Infrared Transceiver, 9.6 kbit/s to 115.2 kbit/s (SIR)

20206-1

DESCRIPTION

TFBS4650 is an infrared transceiver that supports data rates up to 115 kbit/s per the IrDA standard. The link distance is up to 1 meter. The transceiver includes a PIN photodiode, an infrared emitter, and a low-power control IC. These components have not been qualified according to automotive specifications.

FEATURES

- Compliant to the IrDA physical layer specification
- Standard IrDA link distance of 1 m
- Low power consumption, typically less than 70 µA
- Less than 1 µA in shutdown mode
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912

Pb-free

e4

RoHS COMPLIANT

HALOGEN FREE

GREEN (5-2008)

APPLICATIONS

- Short-distance wireless communication and data transfer
- Use in environments where RF is problematic

LINKS TO ADDITIONAL RESOURCES

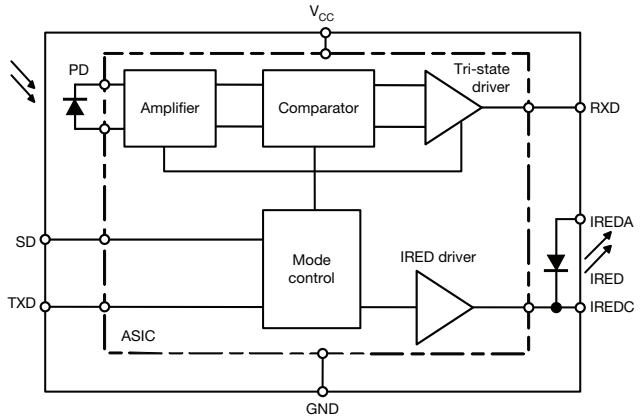
Product Page

Related Documents

DESIGN SUPPORT TOOLS

- 3D model
- Window size calculator
- Symbols and terminology
- IRDC protocol
- Reference layouts and circuit diagrams

FUNCTIONAL BLOCK DIAGRAM



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PRODUCT SUMMARY					
PART NUMBER	DATA RATE (kbit/s)	DIMENSIONS H x L x W (mm x mm x mm)	LINK DISTANCE (m)	OPERATING VOLTAGE (V)	IDLE SUPPLY CURRENT (mA)
TFBS4650	115.2	1.6 x 6.8 x 2.8	0 to ≥ 0.3	2.4 to 5.5	0.075

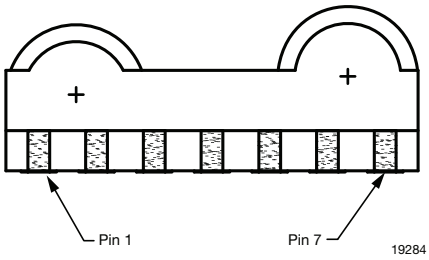
PARTS TABLE		
PART	DESCRIPTION	QTY/REEL
TFBS4650-TR1	Oriented in carrier tape for side view surface mounting	1000 pcs
TFBS4650-TR3	Oriented in carrier tape for side view surface mounting	2500 pcs
TFBS4650-TT3	Oriented in carrier tape for top view surface mounting	2500 pcs

PIN DESCRIPTION				
PIN NUMBER	SYMBOL	DESCRIPTION	I/O	ACTIVE
1	IREDA	IRED anode, connected via a current limiting resistor to V_{CC2}. A separate unregulated power supply can be used.		
2	IREDC	IRED cathode, do not connect for standard operation.		
3	TXD	Transmitter data input. Setting this input above the threshold turns on the transmitter. This input switches the IRED with the maximum transmit pulse width of about 100 µs.	I	High
4	RXD	Receiver output. Normally high, goes low for a defined pulse duration with the rising edge of the optical input signal. Output is a CMOS tri-state driver, which swings between ground and V_{CC}. Receiver echoes transmitter output.	O	Low
5	SD	Shutdown. Logic low at this input enables the receiver, enables the transmitter, and un-tri-states the receiver output. It must be driven high for shutting down the transceiver.	I	High
6	V_{CC}	Power supply, 2.4 V to 5.5 V. This pin provides power for the receiver and transmitter drive section. Connect V_{CC1} via an optional filter.		
7	GND	Ground		

PINOUT

TFBS4650, bottom view

weight 0.05 g



Definitions:

In the Vishay transceiver datasheets the following nomenclature is used for defining the IrDA operating modes:

- SIR: 2.4 kbit/s to 115.2 kbit/s, equivalent to the basic serial infrared standard with the physical layer version IrPhy 1.0
- MIR: 576 kbit/s to 1152 kbit/s
- FIR: 4 Mbit/s
- VFIR: 16 Mbit/s

MIR and FIR were implemented with IrPhy 1.1, followed by IrPhy 1.2, adding the SIR low power standard. IrPhy 1.3 extended the low power option to MIR and FIR and VFIR was added with IrPhy 1.4. A new version of the standard in any case obsoletes the former version.

