SECURITY CODE	A	MITSUBISHI ELECTRIC CORPORATION								
Spec. NAME	Prepared by	S.Iura	REV	F	S.Iura	G	S.Iura	H	S.Iura
Customer's Std. Spec.	Checked by	H.Yamaguchi			I.Umezaki		I.Umezaki		I.Umezaki
	Approved by	M.Yamamoto			H.Yamaguchi		H.Yamaguchi		H.Yamaguchi
	DATE	7-Oct.-2002			18-May-2004		20-May-2004		5-Oct.-2004

HIGH VOLTAGE IGBT MODULE TARGET SPECIFICATION

1. **Type Number** — CM600HG-130H
2. **Structure** — Flat base type (Insulated package, AlSiC base plate)
3. **Application & Customer** — High power converters & Inverters for traction application
4. **Outline** — See Fig. 1
5. **Related Specifications**

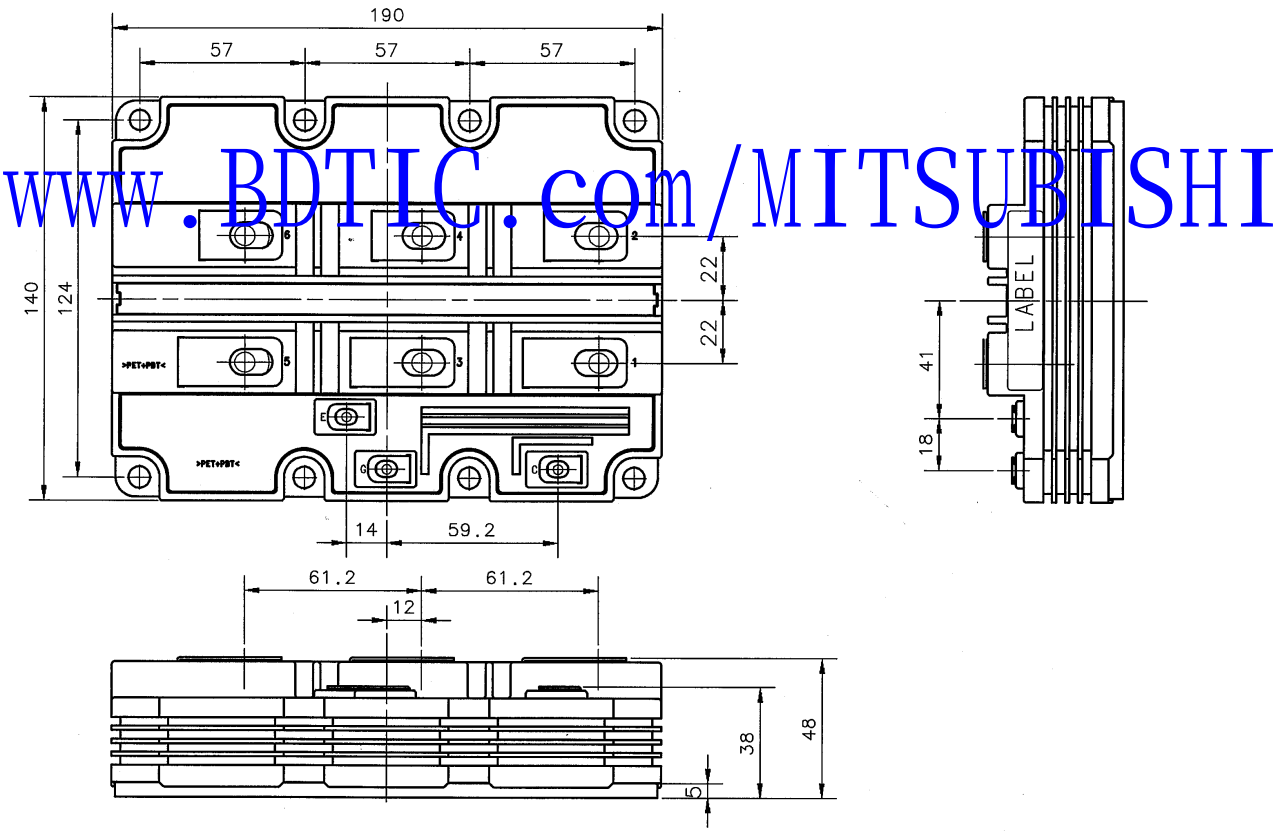


Fig. 1 - Outline drawing

6. Maximum Ratings

Item	Symbol	Conditions	Ratings	Unit
6.1 Collector-emitter voltage	V_{CES}	V_{GE} = 0 V, T_j = −40 °C	5800	V
		V_{GE} = 0 V, T_j = +25 °C	6300	
		V_{GE} = 0 V, T_j = +125 °C	6500	
6.2 Gate-emitter voltage	V_{GES}	V_{CE} = 0 V, T_j = 25 °C	± 20	V
6.3 Collector current	I_C	DC, T_c = 80 °C	600	A
	I_{CM}	Pulse (note 1)	1200	
6.4 Emitter current (note 2)	I_E		600	A
	I_{EM}	Pulse (note 1)	1200	
