PRELIMINARY

PS11025-A

Flat base type
Insulated type

Notice: This is not a final specification. Some parametric limits are subject to change.

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Applications :

Acoustic noise-less 2.2kW/AC200V class, 3 phase inverter, and 0.75kW AC-Servo controller applications.

Integrated Functions and Features :

—3-phase IGBT inverter bridge configured by the latest 3rd. generation IGBT and diode technology.
—Inverter output current capability Io (Note 1) : 100% load : 11.0A (rms)
150% over load : 16.5A (rms) , 1 min.

(Note 1) : The inverter output current is assumed to be sinusoidal and the peak current value of each of the above loading cases is defined as : $Iop = Io \times \sqrt{2}$

Integrated Drive, Protection and System Control Functions :

P-Side IGBTs (upper-arm) : Drive circuit, high voltage isolated high-speed level shifting (opto-less interface), bootstrap circuit supply scheme and drive-supply under-voltage protection (UV_{DB}).

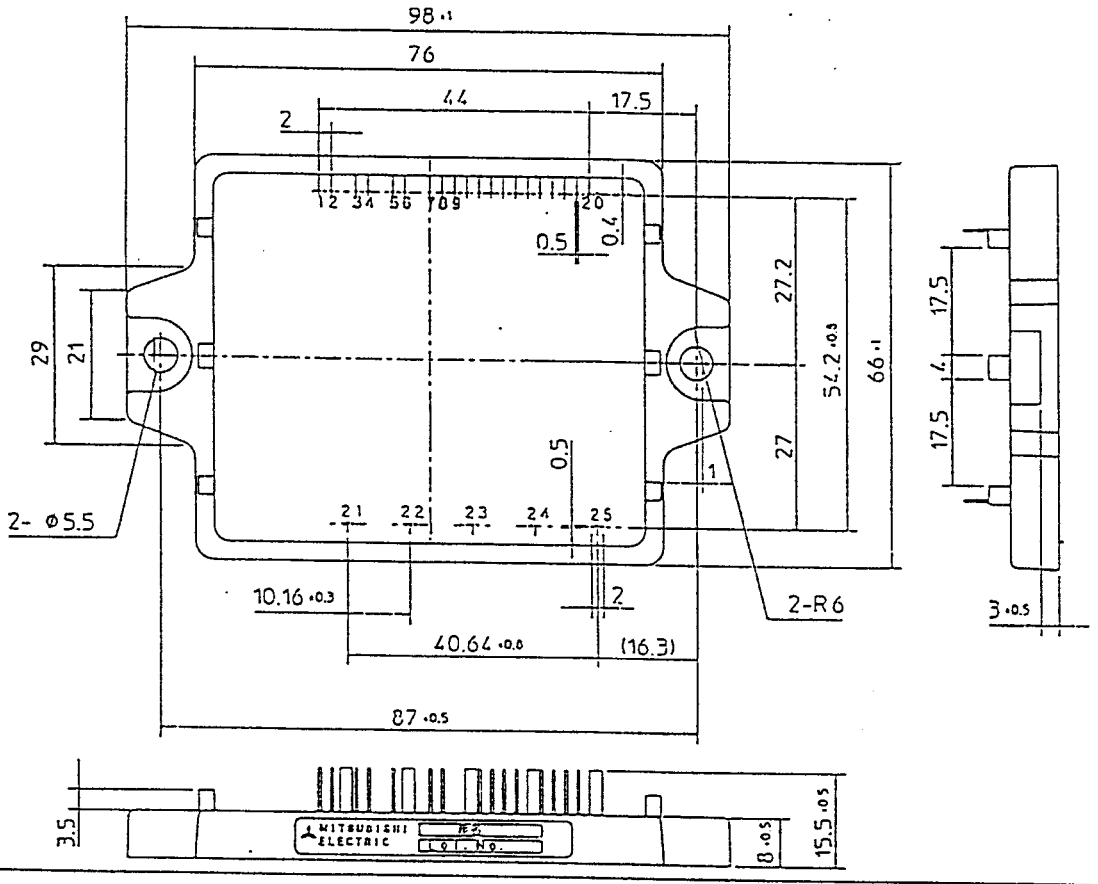
N-Side IGBTs (lower-arm) : Drive circuit, short circuit protection with soft current shut-down control (SC), drive-supply under-voltage protection (UV_D), and system over-temperature protection (OT).

Common warning and fault signaling :
CL : Warning signal output for inverter current overload condition.
FO : Fault signal output for the following conditions : short circuit current (N-side IGBTs), control supply under-voltage abnormality (N-side), and system over-temperature.

