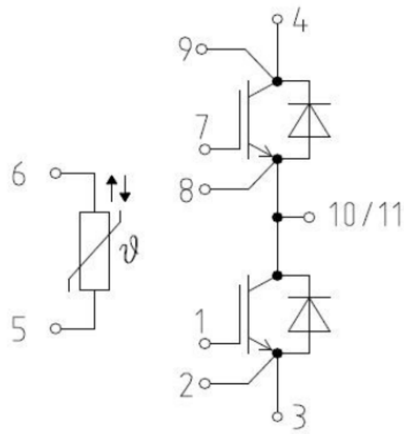
C5 series package: 1700V 600A IGBT module

Preliminary Datasheet



Equivalent
Circuit Schematic

Features:

- V_{CES} = 1700V
- $I_{C\ nom}$ = 600A
- Trenchgate Gen.7 IGBT technology
- $V_{CE(sat)}$ with positive temperature coefficient
- High RBSOA capability
- Low static losses: $V_{CE(sat)}$ = 1,55V@25C

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℃	V_{CES}	1700	V
Implemented Collector Curren		I_{Cnom}	600	A
Continuous DC Collector Current	T_C = 85℃, $T_{vj\,max}$ = 175℃	I_C	600	A
Repetitive Peak Collector Current	t_p $T_{vj\,op}$	I_{CRM}	1200	A
Gate-emitter Peak Voltage		V_{GES}	±20	V

Characteristic Values

			min.	typ.	max.	
Collector-emitter Saturation Voltage[1)]	I_C = 600A, V_{GE} = 15V; T_{vj} = 25℃ / T_{vj} = 125℃ / T_{vj} = 150℃ / T_{vj} = 175℃	V_{CEsat}	-	1.55 / 1.78 / 1.83 / 1.90	-	V
Gate Threshold Voltage	V_{CE} = V_{GE}, I_C = 12mA, T_{vj} = 25℃	V_{GEth}	-	6.10	-	V
Gate Charge	V_{GE} = -10V/15V, V_{CE} = 600V	Q_G	-	5.6	-	μC
Internal Gate Resistor	T_{vj} = 25℃	R_{Gint}	-	0.25	-	Ω
Input Capacitance	f = 100kHz, T_{vj} = 25℃, V_{CE} = 25V, V_{GE} = 0V	C_{ies}	-	60.9	-	nF
Reverse Transfer Capacitance	f = 100kHz, T_{vj} = 25℃, V_{CE} = 25V, V_{GE} = 0V	C_{res}	-	0.22	-	nF
Collector-emitter Cutoff Current	V_{CE} = 1700V, V_{GE} = 0V, T_{vj} = 25℃	I_{CES}	-	-	1	mA
Gate-emitter Leakage Current	V_{CE} = 0V, V_{GE} = 20V, T_{vj} = 25℃	I_{GES}	-	-	100	nA
Turn-on Delay Time, Inductive Load	I_C = 600A, V_{CE} = 900V, V_{GE} = -8V/15V, R_{GON} = 1Ω; T_{vj} = 25℃ / T_{vj} = 125℃ / T_{vj} = 150℃ / T_{vj} = 175℃	t_{don}	-	216 / 222 / 227 / 230	-	ns
Rise Time, Inductive Load	I_C = 600A, V_{CE} = 900V, V_{GE} = -8V/15V, R_{GON} = 1Ω; T_{vj} = 25℃ / T_{vj} = 125℃ / T_{vj} = 150℃ / T_{vj} = 175℃	t_r	-	72 / 85 / 87 / 84	-	ns
Turn-off Delay Time, Inductive Load	I_C = 600A, V_{CE} = 900V, V_{GE} = -8V/15V, R_{Goff} = 1Ω; T_{vj} = 25℃ / T_{vj} = 125℃ / T_{vj} = 150℃ / T_{vj} = 175℃	t_{doff}	-	438 / 478 / 491 / 500	-	ns
Fall Time, Inductive Load	I_C = 600A, V_{CE} = 900V, V_{GE} = -8V/15V, R_{Goff} = 1Ω; T_{vj} = 25℃ / T_{vj} = 125℃ / T_{vj} = 150℃ / T_{vj} = 175℃	t_f	-	116 / 182 / 202 / 230	-	ns
Turn-on Energy Loss per Pulse	I_C = 600A, V_{CE} = 900V, L_σ = 30nH, V_{GE} = -8V/15V, R_{GON} = 1Ω, di/dt = 6000 (T_{vj} = 175℃); T_{vj} = 25℃ / T_{vj} = 125℃ / T_{vj} = 150℃ / T_{vj} = 175℃	E_{on}	-	49.9 / 75.0 / 85.0 / 97.0	-	mJ
Turn-off energy Loss per Pulse	I_C = 600A, V_{CE} = 900V, L_σ = 30nH, V_{GE} = -8V/15V, R_{Goff} = 1Ω, du/dt = 4700/μs (T_{vj} = 175℃); T_{vj} = 25℃ / T_{vj} = 125℃ / T_{vj} = 150℃ / T_{vj} = 175℃	E_{off}	-	49.1 / 55.0 / 62.0 / 72.0	-	mJ
SC Data	V_{GE} = -8V/15V, V_{CE} = 1000V; t_P ≤ 8μs, T_{vj} = 150℃ / t_P ≤ 6μs, T_{vj} = 175℃	I_{SC}	-	2500 / 2400	-	A

