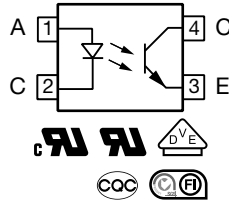
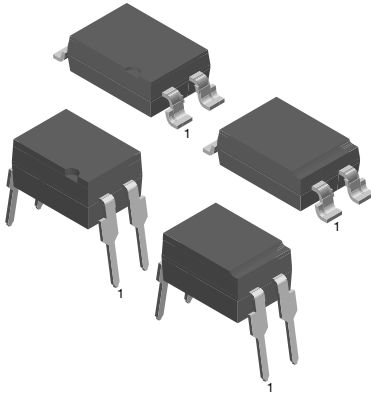




**THE DATASHEET OF  
SFH6186-4**



# Optocoupler, Phototransistor Output, Low Input Current



## FEATURES

- Good CTR linearity depending on forward current
- Low CTR degradation
- High collector emitter voltage,  $V_{CE0} = 55\text{ V}$
- Isolation test voltage,  $5300\text{ V}_{RMS}$
- Low coupling capacitance
- End stackable, 0.100" (2.54 mm) spacing
- High common mode transient immunity
- Material categorization: for definitions of compliance please see [www.vishay.com/doc?99912](http://www.vishay.com/doc?99912)


**RoHS**  
COMPLIANT

## APPLICATIONS

- Telecom
- Industrial controls
- Battery powered equipment
- Office machines

## LINKS TO ADDITIONAL RESOURCES



## DESCRIPTION

The SFH618A (DIP) and SFH6186 (SMD) feature a high current transfer ratio, low coupling capacitance and high isolation voltage. These couplers have a GaAs infrared diode emitter, which is optically coupled to silicon planar phototransistor detector, and is incorporated in a plastic DIP-4 or SMD 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  $> 8\text{ mm}$  achieved with option 6.

## AGENCY APPROVALS

The safety application model number covering all products in this datasheet is SFH618A. This model number should be used when consulting safety agency documents.

- [UL](#)
- [cUL](#)
- [DIN EN 60747-5-5 \(VDE 0884-5\) available with option 1](#)
- [BSI](#)
- [CQC](#)
- [FIMKO](#)

ORDERING INFORMATION					
<div style="display: flex; justify-content: space-around;"> <div style="border: 1px solid black; padding: 2px;">S</div> <div style="border: 1px solid black; padding: 2px;">F</div> <div style="border: 1px solid black; padding: 2px;">H</div> <div style="border: 1px solid black; padding: 2px;">6</div> <div style="border: 1px solid black; padding: 2px;">1</div> <div style="border: 1px solid black; padding: 2px;">8</div> <div style="border: 1px solid black; padding: 2px;">#</div> <div style="border: 1px solid black; padding: 2px;">-</div> <div style="border: 1px solid black; padding: 2px;">#</div> <div style="border: 1px solid black; padding: 2px;">X</div> <div style="border: 1px solid black; padding: 2px;">0</div> <div style="border: 1px solid black; padding: 2px;">#</div> <div style="border: 1px solid black; padding: 2px;">#</div> <div style="border: 1px solid black; padding: 2px;">T</div> </div>	PART NUMBER		CTR BIN	PACKAGE OPTION	TAPE AND REEL
AGENCY CERTIFIED / PACKAGE	CTR (%)				
	1 mA				
<b>UL, cUL, BSI, FIMKO</b>	<b>63 to 125</b>	<b>100 to 200</b>	<b>160 to 320</b>	<b>250 to 500</b>	
DIP-4	SFH618A-2	SFH618A-3	SFH618A-4	SFH618A-5	
DIP-4, 400 mil, option 6	-	SFH618A-3X006	-	-	
SMD-4, option 7	-	-	-	SFH618A-5X007T <sup>(1)</sup>	
SMD-4, option 9	SFH6186-2T <sup>(1)</sup>	SFH6186-3T <sup>(1)</sup> , SFH6186-3T1	SFH6186-4T <sup>(1)</sup>	SFH6186-5T <sup>(1)</sup> , SFH6186-5T1	
<b>UL, cUL, BSI, FIMKO, VDE (option 1)</b>	<b>63 to 125</b>	<b>100 to 200</b>	<b>160 to 320</b>	<b>250 to 500</b>	
DIP-4	-	SFH618A-3X001	SFH618A-4X001	-	
DIP-4, 400 mil, option 6	-	SFH618A-3X016	SFH618A-4X016	SFH618A-5X016	
SMD-4, option 7	-	SFH618A-3X017T <sup>(1)</sup>	-	SFH618A-5X017T <sup>(1)</sup>	
SMD-4, option 9	-	SFH6186-3X001T <sup>(1)</sup> , SFH6186-3X001T1	SFH6186-4X001T	SFH6186-5X001T <sup>(1)</sup>	

