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FAIRCHILD SEMICONDUCTOR®

2013 年 9 月

FOD8160
高抗噪能力、3.3 V / 5 V、10 Mbit/sec 逻辑门光电耦合器，采用宽体 SOP 5 引脚封装

特性

- Optoplanar® 封装技术允许大于10 mm的爬电和间隙距离以及 0.5 mm 的绝缘距离，以实现可靠的高绝缘电压
- 通过共模瞬变抑制 (CMTi) 实现高抗噪能力
  - 20kV/µs 最小 CMTI
- 保证 3 V 至 5.5 V 电源电压规格和 -40°C 到 100°C 的扩展工业温度范围
- 高速， 10 Mbit/sec 数据速率 (NRZ)
- 安全和法规认证
  - UL1577， 5000 VAC_{RMS} 持续 1 分钟
  - DIN-EN/IEC60747-5-5， 1414 V 峰值工作绝缘电压（待审批）

应用

- 隔离智能功率模块
- 隔离工业通信接口

相关资源

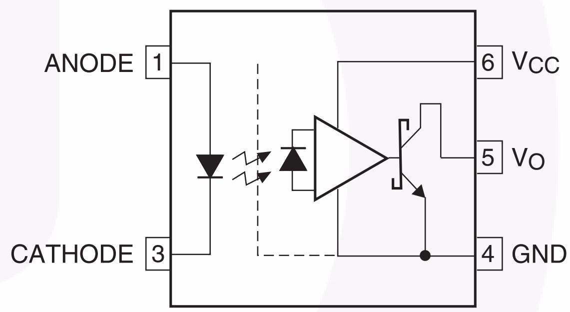
- www.fairchildsemi.com/products/opto/
- www.fairchildsemi.com/pf/FO/FODM8061.html
- www.fairchildsemi.com/pf/FO/FODM611.html

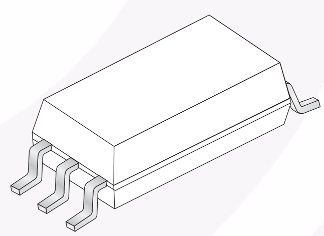
说明

FOD8160 是一款 3.3V/5V 高速逻辑门输出 （开路集电极输出）光电耦合器，支持隔离式通信，允许数字信号在不传导接地环路或危险电压的情况下在系统间通信。该器件采用飞兆专有的 Optoplanar® 共面封装技术，优化了 IC 设计，通过高共模抑制规格实现了高抗噪能力。

FOD8160 封装在宽体 SOP 5 引脚封装中，它由一个铝砷化铝镓 （AlGaAs） LED 和一个集成式高速光检测器组成。检测器 IC 输出是一个开路集电极肖特基箝位晶体管。电子和开关性能在 -40°C 至 100°C 的扩展工业温度范围内得到了保证， V_{CC} 范围为 3V 至 5.5V。

功能原理图





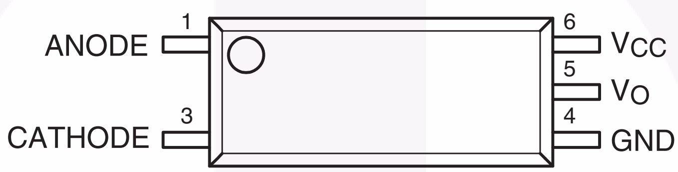
真值表

LED	输出
关断	高
导通	低

引脚定义

引脚号	名称	说明
1	阳极	阳极
3	阴极	阴极
4	GND	输出地
5	V_O	输出电压
6	V_{CC}	输出电源电压

引脚布局



安全性和绝缘标准

根据 DIN EN/IEC60747-5-5 （待审批），此光电耦合器仅适用于安全极限数据之内的 “安全电气绝缘”。通过保护性电路确保各项安全标准达标。

符号	参数	最小值	典型值	最大值	单位
	安装标准符合 DIN VDE 0110/1.89 表 1 对于额定市电电压 <150 Vrms		I–IV		
	对于额定市电电压 <300 Vrms		I–IV		
	对于额定市电电压 <450 Vrms		I–IV		
	对于额定市电电压 <600 Vrms		I–IV		
	气候分类		40/100/21		
	污染等级 (DIN VDE 0110/1.89)		2		
CTI	相比漏电起痕指数	175			
V_{PR}	输入至输出测试电压，方法 b， V_{IORM} x 1.875 = V_{PR}， 100 % 生产测试， t_m = 1 s，局部放电 <5 pC	2,651			V_{peak}
	输入至输出测试电压，方法 a， V_{IORM} x 1.5 = V_{PR}，类型和样品测试， t_m = 60 s，局部放电 <5 pC	2,121			V_{peak}
V_{IORM}	最大工作绝缘电压	1,414			V_{peak}
V_{IOTM}	最高允许过电压	8,000			V_{peak}
	外部爬电距离	10.0			mm
	外部绝缘间隙	10.0			mm
	绝缘厚度	0.5			mm
	安全极限值 – 发生故障时允许的最大值				
T_S	壳体温度	150			°C
$I_{S,INPUT}$	输入电流	200			mA
$P_{S,OUTPUT}$	输出功率	600			mW
R_{IO}	T_S, V_{IO} = 500V 时的绝缘阻抗	10^9			Ω

