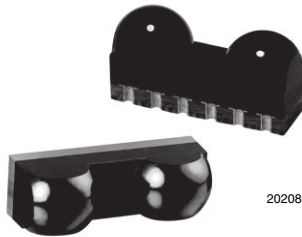




## Low Profile Fast Infrared Transceiver (FIR, 4 Mbit/s) for IrDA® Applications



### FEATURES

- Lowest profile: 1.9 mm
- Smallest footprint: 6 mm x 3.05 mm
- Surface mount package
- IrDA transmit distance: 50 cm typical
- Best remote control distance:  $\geq 6.5$  m on-axis
- Fast data rates: from 9.6 kbit/s to 4 Mbit/s
- Low shutdown current: 0.01  $\mu$ A
- Operating voltage: 2.4 V to 3.6 V
- Reduced pin count: 6 pins
- I/O voltage equal to the supply voltage
- Pin compatibility: TFBS4711
- Integrated EMI protection - no external shield required
- IEC 60825-1 class 1, eye safe
- Qualified for lead (Pb)-free and Sn/Pb processing
- Compliant to IrDA physical layer specification
- Split power supply, transmitter and receiver can be operated from two power supplies with relaxed requirements saving costs, US patent no. 6,157,476
- Qualified for lead (Pb)-free and Sn/Pb processing (MSL4)
- Material categorization: For definitions of compliance please see [www.vishay.com/doc?99912](http://www.vishay.com/doc?99912)



RoHS  
COMPLIANT

### DESCRIPTION

The TFBS6711 is the smallest FIR transceiver available. It is a low profile and low-power IrDA transceiver. Compliant to IrDA's physical layer specification, the TFBS6711 supports data transmission rates from 9.6 kbit/s to 4 Mbit/s with a typical link distance of 50 cm. It also enables mobile phones and PDAs to function as universal remote controls for televisions, DVDs and other home appliances. The TFBS6711 emitter covers a range of 6.5 m with common remote control receivers. Integrated within the transceiver module is a pin photodiode, an infrared emitter, and a low-power control IC. The TFBS6711 can be completely shutdown, achieving very low power consumption. The TFBS6711 has an I/O voltage related to the supply voltage.

### APPLICATIONS

- High-speed data transfer using infrared wireless communication
- Mobile phones
- Camera phones
- PDAs
- MP3 players
- Digital cameras
- IrDA adapters or dongles

### 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)
TFBS6711	4000	1.9 x 6 x 3.1	0 to $\geq 0.3$	2.4 to 3.6	1.9

### PARTS TABLE

PART NUMBER	DESCRIPTION AND REMARKS	QTY/REEL OR TUBE
TFBS6711-TR1	Oriented in carrier tape for side view surface mounting	1000 pcs
TFBS6711-TR3	Oriented in carrier tape for side view surface mounting	2500 pcs
TFBS6711-TT1	Oriented in carrier tape for top view surface mounting	1000 pcs
TFBS6711-TT3	Oriented in carrier tape for top view surface mounting	2500 pcs

**FUNCTIONAL BLOCK DIAGRAM**

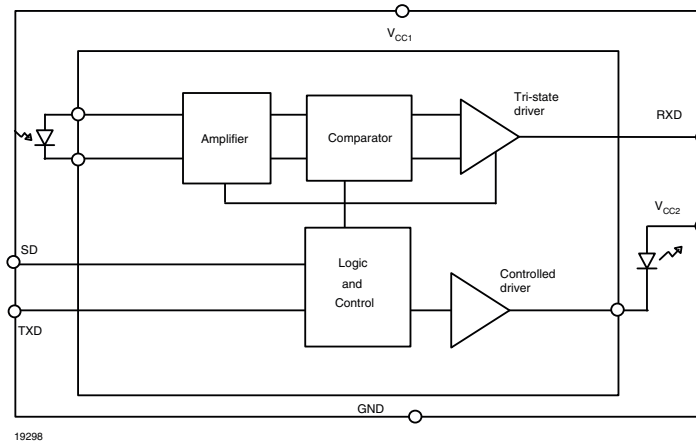


Fig. 1 - Functional Block Diagramm

PIN DESCRIPTION				
PIN NUMBER	FUNCTION	DESCRIPTION	I/O	ACTIVE
1	V <sub>CC2</sub> , IRED anode	IRED anode to be externally connected to V <sub>CC2</sub> . For higher voltages as 3.6 V an external resistor might be necessary for reducing the internal power dissipation. See derating curves. This pin is allowed to be supplied from an uncontrolled power supply separated from the controlled V <sub>CC1</sub> - supply		
2	TXD	Transmit data input	I	High
3	RXD	Received data output, push-pull CMOS driver output capable of driving a standard CMOS load. No external pull-up or pull-down resistor is required. Floating with a weak pull-up of 500 kΩ (typ.) in shutdown mode. The RXD output echos the TXD input during transmission.	O	Low
4	SD	Shutdown, also used for dynamic mode switching	I	High
5	V <sub>CC1</sub>	Supply voltage		
6	GND	Ground		