## Notes

- Additional options may be possible, please contact sales office
- <sup>(1)</sup> Also available in tubes, do not put T to the end



ABSOLUTE MAXIMUM RATINGS (T <sub>amb</sub> = 25 °C, unless otherwise specified)				
PARAMETER	TEST CONDITION	SYMBOL	VALUE	UNIT
<b>INPUT</b>				
Reverse voltage		V <sub>R</sub>	6	V
Power dissipation		P <sub>diss</sub>	70	mW
Forward current		I <sub>F</sub>	60	mA
<b>OUTPUT</b>				
Collector emitter voltage		V <sub>CEO</sub>	55	V
Emitter collector voltage		V <sub>ECO</sub>	7	V
Collector current		I <sub>C</sub>	50	mA
	t <sub>p</sub> ≤ 1 ms	I <sub>C</sub>	100	mA
Power dissipation		P <sub>diss</sub>	150	mW
<b>COUPLER</b>				
Storage temperature range		T <sub>stg</sub>	-55 to +150	°C
Ambient temperature range		T <sub>amb</sub>	-55 to +100	°C
Junction temperature		T <sub>j</sub>	125	°C
Soldering temperature	max. 10 s, dip soldering distance to seating plane ≥ 1.5 mm	T <sub>sld</sub>	260	°C

Note

- 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.



Fig. 1 - Permissible Power Dissipation vs. Ambient Temperature



<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	$I_F = 5\text{ mA}$		$V_F$	-	1.1	1.5	V
Reverse current	$V_R = 6\text{ V}$		$I_R$	-	0.01	10	$\mu\text{A}$
Capacitance	$V_R = 0\text{ V}, f = 1\text{ MHz}$		$C_O$	-	25	-	pF
Thermal resistance			$R_{thja}$	-	1070	-	K/W
<b>OUTPUT</b>							
Collector emitter leakage current	$V_{CE} = 10\text{ V}$		$I_{CEO}$	-	10	200	nA
Collector emitter capacitance	$V_{CE} = 5\text{ V}, f = 1\text{ MHz}$		$C_{CE}$	-	7	-	pF
Thermal resistance			$R_{thja}$	-	500	-	K/W
<b>COUPLER</b>							
Collector emitter saturation voltage	$I_C = 0.32\text{ mA}, I_F = 1\text{ mA}$	SFH618A-2	$V_{CEsat}$	-	0.25	0.4	V
		SFH6186-2	$V_{CEsat}$	-	0.25	0.4	V
	$I_C = 0.5\text{ mA}, I_F = 1\text{ mA}$	SFH618A-3	$V_{CEsat}$	-	0.25	0.4	V
		SFH6186-3	$V_{CEsat}$	-	0.25	0.4	V
	$I_C = 0.8\text{ mA}, I_F = 1\text{ mA}$	SFH618A-4	$V_{CEsat}$	-	0.25	0.4	V
		SFH6186-4	$V_{CEsat}$	-	0.25	0.4	V
	$I_C = 1.25\text{ mA}, I_F = 1\text{ mA}$	SFH618A-5	$V_{CEsat}$	-	0.25	0.4	V
		SFH6186-5	$V_{CEsat}$	-	0.25	0.4	V
Coupling capacitance			$C_C$	-	0.25	-	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
$I_C/I_F$	$I_F = 1\text{ mA}, V_{CE} = 0.5\text{ V}$	SFH618A-2	CTR	63	-	125	%
		SFH6186-2	CTR	63	-	125	%
	$I_F = 0.5\text{ mA}, V_{CE} = 1.5\text{ V}$	SFH618A-2	CTR	32	75	-	%
		SFH6186-2	CTR	32	75	-	%
	$I_F = 1\text{ mA}, V_{CE} = 0.5\text{ V}$	SFH618A-3	CTR	100	-	200	%
		SFH6186-3	CTR	100	-	200	%
	$I_F = 0.5\text{ mA}, V_{CE} = 1.5\text{ V}$	SFH618A-3	CTR	50	120	-	%
		SFH6186-3	CTR	50	120	-	%
	$I_F = 1\text{ mA}, V_{CE} = 0.5\text{ V}$	SFH618A-4	CTR	160	-	320	%
		SFH6186-4	CTR	160	-	320	%
	$I_F = 0.5\text{ mA}, V_{CE} = 1.5\text{ V}$	SFH618A-4	CTR	80	200	-	%
		SFH6186-4	CTR	80	200	-	%
	$I_F = 1\text{ mA}, V_{CE} = 0.5\text{ V}$	SFH618A-5	CTR	250	-	500	%
		SFH6186-5	CTR	250	-	500	%
	$I_F = 0.5\text{ mA}, V_{CE} = 1.5\text{ V}$	SFH618A-5	CTR	125	300	-	%
		SFH6186-5	CTR	125	300	-	%

