

## 1 Form A Solid State Relay

### Features

- Current Limit Protection
- Isolation Test Voltage 5300 V<sub>RMS</sub>
- Typical R<sub>ON</sub> 20 Ω, max 25 Ω
- Load Voltage 350 V
- Load Current 120 mA
- High Surge Capability
- Clean Bounce Free Switching
- Low Power Consumption
- High Reliability Monolithic Detector
- SMD lead available on tape and reel
- Lead-free component
- Component in accordance to RoHS 2002/95/EC and WEEE 2002/96/EC

### Agency Approvals

- UL1577, File No. E52744 System Code H or J, Double Protection
- CSA - Certification 093751
- BSI/BABT Cert. No. 7980
- FIMKO Approval

### Applications

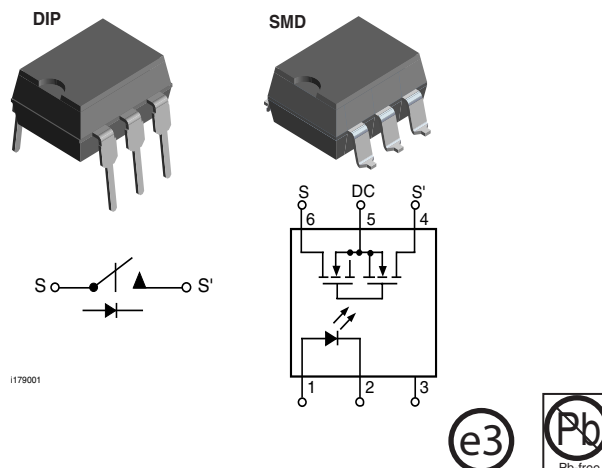
General Telecom Switching

- On/off Hook Control
- Ring Delay
- Dial Pulse
- Ground Start
- Ground Fault Protection

Instrumentation

Industrial Controls

See "Solid State Relays" (Application Note 56)



### Description

The LH1540 is robust, ideal for telecom and ground fault applications. It is a SPST normally open switch (Form A) that replaces electromechanical relays in many applications. It is constructed using a GaAlAs LED for actuation control and an integrated monolithic die for the switch output. The die, fabricated in a high-voltage dielectrically isolated technology, is comprised of a photodiode array, switch control circuitry and MOSFET switches. In addition, it employs current-limiting circuitry which meets FCC 68.302 and other regulatory voltage surge requirements when overvoltage protection is provided.

### Order Information

| Part        | Remarks              |
|-------------|----------------------|
| LH1540AAB   | Thru Hole, SMD-6     |
| LH1540AABTR | Tape and Reel, SMD-6 |
| LH1540AT    | DIP-6                |

## Absolute Maximum Ratings, $T_{amb} = 25\text{ }^{\circ}\text{C}$

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 time can adversely affect reliability.

## SSR

| Parameter                                             | Test condition                   | Symbol     | Value         | Unit               |
|-------------------------------------------------------|----------------------------------|------------|---------------|--------------------|
| LED continuous forward current                        |                                  | $I_F$      | 50            | mA                 |
| LED reverse voltage                                   | $I_R \leq 10\text{ }\mu\text{A}$ | $V_R$      | 8.0           | V                  |
| DC or peak AC load voltage                            | $I_L \leq 50\text{ }\mu\text{A}$ | $V_L$      | 350           | V                  |
| Continuous DC load current - bidirectional operation  |                                  | $I_L$      | 120           | mA                 |
| Continuous DC load current - unidirectional operation |                                  | $I_L$      | 250           | mA                 |
| Peak load current (single shot)                       | $t = 100\text{ ms}$              | $I_P$      | 1)            | mA                 |
| Ambient temperature range                             |                                  | $T_{amb}$  | - 40 to + 85  | $^{\circ}\text{C}$ |
| Storage temperature range                             |                                  | $T_{stg}$  | - 40 to + 150 | $^{\circ}\text{C}$ |
| Pin soldering temperature                             | $t = 10\text{ s max}$            | $T_{sld}$  | 260           | $^{\circ}\text{C}$ |
| Input/output isolation voltage                        |                                  | $V_{ISO}$  | 5300          | $V_{RMS}$          |
| Output power dissipation (continuous)                 |                                  | $P_{diss}$ | 550           | mW                 |

1) Refer to Current Limit Performance Application Note for a discussion on relay operation during transient currents.

