Monsanto

OPTICALLY ISOLATED LOGIC GATE

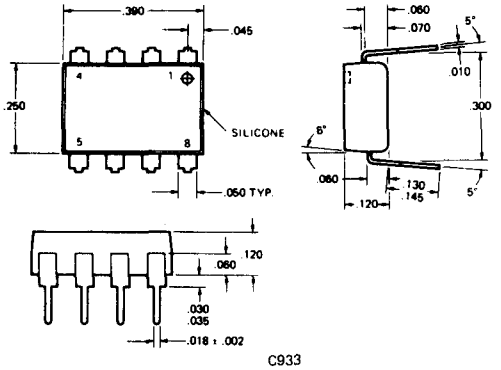
MCL601
MCL611

PRODUCT DESCRIPTION

The MCL601 and MCL611, are optically isolated logic gates in an 8-lead DIP package. A GaAs LED radiates infrared light onto a high speed photodiode detector, thus providing electrical isolation of ±2000 V between input and output. A differential comparator amplifies the photodiode signal, and a Schmitt trigger improves noise immunity by providing threshold and hysteresis. A standard open collector circuit on the output offers normal current sinking capability. The LED drive current requirement matches either mode of logic loading. The output is compatible to most logic systems. The MCL601 has a 0.1 MHz data rate; the MCL 611 has a 1 MHz data rate.

PACKAGE DIMENSIONS

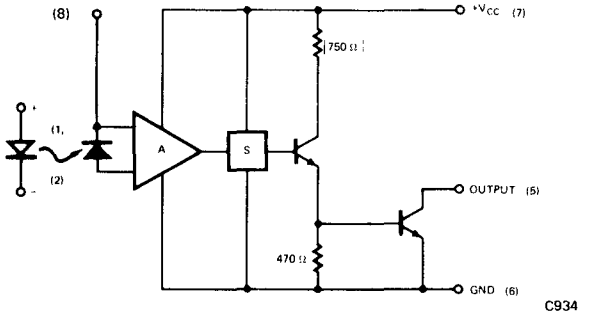
ALL DIMENSIONS IN INCHES



C933

PIN	
1	LED ANODE
2	LED CATHODE
3	N/C
4	N/C
5	OUT
6	GROUND
7	V_{CC}
8	PHOTO DIODE CATHODE

SCHEMATIC DIAGRAM



C934

A = Differential amp, comparator
S = Schmitt trigger, threshold hysteresis

Typical Values Shown

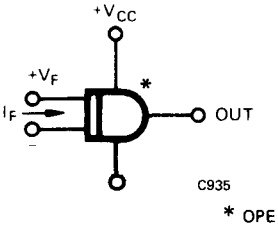
FEATURES

- Compatible TTL input drive load
- Output compatible to TTL, DTL, RTL, CTL, HiNIL
- Single +5 V_{CC} supply required
- High toggle speed, high data rate
- Short transmission delay
- Small 8 pin DIP, two packages fit 16 pin socket
- High isolation between input-output
- High CMRR (Common Mode Rejection Ratio)
- Built-in hysteresis for noise immunity
- Output ORing capability

APPLICATIONS

- Digital logic to digital logic isolator—eliminates spurious grounds
- DC input level sensor—Schmitt trigger toggle
- AC to TTL conversion—square wave shaping
- Line receiver—eliminates CMN and ground loop transients
- Logic level shifter, input-output independent ground systems

SYMBOL



C935

* OPEN COLLECTOR

ABSOLUTE MAXIMUM RATINGS

Storage temperature . . . . . −55°C to +150°C
Operating temperature . . . . . 0°C to +70°C
Lead temperature (Soldering, 10 sec.) . . . . . 260°C

Input Diode
- Forward DC current . . . . . 20 mA
- Reverse Voltage 3V
- Peak forward current (1 μs pulse, 300 pps) . . . . . 3.0 A
- Power dissipation at 25°C ambient . . . . . 100 mW
- Derate linearly from 25°C . . . . . 1.33 mW/°C

Output Gate
- Power dissipation at 25°C ambient . . . . . 100 mW
- Derate linearly from 25°C . . . . . 1.33 mW/°C
- DC supply current I_{CC} . . . . . 30 mA
- Output collector voltage V_{SS} 15V
- V_{CC} 8V
- Output current low—I_{OL} . . . . . 16 mA

Input to output voltage . . . . . ±2000 V DC

Note: The input is not specified as "HI" or "LOW" as with normal gate units. The input is "ON" or "OFF," set by the current flow through the input LED. Thus the input may be "ON" for logic drive "HI" (pull up load system, Figure 1A) or logic drive "LOW" (pull down load systems, Figure 1B, as in open collector output devices.) See Z plot.

