描述/Description

- XNS50660AB/ABS基于Trench FS-IGBT技术，为小功率电机驱动应用（如风机和水泵）提供紧凑型逆变解决方案。
  XNS50660AB/ABS is an Advanced IPM Based on Trench FS-IGBT Technology as a Compact Inverter Solution for Small Power Motor Drive Applications Such as Fans and Pumps.
- XNS50660AB/ABS由6个IGBT和FRD，3个内置测温功能的HVIC和3个自举二极管组成，紧凑高绝缘并具有优化的热性能。
  XNS50660AB/ABS Contains Six IGBTs and FRDs, Three Half-Bridge Gate Drive HVICs with Temperature Sensing, and Three Bootstrap Diodes in a Compact Package Fully Isolated and Optimized for Thermal Performance.
- XNS50660AB/ABS通过优化开关速度和减小寄生电感实现低电磁干扰（EMI）特性。
  XNS50660AB/ABS Features Low Electromagnetic Interference (EMI) Characteristics Through Optimizing Switching Speed and Reducing Parasitic Inductance.
- XNS50660AB/ABS内置于电机的应用和要求紧凑安装的场合。
  XNS50660AB/ABS is the Right Solution for Compact and Reliable Inverter Designs Where the Assembly Space is Constrained.

主要特点

- 内置6个600V/6A IGBT和3个半桥栅极驱动（HVIC）
- 3个独立的IGBT源极副直流端用于变频器电流检测的应用
- HVIC实现驱动和欠压保护功能
- 完全兼容3.3V和5V的MCU接口，高电平有效
- 优化并采用了低电磁干扰设计
- 绝缘级别1500V$_{rms}$/1min
- 内置于HVIC的温度传感器
- 封装内置自举二极管
- 符合ROHS

应用

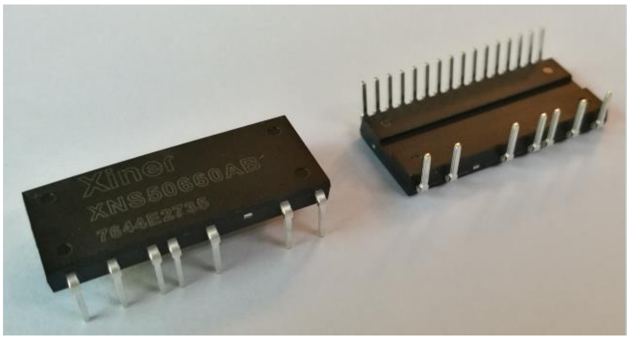
- 小功率电机

Features

- 600 V 6A IGBT 3-Phase Inverter Including HVICs
- Three Separate Open-Source Pins from Low Side IGBTs for Three Leg Current Sensing
- HVIC for Gate Driving and Undervoltage Protection
- Active-High Interface, Can Work With 3.3 V / 5 V Logic
- Optimized for Low Electromagnetic Interference
- Isolation Voltage Rating of 1500 V$_{rms}$ for 1 min.
- Temperature Sense Unit in HVIC
- Embedded Bootstrap Diode in the Package
- ROHS Compliant

Applications

- Small Power AC Motor



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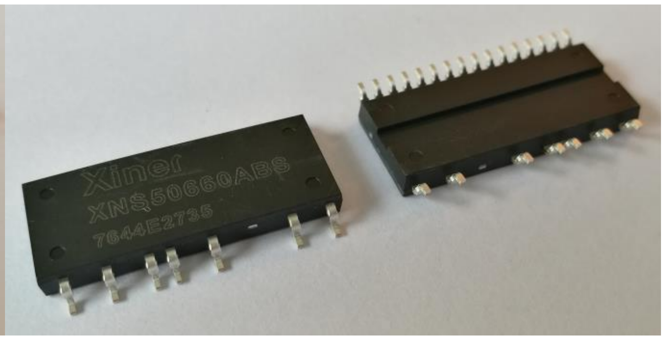


IPM-SOP23

绝对最大额定值 / Absolute Maximum Ratings

逆变器部分(单个IGBT，除非另有说明) / Inverter Part (Each IGBT ® Unless Otherwise Specified)

符号/Symbol	参数/Parameter	工作条件/ Conditions	额定值/Rating	单位/Unit
V_{PN}	加在P-N之间的电源电压 DC Link Input Voltage		450	V
$V_{PN(Surge)}$	加在P-N之间的电源浪涌电压 DC Link Input Voltage Surge		500	
V_{CES}	集电极-发射极之间电压 Collector-Emitter Voltage		600	
$\pm I_C$	单个IGBT集电极电流 Each IGBT Collector Current	T_C= 25°C T_C= 100°C	6 4	A
$\pm I_{CP}$	单个IGBT集电极峰值电流 Each IGBT Collector Peak Current	T_C= 25°C, T_J≤100°C , PW < 1ms	12	
P_C	最大功耗 Maximum Power Dissipation	T_C=25°C, 单个芯片/Per one chip	22	W
T_J	工作结温 Operating Junction Temperature		-40~150	°C

控制部分(单个HVIC，除非另有说明) / Control Part (Each HVIC Unless Otherwise Specified)

符号/Symbol	参数/Parameter	工作条件/ Conditions	额定值/Rating	单位/Unit
V_{CC}	控制电源电压 Control Supply Voltage	施加在V_{CC}和COM之间 Applied Between V_{CC} and COM	20	V
V_{BS}	高端偏置电压 High-side Bias Voltage	施加在V_B和V_S之间 Applied Between V_B and V_S	20	V
V_{IN}	输入信号电压 Input Signal Voltage	施加在IN和COM之间 Applied Between IN and COM	- 0.5~ V_{CC} + 0.5	V

