

< IGBT MODULES >

CM450DX-24S1

HIGH POWER SWITCHING USE
INSULATED TYPE



Dual switch (Half-Bridge)

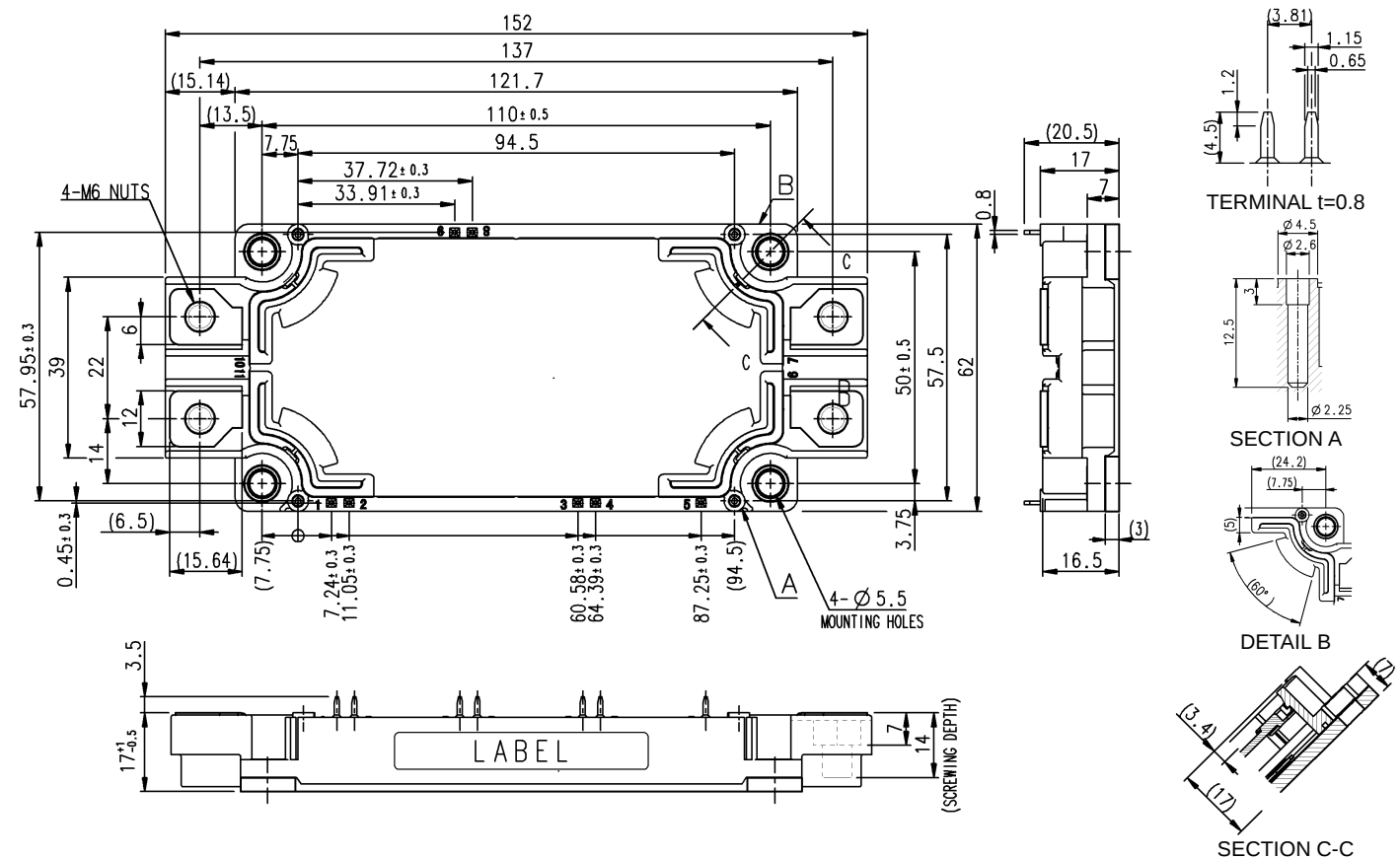
Collector current I_C **450 A**
Collector-emitter voltage V_{CES} **1200 V**
Maximum junction temperature T_{jmax} **175 °C**

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

APPLICATION

AC Motor Control, Motion/Servo Control, Power supply, etc.

OUTLINE DRAWING & INTERNAL CONNECTION



< IGBT MODULES >

CM450DX-24S1

HIGH POWER SWITCHING USE
INSULATED TYPEMAXIMUM RATINGS ($T_J=25\text{ }^{\circ}\text{C}$, unless otherwise specified)

INVERTER PART IGBT/DIODE

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, $T_C=107\text{ }^{\circ}\text{C}$ (Note2, 4)	450	A
I_{CRM}		Pulse, Repetitive (Note3)	900	
P_{tot}	Total power dissipation	$T_C=25\text{ }^{\circ}\text{C}$ (Note2, 4)	2775	W
I_E (Note1)	Emitter current	DC (Note2)	450	A
I_{ERM} (Note1)		Pulse, Repetitive (Note3)	900	

MODULE

Symbol	Item	Conditions	Rating	Unit
V_{isol}	Isolation voltage	Terminals to base plate, RMS, f=60 Hz, AC 1 min	4000	V
T_{jmax}	Maximum junction temperature	Instantaneous event (overload)	175	$^{\circ}\text{C}$
T_{Cmax}	Maximum case temperature	(Note4)	125	
T_{jop}	Operating junction temperature	Continuous operation (under switching)	-40 ~ +150	$^{\circ}\text{C}$
T_{stg}	Storage temperature	-	-40 ~ +125	

