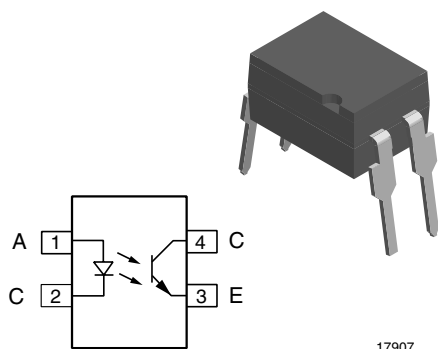


# Optocoupler, Phototransistor Output, High Reliability, 5300 V<sub>RMS</sub>, 110 °C Rated



17907

## DESCRIPTION

The 110 °C rated SFH1617A (DIP) 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 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 spacing. Creepage and clearance distances of > 8.0 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.

## FEATURES

- Operating temperature from - 55 °C to + 110 °C
- Good CTR linearity depending on forward current
- Isolation test voltage, 5300 V<sub>RMS</sub>
- High collector emitter voltage, V<sub>CEO</sub> = 70 V
- Low saturation voltage
- Fast switching times
- Low CTR degradation
- Temperature stable
- Low coupling capacitance
- End stackable, 0.100" (2.54 mm) spacing
- High common mode interference immunity
- Lead (Pb)-free component
- Component in accordance to RoHS 2002/95/EC and WEEE 2002/96/EC


**RoHS**  
COMPLIANT

## APPLICATIONS

- AC adapter
- SMPS
- PLC
- Factory automation
- Game consoles

## AGENCY APPROVALS

- UL1577, file no. E52744 system code H or J, double protection
- CSA 93751
- DIN EN 60747-5-2 (VDE 0884)/DIN EN 60747-5-5 pending available with option 1
- BSI IEC 60950; IEC 60065

## ORDER INFORMATION

| PART       | REMARKS                 |
|------------|-------------------------|
| SFH1617A-1 | CTR 40 to 80 %, DIP-4   |
| SFH1617A-2 | CTR 63 to 125 %, DIP-4  |
| SFH1617A-3 | CTR 100 to 200 %, DIP-4 |
| SFH1617A-4 | CTR 160 to 320 %, DIP-4 |

## ABSOLUTE MAXIMUM RATINGS <sup>(1)</sup>

| PARAMETER                  | TEST CONDITION | SYMBOL           | VALUE | UNIT  |
|----------------------------|----------------|------------------|-------|-------|
| <b>INPUT</b>               |                |                  |       |       |
| Reverse voltage            |                | V <sub>R</sub>   | 6.0   | V     |
| DC forward current         |                | I <sub>F</sub>   | 60    | mA    |
| Surge forward current      | t ≤ 10 μs      | I <sub>FSM</sub> | 2.5   | A     |
| Derate linearly from 25 °C |                |                  | 0.95  | mW/°C |

| ABSOLUTE MAXIMUM RATINGS <sup>(1)</sup>                                                          |                                                             |                  |                    |                  |
|--------------------------------------------------------------------------------------------------|-------------------------------------------------------------|------------------|--------------------|------------------|
| PARAMETER                                                                                        | TEST CONDITION                                              | SYMBOL           | VALUE              | UNIT             |
| OUTPUT                                                                                           |                                                             |                  |                    |                  |
| Collector emitter voltage                                                                        |                                                             | V <sub>CE</sub>  | 70                 | V                |
| Emitter collector voltage                                                                        |                                                             | V <sub>EC</sub>  | 7.0                | V                |
| Collector current                                                                                |                                                             | I <sub>C</sub>   | 50                 | mA               |
|                                                                                                  | t ≤ 1.0 ms                                                  | I <sub>C</sub>   | 100                | mA               |
| Derate linearly from 25 °C                                                                       |                                                             |                  | 1.54               | mW/°C            |
| COUPLER                                                                                          |                                                             |                  |                    |                  |
| Isolation test voltage between emitter and detector, refer to climate DIN 40046, part 2, Nov. 74 |                                                             | V <sub>ISO</sub> | 5300               | V <sub>RMS</sub> |
| Isolation resistance                                                                             | V <sub>IO</sub> = 500 V, T <sub>amb</sub> = 25 °C           | R <sub>IO</sub>  | ≥ 10 <sup>12</sup> | Ω                |
|                                                                                                  | V <sub>IO</sub> = 500 V, T <sub>amb</sub> = 100 °C          | R <sub>IO</sub>  | ≥ 10 <sup>11</sup> | Ω                |
| Storage temperature range                                                                        |                                                             | T <sub>stg</sub> | - 55 to + 150      | °C               |
| Ambient temperature range                                                                        |                                                             | T <sub>amb</sub> | - 55 to + 110      | °C               |
| Soldering temperature <sup>(2)</sup>                                                             | max. 10 s, dip soldering distance to seating plane ≥ 1.5 mm | T <sub>sld</sub> | 260                | °C               |

