



# Optocoupler, Phototransistor Output, High Reliability, 5300 V<sub>RMS</sub>



## FEATURES

- Excellent CTR linearity depending on forward current
- Isolation test voltage, 5300 V<sub>RMS</sub>
- Fast switching times
- Low CTR degradation
- Low coupling capacitance
- Material categorization: for definitions of compliance please see [www.vishay.com/doc?99912](http://www.vishay.com/doc?99912)



## DESCRIPTION

The SFH615A feature a variety of transfer ratios, low coupling capacitance and high isolation voltage. These couplers have a GaAs infrared diode emitter, which is optically coupled to a silicon planar phototransistor detector, and is incorporated in a plastic DIP-4 package.

The coupling devices are designed for signal transmission between two electrically separated circuits.

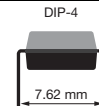
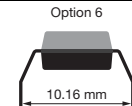

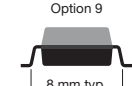
The couplers are end-stackable with 2.54 mm lead spacing. Creepage and clearance distances of > 8 mm are achieved with option 6. This version complies with IEC 60950 (DIN VDE 0805) for reinforced insulation up to an operation voltage of 400 V<sub>RMS</sub> or DC. Specifications subject to change.

## APPLICATIONS

- Switchmode power supply
- Telecom
- Battery powered equipment

## AGENCY APPROVALS

- UL file no. E52744
- cUL tested to CSA 22.2 bulletin 5A
- DIN EN 60747-5-5 (VDE 0884-5) available with option 1
- BSI EN 60950; EN 60065
- FIMKO
- CQC

ORDERING INFORMATION				
<div style="display: flex; justify-content: space-around; align-items: center;"> <div style="border: 1px solid black; padding: 2px 5px;">S</div> <div style="border: 1px solid black; padding: 2px 5px;">F</div> <div style="border: 1px solid black; padding: 2px 5px;">H</div> <div style="border: 1px solid black; padding: 2px 5px;">6</div> <div style="border: 1px solid black; padding: 2px 5px;">1</div> <div style="border: 1px solid black; padding: 2px 5px;">5</div> <div style="border: 1px solid black; padding: 2px 5px;">A</div> <div style="border: 1px solid black; padding: 2px 5px;">-</div> <div style="border: 1px solid black; padding: 2px 5px;">#</div> <div style="border: 1px solid black; padding: 2px 5px;">X</div> <div style="border: 1px solid black; padding: 2px 5px;">0</div> <div style="border: 1px solid black; padding: 2px 5px;">#</div> <div style="border: 1px solid black; padding: 2px 5px;">#</div> <div style="border: 1px solid black; padding: 2px 5px;">T</div> </div> <p style="text-align: center; margin-top: 5px;">PART NUMBER</p>	<div style="border: 1px solid black; padding: 2px 5px;">#</div> <p style="text-align: center; margin-top: 5px;">CTR BIN</p>	<div style="border: 1px solid black; padding: 2px 5px;">X</div> <div style="border: 1px solid black; padding: 2px 5px;">0</div> <div style="border: 1px solid black; padding: 2px 5px;">#</div> <div style="border: 1px solid black; padding: 2px 5px;">#</div> <p style="text-align: center; margin-top: 5px;">PACKAGE OPTION</p>	<div style="border: 1px solid black; padding: 2px 5px;">T</div> <p style="text-align: center; margin-top: 5px;">TAPE AND REEL</p>	<div style="display: flex; justify-content: space-around;"> <div style="text-align: center;"> <p>DIP-4</p>  <p>7.62 mm</p> </div> <div style="text-align: center;"> <p>Option 6</p>  <p>10.16 mm</p> </div> </div> <div style="display: flex; justify-content: space-around; margin-top: 10px;"> <div style="text-align: center;"> <p>Option 7</p>  <p>&gt; 8 mm</p> </div> <div style="text-align: center;"> <p>Option 9</p>  <p>8 mm typ.</p> </div> </div>
AGENCY CERTIFIED/PACKAGE	CTR (%)			
UL, cUL, BSI, FIMKO	40 to 80	63 to 125	100 to 200	160 to 320
DIP-4	SFH615A-1	SFH615A-2	SFH615A-3	SFH615A-4
DIP-4, 400 mil, option 6	SFH615A-1X006	SFH615A-2X006	SFH615A-3X006	-
SMD-4, option 7	-	-	SFH615A-3X007T <sup>(1)</sup>	-
SMD-4, option 9	-	SFH615A-2X009T	SFH615A-3X009T <sup>(1)</sup>	SFH615A-4X009
UL, cUL, VDE, BSI, FIMKO	40 to 80	63 to 125	100 to 200	160 to 320
DIP-4	SFH615A-1X001	SFH615A-2X001	SFH615A-3X001	SFH615A-4X001
DIP-4, 400 mil, option 6	SFH615A-1X016	SFH615A-2X016	SFH615A-3X016	SFH615A-4X016
SMD-4, option 7	SFH615A-1X017T <sup>(1)</sup>	SFH615A-2X017T <sup>(1)</sup>	SFH615A-3X017	SFH615A-4X017T <sup>(1)</sup>
SMD-4, option 9	-	SFH615A-2X019T	-	-
		SFH615A-2X019T3 <sup>(2)</sup>		