<b>SWITCHING CHARACTERISTICS</b> ( $T_{amb} = 25\text{ }^{\circ}\text{C}$ , unless otherwise specified)							
PARAMETER	TEST CONDITION	SYMBOL	MIN.	TYP.	MAX.	UNIT	
Turn on time	$V_{CC} = 5\text{ V}, I_C = 2\text{ mA}, R_L = 100\text{ }\Omega$	$t_{on}$	-	6	-	$\mu\text{s}$	
Rise time	$V_{CC} = 5\text{ V}, I_C = 2\text{ mA}, R_L = 100\text{ }\Omega$	$t_r$	-	3.5	-	$\mu\text{s}$	
Turn off time	$V_{CC} = 5\text{ V}, I_C = 2\text{ mA}, R_L = 100\text{ }\Omega$	$t_{off}$	-	5.5	-	$\mu\text{s}$	
Fall time	$V_{CC} = 5\text{ V}, I_C = 2\text{ mA}, R_L = 100\text{ }\Omega$	$t_f$	-	5	-	$\mu\text{s}$	

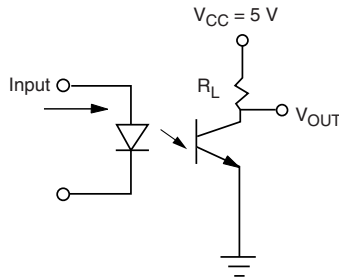


Fig. 2 - Test Circuit

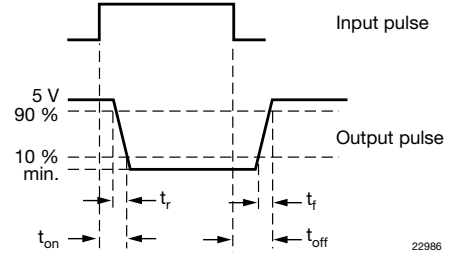


Fig. 3 - Parameter and Limit Definition

SAFETY AND INSULATION RATINGS				
PARAMETER	TEST CONDITION	SYMBOL	VALUE	UNIT
Climatic classification	According to IEC 68 part 1		55 / 100 / 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	$V_{ISO}$	4420	$V_{RMS}$
Tested withstanding isolation voltage	According to UL1577, t = 1 s	$V_{ISO}$	5300	$V_{RMS}$
Maximum transient isolation voltage	According to DIN EN 60747-5-5	$V_{IOTM}$	10 000	$V_{peak}$
Maximum repetitive peak isolation voltage	According to DIN EN 60747-5-5	$V_{IORM}$	890	$V_{peak}$
Isolation resistance	$T_{amb} = 25\text{ }^{\circ}\text{C}$ , $V_{IO} = 500\text{ V}$	$R_{IO}$	$\geq 10^{12}$	$\Omega$
	$T_{amb} = 100\text{ }^{\circ}\text{C}$ , $V_{IO} = 500\text{ V}$	$R_{IO}$	$\geq 10^{11}$	$\Omega$
Output safety power		$P_{SO}$	400	mW
Input safety current		$I_{SI}$	400	mA
Input safety temperature		$T_{SI}$	275	$^{\circ}\text{C}$
Creepage distance	DIP-4		$\geq 7$	mm
Clearance distance			$\geq 7$	mm
Creepage distance	DIP-4, 400 mil, option 6		$\geq 8$	mm
Clearance distance			$\geq 8$	mm
Creepage distance	SMD-4, option 7 and option 9		$\geq 7$	mm
Clearance distance			$\geq 7$	mm
Insulation thickness		DTI	$\geq 0.4$	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)

