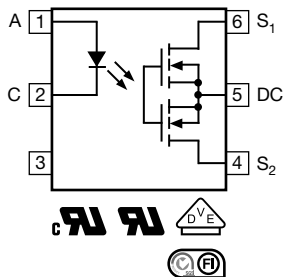
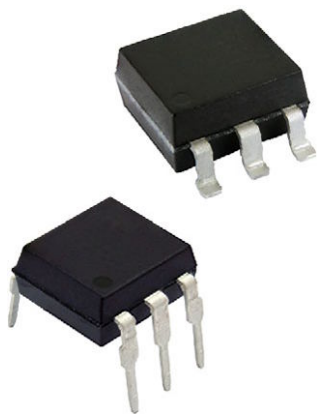


## 1 Form A Solid-State Relay (Normally Open)



## FEATURES

- Isolation test voltage 5300 V<sub>RMS</sub>
- Typical R<sub>ON</sub> 22 Ω
- Load voltage 350 V
- Load current 120 mA / 250 mA
- 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)

## APPLICATIONS

- General telecom switching
- Security equipment
- Instrumentation
- Industrial controls

## LINKS TO ADDITIONAL RESOURCES



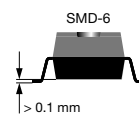
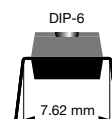
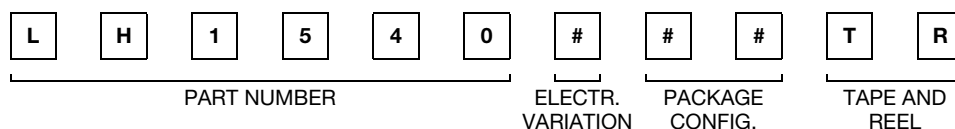
## DESCRIPTION

The LH1540 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.

## AGENCY APPROVALS

- UL
- cUL
- DIN EN 60747-5-5 (VDE 0884
- FIMKO

## ORDERING INFORMATION



| PACKAGE              | UL, cUL, FIMKO, VDE |                |
|----------------------|---------------------|----------------|
| SMD-6, tube          | LH1540AAB           | LH1540AAB-X001 |
| SMD-6, tape and reel | LH1540AABTR         | -              |
| DIP-6, tube          | LH1540AT            | LH1540AT-X001  |

| <b>ABSOLUTE MAXIMUM RATINGS</b> ( $T_{amb} = 25\text{ }^{\circ}\text{C}$ , unless otherwise specified) |                        |            |             |                    |
|--------------------------------------------------------------------------------------------------------|------------------------|------------|-------------|--------------------|
| PARAMETER                                                                                              | CONDITION              | 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 load current (AC/DC configuration)                                                          |                        | $I_L$      | 120         | mA                 |
| Continuous load current (DC only configuration)                                                        |                        | $I_L$      | 250         | mA                 |
| SSR output power dissipation (continuous)                                                              |                        | $P_{diss}$ | 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                                                                    | $V_L = 350\text{ V}$                              | $I_{Foff}$ | 0.05 | 0.15 | -    | mA         |
| IRED forward voltage                                                                                     | $I_F = 10\text{ mA}$                              | $V_F$      | -    | 1.4  | 1.6  | V          |
| <b>OUTPUT</b>                                                                                            |                                                   |            |      |      |      |            |
| On-resistance (AC/DC configuration)                                                                      | $I_F = 5\text{ mA}$ , $I_L = 50\text{ mA}$        | $R_{ON}$   | -    | 22   | 27   | $\Omega$   |
| On-resistance (DC only configuration)                                                                    | $I_F = 5\text{ mA}$ , $I_L = 100\text{ mA}$       | $R_{ON}$   | -    | 5.2  | 7    | $\Omega$   |
| Off-resistance                                                                                           | $I_F = 0\text{ mA}$ , $V_L = \pm 100\text{ V}$    | $R_{OFF}$  | 0.5  | 5000 | -    | G $\Omega$ |
| Off-state leakage current                                                                                | $I_F = 0\text{ mA}$ , $V_L = \pm 100\text{ V}$    | $I_O$      | -    | < 1  | 200  | nA         |
|                                                                                                          | $I_F = 0\text{ mA}$ , $V_L = \pm 350\text{ V}$    | $I_O$      | -    | 6    | 1000 | nA         |
| Output capacitance (AC/DC configuration)                                                                 | $I_F = 0\text{ mA}$ , $V_L = 1\text{ V}$ , 1 MHz  | $C_O$      | -    | 39   | -    | pF         |
|                                                                                                          | $I_F = 0\text{ mA}$ , $V_L = 50\text{ V}$ , 1 MHz | $C_O$      | -    | 6    | -    | pF         |
| <b>TRANSFER</b>                                                                                          |                                                   |            |      |      |      |            |
| Capacitance (input to output)                                                                            | $V_{ISO} = 1\text{ V}$                            | $C_{IO}$   | -    | 0.4  | -    | 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.

