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March 2016



# FOD8163, FOD8163T 3.3 V / 5 V, 10 Mbit/sec, Logic Gate Optocoupler in Stretched Body SOP 6-Pin

### Features

- 8 mm Creepage and Clearance Distance, and 0.4 mm Insulation Distance to Achieve Reliable and High Voltage Insulation
- High Noise Immunity Characterized by Common Mode Transient Immunity (CMTI)
  - 20 kV/µs Minimum CMTI
- Specifications Guaranteed Over 3 V to 5.5 V Supply Voltage and -40°C to 100°C Extended Industrial Temperature Range
- High-Speed, 10 Mbit/s Data Rate (NRZ)
- Safety and Regulatory Approvals
  - UL1577, 5,000 VAC<sub>RMS</sub> for 1 Minute
  - DIN-EN/IEC60747-5-5, 1,140 V Peak Working Immunity Insulation Voltage

# Applications

- Isolating Intelligent Power Module
- Isolating Industrial Communication Interface

# **Related Resources**

- www.fairchildsemi.com/products/optoelectronics/
- www.fairchildsemi.com/pf/FO/FOD8160.html
- www.fairchildsemi.com/pf/FO/FODM8061.html
- www.fairchildsemi.com/pf/FO/FODM611.html

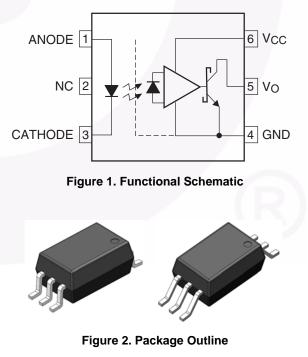
# Description

The FOD8163 series is a 3.3 V / 5 V high-speed logic gate optocoupler with open-collector output, which supports isolated communications allowing digital signals to communicate between systems without conducting ground loops or hazardous voltages.

The FOD8163 series utilizes stretched body package to achieve 8 mm creepage and clearance distances (FOD8163T), and optimized IC design to achieve reliably high-insulation voltage and high-noise immunity.

The FOD8163 series consists of an aluminium gallium arsenide (AlGaAs) light emitting diode and an integrated high-speed photodetector. The output of the detector IC is an open collector schottky-clamped transistor. The electrical and switching characteristics are guaranteed over the extended industrial temperature range of -40°C to 100°C and a V<sub>CC</sub> range of 3 V to 5.5 V.

# **Functional Schematic**



# **Truth Table**

LED	v <sub>o</sub>
Off	HIGH
On	LOW

# **Pin Definitions**

Pin #	Name		Description
1	ANODE	Anode	
2	NC	Not Connected	
3	CATHODE	Cathode	
4	GND	Output Ground	
5	V <sub>O</sub>	Output Voltage	
6	V <sub>CC</sub>	Output Supply Voltage	

# **Pin Configuration**



Figure 3. Pin Configuration

# **Safety and Insulation Ratings**

As per DIN EN/IEC60747-5-5, 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.

Parameter		Charact	eristics
Farameter	FOD8163	FOD8163T	
	< 150 V <sub>RMS</sub>	I–IV	I–IV
Installation Classifications per DIN VDE 0110/1.89 Tab	< 300 V <sub>RMS</sub>	I–IV	I–IV
For Rated Mains Voltage	< 450 V <sub>RMS</sub>	I–III	I–IV
	< 600 V <sub>RMS</sub>	I–III	I–III
Climatic Classification		40/100/21	40/100/21
Pollution Degree (DIN VDE 0110/1.89)		2	2
Comparative Tracking Index		175	175

