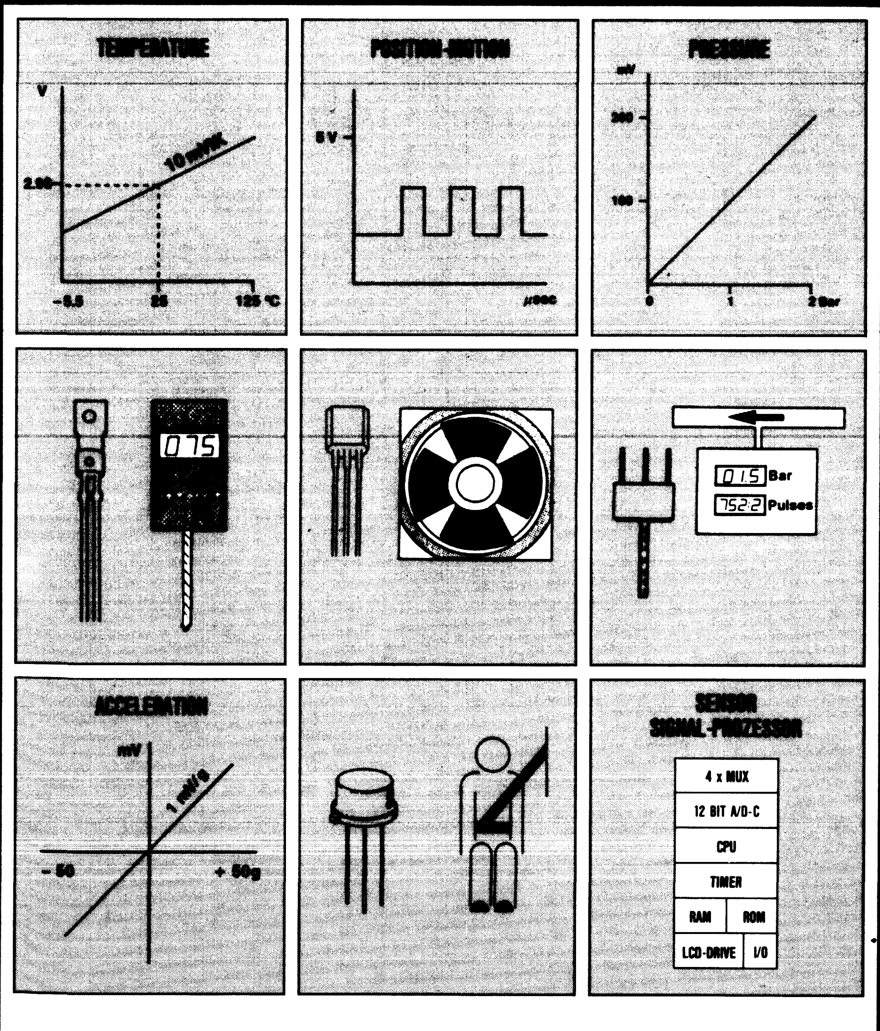
SILICON SENSORS



Sensors

Temperature and Flow Sensors (Temperature – Sensitive Resistors)

TYPE	PACKAGE	R_{25} °C / kΩ	ACCURACY / R_{25} °C	SENSITIVITY @ 25°C	TEMPERATURE RANGE °C	TYPICAL RESPONSE TIME τ
TSF102E	Minitherm	1	±0.5%	0.8%/°C	-55 ... 125°C	2.5 sec in air
TSF102F	Minitherm	1	±1%	0.8%/°C	-55 ... 125°C	2.5 sec in air
TSF102GF1	Minitherm	0.98	±1%	0.8%/°C	-55 ... 125°C	2.5 sec in air
TSF102GF2	Minitherm	1.02	±1%	0.8%/°C	-55 ... 125°C	2.5 sec in air
TSF102G	Minitherm	1	±2%	0.8%/°C	-55 ... 125°C	2.5 sec in air
TSF102H	Minitherm	1	±3%	0.8%/°C	-55 ... 125°C	2.5 sec in air
TSF102J	Minitherm	1	±5%	0.8%/°C	-55 ... 125°C	2.5 sec in air
TSP102E	TO-92	1	±0.5%	0.8%/°C	-55 ... 125°C	10 sec in air
TSP102F	TO-92	1	±1%	0.8%/°C	-55 ... 125°C	10 sec in air
TSP102GF1	TO-92	0.98	±1%	0.8%/°C	-55 ... 125°C	10 sec in air
TSP102GF2	TO-92	1.02	±1%	0.8%/°C	-55 ... 125°C	10 sec in air
TSP102G	TO-92	1	±2%	0.8%/°C	-55 ... 125°C	10 sec in air
TSP102H	TO-92	1	±3%	0.8%/°C	-55 ... 125°C	10 sec in air
TSP102J	TO-92	1	±5%	0.8%/°C	-55 ... 125°C	10 sec in air
TSU102GF1	Minitherm	0.98	±1%	0.8%/°C	-55 ... 125°C	4 sec in air
TSU102GF2	Minitherm	1.02	±1%	0.8%/°C	-55 ... 125°C	4 sec in air
TSU102G	Minitherm	1	±2%	0.8%/°C	-55 ... 125°C	4 sec in air
TSU102H	Minitherm	1	±3%	0.8%/°C	-55 ... 125°C	4 sec in air
TSU102J	Minitherm	1	±5%	0.8%/°C	-55 ... 125°C	4 sec in air
TSP202F	TO-92	2	±1%	0.8%/°C	-55 ... 125°C	10 sec in air
TSP202G	TO-92	2	±2%	0.8%/°C	-55 ... 125°C	10 sec in air
TSP202H	TO-92	2	±3%	0.8%/°C	-55 ... 125°C	10 sec in air
TSF202F	Minitherm	2	±1%	0.8%/°C	-55 ... 125°C	2.5 sec in air
TSF202G	Minitherm	2	±2%	0.8%/°C	-55 ... 125°C	2.5 sec in air
TSF202H	Minitherm	2	±3%	0.8%/°C	-55 ... 125°C	2.5 sec in air
TSF202J	Minitherm	2	±5%	0.8%/°C	-55 ... 125°C	2.5 sec in air
TSF202GF1	Minitherm	1.96	±1%	0.8%/°C	-55 ... 125°C	2.5 sec in air
TSF202GF2	Minitherm	2.04	±1%	0.8%/°C	-55 ... 125°C	2.5 sec in air

Temperature Sensor Integrated Circuits

TYPE	PACKAGE	ACCURACY @ 25°C	OPERATING TEMPERATURE RANGE	SUPPLY CURRENT (mA)	V_{sens} @ 25°C (V)	SENSITIVITY	RESPONSE TIME τ
STP35A	TO-92	±3°C	-40 ... 125°C	0.4 ... 5 mA	2.98	10 mV/k	13 sec in air
STP35B	TO-92	±2°C	-40 ... 125°C	0.4 ... 5 mA	2.98	10 mV/k	13 sec in air
STP35C	TO-92	±1°C	-40 ... 125°C	0.4 ... 5 mA	2.98	10 mV/k	13 sec in air

Hall – Effect Sensors

TYPE	PACKAGE	V_{CC} (V)	MIN B_L (mT)	MAX B_H (mT)	HYSTERESIS (mT)	TEMPERATURE RANGE (°C)	OUTPUT	REMARKS
TL3101C	LU	5 V ± 5%	-25	+25	20	0 ... 70	Open Collect.	Switch
TL3101I	LU	5 V ± 5%	-35	+35	20	-40 ... 85	Open Collect.	Switch
TL3103C	LU	9 ... 15	-50	+50	Sensitivity 16 mV/mT	0 ... 70	–	Analog
TL3103I	LU	9 ... 15	-50	+50	Sensitivity 16 mV/mT	-40 ... 85	–	Analog
TL3019C	LU	4.5 ... 24	12,5	+50	12	0 ... 70	Open Collect.	Normally off switch
TL3020C	LU	4.5 ... 24	5	+35	5,5	0 ... 70	Open Collect.	Normally off switch

Pressure Sensors

TYPE	PACKAGE	V_{CC} MAX (V)	MEASUREMENT RANGE (bar)	SENSITIVITY @ 5V mV/Bar	LINEARITY (% F.S.)	TEMPERATURE RANGE (°C)	MEASUREMENT METHOD
TSP410	TO-39 mod.	16	0 ... 2	100	±2.5	-55 ... 125	Absolut
TSP411	TO-39 mod.	16	0 ... 2	100	±2.5	-55 ... 125	Temp. compens.

Silicon Accelerometer

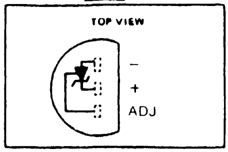
TYPE	PACKAGE	V_{CC} MAX (V)	MEASUREMENT RANGE (bar)	SENSITIVITY @ 5V mV/Bar	LINEARITY (% F.S.)	TEMPERATURE RANGE (°C)	NOISE @ 0 ... 500 Hz (μV)
TSA150	TO-39	16	-50 ... 50	1	±1	-40 ... 85	max. 100

INDEX

Temperature Sensors

- Direct calibrated in °Kelvin
- Available with 1°C, 2°C and 3°C initial accuracy
- Operates from 400µA to 5mA
- Less than 1,2Ω dynamic impedance
- Operating temperature range -40°C to 125°C

LP SILECT' PACKAGE

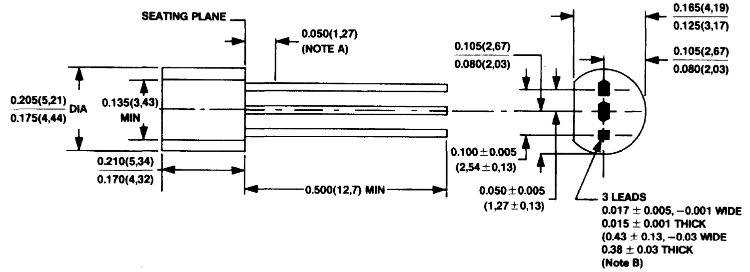


description

The STP35 is a precision, easy to calibrate integrated temperature sensor. Operating as a 2-terminal zener, the STP35 has a breakdown voltage directly proportional to absolute temperature with +10mV/K.

mechanical data

The LP Silect package is an encapsulation in a plastic compound specifically designed for this purpose. The package will withstand soldering temperatures without deformation. The package exhibits stable characteristics under high-humidity conditions and is capable of meeting MIL-STD-202C, Method 106B.



NOTES: A. Lead dimensions are not controlled in this area.
B. Beyond 0.100(2,54) below seating plane, tolerance on lead width reduces to ± 0.001(0.03).
C. Dimensions are in inches and parenthetically in millimeters. Inch dimensions govern.

ALL JEDEC TO 226AA DIMENISIONS AND NOTES ARE APPLICABLE

absolute maximum ratings at 25°C free air temperature (unless otherwise noted)

Reverse current I_R 10mA
Forward current I_F 10mA
Operating temperature range T_{Op} .... -40°C to 125°C
Storage temperature range T_{Stg} .... -65°C to 150°C
Lead temperature 1,6mm from case for 10 seconds .... 260°C

electrical characteristics

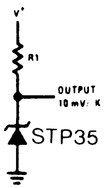
PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
Operating ouput voltage change with current	400µA < I_R < 5mA at constant temperature		2,5	5,5	mV
Dynamic impedance	I_R = 1mA		0,6	1,2	Ohm
Output voltage					
Temperature sensitivity			+10		mV/K
Thermal time constant τ	Moving air 3m/sec T_{A1} = 25°C, T_{A2} = 85°C		13		sec
τ	Stirred silicon oil T_{A1} = 25°C, T_{A2} = 85°C		2		sec

temperature accuracy

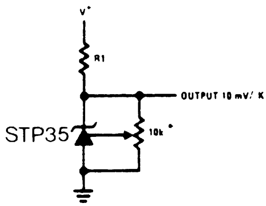
PARAMETER	TEST CONDITIONS	STP35A MIN	STP35A TYP	STP35A MAX	STP35B MIN	STP35B TYP	STP35B MAX	STP35C MIN	STP35C TYP	STP35C MAX	UNI
Operating output voltage	T_C = 25°C, J_R = 1mA	2,95	2,98	3.01	2,96	2,98	3,00	2,97	2,98	2,99	V
Uncalibrated temperature error	T_C = 25°C, J_R = 1mA			±3			±2			±1	°C
Uncalibrated temperature error	-10°C < T_C < 100°C, J_R = 1mA			±5			±4			±3	°C
	-40°C < T_C < 125°C, J_R = 1mA			±6			±5			±4	°C
Temperature error with 25°C calibration	-10°C < T_C < 100°C, J_R = 1mA			±2			±2			±2	°C
	-40°C < T_C < 125°C, J_R = 1mA			±3			±3			±3	°C
Non-Linearity	-10°C < T_C < 100°C, J_R = 1mA			±0,5			±0,5			±0,5	°C

typical applications

Basic temperature sensor



Calibrated sensor



*Calibrate for 2.982V at 25°C

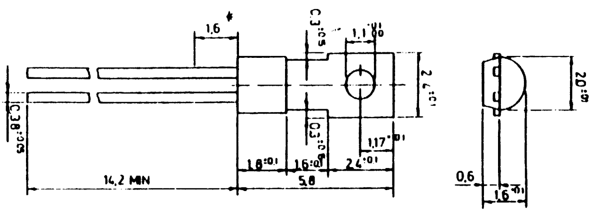
TI cannot assume any responsibility for any circuits shown or represent that they are free from patent infringement. Texas Instruments reserves the right to make changes at any time in order to improve design and to supply the best product possible.

POSITIVE TEMPERATURE COEFFICIENT SILICON SENSOR

JULI 1984

- **Spreading-Resistance Sensor in Silicon Planar Technology**
- **Designed for Fast Temperature Measurements**
- **Simple and Accurate Linearization with One Serial or Parallel Resistor from −55 °C to 125 °C**
- **1000 Ω Nominal Resistance Value at 25 °C**
- **Available in ±0,5 %, ±1 %, ±2 %, ±3 % and ±5 % Tolerances**
- **Postive Temperature Coefficient typ 0,8 %/°C at 25 °C**

mechanical data



* LEAD DIAMETER IS NOT CONTROLLED IN THIS AREA

Mechanical stability according to DIN 40046 sheet 19 § 2/0,5 kp, § 3/0,25 kp

ATTENTION:
Sensor flag is electrically not isolated and must not be connected to any sensor lead.

absolute maximum ratings at 25 °C free-air temperature (unless otherwise noted)

Max. Instantaneous Current I_{PK}	10 mA
Max. Operating Current (see figure 2) I_{max}	2 mA
Operating Temperature Range T_A	−55 °C to 125 °C
Storage Temperature Range T_{stg}	−65 °C to 150 °C
Lead Temperature 1,6 mm from Case for 10 Seconds	260 °C

electrical and thermal characteristics

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
$R_{25°C}$	Nominal Resistance	I = 100 µA, T_A = 25°C		1000		Ω
$R_{125°C}/R_{25°C}$	Resistance Ratio	T_{A1} = 125°C, T_{A2} = 25°C I = 100 µA	1.975	1.99	2.005	
$R_{-55°C}/R_{25°C}$	Resistance Ratio	T_{A1} = −55°C, T_{A2} = 25°C I = 100 µA	0.484	0.489	0.494	
τ	Thermal Time Constant Moving Air	T_{A1} = 25°C, T_{A2} = 85°C V_A = 3m/Sec		2,5		Sec
τ	Thermal Time Constant Still Silicon Oil	T_{A1} = 25°C, T_{A2} = 85°C		1		Sec
τ	Thermal Time Constant Flag Mounted on Cu Block	T_{A1} = 25°C, T_{A2} = 85°C		0.17		Sec
G	Dissipation Constant Free-Air	(see Note 1)		3		mW/°K
G	Dissipation Constant Mounted on Cu Block	(see Note 1)		8		mW/°K

NOTE 1: The self heating can be calculated with formula $\Delta T = \frac{P}{G}$

ΔT = Self heating (°C)
P = Sensor power consumption (mW)
G = Dissipation constant (mW/°C)

TYPE	ACCURACY GROUP	$R_{25°C}$ (Ω) MIN	MAX	IDENTIFICATION COLOR
TSF102E	± 0,5%	995	1005	white
TSF102F	± 1%	990	1010	
TSF102G	± 2%	980	1020	red
TSF102H	± 3%	970	1030	orange
TSF102J	± 5%	950	1050	green

recommended linearization

TEMPERATURE RANGE	TEMPERATURE LINEARITY	SERIAL OR PARALLEL RESISTOR VALUE
0 to 100°C	−0.2°C +0.2°C	2800 Ω

typical sensor temperature coefficient

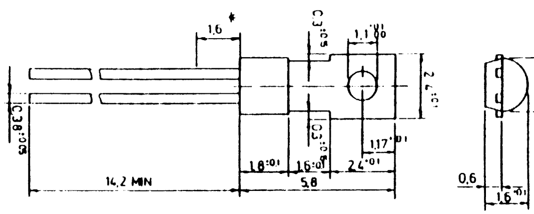
T_A (°C)	-55	-25	0	25	50	75	100	125
R_T (Ω)	489	652	813	1000	1211	1446	1706	1990
σ_{RT} (Ω/°C)	5,43	6,44	7,48	8,44	9,40	10,40	11,36	

TYPE TSF 102 GF
POSITIVE TEMPERATURE COEFFICIENT SILICON SENSOR

FEBRUARY 1983

- Spreading-Resistance Sensor in Silicon Planar Technology
- Designed for Fast Temperature Measurements
- Simple and Accurate Linearization with One Serial or Parallel Resistor from −55 °C to 125 °C
- 1000 Ω Nominal Resistance Value at 25 °C
- Available in two groups, each one with ±1 % tolerance
- Positive Temperature Coefficient typ. 0,8 %/°C at 25 °C

mechanical data



* LEAD DIAMETER IS NOT CONTROLLED IN THIS AREA

Mechanical stability according to DIN 40046 sheet 19 § 2/0,5 kp, § 3/0,25 kp

ATTENTION:
Sensor flag is electrically not isolated and must not be connected to any sensor lead.

