

MITSUBISHI IGBT MODULES CM100MX-12A

HIGH POWER SWITCHING USE

CM100MX-12A

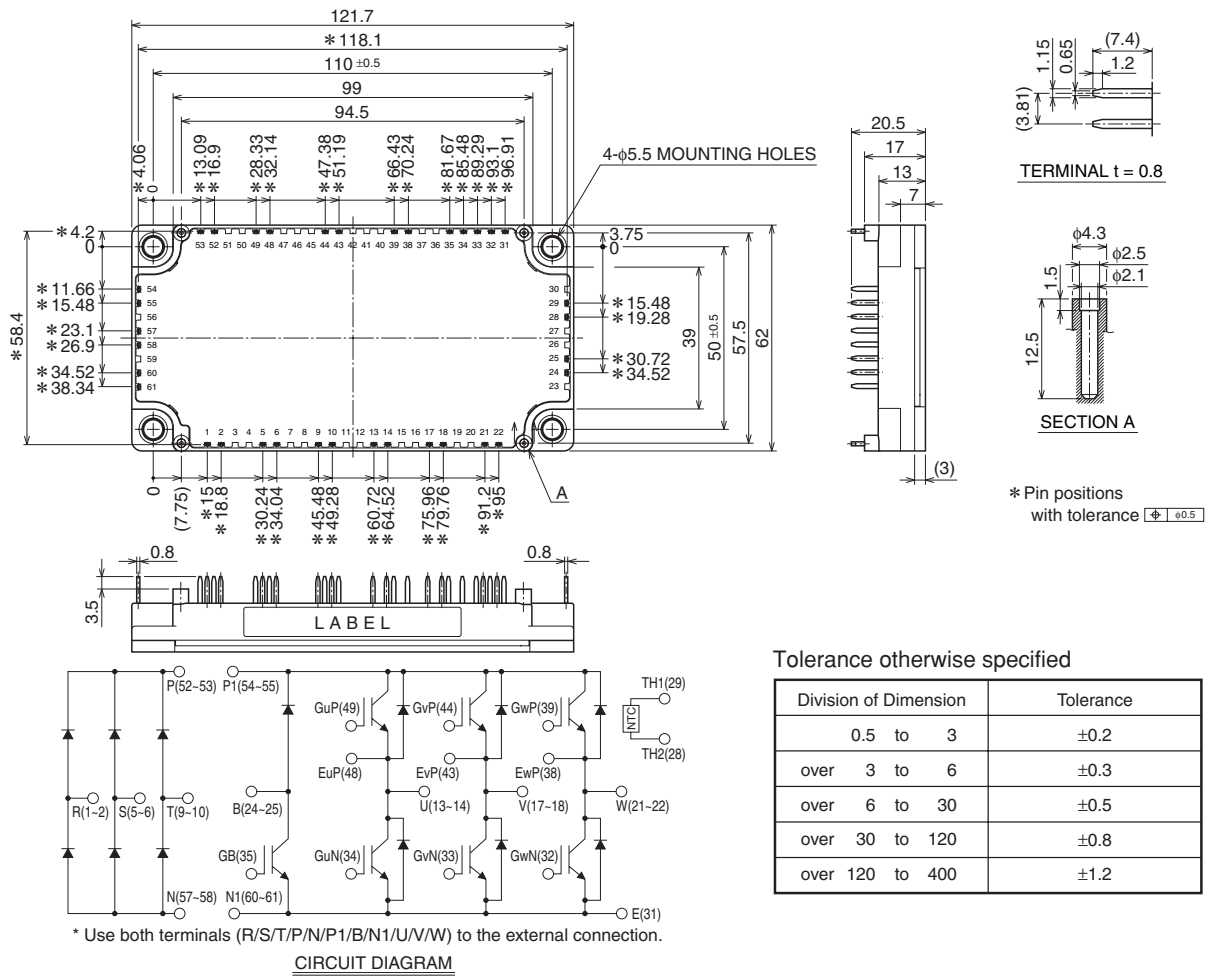


- Ic 100A
- VCES 600V
- CIB (3-phase Converter + 3-phase Inverter + Brake)
- Flatbase Type / Insulated Package / Copper base plate
- RoHS Directive compliant

