# Infrared Transceiver, 9.6 kbit/s to 115.2 kbit/s (SIR) for IrDA® Applications



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

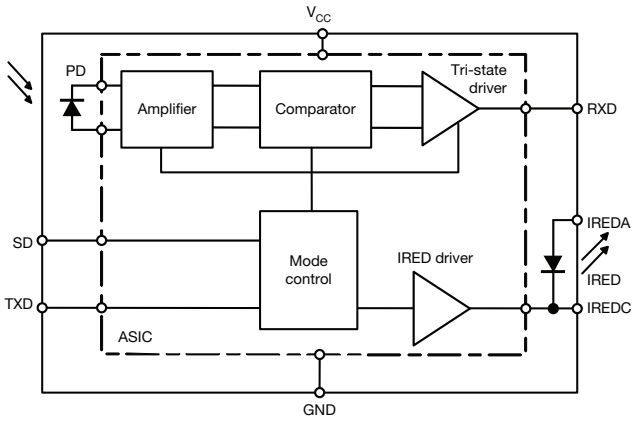
Product Page

Related Documents

## DESIGN SUPPORT TOOLS

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

## FUNCTIONAL BLOCK DIAGRAM




19283



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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 ≥ 1 | 2.4 to 5.5 | 0.07 |

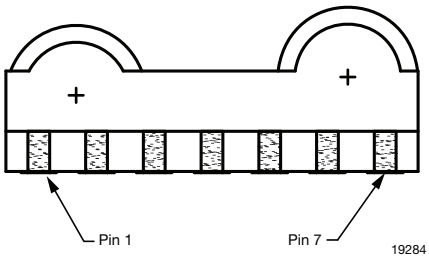
| PARTS TABLE | | |
|---|---|---|
| PART | DESCRIPTION | QTY/REEL |
| TFBS4650-TR1 | Oriented in carrier tape for side view surface mounting | 1000 pcs |
| TFBS4650-TR3 | Oriented in carrier tape for side view surface mounting | 2500 pcs |
| TFBS4650-TT3 | Oriented in carrier tape for top view surface 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 0.04 g






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## ABSOLUTE MAXIMUM RATINGS

| PARAMETER | TEST CONDITIONS | SYMBOL | MIN. | TYP. | MAX. | UNIT |
|---|---|---|---|---|---|---|
| Supply voltage range, transceiver | -0.3 V < $V_{CC2}$ < 6 V | $V_{CC1}$ | -0.5 | - | +6 | V |
| Supply voltage range, transmitter | -0.5 V < $V_{CC1}$ < 6 V | $V_{CC2}$ | -0.5 | - | +6 | V |
| RXD output voltage | -0.5 V < $V_{CC1}$ < 6 V | $V_{RXD}$ | -0.5 | - | $V_{CC1}$ + 0.5 | V |
| Voltage at all inputs | Note: $V_{in} \geq V_{CC1}$ is allowed | $V_{IN}$ | -0.5 | - | +6 | V |
| Input current | For all pins, except IRED anode pin | | - | - | 10 | mA |
| Output sinking current | | | - | - | 25 | 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 | | $T_{stg}$ | -25 | - | +85 | °C |
| Soldering temperature | See recommended solder profile | | - | - | 260 | °C |
| Average output current, pin 1 | | $I_{IRED(DC)}$ | - | - | 85 | mA |
| Repetitive pulsed output current, pin 1 to pin 2 | t < 90 µs, $t_{on}$ < 20 % | $I_{IRED(RP)}$ | - | - | 430 | mA |
| ESD protection | JESD22-A114 | $V_{ESD}$ | 2 | - | - | kV |
| Latchup | JESD78 | | \|± 100\| | - | - | mA |
| Thermal resistance junction-to-ambient | JESD51 | $R_{thJA}$ | - | 300 | - | K/W |

**Note**

- Reference point ground (pin 8) unless otherwise noted. Typical values are for DESIGN AID ONLY, not guaranteed nor subject to production testing.

