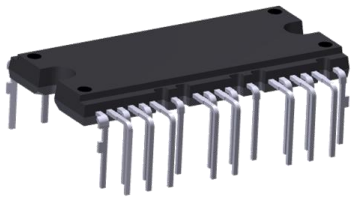
SYIM10G60BT
Intelligent Power Module

Features

- Integrated 6 low-loss IGBTs(600V/10A)
- Integrated high voltage gate drive circuit
- Built-in under voltage protection and over temperature, over current protection and temperature output
- Built-in fast recovery bootstrap diode with current limiting resistor
- Insulation class 1500Vrms/ min
- High reliability and thermal stability, good parameter consistency
- Built-in temperature output



DIP-25

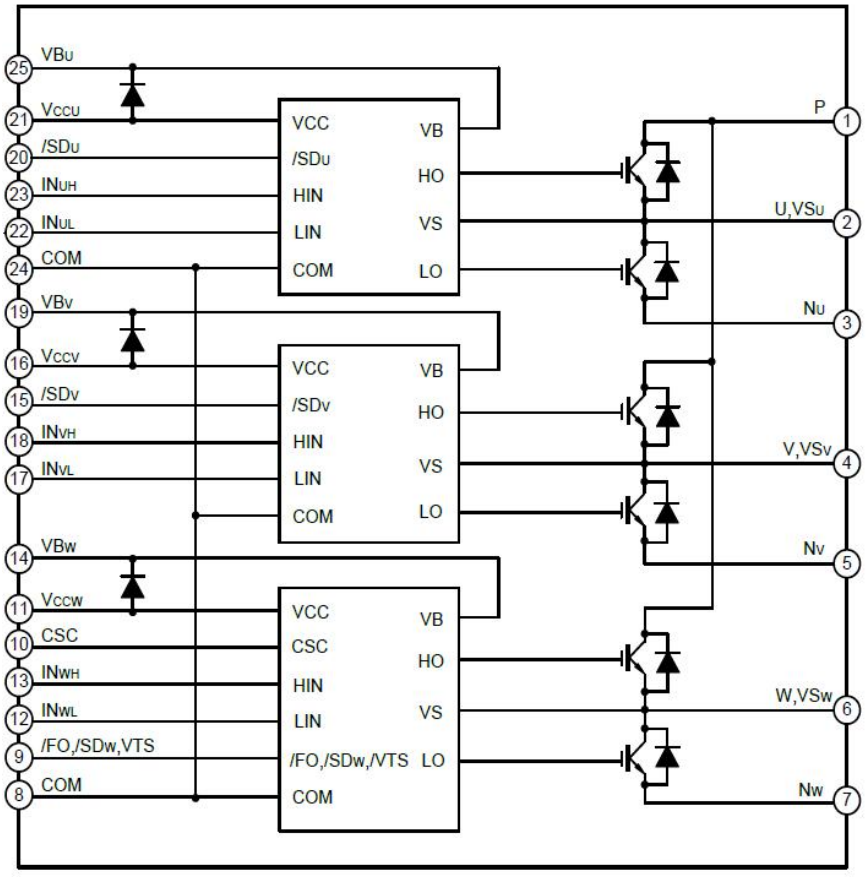
Applications

- Air conditioning compressor
- Refrigerator compressor
- Frequency converter
- Washing Machine

Ordering Information

Product Name	Marking	Package Type
SYIM10G60BTE	SYIM10G60BTE	DIP-25

Internal Electrical Schematic



Absolute Maximum Ratings T_J = 25ºC, unless otherwise noted

Parameter	Symbol	Value	Unit
Inverter Section			
Supply Voltage	V_{PN}	450	V
Supply Voltage (surge)	$V_{PN\ (Surge)}$	500	V
Collector-Emitter voltage	Vce	600	V
Each IGBT Collector Current, T_C=25°C,$T_J \leq$ 150°C	I_C	10	A
Each IGBT Collector Current, (Peak)， T_C = 25°C, $T_J \leq$ 150°C	I_{CP}	20	A
Power dissipation per 1 chip T_C=25°C	P_D	-	W
Control section			
Control the supply voltage	V_{CC}	20	V
High-side control voltage	V_{BS}	20	V
Input signal voltage	V_{IN}	-0.3~VCC+0.3	V
Fault output supply voltage	V_{FO}	-0.3~VCC+0.3	V
Fault Current	I_{FO}	10	mA
Operating junction temperature range	T_J	-30 to 125	°C
Storage temperature range	T_{STG}	-40 to 125	°C
Single IGBT thermal resistance, junction-case	$R_{\theta JCB}$	-	°C/W
Single FRD thermal resistance, junction-case	$R_{\theta JCF}$	-	°C/W
Isolation test voltage (1min, RMS, f = 60Hz)	V_{ISO}	1500	Vrms