ELECTRICAL CHARACTERISTICS ($T_J=25\text{ }^{\circ}\text{C}$, unless otherwise specified)

INVERTER PART IGBT/DIODE

Symbol	Item	Conditions		Limits			Unit
				Min.	Typ.	Max.	
I _{CES}	Collector-emitter cut-off current	V _{CE} =V _{CES} , G-E short-circuited		-	-	1.0	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 =45 mA, V _{CE} =10 V		5.4	6.0	6.6	V
V _{CESat} (Terminal)	Collector-emitter saturation voltage	I _C =450 A, V _{GE} =15 V, Refer to the figure of test circuit (Note5)	T _J =25 °C	-	1.80	2.25	V
			T _J =125 °C	-	2.00	-	
			T _J =150 °C	-	2.05	-	
V _{CESat} (Chip)		I _C =450 A, V _{GE} =15 V, (Note5)	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		-	-	45	nF
C _{oes}	Output capacitance			-	-	9.0	
C _{res}	Reverse transfer capacitance			-	-	0.75	
Q _G	Gate charge	V _{CC} =600 V, I _C =450 A, V _{GE} =15 V		-	945	-	nC
t _{d(on)}	Turn-on delay time	V _{CC} =600 V, I _C =450 A, V _{GE} =±15 V, R _G =0 Ω, Inductive load		-	-	800	ns
t _r	Rise time			-	-	200	
t _{d(off)}	Turn-off delay time			-	-	600	
t _f	Fall time			-	-	300	
V _{EC} ^(Note1) (Terminal)	Emitter-collector voltage	I _E =450 A, G-E short-circuited, Refer to the figure of test circuit (Note5)	T _J =25 °C	-	2.60	3.40	V
			T _J =125 °C	-	2.16	-	
			T _J =150 °C	-	2.10	-	
V _{EC} ^(Note1) (Chip)		I _E =450 A, G-E short-circuited, (Note5)	T _J =25 °C	-	2.50	3.30	V
			T _J =125 °C	-	2.06	-	
			T _J =150 °C	-	2.00	-	
t _{rr} ^(Note1)	Reverse recovery time	V _{CC} =600 V, I _E =450 A, V _{GE} =±15 V, R _G =0 Ω, Inductive load		-	-	300	ns
Q _{rr} ^(Note1)	Reverse recovery charge			-	12	-	
E _{on}	Turn-on switching energy per pulse	V _{CC} =600 V, I _C =I _E =450 A, V _{GE} =±15 V, R _G =0 Ω, T _J =150 °C, Inductive load		-	35.8	-	mJ
E _{off}	Turn-off switching energy per pulse			-	52.4	-	
E _{rr} ^(Note1)	Reverse recovery energy per pulse					-	27.9
R _{CC'+EE'}	Internal lead resistance	Main terminals-chip, per switch, T _C =25 °C ^(Note2)		-	-	0.7	mΩ
r _g	Internal gate resistance	Per switch		-	4.3	-	Ω

ELECTRICAL CHARACTERISTICS (cont.; $T_j=25\text{ }^{\circ}\text{C}$, unless otherwise specified)

NTC THERMISTOR PART

Symbol	Item	Conditions	Limits			Unit
			Min.	Typ.	Max.	
R_{25}	Zero-power resistance	$T_C=25\text{ }^{\circ}\text{C}$ (Note4)	4.85	5.00	5.15	$k\Omega$
$\Delta R/R$	Deviation of resistance	$R_{100}=493\text{ }\Omega$, $T_C=100\text{ }^{\circ}\text{C}$ (Note4)	-7.3	-	+7.8	%
$B_{(25/50)}$	B-constant	Approximate by equation (Note6)	-	3375	-	K
P_{25}	Power dissipation	$T_C=25\text{ }^{\circ}\text{C}$ (Note4)	-	-	10	mW

THERMAL RESISTANCE CHARACTERISTICS

Symbol	Item	Conditions	Limits			Unit
			Min.	Typ.	Max.	
$R_{th(j-c)Q}$	Thermal resistance	Junction to case, per Inverter IGBT (Note4)	-	-	54	K/kW
$R_{th(j-c)D}$		Junction to case, per Inverter DIODE (Note4)	-	-	86	
$R_{th(c-s)}$	Contact thermal resistance	Case to heat sink, per 1 module, Thermal grease applied (Note4, 7)	-	15	-	K/kW

MECHANICAL CHARACTERISTICS

Symbol	Item	Conditions	Limits			Unit
			Min.	Typ.	Max.	
M_t	Mounting torque	Main terminals M 6 screw	3.5	4.0	4.5	N·m
M_s	Mounting torque	Mounting to heat sink M 5 screw	2.5	3.0	3.5	N·m
m	mass	-	-	350	-	g
d_s	Creepage distance	Terminal to terminal	17	-	-	mm
		Terminal to base plate	18.5	-	-	
d_a	Clearance	Terminal to terminal	10	-	-	mm
		Terminal to base plate	16.3	-	-	
e_c	Flatness of base plate	On the centerline X, Y (Note8)	± 0	-	+100	μm

Note1. Represent ratings and characteristics of the anti-parallel, emitter-collector free wheeling diode (DIODE)

- Junction temperature (T_j) should not increase beyond $T_{j\text{max}}$ rating.
- Pulse width and repetition rate should be such that the device junction temperature (T_j) dose not exceed $T_{j\text{max}}$ rating.
- 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.
- Pulse width and repetition rate should be such as to cause negligible temperature rise.

