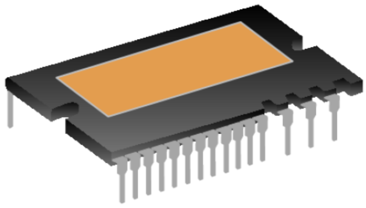
Features

- Low−Loss, Short−Circuit Rated IGBTs
- Integrated high voltage gate drive circuit (HVIC)
- Integrated under voltage protection, over temperature, over current protection and temperature output
- Compatible with 3.3V&5V input signal, effective at high level
- Insulation class 1500Vrms / min
- Integrated bootstrap functionality
- High reliability and thermal stability, good parameter consistency

Applications

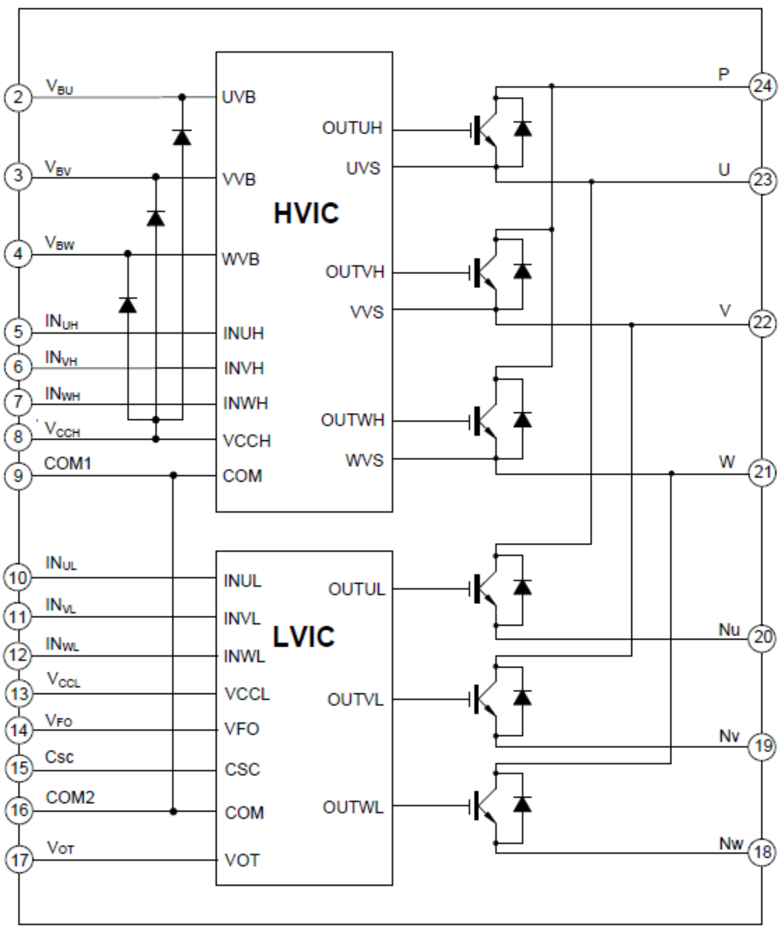
- Frequency converter
- Air Conditioning compressor
- Refrigerator compressor
- Air cleaner

Ordering Information		
Type NO.	**Marking**	**Package Code**
MPBM20N60BTB	MPBM20N60BTB	DIP-24H



DIP-24H

Internal Electrical Schematic



Absolute Maximum Ratings: T_J = 25ºC, unless otherwise noted

Parameter	Symbol	Value	Unit
Inverter Part			
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 ≤ 150°C	I_C	20	A
Each IGBT Collector Current (Peak)， T_C = 25° C, T_J ≤ 150° C	I_{CP}	40	
Power dissipation per 1 chip T_C=25℃	P_D	53	W
Control Part			
Control Supply Voltage	V_{CC}	20	V
High−Side Control Bias 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
Operating junction temperature	T_J	-40 to 150	℃
Storage temperature range	T_{STG}	-40 to 125	℃
Single IGBT thermal resistance, junction-case	$R_{\theta JCB}$	1.89	℃/W
Single FRD thermal resistance, junction-case	$R_{\theta JCF}$	2.35	℃/W
Isolation test voltage (1min, RMS, f = 60Hz)	V_{ISO}	1500	Vrms

Note: The maximum junction temperature of the power chips is 150℃. To ensure the safe operation of DIPIPM, it is recommended that the average junction temperature should be limited to Tj ≤ 125℃(@Tc≤ 100℃)

