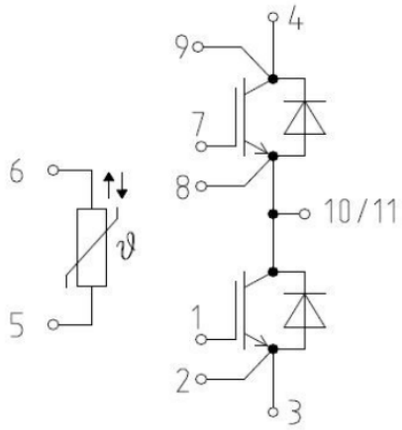
C5 series package: 1700V 600A IGBT module





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: $V_{CE(sat)}$ = 1,6V@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}	–	1.60 1.78 1.86 1.90	–	V
Gate Threshold Voltage	V_{CE} = V_{GE}, I_C = 12mA, T_{vj} = 25℃		V_{GEth}	5.6	6.20	6.80	V
Gate Charge	V_{GE} = -10V/15V, V_{CE} = 900V		Q_G	–	4.3	–	µC
Internal Gate Resistor	T_{vj} = 25℃		R_{Gint}	–	0.46	–	Ω
Input Capacitance	f = 100kHz, T_{vj} = 25℃, V_{CE} = 25V, V_{GE} = 0V		C_{ies}	–	102	–	nF
Reverse Transfer Capacitance	f = 100kHz, T_{vj} = 25℃, V_{CE} = 25V, V_{GE} = 0V		C_{res}	–	0.27	–	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} = ±15V R_{GON} = 1Ω	T_{vj} = 25℃ T_{vj} = 125℃ T_{vj} = 150℃ T_{vj} = 175℃	t_{don}	–	94 101 102 110	–	ns
Rise Time, Inductive Load	I_C = 600A, V_{CE} = 900V V_{GE} = ±15V R_{GON} = 1Ω	T_{vj} = 25℃ T_{vj} = 125℃ T_{vj} = 150℃ T_{vj} = 175℃	t_r	–	47 55 58 60	–	ns
Turn-off Delay Time, Inductive Load	I_C = 600A, V_{CE} = 900V V_{GE} = ±15V R_{Goff} = 1Ω	T_{vj} = 25℃ T_{vj} = 125℃ T_{vj} = 150℃ T_{vj} = 175℃	tdoff	–	394 470 490 500	–	ns
Fall Time, Inductive Load	I_C = 600A, V_{CE} = 900V V_{GE} = ±15V R_{Goff} = 1Ω	T_{vj} = 25℃ T_{vj} = 125℃ T_{vj} = 150℃ T_{vj} = 175℃	t_f	–	404 716 786 850	–	ns
Turn-on Energy Loss per Pulse	I_C = 600A, V_{CE} = 900V, Lσ = 30nH V_{GE} = ±15V, R_{GON} = 1Ω di/dt = 7800 A/µs (T_{vj} = 175℃)	T_{vj} = 25℃ T_{vj} = 125℃ T_{vj} = 150℃ T_{vj} = 175℃	E_{on}	–	97 132 142 165	–	mJ
Turn-off energy Loss per Pulse	I_C = 600A, V_{CE} = 900V, Lσ = 30nH V_{GE} = ±15V, R_{Goff} = 1Ω du/dt = 3800 A/µs (T_{vj} = 175℃)	T_{vj} = 25℃ T_{vj} = 125℃ T_{vj} = 150℃ T_{vj} = 175℃	E_{off}	–	141 209 226 242	–	mJ
SC Data	V_{GE} ≤ 15V V_{CC} = 1000V V_{CEmax}=V_{CES} - L_{sCE}*di/dt	t_P ≤ 10µs, Tvj = 25℃ t_P ≤ 6µs, Tvj = 175℃	I_{sc}	–	3000 2400	–	A

