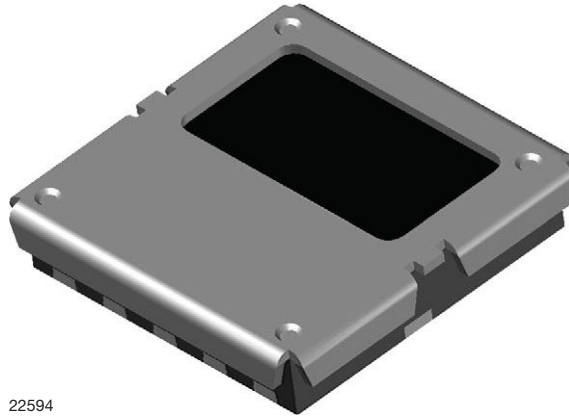




IR Receiver Modules for Remote Control Systems



22594

DESIGN SUPPORT TOOLS

[click logo to get started](#)



ORDERING CODE

Taping:

TSOP57...TT1 - top view taped

TSOP57...TT2 - top view taped

FEATURES

- Improved immunity against HF and RF noise
- Height of 0.8 mm
- ± 75° half angle sensitivity
- Low supply current
- Photo detector and preamplifier in one package
- Supply voltage: 2.5 V to 5.5 V
- Improved immunity against ambient light
- Insensitive to supply voltage ripple and noise
- External metal shield
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912



DESCRIPTION

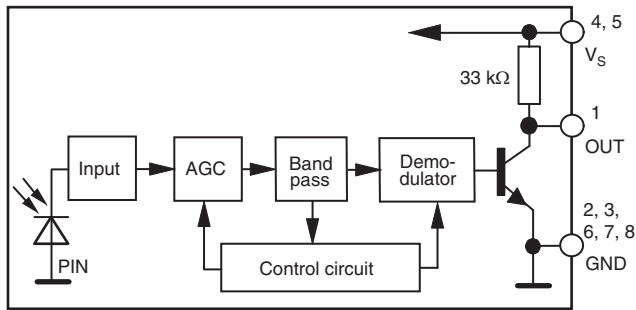
The TSOP573..H, TSOP575..H series are miniaturized receiver modules for infrared remote control systems. A PIN diode and a preamplifier are assembled on a lead frame, the epoxy lens cap contains an IR filter. The demodulated output signal can be directly connected to a microprocessor for decoding.

The TSOP573..H series devices are optimized to suppress almost all spurious pulses from Wi-Fi and CFL sources. They may suppress some data signals if continuously transmitted.

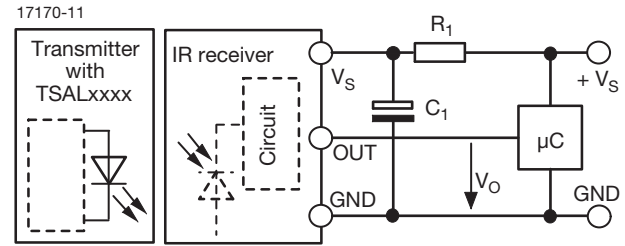
New designs should prefer the TSOP573..H series containing the newer AGC3. The TSOP575..H series are useful to suppress even extreme levels of optical noise, but may also suppress some data signals. Please check compatibility with your codes.

These components have not been qualified according to automotive specifications.

PARTS TABLE			
AGC			
	NOISY ENVIRONMENTS AND SHORT BURSTS (AGC3)	VERY NOISY ENVIRONMENTS AND SHORT BURSTS (AGC5)	
Carrier frequency	36 kHz	TSOP57336H ⁽¹⁾	TSOP57536H ⁽¹⁾
	38 kHz	TSOP57338H ⁽²⁾⁽³⁾⁽⁴⁾⁽⁵⁾	TSOP57538H ⁽²⁾⁽³⁾⁽⁴⁾
	40 kHz	TSOP57340H	TSOP57540H
	56 kHz	TSOP57356H	TSOP57556H
Package	Belobog shield		
Pinning	1= OUT, 2, 3, 6, 7, 8 = GND, 4, 5 = V _S		
Dimensions (mm)	4.3 W x 4.3 H x 1.0 D		
Mounting	SMD		
Application	Remote control		
Best choice for	⁽¹⁾ MCIR ⁽²⁾ Mitsubishi ⁽³⁾ RECS-80 Code ⁽⁴⁾ r-map ⁽⁵⁾ XMP-1, XMP-2		

BLOCK DIAGRAM


20445-6

APPLICATION CIRCUIT

 R_1 and C_1 recommended to reduce supply ripple for $V_S < 2.8\text{ V}$
ABSOLUTE MAXIMUM RATINGS

PARAMETER	TEST CONDITION	SYMBOL	VALUE	UNIT
Supply voltage		V_S	-0.3 to +6	V
Supply current		I_S	5	mA
Output voltage		V_O	-0.3 to $(V_S + 0.3)$	V
Output current		I_O	5	mA
Junction temperature		T_j	100	°C
Storage temperature range		T_{stg}	-25 to +85	°C
Operating temperature range		T_{amb}	-25 to +85	°C
Power consumption	$T_{amb} \leq 85\text{ °C}$	P_{tot}	10	mW

Note

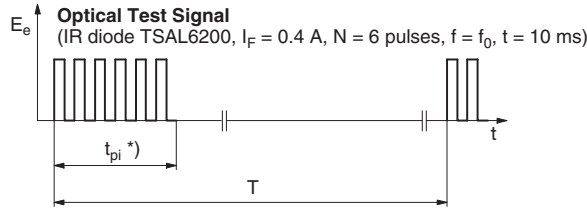
- Stresses beyond those listed under “Absolute Maximum Ratings” may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect the device reliability

ELECTRICAL AND OPTICAL CHARACTERISTICS ($T_{amb} = 25\text{ °C}$, unless otherwise specified)