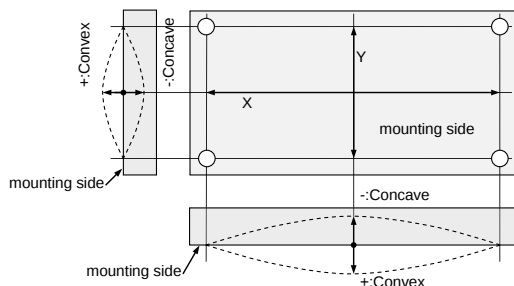
$$6. B_{(25/50)} = \ln\left(\frac{R_{25}}{R_{50}}\right) / \left(\frac{1}{T_{25}} - \frac{1}{T_{50}}\right),$$

R_{25} : resistance at absolute temperature T_{25} [K]; $T_{25}=25\text{ }^{\circ}\text{C}+273.15=298.15$ [K]

R_{50} : resistance at absolute temperature T_{50} [K]; $T_{50}=50\text{ }^{\circ}\text{C}+273.15=323.15$ [K]

- Typical value is measured by using thermally conductive grease of $\lambda=0.9\text{ W/(m}\cdot\text{K)}$.

- The base plate (mounting side) flatness measurement points (X, Y) are as follows of the following figure.



- Use the following screws when mounting the printed circuit board (PCB) on the stand offs.
"φ2.6×10 or φ2.6×12 B1 tapping screw"
The length of the screw depends on thickness (t1.6~t2.0) of the PCB.

< IGBT MODULES >

CM450DX-24S1

HIGH POWER SWITCHING USE

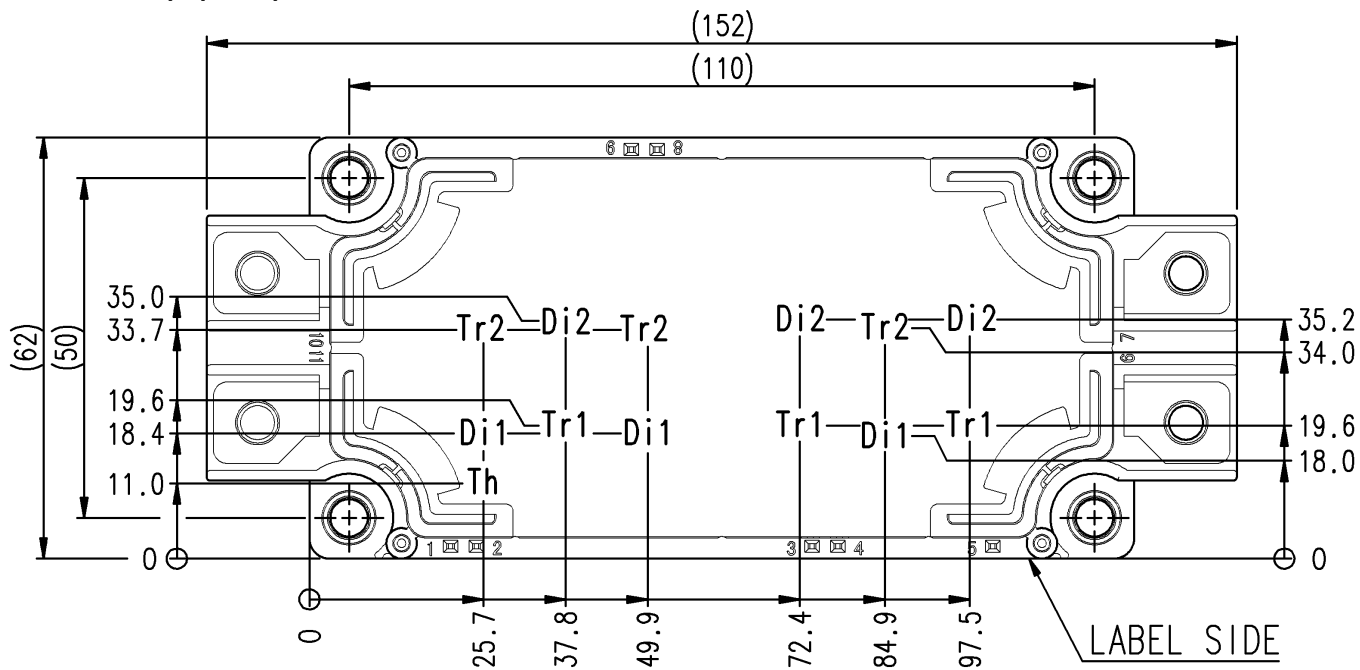
INSULATED TYPE

RECOMMENDED OPERATING CONDITIONS

Symbol	Item	Conditions	Limits			Unit
			Min.	Typ.	Max.	
V_{CC}	(DC) Supply voltage	Applied across C1-E2 terminals	-	600	850	V
V_{GEon}	Gate (-emitter drive) voltage	Applied across G1-Es1/G2-Es2 terminals	13.5	15.0	16.5	V
R_G	External gate resistance	Per switch	0	-	10	Ω

