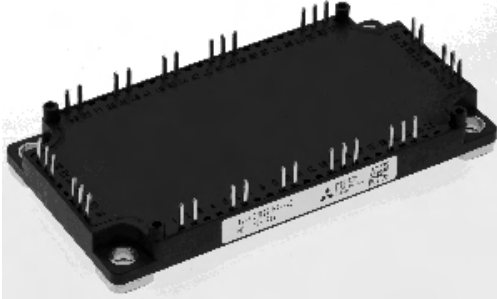


< IGBT MODULES >

CM35MXA-24S

HIGH POWER SWITCHING USE
INSULATED TYPE



CIB (Converter+Inverter+Chopper Brake)

Collector current I_C **35 A**
 Collector-emitter voltage V_{CES} **1200 V**
 Maximum junction temperature T_{jmax} **175 °C**

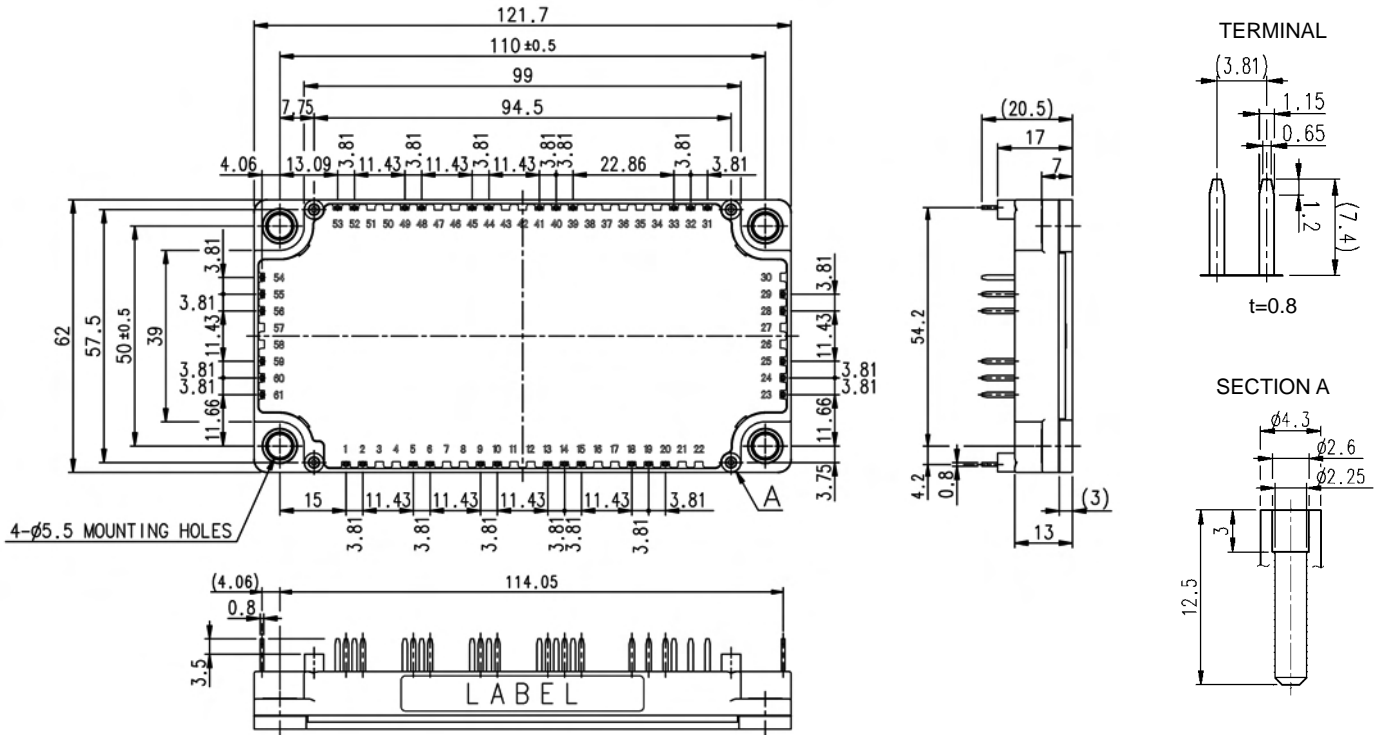
- Flat base Type
- Copper base plate
- Tin plating pin terminals
- RoHS Directive compliant
- Recognized under UL1557, File E323585

APPLICATION

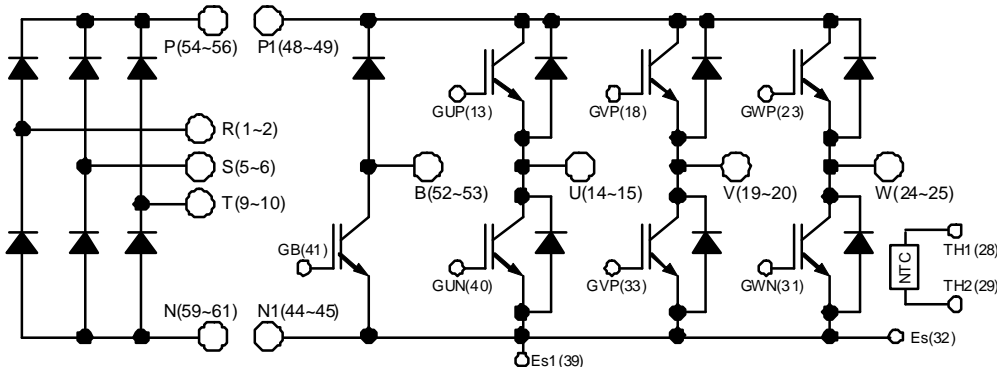
AC Motor Control, Motion/Servo Control, Power supply, etc.

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 >

CM35MXA-24S

HIGH POWER SWITCHING USE
INSULATED TYPE

ABSOLUTE MAXIMUM 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, $T_C=125\text{ }^\circ\text{C}$ (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
I_E (Note1)	Emitter current	(Note2)	35	A
I_{ERM} (Note1)		Pulse, Repetitive (Note3)	70	
T_{jmax}	Maximum junction temperature	Instantaneous event (overload)	175	$^\circ\text{C}$

BRAKE 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, $T_C=125\text{ }^\circ\text{C}$ (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 DIODE

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)	35	A
I_{FSM}	Surge forward current	The sine half wave 1 cycle peak value, $f=60\text{ Hz}$, non-repetitive	350	A
I^2t	Current square time	Value for one cycle of surge current	510	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	mass	-	-	300	-	g
e_c	Flatness of base plate	On the centerline X, Y (Note5)	± 0	-	+100	μm