Thermal Resistance, Junction to Case	Per IGBT / IGBT	R_{thJC}	-	0.049	-	K/W
Thermal Resistance, Case to Heatsink	Per IGBT / IGBT λ_{grease} = 1W/(m·K)	R_{thCH}	-	0.033	-	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}	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 = 600A, V_{GE} = 0V	T_{vj} = 25℃ T_{vj} = 125℃ T_{vj} = 150℃ T_{vj} = 175℃	V_F	-	1.65 1.83 1.82 1.80	-	V
Peak Reverse Recovery Current	I_F = 600A, V_R = 900V $-di_F/dt$ = 10300 A/us (T_{vj} = 175℃) V_{GE} = −15V	T_{vj} = 25℃ T_{vj} = 125℃ T_{vj} = 150℃ T_{vj} = 175℃	I_{RM}	-	808 816 808 760	-	A
Recovery Charge	I_F = 600A, V_R = 900V $-di_F/dt$ = 10300 A/us (T_{vj} = 175℃) V_{GE} = −15V	T_{vj} = 25℃ T_{vj} = 125℃ T_{vj} = 150℃ T_{vj} = 175℃	Q_R	-	86 107 111 119	-	µC
Reverse Recovery Energy	I_F = 600A, V_R = 900V $-di_F/dt$ = 10300 A/us (T_{vj} = 175℃) V_{GE} = −8V	T_{vj} = 25℃ T_{vj} = 125℃ T_{vj} = 150℃ T_{vj} = 175℃	E_{rec}	-	47.3 89.5 84.0 78.5	-	mJ
Thermal Resistance, Junction to Case	Per FRD / FRD		R_{thJC}	-	0.064	-	K/W
Thermal Resistance, Case to Heatsink	Per IGBT / IGBT λ_{grease} = 1W/(m·K)		R_{thCH}	-	0.038	-	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

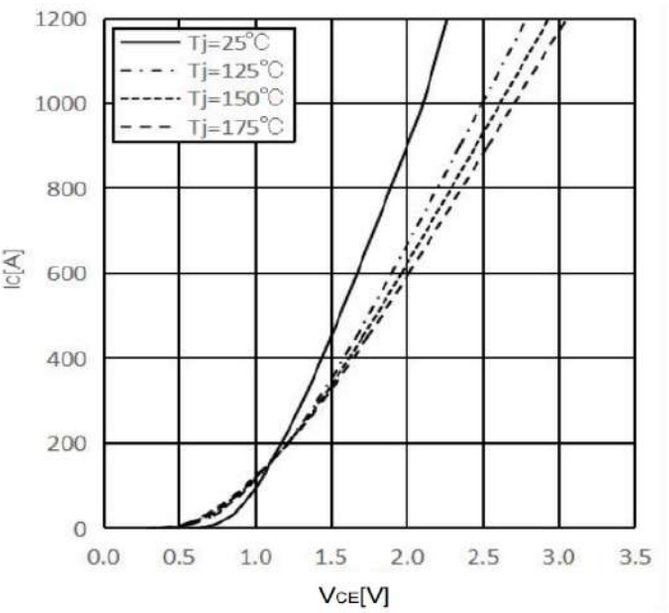
Isolation Test Voltage	RMS, f=50Hz, t=3s	V_{ISOL}	3.4	kV
Isolation Test Voltage of NTC NTC	RMS, f=50Hz, t=3s	$V_{ISOL(NTC)}$	3.4	kV
Material of Module Baseplate			Cu	
Internal Isolation			ZTA	
Creepage Distance	Terminal to heatsink, min Terminal to terminal, min		>14.7 >15.1	mm
Clearance	Terminal to heatsink, min Terminal to terminal, min		>9.6 >12.5	mm
Comparative Tracking Index		CTI	>200[3)]	

			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	4.0	-	5.0	Nm
Mounting Torque for Module Mounting	Screw M6 / M6	M	4.0	-	5.0	Nm
Weight		G	-	345	-	g

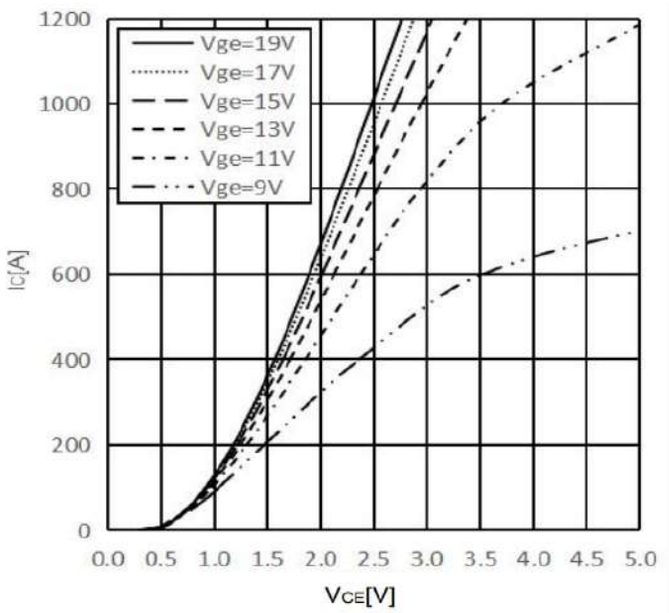
1) Terminal impedance is not included.
2) $T_{vj\ op}$ > 150°C is allowed for operation at overload conditions.
3) CTI is greater than 200

