Integrated Transceiver

Description

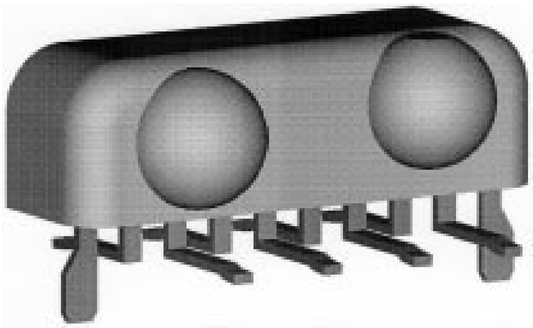
The TFDS4000 is an infrared transceiver for data communication systems. The transceiver is compatible to the IrDA standard, which allows data rates up to 115 kit/s, and also supports the Sharp ASK mode. An internal AGC (**A**utomatic **G**ain **C**ontrol) ensures proper operation under EMI conditions.

The internal IRED driver can be connected by an external current control resistor to an unregulated power supply.

This will add more freedom in circuit design and efficient serial drive capability for additional IREDs for high-power applications.

Features

- Compatible to IrDA standard
- SMD side view
- Wide supply voltage range (2.7 to 5.5 V)
- Sharp ASK mode (5 V supply voltage)
- Low profile (height = 5.6 mm max.)
- Microcomputer-compatible
- Very few external components
- Low power consumption
- AGC for EMI immunity
- Open-collector IRED driver



Pin description*:

1: IRED cathode
2: Rxd (output)
3: V_{CC} (supply voltage)
4: Ground
5: Sensitivity control
6: NC
7: Txd (input)
8: IRED anode

