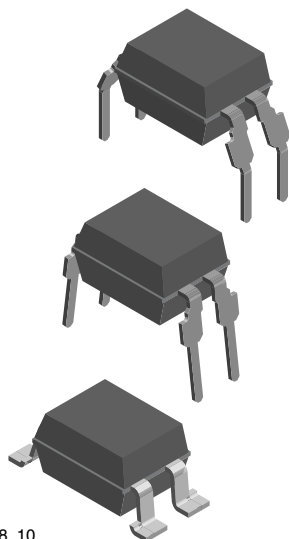
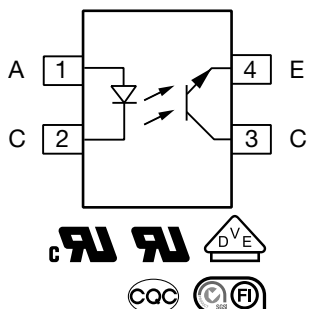


# Optocoupler, Low Input Current, Phototransistor Output



17918\_10



## DESCRIPTION

The VO610A consists of a phototransistor optically coupled to a gallium arsenide infrared-emitting diode in a 4 pin plastic dual inline package.

## FEATURES

- Temperature range -55 °C to +110 °C
- Rated impulse voltage (transient overvoltage)  $V_{IOTM} = 6 \text{ kV}_{peak}$
- Isolation test voltage (partial discharge test voltage)  $V_{pd} = 1.6 \text{ kV}$
- Rated isolation voltage (RMS includes DC)  $V_{IOWM} = 600 \text{ V}_{RMS}$
- Rated recurring peak voltage (repetitive)  $V_{IORM} = 850 \text{ V}_{peak}$
- Thickness through insulation  $\geq 0.4 \text{ mm}$
- Material categorization: for definitions of compliance please see [www.vishay.com/doc?99912](http://www.vishay.com/doc?99912)


**RoHS**  
COMPLIANT

## APPLICATIONS

Circuits for safe protective separation against electrical shock according to safety class II (reinforced isolation):

- For appl. class I - IV at mains voltage  $\leq 300 \text{ V}$
- For appl. class I - IV at mains voltage  $\leq 600 \text{ V}$  according to table 1 of IEC 60664-1, suitable for:
  - Switch-mode power supplies
  - Line receiver
  - Computer peripheral interface
  - Microprocessor system interface

## AGENCY APPROVALS

(All parts are certified under base model VO610A)

- [UL1577](#)
- [cUL](#)
- [DIN EN 60747-5-5 \(VDE 0884-5\), available with option 1](#)
- [BSI](#)
- [CQC](#)

## LINKS TO ADDITIONAL RESOURCES



Design Tools



Related Documents



Models



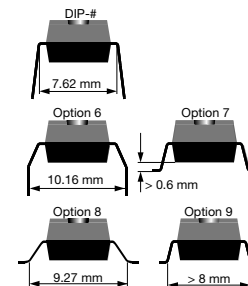
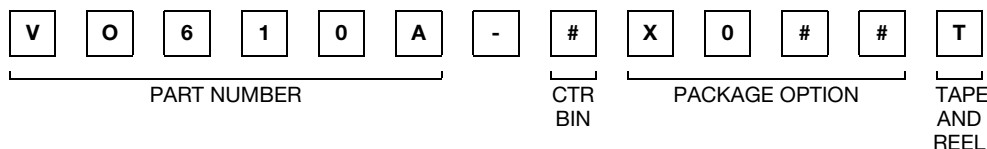
Footprints



Schematics



3D Models

**ORDERING INFORMATION**


| AGENCY CERTIFIED / PACKAGE      | CTR (%)         |                  |                   |                   |
|---------------------------------|-----------------|------------------|-------------------|-------------------|
| <b>BSI, FIMKO, UL, cUL</b>      | <b>40 to 80</b> | <b>63 to 125</b> | <b>100 to 200</b> | <b>160 to 320</b> |
| DIP-4                           | VO610A-1        | VO610A-2         | VO610A-3          | -                 |
| SMD-4, option 7                 | -               | -                | VO610A-3X007T     | -                 |
| SMD-4, option 8                 | -               | -                | VO610A-3X008T     | VO610A-4X008T     |
| SMD-4, option 9                 | -               | -                | VO610A-3X009T     | -                 |
| <b>VDE, BSI, FIMKO, UL, cUL</b> | <b>40 to 80</b> | <b>63 to 125</b> | <b>100 to 200</b> | <b>160 to 320</b> |
| DIP-4                           | -               | -                | VO610A-3X001      | -                 |
| DIP-4, 400 mil, option 6        | -               | -                | VO610A-3X016      | -                 |
| SMD-4, option 7                 | -               | -                | -                 | VO610A-4X017T     |
| SMD-4, option 8                 | -               | -                | VO610A-3X018T     | -                 |
| SMD-4, option 9                 | VO610A-1X019T   | -                | VO610A-3X019T     | VO610A-4X019T     |

