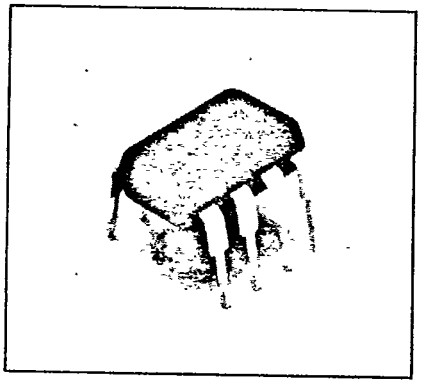
SIEMENS

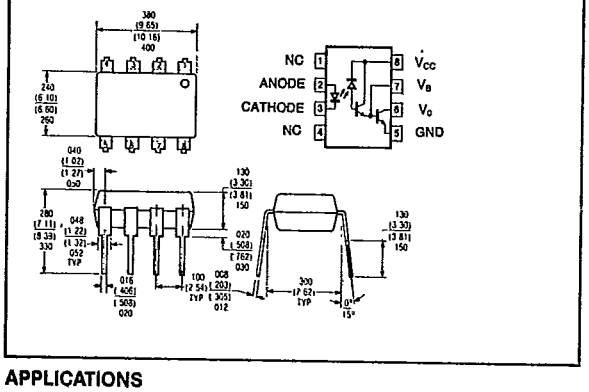
T-41-85

6N138
6N139

LOW INPUT CURRENT, HIGH GAIN OPTOCOUPLER



Package Dimensions in Inches (mm)



FEATURES

- **6000 Volt Isolation Voltage**
- **High Current Transfer Ratio 800%**
- **Low Input Current Requirement - 0.5mA**
- **TTL Compatible Output - 0.1V V_{OL}**
- **High Common Mode Rejection - 500V/μsec.**
- **High Output Current - 60mA**
- **DC to 1 Megabit / Sec. Operation**
- **Adjustable Bandwidth - Access to Base**
- **Standard Molded Dip Plastic Package**
- **UL Approval # E52744**

DESCRIPTION

High common mode transient immunity and very high current transfer ratio together with 6000 volts DC insulation are achieved by coupling an LED with an integrated high gain photon detector in an 8 pin dual inline package. Separate pins for the photodiode and output stage enable TTL compatible saturation voltages with high speed operation. Photo Darlington operation is achieved by tying the Vcc and Vo terminals together. Access to the base terminal allows adjustment to the gain bandwidth.

The 6N138 is ideal for TTL applications since the 300% minimum current transfer ratio with an LED current of 1.6mA enables operation with 1 unit load in and 1 unit load out with a 2.2K Ω pull-up resistor.

The 6N139 is best suited for low power logic applications involving CMOS and low power TTL. A 400% current transfer ratio with only 0.5mA of LED current is guaranteed from 0°C to 70°C.

APPLICATIONS

- Logic ground isolation - TTL/TTL, TTL/CMOS, CMOS/CMOS, CMOS/TTL
- EIA RS 232C Line Receiver
- Low Input Current Line Receiver - Long Lines, Party Lines
- Telephone Ring Detector
- 117 VAC Line Voltage Status Indication–Low Input Power Dissipation
- Low Power Systems - Ground Isolation

Maximum Ratings

Maximum Temperatures	
Storage Temperatures	−55° to +125°C
Operating Temperatures	0°C to +70°C
Lead Temperature (soldering, 10 sec.)	260°C
Average Input Current (I_F)	20mA
Peak Input Current (I_F)	
(50% Duty Cycle — 1ms pulse width)	40mA
Reverse Input Voltage (V_R)	5v
Input Power Dissipation	35mW
(Derate linearly above 50% in free air temperature at 0.7mW/°C)	
Output Current — I_o (Pin 6)	60mA
(Derate linearly above 25°C in free air temperature at 0.7mA/°C)	
Emitter-Base Reverse Voltage (Pin 5-7)	0.5V
Supply and Outage Voltage — V_{CC} (Pin 8-5), V_o (Pin 6-5)	
6N138	−0.5 to 7V
6N139	−0.5 to 18V
Output Power Dissipation	100mW
(Derate Linearly Above 25°C in Free Air Temperature at 2.0mW/°C)	

Caution:
Due to the small geometries of this device it should be handled with Electrostatic Discharge (ESD) precautions. Proper grounding would further prevent damage and/or degradation which may be induced by ESD.

