TENTATIVE

PS21065

Transfer-Mold Type
Insulated Type

Pre.	Shou, M.Sakai, M.Seo, T.Iwagami	Rev.	A	
Apr.	T.Iwamoto 30,Nov.'04			

Applications : AC100~200V three-phase motor variable speed inverter drive.

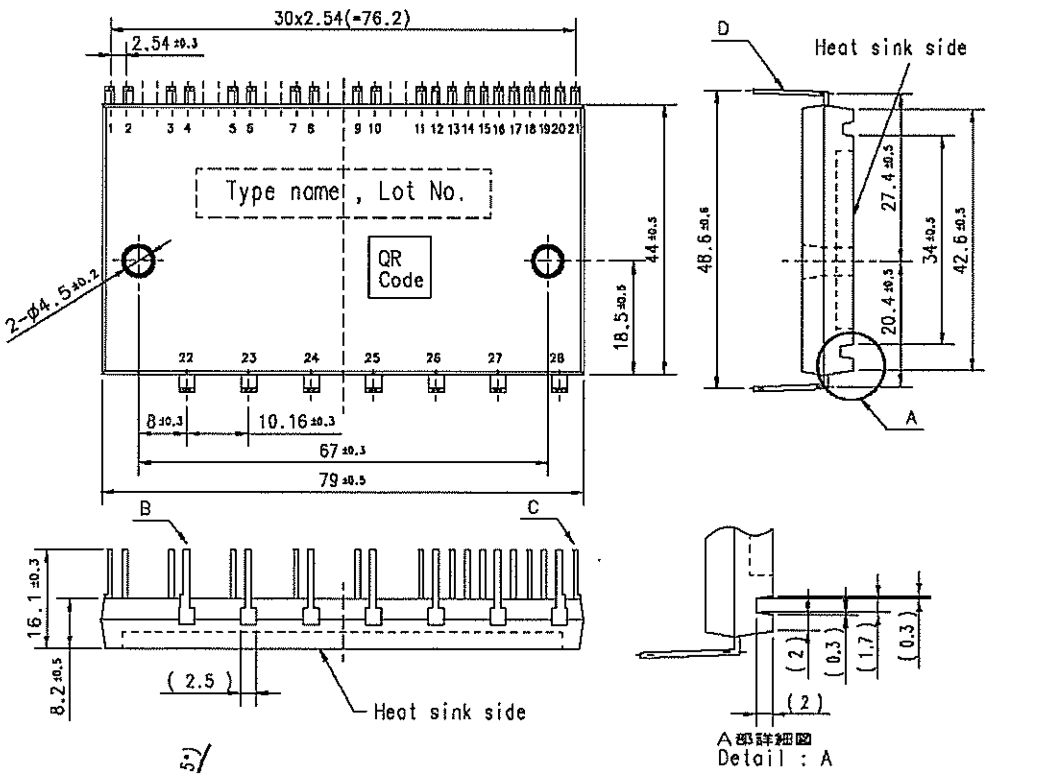
Integrated Power Functions :

600V/20A low-loss 5th generation planar gate IGBT inverter bridge with N-side open emitter structure for DC-to-AC power conversion

Integrated drive, protection and system control functions :

- For upper-leg IGBTs : Drive circuit, High voltage isolated high-speed level shifting, Control supply under-voltage (UV) protection.
- For lower-leg IGBTs : Drive circuit, Control supply under-voltage protection (UV), Short circuit protection (SC).
- Fault signaling : Corresponding to an SC fault (Lower-side IGBT) or a UV fault (Lower-side supply).
- Input interface : 5V line CMOS/TTL compatible, Schmitt Trigger receiver circuit (High Active).

Fig. 1 Package Outlines



1.VUFS
2.VUFB
3.VP1
4.UP
5.VVFS
6.VVFB
7.VP1
8.VP
9.VWFS
10.VWFB
11.VP1
12.VPC
13.WP
14.VN1
15.VNC
16.CIN
17.CFO
18.FO
19.UN
20.VN
21.WN
22.P
23.U
24.V
25.W
26.NU
27.NV
28.NW

Note 1: Package outlines are subjected to change in the development.
2: All lead terminals are treated by Pb-free solder (ingredient: Sn-Cu) plating.