## 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


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| **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 supply current at $V_{CC1}$ (receive mode, no signal) | SD = low, $T_{amb}$ = -25 °C to +85 °C independent of ambient light, $V_{CC1}$ = $V_{CC2}$ = 2.4 V to 5.5 V | $I_{CC1}$ | 40 | 70 | 110 | µA |
| Average dynamic supply current, transmitting | $I_{IRED}$ = 300 mA, 20 % duty cycle | $I_{CC1}$ | - | 0.6 | 2 | mA |
| Standby (SD) (1) supply current | SD = high, $T_{amb}$ = -25 °C to +85 °C independent of ambient light | $I_{SD}$ | - | 0.01 | 1 | µA |
| 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 | $V_{OL}$ | - | - | $V_{CC}$ x 0.15 | V |
| Output voltage high | $I_{OH}$ = 200 µA | $V_{OHi}$ | $V_{CC}$ x 0.8 | - | - | V |
| RXD to $V_{CC}$ pull-up impedance | SD = $V_{CC}$ $V_{CC}$ = 2.4 V to 5 V | $R_{RXD}$ | 400 | 500 | 600 | kΩ |
| Input capacitance (TXD, SD) | | $C_I$ | - | - | 6 | pF |

**Note**

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


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| 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 $\lambda$ = 850 nm to 900 nm | $E_e$ | - | 40 | 81 | mW/m² |
| Maximum irradiance $E_e$ in angular range | $\lambda$ = 850 nm to 900 nm | $E_e$ | 2 | - | - | kW/m² |
| No receiver output input irradiance (3) | According to IrDA IrPHY 1.4, appendix A1, fluorescent light specification | $E_e$ | 4 | - | - | mW/m² |
| 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** | | | | | | |
| 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 | $\alpha$ = 0°, 15°, TXD = high, SD = low | $I_e$ | 40 | 250 | 400 | mW/sr |
| | $V_{CC1}$ = 5 V, $\alpha$ = 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 | | $\alpha$ | - | ± 30 | - | ° |
| Peak - emission wavelength (5) | | $\lambda_p$ | 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 $t_{TXD}$ ≥ 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


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## RECOMMENDED CIRCUIT DIAGRAM

Operated with a clean low impedance power supply the TFBS4650 needs no additional external components. However, depending on the entire system design and board layout, additional components may be required (see Fig. 1).

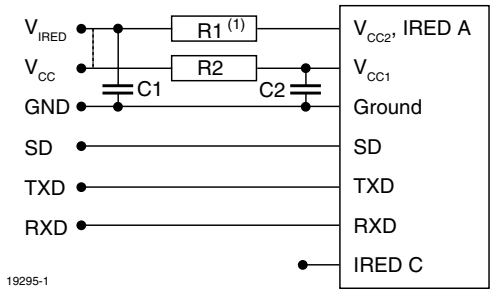



Fig. 1 - Recommended Application Circuit

**Note**

(1) R1 is optional when reduced intensity is used

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. The resistor R1 is the current limiting resistor, which may be used to reduce the operating current to levels below the specified controlled values for saving battery power.

Vishay's 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 shutdown input must be grounded for normal operation, also when the shutdown function is not used.

**TABLE 1 - RECOMMENDED APPLICATION CIRCUIT COMPONENTS**

| COMPONENT | RECOMMENDED VALUE |
|---|---|
| C1 | 4.7 µF |
| C2 | 0.1 µF, ceramic |
| R1 | Depends on current to be adjusted |
| R2 | 47 Ω |

The inputs (TXD, SD) and the output RXD should be directly connected (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 $V_{CC}1$ and injected noise. An unstable power supply with dropping voltage during transmision 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 pins.

When extended wiring is used as in bench tests 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 µF (type, see table under C1) at $V_{CC2}$ will be helpful.

Under extreme EMI conditions as placing an RF-transmitter antenna on top of the transceiver, we recommend to protect all inputs by a low-pass filter, as a minimum a 12 pF capacitor, especially at the RXD port.