自举二极管部分(单个二极管，除非另有说明) / Bootstrap Diode Part (Each Bootstrap Diode Unless Otherwise Specified)

符号/Symbol	参数/Parameter	工作条件/ Conditions	额定值/Rating	单位/Unit
V_{RRMB}	最大重复反向电压 Maximum Repetitive Reverse Voltage		600	V
* I_{FB}	正向电流 Forward Current	T_C= 25°C	1	A
* I_{FPB}	正向电流（峰值） Forward Current (Peak)	T_C= 25°C, Under 1ms Pulse Width	2	A
T_J	工作结温 Operating Junction Temperature		-40~150	°C

热阻 / Thermal Resistance

符号/Symbol	参数/Parameter	工作条件/ Conditions	额定值/Rating	单位/Unit
$R_{th(j-c)Q}$	节点-壳体热阻（注1） Junction to Case Thermal Resistance (Note1)	逆变器工作条件下的单个IGBT Each IGBT under Inverter Operating Condition	5.5	°C /W
$R_{th(j-c)F}$		逆变器工作条件下的单个FRD Each FRD under Inverter Operating Condition (Note 1)	7.0	

整个系统 / Total System

符号/Symbol	参数/Parameter	工作条件/ Conditions	额定值/Rating	单位/Unit
$V_{PN(PROT)}$	自我保护电源电压限制 Self Protection Supply Voltage Limit	V_{CC}=V_{BS}=13.5V~16.5V, T_J=125°C, 非重复性, ＜2us	400	V
T_C	模块壳体工作温度 Module Case Operation Temperature	-40°C≤T_J≤ 150°C	-30 ~ 125	°C
T_{STG}	存储温度 Storage Temperature		-40 ~ 150	
V_{ISO}	绝缘电压 Isolation Voltage	60Hz，正弦波，1分钟，连接基板到引脚 60 Hz, Sinusoidal, 1 minute, Connection Pins to Heatsink	1500	V_{rms}

注 / Note:
1.关于壳体温度（TC）的测量点，参见图5。 / For the Measurement Point of Case Temperature TC, Please refer to Figure 5.
2. 标记"*"的为计算值或设计因素。 / Marking " * " Is Calculation Value or Design Factor

引脚描述 / Pin descriptions

引脚号/Pin Number	引脚名/Pin Name	引脚描述/ Pin Description
1	COM	IC公共电源接地 IC Common Supply Ground
2	$V_{B(U)}$	U相高端IGBT驱动的偏压 Bias Voltage for U Phase High Side IGBT Driving
3	$V_{CC(U)}$	U相IC和低端IGBT驱动的偏压 Bias Voltage for U Phase IC and Low Side IGBT Driving
4	$IN_{(UH)}$	U相高端的信号输入 Signal Input for U Phase High-Side
5	$IN_{(UL)}$	U相低端的信号输入 Signal Input for U Phase Low-Side
6	N.C	无连接 N.C
7	$V_{B(V)}$	V相高端IGBT驱动的偏压 Bias Voltage for V Phase High Side IGBT Driving
8	$V_{CC(V)}$	V相IC和低端IGBT驱动的偏压 Bias Voltage for V Phase IC and Low Side IGBT Driving
9	$IN_{(VH)}$	V相高端的信号输入 Signal Input for V Phase High-Side
10	$IN_{(VL)}$	V相低端的信号输入 Signal Input for V Phase Low-Side
11	V_{TS}	模拟电压输出与 IC 温度成比例关系 Output for HVIC Temperature Sensing
12	$V_{B(W)}$	W相高端IGBT驱动的偏压 Bias Voltage for W Phase High Side IGBT Driving
13	$V_{CC(W)}$	W相IC和低端IGBT驱动的偏压 Bias Voltage for W Phase IC and Low Side IGBT Driving
14	$IN_{(WH)}$	W相高端的信号输入 Signal Input for W Phase High-Side
15	$IN_{(WL)}$	W相低端的信号输入 Signal Input for W Phase Low-Side
16	N.C	无连接 N.C
17	P	直流输入正端 Positive DC–Link Input
18	U, $V_{S(U)}$	高端IGBT驱动的U相偏压接地输出 Output for U Phase & Bias Voltage Ground for High Side IGBT Driving
19	N_U	U相的直流输入负端 Negative DC–Link Input for U Phase
20	N_V	V相的直流输入负端 Negative DC–Link Input for V Phase
21	V, $V_{S(V)}$	高端IGBT驱动的V相偏压接地输出 Output for V Phase & Bias Voltage Ground for High Side IGBT Driving
22	N_W	W相的直流输入负端 Negative DC–Link Input for W Phase
23	W, $V_{S(W)}$	高端IGBT驱动的W相偏压接地输出 Output for W Phase & Bias Voltage Ground for High Side IGBT Driving

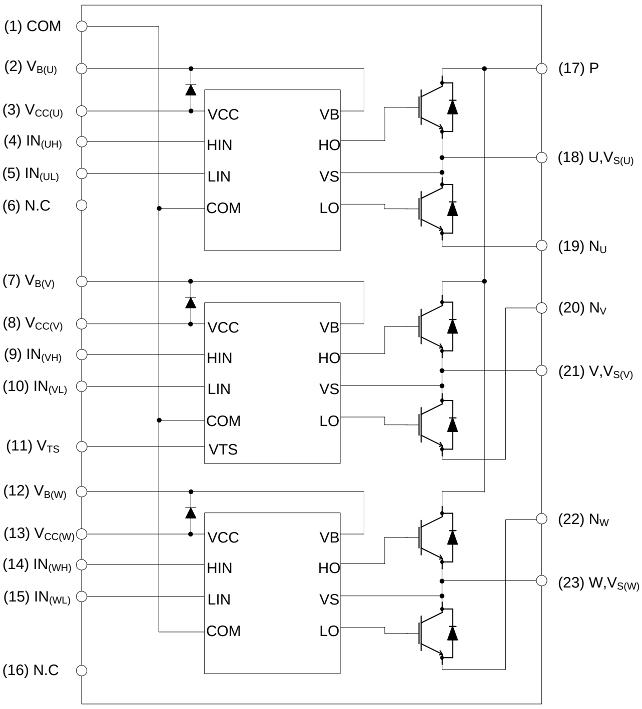


图1. 引脚布局和内部框图（仰视图）

Figure 1. Pin Configuration and Internal Block Diagram (Bottom View)

