

ACSL-6xx0

Multi-Channel and Bi-Directional, 15 MBd Digital Logic Gate Optocoupler

Data Sheet



Description

ACSL-6xx0 are truly isolated, multi-channel and bi-directional, high-speed optocouplers. Integration of multiple optocouplers in monolithic form is achieved through patented process technology. These devices provide full duplex and bi-directional isolated data transfer and communication capability in compact surface mount packages. Available in 15 Mbd speed option and wide supply voltage range.

These high channel density make them ideally suited to isolating data conversion devices, parallel buses and peripheral interfaces.

They are available in 8-pin and 16-pin narrow-body SOIC package and are specified over the temperature range of -40°C to +100°C.

Applications

- Full duplex communication
- Isolated line receiver
- Computer-peripheral interfaces
- Microprocessor system interfaces
- Digital isolation for A/D and D/A conversion
- Switching power supply
- Instrument input/output isolation
- Ground loop elimination
- Pulse transformer replacement

Features

- Available in dual, triple and quad channel configurations
- Bi-directional
- Wide supply voltage range 3.0V to 5.5V
- High-speed: 15 MBd typical, 10 MBd minimum
- 10 kV/ μ s minimum Common Mode Rejection (CMR) at $V_{cm} = 1000 V$
- LSTTL/TTL compatible
- Safety and regulatory approvals (Pending)
 - 2500Vrms for 1 min per UL1577
 - CSA Component Acceptance
 - IEC/EN/DIN EN 60747-5-2
- 16 Pin narrow-body SOIC package for triple and quad channel
- -40 to 100°C temperature range

CAUTION:

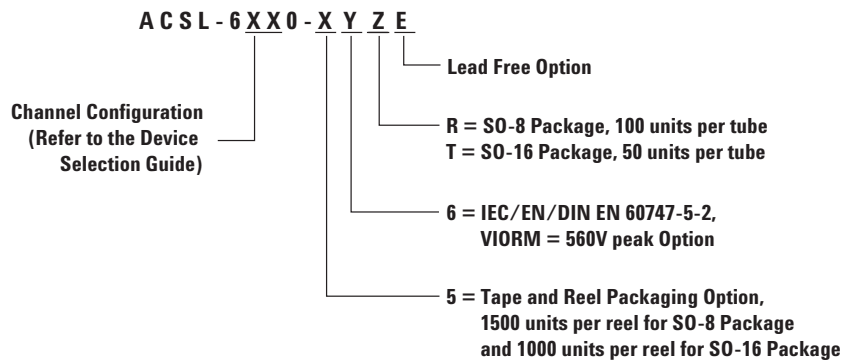
It is advised that normal static precautions be taken in handling and assembly of this component to prevent damage and/or degradation, which may be induced by ESD.

Device Selection Guide

Device Number	Channel Configuration	Package
ACSL-6210	Dual, Bi-Directional`	8-pin Small Outline
ACSL-6300*	Triple, All-in-One	16-pin Small Outline
ACSL-6310*	Triple, Bi-Directional, 2/1	16-pin Small Outline
ACSL-6400	Quad, All-in-One	16-pin Small Outline
ACSL-6410*	Quad, Bi-Directional, 3/1	16-pin Small Outline
ACSL-6420*	Quad, Bi-Directional, 2/2	16-pin Small Outline

* Advanced Information

Ordering Information



Pin Description

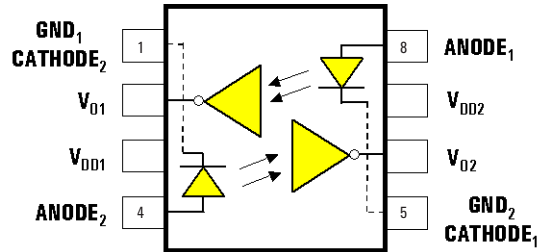
Symbol	Description	Symbol	Description
V_{DD1}	Power Supply 1	GND_1	Power Supply Ground 1
V_{DD2}	Power Supply 2	GND_2	Power Supply Ground 2
$ANODE_x$	LED Anode	NC	Not Connected
$CATHODE_x$	LED Cathode	V_{OX}	Output Signal

Truth Table (Positive Logic)

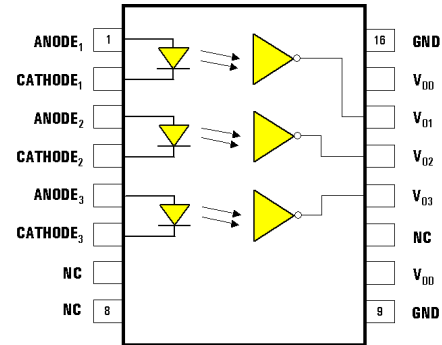
LED	OUTPUT
ON	L
OFF	H

Functional Diagrams

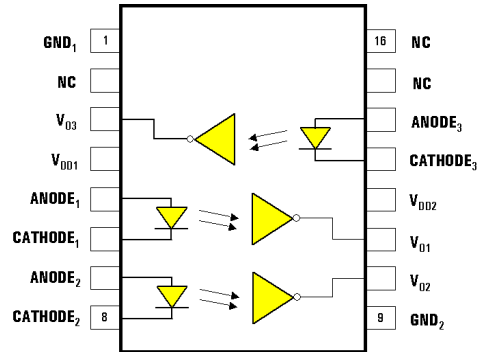
ACSL-6210 - Dual-Ch, Bi-Dir



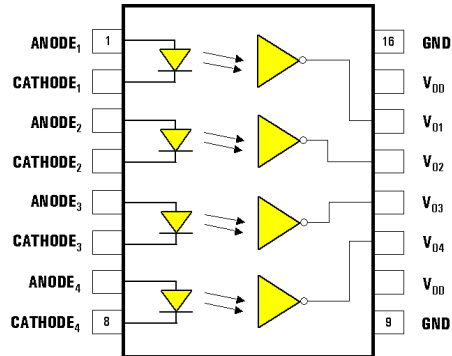
ACSL-6300 - Triple-Ch, All-in-One*



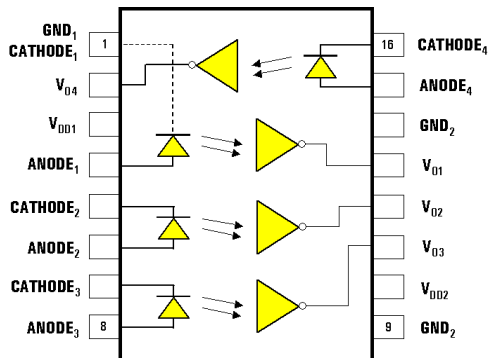
ACSL-6310 - Triple-Ch, Bi-Dir (2/1)*



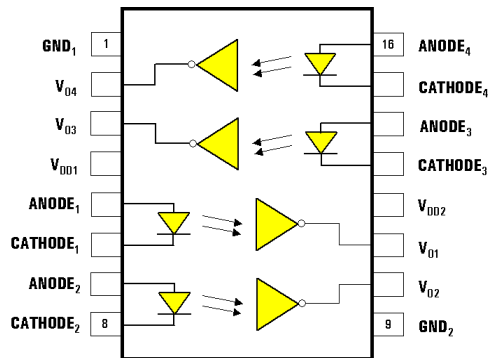
ACSL-6400 - Quad-Ch, All-in-One



ACSL-6410 - Quad-Ch, Bi-Dir (3/1)*



ACSL-6420 - Quad-Ch, Bi-Dir (2/2)*



* Advanced Information

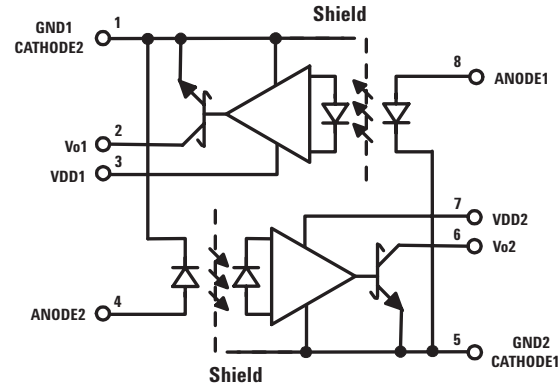
Schematic Diagrams

The ACSL-6xx0 series optocouplers feature the GaAsP LEDs with proprietary back emission design. They offer the designer a broad range of input drive current, from 7 mA to 15 mA, thus providing greater flexibility in designing the drive circuit.