Note 1: The maximum junction temperature of the power chip is 150°C, in order to ensure that IPM can work safely, it is recommended that the average junction temperature Tj≤125°C (@Tc≤100°C)

Recommended Operation Conditions: T_J = 25ºC, unless otherwise noted

Control section

Parameter	Symbol	Min.	Typ.	Max.	Unit
Supply Voltage	V_{PN}	-	300	400	V
Control the supply voltage	V_{CC}	14.0	15	16.5	V
High side control voltage	V_{BS}	14+V_S	15+V_S	16.5+V_S	V
Blanking Time for Preventing Arm − Short	t_{dead}	1	-	-	us
Minimun Input Pulse Width	T_{PWIN}	0.7	-	-	us

Electrical Characteristics: T_J = 25ºC, unless otherwise noted

Inverter Section

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit
Collector-emitter saturation voltage	$V_{CE(SAT)}$	V_{CC}=V_{BS}=15V, V_{IN}=5V I_C=10A, T_J = 25°C	-	1.2	-	V
FRD forward voltage	V_F	V_{IN}=0V, I_F=10A, T_J = 25°C	-	1.7	-	V
Switching time (high side)	t_{on}	V_{PN} = 300V, V_{CC} = V_{BS} = 15V, I_C = 10A, V_{IN} = 0V⟷ 5V, The inductive load is detailed in Figure 1	-	582	-	ns
	t_r		-	74	-	ns
	t_{off}		-	1198	-	ns
	t_f		-	45	-	ns
	t_{rr}		-	128	-	ns
Switching time (low side)	t_{on}		-	599	-	ns
	t_r		-	102	-	ns
	t_{off}		-	1235	-	ns
	t_f		-	53	-	ns
	t_{rr}		-	129	-	ns
Collector-Emitter Leakage current	I_{CES}	V_{CE}=600V	-	-	1	mA

