

## FEATURES

- **Identical Channel to Channel Footprint**
- **Current Transfer Ratio (CTR) Range at  $I_F=10\text{ mA}$**   
 ILD/Q615-1: 40 – 80% Min.  
 ILD/Q615-2: 63 – 125% Min.  
 ILD/Q615-3: 100 – 200% Min.  
 ILD/Q615-4: 160 – 320% Min.
- **Guaranteed CTR at  $I_F=1\text{ mA}$**   
 ILD/Q615-1: 13% Min.  
 ILD/Q615-2: 22% Min.  
 ILD/Q615-3: 34% Min.  
 ILD/Q615-4: 56% Min.
- **High Collector-Emitter Voltage  $BV_{CEO}=70\text{ V}$**
- **Dual and Quad Packages Feature:**
  - Reduced Board Space
  - Lower Pin and Parts Count
  - Better Channel to Channel CTR Match
  - Improved Common Mode Rejection
- **Field-Effect Stable by TRIOS (TRansparent IOShield)**
- **Isolation Test Voltage from Double Molded Package, 5300 VAC<sub>RMS</sub>**
- **UL Approval #E52744**
- **VDE #0884 Available with Option 1**

## Maximum Ratings (Each Channel)

### Emitter

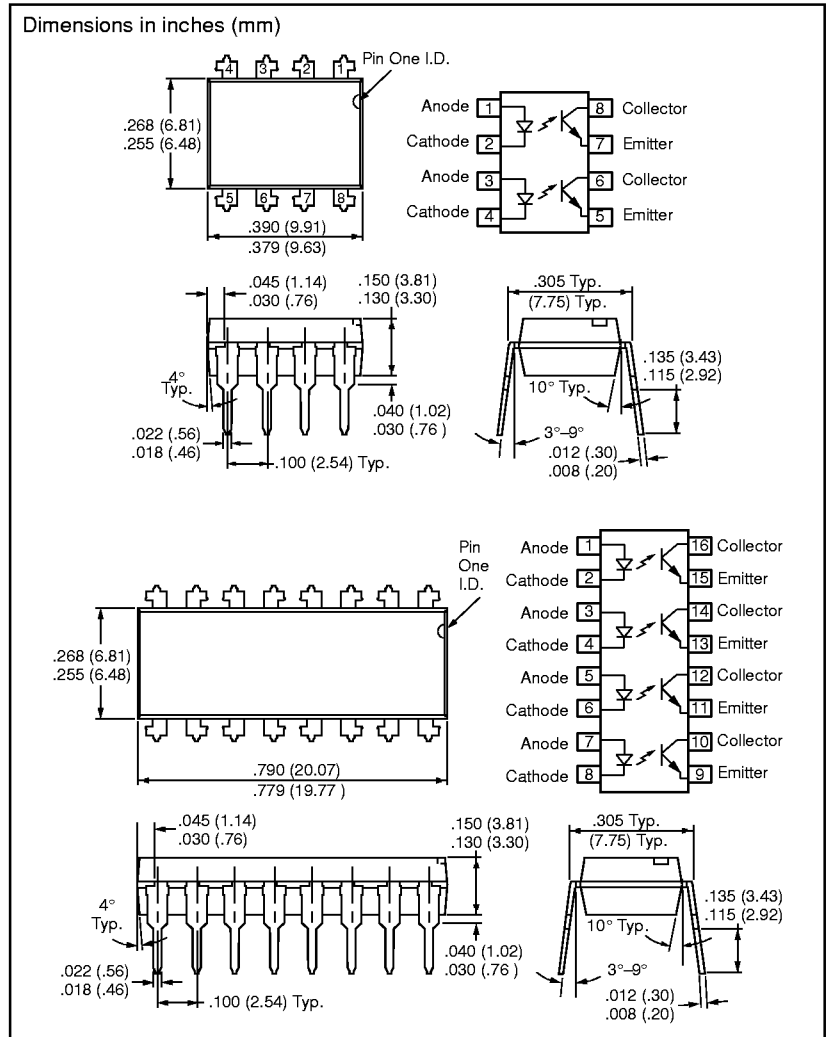
Reverse Voltage .....	6 V
Forward Current .....	60 mA
Surge Current .....	1.5 A
Power Dissipation .....	100 mW
Derate Linearly from 25°C .....	1.33 mW/°C

