MITSUBISHI IGBT MODULES

CM35MX-24A

HIGH POWER SWITCHING USE

CM35MX-24A

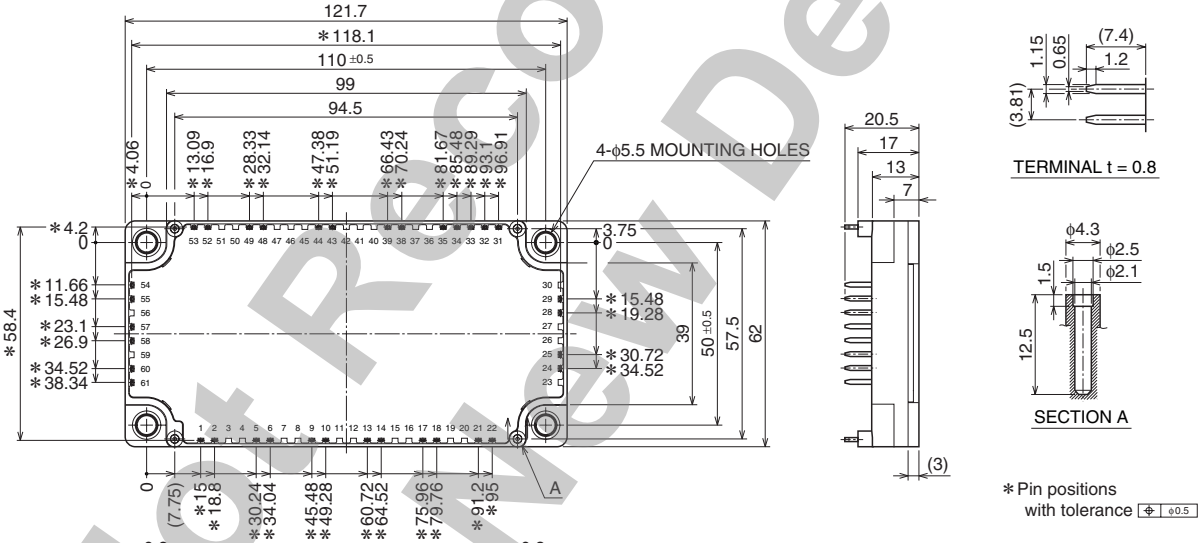
- I_C 35A
- V_{CES} 1200V
- CIB (3-phase Converter + 3-phase Inverter + Brake)
- Flatbase Type / Insulated Package / Copper base plate
- RoHS Directive compliant

APPLICATION

General purpose Inverters, Servo Amplifiers

OUTLINE DRAWING & CIRCUIT DIAGRAM

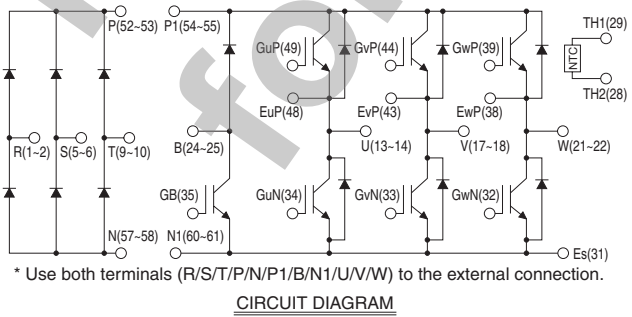
Dimensions in mm



TERMINAL t = 0.8

SECTION A

∗Pin positions with tolerance ⌖ ϕ0.5



* Use both terminals (R/S/T/P/N/P1/B/N1/U/V/W) to the external connection.

CIRCUIT DIAGRAM

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

MITSUBISHI ELECTRIC

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, T_C = 105°C (Note. 1)	35	A
I_{CRM}		Pulse (Note. 4)	70	
P_{tot}	Maximum collector dissipation	T_C = 25°C (Note. 1, 5)	295	W
I_E (Note.3)	Emitter current	T_C = 25°C (Note. 1)	35	A
I_{ERM}(Note.3)	(Free wheeling diode forward current)	Pulse (Note. 4)	70	

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, T_C = 121°C (Note. 1)	20	A
I_{CRM}		Pulse (Note. 4)	40	
P_{tot}	Maximum collector dissipation	T_C = 25°C (Note. 1, 5)	260	W
V_{RRM}(Note.3)	Repetitive peak reverse voltage		1200	V
I_F (Note.3)	Forward current	T_C = 25°C (Note. 1)	20	A
I_{FRM}(Note.3)		Pulse (Note. 4)	40	