APPLICATION

General purpose Inverters, Servo Amplifiers

OUTLINE DRAWING & CIRCUIT DIAGRAM



Jan. 2009



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ABSOLUTE MAXIMUM RATINGS ($T_J = 25^\circ\text{C}$, unless otherwise specified)

INVERTER PART

Symbol	Parameter	Conditions	Rating	Unit
V_{CES}	Collector-emitter voltage	G-E Short	600	V
V_{GES}	Gate-emitter voltage	C-E Short	± 20	
I_C	Collector current	DC, $T_C = 75^\circ\text{C}$ (Note. 1)	100	A
I_{CRM}		Pulse (Note. 4)	200	
P_C	Maximum collector dissipation	$T_C = 25^\circ\text{C}$ (Note. 1, 5)	400	W
I_E (Note.3)	Emitter current	$T_C = 25^\circ\text{C}$ (Note. 1)	100	A
I_{ERM} (Note.3)	(Free wheeling diode forward current)	Pulse (Note. 4)	150	

BRAKE PART

Symbol	Parameter	Conditions	Rating	Unit
V_{CES}	Collector-emitter voltage	G-E Short	600	V
V_{GES}	Gate-emitter voltage	C-E Short	± 20	
I_C	Collector current	DC, $T_C = 97^\circ\text{C}$ (Note. 1)	50	A
I_{CRM}		Pulse (Note. 4)	100	
P_C	Maximum collector dissipation	$T_C = 25^\circ\text{C}$ (Note. 1, 5)	280	W
V_{RRM} (Note.3)	Repetitive peak reverse voltage		600	V
I_F (Note.3)	Forward current	$T_C = 25^\circ\text{C}$ (Note. 1)	50	A
I_{FRM} (Note.3)		Pulse (Note. 4)	100	

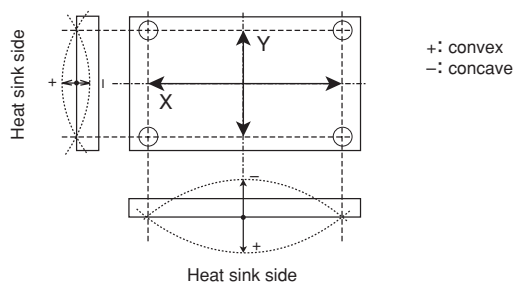
CONVERTER PART

Symbol	Parameter	Conditions	Rating	Unit
V_{RRM}	Repetitive peak reverse voltage		800	V
E_a	Recommended AC input voltage		220	Vrms
I_O	DC output current	3-phase full wave rectifying, $T_C = 137^\circ\text{C}$ (Note. 1)	100	A
I_{FSM}	Surge forward current	The sine half wave 1 cycle peak value, $f = 60\text{Hz}$, non-repetitive	1000	
i^2t	Current square time	Value for one cycle of surge current	4160	A^2s

MODULE

Symbol	Parameter	Conditions	Rating	Unit
T_J	Junction temperature		$-40 \sim +150$	$^\circ\text{C}$
T_{stg}	Storage temperature		$-40 \sim +125$	
V_{iso}	Isolation voltage	Terminals to base plate, $f = 60\text{Hz}$, AC 1 minute	2500	Vrms
—	Base plate flatness	On the centerline X, Y (Note. 8)	$\pm 0 \sim +100$	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 ($T_j = 25^\circ\text{C}$, unless otherwise specified)

