

英飞凌家电生态圈

变频冰箱驱动新动力：iMOTION™ 智能驱动芯片

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2004年毕业于华中科技大学并获得电力电子专业硕士学位，具有丰富的开关电源和电机驱动系统设计经验。2011年加入英飞凌，目前负责北中国地区家电应用的技术支持工作。

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工业功率控制部门
首席应用工程师

英飞凌为变频电机驱动提供灵活的整体方案

Motor Controller + Gate Driver

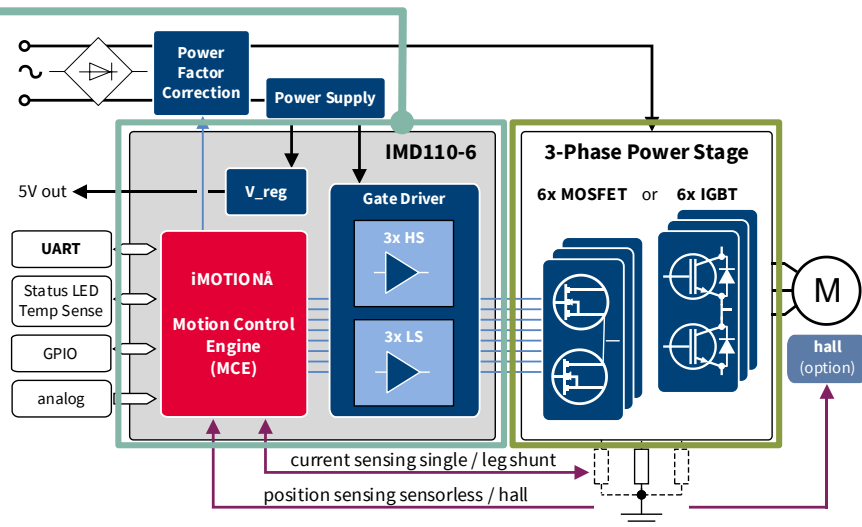
Main component(s)	Product offering
<ul style="list-style-type: none"> > Motor control > .. plus PFC 	<ul style="list-style-type: none"> > IMD111T > IMD112T

Power Stage, MOSFET, high voltage

Main component(s)	Product offering
<ul style="list-style-type: none"> > 6x MOSFET 	<ul style="list-style-type: none"> > CoolMOS™ CFD > CoolMOS™ PFD