绝对最大额定值

应力若超过绝对最大额定值，可能会损坏器件。在超出推荐的工作条件和应力的情况下，该器件可能无法正常工作，所以不建议让器件在这些条件下工作。此外，过度暴露在高于推荐的工作条件的应力下，会影响器件的可靠性。绝对最大额定值仅为额定应力值。 T_A = 25°C，除非另有说明。

符号	参数	数值	单位
T_{STG}	存储温度	-40 至 +125	°C
T_{OPR}	工作温度	-40 至 +100	°C
T_J	结温	-40 至 +125	°C
T_{SOL}	引脚焊接温度 （请参阅第 *12* 页上的回流焊温度曲线）	10 秒 260	°C
输入特性			
I_F	平均正向输入电流	25	mA
V_R	反向输入电压	5.0	V
PD_I	输入功耗 (1)	45	mW
输出特性			
V_{CC}	电源电压	0 至 7.0	V
V_O	输出电压	-0.5 至 V_{CC} + 0.5	V
I_O	平均输出电流	50	mA
PD_O	输出功耗 (1)	85	mW

注意：

1. 至 100°C 无需降额。

推荐工作条件

推荐的操作条件表定义了器件的真实工作条件。指定推荐的工作条件，以确保器件的最佳性能达到数据表中的规格。飞兆不建议超出额定或依照绝对最大额定值进行设计。

符号	参数	最小值	最大值	单位
T_A	工作环境温度	-40	+100	ºC
V_{CC}	电源电压 (2)	3.0	5.5	V
V_{FL}	逻辑低输入电压	0	0.8	V
I_{FL}	逻辑低输入电流		250	µA
I_{FH}	逻辑高输入电流	6.0	15	mA
N	扇出 (R_L = 1 k¾)		5	TTL 负载
R_L	输出上拉电阻	330	4,000	Ω

注意：

2. 0.1 µF 旁路电容必须连接在引脚 4 和 6 之间。

绝缘特性

应用于所有推荐的条件；典型值测量条件为 T_A = 25°C.

符号	参数	工作条件	最小值	典型值	最大值	单位
V_{ISO}	输入输出绝缘电压	T_A = 25° C, R.H. < 50%, t = 1.0 min, $I_{I-O} \le 20\ \mu A$(3)(4)	5,000			VAC_{RMS}
R_{ISO}	Isolation Resistance	V_{I-O} = 500 V(3)		10^{11}		Ω
C_{ISO}	绝缘电容	V_{I-O} = 0 V, 频率 = 1.0 MHz(3)		1.0		pF

注：

3. 器件属于双端器件：引脚 1 和 3 短接在一起，引脚 4、 5 和 6 短接在一起。
4. 1 分钟期间的 5000 VAC_{RMS} 与 1 秒钟期间的 6000 VAC_{RMS} 等效。

电气特性

适用于推荐的所有条件； T_A = -40°C 至 +100°C， 3.0 V ≤ V_{CC} ≤ 5.5 V ；除非另有说明。
典型值测量条件为 T_A = 25°C，且 V_{CC} = 3.3 V 或 V_{CC} = 5 V。

符号	参数	工作条件	最小值	典型值	最大值	单位	图
输入特性							
V_F	正向电压	I_F = 10 mA	1.05	1.45	1.80	V	1
$\Delta(V_F/T_A)$	正向电压温度系数			-1.8		mV/°C	
BV_R	输入反向击穿电压	I_R = 10 µA	5.0			V	
I_{FHL}	输入电流阈值	V_O = 0.6 V, I_{OL}(sink) = 13 mA		2.5	6.0	mA	2
输出特性							
V_{OL}	逻辑低输出电压	I_F = 额定 I_{FHL}, I_{OL} （灌电流） = 13 mA		0.4	0.6	V	3
I_{OH}	逻辑高输出电流	I_F = 250 µA, V_O = 3.3 V		8.0	50.0	µA	4
		I_F = 250 µA, V_O = 5.0 V		3.0	40.0	µA	4
I_{CCL}	逻辑低输出电源电流	I_F = 10 mA, V_{CC} = 3.3 V		5.3	8.5	mA	5, 7
		I_F = 10 mA, V_{CC} = 5.0 V		7.1	10.0	mA	5, 7
I_{CCH}	逻辑高输出电源电流	I_F = 0 mA, V_{CC} = 3.3 V		3.5	7.0	mA	6, 7
		I_F = 0 mA, V_{CC} = 5.0 V		5.3	9.0	mA	6, 7

开关特性

适用于推荐的所有条件； T_A = -40°C 至 +100°C， V_{CC} = 3.3 V， I_F = 6.0 mA ； 除非另有说明。典型值测量条件为 T_A = 25°C 且 V_{CC} = 3.3 V。