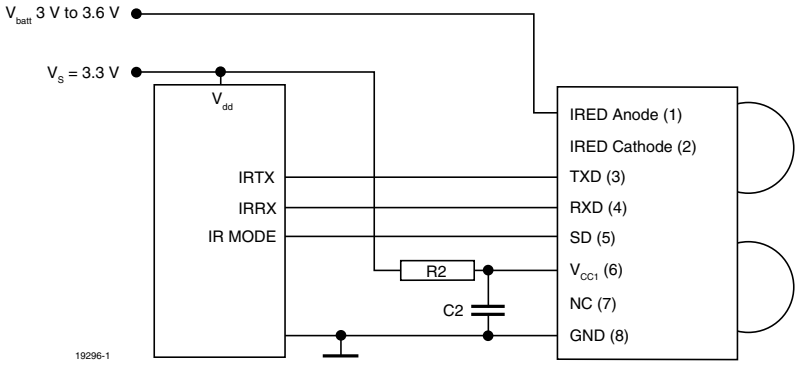



Fig. 2 - Typical Application Circuit

Fig. 2 shows an example of a typical application for to work with a separate supply voltage $V_S$ and using the transceiver with the IRED Anode connected to the unregulated battery $V_{batt}$. This method reduces the peak load of the regulated power supply and saves therefore costs. Alternatively all supplies can also be tied to only one voltage source. R1 and C1 are not used in this case and are depending on the circuit design in most cases not necessary.



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## 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.

For operating at RS232 ports we recommend to use an encoder / decoder-module.

**Note**

- TFBS4650 echoes the TXD signal at the RXD output during transmission. For communication this signal is to be correctly ignored by the controller or the software. The echo signal is implemented for test purposes in mass production

**TABLE 2 - TRUTH TABLE**

| INPUTS | | | OUTPUTS | | REMARK |
|---|---|---|---|---|---|
| SD | TXD | OPTICAL INPUT IRRADIANCE mW/m² | RXD | TRANSMITTER | OPERATION |
| High > 1 ms | x | x | Weakly pulled (500 kΩ) to $V_{CC1}$ | 0 | Shutdown |
| Low | High | x | Low (active) | $I_e$ | Transmitting |
| Low | High > 100 µs | x | High inactive | 0 | Protection is active |
| Low | Low | < 4 | High inactive | 0 | Ignoring low signals below the IrDA defined threshold for noise immunity |
| Low | Low | > min. detection threshold irradiance<br>< max. detection threshold irradiance | Low (active) | 0 | Response to an IrDA compliant optical input signal |
| Low | Low | > max. detection threshold irradiance | Undefined | 0 | Overload conditions can cause unexpected outputs |

## ASSEMBLY INSTRUCTIONS

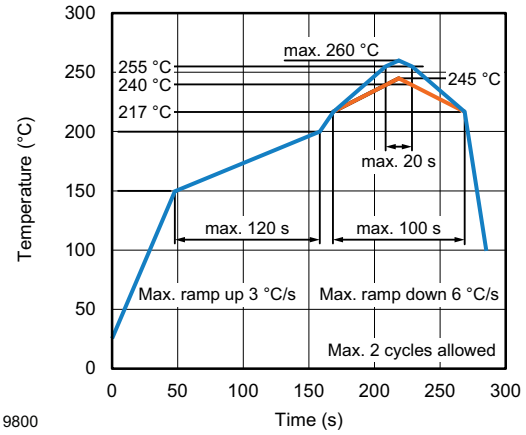
### Reflow Soldering

- 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




19800



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**PACKAGE DIMENSIONS** in millimeters

