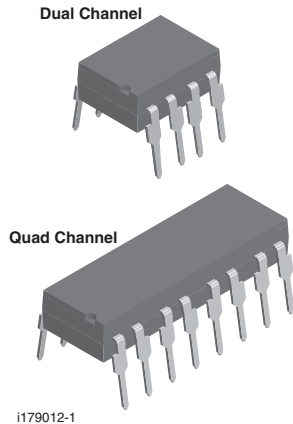
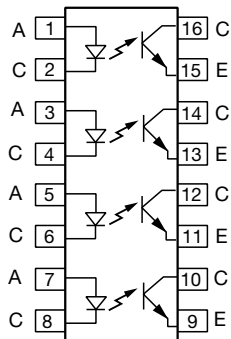
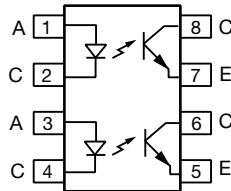


# Optocoupler, Phototransistor Output (Dual, Quad Channel)



i179012-1



## DESCRIPTION

The ILD615, ILQ615 are multi-channel phototransistor optocouplers that use GaAs IRED emitters and high gain NPN phototransistors. These devices are constructed using over / under leadframe optical coupling and double molded insulation technology resulting a withstand test voltage of 7500 V<sub>ACPEAK</sub> and a working voltage of 1700 V<sub>RMS</sub>.

The binned min./max. and linear CTR characteristics make these devices well suited for DC or AC voltage detection. Eliminating the phototransistor base connection provides added electrical noise immunity from the transients found in many industrial control environments.

Because of guaranteed maximum non-saturated and saturated switching characteristics, the ILD615, ILQ615 can be used in medium speed data I/O and control systems. The binned min. / max. CTR specification allow easy worst case interface calculations for both level detection and switching applications. Interfacing with a CMOS logic is enhanced by the guaranteed CTR at I<sub>F</sub> = 1 mA.

## FEATURES

- Identical channel to channel footprint
- Dual and quad packages feature:
  - Reduced board space
  - Lower pin and parts count
  - Better channel to channel CTR match
  - Improved common mode rejection
- Isolation rated voltage from double molded package, 4420 V<sub>RMS</sub>
- Material categorization: for definitions of compliance please see [www.vishay.com/doc?99912](http://www.vishay.com/doc?99912)


**RoHS**  
COMPLIANT

## AGENCY APPROVALS

- [UL 1577](#)
- [cUL](#)
- [DIN EN 60747-5-5 \(VDE 0884-5\)](#), available with option 1
- [CQC: GB8898](#)
- [FIMKO](#)

## LINKS TO ADDITIONAL RESOURCES


[3D Models](#)

[Design Tools](#)

[Related Documents](#)
**SPICE**
[Models](#)





ABSOLUTE MAXIMUM RATINGS ( $T_{amb} = 25\text{ }^{\circ}\text{C}$ , unless otherwise specified)				
PARAMETER	TEST CONDITION	SYMBOL	VALUE	UNIT
<b>COUPLER</b>				
Storage temperature		$T_{stg}$	-55 to +150	$^{\circ}\text{C}$
Operating temperature		$T_{amb}$	-55 to +100	$^{\circ}\text{C}$
Junction temperature		$T_j$	100	$^{\circ}\text{C}$
Soldering temperature <sup>(1)</sup>	2 mm distance from case bottom	$T_{sld}$	260	$^{\circ}\text{C}$
Package power dissipation ILD615			400	mW
Derate linearly from 25 $^{\circ}\text{C}$			5.33	mW/ $^{\circ}\text{C}$
Package power dissipation ILQ615			500	mW
Derate linearly from 25 $^{\circ}\text{C}$			6.67	mW/ $^{\circ}\text{C}$
Total power dissipation		$P_{tot}$	250	mW