Symbol	Parameter	Va	lue	Unit
Symbol	Parameter	FOD8163	FOD8163T	Unit
V	Input-to-Output Test Voltage, Method B, $V_{IORM} \times 1.875 = V_{PR}$ , 100% Production Test with $t_m = 1$ s, Partial Discharge < 5 pC	1,671	2,137	V <sub>peak</sub>
V <sub>PR</sub>	Input-to-Output Test Voltage, Method A, $V_{IORM} \times 1.6 = V_{PR}$ , Type and Sample Test with $t_m = 10$ s, Partial Discharge < 5 pC	1,426	1,824	V <sub>peak</sub>
V <sub>IORM</sub>	Maximum Working Insulation Voltage	891	1,140	V <sub>peak</sub>
V <sub>IOTM</sub>	Highest Allowable Over-Voltage	6,000	8,000	V <sub>peak</sub>
	External Creepage	≥ 8.0	≥ 8.0	mm
	External Clearance	≥ 7.0	≥ 8.0	mm
DTI	Distance Through Insulation (Insulation Thickness)	≥ 0.4	≥ 0.4	mm
	Safety Limit Values – Maximum Values Allowed in the Event of a Failure,			
Τ <sub>S</sub>	Case Temperature	150	150	°C
I <sub>S,INPUT</sub>	Input Current	200	200	mA
P <sub>S,OUTPUT</sub>	Output Power	600	600	mW
R <sub>IO</sub>	Insulation Resistance at $T_S$ , $V_{IO}$ = 500 V	10 <sup>9</sup>	10 <sup>9</sup>	Ω

FOD8163, FOD8163T — 3.3 V / 5 V, 10 Mbit/sec, Logic Gate Optocoupler in Stretched Body SOP 6-Pin

# **Absolute Maximum Ratings**

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.  $T_A = 25^{\circ}C$  unless otherwise specified.

Symbol	Parameter	Value	Unit
T <sub>STG</sub>	Storage Temperature	-40 to +125	°C
T <sub>OPR</sub>	Operating Temperature	-40 to +100	°C
TJ	Junction Temperature	-40 to +125	°C
T <sub>SOL</sub>	Lead Solder Temperature (Refer to Reflow Temperature Profile)	260 for 10 sec	°C
Input Charact	teristics		
١ <sub>F</sub>	Average Forward Input Current	25	mA
V <sub>R</sub>	Reverse Input Voltage	5.0	V
PDI	Input Power Dissipation <sup>(1)</sup>	45	mW
Output Chara	cteristics		
V <sub>CC</sub>	Supply Voltage	0 to 7.0	V
V <sub>O</sub>	Output Voltage	-0.5 to V <sub>CC</sub> + 0.5	V
۱ <sub>0</sub>	Average Output Current	50	mA
PDO	Output Power Dissipation <sup>(1)</sup>	85	mW

#### Note:

1. No derating required up to 100°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.	Unit
T <sub>A</sub>	Ambient Operating Temperature	-40	+100	°C
V <sub>CC</sub>	Supply Voltages <sup>(2)</sup>	3.0	5.5	V
V <sub>FL</sub>	Logic Low Input Voltage	0	0.8	V
I <sub>FL</sub>	Logic Low Input Current		250	μA
I <sub>FH</sub>	Logic High Input Current	6.0	15	mA
N	Fan Out (at $R_L = 1 k\Omega$ )		5	TTL loads
RL	Output Pull-up Resistor	330	4000	Ω

#### Note:

2. 0.1  $\mu$ F bypass capacitor must be connected between pins 4 and 6.

# **Isolation Characteristics**

Symbol	Parameter	Conditions	Min.	Тур.	Max.	Unit
V <sub>ISO</sub>	Input-Output Isolation Voltage	$\begin{array}{l} T_{A} = 25^{\circ}C, \ R.H. < 50\%, \ t = 1.0 \ min, \\ I_{I-O} \leq 20 \ \mu A^{(3)(4)} \end{array}$	5,000			VAC <sub>RMS</sub>
R <sub>ISO</sub>	Isolation Resistance	$V_{I-O} = 500 V^{(3)}$		10 <sup>11</sup>		Ω
C <sub>ISO</sub>	Isolation Capacitance	$V_{I-O} = 0 V$ , frequency = 1.0 MHz <sup>(3)</sup>		1.0		pF

Apply over all recommended conditions, typical value is measured at  $T_A = 25^{\circ}C$ .

#### Notes:

3. Device is considered a two-terminal device: pins 1, 2 and 3 are shorted together and pins 4, 5, and 6 are shorted together.

