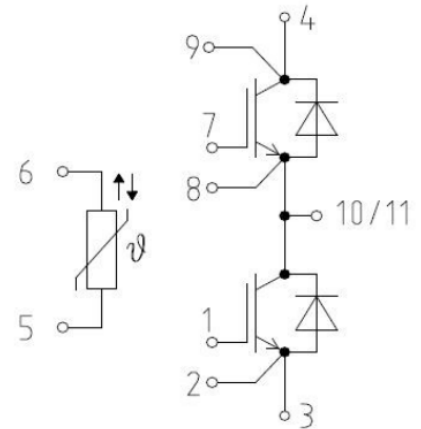


C5 series package: 1200V 1000A IGBT module

Equivalent
Circuit Schematic

Features:

- Trenchgate Gen.7 IGBT technology
- VCE(sat) with positive temperature coefficient
- High RBSOA capability
- Low static losses: VCE(sat) = 1,55V@25C
- Low dynamic losses

Options:

- pre-applied TIM (option +M01)
- adoption for parallel connection (Vf 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}	1000	A
Continuous DC collector current	$T_C = 90^{\circ}\text{C}, T_{vjmax} = 175^{\circ}\text{C}$	I_C	1250	A
Repetitive Peak Collector Current	t_p limited by $T_{vj op} / t_p$	I_{CRM}	2000	A
Gate-emitter Peak Voltage		V_{GES}	± 20	V

Characteristic Values
min. typ. max.

			min.	typ.	max.		
Collector-emitter Saturation Voltage ¹⁾	$I_C = 1000\text{A}, V_{GE} = 15\text{V}$	$T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = 125^{\circ}\text{C}$ $T_{vj} = 150^{\circ}\text{C}$ $T_{vj} = 175^{\circ}\text{C}$	V_{CESat}	-	1.55 1.79 1.81 1.83	-	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	$V_{GE} = -10\text{V}/15\text{V}, V_{CE} = 600\text{V}$		Q_G	-	9.52	-	μC
Internal Gate Resistor	$T_{vj} = 25^{\circ}\text{C}$		R_{Gint}	-	0.28	-	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}	-	208	-	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}	-	0.52	-	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	$I_C = 1000\text{A}, V_{CE} = 600\text{V}$ $V_{GE} = -8\text{V}/15\text{V}$ $R_{GON} = 1\Omega$	$T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = 125^{\circ}\text{C}$ $T_{vj} = 150^{\circ}\text{C}$ $T_{vj} = 175^{\circ}\text{C}$	t_{don}	-	190 196 195 192	-	ns
Rise Time, Inductive Load	$I_C = 1000\text{A}, V_{CE} = 600\text{V}$ $V_{GE} = -8\text{V}/15\text{V}$ $R_{GON} = 1\Omega$	$T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = 125^{\circ}\text{C}$ $T_{vj} = 150^{\circ}\text{C}$ $T_{vj} = 175^{\circ}\text{C}$	t_r	-	104 119 124 130	-	ns
Turn-off Delay Time, Inductive Load	$I_C = 1000\text{A}, V_{CE} = 600\text{V}$ $V_{GE} = -8\text{V}/15\text{V}$ $R_{Goff} = 1\Omega$	$T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = 125^{\circ}\text{C}$ $T_{vj} = 150^{\circ}\text{C}$ $T_{vj} = 175^{\circ}\text{C}$	t_{doff}	-	449 480 490 500	-	ns
Fall Time, Inductive Load	$I_C = 1000\text{A}, V_{CE} = 600\text{V}$ $V_{GE} = -8\text{V}/15\text{V}$ $R_{Goff} = 1\Omega$	$T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = 125^{\circ}\text{C}$ $T_{vj} = 150^{\circ}\text{C}$ $T_{vj} = 175^{\circ}\text{C}$	t_f	-	94 158 178 210	-	ns
Turn-on Energy Loss per Pulse	$I_C = 1000\text{A}, V_{CE} = 600\text{V}, L_{\sigma} = 30\text{nH}$ $V_{GE} = -8\text{V}/15\text{V}, R_{GON} = 1\Omega$ $di/dt = 6353\text{ A}/\mu\text{s} (T_{vj} = 175^{\circ}\text{C})$	$T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = 125^{\circ}\text{C}$ $T_{vj} = 150^{\circ}\text{C}$ $T_{vj} = 175^{\circ}\text{C}$	E_{on}	-	116 184 187 210	-	mJ
Turn-off energy Loss per Pulse	$I_C = 1000\text{A}, V_{CE} = 600\text{V}, L_{\sigma} = 30\text{nH}$ $V_{GE} = -8\text{V}/15\text{V}, R_{Goff} = 1\Omega$ $du/dt = 3243\text{ A}/\mu\text{s} (T_{vj} = 175^{\circ}\text{C})$	$T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = 125^{\circ}\text{C}$ $T_{vj} = 150^{\circ}\text{C}$ $T_{vj} = 175^{\circ}\text{C}$	E_{off}	-	84 112 115 125	-	mJ
SC Data	$V_{GE} = -8\text{V}/15\text{V}$ $V_{CC} = 800\text{V}$	$t_p \leq 8\mu\text{s}, T_{vj} = 150^{\circ}\text{C}$ $t_p \leq 6\mu\text{s}, T_{vj} = 175^{\circ}\text{C}$	I_{sc}	-	3100 3000	-	A

