Main Function and Parameter：

- 600V/15A three-phase DC to AC inverter
- Built-in low-loss trench-gate field-stop IGBT
- Open emitter type
- Built-in bootstrap diode

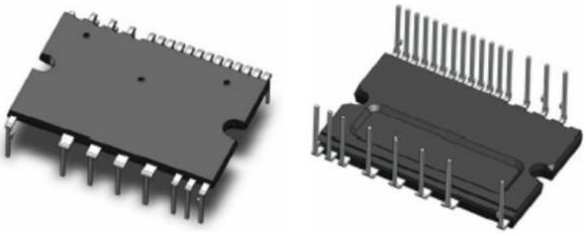
Application:

- Air Fan
- Range hoods
- Air purifier
- The dishwasher pump
- Freezer compressor

Features：

- IGBT Driver: Advanced input filter, Shoot through prevention, High voltage high-speed level shifting, Control supply under-voltage (UV)protection.
- Fault signaling: Corresponding to an SC fault (Upper&Lower-leg IGBT), a UV fault (Lower-side supply).
- Input/Output interface: 3.3V&5V input signal is compatible, high active .
- Temperature Detection: Negative temperature coefficient thermistor detection output

Package Overview



Order codes	Package	Marking
XP15G60AS0-CJB	DIP25	XP15G60AS0-CJB

Internal Block Diagram

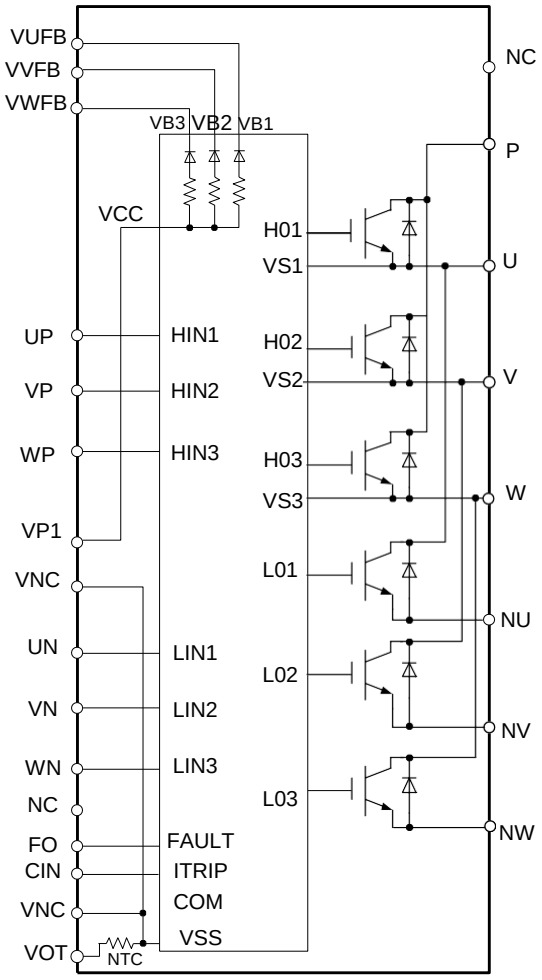


Fig 1：Internal Block Diagram (Bottom View)

Pin configuration

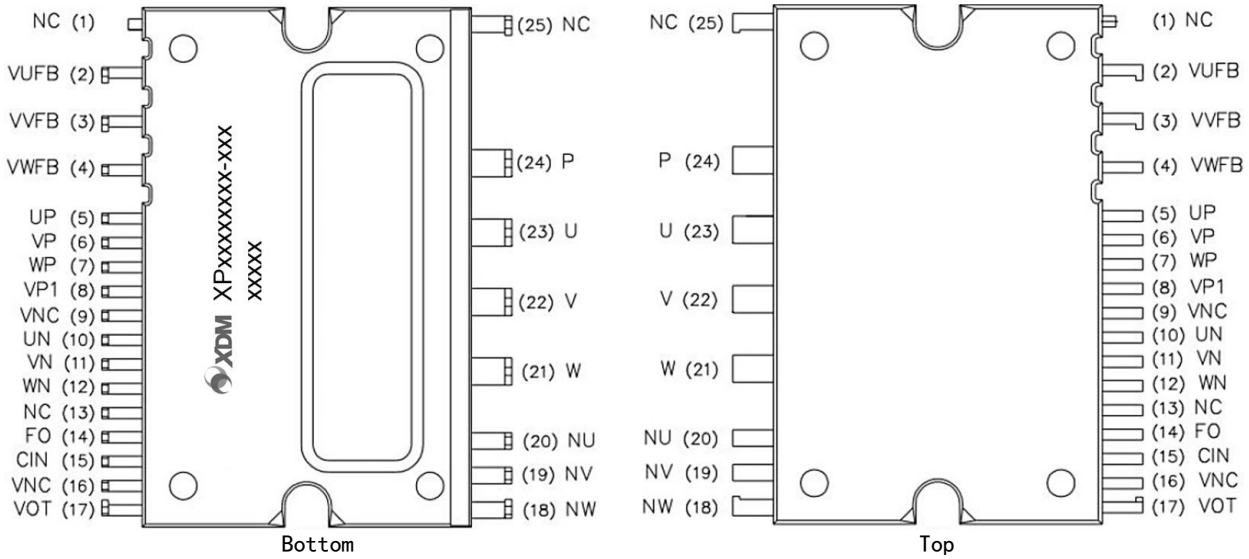


Fig 2：Pin figure

Pin Number	Pin Name	Pin Description
1	NC	No connection
2	VUFB	U-phase high side floating IC supply voltage
3	VVFB	V-phase high side floating IC supply voltage
4	VWFB	W-phase high side floating IC supply voltage
5	UP	U-phase high side gate driver input
6	VP	V-phase high side gate driver input
7	WP	W-phase high side gate driver input
8	VP1	IC supply voltage
9	VNC	Common Supply Ground
10	UN	U-phase low side gate driver input
11	VN	V-phase low side gate driver input
12	WN	W-phase low side gate driver input
13	NC	No connection
14	FO	Fault output
15	CIN	Analog input for over current shutdown
16	VNC	Common Supply Ground
17	VOT	Analog output for temperature monitor
18	NW	Negative DC-Link input for W-phase
19	NV	Negative DC-Link input for V-phase
20	NU	Negative DC-Link input for U-phase
21	W	Motor W-phase output

22	V	Motor V-phase output
23	U	Motor U-phase output
24	P	Positive bus input voltage
25	NC	No connection

Absolute Maximum Ratings (Tj= 25°C, Unless Otherwise Specified)