Power Stage, IGBT, high voltage

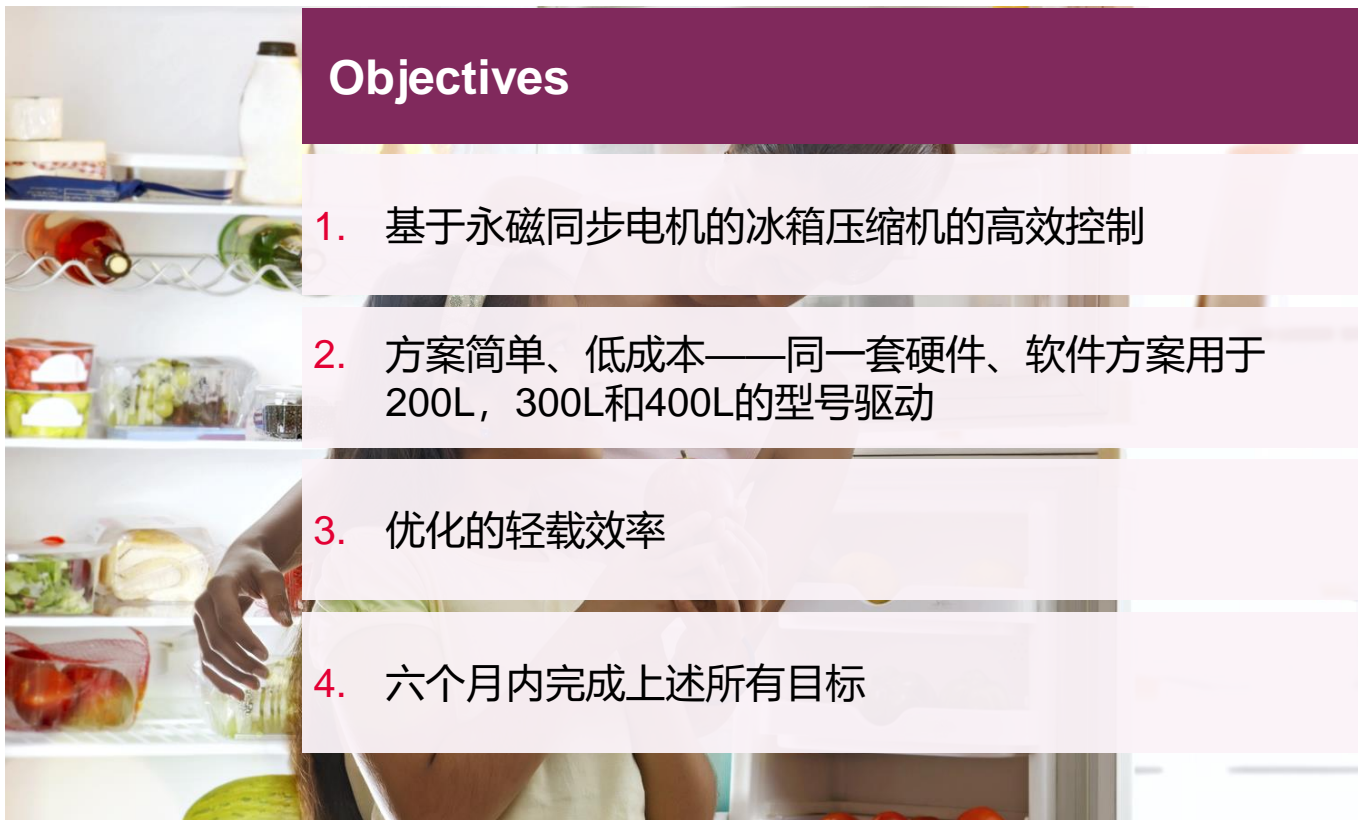
Main component(s)	Product offering
<ul style="list-style-type: none"> > 6x IGBT + diode 	<ul style="list-style-type: none"> > IGBT-RC-D2 > IGBT-6



Power Stage, MOSFET, low voltage

Main component(s)	Product offering
<ul style="list-style-type: none"> > 6x MOSFET 	<ul style="list-style-type: none"> > OptiMOS™ 3/5 > StrongIRFET™

用于变频冰箱压缩机驱动的具体案例

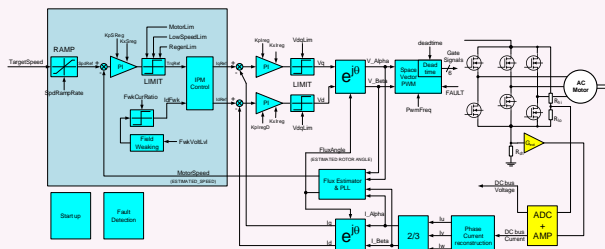


Objectives

1. 基于永磁同步电机的冰箱压缩机的高效控制
2. 方案简单、低成本——同一套硬件、软件方案用于200L, 300L和400L的型号驱动
3. 优化的轻载效率
4. 六个月内完成上述所有目标

1. 用于永磁电机压缩机的高效控制方案

a) MCE是拿来即用的高效永磁电机控制解决方案



b) 高精度的速度控制

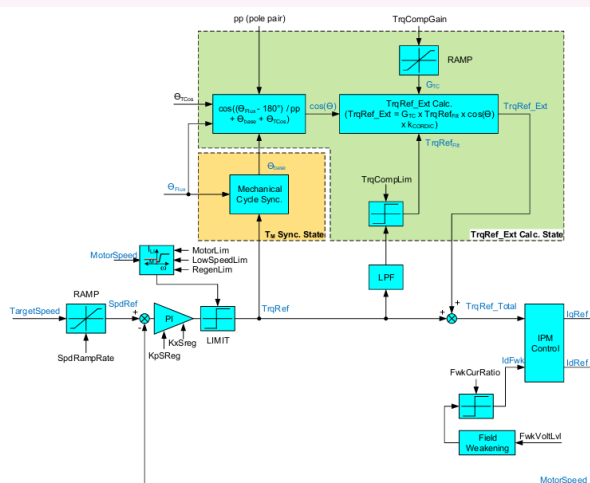
- 压缩机频率可以高达120HZ
- iMOTION™ 2.0 采用了带温度补偿的内部时钟，所以可以达到 $\pm 1\text{Hz}$ 的速度控制精度
- iMOTION™ 2.0 内嵌有温度传感器，(MCE 2.0)每20ms就会校准一次内部时钟
- 实测结果：速度精度 $\pm 0.6\%$ ($T_a: 0 - 105^\circ\text{C}$)