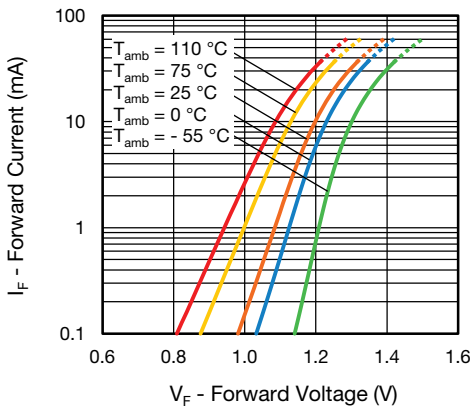


Fig. 4 - Forward Voltage vs. Forward Current

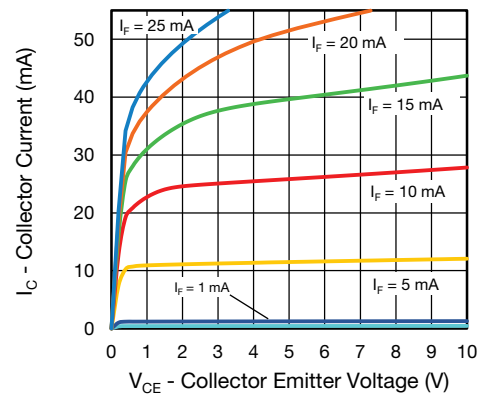


Fig. 5 - Collector Current vs. Collector Emitter Voltage

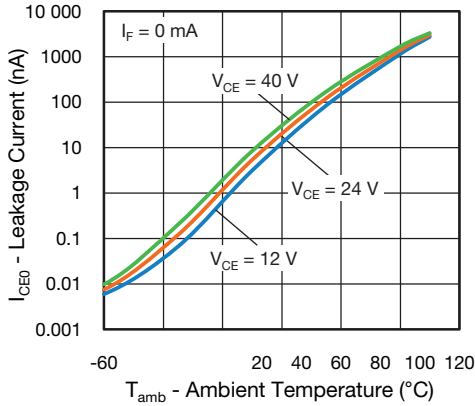


Fig. 6 - Collector-Emitter Current vs. Ambient Temperature

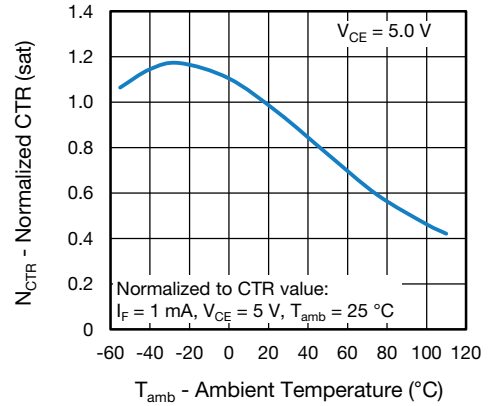


Fig. 9 - Normalized Current Transfer Ratio vs. Ambient Temperature (sat.)

