CM100RX-24S

sevenpack (3φ inverter+Brake)

- 6th Generation NX series -

Collector current I_C .... **100** A

Collector-emitter voltage V_{CES} .... **1200** V

Maximum junction temperature T_{jmax} ... **175** °C

- Flat base Type
- Copper base plate (non-plating)
- Tin plating pin terminals
- RoHS Directive compliant
- UL Recognized under UL1557, File E323585

APPLICATION

AC Motor Control, Motion/Servo Control, etc.

OUTLINE DRAWING & INTERNAL CONNECTION

Dimension in mm

INTERNAL CONNECTION

P(35), GUP(34), EsUP(33), GVP(26), EsVP(25), GWP(18), EsWP(17), B(4), U(1), V(2), W(3), TH1(11), NTC, TH2(10), GB(6), GUN(30), GVN(22), GWN(14), N(36), EsB(5), EsUN(29), EsVN(21), EsWN(13)

TERMINAL

(3.81), 1.15, 0.65, (7.4), 1.2, t=0.8

SECTION A

φ4.3, φ2.6, φ2.25, 3, 12.5
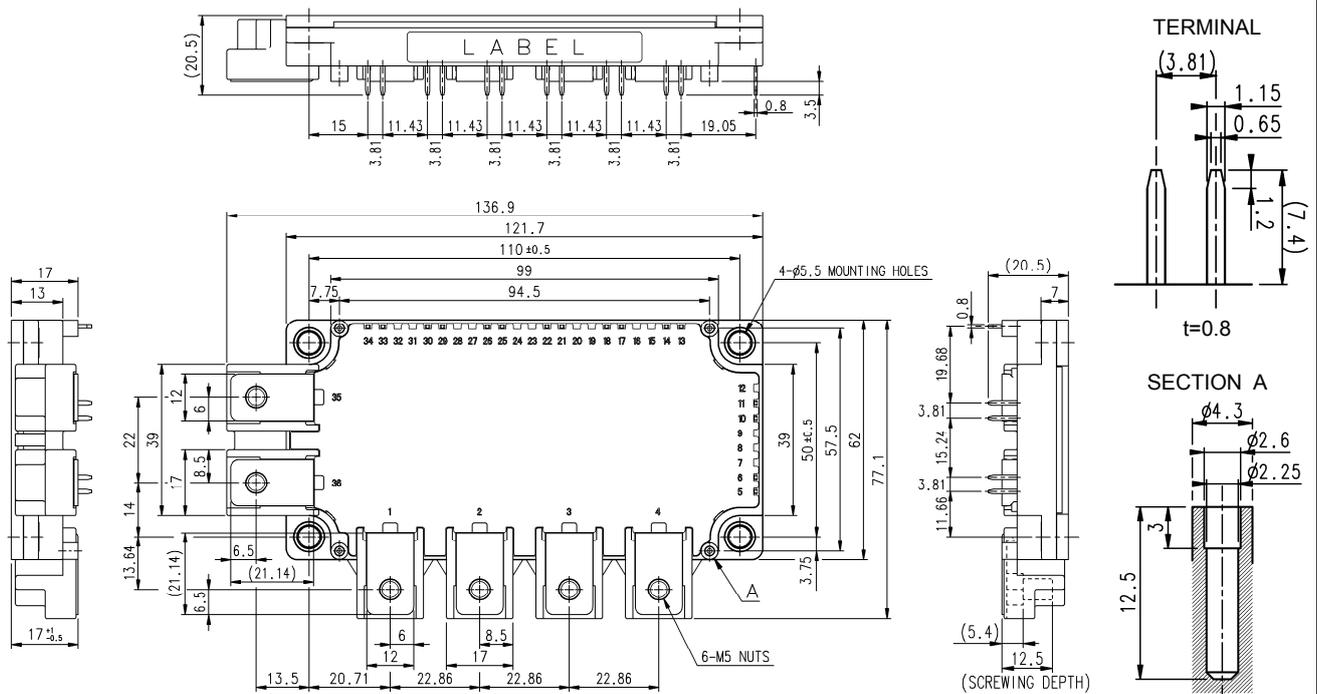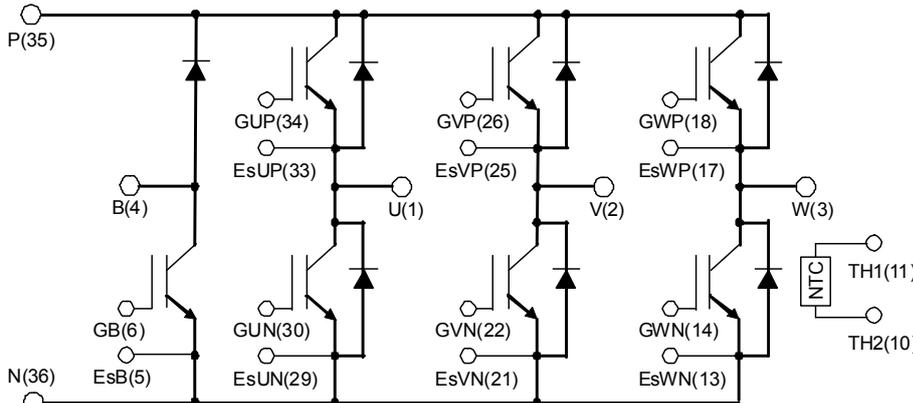
Tolerance otherwise specified

Division of Dimension			Tolerance
0.5	to	3	±0.2
over 3	to	6	±0.3
over 6	to	30	±0.5
over 30	to	120	±0.8
over 120	to	400	±1.2

The Tolerance of size between terminals is assumed to be ±0.4.

Apr. 2011

MITSUBISHI ELECTRIC

ABSOLUTE MAXIMUM RATINGS (T_j=25 °C, unless otherwise specified)

INVERTER PART IGBT/FWDi

Symbol	Item	Conditions	Rating	Unit
V_{CES}	Collector-emitter voltage	G-E short-circuited	1200	V
V_{GES}	Gate-emitter voltage	C-E short-circuited	±20	V
I_C	Collector current	DC, T_C=119 °C (Note.2)	100	A
I_{CRM}		Pulse (Note.3)	200	
P_{tot}	Total power dissipation	T_C=25 °C (Note.2, 4)	750	W
I_E (Note.1)	Emitter current	T_C=25 °C (Note.2, 4)	100	A
I_{ERM} (Note.1)		Pulse (Note.3)	200	

BRAKE PART IGBT/CLAMPDi

Symbol	Item	Conditions	Rating	Unit
V_{CES}	Collector-emitter voltage	G-E short-circuited	1200	V
V_{GES}	Gate-emitter voltage	C-E short-circuited	±20	V
I_C	Collector current	DC, T_C=125 °C (Note.2)	50	A
I_{CRM}		Pulse (Note.3)	100	
P_{tot}	Total power dissipation	T_C=25 °C (Note.2, 4)	425	W
V_{RRM}	Repetitive peak reverse voltage	G-E short-circuited	1200	V
I_F (Note.1)	Forward current	T_C=25 °C (Note.2, 4)	50	A
I_{FRM} (Note.1)		Pulse (Note.3)	100	

MODULE

Symbol	Item	Conditions	Rating	Unit
T_{jmax}	Maximum junction temperature	-	175	°C
T_{Cmax}	Maximum case temperature	(Note.2)	125	
T_{jop}	Operating junction temperature	-	–40 ~ +150	°C
T_{stg}	Storage temperature	-	–40 ~ +125	
V_{isol}	Isolation voltage	Terminals to base plate, RMS, f=60 Hz, AC 1 min	2500	V

