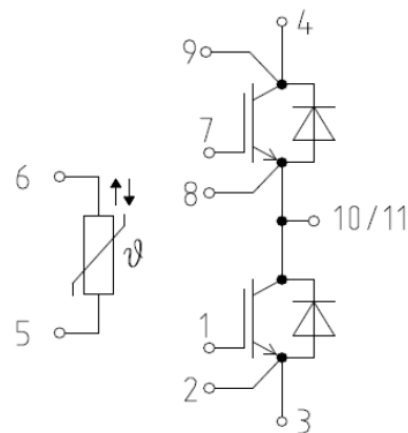


C5 series package: 1200V 900A IGBT module

Datasheet



Equivalent
Circuit Schematic

Features:

- Trenchgate Gen.7 IGBT technology
- $V_{CE(sat)}$ with positive temperature coefficient
- High RBSOA capability
- Low static losses: $V_{CE(sat)} = 1,55V@25^{\circ}C$
- Low dynamic losses

Options:

- Pre-applied TIM (option +M01)
- Adoption for parallel connection (V_f selection)

Typical Applications:

- Motor Drives
- Solar Applications
- UPS Systems
- Energy Storage

IGBT, Inverter / IGBT

Maximum Rated Values

Collector-emitter Voltage	$T_{vj} = 25^{\circ}\text{C}$	V_{CES}	1200	V
Implemented Collector Current		I_{Cnom}	900	A
Continuous DC Collector Current	$T_C = 45^{\circ}\text{C}, T_{vj\ max} = 175^{\circ}\text{C}$	I_C	875	A
Repetitive Peak Collector Current	$t_p = 1\text{ms}$	I_{CRM}	1800	A
Gate-emitter Peak Voltage		V_{GES}	± 20	V

Characteristic Values

min. typ. max.

Collector-emitter Saturation Voltage ¹⁾	$I_C = 900\text{A}, V_{GE} = 15\text{V}$ $T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = 125^{\circ}\text{C}$ $T_{vj} = 175^{\circ}\text{C}$	V_{CEsat}	—	1.55 1.80 1.86	—	V
Gate Threshold Voltage	$V_{CE} = V_{GE}, I_C = 18\text{mA}, T_{vj} = 25^{\circ}\text{C}$	V_{GEth}	5.0	6.0	7.0	V
Gate Charge	$V_{GE} = -15\text{V}/15\text{V}, V_{CE} = 600\text{V}$	Q_G	—	11.2	—	μC
Internal Gate Resistor	$T_{vj} = 25^{\circ}\text{C}$	R_{Gint}	—	0.2	—	Ω
Input Capacitance	$f = 100\text{kHz}, T_{vj} = 25^{\circ}\text{C}, V_{CE} = 25\text{V}, V_{GE} = 0\text{V}$	C_{ies}	—	199	—	nF
Reverse Transfer Capacitance	$f = 100\text{kHz}, T_{vj} = 25^{\circ}\text{C}, V_{CE} = 25\text{V}, V_{GE} = 0\text{V}$	C_{res}	—	0.57	—	nF
Collector-emitter Cutoff Current	$V_{CE} = 1200\text{V}, V_{GE} = 0\text{V}, T_{vj} = 25^{\circ}\text{C}$	I_{CES}	—	—	0.1	mA
Gate-emitter Leakage Current	$V_{CE} = 0\text{V}, V_{GE} = 20\text{V}, T_{vj} = 25^{\circ}\text{C}$	I_{GES}	—	—	500	nA
Turn-on Delay Time, Inductive Load	$I_C = 900\text{A}, V_{CE} = 600\text{V}$ $V_{GE} = -8\text{V}/15\text{V}$ $R_{GON} = 1\Omega$ $T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = 125^{\circ}\text{C}$ $T_{vj} = 175^{\circ}\text{C}$	t_{don}	—	197 262 267	—	ns
Rise Time, Inductive Load	$I_C = 900\text{A}, V_{CE} = 600\text{V}$ $V_{GE} = -8\text{V}/15\text{V}$ $R_{GON} = 1\Omega$ $T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = 125^{\circ}\text{C}$ $T_{vj} = 175^{\circ}\text{C}$	t_r	—	93 107 114	—	ns
Turn-off Delay Time, Inductive Load	$I_C = 900\text{A}, V_{CE} = 600\text{V}$ $V_{GE} = -8\text{V}/15\text{V}$ $R_{Goff} = 1\Omega$ $T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = 125^{\circ}\text{C}$ $T_{vj} = 175^{\circ}\text{C}$	t_{doff}	—	560 582 600	—	ns
Fall Time, Inductive Load	$I_C = 900\text{A}, V_{CE} = 600\text{V}$ $V_{GE} = -8\text{V}/15\text{V}$ $R_{Goff} = 1\Omega$ $T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = 125^{\circ}\text{C}$ $T_{vj} = 175^{\circ}\text{C}$	t_f	—	99 150 198	—	ns
Turn-on Energy Loss per Pulse	$I_C = 900\text{A}, V_{CE} = 600\text{V}, L_{\sigma} = 30\text{nH}$ $V_{GE} = -8\text{V}/15\text{V}, R_{GON} = 1\Omega$ $di/dt = 6131 (T_{vj} = 175^{\circ}\text{C})$ $T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = 125^{\circ}\text{C}$ $T_{vj} = 175^{\circ}\text{C}$	E_{on}	—	122 140 162	—	mJ
Turn-off energy Loss per Pulse	$I_C = 900\text{A}, V_{CE} = 600\text{V}, L_{\sigma} = 30\text{nH}$ $V_{GE} = -8\text{V}/15\text{V}, R_{GON} = 1\Omega$ $du/dt = 4762 (T_{vj} = 175^{\circ}\text{C})$ $T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = 125^{\circ}\text{C}$ $T_{vj} = 175^{\circ}\text{C}$	E_{off}	—	75 92 112	—	mJ
SC Data	$V_{GE} = -8\text{V}/15\text{V}$ $V_{CE} = 600\text{V}$ $t_p \leq 8\mu\text{s}, T_{vj} = 150^{\circ}\text{C}$	I_{sc}	—	3200 3100	—	A

