FAIRCHILD SEMICONDUCTOR®

October 2008

FOD3150
High Noise Immunity, 1.0A Output Current, Gate Drive Optocoupler

Features

- High noise immunity characterized by 20kV/µs minimum common mode rejection
- Use of P-channel MOSFETs at output stage enables output voltage swing close to the supply rail
- Wide supply voltage range from 15V to 30V
- Fast switching speed
  - 500ns max. propagation delay
  - 300ns max. pulse width distortion
- Under Voltage LockOut (UVLO) with hysteresis
- Extended industrial temperate range, -40°C to 100°C temperature range
- Safety and regulatory pending approvals
  - UL1577, 5000 V_{RMS} for 1 min.
  - IEC60747-5-2 (approval pending)
- >8.0mm clearance and creepage distance (option 'T')

Applications

- Industrial inverter
- Uninterruptible power supply
- Induction heating
- Isolated IGBT/Power MOSFET gate drive

Description

The FOD3150 is a 1.0A Output Current Gate Drive Optocoupler, capable of driving most 800V/20A IGBT/MOSFET. It is ideally suited for fast switching driving of power IGBT and MOSFETs used in motor control inverter applications, and high performance power system.

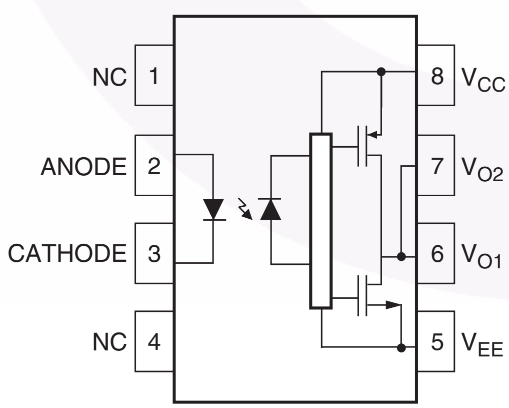
It utilizes Fairchild's patented coplanar packaging technology, Optoplanar®, and optimized IC design to achieve high noise immunity, characterized by high common mode rejection.

It consists of a gallium aluminum arsenide (AlGaAs) light emitting diode optically coupled to an integrated circuit with a high-speed driver for push-pull MOSFET output stage.

Related Resources

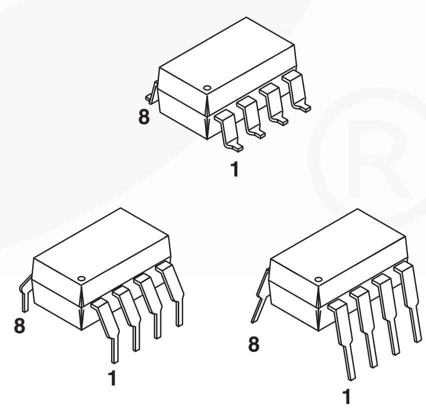
- FOD3120, 2.5A Output Current, Gate Drive Optocoupler Datasheet
- www.fairchildsemi.com/products/opto/

Functional Block Diagram



Note:
A 0.1µF bypass capacitor must be connected between pins 5 and 8.

Package Outlines



Truth Table

LED	$V_{CC} - V_{EE}$ "Positive Going" (Turn-on)	$V_{CC} - V_{EE}$ "Negative Going" (Turn-off)	V_O
Off	0V to 30V	0V to 30V	Low
On	0V to 11V	0V to 9.5V	Low
On	11V to 13.5V	9.5V to 12V	Transition
On	13.5V to 30V	12V to 30V	High

Pin Definitions

Pin #	Name	Description
1	NC	Not Connected
2	Anode	LED Anode
3	Cathode	LED Cathode
4	NC	Not Connected
5	V_{EE}	Negative Supply Voltage
6	V_{O2}	Output Voltage 2 (internally connected to V_{O1})
7	V_{O1}	Output Voltage 1
8	V_{CC}	Positive Supply Voltage

Safety and Insulation Ratings

As per IEC 60747-5-2. This optocoupler is suitable for “safe electrical insulation” only within the safety limit data. Compliance with the safety ratings shall be ensured by means of protective circuits.

Symbol	Parameter	Min.	Typ.	Max.	Unit
	Installation Classifications per DIN VDE 0110/1.89 Table 1				
	For Rated Main Voltage < 150Vrms		I–IV		
	For Rated Main Voltage < 300Vrms		I–IV		
	For Rated Main Voltage < 450Vrms		I–III		
	For Rated Main Voltage < 600Vrms		I–III		
	Climatic Classification		55/100/21		
	Pollution Degree (DIN VDE 0110/1.89)		2		
CTI	Comparative Tracking Index	175			
V_{PR}	Input to Output Test Voltage, Method b, V_{IORM} x 1.875 = V_{PR}, 100% Production Test with tm = 1 sec., Partial Discharge < 5pC	1669			
	Input to Output Test Voltage, Method a, V_{IORM} x 1.5 = V_{PR}, Type and Sample Test with tm = 60 sec.,Partial Discharge < 5 pC	1335			
V_{IORM}	Max Working Insulation Voltage	890			V_{peak}
V_{IOTM}	Highest Allowable Over Voltage	6000			V_{peak}
	External Creepage	8			mm
	External Clearance	7.4			mm
	External Clearance (for Option T-0.4” Lead Spacing)	10.16			mm
	Insulation Thickness	0.5			mm
	Safety Limit Values – Maximum Values Allowed in the Event of a Failure				
T_{Case}	Case Temperature	150			°C
$I_{S,INPUT}$	Input Current	25			mA
$P_{S,OUTPUT}$	Output Power (Duty Factor ≤ 2.7%)	250			mW
R_{IO}	Insulation Resistance at T_S, V_{IO} = 500V	10^9			Ω

Absolute Maximum Ratings (T_A = 25ºC 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	-55 to +125	ºC
T_{OPR}	Operating Temperature	-40 to +100	ºC
T_J	Junction Temperature	-40 to +125	ºC
T_{SOL}	Lead Wave Solder Temperature (refer to page 19 for reflow solder profile)	260 for 10sec	ºC
$I_{F(AVG)}$	Average Input Current	25	mA
V_R	Reverse Input Voltage	5	V
$I_{O(PEAK)}$	Peak Output Current(1)	1.5	A
$V_{CC} – V_{EE}$	Supply Voltage	0 to 35	V
$V_{O(PEAK)}$	Peak Output Voltage	0 to V_{CC}	V
$t_{R(IN)}$, $t_{F(IN)}$	Input Signal Rise and Fall Time	500	ns
PD_I	Input Power Dissipation(2)(4)	45	mW
PD_O	Output Power Dissipation(3)(4)	250	mW