ELECTRICAL CHARACTERISTICS (T_j=25 °C, unless otherwise specified)

INVERTER PART IGBT/FWDi

Symbol	Item	Conditions		Min.	Typ.	Max.	Unit
I_{CES}	Collector-emitter cut-off current	V_{CE}=V_{CES}, G-E short-circuited		-	-	1	mA
I_{GES}	Gate-emitter leakage current	V_{GE}=V_{GES}, C-E short-circuited		-	-	0.5	µA
$V_{GE(th)}$	Gate-emitter threshold voltage	I_C=10 mA, V_{CE}=10 V		5.4	6.0	6.6	V
V_{CEsat} (Terminal)	Collector-emitter saturation voltage	I_C=100 A (Note.5), V_{GE}=15 V	T_j=25 °C	-	1.80	2.25	V
			T_j=125 °C	-	2.00	-	
			T_j=150 °C	-	2.05	-	
V_{CEsat} (Chip)	Collector-emitter saturation voltage	I_C=100 A (Note.5), V_{GE}=15 V	T_j=25 °C	-	1.70	2.15	V
			T_j=125 °C	-	1.90	-	
			T_j=150 °C	-	1.95	-	
C_{ies}	Input capacitance	V_{CE}=10 V, G-E short-circuited		-	-	10	nF
C_{oes}	Output capacitance			-	-	2.0	
C_{res}	Reverse transfer capacitance			-	-	0.17	
Q_G	Gate charge	V_{CC}=600 V, I_C=100 A, V_{GE}=15 V		-	233	-	nC
$t_{d(on)}$	Turn-on delay time	V_{CC}=600 V, I_C=100 A, V_{GE}=±15 V, R_G=6.2 Ω, Inductive load		-	-	300	ns
t_r	Rise time			-	-	200	
$t_{d(off)}$	Turn-off delay time			-	-	600	
t_f	Fall time			-	-	300	
V_{EC} (Note.1) (Terminal)	Emitter-collector voltage	I_E=100 A (Note.5), G-E short-circuited	T_j=25 °C	-	1.8	2.25	V
			T_j=125 °C	-	1.8	-	
			T_j=150 °C	-	1.8	-	
V_{EC} (Note.1) (Chip)	Emitter-collector voltage	I_E=100 A (Note.5), G-E short-circuited	T_j=25 °C	-	1.7	2.15	V
			T_j=125 °C	-	1.7	-	
			T_j=150 °C	-	1.7	-	

Apr. 2011

MITSUBISHI ELECTRIC

ELECTRICAL CHARACTERISTICS (cont.; T_j=25 °C, unless otherwise specified)

INVERTER PART IGBT/FWDi

Symbol	Item	Conditions	Min.	Typ.	Max.	Unit
t_{rr} (Note.1)	Reverse recovery time	V_{CC}=600 V, I_E=100 A, V_{GE}=±15 V,	-	-	300	ns
Q_{rr} (Note.1)	Reverse recovery charge	R_G=6.2 Ω, Inductive load	-	5.3	-	µC
E_{on}	Turn-on switching energy per pulse	V_{CC}=600 V, I_C=I_E=100 A,	-	8.6	-	mJ
E_{off}	Turn-off switching energy per pulse	V_{GE}=±15 V, R_G=6.2 Ω, T_j=150 °C,	-	10.7	-	
E_{rr} (Note.1)	Reverse recovery energy per pulse	Inductive load	-	10.2	-	mJ
$R_{CC'+EE'}$	Internal lead resistance	Main terminals-chip, per switch, T_C=25 °C (Note.2)	-	-	2.2	mΩ
r_g	Internal gate resistance	Per switch	-	0	-	Ω

BRAKE PART IGBT/CLAMPDi

Symbol	Item	Conditions		Min.	Typ.	Max.	Unit
I_{CES}	Collector-emitter cut-off current	V_{CE}=V_{CES}, G-E short-circuited		-	-	1	mA
I_{GES}	Gate-emitter leakage current	V_{GE}=V_{GES}, C-E short-circuited		-	-	0.5	µA
$V_{GE(th)}$	Gate-emitter threshold voltage	I_C=5 mA, V_{CE}=10 V		5.4	6.0	6.6	V
V_{CEsat} (Terminal)	Collector-emitter saturation voltage	I_C=50 A (Note.5), V_{GE}=15 V	T_j=25 °C	-	1.80	2.25	V
			T_j=125 °C	-	2.00	-	
			T_j=150 °C	-	2.05	-	
V_{CEsat} (Chip)	Collector-emitter saturation voltage	I_C=50 A (Note.5), V_{GE}=15 V	T_j=25 °C	-	1.70	2.15	V
			T_j=125 °C	-	1.90	-	
			T_j=150 °C	-	1.95	-	
C_{ies}	Input capacitance			-	-	5.0	nF
C_{oes}	Output capacitance	V_{CE}=10 V, G-E short-circuited		-	-	1.0	
C_{res}	Reverse transfer capacitance			-	-	0.08	
Q_G	Gate charge	V_{CC}=600 V, I_C=50 A, V_{GE}=15 V		-	117	-	nC
$t_{d(on)}$	Turn-on delay time	V_{CC}=600 V, I_C=50 A, V_{GE}=±15 V,		-	-	300	ns
t_r	Rise time			-	-	200	
$t_{d(off)}$	Turn-off delay time	R_G=13 Ω, Inductive load		-	-	600	
t_f	Fall time			-	-	300	
I_{RRM}	Repetitive peak reverse current	V_R=V_{RRM}, G-E short-circuited		-	-	1	mA
V_F (Terminal)	Forward voltage	I_F=50 A (Note.5), G-E short-circuited	T_j=25 °C	-	1.8	2.25	V
			T_j=125 °C	-	1.8	-	
			T_j=150 °C	-	1.8	-	
V_F (Chip)	Forward voltage	I_F=50 A (Note.5), G-E short-circuited	T_j=25 °C	-	1.7	2.15	V
			T_j=125 °C	-	1.7	-	
			T_j=150 °C	-	1.7	-	
t_{rr}	Reverse recovery time	V_{CC}=600 V, I_F=50 A, V_{GE}=±15 V,		-	-	300	ns
Q_{rr}	Reverse recovery charge	R_G=13 Ω, Inductive load		-	2.7	-	µC
E_{on}	Turn-on switching energy per pulse	V_{CC}=600 V, I_C=I_F=50 A,		-	5.5	-	mJ
E_{off}	Turn-off switching energy per pulse	V_{GE}=±15 V, R_G=13 Ω, T_j=150 °C,		-	5.3	-	
E_{rr}	Reverse recovery energy per pulse	Inductive load		-	4.5	-	mJ
r_g	Internal gate resistance	-		-	0	-	Ω

NTC THERMISTOR PART

Symbol	Item	Conditions	Min.	Typ.	Max.	Unit
R_{25}	Zero power resistance	T_C=25 °C (Note.2)	4.85	5.00	5.15	kΩ
$\Delta R/R$	Deviation of resistance	T_C=100 °C, R_{100}=493 Ω	-7.3	-	+7.8	%
$B_{(25/50)}$	B constant	Approximate by equation (Note.6)	-	3375	-	K
P_{25}	Power dissipation	T_C=25 °C (Note.2)	-	-	10	mW

