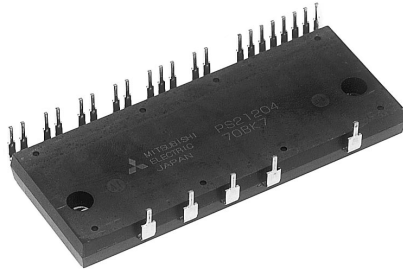


PS21204

TRANSFER-MOLD TYPE
INSULATED TYPE

PS21204



INTEGRATED POWER FUNCTIONS

600V/15A low-loss 3rd generation IGBT inverter bridge for 3 phase DC-to-AC power conversion (Fig. 2)

Application Motor Ratings : Power : 0.75kW, sinusoidal, PWM
Frequency=5kHz
100% load current : 5.0A (rms)*
150% load current : 7.5A (rms)*,
1 minute.

*(Note) : The motor current is assumed to be sinusoidal and the peak current value is defined as : $I_o \times \sqrt{2}$

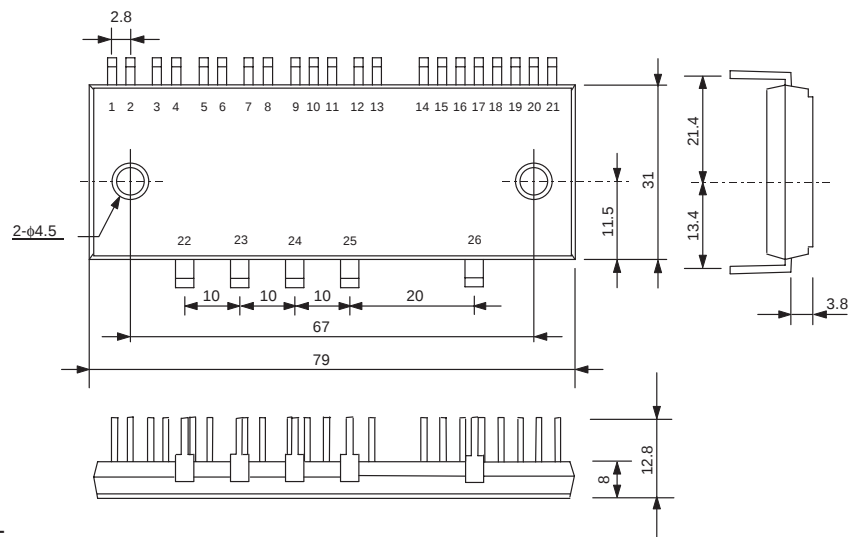
INTEGRATED DRIVE, PROTECTION AND SYSTEM CONTROL FUNCTIONS

- For upper-leg IGBTs : Drive circuit, High voltage isolated high-speed level shifting, Control circuit under-voltage (UV) protection.
Note : Bootstrap supply scheme can be applied (Fig. 2).
- For lower-leg IGBTs : Drive circuit, Control circuit under-voltage protection (UV), Short circuit protection (SC). (Fig. 3)
- Fault signaling : Corresponding to a SC fault (Low-side IGBT) or a UV fault (Low-side supply).
- Input interface : 5V line CMOS/TTL compatible, Schmitt Trigger receiver circuit.

APPLICATION

AC100V~200V three-phase inverter drive for small power (0.75 kW) motor control.

Fig. 1 PACKAGE OUTLINES



TERMINALS CODE

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

Fig. 2 INTERNAL FUNCTIONS BLOCK DIAGRAM (TYPICAL APPLICATION EXAMPLE)

