

SECURITY CODE	A
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MITSUBISHI ELECTRIC CORPORATION

Spec. NAME	Prepared by	S.lura	R E V	F	S.lura	G	S.lura	H	S.lura
Customer's Std. Spec.	Checked by	H.Yamaguchi		I.Umezaki	I.Umezaki				
	Approved by	M.Yamamoto		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**

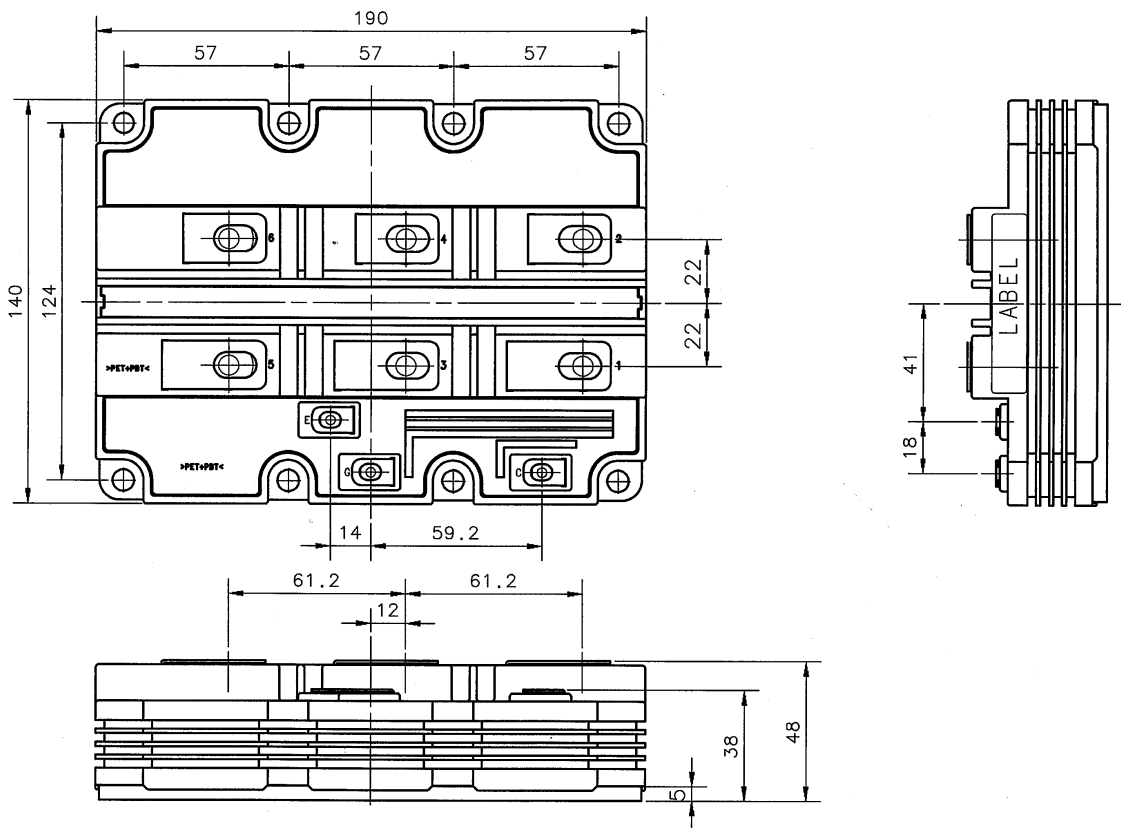


Fig. 1 - Outline drawing

6. Maximum Ratings

Item	Symbol	Conditions	Ratings	Unit
6.1 Collector-emitter voltage	V_{CES}	$V_{GE} = 0 \text{ V}, T_j = -40 \text{ }^\circ\text{C}$	5800	V
		$V_{GE} = 0 \text{ V}, T_j = +25 \text{ }^\circ\text{C}$	6300	
		$V_{GE} = 0 \text{ V}, T_j = +125 \text{ }^\circ\text{C}$	6500	
6.2 Gate-emitter voltage	V_{GES}	$V_{CE} = 0 \text{ V}, T_j = 25 \text{ }^\circ\text{C}$	± 20	V
6.3 Collector current	I_C	DC, $T_c = 80 \text{ }^\circ\text{C}$	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	$T_c = 25 \text{ }^\circ\text{C}$, 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}	$V_1 = 6900 \text{ V}_{rms}, V_2 = 5100 \text{ V}_{rms}$ 60 Hz (acc. to IEC 1287)	10	pC
6.8 Junction temperature	T_j	—	-40 ~ +150	$^\circ\text{C}$
6.9 Storage temperature	T_{stg}	—	-40 ~ +125	$^\circ\text{C}$