System feedback control : Analogue signal feedback reproducing actual inverter output phase currents.

Minimized IGBT gate bias requirement : Minimized to one 15V drive-supply referenced to the negative link of the DC power bus (by using the bootstrap circuit supply scheme).

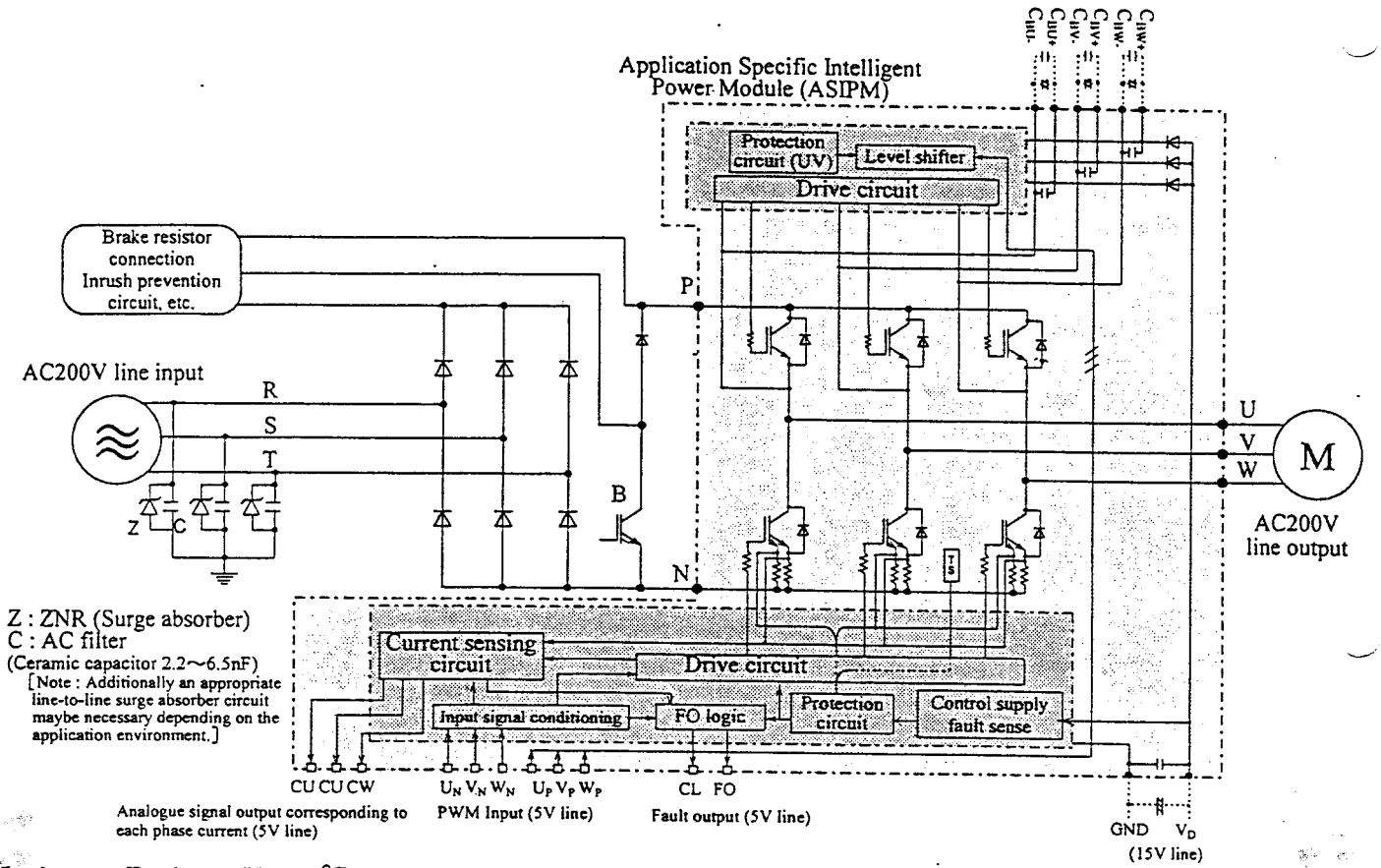
Fig. 1 Package Outlines :



Terminals Code

1	CBU-
2	CBU+
3	CBV-
4	CBV+
5	CBW-
6	CBW+
7	GND
8	VD
9	UPIN
10	VPIN
11	WPIN
12	UNIN
13	VNIN
14	WNIN
15	CU
16	CV
17	CW
18	CL
19	FO
21	P
22	N
23	U
24	V
25	W

Fig. 2 Internal Functions Block Diagram :



