FAIRCHILD SEMICONDUCTOR®

HIGH SPEED-10 MBit/s LOGIC GATE OPTOCOUPLERS

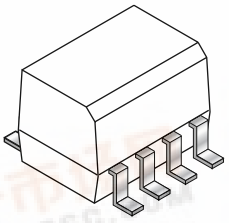
HCPL-0600 HCPL-0601

DESCRIPTION

The HCPL-0600/0601 optocouplers consist of an AlGaAS LED, optically coupled to a very high speed integrated photo-detector logic gate with a strobable output. The devices are housed in a compact small-outline package. This output features an open collector, thereby permitting wired OR outputs. The coupled parameters are guaranteed over the temperature range of -40°C to +85°C. A maximum input signal of 5 mA will provide a minimum output sink current of 13 mA (fan out of 8). An internal noise shield provides superior common mode rejection of typically 10 kV/µs.

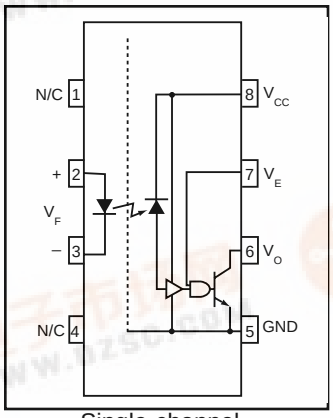
FEATURES

- Compact SO8 package
- Very high speed-10 MBit/s
- Superior CMR-10 kV/µs
- Fan-out of 8 over -40°C to +85°C
- Logic gate output
- Strobable output
- Wired OR-open collector
- U.L. recognized (File # E90700)



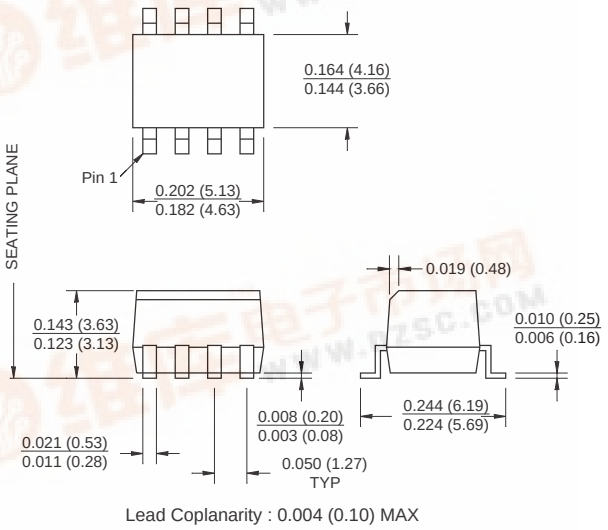
APPLICATIONS

- Ground loop elimination
- LSTTL to TTL, LSTTL or 5-volt CMOS
- Line receiver, data transmission
- Data multiplexing
- Switching power supplies
- Pulse transformer replacement
- Computer-peripheral interface



Single-channel circuit drawing

PACKAGE DIMENSIONS



NOTE
All dimensions are in inches (millimeters)

TRUTH TABLE (Positive Logic)

Input	Enable	Output
H	H	L
L	H	H
H	L	H
L	L	H
H	NC	L
L	NC	H

A 0.1 µF bypass capacitor must be connected between pins 8 and 5. (See note 1)

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ABSOLUTE MAXIMUM RATINGS (No derating required up to 85°C)			
Parameter	**Symbol**	**Value**	**Units**
Storage Temperature	T_{STG}	-40 to +125	°C
Operating Temperature	T_{OPR}	-40 to +85	°C
Lead Solder Temperature	T_{SOL}	260 for 10 sec	°C
EMITTER			
DC/Average Forward Input Current	I_F	50	mA
Enable Input Voltage Not to exceed VCC by more than 500 mV	V_E	5.5	V
Reverse Input Voltage	V_R	5.0	V
Power Dissipation	P_I	45	mW
DETECTOR			
Supply Voltage	V_{CC} (1 minute max)	7.0	V
Output Current	I_O	50	mA
Output Voltage	V_O	7.0	V
Collector Output Power Dissipation	P_O	85	mW

RECOMMENDED OPERATING CONDITIONS				
Parameter	**Symbol**	**Min**	**Max**	**Units**
Input Current, Low Level	I_{FL}	0	250	µA
Input Current, High Level	I_{FH}	*6.3	15	mA
Supply Voltage, Output	V_{CC}	4.5	5.5	V
Enable Voltage, Low Level	V_{EL}	0	0.8	V
Enable Voltage, High Level	V_{EH}	2.0	V_{CC}	V
Operating Temperature	T_A	-40	+85	°C
Fan Out (TTL load)	N		8	

*6.3 mA is a guard banded value which allows for at least 20% CTR degradation. Initial input current threshold value is 5.0 mA or less

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ELECTRICAL CHARACTERISTICS (T_A = -40°C to +85°C Unless otherwise specified.)