### Detector

Collector-Emitter Reverse Voltage .....	70 V
Emitter-Collector Reverse Voltage .....	7 V
Collector Current .....	50 mA
Collector Current ( $t < 1\text{ ms}$ ) .....	100 mA
Power Dissipation .....	150 mW
Derate Linearly from 25°C .....	2 mW/°C

### Package

Storage Temperature .....	-55°C to +150°C
Operating Temperature .....	-55°C to +100°C
Junction Temperature .....	100°C
Soldering Temperature (2 mm distance from case bottom) .....	260°C
Package Power Dissipation, ILD615 .....	400 mW
Derate Linearly from 25°C .....	5.33 mW/°C
Package Power Dissipation, ILQ615 .....	500 mW
Derate Linearly from 25°C .....	6.67 mW/°C
Isolation Test Voltage ( $t=1\text{ sec.}$ ) .....	5300 VAC <sub>RMS</sub>
Creepage .....	7 mm min.
Clearance .....	7 mm min.
Isolation Resistance	
$V_{IO}=500\text{ V}$ , $T_A=25^\circ\text{C}$ .....	$\geq 10^{12}\ \Omega$
$V_{IO}=500\text{ V}$ , $T_A=100^\circ\text{C}$ .....	$\geq 10^{11}\ \Omega$



## DESCRIPTION

The ILD/Q615 are multi-channel phototransistor optocouplers that use GaAs IRLED 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 VAC<sub>PEAK</sub> and a Working Voltage of 1700 VAC<sub>RMS</sub>.

The binned min./max. and linear CTR characteristics combined with the TRIOS (TRansparent IOShield) field-effect process 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 ILD/Q615 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 an  $I_F=1\text{ mA}$ .

See Appnote 45, "How to Use Optocoupler Normalized Curves."