Maximum Ratings (Tj=25℃)

Inverter Part :

Item	Symbol	Condition	Ratings	Unit
Supply voltage	V_{CC}	Applied between P-N	450	V
Supply voltage (surge)	$V_{CC\ (surge)}$	Applied between P-N, Surge-value	500	V
Each output IGBT collector-emitter static voltage	V_P or V_N	Applied between P-U(V,W),or U(V,W)-N	600	V
Each output IGBT collector-emitter switching surge voltage	$V_{P(S)}$ or $V_{N(S)}$	Applied between P-U(V,W),or U(V,W)-N	600	V
Each output IGBT collector current	±Ic (±Icp)	T_C= 25℃ Note1:"( )" means Ic peak value	±30 (±60)	A

Control Part :

Item	Symbol	Condition	Ratings	Unit
Supply voltage	V_D	Applied between V_D-GND	20	
Supply voltage	V_{DB}	Applied between C_{BU+}-C_{BU-},C_{BV+}-C_{BV-},C_{BW+}-C_{BW-}	20	V
Input signal voltage	Vi	Applied between U_P·V_P·W_P·U_N·V_N·W_N-GND	-0.5 ~ 5+0.5	V
Fault output supply voltage	V_{FO}	Applied between FO - GND	-0.5 ~ 7	V
Fault output current	I_{FO}	Sink current of FO	15	mA
Current-limit warning (CL) output voltage	V_{CL}	Applied between CL - GND	-0.5 ~ 7	V
CL output current	I_{CL}	Sink current of CL	15	mA
Analogue current signal output current	I_{CO}	Sink current of CU·CV·CW	±1	mA

Total System :

Item	Symbol	Condition	Ratings	Unit
Junction temperature	Tj	Note2)	-20 ~ +125	℃
Storage temperature	Tstg	-	-40 ~ +125	℃
Module case operating temperature	Tc		-20 ~+100	℃
Isolation voltage	Viso	Sinusoidal AC (60Hz) 1 minute, applied between the connection terminals and the base plate	2500	Vrms
Mounting torque	-	Mounting screw : M 5.0	1.47~1.96	N·m

Note2) The item defines the maximum junction temperature for the power elements (IGBT/Diode) of the ASIPM to ensure safe operation. However, these power elements can endure junction temperature as high as 150℃ instantaneously . To make use of this additional temperature allowance, a detailed study of the exact application conditions is required and, accordingly, necessary information is requested to be provided before use.

Thermal Resistance :

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Junction to case thermal resistance	$R_{th(j-c)Q}$	Inverter IGBT (per 1/6 module)	-	-	1.5	℃/W
	$R_{th(j-c)F}$	Inverter FWDi (per 1/6 module)	-	-	3.0	
Contact thermal resistance	$R_{th(c-f)}$	Case to fin, thermal grease applied (per 1 module)	-	-	0.05	