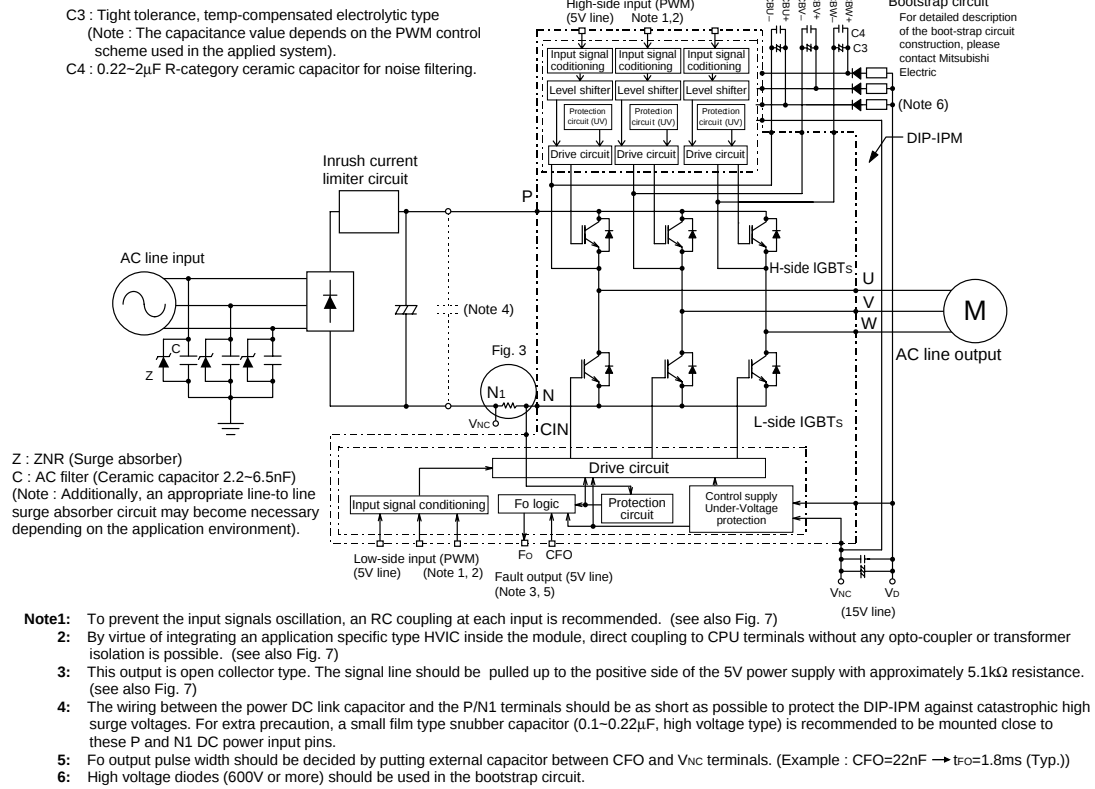
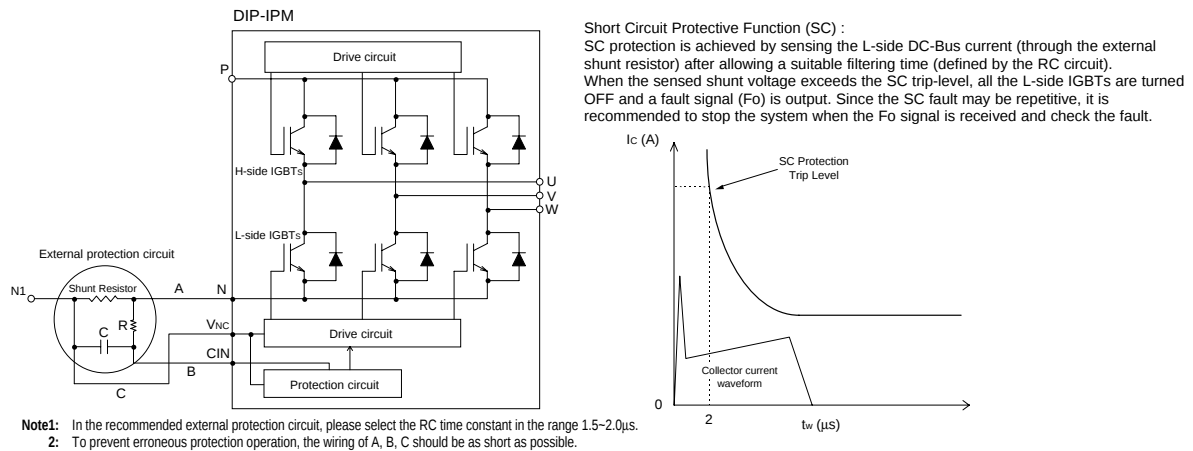


