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2014 年 11 月

FOD8321

2.5 A 输出电流、栅极驱动光耦合器，采用 Optoplanar[®] 宽体 SOP 5 引脚

特性

- Fairchild 的 Optoplanar[®] 封装技术提供可靠的高电压隔离、超过 8 mm 的爬电和间隙距离以及 0.5 mm 的内部绝缘距离，同时还提供紧凑的尺寸
- 用于中等功率 IGBT/MOSFET 的 2.5A 输出电流驱动能力
 - P 沟道 MOSFET 在输出级可实现接近供电轨的输出电压摆幅
- 20kV/ μ s 最小共模抑制
- 宽电源电压范围：15 V 至 30 V
- 在整个工作温度范围内可快速开关：
 - 500 ns 最大传播延迟
 - 300 ns 最大脉宽失真度
- 具有滞回的欠压闭锁 (UVLO)
- 扩展工业温度范围：-40°C 至 100°C
- 安全和法规认证：
 - UL1577、5,000 V_{RMS} 1 分钟
 - DIN EN/IEC60747-5-5, 1,414 V 峰值工作绝缘电压

应用

- AC 和无刷 DC 电机驱动
- 工业变频器
- 不间断电源
- 感应加热
- 隔离 IGBT/ 功率 MOSFET 栅极驱动

相关资源

- [FOD3120, 高抗噪能力、2.5 A 输出电流、栅极驱动光电耦合器数据手册](#)
- www.fairchildsemi.com/products/opto/

描述

FOD8321 是一个 2.5 A 的输出电流栅极驱动光电耦合器，可驱动中等功率的 IGBT/MOSFET。它非常适用于快速开关驱动在电机控制逆变器应用以及高性能电源系统中使用的功率 IGBT 和 MOSFET。

FOD8321 采用 Fairchild 的 Optoplanar[®] 共面封装技术和优化的 IC 设计，实现了高绝缘电压和高抗噪能力。

它是由与具有高速驱动器的集成电路进行光耦合的铝砷化镓 (AlGaAs) 发光二极管 (LED) 组成，可实现推挽式 MOSFET 输出级。该器件包含在一个宽体 5 引脚小型塑料封装中。

功能示意图

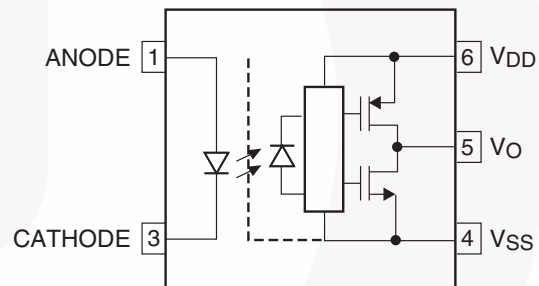


图 1. 原理图

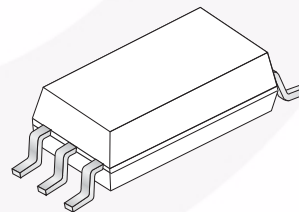


图 2. 封装外形

FOD8321 — 2.5 A 输出电流、栅极驱动光耦合器，采用 Optoplanar[®] 宽体 SOP 5 引脚

真值表

LED	$V_{DD} - V_{SS}$ “正向” (导通)	$V_{DD} - V_{SS}$ “正向” (关断)	V_O
关	0 V 至 30 V	0 V 至 30 V	低
导通	0 V 至 11.5 V	0 V 至 10 V	低
导通	11.5 V 至 14.5 V	10 V 至 13 V	转换
导通	14.5 V 至 30 V	13 V 至 30 V	高

引脚配置

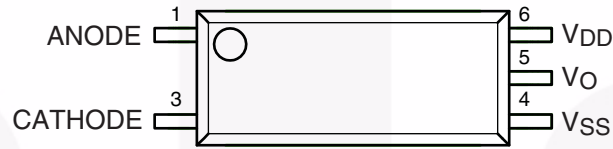


图 3. 引脚配置

引脚定义

引脚号	名称	描述
1	阳极	LED 阳极
3	阴极	LED 阴极
4	V_{SS}	负极电源电压
5	V_O	输出电压
6	V_{DD}	正向电源电压

安全性和绝缘标准

根据 DIN EN/IEC60747-5-5，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				
	用于额定市电电压 < 150 V _{RMS}		I-IV		
	用于额定市电电压 < 300 V _{RMS}		I-IV		
	用于额定市电电压 < 450 V _{RMS}		I-III		
	用于额定市电电压 < 600 V _{RMS}		I-III		
	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} × 1.875 = V _{PR} ，100% 生产测试，t _m = 1 s，局部放电 < 5 pC	2651			V _{peak}
	输入至输出测试电压，方法 a，V _{IORM} × 1.6 = V _{PR} ，类型和样品测试，t _m = 10 s，局部放电 < 5 pC	2262			V _{peak}
V _{IORM}	最大工作绝缘电压	1414			V _{peak}
V _{IOTM}	最高允许过电压	8000			V _{peak}
	外部爬电距离	8.0			mm
	外部绝缘间隙	8.0			mm
	绝缘厚度	0.5			mm
T _S	安全极限值 – 发生故障时允许的最大值				
	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} = 500 V 时的绝缘阻抗	10 ⁹			Ω

绝对最大额定值

应力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，长期在高于推荐的工作条件下工作，会影响器件的可靠性。绝对最大额定值仅是应力规格值。除非另有说明， $T_A = 25^\circ\text{C}$ 。

符号	参数	数值	单位
T_{STG}	存储温度	-40 至 +125	$^\circ\text{C}$
T_{OPR}	工作温度	-40 至 +100	$^\circ\text{C}$
T_J	结温	-40 至 +125	$^\circ\text{C}$
T_{SOL}	引脚焊接温度 请参考第 15 页的回流焊温度曲线。	260, 10 s	$^\circ\text{C}$
$I_{\text{F(AVG)}}$	平均输入电流	25	mA
F	工作频率	50	kHz
V_R	反向输入电压	5.0	V
$I_{\text{O(PEAK)}}$	峰值输出电流 (1)	3.0	A
V_{DD}	电源电压	0 至 35	V
$V_{\text{O(PEAK)}}$	峰值输出电压	0 至 V_{DD}	V
$t_{\text{R(IN)}}, t_{\text{F(IN)}}$	输入信号上升和下降时间	500	ns
PD_I	输入功耗 (2)(4)	45	mW
PD_O	输出功耗 (3)(4)	500	mW

注意：

- 最大脉宽 = 10 μs ，最大占空比 = 0.2%。
- 在整个工作温度范围内无需降额。
- 线性降额，25 $^\circ\text{C}$ 开始，速度为 5.2 mW/ $^\circ\text{C}$ 。
- 不建议在这些条件下运行。如果所经受的条件超出额定值，器件可能出现永久损害。

推荐工作条件

推荐的操作条件表明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	$^\circ\text{C}$
$V_{\text{DD}} - V_{\text{SS}}$	电源电压	16	30	V
$I_{\text{F(ON)}}$	输入电流 (ON)	10	16	mA
$V_{\text{F(OFF)}}$	输入电压 (OFF)	0	0.8	V

