

用于两相无桥功率因数校正的 PFC SPM[®] 3 系列

FPDB60PH60B

概述

FPDB60PH60B 是先进的 PFC SPM 3 模块，为消费、医药和工业应用提供非常全面的高性能无桥功率因数校正输入功率平台。这些模块综合优化了内置 IGBT 的栅极驱动以最小化电磁干扰和能量损耗。同时也提供多重模组保护特性，集成欠压闭锁，过流保护，热量监测和故障报告。这些模块内的高性能输出二极管和分流电阻，为额外节省空间和方便安装起到了重要作用。

特性

- 通过 UL 第 E209204 号认证 (UL1557)
- 600 V – 60 A 两相无桥功率因数校正，包含栅极驱动和保护的控制 IC
- 采用 DBC (AlN) 基板实现非常低的热阻
- 内置负温度系数热敏电阻可实现温度监测
- 内置分流电阻可实现电流感应
- 针对 20 kHz 开关频率进行优化
- 绝缘等级：2500 Vrms / 分钟
- This is a Pb-Free Device

应用

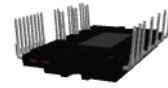
- 两相无桥功率因数校正转换器

相关资料

- [AN-9041 – Bridgeless PFC SPM 3 Series Design Guide](#)

集成的驱动、保护和系统控制功能

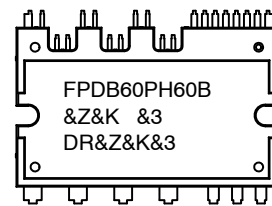
- 对于 IGBT: 栅极驱动电路、过流保护(OCP)、控制电源欠压锁定(UVLO) 保护
- 故障信号：对应 OC 和 UV 故障
- 内置热敏电阻：温度监控
- 输入接口：高电平有效接口，可用于 3.3 / 5 V 逻辑电平，施密特触发脉冲输入



3D Package Drawing
(Click to Activate 3D Content)

SPMCA-027 / PDD STD, SPM27-CA, DBC TYPE
CASE MODFJ

MARKING DIAGRAM



&Z = Assembly Plant Code
&K = 2-Digits Lot Run Traceability Code
&3 = 3-Digit Date Code
FPDB60PH60B = Specific Device Code

ORDERING INFORMATION

See detailed ordering and shipping information on page 9 of this data sheet.