INVERTER PART

Symbol	Parameter	Conditions	Limits			Unit	
			Min.	Typ.	Max.		
ICES	Collector cutoff current	$V_{CE} = V_{CES}, V_{GE} = 0V$	—	—	1	mA	
$V_{GE(th)}$	Gate-emitter threshold voltage	$I_C = 10mA, V_{CE} = 10V$	5	6	7	V	
IGES	Gate leakage current	$\pm V_{GE} = V_{GES}, V_{CE} = 0V$	—	—	0.5	μA	
$V_{CE(sat)}$	Collector-emitter saturation voltage	$I_C = 100A, V_{GE} = 15V$ (Note. 6)	$T_j = 25^\circ\text{C}$	—	1.7	2.1	V
			$T_j = 125^\circ\text{C}$	—	1.9	—	
			Chip	—	1.6	—	
C_{ies}	Input capacitance	$V_{CE} = 10V$ $V_{GE} = 0V$ (Note. 6)		—	—	13.3	nF
C_{oes}	Output capacitance			—	—	1.4	
C_{res}	Reverse transfer capacitance			—	—	0.45	
Q_G	Total gate charge	$V_{CC} = 300V, I_C = 100A, V_{GE} = 15V$	—	270	—	nC	
$t_{d(on)}$	Turn-on delay time	$V_{CC} = 300V, I_C = 100A$	—	—	100	ns	
t_r	Turn-on rise time	$V_{GE} = \pm 15V, R_G = 6.2\Omega$	—	—	100		
$t_{d(off)}$	Turn-off delay time	Inductive load	—	—	300		
t_f	Turn-off fall time		—	—	600		
t_{rr} (Note.3)	Reverse recovery time		—	—	200		
Q_{rr} (Note.3)	Reverse recovery charge	($I_E = 100A$)	—	3.6	—	μC	
V_{EC} (Note.3)	Emitter-collector voltage	$I_E = 100A, V_{GE} = 0V$ (Note. 6)	$T_j = 25^\circ\text{C}$	—	2.0	2.8	V
			$T_j = 125^\circ\text{C}$	—	1.95	—	
			Chip	—	1.9	—	
$R_{th(j-c)Q}$	Thermal resistance (Junction to case) (Note. 1)	per IGBT	—	—	0.31	K/W	
$R_{th(j-c)R}$		per free wheeling diode	—	—	0.59		
R_{Gint}	Internal gate resistance	$T_C = 25^\circ\text{C}$, per switch	—	0	—	Ω	
R_G	External gate resistance		6	—	62		

BRAKE PART

Symbol	Parameter	Conditions	Limits			Unit	
			Min.	Typ.	Max.		
ICES	Collector cutoff current	$V_{CE} = V_{CES}, V_{GE} = 0V$	—	—	1	mA	
$V_{GE(th)}$	Gate-emitter threshold voltage	$I_C = 5mA, V_{CE} = 10V$	5	6	7	V	
IGES	Gate leakage current	$\pm V_{GE} = V_{GES}, V_{CE} = 0V$	—	—	0.5	μA	
$V_{CE(sat)}$	Collector-emitter saturation voltage	$I_C = 50A, V_{GE} = 15V$ (Note. 6)	$T_j = 25^\circ\text{C}$	—	1.7	2.1	V
			$T_j = 125^\circ\text{C}$	—	1.9	—	
			Chip	—	1.6	—	
C_{ies}	Input capacitance	$V_{CE} = 10V$ $V_{GE} = 0V$ (Note. 6)		—	—	9.3	nF
C_{oes}	Output capacitance			—	—	1.0	
C_{res}	Reverse transfer capacitance			—	—	0.3	
Q_G	Total gate charge	$V_{CC} = 300V, I_C = 50A, V_{GE} = 15V$	—	200	—	nC	
I_{RRM} (Note.3)	Repetitive peak reverse current	$V_R = V_{RRM}$	—	—	1	mA	
V_{FM} (Note.3)	Forward voltage drop	$I_F = 50A$ (Note. 6)	$T_j = 25^\circ\text{C}$	—	2.0	2.8	V
			$T_j = 125^\circ\text{C}$	—	1.95	—	
			Chip	—	1.9	—	
$R_{th(j-c)Q}$	Thermal resistance (Junction to case) (Note. 1)	per IGBT	—	—	0.44	K/W	
$R_{th(j-c)R}$		per Clamp diode	—	—	0.85		
R_{Gint}	Internal gate resistance	$T_C = 25^\circ\text{C}$	—	0	—	Ω	
R_G	External gate resistance		13	—	125		

