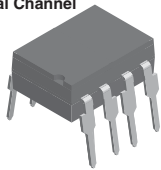
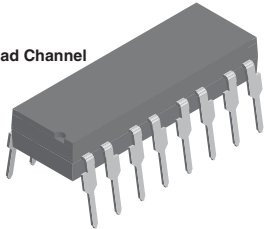


Optocoupler, Phototransistor Output (Dual, Quad Channel)

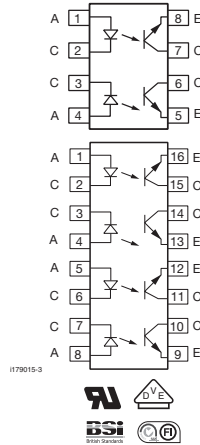
Dual Channel



Quad Channel



i179012-1



FEATURES

- Current transfer ratio at $I_F = 10 \text{ mA}$
- Isolation test voltage, $5300 \text{ V}_{\text{RMS}}$
- Compliant to RoHS Directive 2002/95/EC and in accordance to WEEE 2002/96/EC



RoHS
COMPLIANT

AGENCY APPROVALS

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

DESCRIPTION

The ILD1, ILD2, ILD5, ILQ1, ILQ2, ILQ5 are optically coupled isolated pairs employing GaAs infrared LEDs and silicon NPN phototransistor. Signal information, including a DC level, can be transmitted by the drive while maintaining a high degree of electrical isolation between input and output.

The ILD1, ILD2, ILD5, ILQ1, ILQ2, ILQ5 are especially designed for driving medium-speed logic and can be used to eliminate troublesome ground loop and noise problems. Also these couplers can be used to replace relays and transformers in many digital interface applications such as CTR modulation.

The ILD1, ILD2, ILD5 has two isolated channels in a single DIP package and the ILQ1, ILQ2, ILQ5 has four isolated channels per package.

| ORDERING INFORMATION | | | | | | |
|---|---------------------------|---------------------------|---------------------------|---------------------------|---------------------------|---------------------------|
| <div style="display: flex; justify-content: space-around; align-items: center;"> <div style="border: 1px solid black; padding: 2px 5px;">I</div> <div style="border: 1px solid black; padding: 2px 5px;">L</div> <div style="border: 1px solid black; padding: 2px 5px;">x</div> <div style="border: 1px solid black; padding: 2px 5px;">#</div> <div style="border: 1px solid black; padding: 2px 5px;">-</div> <div style="border: 1px solid black; padding: 2px 5px;">X</div> <div style="border: 1px solid black; padding: 2px 5px;">0</div> <div style="border: 1px solid black; padding: 2px 5px;">#</div> <div style="border: 1px solid black; padding: 2px 5px;">#</div> <div style="border: 1px solid black; padding: 2px 5px;">T</div> </div> <p style="text-align: center;">PART NUMBER PACKAGE OPTION TAPE AND REEL</p> <p style="text-align: center;">x = D (Dual) or Q (Quad)</p> | | | | | | |
| | | | | | | |
| AGENCY CERTIFIED/PACKAGE | DUAL CHANNEL | | | QUAD CHANNEL | | |
| | CTR (%) | | | | | |
| UL, CSA, BSI, FIMKO | 20 to 300 | 100 to 500 | 50 to 400 | 20 to 300 | 100 to 500 | 50 to 400 |
| DIP-8 | ILD1 | ILD2 | ILD5 | - | - | - |
| DIP-8, 400 mil, option 6 | - | ILD2-X006 | - | - | - | - |
| SMD-8, option 7 | ILD1-X007T ⁽¹⁾ | ILD2-X007T ⁽¹⁾ | - | - | - | - |
| SMD-8, option 9 | ILD1-X009T ⁽¹⁾ | ILD2-X009T ⁽¹⁾ | ILD5-X009T ⁽¹⁾ | - | - | - |
| DIP-16 | - | - | - | ILQ1 | ILQ2 | ILQ5 |
| DIP-16, 400 mil, option 6 | - | - | - | ILQ1-X006 | ILQ2-X006 | - |
| SMD-16, option 7 | - | - | - | ILQ1-X007 | ILQ2-X007T ⁽¹⁾ | - |
| SMD-16, option 9 | - | - | - | ILQ1-X009T ⁽¹⁾ | ILQ2-X009T ⁽¹⁾ | ILQ5-X009T ⁽¹⁾ |