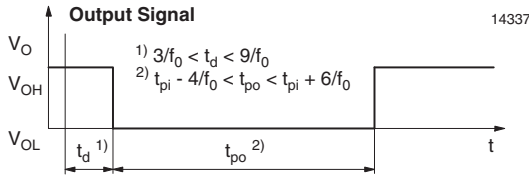
PARAMETER	TEST CONDITION	SYMBOL	MIN.	TYP.	MAX.	UNIT
Supply voltage		V_S	2.5	-	5.5	V
Supply current	$V_S = 5\text{ V}$, $E_v = 0$	I_{SD}	0.55	0.7	0.9	mA
	$E_v = 40\text{ klx}$, sunlight	I_{SH}	-	0.8	-	mA
Transmission distance	$E_v = 0$, IR diode TSAL6200, $I_F = 50\text{ mA}$, test signal see Fig. 1	d	-	18	-	m
Output voltage low	$I_{OSL} = 0.5\text{ mA}$, $E_e = 0.7\text{ mW/m}^2$, test signal see Fig. 1	V_{OSL}	-	-	100	mV
Minimum irradiance	Pulse width tolerance: $t_{pi} - 5/f_o < t_{po} < t_{pi} + 6/f_o$, test signal see Fig. 1	$E_e\text{ min.}$	-	0.2	0.4	mW/m^2
Maximum irradiance	$t_{pi} - 5/f_o < t_{po} < t_{pi} + 6/f_o$, test signal see Fig. 1	$E_e\text{ max.}$	50	-	-	W/m^2
Directivity	Angle of half transmission distance	$\phi_{1/2}$	-	± 75	-	deg



TYPICAL CHARACTERISTICS ($T_{amb} = 25\text{ }^{\circ}\text{C}$, unless otherwise specified)