**Note**

- Additional options may be possible, please contact sales office

**ABSOLUTE MAXIMUM RATINGS** ( $T_{amb} = 25\text{ }^{\circ}\text{C}$ , unless otherwise specified)

| PARAMETER                            | TEST CONDITION                       | SYMBOL     | VALUE       | UNIT               |
|--------------------------------------|--------------------------------------|------------|-------------|--------------------|
| <b>INPUT</b>                         |                                      |            |             |                    |
| Reverse voltage                      |                                      | $V_R$      | 6           | V                  |
| Forward current                      |                                      | $I_F$      | 60          | mA                 |
| Forward surge current                | $t_p \leq 10\text{ }\mu\text{s}$     | $I_{FSM}$  | 1.5         | A                  |
| LED power dissipation                | at $25\text{ }^{\circ}\text{C}$      | $P_{diss}$ | 100         | mW                 |
| <b>OUTPUT</b>                        |                                      |            |             |                    |
| Collector emitter voltage            |                                      | $V_{CEO}$  | 70          | V                  |
| Emitter collector voltage            |                                      | $V_{ECO}$  | 7           | V                  |
| Collector current                    |                                      | $I_C$      | 50          | mA                 |
| Collector peak current               | $t_p/T = 0.5, t_p \leq 10\text{ ms}$ | $I_{CM}$   | 100         | mA                 |
| Output power dissipation             | at $25\text{ }^{\circ}\text{C}$      | $P_{diss}$ | 150         | mW                 |
| <b>COUPLER</b>                       |                                      |            |             |                    |
| Operating ambient temperature range  |                                      | $T_{amb}$  | -55 to +110 | $^{\circ}\text{C}$ |
| Storage temperature range            |                                      | $T_{stg}$  | -55 to +125 | $^{\circ}\text{C}$ |
| Soldering temperature <sup>(1)</sup> | 2 mm from case, $\leq 10\text{ s}$   | $T_{sld}$  | 260         | $^{\circ}\text{C}$ |

**Notes**

- 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.
- <sup>(1)</sup> Refer to reflow profile for soldering conditions for surface mounted parts (SMD), and wave profile for soldering conditions for through hole parts (DIP), please go to "Assembly Instructions" ([www.vishay.com/doc?80054](http://www.vishay.com/doc?80054)).

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

| PARAMETER                            | TEST CONDITION                                                     | SYMBOL      | MIN. | TYP. | MAX. | UNIT          |
|--------------------------------------|--------------------------------------------------------------------|-------------|------|------|------|---------------|
| <b>INPUT</b>                         |                                                                    |             |      |      |      |               |
| Forward voltage                      | $I_F = 50\text{ mA}$                                               | $V_F$       | -    | 1.25 | 1.6  | V             |
| Reverse current                      | $V_R = 6\text{ V}$                                                 | $I_R$       | -    | -    | 100  | $\mu\text{A}$ |
| Junction capacitance                 | $V_R = 0, f = 1\text{ MHz}$                                        | $C_j$       | -    | 50   | -    | pF            |
| <b>OUTPUT</b>                        |                                                                    |             |      |      |      |               |
| Collector emitter voltage            | $I_C = 1\text{ mA}$                                                | $V_{CEO}$   | 70   | -    | -    | V             |
| Emitter collector voltage            | $I_E = 100\text{ }\mu\text{A}$                                     | $V_{ECO}$   | 7    | -    | -    | V             |
| Collector emitter cut-off current    | $V_{CE} = 20\text{ V}, I_F = 0\text{ A}$                           | $I_{CEO}$   | -    | 10   | 100  | nA            |
| <b>COUPLER</b>                       |                                                                    |             |      |      |      |               |
| Collector emitter saturation voltage | $I_F = 10\text{ mA}, I_C = 1\text{ mA}$                            | $V_{CEsat}$ | -    | -    | 0.3  | V             |
| Cut-off frequency                    | $V_{CE} = 5\text{ V}, I_F = 10\text{ mA}, R_L = 100\text{ }\Omega$ | $f_c$       | -    | 110  | -    | kHz           |
| Coupling capacitance                 | $f = 1\text{ MHz}$                                                 | $C_k$       | -    | 0.6  | -    | pF            |

