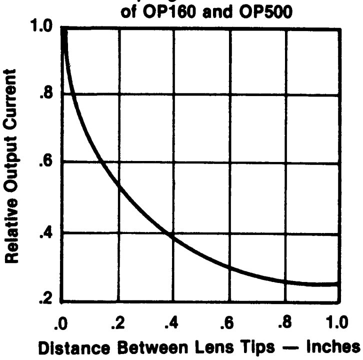
PRODUCT BULLETIN 3028
April 1982

electrical characteristics (25 °C unless otherwise noted)

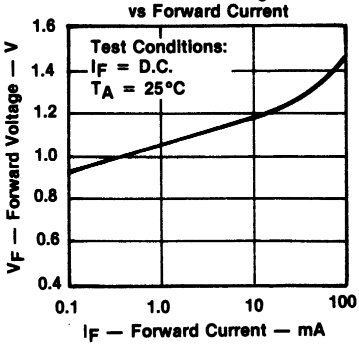
SYMBOL	PARAMETER	MIN	TYP	MAX	UNITS	TEST CONDITIONS
Input Diode						
V_F	Forward Voltage			1.6	V	I_F = 20 mA
I_R	Reverse Current			100	μA	V_R = 2 V
Output Phototransistor						
$V_{(BR)CEO}$	Collector-Emitter Breakdown Voltage	30			V	I_C = 1 mA
$V_{(BR)ECO}$	Emitter-Collector Breakdown Voltage	5			V	I_E = 100 μA
I_{CEO}	Collector Dark Current			100	nA	V_{CE} = 10 V, E_e = 0
Coupled						
$I_{C(ON)}$ (3) (4)	On-State Collector Current	0.5			mA	V_{CE} = 5 V, I_F = 20 mA

Typical Performance Curves

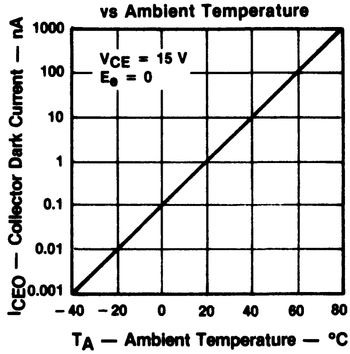
Coupling Characteristics of OP160 and OP500



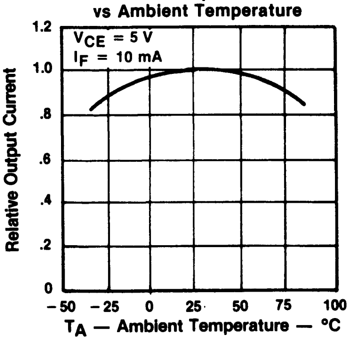
Forward Voltage vs Forward Current



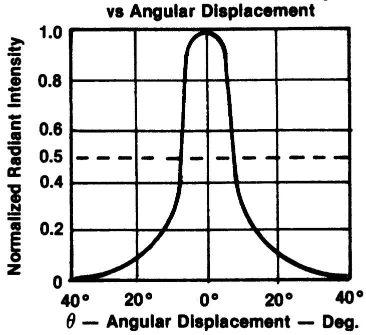
Collector Dark Current vs Ambient Temperature



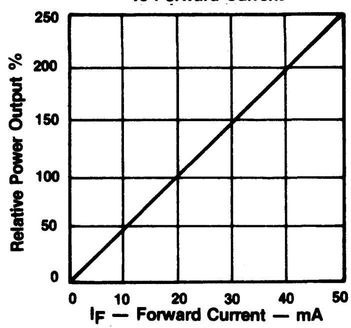
Relative Output Current vs Ambient Temperature



Normalized Radiant Intensity vs Angular Displacement



Relative Power Output vs Forward Current



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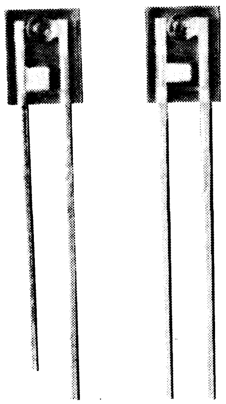
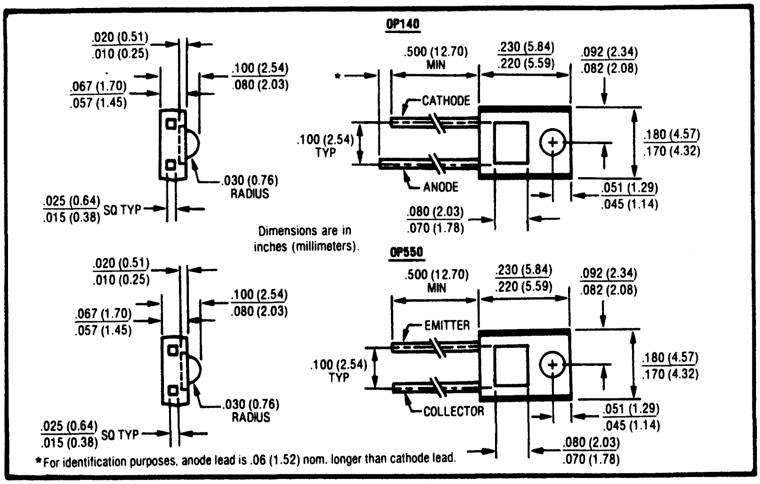
PRODUCT BULLETIN 3029
April 1982

Matched LED and Photosensor Pair

Types OPS690, OPS691, OPS692, OPS693



TWICE ACTUAL SIZE



Features

- LATERAL SIDE LOOKING CLEAR PLASTIC PACKAGE
- HIGH CURRENT TRANSFER RATIO

Description

The OPS690 through OPS693 each consist of a gallium arsenide infrared emitting diode (OP140) and an NPN silicon phototransistor (OP550) mounted in matched lateral side looking clear plastic packages. Matched pairs are desirable where the application is unique and the quantity required does not justify assembly tooling costs. If separation between the LED and sensor is greater than two times the specified $I_{C(ON)}$ distance, proper alignment becomes critical. Also, it should be remembered that the sensor is sensitive to ambient light. On-state collector current ranges are guaranteed to a 2.5% AQL.

All electrical parameters are 100% tested by manufacturing. Specifications are guaranteed to a cumulative .65% AQL.

absolute maximum ratings (25°C unless otherwise noted)

Storage and Operating Temperature Range . . . . −40°C to +100°C
Lead Soldering Temperature (1/16 inch [1.6 mm] from case for 5 sec. with soldering iron)[1] . . . . 240°C

Input Diode

Reverse Voltage . . . . 2 V
Continuous Forward Current . . . . 50 mA
Peak Forward Current (1 μs pulse width, 300 pps) . . . . 3 A
Power Dissipation . . . . 100 mW[2]

Output Phototransistor

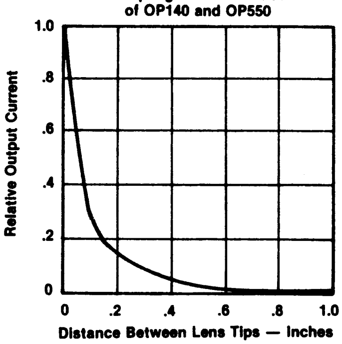
Collector-Emitter Voltage . . . . 30 V
Emitter-Collector Voltage . . . . 5 V
Power Dissipation . . . . 100 mW[2]

Notes: (1) RMA flux is recommended. Duration can be extended to 10 sec. max. when wave soldering.
(2) Derate linearly 1.33 mW/°C above 25°C
(3) Distance from lens tip to lens tip is 0.125 inches (3.18mm).

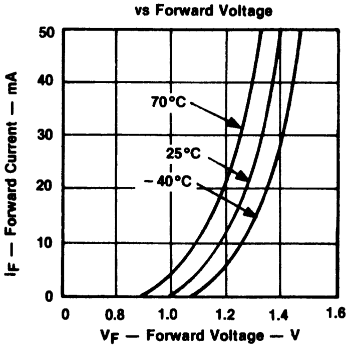
electrical characteristics (25 °C unless otherwise noted)

SYMBOL	PARAMETER		MIN	TYP	MAX	UNITS	TEST CONDITIONS
Input Diode							
V_F	Forward Voltage				1.6	V	I_F = 20 mA
I_R	Reverse Current				100	μA	V_R = 2 V
Output Phototransistor							
$V_{(BR)CEO}$	Collector-Emitter Breakdown Voltage		30			V	I_C = 1 mA
$V_{(BR)ECO}$	Emitter-Collector Breakdown Voltage		5			V	I_E = 100 μA
I_{CEO}	Dark Current				100	nA	V_{CE} = 10 V, E_e = O
Coupled							
$V_{CE(SAT)}$	Saturation Voltage				0.4	V	I_F = 20 mA, I_C = 50 μA(3)
$I_{C(ON)}$(3)	On-State Collector Current	OPS690 OPS691 OPS692 OPS693	100 500 1 2			μA μA mA mA	V_{CE} = 10 V, I_F = 20 mA(3)

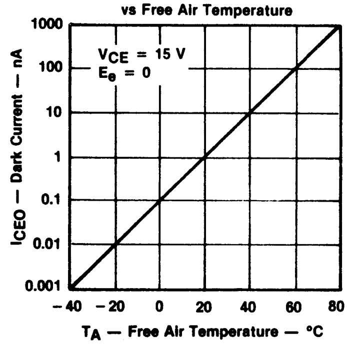
Typical Performance Curves



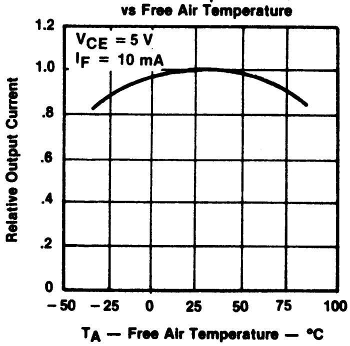
Coupling Characteristics of OP140 and OP550



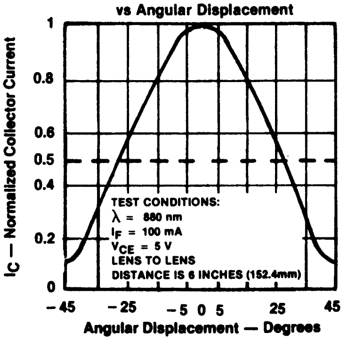
Forward Current vs Forward Voltage



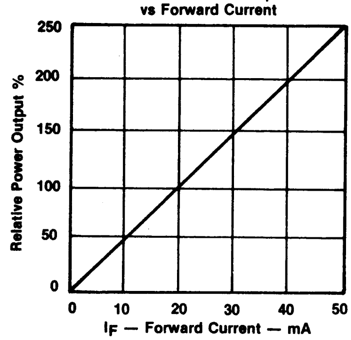
Dark Current vs Free Air Temperature



Relative Output Current vs Free Air Temperature



Normalized Collector Current vs Angular Displacement



Relative Power Output vs Forward Current

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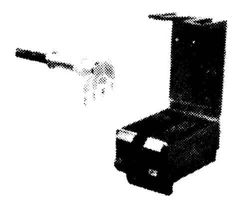
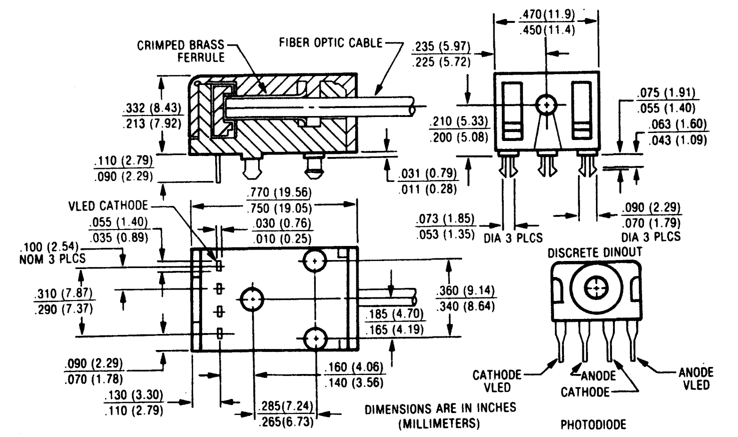
Fiber Optic Data Links

Fiber Optic Data Link
Type OPB950



ONE HALF ACTUAL SIZE



Features

- BIDIRECTIONAL OPERATION
- DATA RATES TO 1 M BAUD
- UP TO 10 METERS SEPARATION BETWEEN TRANSCEIVERS

Description

The OPB950 consists of a low cost high temperature, black plastic housing containing a gallium arsenide phosphide visible light-emitting diode concentrically mounted on a silicon photodiode sensor, which is optically coupled to ferrule terminated fiber optic cable. Minimum light loss at the coupling is ensured by a snap-in feature which holds the ferrule permanently in place. The housing is designed for snap-in mounting to PC boards and is wave solderable. The data link includes two transceiver assemblies and up to 10 meters of fiber optic cable.

absolute maximum ratings (25 °C unless otherwise noted)

Storage and Operating Temperature Range . . . . −40 °C to +85 °C
Lead Soldering Temperature (1/16 inch [1.6 mm] from case for 5 sec. with soldering iron)(1) . . . . 240 °C

Input VLED

Continuous Forward Current . . . . 75 mA(2)
Peak Forward Current . . . . 1 A(3)

Output Photodiode

Reverse Voltage . . . . 80 V

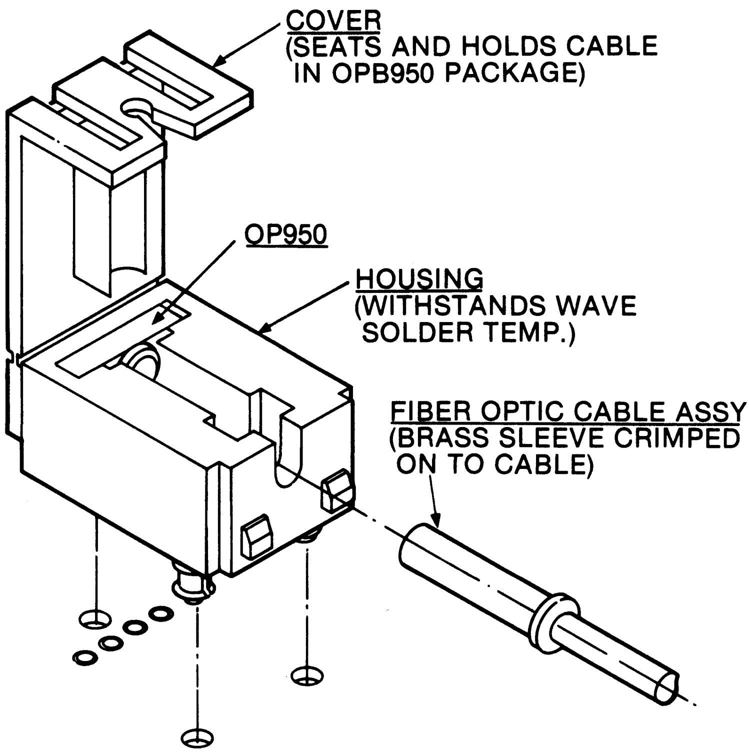
Notes: (1) RMA flux is recommended. Duration can be extended to 10 sec. max. when wave soldering.
(2) Derate linearly 1.25 mA/°C above 25 °C
(3) PW = 100 μs, 0.1% Duty Cycle.
(4) Measured with anode-cathode leads of LED shorted together and anode-cathode leads of photodiode shorted together.

Type OPB950

PRODUCT BULLETIN 3129
April 1982

electrical characteristics (25°C unless otherwise noted)

SYMBOL	PARAMETER	MIN	TYP	MAX	UNITS	TEST CONDITIONS
Input VLED						
V_F	Forward Voltage			2	V	I_F = 50 mA
I_R	Reverse Current			100	μA	V_R = 4 V
Output Photodiode						
I_D	Reverse Dark Current			25	nA	V_R = 12 V, E_e = 0
$V_{(BR)R}$	Reverse Breakdown Voltage	80			V	I_R = 100 μA, E_e = 0
Coupled						
I_L	Reverse Light Current OPB950-0100, 1 Meter Cable Length OPB950-0300, 3 Meter Cable Length OPB950-0700, 7 Meter Cable Length OPB950-1000, 10 Meter Cable Length	 400 200 100 50			 nA nA nA nA	 V_R = 12V, I_F = 50 mA V_R = 12V, I_F = 50 mA V_R = 12V, I_F = 50 mA V_R = 12V, I_F = 50 mA
I_{SO}	Isolation Current			100	nA	V_{CC} = 50 V(4)
C	V_{LED} Capacitance		41 pF			V = 0, I = 0
C	Photodiode Capacitance		37 pF 27 pF			V_R = 12V V_R = 24V



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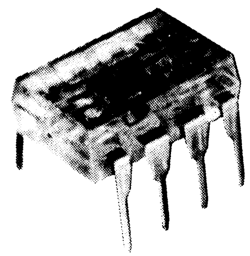
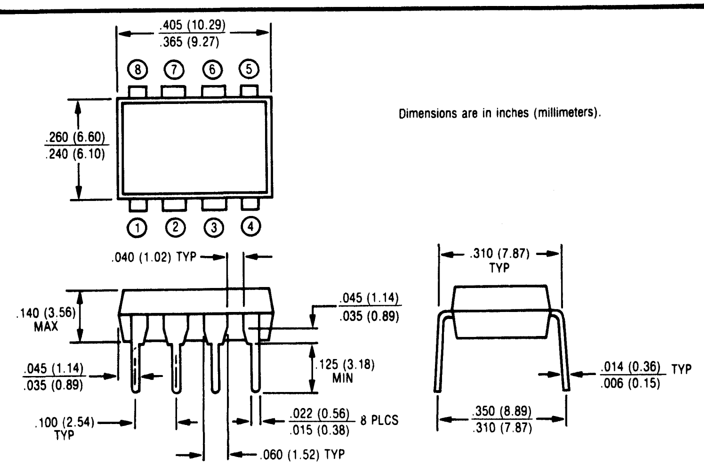
Complex Photologic™ Devices

Photologic™ Automatic Brightness Control

Types OPL100C, OPL100I



TWICE ACTUAL SIZE



Features

- STANDARD 8 PIN CLEAR PLASTIC DIP
- ENTIRE CIRCUIT ON A SINGLE CHIP
- CAN BE USED WITH POWER SUPPLIES RANGING FROM 4.5 V TO 24 V.

Description

The OPL100C and OPL100I each consist of a monolithic integrated circuit containing a 2500 square mil. photodiode, a high gain temperature compensated current amplifier, an op-amp, four comparators, an RS latch, assorted logic functions, an output driver, and a voltage regulator, all on a single silicon chip, mounted in a clear plastic 8 pin DIP.

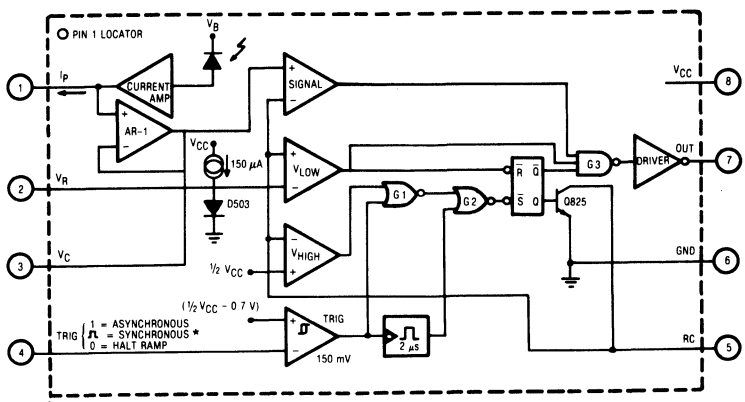
The OPL100C and OPL100I use pulse width modulation to automatically control the brightness of LED, CRT and vacuum fluorescent displays or to control the backlighting of LCD's from 0% to 100%. They can also be used to control display drivers. Featured are external sensitivity adjustment, analog and digital output, and synchronous or asynchronous modes of operation.

absolute maximum ratings (25 °C unless otherwise noted)

Supply Voltage, V_{CC}	24 V
Storage Temperature Range	−65 °C to +125 °C
Operating Temperature Range - OPL100C	0 °C to +70 °C
OPL100I	−20 °C to +100 °C
Lead Soldering Temperature (1/16 inch [1.6 mm] from case for 5 sec. with soldering iron)[1]	240 °C
Output Sourcing Current/Output Sinking Current	−50/20 mA
Power Dissipation	300 mW[3]

Notes: (1) RMA flux is recommended. Duration can be extended to 10 sec. max. when wave soldering.
(2) For typical connections, see Application Bulletin No. 115.
(3) Derate linearly 2.87 mw/°C above 25 °C.
(4) Power dissipation $I_{CC} \cdot V_{CC}$ must not be exceeded.

Block Diagram[2]



* Triggers on leading edge.

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Types OPL100C, OPL100I

PRODUCT BULLETIN 3131
April 1982

absolute maximum ratings (25 °C unless otherwise noted)

SYMBOL	PARAMETER	PIN CONNECTION 1	2	3	4	5	6	7	8	TEST CONDITIONS	MIN	MAX	UNITS
		IP	V_R	V_C	TRIG	RC	GND	OUT	V_{CC}				
I_{CC}	Supply Current OPL100C(3) OPL100I	NC	NC	NC	NC	GND	GND	NC	16V 24V	E_e = 1 mW/cm^2, CT = 2300°K		18.8 12.5	mA
I_{CC}	Supply Current	GND	NC	NC	GND	GND	GND	NC	16V 24V	$E_e \cong 0$		14.8 8.5	mA
I_{PD}	Dark Photo Current	GND	NC	NC	NC	GND	GND	NC	16V 24V	$E_e \cong 0$		−5	μA
I_{PL}	Amplifier Light Current	GND	NC	NC	NC	GND	GND	NC	16V 24V	E_e = 1 mW/cm^2, CT = 2300°K	−200		μA
I_{PL}	Amplifier Light Current	20V	NC	NC	NC	NC	GND	NC	16V 24V	E_e = 1 mW/cm^2, CT = 2300°K	−200		μA
V_{REF}	Diode Reference Voltage	GND	1mA	NC	NC	GND	GND	NC	16V 24V		0.4	0.8	V
V_{RU}	Upper Ramp Theshold Voltage	GND	GND	NC	16V 24V	V	GND	NC	16V 24V	Increase RC Voltage until $I_{RC} \geq$ 5mA	6.0 10.0	10.0 14.0	V
V_{RL}	Lower Ramp Threshold Voltage	4V	GND	NC	16V 24V	V	GND	V_O	16V 24V	Increase RC Voltage until OUT Goes High	0.4	0.8	V
I_{RL}	Ramp Leakage Current	GND	GND	NC	GND	14V 22V	GND	NC	16V 24V	$E_e \cong 0$		±10	μA
V_{LL}	Buffer Amp Linearity, Low Voltage	0.2V	NC	−1mA	GND	GND	GND	NC	16V 24V	Read Voltage at V_R, $E_e \cong 0$	100	300	mV
V_{LM}	Buffer Amp Linearity, Mid Voltage	1V	NC	±1mA	GND	GND	GND	NC	16V 24V	Read Voltage at V_R, $E_e \cong 0$	900	1100	mV
V_{LH}	Buffer Amp Linearity, High Voltage	14V 22V	NC	±1mA	GND	GND	GND	NC	16V 24V	Read Voltage at V_R, $E_e \cong 0$	21.8	22.2	V
V_{OL}	Output Voltage, Low	3.2V 4.8V	NC	NC	16V 24V	4.8V 7.2V	GND	I_{OL} = 20mA	16V 24V	$E_e \cong 0$		0.4	V
V_{OH}	Output Voltage, High	3.2V 4.8V	NC	NC	16V 24V	2V	GND	I_{OH} = -50mA	16V 24V	$E_e \cong 0$	12 20		V
V_T	Trigger Voltage	GND	GND	NC	GND	9.6V 14.4V	GND	NC	16V 24V	Increase Trigger Voltage until $I_{RC} \geq$ 5mA	6 10	9 14	V
I_{T1}	Trigger Leakage	GND	NC	NC	GND	GND	GND	NC	16V 24V	$E_e \cong 0$		±10	μA
I_{T2}	Trigger Leakage	GND	NC	NC	16V 24V	GND	GND	NC	16V 24V	$E_e \cong 0$		±10	μA

NOTES: (3) In blocks where one number appears above another, the upper number relates to the OPL100C and the lower number relates to the OPL100I
(4) Negative current flows out of the device terminals.

PIN FUNCTIONS

PIN 1
Amplified photocurrent is sourced out of PIN 1 from an open-collector PNP current source. Ip is 1 to 2 mA under normal room light conditions. In addition to the dimming function, shorting PIN 1 to V_{CC} forces the OPL100 output (PIN 7) to a logic "1" (V_{CC} - 2 V), turning the display(s) full "on". Shorting PIN 1 to ground forces PIN 7 to a logic "O" corresponding to a full "Off" condition.

PIN 2
This reference voltage is set by ≈ 150 μA current source driving diode (D503). It determines the lower voltage extreme for the sawtooth waveform, and is the tie point for the low side of the sensitivity-adjust potentiometer. $V_R \cong$ 680 mV at room temperature, and has a temperature coefficient of approximately −2 mV/°C.

PIN 3
The control voltage is a buffered analog output proportional to incident light level. In multi-unit applications, this voltage on the main OPL100 is fed into PIN 1 on remote OPL100's, causing the remote units' duty cycle to track with the main unit.

PIN 4
Tying PIN 4 to PIN 8 or V_{CC} causes the sawtooth to free-run (asynchronous mode), with the upper and lower extremes of the sawtooth being ≈ ½ V_{CC} (reference for V_{HIGH} comparator) and V_R (reference for V_{LOW} comparator). Sawtooth repetition rate is set by the external RC connected to PIN 5.

Where synchronous operation is required (e.g., multiplexed digits), a pulse is fed into PIN 4. The rising edge of the pulse should coincide with the beginning of each digit's "enable" time. This edge causes the sawtooth to stop rising, discharge to V_R, then begin its ramp-up.

If PIN 4 is continuously grounded, the sawtooth will stop. This causes PIN 5 to charge to V_{CC} until a change occurs on the trigger input.

PIN 5
This is the tie point for the timing components that set the sawtooth repetition rate. Typical discharge time is 4 μs for a 0.1 μF capacitor Cx. These components can be selected by:

$$f = \frac{1.44}{RxCx}$$

Maximum recommended value for Rx is 100Ω.

PIN 6
Device ground.

PIN 7
The output driver will directly drive the grid of a vacuum fluorescent display. It will source 50 mA at a minimum voltage of V_{CC} 4 V, and will sink 20 mA with a maximum voltage of 0.4 V. Interface to LED's and incandescent bulbs requires additional components.

PIN 8
Supply voltage operating range is 4.5 to 24 volts. Supply current is typically 12 mA, and is relatively constant over this voltage range, with $E_e \cong 0$. Supply current will increase with increasing light levels.

TRW OPTRON, A DIVISION OF TRW INC., 1201 TAPPAN CIRCLE, CARROLLTON, TEXAS, 75006 (214) 323-2200, TWX-910-860-5958

Application Bulletins

TRW OPTRON

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OPTOELECTRONICS
FOR INDUSTRY

June 1982

APPLICATION BULLETIN NO. 101

COMPENSATING FOR DIRTY LENSES IN OPTOTRANSDUCERS

Often, optoelectronic devices are used in industrial environments which are not dirt free. In these applications, oil and dirt can accumulate on the LED and sensor lenses, eventually causing a system malfunction. One solution to compensate for this is frequent maintenance, but this can be quite expensive in labor costs and equipment down time. A more economical solution is the circuit shown below which is designed to electronically compensate for the dirty lens. The circuit operates as follows.

The output of the photodarlington transistor is connected to an LM 3900 Norton amplifier wired as a voltage comparator. The Norton amplifier is an operational amplifier that can be operated with a single power supply of 5V. R_1, a 1-K Ω potentiometer, forms a voltage divider to set the reference voltage for the comparator. When the beam is blocked and the output of the photodarlington rises above the reference, the output of the Norton amplifier goes low. When the output of the photodarlington drops below the reference, the output of the Norton amplifier goes high.

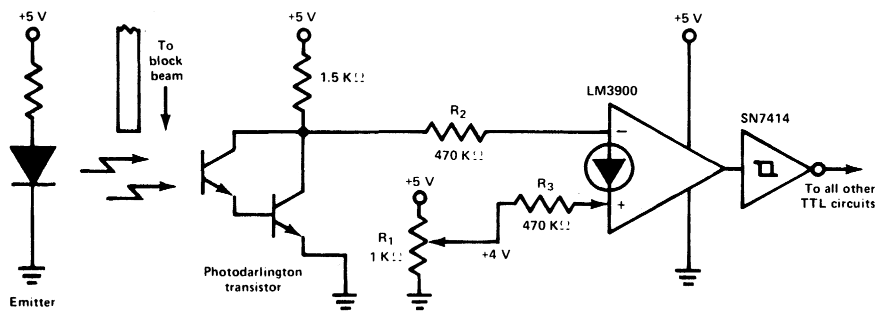
The fan-out capability of the Norton amplifier is relatively low, and the rise and fall times may not be sufficiently short to trigger an edge-sensitive flip-flop. For this reason, the amplifier output signal is fed through a SN7414 type Schmitt trigger that operates other TTL circuits from its output. The values of resistors R_2 and R_3 can vary greatly from the values shown, but their values should be closely matched.

Compensation for dirty lenses is accomplished by adjusting the potentiometer to change the comparator's trip point. Thus, system performance can be resumed readily with a simple one step adjustment.

BRAD MITCHELL
Applications Engineer

Acknowledgement to JOSEPH R. URSCHEL
"MACHINE DESIGN", July, 1978

Compensating Circuit



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APPLICATION BULLETIN 102
September 1980

PROGRAMMABLE VOLTAGES IN EXCESS OF THE NORMAL RANGE OF CONVENTIONAL OPERATIONAL AMPLIFIERS CAN BE EASILY OBTAINED WITH THE OPI 6100 OPTICALLY COUPLED ISOLATOR

The OPI 6100 optically coupled isolator is available from TRW Optron. It may be used with conventional operational amplifiers to extend the output voltage range to approximately ± 100 Volts.

GENERAL DISCUSSION

The output of most operational amplifiers is limited to a range between 10 and 20 Volts. This note shows a method of extending that range to near ±100 Volts. By controlling the circuit with a microprocessor, a sequence of different voltages from near −100 Volts to +100 Volts can be placed at the output within 100 µsec. The input can be controlled from a resistive voltage divider or almost any other voltage reference. It becomes very convenient to control it from a digital-to-analog converter controlled by a microprocessor.

PERFORMANCE CHARACTERISTIC

The circuit shown in Figure 1 utilizes the high output breakdown voltage of the OPI 6100 (≥ 200 Volts) to extend the output range of an operational amplifier. The power transistors, Q_1 and Q_2 (2N6177) are added to allow the output power level to be increased. The circuit shown will drive or sink 30 mA at the programmed voltage.

A gating pulse carrying Pin 1 of the Intersil switch (IH5021) to ground will cause a portion of the reference voltage to be placed on Pin 2 of the Intersil operational amplifier (ICL 8007CTV). If the referenced voltage is positive, then the output of the amplifier will be negative causing Q_2 to be turned on. Q_2 will act as a variable voltage drop from the negative high voltage to ground.

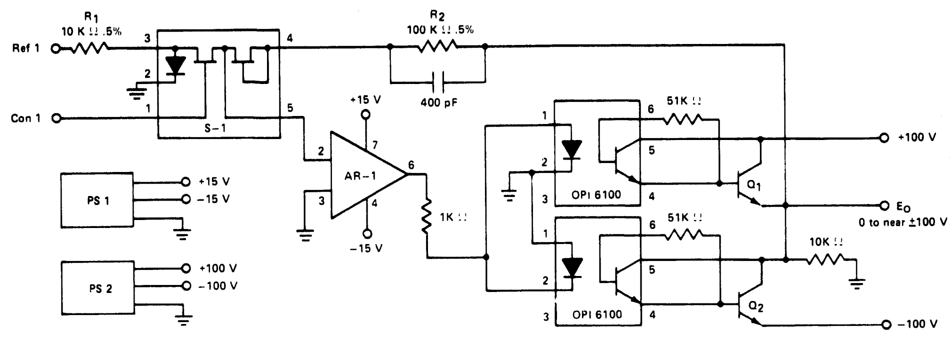
$$E_{out} = -E_{ref}\ (R_2 - R_1)\ \left[R_2 = 100K;\ R_1 = 10K\right]$$

$$E_{out} = -10\ E_{ref}$$

If the reference voltage were a positive 4 Volts, then Q_2 would drop −60 Volts leaving −40 Volts to drop across the load from E_{out} to ground. Correspondingly, if the reference voltage was a negative 4 Volts, then Q_1 would turn on, dropping 60 Volts, leaving 40 Volts across the load. The high voltage unregulated dual power supply should be set at a few Volts above the desired output voltages. This will minimize stress levels on the circuit.

FIGURE 1

Extension of Voltage Swing on Operational Amplifier Output



PS 1 ±15 Volt power supply for operational amplifier
PS 2 High voltage unregulated power supply for Q_1 or Q_2
AR−1 Intersil ICL 8007CTV operational amplifier
S−1 Intersil IH5021 switch

Q_1, Q_2 2N6177 power transistors
Ref 1 Reference voltage input 0 to + 10 V
Con 1 Gating pulse; normally biased @ +4 Volts. Pulse of −4 Volts will place desired voltage @ output.

