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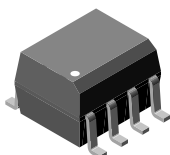
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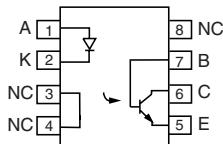
## VO215AT, VO216AT, VO217AT

Vishay Semiconductors

### Optocoupler, Phototransistor Output, Low Input Current, with Base Connection



1178002



#### DESCRIPTION

The VO215AT, VO216AT, VO217AT are optically coupled pairs with a Gallium Arsenide infrared LED and a silicon NPN phototransistor. Signal information, including a DC level, can be transmitted by the device while maintaining a high degree of electrical isolation between input and output.

The high CTR at low input current is designed for low power consumption requirements such as CMOS microprocessor interfaces.

#### FEATURES

- High current transfer ratio
- Isolation test voltage, 4000 V<sub>RMS</sub>
- Lead (Pb)-free component
- Component in accordance to RoHS 2002/95/EC and WEEE 2002/96/EC



RoHS COMPLIANT

#### AGENCY APPROVALS

- UL1577, file no. E52744 system code Y
- CUL - file no. E52744, equivalent to CSA bulletin 5A
- DIN EN 60747-5-5 (VDE 0884) available with option 1

#### ORDER INFORMATION

| PART    | REMARKS             |
|---------|---------------------|
| VO215AT | CTR > 20 %, SOIC-8  |
| VO216AT | CTR > 50 %, SOIC-8  |
| VO217AT | CTR > 100 %, SOIC-8 |

#### ABSOLUTE MAXIMUM RATINGS

| PARAMETER                           | TEST CONDITION   | SYMBOL                | VALUE         | UNIT             |
|-------------------------------------|------------------|-----------------------|---------------|------------------|
| <b>INPUT</b>                        |                  |                       |               |                  |
| Peak reverse voltage                |                  | V <sub>R</sub>        | 6             | V                |
| Peak forward current                | 1 μs, 300 pps    | I <sub>FM</sub>       | 1             | A                |
| Forward continuous current          |                  | I <sub>F</sub>        | 60            | mA               |
| Power dissipation                   |                  | P <sub>diss</sub>     | 90            | mW               |
| Derate linearly from 25 °C          |                  |                       | 1.2           | mW/°C            |
| <b>OUTPUT</b>                       |                  |                       |               |                  |
| Collector emitter breakdown voltage |                  | BV <sub>CEO</sub>     | 30            | V                |
| Emitter collector breakdown voltage |                  | BV <sub>ECO</sub>     | 7             | V                |
| Collector base breakdown voltage    |                  | BV <sub>CB0</sub>     | 70            | V                |
| I <sub>Cmax. DC</sub>               |                  | I <sub>Cmax. DC</sub> | 50            | mA               |
| I <sub>Cmax.</sub>                  | t < 1 ms         | I <sub>Cmax.</sub>    | 100           | mA               |
| Power dissipation                   |                  | P <sub>diss</sub>     | 150           | mW               |
| Derate linearly from 25 °C          |                  |                       | 2             | mW/°C            |
| <b>COUPLER</b>                      |                  |                       |               |                  |
| Isolation test voltage              | 1 s              | V <sub>ISO</sub>      | 4000          | V <sub>RMS</sub> |
| Total package dissipation           | LED and detector | P <sub>tot</sub>      | 240           | mW               |
| Derate linearly from 25 °C          |                  |                       | 3.2           | mW/°C            |
| Storage temperature                 |                  | T <sub>stg</sub>      | - 40 to + 150 | °C               |
| Operating temperature               |                  | T <sub>amb</sub>      | - 40 to + 100 | °C               |
| Soldering time                      | at 260 °C        |                       | 10            | s                |

#### Note

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.

