FAIRCHILD™

Is Now Part of

ON Semiconductor®

To learn more about ON Semiconductor, please visit our website at
www.onsemi.com

Please note: As part of the Fairchild Semiconductor integration, some of the Fairchild orderable part numbers will need to change in order to meet ON Semiconductor's system requirements. Since the ON Semiconductor product management systems do not have the ability to manage part nomenclature that utilizes an underscore (_), the underscore (_) in the Fairchild part numbers will be changed to a dash (-). This document may contain device numbers with an underscore (_). Please check the ON Semiconductor website to verify the updated device numbers. The most current and up-to-date ordering information can be found at www.onsemi.com. Please email any questions regarding the system integration to Fairchild_questions@onsemi.com.

HCPL3700
AC/DC to Logic Interface Optocoupler

Features

- AC or DC input
- Programmable sense voltage
- Logic level compatibility
- Threshold guaranteed over temperature (0°C to 70°C)
- Optoplanar™ construction for high common mode immunity
- UL recognized (file # E90700)
- VDE certified – ordering option 'V', e.g., HCPL3700V

Applications

- Low voltage detection
- 5 V to 240 V AC/DC voltage sensing
- Relay contact monitor
- Current sensing
- Microprocessor Interface
- Industrial controls

Description

The HCPL-3700 voltage/current threshold detection optocoupler consists of an AlGaAs LED connected to a threshold sensing input buffer IC which are optically coupled to a high gain darlington output. The input buffer chip is capable of controlling threshold levels over a wide range of input voltages with a single resistor. The output is TTL and CMOS compatible.

Schematics
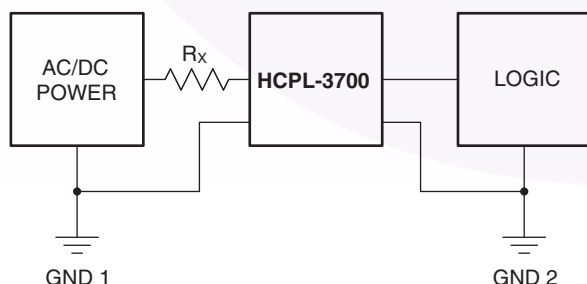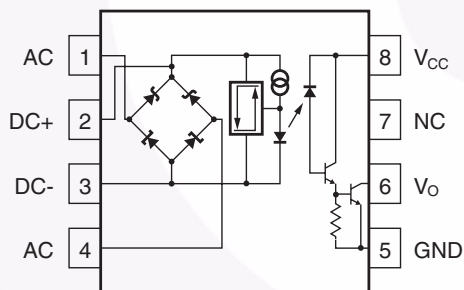
Package Outlines
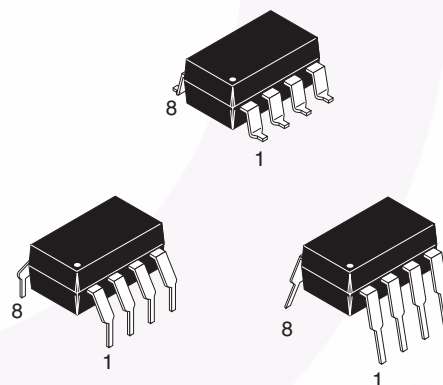
TRUTH TABLE
(Positive Logic)

Input	Output
H	L
L	H

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

Absolute Maximum Ratings (No derating required up to 70°C)

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	°C
T_{OPR}	Operating Temperature		-40 to +85	°C
T_{SOL}	Lead Solder Temperature		260 for 10 sec	°C
EMITTER				
I_{IN}	Input Current	Average	50 (Max.)	mA
		Surge, 3ms, 120Hz Pulse Rate	140 (Max.)	
		Transient, 10μs, 120Hz Pulse Rate	500 (Max.)	
V_{IN}	Input Voltage (Pins 2-3)		-0.5 (Max.)	V
P_{IN}	Input Power Dissipation[1]		230 (Max.)	mW
P_T	Total Package Power Dissipation[2]		305 (Max.)	mW
DETECTOR				
I_O	Output Current (Average)[3]		30 (Max.)	mA
V_{CC}	Supply Voltage (Pins 8-5)		-0.5 to 20	V
V_O	Output Voltage (Pins 6-5)		-0.5 to 20	V
P_O	Output Power Dissipation[4]		210 (Max.)	mW

Notes:
1. Derate linearly above 70°C free-air temperature at a rate of 1.8 mW/°C.
2. Derate linearly above 70°C free-air temperature at a rate of 2.5 mW/°C.
3. Derate linearly above 70°C free-air temperature at a rate of 0.6 mA/°C.
4. Derate linearly above 70°C free-air temperature at a rate of 1.9 mW/°C.