Symbol	Parameter	Conditions	Ratings	Unit
Inverter Part				
V_{CC}	Supply Voltage	Applied between P- NU, NV, NW	450	V
$V_{CC(Surge)}$	Supply Voltage (Surge)	Applied between P- NU, NV, NW	500	V
V_{CES}	Collector-emitter Voltage		600	V
$\pm I_C$	Each IGBT Collector Current	T_C=25°C (Tc refer to Fig:3)	15	A
$\pm I_{CP}$	Each IGBT Collector Current (Peak)	T_C=25°C, less than 1ms	30	A
P_C	Collector Dissipation	T_C=25°C, Per One Chip	30	W
Tj	Operating Junction Temperature	(NOTE 1)	-40~+150	°C
Control Part				
V_{DB}	High side floating supply voltage	Applied between UFB - U, VFB-V,WFB-W	17.5	V
V_D	Low side supply voltage	Applied between VP1,VN1 - VNC	17.5	V
V_{IN}	Input Signal Voltage	Applied between UP,VP,WP,UN,VN ,WN-VNC	-1~10	V
V_{FO}	Fault Output Supply Voltage	Applied between FO - VNC	-0.5~VD+0.5	V
I_{FO}	Fault Output Curren	Sink Current at FO Pin	1.5	mA
V_{SC}	Current Sensing Input Voltage	Applied between CIN - VNC	-0.5~VD+0.5	V
Total System				
$V_{CC(PROT)}$	Self Protection Supply Voltage Limit (Short Circuit Protection Capability)	V_D=V_{DB}=13.5~16.5V Tj=150°C, Non-repetitive, less than 2u	400	V
Tc	Module Case Operation Temperature	-20°C≤Tj≤150°C	-20~+100	°C
Tstg	Storage Temperature		-40~+125	°C
Viso	Isolation Voltage	Sinusoidal, AC 1 minute, between pins and heat-sink plate	2500	Vrms

NOTE 1：To insure safe operation of the IPM, the average junction temperature should be limited to Tj(av) ≤ 150° C (@Tc ≤ 100° C).

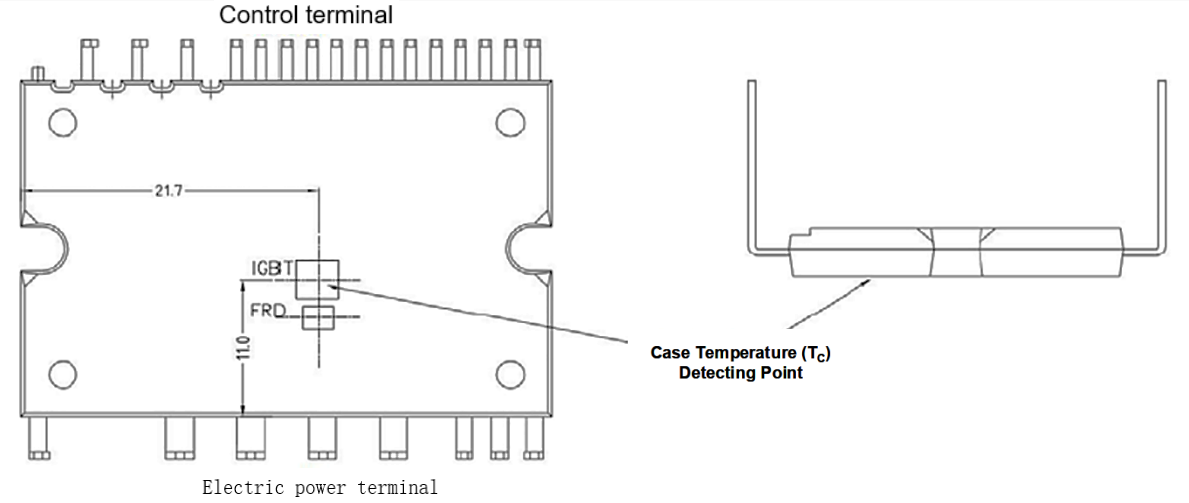


Fig 3. Tc measurement point

Thermal Resistance

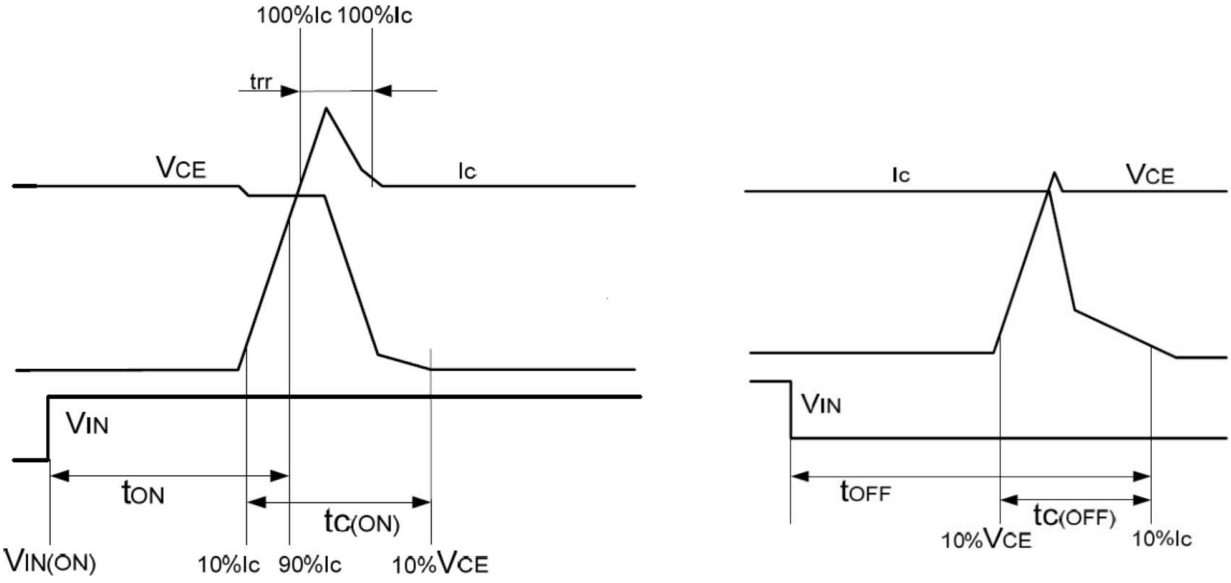
Symbol	Parameter	Condition	Min	Typ	Max	Unit
Rth(j-c)Q	Junction to Case Thermal Resistance	For each IGBT part	-	-	4.2	°C/W
Rth(j-c)F		For each FRD part	-	-	5.0	°C/W

