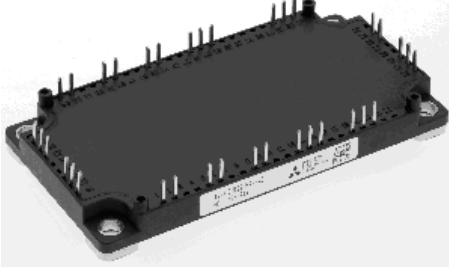


< IGBT MODULES >

CM50MXA-24S

HIGH POWER SWITCHING USE
INSULATED TYPE



Collector current I_C **50 A**
 Collector-emitter voltage V_{CES} **1200 V**
 Maximum junction temperature T_{jmax} **175 °C**

- Flat base Type
- Copper base plate
- Tin plating pin terminals
- RoHS Directive compliant

CIB (Converter+Inverter+Chopper Brake)

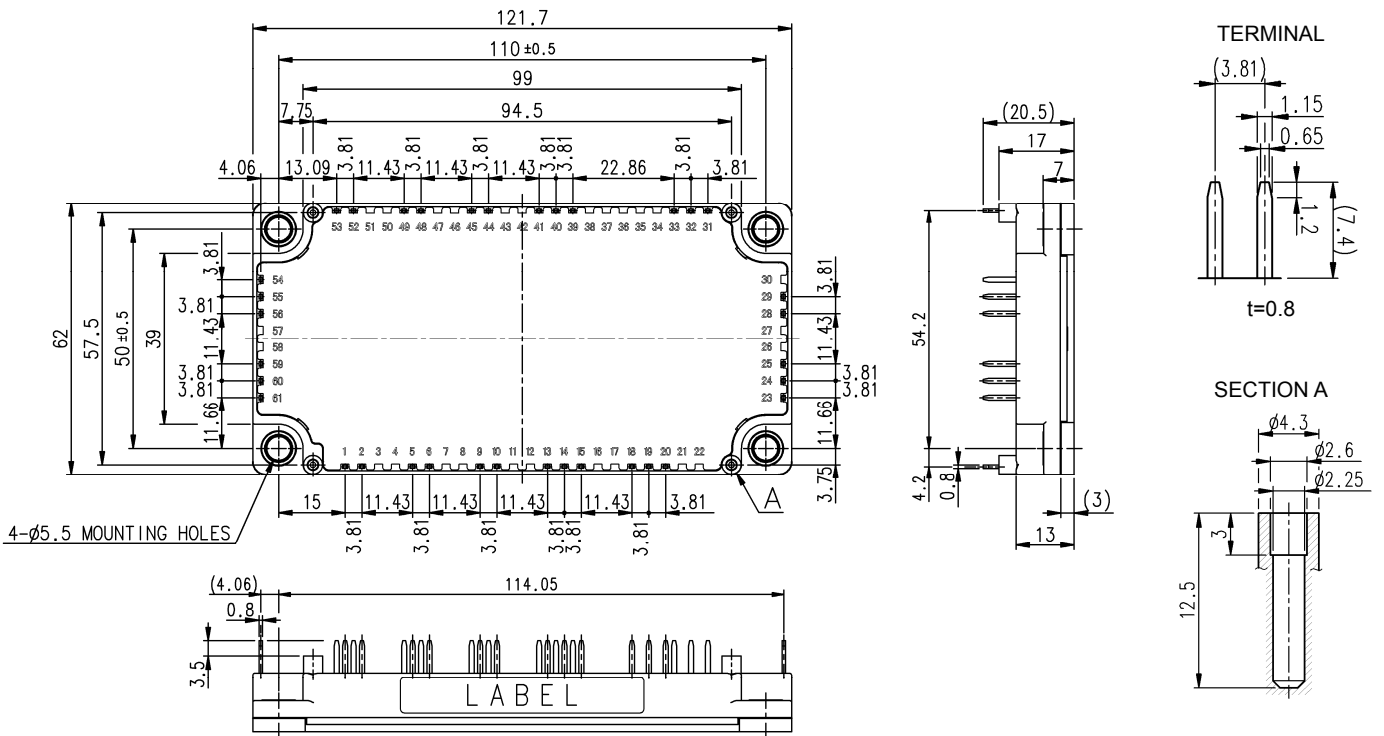
- Recognized under UL1557, File E323585

APPLICATION

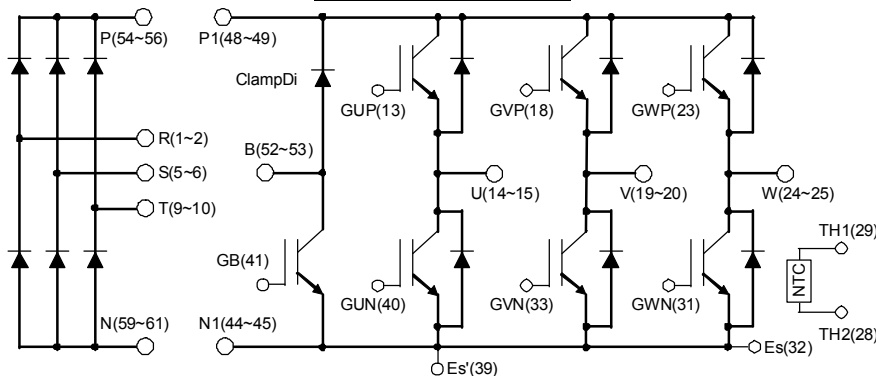
AC Motor Control, Motion/Servo Control, Power supply, etc.

OUTLINE DRAWING & INTERNAL CONNECTION

Dimension in mm



INTERNAL CONNECTION



Caution: Each (two or three) pin terminal of P/N/P1/N1/U/V/W/B/R/S/T is connected in the module, but should use all each three pins for the external wiring.

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.

< IGBT MODULES >

CM50MXA-24S

HIGH POWER SWITCHING USE
INSULATED TYPE

ABSOLUTE MAXIMUM RATINGS ($T_j=25\text{ }^\circ\text{C}$, 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, $T_c=125\text{ }^\circ\text{C}$ (Note2, 4)	50	A
I_{CRM}		Pulse, Repetitive (Note3)	100	
P_{tot}	Total power dissipation	$T_c=25\text{ }^\circ\text{C}$ (Note2, 4)	425	W
I_E (Note1)	Emitter current	(Note2)	50	A
I_{ERM} (Note1)		Pulse, Repetitive (Note3)	100	
T_{jmax}	Maximum junction temperature	Instantaneous event (overload)	175	$^\circ\text{C}$

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, $T_c=125\text{ }^\circ\text{C}$ (Note2, 4)	35	A
I_{CRM}		Pulse, Repetitive (Note3)	70	
P_{tot}	Total power dissipation	$T_c=25\text{ }^\circ\text{C}$ (Note2, 4)	355	W
V_{RRM}	Repetitive peak reverse voltage	G-E short-circuited	1200	V
I_F	Forward current	(Note2)	35	A
I_{FRM}		Pulse, Repetitive (Note3)	70	
T_{jmax}	Maximum junction temperature	Instantaneous event (overload)	175	$^\circ\text{C}$

CONVERTER PART CONVDI

Symbol	Item	Conditions	Rating	Unit
V_{RRM}	Repetitive peak reverse voltage	-	1600	V
E_a	Recommended AC input voltage	RMS	440	V
I_O	DC output current	3-phase full wave rectifying, $T_c=125\text{ }^\circ\text{C}$ (Note4)	50	A
I_{FSM}	Surge forward current	The sine half wave 1 cycle peak value, $f=60\text{ Hz}$, non-repetitive	500	A
I^2t	Current square time	Value for one cycle of surge current	1040	A^2s
T_{jmax}	Maximum junction temperature	Instantaneous event (overload)	150	$^\circ\text{C}$

MODULE

Symbol	Item	Conditions	Rating	Unit
V_{isol}	Isolation voltage	Terminals to base plate, RMS, $f=60\text{ Hz}$, AC 1 min	2500	V
T_{Cmax}	Maximum case temperature	(Note4)	125	$^\circ\text{C}$
T_{jop}	Operating junction temperature	Continuous operation (under switching)	-40 ~ +150	$^\circ\text{C}$
T_{stg}	Storage temperature	-	-40 ~ +125	

MECHANICAL CHARACTERISTICS

Symbol	Item	Conditions	Limits			Unit
			Min.	Typ.	Max.	
M_s	Mounting torque	Mounting to heat sink M 5 screw	2.5	3.0	3.5	N·m
d_s	Creepage distance	Terminal to terminal	6.47	-	-	mm
		Terminal to base plate	14.27	-	-	
d_a	Clearance	Terminal to terminal	6.47	-	-	mm
		Terminal to base plate	12.33	-	-	
m	Weight	-	-	300	-	g
e_c	Flatness of base plate	On the centerline X, Y (Note5)	± 0	-	+100	μm