Circuit Diagram

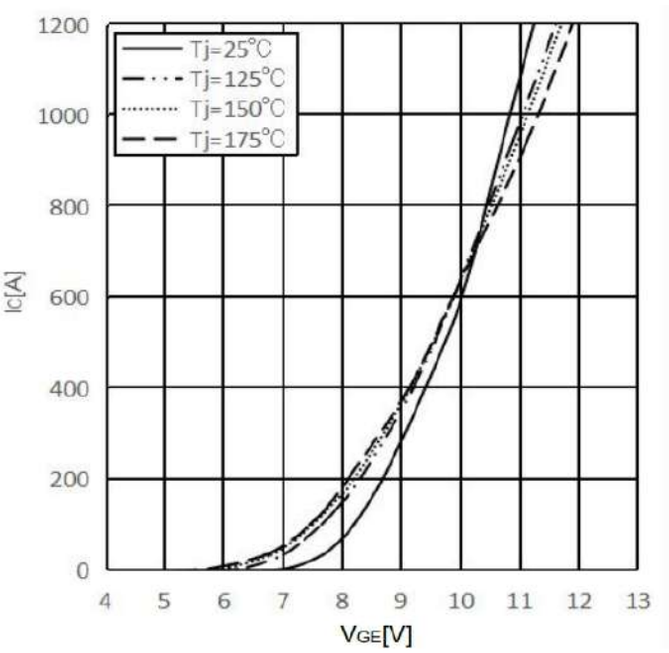
Output characteristic IGBT, Inverter (typical)
Inclusive $R_{CC'+EE'}$
$I_C = f(V_{CE})$, V_{GE} = 15V



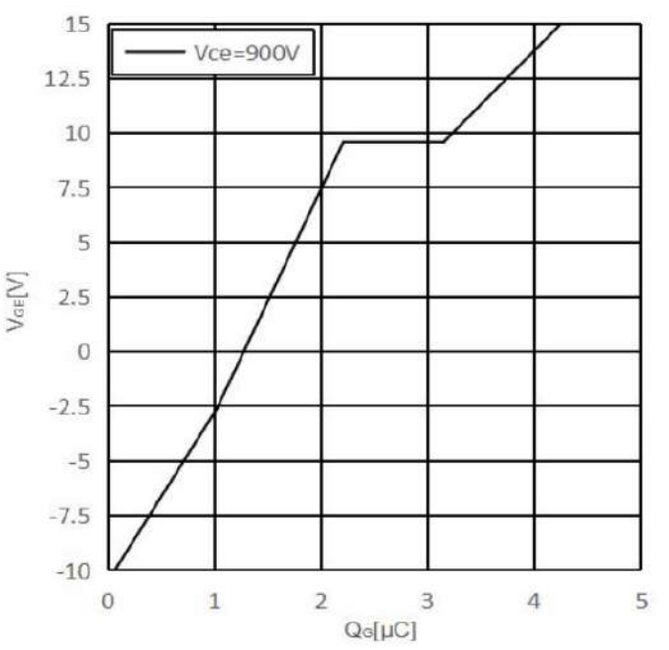
Output characteristic IGBT, Inverter (typical)
Inclusive $R_{CC'+EE'}$
$I_C = f(V_{CE})$, T_j = 175°C