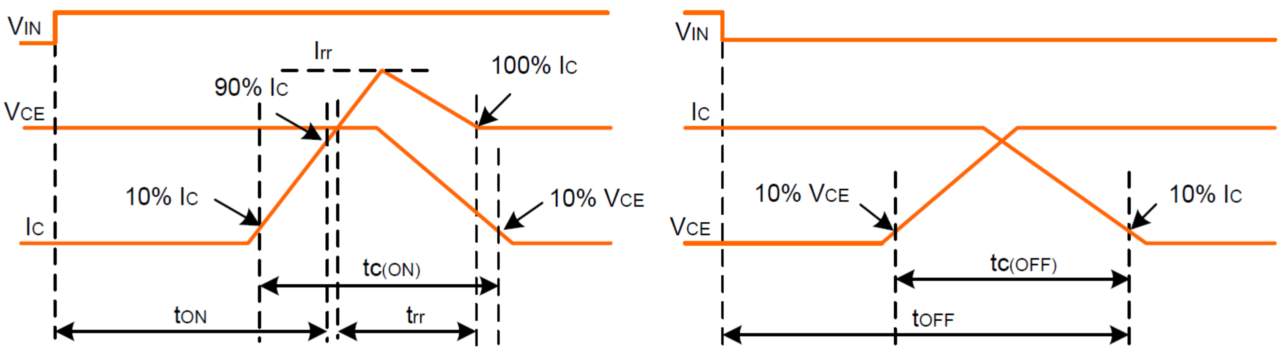
Recommended Operation Conditions: T_J = 25ºC, unless otherwise noted

Parameter	Symbol	Value			Unit
		Min.	Typ.	Max.	
Supply Voltage	V_{PN}	-	300	400	V
Control supply voltage	V_{CC}	13.2	-	20	V
High side control voltage	V_{BS}	13.0	-	20	V
High side grid output voltage	V_{HO}	VS	-	VB	V
Low side grid output voltage	V_{LO}	VSS	-	VCC	V

Electrical Characteristics （unless otherwise noted，T_j=25℃，V_{CC}=V_{BS}=15V）

Inverter Part

Parameter	Symbol	Condition	Value			Unit
			Min.	Typ.	Max.	
Collector－Emitter Saturation Voltage	$V_{CE(SAT)}$	V_{CC}=V_{BS}=15V, V_{IN}=5V I_C=20A	-	1.7	2.2	V
FRD Forward Voltage	V_F	V_{IN}=0V, I_F=20A		1.6	2.2	V
High Side	t_{on}	V_{PN} = 300V, V_{CC} = V_{BS} = 15V, I_C = 20A, V_{IN} = 0V←→ 5V, Inductive load	-	709	-	ns
	t_r		-	39	-	ns
	t_{off}		-	669	-	ns
	t_f		-	57	-	ns
	t_{rr}		-	170	-	ns
Low Side	t_{on}		-	843	-	ns
	t_r		-	114	-	ns
	t_{off}		-	697	-	ns
	t_f		-	44	-	ns
	t_{rr}		-	192	-	ns
Collector－Emitter Leakage Current	I_{CES}	V_{CE}=600V	-	-	250	uA



