

PS22A78-E

Transfer-Mold Type
Insulated Type

TENTATIVE

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Applications : 0.2~5.5kW/AC400Vrms three-phase motor variable speed inverter drive

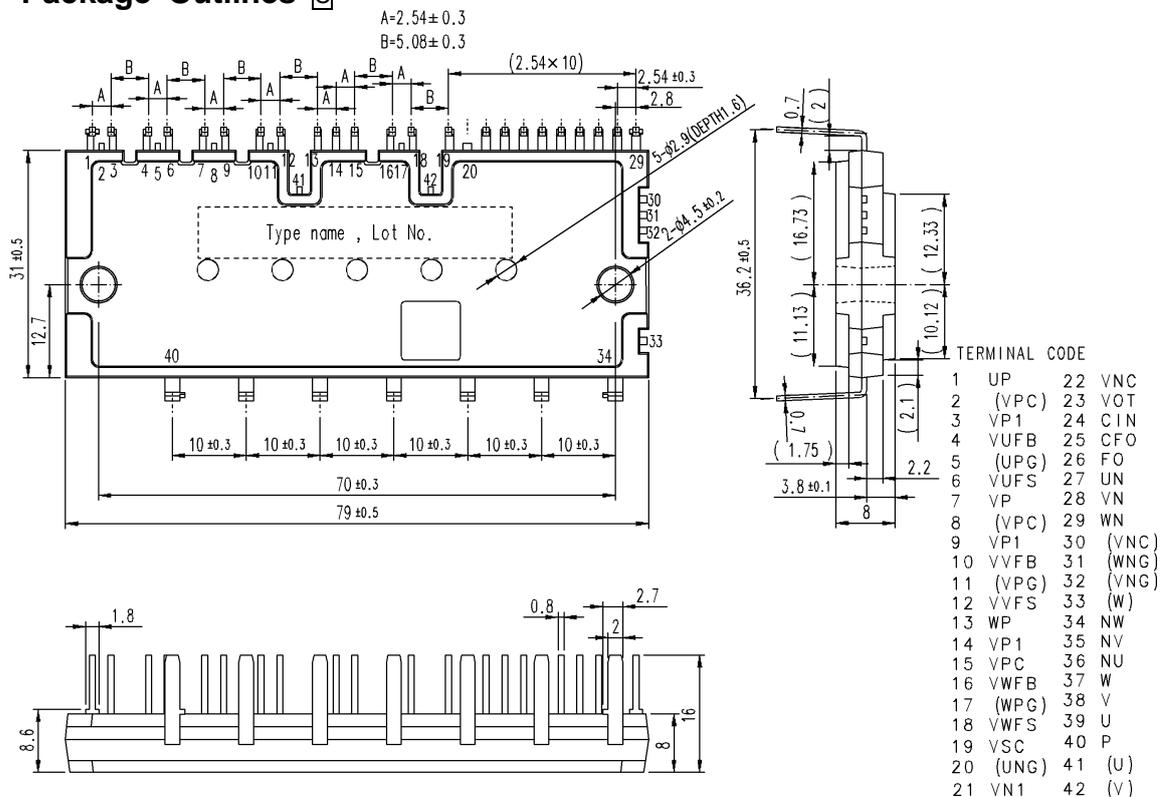
Integrated Power Functions :

1200V/35A low-loss CSTBT inverter bridge with N-side open emitter structure for DC-to-AC power conversion

Integrated drive, protection and system control functions :

- For P-side : Drive circuit, High voltage high-speed level shifting, Control supply under-voltage (UV) protection.
- For N-side : Drive circuit, Control supply under-voltage protection (UV), Short circuit protection (SC)
- Fault signaling : Corresponding to a SC fault (N-side IGBT), a UV fault (N-side supply)
- Input interface : 5V line, Schmitt Trigger receiver circuit (High Active).