4. 5,000 VAC<sub>RMS</sub> for 1-minute duration is equivalent to 6,000 VAC<sub>RMS</sub> for 1-second duration.

# **Electrical Characteristics**

Apply over all recommended conditions;  $T_A = -40^{\circ}C$  to  $+100^{\circ}C$ ,  $3.0 \text{ V} \le V_{CC} \le 5.5 \text{ V}$ ; unless otherwise specified. Typical value is measured at  $T_A = 25^{\circ}C$  and  $V_{CC} = 3.3 \text{ V}$  or  $V_{CC} = 5 \text{ V}$ .

Symbol	Parameter		Conditions	Min.	Тур.	Max.	Unit	Figure
Input Charact	eristics							
V <sub>F</sub>	Forward Voltage			1.05	1.45	1.80	V	4
$\Delta(V_{F} / T_{A})$	Temperature Coefficient of Forward Voltage	۱ <sub>F</sub> =	10 mA		-1.8		mV/°C	
BV <sub>R</sub>	Input Reverse Breakdown Voltage	I <sub>R</sub> =	- 10 μA	5.0			V	
I <sub>FHL</sub>	Threshold Input Current		= 0.6 V, (sink) = 13 mA		2.0	6.0	mA	5
Output Chara	cteristics							
V <sub>OL</sub>	Logic Low Output Voltage		rated I <sub>FHL</sub> , (sink) = 13 mA		0.4	0.6	V	6
	Logic High Output	I <sub>F</sub> =	250 $\mu$ A, V <sub>O</sub> = 3.3 V		8.0	50.0	μΑ	7
I <sub>ОН</sub>	Current	I <sub>F</sub> =	250 $\mu$ A, V <sub>O</sub> = 5.0 V		3.0	40.0	μΑ	7
	Logic Low Output	I <sub>F</sub> =	10 mA, V <sub>CC</sub> = 3.3 V		5.3	8.5	mA	8, 10
ICCL	Supply Current	I <sub>F</sub> =	10 mA, V <sub>CC</sub> = 5.0 V		7.1	10.0	mA	8, 10
	Logic High Output	I <sub>F</sub> =	0 mA, V <sub>CC</sub> = 3.3 V		3.5	7.0	mA	9, 10
ССН	Supply Current	I <sub>F</sub> =	0 mA, $V_{CC}$ = 5.0 V		5.3	9.0	mA	9, 10

# **Switching Characteristics**

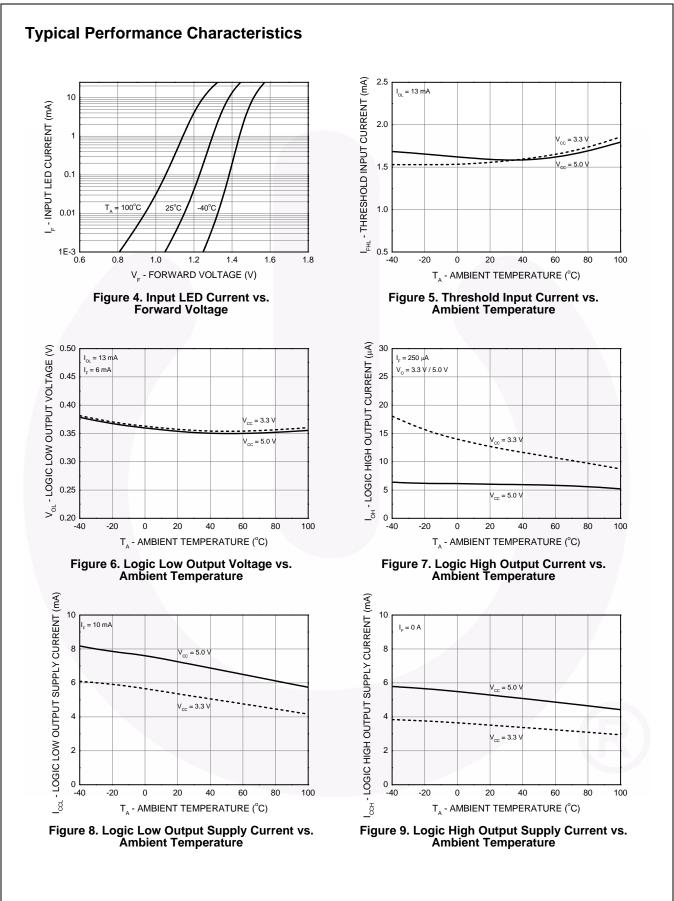
Apply over all recommended conditions;  $T_A = -40^{\circ}C$  to  $+100^{\circ}C$ ,  $3.3 \text{ V} \le V_{CC} \le 5 \text{ V}$ ,  $I_F = 6.0 \text{ mA}$ ; unless otherwise specified. Typical value is measured at  $T_A = 25^{\circ}C$  and  $V_{CC} = 3.3 \text{ V}$ .