< IGBT MODULES >

CM35MXA-24S

HIGH POWER SWITCHING USE
INSULATED TYPE

ELECTRICAL CHARACTERISTICS (T_j=25 °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 =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	
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 _{EC} ^(Note1)	Emitter-collector voltage	I _E =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 _E =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} ^(Note1)	Reverse recovery time	V _{CC} =600 V, I _E =35 A, V _{GE} =±15 V, R _G =18 Ω, Inductive load	-	-	300	ns	
Q _{rr} ^(Note1)	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 _E =35 A, V _{GE} =±15 V, R _G =18 Ω, T _j =150 °C, Inductive load	-	4.2	-	mJ	
E _{off}	Turn-off switching energy per pulse	-	-	3.7	-		
E _{rr} ^(Note1)	Reverse recovery energy per pulse	-	-	3.5	-		
R _{CC+EE}	Internal lead resistance	Main terminals-chip, per switch, T _C =25 °C ^(Note4)	-	-	5.7	mΩ	
r _g	Internal gate resistance	Per switch	-	0	-	Ω	

BRAKE 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 =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 >

CM35MXA-24S

HIGH POWER SWITCHING USE
INSULATED TYPE

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

BRAKE PART IGBT/DIODE

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		
I _{RRM}	Reverse current	V _R =V _{RRM} , G-E short-circuited	-	-	1.0	mA	
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,	-	4.2	-	mJ	
E _{off}	Turn-off switching energy per pulse	V _{GE} =±15 V, R _G =18 Ω, T _j =150 °C,	-	3.7	-		
E _{rr}	Reverse recovery energy per pulse	Inductive load	-	3.5	-		
r _g	Internal gate resistance	-	-	0	-	Ω	

CONVERTER PART DIODE

Symbol	Item	Conditions	Limits			Unit
			Min.	Typ.	Max.	
I _{RRM}	Reverse current	V _R =V _{RRM} , T _j =150 °C	-	-	4.0	mA
V _F (Terminal)	Forward voltage	I _F =35 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	-	-	0.42	K/W
R _{th(j-c)D}		Junction to case, per Inverter DIODE	-	-	0.69	
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 DIODE	-	-	0.69	
R _{th(j-c)D}		Junction to case, per Converter DIODE	-	-	0.45	K/W
R _{th(c-s)}	Contact thermal resistance ^(Note4)	Case to heat sink, per 1 module, Thermal grease applied ^(Note8)	-	15	-	K/kW

< IGBT MODULES >

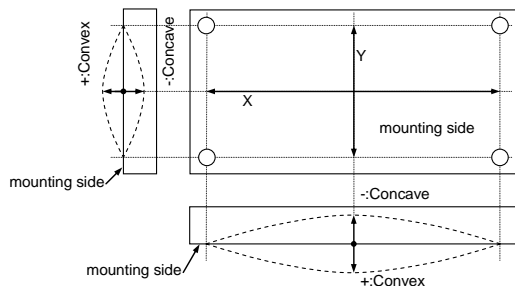
CM35MXA-24S

HIGH POWER SWITCHING USE

INSULATED TYPE

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

2. Junction temperature (T_j) should not increase beyond T_{jmax} rating.
3. Pulse width and repetition rate should be such that the device junction temperature (T_j) dose not exceed T_{jmax} rating.
4. 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.
5. The base plate (mounting side) flatness measurement points (X, Y) are as follows of the following figure.



6. 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]; $T_{25}=25 [^{\circ}\text{C}]+273.15=298.15$ [K]

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

8. Typical value is measured by using thermally conductive grease of $\lambda=0.9$ W/(m·K).
9. Use the following screws when mounting the printed circuit board (PCB) on the stand offs.
 "φ2.6×10 or φ2.6×12 self tapping screw"
 The length of the screw depends on the thickness (t1.6~t2.0) of the PCB.

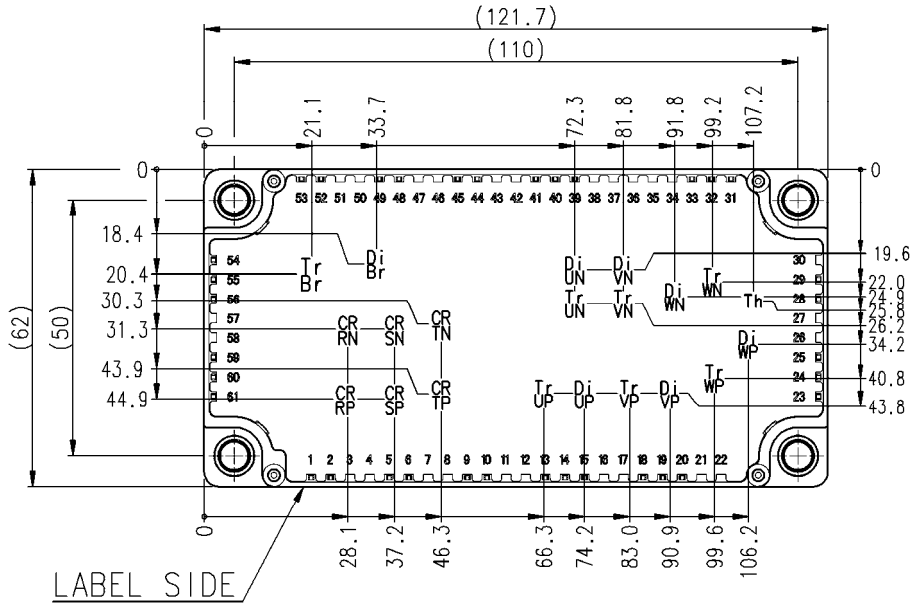
RECOMMENDED OPERATING CONDITIONS

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-Es/ 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	18	-	180	
		Brake IGBT	18	-	180	

< IGBT MODULES >
CM35MXA-24S
 HIGH POWER SWITCHING USE
 INSULATED TYPE

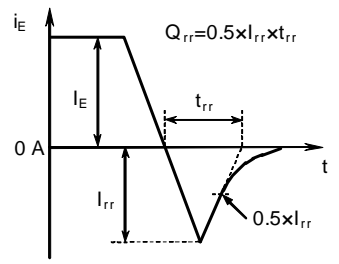
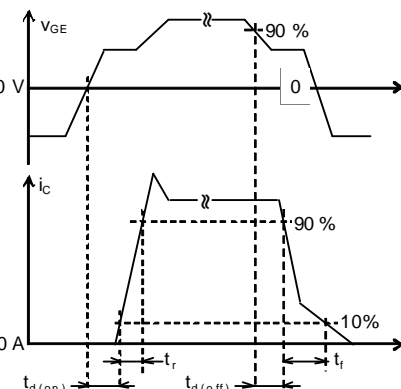
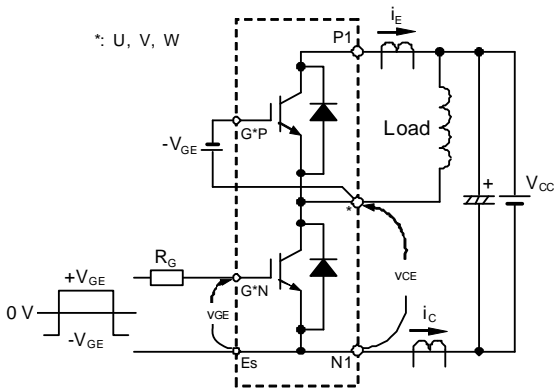
CHIP LOCATION (Top view)

