Optoelectronics Division
TRW Electronic Components Group

Product Bulletin 5248
January 1985

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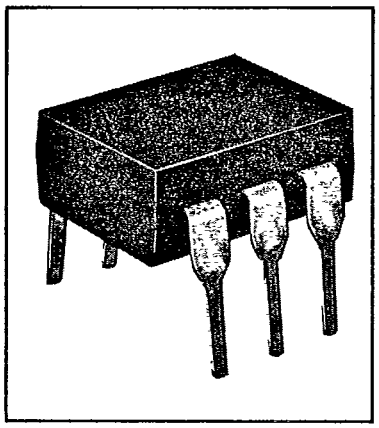
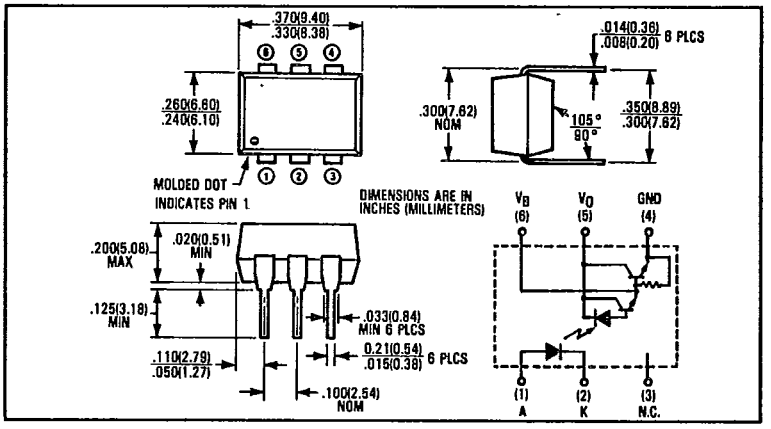
T-41-85

Low Input Current, High Gain Optically Coupled Isolators
Types 4N45, 4N46





Features
- 1000% typical current transfer ratio
- 0.50 mA LED drive current
- 3000 VDC isolation voltage
- External connection to second stage base
- U.L. recognized, File No. E58730

Description
The 4N45 and 4N46 each consist of a gallium aluminum arsenide infrared emitting diode coupled to a high gain photodetector IC mounted in a standard plastic six pin DIP.

High performance over specified temperature range is made possible by an integrated emitter-base bypass resistor which shunts the photodiode and first stage leakage currents to ground.

The high current transfer ratio at very low LED drive current allows broad flexibility in circuit design as well as a wide margin for the effects of CTR degradation over time.

The 4N45 has a 250% minimum CTR at 1 mA LED drive current. The 4N46 has a 350% minimum CTR at 0.5 mA drive current making it ideal for such applications as MOS, CMOS and low power logic interfacing.

Absolute Maximum Ratings (T_A = 25°C unless otherwise noted)

Input-to-Output Isolation Voltage	±3000 VDC(1)
Storage Temperature Range	−55°C to +125°C
Operating Temperature Range	−40°C to +70°C
Lead Soldering Temperature (1/16 inch (1.6 mm) from case for 10 seconds)	260°C
Input Diode	
Average Input Current	20 mA(3)
Peak Input Currrent (1 ms pulse width, 50% duty cycle)	40 mA
Peak Input Transient Current (≤ 1 μs pulse width, 300 pps)	1.00 A
Input Reverse Breakdown Voltage	5.0 V
Input Power Dissipation	35 mW(4)
Output Photodetector	
Output Current	60 mA(5)
Emitter-Base Reverse Voltage (Pins 4 & 6)	0.50 V
Output Voltage (Pins 5 & 4) 4N45	−0.50 V to 7.0 V
4N46	−0.50 V to 20 V
Output Power Dissipation	100 mV(6)

Notes:
(1) Measured with input leads shorted together and output leads shorted together.
(2) RMA flux is recommended. Duration can be extended to 10 seconds max. when flow soldering.
(3) Derate linearly 0.40 mA/°C above 50°C.
(4) Derate linearly 0.70 mW/°C above 50°C.
(5) Derate linearly 0.80 mA/°C above 25°C.
(6) Derate linearly 1.50 mW/°C above 25°C.

