

## Single-Channel: 6N137M, HCPL2601M, HCPL2611M Dual-Channel: HCPL2630M, HCPL2631M (Preliminary) High Speed 10MBit/s Logic Gate Optocouplers

### Features

- 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, Vol. 2)

### Applications

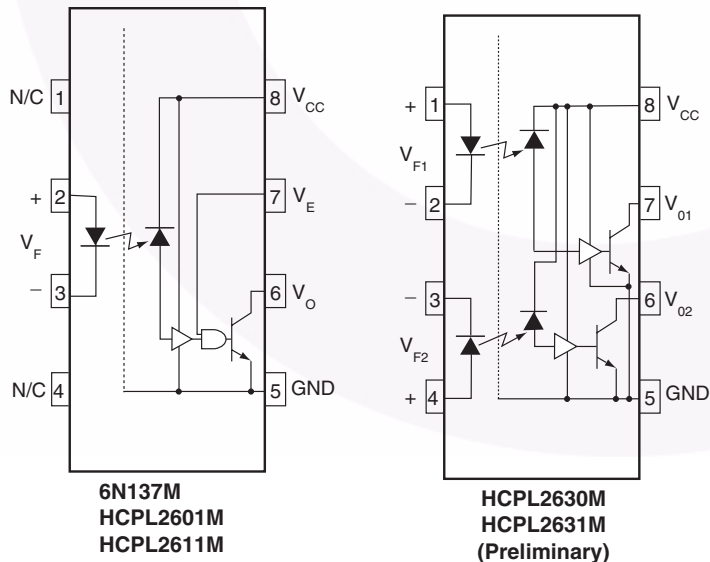
- Ground loop elimination
- LSTTL to TTL, LSTTL or 5-volt CMOS
- Line receiver, data transmission
- Data multiplexing
- Switching power supplies
- Pulse transformer replacement
- Computer-peripheral interface

### Description

The 6N137M, HCPL2601M, HCPL2611M single-channel and HCPL2630M, HCPL2631M dual-channel optocouplers consist of a 850 nm AlGaAs LED, optically coupled to a very high speed integrated photo-detector logic gate with a strobable output. This output features an open collector, thereby permitting wired OR outputs. The switching parameters are guaranteed over the temperature range of -40°C to +85°C. A maximum input signal of 5mA will provide a minimum output sink current of 13mA (fan out of 8).

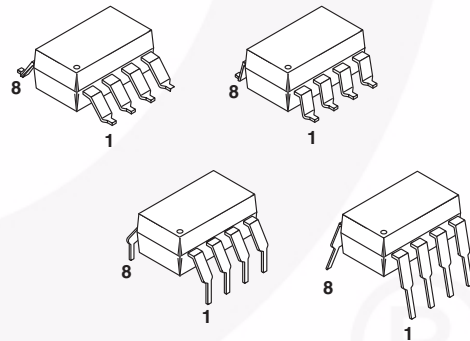
An internal noise shield provides superior common mode rejection of typically 10kV/μs. The HCPL2601M and HCPL2631M has a minimum CMR of 5kV/μs. The HCPL2611M has a minimum CMR of 10kV/μs.

### Schematics



A 0.1μF bypass capacitor must be connected between pins 8 and 5<sup>(1)</sup>.

### Package Outlines



### 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

### Absolute Maximum Ratings ( $T_A = 25^\circ\text{C}$ unless otherwise specified)

Stresses exceeding the absolute maximum ratings may damage the device. The device may not function or be operable above the recommended operating conditions and stressing the parts to these levels is not recommended. In addition, extended exposure to stresses above the recommended operating conditions may affect device reliability. The absolute maximum ratings are stress ratings only.

Symbol	Parameter		Value	Units
$T_{STG}$	Storage Temperature		-40 to +125	$^\circ\text{C}$
$T_{OPR}$	Operating Temperature		-40 to +100	$^\circ\text{C}$
$T_{SOL}$	Lead Solder Temperature		260 for 10 sec	$^\circ\text{C}$
<b>EMITTER</b>				
$I_F$	DC/Average Forward	Single Channel	50	mA
	Input Current	Dual Channel (Each Channel)	30	
$V_E$	Enable Input Voltage Not to Exceed $V_{CC}$ by more than 500mV	Single Channel	5.5	V
$V_R$	Reverse Input Voltage	Each Channel	5.0	V
$P_I$	Power Dissipation	Single Channel	100	mW
		Dual Channel (Each Channel)	45	
<b>DETECTOR</b>				
$V_{CC}$ (1 minute max)	Supply Voltage		7.0	V
$I_O$	Output Current	Single Channel	50	mA
		Dual Channel (Each Channel)	50	
$V_O$	Output Voltage	Each Channel	7.0	V
$P_O$	Collector Output	Single Channel	85	mW
	Power Dissipation	Dual Channel (Each Channel)	60	

### Recommended Operating Conditions

The Recommended Operating Conditions table defines the conditions for actual device operation. Recommended operating conditions are specified to ensure optimal performance to the datasheet specifications. Fairchild does not recommend exceeding them or designing to absolute maximum ratings.