Electrical Characteristics (Tj = 25°C, Unless Otherwise Specified)

Inverter Part

Symbol	Parameter	Condition	Min	Typ	Max	Unit
$V_{CE(sat)}$	Collector – Emitter Saturation Voltage	V_D=V_{DB}=15V V_{IN}=5V,I_C=15A,T_j=25°C	-	1.6	1.9	V
		V_D=V_{DB}=15V V_{IN}=5V,I_C=15A,T_j=125°C	-	1.9	-	V
V_F	FWD Forward Voltage	V_{IN}=0V,I_C=-15A,T_j=25°C		2.5	3.1	V
t_{ON}	Switching Times （NOTE 2）	V_{CC}=300V,V_D=V_{DB}=15V I_C=15A V_{IN}=0V-5V,inductive load	-	0.7	-	μs
$t_{C(ON)}$			-	0.24	-	μs
t_{OFF}			-	0.8	-	μs
$t_{C(OFF)}$			-	0.06	-	μs
t_{rr}			-	0.19	-	μs
E_{on}	Turn-on loss	I_C=15A,Vcc=400V, V_D=V_{DB}=15V R_G=22Ω,L=1.0mH , Tj=25°C	-	35	85	μJ
E_{off}	Turn-off loss		-	240	370	μJ
I_{CES}	Collector-Emitter Leakage Current	V_{CE}=V_{CES} Tj=25°C	-	-	75	μA
		V_{CE}=V_{CES} Tj=125°C	-	-	1	mA

NOTE 2： t_{ON} and t_{OFF} include the propagation delay time of the internal drive I_C. $t_{C(ON)}$ and $t_{C(OFF)}$ are the switching time of IGBT itself under the given gate driving condition internally. For the detailed information, Please Refer to Fig 4.



(a)Turn on (b)Turn off

Fig 4: Switching Time Definition

Control Part

Symbol	Parameter	Condition		Min	Typ	Max	Unit
I_D	Quiescent VD Supply Current	V_D=15V V_{IN}=5V	VP1-VNC	-	0.52	1	mA
I_{DB}	Quiescent VDB Supply Current	V_{DB}=15V V_{IN}=5V	UFB-U,VFB-V,WFB-W	-	360	550	uA
V_{FOH}	Fault Output Voltage	Vsc=0V,V_{FO} Circuit kΩ to 5V Pull-up		4.6	-	-	V
V_{FOL}		Vsc=1V,I_{FO}=1.5mA		-	-	0.3	V
Vsc,TH+	Short circuit positive going threshold	V_D=15V		0.37	0.47	0.65	V
Vsc,TH-	Short circuit negative going threshold	V_D=15V		0.2	0.4	-	V
UV_{DR}	Control supply under-voltage protection	Reset Level		9.5	10.4	11.0	V
UV_{DD}		Trip Level		11.0	12.1	12.8	V
UV_{DBR}		Reset Level		9.5	10.4	11.0	V
UV_{DBD}		Trip Level		11.0	12.1	12.8	V
Ron,FLT	FLT low on resistance	I=1.5mA			50	90	Ω
T_{FO}	Fault-Out Pulse Width			40	65	120	uS
$t_{FIL,IN}$	Input filter time (UP/VP/WP,UN/VN/WN)	V_{IN}=0V&5V		140	290	-	nS
t_{CINMIN}	CIN Input filter time	V_{IN}=0V&5V,V_{CIN}=5V		270	530	780	nS
$V_{IN(ON)}$	ON Threshold Volta	Applied between UP,VP,WP,UN,VN,WN and VNC		1.7	2.1	2.4	V
$V_{IN(OFF)}$	OFF Threshold Volta			0.7	0.85	1.4	V
V_{OT}	Temperature Output NOTE 3	Tc=90°C		1.53	1.59	1.65	V

		Tc=25°C	4.15	4.17	4.19	V
V_F	BSD Forward voltage	IF=10mA including voltage	-	1.0	1.3	V
R_{BSD}	Internal bootstrap diode on	VF1=4V,VF2=5V	22	36	50	Ω

NOTE 3：IPM do not shutdown IGBTs and output fault signal automatically when temperature rises excessively. When temperature exceeds the protective level the user defined, controller(MCU)should stop the IPM. Temperature of HVIC vs VOT output characteristics is described as Fig 5, The Fig 5 was tested by 20Kohm pull-up resistor