Fig. 3 EXTERNAL PART OF THE DIP-IPM PROTECTION CIRCUIT



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MAXIMUM RATINGS (T_j = 25°C, unless otherwise noted)

INVERTER PART

Symbol	Parameter	Condition	Ratings	Unit
V _{CC}	Supply voltage	Applied between P-N	450	V
V _{CC(surge)}	Supply voltage (surge)	Applied between P-N	500	V
V _{CES}	Collector-emitter voltage		600	V
±I _C	Each IGBT collector current	T _c = 25°C	15	A
±I _{CP}	Each IGBT collector current (peak)	T _c = 25°C, instantaneous value (pulse)	30	A
P _C	Collector dissipation	T _c = 25°C, per 1 chip	43	W
T _j	Junction temperature	(Note 1)	-20~+150	°C

Note 1 : The maximum junction temperature rating of the power chips integrated within the DIP-IPM is 150°C (@ T_c ≤ 100°C) however, to insure safe operation of the DIP-IPM, the average junction temperature should be limited to T_{j(ave)} ≤ 125°C (@ T_c ≤ 100°C).

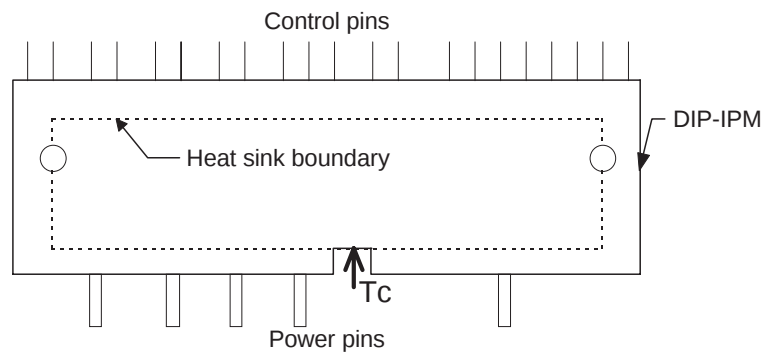
CONTROL (PROTECTION) PART

Symbol	Parameter	Condition	Ratings	Unit
V _D	Control supply voltage	Applied between VP1-VPC, VN1-VNC	20	V
V _{DB}	Control supply voltage	Applied between VUFB-VUFS, VVFB-VVFS, VWFB-VWFS	20	V
V _{CIN}	Input voltage	Applied between UP, VP, WP-VPC, UN, VN, WN-VNC	-0.5~+5.5	V
V _{FO}	Fault output supply voltage	Applied between Fo-VNC	-0.5~V _D +0.5	V
I _{FO}	Fault output current	Sink current at Fo terminal	15	mA
V _{SC}	Current sensing input voltage	Applied between CIN-VNC	-0.5~V _D +0.5	V

TOTAL SYSTEM

Symbol	Parameter	Condition	Ratings	Unit
V _{CC(PROT)}	Self protection supply voltage limit (short circuit protection capability)	V _D = V _{DB} = 13.5~16.5V, Inverter part T _j = 125°C, non-repetitive, less than 2 μs	400	V
T _C	Module case operation temperature	(Note 2)	-20~+100	°C
T _{stg}	Storage temperature		-40~+125	°C
V _{iso}	Isolation voltage	60Hz, Sinusoidal, AC 1 minute, connection pins to heat-sink plate	1500	V _{rms}

Note 2 : T_C MEASUREMENT POINT



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THERMAL RESISTANCE

Symbol	Parameter	Condition	Limits			Unit
			Min.	Typ.	Max.	
R _{th(j-c)Q}	Junction to case thermal resistance	Inverter IGBT part (per 1/6 module)	—	—	2.85	°C/W
R _{th(j-c)F}		Inverter FWDi part (per 1/6 module)	—	—	4.5	
R _{th(c-f)}	Contact thermal resistance	Case to fin, (per 1 module) thermal grease applied	—	—	0.067	

ELECTRICAL CHARACTERISTICS (T_j = 25°C, unless otherwise noted)