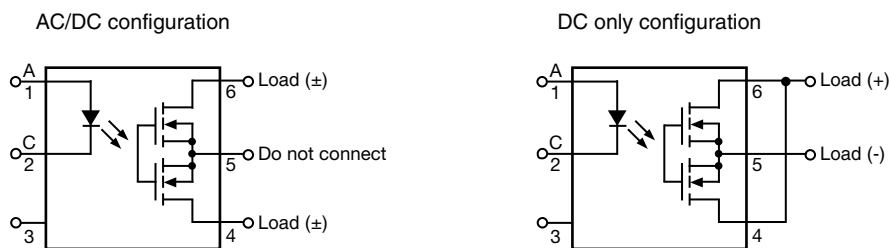
**PIN CONFIGURATION**


Fig. 1 - Pin Configuration

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

| PARAMETER     | TEST CONDITION                             | SYMBOL    | MIN. | TYP. | MAX. | UNIT |
|---------------|--------------------------------------------|-----------|------|------|------|------|
| Turn-on time  | $I_F = 5\text{ mA}$ , $I_L = 50\text{ mA}$ | $t_{on}$  | -    | 0.13 | 2    | ms   |
| Turn-off time | $I_F = 5\text{ mA}$ , $I_L = 50\text{ mA}$ | $t_{off}$ | -    | 0.05 | 2    | ms   |

