

MITSUBISHI IGBT MODULES

CM50MX-24A

HIGH POWER SWITCHING USE

CM50MX-24A

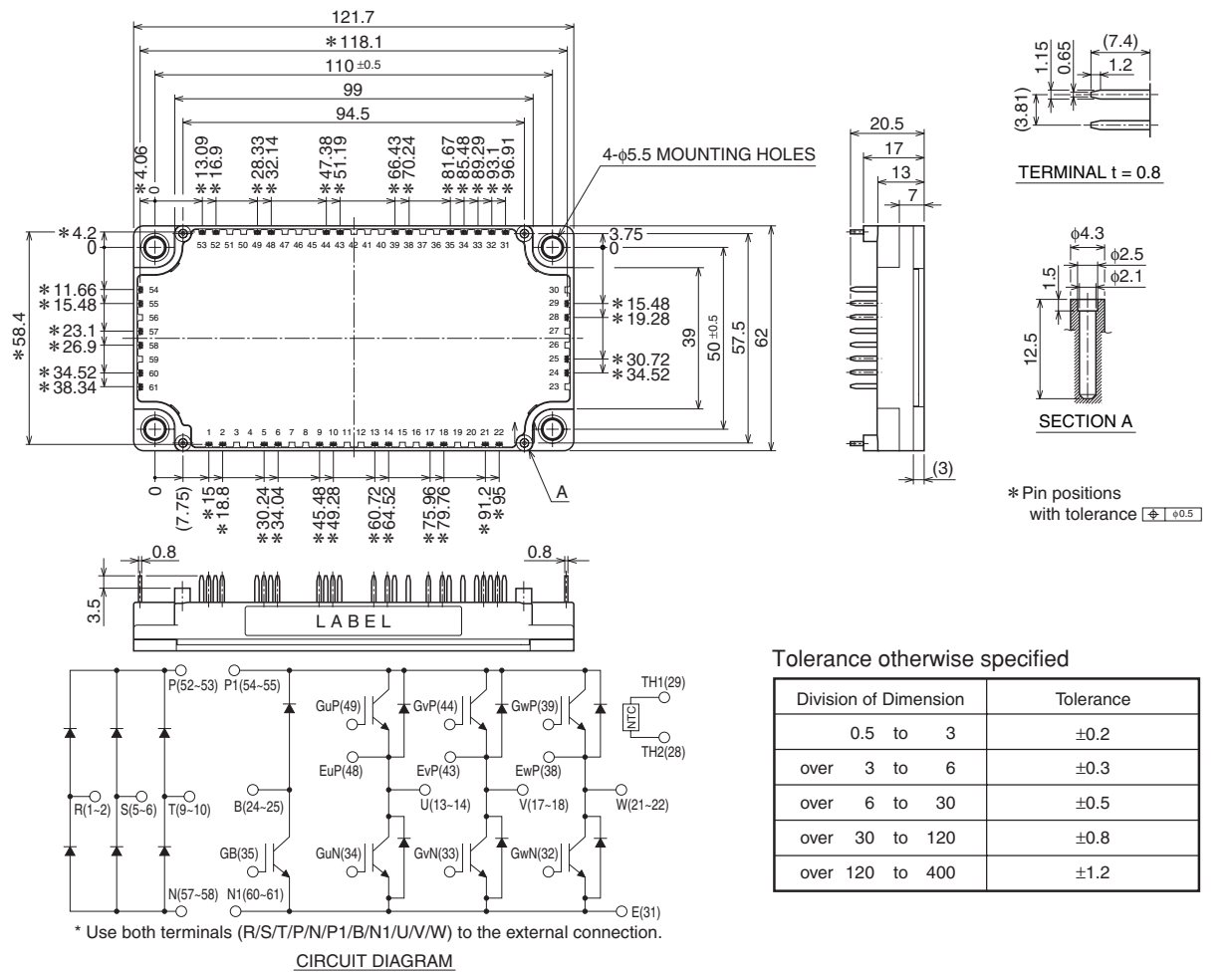


- Ic 50A
- VCES 1200V
- CIB (3-phase Converter +
3-phase Inverter + Brake)
- Flatbase Type / Insulated Package /
Copper base plate
- RoHS Directive compliant