(a)开启 (b)关闭

Figure 1. Switching Time Definition

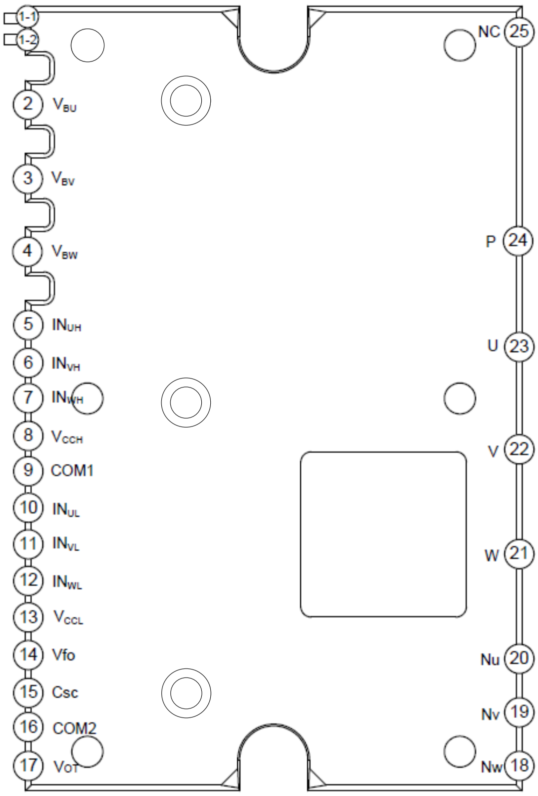
Control Part

Parameter	Symbol	Condition		Value			Unit
				Min.	Typ.	Max.	
Quiescent V_{CC} supply current	I_{QCC}	V_{CC}=15V, V_{IN}=0V		-	-	3.5	mA
Quiescent V_{BS} supply current	I_{QBS}	V_{BS}=0V, V_{IN}=0V		-	75	-	uA
Fault Output Voltage	V_{FOH}	V_{SC} = 0 V, V_F Circuit: 10kΩ to 5V Pull-up		4.9	-	-	V
	V_{FOL}	V_{SC}=1V, I_{FO}=1mA		-	-	0.9	V
Fault−Out Pulse Width	t_{FO}	Fault duration		40	-	-	us
Short−Circuit Trip Level	VSC(ref)	V_{CC}=15V		0.42	0.46	0.51	V
Over temperature protection	OT_t	LVIC temperature		100	120	140	℃
Over temperature protection hysteresis	OT_{rh}	LVIC Temperature Hysteresis		-	10	-	℃
Temperature Output	VOT	LVIC Temperature=25℃		0.88	1.13	1.39	V
		LVIC Temperature=90℃		2.63	2.77	2.91	V
Low side undervoltage protection Figure 5	UV_{Dt}	Detection level		10	11	12	V
	UV_{Dr}	Reset level		9	10	11	V
High side undervoltage protection Figure 6	UV_{DBt}	Detection level		10	11	12	V
	UV_{DBr}	Reset level		9	10	11	V
ON Threshold Voltage	V_{IH}	Logic high level	Between input and COM	-	-	2.5	V
OFF Threshold Voltage	V_{IL}	Logic low level		0.8	-	-	V

Bootstrap diode section

Parameter	Symbol	Condition	Value			Unit
			Min.	Typ.	Max.	
Forward voltage	V_F	I_F=10mA Tc=25℃	-	2.5	4.0	V
Reverse recovery time	t_{rr}	I_F=10mA Tc=25℃	-	50	-	ns

Pin Assignment



Pin Description

Pin Number	Pin name	Pin Description
1-1	COM	Internal common ground terminal
1-2	V_{CC}	Internal power terminal, No Connection
2	V_{BU}	U-phase high side floating IC supply voltage
3	V_{BV}	V-phase high side floating IC supply voltage
4	V_{BW}	W-phase high side floating IC supply voltage
5	I_{NUH}	U-phase high side gate driver input
6	I_{NVH}	V-phase high side gate driver input
7	I_{NWH}	W-phase high side gate driver input
8	VCCH	High side gate drive supply voltage
9	COM1	Module common ground
10	INUL	U-phase low side gate driver input
11	INVL	V-phase low side gate driver input
12	INWL	W-phase low side gate driver input
13	V_{CCL}	low side gate drive supply voltage
14	VFO	Fault Output
15	Csc	External capacitor, used for short-circuit current detection input and low-pass filtering
16	COM2	Module common ground
17	VOT	Temperature output terminal

18	NW	W-phase DC negative terminal
19	NV	V-phase DC negative terminal
20	NU	U-phase DC negative terminal
21	W	Output for W Phase
22	V	Output for V Phase
23	U	Output for U Phase
24	P	Positive DC−Link Input
25	NC	No Connection