Thermal Resistance, Junction to Case	$t_P \leq 6\mu s, T_{vj} = 175^\circ C$					
	Per IGBT	R_{thJC}	—	0.037	—	K/W
Thermal Resistance, Case to Heatsink	Per IGBT, $\lambda_{grease} = 1W(m \cdot K)$	R_{thCH}	—	0.037	—	K/W
Temperature under Switching Conditions		$T_{vj op}$	-40		175	$^\circ C$

Diode, Inverter Maximum Rated Values

Repetitive Peak Reverse Voltage	$T_{vj} = 25^\circ C$	V_{RRM}	1200	V
Continuous DC Forward Current		I_{Fnom}	900	A
Repetitive Peak Forward Current	$t_P = 1ms$	I_{FRM}	1800	A

Characteristic Values

			min.	typ.	max.	
Forward Voltage ¹⁾	$I_F = 900A, V_{GE} = 0V$ $T_{vj} = 25^\circ C$ $T_{vj} = 150^\circ C$ $T_{vj} = 175^\circ C$	V_F	—	1.83 2.12 2.25	—	V
Peak Reverse Recovery Current	$I_F = 900A, V_R = 600V$ $-di_F/dt = 5556A/\mu s (T_{vj} = 175^\circ C)$ $V_{GE} = -8V$ $T_{vj} = 25^\circ C$ $T_{vj} = 125^\circ C$ $T_{vj} = 175^\circ C$	I_{RM}	—	420 444 476	—	A
Recovery Charge	$I_F = 900A, V_R = 600V$ $-di_F/dt = 5556A/\mu s (T_{vj} = 175^\circ C)$ $V_{GE} = -8V$ $T_{vj} = 25^\circ C$ $T_{vj} = 125^\circ C$ $T_{vj} = 175^\circ C$	Q_R	—	34 55 71	—	μC
Reverse Recovery Energy	$I_F = 900A, V_R = 600V$ $-di_F/dt = 5556A/\mu s (T_{vj} = 175^\circ C)$ $V_{GE} = -8V$ $T_{vj} = 25^\circ C$ $T_{vj} = 125^\circ C$ $T_{vj} = 175^\circ C$	E_{rec}	—	7 25 29	—	mJ
Thermal Resistance, Junction to Case	Per FRD	R_{thJC}	—	0.063	—	K/W
Thermal Resistance, Case to Heatsink	Per IGBT, $\lambda_{grease} = 1W(m \cdot K)$	R_{thCH}	—	0.048	—	K/W
Temperature under Switching Conditions		$T_{vj op}$	-40	—	175	$^\circ C$

NTC-Thermistor / NTC Maximum Rated Values

			min.	typ.	max.	
Rated Resistance	$T_{NTC} = 25^\circ C$	R_{25}	—	5	—	K Ω
Deviation of R_{100} R_{100}	$T_{NTC} = 100^\circ C, R_{100} = 465\Omega$	$\Delta R/R$	-7.3	—	7.3	%
Power Dissipation	$T_{NTC} = 25^\circ C$	P_{25}	—	—	10	mW
B-Value B	$R_2 = R_{25} \exp[B_{25/50}(1/T_2 - 1/(298.15K))]$	$B_{25/50}$	—	3380	—	K
	$R_2 = R_{25} \exp[B_{25/80}(1/T_2 - 1/(298.15K))]$	$B_{25/80}$	—	3470	—	K
	$R_2 = R_{25} \exp[B_{25/100}(1/T_2 - 1/(298.15K))]$	$B_{25/100}$	—	3520	—	K

Module

Isolation Test Voltage	RMS, f=50Hz, t=1min	ViSOL	3.0	kV
Material of Module Baseplate			Cu	
Internal Isolation			ZTA	
Creepage Distance	Terminal to heatsink, min Terminal to terminal, min		15.0 13.0	mm
Clearance	Terminal to heatsink, min Terminal to terminal, min		12.5 10.0	mm
Comparative Tracking Index		CTI	200 ²⁾	

min. typ. max.