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
V_{CC}	Supply Voltage	2	18	V
T_A	Operating Temperature	0	70	°C
f	Operating Frequency	0	4	kHz

Electrical Characteristics (T_A = 0°C to 70°C Unless otherwise specified)

Symbol	Parameter		Test Conditions	Min.	Typ.	Max.	Unit
I_{TH+}	Input Threshold Current		$V_{IN} = V_{TH+}$, V_{CC} = 4.5 V	1.96	2.4	3.11	mA
I_{TH-}			V_O = 0.4 V, $I_O \geq 4.2mA$ [5]	1.00	1.2	1.62	mA
V_{TH+}	Input Threshold Voltage	DC (Pins 2,3)	$V_{IN} = V_2 - V_3$ (Pins 1 & 4 Open) V_{CC} = 4.5 V, $V_O = 0.4V$ [5] $I_O \geq 4.2mA$	3.35	3.8	4.05	V
V_{TH-}			$V_{IN} = V_2 - V_3$ (Pins 1 & 4 Open) V_{CC} = 4.5 V, V_O = 2.4 V [5] $I_O \geq 100\mu A$	2.01	2.5	2.86	V
V_{TH+}		AC (Pins 1,4)	$|V_{IN} = V_1 - V_4|$ (Pins 2 & 3 Open) V_{CC} = 4.5 V, V_O = 0.4 V [5] $I_O \geq 4.2$ mA	4.23	5.0	5.50	V
V_{TH-}			$|V_{IN} = |V_1 - V_4|$ (Pins 2 & 3 Open) V_{CC} = 4.5 V, V_O = 2.4 V [5] $I_O \leq 100\mu A$	2.87	3.7	4.20	V
I_{HYS}	Hysteresis		$I_{HYS} = I_{TH+} - I_{TH-}$		1.2		mA
V_{HYS}			$V_{HYS} = V_{TH+} - V_{TH-}$		1.3		V
V_{IHC1}	Input Clamp Voltage		$V_{IHC1} = V_2 - V_3$, V_3 = GND I_{IN} = 10 mA, Pins 1 & 4 connected to Pin 3	5.4	6.3	6.6	V
V_{IHC2}			$V_{IHC2} = |V_1 - V_4|$, $|I_{IN}|$ = 10mA (Pins 2 & 3 Open)	6.1	7.0	7.3	V
V_{IHC3}			$V_{IHC3} = V_2 - V_3$, V_3 = GND, I_{IN} = 15mA (Pins 1 & 4 Open)		12.5	13.4	V
V_{ILC}			$V_{ILC} = V_2 - V_3$, V_3 = GND, I_{IN} = -10mA		-0.75		V
I_{IN}	Input Current		$V_{IN} = V_2 - V_3$ = 5.0V (Pins 1 & 4 Open)	3.0	3.7	4.4	mA
$V_{D1,2}$	Bridge Diode Forward Voltage		I_{IN} = 3mA		0.65		V
$V_{D3,4}$			I_{IN} = 3mA		0.65		V
V_{OL}	Logic LOW Output Voltage		V_{CC} = 4.5 V, I_{OL} = 4.2mA [5]		0.04	0.4	V
I_{OH}	Logic HIGH Output Current		$V_{OH} = V_{CC} = 18V$ [5]			100	µA
I_{CCL}	Logic LOW Supply Current		$V_2 - V_3$ = 5.0V, V_O = Open, V_{CC} = 5V		1.0	4	mA
I_{CCH}	Logic HIGH Supply Current		V_{CC} = 18V, V_O = Open		0.01	4	µA
C_{IN}	Input Capacitance		f = 1MHz, V_{IN} = 0V (Pins 2 & 3, Pins 1 & 4 Open)		50		pF

Note:

5. Logic LOW output level at pin 6 occurs when $V_{IN} \geq V_{TH+}$ and when $V_{IN} > V_{TH-}$ once V_{IN} exceeds V_{TH+}.
   Logic HIGH output level at pin 6 occurs when $V_{IN} \leq V_{TH-}$ and when $V_{IN} < V_{TH+}$ once V_{IN} decreases below V_{TH-}.