< IGBT MODULES >

CM50MXA-24S

HIGH POWER SWITCHING USE
INSULATED TYPE

ELECTRICAL CHARACTERISTICS (T_j=25 °C, unless otherwise specified)
INVERTER PART IGBT/FWDI

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 =5 mA, V _{CE} =10 V	5.4	6.0	6.6	V	
V _{CEsat}	Collector-emitter saturation voltage	I _C =50 A ^(Note6) , V _{GE} =15 V, (Terminal)	T _j =25 °C	-	1.80	2.25	V
			T _j =125 °C	-	2.00	-	
			T _j =150 °C	-	2.05	-	
		I _C =50 A ^(Note6) , V _{GE} =15 V, (Chip)	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	-	-	5.0	nF	
C _{oes}	Output capacitance		-	-	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, R _G =13 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} ^(Note1)	Emitter-collector voltage	I _E =50 A ^(Note6) , G-E short-circuited, (Terminal)	T _j =25 °C	-	1.80	2.25	V
			T _j =125 °C	-	1.80	-	
			T _j =150 °C	-	1.80	-	
		I _E =50 A ^(Note6) , G-E short-circuited, (Chip)	T _j =25 °C	-	1.70	2.15	V
			T _j =125 °C	-	1.70	-	
			T _j =150 °C	-	1.70	-	
t _{rr} ^(Note1)	Reverse recovery time	V _{CC} =600 V, I _E =50 A, V _{GE} =±15 V, R _G =13 Ω, Inductive load	-	-	300	ns	
Q _{rr} ^(Note1)	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 _E =50 A, V _{GE} =±15 V, R _G =13 Ω, T _j =150 °C, Inductive load	-	5.5	-	mJ	
E _{off}	Turn-off switching energy per pulse		-	5.3	-		
E _{rr} ^(Note1)	Reverse recovery energy per pulse	Inductive load	-	4.5	-	mJ	
R _{CC'+EE'}	Internal lead resistance	Main terminals-chip, per switch, T _C =25 °C ^(Note4)	-	-	5.0	mΩ	
r _g	Internal gate resistance	Per switch	-	0	-	Ω	

BRAKE PART IGBT/CLAMPDI

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 =3.5 mA, V _{CE} =10 V	5.4	6.0	6.6	V	
V _{CEsat}	Collector-emitter saturation voltage	I _C =35 A ^(Note6) , V _{GE} =15 V, (Terminal)	T _j =25 °C	-	1.80	2.25	V
			T _j =125 °C	-	2.00	-	
			T _j =150 °C	-	2.05	-	
		I _C =35 A ^(Note6) , V _{GE} =15 V, (Chip)	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	-	-	3.5	nF	
C _{oes}	Output capacitance		-	-	0.7		
C _{res}	Reverse transfer capacitance		-	-	0.06		
Q _G	Gate charge	V _{CC} =600 V, I _C =35 A, V _{GE} =15 V	-	82	-	nC	

< IGBT MODULES >

CM50MXA-24S

HIGH POWER SWITCHING USE
INSULATED TYPE

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

BRAKE PART IGBT/CLAMPDi

Symbol	Item	Conditions	Limits			Unit	
			Min.	Typ.	Max.		
t _{d(on)}	Turn-on delay time	V _{CC} =600 V, I _C =35 A, V _{GE} =±15 V, R _G =18 Ω, Inductive load	-	-	300	ns	
t _r	Rise time		-	-	200		
t _{d(off)}	Turn-off delay time		-	-	600		
t _f	Fall time		-	-	300		
V _F	Forward voltage	I _F =35 A ^(Note6) , G-E short-circuited, (Terminal)	T _j =25 °C	-	1.80	2.25	V
			T _j =125 °C	-	1.80	-	
			T _j =150 °C	-	1.80	-	
		I _F =35 A ^(Note6) , G-E short-circuited, (Chip)	T _j =25 °C	-	1.70	2.15	V
			T _j =125 °C	-	1.70	-	
			T _j =150 °C	-	1.70	-	
t _{rr}	Reverse recovery time	V _{CC} =600 V, I _F =35 A, V _{GE} =±15 V, R _G =18 Ω, Inductive load	-	-	300	ns	
Q _{rr}	Reverse recovery charge	R _G =18 Ω, Inductive load	-	1.9	-	μC	
E _{on}	Turn-on switching energy per pulse	V _{CC} =600 V, I _C =I _F =35 A, V _{GE} =±15 V, R _G =18 Ω, T _j =150 °C,	-	4.2	-	mJ	
E _{off}	Turn-off switching energy per pulse	Inductive load	-	3.7	-		
E _{rr}	Reverse recovery energy per pulse	Inductive load	-	3.5	-		
r _g	Internal gate resistance	-	-	0	-	Ω	

CONVERTER PART CONVDi

Symbol	Item	Conditions	Limits			Unit
			Min.	Typ.	Max.	
I _{RRM}	Repetitive peak reverse current	V _R =V _{RRM} , T _j =150 °C	-	-	6.0	mA
V _F (Terminal)	Forward voltage	I _F =50 A ^(Note6)	-	1.2	1.6	V

NTC THERMISTOR PART

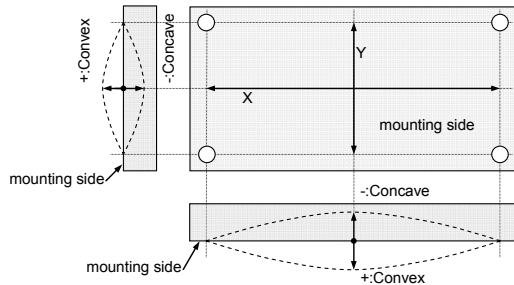
Symbol	Item	Conditions	Limits			Unit
			Min.	Typ.	Max.	
R ₂₅	Zero-power resistance	T _C =25 °C ^(Note4)	4.85	5.00	5.15	kΩ
ΔR/R	Deviation of resistance	R ₁₀₀ =493 Ω, T _C =100 °C ^(Note4)	-7.3	-	+7.8	%
B _(25/50)	B-constant	Approximate by equation ^(Note7)	-	3375	-	K
P ₂₅	Power dissipation	T _C =25 °C ^(Note4)	-	-	10	mW

THERMAL RESISTANCE CHARACTERISTICS

Symbol	Item	Conditions	Limits			Unit
			Min.	Typ.	Max.	
R _{th(j-c)Q}	Thermal resistance ^(Note4)	Junction to case, per Inverter IGBT	-	-	0.35	K/W
R _{th(j-c)D}		Junction to case, per Inverter FWDi	-	-	0.63	
R _{th(j-c)Q}		Junction to case, per Brake IGBT	-	-	0.42	K/W
R _{th(j-c)D}		Junction to case, per Brake ClampDi	-	-	0.69	
R _{th(j-c)D}		Junction to case, per Converter ConvDi	-	-	0.33	K/W
R _{th(c-s)}		Contact thermal resistance ^(Note4)	Case to heat sink, per 1 module, Thermal grease applied ^(Note8)	-	15	-

< IGBT MODULES >
CM50MXA-24S
HIGH POWER SWITCHING USE
INSULATED TYPE

- Note1. Represent ratings and characteristics of the anti-parallel, emitter-collector free wheeling diode (FWDi).
- Junction temperature (T_j) should not increase beyond T_{jmax} rating.
 - Pulse width and repetition rate should be such that the device junction temperature (T_j) dose not exceed T_{jmax} 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.
 - The base plate (mounting side) flatness measurement points (X, Y) are as follows of the following figure.



- Pulse width and repetition rate should be such as to cause negligible temperature rise. Refer to the figure of test circuit.

$$7. B_{(25/50)} = \ln\left(\frac{R_{25}}{R_{50}}\right) / \left(\frac{1}{T_{25}} - \frac{1}{T_{50}}\right),$$

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 $\lambda=0.9\text{ W/(m}\cdot\text{K)}$.
- Use the following screws when mounting the printed circuit board (PCB) on the stand offs.
 "ST2.6×10 or ST2.6×12 self tapping screw"
 The length of the screw depends on the thickness of the PCB.