Thermal Resistance, Junction to Case	Per IGBT	R _{thJC}	-	0.028	-	K/W
Thermal Resistance, Case to Heatsink	Per IGBT λ _{grease} = 1W/(m·K)	R _{thCH}	-	0.035	-	K/W
Temperature under Switching Conditions ²⁾		T _{vj op}	-40		175	°C

Diode, Inverter Maximum Rated Values

Repetitive Peak Reverse Voltage	T _{vj} = 25°C	V _{RRM}		1200		V
Continuous DC Forward Current		I _{Fnom}		1000		A
Repetitive Peak Forward Current	t _p T _{vj op}	I _{FRM}		2000		A

Characteristic Values

				min. typ. max.			
Forward Voltage ¹⁾	I _F = 1000A, V _{GE} = 0V	T _{vj} = 25°C T _{vj} = 125°C T _{vj} = 150°C T _{vj} = 175°C	V _F	-	1.83 2.15 2.20 2.25	-	V
Peak Reverse Recovery Current	I _F = 1000A, V _R = 600V -di _F /dt = 7142 A/us (T _{vj} = 175°C) V _{GE} = -8V	T _{vj} = 25°C T _{vj} = 125°C T _{vj} = 175°C	I _{RM}	-	424 448 448	-	A
Recovery Charge	I _F = 1000A, V _R = 600V -di _F /dt = 7142 A/us (T _{vj} = 175°C) V _{GE} = -8V	T _{vj} = 25°C T _{vj} = 125°C T _{vj} = 175°C	Q _R	-	39 62 77	-	μC
Reverse Recovery Energy	I _F = 1000A, V _R = 600V -di _F /dt = 7142 A/us (T _{vj} = 175°C) V _{GE} = -8V	T _{vj} = 25°C T _{vj} = 125°C T _{vj} = 175°C	E _{rec}	-	13 26 29	-	mJ
Thermal Resistance, Junction to Case	Per FRD		R _{thJC}	-	0.044	-	K/W
Thermal Resistance, Case to Heatsink	Per FRD λ _{grease} = 1W/(m·K)		R _{thCH}	-	0.039	-	K/W
Temperature under Switching Conditions ²⁾			T _{vj op}	-40	-	175	°C

NTC-Thermistor / NTC Characteristic Values

				min. typ. max.			
Rated Resistance	T _{NTC} = 25°C	R ₂₅	-	5	-	KΩ	
Deviation of R100 R100	T _{NTC} = 100°C, R ₁₀₀ = 491Ω	ΔR/R	-5	-	5	%	
Power Dissipation	T _{NTC} = 25°C	P ₂₅	-	-	20	mW	
B-Value B	R ₂ = R ₂₅ exp[B _{25/50} (1/T ₂ -1/(298.15K))]	B _{25/50}	-	3375	-	K	
	R ₂ = R ₂₅ exp[B _{25/80} (1/T ₂ -1/(298.15K))]	B _{25/80}	-	3425	-	K	
	R ₂ = R ₂₅ exp[B _{25/100} (1/T ₂ -1/(298.15K))]	B _{25/100}	-	3443	-	K	

Module

Isolation Test Voltage	RMS, f = 50Hz, t = 3s	V _{ISOL}	4	kV
Isolation Test Voltage of NTC	RMS, f = 50Hz, t = 3s	V _{ISOL(NTC)}	4	kV
Material of Module Baseplate			Cu+Ni ³⁾	
Internal Isolation			Si ₃ N ₄	
Creepage Distance	Terminal to heatsink, min		14.7	mm
	Terminal to terminal, min		15.1	
Clearance	Terminal to heatsink, min		9.6	mm
	Terminal to terminal, min		12.5	
Comparative Tracking Index		CTI	>200	