Switching Characteristics (T_A = 25°C, V_{CC} = 5 V Unless otherwise specified)

Symbol	AC Characteristics	Test Conditions	Min.	Typ.	Max.	Unit
T_{PHL}	Propagation Delay Time (to Output Low Level)	R_L = 4.7kΩ, C_L = 30pF[6]		6.0	15	μs
T_{PLH}	Propagation Delay Time (to Output High Level)	R_L = 4.7kΩ, C_L = 30pF[6]		25.0	40	μs
t_r	Output Rise Time (10–90%)	R_L = 4.7kΩ, C_L = 30pF		45		μs
t_f	Output Fall Time (90–10%)	R_L = 4.7kΩ, C_L = 30pF		0.5		μs
$|CM_H|$	Common Mode Transient Immunity (at Output High Level)	I_{IN} = 0 mA, R_L = 4.7kΩ, $V_{O\,min}$ = 2.0 V, V_{CM} = 1400V[7][8]		4000		V/μs
$|CM_L|$	Common Mode Transient Immunity (at Output Low Level)	I_N = 3.11mA, R_L = 4.7kΩ, $V_{O\,max}$ = 0.8V, V_{CM} = 140V[7][8]		600		V/μs

Package Characteristics (T_A = 0°C to 70°C Unless otherwise specified)

Symbol	Characteristics	Test Conditions	Min.	Typ.	Max.	Unit
V_{ISO}	Withstand Insulation Voltage	Relative humidity < 50%, T_A = 25°C, t = 1 min, I_{I-O} ≤ 2μA[9][10]	2500			V_{RMS}
R_{I-O}	Resistance (input to output)	V_{IO} = 500Vdc[9]		10^{12}		Ω
C_{I-O}	Capacitance (input to output)	f = 1MHz, V_{IO} = 0Vdc		0.6		pF

Notes:

6. T_{PHL} propagation delay is measured from the 2.5V level of the leading edge of a 5.0V input pulse (1μs rise time) to the 1.5 V level on the leading edge of the output pulse. T_{PLH} propagation delay is measured on the trailing edges of the input and output pulse. (Refer to Fig. 9)

7. Common mode transient immunity in logic high level is the maximum tolerable (positive) dV_{cm}/dt on the leading edge of the common mode pulse signal V_{CM}, to assure that the output will remain in a logic high state (i.e., V_O > 2.0 V). Common mode transient immunity in logic low level is the maximum tolerable (negative) dV_{cm}/dt on the trailing edge of the common mode pulse signal, V_{CM}, to assure that the output will remain in a logic low state (i.e., V_O < 0.8 V). Refer to Fig. 10.

8. In applications where dV_{cm}/dt may exceed 50,000 V/μs (Such as static discharge), a series resistor, R_{CC}, should be included to protect the detector chip from destructive surge currents. The recommended value for R_{CC} is 240V per volt of allowable drop in V_{CC} (between pin 8 and V_{CC}) with a minimum value of 240Ω.

9. Device is considered a two terminal device: Pins 1, 2, 3 and 4 are shorted together and Pins 5, 6, 7 and 8 are shorted together.

10. The 2500 V_{RMS}/1 min. capability is validated by a 3.0 kV_{RMS}/1 sec. dielectric voltage withstand test.

11. AC voltage is instantaneous voltage for V_{TH+} & V_{TH-}.

12. All typicals at T_A = 25°C, V_{CC} = 5V unless otherwise specified.

Typical Performance Curves

Fig. 1 Logic Low Supply Current vs. Operating Supply Voltage
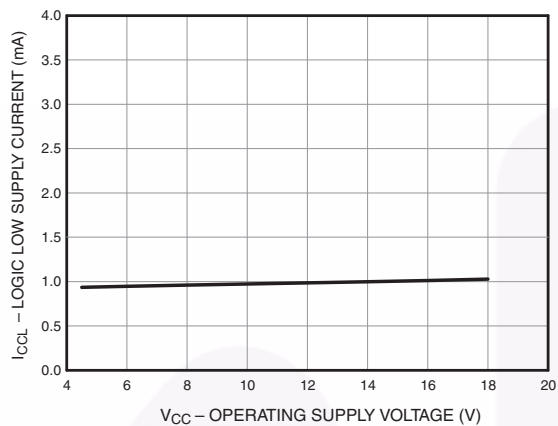

