# TFBS4710

## Vishay Semiconductors

# Serial Infrared Transceiver SIR, 115.2 kbit/s, 2.7 V to 5.5 V Operation

MEMBER
IrDA

## Description

The TFBS4710 is a low profile, full range Infrared Data Transceiver module. It supports IrDA data rates up to 115.2 kbit/s (SIR). The transceiver module consists of a photo PIN photodiode, an infrared emitter (IRED), and a low-power CMOS control IC to provide a total front-end solution in a single package.

The device has a link distance of 1 meter. The RXD pulse width is independent of the duration of TXD pulse and always stays at a fixed width thus making the device optimum for all standard SIR Encoder/ Decoder and interfaces. The Shut Down (SD) feature cuts current consumption to typically 10 nA.
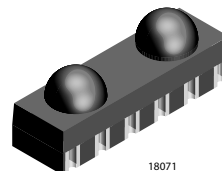
## Features

- Compliant with the latest IrDA physical layer
  specification (9.6 kbit/s to 115.2 kbit/s)
- Small package:
  H 2.74 mm x D 3.33 mm x L 8.96 mm
- Typical Link distance 1 m
- Drop in replacement for IRM5000D/ IRMT5000
- Battery & Power Management Features:
  > Idle Current - 75 µA Typical
  > Shutdown Current - 10 nA Typical
  > Operates from 2.4 V - 5.0 V within specification over full temperature range from - 25 °C to + 85 °C
- Remote Control - transmit distance up to 8 meters
- Tri-State Receiver Output, floating in shutdown with a weak pull-up

- Fixed RXD output pulse width (2 µs typical)
- Meets IrFM Fast Connection requirements
- Split power supply, an independant, unregulated supply for IRED Anode and a well regulated supply for $V_{CC}$
- Directly Interfaces with Various Super I/O and Controller Devices and Encoder/ Decoder such as TOIM4232
- Lead (Pb)-free device
- Qualified for lead (Pb)-free and Sn/Pb processing (MSL4)
- Device in accordance to RoHS 2002/95/EC and WEEE 202/96EC

## Applications

- Ideal for Battery Operated Devices
- PDAs
- Mobile Phones
- Electronic Wallet (IrFM)
- Notebook Computers
- Digital Still and Video Cameras
- Printers, Fax Machines, Photocopiers, Screen Projectors

- Data Loggers
- External Infrared Adapters (Dongles)
- Diagnostics Systems
- Medical and Industrial Data Collection Devices
- Kiosks, POS, Point and Pay Devices
- GPS
- Access Control
- Field Programming Devices
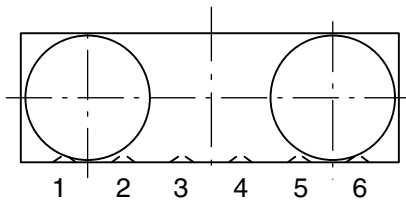
## Parts Table

| Part | Description | Qty / Reel |
|---|---|---|
| TFBS4710-TR1 | Oriented in carrier tape for side view surface mounting | 1000 pcs |
| TFBS4710-TT1 | Oriented in carrier tape for top view surface mounting | 1000 pcs |

## Functional Block Diagram



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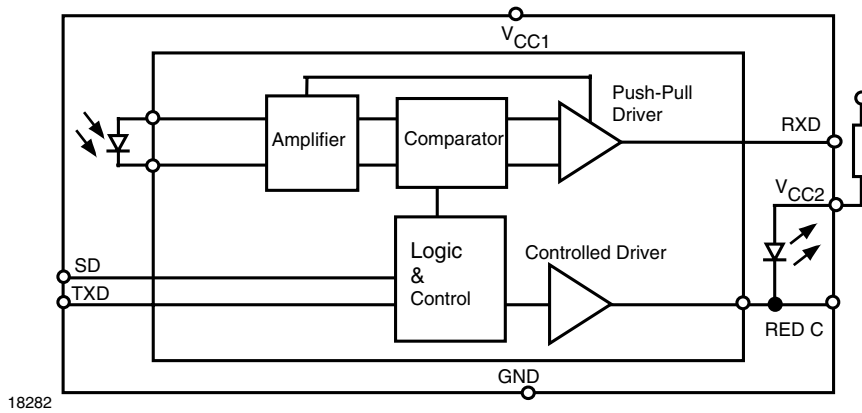
## Pinout

TFBS4710
weight 100 mg



18511

### Definitions:

In the Vishay transceiver data sheets 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.