absolute maximum ratings at 25 °C free-air temperature (unless otherwise noted)

Max. Instantaneous Current I_{PK}	10 mA
Max. Operating Current I_{max}	2 mA
Operating Temperature Range T_A	−55 °C to 125 °C
Storage Temperature Range T_{stg}	−65 °C to 150 °C
Lead Temperature 1,6 mm from Case for 10 Seconds	260 °C

electrical and thermal characteristics

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
$R_{25°C}$	Nominal Resistance	$I = 100\ \mu A$, $T_A = 25°C$		1000		Ω
$R_{125°C}/R_{25°C}$	Resistance Ratio	$T_{A1} = 125°C$, $T_{A2} = 25°C$ $I = 100\ \mu A$	1.975	1.99	2.005	
$R_{-55°C}/R_{25°C}$	Resistance Ratio	$T_{A1} = -55°C$, $T_{A2} = 25°C$ $I = 100\ \mu A$	0.484	0.489	0.494	
τ	Thermal Time Constant Moving Air	$T_{A1} = 25°C$, $T_{A2} = 85°C$ $V_A = 3m/Sec$		2,5		Sec
τ	Thermal Time Constant Still Silicon Oil	$T_{A1} = 25°C$, $T_{A2} = 85°C$		1		Sec
τ	Thermal Time Constant Flag Mounted on Cu Block	$T_{A1} = 25°C$, $T_{A2} = 85°C$		0.17		Sec
G	Dissipation Constant Free-Air	(see Note 1)		3		mW/°C
G	Dissipation Constant Mounted on Cu Block	(see Note 1)		8		mW/°K

NOTE 1: The self heating can be calculated with formula $\Delta T = \frac{P}{G}$

ΔT = Self heating (°C)
P = Sensor power consumption (mW)
G = Dissipation constant (mW/°C)

TYPE	ACCURACY GROUP	$R_{25°C}$ MIN	(Ω) MAX	IDENTIFICATION COLOR
TSF102GF-1	± 1%	970	990	blue
TSF102GF-2	± 1%	1010	1030	yellow

recommended linearization

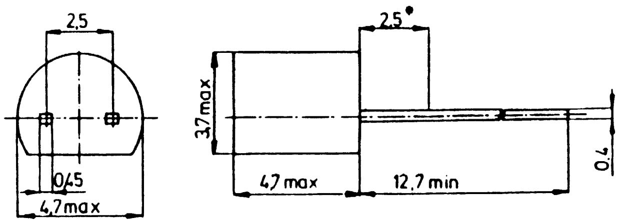
TEMPERATURE RANGE	TEMPERATURE LINEARITY	SERIAL OR PARALLEL RESISTOR VALUE
0 to 100°C	−0.2°C +0.2°C	2800 Ω

TYPE TSP 102
POSITIVE TEMPERATURE COEFFICIENT SILICON SENSOR

JULI 1982

- Spreading-Resistance Sensor in Silicon Planar Technology
- Designed for Fast Temperature Measurements
- Simple and Accurate Linearization with One Serial or Parallel Resistor from −55 °C to 125 °C
- 1000 Ω Nominal Resistance Value at 25 °C
- Available in ±1 %, ±2 %, ±3 %, ±5 % and ±0,5 % Tolerances.
- Positive Temperature Coefficient typ. 0,8 %/°C at 25 °C

mechanical data



* Lead diameter and solderability are not controlled in this area.

absolute maximum ratings at 25 °C free-air temperature (unless otherwise noted)

Max. Instantaneous Current I_{PK}	10 mA
Max. Operating Current I_{max}	2 mA
Operating Temperature Range T_A	−55 °C to 125 °C
Storage Temperature Range T_{stg}	−65 °C to 150 °C
Lead Temperature 1,6 mm from Case for 10 Seconds	260 °C

electrical and thermal characteristics

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
$R_{25°C}$	Nominal Resistance	I = 100 µA, T_A = 25°C		1000		Ω
$R_{125°C}/R_{25°C}$	Resistance Ratio	T_{A1} = 125°C, T_{A2} = 25°C I = 100 µA	1.975	1.99	2.005	
$R_{-55°C}/R_{25°C}$	Resistance Ratio	T_{A1} = −55°C, T_{A2} = 25°C I = 100 µA	0.484	0.489	0.494	
τ	Thermal Time Constant Moving Air	T_{A1} = 25°C, T_{A2} = 85°C V_A 3m/Sec		10		Sec
τ	Thermal Time Constant Still Silicon Oil	T_{A1} = 25°C, T_{A2} = 85°C		4,3		Sec
G	Dissipation Constant Free-Air	(see Note 1)		9		mW/°K

NOTE 1: The self heating can be calculated with formula $\Delta T = \frac{P}{G}$

ΔT = Self heating (°C)
P = Sensor power consumption (mW)
G = Dissipation constant (mW/°C)

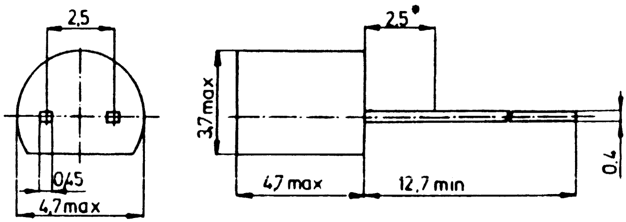
TYPE	ACCURACY GROUP	$R_{25°C}$ (Ω) MIN	$R_{25°C}$ (Ω) MAX	SYMBO
TSP102E	± 0,5%	995	1005	TP102E
TSP102F	± 1%	990	1010	TP102F
TSP102G	± 2%	980	1020	TP102G
TSP102H	± 3%	970	1030	TP102H
TSP102J	± 5%	950	1050	TP102J

recommended linearization

TEMPERATURE RANGE	TEMPERATURE LINEARITY	RL SERIAL OR PARALLEL RESISTOR VALUE
0 to 100°C	−0.2°C +0.2°C	2800 Ω

- Spreading-Resistance Sensor in Silicon Planar Technology
- Designed for Fast Temperature Measurements
- Simple and Accurate Linearization with One Serial or Parallel Resistor from −55 °C to 125 °C
- 1000 Ω Nominal Resistance Value at 25 °C
- Available in two groups, each one with ± 1% tolerance
- Positive Temperature Coefficient typ. 0,8%/°C at 25 °C

mechanical data



* Lead diameter and solderability are not controlled in this area.

absolute maximum ratings at 25 °C free-air temperature (unless otherwise noted)

Max. Instantaneous Current I_{PK}	10 mA
Max. Operating Current I_{max}	2 mA
Operating Temperature Range T_A	−55 °C to 125 °C
Storage Temperature Range T_{stg}	−65 °C to 150 °C
Lead Temperature 1,6 mm from Case for 10 Seconds	260 °C

electrical and thermal characteristics

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
$R_{25°C}$	Nominal Resistance	I = 100 μA, $T_A = 25°C$		1000		Ω
$R_{125°C}/R_{25°C}$	Resistance Ratio	$T_{A1} = 125°C$, $T_{A2} = 25°C$ I = 100 μA	1.975	1.99	2.005	
$R_{-55°C}/R_{25°C}$	Resistance Ratio	$T_{A1} = -55°C$, $T_{A2} = 25°C$ I = 100 μA	0.484	0.489	0.494	
τ	Thermal Time Constant Moving Air	$T_{A1} = 25°C$, $T_{A2} = 85°C$ V_A 3m/Sec		10		Sec
τ	Thermal Time Constant Still Silicon Oil	$T_{A1} = 25°C$, $T_{A2} = 85°C$		4,3		Sec
G	Dissipation Constant Free-Air	(see Note 1)		9		mW/°K

NOTE 1: The self heating can be calculated with formula $\Delta T = \frac{P}{G}$

ΔT = Self heating (°C)
P = Sensor power consumption (mW)
G = Dissipation constant (mW/°C)

TYPE	ACCURACY GROUP	$R_{25°C}$ (Ω) MIN	$R_{25°C}$ (Ω) MAX	SYMBO
TSP102GF-1	± 1 %	970	990	T102F1
TSP102GF-2	± 1 %	1010	1030	T102F2

recommended linearization

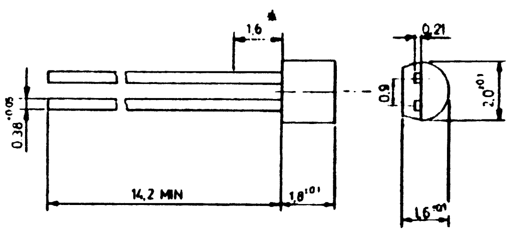
TEMPERATURE RANGE	TEMPERATURE LINEARITY	RL SERIAL OR PARALLEL RESISTOR VALUE
0 to 100°C	−0.2°C +0.2°C	2800 Ω

TYPE TSU 102
POSITIVE TEMPERATURE COEFFICIENT SILICON SENSOR

December 1983

- Spreading-Resistance Sensor in Silicon Planar Technology
- Designed for Fast Temperature Measurements
- Simple and Accurate Linearization with One Serial or Parallel Resistor from −55 °C to 125 °C
- 1000 Ω Nominal Resistance Value at 25 °C
- Available in ±2 %, ±3 %, ±5 %
- Positive Temperature Coefficient typ. 0,8 %/°C at 25 °C

mechanical data



* Lead diameter is not controlled in this area.

Mechanical stability according to DIN 40046 sheet 19 §2/0,5 kp, §3/0,25 kp.

absolute maximum ratings at 25 °C free-air temperature (unless otherwise noted)

Max. Instantaneous Current I_{PK}	10 mA
Max. Operating Current I_{max}	2 mA
Operating Temperature Range T_A	−55 °C to 125 °C
Storage Temperature Range T_{stg}	−65 °C to 150 °C
Lead Temperature 1,6 mm from Case for 10 Seconds	260 °C

electrical and thermal characteristics

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
$R_{25°C}$	Nominal Resistance	I = 100 µA, $T_A = 25°C$		1000		Ω
$R_{125°C}/R_{25°C}$	Resistance Ratio	$T_{A1} = 125°C$, $T_{A2} = 25°C$ I = 100 µA	1.975	1.99	2.005	
$R_{-55°C}/R_{25°C}$	Resistance Ratio	$T_{A1} = -55°C$, $T_{A2} = 25°C$ I = 100 µA	0.484	0.489	0.494	
τ	Thermal Time Constant Moving Air	$T_{A1} = 25°C$, $T_{A2} = 85°C$ V_A 3m/Sec		4		Sec
τ	Thermal Time Constant Still Silicon Oil	$T_{A1} = 25°C$, $T_{A2} = 85°C$		1,5		Sec
G	Dissipation Constant Free-Air	(see Note 1)		2		mW/°K

NOTE 1: The self heating can be calculated with formula $\Delta T = \frac{P}{G}$

ΔT = Self heating (°C)
P = Sensor power consumption (mW)
G = Dissipation constant (mW/°C)

TYPE	ACCURACY GROUP	$R_{25°C}$ (Ω) MIN	$R_{25°C}$ (Ω) MAX	IDENTIFCATION COLOR OR PRINT
TSU102G	± 2%	980	1020	red
TSU102H	± 3%	970	1030	orange
TSU102J	± 5%	950	1050	green

recommended linearization

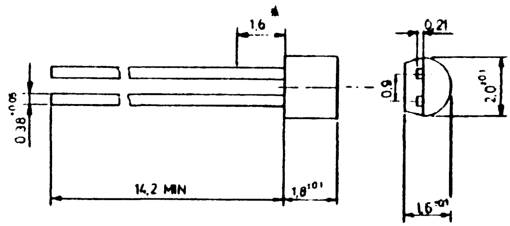
TEMPERATURE RANGE	TEMPERATURE LINEARITY	SERIAL OR PARALLEL RESISTOR VALUE
0 to 100°C	−0.2°C +0.2°C	2800 Ω

TYPE TSU 102 GF
POSITIVE TEMPERATURE COEFFICIENT SILICON SENSOR

December 1983

- Spreading-Resistance Sensor in Silicon Planar Technology
- Designed for Fast Temperature Measurements
- Simple and Accurate Linearization with One Serial or Parallel Resistor from −55 °C to 125 °C
- 1000 Ω Nominal Resistance Value at 25 °C
- Available in two groups, each one with ± 1 % tolerance.
- Positive Temperature Coefficient typ. 0,8 %/°C at 25 °C

mechanical data



* Lead diameter is not controlled in this area.

Mechanical stability according to DIN 40046 sheet 19 §2/0,5 kp, §3/0,25 kp.

absolute maximum ratings at 25 °C free-air temperature (unless otherwise noted)

Max. Instantaneous Current I_{PK}	10 mA
Max. Operating Current I_{max}	2 mA
Operating Temperature Range T_A	−55 °C to 125 °C
Storage Temperature Range T_{stg}	−65 °C to 150 °C
Lead Temperature 1,6 mm from Case for 10 Seconds	260 °C

electrical and thermal characteristics

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
$R_{25°C}$	Nominal Resistance	I = 100 µA, T_A = 25°C		1000		Ω
$R_{125°C}/R_{25°C}$	Resistance Ratio	T_{A1} = 125°C, T_{A2} = 25°C I = 100 µA	1.975	1.99	2.005	
$R_{-55°C}/R_{25°C}$	Resistance Ratio	T_{A1} = −55°C, T_{A2} = 25°C I = 100 µA	0.484	0.489	0.494	
τ	Thermal Time Constant Moving Air	T_{A1} = 25°C, T_{A2} = 85°C V_A 3m/Sec		4		Sec
τ	Thermal Time Constant Still Silicon Oil	T_{A1} = 25°C, T_{A2} = 85°C		1,5		Sec
G	Dissipation Constant Free-Air	(see Note 1)		2		mW/°K

NOTE 1: The self heating can be calculated with formula $\Delta T = \frac{P}{G}$

ΔT = Self heating (°C)
P = Sensor power consumption (mW)
G = Dissipation constant (mW/°C)

TYPE	ACCURACY GROUP	$R_{25°C}$ (Ω) MIN	MAX	IDENTIFICATION COLOR
TSU102GF-1	± 1%	970	990	blue
TSU102GF-2	± 1%	1010	1030	yellow

recommended linearization

TEMPERATURE RANGE	TEMPERATURE LINEARITY	SERIAL OR PARALLEL RESISTOR VALUE
0 to 100°C	−0.2°C +0.2°C	2800 Ω

R_L CALCULATION TO DETERMINE VALUE OF THE LINEARIZATION RESISTOR

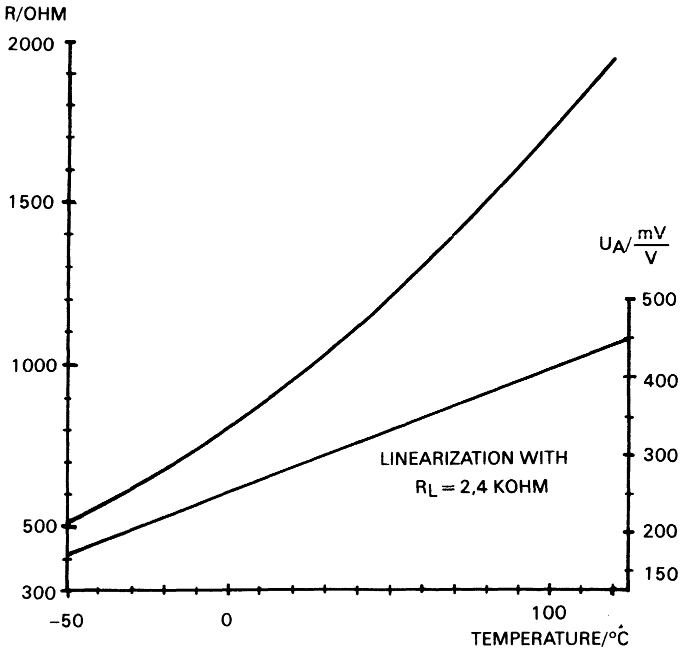
THIS SIMPLIFIED FORMULA CAN BE USED TO CALCULATE THE VALUE OF R_L FOR VARIOUS TEMPERATURE RANGES.

$$R_L = \frac{R_M \times (R_1 + R_2) - 2 \times R_1 \times R_2}{R_1 + R_2 - 2 \times R_M}$$

WHERE R_1 = SENSOR RESISTANCE AT MIN TEMPERATURE POINT
R_2 = SENSOR REISTANCE AT MAX TEMPERATURE POINT
R_M = SENSOR R VALUE FROM TABLE AT THE MIDPOINT OF THE TEMPERATURE RANGE DESIRED IE.

$$\text{TEMP MID POINT } T_M = \frac{T\ MIN + T\ MAX}{2}$$

TYPICAL RESISTANCE VS. TEMPERATURE AND LINEARIZED CURVE FOR 1K OHM SENSORS



Note: The exponential curve is the resistance vs. temperature curve of the nonlinearized temperature sensor. The linear curve with the scale on the left hand shows the total resistance of a sensor linearized with a parallel resistance of 2,4 KOHM and supplied with constant current. The same curve with the scale on the right shows the output voltage U_A of the sensor linearized with a serial resistance of 2,4 KOHM and supplied with constant voltage.