**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>(2)</sup> 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
<b>INPUT</b>						
Forward voltage	$I_F = 10\text{ mA}$	$V_F$	1	1.15	1.3	V
Breakdown voltage	$I_R = 10\text{ }\mu\text{A}$	$V_{BR}$	6	30	-	V
Reverse current	$V_R = 6\text{ V}$	$I_R$	-	0.01	10	$\mu\text{A}$
Capacitance	$V_R = 0\text{ V}$ , $f = 1\text{ MHz}$	$C_O$	-	25	-	pF
Thermal resistance, junction to lead		$R_{THJL}$	-	750	-	K/W
<b>OUTPUT</b>						
Collector emitter capacitance	$V_{CE} = 5\text{ V}$ , $f = 1\text{ MHz}$	$C_{CE}$	-	6.8	-	pF
Collector emitter leakage current, -1, -2	$V_{CE} = 10\text{ V}$	$I_{CEO}$	-	2	50	nA
Collector emitter leakage current, -3, -4	$V_{CE} = 10\text{ V}$	$I_{CEO}$	-	5	100	nA
Collector emitter breakdown voltage	$I_{CE} = 0.5\text{ mA}$	$BV_{CEO}$	70	-	-	V
Emitter collector breakdown voltage	$I_E = 0.1\text{ mA}$	$BV_{ECO}$	7	-	-	V
Thermal resistance, junction to lead		$R_{THJL}$	-	500	-	K/W
<b>PACKAGE TRANSFER CHARACTERISTICS</b>						
Channel/channel CTR match	$I_F = 10\text{ mA}$ , $V_{CE} = 5\text{ V}$	CTRX/CTRY	1 to 1	-	2 to 1	
<b>COUPLER</b>						
Capacitance (input to output)	$V_{IO} = 0\text{ V}$ , $f = 1\text{ MHz}$	$C_{IO}$	-	0.8	-	pF
Channel to channel isolation			500	-	-	VAC

**Note**

- Minimum and maximum values are 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 ( $T_{amb} = 25\text{ }^{\circ}\text{C}$ , unless otherwise specified)							
PARAMETER	TEST CONDITION	PART	SYMBOL	MIN.	TYP.	MAX.	UNIT
Current transfer ratio (collector emitter saturated)	$I_F = 10\text{ mA}$ , $V_{CE} = 0.4\text{ V}$	ILD615-1	$CTR_{CEsat}$	-	25	-	%
		ILQ615-1					
		ILD615-2	$CTR_{CEsat}$	-	40	-	%
		ILQ615-2					
		ILD615-3	$CTR_{CEsat}$	-	60	-	%
		ILQ615-3					
		ILD615-4	$CTR_{CEsat}$	-	100	-	%
ILQ615-4							
Current transfer ratio (collector emitter)	$I_F = 1\text{ mA}$ , $V_{CE} = 5\text{ V}$	ILD615-1	$CTR_{CE}$	13	30	-	%
		ILQ615-1					
		ILD615-2	$CTR_{CE}$	22	45	-	%
		ILQ615-2					
		ILD615-3	$CTR_{CE}$	34	70	-	%
		ILQ615-3					
		ILD615-4	$CTR_{CE}$	56	90	-	%
	ILQ615-4						
	$I_F = 10\text{ mA}$ , $V_{CE} = 5\text{ V}$	ILD615-1	$CTR_{CE}$	40	60	80	%
		ILQ615-1					
		ILD615-2	$CTR_{CE}$	63	80	125	%
		ILQ615-2					
		ILD615-3	$CTR_{CE}$	100	150	200	%
		ILQ615-3					
ILD615-4		$CTR_{CE}$	160	200	320	%	
ILQ615-4							

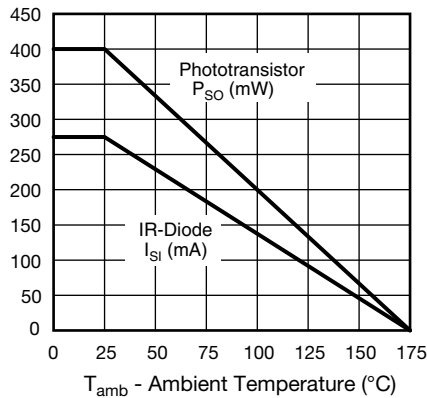


Fig. 1 - Derating Diagram

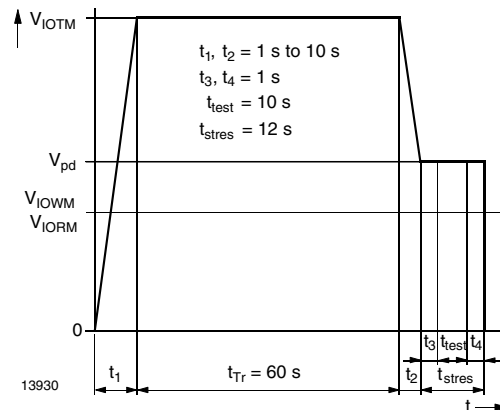


Fig. 2 - Test Pulse Diagram for Sample Test According to DIN EN 60747-5-2 (VDE0884); IEC60747-5-5