Maximum Ratings (Tj=25°C, unless otherwise noted) :

Inverter Part:

Item	Symbol	Condition	Rating	Unit
Supply voltage	V_{CC}	Applied between P-NU,NV,NW	450	V
Supply voltage (surge)	$V_{CC(surge)}$	Applied between P-NU,NV,NW	500	V
Collector-emitter voltage	V_{CES}		600	V
Each IGBT collector current	$\pm I_C$	Tc=25°C	20	A
Each IGBT collector current (peak)	$\pm I_{CP}$	Tc=25°C, less than 1ms	40	A
Collector dissipation	P_C	Tc=25°C, per 1 chip	52.6	W
Junction temperature	T_j	(Note 1)	-20~+125	°C

(Note 1) The maximum junction temperature rating of the power chips integrated within the DIP-IPM is 150°C(@Tc≤100°C). However, in order to ensure safe operation of the DIP-IPM, the average junction temperature should be limited to Tj(ave)≤125°C(@Tc≤100°C).

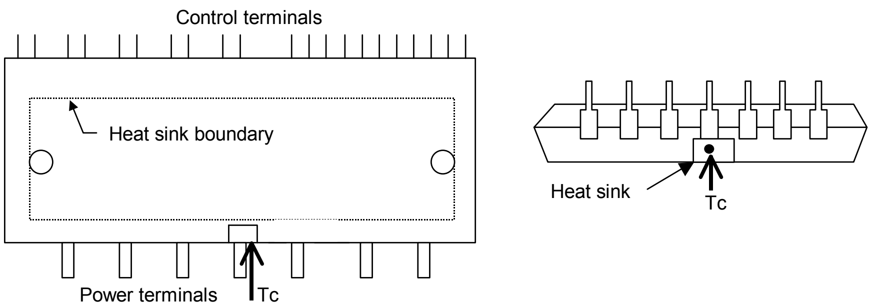
Control (Protection) Part

Item	Symbol	Condition	Rating	Unit
Control supply voltage	V_D	Applied between V_{P1}-V_{PC},V_{N1}-V_{NC}	20	V
Control supply voltage	V_{DB}	Applied between V_{UFB}-V_{UFS}, V_{VFB}-V_{VFS} ,V_{WFB}-V_{WFS}	20	V
Input voltage	V_{IN}	Applied between U_P,V_P,W_P-V_{PC}, U_N,V_N,W_N-V_{NC}	-0.5~V_D+0.5	V
Fault output supply voltage	V_{FO}	Applied between Fo-V_{NC}	-0.5~V_D+0.5	V
Fault output current	I_{FO}	Sink current at Fo terminal	1	mA
Current sensing input voltage	V_{SC}	Applied between CIN-V_{NC}	-0.5~V_D+0.5	V

Total System

Item	Symbol	Condition	Rating	Unit
Self protection supply voltage limit (short circuit protection capability)	$V_{CC(PROT)}$	V_D=13.5~16.5V, Inverter part Tj=125°C, non-repetitive less than 2μs	400	V
Module case operation temperature	Tc	(Note 2)	-20~+100	°C
Storage temperature	Tstg		-40~+125	°C
Isolation voltage	Viso	60Hz, Sinusoidal, AC 1 minutes, connection pins to heat-sink plate	2500	Vrms

(Note 2) Tc measurement position



Thermal Resistance :

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Junction to case thermal resistance	$R_{th(j-c)Q}$	Inverter IGBT part (per 1/6 module)	—	—	1.90	°C / W
	$R_{th(j-c)F}$	Inverter FWD part (per 1/6 module)	—	—	2.85	
Contact thermal resistance (Note 3)	$R_{th(c-f)}$	Between case and fin with grease applied (per 1 module)	—	—	0.047	

(Note 3) Grease with good thermal conductivity and long-term endurance should be applied evenly with about +100μm～+200μm on the contacting surface of DIP-IPM and heat-sink.

Electrical Characteristics (Tj=25°C, unless otherwise noted):
Inverter Part

Item	Symbol	Condition		Min.	Typ.	Max.	Unit
Collector-emitter saturation voltage	$V_{CE(sat)}$	V_D=V_{DB}=15V V_{IN}=5V, I_C=20A,	Tj=25°C	—	1.60	2.10	V
			Tj=125°C	—	1.70	2.20	
FWD forward voltage	V_{EC}	T_j=25°C, V_{IN}=0V, $-I_C$=20A		—	1.50	2.00	V
Switching time	t_{on}	V_{CC}=300V, V_D=V_{DB}=15V V_{IN}=5⇔0V, I_C=20A Tj=125°C Inductive load (upper-lower arm)		0.70	1.30	1.90	μs
	t_{rr}			—	0.30	—	
	$t_{c(on)}$			—	0.40	0.60	
	t_{off}			—	1.60	2.20	
	$t_{c(off)}$			—	0.50	0.80	
Collector-emitter cut-off current	I_{CES}	V_{CE}=V_{CES}	Tj=25°C	—	—	1	mA
			Tj=125°C	—	—	10	