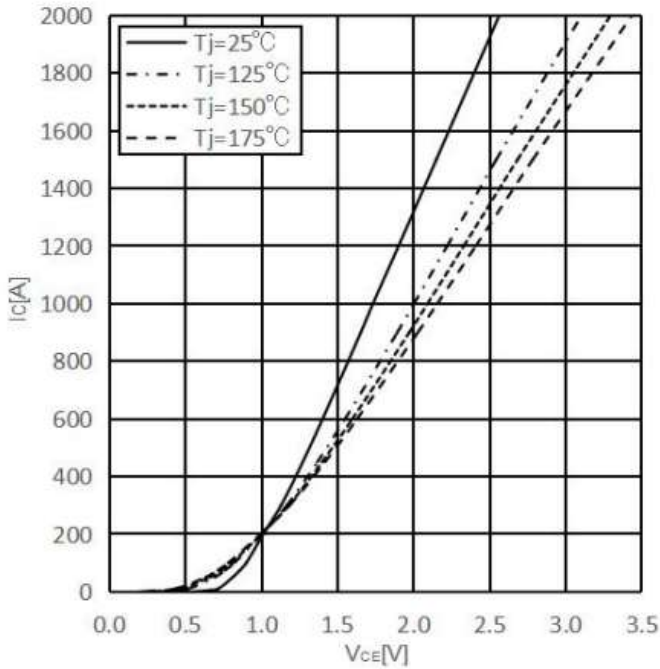
min. typ. max.

Stray Inductance Module		L _{sCE}	-	20	-	nH
Module Lead Resistance, Terminals-Chip	T _C = 25°C, Per Switch	R _{CC'+EE'}	-	0.8	-	mΩ
Thermal Resistance, Case to Heatsink	including thermal coupling, T _s underneath module (λgrease=0.81 W/(m*K))	R _{thCH}	-	0.014	-	K/W
Storage Temperature		T _{stg}	-40	-	125	°C
Mounting Torque for Module	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

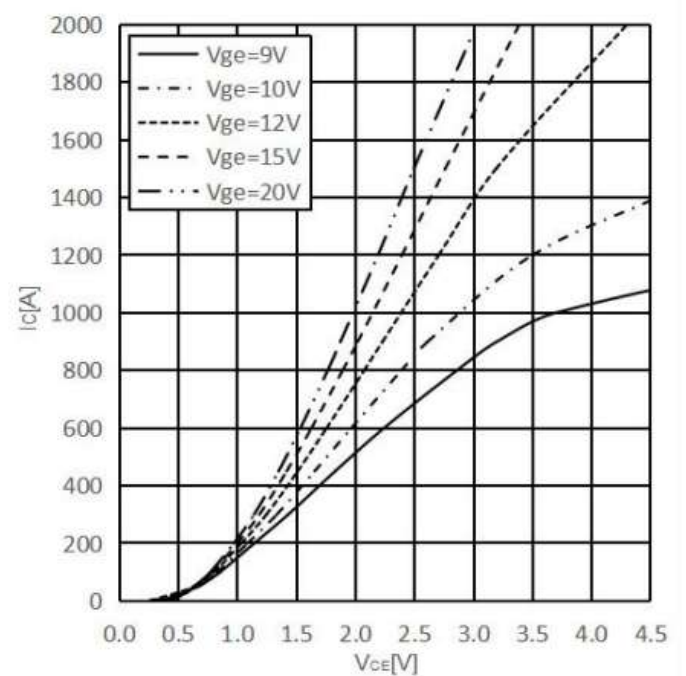
- 1) Terminal impedance is not included.
- 2) T_{vj op} > 150°C is allowed for operation at overload conditions.
- 3) The copper base plate is nickel-plated.

Circuit Diagram

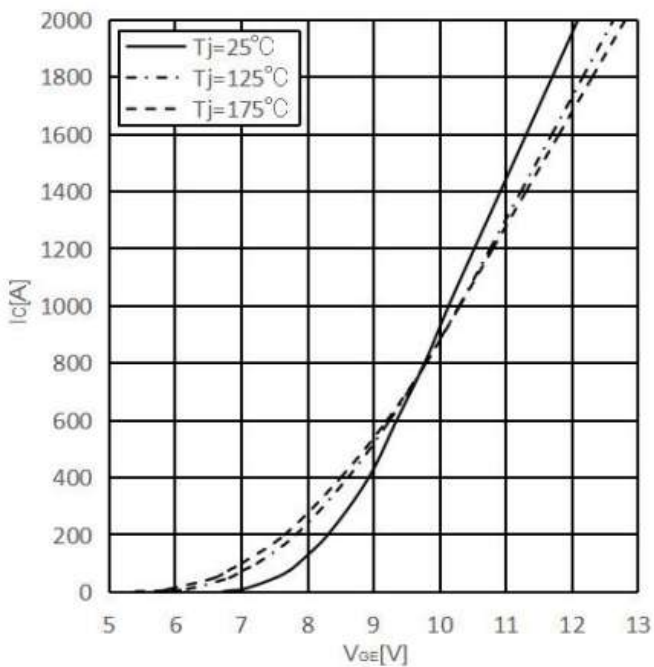
Output characteristic IGBT, Inverter (typical)
Inclusive RCC+EE'
 $I_c = f(V_{CE})$ $V_{GE} = 15V$