Dimension in mm, tolerance: ±1 mm



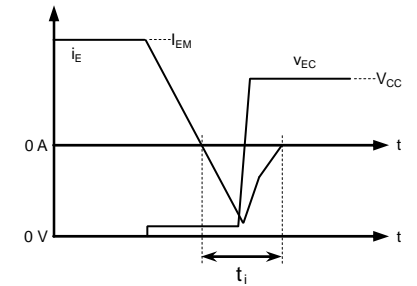
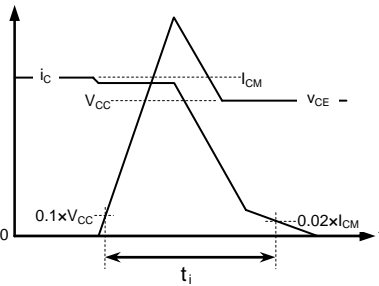
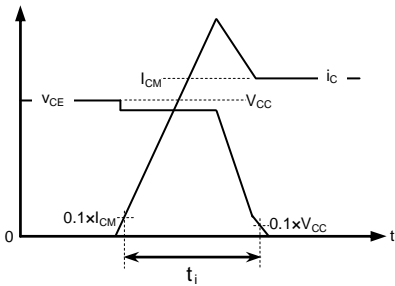
Tr*P/Tr*N/Tr*Br: IGBT, Di*P/Di*N: DIODE (*=U/V/W), Di*Br: BRAKE DIODE, CR*P/CR*N: CONVERTER DIODE (*=R/S/T), Th: NTC thermistor

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

DIODE Reverse recovery energy

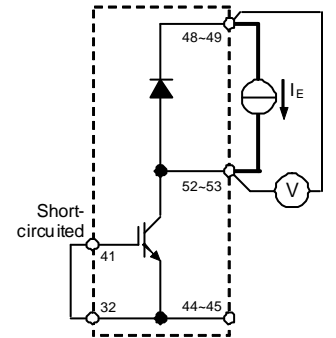
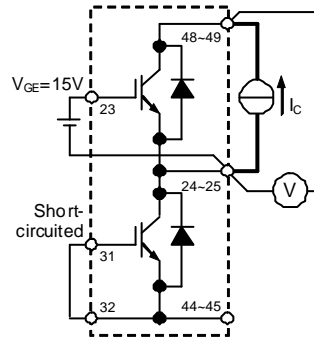
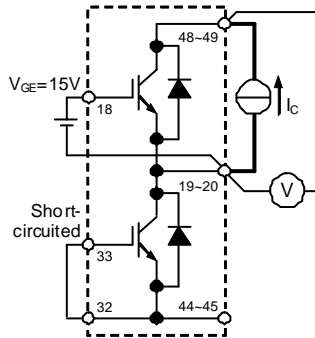
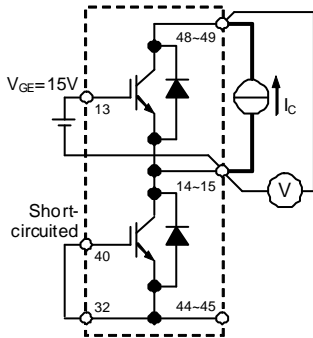
Turn-on / Turn-off switching energy and Reverse recovery energy test waveforms (Integral time instruction drawing)

< IGBT MODULES >

CM35MXA-24S

HIGH POWER SWITCHING USE
INSULATED TYPE

TEST CIRCUIT



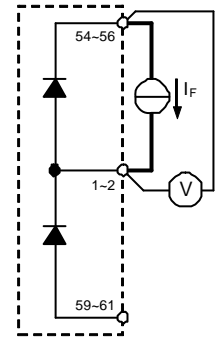
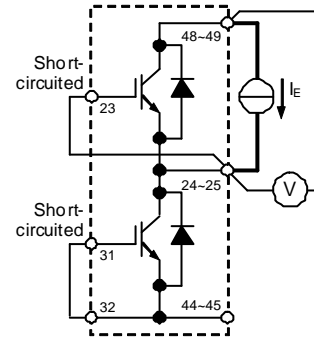
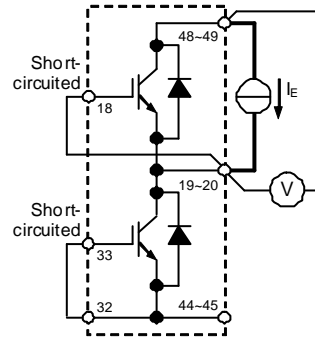
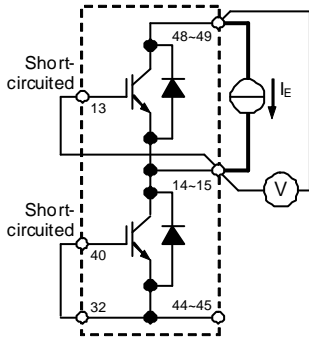
G-E short-circuited
UP / UN IGBT

G-E short-circuited
VP / VN IGBT

G-E short-circuited
WP / WN IGBT

G-E short-circuited
Brake IGBT / DIODE

V_{CEsat} / BRAKE DIODE V_F test circuit



G-E short-circuited
UP / UN DIODE

G-E short-circuited
VP / VN DIODE

G-E short-circuited
WP / WN DIODE

CONVERTER DIODE (ex. phase-R)

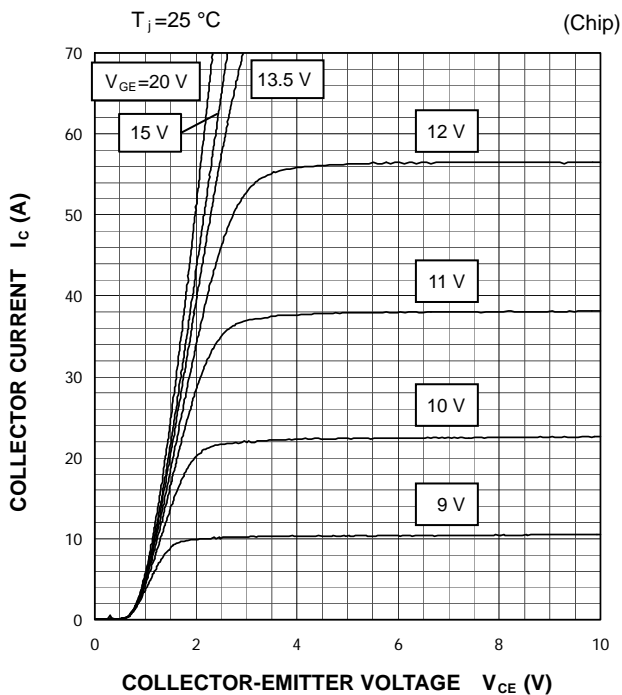
V_{EC} / CONVERTER DIODE V_F test circuit

* 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.