APPLICATION

General purpose Inverters, Servo Amplifiers

OUTLINE DRAWING & CIRCUIT DIAGRAM



Jan. 2009

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ABSOLUTE MAXIMUM RATINGS (Tj = 25°C, unless otherwise specified)

INVERTER PART

Symbol	Parameter	Conditions	Rating	Unit
V _{CES}	Collector-emitter voltage	G-E Short	1200	V
V _{GES}	Gate-emitter voltage	C-E Short	±20	
I _C	Collector current	DC, Tc = 97°C (Note. 1)	50	A
I _{CRM}		Pulse (Note. 4)	100	
P _C	Maximum collector dissipation	Tc = 25°C (Note. 1, 5)	355	W
I _E (Note.3)	Emitter current	Tc = 25°C (Note. 1)	50	A
I _{ERM} (Note.3)	(Free wheeling diode forward current)	Pulse (Note. 4)	100	

BRAKE PART

Symbol	Parameter	Conditions	Rating	Unit
V _{CES}	Collector-emitter voltage	G-E Short	1200	V
V _{GES}	Gate-emitter voltage	C-E Short	±20	
I _C	Collector current	DC, Tc = 106°C (Note. 1)	30	A
I _{CRM}		Pulse (Note. 4)	60	
P _C	Maximum collector dissipation	Tc = 25°C (Note. 1, 5)	260	W
V _{RRM} (Note.3)	Repetitive peak reverse voltage		1200	V
I _F (Note.3)	Forward current	Tc = 25°C (Note. 1)	30	A
I _{FRM} (Note.3)		Pulse (Note. 4)	60	

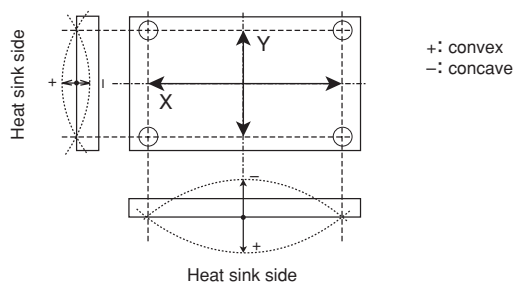
CONVERTER PART

Symbol	Parameter	Conditions	Rating	Unit
V _{RRM}	Repetitive peak reverse voltage		1600	V
E _a	Recommended AC input voltage		440	Vrms
I _O	DC output current	3-phase full wave rectifying, Tc = 141°C (Note. 1)	50	A
I _{FSM}	Surge forward current	The sine half wave 1 cycle peak value, f = 60Hz, non-repetitive	500	
i ² t	Current square time	Value for one cycle of surge current	1040	A ² s

MODULE

Symbol	Parameter	Conditions	Rating	Unit
T _j	Junction temperature		-40 ~ +150	°C
T _{stg}	Storage temperature		-40 ~ +125	
V _{iso}	Isolation voltage	Terminals to base plate, f = 60Hz, AC for 1 minute	2500	Vrms
—	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 CHARACTERISTICS (T_j = 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 = 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 = 50A, VGE = 15V (Note. 6) T _j = 25°C	—	2.0	2.6	V
		T _j = 125°C	—	2.2	—	
		Chip	—	1.9	—	
Cies	Input capacitance	VCE = 10V VGE = 0V (Note. 6)	—	—	8.5	nF
Coes	Output capacitance		—	—	0.75	
Cres	Reverse transfer capacitance		—	—	0.17	
QG	Total gate charge	VCC = 600V, IC = 50A, VGE = 15V	—	250	—	nC
td(on)	Turn-on delay time	VCC = 600V, IC = 50A	—	—	100	ns
tr	Turn-on rise time	VGE = ±15V, RG = 6.2Ω	—	—	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 = 50A)	—	2	—	μC
VEC(Note.3)	Emitter-collector voltage	IE = 50A, VGE = 0V (Note. 6) T _j = 25°C	—	2.6	3.4	V
		T _j = 125°C	—	2.16	—	
		Chip	—	2.5	—	
Rth(j-c)Q	Thermal resistance (Note. 1)	per 1/6 IGBT	—	—	0.35	K/W
Rth(j-c)R		per 1/6 free wheeling diode	—	—	0.63	
RGint	Internal gate resistance	Tc = 25°C, per switch	—	0	—	Ω
RG	External gate resistance		6	—	62	