THERMAL RESISTANCE CHARACTERISTICS

Symbol	Item	Conditions	Limits Min.	Limits Typ.	Limits Max.	Unit
$R_{th(j-c)Q}$	Thermal resistance (Note. 2)	Junction to case, per Inverter IGBT	-	-	0.20	K/W
$R_{th(j-c)D}$		Junction to case, per Inverter FWDi	-	-	0.29	
$R_{th(j-c)Q}$		Junction to case, per Brake IGBT	-	-	0.35	K/W
$R_{th(j-c)D}$		Junction to case, per Brake ClampDi	-	-	0.63	
$R_{th(c-s)}$	Contact thermal resistance (Note.2)	Case to heat sink, per 1 module, Thermal grease applied (Note.7)	-	15	-	K/kW

MECHANICAL CHARACTERISTICS

Symbol	Item	Conditions		Limits Min.	Limits Typ.	Limits Max.	Unit
M_t	Mounting torque	Main terminals	M 5 screw	2.5	3.0	3.5	N·m
M_s		Mounting to heat sink	M 5 screw	2.5	3.0	3.5	
d_s	Creepage distance	Terminal to terminal		10.25	-	-	mm
		Terminal to base plate		12.32	-	-	
d_a	Clearance	Terminal to terminal		10.28	-	-	mm
		Terminal to base plate		10.85	-	-	
m	Weight	-		-	370	-	g
e_c	Flatness of base plate	On the centerline X, Y (Note.8)		±0	-	+100	µm

Note.1: Represent ratings and characteristics of the anti-parallel, emitter-collector free wheeling diode (FWDi).
Note.2: Case temperature (T_C) and heat sink temperature (T_s) are defined on the each surface (mounting side) of base plate and heat sink just under the chips. Refer to the figure of chip location.
   The heat sink thermal resistance should measure just under the chips.
Note.3: Pulse width and repetition rate should be such that the device junction temperature (T_j) dose not exceed T_{jmax} rating.
Note.4: Junction temperature (T_j) should not increase beyond T_{jmax} rating.
Note.5: Pulse width and repetition rate should be such as to cause negligible temperature rise.
   Refer to the figure of test circuit.
Note.6: $B_{(25/50)} = \ln(\frac{R_{25}}{R_{50}})/(\frac{1}{T_{25}} - \frac{1}{T_{50}})$,

   R_{25}: resistance at absolute temperature T_{25} [K]; T_{25}=25 [°C]+273.15=298.15 [K]
   R_{50}: resistance at absolute temperature T_{50} [K]; T_{50}=50 [°C]+273.15=323.15 [K]
Note.7: Typical value is measured by using thermally conductive grease of λ=0.9 W/(m·K).
Note.8: The base plate (mounting side) flatness measurement points (X, Y) are as follows of the following figure.
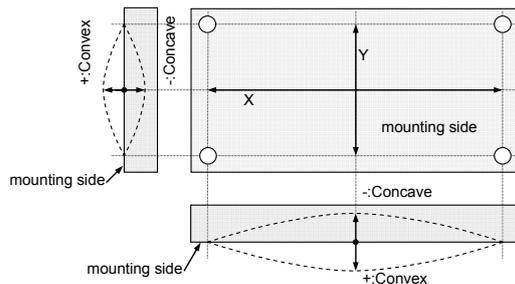
Note.9: Japan Electronics and Information Technology Industries Association (JEITA) standards,
   "EIAJ ED-4701/300: Environmental and endurance test methods for semiconductor devices (Stress test I)"
Note.10: Use the following screws when mounting the printed circuit board (PCB) on the stand offs.
   "M2.6×10 or M2.6×12 self tapping screw"
   The length of the screw depends on the thickness of the PCB.

RECOMMENDED OPERATING CONDITIONS (T_a=25 °C, unless otherwise specified)

Symbol	Item	Conditions		Limits Min.	Limits Typ.	Limits Max.	Unit
V_{CC}	DC supply voltage	Applied across P-N terminals		-	600	850	V
V_{GEon}	Gate-emitter drive voltage	Applied across GB-EsB / G*P-Es*P, G*N-Es*N terminals		13.5	15.0	16.5	V
R_G	External gate resistance	Per switch	Inverter IGBT	6.2	-	62	Ω
			Brake IGBT	13	-	130	

MITSUBISHI ELECTRIC

CHIP LOCATION (top view)

Dimension in mm, Tolerance: ±1 mm

LABEL SIDE
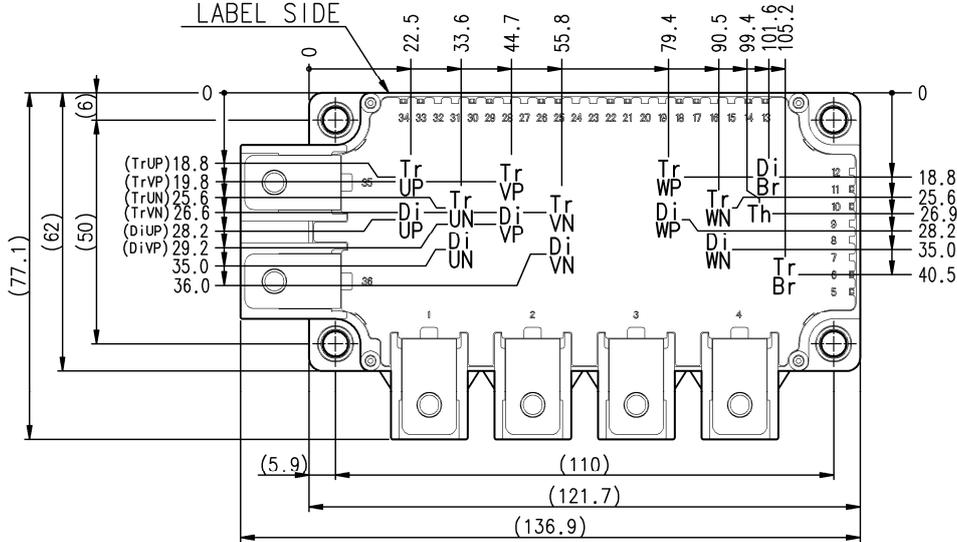
Tr*P/Tr*N/TrBr: IGBT, Di*P/Di*N: FWDi, DiBr: ClampDi, Th: NTC thermistor.

TEST CIRCUIT AND WAVEFORMS
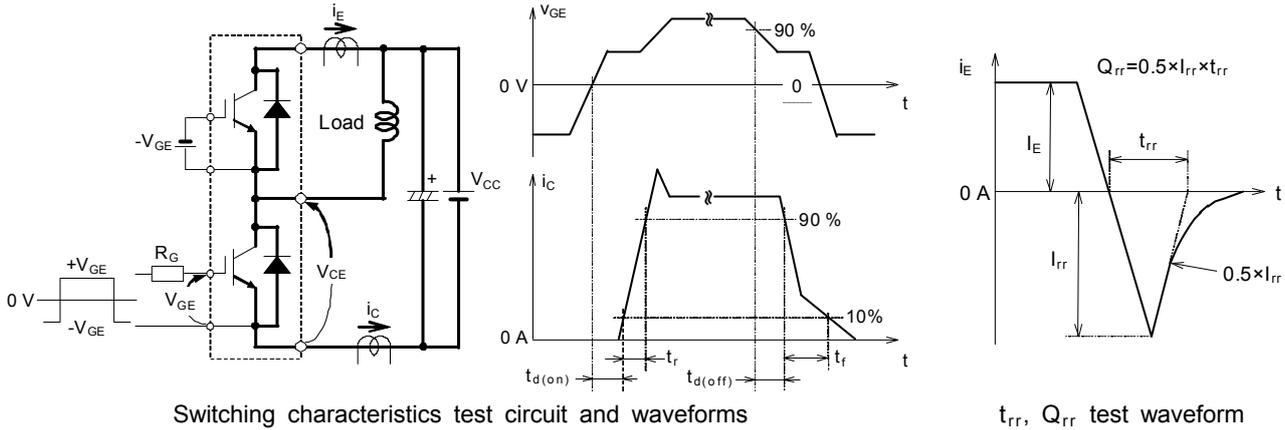
Switching characteristics test circuit and waveforms