Fig. 1 Package Outlines C



Note:

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DIPIPM	DPH-5546e-D	
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TENTATIVEMaximum Ratings ($T_j=25^\circ\text{C}$, unless otherwise noted):

Inverter Part:

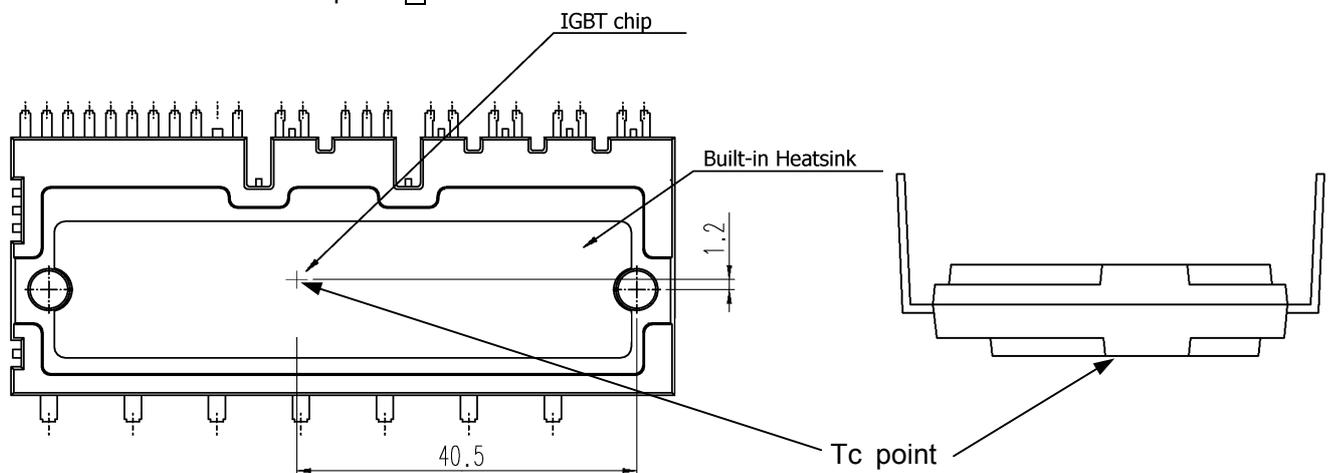
Item	Symbol	Condition	Rating	Unit
Supply voltage	V_{CC}	Applied between P-NU,NV,NW	900	V
Supply voltage (surge)	$V_{CC(surge)}$	Applied between P-NU,NV,NW	1000	V
Collector-emitter voltage	V_{CES}		1200	V
Each IGBT collector current	$\pm I_C$	$T_c=25^\circ\text{C}$	35	A
Each IGBT collector current (peak)	$\pm I_{CP}$	$T_c=25^\circ\text{C}$, less than 1ms	70	A
Collector dissipation	P_C	$T_c=25^\circ\text{C}$, per 1 chip	(129.9)	W
Junction temperature	T_j		-20~+150	$^\circ\text{C}$

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 $V_{UFB}-V_{UFS}, V_{WFB}-V_{WFS}$	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)	$V_{CC(prot)}$	$V_D=13.5\sim 16.5\text{V}$, Inverter part $T_j=125^\circ\text{C}$, non-repetitive less than $2\mu\text{s}$	800	V
Module case operation temperature	T_c	(Note 1)	-20~+100	$^\circ\text{C}$
Storage temperature	T_{stg}		-40~+125	$^\circ\text{C}$
Isolation voltage	V_{iso}	60Hz, Sinusoidal, AC 1 minute, connection pins to heat sink plate	2500	Vrms

Note 1: T_c measurement point 

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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)	-	-	(0.77)	°C / W
	$R_{th(j-c)F}$	Inverter FWDi part (per 1/6 module)	-	-	(1.25)	

(Note 2) Grease with good thermal conductivity and long-term endurance should be applied evenly with about +100 μ m~+200 μ m on the contacting surface of DIPIPM and heat sink.