Symbol	Parameter	Min.	Max.	Units
$I_{FL}$	Input Current, Low Level	0	250	$\mu\text{A}$
$I_{FH}$	Input Current, High Level	*6.3	15	mA
$V_{CC}$	Supply Voltage, Output	4.5	5.5	V
$V_{EL}$	Enable Voltage, Low Level	0	0.8	V
$V_{EH}$	Enable Voltage, High Level	2.0	$V_{CC}$	V
$T_A$	Low Level Supply Current	-40	+85	$^\circ\text{C}$
N	Fan Out (TTL load)		8	

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

## Electrical Characteristics (T<sub>A</sub> = 0 to 70°C unless otherwise specified)

### Individual Component Characteristics

Symbol	Parameter	Test Conditions	Min.	Typ.*	Max.	Unit
<b>EMITTER</b>						
V <sub>F</sub>	Input Forward Voltage	I <sub>F</sub> = 10mA T <sub>A</sub> = 25°C		1.4	1.8 1.75	V
B <sub>VR</sub>	Input Reverse Breakdown Voltage	I <sub>R</sub> = 10μA	5.0			V
C <sub>IN</sub>	Input Capacitance	V <sub>F</sub> = 0, f = 1MHz		60		pF
ΔV <sub>F</sub> / ΔT <sub>A</sub>	Input Diode Temperature Coefficient	I <sub>F</sub> = 10mA		-1.4		mV/°C
<b>DETECTOR</b>						
I <sub>CCH</sub>	High Level Supply Current	V <sub>CC</sub> = 5.5V, I <sub>F</sub> = 0mA, V <sub>E</sub> = 0.5V	Single Channel Dual Channel	6 10	10 15	mA
I <sub>CCL</sub>	Low Level Supply Current	Single Channel Dual Channel	V <sub>CC</sub> = 5.5V, I <sub>F</sub> = 10mA V <sub>E</sub> = 0.5V	8 14	13 21	mA
I <sub>EL</sub>	Low Level Enable Current	V <sub>CC</sub> = 5.5V, V <sub>E</sub> = 0.5V		-0.7	-1.6	mA
I <sub>EH</sub>	High Level Enable Current	V <sub>CC</sub> = 5.5V, V <sub>E</sub> = 2.0V		-0.5	-1.6	mA
V <sub>EH</sub>	High Level Enable Voltage	V <sub>CC</sub> = 5.5V, I <sub>F</sub> = 10mA	2.0			V
V <sub>EL</sub>	Low Level Enable Voltage	V <sub>CC</sub> = 5.5V, I <sub>F</sub> = 10mA <sup>(3)</sup>			0.8	V

### Switching Characteristics (T<sub>A</sub> = -40°C to +85°C, V<sub>CC</sub> = 5V, I<sub>F</sub> = 7.5mA unless otherwise specified)

Symbol	AC Characteristics	Test Conditions	Min.	Typ.*	Max.	Unit		
T <sub>PLH</sub>	Propagation Delay Time to Output HIGH Level	R <sub>L</sub> = 350Ω, C <sub>L</sub> = 15pF <sup>(4)</sup> (Fig. 12) T <sub>A</sub> = 25°C	20	40	75 100	ns		
T <sub>PHL</sub>	Propagation Delay Time to Output LOW Level	T <sub>A</sub> = 25°C <sup>(5)</sup> R <sub>L</sub> = 350Ω, C <sub>L</sub> = 15pF (Fig. 12)	25	40	75 100	ns		
T <sub>PHL</sub> - T <sub>PLH</sub>	Pulse Width Distortion	(R <sub>L</sub> = 350Ω, C <sub>L</sub> = 15pF (Fig. 12))		1	35	ns		
t <sub>r</sub>	Output Rise Time (10–90%)	R <sub>L</sub> = 350Ω, C <sub>L</sub> = 15pF <sup>(6)</sup> (Fig. 12)		30		ns		
t <sub>f</sub>	Output Rise Time (90–10%)	R <sub>L</sub> = 350Ω, C <sub>L</sub> = 15pF <sup>(7)</sup> (Fig. 12)		10		ns		
t <sub>ELH</sub>	Enable Propagation Delay Time to Output HIGH Level	I <sub>F</sub> = 7.5mA, V <sub>EH</sub> = 3.5V, R <sub>L</sub> = 350Ω, C <sub>L</sub> = 15pF <sup>(8)</sup> (Fig. 13)		15		ns		
t <sub>EHL</sub>	Enable Propagation Delay Time to Output LOW Level	I <sub>F</sub> = 7.5mA, V <sub>EH</sub> = 3.5V, R <sub>L</sub> = 350Ω, C <sub>L</sub> = 15pF <sup>(9)</sup> (Fig. 13)		15		ns		
ICM <sub>H</sub>	Common Mode Transient Immunity (at Output HIGH Level)	T <sub>A</sub> = 25°C, IV <sub>CM</sub> I = 50V (Peak), I <sub>F</sub> = 0mA, V <sub>OH</sub> (Min.) = 2.0V, R <sub>L</sub> = 350Ω <sup>(10)</sup> (Fig. 14)	6N137M, HCPL2630M		10,000		V/μs	
			HCPL2601M, HCPL2631M	5000	10,000			
ICM <sub>L</sub>	Common Mode Transient Immunity (at Output LOW Level)	R <sub>L</sub> = 350Ω, I <sub>F</sub> = 7.5mA, V <sub>OL</sub> (Max.) = 0.8V, T <sub>A</sub> = 25°C <sup>(11)</sup> (Fig. 14)	HCPL2611M	10,000	15,000		V/μs	
			6N137M, HCPL2630M		10,000			
			HCPL2601M, HCPL2631M	5000	10,000			
		IV <sub>CM</sub> I = 400V	HCPL2611M	10,000	15,000			