符号	参数	工作条件	最小值	典型值	最大值	单位	图
数据速率		R_L = 350 Ω			10	Mbit/sec	
t_{PHL}	逻辑低输出的传播延迟。	R_L = 350 Ω, C_L = 15 pF		40	80	ns	8, 9, 13
t_{PLH}	逻辑高输出的传播延迟。	R_L = 350 Ω, C_L = 15 pF		50	90	ns	8, 9, 13
PWD	脉宽失真度，| t_{PHL} – t_{PLH}|	R_L = 350 Ω, C_L = 15 pF		10	35	ns	10, 11, 13
t_{PSK}	传播延迟差异	R_L = 350 Ω, C_L = 15 pF (5)			40	ns	
t_R	输出上升时间（10% 至 90%）	R_L = 350 Ω, C_L = 15 pF		20		ns	12, 13
t_F	输出下降时间（90% 至 10%）	R_L = 350 Ω, C_L = 15 pF		10		ns	12, 13
| CM_H |	输出高时的共模瞬态抑制	I_F = 0 mA, V_O > 2 V, V_{CM} = 1,000 V(6)	20	40		kV/µs	14
| CM_L |	输出低时的共模瞬态抑制	I_F = 6.0 mA, V_O < 0.8 V, V_{CM} = 1,000 V(6)	20	40		kV/µs	14

应用于所有推荐的条件； T_A = -40°C 至 +100°C， V_{CC} = 5 V， I_F = 6.0 mA ；除非另有规定。典型值测量条件为 T_A = 25°C 且 V_{CC} = 5 V.

符号	参数	工作条件	最小值	典型值	最大值	单位	图
数据速率		R_L = 350 Ω			10	Mbit/sec	
t_{PHL}	逻辑低输出的传播延迟。	R_L = 350 Ω, C_L = 15 pF		37	80	ns	8, 9, 13
t_{PLH}	逻辑高输出的传播延迟。	R_L = 350 Ω, C_L = 15 pF		41	90	ns	8, 9, 13
PWD	脉宽失真度，| t_{PHL} – t_{PLH}|	R_L = 350 Ω, C_L = 15 pF		4	25	ns	10, 11, 13
t_{PSK}	传播延迟差异	R_L = 350 Ω, C_L = 15 pF(5)			40	ns	
t_R	输出上升时间（10% 至 90%）	R_L = 350 Ω, C_L = 15 pF		22		ns	12, 13
t_F	输出下降时间（90% 至 10%）	R_L = 350 Ω, C_L = 15 pF		9		ns	12, 13
| CM_H |	输出高时的共模瞬态抑制	I_F = 0 mA, V_O > 2 V, V_{CM} = 1,000 V(6)	20	40		kV/µs	14
| CM_L |	输出低时的共模瞬态抑制	I_F = 6.0 mA, V_O < 0.8 V, V_{CM} = 1,000 V(6)	20	40		kV/µs	14

注：

5. t_{PSK} 等于相同制造日期代码的任意两个单元之间的 t_{PHL} 和 / 或 t_{PLH} 最糟情况差异，两个单元在相同壳体温度 (± 5°C)、相同工作条件下运行，具有相同的负载 (R_L = 350 Ω, C_L = 15 pF)，且输入上升时间小于 5 ns。
6. 输出高电平状态下的共模瞬变抑制是共模脉冲信号 V_{CM} 前沿上的最大容许正 dVcm/dt，从而确保输出将保持高电平状态。输出低电平状态下的共模瞬变抑制是共模脉冲信号 V_{CM} 后沿上的最大容许负 dVcm/dt，从而确保输出将保持低电平状态。

典型性能特征

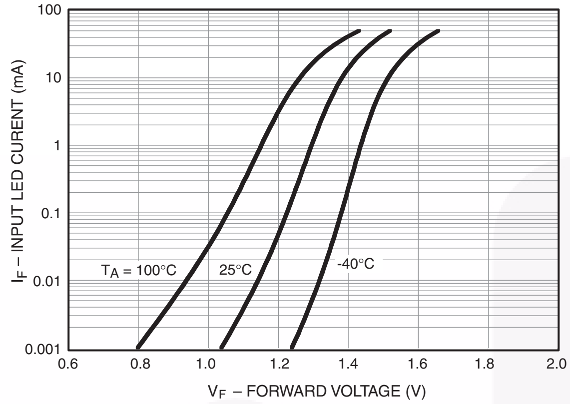


Figure 1. Input LED Current (I_F) vs. Forward Voltage (V_F)