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

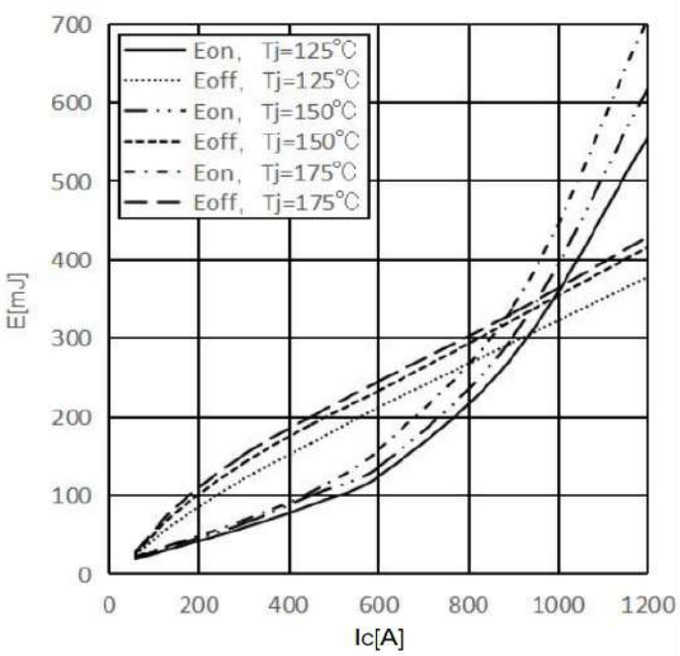


Gate Charge characteristic IGBT,Inverter
$V_{GE} = f(Q_G)$
I_C = 600A,T_{vj} = 25°C



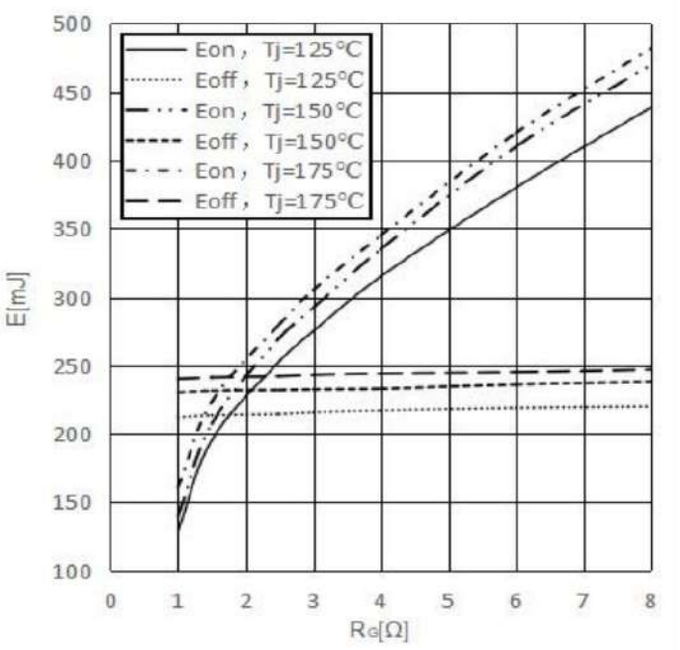
Switching losses IGBT, Inverter(typical)

E = f(I_C), V_{GE} = +15V, R_{gon} = 1Ω, R_{Goff} = 1Ω, V_{CE} = 900V

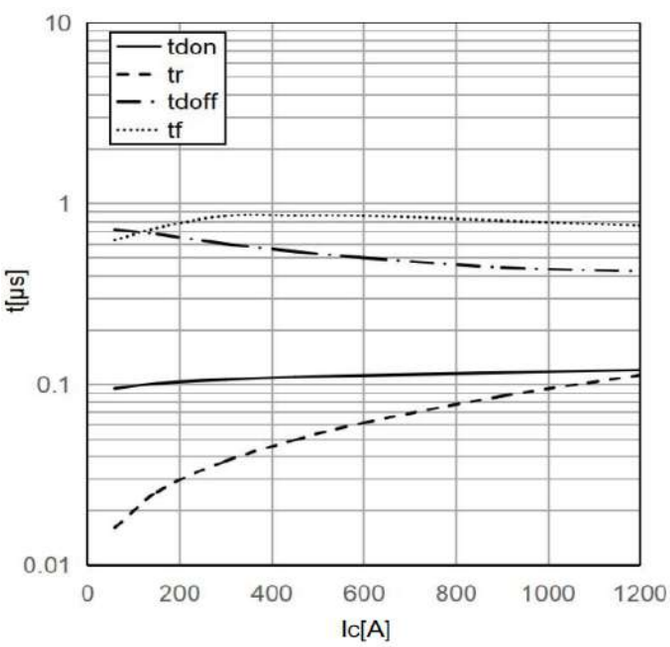


Switching losses IGBT, Inverter(typical)