*) $t_{pi} \geq 6/f_0$ is recommended for optimal function



1) $3/f_0 < t_d < 9/f_0$
2) $t_{pi} - 4/f_0 < t_{po} < t_{pi} + 6/f_0$

Fig. 1 - Output Active Low

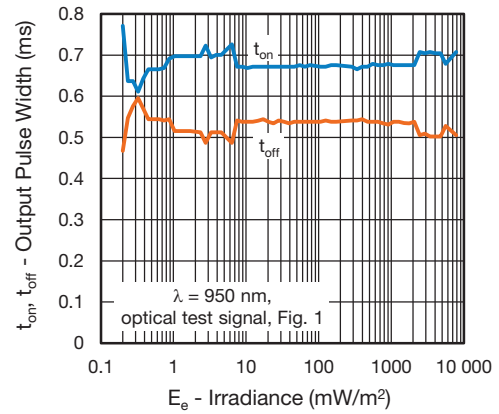


Fig. 4 - Output Pulse Diagram

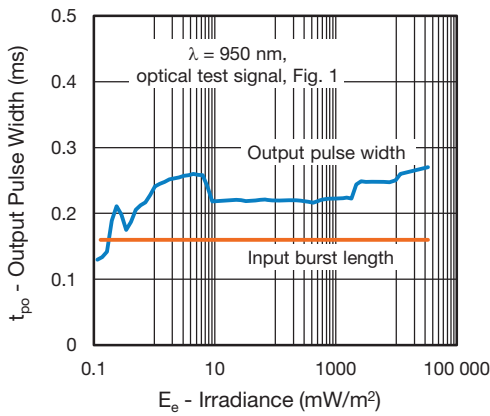


Fig. 2 - Pulse Length and Sensitivity in Dark Ambient

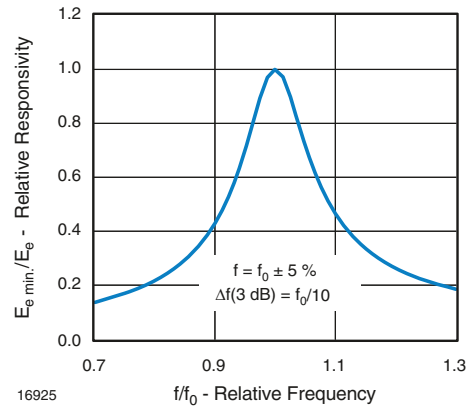


Fig. 5 - Frequency Dependence of Responsivity

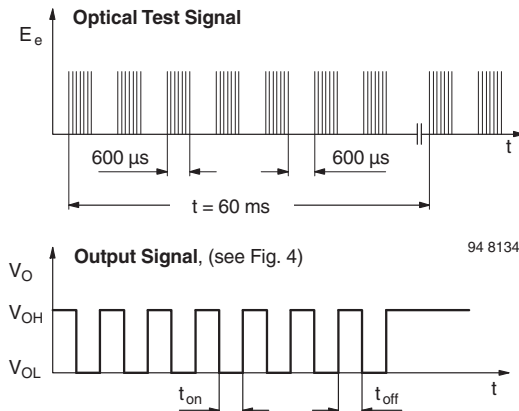


Fig. 3 - Output Function

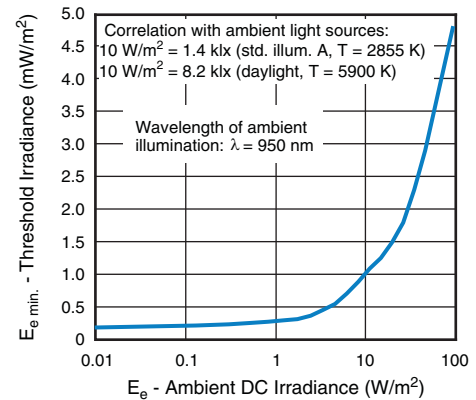


Fig. 6 - Sensitivity in Bright Ambient

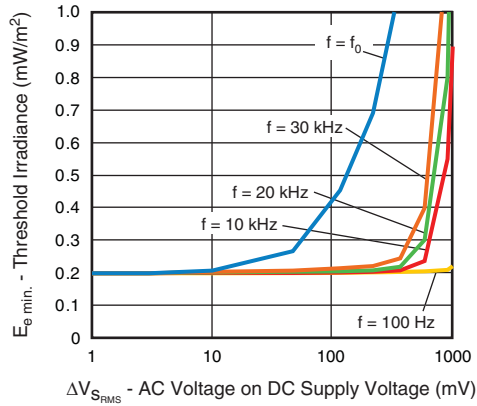


Fig. 7 - Sensitivity vs. Supply Voltage Disturbances

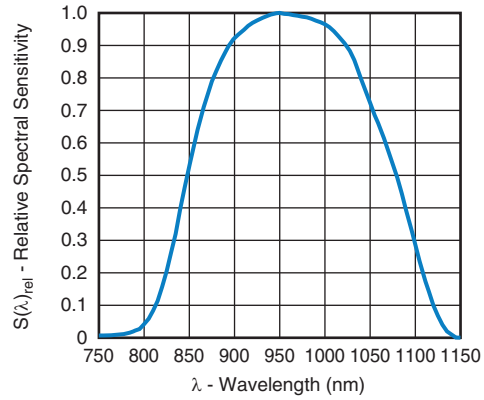


Fig. 10 - Relative Spectral Sensitivity vs. Wavelength

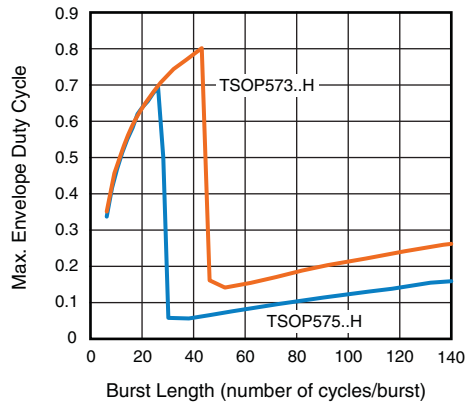
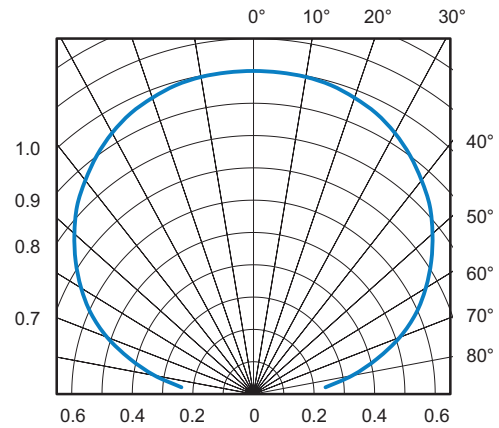


Fig. 8 - Max. Envelope Duty Cycle vs. Burst Length



21947

Fig. 11 - Horizontal Directivity

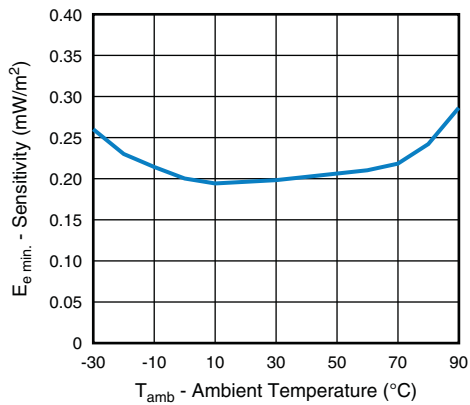


Fig. 9 - Sensitivity vs. Ambient Temperature

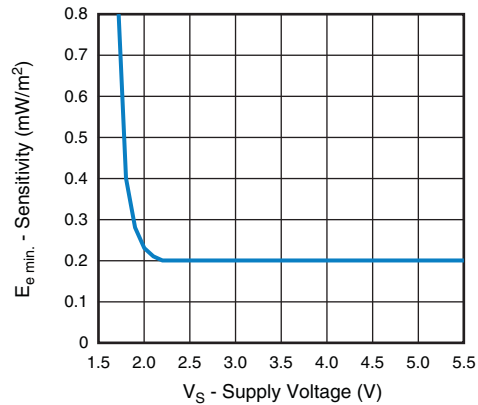


Fig. 12 - Sensitivity vs. Supply Voltage

SUITABLE DATA FORMAT

The TSOP573..H, TSOP575..H series is designed to suppress spurious output pulses due to noise or disturbance signals. The devices can distinguish data signals from noise due to differences in frequency, burst length, and envelope duty cycle. The data signal should be close to the device's band-pass center frequency (e.g. 38 kHz) and fulfill the conditions in the table below.

When a data signal is applied to the TSOP573..H, TSOP575..H in the presence of a disturbance, the sensitivity of the receiver is automatically reduced by the AGC to insure that no spurious pulses are present at the receiver's output. Some examples which are suppressed are:

- DC light (e.g. from tungsten bulbs sunlight)
- Continuous signals at any frequency
- Strongly or weakly modulated patterns from fluorescent lamps with electronic ballasts (see Fig. 13 or Fig. 14)
- 2.4 GHz and 5 GHz Wi-Fi