Electrical Characteristics (T_j=25°C, unless otherwise noted) :

Inverter Part

Item	Symbol	Condition	Min.	Typ.	Max.	Unit	
Collector-emitter saturation voltage	$V_{CE(sat)}$	$V_D=V_{DB}=15V$ $V_{IN}=5V, I_C=35A,$	T _j =25°C	-	(1.9)	(2.6)	V
			T _j =125°C	-	(2.0)	(2.7)	
FWDi forward voltage B	V_{EC}	$V_{IN}=0V, -I_C=35A$	-	(2.8)	(3.3)	V	
Switching time A	t_{on}	$V_{CC}=600V, V_D=V_{DB}=15V$ $I_C=35A, V_{IN}=0-5V$ T _j =125°C Inductive load	(0.8)	(1.5)	(2.2)	μ s	
	t_{rr}		-	(0.3)	-		
	$t_{c(on)}$		-	(0.6)	(0.9)		
	t_{off}		-	(2.8)	(3.8)		
	$t_{c(off)}$		-	(0.7)	(1.0)		
Collector-emitter cut-off current	I_{CES}	$V_{CE}=V_{CES}$	T _j =25°C	-	-	1	mA
			T _j =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 $V_{P1}-V_{PC}, V_{N1}-V_{NC}$	-	-	(3.70)	mA
			$V_{UFB}-V_{UFS}, V_{VFB}-V_{VFS}, V_{WFB}-V_{WFS}$	-	-	(1.30)	
		$V_D=V_{DB}=15V$ $V_{IN}=0V$	Total of $V_{P1}-V_{PC}, V_{N1}-V_{NC}$	-	-	(3.50)	
			$V_{UFB}-V_{UFS}, V_{VFB}-V_{VFS}, V_{WFB}-V_{WFS}$	-	-	(1.30)	
Fo output voltage	V_{FOH}	$V_{sc}=0V, F_o$ terminal pull-up to 5V by 10k Ω	4.9	-	-	V	
	V_{FOL}	$V_{sc}=1V, I_{FO}=1mA$	-	-	1.10		
Input current	I_{IN}	$V_{IN}=5V$	0.7	1.5	2.0	mA	
Short circuit trip level C	I_{SC}	$-20^\circ C \leq T_j \leq 125^\circ C, V_D=15V$ (Note 3)	(59.5)	-	(-)	A	
Control supply under-voltage protection	UV_{DBt}	T _j ≤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 4)	(1.6)	(2.4)	-	ms	
ON threshold voltage A	$V_{th(on)}$	Applied between $U_P, V_P, W_P-V_{PC},$	-	-	(3.5)	V	
OFF threshold voltage	$V_{th(off)}$	U_N, V_N, W_N-V_{NC}	(0.8)	-	-		
Temperature output C	V_{OT}	LVIC temperature = 85°C (Note 5)	(3.50)	(3.63)	(3.76)	V	

(Note 3) Short circuit protection is functioning only for N-side IGBTs.

About rating and external resistance R_s for detecting short circuit are under consideration. C

(Note 4) Fault signal is output when short circuit or control supply under-voltage protective functions operate at N-side.

The fault output pulse-width t_{FO} depends on the capacitance value of C_{FO} ($C_{FO}=9.3 \times 10^{-6} \times t_{FO}$ [F])

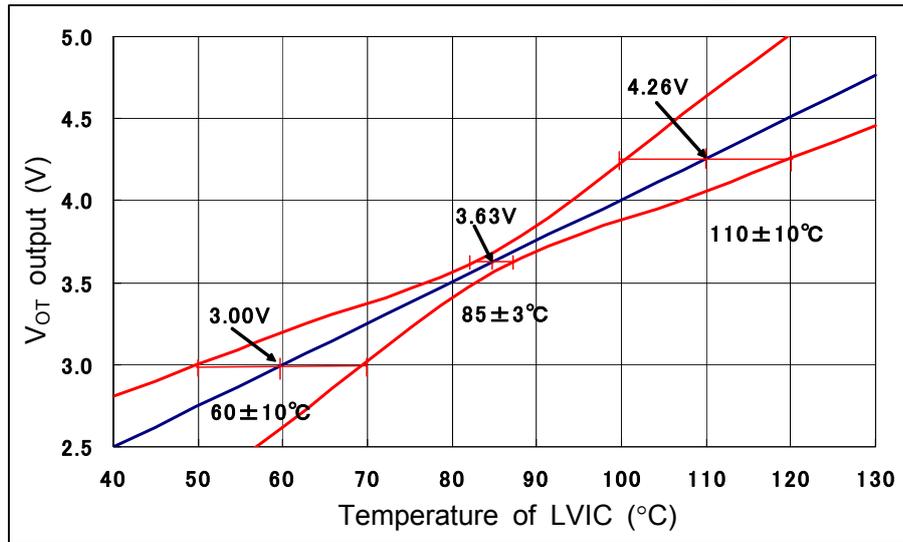
(Note 5) DIPIPM don't shutdown IGBTs and output fault signal automatically when temperature rises excessively.