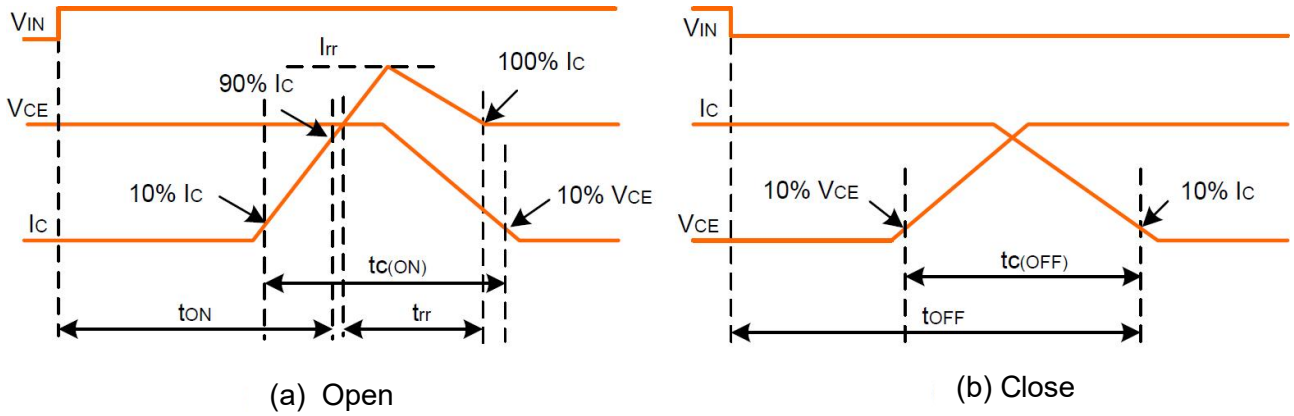


Figure 1. Definition of switching time

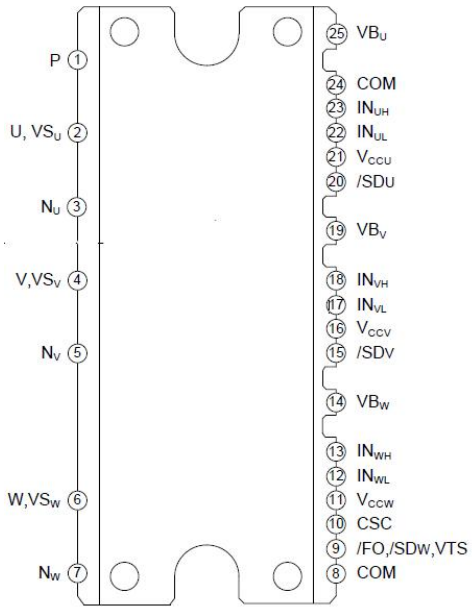
Control section

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit
Quiescent V_{CC} supply current	I_{QCC}	V_{CC}=15V, V_{IN}=0V	-	-	1.5	mA
Quiescent V_{BS} supply current	I_{QBS}	V_{BS}=15V, V_{IN}=0V	-	-	150	uA
Fault output pulse width	t_{FO}	Fault duration	40	-	-	us
Short-circuit protection trigger voltage	$V_{SC(ref)}$	V_{CC}=15V	-	0.48	-	V
Low-side undervoltage protection	UV_{Dt}	V_{CC} senses the voltage	-	11	-	V
	UV_{Dr}	V_{CC} reset voltage	-	11.4	-	V
High-side undervoltage protection	UV_{DBt}	V_{BS} senses voltage	-	10	-	V
	UV_{DBr}	V_{BS} reset voltage	-	11	-	V
On-threshold voltage	V_{IH}	Logic high	-	-	2.2	V
Shutdown threshold voltage	V_{IL}	Logic low	0.8	-	-	V

Bootstrap diode section

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit
Bootstrap Diode Resistance	R_{BS}	-	-	85	-	Ω
Forward voltage	V_F	I_F=10mA, T_C=25°C	-	1.5	-	V

Pin Assignment



Pin Description

Pin Number	Pin Name	Pin Description
1	P	Positive DC−Link Input
2	U, VS_U	Output for U Phase
3	N_U	Negative DC−Link Input for U Phase
4	V, VS_V	Output for V Phase
5	N_V	Negative DC−Link Input for V Phase
6	W, VS_W	Output for W Phase
7	N_W	Negative DC−Link Input for W Phase
8	COM	Common Supply Ground
9	/FO, $/SD_W$, VTS	Fault Output, Shut−Down Input for W Phase, Temperature Output of Drive IC
10	CSC	Shut Down Input for Over Current and Short Circuit Protection
11	V_{CCW}	Common Bias Voltage for IC and IGBTs Driving
12	IN_{WL}	Signal Input for Low−Side W Phase
13	IN_{WH}	Signal Input for High−Side W Phase
14	VB_W	High−Side Bias Voltage for W−Phase IGBT Driving
15	/SDV	Shut−Down Input for V Phase
16	V_{CCV}	Common Bias Voltage for IC and IGBTs Driving
17	IN_{VL}	Signal Input for Low−Side V Phase
18	IN_{VH}	Signal Input for High−Side V Phase
19	VB_V	High−Side Bias Voltage for V−Phase IGBT Driving
20	$/SD_U$	Shut−Down Input for U Phase
21	V_{CCW}	Common Bias Voltage for IC and IGBTs Driving
22	IN_{UL}	Signal Input for Low−Side U Phase
23	IN_{UH}	Signal Input for High−Side U Phase
24	COM	Common Supply Ground
25	VB_U	High−Side Bias Voltage for U−Phase IGBT Driving