**Notes**

(1) T<sub>amb</sub> = 25 °C, unless otherwise specified.

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.

(2) Refer to wave profile for soldering conditions for through hole devices.

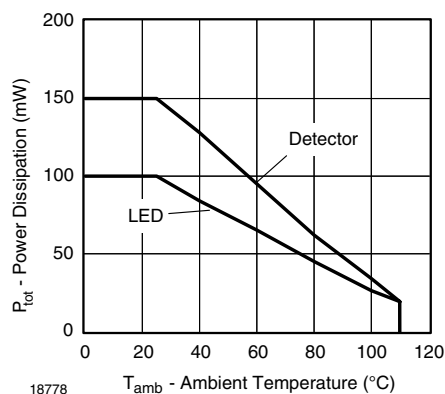


Fig. 1 - Permissible Power Dissipation vs. Ambient Temperature

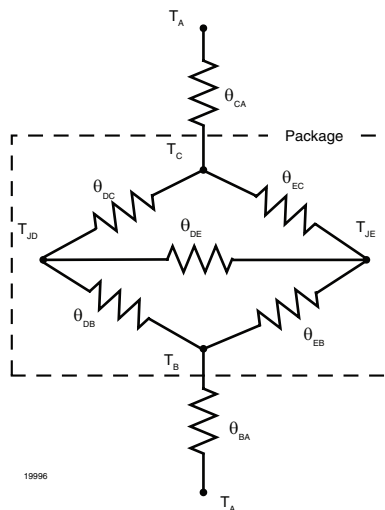


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Rated

| THERMAL CHARACTERISTICS <sup>(1)</sup>                    |                |                   |       |      |
|-----------------------------------------------------------|----------------|-------------------|-------|------|
| PARAMETER                                                 | TEST CONDITION | SYMBOL            | VALUE | UNIT |
| LED power dissipation                                     | at 25 °C       | P <sub>diss</sub> | 100   | mW   |
| Output power dissipation                                  | at 25 °C       | P <sub>diss</sub> | 150   | mW   |
| Maximum LED junction temperature                          |                | T <sub>Jmax</sub> | 125   | °C   |
| Maximum output die junction temperature                   |                | T <sub>Jmax</sub> | 125   | °C   |
| Thermal resistance, junction emitter to board             |                | θ <sub>EB</sub>   | 173   | °C/W |
| Thermal resistance, junction emitter to case              |                | θ <sub>EC</sub>   | 149   | °C/W |
| Thermal resistance, junction detector to board            |                | θ <sub>DB</sub>   | 111   | °C/W |
| Thermal resistance, junction detector to case             |                | θ <sub>DC</sub>   | 127   | °C/W |
| Thermal resistance, junction emitter to junction detector |                | θ <sub>ED</sub>   | 95    | °C/W |
| Thermal resistance, board to ambient <sup>(2)</sup>       |                | θ <sub>BA</sub>   | 195   | °C/W |
| Thermal resistance, case to ambient <sup>(2)</sup>        |                | θ <sub>CA</sub>   | 3573  | °C/W |