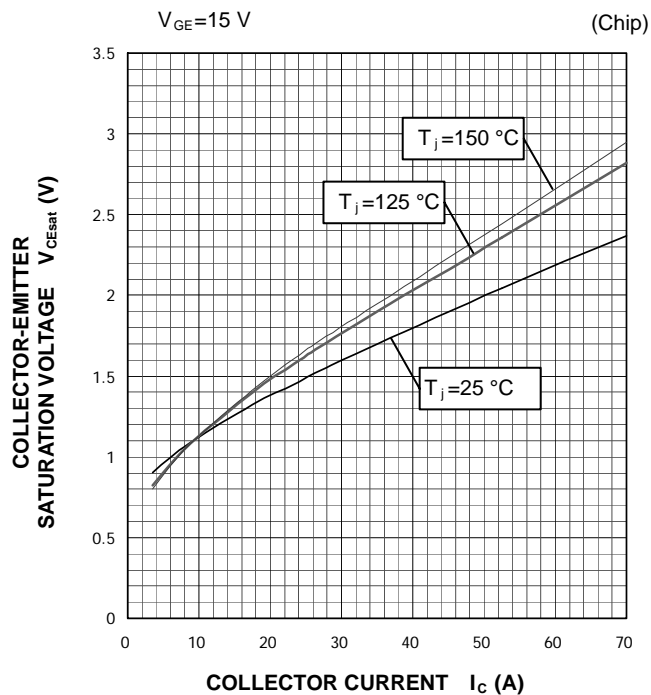
PERFORMANCE CURVES

INVERTER PART

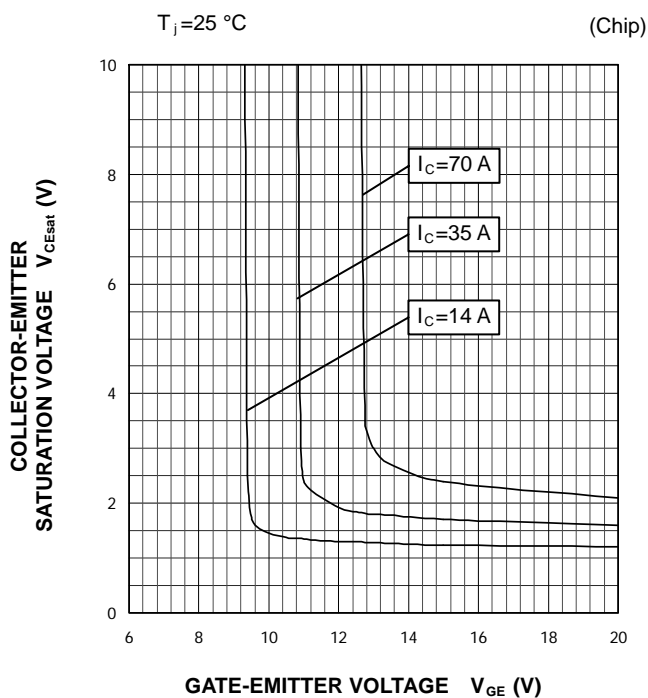
OUTPUT CHARACTERISTICS
(TYPICAL)



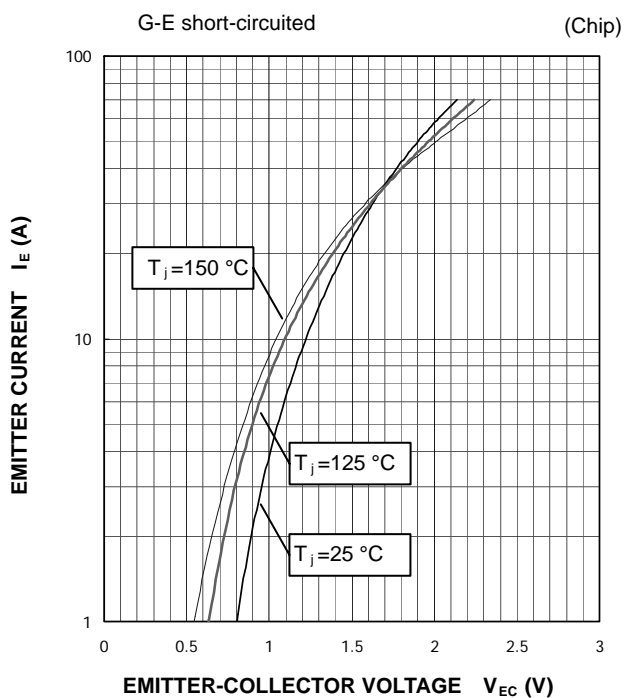
COLLECTOR-EMITTER SATURATION VOLTAGE
CHARACTERISTICS
(TYPICAL)



COLLECTOR-EMITTER SATURATION VOLTAGE
CHARACTERISTICS
(TYPICAL)



FREE WHEELING DIODE
FORWARD CHARACTERISTICS
(TYPICAL)

