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RV4145A — 低功耗接地故障中断器

特性

- 无需任何电位计
- 直接连接至 SCR
- 源自 AC 线路的电源电压 - 26 V 稳压器
- 可调敏感度
- 中性接地故障检测
- 符合 U.L. 943 标准
- 450 μ A 静态电流
- 非常适合 120 V 或 220 V 系统

说明

RV4145A 是交流电源插座接地故障中断器的低功率控制器。在发生有害或致命冲击前，这些器件检测是否有危险的接地情况，比如设备（与 AC 线路反相连接）与水以及与裸露电线接触。

内含一个 26 V 齐纳并联稳压器、一个运算放大器和一个 SCR 驱动器。RV4145A 新增了两个感测变压器、一个整流桥、一个 SCR、一个继电器和一些附加元件，可检测接地的火线和中性线，防止发生接地故障。简单布局和传统设计确保了应用简便和长期可靠。

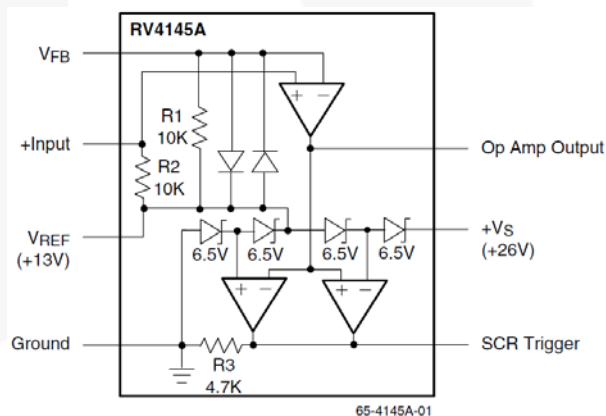


图 1. 框图

订购信息

器件编号	工作温度范围	封装	包装方法
RV4145AN	-35°C 至 +85°C	8 引脚、MDIP、JEDEC MS-001、300" 宽	电轨
RV4145AMT		8 引脚、SOIC、JEDEC MS-012、150" 窄型	卷带

引脚配置

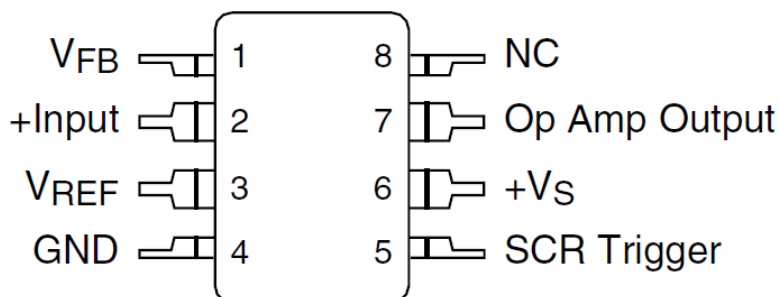


图 2. 引脚分配

引脚描述

引脚编号	名称	说明
1	V_{FB}	感测放大器反向输入
2	+输入	感测放大器正输入
3	V_{REF}	参考电压
4	GND	接地
5	NC	未连接
6	运算放大器输出	感测放大器输出
7	+ V_S	RV4145A 电路的电源输入
8	SCR 触发	检测到故障时触发外部 SCR 的输出

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长期工作。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。

符号	参数		最小值	典型值	最大值	单位
V _{CC}	电源电流				18	mA
P _D	内部功耗				500	mW
T _{STG}	存储温度范围		-65		+150	°C
T _A	工作温度范围		-35		+85	°C
T _J	结温				125	°C
T _L	引脚焊接温度	60 s, DIP			300	°C
		10 s, SOIC			260	
P _D	功耗	T _A < 50°C	SOIC		300	mW
			PDIP		450	
		T _A < 50°C 降额	SOIC		4	mW/°C
			PDIP		6	
Θ _{JA}	热阻	SOIC		240	°C/W	
		PDIP		160		