**Notes**

- <sup>(1)</sup> The thermal model is represented in the thermal network below. Each resistance value given in this model can be used to calculate the temperatures at each node for a given operating condition. The thermal resistance from board to ambient will be dependent on the type of PCB, layout and thickness of copper traces. For a detailed explanation of the thermal model, please reference Vishay's thermal characteristics of optocouplers application note.
- <sup>(2)</sup> For 2 layer FR4 board (4" x 3" x 0.062).



| ELECTRICAL CHARACTERISTICS        |                                      |            |                  |      |      |      |      |
|-----------------------------------|--------------------------------------|------------|------------------|------|------|------|------|
| PARAMETER                         | TEST CONDITION                       | PART       | SYMBOL           | MIN. | TYP. | MAX. | UNIT |
| INPUT                             |                                      |            |                  |      |      |      |      |
| Forward voltage                   | I <sub>F</sub> = 60 mA               |            | V <sub>F</sub>   |      | 1.25 | 1.65 | V    |
| Reverse current                   | V <sub>R</sub> = 6.0 V               |            | I <sub>R</sub>   |      | 0.01 | 10   | μA   |
| Capacitance                       | V <sub>R</sub> = 0 V, f = 1.0 MHz    |            | C <sub>O</sub>   |      | 13   |      | pF   |
| OUTPUT                            |                                      |            |                  |      |      |      |      |
| Collector emitter capacitance     | V <sub>CE</sub> = 5.0 V, f = 1.0 MHz |            | C <sub>CE</sub>  |      | 5.2  |      | pF   |
| Collector emitter leakage current | V <sub>CE</sub> = 10 V               | SFH1617A-1 | I <sub>CEO</sub> |      | 2.0  | 50   | nA   |
|                                   |                                      | SFH1617A-2 | I <sub>CEO</sub> |      | 2.0  | 50   | nA   |
|                                   |                                      | SFH1617A-3 | I <sub>CEO</sub> |      | 5.0  | 100  | nA   |
|                                   |                                      | SFH1617A-4 | I <sub>CEO</sub> |      | 5.0  | 100  | nA   |
| COUPLER                           |                                      |            |                  |      |      |      |      |

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**ELECTRICAL CHARACTERISTICS**

| PARAMETER                            | TEST CONDITION                                | PART | SYMBOL      | MIN. | TYP. | MAX. | UNIT |
|--------------------------------------|-----------------------------------------------|------|-------------|------|------|------|------|
| Collector emitter saturation voltage | $I_F = 10 \text{ mA}$ , $f = 1.0 \text{ MHz}$ |      | $V_{CEsat}$ | 0.4  | 0.25 |      | V    |
| Coupling capacitance                 |                                               |      | $C_C$       |      | 0.4  |      | pF   |

**Note**

$T_{amb} = 25 \text{ °C}$ , unless otherwise specified.

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.

**CURRENT TRANSFER RATIO**

| PARAMETER | TEST CONDITION                                    | PART       | SYMBOL | MIN. | TYP. | MAX. | UNIT |
|-----------|---------------------------------------------------|------------|--------|------|------|------|------|
| $I_C/I_F$ | $I_F = 10 \text{ mA}$ , $V_{CE} = 5.0 \text{ V}$  | SFH1617A-1 | CTR    | 40   |      | 80   | %    |
|           |                                                   | SFH1617A-2 | CTR    | 63   |      | 125  | %    |
|           |                                                   | SFH1617A-3 | CTR    | 100  |      | 200  | %    |
|           |                                                   | SFH1617A-4 | CTR    | 160  |      | 320  | %    |
|           | $I_F = 1.0 \text{ mA}$ , $V_{CE} = 5.0 \text{ V}$ | SFH1617A-1 | CTR    | 13   | 30   |      | %    |
|           |                                                   | SFH1617A-2 | CTR    | 22   | 45   |      | %    |
|           |                                                   | SFH1617A-3 | CTR    | 34   | 70   |      | %    |
|           |                                                   | SFH1617A-4 | CTR    | 56   | 90   |      | %    |

