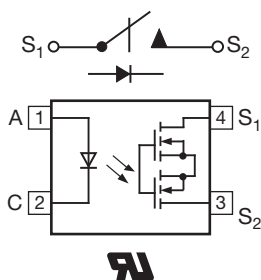


## 1 Form A Solid-State Relay (Normally Open)



### FEATURES

- Current limit protection
- Isolation test voltage 3750 V<sub>RMS</sub>
- Typical R<sub>ON</sub> 22 Ω
- Load voltage 350 V
- Load current 120 mA
- High surge capability
- Clean bounce free switching
- Low power consumption
- Material categorization: for definitions of compliance please see [www.vishay.com/doc?99912](http://www.vishay.com/doc?99912)



**RoHS**  
COMPLIANT  
HALOGEN  
**FREE**  
**GREEN**  
(5-2008)

### DESCRIPTION

The LH1546AEF (4 pin SOP) is robust, ideal for telecom and ground fault applications. It is an SPST normally open switch (1 Form A) that replaces electromechanical relays in many applications. It is constructed using a GaAlAs LED for actuation control and MOSFETs for the switch output. In addition, it employs current-limiting circuitry to provide overvoltage protection.

### APPLICATIONS

- General telecom switching
- Instrumentation
- Industrial controls

### AGENCY APPROVALS

- UL1577, file no. E52744

### ORDERING INFORMATION

|             |   |   |   |   |   |                      |                    |   |                  |   |
|-------------|---|---|---|---|---|----------------------|--------------------|---|------------------|---|
| L           | H | 1 | 5 | 4 | 6 | A                    | #                  | # | T                | R |
| PART NUMBER |   |   |   |   |   | ELECTR.<br>VARIATION | PACKAGE<br>CONFIG. |   | TAPE AND<br>REEL |   |



| PACKAGE                            | UL          |
|------------------------------------|-------------|
| SOP-4, tape and reel               | LH1546AEFTR |
| SOP-4, tape and reel (T2 rotation) | LH1546AEFT2 |
| SOP-4, tubes                       | LH1546AEF   |



| <b>ABSOLUTE MAXIMUM RATINGS</b> ( $T_{amb} = 25\text{ }^{\circ}\text{C}$ , unless otherwise specified) |                        |            |             |                    |
|--------------------------------------------------------------------------------------------------------|------------------------|------------|-------------|--------------------|
| PARAMETER                                                                                              | CONDITIONS             | SYMBOL     | VALUE       | UNIT               |
| <b>INPUT</b>                                                                                           |                        |            |             |                    |
| IRED continuous forward current                                                                        |                        | $I_F$      | 50          | mA                 |
| IRED reverse voltage                                                                                   |                        | $V_R$      | 5           | V                  |
| Input power dissipation                                                                                |                        | $P_{diss}$ | 80          | mW                 |
| <b>OUTPUT</b>                                                                                          |                        |            |             |                    |
| DC or peak AC load voltage                                                                             |                        | $V_L$      | 350         | V                  |
| Continuous DC load current                                                                             |                        | $I_L$      | 120         | mA                 |
| SSR output power dissipation                                                                           |                        | $P_{diss}$ | 550         | mW                 |
| <b>SSR</b>                                                                                             |                        |            |             |                    |
| Ambient temperature range                                                                              |                        | $T_{amb}$  | -40 to +85  | $^{\circ}\text{C}$ |
| Storage temperature range                                                                              |                        | $T_{stg}$  | -40 to +150 | $^{\circ}\text{C}$ |
| Soldering temperature                                                                                  | $t = 10\text{ s max.}$ | $T_{sld}$  | 260         | $^{\circ}\text{C}$ |