**Characteristics,  $T_A=25^\circ\text{C}$** 

	Symbol	Min.	Typ.	Max.	Unit	Condition
<b>Emitter</b>						
Forward Voltage	$V_F$	1	1.15	1.3	V	$I_F=10\text{ mA}$
Breakdown Voltage	$V_{BR}$	6	30		V	$I_R=10\ \mu\text{A}$
Reverse Current	$I_R$		0.01	10	$\mu\text{A}$	$V_R=6\text{ V}$
Capacitance	$C_O$		25		pF	$V_R=0\text{ V}, f=1\text{ MHz}$
Thermal Resistance, Junction to Lead	$R_{THJL}$		750		$^\circ\text{C/W}$	
<b>Detector</b>						
Capacitance	$C_{CE}$		6.8		pF	$V_{CE}=5\text{ V}, f=1\text{ MHz}$
Collector-Emitter Leakage Current, -1, -2	$I_{CEO}$		2	50	nA	$V_{CE}=10\text{ V}$
Collector-Emitter Leakage Current, -3, -4	$I_{CEO}$		5	100	nA	$V_{CE}=10\text{ V}$
Collector-Emitter Breakdown Voltage	$BV_{CEO}$	70			V	$I_{CE}=0.5\text{ mA}$
Emitter-Collector Breakdown Voltage	$BV_{ECO}$	7			V	$I_E=0.1\text{ mA}$
Thermal Resistance, Junction to Lead	$R_{THJL}$		500		$^\circ\text{C/W}$	
<b>Package Transfer Characteristics</b>						
Channel/Channel CTR Match	CTR <sub>X</sub> /CTR <sub>Y</sub>	1 to 1		2 to 1		$I_F=10\text{ mA}, V_{CE}=5\text{ V}$
<b>ILD/Q615-1</b>						
Saturated Current Transfer Ratio	CTR <sub>CEsat</sub>		25		%	$I_F=10\text{ mA}, V_{CE}=0.4\text{ V}$
Current Transfer Ratio	CTR <sub>CE</sub>	40	60	80	%	$I_F=10\text{ mA}, V_{CE}=5\text{ V}$
Current Transfer Ratio	CTR <sub>CE</sub>	13	30		%	$I_F=1\text{ mA}, V_{CE}=5\text{ V}$
<b>ILD/Q615-2</b>						
Saturated Current Transfer Ratio	CTR <sub>CEsat</sub>		40		%	$I_F=10\text{ mA}, V_{CE}=0.4\text{ V}$
Current Transfer Ratio	CTR <sub>CE</sub>	63	80	125	%	$I_F=10\text{ mA}, V_{CE}=5\text{ V}$
Current Transfer Ratio	CTR <sub>CE</sub>	22	45		%	$I_F=1\text{ mA}, V_{CE}=5\text{ V}$
<b>ILD/Q615-3</b>						
Saturated Current Transfer Ratio	CTR <sub>CEsat</sub>		60		%	$I_F=10\text{ mA}, V_{CE}=0.4\text{ V}$
Current Transfer Ratio	CTR <sub>CE</sub>	100	150	200	%	$I_F=10\text{ mA}, V_{CE}=5\text{ V}$
Current Transfer Ratio	CTR <sub>CE</sub>	34	70		%	$I_F=1\text{ mA}, V_{CE}=5\text{ V}$
<b>ILD/Q615-4</b>						
Saturated Current Transfer Ratio	CTR <sub>CEsat</sub>		100		%	$I_F=10\text{ mA}, V_{CE}=0.4\text{ V}$
Current Transfer Ratio	CTR <sub>CE</sub>	160	200	320	%	$I_F=10\text{ mA}, V_{CE}=5\text{ V}$
Current Transfer Ratio	CTR <sub>CE</sub>	56	90		%	$I_F=1\text{ mA}, V_{CE}=5\text{ V}$
<b>Isolation and Insulation</b>						
Common Mode Rejection, Output High	CMH		5000		V/ $\mu\text{s}$	$V_{CM}=50\text{ V}_{P,P}, R_L=1\text{ k}\Omega, I_F=0\text{ mA}$
Common Mode Rejection, Output Low	CML		5000		V/ $\mu\text{s}$	$V_{CM}=50\text{ V}_{P,P}, R_L=1\text{ k}\Omega, I_F=10\text{ mA}$
Common Mode Coupling Capacitance	$C_{CM}$		0.01		pF	
Package Capacitance	CI-O	0.8			pF	$V_{IO}=0\text{ V}, f=1\text{ MHz}$
Insulation Resistance	$R_S$		$10^{14}$		$\Omega$	$V_{IO}=500\text{ V}, T_A=25^\circ\text{C}$
Channel to Channel Isolation		500			VAC	

## Switching Times

Figure 1. Non-saturated switching timing

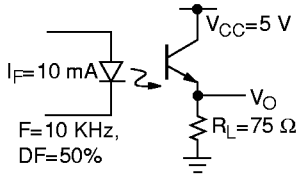


Figure 2. Saturated switching timing

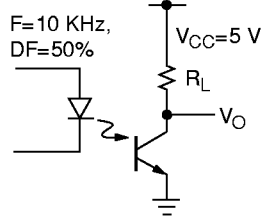


Figure 3. Non-saturated switching timing

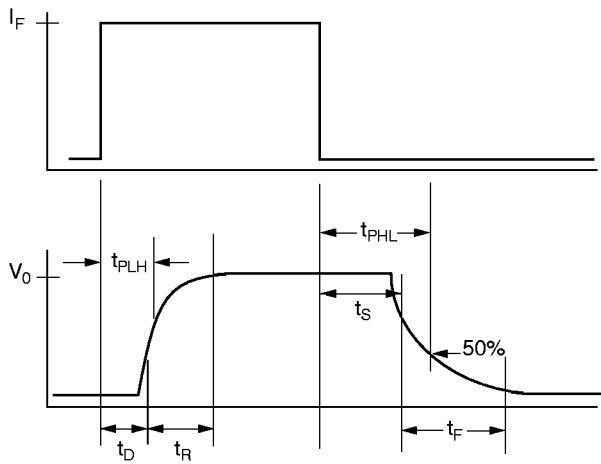
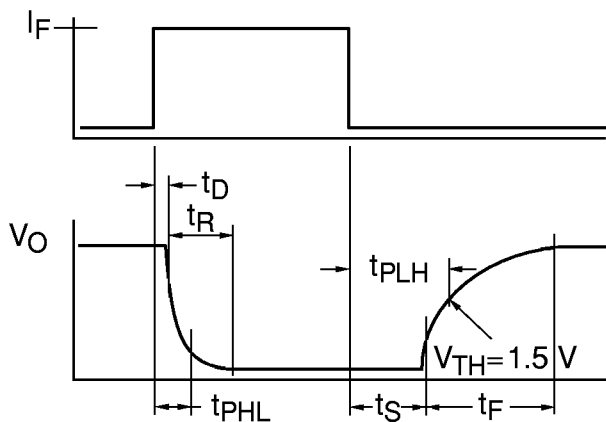