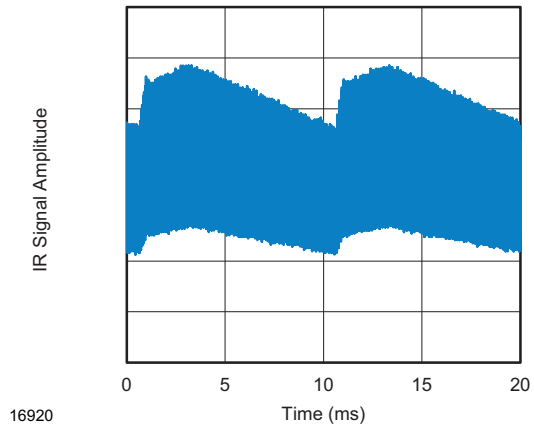


Fig. 13 - IR Signal from Fluorescent Lamp With Low Modulation

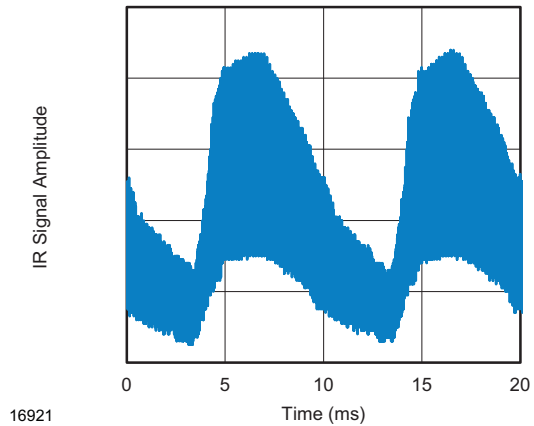


Fig. 14 - IR Signal from Fluorescent Lamp With High Modulation

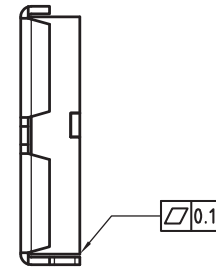
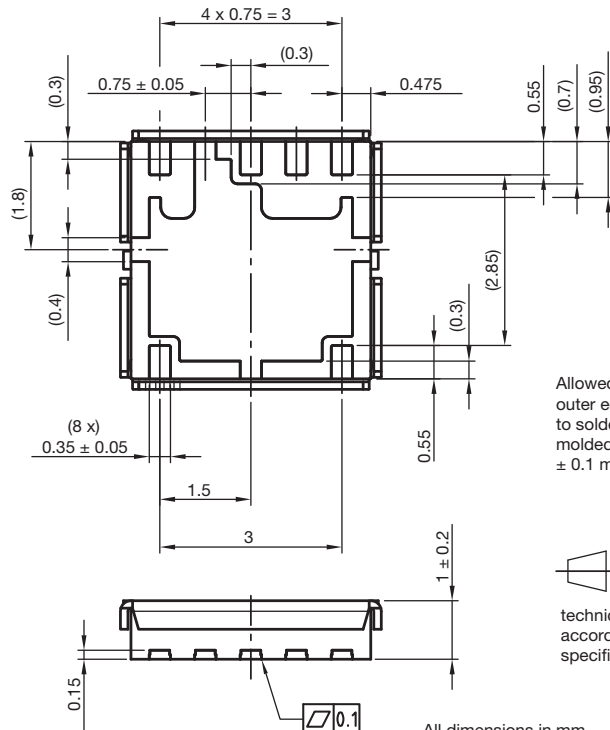
	TSOP573..H	TSOP575..H
Minimum burst length	6 cycles/burst	6 cycles/burst
After each burst of length a minimum gap time is required of	6 to 35 cycles ≥ 10 cycles	6 to 24 cycles ≥ 10 cycles
For bursts greater than a minimum gap time in the data stream is needed of	35 cycles > 6 x burst length	24 cycles > 25 ms
Maximum number of continuous short bursts/second	2000	2000
MCIR code	Preferred	Yes
XMP-1, XMP-2 code	Preferred	Yes
Suppression of interference from fluorescent lamps	Mild and complex disturbance patterns are suppressed (example: signal pattern of Fig. 13 and Fig. 14)	Critical disturbance patterns are suppressed, e.g. highly dimmed LCDs

Note

- For data formats with long bursts (more than 10 carrier cycles) please see the datasheet for TSOP572..H, TSOP574..H

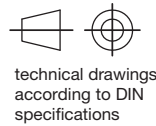


PACKAGE DIMENSIONS in millimeters

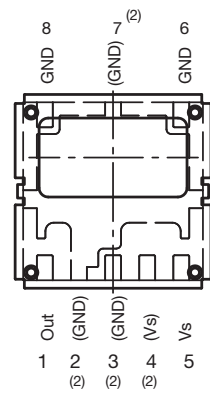


(2) Pins connected internally.
It is not necessary to connect externally.

Allowed offset
outer edge of shield
to solder pads of
molded device
± 0.1 mm

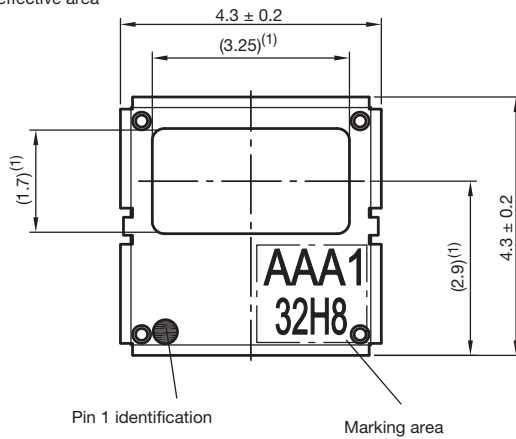


Pinning from Topview



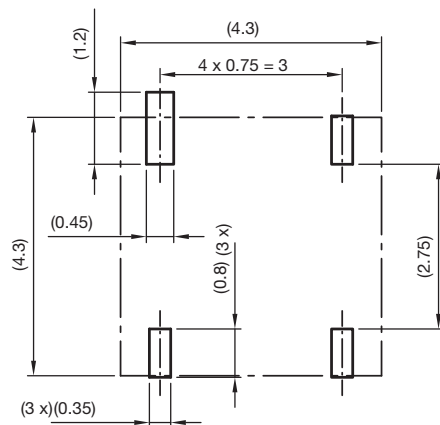
All dimensions in mm
Not indicated tolerances ± 0.1

(1) optically effective area



Drawing-No.: 6.550-5316.01-4
Issue: 2; 12.02.14

Proposed pad layout from
component side
(dim. for reference only)





ASSEMBLY INSTRUCTIONS

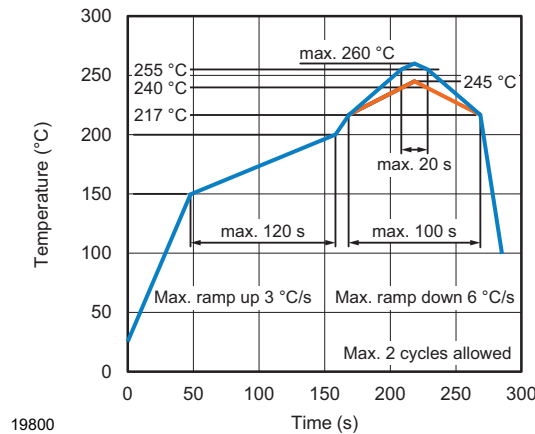
Reflow Soldering

- Reflow soldering must be done within 168 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



ORDERING INFORMATION			
ORDERING CODE	PACKAGING	VOLUME ⁽¹⁾	REMARKS
TSOP57..HTT1	Tape and reel	MOQ: 1500 pcs	3.95 mm x 3.95 mm x 0.75 mm
TSOP57..HTT2		MOQ: 5000 pcs	