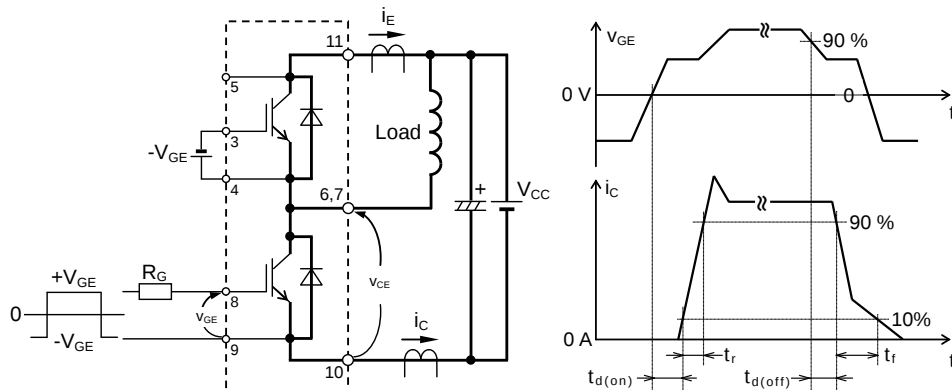
CHIP LOCATION (Top view)

Dimension in mm, tolerance: ± 1 mm

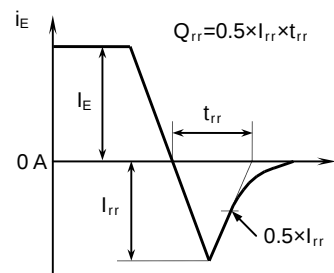


Tr1/Tr2: IGBT, Di1/Di2: DIODE, Th: NTC thermistor

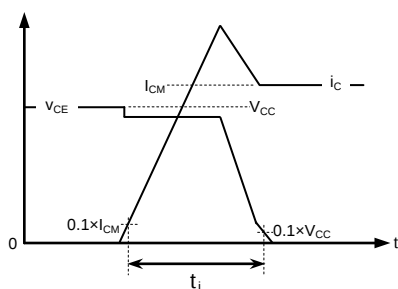
TEST CIRCUIT AND WAVEFORMS



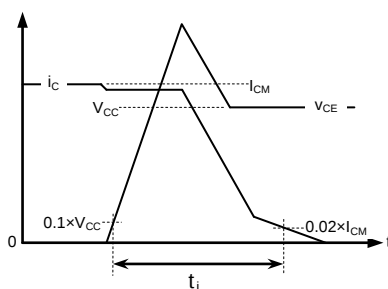
Switching characteristics test circuit and waveforms



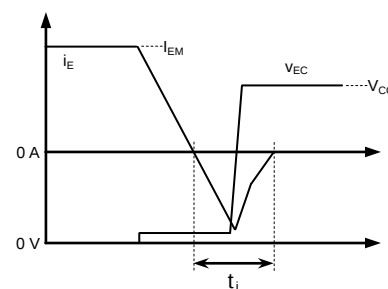
t_{rr} , Q_{rr} characteristics test waveform



IGBT Turn-on switching energy



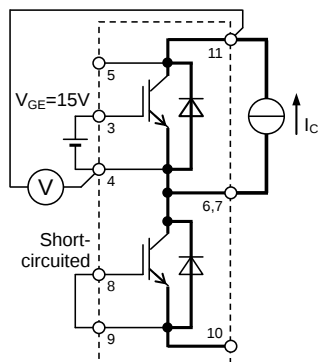
IGBT Turn-off switching energy



DIODE Reverse recovery energy

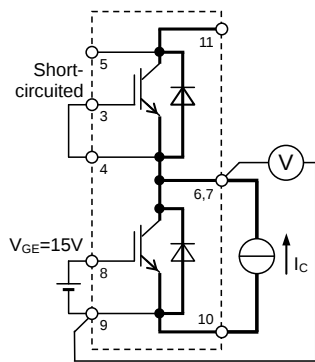
Turn-on / Turn-off switching energy and Reverse recovery energy test waveforms (Integral time instruction drawing)