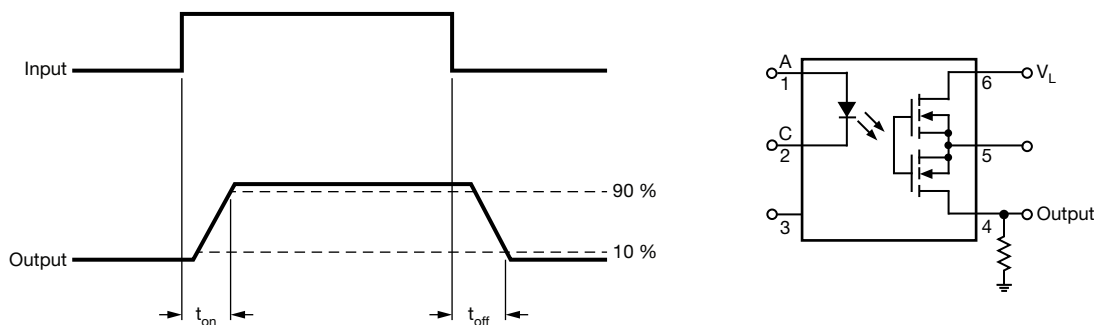


Fig. 2 - Timing Schematic

**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                   | Insulation group IIIa                                                                                                | CTI        | 175            |                    |
| Maximum rated withstanding isolation voltage | According to UL1577, $t = 1\text{ min}$                                                                              | $V_{ISO}$  | 5300           | $V_{RMS}$          |
| Maximum transient isolation voltage          | According to DIN EN 60747-5-5                                                                                        | $V_{IOTM}$ | 8000           | $V_{peak}$         |
| Maximum repetitive peak isolation voltage    | According to DIN EN 60747-5-5                                                                                        | $V_{IORM}$ | 890            | $V_{peak}$         |
| Isolation resistance                         | $V_{IO} = 500\text{ V}$ , $T_{amb} = 25\text{ }^{\circ}\text{C}$                                                     | $R_{IO}$   | $\geq 10^{12}$ | $\Omega$           |
|                                              | $V_{IO} = 500\text{ V}$ , $T_{amb} = 100\text{ }^{\circ}\text{C}$                                                    | $R_{IO}$   | $\geq 10^{11}$ | $\Omega$           |
| Output safety power                          |                                                                                                                      | $P_{SO}$   | 700            | mW                 |
| Input safety current                         |                                                                                                                      | $I_{SI}$   | 240            | mA                 |
| Safety temperature                           |                                                                                                                      | $T_S$      | 175            | $^{\circ}\text{C}$ |
| Creepage distance                            |                                                                                                                      |            | $\geq 7$       | mm                 |
| Clearance distance                           |                                                                                                                      |            | $\geq 7$       | mm                 |
| Insulation thickness                         |                                                                                                                      | DTI        | $\geq 0.4$     | 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 $< 5\text{ pC}$ | $V_{PR}$   | 1669           | $V_{peak}$         |
| Input to output test voltage, method A       | $V_{IORM} \times 1.6 = V_{PR}$ , 100 % sample test with $t_M = 10\text{ s}$ , partial discharge $< 5\text{ pC}$      | $V_{PR}$   | 1424           | $V_{peak}$         |