Thermal Resistance, Junction to Case	Per IGBT / IGBT	R_{thJC}	-	0.047	-	K/W
Thermal Resistance, Case to Heatsink	Per IGBT / IGBT λ_{grease} = 1W/(m·K)	R_{thCH}	-	0.037	-	K/W
Temperature under Switching Conditions		$T_{vj\,op}$	-40		175	℃

Diode, Inverter
Maximum Rated Values

Repetitive Peak Reverse Voltage	T_{vj} = 25℃	V_{RRM}	1700	V
Continuous DC Forward Current		I_{Fnom}	600	A
Repetitive Peak Forward Current	t_p = 1ms	I_{FRM}	1200	A

Characteristic Values

				min.	typ.	max.	
Forward Voltage[1]	I_F = 450A, V_{GE} = 0V	T_{vj} = 25℃ T_{vj} = 125℃ T_{vj} = 175℃	V_F	-	2.10 2.17 2.05	-	V
Peak Reverse Recovery Current	I_F = 600A, V_R = 900V $-di_F/dt$ = 5700A/us (T_{vj} = 175℃) V_{GE} = −8V	T_{vj} = 25℃ T_{vj} = 125℃ T_{vj} = 150℃ T_{vj} = 175℃	I_{RM}	-	745 686 688 688	-	A
Recovery Charge	I_F = 600A, V_R = 900V $-di_F/dt$ = 5700A/us (T_{vj} = 175℃) V_{GE} = −8V	T_{vj} = 25℃ T_{vj} = 125℃ T_{vj} = 150℃ T_{vj} = 175℃	Q_R	-	100 144 159 172	-	μC
Reverse Recovery Energy	I_F = 600A, V_R = 900V $-di_F/dt$ = 5700A/us (T_{vj} = 175℃) V_{GE} = −8V	T_{vj} = 25℃ T_{vj} = 125℃ T_{vj} = 150℃ T_{vj} = 175℃	E_{rec}	-	57 79 88 95	-	mJ
Thermal Resistance, Junction to Case	Per FRD / FRD		R_{thJC}	-	0.062	-	K/W
Thermal Resistance, Case to Heatsink	Per IGBT / IGBT λ_{grease} = 1W/(m·K)		R_{thCH}	-	0.048	-	K/W
Temperature under Switching Conditions[2]			$T_{vj\,op}$	-40	-	150	℃

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} = 465Ω	△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
	$R_2 = R_{25}\exp[B_{25/80}(1/T_2-1/(298.15K))]$	$B_{25/80}$	-	3414	-	K
	$R_2 = R_{25}\exp[B_{25/100}(1/T_2-1/(298.15K))]$	$B_{25/100}$	-	3436	-	K

Module

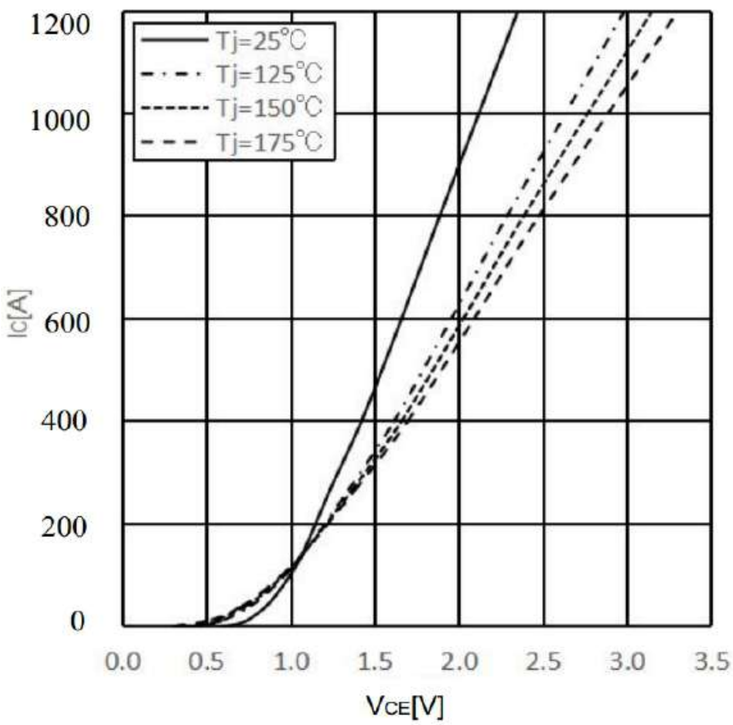
Isolation Test Voltage	RMS, f=50Hz, t=1min	V_{ISOL}	3.4	kV
Isolation Test Voltage of NTC NTC	RMS, f=50Hz, t=1min	$V_{ISOL(NTC)}$	3.4	kV
Material of Module Baseplate			Cu	
Internal Isolation			ZTA	
Creepage Distance	Terminal to heatsink, min Terminal to terminal, min		15 12.1	mm
Clearance	Terminal to heatsink, min Terminal to terminal, min		12.5 10	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 Mounting	Screw M5 / M5	M	3.0	-	6.0	Nm
Mounting Torque for Module Mounting	Screw M6 / M6	M	3.0	-	6.0	Nm
Power terminal installation torque	Screw M6 / M6	M	3.0	-	6.0	Nm
Weight		G	-	345	-	g