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 = 3mA, VCE = 10V	6	7	8	V
IGES	Gate leakage current	±VGE = VGES, VCE = 0V	—	—	0.5	μA
VCE(sat)	Collector-emitter saturation voltage	IC = 30A, VGE = 15V (Note. 6) T _j = 25°C	—	2.0	2.6	V
		T _j = 125°C	—	2.2	—	
		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 = 30A, VGE = 15V	—	150	—	nC
IRRM(Note.3)	Repetitive peak reverse current	VR = VRRM	—	—	1	mA
VFM(Note.3)	Forward voltage drop	IF = 30A (Note. 6) T _j = 25°C	—	2.6	3.4	V
		T _j = 125°C	—	2.16	—	
		Chip	—	2.5	—	
Rth(j-c)Q	Thermal resistance (Note. 1)	per IGBT	—	—	0.48	K/W
Rth(j-c)R		per Clamp diode	—	—	0.79	
RGint	Internal gate resistance	Tc = 25°C	—	0	—	Ω
RG	External gate resistance		10	—	100	

CONVERTER PART

Symbol	Parameter	Conditions	Limits			Unit
			Min.	Typ.	Max.	
IRRM	Repetitive peak reverse current	VR = VRRM, T _j = 150°C	—	—	6	mA
VF	Forward voltage drop	IF = 50A	—	1.2	1.6	V
Rth(j-c)	Thermal resistance (Note. 1)	per Diode	—	—	0.33	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, R ₁₀₀ = 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.	
R _{th(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 (T_c), heat sink temperature (T_f) 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_E, I_{ERM}, V_{EC}, t_r, Q_{rr} and E_{rr} represent ratings and characteristics of the anti-parallel, emitter-collector free wheeling diode (FWDi).

I_F, I_{FRM}, V_F, V_{RRM} and I_{RRM} 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_j) dose not exceed T_{jmax} rating.

5: Junction temperature (T_j) 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_{CE(sat)} and V_{EC})

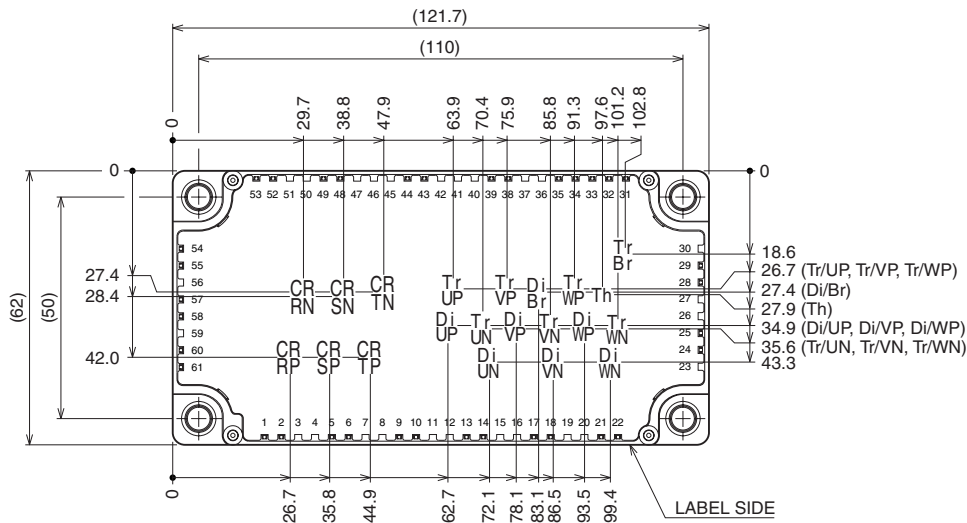
$$7: B(25/50) = \ln\left(\frac{R_{25}}{R_{50}}\right) \left(\frac{1}{T_{25}} - \frac{1}{T_{50}} \right)$$

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)