INDIVIDUAL COMPONENT CHARACTERISTICS

Parameter	Test Conditions	Symbol	Min	Typ**	Max	Unit
EMITTER	(I_F = 10 mA)	V_F			1.8	V
Input Forward Voltage	T_A =25°C				1.75	
Input Reverse Breakdown Voltage	(I_R = 10 µA)	B_{VR}	5.0			V
Input Capacitance	(V_F = 0, f = 1 MHz)	C_{IN}		60		pF
Input Diode Temperature Coefficient	(I_F = 10 mA)	ΔVF/ΔTA		-1.4		mV/°C
DETECTOR						
High Level Supply Current	(V_{CC} = 5.5 V, I_F = 0 mA) (V_E = 0.5 V)	I_{CCH}		7	10	mA
Low Level Supply Current	(V_{CC} = 5.5 V, I_F = 10 mA) (V_E = 0.5 V)	I_{CCL}		9	13	mA
Low Level Enable Current	(V_{CC} = 5.5 V, V_E = 0.5 V)	I_{EL}		-0.8	-1.6	mA
High Level Enable Current	(V_{CC} = 5.5 V, V_E = 2.0 V)	I_{EH}		-0.6	-1.6	mA
High Level Enable Voltage	(V_{CC} = 5.5 V, I_F = 10 mA)	V_{EH}	2.0			V
Low Level Enable Voltage	(V_{CC} = 5.5 V, I_F = 10 mA) (Note 2)	V_{EL}			0.8	V

SWITCHING CHARACTERISTICS (T_A = -40°C to +85°C, V_{CC} = 5 V, I_F = 7.5 mA Unless otherwise specified.)

AC Characteristics	Test Conditions		Device	Symbol	Min	Typ	Max	Unit
Propagation Delay Time to Output High Level	(Note 3) (R_L = 350Ω, C_L = 15 pF) (Fig. 12)	(T_A =25°C)	All	T_{PLH}	20	45	75 100	ns
Propagation Delay Time to Output Low Level	(Note 4) (R_L = 350Ω, C_L = 15 pF) (Fig. 12)	(T_A =25°C)	All	T_{PHL}	25	45	75 100	ns
Pulse Width Distortion	(R_L = 350Ω, C_L = 15 pF) (Fig. 12)		All	$\|T_{PHL}-T_{PLH}\|$		3	35	ns
Output Rise Time (10-90%)	(R_L = 350Ω, C_L = 15 pF) (Note 5) (Fig. 12)		All	t_r		50		ns
Output Fall Time (90-10%)	(R_L = 350Ω, C_L = 15 pF) (Note 6) (Fig. 12)		All	t_f		12		ns
Enable Propagation Delay Time to Output High Level	(I_F = 7.5 mA, V_{EH} = 3.5 V) (R_L = 350Ω, C_L = 15 pF) (Note 7) (Fig. 13)		All	t_{ELH}		20		ns
Enable Propagation Delay Time to Output Low Level	(I_F = 7.5 mA, V_{EH} = 3.5 V) (R_L = 350Ω, C_L = 15 pF) (Note 8) (Fig. 13)		All	t_{EHL}		20		ns
Common Mode Transient Immunity (at Output High Level)	(R_L = 350Ω) (T_A =25°C) (I_F = 0 mA, V_{OH} (Min.) = 2.0 V) (Note 9)(Fig. 14)	$\|V_{CM}\|$ = 10 V	HCPL-0600	$\|CM_H\|$		10,000		V/µs
		$\|V_{CM}\|$ = 50 V	HCPL-0601		5000	10,000		
Common Mode Transient Immunity (at Output Low Level)	(R_L = 350Ω) (T_A =25°C) (I_F = 7.5 mA, V_{OL} (Max.) = 0.8 V) (Note 10)(Fig. 14)	$\|V_{CM}\|$ = 10 V	HCPL-0600	$\|CM_H\|$		10,000		V/µs
		$\|V_{CM}\|$ = 50 V	HCPL-0601		5000	10,000		

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TRANSFER CHARACTERISTICS (T_A = -40°C to +85°C Unless otherwise specified.)