**PINOUT**

TFBS6711  
Weight: 50 mg

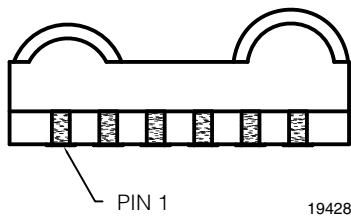


Fig. 2 - Pinning

**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

IrDA, the infrared data association, implemented MIR and FIR 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	$0\text{ V} < V_{CC2} < 6\text{ V}$	$V_{CC1}$	- 0.5		6	V
Supply voltage range, transmitter	$0\text{ V} < V_{CC1} < 6\text{ V}$	$V_{CC2}$	- 0.5		6.5	V
Input currents	For all pins, except IRED anode pin				10	mA
Output sinking current					25	mA
Power dissipation		$P_D$			500	mW
Junction temperature		$T_J$			125	°C
Ambient temperature range (operating)		$T_{amb}$	- 25		+ 85	°C
Storage temperature range		$T_{stg}$	- 25		+ 85	°C
Soldering temperature <sup>(1)</sup>					260	°C
Average output current		$I_{IRED (DC)}$			125	mA
Repetitive pulse output current	$< 90\ \mu\text{s}, t_{on} < 20\ %$	$I_{IRED (RP)}$			600	mA
IRED anode voltage		$I_{IRED A}$	- 0.5		6.5	V
Voltage at all inputs and outputs	$V_{IN} > V_{CC1}$ is allowed	$V_{IN}$	- 0.5		5.5	V

**Notes**

- Reference point pin 8 (ground) unless otherwise noted.  
Typical values are for design aid only, not guaranteed nor subject to production testing.
- <sup>(1)</sup> 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 5 <sup>th</sup> April 2006 on the minimum health and safety requirements regarding the exposure of workers to risks arising from physical agents (artificial optical radiation) (19 <sup>th</sup> 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						
PARAMETERS	TEST CONDITIONS	SYMBOL	MIN.	TYP.	MAX.	UNIT
<b>TRANSCEIVER</b>						
Supply voltage		$V_{CC}$	2.4		3.6	V
Dynamic supply current	Receive mode only. In transmit mode, add additional 85 mA (typ.) for IRED current. Add RXD output current depending on RXD load.					
	SD = low, SIR mode	$I_{CC}$		1.7	3	mA
	SD = low, MIR/FIR mode	$I_{CC}$		1.9	3.3	mA
Shutdown supply current	SD = high T = 25 °C, not ambient light sensitive, detector is disabled in shutdown mode	$I_{SD}$			1	$\mu$ A
Shutdown supply current	SD = high T = 85 °C, not ambient light sensitive	$I_{SD}$			5	$\mu$ A
Operating temperature range		$T_A$	- 25		+ 85	°C
Output voltage low	$I_{OL} = 1$ mA $C_{LOAD} = 15$ pF	$V_{OL}$			0.4	V
Output voltage high	$I_{OH} = - 250$ $\mu$ A $C_{LOAD} = 15$ pF	$V_{OH}$	$0.9 \times V_{CC}$			V
Internal RXD pull-up		$R_{RXD}$	400	500	600	k $\Omega$
Input voltage low (TXD, SD)		$V_{IL}$	- 0.5		0.5	V
Input voltage high (TXD, SD)		$V_{IH}$	$V_{CC} - 0.5$		$V_{CC} + 0.5$	V
Input leakage current (TXD, SD) <sup>(1)</sup>		$I_{ICH}$	- 1	0.05	+ 1	$\mu$ A
Input capacitance (TXD, SD)		$C_I$			5	pF

**Notes**

- $T_{amb} = 25$  °C,  $V_{CC} = 2.4$  V to 3.6 V unless otherwise noted. Typical values are for design aid only, not guaranteed nor subject to production testing.
- <sup>(1)</sup> The typical threshold level is  $0.5 \times V_{CC}$  ( $V_{CC} = 3$  V). It is recommended to use the specified min./max. values to avoid increased operating/shutdown current.

OPTOELECTRONIC CHARACTERISTICS						
PARAMETER	TEST CONDITIONS	SYMBOL	MIN.	TYP.	MAX.	UNIT
<b>RECEIVER</b>						
Minimum irradiance $E_e$ in angular range <sup>(2)</sup>	9.6 kbit/s to 115.2 kbit/s $\lambda = 850$ nm to 900 nm, $V_{CC} = 2.4$ V	$E_e$		50 (5)	80 (8)	mW/m <sup>2</sup> ( $\mu$ W/cm <sup>2</sup> )
Minimum irradiance $E_e$ in angular range MIR mode	1.152 Mbit/s $\lambda = 850$ nm to 900 nm, $V_{CC} = 2.4$ V	$E_e$		100 (10)		mW/m <sup>2</sup> ( $\mu$ W/cm <sup>2</sup> )
Minimum irradiance $E_e$ in angular range FIR mode	4 Mbit/s $\lambda = 850$ nm to 900 nm, $V_{CC} = 2.4$ V	$E_e$		120 (12)	200 (20)	mW/m <sup>2</sup> ( $\mu$ W/cm <sup>2</sup> )
Maximum irradiance $E_e$ in angular range <sup>(3)</sup>	$\lambda = 850$ nm to 900 nm	$E_e$		5 (500)		kW/m <sup>2</sup> (mW/cm <sup>2</sup> )
No detection receiver input irradiance (fluorescent light noise suppression)		$E_e$	4 (0.4)			mW/m <sup>2</sup> ( $\mu$ W/cm <sup>2</sup> )
Rise time of output signal	10 % to 90 %, $C_L = 15$ pF	$t_r$ (RXD)	10		50	ns
Fall time of output signal	90 % to 10 %, $C_L = 15$ pF	$t_f$ (RXD)	10		50	ns
RXD pulse width of output signal, 50 %, SIR mode	Input pulse length $1.4 \mu$ s < $P_{Wopt} < 25$ $\mu$ s	$t_{PW}$	1.4	1.8	2.6	$\mu$ s
RXD pulse width of output signal, 50 %, MIR mode	Input pulse length $P_{Wopt} = 217$ ns, 1.152 Mbit/s	$t_{PW}$	110	250	270	ns
RXD pulse width of output signal, 50 %, FIR mode	Input pulse length $P_{Wopt} = 125$ ns, 4 Mbit/s	$t_{PW}$	110		140	ns