SWITCHING CHARACTERISTICS (T <sub>amb</sub> = 25 °C, unless otherwise specified)							
PARAMETER	TEST CONDITION	PART	SYMBOL	MIN.	TYP.	MAX.	UNIT
<b>NON-SATURATED</b>							
Current	V <sub>CC</sub> = 5 V, R <sub>L</sub> = 75 Ω, 50 % of V <sub>PP</sub>		I <sub>F</sub>	-	10	-	mA
Turn-on time	V <sub>CC</sub> = 5 V, R <sub>L</sub> = 75 Ω, 50 % of V <sub>PP</sub>		t <sub>on</sub>	-	3	-	μs
Rise time	V <sub>CC</sub> = 5 V, R <sub>L</sub> = 75 Ω, 50 % of V <sub>PP</sub>		t <sub>r</sub>	-	2	-	μs
Turn-off time	V <sub>CC</sub> = 5 V, R <sub>L</sub> = 75 Ω, 50 % of V <sub>PP</sub>		t <sub>off</sub>	-	2.3	-	μs
Fall time	V <sub>CC</sub> = 5 V, R <sub>L</sub> = 75 Ω, 50 % of V <sub>PP</sub>		t <sub>f</sub>	-	2	-	μs
Propagation H to L	V <sub>CC</sub> = 5 V, R <sub>L</sub> = 75 Ω, 50 % of V <sub>PP</sub>		t <sub>PHL</sub>	-	1.1	-	μs
Propagation L to H	V <sub>CC</sub> = 5 V, R <sub>L</sub> = 75 Ω, 50 % of V <sub>PP</sub>		t <sub>PLH</sub>	-	2.5	-	μs
<b>SATURATED</b>							
Current	V <sub>CC</sub> = 5 V, R <sub>L</sub> = 1 kΩ, V <sub>TH</sub> = 1.5 V	ILD615-1	I <sub>F</sub>	-	20	-	mA
		ILQ615-1					
		ILD615-2	I <sub>F</sub>	-	10	-	mA
		ILQ615-2					
		ILD615-3	I <sub>F</sub>	-	10	-	mA
		ILQ615-3					
ILD615-4	I <sub>F</sub>	-	5	-	mA		
ILQ615-4							
Turn-on time	V <sub>CC</sub> = 5 V, R <sub>L</sub> = 1 kΩ, V <sub>TH</sub> = 1.5 V	ILD615-1	t <sub>on</sub>	-	3	-	μs
		ILQ615-1					
		ILD615-2	t <sub>on</sub>	-	4.3	-	μs
		ILQ615-2					
		ILD615-3	t <sub>on</sub>	-	4.3	-	μs
		ILQ615-3					
ILD615-4	t <sub>on</sub>	-	6	-	μs		
ILQ615-4							
Rise time	V <sub>CC</sub> = 5 V, R <sub>L</sub> = 1 kΩ, V <sub>TH</sub> = 1.5 V	ILD615-1	t <sub>r</sub>	-	2	-	μs
		ILQ615-1					
		ILD615-2	t <sub>r</sub>	-	2.8	-	μs
		ILQ615-2					
		ILD615-3	t <sub>r</sub>	-	2.8	-	μs
		ILQ615-3					
ILD615-4	t <sub>r</sub>	-	4.6	-	μs		
ILQ615-4							
Turn-off time	V <sub>CC</sub> = 5 V, R <sub>L</sub> = 1 kΩ, V <sub>TH</sub> = 1.5 V	ILD615-1	t <sub>off</sub>	-	18	-	μs
		ILQ615-1					
		ILD615-2	t <sub>off</sub>	-	25	-	μs
		ILQ615-2					
		ILD615-3	t <sub>off</sub>	-	25	-	μs
		ILQ615-3					
ILD615-4	t <sub>off</sub>	-	25	-	μs		
ILQ615-4							
Fall time	V <sub>CC</sub> = 5 V, R <sub>L</sub> = 1 kΩ, V <sub>TH</sub> = 1.5 V	ILD615-1	t <sub>f</sub>	-	11	-	μs
		ILQ615-1					
		ILD615-2	t <sub>f</sub>	-	14	-	μs
		ILQ615-2					
		ILD615-3	t <sub>f</sub>	-	14	-	μs
		ILQ615-3					
ILD615-4	t <sub>f</sub>	-	15	-	μs		
ILQ615-4							