注 / Note:
每个低端IGBT的源极端子与IPM中的电源接地或偏压接地不连接。
Source Terminal of Each Low-Side IGBT is Not Connected to Supply Ground or Bias Voltage Ground Inside IPM.
外部连接应当如图5所示。
External Connections Should be Made as Indicated in Figure 5.

电气特性(T_J= 25°C, V_{CC}=V_{BS}= 15 V，除非另有说明) / Electrical Characteristics (T_J= 25°C, V_{CC}=V_{BS}= 15 V Unless Otherwise Specified)

逆变器部分(单个IGBT，除非另有说明) / Inverter Part(Each IGBT Unless Otherwise Specified)

符号/Symbol		参数/Parameter	工作条件/ Conditions		最小值 /Min	典型值 /Typ	最大值 /Max	单位 /Unit
$V_{CE(SAT)}$		集电极-发射极间饱和电压 Collector-Emitter Saturation Voltage	V_D=V_{DB}=15V, V_{IN}=5V	I_C=6A, T_J=25°C,	-	2.1	2.4	V
				I_C=6A, T_J=125°C,	-	2.3	2.5	
V_{EC}		FWD正向电压 FWD Forward Voltage	V_{IN}= 0V, I_C=-6A,		-	1.7	2.1	
I_{CES}		集电极-发射极间漏电流 Collector-Emitter Leakage Current	V_{CE}=V_{CES}	T_J=25°C,	-	-	1	mA
				T_J=125°C,	-	-	10	
HS	t_{ON}	开关时间	V_{PN}= 300 V, V_D= V_{DB}= 15 V, I_C=6 A V_{IN}= 0 V ↔5 V, 电感负载 / Inductive Load		-	725	-	ns
	$T_{C(ON)}$				-	120	-	
	t_{OFF}				-	380	-	
	$T_{C(OFF)}$				-	75	-	
	t_{rr}				-	100	-	
LS	t_{ON}				-	705	-	
	$T_{C(ON)}$					130	-	
	t_{OFF}					400	-	
	$T_{C(OFF)}$					80	-	
	t_{rr}					100	-	

控制部分(单个 HVIC，除非另有说明) / Control Part(Each HVIC Unless Otherwise Specified)

符号/Symbol	参数/Parameter	工作条件/ Conditions	最小值 /Min	典型值 /Typ	最大值 /Max	单位 /Unit
I_{QCC}	V_{CC}静态电流 Quiescent V_{CC} Current	V_{CC}=15 V, V_{IN}=0V; 施加在V_{CC}和COM之间 Applied Between V_{CC} and COM	-	200	300	uA
I_{QBS}	V_{BS}静态电流 Quiescent V_{BS} Current	V_{BS}=15 V, V_{IN}=0V; 施加在$V_{B(U)}$-U, $V_{B(V)}$-V, $V_{B(W)}$-W Applied Between $V_{B(U)}$-U, $V_{B(V)}$-V, $V_{B(W)}$-W	-	50	100	uA
I_{IN}	Input Current 输入脚电流	V_{IN}=5V -	-	5	10	uA
DT	死区时间 Dead Time		50	100	150	ns
UV_{CCD}	低端欠压保护（图8） Low-Side Undervoltage Protection (Figure 8)	V_{CC}欠压保护检测电平 V_{CC} Undervoltage Protection Detection Level	7.2	8.0	8.8	V
UV_{CCR}		V_{CC}欠压保护复位电平 V_{CC} Undervoltage Protection Reset Level	8.0	8.8	9.8	V
UV_{BSD}	高端欠压保护（图9） High-Side Undervoltage Protection (Figure 9)	V_{BS}欠压保护检测电平 V_{BS} Undervoltage Protection Detection Level	7.2	8.0	8.8	V
UV_{BSR}		V_{BS}欠压保护复位电平 V_{BS} Undervoltage Protection Reset Level	8.0	8.8	9.8	V
V_{TS}	HVIC温度检测电压输出 HVIC Temperature Sensing Voltage Output	V_{CC}= 15 V, T_{HVIC}= 25°C (注 1) V_{CC}= 15 V, T_{HVIC}= 25°C (Note 1)	650	700	750	mV
V_{IH}	导通阈值电压 ON Threshold Voltage	逻辑高电平 Logic High Level; 施加在V_{IN}和COM之间 Applied between IN and COM	-	-	2.8	V
V_{IL}	关断阈值电压 OFF Threshold Voltage	逻辑低电平 Logic Low Level	0.6	-	-	V

自举二极管部分(单个二极管，除非另有说明) / Bootstrap Diode Part(Each Bootstrap Diode Unless Otherwise Specified)

符号/Symbol	参数/Parameter	工作条件/ Conditions	最小值 /Min	典型值 /Typ	最大值 /Max	单位 /Unit
V_{FB}	正向电压 Forward Voltage	I_F= 0.1 A, T_C= 25°C I_F= 0.1 A, T_C= 25°C	-	4.5	-	V
t_{rrB}	反向恢复时间 Reverse Recovery Time	I_F= 0.1 A, T_C= 25°C	-	80	-	ns
R_{BSD}	串联电阻 Resistance between VF=4V and 10V	V_{F1}= 4V, V_{F2}= 10V	20	30	40	Ω