OPTOELECTRONIC CHARACTERISTICS						
PARAMETER	TEST CONDITIONS	SYMBOL	MIN.	TYP.	MAX.	UNIT
<b>RECEIVER</b>						
RXD pulse width of output signal, 50 %, FIR mode	Input pulse length $P_{Wopt} = 250$ ns, 4 Mbit/s	$t_{pw}$	225		275	ns
RXD output jitter, leading edge	Input irradiance = 150 mW/m <sup>2</sup> , 4 Mbit/s 1.152 Mbit/s ≤ 115.2 kbit/s				20 40 350	ns
Receiver start up time	After completion of shutdown programming sequence power on delay				500	μs
Latency <sup>(1)</sup>		$t_L$			100	μs
<b>TRANSMITTER</b>						
IRED operating current, switched current control	For 3.3 V operation no external resistor is needed	$I_D$	330	440	600	mA
Output leakage IRED current	$V_{CC} = V_{IRED} = 3.3$ V, TXD = low	$I_{IRED}$	- 1		1	μA
Output radiant intensity, see figure 3, recommended application circuit	$V_{CC} = V_{IRED} = 3.3$ V, $a = 0^\circ$ TXD = high, SD = low, $R1 = 1 \Omega$	$I_e$	45	115	300	mW/sr
Output radiant intensity, see figure 3, recommended application circuit	$V_{CC} = V_{IRED} = 3.3$ V, $a = 0^\circ, 15^\circ$ TXD = high, SD = low, $R1 = 1 \Omega$	$I_e$	25	75	300	mW/sr
Output radiant intensity	$V_{CC1} = 3.6$ V, $a = 0^\circ, 15^\circ$ 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		$a$		± 24		deg
Peak - emission wavelength		$\lambda_p$	880		900	nm
Optical rise time, optical fall time		$t_{ropt}, t_{fopt}$	10		40	ns
Optical output pulse duration	Input pulse width 217 ns, 1.152 Mbit/s	$t_{opt}$	200	217	230	ns
	Input pulse width 125 ns, 4 Mbit/s	$t_{opt}$	116	125	134	ns
	Input pulse width 250 ns, 4 Mbit/s	$t_{opt}$	241	250	259	ns
	Input pulse width $t < 80 \mu s$ Input pulse width $t \geq 80 \mu s$	$t_{opt}$ $t_{opt}$	20	t	85	μs
Optical overshoot					25	%

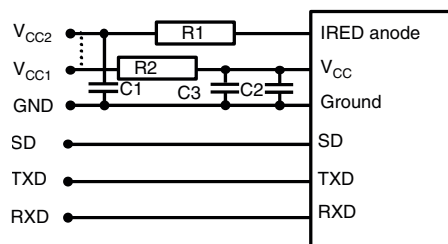
**Notes**

- For more definitions see the document “Symbols and Terminology” on the Vishay website.
  - $T_{amb} = 25^\circ C$ ,  $V_{CC} = 2.4$  V to 3.6 V unless otherwise noted. Typical values are for design aid only, not guaranteed nor subject to production testing. All timing data measured with 4 Mbit/s are measured using the IrDA FIR transmission header. The data given here are valid 5 μs after starting the preamble.
- IrDA latency definition: receiver latency allowance (milliseconds or microseconds) is the maximum time after a node ceases transmitting before the node’s receiver recovers its specified sensitivity. During this period and also during the receiver start up time (after power on or shutdown) the RXD output may be in an undefined state.
  - 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-angle range at the maximum link length.
  - 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.



## RECOMMENDED CIRCUIT DIAGRAM

Operated at a clean low impedance power supply the TFBS6711 needs no additional external components. However, depending on the entire system design and board layout, additional components may be required (see fig. 3).



19299

Fig. 3 - Recommended Application Circuit

The capacitor C1 is buffering the supply voltage and eliminates the inductance of the power supply line. This one should be a tantalum or other fast capacitor to guarantee the fast rise time of the IRED current.

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 (RXD, 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.