## Notes

- Additional options may be possible, please contact sales office.
- <sup>(1)</sup> Also available in tubes; do not add T to end.
- <sup>(2)</sup> T3 rotation in tape and reel packaging.



<b>ABSOLUTE MAXIMUM RATINGS</b> ( $T_{amb} = 25\text{ }^{\circ}\text{C}$ , unless otherwise specified)				
PARAMETER	TEST CONDITION	SYMBOL	VALUE	UNIT
<b>INPUT</b>				
Reverse voltage		$V_R$	6	V
DC forward current		$I_F$	60	mA
Forward surge current	$t_p \leq 10\text{ }\mu\text{s}$	$I_{FSM}$	2.5	A
LED power dissipation	at $25\text{ }^{\circ}\text{C}$	$P_{diss}$	70	mW
<b>OUTPUT</b>				
Collector emitter voltage		$V_{CEO}$	70	V
Emitter collector voltage		$V_{ECO}$	7	V
Collector current		$I_C$	50	mA
Collector peak current	$t_p/T = 0.5, t_p \leq 10\text{ ms}$	$I_{CM}$	100	mA
Output power dissipation	at $25\text{ }^{\circ}\text{C}$	$P_{diss}$	150	mW
<b>COUPLER</b>				
Operation temperature		$T_{amb}$	-55 to +100	$^{\circ}\text{C}$
Storage temperature range		$T_{stg}$	-55 to +150	$^{\circ}\text{C}$
Soldering temperature <sup>(1)</sup>	2 mm from case, $\leq 10\text{ s}$	$T_{sld}$	260	$^{\circ}\text{C}$

**Notes**

- Stresses in excess of the absolute maximum ratings can cause permanent damage to the device. Functional operation of the device is not implied at these or any other conditions in excess of those given in the operational sections of this document. Exposure to absolute maximum ratings for extended periods of the time can adversely affect reliability.

<sup>(1)</sup> Refer to reflow profile for soldering conditions for surface mounted devices (SMD). Refer to wave profile for soldering conditions for through hole devices (DIP).