As a convenience of notation, reference will be made to a pull down type load input connected as in Figure 1B. A logical "LOW" is "ON", and a logical "HI" is "OFF".

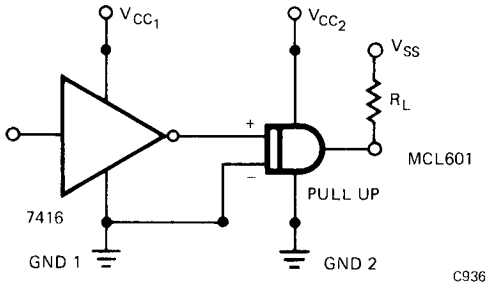


Figure 1A

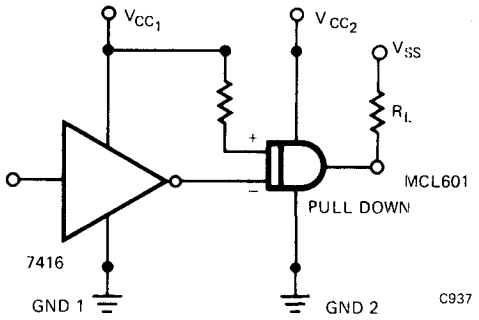


Figure 1B

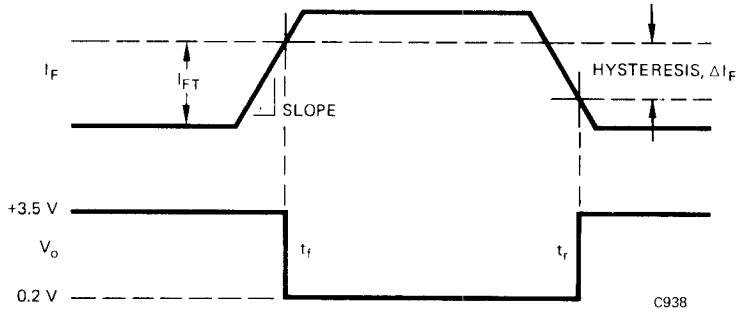


Figure 2A

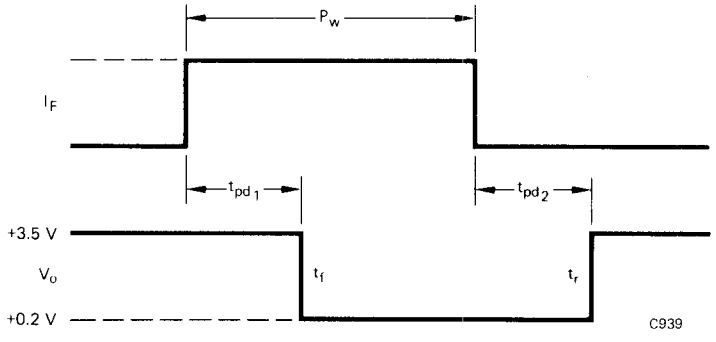


Figure 2B

The MCL input may be driven in series or in parallel with other MCL units, and/or in parallel with other logic units. The input of the MCL has an equivalent unit load (U.L.) rating related to current requirements.

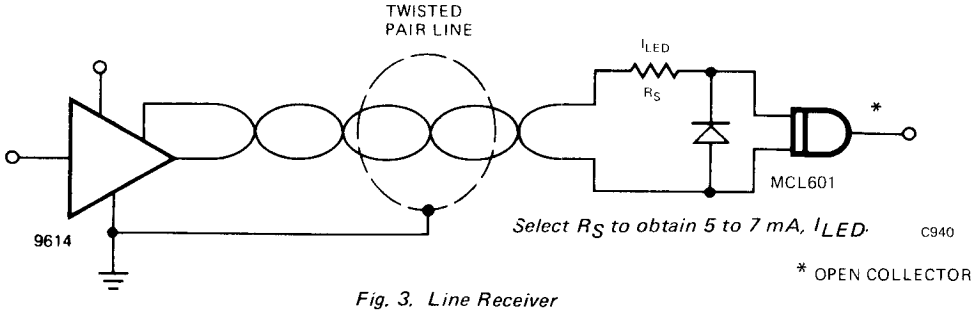


Fig. 3. Line Receiver

RECOMMENDED OPERATING CONDITIONS

PARAMETER			LIMITS MIN.	TYP.	MAX.	UNITS
Supply Voltage V_{CC}			4.5	5.0	5.5	Volts
Operating Free Air Temperature Range			0	25	70	°C
Normalized Fan Out	Logic HIGH				20	U.L.
	Logic LOW				10	U.L.
Maximum Input Rise and Fall Time	Slope			No Restriction		
Minimum Input Rise and Fall Time	Slope			See Fig. 2A		
Minimum Pulse Width				least t_{pd}		