## Electrical Characteristics, $T_{amb} = 25\text{ }^{\circ}\text{C}$

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.

## Input

| Parameter                            | Test condition                             | Symbol     | Min  | Typ. | Max  | Unit |
|--------------------------------------|--------------------------------------------|------------|------|------|------|------|
| LED forward current, switch turn-on  | $I_L = 100\text{ mA}$ , $t = 10\text{ ms}$ | $I_{Fon}$  |      | 1.0  | 2.0  | mA   |
| LED forward current, switch turn-off | $V_L = \pm 300\text{ V}$                   | $I_{Foff}$ | 0.2  | 0.9  |      | mA   |
| LED forward voltage                  | $I_F = 10\text{ mA}$                       | $V_F$      | 1.15 | 1.26 | 1.45 | V    |

## Output

| Parameter                                               | Test condition                                                            | Symbol    | Min | Typ. | Max  | Unit          |
|---------------------------------------------------------|---------------------------------------------------------------------------|-----------|-----|------|------|---------------|
| ON-resistance ac/dc:<br>Pin 4 ( $\pm$ ) to 6 ( $\pm$ )  | $I_F = 5.0\text{ mA}$ , $I_L = 50\text{ mA}$                              | $R_{ON}$  | 12  | 20   | 25   | $\Omega$      |
| ON-resistance dc:<br>Pin 4, 6 (+) to 5 ( $\pm$ )        | $I_F = 5.0\text{ mA}$ , $I_L = 100\text{ mA}$                             | $R_{ON}$  | 3.0 | 5.0  | 6.25 | $\Omega$      |
| Off-resistance                                          | $I_F = 0\text{ mA}$ , $V_L = \pm 100\text{ V}$                            | $R_{OFF}$ | 0.5 | 5000 |      | $G\Omega$     |
| Current limit ac/dc :<br>Pin 4 ( $\pm$ ) to 6 ( $\pm$ ) | $I_F = 5.0\text{ mA}$ , $V_L = \pm 6.0\text{ V}$ ,<br>$t = 5.0\text{ ms}$ | $I_{LMT}$ | 175 | 210  | 250  | mA            |
| Off-state leakage current                               | $I_F = 0\text{ mA}$ , $V_L = \pm 100\text{ V}$                            | $I_O$     |     | 0.32 | 200  | nA            |
|                                                         | $I_F = 0\text{ mA}$ , $V_L = \pm 350\text{ V}$                            | $I_O$     |     |      | 1.0  | $\mu\text{A}$ |
| Output capacitance Pin 4 to 6                           | $I_F = 0\text{ mA}$ , $V_L = 1.0\text{ V}$                                | $C_O$     |     | 55   |      | pF            |
|                                                         | $I_F = 0\text{ mA}$ , $V_L = 50\text{ V}$                                 | $C_O$     |     | 10   |      | pF            |
| Switch offset                                           | $I_F = 5.0\text{ mA}$                                                     | $V_{OS}$  |     | 0.15 |      | V             |

## Transfer

| Parameter                  | Test condition                               | Symbol    | Min | Typ. | Max | Unit |
|----------------------------|----------------------------------------------|-----------|-----|------|-----|------|
| Capacitance (input-output) | $V_{ISO} = 1.0\text{ V}$                     | $C_{IO}$  |     | 0.8  |     | pF   |
| Turn-on time               | $I_F = 5.0\text{ mA}$ , $I_L = 50\text{ mA}$ | $t_{on}$  |     | 1.2  | 2.0 | ms   |
| Turn-off time              | $I_F = 5.0\text{ mA}$ , $I_L = 50\text{ mA}$ | $t_{off}$ |     | 0.5  | 2.0 | ms   |