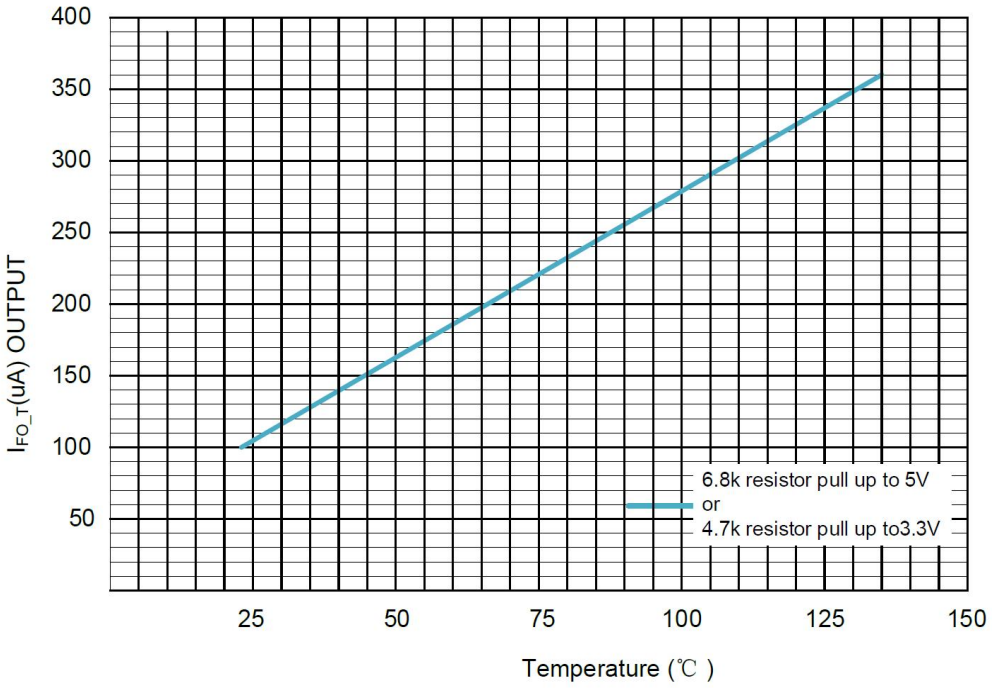


Figure 2.Temperature Profile of V_{OT}(Typical)

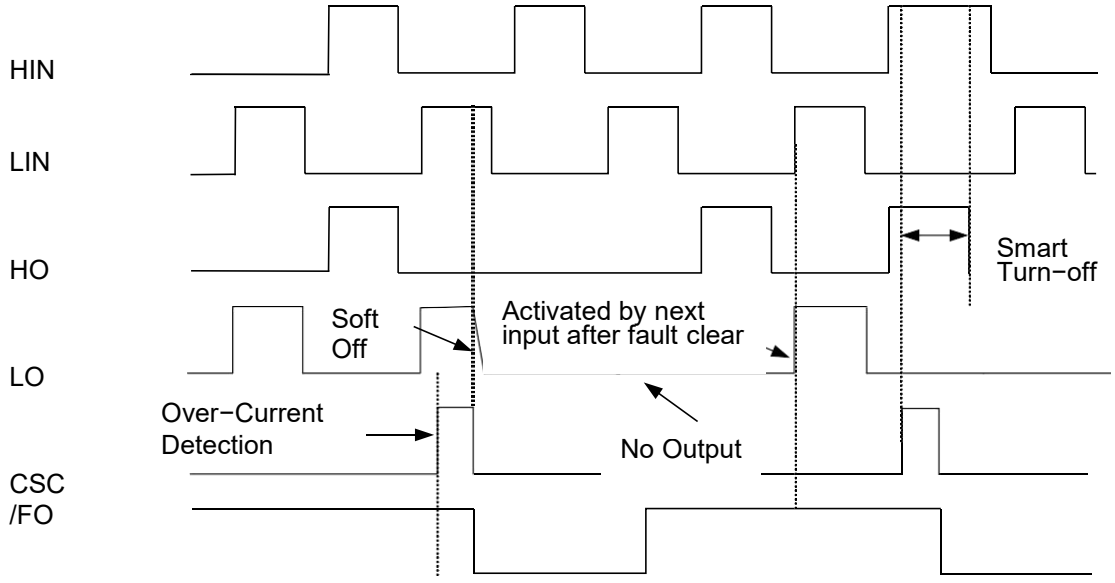


Figure 2. Fault−Out Function by Over Current Protection

HIN : High−side Input Signal
LIN : Low−side Input Signal
HO : High−Side Output Signal
LO : Low−Side Output Signal
CSC : Over Current Detection Input
/FO : Fault Out Function