ELECTRICAL CHARACTERISTICS (25°C)

PARAMETER	SYMBOL	LIMITS MIN.	TYP. (Note 2)	MAX.	UNITS	TEST CONDITIONS (Note 1)
Input Diode						
Forward Voltage	V_F		1.25	1.50	V	I_F = 20 mA
Forward Voltage Temp Coefficient			-1.8		mV/°C	
Reverse Breakdown Voltage	BV_R	3.0	5.5		V	I_R = 10 μA
Reverse Leakage Current			.001	10	μA	V_R = 3.0 V
Junction Capacitance	C_J		50		pF	V_F = 0
Rise Time	tr		20		ns	I_F = 50 mA, 50Ω system
Fall Time	tf		20		ns	I_F = 50 mA, 50Ω system
Output						
Output Current HIGH (collector leakage)	I_{OHL}			200	μA	V_{CC} = 4.5 V, I_F = 0 mA, V_{OH} = 15 V
Output Voltage LOW	V_{OL}		0.2	0.4	Volts	V_{CC} = 4.5 V, I_F = (ON)MAX, I_{OL} = 16 mA
Supply Current HIGH	I_{CCH}		6	15	mA	V_{CC} = 5.5V, I_F = 0 mA
Supply Current LOW	I_{CCL}		10	25	mA	V_{CC} = 5.5V, I_F = MAX
MCL601, 5 mA DRIVE (V_{CC} = 5 V)						
Switching Characteristics (Fig. 2B)						
t_{pd} (On)			2	4	μs	I_F = 3.0 mA
t_{pd} (Off)			2	4	μs	I_F = 3.0 mA
tr, tf			10		ns	C_L = 25 pF, R_L = 280Ω
Binary data rate		0.1	0.2		MHz	I_F = 3.0 mA, R_L = 280 Ω
Input Diode						
I_F (On)			3.0	5.0	mA	
I_F (Off)		0.5	2.0		mA	
ΔI_F (hysteresis)			1.0		mA	
V_F (On)			1.15		V	I_F = 5.0 mA
V_F (Off)			0.95		V	I_F = 1.0 mA
Input load equivalent			2		U.L.	
MCL611, 15 mA DRIVE (V_{CC} = 5 V)						
Switching Characteristics (Fig. 2B)						
t_{pd} (On) (Fig. 9)			.3	.6	μs	I_F = 10 mA
t_{pd} (Off)					μs	I_F = 10 mA
tr, tf			10		ns	C_L = 25 pF, R_L = 280Ω
Binary data rate		1.0	1.2		MHz	I_F = 3.0 mA, R_L = 280 Ω
Input Diode (Fig. 11)						
I_F (On)			10	15	mA	
I_F (Off)		2.0	5		mA	
ΔI_F (hysteresis)			5		mA	
V_F (On)			1.1	1.30	V	I_F = 10 mA
V_F (Off)		1.00	1.1		V	I_F = 2.5 mA
Input load equivalent			6		U.L.	
ISOLATION						
DC Voltage Breakdown		2000			VDC	
AC Voltage Limit @ 60 Hz		800			VRMS	
Capacitance			1.0		pF	
Resistance			10^{12}		Ω	