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Electro-Optical Characteristics (T_A = 0°C to 70°C, Unless Otherwise Specified)

Parameter	Device	Min	Typ	Max	Units	Test Conditions	Note
Current Transfer Ratio (CTR)	6N139	400 500	800 900		%	I_F = 0.5mA, V_o = 0.4V, V_{CC} = 4.5V I_F = 1.6mA, V_o = 0.4V, V_{CC} = 4.5V	5,6
	6N138	300	600		%	I_F = 1.6mA, V_o = 0.4V, V_{CC} = 4.5V	
Logic Low Output Voltage (VOL)	6N139 6N139 6N139		0.1 0.1 0.2	0.4 0.4 0.4	V	I_F = 1.6mA, I_o = 6.4mA, V_{CC} = 4.5V I_F = 5mA, I_o = 15mA, V_{CC} = 4.5V I_F = 12mA, I_o = 24mA, V_{CC} = 4.5V	6
	6N138		0.1	0.4	V	I_F = 1.6mA, I_o = 4.8mA, V_{CC} = 4.5V	6
Logic High Output Current (I_{OH})	6N139		0.05	100	µA	I_F = 0mA, V_o = V_{CC} = 18V	6
	6N138		0.1	250	µA	I_F = 0mA, V_o = V_{CC} = 7V	
Logic Low Supply Current (ICCL)				0.2	mA	I_F = 1.6mA, V_o = OPEN, V_{CC} = 5v	6
Logic High Supply Current (ICCH)				10	mA	I_F = 0mA, V_o = OPEN, V_{CC} = 5v	6
Input Forward Voltage (VF)			1.4	1.7	V	I_F = 1.6mA, T_A = 25°C	
Input Reverse Breakdown Voltage (BVR)		5			V	I_R = 10uA, T_A = 25°C	
Temperature Coefficient of Forward Voltage			− 1.8		mV/°c	I_F = 1.6mA	
Input Capacitance (C_{IN})			60		pF	f = 1MHz, V_F = 0	
Input-Output Insulation Leakage Current (I_{I-O})				1.0	µA	45% Relative Humidity, T_A = 25°C t = 5s, V_{I-O} = 3000VDC	7
Resistance Input-Output) (R_{I-O})			10^{12}		Ω	V_{I-O} = 500V_{DC}	7
Capacitance (Input-Output) (C_{I-O})			0.6		pF	f = 1MHz	7

Switching Specifications (TA = 25°C)

Parameter	Device	Min	Typ	Max	Units	Test Conditions	Note
Propagation Delay Time	6N139	—	5 0.2	25 1	µs	I_F = 0.5mA, R_L = 4.7kΩ I_F = 12mA, R_L = 270Ω	6,8
To Logic Low at Output tPHL	6N138		1	10	µs	I_F = 1.6mA, R_L = 2.2kΩ	
Propagation Delay Time	6N139		5 1	60 7	µs	I_F = 0.5mA, R_L = 4.7kΩ I_F = 12mA, R_L = 270mAΩ	6,8
To Logic High at Output tPLH	6N138		4	35	µs	I_F = 1.6mA, R_L = 2.2kΩ	
Common Mode Transient Immunity at Logic High Level (CM_H) Output			500		v/µs	I_F = 0mA, R_L = 2.2kΩ R_{CC} = 0,/V_{cm}/ = 10V_{p-p}	9,10
Common Mode Transient Immunity at Logic Low Level (CM_L) Output			− 500		v/µs	I_F = 1.6mA, R_L = 2.2kΩ R_{CC} = 0,/V_{CM}/ = 10V_{p-p}	9,10

Notes

1. Derate linearly above 50°C free-air temperature at a rate of 0.4mA/°C.
2. Derate linearly above 50°C free-air temperature at a rate of 0.7mW/°C.
3. Derate linearly above 25°C free-air temperature at a rate of 0.7mA/°C.
4. Derate linearly above 25°C free-air temperature at a rate of 2.0mW/°C.
5. 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%
6. Pin 7 open.
7. Device considered a two-terminal device: pins 1,2,3 and 4 shorted together and pins 5,6,7, and 8 shorted together.
8. Use of a resistor between pin 5 and 7 will decrease gain and delay time.
9. Common mode transient immunity in logic high level is the maximum tolerable (positive) dVcm/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 > 2.0V) common mode transient immunity in logic low level is the maximum tolerable (negative) dVcm/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_p < 0.8V).
10. In applications where dv/dt may exceed 50,000v/us (such as state discharge) a series resistor, R_{cc} should be included to protect I_c from destructively high surge currents. The recommended value us $R_{cc} \approx \frac{IV}{0.15\ I_F\ (mA)}$ kΩ.