

# CM35MX-24A

HIGH POWER SWITCHING USE

## CM35MX-24A

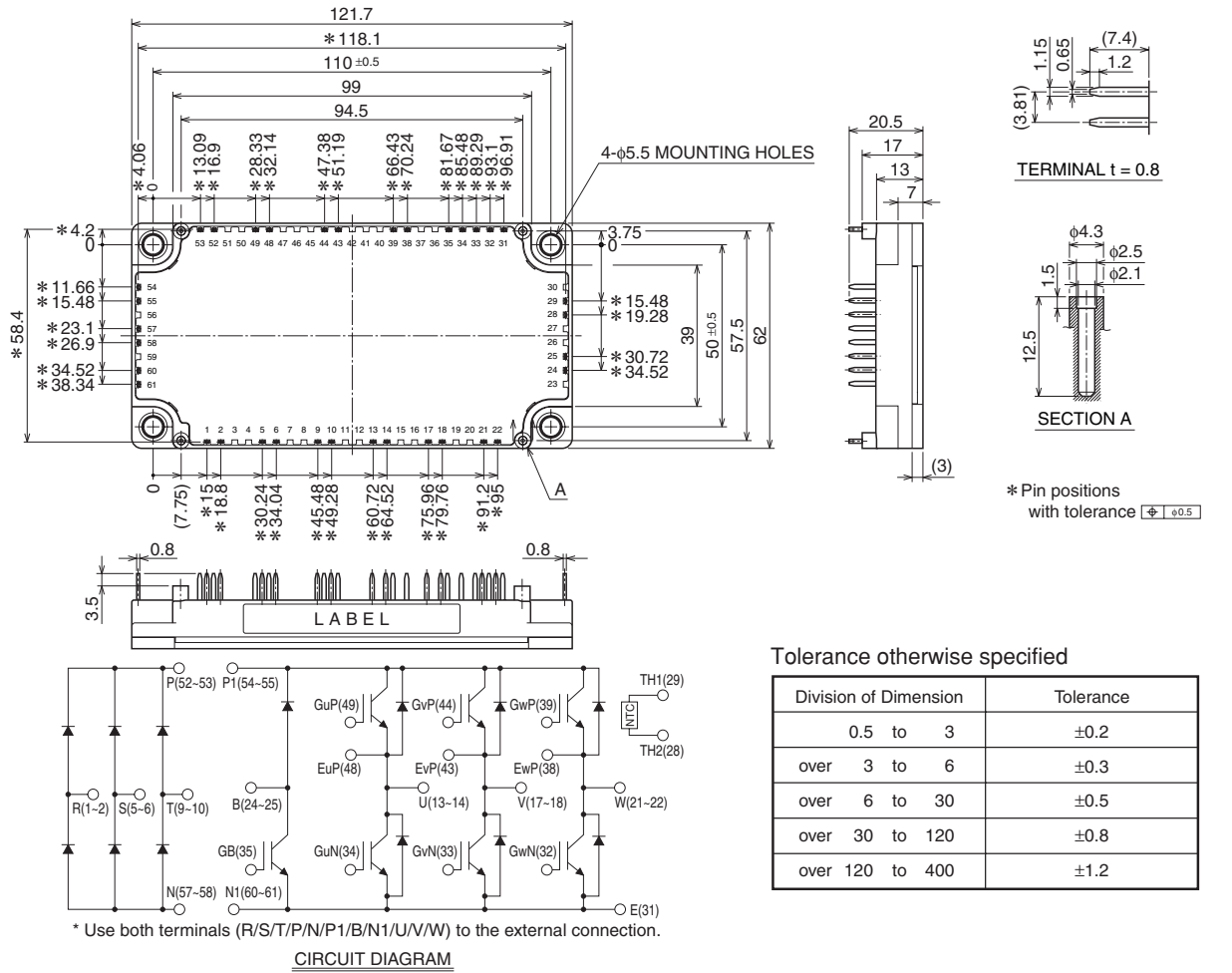


- Ic ..... 35A
- VCES ..... 1200V
- CIB (3-phase Converter + 3-phase Inverter + Brake)
- Flatbase Type / Insulated Package / Copper base plate
- RoHS Directive compliant