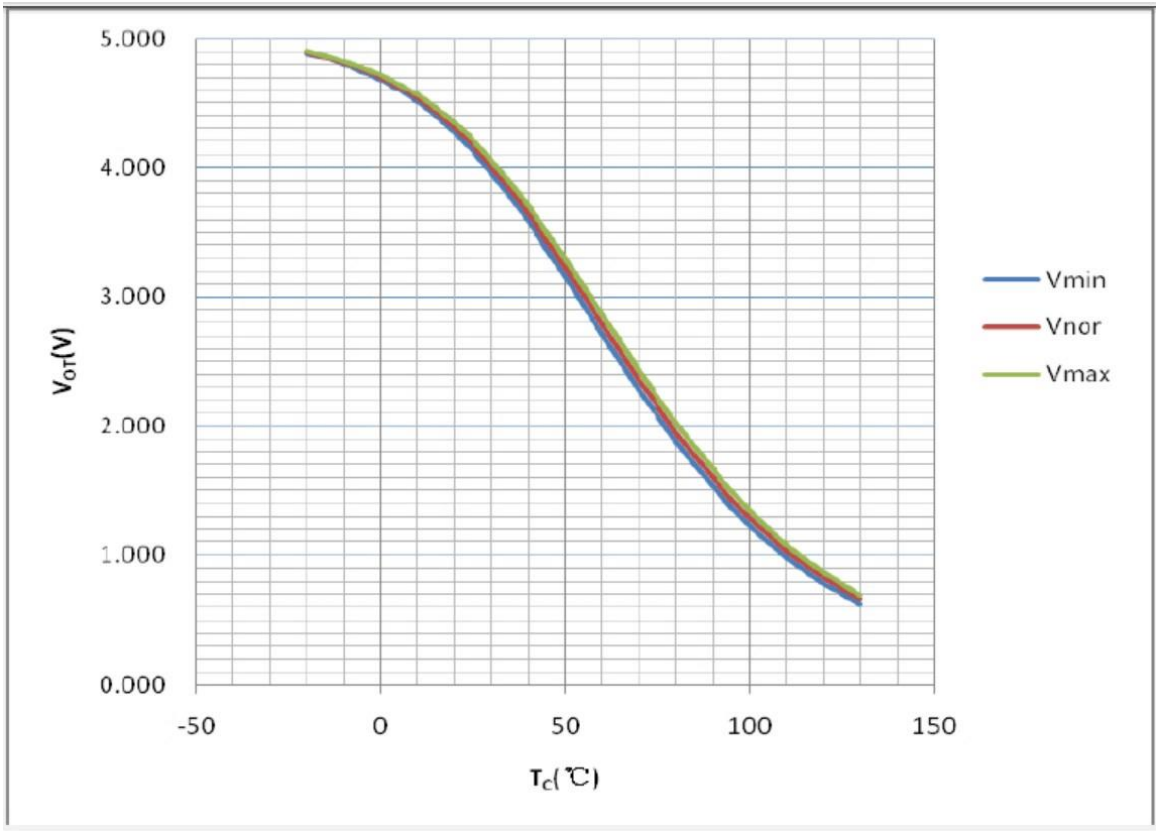


Fig 5： VOT output voltage VS HVIC temperature

Recommended Operating Conditions

Symbol	Parameter	Condition	Value			Unit
			Min	Typ	Max	
V_{cc}	Supply Voltage	Applied between P–NU,NV, NW	0	300	400	V
V_D	Control Supply Voltage	Applied between VP1 – VNC	-	15	-	V
V_{DS}	High-side Bias Voltage	Applied between VUFB – U, VVFB – V, VWFB-W	-	15	-	V
t_{dead}	for Preventing Arm-short	For Each Input Signal,, Tc<=100℃	1	-	-	us
f_{PWM}	PWM Input Signal	-20°C≤Tc≤+100°C -20°C≤Tj≤+150°C	-	-	20	kHz
PWM	Minimum Input Pulse Width	ON	0.7	-	-	us
		OFF	0.7	-	-	us
Tj	Junction temperature		-20	-	Tj	°C
Internal NTC - Thermistor Characteristics						
R_{NTC}	Resistance of Thermistor	T_{NTC}=25°C	97	100	R_{NTC}	KΩ
		T_{NTC}=125°C	3.25	3.46		KΩ
Temperature Range			-40	-	+125	°C

Mechanical Characteristics and Ratings

Parameter	Condition	Value			Unit
		Min	Typ	Max	
Mounting Torque	Mounting Screw：M3	-	0.69	-	N•m
Device Flatness	Refer to Fig 6.	-50	-	+120	um
Weight		-	7	-	g

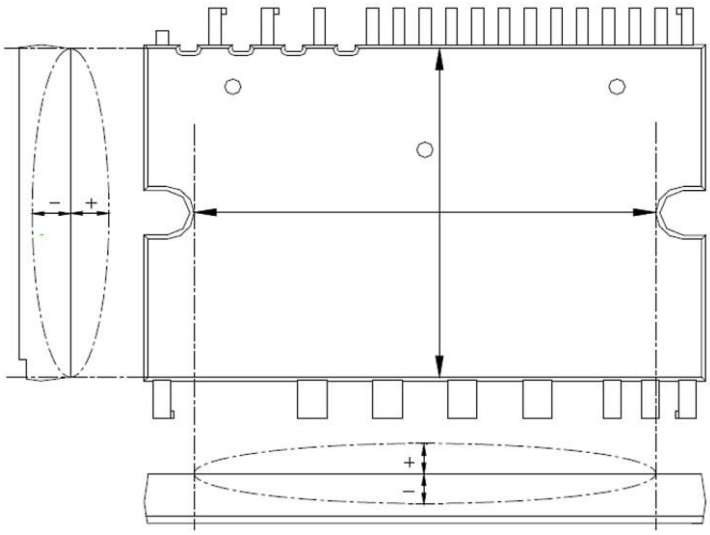


Fig 6：Flatness Measurement Position

Application Guide

Advanced input filter

The advanced input filter allows an improvement in the input/output pulse symmetry of HVIC inside the module and helps to reject noise spikes and short pulses. The advantage of the new filter is shown in Figures 7 and 8.