MAYO NEAL
Electronic Test Equipment Design Manager

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APPLICATION BULLETIN 103
September 1980

MONOLITHIC IC PHOTOSENSOR IMPROVES PERFORMANCE AND REDUCES NECESSARY CIRCUIT COMPONENTS WHEN USED IN PLACE OF PHOTOTRANSISTOR OUTPUT IN OPTICAL INTERRUPTERS

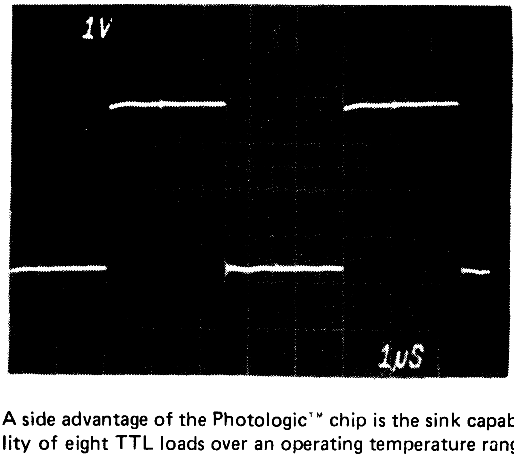
TRW Optron has announced a family of Photologic™ high resolution optical interrupter modules. This family offers superior performance in many applications involving motion sensing.

GENERAL DISCUSSION

Presently available beam interrupter assemblies normally require amplification and/or signal shaping at the output in order to be usable. This can be accomplished by using a one-stage transistor amplifier such as a 2N2222 or a hysteresis amplifier such as a single Schmitt trigger (TAA 560) or a portion of a multiple Schmitt trigger (SN7414). This normally works quite satisfactorily. The clock frequency, however, is limited to approximately 5 kHz without adding extensive detection circuitry. When shaft speed of 600 RPM in conjunction with information needs of 500 bits per revolution or greater are required, this approach becomes marginal. By replacing the output transistor in the beam interrupter assembly with TRW Optron's Photologic™ circuit, the clock frequency is increased to 250 kHz. The Photologic™ circuit is a photosensitive monolithic IC combining a high speed photodiode with an amplifier, Schmitt trigger, and either totem pole or open collector output circuitry. Figure 1 shows the speed of this circuit under full load.

FIGURE 1

Clock Frequency of 200 kHz Driving 8 TTL Loads

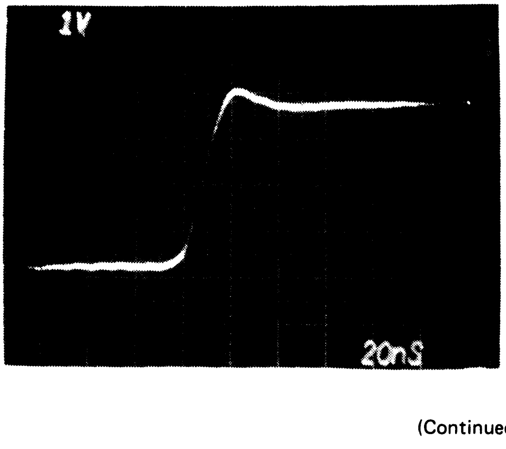


A side advantage of the Photologic™ chip is the sink capability of eight TTL loads over an operating temperature range of −40°C to +70°C.

Many applications utilize a mechanical comb or encoder disc with multiple slots to increase the number of mechanical beam interrupts that occur when the comb or encoder disc is moved a fixed amount. As the number of openings increase within this fixed amount, the aperture width in front of the photosensor must correspondingly be decreased. This normally results in a compromise between mechanical location accuracy and output signal since the output of the presently used phototransistor sensor is decreased in proportion to the decrease in the width of the aperture. The sensor output signal level quickly becomes a major problem. This problem is aggravated if amplification cannot be implemented adjacent to the interrupter. Spurious information or noise pickup can be quite severe. The output capability of the Photologic™ circuit resolves this problem. The OPB 913 series combines the Photologic™ circuit with an aperture 0.010 inch (0.254 mm) wide. Figure 2 shows typical rise time and fall time of this circuit while driving the equivalent of eight TTL loads.

FIGURE 2

t_r While Driving 8 TTL Loads



(Continued)

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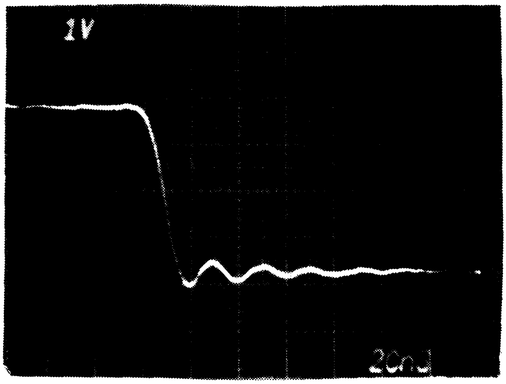
T.M. Trademark TRW INC.

FIGURE 2 (Cont.)
t_f While Driving 8 TTL Loads



System cost is also favorably impacted as the conversion from an output transistor to the output Photologic™ circuit represents only a nominal price adder, and the designer no longer has to add the circuitry required to shape and/or amplify the signal from the output transistor. Table 1 shows the various packages available with this new Photologic™ circuit along with the various circuit options.

TABLE I

PART NO.	FUNCTION	OUTPUT	PACKAGE	PHOTOLOGIC™ CIRCUIT
OPL 550	Buffer	Totem Pole	See Photo 1	See Figure 3
OPB 550-OC	Buffer	Open Collector	See Photo 1	See Figure 4
OPL 551	Inverter	Totem Pole	See Photo 1	See Figure 5
OPL 551-OC	Inverter	Open Collector	See Photo 1	See Figure 6
OPL 800	Buffer	Totem Pole	See Photo 2	See Figure 3
OPB 800-OC	Buffer	Open Collector	See Photo 2	See Figure 4
OPL 801	Inverter	Totem Pole	See Photo 2	See Figure 5
OPL 801-OC	Inverter	Open Collector	See Photo 2	See Figure 6
OPB 913S10	Buffer	Totem Pole	See Photo 3	See Figure 3
OPB 914S10	Buffer	Open Collector	See Photo 3	See Figure 4
OPB 915S10	Inverter	Totem Pole	See Photo 3	See Figure 5
OPB 916S10	Inverter	Open Collector	See Photo 3	See Figure 6
OPB 947	Buffer	Totem Pole	See Photo 4	See Figure 3
OPB 948	Buffer	Open Collector	See Photo 4	See Figure 4

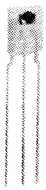


PHOTO 1

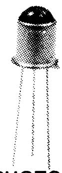


PHOTO 2

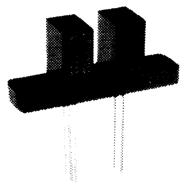


PHOTO 3

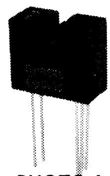


PHOTO 4

FIGURE 3

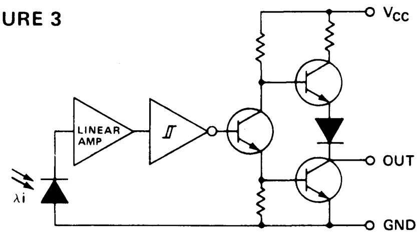


FIGURE 5

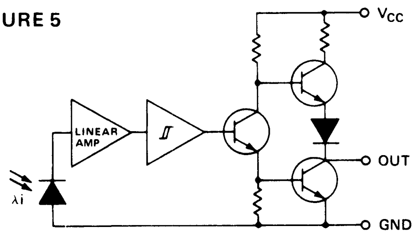


FIGURE 4

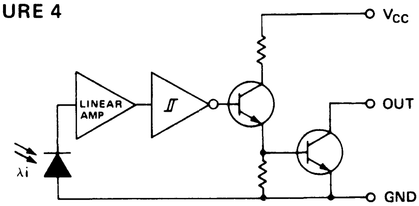
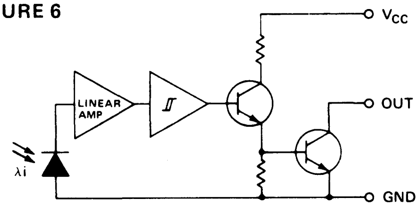


FIGURE 6



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TRW OPTRON
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APPLICATION BULLETIN 104
September 1980

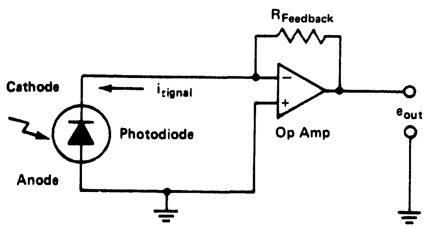
UTILIZING SILICON PIN PHOTODIODES

PIN photodiodes have some inherent advantages over phototransistors. They are faster, more linear, and have a higher level of sensitivity. This application bulletin describes some of the areas where these advantages make it desirable to use PIN photodiodes instead of phototransistors.

GENERAL DISCUSSION

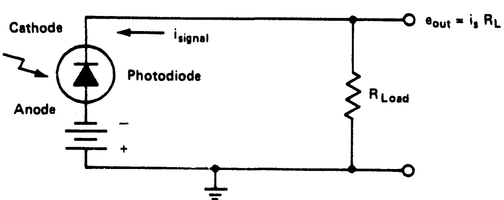
Silicon PIN photodiodes have traditionally been used in applications where their high sensitivity level, fast speed of response, and linearity over several decades of light level input could be exploited. They can be used as photovoltaic sources where the light impinging upon the unit creates a voltage which varies in proportion with the input light. See Figure 1.

FIGURE 1
Silicon PIN Photodiode in Photovoltaic Mode



This mode has no external bias and the photodiode or cell generates an E. M. F. when illuminated. The more common use connects the photodiode in the reverse bias mode with an external voltage source. The impinging light will create photocurrent. See Figure 2.

FIGURE 2
Silicon PIN Photodiode in Photoconductive Mode



The signal current in both cases is the photodiode responsivity in Amps/Watts times the input light in Watts. This current is normally in the nanoampere to microampere range.

A wide variety of applications are possible. The following examples show how the basic characteristics of the silicon PIN photodiode dictates where it is to be used.

LINEARITY OVER SEVERAL DECADES OF LIGHT LEVEL

In camera applications requiring the use of an exposure lamp, the photodiode can be used to integrate the amount of light coming back to the camera to expose the film. If the reflectivity is good or the subject is close, the required time for adequate exposure light will be shorter, requiring less flash time. The photodiode can then be used to control how long the exposure lamp needs to stay on for good film exposure.

FAST SPEED OF RESPONSE

In optical communication of information where the information is rapidly changing states, the photodiode is used. Remote control of household products such as TV sets, slide projectors, phonographs, radios, tape decks, telephones, etc., can be accomplished by utilizing several IR LED's in a control box that produce a coded series of pulses detectable by a photodiode mounted in equipment designed to react to the coded signals.

The infrared energy is silent, invisible, and interference free. With suitable direction of the infrared energy, it could be used for remote security actuations such as:

1. Turning on lights of car in darkened area. It could be extended to start car and allow warm up prior to entering.
2. Deactivation or activation of security systems.
3. Turning on lights and opening garage door.

Short distance secured communications could be accomplished by modulating the LED. The receiver could then amplify and detect the modulated signal.

HIGH SENSITIVITY WITH CORRESPONDING LOW NOISE:

Conventional phototransistor type units have a very small active area with respect to most photodiodes. Phototransistors become marginal for operation at tungsten light levels below 0.1 mW/cm^2. Photodiodes still remain usable 2.5 decades below this or at 0.5 μW/cm^2. This becomes useful when the light signal to be detected is low in applications such as:

1. Optical communications utilizing fiber optics.
2. Intrusion detection where infrared LED's are used as the light source.

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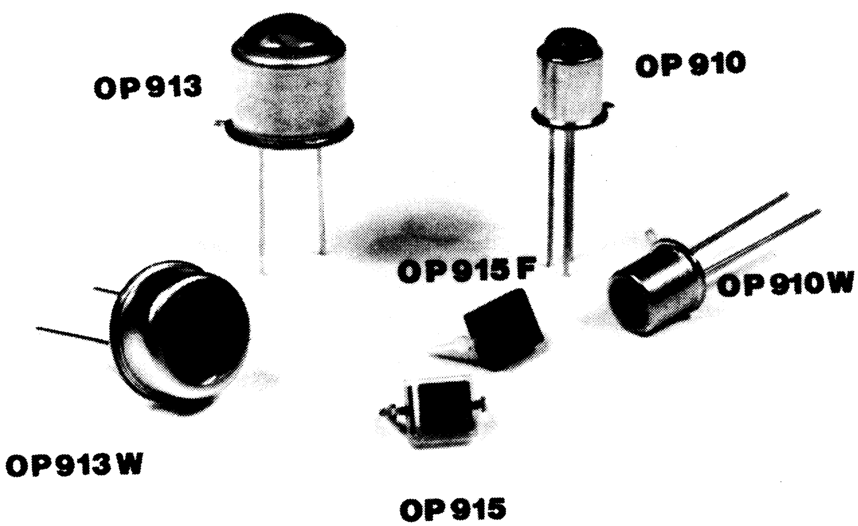
3. Optical smoke detectors.
4. Low level radiometry measurements.

In general, the photodiode is normally the best receiver in any application where light to be detected is pulsed. There are many other cases where the characteristics of the photodiode make it the obvious selection as the sensor.

1. Ambient light sensor. A low cost plastic photodiode makes an excellent ambient light sensor since the sensitivity is very repeatable from unit to unit. Required circuit compensations for gain variations are minimal. Once a package and photodiode is established, the sensitivity variation will be minimal. This characteristic will be exploited more and more as a control for light level on alpha-numerical and instrument lighting.
2. The wide spectral sensitivity of the photodiode allows detection of light sources from 400 to 1100 nanometers. This covers portions of the ultra violet, the visible, and the near infrared spectrum. These spectral characteristics are especially useful in sophisticated measuring systems but may also be used successfully by the designer who is familiar with optical filtering techniques.

TRW Optron has introduced three new families of devices that should broaden the design capability for silicon PIN photodiodes.

HERMETIC PACKAGE	TRW OPTRON DEVICE NO.	R_θ @ V_R = 38 V λ = PEAK WAVELENGTH	I_{SC} @ H = 5 mW/cm^2 CT = 2870°K V_R = 5 Volts	ACTIVE AREA	CONFIGURATION
TO-5	OP 913	0.50 A/Watt	120 μA	7.5 mm^2	Magnifying Lens
TO-5	OP 913W	0.50 A/Watt	40 μA	7.5 mm^2	Flat Window
TO-18	OP 910	0.50 A/Watt	50 μA	3.3 mm^2	Magnifying Lens
TO-18	OP 910W	0.50 A/Watt	8 μA	3.3 mm^2	Flat Window
PLASTIC PACKAGE					
.155 x .175	OP 915	0.49 A/Watt	50 μA	7.5 mm^2	Flat Clear
.155 x .175	OP 915F	0.49 A/Watt	35 μA	7.5 mm^2	Flat w/IR Pass Filter



The hermetic units are capable of high reliability environmental processing for military or space applications while all units are designed for commercial use as well. The case material on the OP 905F and OP 915F acts as a visible filter with a sharp cutoff of wave lengths below 750 nanometers.

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TRW OPTRON
A DIVISION OF TRW INC.

APPLICATION BULLETIN 105
June 1982

THERMAL BEHAVIOR OF GsAs LED's

TABLE OF CONTENTS

1. INTRODUCTION

The output power (P_O) of a GaAs LED is a function of forward current (I_F). As this forward current increases, the output power will also increase. This forward current flowing through the LED generates heat (P_D) which causes the junction temperature (θ_j) of the diode to increase. As the junction temperature increases, the output power decreases.

To obtain optimum operating conditions for a GaAs LED, the knowledge of the different thermal parameters and their influence on the major electro-optical parameters must be known. The purpose of this bulletin is to introduce these thermal parameters to the reader and provide a way to use them. Data will be presented and formulae will be given that will allow readers to determine if their system meets manufacturer's guide lines in both a DC mode and a pulsed mode.

Mathematical assumptions have been made to simplify derivations and provide useful formulae in simple terms; empirical data has verified that the resulting error is less than 5%.

Care should be taken in making use of the information presented. For example:

> A current pulse could be short enough to cause no apparent problem within the presented material. However, it could be of sufficient magnitude and duration to exceed the allowable current density of the bond wire interconnect causing it to fail.

2. THERMAL PARAMETERS

The thermal behavior of a GaAs LED can be considered in a simple way by using the analogy of an electrical circuit. In this circuit, the heat power generator, the temperature differences, the thermal capacitors, and thermal resistors replace the conventional current or voltage generators, voltage differences, capacitors, and resistors respectively. FIGURE 1 shows this equivalent thermal circuit.

FIGURE I

Equivalent Thermal Circuit

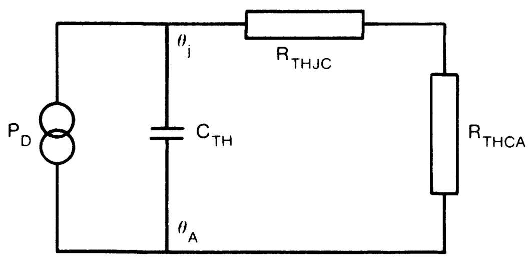


Table 1 defines the various thermal parameters we will be exploring in this bulletin.

TABLE I

Thermal Parameters

SYMBOL	PARAMETER	UNITS
P_O	Output Power	W
P_D	Dissipated Power	W
θ_j	Junction Temperature	°C
θ_A	Ambient Temperature	°C
C_{TH}	Thermal Capacitor	$Ws°C^{-1}$
R_{THJC}	Junction to Case Thermal Resistance	$°CW^{-1}$
R_{THCA}	Case to Ambient Air Thermal Resistance	$°CW^{-1}$
R_{THJA}	Junction to Ambient Air Thermal Resistance	$°CW^{-1}$
τ_{TH}	Thermal Time Constant ($R_{THJA} \times C_{TH}$)	s
K	Thermal Rating Factor	None
K_{eff}	Effective Duty Cycle	None

When forward current (I_F) flows through the GaAs LED, heat or power (P_D) is generated. Most of this heat is generated within:

(a) The upper section of the chip away from the mount area; the "N" area; the cathode.
(b) The mid section of the chip; the junction between the "N" and "P" regions.
(c) The lower section of the chip, the "P" area, the anode.

Heat is also generated in the contact interfaces and the conductors but this is considered negligible. This heat propagates through the chip and the mount surface primarily by thermal conduction. It is then transferred to the ambient air by thermal convection. All of the measurements and data presented in this bulletin were made with the air temperature in the room fairly constant throughout the test period and zero air velocity in the volume surrounding the device except for convection currents. Further, there were no extraneous thermal paths. Normal mounting of the devices in PC boards or adding heat sinks will improve the heat path. This is not considered in this bulletin with the exception of the last four (4) line items in Table 2. R_{THJA} should be considered as R_{THJX} in these cases. Table 2 lists several thermal parameters.

TABLE 2

Thermal Parameters of TRW Optron GaAs LED's

GaAs LED Type	R_{THJA} ($°CW^{-1}$)	C_{TH} ($10^{-5}Ws°C^{-1}$)	τ_{TH} ($10^{-2}s$)	K
OP123/124	980	1.6	1.5	0.008
OP131-133(W)	490	3.0	1.5	0.008
IN6264/5	490	3.0	1.5	0.008
OP135/136	470	4.3	2.0	0.008
OP140	740	5.3	3.9	0.008
OP160	740	5.3	3.9	0.008
OP168	840	5.0	4.2	0.008
"P" Dip LED	750	2.3	1.7	0.008
OPB706 (LED)	700	5.2	3.6	0.008
OPB950 (LED)	250	1.3	.32	0.008
OP123/124 (1)	240	4.6	1.1	0.008
OP123/124 (2)	400	4.5	1.8	0.008
"P" Dip (LED) (3)	450	3.8	1.7	0.008
"P" Dip (LED) (4)	500	3.4	1.7	0.008

(1) OP123/124 mounted in .062" double sided PC board.
(2) OP123/124 mounted in OPB125/253 housing.
(3) "P" Dip soldered in 0.062" double sided PC board.
(4) "P" Dip mounted in standard Dip socket.

The first four (OP123 through OP136) GaAs LED's are all hermetic packages. The maximum allowable junction temperature is 125° C. See the example below for one use of Table 2.

(1) OP123/124 has $R_{THJA} = 980°CW^{-1}$

With $\Delta T_j = (125°C - 25°C) = 100°C$.

The maximum power that can be dissipated is:

$$P_{D(max)} = \frac{\Delta T_j}{R_{THJA}} = \frac{100°C}{980°CW^{-1}} = 102\ mW$$

The next three of the units listed are plastic packages. The maximum allowable junction temperature is 85° C.

OP140 has $R_{THJA} = 740°CW^{-1}$

With $\Delta T_j = (85°C - 25°C) = 60°C$

The maximum power that can be dissipated is:

$$P_{D(max)} = \frac{\Delta T_j}{R_{THJA}} = \frac{60°C}{740°CW^{-1}} = 81\ mW$$

The derating factor above 25° C can be readily calculated from this information.

(2) OP123/124

$$\text{Derating Factor} = \frac{\Delta P_D}{\Delta T_j} = \frac{102\ mW}{100°C} = 1.02\ mW°C^{-1}$$

OP140

$$\text{Derating Factor} = \frac{81mW}{60°C} = 1.35\ mW°C^{-1}$$

Most manufacturers will give more conservative deratings than these numbers. This is normally due to the devices being used in a quasi heat sink. For example, the OP123/124 is normally mounted in a double sided PC board. The OP140 is normally soldered into a PC board. This would improve the R_{THJA} numbers. This becomes readily apparent by referring to the R_{THJA} number of $980°CW^{-1}$ for the OP123/124 in free air and the R_{THJX} number of $240°CW^{-1}$ when the units are mounted in a double sided PC board as shown in Table 2 or the $400°CW^{-1}$ when they are mounted in the OPB125 or OPB253 housing. There is also a variation in R_{THJA} brought about by a variation in the integrity of the thermal bond between the GaAs LED and the mount surface. This is not easy to measure and is not adaptable to 100% production testing.

3. TEMPERATURE RESPONSE TO A THERMAL POWER STEP

A forward current step is introduced into a GaAs LED causing heat to be generated in the unit and causing the junction temperature to rise. The rise in junction temperature follows the formula shown below:

$$\theta_j(t) = \theta_A + P_D \times R_{THJA}\left(1 - e^{-\frac{t}{\tau_{TH}}}\right) \quad (3)$$

Where t is time in seconds

P_D is dissipated power

τ_{TH} is thermal time constant

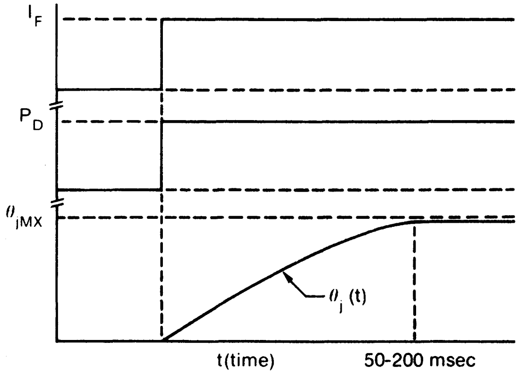
R_{THJA} is junction to ambient air thermal resistance

θ_A is ambient temperature

The junction temperature will approach its maximum value after $t = 5\ \tau_{TH}$ or 5 thermal time constants which approximates 50 to 200 milliseconds. Figure 2 shows the forward current step, the resulting power generated within the chip itself, and the rise in junction temperature versus time.

FIGURE 2

I_F, P_D, and Junction Temperature Versus Time



Practically, P_O will decrease slightly as soon as the junction temperature of the chip starts to rise and will stabilize 50 to 200 milliseconds after the power is applied. This is discussed in more detail in the section on power droop.

At temperature equilibrium, the maximum junction temperature (θ_{jMX}) is:

(4) $\theta_{jMX} = \theta_A + P_D^* \times R_{THJA}$

Where $P_D^* = V_F \times I_F$

V_F = Forward Voltage @ θ_{jMX}

θ_A = Ambient Temperature

* For purpose of calculation, P_D = P @ 25°C. The resulting error will have minor impact on the answer. Since V_F decreases with increasing temperature, the resulting answers will be conservative.

Example: Using an OP133 which has a measured output of 5.3 mW @ θ_A = 25°C, calculate the output in a system where I_F = 40 mA and θ_A = 50°C. The I_F versus P_O without heating is relatively linear above 5 mA.

P_O (40 mA @ 25°C) = P_O (100 mA) x 40/100
= 5.3 mW x 0.4
= 2.12 mW

The power generated within the LED causing the junction temperature to rise is:

$P_D = V_F \times I_F$
= 1.5 volts x 0.04A
= 0.06 watts

The rise in junction temperature is:

$\theta_j = \theta_A + P_D R_{THJA}$
= 50°C + (0.06 x 490)
= 79.4°C

The output power of the OP133 is:

(5) $P_O(\theta_j) = P_O(25°C) \times e^{-K(\theta_j - 25°C)}$

$P_O(79.4°C) = 2.12 \times e^{-0.008(79.4 - 25)}$
= 1.38 mW

This constitutes a 35% decrease in output power from the 25°C level. The value of K was taken from Table 2.

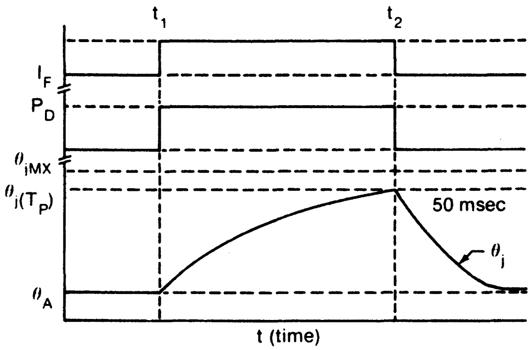
4. TEMPERATURE RESPONSE TO A THERMAL POWER PULSE

A forward current pulse is introduced into a GaAs LED. This pulse is shorter than the 50 to 200 milliseconds required for the junction temperature to approach its highest value.

Figure 3 shows the relationship of the current pulse to the power pulse to the junction temperature versus time.

FIGURE 3

Current Pulse, Power Pulse, and $\theta_{j(T_P)}$ Versus Time



When I_F begins to flow, the power generated within the LED causes $\theta_{j(t)}$ to follow the relationship:

(6) $$\theta_{j(t)} = \theta_A + P_D R_{THJA}\left(1 - e^{-\frac{t}{\tau_{TH}}}\right) \quad t_1 \leq t \leq t_2$$

When I_F stops @ time t_2, the P_D will stop and the junction temperature θ_j will start to decrease. This will follow the relationship:

(7) $$\theta_{j(t)} = \theta_A + \left[P_D R_{THJA}\left(1 - e^{-\frac{T_P}{\tau_{TH}}}\right)\right]\left(e^{-\frac{t}{\tau_{TH}}}\right) \quad t > t_2$$

Example: A single 1A pulse 100 µsec wide is applied to an OP136. What will the junction temperature be at the end of the 100 µsec pulse?

$$\theta_{jMX}\,(100\ \mu sec) = \theta_A + P_D R_{THJA}\left(1 - e^{-\frac{t}{\tau_{TH}}}\right)$$

θ_{jMX} (100μsec) = (see below)

$$25°C + (2V \times 1A) \times 470 \left(1 - e^{-\frac{10^{-4}}{2 \times 10^{-2}}}\right)$$

$$= 25°C + 4.6°C$$

$$= 29.6°C$$

Same as above except t = 1 msec

θ_{jMX} (1 msec) = (see below)

$$25°C + 2 \times 470 \left(1 - e^{-\frac{10^{-3}}{2 \times 10^{-2}}}\right)$$

$$= 25°C + 45.5°C$$

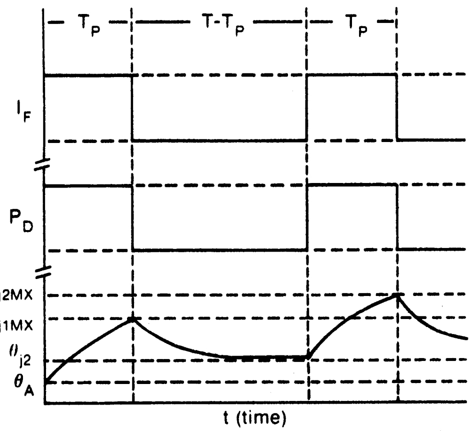
$$= 70.5°C$$

5. TEMPERATURE RESPONSE TO RECURRENT THERMAL PULSES

A forward current pulse is introduced into a GaAs LED. At some later time, the pulse is repeated. Figure 4 shows the relationship of I_F to P_D to θ_j.

FIGURE 4

I_F, P_D, and θ_j Versus Time



The junction temperature θ_j rises during the first power pulse from θ_A to θ_{j1MX}.

Equation (3), $$\theta_{j1MX} = \theta_A + P_D R_{THJA}\left(1 - e^{-\frac{T_P}{\tau_{TH}}}\right)$$

The junction temperature θ_j decreases during the off time of the power pulse from θ_{j1MX} to θ_{j2}

Equation (7) $$\theta_{j2} = \theta_A + \left[P_D R_{THJA}\left(1 - e^{-\frac{T_P}{\tau_{TH}}}\right)\right]\left(e^{-\frac{(T - T_P)}{\tau_{TH}}}\right)$$

During the second pulse, the junction temperature will rise from θ_{j2} to θ_{j2MX}.

Equation (3), (6) $$\theta_{j2MX} = \theta_{j2} + P_D R_{THJA}\left(1 - e^{-\frac{T_P}{\tau_{TH}}}\right)$$

After the second pulse is removed, the junction temperature will decrease to a new minimum temperature θ_{j3}.

Equation (7) $$\theta_{j3} = \left[\theta_{j2} + P_D R_{THJA}\left(1 - e^{-\frac{T_P}{\tau_{TH}}}\right)\right]\left(e^{-\frac{(T - T_P)}{\tau_{TH}}}\right)$$

This swinging movement of θ_j goes on and on with $\theta_{jMX(n)}$ and $\theta_{j(n)}$ gradually rising to a stabilized value. At the end of the n^{th} pulse, the junction temperature is θ_{jn}MX.

Equation (8) $$\theta_{jnMX} = \theta_A + \left[P_D R_{THJA}\left(1 - e^{-\frac{T_P}{\tau_{TH}}}\right)\right] \times \left[\sum_{i=0}^{i=n-1}\left(e^{-\frac{(T - T_P)}{\tau_{TH}}}\right)\right]$$

When the temperature stabilization point is finally reached, the θ_{jMX} becomes:

Equation (9) $$\theta_{jMX} = \theta_A + P_D R_{THJA}\left(\frac{1 - e^{-\frac{T_P}{\tau_{TH}}}}{1 - e^{-\frac{T_P}{\tau_{TH}\left(\frac{1-n}{n}\right)}}}\right)$$

Where $n = \frac{T_P}{T}$ or duty cycle

For small values of (n), the equation simplifies to:

Equation (10) $$\theta_{jMX} = \theta_A + P_D R_{THJA} K_{eff}$$

Where $$K_{eff} = \frac{1 - e^{-\frac{T_P}{\tau_{TH}}}}{1 - e^{-\frac{T_P}{n\tau_{TH}}}}$$ = effective duty cycle

The minimum junction temperature becomes:

Equation (11) $$\theta_{jMIN} = \theta_A + P_D R_{THJA} K_{eff}\left(e^{-\frac{T_P}{n\tau_{TH}}}\right)$$

The delta temperature or the difference between θ_{jMX} and θ_{jMIN} becomes:

Equation (12) $$\Delta\theta_j = \theta_{jMX} - \theta_{jMIN}$$

$$\Delta\theta_j = P_D R_{THJA} K_{eff}\left(1 - e^{-\frac{T_P}{n\tau_{TH}}}\right) = P_D R_{THJA}\left(1 - e^{-\frac{T_P}{\tau_{TH}}}\right)$$

Example: An OP136 is operated at I_F = 1A, n = 1%, T_P = 100 μsec. What is θ_{jMX}? θ_{jMIN}? $\Delta\theta_j$?

$$\text{OP136 } R_{THJA} = 470°CW^{-1}$$

$$P_D = 1A \times 2V = 2W$$

$$K_{eff} = \frac{1 - e^{-\frac{10^{-4}}{2 \times 10^{-2}}}}{1 - e^{-\frac{10^{-4}}{2 \times 10^{-4}}}} = 1.26 \times 10^{-2}$$

$$\theta_{jMX} \text{ (Equation 10)} = 25°C + (2 \times 470 \times 1.26 \times 10^{-2}) = 36.7°C$$

$$\theta_{jMIN} \text{ (Equation 11)} = 25°C + (2 \times 470 \times 1.26 \times 10^{-2})\left(e^{-\frac{10^{-4}}{2 \times 10^{-4}}}\right) = 32.1°C$$

$$\Delta\theta_j \text{ (Equation 12)} = 36.7° - 32.1 = 4.6°C$$

Verifying

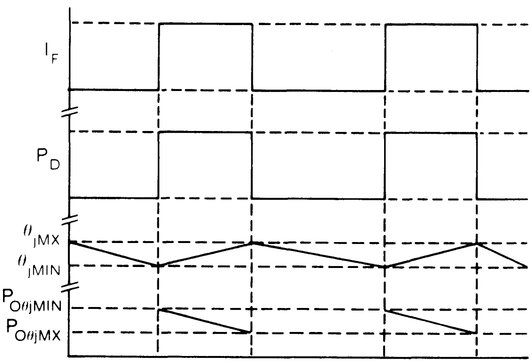
$$\Delta\theta_j \text{ (Equation 12)} = 2 \times 470 \left(1 - e^{-\frac{10^{-4}}{2 \times 10^{-2}}}\right) = 4.6°C$$

6. POWER DROOP

The junction temperature of an LED will oscillate between θ_{jMX} and θ_{jMIN} under recurrent pulses after the pulses have been on for a period of time. The radiant power output (P_O) will decrease during the "ON" time as the junction temperature rises from θ_{jMIN} to θ_{jMX}. This is shown in Figure 5 and is called power droop.