1. 用于永磁电机压缩机的高效控制方案

c) 带转矩补偿的振动抑制

- 压缩机活塞在一个机械循环中遇到转矩的变化。因此，压缩机电机转速在一个机械循环内变化，从而产生噪音和振动
- iMOTION™ 2.0 包括转矩补偿，以在一个机械循环内调节转矩，从而降低噪音和振动，节约能源

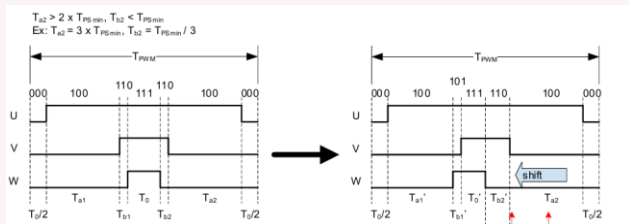


1. 用于永磁电机压缩机的高效控制方案

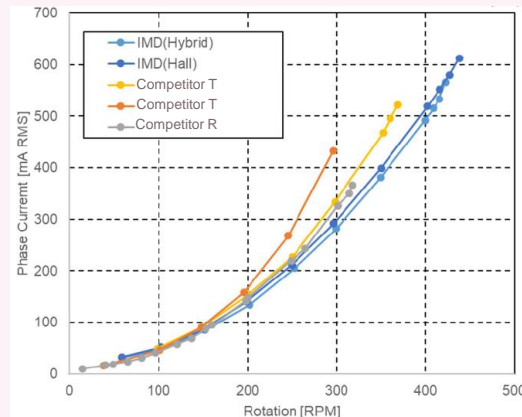
d) 优异的低速精度控制，提高轻载效率



- 基于移相PWM算法的高品质单电阻采样方案

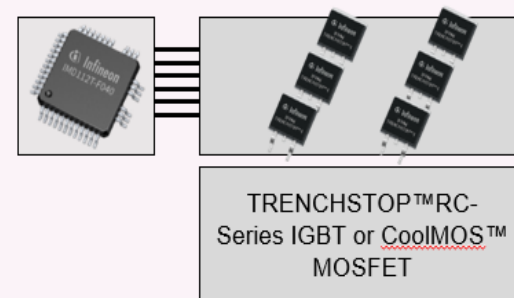
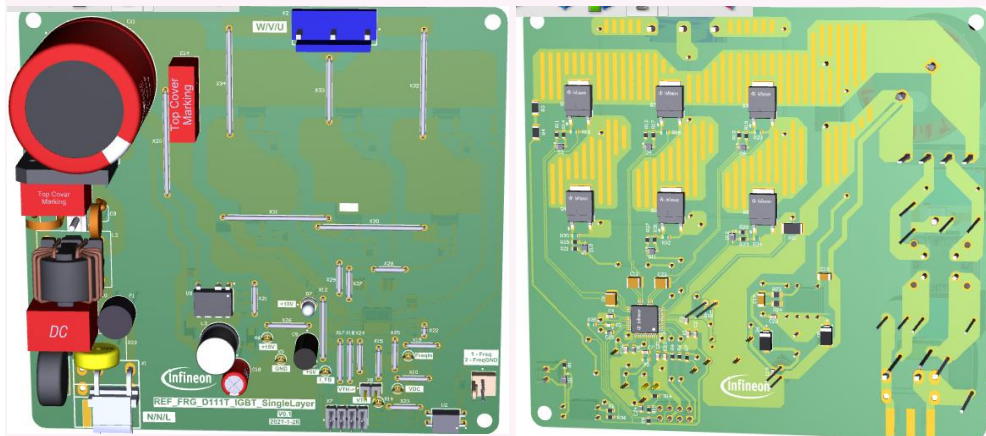