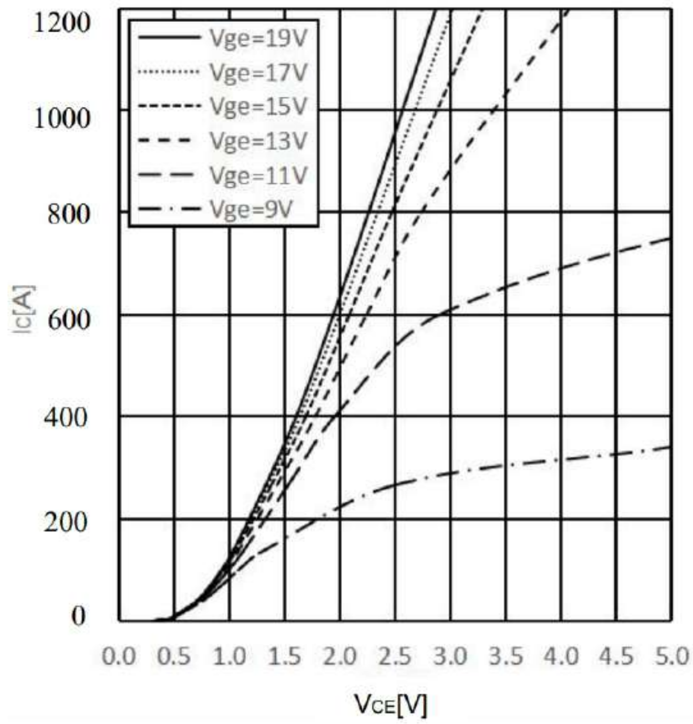
1) Terminal impedance is not included.
2) $T_{vj\ op}$ > 150°C is allowed for operation at overload conditions.

Circuit Diagram

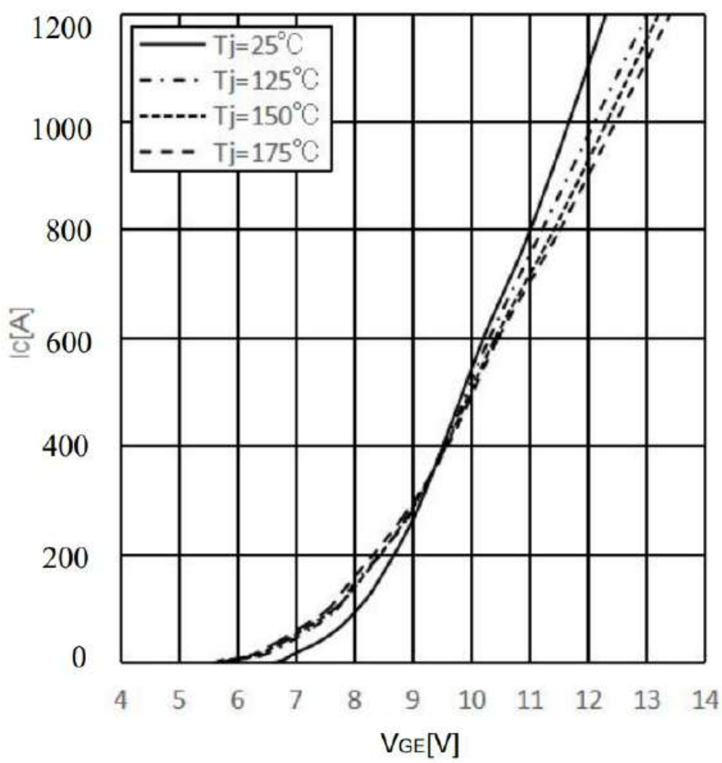
Output characteristic IGBT, Inverter (typical), IGBT
$I_c = f(V_{CE})$, V_{GE} = 15V



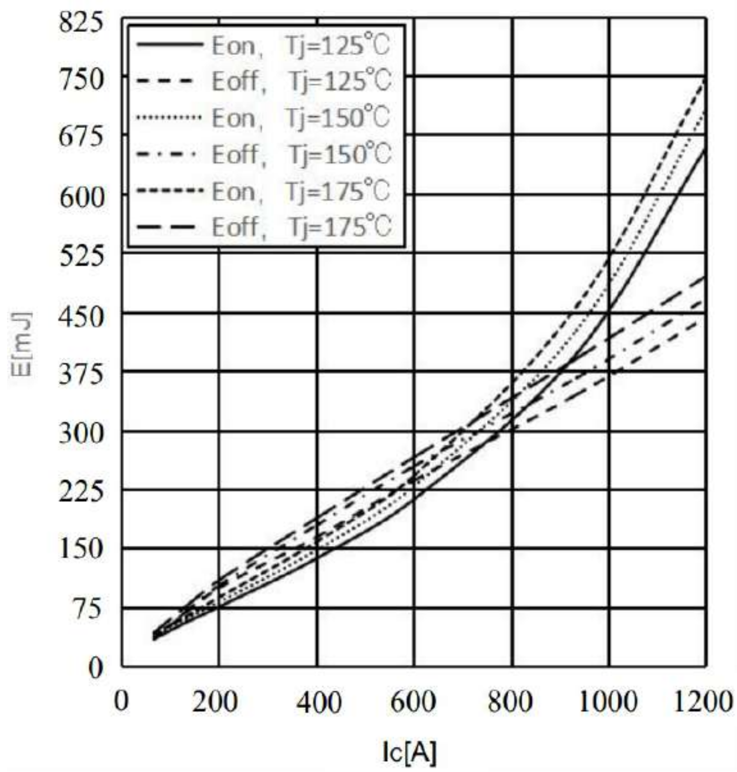
Output characteristic IGBT, Inverter (typical), IGBT
$I_c = f(V_{CE})$, T_{vj} = 175°C



