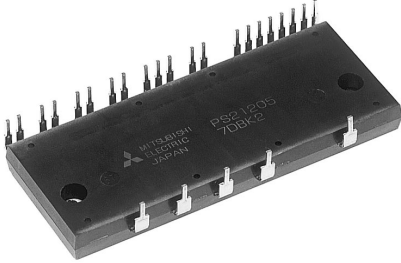


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INTEGRATED POWER FUNCTIONS

600V/20A low-loss 3rd generation IGBT inverter bridge for 3 phase DC-to-AC power conversion (Fig. 2)

Application Motor Ratings : Power : 1.5kW, sinusoidal, PWM
Frequency=5kHz
100% load current : 8.0A (rms)*
150% load current : 12.0A (rms)*,
1 minute.

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

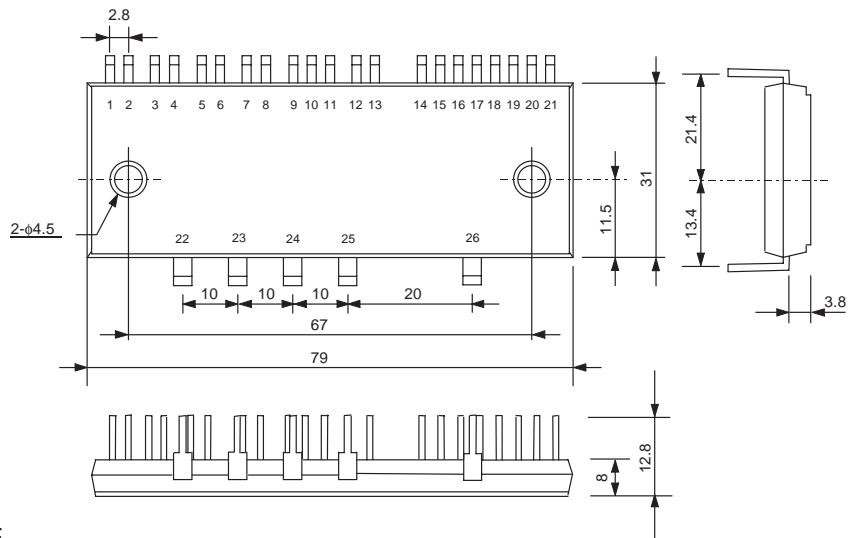
INTEGRATED DRIVE, PROTECTION AND SYSTEM CONTROL FUNCTIONS

- 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 (1.5 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)