FPDB60PH60B

引脚布局

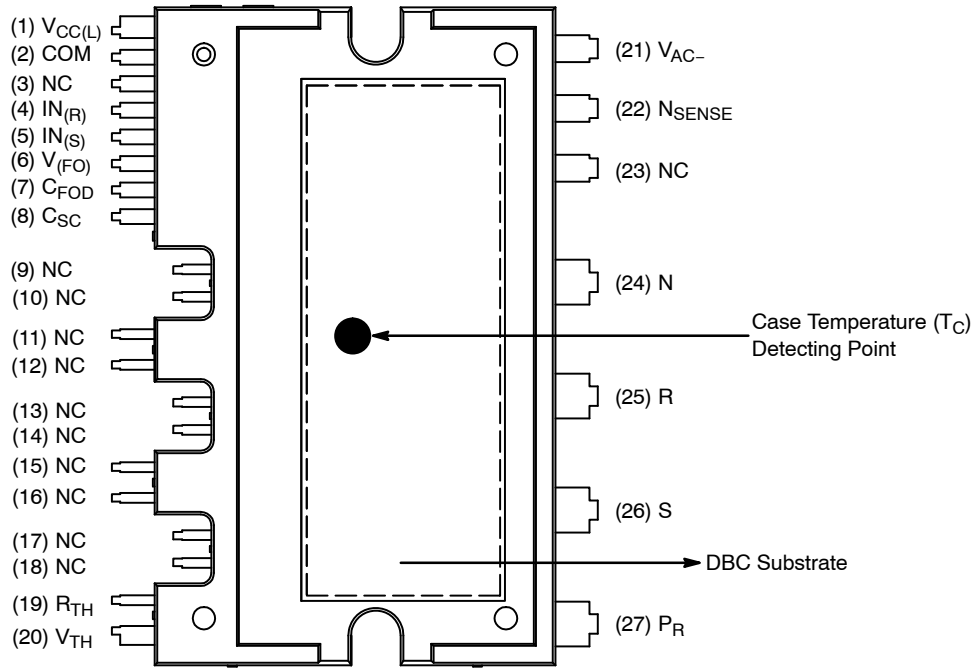


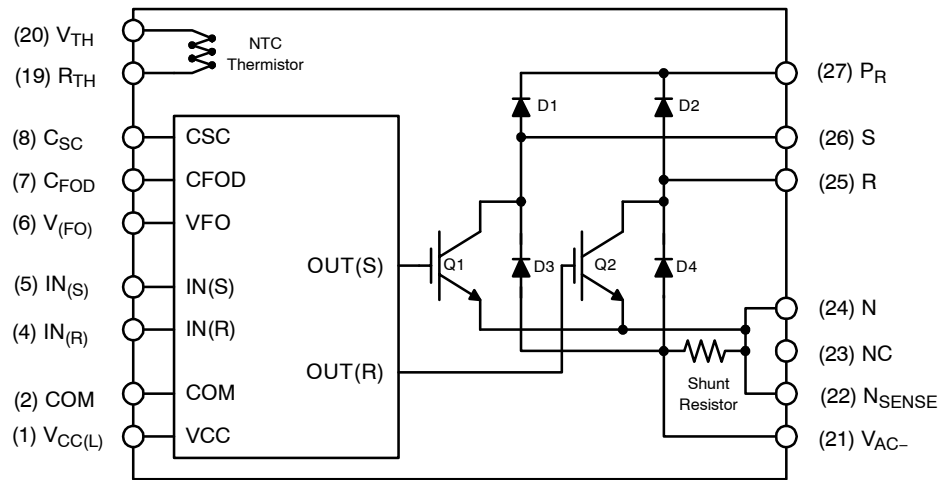
图 1. 俯视图

引脚描述

引脚号	引脚名	引脚描述
1	V_{CC}	IC 和 IGBT 驱动的公共偏压
2	COM	公共电源接地
4	$IN_{(R)}$	低端 R 相 IGBT 的信号输入
5	$IN_{(S)}$	低端 S 相 IGBT 的信号输入
6	V_{FO}	故障输出
7	C_{FOD}	设置故障输出持续时间的电容
8	C_{SC}	过电流感测电容 (低通滤波器)
19	$R_{(TH)}$	供热敏电阻使用的串联电阻器
20	$V_{(TH)}$	热敏电阻偏压
21	V_{AC-}	电流感测端
22	N_{SENSE}	电流感测参考端
24	N	直流负端
25	R	R 相输出
26	S	S 相输出
27	P_R	直流正端
3, 9 ~ 18, 23	NC	无连接

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内部等效电路



注:

1. 转换器由两个 IGBT 组成，内置有四个二极管，以及一个具有栅极驱动和保护功能的 IC。

图 2. 内部框图

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绝对最大额定值 ($T_J = 25^{\circ}\text{C}$, 除非另有说明。)

符号	项目	条件	额定值	单位
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转换器部分

V_i	电源电压	施加在 R - S 之间	264	V_{rms}
$V_{i(Surge)}$	电源电压 (浪涌)	施加在 R - S 之间	500	V
V_{PN}	输出电压	施加在 P - N 之间	450	V
$V_{PN(Surge)}$	输出电压 (浪涌)	施加在 R - N 之间	500	V
V_{CES}	集电极 - 发射极之间电压		600	V
$\pm I_C$	单个 IGBT 的集电极电流	$T_C = 25^{\circ}\text{C}$	60	A
$\pm I_{CP}$	单个 IGBT 的集电极电流 (峰值)	$T_C = 25^{\circ}\text{C}$, 脉冲宽度小于 1 ms	90	A
P_C	集电极功耗	$T_C = 25^{\circ}\text{C}$ 单个 IGBT	178	W
V_{RRM}	重复峰值反向电压		600	V
I_{FSM}	正向浪涌峰值电流	单一正弦半波	350	A
P_{RSH}	分流电阻的额定功率	$T_C < 125^{\circ}\text{C}$	2	W
T_J	工作结温	(注 2)	-40 ~ 150	$^{\circ}\text{C}$

