

# CM35MX-24A

HIGH POWER SWITCHING USE

## CM35MX-24A

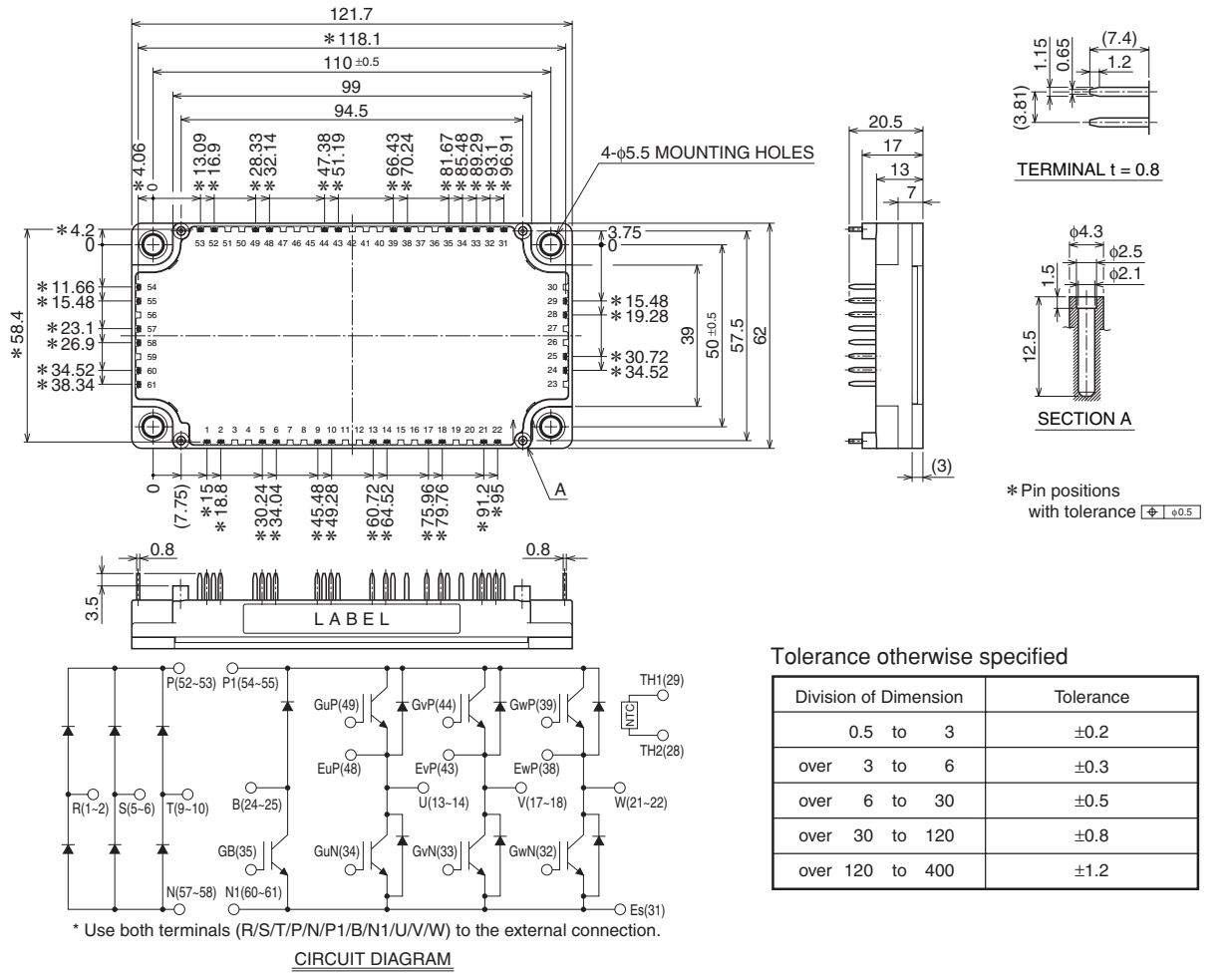


- Ic ..... 35A
- VCES ..... 1200V
- CIB (3-phase Converter + 3-phase Inverter + Brake)
- Flatbase Type / Insulated Package / Copper base plate
- RoHS Directive compliant