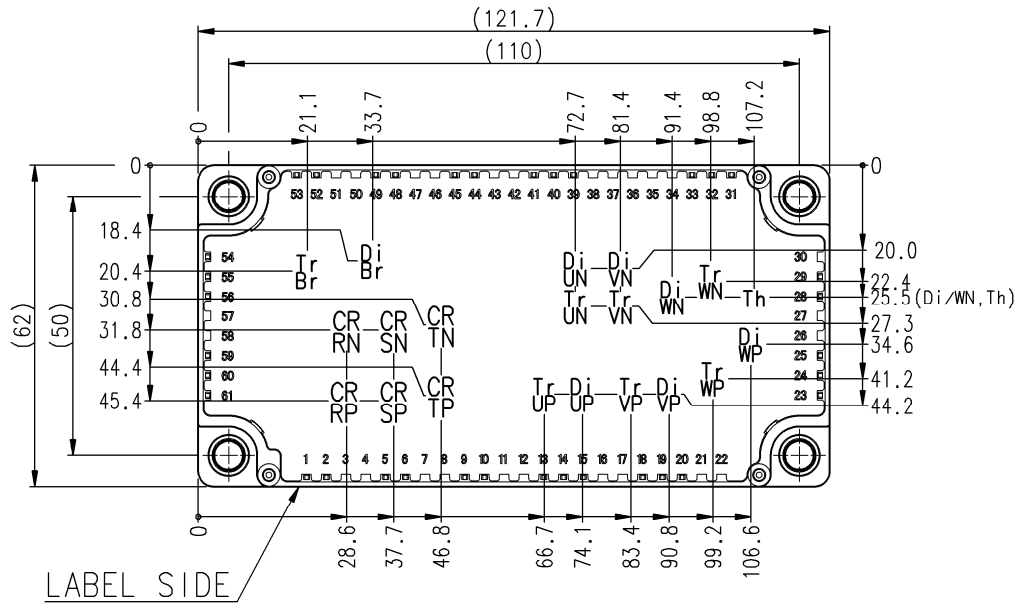
RECOMMENDED OPERATING CONDITIONS

Symbol	Item	Conditions	Limits			Unit
			Min.	Typ.	Max.	
V_{CC}	(DC) Supply voltage	Applied across P-N/P1-N1 terminals	-	600	850	V
V_{GEon}	Gate (-emitter drive) voltage	Applied across GB-Es1/ G*P-*/G*N-Es(*=U, V, W) terminals	13.5	15.0	16.5	V
R_G	External gate resistance	Per switch				Ω
		Inverter IGBT	13	-	130	
		Brake IGBT	18	-	180	

< IGBT MODULES >
CM50MXA-24S
 HIGH POWER SWITCHING USE
 INSULATED TYPE

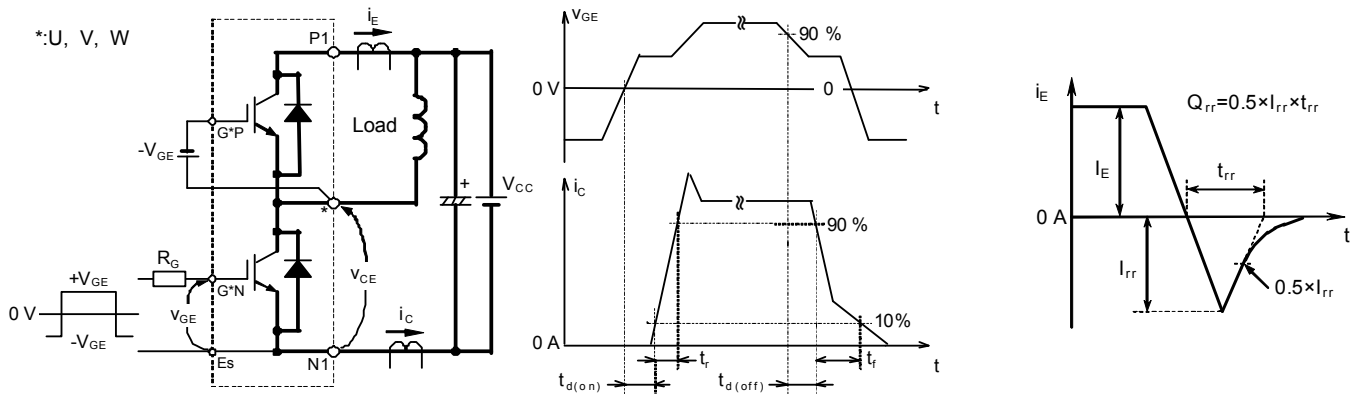
CHIP LOCATION (Top view)

Dimension in mm, tolerance: ±1 mm



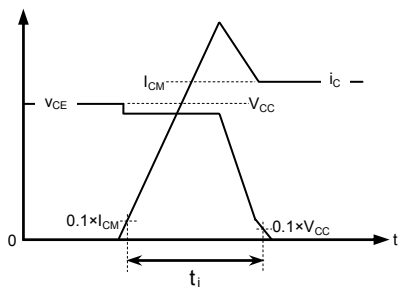
Tr*P/Tr*N/TrBr: IGBT, Di*P/Di*N: FWDi (*=U/V/W), DiBr: ClampDi, CR*P/CR*N: ConvDi (*=R/S/T), Th: NTC thermistor