Guide pins internally connected to ground
* see page 6

Block Diagram

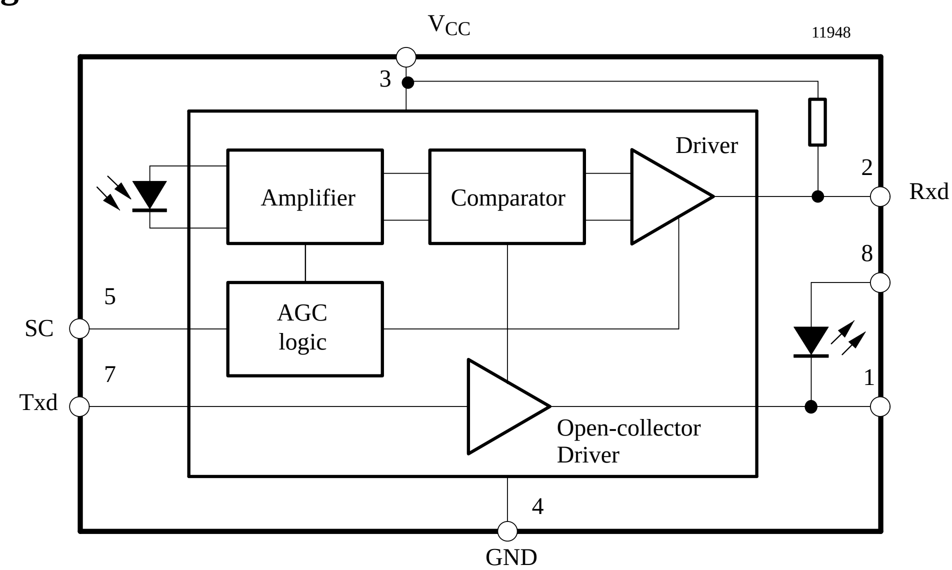


Figure 1. Block diagram

Absolute Maximum Ratings

Reference point Pin 4, unless otherwise specified

Parameters	Test Conditions / Pins	Symbol	Min.	Typ.	Max.	Unit
Supply voltage range		V_{CC}	–0.5		6	V
Voltage range of IRED drive output	Pin 8 Txd “LOW”		–0.5		6	V
Input currents	All pins except 1, 8 see IRED current				10	mA
Output sinking current	Pin 2				25	mA
Output sinking current					25	mW
Power dissipation	See derating curve, page 8	P_{tot}			200	mW
Junction temperature		T_J			125	°C
Ambient temperature range (operating)		T_{amb}	0		70	°C
Storage temperature range		T_{stg}	–25		85	°C
Soldering temperature	t = 20 s @215°C See figure 11, introductory text, IrDA Design Guide			215	230	°C
Average IRED current		I_{IRED}(DC)			100	mA
Rep. pulsed IRED current	< 90 µs, t_{on} < 20%	I_{IRED}(RP)			500	mA
Peak IRED current	< 2 µs, t_{on} < 10%	I_{IRED}(PK)			1	A
IRED anode voltage		V_{IREDA}	–0.5		6	V
Transmitter data input voltage		V_{Txd}	–0.5		V_{CC} + 0.5	V
Receiver data output voltage		V_{Rxd}	–0.5		V_{CC} + 0.5	V

Optoelectronic Characteristics

T_{amb} = 25°C, V_{CC} = 5 V unless otherwise specified

Parameters	Test Conditions / Pins	Symbol	Min.	Typ.	Max.	Unit
Transceiver						
Supported data rates	Baseband Carrier frequency 500 kHz ASK mode		2.4		115.2 38.2	kBit/s kBit/s
Supply voltage range	Reduced function down to 2.5 V	V_{CC}	2.7	5	5.5	V
Supply current, Pin 3	V_{CC} = 5 V	I_S		1.3	2.5	mA
Supply current, Pin 3	V_{CC} = 3 V	I_S		1.0	1.5	mA
Leakage current of IR emitter, Pin 8	V_{CC}, Pin 3: Off, Txd: ‘‘LOW” V_{CC2} = 6 V, T = 25 to 85°C See recommended application circuit page 5			0.005	0.5	µA
Transceiver power on settling time	Time from switching on V_{CC} to established specified operation				50	µs
Receiver						
Min. detection threshold irradiance, SC = ‘‘LOW”	$\alpha = \pm 15°$ SIR mode **)	E_{emin}		0.020	0.035	Wm^{-2}
Min. detection threshold irradiance, SC = ‘‘HIGH”	$\alpha = \pm 15°$ SIR mode **)	E_{emin}	0.006	0.010	0.015	Wm^{-2}
Max. detection threshold irradince	$\alpha = \pm 90°$, V_{CC} = 5 V, SIR mode **)	E_{max}	3300	5000		Wm^{-2}
Max. detection threshold irradiance	$\alpha = \pm 90°$, V_{CC} = 3 V, SIR mode **)	E_{emax}	8000	15000		Wm^{-2}
Min. detection threshold irradiance, SC = ‘‘HIGH”	$\alpha = \pm 15°$, 500 kHz duty cycle 0.5 ASK Sharp mode	E_{emin}			0.035	Wm^{-2}
Logic LOW receiver input irradiance, SC = ‘‘HIGH” or SC = “LOW”		$E_{emaxlow}$			0.004	Wm^{-2}
Output voltage RxD	Active C = 15 pF, R = 2.2 kΩ	V_{OL}		0.5	0.8	V
Output voltage RxD	Non-active C = 15 pF, R = 2.2 kΩ	V_{OH}	V_{CC} –0.5			V
Output current V_{OL} < 0.8 V				4		mA
Rise time @load = C = 15 pF, R = 2.2 kΩ			20		200	ns
Fall time @load = C = 15 pF, R = 2.2 kΩ			20		200	ns

**) BER = 10^{-8} (IrDA specification)

Optoelectronic Characteristics (continued)