CONVERTER PART

Symbol	Parameter	Conditions	Limits			Unit
			Min.	Typ.	Max.	
I_{RRM}	Repetitive peak reverse current	$V_R = V_{RRM}, T_j = 150^\circ\text{C}$	—	—	20	mA
V_F	Forward voltage drop	$I_F = 100A$	—	1.2	1.6	V
$R_{th(j-c)}$	Thermal resistance (Junction to case) (Note. 1)	per Diode	—	—	0.24	K/W

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NTC THERMISTOR PART

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

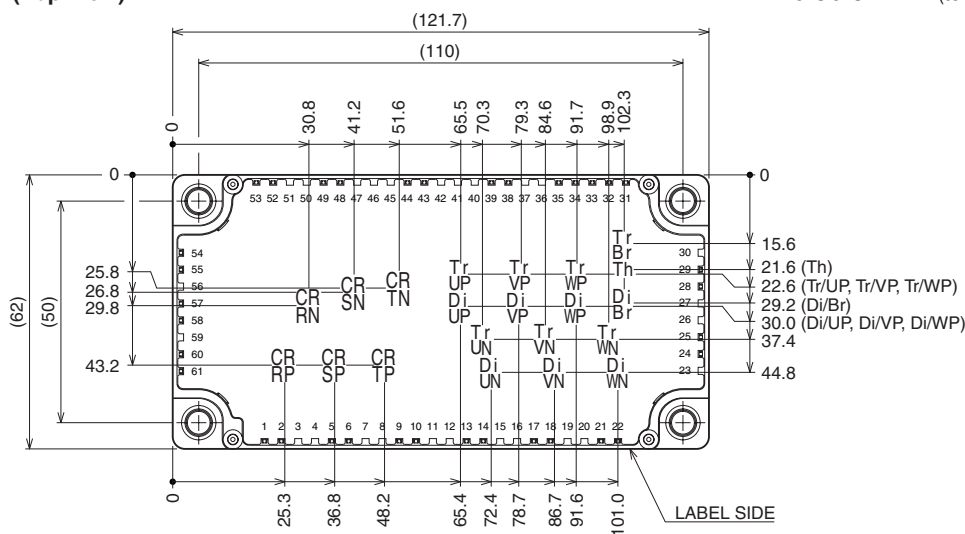
$$7: B(25/50) = \ln\left(\frac{R_{25}}{R_{50}}\right) \left(\frac{1}{T_{25}} - \frac{1}{T_{50}} \right)$$

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)



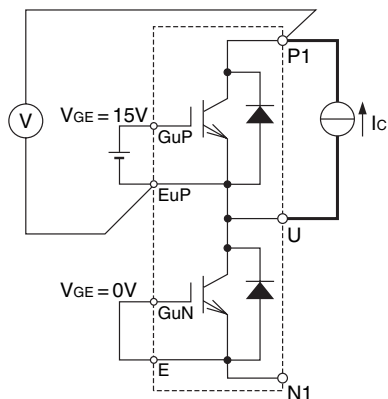
Each mark points the center position of each chip. Tr**: IGBT, Di**: FWDi (DiBr: Clamp diode), CR**: Converter diode, Th: NTC thermistor