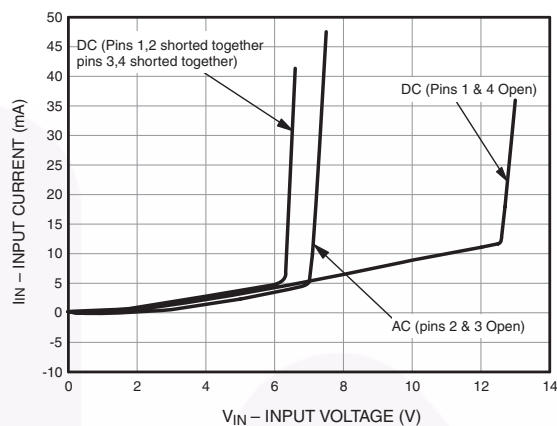**Fig. 2 Input Current vs. Input Voltage**

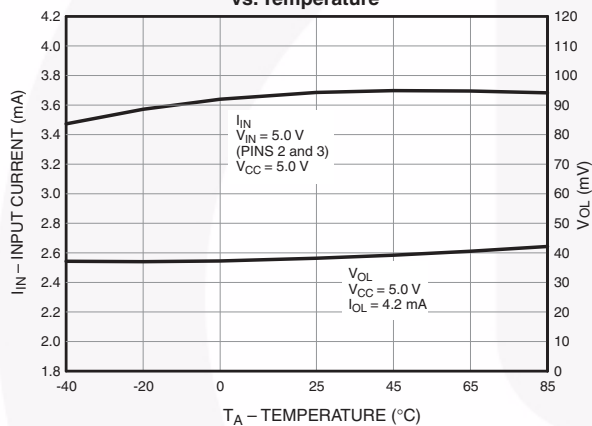**Fig. 3 Input Current/Low Level Output Voltage vs. Temperature**

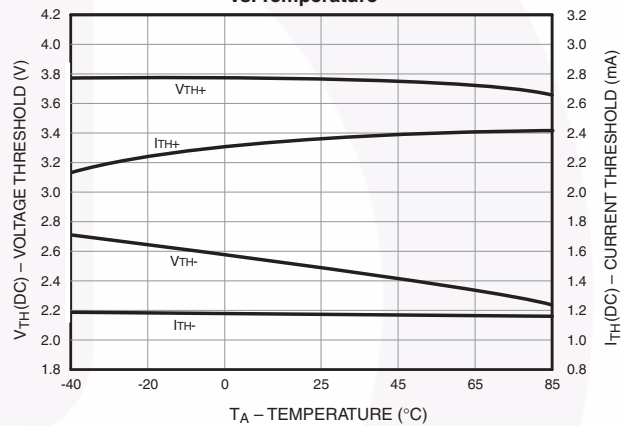**Fig. 4 Current Threshold/Voltage Threshold vs. Temperature**

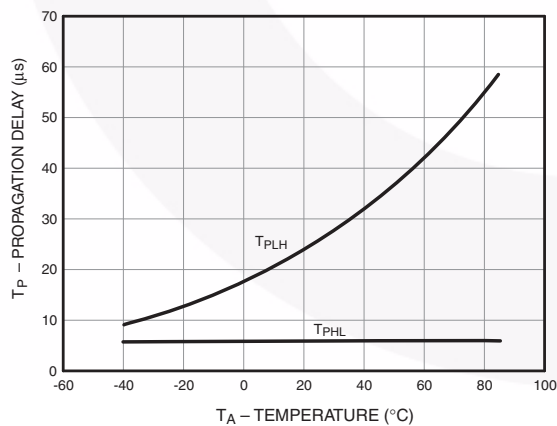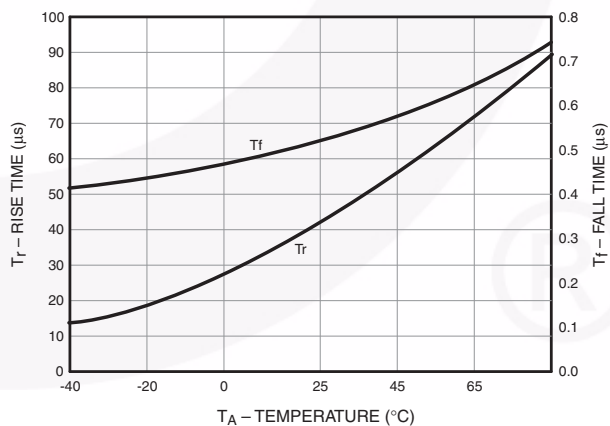**Fig. 5 Propagation Delay vs. Temperature**