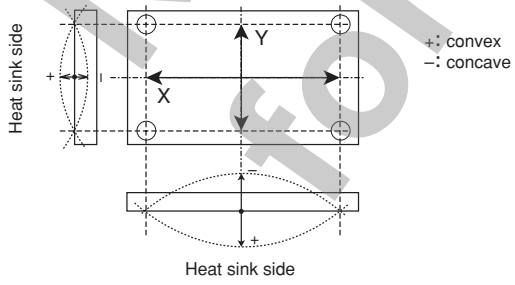
CONVERTER PART

Symbol	Parameter	Conditions	Rating	Unit
V_{RRM}	Repetitive peak reverse voltage		1600	V
E_a	Recommended AC input voltage		440	V
I_O	DC output current	3-phase full wave rectifying, T_C = 125°C (Note. 1)	35	A
I_{FSM}	Surge forward current	The sine half wave 1 cycle peak value, f = 60Hz, non-repetitive	350	
I^2t	Current square time	Value for one cycle of surge current	510	A^2s

MODULE

Symbol	Parameter	Conditions	Rating	Unit
T_j	Junction temperature		–40 ~ +150	°C
T_{stg}	Storage temperature		–40 ~ +125	
V_{isol}	Isolation voltage	Terminals to base plate, f = 60Hz, AC 1 min, RMS	2500	V
—	Base plate flatness	On the centerline X, Y (Note. 8)	±0 ~ +100	μm
—	Mounting 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.



ELECTRICAL and THERMAL RESISTANCE CHARACTERISTICS (T_j = 25°C, unless otherwise specified)

INVERTER PART

Symbol	Parameter	Conditions		Limits Min.	Limits Typ.	Limits Max.	Unit
I_{CES}	Collector cut-off current	V_{CE} = V_{CES}, G-E Short		—	—	1	mA
$V_{GE(th)}$	Gate-emitter threshold voltage	I_C = 3.5mA, V_{CE} = 10V		6	7	8	V
I_{GES}	Gate-emitter leakage current	V_{GE} = V_{GES}, C-E Short		—	—	0.5	µA
V_{CEsat}	Collector-emitter saturation voltage	I_C = 35A, V_{GE} = 15V (Note. 6)	T_j = 25°C	—	2.0	2.6	V
			T_j = 125°C	—	2.2	—	
		I_C = 35A, V_{GE} = 15V	Chip	—	1.9	—	
C_{ies}	Input capacitance	V_{CE} = 10V, G-E Short (Note. 6)		—	—	6.0	nF
C_{oes}	Output capacitance			—	—	0.53	
C_{res}	Reverse transfer capacitance			—	—	0.12	
Q_G	Gate charge	V_{CC} = 600V, I_C = 35A, V_{GE} = 15V		—	180	—	nC
$t_{d(on)}$	Turn-on delay time	V_{CC} = 600V, I_C = 35A, V_{GE} = ±15V, R_G = 9.1Ω, Inductive load		—	—	100	ns
t_r	Rise time			—	—	50	
$t_{d(off)}$	Turn-off delay time			—	—	300	
t_f	Fall time			—	—	600	
t_{rr} (Note.3)	Reverse recovery time	(I_E = 35A)		—	—	200	
Q_{rr} (Note.3)	Reverse recovery charge			—	1.5	—	µC
V_{EC}(Note.3)	Emitter-collector voltage	I_E = 35A, G-E Short (Note. 6)	T_j = 25°C	—	2.6	3.4	V
			T_j = 125°C	—	2.16	—	
		I_E = 35A, G-E Short	Chip	—	2.5	—	
$R_{th(j-c)Q}$	Thermal resistance (Junction to case) (Note. 1)	per IGBT		—	—	0.42	K/W
$R_{th(j-c)D}$		per free wheeling diode		—	—	0.69	
r_g	Internal gate resistance	T_C = 25°C, per switch		—	0	—	Ω
R_G	External gate resistance			8.9	—	89	