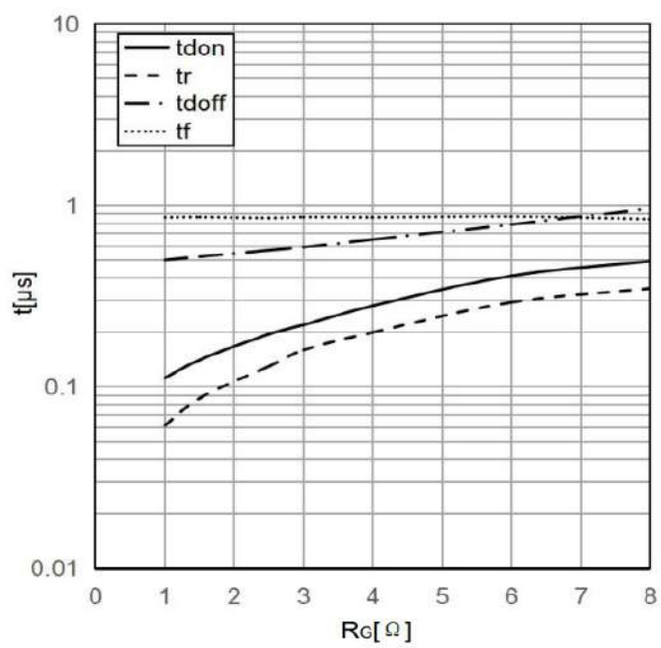
E = f(R_G), V_{GE} = +15V, I_C = 600A, V_{CE} = 900V



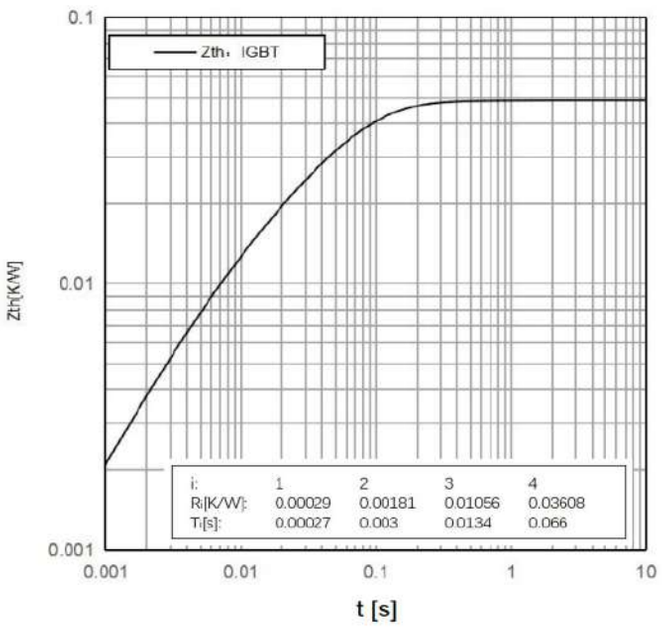
Switching times IGBT, Inverter (typical)
t = f(I_C), V_{GE} = ±15V, V_{CE} = 900V, T_j = 175°C
R_{Gon} = 1Ω, R_{Goff} = 1Ω



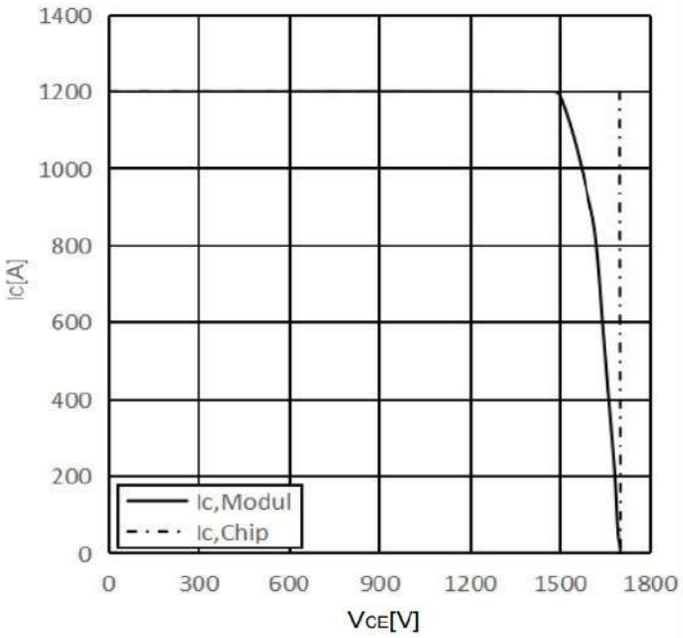
Switching times IGBT, Inverter (typical)
t = f(R_G), V_{GE} = ±15V, V_{CE} = 900V, T_j = 175°C
I_C = 600A