## Electrical Characteristics (Continued)

### Transfer Characteristics ( $T_A = -40$ to $+85^\circ\text{C}$ unless otherwise specified)

Symbol	DC Characteristics	Test Conditions	Min.	Typ.*	Max.	Unit
$I_{OH}$	HIGH Level Output Current	$V_{CC} = 5.5\text{V}$ , $V_O = 5.5\text{V}$ , $I_F = 250\mu\text{A}$ , $V_E = 2.0\text{V}^{(2)}$			100	$\mu\text{A}$
$V_{OL}$	LOW Level Output Current	$V_{CC} = 5.5\text{V}$ , $I_F = 5\text{mA}$ , $V_E = 2.0\text{V}$ , $I_{CL} = 13\text{mA}^{(2)}$		0.4	0.6	V
$I_{FT}$	Input Threshold Current	$V_{CC} = 5.5\text{V}$ , $V_O = 0.6\text{V}$ , $V_E = 2.0\text{V}$ , $I_{OL} = 13\text{mA}$		3	5	mA

### Isolation Characteristics ( $T_A = -40^\circ\text{C}$ to $+85^\circ\text{C}$ unless otherwise specified.)

Symbol	Characteristics	Test Conditions	Min.	Typ.*	Max.	Unit
$I_{I-O}$	Input-Output Insulation Leakage Current	Relative humidity = 45%, $T_A = 25^\circ\text{C}$ , $t = 5\text{s}$ , $V_{I-O} = 3000\text{VDC}^{(12)}$			1.0*	$\mu\text{A}$
$V_{ISO}$	Withstand Insulation Test Voltage	$RH < 50\%$ , $T_A = 25^\circ\text{C}$ , $I_{I-O} \leq 10\mu\text{A}$ , $t = 1\text{min.}^{(12)}$	5000			$V_{RMS}$
$R_{I-O}$	Resistance (Input to Output)	$V_{I-O} = 500\text{V}^{(12)}$		$10^{11}$		$\Omega$
$C_{I-O}$	Capacitance (Input to Output)	$f = 1\text{MHz}^{(12)}$		1		pF

\*All Typical at  $V_{CC} = 5\text{V}$ ,  $T_A = 25^\circ\text{C}$

#### Notes:

- The  $V_{CC}$  supply to each optoisolator must be bypassed by a  $0.1\mu\text{F}$  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.
- Each channel.
- Enable Input – No pull up resistor required as the device has an internal pull up resistor.
- $t_{PLH}$  – Propagation delay is measured from the  $3.75\text{mA}$  level on the HIGH to LOW transition of the input current pulse to the  $1.5\text{V}$  level on the LOW to HIGH transition of the output voltage pulse.
- $t_{PHL}$  – Propagation delay is measured from the  $3.75\text{mA}$  level on the LOW to HIGH transition of the input current pulse to the  $1.5\text{V}$  level on the HIGH to LOW transition of the output voltage pulse.
- $t_r$  – Rise time is measured from the 90% to the 10% levels on the LOW to HIGH transition of the output pulse.
- $t_f$  – Fall time is measured from the 10% to the 90% levels on the HIGH to LOW transition of the output pulse.
- $t_{ELH}$  – Enable input propagation delay is measured from the  $1.5\text{V}$  level on the HIGH to LOW transition of the input voltage pulse to the  $1.5\text{V}$  level on the LOW to HIGH transition of the output voltage pulse.
- $t_{EHL}$  – Enable input propagation delay is measured from the  $1.5\text{V}$  level on the LOW to HIGH transition of the input voltage pulse to the  $1.5\text{V}$  level on the HIGH to LOW transition of the output voltage pulse.
- $CM_H$  – The maximum tolerable rate of rise of the common mode voltage to ensure the output will remain in the HIGH state (i.e.,  $V_{OUT} > 2.0\text{V}$ ). Measured in volts per microsecond ( $\text{V}/\mu\text{s}$ ).
- $CM_L$  – The maximum tolerable rate of rise of the common mode voltage to ensure the output will remain in the LOW output state (i.e.,  $V_{OUT} < 0.8\text{V}$ ). Measured in volts per microsecond ( $\text{V}/\mu\text{s}$ ).
- Device considered a two-terminal device: Pins 1, 2, 3 and 4 shorted together, and Pins 5, 6, 7 and 8 shorted together.