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	Value	Units
T_A	Ambient Operating Temperature	-40 to +100	°C
$V_{CC} – V_{EE}$	Power Supply	15 to 30	V
$I_{F(ON)}$	Input Current (ON)	7 to 16	mA
$V_{F(OFF)}$	Input Voltage (OFF)	0 to 0.8	V

Isolation Characteristics

Apply over all recommended conditions, typical value is measured at T_A = 25ºC

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Units
V_{ISO}	Input-Output Isolation Voltage	T_A = 25ºC, R.H.< 50%, t = 1.0min, $I_{I-O} \leq 10\mu A$, 50Hz(5)(6)	5000			V_{RMS}
R_{ISO}	Isolation Resistance	V_{I-O} = 500V(5)		10^{11}		Ω
C_{ISO}	Isolation Capacitance	V_{I-O} = 0V, Freq = 1.0MHz(5)		1		pF

Electrical Characteristics

Apply over all recommended conditions, typical value is measured at V_{CC} = 30V, V_{EE} = Ground, T_A = 25°C unless otherwise specified.

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Units
V_F	Input Forward Voltage	I_F = 10mA	1.2	1.5	1.8	V
$\Delta(V_F / T_A)$	Temperature Coefficient of Forward Voltage			-1.8		mV/ºC
BV_R	Input Reverse Breakdown Voltage	I_R = 10µA	5			V
C_{IN}	Input Capacitance	f = 1MHz, VF = 0V		60		pF
I_{OH}	High Level Output Current(1)	$V_O = V_{CC} – 0.75V$	0.2			A
		$V_O = V_{CC} – 4V$	1.0			
I_{OL}	Low Level Output Current(1)	$V_O = V_{EE}$ + 0.75V	0.2			A
		$V_O = V_{EE}$ + 4V	1.0			
V_{OH}	High Level Output Voltage	I_F = 10mA, I_O = -1A	V_{CC} – 4V	V_{CC} – 6V		V
		I_F = 10mA, I_O = -100mA	V_{CC} – 0.5V	V_{CC} – 0.1V		
V_{OL}	Low Level Output Voltage	I_F = 0mA, I_O = 1A		V_{EE} + 6V	V_{EE} + 4V	V
		I_F = 0mA, I_O = 100mA		V_{EE} + 0.1V	V_{EE} + 0.5V	
I_{CCH}	High Level Supply Current	V_O = Open, I_F = 7 to 16mA		2.8	5	mA
I_{CCL}	Low Level Supply Current	V_O = Open, V_F = 0 to 0.8V		2.8	5	mA
I_{FLH}	Threshold Input Current Low to High	I_O = 0mA, V_O > 5V		2.3	5.0	mA
V_{FHL}	Threshold Input Voltage High to Low	I_O = 0mA, V_O < 5V	0.8			V
V_{UVLO+}	Under Voltage Lockout Threshold	I_F = 10mA, V_O > 5V	11	12.7	13.5	V
$V_{UVLO–}$		I_F = 10mA, V_O < 5V	9.5	11.2	12.0	V
$UVLO_{HYS}$	Under Voltage Lockout Threshold Hysteresis			1.5		V

Switching Characteristics

Apply over all recommended conditions, typical value is measured at V_{CC} = 30V, V_{EE} = Ground, T_A = 25°C unless otherwise specified.

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Units
t_{PHL}	Propagation Delay Time to Logic Low Output	I_F = 7mA to 16mA, Rg = 20Ω, Cg =10nF, f = 10kHz, Duty Cycle = 50%	100	275	500	ns
t_{PLH}	Propagation Delay Time to Logic High Output		100	255	500	ns
PWD	Pulse Width Distortion, $\mid t_{PHL} – t_{PLH} \mid$			20	300	ns
PDD (Skew)	Propagation Delay Difference Between Any Two Parts or Channels, $(t_{PHL} – t_{PLH})$(7)		-350		350	ns
t_r	Output Rise Time (10% – 90%)			60		ns
t_f	Output Fall Time (90% – 10%)			60		ns
$t_{UVLO\ ON}$	UVLO Turn On Delay	I_F = 10mA , V_O > 5V		1.6		µs
$t_{UVLO\ OFF}$	UVLO Turn Off Delay	I_F = 10mA , V_O < 5V		0.4		µs
$\mid CM_H \mid$	Common Mode Transient Immunity at Output High	T_A = 25°C, V_{CC} = 30V, I_F = 7 to 16mA, V_{CM} = 2000V(8)	20	50		kV/µs
$\mid CM_L \mid$	Common Mode Transient Immunity at Output Low	T_A = 25°C, V_{CC} = 30V, V_F = 0V, V_{CM} = 2000V(9)	20	50		kV/µs

Notes:

1. Maximum pulse width = 10µs, maximum duty cycle = 0.2%
2. Derate linearly above 87°C, free air temperature at a rate of 0.77mW/°C
3. No derating required across temperature range.
4. Functional operation under these conditions is not implied. Permanent damage may occur if the device is subjected to conditions outside these ratings.
5. Device is considered a two terminal device: Pins 2 and 3 are shorted together and Pins 5, 6, 7 and 8 are shorted together.
6. 5,000 V_{RMS} for 1 minute duration is equivalent to 6,000 VAC_{RMS} for 1 second duration.
7. The difference between t_{PHL} and t_{PLH} between any two FOD3150 parts under same test conditions.
8. Common mode transient immunity at output high is the maximum tolerable negative dVcm/dt on the trailing edge of the common mode impulse signal, Vcm, to assure that the output will remain high (i.e. V_O > 15.0V).
9. Common mode transient immunity at output low is the maximum tolerable positive dVcm/dt on the leading edge of the common pulse signal, Vcm, to assure that the output will remain low (i.e. V_O < 1.0V).