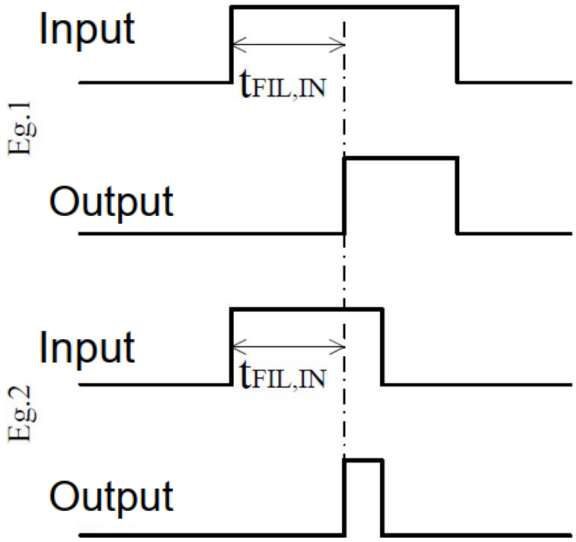


Fig 7：Typical input filter

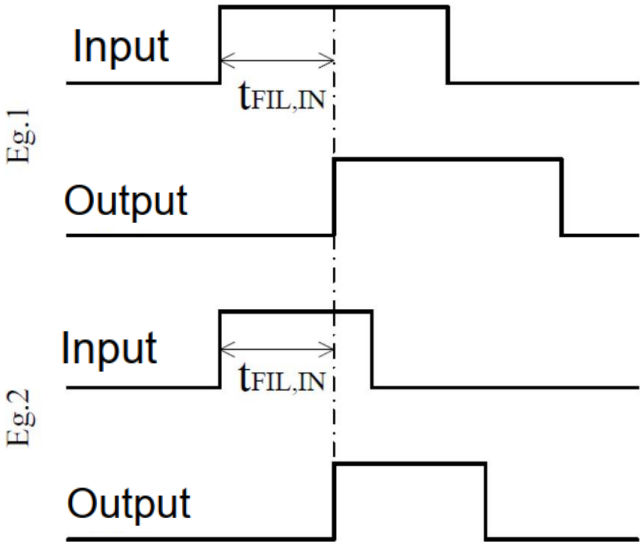


Fig 8：Advanced input filter

Time Charts of Protective Function

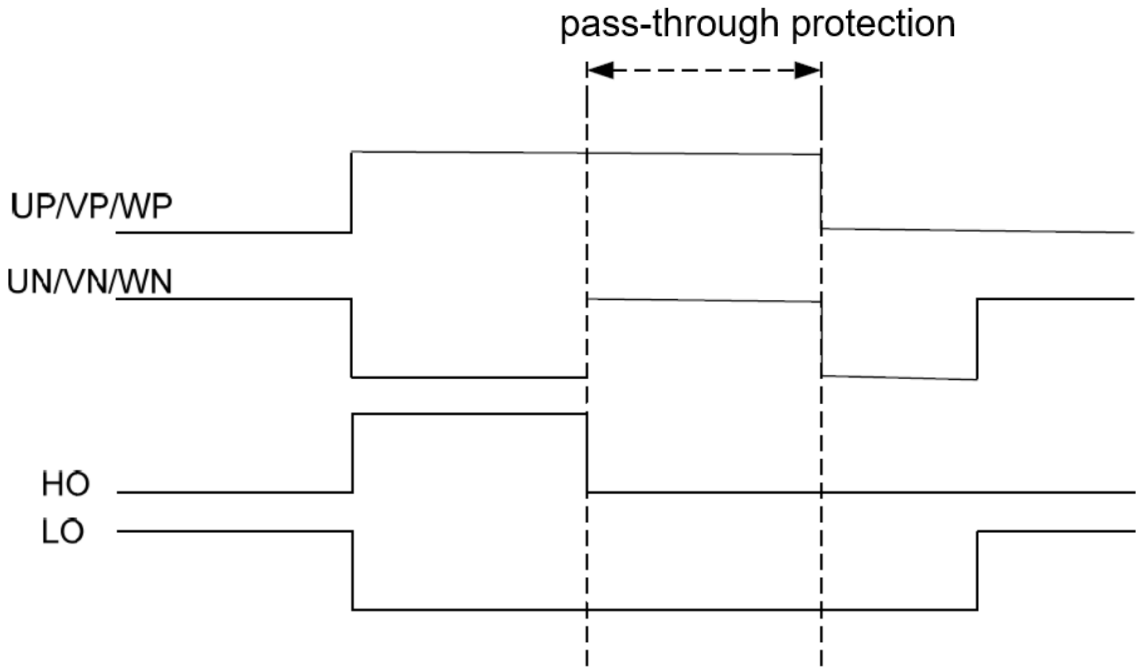


Fig 8：Advanced input filter

NOTE 4：The signal HO and LO are gate output of the internal HVIC

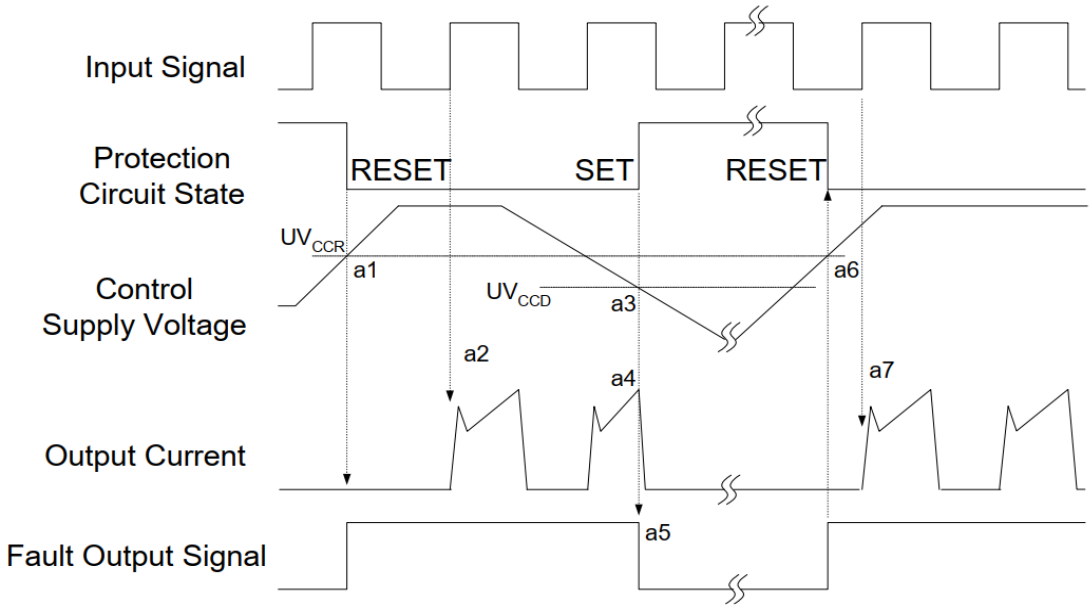


Fig 10：Under-Voltage Protection (Low-side Operation)

a1 : Control supply voltage rises: After the voltage rises UVDr, the circuits start to operate when next input is Applied

a2 : Normal operation: IGBT ON and carrying current

a3 : Under voltage detection (UVDt).

a4 : IGBT OFF in spite of control input condition

a5 : Fault output operation starts

a6 : Under voltage reset (UVDr)

a7 : Normal operation: IGBT ON and carrying current。

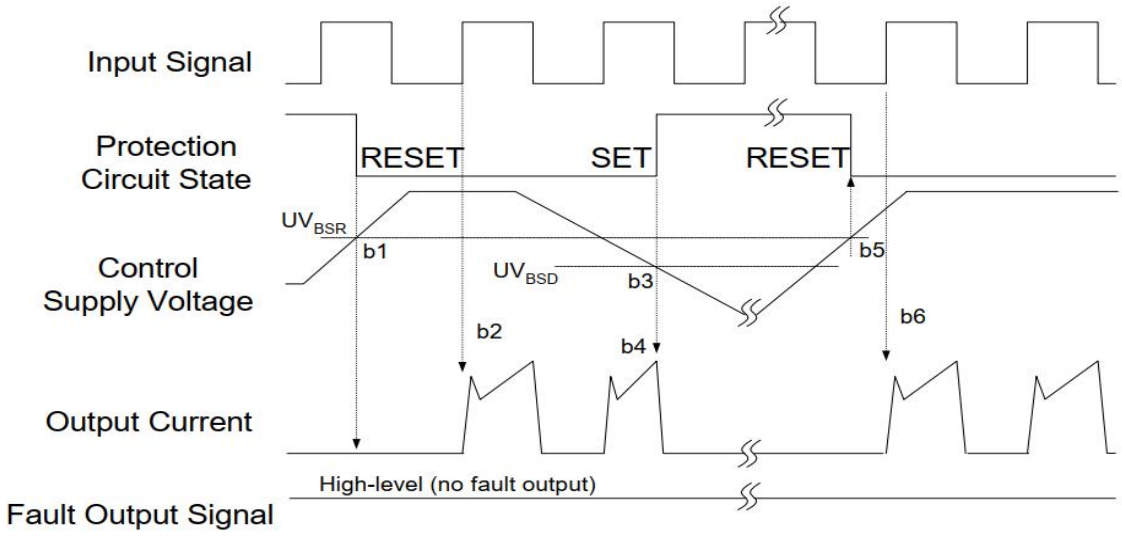


Fig 11：Under-Voltage Protection (High-side Operation only)

b1 : Control supply voltage rises: After the voltage reaches UVDBr, the circuits start to operate when next input is applied

b2 : Normal operation: IGBT ON and carrying current

b3 : Under voltage detection (UVDBt)

b4 : IGBT OFF in spite of control input condition, but there is no fault output signal.