Figure 4. Saturated switching timing



Parameter	Typ.	Unit	Test Condition
$t_{ON}$	3.0	$\mu s$	$R_L = 75 \Omega$ $I_F = 10 \text{ mA}$ $V_{CC} = 5 \text{ V}$
$t_R$	2.0	$\mu s$	
$t_{OFF}$	2.3	$\mu s$	
$t_F$	2.0	$\mu s$	
$t_{PHL}$ Propagation H-L (50% of $V_{PP}$ )	1.1	$\mu s$	
$t_{PLH}$ Propagation L-H	2.5	$\mu s$	

Parameter	-1 $I_F = 20 \text{ mA}$	-1,-3 $I_F = 10 \text{ mA}$	-4 $I_F = 5 \text{ mA}$	Unit	Test Condition
	Typ.	Typ.	Typ.		
$t_{ON}$	3.0	4.3	6.0	$\mu s$	$R_L = 1 \Omega$ $V_{CC} = 5 \text{ V}$ $V_{TH} = 1.5 \text{ V}$
$t_R$	2.0	2.8	4.6	$\mu s$	
$t_{OFF}$	18	25	25	$\mu s$	
$t_F$	11	14	15	$\mu s$	
$t_{PHL}$ Propagation H-L	1.6	2.6	5.4	$\mu s$	
$t_{PLH}$ Propagation L-H	8.6	7.2	7.4	$\mu s$	