SENSOR RESISTANCE VERSUS TEMPERATURE FOR 1KΩ SENSORS

TS.102E [0.5%]

T/GRAD °C	R min	R nom	R max
–55	481.6	489.0	496.5
–50	506.2	513.6	521.1
–45	531.8	539.2	546.6
–40	558.4	565.8	573.2
–35	586.1	593.3	600.7
–30	614.7	621.9	629.1
–25	644.3	651.4	658.5
–20	674.8	681.8	688.8
–15	706.5	713.3	720.2
–10	739.1	745.7	752.4
–5	772.6	779.1	785.6
0	807.1	813.5	819.8
5	842.8	848.8	855.0
10	879.5	885.2	891.0
15	916.9	922.5	928.0
20	955.5	960.7	966.0
25	995.0	1000.0	1005.0
30	1034.5	1040.2	1046.0
35	1075.0	1081.4	1087.9
40	1116.4	1123.6	1130.9
45	1158.8	1166.8	1174.8
50	1202.1	1210.9	1219.9
55	1246.2	1256.0	1265.8
60	1291.5	1302.1	1312.8
65	1337.6	1349.2	1360.8
70	1384.7	1397.2	1409.8
75	1432.7	1446.2	1459.8
80	1481.8	1496.2	1510.8
85	1531.6	1547.2	1562.8
90	1582.5	1599.1	1615.8
95	1634.3	1652.0	1669.8
100	1687.2	1705.9	1724.8
105	1740.9	1760.8	1780.9
110	1795.5	1816.6	1837.8
115	1851.1	1873.4	1895.9
120	1907.6	1931.2	1954.9
125	1965.1	1990.0	2015.0

SENSOR RESISTANCE VERSUS TEMPERATURE FOR 1KΩ SENSORS

TS.102F [1.0%]

T/GRAD °C	R min	R nom	R max
-55	479.2	489.0	498.9
-50	503.6	513.6	523.7
-45	529.2	539.2	549.3
-40	555.6	565.8	576.0
-35	583.1	593.3	603.7
-30	611.6	621.9	632.3
-25	641.0	651.4	661.8
-20	671.4	681.8	692.3
-15	702.9	713.3	723.8
-10	735.4	745.7	756.2
-5	768.7	779.1	789.5
0	803.1	813.5	823.9
5	838.5	848.8	859.2
10	875.1	885.2	895.5
15	912.3	922.5	932.6
20	950.7	960.7	970.8
25	990.0	1000.0	1010.0
30	1029.3	1040.2	1051.2
35	1069.6	1081.4	1093.3
40	1110.8	1123.6	1136.6
45	1153.0	1166.8	1180.7
50	1196.0	1210.9	1225.9
55	1240.0	1256.0	1272.1
60	1285.0	1302.1	1319.4
65	1330.9	1349.2	1367.5
70	1377.8	1397.2	1416.8
75	1425.5	1446.2	1467.0
80	1474.3	1496.2	1518.3
85	1523.9	1547.2	1570.6
90	1574.6	1599.1	1623.9
95	1626.1	1652.0	1678.1
100	1678.6	1705.9	1733.4
105	1732.1	1760.8	1789.7
110	1786.5	1816.6	1847.0
115	1841.8	1873.4	1905.4
120	1898.0	1931.2	1964.7
125	1955.3	1990.0	2025.1

SENSOR RESISTANCE VERSUS TEMPERATURE FOR 1KΩ SENSORS

TS.102G [2.0%]

T/GRAD °C	R min	R nom	R max
-55	474.3	489.0	503.9
-50	498.5	513.6	528.9
-45	523.8	539.2	554.8
-40	550.0	565.8	581.7
-35	577.2	593.3	609.7
-30	605.4	621.9	638.5
-25	634.6	651.4	668.3
-20	664.6	681.8	699.1
-15	695.8	713.3	730.9
-10	727.9	745.7	763.7
-5	761.0	779.1	797.3
0	795.0	813.5	832.0
5	830.1	848.8	867.7
10	866.2	885.2	904.3
15	903.1	922.5	941.9
20	941.1	960.7	980.4
25	980.0	1000.0	1020.0
30	1018.9	1040.2	1061.6
35	1058.8	1081.4	1104.2
40	1099.6	1123.6	1147.8
45	1141.3	1166.8	1192.4
50	1183.9	1210.9	1238.1
55	1227.5	1256.0	1284.7
60	1272.0	1302.1	1332.4
65	1317.4	1349.2	1381.1
70	1363.9	1397.2	1430.9
75	1411.1	1446.2	1481.6
80	1459.4	1496.2	1533.4
85	1508.5	1547.2	1586.1
90	1558.7	1599.1	1640.0
95	1609.7	1652.0	1694.7
100	1661.7	1705.9	1750.5
105	1714.6	1760.8	1807.4
110	1768.4	1816.6	1865.3
115	1823.2	1873.4	1924.2
120	1878.9	1931.2	1984.1
125	1935.5	1990.0	2045.1

SENSOR RESISTANCE VERSUS TEMPERATURE FOR 1KΩ SENSORS

TS.102H [3.0%]

T/GRAD °C	R min	R nom	R max
-55	469.5	489.0	508.8
-50	493.4	513.6	534.1
-45	518.5	539.2	560.2
-40	544.4	565.8	587.4
-35	571.3	593.3	615.6
-30	599.3	621.9	644.8
-25	628.1	651.4	674.9
-20	657.9	681.8	706.0
-15	688.7	713.3	738.1
-10	720.5	745.7	771.2
-5	753.2	779.1	805.2
0	786.9	813.5	840.2
5	821.6	848.8	876.2
10	857.4	885.2	913.2
15	993.9	922.5	951.1
20	931.5	960.7	990.0
25	970.0	1000.0	1030.0
30	1008.5	1040.2	1072.0
35	1048.0	1081.4	1115.0
40	1088.3	1123.6	1159.1
45	1129.7	1166.8	1204.1
50	1171.9	1210.9	1250.2
55	1214.9	1256.0	1297.3
60	1259.1	1302.1	1345.5
65	1304.0	1349.2	1394.6
70	1349.9	1397.2	1444.9
75	1396.7	1446.2	1496.1
80	1444.5	1496.2	1548.4
85	1493.1	1547.2	1601.7
90	1542.8	1599.1	1656.0
95	1593.2	1652.0	1711.3
100	1644.7	1705.9	1767.7
105	1697.1	1760.8	1825.2
110	1750.4	1816.6	1883.6
115	1804.6	1873.4	1943.1
120	1859.7	1931.2	2003.6
125	1915.8	1990.0	2065.2

SENSOR RESISTANCE VERSUS TEMPERATURE FOR 1KΩ SENSORS

TS.102J [5.0%]

T/GRAD °C	R min	R nom	R max
-55	459.8	489.0	518.7
-50	483.3	513.6	544.4
-45	507.8	539.2	571.1
-40	533.1	565.8	598.8
-35	559.6	593.3	627.6
-30	586.9	621.9	657.3
-25	615.1	651.4	688.0
-20	644.3	681.8	719.7
-15	674.5	713.3	752.4
-10	705.7	745.7	786.1
-5	737.7	779.1	820.8
0	770.6	813.5	856.5
5	804.7	848.8	893.2
10	839.7	885.2	930.9
15	875.4	922.5	969.6
20	912.3	960.7	1009.3
25	950.0	1000.0	1050.0
30	987.7	1040.2	1092.8
35	1026.4	1081.4	1136.6
40	1065.9	1123.6	1181.6
45	1106.4	1166.8	1227.5
50	1147.7	1210.9	1274.5
55	1189.9	1256.0	1322.5
60	1233.1	1302.1	1371.6
65	1277.1	1349.2	1421.7
70	1322.1	1397.2	1472.9
75	1367.9	1446.2	1525.1
80	1414.7	1496.2	1578.5
85	1462.3	1547.2	1632.8
90	1511.0	1599.1	1688.2
95	1560.4	1652.0	1744.6
100	1610.8	1705.9	1802.0
105	1662.1	1760.8	1860.6
110	1714.3	1816.6	1920.1
115	1767.4	1873.4	1980.8
120	1821.3	1931.2	2042.5
125	1876.3	1990.0	2105.3

SENSOR RESISTANCE VERSUS TEMPERATURE FOR 1KΩ SENSORS

TS.102GF1 [1.0%]

T/GRAD °C	R min	R nom	R max
-55	469.5	479.2	489.1
-50	493.4	503.3	513.3
-45	518.5	528.4	538.5
-40	544.4	554.5	564.6
-35	571.3	581.4	591.7
-30	599.3	609.5	619.7
-25	628.1	638.4	648.6
-20	657.9	668.2	678.5
-15	688.7	699.0	709.4
-10	720.5	730.8	741.2
-5	753.2	763.5	773.9
0	786.9	797.2	807.5
5	821.6	831.8	842.2
10	857.4	867.5	877.7
15	893.9	904.1	914.2
20	931.5	941.5	951.6
25	970.0	980.0	990.0
30	1008.5	1019.4	1030.4
35	1048.0	1059.8	1071.7
40	1088.3	1101.1	1114.0
45	1129.7	1143.5	1157.3
50	1171.9	1186.7	1201.7
55	1214.9	1230.9	1246.9
60	1259.1	1276.1	1293.2
65	1304.0	1322.2	1340.5
70	1349.9	1369.3	1388.8
75	1396.7	1417.3	1438.0
80	1444.5	1466.3	1488.3
85	1493.1	1516.3	1539.5
90	1542.8	1567.1	1591.7
95	1593.2	1619.0	1644.9
100	1644.7	1671.8	1699.0
105	1697.1	1725.6	1754.3
110	1750.4	1780.3	1810.4
115	1804.6	1835.9	1867.6
120	1859.7	1892.6	1925.7
125	1915.8	1950.2	1985.0

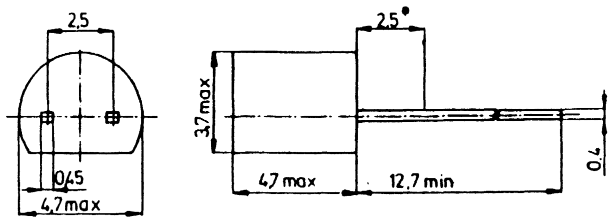
SENSOR RESISTANCE VERSUS TEMPERATURE FOR 1KΩ SENSORS

TS.102GF2 [1.0%]

T/GRAD °C	R min	R nom	R max
-55	488.8	498.8	508.8
-50	513.8	523.9	534.1
-45	539.8	550.0	560.2
-40	566.8	577.1	587.4
-35	594.9	605.2	615.6
-30	624.0	634.3	644.8
-25	654.0	664.4	674.9
-20	685.0	695.4	706.0
-15	717.1	727.6	738.1
-10	750.2	760.6	771.2
-5	784.3	794.7	805.2
0	819.3	829.8	840.2
5	855.5	865.8	876.2
10	892.7	902.9	913.2
15	930.7	941.0	951.1
20	969.9	979.9	990.0
25	1010.0	1020.0	1030.0
30	1050.1	1061.0	1072.0
35	1091.2	1103.0	1115.0
40	1133.2	1146.1	1159.1
45	1176.2	1190.1	1204.1
50	1220.2	1235.1	1250.2
55	1265.0	1281.1	1297.3
60	1311.0	1328.1	1345.5
65	1357.7	1376.2	1394.6
70	1405.6	1425.1	1444.9
75	1454.3	1475.1	1496.1
80	1504.1	1526.1	1548.4
85	1554.7	1578.1	1601.7
90	1606.4	1631.1	1656.0
95	1658.9	1685.0	1711.3
100	1712.6	1740.0	1767.7
105	1767.1	1796.0	1825.2
110	1822.5	1852.9	1883.6
115	1879.0	1910.9	1943.1
120	1936.4	1969.8	2003.6
125	1994.8	2029.8	2065.2

- Spreading-Resistance Sensor in Silicon Planar Technology
- Designed for Fast Temperature Measurements
- Simple and Accurate Linearization with One Serial or Parallel Resistor from −55 °C to 125 °C
- 2000 Ω Nominal Resistance Value at 25 °C
- Available in ±1 %, ±2 %, ±3 %,
- Positive Temperature Coefficient typ. 0,8 %/°C at 25 °C

mechanical data



* Lead diameter and solderability are not controlled in this area.

absolute maximum ratings at 25 °C free-air temperature (unless otherwise noted)

Max. Instantaneous Current I_{PK}	4 mA
Max. Operating Current I_{max}	1 mA
Operating Temperature Range T_A	−55 °C to 125 °C
Storage Temperature Range T_{stg}	−65 °C to 150 °C
Lead Temperature 1,6 mm from Case for 10 Seconds	260 °C

electrical and thermal characteristics

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
$R_{25°C}$	Nominal Resistance	$I = 100\ \mu A$, $T_A = 25°C$		2000		Ω
$R_{125°C}/R_{25°C}$	Resistance Ratio	$T_{A1} = 125°C$, $T_{A2} = 25°C$ $I = 100\ \mu A$		1.98		
$R_{100°C}/R_{25°C}$	Resistance Ratio	$T_{A1} = 100°C$, $T_{A2} = 25°C$ $I = 100\ \mu A$	1.68	1.7	1.72	
$R_{-55°C}/R_{25°C}$	Resistance Ratio	$T_{A1} = -55°C$, $T_{A2} = 25°C$ $I = 100\ \mu A$	0.47	0.49	0.51	
τ	Thermal Time Constant Moving Air	$T_{A1} = 25°C$, $T_{A2} = 82°C$ V_A 3m/Sec		10		Sec
τ	Thermal Time Constant Still Silicon Oil	$T_{A1} = 25°C$, $T_{A2} = 85°C$		4,3		Sec
G	Dissipation Constant Free Air	(see Note 1)		9		mW/°K

Note 1: The self heating can be calculated with formula $\Delta T = \frac{P}{G}$

ΔT = Self heating (°C)
P = Sensor power consumption (mW)
G = Dissipation constant (mW/°C)

TYPE	ACCURACY GROUP	$R_{25°C}$ (Ω) MIN	MAX	SYMBO
TSP202F	±1%	1980	2020	TP202F
TSP202G	±2%	1960	2040	TP202G
TSP202H	±3%	1940	2060	TP202H

recommended linearization

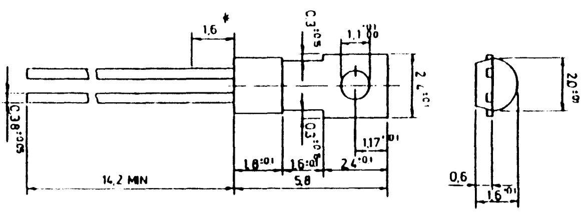
TEMPERATURE RANGE	TEMPERATURE LINEARITY	SERIAL OR PARALLEL RESISTOR VALUE
0 to 100°C	−0.2°C +0.2°C	5760 Ω

TYPE TSF202
POSITIVE TEMPERATURE COEFFICIENT SILICON SENSOR

April 1987

- **Spreading-Resistance Sensor in Silicon Planar Technology**
- **Designed for Fast Temperature Measurements**
- **Simple and Accurate Linearization with One Serial or Parallel Resistor from −55 °C to 125 °C**
- **2000 Ω Nominal Resistance Value at 25 °C**
- **Available in ±1 %, ±2 %, ±3 % and ±5 % Tolerances**
- **Positive Temperature Coefficient typ. 0,8 %/°C at 25 °C**

mechanical data



* LEAD DIAMETER IS NOT CONTROLLED IN THIS AREA

Mechanical stability according to DIN 40046 sheet 19 § 2/0,5 kp, § 3/0,25 kp

ATTENTION:
Sensor flag is electrically not isolated and must not be connected to any sensor lead.

absolute maximum ratings at 25 °C free-air temperature (unless otherwise noted)

Max. Instantaneous Current I_{PK}	4 mA
Max. Operating Current I_{max}	1 mA
Operating Temperature Range T_A	−55 °C to 125 °C
Storage Temperature Range T_{stg}	−65 °C to 150 °C
Lead Temperature 1,6 mm from Case for 10 Seconds	260 °C

electrical and thermal characteristics

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
$R_{25°C}$	Nominal Resistance	$I = 100\ \mu A$, $T_A = 25°C$		2000		Ω
$R_{125°C}/R_{25°C}$	Resistance Ratio	$T_{A1} = 125°C$, $T_{A2} = 25°C$ $I = 100\ \mu A$		1.98		
$R_{100°C}/R_{25°C}$	Resistance Ratio	$T_{A1} = 100°C$, $T_{A2} = 25°C$ $I = 100\ \mu A$	1.68	1.7	1.72	
$R_{-55°C}/R_{25°C}$	Resistance Ratio	$T_{A1} = -55°C$, $T_{A2} = 25°C$ $I = 100\ \mu A$	0.47	0.49	0.51	
τ	Thermal Time Constant Moving Air	$T_{A1} = 25°C$, $T_{A2} = 85°C$ $V_A = 3m/Sec$		2.5		Sec
τ	Thermal Time Constant Still Silicon Oil	$T_{A1} = 25°C$, $T_{A2} = 85°C$		1		Sec
τ	Thermal Time Constant Flag Mounted on Cu Block	$T_{A1} = 25°C$, $T_{A2} = 85°C$		0.17		Sec
G	Dissipation Constant Free Air	(see Note 1)		3		mW/°K
G	Dissipation Constant Mounted on Cu Block	(see Note 1)		8		mW/°K

Note 1: The self heating can be calculated with formula $\Delta T = \frac{P}{G}$

ΔT = Self heating (°C)
P = Sensor power consumption (mW)
G = Dissipation constant (mW/°C)

TYPE	ACCURACY GROUP	$R_{25°C}$ MIN	(Ω) MAX	IDENTIFICATION COLOR
TSF202F	±1%	1980	2020	
TSF202G	±2%	1960	2040	red
TSF202H	±3%	1940	2060	orange
TSF202J	±5%	1900	2100	green

recommended linearization

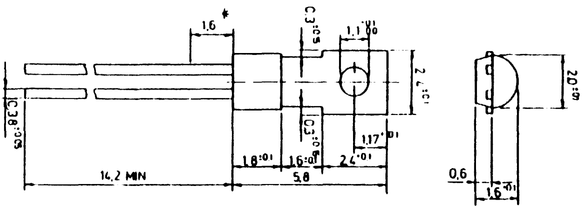
TEMPERATURE RANGE	TEMPERATURE LINEARITY	SERIAL OR PARALLEL RESISTOR VALUE
0 to 100°C	−0.2°C +0.2°C	5760 Ω