绝缘特性

应用于所有推荐的条件，典型值测量为 $T_A = 25^\circ\text{C}$

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	$T_A = 25^\circ\text{C}$ 、R.H. < 50%、 $t = 60\text{ s}$ 、 $I_{\text{I-O}} \leq 20\ \mu\text{A}$ 、50 Hz ⁽⁵⁾⁽⁶⁾	5,000			V_{RMS}
R_{ISO}	绝缘电阻	$V_{\text{I-O}} = 500\text{ V}$ ⁽⁵⁾		10^{11}		Ω
C_{ISO}	绝缘电容	$V_{\text{I-O}} = 0\text{ V}$ ，频率 = 1.0 MHz ⁽⁶⁾		1		pF

注意：

- 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。
- 5,000 VAC_{RMS} 持续 1 分钟相当于 6,000 VAC_{RMS} 持续 1 秒钟。

电气特性

应用于所有建议条件，典型值在 $V_{\text{DD}} = 30\text{ V}$ ， $V_{\text{SS}} = \text{接地}$ ， $T_A = 25^\circ\text{C}$ 时测得（除非另有说明）。

符号	参数	工作条件	最小值	典型值	最大值	单位	图
V_{F}	输入正向电压	$I_{\text{F}} = 10\text{ mA}$	1.1	1.5	1.8	V	19
$\Delta(V_{\text{F}}/T_A)$	正向电压温度系数		-1.8			mV/°C	
BV_{R}	反向击穿输入电压	$I_{\text{R}} = 10\ \mu\text{A}$	5			V	
C_{IN}	输入电容	$f = 1\text{ MHz}$ ， $V_{\text{F}} = 0\text{ V}$		60		pF	
I_{OH}	高电平输出电流 ⁽¹⁾	$V_{\text{OH}} = V_{\text{DD}} - 3\text{ V}$	1.0	2.0	2.5	A	4, 6
		$V_{\text{OH}} = V_{\text{DD}} - 6\text{ V}$	2.0		2.5	A	4, 6, 22
I_{OL}	低电平输出电流 ⁽¹⁾	$V_{\text{OL}} = V_{\text{SS}} + 3\text{ V}$	1.0	2.0	2.5	A	7, 9
		$V_{\text{OL}} = V_{\text{SS}} + 6\text{ V}$	2.0		2.5	A	7, 9, 21
V_{OH}	高电平输出电压 ⁽⁷⁾⁽⁸⁾	$I_{\text{F}} = 10\text{ mA}$ ， $I_{\text{O}} = -2.5\text{ A}$	$V_{\text{DD}} - 6.25$	$V_{\text{DD}} - 2.5$		V	4
		$I_{\text{F}} = 10\text{ mA}$ ， $I_{\text{O}} = -100\text{ mA}$	$V_{\text{DD}} - 0.5$	$V_{\text{DD}} - 0.1$		V	4, 5, 23
V_{OL}	低电平输出电压 ⁽⁷⁾⁽⁸⁾	$I_{\text{F}} = 10\text{ mA}$ ， $I_{\text{O}} = 2.5\text{ A}$		$V_{\text{SS}} + 2.5$	$V_{\text{SS}} + 6.25$	V	7
		$I_{\text{F}} = 0\text{ mA}$ ， $I_{\text{O}} = 100\text{ mA}$		$V_{\text{SS}} + 0.1$	$V_{\text{SS}} + 0.5$	V	8, 24
I_{DDH}	高电平电源电流	V_{O} 开路， $I_{\text{F}} = 10$ 至 16 mA		2.9	5	mA	10, 11, 25
I_{DDL}	低电平电源电流	V_{O} 开路， $V_{\text{F}} = 0$ 至 0.8 mA		2.8	5	mA	10, 11, 26
I_{FLH}	阈值输入电流 低电平至高电平	$I_{\text{O}} = 0\text{ mA}$ ， $V_{\text{O}} > 5\text{ V}$		2.4	7.5	mA	12, 18, 27
V_{FHL}	阈值输入电压 高至低	$I_{\text{O}} = 0\text{ mA}$ ， $V_{\text{O}} < 5\text{ V}$	0.8			V	28
$V_{\text{UVLO+}}$	欠压闭锁阈值	$I_{\text{F}} = 10\text{ mA}$ ， $V_{\text{O}} > 5\text{ V}$	11.5	12.7	14.5	V	20, 29
$V_{\text{UVLO-}}$		$I_{\text{F}} = 10\text{ mA}$ ， $V_{\text{O}} < 5\text{ V}$	10.0	11.2	13.0	V	20, 29
$UVLO_{\text{HYS}}$	欠压闭锁阈值滞后			1.5		V	

注意：

- 在此测试中， V_{OH} 在 dc 负载电流为 100 mA 时测得。驱动容性负载时， V_{OH} 将随着 I_{OH} 接近 0 A 而接近 V_{DD} 。
- 最大脉宽 = 1 ms，最大占空比 = 20%。

开关特性

应用于所有建议条件，典型值在 $V_{DD} = 30\text{ V}$ ， $V_{SS} = \text{接地}$ ， $T_A = 25^\circ\text{C}$ 时测得（除非另有说明）。

符号	参数	工作条件	最小值	典型值	最大值	单位	图
t_{PHL}	逻辑低输出的传播延迟时间 ⁽⁹⁾	$I_F = 10\text{ mA}$ 至 16 mA ， $R_g = 10\ \Omega$ ， $C_g = 10\text{ nF}$ ， $f = 10\text{ kHz}$ ， 占空比 = 50%	100	285	500	ns	13, 14, 15, 16, 17, 30
t_{PLH}	逻辑高输出的传播延迟时间 ⁽¹⁰⁾		100	260	500	ns	13, 14, 15, 16, 17, 20
PWD	脉宽失真 ⁽¹¹⁾ $ t_{PHL} - t_{PLH} $		25	300	ns		
PDD (偏斜)	任何两个器件之间的传播延迟差 ⁽¹²⁾		-350	350			
t_R	输出上升时间 (10% 至 90%)		60		ns	30	
t_F	输出下降时间 (90% 至 10%)		60		ns	30	
$t_{ULVO\ ON}$	ULVO 导通延迟		$I_F = 10\text{ mA}$ ， $V_O > 5\text{ V}$		0.8		μs
$t_{ULVO\ OFF}$	ULVO 关断延迟	$I_F = 10\text{ mA}$ ， $V_O < 5\text{ V}$		0.4		μs	
$ CM_H $	输出高时的共模瞬态抑制性	$T_A = 25^\circ\text{C}$ ， $V_{DD} = 30\text{ V}$ ， $I_F = 10\text{ mA}$ 至 16 mA ， $V_{CM} = 2000\text{ V}$ ⁽¹³⁾	20	50		kV/ μs	31
$ CM_L $	输出低时的共模瞬态抑制性	$T_A = 25^\circ\text{C}$ ， $V_{DD} = 30\text{ V}$ ， $V_F = 0\text{ V}$ ， $V_{CM} = 2000\text{ V}$ ⁽¹⁴⁾	20	50		kV/ μs	31