FIGURE 5

I_F, P_D, θ_j, and P_O Versus Time



This decrease in power out or power droop during the "ON" cycle is dependent on θ_{jMX} and θ_{jMIN}. Most systems desire this droop to be kept below 5-10% in order to limit the influence on system operation. The major factors that control this are the forward current (I_F), forward voltage drop (V_F), pulse duration (T_P), duty cycle (n), and thermal resistance (R_{THJA}).

$$P_O(\theta_{jMIN}) = P_O(25°C) \times e^{-K(\theta_{jMIN} - 25°C)}$$

$$P_O(\theta_{jMX}) = P_O(25°C) \times e^{-K(\theta_{jMX} - 25°C)}$$

By definition, the power droop is:

$$P_{Droop} = \frac{P_O(\theta_{jMIN}) - P_O(\theta_{jMX})}{P_O(\theta_{jMIN})}$$

Equation (13) $P_{Droop} = 1 - e^{-K(\theta_{jMX} - \theta_{jMIN})}$

Example: An OP136 is being operated at I_F = 1A and n = 1%. What is the maximum pulse width for a droop of 5%?

$$P_{Droop} = 1 - e^{-K(\theta_{jMX} - \theta_{jMIN})}$$

$$0.05 = 1 - e^{-0.008(\theta_{jMX} - \theta_{jMIN})}$$

$$\theta_{jMX} - \theta_{jMIN} = 6.41°C$$

From Equation (12) for $\Delta\theta_j$

$$\Delta\theta_j = P_D R_{THJA}\left(1 - e^{-\frac{T_P}{\tau_{TH}}}\right)$$

$$6.41 = 2 \times 470\left(1 - e^{-\frac{T_P}{2 \times 10^{-2}}}\right)$$

$$T_P = 138\ \mu sec$$

Example: What is the power droop if T_P is changed to 100 μsec?

$$\Delta\theta_j = P_D R_{THJA}\left(1 - e^{-\frac{T_P}{\tau_{TH}}}\right)$$

$$= 2 \times 470\left(1 - e^{-\frac{1 \times 10^{-4}}{2 \times 10^{-2}}}\right)$$

$$= 4.6°C$$

$$P_{Droop} = 1 - e^{-0.008(4.6°C)}$$

$$= 3.6\%$$

Example: What is the power droop on the OP133 under the same conditions as the OP136?

$$I_F = 1A,\ n = 1\%,\ T_P = 100\mu sec$$

$$\Delta\theta_j = P_D R_{THJA}\left(1 - e^{-\frac{T_P}{\tau_{TH}}}\right)$$

$$\Delta\theta_j = (1A \times 2.5V) \times 490\left(1 - e^{-\frac{10^{-4}}{1.5 \times 10^{-2}}}\right)$$

$\Delta\theta_j = 8.07$

$P_{Droop} = 1 - e^{-0.008\,(8.07)}$

$P_{Droop} = 0.0625 = 6.25\%$

Example: What is the maximum power that can be dissipated in the OPB950 when T_P is 20μsec, duty cycle is 1%, and droop is restricted to 5% maximum.

$$P_{Droop} = 1 - e^{-K\,(\theta_{jMX} - \theta_{jMIN})}$$

$$0.05 = 1 - e^{-0.008\,(\theta_{jMX} - \theta_{jMIN})}$$

$$(\theta_{jMX} - \theta_{jMIN}) = 6.41°C$$

$$\Delta\theta_j = P_D R_{THJA}\left(1 - e^{-\frac{T_P}{\tau_{TH}}}\right)$$

$$6.41 = P_D \times 250\left(1 - e^{-\frac{20 \times 10^{-6}}{3.24 \times 10^{-3}}}\right)$$

$$P_D = 4.23$$

With a V_F of approximately 2.5 volts, the maximum I_F under the above conditions would be 1.7 Amps.

7. CONCLUSION

The data presented will allow calculations that effect various power levels, pulse widths, and duty cycles on TRW Optron GaAs LED's. All standard products are covered. The pertinent thermal formulae are included as a separate section for easy reference. These formulae coupled with the information given in Table 2 will allow designers to optimize their design utilizing TRW Optron LED's in the pulse mode.

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8. THERMAL FORMULAE

1. Maximum Power Dissipation

$$P_{D(MAX)} = \frac{T_j}{R_{THJA}}$$

2. Derating Factor

$$\frac{\Delta P_D}{\Delta T_j}$$

3. Effective Duty Cycle (Square current pulses)

$$K_{eff} = \frac{1 - e^{-\frac{T_P}{\tau_{TH}}}}{1 - e^{-\frac{T_P}{n\tau_{TH}}}}$$

4. Maximum Junction Temperature (Repetitive Pulses)

$$\theta_{jMX} = \theta_A \cdot P_D R_{THJA} K_{eff}$$

5. Minimum Junction Temperature (Repetitive Pulses)

$$\theta_{jMIN} = \theta_A \cdot P_D R_{THJA} K_{eff}\left(e^{-\frac{T_P}{n\tau_{TH}}}\right)$$

6. Junction Temperature Swing

$$\Delta\theta_j = P_D R_{THJA}\left(1 - e^{-\frac{T_P}{\tau_{TH}}}\right)$$

7. Power Droop

$$P_{Droop} = 1 - e^{-0.008\,(\Delta\theta_j)}$$

TRW OPTRON
A DIVISION OF TRW INC.

APPLICATION BULLETIN 106
November 1980

DC OPERATION WITH THE OPB 950 BI-DIRECTIONAL FIBER OPTIC COMMUNICATION LINK FROM VERY LOW DATA RATES TO 1.5 MHz UTILIZING NATIONAL SEMICONDUCTOR LH0082

National Semiconductor has announced a general purpose, low-noise, fiber optic receiver. The LH0082 (data sheet dated February, 1980) optical communication receiver works very well with TRW Optron's OPB 950 bi-directional fiber optic communication link.

GENERAL DISCUSSION

Information regarding the forward voltage drop and the coupled output current, at a pulsed I_F of 50 mA, 100 mA, and 200 mA, is provided with each OPB 950 shipped. As the fiber optic link gets longer, the coupled output current for a fixed LED current will decrease. This means that the 1 meter unit will have significantly more output than the 10 meter unit with the same input conditions. This condition leads to a variety of hookup possibilities with the application circuits shown using the LH0082.

PERFORMANCE CHARACTERISTICS

Figure 1 shows the general block diagram for utilizing the OPB 950 bi-directional fiber optic communication link in one direction.

FIGURE 1
1/2 Bi-directional Fiber Optic Communication Link

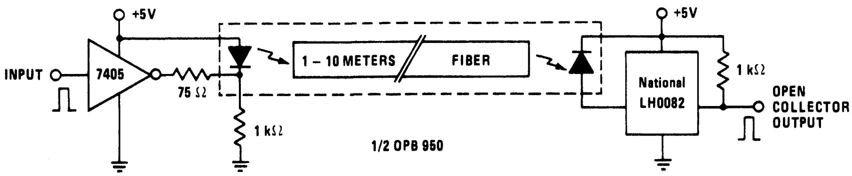


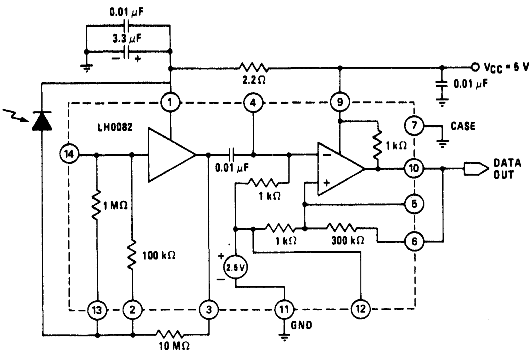
Table 1 shows the possible combination of hookups. The LED's should be driven from 3 mA for a "zero" to 40 mA for a "one".

TABLE 1

OPB 950-0100	Figure 2	Figure 3	Figure 4
OPB 950-0300	Figure 2	Figure 3	Figure 4
OPB 950-0700	Figure 2	Figure 3	—
OPB 950-1000	Figure 2	—	—

The low speed, high sensitivity circuit shown in Figure 2 is used primarily with the 10 meter link. If the speed is not critical, this circuit can be used to advantage on the other links by reducing the 40 mA drive current to the LED. This would significantly improve the life characteristics of the system. Another technique that could be used is reducing the 10 megohm feedback resistor that was added between pins 3 and 13, toward zero. This change in resistance would cause the performance of the Figure 2 circuit to approach the performance of the Figure 3 circuit.

FIGURE 2
Fiber Optics Receiver — Very High Sensitivity (3 nW) — Low Speed, (50 kHz)

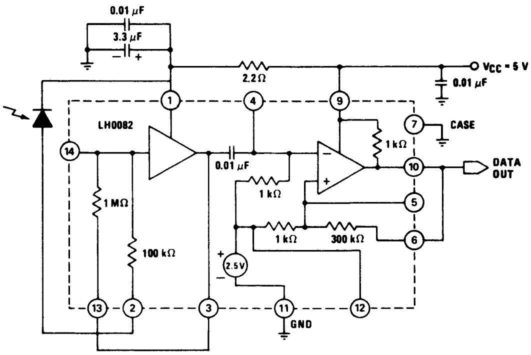


The 7, 3, and 1 meter links will work well with the medium sensitivity, medium speed circuit shown in Figure 3.

®Trademark TRW INC.

FIGURE 3

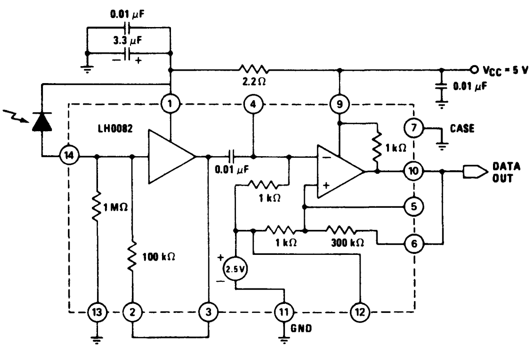
Fiber Optics Receiver – Medium Sensitivity (30 nW) – Medium Speed, (325 kHz)



The 3 and 1 meter links will work well with the circuit configuration shown in Figure 4. The speed that can be obtained is limited to approximately 1.5 MHz rather than the 2.5 MHz shown on the LH0082.

FIGURE 4

Fiber Optics Receiver – Low Sensitivity (300 nW – High Speed, (1.5 MHz)



The amplifier input is calculated at 0.5 A/W. The high sensitivity receiver shown in Figure 2 requires 3 nW of input. This calculates to 1.5 nA of current from the PIN photodiode in the OPB 950. The designer should apply a slight safety factor to this value.

The maximum DC current allowed through the OPB 950 LED is 40 mA. The estimated output current can be simply approximated by multiplying 0.8 (40 mA/50 mA) times the pulsed PIN diode current value at 50 mA supplied with each OPB 950.

Effort will continue to be expended to improve both the efficiency of energy transfer and the maximum speeds that can be obtained.

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Applications Specialist

TRW OPTRON
A DIVISION OF TRW INC.

APPLICATION BULLETIN 107
October 1980

OPERATIONAL AMPLIFIER INPUT PROTECTION WITH VISUAL FAULT INDICATION CAN BE SIMPLY ATTAINED

The AC input 6 pin isolator OPI 2500 available from TRW Optron can be used to protect the inputs of an operational amplifier. At the same time, the phototransistor output can generate an overload signal which can be used to provide visual indication of the overload condition and give a logic level change for documentation.

GENERAL DISCUSSION

Two computer diodes, back to back, in parallel across the inputs of an operational amplifier, have been widely used to protect the inputs of an operational amplifier. The leakage characteristics of the diodes make this method impractical under many conditions. Also an overload signal is not obtained with this system.

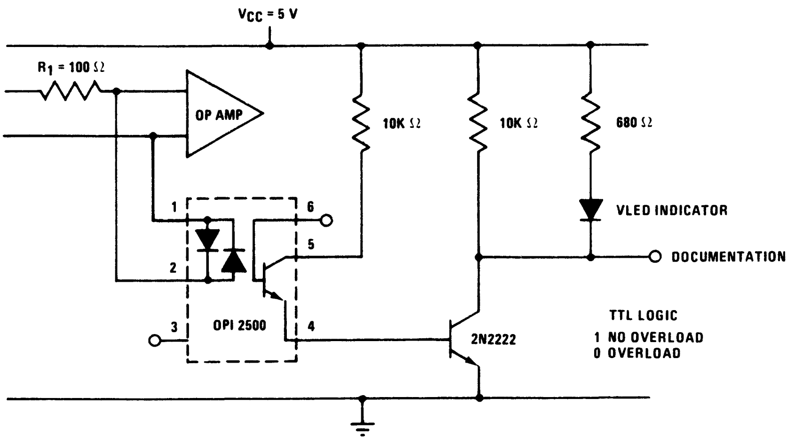
PERFORMANCE CHARACTERISTICS

The circuit shown in Figure 1 can be used to protect the inputs of an operational amplifier while providing an overload signal for documentation and visual indication.

The inputs to the operational amplifier may be at any potential (within specifications) with respect to ground. When an overload occurs, a differential voltage will appear between the inputs of the amplifier. The input LED's in the OPI 2500 conduct current when the differential voltage exceeds the forward voltage threshold of the LED's. This will vary from approximately 0.9 Volts at 70°C to 1.05 Volts at −40°C. R_1 is utilized as a current limiter, to protect the LED's. When current in either diode exceeds approximately 1 mA, the 2N2222 will turn on causing the visible LED to turn on and the output TTL signal to go to "0". The overload will not indicate for low currents through the LED's, but the protection feature will still be there. The LED's in the OPI 2500 have very low leakage characteristics near zero Volts.

FIGURE I

Operational Amplifier Overload Protection Circuit



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APPLICATION BULLETIN 108
November 1980

MOTION SENSING WITH OPTICAL INTERRUPTERS IS VERY COMMON. A WIDE VARIETY OF OPTICAL INTERRUPTERS ARE AVAILABLE. CARE MUST BE TAKEN IN THE SELECTION OF THE APPROPRIATE SENSOR FOR THE SYSTEM FUNCTION

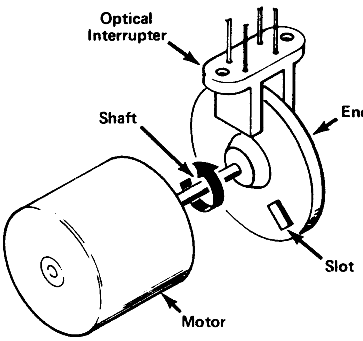
This application note will discuss many of the variables associated with single channel encoding including design considerations for using non-apertured, apertured, double apertured or Photologic™ series devices.

GENERAL DISCUSSION

The most common application of optoelectronics is the sensing of motion with an optical interrupter. The normal single channel optical interrupter module consists of an emitter or light source and a receiver or light sensor separated by a slot or air gap. The interruption of this beam causes an on/off signal from the light sensor. When the light path is blocked, the sensor will be "off" allowing only leakage current to flow. When the light path is open, the sensor will be "on", causing significantly higher currents to flow. This is often accomplished by placing a rotating plate (or encoder disc) in the slot between the LED and light sensor as shown in Figure 1.

FIGURE 1

Tachometer or Motor Speed Monitor

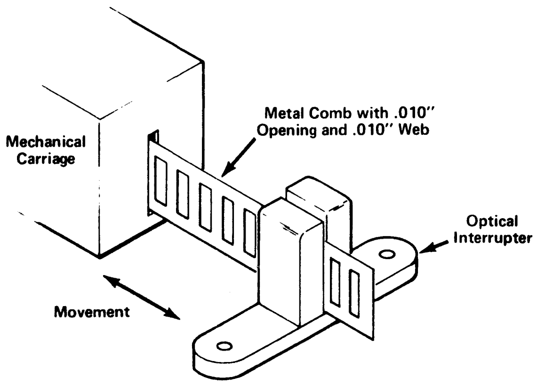


There is usually an opening or slot in the encoder disc that allows the light sensor to be exposed to light from the LED once each revolution. The light through the slot will cause the sensor to turn on when the slot is present and turn off after the slot goes by. This light pulse will relate the mechanical motion of the encoder disc to the electrical signal by giving one pulse per revolution. By counting these pulses for a given time interval, the speed of rotation may be determined. This gives rise to the "Tachometer" or motor speed monitor.

This encoder disc may be replaced with a fence or comb that passes through the same slot. The same logic presented for the encoder disc will hold true. One light pulse or electrical pulse is formed for each opening in the fence or comb that passes the LED/sensor pair. Thus the linear motion of the fence or comb can be related to an electrical series of pulses. Figure 2 shows this mechanical system pictorially.

FIGURE 2

Linear Encoder Relating Distance Versus Pulses



Analysis of the use of an optical interrupter module for a specific application requires several considerations to be analyzed. Most design engineers consider cost, functionality, and reliability goals in their design. Most important, however, is total application performance. The part must be designed so that minimum support is required in a production type environment. This production environment begins with the fabrication of the basic design and continues through the design performance in subsequent sub-assemblies until the final product is complete. The design is considered successful if, once implementation is complete, the system runs so smoothly, the designer receives no negative feedback. This requires "luck" or a systematic approach to understanding and considering all major variables. This application note will use a tachometer design as the mechanism to apply the philosophy of "successful designer approach".

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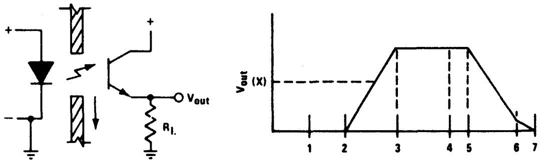
NON-APERTURED ENCODING

Most tachometer applications require a digital signal which can be easily processed to determine the speed at which a mechanical motion is taking place. There are several variables that need to be discussed that control this digital signal. Figure 3 pictorially represents the general wave shape that will appear across the load resistor as the slot goes by the sensor.

FIGURE 3

Pictorial Representation of Signal Pulse



POINTS		DESCRIPTION
Turn on delay time	1	Sensor starts to be uncovered
Gain + turn on time	2	Sensor starts to turn "on"
Slot Width	3	Sensor reaches maximum turn on or saturation
Turn off delay time	4	Sensor starts to be covered
	5	Sensor starts to turn "off"
Turn off time	6	Sensor is completely covered
	7	Sensor output of signal current decreases to leakage

As the slot starts to open up the light path between the sensor and the LED, the sensor will start to turn on. If the system has adequate gain, the sensor will saturate prior to the trailing edge of the slot reaching the leading edge of the sensor. The signal level will diminish as the slot goes by reducing the light level to the sensor.

This time interval from 1 through 7 will remain fairly consistent for a given setup. As different units from various production runs are substituted, the main variations that will be viewed are:

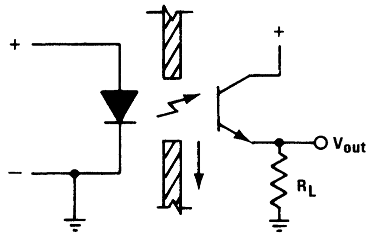
a. Variations in slope between 2 and 3
b. Variations in slope between 5 and 7

As the system gain increases, the turn on time will decrease and the flat portion betwen 3 and 5 will get wider. In other words, 3 will move to the left and 5 will move to the right. The turn on delay will decrease slightly, moving 2 to the left. The point labeled 7 will move to the right showing the sensor turn off time has increased. This will cause the voltage reading at point 6 to increase. As the system gain decreases, the inverse will happen. Points 3, 4, and 5 will become one point and start to decrease. Points 1 and 6 never move. If the circuit is desired to turn on or off at level "X", the "X" will move as these slopes change.

The OPB 813 is a commercially available optical interrupter from TRW Optron. It has no built-in aperture. It will be used as an example for the discussion of the choice of a specified load resistor. Figure 4 shows a typical circuit where V_{out} will drive the input of a TTL gate such as the SN7414 Schmitt Trigger.

FIGURE 4

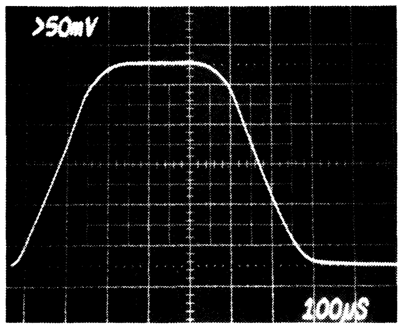
Optical Beam Interrupter



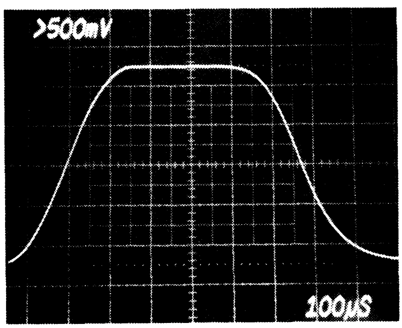
The choice of this load resistor is usually the first parameter the design engineer must consider. The end result is a TTL compatible analog voltage generated across this load resistor. The minimum allowed on-state current and the maximum allowed off-state current of the OPB 813 become the first two restrictions on the choice of this load resistor. In order to be able to generate a reliable digital output, the system must guarantee the analog voltage will swing above and below the positive and negative going thresholds, respectively, of the TTL gate. Figure 5 shows the output of the OPB 813 with the resistive load of 1000 ohms, and 10,000 ohms.

FIGURE 5

OPB 813 Output Versus R_L



R_L = 1000 ohms



R_L = 10,000 ohms

A study of these photographs will quickly show a positive and a negative aspect. As you increase the value of the load resistor, the analog voltage swing across it quickly increases. The standard product guarantees 500 μA of output with 10 mA input. This corresponds to 500 mV across 1000 ohms and 5 Volts across 10,000 ohms. The maximum turn on voltage required to trip the SN7414 is 2.0 Volts. It also becomes apparent that as you increase the value of the load resistance, the rise and fall time is adversely affected. The rise time (10% to 90%) is 160 μseconds with the 1000 Ω load increasing to 180 μseconds with the 10,000 Ω load. The fall time (90% to 10%) is 170 μseconds with the 1000 Ω load increasing to 200 μseconds with the 10,000 Ω load. The frequency response is significantly decreased with increased load resistance. Keep in mind that the measured rise times and fall times are a combination of the electrical rise and fall time of the sensor as well as the mechanical rise and fall time of the system. The sensor gradually is exposed to the light as it is uncovered and the light is gradually removed as it is covered. This increase in load resistance may lead to a secondary problem.

As the magnitude of the load resistor in increased, greater care must be taken in the mechanical design to prevent off-state problems. This means guarding against spurious light signals that may create noise or unwanted signal levels adequate to give a signal pulse when none is there.

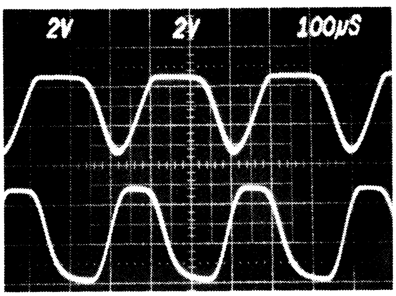
Two other options become potential problem solvers. Increasing the LED drive current will increase the output current. Care must be taken as increasing the drive current will also decrease reliability. The supplier may be asked to select units that will give a higher output. This will increase the cost in inverse proportion to the amount of units meeting the new requirements that lie within the distribution.

APERTURED ENCODING

The OPB 813S series are apertured versions of the OPB 813. They are available with apertures that are .010", .007", .005" and .003" wide. All are .040" high. The OPB 813S10 which has a .010" x .040" aperture will be the only unit discussed. It offers a good alternative to the OPB 813 when resolution becomes more critical. Figure 6 shows the comparison of the wave shapes across the 1000 Ω R_L of the OPB 813 and OPB 813S10.

FIGURE 6

OPB 813 (upper) Versus OPB 813S10 (lower)

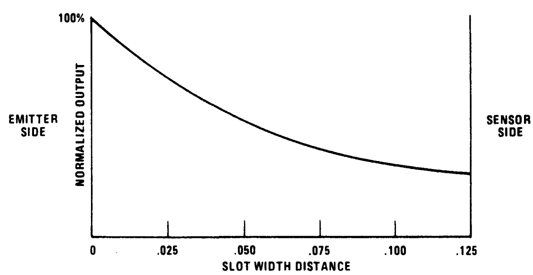


The waveforms shown in Figure 6 are made with an apertured disc that had .025" openings and .038" opaque areas for its total periphery. This causes the OPB 813 (top trace) not to go completely to ground potential which is the cross hatched "x" line on the scope faceplate. This is due to the light bleed around the .038" opaque area causing the sensor to continue conduction. This would not be present in single pulses per revolution. The turn on and turn off times are about 60 μseconds for the OPB 813S10 and 80 μseconds for the OPB 813. This is due to the mechanical turn on and turn off times being limited to .010" in the OPB 813S10 while going as long as .060" on the OPB 813.

Another problem that can be encountered comes about when the slot in the encoder wheel is close to the size or smaller than the aperture in front of the sensor. The output level of the sensor in an individual unit will decrease as the encoder wheel moves laterally from the LED or emitter side toward the sensor side of the unit. This is shown in Figure 7.

FIGURE 7

Normalized Sensor Output Versus Lateral Slot Opening



This is brought about because the light from the LED is not collimated and does not have a point source radiation pattern. The effect can be minimized by minimizing wobble or location change of the encoder wheel within the interrupter slot or by adding an aperture in front of the LED. The most effective of these is to place an aperture in front of the LED. This solution has two major drawbacks.

a. Increased Cost
b. Significantly decreased output

Another problem that frequently occurs in this type of application is that the signal level becomes quite small. This is due to low LED drive (improved reliability) and aperture or apertures in the light path becoming quite narrow to improve timing accuracy. Normally, it is not convenient to place amplifying circuitry in close physical proximity to the optical interrupter module. Noise pickup may cause spurious signals which could upset system performance.

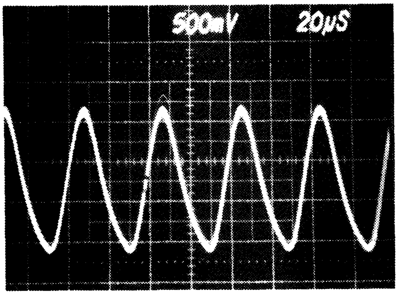
The OPB 813 and OPB 813S10 offer successful use in many design applications. If, however, they cannot be used due to output levels, speed or associated problems, there is a viable solution.

APERTURED FUNCTION ENCODING

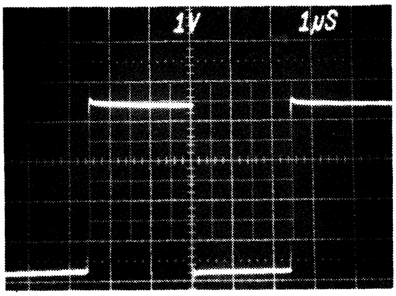
The solution to the problems presented before is a sensor function. The OPB 913S10 is similar in appearance to the OPB 813 or OPB 813S10. It requires three leads for the sensor rather than two leads. The sensor function is a Photologic™ chip consisting of a photo sensitive element and a Schmitt Trigger buffer integrated on a common chip. The housing contains a .010" aperture in front of the Photologic™ sensor to allow for high resolution encoding. The frequency response of the OPB 913S10 is improved over the OPB 813S10 to 250 kHz with typical rise and fall times of 25 nsec. The output is capable of driving 8 TTL loads over the temperature range of −40°C to +70°C. Figure 8 clearly shows the suitability of the OPB 913S10 when compared to the OPB 813S10.

FIGURE 8

OPB 813S10 @ 25 kHz
Sinking 1 TTL Load



OPB 913S10 @ 200 kHz
Sinking 8 TTL Loads



As long as the required frequency response is slow enough and the output is adequate, the OPB 813S10 is the best choice from a system cost. This is further supported if unused logic gates exist for the designer to process the opto signal into a digital output. As the applications become more sophisticated and importance is shifted to improved performance and simplification of complex processing circuits, the OPB 913S10 becomes the best choice for the designer. A major advantage to the designer is the guaranteed performance from −40°C to +70°C. The result is a much more reliable design in terms of degradation and system performance.

CONCLUSION

The OPB 813 (non-apertured optical interrupter) will perform quite reliably in low speed, low resolution encoding. The OPB 813S family offers an improvement in resolution. The narrow apertures offer superior resolution in linear encoders where .003" resolution is attainable. The OPB 913S10 family is the choice where higher output levels, speed, and precise resolution are required.

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APPLICATION BULLETIN 109
November 1980

TEMPERATURE COMPENSATION ON LED's WHICH CAN MAINTAIN POWER OUTPUT WITHIN ±5% OVER THE FULL OPERATING TEMPERATURE RANGE, IS EASILY OBTAINED

This application note presents a method whereby a string of LED's can have their outputs controlled within ±5% of their 25°C value, over the full temperature range. When using plastic encapsulated LED's, the opto coupler, OPI 2150 is recommended, while the OPI 102 is recommended when using hermetic or metal can LED's.

GENERAL DISCUSSION

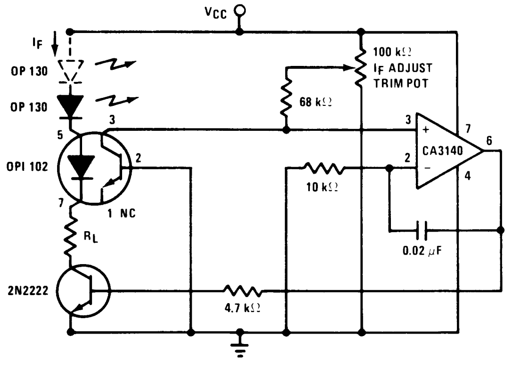
Near infrared LED's have a negative temperature coefficient. They decrease in output at a rate of approximately 0.9% per °C increase. The circuit described will compensate for this change and cause the output power to remain within ±5%.

PERFORMANCE CHARACTERISTICS

Figure 1 shows a circuit that can be used to maintain a relatively constant output power by varying the forward current through the LED string. The LED in the OPI 102 is used as a reference LED to indicate the relative power output of the LED's in the string. The collector-to-base photodiode of the sensor is used as an output monitor because of its relative stability over a wide temperature range. The magnitude of the I_F current is set by the I_F ADJUST TRIM POT. The operational amplifier CA3140 regulates I_F in maintaining a fixed current from the sensor.

FIGURE 1

LED Constant Power Output vs Temperature Control Circuit

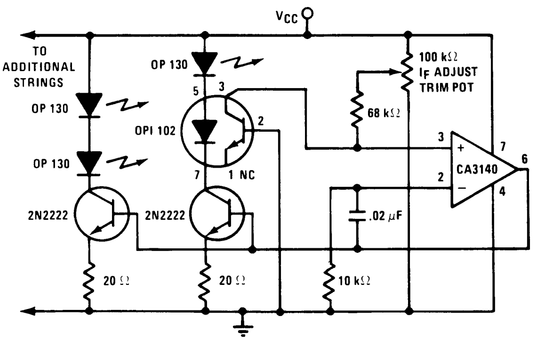


V_{CC} should be high enough to provide adequate voltage. It should be greater than 2.4 Volts plus 1.4 x the number of LED's to be controlled. Matching the LED's in the string will improve performance versus temperature. The resistor R_L is used to control maximum current. Its value will be determined by the desired current limit and the amount of V_{CC} less all the diode drops above the minimum required.

There are times when it is not possible to string all of the LED's into one string due to limited V_{CC}. Figure 2 shows how the strings may be broken up into shorter groups. Each of the transistors should have V_{BE} vs I_C matched to provide equal I_F regulation for each string.

FIGURE 2

Alternate Control Circuit for LED Strings



This method is not as efficient but it does provide a compromise when a single string is not feasible.

All of the components in Figure 1 and 2 are in hermetic packages. When plastic LED's are being controlled, all other components may be changed to plastic parts for economy.

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APPLICATION BULLETIN 110
October 1980

THE INCREASE IN HOME APPLIANCES WHICH USE ELECTRONIC CONTROLS, AND THE NEED TO PROTECT THE USER FROM THE AC LINE VOLTAGE HAS CREATED AN EXPANDING MARKET FOR AN OPTICALLY ISOLATED TRIAC DRIVER

The OPI 3009, OPI 3010, and OPI 3011 series of optically coupled isolators use a GaAs infrared emitting diode input with a photosensitive silicon bilateral switch output that functions like a triac. These parts may be used as the interface between the electronic controls of a home appliance and the power triac used to control the load. An added advantage is obtained from this approach since the user of the appliance is isolated from the 115 VAC line by the optically coupled isolator. This appliance bulletin will discuss several variations of input and output circuitry necessary to perform this type of control.

GENERAL DISCUSSION

The OPI 3009 series requires a minimum of 10 to 30 mA of LED current (depending on the device specified) to latch the output into the "ON" condition. The control pulse to the LED must have adequate drive capability to supply this current. When the control or signal pulse is applied and the output is latched into the "ON" condition, the bilateral switch will sink up to 100 mA AC. This current would normally be used as control or gating current for a power triac or as drive current for any load requiring less than 100 mA. When the control or signal pulse current through the LED is removed and the bilateral switch output is in the "OFF" condition, the output current will drop below 100 nA at rated V_{DRM} at room temperature. Thus, the AC load is controlled by a signal pulse from the control electronics through the optically coupled isolator, and users giving inputs to the control electronics will be isolated from the line voltage by the coupler.