b5 : Under voltage reset (UVDBr)

b6 : Normal operation: IGBT ON and carrying current

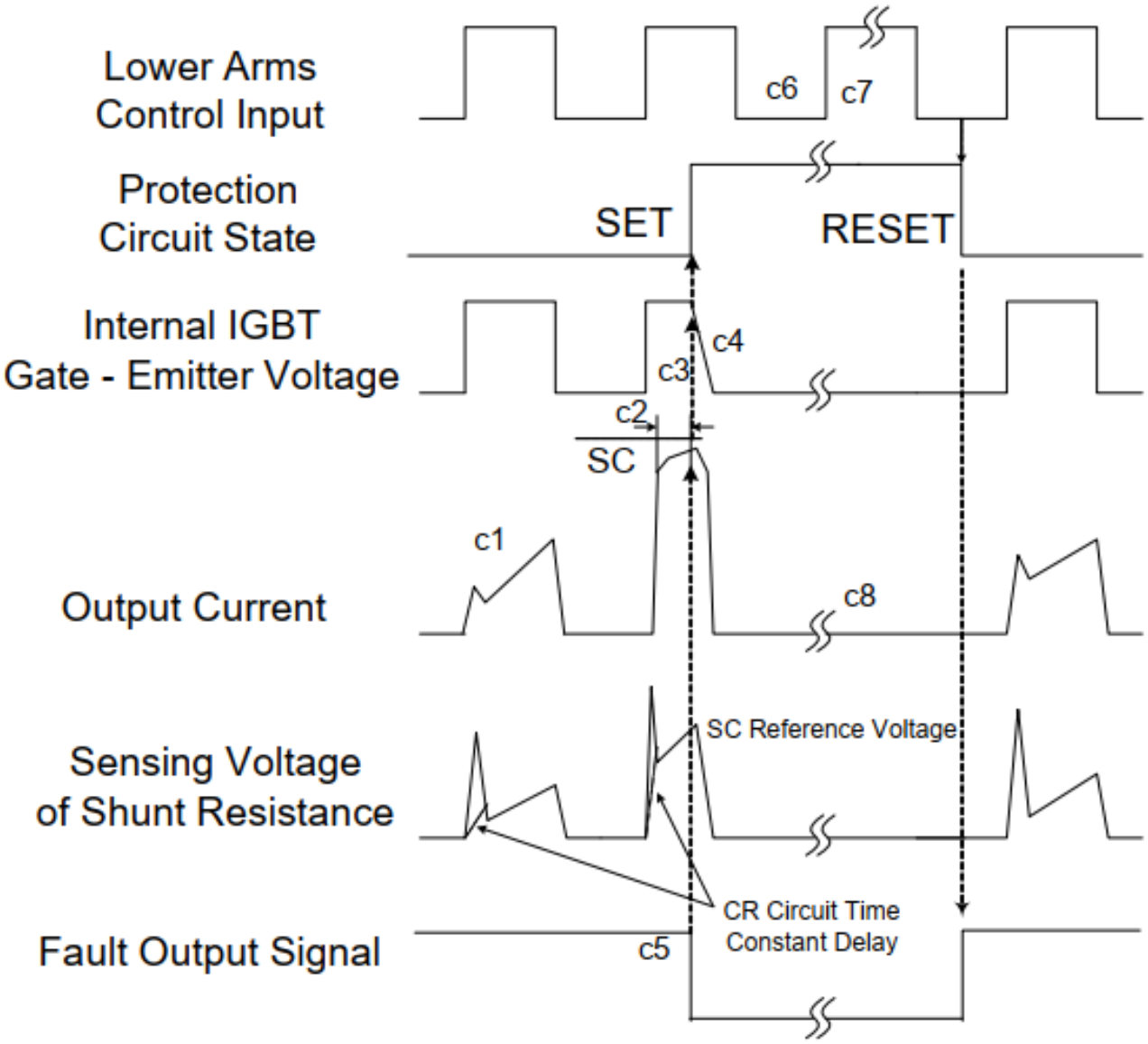


Fig 12：short-Circuit Current Protection (Low-side And High-side Operation)

(with the external shunt resistance connection)

c1 : Normal operation: IGBT ON and carrying current.

c2 : Short circuit current detection (CIN trigger).

c3 : Hard IGBT gate interrupt.

c4 : IGBT turns OFF.

c5 : Fault output timer operation starts: The pulse width of the fault output signal is set by the internal capacitor.

c6 : Input “L” : IGBT OFF state.

c7 : Input “H”: IGBT ON state, but during the active period of fault output the IGBT doesn’t turn ON

c8 : IGBT OFF state

Input/Output Interface Circuit

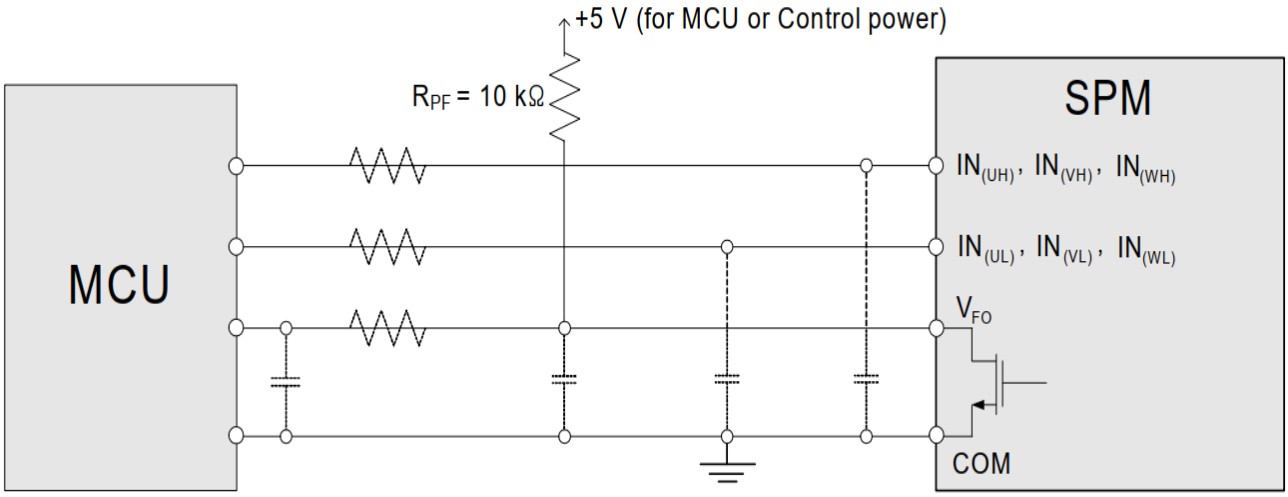


Fig 13：Recommended CPU I/O Interface Circuit

NOTE 5：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.