**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

| <b>ELECTRICAL CHARACTERISTICS</b> ( $T_{amb} = 25\text{ }^{\circ}\text{C}$ , unless otherwise specified) |                                                                  |             |      |      |      |                  |
|----------------------------------------------------------------------------------------------------------|------------------------------------------------------------------|-------------|------|------|------|------------------|
| PARAMETER                                                                                                | TEST CONDITION                                                   | SYMBOL      | MIN. | TYP. | MAX. | UNIT             |
| <b>INPUT</b>                                                                                             |                                                                  |             |      |      |      |                  |
| IRED forward current, switch turn-on                                                                     | $I_L = 100\text{ mA}$ , $t = 10\text{ ms}$                       | $I_{Fon}$   | -    | 0.3  | 2    | mA               |
| IRED forward current, switch turn-off                                                                    | $V_L = \pm 350\text{ V}$ , $I_L < 1\text{ }\mu\text{A}$          | $I_{Foff}$  | 0.05 | 0.2  | -    | mA               |
| IRED forward voltage                                                                                     | $I_F = 10\text{ mA}$                                             | $V_F$       | 1    | 1.36 | 1.45 | V                |
| <b>OUTPUT</b>                                                                                            |                                                                  |             |      |      |      |                  |
| On-resistance                                                                                            | $I_F = 5\text{ mA}$ , $I_L = 50\text{ mA}$                       | $R_{ON}$    | -    | 22   | 27   | $\Omega$         |
| Off-resistance                                                                                           | $I_F = 0\text{ mA}$ , $V_L = \pm 100\text{ V}$                   | $R_{OFF}$   | 0.5  | 850  | -    | $\text{G}\Omega$ |
| Off-state leakage current                                                                                | $I_F = 0\text{ mA}$ , $V_L = \pm 100\text{ V}$                   | $I_{leak}$  | -    | < 1  | 200  | nA               |
|                                                                                                          | $I_F = 0\text{ mA}$ , $V_L = \pm 350\text{ V}$                   | $I_{leak}$  | -    | -    | 1    | $\mu\text{A}$    |
| Output capacitance                                                                                       | $I_F = 0\text{ mA}$ , $V_L = 1\text{ V}$ , 1 MHz                 | $C_O$       | -    | 39   | -    | pF               |
|                                                                                                          | $I_F = 0\text{ mA}$ , $V_L = 50\text{ V}$ , 1 MHz                | $C_O$       | -    | 6    | -    | pF               |
| Current limit AC/DC                                                                                      | $I_F = 5\text{ mA}$ , $t = 5\text{ ms}$ , $V_L = \pm 6\text{ V}$ | $I_{limit}$ | 170  | 300  | 450  | mA               |
| <b>COUPLER</b>                                                                                           |                                                                  |             |      |      |      |                  |
| Capacitance (input to output)                                                                            | $V_{IO} = 1\text{ V}$                                            | $C_{IO}$    | -    | 0.6  | -    | pF               |

**Note**

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

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

| PARAMETER     | TEST CONDITION                             | SYMBOL    | MIN. | TYP. | MAX. | UNIT |
|---------------|--------------------------------------------|-----------|------|------|------|------|
| Turn-on time  | $I_F = 5\text{ mA}$ , $I_L = 50\text{ mA}$ | $t_{on}$  | -    | 0.2  | 3    | ms   |
| Turn-off time | $I_F = 5\text{ mA}$ , $I_L = 50\text{ mA}$ | $t_{off}$ | -    | 0.05 | 3    | ms   |