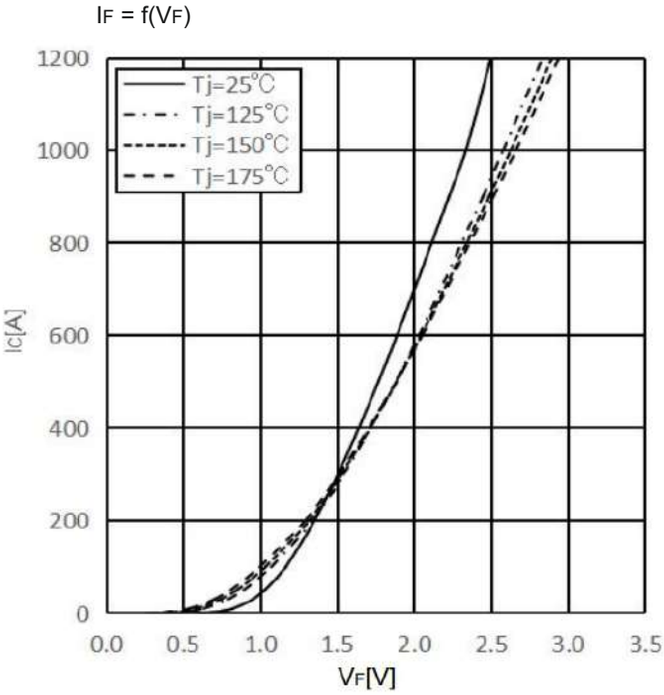
Transient thermal impedance IGBT, Inverter
$Z_{thJC}=f(t)$



Reverse bias safe operating area IGBT, Inverter(RBSOA)
$I_C = f(V_{CE}), V_{GE}$ = +15V, R_{Goff} = 1Ω, T_j = 175°C

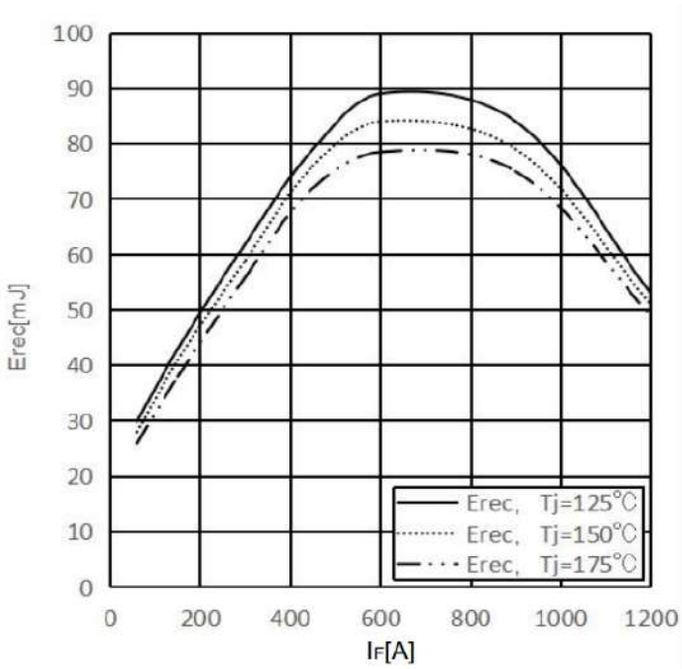


Forward characteristic FRD, Inverter(typical), Inclusiver $R_{CC'+EE'}$
$I_F = f(V_F)$