BRAKE PART

Symbol	Parameter	Conditions		Limits Min.	Limits Typ.	Limits Max.	Unit
I_{CES}	Collector cut-off current	V_{CE} = V_{CES}, V_{GE} = 0V		—	—	1	mA
$V_{GE(th)}$	Gate-emitter threshold voltage	I_C = 2mA, V_{CE} = 10V		6	7	8	V
I_{GES}	Gate-emitter leakage current	V_{GE} = V_{GES}, V_{CE} = 0V		—	—	0.5	µA
V_{CEsat}	Collector-emitter saturation voltage	I_C = 20A, V_{GE} = 15V (Note. 6)	T_j = 25°C	—	2.0	2.6	V
			T_j = 125°C	—	2.2	—	
		I_C = 20A, V_{GE} = 15V	Chip	—	1.9	—	
C_{ies}	Input capacitance	V_{CE} = 10V, V_{GE} = 0V (Note. 6)		—	—	5.1	nF
C_{oes}	Output capacitance			—	—	0.45	
C_{res}	Reverse transfer capacitance			—	—	0.1	
Q_G	Gate charge	V_{CC} = 600V, I_C = 20A, V_{GE} = 15V		—	150	—	nC
I_{RRM}(Note.3)	Repetitive peak reverse current	V_R = V_{RRM}		—	—	1	mA
V_F(Note.3)	Forward voltage	I_F = 20A (Note. 6)	T_j = 25°C	—	2.6	3.4	V
			T_j = 125°C	—	2.16	—	
		I_F = 20A	Chip	—	2.5	—	
$R_{th(j-c)Q}$	Thermal resistance (Junction to case) (Note. 1)	per IGBT		—	—	0.48	K/W
$R_{th(j-c)D}$		per Clamp diode		—	—	1.1	
r_g	Internal gate resistance	T_C = 25°C		—	0	—	Ω
R_G	External gate resistance			15	—	150	

CONVERTER PART

Symbol	Parameter	Conditions	Limits Min.	Limits Typ.	Limits Max.	Unit
I_{RRM}	Repetitive peak reverse current	V_R = V_{RRM}, T_j = 150°C	—	—	4	mA
V_F	Forward voltage	I_F = 35A	—	1.2	1.6	V
$R_{th(j-c)}$	Thermal resistance (Junction to case) (Note. 1)	per Diode	—	—	0.45	K/W

NTC THERMISTOR PART

Symbol	Parameter	Conditions	Limits			Unit
			Min.	Typ.	Max.	
R_{25}	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

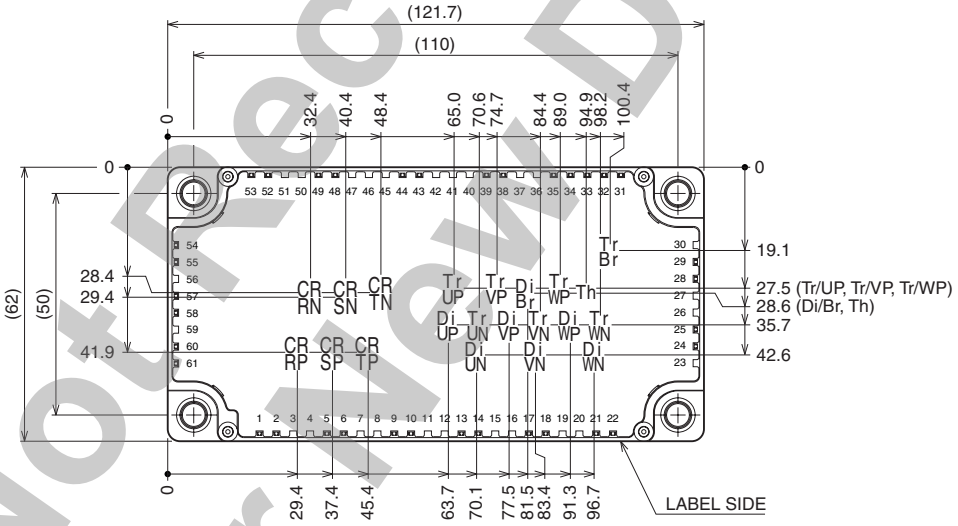
MODULE

Symbol	Parameter	Conditions	Limits			Unit
			Min.	Typ.	Max.	
$R_{th(c-s)}$	Contact thermal resistance (Case to heat sink) (Note. 1)	Thermal grease applied per 1 module (Note. 2)	—	0.015	—	K/W