**SWITCHING CHARACTERISTICS**

| PARAMETER            | TEST CONDITION                                                       | PART       | SYMBOL    | MIN. | TYP. | MAX. | UNIT          |
|----------------------|----------------------------------------------------------------------|------------|-----------|------|------|------|---------------|
| <b>NON-SATURATED</b> |                                                                      |            |           |      |      |      |               |
| Turn-on time         | $I_F = 10 \text{ mA}$ , $V_{CC} = 5.0 \text{ V}$ , $R_L = 75 \Omega$ |            | $t_{on}$  |      | 3.0  |      | $\mu\text{s}$ |
| Rise time            | $I_F = 10 \text{ mA}$ , $V_{CC} = 5.0 \text{ V}$ , $R_L = 75 \Omega$ |            | $t_r$     |      | 2.0  |      | $\mu\text{s}$ |
| Turn-off time        | $I_F = 10 \text{ mA}$ , $V_{CC} = 5.0 \text{ V}$ , $R_L = 75 \Omega$ |            | $t_{off}$ |      | 2.3  |      | $\mu\text{s}$ |
| Fall time            | $I_F = 10 \text{ mA}$ , $V_{CC} = 5.0 \text{ V}$ , $R_L = 75 \Omega$ |            | $t_f$     |      | 2.0  |      | $\mu\text{s}$ |
| Cut-off frequency    | $I_F = 10 \text{ mA}$ , $V_{CC} = 5.0 \text{ V}$                     |            | $f_{ctr}$ |      | 250  |      | kHz           |
| <b>SATURATED</b>     |                                                                      |            |           |      |      |      |               |
| Turn-on time         | $I_F = 20 \text{ mA}$                                                | SFH1617A-1 | $t_{on}$  |      | 3.0  |      | $\mu\text{s}$ |
|                      | $I_F = 10 \text{ mA}$                                                | SFH1617A-2 | $t_{on}$  |      | 4.2  |      | $\mu\text{s}$ |
|                      |                                                                      | SFH1617A-3 | $t_{on}$  |      | 4.2  |      | $\mu\text{s}$ |
|                      | $I_F = 5.0 \text{ mA}$                                               | SFH1617A-4 | $t_{on}$  |      | 6.0  |      | $\mu\text{s}$ |
| Rise time            | $I_F = 20 \text{ mA}$                                                | SFH1617A-1 | $t_r$     |      | 2.0  |      | $\mu\text{s}$ |
|                      | $I_F = 10 \text{ mA}$                                                | SFH1617A-2 | $t_r$     |      | 3.0  |      | $\mu\text{s}$ |
|                      |                                                                      | SFH1617A-3 | $t_r$     |      | 3.0  |      | $\mu\text{s}$ |
|                      | $I_F = 5.0 \text{ mA}$                                               | SFH1617A-4 | $t_r$     |      | 4.6  |      | $\mu\text{s}$ |
| <b>SATURATED</b>     |                                                                      |            |           |      |      |      |               |
| Turn-off time        | $I_F = 20 \text{ mA}$                                                | SFH1617A-1 | $t_{off}$ |      | 18   |      | $\mu\text{s}$ |
|                      | $I_F = 10 \text{ mA}$                                                | SFH1617A-2 | $t_{off}$ |      | 23   |      | $\mu\text{s}$ |
|                      |                                                                      | SFH1617A-3 | $t_{off}$ |      | 23   |      | $\mu\text{s}$ |
|                      | $I_F = 5.0 \text{ mA}$                                               | SFH1617A-4 | $t_{off}$ |      | 25   |      | $\mu\text{s}$ |
| Fall time            | $I_F = 20 \text{ mA}$                                                | SFH1617A-1 | $t_f$     |      | 11   |      | $\mu\text{s}$ |
|                      | $I_F = 10 \text{ mA}$                                                | SFH1617A-2 | $t_f$     |      | 14   |      | $\mu\text{s}$ |
|                      |                                                                      | SFH1617A-3 | $t_f$     |      | 14   |      | $\mu\text{s}$ |
|                      | $I_F = 5.0 \text{ mA}$                                               | SFH1617A-4 | $t_f$     |      | 15   |      | $\mu\text{s}$ |