TEST CIRCUIT AND WAVEFORMS

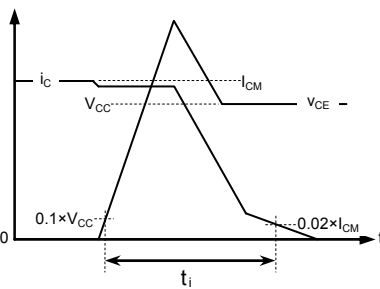


Switching characteristics test circuit and waveforms

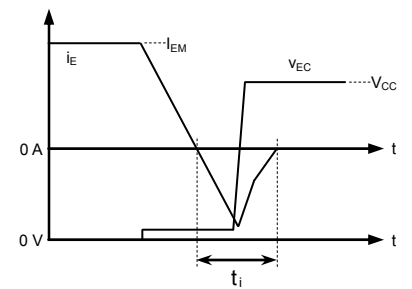
t_{rr} , Q_{rr} test waveform



IGBT Turn-on switching energy



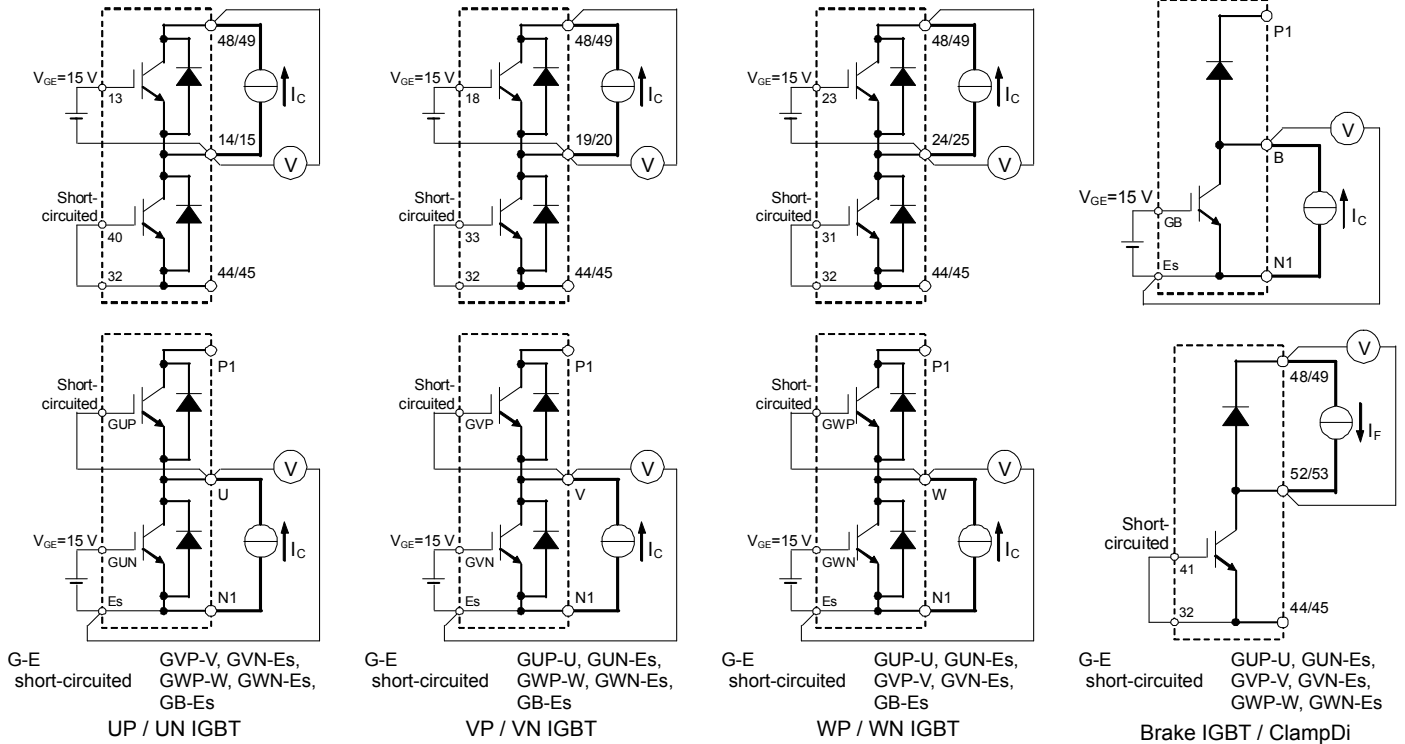
IGBT Turn-off switching energy



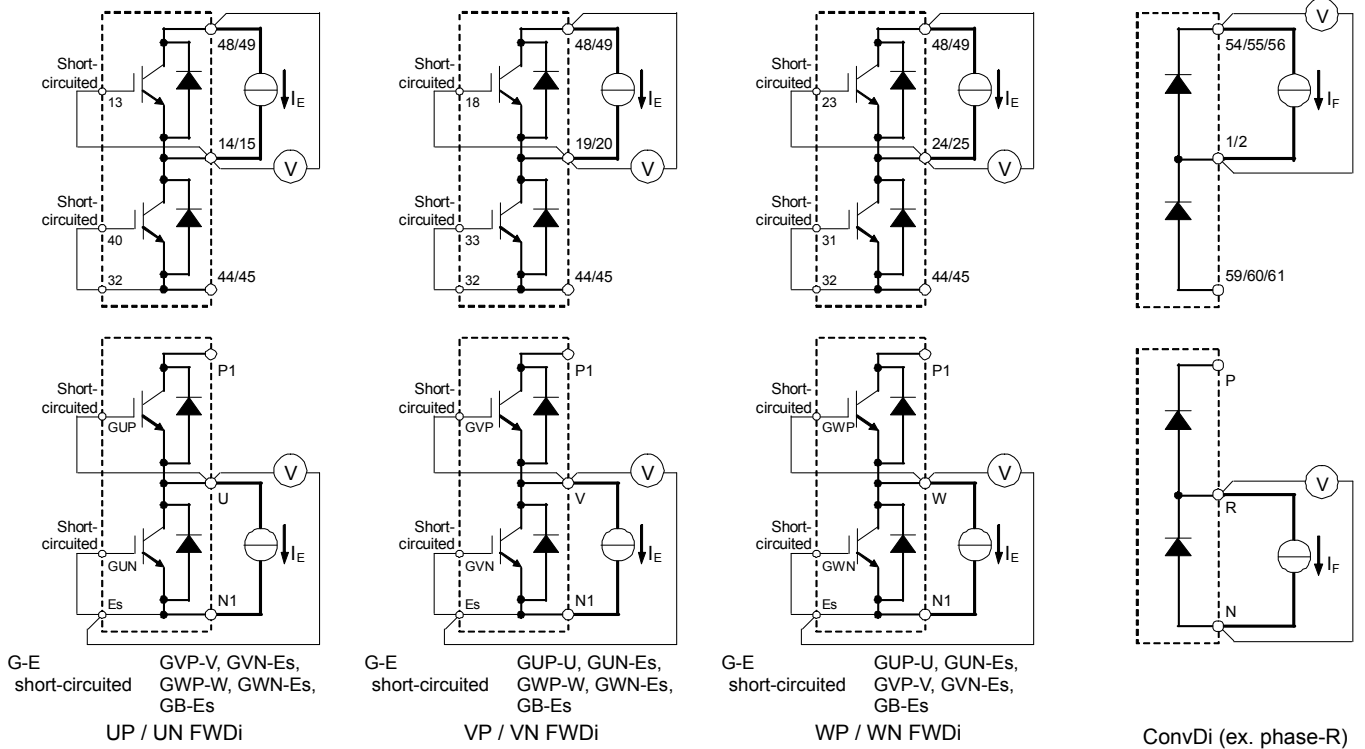
FWDi Reverse recovery energy

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

TEST CIRCUIT



V_{CEsat} / ClampDi V_F test circuit



V_{EC} / ConvDi V_F test circuit

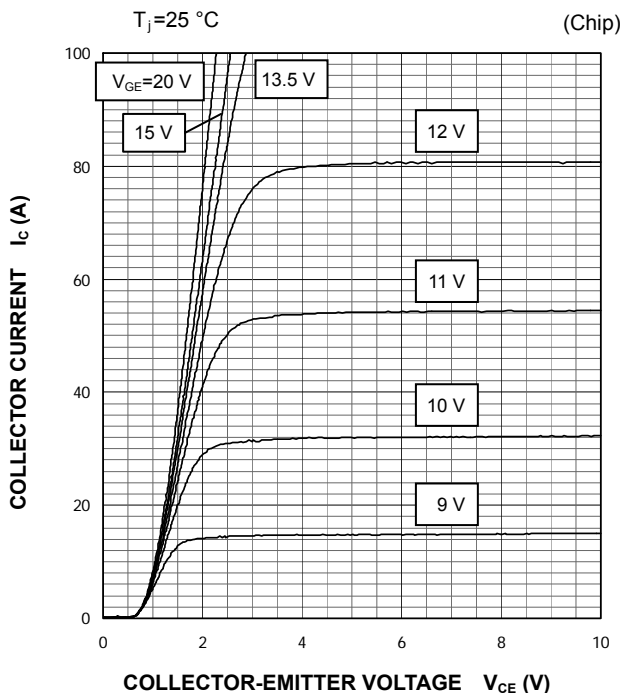
* In the above test circuit, should use all three main pin terminals (P1/N1/P/N/U/V/W) for connection with the terminals and the current source.

< IGBT MODULES >
CM50MXA-24S
 HIGH POWER SWITCHING USE
 INSULATED TYPE

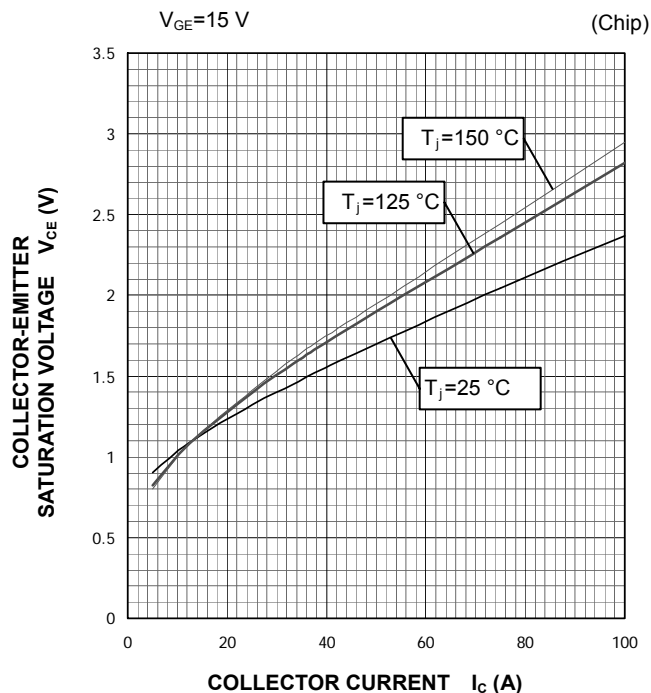
PERFORMANCE CURVES

INVERTER PART

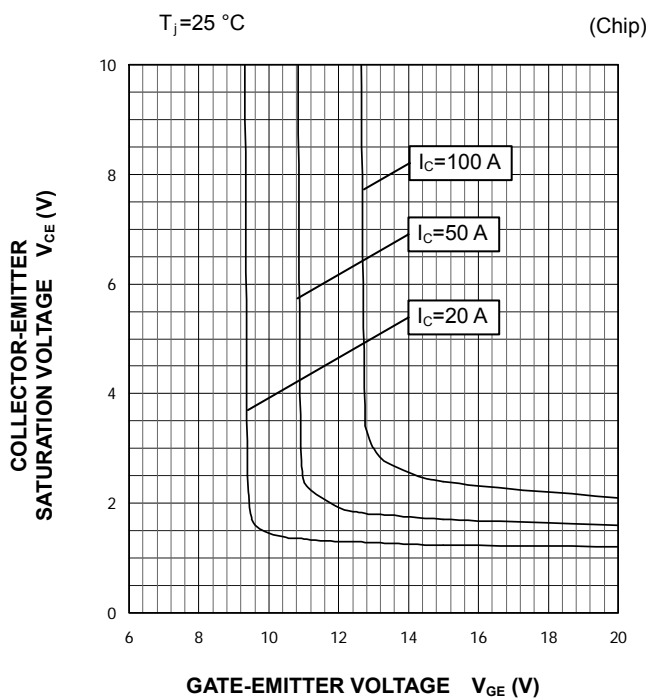
OUTPUT CHARACTERISTICS
(TYPICAL)