When temperature exceeds the protect level that customer defined, controller (MCU) should stop the DIPIPM. C

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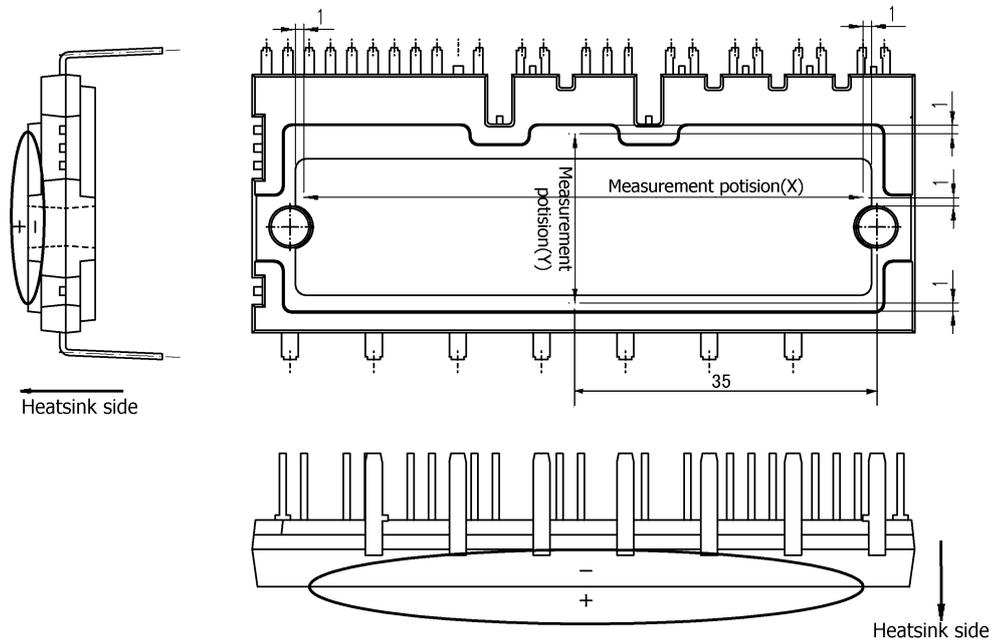
Fig.2 Temperature of LVIC - V_{OT} output characteristics C



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			-	(65)	-	g
Heat sink flatness		(Note 6)	(-50)	-	(100)	μ m

Note 6: Flatness measurement position D



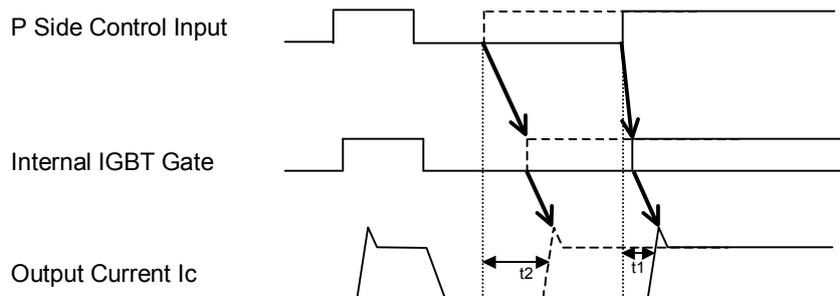
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Recommended Operation Conditions :