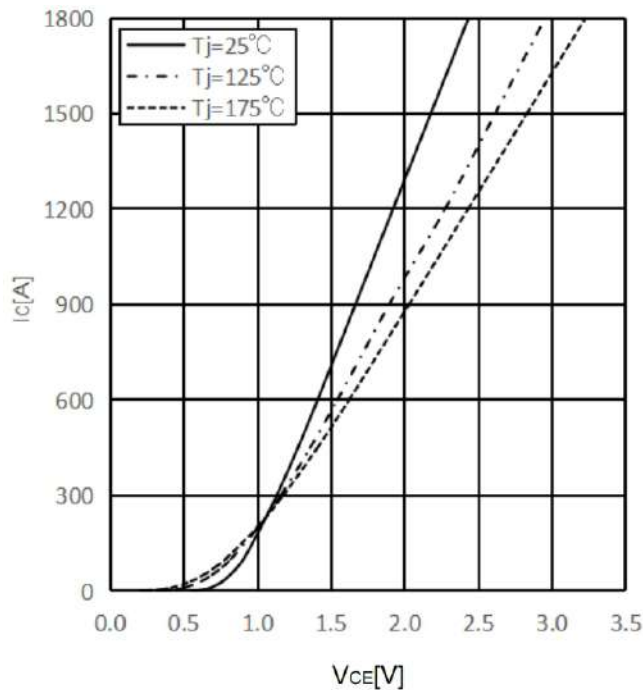
Stray Inductance Module		L _{sCE}	—	20	—	nH
Module Lead Resistance, Terminals-Chip	T _C = 25°C, Per Switch	R _{CC'+EE'}	—	0.8	—	mΩ
Storage Temperature		T _{stg}	-40	—	125	°C
Mounting Torque for Module Mounting	Screw M5 / M5	M	3.0	—	6.0	Nm
Power terminal installation torque	Screw M6 / M6	M	3.0	—	6.0	Nm
Weight		G	—	345	—	g

1) Terminal impedance is not included.

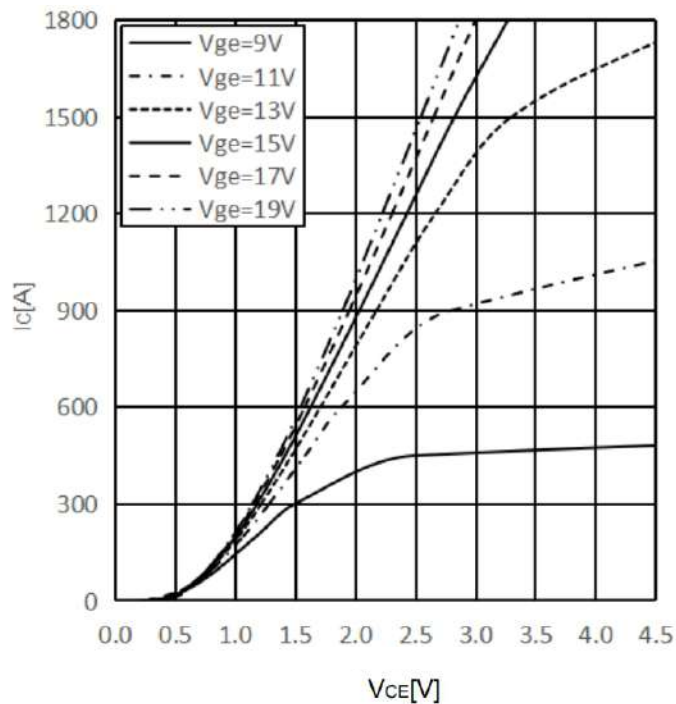
2) CTI is about 200.

Circuit Diagram

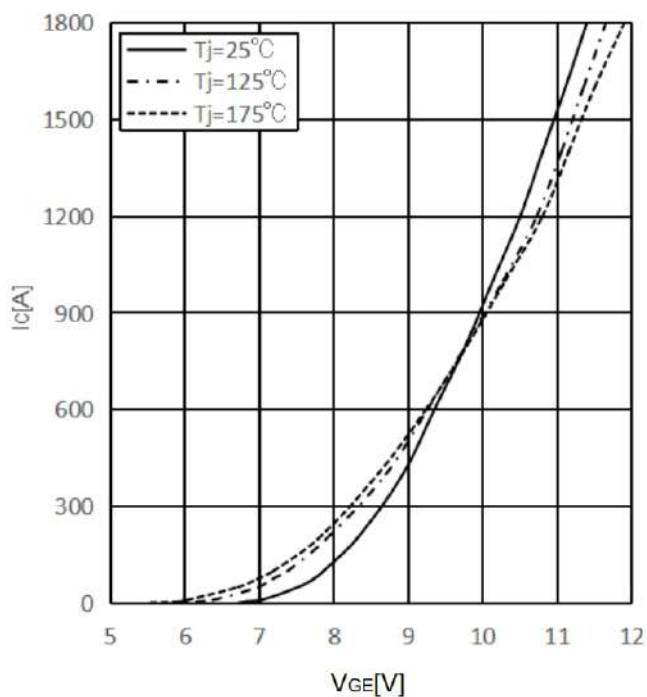
Output characteristic IGBT, Inverter (typical),
Inclusive $R_{CC}+EE'$ $I_c = f(V_{CE})$, $V_{GE} = 15V$