**Note**

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

| PARAMETER | TEST CONDITION                            | PART     | SYMBOL | MIN. | TYP. | MAX. | UNIT |
|-----------|-------------------------------------------|----------|--------|------|------|------|------|
| $I_C/I_F$ | $V_{CE} = 5\text{ V}, I_F = 1\text{ mA}$  | VO610A-1 | CTR    | 13   | 30   | -    | %    |
|           |                                           | VO610A-2 | CTR    | 22   | 45   | -    | %    |
|           |                                           | VO610A-3 | CTR    | 34   | 70   | -    | %    |
|           |                                           | VO610A-4 | CTR    | 56   | 90   | -    | %    |
|           | $V_{CE} = 5\text{ V}, I_F = 10\text{ mA}$ | VO610A-1 | CTR    | 40   | -    | 80   | %    |
|           |                                           | VO610A-2 | CTR    | 63   | -    | 125  | %    |
|           |                                           | VO610A-3 | CTR    | 100  | -    | 200  | %    |
|           |                                           | VO610A-4 | CTR    | 160  | -    | 320  | %    |

**SAFETY AND INSULATION RATINGS**

| PARAMETER                                    | TEST CONDITION                                                 | SYMBOL     | VALUE          | UNIT               |
|----------------------------------------------|----------------------------------------------------------------|------------|----------------|--------------------|
| Climatic classification                      | According to IEC 68 part 1                                     |            | 55/110/21      |                    |
| Pollution degree                             | According to DIN VDE 0109                                      |            | 2              |                    |
| Comparative tracking index                   | Insulation group IIIa                                          | CTI        | 175            |                    |
| Maximum rated withstanding isolation voltage | According to UL1577, $t = 1\text{ min}$                        | $V_{ISO}$  | 5000           | $V_{RMS}$          |
| Maximum transient isolation voltage          | According to DIN EN 60747-5-5                                  | $V_{IOTM}$ | 6000           | $V_{peak}$         |
| Maximum repetitive peak isolation voltage    | According to DIN EN 60747-5-5                                  | $V_{IORM}$ | 850            | $V_{peak}$         |
| Isolation resistance                         | $T_{amb} = 25\text{ }^{\circ}\text{C}, V_{IO} = 500\text{ V}$  | $R_{IO}$   | $\geq 10^{12}$ | $\Omega$           |
|                                              | $T_{amb} = 100\text{ }^{\circ}\text{C}, V_{IO} = 500\text{ V}$ | $R_{IO}$   | $\geq 10^{11}$ | $\Omega$           |
|                                              | $T_{amb} = T_S, V_{IO} = 500\text{ V}$                         | $R_{IO}$   | $\geq 10^9$    | $\Omega$           |
| Output safety power                          |                                                                | $P_{SO}$   | 265            | mW                 |
| Input safety current                         |                                                                | $I_{SI}$   | 130            | mA                 |
| Input safety temperature                     |                                                                | $T_S$      | 150            | $^{\circ}\text{C}$ |
| Creepage distance                            | DIP-4; SMD-4, option 7;<br>SMD-4, option 9                     |            | $\geq 7.6$     | mm                 |
| Clearance distance                           |                                                                |            | $\geq 7.6$     | mm                 |
| Creepage distance                            | DIP-4, 400 mil, option 6;<br>SMD-4, option 8                   |            | $\geq 8$       | mm                 |
| Clearance distance                           |                                                                |            | $\geq 8$       | mm                 |
| Insulation thickness                         |                                                                | DTI        | $\geq 0.4$     | mm                 |

**Note**

- According to DIN EN 60747-5-5 (VDE 0884), § 7.4.3.8.2 (see Fig. 2). This optocoupler is suitable for safe electrical isolation only within the safety ratings. Compliance with the safety ratings shall be ensured by means of suitable protective circuits.

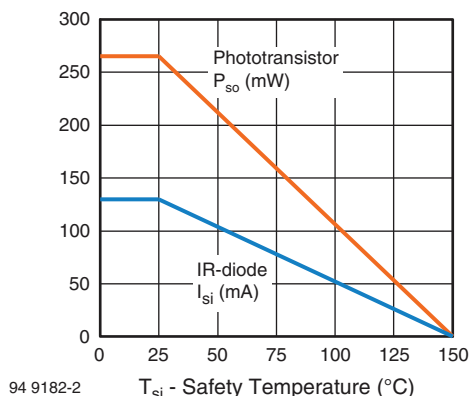


Fig. 1 - Derating Diagram

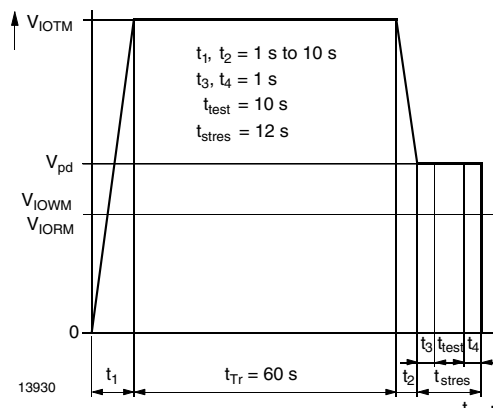


Fig. 2 - Test Pulse Diagram for Sample Test according to DIN EN 60747-5-5 (VDE0884), IEC 60747