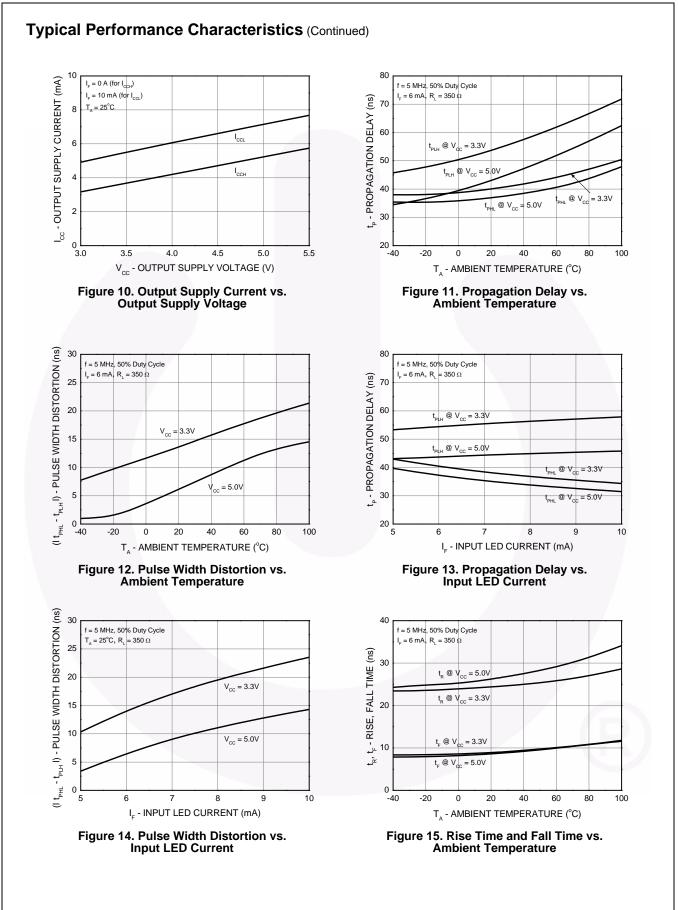
Symbol	Parameter	Conditions	Min.	Тур.	Max.	Unit	Figure
Data Rate		R <sub>L</sub> = 350 Ω			10	Mbit/sec	
t <sub>PHL</sub>	Propagation Delay to Logic Low Output	$R_L = 350 \ Ω, C_L = 15 \ pF$		42	80	ns	11, 13, 16
t <sub>PLH</sub>	Propagation Delay to Logic High Output	R <sub>L</sub> = 350 Ω, C <sub>L</sub> = 15 pF		53	90	ns	11, 13, 16
PWD	Pulse Width Distortion,   t <sub>PHL</sub> - t <sub>PLH</sub>	$R_L$ = 350 Ω, $C_L$ = 15 pF		11	35	ns	12, 14, 16
t <sub>PSK</sub>	Propagation Delay Skew	$R_L$ = 350 Ω, $C_L$ = 15 pF <sup>(5)</sup>			40	ns	
t <sub>R</sub>	Output Rise Time (10% to 90%)	R <sub>L</sub> = 350 Ω, C <sub>L</sub> = 15 pF		20		ns	15, 16
t <sub>F</sub>	Output Fall Time (90% to 10%)	R <sub>L</sub> = 350 Ω, C <sub>L</sub> = 15 pF		10		ns	15, 16
CM <sub>H</sub>	Common-Mode Transient Immunity at Output High	$I_F = 0 \text{ mA}, V_O > 2 \text{ V},$ $V_{CM} = 1500 \text{ V}^{(6)}$	20	40		kV/μs	17
CM <sub>L</sub>	Common-Mode Transient Immunity at Output Low	$I_F = 6.0 \text{ mA}, V_O < 0.8 \text{ V},$ $V_{CM} = 1500 \text{ V}^{(6)}$	20	40		kV/μs	17