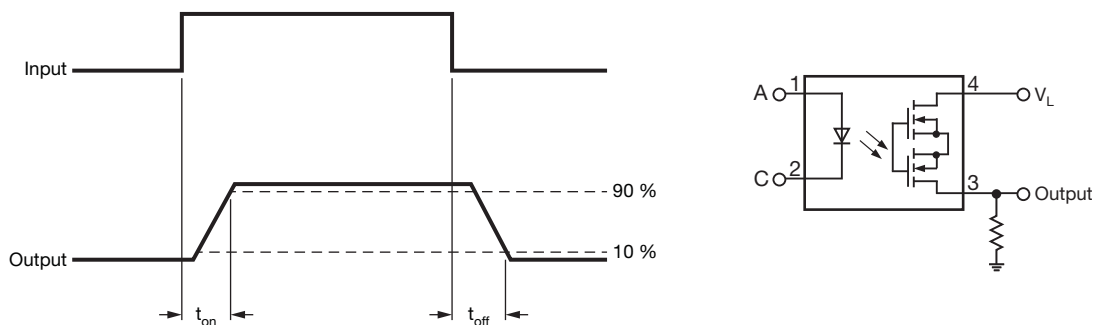


Fig. 1 - Timing Schematic

**SAFETY AND INSULATION RATINGS**

| PARAMETER                                    | TEST CONDITION                                                                                                       | SYMBOL     | VALUE          | UNIT               |
|----------------------------------------------|----------------------------------------------------------------------------------------------------------------------|------------|----------------|--------------------|
| Climatic classification                      | According to IEC 68 part 1                                                                                           |            | 40 / 85 / 21   |                    |
| Pollution degree                             | According to DIN VDE 0109                                                                                            |            | 2              |                    |
| Comparative tracking index                   |                                                                                                                      | CTI        | 175            |                    |
| Maximum rated withstanding isolation voltage | According to UL1577, $t = 1\text{ min}$                                                                              | $V_{ISO}$  | 3750           | $V_{RMS}$          |
| Maximum transient isolation voltage          | According to DIN EN 60747-5-5                                                                                        | $V_{IOTM}$ | 6000           | $V_{peak}$         |
| Maximum repetitive peak isolation voltage    | According to DIN EN 60747-5-5                                                                                        | $V_{IORM}$ | 707            | $V_{peak}$         |
| 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                          |                                                                                                                      | $P_{SO}$   | 350            | mW                 |
| Input safety current                         |                                                                                                                      | $I_{SI}$   | 150            | mA                 |
| Input safety temperature                     |                                                                                                                      | $T_S$      | 165            | $^{\circ}\text{C}$ |
| Clearance distance                           | SOP-4                                                                                                                |            | $\geq 5$       | mm                 |
| Creepage distance                            | SOP-4                                                                                                                |            | $\geq 5$       | mm                 |
| Input to output test voltage, method B       | $V_{IORM} \times 1.875 = V_{PR}$ , 100 % production test with $t_M = 1\text{ s}$ , partial discharge $< 5\text{ pC}$ | $V_{PR}$   | 1326           | $V_{peak}$         |
| Input to output test voltage, method A       | $V_{IORM} \times 1.6 = V_{PR}$ , sample test with $t_M = 10\text{ s}$ , partial discharge $< 5\text{ pC}$            | $V_{PR}$   | 1131           | $V_{peak}$         |