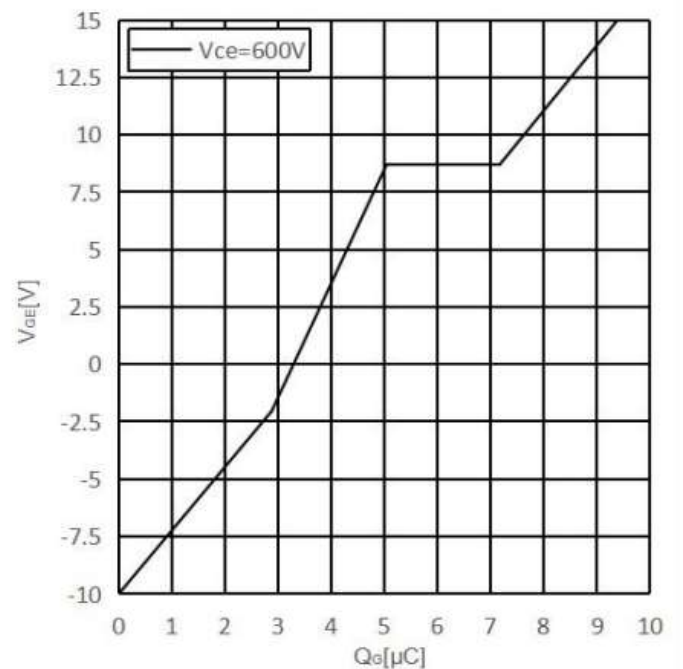
Output characteristic IGBT, Inverter (typical)
Inclusive RCC+EE'
 $I_c = f(V_{CE})$ $T_i = 175^\circ C$



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



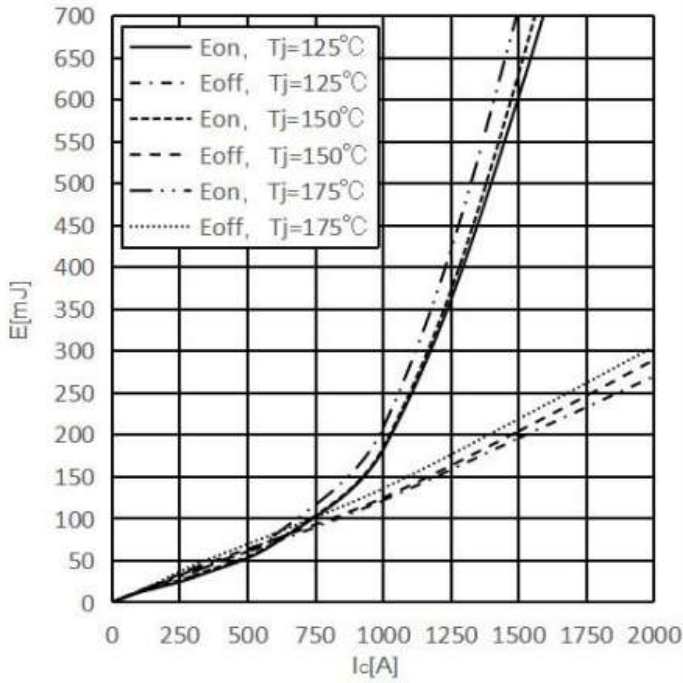
Gate Charge characteristic IGBT, Inverter
 $V_{GE} = f(Q_G)$
 $I_c = 1000A$, $T_{vj} = 25^\circ C$



Switching losses IGBT, Inverter (typical)

Inclusive $R_{CC}+E E'$

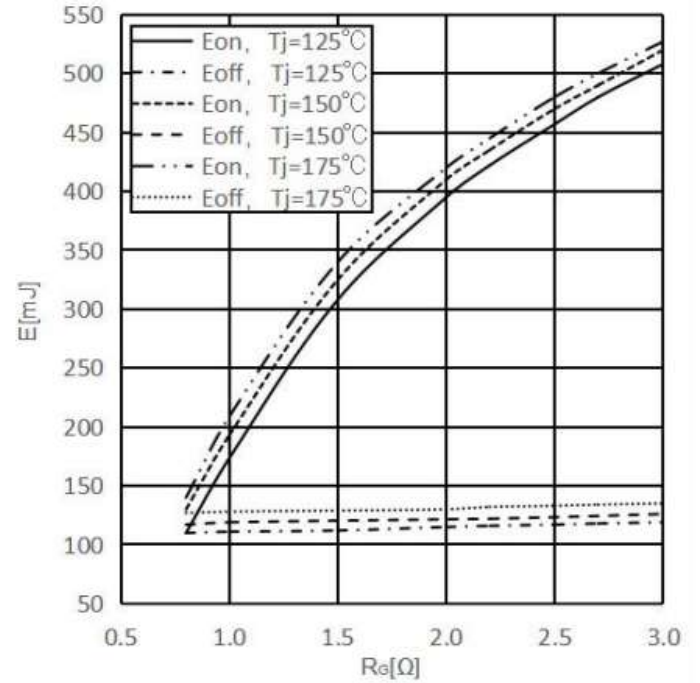
$E = f(I_c)$, $V_{GE} = +15V/-8V$, $R_{gon} = 1\Omega$, $R_{Goff} = 3\Omega$, $V_{CE} = 600V$



