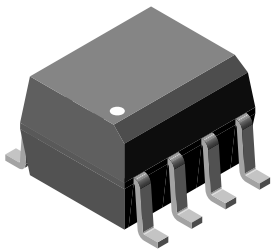
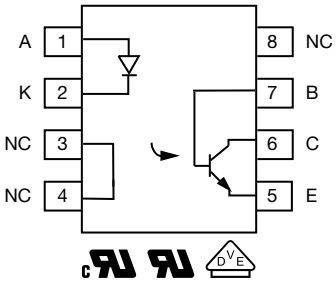
# Optocoupler, Phototransistor Output, Low Input Current, With Base Connection






## 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 $V_{RMS}$
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912

Pb-free

e3

RoHS COMPLIANT

## AGENCY APPROVALS

- UL
- cUL
- DIN EN 60747-5-5 (VDE 0884-5), available with option 1

## LINKS TO ADDITIONAL RESOURCES

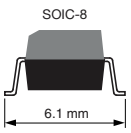
Product Page

## ORDERING INFORMATION

| V | O | 2 | 1 | # | # | A | T |
|---|---|---|---|---|---|---|---|

PART NUMBER

TAPE AND REEL




| AGENCY CERTIFIED / PACKAGE | CTR (%) | | |
|---|---|---|---|
| **UL, cUL, VDE** | **≥ 20** | **≥ 50** | **≥ 100** |
| SOIC-8 | VO215AT | VO216AT | VO217AT |

| **ABSOLUTE MAXIMUM RATINGS** ($T_{amb}$ = 25 °C, unless otherwise specified) | | | | |
|---|---|---|---|---|
| **PARAMETER** | **TEST CONDITION** | **SYMBOL** | **VALUE** | **UNIT** |
| **INPUT** | | | | |
| Peak reverse voltage | | $V_R$ | 6 | V |
| Peak forward current | 1 µs, 300 pps | $I_{FM}$ | 1 | A |
| Forward continuous current | | $I_F$ | 60 | mA |
| Power dissipation | | $P_{diss}$ | 90 | mW |
| Derate linearly from 25 °C | | | 1.2 | mW/°C |
| **OUTPUT** | | | | |
| Collector emitter breakdown voltage | | $BV_{CEO}$ | 30 | V |
| Emitter collector breakdown voltage | | $BV_{ECO}$ | 7 | V |
| Collector base breakdown voltage | | $BV_{CBO}$ | 70 | V |
| $I_{Cmax.\ DC}$ | | $I_{Cmax.\ DC}$ | 50 | mA |
| $I_{Cmax.}$ | t < 1 ms | $I_{Cmax.}$ | 100 | mA |
| Power dissipation | | $P_{diss}$ | 150 | mW |
| Derate linearly from 25 °C | | | 2 | mW/°C |
| **COUPLER** | | | | |
| Isolation test voltage | 1 s | $V_{ISO}$ | 4000 | $V_{RMS}$ |
| Total package dissipation | LED and detector | $P_{tot}$ | 240 | mW |
| Derate linearly from 25 °C | | | 3.2 | mW/°C |
| Storage temperature | | $T_{stg}$ | -40 to +150 | °C |
| Operating temperature | | $T_{amb}$ | -40 to +100 | °C |
| Soldering time | At 260 °C | | 10 | s |

**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.

| **ELECTRICAL CHARACTERISTICS** ($T_{amb}$ = 25 °C, unless otherwise specified) | | | | | | |
|---|---|---|---|---|---|---|
| **PARAMETER** | **TEST CONDITION** | **SYMBOL** | **MIN.** | **TYP.** | **MAX.** | **UNIT** |
| **INPUT** | | | | | | |
| Forward voltage | $I_F$ = 1 mA | $V_F$ | - | 1 | 1.5 | V |
| Reverse current | $V_R$ = 6 V | $I_R$ | - | 0.1 | 100 | µA |
| Capacitance | $V_R$ = 0 V | $C_O$ | - | 13 | - | pF |
| **OUTPUT** | | | | | | |
| Collector emitter breakdown voltage | $I_C$ = 100 µA | $BV_{CEO}$ | 30 | - | - | V |
| Emitter collector breakdown voltage | $I_C$ = 10 µA | $BV_{ECO}$ | 7 | - | - | V |
| Collector base breakdown voltage | $I_C$ = 100 µA | BVCBO | 100 | - | - | V |
| Collector base current | | ICBO | - | - | 1 | nA |
| Emitter base current | | $I_{EBO}$ | - | - | 1 | nA |
| Dark current collector emitter | $V_{CE}$ = 10 V, $I_F$ = 0 A | $I_{CEO}$ | - | 5 | 50 | nA |
| Collector emitter capacitance | $V_{CE}$ = 0 | $C_{CE}$ | - | 10 | - | pF |
| Saturation voltage, collector emitter | $I_F$ =1 mA, $I_C$ = 0.1 mA | $V_{CEsat}$ | - | | 0.4 | V |
| **COUPLER** | | | | | | |
| Capacitance (input to output) | | $C_{IO}$ | - | 0.5 | - | pF |