$Q_{rr}=0.5 \times I_{rr} \times t_{rr}$

t_{rr}, Q_{rr} test waveform
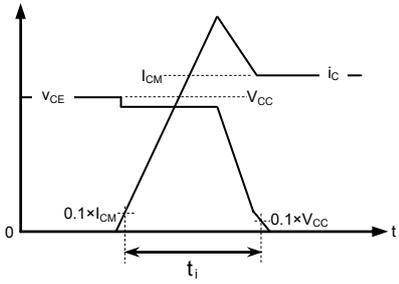
IGBT Turn-on switching energy
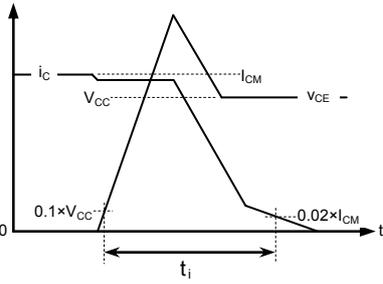
IGBT Turn-off switching energy
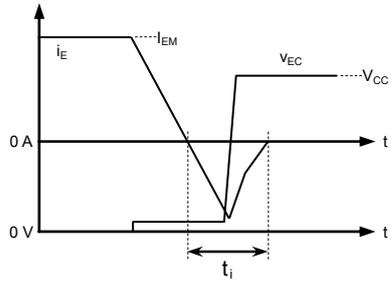
FWDi Reverse recovery energy

Turn-on / Turn-off switching energy and Reverse recovery energy test waveforms (Integral time instruction drawing)
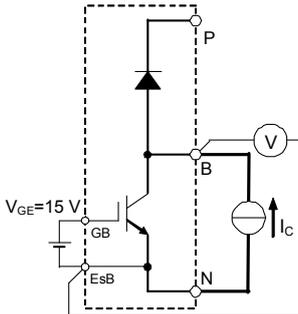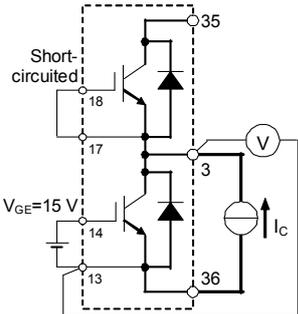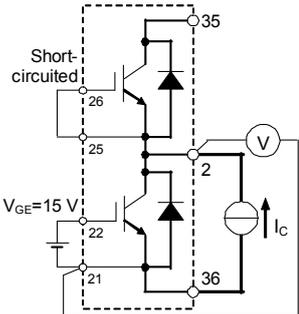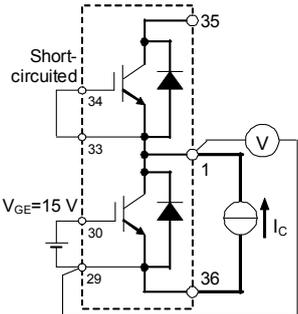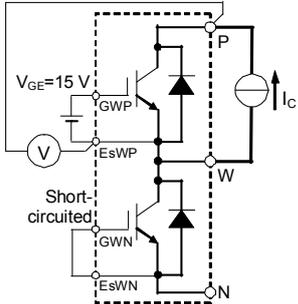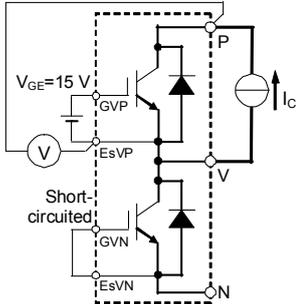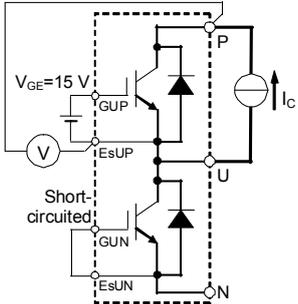
Apr. 2011

MITSUBISHI ELECTRIC

TEST CIRCUIT

Gate-emitter short-circuited	GVP-EsVP GVN-EsVN, GWP-EsWP, GWN-EsWN, GB-EsB

UP / UN IGBT

Gate-emitter short-circuited	GUP-EsUP, GUN-EsUN, GWP-EsWP, GWN-EsWN, GB-EsB

VP / VN IGBT

Gate-emitter short-circuited	GUP-EsUP, GUN-EsUN, GVP-EsVP, GVN-EsVN, GB-EsB

WP / WN IGBT

Gate-emitter short-circuited	GUP-EsUP, GUN-EsUN, GVP-EsVP, GVN-EsVN, GWP-EsWP, GWN-EsWN

Brake IGBT

V_{CEsat} test circuit
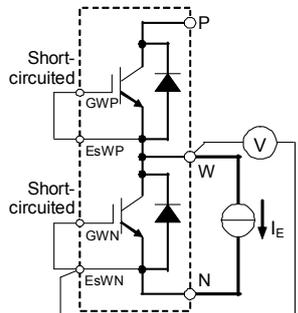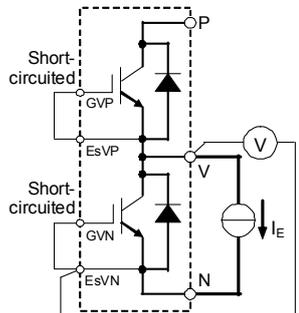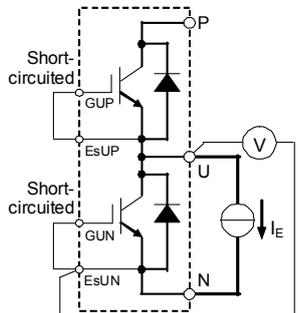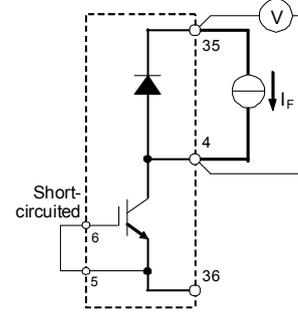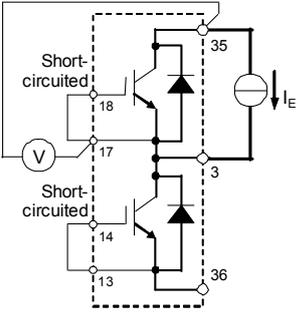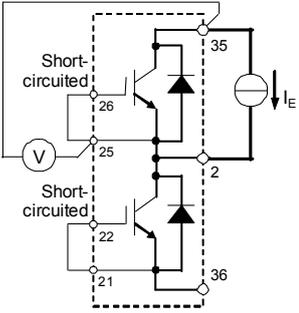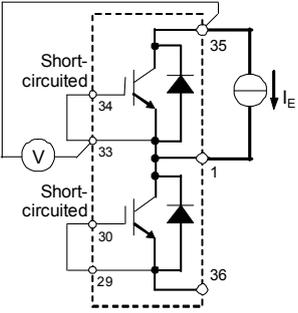
Gate-emitter short-circuited	GVP-EsVP GVN-EsVN, GWP-EsWP, GWN-EsWN, GB-EsB