Switching losses IGBT, Inverter (typical)

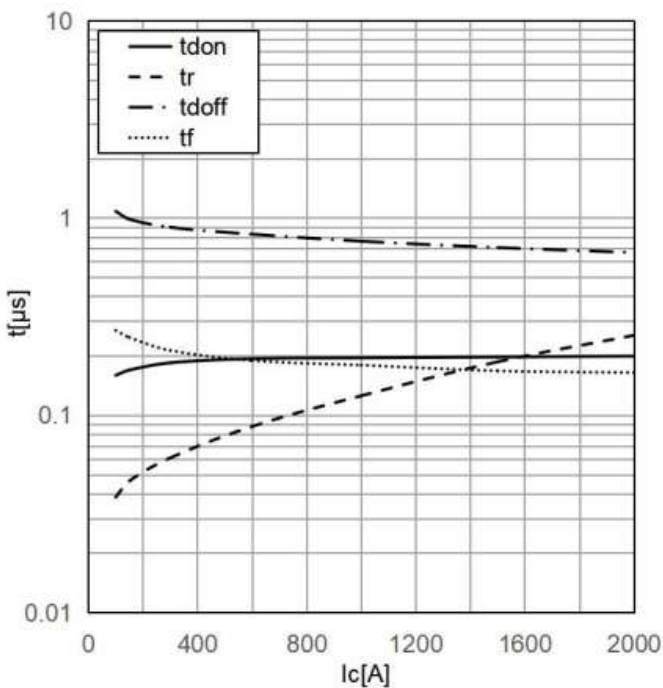
Inclusive $R_{CC}+E E'$

$E = f(R_G)$, $V_{GE} = +15V/-8V$, $I_c = 1000A$, $V_{CE} = 600V$



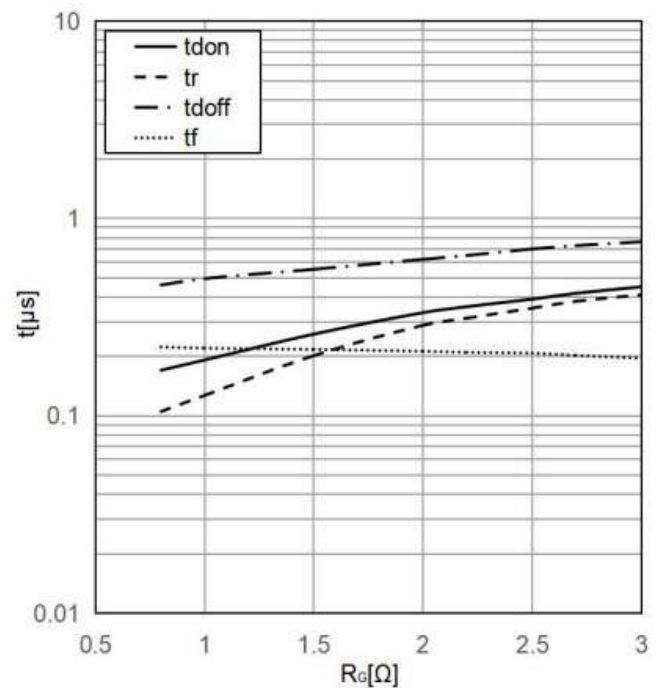
Switching times IGBT, Inverter (typical)

$t = f(I_c)$, $V_{GE} = +15V/-8V$, $V_{CE} = 600V$, $T_{vj} = 175^\circ C$, $R_{gon} = 1\Omega$, $R_{Goff} = 1\Omega$

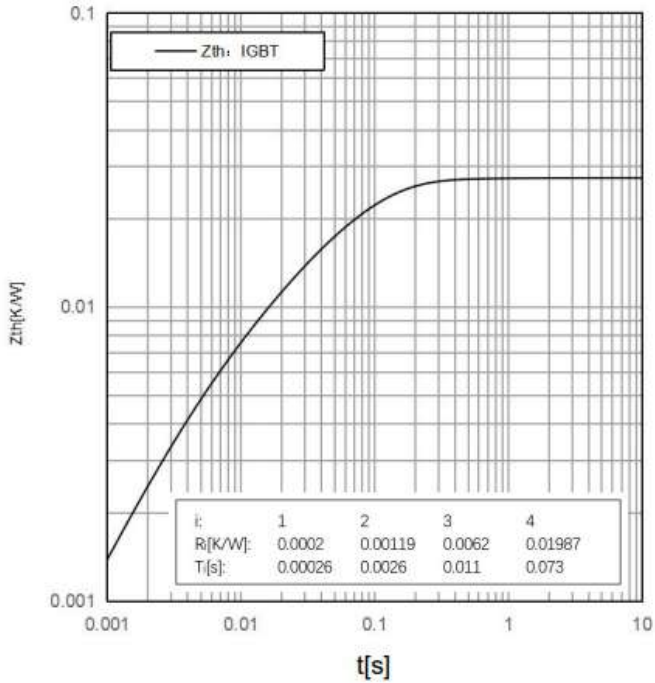


Switching times IGBT, Inverter (typical)

