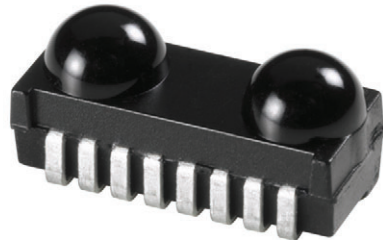


## Infrared Transceiver Module (SIR, 115.2 kbit/s) for IrDA® Applications



20110-1

### DESCRIPTION

TFDU9101 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  $\mu$ A
- Less than 1  $\mu$ A in shutdown mode
- Material categorization:  
for definitions of compliance please see [www.vishay.com/doc?99912](http://www.vishay.com/doc?99912)



### APPLICATIONS

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

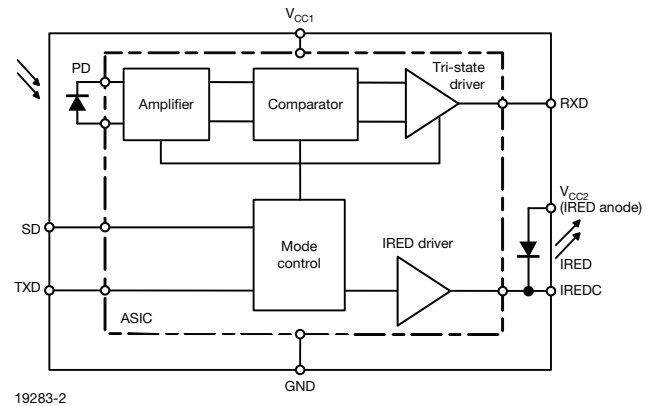
### DESIGN SUPPORT TOOLS

- [3D model](#)
- [Window size calculator](#)
- [Symbols and terminology](#)
- [IRDC protocol](#)
- [Reference layouts and circuit diagrams](#)

### LINKS TO ADDITIONAL RESOURCES



### FUNCTIONAL BLOCK DIAGRAM





**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)
TFDU9101	115.2	4 x 9.7 x 4.7	0 to ≥ 1	2.4 to 5.5	0.07

**PARTS TABLE**

PART	DESCRIPTION	QTY/REEL
TFDU9101-TR3	Oriented in carrier tape for side view surface mounting	1000 pcs
TFDU9101-TT3	Oriented in carrier tape for top view surface mounting	1000 pcs

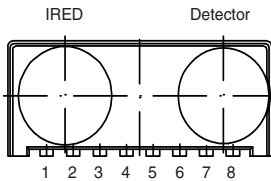
**PIN DESCRIPTION**

PIN NUMBER	SYMBOL	DESCRIPTION	I/O	ACTIVE
1	V <sub>CC2</sub> IRED anode	IRED anode to be externally connected to V <sub>CC2</sub> . An external resistor is only necessary for controlling the IRED current when a current reduction below 300 mA is intended to operate in IrDA low power mode. This pin is allowed to be supplied from an uncontrolled power supply separated from the controlled V <sub>CC1</sub> - supply.		
2	IRED cathode	IRED cathode, internally connected to driver transistor		
3	TXD	This Schmitt-Trigger input is used to transmit serial data when SD is low. An on-chip protection circuit disables the LED driver if the TXD pin is asserted for longer than 50 μs (max. 300 μs).	I	High
4	RXD	Received data output, push-pull CMOS driver output capable of driving standard CMOS or TTL loads. During transmission the RXD output is active (echo-on). No external pull-up or pull-down resistor is required. Floating with a weak pull-up of 500 kΩ (typ.) in shutdown mode.	O	Low
5	SD	Shutdown	I	High
6	V <sub>CC1</sub>	Supply voltage		
7	NC	No internal connection	I	
8	GND	Ground		

**PINOUT**

TFDU9101  
Weigh 212 mg

"U" Option Baby Face (universal)



17087



ABSOLUTE MAXIMUM RATINGS						
PARAMETER	TEST CONDITIONS	SYMBOL	MIN.	TYP.	MAX.	UNIT
Supply voltage range, transceiver	$-0.3\text{ V} < V_{CC2} < 6\text{ V}$	$V_{CC1}$	-0.5	-	+6	V
Supply voltage range, transmitter	$-0.5\text{ V} < V_{CC1} < 6\text{ V}$	$V_{CC2}$	-0.5	-	+6	V
RXD output voltage	$-0.5\text{ V} < V_{CC1} < 6\text{ V}$	$V_{RXD}$	-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	$t < 90\ \mu\text{s}$ , $t_{on} < 20\%$	$I_{IRED(RP)}$	-	-	430	mA
ESD protection	JESD22-A114	$V_{ESD}$	2	-	-	kV
Latchup	JESD78		$ \pm 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 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