PERFORMANCE CHARACTERISTICS

The control pulse from the electronic controller may be used to control any number of loads. In a dishwasher, it might control:

Water Solenoid . . . . "ON" or "OFF"
Drain Pump . . . . "ON" or "OFF"
Circulating Fan . . . . "ON" or "OFF"
Heating Element* . . . . "ON" or "OFF"

*The heating element could also be controlled as a percentage ON/OFF by varying the control pulse width within a time period for different levels of heat. If one minute time periods were selected, the input control could pulse the heating element "ON" a maximum of 7200 times within this minute for 60 cycle AC, or any percentage of that time.

INPUT REQUIREMENTS

An electronic controller for the dishwasher functions would need a minimum of four control elements. If the microprocessor used as the controller were MOS with a sink capability of 0.5 mA or less, amplification of the control pulse would be required to actuate the coupler. A hex buffer or inverter could provide this amplification and control the four functions leaving two buffers or inverters unused. Table 1 shows the components required. The schematic is shown in Figure 1. For supply voltage of 12 or 15 Volts, use one of the circuits shown in Figure 2.

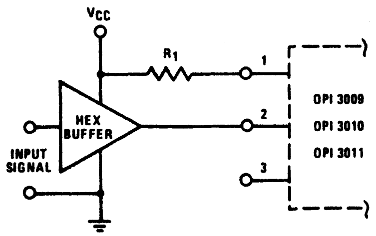
When the circuit has to operate below 25°C, the drive to the LED's must be increased. A 10% increase will allow operation to 0°C. The curve for this is shown on Product Bulletin No. 2076. The drive must also be increased to allow for operational life degradation. Increases of 30% on the OPI 3009, 15% on the OPI 3010, and 10% on the OPI 3011 should allow operation for 50,000 hours.

TABLE 1

V_{CC} Volts DC	R_1 (ohms) OPI 3009 30 mA	R_1 (ohms) OPI 3010 15 mA	R_1 (ohms) OPI 3011 10 mA	Hex Buffer
5	100	200	300	SN7416

FIGURE 1

Typical Input Circuitry for Low Control Current Values
Signal Input Low – Isolator Output "ON"



The optical coupler can be driven in this manner from any type of electronic controls which have output levels too low to drive the coupler directly. If the output current sink levels are adequate to drive the coupler directly, the designer can select the appropriate coupler.

The hex buffer may not be the most economical method for supplying the control current required by the optical

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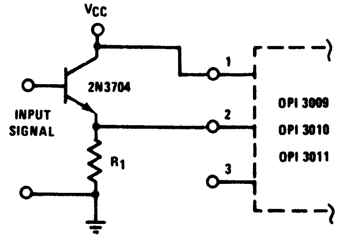
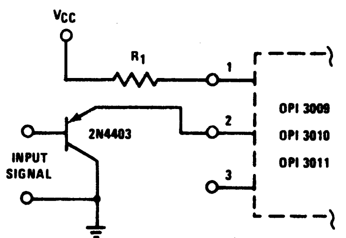
coupler if the electronic controller is used to control only one or two functions. In this case, the circuits shown in Figure 2 may be more desirable. The first two have identical function performance to the circuit shown in Figure 1, while the third one is equivalent to replacing the buffer with an inverter. The gain of the transistors shown is adequate to drive any of the optical couplers with 0.5 mA of signal current. R_1 should be selected based on the supply voltage and the LED current required to operate the optical isolator. A base current limiting resistor may be used in circuit 3 if the drive levels exceed 0.5 mA.

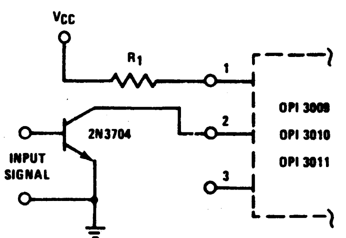
FIGURE 2
Input Circuitry for Small Number of Control Functions



CIRCUIT 1
(SIGNAL INPUT "LOW", ISOLATOR OUTPUT "ON")



CIRCUIT 2
(SIGNAL INPUT "LOW", ISOLATOR OUTPUT "ON")



CIRCUIT 3
(SIGNAL INPUT "LOW", ISOLATOR OUTPUT "OFF")

The input drivers shown in Figures 1 and 2 are adequate to cover the normal type of electronic controllers.

OUTPUT REQUIREMENTS

The output of the coupler will vary as a function of the input signal or control pulse and with the type of load. Figure 3 shows the principal voltage and current waveforms across the power triac or the bilateral switch when the load is resistive. The triac turns "ON" when the signal pulse is applied and the gate current exceeds the minimum triac gate current. If the gate or control signal is removed at time T_2, the device continues to conduct until the instantaneous current approaches zero. The device is now in the "OFF" state. Current will drop to the leakage value and the device supports the source voltage across its main terminals. Figure 4 shows a typical output circuit for a resistive load such as a heater element. The 180 ohm resistor is added to protect the photosensitive bilateral switch in the optical coupler from current surges.

FIGURE 3
Principal Voltage and Current Waveform with Resistive Load

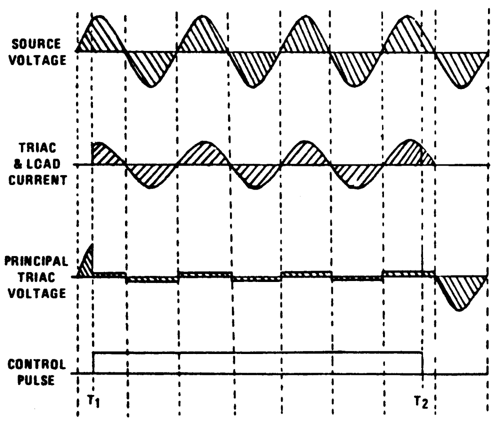
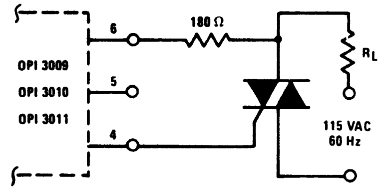
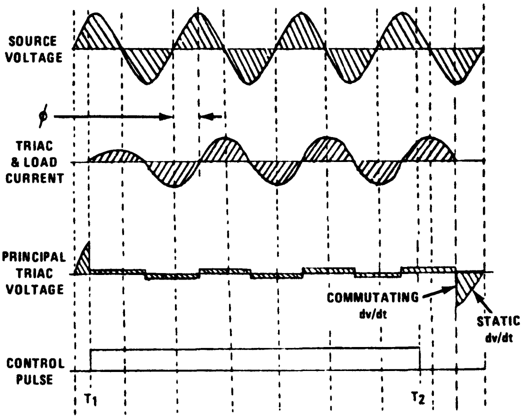


FIGURE 4
Output Driving Resistive Load



When the load is inductive (fan motor, water pump, solenoid), additional precautions must be taken. Figure 5 shows the power triac or the bilateral switch principal voltage and current waveforms with an inductive load. When the control pulse is turned "ON" the triac will turn "ON" after the minimum gate turn-on current is exceeded.

FIGURE 5
Principal Voltage and Current Waveform with an Inductive Load



In a circuit with an inductive load, the voltage leads the current by some phase angle ϕ as shown in Figure 5. When the gate or trigger current is removed at time T_2, the bilateral switch or the triac will continue to conduct until the current drops below the holding current level. The voltage drop across the inductive load will then be impressed across the main terminals of the device. The rate at which this voltage is impressed is primarily governed by the characteristics of the bilateral switch or triac and the characteristics of the inductive load. The rate of voltage change across the main terminals of the control device when the device cuts off is called "commutating" dv/dt. When the device is off and the sustaining line voltage is being blocked, the dv/dt drops to "static" dv/dt. The rate of change of either commutating or static dv/dt may be adequate to turn the devices on. The addition of a "snubber" network will reduce the rate of voltage rise seen by the control device by forming a parallel RC path. Figure 6 shows the output circuit with the snubber network (shown with darkened lines) placed across the main terminals of the power triac.

FIGURE 6
Application of "Snubber" Network for Inductive Loads

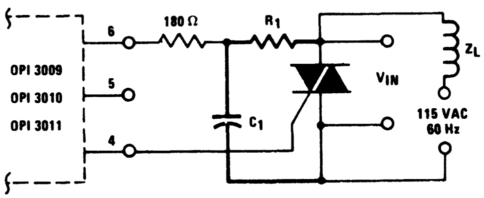


Table 2 shows the values of R_1 and C_1 for ranges of power triac gate current from 10 to 100 mA while maintaining the trigger voltage, V_{IN}, at ≈ 40 Volts.

TABLE 2
Value of R_1 and C_1 for Various Gate Current Ranges

I_{GT}(mA)	R_1 (Ω)	C_1 (μF)	V_{in} Trigger Voltage (V)
100	220	0.10	43
70	400	0.06	44
40	800	0.03	42
30	1200	0.02	44
15	2400	0.01	42
10	3600	0.006	45

1. The 180 ohm resistor is chosen to limit the surge current into the coupler. It is:
   $$R = V_{peak}/I_{max} = 180/1.2A^* = 150\ \Omega$$
   The 180 ohm resistor is the closest 10% standard value above 150 Ω to limit the C_1 discharge current to less than 1.2A.
2. The R_1C_1 time is obtained by:
   $$dv/dt = V_{t_{off}}/R_1C_1 \text{ (Worst Case)}$$
   Static dv/dt (T_j = 70°C) = 8.0 V/μs = 8 x 10^6 V/s (Worst Case)
   $$R_1C_1 = V_{t_{off}}\ (dv/dt) = \frac{180}{8 \times 10^6} = 22.5 \times 10^{-6}$$
   If the gate is to be triggered at ≈ 40 Volts and requires 100 mA of I_{GT}, then:
   $$(180 + R_1) = V_{IN}/I_{GT} = 40/.1 = 400\ \Omega$$
   $$R_1 = 220\ \Omega$$
   $$R_1C_1 = 22.5 \times 10^{-6} \text{ sec}$$
   $$C_1 = 22.5 \times 10^{-6} / 220 \approx 0.1\ \mu F$$
   Solving more precisely for V_{IN}:
   $$V_{IN} = (100 \text{ mA} \times 180\Omega) + (100 \text{ mA} \times 220\Omega) + (V_{DROP} \text{ in coupler}^* \text{ or } 3.0 \text{ V})$$
   $$V_{IN} = 18 + 22 + 3 = 43 \text{ Volts}$$
   The triac will trigger at 43 Volts with 100 mA of gate current with R_1 = 220 Ω and C_1 = 0.1 μF and will sustain a worst case dv/dt of 8.0 V/μs.

*From Product Bulletin 2076

Figure 7 shows a typical layout of a system using a microprocessor driving a hex buffer, which in turn drives 6 opto couplers. The isolators are in turn driving:

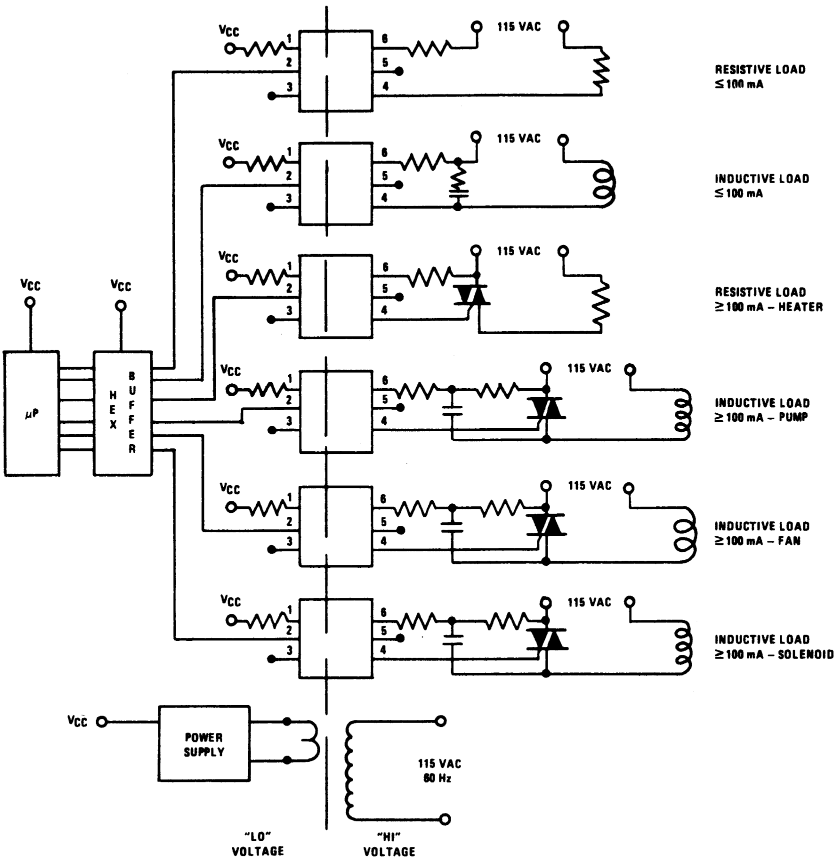
1. A resistive load of ≤ 100 mA directly.
2. An inductive load of ≤ 100 mA directly.
3. A power triac with gate current ≥ 100 mA driving a heating element.
4. A power triac with gate current ≥ 100 mA driving a water pump.
5. A power triac with gate current ≥ 100 mA driving a fan motor.
6. A power triac with gate current ≥ 100 mA driving a solenoid.

The additional connection shows the transformer from the 115 VAC line which provides the DC power supply for the hex buffer, opto coupler inputs, and the microprocessor.

The dashed line shows the separation of high and low voltages.

FIGURE 7

Block Diagram Layout of System



CONCLUSION

The OPI 3009 series offers a versatile combination of interfaces between electronic controls and the load in home appliances. The introduction of the OPI 3020 and OPI 3021 will expand this series to allow interface in applications where 220 VAC replaces the 115 VAC line voltages. The introduction of the OPI 3030 and OPI 3031with zero voltage crossing will further expand the series by eliminating the need for a "snubber" circuit in applications where an inductive or capacitive load is driven.

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TRW OPTRON

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®

APPLICATION BULLETIN 111
October 1980

MANUFACTURER'S DATA SHEETS ON SEMICONDUCTOR PRODUCTS NEED TO BE SUPPLEMENTED TO PROVIDE ADEQUATE INFORMATION FOR MAKING SOLDER CONTACT TO LEADS

Normal lead soldering information furnished on semiconductor product data sheets is limited to the maximum temperature, the maximum time at this temperature and the minimum distance from the temperature to the case of the unit. This bulletin discusses some of the aspects of soldering using an iron, a pot, or a flow bath. This will involve discussions of both hermetic or metal packaged parts and plastic encapsulated parts.

GENERAL DISCUSSION

A variety of different methods are used to make a solder joint between a semiconductor product and the circuit to which it is wired. Care and expertise are required to minimize unit loss and maximize unit yield. A few technique improvements, and suggestions as to proper solder and flux selections are discussed. Familiarization with the points brought out in this bulletin will assist the user to minimize solder problems.

PERFORMANCE CHARACTERISTICS

A typical data sheet will have the following information in the absolute maximum ratings:

Lead Soldering Temperature . . . . 240°C
(1/16 inch from case for 3 seconds)

These conditions except for "time" are readily controlled in flow soldering and solder pot applications. It becomes difficult to control the maximum temperature in solder iron applications. The normal solder used is 60/40 lead tin which softens at 180°C and flows at 220°C. If the temperature of the iron or the time it is in contact with the solder lead interface is not controlled, the 240°C can be significantly exceeded. Several techniques or controls are helpful in preventing this overheating.

1. Limiting the maximum temperature of the iron by controlling the power to the iron. The slower the operator is, the cooler the iron should be.
2. Careful selection of proper solder, flux, iron, tip and surface preparation can minimize problems.
3. Verbal explanation, knowledgeable tutoring and assistance, and pictorial examples can also be helpful.
4. Proper design of the work station to minimize fatigue and encourage repeatable operator steps such that the solder operation is done in the same sequence by the same motions.
5. Once the technique is learned, it is very important to encourage speed. Normally, the higher the output, the higher the quality level once the basic technique has been mastered.
6. Design of the PC board land patterns with the unit and method of soldering of uppermost importance can be of significant help. The subsequent discussion on soldering of the pill package will illustrate this.

Table I lists the solder, flux, dwell times and distances recommended by TRW Optron on their hermetic and plastic encapsulated components.

TABLE I

Soldering Components Listing

PACKAGE	TYPE OF SOLDER	TYPE OF FLUX	MAX DWELL TIME	DISTANCE FROM CASE	COMMENTS
Flow Soldering					
Hermetic	63/37 Tin Lead Bar	Active Rosin foaming flux (Kester 197 is suitable)	10 Sec	1/16"	Except for "pill" packages
Plastic	63/37 Tin Lead Bar		10 Sec	1/16"	
Solder Pot					
Hermetic	63/37 Tin Lead Bar	Kester 1544 is suitable	10 Sec	1/16"	Use water white rosin flux on pills (Alpha 100 is suitable)
Plastic	63/37 Tin Lead Bar		10 Sec	1/16"	
Solder Iron					
Hermetic	60/40 Tin Lead Wire Rosin Core, as small a diameter as possible		3 Sec	1/16"	If fluxing is required, use mildly activated rosin flux dispensed from hypodermic needle. Kester 1544 is suitable.
Plastic			3 Sec	1/16"	

All rosin flux residue can be removed with isopropyl alcohol and water rinses. (All recommended fluxes are rosin base.)

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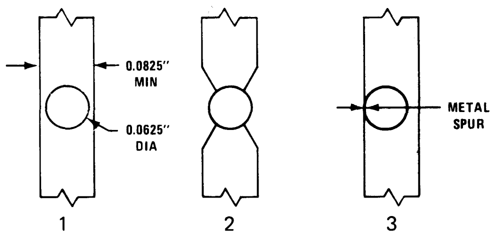
The pill package (OP 600—OP 123 types) requires more care than any other package. The unit is designed for solder contact on either side of a PC board by any of the three techniques. It is not normally flow soldered since two passes must be made through the machine, and tooling can be complicated. Care must be taken in the PC board design to prevent subsequent problems. The mounting hole should be drilled to 0.0625" ±0.001". The following should be considered when designing the land area for the lens side of the device:

FIGURE I

PC Land Pattern Design



1. If space permits, allow a minimum of 0.010" on either side of mounting holes.
2. Design with cutaways when lands are narrow or consistent orientation of tabs is desired.
3. Hole off center with narrow lands will create fingers of land pattern due to "undercut" that may short the unit as the package is inserted into the hole.

The two desirable factors are: To have as much surface area of land pattern adjacent to the unit as possible to ensure support of both lens mounting tabs to prevent tilting, and to provide mechanical strength of land pattern when unit is being reworked or removed.

HAND SOLDERING

Once the packages are inserted into the PC board, the board should be turned so lens side is down and resting on a hard rubber or similar surface that will prevent damage to the glass lens but firmly support it. The operator will then press firmly down on the board with one hand. The iron is held in the other hand with the tip resting on the land pattern approximately 1/4" from the unit. The tip is slowly moved toward the unit; while watching the land pattern melt ahead of the tip. The speed of travel is as fast as the operator can handle the movement comfortably ensuring the land pattern melts. At the time the tip reaches the unit, solder is fed by the hand resting on the board without removing the downward pressure. The iron is wiped around the unit at the same rate of travel as was used on the land pattern. Once the 360° circle is complete, the solder wire is removed. The operator may make another 360° turn with the iron. Experience will show the best way. After all the plug sides are soldered, the board will be inverted and the lens tabs will be soldered to the two land patterns. The same technique is used except omit the 360° circle. The tabs are soldered in two operations.

SOLDER POT or DIP SOLDERING

A popular method of soldering pills in PC boards, when the design permits, is dip soldering or immersing the pill in the PC board in molten solder. The following conditions called out in Table II should be used.

TABLE II

Dip Soldering

Temperature of solder	230°C ±5°C
Insertion or retraction rate	0.25 inches/second
Dwell Time	3—5 seconds
Flux	"R" type (non-activated)
Flux Dilution	Methanol

CAUTION: After removing from the solder pot, the unit should be held still until the solder has hardened. Vertical insertion and removal with minimum lateral movement is required for minimum problems (inadequate coverage or shorts). There should be a minimum of 0.025" clearance between lands to prevent bridging.

All solder joints on all other packages in 0.062" PC boards should be soldered on the side away from the component. This guarantees the minimum distance of 1/16" from device to heat source. On open air solder joints, a pair of long nose pliers or some other heat sink gripping the lead between the joint and the unit can prevent problems. By following the information given above and exercising good judgement and common sense, the user will encounter very few problems related to solder joints on TRW Optron components.

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APPLICATION BULLETIN 112
June 1982

TWO CHANNEL OPTICAL INTERRUPTERS MAY BE USED FOR DETERMINING DIRECTION OF ROTATION, SPEED, AND THE RELATIVE LOCATION OF A ROTATING SHAFT

TRW Optron has two types of dual channel optical interrupters available. The OPB 822 family has two side-by-side channels on 0.212" centers and the OPB 831S20 has two vertical channels on 0.200" centers. These standard parts may be used for determining direction of rotation, speed, and relative location of a rotating shaft. This bulletin will discuss some of the design aspects of two channel encoding along with circuit concepts and unit performance.

GENERAL DISCUSSION

Rotational direction of a shaft can be readily determined by utilizing the two channels of an optical interrupter, an encoder disc with a number of openings around the circumference, and some simple electronics. The speed and relative shaft location information is available as a by-product and requires some additional electronics.

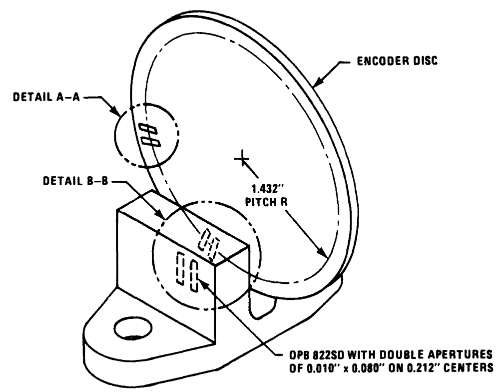
Figure 1 is a pictorial definition of terms used in this bulletin and should be referred to for clarification. A period is defined as 360 electrical degrees or the mechanical width of one opening plus one closure at the central point of the slot near the circumference of the encoder disc. When using a vertical, dual-channel unit, the outer row of periods are normally offset by 90 electrical degrees, or 1/4 period, from the inner row of periods. This will cause one channel to turn on approximately 90 electrical degrees ahead of the other as a function of rotation. In shaft encoding terminology, quadrature is the term defining determination of rotational direction by the phase relationship between the outputs of the two channels. System design normally uses 90° for this phase shift. Speed can be determined by accumulating the number of signal pulses for a fixed period of time, dividing by the number of periods per revolution thus obtaining the revolutions for this time period. Relative location is determined by dividing 360 by the number of periods around the circumference. A pulse is generated for each of these rotational segments. Counters may be used to relate a certain number of pulses to a desired action. This bulletin will describe the method of obtaining the three pieces of information (rotation direction, speed, and relative location) rather than what is done with the information.

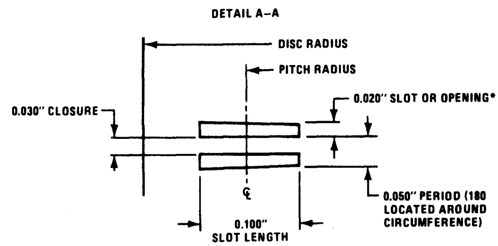
PERFORMANCE CHARACTERISTICS

The OPB 822SD is used as the demonstration interrupter to describe method and operation. Apertures (0.010" x 0.080") are mounted in front of both sensors and LED's. The 0.010" dimension is perpendicular to the rotational vector of the encoder disc at the slot between the sensor and LED. A system is desired with 2° mechanical resolution of rotational movement, thus 360°/2 or 180 cycles or periods around the circumference. Each cycle or period corresponds to an opening and a closure in the encoder disc passing a sensor and LED combination.

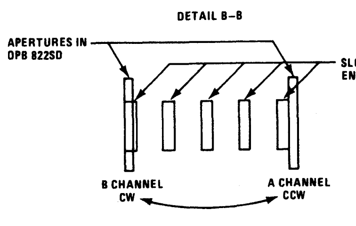
FIGURE 1

Pictorial Definition of Terms





* The sides of the slots lie on the extension of the two radii that are 1.432" long and 0.020" apart at the chord that defines the width of the center of the slot. The contained ∠ at that point is 0.8°.



An off-multiple of periods between the center line of the sensor apertures (0.212") is required for the 90° phase shift. This off-multiple can be 1/4, 3/4, 1-1/4, 1-3/4, 2-1/4, 2-3/4 etc. periods. For example, a period of 0.050" will yield 4-1/4 cycles or periods in the 0.212" distance between these apertures.* The radius of the encoder disc is determined to be 1.432". (0.050" period x 180 periods per revolution x 1/2 π = radius). The opening in the disc should not be less than 0.010" as this would decrease the guaranteed output signal. A good rule for designing encoders is to keep the ratio of the opening to the closure at 2/3's. The disc can now be specified as:

Pitch radius – 1.432" (From center of wheel to ℄ of slots and apertures)

Slot length – 0.100" (0.020" tolerance above 0.080" aperture)

Disc radius – 1.562" (0.025" tolerance between disc and bottom of slot)

Openings – 0.020" on chord @ 1.432" radius (180 required)

Closure – 0.030" on chord @ 1.432" radius (180 required)

Disc material and thickness – Polycarbonate plastic, 0.060" thick

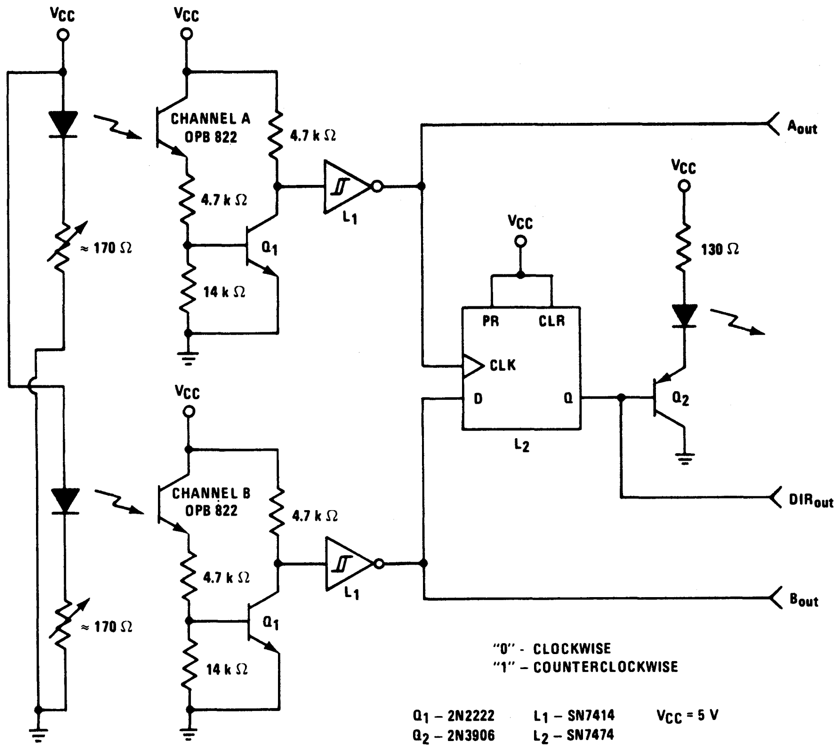
Crosstalk will not occur due to the narrow apertures (0.010") on both sensor and LED. This disc was then paired with the circuit shown in Figure 2.

* $\frac{0.212}{\text{off-multiple}}$ x mechanical resolution (pulses/revolution) x 1/2 π = pitch radius.

As shown in Figure 2, channel "B" provides the "D" input and channel "A" provides the "clock" input to the SN7474. (The SN7414 converts the relatively slow transitions from the mechanical motion to TTL compatible rise and fall times.) Since channel "A" clocks the latch at its positive transition, the state of channel "B" at "D" determines the state of the latch. If the "Q" output of the latch is high (1 state) then the "D" input was high when channel "A" turned "ON". Thus channel "B" turned "ON" prior to channel "A". This implies counterclockwise direction of

FIGURE 2

Schematic for Determination of Rotation Direction, Relative Position and Speed



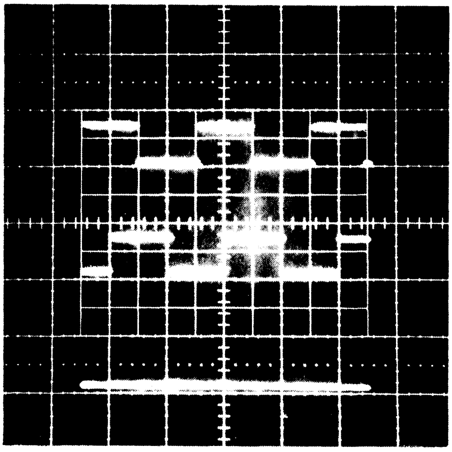
rotation. For clockwise rotation, channel "A" turns on prior to channel "B" and the "Q" output of the latch will be low (0 state). The pulses at A out or B out may be used for speed and/or relative location. Speed may be determined by counting the output pulses for a given time period and dividing the total count by 180 (pulses per revolution). Relative event location may be controlled within approximate 2° accuracy $\left(\frac{360^\circ}{180}\right)$ by specifying the number of pulses between related events. For example, 45 pulses would correspond to 1/4 rotation or 90 mechanical rotational degrees.

The photographs shown in Figure 3 demonstrate the "0" and "1" level for clockwise and counterclockwise rotation.

The left photograph shows a "0" level denoting clockwise rotation. The right photograph shows the opposite. Additional circuitry may be added using the time base pulses already present. If a third interrupter channel were added that could relate back to a fixed location of the shaft, then the relative location could be changed to true location. This might become the left margin control, right margin control and/or index for next line control. All of these functions could be performed quite easily. The same technique may be used in linear motion where the encoder disc is replaced by a comb with a series of openings and closures. The direction of movement, speed, and the relative location of the comb could be used as discussed before by molding the comb with the openings 0.020" wide by 0.100" high every 0.050" length along the comb.

FIGURE 3

50 μsec/Div 5 V/Div



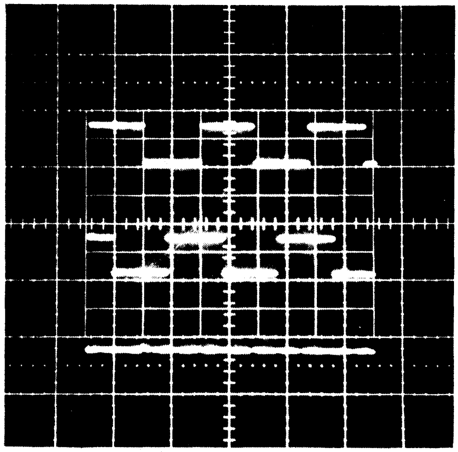
Clockwise Direction

Channel "A" Output

Channel "B" Output

Direction Output

50 μsec/Div 5 V/Div



Counterclockwise Direction

Operating Frequency 10 kHz

In summary, this is a very versatile technique for relating electrical signals to linear or rotational motion, speed and either relative or true location of that motion.

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TRW OPTRON
A DIVISION OF TRW INC.

APPLICATION BULLETIN 114
June 1982

GALLIUM ALUMINUM ARSENIDE INFRARED EMITTING DIODES (GaAlAs LED's) ARE SUPERIOR TO GALLIUM ARSENIDE (GaAs) IN SEVERAL WAYS. THEY ARE THE NEXT AND POSSIBLY FINAL STEP IN INFRARED EMITTING DIODE EVOLUTION.

The first light source for actuating an optoelectronic photosensor was the tungsten filament or incandescent lamp. It was eventually replaced by the GaAs infrared emitting diode which offered longer life, smaller size, less power to operate and less heat generated. The GaAs LED is still the workhorse of the industry and will continue to be used in steadily decreasing numbers for the next few years. It will eventually be replaced by GaAlAs as the industry standard for two major reasons: GaAlAs offers at least twice the power output at the same input current (I_F) level and significantly improved coupling efficiency.

GENERAL DESCRIPTION

Typically, a GaAs LED mounted on a TO-46 header with a flat window can will emit 5 milliwatts total radiant flux at an I_F = 100 mA. At the same I_F, a GaAlAs LED will typically emit 10 milliwatts total radiant flux. Similar increases are possible in other packages. This allows the designer some options which have not been available before.

In addition, silicon doped GaAs has a spectral emission centered at approximately 935 nanometers. GaAlAs has a spectral emission of approximately 880 nanometers which is very close to the peak response of silicon phototransistors. This improves coupling efficiency by approximately 16%.