推荐工作条件 / Recommended Operating Condition

符号/Symbol	参数/Parameter	工作条件/ Conditions	最小值 /Min	典型值 /Typ	最大值 /Max	单位 /Unit
V_{PN}	电源电压 Supply Voltage	施加在P和N之间 Applied Between P and N	-	300	400	V
V_{CC}	控制电源电压 Control Supply Voltage	施加在V_{CC}和COM之间 Applied Between V_{CC} and COM	13.5	15	16.5	V
V_{BS}	高端偏压 High-Side Bias Voltage	施加在V_B和V_S之间 Applied Between V_B and V_S	13.5	15	16.5	V
d_{VCC}/d_t, d_{VBS}/d_t	控制电源波动 Control Supply Variation		-1	-	1	V/us
$V_{IN(ON)}$	输入导通阈值电压 Input ON Threshold Voltage	施加在V_{IN}和COM之间 Applied Between IN and COM	2.8	-	V_{CC}	V
$V_{IN(OFF)}$	输入关断阈值电压 Input OFF Threshold Voltage		0	-	0.6	V
t_{dead}	防止桥臂直通的死区时间 Blanking Time for Preventing Arm-Short	V_{CC}=V_{BS}= 13.5 ~ 16.5 V, T_J≤ 150°C	1	-	-	us
f_{PWM}	PWM开关频率 PWM Switching Frequency	T_J ≤ 150°C	-	-	20	kHz
COM	COM电压波动 COM variation	COM和NU, NV, NW 之间（包括浪涌） Between COM - NU, NV, NW (including surge)	-5	-	+5	V

注/Note:

1.V_{TS}只能用于模块的温度检测，但不能自动关闭IGBTs。
V_{TS} is only for sensing temperature of module and cannot shutdown IGBTs automatically.

Built in Bootstrap Diode V_F-I_F Characteristic

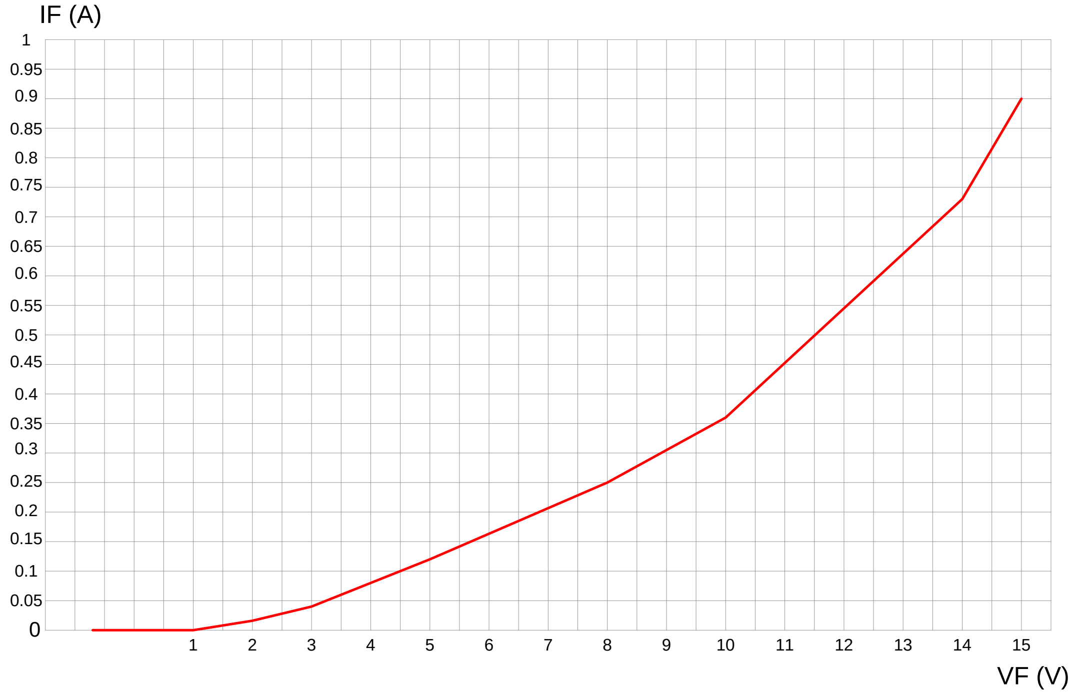


图2. 内置自举二极管特性（典型值）

Figure 2. Built in Bootstrap Diode Characteristics (Typ.)