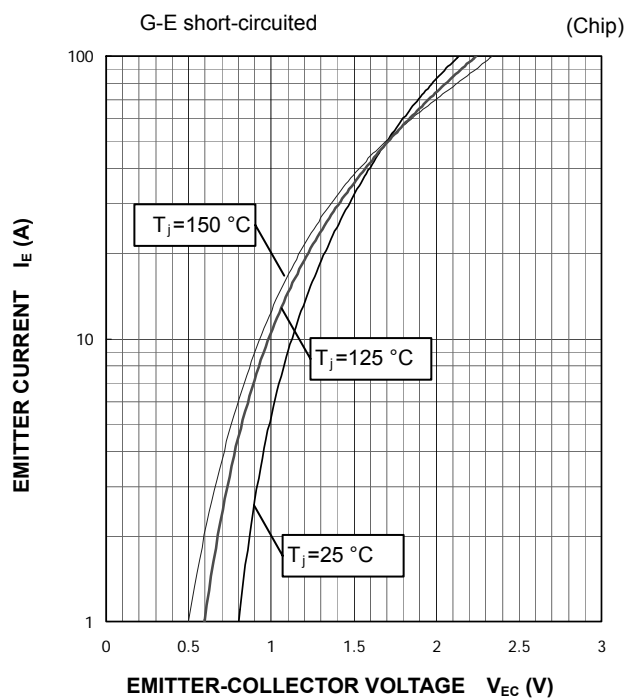
COLLECTOR-EMITTER SATURATION VOLTAGE
CHARACTERISTICS
(TYPICAL)



COLLECTOR-EMITTER SATURATION VOLTAGE
CHARACTERISTICS
(TYPICAL)



FREE WHEELING DIODE
FORWARD CHARACTERISTICS
(TYPICAL)

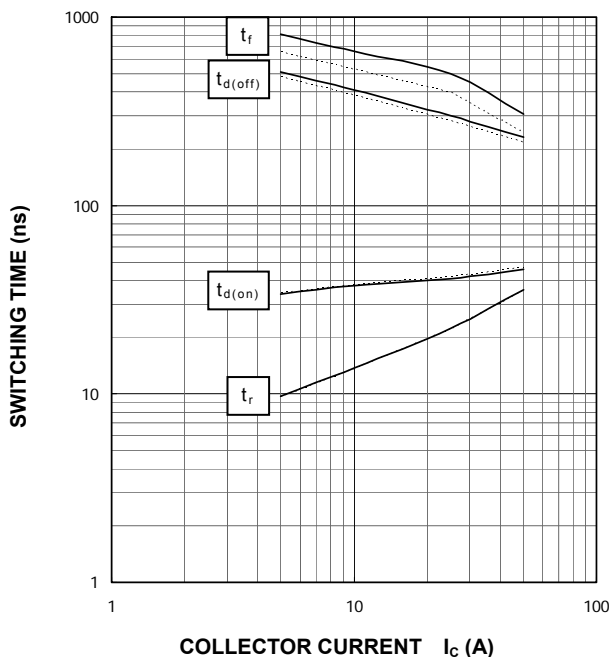


PERFORMANCE CURVES

INVERTER PART

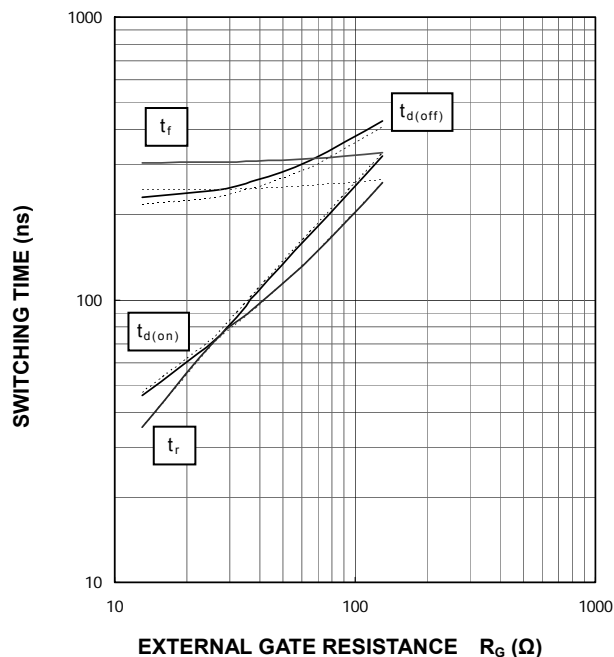
HALF-BRIDGE
SWITCHING CHARACTERISTICS
(TYPICAL)

$V_{CC}=600\text{ V}$, $V_{GE}=\pm 15\text{ V}$, $R_G=13\ \Omega$, INDUCTIVE LOAD
——: $T_j=150\text{ }^\circ\text{C}$, - - - -: $T_j=125\text{ }^\circ\text{C}$



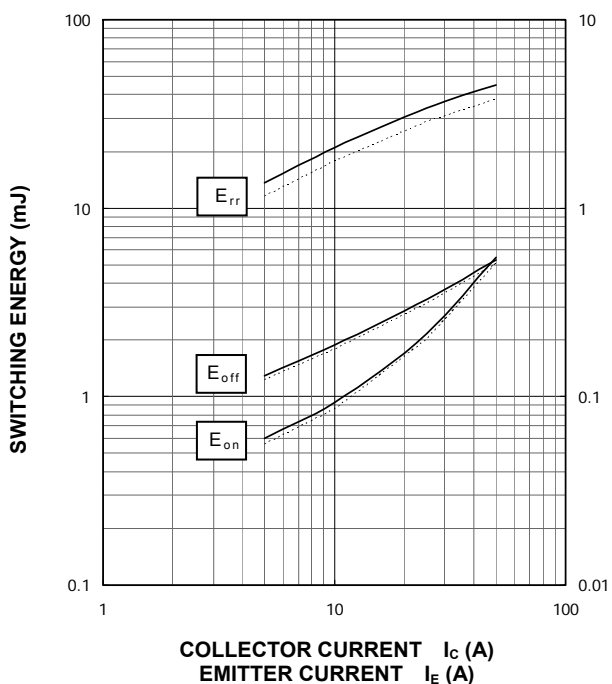
HALF-BRIDGE
SWITCHING CHARACTERISTICS
(TYPICAL)

$V_{CC}=600\text{ V}$, $V_{GE}=\pm 15\text{ V}$, $I_C=50\text{ A}$, INDUCTIVE LOAD
——: $T_j=150\text{ }^\circ\text{C}$, - - - -: $T_j=125\text{ }^\circ\text{C}$



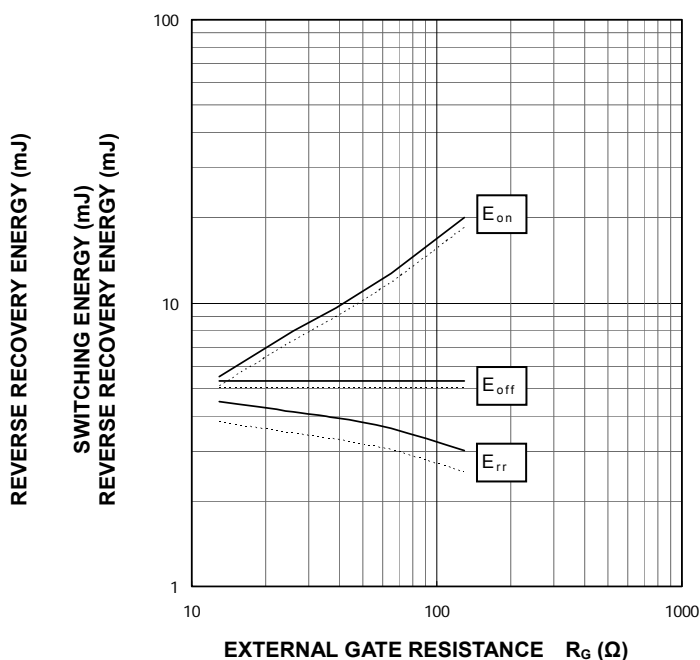
HALF-BRIDGE
SWITCHING CHARACTERISTICS
(TYPICAL)