DC Characteristics	Test Conditions	Symbol	Min	Typ**	Max	Unit
High Level Output Current	(V_{CC} = 5.5 V, V_O = 5.5 V) (I_F = 250 µA, V_E = 2.0 V) (Note 2)	I_{OH}			100	µA
Low Level Output Voltage	(V_{CC} = 5.5 V, I_F = 5 mA) (V_E = 2.0 V, I_{OL} = 13 mA) (Note 2)	V_{OL}		.35	0.6	V
Input Threshold Current	(V_{CC} = 5.5 V, V_O = 0.6 V, V_E = 2.0 V, I_{OL} = 13 mA)	I_{FT}		3	5	mA

ISOLATION CHARACTERISTICS (T_A = -40°C to +85°C Unless otherwise specified.)

Characteristics	Test Conditions	Symbol	Min	Typ**	Max	Unit
Input-Output Insulation Leakage Current	(Relative humidity = 45%) (T_A = 25°C, t = 5 s) (V_{I-O} = 3000 VDC) (Note 11)	I_{I-O}			1.0*	µA
Withstand Insulation Test Voltage	(R_H < 50%, T_A = 25°C) (Note 11) (t = 1 min.)	V_{ISO}	2500			V_{RMS}
Resistance (Input to Output)	(V_{I-O} = 500 V) (Note 11)	R_{I-O}		10^{12}		Ω
Capacitance (Input to Output)	(f = 1 MHz) (Note 11)	C_{I-O}		0.6		pF

** All typical values are at V_{CC} = 5 V, T_A = 25°C

NOTES

1. The V_{CC} supply to each optoisolator must be bypassed by a 0.1µF capacitor or larger. This can be either a ceramic or solid tantalum capacitor with good high frequency characteristic and should be connected as close as possible to the package V_{CC} and GND pins of each device.
2. Enable Input - No pull up resistor required as the device has an internal pull up resistor.
3. t_{PLH} - Propagation delay is measured from the 3.75 mA level on the HIGH to LOW transition of the input current pulse to the 1.5V level on the LOW to HIGH transition of the output voltage pulse.
4. t_{PHL} - Propagation delay is measured from the 3.75 mA level on the LOW to HIGH transition of the input current pulse to the 1.5V level on the HIGH to LOW transition of the output voltage pulse.
5. t_r - Rise time is measured from the 90% to the 10% levels on the LOW to HIGH transition of the output pulse.
6. t_f - Fall time is measured from the 10% to the 90% levels on the HIGH to LOW transition of the output pulse.
7. t_{ELH} - Enable input propagation delay is measured from the 1.5V level on the HIGH to LOW transition of the input voltage pulse to the 1.5V level on the LOW to HIGH transition of the output voltage pulse.
8. t_{EHL} - Enable input propagation delay is measured from the 1.5V level on the LOW to HIGH transition of the input voltage pulse to the 1.5V level on the HIGH to LOW transition of the output voltage pulse.
9. CM_H - The maximum tolerable rate of rise of the common mode voltage to ensure the output will remain in the high state (i.e., V_{OUT} > 2.0 V). Measured in volts per microsecond (V/µs).
10. CM_L - The maximum tolerable rate of fall of the common mode voltage to ensure the output will remain in the low output state (i.e., V_{OUT} < 0.8 V). Measured in volts per microsecond (V/µs).
11. Device considered a two-terminal device: Pins 1,2,3 and 4 shorted together, and Pins 5,6,7 and 8 shorted together.