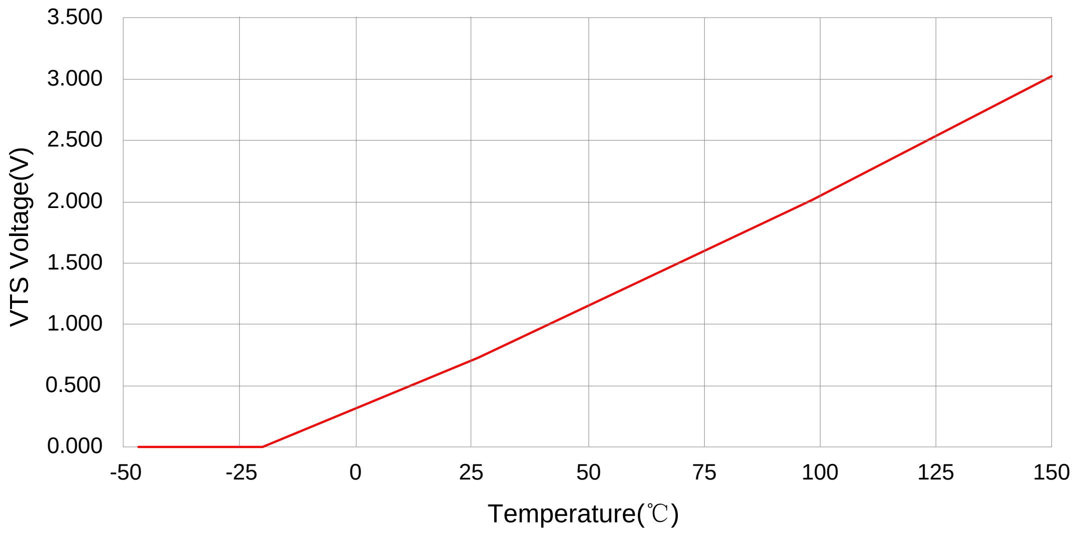
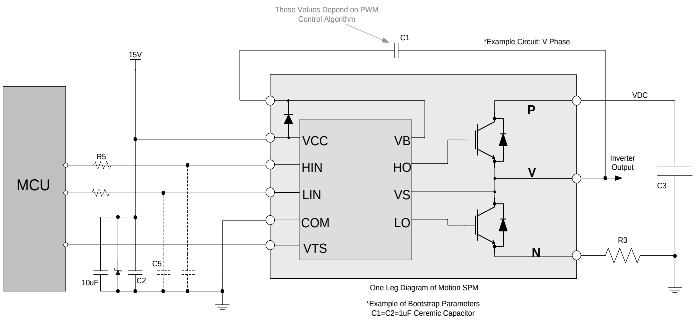


图3. V_{TS}的温度曲线

Figure 3. Temperature Profile of V_{TS}



HIN	LIN	Output	Note
0	0	Z	Both IGBT Off
0	1	0	Low side IGBT On
1	0	V_{DC}	High side IGBT On
1	1	Forbidden	Shoot through
Open	Open	Z	Same as (0,0)

图4. 推荐的MCU接口和自举电路及其参数

Figure 4. Recommended MCU Interface and Bootstrap Circuit with Parameters

注/Note:

1. 自举电路的参数取决于PWM算法。上述为开关频率15K时的参数的典型例子。
   Parameters for Bootstrap Circuit Elements are Dependent on PWM Algorithm. For 15 kHz of Switching Frequency, Typical Example of Parameters is Shown Above.
2. IPM产品和MCU（虚线显示部分）的每个输入端的RC耦合（R_5和C_5）和C_4，可用于防止由浪涌噪声产生的错误信号。
   RC coupling (R_5 and C_5) and C_4 at Each Input of IPM and Mcu (Indicated as Dotted Lines) May be Used to Prevent Improper Signal Due to Surge Noise.
3. 印刷电路板图形中的粗线应尽量短且粗，以减小电路中的寄生电感，从而导致浪涌电压的降低。旁路电容C_1，C_2和C_3应具有良好的高频特性，以吸收高频纹波电流。
   Bold lines should be short and thick in PCB pattern to have small stray inductance of circuit, which results in the reduction of surge voltage. Bypass capacitors such as C_1, C_2 and C_3 Should Have Good High-Frequency characteristics to Absorb High-Frequency Ripple Current.

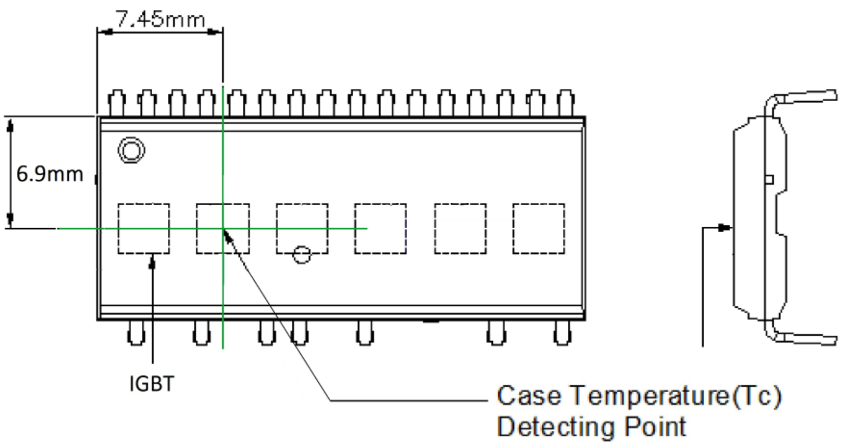


图5. 壳体温度测量

Figure 5. Case Temperature Measurement

注/Note:

将热电偶贴在IPM封装（如果应用到，放在IPM封装和散热器中间）的散热片的顶部，以获得正确的温度测量数值。
Attach the thermocouple on top of the heatsink-side of IPM (between IPM and heatsink if applied) to get the correct temperature measurement.