R2, C1 and C2 are optional and dependent 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.

A tantalum capacitor should be used for C1 while a ceramic capacitor is used for C2.

In addition, when connecting the described circuit to the power supply, low impedance wiring should be used.

When extended wiring is used 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 rise time. In that case another 4.7  $\mu\text{F}$  (type, see table under C1) 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, Winfield Hill, 1989, Cambridge University Press, ISBN: 0521370957.

### TABLE 1 - RECOMMENDED APPLICATION CIRCUIT COMPONENTS

COMPONENT	RECOMMENDED VALUE
C1	4.7 $\mu\text{F}$ , 16 V Vishay part#: 293D 475X9 016B
C2	0.1 $\mu\text{F}$ , ceramic Vishay part#: VJ1206 Y 104 J XXMT
R1	<b>3.3 V supply voltage:</b> no resistor is necessary, the internal controller is able to control the current
R2	4.7 $\Omega$ , 0.125 W

## I/O AND SOFTWARE

In the description, already different I/Os are mentioned. Different combinations are tested and the function verified with the special drivers available from the I/O suppliers. In special cases refer to the I/O manual, the Vishay application notes, or contact directly Vishay Sales, Marketing, or Application.

## MODE SWITCHING

The TFBS6711 is in the SIR mode after power on as a default mode, therefore the FIR data transfer rate has to be set by a programming sequence using the TXD and SD inputs as described below. The low frequency mode covers speeds up to 115.2 kbit/s. Signals with higher data rates should be detected in the high frequency mode. Lower frequency data can also be received in the high frequency mode but with reduced sensitivity. To switch the transceivers from low frequency mode to the high frequency mode and vice versa, the programming sequences described below are required.

## SETTING TO THE HIGH BANDWIDTH MODE (0.576 Mbit/s to 4 Mbit/s)

1. Set SD input to logic "high".
2. Set TXD input to logic "high". Wait  $t_s \geq 200$  ns.
3. Set SD to logic "low" (this negative edge latches state of TXD, which determines speed setting).
4. After waiting  $t_h \geq 200$  ns TXD can be set to logic "low". The hold time of TXD is limited by the maximum allowed pulse length.

TXD is now enabled as normal TXD input for the high bandwidth mode.



**SETTING TO THE LOWER BANDWIDTH MODE**

(2.4 kbit/s to 115.2 kbit/s)

1. Set SD input to logic “high”.
2. Set TXD input to logic “low”. Wait  $t_s \geq 200$  ns.
3. Set SD to logic “low” (this negative edge latches state of TXD, which determines speed setting).
4. TXD must be held for  $t_h \geq 200$  ns.

TXD is now enabled as normal TXD input for the lower bandwidth mode.

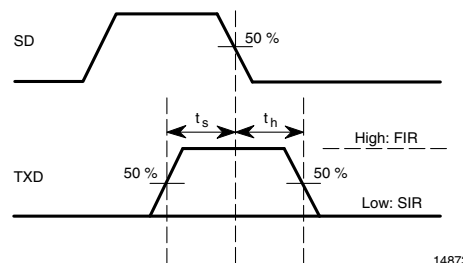


Fig. 4 - Mode Switching Timing Diagram

INPUTS			OUTPUTS	
SD	TXD	INPUT IRRADIANCE mW/m <sup>2</sup>	RXD	TRANSMITTER
High	x	x	Weakly pulled (500 kΩ) high	0
Low	High	x	Low active (echo)	$I_e$
Low	High > 80 μs	x	High	0
Low	Low	< 4	High	0
Low	Low	> min. irradiance $E_e$ in angular range < max. irradiance $E_e$ in angular range	Low (active)	0
Low	Low	> max. irradiance $E_e$ in angular range	x	0

**RECOMMENDED SOLDER PROFILES**

**Solder Profile for Sn/Pb Soldering**

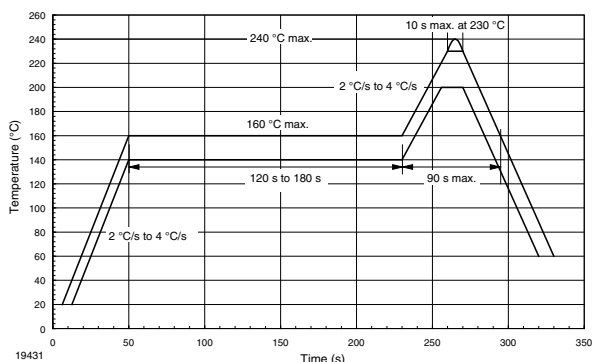


Fig. 5 - Recommended Solder Profile for Sn/Pb Soldering

**Lead (Pb)-free, Recommended Solder Profile**

The TFBS6711 is a lead (Pb)-free transceiver and qualified for lead (Pb)-free processing. For lead (Pb)-free solder paste like Sn<sub>(3.0-4.0)</sub>Ag<sub>(0.5-0.9)</sub>Cu, there are two standard reflow profiles: Ramp-Soak-Spike (RSS) and Ramp-To-Spike (RTS). The Ramp-Soak-Spike profile was developed primarily for reflow ovens heated by infrared radiation. With widespread use of forced convection reflow ovens the Ramp-To-Spike profile is used increasingly. Shown in figure 5 and 6 are Vishay’s recommended profiles for use with the TFBS6711 transceivers. For more details please refer to the application note “SMD Assembly Instructions”.