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TYPICAL PERFORMANCE CURVES

Fig. 1 Forward Current vs. Input Forward Voltage

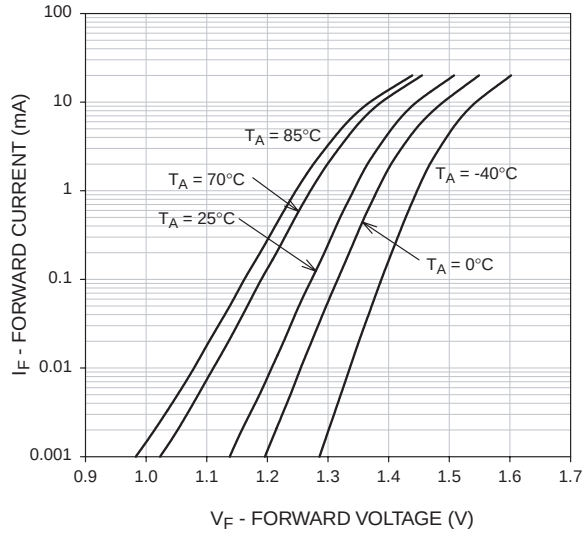


Fig. 2 Output Voltage vs. Forward Current

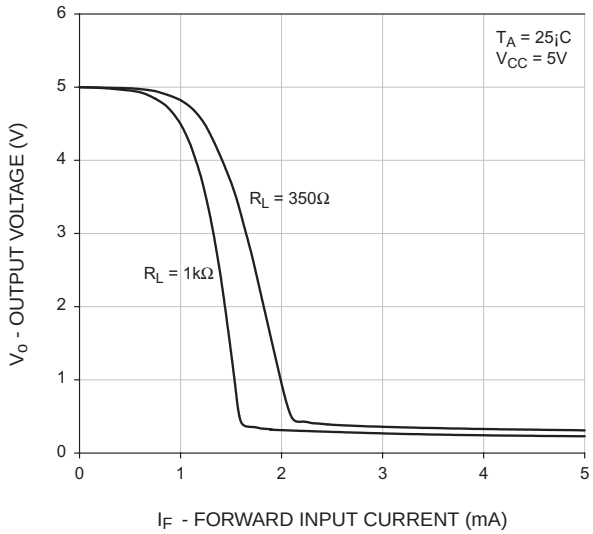


Fig. 3 Input Threshold Current vs. Temperature

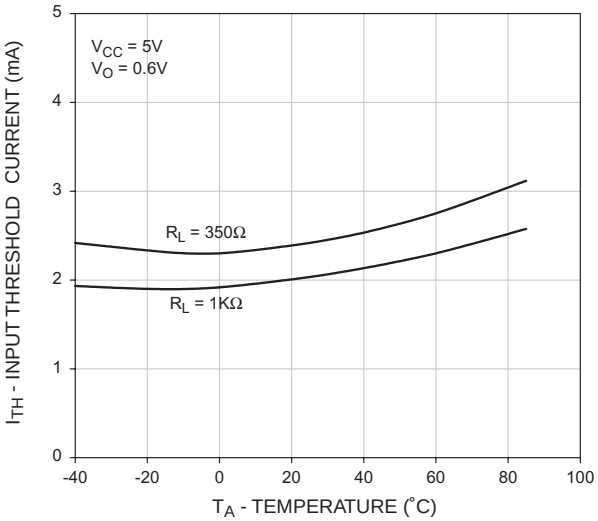


Fig. 4 High Level Output Current vs. Temperature