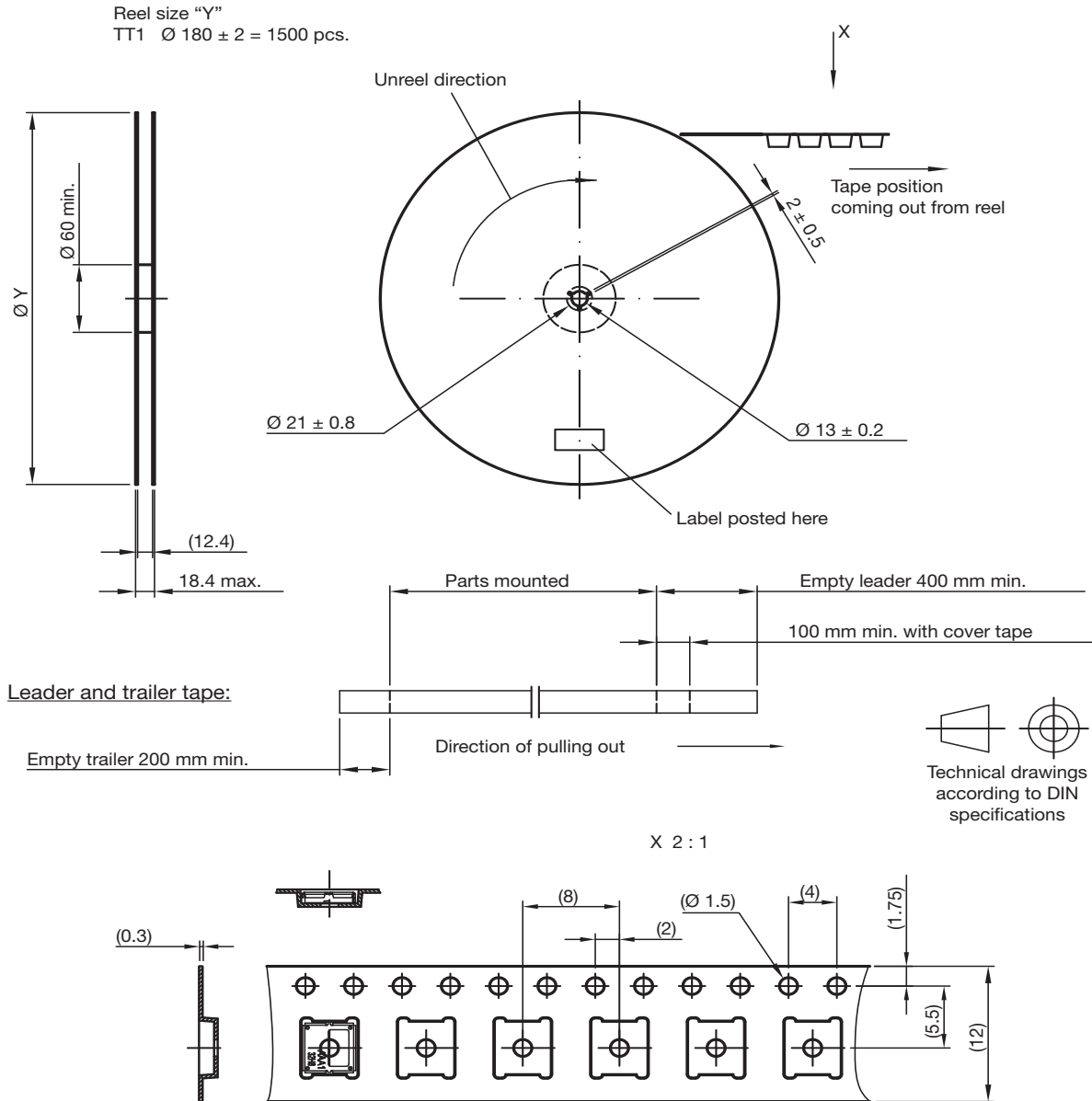
Note

⁽¹⁾ MOQ: minimum order quantity



TAPING VERSION TSOP57..H DIMENSIONS in millimeters

Tape and reel dimensions:



Drawing-No.: 9.700-5380.01-4
Issue: 3; 07.03.18

Not indicated tolerances ± 0.1

LABEL
Standard bar code labels for finished goods

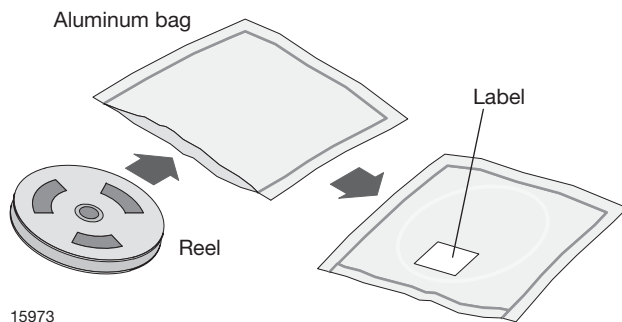
The standard bar code labels are product labels and used for identification of goods. The finished goods are packed in final packing area. The standard packing units are labeled

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.

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

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 168 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 3 label is included on all dry bags.





Caution
This bag contains
MOISTURE-SENSITIVE DEVICES

LEVEL
3

If blank, see adjacent bar code label

1. Calculated shelf life in sealed bag: 12 months at <40°C and <90% relative humidity (RH)
2. Peak package body temperature: 260 °C
If blank, see adjacent bar code label
3. After bag is opened, devices that will be subjected to reflow solder or other high temperature process must be
 - a) Mounted within: 168 hours of factory conditions
If blank, see adjacent bar code label
 - $\leq 30^{\circ}\text{C}/60\% \text{ RH}$, or
 - b) Stored per J-STD-033
4. Devices require bake, before mounting, if:
 - a) Humidity Indicator Card reads > 10% for level 2a - 5a devices or >60% for level 2 devices when read at 23±5°C
 - b) 3a or 3b are not met
5. If baking is required, refer to IPC/JEDEC J-STD-033 for bake procedure

Bag Seal Date: _____
If blank, see adjacent bar code label

Note: Level and body temperature defined by IPC/JEDEC J-STD-020

22650

EIA JEDEC standard J-STD-020 level 3 label is included on all dry bags

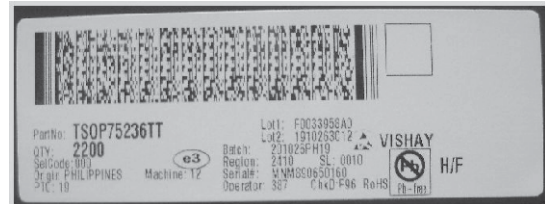
ESD PRECAUTION

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.

BAR CODE PRODUCT LABEL (example)



22178



Tape and Reel Standards for Surface-Mount IR Receiver Modules

Vishay Semiconductor surface-mount IR receivers are packaged on tape and reel. The following specification is based on IEC publication 286, which takes the industrial requirements for automatic insertion into account.

Absolute maximum ratings, mechanical dimensions, optical and electrical characteristics for taped devices are identical to the basic catalog types and can be found in the specifications for untaped devices.

PACKAGING

The tapes of components are available on reels. Each reel is marked with labels which contain the following information:

- Vishay
- Type
- Group
- Tape code, normally part of type name
- Production code
- Quantity

MISSING COMPONENTS

Up to 3 consecutive components may be missing if the gap is followed by at least 6 components. A maximum of 0.5 % of the components per reel quantity may be missing. At least 5 empty positions are present at the start and the end of the tape to enable tape insertion.