热阻

V_{CC}	控制电源电压	施加在 $V_{CC} - \text{COM}$ 之间	20	V
V_{IN}	输入信号电压	施加在 $IN - \text{COM}$ 之间	-0.3 ~ 17.0	V
V_{FO}	故障输出电源电压	施加在 $V_{FO} - \text{COM}$ 之间	-0.3 ~ $V_{CC} + 0.3$	V
I_{FO}	故障输出电流	V_{FO} 引脚处的灌电流	5	mA
V_{SC}	电流感测输入电压	施加在 $CSC - \text{COM}$ 之间	-0.3 ~ $V_{CC} + 0.3$	V

整个系统

T_C	模块壳体工作温度		-30 ~ 100	$^{\circ}\text{C}$
T_{STG}	存储温度		-40 ~ 150	$^{\circ}\text{C}$
V_{ISO}	绝缘电压	60 Hz, 正弦波形, 交流 1 分钟, 连接陶瓷基板到引脚	2500	V_{rms}

Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

(参考译文)

如果电压超过最大额定值表中列出的值范围, 器件可能会损坏。如果超过任何这些限值, 将无法保证器件功能, 可能会导致器件损坏, 影响可靠性。

2. PFC SPM 产品中集成的功率芯片的最大结温额定值为 150°C (@ $T_C \leq 100^{\circ}\text{C}$)。

热阻

符号	项目	条件	最小值	典型值	最大值	单位
$R_{\theta(j-c)Q}$	结点 - 壳体的热阻 (参考 PKG 中心)	IGBT	-	-	0.7	$^{\circ}\text{C}/\text{W}$
$R_{\theta(j-c)HD}$		高端二极管	-	-	1.5	$^{\circ}\text{C}/\text{W}$
$R_{\theta(j-c)LD}$		低端二极管	-	-	0.85	$^{\circ}\text{C}/\text{W}$

3. 关于壳体温度 (T_C) 的测量点, 请参见图 1。

电气特性 (T_J = 25°C, 除非另有说明。)

符号	项目	条件	最小值	典型值	最大值	单位
转换器部分						
V _{CE(SAT)}	IGBT 饱和电压	V _{CC} = 15 V, V _{IN} = 5 V, I _C = 50 A	–	2.0	2.5	V
V _{FH}	高端二极管电压	I _F = 50 A	–	2.4	2.9	V
V _{FL}	低端二极管电压	I _F = 50 A	–	1.2	1.6	V
t _{ON}	开关时间	V _{PN} = 400 V, V _{CC} = 15 V, I _C = 60 A, V _{IN} = 0 V ↔ 5 V, 电感负载 (注 4)	–	560	–	ns
t _{C(ON)}			–	270	–	ns
t _{OFF}			–	520	–	ns
t _{C(OFF)}			–	110	–	ns
t _{rr}			–	44	–	ns
I _{rr}			–	6.5	–	A
R _{SENSE}	电流感测电阻		1.8	2.0	2.2	mΩ
I _{CES}	集电极 – 发射极间漏电流	V _{CE} = V _{CES}	–	–	250	μA

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

(参考译文)
除非另有说明，“电气特性”表格中列出的是所列测试条件下的产品性能参数。如果在不同条件下运行，产品性能可能与“电气特性”表格中所列性能参数不一致。
4. t_{ON} 和 t_{OFF} 包括模块内部驱动 I_C 的传输延迟时间。t_{C(ON)} 和 t_{C(OFF)} 指在内部给定的栅极驱动条件下，IGBT 本身的开关时间。详细信息，请参见图 3。