Typical Performance Curves

Fig. 1 Output High Voltage Drop vs. Output High Current

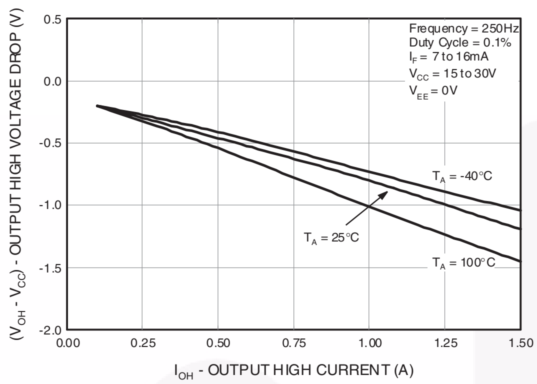


Fig. 2 Output High Voltage Drop vs. Ambient Temperature

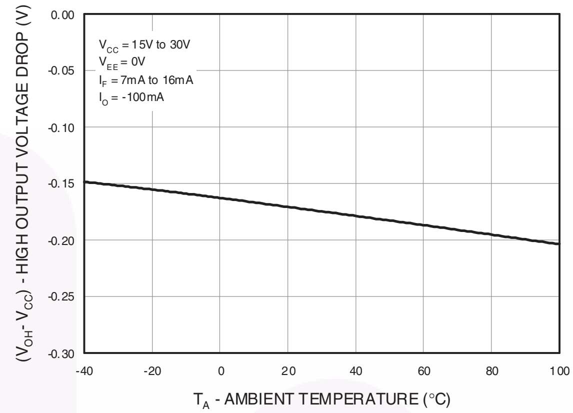


Fig. 3 Output Low Voltage vs. Output Low Current

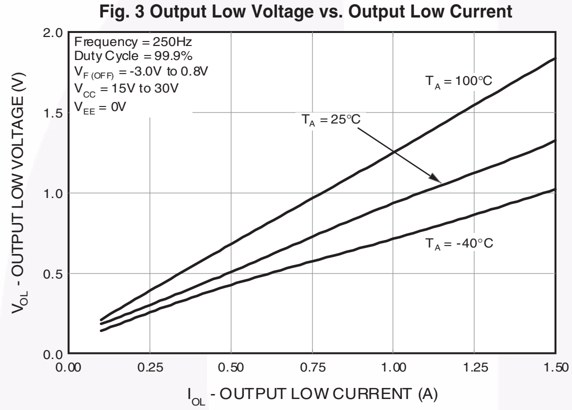


Fig. 4 Output Low Voltage vs. Ambient Temperature

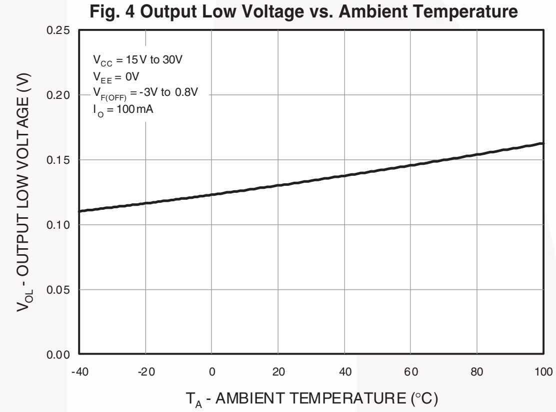


Fig. 5 Supply Current vs. Ambient Temperature

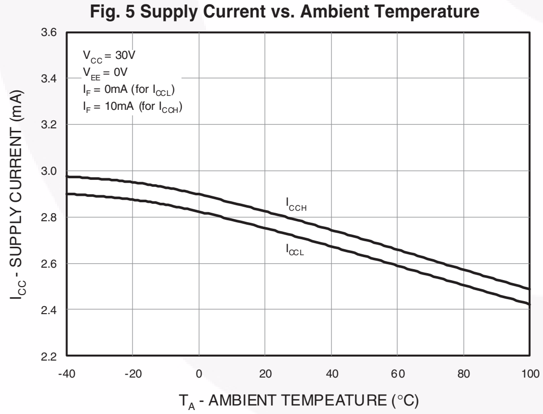
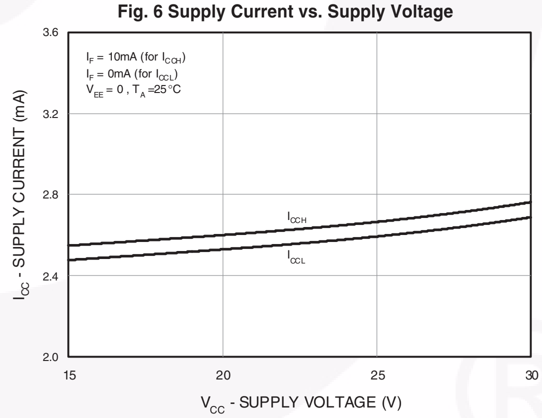


Fig. 6 Supply Current vs. Supply Voltage



Typical Performance Curves (Continued)