| SWITCHING CHARACTERISTICS ( $T_{amb} = 25\text{ }^{\circ}\text{C}$ , unless otherwise specified) |                                                                                     |           |      |      |      |               |
|--------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-----------|------|------|------|---------------|
| PARAMETER                                                                                        | TEST CONDITION                                                                      | SYMBOL    | MIN. | TYP. | MAX. | UNIT          |
| Delay time                                                                                       | $V_S = 5\text{ V}$ , $I_C = 2\text{ mA}$ , $R_L = 100\text{ }\Omega$ , (see Fig. 3) | $t_d$     | -    | 3    | -    | $\mu\text{s}$ |
| Rise time                                                                                        | $V_S = 5\text{ V}$ , $I_C = 2\text{ mA}$ , $R_L = 100\text{ }\Omega$ , (see Fig. 3) | $t_r$     | -    | 3    | -    | $\mu\text{s}$ |
| Fall time                                                                                        | $V_S = 5\text{ V}$ , $I_C = 2\text{ mA}$ , $R_L = 100\text{ }\Omega$ , (see Fig. 3) | $t_f$     | -    | 4.7  | -    | $\mu\text{s}$ |
| Storage time                                                                                     | $V_S = 5\text{ V}$ , $I_C = 2\text{ mA}$ , $R_L = 100\text{ }\Omega$ , (see Fig. 3) | $t_s$     | -    | 0.3  | -    | $\mu\text{s}$ |
| Turn-on time                                                                                     | $V_S = 5\text{ V}$ , $I_C = 2\text{ mA}$ , $R_L = 100\text{ }\Omega$ , (see Fig. 3) | $t_{on}$  | -    | 6    | -    | $\mu\text{s}$ |
| Turn-off time                                                                                    | $V_S = 5\text{ V}$ , $I_C = 2\text{ mA}$ , $R_L = 100\text{ }\Omega$ , (see Fig. 3) | $t_{off}$ | -    | 5    | -    | $\mu\text{s}$ |
| Turn-on time                                                                                     | $V_S = 5\text{ V}$ , $I_F = 10\text{ mA}$ , $R_L = 1\text{ k}\Omega$ , (see Fig. 4) | $t_{on}$  | -    | 9    | -    | $\mu\text{s}$ |
| Turn-off time                                                                                    | $V_S = 5\text{ V}$ , $I_F = 10\text{ mA}$ , $R_L = 1\text{ k}\Omega$ , (see Fig. 4) | $t_{off}$ | -    | 10   | -    | $\mu\text{s}$ |