ABSOLUTE MAXIMUM RATINGS

PARAMETER	TEST CONDITIONS	SYMBOL	MIN.	TYP.	MAX.	UNIT
Supply voltage range, transceiver	0 V < V_{CC2} < 6 V	V_{CC1}	-0.5	-	6	V
Supply voltage range, transmitter	0 V < V_{CC1} < 6 V	V_{CC2}	-0.5	-	6	V
Voltage at RXD	All states	V_{IN}	-0.5	-	V_{CC} + 0.5	V
Input voltage range, transmitter TXD	Independent of V_{CC1} or V_{CC2}	V_{IN}	-0.5	-	6	V
Input currents	For all pins, except IRED anode pin		-40	-	40	mA
Output sinking current			-	-	20	mA
Power dissipation		P_D	-	-	250	mW
Junction temperature		T_J	-	-	125	°C
Ambient temperature range (operating)		T_{amb}	-25	-	+85	°C
Storage temperature range		T_{stg}	-40	-	+100	°C
Soldering temperature (1)	See section "Recommended Solder Profile"		-	-	-	°C
Repetitive pulse output current	< 90 µs, t_{on} < 20 %	I_{IRED} (RP)	-	-	500	mA
Average output current (transmitter)		I_{IRED} (DC)	-	-	100	mA
Thermal resistance junction-to-ambient	JESD51	R_{thJA}	-	300	-	K/W

Notes

- Reference point pin, ground unless otherwise noted
  Typical values are for DESIGN AID ONLY, not guaranteed nor subject to production testing

(1) Sn/lead (Pb)-free soldering. The product passed Vishay's standard convection reflow profile soldering test

EYE SAFETY INFORMATION

STANDARD	CLASSIFICATION
IEC/EN 60825-1 (2007-03), DIN EN 60825-1 (2008-05) "SAFETY OF LASER PRODUCTS - Part 1: equipment classification and requirements", simplified method	Class 1
IEC 62471 (2006), CIE S009 (2002) "Photobiological Safety of Lamps and Lamp Systems"	Exempt
DIRECTIVE 2006/25/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 5th April 2006 on the minimum health and safety requirements regarding the exposure of workers to risks arising from physical agents (artificial optical radiation) (19th individual directive within the meaning of article 16(1) of directive 89/391/EEC)	Exempt

Note

- Vishay transceivers operating inside the absolute maximum ratings are classified as eye safe according the above table

ELECTRICAL CHARACTERISTICS (T_{amb} = 25 °C, V_{CC} = 2.4 V to 5.5 V unless otherwise noted)						
PARAMETER	**TEST CONDITIONS**	**SYMBOL**	**MIN.**	**TYP.**	**MAX.**	**UNIT**
TRANSCEIVER						
Supply voltage range		V_{CC}	2.4	-	5.5	V
Dynamic supply current						
Idle, dark ambient	SD = low (< 0.8 V), E_{eamb} = 0 klx, E_e < 4 mW/m^2 -25 °C ≤ T ≤ +85 °C	I_{CC}	-	90	130	µA
Idle, dark ambient	SD = low (< 0.8 V), E_{eamb}= 0 klx, E_e < 4 mW/m^2 T = +25 °C	I_{CC}	-	75	-	µA
Peak supply current during transmission	SD = low, TXD = high	I_{ccpk}	-	2	3	mA
Shutdown supply current dark ambient	SD = high (> V_{CC} - 0.5 V), T = 25 °C, E_e = 0 klx	I_{SD}	-	-	0.1	µA
Shutdown supply current, dark ambient	SD = high (> V_{CC} - 0.5 V), -25 °C ≤ T ≤ +85 °C	I_{SD}	-	-	1	µA
Operating temperature range		T_A	-25	-	+85	°C
Input voltage low (TXD, SD)		V_{IL}	-0.5	-	0.5	V
Input voltage high	V_{CC} = 2.4 V to 5.5 V	V_{IH}	V_{CC} - 0.5	-	6	V
Input voltage threshold SD	V_{CC} = 2.4 V to 5.5 V		0.9	1.35	1.8	V
Output voltage low	V_{CC} = 2.4 V to 5.5 V C_{LOAD} = 15 pF	V_{OL}	-0.5	-	V_{CC} x 0.15	V
Output voltage high	V_{CC} = 2.4 V to 5.5 V C_{LOAD} = 15 pF	V_{OH}	V_{CC} x 0.8	-	V_{CC} + 0.5	V
RXD to V_{CC} pull-up impedance	SD = V_{CC} V_{CC} = 2.4 V to 5 V	R_{RXD}	-	500	-	kΩ
Input capacitance (TXD, SD)		C_I	-	-	6	pF

Note

- Typical values are for design aid only, not guaranteed nor subject to production testing