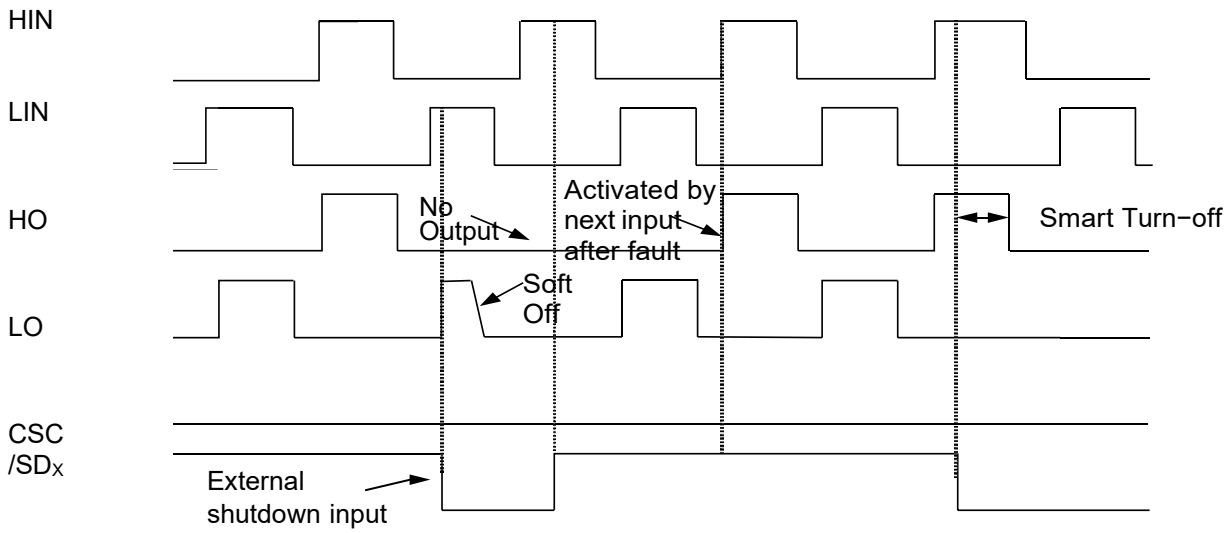


Figure 3. Shutdown Input Function by External Command Protection

HIN : High−side Input Signal
LIN : Low−side Input Signal
HO : High−Side Output Signal
LO : Low−Side Output Signal
CSC : Over Current Detection Input
/SDx : Shutdown Input Function