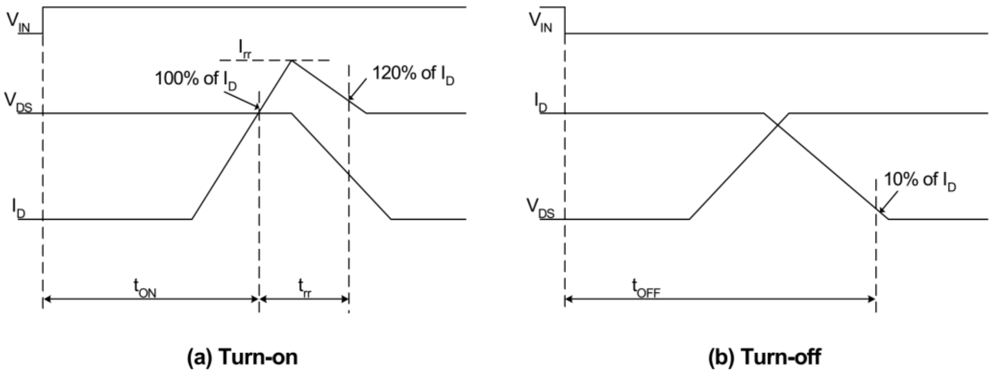


图6. 开关时间定义

Figure 6. Switching Time Definitions

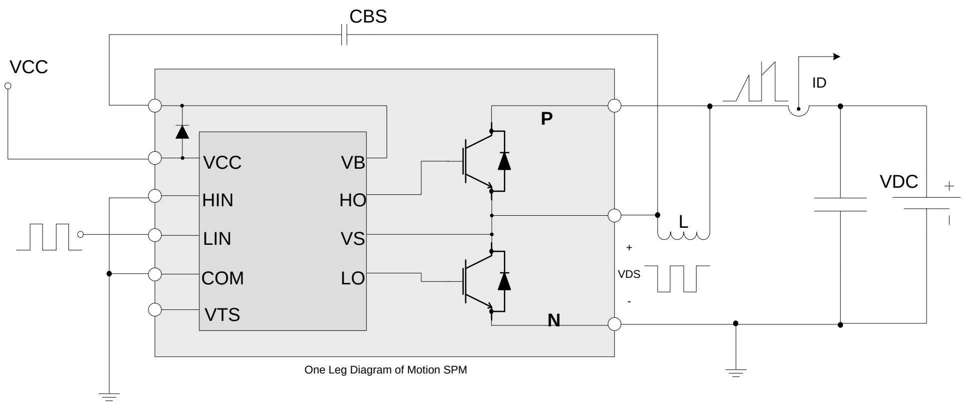


图7. 开关和RBSOA（单脉冲）测试电路（低端）

Figure 7. Switching and RBSOA (Single-pulse) Test Circuit (Low-side)

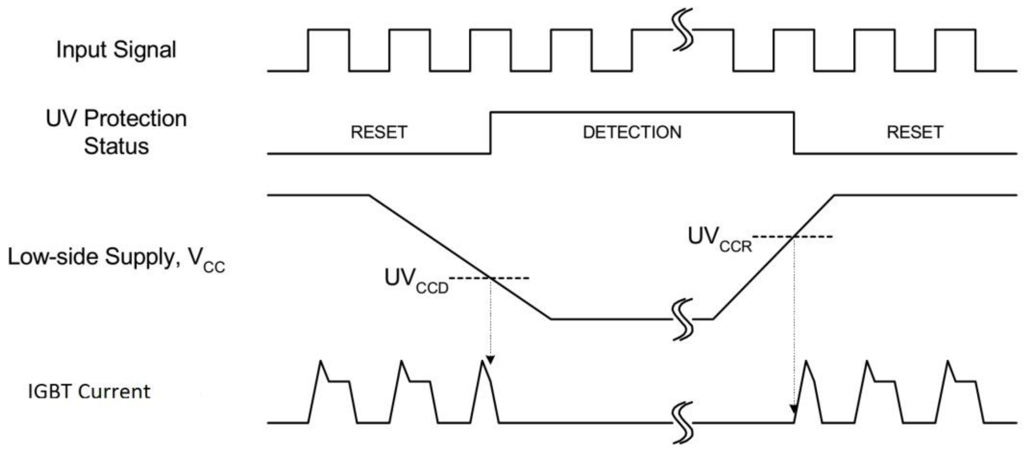


图8. 欠压保护（低端）

Figure 8. Undervoltage Protection (Low-side)

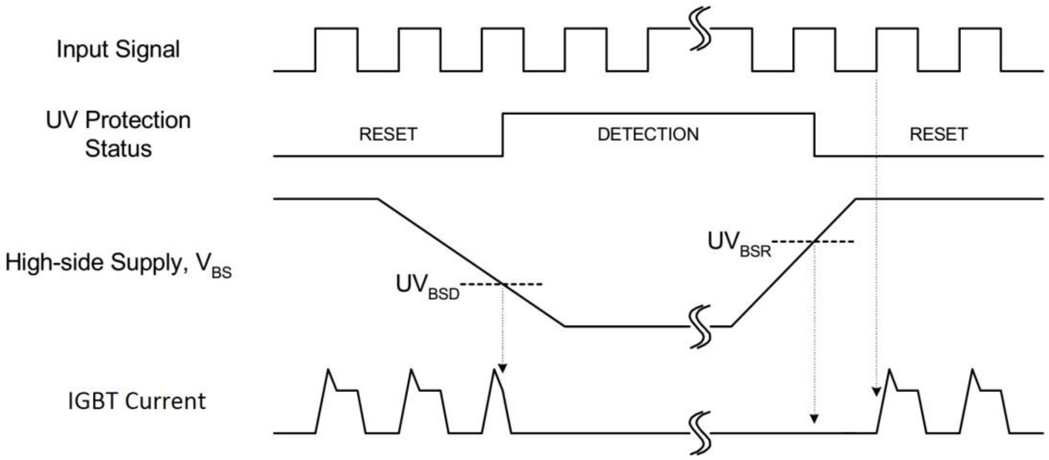


图9. 欠压保护（高端）

Figure 9. Undervoltage Protection (High-side)