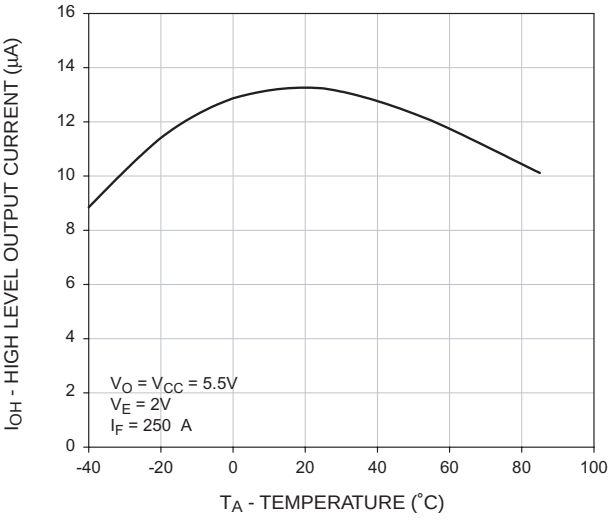


Fig. 5 Low Level Output Voltage vs. Temperature

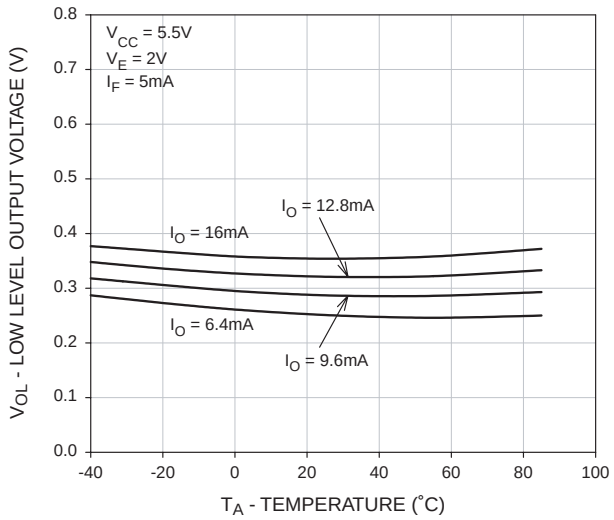


Fig. 6 Low Level Output Current vs. Temperature

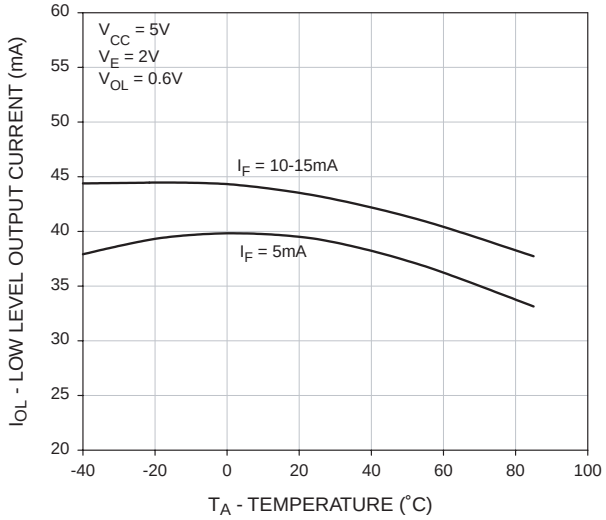


Fig. 7 Propagation Delay vs. Temperature

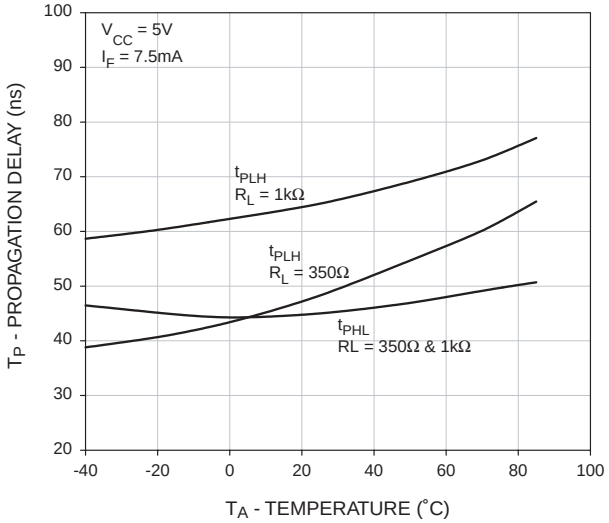


Fig. 8 Propagation Delay vs. Pulse Input Current

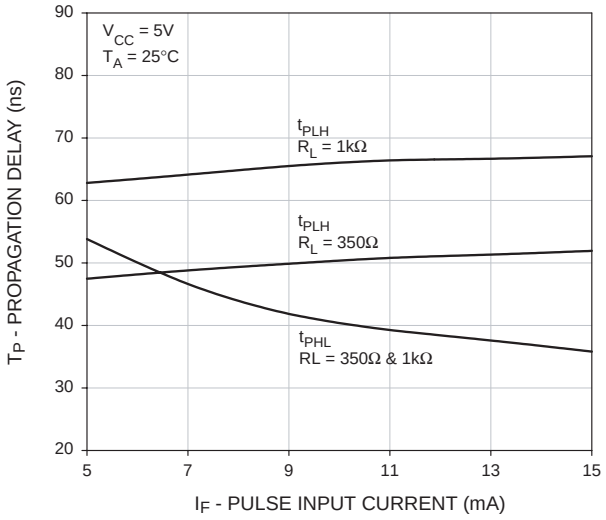