UP / UN FWDi

Gate-emitter short-circuited	GUP-EsUP, GUN-EsUN, GWP-EsWP, GWN-EsWN, GB-EsB

VP / VN FWDi

Gate-emitter short-circuited	GUP-EsUP, GUN-EsUN, GVP-EsVP, GVN-EsVN, GB-EsB

WP / WN FWDi

Gate-emitter short-circuited	GUP-EsUP, GUN-EsUN, GVP-EsVP, GVN-EsVN, GWP-EsWP, GWN-EsWN

Brake ClampDi

V_{EC} / V_F test circuit

Apr. 2011

MITSUBISHI ELECTRIC

PERFORMANCE CURVES

INVERTER PART

OUTPUT CHARACTERISTICS (TYPICAL)
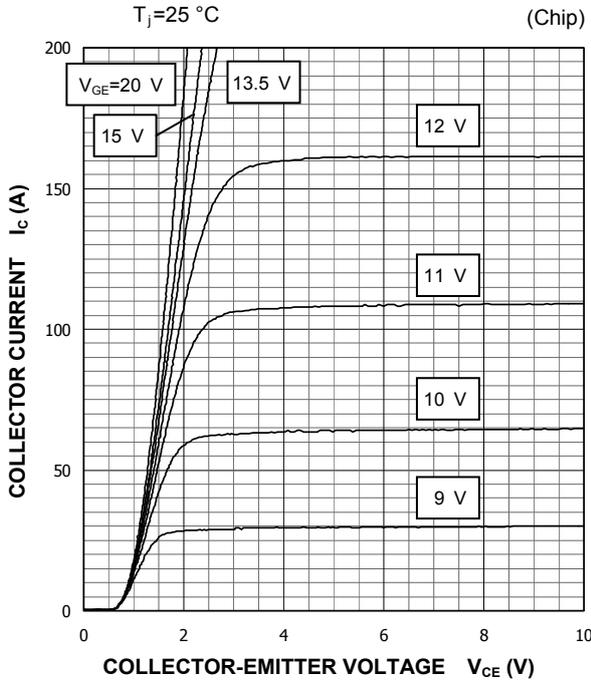
T_j=25 °C　(Chip)

COLLECTOR-EMITTER SATURATION VOLTAGE CHARACTERISTICS (TYPICAL)

V_{GE}=15 V　(Chip)

COLLECTOR-EMITTER SATURATION VOLTAGE CHARACTERISTICS (TYPICAL)

T_j=25 °C　(Chip)
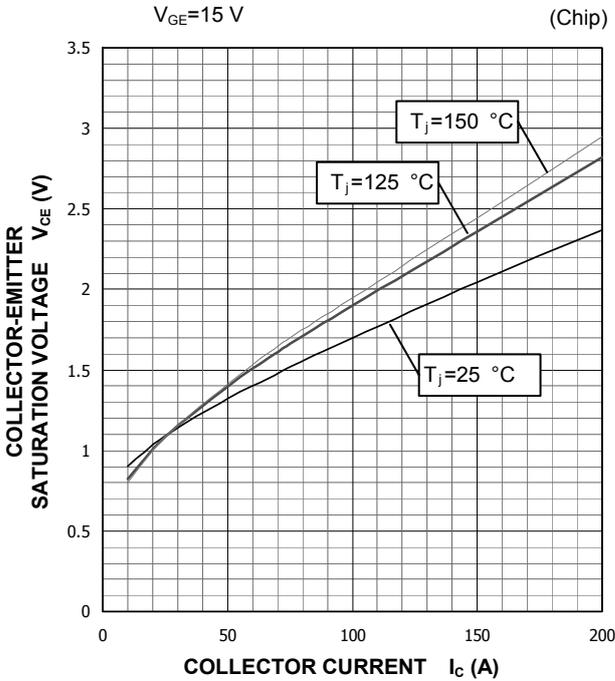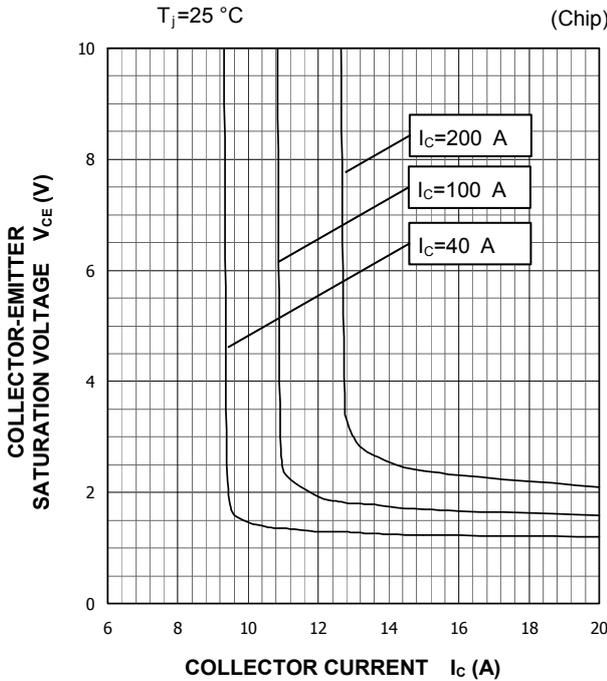
FREE WHEELING DIODE FORWARD CHARACTERISTICS (TYPICAL)

G-E short-circuited　(Chip)

Apr. 2011

MITSUBISHI ELECTRIC

HALF-BRIDGE
SWITCHING CHARACTERISTICS
(TYPICAL)
V_{CC}=600 V, V_{GE}=±15 V, R_G=6.2 Ω,
————: T_j=150 °C, - - - - -: T_j=125 °C
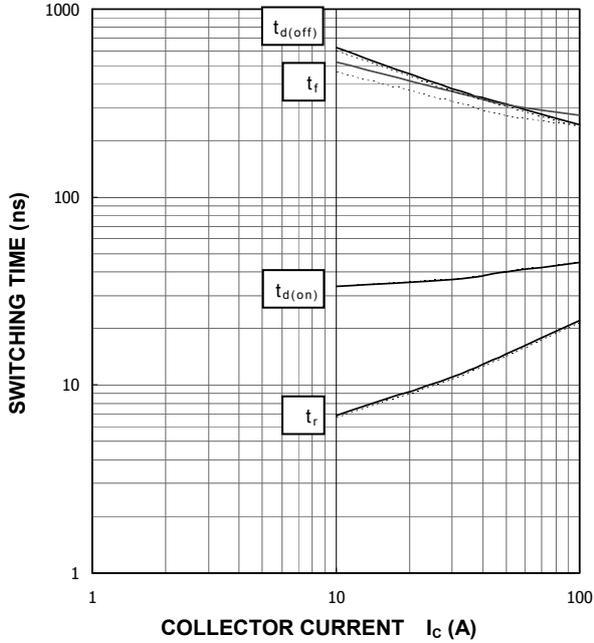
HALF-BRIDGE
SWITCHING CHARACTERISTICS
(TYPICAL)
V_{CC}=600 V, V_{GE}=±15 V, I_C=100 A,
————: T_j=150 °C, - - - - -: T_j=125 °C

