

SECURITY CODE	
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MITSUBISHI ELECTRIC CORPORATION

SPEC.NAME Customer's Std. Spec.	Prepared by	S.Iura	R E V	A	S.Iura	B	S.Iura	C	I.Umesaki
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	DATE	Dec.11.2001			Oct.11.2002		Jan.28.2003		Jul.4.2003

**HIGH VOLTAGE IGBT MODULE SPECIFICATION**

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1. Type number **CM1600HC-34H**
2. Structure Flat base type (Insulated package, AlSiC base plate)
3. Application & Customer High power converters and inverters
4. Outline See Fig. 4
5. Related specifications
6. Maximum ratings

Item	Symbol	Conditions	Ratings	Unit
6.1 Collector-emitter voltage	$V_{CES}$	$V_{GE}=0V, T_j=25^{\circ}C$	1700	V
6.2 Gate-emitter voltage	$V_{GES}$	$V_{CE}=0V, T_j=25^{\circ}C$	$\pm 20$	V
6.3 Collector current	$I_C$	DC, $T_C=80^{\circ}C$	1600	A
	$I_{CM}$	Pulse (note1)	3200	A
6.4 Emitter current	$I_E$ (note2)	$T_C=25^{\circ}C$	1600	A
	$I_{EM}$ (note2)	Pulse (note1)	3200	A
6.5 Maximum collector dissipation	$P_C$ (note3)	$T_C=25^{\circ}C$ , IGBT part	12500	W
6.6 Isolation voltage	$V_{iso}$	Charged part to base plate, rms sinusoidal, AC60Hz 1min.	4000	V
6.7 Junction temperature	$T_j$	—	-40 ~ +150	$^{\circ}C$
6.8 Storage temperature	$T_{stg}$	—	-40 ~ +125	$^{\circ}C$
6.9 Operating temperature	$T_{op}$	—	-40 ~ +125	$^{\circ}C$
6.10 Turn-off switching safe operating area (RBSOA/SWSOA)	Test conditions: $V_{CC}=1150V, I_C=3200A, T_j=125^{\circ}C, V_{GE1}=-V_{GE2}=15V, R_{G(on)}=1.6\Omega, R_{G(off)}=30\Omega$ Half bridge switching operation [See Fig.1(b)] (note4)			
6.11 Short-circuit safe operating area (SCSOA)	Test conditions: $V_{CC}=1150V, T_j=125^{\circ}C, V_{GE1}=-V_{GE2}=15V, R_{G(on)}=1.6\Omega, R_{G(off)}=30\Omega$ Pulse width: $t_w=10\mu s$ [See Fig.1(c)] (note4)			
6.12 Reverse recovery safe operating area (RRSOA)	Test conditions: $V_{CC}=1150V, I_C=2200A, di/dt=-4300A/\mu s, T_j=125^{\circ}C, L_S=100nH(=L_{S2})$ Half bridge switching operation [See Fig.1(b)]			

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Note 1. Pulse width and repetition rate should be such that junction temperature ( $T_j$ ) does not exceed  $T_{jmax}$  rating ( $125^{\circ}C$ )

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 ( $150^{\circ}C$ ).

Note 4.  $R_{G(off)}$  can be reduced to  $1.6\Omega$  by suppressing  $V_{CE}$  less than  $V_{CES}$  ( $1700V$ ) with soft turn-off technique that means  $-di/dt_{(off)}$  decreasing control.

HIGH VOLTAGE IGBT MODULE SPECIFICATION	HCM-951-C	(P2-OU)	PAGE 1 / 6
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7. Electrical characteristics