Temperature output function description

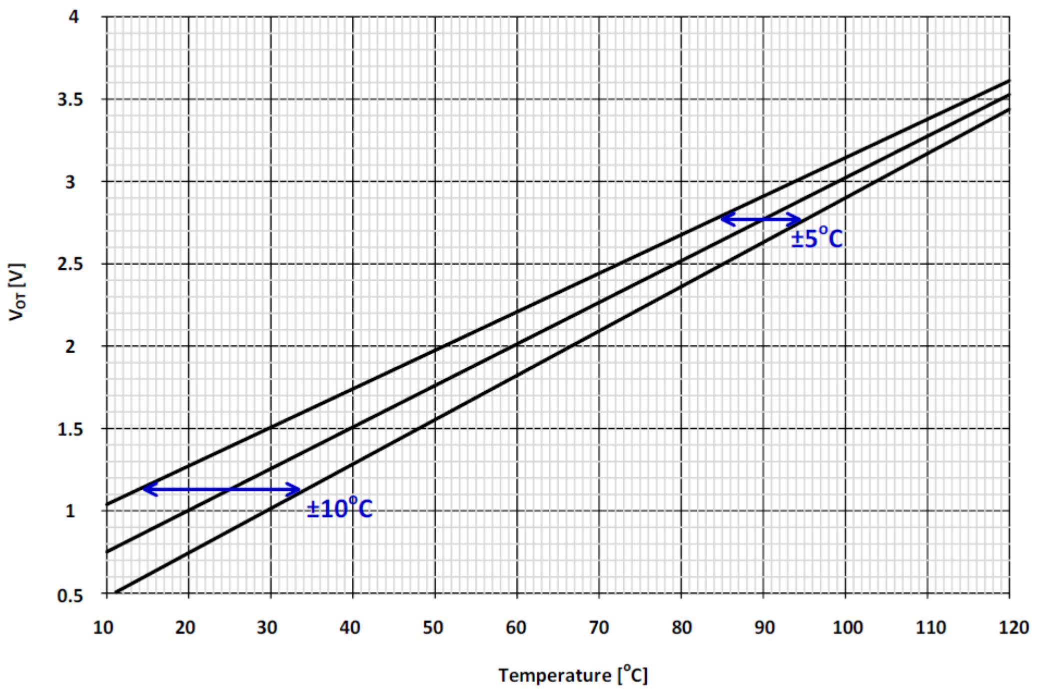


Figure 2. LVIC Temperature - VOT Temperature Characteristics

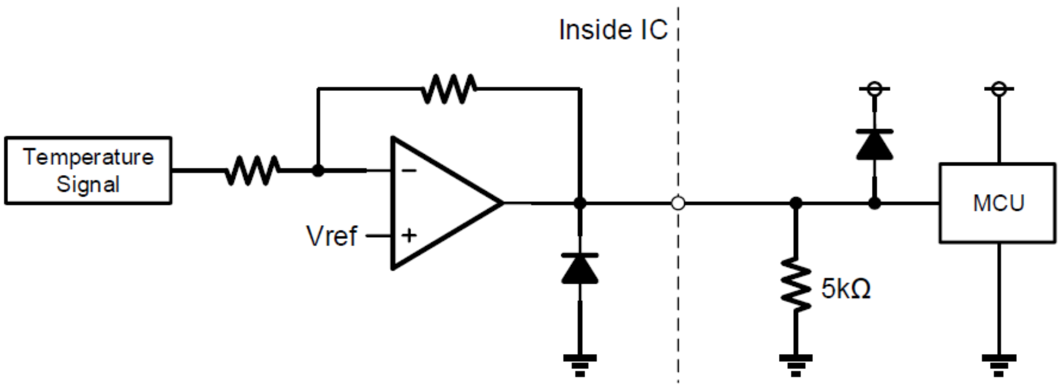


Figure 3. VOT Output Circuit

(1) If the temperature monitoring function is used, 5kΩ is connected to the VOT pin, the internal OTP function is ignored. If the internal over temperature shut-down function is used, keep the VOT pin open (no connection).
(2) When the IPM is used for low-voltage control (for example, the working voltage of MCU is 3.3V), the VOT output voltage may be 3.3V higher than the control power supply voltage when the temperature rises sharply. If the system is used for low-voltage control, it is recommended to connect a clamping diode between the control power supply and the VOT output signal to prevent overvoltage damage.

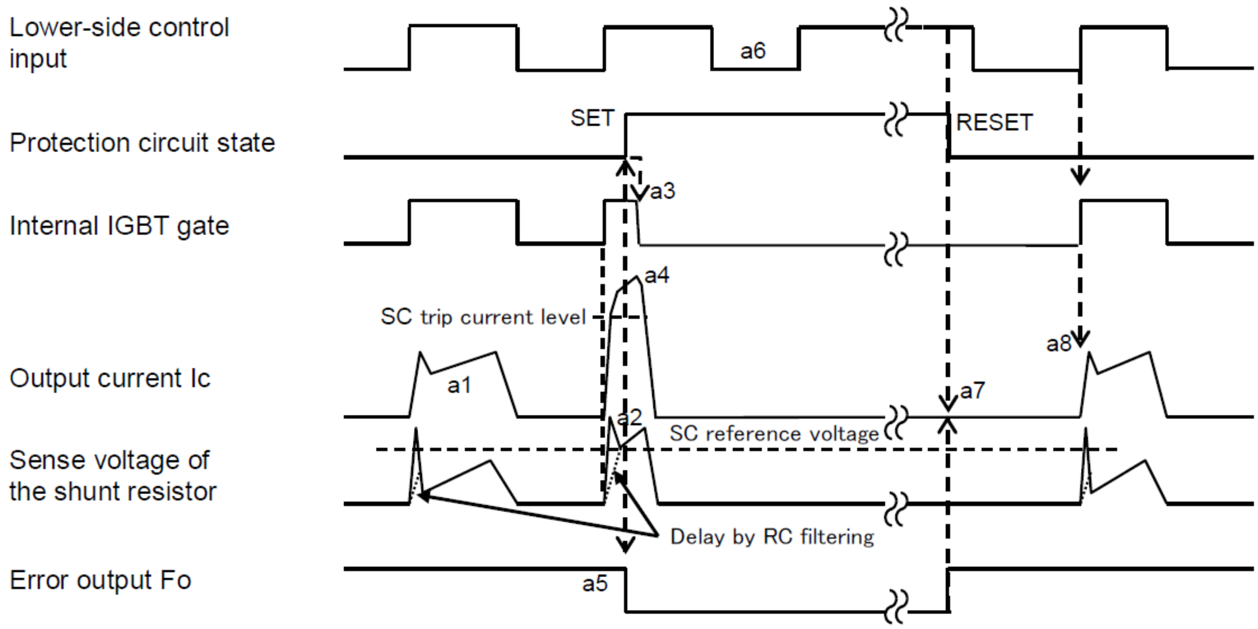


Figure 4. Short circuit current protection (low side only)