$V_{CC}=600\text{ V}$, $V_{GE}=\pm 15\text{ V}$, $R_G=13\ \Omega$,
INDUCTIVE LOAD, PER PULSE
——: $T_j=150\text{ }^\circ\text{C}$, - - - -: $T_j=125\text{ }^\circ\text{C}$



HALF-BRIDGE
SWITCHING CHARACTERISTICS
(TYPICAL)

$V_{CC}=600\text{ V}$, $V_{GE}=\pm 15\text{ V}$, $I_C=50\text{ A}$,
INDUCTIVE LOAD, PER PULSE
——: $T_j=150\text{ }^\circ\text{C}$, - - - -: $T_j=125\text{ }^\circ\text{C}$

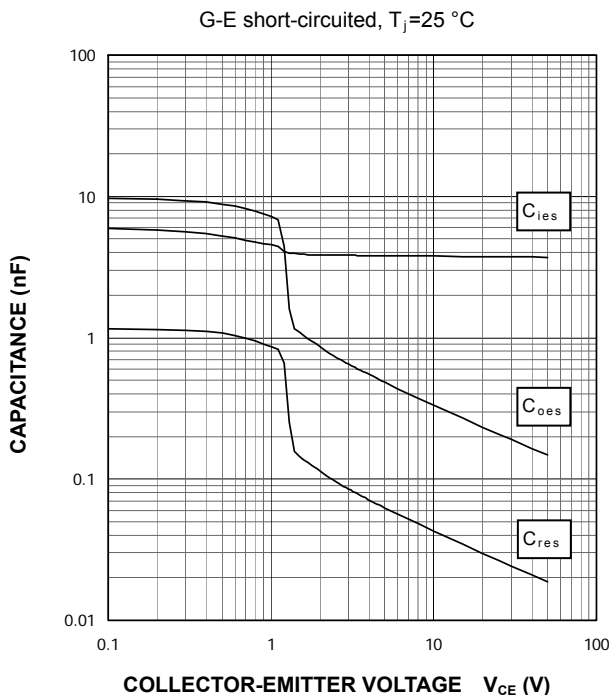


< IGBT MODULES >
CM50MXA-24S
 HIGH POWER SWITCHING USE
 INSULATED TYPE

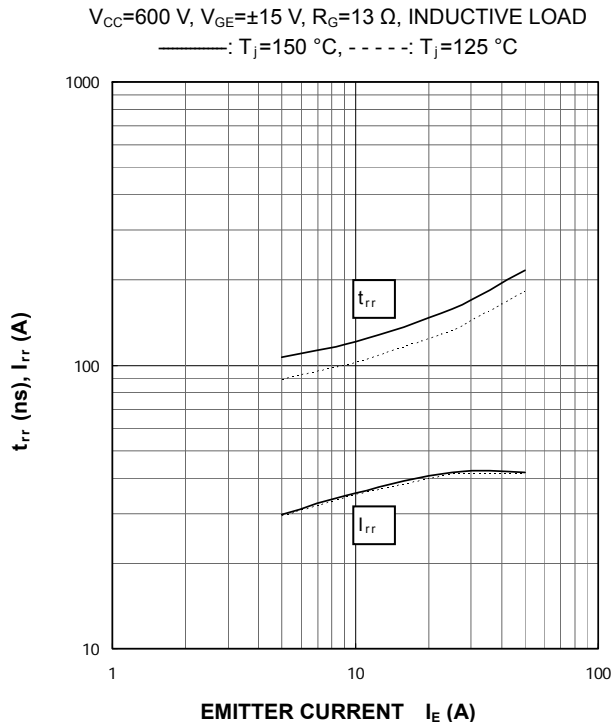
PERFORMANCE CURVES

INVERTER PART

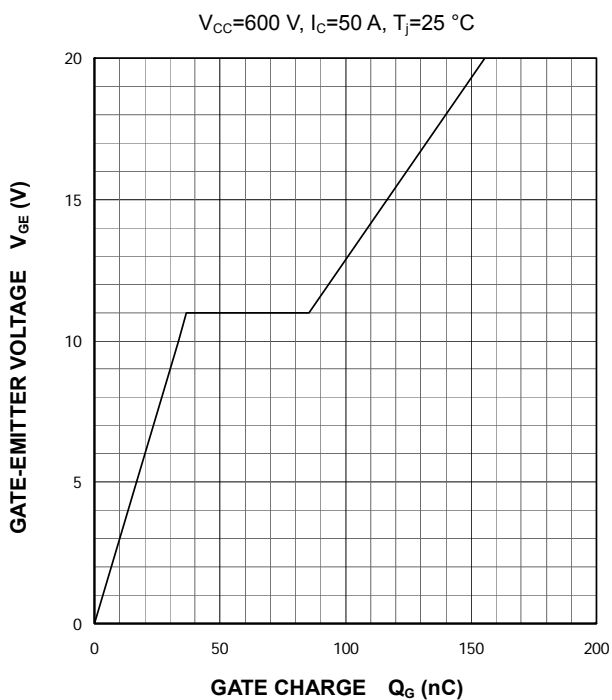
**CAPACITANCE CHARACTERISTICS
 (TYPICAL)**