Figure 5. Maximum LED current versus ambient temperature

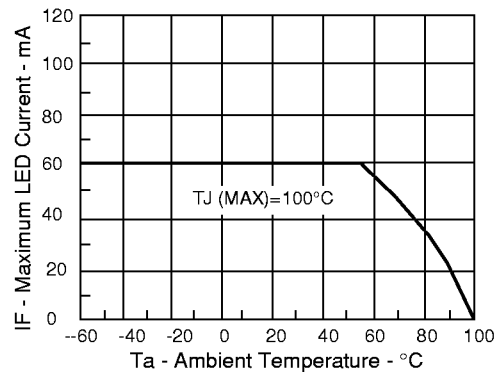


Figure 6. Maximum LED power dissipation

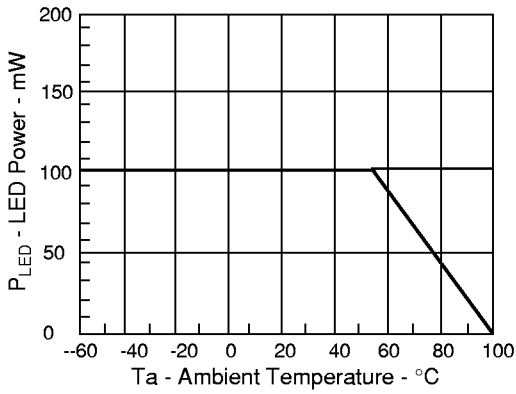


Figure 7. Forward voltage versus forward current

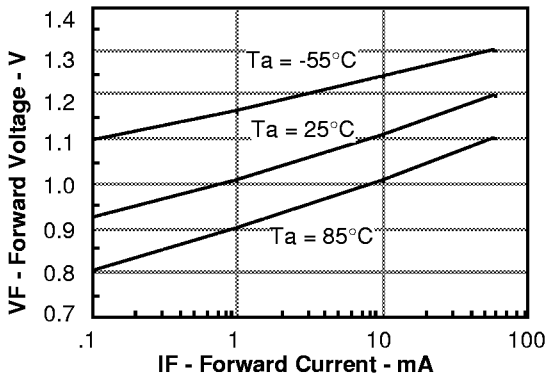


Figure 8. Peak LED current versus pulse detection, Tau

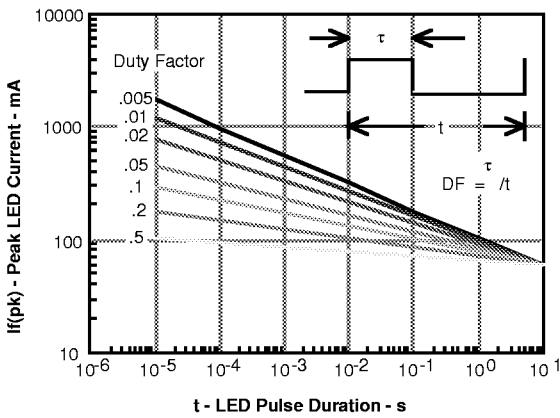


Figure 9. Maximum detector power dissipation

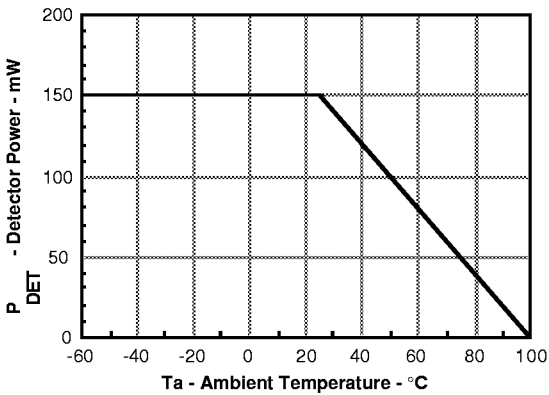


Figure 10. Maximum collector current versus collector voltage

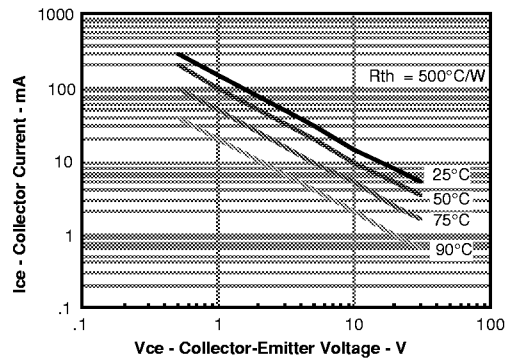


Figure 11. Normalization factor for non-saturated and saturated CTR  $T_A=25^\circ C$  versus if

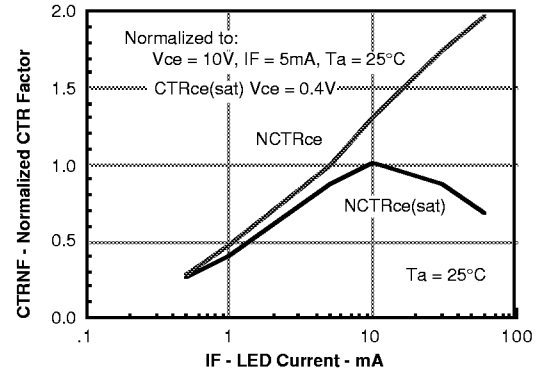


Figure 12. Normalization factor for non-saturated and saturated CTR  $T_A=50^\circ C$  versus if

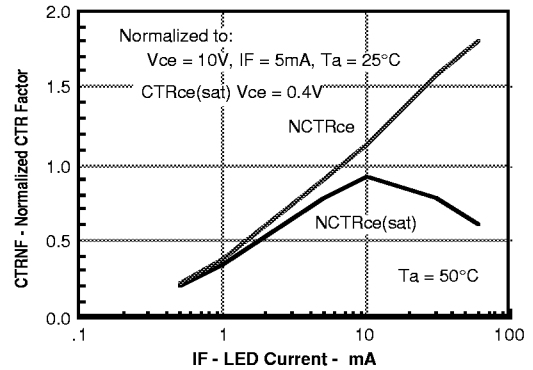


Figure 13. Normalization factor for non-saturated and saturated CTR  $T_A=70^\circ C$  versus if