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Electrical Characteristics (T_A = 0°C to 70°C, unless otherwise noted)

Symbol	Parameter	Device	Min.	Typ.**	Max.	Units	Test Conditions
Input Diode							
V_F*	Input Forward Voltage			1.20	1.70	V	I_F = 1.00 mA, T_A = 25°C
BV_R*	Input Reverse Breakdown Voltage		5.0	59		V	I_R = 10.0 μA, T_A = 25°C
$\frac{\Delta V_F}{\Delta T_A}$	Temperature Coefficient of Forward Voltage			-1.80		mV/°C	I_F = 1.00 mA
Coupled							
CTR*	Current Transfer Ratio	4N45	250	1000		%	I_F = 1.00 mA, V_O = 1.00 V
			200	500		%	I_F = 10.0 mA, V_O = 1.20 V
		4N46	350	1300		%	I_F = 0.50 mA, V_O = 1.00 V
			500	1100		%	I_F = 1.00 mA, V_O = 1.20 V
			200	700		%	I_F = 10.0 mA, V_O = 1.20 V
V_{OL}	Logic Low Output Voltage	4N45		0.89	1.00	V	I_F = 1.00 mA, I_{OL} = 2.5 mA
				0.94	1.20	V	I_F = 10.0 mA, I_{OL} = 20 mA
		4N46		0.89	1.00	V	I_F = 0.50 mA, I_{OL} = 1.75 mA
				0.93	1.00	V	I_F = 1.00 mA, I_{OL} = 5.0 mA
				0.94	1.20	V	I_F = 10.0 mA, I_{OL} = 20 mA
I_{OH}	Logic High Output Current	4N45		0.001	250	μA	I_F = 0, V_O = 5.0 V
		4N46		0.001	100	μA	I_F = 0, V_O = 18.0 V
C_{IN}	Input Capacitance			60		pF	f = 1.00 MHz, V_F = 0
I_{I-O}*	Input-Output Insulation Leakage Current				1.00	μA	45% Relative Humidity, T_A = 25°C, t = 5.0 sec, V_{I-O} = 3000 VDC
R_{I-O}	Input-Output Resistance			10^{12}		Ω	V_{I-O} = 500 VDC
C_{I-O}	Input-Output Capacitance			0.60		pF	f = 1.00 MHz

Switching Specifications (T_A = 25°C)

t_{PHL}	Propagation Delay Time to Logic Low at Output			80		μs	I_F = 1.00 mA, R_L = 10.0 kΩ
t_{PHL}*	Propagation Delay Time to Logic Low at Output			2.5	50	μs	I_F = 10.0 mA, R_L = 220 Ω
t_{PLH}	Propagation Delay Time to Logic High at Output			1500		μs	I_F = 1.00 mA, R_L = 10.0 kΩ
t_{PLH}*	Propagation Delay Time to Logic High at Output			52	500	μs	I_F = 10.0 mA, R_L = 220 Ω
CM_H	Common Mode Transient Immunity at Logic High Level Output			500		V/μs	I_F = 0, R_L = 10.0 kΩ, V_{cm} = 10.0 V_{p-p}
CM_L	Common Mode Transient Immunity at Logic Low Level Output			-500		V/μs	I_F = 1.00 mA, R_L = 10.0 kΩ, V_{cm} = 10.0 V_{p-p}

* All Min-Max ratings are JEDEC Registered. ** All typicals are at T_A = 25°C

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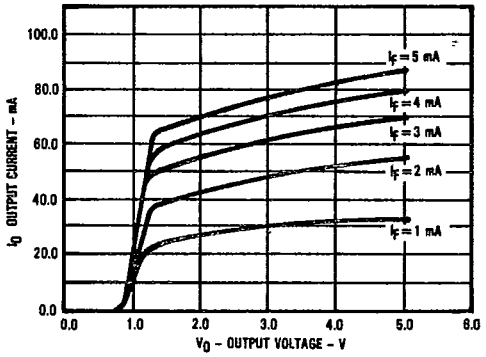
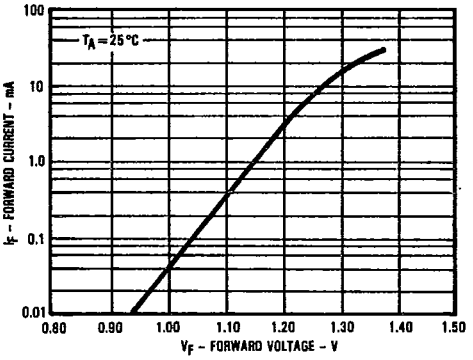
Typical Performance Curves