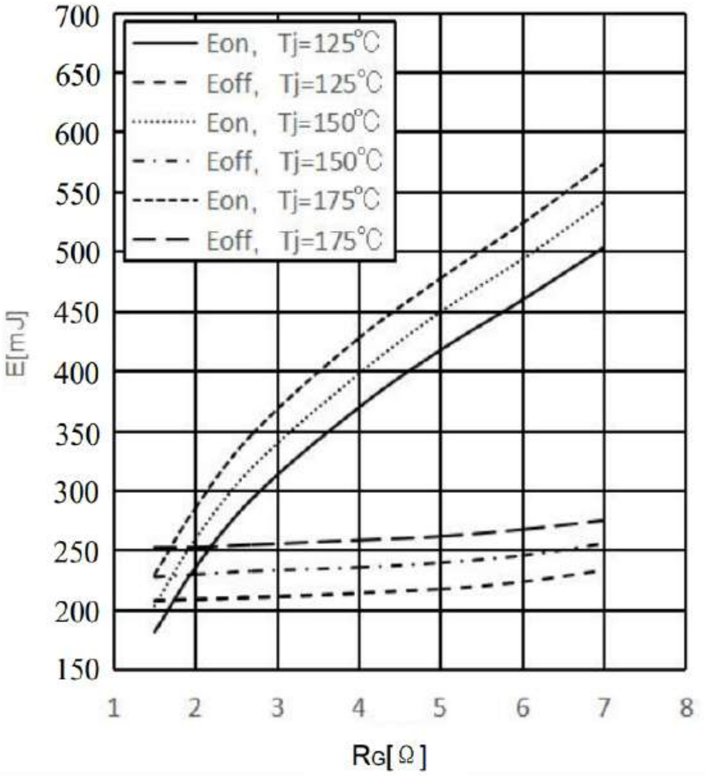
Transfer characteristic IGBT, Inverter(typical),
Inclusive $R_{CC'+EE'}$
$I_C = f(V_{GE})$, V_{CE} = 20V



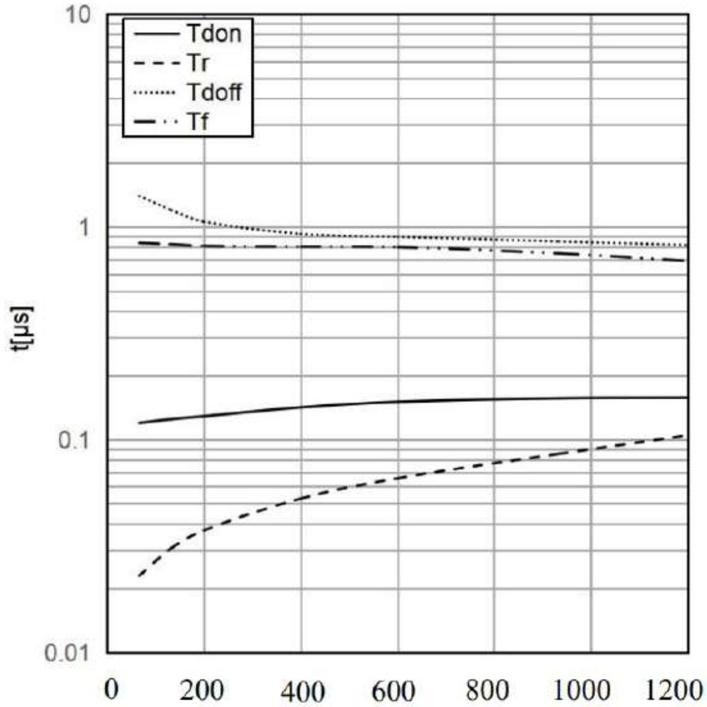
Switching losses IGBT, Inverter (Typical), IGBT
$E = f(I_C)$, V_{GE} = +15V/-8V,
R_{gon} = 1.6Ω, R_{Goff} = 3.5Ω, V_{CE} = 900V



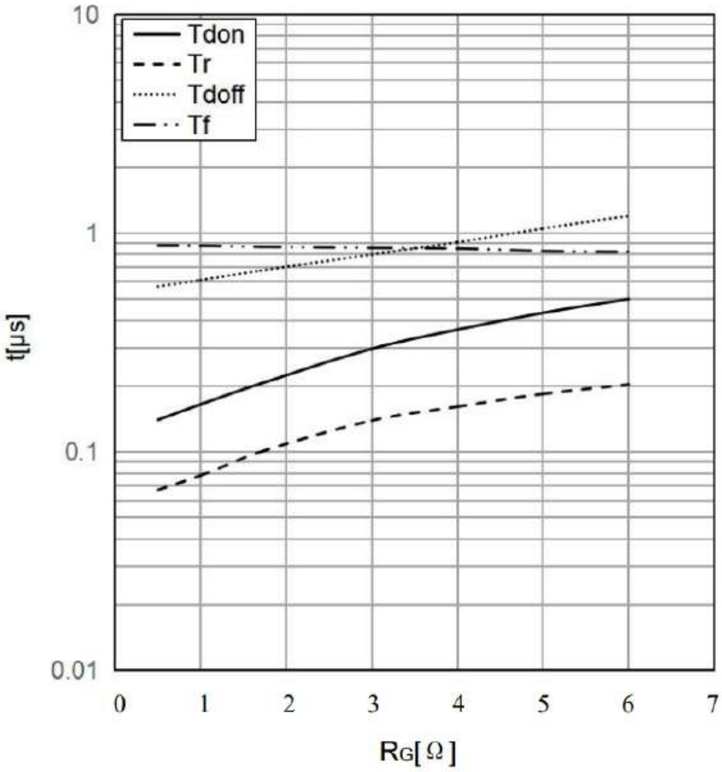
Switching losses IGBT, Inverter(typical),
Inclusive $R_{CC'+EE'}$
$E = f(R_G)$, V_{GE} = +15V/-8V, I_C = 600A, V_{CE} = 6900V



