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系统方案指南 – 预览

热泵



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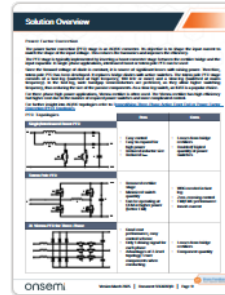
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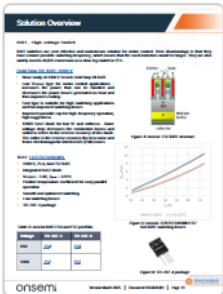
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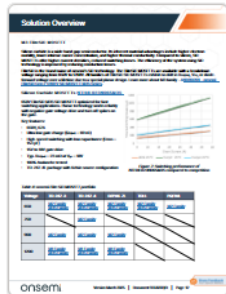
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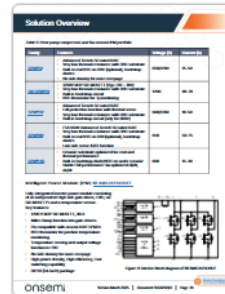
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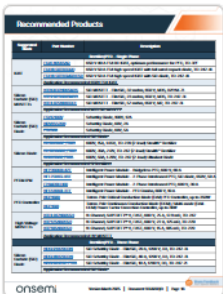
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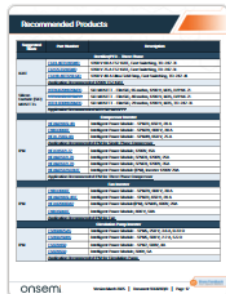
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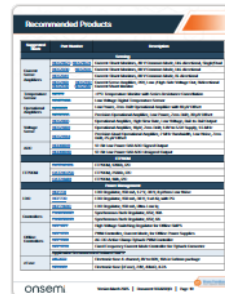
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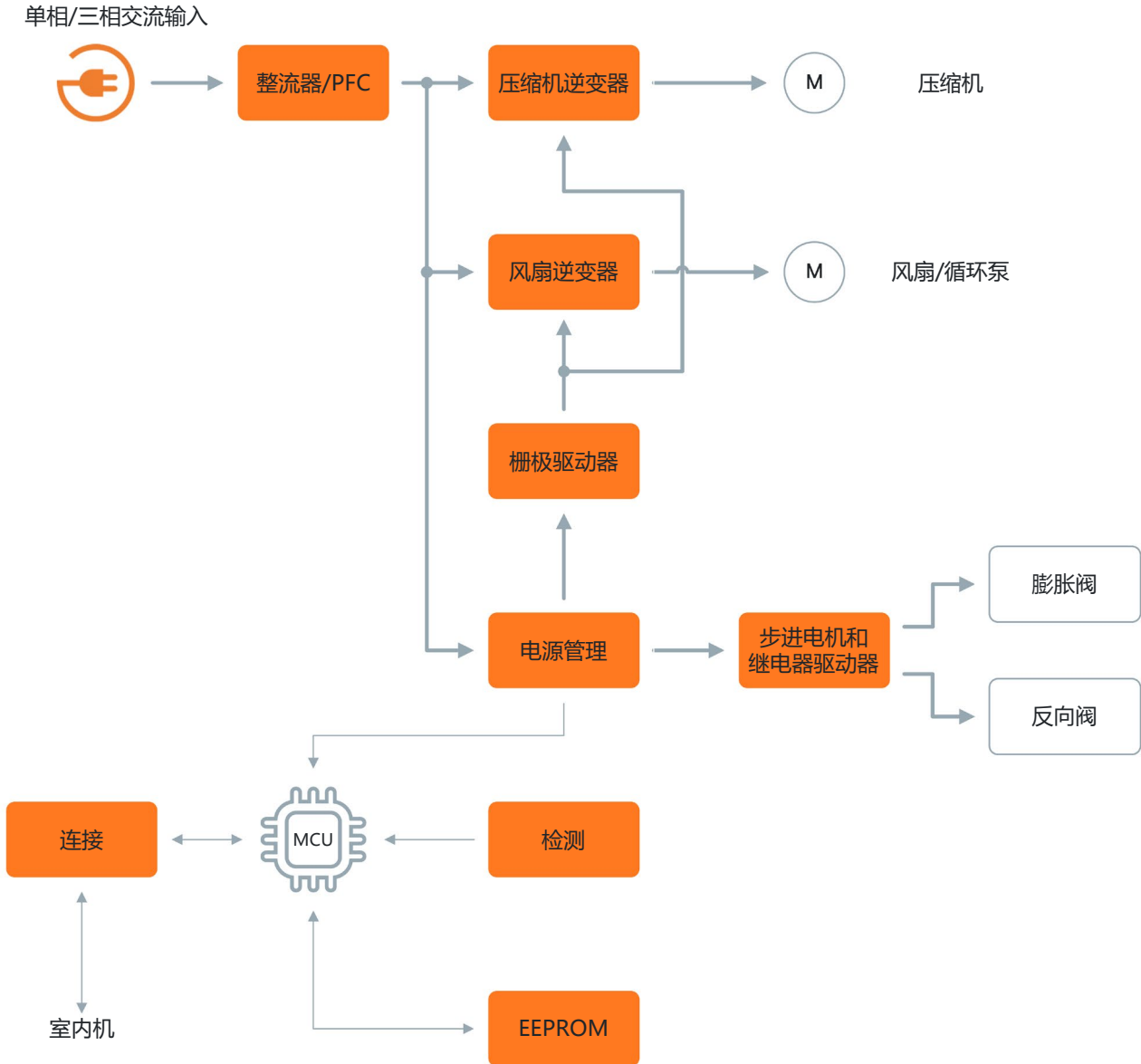
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热泵室外机顶层拓扑结构