**Note**

- As per IEC 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

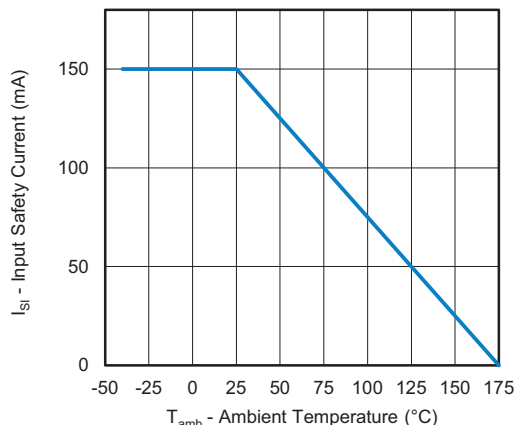


Fig. 2 - Safety Input Current vs. Ambient Temperature

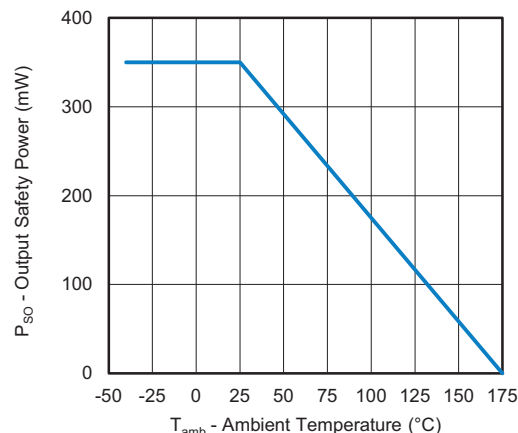


Fig. 3 - Safety Power Dissipation vs. Ambient Temperature

## TYPICAL CHARACTERISTICS ( $T_{amb} = 25$ °C, unless otherwise specified)

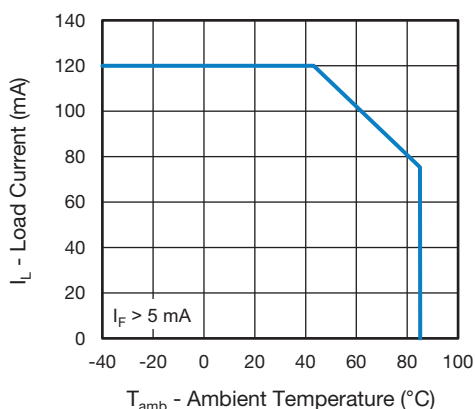


Fig. 4 - Maximum Load Current vs. Ambient Temperature

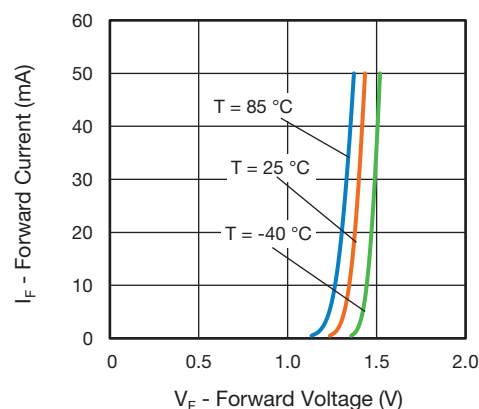


