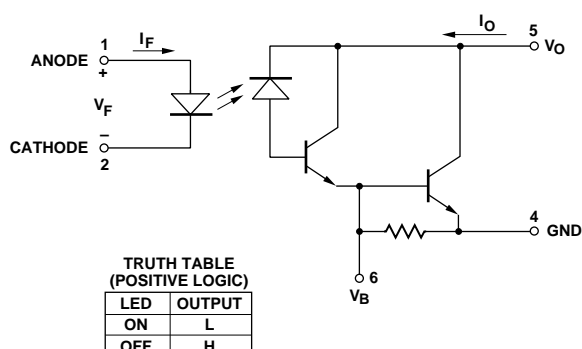


Specify part number followed by Option Number (if desired).

300 = Gull Wing Surface Mount Lead Option
500 = Tape/Reel Package Option (1 K min)

Schematic

[illegible]

DIMENSIONS IN MILLIMETERS AND (INCHES).

DIMENSIONS IN mm (INCHES)
TOLERANCES: xx.xx = 0.01
xx.xxx = 0.001
(unless otherwise specified)

LEAD COPLANARITY^{[3] [5]}
MAXIMUM: 0.102 (0.004)

Thermal Profile (Option #300)

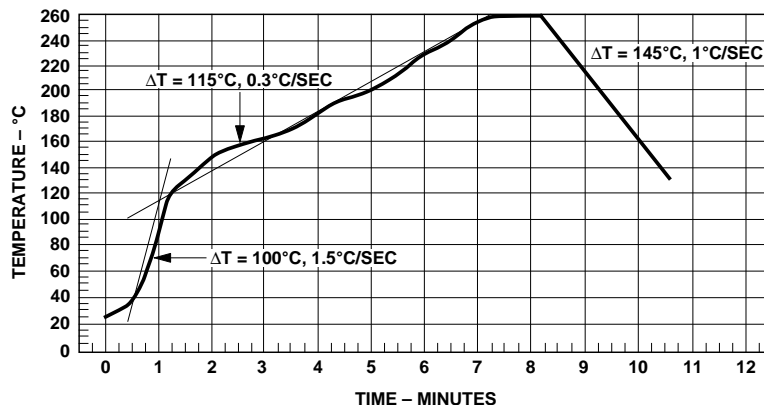


Figure 1. Maximum Solder Reflow Thermal Profile.
(Note: Use of non-chlorine activated fluxes is recommended.)

Regulatory Information

The 4N45 and 4N46 have been approved by the following regulatory organizations:

UL

Recognized under UL 1577, Component Recognition Program, File E55361.

CSA

Approved under CSA Component Acceptance Notice #5, File CA 88324.

Insulation and Safety Related Specifications

Parameter	Symbol	Value	Units	Conditions
Min. External Air Gap (External Clearance)	L(IO1)	7.1	mm	Measured from input terminals to output terminals, shortest distance through air
Min. External Tracking Path (External Creepage)	L(IO2)	7.4	mm	Measured from input terminals to output terminals, shortest distance path along body
Min. Internal Plastic Gap (Internal Clearance)		0.08	mm	Through insulation distance, conductor to conductor, usually the direct distance between the photoemitter and photodetector inside the optocoupler cavity
Tracking Resistance (Comparative Tracking Index)	CTI	200	Volts	DIN IEC 112/VDE 0303 PART 1
Isolation Group		IIIa		Material Group (DIN VDE 0110, 1/89, Table 1)

Option 300 – surface mount classification is Class A in accordance with CECC 00802.

Absolute Maximum Ratings

Storage Temperature, T_S -55°C to +125°C
 Operating Temperature, T_A -40°C to +85°C
 Lead Solder Temperature, max 260°C for 10 s
 (1.6 mm below seating plane)
 Average Input Current, I_F 20 mA^[1]
 Peak Input Current, I_F 40 mA
 (50% duty cycle, 1 ms pulse width)
 Peak Transient Input Current, I_F 1.0 A
 ($\leq 1 \mu s$ pulse width, 300 pps)
 Reverse Input Voltage, V_R 5 V
 Input Power Dissipation, P_I 35 mW^[2]
 Output Current, I_O (Pin 5) 60 mA^[3]
 Emitter-Base Reverse Voltage (Pins 4-6) 0.5 V
 Output Voltage, V_O (Pin 5-4)
 4N45 -0.5 to 7 V
 4N46 -0.5 to 20 V
 Output Power Dissipation 100 mW^[4]
 Infrared and Vapor Phase Reflow Temperature
 (Option #300) see Fig. 1, Thermal Profile