TEST CIRCUIT

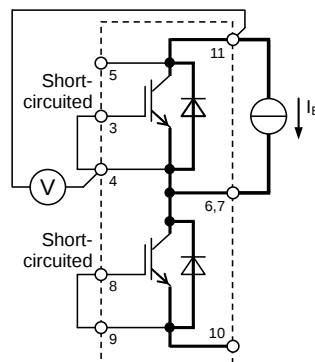


Tr1

V_{CEsat} characteristics test circuit

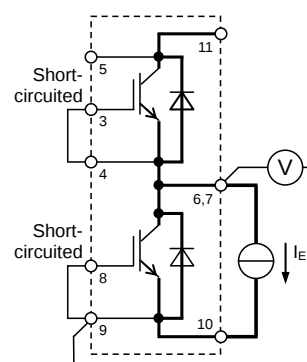


Tr2



Di1

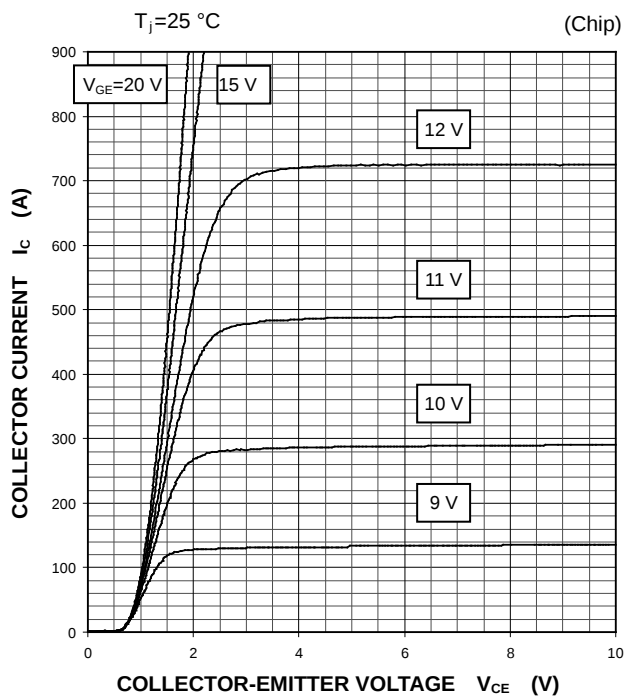
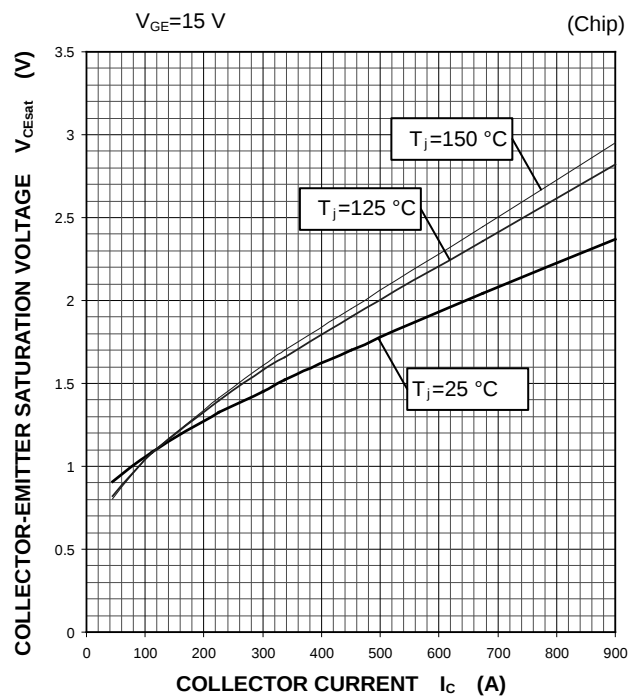
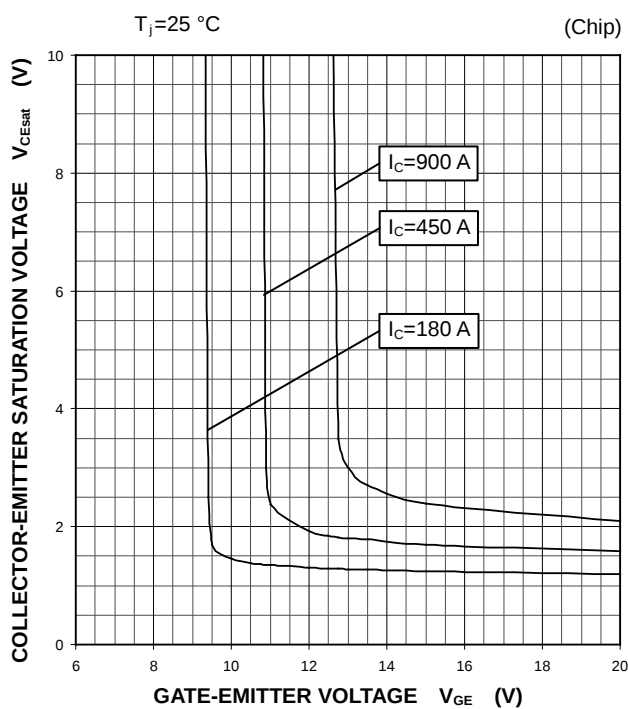
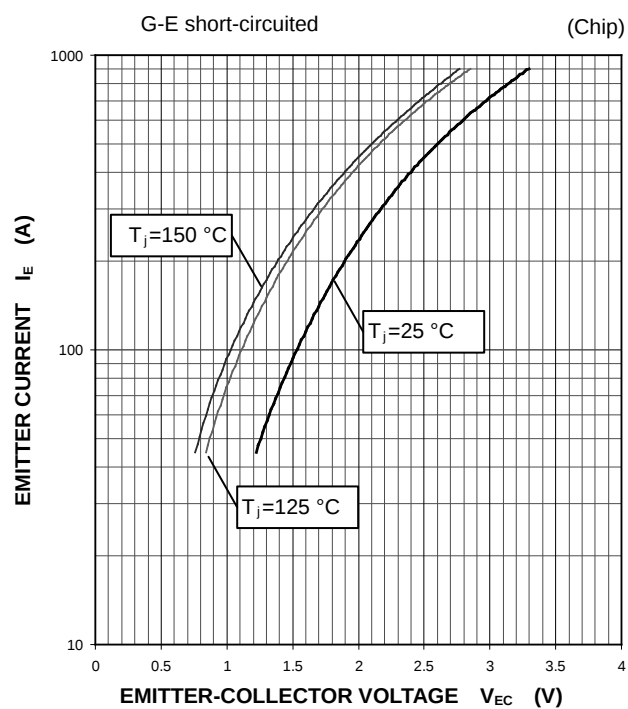
V_{EC} characteristics test circuit