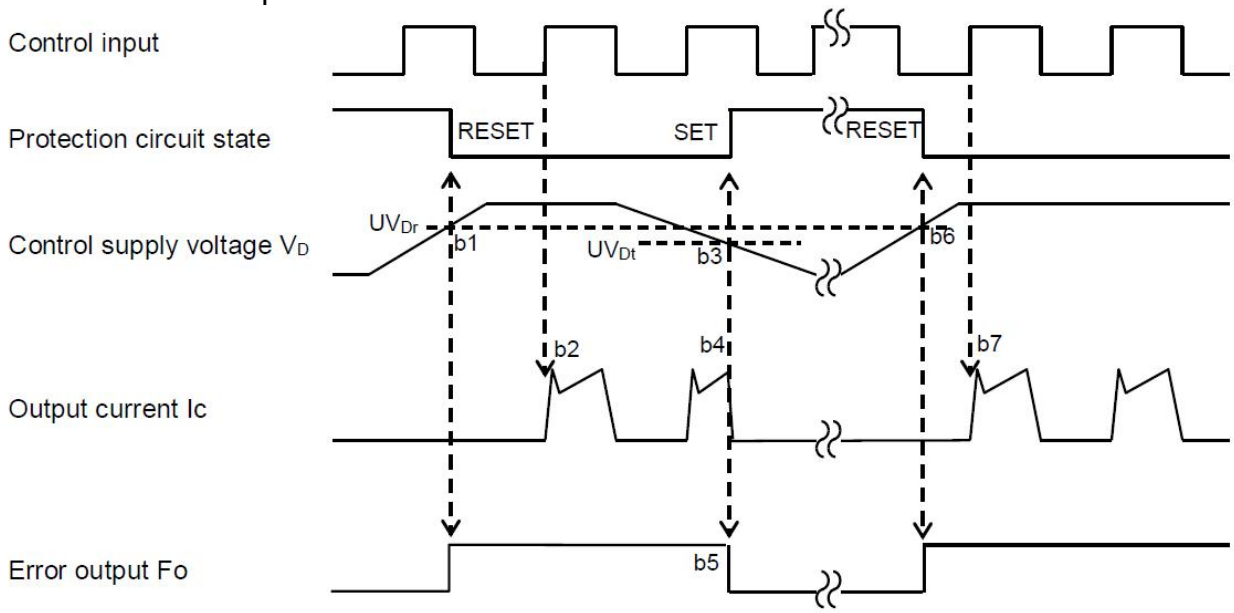


Figure 4. Undervoltage Protection (Low Side)

b1: Control supply voltage VD exceeds under voltage reset level UV_{Dr}, and the circuit starts to work when the next input waveform arrives.
b2: Normal operation: IGBT ON and outputs current.
b3: VD level drops under voltage trip level (UV_{Dt}).
b4: All low side IGBTs turn off in spite of control input condition.
b5: FO pin outputs fault signal ($t_{FO} \geq 40us$, and continuously outputs fault signal during under

voltage).
b6: VD level reaches UV_{Dr}.
b7: Normal operation: IGBT ON and outputs current.

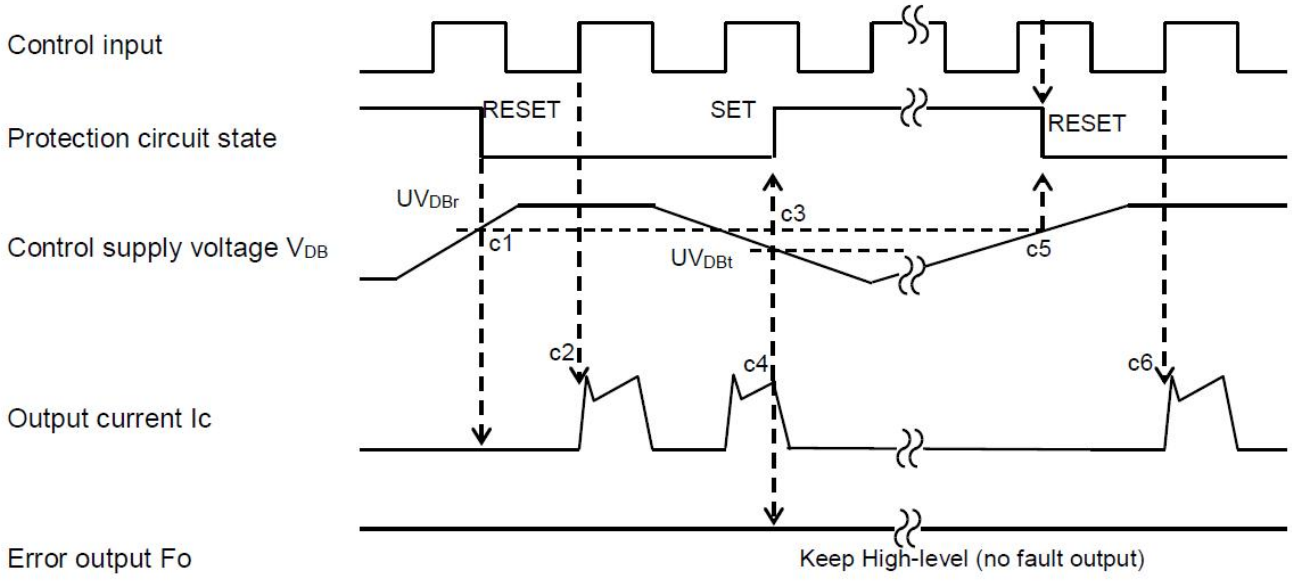


Figure 5. Undervoltage Protection (High Side)

c1: Control supply voltage V_{DB} rises to UV_{DBR}, and the circuit starts to work when the next input signal arrives.
c2: Normal operation: IGBT ON and outputs current.
c3: VDB level drops to under voltage trip level (UV_{DBt}).
c4: No matter what signal input, IGBT is turned off, but there is no fault signal output.
c5: VDB level reaches UV_{DBr}.
c6: Normal operation: IGBT ON and outputs current.