TYPE TSF202GF
POSITIVE TEMPERATURE COEFFICIENT SILICON SENSOR

April 1987

- **Spreading-Resistance Sensor in Silicon Planar Technology**
- **Designed for Fast Temperature Measurements**
- **Simple and Accurate Linearization with One Serial or Parallel Resistor from − 55 °C to 125 °C**
- **2000 Ω Nominal Resistance Value at 25 °C**
- **Available in two groups, each one with ± 1 % tolerances**
- **Positive Temperature Coefficient typ. 0,8 %/°C at 25 °C**

mechanical data



* LEAD DIAMETER IS NOT CONTROLLED IN THIS AREA

Mechanical stability according to DIN 40046 sheet 19 § 2/0,5 kp, § 3/0,25 kp

ATTENTION:
Sensor flag is electrically not isolated and must not be connected to any sensor lead.

absolute maximum ratings at 25 °C free-air temperature (unless otherwise noted)

Max. Instantaneous Current I_{PK}	4 mA
Max. Operating Current I_{max}	1 mA
Operating Temperature Range T_A	−55 °C to 125 °C
Storage Temperature Range T_{stg}	−65 °C to 150 °C
Lead Temperature 1,6 mm from Case for 10 Seconds	260 °C

electrical and thermal characteristics

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
$R_{25°C}$	Nominal Resistance	$I = 100\ \mu A$, $T_A = 25°C$		2000		Ω
$R_{125°C}/R_{25°C}$	Resistance Ratio	$T_{A1} = 125°C$, $T_{A2} = 25°C$ $I = 100\ \mu A$		1.98		
$R_{100°C}/R_{25°C}$	Resistance Ratio	$T_{A1} = 100°C$, $T_{A2} = 25°C$ $I = 100\ \mu A$	1.68	1.7	1.72	
$R_{-55°C}/R_{25°C}$	Resistance Ratio	$T_{A1} = -55°C$, $T_{A2} = 25°C$ $I = 100\ \mu A$	0.47	0.49	0.51	
τ	Thermal Time Constant Moving Air	$T_{A1} = 25°C$, $T_{A2} = 85°C$ $V_A = 3m/Sec$		2.5		Sec
τ	Thermal Time Constant Still Silicon Oil	$T_{A1} = 25°C$, $T_{A2} = 85°C$		1		Sec
τ	Thermal Time Constant Flag Mounted on Cu Block	$T_{A1} = 25°C$, $T_{A2} = 85°C$		0.17		Sec
G	Dissipation Constant Free Air	(see Note 1)		3		mW/°K
G	Dissipation Constant Mounted on Cu Block	(see Note 1)		8		mW/°K

Note 1: The self heating can be calculated with formula $\Delta T = \frac{P}{G}$

ΔT = Self heating (°C)
P = Sensor power consumption (mW)
G = Dissipation constant (mW/°C)

TYPE	ACCURACY GROUP	$R_{25°C}$ (Ω) MIN	MAX	IDENTIFICATION COLOR
TSF202GF-1	±1%	1940	1980	blue
TSF202GF-2	±1%	2020	2060	yellow

recommended linearization

TEMPERATURE RANGE	TEMPERATURE LINEARITY	SERIAL OR PARALLEL RESISTOR VALUE
0 to 100°C	−0.2°C +0.2°C	5760 Ω

SENSOR RESISTANCE VERSUS TEMPERATURE FOR 2KΩ SENSORS

TS.202F [1.0%]

T/GRAD °C	R min	R nom	R max
-55	930.6	980.0	1030.2
-50	984.5	1029.4	1075.1
-45	1039.9	1080.8	1122.2
-40	1096.9	1134.0	1171.6
-35	1155.5	1189.2	1223.3
-30	1215.7	1246.3	1277.2
-25	1277.1	1305.2	1333.4
-20	1340.6	1366.1	1391.9
-15	1405.4	1428.9	1452.6
-10	1471.8	1493.6	1515.6
-5	1539.7	1560.2	1580.9
0	1609.2	1628.8	1648.4
5	1680.2	1699.2	1718.2
10	1752.8	1771.5	1790.3
15	1827.0	1845.8	1864.6
20	1902.7	1921.9	1941.2
25	1980.0	2000.0	2020.0
30	2058.8	2080.0	2101.1
35	2139.2	2161.9	2184.5
40	2221.2	2245.7	2270.1
45	2304.7	2331.3	2358.0
50	2389.8	2419.0	2448.2
55	2476.5	2508.5	2540.6
60	2564.7	2599.9	2635.3
65	2654.4	2693.2	2732.3
70	2745.7	2788.5	2831.5
75	2838.6	2885.6	2933.0
80	2933.1	2984.7	3036.7
85	3029.1	3085.7	3142.8
90	3126.6	3188.5	3251.0
95	3225.7	3293.3	3361.6
100	3326.4	3400.0	3474.4
105	3428.6	3508.6	3589.5
110	3532.4	3619.1	3706.8
115	3637.8	3731.5	3826.4
120	3744.7	3845.9	3948.3
125	3853.2	3962.1	4072.4

SENSOR RESISTANCE VERSUS TEMPERATURE FOR 2KΩ SENSORS

TS.202G [2.0%]

T/GRAD °C	R min	R nom	R max
-55	921.2	980.0	1040.4
-50	974.6	1029.4	1085.7
-45	1029.4	1080.8	1133.3
-40	1085.9	1134.0	1183.2
-35	1143.8	1189.2	1235.4
-30	1203.7	1246.3	1289.9
-25	1264.2	1305.2	1346.6
-20	1327.0	1366.1	1405.7
-15	1391.2	1428.9	1467.0
-10	1456.9	1493.6	1530.6
-5	1524.1	1560.2	1596.5
0	1592.9	1628.8	1664.7
5	1663.2	1699.2	1735.2
10	1735.1	1771.5	1808.0
15	1808.5	1845.8	1883.0
20	1883.5	1921.9	1960.4
25	1960.0	2000.0	2040.0
30	2038.0	2080.0	2121.9
35	2117.6	2161.9	2206.1
40	2198.8	2245.7	2292.6
45	2281.4	2331.3	2381.4
50	2365.7	2419.0	2472.4
55	2451.4	2508.5	2565.8
60	2538.7	2599.9	2661.4
65	2627.6	2693.2	2759.3
70	2718.0	2788.5	2859.5
75	2809.9	2885.6	2962.0
80	2903.4	2984.7	3066.8
85	2998.5	3085.7	3173.9
90	3095.0	3188.5	3283.2
95	3193.1	3293.3	3394.9
100	3292.8	3400.0	3508.8
105	3394.0	3508.6	3625.0
110	3496.7	3619.1	3743.5
115	3601.0	3731.5	3864.3
120	3706.9	3845.9	3987.4
125	3814.3	3962.1	4112.7

SENSOR RESISTANCE VERSUS TEMPERATURE FOR 2KΩ SENSORS

TS.202H [3.0%]

T/GRAD °C	R min	R nom	R max
-55	911.8	980.0	1050.6
-50	964.6	1029.4	1096.4
-45	1018.9	1080.8	1144.4
-40	1074.8	1134.0	1194.8
-35	1132.2	1189.2	1247.5
-30	1191.1	1246.3	1302.5
-25	1251.3	1305.2	1359.8
-20	1313.5	1366.1	1419.5
-15	1377.0	1428.9	1481.4
-10	1442.0	1493.6	1545.6
-5	1508.6	1560.2	1612.2
0	1576.7	1628.8	1681.1
5	1646.3	1699.2	1752.2
10	1717.4	1771.5	1825.7
15	1790.1	1845.8	1901.5
20	1864.3	1921.9	1979.6
25	1940.0	2000.0	2060.0
30	2017.3	2080.0	2142.7
35	2096.0	2161.9	2227.7
40	2176.3	2245.7	2315.1
45	2258.2	2331.3	2404.7
50	2341.5	2419.0	2496.7
55	2426.4	2508.5	2590.9
60	2512.8	2599.9	2687.5
65	2600.8	2693.2	2786.4
70	2690.3	2788.5	2887.6
75	2781.3	2885.6	2991.1
80	2873.8	2984.7	3096.9
85	2967.9	3085.7	3205.0
90	3063.4	3188.5	3315.4
95	3160.6	3293.3	3428.2
100	3259.2	3400.0	3543.2
105	3359.4	3508.6	3660.6
110	3461.1	3619.1	3780.2
115	3564.3	3731.5	3902.2
120	3669.1	3845.9	4026.5
125	3775.3	3962.1	4153.1

SENSOR RESISTANCE VERSUS TEMPERATURE FOR 2KΩ SENSORS

TS.202J [5.0%]

T/GRAD °C	R min	R nom	R max
−55	893.0	980.0	1071.0
−50	944.7	1029.4	1117.7
−45	997.9	1080.8	1166.7
−40	1052.6	1134.0	1218.0
−35	1108.8	1189.2	1271.7
−30	1166.5	1246.3	1327.8
−25	1225.5	1305.2	1386.3
−20	1286.4	1366.1	1447.0
−15	1348.6	1428.9	1510.2
−10	1412.3	1493.6	1575.7
−5	1477.5	1560.2	1643.5
0	1544.2	1628.8	1713.7
5	1612.3	1699.2	1786.2
10	1682.0	1771.5	1861.2
15	1753.2	1845.8	1938.4
20	1825.8	1921.9	2018.0
25	1900.0	2000.0	2100.0
30	1975.7	2080.0	2184.3
35	2052.8	2161.9	2271.0
40	2131.5	2245.7	2360.0
45	2211.6	2331.3	2451.4
50	2293.3	2419.0	2545.1
55	2376.4	2508.5	2641.2
60	2461.0	2599.9	2739.7
65	2547.2	2693.2	2840.5
70	2634.8	2788.5	2943.6
75	2723.9	2885.6	3049.1
80	2814.5	2984.7	3157.0
85	2906.7	3085.7	3267.2
90	3000.3	3188.5	3379.8
95	3095.4	3293.3	3494.7
100	3192.0	3400.0	3612.0
105	3290.1	3508.6	3731.6
110	3389.7	3619.1	3853.6
115	3490.8	3731.5	3978.0
120	3593.4	3845.9	4104.6
125	3697.5	3962.1	4233.7

SENSOR RESISTANCE VERSUS TEMPERATURE FOR 2KΩ SENSORS

TS.202GF1 [1.0%]

T/GRAD °C	R min	R nom	R max
-55	911.8	960.4	1009.8
-50	964.6	1008.9	1053.8
-45	1018.9	1059.2	1100.0
-40	1074.8	1111.3	1148.4
-35	1132.2	1165.4	1199.1
-30	1191.1	1221.3	1252.0
-25	1251.3	1279.1	1307.0
-20	1313.5	1338.8	1364.3
-15	1377.0	1400.3	1423.9
-10	1442.0	1463.8	1485.6
-5	1508.6	1529.0	1549.6
0	1576.7	1596.2	1615.8
5	1646.3	1665.2	1684.2
10	1717.4	1736.1	1754.8
15	1790.1	1808.9	1827.6
20	1864.3	1883.5	1902.7
25	1940.0	1960.0	1980.0
30	2017.3	2038.4	2059.5
35	2096.0	2118.6	2141.2
40	2176.3	2200.7	2225.2
45	2258.2	2284.7	2311.3
50	2341.5	2370.6	2399.7
55	2426.4	2458.3	2490.3
60	2512.8	2547.9	2583.1
65	2600.8	2639.4	2678.2
70	2690.3	2732.7	2775.4
75	2781.3	2827.9	2874.9
80	2873.8	2925.0	2976.6
85	2967.9	3023.9	3080.5
90	3063.4	3124.7	3186.7
95	3160.6	3227.4	3295.0
100	3259.2	3332.0	3405.6
105	3359.4	3438.4	3518.4
110	3461.1	3546.7	3633.4
115	3564.3	3656.9	3750.6
120	3669.1	3768.9	3870.1
125	3775.3	3882.9	3991.8

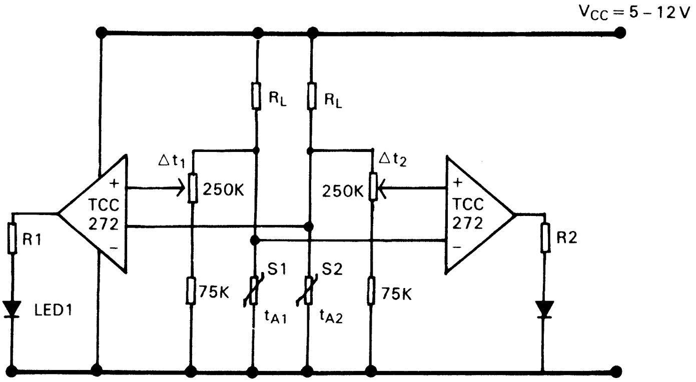
SENSOR RESISTANCE VERSUS TEMPERATURE FOR 2KΩ SENSORS

TS.202GF2 [1.0%]

T/GRAD °C	R min	R nom	R max
-55	949.4	999.6	1050.6
-50	1004.4	1050.0	1096.4
-45	1061.0	1102.4	1144.4
-40	1119.1	1156.7	1194.8
-35	1178.9	1213.0	1247.5
-30	1240.2	1271.2	1302.5
-25	1302.9	1331.3	1359.8
-20	1367.7	1393.5	1419.5
-15	1433.8	1457.5	1481.4
-10	1501.5	1523.5	1545.6
-5	1570.8	1591.4	1612.2
0	1641.7	1661.3	1681.1
5	1714.2	1733.2	1752.2
10	1788.2	1807.0	1825.7
15	1863.9	1882.7	1901.5
20	1941.2	1960.4	1979.6
25	2020.0	2040.0	2060.0
30	2100.4	2121.6	2142.7
35	2182.5	2205.1	2227.7
40	2266.1	2290.6	2315.1
45	2351.3	2378.0	2404.7
50	2438.1	2467.3	2496.7
55	2526.5	2558.6	2590.9
60	2616.5	2651.9	2687.5
65	2708.0	2747.1	2786.4
70	2801.2	2844.2	2887.6
75	2896.0	2943.3	2991.1
80	2992.3	3044.4	3096.9
85	3090.2	3147.4	3205.0
90	3189.8	3252.3	3315.4
95	3290.9	3359.2	3428.2
100	3393.6	3468.0	3543.2
105	3497.9	3578.8	3660.6
110	3603.8	3691.5	3780.2
115	3711.3	3806.2	3902.2
120	3820.4	3922.8	4026.5
125	3931.0	4041.3	4153.1

Temperature Sensor Applications

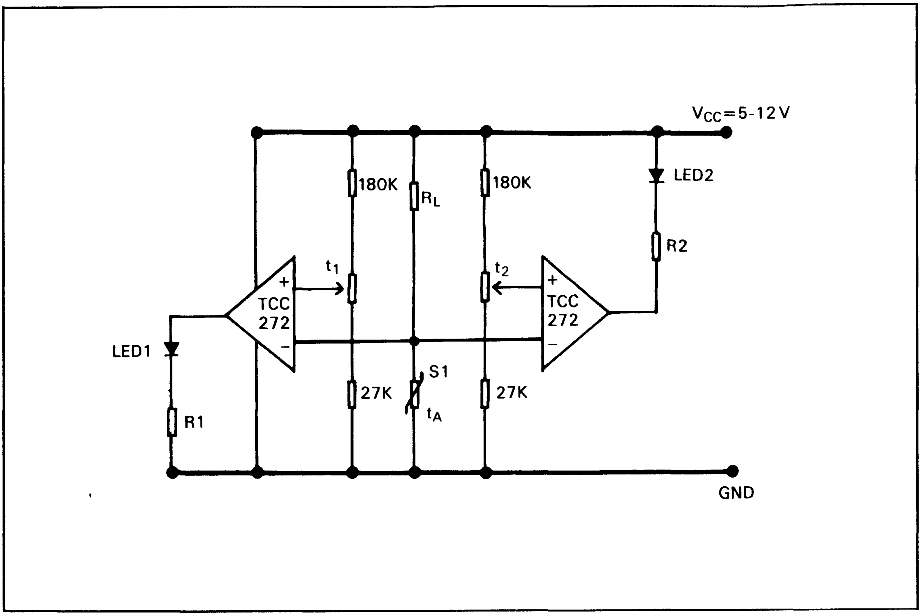
Dual Temperature Indicator/Regulator



Single Temperature sensing point and dual Indicator/Regulator output circuit shown in above figure could be easily expanded to multi output capability.

OUT / IN	LED 1	LED 2
$t_{A1}-\Delta t_1 > t_2$	ON	x
$t_{A1}-\Delta t_1 < t_2$	OFF	x
$t_{A2}-\Delta t_2 > t_1$	x	ON
$t_{A2}-\Delta t_2 < t_1$	x	OFF

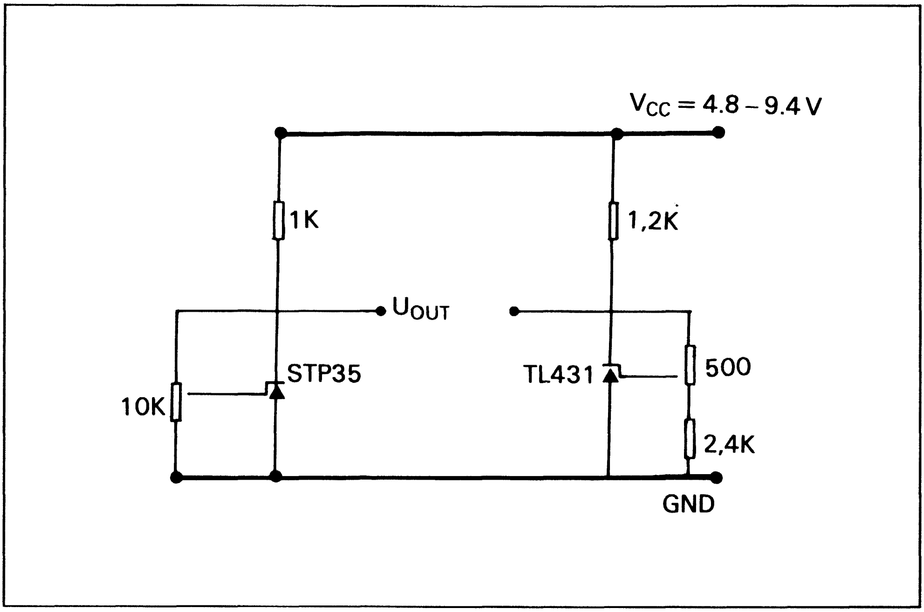
Differential Temperature level Indicator



This figure shows a circuit for dual temperature sensing points and dual Indicator/Regulator output.