6.5 Maximum Collector dissipation	P_C	T_c = 25 °C, IGBT part (note 3)	8900	W
6.6 Isolation voltage	V_{iso}	Charged part to the baseplate RMS sinusoidal, 60Hz 1min.	10200	V
6.7 Partial discharge	Q_{pd}	V_1 = 6900 V_{rms}, V_2 = 5100 V_{rms} 60 Hz (acc. to IEC 1287)	10	pC
6.8 Junction temperature	T_j	—	−40 ~ +150	°C
6.9 Storage temperature	T_{stg}	—	−40 ~ +125	°C
6.10 Operating temperature	T_{op}	—	−40 ~ +125	°C
6.11 Maximum turn-off switching current	—	V_{CC} ≤ 4500 V V_{GE} = ±15 V, T_j = 125 °C [See Fig. 2 (a)]	1200	A
6.12 Short circuit capability (maximum pulse width)	—	V_{CC} ≤ 4500 V V_{GE} = ±15 V, T_j = 125 °C [See Fig. 2 (b)]	10	µs
6.13 Maximum reverse recovery instantaneous power (note 2)	—	V_{CC} ≤ 4500 V di_e/dt ≤ 3000 A/µs, T_j = 125 °C [See Fig. 2 (a)]	3600	kW

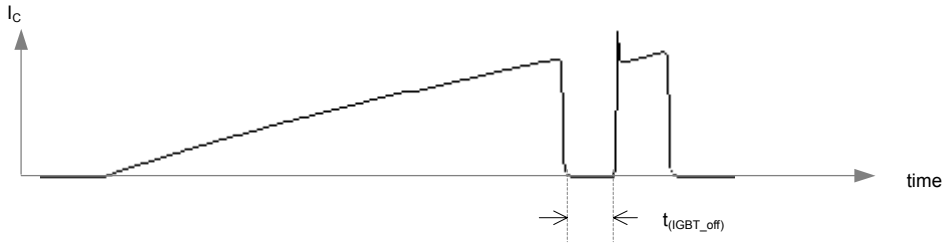
Note 1. Pulse width and repetition rate should be such that junction temperature (T_j) does not exceed T_{opmax} rating (125°C).
Note 2. The symbols represent characteristics of the anti-parallel, emitter to collector free-wheel diode (FWDi).
Note 3. Junction temperature (T_j) should not exceed T_{jmax} rating (150°C).