## Typical Performance Curves

Fig. 1 Low Level Output Voltage vs. Ambient Temperature

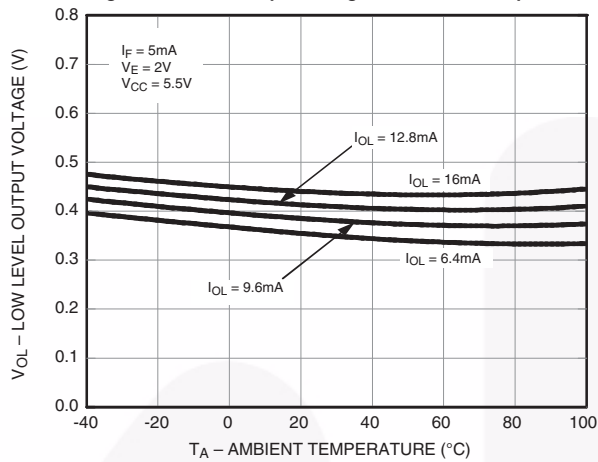


Fig. 2 Input Diode Forward Voltage vs. Forward Current

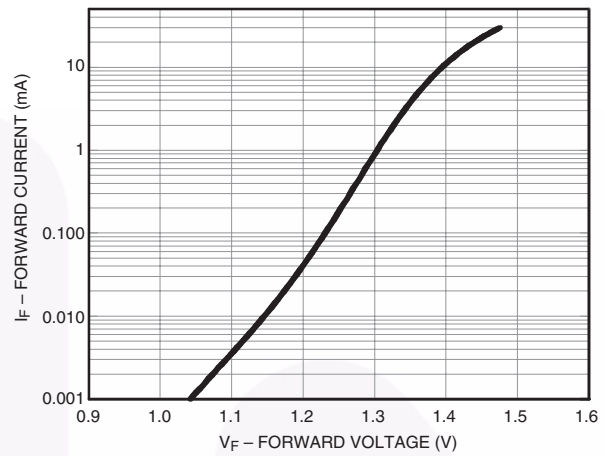


Fig. 3 Switching Time vs. Forward Current

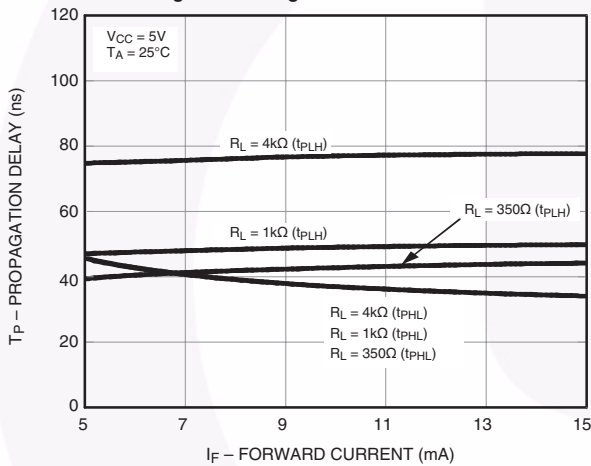


Fig. 4 Low Level Output vs. Ambient Temperature

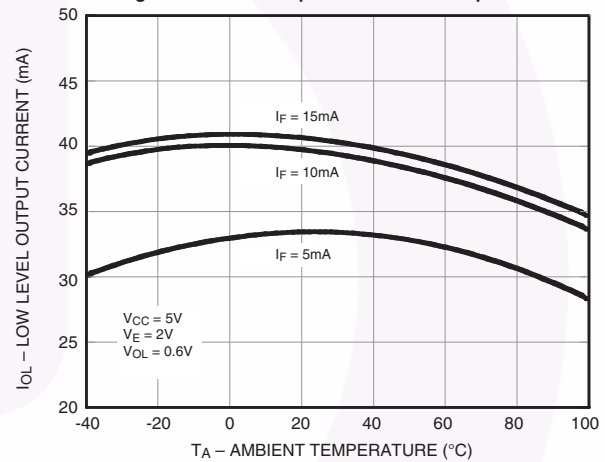


Fig. 5 Input Threshold Current vs. Ambient Temperature

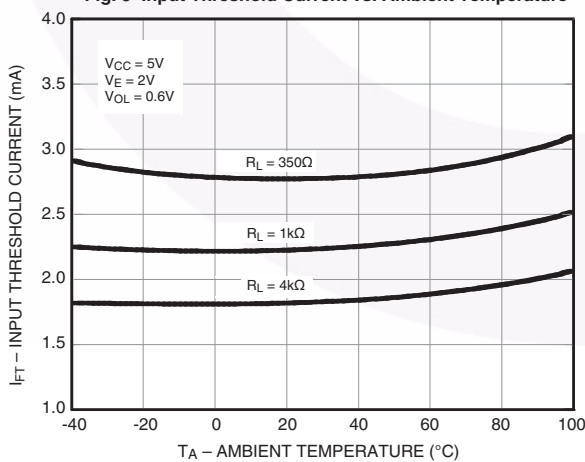
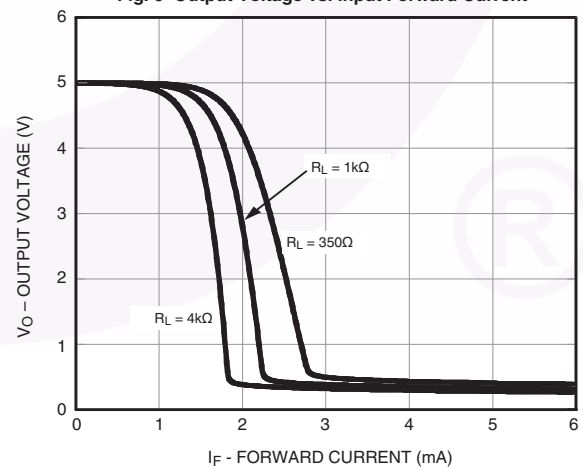