Fig. 9 Typical Enable Propagation Delay vs. Temparature

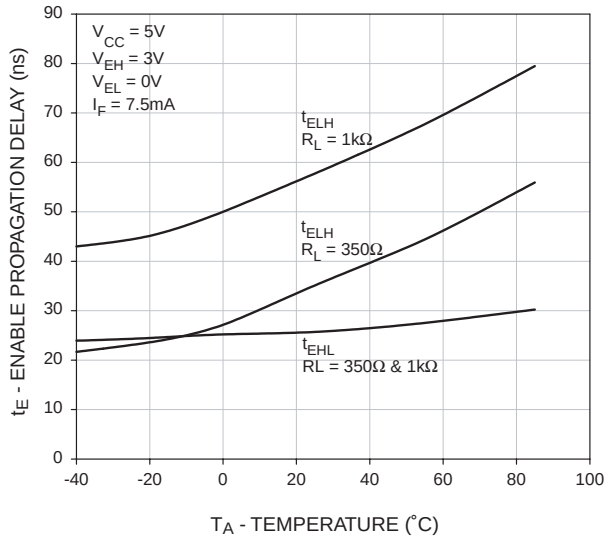


Fig. 10 Typical Rise and Fall Time vs. Temperature

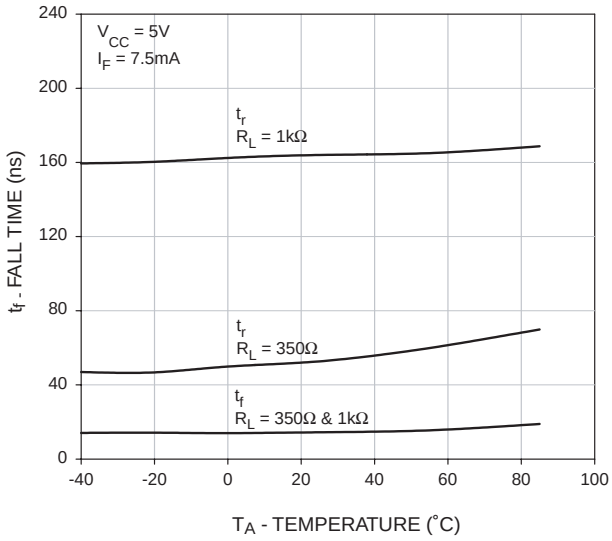
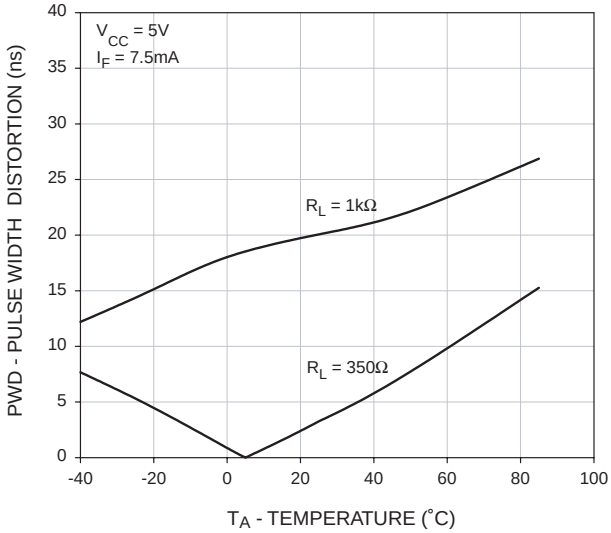


Fig. 11 Typical Pulse Width Distortion vs. Temperature



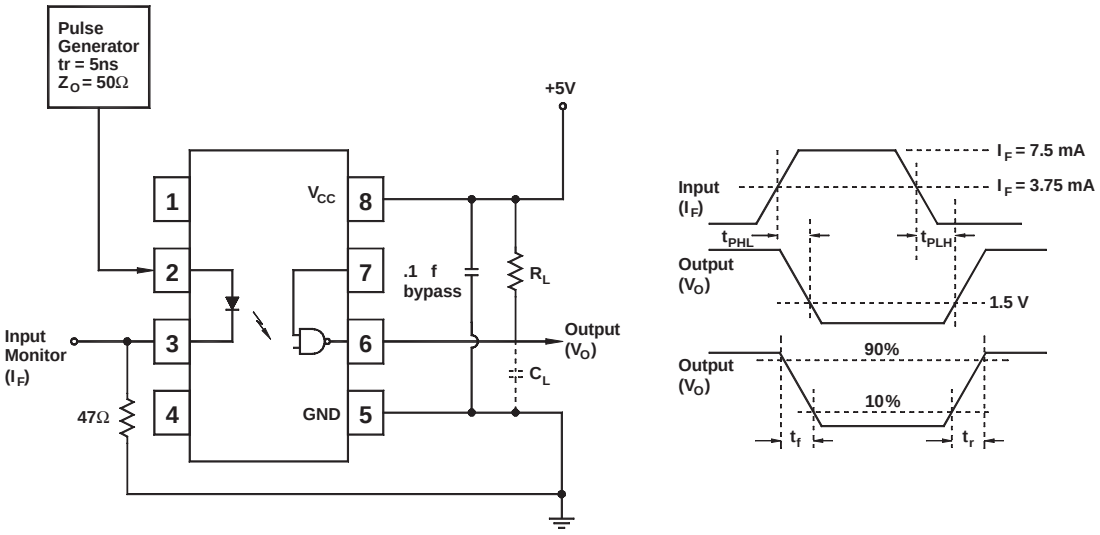


Fig. 12 Test Circuit and Waveforms for t_{PLH}, t_{PHL}, t_r and t_f.