Item	Symbol	Conditions	Limits			Unit	
			Min.	Typ.	Max.		
7.1 Collector cutoff current	$I_{CES}$	$V_{CE}=V_{CES}$ $V_{GE}=0V$	$T_j=25^{\circ}C$	—	—	24	mA
			$T_j=125^{\circ}C$	—	6	60	
7.2 Gate-emitter threshold voltage	$V_{GE(th)}$	$I_C=160mA, V_{CE}=10V, T_j=25^{\circ}C$	4.5	5.5	6.5	V	
7.3 Gate leakage current	$I_{GES}$	$V_{GE}=V_{GES}, V_{CE}=0V, T_j=25^{\circ}C$	—	—	0.5	$\mu A$	
7.4 Collector-emitter saturation voltage	$V_{CE(sat)}$	$I_C=1600A$ $V_{GE}=15V$ (note5)	$T_j=25^{\circ}C$	—	2.60	—	V
			$T_j=125^{\circ}C$	—	3.20	—	
7.5 Input capacitance	$C_{ies}$	$V_{CE}=10V$	$f=100kHz$	—	140	—	nF
7.6 Output capacitance	$C_{oes}$	$V_{GE}=0V$	$f=100kHz$	—	20.0	—	
7.7 Reverse transfer capacitance	$C_{res}$	$T_j=25^{\circ}C$	$f=1MHz$	—	7.6	—	
7.8 Total gate charge	$Q_G$	$V_{CC}=850V, I_C=1600A, T_j=25^{\circ}C$ $V_{GE}=-15 \sim +15V$	—	13.2	—	$\mu C$	
7.9 Turn-on delay time	$t_{d(on)}$	Resistive load switching operation [See Fig.1(a),Fig.2] $V_{CC}=850V, I_C=1600A, T_j=25^{\circ}C$ $V_{GE1}=-V_{GE2}=15V, R_G=1.6\Omega$	—	—	1.60	$\mu s$	
7.10 Turn-on rise time	$t_r$		—	—	2.00		
7.11 Turn-off delay time	$t_{d(off)}$		—	—	2.70		
7.12 Turn-off fall time	$t_f$		—	—	0.80		
7.13 Emitter-collector voltage (FWDi forward voltage)	$V_{EC}$ (note3)	$I_E=1600A$ $V_{GE}=0V$ (note5)	$T_j=25^{\circ}C$	—	2.60	—	V
			$T_j=125^{\circ}C$	—	2.00	—	
7.14 Reverse recovery time	$t_{rr}$ (note3)	$V_{CC}=850V$ $I_E=1600A$ $di_e/dt=-3800A/\mu s,$ $V_{GE3}=-15V$ [See Fig.3]	$T_j=25^{\circ}C$	—	—	2.70	$\mu s$
			$T_j=125^{\circ}C$	—	—	2.70	
7.15 Reverse recovery charge	$Q_{rr}$ (note3)	$V_{GE3}=-15V$ [See Fig.3]	$T_j=25^{\circ}C$	—	200	—	$\mu C$
			$T_j=125^{\circ}C$	—	420	—	
7.16 Turn-on delay time	$t_{d(on)}$	Half bridge switching operation [See Fig.1(b),Fig.2,Fig.3] $V_{CC}=850V, T_j=125^{\circ}C$	—	—	1.60	$\mu s$	
7.17 Turn-on rise time	$t_r$		—	—	1.30		
7.18 Turn-off delay time	$t_{d(off)}$		—	—	2.70		
7.19 Turn-off fall time	$t_f$		—	—	0.80		
7.20 Reverse recovery time	$t_{rr}$ (note3)		—	—	2.70		
7.21 Reverse recovery charge	$Q_{rr}$ (note3)	IGBT(N): IGBT operation $I_C=1600A, V_{GE1}=-V_{GE2}=15V,$ $R_G=1.6\Omega$	—	420	—	$\mu C$	
7.22 Turn-on switching energy	$E_{on}$	IGBT(P): FWDi operation $I_E=1600A, V_{GE3}=-15V,$ $R_G=1.6\Omega$	—	0.60	—	J/P	
7.23 Turn-off switching energy	$E_{off}$		—	0.52	—		
7.24 Reverse recovery energy (FWDi switching energy)	$E_{rec}$ (note3)		—	0.22	—		

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Note 5. Pulse width and repetition rate should be such as to cause negligible temperature rise.

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	—	—	0.010	K/W
8.2 Thermal resistance	$R_{th(j-c)R}$	Junction to case, FWDi part	—	—	0.017	
8.3 Contact thermal resistance	$R_{th(c-f)}$	Case to fin, conductive grease applied (note6)	—	0.008	—	

Note 6. Typical value is measured by using Shin-etsu Silicone “G-747” with a thickness of 100 $\mu$ m.

