

# PM400DVA060

FLAT-BASE TYPE  
INSULATED PACKAGE

## PM400DVA060



### FEATURE

- 1φ 400A, 600V Current-sense IGBT for 20kHz switching
  - Monolithic gate drive & protection logic
  - Detection, protection & status indication circuits for over-current, short-circuit, over-temperature & under-voltage (P-Fo available from upper leg devices)
  - Acoustic noise-less 37kW class inverter application
  - UL Recognized
- Yellow Card No. E80276(N)  
File No. E80271

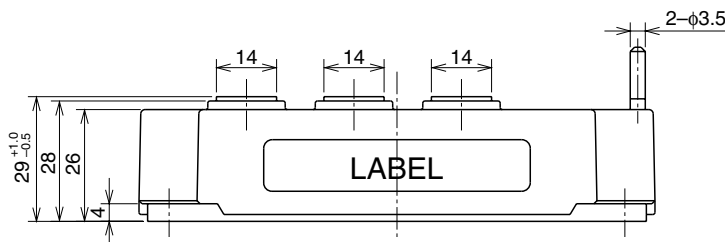
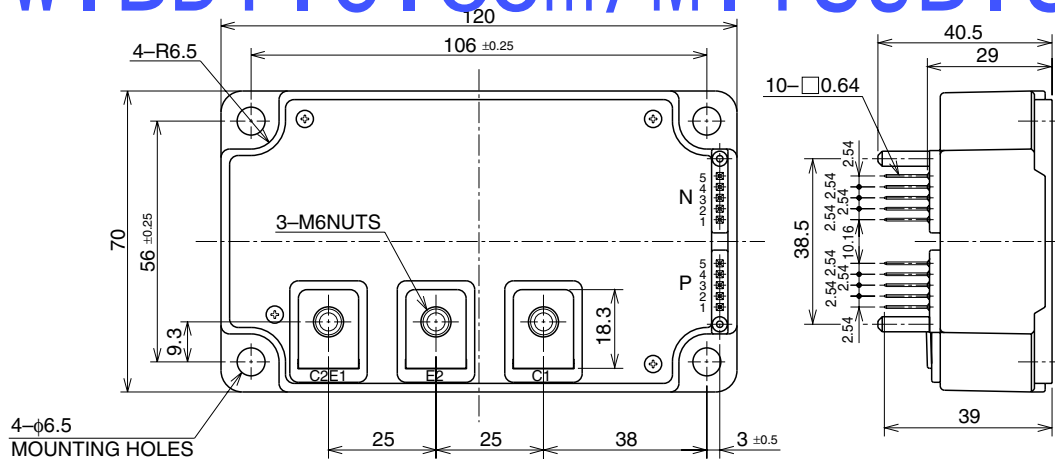
### APPLICATION

General purpose inverter, servo drives and other motor controls

### PACKAGE OUTLINES

Dimensions in mm

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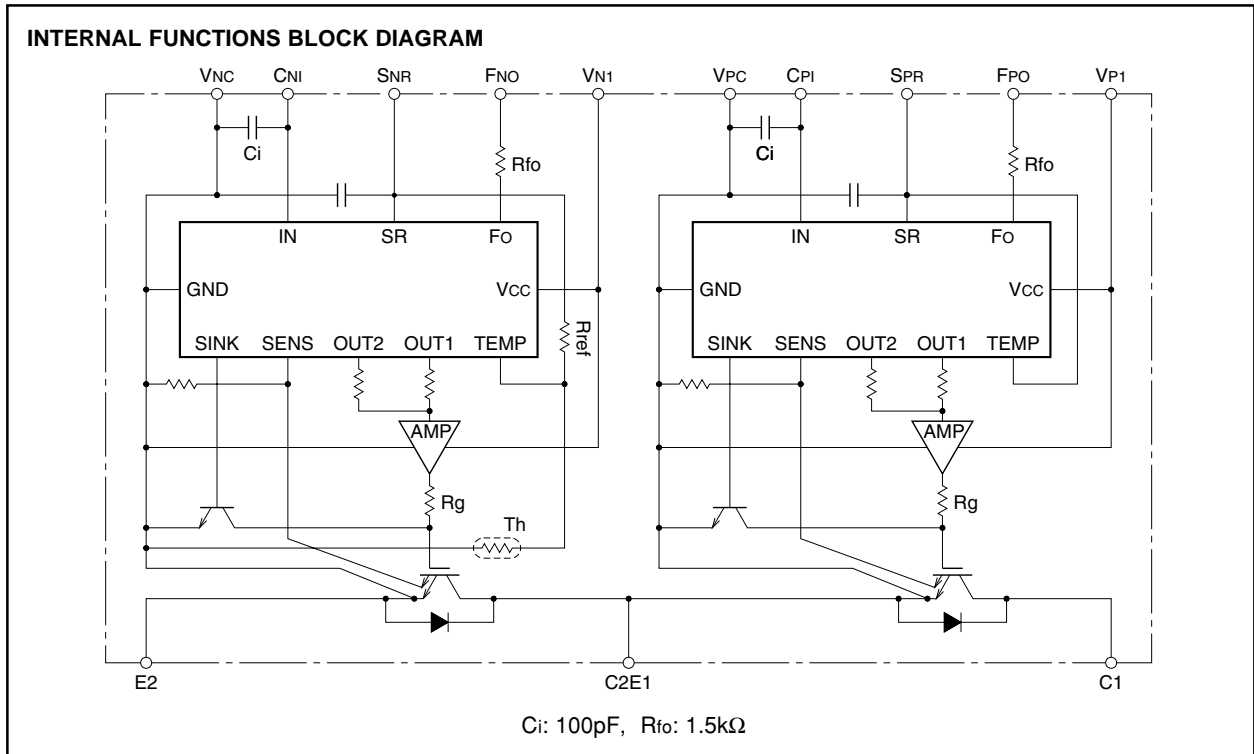


### TERMINAL CODE

- 5 : FNO
- 4 : VNC
- N 3 : CNI
- 2 : SNR
- 1 : VN1
- 5 : FPO
- 4 : VPC
- P 3 : CPI
- 2 : SPR
- 1 : VP1

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**MAXIMUM RATINGS** (T<sub>j</sub> = 25°C unless otherwise noted)  
INVERTER PART

Symbol	Parameter	Condition	Ratings	Unit
V <sub>CES</sub>	Collector-Emitter Voltage	V <sub>D</sub> = 15V, V <sub>CIN</sub> = 5V	600	V
±I <sub>C</sub>	Collector Current	T <sub>C</sub> = 25°C	400	A
±I <sub>CP</sub>	Collector Current (Peak)	T <sub>C</sub> = 25°C	800	A
P <sub>C</sub>	Collector Dissipation	T <sub>C</sub> = 25°C	1033	W
T <sub>j</sub>	Junction Temperature		-20 ~ +150	°C

**CONTROL PART**

Symbol	Parameter	Condition	Ratings	Unit
V <sub>D</sub>	Supply Voltage	Applied between : VP1-VPC, VN1-VNC	20	V
V <sub>CIN</sub>	Input Voltage	Applied between : CPI-VPC, CNI-VNC	10	V
V <sub>FO</sub>	Fault Output Supply Voltage	Applied between : FPO-VPC, FNO-VNC	20	V
I <sub>FO</sub>	Fault Output Current	Sink current at FPO, FNO terminal	20	mA

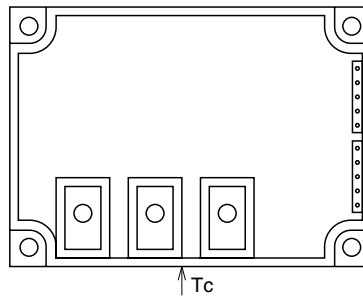
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## TOTAL SYSTEM

Symbol	Parameter	Condition	Ratings	Unit
V <sub>CC(Prot)</sub>	Supply Voltage Protected by SC	V <sub>D</sub> = 13.5 ~ 16.5V, Inverter Part, T <sub>j</sub> = 125°C Start	400	V
V <sub>CC(surge)</sub>	Supply Voltage (Surge)	Applied between : C1-E2, Surge value or without switching	500	V
T <sub>c</sub>	Module Case Operating Temperature	(Note-1)	-20 ~ +100	°C
T <sub>stg</sub>	Storage Temperature		-40 ~ +125	°C
V <sub>iso</sub>	Isolation Voltage	60Hz, Sinusoidal, Charged part to Base, AC 1 min.	2500	V <sub>rms</sub>

(Note-1) T<sub>c</sub> measurement point is below. (3mm depth at the center of the side of base plate)



## ELECTRICAL CHARACTERISTICS (T<sub>j</sub> = 25°C, unless otherwise noted)

### INVERTER PART

Symbol	Parameter	Test Condition	Limits			Unit
			Min.	Typ.	Max.	
V <sub>CE(sat)</sub>	Collector-Emitter Saturation Voltage	V <sub>D</sub> = 15V, I <sub>c</sub> = 400A V <sub>CIN</sub> = 0V	—	2.5	2.80	V
V <sub>EC</sub>	FWD: Forward Voltage	-I <sub>c</sub> = 400A, V <sub>D</sub> = 15V, V <sub>CIN</sub> = 5V	—	2.20	3.30	V
t <sub>on</sub>	Switching Time	V <sub>D</sub> = 15V, V <sub>CIN</sub> = 0V↔5V V <sub>CC</sub> = 300V, I <sub>c</sub> = 400A T <sub>j</sub> = 125°C Inductive Load (upper and lower arm)	0.4	0.8	2.1	μs
t <sub>rr</sub>			—	0.2	0.3	
t <sub>c(on)</sub>			—	0.3	1.1	
t <sub>off</sub>			—	1.8	2.9	
t <sub>c(off)</sub>			—	0.6	1.2	
I <sub>CES</sub>	Collector-Emitter Cutoff Current	V <sub>CE</sub> = V <sub>CES</sub> , V <sub>CIN</sub> = 5V	—	—	1	mA
			—	—	10	

### CONTROL PART

Symbol	Parameter	Test Condition	Limits			Unit	
			Min.	Typ.	Max.		
I <sub>D</sub>	Circuit Current	V <sub>D</sub> = 15V, V <sub>CIN</sub> = 5V	—	27	38	mA	
		V <sub>N1</sub> -V <sub>N3</sub> V <sub>P1</sub> -V <sub>PC</sub>	—	27	38		
V <sub>th(ON)</sub>	Input ON Threshold Voltage	Applied between : C <sub>P1</sub> -V <sub>PC</sub> , C <sub>N1</sub> -V <sub>N3</sub>	1.2	1.5	1.8	V	
V <sub>th(OFF)</sub>	Input OFF Threshold Voltage		1.7	2.0	2.3		
SC	Short Circuit Trip Level	-20 ≤ T <sub>j</sub> ≤ 125°C, V <sub>D</sub> = 15V	500	—	—	A	
t <sub>off(SC)</sub>	Short Circuit Current Delay Time	V <sub>D</sub> = 15V	—	10	—	μs	
OT	Over Temperature Protection (Lower-arms only)	Base-plate Temperature detection, V <sub>D</sub> = 15V	Trip level	111	118	125	°C
OT <sub>r</sub>			Reset level	—	100	—	
UV	Supply Circuit Under-Voltage Protection	-20 ≤ T <sub>j</sub> ≤ 125°C	Trip level	11.5	12.0	12.5	V
UV <sub>r</sub>			Reset level	—	12.5	—	
I <sub>FO(H)</sub>	Fault Output Current	V <sub>D</sub> = 15V, V <sub>FO</sub> = 15V	(Note-2)			mA	
I <sub>FO(L)</sub>			—	10	15		
t <sub>FO</sub>	Minimum Fault Output Pulse Width	V <sub>D</sub> = 15V	(Note-2)			ms	
V <sub>SXR</sub>	SXR Terminal Output Voltage	-20 ≤ T <sub>j</sub> ≤ 125°C, R <sub>in</sub> = 6.8kΩ	4.5	5.1	5.6	V	

(Note-2) Fault output is given only when the internal SC, OT & UV protection.  
 Fault output of OT protection operate by lower arm  
 Fault output of OT, UV protection given pulse while over level.

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Symbol	Parameter	Test Condition	Limits			Unit
			Min.	Typ.	Max.	
R <sub>th(j-c)Q</sub>	Junction to case Thermal Resistances	Inverter IGBT part (per 1/2 module)	—	—	0.121	°C/W
R <sub>th(j-c)F</sub>		Inverter FWDI part (per 1/2 module)	—	—	0.18	
R <sub>th(c-f)</sub>	Contact Thermal Resistance	Case to fin, Thermal grease applied (per 1/2 module)	—	—	0.075	

**MECHANICAL RATINGS AND CHARACTERISTICS**

Symbol	Parameter	Test Condition	Limits			Unit
			Min.	Typ.	Max.	
—	Mounting torque	Mounting part screw : M6	3.92	4.90	5.88	N • m
—	Mounting torque	Main terminal screw : M6	3.92	4.90	5.88	N • m
—	Weight		—	510	—	g

**RECOMMENDED CONDITIONS FOR USE**

Symbol	Parameter	Test Condition	Recommended value	Unit
V <sub>CC</sub>	Supply Voltage	Applied across C1-E2 terminals	≤ 400	V
V <sub>D</sub>	Control Supply Voltage	Applied between : V <sub>P1</sub> -V <sub>PC</sub> , V <sub>N1</sub> -V <sub>NC</sub> (Note-3)	15 ± 1.5	V
V <sub>CIN(ON)</sub>	Input ON Voltage	Applied between : C <sub>P1</sub> -V <sub>PC</sub> , C <sub>N1</sub> -V <sub>NC</sub>	≤ 0.8	V
V <sub>CIN(OFF)</sub>	Input OFF Voltage		≥ 4.0	
t <sub>dead</sub>	Arm Shoot-through Blocking Time	For IPM's each input signals	≥ 3.0	μs
f <sub>PWM</sub>	PWM Input Frequency	Using Application Circuit input signal of IPM, 3φ Sinusoidal PWM VVVF inverter	≤ 20	kHz

(Note-1) With ripple satisfying the following conditions dv/dt : dv/dt ≤ 2V/μs, Variation ≤ 2V peak to peak

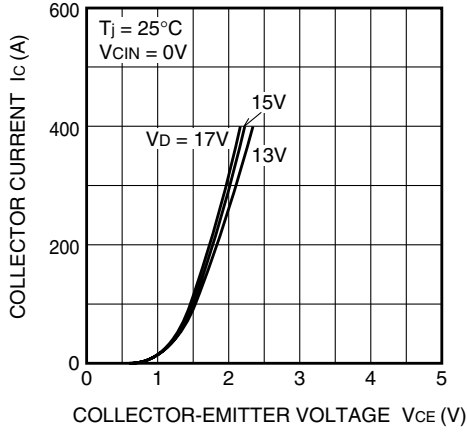
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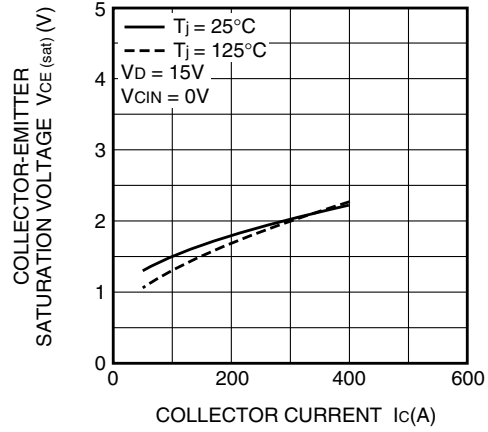
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**PERFORMANCE CURVES**

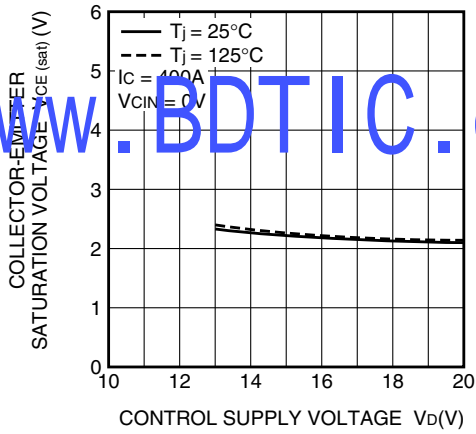
**OUTPUT CHARACTERISTICS (TYPICAL)**



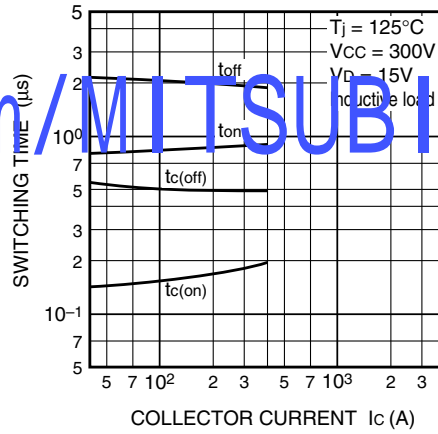
**COLLECTOR-EMITTER SATURATION VOLTAGE CHARACTERISTICS (TYPICAL)**



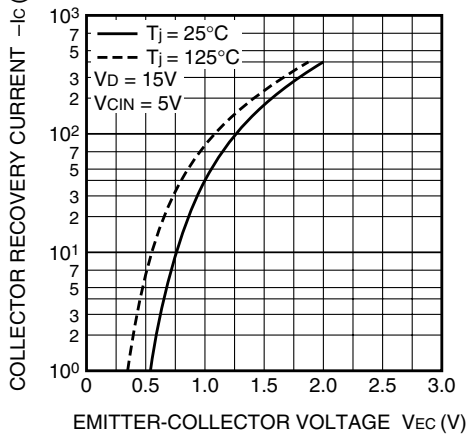
**COLLECTOR-EMITTER SATURATION VOLTAGE CHARACTERISTICS (TYPICAL)**



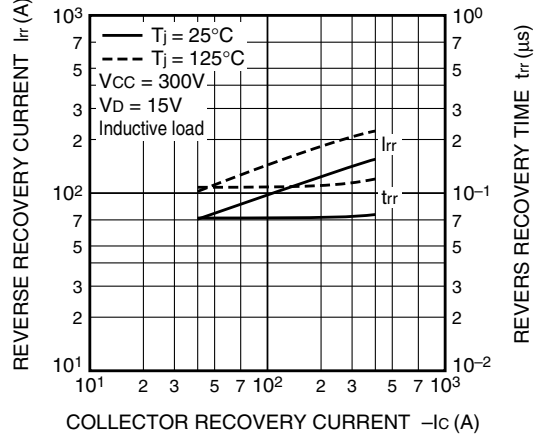
**SWITCHING CHARACTERISTICS (TYPICAL)**



**DIODE FORWARD CHARACTERISTICS (TYPICAL)**



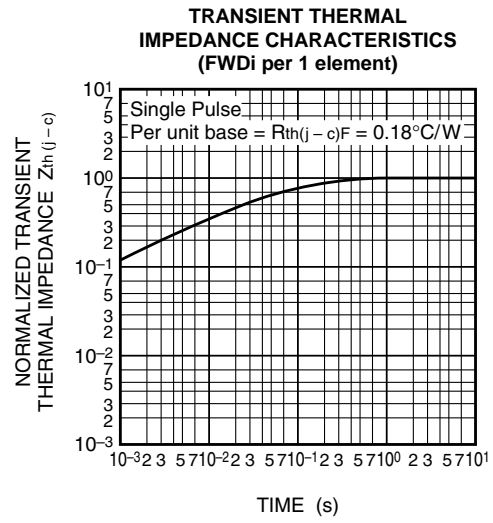
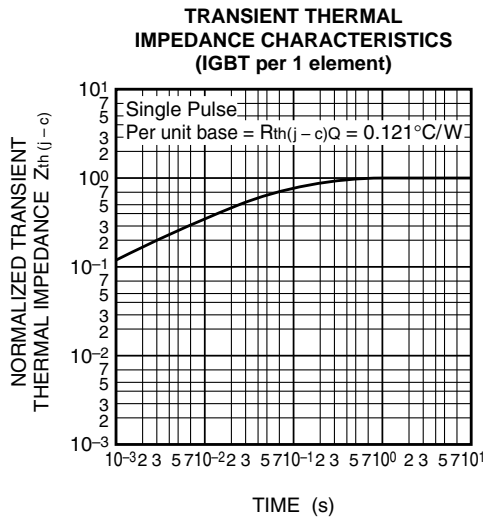
**DIODE REVERSE RECOVERY CHARACTERISTICS (TYPICAL)**



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