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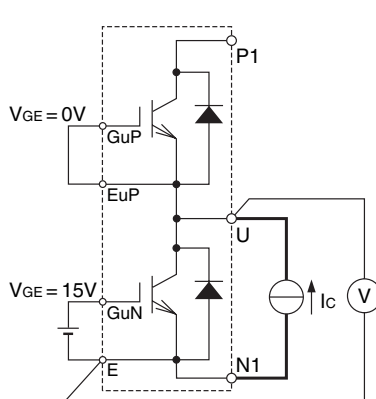
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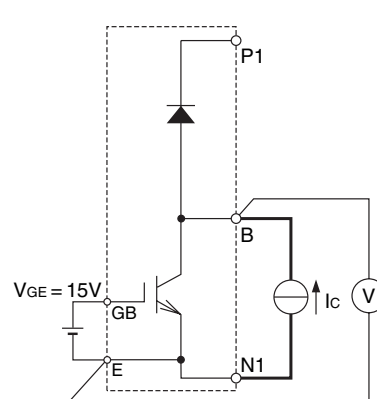
HIGH POWER SWITCHING USE



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

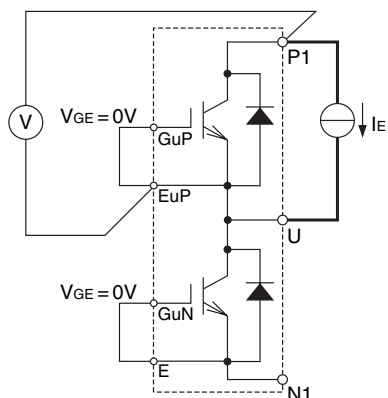


N side Inverter part Tr
(example of U arm)
 $V_{G^*E^*} = 0V$
(GvP-EvP, GwP-EwP, GvN-E, GwN-E, GB-E)

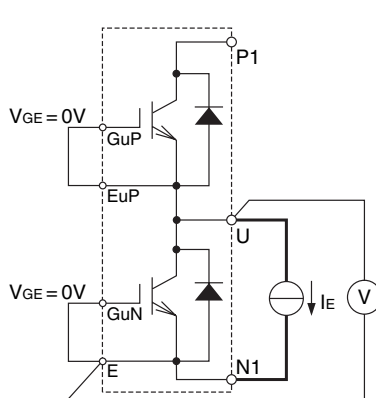


Br Tr
 $V_{G^*E^*} = 0V$
(GuP-EuP, GvP-EvP, GwP-EwP, GuN-E, GvN-E, GwN-E)

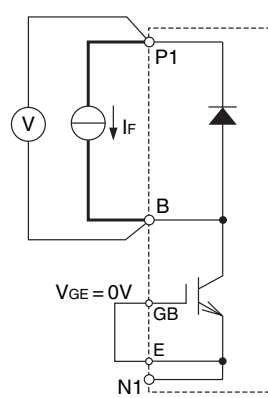
VCE(sat) test circuit



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

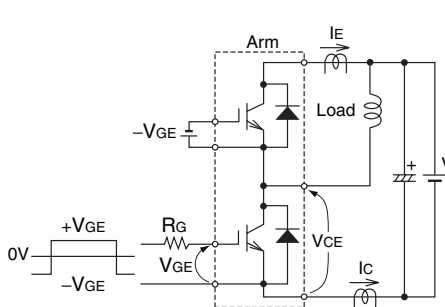


N side Inverter part Di
(example of U arm)
 $V_{G^*E^*} = 0V$
(GvP-EvP, GwP-EwP, GvN-E, GwN-E, GB-E)

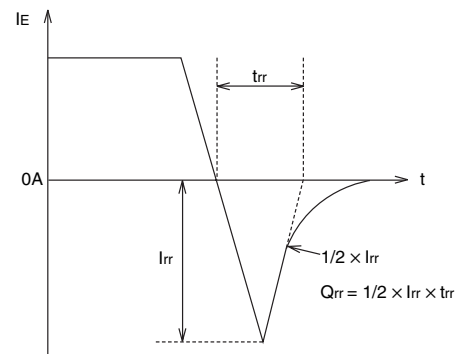
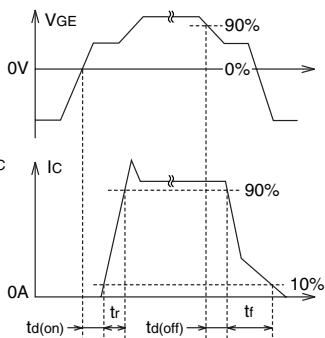