注意：

9. 传播延迟 t_{PHL} 的测量是从输入脉冲下降沿的 50% 电平至 V_O 信号下降沿的 50% 电平。
10. 传播延迟 t_{PLH} 的测量是从输入脉冲上升沿的 50% 电平至 V_O 信号上升沿的 50% 电平。
11. 在任何给定器件上，PWD 被定义为 $|t_{PHL} - t_{PLH}|$ 。
12. 在相同的工作条件下，负载相同的任意两个 FOD8321 器件之间 t_{PHL} 和 t_{PLH} 之差。
13. 输出高电平状态下的共模瞬态抑制性是共模脉冲信号后沿上的最大容许负 dV_{cm}/dt ， V_{CM} ，从而确保输出将保持高电平状态（即 $V_O > 15.0\text{ V}$ ）。
14. 输出低电平状态下的共模瞬态抑制性是共模脉冲信号前沿上的最大容许正 dV_{cm}/dt ， V_{CM} ，从而确保输出将保持低电平状态（即 $V_O < 1.0\text{ V}$ ）。

典型性能特征

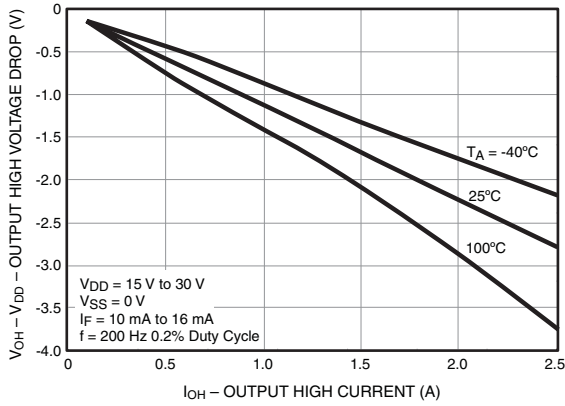


Figure 4. Output High Voltage Drop vs. Output High Current

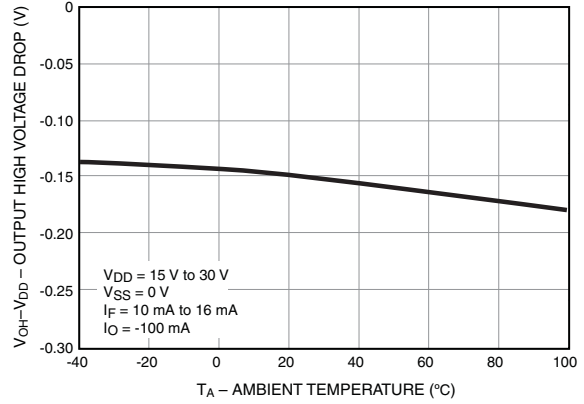


Figure 5. Output High Voltage Drop vs. Ambient Temperature

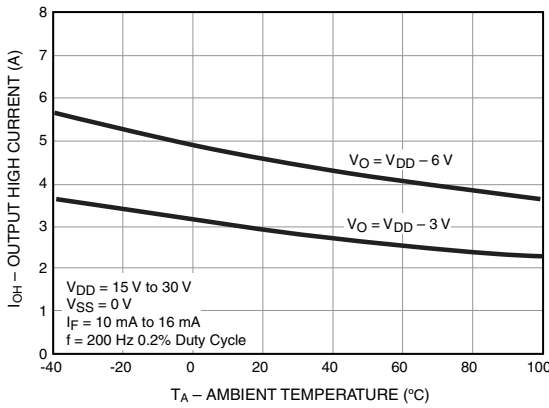


Figure 6. Output High Current vs. Ambient Temperature

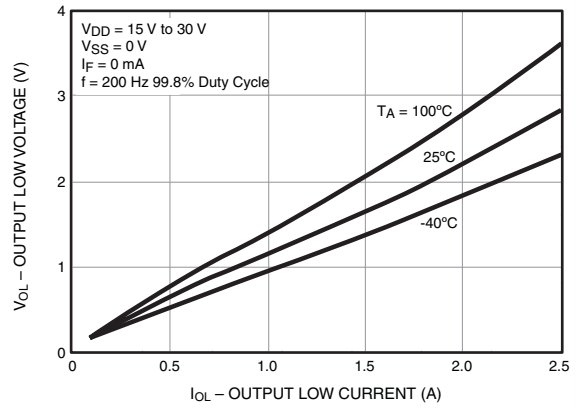


Figure 7. Output Low Voltage vs. Output Low Current

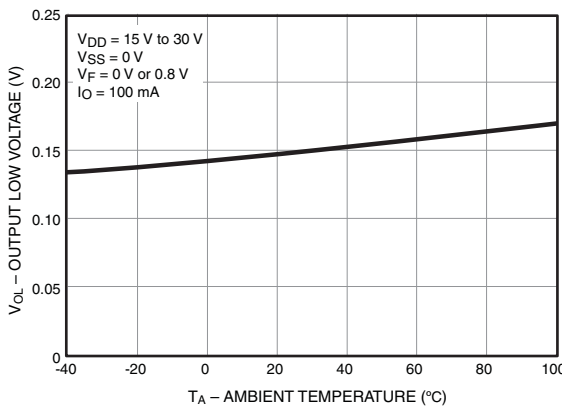


Figure 8. Output Low Voltage vs. Ambient Temperature

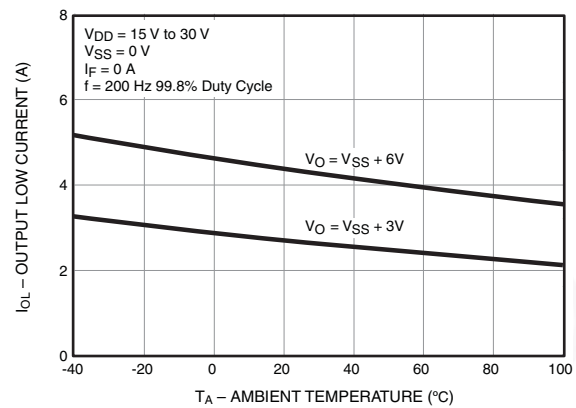


Figure 9. Output Low Current vs. Ambient Temperature

典型性能特性 (接上页)