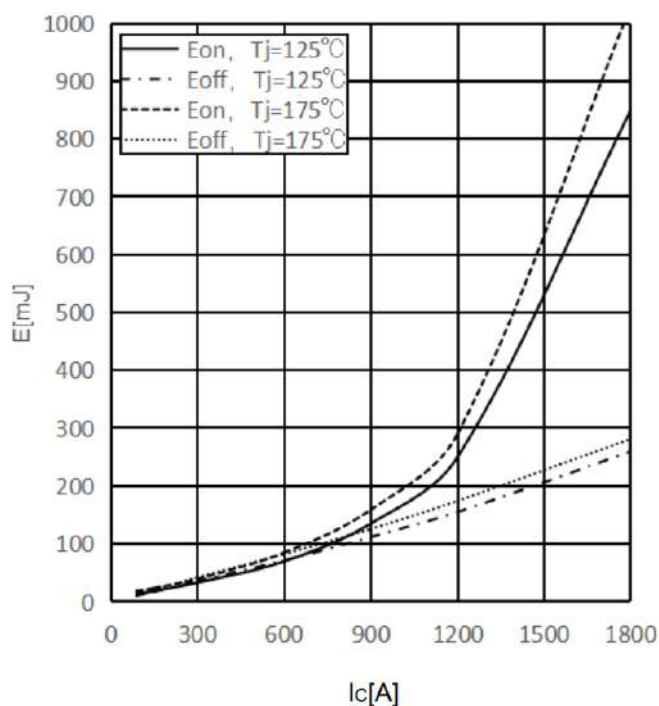
Output characteristic IGBT, Inverter (typical),
Inclusive $R_{CC}+EE'$ $I_c = f(V_{CE})$, $T_j = 175^{\circ}C$



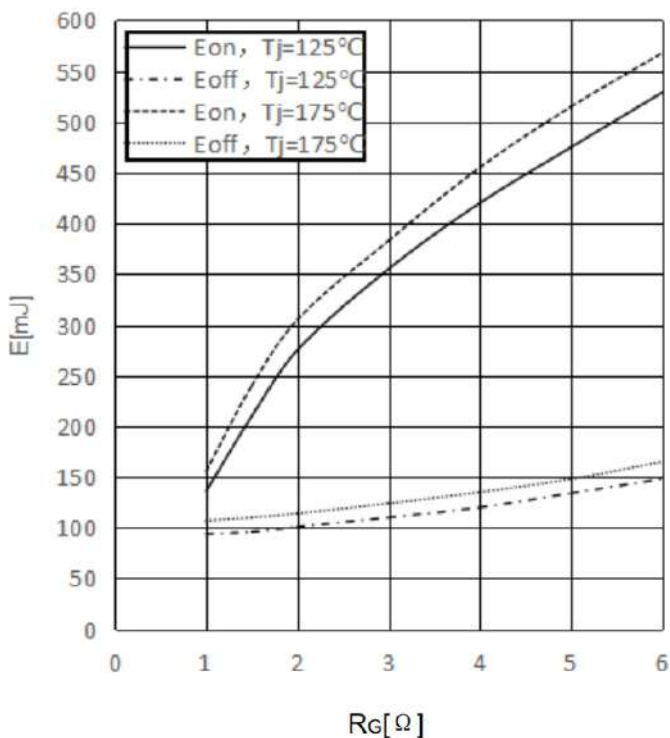
Transfer characteristic IGBT, Inverter (typical),
Inclusive $R_{CC}+EE'$ $I_c = f(V_{GE})$, $V_{CE} = 20V$