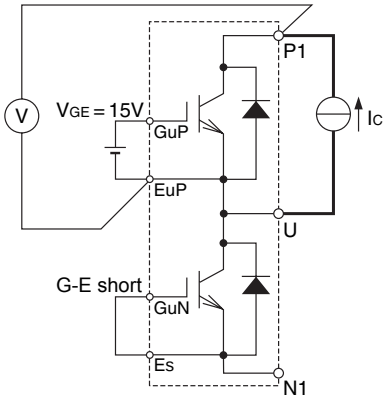
Note. 1: Case temperature (T_C), heat sink temperature (T_S) measured point is just under the chips. (Refer to the figure of the chip location.)
2: Typical value is measured by using thermally conductive grease of λ = 0.9W/(m·K).
3: I_E, I_{ERM}, V_{EC}, t_{rr}, Q_{rr} and E_{rr} represent ratings and 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 Tjmax 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_{CEsat} and V_{EC})
7: $B_{(25/50)} = \ln(\frac{R_{25}}{R_{50}})/(\frac{1}{T_{25}} - \frac{1}{T_{50}})$
R_{25}: resistance at absolute temperature T_{25} [K]; T_{25} = 25 [°C]+273.15 = 298.15 [K]
R_{50}: resistance at absolute temperature T_{50} [K]; T_{50} = 50 [°C]+273.15 = 323.15 [K]

Chip Location (Top view)

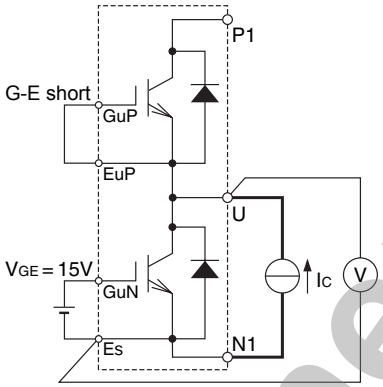
Dimensions in mm (tolerance: ±1mm)



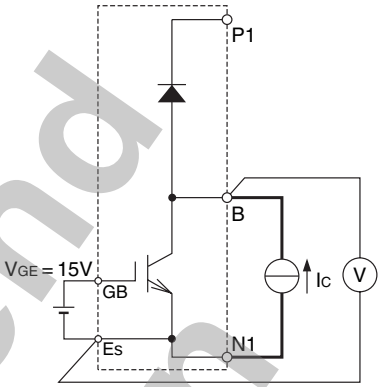
Each mark points the center position of each chip. Tr**: IGBT, Di**: FWDi (DiBr: Clamp diode), CR**: Converter diode, Th: NTC thermistor



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



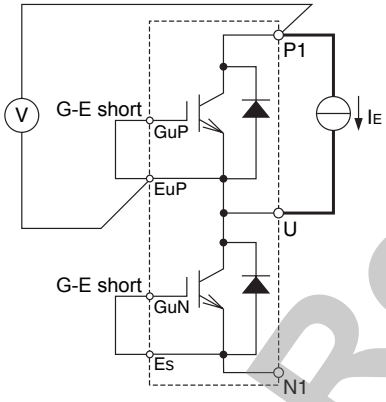
N side Inverter part T_r
(example of U arm)
G-E short
(GvP-EvP, GwP-EwP, GvN-Es, GwN-Es, GB-Es)