NOTE 6：The logic input is compatible with standard CMOS or LSTTL outputs

Wiring Around The Shunt Resistor

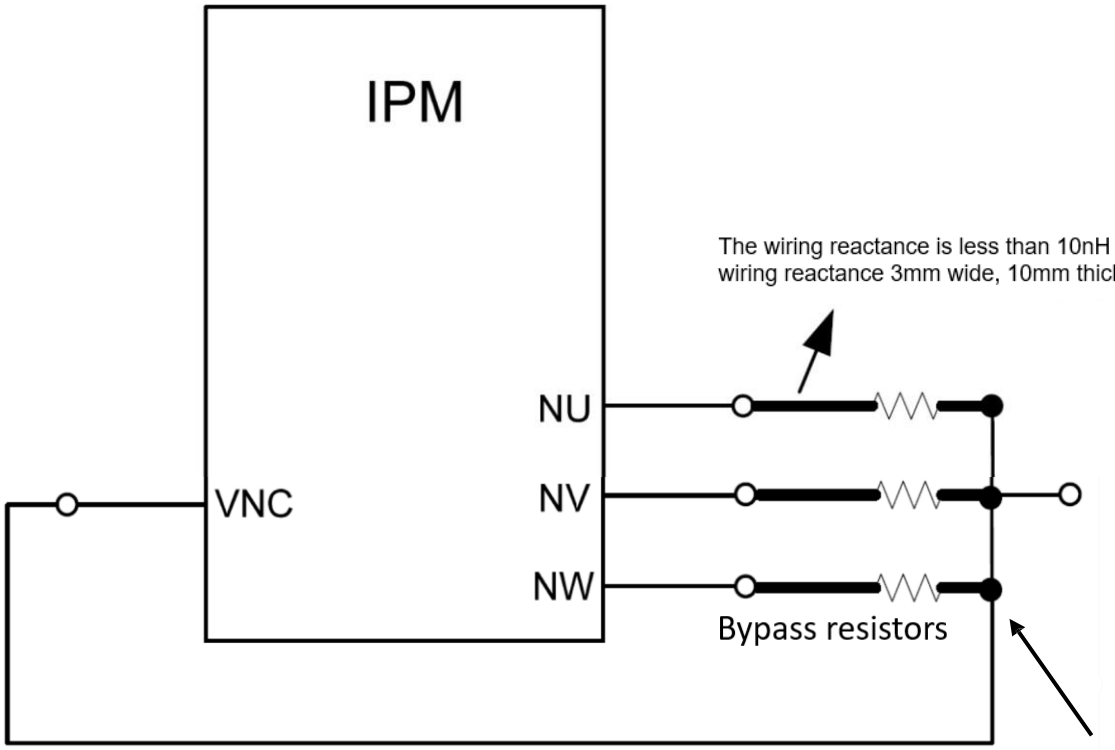


Fig 14：Recommended Wiring Around The Shunt Resisto

Typical Application Circuit

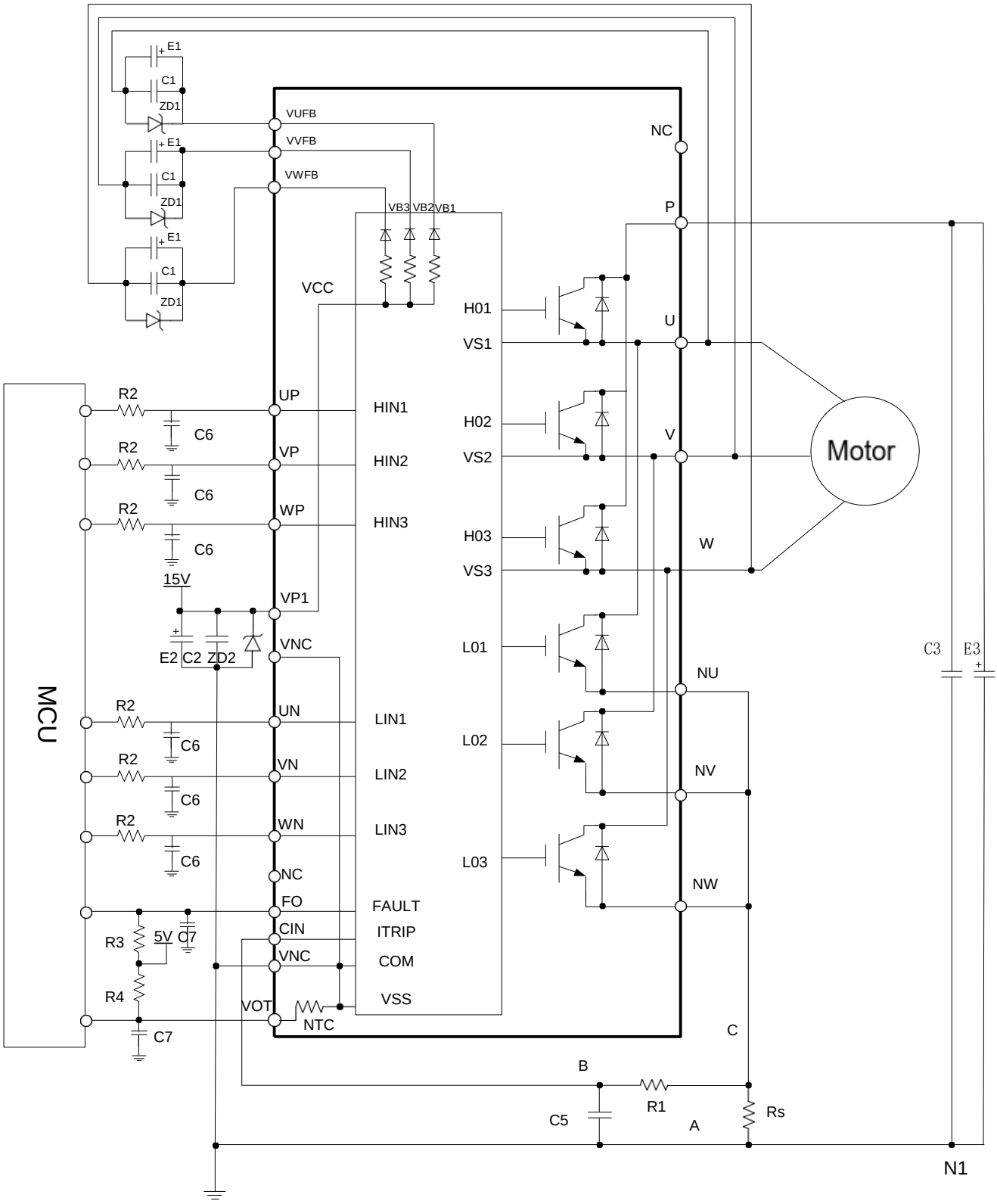


Fig 15: Typical Application Circuit

NOTE 7：Input drive is High-Active type. There is a 5.1kΩ(typ.) pull-down resistor integrated in the IC input circuit. To prevent malfunction, the wiring of each input should be as short as possible. When using RC coupling circuit,make sure the input signal level meet the turn-on and turn-off threshold voltage.

NOTE8：Thanks for HVIC inside modules, direct coupling to MCU without any opto-coupler or transformer isolation is possible.

NOTE 9：Bootstrap negative electrodes should be connected to U，V，W terminals directly and separated from the main output wires.

NOTE 10：Fo output is open drain type. It should be pulled up to the positive side of a 5V power supply by a resistor of about 10kΩ.