Control (Protection) Part:

Item	Symbol	Condition		Min.	Typ.	Max.	Unit
Circuit current	I_D	V_D=V_{DB}=15V V_{IN}=5V	Total of V_{P1}-V_{PC},V_{N1}-V_{NC}	—	—	7.00	mA
			V_{UFB}-V_{UFS},V_{VFB}-V_{VFS},V_{WFB}-V_{WFS}	—	—	0.55	
		V_D=V_{DB}=15V V_{IN}=0V	Total of V_{P1}-V_{PC},V_{N1}-V_{NC}	—	—	7.00	
			V_{UFB}-V_{UFS},V_{VFB}-V_{VFS},V_{WFB}-V_{WFS}	—	—	0.55	
Fo output voltage	V_{FOH}	Vsc=0V, Fo circuit:10kΩ to 5V pull-up		4.9	—	—	V
	V_{FOL}	Vsc=1V, I_{FO}=1mA		—	—	0.95	
Input current	I_{IN}	V_{IN}=5V		1.0	1.5	2.0	mA
short circuit trip level	$V_{SC(ref)}$	Tj=25°C, V_D=15V (Note 4)		0.43	0.48	0.53	V
Control supply under-voltage protection	UV_{DBt}	Tj≤125°C	Trip level	10.0	—	12.0	V
	UV_{DBr}		Reset level	10.5	—	12.5	
	UV_{Dt}		Trip level	10.3	—	12.5	
	UV_{Dr}		Reset level	10.8	—	13.0	
Fault output pulse width	t_{FO}	C_{FO}=22nF (Note 5)		1.0	1.8	—	ms
ON threshold voltage	Vth(on)	Applied between U_P,V_P,W_P-V_{PC}, U_N,V_N,W_N-V_{NC}		2.1	2.3	2.6	V
OFF threshold voltage	Vth(off)			0.8	1.4	2.1	

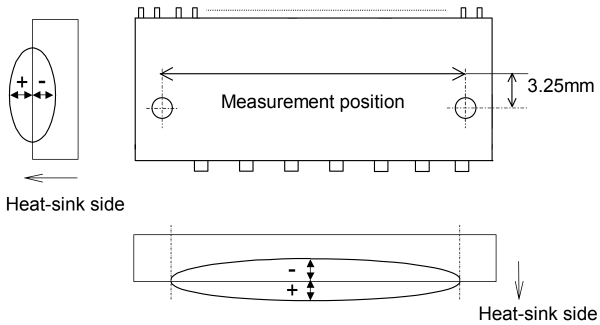
(Note 4) Short circuit protection functions only for the N-side IGBTs. Please select the external shunt resistance such that the SC trip-level is less than 1.7 times of the rated current.

(Note 5) Fault signal is output when the lower arms short circuit or control supply under-voltage protection happens. The fault output pulse-width t_{FO} depends on the capacitance value of C_{FO} (C_{FO}= 12.2 × 10^{-6} × t_{FO} [F])

Mechanical Characteristics and Ratings:

Item	Condition		Min.	Typ.	Max.	Unit
Mounting torque	Mounting screw: (M4)	Recommended: 1.18N·m	0.98	–	1.47	N·m
Weight			–	77	–	g
Heat-sink flatness		(Note 6)	–50	–	100	μm

(Note 6)



Recommended Operation Conditions:

Item	Symbol	Condition		Recommended Min.	Recommended Typ.	Recommended Max.	Unit
Supply voltage	V_{CC}	Applied between P-NU,NV,NW		0	300	400	V
Control supply voltage	V_D	Applied between V_{P1}-V_{PC},V_{N1}-V_{NC}		13.5	15.0	16.5	V
Control supply voltage	V_{DB}	Applied between V_{UFB}-V_{UFS},V_{VFB}-V_{VFS},V_{WFB}-V_{WFS}		13.0	15.0	18.5	V
Control supply variation	ΔV_D,ΔV_{DB}			-1	—	+1	V/μs
Arm-shoot-through blocking time	t_{dead}	For each input signal, Tc≤100°C		2.0	—	—	μs
PWM input frequency	f_{PWM}	Tc≤100°C, Tj≤125°C		—	—	20	kHz
Minimum input pulse width	PWIN(on)	(Note 7)		0.3	—	—	μs
	PWIN(off)	200≤V_{CC}≤350V, 13.5≤V_D≤16.5V, 13.0≤V_{DB}≤18.5V, -20≤T_f≤100°C, N line wiring inductance less than 10nH (Note 8)	I_C≤20A	1.4	—	—	
			20<I_C≤34A	2.5	—	—	
V_{NC} variation	V_{NC}	Potential difference between V_{NC}-NU,NV,NW including surge voltage		-5.0	—	+5.0	V