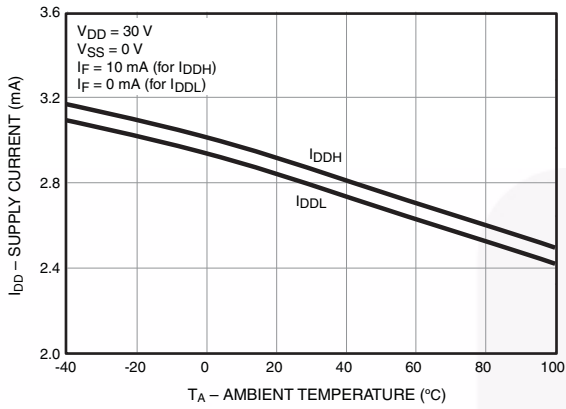


Figure 10. Supply Current vs. Ambient Temperature

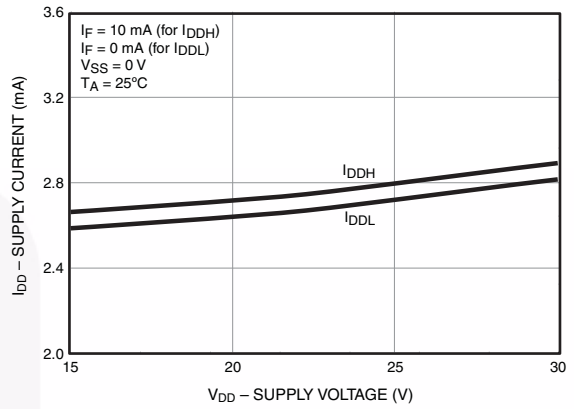


Figure 11. Supply Current vs. Supply Voltage

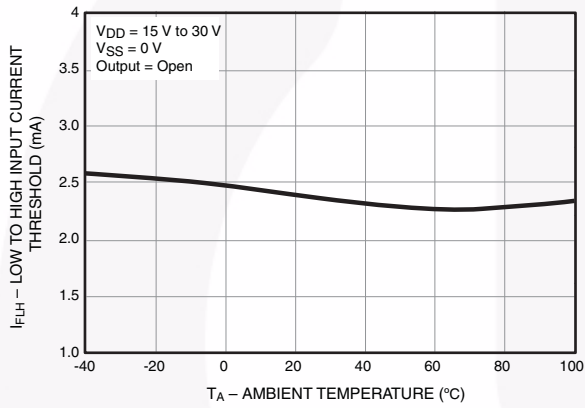


Figure 12. Low to High Input Current Threshold vs. Ambient Temperature

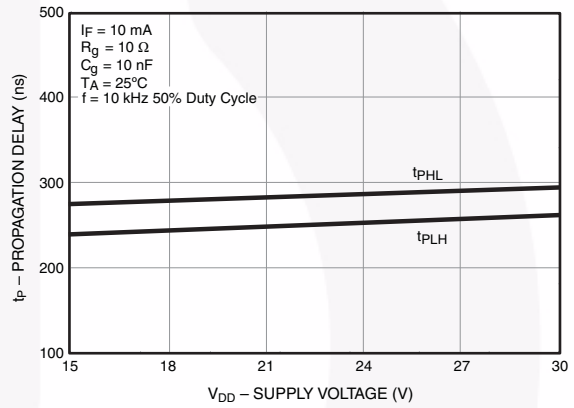


Figure 13. Propagation Delay vs. Supply Voltage

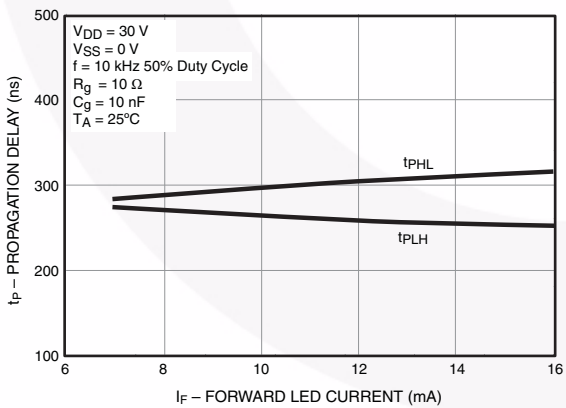


Figure 14. Propagation Delay vs. LED Forward Current

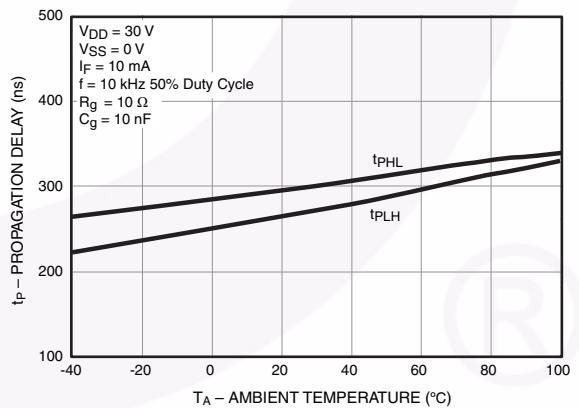


Figure 15. Propagation Delay vs. Ambient Temperature

典型性能特性 (接上页)