INVERTER PART

Symbol	Parameter	Condition	Limits			Unit
			Min.	Typ.	Max.	
V _{CE(sat)}	Collector-emitter saturation voltage	V _D = V _{DB} = 15V V _{CIN} = 0V	—	1.8	—	V
		I _C = 15A, T _j = 25°C I _C = 15A, T _j = 125°C	—	2.0	—	
V _{EC}	FWDi forward voltage	T _j = 25°C, -I _C = 15A, V _{CIN} = 5V	—	2.2	—	V
t _{on}	Switching times	V _{CC} = 300V, V _D = V _{DB} = 15V I _C = 15A, T _j = 125°C, V _{CIN} = 5V → 0V Inductive load (upper-lower arm) Note: t _{on} , t _{off} include delay time of the internal control circuit	—	0.7	—	μs
t _{tr}			—	0.1	—	
t _{c(on)}			—	0.4	—	
t _{off}			—	1.9	—	
t _{c(off)}			—	0.9	—	
I _{CES}	Collector-emitter cut-off current	V _{CE} = V _{CES}	—	—	1.0	mA
		T _j = 25°C T _j = 125°C	—	—	10	

CONTROL (PROTECTION) PART

Symbol	Parameter	Condition		Limits			Unit
				Min.	Typ.	Max.	
V _D	Control supply voltage	Applied between V _{P1} -V _{PC} , V _{N1} -V _{NC}		13.5	15.0	16.5	V
V _{DB}	Control supply voltage	Applied between V _{UFB} -V _{UFS} , V _{VFB} -V _{VFS} , V _{WFB} -V _{WFS}		13.5	15.0	16.5	V
I _D	Circuit current	V _D = V _{DB} = 15V, input = OFF	V _{P1} -V _{PC} , V _{N1} -V _{NC}	—	4.25	8.50	mA
			V _{UFB} -V _{UFS} , V _{VFB} -V _{VFS} , V _{WFB} -V _{WFS}	—	0.50	1.00	mA
		V _D = V _{DB} = 15V, input = ON	V _{P1} -V _{PC} , V _{N1} -V _{NC}	—	4.95	9.70	mA
			V _{UFB} -V _{UFS} , V _{VFB} -V _{VFS} , V _{WFB} -V _{WFS}	—	0.50	1.00	mA
V _{FOH}	Fault output voltage	V _{SC} = 0V, F _O circuit : 10kΩ to 5V pull-up		4.9	—	—	V
V _{FOL}		V _{SC} = 1V, F _O circuit : 10kΩ to 5V pull-up		—	1.0	2.0	V
V _{FOsat}		V _{SC} = 1V, I _{FO} = 15mA		0.8	1.2	1.8	V
f _{PWM}	PWM input frequency	T _C ≤ 100°C, T _J ≤ 125°C		—	5.0	—	kHz
t _{dead}	Allowable deadtime	Relates to corresponding input signal for blocking arm shoot-through. –20°C ≤ T _C ≤ 100°C		3.0	—	—	μs
V _{SC(ref)}	Short circuit trip level	T _J = 25°C, V _D = 15°C (Note 2)		0.45	0.5	0.55	V
UV _{DBt}	Supply circuit under-voltage protection	T _J ≤ 125°C	Trip level	10.0	—	12.0	V
UV _{DBr}			Reset level	10.5	—	12.5	V
UV _{Dt}			Trip level	10.3	—	12.5	V
UV _{Dr}			Reset level	10.8	—	13.0	V
t _{FO}	Fault output pulse width (Note 3)	C _{FO} = 22nF (connected between C _{FO} –V _{NC})		1.0	1.8	—	ms
V _{th(on)}	ON threshold voltage	H-side	Applied between:	0.8	1.4	2.0	V
V _{th(off)}	OFF threshold voltage		U _P , V _P , W _P -V _{PC}	2.5	3.0	4.0	
V _{th(on)}	ON threshold voltage	L-side	Applied between:	0.8	1.4	2.0	V
V _{th(off)}	OFF threshold voltage		U _N , V _N , W _N -V _{NC}	2.5	3.0	4.0	

Note 2 : Short circuit protection is functioning only at the low-arms. Please select the value of the external shunt resistor such that the SC trip-level is less than 25.5 A.