<b>ELECTRICAL CHARACTERISTICS</b> ( $T_{amb} = 25\text{ }^{\circ}\text{C}$ , unless otherwise specified)							
PARAMETER	TEST CONDITION	PART	SYMBOL	MIN.	TYP.	MAX.	UNIT
<b>INPUT</b>							
Forward voltage	$I_F = 60\text{ mA}$		$V_F$		1.35	1.65	V
Reverse current	$V_R = 6\text{ V}$		$I_R$		0.01	10	$\mu\text{A}$
Capacitance	$V_R = 0\text{ V}, f = 1\text{ MHz}$		$C_O$		13		pF
<b>OUTPUT</b>							
Collector emitter capacitance	$V_{CE} = 5\text{ V}, f = 1\text{ MHz}$		$C_{CE}$		5.2		pF
Collector emitter leakage current	$V_{CE} = 10\text{ V}$	SFH615A-1	$I_{CEO}$		2	50	nA
		SFH615A-2	$I_{CEO}$		2	50	nA
		SFH615A-3	$I_{CEO}$		5	100	nA
		SFH615A-4	$I_{CEO}$		5	100	nA
<b>COUPLER</b>							
Collector emitter saturation voltage	$I_F = 10\text{ mA}, f = 1\text{ MHz}$		$V_{CEsat}$		0.25	0.4	V
Coupling capacitance			$C_C$		0.4		pF

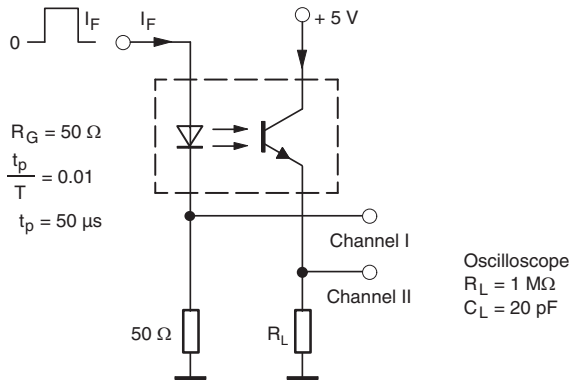
**Note**

- Minimum and maximum values are testing requirements. Typical values are characteristics of the device and are the result of engineering evaluation. Typical values are for information only and are not part of the testing requirements.



<b>CURRENT TRANSFER RATIO</b> ( $T_{amb} = 25\text{ }^{\circ}\text{C}$ , unless otherwise specified)							
PARAMETER	TEST CONDITION	PART	SYMBOL	MIN.	TYP.	MAX.	UNIT
$I_C/I_F$	$I_F = 10\text{ mA}$ , $V_{CE} = 5\text{ V}$	SFH615A-1	CTR	40		80	%
		SFH615A-2	CTR	63		125	%
		SFH615A-3	CTR	100		200	%
		SFH615A-4	CTR	160		320	%
	$I_F = 1\text{ mA}$ , $V_{CE} = 5\text{ V}$	SFH615A-1	CTR	13	30		%
		SFH615A-2	CTR	22	45		%
		SFH615A-3	CTR	34	70		%
		SFH615A-4	CTR	56	90		%