- iMOTION™ 2.0 系统在给定低速下降低了负载相电流
- 更高的系统轻载效率



2. 简单低成本：同一套软硬件设计用于200L、300L和400L系列冰箱

Reference design for fridge:
IMD111T & IKN04N60RC2



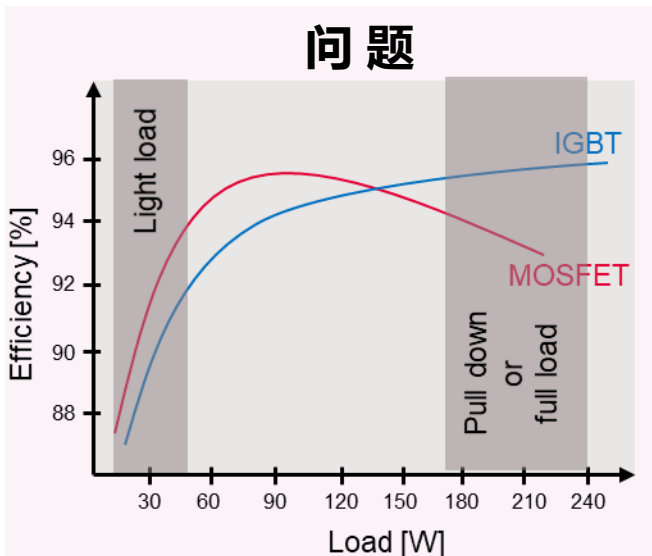
Single layer PCB with simplified BOM

UART Connectivity

Multiple parameter programming

IEC / UL 60730-1 Class B certification