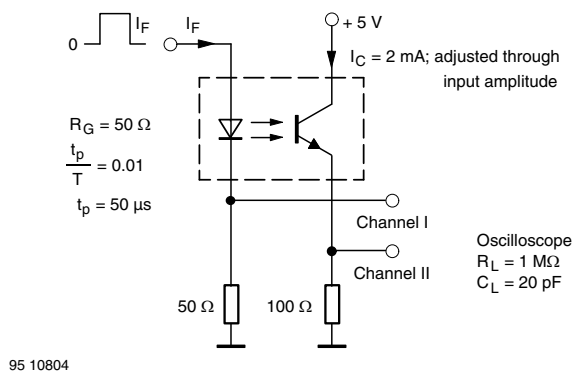


Fig. 3 - Test Circuit, Non-Saturated Operation

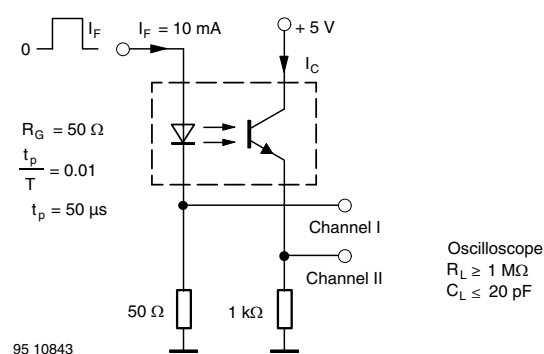


Fig. 4 - Test Circuit, Saturated Operation

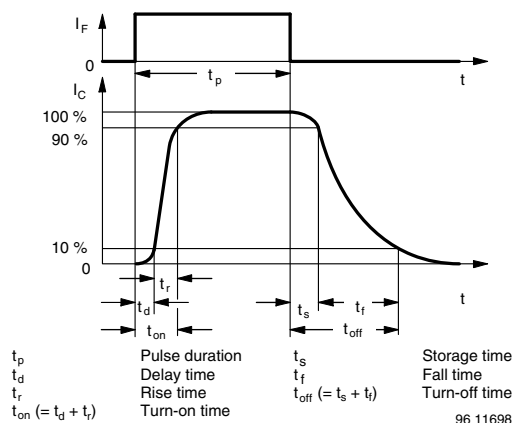


Fig. 5 - Switching Times

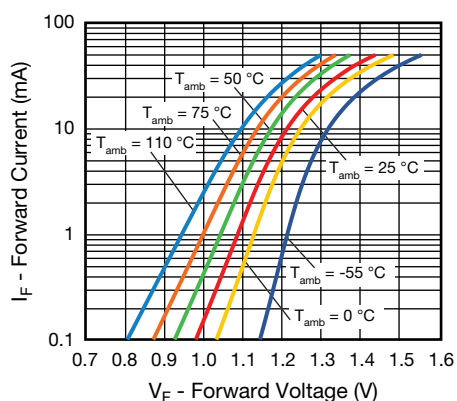
**TYPICAL CHARACTERISTICS** ( $T_{amb} = 25\text{ }^{\circ}\text{C}$ , unless otherwise specified)


Fig. 6 - Forward Current vs. Forward Voltage

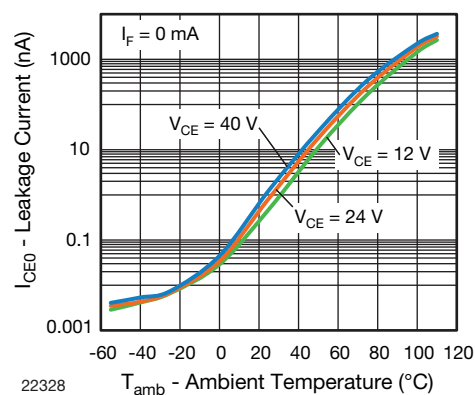


Fig. 8 - Leakage Current vs. Ambient Temperature

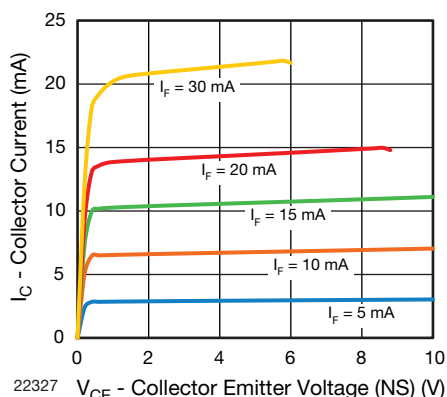


Fig. 7 - Collector Current vs. Collector Emitter Voltage (non-saturated)

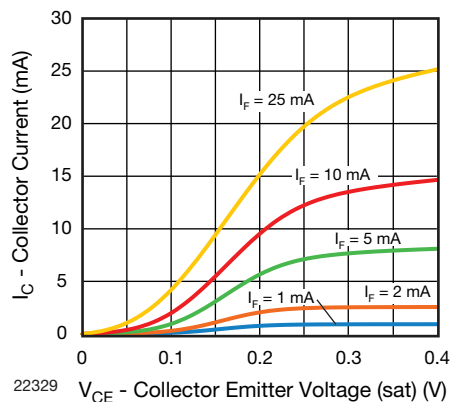


Fig. 9 - Collector Current vs. Collector Emitter Voltage (saturated)