电气特性

 $I_S = 1.5 \text{ mA}$ 且 $T_A = +25^\circ\text{C}$ 。

符号	参数	工作条件	最小值	典型值	最大值	单位
	检测器参考电压	引脚 7 至引脚 3	6.8	7.2	8.1	$\pm\text{V}$
并联稳压器						
$+V_S$	齐纳电压	引脚 6 至引脚 4	25.0	26.0	29.2	V
V_{REF}	参考电压	引脚 3 至引脚 4	12.5	13.0	14.6	V
I_S	静态电流	$+V_S = 24 \text{ V}$		450	750	μA
运算放大器						
	失调电压	引脚 2 至引脚 3	-3.0	0.5	+3.0	mV
	+输出电压摆幅	引脚 7 至引脚 3	6.8	7.2	8.1	V
	-输出电压摆幅	引脚 7 至引脚 3	-9.5	-11.2	-13.5	V
	+输出源电流	引脚 7 至引脚 3		650		μA
	-输出源电流	引脚 7 至引脚 3		1.0		mA
	增益带宽积	$f = 50 \text{ kHz}$	1.0	1.8		MHz
电阻						
R1	电阻, $I_S = 0 \text{ mA}$	引脚 1 至引脚 3		10		k Ω
R2		引脚 2 至引脚 3		10		
R3		引脚 5 至引脚 4	3.5	4.7	5.9	
SCR触发						
	检测器开	引脚 5 至引脚 4	1.5	2.8		V
	检测器关		0	1	10	mV

电气特性

 $I_S = 1.5 \text{ mA}$ 且 $-35^\circ\text{C} \leq T_A \leq +85^\circ\text{C}$ 。

符号	参数	工作条件	最小值	典型值	最大值	单位
	检测器参考电压	引脚 7 至引脚 3	6.5	7.2	8.3	$\pm\text{V}$
并联稳压器						
$+V_S$	齐纳电压	引脚 6 至引脚 4	24	26	30	V
V_{REF}	参考电压	引脚 3 至引脚 4	12	13	15	V
I_S	静态电流	$+V_S = 23 \text{ V}$		500		μA
运算放大器						
	失调电压	引脚 2 至引脚 3	-5.0	0.5	+5.0	mV
	+输出电压摆幅	引脚 7 至引脚 3	6.5	7.2	8.3	V
	-输出电压摆幅	引脚 7 至引脚 3	-9.0	-11.2	-14.0	V
	增益带宽积	$f = 50 \text{ kHz}$		1.8		MHz
电阻						
R1	电阻, $I_S = 0 \text{ mA}$	引脚 1 至引脚 3		10		k Ω
R2		引脚 2 至引脚 3		10		
R3		引脚 5 至引脚 4	3.5	4.7	5.9	
SCR触发						
	检测器开	引脚 5 至引脚 4	1.3	2.8		V
	检测器关		0	3	50	mV

工作原理

将串联齐纳二极管产生的 26 V 并联稳压器电压分为三个参考电压： $\frac{3}{4} V_S$ 、 $\frac{1}{2} V_S$ 和 $\frac{1}{4} V_S$ 。 V_{REF} 等于 $\frac{1}{2} V_S$ ，用作参考以便建立运算放大器同相输入端的 +13 V 人为接地。

图 3 显示采用 RV4145A 的三线式 120 V 交流电源插座 GFI 应用。来自感测变压器的故障信号交流耦合至输入端，并根据下式放大：

$$V_7 = R_{SENSE} \times I_{SENSE} / N \quad (1)$$

其中， V_7 是引脚 7 上相对于引脚 3 的 RMS 电压， R_{SENSE} 是连接引脚 7 和引脚 1 的反馈电阻值， I_{SENSE} 是故障电流（仪表放大器）RMS， N 是变压器匝数比。

当 V_7 相对于引脚 3 超过 ± 7.2 V 时，SCR 触发输出变为高电平，启动外部 SCR。

V_7 等式取近似值，因为它没有将感测变压器特性纳入计算。

当短路或故障使得感测变压器和中性接地变压器之间的磁路通道关闭时，便完成了中性接地故障检测。其产生的交流耦合使围绕运算放大器的正反馈路径闭合，并且运算放大器开始振荡。当振荡电压峰值超过 SCR 触发比较器阈值时，SCR 输出变为高电平。

并联稳压器

R_{LINE} 限制进入并联稳压器的电流；在 220 V 应用中必须以 47 k Ω 电阻代替。除了为 IC 提供电源，并联稳压器还产生内部参考电压。

运算放大器

R_{SENSE} 表示反馈电阻，可用来设置增益，进而设置一般故障的灵敏度。如需调节 R_{SENSE} ，应施加所需的故障电流（UL 943 标准中电流存在 5 mA 差异），然后向上调节 R_{SENSE} ，直到激活 SCR。 R_{SENSE} 可以采用固定电阻，因为 $\pm 15\%$ 的灵敏度变化符合 UL 943 4-6 mA 规范。