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**SAFETY AND INSULATION RATINGS**

| PARAMETER                                               | TEST CONDITION         | SYMBOL | MIN.  | TYP.      | MAX. | UNIT |
|---------------------------------------------------------|------------------------|--------|-------|-----------|------|------|
| Climatic classification<br>(according to IEC 68 part 1) |                        |        |       | 55/110/21 |      |      |
| Comparative tracking index                              |                        | CTI    | 175   |           | 399  |      |
| V <sub>IOTM</sub>                                       |                        |        | 10000 |           |      | V    |
| V <sub>IORM</sub>                                       |                        |        | 890   |           |      | V    |
| P <sub>SO</sub>                                         |                        |        |       |           | 400  | mW   |
| I <sub>SI</sub>                                         |                        |        |       |           | 275  | mA   |
| T <sub>SI</sub>                                         |                        |        |       |           | 175  | °C   |
| Creepage distance                                       | standard DIP-4         |        | 7     |           |      | mm   |
| Clearance distance                                      | standard DIP-4         |        | 7     |           |      | mm   |
| Creepage distance                                       | 400 mil DIP-4          |        | 8     |           |      | mm   |
| Clearance distance                                      | 400 mil DIP-4          |        | 8     |           |      | mm   |
| Insulation thickness,<br>reinforced rated               | per IEC 60950 2.10.5.1 |        | 0.4   |           |      | mm   |

**Note**

As per IEC 60747-5-2, § 7.4.3.8.1, 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<sub>amb</sub> = 25 °C, unless otherwise specified