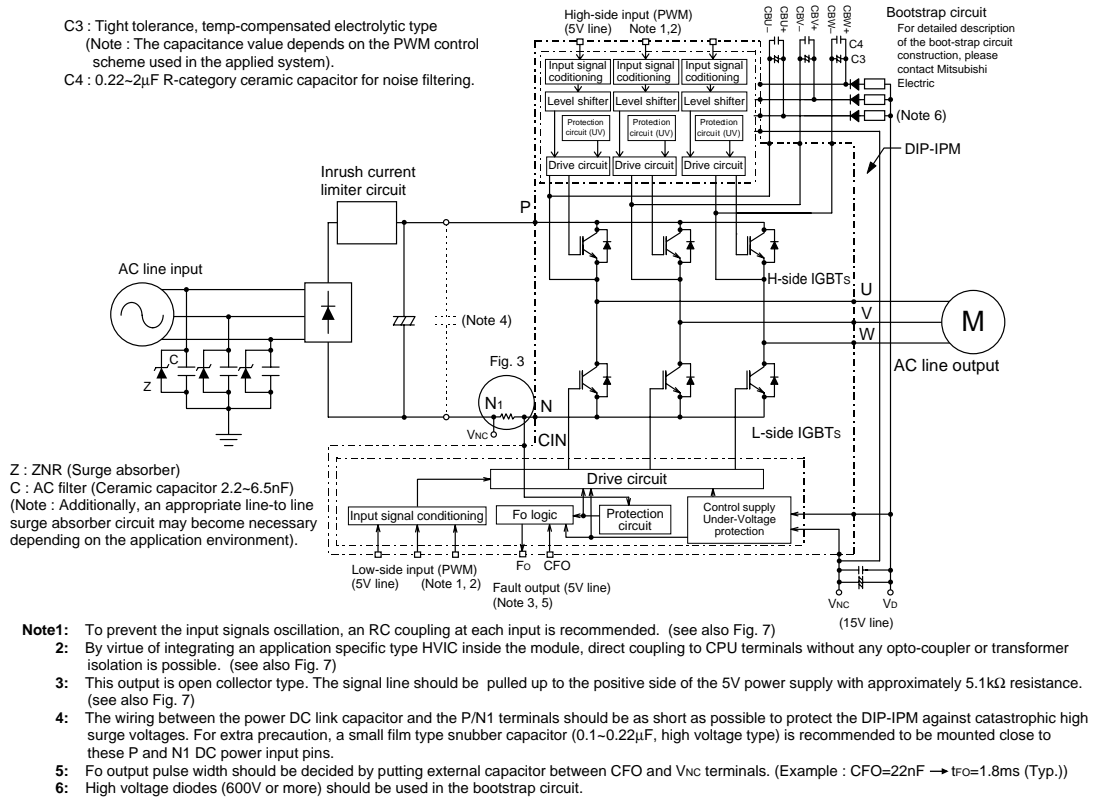
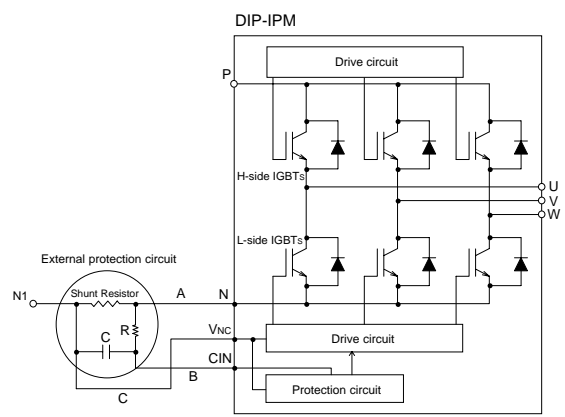
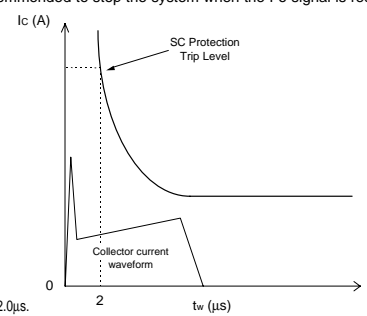


Fig. 3 EXTERNAL PART OF THE DIP-IPM PROTECTION CIRCUIT



Short Circuit Protective Function (SC) :
SC protection is achieved by sensing the L-side DC-Bus current (through the external shunt resistor) after allowing a suitable filtering time (defined by the RC circuit). When the sensed shunt voltage exceeds the SC trip-level, all the L-side IGBTs are turned OFF and a fault signal (Fo) is output. Since the SC fault may be repetitive, it is recommended to stop the system when the Fo signal is received and check the fault.



- Note1:** In the recommended external protection circuit, please select the RC time constant in the range 1.5~2.0μs.
2: To prevent erroneous protection operation, the wiring of A, B, C should be as short as possible.

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MAXIMUM RATINGS ($T_j = 25^\circ\text{C}$, unless otherwise noted)

INVERTER PART

Symbol	Parameter	Condition	Ratings	Unit
VCC	Supply voltage	Applied between P-N	450	V
VCC(surge)	Supply voltage (surge)	Applied between P-N	500	V
VCEs	Collector-emitter voltage		600	V
$\pm I_C$	Each IGBT collector current	$T_c = 25^\circ\text{C}$	20	A
$\pm I_{CP}$	Each IGBT collector current (peak)	$T_c = 25^\circ\text{C}$, instantaneous value (pulse)	40	A
PC	Collector dissipation	$T_c = 25^\circ\text{C}$, per 1 chip	56	W
T_j	Junction temperature	(Note 1)	-20~+150	$^\circ\text{C}$