SWITCHING CHARACTERISTICS (T <sub>amb</sub> = 25 °C, unless otherwise specified)							
PARAMETER	TEST CONDITION	PART	SYMBOL	MIN.	TYP.	MAX.	UNIT
<b>SATURATED</b>							
Propagation H to L	V <sub>CC</sub> = 5 V, R <sub>L</sub> = 1 kΩ, V <sub>TH</sub> = 1.5 V	ILD615-1	t <sub>PHL</sub>	-	1.6	-	μs
		ILQ615-1					
		ILD615-2	t <sub>PHL</sub>	-	2.6	-	μs
		ILQ615-2					
		ILD615-3	t <sub>PHL</sub>	-	2.6	-	μs
		ILQ615-3					
ILD615-4	t <sub>PHL</sub>	-	5.4	-	μs		
ILQ615-4							
Propagation L to H	V <sub>CC</sub> = 5 V, R <sub>L</sub> = 1 kΩ, V <sub>TH</sub> = 1.5 V	ILD615-1	t <sub>PLH</sub>	-	8.6	-	μs
		ILQ615-1					
		ILD615-2	t <sub>PLH</sub>	-	7.2	-	μs
		ILQ615-2					
		ILD615-3	t <sub>PLH</sub>	-	7.2	-	μs
		ILQ615-3					
		ILD615-4	t <sub>PLH</sub>	-	7.4	-	μs
		ILQ615-4					

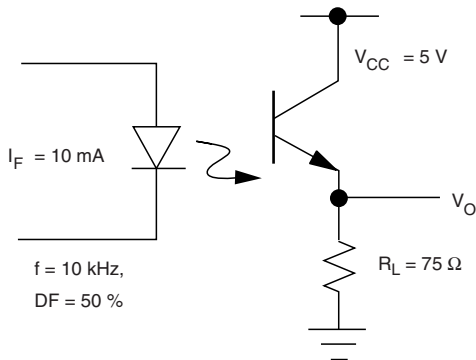
COMMON MODE TRANSIENT IMMUNITY (T <sub>amb</sub> = 25 °C, unless otherwise specified)						
PARAMETER	TEST CONDITION	SYMBOL	MIN.	TYP.	MAX.	UNIT
Common mode rejection output high	V <sub>CM</sub> = 50 V <sub>P-P</sub> , R <sub>L</sub> = 1 kΩ, I <sub>F</sub> = 0 mA	CM <sub>H</sub>	-	5000	-	V/μs
Common mode rejection output low	V <sub>CM</sub> = 50 V <sub>P-P</sub> , R <sub>L</sub> = 1 kΩ, I <sub>F</sub> = 0 mA	CM <sub>L</sub>	-	5000	-	V/μs
Common mode coupling capacitance		C <sub>CM</sub>	-	0.01	-	pF

SAFETY AND INSULATION RATINGS				
PARAMETER	TEST CONDITION	SYMBOL	VALUE	UNIT
Climatic classification	According to IEC 68 part 1		55 / 100 / 21	
Comparative tracking index		CTI	175	
Maximum rated withstanding isolation voltage	t = 1 min	V <sub>ISO</sub>	4420	V <sub>RMS</sub>
Maximum transient isolation voltage		V <sub>IOTM</sub>	10 000	V <sub>peak</sub>
Maximum repetitive peak isolation voltage		V <sub>IORM</sub>	890	V <sub>peak</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
	V <sub>IO</sub> = 500 V, T <sub>amb</sub> = 175 °C (construction test only)	R <sub>IO</sub>	≥ 10 <sup>9</sup>	Ω
Output safety power		P <sub>SO</sub>	400	mW
Input safety current		I <sub>SI</sub>	275	mA
Safety temperature		T <sub>S</sub>	175	°C
Creepage distance			≥ 7	mm
Clearance distance			≥ 7	mm
Insulation thickness		DTI	≥ 0.4	mm
Partial discharge test voltage - routine test	100 %, t <sub>test</sub> = 1 s	V <sub>pd</sub>	1.669	kV <sub>peak</sub>
Partial discharge test voltage - lot test (sample test)	t <sub>Tr</sub> = 60 s, t <sub>test</sub> = 10 s, (see Fig. 2)	V <sub>pd</sub>	1.424	kV <sub>peak</sub>

**Note**

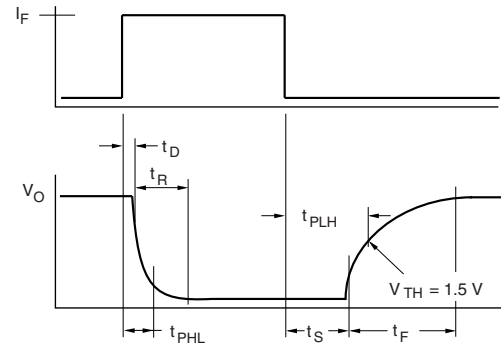
- As per IEC 60747-5-5, § 7.4.3.8.2, this optocoupler is suitable for “safe electrical insulation” only within the safety ratings. Compliance with the safety ratings shall be ensured by means of protective circuits.