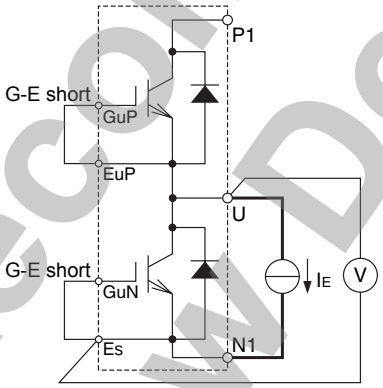
Br T_r

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

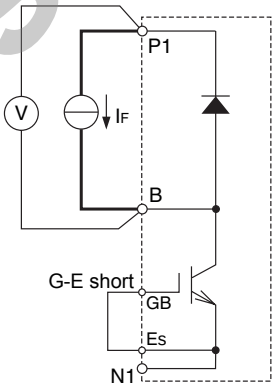
V_{CEsat} test circuit



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



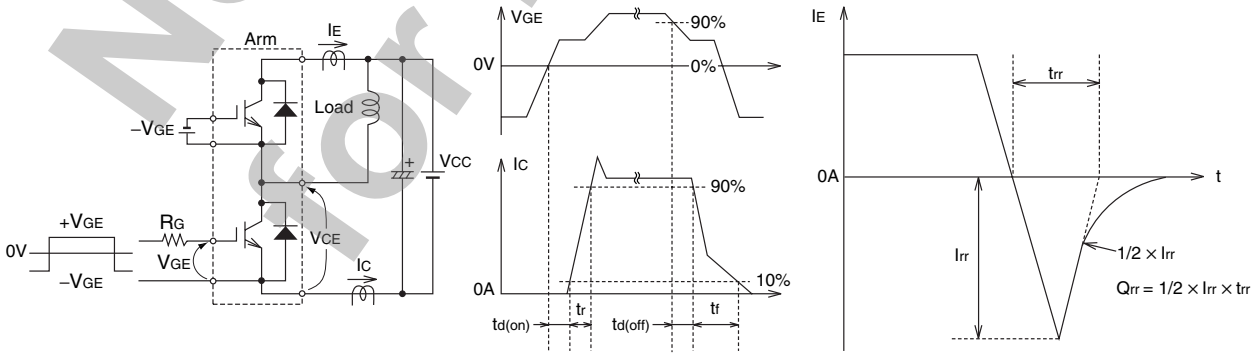
N side Inverter part D_i
(example of U arm)
G-E short
(GvP-EvP, GwP-EwP, GvN-Es, GwN-Es, GB-Es)



Br D_i

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

V_{EC}/V_F test circuit

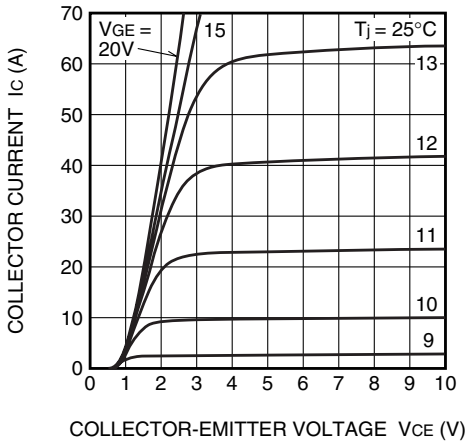


Switching time test circuit and waveforms

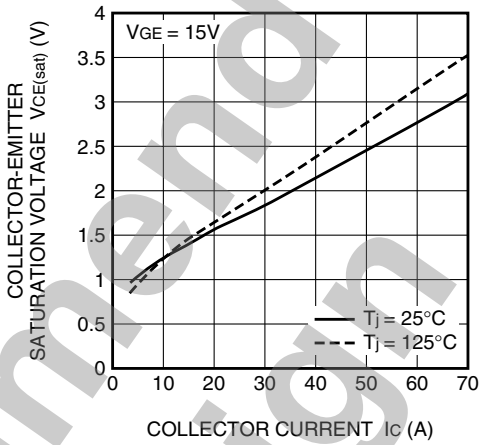
trr, Qrr test waveform

PERFORMANCE CURVES

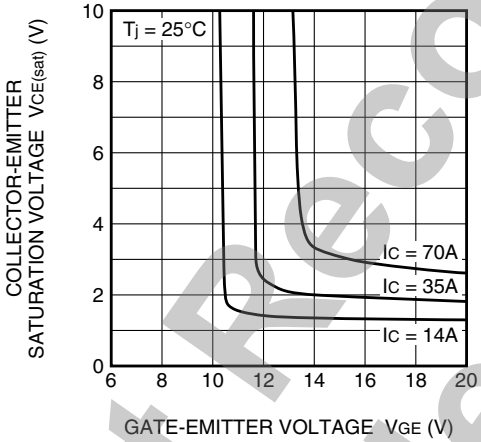
OUTPUT CHARACTERISTICS (TYPICAL) Inverter part