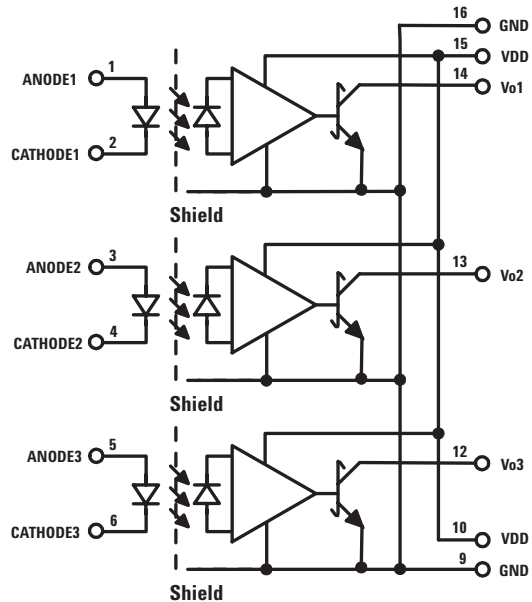
The output detector integrated circuit (IC) in the optocoupler consists of a photodiode at the input of a two-stage amplifier that provides both high gain and high bandwidth. The secondary amplifier stage of the detector IC feeds into an open collector Schottky-clamped transistor.

The entire output circuit is electrically shielded so that any common-mode transient capacitively coupled from the LED side of the optocoupler is diverted from the photodiode to ground. With this electric shield, the optocoupler can withstand transients that slopes up to 10,000V/μs, and amplitudes up to 1,000V.

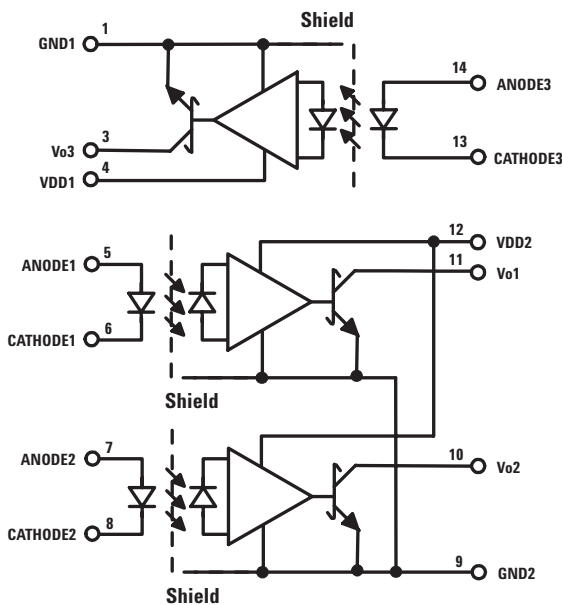
ACSL-6210 - Dual-Ch, Bi-Dir



ACSL-6300 - Triple-Ch, All-in-One*



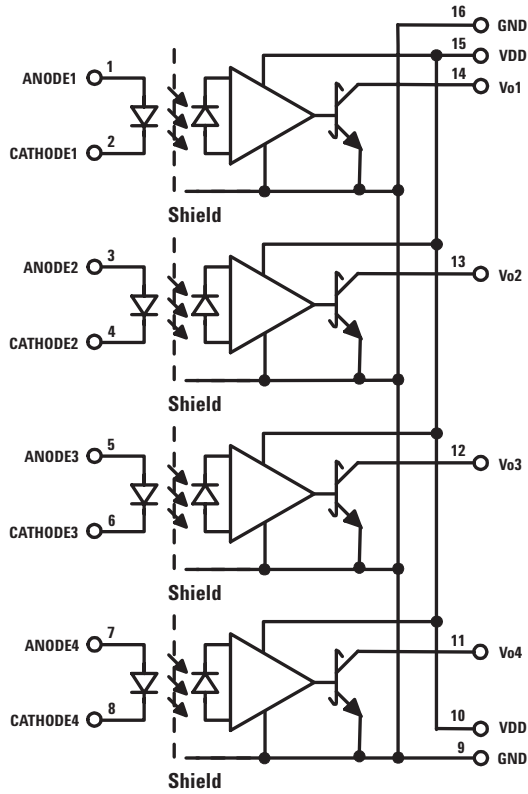
ACSL-6310 - Triple-Ch, Bi-Dir (2/1)*



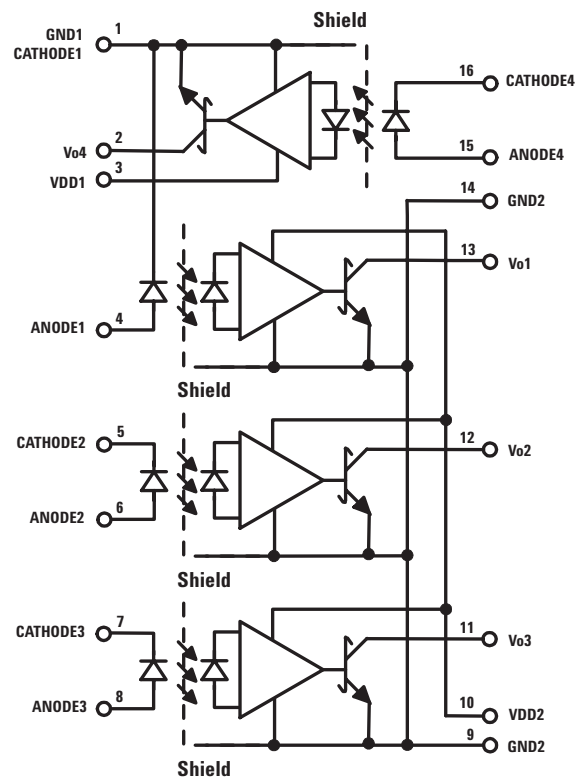
* Advanced Information

Schematic Diagrams, continued

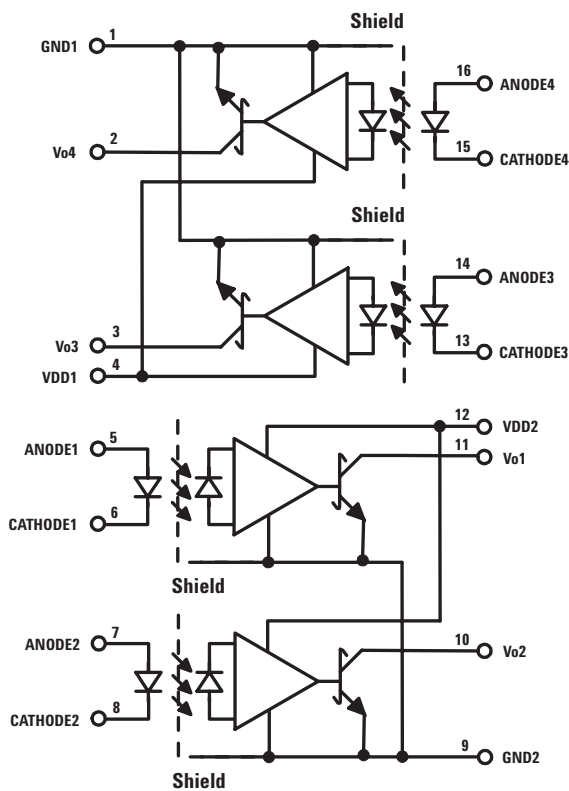
ACSL-6400 - Quad-Ch, All-in-One



ACSL-6410 - Quad-Ch, Bi-Dir (3/1)*



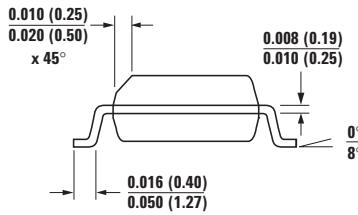
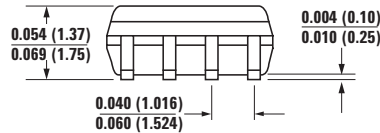
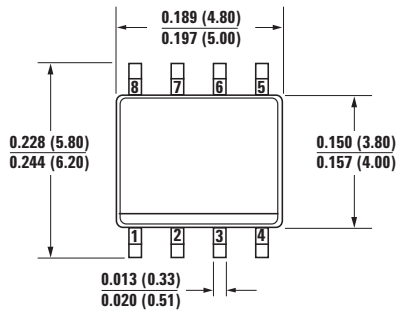
ACSL-6420 - Quad-Ch, Bi-Dir (2/2)*