Tensile strength of the tape: > 15 N

NUMBER OF COMPONENTS

- A. Panhead: quantity per reel:
 - TT, top view package, 1190 pcs
 - TR, side view package, 1120 pcs
- B. Heimdall: quantity per reel:
 - TT, top view package, 2200 pcs
 - TR, side view package, 2300 pcs
- C. Heimdall without lens: quantity per reel:
 - WTT, top view package, 2200 pcs
 - WTR, side view package, 2300 pcs
- D. Belobog: quantity per reel:
 - TT1, top view package, 1800 pcs
- E. Belobog with shield: quantity per reel:
 - TT1, top view package, 1500 pcs
- F. Minimold DF1P: quantity per reel:
 - DF1P, 1100 pcs
- G. TVCastSMD TR1: quantity per reel:
 - TR1, side view package, 2000 pcs

ORDER DESIGNATION

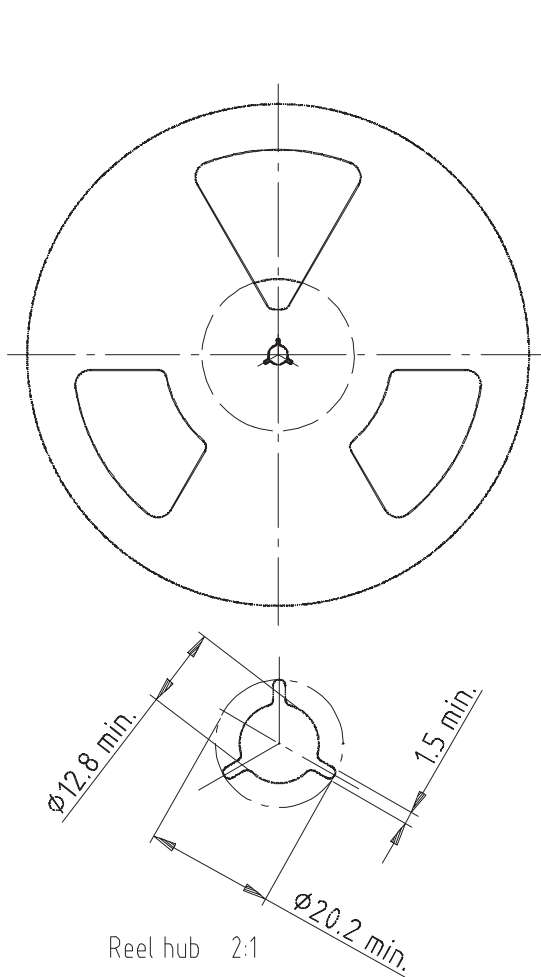
The type designation of the device is extended by TT or TT1 for top view or TR for side view.

Example:

- TSOP6238TR (reel packing)
- TSOP75238TR (reel packing)
- TSOP75338WTT (reel packing)
- TSOP57438TT1 (reel packing)
- TSOP57238HTT1 (reel packing)
- TSOP39438TR1 (reel packing)



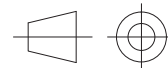
REEL DIMENSIONS FOR PANHEAD, HEIMDALL, AND TVCASTSMD TR in millimeters



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

Dimension acc. to IEC EN 60 286-3

Tape width 16



technical drawings according to DIN specifications

Drawing-No.: 9.800-5052.V2-4

Issue: 1; 07.05.02

16734

Note

- The body structure of the reel can vary



TAPING VERSION TSOP..TT (TOP VIEW) DIMENSIONS in millimeters

A. Panhead (TSOP36...TT, TSSP...TT, TSOP6...TT, TSOP16...TT, TSOP96...TT)



Drawing-No.: 9.700-5259.01-4

Issue: 1; 05.09.01

16584

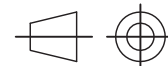


TAPING VERSION TSOP..TT (TOP VIEW) DIMENSIONS in millimeters

B. Heimdall (TSOP75...TT, TSOP77...TT, TSSP77...TT, TSOP15...TT, TSOP95...TT)



Drawing-No.: 9.700-5338.01-4
Issue: 4; 12.06.13



technical drawings
according to DIN
specifications

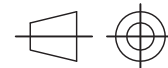


TAPING VERSION TSOP..TT (TOP VIEW) DIMENSIONS in millimeters

C. Heimdall without lens (TSOP75...WTT, TSOP77...WTT, TSSP77...WTT, TSOP15...WTT, TSOP95...WTT)



Drawing-No.: 9.700-5341.01-4
Issue: 3; 06.10.15



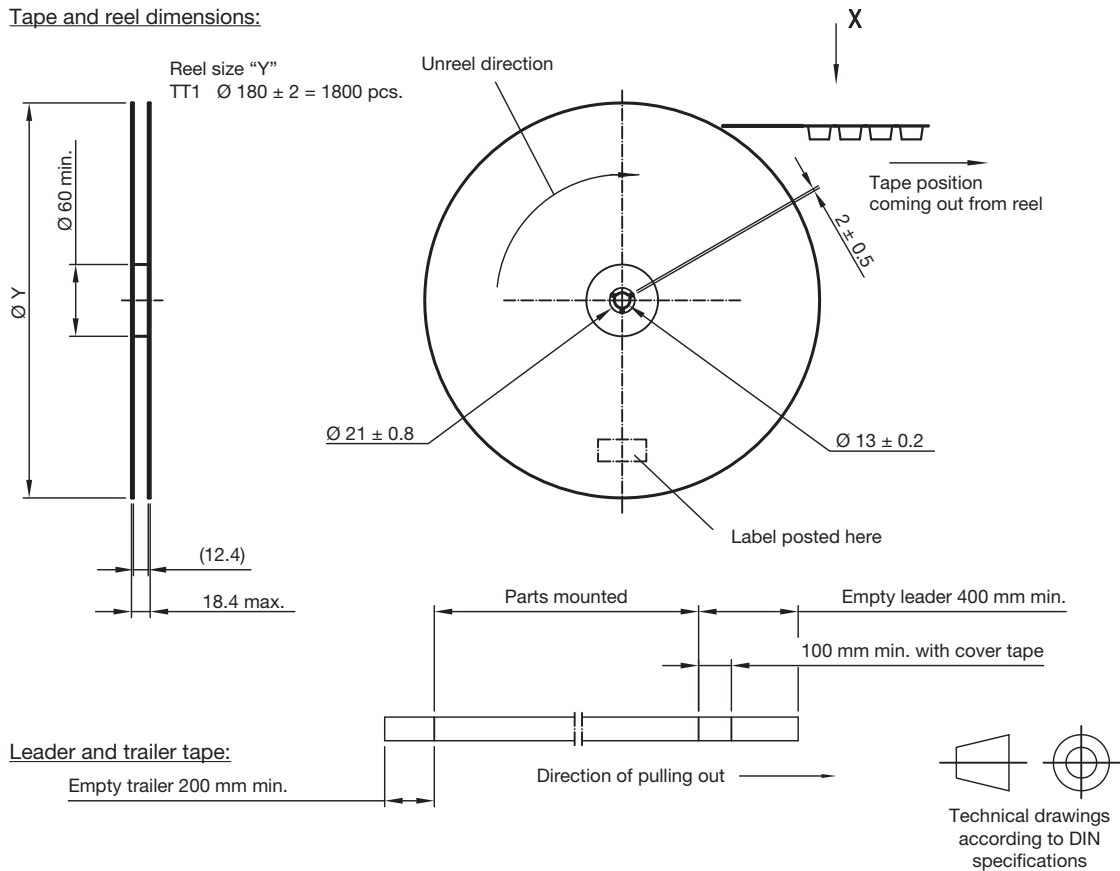
technical drawings
according to DIN
specifications