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



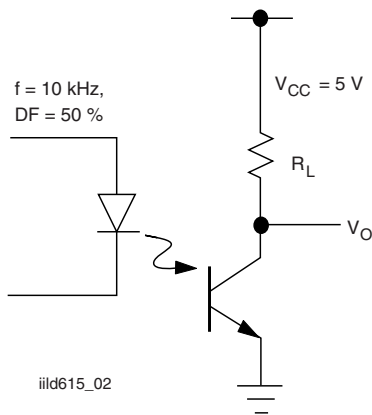
ild615\_01

Fig. 1 Non-Saturated Switching Timing



ild615\_04

Fig. 5 - Saturated Switching Timing



ild615\_02

Fig. 3 - Saturated Switching Timing

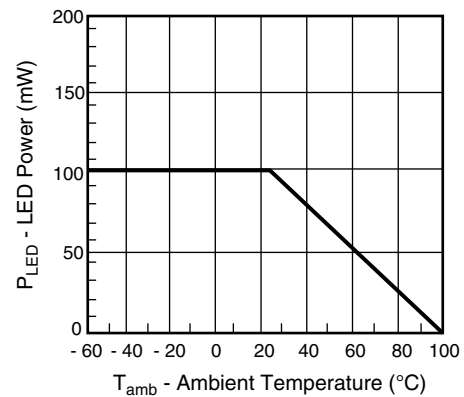
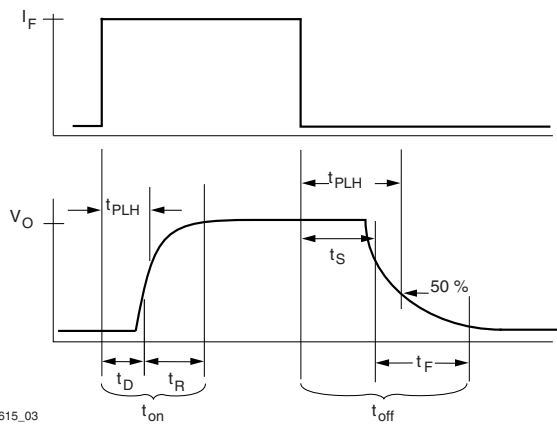
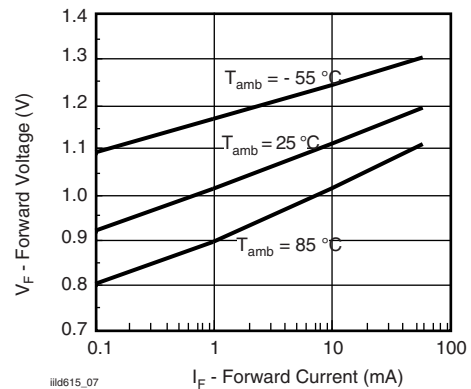