滚降频率高于中性接地故障振荡频率，以便保持用于振荡的环路增益（由 200:1 变压器电感和 C4 确定）。

通过改变振荡频率，可调节中性接地故障灵敏度。降低正反馈电路的环路增益后，增加频率会降低灵敏度。随着频率增加，信号开始衰减，环路增益下降。采用图 3 中的数值，则利用 2 Ω 或数值更低的电阻可使电路检测中性接地。

利用背对背二极管，可防止运算放大器输入遭受过压。

硅控整流器 (SCR) 驱动器

SCR 必须具有高 dV/dt 额定值，才能确保线路噪声（由会发出噪声的设备产生，比如钻孔电机）不会误触发 SCR。SCR 的栅极驱动要求必须小于 200 μA 。 C_F 是一个噪声滤波器电容，可防止窄脉冲触发 SCR。

继电器电磁阀的响应时间应小于等于 3 ms，以满足 UL 943 的时序要求。

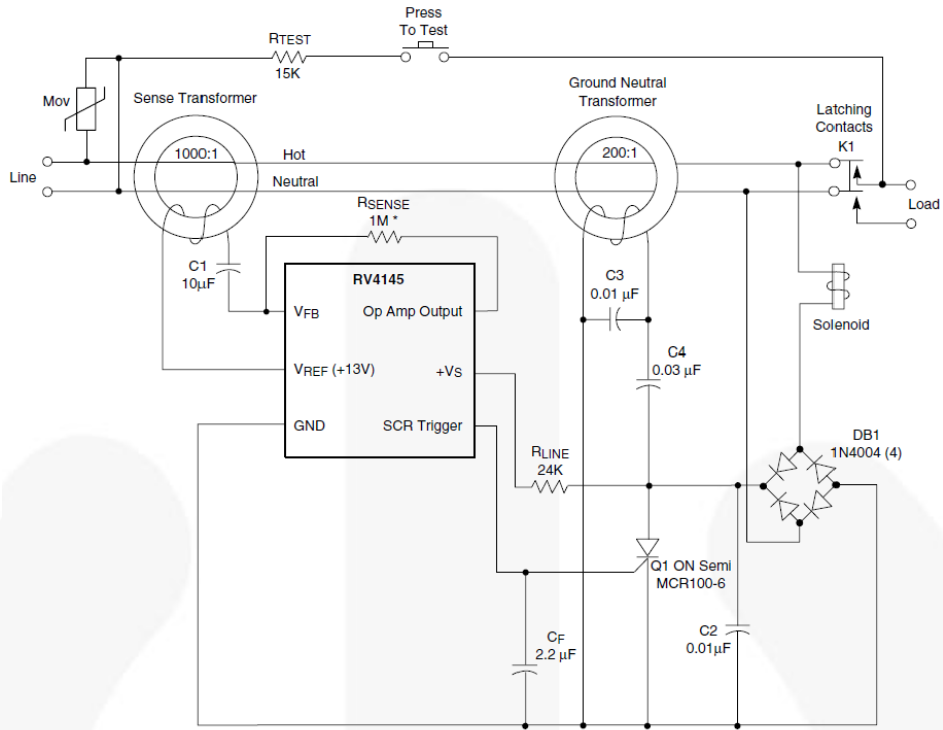
感测变压器和磁芯

感测和中性接地变压器磁芯通常使用高磁导率的层叠钢环制造。它们的单匝主电流由通过其磁芯的线路和中性线产生。次级线圈通常是 200 到 1500 匝。

Magnetic Metals Corporation www.magmet.com 是全系列环形磁芯和变压器供应商，产品专为 GFI 应用而设计。

双线式应用电路

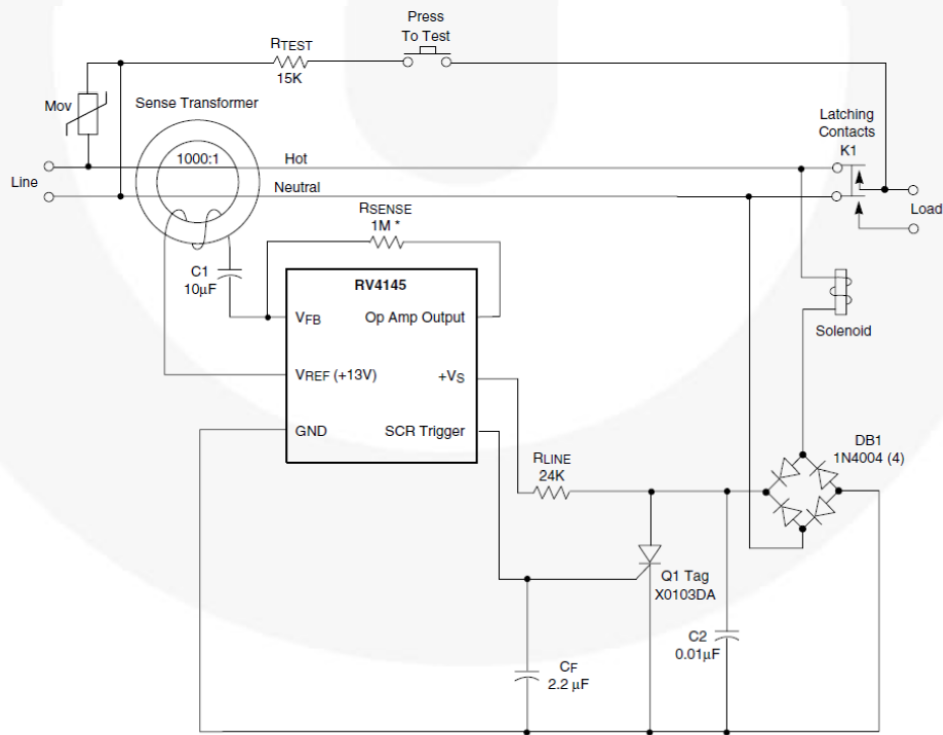
图 4 显示采用 RV4145A 的双线式 120 V 交流电源插座 GFI 电路框图。该电路并非设计用来检测中性接地故障。由于这个原因，图 3 的中性接地变压器、电容 C3 和 C4 未被使用。



65-4145A-03

* Value depends on transformer characteristics.

图 3. GFI 应用电路 (三线式插头)