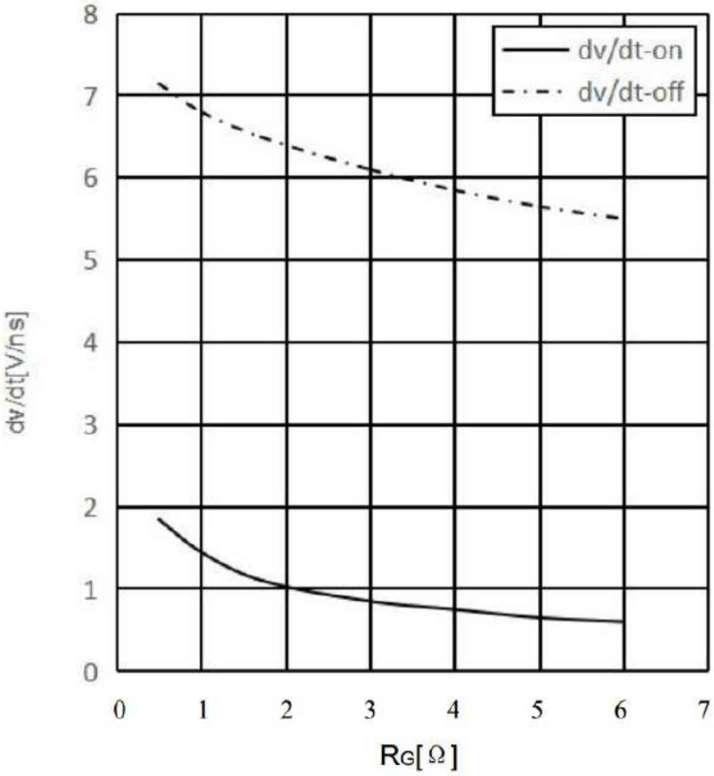
Switching times IGBT, Inverter(typical)
$t_{don} = f(I_C)$, $t_r = f(I_C)$, V_{GE} = +15V/-8V, V_{CE} = 900V
R_{gon} = 1.6Ω, R_{Goff} = 3.5Ω, T_j = 175°C



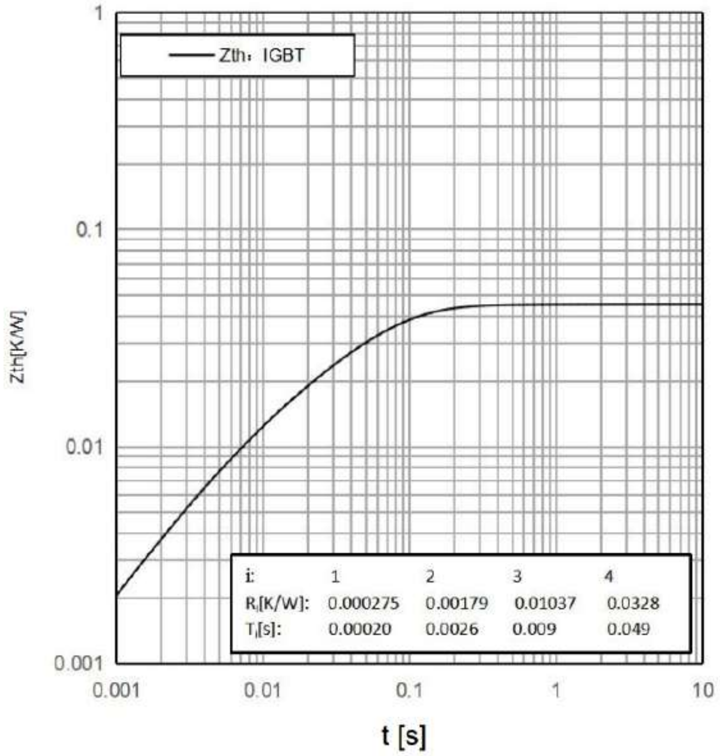
Switching times IGBT, Inverter(typical
$t_{don} = f(R_G)$, $t_r = f(R_G)$, V_{GE} = +15V/-8V,
I_C = 600A, V_{CE} = 900V, T_j = 175°C