Fig. 7 Low to High Input Current Threshold vs. Ambient Temperature

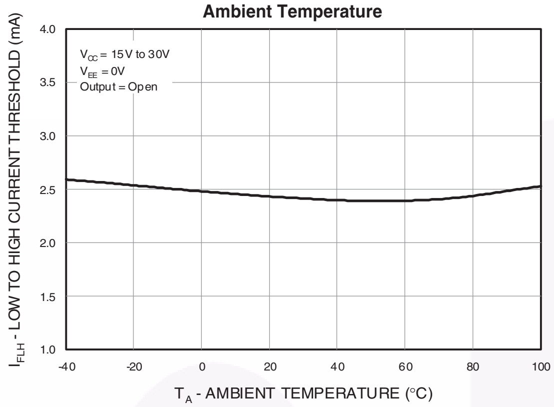


Fig. 8 Propagation Delay vs. Supply Voltage

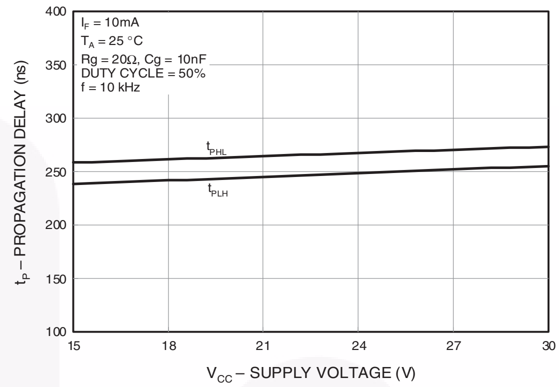


Fig. 9 Propagation Delay vs. LED Forward Current

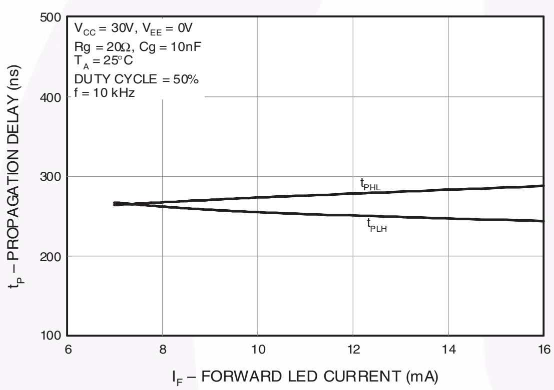


Fig. 10 Propagation Delay vs. Ambient Temperature

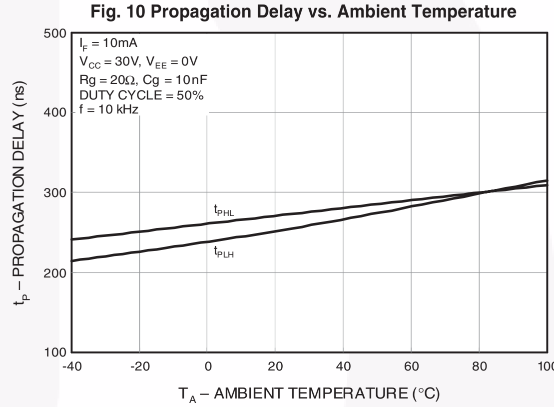


Fig. 11 Propagation Delay vs. Series Load Resistance

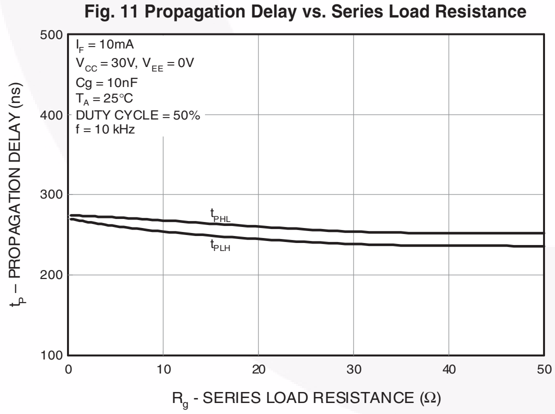
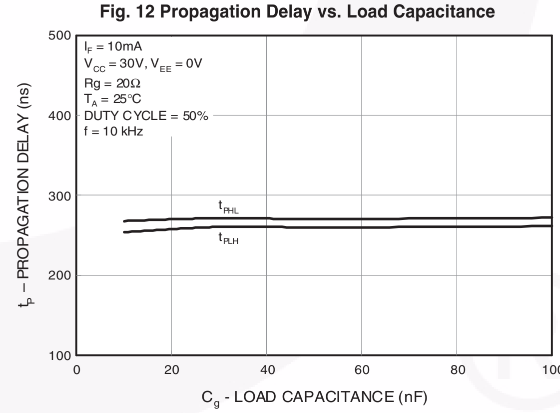


Fig. 12 Propagation Delay vs. Load Capacitance



Typical Performance Curves (Continued)

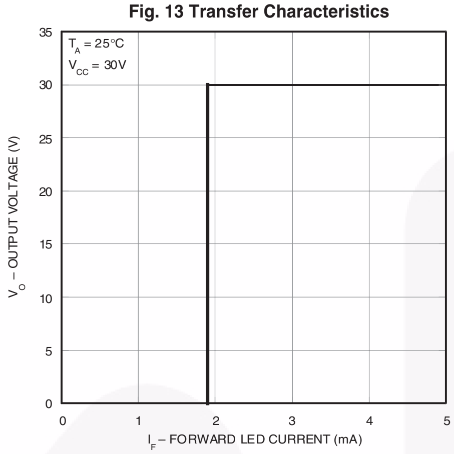


Fig. 13 Transfer Characteristics

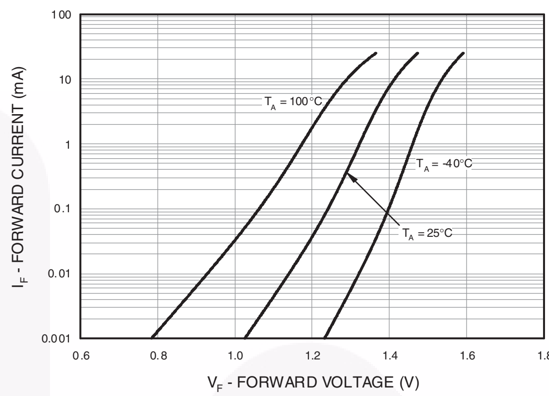


Fig. 14 Input Forward Current vs. Forward Voltage

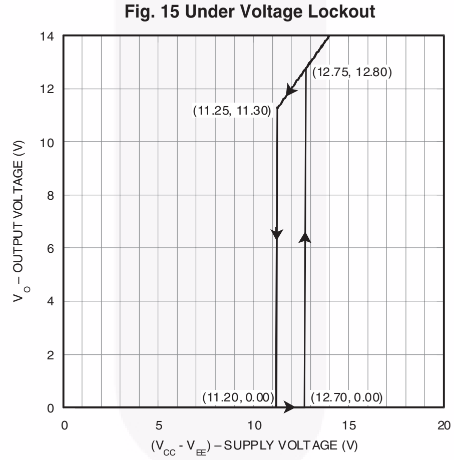
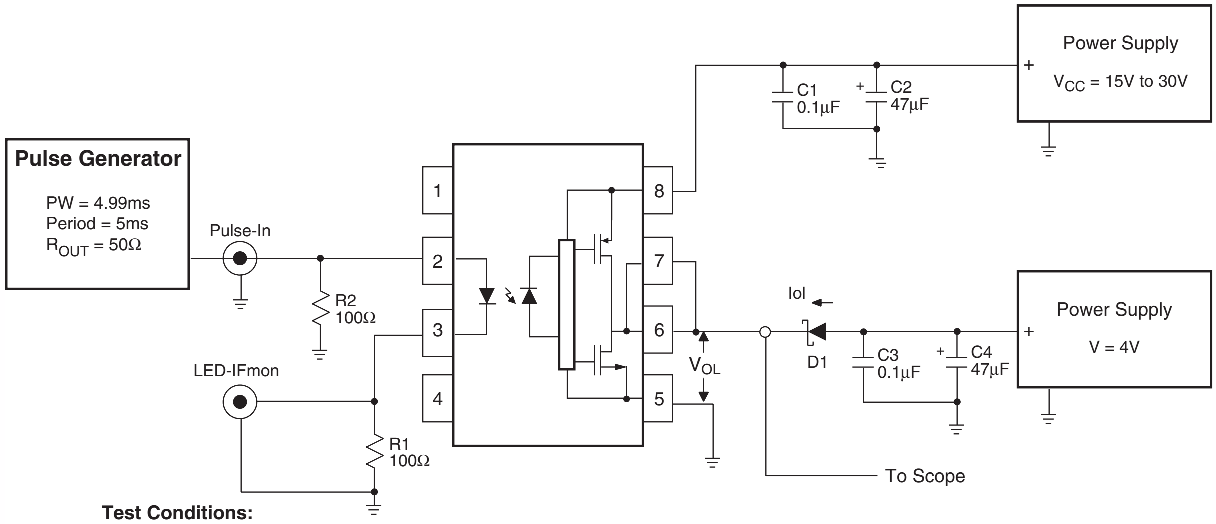