OPTOELECTRONIC CHARACTERISTICS (T_{amb} = 25 °C, V_{CC} = 2.4 V to 5.5 V unless otherwise noted)						
PARAMETER	**TEST CONDITIONS**	**SYMBOL**	**MIN.**	**TYP.**	**MAX.**	**UNIT**
RECEIVER						
Sensitivity: minimum irradiance E_e in angular range (1)(2)	9.6 kbit/s to 115.2 kbit/s λ = 850 nm to 900 nm	E_e	-	40 (4)	81 (8.1)	mW/m² (µW/cm²)
Maximum irradiance E_e in angular range	λ = 850 nm to 900 nm	E_e	5 (500)	-	-	kW/m² (mW/cm²)
No receiver output input irradiance (3)	According to IrDA IrPHY 1.4, appendix A1, fluorescent light specification	E_e	4 (0.4)	-	-	mW/m² (µW/cm²)
Rise time of output signal	10 % to 90 %, C_L = 15 pF	$t_{r\ (RXD)}$	20	-	100	ns
Fall time of output signal	90 % to 10 %, C_L = 15 pF	$t_{f\ (RXD)}$	20	-	100	ns
RXD pulse width of output signal, 50 % (4)	Input pulse width 1.63 µs	t_{PW}	1.7	2	2.9	µs
Receiver start up time	Power on delay		-	100	150	µs
Latency		t_L	-	50	200	µs
TRANSMITTER (new surface emitter values introduced via PCN)						
IRED operating current limitation	No external resistor for current limitation (4)	I_D	200	300	430	mA
Forward voltage of built-in IRED	I_f = 300 mA	V_f	1.4	1.8	1.9	V
Output leakage IRED current	TXD = 0 V, 0 < V_{CC1} < 5.5 V	I_{IRED}	-1	0.01	1	µA
Output radiant intensity	α = 0°, 15°, TXD = high, SD = low	I_e	40	250	400	mW/sr
	V_{CC1} = 5 V, α = 0°, 15°, TXD = low or SD = high (receiver is inactive as long as SD = high)	I_e	-	-	0.04	mW/sr
Output radiant intensity, angle of half intensity		α	-	± 30	-	°
Peak - emission wavelength (5)		λ_p	870	-	910	nm
Spectral bandwidth		$\Delta\lambda$	-	45	-	nm
Optical rise time, fall time		t_{ropt}, t_{fopt}	10	50	300	ns
Optical output pulse duration	Input pulse width 1.6 < t_{TXD} < 23 µs	t_{opt}	t_{TXD} - 0.15	-	t_{TXD} + 0.15	µs
	Input pulse width $t_{TXD} \geq$ 23 µs	t_{opt}	23	50	100	µs
Optical overshoot			-	-	25	%

Notes

- Typical values are for design aid only, not guaranteed nor subject to production testing

(1) This parameter reflects the backlight test of the IrDA physical layer specification to guarantee immunity against light from fluorescent lamps.

(2) IrDA sensitivity definition: minimum irradiance E_e in angular range, power per unit area. The receiver must meet the BER specification while the source is operating at the minimum intensity in angular range into the minimum half-angular range at the maximum link length

(3) Maximum irradiance E_e in angular range, power per unit area. The optical delivered to the detector by a source operating at the maximum intensity in angular range at minimum link length must not cause receiver overdrive distortion and possible related link errors. If placed at the active output interface reference plane of the transmitter, the receiver must meet its bit error ratio (BER) specification. For more definitions see the document “Symbols and Terminology” on the Vishay website

(4) RXD output is edge triggered by the rising edge of the optical input signal. The output pulse duration is independent of the input pulse duration

(5) The radiant intensity can be adjusted by the external current limiting resistor to adapt the intensity to the desired value. The given value is for minimum current consumption. This transceiver can be adapted to > 50 cm operation by increasing the current to > 200 mA, e.g. operating the transceiver without current control resistor (i.e. R1 = 0 Ω) and using the internal current control

TRUTH TABLE				
INPUTS			OUTPUTS	
SD	TXD	OPTICAL INPUT IRRADIANCE mW/m²	RXD	TRANSMITTER
High	x	x	Tri-state floating with a weak pull-up to the supply voltage	0
Low	High	x	Low (echo on)	I_e
Low	High > 50 µs	x	High	0
Low	Low	< 4	High	0
Low	Low	> min. irradiance E_e < max. irradiance E_e	Low (active)	0
Low	Low	> max. irradiance E_e	x	0

RECOMMENDED CIRCUIT DIAGRAM

Operated at a clean low impedance power supply the TFBS4650 needs only one additional external component when the IRED drive current should be minimized for minimum current consumption according the low power IrDA standard. When combined operation in IrDA and remote control is intended no current limiting resistor is recommended.

However, depending on the entire system design and board layout, additional components may be required (see Fig. 1). When long wires are used for bench tests, the capacitors are mandatory for testing rise / fall time correctly.

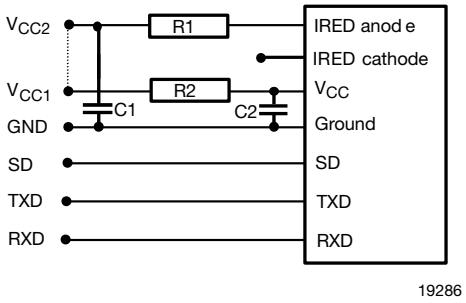


Fig. 1 - Recommended Application Circuit

The capacitor C1 is buffering the supply voltage V_{CC2} and eliminates the inductance of the power supply line. This one should be a small ceramic version or other fast capacitor to guarantee the fast rise time of the IRED current. The resistor R1 is necessary for controlling the IRED drive current when the internally controlled current is too high for the application.