Short circuit protection (including external shunt resistor and RC filter).
a1: Normal operation: IGBT ON and outputs current.
a2: Short circuit current detection (short circuit triggering).
a3: All low side IGBT’s gates are hard interrupted.
a4: All low side IGBTs are turned off.
a5: Fault output pin outputs a fixed pulse width signal ($t_{FO} \geq 40us$).
a6: Input is "L": IGBT off state.
a7: Input is "H": although the input is "H", there is a fault output signal during this period, and IGBT is still in the off state.
a8: Normal operation: IGBT ON and outputs current.

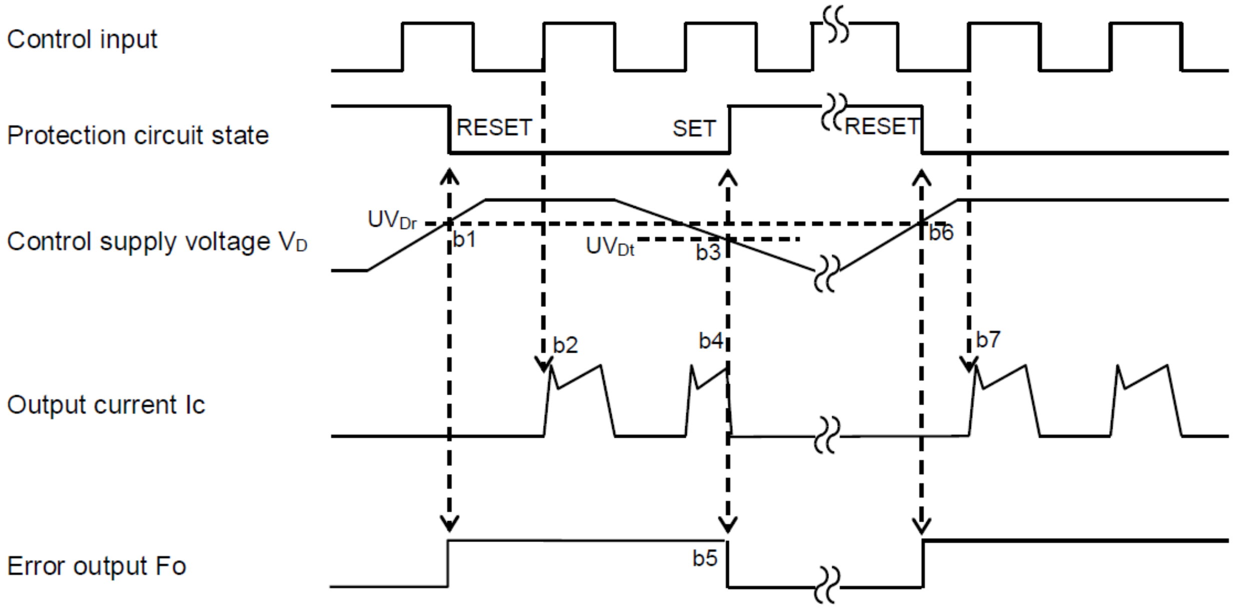


Figure 5. Under voltage protection (low side)

b1: Control supply voltage V_D 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: V_D 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} ≥ 40us, and continuously outputs fault signal during under voltage).
b6: V_D level reaches UV_{Dr}.
b7: Normal operation: IGBT ON and outputs current.