FIGURE 1

Photodiode Collector Current Versus LED Forward Current With Both GaAlAs and GaAs

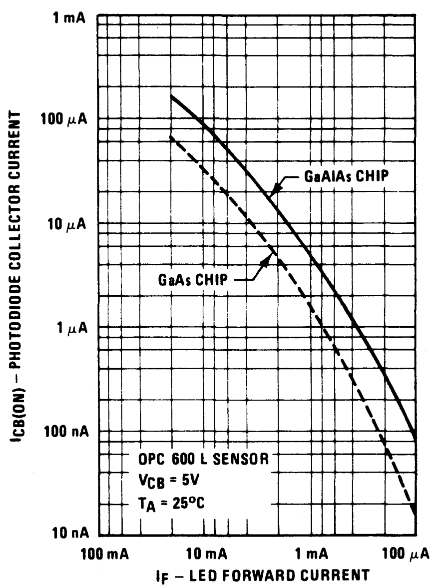
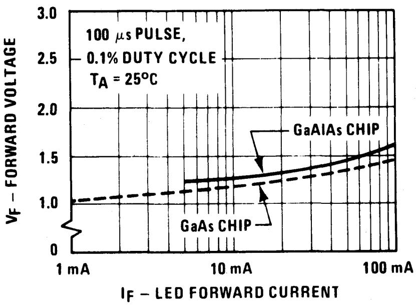


Figure 1 graphically illustrates the improvement in photodiode collector current as a result of both the higher radiant flux and the optimized spectral emission.

The only negatives to GaAlAs are a slightly higher forward voltage (V_F) (see Figure 2) and a slightly higher initial cost. With process improvements, this cost difference should eventually disappear.

FIGURE 2

Forward Voltage Versus LED Forward Current



CHIP FABRICATION

All TRW Optron GaAlAs LED's are made by means of a straightforward single step solution grown liquid phase epitaxial (LPE) preparation technique. Initially it is much the same process as making GaAs LED's. N type GaAs substrates approximately 16 mils thick are placed in a furnace and heated to around 920°C. A melted mixture of gallium, gallium arsenide and silicon (called the "melt") is then placed on top of the substrates. In the case of GaAlAs, aluminum (Al) is added to the melt. The furnace then starts cooling, and an epitaxial N type layer begins to grow on top of the substrates. As the cooling continues, the silicon in the melt which is amphoteric changes polarity or "flips" to P type material at approximately 860°C, forming the PN junction. The growth process continues until the epi layer reaches a thickness of 7–8 mils. (See Figure 3.)

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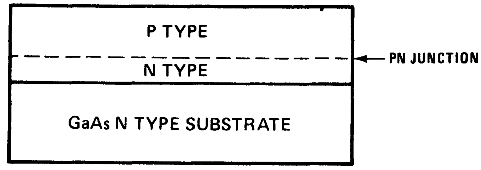
FIGURE 3

Typical Epitaxial Layer Growth



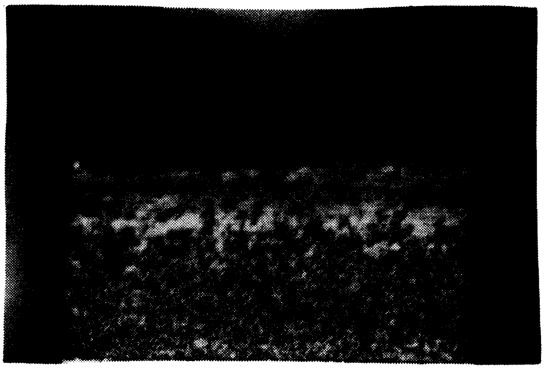
The nature of the Al in the melt is such that it is depleted or used up rapidly in the early stages of the epi growth. Concentration is virtually zero at the top of the P layer.

The substrate is then etched away with an etchant that readily dissolves GaAs. As the etchant contacts the N layer, the aluminum causes the etch rate to be slowed to 1/100th of the initial rate. This is convenient because it helps to ensure that the N layer is not materially etched.

After etching, appropriate ohmic contacts are added by evaporation techniques. A gold contact completely covers the P layer or backside, and a dot matrix contact is put on the N layer or topside. The chips are then sawed into their final size. A final etching is done to remove saw damage and to roughen the surface of the N layer which enhances light output. (See Figure 4.)

FIGURE 4

Typical Chip Cross Section



WHAT MAKES GaAlAs SUPERIOR?

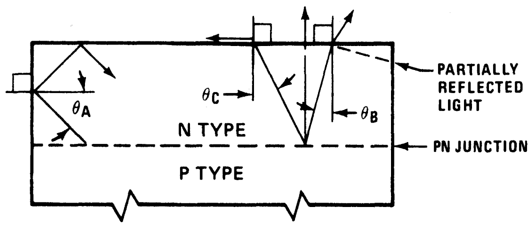
The wavelength of the emitted light of an LED is related to the energy in the photons of light it emits. Also the higher the band gap energy of the semiconductor material, the higher the photon energy. Al atoms increase the band gap energy in proportion to the concentration which allows adjustment of the photon wavelength. By controlling this concentration, the wavelength can be varied to approximate the peak spectral response of a silicon phototransistor or 880 nanometers.

GaAlAs also has an improved radiation window. In order for an LED to emit more light, absorption of photons traveling through the material must be as low as possible. In other words, there must be a high probability that the photons generated at the junction will reach a surface and escape. For this to happen effectively, the photon energy must be less than the band gap energy of the material. In previous discussions, it was mentioned that Al atoms increase the band gap energy. The heaviest concentration of Al atoms is at the N layer surface with rapidly decreasing concentration toward the PN junction. Photons generated at the junction then travel a path through steadily increasing band gap energy levels until they reach the surface. This property ensures a much reduced chance of re-absorption of photons than does a material in which the band gap energy is constant from junction to surface such as GaAs.

One final plus, GaAlAs has an index of refraction which is slightly lower than GaAs. This affects the critical angle which defines the angle at which there is total internal reflection. (See Figure 5.)

FIGURE 5

Definition of Critical Angle



The critical angle is determined by the formula:

$\text{SIN } \theta_C = \frac{n_1}{n_2}$ Where n_1 is the index of refraction of air, or 1, and n_2 is the index of refraction of the chip material.

With GaAs, $n_2 = 3.6$

$$\text{SIN } \theta_C = \frac{1}{3.6}$$

$$\theta_C = 16^\circ$$

With GaAlAs, $n_2 = 3.4$

$$\text{SIN } \theta_C = \frac{1}{3.4}$$

$$\theta_C = 17^\circ$$

At angles less than the critical angle, there is partial reflection. (See angle θ_B in Figure 5.) At angles greater than the critical angle, there is total internal reflection. (See angle θ_A in Figure 5.)

There are ways of improving surface emission. One, mentioned earlier, is the post-dicing etch cleanup which roughens the chip surface. This increases the likelihood of photons striking the surface at less than the critical angle. Another improvement is the addition of a clear epoxy, anti-reflective, domed lens placed over the chip which actually enlarges the critical angle to approximately 24°.

RELIABILITY

Since GaAlAs and GaAs junctions are formed in the same manner, the chips should have the same reliability. Life tests to date indicate that this is true. Data shows that both GaAlAs and GaAs have from 5 to 8% degradation after 1,000 hours of maximum rated operation.

DRAWBACKS

GaAlAs has inherently high V_F. The higher the band gap energy, the higher the V_F must be to impart adequate energy to the electrons. Typical V_F for TRW Optron's GaAs LED's at 100 mA is 1.5V vs. 1.75V for GaAlAs. This difference increases slightly at higher current levels.

CONCLUSION

Many power-starved optical assembly packages will be helped immediately by using GaAlAs. Special optosensor assemblies such as card readers, paper tape readers, paper sensors and precision shaft encoders will become easier to design.

Electronic assemblies which operated with an LED/sensor pair will benefit immediately.

- With optocouplers, higher current transfer ratios will be available, and the LED and sensor will not need to be mounted as close to each other which will allow higher isolation voltages.
- With reflective assemblies, reflective objects will be able to be sensed at greater distances than before.
- With interrupter assemblies, precise alignment and gap width will not be as critical. Since there is more light available, aperturing can be reduced for higher resolution or photosensor gain can be reduced for better signal-to-noise ratio and improved gain-bandwidth product.
- In battery-operated applications, a GaAlAs LED can replace a GaAs LED and provide the same light output at ½ the current drive.
- Since the same light output can be produced at ½ the current drive, GaAlAs LED's will have much longer operating life.

GaAlAs, with its superior performance, will give the designer more options and design flexibilities than were previously available.

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TRW OPTRON
A DIVISION OF TRW INC.

APPLICATION BULLETIN 115
August 1981

A MONOLITHIC INTEGRATED CIRCUIT ON A SINGLE SILICON CHIP IS CAPABLE OF AUTOMATICALLY ADJUSTING THE BRIGHTNESS OF A DISPLAY IN RELATION TO VARIATIONS IN AMBIENT LIGHT

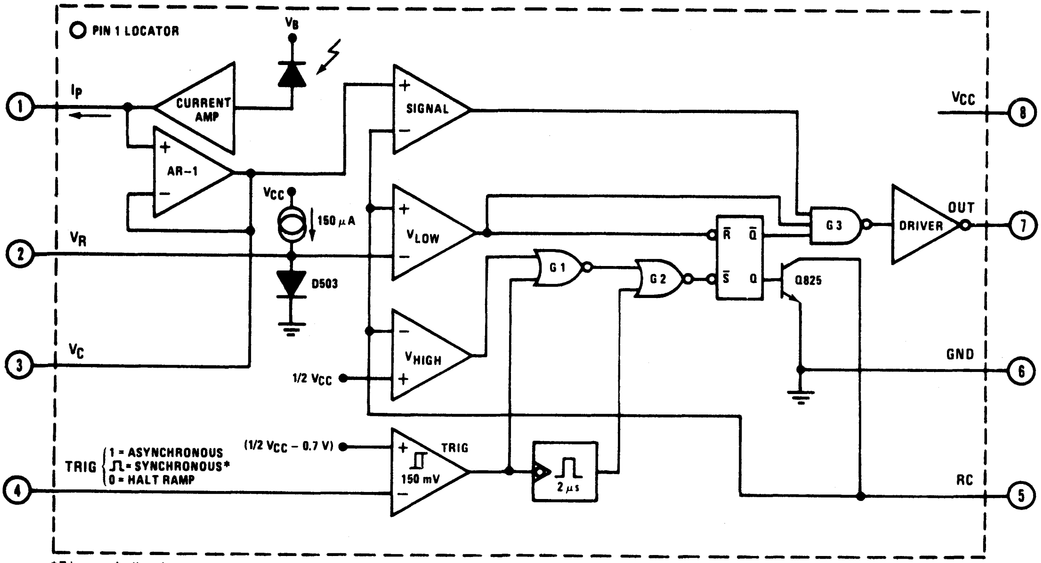
The Automatic Brightness Control or ABC sensor is a monolithic IC containing on-chip a 2,500 square mil photodiode, a high-gain temperature compensated current amplifier, an operational amplifier, four comparators, an RS latch, random logic, an output driver and a voltage regulator. The device adjusts the brightness of display systems by pulse width modulation. That is, the duty cycle of the output varies proportionally with the ambient light level. The ABC sensor can be used to control the brightness of vacuum fluorescent, LED, incandescent and other types of displays. It can also be used to control display drivers.

GENERAL DISCUSSION

The ABC sensor controls display brightness in the following manner: A ramp frequency, determined by an external resistor and capacitor, is generated at pin 5. See Figure 1.

FIGURE I

OPL 100 Block Diagram



* Triggers on leading edge.

The output of the ramp generator is internally connected to the "signal" comparator. A control voltage, proportional to received ambient light, is also internally connected to the signal comparator. When the control voltage is greater than the ramp voltage, the comparator is switched on. When the control voltage is less than the ramp voltage, the comparator is switched off. These waveforms are shown in Figure 2.

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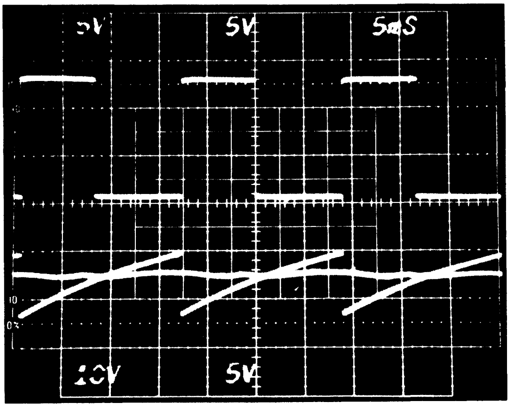
FIGURE 2



The comparator output is squared by going through additional logic gates which also serve to make sure the sensor is synchronized with an external sync signal, if used.

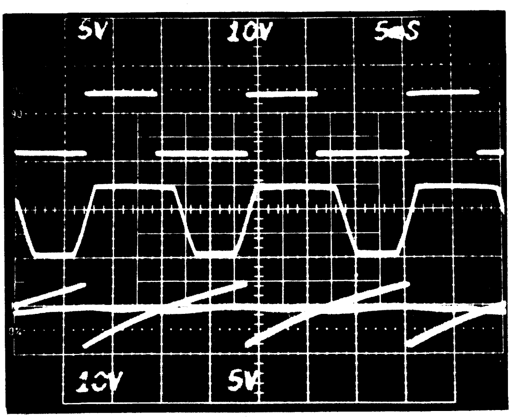
It can be seen from Figure 2 that the output pulse and the ramp pulse start together. The output pulse continues until the ramp pulse contacts the superimposed line representing the control voltage, V_C. It can also be seen that as ambient light increases, V_C will rise causing a corresponding increase in pulse width which increases the brightness of the display. The approximate ramp frequency can be determined by using the formula:

$$f = \frac{1.4}{RC}$$

To obtain an asynchronous ramp signal, pin 4, TRIG, is connected to pin 8, V_{CC}. This lets the ramp frequency run free with the ramp voltage climbing to 1/2 V_{CC} and then dropping to 0.7 V.

To obtain a synchronous ramp signal, apply a sync pulse to pin 4. See Figure 3.

FIGURE 3



The ramp is then synchronized and triggers on the positive going edge of the trigger pulse. The trigger pulse must be greater than 1/2 V_{CC} − 0.7 V. Ideally, the asynchronous ramp frequency, determined by the RC constant at pin 5, should be slightly lower than the frequency with which the designer is trying to synchronize. If it is not, the trigger pulse will keep the ramp voltage from climbing to 1/2 V_{CC} and, therefore, limit the adjustment range of the device. If the asynchronous ramp frequency is set faster than the synchronous frequency and pin 4 is left high after a trigger pulse is received, the sensor will generate an early trigger pulse. This will start the ramp, and it will be restarted when the next trigger pulse is applied. Early triggering is inhibited by logic gate G1 as long as the trigger input is low when the ramp voltage passes through 1/2 V_{CC}. The ramp frequency will not vary with supply voltage changes in either direction.

The ABC sensor is equipped with an externally adjustable light sensitivity level. The sensitivity is set by placing a resistor between pin 1, I_P, and pin 2, V_R. This resistor is the load resistance of the current amplifier. The resistance needed will range from 25 kΩ to 200 kΩ depending on the ambient light level with which the designer is working. The buffered analog response of the circuit is then available at pin 3.

The ABC sensor is capable of working with power supply voltages ranging from 4.5 to 24 Volts. If the sensor is used in a battery controlled system and the battery voltage drops, the sensor will increase its duty cycle and cause the display it is controlling to maintain a constant light output. The sensor is equipped with totem pole output which will sink 20 mA or source up to 50 mA. Care must be taken not to exceed the maximum power dissipation for the particular package style being used.

APPLICATIONS

FIGURE 4

Controlling Brightness of a VLED

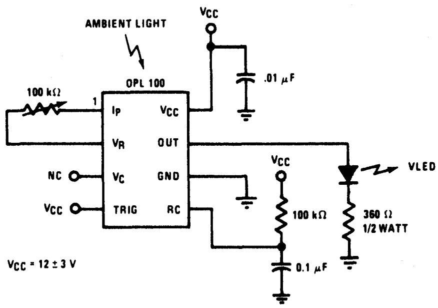


Figure 4 demonstrates the use of the ABC sensor to adjust the light output of a standard LED. With a 12 VDC supply voltage, the maximum average current through the LED would be 32 mA.

FIGURE 5

Controlling Brightness of Vacuum Fluorescent Displays

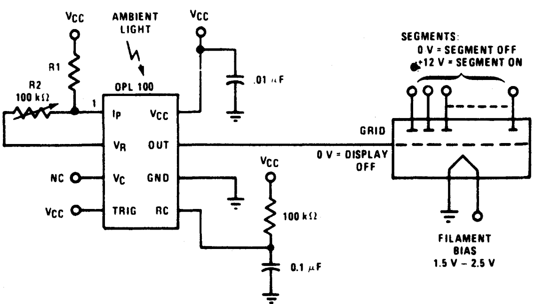


Figure 5 demonstrates the use of the ABC sensor to control a vacuum fluorescent display. The sensor is capable of adjusting the display brightness from 0 to 100%. Resistor R1 is added to the circuit to keep the display from going completely off when the sensor is in total darkness. The sensor should be mounted such that it receives light coming from the direction from which the display will be viewed. Resistor R2 is adjusted for a brightness level that is pleasing to the eye. The sensor will now adjust for changes in ambient light and make the display appear to remain at the same brightness level.

FIGURE 6

Display Brightness Controller via Display Driver

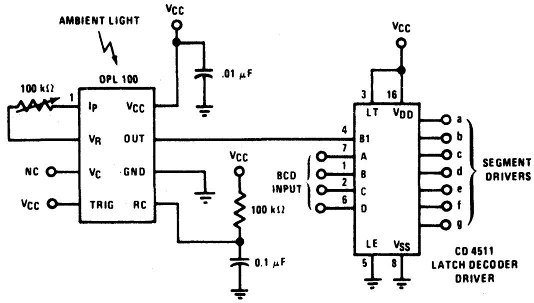


Figure 6 is an example of the ABC sensor controlling a latch decoder driver. If several drivers are used and multiplexed, they can all be controlled by a single ABC sensor. The strobe or enable line for each display should be connected to pin 4 via appropriate logic circuitry.

FIGURE 7

Analog Coupling System

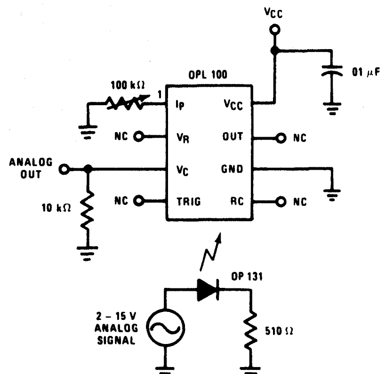


Figure 7 illustrates the use of an ABC sensor as an analog sensor. Only the photodiode current amplifier and the buffer amplifiers are used. In this mode it is possible to modulate an LED with a signal, then receive the modulated signal with the ABC sensor and convert it back into a usable electrical signal. The front end of the ABC sensor was designed for high gain, not speed, so its bandwidth is limited to about 1.0 kHz.

FIGURE 8
Ambient Light Level Controller

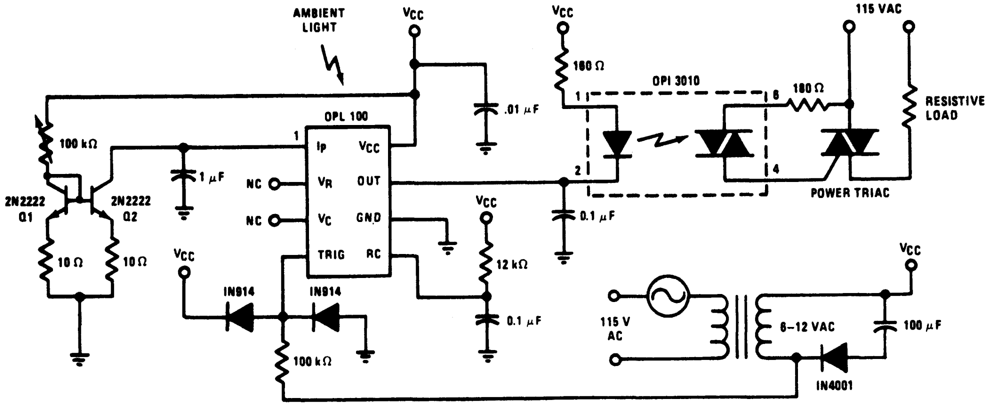


Figure 8 illustrates an inverse application for the ABC sensor. In this case, the sensor is used to keep the ambient light environment at a constant level. As an example, lighting in a room can be increased in brightness to compensate for an outside decrease in sunlight. This is accomplished by driving a triac driver with the output of the ABC sensor. To obtain proper gating of the triac, the sensor must be synchronized with AC line voltage. The light level is established by setting a constant current through transistor Q1. The ABC sensor will then set the duty cycle of the output at a level which will produce enough light to generate an I_P current at pin 1 which is equal to the current through Q1.

CONCLUSION

All the circuits necessary to provide automatic brightness control of most displays are available on a single silicon chip. The Automatic Brightness Control, which has totem pole output, will source or sink 50 mA or 20 mA respectively, can be externally adjusted for sensitivity and is capable of both analog and digital output and synchronous or asynchronous modes of operation.

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May 1982

Optoelectronics Interchangeability Guide

TRW OPTRON, A DIVISION OF TRW INC., 1201 TAPPAN CIRCLE, CARROLLTON, TEXAS, 75006 (214) 323-2200, TWX-910-860-5958

INTERCHANGEABILITY GUIDE

The TRW Optron products shown herein are believed to be equivalents to the competitive products against which they are cross referenced. Where slight mechanical or electrical variations exist, the listed equivalent should satisfy the application.

Though data contained in this guide is believed to be accurate, TRW Optron assumes no responsibility for its use in actual circuit design. The pertinent TRW Optron data sheet should be used as the determining factor for actual replacement. To make this guide more useful, the following letter code is used to identify the extent of variation between the listed product and the nearest TRW Optron equivalent.

CODE DEFINITIONS

A .... Direct Replacement
B .... Minor Electrical
C .... Minor Mechanical
D .... Major Electrical
E .... Major Mechanical
F .... Call TRW Optron*
G .... No Equivalent

*Devices that can be second sourced if volume and pricing warrant

INDEX

TRW OPTRON, A DIVISION OF TRW INC., 1201 TAPPAN CIRCLE, CARROLLTON, TEXAS, 75006 (214) 323-2200, TWX-910-860-5958

CLAIREX

Clairex Part No.	Description	TRW Optron Part No.	Code
CLA7	Axial Transistor Coupler	OPI1264A	B,E
CLA7P	Axial Darlington Coupler	––	G
CLI-2	6 Pin Transistor Coupler	––	F
CLI-3	6 Pin Transistor Coupler	––	F
CLI-4	6 Pin Transistor Coupler	––	F
CLI-5	6 Pin Transistor Coupler	OPI2252	A
CLI-6	6 Pin Transistor Coupler	OPI2253	A
CLI-7	6 Pin Transistor Coupler	OPI2251	A
CLI-8	6 Pin Transistor Coupler	OPI2252	A
CLI-9	6 Pin Transistor Coupler	––	F
CLI-10	6 Pin Darlington Coupler	––	F
CLI-11	6 Pin Darlington Coupler	OPI3253	A
CLI-12	6 Pin Darlington Coupler	OPI3251	A
CLI-13	6 Pin Darlington Coupler	OPI3252	A
CLI-14	6 Pin Darlington Coupler	OPI3251	A
CLI-25	6 Pin Transistor Coupler	––	F
CLI-26	6 Pin Transistor Coupler	––	F
CLI-27	6 Pin Darlington Coupler	––	G
CLI-28	6 Pin Darlington Coupler	––	G
CLI-55	Transistor Interrupter	––	G
CLI-55A	Transistor Interrupter	––	G
CLI-55B	Transistor Interrupter	––	G
CLI-55C	Transistor Interrupter	––	G
CLI-200	Transistor Interrupter	––	F
CLI-200D	Transistor Interrupter	––	G
CLI-200S	Transistor Interrupter	––	G
CLI-210	Transistor Interrupter	OPB804	B,E
CLI-220	Transistor Interrupter	––	G
CLI-230	Transistor Interrupter	––	G
CLI-300	Transistor Interrupter	––	G
CLI-305	Transistor Interrupter	––	G
CLI-325	Transistor Interrupter	––	G
CLI-355	Transistor Interrupter	––	G
CLI-375	Transistor Interrupter	––	G
CLI-395	Transistor Interrupter	––	G
CLI-506	6 Pin Transistor Coupler	OPI2251	A
CLR2049	Hermetic Darlington	––	F
CLR2050	Hermetic Darlington	––	F
CLR2060	Hermetic Darlington	––	F
CLR2170	Hermetic Darlington	––	F
CLR2180	Hermetic Darlington	OP830W	B
CLR3180	Pill Transistor	––	G
CLR5101	Hermetic Darlington	––	G
CLT2020	Hermetic Transistor	––	F
CLT2030	Hermetic Transistor	––	F
CLT2035	Hermetic Transistor	OP802W	B
CLT2140	Hermetic Transistor	––	F
CLT2150	Hermetic Transistor	OP802	B
CLT2160	Hermetic Transistor	OP803	A
CLT2164	Hermetic Transistor	OP804	A
CLT2165	Hermetic Transistor	OP805	A
CLT3020	Pill Transistor	––	G
CLT3030	Pill Transistor	––	G
CLT3160	Pill Transistor	OP602	A
CLT3170	Pill Transistor	OP604	A
CLT5160	Hermetic Transistor	––	G
CLT5170	Hermetic Transistor	––	G

FAIRCHILD

Fairchild Part No.	Description	TRW Optron Part No.	Code
FCD810	6 Pin Transistor Coupler	OPI2251	A
FCD810A	6 Pin Transistor Coupler	OPI2151	A
FCD810C	6 Pin Transistor Coupler	––	G
FCD810D	6 Pin Transistor Coupler	––	G
FCD820	6 Pin Transistor Coupler	OPI2252	A
FCD820A	6 Pin Transistor Coupler	OPI2152	A
FCD820B	6 Pin Transistor Coupler	OPI2252	A
FCD820C	6 Pin Transistor Coupler	––	G
FCD820D	6 Pin Transistor Coupler	––	G
FCD825	6 Pin Transistor Coupler	OPI2153	A
FCD825A	6 Pin Transistor Coupler	OPI2153	A
FDC825B	6 Pin Transistor Coupler	OPI2253	A
FCD825C	6 Pin Transistor Coupler	––	G
FCD825D	6 Pin Transistor Coupler	––	G
FCD830	6 Pin Transistor Coupler	OPI2152	B
FCD830A	6 Pin Transistor Coupler	OPI2252	B
FCD830B	6 Pin Transistor Coupler	OPI2252	B
FCD830C	6 Pin Transistor Coupler	––	G
FCD830D	6 Pin Transistor Coupler	––	G
FCD831	6 Pin Transistor Coupler	OPI2251	B
FCD831A	6 Pin Transistor Coupler	OPI2151	B
FCD831B	6 Pin Transistor Coupler	OPI2251	B
FCD831C	6 Pin Transistor Coupler	––	G
FCD831D	6 Pin Transistor Coupler	––	G
FCD836	6 Pin Transistor Coupler	OPI2151	B
FCD836C	6 Pin Transistor Coupler	––	G
FCD836D	6 Pin Transistor Coupler	––	G
FCD850	6 Pin Darlington Coupler	OPI3250	C
FCD850C	6 Pin Darlington Coupler	––	G
FCD855	6 Pin Darlington Coupler	OPI3252	C

TRW OPTRON reserves the right to make changes at any time in order to improve design and to supply the best product possible.

FAIRCHILD (continued)

Fairchild Part No.	Description	TRW Optron Part No.	Code	Fairchild Part No.	Description	TRW Optron Part No.	Code
FCD855C	6 Pin Darlington Coupler	——	G	FPT131	Plastic Transistor	OP500SLE	B,E
FCD860	6 Pin Darlington Coupler	OPI3251	C	FPT132	Plastic Transistor	OP500SLE	B,E
FCD860C	6 Pin Darlington Coupler	——	G	FPT136	Plastic Transistor	OP800W	B,E
FCD865	6 Pin Darlington Coupler	OPI3253	C	FPT137	Plastic Transistor	OP802W	B,E
FCD865C	6 Pin Darlington Coupler	——	G	FPT220	Plastic Transistor	——	F
FCD880	Dual Transistor Coupler	——	G	FPT230	Plastic Transistor	——	F
FCD855	Dual Transistor Coupler	——	G	FPT320	Plastic Transistor	——	F
FPA100	Matched Pair Arrays	——	G	FPT330	Plastic Transistor	——	F
FPA101	Matched Pair Arrays	——	G	FPT400	Plastic Darlington	——	F
FPA102	Matched Pair Arrays	——	G	FPT410	Plastic Darlington	——	F
FPA103	Transistor Reflective	——	G	FPT500	Hermetic Transistor	OP804	B
FPA104	Transistor Reflective	——	G	FPT500A	Hermetic Transistor	OP805	B
FPA105	Transistor Reflective	——	G	FPT510	Hermetic Transistor	OP801W	A
FPA106	Transistor Reflective	——	F	FPT510A	Hermetic Transistor	——	F
FPA107	Transistor Reflective	——	F	FPT520	Hermetic Transistor	OP805	D
FPA108	Transistor Reflective	——	F	FPT520A	Hermetic Transistor	——	G
FPA103A	Transistor Reflective	——	G	FPT530	Hermetic Transistor	OP802W	B
FPA104A	Transistor Reflective	——	G	FPT530A	Hermetic Transistor	——	G
FPA105A	Transistor Reflective	——	G	FPT540	Hermetic Transistor	——	G
FPA106A	Transistor Reflective	OPB706C	A	FPT540A	Hermetic Transistor	——	G
FPA107A	Transistor Reflective	OPB706B	A	FPT550	Hermetic Transistor	——	G
FPA108A	Transistor Reflective	OPB706A	A	FPT550A	Hermetic Transistor	——	G
FPA700	Transistor Array	——	G	FPT560	Hermetic Darlington	OP830	B
FPA700A	Transistor Array	——	G	FPT570	Hermetic Darlington	OP830W	B
FPA710	Transistor Array	——	G	FPT610	Ceramic Transistor	——	G
FPA710A	Transistor Array	——	G	FPT630	Ceramic Transistor	——	G
FPA720	Transistor Array	——	G	FPT700	Plastic Transistor	OP500	B,C
FPA720A	Transistor Array	——	G	FPT720	Plastic Photodiode	——	F
FPE100	Plastic LED	OP130W	D,E	H11A1	6 Pin Transistor Coupler	OPI2253	A
FPE104	Plastic LED	OP160	D,E	H11A2	6 Pin Transistor Coupler	OPI2152	A
FPE106	Plastic LED	——	G	H11A3	6 Pin Transistor Coupler	OPI2252	A
FPE500	Hermetic LED	OP130	D,E	H11A4	6 Pin Transistor Coupler	OPI2151	A
FPE510	Hermetic LED	OP130W	D,E	H11B1	6 Pin Transistor Coupler	OPI3253	A
FPE520	Hermetic LED	OP133	A	H11B2	6 Pin Darlington Coupler	OPI3150	C
FPE530	Hermetic LED	OP133W	A	H11D1	6 Pin Transistor Coupler	——	G
FPT100	Plastic Transistor	OP500	B,E	H11D2	6 Pin Transistor Coupler	——	G
FPT100A	Plastic Transistor	OP500SLD	B,E	H11D3	6 Pin Transistor Coupler	——	F
FPT100B	Plastic Transistor	——	G	H11D4	6 Pin Transistor Coupler	OPI6100	A
FPT101	Hermetic Transistor	OP700	A	IL1	6 Pin Transistor Coupler	OPI2252	A
FPT102	Hermetic Photodiode	OP790	A	IL12	6 Pin Transistor Coupler	OPI2151	A
FPT110	Plastic Transistor	OP800W	B,E	IL15	6 Pin Transistor Coupler	OPI2151	A
FPT110A	Plastic Transistor	——	F	IL16	6 Pin Transistor Coupler	OPI2151	A
FPT110B	Plastic Transistor	——	F	IL74	6 Pin Transistor Coupler	OPI2152	A
FPT120	Plastic Transistor	OP500SLD	B,E	MCA230	6 Pin Darlington Coupler	OPI3150	A
FPT120A	Plastic Transistor	——	F	MCA231	6 Pin Darlington Coupler	OPI3151	A
FPT120B	Plastic Transistor	——	F	MCA255	6 Pin Darlington Coupler	OPI3152	A
FPT120C	Plastic Transistor	——	F	MCT2	6 Pin Transistor Coupler	OPI2152	A
FPT130	Plastic Transistor	OP802W	B,E	MCT2E	6 Pin Transistor Coupler	OPI2252	A
FPT130A	Plastic Transistor	——	G	MCT26	6 Pin Transistor Coupler	OPI2151	A
FPT130B	Plastic Transistor	——	G	MCT210	6 Pin Transistor Coupler	——	F

FAIRCHILD (continued)

Fairchild Part No.	Description	TRW Optron Part No.	Code	Fairchild Part No.	Description	TRW Optron Part No.	Code
MOC1000	6 Pin Transistor Coupler	OPI2152	A	4N25	6 Pin Transistor Coupler	4N25	A
MOC1001	6 Pin Transistor Coupler	OPI2252	A	4N26	6 Pin Transistor Coupler	4N26	A
MOC1002	6 Pin Transistor Coupler	OPI2152	A	4N27	6 Pin Transistor Coupler	4N27	A
MOC1003	6 Pin Transistor Coupler	OPI2151	A	4N28	6 Pin Transistor Coupler	4N28	A
TIL111	6 Pin Transistor Coupler	OPI2151	C	4N29	6 Pin Darlington Coupler	4N29	A
TIL112	6 Pin Transistor Coupler	OPI2150	A	4N30	6 Pin Darlington Coupler	4N30	A
TIL113	6 Pin Darlington Coupler	OPI3151	A	4N31	6 Pin Darlington Coupler	4N31	A
TIL114	6 Pin Transistor Coupler	OPI2251	C	4N32	6 Pin Darlington Coupler	4N32	A
TIL115	6 Pin Transistor Coupler	OPI2250	A	4N33	6 Pin Darlington Coupler	4N33	A
TIL116	6 Pin Transistor Coupler	OPI2252	A	4N35	6 Pin Transistor Coupler	4N35	A
TIL117	6 Pin Transistor Coupler	OPI2253	A	4N36	6 Pin Transistor Coupler	4N36	A
TIL118	6 Pin Transistor Coupler	OPI2151	A	4N37	6 Pin Transistor Coupler	4N37	A
TIL119	6 Pin Darlington Coupler	OPI3150	A				
VCA231	6 Pin Darlington Coupler	OPI3151	C				
VCA255	6 Pin Darlington Coupler	OPI3152	C				