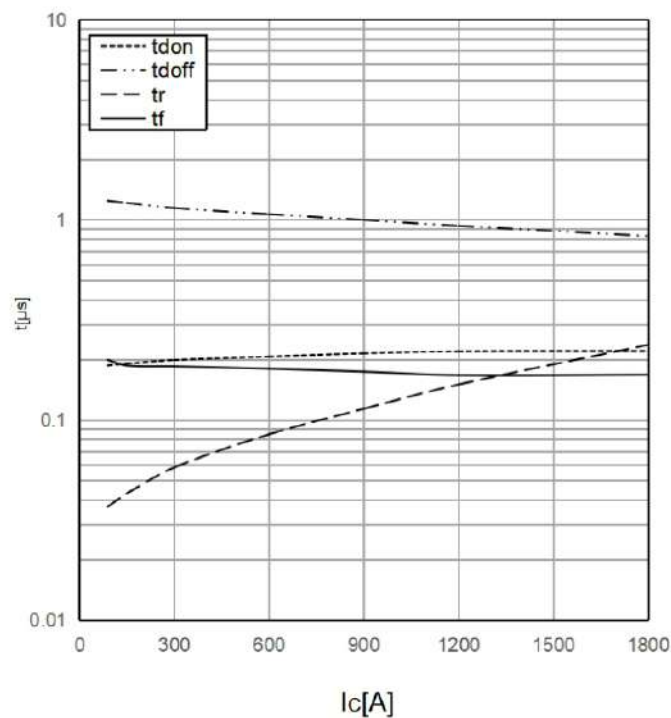


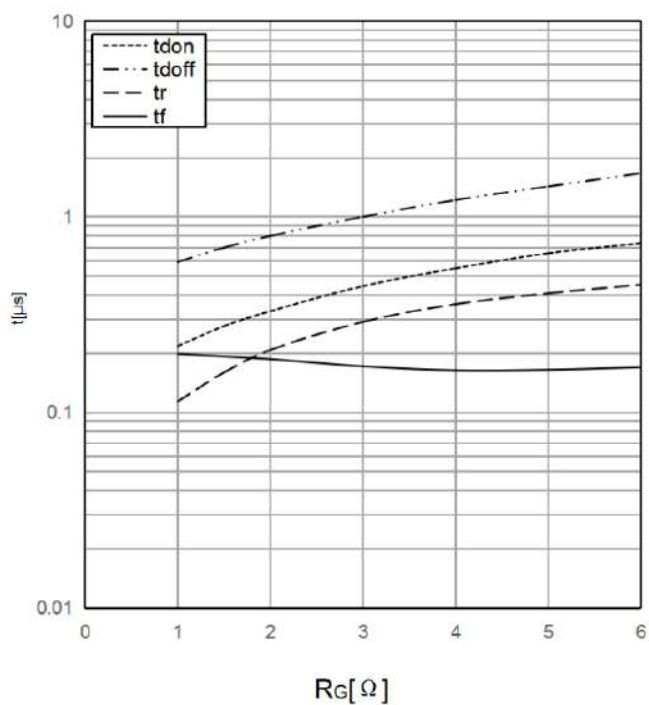
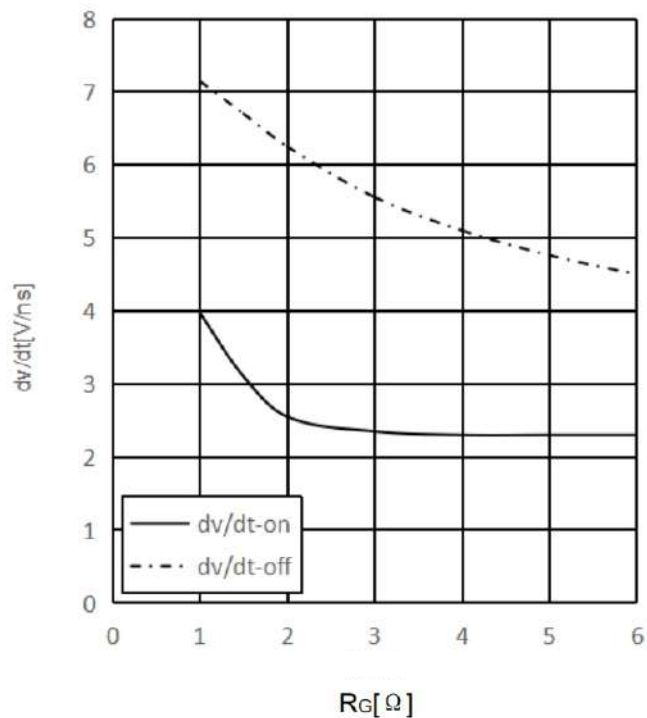
Switching losses IGBT, Inverter (Typical),
Inclusive $R_{CC}+EE'$
 $E = f(I_c)$, $V_{GE} = +15V/-8V$, $R_{Gon} = 1\Omega$,
 $R_{Goff} = 3\Omega$, $V_{CC} = 600V$



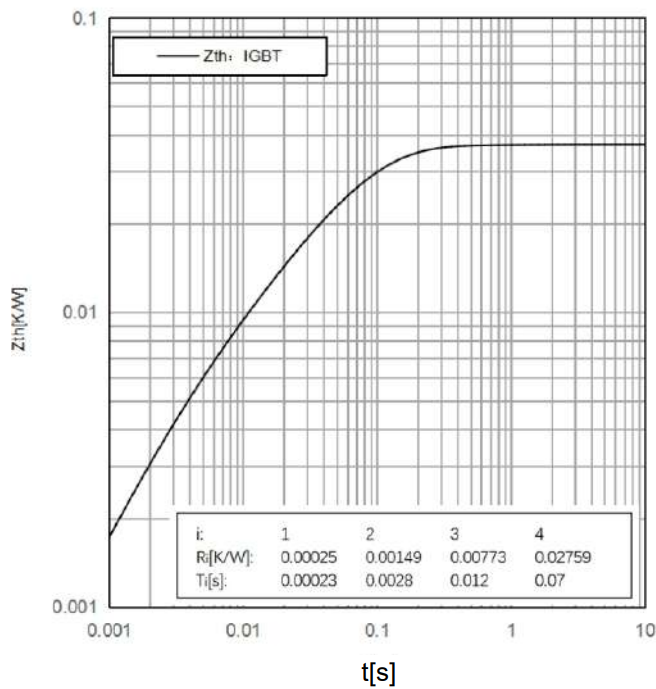
Switching losses IGBT, Inverter (Typical)

 Inclusive $R_{CC} + E_E$
 $E = f(R_G)$, $V_{GE} = +15V/-8V$, $I_C = 900A$, $V_{CE} = 600V$

Switching times IGBT, Inverter (Typical)
 $t_{don} = f(I_C)$, $t_r = f(I_C)$, $V_{GE} = +15V/-8V$,