Recommended Operating Conditions

Parameter	Symbol	Min.	Max.	Units
Output Voltage (4N46)	V_O	4.5	20	V
Output Voltage (4N45)		4.5	7	V
Input Current (High)	$I_{F(ON)}$	0.5	10	mA
Input Voltage (Low)	$V_{F(OFF)}$	0	0.8	V
Operating Temperature	T_A	0	70	°C

DC Electrical Specifications

Over recommended temperature ($T_A = 0^\circ\text{C}$ to 70°C), unless otherwise specified.

Parameter	Device	Symbol	Min.	Typ.*	Max.	Units	Test Conditions	Fig.	Note
Current Transfer Ratio	4N46	CTR	350*	1500	3200	%	$I_F = 0.5\text{ mA}, V_O = 1.0\text{ V}$	3, 4, 5, 11, 12	5, 6, 8
			500*	1500	2000		$I_F = 1.0\text{ mA}, V_O = 1.0\text{ V}$		
			200*	600	1000		$I_F = 10\text{ mA}, V_O = 1.2\text{ V}$		
	4N45		250*	1200	2000		$I_F = 1.0\text{ mA}, V_O = 1.0\text{ V}$		
Logic Low Output Voltage	4N46	V_{OL}		0.90	1.0	V	$I_F = 0.5\text{ mA}, I_{OL} = 1.75\text{ mA}$	3	6
				0.92	1.0		$I_F = 1.0\text{ mA}, I_{OL} = 5.0\text{ mA}$		
				0.95	1.2		$I_F = 10\text{ mA}, I_{OL} = 20\text{ mA}$		
	4N45			0.90	1.0		$I_F = 1.0\text{ mA}, I_{OL} = 2.5\text{ mA}$		
Logic High Output Current	4N46	I_{OH}^*		0.001	100	μA	$I_F = 0\text{ mA}, V_O = 18\text{ V}$		6
	4N45			0.001	250	μA	$I_F = 0\text{ mA}, V_O = 5\text{ V}$		
Input Forward Voltage		V_F		1.4	1.7*	V	$T_A = 25^\circ\text{C}, I_F = 1.0\text{ mA}$	2	
					1.75				
Temperature Coefficient of Forward Voltage		$\frac{\Delta V_F}{\Delta T_A}$		-1.8		mV/°C	$I_F = 1.0\text{ mA}$		
Input Reverse Breakdown Voltage		BV_R^*	5			V	$I_R = 10\text{ }\mu\text{A}$		
Input Capacitance		C_{IN}		60		pF	$f = 1\text{ MHz}, V_F = 0$		

Switching Specifications

(Over recommended temperature $T_A = 0^\circ\text{C}$ to 70°C unless otherwise specified. $V_{CC} = 5.0\text{ V}$.)

Parameter	Symbol	Min.	Typ.*	Max.	Units	Test Conditions	Fig.	Note
Propagation Delay Time to Logic Low at Output	t_{PHL}		80		μs	$T_A = 25^\circ\text{C}, I_F = 0.5\text{ mA}, R_L = 10\text{ k}\Omega$	6, 7, 8, 9, 11, 13	6, 8
			5	50*		$T_A = 25^\circ\text{C}, I_F = 10\text{ mA}, R_L = 2.2\text{ k}\Omega$		
	t_{PLH}		1500			$T_A = 25^\circ\text{C}, I_F = 10\text{ mA}, R_L = 10\text{ k}\Omega$	6, 7, 8, 9, 11, 13	
			150	500*		$T_A = 25^\circ\text{C}, I_F = 10\text{ mA}, R_L = 220\text{ k}\Omega$		
Common Mode Transient Immunity at High Output Level	$ CM_H $		500		V/ μs	$I_F = 0\text{ mA}, R_L = 10\text{ k}\Omega, V_{CM} = 10\text{ V}_{P-P}$	10	9
Common Mode Transient Immunity at Low Output Level	$ CM_L $		500		V/ μs	$I_F = 1.0\text{ mA}, R_L = 10\text{ k}\Omega, V_{CM} = 10\text{ V}_{P-P}$	10	9

*JEDEC Registered Data.