7. Electrical Characteristics

Item	Symbol	Conditions		Limits			Unit
				Min.	Typ.	Max.	
7.1 Collector cutoff current	I_{CES}	V_{CE} = V_{CES} V_{GE} = 0 V	T_j = 25 °C	—	—	10	mA
			T_j = 125 °C	—	30	90	
7.2 Gate-emitter threshold voltage	$V_{GE(th)}$	I_C = 60 mA, V_{CE} = 10 V T_j = 25 °C		5.0	6.0	7.0	V
7.3 Gate leakage current	I_{GES}	V_{GE} = V_{GES}, V_{CE} = 0 V T_j = 25 °C		—	—	0.5	µA

Item	Symbol	Conditions		Limits Min.	Limits Typ.	Limits Max.	Unit
7.4 Collector-emitter saturation voltage	$V_{CE(sat)}$	I_C = 600 A (note 4), V_{GE} = 15 V	T_j = 25 °C	—	5.10	—	V
			T_j = 125 °C	—	5.00	—	
7.5 Input capacitance	C_{ies}	V_{CE} = 10 V, V_{GE} = 0 V, f = 100 kHz, T_j = 25 °C		—	124	—	nF
7.6 Output capacitance	C_{oes}	V_{CE} = 10 V, V_{GE} = 0 V, f = 100 kHz, T_j = 25 °C		—	7.6	—	nF
7.7 Reverse transfer capacitance	C_{res}	V_{CE} = 10 V, V_{GE} = 0 V, f = 100 kHz, T_j = 25 °C		—	2.2	—	nF
7.8 Total gate charge	Q_G	V_{CC} = 3600 V, I_C = 600 A, V_{GE} = 15 V, T_j = 25 °C		—	9.9	—	μC
7.9 Emitter-collector voltage (note 2)	V_{EC}	I_E = 600 A (note 4), V_{GE} = 0 V	T_j = 25 °C	—	4.00	—	V
			T_j = 125 °C	—	3.60	—	
7.10 Turn-on delay time	$t_{d(on)}$	V_{CC} = 3600 V, I_C = 600 A, V_{GE1} = −V_{GE2} = 15 V, $R_{G(on)}$ = 10 Ω, T_j = 125 °C, t_{off} = 60 μs (note 5), Inductive load, [See Fig. 2 (a), Fig. 3]		—	1.20	—	μs
7.11 Turn-on rise time	t_r			—	0.35	—	μs
7.12 Turn-on switching energy	E_{on}			—	4.50	—	J/P
7.13 Turn-off delay time	$t_{d(off)}$	V_{CC} = 3600 V, I_C = 600 A, V_{GE1} = −V_{GE2} = 15 V, $R_{G(on)}$ = 24 Ω, T_j = 125 °C, $t_{(IGBT\_off)}$ = 60 μs (note 5), Inductive load, [See Fig. 2 (a), Fig. 3]		—	6.60	—	μs
7.14 Turn-off fall time	t_{f1}			—	0.50	—	μs
7.15 Turn-off fall time	t_{f2}			—	3.30	—	μs
7.16 Turn-off switching energy	E_{off}			—	3.50	—	J/P
7.17 Reverse recovery time (note 2)	t_{rr1}	V_{CC} = 3600 V, I_E = 600 A, di_e/dt = −2000 A/μs, T_j = 125 °C, t_{off} = 60 μs (note 5), Inductive load, [See Fig. 2 (a), Fig. 4]		—	1.00	—	μs
7.18 Reverse recovery time (note 2)	t_{rr2}			—	2.40	—	μs
7.19 Reverse recovery charge (note 2)	Q_{rr}			—	1100	—	μC
7.20 Reverse recovery energy (note 2)	E_{rec}			—	2.00	—	J/P

Note 4. Pulse width and repetition rate should be such as to cause negligible temperature rise.
Note 5. $t_{(IGBT\_off)}$ definition is shown as follows.