<b>ELECTRICAL CHARACTERISTICS</b> ( $T_{amb} = 25\text{ }^{\circ}\text{C}$ , $V_{CC1} = V_{CC2} = 2.4\text{ V to }5.5\text{ V}$ unless otherwise noted)						
PARAMETER	TEST CONDITIONS	SYMBOL	MIN.	TYP.	MAX.	UNIT
<b>TRANSCEIVER</b>						
Supply voltage		$V_{CC1}$	2.4	-	5.5	V
Operating temperature range		$T_{amb}$	-25	-	+85	$^{\circ}\text{C}$
Data rates			9.6	-	115.2	kbit/s
Idle supply current at $V_{CC1}$ (receive mode, no signal)	SD = low, $T_{amb} = -25\text{ }^{\circ}\text{C to }+85\text{ }^{\circ}\text{C}$ independent of ambient light, $V_{CC1} = V_{CC2} = 2.4\text{ V to }5.5\text{ V}$	$I_{CC1}$	40	70	110	$\mu\text{A}$
Average dynamic supply current, transmitting	$I_{IRED} = 300\text{ mA}$ , 20 % duty cycle	$I_{CC1}$	-	0.6	2	mA
Standby (SD) <sup>(1)</sup> supply current	SD = high, $T_{amb} = -25\text{ }^{\circ}\text{C to }+85\text{ }^{\circ}\text{C}$ independent of ambient light	$I_{SD}$	-	0.01	1	$\mu\text{A}$
RXD to $V_{CC1}$ impedance	SD = high	$R_{RXD}$	400	500	600	$\text{k}\Omega$
Input voltage low (TXD, SD)		$V_{ILo}$	-0.3	-	0.4	V
Input voltage high (SD)	For compliance with ISD spec.	$V_{IHl}$	$V_{CC1} - 0.3$	-	6	V
Input voltage high (TXD)		$V_{IHl}$	$V_{CC1} - 0.5$	-	6	V
Timing logic decision level			-	$0.5 \times V_{CC1}$	-	
Input leakage current low	$V_{ILo} \leq 0.3\text{ V}$	$I_{ILo}$	-	0.01	10	$\mu\text{A}$
Input leakage current high	$V_{IHl} \geq V_{CC1} - 0.3\text{ V}$	$I_{IHl}$	-	0.01	10	$\mu\text{A}$
Input capacitance (TXD, SD)		$C_{IN}$	-	-	5	pF
Output voltage low, RXD	$C_{load} = 8\text{ pF}$ , $I_{OLo} \leq  +500\text{ }\mu\text{A} $	$V_{OLo}$	-	-	$0.15 \times V_{CC1}$	V
Output voltage high, RXD	$I_{OH} = 200\text{ }\mu\text{A}$	$V_{OHl}$	$0.8 \times V_{CC1}$	-	-	V

**Notes**

- Typical values are for DESIGN AID ONLY, not guaranteed nor subject to production testing
- <sup>(1)</sup> SD mode becomes active when SD is set high for more than 0.2  $\mu\text{s}$ . In SD mode the detector is disabled and the output disconnected