**All typicals at $T_A = 25^\circ\text{C}$, unless otherwise noted.

Package Characteristics

For $0^{\circ}\text{C} \leq T_A \leq 70^{\circ}\text{C}$, unless otherwise specified. All typicals at $T_A = 25^{\circ}\text{C}$.

Parameter	Symbol	Min.	Typ.	Max.	Units	Test Conditions	Fig.	Notes
Input-Output Momentary Withstand Voltage*	V_{ISO}	2500			V rms	$RH \leq 50\%$, $t = 1 \text{ min}$, $T_A = 25^{\circ}\text{C}$		7, 10
Resistance, Input-Output	$R_{\text{I-O}}$		10^{12}		Ω	$V_{\text{I-O}} = 500 \text{ Vdc}$		7
Capacitance, Input-Output	$C_{\text{I-O}}$		0.6		pF	$f = 1 \text{ MHz}$		7

*The Input-Output Momentary Withstand Voltage is a dielectric voltage rating that should not be interpreted as an input-output continuous voltage rating. For the continuous voltage rating refer to the VDE 0884 Insulation Characteristics Table (if applicable), your equipment level safety specification, or HP Application Note 1074, "Optocoupler Input-Output Endurance Voltage."

Notes:

- Derate linearly above 50°C free-air temperature at a rate of $0.4 \text{ mA}/^{\circ}\text{C}$.
- Derate linearly above 50°C free-air temperature at a rate of $0.7 \text{ mW}/^{\circ}\text{C}$.
- Derate linearly above 25°C free-air temperature at a rate of $0.8 \text{ mA}/^{\circ}\text{C}$.
- Derate linearly above 25°C free-air temperature at a rate of $1.5 \text{ mW}/^{\circ}\text{C}$.
- DC CURRENT TRANSFER RATIO is defined as the ratio of output collector current, I_O , to the forward LED input current, I_F , times 100%.
- Pin 6 Open.
- Device considered a two-terminal device: Pins 1, 2, 3 shorted together and Pins 4, 5, and 6 shorted together.
- Use of a resistor between pin 4 and 6 will decrease gain and delay time. (See Figures 11, 12, and 13.)
- Common mode transient immunity in Logic High level is the maximum tolerable (positive) dV_{cm}/dt on the leading edge of the common mode pulse, V_{CM} , to assure that the output will remain in a Logic High state (i.e., $V_O > 2.5 \text{ V}$). Common mode transient immunity in Logic Low level is the maximum tolerable (negative) dV_{cm}/dt on the trailing edge of the common mode pulse signal, V_{cm} , to assure that the output will remain in a Logic Low state (i.e., $V_O < 2.5 \text{ V}$).
- In accordance with UL 1577, each optocoupler is proof tested by applying an insulation test voltage $\geq 3000 \text{ V rms}$ for 1 second (leakage detection current limit, $I_{\text{I-O}} \leq 5 \mu\text{A}$).

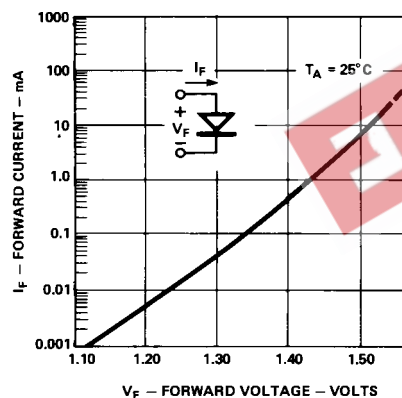


Figure 2. Input Diode Forward Current vs. Forward Voltage.