## Typical Characteristics ( $T_{amb} = 25\text{ }^{\circ}\text{C}$ unless otherwise specified)

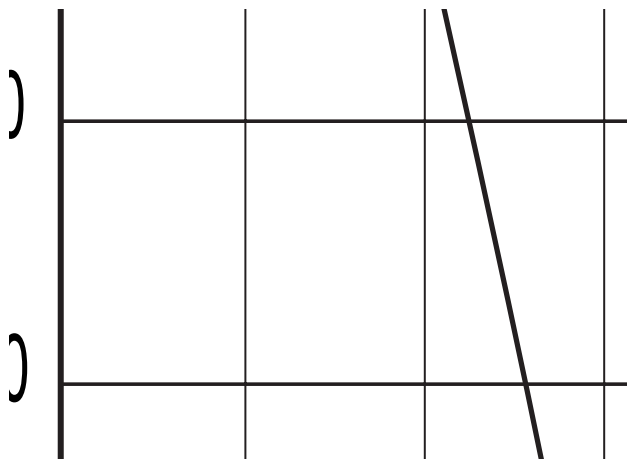


Figure 1. Recommended Operating Conditions

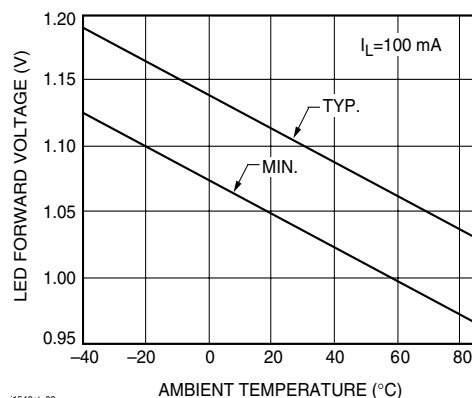


Figure 3. LED Dropout Voltage vs. Temperature

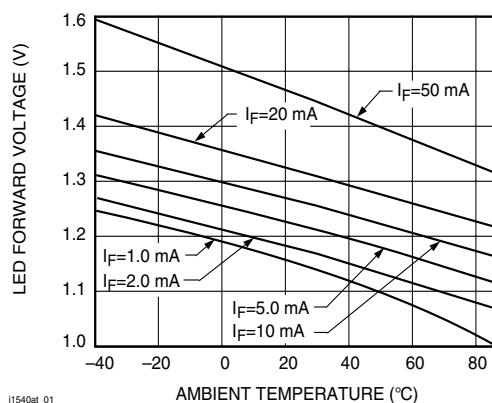


Figure 2. LED Voltage vs. Temperature

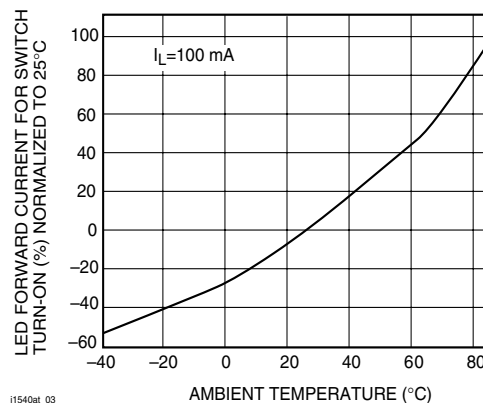


Figure 4. LED Current for Switch Turn-on vs. Temperature