HALF-BRIDGE
SWITCHING CHARACTERISTICS
(TYPICAL)
V_{CC}=600 V, V_{GE}=±15 V, R_G=6.2 Ω,
————: T_j=150 °C, - - - - -: T_j=125 °C
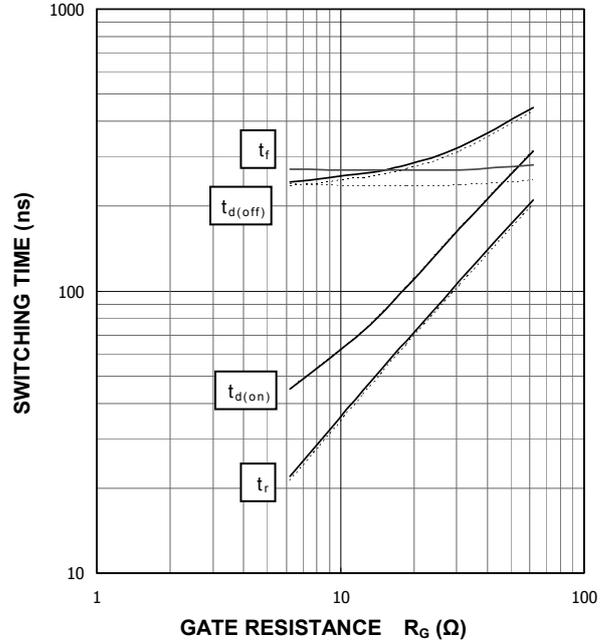
HALF-BRIDGE
SWITCHING CHARACTERISTICS
(TYPICAL)
V_{CC}=600 V, V_{GE}=±15 V, I_C=100 A,
————: T_j=150 °C, - - - - -: T_j=125 °C

MITSUBISHI
ELECTRIC

CAPACITANCE CHARACTERISTICS
(TYPICAL)

G-E short-circuited, T_j=25 °C
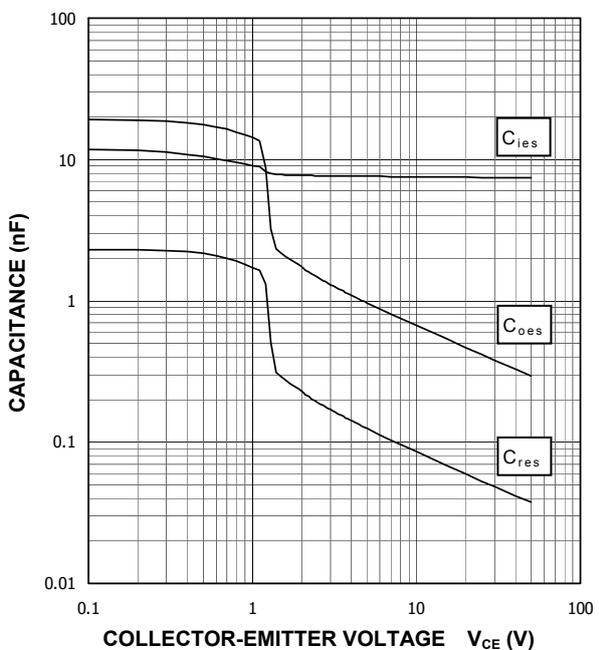
FREE WHEELING DIODE
REVERSE RECOVERY CHARACTERISTICS
(TYPICAL)

V_{CC}=600 V, V_{GE}=±15 V, R_G=6.2 Ω,
————: T_j=150 °C, - - - - -: T_j=125 °C
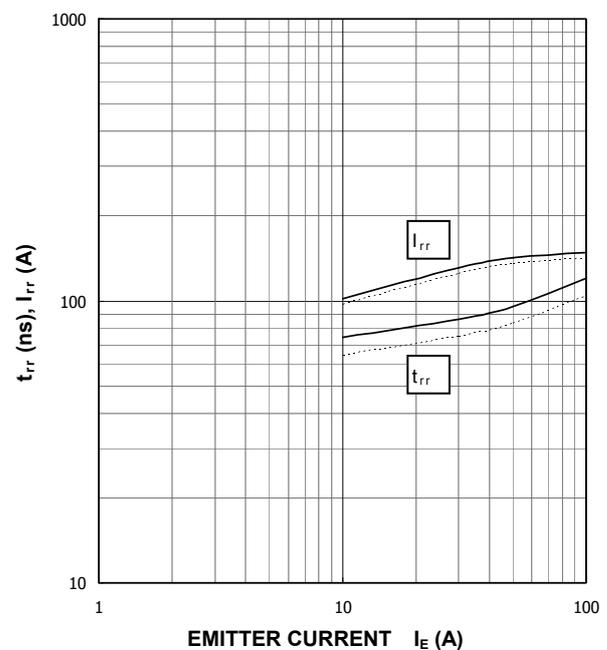
GATE CHARGE CHARACTERISTICS
(TYPICAL)

V_{CC}=600 V, I_C=100 A, T_j=25 °C
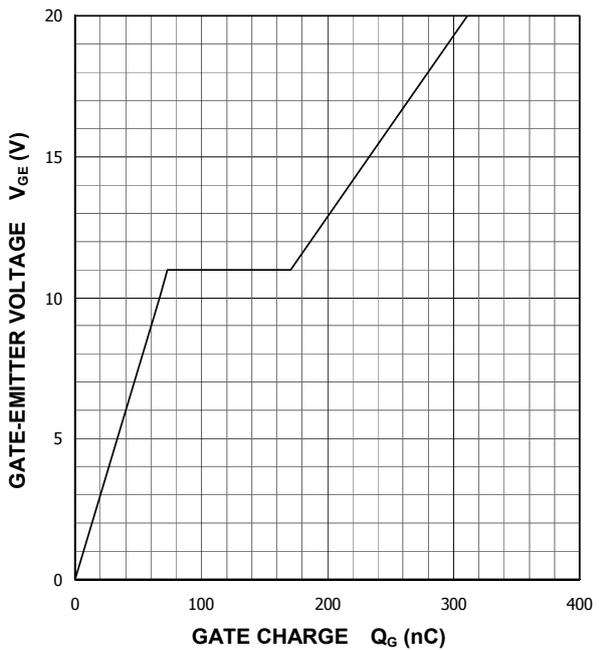
TRANSIENT THERMAL IMPEDANCE
CHARACTERISTICS
(MAXIMUM)

Single pulse, T_C=25 °C

$R_{th(j-c)Q}$=0.20 K/W, $R_{th(j-c)D}$=0.29 K/W

Apr. 2011

MITSUBISHI ELECTRIC
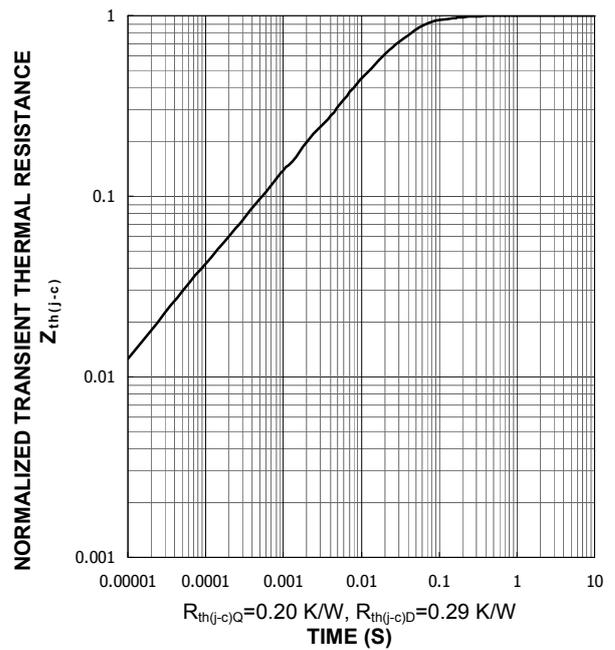
BRAKE PART

COLLECTOR-EMITTER SATURATION VOLTAGE CHARACTERISTICS (TYPICAL)
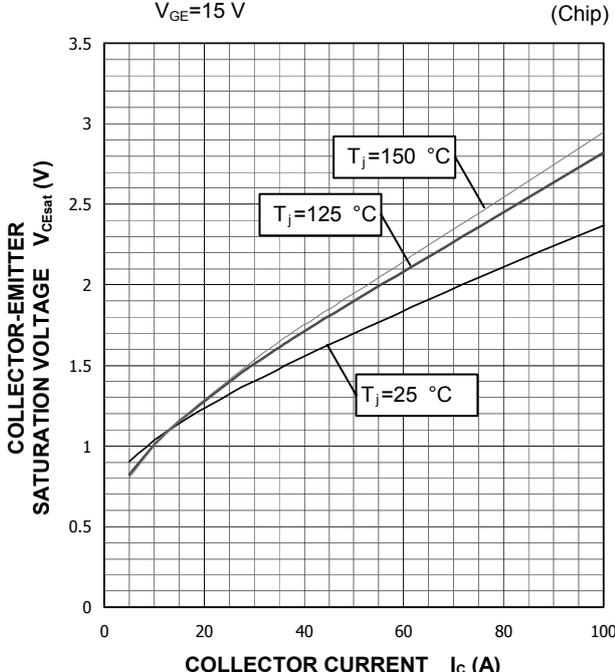
V_{GE}=15 V   (Chip)