下图为安森美 (onsemi) 推荐的热泵室外机方案框图。热泵系统的室外机包含蒸发器 (空气源热泵) 或地热交换器 (地源热泵)。其他主要部件包括循环泵、压缩机和风扇。上述所有应用都需要逆变器, 而 IGBT IPM 通常可以满足这一需求。其他模块包括检测 (电压、电流、温度)、CPU 和与室内机的连接。



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智能功率模块 (IPM)

智能功率模块是一种高度集成的器件，用作电源开关，是目前集成度最高的器件之一。IPM 可采用 IGBT 或 Si MOSFET 设计，常用于电机控制应用、风扇、水泵和通用驱动器。IPM 不仅可以将功率开关和栅极驱动器集成到单个封装中，还可以将 PFC 级和/或无源器件（如 NTC）集成到单个封装中。其他优点包括改善电磁干扰、优化空间利用、降低功率损耗，从而更容易进行散热设计。

IPM 功能特性

- IPM 包含逆变器功率级、栅极驱动器、NTC（可选）、自举二极管和功率开关
- 将单相和三相输入交流驱动器的功率提高到 1-20kW
- 直接键合铜：
 - 优异的导热系数：24(Al₂O₃) 至 170 (AlN) W/mK
 - 高效隔离，无任何性能下降：>20kV/mm
 - 极高的电阻率 > 10Ωcm @20°C
 - 宽温度范围
 - 用于 P2P 替换的常见封装类型