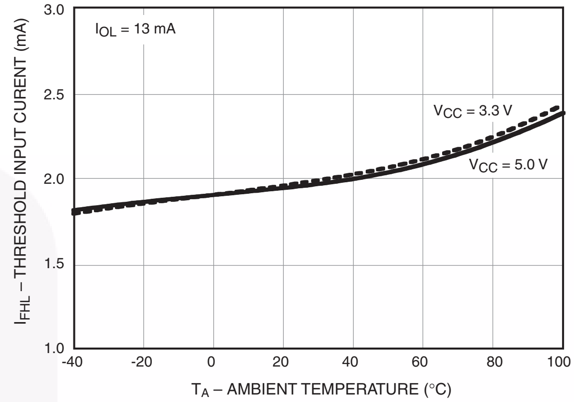


Figure 2. Threshold Input Current (I_{FHL}) vs. Ambient Temperature

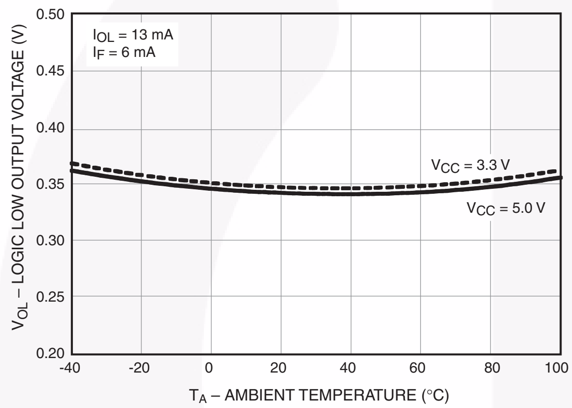


Figure 3. Logic Low Output Voltage (V_{OL}) vs. Ambient Temperature

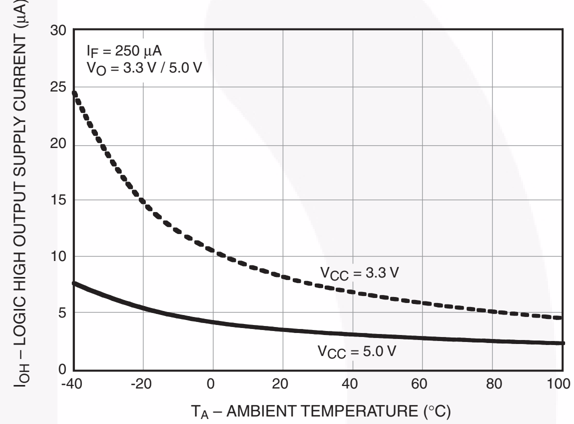


Figure 4. Logic High Output Current (I_{OH}) vs. Ambient Temperature

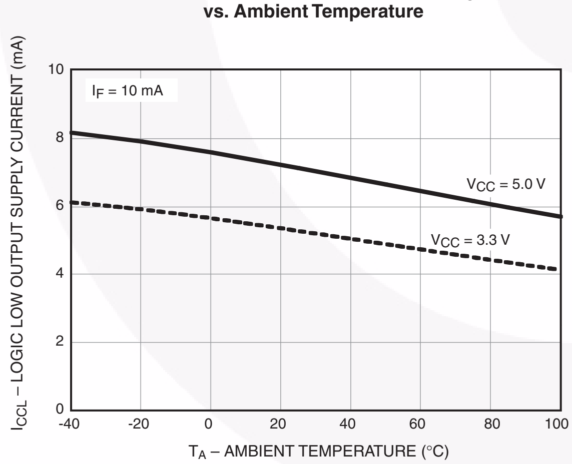


Figure 5. Logic Low Output Supply Current (I_{CCL}) vs. Ambient Temperature

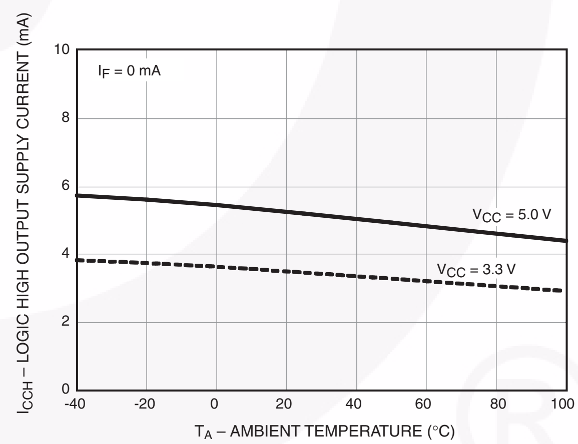


Figure 6. Logic High Output Supply Current (I_{CCH}) vs. Ambient Temperature

典型性能特征（续）

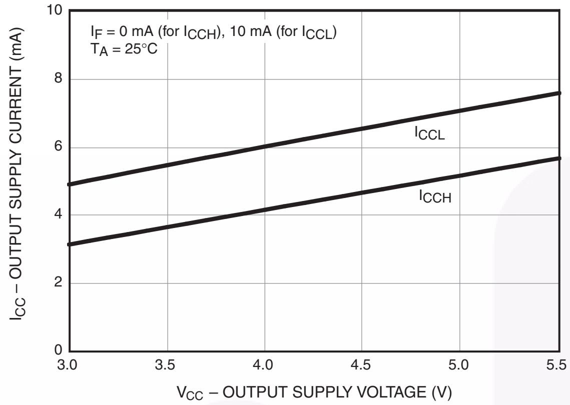


Figure 7. Output Supply Current (I_{CC}) vs. Output Supply Voltage (V_{CC})