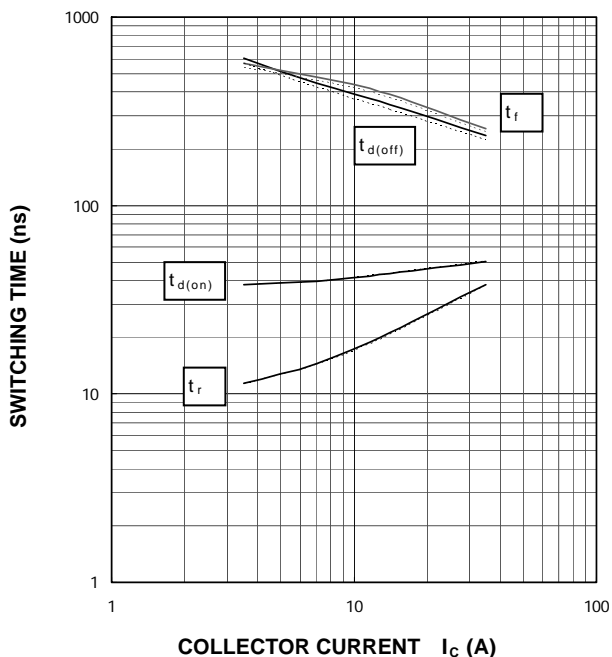


PERFORMANCE CURVES

INVERTER PART

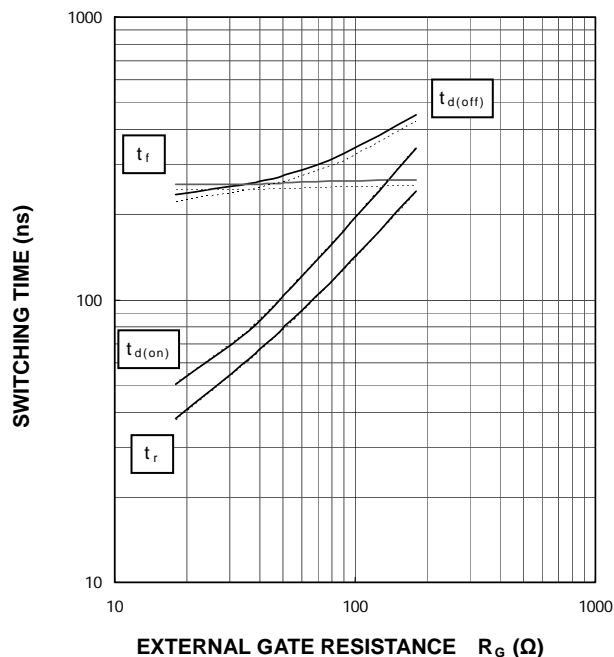
HALF-BRIDGE
SWITCHING CHARACTERISTICS
(TYPICAL)

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



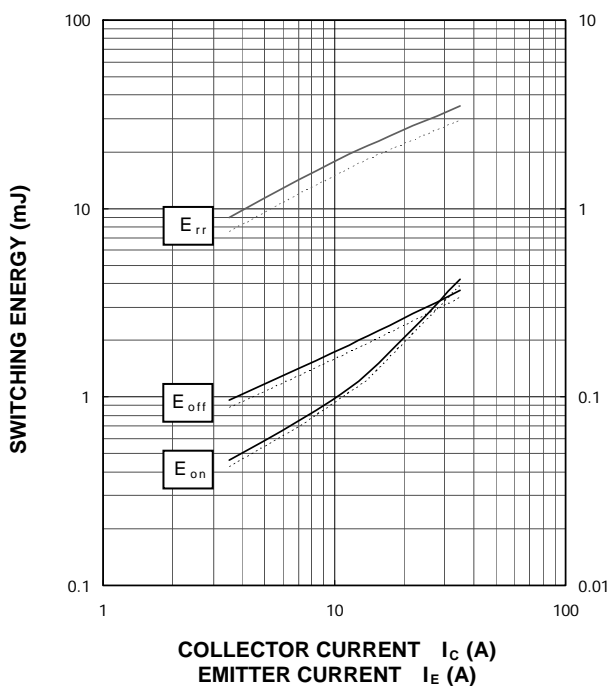
HALF-BRIDGE
SWITCHING CHARACTERISTICS
(TYPICAL)

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



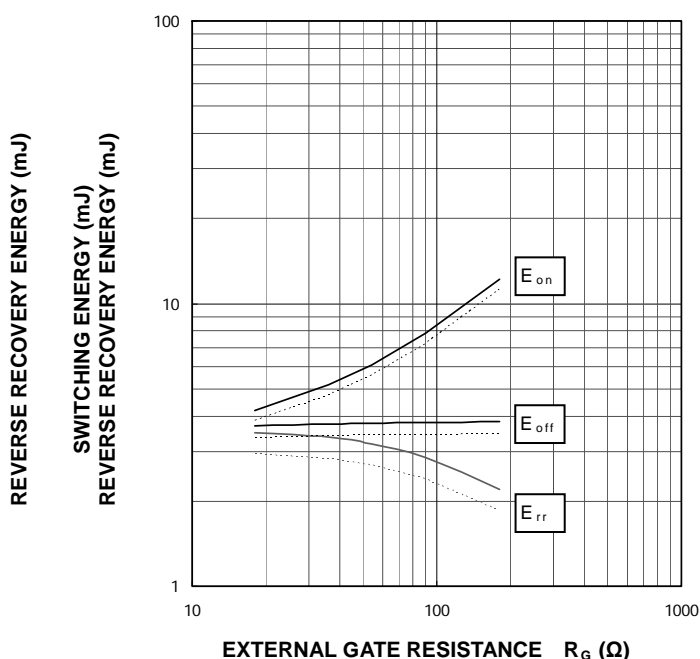
HALF-BRIDGE
SWITCHING CHARACTERISTICS
(TYPICAL)

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



HALF-BRIDGE
SWITCHING CHARACTERISTICS
(TYPICAL)

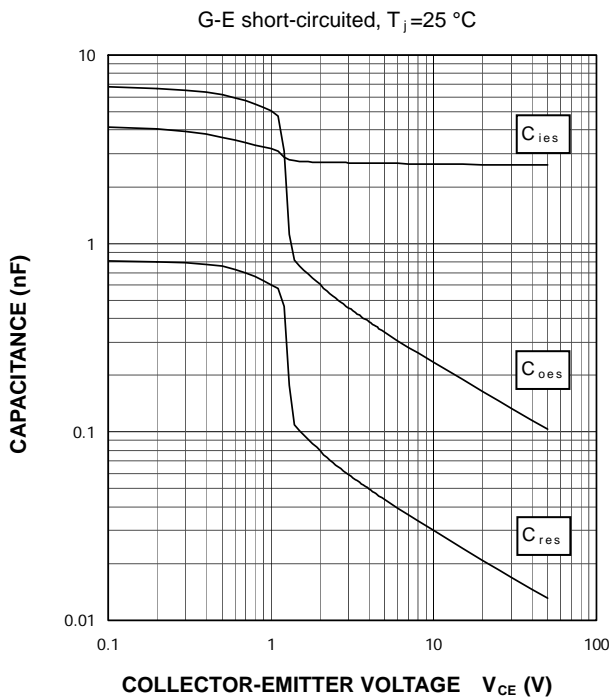
$V_{CC}=600\text{ V}$, $V_{GE}=\pm 15\text{ V}$, $I_C=35\text{ A}$,
INDUCTIVE LOAD, PER PULSE
—: $T_j=150\text{ }^\circ\text{C}$, - - - -: $T_j=125\text{ }^\circ\text{C}$