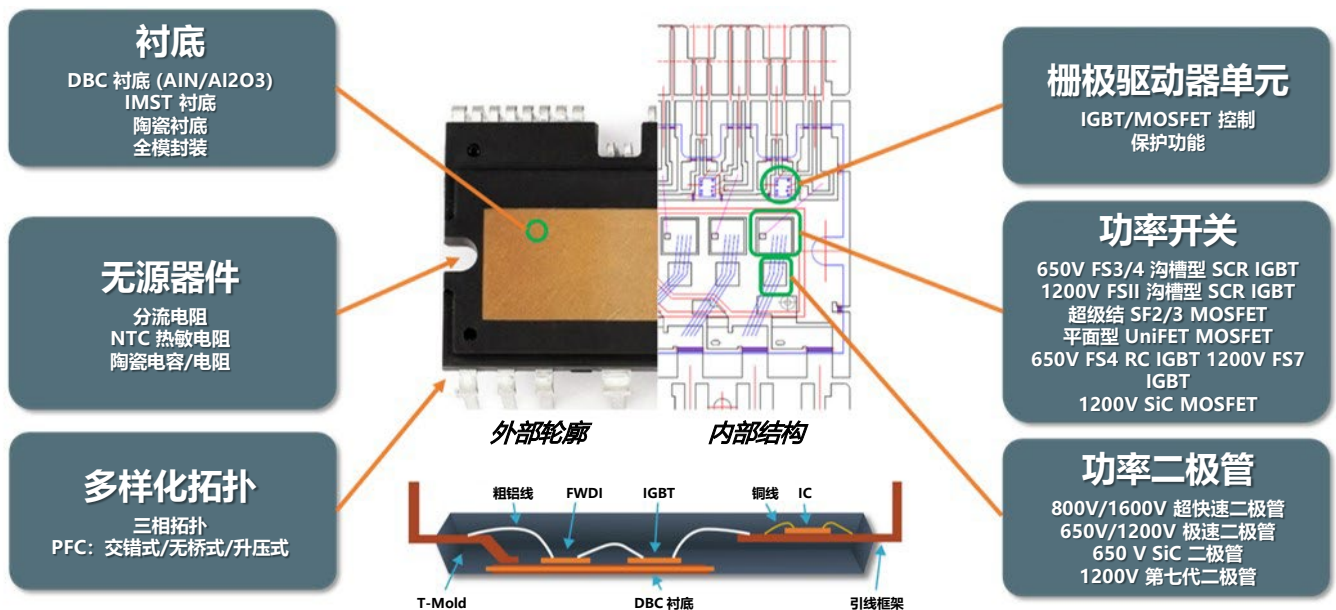


图 8: 安森美 IPM 的集成度

热泵的功率等级因预期用途而异。一般来说，家用热泵的功率在 2kW 至 7kW 之间，而商用三相热泵的功率在 8kW 至 15kW 之间。

IPM 用途极为广泛，在热泵系统中可用于控制以下组件：

- 主压缩机 – 600/1200V
- 室内机风扇 – 600V 单相
- 循环泵 – 600V 单相，低功率
- 室外机风扇 – 600/1200V

表 5: 安森美 IPM 产品组合中的热泵压缩机和风扇

系列	特性	电压 (V)	电流 (A)
SPM®31	<ul style="list-style-type: none"> • 先进沟槽 SC 级 IGBT • 采用 DBC 衬底时, 热阻极低 • DBC 上内置真实 NTC (可选), 自举二极管 • 无需侧边虚设引脚, 可增加爬电距离 	650/1200	15-50
SiC SPM®31	<ul style="list-style-type: none"> • 1200V M3P SiC MOSFET (Vgs: 0V ~ 18V) • 采用 DBC 衬底时, 热阻极低 • 内置自举电路 • 用于结温监测的 NTC 热敏电阻 	1200	40-70
SPM®3V	<ul style="list-style-type: none"> • 先进沟槽 SC 级 IGBT • 具备热感应检测的全面保护功能 • 采用 DBC 衬底时, 热阻极低 • 内置自举电路 (仅适用于 600V) 	600/1200	10-50
SPM®49	<ul style="list-style-type: none"> • FS4 650V 先进沟槽 SC 级 IGBT • 采用 DBC 衬底时, 热阻极低 • DBC 上内置真实 NTC (可选), 自举二极管 • 下桥感应 IGBT 功能 	650	50-75
SPM® 45	<ul style="list-style-type: none"> • 陶瓷衬底针对成本和散热性能进行了优化 • 陶瓷衬底下方内置自举二极管/NTC • 通过优化 di/dt、dv/dt 实现稳定的 EMI 性能 	600	15-30

智能功率模块 (IPM) [NFAM5312SCBUT](#)

全整合逆变器功率模块, 由独立的上桥栅极驱动器、LVIC、六个 SiC MOSFET 和温度传感器组成。

关键特性:

- 1200V M3P SiC MOSFET, 40A
- 米勒钳位功能集成到栅极驱动器中
- 引脚与安森美 IGBT SPM31 兼容
- 用于结温监测的 NTC 热敏电阻
- LVIC 中的温度检测和输出电压功能
- 无需侧边虚设引脚, 可增加爬电距离
- 高功率密度、高效率、快速开关能力
- DIP39 (54.5x31) 封装

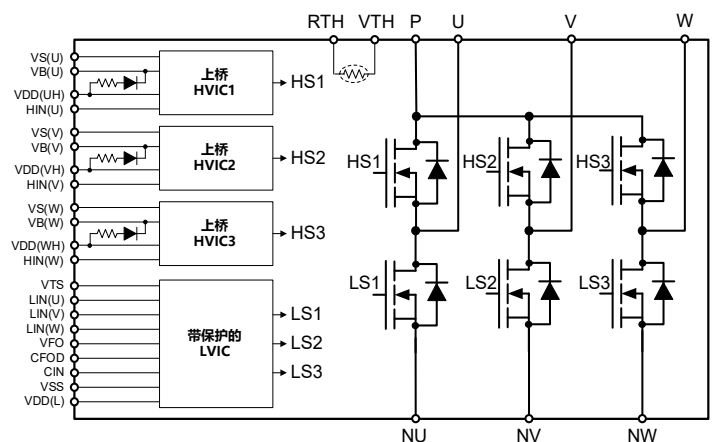


图 9: NFAM5312SCBUT 的内部框图

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