Di2

PERFORMANCE CURVES

INVERTER PART

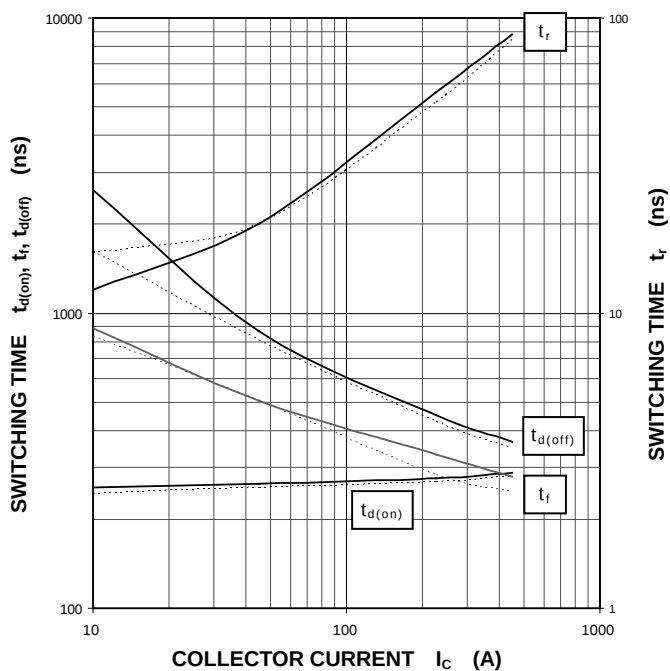
OUTPUT CHARACTERISTICS
(TYPICAL)COLLECTOR-EMITTER SATURATION VOLTAGE
CHARACTERISTICS
(TYPICAL)COLLECTOR-EMITTER SATURATION VOLTAGE
CHARACTERISTICS
(TYPICAL)FREE WHEELING DIODE
FORWARD CHARACTERISTICS
(TYPICAL)

PERFORMANCE CURVES

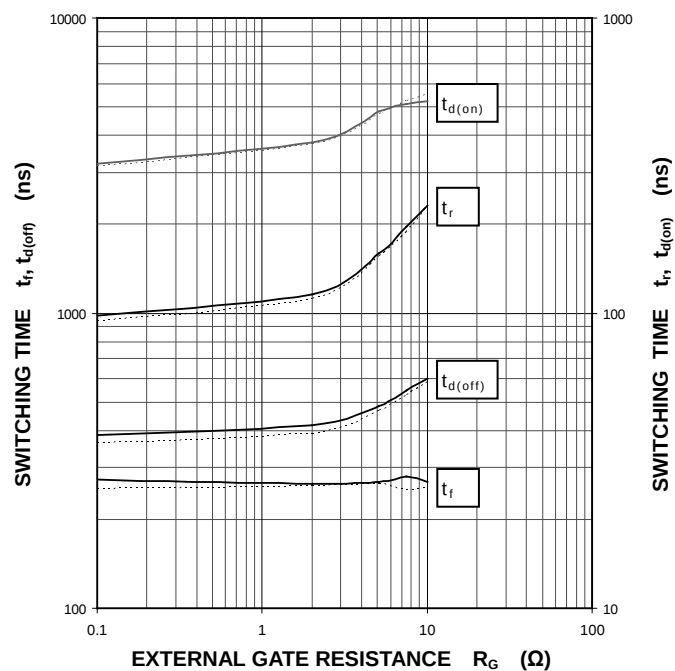
INVERTER PART

HALF-BRIDGE
SWITCHING CHARACTERISTICS
(TYPICAL)

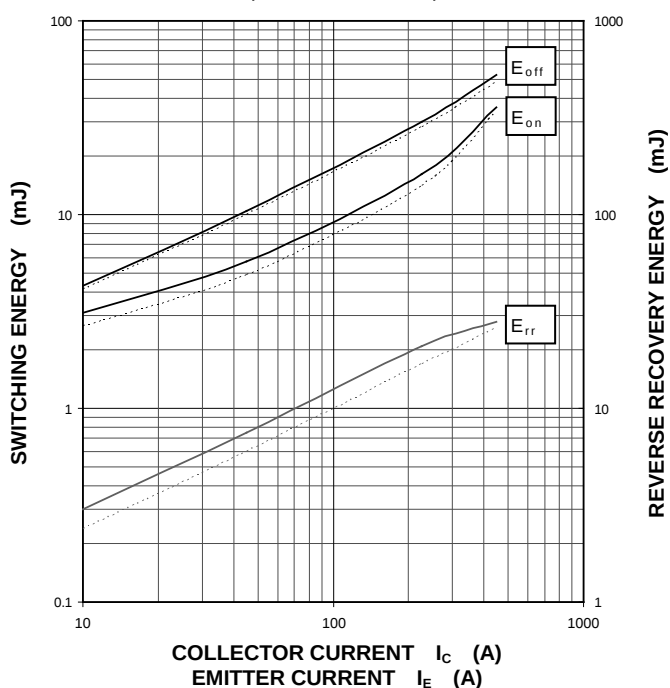
$V_{CC}=600\text{ V}$, $V_{GE}=\pm 15\text{ V}$, $R_G=0\ \Omega$, INDUCTIVE LOAD
 —: $T_J=150\text{ }^\circ\text{C}$, - - - -: $T_J=125\text{ }^\circ\text{C}$