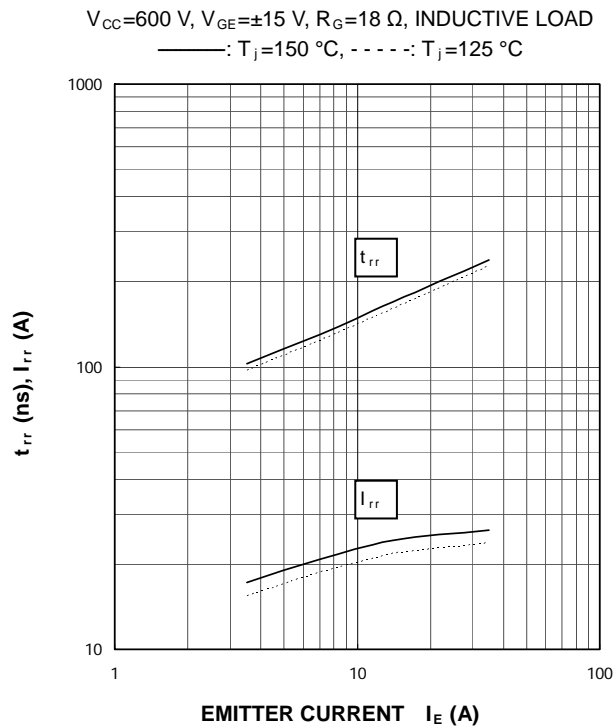
PERFORMANCE CURVES

INVERTER PART

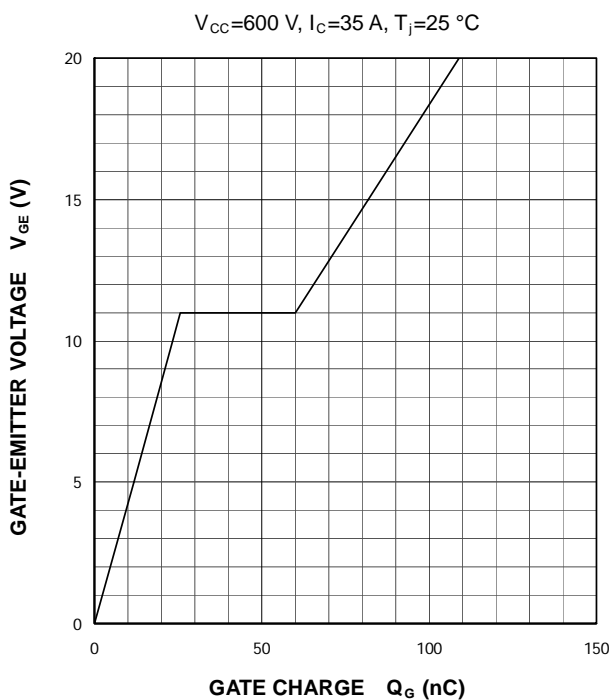
CAPACITANCE CHARACTERISTICS
(TYPICAL)



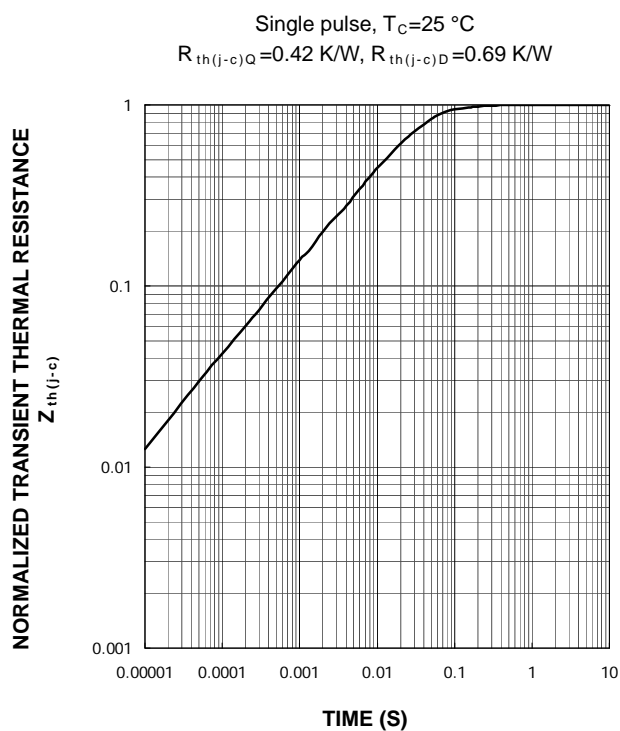
FREE WHEELING DIODE
REVERSE RECOVERY CHARACTERISTICS
(TYPICAL)



GATE CHARGE CHARACTERISTICS
(TYPICAL)



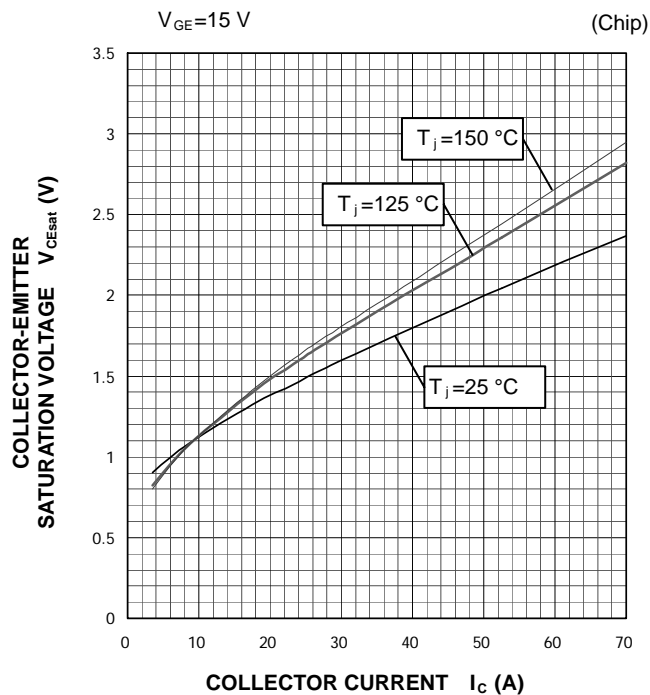
TRANSIENT THERMAL IMPEDANCE CHARACTERISTICS
(MAXIMUM)



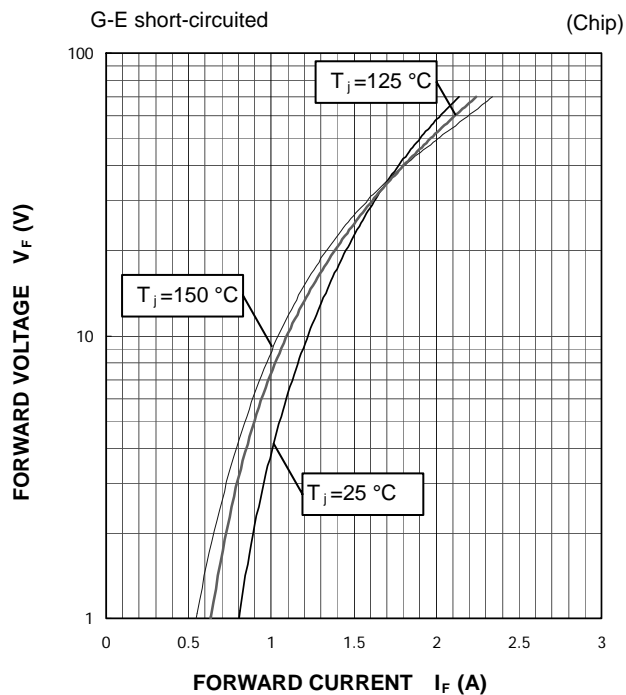
PERFORMANCE CURVES

BRAKE PART

COLLECTOR-EMITTER SATURATION
VOLTAGE CHARACTERISTICS
(TYPICAL)