Fig. 6 - Maximum LED Power Dissipation



ild615\_03

Fig. 4 - Non-Saturated Switching Timing



ild615\_07

Fig. 7 - Forward Voltage vs. Forward Current

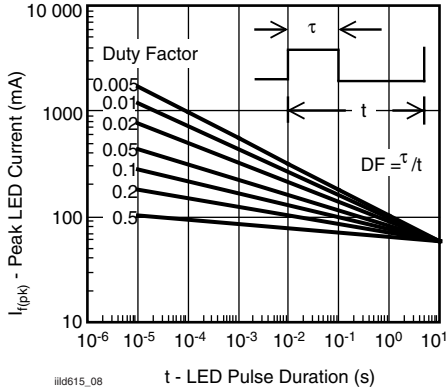


Fig. 8 - Peak LED Current vs. Pulse Duration,  $\tau$

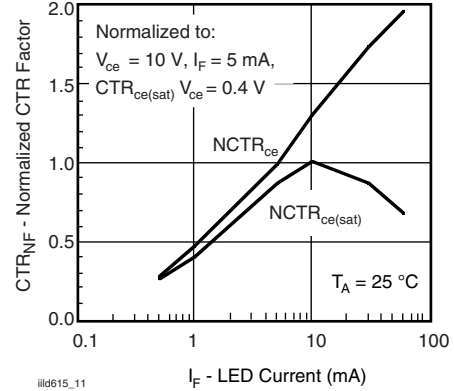


Fig. 11 - Normalization Factor for Non-Saturated and Saturated CTR vs.  $I_F$

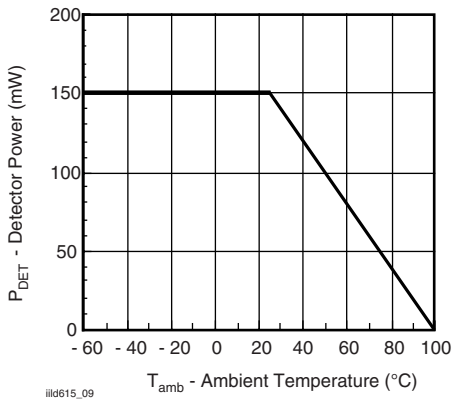


Fig. 9 - Maximum Detector Power Dissipation

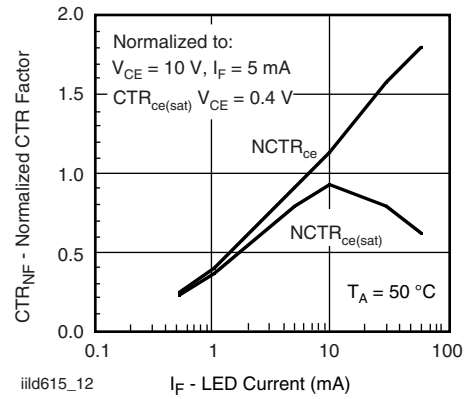


Fig. 12 - Normalization Factor for Non-Saturated and Saturated CTR vs.  $I_F$

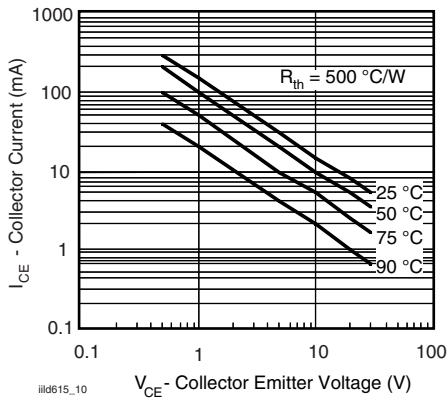


Fig. 10 - Maximum Collector Current vs. Collector Voltage

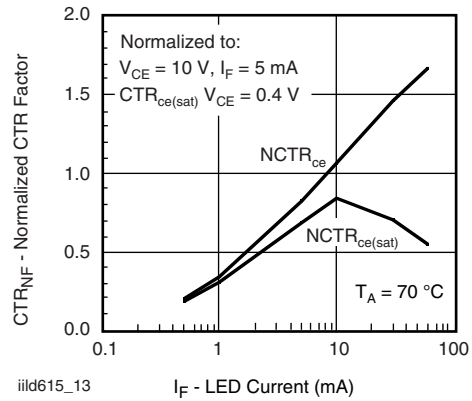


Fig. 13 - Normalization Factor for Non-Saturated and Saturated CTR vs.  $I_F$



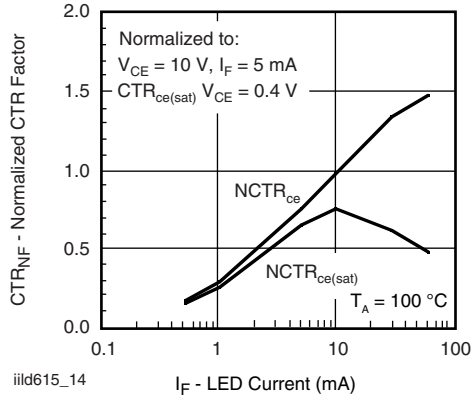