* Advanced Information

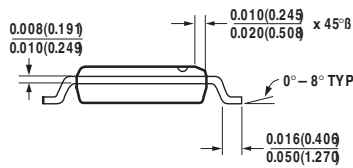
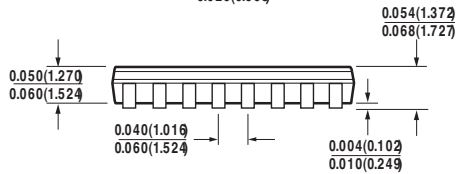
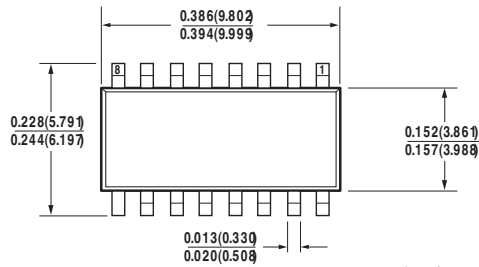
Package Outline Drawings

ACSL-6210 Small Outline SO-8 Package



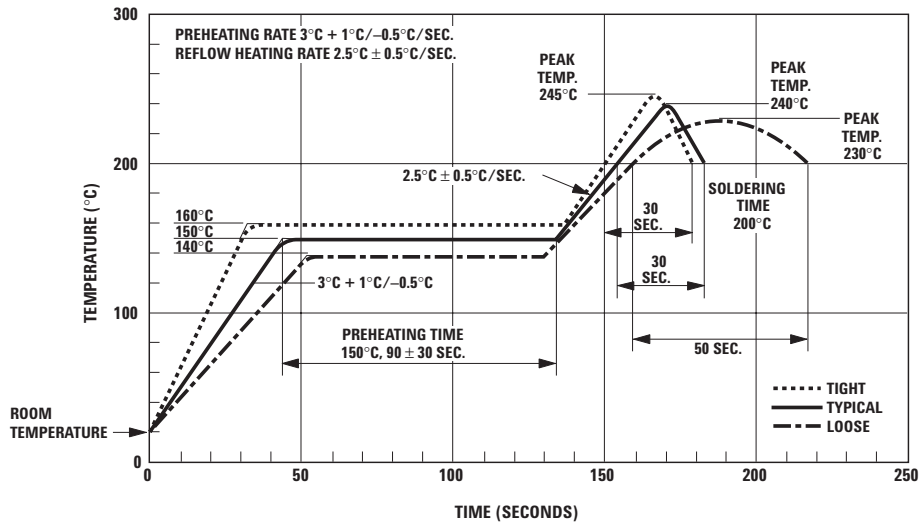
DIMENSIONS: INCHES (MILLIMETERS) MIN MAX

ACSL-6300*, ACSL-6310*, ACSL-6400, ACSL-6410* and ACSL-6420* Small Outline SO-16 Package

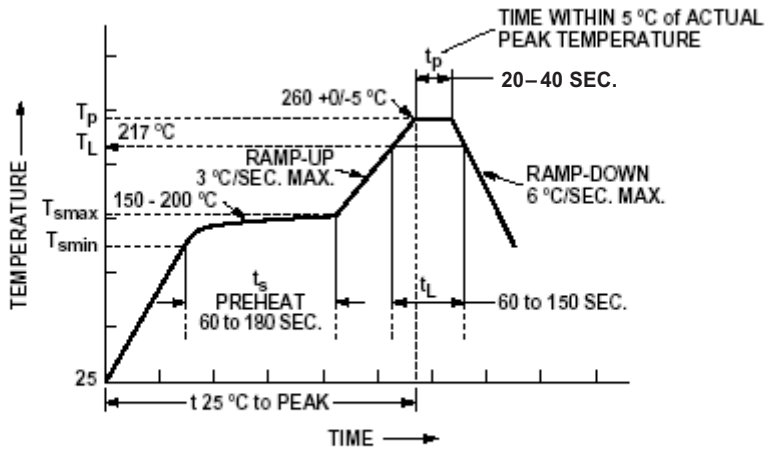


DIMENSIONS: INCHES (MILLIMETERS) MIN MAX

Solder Reflow Temperature Profile



Recommended Pb-free IR Profile



NOTES:
 THE TIME FROM 25°C TO PEAK TEMPERATURE = 8 MINUTES MAX.
 $T_{smax} = 200^{\circ}\text{C}$, $T_{smin} = 150^{\circ}\text{C}$

Regulatory Information

Insulation and Safety Related Specifications

Parameter	Symbol	Value	Units	Conditions
Minimum External Air Gap (Clearance)	L(I01)	4.9	mm	Measured from input terminals to output terminals, shortest distance through air
Minimum External Tracking(Creepage)	L(I02)	4.5	mm	Measured from input terminals to output terminals, shortest distance path through body
Minimum Internal Plastic Gap (Internal Clearance)		0.08	mm	Insulation thickness between emitter and detector; also known as distance through insulation
Tracking Resistance (Comparative Tracking Index)	CTI	175	Volts	DIN IEC 112/VDE0303 Part 1
Isolation Group		IIIa		Material Group (DIN VDE 0110, 1/89, Table 1)

IEC/EN/DIN EN 60747-5-2 Insulation Related Characteristics (Option X6X Only)

Description	Symbol	ACSL-6XX0-X6X	Units
Installation Classification per DIN VDE 0110/1.89, Table 1 for rated mains voltage $\leq 150V$ rms for rated mains voltage $\leq 300V$ rms		I-IV I-III	
Climatic Classification		55/100/21	
Pollution Degree (DIN VDE 0110/1.89)		2	
Maximum Working Insulation Voltage	V_{IORM}	560	V_{peak}
Input to Output Test Voltage, Method b * $V_{IORM} \times 1.875 = V_{PR}$, 100% Production Test with $t_m = 1$ sec, Partial Discharge < 5 pC	V_{PR}	1050	V_{peak}
Input to Output Test Voltage, Method a * $V_{IORM} \times 1.5 = V_{PR}$, Type and Sample Test, $T_m = 60$ sec, Partial Discharge < 5 pC	V_{PR}	840	V_{peak}
Highest Allowable Overvoltage * (Transient Overvoltage, $t_{ni} = 10$ sec)	V_{IOTM}	4000	V_{peak}
Safety Limiting Values (Maximum values allowed in the event of a failure)			
Case Temperature	T_S	175	$^{\circ}C$
Input Current	$I_{S,INPUT}$	150	mA
Output Power	$P_{S,OUTPUT}$	600	mW
Insulation Resistance at T_S , $V_{IO} = 500V$	R_{IO}	10^9	Ω

*Refer to the front of the optocoupler section of the current catalog, under Product Safety Regulations section, IEC/EN/DIN EN 60747-5-2, for a detailed description.

Note: Isolation characteristics are guaranteed only within the safety maximum ratings, which must be ensured by protective circuits in application.

Absolute Maximum Ratings

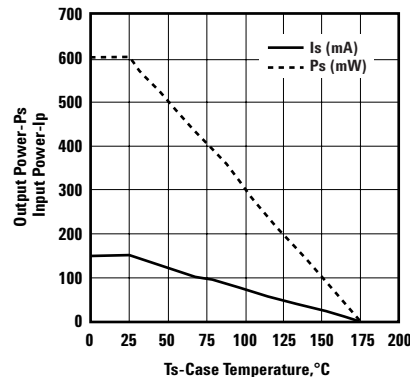
Parameter	Symbol	Min.	Max.	Units
Storage Temperature	T_s	-55	125	°C
Operating Temperature	T_A	-40	100	°C
Supply Voltage (1 Minute Maximum)	V_{DD1}, V_{DD2}		7	V
Reverse Input Voltage (Per Channel)	V_R		5	V
Output Voltage (Per Channel)	V_O		7	V
Average Forward Input Current ^[1] (Per Channel)	I_F		15	mA
Output Current (Per Channel)	I_O		50	mA
Input Power Dissipation ^[2] (Per Channel)	P_I		24	mW
Output Power Dissipation ^[2] (Per Channel)	P_O			
SO8 package			60	mW
SO16 package			40	mW

Recommended Operating Conditions

Parameter	Symbol	Min.	Max.	Units
Operating Temperature	T_A	-40	100	°C
Input Current, Low Level ^[3]	I_{FL}	0	250	μA
Input Current, High Level ^[4]	I_{FH}	7	15	mA
Supply Voltage	V_{DD1}, V_{DD2}	3.0	5.5	V
Fan Out (at $R_L = 1k\Omega$)	N		5	TTL Loads
Output Pull-up Resistor	R_L	330	4k	Ω

Notes:

1. Peaking circuits may produce transient input currents up to 50 mA, 50 ns max. pulse width, provided average current does not exceed its max. values.
2. Derate total package power dissipation, PT linearly above +85°C free-air temperature at a rate of 6.4 mW/°C for the SO8 package mounted on low conductivity board per JESD 51-3. Derate total package power dissipation, PT linearly above +78°C free-air temperature at a rate of 7.98 mW/°C for the SO16 package mounted on low conductivity board per JESD 51-3. PT= number of channels multiplied by (PI+PO).
3. The off condition can be guaranteed by ensuring that $V_{FL} \leq 0.8V$.
4. The initial switching threshold is 7 mA or less. It is recommended that minimum 8 mA be used for best performance and to permit guardband for LED degradation.