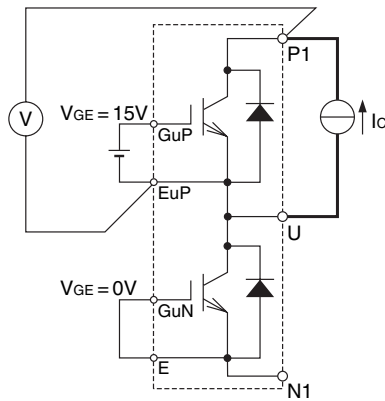
Dimensions in mm (tolerance: ±1mm)



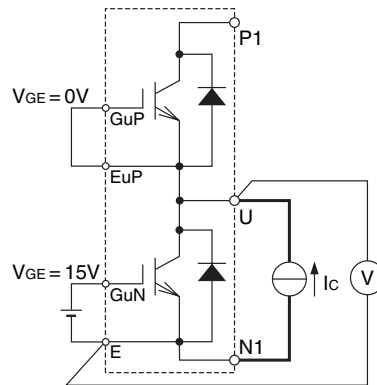
Each mark points the center position of each chip. Tr**: IGBT, Di**: FWDi (DiBr: Clamp diode), CR**: Converter diode, Th: NTC thermistor

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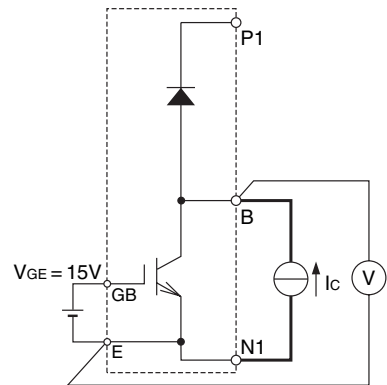


P side Inverter part Tr
(example of U arm)
 $V_{G^*E^*} = 0V$
(GvP-EvP, GwP-EwP, GvN-E, GwN-E, GB-E)

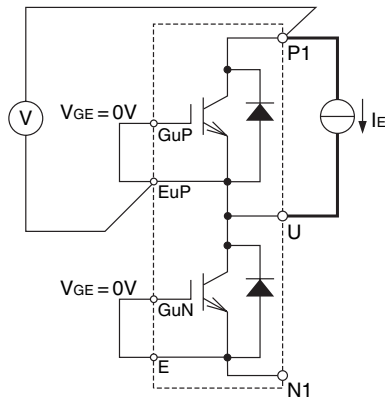


N side Inverter part Tr
(example of U arm)
 $V_{G^*E^*} = 0V$
(GvP-EvP, GwP-EwP, GvN-E, GwN-E, GB-E)

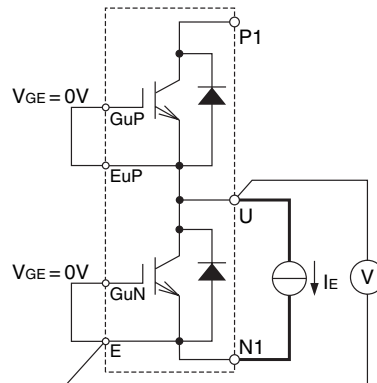
VCE(sat) test circuit



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

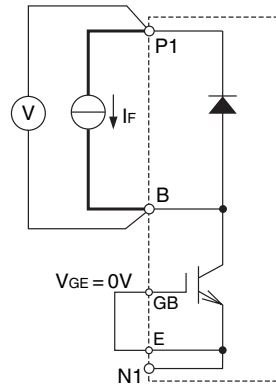


P side Inverter part Di
(example of U arm)
 $V_{G^*E^*} = 0V$
(GvP-EvP, GwP-EwP, GvN-E, GwN-E, GB-E)

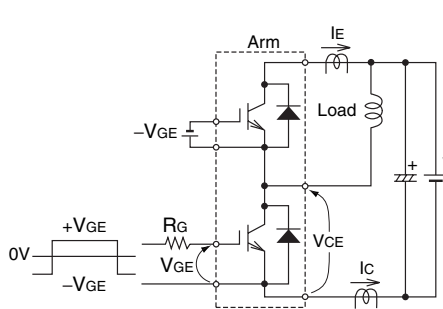


N side Inverter part Di
(example of U arm)
 $V_{G^*E^*} = 0V$
(GvP-EvP, GwP-EwP, GvN-E, GwN-E, GB-E)