Vishay transceivers integrate a sensitive receiver and a built-in power driver. The combination of both needs a careful circuit board layout. The use of thin, long, resistive and inductive wiring should be avoided. The inputs (TXD, SD) and the output RXD should be directly (DC) coupled to the I/O circuit.

The capacitor C2 combined with the resistor R2 is the low pass filter for smoothing the supply voltage.

As already stated above R2, C1 and C2 are optional and depend on the quality of the supply voltages V_{CCx} and injected noise. An unstable power supply with dropping voltage during transmission may reduce the sensitivity (and transmission range) of the transceiver.

The placement of these parts is critical. It is strongly recommended to position C2 as close as possible to the transceiver power supply pins.

When connecting the described circuit to the power supply, low impedance wiring should be used.

In case of extended wiring the inductance of the power supply can cause dynamically a voltage drop at V_{CC2}. Often some power supplies are not able to follow the fast current is rise time. In that case another 10 µF cap at V_{CC2} will be helpful.

Keep in mind that basic RF-design rules for circuit design should be taken into account. Especially longer signal lines should not be used without termination. See e.g. “The Art of Electronics” Paul Horowitz, Wienfield Hill, 1989, Cambridge University Press, ISBN: 0521370957.

RECOMMENDED APPLICATION CIRCUIT COMPONENTS	
COMPONENT	RECOMMENDED VALUE
C1, C2	0.1 µF, Ceramic Vishay part# VJ 1206 Y 104 J XXMT
R1	See table below
R2	47 Ω, 0.125 W (V_{CC1} = 3 V)

RECOMMENDED RESISTOR R1 (Ω)	
V_{CC2} (V)	MINIMIZED CURRENT CONSUMPTION, IrDA LOW POWER COMPLIANT
2.7	24
3	30
3.3	36

ASSEMBLY INSTRUCTIONS

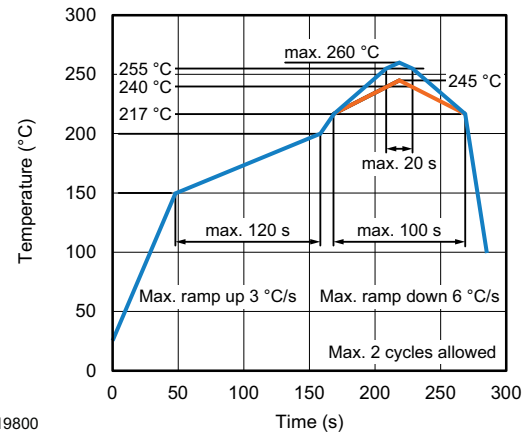
Reflow Soldering

- Reflow soldering must be done within 72 h while stored under a max. temperature of 30 °C, 60 % RH after opening the dry pack envelope
- Set the furnace temperatures for pre-heating and heating in accordance with the reflow temperature profile as shown in the diagram. Exercise extreme care to keep the maximum temperature below 260 °C. The temperature shown in the profile means the temperature at the device surface. Since there is a temperature difference between the component and the circuit board, it should be verified that the temperature of the device is accurately being measured
- Handling after reflow should be done only after the work surface has been cooled off

Manual Soldering

- Use a soldering iron of 25 W or less. Adjust the temperature of the soldering iron below 300 °C
- Finish soldering within 3 s
- Handle products only after the temperature has cooled off