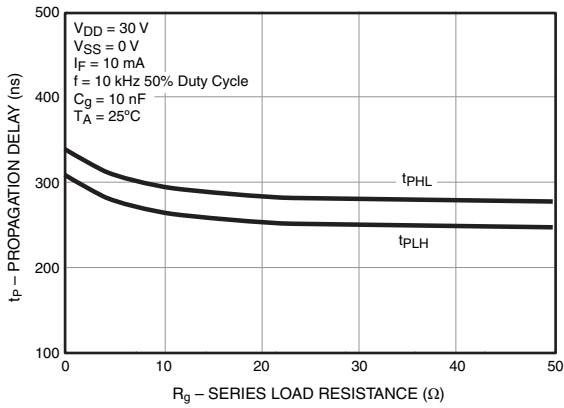


Figure 16. Propagation Delay vs. Series Load Resistance

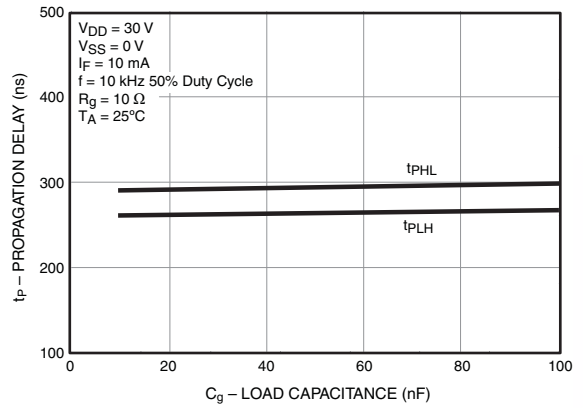


Figure 17. Propagation Delay vs. Load Capacitance

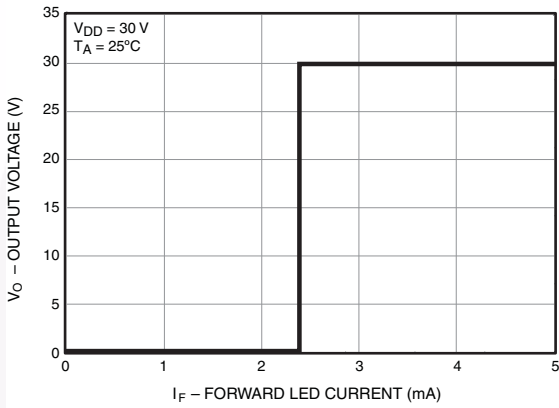


Figure 18. Transfer Characteristics

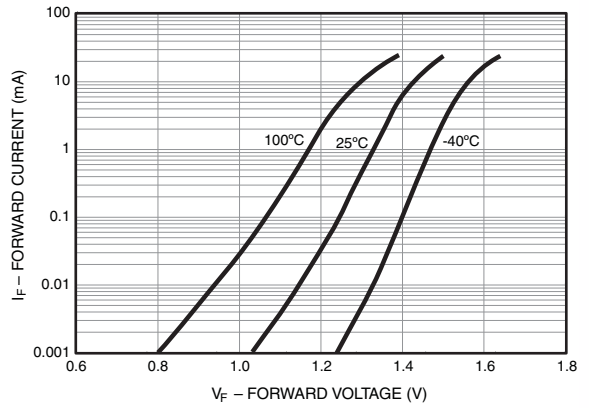


Figure 19. Input Forward Current vs. Forward Voltage

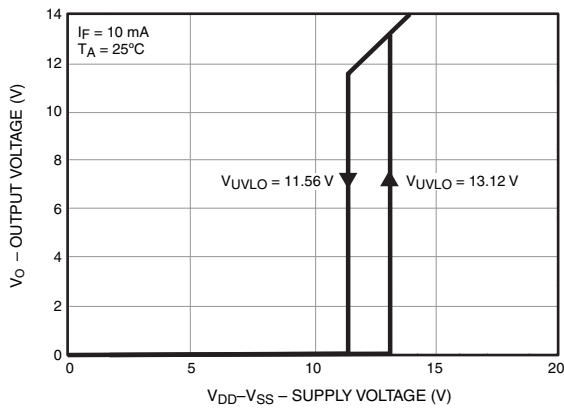


Figure 20. Under Voltage Lockout

测试电路

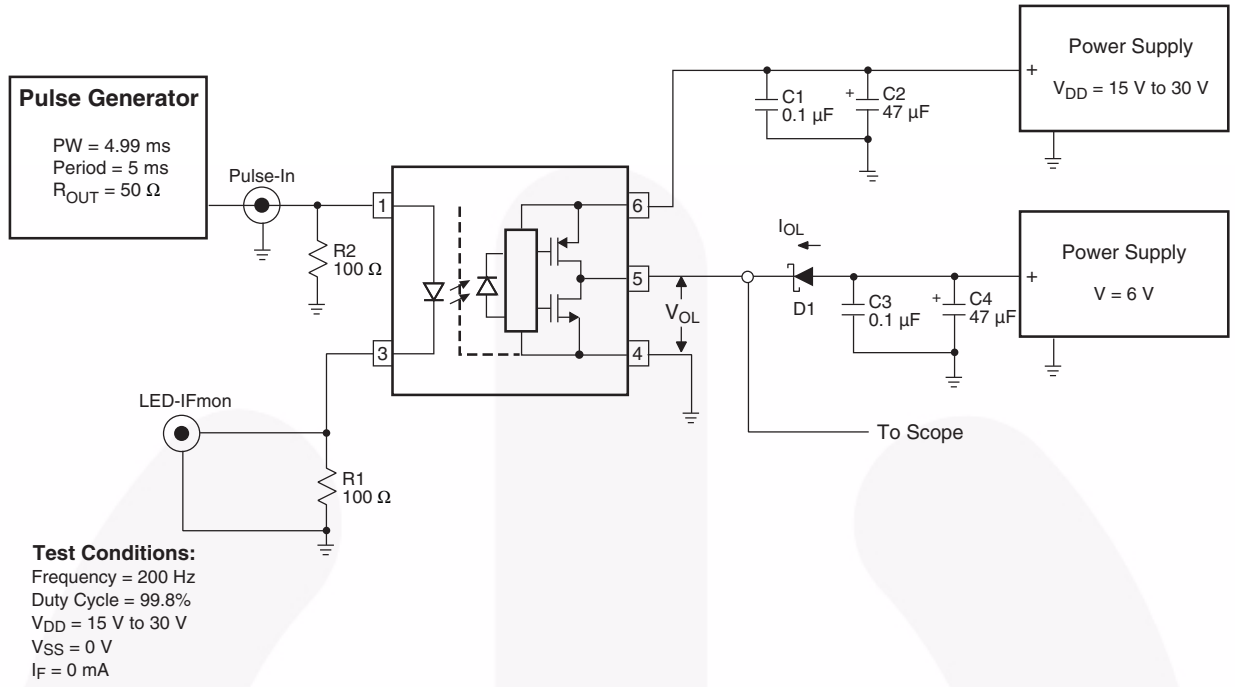


图 21. I_{OL} 测试电路

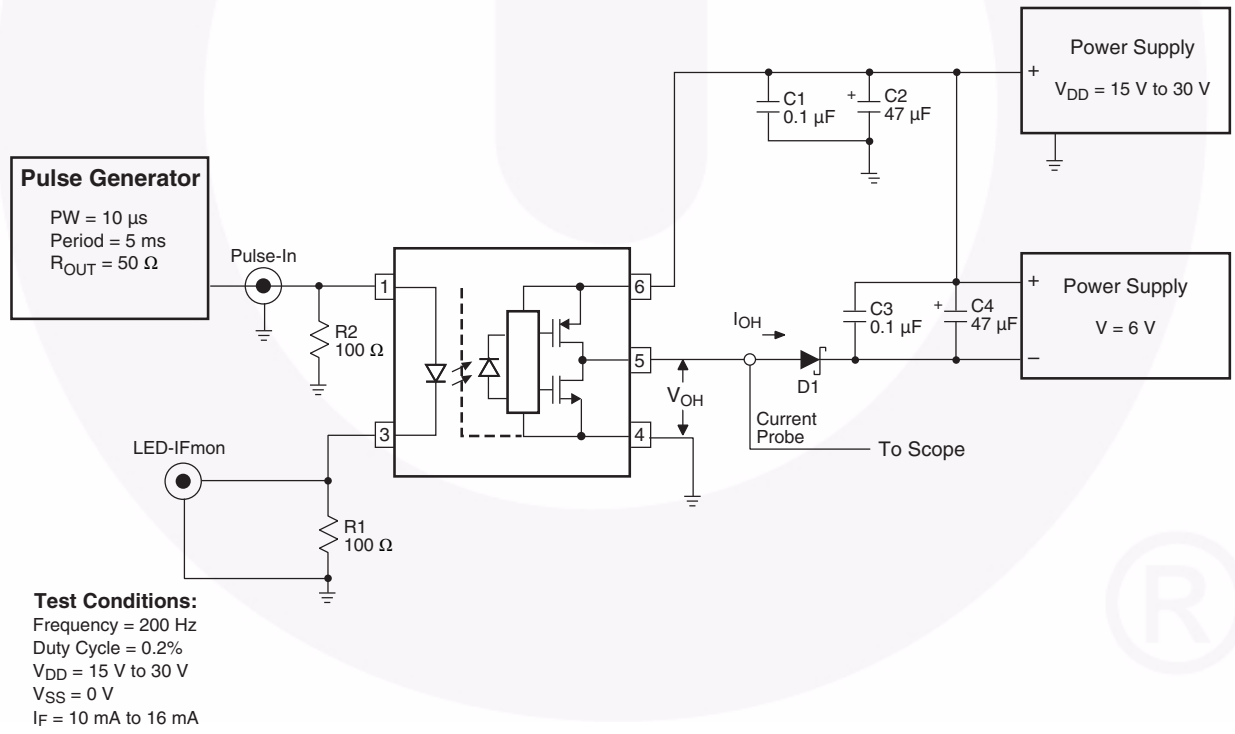


图 22. I_{OH} 测试电路

测试电路 (续)