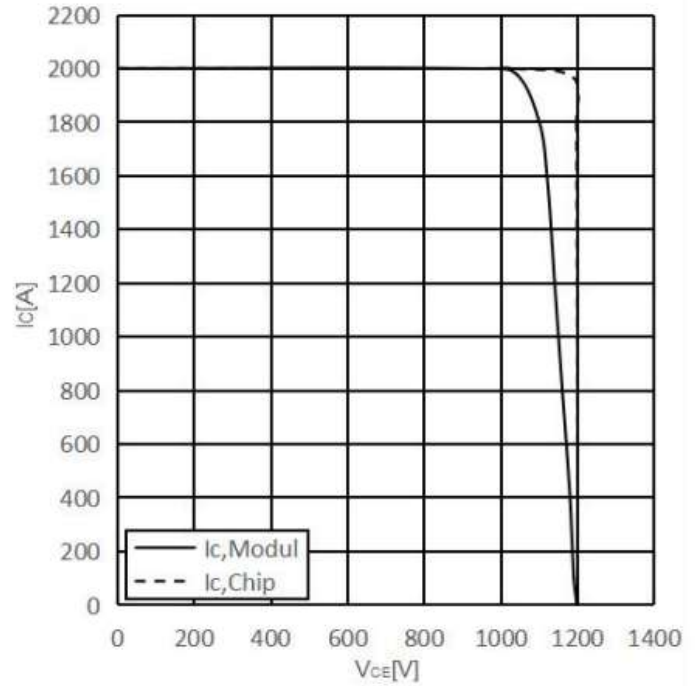
$t = f(R_G)$, $V_{GE} = +15V/-8V$, $V_{CE} = 600V$, $T_{vj} = 175^\circ C$, $I_c = 1000A$



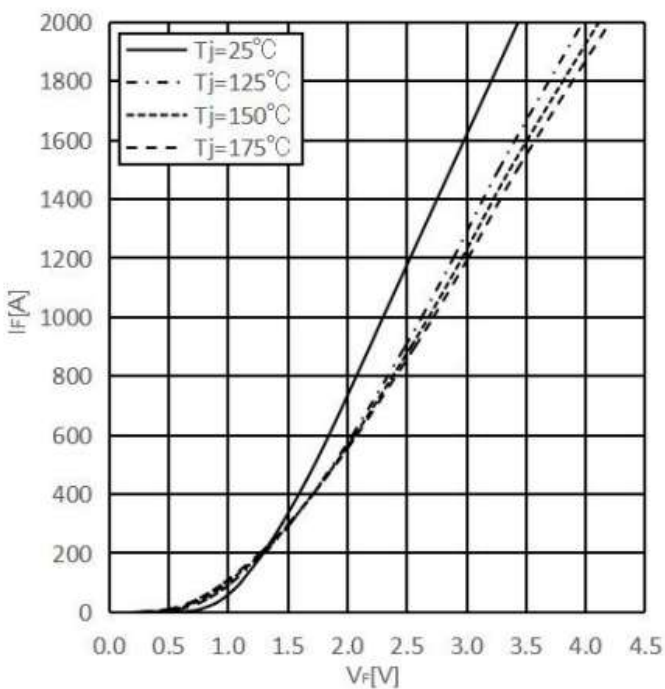
Transient thermal impedance IGBT, Inverter
 $Z_{thJC}=f(t)$



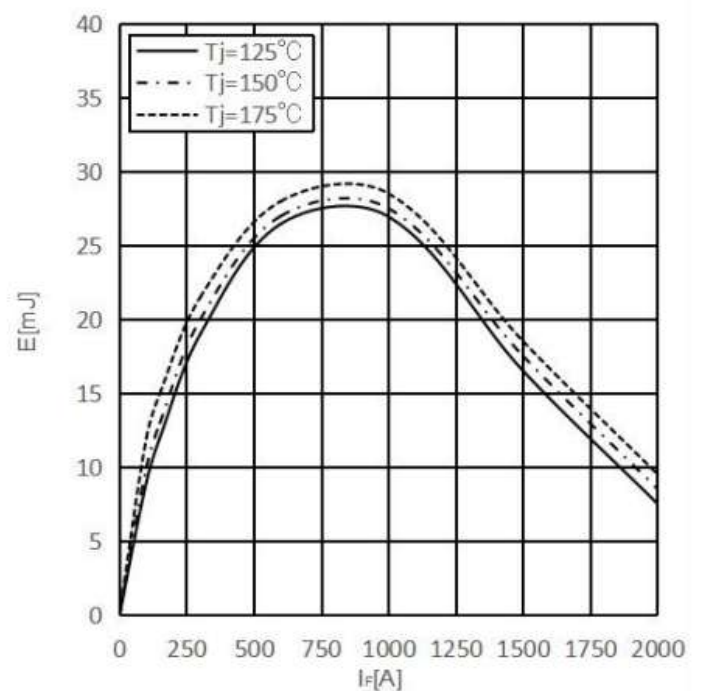
Reverse bias safe operating area IGBT,
 Inverter(RBSOA)
 $I_C = f(V_{CE}), V_{GE} = +15V/-8V, R_{Goff} = 3\Omega, T_j = 175^\circ C$