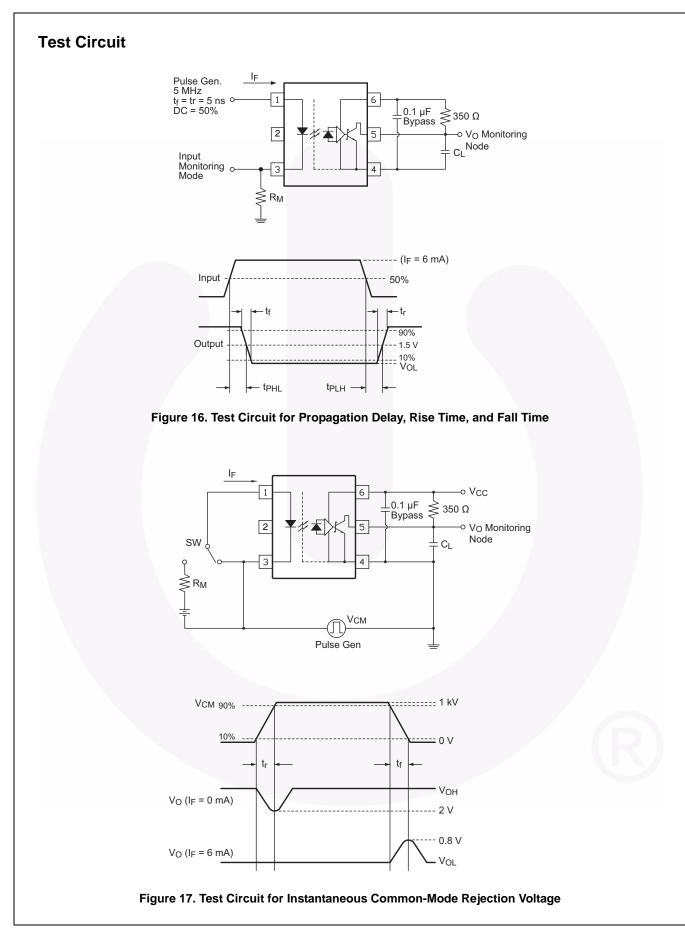
#### Notes:

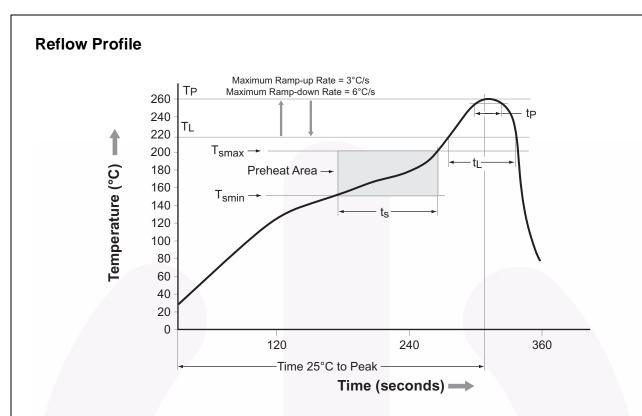
5.  $t_{PSK}$  is equal to the magnitude of the worst-case difference in  $t_{PHL}$  and/or  $t_{PLH}$  between any two units from the same manufacturing date code that are operated at same case temperature (±5°C), at same operating conditions, with equal loads ( $R_L = 350 \Omega$ ,  $C_L = 15 pF$ ), and with an input rise time less than 5 ns.