Fig. 14 - Normalization Factor for Non-Saturated and Saturated CTR vs.  $I_F$

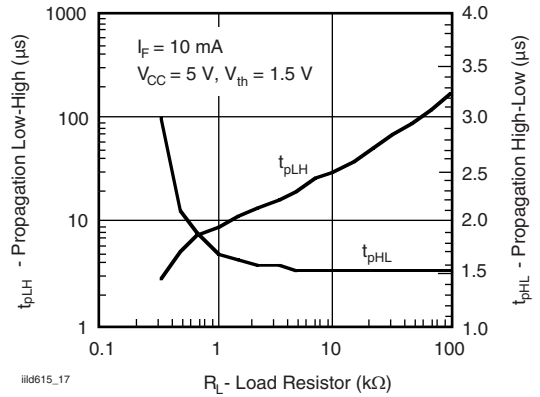


Fig. 17 - -1, Propagation Delay vs. Collector Load Resistor

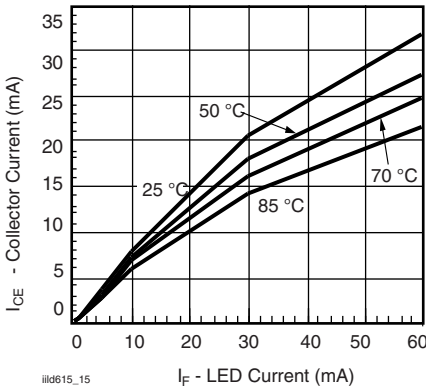


Fig. 15 - Collector Emitter Current vs. Temperature and LED Current

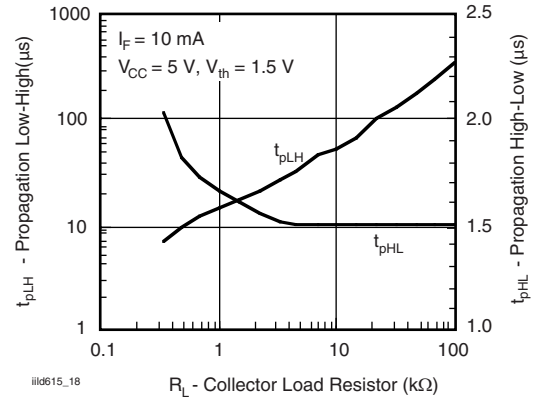


Fig. 18 - -2, -3, Propagation Delay vs. Collector Load Resistor

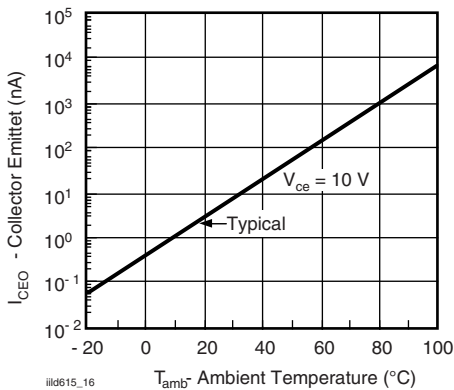


Fig. 16 - Collector Emitter Leakage vs. Temperature

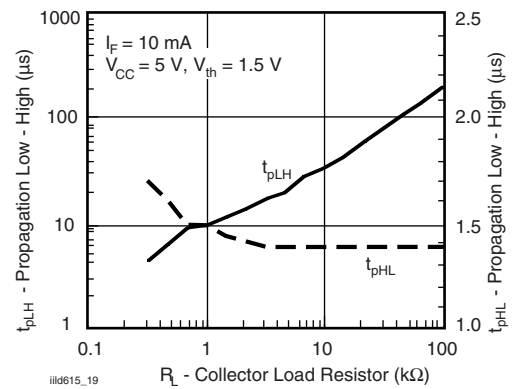
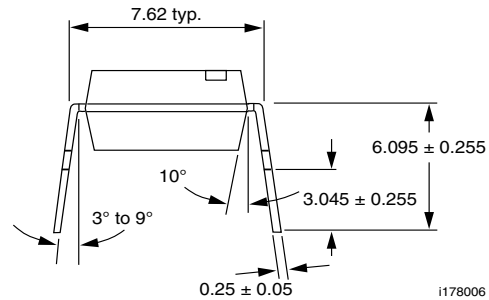
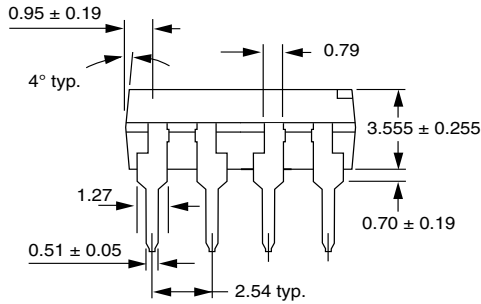
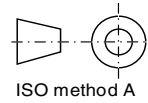
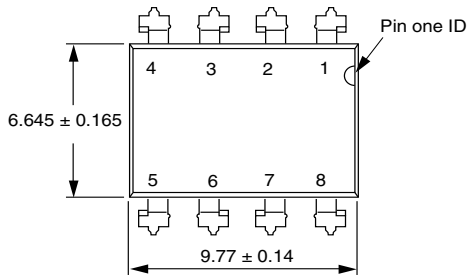


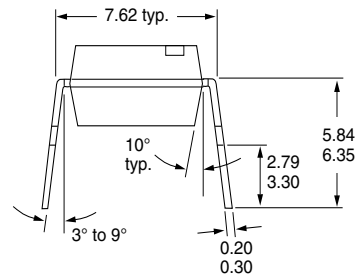
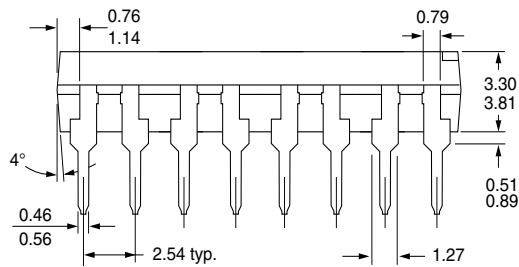
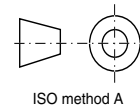
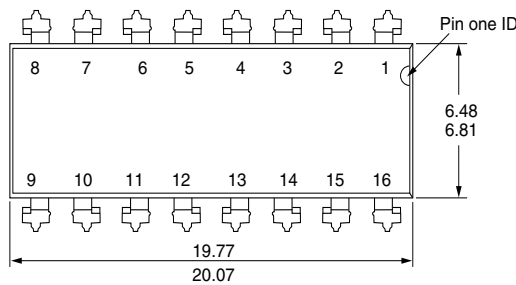
Fig. 19 - -4, Propagation Delay vs. Collector Load Resistor