Fig. 6 Rise and Fall Time vs. Temperature

Typical Performance Curves (Continued)
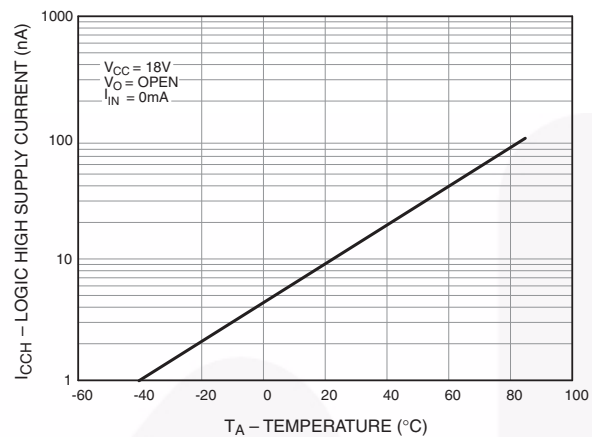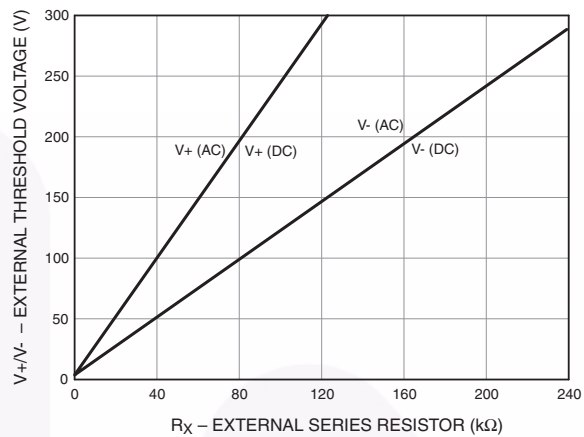
Fig. 7 Logic High Supply Current vs. Temperature

Fig. 8 External Threshold Characteristics V+/V- vs. Rx

Test Circuits

V_{IN}
Pulse Amplitude = 50V
Pulse Width = 1ms
f = 100Hz
$T_r = T_f = 1.0\mu s$ (10%–90%)
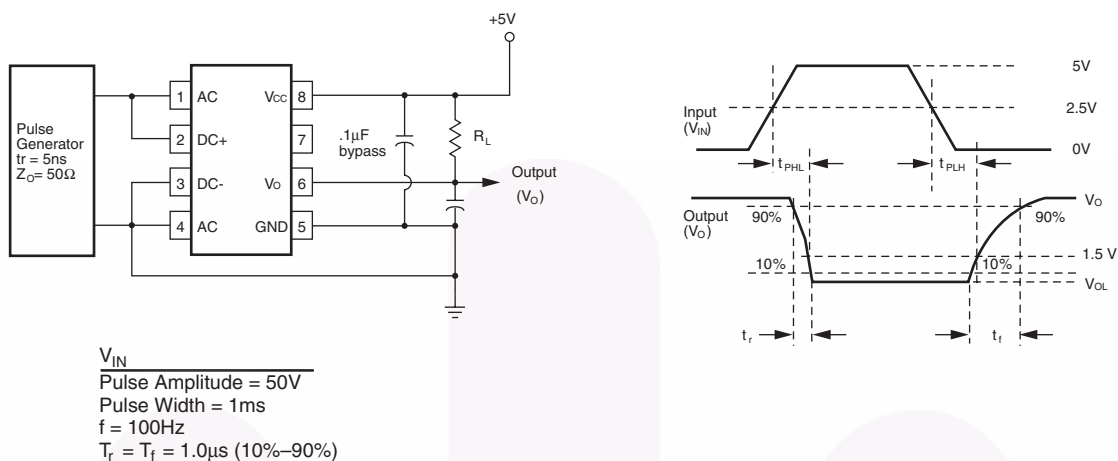
Fig. 9. Switching Test Circuit