6.10 Operating temperature	T_{op}	—	-40 ~ +125	$^\circ\text{C}$
6.11 Maximum turn-off switching current	—	$V_{CC} \leq 4500 \text{ V}$ $V_{GE} = \pm 15 \text{ V}, T_j = 125 \text{ }^\circ\text{C}$ [See Fig. 2 (a)]	1200	A
6.12 Short circuit capability (maximum pulse width)	—	$V_{CC} \leq 4500 \text{ V}$ $V_{GE} = \pm 15 \text{ V}, T_j = 125 \text{ }^\circ\text{C}$ [See Fig. 2 (b)]	10	μs
6.13 Maximum reverse recovery instantaneous power ^(note 2)	—	$V_{CC} \leq 4500 \text{ V}$ $di_e/dt \leq 3000 \text{ A}/\mu\text{s}, T_j = 125 \text{ }^\circ\text{C}$ [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 $^\circ\text{C}$).

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 $^\circ\text{C}$).

7. Electrical Characteristics

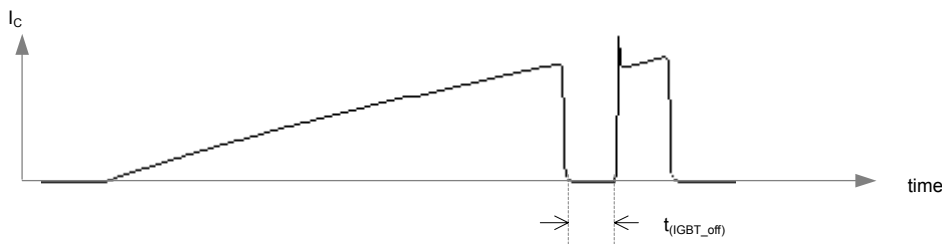
Item	Symbol	Conditions	Limits			Unit	
			Min.	Typ.	Max.		
7.1 Collector cutoff current	I_{CES}	$V_{CE} = V_{CES}$ $V_{GE} = 0 \text{ V}$	$T_j = 25 \text{ }^\circ\text{C}$	—	—	10	mA
			$T_j = 125 \text{ }^\circ\text{C}$	—	30	90	
7.2 Gate-emitter threshold voltage	$V_{GE(th)}$	$I_C = 60 \text{ mA}, V_{CE}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