Item	Symbol	Condition	Recommended			Unit
			Min.	Typ.	Max.	
Supply voltage	V_{CC}	Applied between P-NU,NV,NW	350	600	800	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 \square	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	$\Delta V_D, \Delta V_{DB}$		-1	-	+1	V/ μ s
Arm-shoot-through blocking time	t_{dead}	For each input signal, $T_C \leq 100^\circ\text{C}$	(3.3)	-	-	μ s
PWM input frequency	f_{PWM}	$T_C \leq 100^\circ\text{C}$, $T_j \leq 125^\circ\text{C}$	-	-	(15)	kHz
Allowable rms current	I_O	$V_{CC}=600\text{V}$, $V_D=15\text{V}$, $f_C=15\text{kHz}$, P.F=0.8, Sinusoidal PWM, $T_C \leq 100^\circ\text{C}$, $T_j \leq 125^\circ\text{C}$ (Note 7)	-	-	(12.8)	A_{rms}
Minimum input pulse width \square	PWIN(on)	(Note 8)	(-)	-	-	μ s
	PWIN(off)	$350 \leq V_{CC} \leq 800\text{V}$, $13.5 \leq V_D \leq 16.5\text{V}$, $13.5 \leq V_{DB} \leq 16.5\text{V}$, $-20 \leq T_C \leq 100^\circ\text{C}$, N line wiring inductance less than 10nH (Note 9)	$I_C \leq 35\text{A}$	(-)	-	
		$35 < I_C \leq 59.5\text{A}$	(-)	-	-	
V_{NC} variation	V_{NC}	Potential difference between V_{NC} -NU,NV,NW including surge voltage	-5.0	-	+5.0	V
Junction temperature	T_j		-20	-	125	$^\circ\text{C}$

(Note 7) The allowable output rms current also depends on user application conditions.

(Note 8) DIPIPM might make no response to the input on signal with pulse width less than PWIN(on).

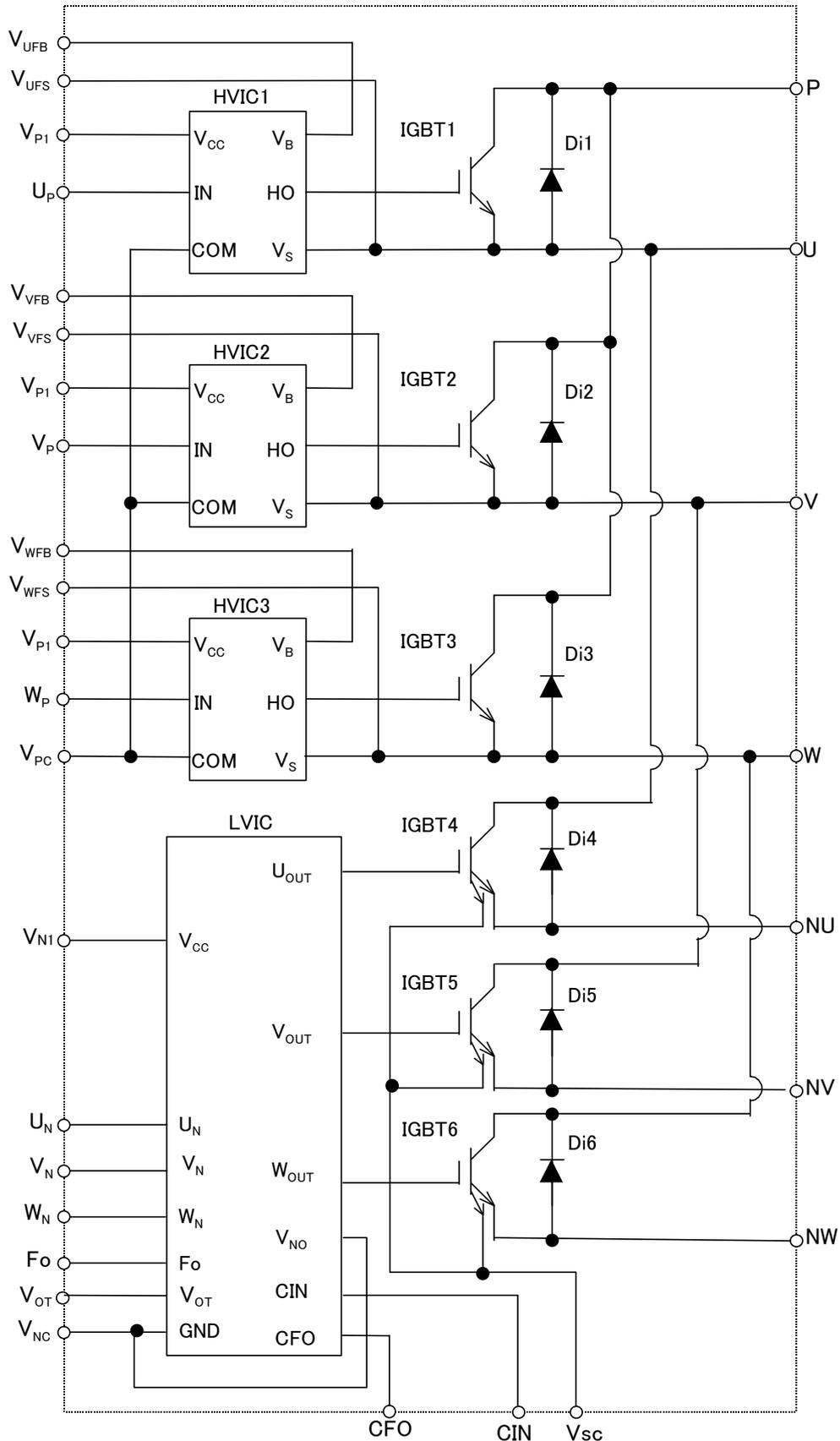
(Note 9) IPM might make delayed response (less than about 2 μ s) or no response for the input signal with off pulse width less than PWIN(off). Please refer Fig. 3 about delayed response. \square **Fig.3 About Delayed Response Against Shorter Input Off Signal Than PWIN(off) (P side only) \square** 