With introducing the updated versions the old versions are obsolete. Therefore the only valid IrDA standard is the actual version IrPhy 1.4 (in Oct. 2002).

## Pin Description

| Pin Number | Function | Description | I/O | Active |
|---|---|---|---|---|
| 1 | IRED Anode | IRED Anode is connected to a power supply. The LED current can be decreased by adding a resistor in series between the power supply and IRED Anode. A separate unregulated power supply can be used at this pin. | | |
| 2 | TXD | This Input is used to turn on IRED transmitter when SD is low. An on-chip protection circuit disables the LED driver if the TXD pin is asserted for longer than 80 µs | I | HIGH |
| 3 | RXD | Received Data Output, normally stays high but goes low for a fixed duration during received pulses. It is capable of driving a standard CMOS or TTL load. | O | LOW |
| 4 | SD | Shutdown. Setting this pin active for more than 1.5 ms switches the device into shutdown mode | I | HIGH |
| 5 | $V_{CC}$ | Regulated Supply Voltage | | |
| 6 | GND | Ground | | |

## Absolute Maximum Ratings

Reference Point Ground, Pin 6 unless otherwise noted.

| Parameter | Test Conditions | Symbol | Min | Typ. | Max | Unit |
|---|---|---|---|---|---|---|
| Supply voltage range, all states | | $V_{CC}$ | - 0.3 | | + 6.0 | V |
| Input current | For all Pins except IRED Anode Pin | $I_{CC}$ | | | 10.0 | mA |
| Output Sink Current, RXD | | | | | 25.0 | mA |
| Average output current, pin 1 | 20 % duty cycle | $I_{IRED}$ (DC) | | | 60 | mA |
| Repetitive pulsed output current | < 90 µs, $t_{on}$ < 20 % | $I_{IRED}$ (RP) | | | 300 | mA |
| IRED anode voltage, pin 1 | | $V_{IREDA}$ | - 0.5 | | + 6.0 | V |
| Voltage at all inputs and outputs | $V_{in}$ > $V_{CC}$ is allowed | $V_{IN}$ | - 0.5 | | + 6.0 | V |
| Power dissipation | See derating curve | | | | 200 | mW |
| Junction temperature | | | | | 125 | °C |
| Ambient temperature range (operating) | | $T_{amb}$ | - 30 | | + 85 | °C |
| Storage temperature range | | $T_{stg}$ | - 40 | | + 100 | °C |
| Soldering temperature | See Recommended Solder Profile | | | | 260 | °C |

## Electrical Characteristics

## Transceiver

$T_{amb}$ = 25 °C, $V_{CC}$ = $V_{IREDA}$ = 2.4 V to 5.5 V unless otherwise noted.