| AGENCY CERTIFIED/PACKAGE | DUAL CHANNEL | | | QUAD CHANNEL | | |
|---------------------------|--------------|------------|-----------|--------------|---------------------------|-----------|
| | CTR (%) | | | | | |
| VDE, UL, CSA, BSI, FIMKO | 20 to 300 | 100 to 500 | 50 to 400 | 20 to 300 | 100 to 500 | 50 to 400 |
| DIP-8 | ILD1-X001 | ILD2-X001 | ILD5-X001 | - | - | - |
| DIP-8, 400 mil, option 6 | - | ILD2-X016 | - | - | - | - |
| SMD-8, option 7 | - | ILD2-X017 | - | - | - | - |
| SMD-8, option 9 | ILD1-X019T | - | - | - | - | - |
| DIP-16 | - | - | - | - | ILQ2-X001 | - |
| DIP-16, 400 mil, option 6 | - | - | - | - | ILQ2-X016 | - |
| SMD-16, option 7 | - | - | - | - | ILQ2-X017T ⁽¹⁾ | - |

Notes

- Additional options may be possible, please contact sales office.
- ⁽¹⁾ Also available in tubes; do not put T on end.

| ABSOLUTE MAXIMUM RATINGS (T _{amb} = 25 °C, unless otherwise specified) | | | | | |
|---|--|------|-------------------|--------------------|------------------|
| PARAMETER | TEST CONDITION | PART | SYMBOL | VALUE | UNIT |
| INPUT | | | | | |
| Reverse voltage | | | V _R | 6 | V |
| Forward current | | | I _F | 60 | mA |
| Surge current | | | I _{FSM} | 2.5 | A |
| Power dissipation | | | P _{diss} | 100 | mW |
| Derate linearly from 25 °C | | | | 1.3 | mW/°C |
| OUTPUT | | | | | |
| Collector emitter reverse voltage | | ILD1 | V _{CEO} | 50 | V |
| | | ILQ1 | V _{CEO} | 50 | V |
| | | ILD2 | V _{CEO} | 70 | V |
| | | ILQ2 | V _{CEO} | 70 | V |
| | | ILD5 | V _{CEO} | 70 | V |
| | | ILQ5 | V _{CEO} | 70 | V |
| Collector current | t < 1 ms | | I _C | 50 | mA |
| | | | I _C | 400 | mA |
| Power dissipation | | | P _{diss} | 200 | mW |
| Derate linearly from 25 °C | | | | 2.6 | mW/°C |
| COUPLER | | | | | |
| Isolation test voltage between emitter and detector | | | V _{ISO} | 5300 | V _{RMS} |
| Creepage distance | | | | ≥ 7 | mm |
| Clearance distance | | | | ≥ 7 | mm |
| Isolation resistance | V _{IO} = 500 V, T _{amb} = 25 °C | | R _{IO} | ≥ 10 ¹² | Ω |
| | V _{IO} = 500 V, T _{amb} = 100 °C | | R _{IO} | ≥ 10 ¹¹ | |
| Package power dissipation | | | P _{tot} | 250 | mW |
| Derate linearly from 25 °C | | | | 3.3 | mW/°C |
| Storage temperature | | | T _{stg} | - 40 to + 150 | °C |
| Operating temperature | | | T _{amb} | - 40 to + 100 | °C |
| Junction temperature | | | T _j | 100 | °C |
| Soldering temperature ⁽²⁾ | 2 mm from case bottom | | T _{slid} | 260 | °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.
- ⁽¹⁾ Refer to reflow profile for soldering conditions for surface mounted devices (SMD). Refer to wave profile for soldering conditions for through hole devices (DIP).