Real line...off pulse width > PWIN(off); turn on time t1

Broken line...off pulse width < PWIN(off); turn on time t2

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Fig.4 DIIPM Internal Circuit

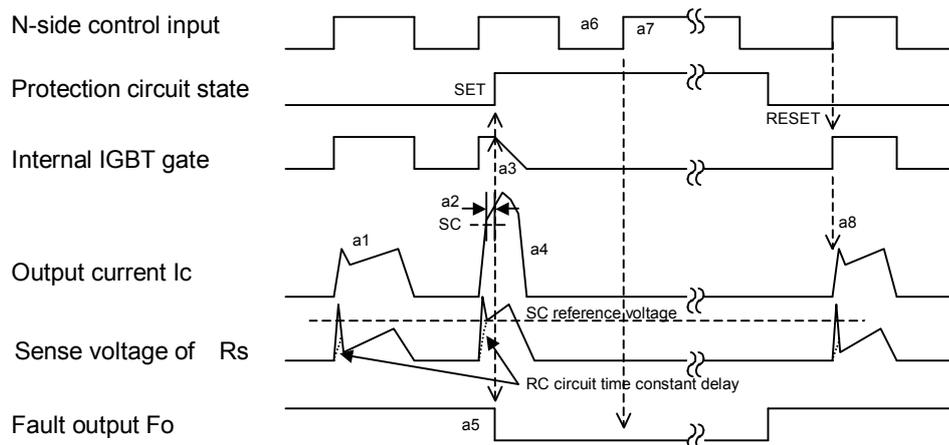


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TENTATIVE**Fig.5 Timing Charts of the Protective Functions**

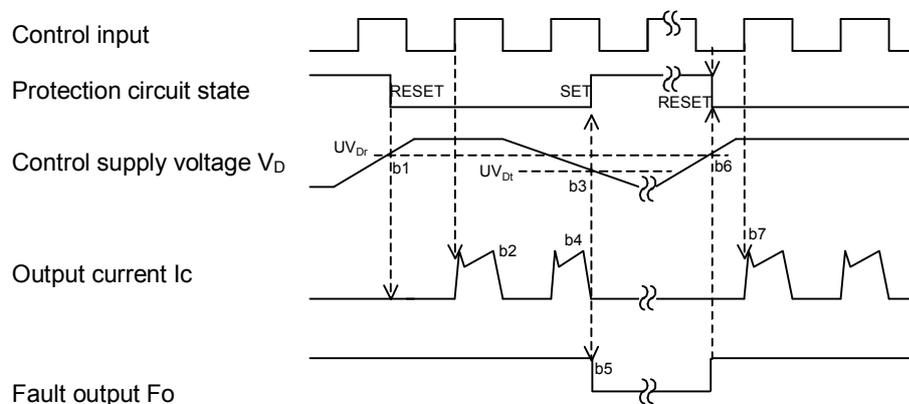
[A] Short-Circuit Protection (N-side only, with external resistor and RC filter)