Fig. 6 Output Voltage vs. Input Forward Current



## Typical Performance Curves (Continued)

Fig. 7 Pulse Width Distortion vs. Temperature

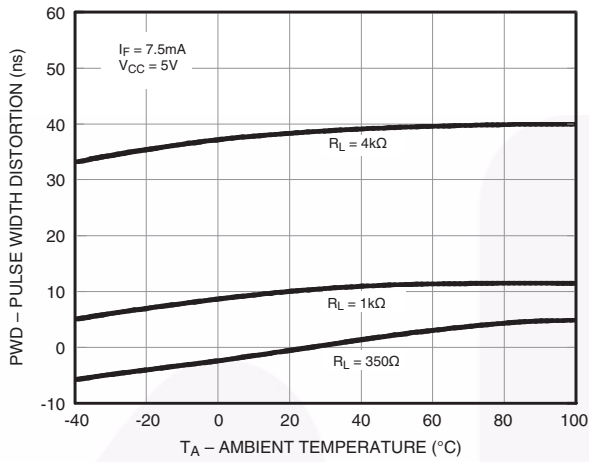


Fig. 8 Rise and Fall Time vs. Temperature

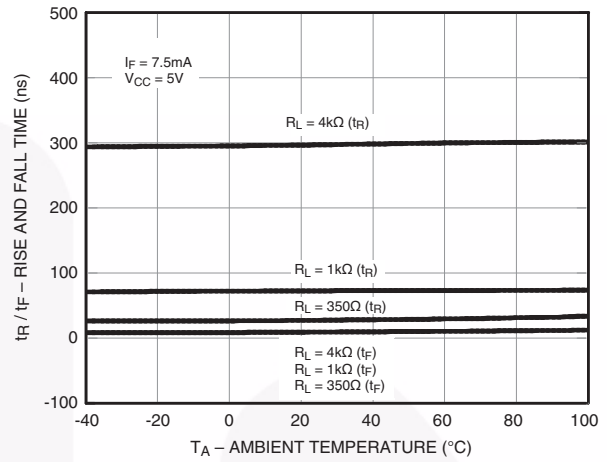


Fig. 9 Enable Propagation Delay vs. Temperature

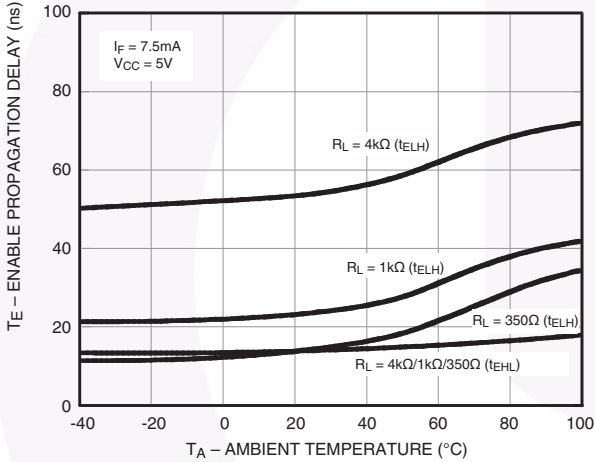


Fig. 10 Switching Time vs. Temperature

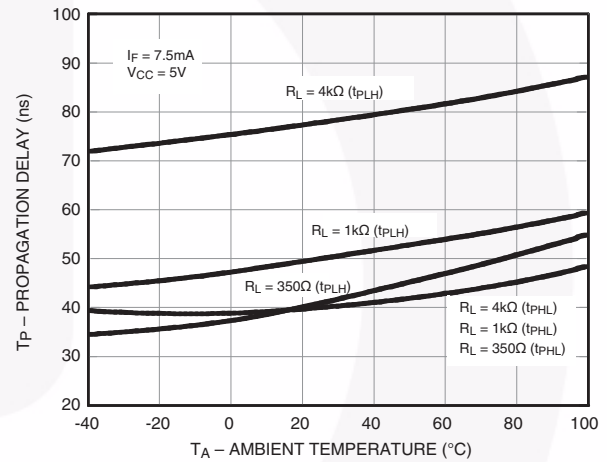
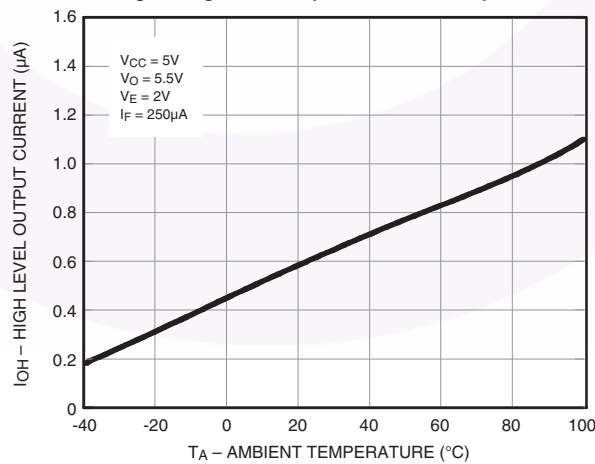