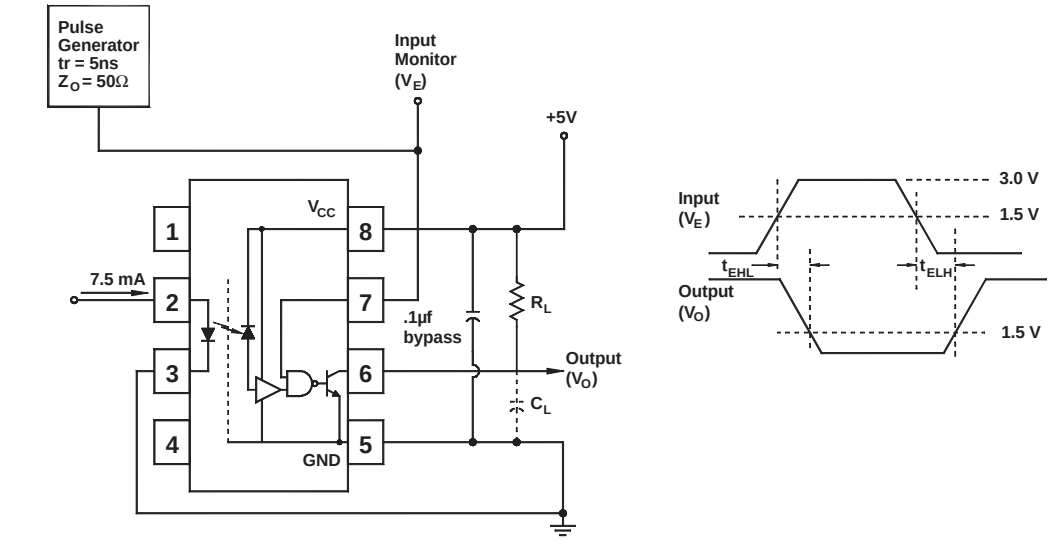


Fig. 13 Test Circuit t_{EHL} and t_{ELH}.

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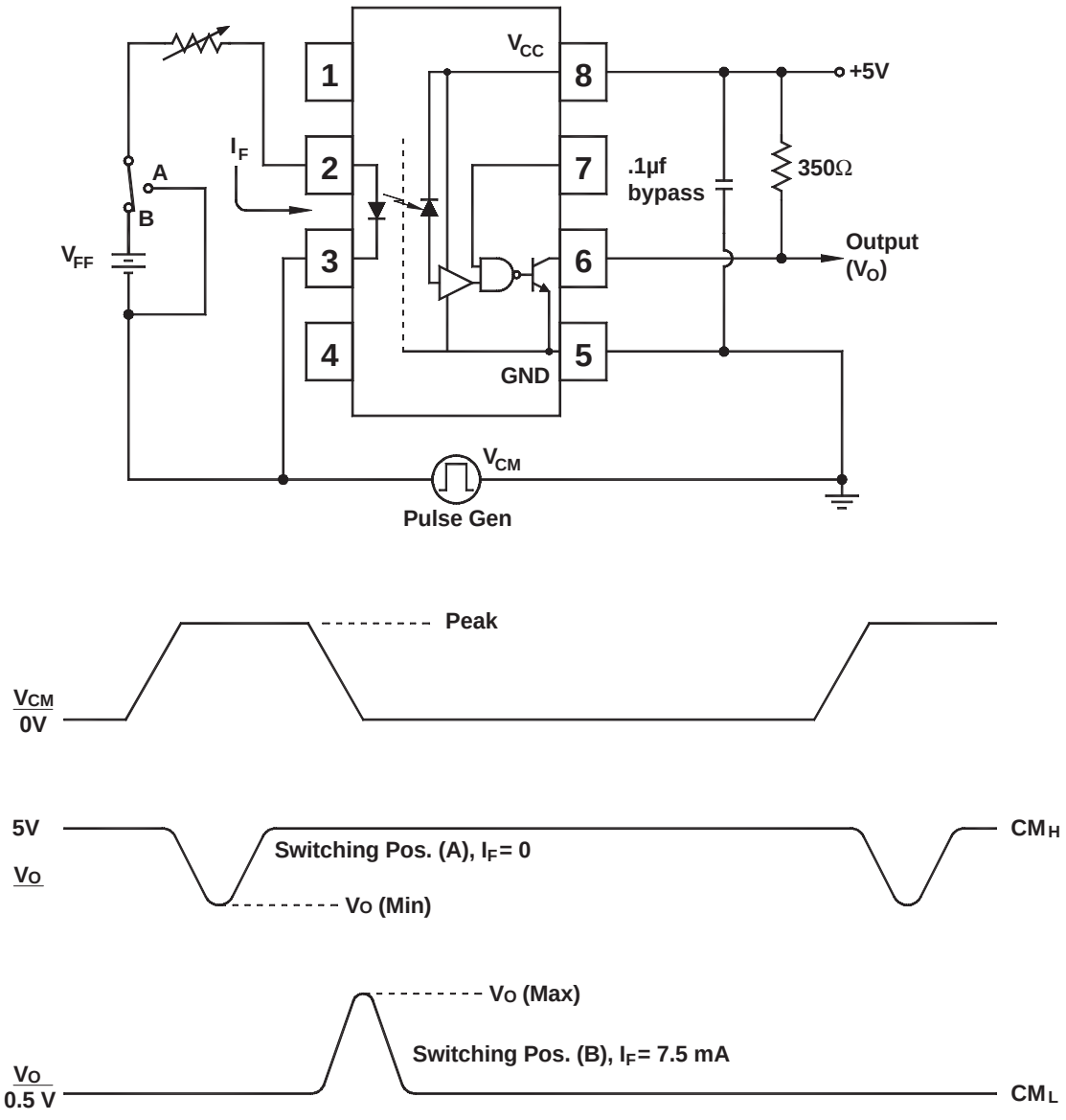