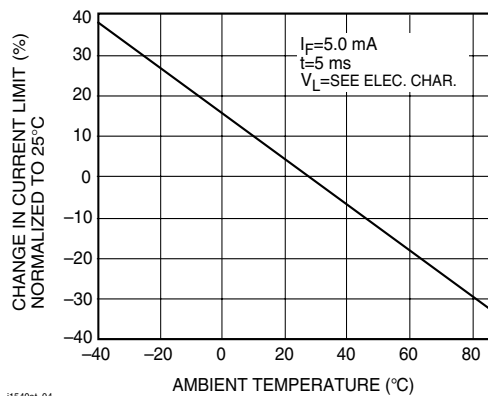


Figure 5. Current Limit vs. Temperature

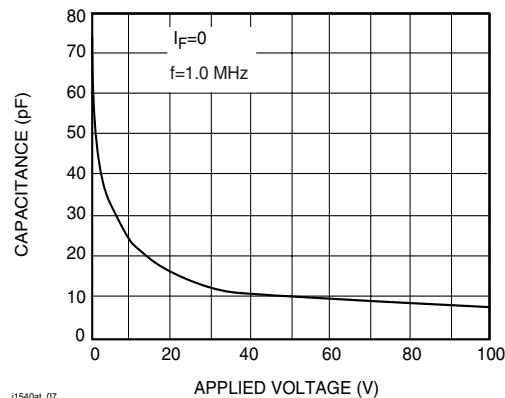


Figure 8. Switch Capacitance vs. Applied Voltage

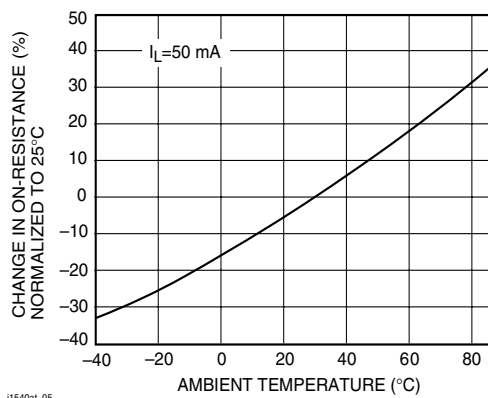


Figure 6. ON-Resistance vs. Temperature

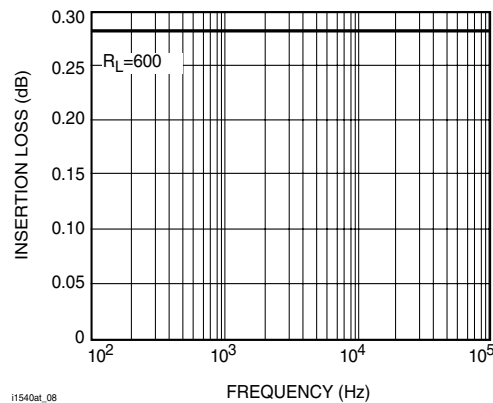


Figure 9. Insertion Loss vs. Frequency

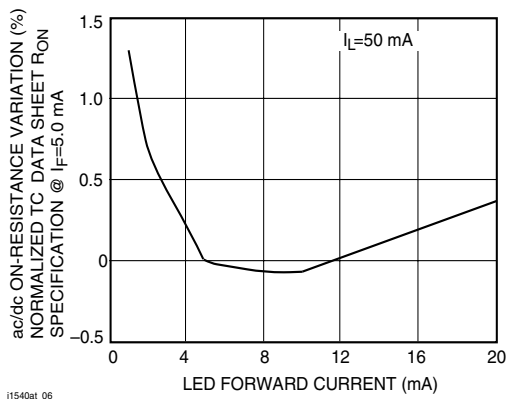


Figure 7. Variation in ON-Resistance vs. LED Current