<b>SWITCHING CHARACTERISTICS</b> ( $T_{amb} = 25\text{ }^{\circ}\text{C}$ , unless otherwise specified)							
PARAMETER	TEST CONDITION	PART	SYMBOL	MIN.	TYP.	MAX.	UNIT
<b>NON-SATURATED</b>							
Turn-on time	$I_F = 10\text{ mA}$ , $V_{CC} = 5\text{ V}$ , $R_L = 75\text{ }\Omega$		$t_{on}$		3		$\mu\text{s}$
Rise time	$I_F = 10\text{ mA}$ , $V_{CC} = 5\text{ V}$ , $R_L = 75\text{ }\Omega$		$t_r$		2		$\mu\text{s}$
Turn-off time	$I_F = 10\text{ mA}$ , $V_{CC} = 5\text{ V}$ , $R_L = 75\text{ }\Omega$		$t_{off}$		2.3		$\mu\text{s}$
Fall time	$I_F = 10\text{ mA}$ , $V_{CC} = 5\text{ V}$ , $R_L = 75\text{ }\Omega$		$t_f$		2		$\mu\text{s}$
Cut-off frequency	$I_F = 10\text{ mA}$ , $V_{CC} = 5\text{ V}$ , $R_L = 75\text{ }\Omega$		$f_{CO}$		208		kHz
<b>SATURATED</b>							
Turn-on time	$I_F = 20\text{ mA}$	SFH615A-1	$t_{on}$		3		$\mu\text{s}$
	$I_F = 10\text{ mA}$	SFH615A-2	$t_{on}$		4.2		$\mu\text{s}$
		SFH615A-3	$t_{on}$		4.2		$\mu\text{s}$
	$I_F = 5\text{ mA}$	SFH615A-4	$t_{on}$		6		$\mu\text{s}$
Rise time	$I_F = 20\text{ mA}$	SFH615A-1	$t_r$		2		$\mu\text{s}$
	$I_F = 10\text{ mA}$	SFH615A-2	$t_r$		3		$\mu\text{s}$
		SFH615A-3	$t_r$		3		$\mu\text{s}$
	$I_F = 5\text{ mA}$	SFH615A-4	$t_r$		4		$\mu\text{s}$
Turn-off time	$I_F = 20\text{ mA}$	SFH615A-1	$t_{off}$		18		$\mu\text{s}$
	$I_F = 10\text{ mA}$	SFH615A-2	$t_{off}$		23		$\mu\text{s}$
		SFH615A-3	$t_{off}$		23		$\mu\text{s}$
	$I_F = 5\text{ mA}$	SFH615A-4	$t_{off}$		25		$\mu\text{s}$
Fall time	$I_F = 20\text{ mA}$	SFH615A-1	$t_f$		11		$\mu\text{s}$
	$I_F = 10\text{ mA}$	SFH615A-2	$t_f$		14		$\mu\text{s}$
		SFH615A-3	$t_f$		14		$\mu\text{s}$
	$I_F = 5\text{ mA}$	SFH615A-4	$t_f$		15		$\mu\text{s}$



95 10804-3

Fig. 1 - Test Circuit, Non-Saturated Operation

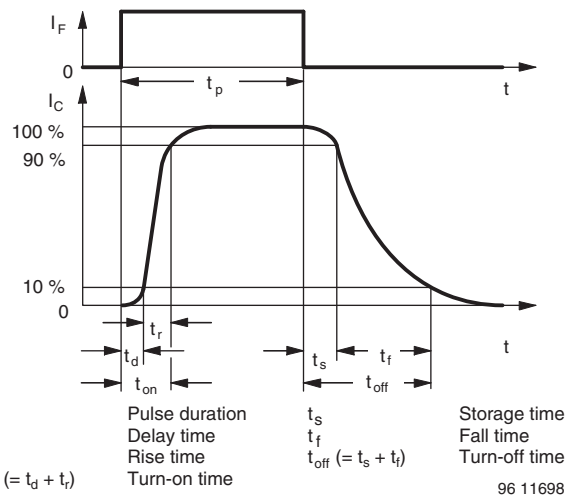


Fig. 3 - Switching Times



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Fig. 2 - Test Circuit, Saturated Operation