**Note**

- Minimum and maximum values were tested requierements. 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** ($T_{amb}$ = 25 °C, unless otherwise specified) | | | | | | | |
|---|---|---|---|---|---|---|---|
| **PARAMETER** | **TEST CONDITION** | **PART** | **SYMBOL** | **MIN.** | **TYP.** | **MAX.** | **UNIT** |
| DC current transfer ratio | $I_F$ = 1 mA, $V_{CE}$ = 5 V | VO215AT | $CTR_{DC}$ | 20 | 50 | - | % |
| | | VO216AT | $CTR_{DC}$ | 50 | 80 | - | % |
| | | VO217AT | $CTR_{DC}$ | 100 | 130 | - | % |

| **SWITCHING CHARACTERISTICS** ($T_{amb}$ = 25 °C, unless otherwise specified) | | | | | | |
|---|---|---|---|---|---|---|
| **PARAMETER** | **TEST CONDITION** | **SYMBOL** | **MIN.** | **TYP.** | **MAX.** | **UNIT** |
| Turn-on time | $I_C$ = 2 mA, $R_L$ = 100 Ω, $V_{CC}$ = 10 V | $t_{on}$ | - | 3 | - | µs |
| Turn-off time | $I_C$ = 2 mA, $R_L$ = 100 Ω, $V_{CC}$ = 10 V | $t_{off}$ | - | 3 | - | µs |
| Rise time | $I_C$ = 2 mA, $R_L$ = 100 Ω, $V_{CC}$ = 10 V | $t_r$ | - | 3 | - | µs |
| Fall time | $I_C$ = 2 mA, $R_L$ = 100 Ω, $V_{CC}$ = 10 V | $t_f$ | - | 2 | - | µs |

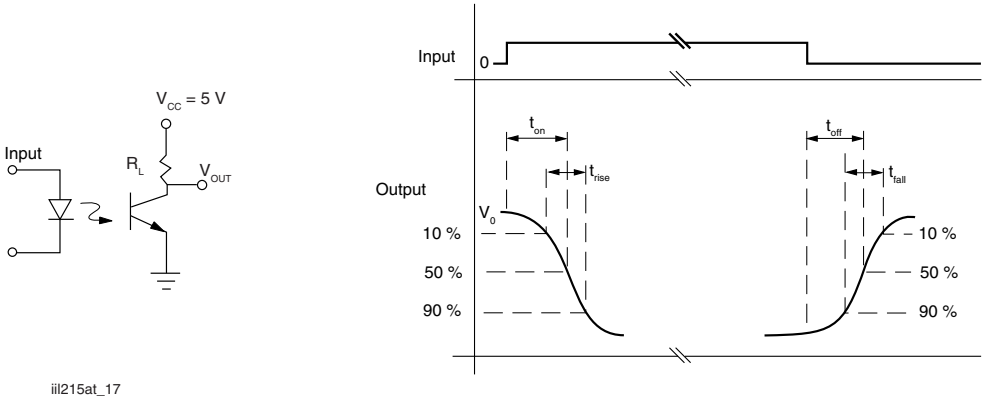



Fig. 1 - Switching Test Circuit

| **COMMON MODE TRANSIENT IMMUNITY** | | | | | | |
|---|---|---|---|---|---|---|
| **PARAMETER** | **TEST CONDITION** | **SYMBOL** | **MIN.** | **TYP.** | **MAX.** | **UNIT** |
| Common mode transient immunity at logic high | $V_{CM}$ = 1000 $V_{P-P}$, $R_L$ = 1 kΩ, $I_F$ = 0 mA | $\|C_{MH}\|$ | - | 5000 | - | V/µs |
| Common mode transient immunity at logic low | $V_{CM}$ = 1000 $V_{P-P}$, $R_L$ = 1 kΩ, $I_F$ = 10 mA | $\|C_{ML}\|$ | - | 5000 | - | V/µs |