| ELECTRICAL CHARACTERISTICS ($T_{amb} = 25\text{ }^{\circ}\text{C}$, unless otherwise specified) | | | | | | |
|--|---|-------------|------|------|------|---------------|
| PARAMETER | TEST CONDITION | SYMBOL | MIN. | TYP. | MAX. | UNIT |
| INPUT | | | | | | |
| Forward voltage | $I_F = 60\text{ mA}$ | V_F | | 1.25 | 1.65 | V |
| Reverse current | $V_R = 6\text{ V}$ | I_R | | 0.01 | 10 | μA |
| Capacitance | $V_R = 0\text{ V}$, $f = 1\text{ MHz}$ | C_O | | 25 | | pF |
| Thermal resistance, junction to lead | | T_{thJL} | | 750 | | K/W |
| OUTPUT | | | | | | |
| Collector emitter capacitance | $V_{CE} = 5\text{ V}$, $f = 1\text{ MHz}$ | C_{CE} | | 6.8 | | pF |
| Collector emitter leakage current | $V_{VCE} = 10\text{ V}$ | I_{CEO} | | 5 | 50 | nA |
| Saturation voltage, collector emitter | $I_C = 1\text{ mA}$, $I_B = 20\text{ }\mu\text{A}$ | V_{CESAT} | | 0.25 | 0.4 | V |
| DC forward current gain | $V_{CE} = 10\text{ V}$, $I_B = 20\text{ }\mu\text{A}$ | h_{FE} | 200 | 650 | 1800 | |
| DC forward current gain saturated | $V_{CE} = 0.4\text{ V}$, $I_B = 20\text{ }\mu\text{A}$ | h_{FEsat} | 120 | 400 | 600 | |
| Thermal resistance, junction to lead | | R_{thjL} | | 500 | | K/W |
| COUPLER | | | | | | |
| Capacitance (input to output) | $V_{IO} = 0\text{ V}$, $f = 1\text{ MHz}$ | C_{IO} | | 0.8 | | 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 (collector emitter saturated) | $I_F = 10\text{ mA}$, $V_{CE} = 0.4\text{ V}$ | ILD1 | CTR_{CEsat} | | 75 | | % |
| | | ILQ1 | CTR_{CEsat} | | 75 | | % |
| | | ILD2 | CTR_{CEsat} | | 170 | | % |
| | | ILQ2 | CTR_{CEsat} | | 170 | | % |
| | | ILD5 | CTR_{CEsat} | | 100 | | % |
| | | ILQ5 | CTR_{CEsat} | | 100 | | % |
| | $I_F = 10\text{ mA}$, $V_{CE} = 10\text{ V}$ | ILD1 | CTR_{CE} | 20 | 80 | 300 | % |
| | | ILQ1 | CTR_{CE} | 20 | 80 | 300 | % |
| | | ILD2 | CTR_{CE} | 100 | 200 | 500 | % |
| | | ILQ2 | CTR_{CE} | 100 | 200 | 500 | % |
| | | ILD5 | CTR_{CE} | 50 | 130 | 400 | % |
| | | ILQ5 | CTR_{CE} | 50 | 130 | 400 | % |

| SAFETY AND INSULATION RATINGS | | | | | | |
|--|--|------------|-----------|-----------|------|-----------|
| PARAMETER | TEST CONDITION | SYMBOL | MIN. | TYP. | MAX. | UNIT |
| Isolation test voltage between emitter and detector | | V_{ISO} | 5300 | | | V_{RMS} |
| Isolation resistance | $V_{IO} = 500\text{ V}, T_{amb} = 25\text{ °C}$ | R_{IO} | 10^{12} | | | Ω |
| | $V_{IO} = 500\text{ V}, T_{amb} = 100\text{ °C}$ | | 10^{11} | | | |
| Climatic classification (according to IEC 68 part 1) | | | | 55/100/21 | | |
| Comparative tracking index | | CTI | 175 | | | |
| Rated impulse voltage | | V_{IOTM} | | | 10 | kV |
| Maximum working voltage | Recurring peak voltage | V_{IORM} | | | 890 | V |
| Forward current | | I_{SI} | | | 275 | mA |
| Power dissipation | | P_{SO} | | | 400 | mW |
| Safety temperature | | T_{SI} | | | 175 | °C |
| Creepage distance | | | 7.0 | | | mm |
| Clearance distance | | | 7.0 | | | mm |
| Insulation distance | per IEC 60950 2.10.5.1 | | 0.4 | | | mm |

Note

- According to DIN EN 60747-5-2 (VDE 0884) (see figure 2). These optocouplers are suitable for “safety electrical insulation” only within the safety ratings. Compliance with the safety ratings shall be ensured by means of suitable protective circuits.

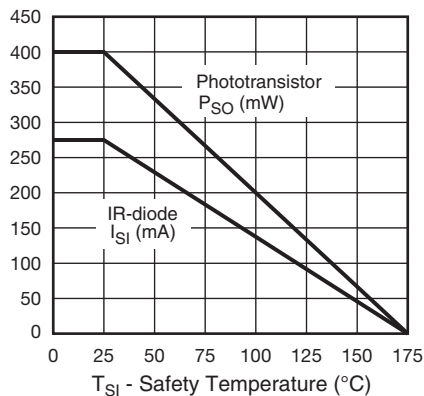


Fig. 1 - Derating Diagram

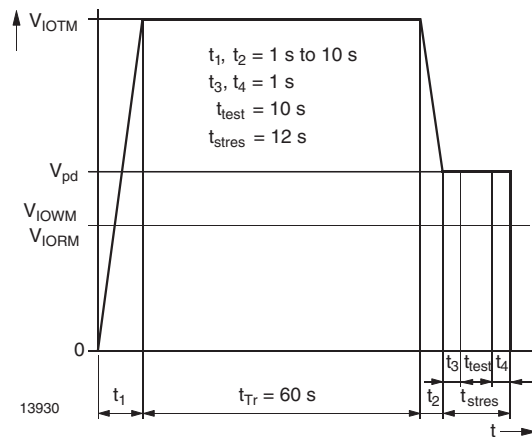


Fig. 2 - Test Pulse Diagram for Sample Test according to DIN EN 60747-5-2 (VDE 0884); IEC 60747-5-5