Fig. 6 - Forward Current vs. Forward Voltage

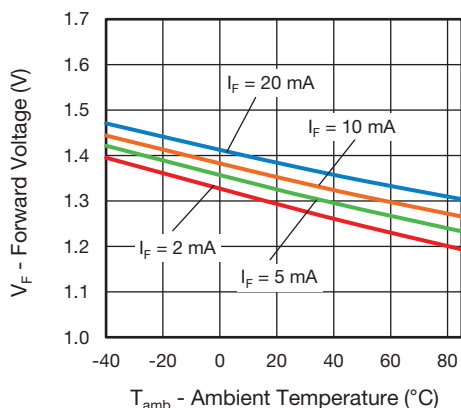


Fig. 5 - Forward Voltage vs. Ambient Temperature

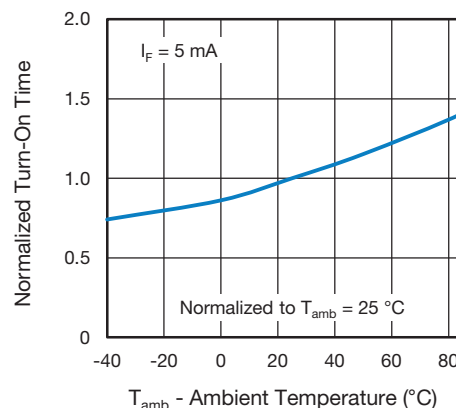


Fig. 7 - Normalized Forward Current for Switch Turn-On vs. Ambient Temperature

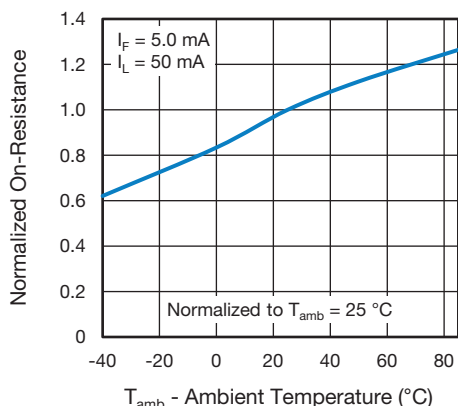


Fig. 8 - Normalized On-Resistance vs. Ambient Temperature

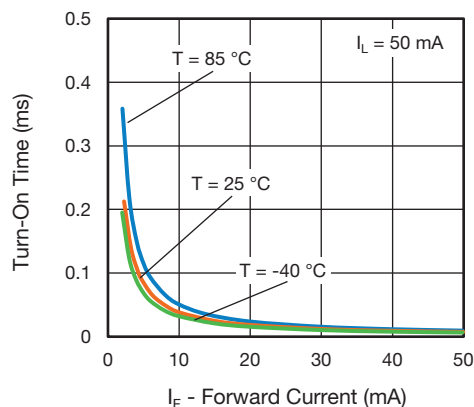


Fig. 11 - Turn-On Time vs. Forward Current

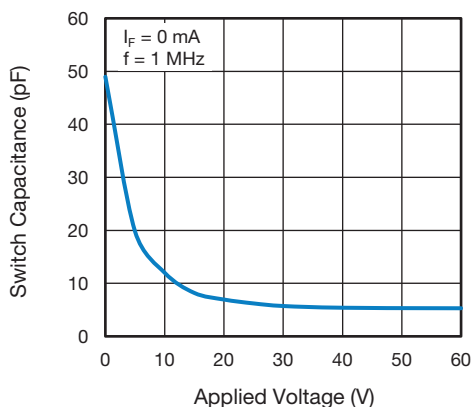