8. Thermal Characteristics

Item	Symbol	Conditions	Limits			Unit
			Min.	Typ.	Max.	
8.1 Thermal resistance	$R_{th(j-c)Q}$	Junction to case IGBT part	—	—	14.0	K/kW
8.2 Thermal resistance (note 2)	$R_{th(j-c)R}$	Junction to case FWDi part	—	—	22.0	K/kW
8.3 Contact thermal resistance	$R_{th(c-f)}$	Case to fin (note 6) Conductive grease applied	—	6.0	—	K/kW

Note 6. Thermal conductivity is 1W/mK with a thickness of 100μm.

9. Mechanical Characteristics

Item	Symbol	Conditions	Limits			Unit
			Min.	Typ.	Max.	
9.1 Mounting torque	—	Main terminal screw : M8	7.0	—	15.0	N·m
9.2 Mounting torque	—	Mounting screw : M6	3.0	—	6.0	N·m
9.3 Mounting torque	—	Auxiliary terminal screw : M4	1.0	—	3.0	N·m
9.4 Mass	—	—	—	1.35	—	kg
9.5 Comparative tracking index	CTI	—	600	—	—	—
9.6 Clearance	—	—	26.0	—	—	mm
9.7 Creepage distance	—	—	56.0	—	—	mm
9.8 Internal inductance	$L_{C-E(int)}$	—	—	18	—	nH
9.9 Internal lead resistance	$R_{C-E(int)}$	T_c = 25 °C	—	0.18	—	mΩ

10. Shipping Inspection Report Item (note 7)

Static characteristics : I_{CES} [7.1], $V_{GE(th)}$ [7.2], I_{GES} [7.3], $V_{CE(sat)}$ [7.4], V_{EC} [7.9]

Switching characteristics : $t_{d(on)}$ [7.10], t_r [7.11], $t_{d(off)}$ [7.13], t_f [7.14], Short circuit current [6.11]

Note 7. One shipping inspection report with the above item values is submitted when modules are delivered. The conductions are defined in bracket.