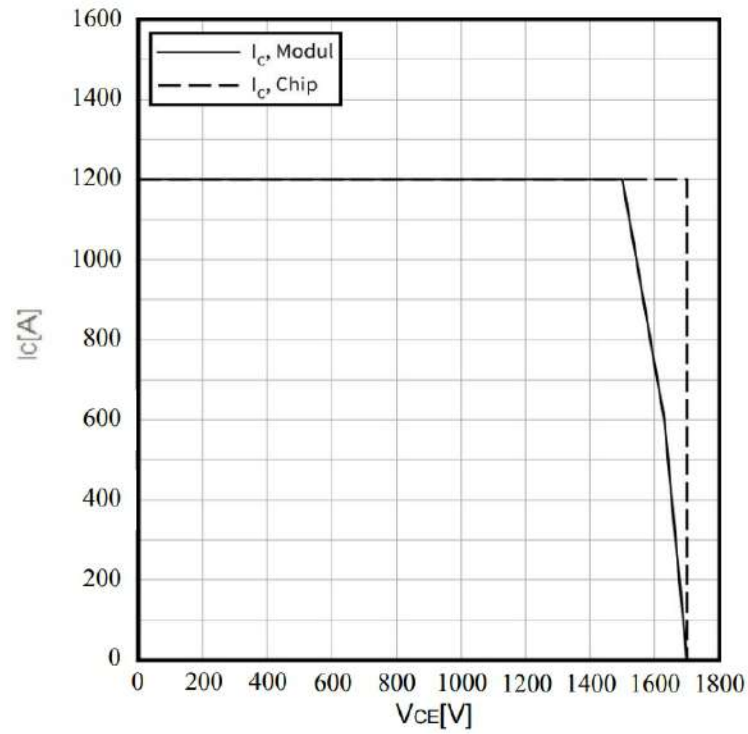
IGBT, Inverter (typical)
$dv/dt = f(R_G)$, V_{GE} = +15V/-8V,
I_C = 600A, V_{CE} = 900V, T_j = 25°C



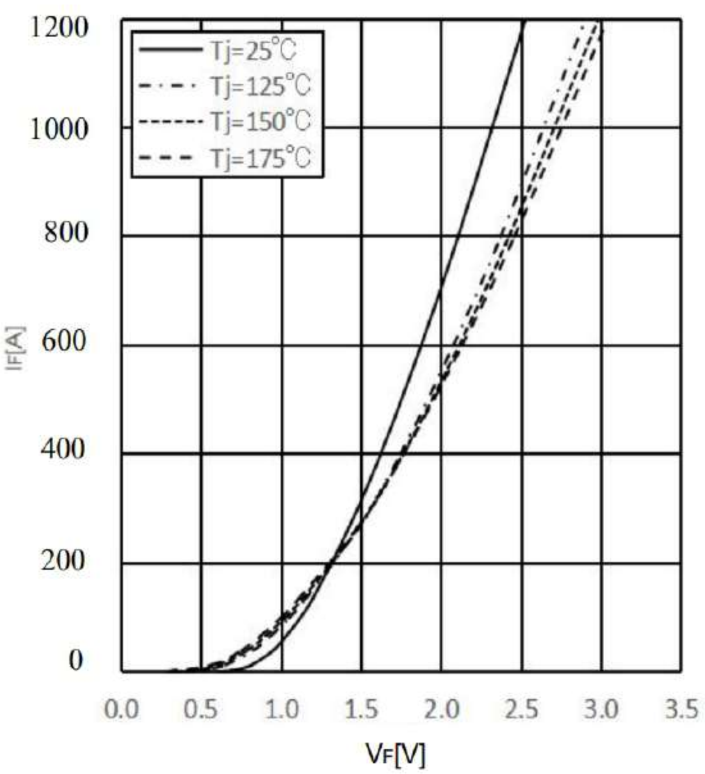
Transient thermal impedance IGBT, Inverter
Z_{thJC}=f(t)



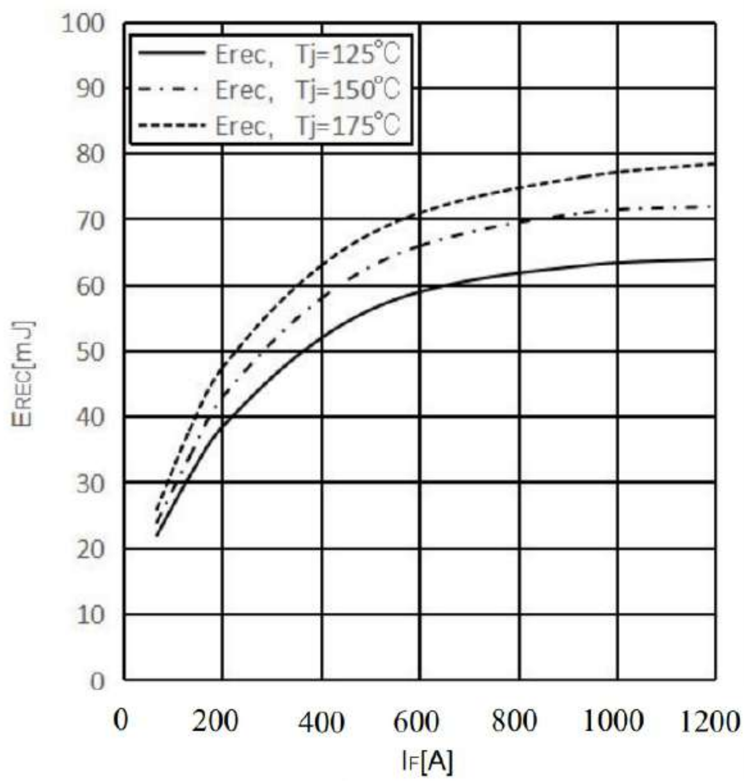
Reverse bias safe operating area IGBT,
Inverter(RBSOA)
I_C = f(V_{CE}),V_{GE} = +15V/-8V, R_{Goff} = 3.5Ω, T_j = 175°C