T_{amb} = 25°C, V_{CC} = 5 V unless otherwise specified

Parameters	Test Conditions / Pins	Symbol	Min.	Typ.	Max.	Unit
Receiver (continued)						
Rxd signal electrical output pulse width	2.4 kBit/s, input pulse length 1.41 µs to 3/16 of bit length		1.41		20	µs
Rxd signal electrical output pulse width	115.2 kBit/s, input pulse length 1.41 µs to 3/16 of bit length		1.41		8	µs
Rxd signal electrical output pulse width	500 kHz, duty cycle 50% V_{CC} = 5 V only		0.8	1	1.2	µs
Output delay time (Rxd)	Output level = 0.5 x V_{CC} @E_e = 0.040 W/m^2 Max. delay of leading edge of output signal related to leading edge of optical input signal			1	2	µs
Jitter, leading edge of output signal	Over a period of 10 bit, 115.2 kBd				2	µs
Output delay time (Rxd)	Output level = 0.5 x V_{CC} Max. delay of trailing edge of output signal related to trailing edge of optical input signal				6.5	µs
Latency	Recovery from last transmitted pulse to 1.1 × threshold sensitivity	t_L		100	800	µs
Transmitter						
Supply voltage		V_{CC}	3		5.5	V
Driver current IRED	Current limiting resistor in series to IRED: R_S = 8.2 @ 5 V I_d can be adjusted by variation of R_S, see IrDA Design Guide	I_d		0.3	0.5	A
Logic LOW transmitter Input voltage		V_{IL}(Txd)	0		0.8	V
Logic HIGH transmitter Input voltage		V_{IH}(txd)	2.4		V_{CC}	V

Optoelectronic Characteristics (continued)

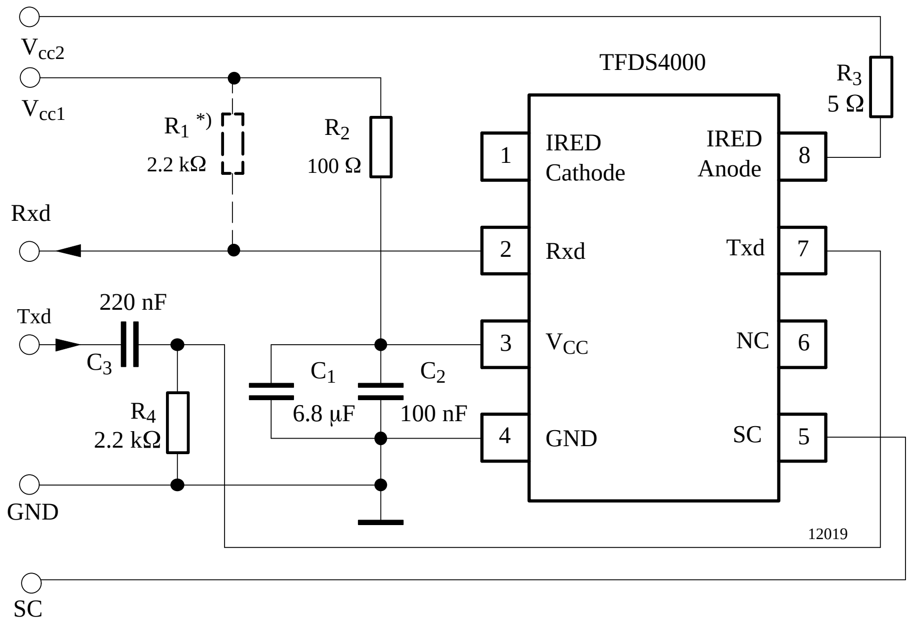
T_{amb} = 25°C, V_{CC} = 5 V unless otherwise specified

Parameters	Test Conditions / Pins	Symbol	Min.	Typ.	Max.	Unit
Transmitter (continued)						
Output radiant intensity, α = ± 15°	Current limiting resistor in series to IRED: R_S = 8.2 Ω, V_{CC2} = 5 V In agreement with prospective future eye safety limits of IEC825		45	150	200	mW/sr
Angle of half intensity		α		± 24		°
Peak wavelength of emission		λ_p	850		900	nm
Halfwidth of emission spectrum				60		nm
Optical rise/fall time	115.2 kHz square wave signal (1:1)			200	600	ns
Output radiant intensity	Logic LOW level				0.04	μW/sr
Overshoot, optical					25	%
Rising edge Peak-to-peak jitter	Over a period of 10 bits, independent of information content	t_j			0.2	μs

Application

For more application circuits, see IrDA Design Guide and TOIM3... Design Notes.