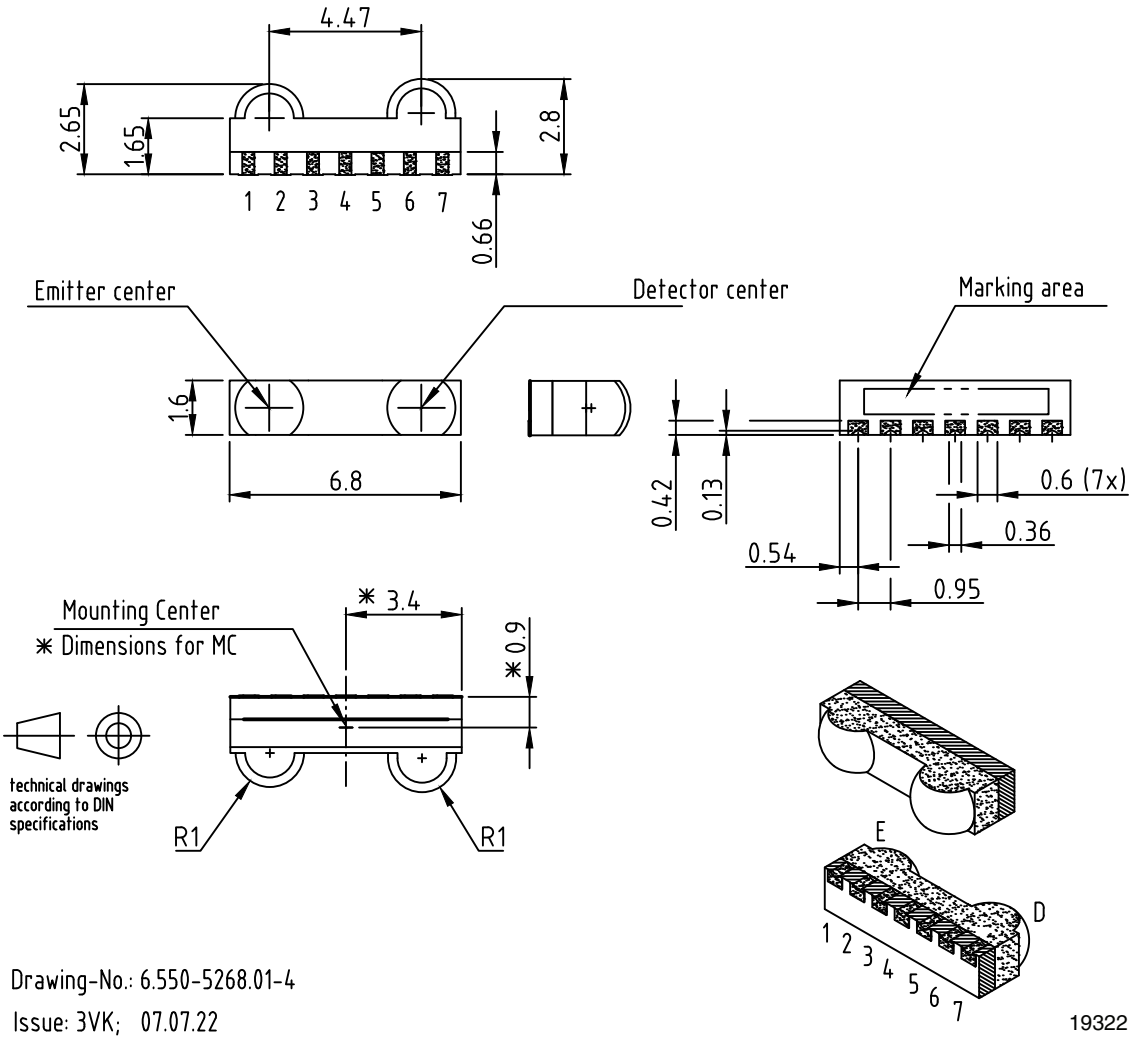



Fig. 3 - TFBS4650 Mechanical Dimensions, Tolerance ± 0.2 mm, if not Otherwise Mentioned

