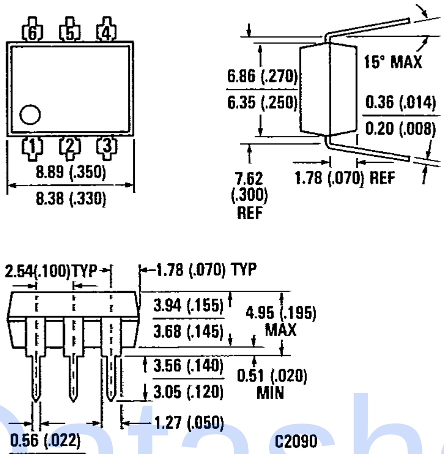
GENERAL INSTRUMENT

PHOTOTRANSISTOR OPTOCOUPLERS

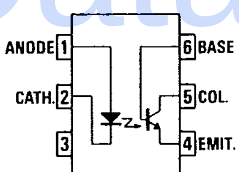
Optocouplers

4N35
4N36
4N37

PACKAGE DIMENSIONS



C2090 DIMENSIONS IN mm (INCHES)



C2079

Equivalent Circuit

DESCRIPTION

The 4N35, 4N36, and 4N37 series of optocouplers have an NPN silicon planar phototransistor optically coupled to a gallium arsenide infrared emitting diode.

FEATURES & APPLICATIONS

- AC line/digital logic isolator
- Digital logic/digital logic isolator
- Telephone/telegraph line receiver
- Twisted pair line receiver
- High frequency power supply feed-back control
- Relay contact monitor
- Power supply monitor
- Industrial controls
- Covered under UL component recognition program, reference File E50151
- High DC current transfer ratio
- High isolation voltage V_{ISO} = 2500 V RMS, 1 minute

ABSOLUTE MAXIMUM RATINGS

*Relative humidity 85% @ 85°C
*Storage temperature −55°C to 150°C
*Operating temperature −55°C to 100°C
*Lead temperature (soldering, 10 sec) 260°C

Input Diode
*Forward DC current (continuous) . . . . . 60 mA
Reverse voltage . . . . 6 volts
*Peak forward current
(1 μs pulse, 300 pps) . . . . 3.0 A
*Power dissipation at T_A = 25°C . . . . 100 mW†
*Power dissipation at T_C = 25°C . . . . 100 mW†
(T_C indicates collector lead temp 1/32" from case)

Output Transistor
*Power dissipation at 25°C ambient . . . . . 300 mW
Derate linearly above 25°C . . . . 4 mW/°C
*Power dissipation at T_C = 25°C . . . . . . 500 mW††
(T_C indicates collector lead temp 1/32" from case)

*V_{CEO} . . . . 30 volts
*V_{CBO} . . . . 70 volts
*V_{ECO} . . . . 7 volts
*Collector current (continuous) . . . . 100 mA

*Indicates JEDEC registered values
†Derate 1.33 mW/°C above 25°C.
††Derate 6.7 mW/°C above 25°C.

ELECTRO-OPTICAL CHARACTERISTICS (25°C Free Air Temperature Unless Otherwise Specified)

CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
Input Diode						
*Forward voltage	V_F	.8		1.50	V	I_F = 10 mA
*Forward voltage temp. coefficient	V_F	.9		1.7	V	I_F = 10 mA, T_A = −55°C
*Forward voltage	V_F	.7		1.4	V	I_F = 10 mA, T_A = +100°C
*Junction capacitance	C_J			100	pF	V_F = 0 V, f = 1 mHz
*Reverse leakage current			.01	10	μA	V_R = 6.0 V
Output Transistor						
DC forward current gain	h_{FE}		250			V_{CE} = 5 V, I_C = 100 μA
*Collector to emitter breakdown voltage	BV_{CEO}	30	65		V	I_C = 10 mA, I_F = 0
*Collector to base breakdown voltage	BV_{CBO}	70	165		V	I_C = 100 μA
*Emitter to collector breakdown voltage	BV_{ECO}	7	14		V	T_E = 100 μA, I_F = 0
Collector to emitter, leakage current	I_{CEO}		5	50	nA	V_{CE} = 10 V, I_F = 0
*Collector to emitter leakage current (dark)	I_{CEO}			500	μA	V_{CE} = 30 V, I_F = 0, T_A = 100°C
Capacitance collector to emitter			8		pF	V_{CE} = 0
Capacitance collector to base			20		pF	V_{CB} = 10 V
Capacitance base to emitter	C_{BEO}		10		pF	V_{BE} = 0
Coupled						
†*DC current transfer ratio	CTR	100			%	I_F = 10 mA, V_{CE} = 10 V
†*DC current transfer ratio	CTR	40			%	I_F = 10 mA, V_{CE} = 10 V, T_A = − 55°C
†*DC current transfer ratio	CTR	40			%	I_F = 10 mA, V_{CE} = 10 V, T_A = +100°C
*Saturation voltage—collector to emitter	$V_{CE(SAT)}$			.3	volts	I_F = 10 mA, I_C = 0.5 mA
Isolation voltage all devices	V_{ISO}	2500			volts	RMS, t = 1 minute
*Input to output isolation current (pulse width = 8 msec) (see Note 1)	$I_{I\text{-}O}$					
*Input to output voltage = 3550 V (peak)		4N35		100	μA	
*Input to output voltage = 2500 V (peak)		4N36		100	μA	
*Input to output voltage = 1500 V (peak)		4N37		100	μA	
*Input to output resistance	$R_{I\text{-}O}$	100			gigaohms	Input to output voltage = 500 V (see Note 1)
*Input to output capacitance	$C_{I\text{-}O}$			2.5	picofarads	Input to output voltage = 0 V, f = 1 MHz (see Note 1)
*Turn on time—t_{on}	t_{ON}		5	10	μsec	V_{CC} = 10 V, I_C = 2 mA, R_L = 100Ω, (see Fig. 15)
*Turn off time—t_{off}	t_{OFF}		5	10	μsec	V_{CC} = 10 V, I_C = 2 mA, R_L = 100Ω, (see Fig. 15)

*Indicates JEDEC registered values

†Pulse test: pulse width = 300μS, duty cycle ≤ 2.0%

TYPICAL ELECTRO-OPTICAL CHARACTERISTIC CURVES

(25°C Free Air Temperature Unless Otherwise Specified)

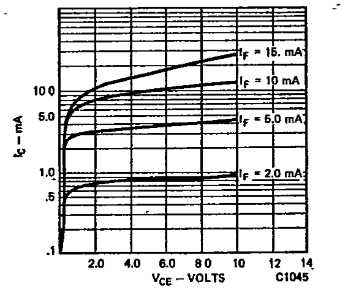


Fig. 1. Collector Current vs. Collector Voltage

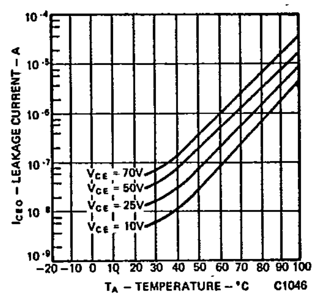


Fig. 2. Dark Current vs. Temperature

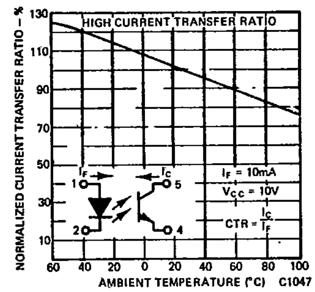


Fig. 3. Current Transfer Ratio vs. Temperature

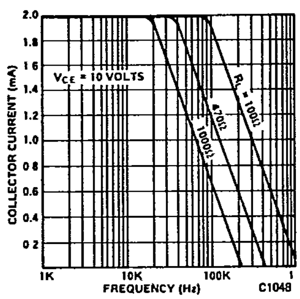


Fig. 4. Collector Current vs. Frequency

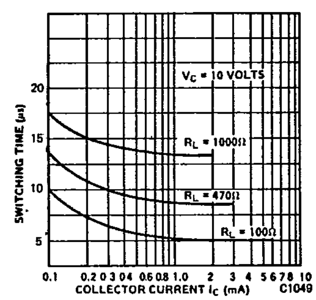


Fig. 5. Switching Time vs. Collector Current

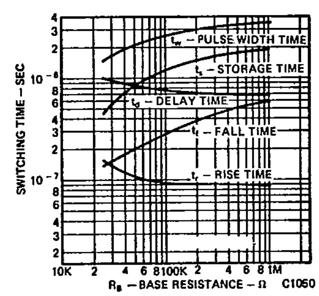


Fig. 6. Switching Time vs. Base Resistance

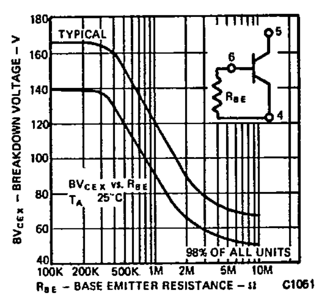


Fig. 7. Collector–Emitter Breakdown Voltage vs. Base Resistance

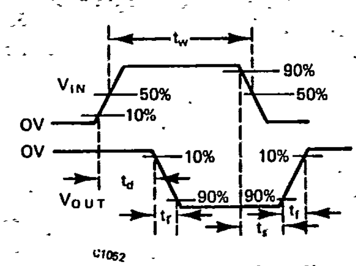


Fig. 8. Test Pulse Definition (Note 3)