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

Item		Symbol	Condition		Min.	Typ.	Max.	Unit
Collector-emitter saturation voltage		$V_{CE(sat)}$	T_j=25℃, I_C=30A, V_D=V_{DB}=15V		-	-	2.9	V
FWDi forward voltage		V_{EC}	T_j= 25℃, -I_C = 30A, Input=OFF		-	-	2.9	V
Switching times		t_{on}	1/2 Bridge inductive load, Input=ON		0.4	0.8	1.7	μs
		$t_{c(on)}$	V_{CC}=300V, I_C = 30A, T_j=125℃		-	0.4	1.2	
		t_{off}	V_D=V_{DB}=15V		-	1.8	2.6	
		$t_{c(off)}$	Note: t_{on},t_{off} include delay time of		-	0.6	1.5	
FWD reverse recovery time		t_{rr}	the internal control circuit		-	0.12	-	
Short circuit endurance (output, arm, and load short circuit modes)			V_{CC}≦400V, Input=ON (one-shot) T_j=125℃ (start) 13.5V≦V_D=V_{DB}≦16.5		·No destruction ·FO output by protection operation			
Switching SOA			V_{CC}≦400V, T_j≦125℃, T_C≦100℃ I_C<I_{OL}(CL) operation level, Input=ON 13.5V≦V_D=V_{DB}≦16.5V		·No destruction ·No protecting operation ·No FO output			
Circuit current		I_D	V_D=15V, V_{CIN}=5V		-	-	150	mA
Input ON threshold voltage		$V_{CIN(ON)}$			0.8	1.4	2.0	V
Input OFF threshold voltage		$V_{CIN(OFF)}$			2.2	3.0	4.0	V
PWM input frequency		f_{PWM}	T_C≦100℃, T_j≦125℃		2	-	20	kHz
Allowable input ON-pulse width		t_{xx}	V_D=15V ± 0.1V T_C=-20℃~+100℃ Note3)		1	-	500	μs
Allowable input signal dead time for blocking arm shoot-through		t_{dead}	Relates to corresponding input T_C=-20~+100℃		2.0	-	-	μs
Output current analogue signaling (corresponds to each N-side arm current)	Analogue signal linearity with output current	V_{CO}	I_C=0A	V_D=15V	2.40	2.50	2.60	V
		$V_{C+(200\%)}$	I_C=$I_{OP(200\%)}$		1.30	1.40	1.50	V
		$V_{C-(200\%)}$	I_C=-$I_{OP(200\%)}$	T_C=-20~+100℃ Fig 3	3.50	3.60	3.70	V
	Analogue signal output voltage limit	V_{C+}	I_C>$I_{OP(200\%)}$, V_D=15V		-	-	0.7	V
		V_{C-}	I_C<$I_{OP(-200\%)}$, V_D=15V Fig 3		5.0	-	-	V
	Offset change area vs temperature	| ΔV_{CO} |	V_D=V_{DB}=15V T_C=-20~+100℃		-	15	-	mV
	Analogue signal over all linear variation	Δ$V_{C(200\%)}$	|V_{CO} - $V_{C±(200\%)}$|		-	1.1	-	V
	Analogue signal data hold accuracy	r_{CH}	Corresponds to 500 μs (max.) data hold period only, I_C=$I_{OP(200\%)}$ Fig 4		-5	-	5	%
	Analogue signal reading time	$t_{d(read)}$	After input signal trigger point Fig 6		-	3	-	μs
Current limit warning (CL) operation level		±I_{OL}	V_D=15V, T_C=-20~+100℃ Note4)		-	35	-	A
Signal output current value corresponding to CL operation		$I_{CL(H)}$	Open collector output		-	1	-	mA
		$I_{CL(L)}$			-	-	1	μA
Short circuit current trip level		I_{SC}	T_j=25℃ Note5)			60	-	A
Over temperature protection		OT	V_D= 15V	Trip level	100	110	120	℃
		OTr		Reset level	-	90	-	℃
Supply under-voltage protection		UV_{DB}	T_C=-20~+100℃ T_j≦125℃	Trip level	10.0	11.0	12.0	V
		UV_{DBr}		Reset level	10.5	11.5	12.5	
		UV_D		Trip level	11.05	12.00	12.75	
		UV_{Dr}		Reset level	11.55	12.50	13.25	
		t_{dV}		Filter time	-	10	-	μs
Fault output current		$I_{FO(H)}$	Open collector output		-	1	-	mA
		$I_{FO(L)}$			-	-	1	μA

Note3) : (a) Allowable minimum input ON-pulse width : This item applies to P-side circuit only.
(b) Allowable maximum input ON-pulse width : This item applies to both P-side and N-side circuits.

Note4) : CL output : The current limit warning circuit outputs warning signal whenever a lower-arm current exceeds the(±I_{OL}) level. The circuit is reset automatically by the next input signal and thus, it operates on a pulse-by-pulse basis.

Note5) : The short circuit protection (SC) works instantaneously when a momentarily rising up high short circuit current flows through an internal IGBT. The protection function is, thus meant primarily to protect the ASIPM against short circuit destruction. Therefore, this function is not recommended to be used for any system load current regulation or any over load control as this might cause a failure due to excessive temperature rise. Instead, the analogue current output feature or the over load warning feature (CL) should be appropriately used for such current regulation or over load control operation. In other words, the PWM signals to the ASIPM should be shut down, in principle, and not to be restarted before the junction temperature would recover to normal, as soon as a fault is fed back from the ASIPM FO pin indicating a short circuit situation.

Recommended Conditions :

Item	Symbol	Condition	Recommended Value	Unit
Supply voltage	V_{CC}	Applied between : P-N	0 ~ 400	V
Supply voltage	V_D	Applied between : V_D-GND	15.0 ± 1.5	V
Supply voltage ripple	ΔV_D, ΔV_{DB}		±1 (max.)	V/μs
Input on voltage	$V_{CIN(on)}$		0.8 (max.)	V
Input off voltage	$V_{CIN(off)}$		4.0 (min.)	V
PWM carrier frequency	f_{PWM}	Using typical application circuit.	2 ~ 20	kHz
Arm shoot-through blocking time	t_{dead}		2.0 (min.)	μS

Fig. 3 Output Current Analogue Signaling Linearity :