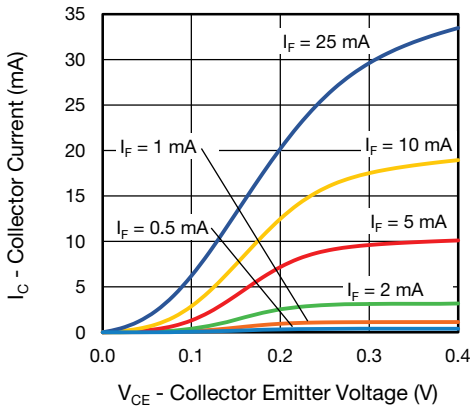


Fig. 7 - Collector Current vs. Collector-Emitter Voltage

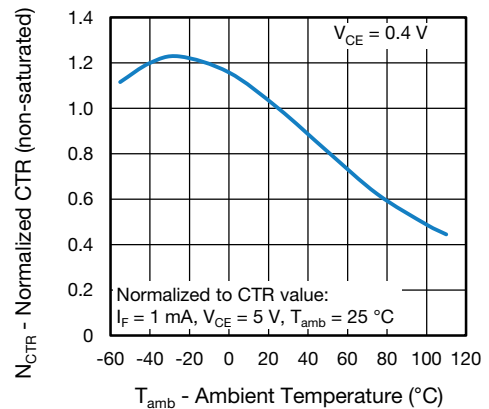


Fig. 10 - Normalized Current Transfer Ratio vs. Ambient Temperature (non-sat.)

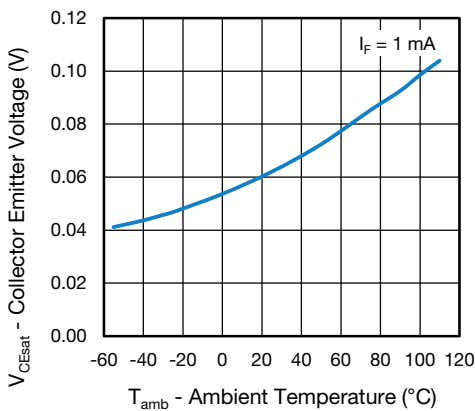


Fig. 8 - Collector-Emitter Voltage vs. Ambient Temperature

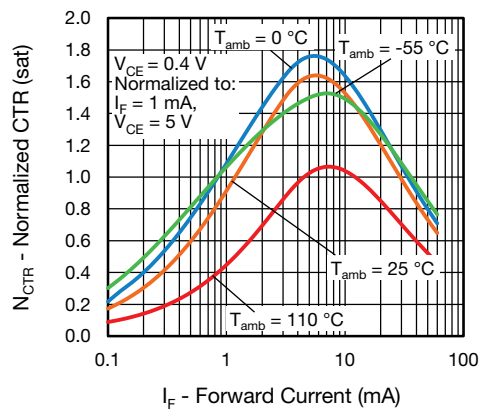


Fig. 11 - Current Transfer Ratio vs. Forward Current (sat.)

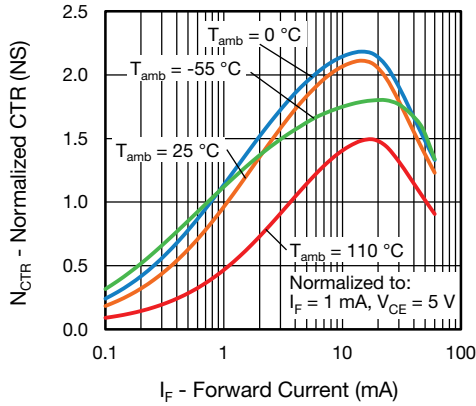


Fig. 12 - Current Transfer Ratio vs. Forward Current (non-sat.)