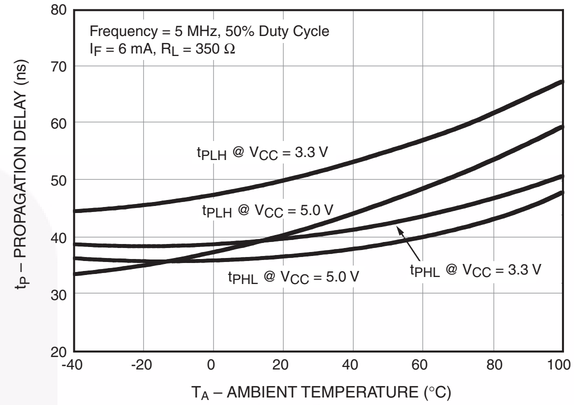


Figure 8. Propagation Delay vs. Ambient Temperature

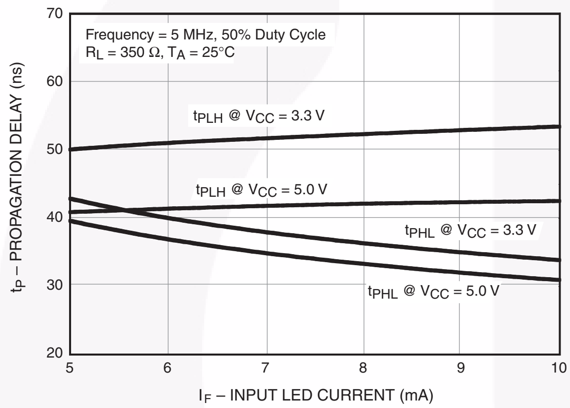


Figure 9. Propagation Delay vs. Input LED Current (I_F)

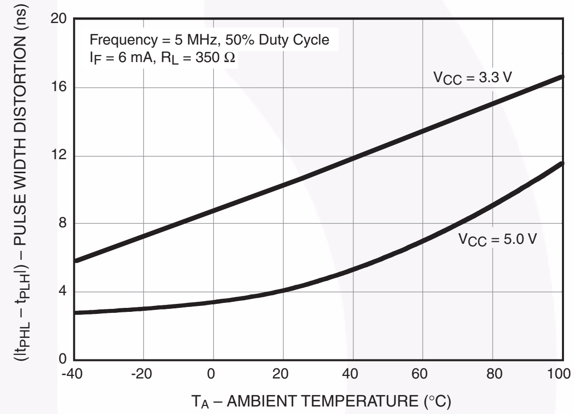


Figure 10. Pulse Width Distortion vs. Ambient Temperature

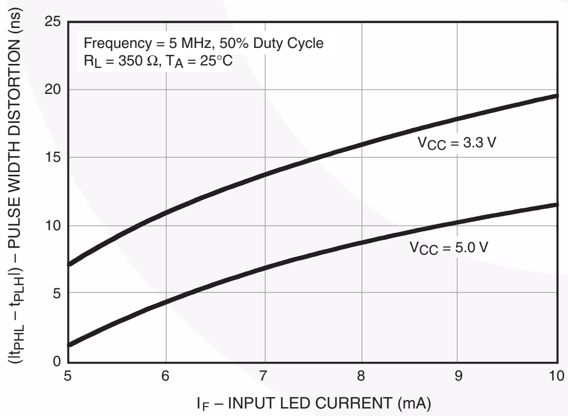


Figure 11. Pulse Width Distortion vs. Input LED Current (I_F)