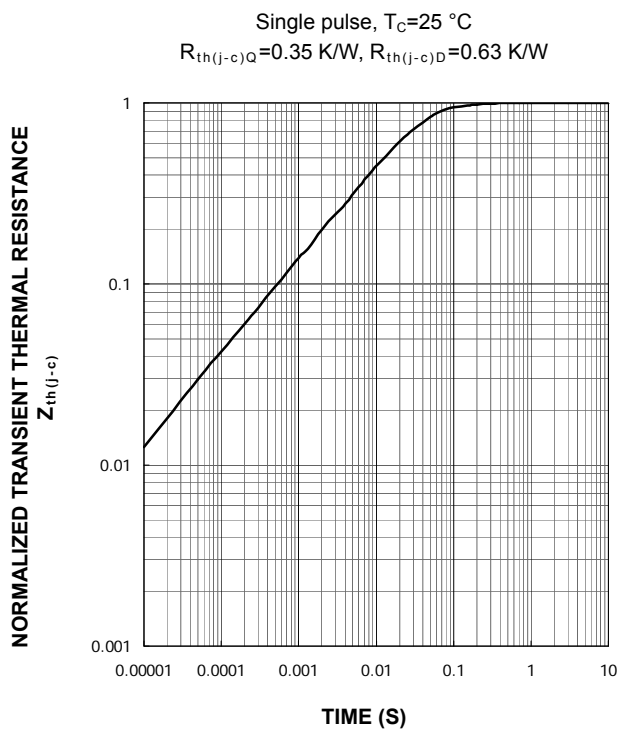
**FREE WHEELING DIODE
 REVERSE RECOVERY CHARACTERISTICS
 (TYPICAL)**



**GATE CHARGE CHARACTERISTICS
 (TYPICAL)**



**TRANSIENT THERMAL IMPEDANCE CHARACTERISTICS
 (MAXIMUM)**

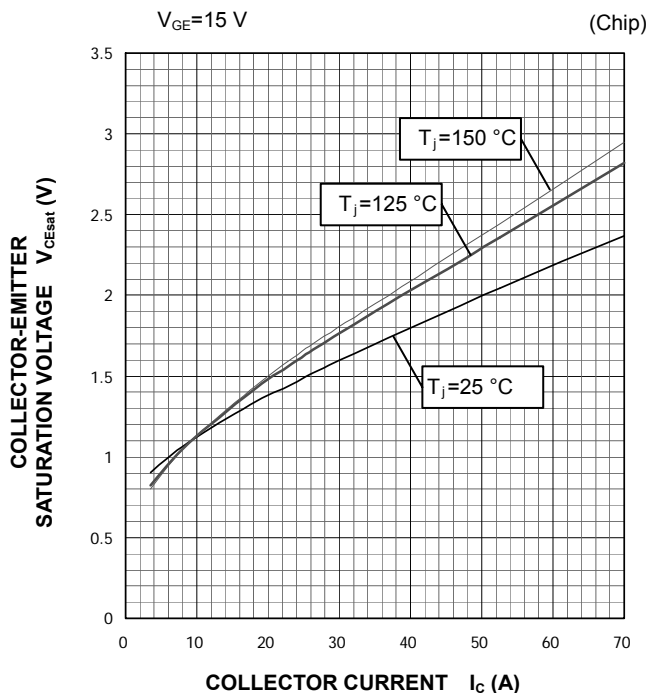


< IGBT MODULES >
CM50MXA-24S
 HIGH POWER SWITCHING USE
 INSULATED TYPE

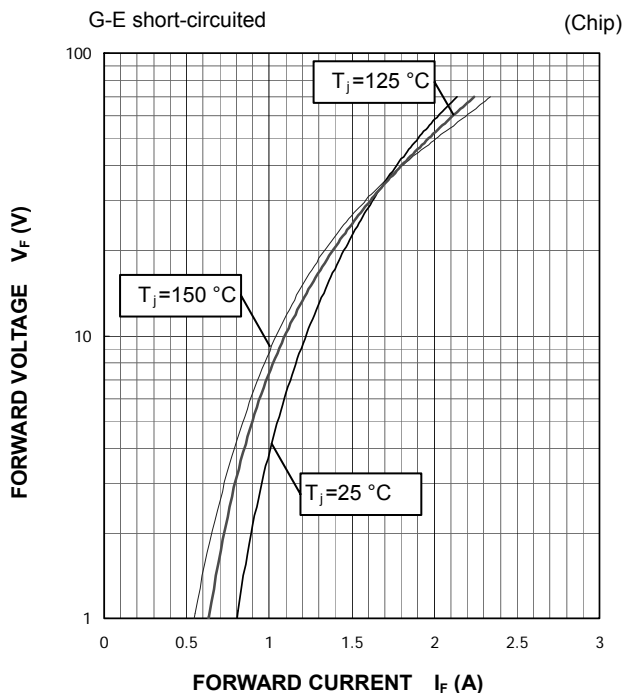
PERFORMANCE CURVES

BRAKE PART

COLLECTOR-EMITTER SATURATION VOLTAGE CHARACTERISTICS (TYPICAL)

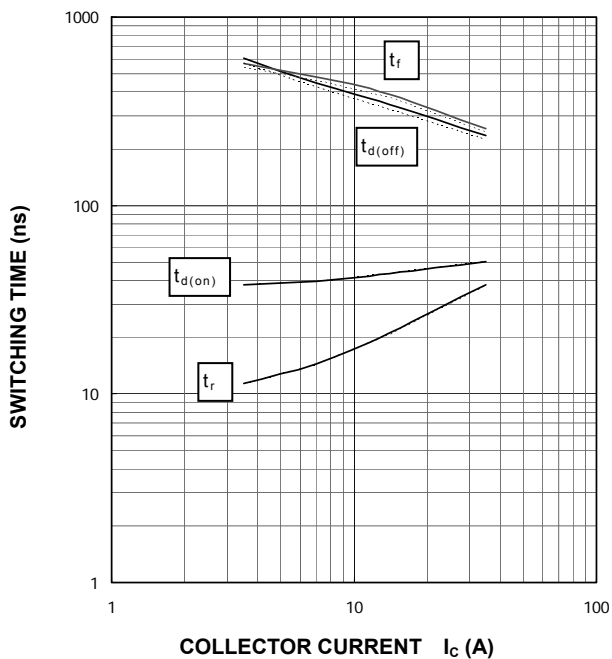


CLAMP DIODE FORWARD CHARACTERISTICS (TYPICAL)



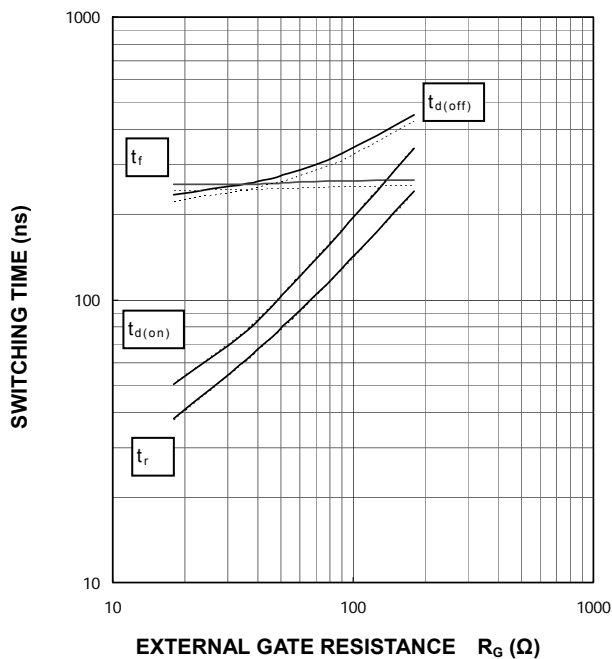
HALF-BRIDGE SWITCHING CHARACTERISTICS (TYPICAL)

$V_{CC}=600\text{ V}$, $V_{GE}=\pm 15\text{ V}$, $R_G=18\ \Omega$, INDUCTIVE LOAD
 —: $T_j=150\text{ }^\circ\text{C}$, - - - -: $T_j=125\text{ }^\circ\text{C}$



HALF-BRIDGE SWITCHING CHARACTERISTICS (TYPICAL)

$V_{CC}=600\text{ V}$, $I_c=35\text{ A}$, $V_{GE}=\pm 15\text{ V}$, INDUCTIVE LOAD
 —: $T_j=150\text{ }^\circ\text{C}$, - - - -: $T_j=125\text{ }^\circ\text{C}$

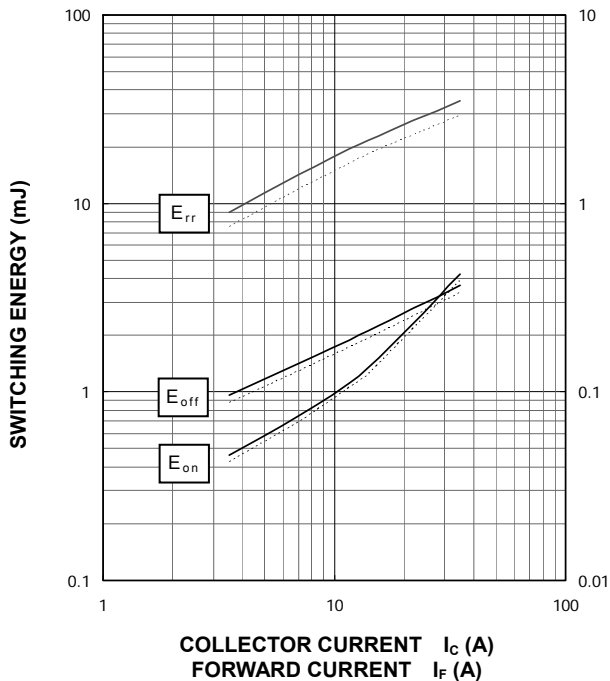


PERFORMANCE CURVES

BRAKE PART

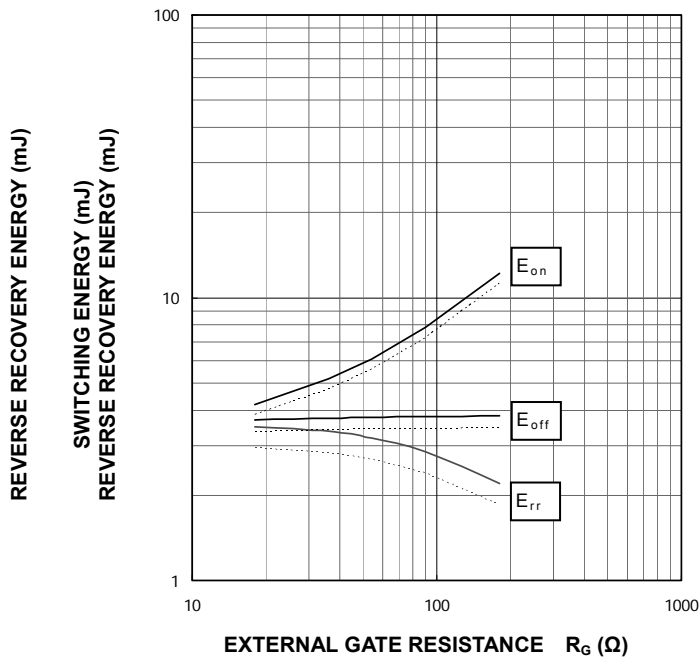
HALF-BRIDGE
SWITCHING CHARACTERISTICS
(TYPICAL)