Electrical Specifications

Over recommended operating range ($3.0V \leq V_{DD1} \leq 3.6V$, $3.0V \leq V_{DD2} \leq 3.6V$, $T_A = -40^\circ C$ to $+100^\circ C$) unless otherwise specified.

All typical specifications are at $T_A = +25^\circ C$, $V_{DD1} = V_{DD2} = +3.3V$.

Parameter	Symbol	Min.	Typ.	Max.	Units	Test Conditions
Input Threshold Current	I_{TH}		2.7	7.0	mA	$I_{OL(Sinking)} = 13 \text{ mA}$, $V_O = 0.6V$
High Level Output Current	I_{OH}		4.7	100.0	μA	$I_F = 250 \mu A$, $V_O = 3.3V$
Low Level Output Voltage	V_{OL}		0.36	0.68	V	$I_{OL(Sinking)} = 13 \text{ mA}$, $I_F = 7 \text{ mA}$
High Level Supply Current (per channel)	I_{DDH}		3.2	5.0	mA	$I_F = 0 \text{ mA}$
Low Level Supply Current (per channel)	I_{DDL}		4.6	7.5	mA	$I_F = 10 \text{ mA}$
Input Forward Voltage	V_F	1.25	1.52	1.80	V	$I_F = 10 \text{ mA}$, $T_A = 25^\circ C$
Input Reverse Breakdown Voltage	BV_R	5.0			V	$I_R = 10 \mu A$
Input Diode Temperature Coefficient	$\Delta V_F / \Delta T_A$		-1.8		mV/ $^\circ C$	$I_F = 10 \text{ mA}$
Input Capacitance	C_{IN}		80		pF	$f = 1 \text{ MHz}$, $V_F = 0V$

Switching Specifications

Over recommended operating range ($3.0V \leq V_{DD1} \leq 3.6V$, $3.0V \leq V_{DD2} \leq 3.6V$, $I_F = 8.0 \text{ mA}$, $T_A = -40^\circ C$ to $+100^\circ C$) unless otherwise specified.

All typical specifications are at $T_A = +25^\circ C$, $V_{DD1} = V_{DD2} = +3.3V$.

Parameter	Symbol	Min.	Typ.	Max.	Units	Test Conditions
Maximum Data Rate		10	15		MBd	$R_L = 350\Omega$, $C_L = 15 \text{ pF}$
Pulse Width	t_{PW}	100			ns	$R_L = 350\Omega$, $C_L = 15 \text{ pF}$
Propagation Delay Time to Logic High Output Level ^[5]	t_{PLH}		52	100	ns	$R_L = 350\Omega$, $C_L = 15 \text{ pF}$
Propagation Delay Time to Logic Low Output Level ^[6]	t_{PHL}		44	100	ns	$R_L = 350\Omega$, $C_L = 15 \text{ pF}$
Pulse Width Distortion $ t_{PHL} - t_{PLH} $	$ PWD $		8	35	ns	$R_L = 350\Omega$, $C_L = 15 \text{ pF}$
Propagation Delay Skew ^[7]	t_{PSK}			40	ns	$R_L = 350\Omega$, $C_L = 15 \text{ pF}$
Output Rise Time (10 – 90%)	t_R		35		ns	$R_L = 350\Omega$, $C_L = 15 \text{ pF}$
Output Fall Time (10 – 90%)	t_F		12		ns	$R_L = 350\Omega$, $C_L = 15 \text{ pF}$
Logic High Common Mode Transient Immunity ^[8]	$ CM_H $	10			kV/ μs	$V_{cm} = 1000V$, $I_F = 0 \text{ mA}$, $V_O = 2.0V$, $R_L = 350\Omega$, $T_A = 25^\circ C$
Logic Low Common Mode Transient Immunity ^[8]	$ CM_L $	10			kV/ μs	$V_{cm} = 1000V$, $I_F = 8 \text{ mA}$, $V_O = 0.8V$, $R_L = 350\Omega$, $T_A = 25^\circ C$

Notes:

- t_{PLH} is measured from the 4.0 mA level on the falling edge of the input pulse to the 1.5V level on the rising edge of the output pulse.
- t_{PHL} is measured from the 4.0 mA level on the rising edge of the input pulse to the 1.5V level on the falling edge of the output pulse.
- t_{PSK} is equal to the worst case difference in t_{PHL} and/or t_{PLH} that will be seen between units at any given temperature and specified test conditions.
- CM_H is the maximum common mode voltage slew rate that can be sustained while maintaining $V_O > 2.0V$. CM_L is the maximum common mode voltage slew rate that can be sustained while maintaining $V_O < 0.8V$. The common mode voltage slew rates apply to both rising and falling common mode voltage edges.

Electrical Specifications

Over recommended operating range ($4.5V \leq V_{DD1} \leq 5.5V$, $4.5V \leq V_{DD2} \leq 5.5V$, $T_A = -40^\circ C$ to $+100^\circ C$) unless otherwise specified.

All typical specifications are at $T_A = +25^\circ C$, $V_{DD1} = V_{DD2} = +5.0V$.

Parameter	Symbol	Min.	Typ.	Max.	Units	Test Conditions
Input Threshold Current	I_{TH}		2.7	7.0	mA	$I_{OL(Sinking)}=13\text{ mA}$, $V_O=0.6V$
High Level Output Current	I_{OH}		3.8	100.0	μA	$I_F=250\ \mu A$, $V_O=5.5V$
Low Level Output Voltage	V_{OL}		0.36	0.6	V	$I_{OL(Sinking)}=13\text{ mA}$, $I_F=7\text{ mA}$
High Level Supply Current (per channel)	I_{DDH}		4.3	7.5	mA	$I_F=0\text{ mA}$
Low Level Supply Current (per channel)	I_{DDL}		5.8	10.5	mA	$I_F=10\text{ mA}$
Input Forward Voltage	V_F	1.25	1.52	1.8	V	$I_F=10\text{ mA}$, $T_A=25^\circ C$
Input Reverse Breakdown Voltage	BV_R	5.0			V	$I_R=10\ \mu A$
Input Diode Temperature Coefficient	$\Delta V_F / \Delta T_A$		-1.8		mV/ $^\circ C$	$I_F=10\text{ mA}$
Input Capacitance	C_{IN}		80		pF	$f=1\text{ MHz}$, $V_F=0V$

Switching Specifications

Over recommended operating range ($4.5V \leq V_{DD1} \leq 5.5V$, $4.5V \leq V_{DD2} \leq 5.5V$, $I_F = 8.0\text{ mA}$, $T_A = -40^\circ C$ to $+100^\circ C$) unless otherwise specified.

All typical specifications are at $T_A = +25^\circ C$, $V_{DD1} = V_{DD2} = +5.0V$.