Fig. 11 High Level Output Current vs. Temperature



### Test Circuits

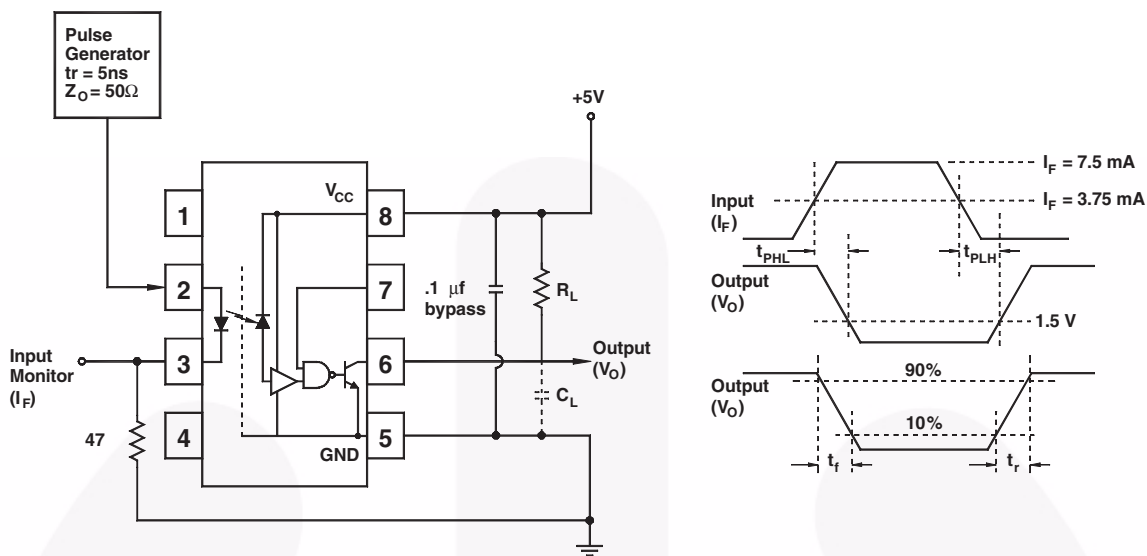


Fig. 12 Test Circuit and Waveforms for  $t_{PLH}$ ,  $t_{PHL}$ ,  $t_r$  and  $t_f$

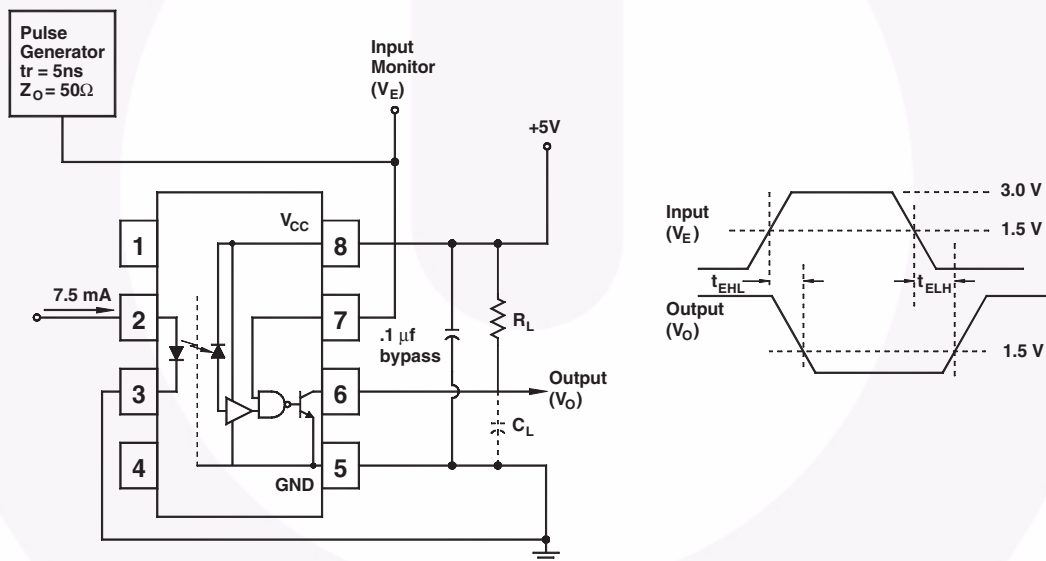


Fig. 13 Test Circuit  $t_{EHL}$  and  $t_{ELH}$

Test Circuits (Continued)