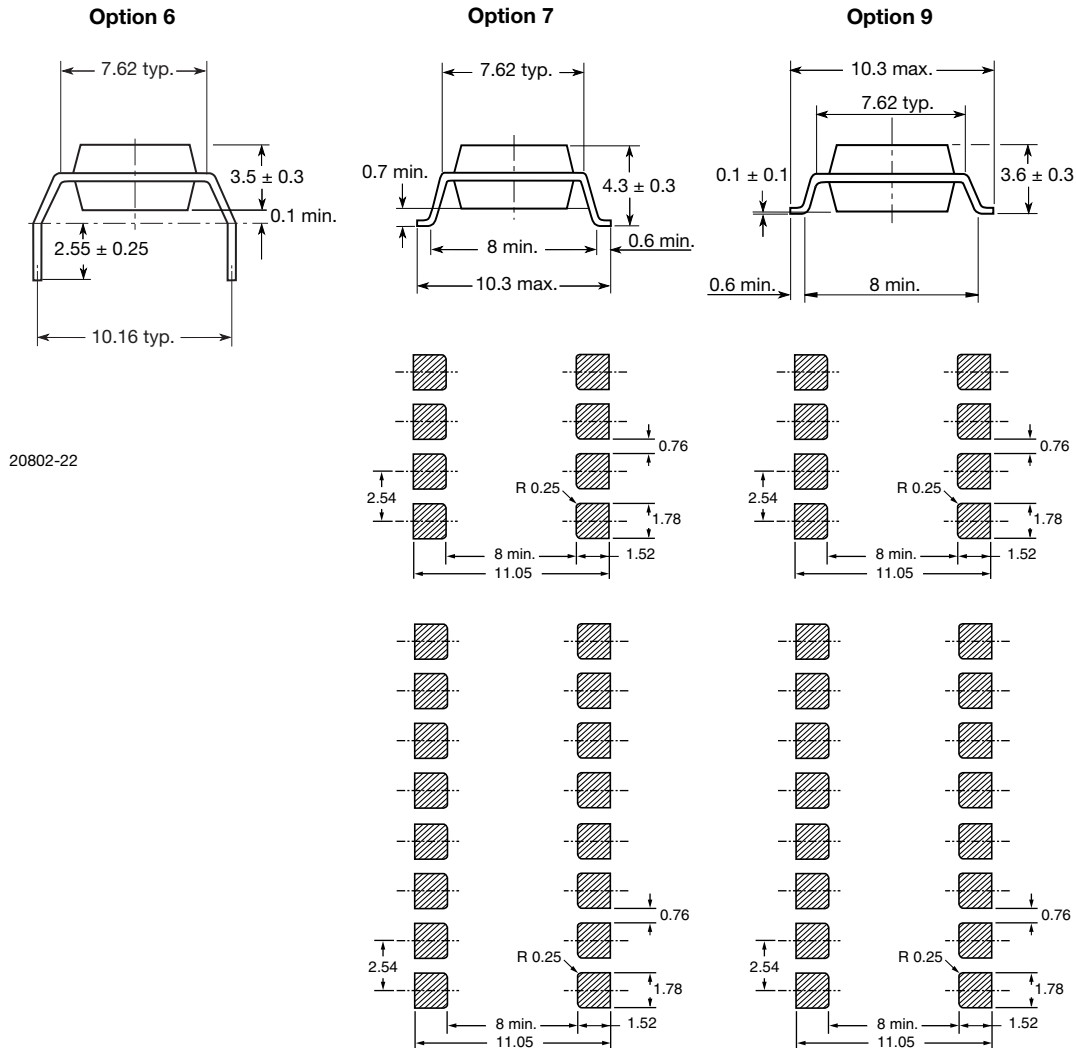
### PACKAGE DIMENSIONS in millimeters



i178006

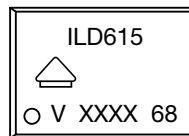


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**PACKAGE MARKING** (example)



21764-88

**Notes**

- XXXX = LMC (lot marking code)
- Only options 1 and 7 reflected in the package marking
- The VDE Logo is only marked on option1 parts
- Tape and reel suffix (T) is not part of the package marking



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