- a1. Normal operation: IGBT turn on and carry current.
- a2. Short circuit current detected (SC trigger).
- a3. All N-side IGBTs' gates are hard interrupted.
- a4. All N-side IGBTs turn OFF.
- a5. Fo output with a fixed pulse width (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 turns ON when L→H signal is input after Fo is reset.



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

- b1. Control supply voltage V_D rises: After V_D level reaches under voltage reset level (UV_{Dr}), the circuits start to operate when next input is applied.
- b2. Normal operation: IGBT turn on and carry current.
- b3. V_D level dips to under voltage trip level. (UV_{Dt}).
- b4. All N-side IGBTs turn OFF in spite of control input condition.
- b5. Fo is output for the period determined by the capacitance C_{FO} but continuously during UV period.
- b6. V_D level reaches UV_{Dr} .
- b7. Normal operation: IGBT turn on and carry current.



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

- c1. Control supply voltage V_{DB} rises : After V_{DB} level reaches under voltage reset level (UV_{DBr}), the circuits start to operate when next input is applied.
- c2. Normal operation: IGBT turn on and carry current.
- c3. V_{DB} level dips to under voltage trip level (UV_{DBt}).
- c4. P-side IGBT turns OFF in spite of control input signal level, but there is no Fo signal output.
- c5. V_{DB} level reaches UV_{DBr} .
- c6. Normal operation: IGBT turn on and carry current.

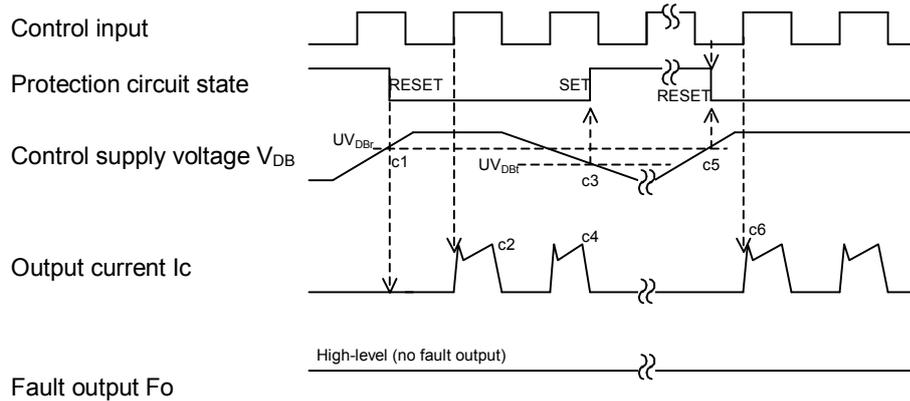
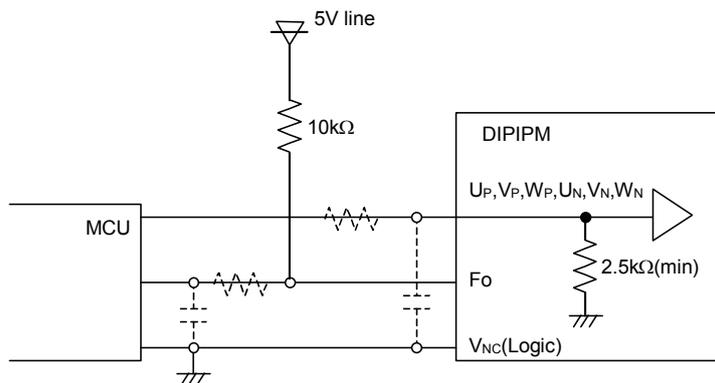
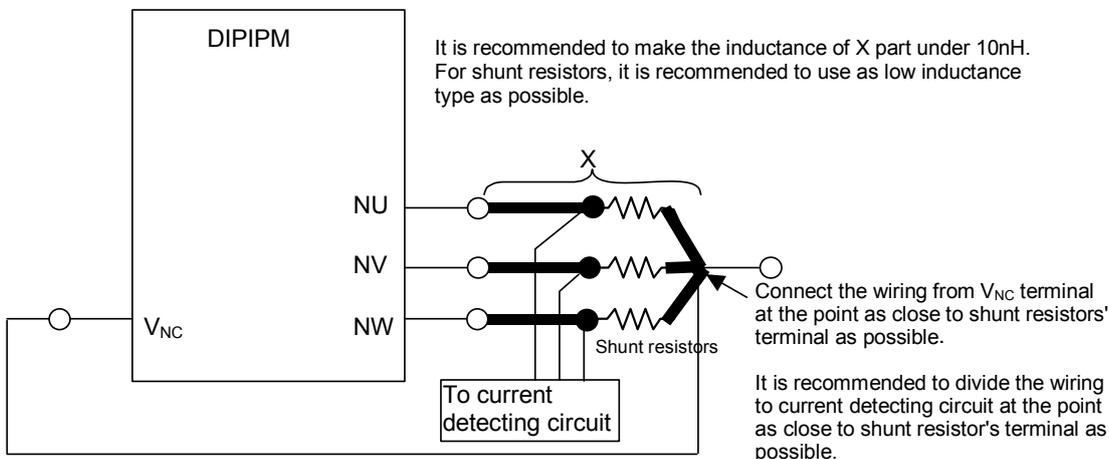