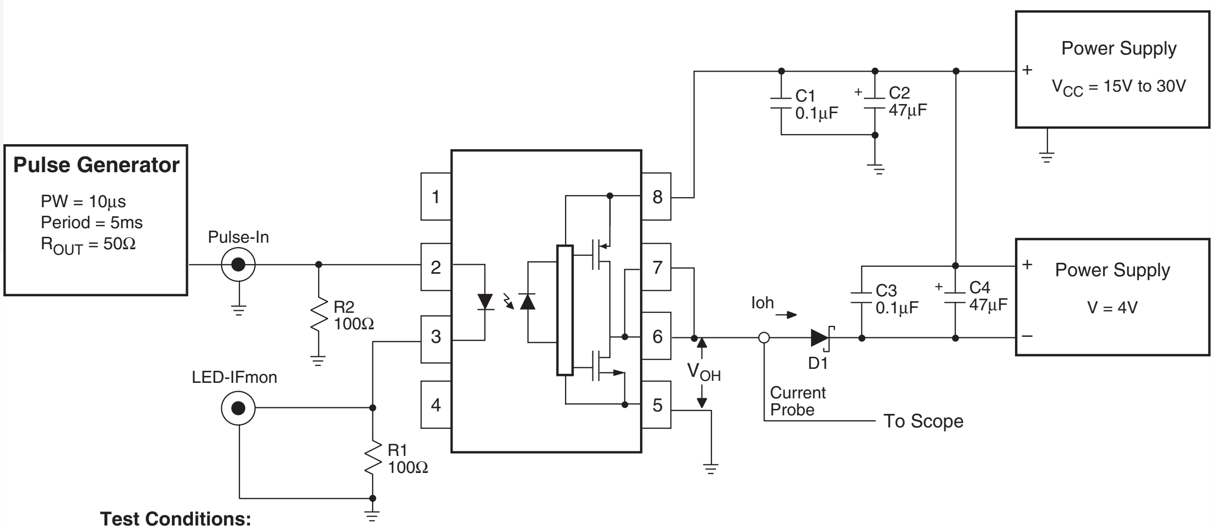
Fig. 15 Under Voltage Lockout

Test Circuit



Test Conditions:
Frequency = 200Hz
Duty Cycle = 99.8%
V_{CC} = 15V to 30V
V_{EE} = 0V
$V_{F(OFF)}$ = -3.0V to 0.8V

Figure 20. I_{OL} Test Circuit



Test Conditions:
Frequency = 200Hz
Duty Cycle = 0.2%
V_{CC} = 15V to 30V
V_{EE} = 0V
I_F = 7mA to 16mA

Figure 21. I_{OH} Test Circuit

Test Circuit (Continued)

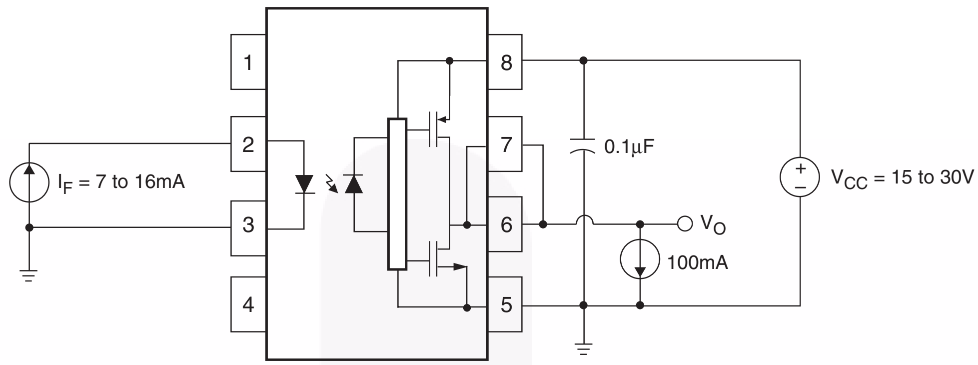


Figure 22. V_{OH} Test Circuit

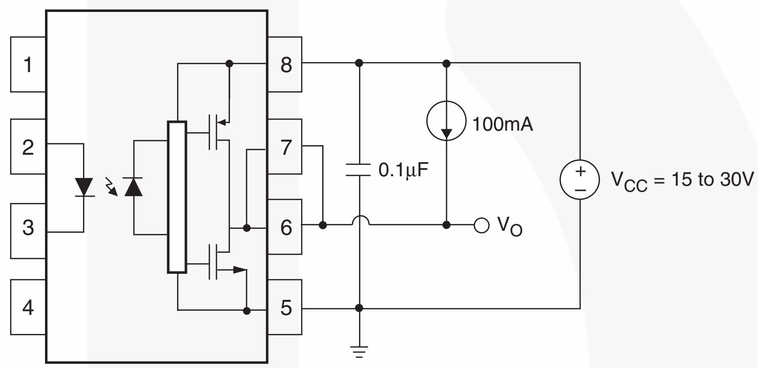


Figure 23. V_{OL} Test Circuit

Test Circuit (Continued)