<b>OPTOELECTRONIC CHARACTERISTICS</b> ( $T_{amb} = 25\text{ }^{\circ}\text{C}$ , $V_{CC1} = V_{CC2} = 2.4\text{ V to }5.5\text{ V}$ unless otherwise noted)						
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, $\lambda = 850\text{ nm to }900\text{ nm}$ ; $\alpha = 0^{\circ}, 15^{\circ}$	$E_e$	-	15	40	mW/m <sup>2</sup>
Maximum irradiance $E_e$ In Angular Range <sup>(3)</sup>	$\lambda = 850\text{ nm to }900\text{ nm}$	$E_e$	2	5	-	kW/m <sup>2</sup>
Maximum no detection irradiance <sup>(1)</sup>	$\lambda = 850\text{ nm to }900\text{ nm}$ , $t_r, t_f < 40\text{ ns}$ , $t_{po} = 1.6\text{ }\mu\text{s}$ at $f = 115\text{ kHz}$ , no output signal allowed	$E_e$	4 (0.4)	-	-	mW/m <sup>2</sup> ( $\mu\text{W/cm}^2$ )
Rise time of output signal	10 % to 90 %, $C_L = 8\text{ pF}$	$t_{r(RXD)}$	10	30	80	ns
Fall time of output signal	90 % to 10 %, $C_L = 8\text{ pF}$	$t_{f(RXD)}$	10	30	80	ns
RXD pulse width of output signal	Input pulse length $> 1.2\text{ }\mu\text{s}$	$t_{PW}$	1.7	2.2	3	$\mu\text{s}$
Stochastic jitter, leading edge	Input irradiance = 100 mW/m <sup>2</sup> , $\leq 115.2\text{ kbit/s}$		-	-	350	ns
Standby/shutdown delay, receiver startup time	After shutdown active or power-on		-	100	500	$\mu\text{s}$
Latency		$t_L$	-	50	150	$\mu\text{s}$
<b>TRANSMITTER</b>						
IRED operating current limitation	No external resistor for current limitation <sup>(4)</sup>	$I_D$	200	300	430	mA
Forward voltage of built-in IRED	$I_f = 300\text{ mA}$	$V_f$	1.4	1.8	1.9	V
Output leakage IRED current	$\text{TXD} = 0\text{ V}$ , $0 < V_{CC1} < 5.5\text{ V}$	$I_{\text{IRED}}$	-1	0.01	1	$\mu\text{A}$
Output radiant intensity	$\alpha = 0^{\circ}, 15^{\circ}$ , $\text{TXD} = \text{high}$ , $\text{SD} = \text{low}$	$I_e$	50	150	400	mW/sr
	$V_{CC1} = 5\text{ V}$ , $\alpha = 0^{\circ}, 15^{\circ}$ , $\text{TXD} = \text{low}$ or $\text{SD} = \text{high}$ (receiver is inactive as long as $\text{SD} = \text{high}$ )	$I_e$	-	-	0.04	mW/sr
Output radiant intensity, angle of half intensity		$\alpha$	-	$\pm 30$	-	$^{\circ}$
Peak - emission wavelength <sup>(5)</sup>		$\lambda_p$	870	-	910	nm
Spectral bandwidth		$\Delta\lambda$	-	45	-	nm
<b>TRANSMITTER</b>						
Optical rise time, fall time		$t_{\text{ropt}}, t_{\text{fopt}}$	10	50	100	ns
Optical output pulse duration	Input pulse width $1.6 < t_{\text{TXD}} < 23\text{ }\mu\text{s}$	$t_{\text{opt}}$	$t_{\text{TXD}} - 0.15$		$t_{\text{TXD}} + 0.15$	$\mu\text{s}$
	Input pulse width $t_{\text{TXD}} \geq 23\text{ }\mu\text{s}$	$t_{\text{opt}}$	23	50	100	$\mu\text{s}$
Optical overshoot					25	%

**Notes**

- Typical values are for DESIGN AID ONLY, not guaranteed nor subject to production testing
- <sup>(1)</sup> Equivalent to IrDA background light and electromagnetic field test: fluorescent lighting immunity
- <sup>(2)</sup> 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
- <sup>(3)</sup> 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). For more definitions see the document "Symbols and Terminology" on the Vishay website
- <sup>(4)</sup> Using an external current limiting resistor is allowed and recommended to reduce IRED intensity and operating current when current reduction is intended to operate at the IrDA low power conditions. E.g. for  $V_{CC2} = 3.3\text{ V}$  a current limiting resistor of  $R_S = 56\text{ }\Omega$  will allow a power minimized operation at IrDA low power conditions
- <sup>(5)</sup> Due to this wavelength restriction compared to the IrDA spec of 850 nm to 900 nm the transmitter is able to operate as source for the standard remote control applications with codes as e.g. Phillips RC5/RC6<sup>®</sup> or RECS 80

**RECOMMENDED CIRCUIT DIAGRAM**

Operated with a clean low impedance power supply the TFDU9101 needs no additional external components. However, depending on the entire system design and board layout, additional components may be required (see figure 1). That is especially the case when separate power supplies are used for bench tests. When using compact wiring and regulated supplies as e. g. in phone applications in most cases no external components are necessary.

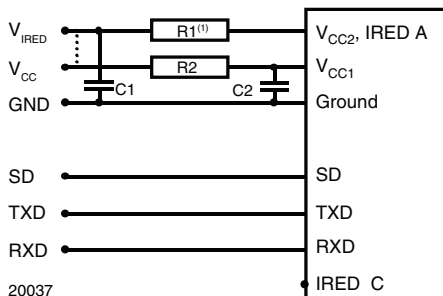


Fig. 1 - Recommended Test Circuit

**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.

A resistor R1 of 22 Ω is recommended to stay below the intensity limitation of the IrDA specification at the emission angle of ± 15° ( $I_e < 40 \text{ mW/sr}$ ).

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.

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  $V_{CC1}$  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 extended wiring is used (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.

TABLE 1 - RECOMMENDED TESTS AND APPLICATION CIRCUIT COMPONENTS	
COMPONENT	RECOMMENDED VALUE
C1	4.7 μF, 16 V
C2	0.1 μF, ceramic
R1	Depends on current to be adjusted
R2	47 Ω

Fig. 2 shows an example of a typical application 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.