Fig. 9 - Output Capacitance vs. Load Voltage

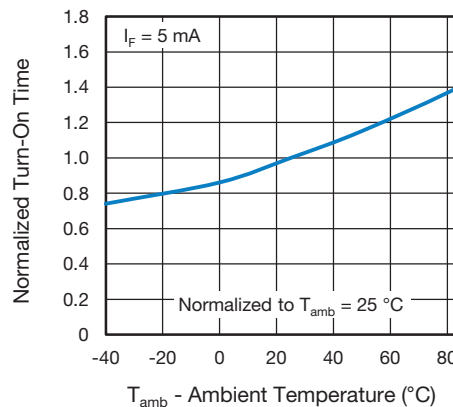


Fig. 12 - Normalized Turn-On Time vs. Ambient Temperature

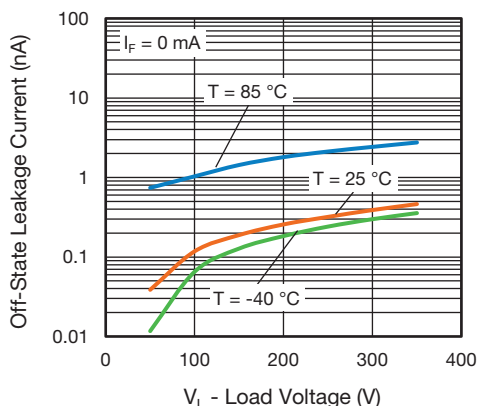


Fig. 10 - Off-State Leakage Current vs. Load Voltage

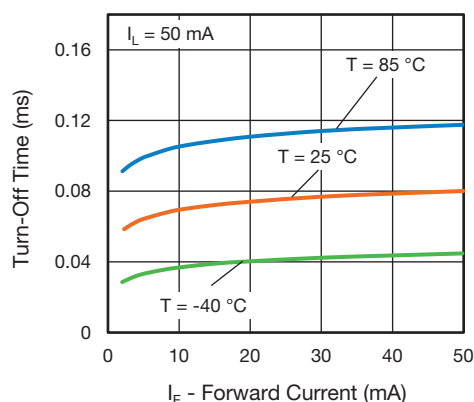


Fig. 13 - Turn-Off Time vs. Forward Current

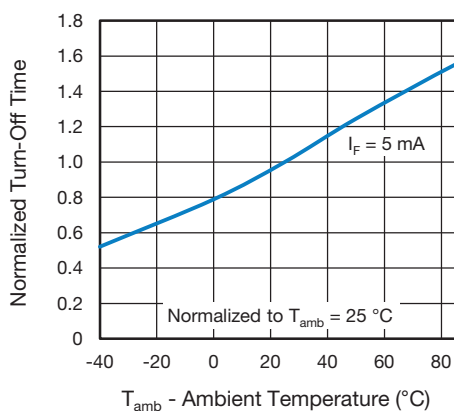


Fig. 14 - Normalized Turn-Off Time vs. Ambient Temperature

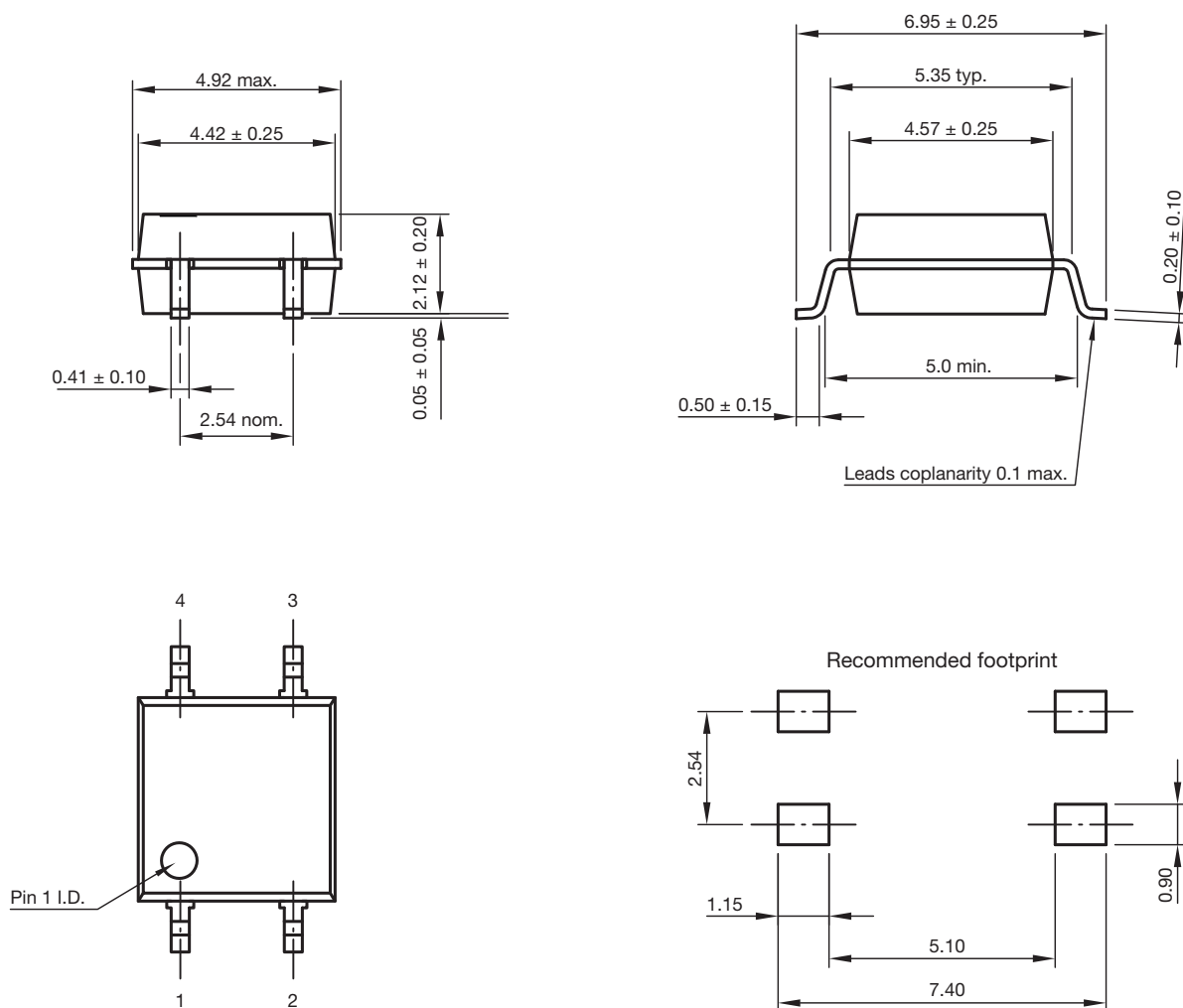
**PACKAGE DIMENSIONS** (in millimeters)