9. Mechanical characteristics

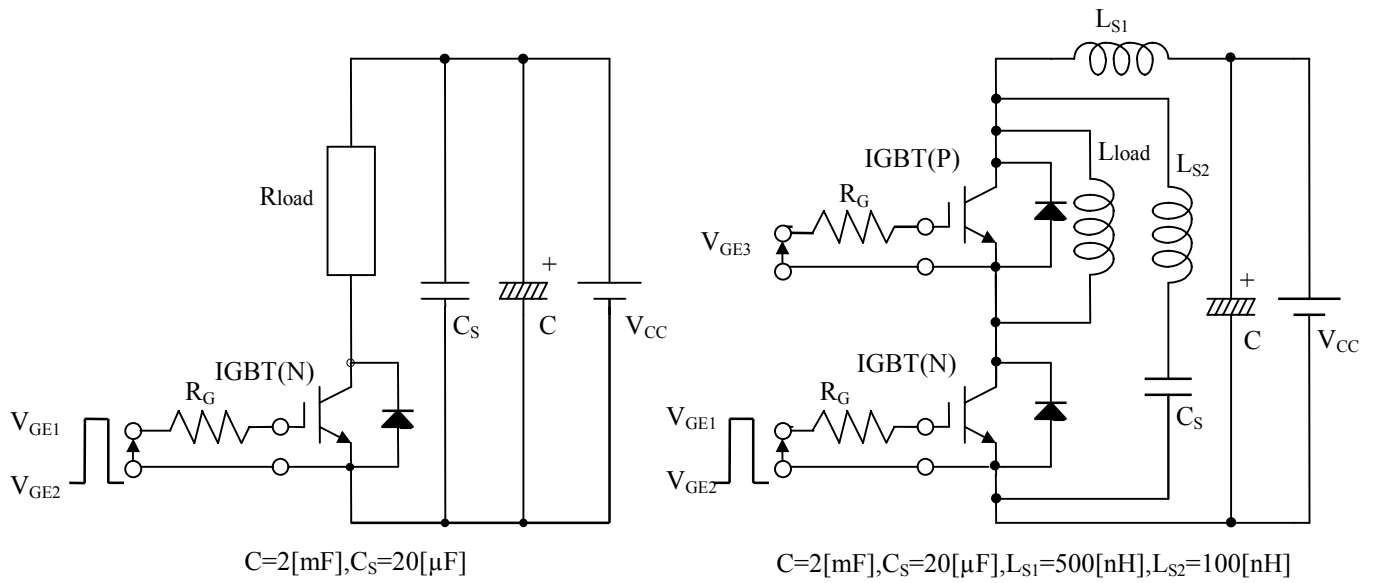
Item	Symbol	Conditions	Limits			Unit
			Min.	Typ.	Max.	
9.1 Mounting torque	—	Main terminal screw : M8	6.67	7.45	13.0	N·m
9.2 Mounting torque	—	Mounting screw : M6	2.84	3.14	6.00	
9.3 Mounting torque	—	Auxiliary terminal screw : M4	0.88	0.98	2.00	
9.4 Mass	—	—	—	1.0	—	kg

10. Shipping inspection report item (note7)

$I_{CES}$ [7.1],  $V_{GE(th)}$ [7.2],  $I_{GES}$ [7.3],  $V_{CE(sat)}$ [7.4 @ $T_j=25^\circ\text{C}$ ],  $V_{EC}$ [7.13 @ $T_j=25^\circ\text{C}$ ]  
 $t_{d(on)}$ [7.16],  $t_r$ [7.17],  $t_{on}$ [Fig.2],  $t_{d(off)}$ [7.18],  $t_f$ [7.19],  $t_{off}$ [Fig.2],  $I_{CP}$ [6.11] (note8)

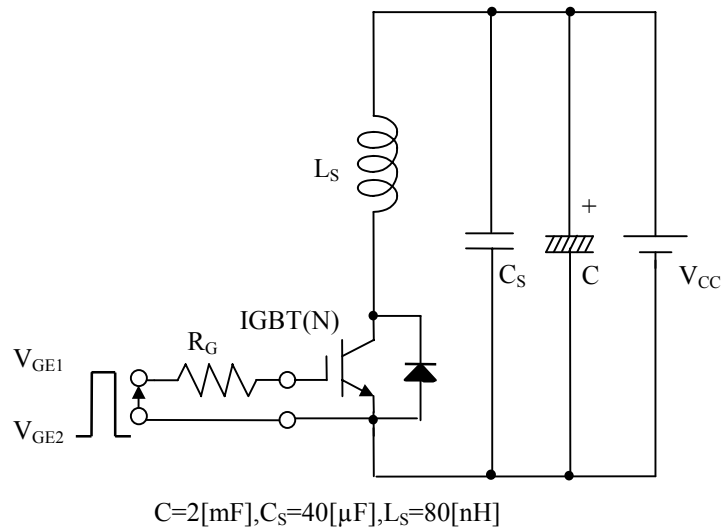
Note 7. One shipping inspection report with the above item values is submitted when modules are delivered.  
 The conditions are defined in bracket.