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 Output, Low Input Current,  
 with Base Connection

| ELECTRICAL CHARACTERISTICS            |                                            |      |             |      |      |      |               |
|---------------------------------------|--------------------------------------------|------|-------------|------|------|------|---------------|
| PARAMETER                             | TEST CONDITION                             | PART | SYMBOL      | MIN. | TYP. | MAX. | UNIT          |
| <b>INPUT</b>                          |                                            |      |             |      |      |      |               |
| Forward voltage                       | $I_F = 1 \text{ mA}$                       |      | $V_F$       |      | 1    | 1.5  | V             |
| Reverse current                       | $V_R = 6 \text{ V}$                        |      | $I_R$       |      | 0.1  | 100  | $\mu\text{A}$ |
| Capacitance                           | $V_R = 0 \text{ V}$                        |      | $C_O$       |      | 13   |      | pF            |
| <b>OUTPUT</b>                         |                                            |      |             |      |      |      |               |
| Collector emitter breakdown voltage   | $I_C = 100 \mu\text{A}$                    |      | $BV_{CEO}$  | 30   |      |      | V             |
| Emitter collector breakdown voltage   | $I_C = 10 \mu\text{A}$                     |      | $BV_{ECO}$  | 7    |      |      | V             |
| Collector base breakdown voltage      | $I_C = 100 \mu\text{A}$                    |      | $BV_{CBO}$  | 100  |      |      | V             |
| Collector base current                |                                            |      | $I_{CBO}$   |      |      | 1    | nA            |
| Emitter base current                  |                                            |      | $I_{EBO}$   |      |      | 1    | nA            |
| Dark current collector emitter        | $V_{CE} = 10 \text{ V}, I_F = 0 \text{ A}$ |      | $I_{CEO}$   |      | 5    | 50   | nA            |
| Collector emitter capacitance         | $V_{CE} = 0$                               |      | $C_{CE}$    |      | 10   |      | pF            |
| Saturation voltage, collector emitter | $I_F = 1 \text{ mA}, I_C = 0.1 \text{ mA}$ |      | $V_{CEsat}$ |      |      | 0.4  | V             |
| <b>COUPLER</b>                        |                                            |      |             |      |      |      |               |
| Capacitance (input to output)         |                                            |      | $C_{IO}$    |      | 0.5  |      | pF            |

**Note**

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

Minimum and maximum values were tested 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.

| CURRENT TRANSFER RATIO    |                                            |         |            |      |      |      |      |
|---------------------------|--------------------------------------------|---------|------------|------|------|------|------|
| PARAMETER                 | TEST CONDITION                             | PART    | SYMBOL     | MIN. | TYP. | MAX. | UNIT |
| DC current transfer ratio | $I_F = 1 \text{ mA}, V_{CE} = 5 \text{ V}$ | VO215AT | $CTR_{DC}$ | 20   | 50   |      | %    |
|                           |                                            | VO216AT | $CTR_{DC}$ | 50   | 80   |      | %    |
|                           |                                            | VO217AT | $CTR_{DC}$ | 100  | 130  |      | %    |