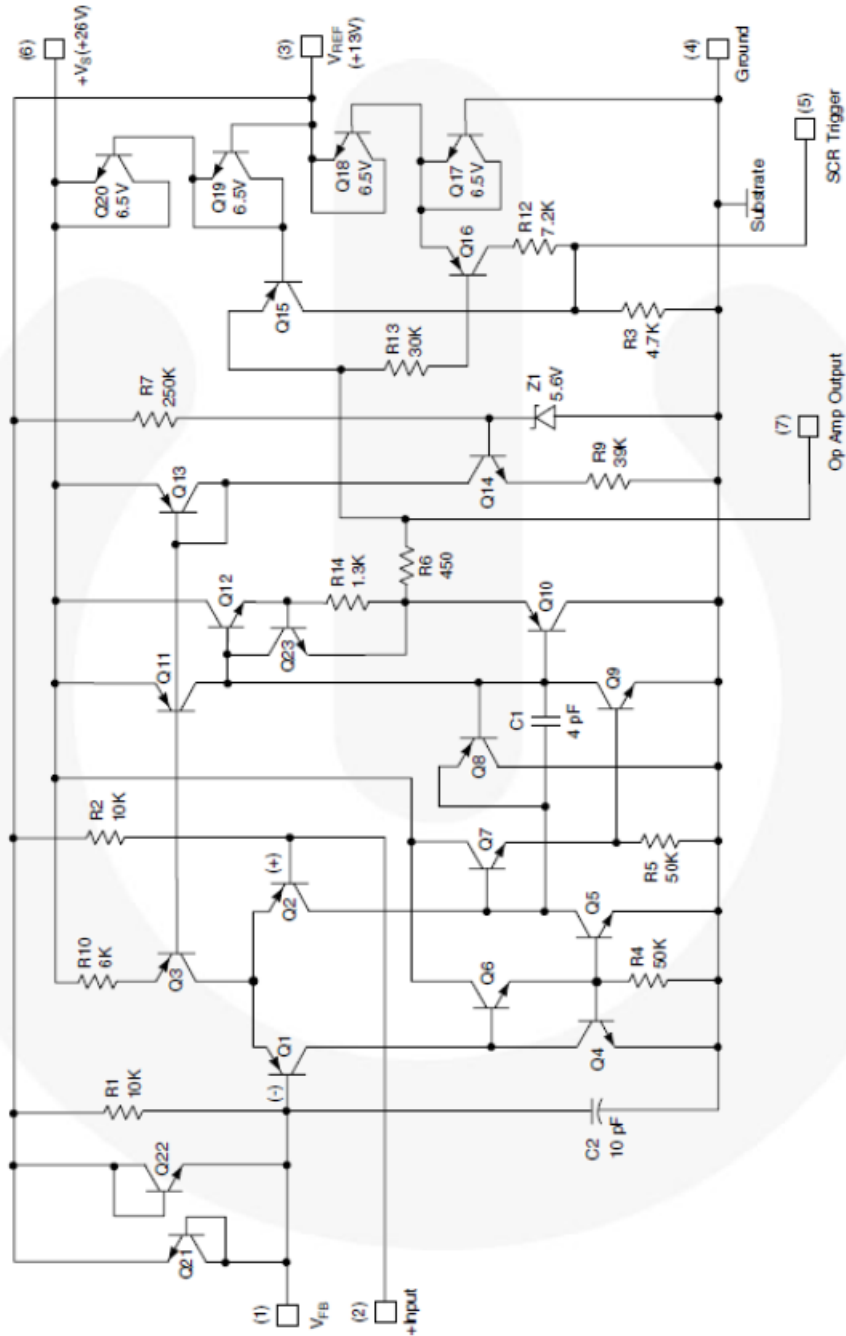


65-4145A-04

* Value depends on transformer characteristics.

图 4. GFI 应用电路 (双线式插头)