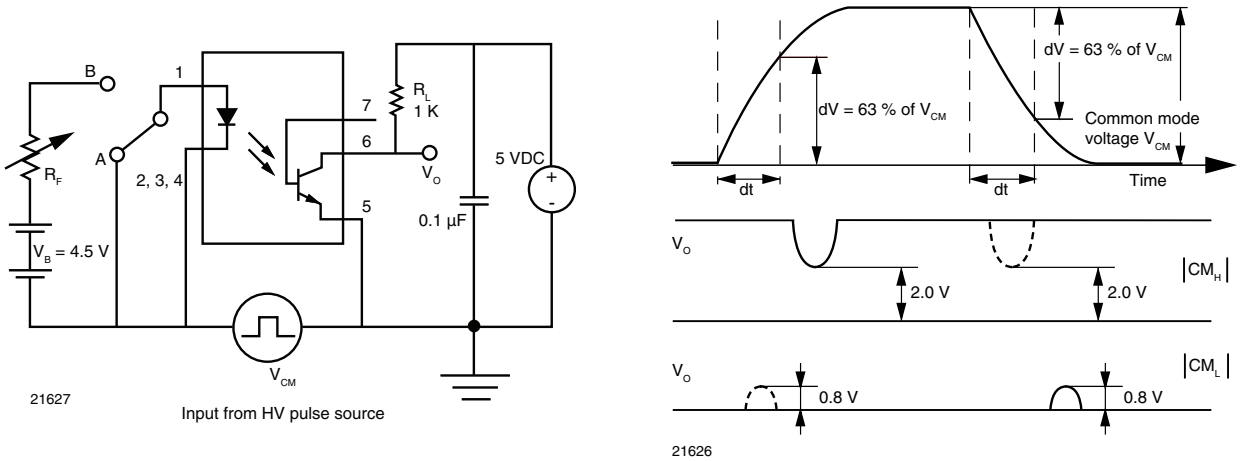



Fig. 2 - Test Circuit for Common Mode Transient Immunity

| 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 | - | GΩ |
| Safety rating - power output | | $P_{SO}$ | - | - | 350 | mW |
| Safety rating - input current | | $I_{SI}$ | - | - | 150 | mA |
| Safety rating - temperature | | $T_{SI}$ | - | - | 165 | °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 °C, unless otherwise specified)