 $R_{Gon} = 1\Omega$, $R_{Goff} = 1\Omega$, $V_{CE} = 600V$, $T_{vj} = 175^\circ C$

Switching times IGBT, Inverter (Typical)
 $t_{don} = f(R_G)$, $t_r = f(R_G)$, $V_{GE} = +15V/-8V$,

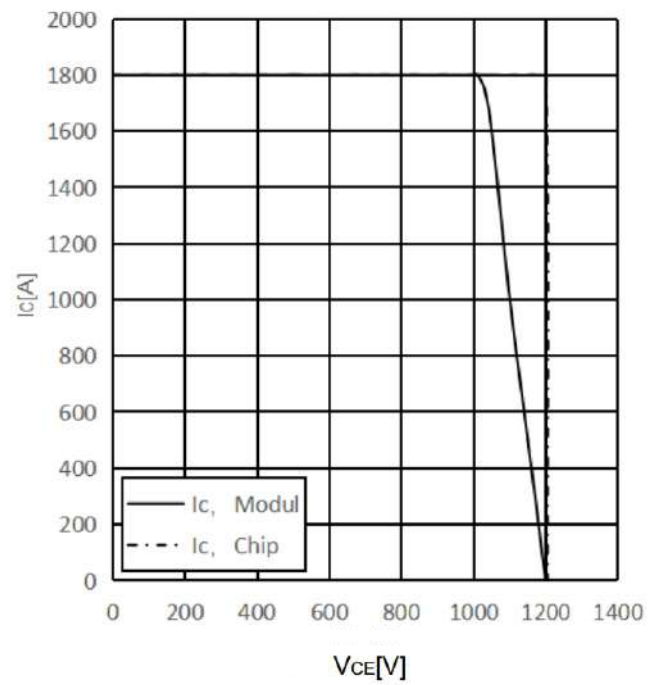
 $I_C = 900A$, $V_{CE} = 600V$, $T_{vj} = 175^\circ C$

IGBT, Inverter (Typical)
 $dv/dt = f(R_G)$, $V_{GE} = +15V/-8V$
 $I_C = 900A$, $V_{CE} = 600V$, $T_j = 125^\circ C$


Transient thermal impedance IGBT, Inverter
 $Z_{thJC} = f(t)$

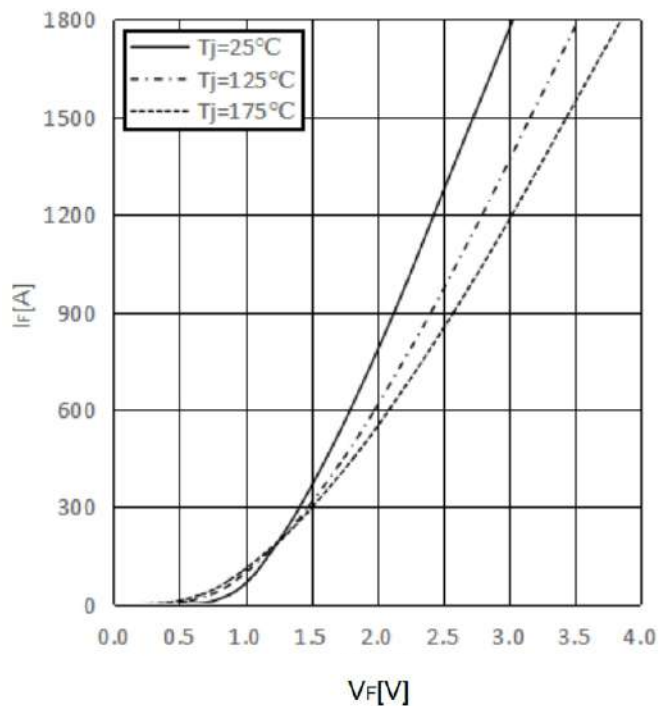


Reverse bias safe operating area IGBT,
 Inverter(RBSOA)

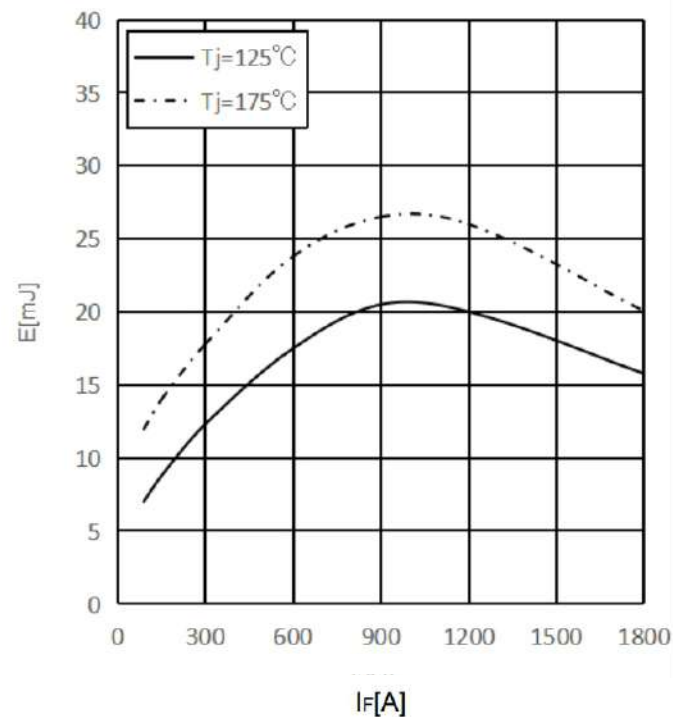
$I_c = f(V_{CE})$
 $V_{GE} = +15V/-8V$, $R_{Goff} = 3\Omega$, $T_j = 175^\circ C$