Fig. 15 - Package Drawing



## PACKAGE MARKING (example)

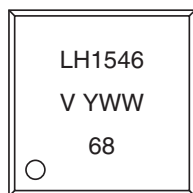


Fig. 16 - LH1546AEF

### Note

- Tape and reel suffix (TR) is not part of the package marking

## PACKAGING INFORMATION (in millimeters)

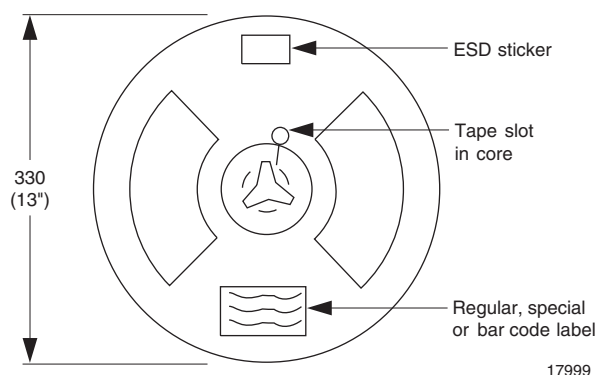


Fig. 17 - Tape and Reel Shipping Medium  
(EIA-481, revision A, and IEC 60286), 2000 units per reel

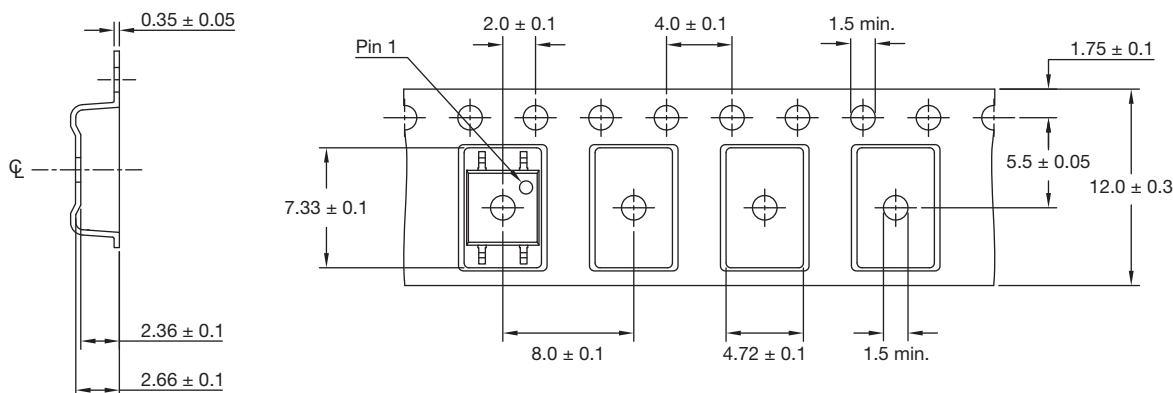


Fig. 18 - Tape and Reel Packing

### Notes

- Cumulative tolerance of 10 sprocket holes is 0.20 mm
- Applicable orientation as below:



| DEVICES PER REEL |            |
|------------------|------------|
| TYPE             | UNITS/REEL |
| SOP-4            | 2000       |



## SOLDER PROFILES

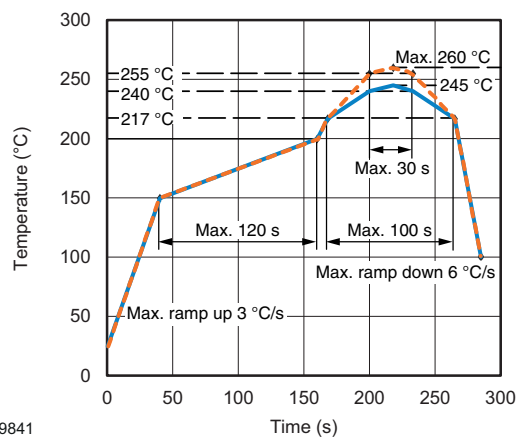


Fig. 19 - Lead (Pb)-free Reflow Solder Profile  
According to J-STD-020 for SMD Devices

## HANDLING AND STORAGE CONDITIONS

ESD level: HBM class 2

Floor life: unlimited

Conditions:  $T_{amb} < 30\text{ °C}$ , RH < 60 %

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



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