Parameter	Symbol	Min.	Typ.	Max.	Units	Test Conditions
Maximum Data Rate		10	15		MBd	$R_L=350\ \Omega$, $C_L=15\text{ pF}$
Pulse Width	t_{PW}	100			ns	$R_L=350\ \Omega$, $C_L=15\text{ pF}$
Propagation Delay Time to Logic High Output Level ^[5]	t_{PLH}		46	100	ns	$R_L=350\ \Omega$, $C_L=15\text{ pF}$
Propagation Delay Time to Logic Low Output Level ^[6]	t_{PHL}		43	100	ns	$R_L=350\ \Omega$, $C_L=15\text{ pF}$
Pulse Width Distortion $ t_{PHL} - t_{PLH} $	$ PWD $		5	35	ns	$R_L=350\ \Omega$, $C_L=15\text{ pF}$
Propagation Delay Skew ^[7]	t_{PSK}			40	ns	$R_L=350\ \Omega$, $C_L=15\text{ pF}$
Output Rise Time (10 – 90%)	t_R		30		ns	$R_L=350\ \Omega$, $C_L=15\text{ pF}$
Output Fall Time (10 – 90%)	t_F		12		ns	$R_L=350\ \Omega$, $C_L=15\text{ pF}$
Logic High Common Mode Transient Immunity ^[8]	$ CM_H $	10			kV/ μs	$V_{cm}=1000V$, $I_F=0\text{ mA}$, $V_O=2.0V$, $R_L=350\ \Omega$, $T_A=25^\circ C$
Logic Low Common Mode Transient Immunity ^[8]	$ CM_L $	10			kV/ μs	$V_{cm}=1000V$, $I_F=8\text{ mA}$, $V_O=0.8V$, $R_L=350\ \Omega$, $T_A=25^\circ C$

Notes:

- t_{PLH} is measured from the 4.0 mA level on the falling edge of the input pulse to the 1.5V level on the rising edge of the output pulse.
- t_{PHL} is measured from the 4.0 mA level on the rising edge of the input pulse to the 1.5V level on the falling edge of the output pulse.
- t_{PSK} is equal to the worst case difference in t_{PHL} and/or t_{PLH} that will be seen between units at any given temperature and specified test conditions.
- CM_H is the maximum common mode voltage slew rate that can be sustained while maintaining $V_O > 2.0V$. CM_L is the maximum common mode voltage slew rate that can be sustained while maintaining $V_O < 0.8V$. The common mode voltage slew rates apply to both rising and falling common mode voltage edges.

Package Characteristics

All specifications are at $T_A=+25^{\circ}\text{C}$.

Parameter		Symbol	Min.	Typ.	Max.	Units	Test Conditions
Input-Output Momentary Withstand Voltage ^[9]	S08	V_{ISO}	2500			V_{RMS}	RH \leq 50%, t = 1 min
	S016	V_{ISO}	2500				RH \leq 50%, t = 1 min
Input-Output Insulation ^{[10][11]}	S08	I_{I-O}			5	μA	45% RH, t=5 sec, $V_{I-O}=3\text{kV DC}$
	S016	I_{I-O}			5		45% RH, t=5 sec, $V_{I-O}=3\text{kV DC}$
Input-Output Resistance ^[10]	S08	R_{I-O}	10^9	10^{11}		Ω	$V_{I-O}=500\text{V DC}$
	S016	R_{I-O}	10^9	10^{11}			$V_{I-O}=500\text{V DC}$
Input-Output Capacitance ^[10]	S08	C_{I-O}		0.7		pF	f = 1 MHz
	S016	C_{I-O}		0.7			f = 1 MHz
Input-Input Insulation Leakage Current ^[12]	S08	I_{I-I}		0.005		μA	RH \leq 45%, t = 5 sec, $V_{I-I}=500\text{V}$
	S016	I_{I-I}		0.005			RH \leq 45%, t = 5 sec, $V_{I-I}=500\text{V}$
Input-Input Resistance ^[12]	S08	R_{I-I}		10^{11}		Ω	RH \leq 45%, t = 5 sec, $V_{I-I}=500\text{V}$
	S016	R_{I-I}		10^{11}			RH \leq 45%, t = 5 sec, $V_{I-I}=500\text{V}$
Input-Input Capacitance ^[12]	S08	C_{I-I}		0.1		pF	f = 1 MHz
	S016	C_{I-I}		0.12			f = 1 MHz

Electrostatic Discharge Sensitivity

This product has been tested for electrostatic sensitivity to the limits stated in the specifications. However, Avago recommends that all integrated circuits be handled with appropriate care to avoid damage. Damage caused by inappropriate handling or storage could range from performance degradation to complete failure.

Notes:

- V_{ISO} is a dielectric voltage rating that should not be interpreted as an input-output continuous voltage rating. For continuous voltage rating, refer to the IEC/EN/DIN EN 60747-5-2 Insulation Characteristics Table (if applicable), the equipment level safety specification or Avago Application Note 1074 entitled "Optocoupler Input-Output Endurance Voltage."
- Measured between each input pair shorted together and all output connections for that channel shorted together.
- In accordance with UL1577, each optocoupler is proof tested by applying an insulation test voltage $\geq 3000\text{Vrms}$ for 1 sec (leakage detection current limit, $I_{I-O} \leq 5\mu\text{A}$). This test is performed before the 100% production test for partial discharge (Method b) shown in the IEC/EN/DIN EN 60747-5-2 Insulation Characteristics Table, if applicable.
- Measured between inputs with the LED anode and cathode shorted together.

Typical Performance

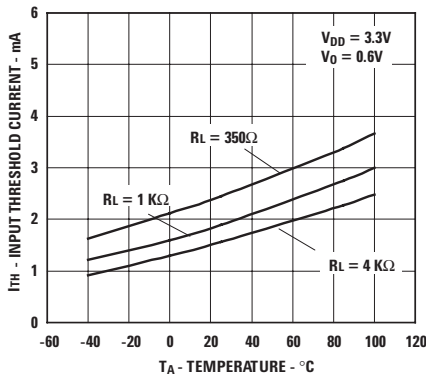


Figure 1. Typical input threshold current vs. temperature for 3.3V operation.

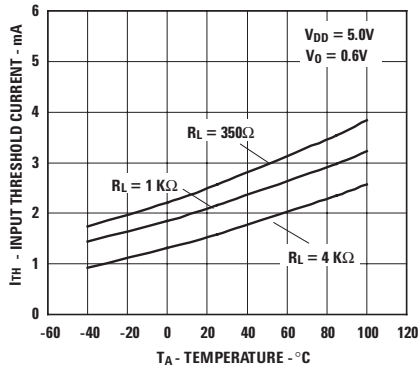


Figure 2. Typical input threshold current vs. temperature for 5V operation.

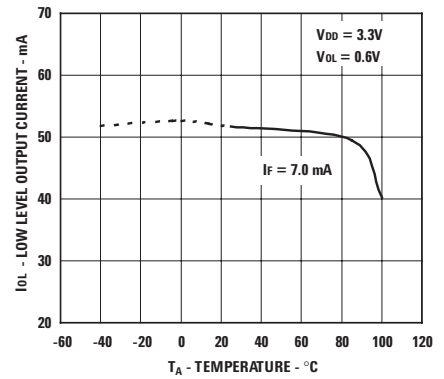


Figure 3. Typical low level output current vs. temperature for 3.3V operation.

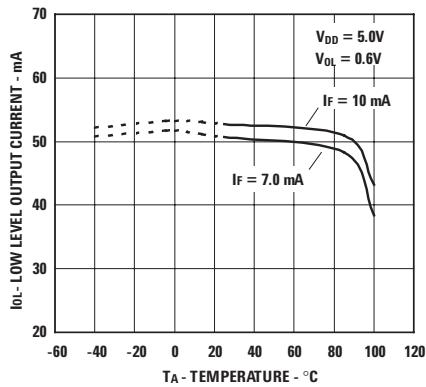


Figure 4. Typical low level output current vs. temperature for 5V operation.

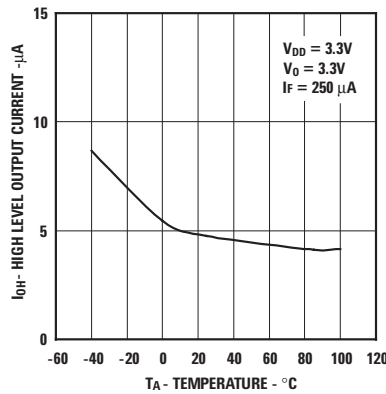


Figure 5. Typical high level output current vs. temperature for 3.3V operation.

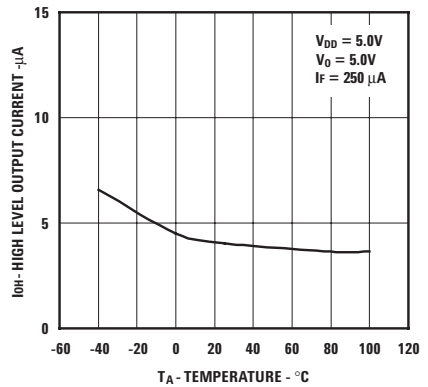


Figure 6. Typical high level output current vs. temperature for 5V operation.