11. Test Circuit & Definition of Switching Characteristics

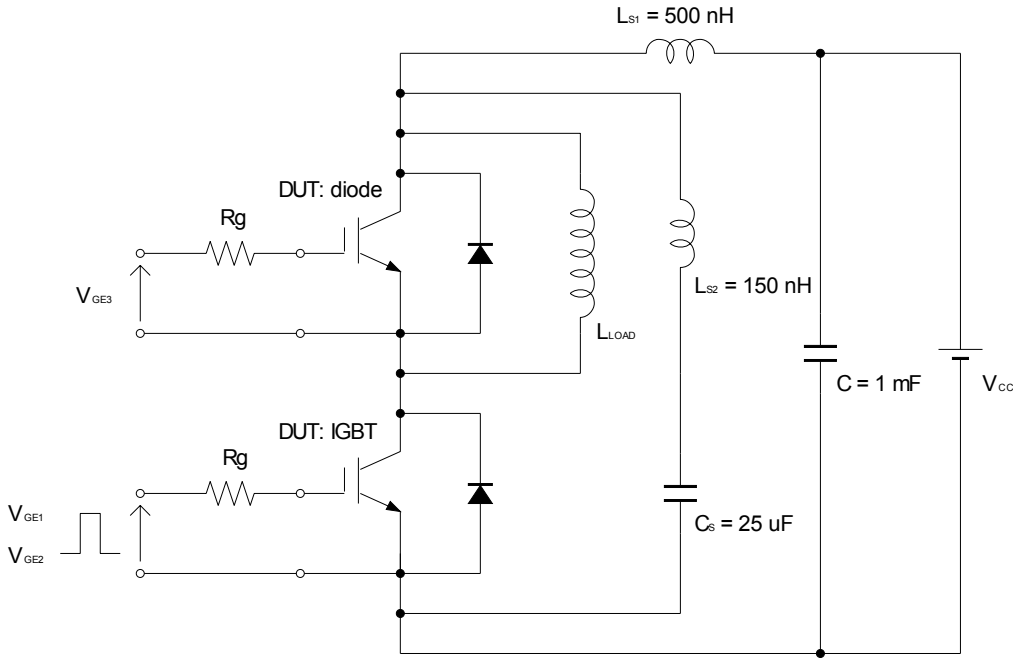


Fig. 2 (a) – Switching test circuit

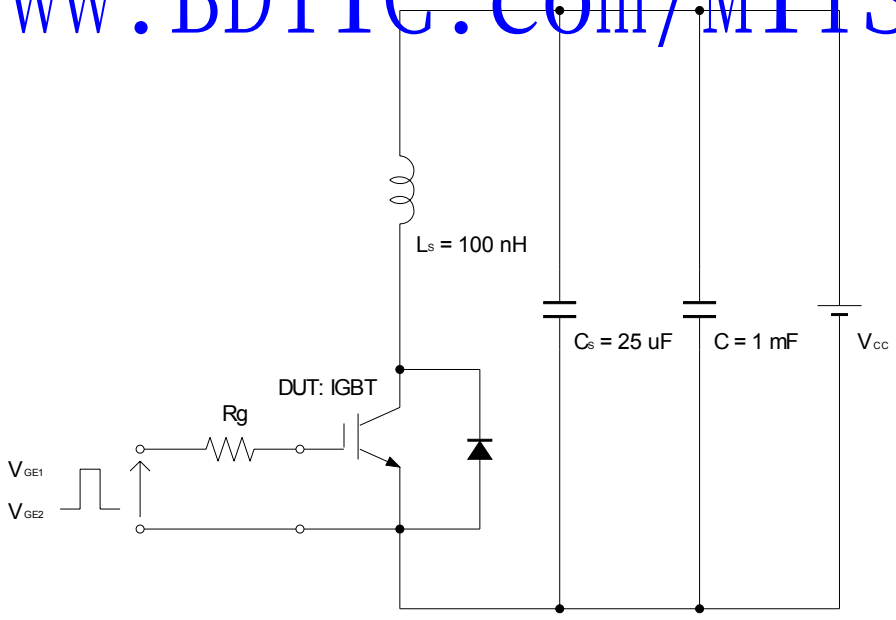
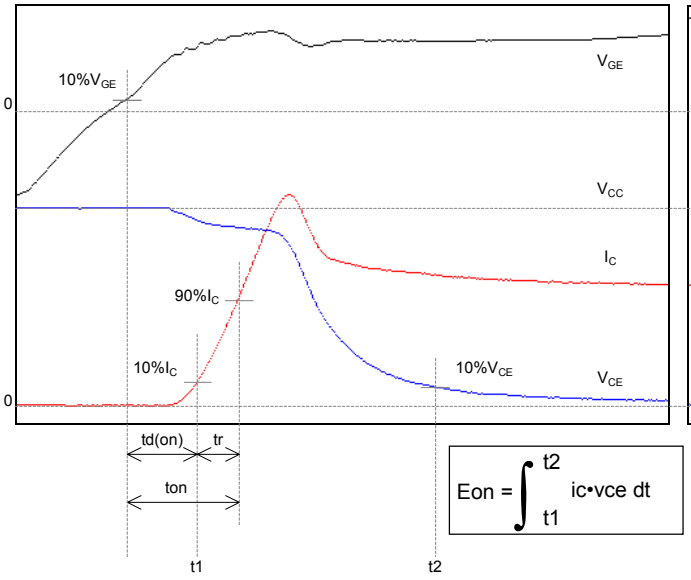