 Common-mode transient immunity at output HIGH is the maximum tolerable positive dVcm/dt on the leading edge of the common-mode impulse signal, V<sub>CM</sub>, to assure that the output remains HIGH. Common-mode transient immunity at output LOW is the maximum tolerable negative dVcm/dt on the trailing edge of the common pulse signal, V<sub>CM</sub>, to assure that the output remains LOW.









Profile Freature	Pb-Free Assembly Profile			
Temperature Minimum (T <sub>smin</sub> )	150°C			
Temperature Maximum (T <sub>smax</sub> )	200°C			
Time ( $t_S$ ) from ( $T_{smin}$ to $T_{smax}$ )	60 s to 120 s			
Ramp-up Rate (t <sub>L</sub> to t <sub>P</sub> )	3°C/second maximum			
Liquidous Temperature (T <sub>L</sub> )	217°C			
Time $(t_L)$ Maintained Above $(T_L)$	60 s to 150 s			
Peak Body Package Temperature	260°C +0°C / –5°C			
Time (t <sub>P</sub> ) within 5°C of 260°C	30 s			
Ramp-Down Rate (T <sub>P</sub> to T <sub>L</sub> )	6°C/s maximum			
Time 25°C to Peak Temperature	8 minutes maximum			

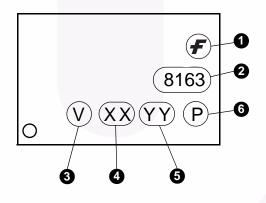
Figure 18. Reflow Profile

# **Ordering Information**

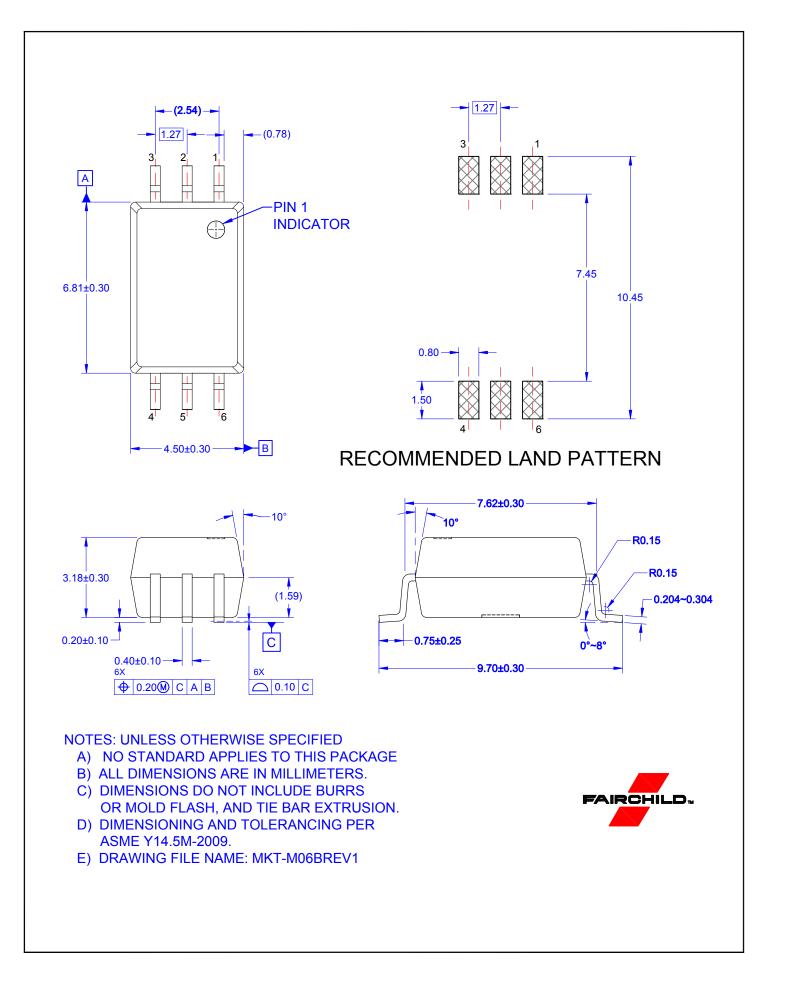
Part Number	Package	Packing Method
FOD8163	Stretched Body SOP 6-Pin	Tube (100 units per tube)
FOD8163R2	Stretched Body SOP 6-Pin	Tape and Reel (1,000 units per reel)
FOD8163V	Stretched Body SOP 6-Pin, DIN EN/IEC60747-5-5 Option	Tube (100 units per tube)
FOD8163R2V	Stretched Body SOP 6-Pin, DIN EN/IEC60747-5-5 Option	Tape and Reel (1,000 units per reel)
FOD8163T	Stretched Body SOP 6-Pin, Wide Lead	Tube (100 units per tube)
FOD8163TR2	Stretched Body SOP 6-Pin, Wide Lead	Tape and Reel (1,000 units per reel)
FOD8163TV	Stretched Body SOP 6-Pin, Wide Lead, DIN EN/IEC60747-5-5 Option	Tube (100 units per tube)
FOD8163TR2V	Stretched Body SOP 6-Pin, Wide Lead, DIN EN/IEC60747-5-5 Option	Tape and Reel (1,000 units per reel)