Br Di
 $V_{G^*E^*} = 0V$
(GuP-EuP, GvP-EvP, GwP-EwP, GuN-E, GvN-E, GwN-E)

Vec/VFM test circuit



Switching time test circuit and waveforms



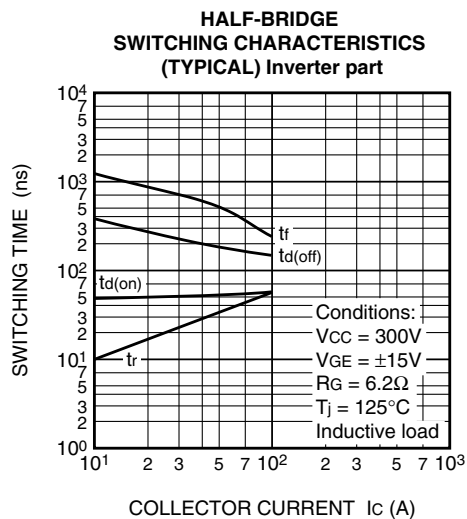
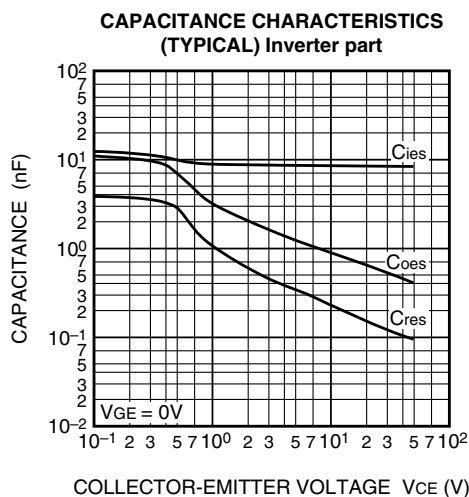
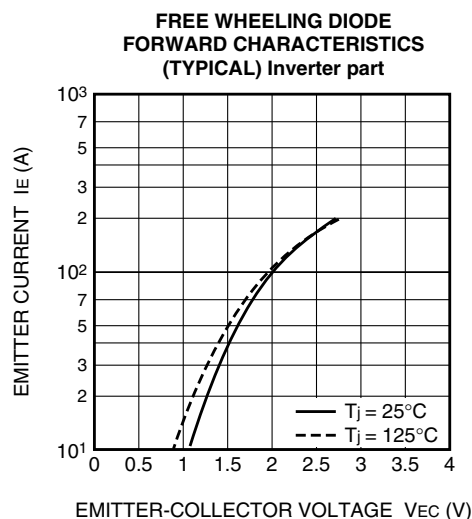
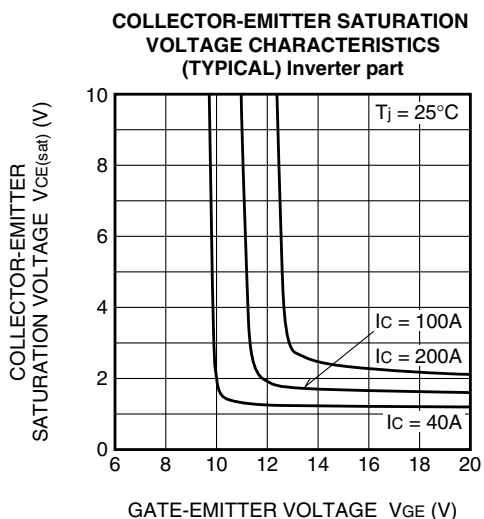
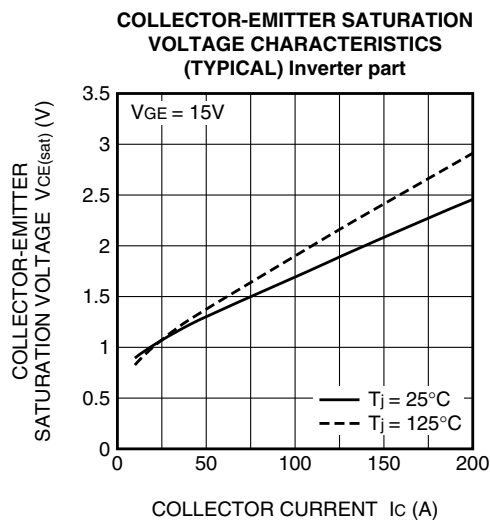
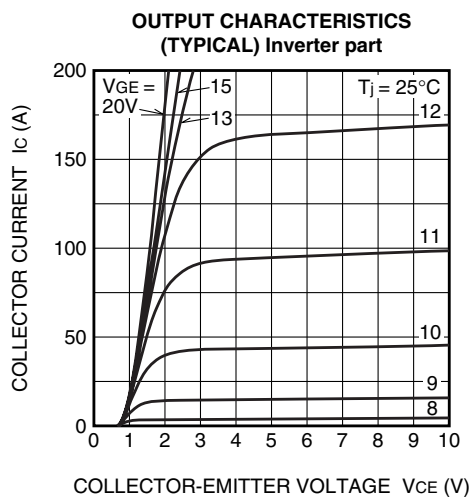
trr, Qrr test waveform