| Parameter | Test Conditions | Symbol | Min | Typ. | Max | Unit |
|---|---|---|---|---|---|---|
| Supply voltage range, all states | | $V_{CC}$ | 2.4 | | 5.5 | V |
| Idle supply current at $V_{CC1}$ (receive mode, no signal) | SD = Low, $E_e$ = 1 klx[*)], $T_{amb}$ = - 25 °C to + 85 °C, $V_{CC1}$ = $V_{CC2}$ = 2.7 V to 5.5 V | $I_{CC1}$ | | 90 | 130 | µA |
| | SD = Low, $E_e$ = 1 klx[*)], $T_{amb}$ = 25 °C, $V_{CC1}$ = $V_{CC2}$ = 2.7 V to 5.5 V | $I_{CC1}$ | | 75 | | µA |
| Receive current | $V_{CC}$ = 2.7 V | $I_{CC}$ | | 280 | | µA |
| Shutdown current | SD = High, T = 25 °C, $E_e$ = 0 klx | $I_{SD}$ | | | 2 | µA |
| | SD = High, T = 85 °C | $I_{SD}$ | | | 3 | µA |
| Operating temperature range | | $T_A$ | - 25 | | + 85 | °C |
| Output voltage low, RXD | $I_{OL}$ = 1 mA | $V_{OL}$ | - 0.5 | | 0.15 x $V_{CC}$ | V |
| Output voltage high, RXD | $I_{OH}$ = - 500 µA | $V_{OH}$ | 0.8 x $V_{CC}$ | | $V_{CC}$ + 0.5 | V |
| | $I_{OH}$ = - 250 µA | $V_{OH}$ | 0.9 x $V_{CC}$ | | $V_{CC}$ + 0.5 | V |
| RXD to $V_{CC}$ impedance | | $R_{RXD}$ | 400 | 500 | 600 | kΩ |
| Input voltage low: TXD, SD | | $V_{IL}$ | - 0.5 | | 0.5 | V |
| Input voltage high: TXD, SD | CMOS level (0.5 x $V_{CC}$ typ, threshold level) | $V_{IH}$ | $V_{CC}$ - 0.5 | | 6.0 | V |
| Input leakage current (TXD, SD) | $V_{in}$ = 0.9 x $V_{CC}$ | $I_{ICH}$ | - 2 | | + 2 | µA |
| Controlled pull down current | SD, TXD = "0" or "1", 0 < $V_{in}$ < 0.15 $V_{CC}$ | $I_{IRTx}$ | | | + 150 | µA |
| | SD, TXD = "0" or "1" $V_{in}$ > 0.7 $V_{CC}$ | $I_{IRTx}$ | - 1 | 0 | 1 | µA |
| Input capacitance | | $C_{IN}$ | | | 5 | pF |

## Optoelectronic Characteristics

### Receiver

$T_{amb}$ = 25 °C, $V_{CC}$ = 2.4 V to 5.5 V unless otherwise noted

| Parameter | Test Conditions | Symbol | Min | Typ. | Max | Unit |
|---|---|---|---|---|---|---|
| Minimum detection threshold irradiance, SIR mode | 9.6 kbit/s to 115.2 kbit/s<br>$\lambda$ = 850 nm - 900 nm,<br>$\alpha$ = 0°, 15° | $E_e$ | 10<br>(1.0) | 25<br>(2.5) | 40<br>(4) | mW/m$^2$<br>($\mu$W/cm$^2$) |
| Maximum detection threshold irradiance | $\lambda$ = 850 nm - 900 nm | $E_e$ | | 5<br>(500) | | kW/m$^2$<br>(mW/cm$^2$) |
| Maximum no detection threshold irradiance | | $E_e$ | | | 4<br>(0.4) | mW/m$^2$<br>($\mu$W/cm$^2$) |
| Rise time of output signal | 10 % to 90 %, $C_L$ = 15 pF | $t_{r(RXD)}$ | 10 | | 100 | ns |
| Fall time of output signal | 90 % to 10 %, $C_L$ = 15 pF | $t_{f(RXD)}$ | 10 | | 100 | ns |
| RXD pulse width | Input pulse width > 1.2 $\mu$s | $t_{PW}$ | 1.65 | 2.0 | 3.0 | $\mu$s |
| Leading edge jitter | Input Irradiance = 100 mW/m$^2$,<br>$\leq$ 115.2 kbit/s | | | | 250 | ns |
| Standby /Shutdown delay | After shutdown active | | | | 150 | $\mu$s |
| Receiver startup time | Power-on delay | | | | | |
| Latency | | $t_L$ | | | 150 | $\mu$s |

### Transmitter

$T_{amb}$ = 25 °C, $V_{CC}$ = 2.4 V to 5.5 V unless otherwise noted.