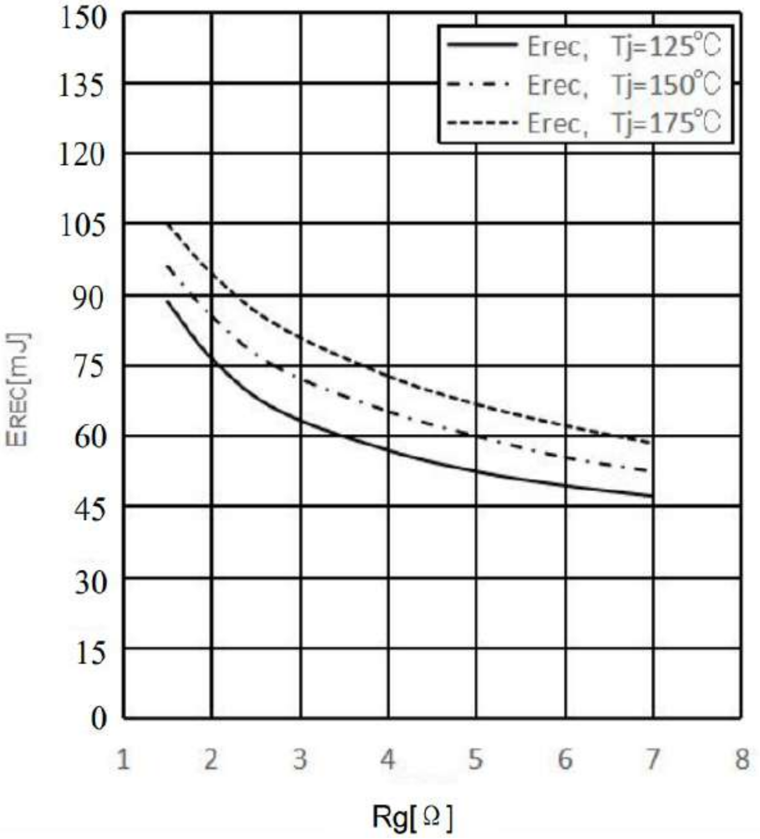
Forward characteristic FRD, Inverter(typical),
Inclusiver $R_{CC'+EE'}$
I_F = f(V_F)



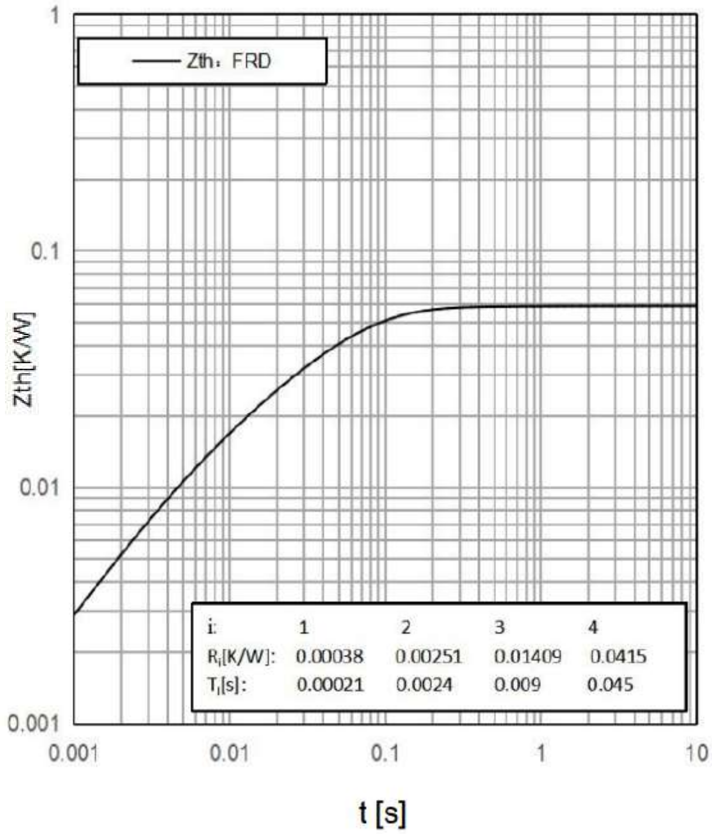
Swiching Losses FRD, Inverter (typical),
Inclusive $R_{CC'+EE'}$ FRD
E_{rec} = f(I_F),R_{Gon} = 3.5Ω, V_{CE} = 900V



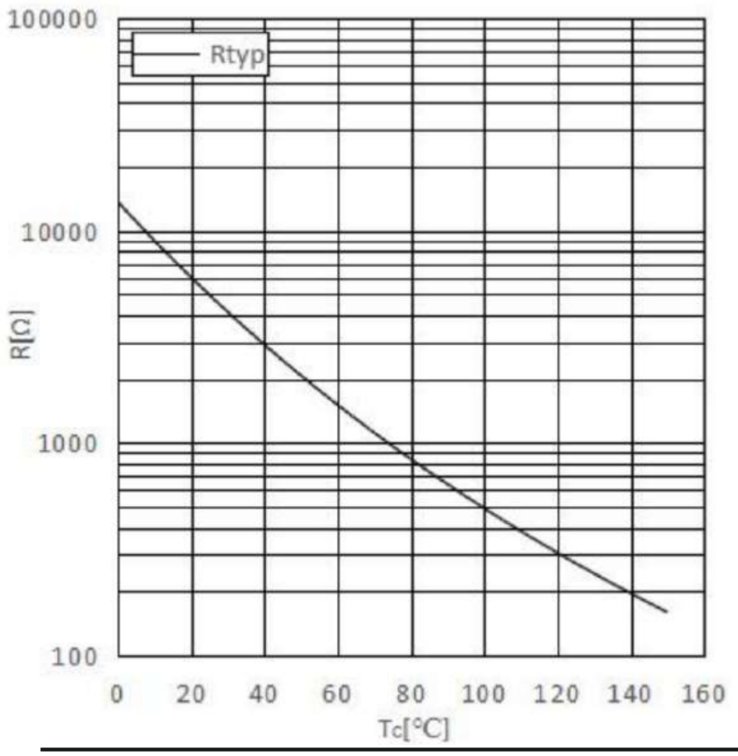
Swiching Losses FRD, Inverter (typical),
Inclusive $R_{CC'+EE'}$ FRD
$E_{rec} = f(R_g)$



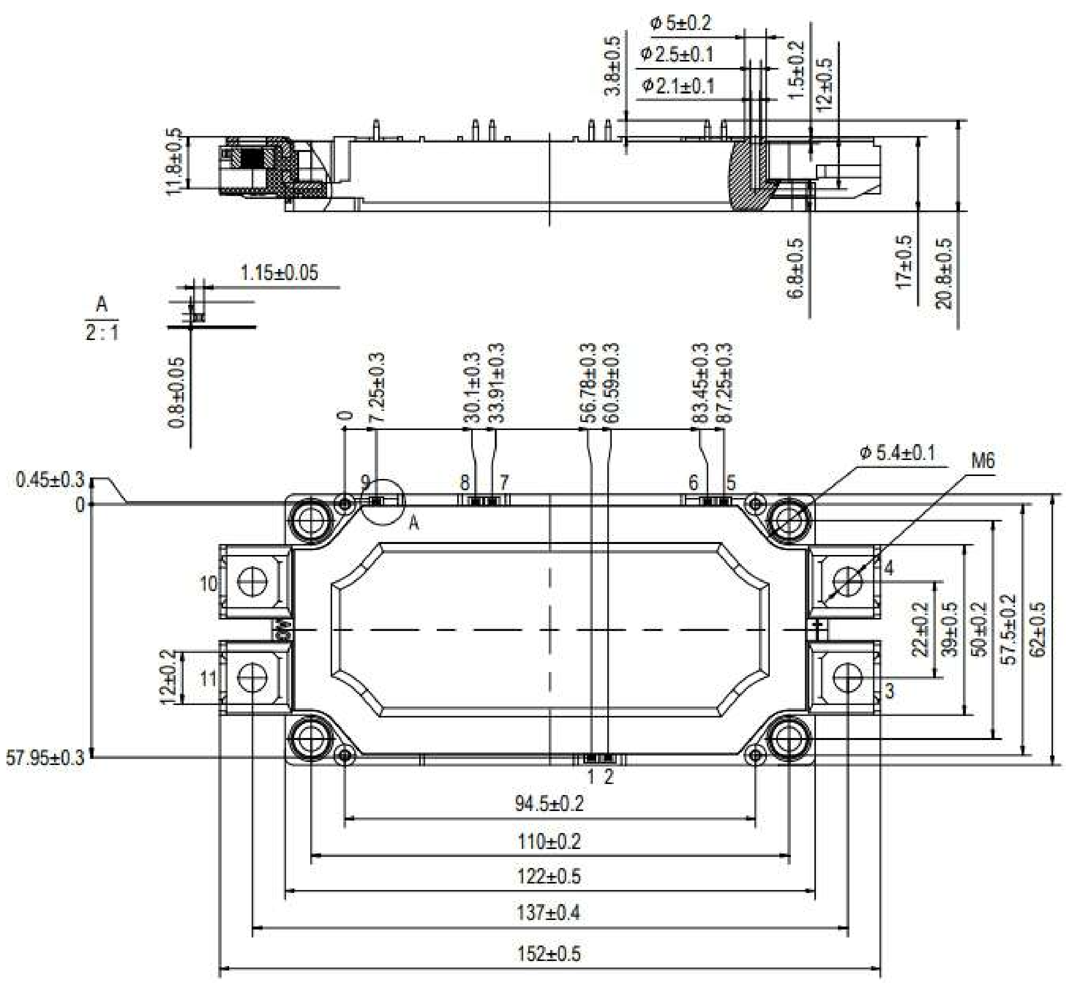
Transient thermal impedance FRD, Inverter
FRD
$Z_{thJC} = f(t)$



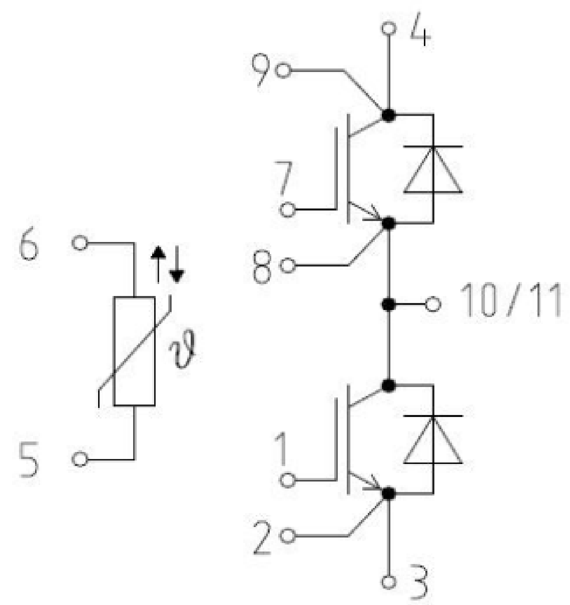
NTC Thermistor temperature characteristic
(typical)
NTC
R = f(T)



Package outlines
Dimensions in Millimeters



Internal Circuit



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