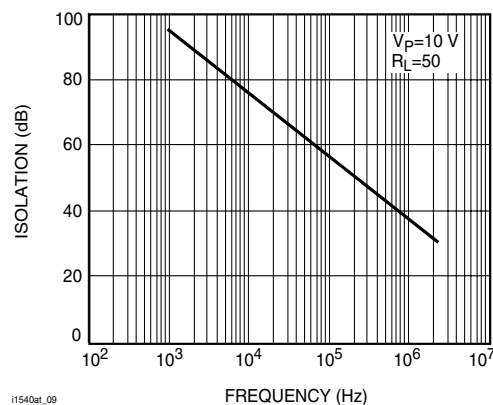


Figure 10. Output Isolation

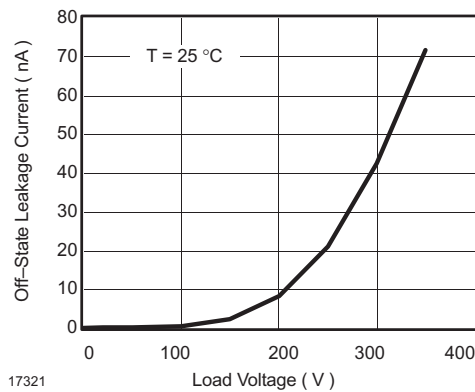


Figure 11. Leakage Current vs. Applied Voltage

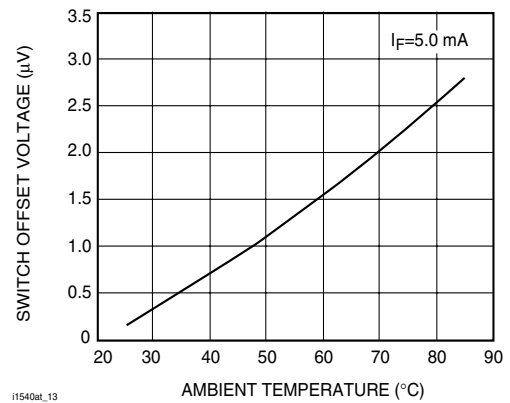


Figure 14. Switch Offset Voltage vs. Temperature

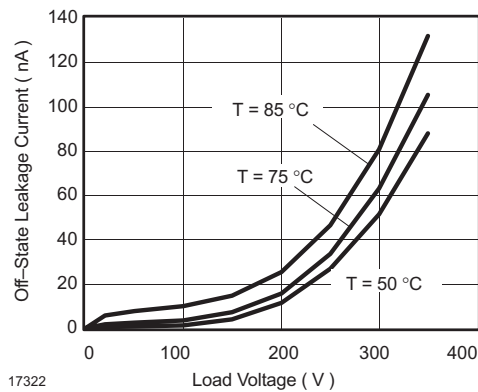


Figure 12. Leakage Current vs. Applied Voltage at Elevated Temperatures

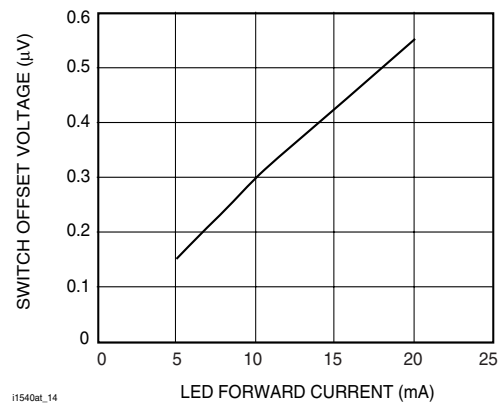


Figure 15. Switch Offset Voltage vs. LED Current