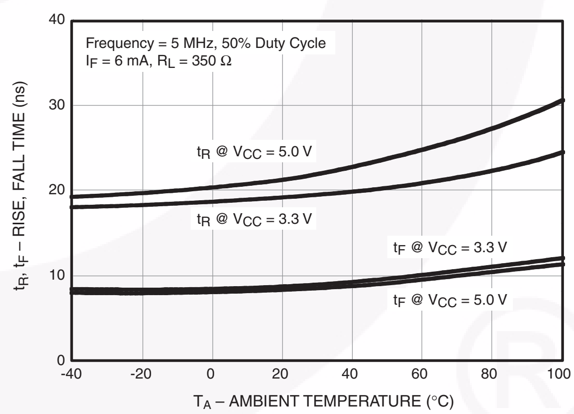


Figure 12. Rise Time (t_R) and Fall Time (t_F) vs. Ambient Temperature

测试电路

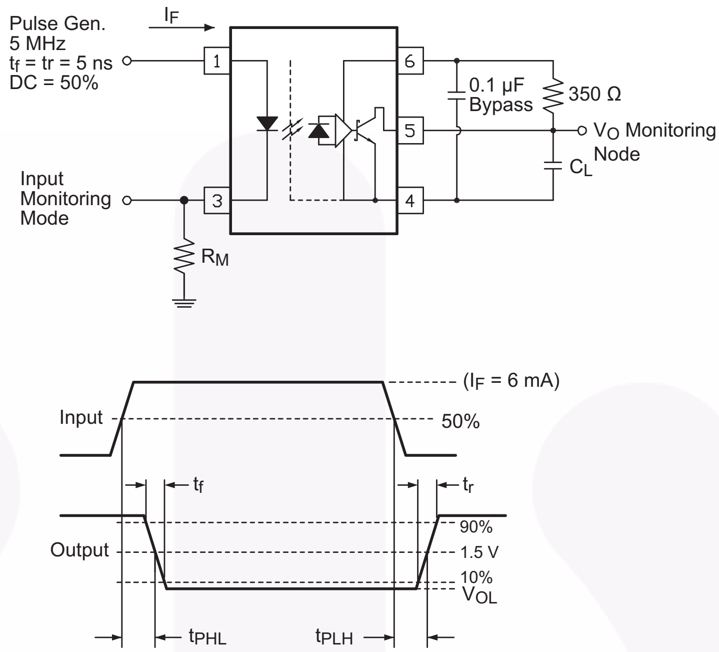


图 13. 传播延迟、上升时间和下降时间的测试回路

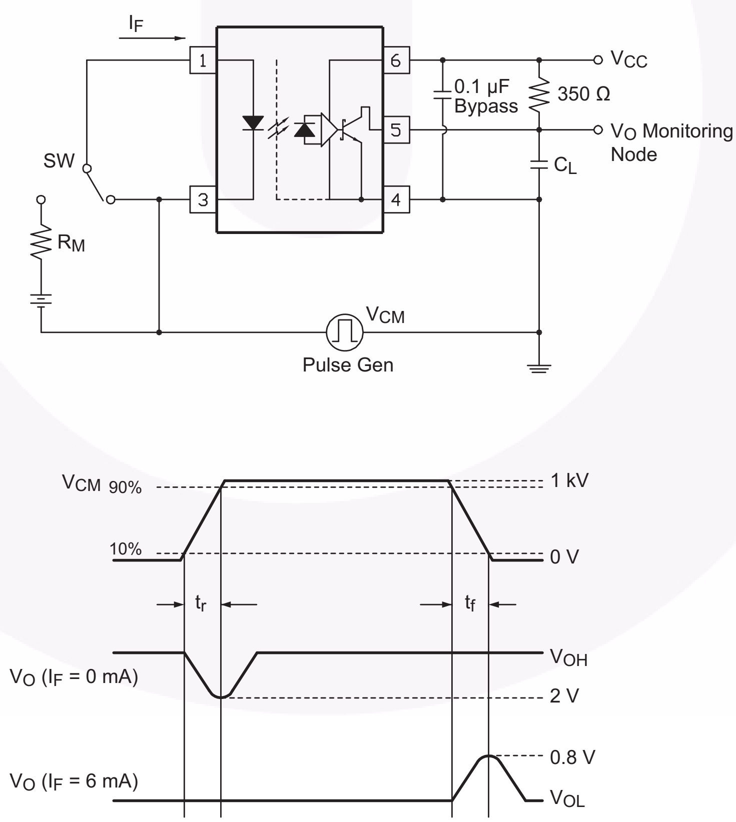


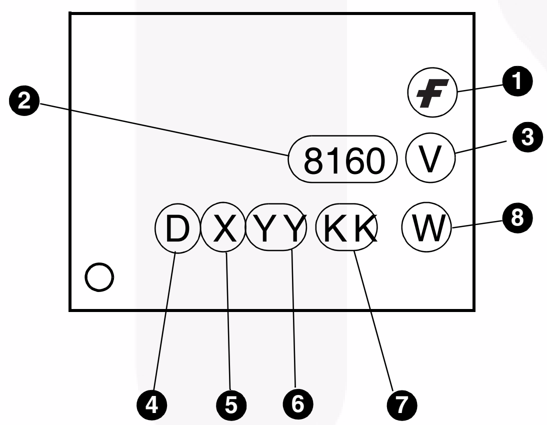
图 14. 瞬时共模抑制电压的测试回路

订购信息

器件编号	封装	包装方法
FOD8160	宽体 5 引脚 SOP 封装	管 （每管 100 单位）
FOD8160R2	宽体 5 引脚 SOP 封装	编卷带包装 （每卷 1000 单位）
FOD8160V （初始版）	宽体 SOP 5 引脚， DIN EN/IEC60747-5-5 选项 （待审批）	管 （每管 100 单位）
FOD8160R2V （初始版）	宽体 SOP 5 引脚， DIN EN/IEC60747-5-5 选项 （待审批）	编卷带包装 （每卷 1000 单位）