(Note 7) DIP-IPM might make no response to the input on signal with pulse width less than PWIN(on).

(Note 8) DIP-IPM might make no response to the input off signal with pulse width less than PWIN(off), or P-side only the turn on time becomes long as shown in Fig.2. However, off-latch will not happen for next input on signal in this case. For the wiring inductance of N line, please refer to Fig.6.

Fig.2 Output behavior under short input off signal with pulse width less than PWIN(off)

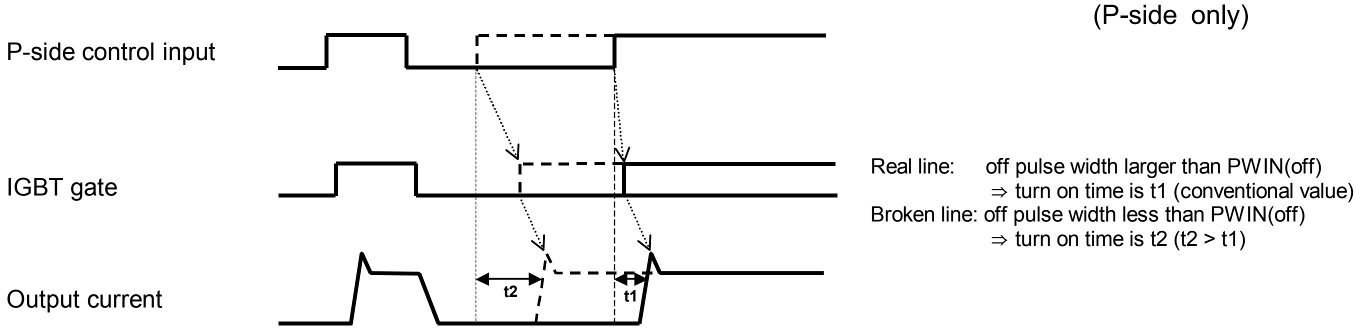


Fig.3 DIP-IPM Internal Circuit

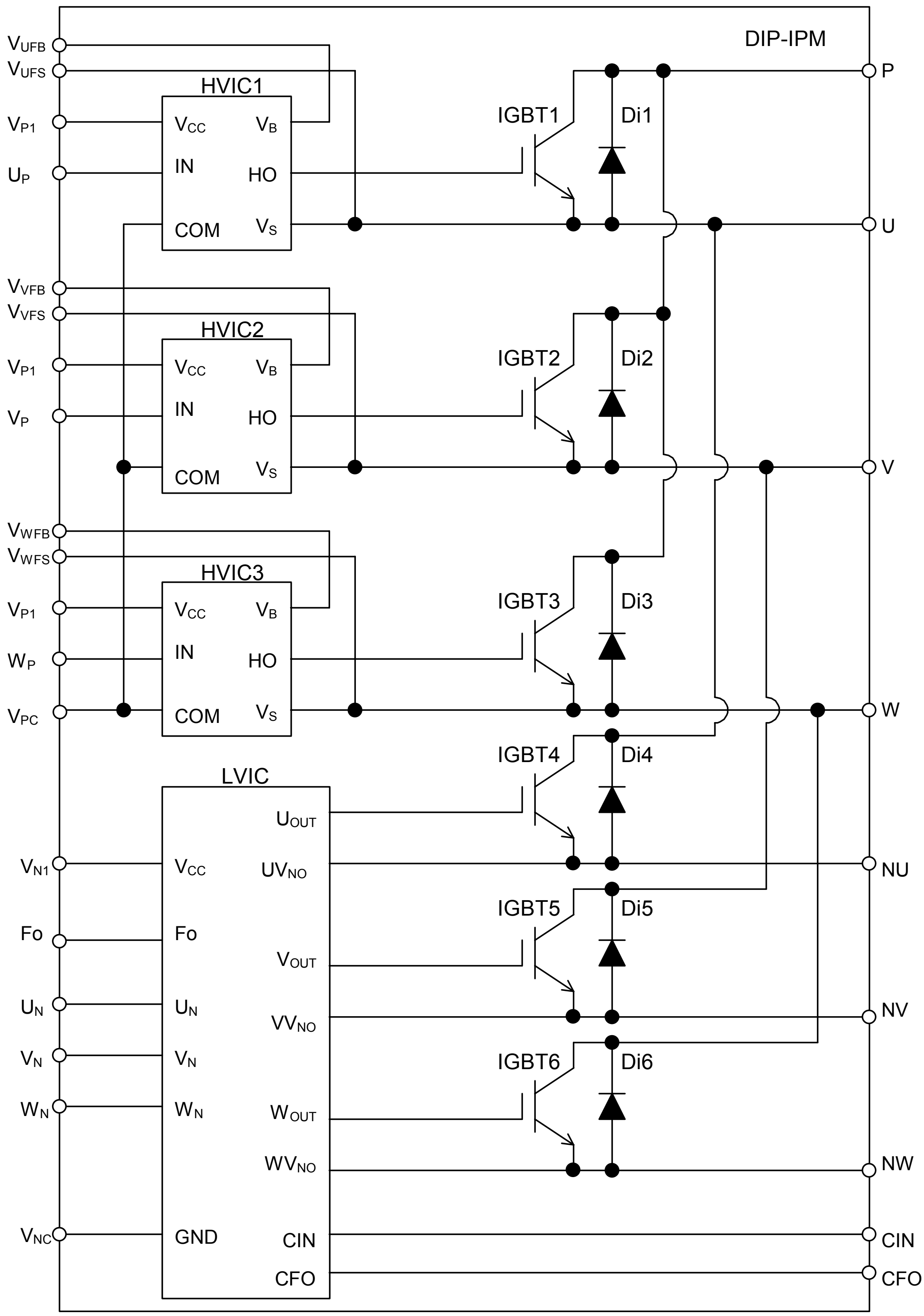
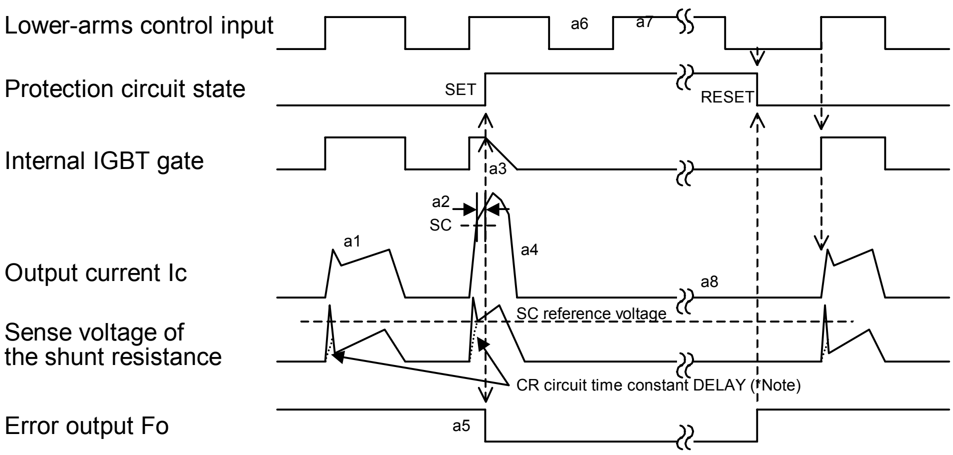


Fig.4 Timing Charts of the DIP-IPM Protective Functions

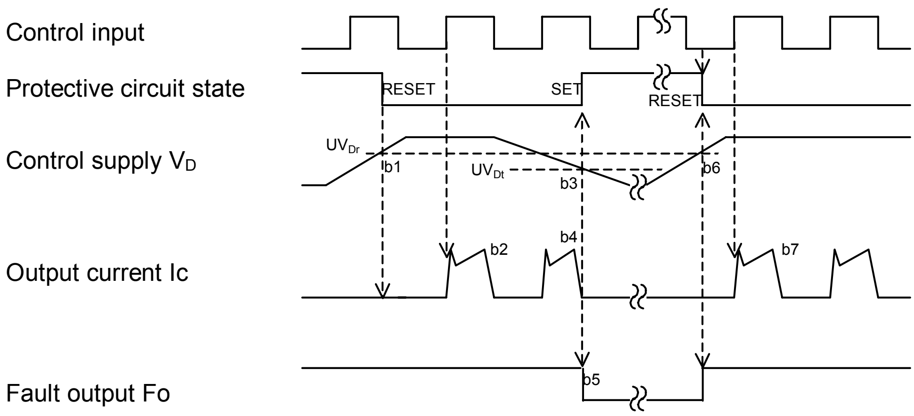
[A] Short-Circuit Protection (N-side only)
(with external shunt resistor and CR filter)