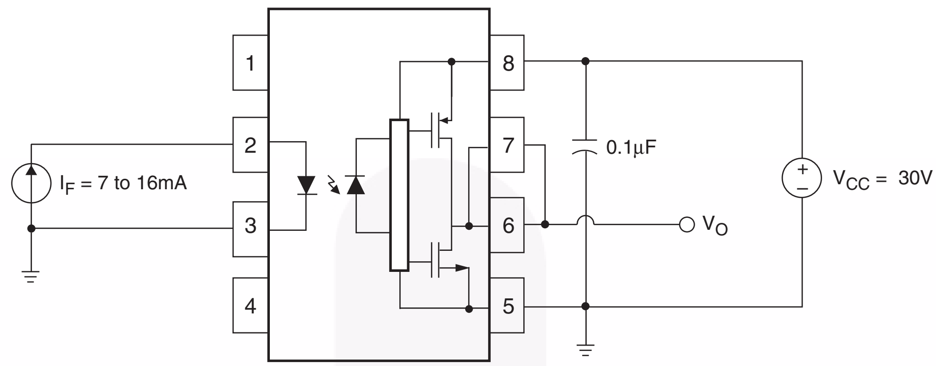


Figure 24. I_{CCH} Test Circuit

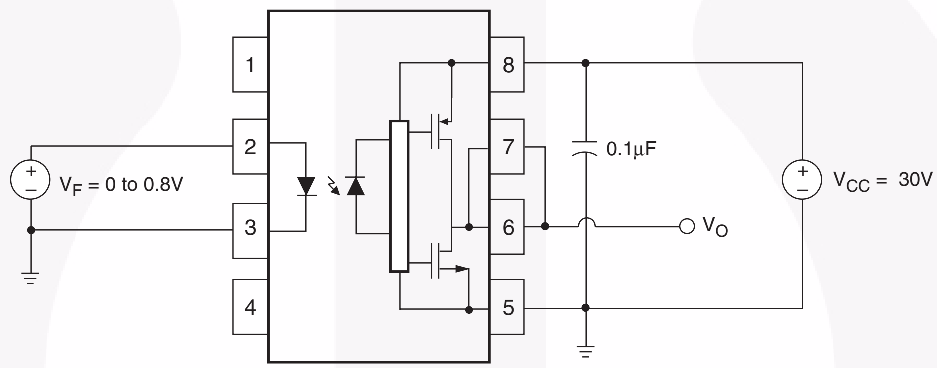


Figure 25. I_{CCL} Test Circuit

Test Circuit (Continued)

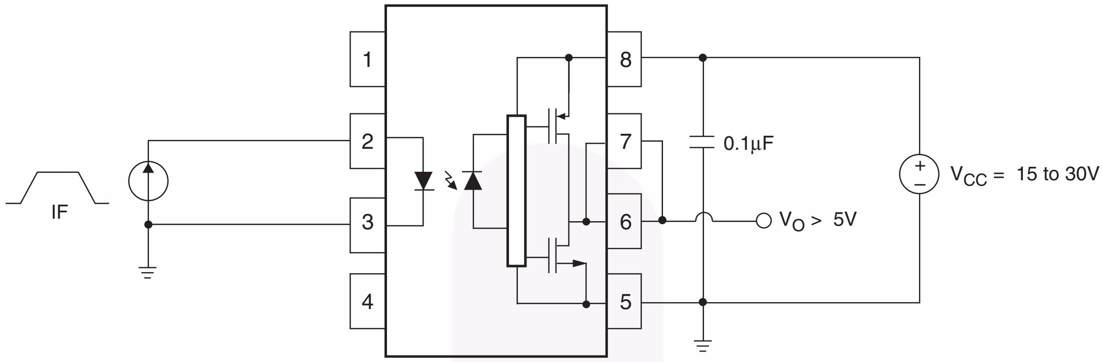


Figure 26. I_{FLH} Test Circuit

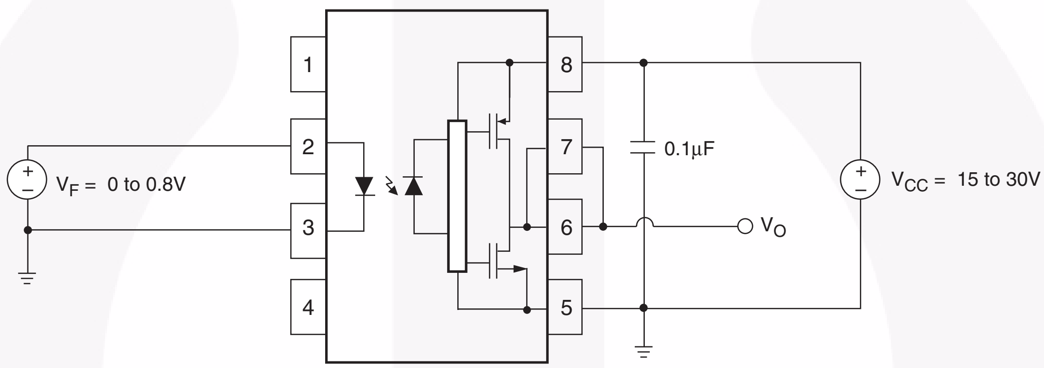


Figure 27. V_{FHL} Test Circuit

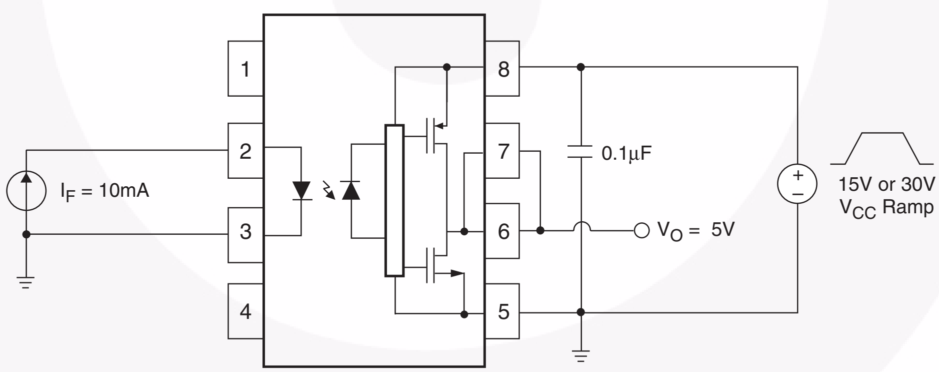


Figure 28. UVLO Test Circuit

Test Circuit (Continued)