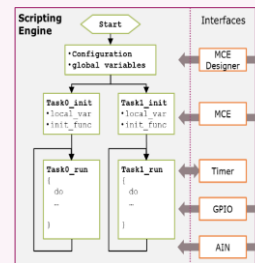
3. 优化轻载效率



在冰箱的全部工作周期内，满载的情况占比很小

变频驱动逆变器和散热器的设计由满载工况决定

方案： MCE 2.0 脚本语言引擎

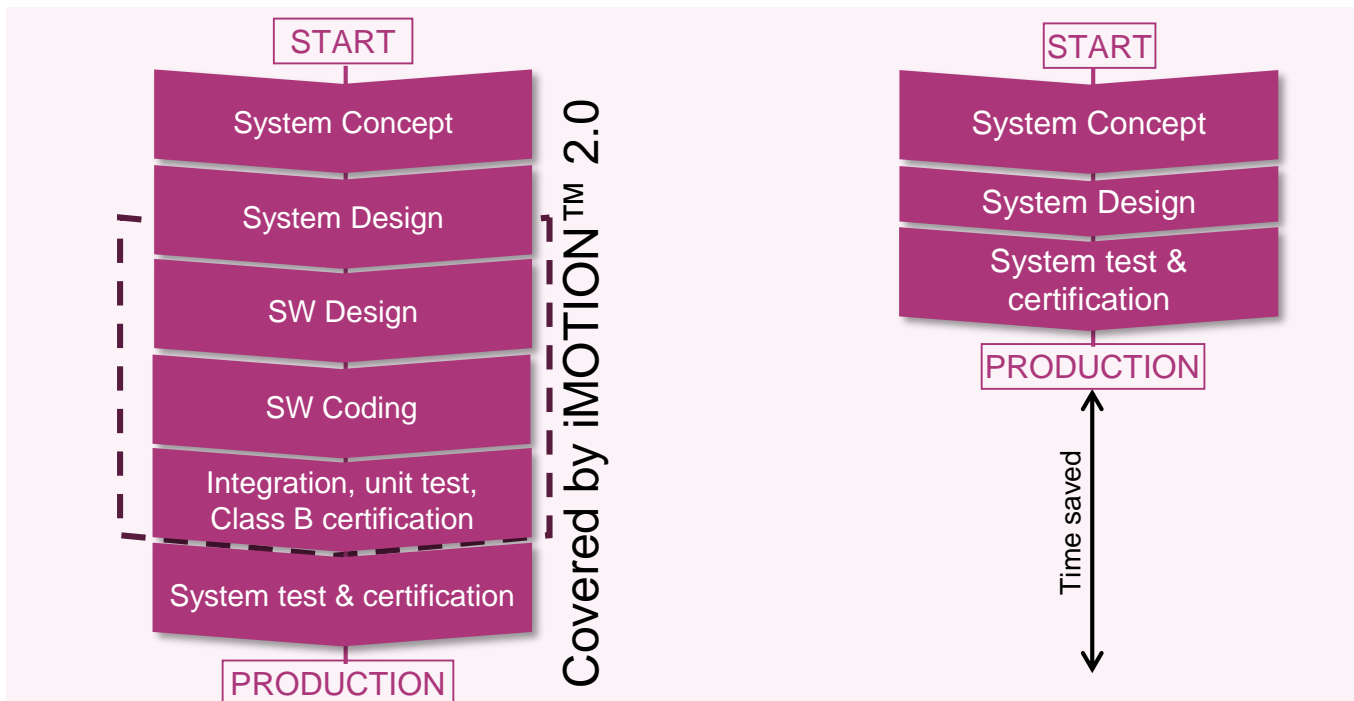


通过管理满载情况的工作模式，减少散热器的需求：

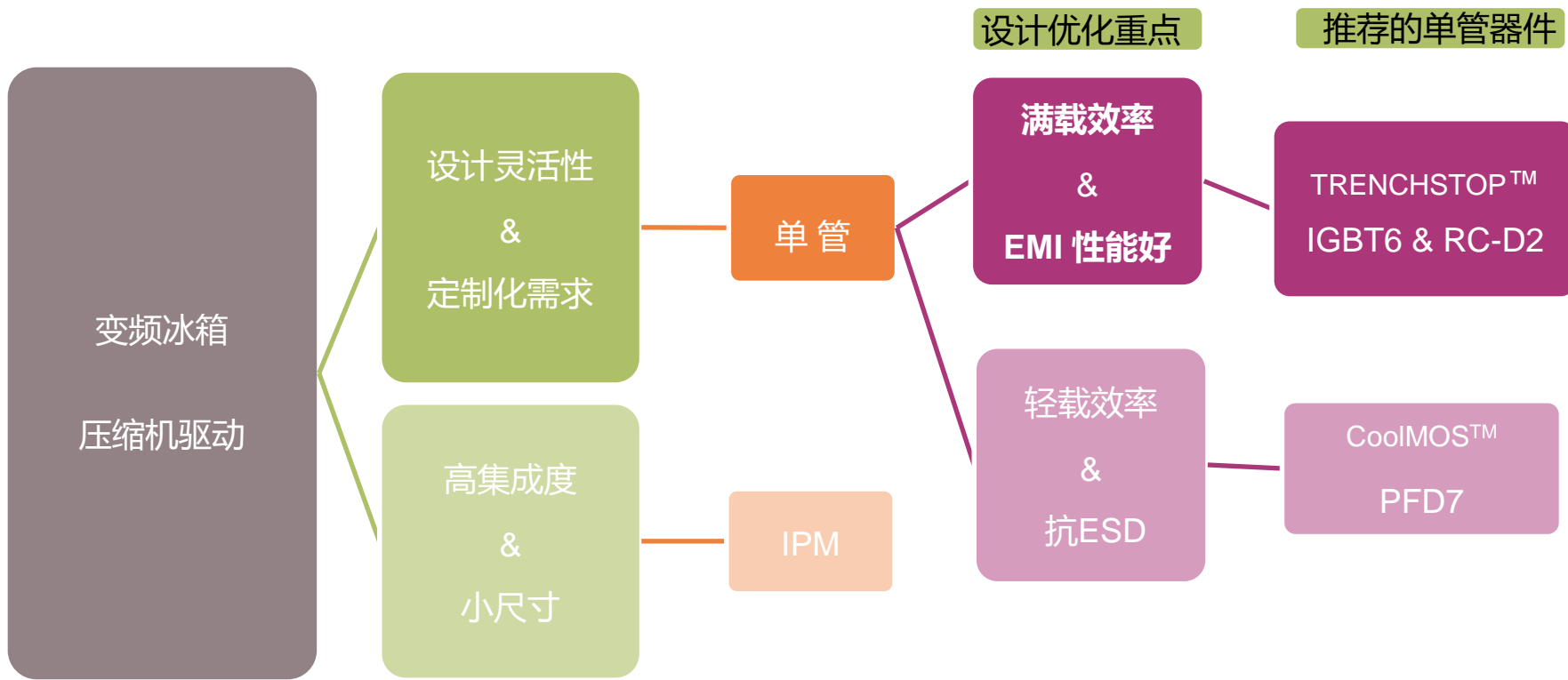
1. 实时读取压缩机和逆变器NTC的温度
2. 当温度过高时，降低压缩机转速，反之，增加压缩机转速