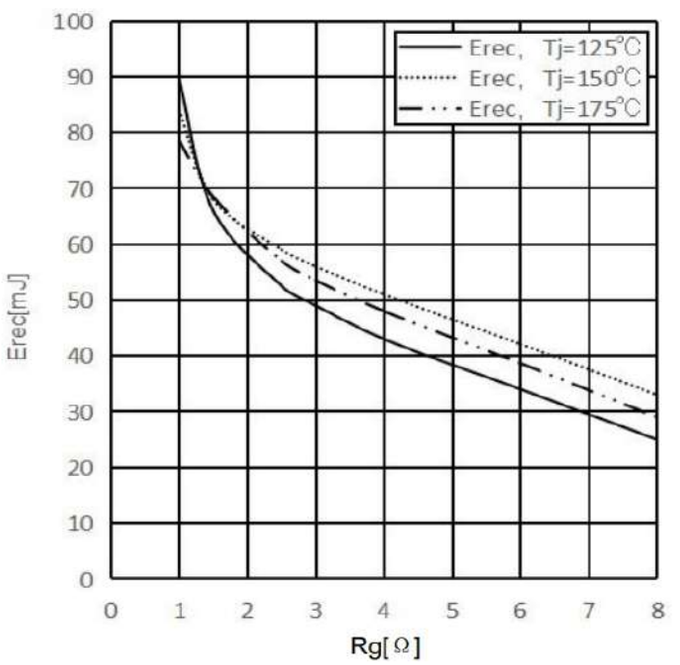
Swiching Losses FRD, Inverter (typical),

$E_{rec} = f(I_F)$, R_{Gon} = 1Ω, V_{CE} = 900V

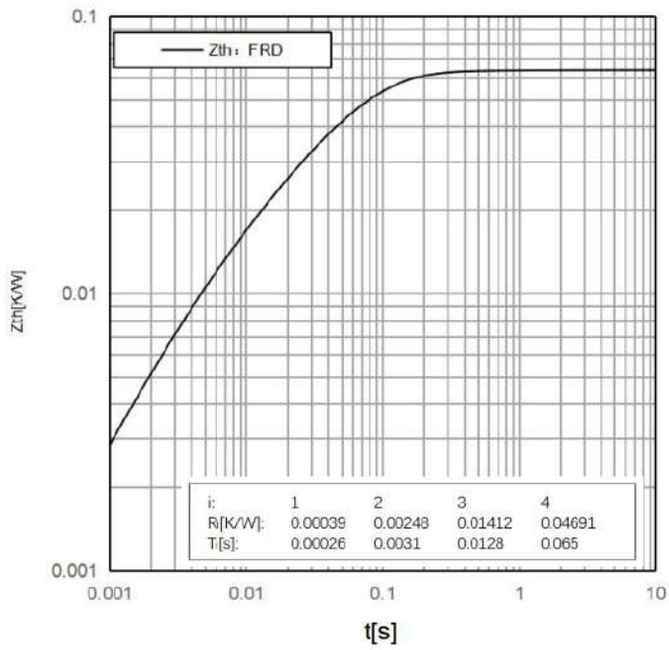


Swiching Losses FRD, Inverter (typical),

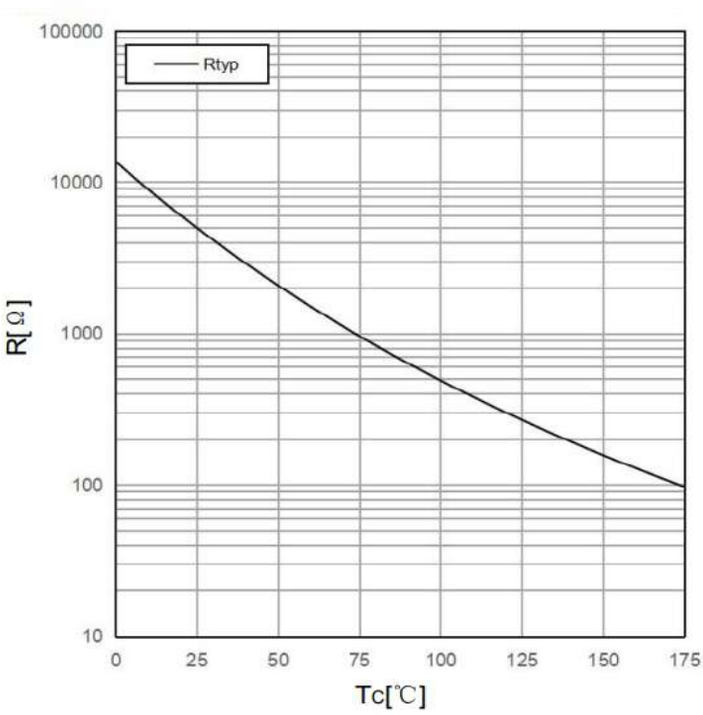
$E_{rec} = f(R_g)$, $I_C = 600A$, $V_{CE} = 900V$