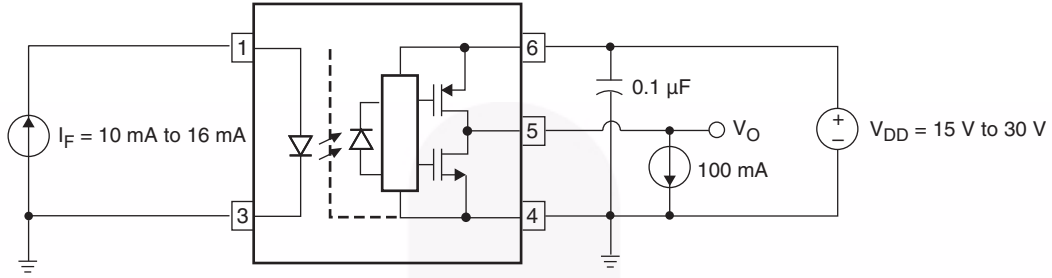


图 23. V_{OH} 测试电路

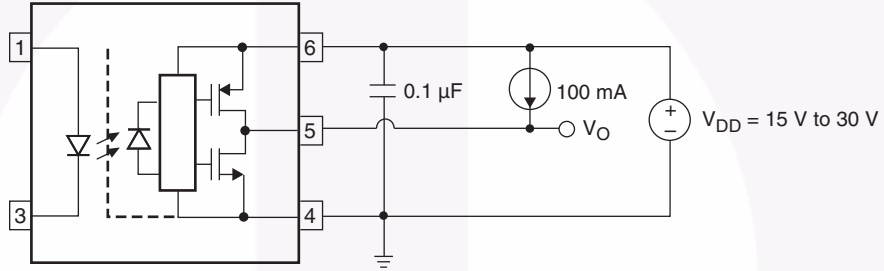


图 24. V_{OL} 测试电路

测试电路 (续)

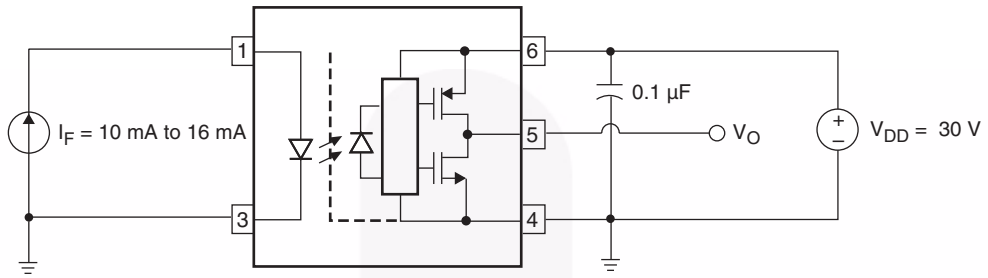


图 25. I_{DDH} 测试电路

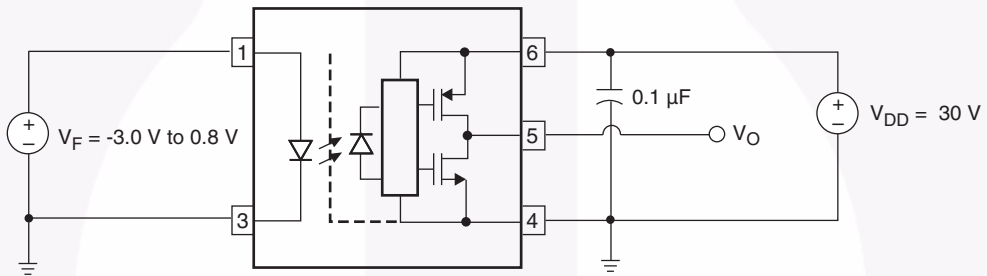


图 26. I_{DDL} 测试电路

测试电路 (续)

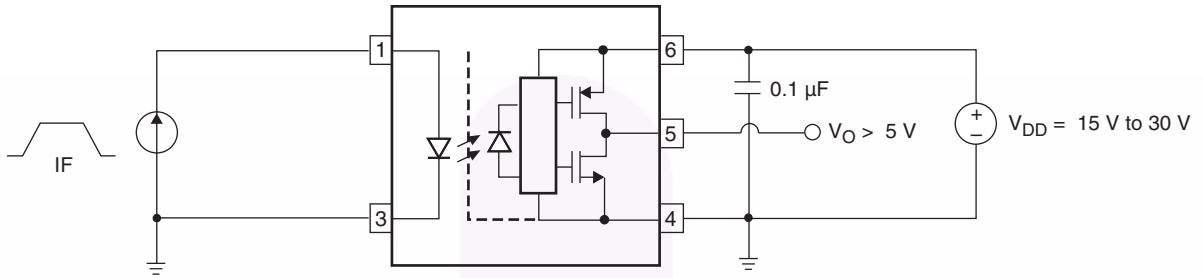


图 27. I_{FLH} 测试电路

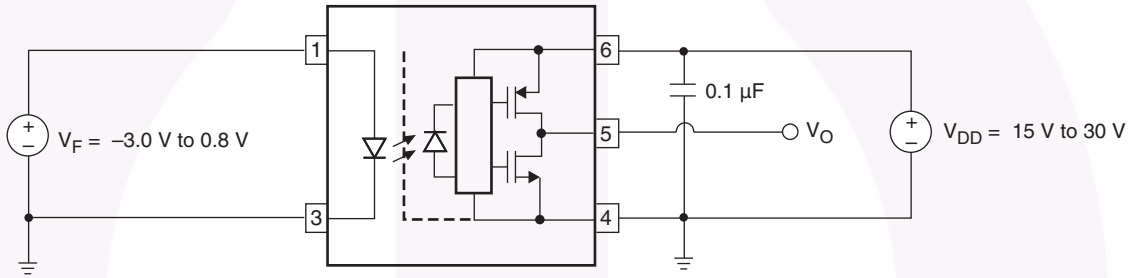


图 28. V_{FHL} 测试电路

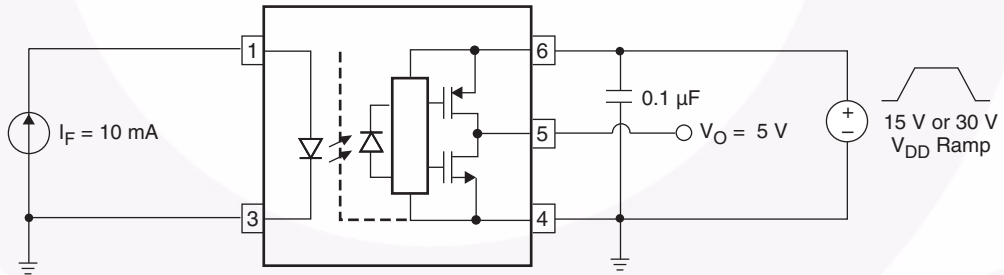


图 29. UVLO 测试电路

测试电路 (续)

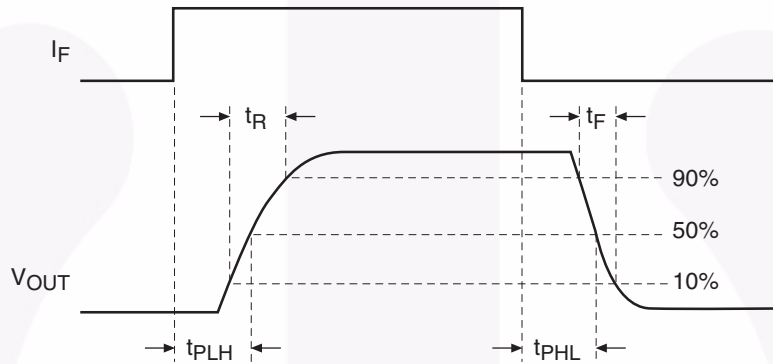
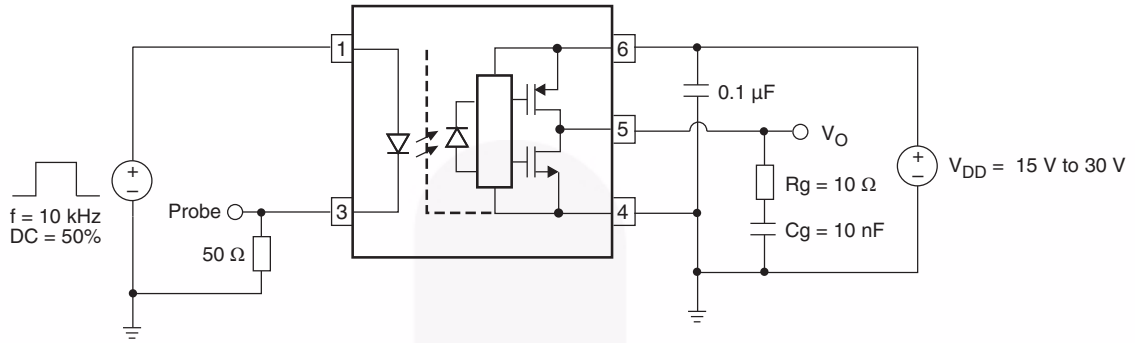


图 30. t_{PHL} 、 t_{PLH} 、 t_R 和 t_F 测试电路和波形

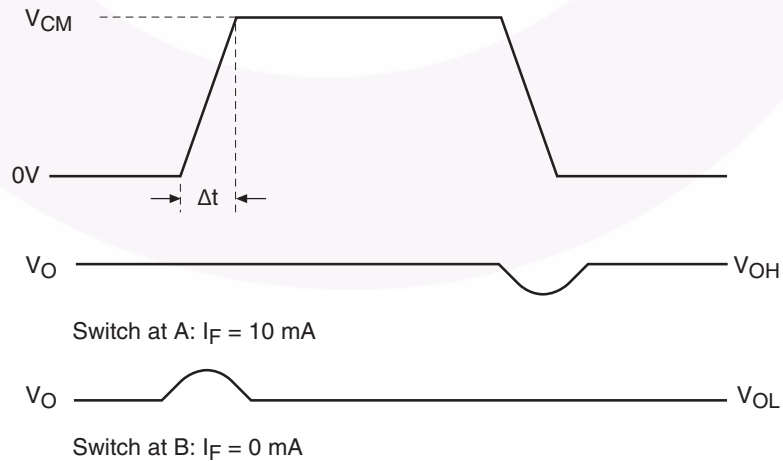
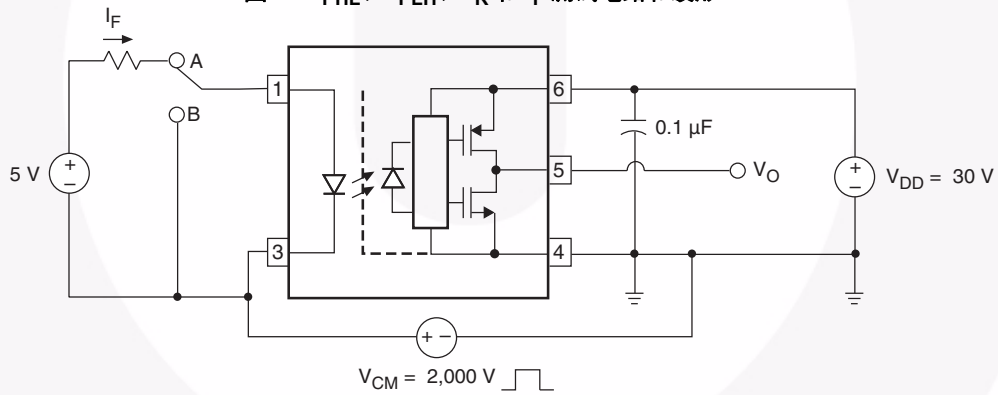
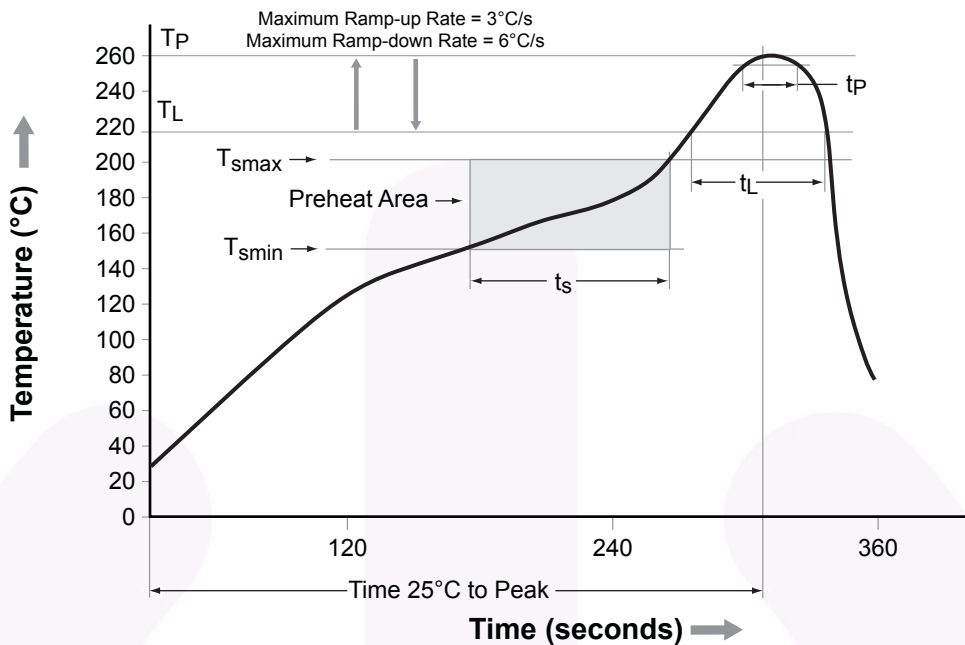