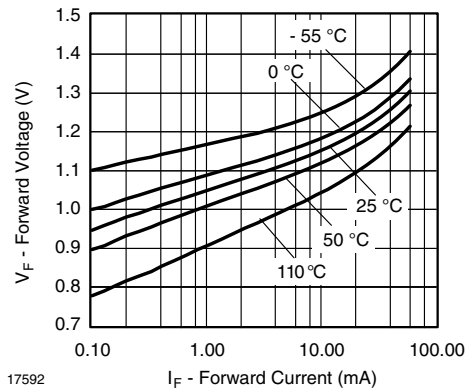


Fig. 2 - Forward Voltage vs. Forward Current

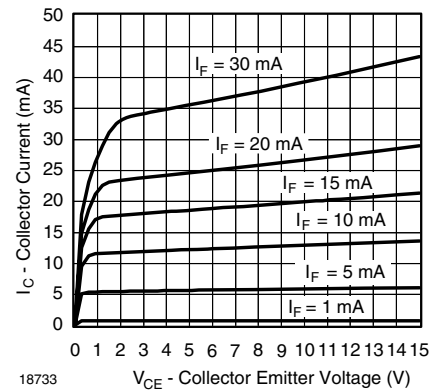


Fig. 3 - Collector Current vs. Collector Emitter Voltage

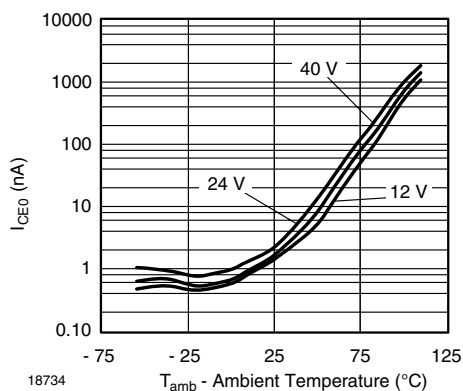


Fig. 4 - Collector to Emitter Dark Current vs. Ambient Temperature

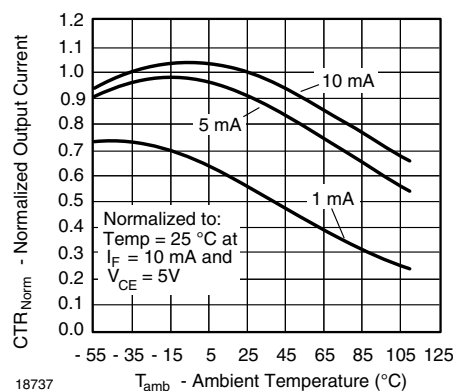


Fig. 7 - Normalized CTR vs. Temperature

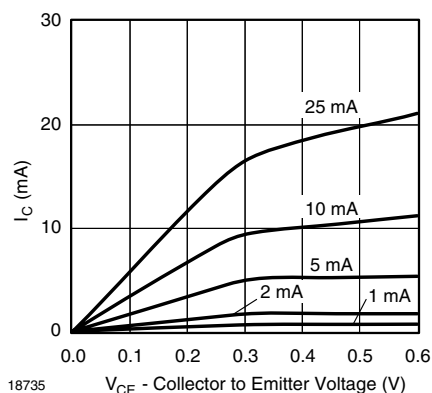


Fig. 5 - Normalized Current vs. Collector Emitter Saturation Voltage

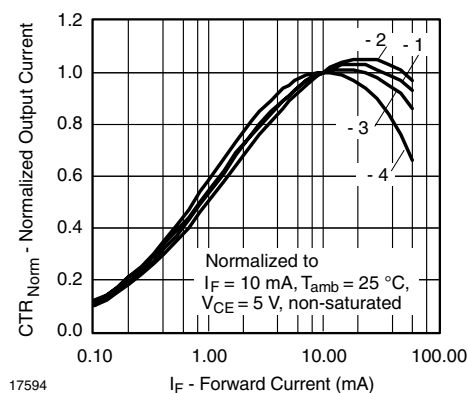


Fig. 8 - Normalized CTR vs. Forward Current

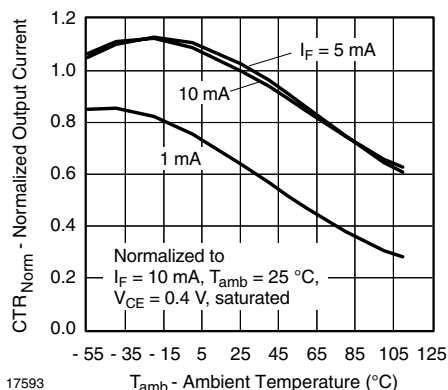


Fig. 6 - Normalized Current Transfer Ratio vs. Ambient Temperature

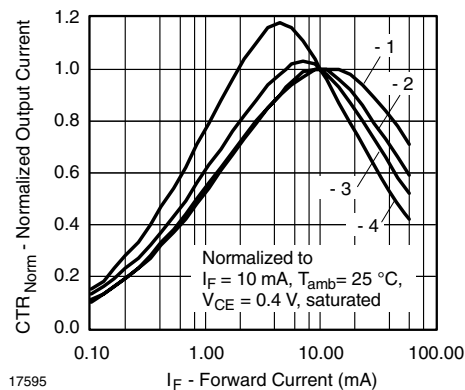


Fig. 9 - Normalized CTR vs. Forward Current

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Fig. 10 - Forward Resistance vs. Forward Current