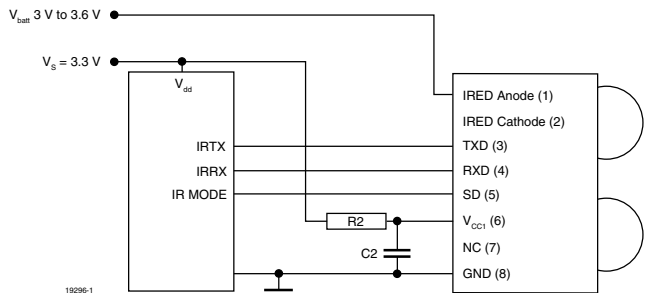


Fig. 2 - Typical Application Circuit



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

- TFDU9101 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. Table with 6 columns: SD, TXD, OPTICAL INPUT IRRADIANCE, RXD, TRANSMITTER, OPERATION. It details the device's response to various input conditions like high/low signal levels and irradiance.



**ASSEMBLY INSTRUCTIONS**

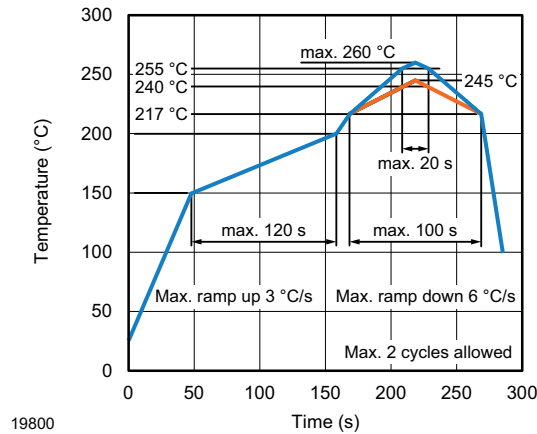