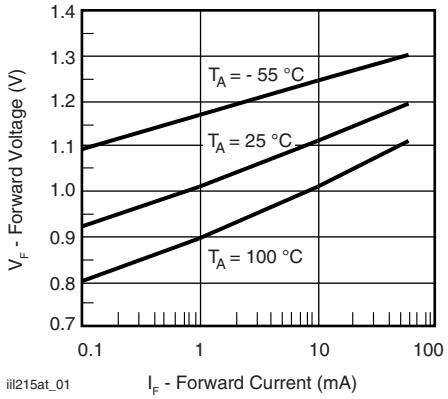



Fig. 3 - Forward Voltage vs. Forward Current

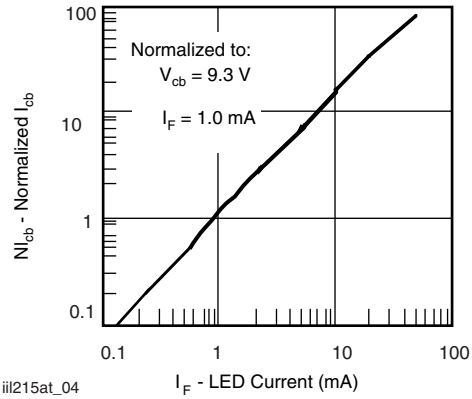



Fig. 6 - Normalized Collector Base Photocurrent vs. LED Current

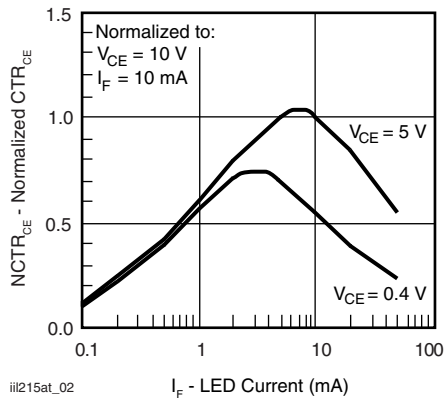



Fig. 4 - Normalized Non-Saturated and Saturated $CTR_{CE}$ vs. LED Current

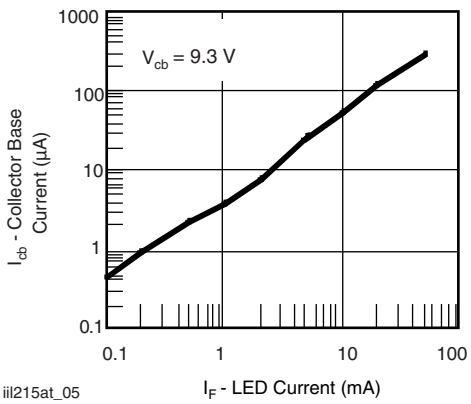



Fig. 7 - Collector Base Photocurrent vs. LED Current

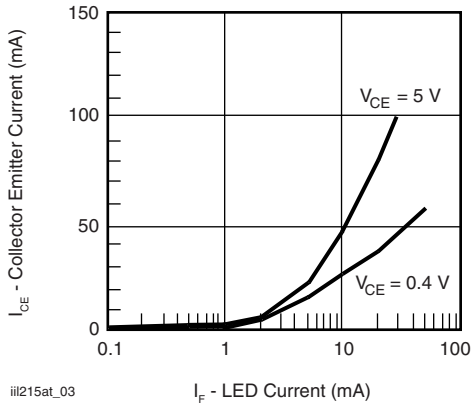



Fig. 5 - Collector Emitter Current vs. LED Current

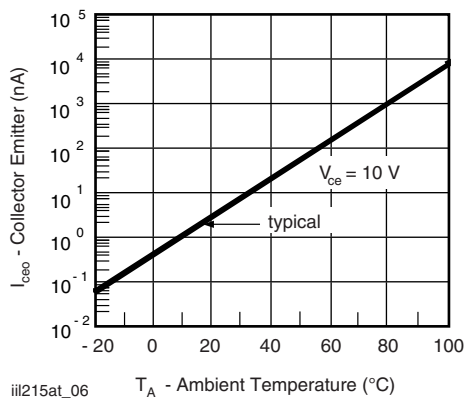



Fig. 8 - Collector Emitter Leakage Current vs.Temperature

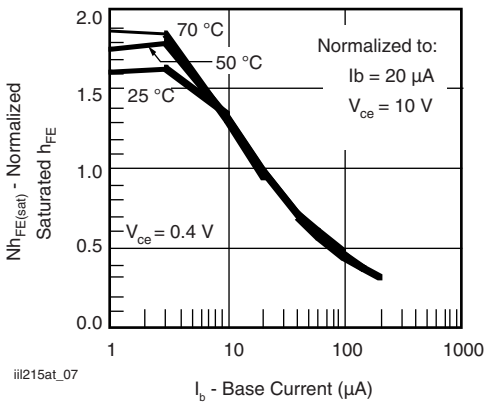



Fig. 9 - Normalized Saturated $h_{FE}$ vs. Base Current and Temperature

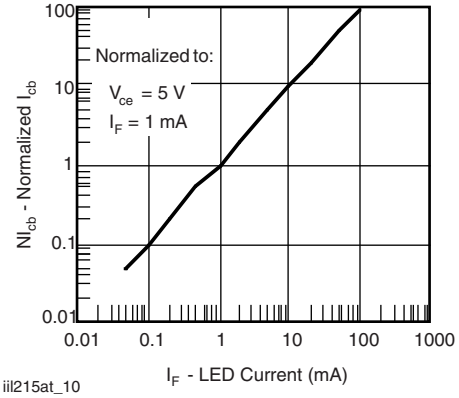