图 31. CMR 测试电路与波形

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 s 至 120 s
斜升率 (t_L to t_P)	3°C/秒 (最大值)
液态温度 (T_L)	217°C
保持在 (t_L) 以上的时间 (t_L)	60 s 至 150 s
体封装温度峰值	260°C +0°C / -5°C
时间 (t_P) 在 260°C 中的 5°C 内	30 s
斜降率 (T_P 至 T_L)	6°C/s (最大值)
25°C 至峰值温度的时间	8 分钟 (最大值)

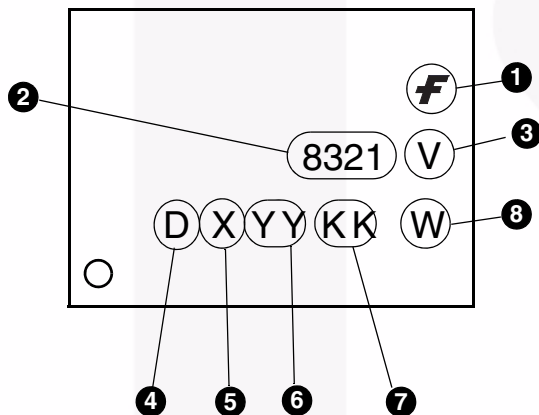
图 32. 回流焊数据

订购信息

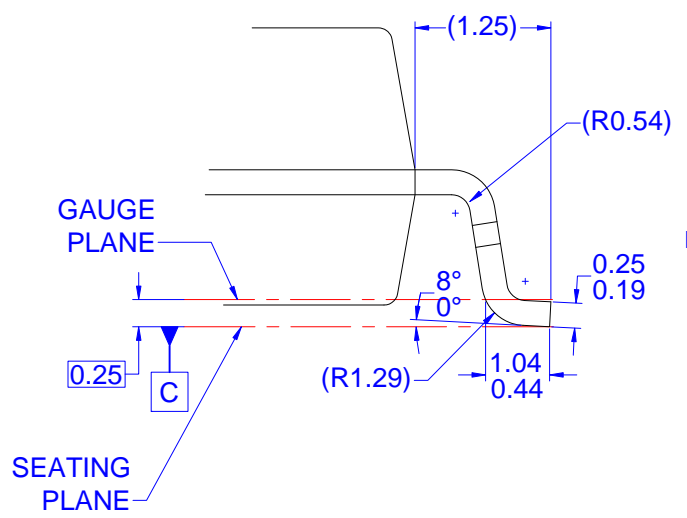
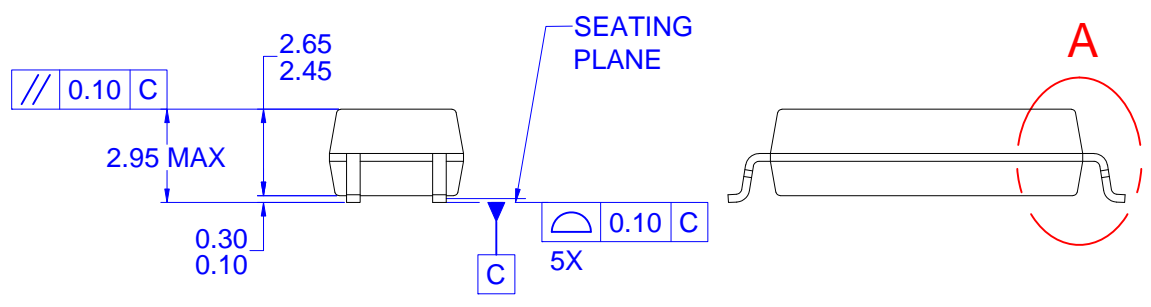
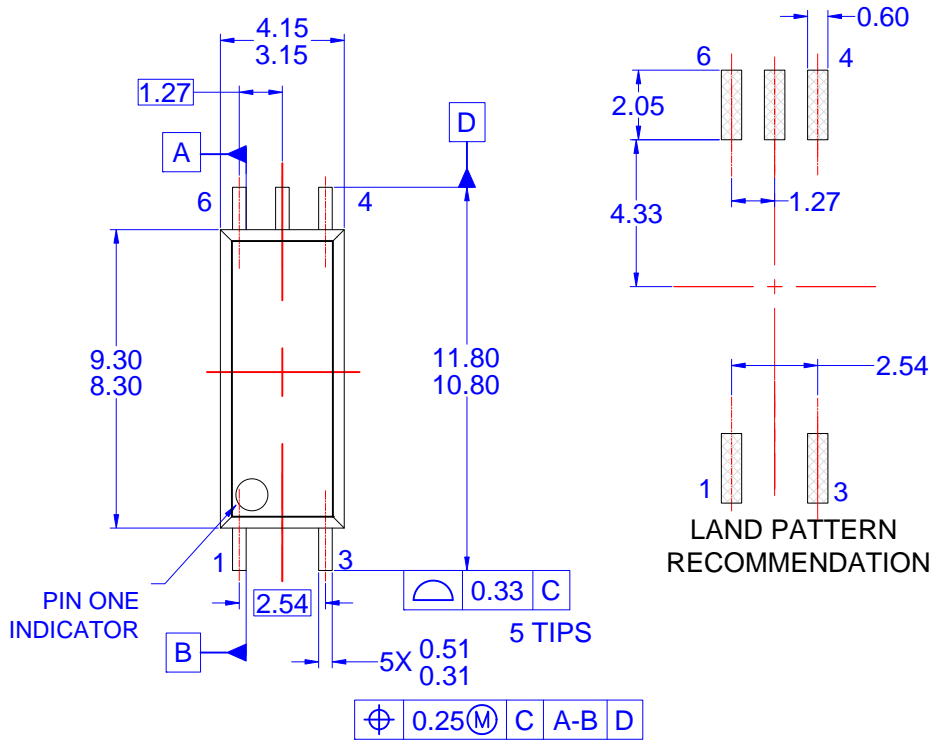
器件编号	封装	包装方法
FOD8321	宽体 SOP 5 引脚	卷管（每卷管 100 装）
FOD8321R2	宽体 SOP 5 引脚	卷带和卷盘（每卷 1000 装）
FOD8321V	宽体 SOP 5 引脚，DIN EN/IEC60747-5-5 选项	卷管（每卷管 100 装）
FOD8321R2V	宽体 SOP 5 引脚，DIN EN/IEC60747-5-5 选项	卷带和卷盘（每卷 1000 装）

 根据 JEDEC:J-STD-020B 标准，J-STD-020B 标准。

标识信息



定义	
1	Fairchild 徽标
2	器件号，例如，“8321”代表 FOD8321
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，“C”代表 2012
6	两位数工作周数，从“01”到“53”
7	批量可追溯性代码
8	封装装配代码，W



DETAIL A
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