TAPING VERSION TSOP..TT1 (TOP VIEW) DIMENSIONS in millimeters

D. Belobog (TSOP37...TT1, TSOP57...TT1, TSOP17...TT1, TSOP97...TT1)

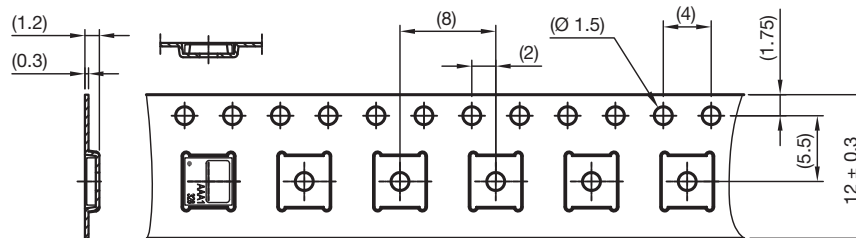
Tape and reel dimensions:



Leader and trailer tape:

Empty trailer 200 mm min.

X 2:1



Drawing-No.: 9.700-5347.01-4
Issue: 2; 07.03.18

Not indicated tolerances ± 0.1



TAPING VERSION TSOP..TT1 (TOP VIEW) DIMENSIONS in millimeters

E. Belobog with shield (TSOP37...HTT1, TSOP57...HTT1, TSOP17...HTT1, TSOP97...HTT1)

Tape and reel dimensions:



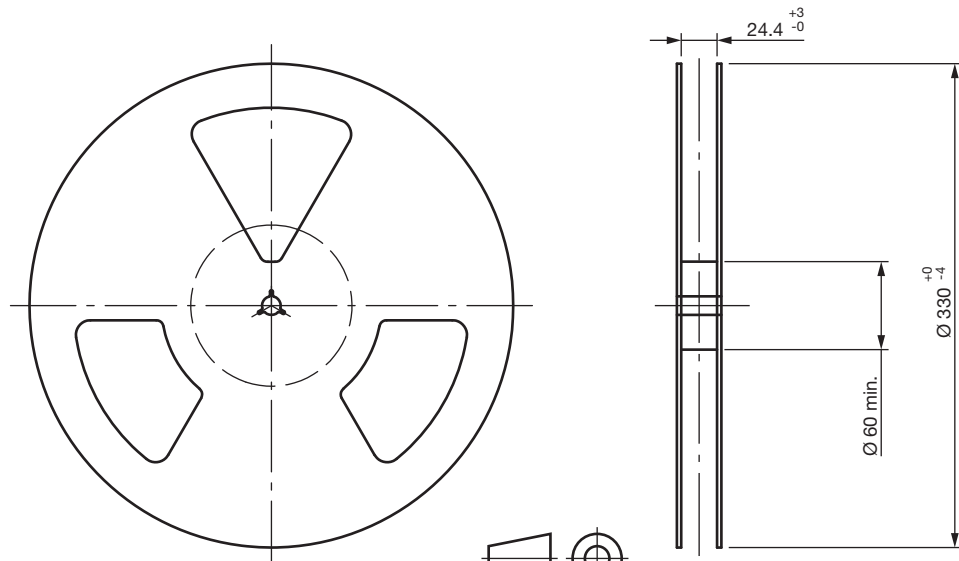
Drawing-No.: 9.700-5380.01-4
Issue: 3; 07.03.18

Not indicated tolerances ± 0.1



TAPING VERSION TSOP..DF1P (SIDE VIEW) DIMENSIONS in millimeters

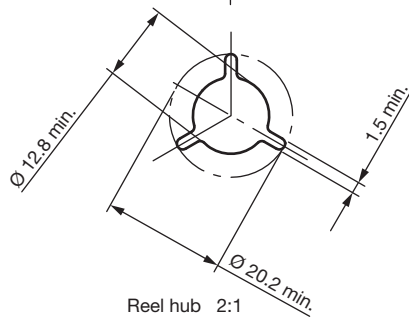
F. Minimold DF1P (TSOP33...DF1P, TSOP53...DF1P, TSOP13...DF1P, TSOP93...DF1P)