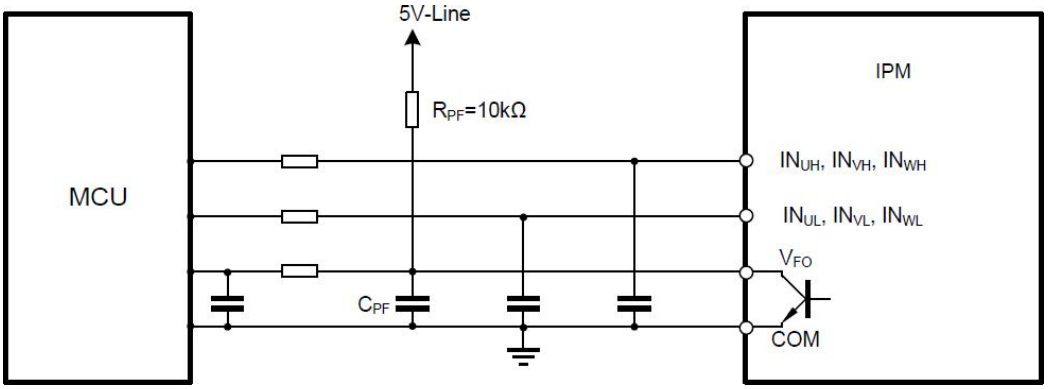
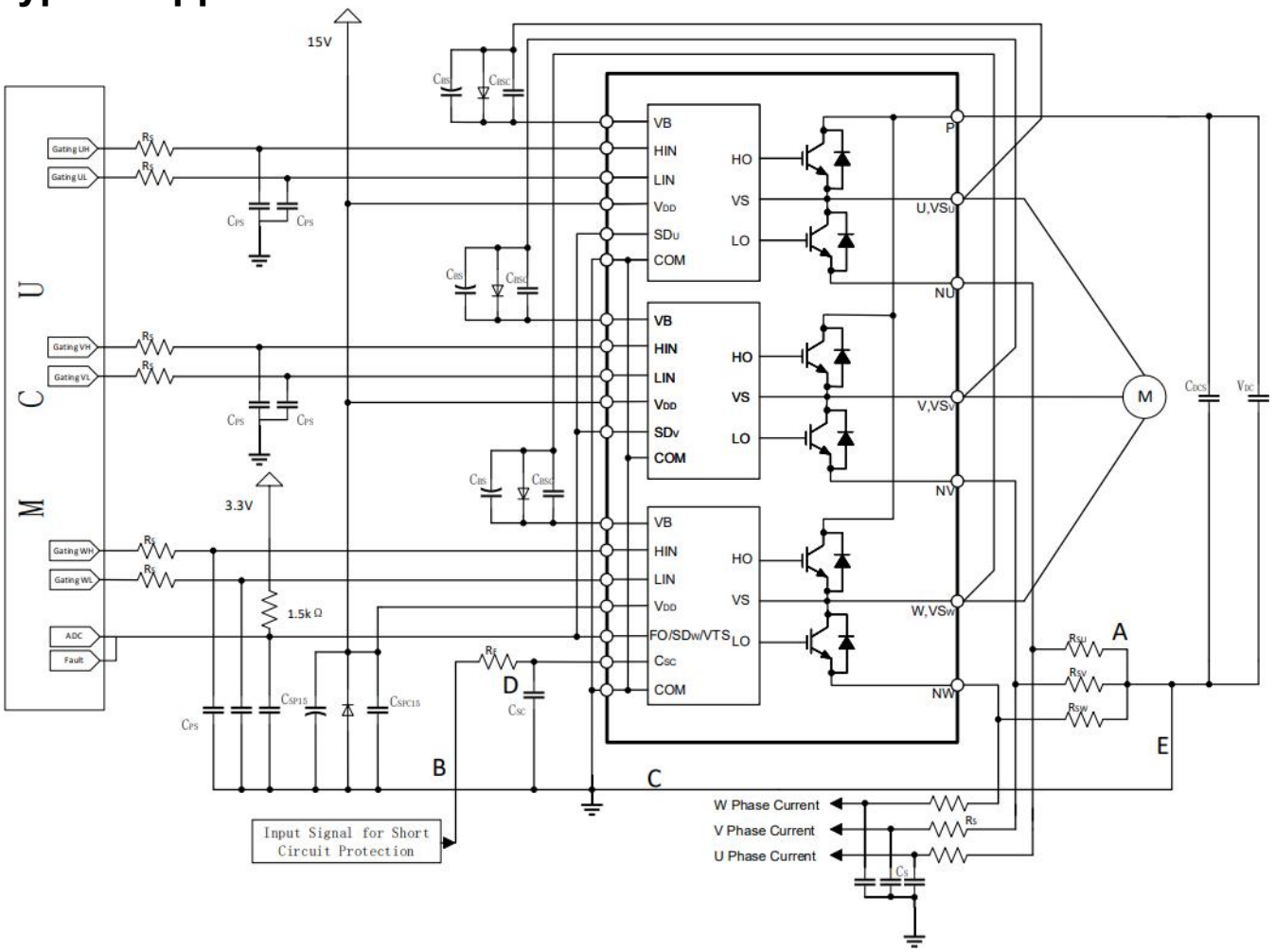