**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.

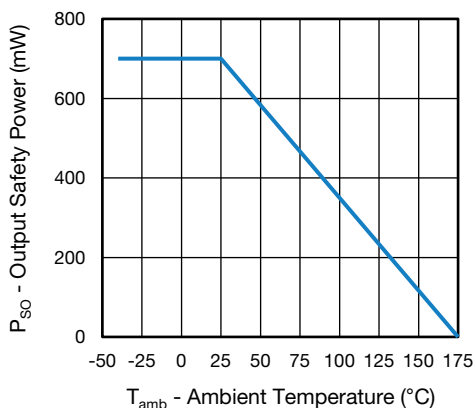


Fig. 3 - Safety Power Dissipation vs. Ambient Temperature

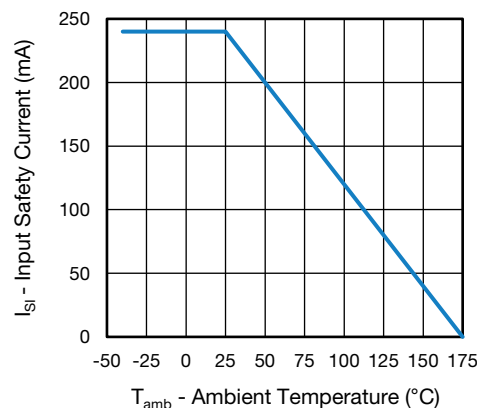


Fig. 4 - Safety Input Current vs. Ambient Temperature

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

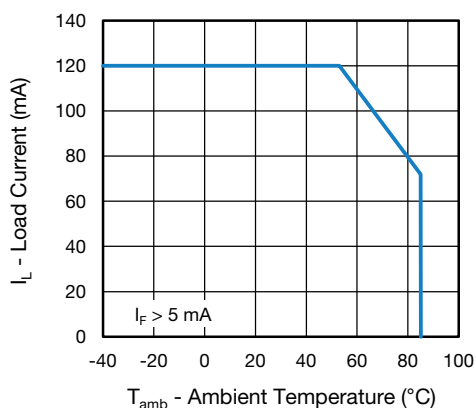


Fig. 5 - Maximum Load Current vs. Ambient Temperature

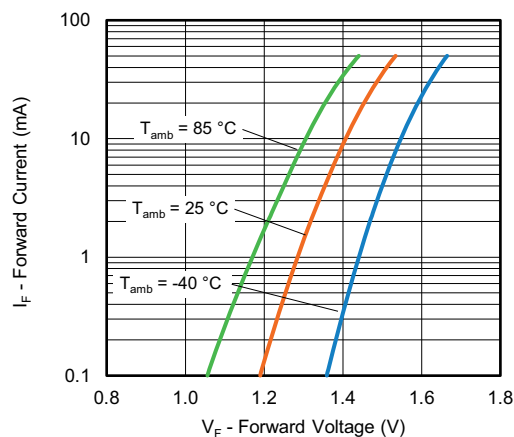


Fig. 7 - Forward Current vs. Forward Voltage

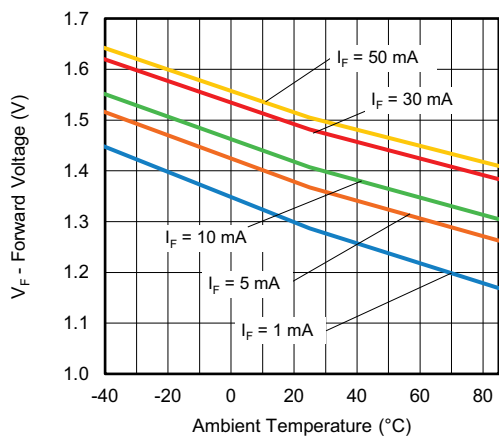


Fig. 6 - Forward Voltage vs. Ambient Temperature

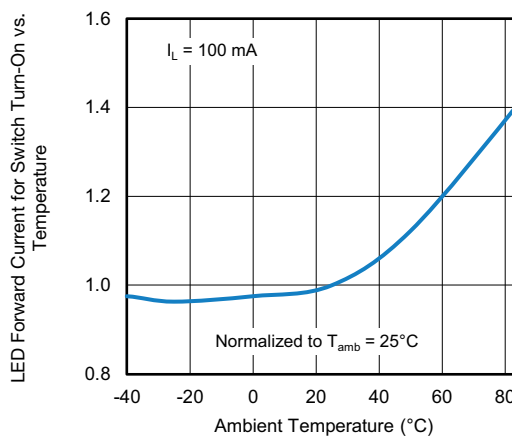


Fig. 8 - Normalized Forward Current for Switch Turn-On vs. Ambient Temperature

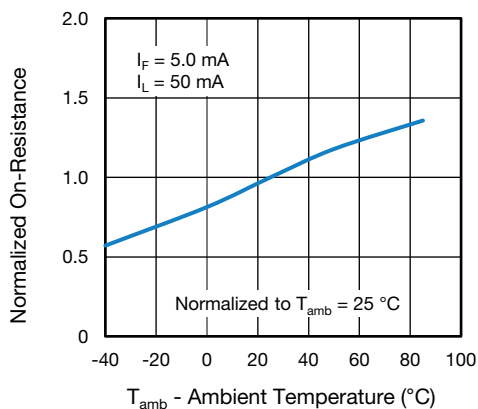


Fig. 9 - Normalized On-Resistance vs. Ambient Temperature

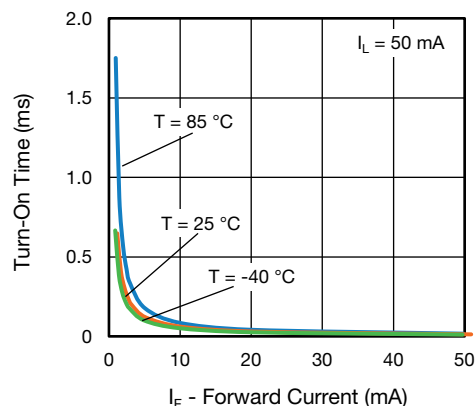


Fig. 12 - Turn-On Time vs. Forward Current

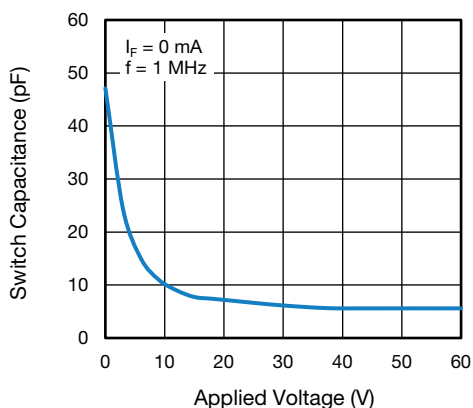


Fig. 10 - Switch Capacitance vs. Applied Voltage

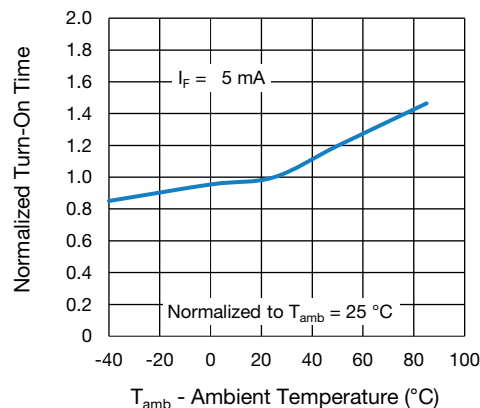


Fig. 13 - Normalized Turn-On Time vs. Ambient Temperature

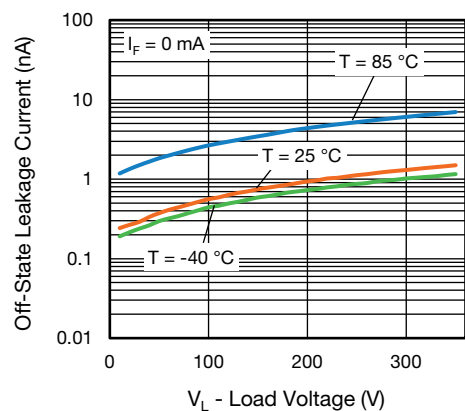


Fig. 11 - Off-State Leakage Current vs. Load Voltage

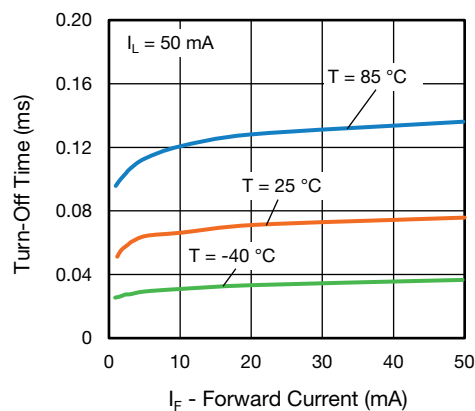


Fig. 14 - Turn-Off Time vs. Forward Current

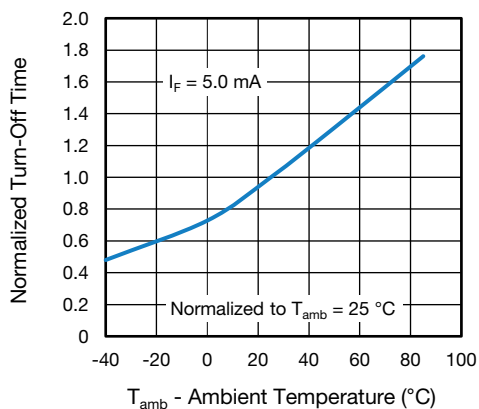
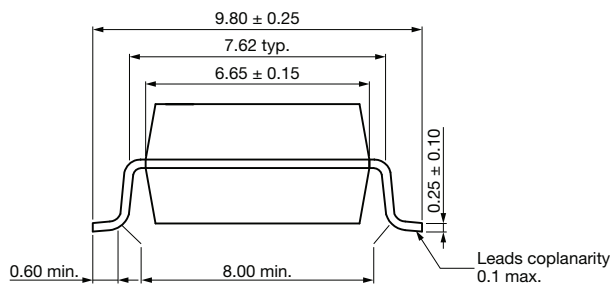
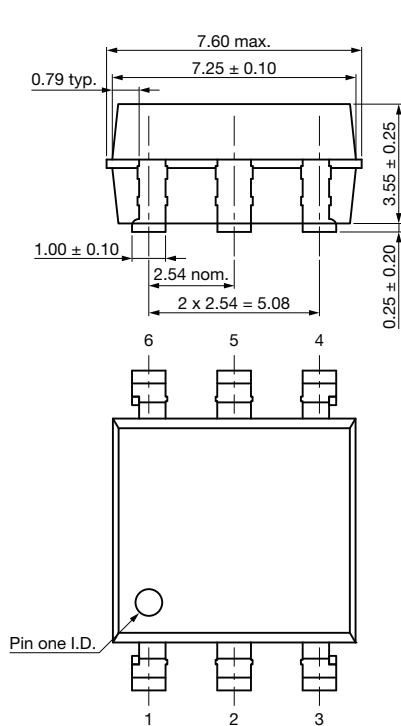


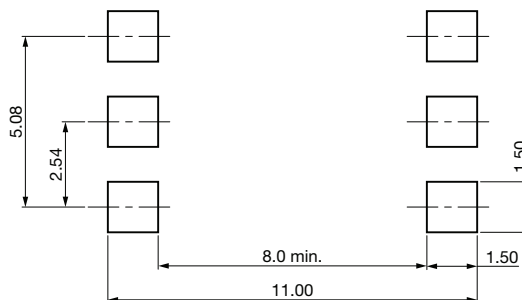
Fig. 15 - Normalized Turn-Off Time vs. Ambient Temperature