Fig. 2 (b) – Short circuit test circuit

IGBT part: turn-on switching



IGBT part: turn-off switching

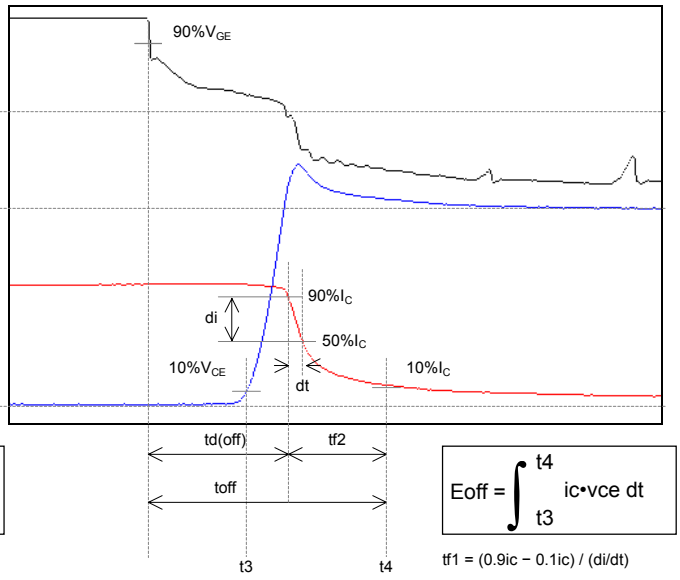
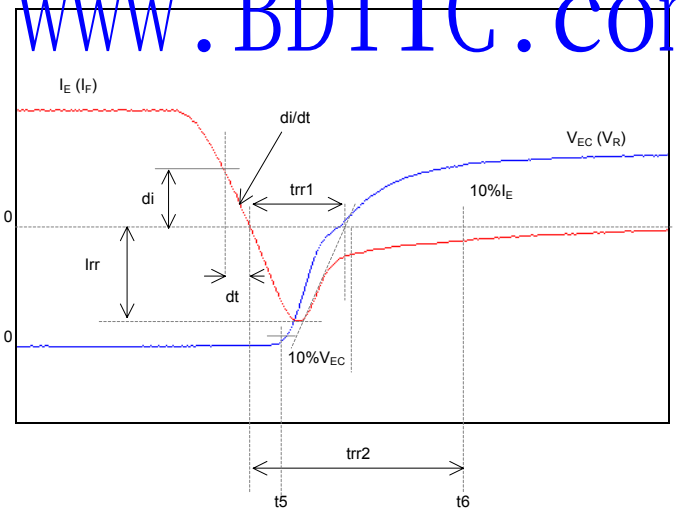


Fig. 3 – Definitions of switching times & energies of IGBT part

Diode part: reverse recovery



$$Qrr = -\int_{0}^{t6} ie\ dt$$

$$Erec = -\int_{t5}^{t6} ie \bullet vec\ dt$$

Fig. 4 – Definitions of reverse recovery charge & energy of FWDi part

Rev. No.	Summary of changes	Signature & date
−	Original	S.Iura 7-Oct.-2002
A	The following items changed. 6.1, 6.3, 6.4	S.Iura 20-Dec.-2002
B	The following item changed. 6.3 The following item added. 6.6	S.Iura 31-Mar.-2003
C	The following items changed. 7.4, 7.9, 7.17 The following items added. 6.11, 6.12, 6.13, 7.10, 7.11, 7.12, 7.13, 7.14, 7.15, 8.3, 9.1, 9.2, 9.3, 9.4, 9.5, 9.6, 9.7, 10	S.Iura 10-Dec.-2003
D	The following items changed. 4, 7.9, 7.10, 7.11, 7.14, 7.15, 7.16, 7.17, 7.18 The following items added. 7.5, 7.6, 7.7, 10	S.Iura 22-Jan.-2004
E	The following items changed. 7.4, 7.9, 7.16 The following items added. 7.14, 7.17, 9.9, Note 5, Fig. 2 (a), Fig. 2 (b)	S.Iura 26-Jan.-2004
F	The following items changed. 7.13, 7.15, 7.16, 7.20 The following items added. 9.8	S.Iura 17-May-2004
G	The following item changed. 6.13	S.Iura 20-May-2004
H	The following items changed. 7.2, 7.4, 7.8, 7.9, 7.13, 7.15, 7.16, 7.19, 7.20, 8.2, 9.1, 9.3, 9.4	S.Iura 1-Oct.-2004