## APPLICATION

General purpose Inverters, Servo Amplifiers

### OUTLINE DRAWING & CIRCUIT DIAGRAM



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### ABSOLUTE MAXIMUM RATINGS (T<sub>J</sub> = 25°C, unless otherwise specified)

#### INVERTER PART

Symbol	Parameter	Conditions	Rating	Unit
V <sub>CEs</sub>	Collector-emitter voltage	G-E Short	1200	V
V <sub>GEs</sub>	Gate-emitter voltage	C-E Short	±20	
I <sub>C</sub>	Collector current	DC, T <sub>c</sub> = 105°C (Note. 1)	35	A
I <sub>CRM</sub>		Pulse (Note. 4)	70	
P <sub>q c</sub>	Maximum collector dissipation	T <sub>c</sub> = 25°C (Note. 1, 5)	295	W
I <sub>E</sub> (Note.3)	Emitter current	T <sub>c</sub> = 25°C (Note. 1)	35	A
I <sub>ERM</sub> (Note.3)	(Free wheeling diode forward current)	Pulse (Note. 4)	70	

#### BRAKE PART

Symbol	Parameter	Conditions	Rating	Unit
V <sub>CEs</sub>	Collector-emitter voltage	G-E Short	1200	V
V <sub>GEs</sub>	Gate-emitter voltage	C-E Short	±20	
I <sub>C</sub>	Collector current	DC, T <sub>c</sub> = 121°C (Note. 1)	20	A
I <sub>CRM</sub>		Pulse (Note. 4)	40	
P <sub>q c</sub>	Maximum collector dissipation	T <sub>c</sub> = 25°C (Note. 1, 5)	260	W
V <sub>RRM</sub> (Note.3)	Repetitive peak reverse voltage		1200	V
I <sub>F</sub> (Note.3)	Forward current	T <sub>c</sub> = 25°C (Note. 1)	20	A
I <sub>FRM</sub> (Note.3)		Pulse (Note. 4)	40	

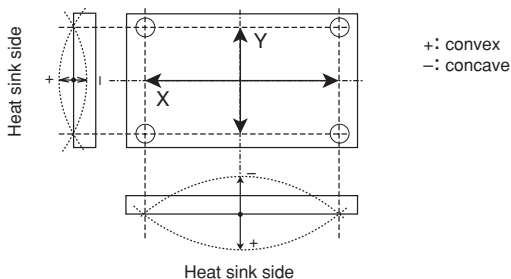
#### CONVERTER PART

Symbol	Parameter	Conditions	Rating	Unit
V <sub>RRM</sub>	Repetitive peak reverse voltage		1600	V
E <sub>a</sub>	Recommended AC input voltage		440	V
I <sub>o</sub>	DC output current	3-phase full wave rectifying, T <sub>c</sub> = 105°C (Note. 1)	35	A
I <sub>FSM</sub>	Surge forward current	The sine half wave 1 cycle peak value, f = 60Hz, non-repetitive	350	
i <sup>2</sup> t	Current square time	Value for one cycle of surge current	510	A <sup>2</sup> s

#### MODULE

Symbol	Parameter	Conditions	Rating	Unit
T <sub>j</sub>	Junction temperature		-40 ~ +150	°C
T <sub>stg</sub>	Storage temperature		-40 ~ +125	
V <sub>iso</sub>	Isolation voltage	Terminals to base plate, f = 60Hz, AC 1 min (Note. 8)	2500	V
—	Base plate flatness	On the centerline X, Y (Note. 8)	±0 ~ +100	μm
—	Torque	Mounting M5 screw	2.5 ~ 3.5	N·m
—	Weight	(Typical)	270	g

Note. 8: The base plate flatness measurement points are in the following figure.



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**ELECTRICAL and THERMAL RESISTANCE CHARACTERISTICS (T<sub>j</sub> = 25°C, unless otherwise specified)**