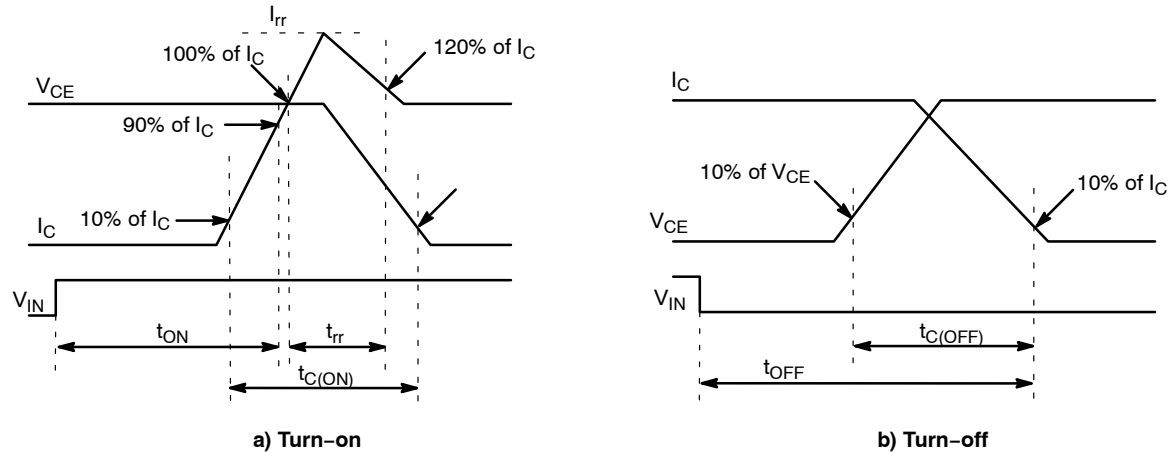


图 3. 开关时间的定义

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电气特性 (T_J = 25°C, 除非另有说明。)

符号	项目	条件	最小值	典型值	最大值	单位
控制部分						
I _{QCCL}	V _{CC} 静态电源电流	V _{CC} = 15 V, I _N = 0 V	V _{CC} - COM	-	-	26 mA
V _{FOH}	故障输出电压	V _{SC} = 0 V, V _{FO} 电路: 4.7 kΩ 至 5 V 上拉	4.5	-	-	V
V _{FOL}		V _{SC} = 1 V, V _{FO} 电路: 4.7 kΩ 至 5 V 上拉	-	-	0.8	V
V _{SC(ref)}	过电流保护触发电平	V _{CC} = 15 V	0.45	0.50	0.55	V
UV _{CCD}	电源电路欠压保护	检测电平	10.7	11.9	13.0	V
UV _{CCR}		复位电平	11.2	12.4	13.2	V
t _{FOD}	故障输出脉宽	C _{FOD} = 33 nF (注 5)	1.4	1.8	2.0	ms
V _{IN(ON)}	导通阈值电压	施加在 IN - COM 之间	3.0	-	-	V
V _{IN(OFF)}	关断阈值电压-		-	-	0.8	V
R _{TH}	热敏电阻的阻值	At T _C = 25°C (见图 4)	-	50	-	kΩ
		At T _C = 80°C (见图 4)	-	5.76	-	kΩ

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

(参考译文)

除非另有说明, “电气特性” 表格中列出的是所列测试条件下的产品性能参数。如果在不同条件下运行, 产品性能可能与 “电气特性” 表格中所列性能参数不一致。

5. 故障输出脉宽 t_{FOD} 取决于电容 C_{FOD} 的值, 可采用下面的近似公式进行计算: C_{FOD} = 18.3 × 10⁻⁶ × t_{FOD}[F]

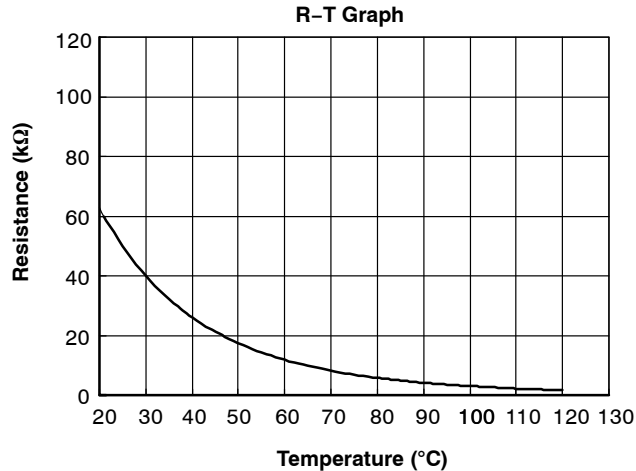


图 4. 内置热敏电阻的 R-T 曲线

推荐工作条件

符号	项目	条件	最小值	典型值	最大值	单位
V _I	输入电源电压	施加在 R - S 之间	180	-	264	V _{rms}
V _{PN}	输出电压	施加在 P - N 之间	-	280	400	V
V _{CC}	控制电源电压	施加在 VCC - COM 之间	13.5	15	16.5	V
dV _{CC} / dt	控制电源波动	施加在 IN - COM 之间	-1	-	1	V/μs
f _{PWM}	PWM 输入信号	T _C ≤ 100°C, T _J ≤ 125°C, 单个 IGBT	-	20	-	kHz

Functional operation above the stresses listed in the Recommended Operating Ranges is not implied. Extended exposure to stresses beyond the Recommended Operating Ranges limits may affect device reliability.