VISHAY LEAD (Pb)-FREE REFLOW SOLDER PROFILE



PACKAGE DIMENSIONS in millimeters

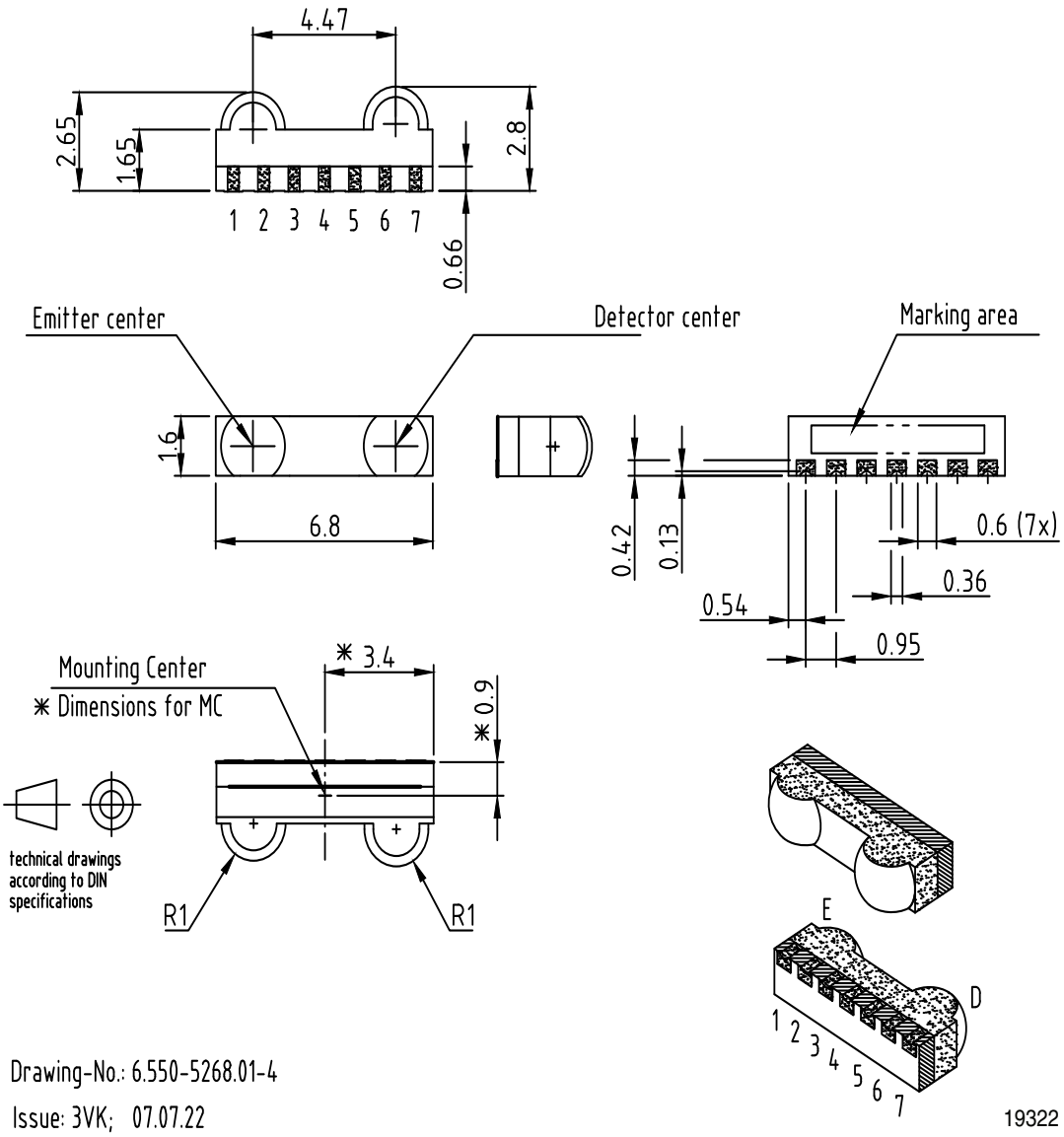


Fig. 2 - TFBS4650 Mechanical Dimensions, Tolerance ± 0.2 mm, if not otherwise mentioned

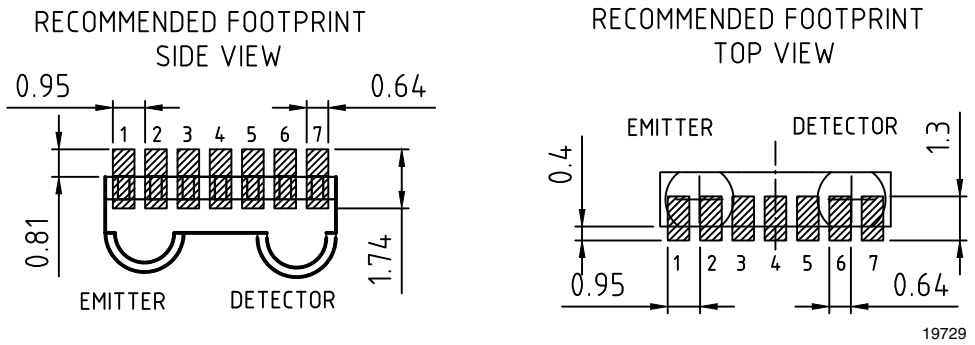
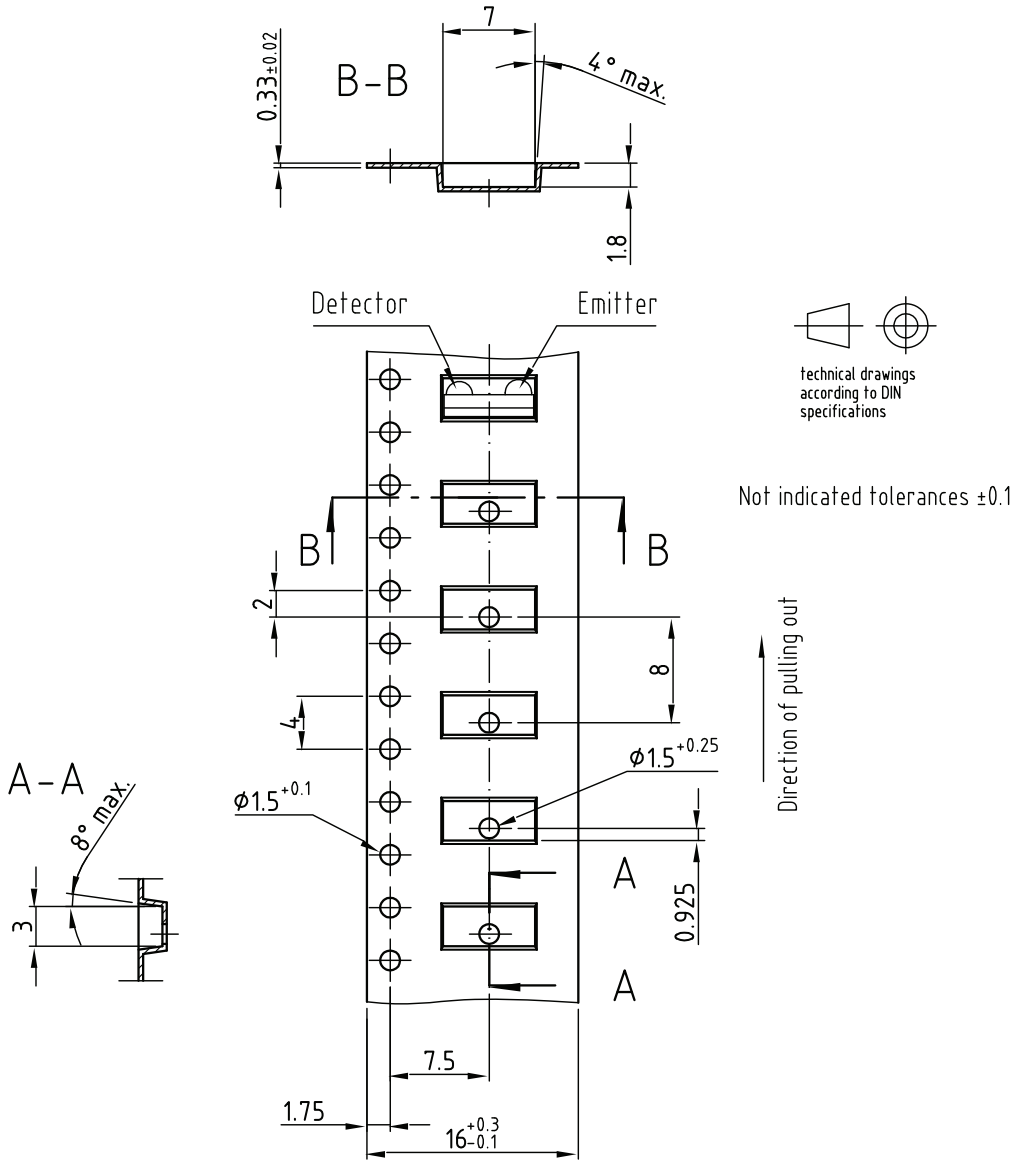