IN \ OUT	LED 1	LED 2
$t_A > t_1$	OFF	x
$t_A < t_1$	ON	x
$t_A > t_2$	x	ON
$t_A < t_2$	x	OFF

Analog Temperature meter



This figure shows a temperature sensing circuit with an integrated temperature sensor STP35 and a voltage reference IC TL431.

This circuit supports you with a voltage analog to the temperature.

You can connect this circuit directly to a voltage measuring instrument, which gives you a simple temperature sensing instrument.

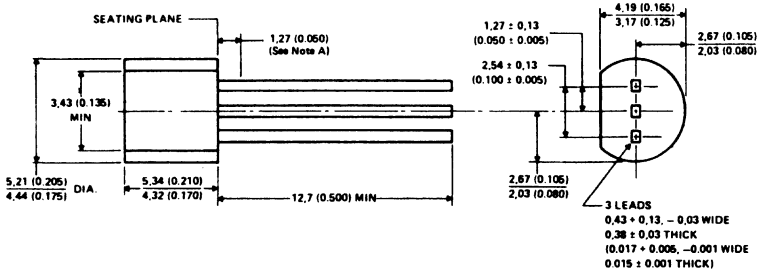
Hall – Effect Sensors

MECHANICAL DATA

LP and LU plastic packages

These packages each consists of a circuit mounted on a lead frame and encapsulated within a plastic compound. The compound will withstand soldering temperature with no deformation and circuit performance characteristics remain stable when operated in high-humidity conditions. Leads require no additional cleaning or processing when used in soldered assembly.

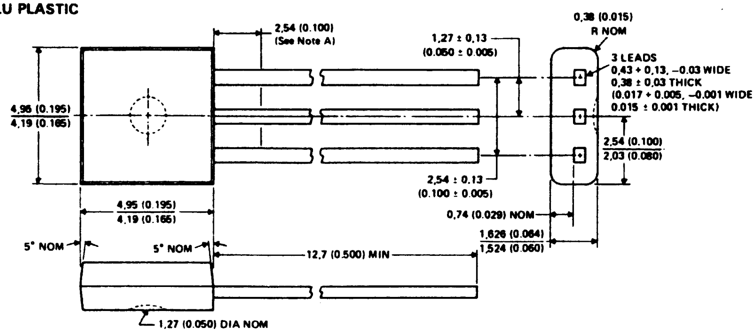
LP PLASTIC



Falls Within JEDEC TO-226AA Dimensions
(TO-226AA Replaces TO-92)
ALL LINEAR DIMENSIONS ARE IN MILLIMETERS AND PARENTHETICALLY IN INCHES

NOT TO SCALE

LU PLASTIC



ALL LINEAR DIMENSIONS ARE IN MILLIMETERS AND PARENTHETICALLY IN INCHES

NOT TO SCALE

NOTE A: Lead dimensions are not controlled within this area.

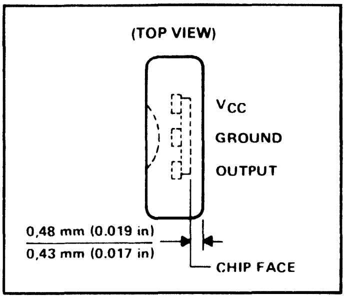
LINEAR INTEGRATED CIRCUITS

TL3101I, TL3101C SILICON HALL-EFFECT SWITCH

APRIL 1985

- Magnetic-Field Sensing Hall-Effect Input
- On-Off Hysteresis
- Small Size
- Solid-State Technology
- Open-Collector Output
- Buried Hall-Effect Cell Reduces Threshold Drift Caused By Temperature Variation and Aging

LU PACKAGE



description

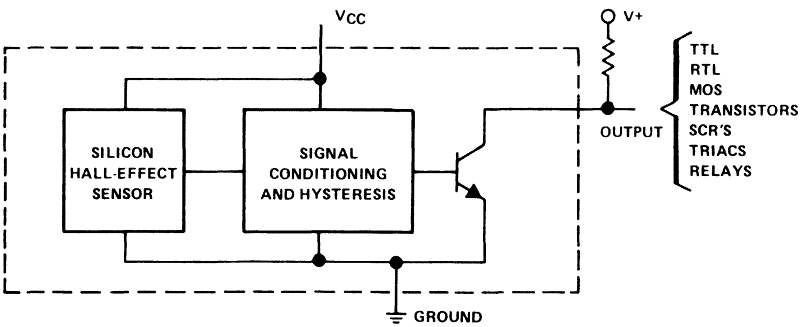
The TL3101I and TL3101C are low-cost magnetically operated electronic switches that utilize the Hall Effect to sense steady-state magnetic fields. Each circuit consists of a Hall-Effect sensor, signal conditioning and hysteresis functions, and an output transistor integrated into a monolithic chip. The outputs of these circuits can be directly connected to many different types of electronic components.

The TL3101C is characterized for operation over the temperature range of 0°C to 70°C. The TL3101I is characterized for operation over the range of -40°C to 85°C.

FUNCTION TABLE 0°C TA ≤ 70°C

FLUX DENSITY	OUTPUT
≤ −25 mT	Off
−25 mT < B < 25 mT	Undefined
≥ 25 mT	On

functional block diagram



ADVANCE INFORMATION
This document contains information on a new product. Specifications are subject to change without notice.

TEXAS INSTRUMENTS

absolute maximum ratings over operating free-air temperature range (unless otherwise noted)

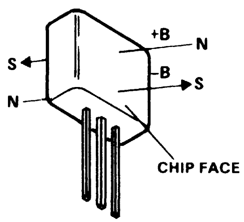
Supply voltage, V_{CC} (see Note 1) .... 7 V
Output voltage .... 30 V
Output current .... 20 mA
Operating free-air temperature range: TL3101C .... 0°C to 70°C
TL3101I .... -40°C to 85°C
Storage temperature range .... -65°C to 150°C
Lead temperature 1,6 mm (1/16 inch) from case for 10 seconds .... 260°C
Magnetic flux density .... unlimited

NOTE 1: Voltage values are with respect to network ground terminal.

electrical characteristics at specified free-air temperature, V_{CC} = 5 V ± 5% (unless otherwise noted)

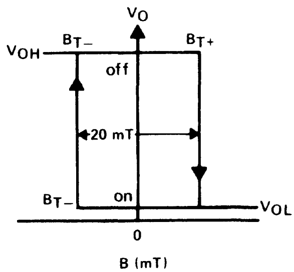
	PARAMETER	TEST CONDITIONS			MIN	TYP	MAX	UNIT
B_{T+}	Threshold of positive going magnetic flux density†			0°C to 70°C	0		25	mT§
				-40°C to 85°C	0		35	
B_{T-}	Threshold of negative going magnetic flux density†			0°C to 70°C	-25‡		0	mT§
				-40°C to 85°C	-35‡		0	
$B_{T+} - B_{T-}$	Hysteresis			0°C to 70°C	5	20		mT‡
I_{OH}	High-level output current	V_{OH} = 20 V		0°C to 70°C			100	μA
V_{OL}	Low-level output voltage	V_{CC} = 4.75, I_{OL} = 16 mA		0°C to 70°C			0.4	V
I_{CC}	Supply current	V_{CC} = 5.25 V	Output low	0°C to 70°C			6	mA
			Output high				4	

†Threshold values are those levels of magnetic flux density at which the output changes state. For the TL3101, a level more positive than B_{T+} causes the output to go to a low level and a level more negative than B_{T-} causes the output to go to a high level. See Figures 1 and 2.
‡The algebraic convention, where the most negative limit is designated as minimum, is used in this data sheet for flux density threshold levels only.
§The unit of magnetic flux density in the International System of Units (SI) is the tesla (T). The tesla is equal to one weber per square meter. Values expressed in milliteslas may be converted to gauss by multiplying by ten.



The north pole of a magnet is the pole that is attracted by the geographical north pole. The north pole of a magnet repels the north-seeking pole of a compass. By accepted magnetic convention, lines of flux emanate from the north pole of a magnet and enter the south pole.

FIGURE 1. DEFINITION OF MAGNETIC FLUX POLARITY



The positive-going threshold (B_{T+}) is a positive B level at which a positive-going flux density results in the TL3101 output turning on. The negative-going threshold is negative B level at which a negative-going flux density results in the TL3101 turning off.

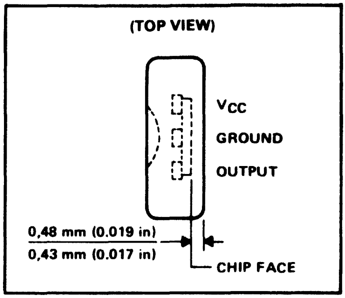
FIGURE 2. REPRESENTATIVE CURVES OF V_O vs B

TL3103I, TL3103C
LINEAR HALL-EFFECT SENSORS

MAY 1985

- Output Voltage Linear with Applied Magnetic Field
- Sensitivity Stable Over Wide Operating Temperature Range
- Buried Hall Cell Reduces Drift Due to Temperature Variation and Aging
- Solid-State Technology
- Three-Terminal Device
- Senses Static or Dynamic Magnetic Fields

LU PACKAGE

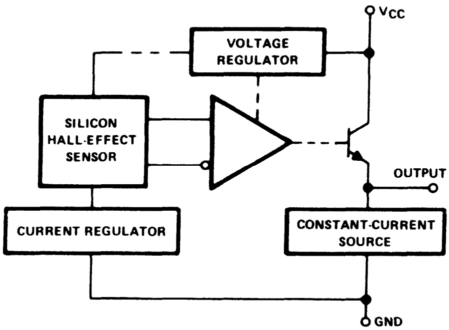


description

The TL3103I and TL3103C are low-cost magnetic-field sensors designed to provide a linear output voltage proportional to the magnetic field they sense. These monolithic circuits incorporate a Hall element as the primary sensor along with a voltage reference and a precision amplifier. Temperature stabilization and internal trimming circuitry yield a device that features high overall sensitivity accuracy with less than 5% error over its operating temperature range.

The TL3103I is characterized for operation from -40°C to 85°C. The TL3103C is characterized for operation from 0°C to 70°C.

functional block diagram



absolute maximum ratings over operating free-air temperature range (unless otherwise noted)

Supply voltage, V_{CC} (see Note 1)	25 V
Continuous total dissipation at (or below) 25°C free-air temperature (see Note 2)	775 mW
Operating free-air temperature range: TL3103I	-40°C to 85°C
TL3103C	0°C to 70°C
Storage temperature range	-65°C to 150°C
Lead temperature 1,6 mm (1/16 inch) from case for 10 seconds	260°C
Magnetic flux density	unlimited

NOTES: 1. Voltage values are with respect to network ground terminal.
2. For operation above 25°C free-air temperature, derate linearly at the rate of 6.2 mW/°C.

ADVANCE INFORMATION
This document contains information on a new product. Specifications are subject to change without notice.

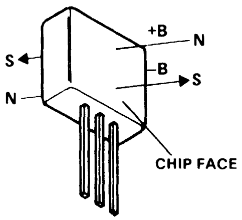
recommended operating conditions

		TL3103I			TI3103C			UNIT
		MIN	NOM	MAX	MIN	NOM	MAX	
Supply voltage, V_{CC}		9	12	15	9	12	15	V
Magnetic flux density, B				±50			±50	mT
Output current, I_O	Sink			0.5			0.5	mA
	Source			-2			-2	mA
Operating free-air temperature, T_A		-40		85	0		70	°C

electrical characteristics over recommended ranges of supply voltage and magnetic flux density, T_A = 25°C (unless otherwise noted)

	PARAMETER	TEST CONDITIONS†		MIN	TYP‡	MAX	UNIT
V_O	Output voltage	I_O = -2 mA to 0.5 mA,		5.8	6	6.2	V
k_{SVS}	Supply voltage sensitivity ($\Delta V_{IO}/\Delta V_{CC}$)	B = 0 mT§			18		mV/V
S	Magnetic sensitivity ($\Delta V_O/\Delta B$)	B = -50 to 50 mT§		14	16	18	V/T§
ΔS	Magnetic sensitivity change with temperature	ΔT_A = 25°C to MIN or MAX				±5	%
I_{CC}	Supply current	B = 0 mT§,	I_O = 0		8	12	mA
f_{max}	Maximum operating frequency				100		kHz

†For conditions shown as MIN or MAX, use the appropriate value specified under recommended operating conditions.
‡Typical values are at V_{CC} = 12 V at T_A = 25°C.
§The unit of magnetic flux density in the International System of Units (SI) is the tesla (T). The tesla is equal to one weber per square meter. Values expressed in milliteslas may be converted to gauss by multiplying by ten, e.g., 50 millitesla = 500 gauss.



The north pole of a magnet is the pole that is attracted by the geographical north pole. The north pole of a magnet repels the north-seeking pole of a compass. By accepted magnetic convention, lines of flux emanate from the north pole of a magnet and enter the south pole.

FIGURE 1. DEFINITION OF MAGNETIC FLUX POLARITY

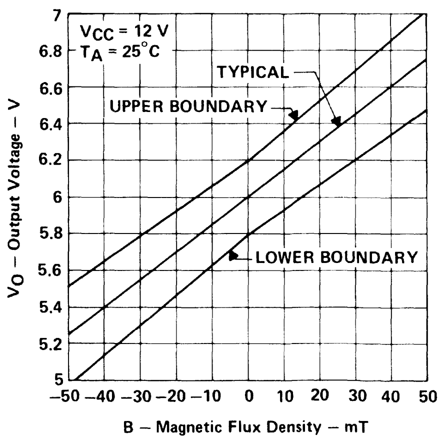


FIGURE 2

TYPICAL APPLICATION DATA

The circuit in Figure 3 may be used to set the output voltage at zero field strength to exactly 6 V (using R1), to set the sensitivity to exactly −15 V/T (using R2), as depicted in Figure 4.

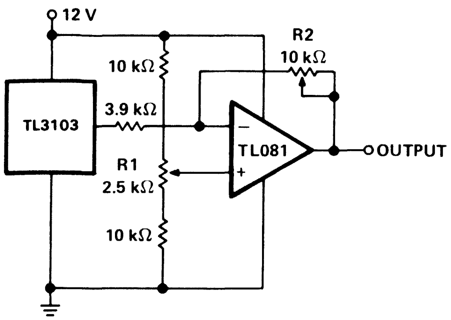


FIGURE 3. COMPENSATION CIRCUIT

COMPENSATED OUTPUT VOLTAGE
vs
MAGNETIC FLUX DENSITY

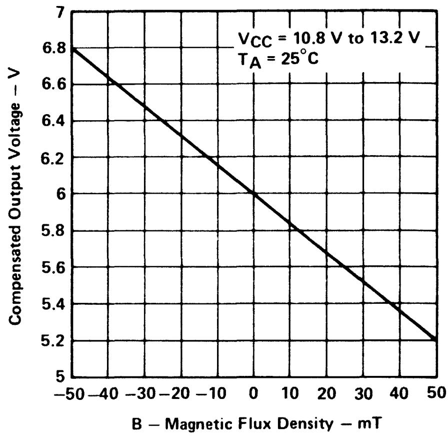


FIGURE 4

OUTPUT VOLTAGE
vs
SUPPLY VOLTAGE

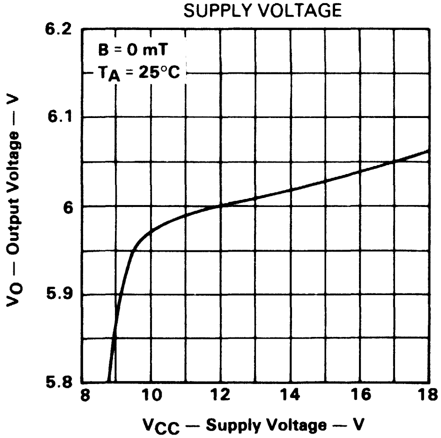


FIGURE 5

OUTPUT VOLTAGE
vs
FREE-AIR TEMPERATURE

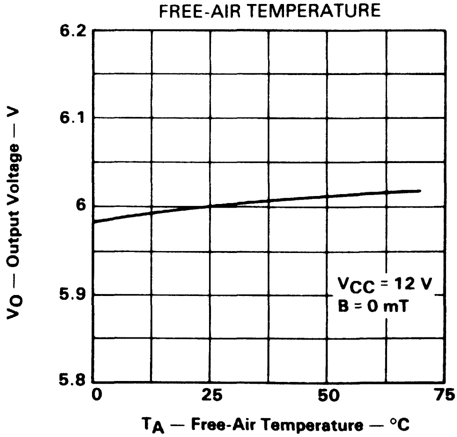


FIGURE 6

MAGNETIC SENSITIVITY
vs
SUPPLY VOLTAGE

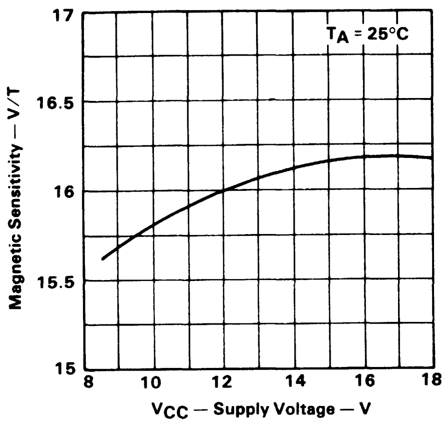


FIGURE 7

MAGNETIC SENSITIVITY
vs
FREE-AIR TEMPERATURE

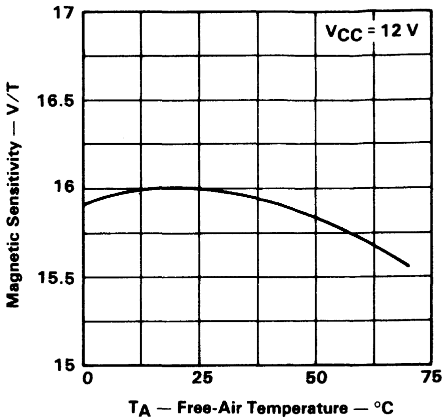


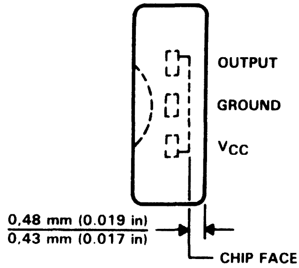
FIGURE 8

TL3019C SILICON HALL-EFFECT SWITCH

D2903, JULY 1985

- **Magnetic-Field Sensing Hall-Effect Input**
- **On-Off Hysteresis**
- **Small Size**
- **Standard Bipolar Technology Minimizes ESD Susceptibility**
- **I_{OL} . . . 20 mA Min at V_{OL} = 0.4 V**
- **I_{OH} . . . 1 μA Max at V_{OH} = 24 V**
- **Buried Hall-Effect Cell Reduces Threshold Drift Caused by Temperature Variation and Aging**
- **Direct Replacement for the Sprague UGN3019**

LU PACKAGE (TOP VIEW)



description

The TL3019C is a low-cost magnetically operated electronic switch that utilizes the Hall Effect to sense magnetic fields. Each circuit consists of a Hall-Effect sensor, signal conditioning and hysteresis functions, and an output transistor integrated into a monolithic chip. The outputs of these circuits can be directly connected to many different types of electronic components.

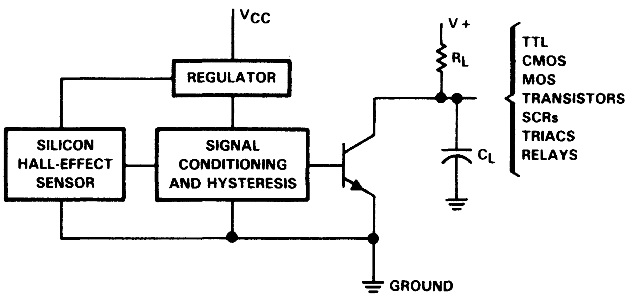
The TL3019C is characterized for operation over the temperature range of 0°C to 70°C.

FUNCTION TABLE (0°C ≤ T_A ≤ 70°C)

FLUX DENSITY	OUTPUT
B ≤ 12.5 mT (125 G)	Off
12.5 mT (125 G) < B < 50 mT (500 G)	Undefined
B ≥ 50 mT (500 G)	On

The unit of magnetic density in the International System of Units (SI) is the tesla (T). The tesla is equal to one weber per square meter. Values expressed in milliteslas may be converted to gauss (G) by multiplying by ten.

functional block diagram



absolute maximum ratings over operating free-air temperature range (unless otherwise noted)

Supply voltage, V_{CC} (see Note 1)	40 V
Output voltage	40 V
Output current	30 mA
Magnetic flux density	unlimited
Operating free-air temperature range	0°C to 70°C
Storage temperature range	−65°C to 150°C
Lead temperature 1,6 mm (1/16 inch) from case for 10 seconds	260°C

NOTE 1. Voltage values are with respect to the network ground terminal.

electrical characteristics over operating free-air temperature range, V_{CC} = 4.5 V to 24 V (unless otherwise noted)

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
B_{OP}	Operate-point magnetic flux density (see Figure 2)			42	50	mT†
B_{RP}	Release-point magnetic flux density (see Figure 2)		12.5	30		mT†
B_{hys}	Hysteresis ($B_{OP} - B_{RP}$)		5	12		mT†
α_B	Temperature coefficient of B_{OP} and B_{RP}			±0.25		%/°C
V_{OL}	Low-level output voltage	I_{OL} = 20 mA			0.4	V
I_{OH}	High-level output current	V_{OH} = 24 V			1	μA
I_{CC}	Supply current			3	7	mA

†The unit of magnetic density in the International System of Units (SI) is the tesla (T). The tesla is equal to one weber per square meter. Values expressed in milliteslas may be converted to gauss (G) by multiplying by ten.

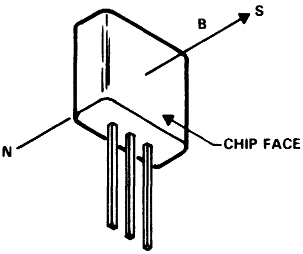


FIGURE 1. DEVICE ORIENTATION IN A MAGNETIC FIELD

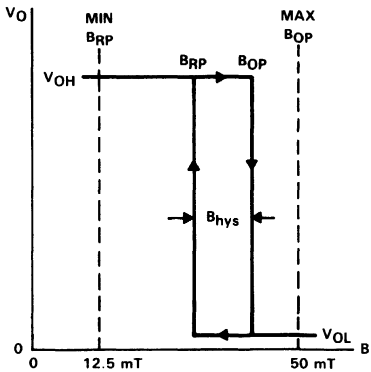


FIGURE 2. REPRESENTATIVE CURVE OF V_O vs B

switching characteristics at V_{CC} = 12 V, T_A = 25°C (unless otherwise noted)

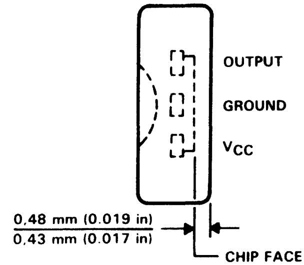
PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
t_r	Output rise time	R_L = 820 Ω, C_L = 20 pF		350		ns
t_f	Output fall time			85		

TL3020C SILICON HALL-EFFECT SWITCH

D2903, OCTOBER 1985

- **Magnetic-Field Sensing Hall-Effect Input**
- **On-Off Hysteresis**
- **Small Size**
- **Standard Bipolar Technology Minimizes ESD Susceptibility**
- **I_{OL} . . . 20 mA Min at V_{OL} = 0.4 V**
- **I_{OH} . . . 1 μA Max at V_{OH} = 24 V**
- **Buried Hall-Effect Cell Reduces Threshold Drift Caused by Temperature Variation and Aging**
- **Direct Replacement for the Sprague UGN3020**

LU PACKAGE (TOP VIEW)



FUNCTION TABLE (0°C ≤ T_A ≤ 70°C)

FLUX DENSITY	OUTPUT
B ≤ 5 mT (50 G)	Off
5 mT (50 G) < B < 35 mT (350 G)	Undefined
B ≥ 35 mT (350 G)	On

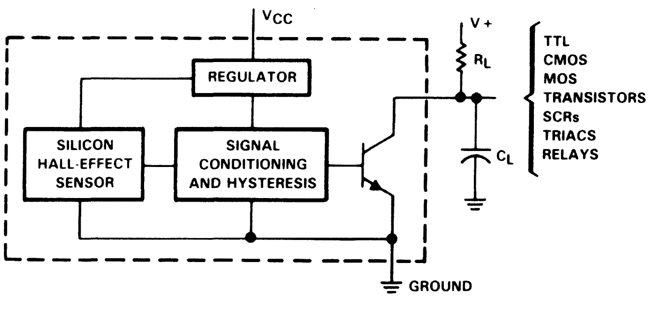
The unit of magnetic density in the International System of Units (SI) is the tesla (T). The tesla is equal to one weber per square meter. Values expressed in milliteslas may be converted to gauss (G) by multiplying by ten.

description

The TL3020C is a low-cost magnetically operated electronic switch that utilizes the Hall effect to sense magnetic fields. Each circuit consists of a Hall-effect sensor, signal conditioning and hysteresis functions, and an output transistor integrated into a monolithic chip. The outputs of these circuits can be directly connected to many different types of electronic components.

The TL3020C is characterized for operation over the temperature range of 0°C to 70°C.

functional block diagram



TEXAS INSTRUMENTS

absolute maximum ratings over operating free-air temperature range (unless otherwise noted)

Supply voltage, V_{CC} (see Note 1)	40 V
Output voltage	40 V
Output current	30 mA
Magnetic flux density	unlimited
Operating free-air temperature range	0 °C to 70 °C
Storage temperature range	−65 °C to 150 °C
Lead temperature 1,6 mm (1/16 inch) from case for 10 seconds	260 °C

NOTE 1. Voltage values are with respect to the network ground terminal.

electrical characteristics over operating free-air temperature range, V_{CC} = 4.5 V to 24 V (unless otherwise noted)

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
B_{OP}	Operate-point magnetic flux density (see Figure 2)			22	35	mT†
B_{RP}	Release-point magnetic flux density (see Figure 2)		5	16.5		mT†
B_{hys}	Hysteresis ($B_{OP} - B_{RP}$)		2	5.5		mT†
α_B	Temperature coefficient of B_{OP} and B_{RP}			±0.25		%/°C
V_{OL}	Low-level output voltage	I_{OL} = 20 mA			0.4	V
I_{OH}	High-level output current	V_{OH} = 24 V			1	µA
I_{CC}	Supply current			3	7	mA

†The unit of magnetic density in the International System of Units (SI) is the tesla (T). The tesla is equal to one weber per square meter. Values expressed in milliteslas may be converted to gauss (G) by multiplying by ten.

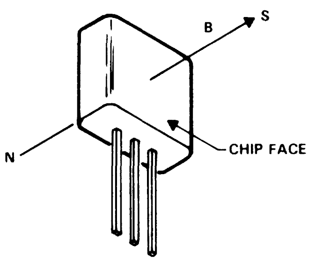


FIGURE 1. DEVICE ORIENTATION IN A MAGNETIC FIELD

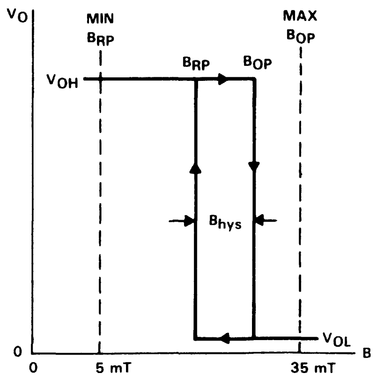


FIGURE 2. REPRESENTATIVE CURVE OF V_O vs B

switching characteristics at V_{CC} = 12 V, T_A = 25 °C (unless otherwise noted)

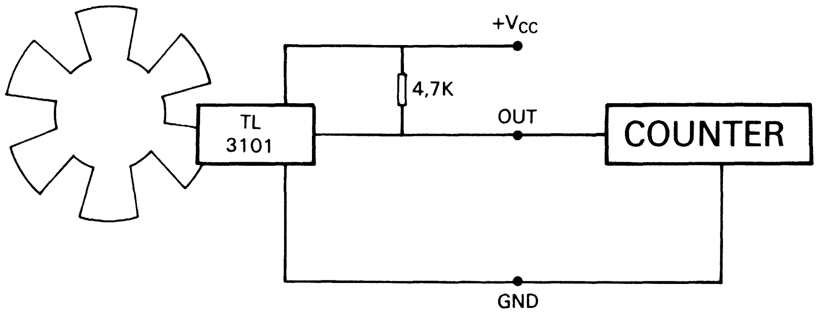
PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
t_r	Output rise time	R_L = 820 Ω, C_L = 20 pF		350		ns
t_f	Output fall time			85		

Hall Effect Sensor Application

This Figure shows a rotary speed sensing circuit with the hall sensor TL3101CLU and a counter.

The open collector output of the hall-effect sensor is directly connected to the input of the counter.

The time interval between the pulses is proportional to the speed of the shaft.



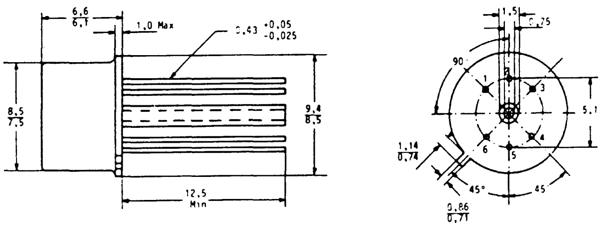
Pressure Sensors

- 0 ... 2 Bar pressure range
- Overpressure up to 4 Bars
- External signal conditioning offers individual transducer circuit development to the designer
- Small, hermetically sealed package, suitable for PC-Board mounting
- Low cost construction for high volume applications like automotive pressure control or medical diagnostics

MECHANICAL DIMENSIONS (MM)

TSP410HL-A

THE CASE IS ELECTRICAL CONNECTED WITH THE GROUNDLEAD

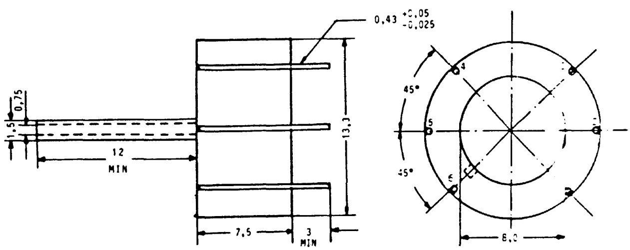


LEAD CONNECTIONS

1 – Pressure out
2 + VCC Pressure
3 + VCC Pressure
4 Not connected
5 + Pressure out
6 Ground + Case

TSP410HB-A

THE METALCASE IS ELECTRICAL CONNECTED WITH THE GROUNDLEAD



PRELIMINARY DATASHEET

Supplement data may be published at a later date.

TEXAS INSTRUMENTS
DEUTSCHLAND GMBH
8050 Freising, Haggertystr. 1

DESCRIPTION

The TSP410A is a piezoresistive pressure sensor using a small monolithic silicon chip with a thin diaphragm formed by micromachining technology. Four ion implanted resistors are integrated on the diaphragm forming a bridge which converts the diaphragm's stress into an electrical signal. The bridge is open at one supply port giving more flexibility for circuit design.
Polarity of supply voltage may be reversed. The pressure medium is applied to the diaphragm's backside and is not in contact with the active sensor circuitry.
A special signal conditioning circuit is presently under development at Texas Instruments.

ABSOLUTE MAXIMUM RATINGS

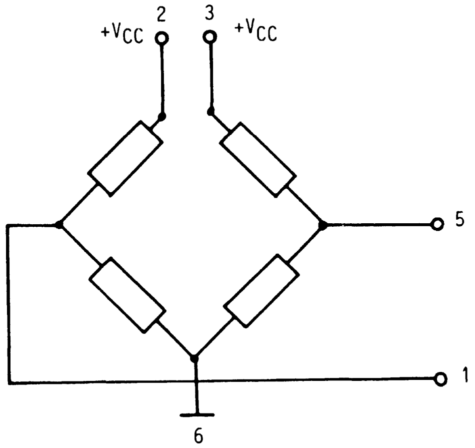
Operating pressure range .... 0 ... 2 Bar
Overpressure .... 4 Bar
Excitation voltage.. 16 V
Operating temperature range....................... −55 ... +125°C
Storage temperature range......................... −55 ... +125°C
Lead soldering temperature (10 sec) .... 260°C

OPERATING CHARACTERISTICS AT 25°C, VCC = 5V (UNLESS OTHERWISE SPECIFIED)

PARAMETER	SYMBOL	MIN	TYP	MAX	UNIT
Sensitivity 0 ... 1 Bar	$\Delta V_{out\,1}/\Delta P$	15	20		mV/V x Bar
Sensitivity 1 ... 2 Bar	$\Delta V_{out\,2}/\Delta P$		17		mV/V x Bar
Linearity 0 ... 1 Bar				2,5	% (Note 1)
Linearity 1 ... 2 Bar				4	% (Note 2)
Zero pressure offset	V_{off}			± 40	mV
Repeatability			0,15		% FS
Hysteresis			0,15		% FS
Bridge resistance	$R_{Br.}$	2	3	4	K Ohm
Temperature coeffecient	T_C		− 0,2		%/ K FS

1) Maximum deviation from the straight line from 0 to 1 Bar
2) Maximum deviation from the straight line from 1 to 2 Bar

SCHEMATIC DIAGRAM



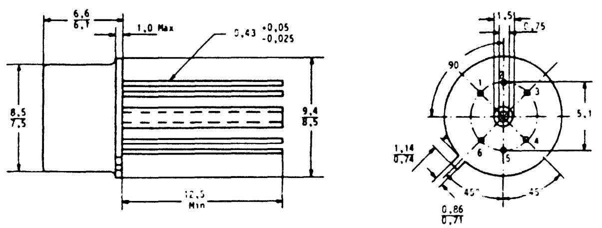
Note : Output Pin 5 changes in positive direction when supply voltage at Pin 2 and 3 is positive and pressure is increasing.
The polarity of supply voltage may be reversed, the output polarity changes correspondingly.