Fig. 12 - Normalized Collector Base Photocurrent vs. LED Current

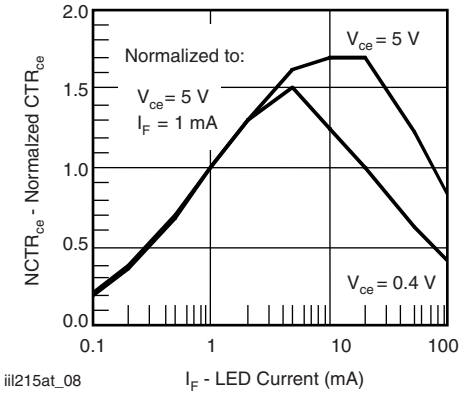



Fig. 10 - Normalized Non-Saturated and Saturated $CTR_{CE}$ vs. LED Current

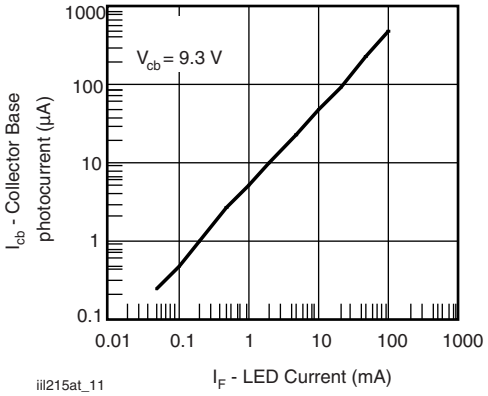



Fig. 13 - Collector Base Photocurrent vs. LED Current

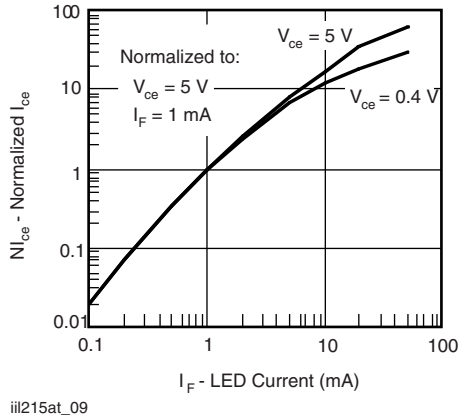



Fig. 11 - Normalized Non-Saturated and Saturated Collector Emitter Current vs. LED Current

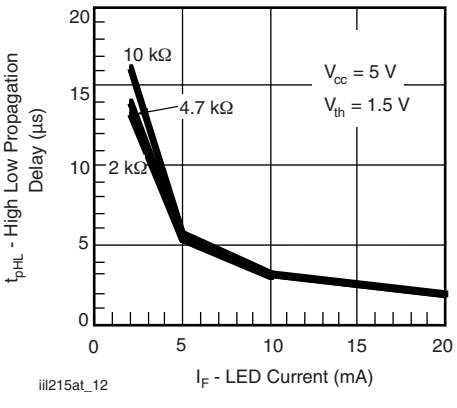



Fig. 14 - High to Low Propagation Delay vs. LED Current and Load Resistor

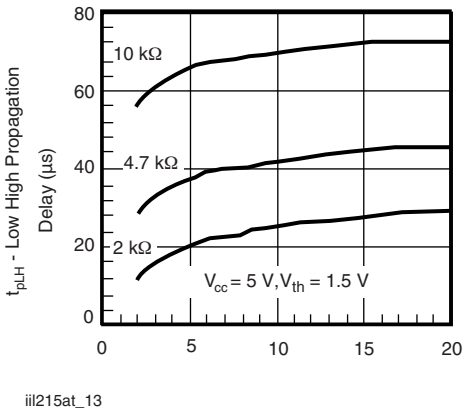



Fig. 15 - Low to High Propagation Delay vs. LED Current and Load Resistor

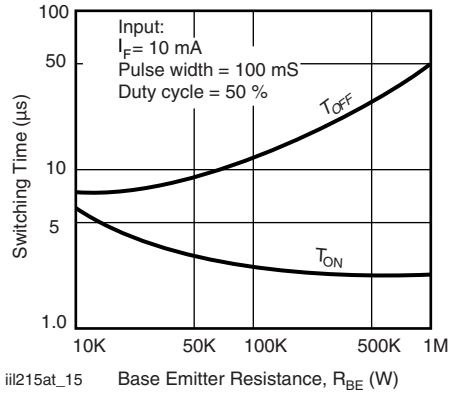



Fig. 17 - Typical Switching Characteristics vs. Base Resistance (Saturated Operation)