GENERAL ELECTRIC

G.E. Part No.	Description	TRW Optron Part No.	Code	G.E. Part No.	Description	TRW Optron Part No.	Code
BPW36	Hermetic Transistor	OP804	A	H11A3	6 Pin Transistor Coupler	OPI2252	A
BPW37	Hermetic Transistoer	OP803	A	H11A4	6 Pin Transistor Coupler	OPI2151	A
BPW38	Hermetic Darlington	OP830	B	H11A5	6 Pin Transistor Coupler	OPI2153	A
CNY17/I	6 Pin Transistor Coupler	CNY17/I	A	H11A10	6 Pin Transistor Coupler	OPI2151	B
CNY17/II	6 Pin Transistor Coupler	CNY17/II	A	H11A520	6 Pin Transistor Coupler	OPI5000A	A
CNY17/III	6 Pin Transistor Coupler	CNY17/III	A	H11A550	Transistor Coupler	——	G
CNY17/IV	6 Pin Transistor Coupler	——	G	H11A5100	Transistor Coupler	——	G
CNY28	Transistor Interrupter	OPB816	C	H11AA1	AC Input Coupler	——	F
CNY29	Darlington Interrupter	——	F	H11AA2	AC Input Coupler	OPI2500	A
CNY31	Darlington Coupler	OPI7340	C	H11AV1	6 Pin Transistor Coupler	——	G
CNY32	Transistor Coupler	OPI7002	C	H11AV2	6 Pin Transistor Coupler	——	G
CNY33	6 Pin Hi Volt Coupler	OPI6100	D	H11AV3	6 Pin Transistor Coupler	——	G
CNY35	6 Pin AC Input Coupler	OPI2500	B	H11B1	6 Pin Darlington Coupler	OPI3153	A
CNY47	Transistor Coupler	——	F	H11B2	6 Pin Darlington Coupler	OPI3150	B
CNY47A	Transistor Coupler	——	F	H11B3	6 Pin Darlington Coupler	OPI3150	A
CNY48	6 Pin Darlington Coupler	OPI3153	B	H11B255	6 Pin Darlington Coupler	OPI3152	A
CNY51	Transistor Coupler	——	G	H11BX522	6 Pin Darlington Coupler	OPI3252	A
CQX14	Hermetic LED	OP133	B	H11D1	Hi Volt Coupler	——	G
CQX15	Hermetic LED	OP133W	B	H11D2	Hi Volt Coupler	——	G
CQX16	Hermetic LED	OP131	A	H11D3	Hi Volt Coupler	——	F
CQX17	Hermetic LED	OP131W	A	H11D4	Hi Volt Coupler	OPI6100	A
CQY80	6 Pin Transistor Coupler	OPI2100	B	H11F1	FET Coupler	——	G
F5D1	Hermetic LED	OP233	A	H11F2	FET Coupler	——	G
F5D2	Hermetic LED	OP232	B	H11F3	FET Coupler	——	G
F5D3	Hermetic LED	OP232	B	H11G1	Hi Volt Coupler	——	G
F5E1	Hermetic LED	OP233W	A	H11G2	Hi Volt Coupler	——	G
F5E2	Hermetic LED	OP232W	B	H11G3	Hi Volt Coupler	——	G
F5E3	Hermetic LED	OP232W	B	H11J1	6 Pin Triac Driver Coupler	——	G
H11A1	6 Pin Transistor Coupler	OPI2253	A	H11J2	6 Pin Triac Driver Coupler	——	G
H11A2	6 Pin Transistor Coupler	OPI2153	A	H11J3	6 Pin Triac Driver Coupler	——	G

GENERAL ELECTRIC (continued)

G.E. Part No.	Description	TRW Optron Part No.	Code	G.E. Part No.	Description	Trw Optron Part No.	Code
H11J4	6 Pin Triac Driver Coupler	——	G	L14F2	Hermetic Darlington	OP830	B
H11J5	6 Pin Triac Driver Coupler	OPI3010	GA	L14G1	Hermetic Transistor	OP813	B
H11L1	6 Pin Schmitt Trigger Coupler	——	G	L14G2	Hermetic Transistor	OP812	B
H11L2	6 Pin Schmitt Trigger Coupler	——	F	L14G3	Hermetic Transistor	OP814	B
H13A1	Transistor Interrupter	OPB870T55	C	L15H1	Hermetic Transistor	OP811	B
H13A2	Transistor Interrupter	OPB870T55	C	L14H2	Hermetic Transistor	OP812	B
H13B1	Darlington Interrupter	OPB872T55	C,D	L14H3	Hermetic Transistor	OP812	B
H13B2	Darlington Interrupter	OPB871T55	C,D	L14H4	Hermetic Transistor	OP811	B
H15A1	Transistor Coupler	OPI7002	C	LED55B	Hermetic LED	OP132	A
H15A2	Transistor Coupler	OPI7002	C	LED55BF	Hermetic LED	OP132W	A
H15B1	Darlington Coupler	OPI7340	C	LED55C	Hermetic LED	OP133	B
H15B2	Darlington Coupler	OPI7320	C	LED55CF	Hermetic LED	OP133W	B
H17A1	Matached Transistor Pair	——	G	LED56	Hermetic LED	OP131	A
H17B1	Matched Darlington Pair	——	G	LED56F	Hermetic LED	OP131W	A
H20A1	Transistor Interrupter	OPB875N55	C	1N6264	Hermetic LED	——	F
H20A2	Transistor Interrupter	OPB875N55	C	1N6265	Hermetic LED	——	F
H20B1	Darlington Interrupter	OPB877N55	F	1N6266	Hermetic LED	——	F
H20B2	Darlington Interrupter	——	F	2N5777	Darlington	——	G
H21A1	Transistor Interrupter	OPB871T55	C	2N5778	Darlington	——	G
H21A2	Transistor Interrupter	OPB872T55	C	2N5779	Darlington	——	G
H21A3	Transistor Interrupter	OPB877T65	C	2N5780	Darlington	——	G
H21A4	Transistor Interrupter	OPB871T55	C	4N25	6 Pin Transistor Coupler	4N25	A
H21A5	Transistor Interrupter	OPB872T55	C	4N25A	6 Pin Transistor Coupler	——	F
H21A6	Transistor Interrupter	OPB872T55	C	4N26	6 Pin Transistor Coupler	4N26	A
H21B1	Darlington Interrupter	OPB872T55	C,D	4N27	6 Pin Transistor Coupler	4N27	A
H21B2	Darlington Interrupter	——	F	4N28	6 Pin Transistor Coupler	4N28	A
H21B3	Darlington Interrupter	——	F	4N29	6 Pin Darlington Coupler	4N29	A
H21B4	Darlington Interrupter	OPB872T55	C,D	4N29A	6 Pin Darlington Coupler	——	F
H21B5	Darlington Interrupter	——	F	4N30	6 Pin Darlington Coupler	4N30	A
H21B6	Darlington Interrupter	——	F	4N31	6 Pin Darlington Coupler	4N31	A
H22A1	Transistor Interrupter	OPB871N55	C	4N32	6 Pin Darlington Coupler	4N32	A
H22A2	Transistor Interrupter	OPB872N55	C	4N32A	6 Pin Darlington Coupler	——	F
H22A3	Transistor Interrupter	OPB872N55	F	4N33	6 Pin Darlington Coupler	4N33	A
H22A4	Transistor Interrupter	OPB871N55	F	4N35	6 Pin Transistor Coupler	4N35	A
H22A5	Transistor Interrupter	OPB872N55	F	4N36	6 Pin Transistor Coupler	4N36	A
H22A6	Transistor Interrupter	OPB872N55	F	4N37	6 Pin Transistor Coupler	4N37	A
H22B1	Transistor Interrupter	OPB872N55	F	4N38	6 Pin Hi Volt Coupler	4N38	A
H22B2	Transistor Interrupter	——	F	4N38A	6 Pin Hi Volt Coupler	4N38A	A
H22B3	Darlington Interrupter	——	F				
H22B4	Darlington Interrupter	——	F				
H22B5	Darlington Interrupter	——	F				
H22B6	Darlington Interrupter	——	F				
H23A1	Matched Transistor Pair	——	F				
H23B1	Matched Darlington Pair	——	F				
H24A1	Transistor Coupler	OPI7010	A				
H24A2	Transistor Coupler	OPI7002	A				
H24B1	Darlington Coupler	——	G				
H24B2	Darlington Coupler	OPI7340	A				
H74A1	6 Pin Transistor Coupler	OPI2152	B				
L14F1	Hermetic Darlington	OP830	B				

GENERAL INSTRUMENTS (MONSANTO)

G.I. Part No.	Description	TRW Optron Part No.	Code
MCA7	Reflective Transducer	OPB711	A
MCA8	Transistor Interrupter	OPB870T55	C,D
MCA81	Transistor Interrupter	OPB870T55	C,D
MCA230	6 Pin Darlington Coupler	——	G
MCA231	6 Pin Darlington Coupler	——	G
MCA255	6 Pin Darlington Coupler	——	G
MCC670	8 Pin Darlington Coupler	——	G
MCC671	8 Pin Darlington Coupler	——	G
MCL201	8 Pin Darlington Coupler	——	F
MCL601	8 Pin Logic Coupler	——	F
MCL611	8 Pin Logic Coupler	——	F
MCT2	6 Pin Transistor Coupler	OPI2152	A
MCT2E	6 Pin Transistor Coupler	——	F
MCT4	TO-18 Coupler	3N243	A
MCT4R	TO-18 Coupler	3N243R	A
MCT6	Dual Transistor Coupler	——	G
MCT8	Transistor Interrupter	OPB872T55	C,D
MCT26	6 Pin Transistor Coupler	OPI2151	A
MCT66	Dual Transistor Coupler	——	G
MCT81	Transistor Interrupter	OPB872T55	C,D
MCT210	6 Pin Transistor Coupler	OPI2100	A
MCT271	6 Pin Transistor Coupler	——	F
MCT272	6 Pin Transistor Coupler	——	F
MCT273	6 Pin Transistor Coupler	——	F
MCT274	6 Pin Transistor Coupler	——	F
MCT275	6 Pin Transistor Coupler	——	F
MCT276	6 Pin Transistor Coupler	——	F
MCT277	6 Pin Darlington Coupler	4N29	A
ME60	Plastic LED	——	F
ME61	Plastic LED	——	F

G.I. Part No.	Description	Trw Optron Part No.	Code
ME7021	Plastic LED	——	F
ME7024	Plastic LED	——	F
ME7121	Plastic LED	——	F
ME7124	Plastic LED	——	F
ME7161	Plastic LED	——	F
MID400	AC Input Logic Coupler	OPI8013	F
MT1	Hermetic Transistor	OP802W	A
MT2	Hermetic Transistor	OP804	A
MT8020	Hermetic Transistor	——	F
4N25	6 Pin Transistor Coupler	4N25	A
4N26	6 Pin Transistor Coupler	4N26	A
4N27	6 Pin Transistor Coupler	4N27	A
4N28	6 Pin Transistor Coupler	4N28	A
4N29	6 Pin Darlington Coupler	4N29	A
4N30	6 Pin Darlington Coupler	4N30	A
4N31	6 Pin Darlington Coupler	4N31	A
4N32	6 Pin Darlington Coupler	4N32	A
4N33	6 Pin Darlington Coupler	4N33	A
4N35	6 Pin Transistor Coupler	4N35	A
4N36	6 Pin Transistor Coupler	4N36	A
4N37	6 Pin Transistor Coupler	4N37	A
6N137	8 Pin Logic Coupler	——	F
6N138	8 Pin Darlington Coupler	——	F
6N139	8 Pin Darlington Coupler	——	F

HEWLETT-PACKARD

H.P. Part No.	Description	TRW Optron Part No.	Code
HCPL-2502	8 Pin Transistor Coupler	——	F
HCPL-2503	8 Pin Transistor Coupler	——	F
HCPL-2530	8 Pin Dual Transistor Coupler	——	G
HCPL-2531	8 Pin Dual Transistor Coupler	——	G
HCPL-2533	8 Pin Dual Transistor Coupler	——	G
HCPL-2601	8 Pin Logic Coupler	——	G
HCPL-2602	8 Pin Logic Coupler	——	G
HCPL-2630	8 Pin Dual Logic Coupler	——	G
HCPL-2730	8 Pin Dual Darlington Coupler	——	G
HCPL-2731	8 Pin Dual Darlington Coupler	——	G
HCPL-3700	AC Input Coupler	——	G
4N45	6 Pin Darlington Coupler	——	F
4N46	6 Pin Darlington Coupler	——	F
4N55	16 Pin Dual Transistor Coupler	——	G
6N134	16 Pin Dual Transistor Coupler	——	G

H.P. Part No.	Description	Trw Optron Part No.	Code
6N135	8 Pin Transistor Coupler	——	F
6N136	8 Pin Transistor Coupler	——	F
6N137	8 Pin Logic Coupler	——	F
6N138	8 Pin Darlington Coupler	——	F
6N139	8 Pin Darlington Coupler	——	F
6N140	16 Pin Quad Transistor Coupler	——	G

HONEYWELL (SPECTRONICS)

Honeywell Part No.	Description	TRW Optron Part No.	Code	Honeywell Part No.	Description	TRW Optron Part No.	Code
SCD11B1	6 Pin Coupler	——	G	SDP8405-2	Plastic Transistor	OP500SLE	A
SCD11B2	6 Pin Coupler	——	G	SDP8405-3	Plastic Transistor	OP500SLD	A
SCD11B3	6 Pin Coupler	——	G	SDP8405-4	Plastic Transistor	OP500SLC	A
SCD255	6 Pin Coupler	——	G	SDP8405-5	Plastic Transistor	OP500SLB	A
SCS11C1	6 Pin SCR Coupler	——	G	SDP8405-6	Plastic Transistor	OP500SLA	A
SCS11C3	6 Pin SCR Coupler	——	G	SDP8406-1	Plastic Transistor	OP550	C
SCS11C4	6 Pin SCR Coupler	——	G	SE1450-1	Hermetic LED	——	G
SCD11C6	6 Pin SCR Coupler	——	G	SE1450-2	Hermetic LED	——	G
SD1410-1	Darlington	——	G	SE1450-3	Hermetic LED	——	G
SD1410-2	Darlington	——	G	SE1450-4	Hermetic LED	——	G
SD1410-3	Darlington	——	G	SE2450-1	Hermetic LED	——	G
SD1410-4	Darlington	——	G	SE2450-2	Hermetic LED	——	G
SD1420-2	Hermetic Photodiode	——	G	SE2450-3	Hermetic LED	——	G
SD1440-1	Hermetic Transistor	——	G	SE2460-1	Pill LED	OP123	B
SD1440-2	Hermetic Transistor	——	G	SE2460-2	Pill LED	OP123	B
SD1440-3	Hermetic Transistor	——	G	SE2460-3	Pill LED	OP124	B
SD1440-4	Hermetic Transistor	——	G	SE3453-1	TO-18 LED	OP130W	B
SD2440-1	Hermetic Transistor	OP601	B	SE3453-2	TO-18 LED	OP131W	B
SD2440-2	Hermetic Transistor	OP602	B	SE3453-3	TO-18 LED	OP131W	B
SD2440-3	Hermetic Transistor	OP603	B	SE3453-4	TO-18 LED	OP133W	B
SD2440-4	Hermetic Transistor	OP604	B	SE3455-1	TO-18 LED	OP131W	B
SD2441-1	Hermetic Transistor	——	G	SE3455-2	TO-18 LED	OP132W	B
SD2441-2	Hermetic Transistor	——	G	SE3455-3	TO-18 LED	OP133W	B
SD2441-3	Hermetic Transistor	——	G	SE3455-4	TO-18 LED	OP133W	B
SD2441-4	Hermetic Transistor	——	G	SE5453	TO-18 LED	OP135	B
SD3410-1	Darlington	——	F	SE5453-1	TO-18 LED	OP135	B
SD3410-2	Darlington	OP830W	B	SE5453-3	TO-18 LED	OP136	B
SD3410-3	Darlington	——	F	SE5453-4	TO-18 LED	OP136	B
SD3410-4	Darlington	——	F	SE5455-1	TO-18 LED	OP131	B
SD3420-2	Hermetic Photodiode	——	F	SE5455-2	TO-18 LED	OP132	B
SD3421-2	Hermetic Photodiode	——	F	SE5455-3	TO-18 LED	OP133	B
SD3422-2	Hermetic Photodiode	——	F	SE5455-4	TO-18 LED	OP133	B
SD3443-1	Hermetic Transistor	OP801W	B	SEP8502-1	Plastic LED	OP160	B,C
SD3443-2	Hermetic Transistor	——	F	SEP8503-1	Plastic LED	OP160	B,C
SD3443-3	Hermetic Transistor	OP802W	B	SEP8504-1	Plastic LED	OP140	B,C
SD5410-1	Darlington	——	F	SEP8505-1	Plastic LED	OP160	A
SD5410-2	Darlington	——	F	SEP8505-2	Plastic LED	——	F
SD5410-3	Darlington	——	F	SEP8505-3	Plastic LED	——	F
SD5410-4	Darlington	——	G	SEP8505-4	Plastic LED	——	F
SD5420-2	Hermetic Photodiode	——	F	SEP8505-5	Plastic LED	——	F
SD5421-2	Hermetic Photodiode	——	F	SEP8505-6	Plastic LED	——	F
SD5422-2	Hermetic Photodiode	——	F	SEP8506-1	Plastic LED	OP140	B,C
SD5443-1	Hermetic Transistor	OP802	A	SPX2E	6 Pin Coupler	——	G
SD5443-2	Hermetic Transistor	OP803	A	SPX6	6 Pin Coupler	——	G
SD5443-3	Hermetic Transistor	OP804	B	SPX26	6 Pin Coupler	——	F
SD5443-4	Hermetic Transistor	OP805	B	SPX33	6 Pin Coupler	——	F
SDP8402-1	Plastic Transistor	OP500	A	SPX35	6 Pin Coupler	——	G
SDP8403-1	Plastic Transistor	OP500	C	SPX53	6 Pin Coupler	——	F
SDP8404-1	Plastic Transistor	OP550	A	SPX103	6 Pin Coupler	——	G
SDP8405-1	Plastic Transistor	OP500	A	SPX1180-1	Transistor Reflective	——	G

HONEYWELL (SPECTRONICS) continued

Honeywell Part No.	Description	TRW Optron Part No.	Code	Honeywell Part No.	Description	TRW Optron Part No.	Code
SPX1180-2	Transistor Reflective	——	G	SPX2762-1	Transistor Interrupter	——	G
SPX1180-3	Transistor Reflective	——	G	SPX2762-2	Transistor Interrupter	——	G
SPX1396-1	Transistor Reflective	OPB710	B,D	SPX2762-3	Transistor Interrupter	——	G
SPX1396-2	Transistor Reflective	OPB710	B,D	SPX2762-4	Transistor Interrupter	——	G
SPX1396-3	Transistor Reflective	OPB710	B,D	SPX2862-1	Transistor Interrupter	——	G
SPX1404-1	Transistor Reflective	OPB703	B,D	SPX2862-2	Transistor Interrupter	——	G
SPX1404-2	Transistor Reflective	OPB703	B,D	SPX2862-3	Transistor Interrupter	——	G
SPX1404-3	Transistor Reflective	OPB703	B,D	SPX2862-4	Transistor Interrupter	——	G
SPX1872-1	Transistor Interrupter	——	G	SPX7110	6 Pin Coupler	——	G
SPX1872-2	Transistor Interrupter	——	G	SPX7130	6 Pin Coupler	——	G
SPX1872-3	Transistor Interrupter	——	G	SPX7150	6 Pin Coupler	——	G
SPX1872-4	Transistor Interrupter	——	G	SPX7270	6 Pin Coupler	——	G
SPX1872-11	Transistor Interrupter	OPB870N55	C,D	SPX7271	6 Pin Coupler	——	G
SPX1872-12	Transistor Interrupter	OPB870N55	C,D	SPX7272	6 Pin Coupler	——	G
SPX1872-13	Transistor Interrupter	OPB872N55	C,D	SPX7273	6 Pin Coupler	——	G
SPX1872-14	Transistor Interrupter	OPB872N55	F	SPX74A1	6 Pin Coupler	——	G
SPX1873-1	Transistor Interrupter	——	G	SPX7530	6 Pin Coupler	——	G
SPX1873-2	Transistor Interrupter	——	G	SPX7550	6 Pin Coupler	——	G
SPX1873-3	Transistor Interrupter	——	F	SPX7590	6 Pin Coupler	——	G
SPX1873-4	Transistor Interrupter	——	G	4N25	6 Pin Transistor Coupler	4N25	A
SPX1873-11	Transistor Interrupter	OPB870T55	C,D	4N25A	6 Pin Transistor Coupler	——	F
SPX1873-12	Transistor Interrupter	OPB870T55	C,D	4N26	6 Pin Transistor Coupler	4N26	A
SPX1873-13	Darlington Interrupter	OPB872T55	C,D	4N27	6 Pin Transistor Coupler	4N27	A
SPX1873-14	Transistor Interrupter	——	G	4N28	6 Pin Transistor Coupler	4N28	A
SPX1874-1	Transistor Interrupter	——	G	4N29	6 Pin Darlington Coupler	4N29	A
SPX1874-2	Transistor Interrupter	——	G	4N29A	6 Pin Darlington Coupler	——	F
SPX1874-3	Transistor Interrupter	——	G	4N30	6 Pin Darlington Coupler	4N30	A
SPX1874-4	Transistor Interrupter	——	G	4N31	6 Pin Darlington Coupler	4N31	A
SPX1874-11	Transistor Interrupter	OPB813	B,C	4N32	6 Pin Darlington Coupler	4N32	A
SPX1874-12	Transistor Interrupter	OPB813	B,C	4N32A	6 Pin Darlington Coupler	——	F
SPX1874-13	Transistor Interrupter	OPB814	B,C	4N33	6 Pin Darlington Coupler	4N33	A
SPX1874-14	Transistor Interrupter	OPB872T55	F	4N35	6 Pin Transistor Coupler	4N35	A
SPX1878-11	Transistor Interrupter	OPB875T55	C	4N36	6 Pin Transistor Coupler	4N36	A
SPX1878-12	Transistor Interrupter	OPB875T55	C	4N37	6 Pin Transistor Coupler	4N37	A
SPX1878-13	Transistor Interrupter	OPB875T55	C	4N38	6 Pin Transistor Coupler	4N38	A
SPX1878-14	Transistor Interrupter	OPB877T55	C	4N38A	6 Pin Transistor Coupler	4N38A	A
SPX1879-11	Transistor Interrupter	OPB865T55	A	6N135	8 Pin Transistor Coupler	——	F
SPX1879-12	Transistor Interrupter	OPB866T55	A	6N136	8 Pin Transistor Coupler	——	F
SPX1879-14	Transistor Interrupter	OPB867T55	A	6N138	8 Pin Darlington Coupler	——	F
SPX1879-15	Transistor Interrupter	OPB865T51	A	6N139	8 Pin Darlington Coupler	——	F

LITRONIX

Litronix Part No.	Description	TRW Optron Part No.	Code	Litronix Part No.	Description	TRW Optron Part No.	Code
BP103-1	TO-18 Transistor	——	G	BP103B-2	Plastic Transistor	——	G
BP103-2	TO-18 Transistor	——	G	BP103B-3	Plastic Transistor	——	G
BP103-3	TO-18 Transistor	——	G	BP103B-4	Plastic Transistor	——	G
BP103-4	TO-18 Transistor	——	G	BP104	Plastic Photodiode	——	G
BP103B-1	Plastic Transistor	——	G	BPW32	Photodiode	OP915	D,E

LITRONIX (continued)

Litronix Part No.	Description	TRW Optron Part No.	Code
BPW33	Photodiode	OP915	D,E
BPW34	Photodiode	OP915	D,E
BPX38-1	Hermetic Transistor	——	F
BPX38-2	Hermetic Transistor	OP801W	B
BPX38-3	Hermetic Transistor	OP801W	B
BPX38-4	Hermetic Transistor	——	F
BPX43-1	Hermetic Transistor	OP801	B
BPX43-2	Hermetic Transistor	OP802	B
BPX43-3	Hermetic Transistor	OP803	B
BPX43-4	Hermetic Transistor	OP803	B
BPX48	Plastic Photodiode	——	G
BPX60	Hermetic Photodiode	OP903W	B
BPX61	Hermetic Photodiode	OP903W	B
BPX63	TO-18 Plastic Photodiode	——	G
BPX65	TO-18 Photodiode	——	G
BPX66	TO-18 Photodiode	——	G
BPX80	Plastic Transistor Array	——	G
BPX81-1	Plastic Transistor	——	G
BPX81-2	Plastic Transistor	——	G
BPX81-3	Plastic Transistor	——	G
BPX81-4	Plastic Transistor	——	G
BPX82	Plastic Transistor Array	——	G
BPX83	Plastic Transistor Array	——	G
BPX84	Plastic Transistor Array	——	G
BPX85	Plastic Transistor Array	——	G
BPX86	Plastic Transistor Array	——	G
BPX87	Plastic Transistor Array	——	G
BPX88	Plastic Transistor Array	——	G
BPX89	Plastic Transistor Array	——	G
BPX90	Plastic Photodiode	——	G
BPX91	Plastic Photodiode	——	G
BPX92	Plastic Photodiode	——	G
BPX93	Plastic Photodiode	——	G
BPY61-I	Glass Transistor	——	G
BPY61-II	Glass Transistor	——	G
BPY61-III	Glass Transistor	——	G
BPY61-IV	Glass Transistor	——	G
BPY62-I	TO-18 Transistor	——	F
BPY62-II	TO-18 Transistor	——	F
BPY62-III	TO-18 Transistor	OP802	B,C
CNY17-1	6 Pin Transistor Coupler	CNY17/I	A
CNY17-2	6 Pin Transistor Coupler	CNY17/II	A
CNY17-3	6 Pin Transistor Coupler	CNY17/III	A
CNY17-4	6 Pin Transistor Coupler	CNY17/IV	A
CNY18-1	TO-18 Transistor Coupler	——	F
CNY18-2	TO-18 Transistor Coupler	——	F
CNY18-3	TO-18 Transistor Coupler	——	F
CNY18-4	TO-18 Transistor Coupler	——	F
CNY18-5	TO-18 Transistor Coupler	——	F
CQY17-IV	TO-18 LED	——	F
CQY17-V	TO-18 LED	——	F
CQY77-I	TO-18 LED	——	F
CQY77-II	TO-18 LED	——	F
CQY77-III	TO-18 LED	——	F
CQY78-I	TO-18 LED	——	F
CQY78-II	TO-18 LED	——	F
CQY78-III	TO-18 LED	——	F
H11AA1	AC Input Coupler	——	F
IL-1	6 Pin Transistor Coupler	OPI2252	A
IL-5	6 Pin Transistor Coupler	OPI2253	A
IL-12	6 Pin Transistor Coupler	OPI2151	A
IL-15	6 Pin Transistor Coupler	OPI2151	A
IL-74	6 Pin Transistor Coupler	OPI2152	A
IL-100	8 Pin Logic Coupler	——	F
IL-101	8 Pin Logic Coupler	——	F
IL-201	6 Pin Transistor Coupler	——	G
IL-202	6 Pin Transistor Coupler	——	G
IL-203	6 Pin Transistor Coupler	——	G
IL-250	6 Pin Transistor Coupler	——	G
IL-501	6 Pin Transistor Coupler	OPI5000A	A
IL-505	6 Pin Transistor Coupler	OPI5000A	B
IL-512	6 Pin Transistor Coupler	OPI5010A	A
IL-530	6 Pin Darlington Coupler	——	G
IL-555	6 Pin Darlington Coupler	——	G
ILA-30	6 Pin Darlington Coupler	OPI3251	B
ILA-55	6 Pin Darlington Coupler	OPI3252	B
ILCA-2-30	6 Pin Coupler	——	F
ILCA-2-55	6 Pin Coupler	——	F
ILCT-6	16 Pin Coupler	——	G
ILD-1	16 Pin Coupler	——	G
ILD-74	16 Pin Coupler	——	G
ILD-506	8 Pin Dual Transistor Coupler	——	G
ILQ-1	8 Pin Coupler	——	G
ILQ-74	8 Pin Coupler	——	G
IRL-60	Plastic Axial LED	——	G
LD242-1	Plastic TO-18 LED	——	G
LD242-2	Plastic TO-18 LED	——	G
LD242-3	Plastic TO-18 LED	——	G
LD260	Plastic Ten LED	——	G
LD261-4	Plastic Radial LED	——	G
LD261-5	Plastic Radial LED	——	G
LD261-6	Plastic Radial LED	——	G
LD262	Plastic Dual LED	——	G
LD263	Plastic Three LED	——	G
LD264	Plastic Four LED	——	G
LD265	Plastic Five LED	——	G
LD266	Plastic Six LED	——	G
LD267	Plastic Seven LED	——	G
LD268	Plastic Eight LED	——	G
LD269	Plastic Nine LED	——	G

TRW OPTRON reserves the right to make changes at any time in order to improve design and to supply the best product possible.