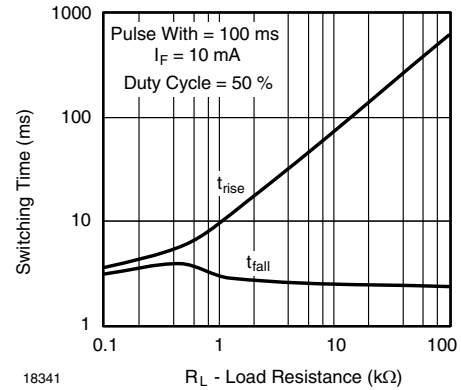
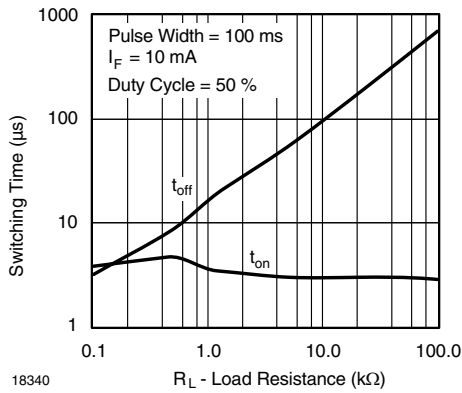
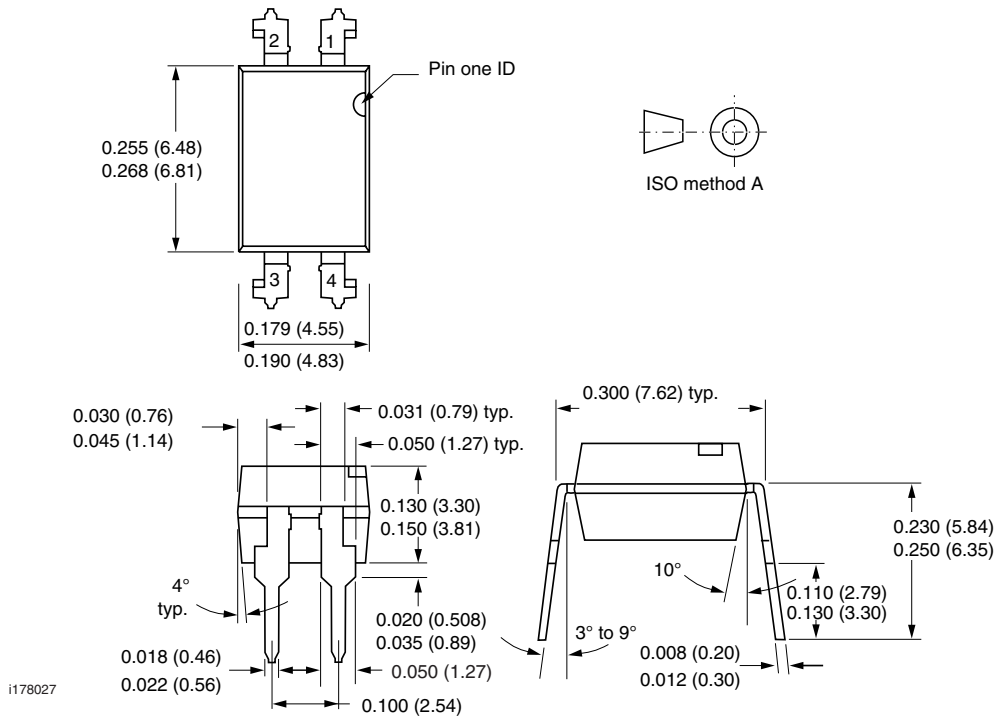


Fig. 11 - Forward Resistance vs. Forward Current

**PACKAGE DIMENSIONS** in inches (millimeters)



## **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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Vishay Semiconductor GmbH, P.O.B. 3535, D-74025 Heilbronn, Germany



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### Офис по работе с юридическими лицами:

105318, г.Москва, ул.Щербаковская д.3, офис 1107, 1118, ДЦ «Щербаковский»

Телефон: +7 495 668-12-70 (многоканальный)

Факс: +7 495 668-12-70 (доб.304)

E-mail: [info@moschip.ru](mailto:info@moschip.ru)

Skype отдела продаж:

moschip.ru

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