## PACKAGE DIMENSIONS (in millimeters)

### SMD-6



### Recommended footprint



## DIP-6

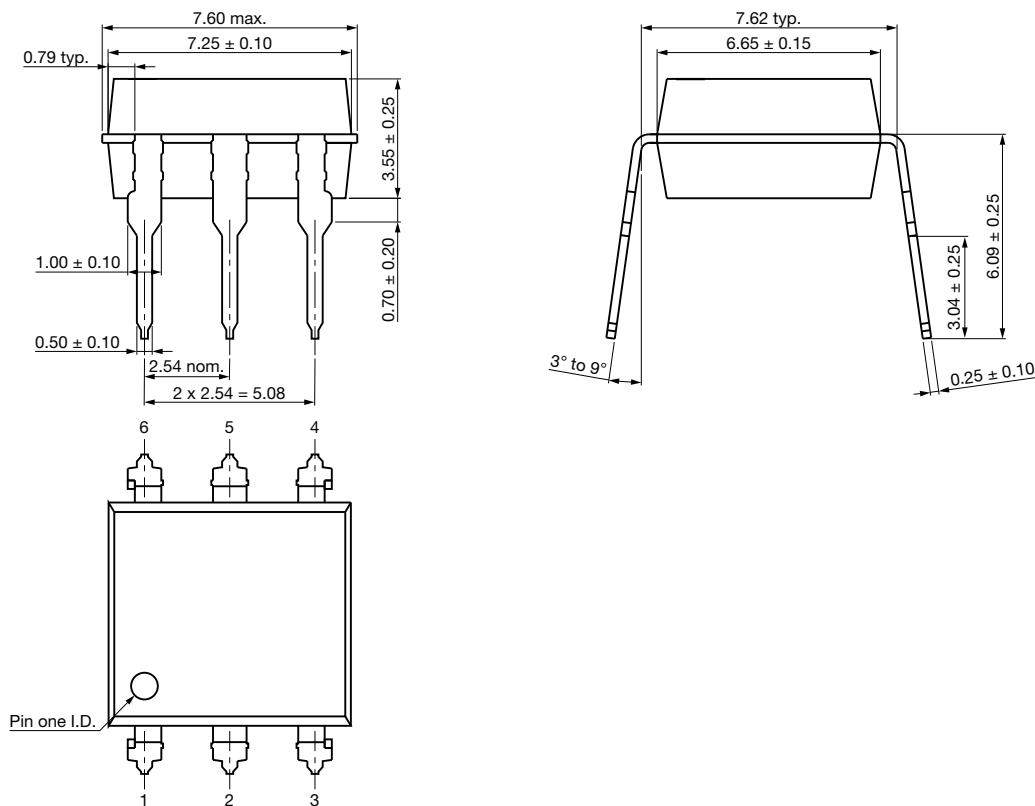


Fig. 16 - Package Drawings

## PACKAGE MARKING

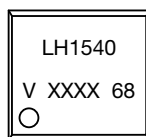
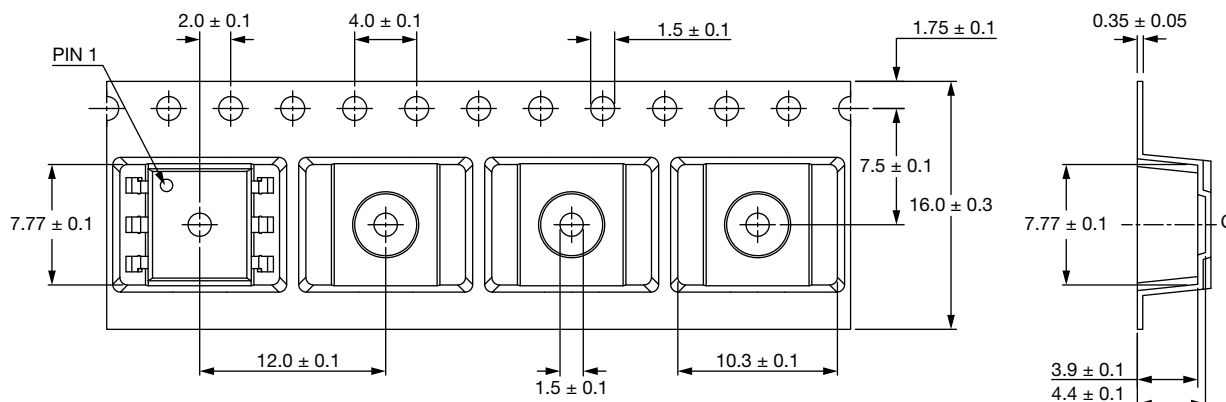


Fig. 17 - LH1540

## Notes

- XXXX = LMC (lot marking code)
- Tape and reel suffix (TR) is not part of the package marking

## PACKING INFORMATION (in millimeters)



### Note:

- Cummulative tolerance of 10 spocket holes is 0.20 mm

Fig. 18 - Tape and Reel Packing

| TAPE AND REEL PACKING |            |
|-----------------------|------------|
| TYPE                  | UNITS/REEL |
| SMD-6                 | 1000       |

| TUBE PACKING |            |           |           |
|--------------|------------|-----------|-----------|
| TYPE         | UNITS/TUBE | TUBES/BOX | UNITS/BOX |
| SMD-6        | 50         | 40        | 2000      |
| DIP-6        | 50         | 40        | 2000      |