NOTE 11：To prevent erroneous protection, the wiring of A, B, C should be as short as possible.

NOTE 12：The time constant R1、C5 of the protection circuit should be selected in the range of 1.0-2μs. SC interrupting time might vary with the wiring pattern. Tight tolerance, temp-compensated type is recommended for R1, C5.

NOTE 13：All capacitors should be mounted as close to the terminals of the IPM as possible.

NOTE 14：To prevent surge destruction, the wiring between the smoothing capacitor and the P, N1 terminals should be as short as possible. Generally, a 0.1-0.22μF snubber between the P-N1 terminals is recommended.

NOTE 15：Two VNC terminals (9 & 16 pin) are connected inside IPM, please connect either one to the 15V power supply GND outside and leave another one open.

NOTE 16：If control GND is connected to power GND by broad pattern, it may cause malfunction by power GND fluctuation. It is recommended to connect control GND and power GND at only one point.

Detailed Package Outline Drawings

Unit: mm

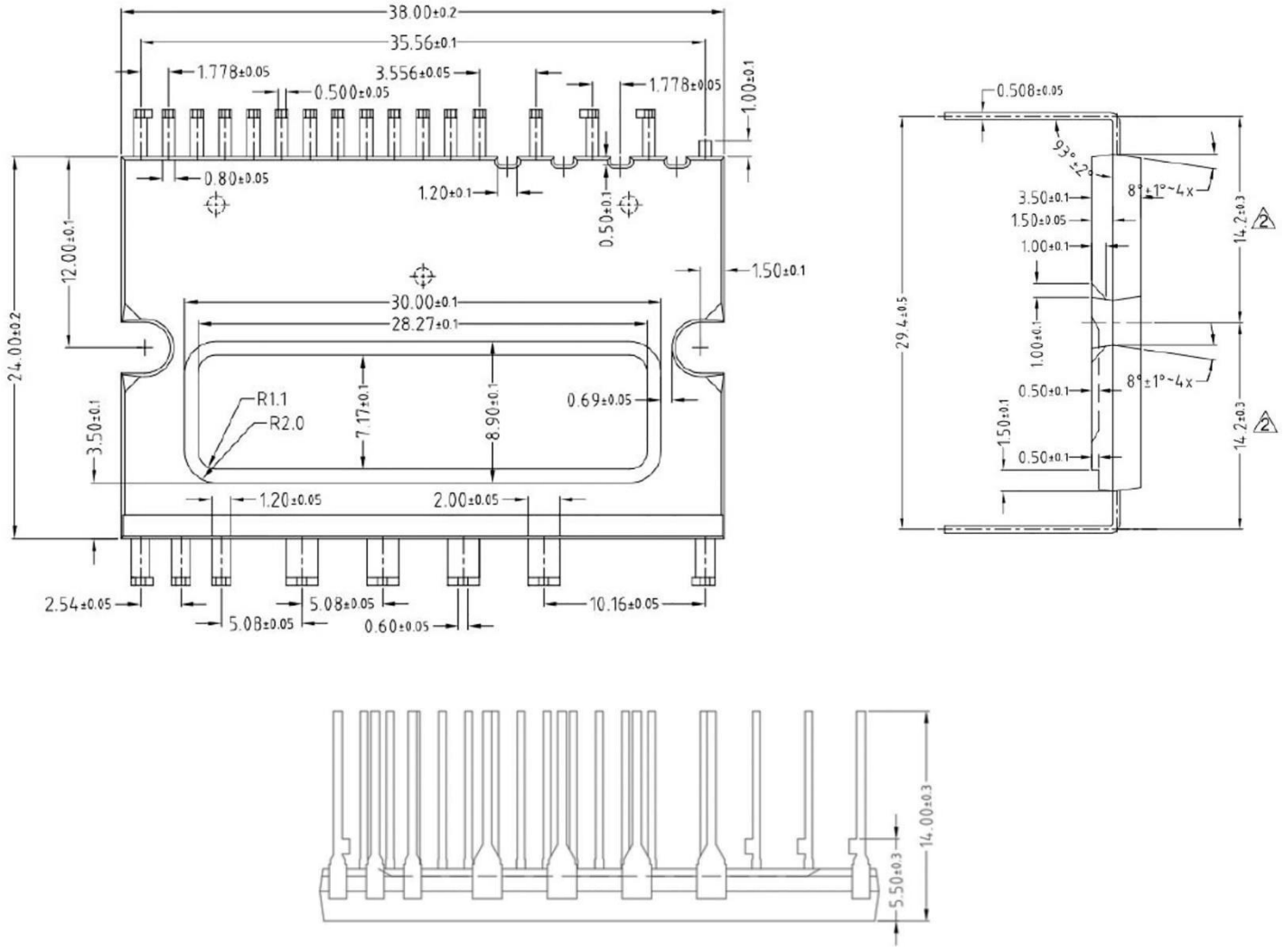


Fig 16: Package Outline