| Parameter | Test Conditions | Symbol | Min | Typ. | Max | Unit |
|---|---|---|---|---|---|---|
| IRED operating current | | $I_D$ | 250 | 300 | 350 | mA |
| IRED forward voltage | $I_r$ = 300 mA | $V_f$ | 1.4 | 1.8 | 1.9 | V |
| IRED leakage current | TXD = 0 V, 0 < $V_{CC}$ < 5.5 V | $I_{IRED}$ | - 1 | | 1 | $\mu$A |
| Output radiant intensity | $\alpha$ = 0°, 15°, TXD = High,<br>SD = Low | $I_e$ | 40 | 70 | 350 | mW/sr |
| | $V_{CC}$ = 5.0 V, $\alpha$ = 0°, 15°,<br>TXD = High or SD = High (Receiver is inactive as long as SD = High) | $I_e$ | | | 0.04 | mW/sr |
| Output radiant intensity, angle of half intensity | | $\alpha$ | | $\pm$ 24 | | ° |
| Peak-emission wavelength | | $\lambda_p$ | 880 | | 900 | nm |
| Spectral bandwidth | | $\Delta\lambda$ | | 45 | | nm |
| Optical rise time | | $t_{ropt}$ | 10 | | 100 | ns |
| Optical fall time | | $t_{fopt}$ | 10 | | 100 | ns |
| Optical output pulse duration | Input pulse width 1.63 $\mu$s,<br>115.2 kbit/s | $t_{opt}$ | 1.46 | 1.63 | 1.8 | $\mu$s |
| | Input pulse width $t_{TXD}$ < 20 $\mu$s | $t_{opt}$ | $t_{TXD}$ | | t + 0.15 | $\mu$s |
| | Input pulse width $t_{TXD}$ $\geq$ 20 $\mu$s | $t_{opt}$ | | | 50 | $\mu$s |
| Optical overshoot | | | | | 25 | % |

## Recommended Solder Profiles
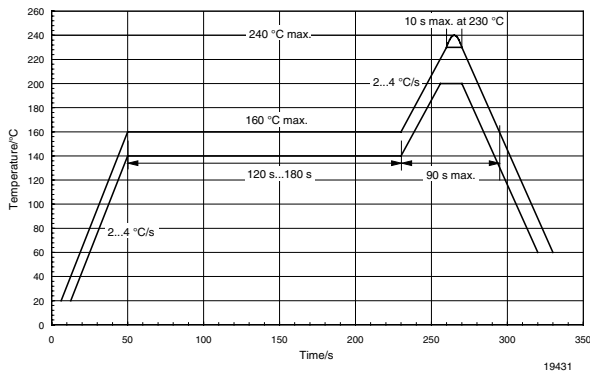
### Solder Profile for Sn/Pb soldering



Figure 1. Recommended Solder Profile for Sn/Pb soldering

### Lead (Pb)-Free, Recommended Solder Profile

The TFBS4710 is a lead (Pb)-free transceiver and qualified for lead (Pb)-free processing. For lead (Pb)-free solder paste like $Sn_{(3.0-4.0)}Ag_{(0.5-0.9)}Cu$, 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 below in figure 2 is VISHAY's recommended profiles for use with the TFBS4710 transceivers. For more details please refer to Application note: SMD Assembly Instruction.

### 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.

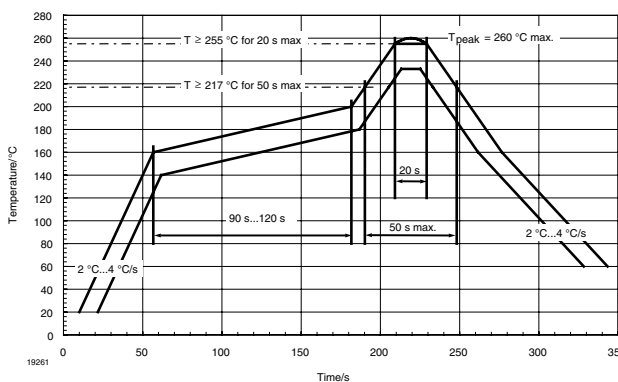The data for the drying procedure is given on labels on the packing and also in the application note "Taping, Labeling, Storage and Packing" (http://www.vishay.com/docs/82601/82601.pdf).
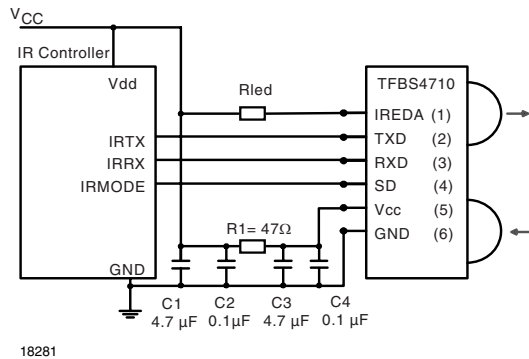


Figure 2. Solder Profile, RSS Recommendation

## Recommended Circuit Diagram



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Figure 3. Recommended Application Circuit

The TFBS4710 integrates a sensitive receiver and a built-in power driver. This combination needs a careful circuit 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 combination of resistor R1 and capacitors C1, C2, C3 and C4 filter out any power supply noise to provide a smooth supply voltage.

The placement of these components is critical. It is strongly recommended to position C3 and C4 as close as possible to the transceiver power supply pins. A Tantalum capacitor should be used for C1 and C3 while a ceramic capacitor should be used for C2 and C4.

A current limiting resistor is not needed for normal operation. It is strongly recommended to use the Rled values mentioned in Table 1 below for high temperature operation. For Low Power Mode, IRED Anode voltage of less than 5 V is recommended.

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

Basic RF design rules for circuit design should be followed. Especially longer signal lines should not be used without proper termination. For reference see "The Art of Electronics" by Paul Horowitz, Winfield Hill, 1989, Cambridge University Press, ISBN: 0521370957.

## Table 1.
## High Operating Temperature > 70 °C

| $V_{LED}$ (V) | Rled ($\Omega$) Standard Power Mode (Intensity > 40 mW/sr, 0° - 15°) | Rled ($\Omega$) Low Power Mode (Intensity > 3.6 mW/sr, 0° - 15°) |
|---|---|---|
| 2.7 | 3 | 50 |
| 3.3 | 6 | > 50 |
| 5.0 | 18 | > 60 |

## 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.

## Table 2.
## Recommended Application Circuit Components

| Component | Recommended Value | Vishay Part Number |
|---|---|---|
| C1, C3 | 4.7 µF, 16 V | 293D 475X9 016B |
| C2, C4 | 0.1 µF, Ceramic | VJ 1206 Y 104 J XXMT |
| R1 | 47 $\Omega$, 0.125 W | CRCW-1206-47R0-F-RT1 |
| Rled | See Table 1 | |

## Table 3.
## Truth table

| Inputs | | | Outputs | | Remark |
|---|---|---|---|---|---|
| SD | TXD | Optical input Irradiance mW/m$^2$ | RXD | Transmitter | Operation |
| high > 1 ms | x | x | weakly pulled (500 Ω) to $V_{CC1}$ | 0 | Shutdown |
| low | high | x | high inactive | $I_e$ | Transmitting |
| | high > µs | x | high inactive | 0 | Protection is active |
| | low | < 4 | high inactive | 0 | Ignoring low signals below the IrDA defined threshold for noise immunity |
| | low | > Min. Detection Threshold Irradiance < Max. Detection Threshold Irradiance | low (active) | 0 | Response to an IrDA compliant optical input signal |
| | low | > Max. Detection Threshold Irradiance | undefined | 0 | Overload conditions can cause unexpected outputs |