**INVERTER PART**

Symbol	Parameter	Conditions	Limits			Unit	
			Min.	Typ.	Max.		
ICES	Collector cut-off current	VCE = VCES, G-E Short	—	—	1	mA	
VGE(th)	Gate-emitter threshold voltage	IC = 3.5mA, VCE = 10V	6	7	8	V	
IGES	Gate-emitter leakage current	VGE = VGES, C-E Short	—	—	0.5	μA	
VCEsat	Collector-emitter saturation voltage	IC = 35A, VGE = 15V (Note. 6)	T <sub>j</sub> = 25°C	—	2.0	2.6	V
		IC = 35A, VGE = 15V	Chip	—	2.2	—	
Cies	Input capacitance	VCE = 10V G-E Short (Note. 6)	—	—	6.0	nF	
Coes	Output capacitance		—	—	0.53		
Cres	Reverse transfer capacitance		—	—	0.12		
QG	Gate charge	VCC = 600V, IC = 35A, VGE = 15V	—	180	—	nC	
td(on)	Turn-on delay time	VCC = 600V, IC = 35A	—	—	100	ns	
tr	Rise time	VGE = ±15V, RG = 9.1Ω	—	—	50		
td(off)	Turn-off delay time	Inductive load	—	—	300		
tf	Fall time		—	—	600		
trr (Note.3)	Reverse recovery time		(IE = 35A)	—	—		200
Qrr (Note.3)	Reverse recovery charge		—	1.5	—	μC	
VEC(Note.3)	Emitter-collector voltage	IE = 35A, G-E Short (Note. 6)	T <sub>j</sub> = 25°C	—	2.6	3.4	V
		IE = 35A, G-E Short	Chip	—	2.16	—	
Rth(j-c)Q	Thermal resistance (Junction to case) (Note. 1)	per IGBT	—	—	0.42	K/W	
Rth(j-c)D		per free wheeling diode	—	—	0.69		
l*	Internal gate resistance	Tc = 25°C, per switch	—	0	—	Ω	
RG	External gate resistance		8.9	—	89		

**BRAKE PART**

Symbol	Parameter	Conditions	Limits			Unit	
			Min.	Typ.	Max.		
ICES	Collector cut-off current	VCE = VCES, VGE = 0V	—	—	1	mA	
VGE(th)	Gate-emitter threshold voltage	IC = 2mA, VCE = 10V	6	7	8	V	
IGES	Gate-emitter leakage current	VGE = VGES, VCE = 0V	—	—	0.5	μA	
VCEsat	Collector-emitter saturation voltage	IC = 20A, VGE = 15V (Note. 6)	T <sub>j</sub> = 25°C	—	2.0	2.6	V
		IC = 20A, VGE = 15V	Chip	—	2.2	—	
Cies	Input capacitance	VCE = 10V VGE = 0V (Note. 6)	—	—	5.1	nF	
Coes	Output capacitance		—	—	0.45		
Cres	Reverse transfer capacitance		—	—	0.1		
QG	Gate charge	VCC = 600V, IC = 20A, VGE = 15V	—	150	—	nC	
I <sub>RRM</sub> (Note.3)	Repetitive peak reverse current	VR = VRRM	—	—	1	mA	
VF(Note.3)	Forward voltage	IF = 20A (Note. 6)	T <sub>j</sub> = 25°C	—	2.6	3.4	V
		IF = 20A	Chip	—	2.16	—	
Rth(j-c)Q	Thermal resistance (Junction to case) (Note. 1)	per IGBT	—	—	0.48	K/W	
Rth(j-c)D		per Clamp diode	—	—	1.1		
l*	Internal gate resistance	Tc = 25°C	—	0	—	Ω	
RG	External gate resistance		15	—	150		

**CONVERTER PART**

Symbol	Parameter	Conditions	Limits			Unit
			Min.	Typ.	Max.	
I <sub>RRM</sub>	Repetitive peak reverse current	VR = VRRM, T <sub>j</sub> = 150°C	—	—	4	mA
VF	Forward voltage	IF = 35A	—	1.2	1.6	V
Rth(j-c)	Thermal resistance (Junction to case) (Note. 1)	per Diode	—	—	0.45	K/W

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### NTC THERMISTOR PART

Symbol	Parameter	Conditions	Limits			Unit
			Min.	Typ.	Max.	
R <sub>g</sub>	Zero power resistance	T <sub>c</sub> = 25°C	4.85	5.00	5.15	kΩ
ΔR/R	Deviation of resistance	T <sub>c</sub> = 100°C, R <sub>100</sub> = 493Ω	-7.3	—	+7.8	%
B <sub>(25/50)</sub>	B constant	Approximate by equation (Note. 7)	—	3375	—	K
P <sub>25</sub>	Power dissipation	T <sub>c</sub> = 25°C	—	—	10	mW