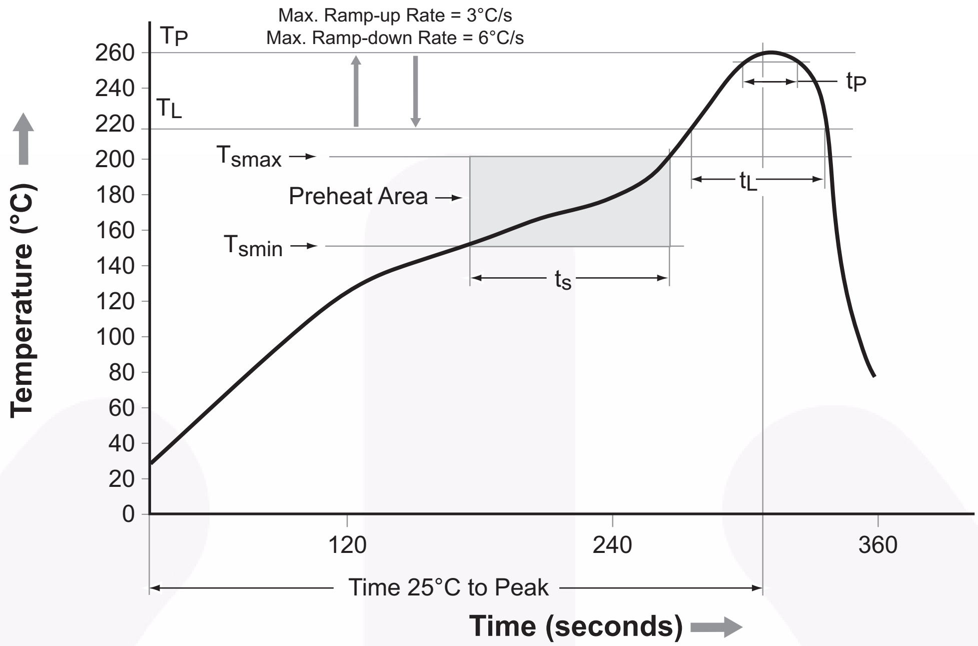
根据 JEDEC:J-STD-020B 标准，所有包装都是无铅的。

标识信息



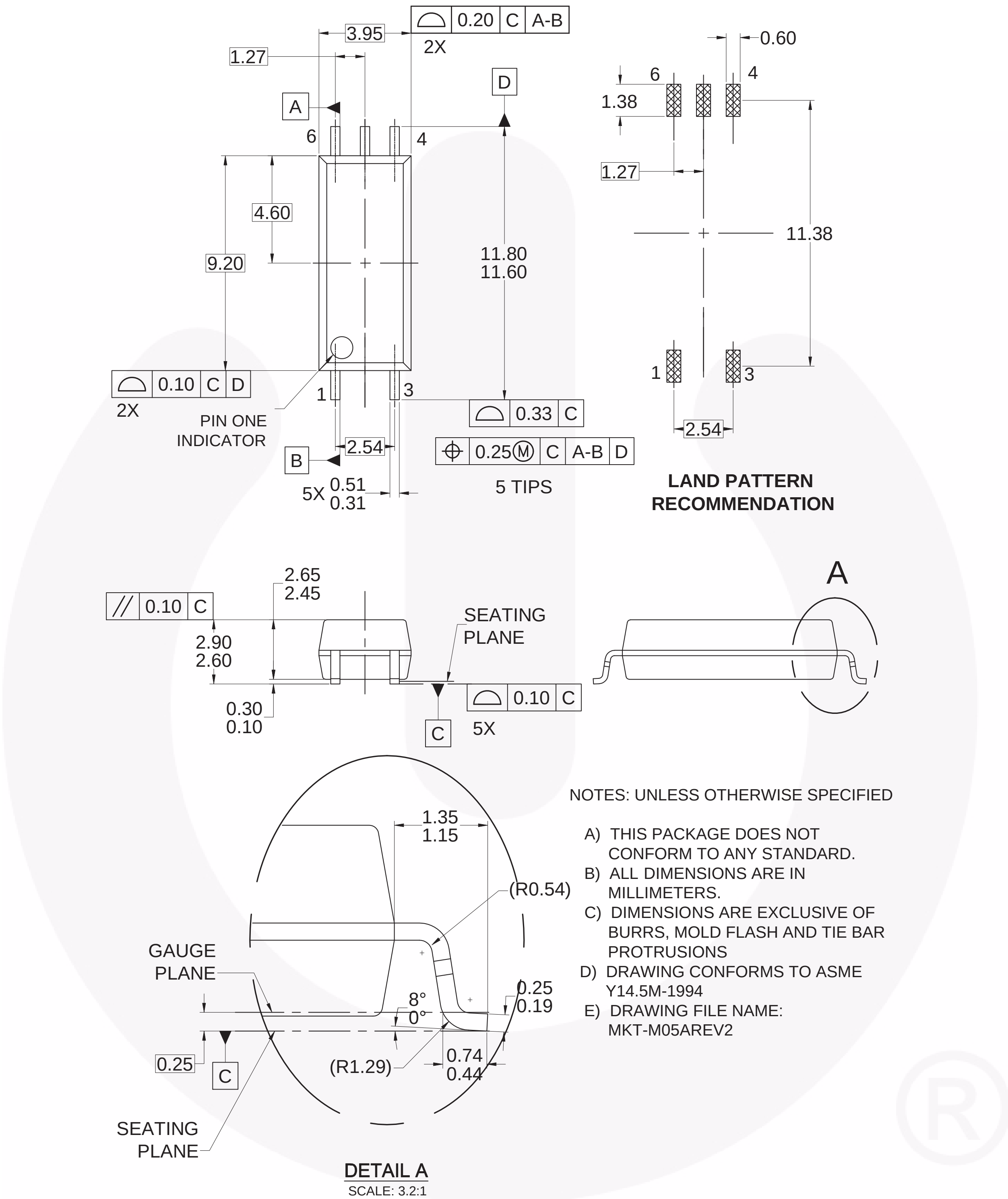
定义	
1	飞兆徽标
2	器件号，例如，“8160”代表 FOD8160
3	DIN EN/IEC60747-5-5 选项 （只有组件订购附带此选项时出现）
4	工厂代码，例如，“D”
5	上一个数字年份代码，例如，“D”代表 2013
6	两位数的工作周数，从 “01” 到 “53”
7	批量可追溯性代码
8	包装组装代码， W