Fig. 3 - TFBS4650 Soldering Footprint, Tolerance ± 0.2 mm, if not otherwise mentioned

TAPE DIMENSIONS FOR TR1 AND TR3 in millimeters

Tape for Side View Oriented Parts



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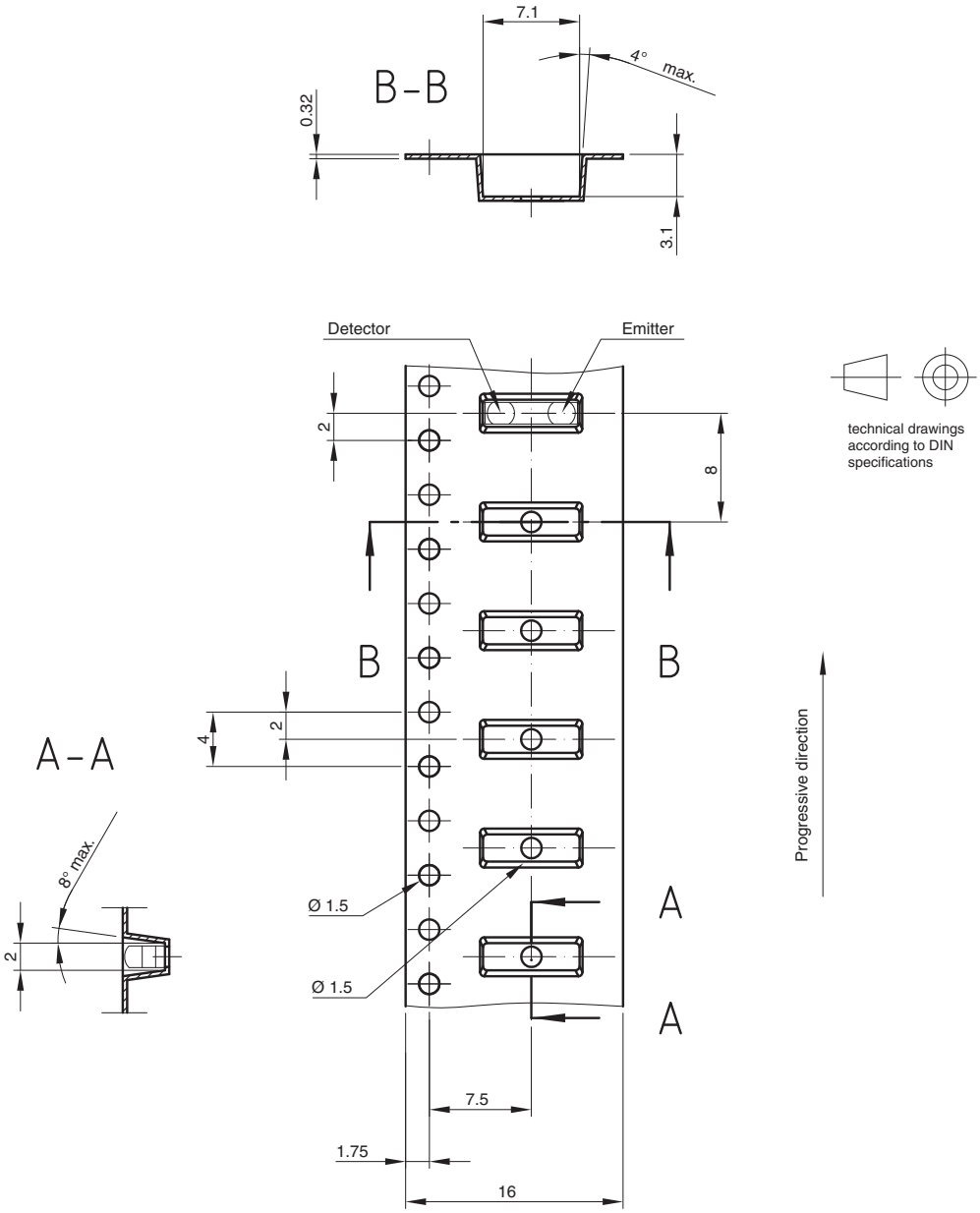
Issue: prel. copy; 24.11.04