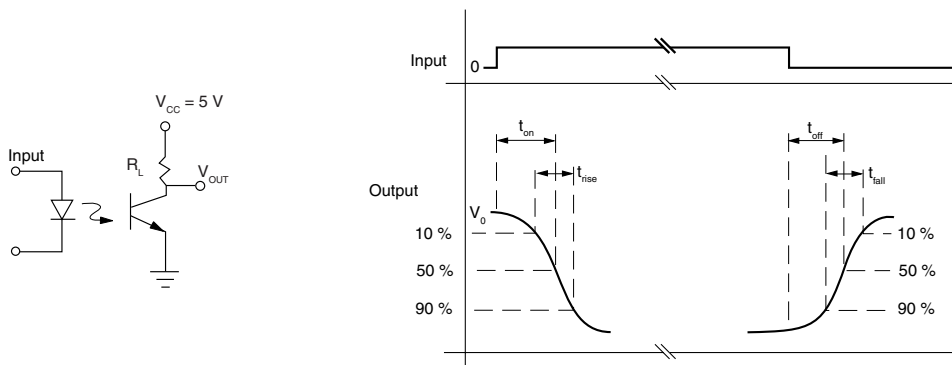


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Optocoupler, Phototransistor  
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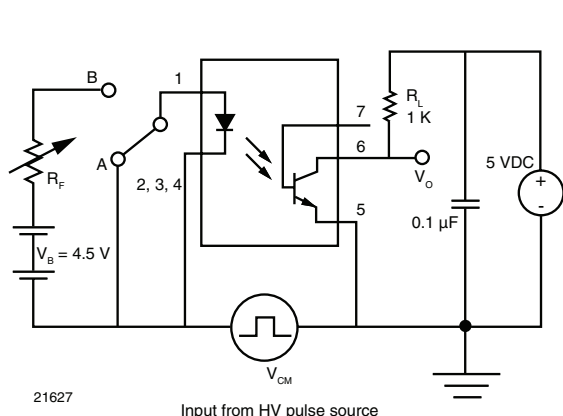
| SWITCHING CHARACTERISTICS |                                                                        |           |      |      |      |               |
|---------------------------|------------------------------------------------------------------------|-----------|------|------|------|---------------|
| PARAMETER                 | TEST CONDITION                                                         | SYMBOL    | MIN. | TYP. | MAX. | UNIT          |
| Turn-on time              | $I_C = 2 \text{ mA}$ , $R_L = 100 \Omega$ ,<br>$V_{CC} = 10 \text{ V}$ | $t_{on}$  |      | 3    |      | $\mu\text{s}$ |
| Turn-off time             | $I_C = 2 \text{ mA}$ , $R_L = 100 \Omega$ ,<br>$V_{CC} = 10 \text{ V}$ | $t_{off}$ |      | 3    |      | $\mu\text{s}$ |
| Rise time                 | $I_C = 2 \text{ mA}$ , $R_L = 100 \Omega$ ,<br>$V_{CC} = 10 \text{ V}$ | $t_r$     |      | 3    |      | $\mu\text{s}$ |
| Fall time                 | $I_C = 2 \text{ mA}$ , $R_L = 100 \Omega$ ,<br>$V_{CC} = 10 \text{ V}$ | $t_f$     |      | 2    |      | $\mu\text{s}$ |



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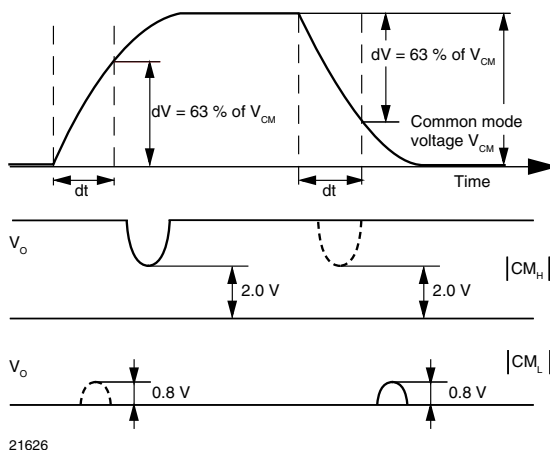
Fig. 1 - Switching Test Circuit

| COMMON MODE TRANSIENT IMMUNITY               |                                                                                        |            |      |      |      |                        |
|----------------------------------------------|----------------------------------------------------------------------------------------|------------|------|------|------|------------------------|
| PARAMETER                                    | TEST CONDITION                                                                         | SYMBOL     | MIN. | TYP. | MAX. | UNIT                   |
| Common mode transient immunity at logic high | $V_{CM} = 1000 \text{ V}_{P-P}$ , $R_L = 1 \text{ k}\Omega$ ,<br>$I_F = 0 \text{ mA}$  | $ C_{MH} $ |      | 5000 |      | $\text{V}/\mu\text{s}$ |
| Common mode transient immunity at logic low  | $V_{CM} = 1000 \text{ V}_{P-P}$ , $R_L = 1 \text{ k}\Omega$ ,<br>$I_F = 10 \text{ mA}$ | $ C_{ML} $ |      | 5000 |      | $\text{V}/\mu\text{s}$ |