Figure 6. MCU input/output connection circuit (recommended)

NOTE: RC coupling at each input (parts shown dotted) might change depending on the PWM control scheme used in the application and the wiring impedance of the application's printed circuit board. The input signal section of the SPM 8 product integrates 5 kΩ (typ.) pull−down resistor. Therefore, when using an external filtering resistor, please pay attention to the signal voltage drop at input terminal.

Typical Application Schematic:



Remark:

(1) To avoid malfunction, the wiring of each input should be as short as possible (Less than 2 ~ 3 cm).

(2) When using the module's temperature sense output function, PIN9 needs to be connected to the MCU's ADC and fault detection terminals; Since the PIN9 pin is an open-drain type, it must be pulled up to 3.3V through the pull-up resistor, which is recommended to be 1.5KΩ.

(3) $C_{SP}15$ of around seven times larger than bootstrap capacitor C_{BS} is recommended.

(4) Input signal is active−HIGH type. There is a 5 KΩ resistor inside the IC to pull down each input signal line to GND. RC coupling circuits are recommended for the prevention of input signal oscillation. RSCPS time constant should be selected in the range 50 ~ 150 ns (Recommended RS = 100Ω, C_{PS} = 1 nF).

(5) Each wiring pattern inductance of A point should be minimized (Recommend less than 10nH). Use the shunt resistor $R_{S(U/V/W)}$ of surface mounted (SMD) type to reduce wiring inductance. To prevent malfunction, wiring of point E should be connected to the terminal of the shunt resistor $R_{S(U/V/W)}$ as close as possible.

(6) To prevent errors of the protection function, the wiring of B, C, and D point should be as short as possible.

(7) In the short−circuit current protection circuit, please select the R_FC_{SC} time constant in the range 1.5 ~ 2 μs. Do enough evaluation on the real system because short−circuit protection time may vary wiring pattern layout and value of the R_F and C_{SC} time constant.

(8) The connection between control GND line and power GND line which includes the NU, NV, NW must be connected to only one point. Please do not connect the control GND to the power GND by the broad pattern. Also, the wiring distance between control GND and power GND should be as short as possible.

(9) Each capacitor should be mounted as close to the pins of the Motion product as possible.
(10) To prevent surge destruction, the wiring between the smoothing capacitor and the P and GND pins should be as short as possible. The use of a high frequency non−inductive capacitor of around 0.1 ~ 0.22 μF between the P and GND pins is recommended.
(11) Relays are used in almost every system of electrical equipment of home appliances. In these cases, there should be sufficient distance between the CPU and the relays.
(12) The zener diode or transient voltage suppressor should be adapted for the protection of ICs from the surge destruction between each pair of control supply terminals (Recommended Zener diode is 22 V / 1 W, which has the lower zener impedance characteristic than about 15Ω).
(13) Please choose the electrolytic capacitor with good temperature characteristic in CBS. Also, choose 0.1 ~ 0.2 μF R−category ceramic capacitors with good temperature and frequency characteristics in C_{BSC}.
(14) For the detailed information, please refer to the application notes.
(15) FO and $SD_{U/V/W}$ must be connected as short as possible.

Package Outline DIP-25