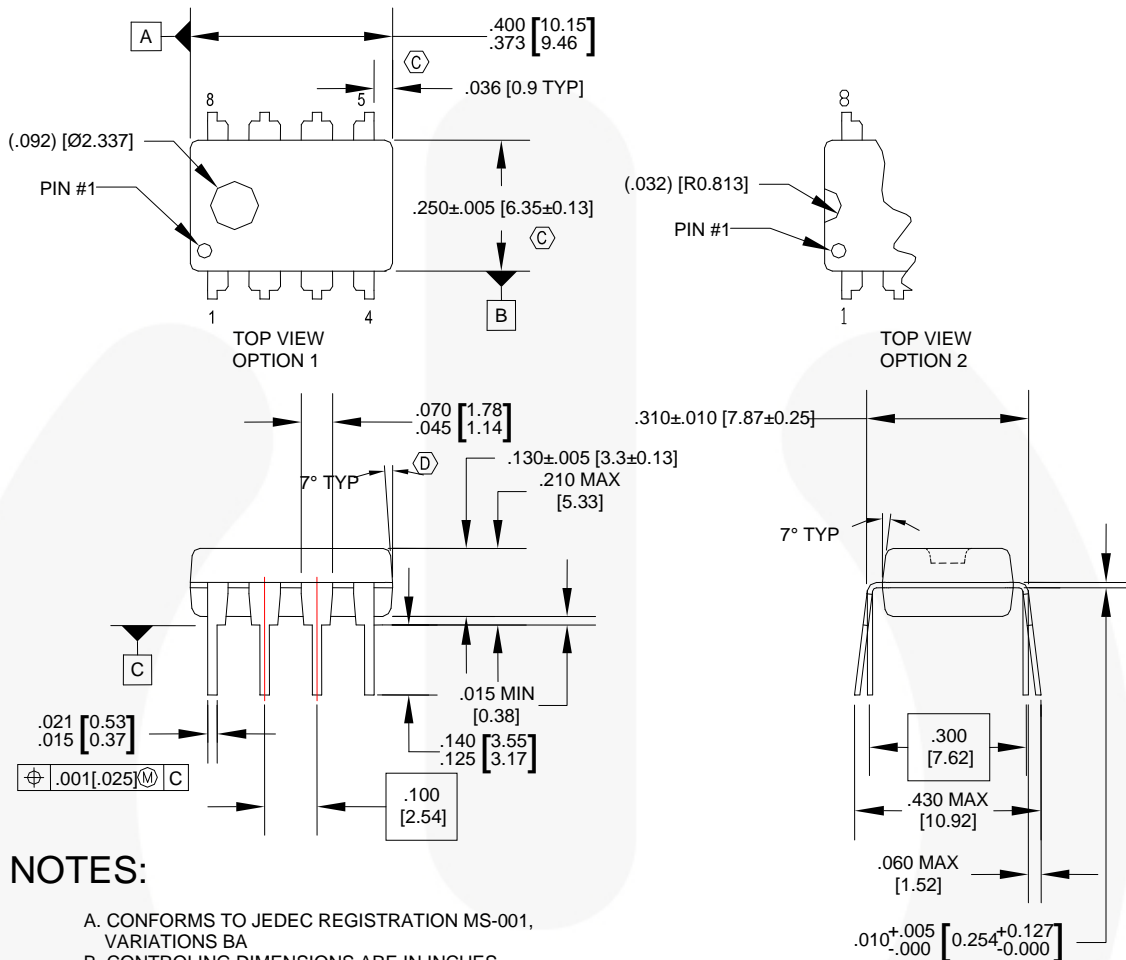
原理示意图



65-4145A-05

图 5. 原理图

物理尺寸



N08EREVG

图 6. 8 引脚、MDIP、JEDEC MS-001、300" 宽

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物理尺寸