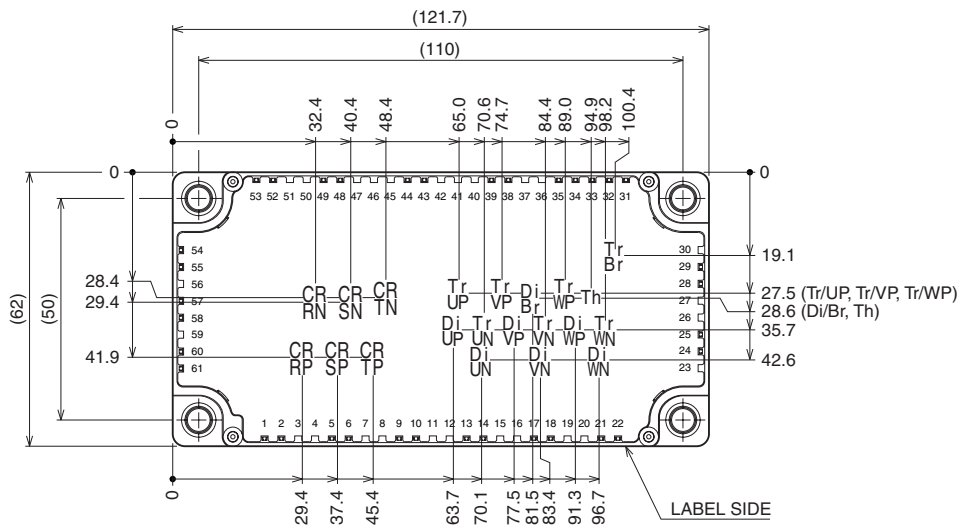
### MODULE

Symbol	Parameter	Conditions	Limits			Unit
			Min.	Typ.	Max.	
R <sub>th(c-*)</sub>	Contact thermal resistance (Case to $\theta_{cs}$ in) (Note. 1)	Thermal grease applied per 1 module (Note. 2)	—	0.015	—	K/W

- Note. 1: Case temperature (T<sub>c</sub>), heat sink temperature (T<sub>\*</sub>) measured point is just under the chips. (Refer to the figure of the chip location.)  
 2: Typical value is measured by using thermally conductive grease of λ = 0.9W/(m·K).  
 3: I<sub>E</sub>, I<sub>ERM</sub>, V<sub>EC</sub>, t<sub>r</sub>, Q<sub>rr</sub> and E<sub>rr</sub> represent ratings and characteristics of the anti-parallel, emitter-collector free wheeling diode (FWDi).  
 I<sub>F</sub>, I<sub>FRM</sub>, V<sub>F</sub>, V<sub>RRM</sub> and I<sub>RRM</sub> represent ratings and characteristics of the Clamp diode of Brake part.  
 4: Pulse width and repetition rate should be such that the device junction temperature (T<sub>j</sub>) dose not exceed T<sub>jmax</sub> rating.  
 5: Junction temperature (T<sub>j</sub>) should not increase beyond 150°C.  
 6: Pulse width and repetition rate should be such as to cause negligible temperature rise.  
 (Refer to the figure of the test circuit for V<sub>CEsat</sub> and V<sub>EC</sub>)  
 7:  $B_{(25/50)} = \ln\left(\frac{R_{25}}{R_{50}}\right) / \left(\frac{1}{T_{25}} - \frac{1}{T_{50}}\right)$   
 R<sub>25</sub>: resistance at absolute temperature T<sub>25</sub> [K]; T<sub>25</sub> = 25 [°C]+273.15 = 298.15 [K]  
 R<sub>50</sub>: resistance at absolute temperature T<sub>50</sub> [K]; T<sub>50</sub> = 50 [°C]+273.15 = 323.15 [K]

### Chip Location (Top view)

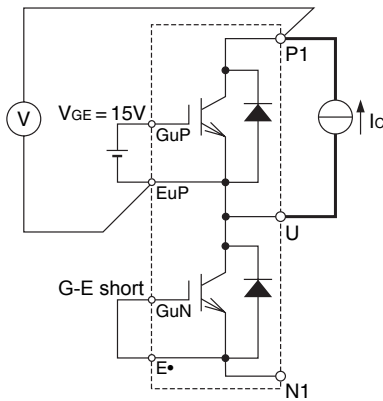
Dimensions in mm (tolerance: ±1mm)