TYPICAL ELECTRO-OPTICAL CHARACTERISTIC CURVES

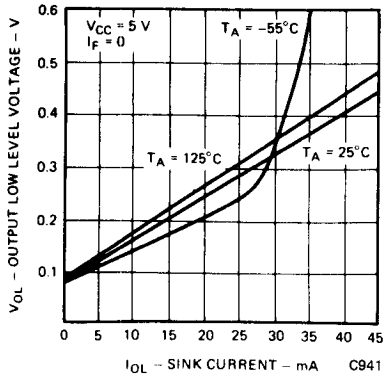


Fig. 4. Low Level Output Voltage vs. Sink Current

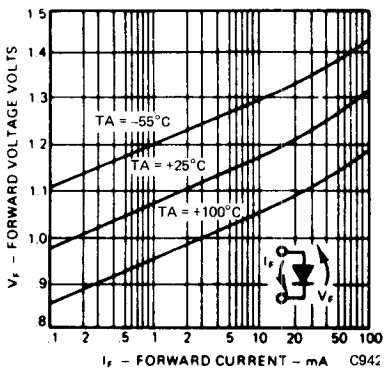


Fig. 5. Forward Voltage vs. Forward Current

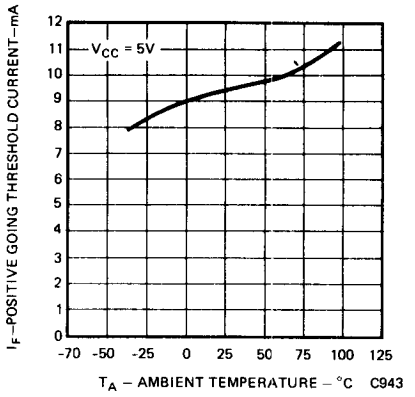


Fig. 6. MCL 611—Positive Going Threshold Current vs. Ambient Temperature

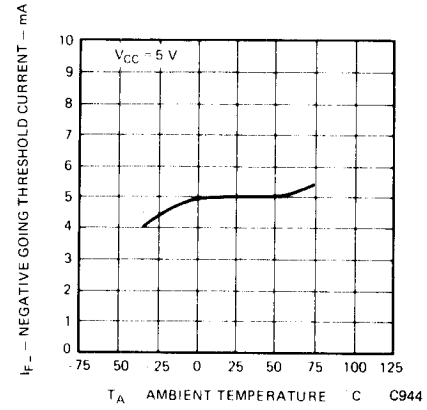


Fig. 7. MCL611—Negative-Going Threshold Current vs. Ambient Temperature

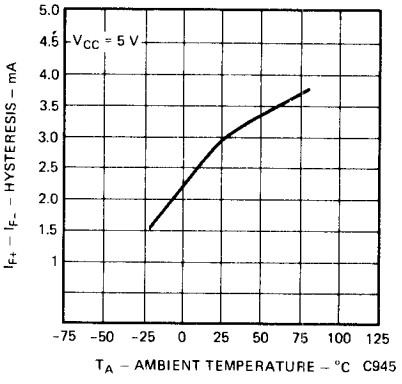


Fig. 8. MCL611—Hysteresis vs. Ambient Temperature

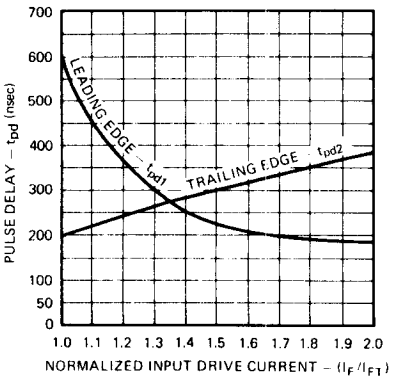


Fig. 9. MCL611—Normalized Input Drive Current vs. Pulse Delay

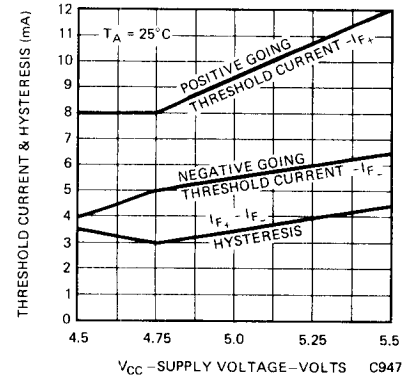


Fig. 10. MCL611—Threshold Current & Hysteresis vs. Supply Voltage

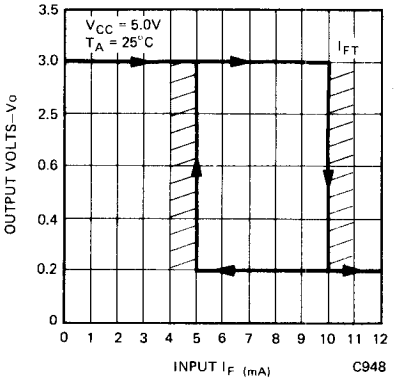


Fig. 11. MCL611—Threshold & Hysteresis of Input/Output

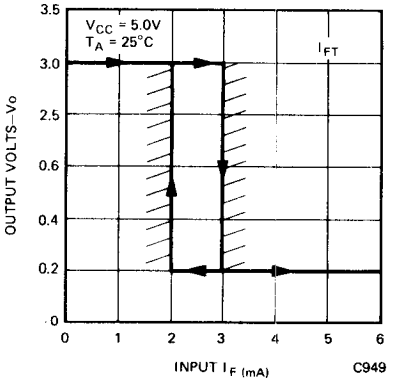


Fig. 12. MCL601—Threshold & Hysteresis of Input/Output

NOTES:

1. *For conditions shown as MIN. or MAX., use the appropriate value specified under recommended operating conditions for the applicable device type.*
2. *Typical limits are at V_{CC} = 5.0 V, 25° C.*