## 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>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>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	

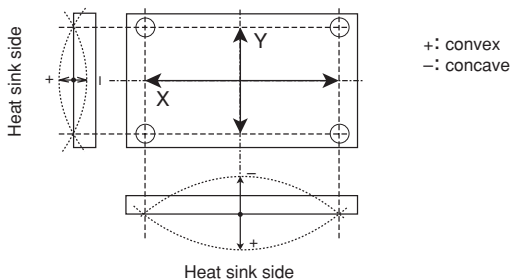
**CONVERTER PART**

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 <sub>rms</sub>
I <sub>o</sub>	DC output current	3-phase full wave rectifying, T <sub>c</sub> = 141°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 minute	2500	V <sub>rms</sub>
—	Base plate flatness	On the centerline X, Y (Note. 8)	±0 ~ +100	μm
—	Torque strength	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 cutoff current	VCE = VCES, VGE = 0V	—	—	1	mA	
VGE(th)	Gate-emitter threshold voltage	IC = 3.5mA, VCE = 10V	6	7	8	V	
IGES	Gate leakage current	±VGE = VGES, VCE = 0V	—	—	0.5	μA	
VCE(sat)	Collector-emitter saturation voltage	IC = 35A, VGE = 15V (Note. 6)	T <sub>j</sub> = 25°C	—	2.0	2.6	V
			T <sub>j</sub> = 125°C	—	2.2	—	
		IC = 35A, VGE = 15V	Chip	—	1.9	—	
Cies	Input capacitance	VCE = 10V VGE = 0V (Note. 6)	—	—	6.0	nF	
Coes	Output capacitance		—	—	0.53		
Cres	Reverse transfer capacitance		—	—	0.12		
QG	Total gate charge	VCC = 600V, IC = 35A, VGE = 15V	—	180	—	nC	
td(on)	Turn-on delay time	VCC = 600V, IC = 35A	—	—	100	ns	
tr	Turn-on rise time	VGE = ±15V, RG = 9.1Ω	—	—	50		
td(off)	Turn-off delay time	Inductive load	—	—	300		
tf	Turn-off fall time		—	—	600		
trr (Note.3)	Reverse recovery time		—	—	200		
Qrr (Note.3)	Reverse recovery charge	(IE = 35A)	—	1.5	—	μC	
VEC(Note.3)	Emitter-collector voltage	IE = 35A, VGE = 0V (Note. 6)	T <sub>j</sub> = 25°C	—	2.6	3.4	V
			T <sub>j</sub> = 125°C	—	2.16	—	
		IE = 35A, VGE = 0V	Chip	—	2.5	—	
Rth(j-c)Q	Thermal resistance (Junction to case) (Note. 1)	per IGBT	—	—	0.42	K/W	
Rth(j-c)R		per free wheeling diode	—	—	0.69		
RGint	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 cutoff current	VCE = VCES, VGE = 0V	—	—	1	mA	
VGE(th)	Gate-emitter threshold voltage	IC = 2mA, VCE = 10V	6	7	8	V	
IGES	Gate leakage current	±VGE = VGES, VCE = 0V	—	—	0.5	μA	
VCE(sat)	Collector-emitter saturation voltage	IC = 20A, VGE = 15V (Note. 6)	T <sub>j</sub> = 25°C	—	2.0	2.6	V
			T <sub>j</sub> = 125°C	—	2.2	—	
		IC = 20A, VGE = 15V	Chip	—	1.9	—	
Cies	Input capacitance	VCE = 10V VGE = 0V (Note. 6)	—	—	5.1	nF	
Coes	Output capacitance		—	—	0.45		
Cres	Reverse transfer capacitance		—	—	0.1		
QG	Total gate charge	VCC = 600V, IC = 20A, VGE = 15V	—	150	—	nC	
IRRM(Note.3)	Repetitive peak reverse current	VR = VRRM	—	—	1	mA	
VFM(Note.3)	Forward voltage drop	IF = 20A (Note. 6)	T <sub>j</sub> = 25°C	—	2.6	3.4	V
			T <sub>j</sub> = 125°C	—	2.16	—	
		IF = 20A	Chip	—	2.5	—	
Rth(j-c)Q	Thermal resistance (Junction to case) (Note. 1)	per IGBT	—	—	0.48	K/W	
Rth(j-c)R		per Clamp diode	—	—	1.1		
RGint	Internal gate resistance	Tc = 25°C	—	0	—	Ω	
RG	External gate resistance		15	—	150		