HALF-BRIDGE
SWITCHING CHARACTERISTICS
(TYPICAL)

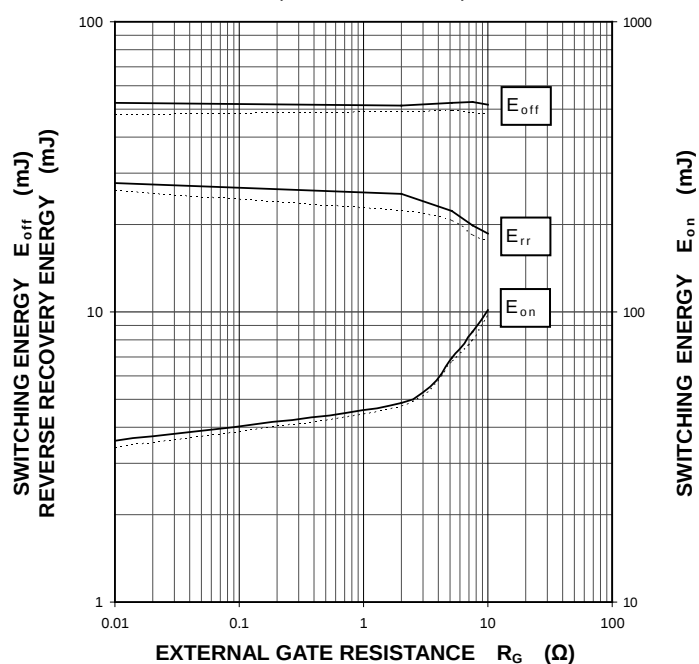
$V_{CC}=600\text{ V}$, $V_{GE}=\pm 15\text{ V}$, $I_C=450\text{ A}$, INDUCTIVE LOAD
 —: $T_J=150\text{ }^\circ\text{C}$, - - - -: $T_J=125\text{ }^\circ\text{C}$

HALF-BRIDGE
SWITCHING CHARACTERISTICS
(TYPICAL)

$V_{CC}=600\text{ V}$, $V_{GE}=\pm 15\text{ V}$, $R_G=0\ \Omega$,
INDUCTIVE LOAD, PER PULSE
 —: $T_J=150\text{ }^\circ\text{C}$, - - - -: $T_J=125\text{ }^\circ\text{C}$