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Item	Symbol	Conditions	Limits			Unit	
			Min.	Typ.	Max.		
7.4 Collector-emitter saturation voltage	$V_{CE(sat)}$	$I_C = 600\text{ A}$ (note 4) $V_{GE} = 15\text{ V}$	$T_j = 25\text{ }^\circ\text{C}$	—	5.10	—	V
			$T_j = 125\text{ }^\circ\text{C}$	—	5.00	—	
7.5 Input capacitance	C_{ies}	$V_{CE} = 10\text{ V}, V_{GE} = 0\text{ V}$ $f = 100\text{ kHz}, T_j = 25\text{ }^\circ\text{C}$	—	124	—	nF	
7.6 Output capacitance	C_{oes}	$V_{CE} = 10\text{ V}, V_{GE} = 0\text{ V}$ $f = 100\text{ kHz}, T_j = 25\text{ }^\circ\text{C}$	—	7.6	—	nF	
7.7 Reverse transfer capacitance	C_{res}	$V_{CE} = 10\text{ V}, V_{GE} = 0\text{ V}$ $f = 100\text{ kHz}, T_j = 25\text{ }^\circ\text{C}$	—	2.2	—	nF	
7.8 Total gate charge	Q_G	$V_{CC} = 3600\text{ V}, I_C = 600\text{ A}$ $V_{GE} = 15\text{ V}, T_j = 25\text{ }^\circ\text{C}$	—	9.9	—	μC	
7.9 Emitter-collector voltage (note 2)	V_{EC}	$I_E = 600\text{ A}$ (note 4) $V_{GE} = 0\text{ V}$	$T_j = 25\text{ }^\circ\text{C}$	—	4.00	—	V
			$T_j = 125\text{ }^\circ\text{C}$	—	3.60	—	
7.10 Turn-on delay time	$t_{d(on)}$	$V_{CC} = 3600\text{ V}, I_C = 600\text{ A}$ $V_{GE1} = -V_{GE2} = 15\text{ V}$ $R_{G(on)} = 10\ \Omega, T_j = 125\text{ }^\circ\text{C}$ $t_{off} = 60\ \mu\text{s}$ (note 5) Inductive load	—	1.20	—	μs	
7.11 Turn-on rise time	t_r		—	0.35	—	μs	
7.12 Turn-on switching energy	E_{on}	[See Fig. 2 (a), Fig. 3]	—	4.50	—	J/P	
7.13 Turn-off delay time	$t_{d(off)}$	$V_{CC} = 3600\text{ V}, I_C = 600\text{ A}$ $V_{GE1} = -V_{GE2} = 15\text{ V}$ $R_{G(off)} = 24\ \Omega, T_j = 125\text{ }^\circ\text{C}$ $t_{(IGBT_off)} = 60\ \mu\text{s}$ (note 5) Inductive load	—	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}	[See Fig. 2 (a), Fig. 3]	—	3.50	—	J/P	
7.17 Reverse recovery time (note 2)	t_{rr1}	$V_{CC} = 3600\text{ V}, I_E = 600\text{ A}$ $di_e/dt = -2000\text{ A}/\mu\text{s}$ $T_j = 125\text{ }^\circ\text{C}$ $t_{off} = 60\ \mu\text{s}$ (note 5) Inductive load	—	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}	[See Fig. 2 (a), Fig. 4]	—	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 100 μ m.

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	$R_{C-E(int)}$	$T_c = 25\text{ }^\circ\text{C}$	—	0.18	—	m Ω