| SWITCHING CHARACTERISTICS (T _{amb} = 25 °C, unless otherwise specified) | | | | | | | |
|--|---|------|------------------|------|------|------|------|
| PARAMETER | TEST CONDITION | PART | SYMBOL | MIN. | TYP. | MAX. | UNIT |
| NON-SATURATED | | | | | | | |
| Current | V _{CE} = 5 V, R _L = 75 Ω, 50 % of V _{PP} | ILD1 | I _F | | 20 | | mA |
| | | ILQ1 | I _F | | 20 | | mA |
| | | ILD2 | I _F | | 5 | | mA |
| | | ILQ2 | I _F | | 5 | | mA |
| | | ILD5 | I _F | | 10 | | mA |
| | | ILQ5 | I _F | | 10 | | mA |
| Delay | V _{CE} = 5 V, R _L = 75 Ω, 50 % of V _{PP} | ILD1 | t _D | | 0.8 | | μs |
| | | ILQ1 | t _D | | 0.8 | | μs |
| | | ILD2 | t _D | | 1.7 | | μs |
| | | ILQ2 | t _D | | 1.7 | | μs |
| | | ILD5 | t _D | | 1.7 | | μs |
| | | ILQ5 | t _D | | 1.7 | | μs |
| Rise time | V _{CE} = 5 V, R _L = 75 Ω, 50 % of V _{PP} | ILD1 | t _r | | 1.9 | | μs |
| | | ILQ1 | t _r | | 1.9 | | μs |
| | | ILD2 | t _r | | 2.6 | | μs |
| | | ILQ2 | t _r | | 2.6 | | μs |
| | | ILD5 | t _r | | 2.6 | | μs |
| | | ILQ5 | t _r | | 2.6 | | μs |
| Storage | V _{CE} = 5 V, R _L = 75 Ω, 50 % of V _{PP} | ILD1 | t _s | | 0.2 | | μs |
| | | ILQ1 | t _s | | 0.2 | | μs |
| | | ILD2 | t _s | | 0.4 | | μs |
| | | ILQ2 | t _s | | 0.4 | | μs |
| | | ILD5 | t _s | | 0.4 | | μs |
| | | ILQ5 | t _s | | 0.4 | | μs |
| Fall time | V _{CE} = 5 V, R _L = 75 Ω, 50 % of V _{PP} | ILD1 | t _f | | 1.4 | | μs |
| | | ILQ1 | t _f | | 1.4 | | μs |
| | | ILD2 | t _f | | 2.2 | | μs |
| | | ILQ2 | t _f | | 2.2 | | μs |
| | | ILD5 | t _f | | 2.2 | | μs |
| | | ILQ5 | t _f | | 2.2 | | μs |
| Propagation H to L | V _{CE} = 5 V, R _L = 75 Ω, 50 % of V _{PP} | ILD1 | t _{PHL} | | 0.7 | | μs |
| | | ILQ1 | t _{PHL} | | 0.7 | | μs |
| | | ILD2 | t _{PHL} | | 1.2 | | μs |
| | | ILQ2 | t _{PHL} | | 1.2 | | μs |
| | | ILD5 | t _{PHL} | | 1.1 | | μs |
| | | ILQ5 | t _{PHL} | | 1.1 | | μs |
| Propagation L to H | V _{CE} = 5 V, R _L = 75 Ω, 50 % of V _{PP} | ILD1 | t _{PLH} | | 1.4 | | μs |
| | | ILQ1 | t _{PLH} | | 1.4 | | μs |
| | | ILD2 | t _{PLH} | | 2.3 | | μs |
| | | ILQ2 | t _{PLH} | | 2.3 | | μs |
| | | ILD5 | t _{PLH} | | 2.5 | | μs |
| | | ILQ5 | t _{PLH} | | 2.5 | | μs |