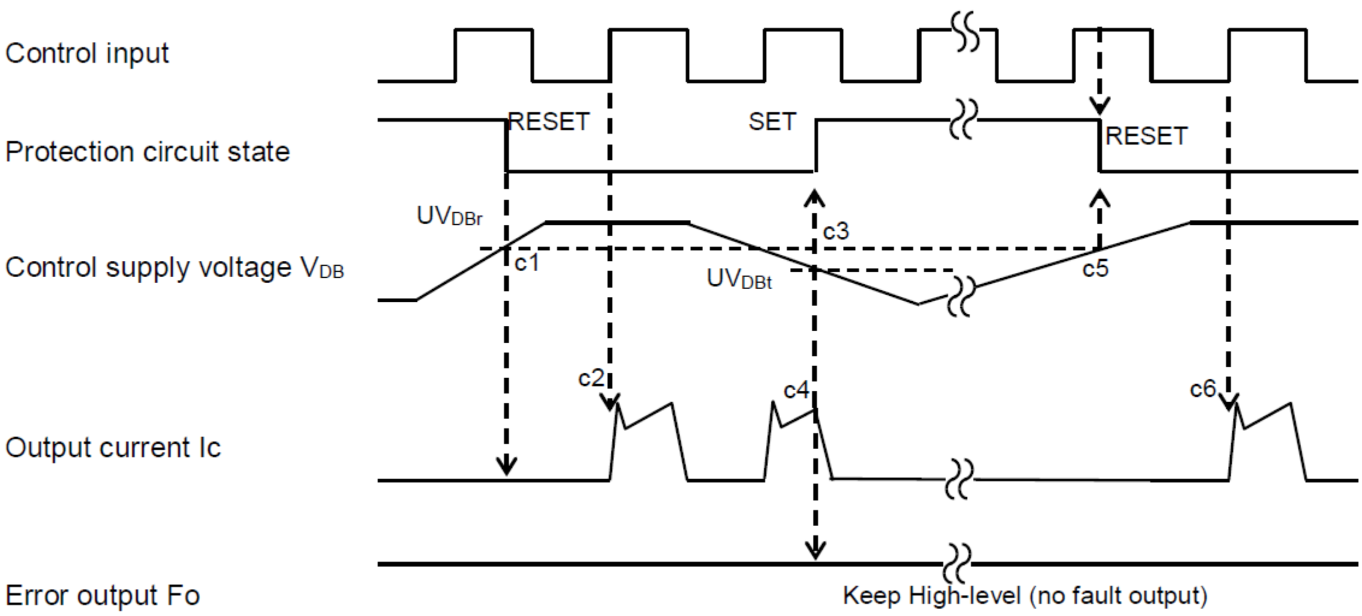


Figure 6. Under voltage protection (High side)

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: V_{DB} 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: V_{DB} level reaches UV_{DBr}.
c6: Normal operation: IGBT ON and outputs current.