Fig. 14 Test Circuit Common Mode Transient Immunity

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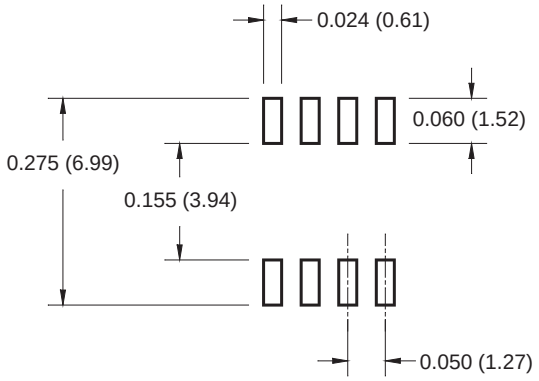
8-Pin Small Outline



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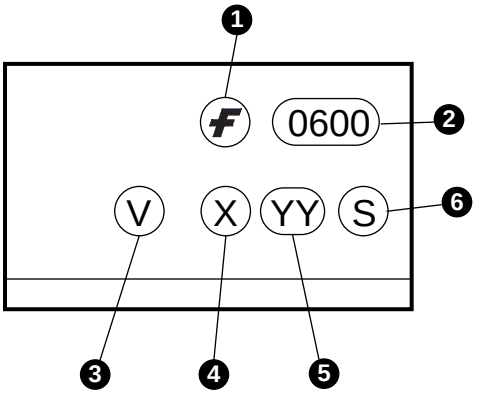
ORDERING INFORMATION

Option	Order Entry Identifier	Description
R1	.R1	Tape and Reel (500 per Reel)
R2	.R2	Tape and Reel (2500 per Reel)

MARKING INFORMATION



Definitions	
1	Fairchild logo
2	Device number
3	VDE mark (Note: Only appears on parts ordered with VDE option – See order entry table)
4	One digit year code, e.g., ‘3’
5	Two digit work week ranging from ‘01’ to ‘53’
6	Assembly package code

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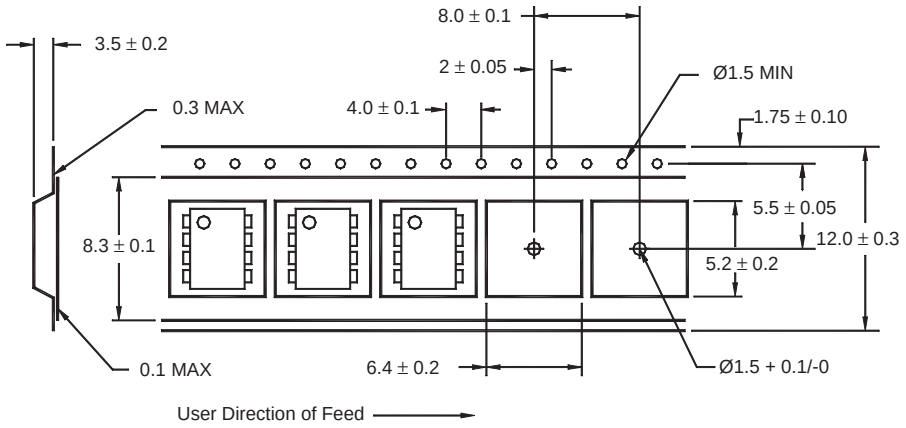
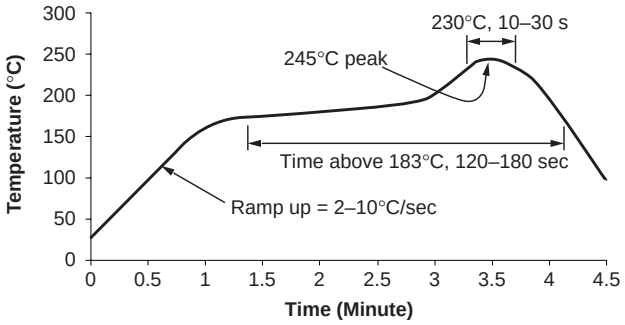
Carrier Tape Specifications



Reflow Profile



- Peak reflow temperature: 245°C (package surface temperature)
- Time of temperature higher than 183°C for 120–180 seconds
- One time soldering reflow is recommended

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