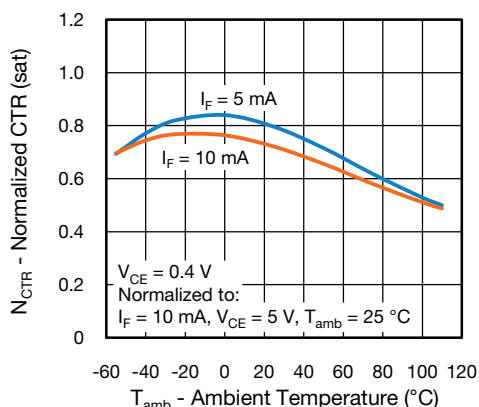


Fig. 10 - Normalized CTR (saturated) vs. Ambient Temperature

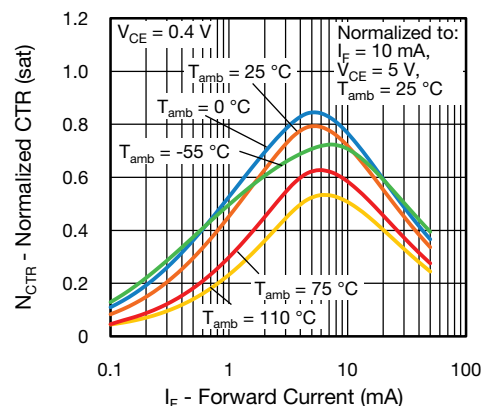


Fig. 13 - Normalized CTR (saturated) vs. Forward Current

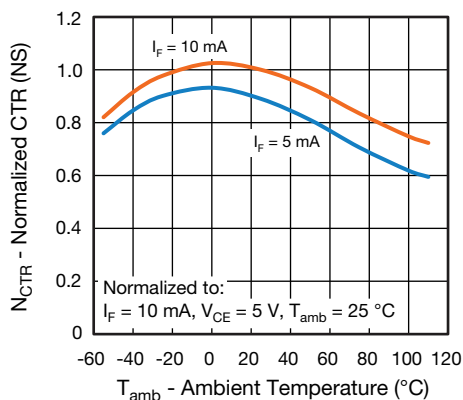


Fig. 11 - Normalized CTR (non-saturated) vs. Ambient Temperature

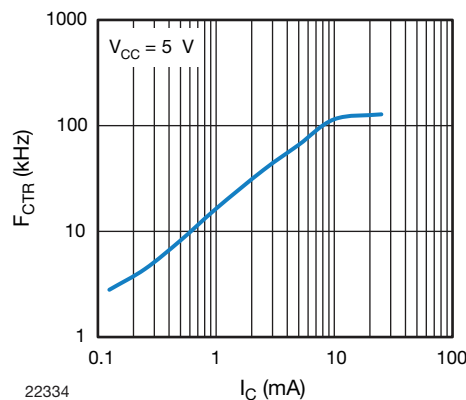
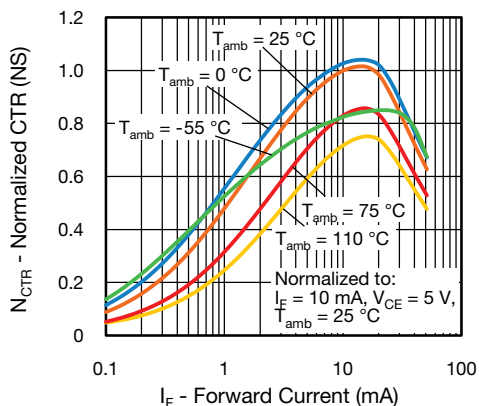

Fig. 14 -  $F_{CTR}$  vs.  $I_C$  (saturated) (mA)