**Wave Soldering**

For TFDUxxxx and TFBSxxxx transceiver devices wave soldering is not recommended.

**Manual Soldering**

Manual soldering is the standard method for lab use. However, for a production process it cannot be recommended because the risk of damage is highly dependent on the experience of the operator. Nevertheless, we added a chapter to the above mentioned application note, describing manual soldering and desoldering.

**Storage**

The storage and drying processes for all Vishay transceivers (TFDUxxxx and TFBSxxx) are equivalent to MSL4.

The data for the drying procedure is given on labels on the packing and also in the application note “Taping, Labeling, Storage and Packing”.

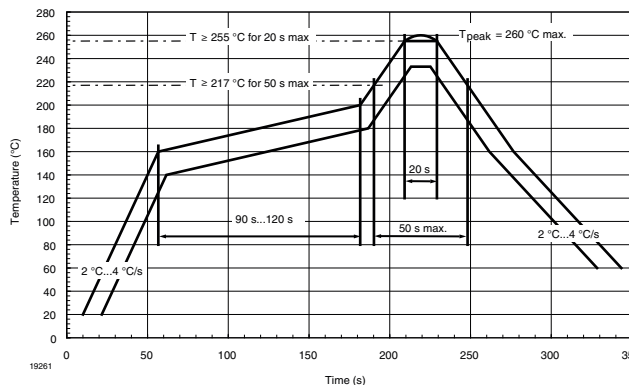
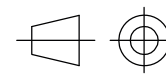
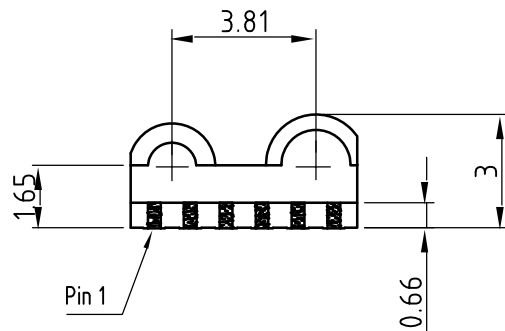


Fig. 6 - Solder Profile, RSS Recommendation



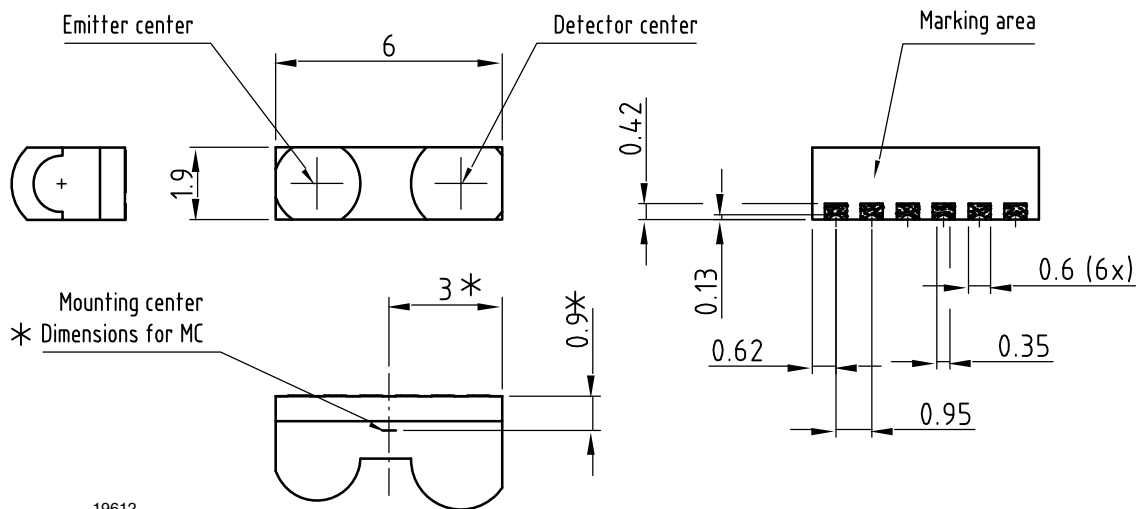


**TFBS6711 PACKAGE DIMENSIONS** in millimeters



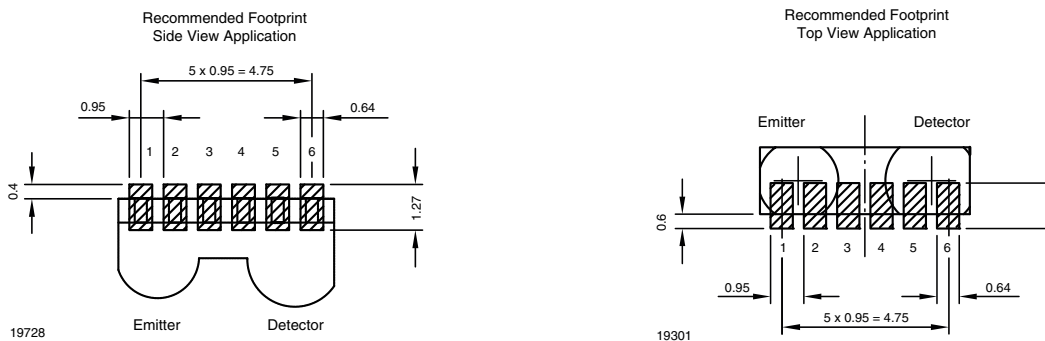
technical drawings according to DIN specifications