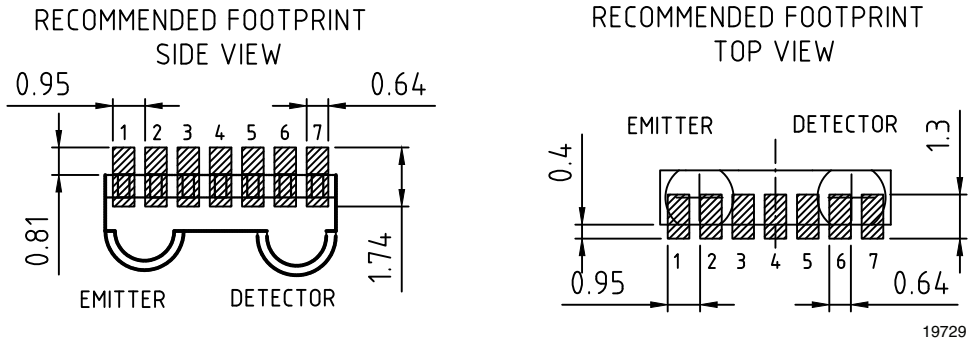


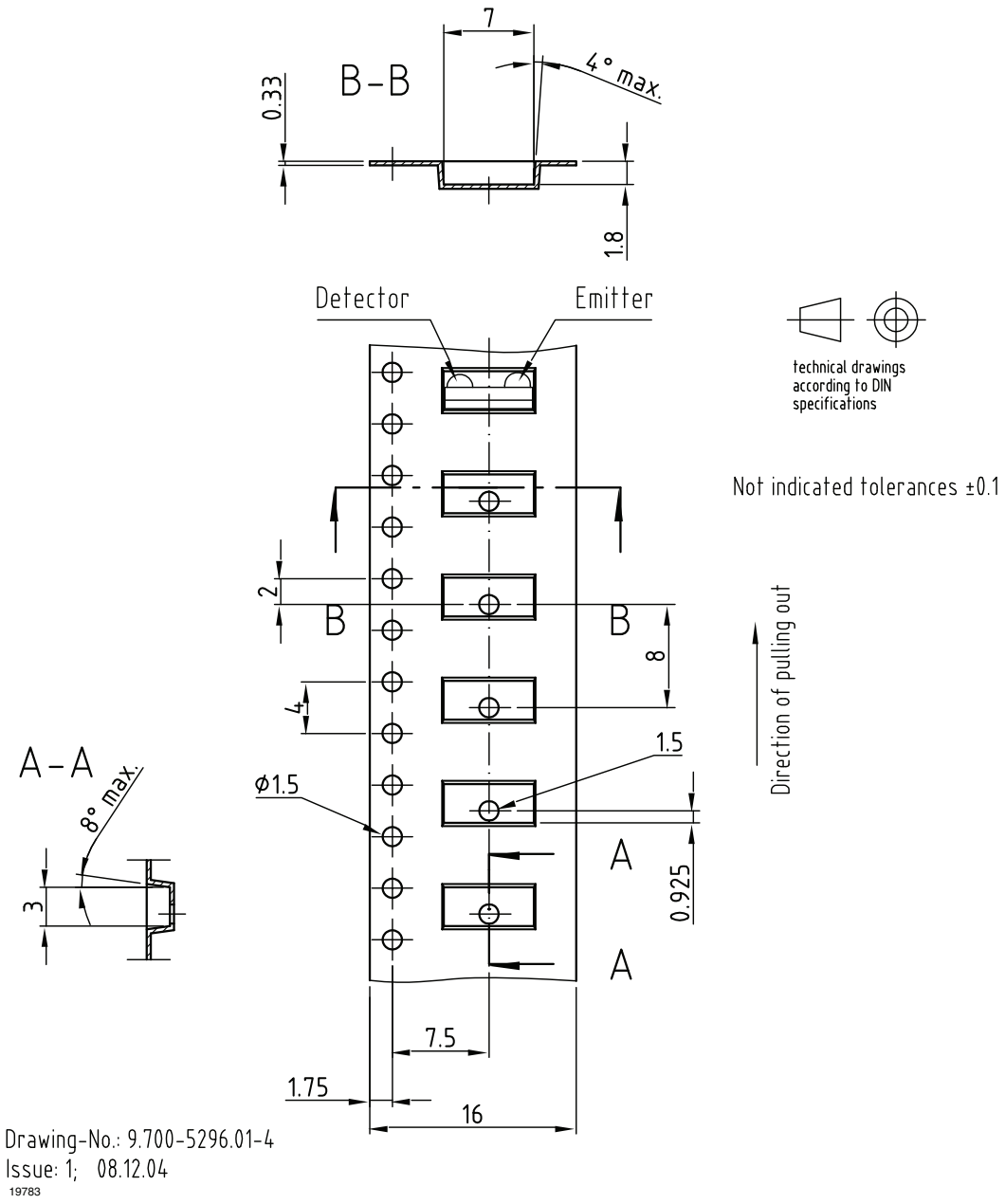

Fig. 4 - TFBS4650 Soldering Footprint, Tolerance ± 0.2 mm, if not Otherwise Mentioned



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**TAPE DIMENSIONS FOR TR1 AND TR3** in millimeters