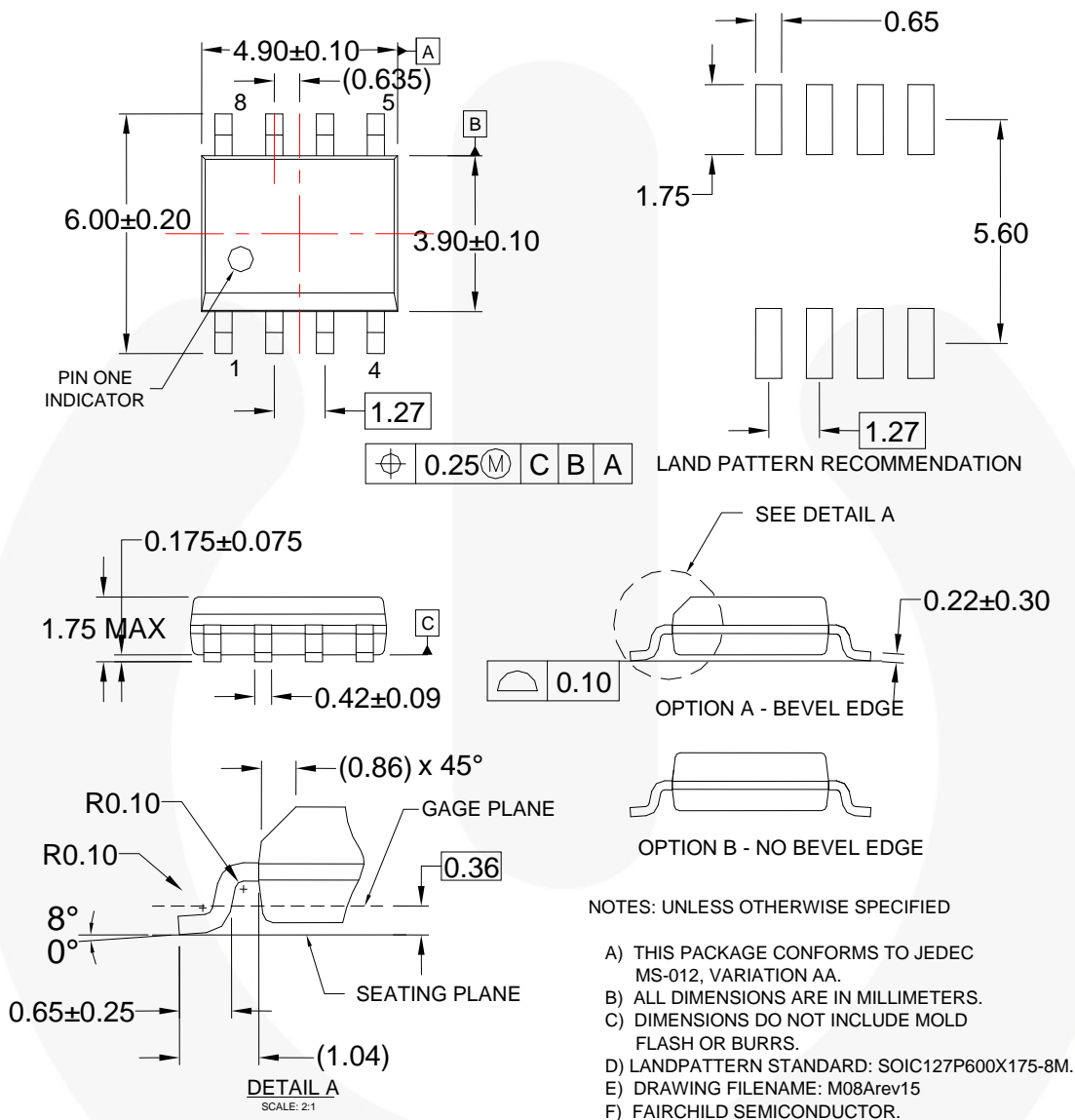


图 7. 8 引线, SOIC, JEDEC MS-012, 0.150 英寸窄体

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