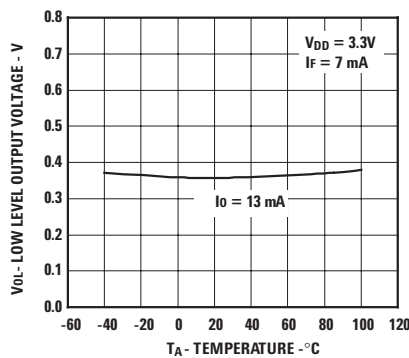


Figure 7. Typical low level output voltage vs. temperature for 3.3V operation.

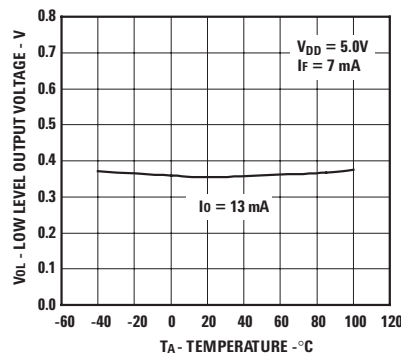


Figure 8. Typical low level output voltage vs. temperature for 5V operation.

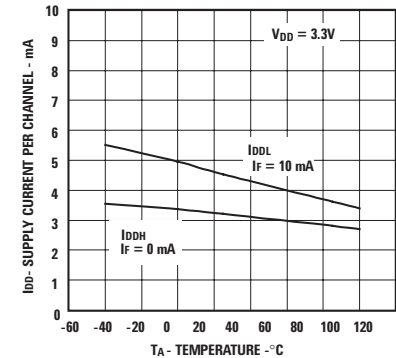


Figure 9. Typical supply current per channel vs. temperature for 3.3V operation.

Typical Performance, continued

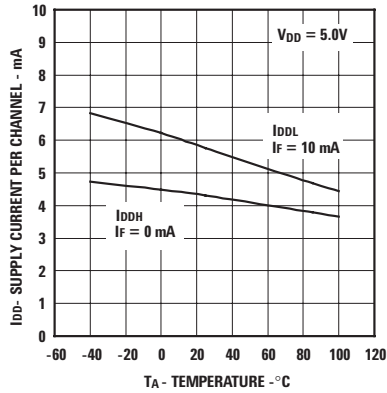


Figure 10. Typical supply current per channel vs. temperature for 5V operation.

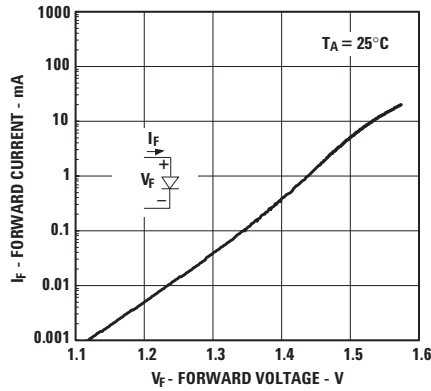


Figure 11. Typical input diode forward characteristics.

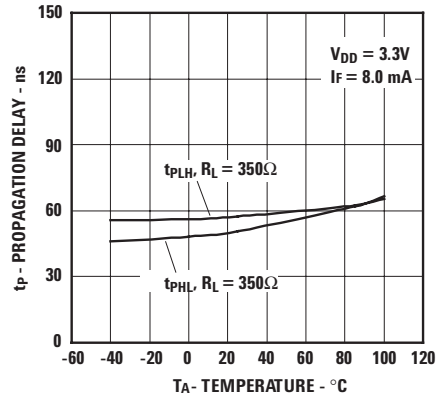


Figure 12. Typical propagation delay vs. temperature for 3.3V operation.

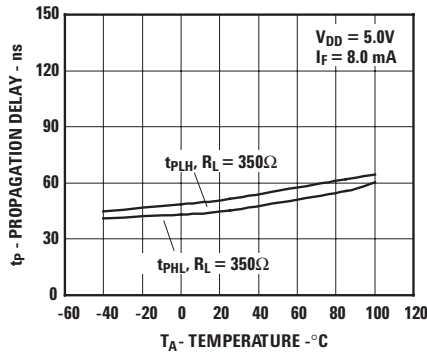


Figure 13. Typical propagation delay vs. temperature for 5V operation.

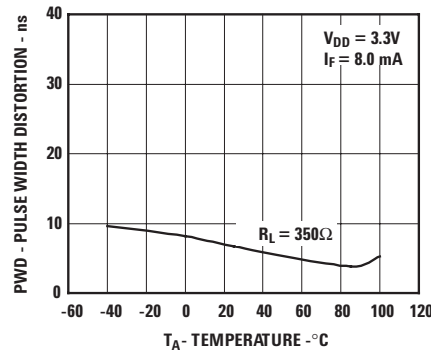


Figure 14. Typical pulse width distortion vs. temperature for 3.3V operation.

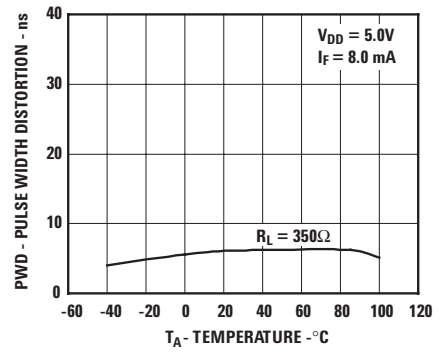


Figure 15. Typical pulse width distortion vs. temperature for 5V operation.

Test Circuits

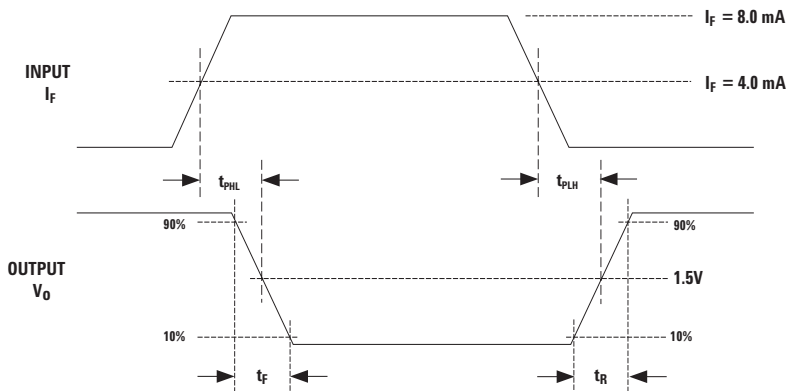
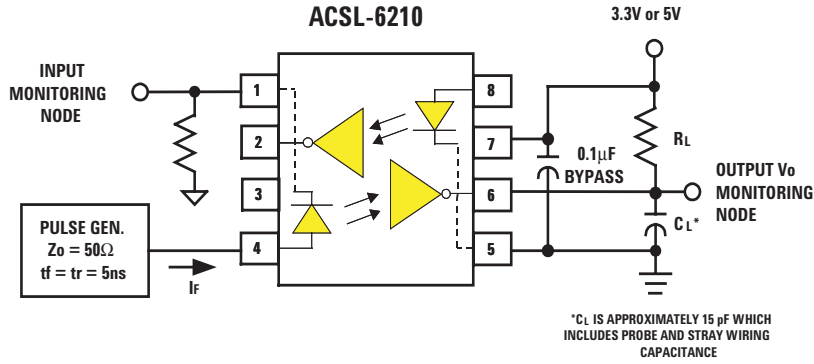


Figure 16. Test circuit for t_{PHL} , t_{PLH} , t_f and t_r .

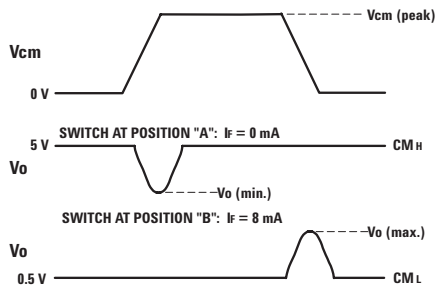
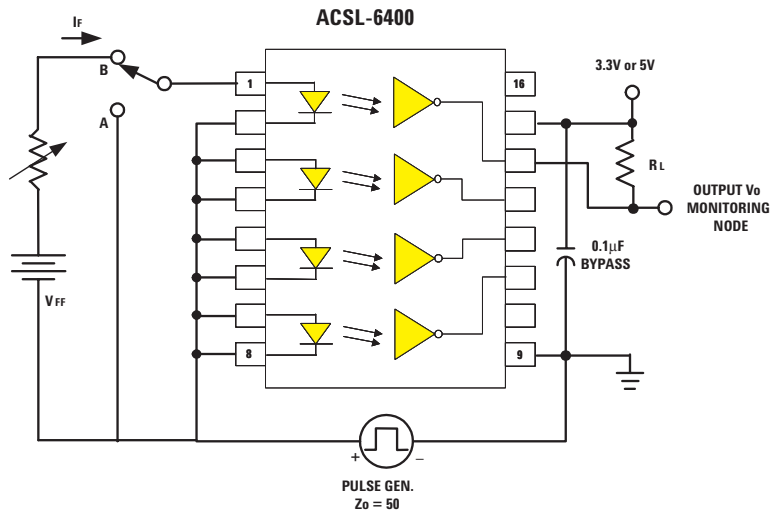


Figure 17. Test circuit for common mode transient immunity and typical waveforms.