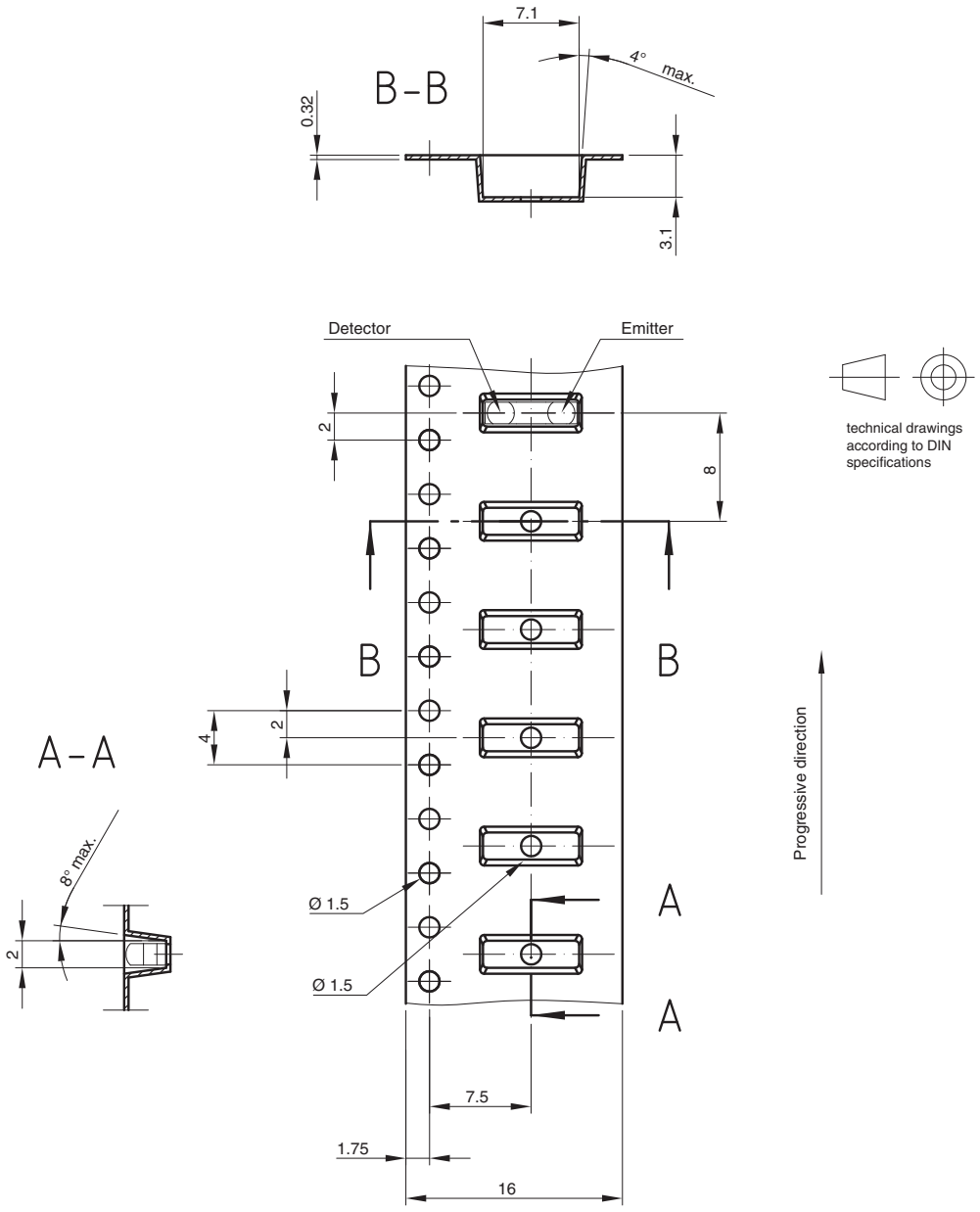





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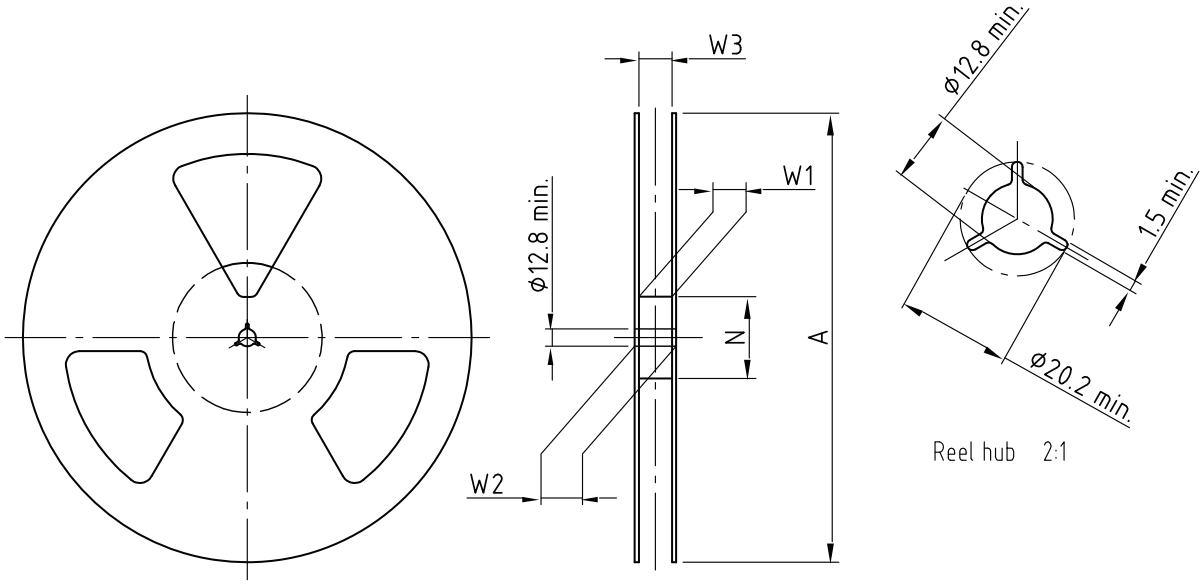
**TAPE DIMENSIONS FOR TT3** in millimeters