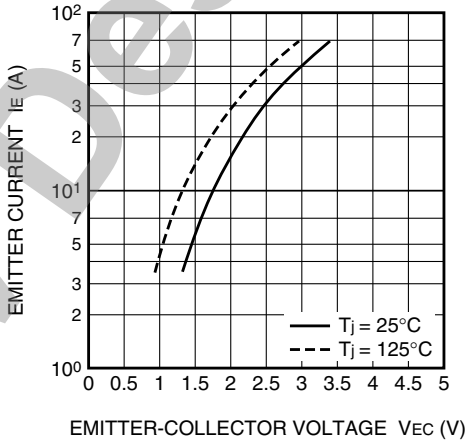
COLLECTOR-EMITTER SATURATION VOLTAGE CHARACTERISTICS (TYPICAL) Inverter part



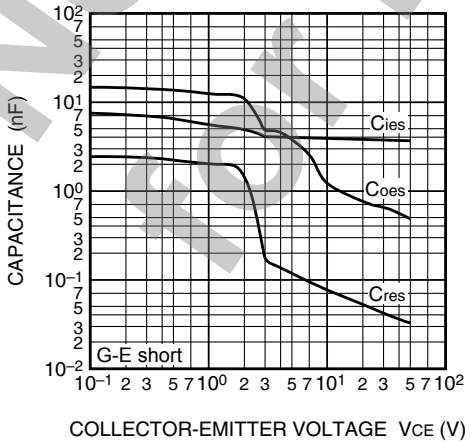
COLLECTOR-EMITTER SATURATION VOLTAGE CHARACTERISTICS (TYPICAL) Inverter part



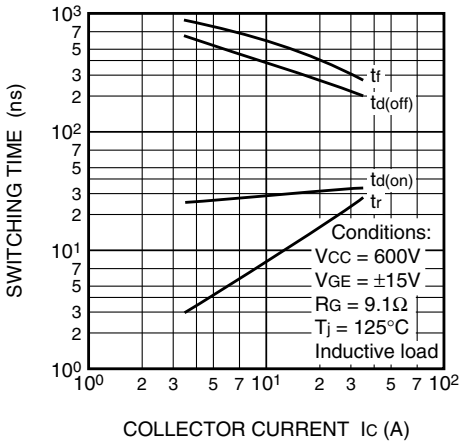
FREE WHEELING DIODE FORWARD CHARACTERISTICS (TYPICAL) Inverter part



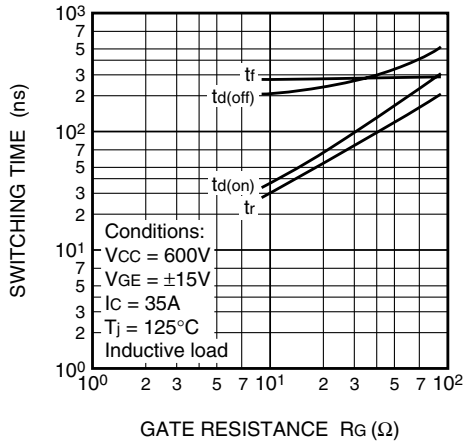
CAPACITANCE CHARACTERISTICS (TYPICAL) Inverter part



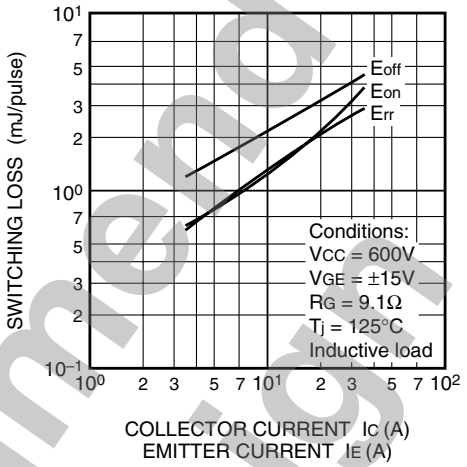
HALF-BRIDGE SWITCHING CHARACTERISTICS (TYPICAL) Inverter part



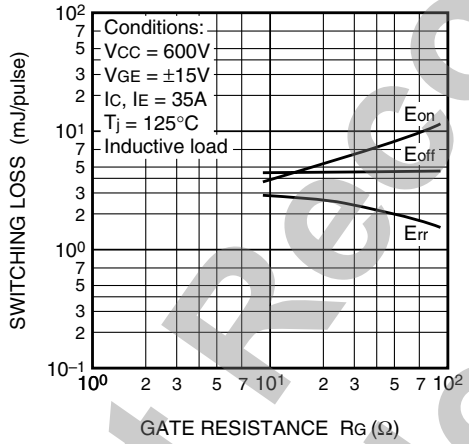
HALF-BRIDGE SWITCHING CHARACTERISTICS (TYPICAL) Inverter part