**SAFETY AND INSULATION RATINGS**

PARAMETER	TEST CONDITION	SYMBOL	VALUE	UNIT
Climatic classification	According to IEC 68 part 1		55/115/21	
Pollution degree	According to DIN VDE 0109		2	
Comparative tracking index	Insulation group IIIa	CTI	175	
Maximum rated withstanding isolation voltage	According to UL1577, t = 1 min	V <sub>ISO</sub>	4470	V <sub>RMS</sub>
Tested withstanding isolation voltage	According to UL1577, t = 1 s	V <sub>ISO</sub>	5300	V <sub>RMS</sub>
Maximum transient isolation voltage	According to DIN EN 60747-5-5	V <sub>IOTM</sub>	8000	V <sub>peak</sub>
Maximum repetitive peak isolation voltage	According to DIN EN 60747-5-5	V <sub>IORM</sub>	890	V <sub>peak</sub>
Isolation resistance	T <sub>amb</sub> = 25 °C, V <sub>IO</sub> = 500 V	R <sub>IO</sub>	≥ 10 <sup>12</sup>	Ω
	T <sub>amb</sub> = 100 °C, V <sub>IO</sub> = 500 V	R <sub>IO</sub>	≥ 10 <sup>11</sup>	Ω
Output safety power		P <sub>SO</sub>	700	mW
Input safety current		I <sub>SI</sub>	400	mA
Input safety temperature		T <sub>S</sub>	175	°C
Creepage distance	DIP-4		≥ 7	mm
Clearance distance	DIP-4		≥ 7	mm
Creepage distance	DIP-4, 400 mil, option 6		≥ 8	mm
Clearance distance	DIP-4, 400 mil, option 6		≥ 8	mm
Creepage distance	SMD-4, option 7 and option 9		≥ 7	mm
Clearance distance	SMD-4, option 7 and option 9		≥ 7	mm
Insulation thickness		DTI	≥ 0.4	mm

**Note**

- As per DIN EN 60747-5-5, § 7.4.3.8.2, this optocoupler is suitable for “safe electrical insulation” only within the safety ratings. Compliance with the safety ratings shall be ensured by means of protective circuits.

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



Fig. 4 - Forward Voltage vs. Forward Current



Fig. 7 - Leakage Current vs. Ambient Temperature



Fig. 5 - Collector Current vs. Collector Emitter Voltage (non-saturated)

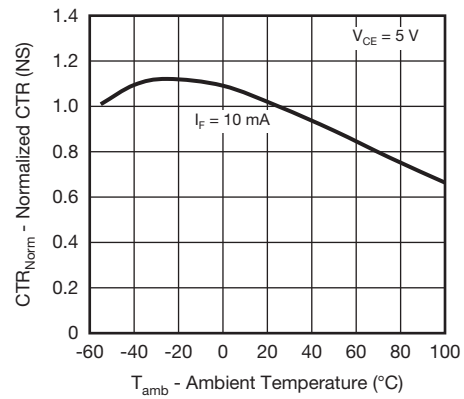


Fig. 8 - Normalized CTR (non-saturated) vs. Ambient Temperature



Fig. 6 - Collector Current vs. Collector Emitter Voltage (saturated)