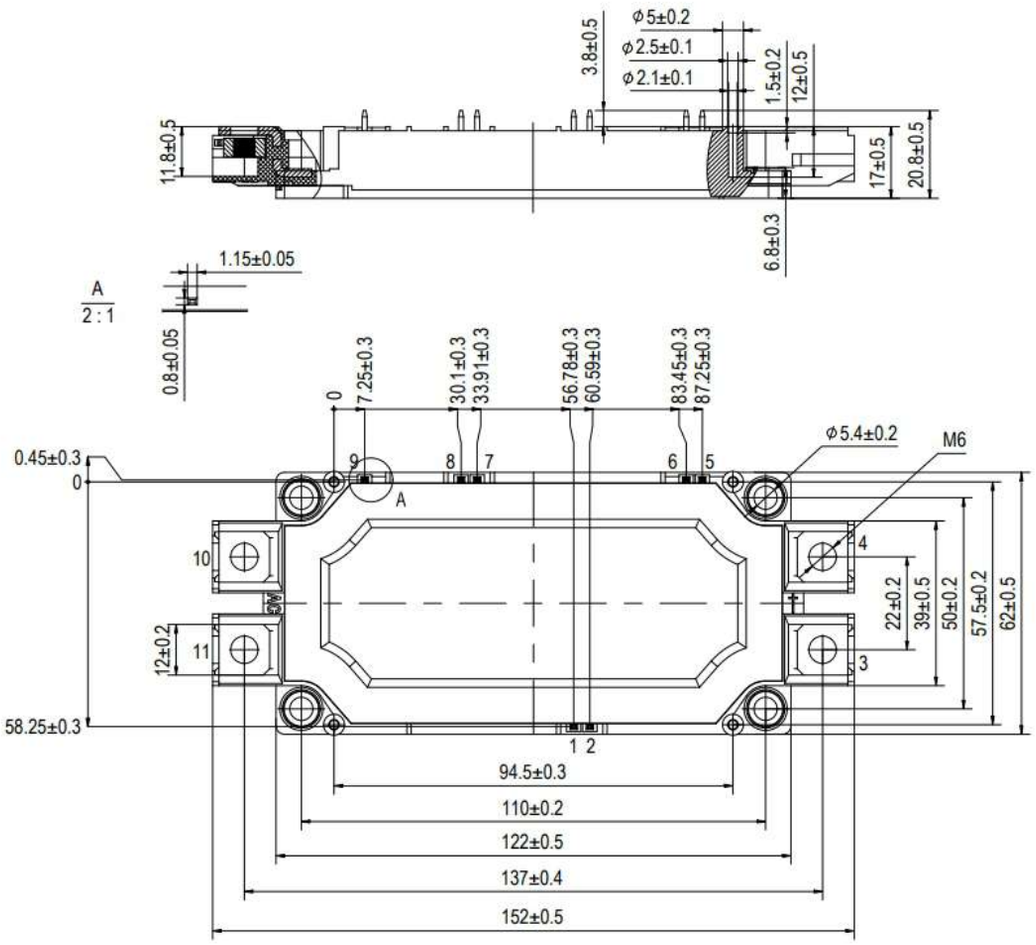
Transient thermal impedance FRD, Inverter
FRD
$Z_{thJC} = f(t)$



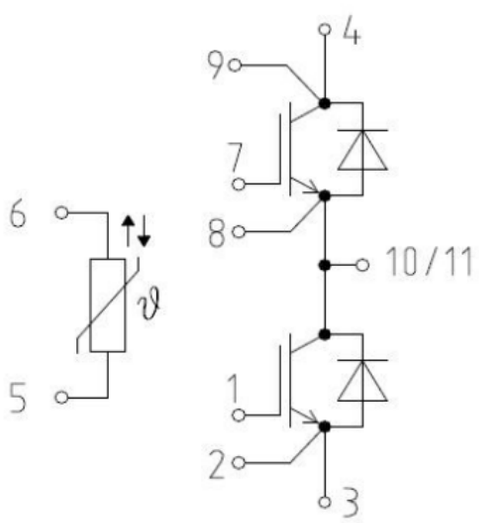
NTC Thermistor temperature characteristic
(typical)
R = f(T)



Package Dimension/
Dimensions in Millimeters



Internal Circuit



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