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Input from HV pulse source



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Fig. 2 - Test Circuit for Common Mode Transient Immunity

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| SAFETY AND INSULATION RATINGS                        |                |            |      |           |      |             |
|------------------------------------------------------|----------------|------------|------|-----------|------|-------------|
| PARAMETER                                            | TEST CONDITION | SYMBOL     | MIN. | TYP.      | MAX. | UNIT        |
| Climatic classification (according to IEC 68 part 1) |                |            |      | 40/100/21 |      |             |
| Polution degree                                      |                |            |      | 2         |      |             |
| Comparative tracking index                           |                | CTI        | 175  |           | 399  |             |
| Isolation test voltage                               | 1 s            | $V_{ISO}$  | 4000 |           |      | $V_{RMS}$   |
| Peak transient overvoltage                           |                | $V_{IOTM}$ | 6000 |           |      | V           |
| Peak insulation voltage                              |                | $V_{IORM}$ | 560  |           |      | V           |
| Resistance (input to output)                         |                | $R_{IO}$   |      | 100       |      | $G\Omega$   |
| Safety rating - power output                         |                | $P_{SO}$   |      |           | 350  | mW          |
| Safety rating - input current                        |                | $I_{SI}$   |      |           | 150  | mA          |
| Safety rating - temperature                          |                | $T_{SI}$   |      |           | 165  | $^{\circ}C$ |
| External creepage distance                           |                |            | 4    |           |      | mm          |
| External clearance distance                          |                |            | 4    |           |      | mm          |
| Internal creepage distance                           |                |            | 3.3  |           |      | mm          |
| Insulation thickness                                 |                |            | 0.2  |           |      | 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**

$T_{amb} = 25^{\circ}C$ , unless otherwise specified

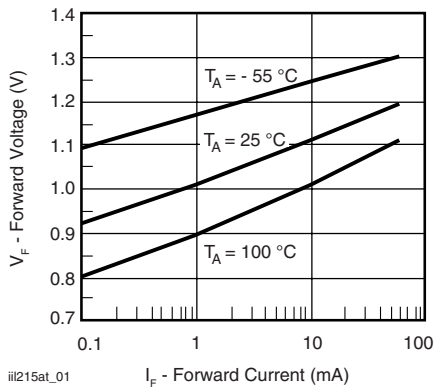


Fig. 3 - Forward Voltage vs. Forward Current

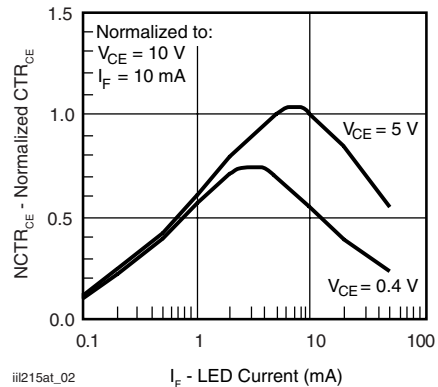


Fig. 4 - Normalized Non-Saturated and Saturated  $CTR_{CE}$  vs. LED Current



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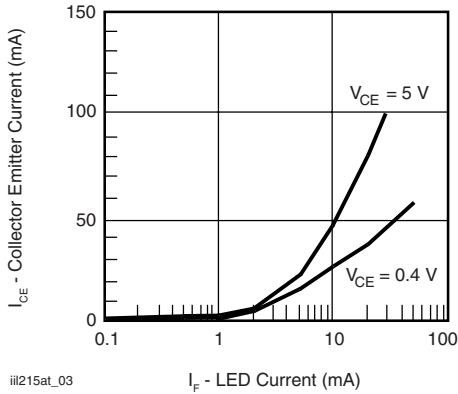