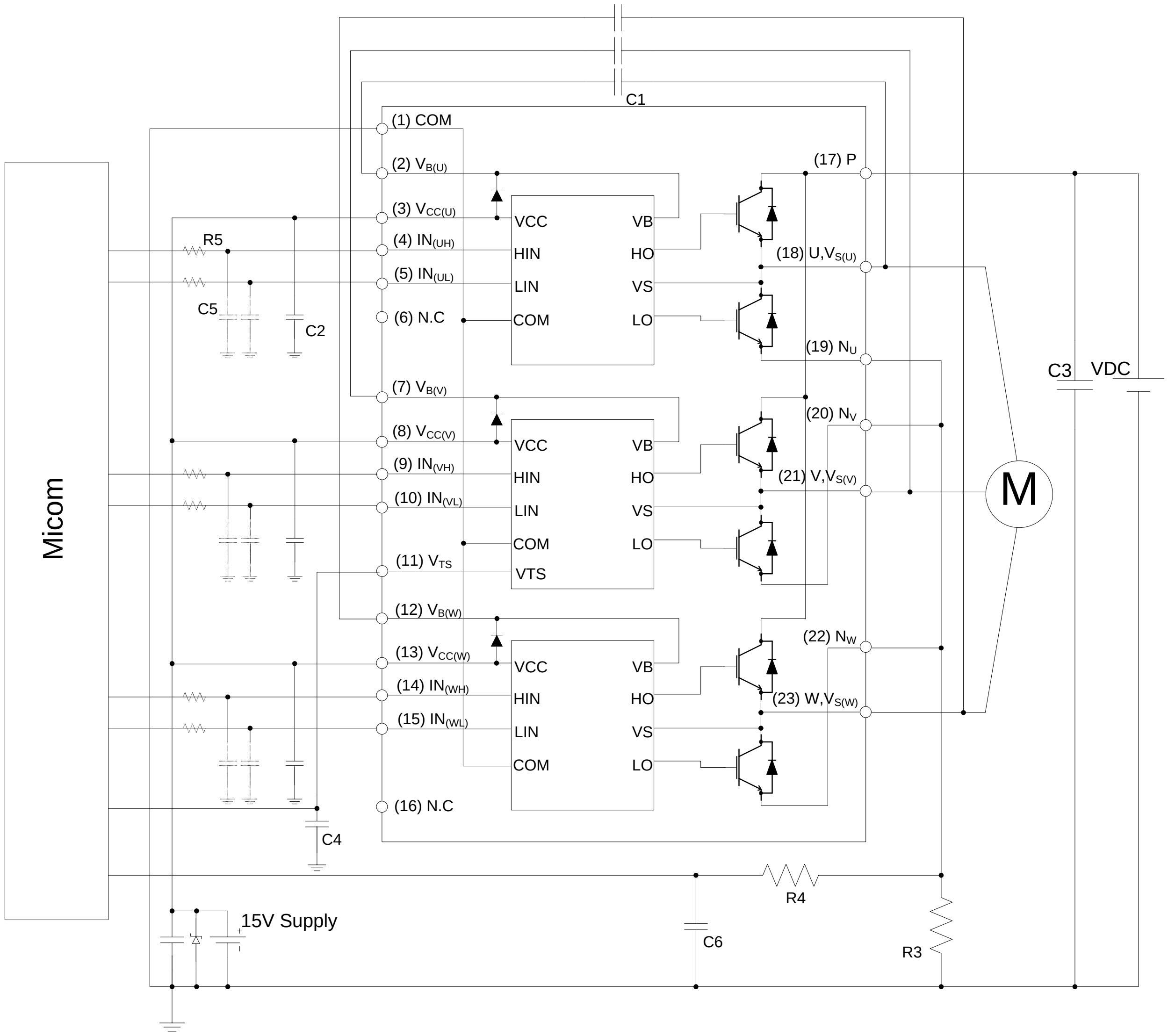


图10. 应用电路实例

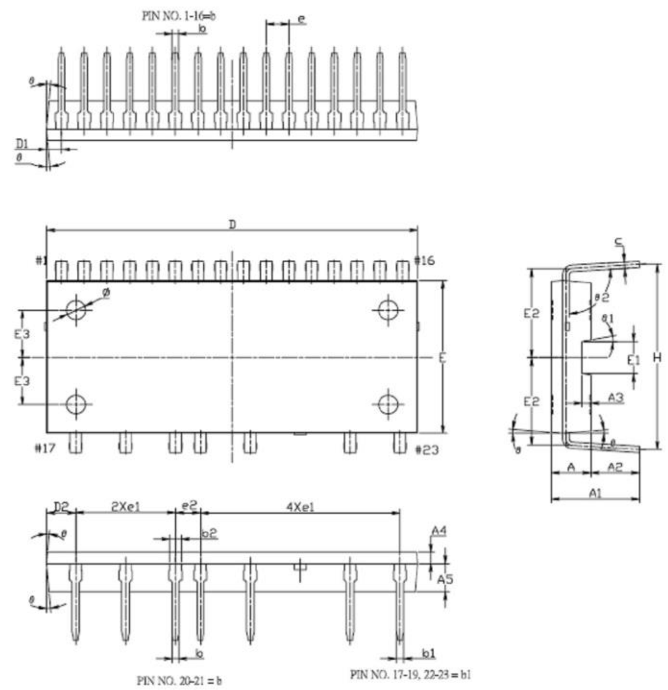
Figure 10. Example of Application Circuit

注/Note:

1. 关于引脚的位置请参阅图1。
   About Pin Position, Refer to Figure 1.
2. IPM产品和MCU的每个输入端的RC耦合（R_5和C_5，R_4和C_6）和C_4，能有效地防止由浪涌噪声产生的错误的输入信号。
   RC Coupling (R_5 and C_5, $R_4$and C_6) and C_4 at Each Input of IPM Mcu are Useful to Prevent Improper Input Signal Caused by Surge Noise.
3. 由于位于COM和低端IGBT的源极端子之间，R3的压降会影响低端的开关性能和自举特性。为此稳态情况下的R3的压降应小于1V。
   The voltage Drop Across R_3 Affects the Low Side Switching Performance and the Bootstrap Characteristics Since it is Placed Between COM and the Source Terminal of the Low Side IGBT. For this Reason, the Voltage Drop Across R_3 Should Be Less Than 1 V in the Steady-State.
4. 为避免浪涌电压和HVIC故障，接地线和输出端子之间的接线应短且粗。
   Ground Wires and Output Terminals, Should Be Thick and Short in Order to Avoid Surge Voltage and Malfunction of HVIC.
5. 所有的滤波电容器应紧密连接到IPM产品，他们应当具有能够很好的阻挡高频纹波电流的特性。
   All the Filter Capacitors Should Be Connected Close to Motion SPM, and They Should Have Good Characteristics for Rejecting High-Frequency Ripple Current.