Recommended Application Circuit



*) R_1 not necessary in on-board applications

The Txd input should be dc-coupled. R4 and C3 are only necessary when the input signal is active for longer periods. This might occur under certain conditions, for example, if the TFDS4000 is connected to the NSC or SMC Super I/Os™ (see the National Semiconductors application note).

The load resistor R1 is optional when longer cables must be driven. Internally, RxD is connected to V_{CC} by a 20 kΩ load.

C1 and C2 are dependent on the quality of the supply voltage V_{CC}. A combination of 6.8 µF with 100 nF will work in most cases.

The power supply for V_{CC1} has to source only about 1 mA typically.

R3 is used for controlling the current through the IR emitter. To increase the output power, the value of R3 has to be reduced. To reduce the output power, the value of R3 has to be increased as described in TEMIC's IrDA Design Guide. The upper drive current limitation is depending on the duty cycle and is given by the absolute maximum ratings (see page 2)

Shut Down

The TFDS4000 can be shut off very efficiently by keeping the IRED connected to the power supply V_{CC2}, but switching V_{CC1} off. Therefore, a special shut down is not needed.

The V_{CC2} source can be an unregulated power supply. The voltage at Pin 8 is limited to maximum 6 V. The settling time after switching V_{CC1} on is less than 50 µs.

The TOIM3232 interface circuit is designed for this application. The S0 or S1 outputs can be used to power the TFDS4000 with a supply current of 1 mA.

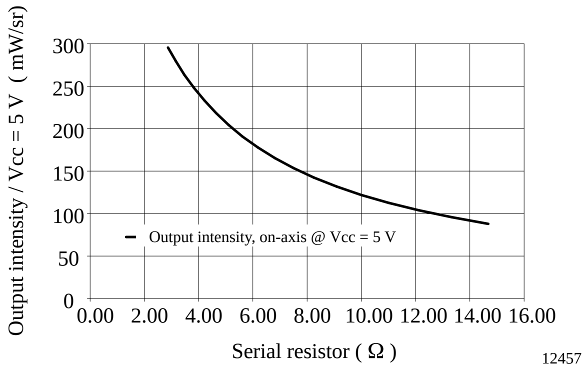


Figure 2.

Latency

The receiver is in specified conditions after the defined latency. In a UART related application that time (typically 100 µs) the receiver buffer of the UART must be cleared. Therefore the transceiver has to wait at least the specified latency after receiving the last bit before starting the transmission to be sure that the corresponding receiver is in a defined state.

Pin Assignment

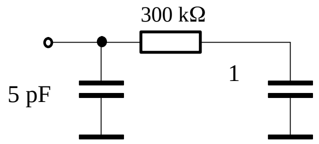
Pin	Pin Name	Description	I/O	Active
1	IRED cathode	IRED cathode, internally connected to driver transistor		
2	Rxd	Received data	O	LOW
3	V_{CC}	Supply voltage		
4	GND	Ground		
5	SC	Sensitivity control	I	HIGH
6	NC	Not connected		
7	Txd	Transmit data	I	HIGH
8	IRED anode	IRED anode		
–	2 guide pins	Internally connected to ground		

Input Equivalent Circuit (Typical Chip Data from Simulation)

Typically 2 pF of package has to be added for every input.

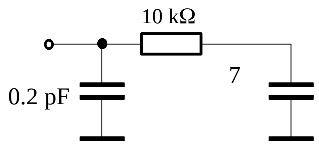
Txd Input

Txd Low (0 V):
I(Txd, low) = 1.0 pA
C(Txd, low = 0.2 pF
Txd High (V_{CC}):
I(Txd, high) = 27 µA
C(Txd, high) is represented by



Sensitivity Control

SC Low (= V):
I(SC, low = 110 nA
C(SC, low) = 5 pF



SC High (V_{CC}):
I(SC, high = 15 µA
C(SC, high) = 5 pF

RF – Environment Tests

Test	Conditions	Test method	Result
ESD	3 kV discharge, human body, 100pF, 1.5 kΩ	MIL 883D, 3015.7 equiv. to ESD S 5.1	o.k.
	250 V, machine model, 200 pF	ESD S 5.2	o.k.
	15 kV air discharge		o.k.

Electromagnetic Susceptibility

Frequency Band [MHz]	Antenna Polarity	Frequency Mode	Signal Strength [V/m]	Result
0.1–0.5				Not tested
0.5–30	Vertical	AM	7	o.k.
30–41	Vertical	AM, FM	2	o.k.
41–88	Horizontal	AM, FM	2	o.k.
88–108	Vertical, horizontal	FM	2	o.k.
136–174	Vertical	FM	8	o.k.
174–230	Horizontal	AM, FM	2	o.k.
440–512	Vertical, horizontal	FM	22	o.k.
806–845	Vertical, horizontal	FM	30	o.k.

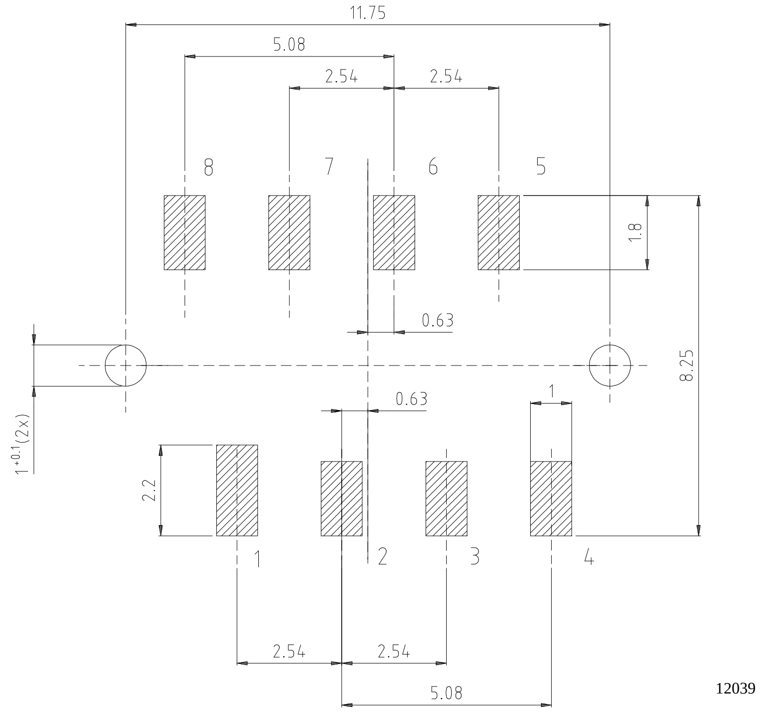
Radar

Frequency Band [MHz]	Pulse width [µs]	Pulse Rate [Hz]	Antenna Polarity	Signal Strength [V/m]	Result
600		250	Vertical, horizontal	13	o.k.
1300		333	Vertical, horizontal	10	o.k.
2800		1000	Vertical, horizontal	13	o.k.

European Requirements

Frequency Band [MHz]	Freqency mode	Antenna Polarity	Signal Strength [V/m]	Result
27–80	Non modulated, cw	Vertical, horizontal	1	o.k.
80–200	Non modulated, cw	Vertical, horizontal	1	o.k.