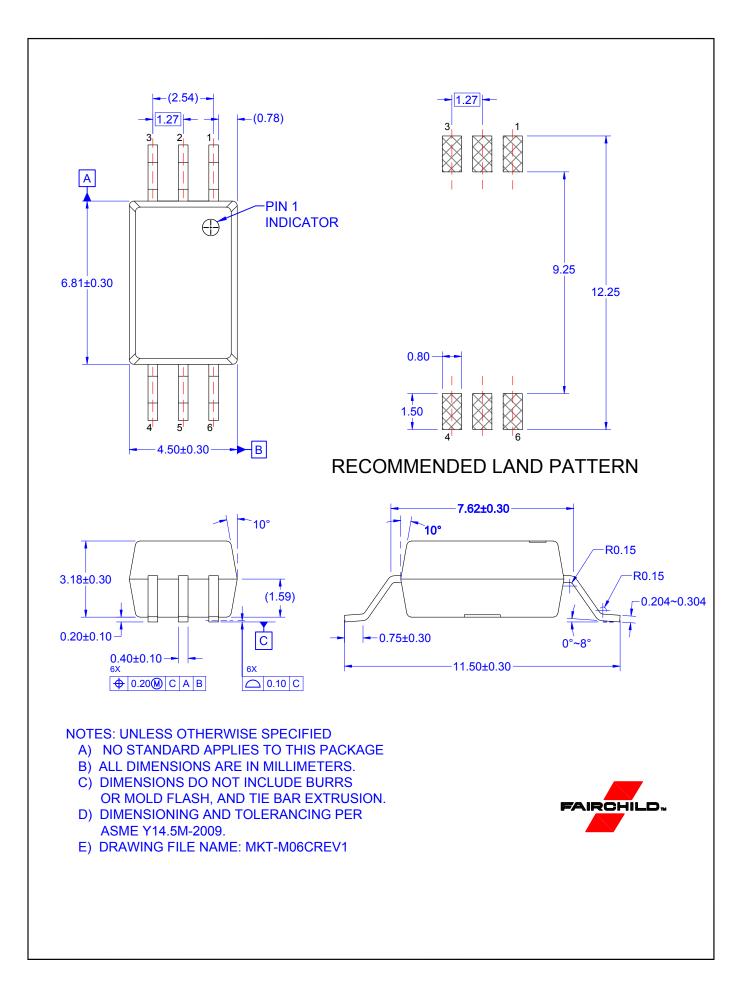
All packages are lead free per JEDEC: J-STD-020B standard.

# **Marking Information**



Definiti	ons
1	Fairchild Logo
2	Device Number, e.g. 8163
3	DIN EN/IEC60747-5-5 Option (only appears on component ordered with this option)
4	One Digit Year Code, e.g. '5'
5	Two Digit Work Week Ranging from '01' to '53'
6	Assembly Package Code





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