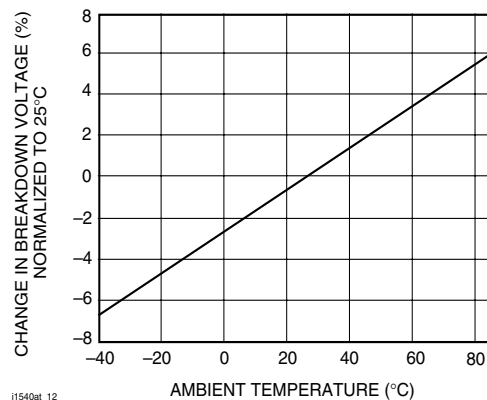


Figure 13. Switch Breakdown Voltage vs. Temperature

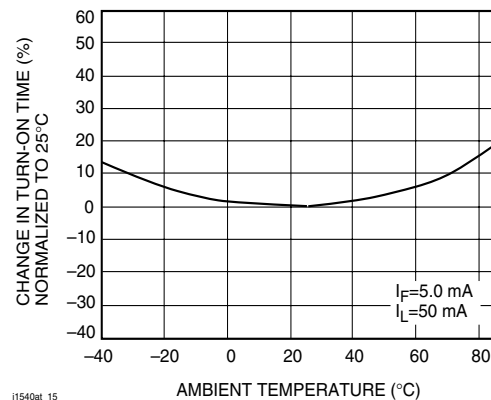


Figure 16. Turn-on Time vs. Temperature

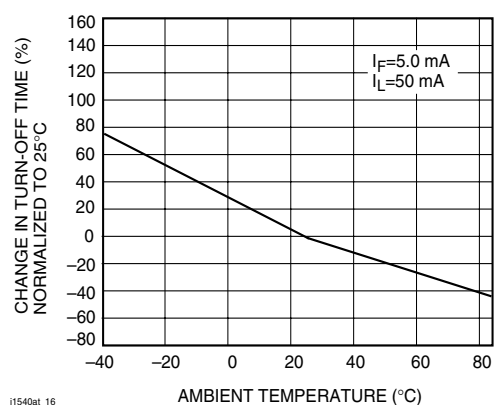


Figure 17. Turn-off Time vs. Temperature

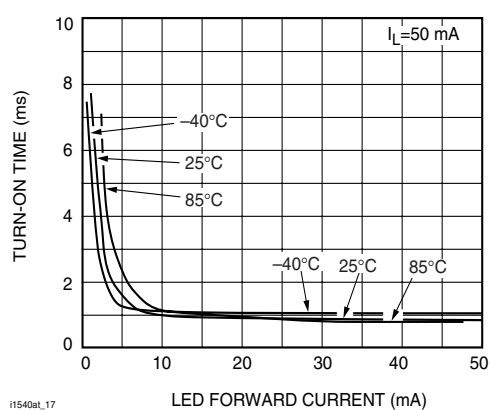


Figure 18. Turn-on Time vs. LED Current

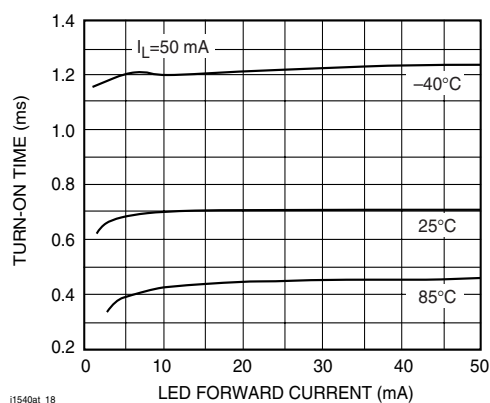
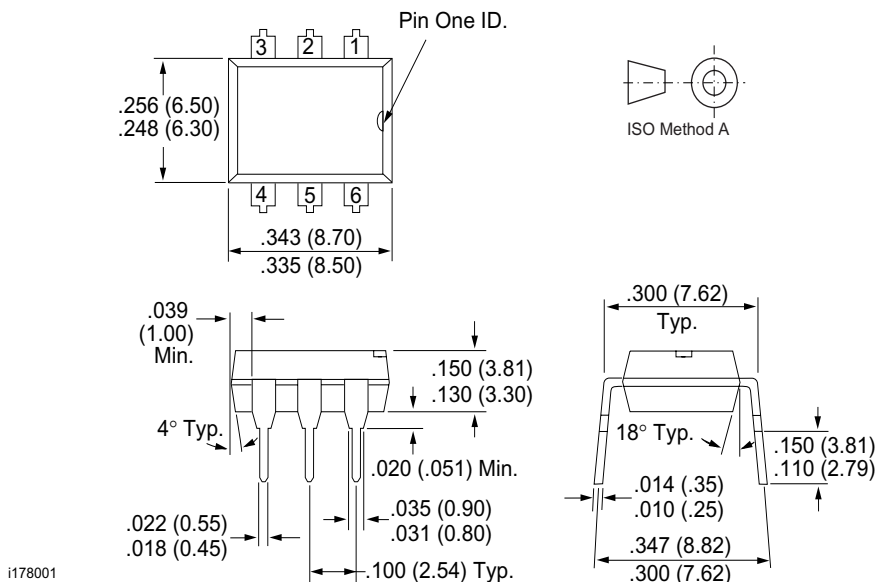