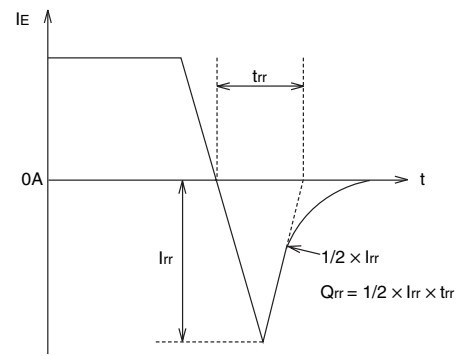
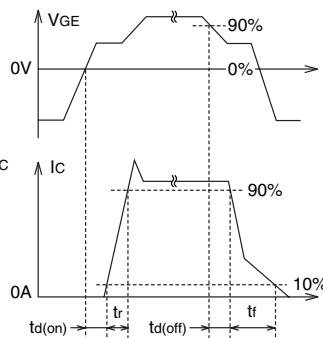
VEC/VFM test circuit



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



Switching time test circuit and waveforms

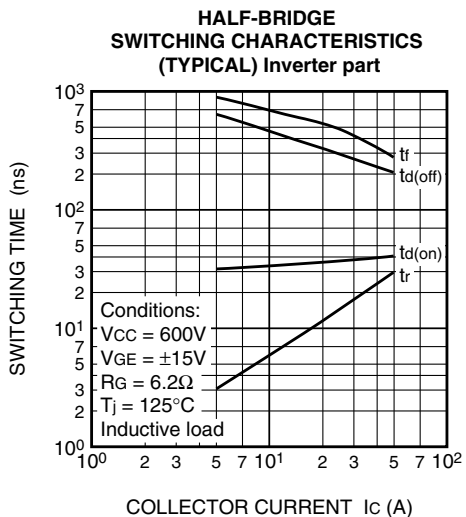
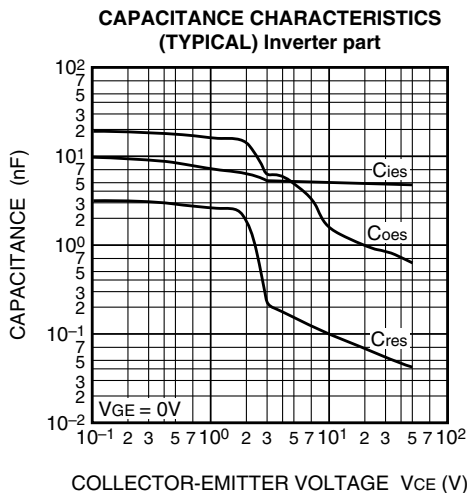
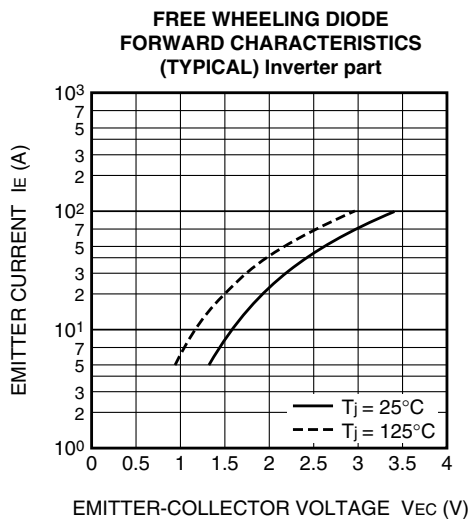
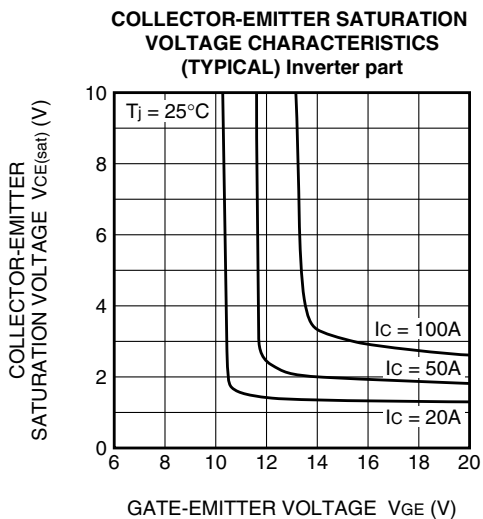
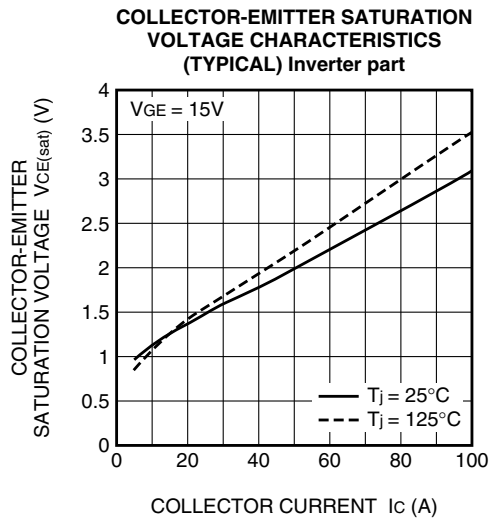
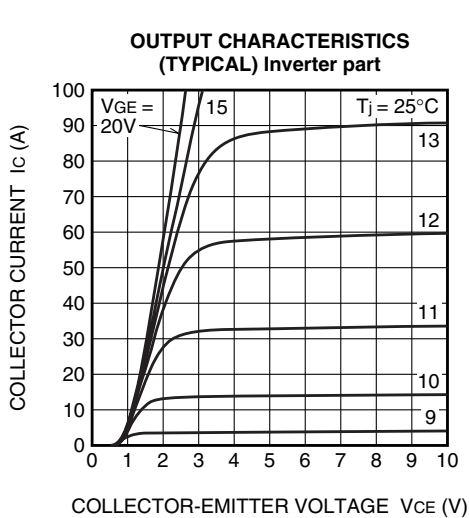