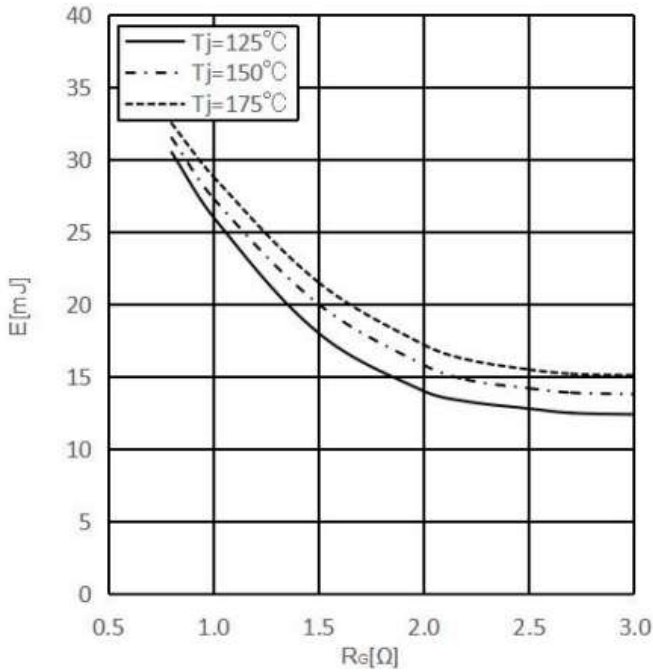
Forward characteristic FRD, Inverter(typical),
 Inclusive RCC+EE'
 $I_F = f(V_F)$



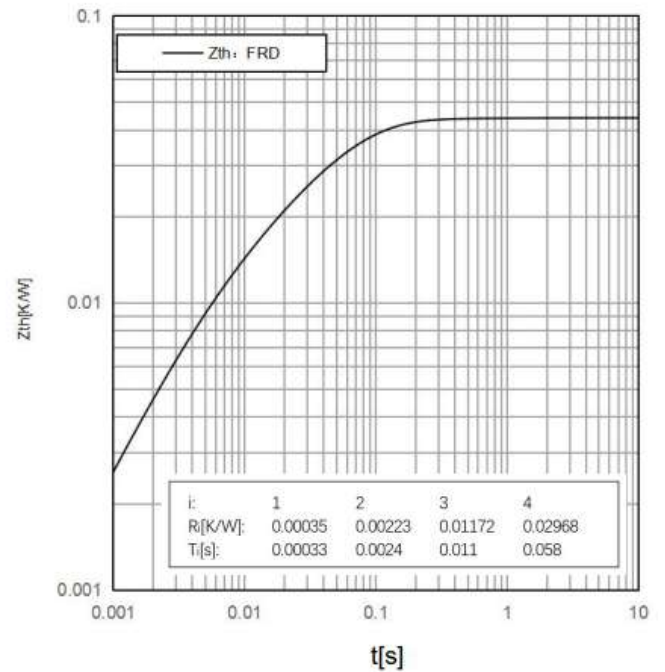
Switching Losses FRD, Inverter (typical),
 Inclusive RCC+EE'
 $E_{rec} = f(I_F), R_{Gon} = 1\Omega, V_{CE} = 600V$



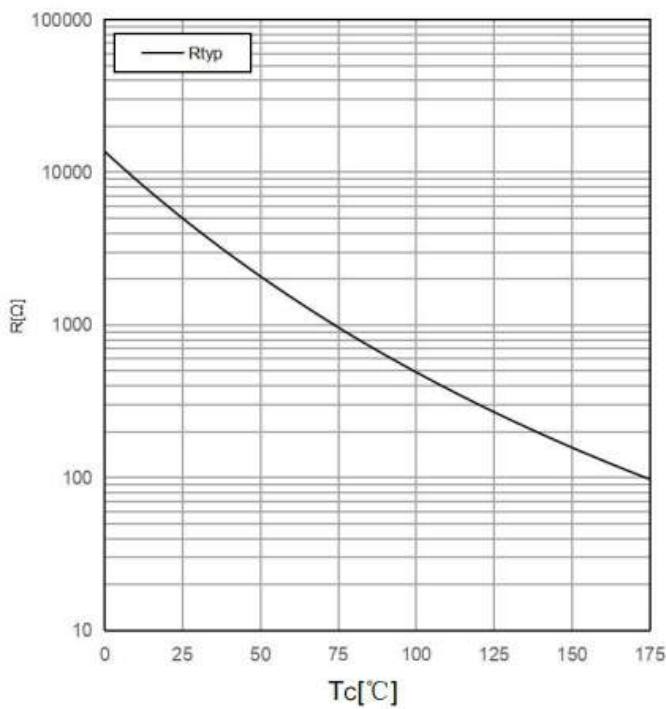
Switching Losses FRD, Inverter (typical),
 Inclusive RCC+EE'
 $E_{rec} = f(R_G)$, $I_C = 1000A$, $V_{CE} = 600V$