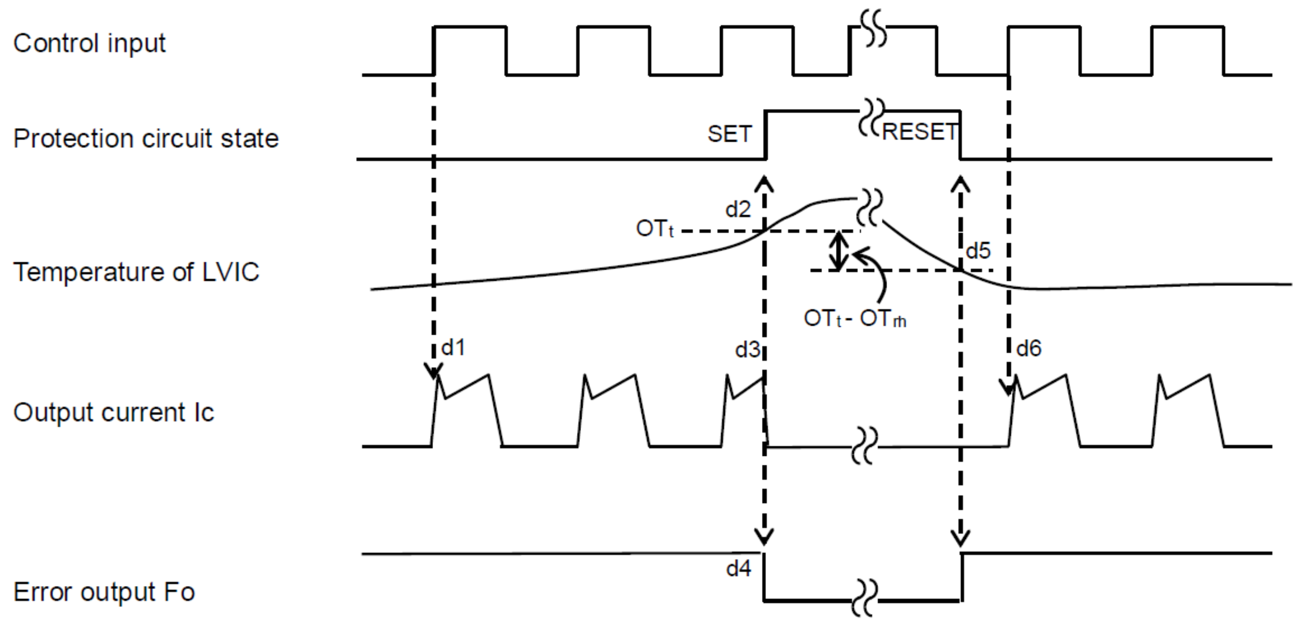
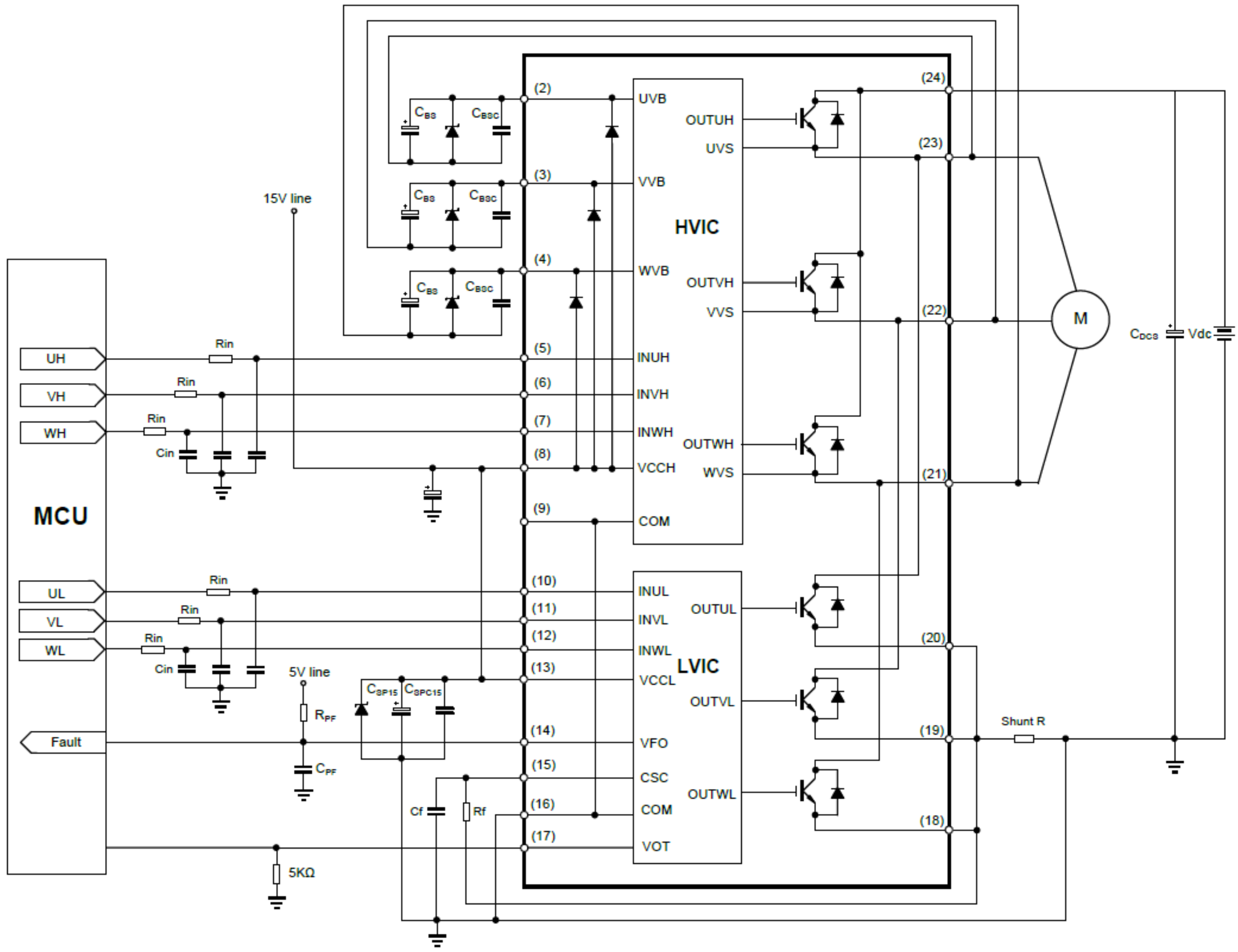


Figure 7. Over Temperature protection (low side only)

d1: Normal operation: IGBT ON and outputs current.
d2: LVIC temperature exceeds the over temperature protection trigger level(OT_t).
d3: All low side IGBTs are turned off in spite of control input condition.
d4:Continuously output fault signal during overtemperature, and the minimum pulse width is 40us.
d5: The LVIC will reset when the temperature is lower than the over temperature protection level.
d6: IGBT turns on when the next input signal control signal comes.

Typical Application Schematic:



Remarks:

(1) The wiring of each input pin shall be as short as possible, otherwise it may cause mis operation;

(2) The input signal is active at high level, and a 5KΩ pull-down resistor is connected to the ground at the input end of each channel of HVIC; In addition, RC filter circuit can be added at the input end to prevent surge noise caused by incorrect input;

(3) To prevent surge damage, it is recommended to add a high-frequency non inductive smoothing capacitor (0.1μF~0.22μF) between P and N, the connecting wire of capacitor shall be as short as possible;

(4) The connection between the current detection resistor and the IPM should be as short as possible, otherwise the large surge voltage generated by connecting the inductor may cause damage;