t_{rr} , Q_{rr} test waveform

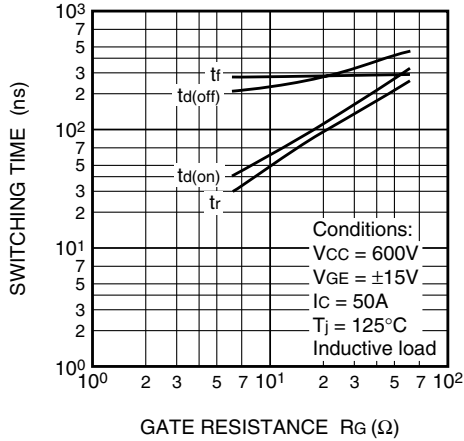
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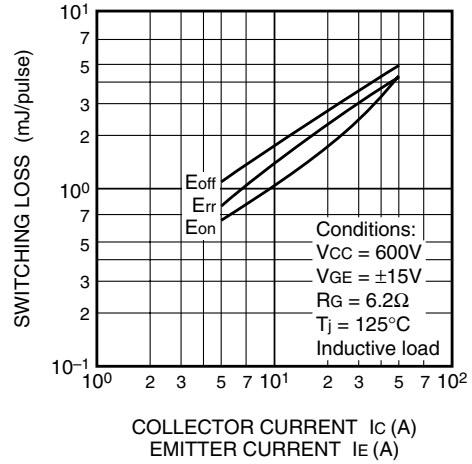
PERFORMANCE CURVES



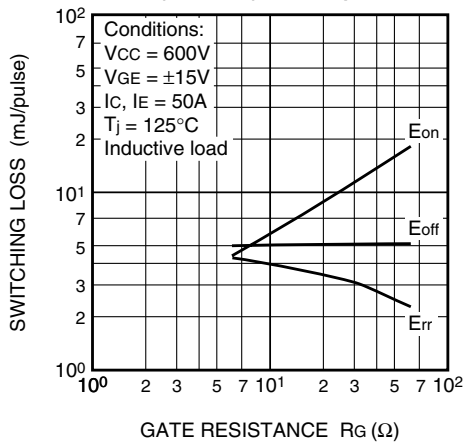
HALF-BRIDGE
SWITCHING CHARACTERISTICS
(TYPICAL) Inverter part