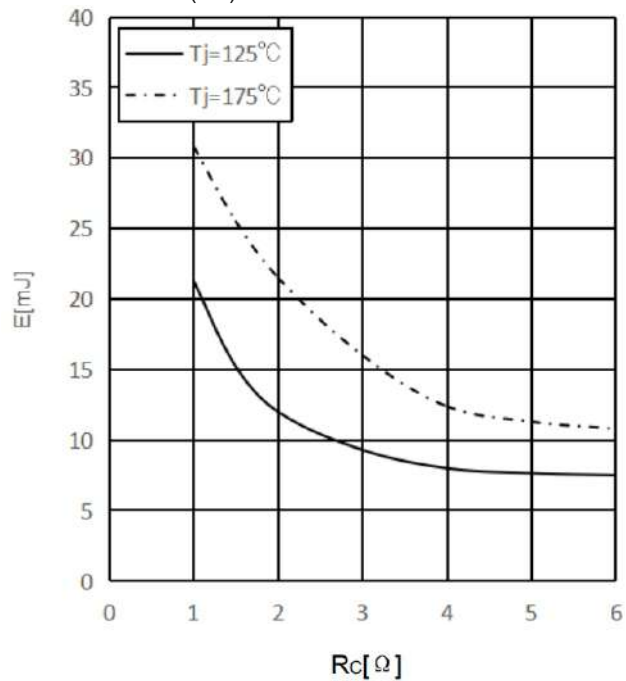
Forward characteristic FRD, Inverter (typical)
 Inclusive $R_{CC} + EE'$
 $I_F = f(V_F)$



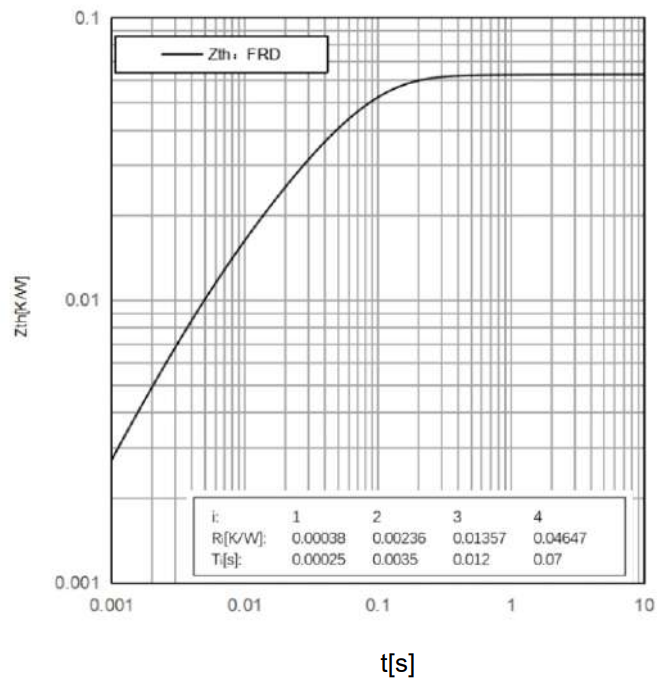
Switching losses FRD, Inverter (typical)
 Inclusive $R_{CC} + EE'$
 $E_{rec} = f(I_F)$, $R_{Gon} = 1\Omega$, $V_{CE} = 400V$



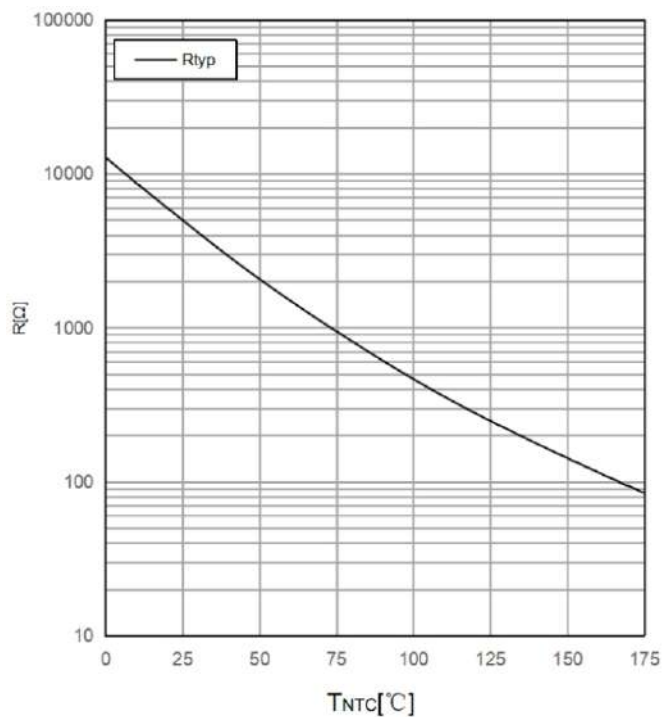
Switching losses FRD, Inverter (typical)
Inclusive $R_{CC} + E_E$
 $E_{rec} = f(R_G)$