Fig. 12 - Normalized CTR (non-saturated) vs. Forward Current

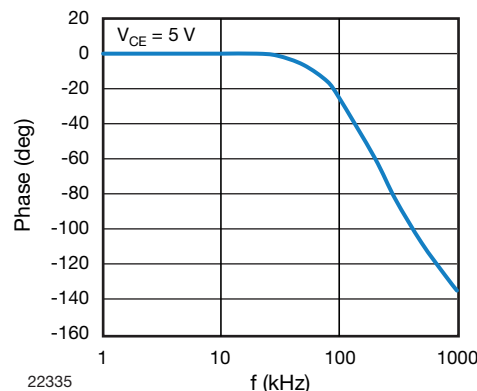


Fig. 15 - Phase Angle vs. Frequency

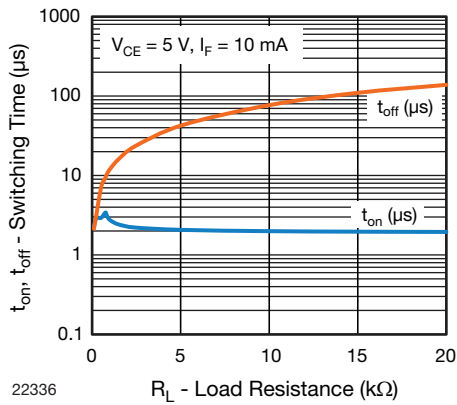
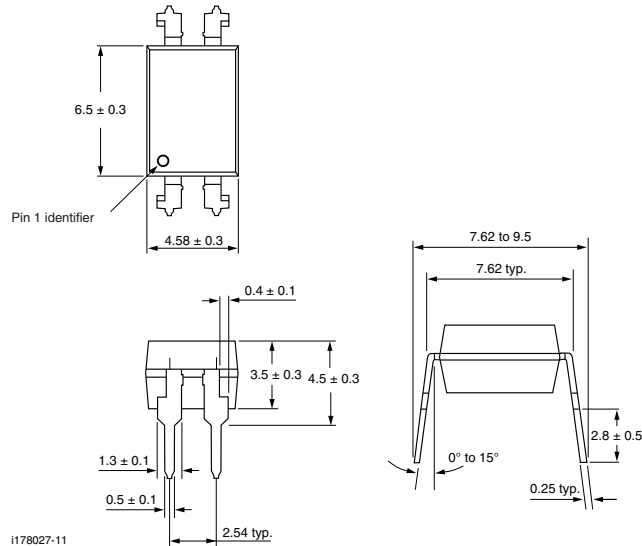
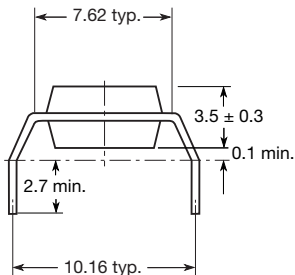
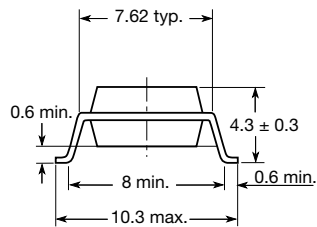
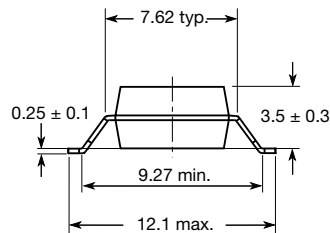
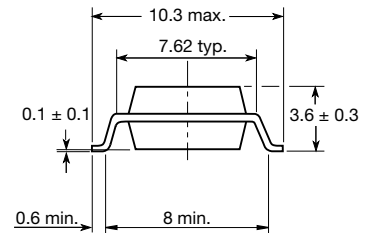
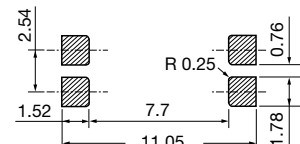
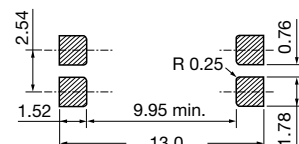
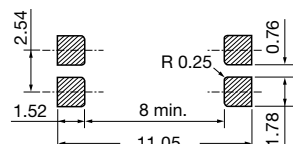
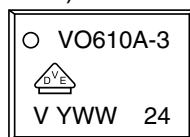


Fig. 16 - Switching Time vs. Load Resistance

**PACKAGE DIMENSIONS** in millimeters

**Option 6**

**Option 7**

**Option 8**

**Option 9**


20802-38



**PACKAGE MARKING** (Example of VO617A-3X018T)

**Notes**

- Only options 1, 7, and 8 are reflected in the package marking.
- The VDE logo is only printed on option 1 parts.
- Tape and reel suffix (T) is not part of the package marking.

**PACKING INFORMATION**

| DEVICE PER TUBE              |            |           |           |
|------------------------------|------------|-----------|-----------|
| TYPE                         | UNITS/TUBE | TUBES/BOX | UNITS/BOX |
| DIP-4, standard and option 6 | 100        | 40        | 4000      |