- Absolute pressure sensor
- Calibrated absolute temperature sensor
- 0 ... 2 Bar pressure sensor
- −40 to 125°C temperature range
- Temperature calibrated in °K
- Small, hermetically sealed package, suitable for PC-Board mounting
- Simple temperature compensation for pressure measurement
- Supply voltage stabilisation

MECHANICAL DIMENSIONS (MM)

TSP411HL-A

THE CASE IS ELECTRICAL CONNECTED WITH THE GROUNDLEAD

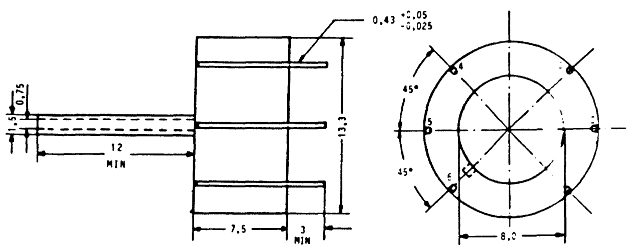


LEAD CONNECTIONS

1 – Pressure out
2 + VCC Pressure
3 + VCC Pressure
4 Temperature out
5 + Pressure out
6 Ground + Case

TSP411HB-A

THE METALCASE IS ELECTRICAL CONNECTED WITH THE GROUNDLEAD



PRESSURE SENSOR

Absolute Maximum Ratings

Operating pressure range .... 0 ... 2 Bar
Overpressure .... 4 Bar
Excitation voltage.. 16 V
Operating temperature range...................... −55 ... +125°C
Storage temperature range......................... −55 ... +125°C
Lead soldering temperature (10 sec) .... 260°C

OPERATING CHARACTERISTICS AT 25°C, V_{CC} = 5V (UNLESS OTHERWISE SPECIFIED)

PARAMETER	SYMBOL	MIN	TYP	MAX	UNIT
Sensitivity 0 ... 1 Bar	$\Delta V_{out\,1}/\Delta P$	15	20		mV/V x Bar
Sensitivity 1 ... 2 Bar	$\Delta V_{out\,2}/\Delta P$		17		mV/V x Bar
Linearity 0 ... 1 Bar				2,5	% (Note 1)
Linearity 1 ... 2 Bar				4	% (Note 2)
Zero pressure offset	V_{off}			± 40	mV
Repeatability			0,15		% FS
Hysteresis			0,15		% FS
Bridge resistance	$R_{Br.}$	2	3	4	K Ohm
Temperature coeffecient	T_C		− 0,2		%/ K FS

1) Maximum deviation from the straight line from 0 to 1 Bar
2) Maximum deviation from the straight line from 1 to 2 Bar

TEXAS INSTRUMENTS
DEUTSCHLAND GMBH
8050 Freising, Haggertystr. 1

TEMPERATURE SENSOR

Absolute maximum ratings at 25°C free air temperature (unless otherwise noted)

Reverse current I_R .... 10 mA
Forward current I_F .... 10 mA
Operating temperature range T_{Op} .... −40°C to 125°C
Storage temperature range T_{Stg} .... −55°C to 150°C
Lead temperature, 1,6mm from case for 10 seconds .... 260°C

ELECTRICAL CHARACTERISTICS

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
Operating output voltage change with current	400uA < I_R < 5 mA at constant temperature		2,5	5,5	mV
Dynamic impedance	I_R = 1 mA		0,6	1,2	Ohm
Output voltage temp. sensitivity			+ 10		mV/K

TEMPERATURE ACCURACY

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
Operating output voltage	T_C = 25°C, I_R = 1 mA	2,96	2,98	3,00	V
Uncalibrated temp. error	T_C = 25°C, I_R = 1 mA			±2	°C
Uncalibrated temp. error	− 10°C < T_C < 100°C, I_R = 1 mA			±4	°C
	− 40°C < T_C < 125°C, I_R = 1 mA			±5	°C
Non-linearity	− 10°C < T_C < 100°C, I_R = 1 mA			±0,5	°C

DESCRIPTION

The TSP411 combines two separate absolute sensors for pressure and temperature in one metal package similar to TO-39

The pressure sensor is a piezoresistive device using a small silicon chip with a thin diaphragm formed by micromachining technology. Four ion implated resistors are integrated on the diaphragm forming a bridge which converts the diaphragm's stress into an electrical signal. The bridge is open at one supply port giving more flexibility for circuit design (Fig. 1).
Polarity of supply voltage may be reversed. The pressure medium is applied to the diaphragm's backside and is not in contact with the active sensor circuitry.

The temperature sensor performs as a calibrated, temperature dependent zener diode with a zener voltage direct proportional to absolute temperature (2980mV at 298°K).
As the temperature coefficient is constant 10mV/K the sensor can be directly connected to an A/D-converter without additional liniarization.

A temperature compensation for the pressure sensor can be achieved by connection of the pressure and temperature sensors as proposed in figure 2. The zener voltage of the temperature sensor is used as supply voltage for the pressure sensor. Its positive TC compensates the negative TC of the pressure sensor from typically −0,2%/K at 1 Bar to typically ±0,02%/K for the temperatur range 0 to 70°c.

TEXAS INSTRUMENTS
DEUTSCHLAND GMBH
8050 Freising, Haggertystr. 1

SCHEMATIC DIAGRAM

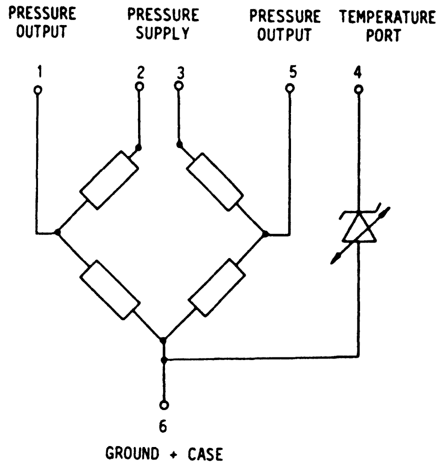


Fig. 1

Note: Pressure output Pin 5 goes positive when supply voltage at Pin 2 and 3 is positive and pressure is increasing. The polarity of supply voltage may be reversed; the output polarity changes correspondingly.

TEMPERATURE COMPENSATION

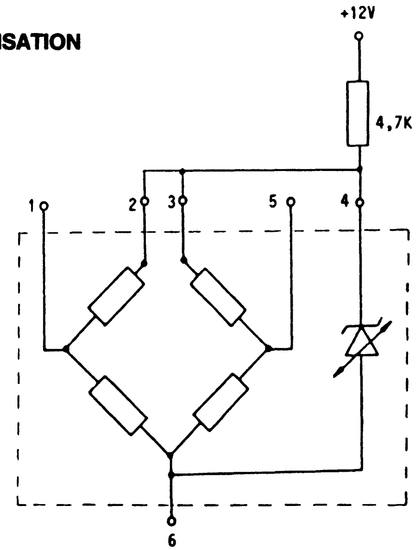


Fig. 2

TEXAS INSTRUMENTS

SENSOR SIGNAL PROCESSOR

TSS 400

PRELIMINARY SPECIFICATION

SECTION 1

1.1 TSS400

This specification describes the functional and electrical characteristics of the CMOS sensor signal processor with computing capability. Its key applications are converting, calculating, controlling and displaying many physical properties of environment and easy to interface with sensors and actuators.

Typical applications are:
- temperature measurement, calculating, controlling, warning,
- pressure and acceleration measurement
- home appliance
- intelligent keyboard and display driver
- timer with control functions,
- subsystem capability

For detailed informations ask for the TSS400 User Guide at your next Texas Instruments sales office or distributor.

1.1.1 Functional Specification

- 2048 nine bit words of ROM
- 576 bit static RAM
- Three instruction BCD addition
- 64 character, 7 segment output PLA (DP switchable independently)
- Three levels of subroutine
- Timekeeping capability (32 768 Hz XTAL)
- Direct drive of LCD: (32 768 Hz XTAL)
  Option 2MUX: 1/2 duty cycle containing up to 40 segments
  Option 4MUX: 1/4 duty cycle containing up to 80 segments
- Low power silicon gate CMOS process
  - Low power consumption at sleep mode (acitve timer/RAM)
  - Very low power consumption at off mode (active RAM)
- 12 Bit A/D-Converter with 4-MUX-inputs and programmable range for Pt sensors and silicon planar sensors
- Programmable current source from 0.15 to 0.6 mA x V_{DD}/V
- Internal MOS oscillator with frequency options

Functional Blockdiagramm of TSS400

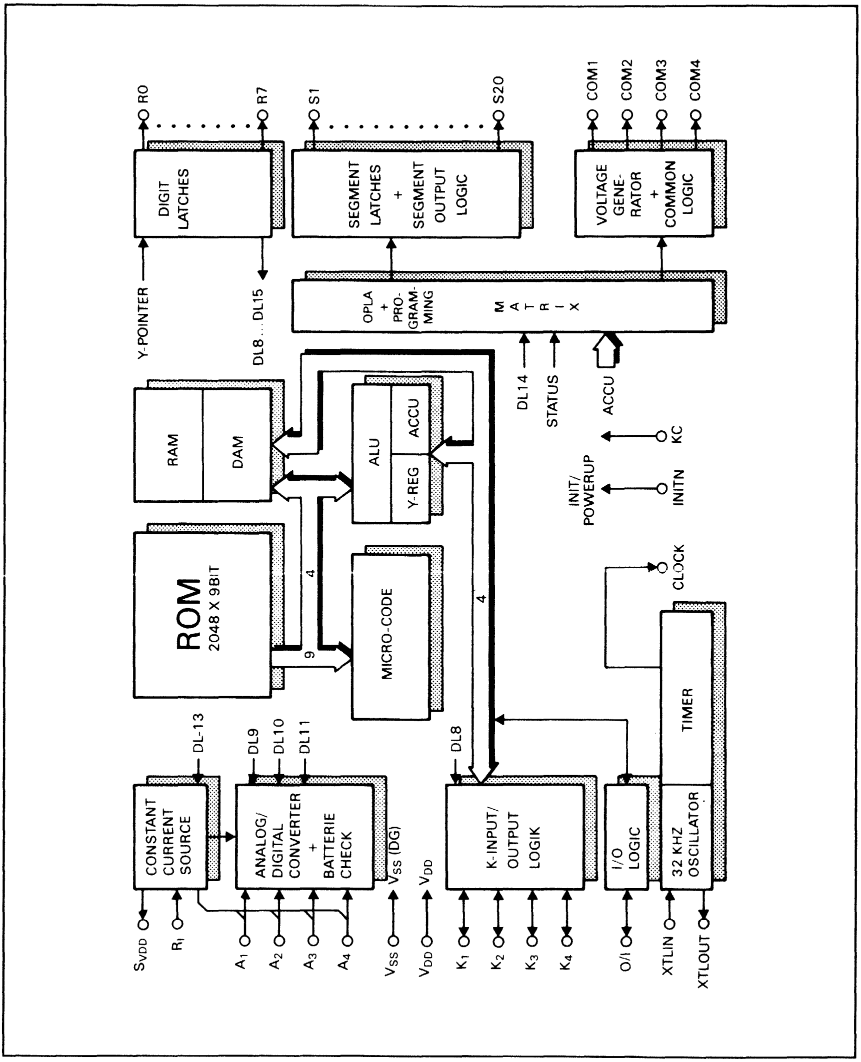


Figure 1-1

1.1.2 K-Line structure

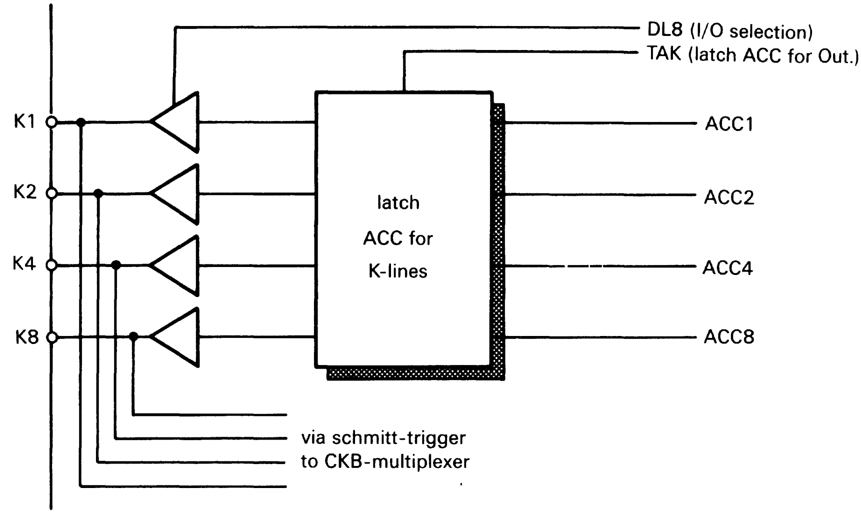


Figure 1-2 K-Line structur

The present state of Digit latch DL8 defines the state of K-Lines to be Input or Output:

- Input if DL8 = "0"
- Output if DL8 = "1"

PUC signal will reset DL8 to "0" – Input.

The TAK instruction latches the 4 bit ACC. If DL8 is "1" the ACC is available at the K-Lines:

K1 --- ACC1
K2 --- ACC2
K4 --- ACC4
K8 --- ACC8

1.1.3 I/O structure

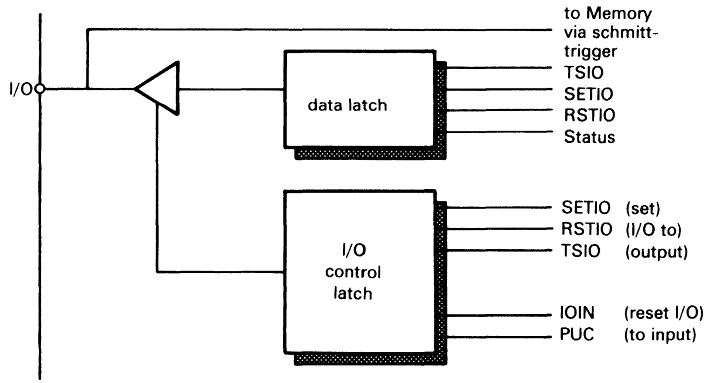


Figure 1-3 I/O structure

PUC signal as well as IOIN instruction will reset the I/O to be input (output buffer is 3-state)

Three instructions define the state of the I/O to be output:

- SETIO: set I/O to "1"
- RSTIO: reset I/O to "0"
- TSIO: transfer Status from the previous instruction to the output.

1.1.4 Clock

The Clock signal can be used by selecting it for a pin and the frequency:

- NONE: not selected
- 256HZ: $f_{Clock} = \frac{f_{XTLIN}}{128}$
- 1024HZ: $f_{Clock} = \frac{f_{XTLIN}}{32}$

When using the Clock signal together with the OFF mode pay attention to the application S/W and H/W.

Note: The signal at the pin 'Clock' is not the same as XTLIM

1.2 Analog/Digital-Converter (ADC)

The A/D-Converter has been specifically designed for use as a sensor signal processing unit with four mask programmable conversion ranges to allow optimization for various sensor types like:

- Silicon planar temperature and pressure sensors
- Pt-Elements in conjunction with current source
- Strain gauges
- and many other applications.

The A/D-Converter compares an external analog voltage with an internal voltage.
There are four AD ranges available: one of them should be selected.

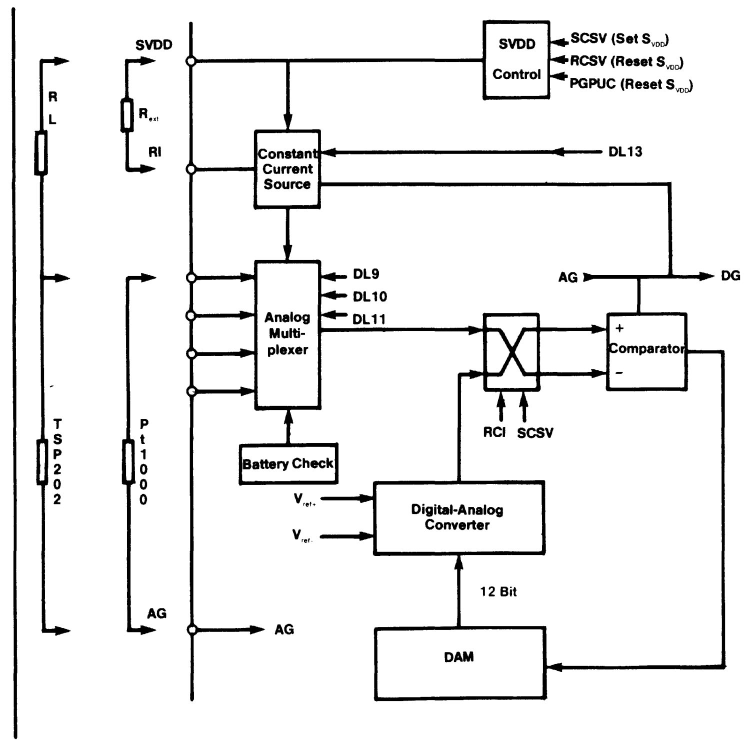


Figure 1-4: Principle of A/D-Converter

1.2.1 Description of conversion

The A/D-conversion is done by a software program.
The A/D-converter consists of:

- a D/A converter as voltage reference source
- a Comparator
- an analog switch to exchange input signals at comparator
- an analog multiplexer (4 to 1)
- a constant current source; programmable by one external resistor and enabled or disabled by DL13
- the SVDD control
- a Battery check (voltage source)

The D/A converter is controlled by 12 bits.
These 12 bits are memory bits located in the DAM.

1.2.2 Battery check

If DL9 is "1" the Battery check is activated by supplying the Comparator with a voltage independent of SVDD instead of an external analog voltage. Due to the dependence of V_{ref+} and V_{ref-}, from SVDD (→VDD) a comparision between a "constant" voltage and the ADC voltage (by DAM) will result in a Battery check. The TCTM instruction sets or resets a bit in the RAM: if Battery (VDD) is higher then comparison value this bit is "0" otherwise "1".

The DAM-value and so the VDD limit* can be measured by supplying the VDD-Pin of the microcomputer with the VDD limit*, activating a SW routine and storing this limit in the microcomputer DAM/RAM.

*Note: VDD limit means the lowest VDD voltage where a warning should take place (Battery check).

1.3.1 Common Select Lines

There are four Common Select Lines. Each has a unique output waveform that when used in combination with the twenty(20) Select Lines can control 40/80 different segments on a liquid crystal display (LCD).

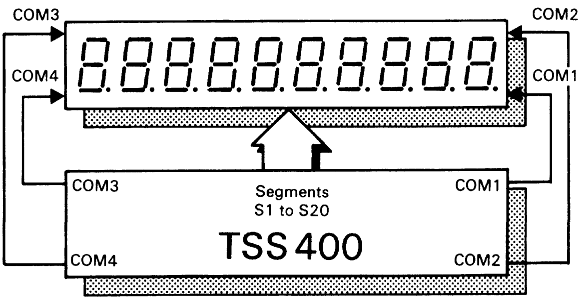
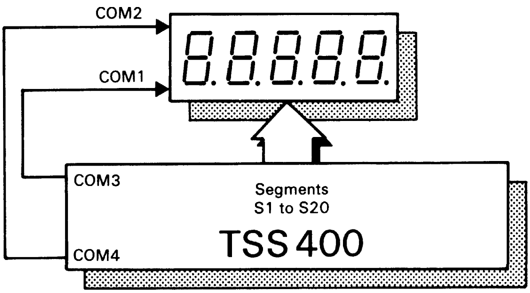


Figure 1-5 4 Mux LCD application example



Note: COM1/COM2 pads without function

Figure 1-6 2 Mux LCD application example

1.3.2 Select Lines

Up to twenty Select Lines are available as outputs.