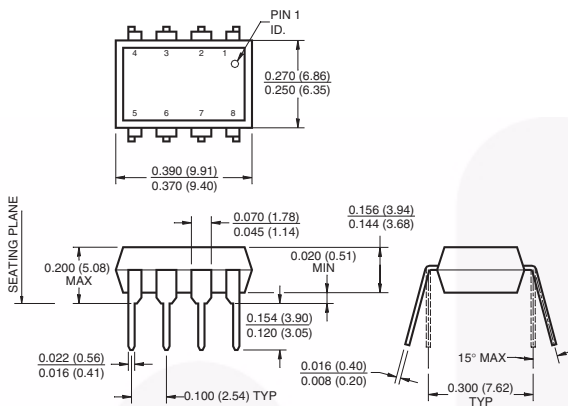


Fig. 14 Test Circuit Common Mode Transient Immunity

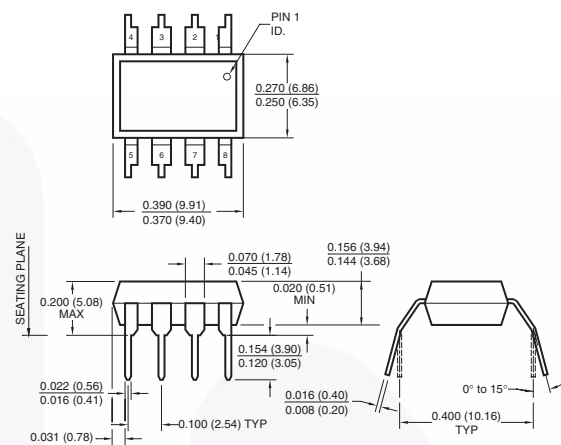


## Package Dimensions

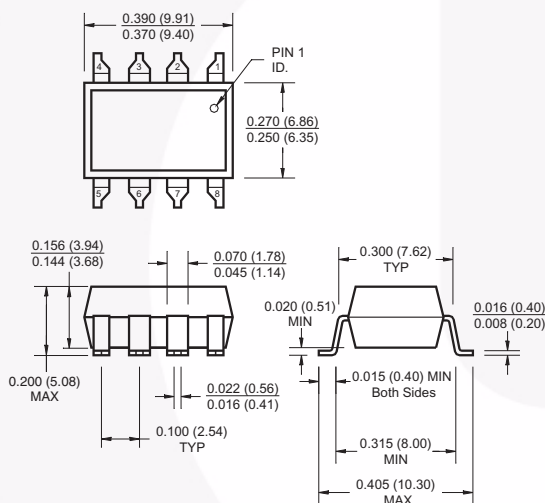
### Through Hole



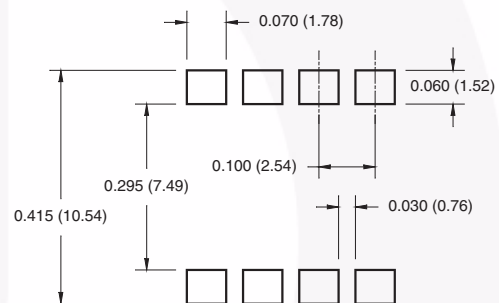
### 0.4" Lead Spacing (Option TV) (Pending)



### Surface Mount – 0.3" Lead Spacing (Option S)



### 8-Pin Surface Mount DIP – Land Pattern (Option S)



**Note:**

All dimensions are in inches (millimeters)

Package drawings are provided as a service to customers considering Fairchild components. Drawings may change in any manner without notice. Please note the revision and/or date on the drawing and contact a Fairchild Semiconductor representative to verify or obtain the most recent revision. Package specifications do not expand the terms of Fairchild's worldwide terms and conditions, specifically the warranty therein, which covers Fairchild products.

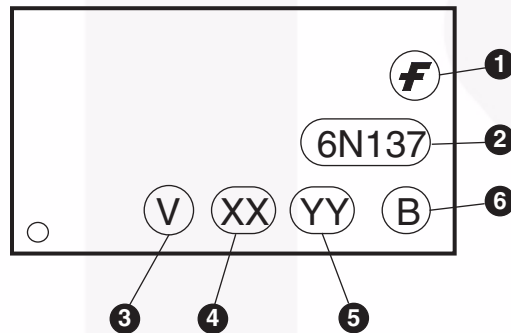
Always visit Fairchild Semiconductor's online packaging area for the most recent package drawings:

<http://www.fairchildsemi.com/packaging/>

## Ordering Information

Option	Example Part Number	Description
No Suffix	6N137M	Standard Through Hole Device, 50 pcs per tube
S	6N137SM	Surface Mount Lead Bend
SD	6N137SDM	Surface Mount; Tape and Reel
V	6N137VM	IEC60747-5-2 approval pending (VDE)
TV	6N137TVM	IEC60747-5-2 approval pending (VDE), 0.4" lead spacing
SV	6N137SVM	IEC60747-5-2 approval pending (VDE), surface mount
SDV	6N137SDVM	IEC60747-5-2 approval pending (VDE), surface mount, tape and reel

## Marking Information



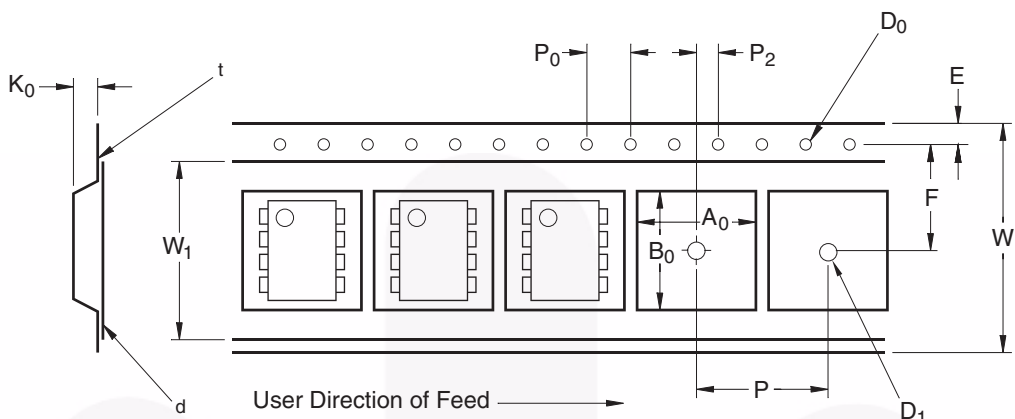
Definitions	
1	Fairchild logo
2	Device number
3	VDE mark (Note: Only appears on parts ordered with VDE option – See order entry table) (pending approval)
4	Two digit year code, e.g., '07'
5	Two digit work week ranging from '01' to '53'
6	Assembly package code

### Note:

'HCPL' devices are marked only with the numerical characters (for example, HCPL2630 is marked as '2630').