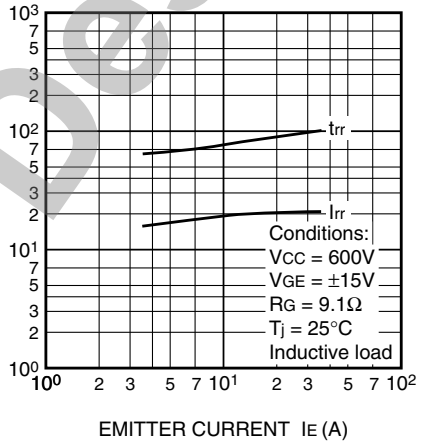
HALF-BRIDGE SWITCHING CHARACTERISTICS (TYPICAL) Inverter part



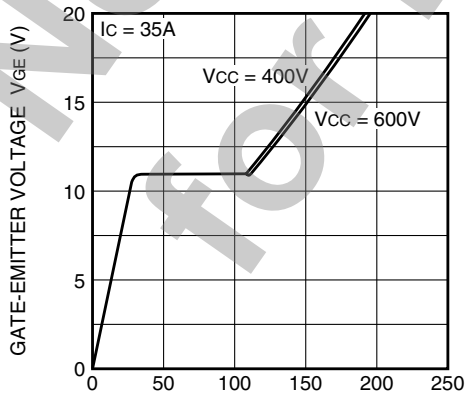
HALF-BRIDGE SWITCHING CHARACTERISTICS (TYPICAL) Inverter part



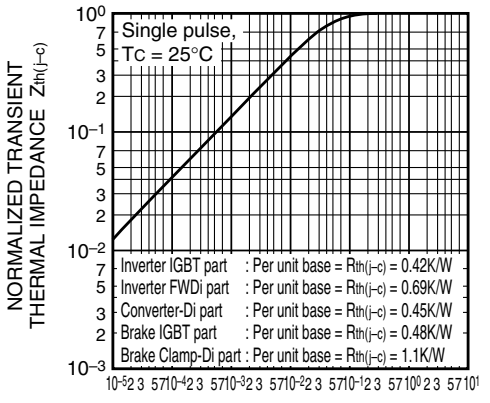
REVERSE RECOVERY CHARACTERISTICS OF FREE WHEELING DIODE (TYPICAL) Inverter part



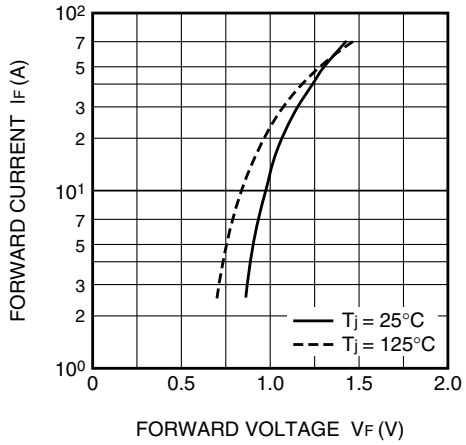
GATE CHARGE CHARACTERISTICS (TYPICAL) Inverter part



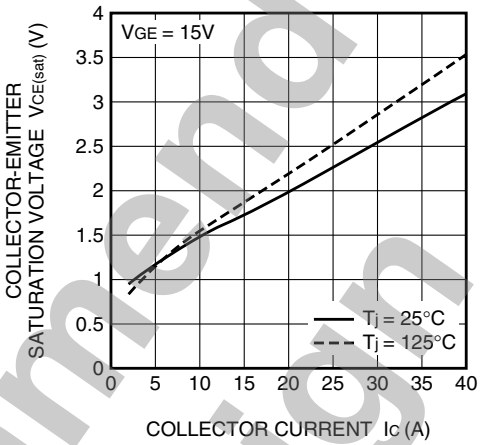
TRANSIENT THERMAL IMPEDANCE CHARACTERISTICS



RECTIFIER DIODE FORWARD CHARACTERISTICS (TYPICAL) Converter part



COLLECTOR-EMITTER SATURATION VOLTAGE CHARACTERISTICS (TYPICAL) Brake part



CLAMP DIODE FORWARD CHARACTERISTICS (TYPICAL) Brake part