Not indicated tolerances  $\pm 0.2$



19612

Fig. 7 - Package Drawing, Tolerances: Height + 0.1, - 0.2 mm, otherwise  $\pm 0.2$  mm if not indicated



19728

19301

Fig. 8 - Soldering Footprints

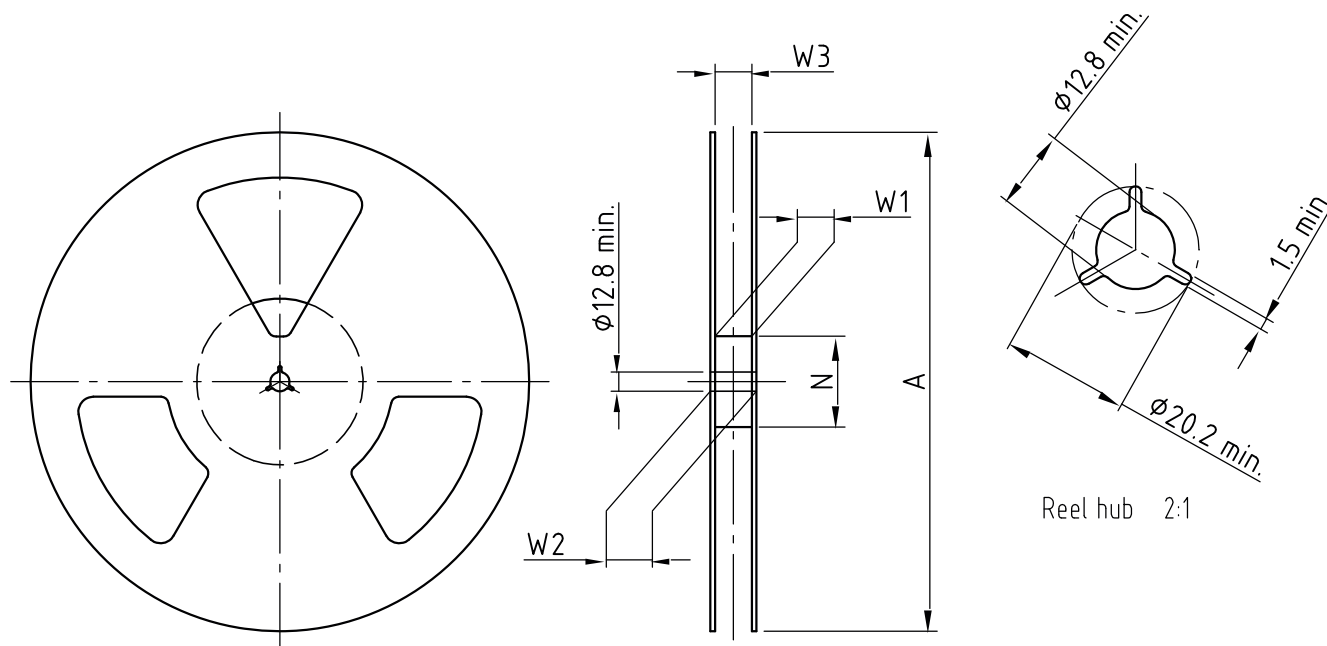
**Design Rules for Optical Windows**

For optical windows see the application note on the web.





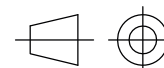
**REEL DIMENSIONS** in millimeters



Drawing-No.: 9.800-5090.01-4  
 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