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HIGH POWER SWITCHING USE

PERFORMANCE CURVES

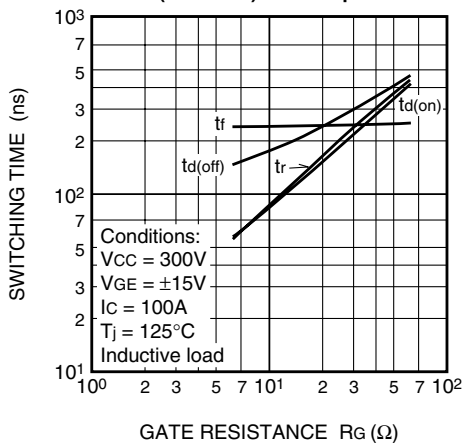


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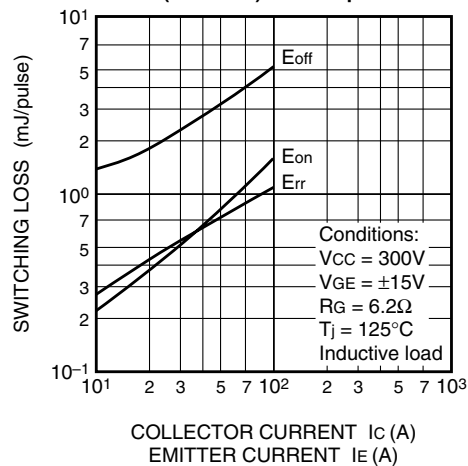
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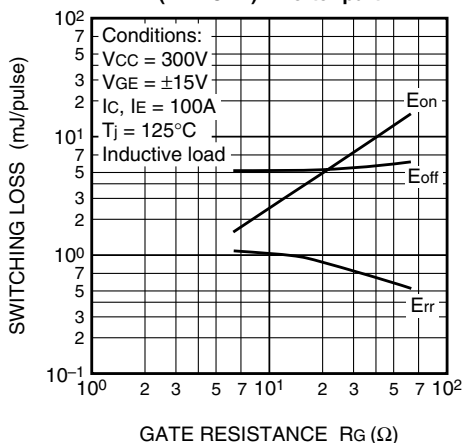
HALF-BRIDGE SWITCHING CHARACTERISTICS (TYPICAL) Inverter part