LITRONIX (continued)

Litronix Part No.	Description	TRW Optron Part No.	Code
LD270	Plastic Ten LED	——	G
LD271	Plastic T1¾ LED	——	G
LD271A	Plastic T1¾ LED	——	G
LD271L	Plastic T1¾ LED	——	G
LD273	Plastic Dual LED	——	G
LPT100	Ceramic Lensed LED	——	G
LPT100A	Ceramic Lensed LED	——	G
LPT100B	Ceramic Lensed LED	——	G
LPT110	Ceramic Flat LED	——	G
LPT110A	Ceramic Flat LED	——	G
LPT110B	Ceramic Flat LED	——	G
SFH200	Photodiode	——	G
SFH202	Pin Photodiode	——	G
SFH203	Photodiode	——	G
SFH204	Four Quadrant Photodiode	——	G
SFH205	Pin Photodiode	——	G
SFH206	Pin Photodiode	——	G
SFH206K	Pin Photodiode	——	G
SFH305-2	Plastic Transistor	——	G
SFH305-3	Plastic Transistor	——	G
SFH309	Plastic Transistor	OP501	C
SFH400-1	Hermetic LED	OPI35	B
SFH400-2	Hermetic LED	OPI36	B
SFH400-3	Hermetic LED	——	F
SFH401-1	Hermetic LED	OPI35	B
SFH401-2	Hermetic LED	OPI36	B
SFH401-3	Hermetic LED	——	F
SFH402-1	Hermetic LED	OPI35W	B
SFH402-2	Hermetic LED	OPI36W	B
SFH402-3	Hermetic LED	——	F
SFH404	TO-18 LED	——	G
SFH405-1	Plastic LED	——	G
SFH405-2	Plastic LED	——	G
SFH405-3	Plastic LED	——	G
SFH405-4	Plastic LED	——	G
SFH407-1	TO-46 LED	——	G
SFH407-2	TO-46 LED	——	G
SFH407-3	TO-46 LED	——	G
SFH409	Plastic LED	——	G
SFH500	Hermetic Transistor	OP802W	D
SFH600-0	6 Pin Transistor Coupler	OPI2253	B
SFH600-1	6 Pin Transistor Coupler	——	G
SFH600-2	6 Pin Transistor Coupler	——	G
SFH600-3	6 Pin Transistor Coupler	——	G
SFH601-1	6 Pin Transistor Coupler	——	G
SFH601-2	6 Pin Transistor Coupler	——	G
SFH601-3	6 Pin Transistor Coupler	——	G
SFH601-4	6 Pin Transistor Coupler	——	G
SFH900	Transistor Reflective	——	G
4N25	6 Pin Transistor Coupler	4N25	A
4N26	6 Pin Transistor Coupler	4N26	A
4N27	6 Pin Transistor Coupler	4N27	A
4N28	6 Pin Transistor Coupler	4N28	A
4N32	6 Pin Darlington Coupler	4N32	A
4N33	6 Pin Darlington Coupler	4N33	A
4N35	6 Pin Transistor Coupler	4N35	A
4N36	6 Pin Transistor Coupler	4N36	A
4N37	6 Pin Transistor Coupler	4N37	A

MOTOROLA

Motorola Part No.	Description	TRW Optron Part No.	Code
H11A1	6 Pin Transistor Coupler	OPI2253	A*
H11A2	6 Pin Transistor Coupler	OPI2153	A*
H11A3	6 Pin Transistor Coupler	OPI2252	A*
H11A4	6 Pin Transistor Coupler	OPI2151	A*
H11A5	6 Pin Transistor Coupler	OPI2153	A*
H11A10	6 Pin Transistor Coupler	OPI2151	B*
H11A520	6 Pin Transistor Coupler	OPI5000A	A*
H11A550	6 Pin Transistor Coupler	——	G
H11A5100	6 Pin Transistor Coupler	——	G
H11B1	6 Pin Darlington Coupler	OPI3153	A*
H11B2	6 Pin Darlington Coupler	OPI3150	B*
H11B3	6 Pin Darlington Coupler	OPI3150	A*
H11B255	6 Pin Darlington Coupler	OPI3152	A*
IL1	6 Pin Transistor Coupler	OPI2252	A*
IL12	6 Pin Transistor Coupler	OPI2251	A*
IL15	6 Pin Transistor Coupler	OPI2251	A*
IL16	6 Pin Transistor Coupler	OPI2251	A*
L14H1	Plastic Phototransistor	——	G
L14H2	Plastic Phototransistor	——	G
L14H3	Plastic Phototransistor	——	G

MOTOROLA (continued)

Motorola Part No.	Description	TRW Optron Part No.	Code
L14H4	Plastic Phototransistor	——	G
MCA230	6 Pin Darlington Coupler	——	G
MCA231	6 Pin Darlington Coupler	——	G
MCA255	6 Pin Darlington Coupler	——	G
MCT2	6 Pin Transistor Coupler	OPI2152	A*
MCT26	6 Pin Transistor Coupler	OPI2152	A*
MFOD100	TO-18 Diode	——	G
MFOD102F	Fiber Optic Diode	——	G
MFOD200	TO-18 Phototransistor	——	G
MFOD202F	Fiber Optic Transistor	——	G
MFOD300	TO-18 Photodarlington	——	G
MFOD302F	Fiber Optic Darlington	——	G
MFOD402F	Fiber Optic Amplifier	——	G
MFOE102F	Fiber Optic LED	——	G
MFOE200	TO-18 LED	——	G
MLED60	Plastic LED	——	G
MLED90	Plastic LED	——	G
MLED92	Plastic LED	——	G
MLED93	Plastic LED	——	G
MLED94	Plastic LED	——	G
MLED95	Plastic LED	——	G
MLED900	Plastic LED	——	G
MLED910	Pill LED	——	G
MLED930	TO-18 LED	——	G
MOC119	6 Pin Darlington Coupler	OPI3250	A*
MOC1005	6 Pin Transistor Coupler	OPI2251	B*
MOC1006	6 Pin Transistor Coupler	——	G
MOC3009	6 Pin Triac Coupler	OPI3009	A*
MOC3010	6 Pin Triac Coupler	OPI3010	A*
MOC3011	6 Pin Triac Coupler	OPI3011	A*
MOC3020	6 Pin Triac Coupler	OPI3020	A*
MOC3021	6 Pin Triac Coupler	OPI3021	A*
MOC3030	6 Pin Triac Coupler	——	F
MOC3031	6 Pin Triac Coupler	——	F
MOC5003	6 Pin Logic Coupler	OPI8012	A*
MOC5004	6 Pin Logic Coupler	OPI8012	A*
MOC5005	6 Pin Logic Coupler	——	F
MOC5006	6 Pin Logic Coupler	——	F
MOC5010	6 Pin Amplifier Coupler	——	F
MOC8020	6 Pin Darlington Coupler	OPI3253	B*
MOC8021	6 Pin Darlington Coupler	——	G
MOC8030	6 Pin Darlington Coupler	——	G
MOC8050	6 Pin Darlington Coupler	OPI3252	A*
MRD14B	Plastic Darlington	——	G
MRD150	Plastic Transistor	——	G
MRD300	TO-18 Phototransistor	OP804	B
MRD310	TO-18 Phototransistor	OP803	A
MRD360	TO-18 Photodarlington	OP830	B
MRD370	TO-18 Photodarlington	OP830	A
MRD450	Plastic Transistor	——	G
MRD500	TO-18 Photodiode	——	G
MRD510	TO-18 Photodiode	——	G
MRD601	Pill Phototransistor	OP602	A
MRD602	Pill Phototransistor	OP603	A
MRD603	Pill Phototransistor	OP604	A
MRD604	Pill Phototransistor	OP604	B
MRD3010	TO-18 Phototriac	——	G
MRD3011	TO-18 Phototriac	——	G
MRD3050	TO-18 Phototransistor	OP800	A
MRD3051	TO-18 Phototransistor	OP800	A
MRD3054	TO-18 Phototransistor	OP802	A
MRD3055	TO-18 Phototransistor	OP802	A
MRD3056	TO-18 Phototransistor	OP803	A
TIL111	6 Pin Transistor Coupler	OPI2152	A*
TIL112	6 Pin Transistor Coupler	OPI2150	A*
TIL113	6 Pin Darlington Coupler	OPI3151	A*
TIL114	6 Pin Transistor Coupler	OPI2252	A*
TIL115	6 Pin Transistor Coupler	OPI2250	A*
TIL116	6 Pin Transistor Coupler	OPI2252	A*
TIL117	6 Pin Transistor Coupler	OPI2253	A*
TIL118	6 Pin Transistor Coupler	OPI2251	A*
TIL119	6 Pin Darlington Coupler	OPI3150	A*
2N5777	Plastic Photodarlington	——	G
2N5778	Plastic Photodarlington	——	G
2N5779	Plastic Photodarlington	——	G
2N5780	Plastic Photodarlington	——	G
4N25	6 Pin Transistor Coupler	4N25	A*
4N26	6 Pin Transistor Coupler	4N26	A*
4N27	6 Pin Transistor Coupler	4N27	A*
4N28	6 Pin Transistor Coupler	4N28	A*
4N29	6 Pin Darlington Coupler	4N29	A*
4N30	6 Pin Darlington Coupler	4N30	A*
4N31	6 Pin Darlington Coupler	4N31	A*
4N32	6 Pin Darlington Coupler	4N32	A*
4N33	6 Pin Darlington Coupler	4N33	A*
4N35	6 Pin Transistor Coupler	4N35	A*
4N36	6 Pin Transistor Coupler	4N36	A*
4N37	6 Pin Transistor Coupler	4N37	A*
4N38	6 Pin Transistor Coupler	4N38	A*

*The Motorola standard specification is 7500V on all couplers. Verify that the isolation voltage on our equivalent parts is adequate.

OPTEK

Optek Part No.	Description	TRW Optron Part No.	Code
K-5100	Hermetic Transistor	--	G
K-5101	Hermetic Transistor	--	G
K-5102	Hermetic Transistor	--	G
K-5103	Hermetic Transistor	--	G
K-5150	Plastic Transistor	--	G
K-5151	Plastic Transistor	--	G
K-5200	TO-18 Transistor	OP802W	A
K-5201	TO-18 Transistor	OP800W	A
K-5202	TO-18 Transistor	OP801W	A
K-5203	TO-18 Transistor	--	G
K-5210	TO-18 Transistor	OP842W	B
K-5211	TO-18 Transistor	OP844W	A
K-5203	TO-18 Transistor	--	G
K-5250	TO-18 Transistor	OP803	A
K-5251	TO-18 Transistor	--	G
K-5253	TO-18 Transistor	OP800	A
K-5254	TO-18 Transistor	OP801	A
K-5255	TO-18 Transistor	OP802	A
K-5256	TO-18 Transistor	OP804	A
K-5257	TO-18 Transistor	--	G
K-5258	TO-18 Transistor	OP805	A
K-5259	TO-18 Transistor	--	G
K-5500	Plastic Transistor	OP500	B,E
K-5501	Plastic Transistor	OP5005LA	E
K-5502	Plastic Transistor	OP5005LB	E
K-5503	Plastic Transistor	OP5005LC	E
K-5504	Plastic Transistor	OP5005LD	E
K-5505	Plastic Transistor	OP5005LE	E
K-5550	Plastic Transistor	OP550	E
K-6100	Hermetic Transistor	--	G
K-6101	Hermetic Transistor	--	G
K-6102	Hermetic Transistor	--	G
K-6103	Hermetic Transistor	--	G
K-6150	Plastic Transistor	--	G
K-6151	Plastic Transistor	--	G
K-6200	TO-46 Transistor	OP131W	A
K-6201	TO-46 Transistor	OP130W	A
K-6202	TO-46 Transistor	OP132W	A
K-6203	TO-46 Transistor	OP133W	A
K-6204	TO-46 Transistor	--	G
K-6250	TO-46 Transistor	OP132	A
K-6251	TO-46 Transistor	OP130	A
K-6252	TO-46 Transistor	OP131	A
K-6253	TO-46 Transistor	OP133	A
K-6254	TO-46 Transistor	--	G
K-6500	Plastic Transistor	OP160	A
K-6501	Plastic Transistor	OP1605LA	A
K-6502	Plastic Transistor	OP1605LB	A
K-6503	Plastic Transistor	OP1605LC	A
K-6504	Plastic Transistor	OP1605LD	A
K-6505	Plastic Transistor	OP1605LE	A
K-6550	Plastic Transistor	OP140	A
K-6551	Plastic Transistor	OP1405LA	A
K-6552	Plastic Transistor	OP1405LB	A
K-6553	Plastic Transistor	OP1405LC	A
K-6554	Plastic Transistor	OP1405LD	A
K-6555	Plastic Transistor	OP1405LE	A
K-7100	Hermetic Photodiode	--	G
K-7200	Hermetic Photodiode	OP903W	B,E
K-7250	Hermetic Photodiode	OP903	B,E
K-7300	Plastic Photodiode	--	G
K-7350	Plastic Photodiode	--	G
K-7400	Plastic Photodiode	--	G
K-8010	Hermetic Matched Pair	--	G
K-8020	Plastic Matched Pair	OP5660	A
K-8030	Plastic Matched Pair	OP5690	E
K-8040	Plastic Matched Pair	--	G
K-8100	Transistor Interrupter	OPB867T55	B
K-8101	Transistor Interrupter	OPB862T55	B
K-8102	Transistor Interrupter	OPB860T55	B
K-8103	Transistor Interrupter	OPB861T55	B
K-8105	Transistor Interrupter	OPB865T55	B
K-8110	Transistor Interrupter	OPB860T51	B
K-8111	Transistor Interrupter	OPB865T51	B
K-8112	Transistor Interrupter	OPB813S7	A
K-8113	Transistor Interrupter	OPB813S5	A
K-8114	Transistor Interrupter	OPB813S3	A
K-8115	Transistor Interrupter	--	G
K-8116	Transistor Interrupter	--	G
K-8117	Transistor Interrupter	--	G
K-8118	Transistor Interrupter	--	G
K-8120	Transistor Interrupter	OPB66N55	B
K-8121	Transistor Interrupter	OPB867N55	B
K-8130	Transistor Interrupter	OPB865N51	B
K-8140	Transistor Interrupter	OPB870N51	B
K-8141	Transistor Interrupter	OPB872N55	B
K-8150	Transistor Interrupter	OPB820	A
K-8151	Transistor Interrupter	OPB820S10	A
K-8152	Transistor Interrupter	OPB820S7	A
K-8153	Transistor Interrupter	OPB820S5	A
K-8154	Transistor Interrupter	--	F
K-8155	Transistor Interrupter	--	F
K-8160	Transistor Interrupter	OPB821	A
K-8161	Transistor Interrupter	PB821S10	A
K-8162	Transistor Interrupter	OPB821S7	A
K-8163	Transistor Interrupter	OPB820S5	A
K-8164	Transistor Interrupter	--	F
K-8165	Transistor Interrupter	--	F
K-8170	Transistor Interrupter	OPB823	A
K-8171	Transistor Interrupter	--	F

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OPTEK (continued)

Optek Part No.	Description	TRW Optron Part No.	Code
K-8180	Transistor Interrupter	OPB875T51	B
K-8181	Transistor Interrupter	OPB877T55	B
K-8190	Transistor Interrupter	OPB871N55	B
K-8250	Transistor Interrupter	——	G
K-8251	Transistor Interrupter	——	G
K-8255	Transistor Interrupter	——	G
K-8256	Transistor Interrupter	——	G
K-8700	Transistor Reflective	OPB708	B
K-8701	Transistor Reflective	——	G
K-8702	Transistor Reflective	——	G
K-8703	Transistor Reflective	——	G
K-8710	Transistor Reflective	OPB709	D
K-8711	Transistor Reflective	——	G
K-8712	Transistor Reflective	——	G
K-8713	Transistor Reflective	——	G
K-8720	Transistor Reflective	——	G
K-8740	Transistor Reflective	——	G
K-8900	Axial Transistor Coupler	OPI110	A
K-8910	Axial Darlington Coupler	OPI113	A
K-8920	Axial Transistor Coupler	OPI120	A
K-8930	Axial Darlington Coupler	OPI123	A
K-8940	Hermetic Transistor Coupler	OPI102	A
K-8941	Hermetic Transistor Coupler	OPI103	A
K-8945	Hermetic Darlington Coupler	OPI130	A
K-8950	Hermetic Transistor Coupler	OPI140	A
K-9000	Plastic Darlington	OP530	A
K-9001	Plastic Darlington	——	F
K-9002	Plastic Darlington	——	F
K-9010	Plastic Darlington	OP560	B,E
K-9011	Plastic Darlington	——	F
K-9012	Plastic Darlington	——	F
K-9020	Hermetic Darlington	OP830	A
K-9021	Hermetic Darlington	——	F
K-9022	Hermetic Darlington	——	F
K-9030	Hermetic Darlington	OP830W	A
K-9031	Hermetic Darlington	——	F
K-9032	Hermetic Darlington	——	F

RCA

RCA Part No.	Description	TRW Optron Part No.	Code
SG1002	Hermetic LED	——	G
SG1003	Hermetic LED	——	G
SG1004	Hermetic LED	——	G
SG1009A	Hermetic LED	OP132	A
SG1009F	Hermetic LED	OP132W	A
SG1010A	Hermetic LED	OP131	A
SG1010F	Hermetic LED	OP131W	A
C30122	Hermetic LED	OP130	A
C8602SE	Hermetic LED	——	F

SENSOR TECHNOLOGY

Sensor Tech Part No.	Description	TRW Optron Part No.	Code
ASTCD-0	Darlington Interrupter	——	G
ASTCD-1	Darlington Interrupter	——	G
ASTCD-2	Darlington Interrupter	——	G
ASTCT-0	Darlington Interrupter	——	G
ASTCT-0A	Transistor Interrupter	——	G
ASTCT-1	Transistor Interrupter	——	G
ASTCT-1A	Transistor Interrupter	——	G
ASTCT-1S	Transistor Interrupter	——	G
ASTCT-2	Transistor Interrupter	——	G
ASTCT-2A	Transistor Interrupter	——	G
ASTCT-2S	Transistor Interrupter	——	G
BSTCD-0	Darlington Interrupter	——	G
BSTCD-1	Darlington Interrupter	——	G
BSTCD-2	Darlington Interrupter	——	G
BSTCT-0	Transistor Interrupter	——	G
BSTCT-0A	Transistor Interrupter	——	G
BSTCT-1	Transistor Interrupter	——	G
BSTCT-1A	Transistor Interrupter	——	G
BSTCT-2	Transistor Interrupter	——	G
BSTCT-2A	Transistor Interrupter	——	G
CSTCD-0	Darlington Interrupter	——	G
CSTCD-1	Darlington Interrupter	——	G
CSTCD-2	Darlington Interrupter	——	G
CSTCT-0	Transistor Interrupter	——	G
CSTCT-0A	Transistor Interrupter	——	G
CSTCT-1	Transistor Interrupter	——	G
CSTCT-1A	Transistor Interrupter	——	G
CSTCT-2	Transistor Interrupter	——	G
CSTCT-2A	Transistor Interrupter	——	G
CSTCT-2042S	Schmitt Interrupter	——	G

SENSOR TECHNOLOGY (continued)

Sensor Tech Part No.	Description	TRW Optron Part No.	Code	Sensor Tech Part No.	Description	TRW Optron Part No.	Code
ST/A-71	9 Transistor Array	--	G	STLD-2000-3	Hermetic LED	OP131	C
ST/A-71-SS	9 LED-Transistor Array	--	G	STLD-2100-1	Hermetic LED	OP130	A
ST/A-72	9 Transistor Array	--	G	STLD-2100-2	Hermetic LED	OP131	A
ST/A-73	12 Transistor Array	--	G	STLD-2100-3	Hermetic LED	OP132	A
ST/A-73-SS	12 LED Transistor Array	--	G	STLD-2100-4	Hermtic LED	OP133	B
ST/A-74-SS	10 LED Transistor Array	--	G	STOC-1300	Darlington Coupler	--	G
STCT-1S	Transistor Interrupter	--	G	STOC-1400	Darlington Coupler	OPI113	E
STCT-2S	Transistor Interrupter	--	G	STOC-1401	Darlington Coupler	--	F
STD-1540-1	Photodiode	--	G	STOC-1402	Darlington Coupler	--	F
STD-1540-2	Photodiode	--	G	STOC-1410	Diode Coupler	--	G
STD-1710-1	Photodiode	OP900	A	STOC-1411	Diode Coupler	--	G
STD-1710-2	Photodiode	OP900	A	STOC-1412	Diode Coupler	--	G
STD-1840-1	Photodiode	--	G	STOC-1420	Transistor Coupler	--	F
STD-1840-2	Photodiode	--	G	STOC-1421	Transistor Coupler	--	F
STD-1850-2	Photodiode	--	G	STOC-1422	Transistor Coupler	--	F
STD-1860-2	Photodiode	--	G	STOC-1430	Transistor Coupler	--	G
STD-2040-1	Photodiode	--	G	STOC-1431	Transistor Coupler	--	G
STD-2040-2	Photodiode	--	G	STOC-1432	Transistor Coupler	--	G
STD-2050-1	Photodiode	--	G	STPD-1510-1	Photodarlington	--	G
STD-2050-2	Photodiode	--	G	STPD-1510-2	Photodarlington	--	G
STDD-210	Dual Photodiode	--	G	STPD-1510-3	Photodarlington	--	G
STIN-130-T1	Transistor Interrupter	OPB816	A	STPD-1510-4	Photodarlington	--	G
STIN-135-D1	Transistor Interrupter	OPB814	A	STPD-1610-1	Photodarlington	OP302	A
STIN-135-D2	Transistor Interrupter	OPB813	A	STPD-1610-2	Photodarlington	OP303	A
STIN-135-T1	Transistor Interrupter	OPB813	A	STPD-1610-3	Photodarlington	OP304	A
STIN-135-T2	Transistor Interrupter	OPB813	A	STPD-1810-1	Photodarlington	OP830W	A
STIN-140-T1	Transistor Interrupter	--	F	STPD-1810-2	Photodarlington	OP830W	A
STIN-1367	Transistor Interrupter	--	G	STPD-1810-3	Photodarlington	OP830W	A
STIN-1600	Transistor Interrupter	--	G	STPD-1810-4	Photodarlington	OP830W	A
STIN-1651	Transistor Interrupter	--	G	STPD-2010-1	Photodarlington	OP830	A
STIN-2003	Transistor Interrupter	--	G	STPD-2010-2	Photodarlington	OP830	A
STLD-1500-1	Hermetic LED	--	G	STPD-2010-3	Photodarlington	OP830	B
STLD-1500-2	Hermetic LED	--	G	STPT-40	Phototransistor	--	G
STLD-1500-3	Hermetic LED	--	G	STPT-60	Phototransistor	OP600	A
STLD-1500-4	Hermetic LED	--	G	STPT-61	Phototransistor	OP601	A
STLD-1600-1	Hermetic LED	OP123	A	STPT-62	Phototransistor	OP602	A
STLD-1600-2	Hermetic LED	OP123	A	STPT-63	Phototransistor	OP603	A
STLD-1600-3	Hermetic LED	OP124	A	STPT-64	Hermetic Transistor	OP604	A
STLD-1700-1	Hermetic LED	OP123	A	STPT-100	Hermetic Transistor	--	G
STLD-1700-2	Hermetic LED	OP123	A	STPT-100A	Hermetic Transistor	--	G
STLD-1700-3	Hermetic LED	OP124	A	STPT-100B	Hermetic Transistor	--	G
STLD-1700-4	Hermetic LED	--	F	STPT-110	Hermetic Transistor	--	G
STLD-1800-1	Hermetic LED	OP130W	C	STPT-110A	Hermetic Transistor	--	G
STLD-1800-2	Hermetic LED	OP131W	C	STPT-110B	Hermetic Transistor	--	G
STLD-1800-3	Hermetic LED	OP132W	C	STPT-120	Hermetic Transistor	--	G
STLD-1900-1	Hermetic LED	OP130W	C	STPT-120A	Hermetic Transistor	--	G
STLD-1900-2	Hermetic LED	OP131W	C	STPT-120B	Hermetic Transistor	--	G
STLD-1900-3	Hermetic LED	OP132W	C	STPT-130	Hermetic Transistor	--	G
STLD-2000-1	Hermetic LED	OP130	C	STPT-130A	Hermetic Transistor	--	G
STLD-2000-2	Hermetic LED	OP130	C	STPT-130B	Hermetic Transistor	--	G

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SENSOR TECHNOLOGY (continued)

Sensor Tech Part No.	Description	TRW Optron Part No.	Code	Sensor Tech Part No.	Description	TRW Optron Part No.	Code
STPT-225P	Hermetic Transistor	––	G	STPT-2020-1	Hermetic Transistor	OP802	A
STPT-240P	Hermetic Transistor	––	G	STPT-2020-2	Hermetic Transistor	OP802	A
STPT-260P	Hermetic Transistor	––	G	STPT-2020-3	Hermetic Transistor	OP805	A
STPT-260Q	Hermetic Transistor	––	G	STPT-2030-1	Hermetic Transistor	––	G
STPT-300	Hermetic Transistor	OP803	A	STPT-2030-2	Hermetic Transistor	––	G
STPT-310	Hermetic Transistor	OP802	A	STPT-2030-3	Hermetic Transistor	––	G
STPT-1520-1	Hermetic Transistor	––	G	STRD-70	Darlington Reflective	OPB711	A
STPT-1520-2	Hermetic Transistor	––	G	STRD-70/F	Darlington Reflective	OPB711	A
STPT-1520-3	Hermetic Transistor	––	G	STRD-850	Darlington Reflective	––	F
STPT-1520-4	Hermetic Transistor	––	G	STRT-850	Transistor Reflective	––	F
STPT-1530-1	Hermetic Transistor	––	G	STRT-850/F	Transistor Reflective	––	F
STPT-1530-2	Hermetic Transistor	––	G	STRT-850A/F	Transistor Reflective	––	F
STPT-1530-3	Hermetic Transistor	––	G	STRT-850B	Transistor Reflective	––	F
STPT-1530-4	Hermetic Transistor	––	G	STRT-850B/F	Transistor Reflective	––	F
STPT-1630-1	Hermetic Transistor	OP642	B,C	STRT-900-1	Transistor Reflective	––	G
STPT-1630-2	Hermetic Transistor	OP643	B,C	STRT-910-2	Transistor Reflective	––	G
STPT-1630-3	Hermetic Transistor	OP644	B,C	STRT-920-3	Transistor Reflective	––	G
STPT-1630-4	Hermetic Transistor	––	G	STRT-950	Transistor Reflective	––	G
STPT-1820-1	Hermetic Transistor	OP800W	A	STRT-1747	Transistor Reflective	––	G
STPT-1820-2	Hermetic Transistor	OP800W	A	10-53-0032-1	Plastic LED	––	F
STPT-1820-3	Hermetic Transistor	OP801W	A	10-53-0032-2	Plastic LED	––	F
STPT-1820-4	Hermetic Transistor	OP802W	A	10-53-0032-3	Plastic LED	––	F
STPT-1830-1	Hermetic Transistor	––	G	10-53-0032-4	Plastic LED	––	F
STPT-1830-2	Hermetic Transistor	––	G	10-53-0032-5	Plastic LED	––	F
STPT-1830-3	Hermetic Transistor	––	G				

SIEMENS

Siemens Part No.	Description	TRW Optron Part No.	Code	Siemens Part No.	Description	TRW Optron Part No.	Code
BP100	Plastic Photodiode	––	G	BPX38/III	TO-18 Transistor	OP802W	B
BP101/I	Plastic Transistor	––	G	BPX38/IV	TO-18 Transistor	––	G
BP101/II	Plastic Transistor	––	G	BPX43/I	TO-18 Transistor	OP802	B
BP101/III	Plastic Transistor	––	G	BPX43/II	TO-18 Transistor	OP803	B
BP101/IV	Plastic Transistor	––	G	BPX43/III	TO-18 Transistor	OP804	B
BP102/I	Plastic Transistor	––	G	BPX43/IV	TO-18 Transistor	OP805	B
BP102/II	Plastic Transistor	––	G	BPX48	Plastic PIN Photodiode	––	G
BP102/III	Plastic Transistor	––	G	BPX60	Window TO-5 Photodiode	OP903W	B
BP102/IV	Plastic Transistor	OP801	D,E	BPX61	Window TO-5 Photodiode	OP903W	B
BP103/I	Plastic Transistor	––	G	BPX62/I	Pill Transistor	OP602	B
BP103/II	Plastic Transistor	––	G	BPX62/II	Pill Transistor	OP602	B
BP103/III	Plastic Transistor	––	G	BPX/62III	Pill Transistor	OP603	B
BP103/IV	Plastic Transistor	OP801	D,E	BPX62/IV	Pill Transistor	OP604	B
BP103B	Plastic Transistor	––	G	BPX63	Plastic TO-18 Photodiode	––	G
BP104	Plastic PIN Photodiode	OP915	B	BPX65	TO-18 Photodiode	––	G
BPW32	Plastic PIN Photodiode	––	G	BPX66	TO-18 Photodiode	––	G
BPW33	Plastic PIN Photodiode	OP915	D,E	BPX79	Plastic Photodiode	––	G
BPW34	Plastic PIN Photodiode	OP915	D,E	BPX80	10 Element Plastic Transistor	––	G
BPX38/I	TO-18 Transistor	OP800W	B	BPX81	1 Element Plastic Transistor	––	G
BPX38/II	TO-18 Transistor	OP801W	B	BPX81/I	Plastic Transistor	––	G

SIEMENS (continued)

Siemens Part No.	Description	TRW Optron Part No.	Code	Siemens Part No.	Description	TRW Optron Part No.	Code
BPX81/II	Plastic Transistor	——	G	CQY77/III	TO-18 LED	——	G
BPX81/III	Plastic Transistor	——	G	CQY78/I	TO-18 LED	OPI35W	B
BPX81/IV	Plastic Transistor	——	G	CQY78/II	TO-18 LED	OPI36W	B
BPX82	2 Element Plastic Transistor	——	G	CQY78/III	TO-18 LED	——	G
BPX83	3 Element Plastic Transistor	——	G	LD241/I	Plastic TO-18 LED	——	G
BPX84	4 Element Plastic Transistor	——	G	LD241/II	Plastic TO-18 LED	——	G
BPX85	5 Element Plastic Transistor	——	G	LD241/III	Plastic TO-18 LED	——	G
BPX86	6 Element Plastic Transistor	——	G	LD260(10)	10 Element LED	——	G
BPX87	7 Element Plastic Transistor	——	G	LD261/I	Plastic LED	——	G
BPX88	8 Element Plastic Transistor	——	G	LD261/II	Plastic LED	——	G
BPX89	9 Element Plastic Transistor	——	G	LD261/III	Plastic LED	——	G
BPX90	Plastic Photodiode	——	G	LD261/IV	Plastic LED	——	G
BPX91	Plastic PIN Photodiode	OP915	B	LD261(1)	1 Element LED	——	G
BPX92	Plastic PIN Photodiode	——	G	LD262(2)	2 Element LED	——	G
BPX93	Plastic PIN Photodiode	——	G	LD263(3)	3 Element LED	——	G
BPY11/I	Plastic Photodiode	——	G	LD264(4)	4 Element LED	——	G
BPY11/II	Plastic Photodiode	——	G	LD265(5)	5 Element LED	——	G
BPY11/III	Plastic Photodiode	——	G	LD266(6)	6 Element LED	——	G
BPY11/IV	Plastic Photodiode	——	G	LD267(7)	7 Element LED	——	G
BPY11/P	Plastic Photodiode	——	G	LD268(8)	8 Element LED	——	G
BPY12	Plastic Photodiode	——	G	LD269(9)	9 Element LED	——	G
BPY47	Plastic Photodiode	——	G	LD271	Plastic LED	——	F
BPY48	Plastic Photodiode	——	G	LD271A	Plastic LED	——	F
BPY61/I	Plastic Transistor	——	G	LD271H	Plastic LED	——	F
BPY61/II	Plastic Transistor	——	G	SFH100	Photodiode	——	G
BPY61/III	Plastic Transistor	——	G	SFH200	Photodiode	——	G
BPY61/IV	Plastic Transistor	——	G	SFH202	Plastic PIN Photodiode	——	G
BPY62/I	TO-18 Transistor	OP801	B	SFH203	Plastic PIN Photodiode	——	G
BPY62/II	TO-18 Transistor	OP802	B	SFH204	Four Quadrant Photodiode	——	G
BPY62/III	TO-18 Transistor	OP803	B	SFH205	Plastic PIN Photodiode	——	G
BPY64	Plastic Photodiode	——	G	SFH206	Plastic PIN Photodiode	——	G
CNY17/I	6 Pin Transistor Coupler	CNY17/I	A	SFH206K	Plastic PIN Photodiode	——	G
CNY17/II	6 Pin Transistor Coupler	CNY17/II	A	SFH305-1	Plastic Transistor	——	G
CNY17/III	6 Pin Transistor Coupler	CNY17/III	A	SFH305-2	Plastic Transistor	——	G
CNY17/IV	6 Pin Transistor Coupler	——	G	SFH305-3	Plastic Transistor	——	G
CNY18/I	TO-18 Coupler	3N243	B,E	SFH305-4	Plastic Transistor	——	G
CNY18/II	TO-18 Coupler	3N244	B,E	SFH500	Hermetic Transistor	OP802W	D
CNY18/III	TO-18 Coupler	3N244	B,E	SFH600-0	6 PIN Transistor Coupler	OPI2253	B
CNY18/IV	TO-18 Coupler	3N245	B,E	SFH600-1	6 PIN Transistor Coupler	——	G
CQY17/IV	TO-18 LED	OP132	A	SFH600-2	6 PIN Transistor Coupler	——	G
CQY17/V	TO-18 LED	OP133	B	SFH600-3	6 Pin Transistor Coupler	——	G
CQY18/III	TO-18 LED	OP131W	A	SFH601-1	6 PIN Transistor Coupler	——	G
CQY18/IV	TO-18 LED	OP132W	A	SFH601-2	6 PIN Transistor Coupler	——	G
CQY18/V	TO-18 LED	OP133W	B	SFH601-3	6 PIN Transistor Coupler	——	G
CQY57/I	PiI LED	OP124	A	SFH601-4	6 PIN Transistor Coupler	——	G
CQY57/II	PiII LED	——	G	TP60	Photodiode	——	G
CQY57/III	PiII LED	——	G	TP61	Photodiode	——	G
CQY57/IV	PiII LED	——	G				
CQY77/I	TO-18 LED	OP135	B				
CQY77/II	TO-18 LED	OP136	B				

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TELEFUNKEN

Telefunken Part No.	Description	TRW Optron Part No.	Code	Telefunken Part No.	Description	TRW Optron Part No.	Code
BPW12	TO-18 Photodiode	——	G	CNY36	Transistor Interrupter	CNY36	A
BPW13	TO-18 Transistor	OP800W Ser.	D	CNY37	Transistor Interrupter	OPB813	B,C
BPW14	TO-18 Transistor	OP800 Ser.	D	CQX18	Plastic TO-18 LED	——	G
BPW16	Plastic Transistor	——	G	CQY31	TO-18 LED	OP131W	B,C
BPW16/9	9 Element Transistor Array	OPA508	D,E	CQY32	TO-18 LED	OP131	B,C
BPW17	Plastic Transistor	——	G	CQY33	TO-18 LED	OP132W	B,C
BPW17/9	9 Element Transistor Array	OPA508	D,E	CQY34	TO-18 LED	OP132	B,C
BPW19	10 Element Transistor Array	——	G	CQY35	TO-18 LED	OP133	B,C
BPW20	TO-56 Photodiode	OP913W	D,E	CQY36	Plastic LED	——	G
BPW21	TO-56 Photodiode	——	G	CQY36/9	9 Element LED Array	OPE508	D,E
BPW24	TO-18 Photodiode	——	G	CQY37	Plastic LED	——	G
BPW28	TO-18 Photodiode	——	G	CQY37/9	9 Element LED Array	OPE508	D,E
BPW30	TO-18 Darlington	OP830	B	CQY38H	Plastic TO-18 LED	——	G
BPW34	Dual-In-Line Photodiode	OP915	D,E	CQY39	11 Element LED Array	——	G
BPW39	Plastic Transistor	——	G	CQY42	TO-18 Isolator	3N243	D,E
BPW40	Plastic Transistor	——	G	CQY80	6 Pin Transistor Coupler	OPI2100	B
BPX58	11 Element Transistor Array	——	G	CQY99	Plastic LED	OP160SLA	D,E
BPX99	TO-52 Darlington	OP830	D,E	U102P	Hermetic Theshold Switch	——	G
CNY18	TO-72 Isolator	3N243 Ser.	D,E	U103P	Dual-In-Line Pulse Amplifier	——	G
CNY21	Axial Transistor Coupler	OPI1264A	D,E				