**Reflow Soldering**

- 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

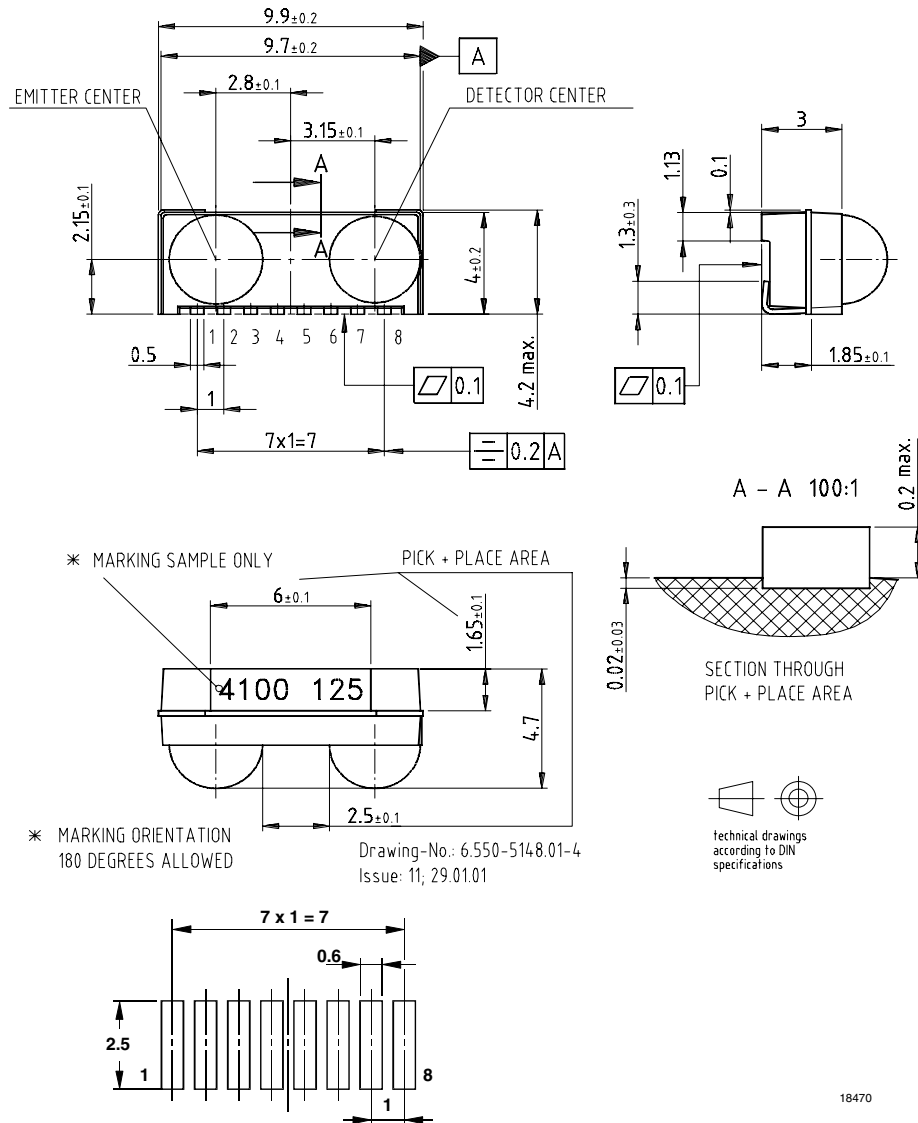


Fig. 3 - Package Drawing TFDU9101. Tolerance  $\pm 0.2$  mm if not otherwise mentioned

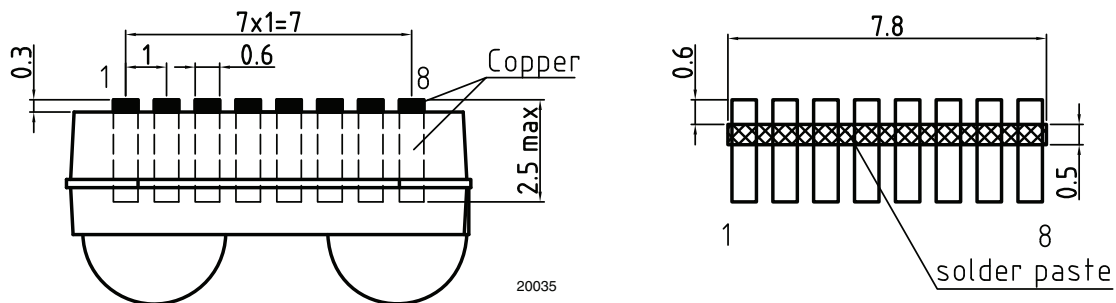


Fig. 4 - Recommended Footprint for Side View Applications and Solderpaste Mask

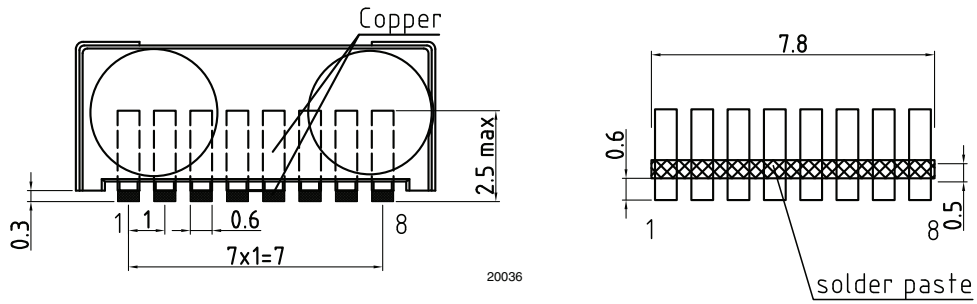
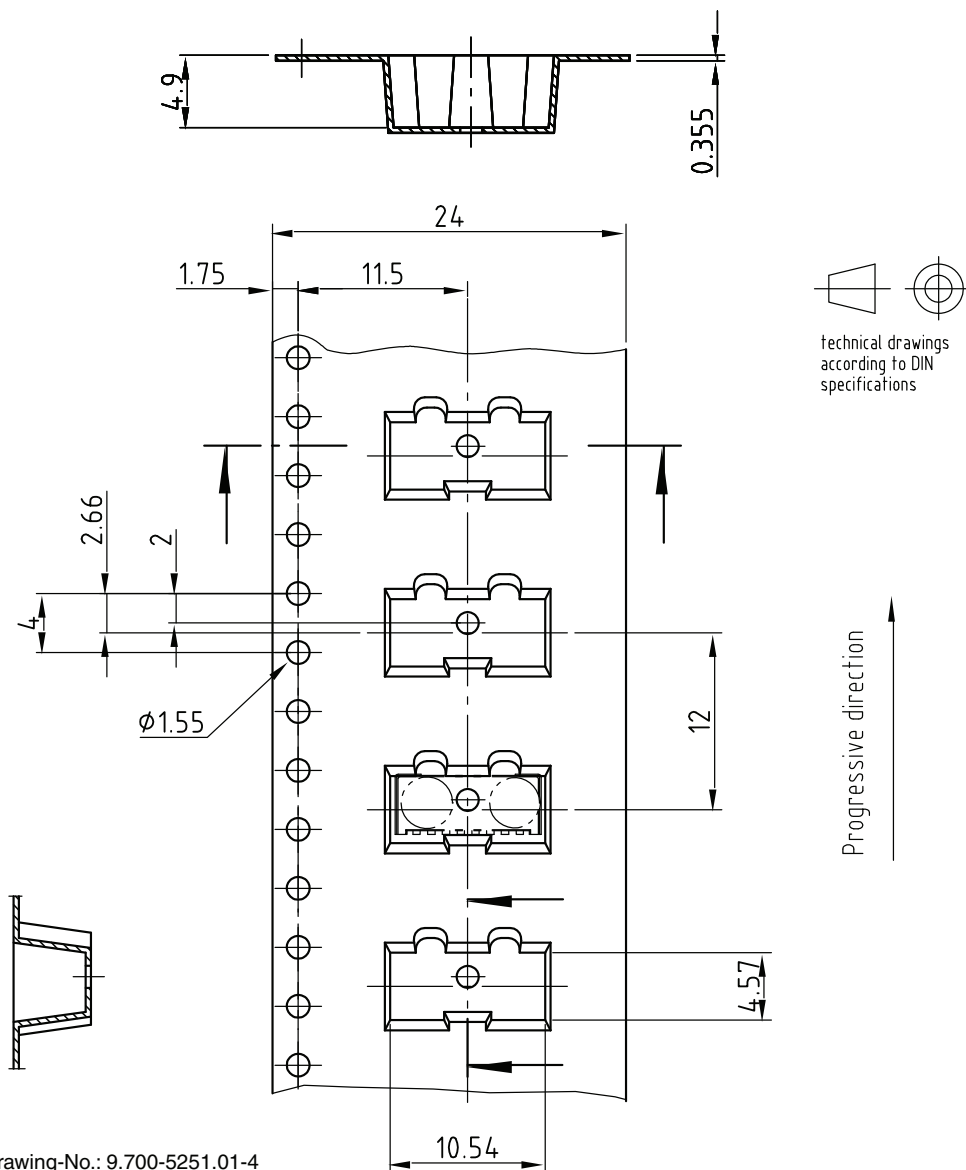