回流焊数据



特征	无铅装配数据
最低温度 (T_{smin})	150°C
最高温度 (T_{smax})	200°C
时间 （t_S）（T_{smin} 至 T_{smax}）	60 至 120 秒
斜升率 （t_L 至 t_P）	3°C/ 秒最大
液态温度 (T_L)	217°C
保持在 (tL) 以上的时间 (t_L)	60 至 150 秒
体封装温度峰值	260°C +0°C / – 5°C
时间 (t_P)， 260°C 的 5°C 内	30 秒
斜降率 （T_P 至 T_L）	6°C/ 秒最大
25°C 至峰值温度的时间	8 分钟最大

封装尺寸



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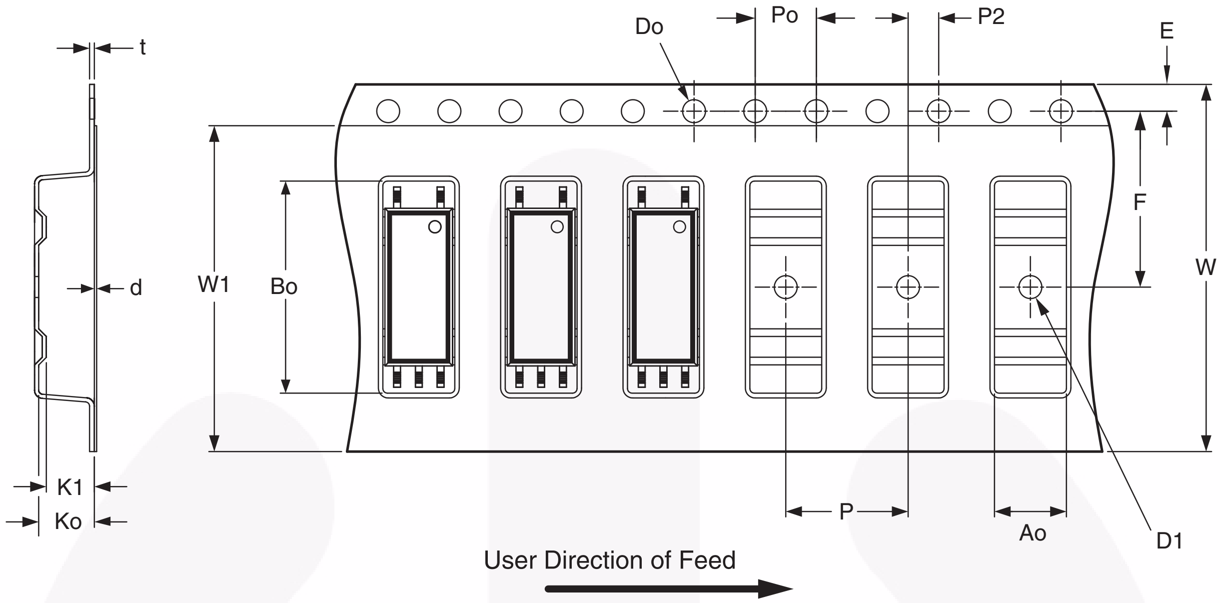
承载带规格（SOIC-5L OPTO R2 & R2V 选项）



符号	说明	尺寸 (mm)
W	带宽	24.00 +0.20 / -0.10
t	带厚	0.30 ± 0.05
Po	孔距	4.00 ± 0.20
Do	孔径	1.50 +0.10 / -0.00
D1	Pocket Hole Diameter	1.50 +0.25 / -0.00
E	孔位置	1.75 ± 0.10
F	Pocket 位置	11.50 ± 0.10
P2		2.00 ± 0.10
P	Pocket 间距	8.00 ± 0.10
Ao	Pocket 直径	4.50 ± 0.10
Bo		12.00 ± 0.10
Ko		3.35 ± 0.10
K1		2.85 ± 0.10
W1	覆带宽	21.30 ± 0.10
d	覆带厚	0.05 ± 0.01
	组件翻转或倾斜的最大值	10°

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