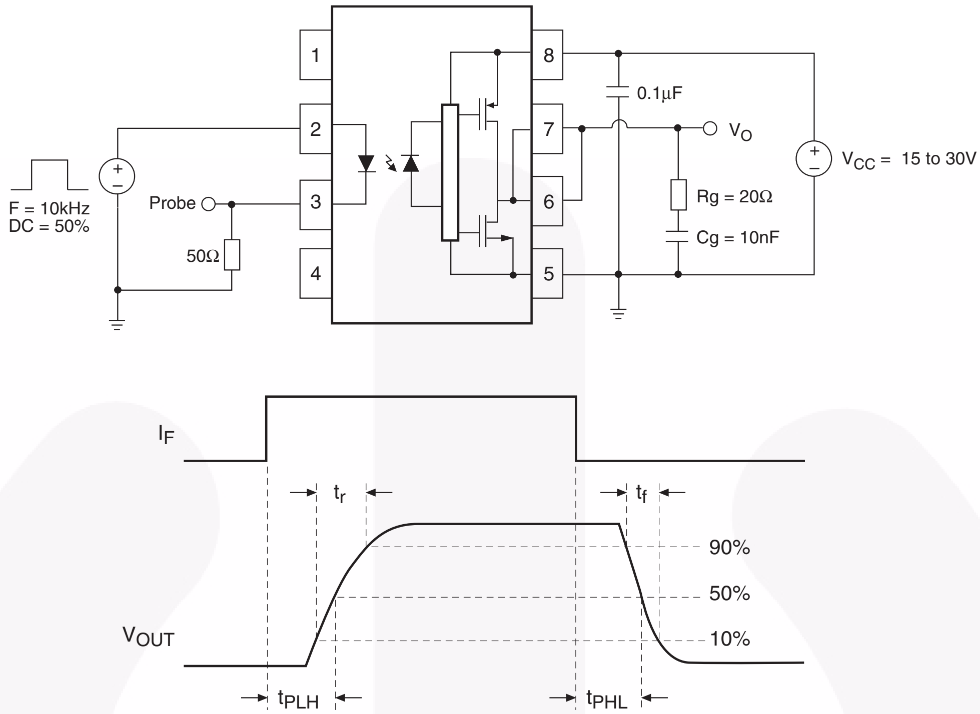


Figure 29. t_{PHL}, t_{PLH}, t_R and t_F Test Circuit and Waveforms

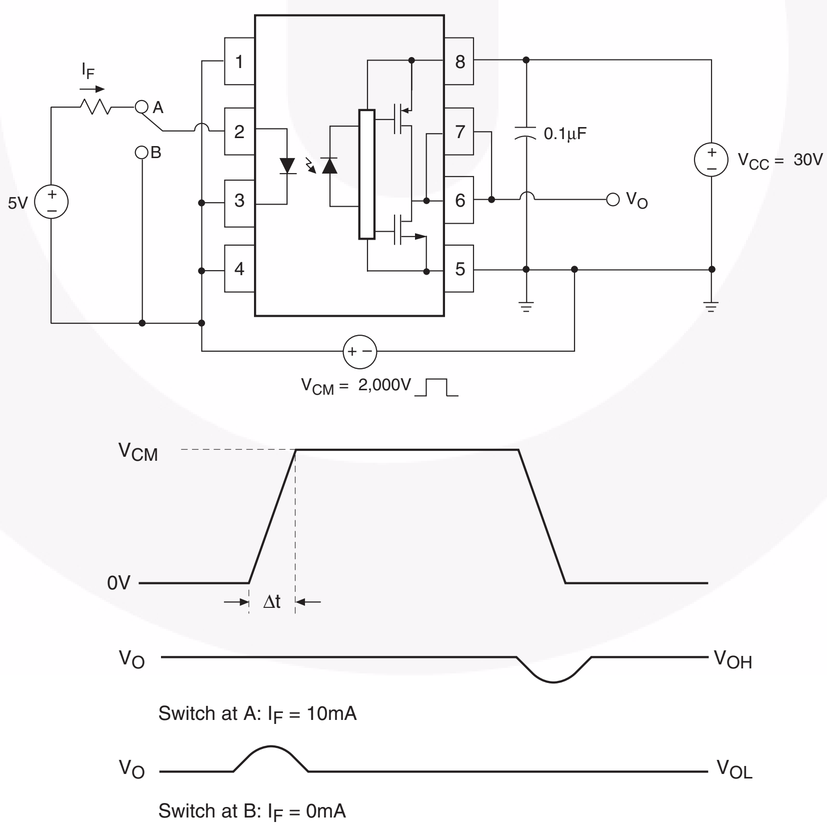
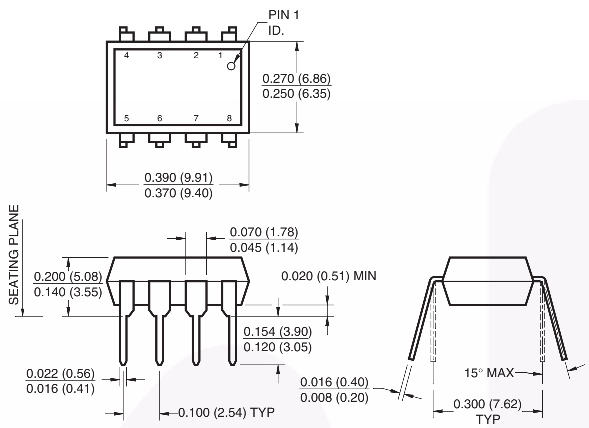


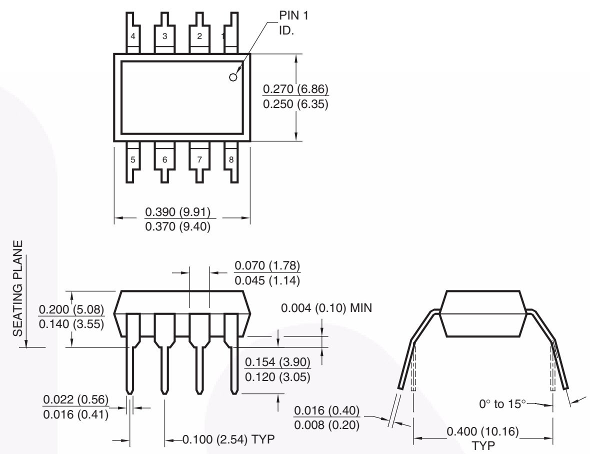
Figure 30. CMR Test Circuit and Waveforms