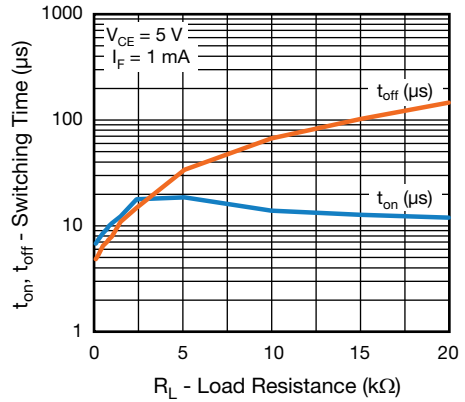


Fig. 15 - Switching Time vs. Load Resistance

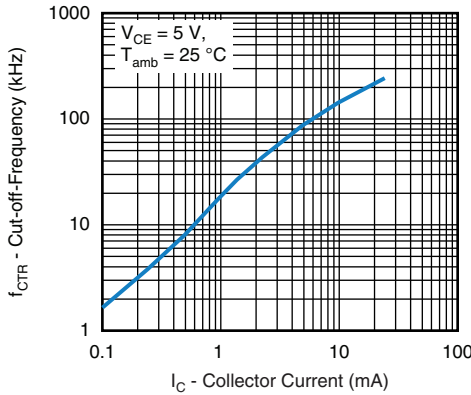


Fig. 13 - Cut-Off Frequency vs. Collector Current

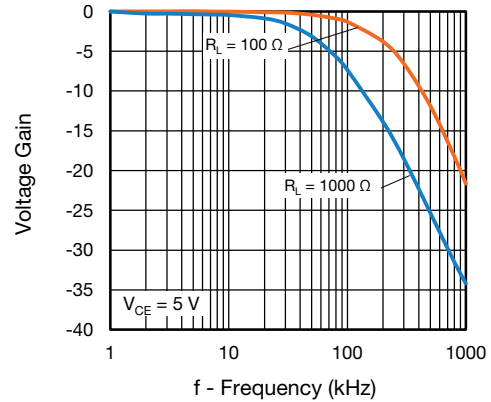


Fig. 16 - Voltage Gain vs. Frequency

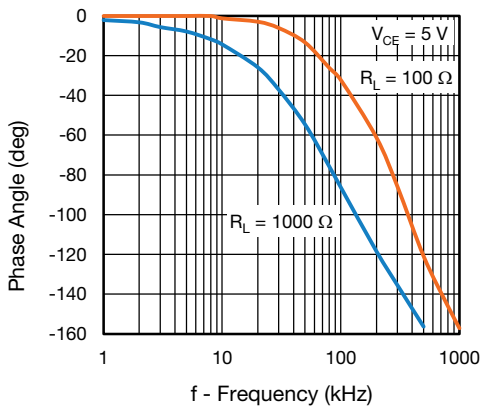
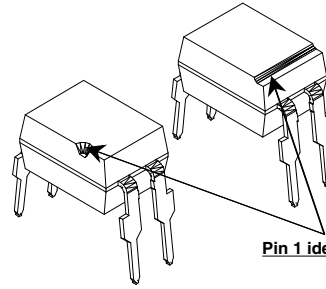
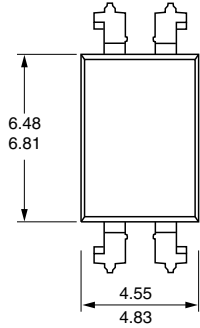


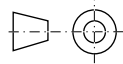
Fig. 14 - Phase Angle vs. Frequency



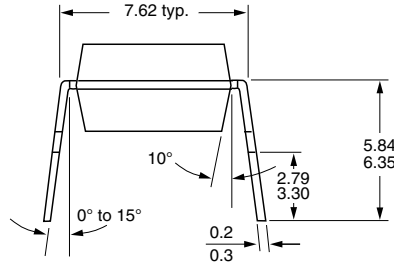
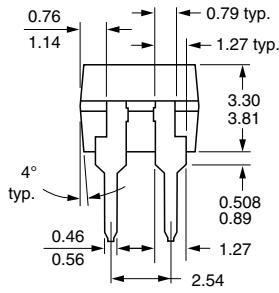
### PACKAGE DIMENSIONS (in millimeters)



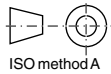
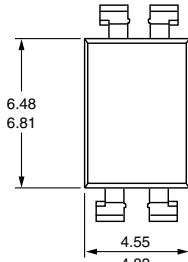
Pin 1 identification



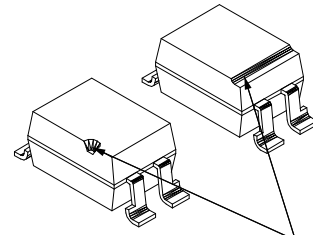
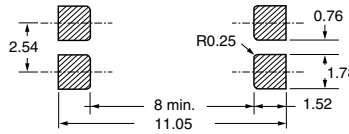
ISO method A