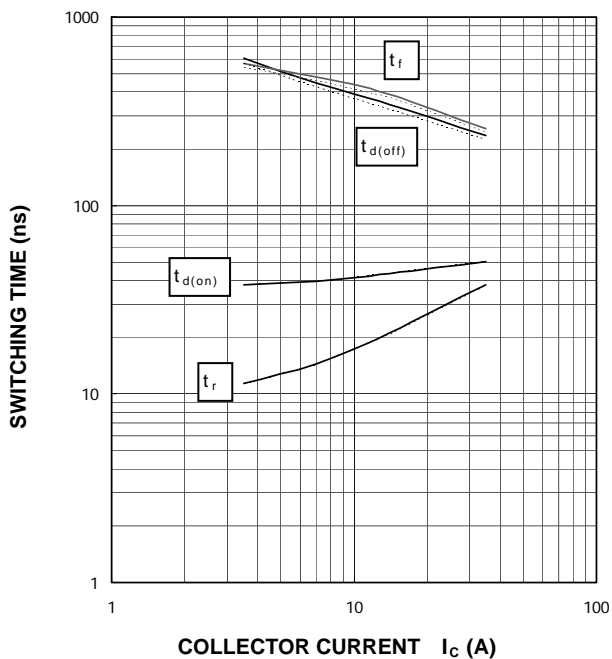


CLAMP DIODE
FORWARD CHARACTERISTICS
(TYPICAL)



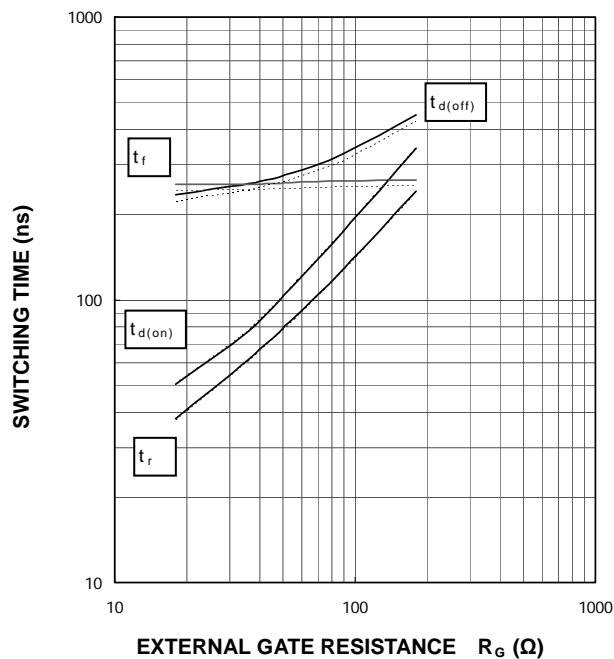
HALF-BRIDGE
SWITCHING CHARACTERISTICS
(TYPICAL)

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



HALF-BRIDGE
SWITCHING CHARACTERISTICS
(TYPICAL)

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

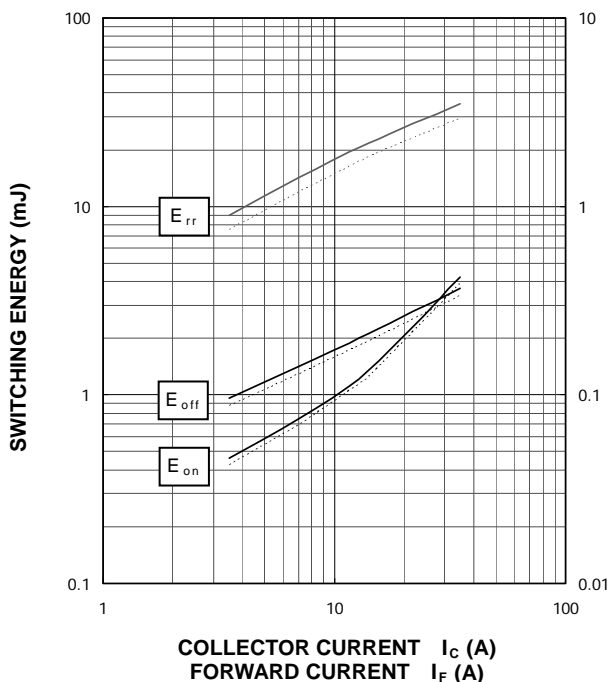


PERFORMANCE CURVES

BRAKE PART

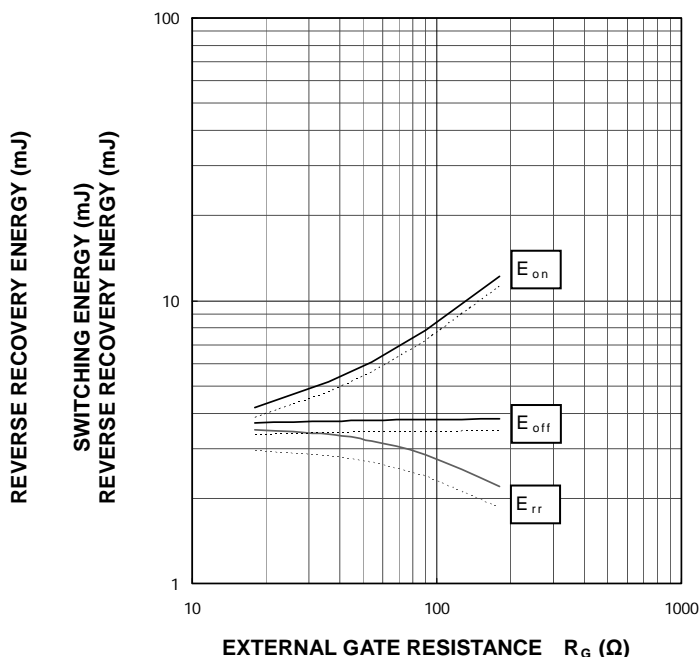
HALF-BRIDGE
SWITCHING CHARACTERISTICS
(TYPICAL)

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



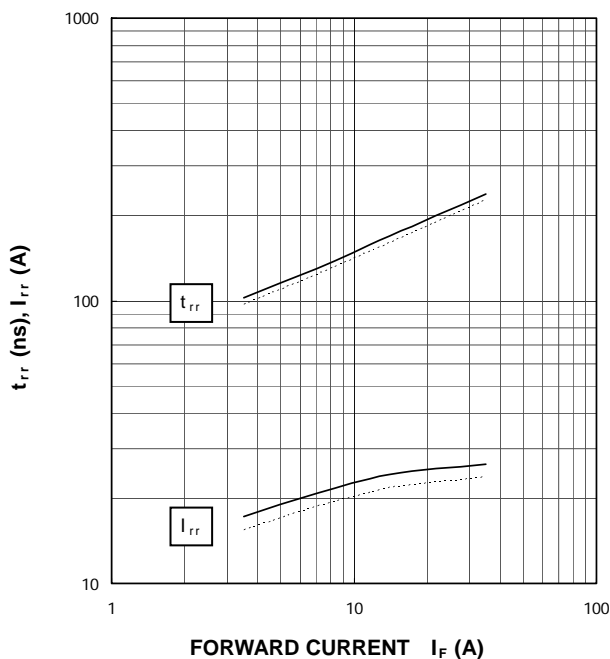
HALF-BRIDGE
SWITCHING CHARACTERISTICS
(TYPICAL)