Package Dimensions

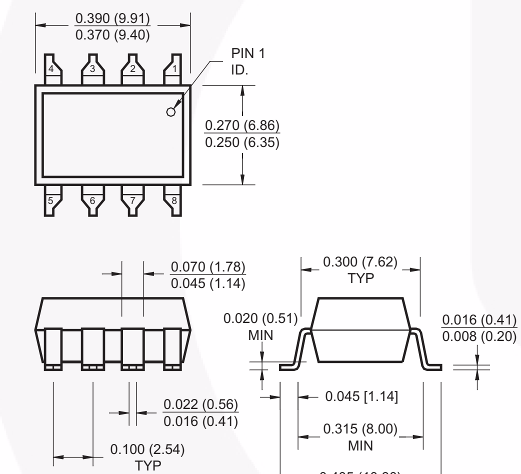
Through Hole



0.4" Lead Spacing

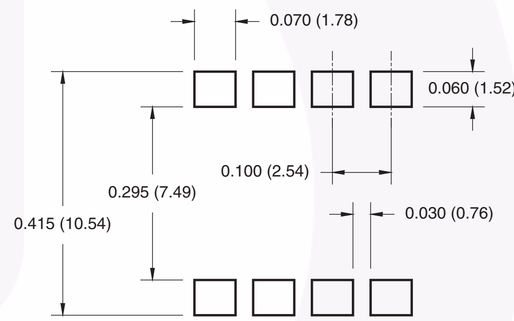


Surface Mount



Lead Coplanarity : 0.004 (0.10) MAX

8-Pin DIP – Land Pattern



Note:
All dimensions are in inches (millimeters)

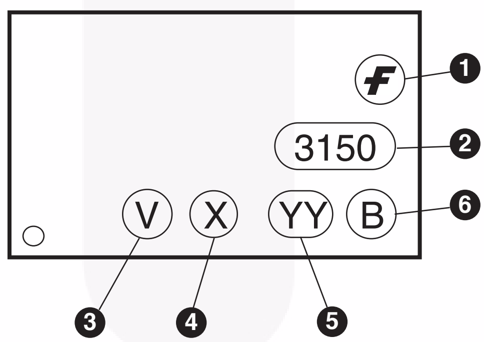
Package drawings are provided as a service to customers considering Fairchild components. Drawings may change in any manner without notice. Please note the revision and/or date on the drawing and contact a Fairchild Semiconductor representative to verify or obtain the most recent revision. Package specifications 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

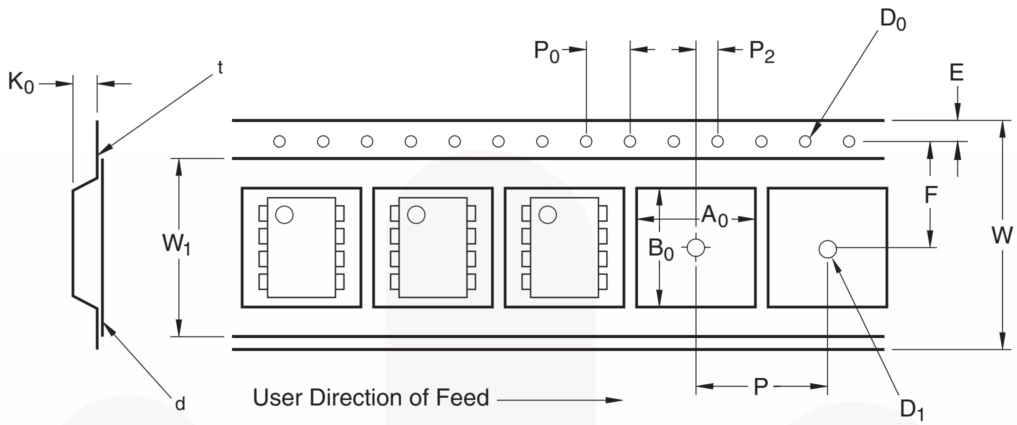
Part Number	Package	Packing Method
FOD3150	DIP 8-Pin	Tube (50 units per tube)
FOD3150S	SMT 8-Pin (Lead Bend)	Tube (50 units per tube)
FOD3150SD	SMT 8-Pin (Lead Bend)	Tape and Reel (1,000 units per reel)
FOD3150V	DIP 8-Pin, IEC60747-5-2 option (Pending approval)	Tube (50 units per tube)
FOD3150SV	SMT 8-Pin (Lead Bend), IEC60747-5-2 option (Pending approval)	Tube (50 units per tube)
FOD3150SDV	SMT 8-Pin (Lead Bend), IEC60747-5-2 option (Pending approval)	Tape and Reel (1,000 units per reel)
FOD3150T	DIP 8-Pin, 0.4" Lead Spacing	Tube (50 units per tube)
FOD3150TV	DIP 8-Pin, 0.4" Lead Spacing , IEC60747-5-2 option (Pending approval)	Tube (50 units per tube)

Marking Information



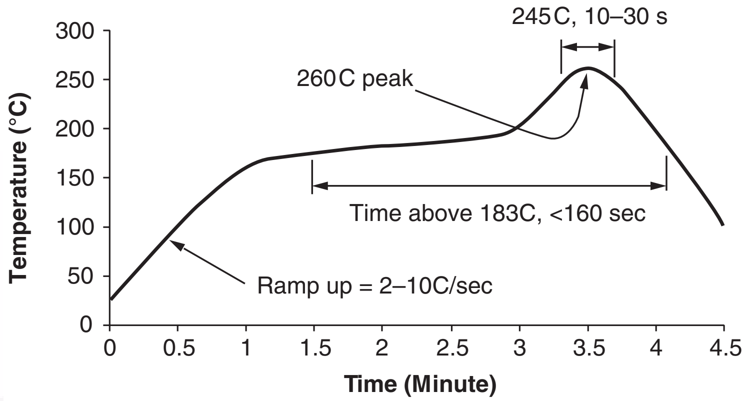
Definitions	
1	Fairchild logo
2	Device number
3	IEC60747-5-2 Option (only appears on component ordered with this option) (Pending approval)
4	One digit year code, e.g., '8'
5	Two digit work week ranging from '01' to '53'
6	Assembly package code

Carrier Tape Specifications



Symbol	Description	Dimension in mm
W	Tape Width	16.0 ± 0.3
t	Tape Thickness	0.30 ± 0.05
P_0	Sprocket Hole Pitch	4.0 ± 0.1
D_0	Sprocket Hole Diameter	1.55 ± 0.05
E	Sprocket Hole Location	1.75 ± 0.10
F	Pocket Location	7.5 ± 0.1
P_2		2.0 ± 0.1
P	Pocket Pitch	12.0 ± 0.1
A_0	Pocket Dimensions	10.30 ±0.20
B_0		10.30 ±0.20
K_0		4.90 ±0.20
W_1	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



- Peak reflow temperature: 260C (package surface temperature)
- Time of temperature higher than 183C for 160 seconds or less
- One time soldering reflow is recommended

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