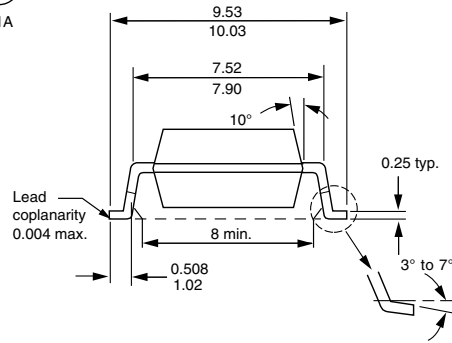
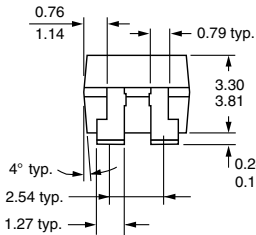
i178027-8



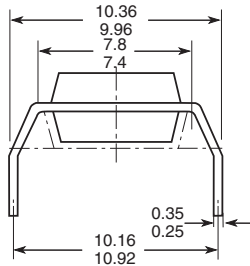
ISO method A



Pin 1 identification

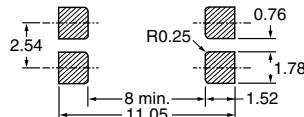
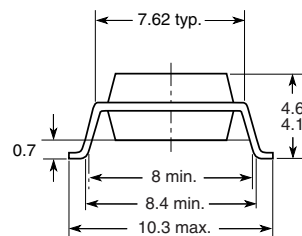


#### Option 6

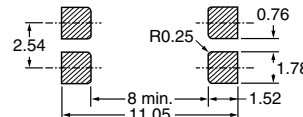
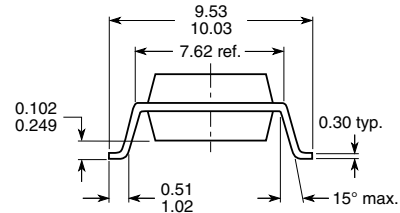


18450-11

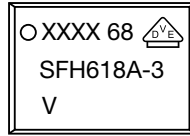
#### Option 7



#### Option 9 or SFH6186



## PACKAGE MARKING (example of SFH618A-3X001)



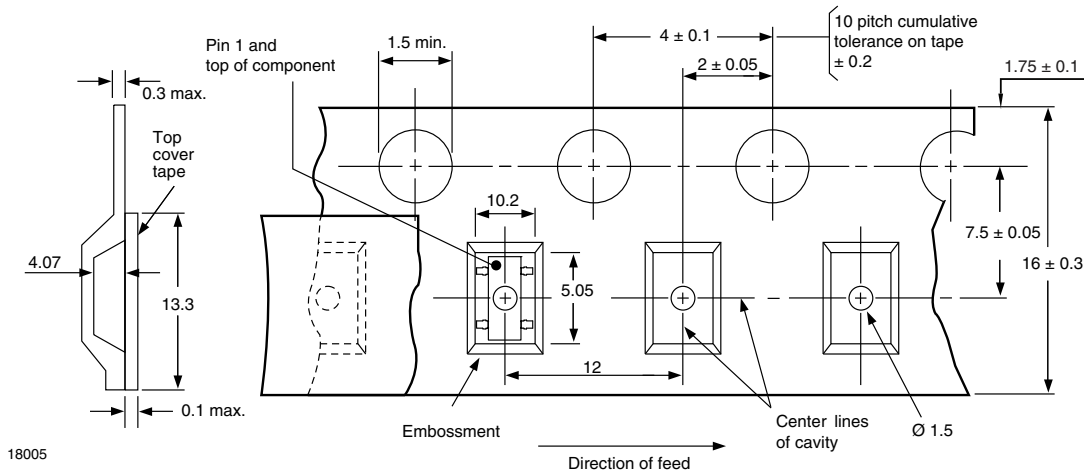
### Notes

- XXXX = LMC (lot marking code)
- VDE logo is only marked on option 1 parts
- Tape and reel suffix (T) is not part of the package marking