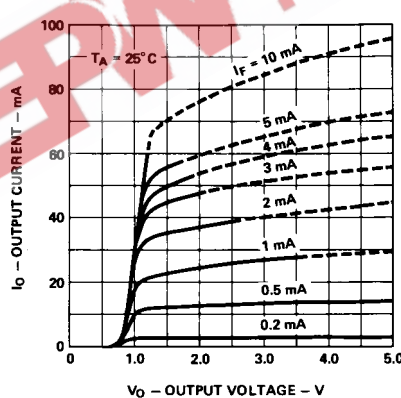


Figure 3. Typical DC Transfer Characteristics.

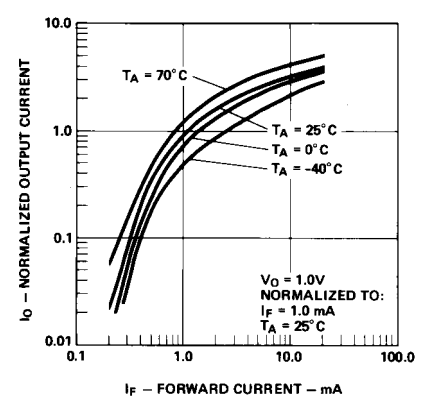


Figure 4. Output Current vs. Input Current.

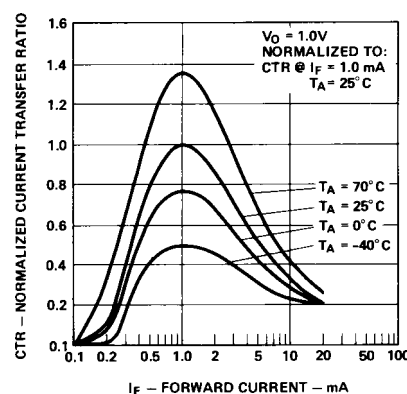


Figure 5. Current Transfer Ratio vs. Input Current.

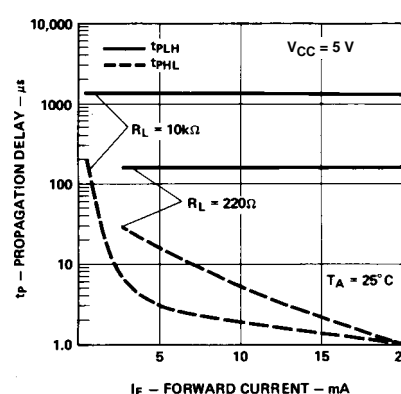


Figure 6. Propagation Delay vs. Forward Current.

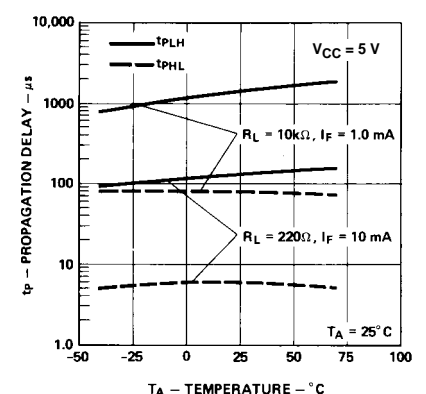


Figure 7. Propagation Delay vs. Temperature.

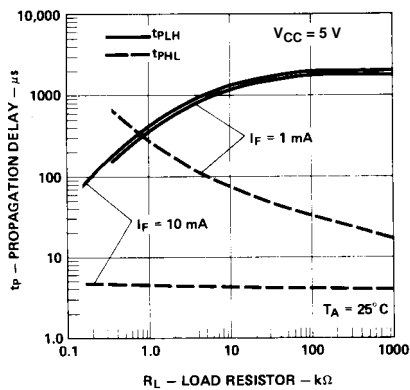


Figure 8. Propagation Delay vs. Load Resistor.

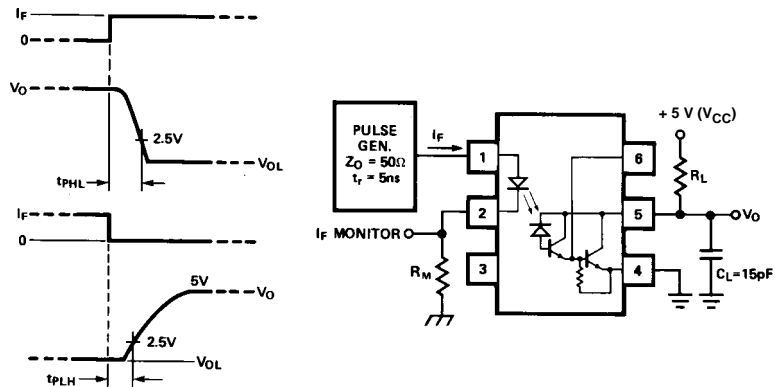


Figure 9. Switching Test Circuit.