Application Information

ON and OFF Conditions

The ACSL-6xx0 series has the ON condition defined by current, and the OFF condition defined by voltage. In order to guarantee that the optocoupler is OFF, the forward voltage across the LED must be less than or equal to 0.8 volt for the entire operating temperature range. This has direct implications for the input drive circuit. If the design uses a TTL gate to drive the input LED, then one has to ensure that the gate output voltage is sufficient to cause the forward voltage to be less than 0.8 volt. The typical threshold current for the ACSL-6xx0 series optocouplers is 2.7 mA; however, this threshold could increase over time due to the aging effects of the LED. Drive circuit arrangements must provide for the ON state LED forward current of at least 7 mA, or more if faster operation is desired.

Maximum Input Current and Reverse Voltage

The average forward input current should not exceed the 15 mA Absolute Maximum Rating as stated; however, peaking circuits with transient input currents up to 50 mA are allowed provided the average current does not exceed 15 mA. If the input current maximum rating is exceeded, the local temperature of the LED can rise, which in turn may affect the long-term reliability of the device. When designing the input circuit, one must also ensure that the input reverse voltage does not exceed 5V. If the optocoupler is subjected to reverse voltage transients or accidental situations that may cause a reverse voltage to be applied, thus an anti-parallel diode across the LED is recommended.

Suggested Input Circuits for Driving the LED

Figures 18, 19, and 20 show some of the several techniques for driving the ACSL-6xx0 LED. Figure 18 shows the recommended circuit when using any type of TTL gate. The buffer PNP transistor allows the circuit to be used with TTL or CMOS gates that have low sinking current capability. One advantage of this circuit is that there is very little variation in power supply current due to the switching of the optocoupler LED. This can be important in high-resolution analog-to-digital (A/D) systems where ground loop currents due to the switching of the LEDs can cause distortion in the A/D output.

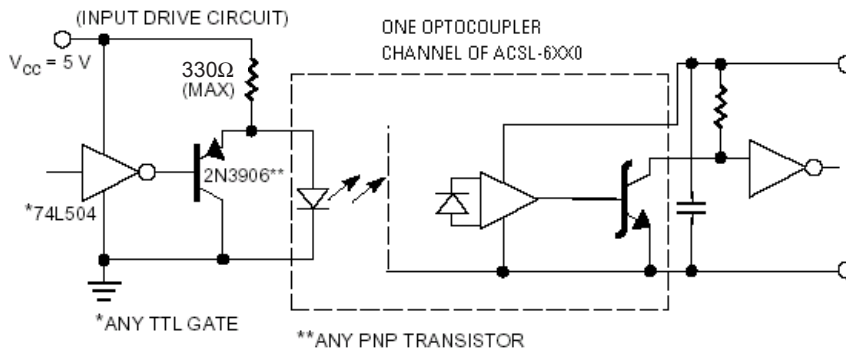
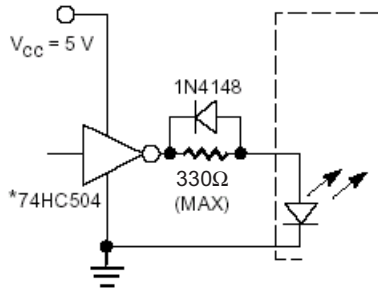


Figure 18. TTL interface circuit for the ACSL-6xx0.

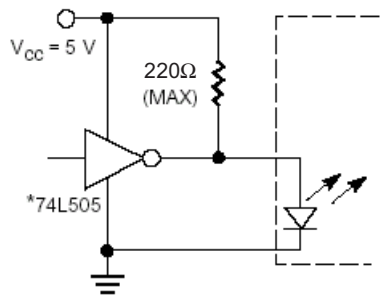
With a CMOS gate to drive the optocoupler, the circuit shown in Figure 19 can be used. The diode in parallel to the current limiting resistor speeds the turn-off of the optocoupler LED. Any HC or HCT series CMOS gate can be used in this circuit.



*ANY CMOS HC OR HCT GATE

Figure 19. CMOS drive circuit for the ACSL-6xx0.

For high common-mode rejection applications, the drive circuit shown in Figure 20 is recommended. In this circuit, only an open-collector TTL, or an open drain CMOS gate can be used. This circuit drives the optocoupler LED with a 220 ohm current-limiting resistor to ensure that an I_F of 7 mA is applied under worst case conditions and thus guarantee the 10,000 V/ μ s optocoupler common mode rejection rating. The designer can obtain even higher common-mode rejection performance than 10,000 V/ μ s by driving the LED harder than 7 mA.



*ANY OPEN COLLECTOR TTL OR OPEN DRAIN CMOS GATE.

Figure 20. High CMR drive circuit for the ACSL-6xx0.

Phase Relationship to Input

The output of the optocoupler is inverted when compared to the input. The input is defined to be logic HIGH when the LED is ON. If there is a design that requires the optocoupler to behave as a non-inverting gate, then the series input drive circuit shown in Figure 19 can be used. This input drive circuit has an inverting function, and since the optocoupler also behaves as an inverter, the total circuit is non-inverting. The shunt drive circuits shown in Figures 18 and 20 will cause the optocoupler to function as an inverter.

Current and Voltage Limitations

The absolute maximum voltage allowable at the output supply voltage pin and the output voltage pin of the optocoupler is 7 volts. However, the recommended maximum voltage at these two pins is 5.5 volts. The output sinking current should not exceed 13 mA in order to make the Low Level Output Voltage be less than 0.6 volt. If the output voltage is not a consideration, then the absolute maximum current allowed through the ACSL-6xx0 is 50 mA. If the output requires switching either higher currents or voltages, output buffer stages as shown in Figures 21 and 22 are suggested.

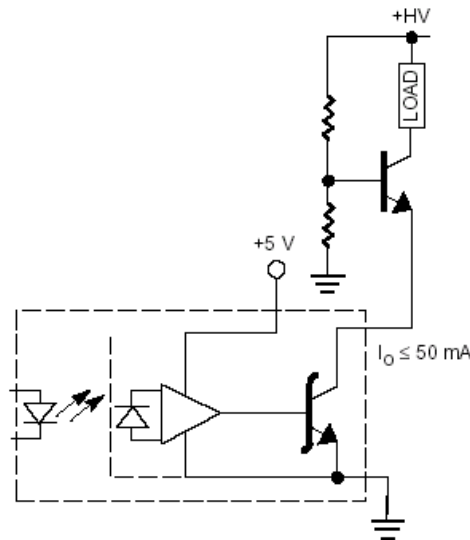


Figure 21. High voltage switching with ACSL-6xx0.

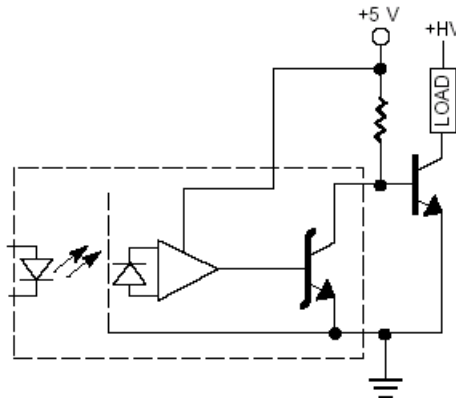


Figure 22. High voltage and high current switching with ACSL-6xx0.

Propagation Delay, Pulse-Width Distortion and Propagation Delay Skew

Propagation delay is a figure of merit which describes how quickly a logic signal propagates through a system. The propagation delay from low to high (t_{PLH}) is the amount of time required for an input signal to propagate to the output, causing the output to change from low to high. Similarly, the propagation delay from high to low (t_{PHL}) is the amount of time required for the input signal to propagate to the output causing the output to change from high to low (see Figure 16).