| SWITCHING CHARACTERISTICS ($T_{amb} = 25\text{ }^{\circ}\text{C}$, unless otherwise specified) | | | | | | | |
|--|---|------|-----------|------|------|------|---------------|
| PARAMETER | TEST CONDITION | PART | SYMBOL | MIN. | TYP. | MAX. | UNIT |
| SATURATED | | | | | | | |
| Current | $V_{CE} = 0.4\text{ V}$, $R_L = 1\text{ k}\Omega$, $V_{CC} = 5\text{ V}$, $V_{TH} = 1.5\text{ V}$ | ILD1 | I_F | | 20 | | mA |
| | | ILQ1 | I_F | | 20 | | mA |
| | | ILD2 | I_F | | 5 | | mA |
| | | ILQ2 | I_F | | 5 | | mA |
| | | ILD5 | I_F | | 10 | | mA |
| | | ILQ5 | I_F | | 10 | | mA |
| Delay | $V_{CE} = 0.4\text{ V}$, $R_L = 1\text{ k}\Omega$, $V_{CC} = 5\text{ V}$, $V_{TH} = 1.5\text{ V}$ | ILD1 | t_D | | 0.8 | | μs |
| | | ILQ1 | t_D | | 0.8 | | μs |
| | | ILD2 | t_D | | 1 | | μs |
| | | ILQ2 | t_D | | 1 | | μs |
| | | ILD5 | t_D | | 1.7 | | μs |
| | | ILQ5 | t_D | | 1.7 | | μs |
| Rise time | $V_{CE} = 0.4\text{ V}$, $R_L = 1\text{ k}\Omega$, $V_{CC} = 5\text{ V}$, $V_{TH} = 1.5\text{ V}$ | ILD1 | t_r | | 1.2 | | μs |
| | | ILQ1 | t_r | | 1.2 | | μs |
| | | ILD2 | t_r | | 2 | | μs |
| | | ILQ2 | t_r | | 2 | | μs |
| | | ILD5 | t_r | | 7 | | μs |
| | | ILQ5 | t_r | | 7 | | μs |
| Storage | $V_{CE} = 0.4\text{ V}$, $R_L = 1\text{ k}\Omega$, $V_{CC} = 5\text{ V}$, $V_{TH} = 1.5\text{ V}$ | ILD1 | t_s | | 7.4 | | μs |
| | | ILQ1 | t_s | | 7.4 | | μs |
| | | ILD2 | t_s | | 5.4 | | μs |
| | | ILQ2 | t_s | | 5.4 | | μs |
| | | ILD5 | t_s | | 4.6 | | μs |
| | | ILQ5 | t_s | | 4.6 | | μs |
| Fall time | $V_{CE} = 0.4\text{ V}$, $R_L = 1\text{ k}\Omega$, $V_{CC} = 5\text{ V}$, $V_{TH} = 1.5\text{ V}$ | ILD1 | t_f | | 7.6 | | μs |
| | | ILQ1 | t_f | | 7.6 | | μs |
| | | ILD2 | t_f | | 13.5 | | μs |
| | | ILQ2 | t_f | | 13.5 | | μs |
| | | ILD5 | t_f | | 20 | | μs |
| | | ILQ5 | t_f | | 20 | | μs |
| Propagation H to L | $V_{CE} = 0.4\text{ V}$, $R_L = 1\text{ k}\Omega$, $V_{CC} = 5\text{ V}$, $V_{TH} = 1.5\text{ V}$ | ILD1 | t_{PHL} | | 1.6 | | μs |
| | | ILQ1 | t_{PHL} | | 1.6 | | μs |
| | | ILD2 | t_{PHL} | | 5.4 | | μs |
| | | ILQ2 | t_{PHL} | | 5.4 | | μs |
| | | ILD5 | t_{PHL} | | 2.6 | | μs |
| | | ILQ5 | t_{PHL} | | 2.6 | | μs |
| Propagation L to H | $V_{CE} = 0.4\text{ V}$, $R_L = 1\text{ k}\Omega$, $V_{CC} = 5\text{ V}$, $V_{TH} = 1.5\text{ V}$ | ILD1 | t_{PLH} | | 8.6 | | μs |
| | | ILQ1 | t_{PLH} | | 8.6 | | μs |
| | | ILD2 | t_{PLH} | | 7.4 | | μs |
| | | ILQ2 | t_{PLH} | | 7.4 | | μs |
| | | ILD5 | t_{PLH} | | 7.2 | | μs |
| | | ILQ5 | t_{PLH} | | 7.2 | | μs |

| COMMON MODE TRANSIENT IMMUNITY ($T_{amb} = 25\text{ }^{\circ}\text{C}$, unless otherwise specified) | | | | | | |
|--|--|----------|------|------|------|------------------------|
| PARAMETER | TEST CONDITION | SYMBOL | MIN. | TYP. | MAX. | UNIT |
| Common mode rejection, output high | $V_{CM} = 50\text{ V}_{P-P}$, $R_L = 1\text{ k}\Omega$, $I_F = 0\text{ mA}$ | CM_H | | 5000 | | $\text{V}/\mu\text{s}$ |
| Common mode rejection, output low | $V_{CM} = 50\text{ V}_{P-P}$, $R_L = 1\text{ k}\Omega$, $I_F = 10\text{ mA}$ | CM_L | | 5000 | | $\text{V}/\mu\text{s}$ |
| Common mode coupling capacitance | | C_{CM} | | 0.01 | | pF |