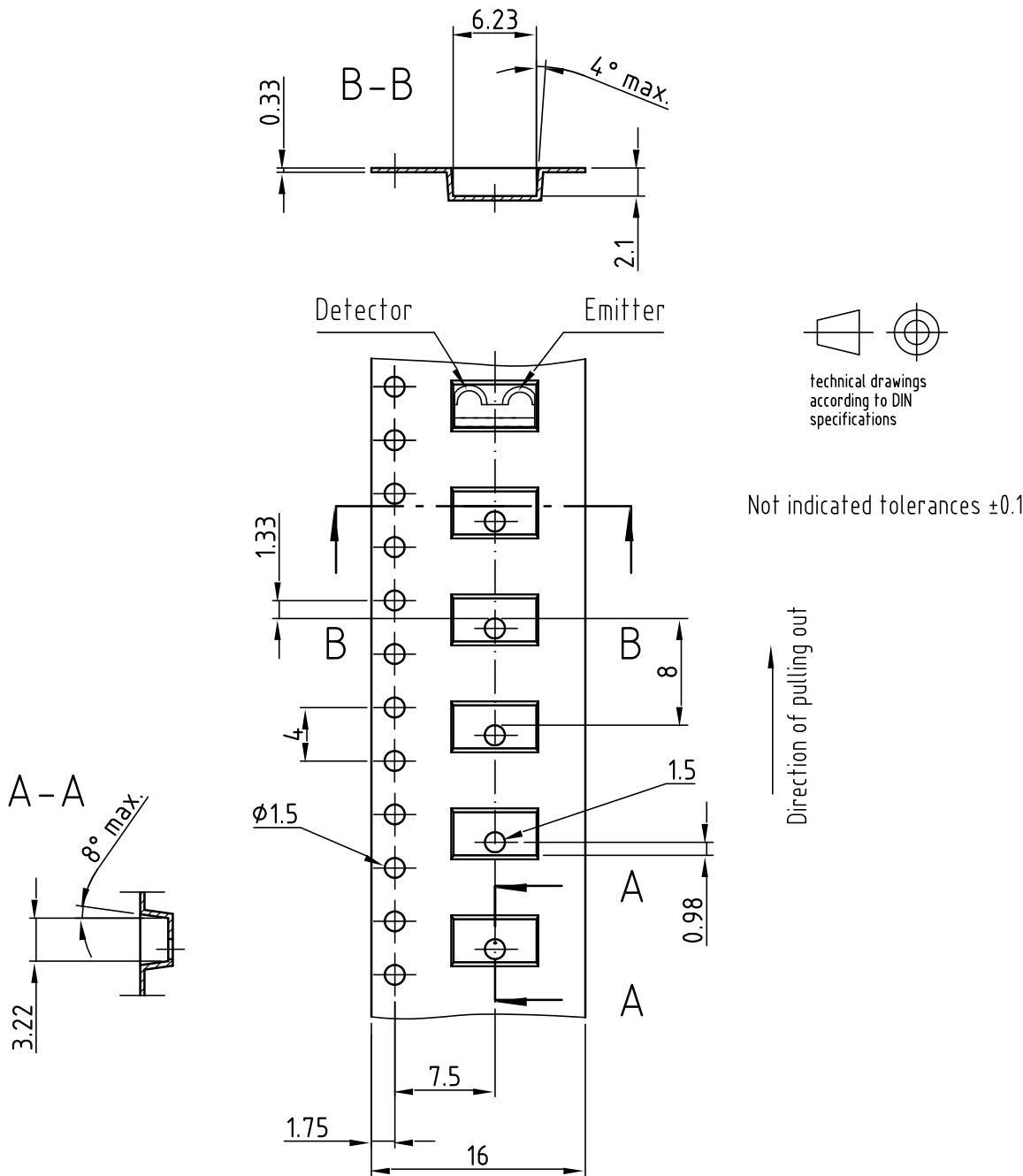


technical drawings according to DIN specifications

TAPE WIDTH (mm)	A MAX. (mm)	N (mm)	W <sub>1</sub> MIN. (mm)	W <sub>2</sub> MAX. (mm)	W <sub>3</sub> MIN. (mm)	W <sub>3</sub> MAX. (mm)
16	330	50	16.4	22.4	15.9	19.4