CLAMP DIODE FORWARD CHARACTERISTICS (TYPICAL)
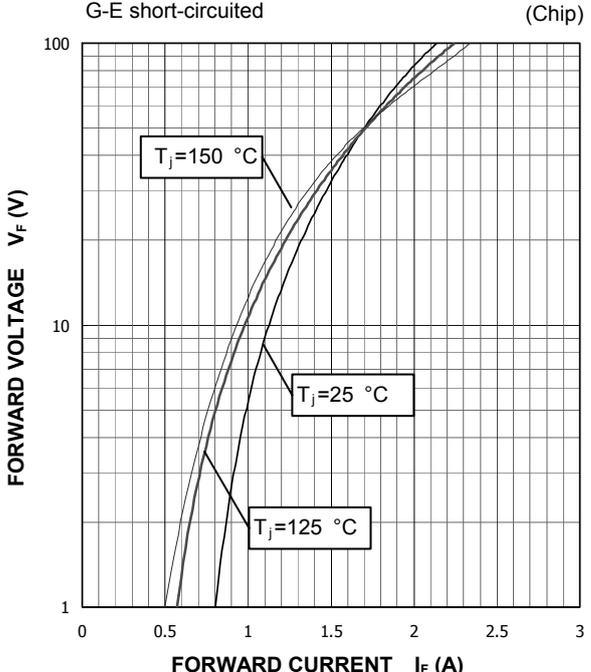
G-E short-circuited   (Chip)

HALF-BRIDGE SWITCHING CHARACTERISTICS (TYPICAL)

V_{CC}=600 V, V_{GE}=±15 V, R_G=13 Ω, INDUCTIVE LOAD
————: T_j=150 °C, - - - - -: T_j=125 °C
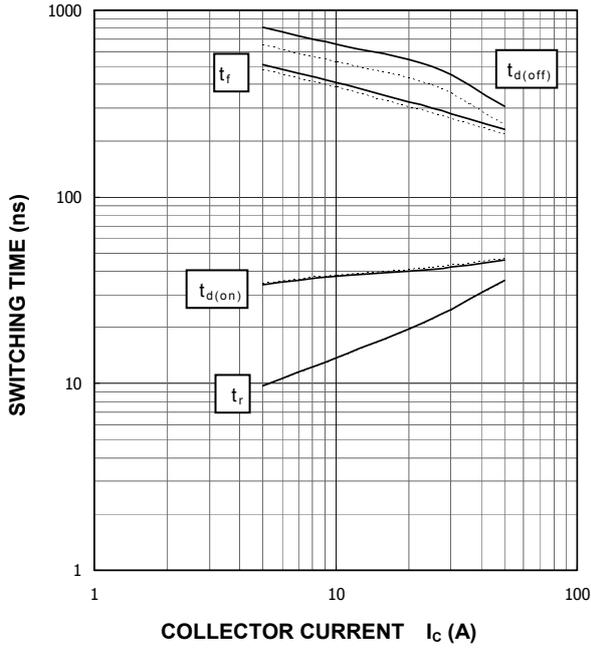
### HALF-BRIDGE SWITCHING CHARACTERISTICS (TYPICAL)

V_{CC}=600 V, I_C=50 A, V_{GE}=±15 V, INDUCTIVE LOAD
————: T_j=150 °C, - - - - -: T_j=125 °C
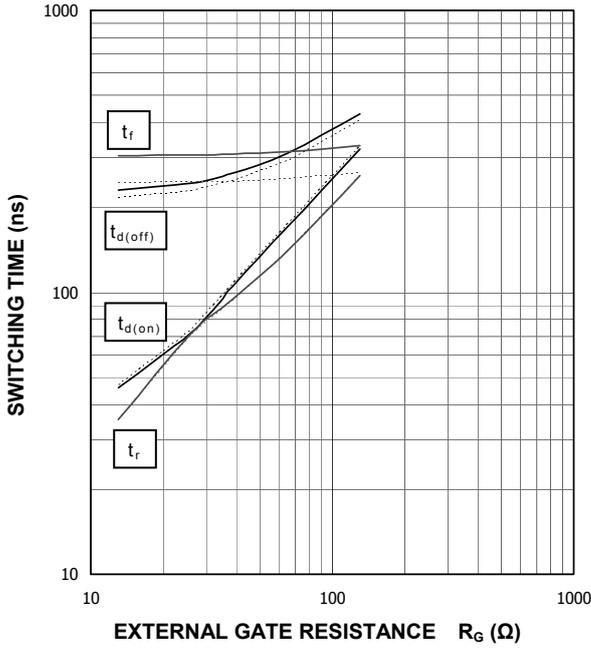
Apr. 2011

MITSUBISHI ELECTRIC

HALF-BRIDGE
SWITCHING CHARACTERISTICS
(TYPICAL)
V_{CC}=600 V, V_{GE}=±15 V, R_G=13 Ω,
INDUCTIVE LOAD, PER PULSE
———: T_j=150 °C, - - - - -: T_j=125 °C
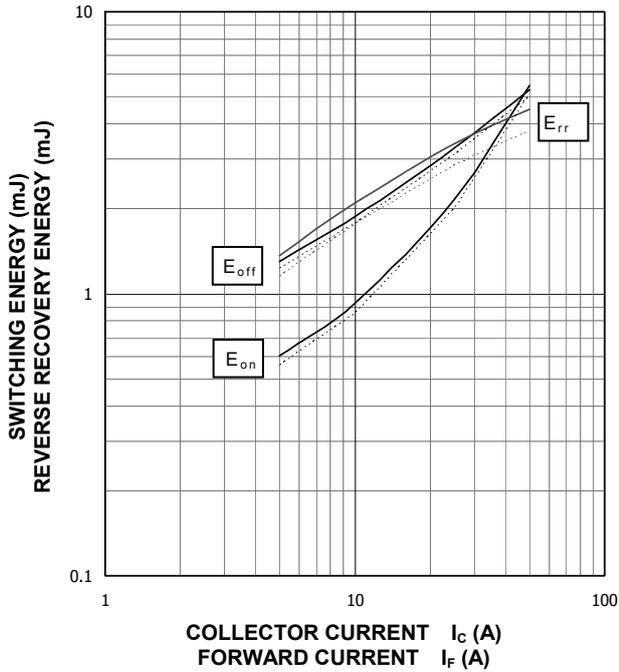
HALF-BRIDGE
SWITCHING CHARACTERISTICS
(TYPICAL)
V_{CC}=600 V, I_C/I_F=50 A, V_{GE}=±15 V,
INDUCTIVE LOAD, PER PULSE
———: T_j=150 °C, - - - - -: T_j=125 °C
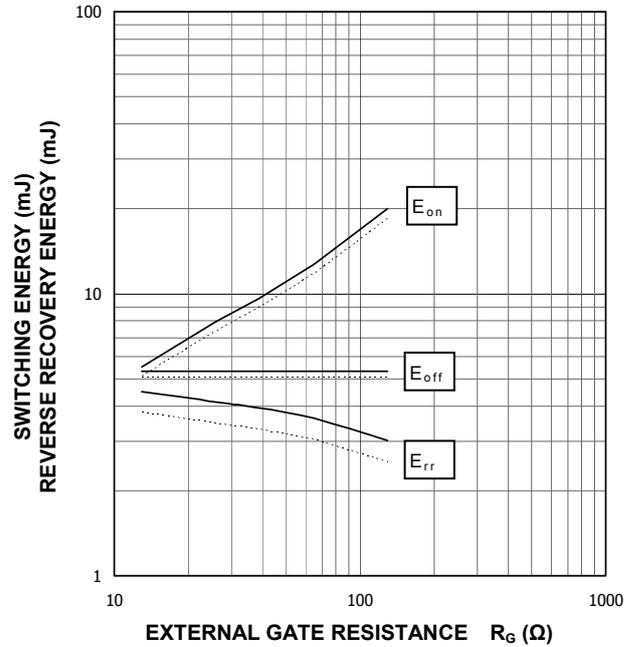
CLAMP DIODE
REVERSE RECOVERY CHARACTERISTICS
(TYPICAL)
V_{CC}=600 V, V_{GE}=±15 V, R_G=13 Ω, INDUCTIVE LOAD
———: T_j=150 °C, - - - - -: T_j=125 °C