**CONVERTER PART**

Symbol	Parameter	Conditions	Limits			Unit
			Min.	Typ.	Max.	
IRRM	Repetitive peak reverse current	VR = VRRM, T <sub>j</sub> = 150°C	—	—	4	mA
VF	Forward voltage drop	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	Zero power resistance	Tc = 25°C	4.85	5.00	5.15	kΩ
ΔR/R	Deviation of resistance	Tc = 100°C, R100 = 493Ω	-7.3	—	+7.8	%
B(25/50)	B constant	Approximate by equation (Note. 7)	—	3375	—	K
P25	Power dissipation	Tc = 25°C	—	—	10	mW

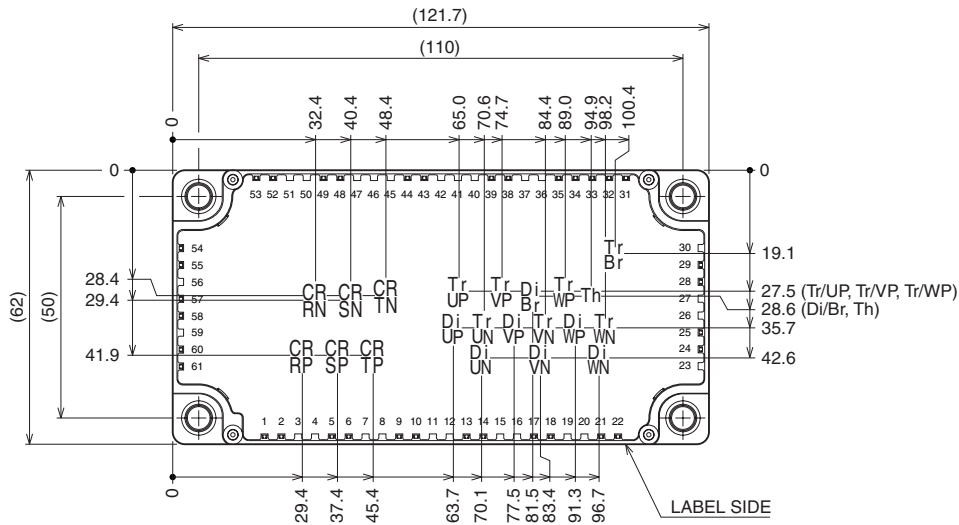
### MODULE

Symbol	Parameter	Conditions	Limits			Unit
			Min.	Typ.	Max.	
Rth(c-f)	Contact thermal resistance (Case to fin) (Note. 1)	Thermal grease applied per 1 module (Note. 2)	—	0.015	—	K/W

- Note. 1: Case temperature (Tc), heat sink temperature (Tf) 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: IE, IERM, VEC, tr, Qrr and Err represent ratings and characteristics of the anti-parallel, emitter-collector free wheeling diode (FWDi).  
 IF, IFRM, VF, VRRM and IRRM 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 (Tj) dose not exceed Tjmax rating.  
 5: Junction temperature (Tj) 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 VCE(sat) and VEC)  
 7:  $B(25/50) = \ln\left(\frac{R_{25}}{R_{50}}\right) / \left(\frac{1}{T_{25}} - \frac{1}{T_{50}}\right)$   
 R25: resistance at absolute temperature T25 [K]; T25 = 25 [°C]+273.15 = 298.15 [K]  
 R50: resistance at absolute temperature T50 [K]; T50 = 50 [°C]+273.15 = 323.15 [K]

### Chip Location (Top view)

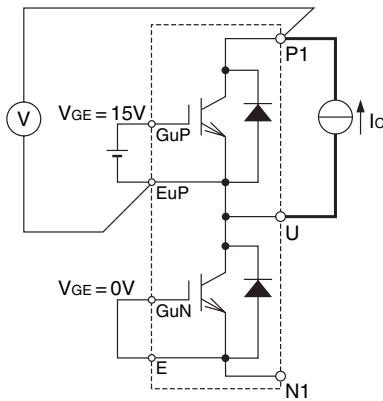
Dimensions in mm (tolerance: ±1mm)