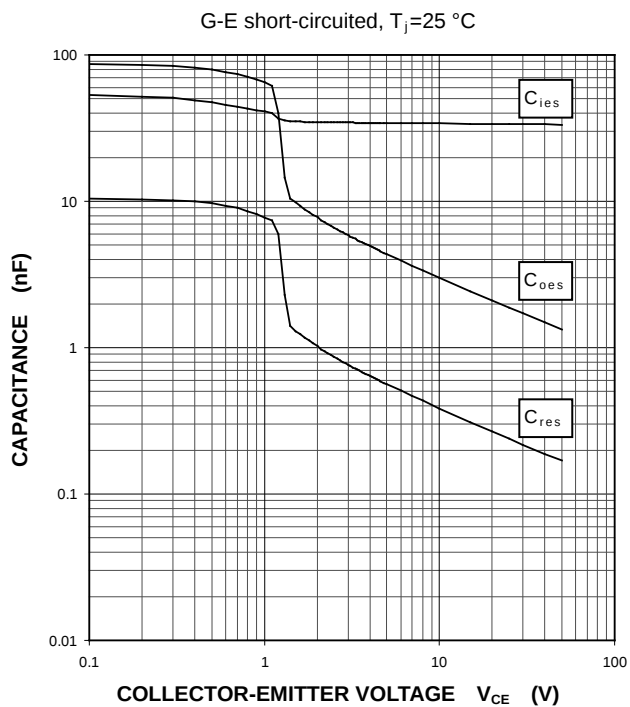
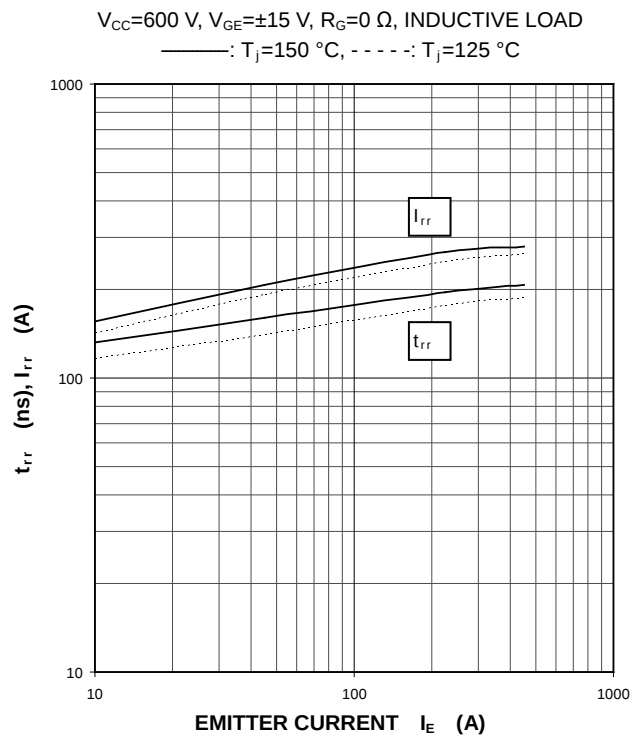
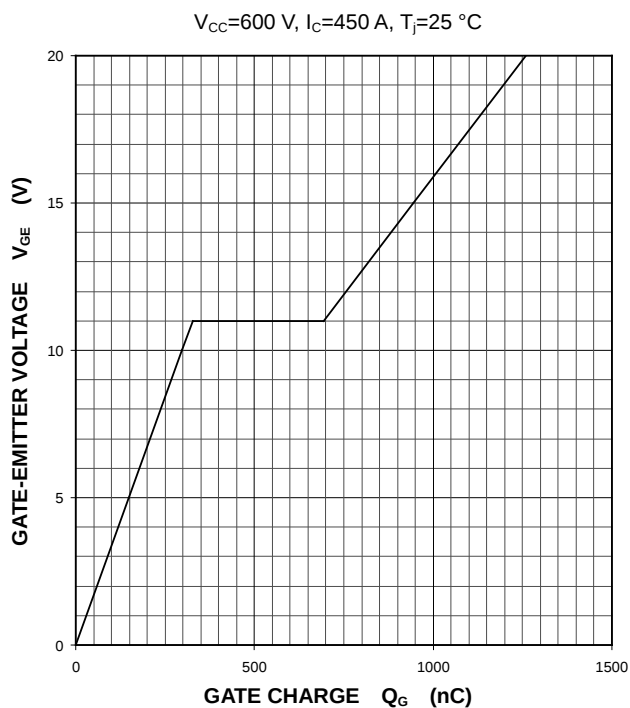
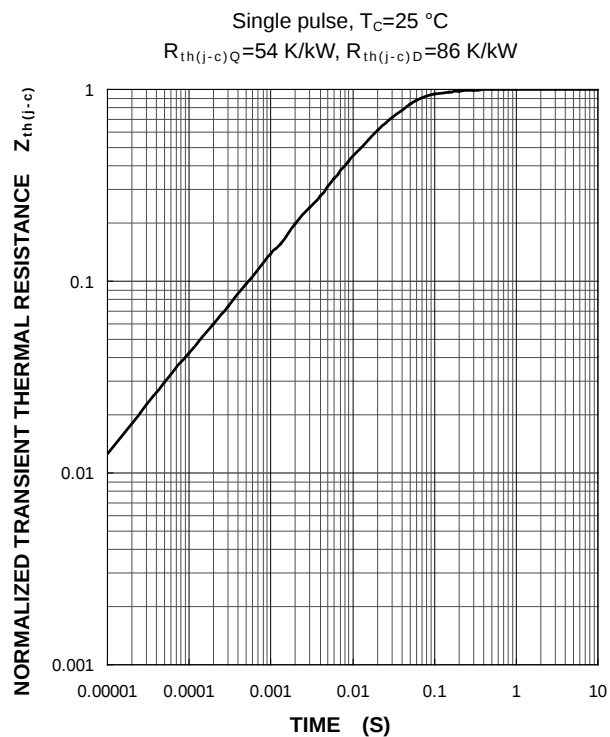
HALF-BRIDGE
SWITCHING CHARACTERISTICS
(TYPICAL)

$V_{CC}=600\text{ V}$, $V_{GE}=\pm 15\text{ V}$, $I_C/I_E=450\text{ A}$,
INDUCTIVE LOAD, PER PULSE
 —: $T_J=150\text{ }^\circ\text{C}$, - - - -: $T_J=125\text{ }^\circ\text{C}$



PERFORMANCE CURVES

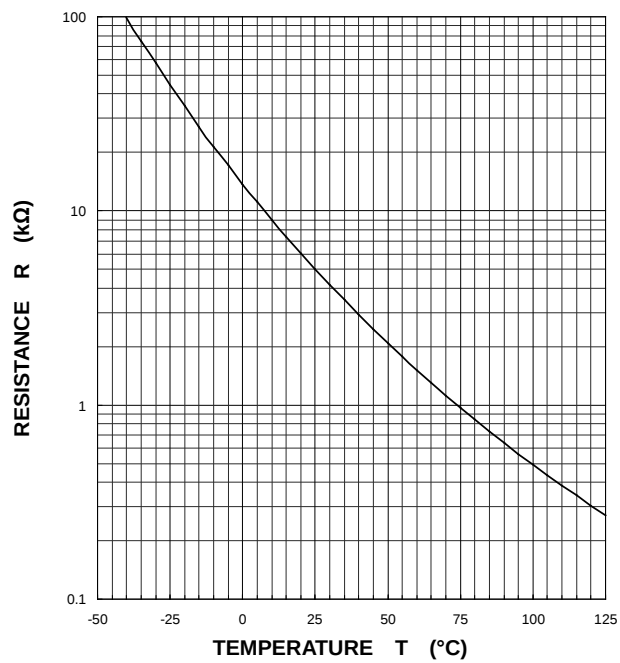
INVERTER PART

CAPACITANCE CHARACTERISTICS
(TYPICAL)FREE WHEELING DIODE
REVERSE RECOVERY CHARACTERISTICS
(TYPICAL)GATE CHARGE CHARACTERISTICS
(TYPICAL)TRANSIENT THERMAL IMPEDANCE CHARACTERISTICS
(MAXIMUM)

PERFORMANCE CURVES

NTC thermistor part

TEMPERATURE CHARACTERISTICS
(TYPICAL)



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