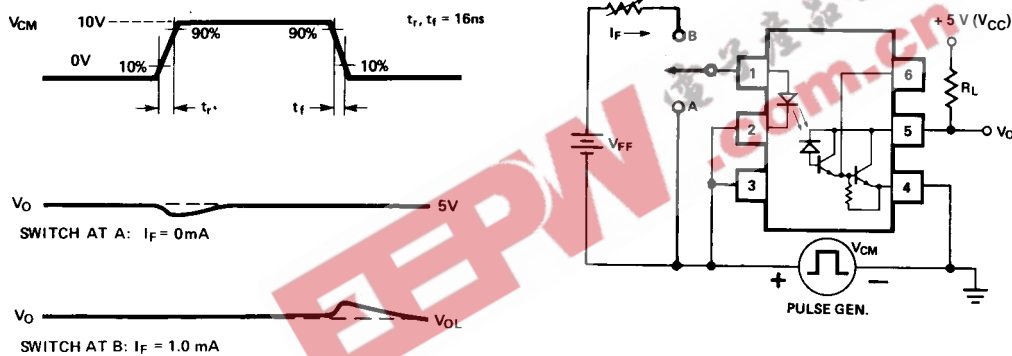


Figure 10. Test Circuit for Transient Immunity and Typical Waveforms.

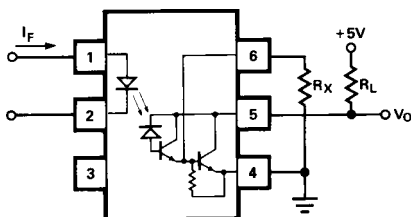


Figure 11. External Base Resistor, R_X .

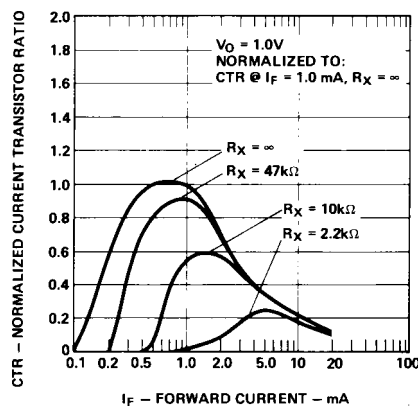


Figure 12. Effect of R_X On Current Transfer Ratio.