## TAPE AND REEL PACKAGING (in millimeters)

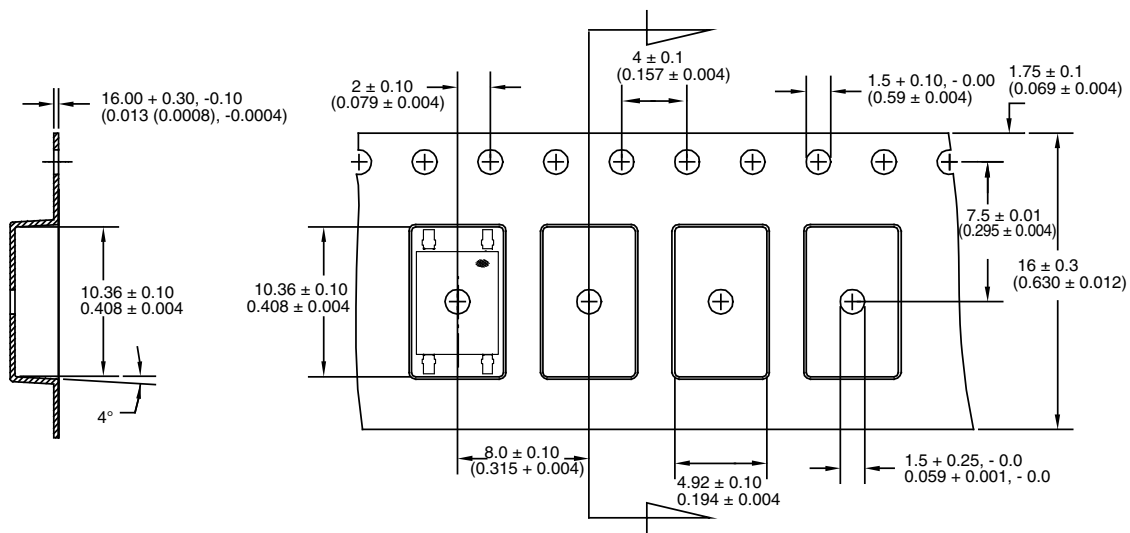
The tape is 16 mm and is wound on a 33 cm reel. There are 1000 parts per reel. Taped and reeled 4 pin optocouplers conform to EIA-481-2 and IEC60286-3.

### SMD-4 ("T")



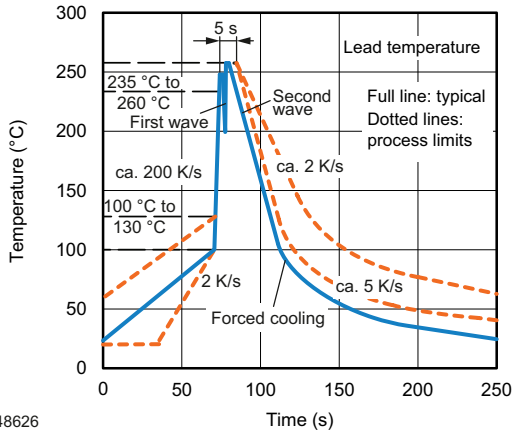
18005

### SMD-4, 90° Rotation ("T1")



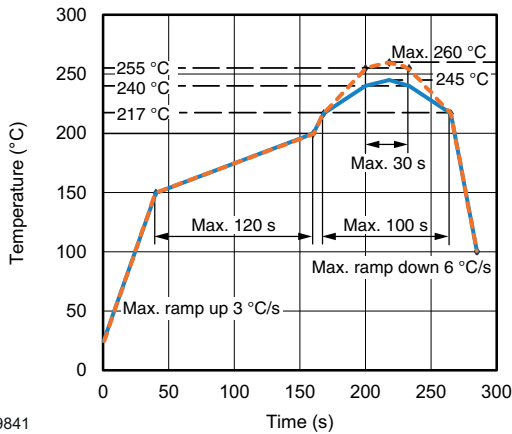
18401

## SOLDER PROFILES



948626

Fig. 17 - Recommended Wave Soldering Double Wave Profile for DIP Devices



19841

Fig. 18 - Recommended Lead (Pb)-free Reflow Solder Profile for SMD 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



## Disclaimer

ALL PRODUCT, PRODUCT SPECIFICATIONS AND DATA ARE SUBJECT TO CHANGE WITHOUT NOTICE TO IMPROVE RELIABILITY, FUNCTION OR DESIGN OR OTHERWISE.

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