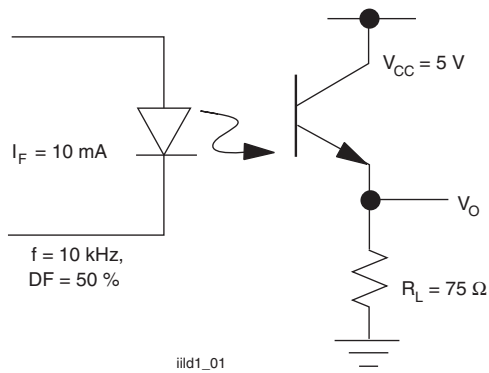
TYPICAL CHARACTERISTICS ($T_{amb} = 25\text{ }^{\circ}\text{C}$, unless otherwise specified)


Fig. 3 - Non-Saturated Switching Schematic

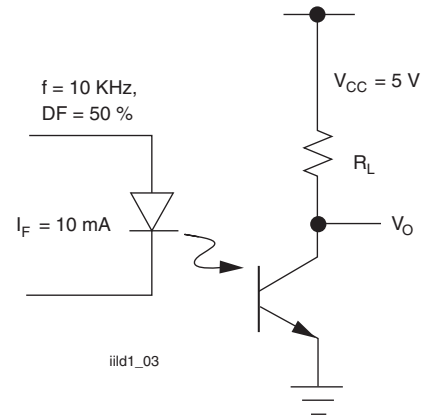


Fig. 5 - Saturated Switching Schematic

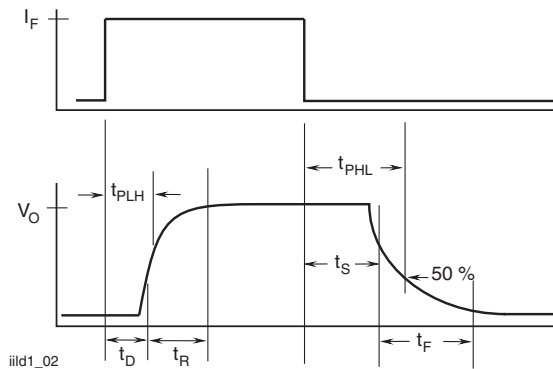


Fig. 4 - Non-Saturated Switching Timing

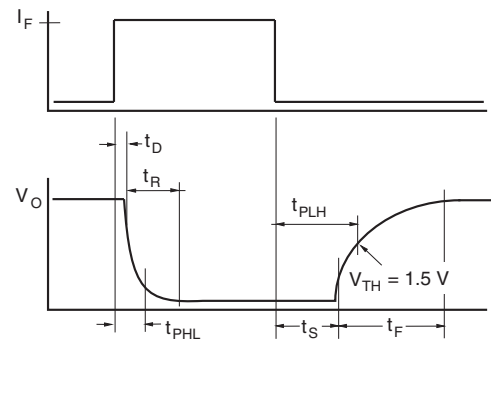


Fig. 6 - Saturated Switching Timing

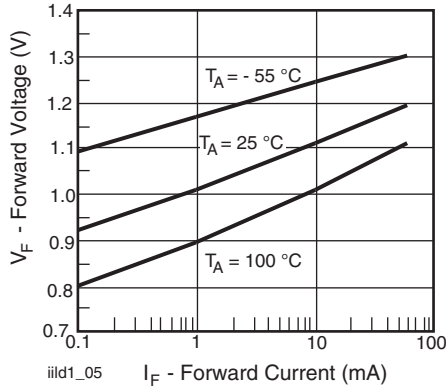


Fig. 7 - Normalized Non-Saturated and Saturated CTR vs. LED Current

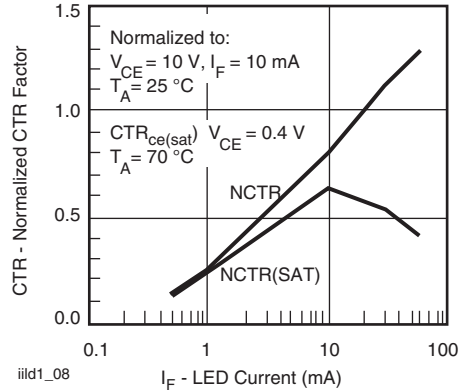


Fig. 10 - Normalized Non-Saturated and Saturated CTR vs. LED Current

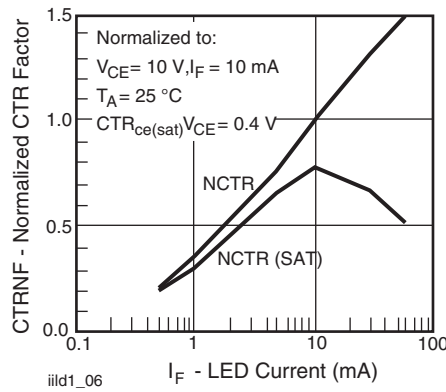