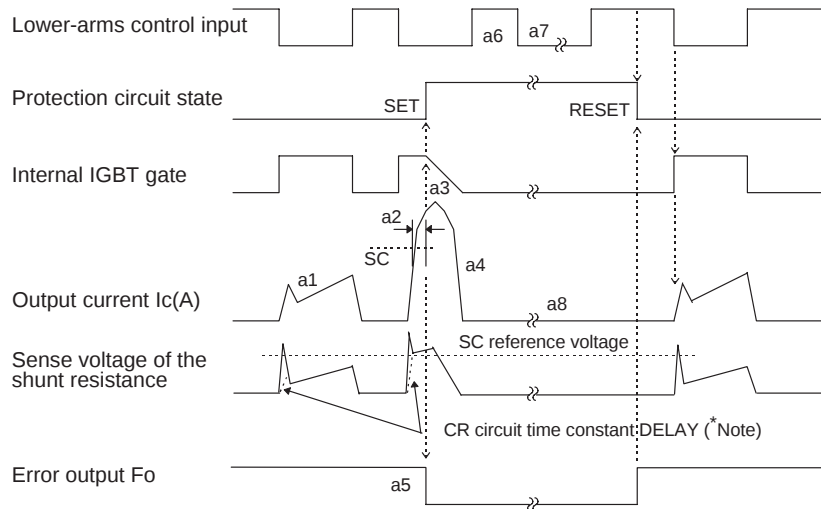
3 : Fault signal is output when the low-arms short circuit or control supply under-voltage protective functions operate. The fault output pulse-width t_{FO} depends on the capacitance value of C_{FO} according to the following approximate equation : C_{FO} = 12.2 × 10⁻⁶ × t_{FO} [F].

Fig. 5 TIMING CHARTS OF THE DIP-IPM PROTECTIVE FUNCTIONS

[A] Short-Circuit Protection (Lower-arms only)

(For the external shunt resistance and CR connection, please refer to Fig. 3.)

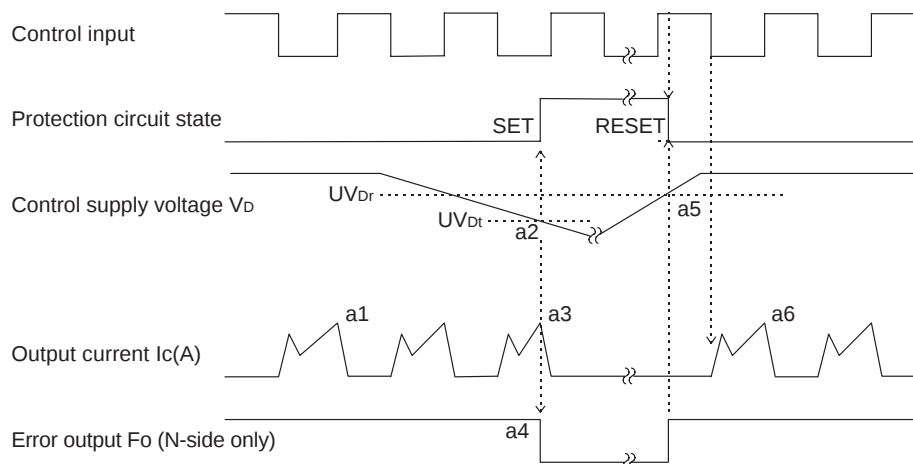
- a1. Normal operation : IGBT ON and carrying current.
- a2. Short circuit current detection (SC trigger).
- a3. Hard IGBT gate interrupt.
- a4. IGBT turns OFF.
- a5. Fo timer operation starts : The pulse width of the Fo signal is set by the external capacitor C_{FO}.
- a6. Input "H" : IGBT OFF state.
- a7. Input "L" : IGBT ON state, but during the Fo active signal the IGBT doesn't turn ON.
- a8. IGBT OFF state.