Note 8.  $I_{CP}$  shows the maximum collector current value in short-circuit test.



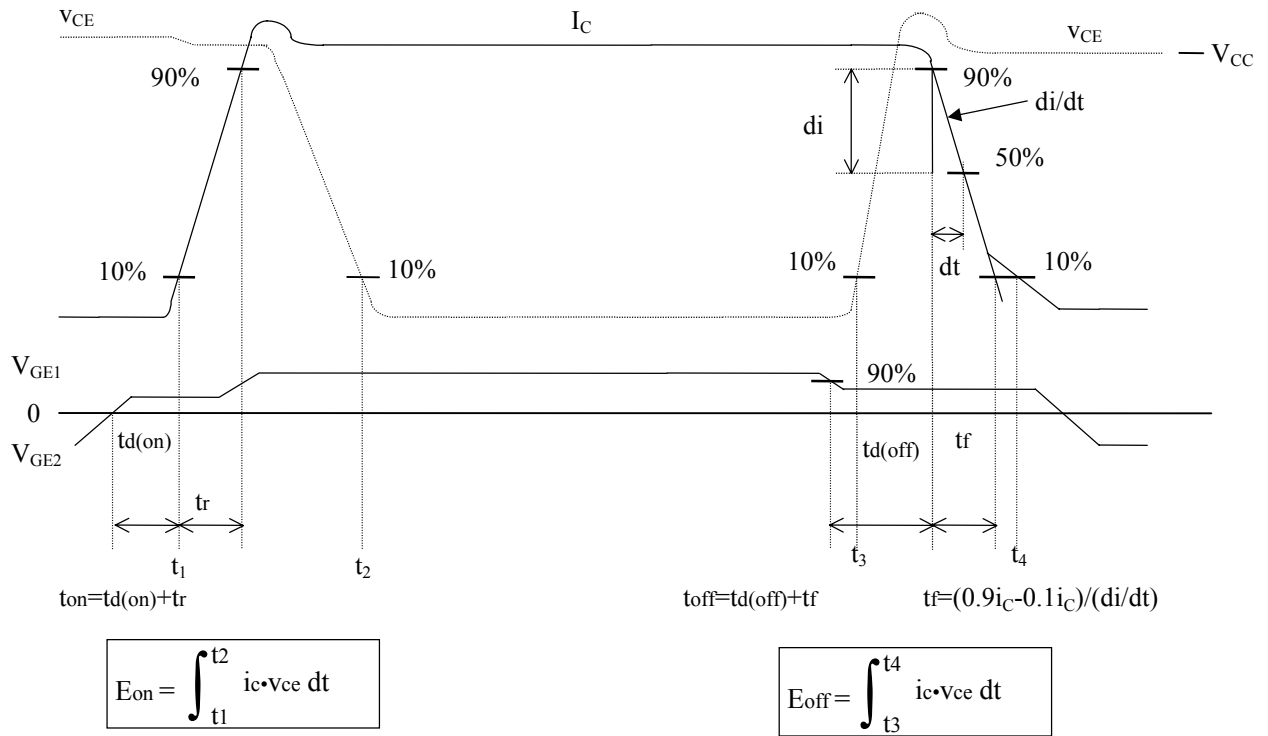
(a) Resistive load switching test circuit

(b) Half bridge switching test & turn-off switching safe operating area (RBSOA/SWSOA) & reverse recovery safe operating area (RRSOA) test circuit