TRANSIENT THERMAL IMPEDANCE
CHARACTERISTICS
(MAXIMUM)

Single pulse, T_C=25 °C

$R_{th(j-c)Q}$=0.35 K/W, $R_{th(j-c)D}$=0.63 K/W
TIME (S)
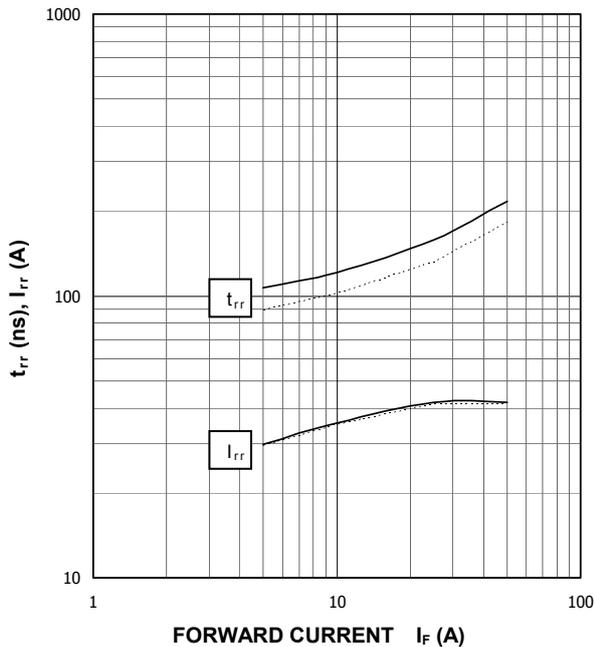
MITSUBISHI ELECTRIC
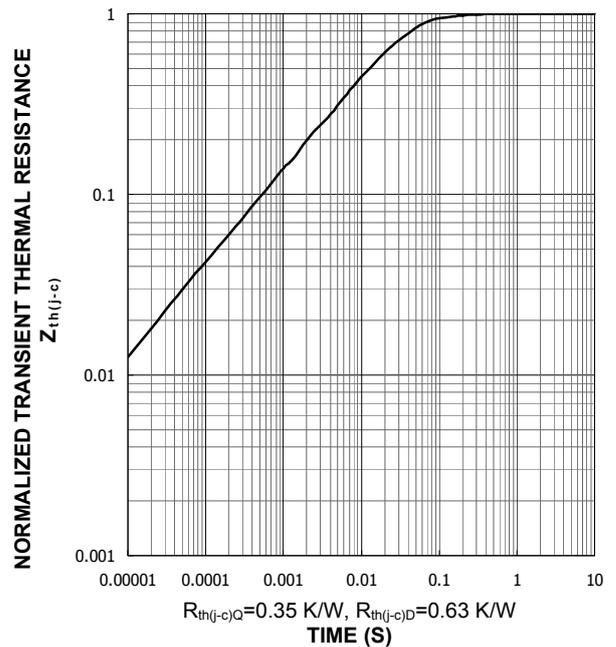
Keep safety first in your circuit designs!

· Mitsubishi Electric Corporation puts the maximum effort into making semiconductor products better and more reliable, but there is always the possibility that trouble may occur with them. Trouble with semiconductors may lead to personal injury, fire or property damage.
Remember to give due consideration to safety when making your circuit designs, with appropriate measures such as (i) placement of substitutive, auxiliary circuits, (ii) use of non-flammable material or (iii) prevention against any malfunction or mishap.

Notes regarding these materials

· These materials are intended as a reference to assist our customers in the selection of the Mitsubishi semiconductor product best suited to the customer's application; they do not convey any license under any intellectual property rights, or any other rights, belonging to Mitsubishi Electric Corporation or a third party.
· Mitsubishi Electric Corporation assumes no responsibility for any damage, or infringement of any third-party's rights, originating in the use of any product data, diagrams, charts, programs, algorithms, or circuit application examples contained in these materials.
· All information contained in these materials, including product data, diagrams, charts, programs and algorithms represents information on products at the time of publication of these materials, and are subject to change by Mitsubishi Electric Corporation without notice due to product improvements or other reasons. It is therefore recommended that customers contact Mitsubishi Electric Corporation or an authorized Mitsubishi Semiconductor product distributor for the latest product information before purchasing a product listed herein.
The information described here may contain technical inaccuracies or typographical errors. Mitsubishi Electric Corporation assumes no responsibility for any damage, liability, or other loss rising from these inaccuracies or errors.
Please also pay attention to information published by Mitsubishi Electric Corporation by various means, including the Mitsubishi Semiconductor home page (http://www.mitsubishichips.com/Global/index.html).
· When using any or all of the information contained in these materials, including product data, diagrams, charts, programs, and algorithms, please be sure to evaluate all information as a total system before making a final decision on the applicability of the information and products. Mitsubishi Electric Corporation assumes no responsibility for any damage, liability or other loss resulting from the information contained herein.
· Mitsubishi Electric Corporation semiconductors are not designed or manufactured for use in a device or system that is used under circumstances in which human life is potentially at stake. Please contact Mitsubishi Electric Corporation or an authorized Mitsubishi Semiconductor product distributor when considering the use of a product contained herein for any specific purposes, such as apparatus or systems for transportation, vehicular, medical, aerospace, nuclear, or undersea repeater use.
· The prior written approval of Mitsubishi Electric Corporation is necessary to reprint or reproduce in whole or in part these materials.
· If these products or technologies are subject to the Japanese export control restrictions, they must be exported under a license from the Japanese government and cannot be imported into a country other than the approved destination.
Any diversion or reexport contrary to the export control laws and regulations of Japan and/or the country of destination is prohibited.
· Please contact Mitsubishi Electric Corporation or an authorized Mitsubishi Semiconductor product distributor for further details on these materials or the products contained therein.

MITSUBISHI ELECTRIC