19285

TAPE DIMENSIONS FOR TT1 in millimeters

Tape for Top View Oriented Parts



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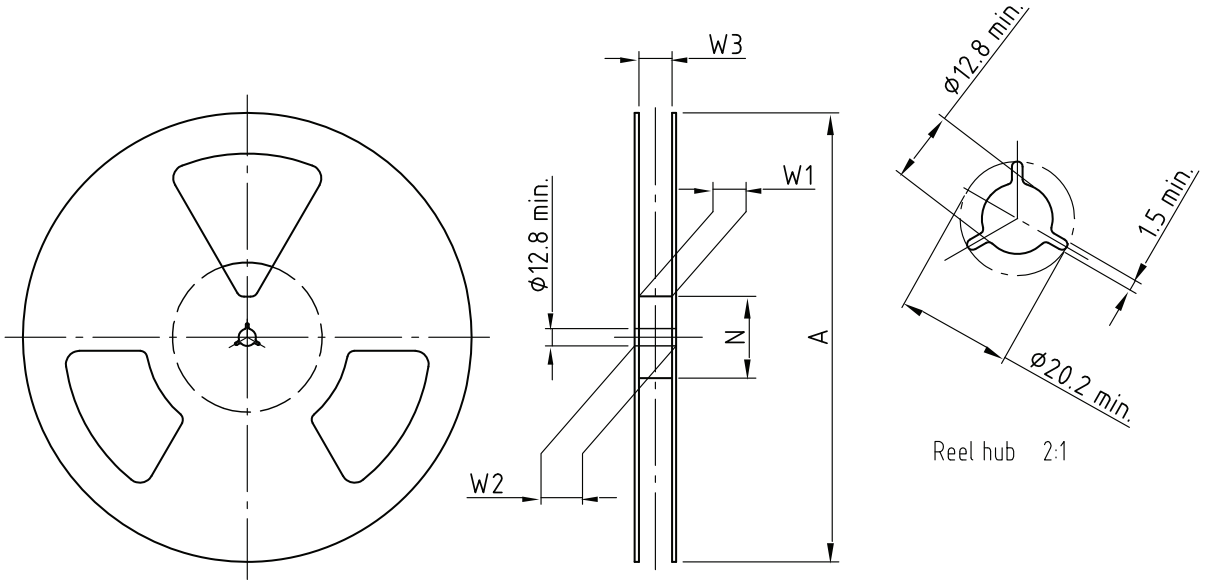
Issue: 1; 15.01.09
21663

REEL DIMENSIONS in millimeters



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Issue: 1; 29.11.05
14017

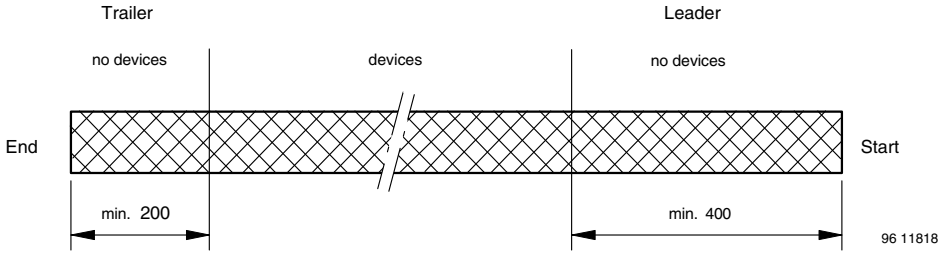
Form of the leave open
of the wheel is supplier specific.