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

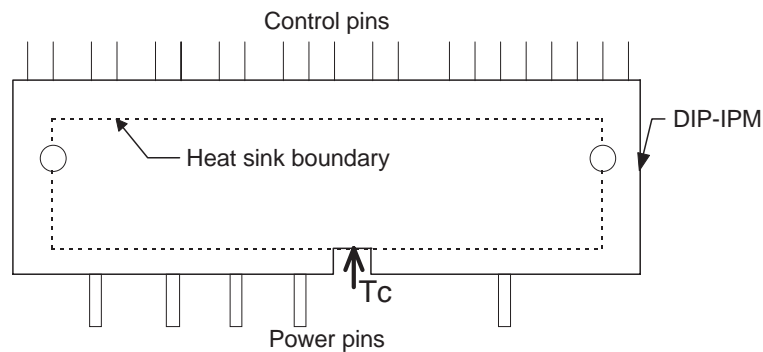
CONTROL (PROTECTION) PART

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
VCC(PROT)	Self protection supply voltage limit (short circuit protection capability)	V _D = V _{DB} = 13.5~16.5V, Inverter part $T_j = 125^\circ\text{C}$, non-repetitive, less than 2 μs	400	V
T _c	Module case operation temperature	(Note 2)	-20~+100	$^\circ\text{C}$
T _{stg}	Storage temperature		-40~+125	$^\circ\text{C}$
V _{iso}	Isolation voltage	60Hz, Sinusoidal, AC 1 minute, connection pins to heat-sink plate	1500	V _{rms}

Note 2 : T_c MEASUREMENT POINT



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)	—	—	2.2	°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 = 20A, T _j = 25°C I _C = 20A, T _j = 125°C	—	2.0	—	
V _{EC}	FWDi forward voltage	T _j = 25°C, -I _C = 20A, V _{CIN} = 5V	—	2.2	—	V
t _{on}	Switching times	V _{CC} = 300V, V _D = V _{DB} = 15V I _C = 20A, 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	—	0.8	—	μs
t _{tr}			—	0.1	—	
t _{c(on)}			—	0.5	—	
t _{off}			—	2.0	—	
t _{c(off)}			—	1.0	—	
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	—	4.25	8.50	mA		
		V _D = V _{DB} = 15V, input = ON	—	0.50	1.00			
		V _D = V _{DB} = 15V, input = OFF	—	4.95	9.70	mA		
		V _D = V _{DB} = 15V, input = ON	—	0.50	1.00			
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		
UV _{Dt}			Trip level	10.3	—	12.5	V	
UV _{Dr}			Reset level	10.8	—	13.0		
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: U _P , V _P , W _P -V _{PC}		0.8	1.4	2.0	V
V _{th(off)}	OFF threshold voltage		2.5	3.0	4.0			
V _{th(on)}	ON threshold voltage	L-side	Applied between: U _N , V _N , W _N -V _{NC}		0.8	1.4	2.0	V
V _{th(off)}	OFF threshold voltage		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 34.0 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].

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MECHANICAL CHARACTERISTICS AND RATINGS

Parameter	Condition	Limits			Unit	
		Min.	Typ.	Max.		
Mounting torque	Mounting screw : M4	Recommended 12kg-cm	10	—	15	kg-cm
		Recommended 1.18N-m	0.98	—	1.47	N-m
Weight		—	54	—	g	

RECOMMENDED OPERATION CONDITIONS

Symbol	Parameter	Condition	Limits			Unit
			Min.	Typ.	Max.	
V _{CC}	Supply voltage	Applied between P-N	0	300	400	V
V _D	Control supply voltage	Applied between VP1-VP _C , VN1-VN _C	13.5	15.0	16.5	V
V _{DB}	Control supply voltage	Applied between VU _{FB} -VU _{F_S} , VV _{FB} -VV _{F_S} , VW _{FB} -VW _{F_S}	13.5	15.0	16.5	V
ΔV _D , ΔV _{DB}	Control supply variation		-1	—	1.0	V/μs
t _{dead}	Arm shoot-through blocking time	For each input signal	3	—	—	μs
f _{PWM}	PWM input frequency	T _c ≤ 100°C, T _j ≤ 125°C	—	5	—	kHz
V _{CIN(ON)}	Input ON threshold voltage	Applied between UP, VP, WP-VP _C	0-0.65			V
V _{CIN(OFF)}	Input OFF threshold voltage	Applied between UN, VN, WN-VN _C	4.0-5.5			V

Fig. 4 THE DIP-IPM INTERNAL CIRCUIT