Fig. 5 - Collector Emitter Current vs. LED Current

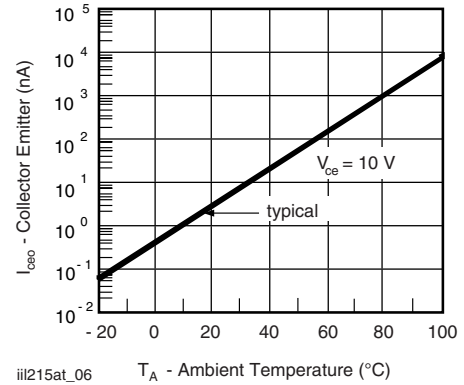


Fig. 8 - Collector Emitter Leakage Current vs. Temperature

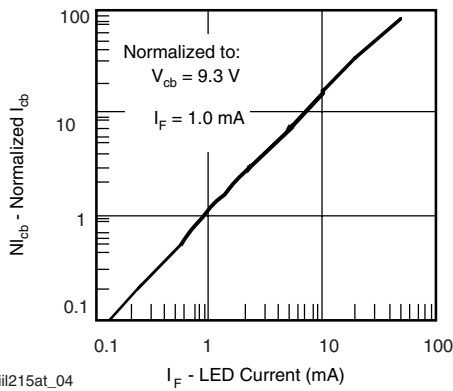


Fig. 6 - Normalized Collector Base Photocurrent vs. LED Current

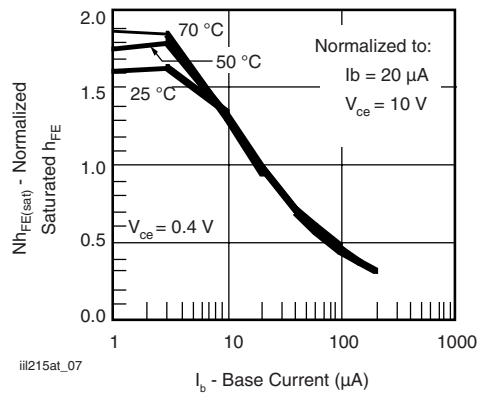


Fig. 9 - Normalized Saturated  $h_{FE}$  vs. Base Current and Temperature

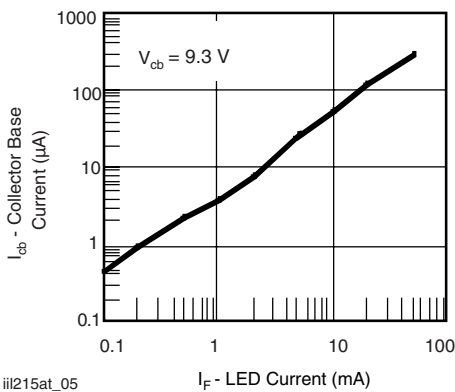


Fig. 7 - Collector Base Photocurrent vs. LED Current

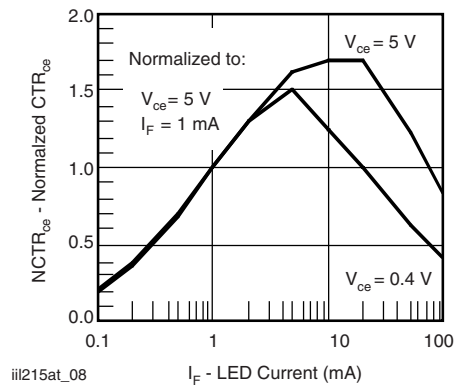
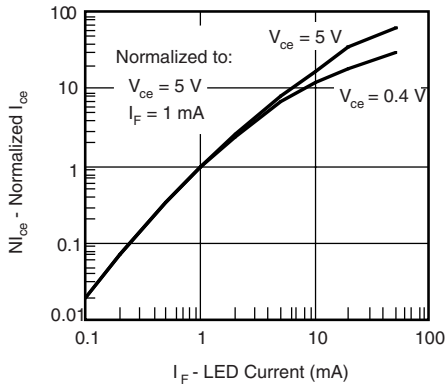