Dimension acc. to IEC EN 60 286-3

technical drawings
according to DIN
specifications

TAPING VARIANT	TAPE WIDTH (mm)	A MAX. (mm)	N (mm)	W_1 MIN. (mm)	W_2 MAX. (mm)	W_3 MIN. (mm)	W_3 MAX. (mm)
TT1 / TR1	16	180	60	16.4	22.4	15.9	19.4
TT3 / TR3	16	330	50	16.4	22.4	15.9	19.4

LEADER AND TRAILER DIMENSIONS in millimeters



COVER TAPE PEEL STRENGTH

According to DIN EN 60286-3

0.1 N to 1.3 N

300 ± 10 mm/min.

165° to 180° peel angle

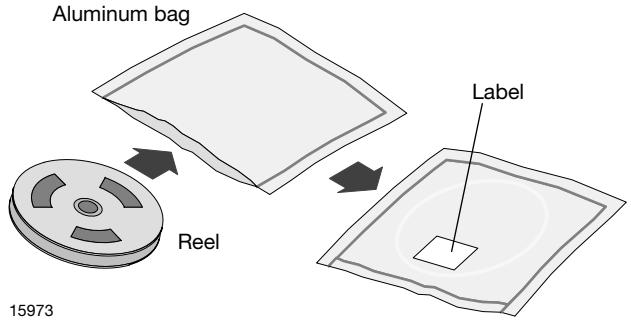
LABEL

Standard bar code labels for finished goods

The standard bar code labels are product labels and used for identification of goods. The finished goods are packed in final packing area. The standard packing units are labeled with standard bar code labels before transported as finished goods to warehouses. The labels are on each packing unit and contain Vishay Semiconductor GmbH specific data.

DRY PACKING

The reel is packed in an anti-humidity bag to protect the devices from absorbing moisture during transportation and storage.



FINAL PACKING

The sealed reel is packed into a cardboard box.

RECOMMENDED METHOD OF STORAGE

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

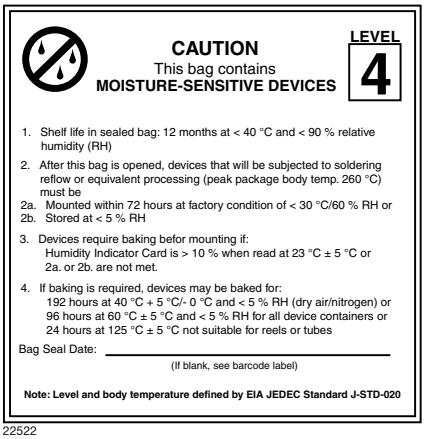
- Storage temperature 10 °C to 30 °C
- Storage humidity ≤ 60 % RH max.

After more than 72 h under these conditions moisture content will be too high for reflow soldering.

In case of moisture absorption, the devices will recover to the former condition by drying under the following condition:

192 h at 40 °C + 5 °C / - 0 °C and < 5 % RH (dry air / nitrogen) or
96 h at 60 °C + 5 °C and < 5 % RH for all device containers or
24 h at 125 °C + 5 °C not suitable for reel or tubes.

An EIA JEDEC® standard J-STD-020 level 4 label is included on all dry bags.

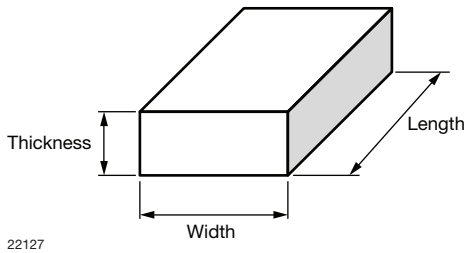


EIA JEDEC standard J-STD-020 level 4 label is included on all dry bags

OUTER PACKAGING

The sealed reel is packed into a pizza box.

CARTON BOX DIMENSIONS in millimeters



ORDER CODE	BOXING	THICKNESS	WIDTH	LENGTH
TT3 / TR3	Pizza box (taping in reels)	50	340	340
TT1 / TR1	Pizza box (taping in reels)	32	190	190

VISHAY SEMICONDUCTOR GmbH STANDARD BAR CODE PRODUCT LABEL (finished goods)		
PLAIN WRITING	**ABBREVIATION**	**LENGTH**
Item-description	-	18
Item-number	INO	8
Selection-code	SEL	3
LOT-/serial-number	BATCH	10
Data-code	COD	3 (YWW)
Plant-code	PTC	2
Quantity	QTY	8
Accepted by	ACC	-
Packed by	PCK	-
Mixed code indicator	MIXED CODE	-
Origin	xxxxxxx+	Company logo
Long bar code top	**Type**	**Length**
Item-number	N	8
Plant-code	N	2
Sequence-number	X	3
Quantity	N	8
Total length	-	21
Short bar code bottom	**Type**	**Length**
Selection-code	X	3
Data-code	N	3
Batch-number	X	10
Filter	-	1
Total length	-	17

ESD PRECAUTION

Proper storage and handling procedures should be followed to prevent ESD damage to the devices especially when they are removed from the antistatic shielding bag. Electrostatic sensitive devices warning labels are on the packaging.

VISHAY SEMICONDUCTORS STANDARD BAR CODE LABELS

The Vishay Semiconductors standard bar code labels are printed at final packing areas. The labels are on each packing unit and contain Vishay Semiconductors specific data.

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