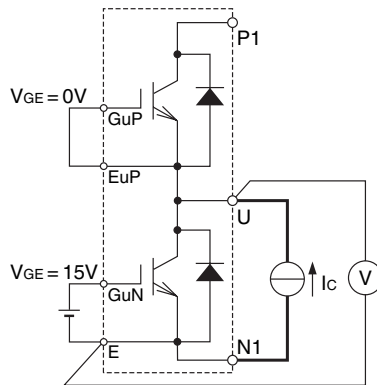
Each mark points the center position of each chip. Tr\*\*: IGBT, Di\*\*: FWDi (DiBr: Clamp diode), CR\*\*: Converter diode, Th: NTC thermistor

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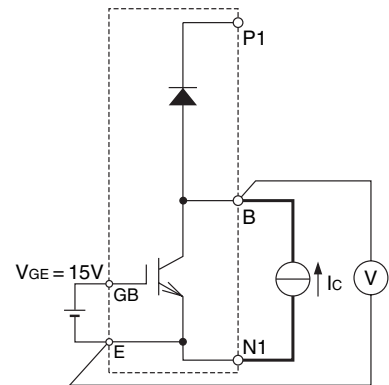


P side Inverter part Tr  
(example of U arm)  
 $V_{G^*E^*} = 0V$   
(GvP-EvP, GwP-EwP, GvN-E, GwN-E, GB-E)

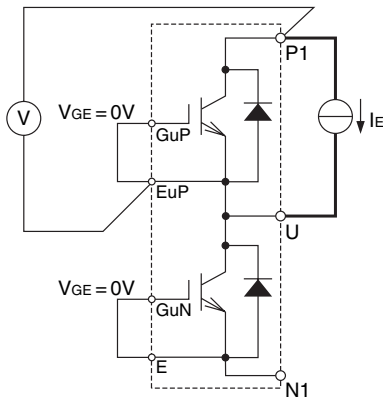


N side Inverter part Tr  
(example of U arm)  
 $V_{G^*E^*} = 0V$   
(GvP-EvP, GwP-EwP, GvN-E, GwN-E, GB-E)

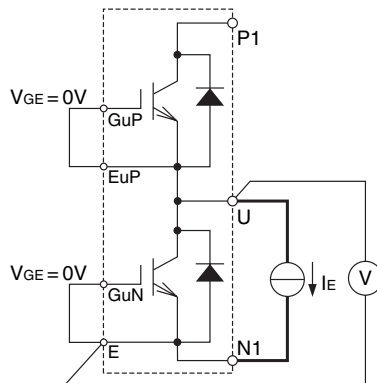
**VCE(sat) test circuit**



Br Tr  
 $V_{G^*E^*} = 0V$   
(GuP-EuP, GvP-EvP, GwP-EwP, GuN-E, GvN-E, GwN-E)

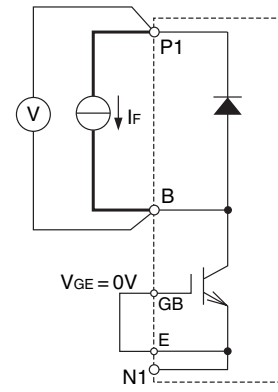


P side Inverter part Di  
(example of U arm)  
 $V_{G^*E^*} = 0V$   
(GvP-EvP, GwP-EwP, GvN-E, GwN-E, GB-E)

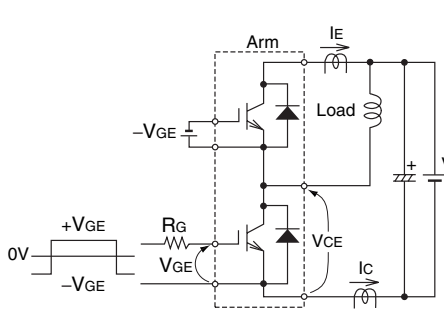


N side Inverter part Di  
(example of U arm)  
 $V_{G^*E^*} = 0V$   
(GvP-EvP, GwP-EwP, GvN-E, GwN-E, GB-E)