Drawing-No.: 9.700-5340.01-4
Issue: 1; 15.01.09
21663


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## REEL DIMENSIONS in millimeters




Drawing-No.: 9.800-5090.01-4
Issue: 1; 29.11.05
14017

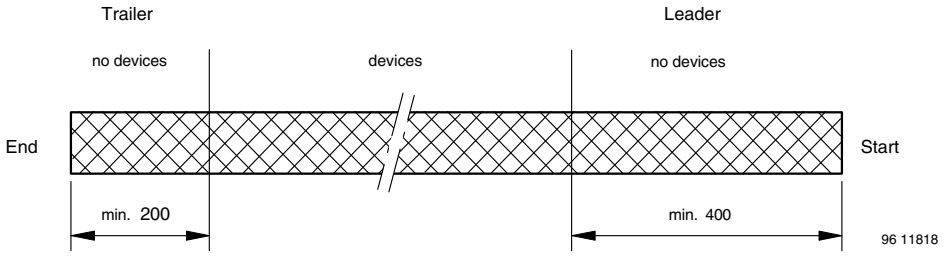
Form of the leave open
of the wheel is supplier specific.

Dimension acc. to IEC EN 60 286-3

technical drawings
according to DIN
specifications

| 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.

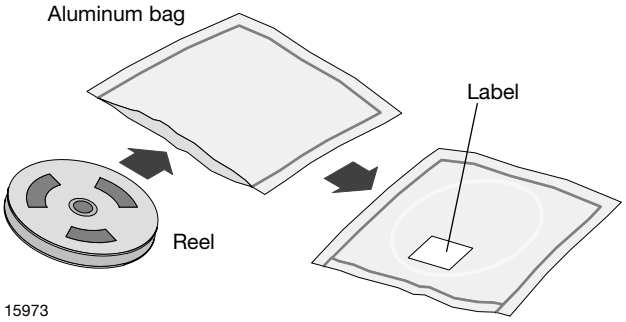


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## DRY PACKING

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




15973

## 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.

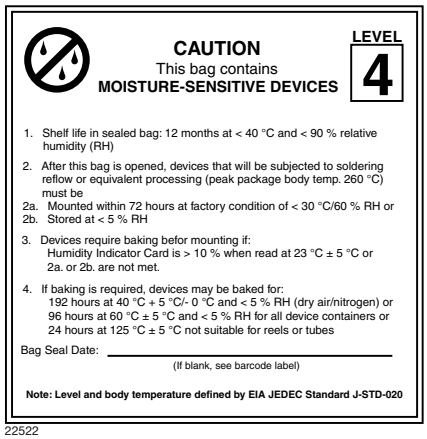
In case of moisture absorption, the devices will recover to the former condition by drying under the following condition:

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.



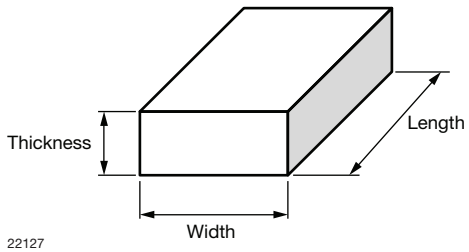

22522

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




22127

| 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 |



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| 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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