Note : The CR time constant safe guards against erroneous SC fault signals resulting from di/dt generated voltages when the IGBT turns ON.
The optimum setting for the CR circuit time constant is 1.5~2.0 μ s.

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

- a1. Normal operation : IGBT ON and carrying current.
- a2. Under voltage trip (UV_{Dt}).
- a3. IGBT OFF inspite of control input condition.
- a4. Fo timer operation starts : The pulse width of the Fo signal is set by the external capacitor C_{FO}.
- a5. Under voltage reset (UV_{Dr}).
- a6. Normal operation : IGBT ON and carrying current.



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

- a1. Control supply voltage rises : After the voltage level reaches UV_{DBr} , the circuits start to operate when the next input is applied.
- a2. Normal operation : IGBT ON and carrying current.
- a3. Under voltage trip (UV_{DBt}).
- a4. IGBT OFF inspite of control input condition, but there is no Fo signal output.
- a5. Under-voltage reset (UV_{DBr}).
- a6. Normal operation : IGBT ON and carrying current.

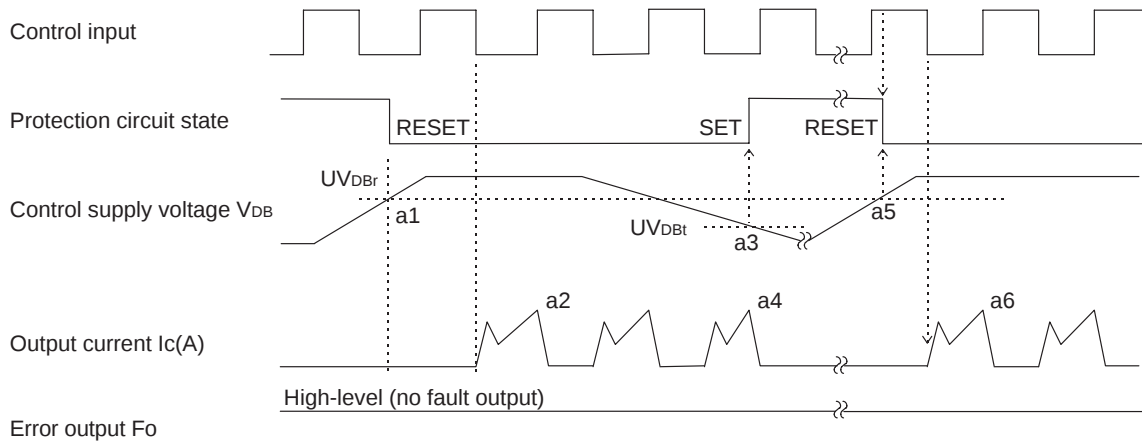
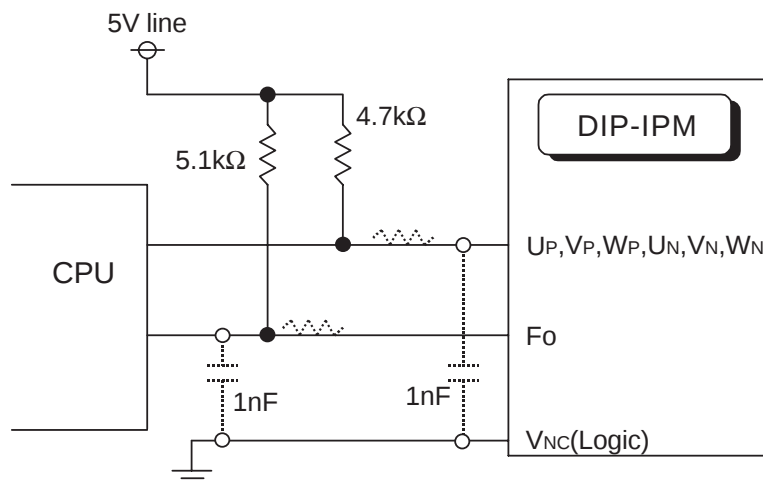


Fig. 7 RECOMMENDED CPU I/O INTERFACE CIRCUIT



Note : RC coupling at each input (parts shown dotted) may change depending on the PWM control scheme used in the application and on the wiring impedances of the application's printed circuit board.