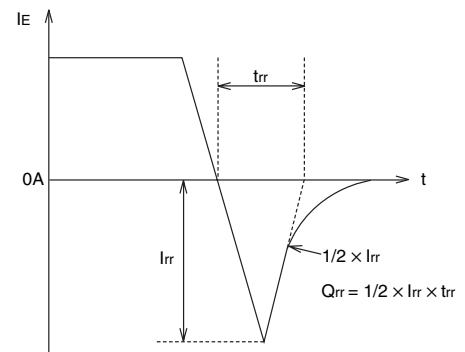
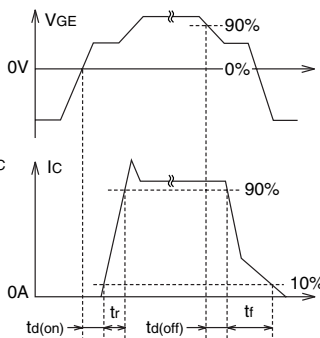
**VEC/VFM test circuit**



Br Di  
 $V_{G^*E^*} = 0V$   
(GuP-EuP, GvP-EvP, GwP-EwP, GuN-E, GvN-E, GwN-E)



Switching time test circuit and waveforms

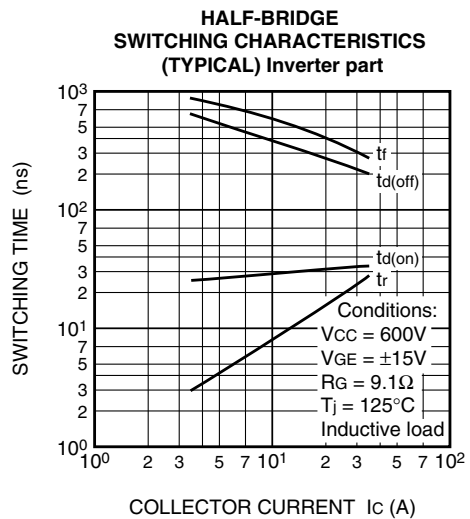
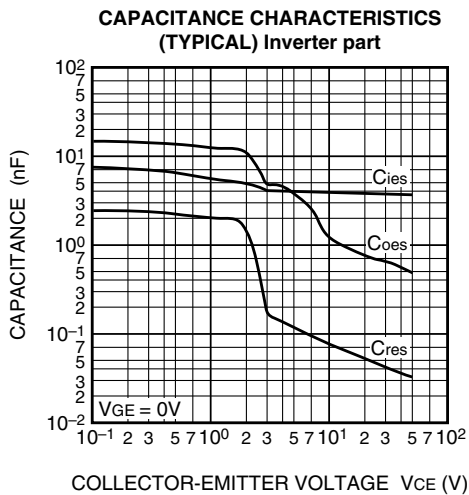
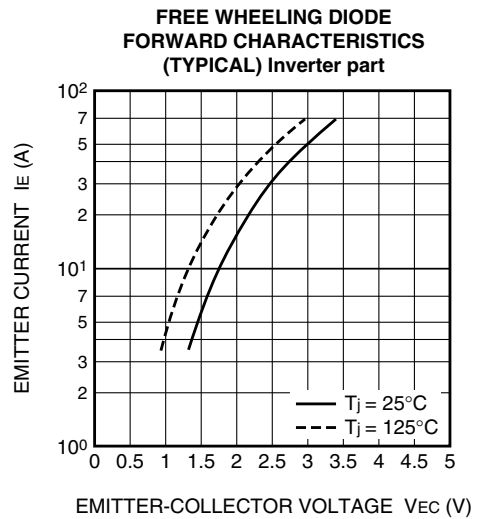
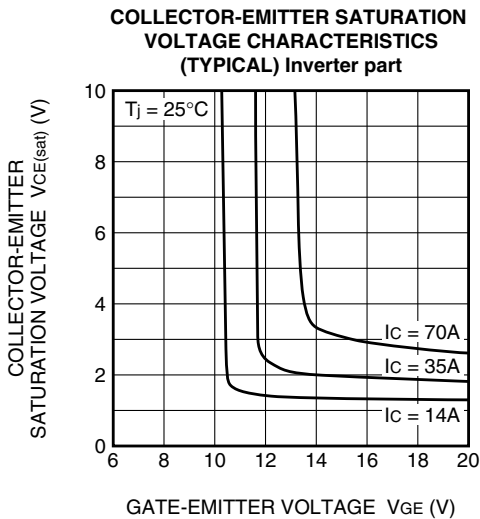
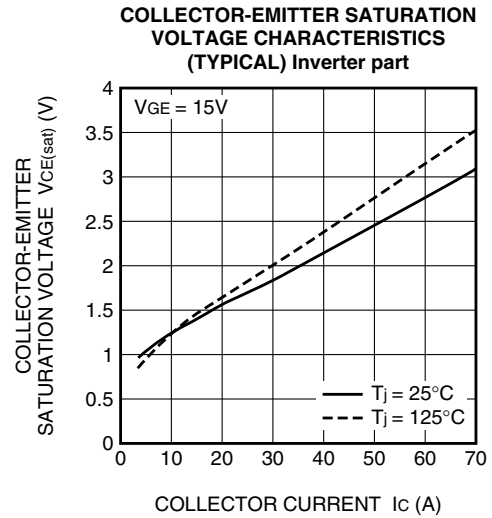
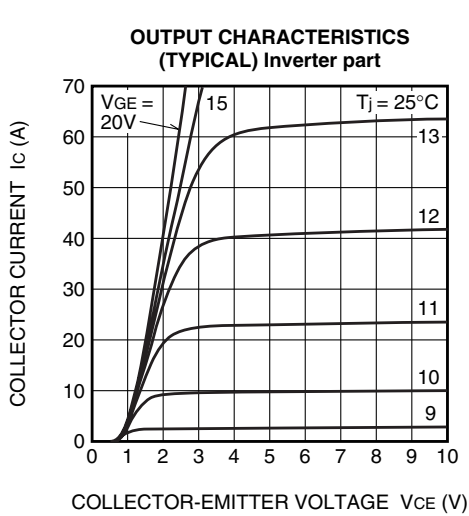