## SOLDER PROFILES

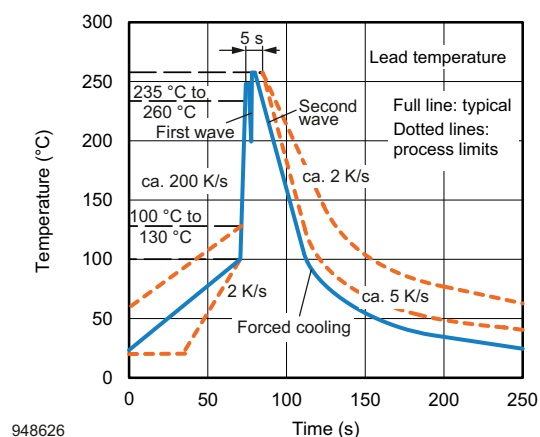


Fig. 19 - Wave Soldering Double Wave Profile  
According to J-STD-020 for DIP Devices

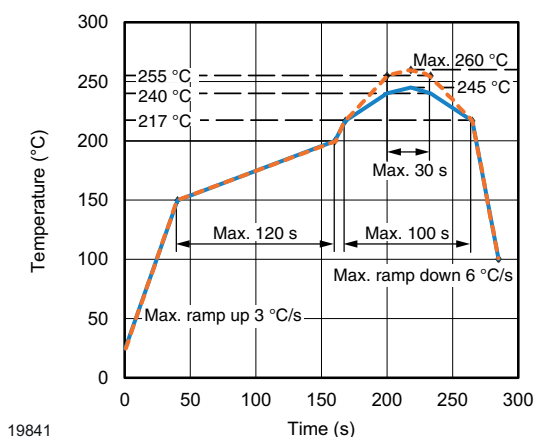


Fig. 20 - Lead (Pb)-free Reflow Solder Profile  
According to J-STD-020 for SMD Devices

## 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





## Footprint and Schematic Information for LH1540

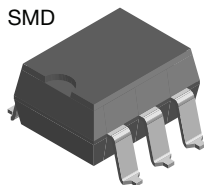
The footprint and schematic symbols for the following parts can be accessed using the associated links. They are available in Eagle, Altium, KiCad, OrCAD / Allegro, Pulsonix, and PADS.

Note that the 3D models for these parts can be found on the Vishay product page.

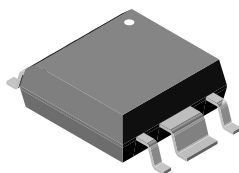
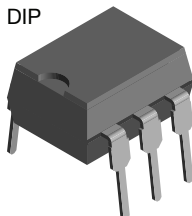
| PART NUMBER | FOOTPRINT / SCHEMATIC                                                                                                      |
|-------------|----------------------------------------------------------------------------------------------------------------------------|
| LH1540AAB   | <a href="http://www.snapeda.com/parts/LH1540AAB/Vishay/view-part">www.snapeda.com/parts/LH1540AAB/Vishay/view-part</a>     |
| LH1540AABTR | <a href="http://www.snapeda.com/parts/LH1540AABTR/Vishay/view-part">www.snapeda.com/parts/LH1540AABTR/Vishay/view-part</a> |
| LH1540ACD   | <a href="http://www.snapeda.com/parts/LH1540ACD/Vishay/view-part">www.snapeda.com/parts/LH1540ACD/Vishay/view-part</a>     |
| LH1540ACDTR | <a href="http://www.snapeda.com/parts/LH1540ACDTR/Vishay/view-part">www.snapeda.com/parts/LH1540ACDTR/Vishay/view-part</a> |
| LH1540AT    | <a href="http://www.snapeda.com/parts/LH1540AT/Vishay/view-part">www.snapeda.com/parts/LH1540AT/Vishay/view-part</a>       |

For technical issues and product support, please contact [optocoupleranswers@vishay.com](mailto:optocoupleranswers@vishay.com).

SMD



DIP





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