(参考译文)

高于推荐工作范围表格中所列电压时, 不保证能够正常运行。长时间在推荐工作范围表格中规定范围以外的电压下运行, 可能会影响器件的可靠性。

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机械特性和额定值

项目	条件		最小值	典型值	最大值	单位
安装扭矩	安装螺钉：M3	建议 0.62 N•m	0.51	0.62	0.72	N•m
器件平面度	见图 5		0	–	+120	μm
重量			–	15.00	–	g

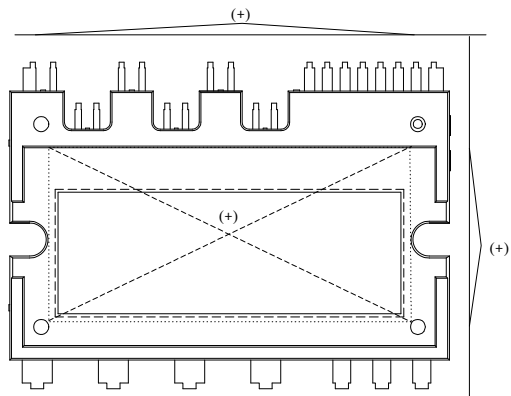
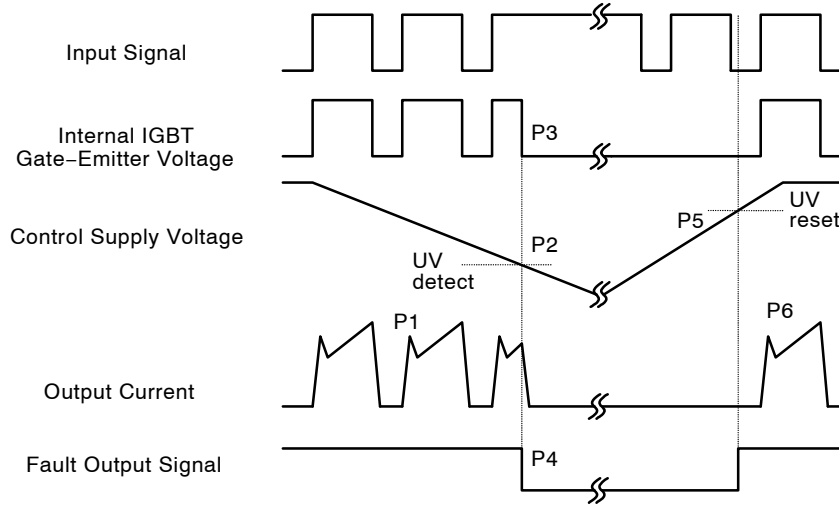


图 5. 平面度测量位置

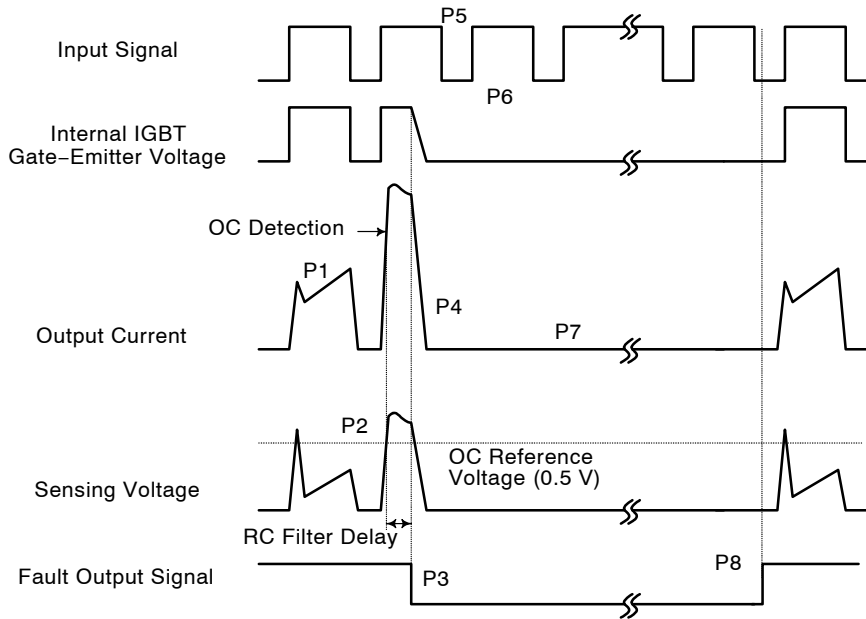
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保护功能时序图