Fig.6 An Instance of Interface Circuit



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 DIPIPM 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.

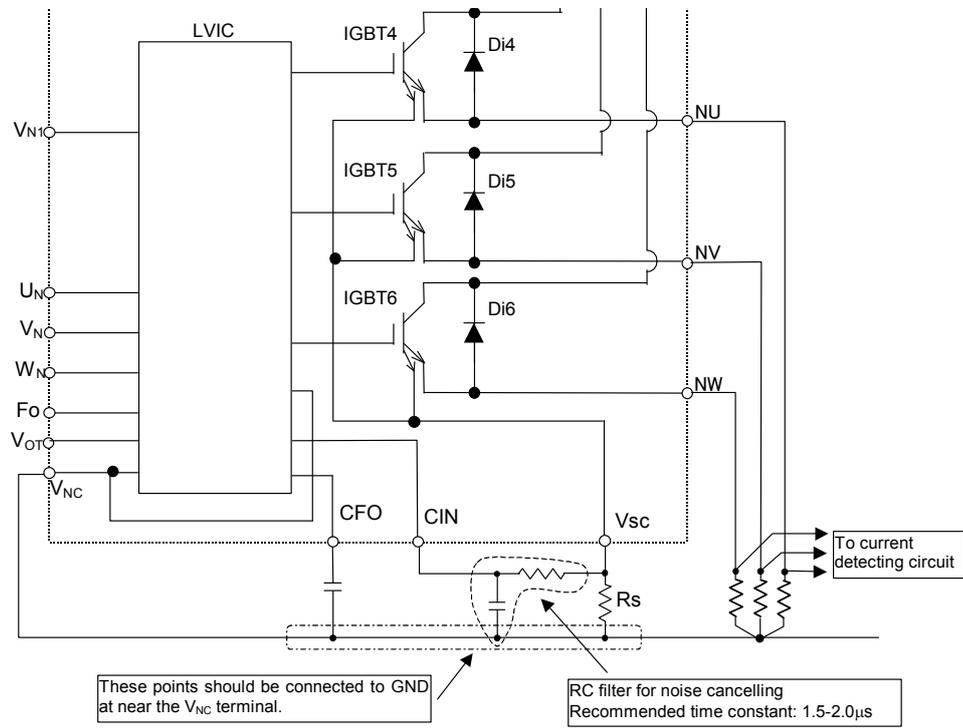
Fig.7 An Instance of Current Detecting Part C



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Fig.8 An Instance of SC Protection Circuit



TENTATIVE**Keep safety first in your circuit designs!**

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