Fig. 10 - Normalized Non-Saturated and Saturated  $CTR_{CE}$  vs. LED Current

# VO215AT, VO216AT, VO217AT

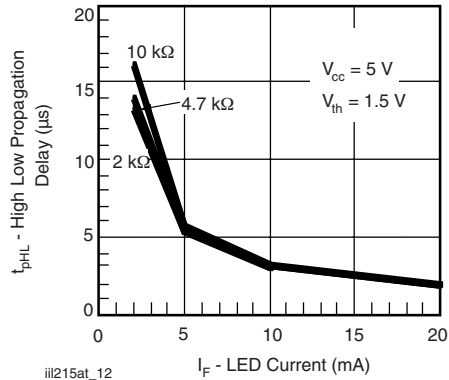
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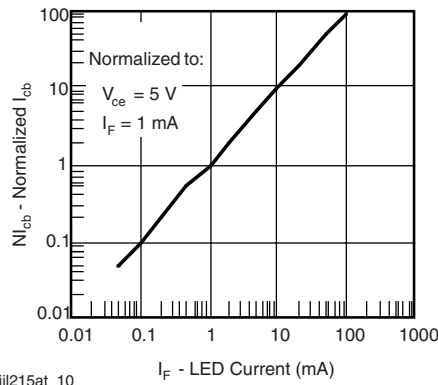
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Fig. 11 - Normalized Non-Saturated and Saturated Collector Emitter Current vs. LED Current



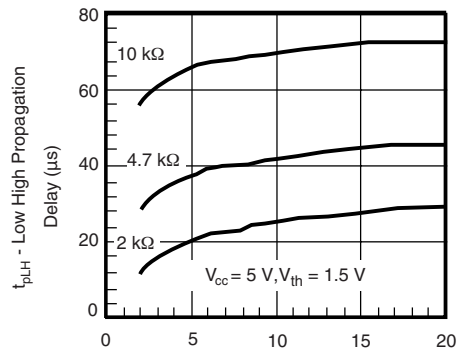
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Fig. 14 - High to Low Propagation Delay vs. LED Current and Load Resistor



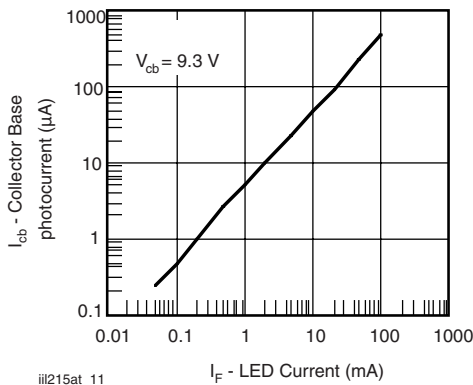
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Fig. 12 - Normalized Collector Base Photocurrent vs. LED Current



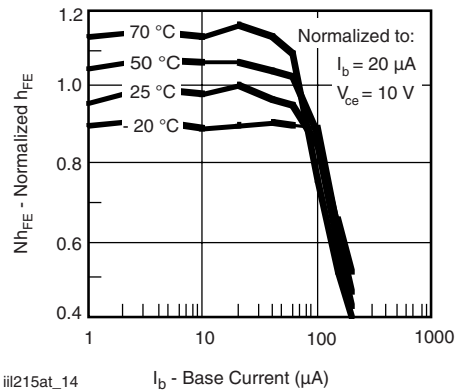
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Fig. 15 - Low to High Propagation Delay vs. LED Current and Load Resistor



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Fig. 13 - Collector Base Photocurrent vs. LED Current



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Fig. 16 - Normalized Non-Saturated  $h_{FE}$  vs. Base Current and Temperature