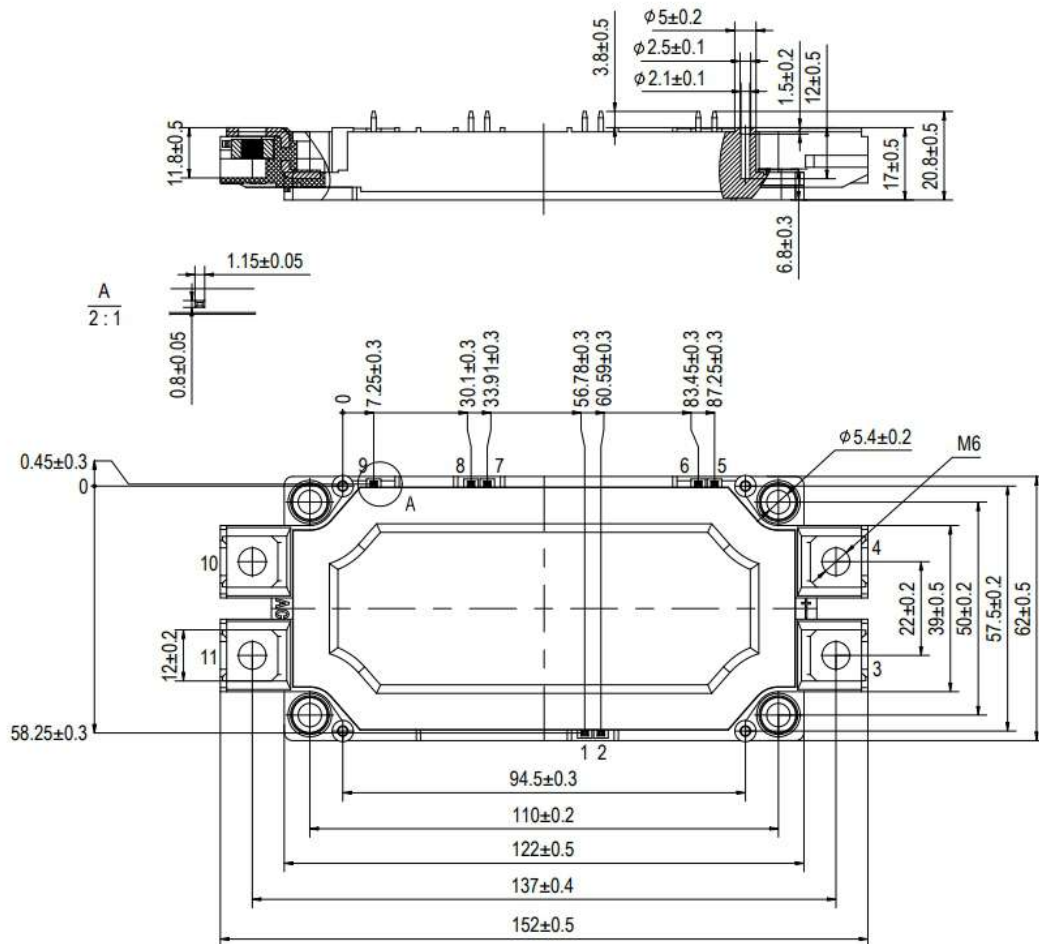
Transient thermal impedance FRD, Inverter
 FRD
 $Z_{thJC} = f(t)$



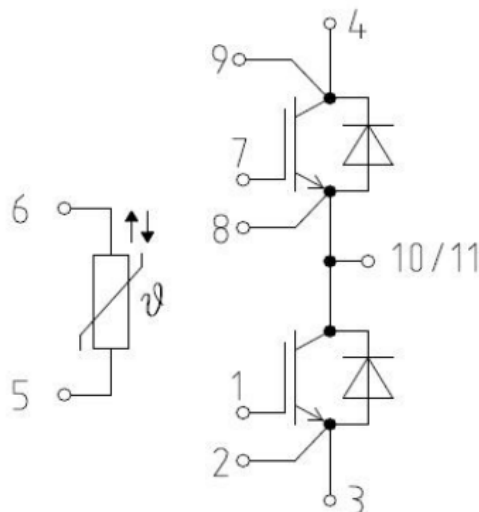
NTC Thermistor temperature characteristic
 (typical)
 $R = f(T)$



Package Dimension/
Dimensions in Millimeters



Internal Circuit



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