- P1: 正常工作: IGBT 导通并传导电流。
P2: 欠压检测。
P3: IGBT 栅极中断。
P4: 故障信号产生。
P5: 欠压复位。
P6: 正常工作: IGBT 导通并传导电流。

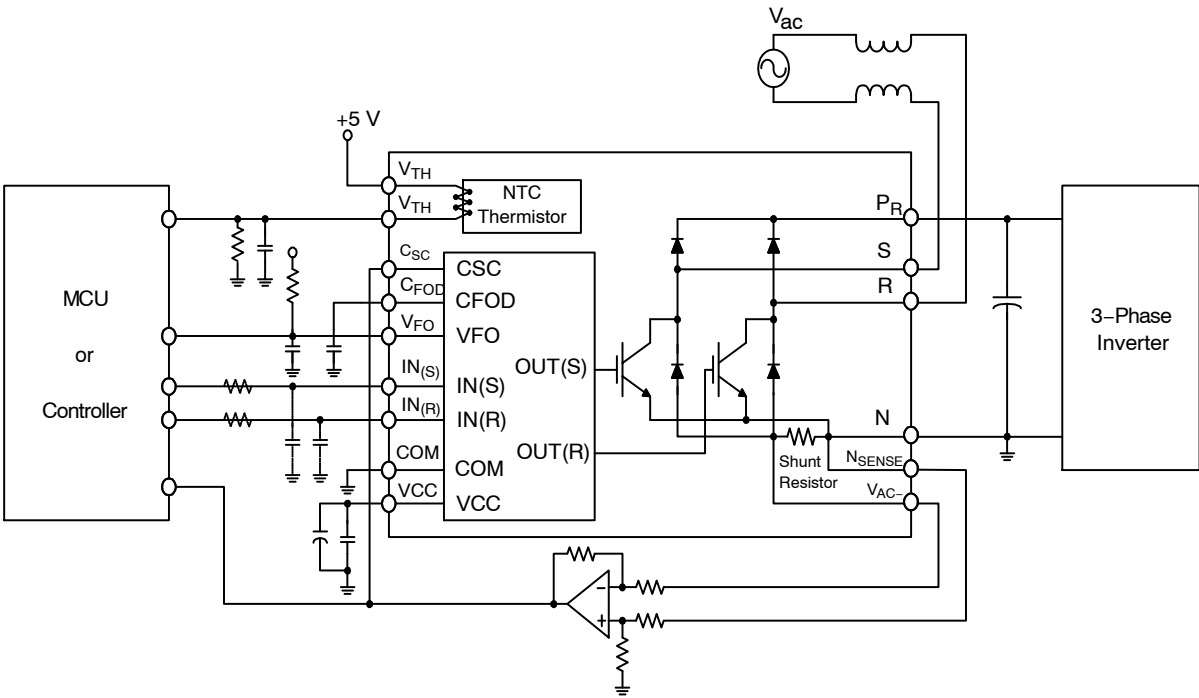
图 6. 欠压保护



- P1: 正常工作: IGBT 导通并传导电流。
P2: 过流检测。
P3: IGBT 栅极中断 / 故障信号产生。
P4: IGBT 缓慢关断。
P5: IGBT 关断信号。
P6: IGBT 导通信号: 但是在故障输出有效的时间内, IGBT 不导通。
P7: IGBT 关断状态。
P8: 故障输出复位并启动正常工作。

图 7. 过流保护

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注：
6. 关于过流保护，时间常数应在 3 ~ 4 μ s 的范围内进行选择。