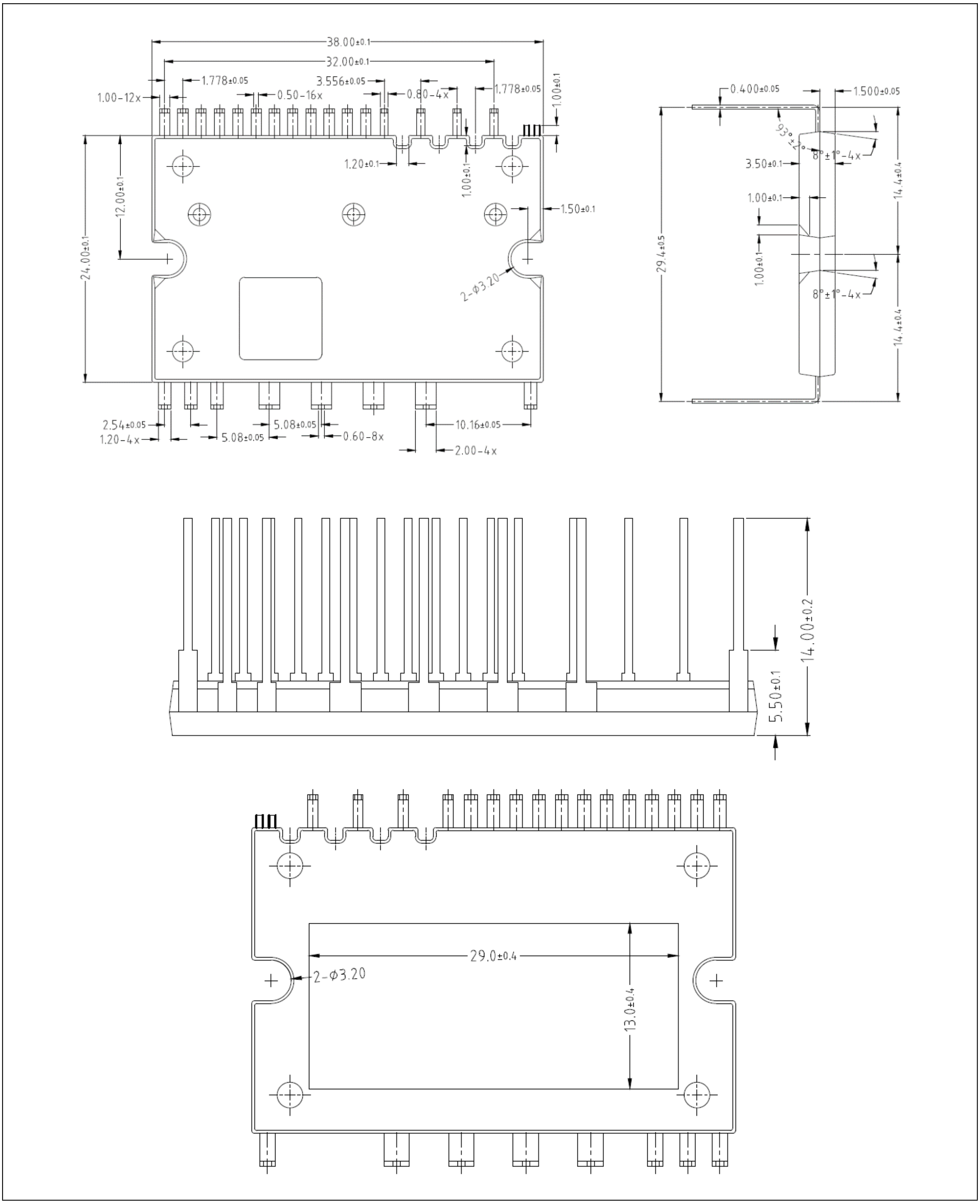
(5) It is recommended that the filter capacitance at the input end of 15V power supply be at least 7 times the bootstrap capacitance CBS;

(6) Each external capacitor shall be placed as close to the IPM pin as possible;

(7) If the V_{FO} output is open circuit, it should be pulled up to the 5V power supply through resistance to make Ifo 1mA;

(8) In the short-circuit protection circuit, please select a time constant of 1.5~2μs and the wiring around the RF and CSC should be as short as possible. RF wiring shall be close to shunt resistor.

Package Outline DIP24



Revision History：

Revision	Date	Subjects (major changes since last revision)
1.0	2023-03	Initial version

Disclaimer:

Operating conditions may differ from simulation assumptions in several aspects like level of DC-link voltage, applied gate-voltage and gate-resistor, case and junction temperatures as well as the power circuit stray-inductance. Therefore, deviations of parameters and assumptions used for the simulation and the real application may exist.

For these reasons we cannot take any responsibility or liability for the exactness or validity of the form's results. The form cannot replace a detailed reflection of the customers application with all of its operating conditions.

Accurate results depend on huge data，so with the measured data is increasing, we should be updated in real time and send it to the corresponding engineer so that he can know it in real time.