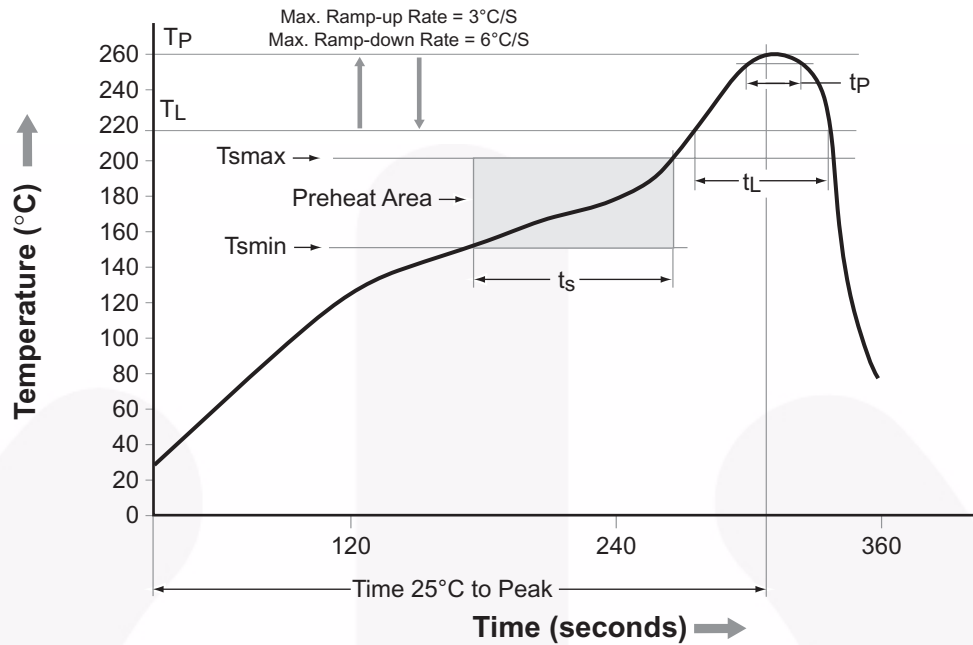
The 'M' suffix on the part number is an order identifier only. It is used to identify orders for the white package version. The 'M' does not appear on the device's top mark.

## Carrier Tape Specifications (Option SD)



Symbol	Description	Dimension in mm
W	Tape Width	16.0 ± 0.3
t	Tape Thickness	0.30 ± 0.05
P <sub>0</sub>	Sprocket Hole Pitch	4.0 ± 0.1
D <sub>0</sub>	Sprocket Hole Diameter	1.55 ± 0.05
E	Sprocket Hole Location	1.75 ± 0.10
F	Pocket Location	7.5 ± 0.1
P <sub>2</sub>		2.0 ± 0.1
P	Pocket Pitch	12.0 ± 0.1
A <sub>0</sub>	Pocket Dimensions	10.30 ± 0.20
B <sub>0</sub>		10.30 ± 0.20
K <sub>0</sub>		4.90 ± 0.20
W <sub>1</sub>	Cover Tape Width	13.2 ± 0.2
d	Cover Tape Thickness	0.1 max
	Max. Component Rotation or Tilt	10°
R	Min. Bending Radius	30

## Reflow Profile





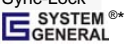


Profile Feature	Pb-Free Assembly Profile
Temperature Min. (T <sub>smin</sub> )	150°C
Temperature Max. (T <sub>smax</sub> )	200°C
Time (t <sub>s</sub> ) from (T <sub>smin</sub> to T <sub>smax</sub> )	60–120 seconds
Ramp-up Rate (t <sub>L</sub> to t <sub>p</sub> )	3°C/second max.
Liquidous Temperature (T <sub>L</sub> )	217°C
Time (t <sub>L</sub> ) Maintained Above (T <sub>L</sub> )	60–150 seconds
Peak Body Package Temperature	260°C +0°C / -5°C
Time (t <sub>p</sub> ) within 5°C of 260°C	30 seconds
Ramp-down Rate (T <sub>P</sub> to T <sub>L</sub> )	6°C/second max.
Time 25°C to Peak Temperature	8 minutes max.



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CTL™	IntelliMAX™	RapidConfigure™	TINYOPTO™
Current Transfer Logic™	ISOPLANAR™	 ™	TinyPower™
DEUXPEED®	MegaBuck™	Saving our world, 1mW/W/kW at a time™	TinyPWM™
Dual Cool™	MICROCOUPLER™	SignalWise™	TinyWire™
EcoSPARK®	MicroFET™	SmartMax™	TriFault Detect™
EfficientMax™	MicroPak™	SMART START™	TRUECURRENT™*
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Fairchild Semiconductor®	MotionMax™	SuperFET™	UHC®
FACT Quiet Series™	Motion-SPM™	SuperSOT™-3	Ultra FRFET™
FACT®	OptoHit™	SuperSOT™-6	UniFET™
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### PRODUCT STATUS DEFINITIONS

#### Definition of Terms

Datasheet Identification	Product Status	Definition
Advance Information	Formative / In Design	Datasheet contains the design specifications for product development. Specifications may change in any manner without notice.
Preliminary	First Production	Datasheet contains preliminary data; supplementary data will be published at a later date. Fairchild Semiconductor reserves the right to make changes at any time without notice to improve design.
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