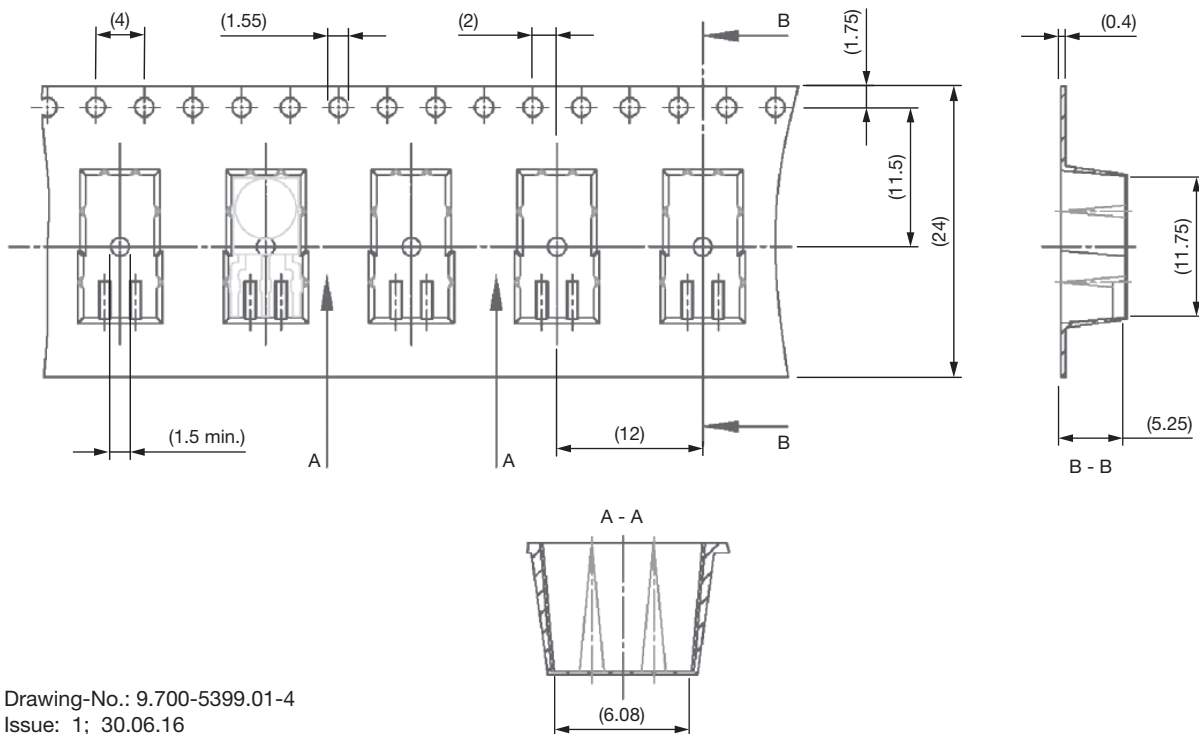
Technical drawing according to DIN specifications

Form of the leave open of the wheel is supplier specific. Dimensions according to IEC EN 60 286-3

Tape width: 24



Drawing-No.: 9.800-5052.V3-4
Issue: 1; 17.12.02



Drawing-No.: 9.700-5399.01-4
Issue: 1; 30.06.16

TAPING VERSION TSOP..TR (SIDE VIEW) DIMENSIONS in millimeters

G. TVCastSMD TR1 (TSOP59...TR1, TSOP39...TR1, TSOP19...TR1, TSOP99...TR1)



Drawing-No.: GO-100220.10_Z
Issue B: 08.02.17

TAPING VERSION TSOP..TR (SIDE VIEW) DIMENSIONS in millimeters

A. Panhead (TSOP36...TR, TSSP6...TR, TSOP6...TR, TSOP16...TR, TSOP96...TR)



Drawing-No.: 9.700-5260.01-4

Issue: 2; 25.09..01

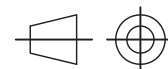
16585

TAPING VERSION TSOP..TR (SIDE VIEW) DIMENSIONS in millimeters

B. Heimdall (TSSP7...., TSOP75...TR, TSOP77...TR, TSSP7....TR, TSOP15...TR, TSOP95...TR)



Drawing-No.: 9.700-5337.01-4
Issue: 2; 06.10.15



technical drawings
according to DIN
specifications

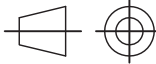


TAPING VERSION TSOP..TR (SIDE VIEW) DIMENSIONS in millimeters

C. Heimdall without lens (TSOP75...WTR, TSOP77...WTR, TSSP...WTR, TSOP15...WTR, TSOP95...WTR)



Drawing-No.: 9.700-5342.01-4
Issue: 2; 12.06.13


technical drawings
according to DIN
specifications

LEADER AND TRAILER DIMENSIONS in millimeters



COVER TAPE REEL STRENGTH

According to DIN EN 60286-3

0.1 N to 1.3 N

300 mm/min. \pm 10 mm/min.

165° to 180° peel angle

LABEL

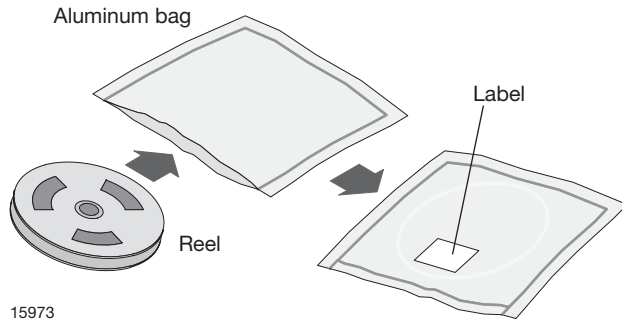
Standard bar code labels for finished goods

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.

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 TOP	TYPE	LENGTH
Selection-code	X	3
Data-code	N	3
Batch-number	X	10
Filter	-	1
Total length	-	17

DRY PACKAGING

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



15973

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 JSTD-020 level 4 label is included on all dry bags.



22522

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

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.



16962

OUTER PACKAGING

The sealed reel is packed into a pizza box.

CARTON BOX DIMENSIONS in millimeters			
	THICKNESS	WIDTH	LENGTH
Pizza box (SMD and heimdall) (taping in reels)	50	340	340

22127



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Наши преимущества:

- Поставка оригинальных импортных электронных компонентов напрямую с производств Америки, Европы и Азии, а так же с крупнейших складов мира;
- Широкая линейка поставок активных и пассивных импортных электронных компонентов (более 30 млн. наименований);
- Поставка сложных, дефицитных, либо снятых с производства позиций;
- Оперативные сроки поставки под заказ (от 5 рабочих дней);
- Экспресс доставка в любую точку России;
- Помощь Конструкторского Отдела и консультации квалифицированных инженеров;
- Техническая поддержка проекта, помощь в подборе аналогов, поставка прототипов;
- Поставка электронных компонентов под контролем ВП;
- Система менеджмента качества сертифицирована по Международному стандарту ISO 9001;
- При необходимости вся продукция военного и аэрокосмического назначения проходит испытания и сертификацию в лаборатории (по согласованию с заказчиком);
- Поставка специализированных компонентов военного и аэрокосмического уровня качества (Xilinx, Altera, Analog Devices, Intersil, Interpoint, Microsemi, Actel, Aeroflex, Peregrine, VPT, Syfer, Eurofarad, Texas Instruments, MS Kennedy, Miteq, Cobham, E2V, MA-COM, Hittite, Mini-Circuits, General Dynamics и др.);

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«JONHON» (основан в 1970 г.)

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«FORSTAR» (основан в 1998 г.)

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