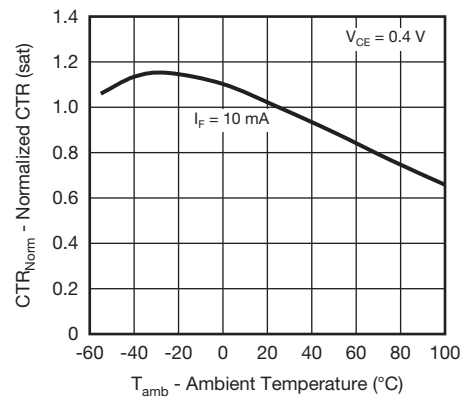


Fig. 9 - Normalized CTR (saturated) vs. Ambient Temperature

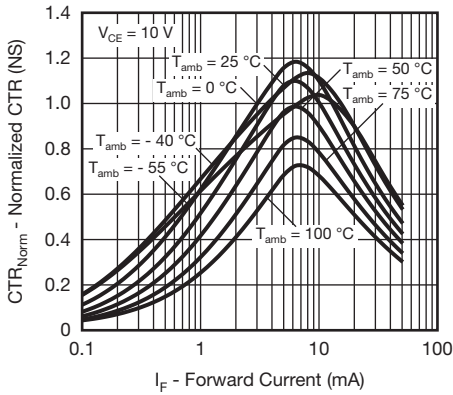


Fig. 10 - Normalized CTR (non-saturated) vs. Forward Current



Fig. 13 - Cut-Off Frequency vs. Collector Current

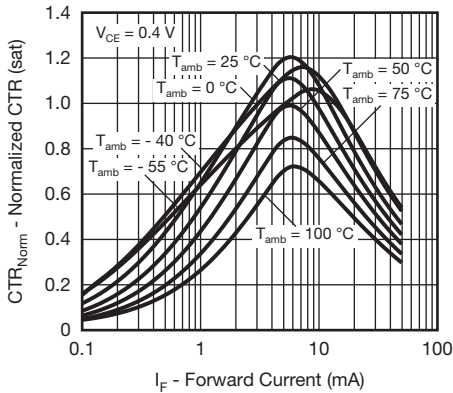


Fig. 11 - Normalized CTR (saturated) vs. Forward Current



Fig. 14 - Switching Time vs. Load Resistance

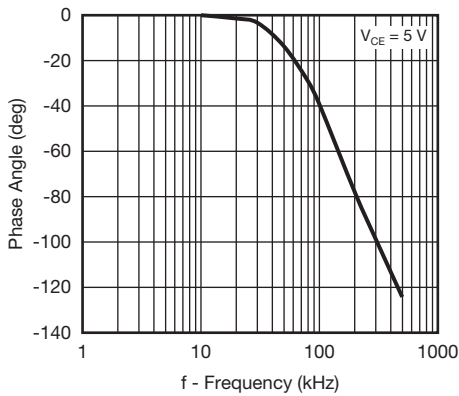


Fig. 12 - Phase Angle vs. Frequency



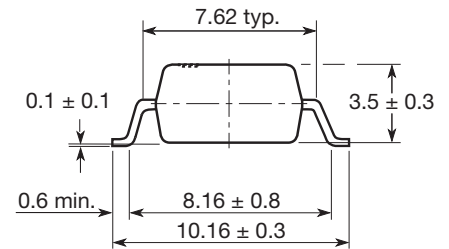
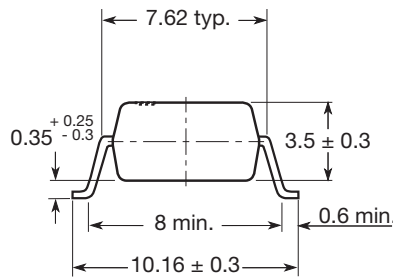
PACKAGE DIMENSIONS in millimeters



Option 6

Option 7

Option 9



20802-28



PACKAGE MARKING (Example)



Notes

- VDE logo is only marked on option 1 parts. Option information is not marked on the part.
- Tape and reel suffix (T) is not part of the package marking.