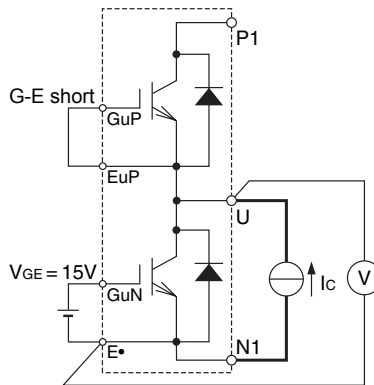
Each mark points the center position of each chip. Tr\*\*: IGBT, Di\*\*: FWDi (DiBr: Clamp diode), CR\*\*: Converter diode, Th: NTC thermistor

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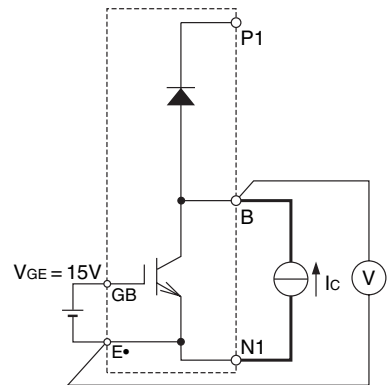
## HIGH POWER SWITCHING USE



P side Inverter part Tr  
(example of U arm)  
G-E short  
(GvP-EvP, GwP-EwP, GvN-Es, GwN-Es, GB-Es) (GvP-EvP, GwP-EwP, GvN-Es, GwN-Es, GB-Es)

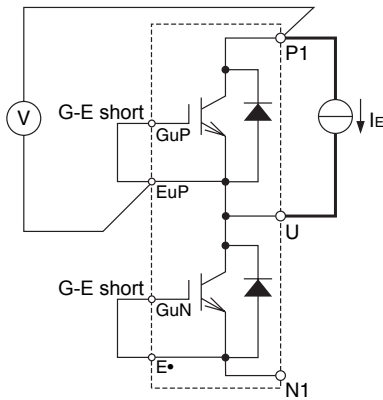


N side Inverter part Tr  
(example of U arm)  
G-E short

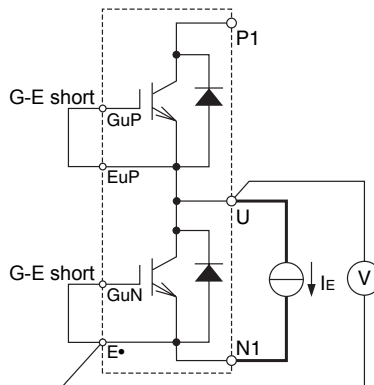


Br Tr  
G-E short  
(GuP-EuP, GvP-EvP, GwP-EwP, GuN-Es, GvN-Es, GwN-Es)

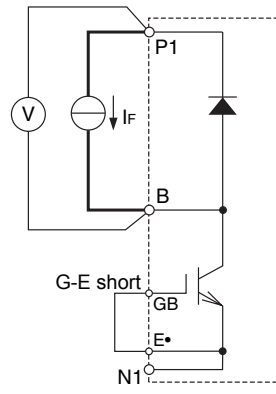
### VCEsat test circuit



P side Inverter part Di  
(example of U arm)  
G-E short  
(GvP-EvP, GwP-EwP, GvN-Es, GwN-Es, GB-Es) (GvP-EvP, GwP-EwP, GvN-Es, GwN-Es, GB-Es)

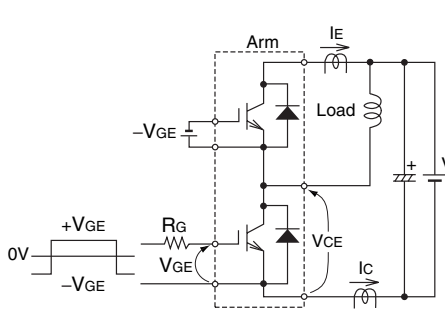


N side Inverter part Di  
(example of U arm)  
G-E short

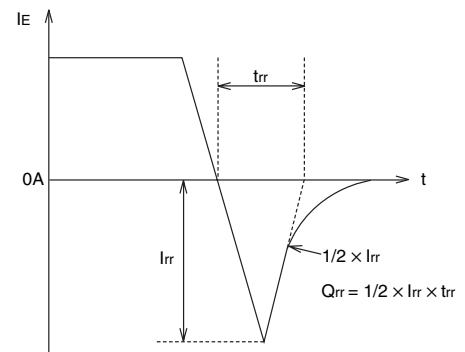
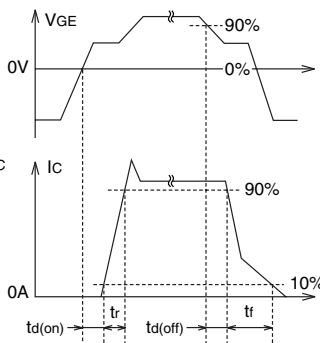


Br Di  
G-E short  
(GuP-EuP, GvP-EvP, GwP-EwP, GuN-Es, GvN-Es, GwN-Es)

### VEC/VF test circuit



Switching time test circuit and waveforms

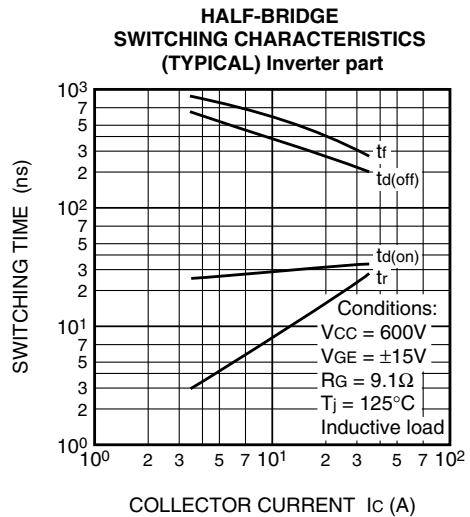
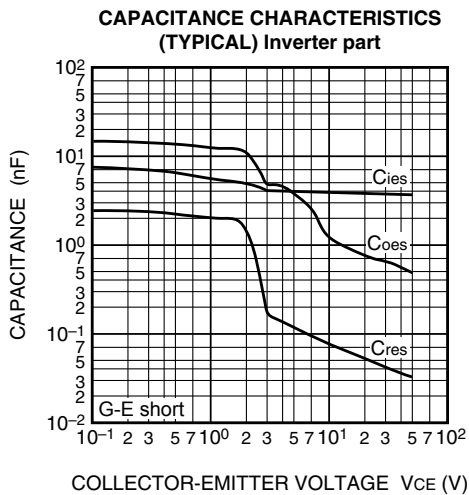
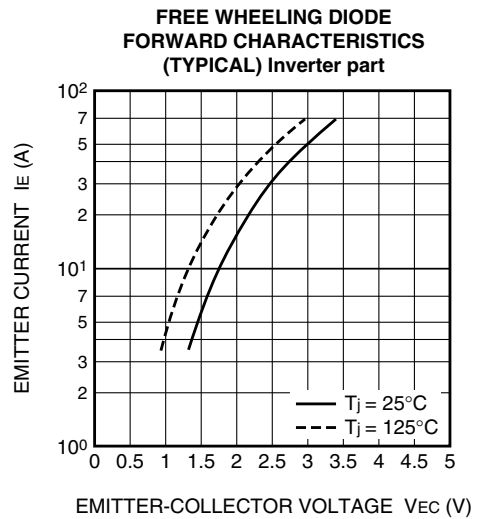
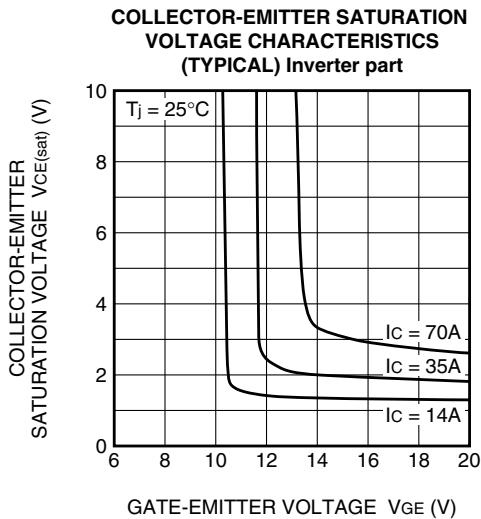
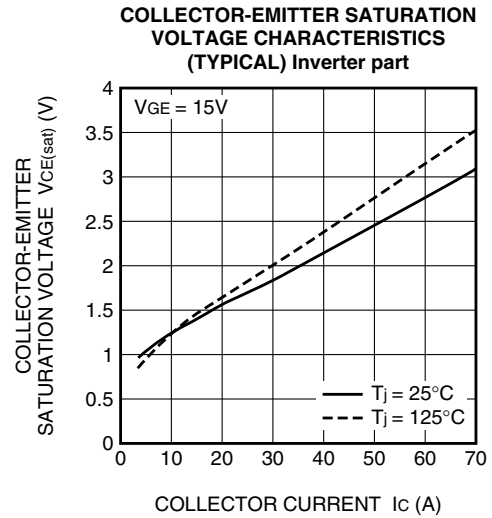
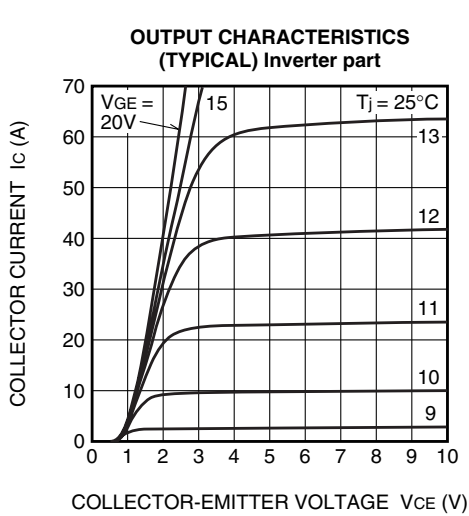


tr, Qrr test waveform

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HIGH POWER SWITCHING USE

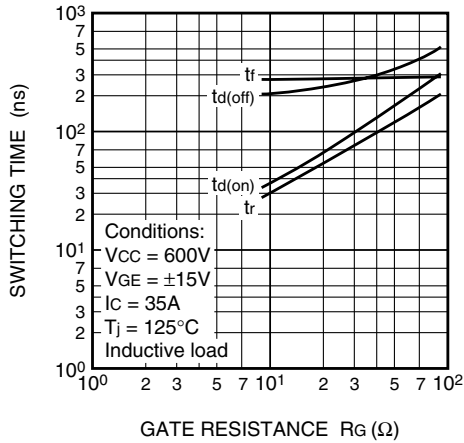
## PERFORMANCE CURVES



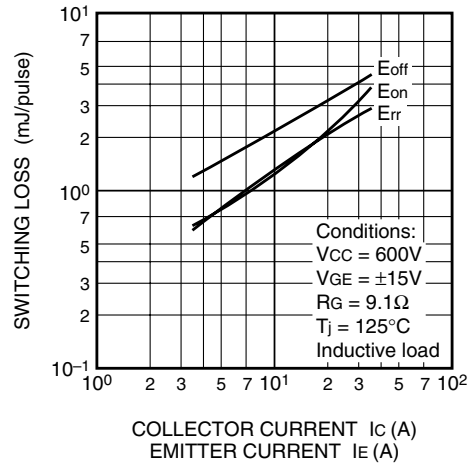
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HIGH POWER SWITCHING USE

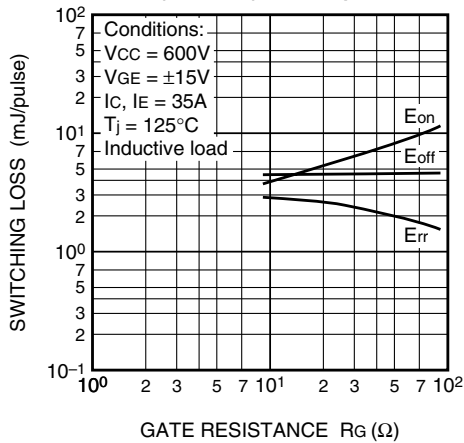
**HALF-BRIDGE SWITCHING CHARACTERISTICS (TYPICAL) Inverter part**



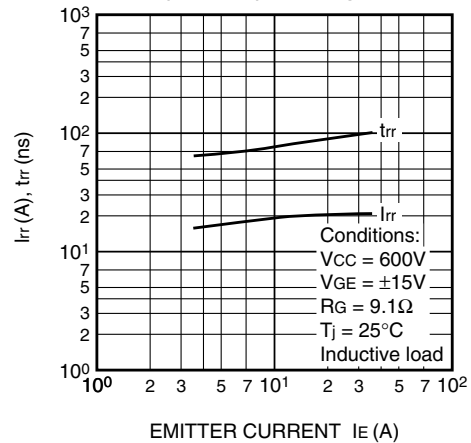
**HALF-BRIDGE SWITCHING CHARACTERISTICS (TYPICAL) Inverter part**



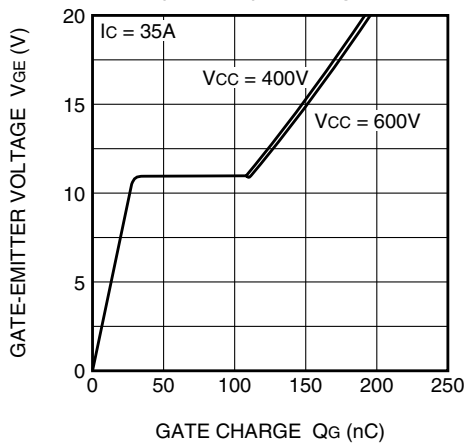
**HALF-BRIDGE SWITCHING CHARACTERISTICS (TYPICAL) Inverter part**



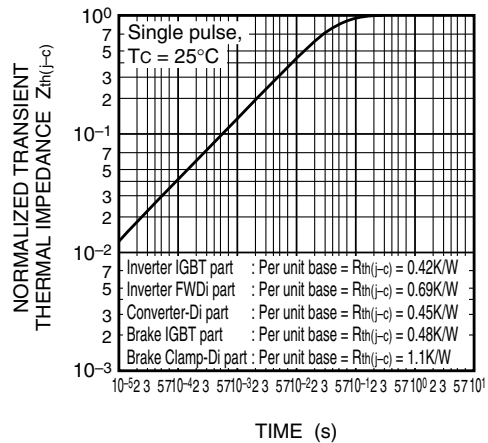
**REVERSE RECOVERY CHARACTERISTICS OF FREE WHEELING DIODE (TYPICAL) Inverter part**



**GATE CHARGE CHARACTERISTICS (TYPICAL) Inverter part**



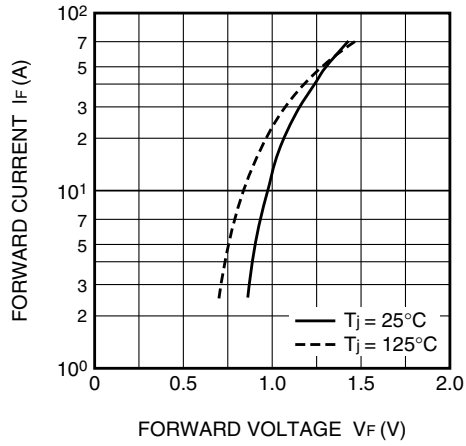
**TRANSIENT THERMAL IMPEDANCE CHARACTERISTICS**



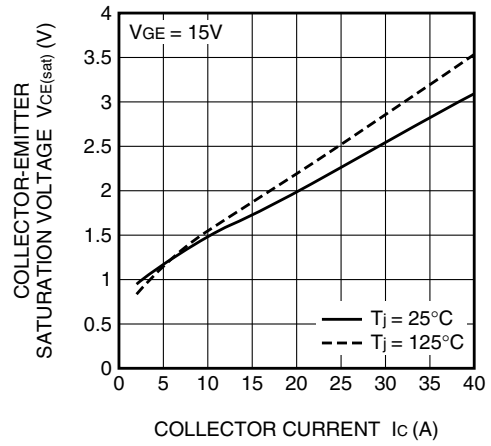
**CM35MX-24A**

HIGH POWER SWITCHING USE

**RECTIFIER DIODE  
FORWARD CHARACTERISTICS  
(TYPICAL) Converter part**



**COLLECTOR-EMITTER SATURATION  
VOLTAGE CHARACTERISTICS  
(TYPICAL) Brake part**



**CLAMP DIODE  
FORWARD CHARACTERISTICS  
(TYPICAL) Brake part**