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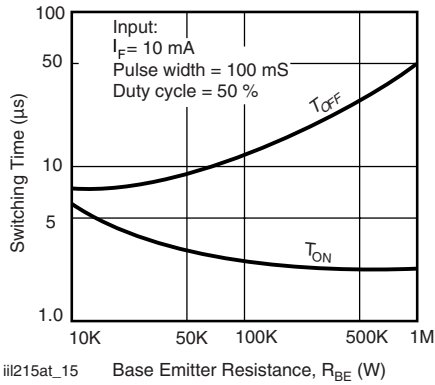


Fig. 17 - Typical Switching Characteristics vs. Base Resistance (Saturated Operation)

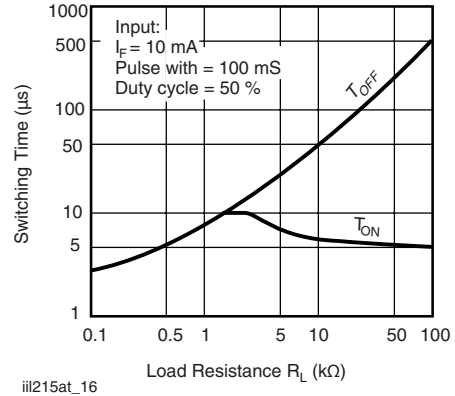
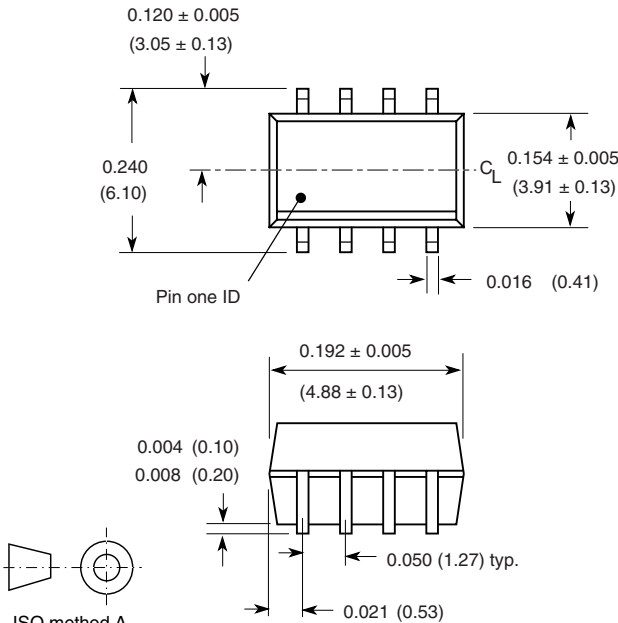
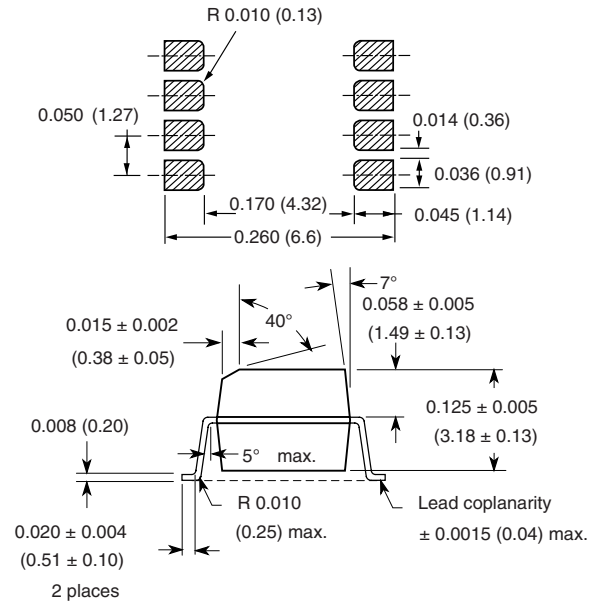


Fig. 18 - Typical Switching Times vs. Load Resistance

**PACKAGE DIMENSIONS** in inches (millimeters)



i178003





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### **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



## Legal Disclaimer Notice

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Vishay

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