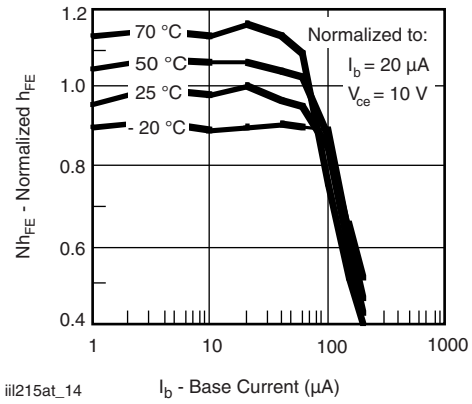



Fig. 16 - Normalized Non-Saturated $h_{FE}$ vs. Base Current and Temperature

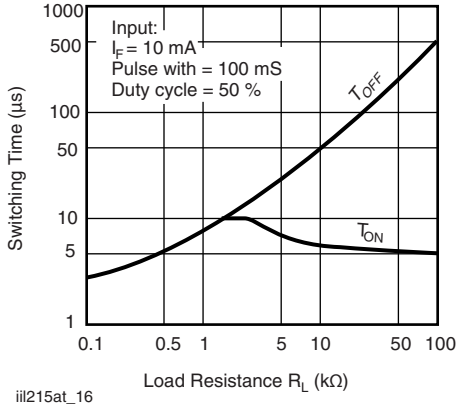
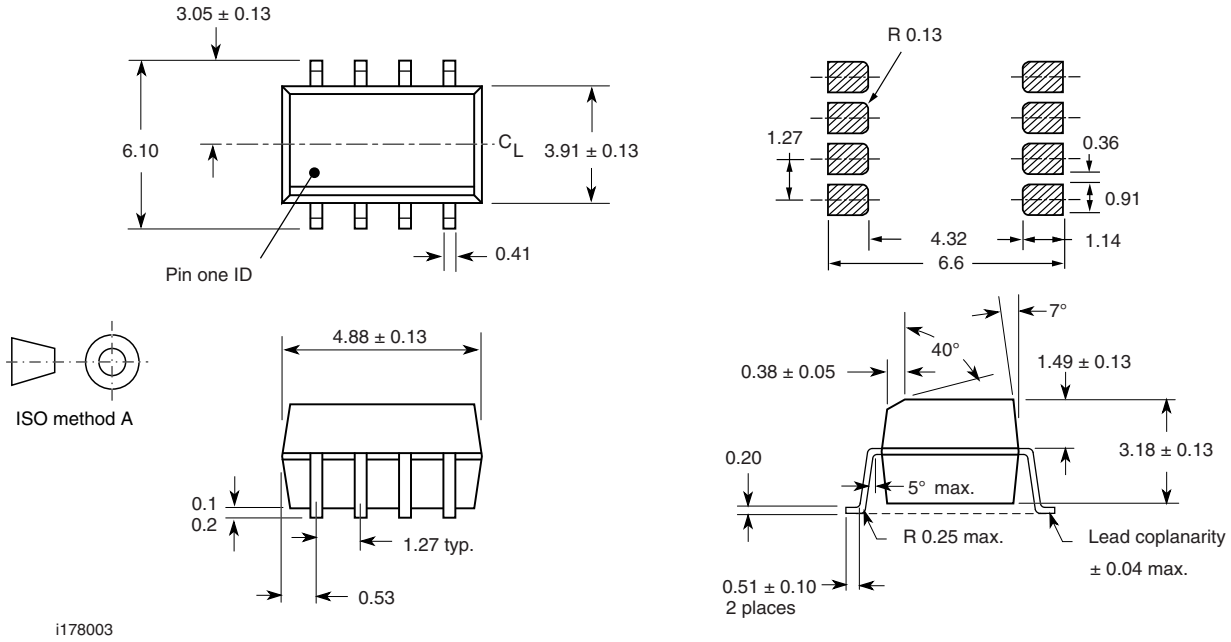



Fig. 18 - Typical Switching Times vs. Load Resistance

## **PACKAGE DIMENSIONS** in millimeters




## **PACKAGE MARKING** (Example)

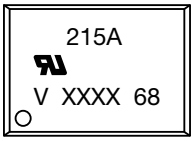



Fig. 19 - Example of VO215AT

**Notes**

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

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