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

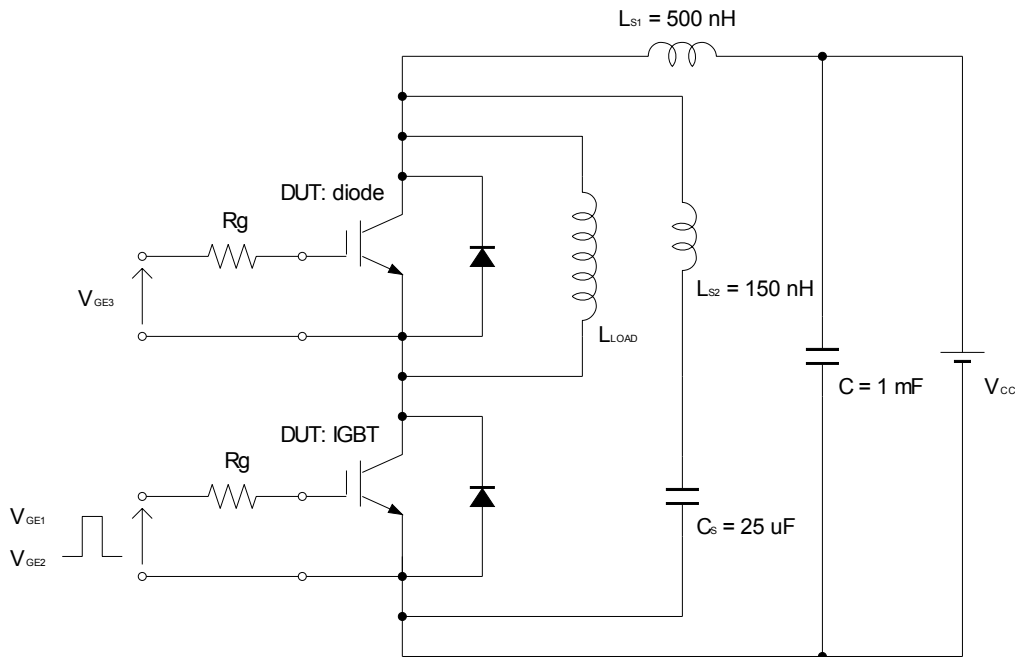


Fig. 2 (a) – Switching test circuit

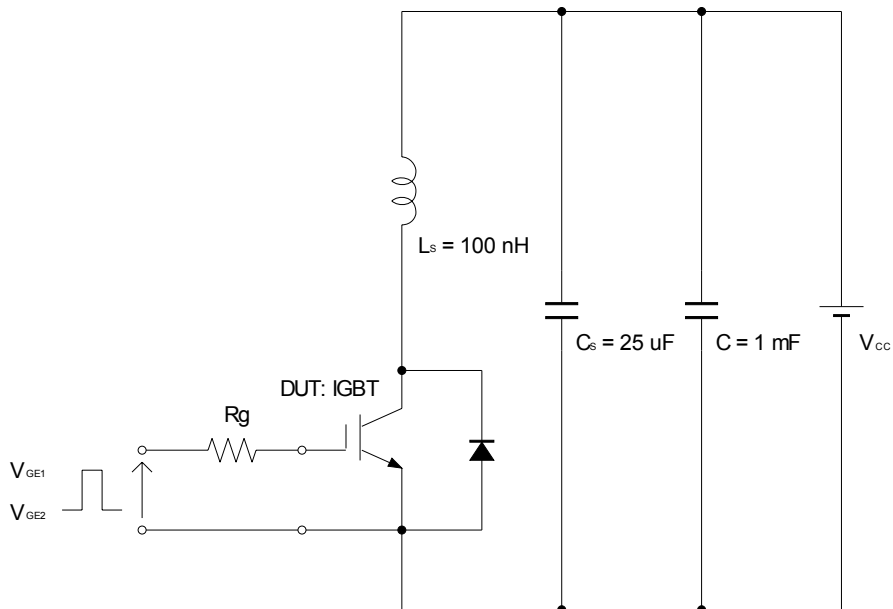


Fig. 2 (b) – Short circuit test circuit

IGBT part: turn-on switching

IGBT part: turn-off switching

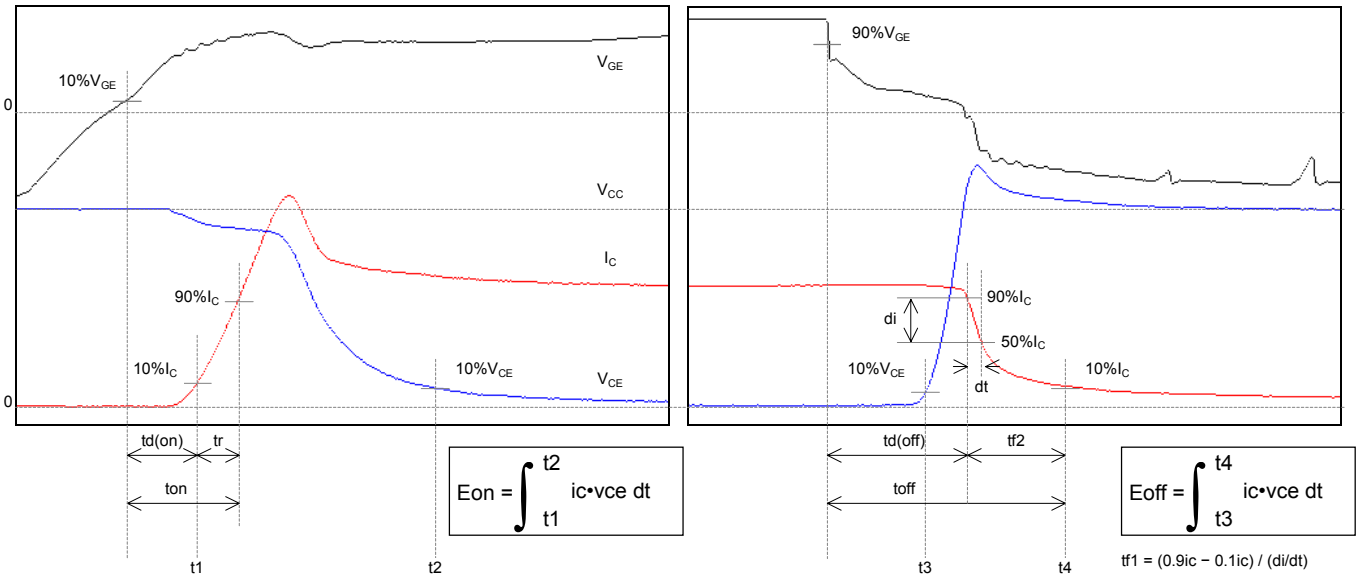


Fig. 3 – Definitions of switching times & energies of IGBT part

Diode part: reverse recovery

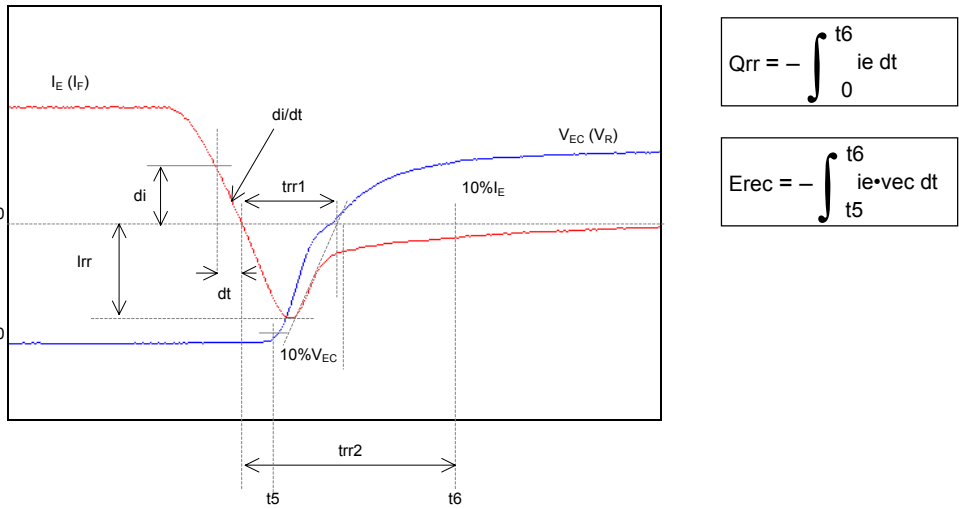


Fig. 4 – Definitions of reverse recovery charge & energy of FWDi part

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Rev. No.	Summary of changes	Signature & date
-	Original	S.lura 7-Oct.-2002
A	The following items changed. 6.1, 6.3, 6.4	S.lura 20-Dec.-2002
B	The following item changed. 6.3 The following item added. 6.6	S.lura 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.lura 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.lura 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.lura 26-Jan.-2004
F	The following items changed. 7.13, 7.15, 7.16, 7.20 The following items added. 9.8	S.lura 17-May-2004
G	The following item changed. 6.13	S.lura 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.lura 1-Oct.-2004