a1. Normal operation: IGBT turn on and carry current.
a2. Short circuit current detected (SC trigger).
a3. IGBT gate hard interrupted.
a4. IGBT turn off.
a5. Fo output: Fo output pulse width is determined by the external capacitance C_{FO}.
a6. Input “L” : IGBT off.
a7. Input “H” : IGBT on, but during the Fo output period the IGBT will not turn on.
a8. IGBT keep in off state.



[B] Under- Voltage Protection (N-side, UV_D)

b1. Control supply voltage rise: After the voltage level reaches UV_{Dr}, the drive circuits begin to work at the rising edge of the next input signal.
b2. Normal operation: IGBT turn on and carry current.
b3. Under voltage trip (UV_{Dt}).
b4. IGBT turn off regardless of the control input level.
b5. Fo output.
b6. Under voltage reset (UV_{Dr}).
b7. Normal operation: IGBT turn on and carry current.



[C] Under- Voltage Protection (P-side, UV_{DB})

c1. Control supply voltage rise: After the voltage reaches UV_{DBr}, the drive circuit begins to work.
c2. Normal operation: IGBT turn on and carry current.
c3. Under voltage trip (UV_{DBt}).
c4. IGBT turn off regardless of the control input level, but there is no Fo signal output.
c5. Under voltage reset (UV_{DBr}).
c6. Normal operation: IGBT turn on and carry current.

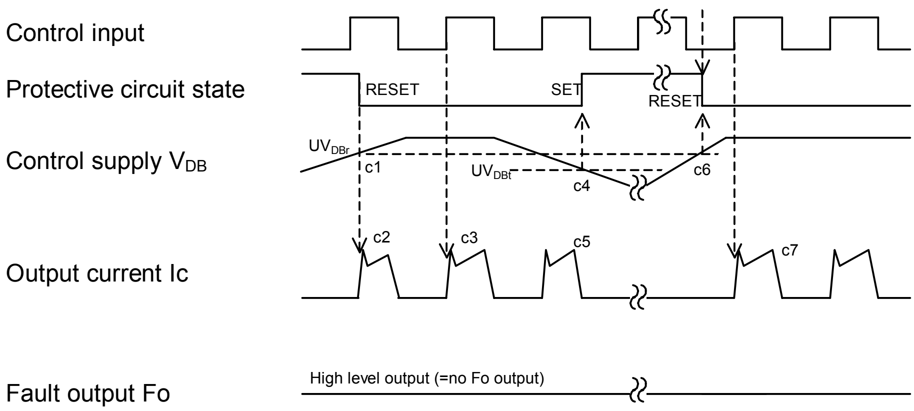
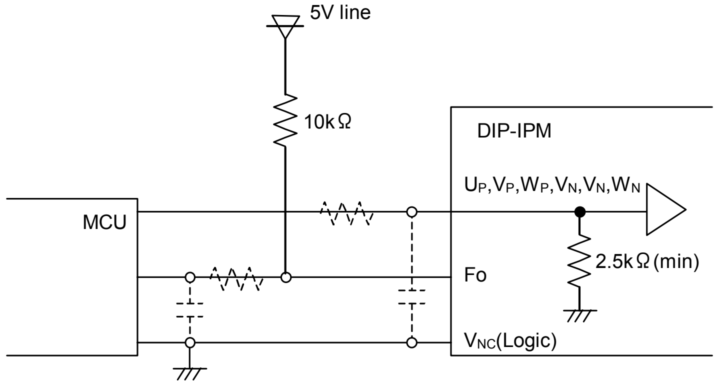


Fig.5 Recommended MCU I/O interface circuit



Note) RC coupling at each input (parts shown dotted) may change depending on the PWM control scheme used in the application and the wiring impedance of the application's printed circuit board. The DIP-IPM input signal section integrates a 2.5kΩ(min) pull-down resistor. Therefore, when using a external filtering resistor, care must be taken to satisfy the turn-on threshold voltage requirement.

Fig.6 Wiring method of shunt resistor circuit