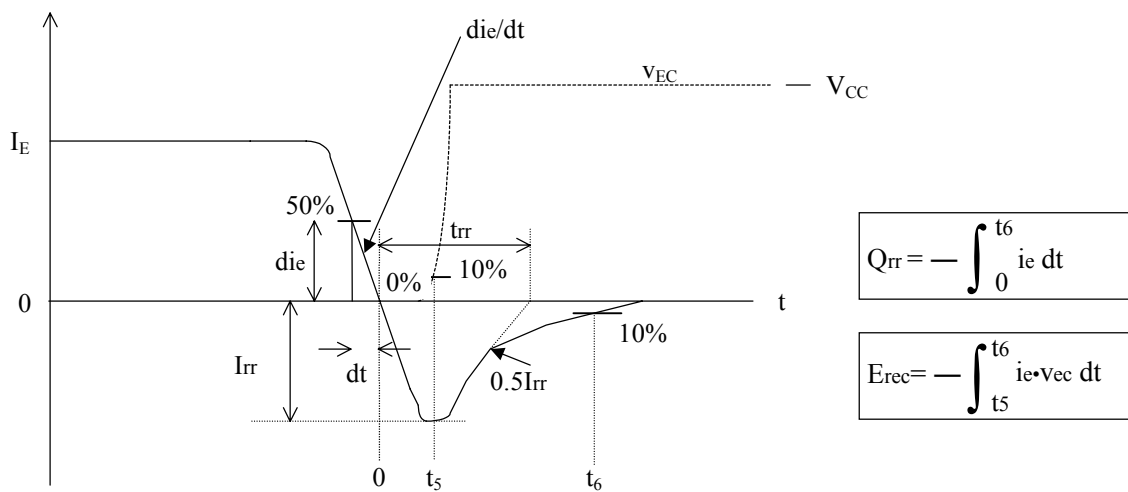


(c) Short-circuit safe operating area (SCSOA) test circuit

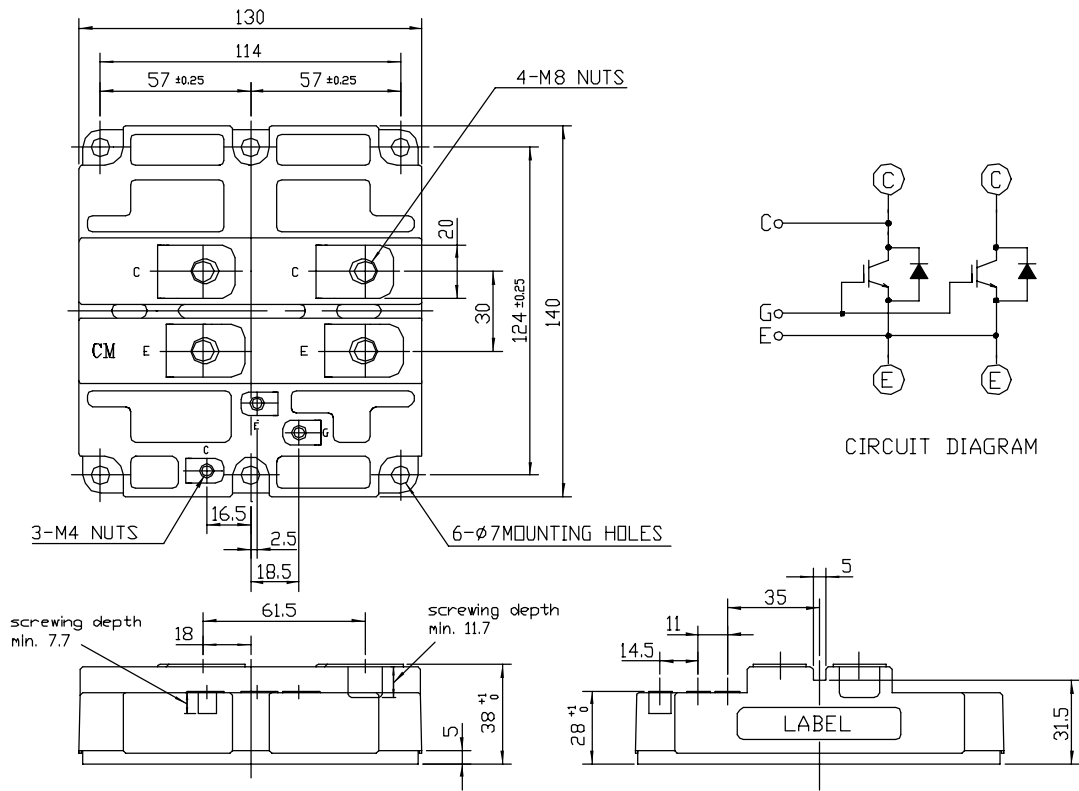
Fig.1 Switching test circuit



**Fig.2** Definitions of switching time & energy of IGBT part



**Fig.3** Definitions of switching time, charge & energy of FWDi part



**Fig.4 Outline drawing & circuit diagram**