**PACKING INFORMATION**

DEVICE PER TUBE			
TYPE	UNITS/TUBE	TUBES/BOX	UNITS/BOX
DIP-4	100	40	4000

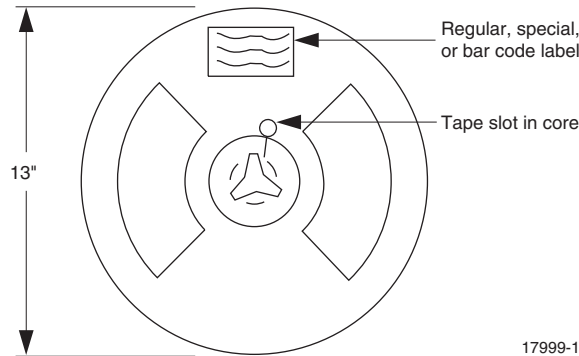


Fig. 15 - Tape and Reel Shipping Medium

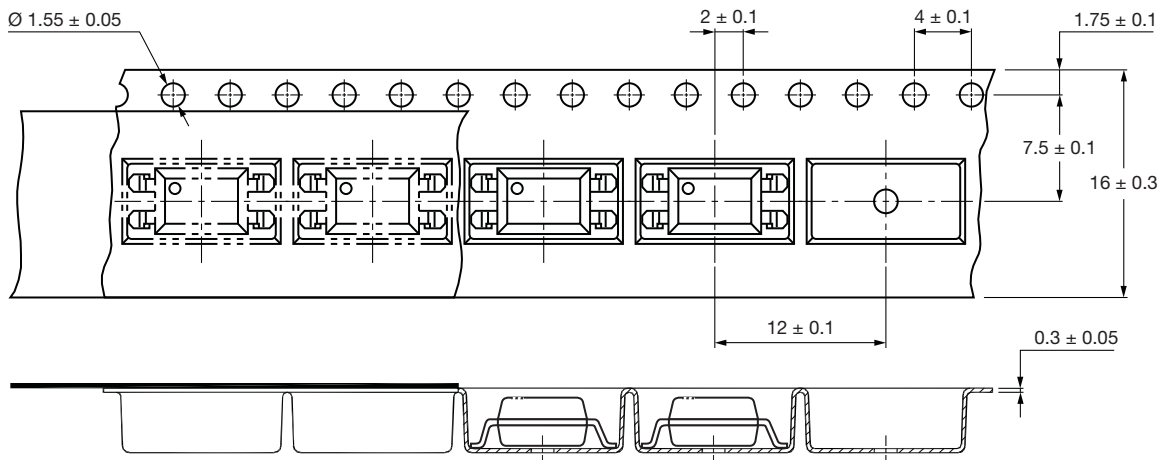


Fig. 16 - Tape and Packing for Option 7 and Option 9

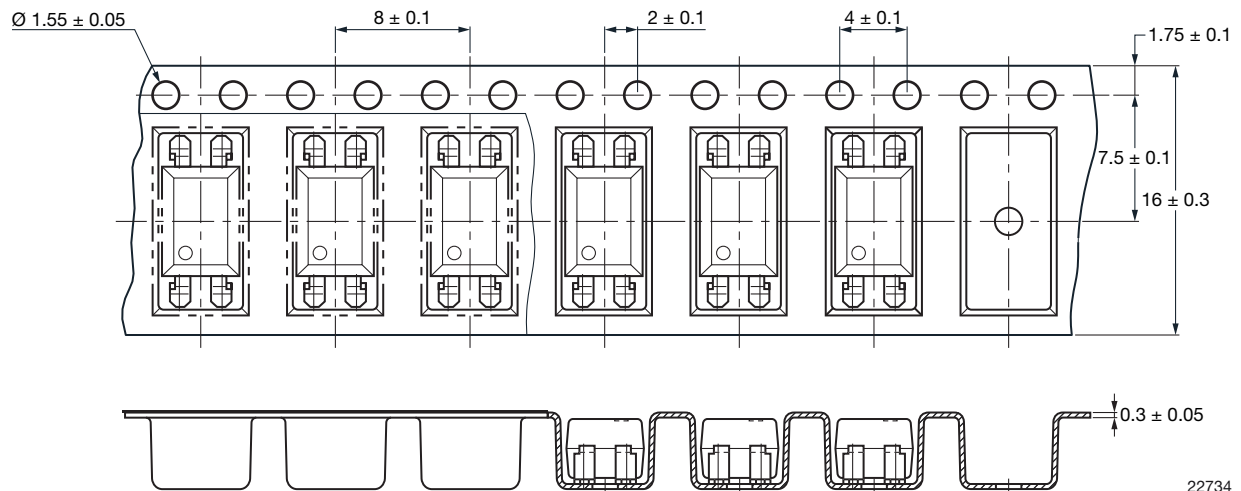


Fig. 17 - Tape Packing for Option 7 and Option 9, T3 Rotation (2000 units per reel)



**SOLDER PROFILES**



Fig. 18 - Wave Soldering Double Wave Profile According to J-STD-020 for DIP-8 Devices

**HANDLING AND STORAGE CONDITIONS**

ESD level: HBM class 2

Floor life: unlimited

Conditions:  $T_{amb} < 30\text{ °C}$ , RH < 85 %

Moisture sensitivity level 1, according to J-STD-020



Fig. 19 - Lead (Pb)-free Reflow Solder Profile According to J-STD-020 for SMD-8 Devices



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