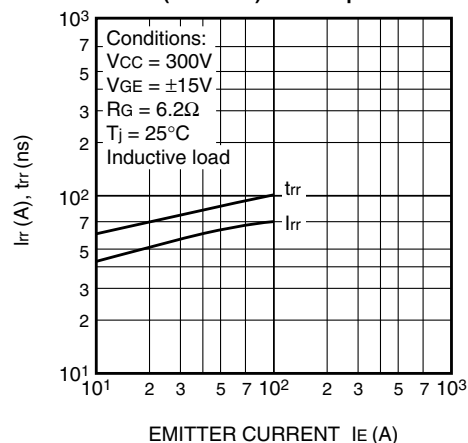
HALF-BRIDGE SWITCHING CHARACTERISTICS (TYPICAL) Inverter part



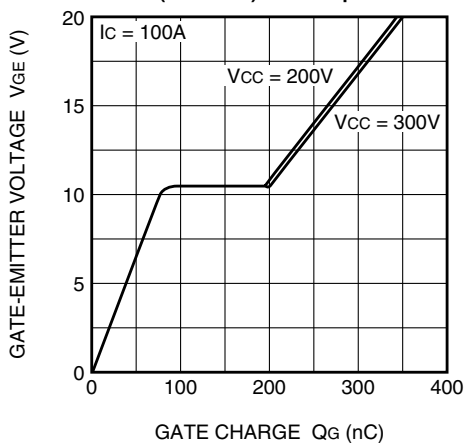
HALF-BRIDGE SWITCHING CHARACTERISTICS (TYPICAL) Inverter part



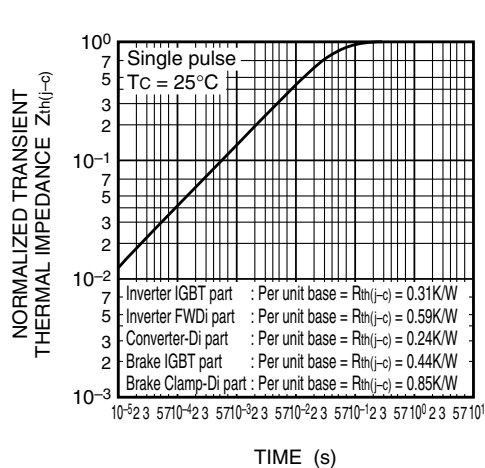
REVERSE RECOVERY CHARACTERISTICS OF FREE WHEELING DIODE (TYPICAL) Inverter part



GATE CHARGE CHARACTERISTICS (TYPICAL) Inverter part



TRANSIENT THERMAL IMPEDANCE CHARACTERISTICS

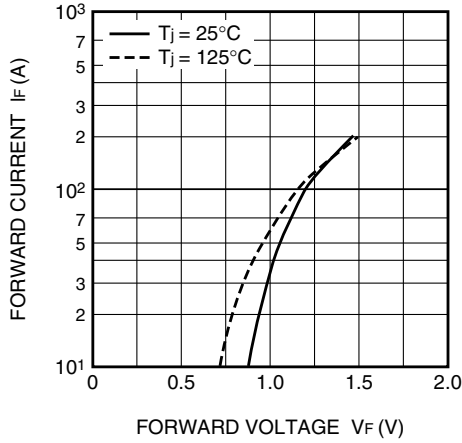


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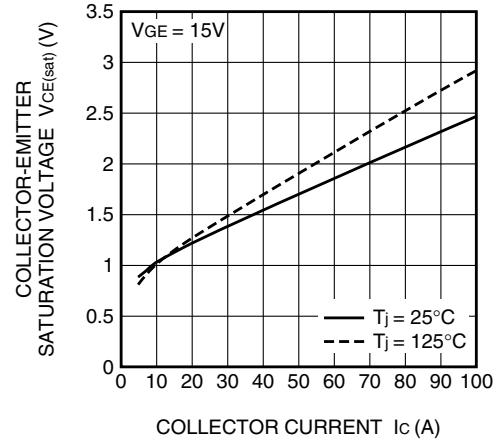
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HIGH POWER SWITCHING USE

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



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



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