$tr_r, Q_{rr}$  test waveform

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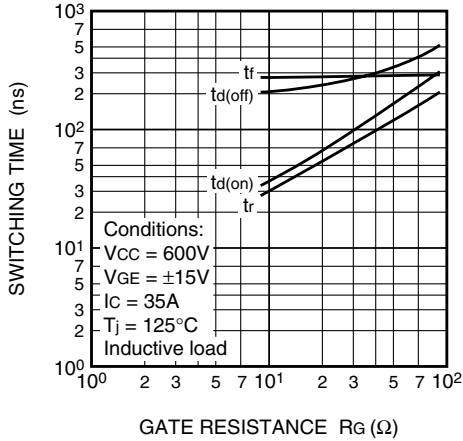
## PERFORMANCE CURVES



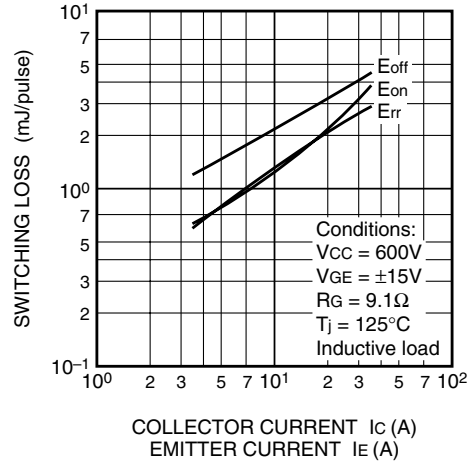
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HIGH POWER SWITCHING USE

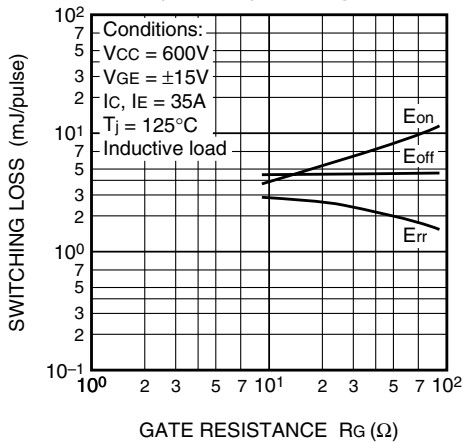
**HALF-BRIDGE SWITCHING CHARACTERISTICS (TYPICAL) Inverter part**