## Package Dimensions
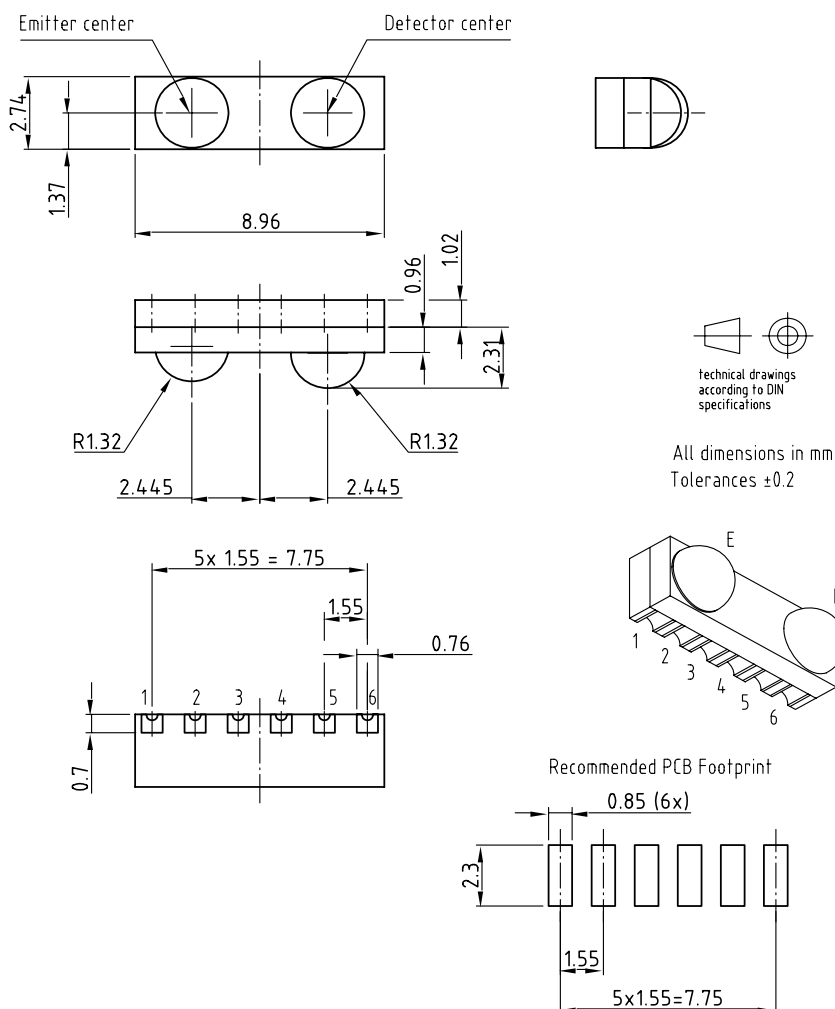


Drawing-No.: 6.550-5256.01-4
Issue: 1; 24.06.03

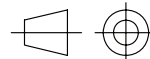Figure 4. Package drawing TFBS4710

## Reel Dimensions
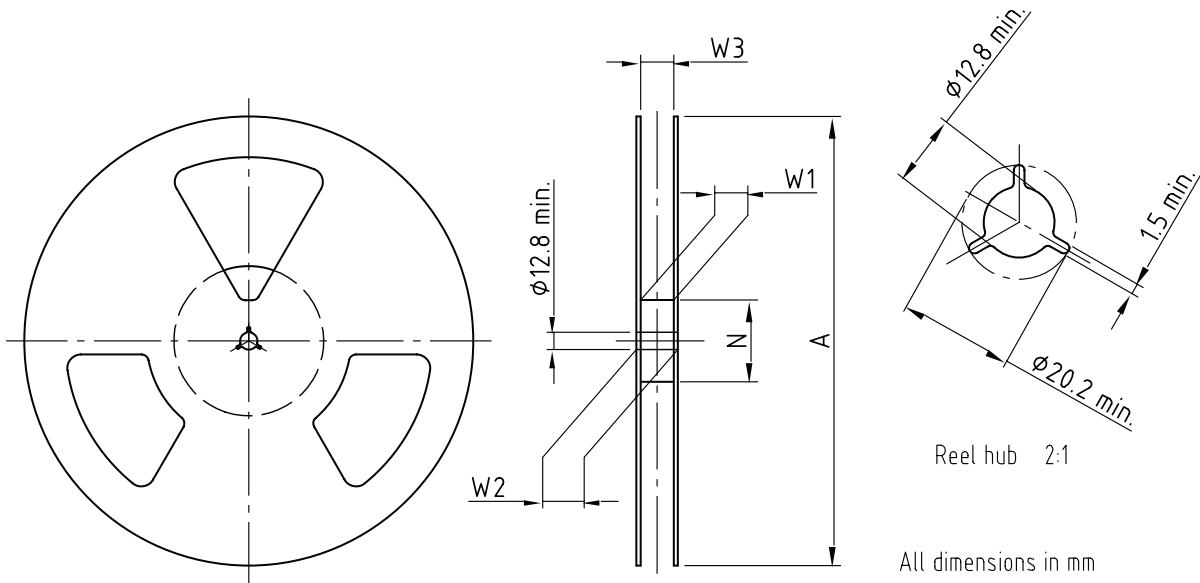


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Issue: 1; 29.11.05
14017

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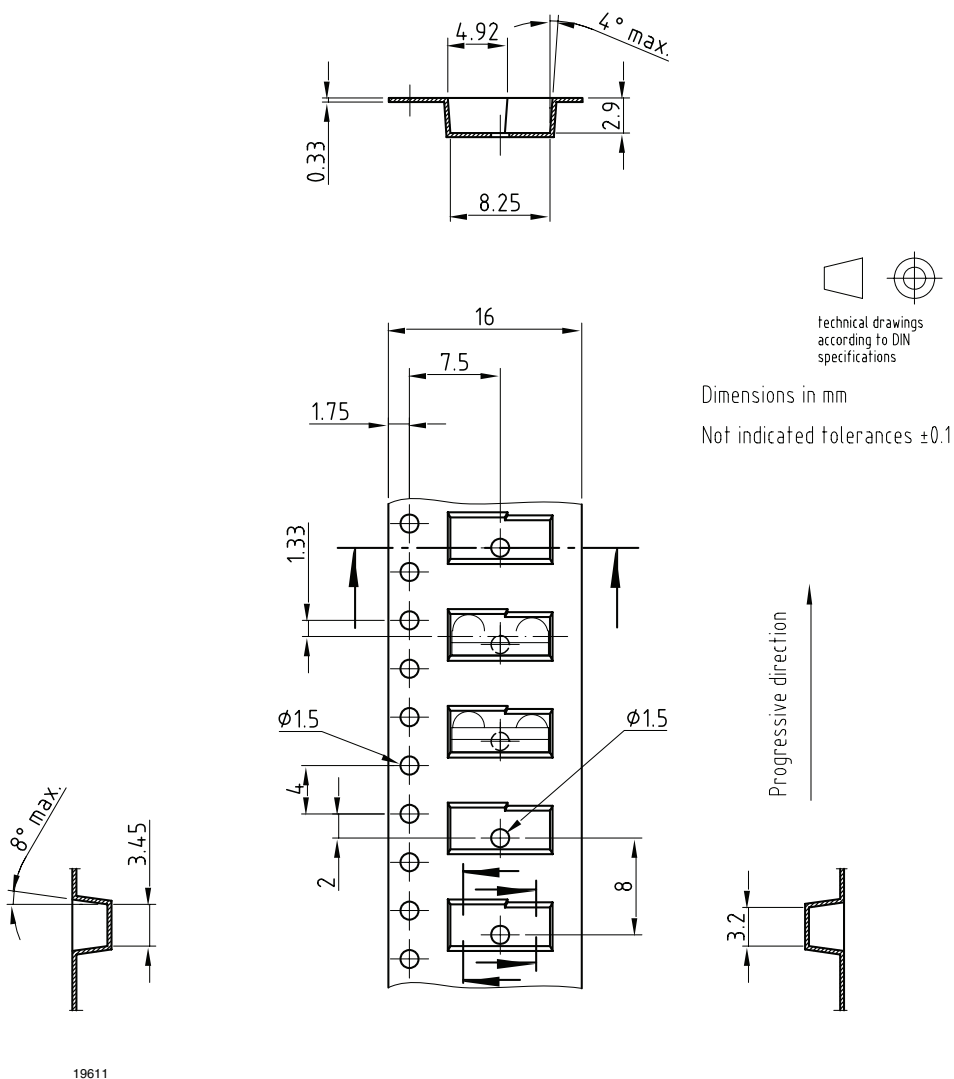of the wheel is supplier specific.

Dimension acc. to IEC EN 60 286-3

All dimensions in mm

Reel hub    2:1

technical drawings
according to DIN
specifications

| Tape Width | A max. | N | W$_1$ min. | W$_2$ max. | W$_3$ min. | W$_3$ max. |
|---|---|---|---|---|---|---|
| mm | mm | mm | mm | mm | mm | mm |
| 16 | 330 | 50 | 16.4 | 22.4 | 15.9 | 19.4 |

# TFBS4710

**Vishay Semiconductors**

## Tape Dimensions



Drawing-No.: 9.700-5299.01-4
Issue: 1; 18.08.05

Figure 5. Tape drawing for TFBS4710 for side view mounting

## Ozone Depleting Substances Policy Statement

It is the policy of Vishay Semiconductor 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.

Vishay Semiconductor GmbH 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.

Vishay Semiconductor GmbH 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
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