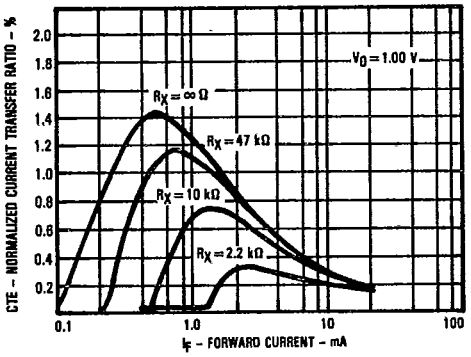
Output Current vs Output Voltage



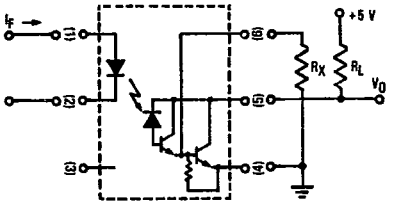
Forward Current vs Forward Voltage



Forward Diode Current vs CTR for Different External Base Resistors

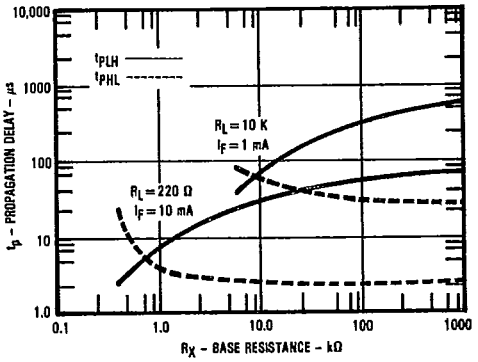


Circuit Diagram – External Base Resistor – R_X

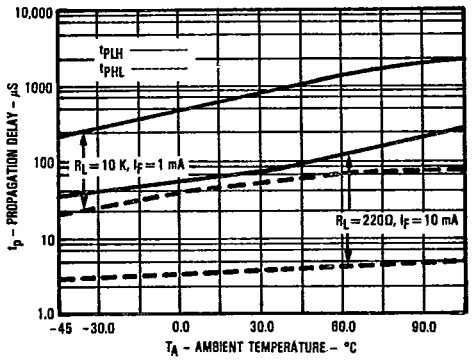


Typical Performance Curves

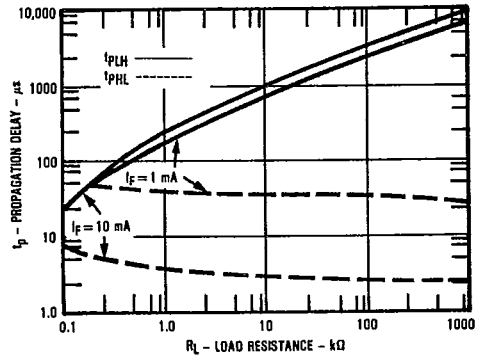
Propagation Delay vs Base Resistance



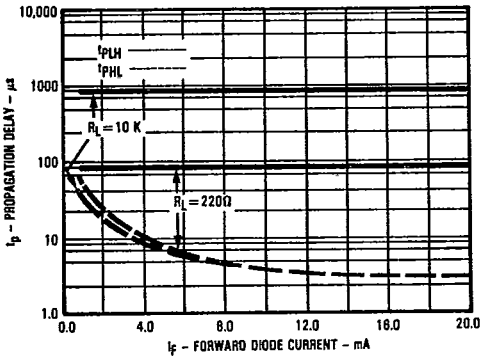
Propagation Delay vs Ambient Temperature



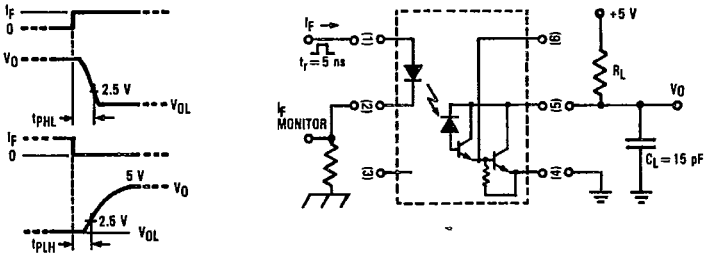
Propagation Delay vs Load Resistance



Propagation Delay vs Forward Diode Current



Switching Time Test Circuit



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