Xiner

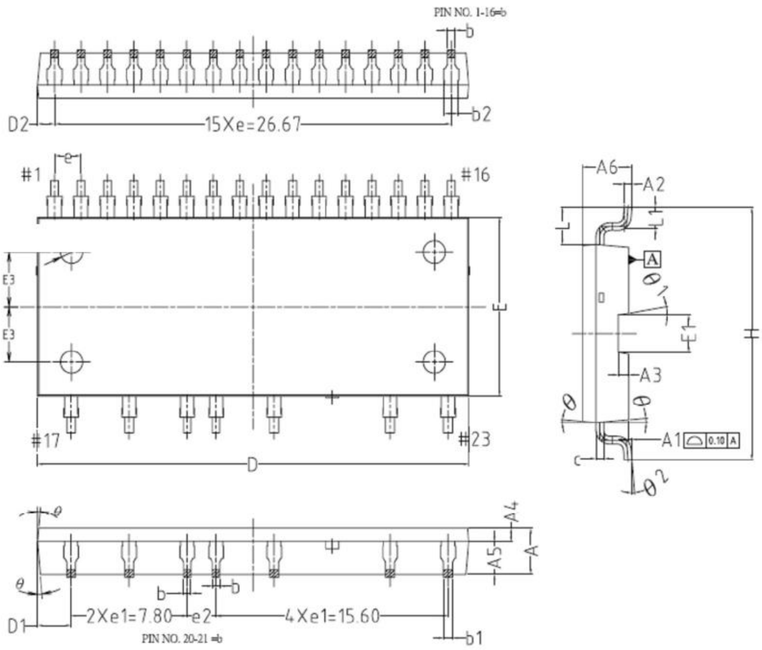
轮廓封装详图 / Detailed Package Outline Drawings



SYMBOL	COMMON			
	MM		INCH	
	MIN	MAX	MIN	MAX
A	2.90	3.30	0.1142	0.1299
A1	6.70	7.10	0.2638	0.2795
A2	3.60	4.00	0.1417	0.1575
A3	0.70 BSC		0.0276 BSC	
A4	0.90 BSC		0.0354 BSC	
A5	2.20 BSC		0.0866 BSC	
b	0.40	0.60	0.0157	0.0236
b1	0.50	0.70	0.0197	0.0276
b2	/	1.00	/	0.0394
c	0.45	0.55	0.0177	0.0217
D	28.80	29.80	1.1339	1.1732
D1	1.165 BSC		0.0459 BSC	
D2	2.275 BSC		0.0896 BSC	
E	11.80	12.20	0.4646	0.4803
E1	2.50 BSC		0.0984 BSC	
E2	6.90 BSC		0.2717 BSC	
E3	3.70 BSC		0.1457 BSC	
e	1.778 BSC		0.0700 BSC	
e1	3.90 BSC		0.1535 BSC	
e2	1.95 BSC		0.0768 BSC	
H	14.25	14.85	0.5610	0.5846
θ	5° REF		5° REF	
θ1	10° REF		10° REF	
θ2	91°	96°	91°	96°
Φ	1.50 BSC		0.0591 BSC	

图11. IPM-DIP23

Figure 11. IPM-DIP23



SYMBOL	COMMON			
	MM		INCH	
	MIN	MAX	MIN	MAX
A	2.90	3.30	0.1142	0.1299
A1	0.05	0.30	0.0020	0.0118
A2	0.50 BSC		0.0197 BSC	
A3	0.70 BSC		0.0276 BSC	
A4	0.90 BSC		0.0354 BSC	
A5	2.20 BSC		0.0866 BSC	
A6	/	3.50	/	0.1378
b	0.40	0.60	0.0157	0.0236
b1	0.50	0.70	0.0197	0.0276
b2	/	1.00	/	0.0394
c	0.45	0.55	0.0177	0.0217
D	28.80	29.80	1.1339	1.1732
D1	2.275 BSC		0.0896 BSC	
D2	1.165 BSC		0.0459 BSC	
E	11.80	12.20	0.4646	0.4803
E1	2.50 BSC		0.0984 BSC	
E3	3.70 BSC		0.1457 BSC	
e	1.778 BSC		0.070 BSC	
e1	3.90 BSC		0.1535 BSC	
e2	1.65	2.25	0.0650	0.0886
L	2.50 BSC		0.0984 BSC	
L1	1.30	1.70	0.0512	0.0669
H	17.00 BSC		0.6693 BSC	
θ	5° REF		5° REF	
θ1	10° REF		10° REF	
θ2	3°	6°	3°	6°
Φ	1.50 BSC		0.0591 BSC	

图12. IPM-SOP23

Figure 12. IPM-SOP23

封装打标和订货信息/Package Marking & Ordering Information

Device Marking	Device	Package	Reel Size	Packing Type	Quantity
XNS50660AB	XNS50660AB	IPM-DIP23	-	RAIL	15
XNS50660ABS	XNS50660ABS	IPM-SOP23	-	RAIL	15

For technical support, please contact Xiner's Technical Assistance Center
www.invsemi.com

WORLD HEADQUARTERS: