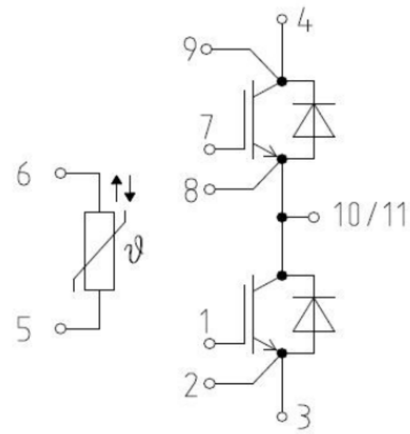
C5 series package: 1200V 1000A IGBT module



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°C	V_{CES}	1200	V
Implemented Collector Current		I_{Cnom}	1000	A
Continuous DC collector current	T_C = 90°C, T_{vjmax} = 175°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.	
Collector-emitter Saturation Voltage[1)]	I_C = 1000A, V_{GE} = 15V	T_{vj} = 25°C T_{vj} = 125°C T_{vj} = 175°C	V_{CEsat}	-	1.55 1.79 1.83	-	V
Gate Threshold Voltage	V_{CE} = V_{GE}, I_C = 18mA, T_{vj} = 25°C		V_{GEth}	5.0	6.0	7.0	V
Gate Charge	V_{GE} = -10V/15V, V_{CE} = 600V		Q_G	-	9.52	-	μC
Internal Gate Resistor	T_{vj} = 25°C		R_{Gint}	-	0.28	-	Ω
Input Capacitance	f = 100kHz, T_{vj} = 25°C, V_{CE} = 25V, V_{GE} = 0V		C_{ies}	-	208	-	nF
Reverse Transfer Capacitance	f = 100kHz, T_{vj} = 25°C, V_{CE} = 25V, V_{GE} = 0V		C_{res}	-	0.52	-	nF
Collector-emitter Cutoff Current	V_{CE} = 1200V, V_{GE} = 0V, T_{vj} = 25°C		I_{CES}	-	-	0.1	mA
Gate-emitter Leakage Current	V_{CE} = 0V, V_{GE} = 20V, T_{vj} = 25°C		I_{GES}	-	-	500	nA
Turn-on Delay Time, Inductive Load	I_C = 1000A, V_{CE} = 600V V_{GE} = -8V/15V R_{GON} = 1Ω	T_{vj} = 25°C T_{vj} = 125°C T_{vj} = 175°C	t_{don}	-	187 193 192	-	ns
Rise Time, Inductive Load	I_C = 1000A, V_{CE} = 600V V_{GE} = -8V/15V R_{GON} = 1Ω	T_{vj} = 25°C T_{vj} = 125°C T_{vj} = 175°C	t_r	-	104 119 130	-	ns
Turn-off Delay Time, Inductive Load	I_C = 1000A, V_{CE} = 600V V_{GE} = -8V/15V R_{Goff} = 1Ω	T_{vj} = 25°C T_{vj} = 125°C T_{vj} = 175°C	t_{doff}	-	449 480 500	-	ns
Fall Time, Inductive Load	I_C = 1000A, V_{CE} = 600V V_{GE} = -8V/15V R_{Goff} = 1Ω	T_{vj} = 25°C T_{vj} = 125°C T_{vj} = 175°C	t_f	-	111 186 210	-	ns
Turn-on Energy Loss per Pulse	I_C = 1000A, V_{CE} = 600V, $L_σ$ = 30nH V_{GE} = -8V/15V, R_{GON} = 1Ω di/dt = 6353 A/μs (T_{vj} = 175°C)	T_{vj} = 25°C T_{vj} = 125°C T_{vj} = 175°C	E_{on}	-	116 184 210	-	mJ
Turn-off energy Loss per Pulse	I_C = 1000A, V_{CE} = 600V, $L_σ$ = 30nH V_{GE} = -8V/15V, R_{Goff} = 1Ω du/dt = 3243 A/μs (T_{vj} = 175°C)	T_{vj} = 25°C T_{vj} = 125°C T_{vj} = 175°C	E_{off}	-	84 112 125	-	mJ
SC Data	V_{GE} = -8V/15V V_{CC} = 800V	t_P ≤ 8μs, Tvj = 150°C t_P ≤ 6μs, Tvj = 175°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	℃

Diode, Inverter
Maximum Rated Values

Repetitive Peak Reverse Voltage	T_{vj} = 25℃	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℃ T_{vj} = 150℃ T_{vj} = 175℃	V_F	–	1.83 2.15 2.25	–	V
Peak Reverse Recovery Current	I_F = 1000A, V_R = 600V -di_F/dt = 7142 A/us (T_{vj} = 175℃) V_{GE} = −8V	T_{vj} = 25℃ T_{vj} = 125℃ T_{vj} = 175℃	I_{RM}	–	424 448 448	–	A
Recovery Charge	I_F = 1000A, V_R = 600V -di_F/dt = 7142 A/us (T_{vj} = 175℃) V_{GE} = −8V	T_{vj} = 25℃ T_{vj} = 125℃ T_{vj} = 175℃	Q_R	–	39 62 77	–	μC
Reverse Recovery Energy	I_F = 1000A, V_R = 600V -di_F/dt = 7142 A/us (T_{vj} = 175℃) V_{GE} = −8V	T_{vj} = 25℃ T_{vj} = 125℃ T_{vj} = 175℃	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	℃

NTC-Thermistor / NTC
Characteristic Values

			min.	typ.	max.	
Rated Resistance	T_{NTC} = 25℃	R_{25}	–	5	–	KΩ
Deviation of R100 R100	T_{NTC} = 100℃, R_{100} = 491Ω	△R/R	-5	–	5	%
Power Dissipation	T_{NTC} = 25℃	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

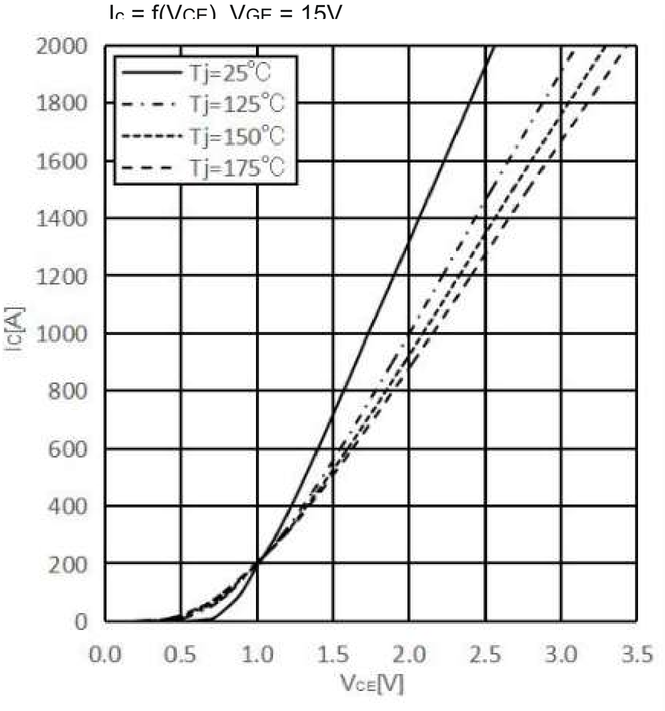
Isolation Test Voltage	RMS, f = 50Hz, t = 3s	V_{ISOL}	4	kV
Isolation Test Voltage of NTC	RMS, f = 50Hz, t = 3s	$V_{ISOL(NTC)}$	4	kV
Material of Module Baseplate			Cu+Ni [3)]	
Internal Isolation			Si_3N_4	
Creepage Distance	Terminal to heatsink, min Terminal to terminal, min		14.7 15.1	mm
Clearance	Terminal to heatsink, min Terminal to terminal, min		9.6 12.5	mm
Comparative Tracking Index		CTI	>200	

			min.	typ.	max.	
Stray Inductance Module		L_{sCE}	-	20	-	nH
Module Lead Resistance, Terminals-Chip	T_C = 25℃, Per Switch	$R_{CC'+EE'}$	-	0.8	-	mΩ
Storage Temperature		T_{stg}	-40	-	125	℃
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

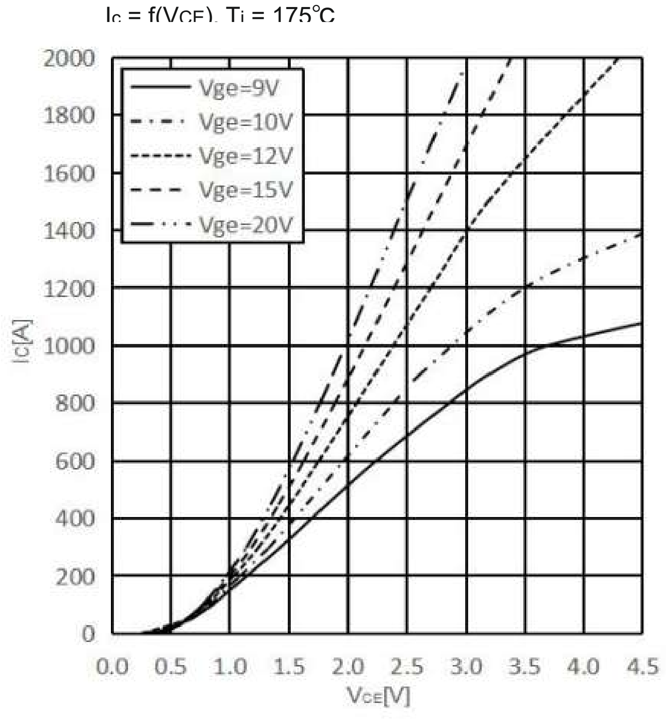
1) Terminal impedance is not included.
2) $T_{vj\ op}$ > 150°C is allowed for operation at overload conditions.
3) The copper base plate is nickel-plated.

Circuit Diagram

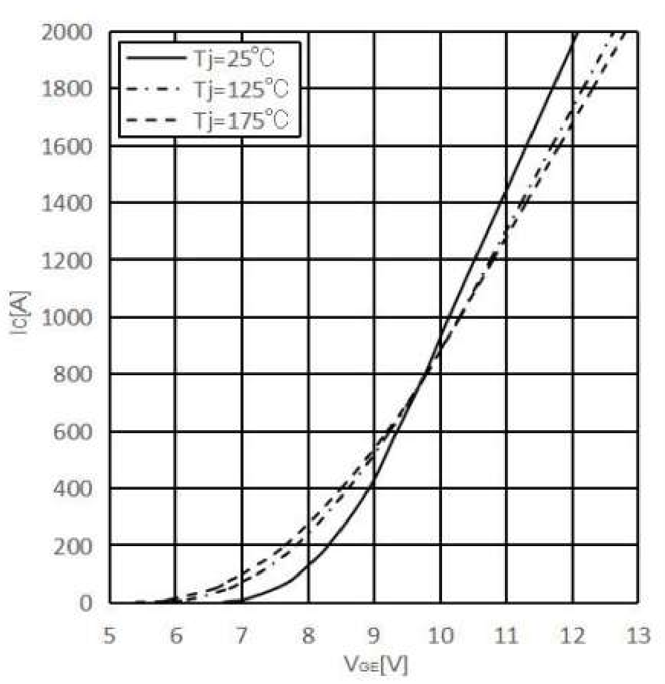
Output characteristic IGBT, Inverter (typical)
Inclusive $R_{CC'+EE'}$
$I_C = f(V_{CE})$, $V_{GE} = 15V$



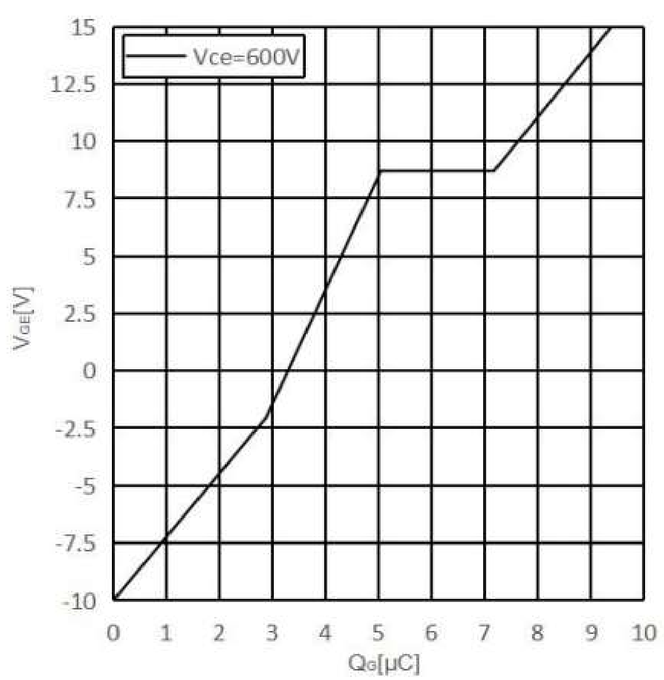
Output characteristic IGBT, Inverter (typical)
Inclusive $R_{CC'+EE'}$
$I_C = f(V_{CE})$, $T_j = 175°C$



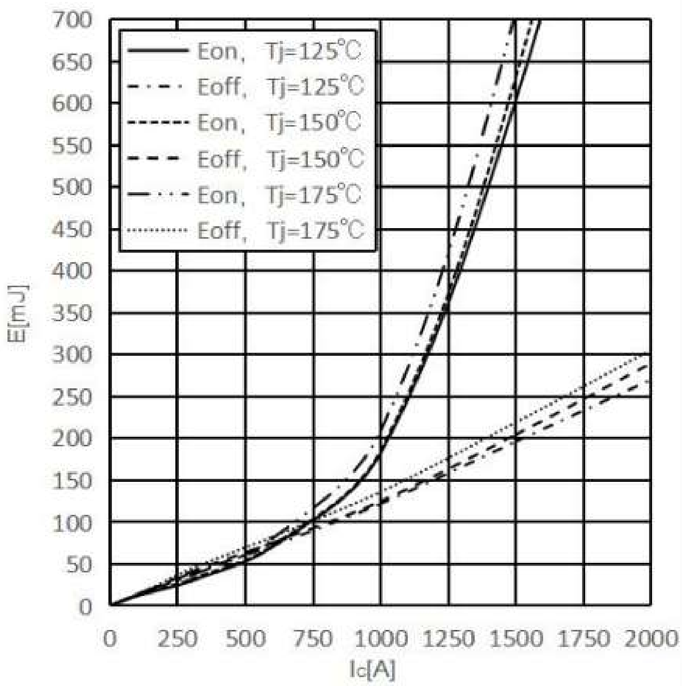
Transfer characteristic IGBT, Inverter(typical),
Inclusive $R_{CC'+EE'}$
$I_C = f(V_{GE})$, $V_{CE} = 20V$



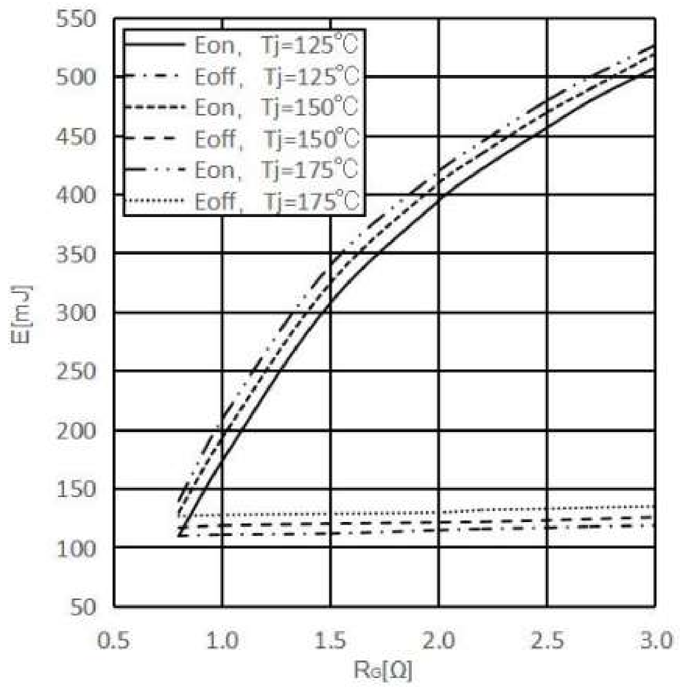
Gate Charge characteristic IGBT, Inverter
$V_{GE} = f(Q_G)$
$I_C = 1000A$, $T_{vj} = 25°C$



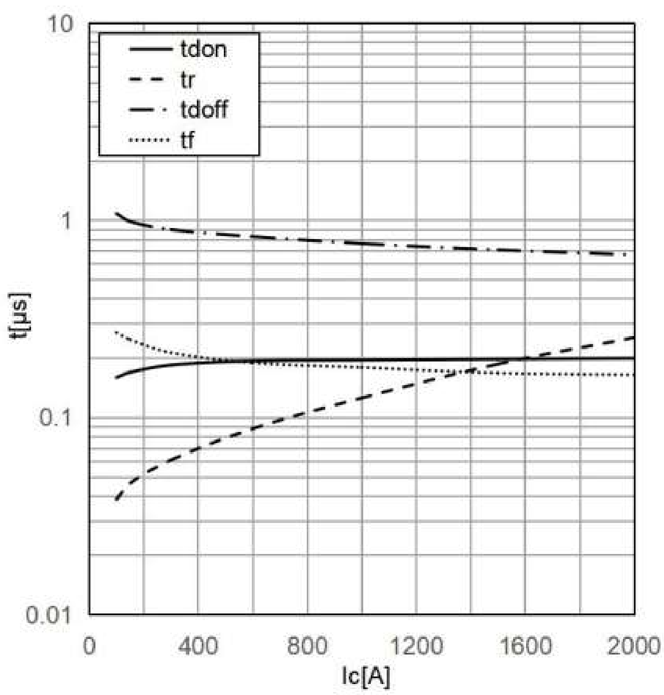
Switching losses IGBT, Inverter (typical)
Inclusive $R_{CC'+EE'}$
$E = f(I_C)$, V_{GE} = +15V/-8V, R_{gon} = 1Ω, R_{Goff} = 3Ω, V_{CE} = 600V



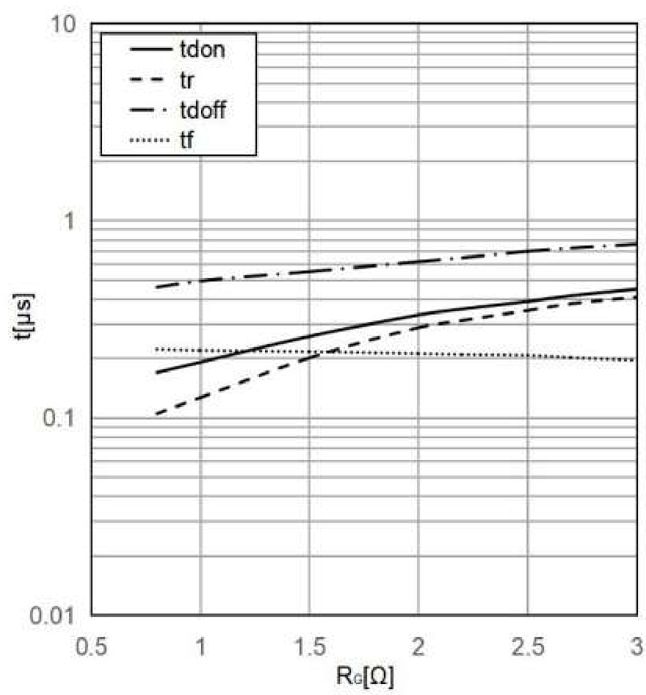
Switching losses IGBT, Inverter(typical)
Inclusive $R_{CC'+EE'}$
$E = f(R_G)$, V_{GE} = +15V/-8V, I_C = 1000A, V_{CE} = 600V



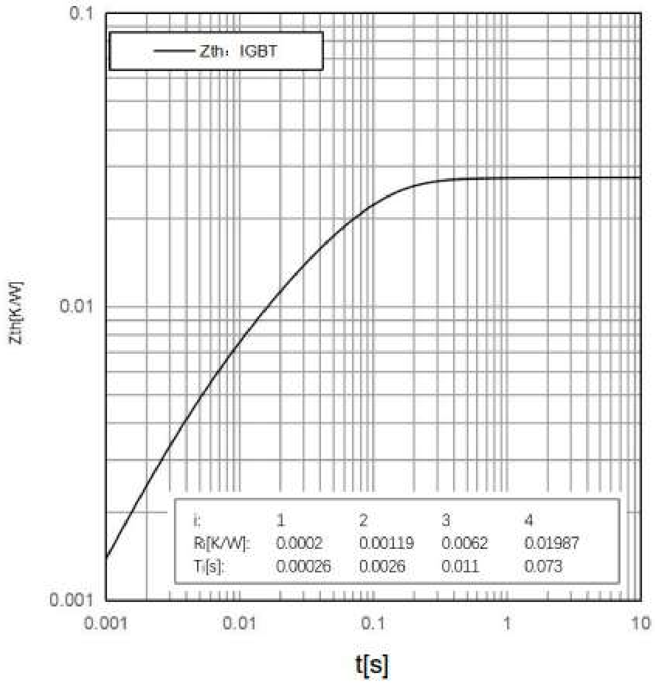
Switching times IGBT, Inverter(typical)
$t = f(I_C)$, VGE = +15V/-8V, V_{CE} = 600V, T_{vj} = 175°C
R_{gon} = 1Ω，R_{Goff} = 1Ω



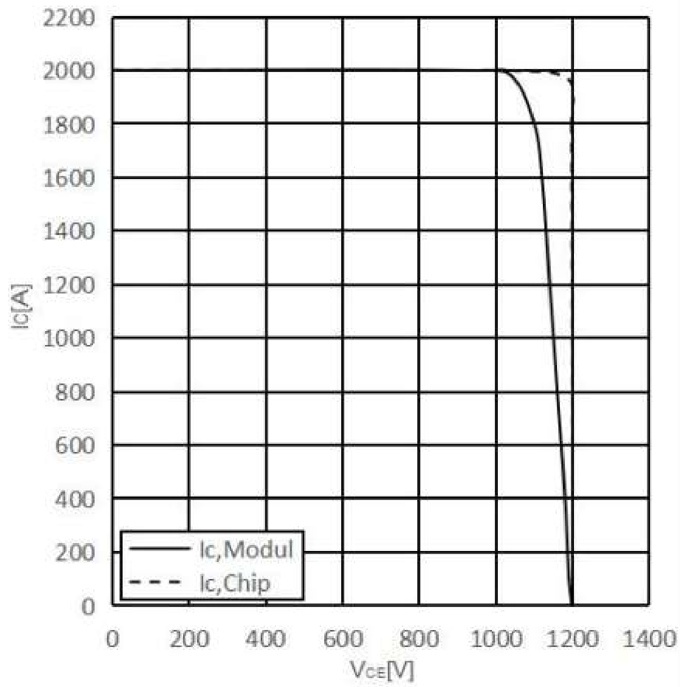
Switching times IGBT, Inverter (typical)
$t = f(R_G)$, V_{GE} = +15V/-8V, V_{CE} = 600V, T_{vj} = 175°C
I_C = 1000A



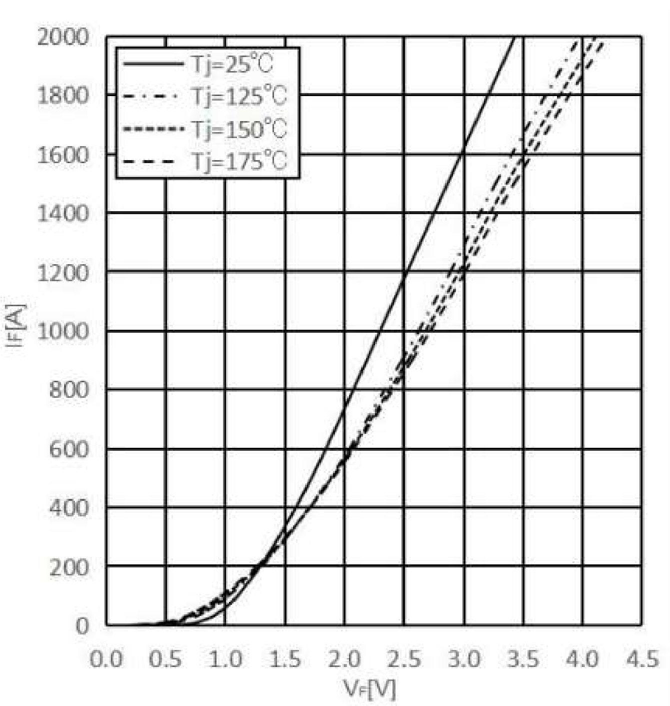
Transient thermal impedance IGBT, Inverter
Z_{thJC}=f(t)



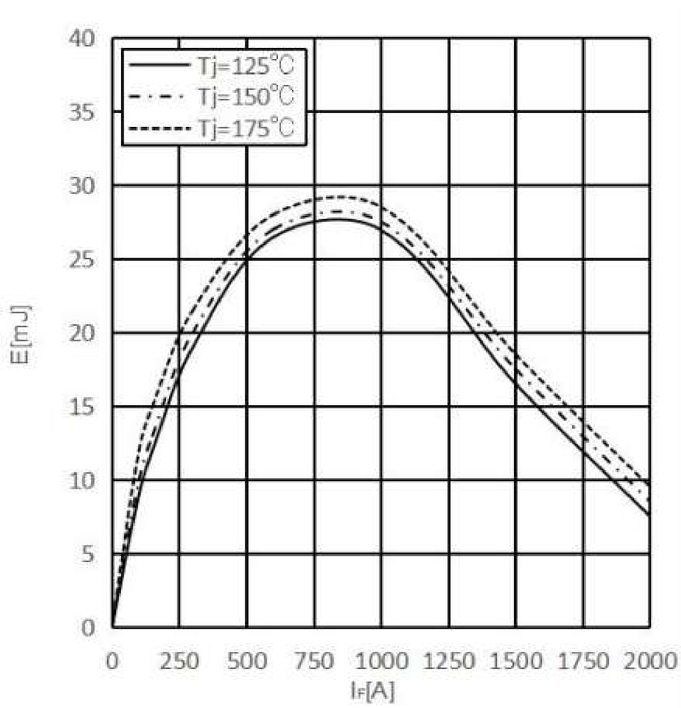
Reverse bias safe operating area IGBT, Inverter(RBSOA)
I_C = f(V_{CE}),V_{GE} = +15V/-8V, R_{Goff} = 3Ω, T_j = 175°C



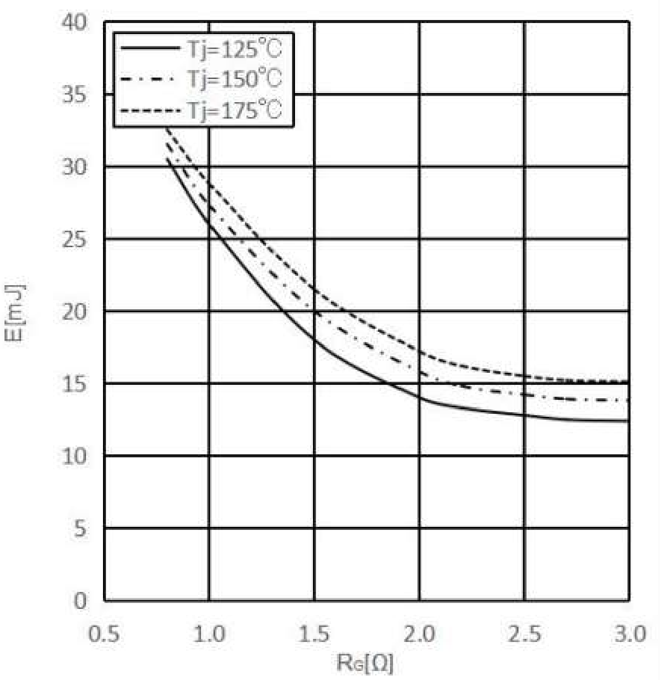
Forward characteristic FRD, Inverter(typical), Inclusiver $R_{CC'+EE'}$
I_F = f(V_F)



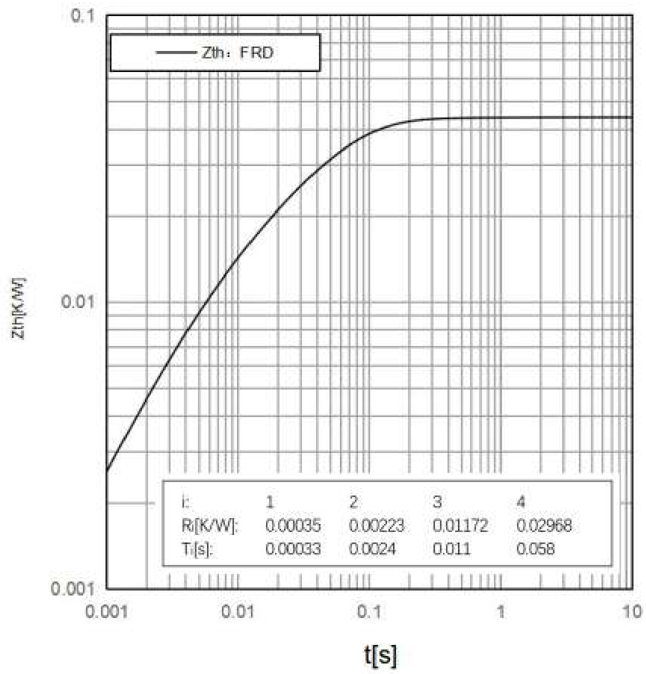
Swiching Losses FRD, Inverter (typical), Inclusive $R_{CC'+EE'}$
E_{rec} = f(I_F), R_{Gon} = 1Ω, V_{CE} = 600V



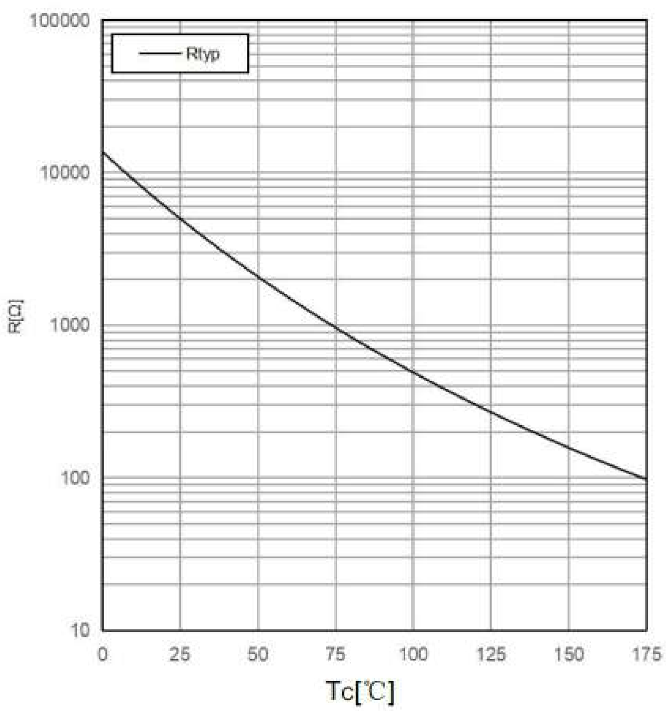
Swiching Losses FRD, Inverter (typical),
Inclusive $R_{CC'+EE'}$
$E_{rec} = f(R_G)$, I_C = 1000A, V_{CE} = 600V



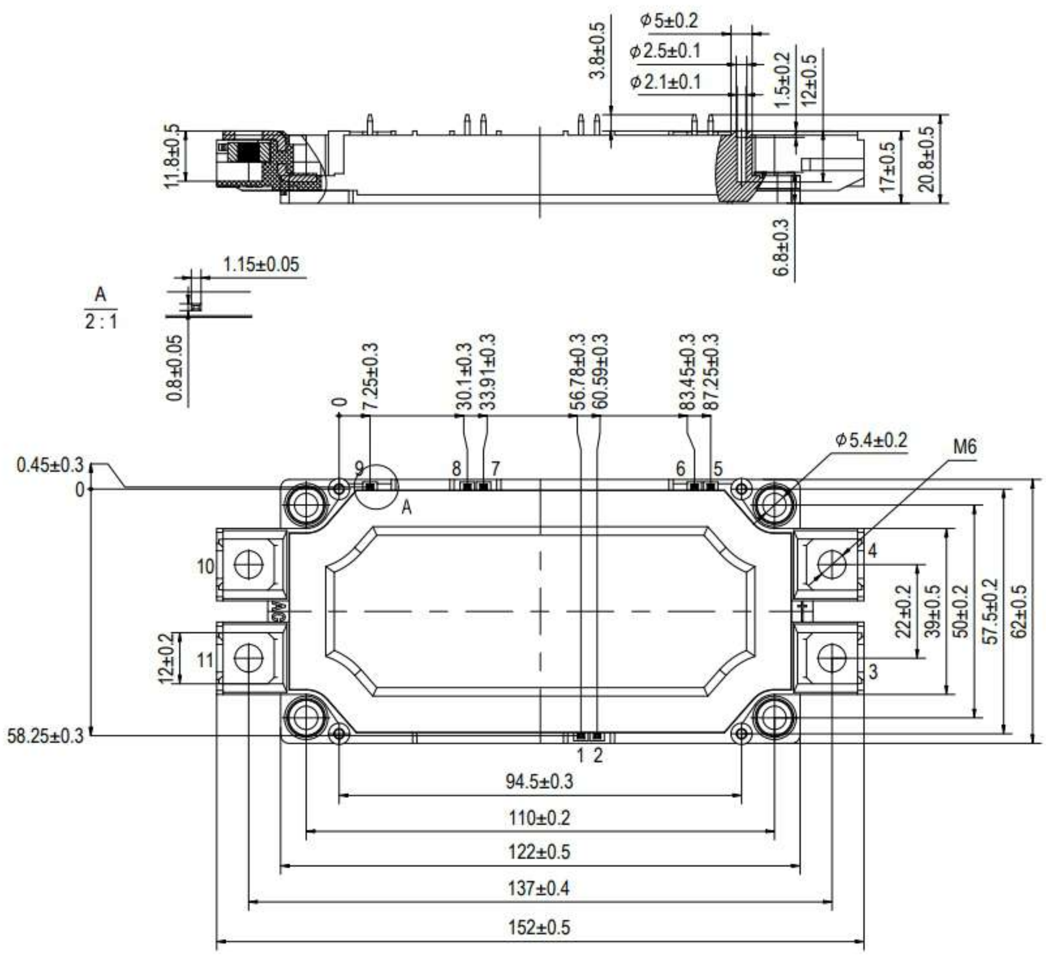
Transient thermal impedance FRD, Inverter
FRD
$Z_{thJC} = f(t)$



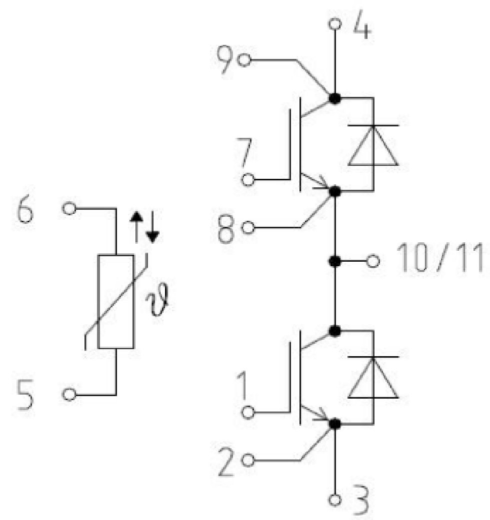
NTC Thermistor temperature characteristic
(typical)
R = f(T)



Package Dimension/
Dimensions in Millimeters



Internal Circuit



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