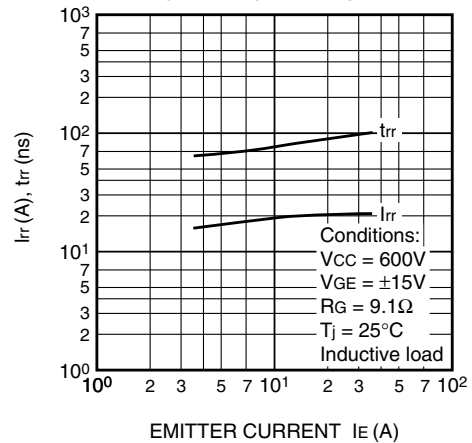
**HALF-BRIDGE SWITCHING CHARACTERISTICS (TYPICAL) Inverter part**



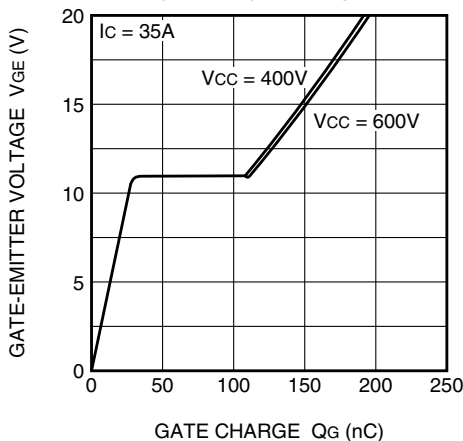
**HALF-BRIDGE SWITCHING CHARACTERISTICS (TYPICAL) Inverter part**



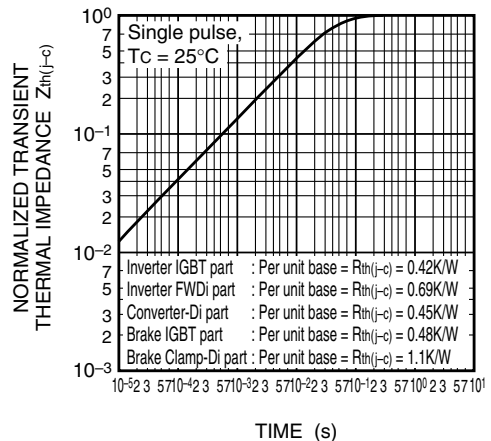
**REVERSE RECOVERY CHARACTERISTICS OF FREE WHEELING DIODE (TYPICAL) Inverter part**



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



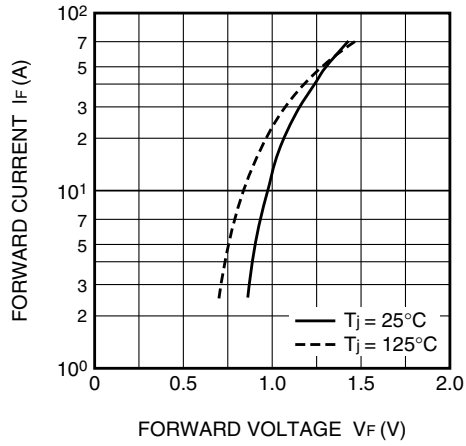
**TRANSIENT THERMAL IMPEDANCE CHARACTERISTICS**



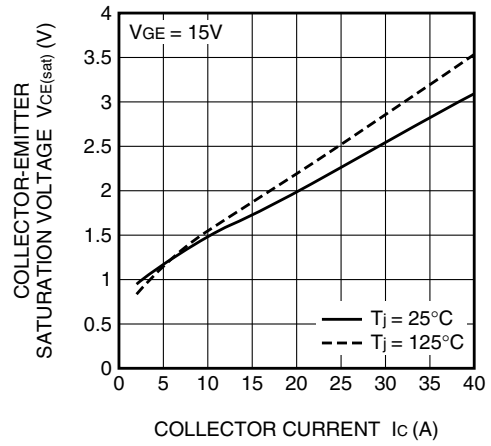
**CM35MX-24A**

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**