使用iMOTION™ 2.0 脚本语言引擎解决系统级问题

4. 使用iMOTION™ 2.0, 6个月完成全部开发流程

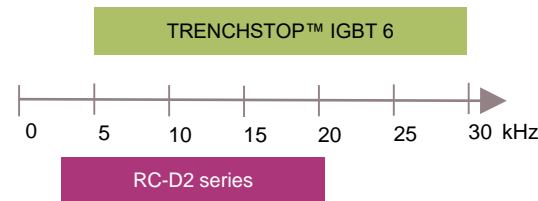



如何为小功率应用(小于300 W)选择功率器件









用于小功率应用的IGBT单管产品

	Value	Application focus
650V TRENCHSTOP™ IGBT 6	Performance optimized up to 30 kHz Co-packed with/out diodes Lowest switching losses and improved EMI SC rating up to 3us	Motor control, drives especially refrigerators, fans, pumps Medium to high frequency converters
600V RC-D2	Cost optimized in SMT packages Monolithically integrated diode New! First IGBT in SOT-223 SC rating up to 5us	Motor control, drives, refrigerators, washing machines, fans & pumps Low to medium frequency converters



Ic 100°C	SOT-223	DPAK			D ² PAK	TO-220	TO-220FP	
	RC-D2	RC-DF	RC-D2	TRENCHSTOP™ IGBT 6	TRENCHSTOP™	TRENCHSTOP™	TRENCHSTOP™	TRENCHSTOP™ IGBT 6
3	IKN03N60RC2	IKD03N60RF						
4	IKN04N60RC2	IKD04N60RF	IKD04N60RC2			IKP04N60T		
6	IKN06N60RC2	IKD06N60RF	IKD06N60RC2	IKD06N65ET6	IKB06N60T	IKP06N60T		
8				IKD08N65ET6				IKA08N65ET6
10		IKD10N60RF	IKD10N60RC2		IKB10N60T	IKP10N60T	IKA10N60T	IKA10N65ET6
15		IKD15N60RF	IKD15N60RC2		IKB15N60T	IKP15N60T	IKA15N60T	IKA15N65ET6
20	Recommendation: SOT-223, the cost-effective drop-in replacement for DPAK					IKP20N60T		
6						IGP06N60T		
10				IGD10N65T6	IGB10N60T	IGP10N60T		
15				IGD15N65T6	IGB15N60T	IGP15N60T		

用于小功率应用的600 V CoolIMOS™ PFD7

	600 V CoolIMOS™ PFD7 SJ MOSFETs					EiceDRIVER™ Gate Drivers
$R_{DS(on)}$ [mΩ]	 TO-220 FullPAK Narrow leads	 IPAK Short leads	 DPAK	 SOT-223	 ThinPAK 5x6	 EiceDRIVER™ Gate Drivers
2000			IPD60R2K0PFD7S	IPN60R2K0PFD7S		2ED28073J06F 2ED2304S06F, for 3-phase gate driver: 6EDL04x06xT 600 V, BSD
1500			IPD60R1K5PFD7S	IPN60R1K5PFD7S	IPLK60R1K5PFD7	
1000		IPS60R1K0PFD7S	IPD60R1K0PFD7S	IPN60R1K0PFD7S	IPLK60R1K0PFD7	
600		IPS60R600PFD7S	IPD60R600PFD7S	IPN60R600PFD7S	IPLK60R600PFD7	
360	IPAN60R360PFD7S	IPS60R360PFD7S	IPD60R360PFD7S	IPN60R360PFD7S	IPLK60R360PFD7	
280	IPAN60R280PFD7S	IPS60R280PFD7S	IPD60R280PFD7S			
210	IPAN60R210PFD7S	IPS60R210PFD7S	IPD60R210PFD7S			
125	IPAN60R125PFD7S					

www.infineon.com/600V-PFD7
www.infineon.com/eicedriver

 Recommended for low power drives applications

总结

英飞凌为变频冰箱驱动提供灵活的全套方案

iMOTION™智能驱动芯片简单易用，性能可靠

基于iMOTION™智能驱动芯片的全套方案能够帮助客户降低系统成本



Part of your life. Part of tomorrow.