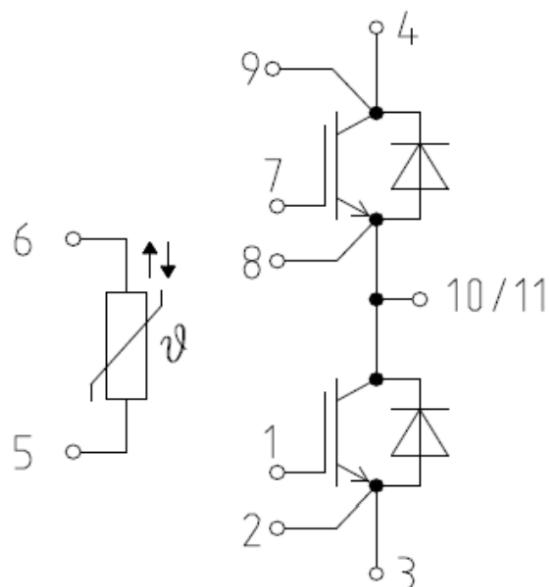
Transient thermal impedance FRD, Inverter
 $Z_{thJC} = f(t)$



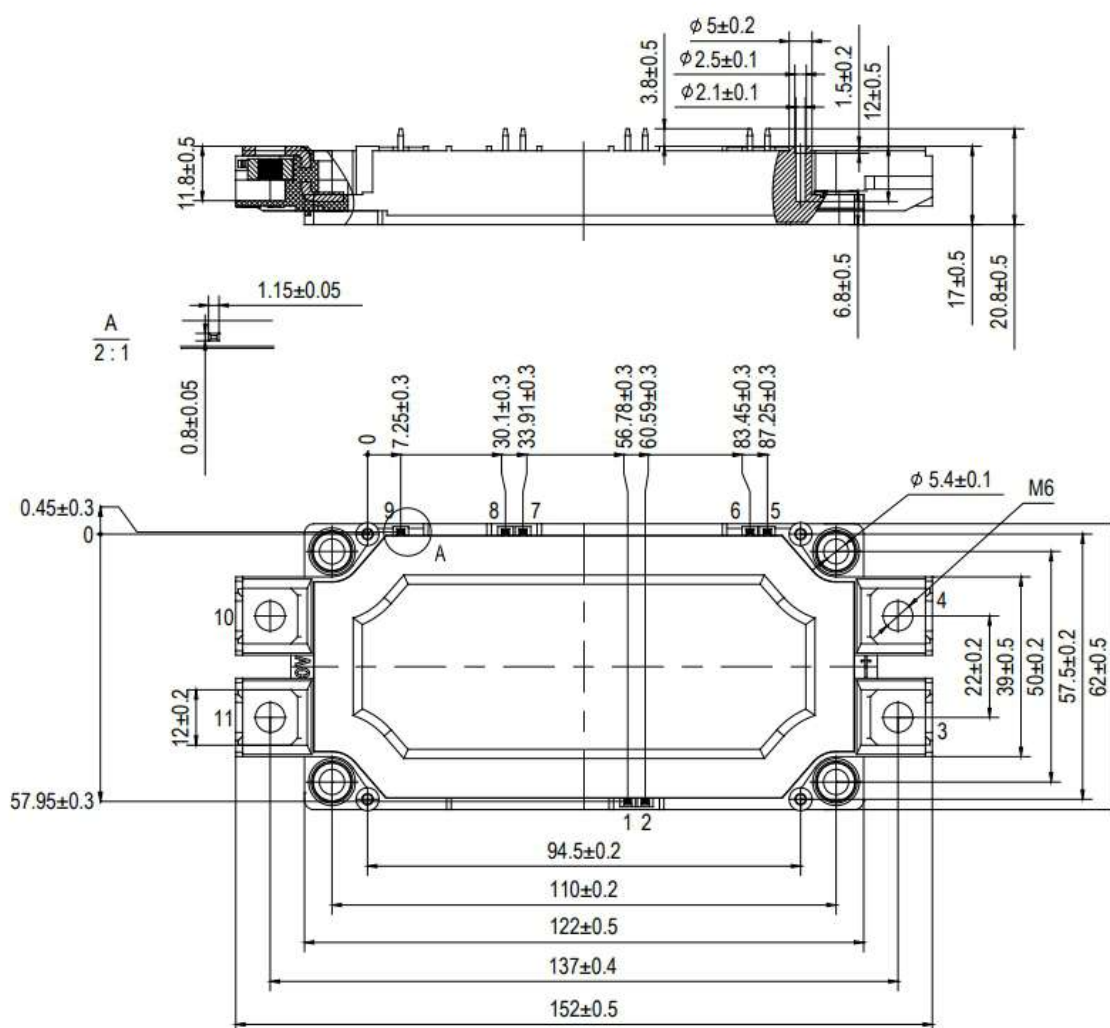
NTC Thermistor temperature characteristic (typical)
 $R = f(T)$



Internal Circuit



Package Dimension Dimensions in Millimeters



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