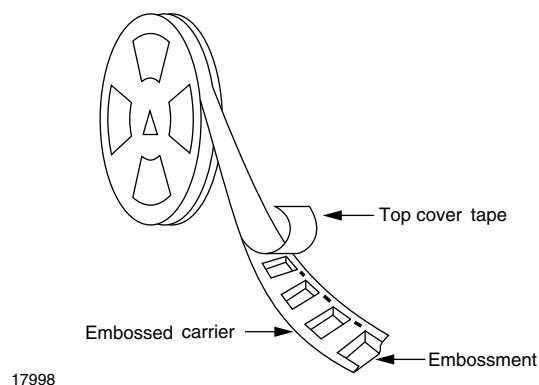


Fig. 17 - Tape and Reel Shipping Medium

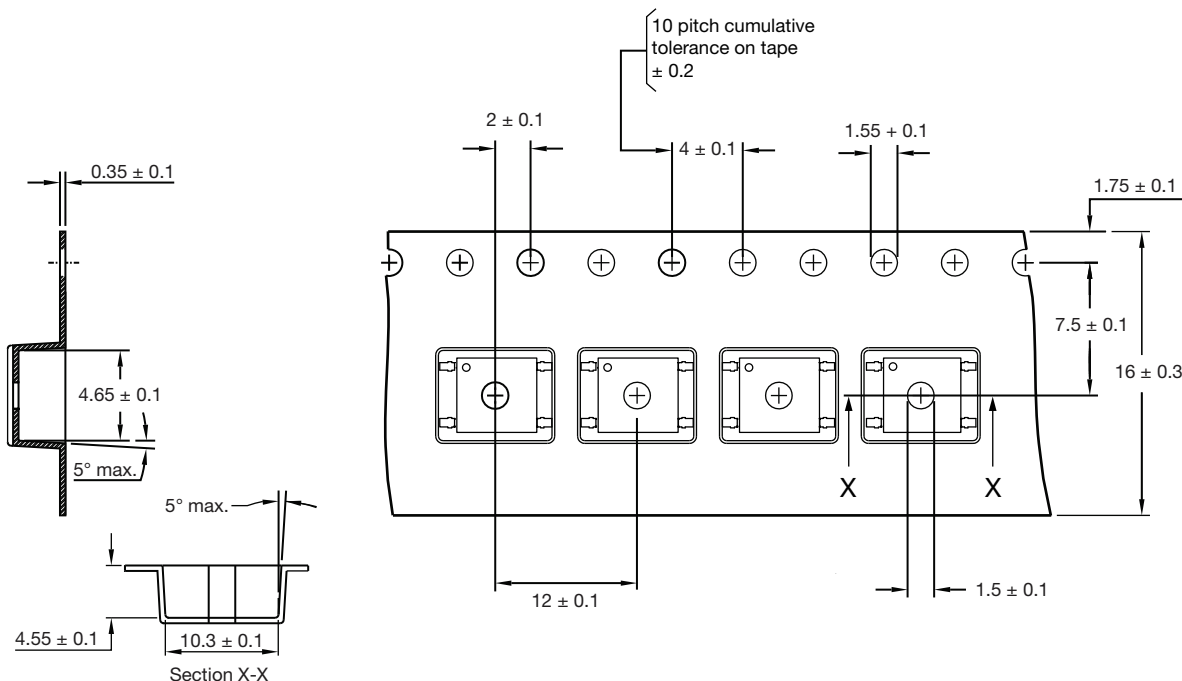


Fig. 18 - Tape and Reel Packing for Option 7 and Option 9  
(1000 units per reel)

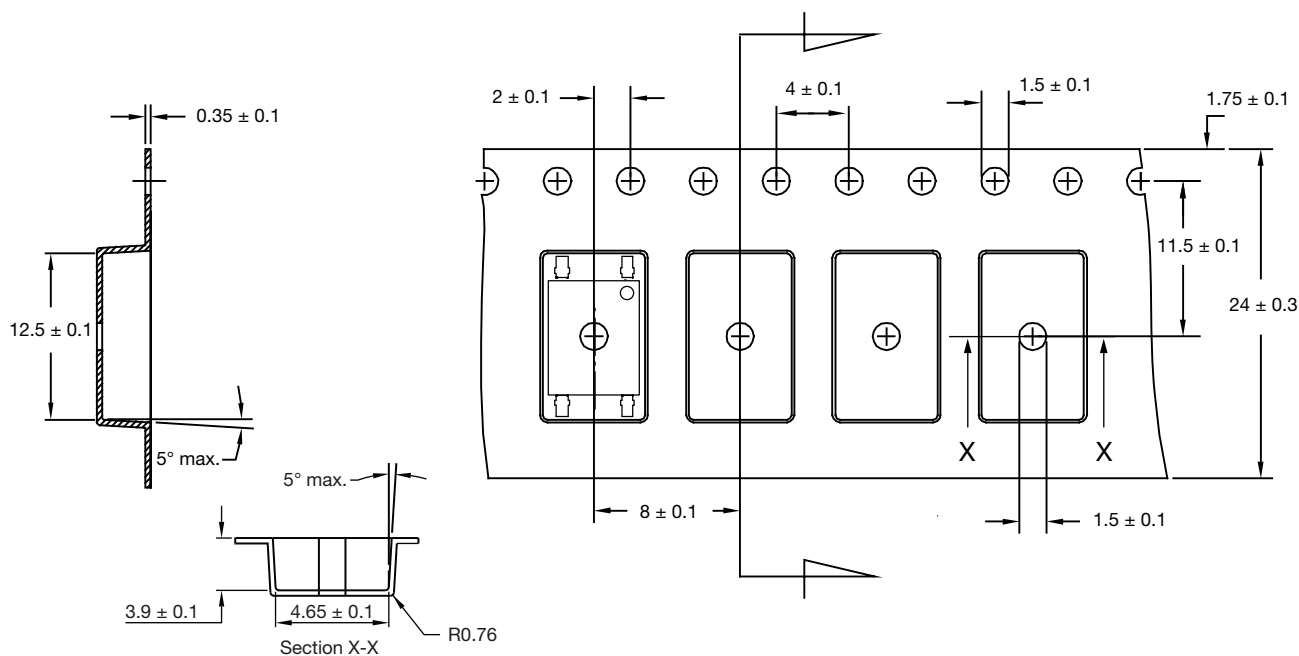


Fig. 19 - Tape and Reel Packing for Option 8  
(2000 units per reel)



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