** C_L IS 30 pF, WHICH INCLUDES PROBE
AND STRAY WIRING CAPACITANCE
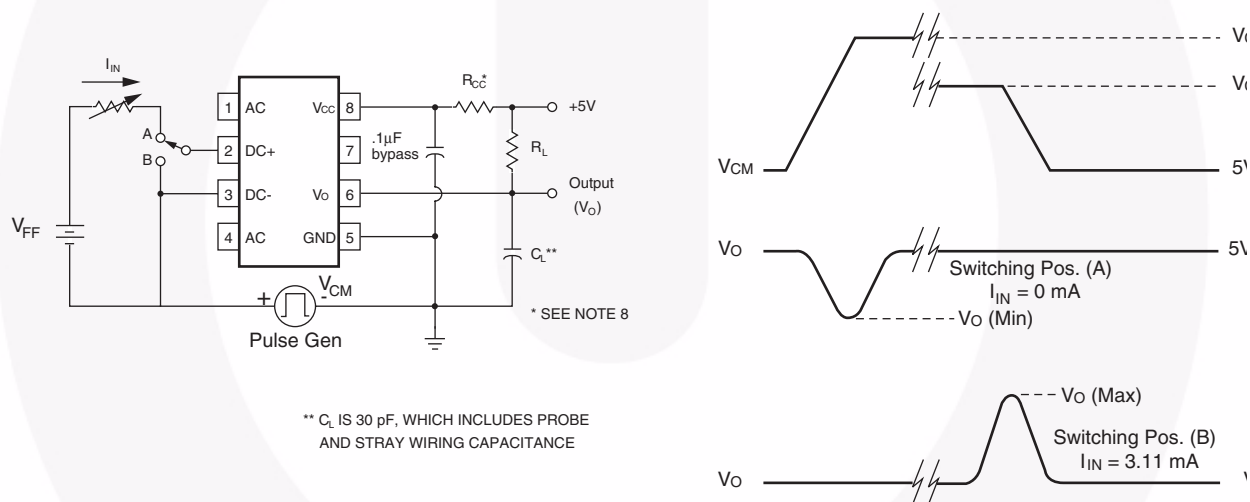
Fig. 10. Test Circuit for Common Mode Transient Immunity and Typical Waveforms

Ordering Information

Option	Example Part Number	Description
No Suffix	HCPL3700	Shipped in Tubes
S	HCPL3700S	Surface Mount Lead Bend
SD	HCPL3700SD	Surface Mount; Tape and Reel
W	HCPL3700W	0.4" Lead Spacing
V	HCPL3700V	VDE0884
WV	HCPL3700WV	VDE0884; 0.4" Lead Spacing
SV	HCPL3700SV	VDE0884; Surface Mount
SDV	HCPL3700SDV	VDE0884; Surface Mount; Tape and Reel

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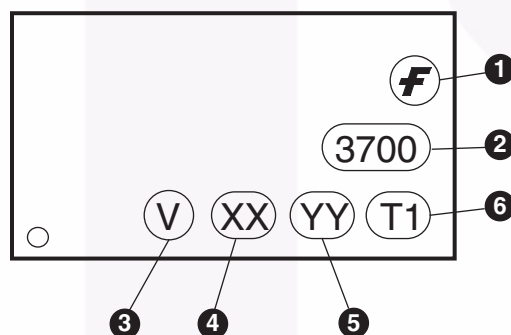
Definitions	
1	Fairchild logo
2	Device number
3	VDE mark (Note: Only appears on parts ordered with VDE option – See order entry table)
4	Two digit year code, e.g., '07'
5	Two digit work week ranging from '01' to '53'
6	Assembly package code

Carrier Tape Specifications

4.90 ± 0.20

0.30 ± 0.05

4.0 ± 0.1

4.0 ± 0.1

12.0 ± 0.1

Ø1.55 ± 0.05

1.75 ± 0.10

13.2 ± 0.2

7.5 ± 0.1

16.0 ± 0.3

10.30 ± 0.20

0.1 MAX

10.30 ± 0.20

Ø1.6 ± 0.1

User Direction of Feed
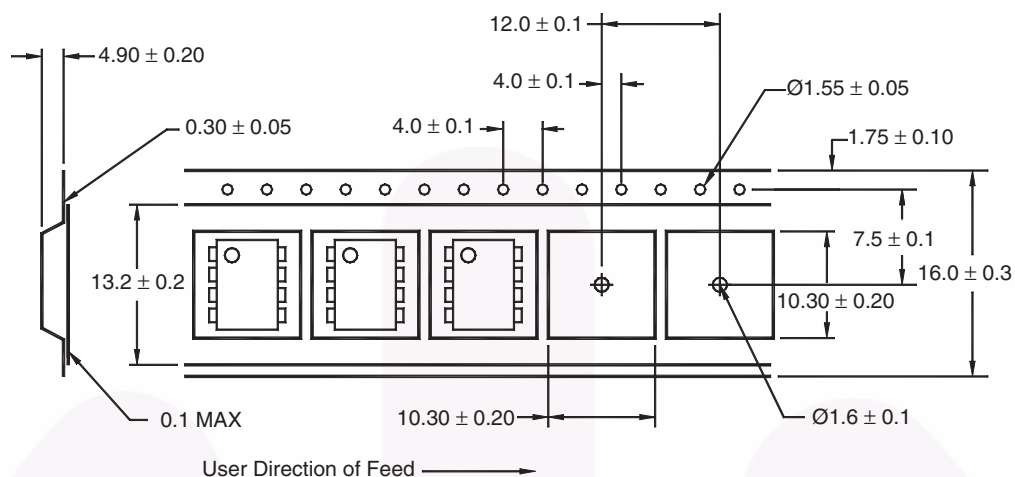
Note:

All dimensions are in inches (millimeters)

Reflow Profile

215C, 10–30 s

225C peak

Time above 183C, 60–150 sec

Ramp up = 3C/sec

Temperature (°C)

300
250
200
150
100
50
0

0   0.5   1   1.5   2   2.5   3   3.5   4   4.5

Time (Minute)
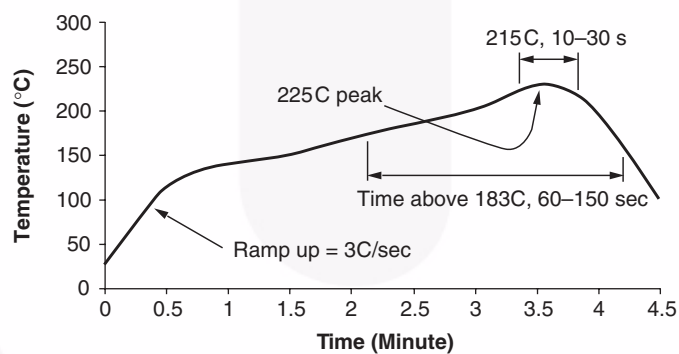
- Peak reflow temperature: 225C (package surface temperature)
- Time of temperature higher than 183C for 60–150 seconds
- One time soldering reflow is recommended
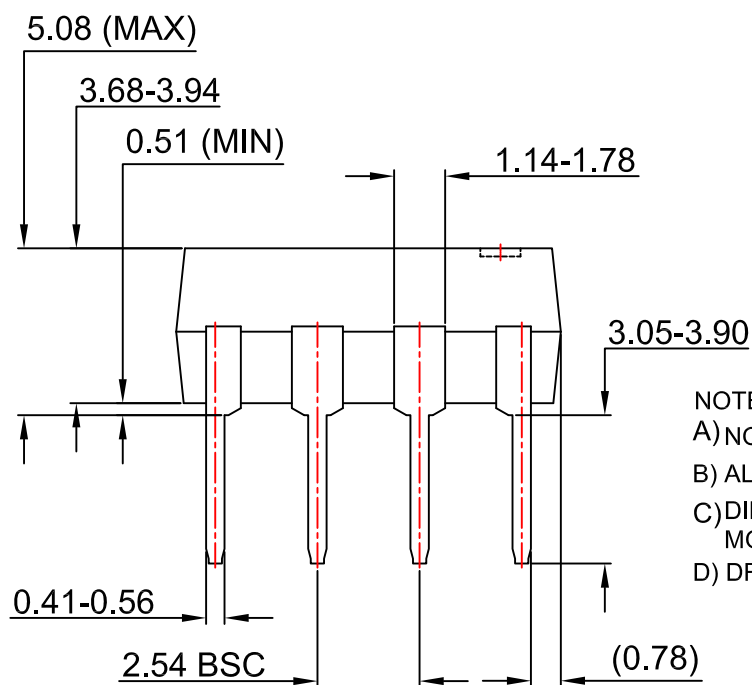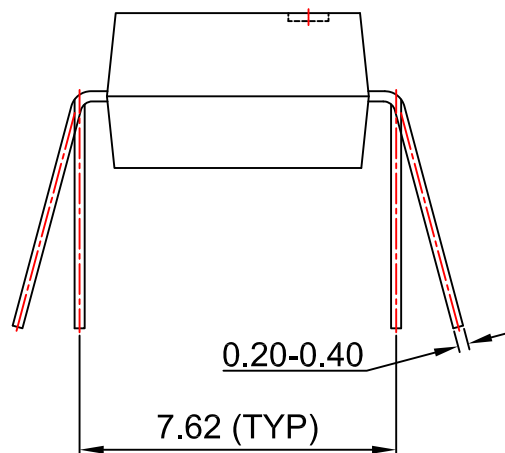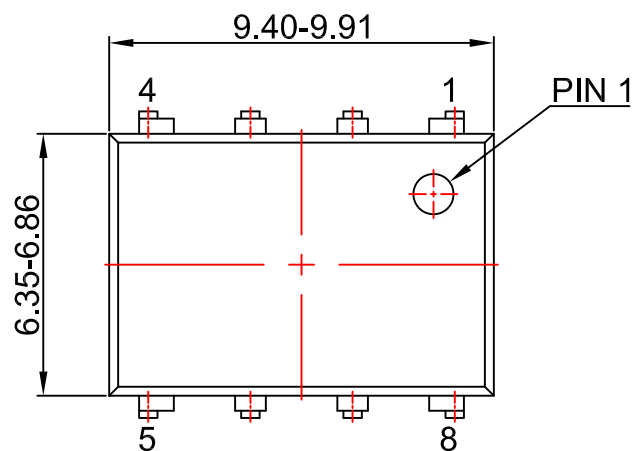
9.40-9.91