Fig. 5 - Recommended Footprint for Top View Applications and Solderpaste Mask

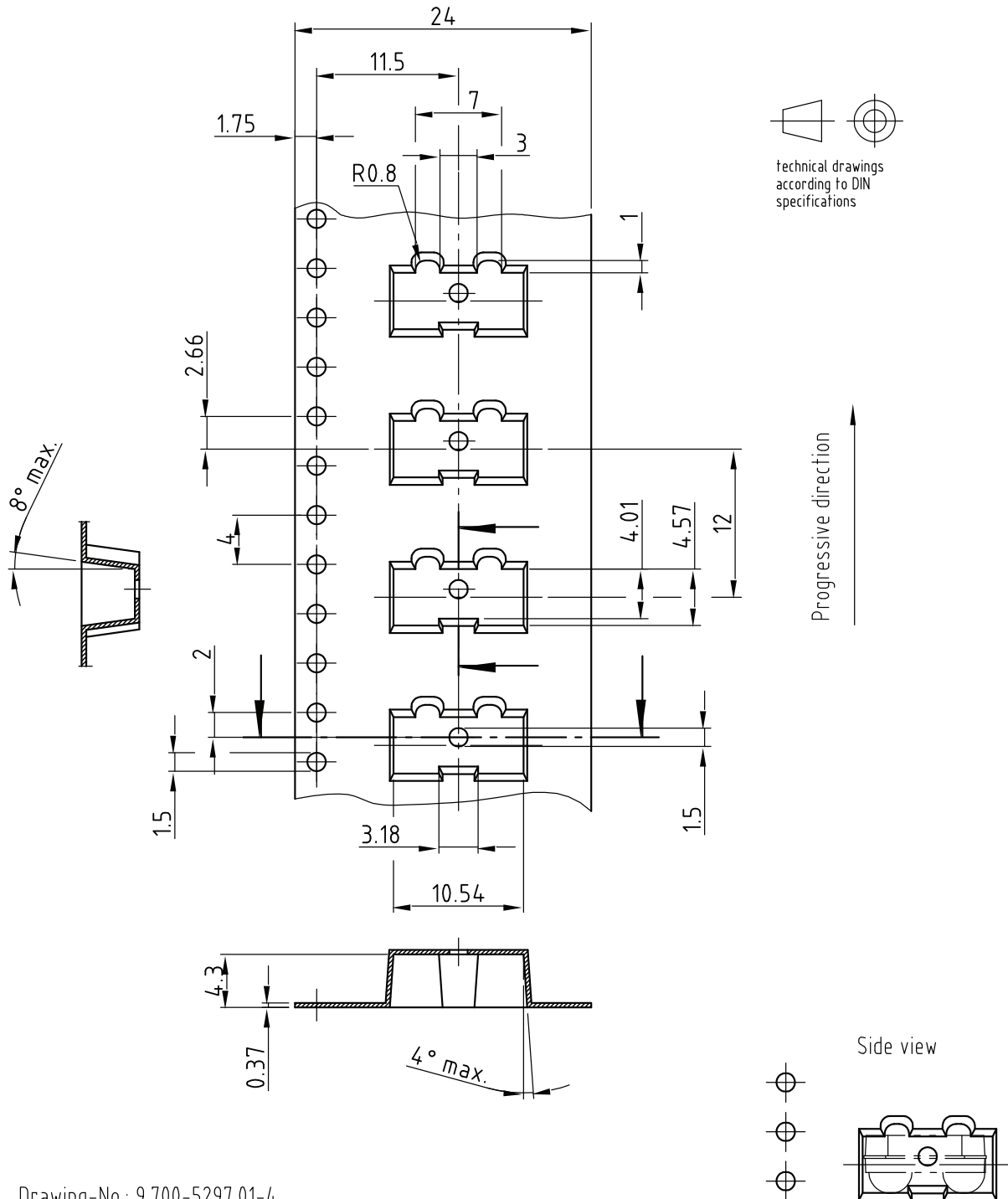
**TAPE DIMENSIONS FOR TT3** in millimeters



Drawing-No.: 9.700-5251.01-4  
 Issue: 3; 02.09.05  
 19824

Fig. 6 - Tape Drawing, TFDU9101 for Top View Mounting, Tolerance  $\pm 0.1$  mm

TAPE DIMENSIONS FOR TR3 in millimeters



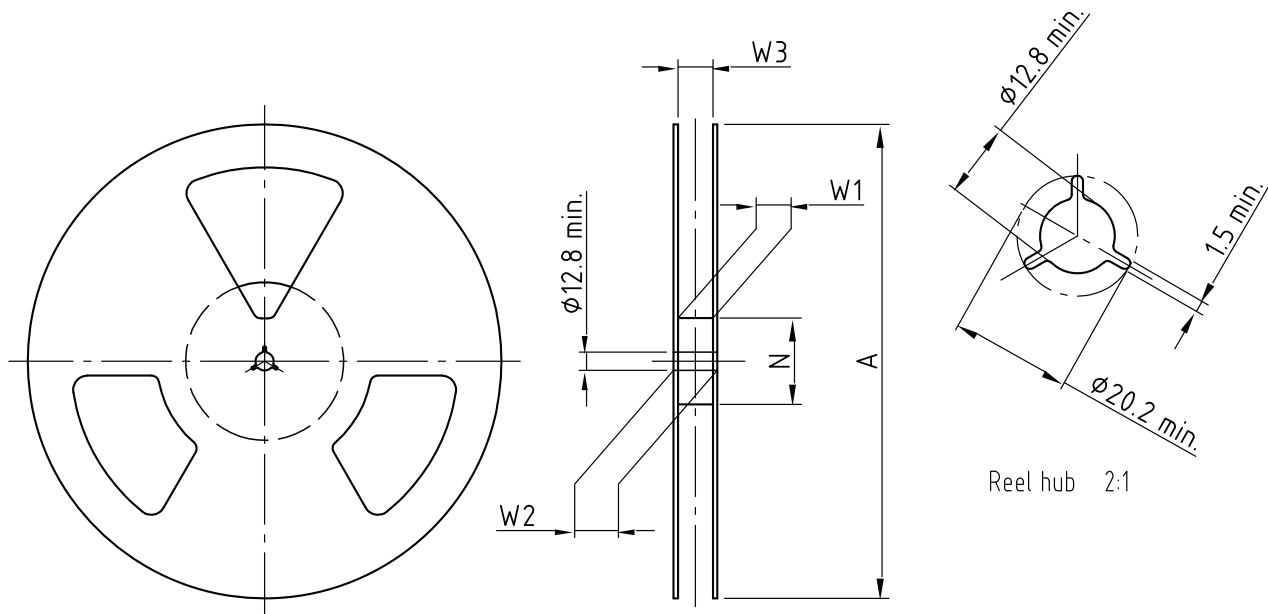
Drawing-No.: 9.700-5297.01-4

Issue: 3; 21.12.05

19875

Fig. 7 - Tape Drawing, TFDU9101 for Side View Mounting, Tolerance ± 0.1 mm

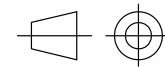
**REEL DIMENSIONS** in millimeters



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

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

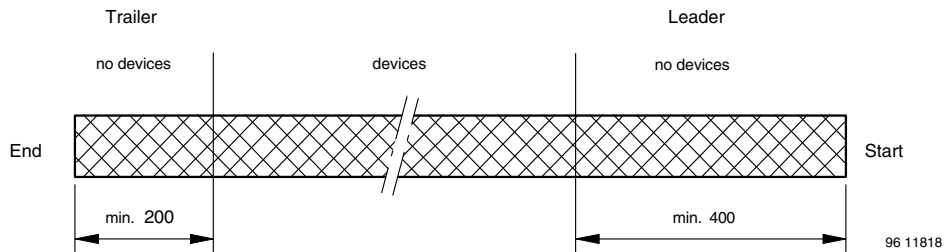
Dimension acc. to IEC EN 60 286-3



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)
24	330	60	24.4	30.4	23.9	27.4

**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

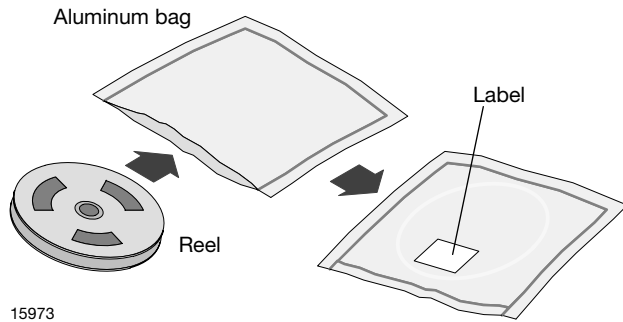
**LABEL**

**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**

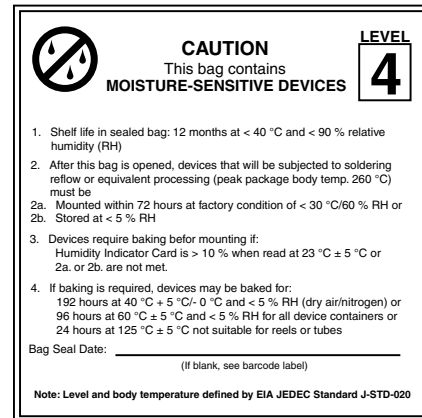
Dry box storage is recommended as soon as the aluminum bag has been opened to prevent moisture absorption. The following conditions should be observed, if dry boxes are not available:

- 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				
<p>22127</p>				
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

<b>VISHAY SEMICONDUCTOR GmbH STANDARD BAR CODE PRODUCT LABEL (finished goods)</b>		
<b>PLAIN WRITING</b>	<b>ABBREVIATION</b>	<b>LENGTH</b>
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
<b>Long bar code top</b>	<b>Type</b>	<b>Length</b>
Item-number	N	8
Plant-code	N	2
Sequence-number	X	3
Quantity	N	8
Total length	-	21
<b>Short bar code bottom</b>	<b>Type</b>	<b>Length</b>
Selection-code	X	3
Data-code	N	3
Batch-number	X	10
Filter	-	1
Total length	-	17

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.

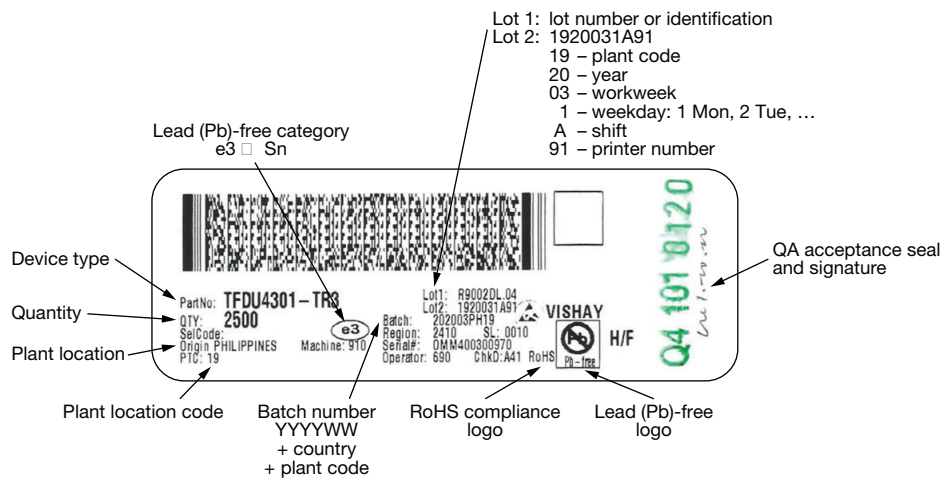


Fig. 8 - 2D Bar Code Label (according the bar code standard for 2D label PDF 417) for a Lead (Pb)-Free Device Made in Philippines, Detailed Description

### 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.



## **Disclaimer**

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