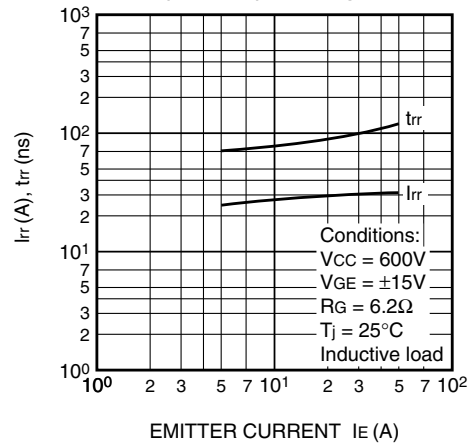
HALF-BRIDGE
SWITCHING CHARACTERISTICS
(TYPICAL) Inverter part



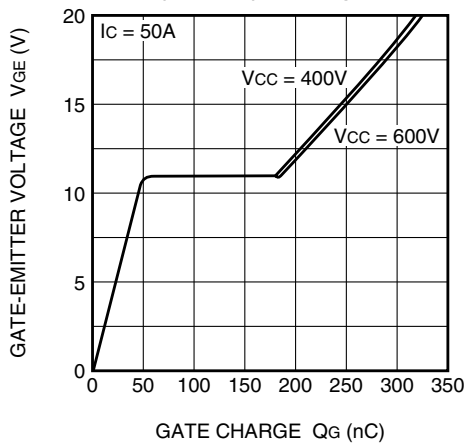
HALF-BRIDGE
SWITCHING CHARACTERISTICS
(TYPICAL) Inverter part



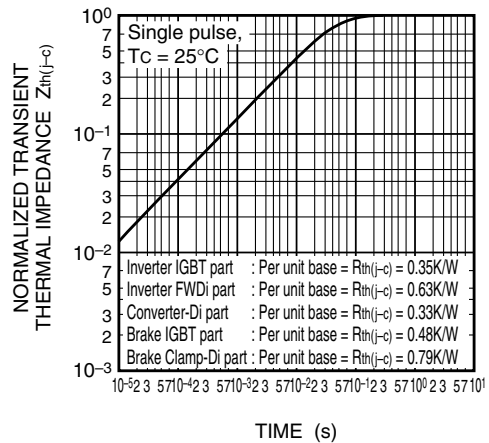
REVERSE RECOVERY CHARACTERISTICS
OF FREE WHEELING DIODE
(TYPICAL) Inverter part



GATE CHARGE CHARACTERISTICS
(TYPICAL) Inverter part



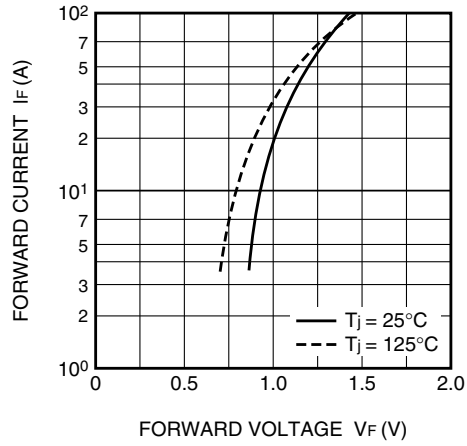
TRANSIENT THERMAL
IMPEDANCE CHARACTERISTICS



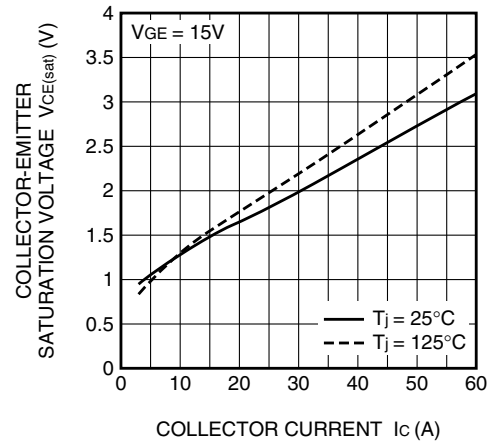
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HIGH POWER SWITCHING USE

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



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



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