4　　　　　　　1

PIN 1

6.35-6.86

5　　　　　　　8

0.20-0.40

7.62 (TYP)

5.08 (MAX)

3.68-3.94

0.51 (MIN)

1.14-1.78

3.05-3.90

0.41-0.56

2.54 BSC

(0.78)

NOTES:
A) NO STANDARD APPLIES TO THIS PACKAGE
B) ALL DIMENSIONS ARE IN MILLIMETERS.
C) DIMENSIONS ARE EXCLUSIVE OF BURRS,
   MOLD FLASH, AND TIE BAR EXTRUSION
D) DRAWING FILENAME AND REVSION: MKT-N08GREV7

FAIRCHILD™

9.40-9.91

4   1

PIN 1

6.35-6.86

5   8

(1.78)   (2.54)   (1.52)

(10.54)

(7.49)

(0.76)
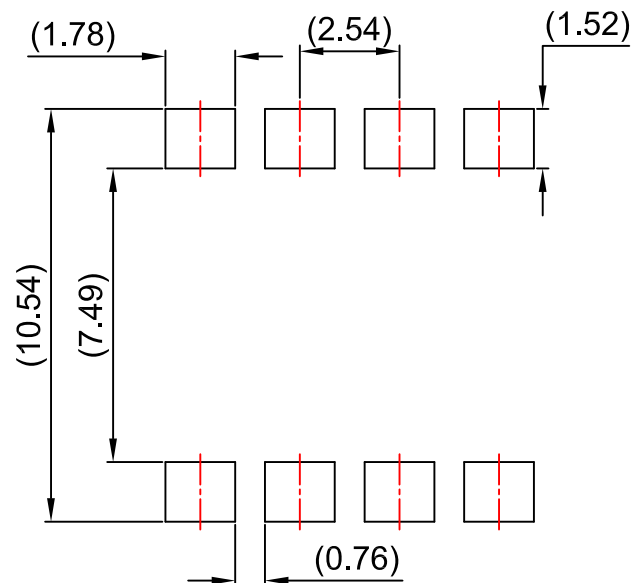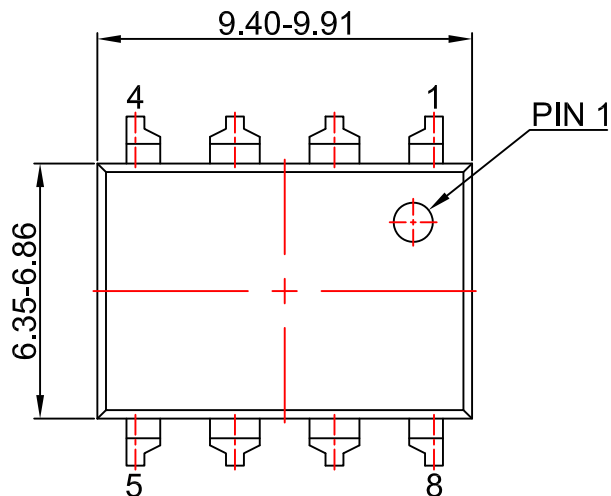
LAND PATTERN RECOMMENDATION

5.08 (MAX)

3.68-3.94

0.51 (MIN)

1.14-1.78

(0.78)

2.54BSC   0.41-0.56

0.20-0.40

0.40 (MIN)
B0TH SIDE

8.00 (MIN)

10.30 (MAX)

NOTES:

A) NO STANDARD APPLIES TO THIS PACKAGE

B) ALL DIMENSIONS ARE IN MILLIMETERS.

C) DIMENSIONS ARE EXCLUSIVE OF BURRS,
    MOLD FLASH, AND TIE BAR EXTRUSION

D) DRAWING FILENAME AND REVSION: MKT-N08Hrev7.

FAIRCHILD.

PUBLICATION ORDERING INFORMATION

www.onsemi.com

Mouser Electronics

Authorized Distributor

Click to View Pricing, Inventory, Delivery & Lifecycle Information: