

# APPLICATION NOTE

# MITSUBISHI<IGBT MODULE> CP25TD1-24A

LOW POWER SWITCHING USE  
TRANSFER MOLD TYPE,INSULATED TYPE

Pre.	S.Kou, M.Seo	Rev.	
Apr.	T.Igarashi May 7, 2005		

TENTATIVE

- $I_C$ .....25A
- $V_{CES}$ .....1200V
- Insulated Type
- DIP-CIB Module
- 3ΦInverter+3ΦConverter+Brake

## APPLICATION

AC & DC motor controls, General purpose inverters

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

### Inverter Part

Symbol	Parameter	Condition	Rating	Units
$V_{CES}$	Collector-emitter voltage	G-E Short	1200	V
$V_{GES}$	Gate-emitter voltage	C-E Short	±20	V
$I_C$	Collector current	DC, T <sub>c</sub> =86° C (Note 1)	25	A
$I_{CM}$		Pulse (Note 3)	50	A
$P_C$	Maximum collector dissipation	T <sub>c</sub> =25° C	(138)	W
$I_E$ (Note2)	Emitter current	DC, T <sub>c</sub> =30° C (Note 1)	25	A
$I_{EM}$ (Note2)		Pulse (Note 3)	50	A

### Brake Part

Symbol	Parameter	Condition	Rating	Units
$V_{CES}$	Collector-emitter voltage	G-E Short	1200	V
$V_{GES}$	Gate-emitter voltage	C-E Short	±20	V
$I_C$	Collector current	DC, T <sub>c</sub> =100° C (Note 1)	15	A
$I_{CM}$		Pulse (Note 3)	30	A
$P_C$ (Note4)	Maximum collector dissipation	T <sub>c</sub> =25° C	(113)	W
$V_{RRM}$	Repetitive peak reverse voltage	Clamp diode part	1200	V
$I_{FM}$ (Note4)	Forward current	Clamp diode part	15	A

### Converter Part

Symbol	Parameter	Condition	Rating	Units
$V_{RRM}$	Repetitive peak reverse voltage		1600	V
$E_a$	Recommended AC input voltage		440	V
$I_O$	DC output current	3Φ rectifying circuit	25	A
$I_{FSM}$	Surge forward current	1/2cycle at 60Hz,Peak value Non-repetitive	(250)	A
$I^2t$	$I^2t$ for fusing	Value for 1cycle of surge current	(260)	A <sup>2</sup> s

## CP25TD1-24A

LOW POWER SWITCHING USE  
TRANSFER MOLD TYPE, INSULATED TYPE

## Common Rating

Symbol	Parameter	Condition	Rating	Units
T <sub>j</sub>	junction temperature (Note 5)	Inverter, brake, converter part	-20 ~ 125	°C
T <sub>stg</sub>	Storage temperature		-20 ~ 125	°C
Viso	Isolation voltage	60Hz, Sinusoidal AC 1 min. Applied between pins and heat-sink	2500	V <sub>rms</sub>
-	Mounting torque	Screw: M4   Recommended: 1.18N·m	(0.98~1.47)	N·m
-	Weight	Typical value	52	g

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

## Inverter Part

Symbol	Parameter	Conditions	Characteristics			Units
			Min.	Typ.	Max.	
I <sub>CES</sub>	Collector cutoff current	V <sub>CE</sub> =V <sub>CES</sub> , V <sub>GE</sub> =0V	—	—	1	mA
V <sub>GE(th)</sub>	Gate emitter threshold voltage	I <sub>C</sub> =2.5mA, V <sub>CE</sub> =10V	6.5	7.5	8.5	V
I <sub>GES</sub>	Gate emitter cutoff current	V <sub>GE</sub> =20V, V <sub>CE</sub> =0V	—	—	1	μA
V <sub>CE(sat)</sub>	Collector emitter saturation voltage	I <sub>C</sub> =25A	—	1.8	(2.5)	V
		V <sub>GE</sub> =15V (Note6) T <sub>j</sub> =125° C	—	2.0	—	
C <sub>ies</sub>	Input capacitance	V <sub>CE</sub> =10V, V <sub>GE</sub> =0V f=1MHz	—	—	(4.94)	nF
C <sub>oes</sub>	Output Capacitance		—	—	(0.34)	
C <sub>res</sub>	Reverse transfer capacitance		—	—	(0.10)	
Q <sub>G</sub>	Total gate charge	V <sub>CC</sub> =600V, I <sub>C</sub> =25A, V <sub>GE</sub> =15V	—	(167)	—	nC
td(on)	Turn-on delay time	V <sub>CC</sub> =600V, I <sub>C</sub> =25A V <sub>GE</sub> =15V, R <sub>G</sub> =13Ω T <sub>j</sub> =25° C	—	—	100	ns
t <sub>r</sub>	Turn-on rise time		—	—	75	
td(off)	Turn-off delay time		—	—	300	
t <sub>f</sub>	Turn-off fall time		Inductive load	—	—	
V <sub>EC (Note1)</sub>	Emitter-collector voltage	I <sub>E</sub> =25A, V <sub>GE</sub> =0V	—	3.2	4.4	V
t <sub>rr (Note1)</sub>	Reverse recovery time	V <sub>CC</sub> =600V, I <sub>C</sub> =25A, V <sub>GE</sub> =0V	—	200	—	ns
Q <sub>rr (Note1)</sub>	Reverse recovery charge	R <sub>G</sub> =13Ω, T <sub>j</sub> =25° C	—	0.5	—	μC
R <sub>th(j-c)Q</sub>	Thermal resistance	IGBT part, per 1/6 module	—	—	(0.9)	°C/W
R <sub>th(j-c)R</sub>		FWDi part, per 1/6 module	—	—	(1.5)	
R <sub>g</sub>	External gate resistance		13	—	130	Ω

**Brake Part**

Symbol	Parameter	Conditions	Characteristics			Units
			Min.	Typ.	Max.	
$I_{CES}$	Collector cutoff current	$V_{CE}=V_{CES}, V_{GE}=0V$	—	—	1	mA
$V_{GE(th)}$	Gate emitter threshold voltage	$I_C=1.5mA, V_{CE}=10V$	6.5	7.5	8.5	V
$I_{GES}$	Gate emitter cutoff current	$V_{GE}=20V, V_{CE}=0V$	—	—	1	$\mu A$
$V_{CE(sat)}$	Collector emitter saturation voltage	$I_C=15A$	—	1.8	(2.5)	V
		$V_{GE}=15V$ (Note6)	—	2.0	—	
$C_{ies}$	Input capacitance	$V_{CE}=25V, V_{GE}=0V$ $f=1MHz$	—	—	(3.14)	nF
$C_{oes}$	Output Capacitance		—	—	(0.22)	
$C_{res}$	Reverse transfer capacitance		—	—	(0.06)	
$Q_G$	Total gate charge	$V_{CC}=600V, I_C=15A, V_{GE}=15V$	—	(100)	—	nC
$t_{d(on)}$	Turn-on delay time	$V_{CC}=600V, I_C=15A$ $V_{GE}=15V, R_G=22\Omega$ $T_j=25^\circ C$ Inductive load	—	—	100	ns
$T_r$	Turn-on rise time		—	—	75	
$t_{d(off)}$	Turn-off delay time		—	—	300	
$T_f$	Turn-off fall time		—	—	400	
$V_{FM}$	Forward voltage drop	$I_F=15A, \text{Clamp diode part}$	—	2.7	3.5	V
$T_{rr}$	Reverse recovery time	$V_{CC}=600V, I_C=15A, V_{GE}=15V,$ $R_G=22\Omega, T_j=25^\circ C$	—	200	—	ns
$Q_{rr}$	Reverse recovery charge		—	0.3	—	$\mu C$
$R_{th(j-c)Q}$	Thermal resistance	IGBT part	—	—	(1.1)	$^\circ C/W$
$R_{th(j-c)R}$		FWDi part	—	—	(1.4)	
$R_g$	External gate resistance		22	—	220	$\Omega$

**Converter Diode Part**

Symbol	Parameter	Conditions	Characteristics			Units
			Min.	Typ.	Max.	
$I_{RRM}$	Repetitive reverse current	$V_R=V_{RRM}, T_j=125^\circ C$	—	—	(1.0)	mA
$V_{FM}$	Forward voltage drop	$I_F=25A$	—	1.7	2.1	V
$R_{th(j-c)}$	Thermal resistance	Per 1/6 module	—	—	(1.0)	$^\circ C/W$

**NTC Thermistor Part**

Symbol	Parameter	Conditions	Characteristics			Units
			Min.	Typ.	Max.	
$R_{TH}$	Resistance	$T_c=25^\circ C$	(9.5)	10.0	(10.5)	k $\Omega$
$B_{(25/100)}$	B Constant	Resistance at $25^\circ C, 100^\circ C$ (Note 7)	—	3450	—	K

**Common Rating**

Symbol	Parameter	Conditions	Characteristics			Units
			Min.	Typ.	Max.	
$R_{th(c-f)}$	Contact thermal resistance	Case to fin, thermal compound applied (1module)	—	—	—	$^\circ C/W$

Note1  $T_c$  is measured at the position just underneath the power chip.

Note2  $I_E, V_{EC}, t_{rr}$ , and  $Q_{rr}$  represent characteristics of the anti-parallelled emitter to collector free-wheel diode(FWDi).

Note3. Pulse width and repetition rate should be such that the device junction temp.( $T_j$ ) does not exceed  $T_{jmax}$  rating.

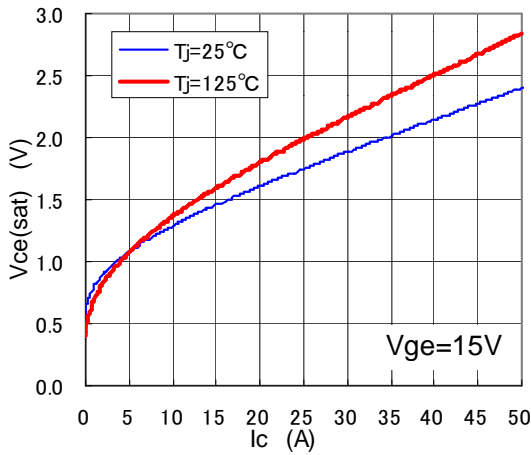
Note4 Junction temperature( $T_j$ ) should not increase beyond  $150^\circ C$

Note5 The maximum junction temperature rating of the power chips integrated inside DIP-CIB is  $150^\circ C$ . However, to ensure safe operation of DIP-CIB, the average junction temperature should be limited to below  $125^\circ C$

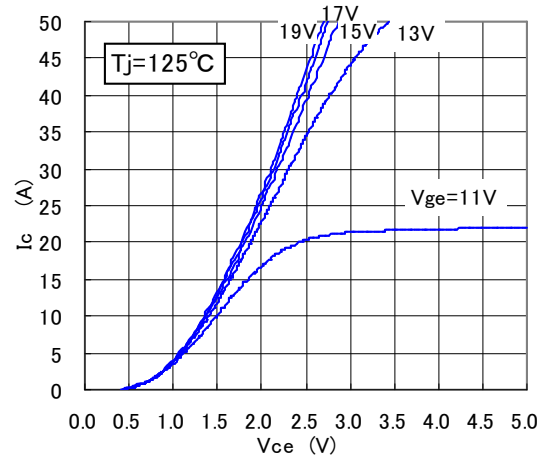
Note6 Pulse width and repetition rate should be such as to cause negligible temperature rise.

Note7  $B = (\ln R_1 - \ln R_2) / (1/T_1 - 1/T_2)$  where  $R_1$  is the resistance at  $T_1(K)$ ,  $R_2$  the resistance at  $T_2(K)$

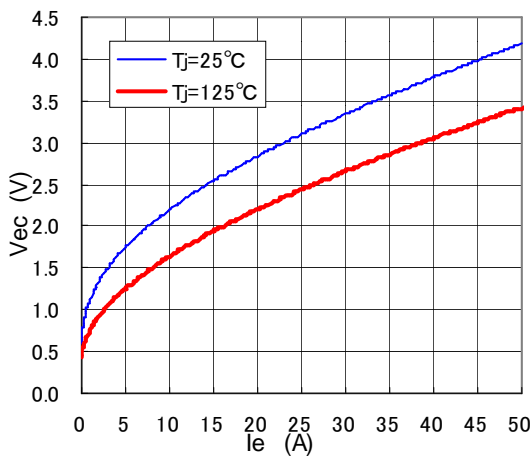
Performance Curves (Typical)



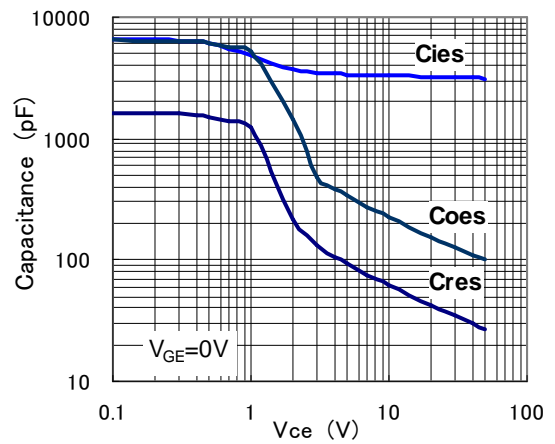
Inverter IGBT output characteristics



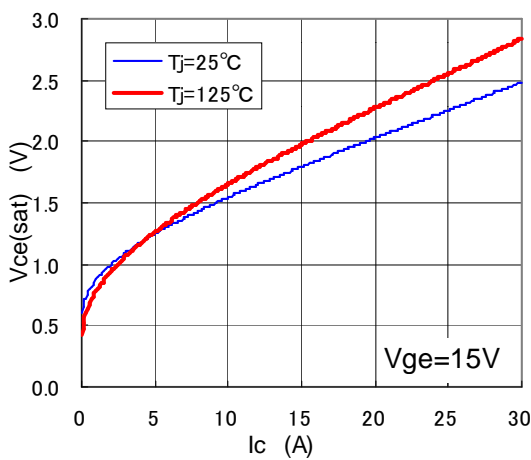
Inverter IGBT output characteristics



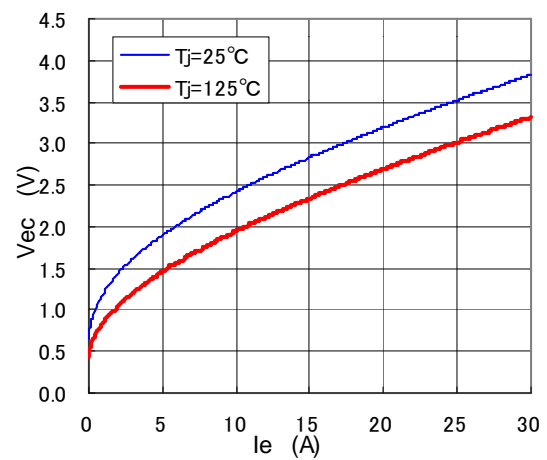
Inverter FWD forward characteristics



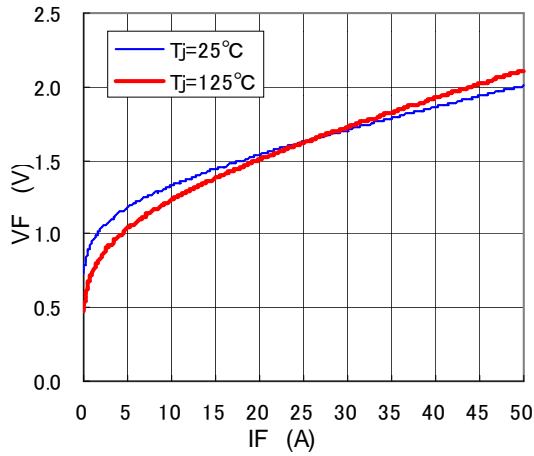
Inverter IGBT capacitance characteristics



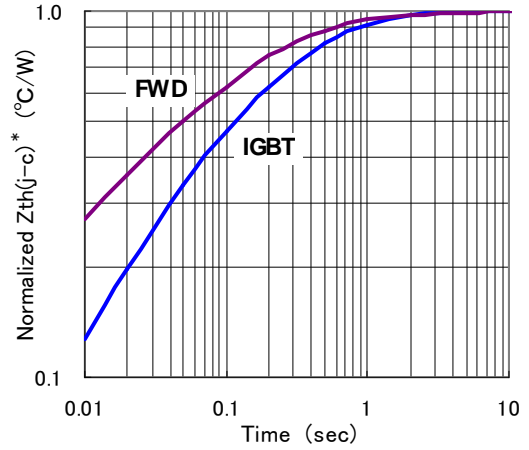
Brake-chopper IGBT output characteristics



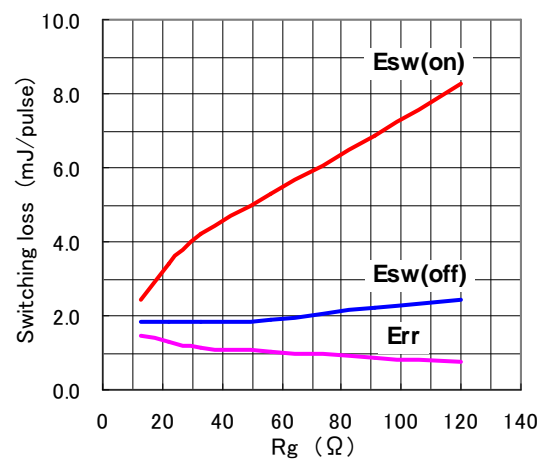
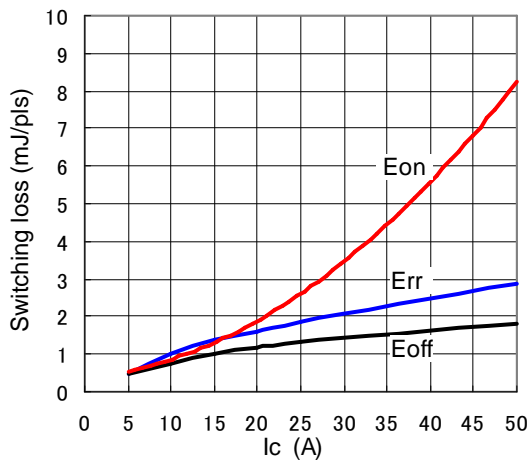
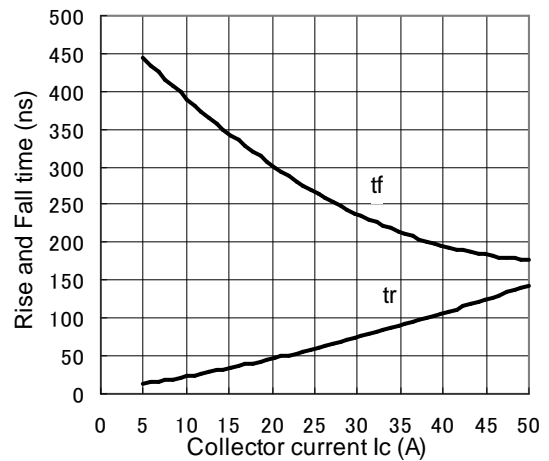
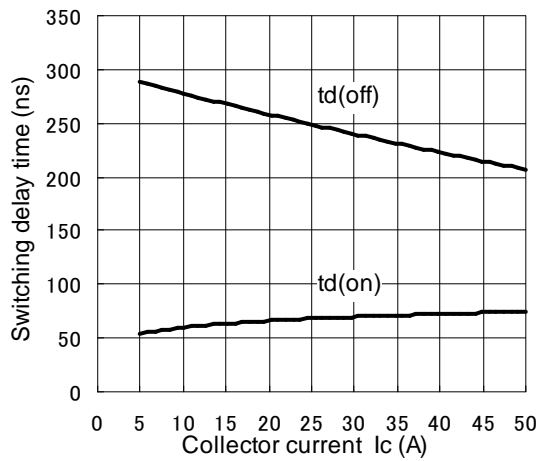
Brake-clamp FWD forward characteristics



Converter diode forward characteristics

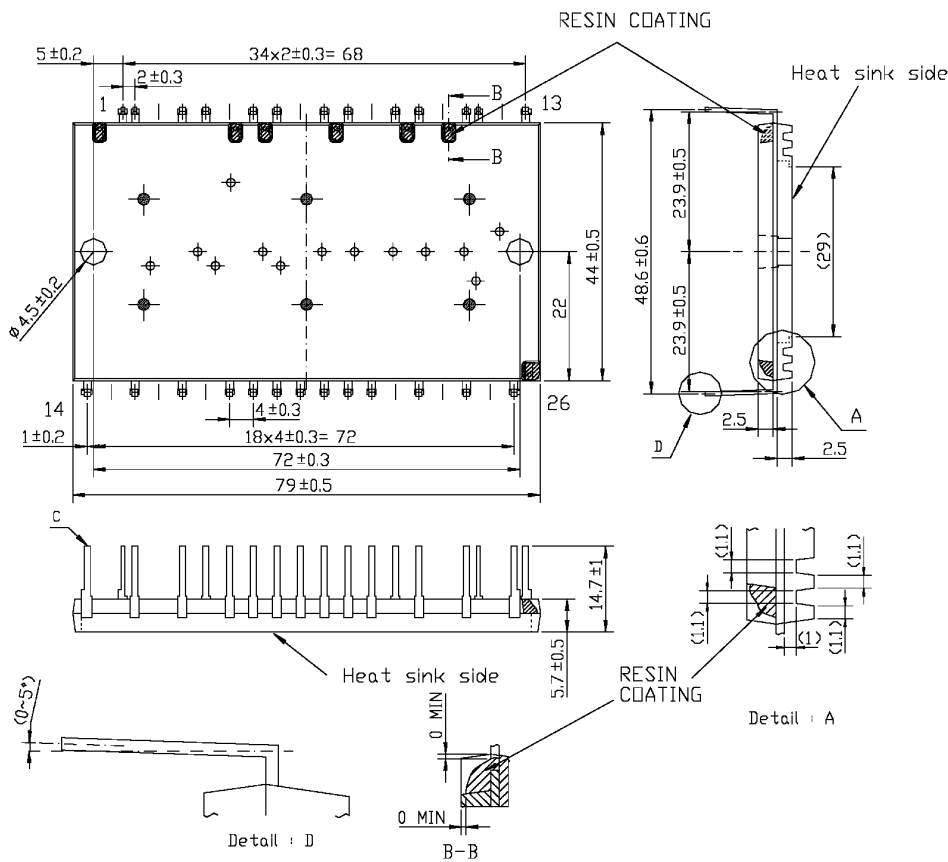


Inverter part transient thermal impedance



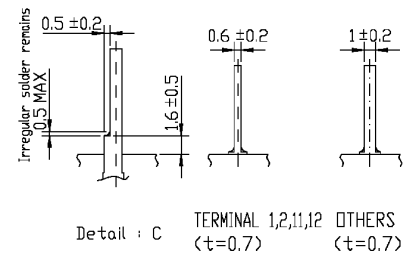
Note: Switching test condition: Vcc=600V, V<sub>D</sub>=15V, R<sub>G</sub>=13Ω, T<sub>J</sub>=125°C, Inductive load.

Outline Drawing



TERMINAL CODE

- |          |         |
|----------|---------|
| 1. TH1   | 15. S   |
| 2. TH2   | 16. T   |
| 3. P1    | 17. N1  |
| 4. P     | 18. GUN |
| 5. GUP   | 19. UN  |
| 6. EUP   | 20. GVN |
| 7. GVP   | 21. VN  |
| 8. EVP   | 22. GWN |
| 9. GWP   | 23. WN  |
| 10. EWP  | 24. U   |
| 11. GB   | 25. V   |
| 12. N(B) | 26. W   |
| 13. B    |         |
| 14. R    |         |



Circuit Diagram