Each Select Line defines two/four Segment Lines as shown below. A 64 term gate programmable segment PLA (decoded by ACC1, ACC2, ACC4, ACC8 Status, DL14) and SGH determines which segments are to be turned on.

These are then loaded into the Segment Latches by Y-Decoder/TDO-instruction and time-multiplexed to the Output Select Lines.

SECTION 4
ELECTRICAL DESCRIPTION

2.1 Absolute Maximum Ratings

Voltage applied at V_{DD} to V_{SS}	−0.3 V to +7.0 V
Voltage applied to any pin (referenced to V_{SS})	V_{SS} −0.3 V to V_{DD} +0.3 V
Input diode current	−2 mA
Output diode current ($\overline{INIT}$, XOSCIN, RI, SVDD, A1-A4, K, R, I/O, CLOCK, S1-S20, COM1-COM4)	±2 mA
Storage Temperature	−55 °C to 150 °C

2.2 Operating Conditions

Parameter		MIN	NOM	MAX	UNITS
Supply Voltage, V_{DD}		2.6	3.0	5.5	V
Supply Voltage, V_{SS}		0.0	0.0	0.0	V
Operating Temperature		−25	27	+85	°C
Timer Frequency (XTAL)			32.768		kHz
Processor Frequency (internal):	Option Frequ. LOW	150	300	450	kHz
	Option Frequ. MEDIUM	350	500	650	kHz
	Option Frequ. HIGH	550	700	850	kHz

2.3 Operating Characteristics

Parameter	Conditions	Sympol	Min	Nom	Max	Unit
Supply current	(excluding external current)					
	(processor frequency option 1)					
	Active Mode with A/D	$I_{A/D}$				
(into VDD)	V_{DD} = 3.0 V					
	T_A = 0 to 80°C			400	600	μA
	T_A = −25 to 85 °C			700	1000	μA
	Active Mode without A/D	I_{act}				
	V_{DD} = 3.0 V					
	T_A = 0 to 80°C			100	250	μA
	T_A = −25 to 85 °C			150	370	μA
	Standby Mode (DONE)	I_{DONE}				
	XTAL, V_{DD} = 3.0 V					
	T_A = 0 to 80°C			4	8	μA
	T_A = −25 to 85 °C			6	9	μA
	Halt Mode (OFF), V_{DD} = 3.0 V	I_{OFF}				
	T_A = 0 to 80°C				1	μA
	T_A = −25 to 85 °C				1.5	μA

2.3 Operating Characteristics (continued): $T_A = 0$ to 80°C

Parameter		Condition	Symbol	Min	Nom	Max	Unit
K, I/O inputs (Schmitt-tr)							
V_{T+} (positive going threshod voltage)		KIH see option; $V_{DD} = 3\,V$	V_{KH}	1.5		2.5	V
V_{T-} (negative going threshold voltage)		KIH see option; $V_{DD} = 3\,V$	V_{KL}	0.5		1.5	V
$V_{T+} - V_{T-}$ (Hysteresis)		$V_{DD} = 3\,V$		0.5		2.0	V
K as output	"1"	$V_{DD} = 3\,V$; $I_{KHmax} = -0.1$ mA	V_{KH}	$V_{DD} - 0.2$		V_{DD}	V
	"1"	$V_{DD} = 3\,V$; $I_{KHmax} = -0.3$ mA	V_{KH}	$V_{DD} - 0.6$		V_{DD}	V
	"0"	$V_{DD} = 3\,V$; $I_{KLmax} = +0.5$ mA	V_{KL}	V_{SS}		$V_{SS} + 0.4$	V
I/O as output	"1"	$V_{DD} = 3\,V$; $I_{KHmax} = -0.3$ mA	V_{KH}	$V_{DD} - 0.2$		V_{DD}	V
	"0"	$V_{DD} = 3\,V$; $I_{KLmax} = +1.2$ mA	V_{KL}	V_{SS}		$V_{SS} + 0.4$	V
R output	"1"	$V_{DD} = 3\,V$; $I_{RHmax} = -0.1$ mA	V_{RH}	$V_{DD} - 0.2$		V_{DD}	V
	"1"	$V_{DD} = 3\,V$; $I_{RHmax} = -0.3$ mA	V_{RH}	$V_{DD} - 0.6$		V_{DD}	V
	"0"	$V_{DD} = 3\,V$; $I_{RLmax} = +0.5$ mA	V_{RL}	V_{SS}		$V_{SS} + 0.4$	V
Clock (Opt.:NONE,256Hz,1024Hz) output "1"		$V_{DD} = 3\,V$; $I_{CH} = -50\,\mu A$	V_{CH}	$V_{DD} - 0.2$		V_{DD}	V
output "0" (not active at OFF Mode)		$V_{DD} = 3\,V$; $I_{CL} = +100\,\mu A$	V_{CL}	V_{SS}		$V_{SS} + 0.4$	V
LCD lines common (1/2 duty cycle) output "1"		$V_{DD} = 3\,V$; $I_{CH} = -100\,\mu A$	V_{CH}	$V_{DD} - 0.4$		V_{DD}	V
"1/2 Hz" *)		$V_{DD} \doteq 3\,V$; $I_{CHz} = \pm 10$ nA	V_{Hz}	$V_{DD}/2$ -0.06	$V_{DD}/2$	$V_{DD}/2$ $+0.06$	V
output "0"		$V_{DD} = 3\,V$; $I_{CL} = +100\,\mu A$	V_{CL}	V_{SS}		$V_{SS} + 0.4$	V

*Note: During KSC=Low (see 1.4.4) the analog voltage is generated by a low resistance R-divider
During KSC=High (see 1.4.4) the analog voltage is generated ba a high resistance R-divider
This mechanism is done at 1/2 and 1/4 duty cycle to speed up reloading display capacitance

2.3 Operating Characteristics (continued): $T_A = 0$ to 80°C

Parameter	Condition	Symbol	Min	Nom	Max	Unit
LCD lines segment (1/2 duty cycle)						
output "1"	$V_{DD} = 3V$; $I_{CH} = -100\ \mu A$	V_{SH}	$V_{DD} - 0.4$		V_{DD}	V
output "0"	$V_{DD} = 3V$; $I_{CL} = +100\ \mu A$	V_{SL}	V_{SS}		$V_{SS} + 0.4$	V
LCD lines common, segment (1/4 duty cycle)						
output "1"	$V_{DD} = 3V$; $I_{CH} = -100\ \mu A$	V_{CH}	$V_{DD} - 0.4$		V_{DD}	V
"2/3 Hz" *)	$V_{DD} = 3V$; $I_{CHz} = 10$ nA	V_{Hz}	$2 \cdot V_{DD}/3 - 0.04$	$2 \cdot V_{DD}/3$	$2 \cdot V_{DD}/3 + 0.04$	V
"1/3 Hz" *)	$V_{DD} = 3V$; $I_{CHz} = 10$ nA	V_{Hz}	$V_{DD}/3 - 0.04$	$V_{DD}/3$	$V_{DD}/3 + 0.04$	V
output "0"	$V_{DD} = 3V$; $I_{CL} = +100\ \mu A$	V_{CL}	V_{SS}		$V_{SS} + 0.4$	V
$\overline{\text{INIT}}$	$V_{DD} = 3V$; $V_{IN} = 0V$	I_{INIT}	-0.1		-0.5	µA
SVDD (switched VDD)	$V_{DD} = 2.6V$; ISVDD = 2 mA	VSVDD	$V_{DD} - 0.2$		V_{DD}	V
A/D Converter Current source						
Range large	$V_{DD} = 3V$; $T_A = 25°C$ $V_{Rext} = V_{SVDD} - V_{RI}$; $I_{RI} = 1.3$ mA	V_{Rext}		.244403 xS_{VDD}		V
Range small	$V_{DD} = 3V$; $T_A = 25°C$ $V_{Rext} = V_{SVDD} - V_{RI}$; $I_{RI} = 1.3$ mA	V_{Rext}		.240238 xS_{VDD}		
Range medium-high	$V_{DD} = 3V$; $T_A = 25°C$ $V_{Rext} = V_{SVDD} - V_{RI}$; $I_{RI} = 1.3$ mA	V_{Rext}		.241603 xS_{VDD}		
Range medium-low	$V_{DD} = 3V$; $T_A = 25°C$ $V_{Rext} = V_{SVDD} - V_{RI}$; $I_{RI} = 1.3$ mA	V_{Rext}		.241199 xS_{VDD}		
external Resistor	$V_{DD} = 3V$; $T_A = 25°C$	Rext	0.39		1.6	kOhm

*Note: During KSC=Low (see 1.4.4) the analog voltage is generated by a low resistance R-divider
During KSC=High (see 1.4.4) the analog voltage is generated ba a high resistance R-divider
This mechanism is done at 1/2 and 1/4 duty cycle to speed up reloading display capacitance

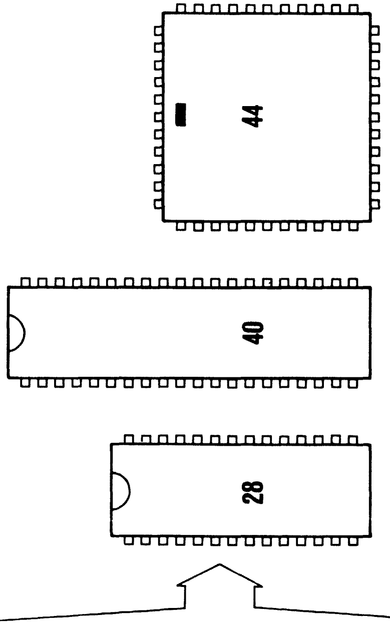
2.3 Operating Characteristics (continued): $T_A = 0$ to 80°C

Parameter	Condition	Symbol	Min	Nom	Max	Unit
A/D Converter Input current (any inp.)	$V_{DD} = 3V$; $V_{IN} = V_{SS}$ to V_{DD} (no current source)	IA1/2/3/4			±30	nA
Conversion analog input to digital value						
Range large						
Low analog input voltage	digital value 001_{16}	LAV		0.101309 x S_{VDD}		
High analog input volt.	digital value FFE_{16}	HAV		0.494607 x S_{VDD}		
LSB Voltage				96.1×10^{-6} x S_{VDD}		
Range small						
Low analog input voltage	digital value 001_{16}	LAV		0.231314 x S_{VDD}		
High analog input volt.	digital value FFE_{16}	HAV		0.407511 x S_{VDD}		
LSB Voltage				43.0×10^{-6} x S_{VDD}		
Range medium-high						
Low analog input voltage	digital value 001_{16}	LAV		0.232683 x S_{VDD}		
High analog input volt.	digital value FFE_{16}	HAV		0.500413 x S_{VDD}		
LSB Voltage				65.4×10^{-6} x S_{VDD}		
Range medium low						
Low analog input voltage	digital value 001_{16}	LAV		0.100369 x S_{VDD}		
High analog input volt.	digital value FFE_{16}	HAV		0.402501 x S_{VDD}		
LSB Voltage (all Ranges)				73.8×10^{-6} x S_{VDD}		
Linearity	Delta digital value $\leq$ 120 LSB		−1		+1	LSB
	120 LSB < DDV $\leq$ 240 LSB		−1 ½		+1 ½	LSB
	240 LSB < DDV $\leq$ 2600 LSB		−2 ½		+2 ½	LSB
	DDV > 2600		−4 ½		+4 ½	LSB

TSS400 Functions to pinning

SIGNAL	SELECTABLE	MANDATORY
OUTPUT PORTS		
8 x A	X	
BI-DIRECTIONAL PORTS		
4 x K	X	
1 x I/O	X	
ANALOG		
4 x AD Inputs	X	
1 x S_{VDD}		X
1 x Ri	X	
1 x AG	X	
LCD-CONTROL		
4 x Common	X	
20 x Seg	X	
MISCELLEANOUS		
1 x Timer Out	X	
1 x V_{DD}		X
1 x V_{SS} (DG)		X
1 x INITN		X
2 x Osc		X
1 x KC		X
TOTAL 51 FUNCTIONS		

AVAILABLE PACKAGES



NOTIZEN:

TI Sales Offices

BELGIË/BELGIQUE
N.V. Texas Instruments Belgium S.A.
J. Bordetlaan 11, Avenue J. Bordet
1140 Brussel/Bruxelles
Tel.: (02) 2423080
Telex: 61161 TEXBEL

DANMARK
Texas Instruments A/S
Marielundvej 46E
2730 Herlev
Tel.: (02) 917400
Telex: 35123 TEXIN

DEUTSCHLAND
Texas Instruments
Deutschland GmbH
Haggertystraße 1
8050 Freising
Tel.: 08161/80-0
Telex: 526529 Texin d

Kurfürstendamm 195-196
1000 Berlin 31
Tel.: 030/8827365

Düsseldorfer Straße 40
6236 Eschborn 1
Tel.: 06196/8070

III. Hagen 43/Kibbelstraße 19
4300 Essen 1
Tel.: 0201/24 25-0

Kirchhorster Straße 2
3000 Hannover 51
Tel.: 0511/648021

Maybachstraße 11
7302 Ostfildern 2 (Nellingen)
Tel.: 0711/3403-0

EIRE
Texas Instruments Ireland Ltd
7/8 Harcourt Street
Dublin 2
Tel.: (01) 781677
Telex: 32626

ESPAÑA
Texas Instruments España S.A.
C/José Lázaro Galdiano No. 6
28036 Madrid
Tel.: (1) 4581458
Telex: 23634

FRANCE
Texas Instruments France
8-10 Avenue Morane Saulnier
78141 Vélizy-Villacoublay Cedex
Tel.: (1) 39469712
Telex: 698707 F

HOLLAND
Texas Instruments Holland B.V.
Hogehilweg 19
Postbus 12995
1100 AZ Amsterdam-Zuidoost
Tel.: (020) 5602911
Telex: 12196

ITALIA
Texas Instruments Italia S.p.A.
Divisione Semiconduttori
Nucleo Industriale
Viale Delle Scienze, 1
02015 Cittaducale (Rieti)
Tel.: (0746) 6941
Telex: 611003 TISIT I

NORGE
Texas Instruments Norge A/S
PB 106
Refstad (Sinsenveien 53)
0585 Oslo 5
Tel.: (02) 155090

ÖSTERREICH
Texas Instruments Ges.m.b.H.
Hietzinger Kai 101-105
A-1130 Wien
Tel.: 0222/9100-0
Telex: 136796

PORTUGAL
Texas Instruments Equipamento Electronico (Portugal) LDA.
R. Eng. Frederico Ulrich, 2650
Moreira Da Maia
4470 Maia
Tel.: (2) 948 1003
Telex: 22485

SCHWEIZ/SUISSE
Texas Instruments Switzerland AG
Riedstraße 6
CH-8953 Dietikon
Tel.: (01) 7402220
Telex: 825260 TEXIN

SUOMI FINLAND
Texas Instruments OY
Ahertajantie 3
P.O. Box 81,
0201 Espoo
Tel.: (90) 0-461-422
Telex: 121457

SVERIGE
Texas Instruments
International Trade Corporation
(Sverigefilialen)
Nörra Hamnvagen 3
BOX 39103
10054 Stockholm
Tel.: (08) 235480
Telex: 10377

UNITED KINGDOM
Texas Instruments Ltd.
Manton Lane,
Bedford, MK41 7PA
Tel.: (0234) 270 111
Telex: 82178

Technical Enquiry Service
Tel.: (0234) 223000

TEXAS INSTRUMENTS

TI Regional Technology Centres

DEUTSCHLAND
Texas Instruments
Deutschland GmbH.
Haggertystraße 1
8050 Freising
Tel.: 08161/80-4043

Kirchhorster Straße 2
3000 Hannover 51
Tel.: 0511/648021

Düsseldorfer Straße 40
6236 Eschborn
Frankfurt
Tel.: 06196/807418

Maybachstraße 11
7302 Ostfildern (Nellingen)
Stuttgart
Tel.: 0711/3403-0

FRANCE
Centre de Technologie
Texas Instruments France
8-10 Avenue Morane Saulnier
78141 Vélizy-Villacoublay Cedex
Tel.: (1) 39469712
Telex: 698707 F

Texas Instruments France
Boite Postale 5
06270 Villeneuve-Loubet
Tel.: 93200101
Telex: 470127 F

HOLLAND
Texas Instruments Holland B.V.
Hogehilweg 19
Postbus 12995
1100 AZ Amsterdam-Zuidoost
Tel.: (020) 5602911
Telex: 12196

ITALIA
Texas Instruments Italia S.p.A.
Divisione Semiconduttori
Nucleo Industriale
Viale Delle Scienze, 1
02015 Cittaducale (Rieti)
Tel.: (0746) 6941
Telex: 611003 TISIT I

Texas Instruments Italia S.p.A.
Divisione Semiconduttori
Viale Europa 40,
20093 Cologno Monzese (Milano)
Tel.: (02) 25300 1
Telex: 332633 MITEX I

SVERIGE
Texas Instruments
International Trade Corporation
(Sverigefilialen)
Nörra Hamnvagen 3
BOX 39103
10054 Stockholm
Tel.: (08) 235480
Hotline: (08) 615448

UNITED KINGDOM
Texas Instruments Ltd.
Regional Technology Centre
Manton Lane,
Bedford, MK41 7PA
Tel.: (0234) 270 111
Telex: 82178

Technical Enquiry Serice
Tel.: (0234) 223000

Printed in Germany