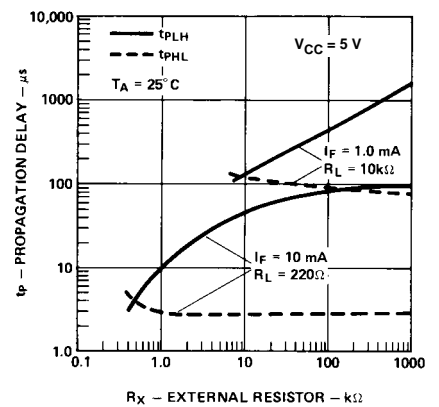
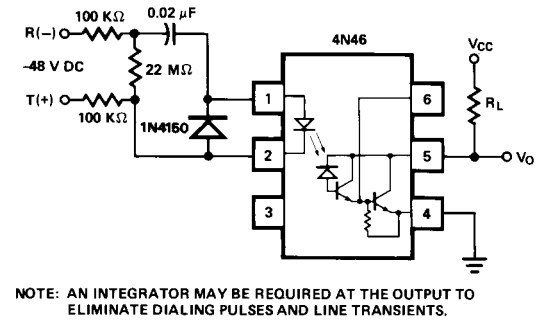
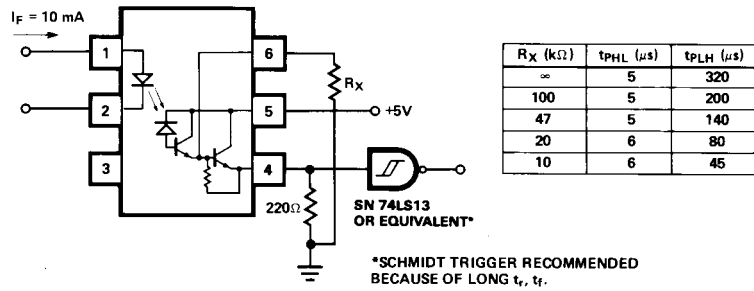
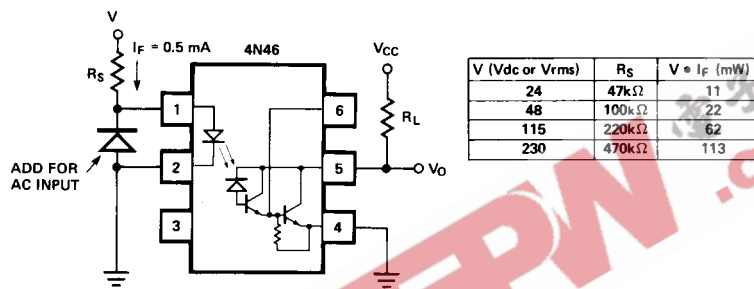


Figure 13. Effect of R_X On Propagation Delay.

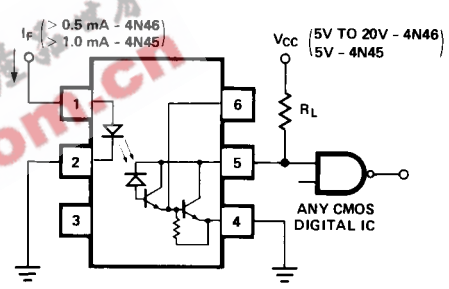
Applications



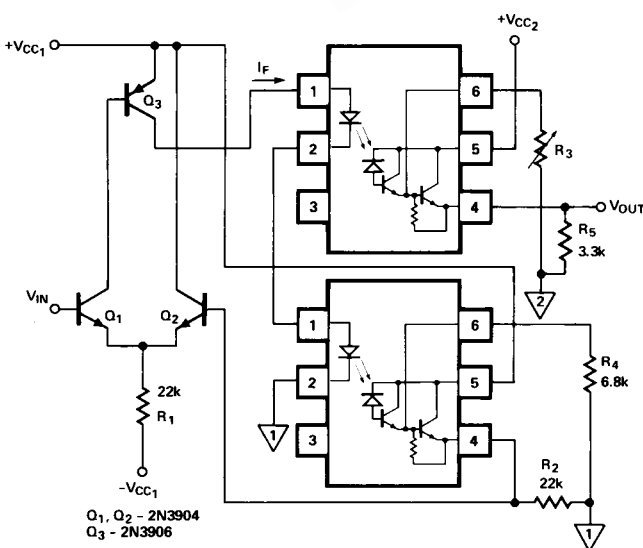
TTL Interface



Telephone Ring Detector



Line Voltage Monitor



CMOS Interface

CHARACTERISTICS

$R_{IN} \approx 30M\Omega$, $R_{OUT} \approx 50\Omega$
 $V_{IN(MAX)} = V_{CC1} - 1V$, LINEARITY BETTER THAN 5%

DESIGN COMMENTS

R_1 - NOT CRITICAL ($\ll \frac{V_{IN(MAX)} - (-V_{CC1}) - V_{BE}}{I_F(MAX.)}$) $h_{FE} Q_3$
 R_2 - NOT CRITICAL (OMIT IF 0.2 TO 0.3V OFFSET IS TOLERABLE)

$R_4 > \frac{V_{IN(MAX)} + V_{BE}}{1 \text{ mA}}$

$R_5 > \frac{V_{IN(MAX)}}{2.5 \text{ mA}}$

NOTE: ADJUST R_3 SO $V_{OUT} = V_{IN}$ AT $V_{IN} = \frac{V_{IN(MAX)}}{2}$

Analog Signal Isolation