Figure 19. Turn-off Time vs. LED Current

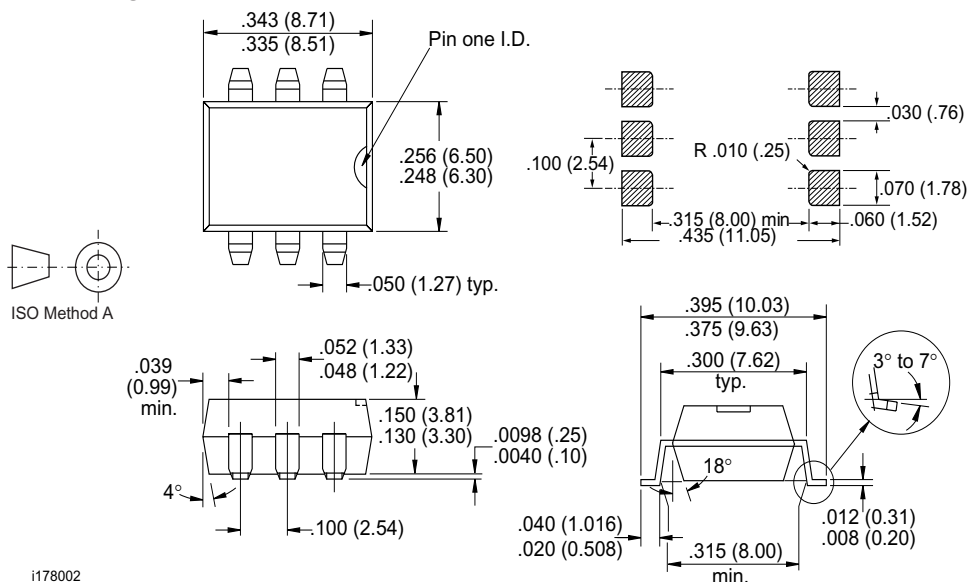
## Package Dimensions in Inches (mm)

### DIP



## Package Dimensions in Inches (mm)

### SMD



## Ozone Depleting Substances Policy Statement

It is the policy of Vishay Semiconductor GmbH to

1. Meet all present and future national and international statutory requirements.
2. Regularly and continuously improve the performance of our products, processes, distribution and operating systems with respect to their impact on the health and safety of our employees and the public, as well as their impact on the environment.

It is particular concern to control or eliminate releases of those substances into the atmosphere which are known as ozone depleting substances (ODSs).

The Montreal Protocol (1987) and its London Amendments (1990) intend to severely restrict the use of ODSs and forbid their use within the next ten years. Various national and international initiatives are pressing for an earlier ban on these substances.

Vishay Semiconductor GmbH has been able to use its policy of continuous improvements to eliminate the use of ODSs listed in the following documents.

1. Annex A, B and list of transitional substances of the Montreal Protocol and the London Amendments respectively
2. Class I and II ozone depleting substances in the Clean Air Act Amendments of 1990 by the Environmental Protection Agency (EPA) in the USA
3. Council Decision 88/540/EEC and 91/690/EEC Annex A, B and C (transitional substances) respectively.

Vishay Semiconductor GmbH can certify that our semiconductors are not manufactured with ozone depleting substances and do not contain such substances.

We reserve the right to make changes to improve technical design  
and may do so without further notice.

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