$V_{CC}=600\text{ V}$, $V_{GE}=\pm 15\text{ V}$, $R_G=18\ \Omega$,
INDUCTIVE LOAD, PER PULSE
——: $T_j=150\text{ }^\circ\text{C}$, - - - -: $T_j=125\text{ }^\circ\text{C}$



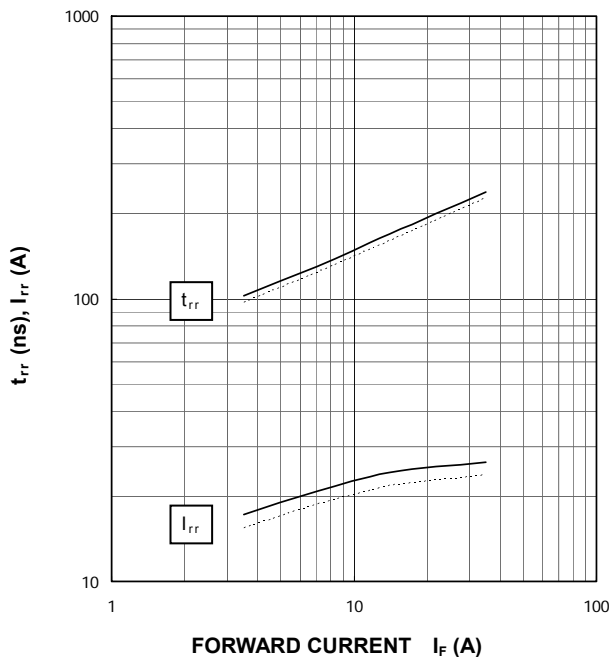
HALF-BRIDGE
SWITCHING CHARACTERISTICS
(TYPICAL)

$V_{CC}=600\text{ V}$, $I_C/I_F=35\text{ A}$, $V_{GE}=\pm 15\text{ V}$,
INDUCTIVE LOAD, PER PULSE
——: $T_j=150\text{ }^\circ\text{C}$, - - - -: $T_j=125\text{ }^\circ\text{C}$



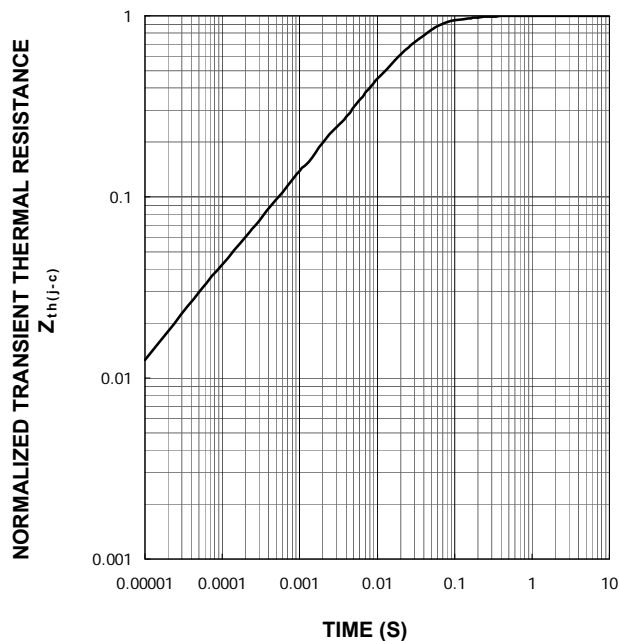
CLAMP DIODE
REVERSE RECOVERY CHARACTERISTICS
(TYPICAL)

$V_{CC}=600\text{ V}$, $V_{GE}=\pm 15\text{ V}$, $R_G=18\ \Omega$, INDUCTIVE LOAD
——: $T_j=150\text{ }^\circ\text{C}$, - - - -: $T_j=125\text{ }^\circ\text{C}$



TRANSIENT THERMAL IMPEDANCE CHARACTERISTICS
(MAXIMUM)

Single pulse, $T_C=25\text{ }^\circ\text{C}$
 $R_{th(j-c)Q}=0.42\text{ K/W}$, $R_{th(j-c)D}=0.69\text{ K/W}$

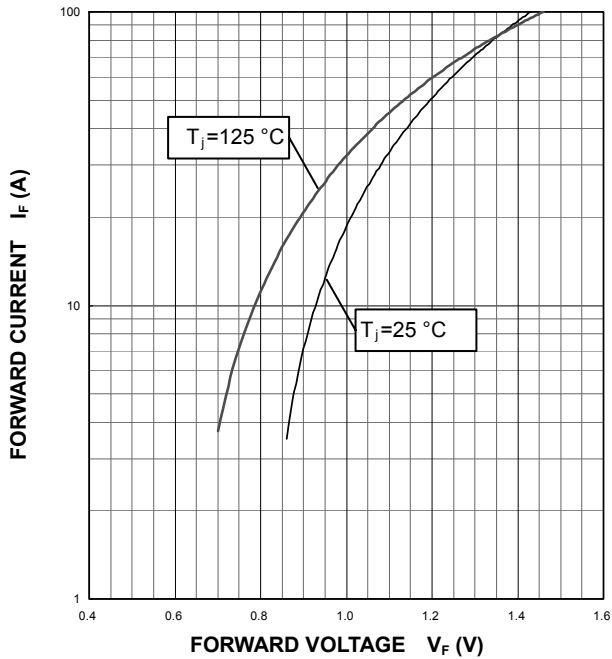


< IGBT MODULES >
CM50MXA-24S
 HIGH POWER SWITCHING USE
 INSULATED TYPE

PERFORMANCE CURVES

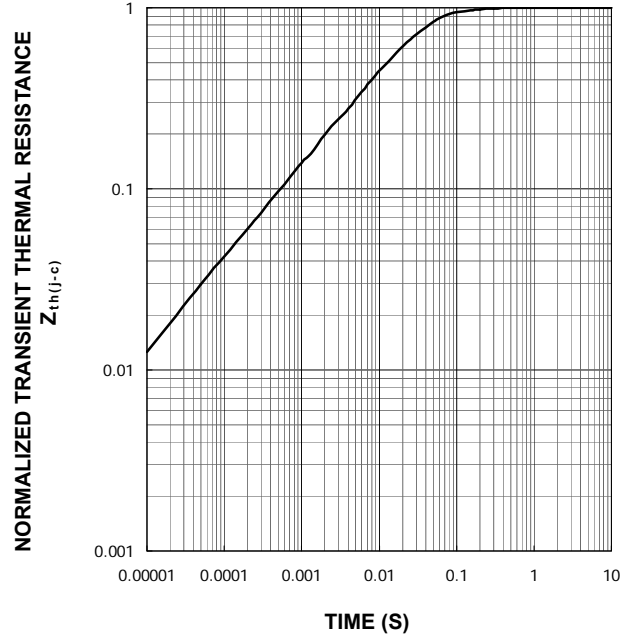
CONVERTER PART

**CONVERTER DIODE
 FORWARD CHARACTERISTICS
 (TYPICAL)**



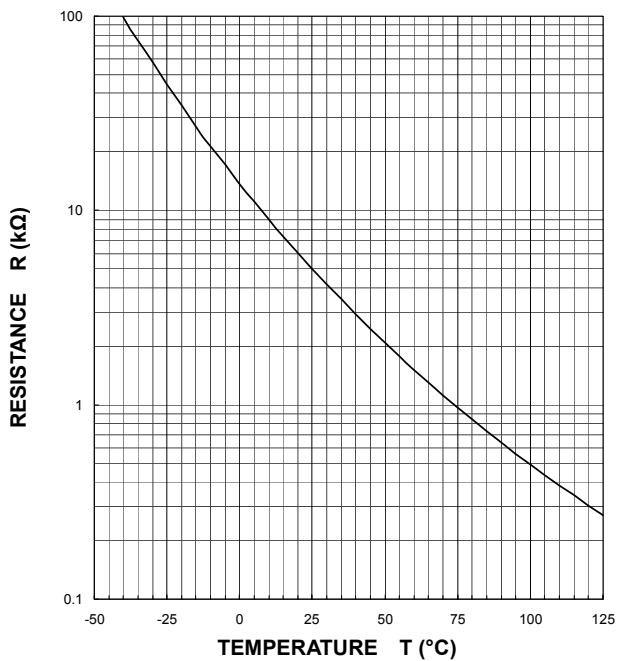
**TRANSIENT THERMAL IMPEDANCE CHARACTERISTICS
 (MAXIMUM)**

Single pulse, $T_c = 25\text{ °C}$
 $R_{th(j-c)D} = 0.33\text{ K/W}$



NTC thermistor part

**TEMPERATURE CHARACTERISTICS
 (TYPICAL)**



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