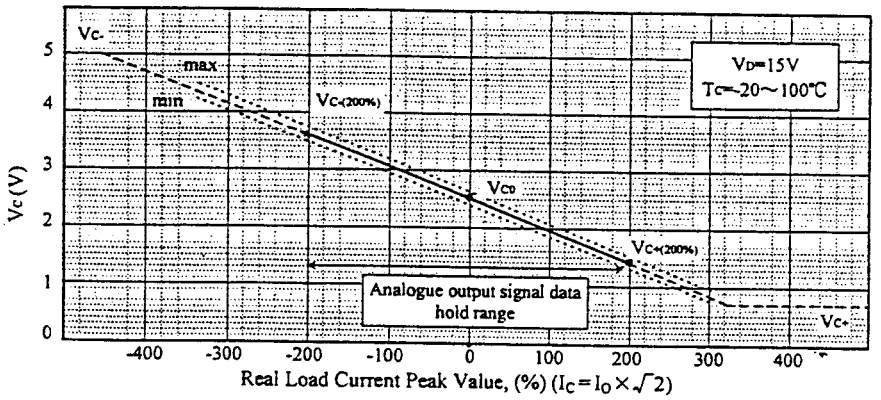
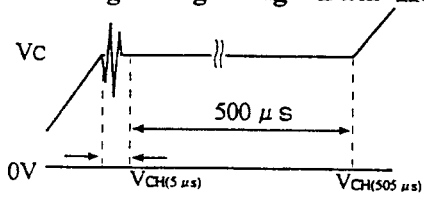


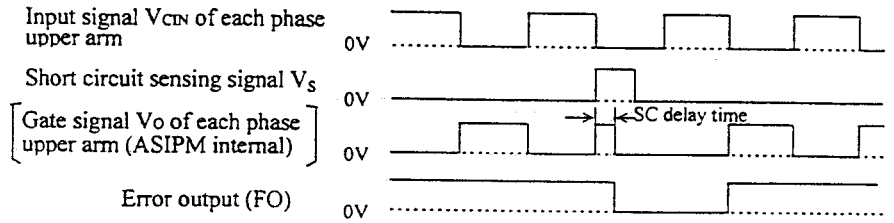
Fig. 4 Output Current Analogue Signaling "Data Hold" Definition :



$$r_{CH} = \frac{V_{CH(505\,\mu s)} - V_{CH(5\,\mu s)}}{V_{CH(5\,\mu s)}}$$

Note: Ringing may occur around the point where the signal output voltage changes state from "analogue" to "data hold" due to the test circuit arrangement and instrumentational trouble. Therefore, the rate of change measurment starts at a 5 μs delayed point.

Fig. 5 Timing Chart of the Short Circuit Protection Operation :



Note : Short circuit protection operation : The protection (by gate shut-down) is given only to the IGBT that senses a short circuit overload condition. The SC protection function gives an "FO" flag which is "Reset" on a pulse-by-pulse basis.

Fig. 6 Inverter Output Analogue Current Sensing and Signaling Timing Chart :

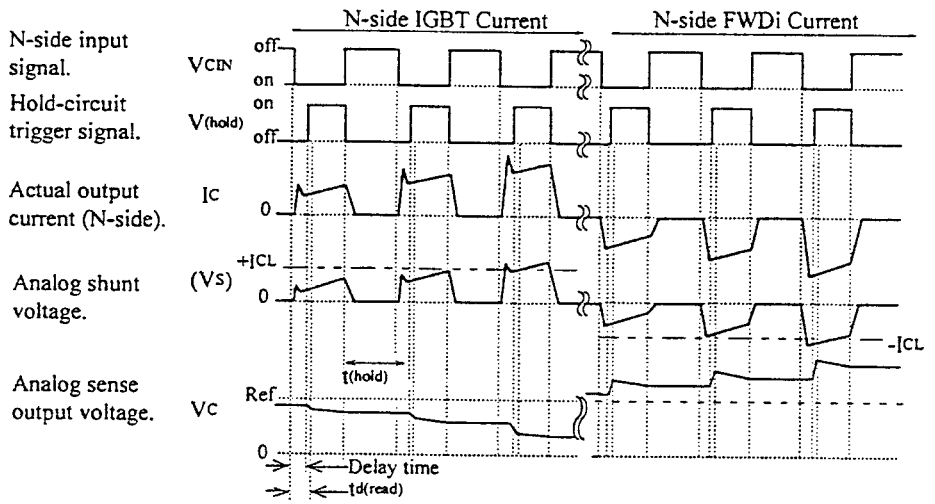


Fig. 7 Recommended I/O Interface Circuit :