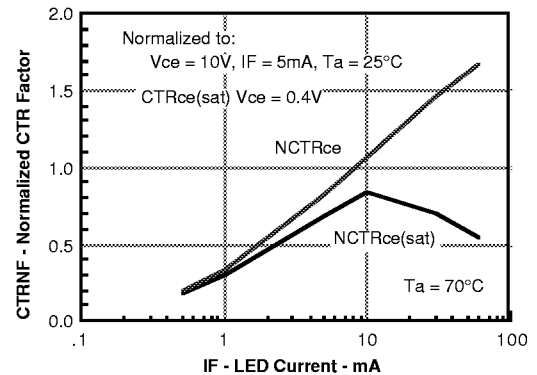


Figure 14. Normalization factor for non-saturated and saturated CTR  $T_A=85^\circ\text{C}$  versus  $I_F$

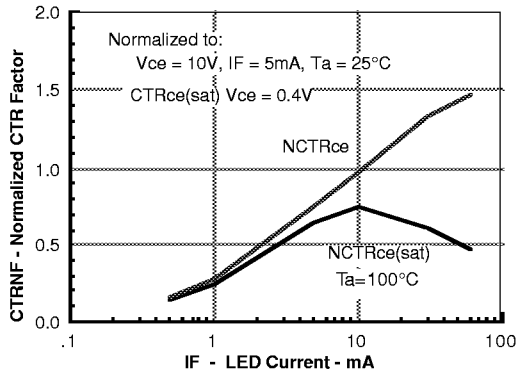


Figure 15. Collector-emitter current versus temperature and LED current

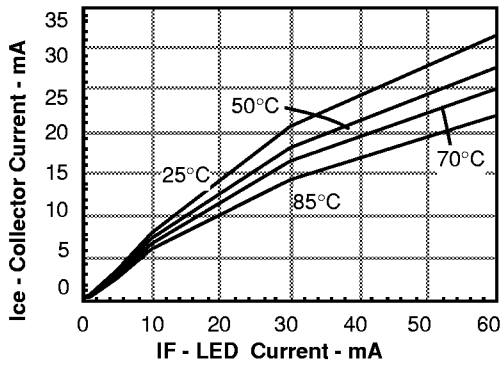


Figure 16. Collector-emitter leakage versus temperature

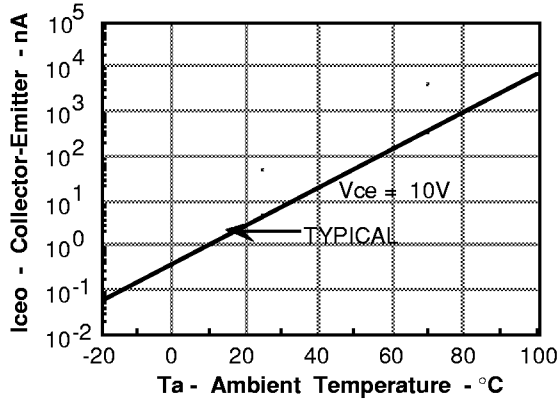


Figure 17. -1 Propagation delay versus collector load resistor

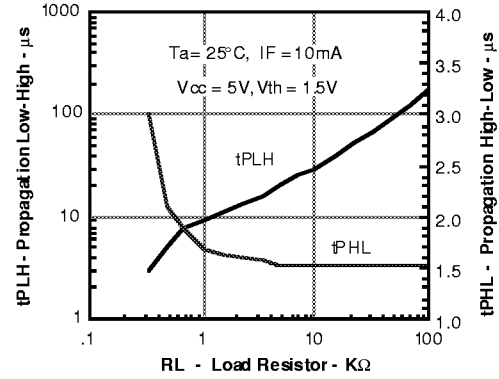


Figure 18. -2, -3 Propagation delay versus collector load resistor

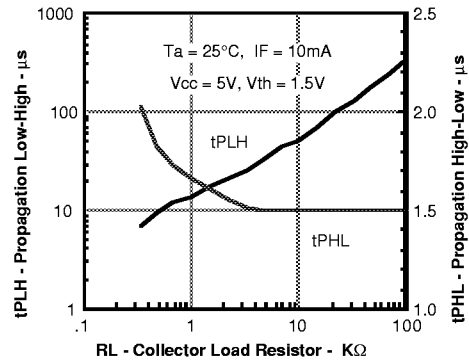


Figure 19. -4 Propagation delay versus collector load resistor