Pulse-width distortion (PWD) results when t_{PLH} and t_{PHL} differ in value. PWD is defined as the difference between t_{PLH} and t_{PHL} and often determines the maximum data rate capability of a transmission system. PWD can be expressed in percent by dividing the PWD (in ns) by the minimum pulse width (in ns) being transmitted. Typically, PWD on the order of 20-30% of the minimum pulse width is tolerable; the exact figure depends on the particular application (RS232, RS422, T-1, etc.).

Propagation delay skew, t_{PSK} , is an important parameter to consider in parallel data applications where synchronization of signals on parallel data lines is a concern. If the parallel data is

being sent through a group of optocouplers, differences in propagation delays will cause the data to arrive at the outputs of the optocouplers at different times. If this difference in propagation delays is large enough, it will determine the maximum rate at which parallel data can be sent through the optocouplers.

Propagation delay skew is defined as the difference between the minimum and maximum propagation delays, either t_{PLH} or t_{PHL} , for any given group of optocouplers which are operating under the same conditions (i.e., the same drive current, supply voltage, output load, and operating temperature). As illustrated in Figure 23, if the inputs of a group of optocouplers are switched either ON or OFF at the same time, t_{PSK} is the difference between the shortest propagation delay, either t_{PLH} or t_{PHL} , and the longest propagation delay, either t_{PLH} or t_{PHL} .

As mentioned earlier, t_{PSK} can determine the maximum parallel data transmission rate. Figure 24 is the timing diagram of a typical parallel data application with both the clock and the data lines being sent through optocouplers. The figure shows data and clock signals at the inputs and outputs

of the optocouplers. To obtain the maximum data transmission rate, both edges of the clock signal are being used to clock the data; if only one edge were used, the clock signal would need to be twice as fast.

Propagation delay skew represents the uncertainty of where an edge might be after being sent through an optocoupler.

Figure 24 shows that there will be uncertainty in both the data and the clock lines. It is important that these two areas of uncertainty not overlap, otherwise the clock signal might arrive before all of the data outputs have settled, or some of the data outputs may start to change before the clock signal has arrived. From these considerations, the absolute minimum pulse width that can be sent through optocouplers in a parallel application is twice t_{PSK} . A cautious design should use a slightly longer pulse width to ensure that any additional uncertainty in the rest of the circuit does not cause a problem.

The t_{PSK} specified optocouplers offer the advantages of guaranteed specifications for propagation delays, pulsewidth distortion and propagation delay skew over the recommended temperature, input current, and power supply ranges.

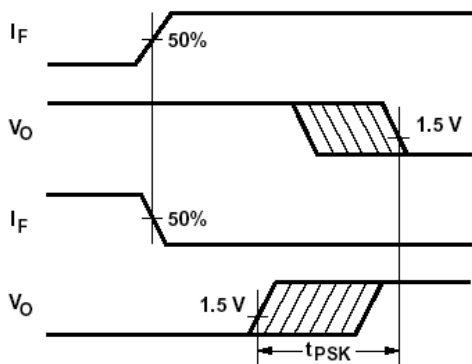


Figure 23. Propagation delay skew - t_{PSK} .

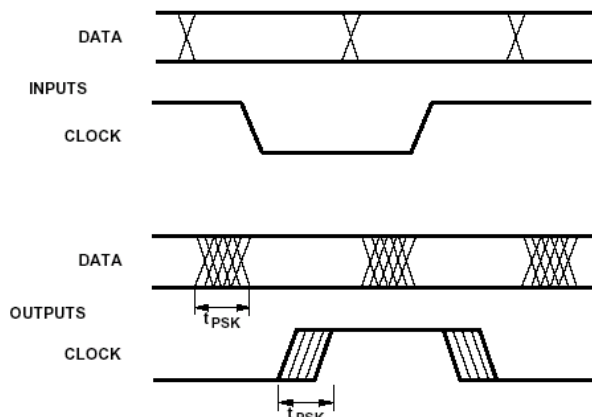


Figure 24. Parallel data transmission example.

For product information and a complete list of distributors, please go to our web site:

www.avagotech.com

Avago, Avago Technologies, and the A logo are trademarks of Avago Technologies, Pte. in the United States and other countries.

Data subject to change. Copyright © 2006 Avago Technologies Pte. All rights reserved.

Obsoletes 5989-1343EN

5989-2159EN January 16, 2006



SUNSTAR 商斯达实业集团是集研发、生产、工程、销售、代理经销、技术咨询、信息服务等为一体的高科技企业，是专业高科技电子产品生产厂家，是具有 10 多年历史的专业电子元器件供应商，是中国最早和最大的仓储式连锁规模经营大型综合电子零部件代理分销商之一，是一家专业代理和分销世界各大品牌 IC 芯片和电子元器件的连锁经营综合性国际公司，专业经营进口、国产名厂名牌电子元件，型号、种类齐全。在香港、北京、深圳、上海、西安、成都等全国主要电子市场设有直属分公司和产品展示展销窗口门市部专卖店及代理分销商，已在全国范围内建成强大统一的供货和代理分销网络。我们专业代理经销、开发生产电子元器件、集成电路、传感器、微波光电元器件、工控机/DOC/DOM 电子盘、专用电路、单片机开发、MCU/DSP/ARM/FPGA 软件硬件、二极管、三极管、模块等，是您可靠的一站式现货配套供应商、方案提供商、部件功能模块开发配套商。商斯达实业公司拥有庞大的资料库，有数位毕业于著名高校——有中国电子工业摇篮之称的西安电子科技大学（西军电）并长期从事国防尖端科技研究的高级工程师为您精挑细选、量身订做各种高科技电子元器件，并解决各种技术问题。

微波光电部专业代理经销高频、微波、光纤、光电元器件、组件、部件、模块、整机；电磁兼容元器件、材料、设备；微波 CAD、EDA 软件、开发测试仿真工具；微波、光纤仪器仪表。欢迎国外高科技微波、光纤厂商将优秀产品介绍到中国、共同开拓市场。长期大量现货专业批发高频、微波、卫星、光纤、电视、CATV 器件：晶振、VCO、连接器、PIN 开关、变容二极管、开关二极管、低噪晶体管、功率电阻及电容、放大器、功率管、MMIC、混频器、耦合器、功分器、振荡器、合成器、衰减器、滤波器、隔离器、环行器、移相器、调制解调器；光电子器件和组件：红外发射管、红外接收管、光电开关、光敏管、发光二极管和发光二极管组件、半导体激光二极管和激光器组件、光电探测器和光接收组件、光发射接收模块、光纤激光器和光放大器、光调制器、光开关、DWDM 用光发射和接收器件、用户接入系统光收发器件与模块、光纤连接器、光纤跳线/尾纤、光衰减器、光纤适配器、光隔离器、光耦合器、光环行器、光复用器/转换器；无线收发芯片和模组、蓝牙芯片和模组。

更多产品请看本公司产品专用销售网站：

商斯达微波光电产品网：[HTTP://www.rfoe.net/](http://www.rfoe.net/)

商斯达中国传感器科技信息网：<http://www.sensor-ic.com/>

商斯达工控安防网：<http://www.pc-ps.net/>

商斯达电子元器件网：<http://www.sunstare.com/>

商斯达消费电子产品网：<http://www.icasic.com/>

商斯达实业科技产品网：<http://www.sunstars.cn/> 射频微波光电元器件销售热线：

地址：深圳市福田区福华路福庆街鸿图大厦 1602 室

电话：0755-83396822 83397033 83398585 82884100

传真：0755-83376182 (0) 13823648918 MSN: SUNS8888@hotmail.com

邮编：518033 E-mail:szss20@163.com QQ: 195847376

深圳赛格展销部：深圳华强北路赛格电子市场 2583 号 电话：0755-83665529 25059422

技术支持：0755-83394033 13501568376

欢迎索取免费详细资料、设计指南和光盘；产品凡多，未能尽录，欢迎来电查询。

北京分公司：北京海淀区知春路 132 号中发电子大厦 3097 号

TEL: 010-81159046 82615020 13501189838 FAX: 010-62543996

上海分公司：上海市北京东路 668 号上海赛格电子市场 D125 号

TEL: 021-28311762 56703037 13701955389 FAX: 021-56703037

西安分公司：西安高新开发区 20 所(中国电子科技集团导航技术研究所)

西安劳动南路 88 号电子商城二楼 D23 号

TEL: 029-81022619 13072977981 FAX:029-88789382