Fig. 8 - Normalized Non-Saturated and Saturated CTR vs. LED Current

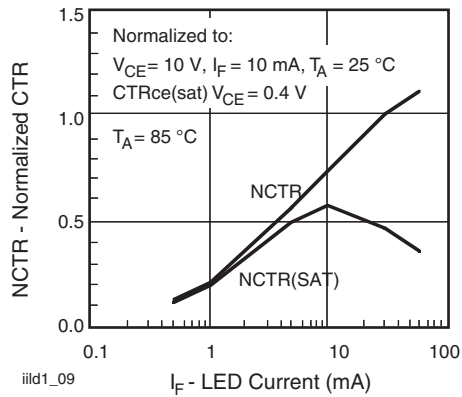


Fig. 11 - Normalized Non-Saturated and Saturated CTR vs. LED Current

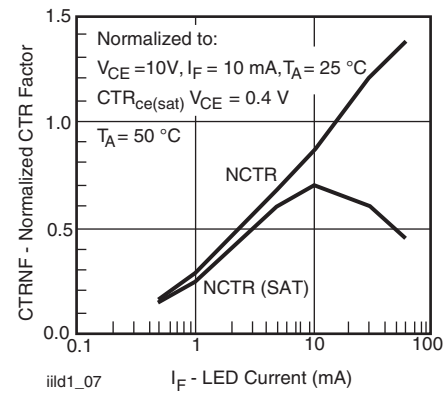


Fig. 9 - Normalized Non-Saturated and Saturated CTR vs. LED Current

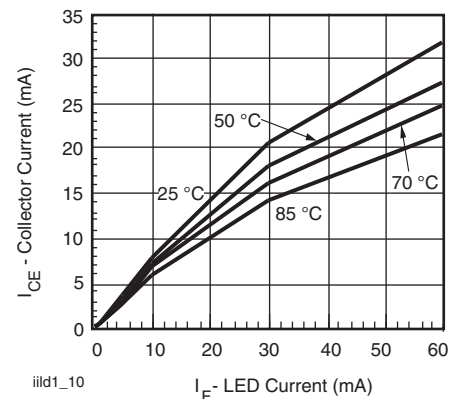


Fig. 12 - Collector Emitter Current vs. Temperature and LED Current

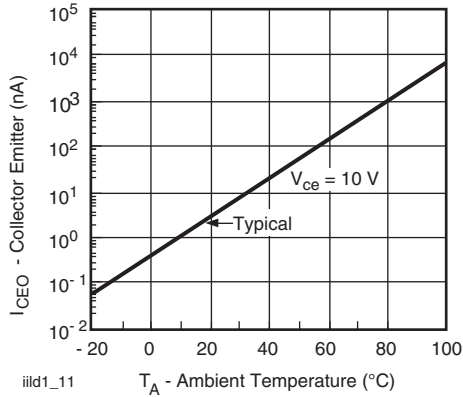


Fig. 13 - Collector Emitter Leakage Current vs. Temperature

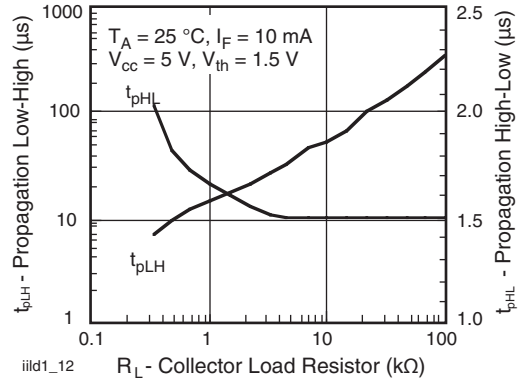
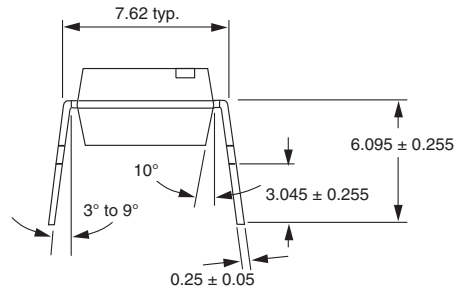
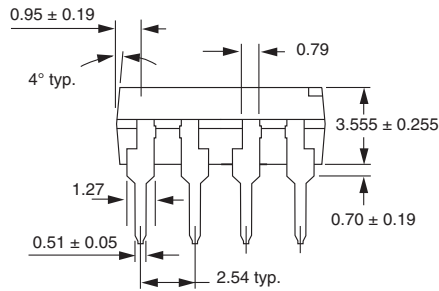
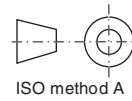
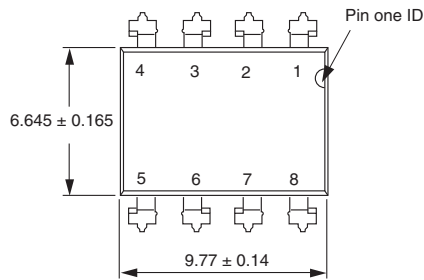