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



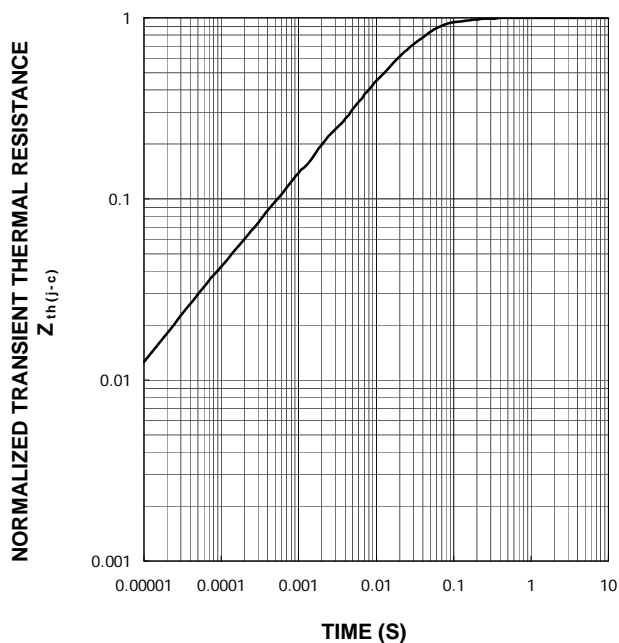
CLAMP DIODE
REVERSE RECOVERY CHARACTERISTICS
(TYPICAL)

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



TRANSIENT THERMAL IMPEDANCE CHARACTERISTICS
(MAXIMUM)

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

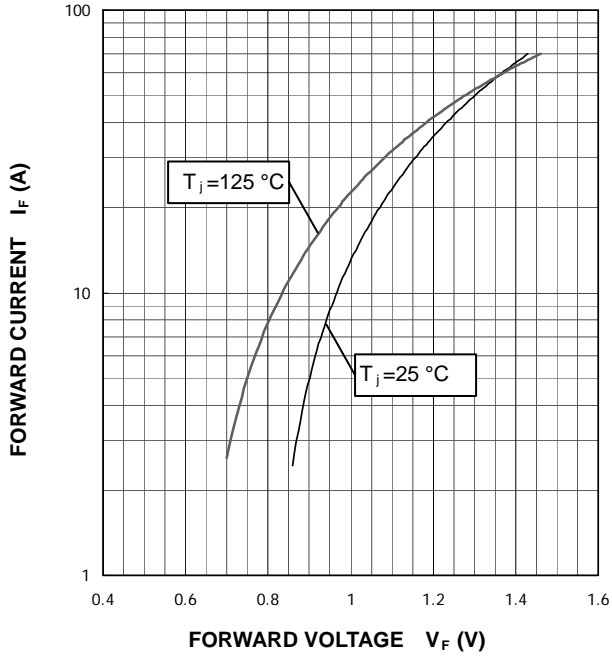


< IGBT MODULES >
CM35MXA-24S
 HIGH POWER SWITCHING USE
 INSULATED TYPE

PERFORMANCE CURVES

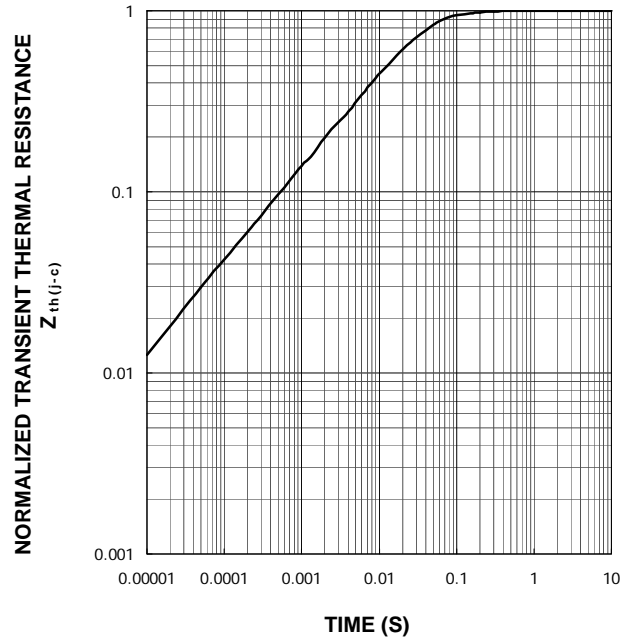
CONVERTER PART

**CONVERTER DIODE
 FORWARD CHARACTERISTICS
 (TYPICAL)**



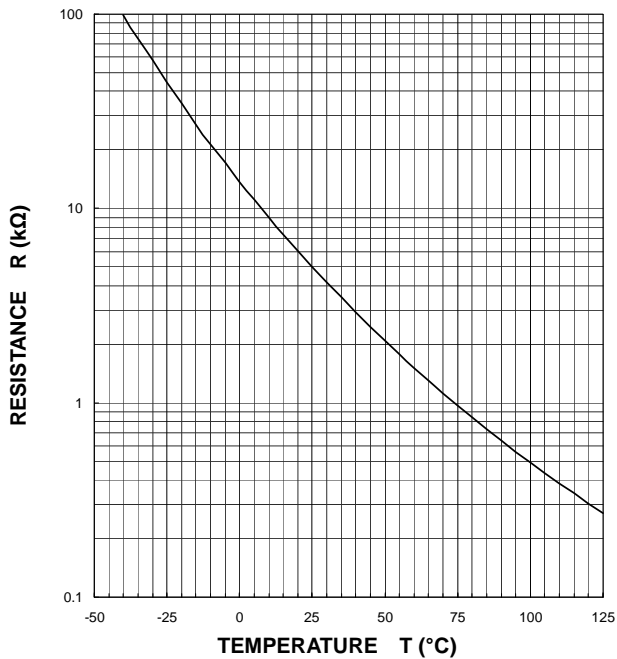
**TRANSIENT THERMAL IMPEDANCE CHARACTERISTICS
 (MAXIMUM)**

Single pulse, $T_c = 25\text{ °C}$
 $R_{th(j-c)D} = 0.45\text{ K/W}$



NTC thermistor part

**TEMPERATURE CHARACTERISTICS
 (TYPICAL)**



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