TAPE DIMENSIONS in millimeters

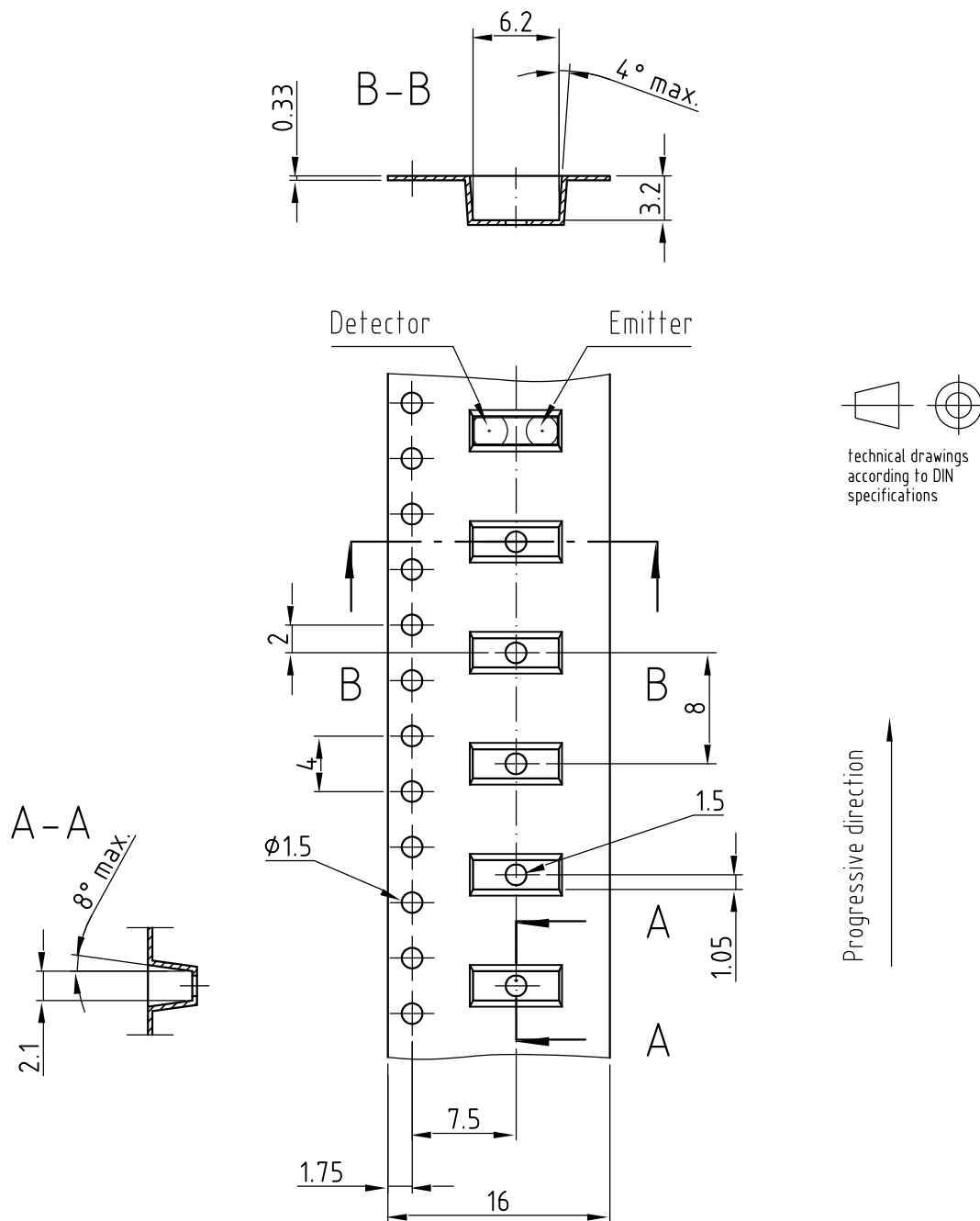


Drawing-No.: 9.700-5294.01-4  
 Issue: 1; 08.12.04  
 19613

Fig. 9 - Tape Drawing, TFBS6711 for Side View Mounting, Tolerance  $\pm 0.1$  mm



TAPE DIMENSIONS in millimeters



Drawing-No.: 9.700-5295.01-4  
Issue: 1; 08.12.04  
20416

Fig. 10 - Tape Drawing, TFBS6711 for Top View Mounting, Tolerance ± 0.1 mm



## Disclaimer

ALL PRODUCT, PRODUCT SPECIFICATIONS AND DATA ARE SUBJECT TO CHANGE WITHOUT NOTICE TO IMPROVE RELIABILITY, FUNCTION OR DESIGN OR OTHERWISE.

Vishay Intertechnology, Inc., its affiliates, agents, and employees, and all persons acting on its or their behalf (collectively, "Vishay"), disclaim any and all liability for any errors, inaccuracies or incompleteness contained in any datasheet or in any other disclosure relating to any product.

Vishay makes no warranty, representation or guarantee regarding the suitability of the products for any particular purpose or the continuing production of any product. To the maximum extent permitted by applicable law, Vishay disclaims (i) any and all liability arising out of the application or use of any product, (ii) any and all liability, including without limitation special, consequential or incidental damages, and (iii) any and all implied warranties, including warranties of fitness for particular purpose, non-infringement and merchantability.

Statements regarding the suitability of products for certain types of applications are based on Vishay's knowledge of typical requirements that are often placed on Vishay products in generic applications. Such statements are not binding statements about the suitability of products for a particular application. It is the customer's responsibility to validate that a particular product with the properties described in the product specification is suitable for use in a particular application. Parameters provided in datasheets and/or specifications may vary in different applications and performance may vary over time. All operating parameters, including typical parameters, must be validated for each customer application by the customer's technical experts. Product specifications do not expand or otherwise modify Vishay's terms and conditions of purchase, including but not limited to the warranty expressed therein.

Except as expressly indicated in writing, Vishay products are not designed for use in medical, life-saving, or life-sustaining applications or for any other application in which the failure of the Vishay product could result in personal injury or death. Customers using or selling Vishay products not expressly indicated for use in such applications do so at their own risk. Please contact authorized Vishay personnel to obtain written terms and conditions regarding products designed for such applications.

No license, express or implied, by estoppel or otherwise, to any intellectual property rights is granted by this document or by any conduct of Vishay. Product names and markings noted herein may be trademarks of their respective owners.

## Material Category Policy

**Vishay Intertechnology, Inc. hereby certifies that all its products that are identified as RoHS-Compliant fulfill the definitions and restrictions defined under Directive 2011/65/EU of The European Parliament and of the Council of June 8, 2011 on the restriction of the use of certain hazardous substances in electrical and electronic equipment (EEE) - recast, unless otherwise specified as non-compliant.**

**Please note that some Vishay documentation may still make reference to RoHS Directive 2002/95/EC. We confirm that all the products identified as being compliant to Directive 2002/95/EC conform to Directive 2011/65/EU.**

**Vishay Intertechnology, Inc. hereby certifies that all its products that are identified as Halogen-Free follow Halogen-Free requirements as per JEDEC JS709A standards. Please note that some Vishay documentation may still make reference to the IEC 61249-2-21 definition. We confirm that all the products identified as being compliant to IEC 61249-2-21 conform to JEDEC JS709A standards.**