Fig. 14 - Propagation Delay vs. Collector Load Resistor

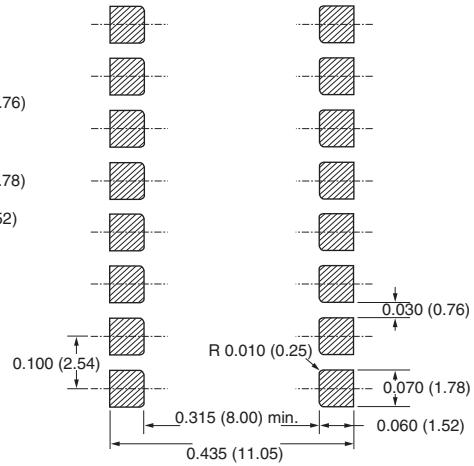
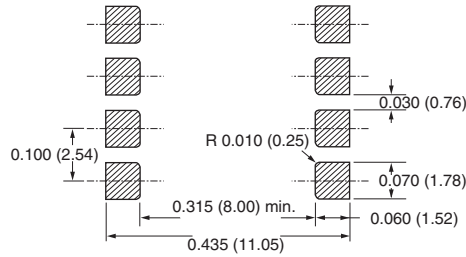
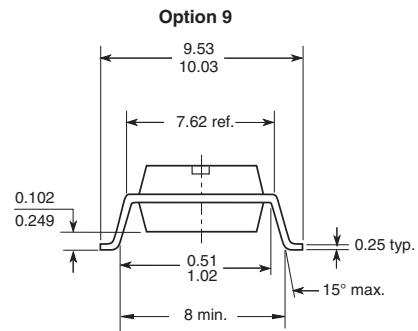
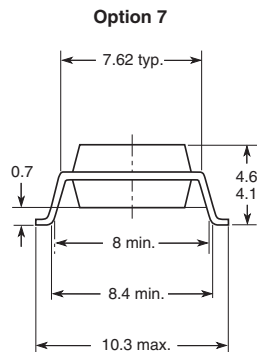
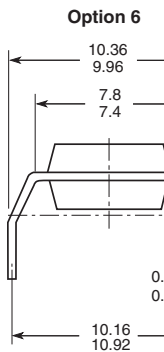
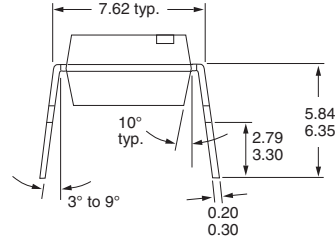
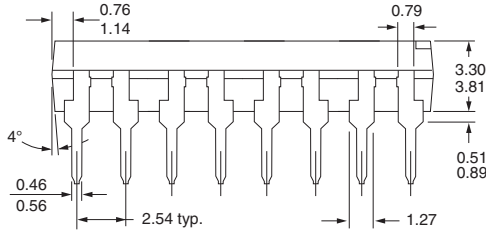
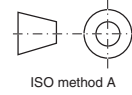
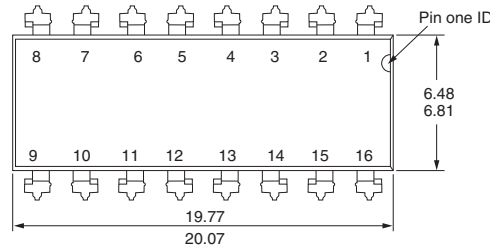
PACKAGE DIMENSIONS in millimeters



i178006

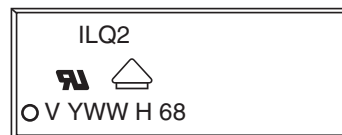
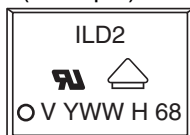


PACKAGE DIMENSIONS in millimeters



18450-9

PACKAGE MARKING (example)



Notes

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



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