图 8. 应用实例

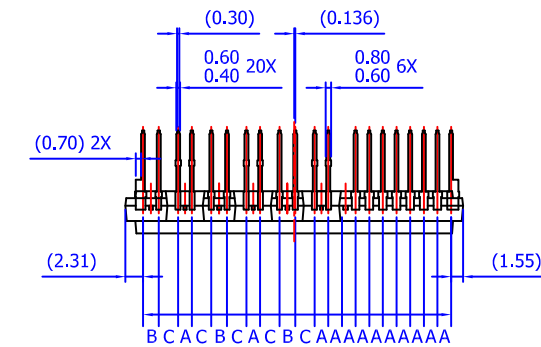
封装标识与订购信息

器件	器件标识	封装	Shipping
FPDB60PH60	FPDB60PH60B	SPMCA-027 / PDD STD, SPM27-CA, DBC TYPE (Pb-Free / Halide Free)	60 Units / Tube

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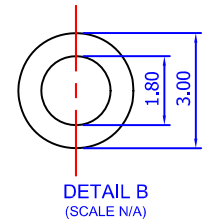
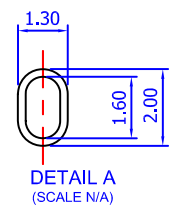
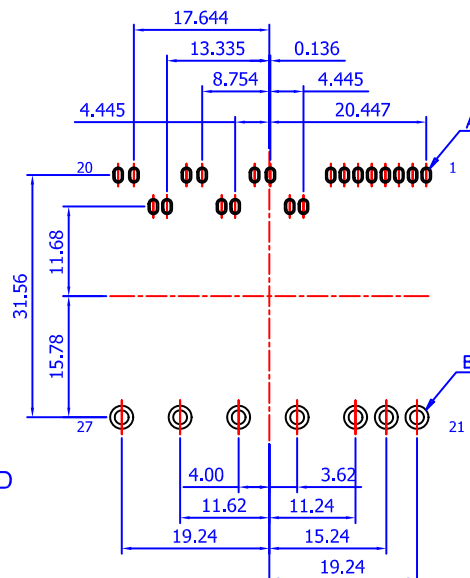
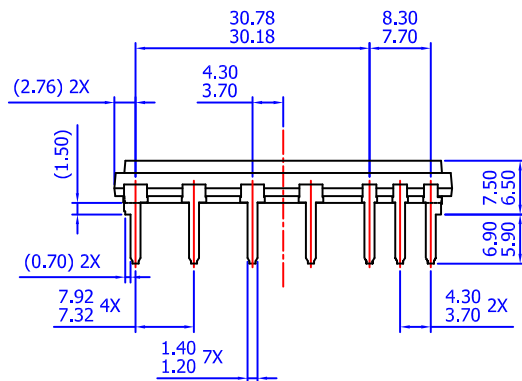
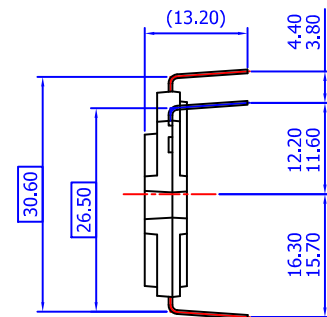
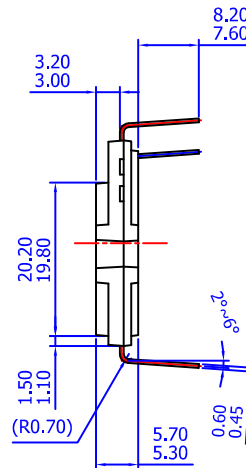
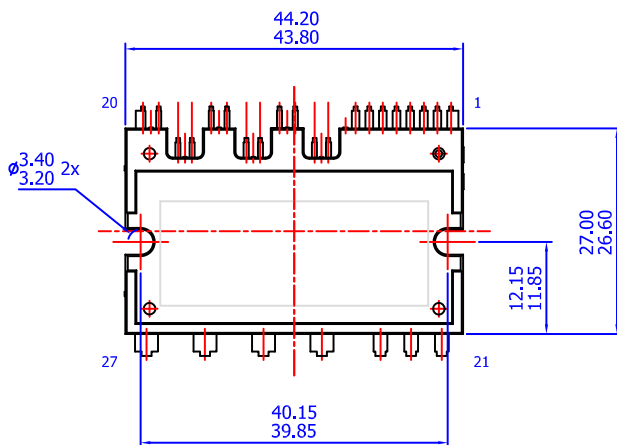
SPMCA-027 / PDD STD, SPM27-CA, DBC TYPE
CASE MODFJ
ISSUE O

DATE 31 JAN 2017



LEAD PITCH (TOLERANCE : ± 0.30)

A : 1.778
B : 2.050
C : 2.531



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