Recommended SMD Soldering Pads for TFDS4000
Dimensions in mm



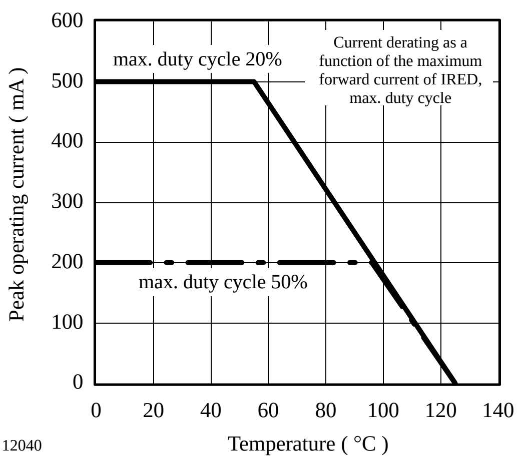


Figure 3. Current derating as a function of ambient temperature and max. duty cycle

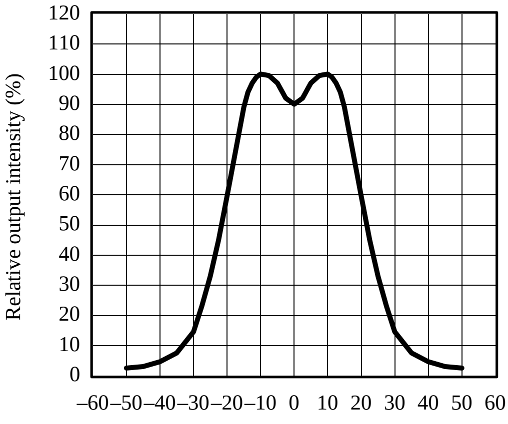


Figure 4. Angular emission characteristic

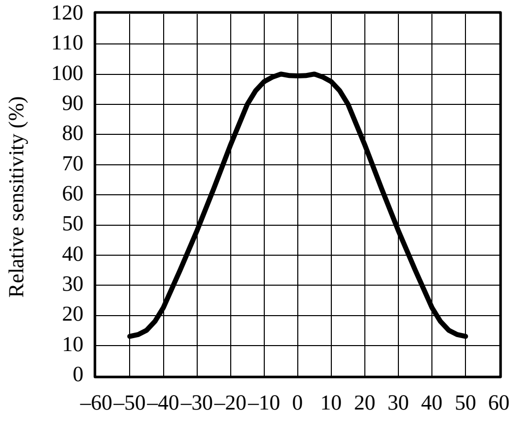
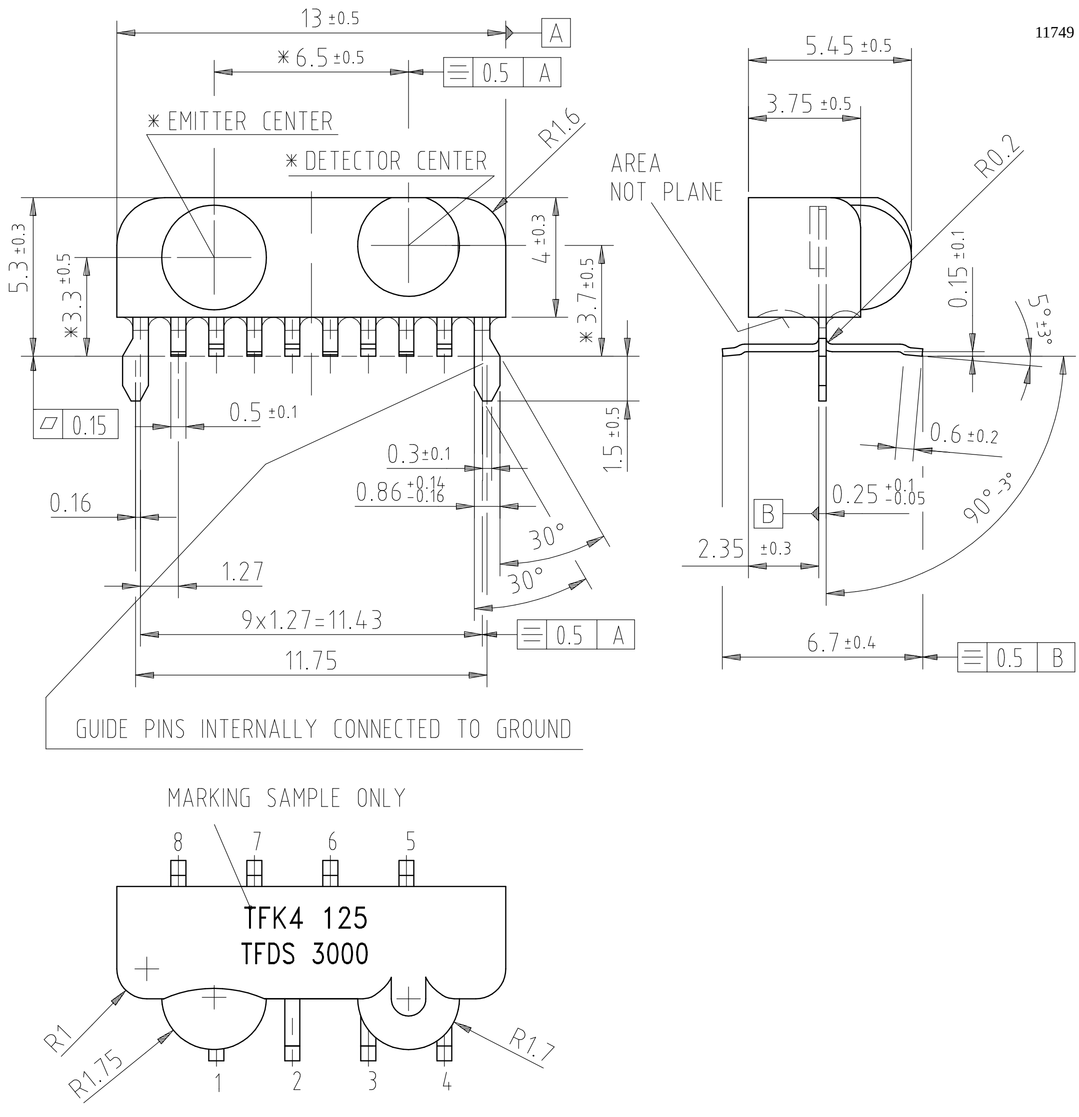


Figure 5. Angular receiving characteristic

Mechanical Dimensions



Preliminary Information

Ozone Depleting Substances Policy Statement

It is the policy of **TEMIC TELEFUNKEN microelectronic GmbH** to

1. Meet all present and future national and international statutory requirements.

2. Regularly and continuously improve the performance of our products, processes, distribution and operating systems with respect to their impact on the health and safety of our employees and the public, as well as their impact on the environment.

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

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

TEMIC TELEFUNKEN microelectronic GmbH semiconductor division has been able to use its policy of continuous improvements to eliminate the use of ODSs listed in the following documents.

1. Annex A, B and list of transitional substances of the Montreal Protocol and the London Amendments respectively

2. Class I and II ozone depleting substances in the Clean Air Act Amendments of 1990 by the Environmental Protection Agency (EPA) in the USA

3. Council Decision 88/540/EEC and 91/690/EEC Annex A, B and C (transitional substances) respectively.

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

We reserve the right to make changes to improve technical design and may do so without further notice.
Parameters can vary in different applications. All operating parameters must be validated for each customer application by the customer. Should the buyer use TEMIC products for any unintended or unauthorized application, the buyer shall indemnify TEMIC against all claims, costs, damages, and expenses, arising out of, directly or indirectly, any claim of personal damage, injury or death associated with such unintended or unauthorized use.

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