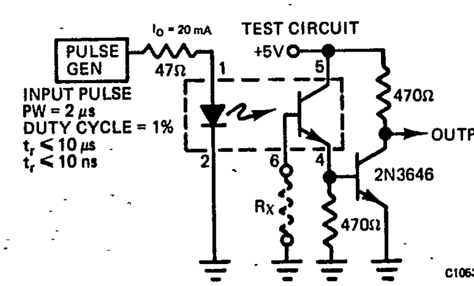


Fig. 9. Pulse Test Circuit for Fig. 7

TYPICAL ELECTRO-OPTICAL CHARACTERISTIC CURVES

(25° C Free Air Temperature Unless Otherwise Specified)

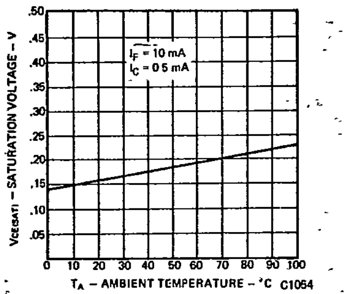


Fig. 10. Saturation Voltage vs. Temperature

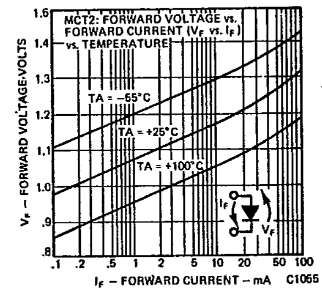


Fig. 11. Forward Voltage vs. Forward Current

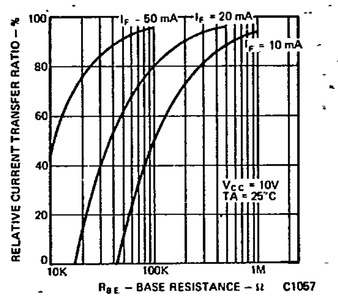


Fig. 12. Sensitivity vs. Base Resistance

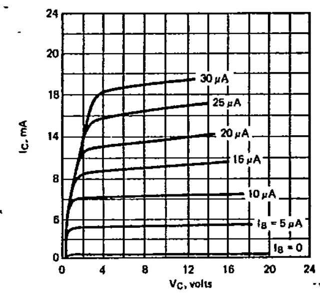


Fig. 13. Detector Standard Transfer Curves

OPERATING SCHEMATICS

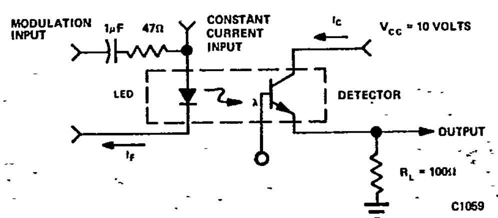


Fig. 14. Modulation Circuit Used to Obtain Output vs. Frequency Plot (Fig. 4)

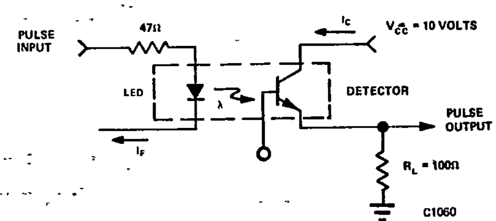


Fig. 15. Circuit Used to Obtain Switching Time vs. Collector Current Plot (Fig. 5)

NOTES

1. *Tests of input to output isolation current resistance and capacitance are performed with the input terminals (diode) shorted together and the output terminals (transistor) shorted together.*
2. *The current transfer ratio (I_C/I_F) is the ratio of the detector collector current to the LED input current with V_{CE} at 10 volts.*
3. *Rise time (t_r) is the time required for the collector current to increase from 10% of its final value, to 90%. Fall time (t_f) is the time required for the collector current to decrease from 90% of its initial value to 10%.*