TEXAS INSTRUMENTS

T.I. Part No.	Description	TRW Optron -Part No.	Code	T.I. Part No.	Description	TRW Optron Part No.	Code
LS400	Glass Sleeve Transistor	——	G	TIL159	Transistor Interrupter	OPB870T55	C,D
LS600	Pill Transistor	OP600	B	TIL160	Transistor Interrupter	OPB872T55	C,D
MCT2	6 Pin Transistor Coupler	OPI2152	A	TIL161	Transistor Interrupter	OPB872T55	C,D
MCT2E	6 Pin Transistor Coupler	OPI2252	A	TIL401	Glass Sleeve Transistor	——	G
TIES06	Hermetic LED	——	G	TIL402	Glass Sleeve Transistor	——	G
TIES12	Hermetic LED	——	G	TIL403	Glass Sleeve Transistor	——	G
TIES14	Hermetic LED	——	G	TIL404	Glass Sleeve Transistor	——	G
TIES15	Hermetic LED	——	G	TIL405	Glass Sleeve Transistor	——	G
TIES16A	Hermetic LED	——	G	TIL406	Glass Sleeve Transistor	——	G
TIES16B	Hermetic LED	——	G	TIL411	Plastic Transistor	OP550	C
TIES16C	Hermetic LED	——	G	TIL412	Plastic Darlington	——	G
TIES27	Hermetic LED	——	G	TIL413	Plastic Photodiode	——	G
TIES35	Hermetic LED	——	G	TIL414	Plastic Transistor	——	G
TIES36	Hermetic LED	——	G	TIL25	Pill Hermetic LED	OP124	A
TIL23	Pill Hermetic LED	OP123	A	TIL25HR	Pill Hermetic LED	OP124	D
TIL23HR	Pill Hermetic LED	OP123	D	TIL26	LED	——	G
TIL24	Pill Hermetic LED	OP124	A	TIL31	TO-46 Hermetic LED	OP132	A
TIL24HR	Pill Hermetic LED	OP124	D	TIL32	Plastic LED	OP160	A
TIL149	Transistor Reflective	OPB711	C	TIL33	TO-46 Hermetic LED	OP131	A
TIL153	6 Pin Isolator	——	F	TIL34	TO-46 Hermetic LED	OP131	A
TIL154	6 Pin Isolator	——	F	TIL38	Plastic LED	——	G
TIL155	6 Pin Isolator	——	F	TIL39	Plastic LED	OP140	A
TIL156	6 Pin Darlington Coupler	——	F	TIL40	Plastic LED	——	F
TIL157	6 Pin Darlington Coupler	——	G	TIL41	Plastic LED	——	G
TIL158	Transistor Interrupter	OPB870T55	C,D	TIL42	Plastic LED	——	G

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TEXAS INSTRUMENTS (continued)

T.I. Part No.	Description	TRW Optron Part No.	Code
TIL43	Plastic LED	——	G
TIL44	Plastic LED	——	G
TIL45	Plastic LED	——	G
TIL46	Plastic LED	——	G
TIL47	Plastic LED	——	G
TIL48	Plastic LED	——	G
TIL49	Plastic LED	——	G
TIL50	Plastic LED	——	G
TIL63	Hermetic Transistor	——	G
TIL64	Hermetic Transistor	——	G
TIL65	Hermetic Transistor	——	G
TIL66	Hermetic Transistor	——	G
TIL67	Hermetic Transistor	——	G
TIL78	Plastic Transistor	OP500	A
TIL81	TO-18 Hermetic Transistor	OP804	B
TIL99	TO-18 Hermetic Transistor	OP802W	B
TIL100	Plastic Photodiode	——	G
TIL102	Hermetic Transistor Coupler	OPI102	B
TIL103	Hermetic Transistor Coupler	OPI103	B
TIL107	Hermetic Transistor Coupler	——	G
TIL108	Hermetic Transistor Coupler	——	G
TIL109	Axial Transistor Coupler	OPI1264A	E
TIL111	6 Pin Transistor Coupler	OPI2152	A
TIL112	6 Pin Transistor Coupler	OPI2150	A
TIL113	6 Pin Darlington Coupler	OPI3151	A
TIL114	6 Pin Transistor Coupler	OPI2252	A
TIL115	6 Pin Transistor Coupler	OPI2250	A
TIL116	6 Pin Transistor Coupler	OPI2252	A
TIL117	6 Pin Transistor Coupler	OPI2253	A
TIL118	6 Pin Transistor Coupler	OPI2251	A
TIL119	6 Pin Darlington Coupler	OPI3150	A
TIL120	4 Pin TO-18 Isolator	3N244	B
TIL121	4 Pin TO-18 Isolator	3N245	B
TIL124	6 Pin Transistor Coupler	OPI5010A	B
TIL125	6 Pin Transistor Coupler	OPI5000A	B
TIL126	6 Pin Isolator	——	G
TIL127	6 Pin Isolator	——	G
TIL128	6 Pin Isolator	——	G
TIL131	9 Element LED Array	OPE508	B,E
TIL132	9 Element Transistor Array	OPA508	B,E
TIL133	9 Element Pair	OPB508	B,E
TIL134	12 Element LED Array	OPE512	B,E
TIL135	12 Element Transistor Array	OPA512	B,E
TIL136	12 Element Pair	OPB512	B,E
TIL138	Transistor Interrupter	OPB806	A
TIL139	Transistor Reflective	OPB708	A
TIL141	12 Channel Reader	OPB841	A
TIL142	12 Channel Reader	OPB842	A
TIL143	Transistor Interrupter	OPB870T55	C,D
TIL144	Transistor Interrupter	OPB870T55	C,D
TIL145	Transistor Interrupter	OPB872T55	C,D
TIL146	Transistor Interrupter	OPB872T55	C,D
TIL147	Transistor Interrupter	OPB847	A
TIL148	Transistor Interrupter	OPB848	A
TIL601	Pill Hermetic Transistor	OP601	B
TIL601HR	Pill Hermetic Transistor	OP601	D
TIL602	Pill Hermetic Transistor	OP602	B
TIL602HR	Pill Hermetic Transistor	OP602	D
TIL603	Pill Hermetic Transistor	OP603	B
TIL603HR	Pill Hermetic Transistor	OP603	D
TIL604	Pill Hermetic Transistor	OP604	B
TIL604HR	Pill Hermetic Transistor	OP604	D
TIL605	Pill Flat Transistor	——	G
TIL606	Pill Flat Transistor	——	G
TIL607	Pill Flat Transistor	——	G
TIL608	Pill Flat Transistor	——	G
TIL609	Coaxial Pill Transistor	——	G
TIL610	Coaxial Pill Transistor	——	G
TIL611	Coaxial Pill Transistor	——	G
TIL612	Coaxial Pill Transistor	——	G
TIL613	Coaxial Pill Transistor	——	G
TIL614	Coaxial Pill Transistor	——	G
TIL615	Coaxial Pill Transistor	——	G
TIL616	Coaxial Pill Transistor	——	G
TIL621	Plastic Transistor	——	G
TIL622	Plastic Transistor	——	G
TIL623	Plastic Transistor	——	G
TIL624	Plastic Transistor	——	G
TIL625	Plastic Transistor	——	G
TIL626	Plastic Transistor	——	G
TIL627	Plastic Transistor	——	G
TIL628	Plastic Transistor	——	G
TIL629	Plastic Transistor	——	G
TIL630	Plastic Transistor	——	G
TIXL06	Hermetic LED	——	G
TIXL12	Hermetic LED	——	G
TIXL13	Hermetic LED	——	G
TIXL14	Hermetic LED	——	G
TIXL15	Hermetic LED	——	G
TIXL27	LED	——	G
TIXL35	LED	——	G
TIXL80	Hermetic Photodiode	——	G
TIXL82	Four Quadrant Photodiode	——	G
TIXL98	Photodiode	——	G
TIXL471	Hermetic LED	——	G
TIXL474	Hermetic LED	——	G
TIXL474A	Hermetic LED	——	G
1N5722	Pill Hermetic Transistor	OP601	B
1N5723	Pill Hermetic Transistor	OP602	B
1N5724	Pill Hermetic Transistor	OP603	B

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TEXAS INSTRUMENTS (continued)

T.I. Part No.	Description	TRW Optron Part No.	Code	T.I. Part No.	Description	TRW Optron Part No.	Code
1N5725	Pill Hermetic Transistor	OP604	B	4N26	6 Pin Transistor Coupler	4N26	A
3N219	In Line Isolator	——	G	4N27	6 Pin Transistor Coupler	4N27	A
3N220	In Line Isolator	——	G	4N28	6 Pin Transistor Coupler	4N28	A
3N261	6 Pin Darlington Coupler	——	G	4N35	6 Pin Transistor Coupler	4N35	A
3N262	6 Pin Darlington Coupler	——	G	4N36	6 Pin Transistor Coupler	4N36	A
3N263	6 Pin Darlington Coupler	——	G	4N37	6 Pin Transistor Coupler	4N37	A
4N22	TO-5 Isolator	4N22A	B	4N47	TO-5 Isolator	——	G
4N23	TO-5 Isolator	4N23A	B	4N48	TO-5 Isolator	——	G
4N24	TO-5 Isolator	4N24A	B	4N49	TO-5 Isolator	——	G
4N25	6 Pin Transistor Coupler	4N25	A				

VACTEC

Vactec Part No.	Description	TRW Optron Part No.	Code	Vactec Part No.	Description	TRW Optron Part No.	Code
VTA7121	Plastic Darlington	——	F	VTL11D5	Transistor Interrupter	OPB860T51	B
VTA7122	Plastic Darlington	——	F	VTL11D6	Transistor Interrupter	——	G
VTA7123	Plastic Darlington	——	F	VTL11D7	Transistor Interrupter	——	G
VTE7121	Plastic LED	OP140SLB	A	VTL11E1	Transistor Interrupter	——	G
VTE7122	Plastic LED	OP140SLA	B	VTL11E2	Transistor Interrupter	——	G
VTE7123	Plastic LED	——	F	VTL11E3	Transistor Interrupter	——	G
VTE7124	Plastic LED	——	F	VTL11E4	Transistor Interrupter	——	G
VTE1012	Hermetic LED	OP135W	A	VTL11E5	Transistor Interrupter	——	G
VTE1013	Hermetic LED	OP136W	A	VTL12D1	Transistor Interrupter	OPB865T55	B
VTE1015	Hermetic LED	OP130W	A	VTL12D2	Transistor Interrupter	OPB866T55	B
VTE1016	Hermetic LED	OP131W	A	VTL12D3	Transistor Interrupter	OPB867T55	B
VTE1017	Hermetic LED	OP132W	A	VTL12D4	Transistor Interrupter	——	G
VTE1018	Hermetic LED	OP133W	A	VTL12D5	Transistor Interrupter	OPB865T51	B
VTE1112	Hermetic LED	OP135	A	VTL12D6	Transistor Interrupter	——	G
VTE1113	Hermetic LED	OP136	A	VTL12D7	Transistor Interrupter	——	G
VTE1115	Hermetic LED	OP130	A	VTL12E1	Transistor Interrupter	——	G
VTE1116	Hermetic LED	OP131	A	VTL12E2	Transistor Interrupter	——	G
VTE1117	Hermetic LED	OP132	A	VTL12E3	Transistor Interrupter	——	G
VTE1118	Hermetic LED	OP133	A	VTL12E4	Transistor Interrupter	——	G
VTL10D1	Transistor Interrupter	OPB860T55	C	VTL12E5	Transistor Interrupter	——	G
VTL10D2	Transistor Interrupter	OPB861T55	C	VTL13D1	Transistor Interrupter	OP824	A
VTL10D3	Transistor Interrupter	OPB862T55	B,C	VTL13D2	Transistor Interrupter	——	G
VTL10D4	Transistor Interrupter	——	G	VTL13D3	Transistor Interrupter	——	G
VTL10D5	Transistor Interrupter	OPB860T51	C	VTL13D4	Transistor Interrupter	——	G
VTL10D6	Transistor Interrupter	——	G	VTL13D5	Transistor Interrupter	——	G
VTL10D7	Transistor Interrupter	——	G	VTL13D6	Transistor Interrupter	——	G
VTL10E1	Transistor Interrupter	——	G	VTL13D7	Transistor Interrupter	——	G
VTL10E2	Transistor Interrupter	——	G	VTL13E1	Transistor Interrupter	——	G
VTL10E3	Transistor Interrupter	——	G	VTL13E2	Transistor Interrupter	——	G
VTL10E4	Transistor Interrupter	——	G	VTL13E3	Transistor Interrupter	——	G
VTL10E5	Transistor Interrupter	——	G	VTL13E4	Transistor Interrupter	——	G
VTL11D1	Transistor Interrupter	OPB860T55	B	VTL13E5	Transistor Interrupter	——	G
VTL11D2	Transistor Interrupter	OPB861T55	B	VTM7121	Plastic Matched Pair	OP5690	A
VTL11D3	Transistor Interrupter	OPB862T55	B	VTM7122	Plastic Matched Pair	OP5691	B
VTL11D4	Transistor Interrupter	——	G	VTM7123	Plastic Matched Pair	OP5692	B

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VACTEC (continued)

Vactec Part No.	Description	TRW Optron Part No.	Code
VTM7124	Plastic Matched Pair	OP5693	B
VTR16	Transistor Reflective	OPB703A	D
VTR17	Transistor Reflective	——	G
VTR17C	Transistor Reflective	——	G
VTT3321	Plastic Transistor	OP550SLA	A
VTT3322	Plastic Transistor	OP550SLB	A
VTT3323	Plastic Transistor	OP550SLC	A
VTT3324	Plastic Transistor	OP550SLD	A
VTT3325	Plastic Transistor	OP550SLE	A
VTT7111	Plastic Transistor	OP550SLD	B
VTT7112	Plastic Transistor	OP550SLC	B
VTT7113	Plastic Transistor	OP550SLB	B
VTT7114	Plastic Transistor	OP550SLA	B
VTT7121	Plastic Transistor	OP550SLB	A
VTT7122	Plastic Transistor	OP550SLB	A
VTT7123	Plastic Transistor	OP550SLC	A
VTT7124	Plastic Transistor	OP550SLB	A
VTT7125	Plastic Transistor	OP550SLA	A
VTT7221	Plastic Transistor	——	G
VTT7222	Plastic Transistor	——	G
VTT7223	Plastic Transistor	——	G
VTT7224	Plastic Transistor	——	G
VTT7225	Plastic Transistor	——	G

XCITON

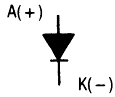
Xciton Part No.	Description	TRW Optron Part No.	Code
XC-1209	Plastic LED	OP160	A
XC-1288-A	Plastic LED	OP260SLC	A
XC-1288-B	Plastic LED	OP260SLC	A
XC-1288-C	Plastic LED	OP260SLB	A
XC-1288-D	Plastic LED	——	F
XC-55FA	Hermetic LED	OP131W	A
XC-55FB	Hermetic LED	OP131W	A
XC-55FC	Hermetic LED	OP132W	A
XC-55FD	Hermetic LED	OP133W	A
XC-55PA	Hermetic LED	OP130	A
XC-55PB	Hermetic LED	OP131	A
XC-55PC	Hermetic LED	OP132	A
XC-55PD	Hermetic LED	OP133	A
XC-55-10	Hermetic LED	OP131	A
XC-55-25	Hermetic LED	OP133	B
XC-66-10	Hermetic LED	OP131	A
XC-66-25	Hermetic LED	OP133	B
XC-88-FA	Hermetic LED	OP231W	A
XC-88-FB	Hermetic LED	OP232W	A
XC-88-FC	Hermetic LED	OP233W	A
XC-88-FD	Hermetic LED	OP233W	A
XC-88-PA	Hermetic LED	OP231	A
XC-88-PB	Hermetic LED	OP232	A
XC-88-PC	Hermetic LED	OP233	A
XC-88-PD	Hermetic LED	OP233	A
XC-88-30	Hermetic LED	——	F
XC-88-50	Hermetic LED	——	F
XC-880-A	Plastic LED	——	F
XC-880-B	Plastic LED	——	F
XC-880-C	Plastic LED	——	F
XC-880-D	Plastic LED	——	F
XC-881-A	Plastic LED	——	F
XC-881-B	Plastic LED	——	F
XC-881-C	Plastic LED	——	F
XC-881-D	Plastic LED	——	F
XC-99-30	Plastic LED	OP233	A
XC-99-50	Plastic LED	——	F

Glossary of Symbols and Terms

GLOSSARY OF SYMBOLS AND TERMS

TERM	SYMBOL	DESCRIPTION
Ambient Temperature	T_A	Temperature of air or liquid surrounding any electrical part or device.
Angstrom	Å	10^{-10} meter; a unit of length sometimes used to describe wavelengths of optical radiation.
Anode	A	The positive terminal of a diode, i.e., the terminal which must have a positive voltage relative to the other terminal (cathode) before the device will conduct.
Aperture	—	A hole or window in an opaque material, used to control the transmission of light.
Aperture Angle	Θ	For radiation sources, the angle between the half power points.
Base	B	The control terminal of a transistor. In a phototransistor, control is provided by light or infrared energy which falls on the transistor and generates a current in the base.
Buffer Amp Linearity, Low Voltage	V_{LL}	Output voltage from the buffer of the ABC sensor with a specified input voltage applied to the buffer.
Cathode	K	The negative terminal of a diode, i.e., the terminal which must have a negative voltage relative to the other terminal (anode) before the device will conduct.
Collector	C	The positive current carrying terminal of an NPN transistor.
Collector-Base Breakdown Voltage	$V_{(BR)CBO}$	The reverse bias voltage at which the collector-base junction of a transistor will conduct a specified (non-destructive) current much higher than the normal leakage currents that occur at lower voltages. In an NPN transistor, it is measured with the collector positive, the base negative, and the emitter open.
Collector Current	I_C	The amount of current flowing into the collector terminal of a transistor.
Collector-Emitter Breakdown Voltage	$V_{(BR)CEO}$	The voltage at which a transistor, biased in the normal direction with no optical or electrical input to the base, will conduct a specified (non-destructive) current much higher than the normal leakage currents which occur at lower voltages.
Collector-Emitter Saturation Voltage	$V_{CE(SAT)}$	The collector-emitter voltage of a transistor which is turned "on" by an optical or electrical input to the base, measured under specified conditions of input level and output current load.
Common Emitter	—	A circuit configuration in which the emitter terminal is common to both input and output current loops; also called grounded emitter.
Commutating dV/d_t	—	A measure of the ability of a triac to block a rapidly riding voltage immediately after conducting a current in the opposite polarity. Usually expressed in volts/microsecond.
Critical Angle	θ_C	The maximum angle of incidence for which light will be transmitted from one medium to another. Light approaching at a greater angle of incidence will be reflected.
Current Transfer Ratio	C.T.R.	In an optically coupled isolator, the ratio of output (transistor) current to input (LED) current under specified conditions.

GLOSSARY OF SYMBOLS AND TERMS

TERM	SYMBOL	DESCRIPTION
Dark Current	I_D	The current that flows through a photodetector when there is no optical input; usually used in reference to photodiodes.
DC Current Gain	h_{FE}	The ratio of collector current to base current in a transistor biased in the common emitter configuration.
Delay Time	t_d	The time elapsed between a step increase in the input and a change in the output equal to 10% of its maximum change.
Diode	—	A two terminal device (usually semiconductor) which freely conducts current in one direction and blocks it in the other. 
Duty Cycle	dc	In a signal composed of regularly recurring pulses, the product of the pulse width and the repetition frequency multiplied by 100 to give a percentage.
Duty Factor	—	In a signal composed of regularly recurring pulses, the product of the pulse width and the repetition frequency. Same as duty cycle except that it is expressed as a ratio rather than a percentage.
Emission Angle	—	For radiation sources, the angle with respect to the optical axis at which the radiant power is half the maximum.
Emitter	E	The negative current carrying terminal of an NPN transistor.
Emitter (Radiometric)		In radiometrics, a source of radiation.
Emitter-Collector Breakdown Voltage	$V_{(BR)ECO}$	The voltage at which a transistor, biased opposite its normal direction with no optical or electrical input to the base, will conduct a specified (non-destructive) current much higher than the normal leakage currents which occur at lower voltages.
Emitter Current	I_E	The value of current flowing in the emitter terminal of a transistor.
Fall Time	t_f	The time that elapses while a pulse waveform decreases from 90% to 10% of its maximum value.
Fiber Optics	—	Generally, the technology of using transparent glass or plastic fibers which carry light. Signals can be sent over large distances at high speed by coupling optoelectronic devices via fiber optics.
Forward Bias Voltage	V_F	An external voltage applied in the conducting direction of a PN junction. The positive terminal is connected to the P-type region, and the negative terminal to the N-type region.
Forward Current	I_F	The current which flows across a semiconductor junction when a forward-bias voltage is applied.
Forward Voltage	V_F	The voltage across a diode when it is forward biased at a specified current.
Frequency	f	The number of recurrences of a periodic phenomenon in a unit of time. Usually expressed in hertz (Hz), which is the number of recurrences per second.

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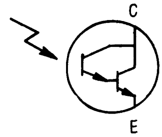
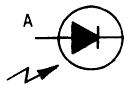
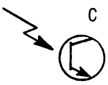
TERM	SYMBOL	DESCRIPTION
Gallium Aluminum Arsenide	GA AL AS	A crystalline compound used to make IREDS. Note: the addition of aluminum to the GA AS roughly doubles the power output of the device at the same input current.
Gallium Arsenide	GA AS	A crystalline compound used to make IREDS.
Half Power Point	HP	For radiation sources, the point in the radiation pattern at which the radiant intensity is half the maximum.
High Level Output Voltage	V_{OH}	The voltage on the output terminal of a logic circuit with input level and output load applied that, according to the product specification, will establish a high level at the output.
High Level Supply Current	I_{CCH}	In a logic circuit, the supply current required to operate the circuit when input conditions are such that the output is in the high logic state.
Holding Current	I_H	In a triac, the minimum current through the main terminals which will maintain the device in the on-state in the absence of an input to the gate.
Infrared	IR	Optical radiation that is characterized by wavelength longer than normally perceived by the eye, but shorter than radio waves. TRW Optron emitters radiate in the infrared range (just below the visible spectrum).
Infrared Emitting Diode	IRED	A diode which emits infrared radiation when forward biased.
Input-to-Output Resistance	R_{IO}	The resistance between the input and output of a optoisolator when the input leads are shorted together and the output leads are shorted together.
Interrupter Assembly	—	See Transmissive Assembly.
Irradiance	E_e	The radiant flux density incident on a surface; the quotient of the flux divided by the area of the irradiated surface. Units: watts/square meter, milliwatts/square cm.
Isolation Leakage Current	I_{ISO}	The current produced in an optoisolator when the input leads are shorted together, the output leads are shorted together, and a specified voltage is applied between the input and output.
Isolation Voltage	V_{ISO}	The input-to-output voltage withstanding capability of an optically coupled isolator.
Junction Temperature	T_J	The temperature at the PN junction within a semiconductor device.
Light	—	Optical radiation in the range of wavelengths which can be perceived by the human eye.
Light Current	I_L	Current flow through a photosensitive device when exposed to radiant energy.
Low Level Output Voltage	V_{OL}	The voltage on the output terminal of a logic circuit with input level and output loading applied that, according to the product specification, will establish a low level at the output.

GLOSSARY OF SYMBOLS AND TERMS

TERM	SYMBOL	DESCRIPTION
Low Level Supply Current	I_{CCL}	In a logic circuit, the supply current required to operate the circuit when the input conditions are such that the output is in the low logic state.
Lower Ramp Theshold Voltage	V_{RL}	The lower threshold voltage of the RC pin on the ABC sensor. The circuit discharges a capacitor connected to this pin until the voltage on the capacitor reaches the lower threshold voltage.
Maximum Power Dissipation	$P_{D(MAX)}$	Maximum power that a device can safely dissipate under specified conditions which include ambient temperature, heat sinking, and air circulation.
Micron	—	10^{-6} meter.
Nanometer	nm	10^{-9} meter; equal to 10 angstroms or 10^{-3} micron.
Noise Equivalent Power	NEP	The radiant flux at a specific wavelength incident on a detector which gives a signal-to-noise ratio of unity. Unit: watts.
Off-State Collector Current	I_{CEO}	The collector current in a transistor with no optical or electrical input to the base.
Off Time	t_{off}	Storage time plus fall time.
On-State Collector Current	$I_{C(ON)}$	The output (collector) current of a transistor when there is a specified optical or electrical input to the base.
On Time	t_{on}	Delay time plus rise time.
Operating Temperature	T_O	The temperature or range of temperatures over which a device is expected to operate within specified performance limits.
Optical Axis	—	A line about which the radiant energy pattern is centered; usually perpendicular to the active area.
Optical Radiation	—	Electromagnetic radiation in the range of wavelengths from 10 nanometers (extreme ultraviolet) to 1 millimeter (extreme infrared).
Optically Coupled Isolator	—	A device that is designed for transferring electrical signals by utilizing optical energy to provide coupling, with electrical isolation between input and output. Optically coupled isolators usually consist of an IRED coupled to one of a variety of sensor types, shielded from ambient light.
Optically Coupled Triac Driver	—	An optically coupled isolator whose output is designed to control the gate of a power triac.
Optocoupler	—	See Optically Coupled Isolator.
Optoelectronic Device	—	A device which responds to, emits, or modifies electromagnetic radiation in the visible, infrared, and/or ultraviolet spectral regions, or a device that utilizes such radiation for its internal operation.
Optoisolator	—	See Optically Coupled Isolator.
Peak On-State Surge Current	$I_{TM(SURGE)}$	An on-state current of short duration and specified waveshape which represents the maximum current surge capacity of a triac.

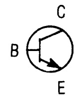
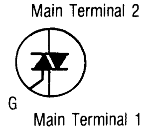
GLOSSARY OF SYMBOLS AND TERMS

TERM	SYMBOL	DESCRIPTION
Peak Wavelength	λ_P	The wavelength at which the power output of an emitter is maximum.
Photocoupler	—	See Optically Coupled Isolator.
Photocurrent	—	The difference between light current and dark current in a photodetector.
Photodarlington	—	A photosensor consisting of two transistors on a single chip, configured such that the current from the first (photosensitive) transistor is amplified by the gain of the second transistor. Note: photodarlingtons have very high current output compared to phototransistors but speed and linearity are relatively poor. 
Photodetector	—	A device that responds electrically when exposed to radiant energy.
Photodiode	—	A diode which is sensitive to incident radiation. Incident photons cause the diode to conduct (if reverse biased) or to generate a current. Note: photodiodes typically have much less output current than phototransistors but are faster and more linear. 
Photon	—	A quantum (the smallest possible unit) of radiant energy; a photon carries a quantity of energy equal to Planck's constant times the frequency.
Photosensor	—	A device which controls or generates an electric current when irradiated by light.
Phototransistor	—	A transistor which is sensitive to incident radiation. The incident photons result in a base current which is then amplified by the gain of the transistor. 
Point Source	—	A radiation source with a maximum dimension less than 1/10 the distance between source and detector.
Propagation Delay	t_{PLH}, t_{PHL}	In a logic circuit, the time delay between a specified change in input and a corresponding change in the output logic state. t_{PLH} is measured with the output changing from low to high and t_{PHL} with the output changing from high to low.
Radiance	N, L_e	The radiant intensity of the energy leaving or passing through a surface, divided by its area.
Radiant Flux	Φ_e	Rate of flow of radiant energy, expressed in watts.
Radiant Intensity	I_e	The radiant flux generated per unit solid angle in a given direction, expressed in milliwatts per steradian (mW/sr).
Radiation Pattern	—	The representation of the intensity of emission as a function of direction, in a given plane.
Radiometric	—	Of or pertaining to radiation in all wavelengths.

GLOSSARY OF SYMBOLS AND TERMS

TERM	SYMBOL	DESCRIPTION
Ramp Leakage Current	I_{RL}	In the ABC sensor, the current that flows through the RC pin (pins) when the device is operated under specified conditions.
Reflective Assembly	—	A device in which an IRED and a photosensor are mounted side by side, such that the photosensor is only irradiated when a reflective object passes in front of the device. Reflective assemblies are used to sense the presence of reflective objects.
Repetitive Peak Off-State Current	I_{DRM}	In a triac, the maximum instantaneous value of the off-state current that results from the application of repetitive peak off-state voltage.
Responsivity	R	A description of the optical sensitivity of a photosensor. It is the ratio of the output current or voltage to the input radiant flux, typically expressed as amps per watt or volts per watt.
Reverse Breakdown Voltage	$V_{(BR)R}$	The reverse bias voltage at which a diode will conduct a specified (non-destructive) current much higher than the normal leakage currents which occur at lower voltages.
Reverse Current	I_R	The current that flows when a reverse bias voltage is applied to a semiconductor junction.
Rise Time	t_r	The time that elapses while a pulse waveform increases from 10% to 90% of its maximum value.
RMS On-State Current	$I_{T(RMS)}$	In a triac, the principal current when the device is in the on-state.
Silicon	Si	An element, abundant in the earth's crust, which is used in highly purified form to make most of the semiconductors used in the modern electronics industry (including all TRW Optron photodetectors). Pure crystalline silicon is carefully "doped" with very small amounts of impurities to control its electrical characteristics.
Spectral Bandwidth	BW	The wavelength interval in which a photometric or radiometric spectral quantity is not less than half of its maximum value.
Spectral Response	—	A description of the electrical output characteristic versus wavelength of radiation incident upon a device, usually expressed by a curve.
Static dV/d_t	dV/d_t	The measure of the ability of a triac or SCR to block a rapidly rising voltage. Statid dV/d_t is usually measured with application of full rated voltage to the device in a very short but controlled time period. It is expressed in volts/microsecond.
Static Gate Trigger Current	I_{GT}	In a triac, the minimum gate current required to switch the device from the off-state to the on-state.
Steradian	sr	The solid angle subtending an area on the surface of a sphere equal to the square of the sphere's radius. There are 4 π (PI) steradians in a sphere.
Storage Temperature	T_{STG}	The maximum temperature at which a device may be stored with no power applied.

GLOSSARY OF SYMBOLS AND TERMS

TERM	SYMBOL	DESCRIPTION
Storage Time	t_S	The time elapsed between a step decrease in the input and a change in the output equal to 10% of its maximum change.
Supply Voltage	V_{CC}	The power supply voltage required to operate a circuit.
Total Power Output	P_O	The total power that is radiated by a device, expressed in watts or milliwatts.
Transistor	—	A three terminal active semiconductor device which is capable of providing power amplification. 
Transmissive assembly	—	A device in which an IRED and a photosensor are mounted facing each other on either side of a slot, such that an opaque object passing through the slot will interrupt the I_R radiation path and be detected by the photosensor.
Triac	—	A five layer semiconductor device which provides switching action for either polarity of applied voltage and can be controlled in either polarity by a single gate electrode. Triacs are usually used in power control applications. 
Trigger Leakage	I_{T1}, I_{T2}	The current that flows in the trigger terminal of the ABC sensor. I_{T1} is measured with the trigger pin at ground potential and I_{T2} with the trigger pin at V_{CC} potential.
Trigger Voltage	V_T	The minimum voltage which, when applied to the trigger pin of the ABC sensor, will force the RC pin to sink current. Once triggered by a rising edge of this minimum amplitude, the RC pin sinks current until the voltage on the capacitor reaches the lower ramp threshold voltage.
Upper Ramp Threshold Voltage	V_{RU}	The upper threshold voltage of the RC pin on the ABC sensor. The circuit charges a capacitor connected to this pin until the voltage on the capacitor reaches the upper threshold voltage.
Wavelength	λ	The velocity of a wave divided by its frequency. The wavelength of infrared radiation is usually expressed in nanometers.

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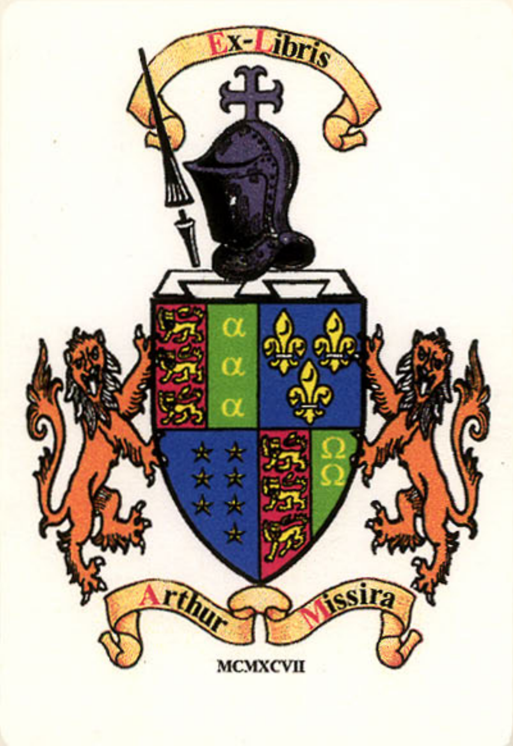
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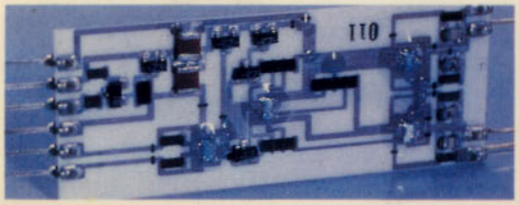

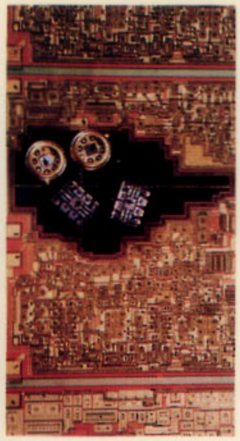

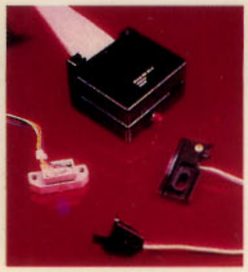

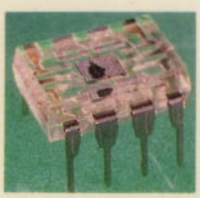

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