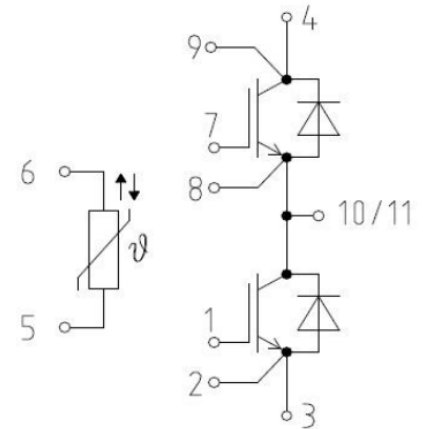


**C5 series package: 1700V 600A IGBT module**

Equivalent  
Circuit Schematic

**Features:**

- $V_{CES} = 1700V$
- $I_C \text{ nom} = 600A$
- 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 ( $V_f$  selection)

**Typical Applications:**

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

**IGBT, Inverter / IGBT  
Maximum Rated Values**

Collector-emitter Voltage	$T_{vj} = 25^{\circ}\text{C}$	$V_{CES}$	1700	V
Implemented Collector Current		$I_{Cnom}$	600	A
Continuous DC Collector Current	$T_C = 85^{\circ}\text{C}, T_{vj\ max} = 175^{\circ}\text{C}$	$I_C$	600	A
Repetitive Peak Collector Current	$t_p T_{vj\ op}$	$I_{CRM}$	1200	A
Gate-emitter Peak Voltage		$V_{GES}$	$\pm 20$	V

**Characteristic Values**
**min. typ. max.**

Collector-emitter Saturation Voltage <sup>1)</sup>	$I_C = 600\text{A}, V_{GE} = 15\text{V}$	$T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = 125^{\circ}\text{C}$ $T_{vj} = 150^{\circ}\text{C}$ $T_{vj} = 175^{\circ}\text{C}$	$V_{CEsat}$	-	1.60 1.78 1.86 1.90	-	V
Gate Threshold Voltage	$V_{CE} = V_{GE}, I_C = 12\text{mA}, T_{vj} = 25^{\circ}\text{C}$		$V_{GEth}$	5.6	6.20	6.80	V
Gate Charge	$V_{GE} = -10\text{V}/15\text{V}, V_{CE} = 900\text{V}$		$Q_G$	-	4.3	-	$\mu\text{C}$
Internal Gate Resistor	$T_{vj} = 25^{\circ}\text{C}$		$R_{Gint}$	-	0.46	-	$\Omega$
Input Capacitance	$f = 100\text{kHz}, T_{vj} = 25^{\circ}\text{C}, V_{CE} = 25\text{V}, V_{GE} = 0\text{V}$		$C_{ies}$	-	102	-	nF
Reverse Transfer Capacitance	$f = 100\text{kHz}, T_{vj} = 25^{\circ}\text{C}, V_{CE} = 25\text{V}, V_{GE} = 0\text{V}$		$C_{res}$	-	0.27	-	nF
Collector-emitter Cutoff Current	$V_{CE} = 1700\text{V}, V_{GE} = 0\text{V}, T_{vj} = 25^{\circ}\text{C}$		$I_{CES}$	-	-	1	mA
Gate-emitter Leakage Current	$V_{CE} = 0\text{V}, V_{GE} = 20\text{V}, T_{vj} = 25^{\circ}\text{C}$		$I_{GES}$	-	-	100	nA
Turn-on Delay Time, Inductive Load	$I_C = 600\text{A}, V_{CE} = 900\text{V}$ $V_{GE} = \pm 15\text{V}$ $R_{GON} = 1\Omega$	$T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = 125^{\circ}\text{C}$ $T_{vj} = 150^{\circ}\text{C}$ $T_{vj} = 175^{\circ}\text{C}$	$t_{don}$	-	94 101 102 110	-	ns
Rise Time, Inductive Load	$I_C = 600\text{A}, V_{CE} = 900\text{V}$ $V_{GE} = \pm 15\text{V}$ $R_{GON} = 1\Omega$	$T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = 125^{\circ}\text{C}$ $T_{vj} = 150^{\circ}\text{C}$ $T_{vj} = 175^{\circ}\text{C}$	$t_r$	-	47 55 58 60	-	ns
Turn-off Delay Time, Inductive Load	$I_C = 600\text{A}, V_{CE} = 900\text{V}$ $V_{GE} = \pm 15\text{V}$ $R_{Goff} = 1\Omega$	$T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = 125^{\circ}\text{C}$ $T_{vj} = 150^{\circ}\text{C}$ $T_{vj} = 175^{\circ}\text{C}$	$t_{doff}$	-	394 470 490 500	-	ns
Fall Time, Inductive Load	$I_C = 600\text{A}, V_{CE} = 900\text{V}$ $V_{GE} = \pm 15\text{V}$ $R_{Goff} = 1\Omega$	$T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = 125^{\circ}\text{C}$ $T_{vj} = 150^{\circ}\text{C}$ $T_{vj} = 175^{\circ}\text{C}$	$t_f$	-	404 716 786 850	-	ns
Turn-on Energy Loss per Pulse	$I_C = 600\text{A}, V_{CE} = 900\text{V}, L_{\sigma} = 30\text{nH}$ $V_{GE} = \pm 15\text{V}, R_{GON} = 1\Omega$ $di/dt = 7800\text{ A}/\mu\text{s} (T_{vj} = 175^{\circ}\text{C})$	$T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = 125^{\circ}\text{C}$ $T_{vj} = 150^{\circ}\text{C}$ $T_{vj} = 175^{\circ}\text{C}$	$E_{on}$	-	97 132 142 165	-	mJ
Turn-off energy Loss per Pulse	$I_C = 600\text{A}, V_{CE} = 900\text{V}, L_{\sigma} = 30\text{nH}$ $V_{GE} = \pm 15\text{V}, R_{Goff} = 1\Omega$ $du/dt = 3800\text{ A}/\mu\text{s} (T_{vj} = 175^{\circ}\text{C})$	$T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = 125^{\circ}\text{C}$ $T_{vj} = 150^{\circ}\text{C}$ $T_{vj} = 175^{\circ}\text{C}$	$E_{off}$	-	141 209 226 242	-	mJ
SC Data	$V_{GE} \leq 15\text{V}$ $V_{CC} = 1000\text{V}$ $V_{CEmax} = V_{CES} - L_{sCE} \cdot di/dt$	$t_p \leq 10\mu\text{s},$ $T_{vj} = 25^{\circ}\text{C}$ $t_p \leq 6\mu\text{s},$ $T_{vj} = 175^{\circ}\text{C}$	$I_{sc}$	-	3000 2400	-	A

Thermal Resistance, Junction to Case	Per IGBT	R <sub>thJC</sub>	-	0.049	-	K/W
Thermal Resistance, Case to Heatsink	Per IGBT $\lambda_{grease} = 1W/(m \cdot K)$	R <sub>thCH</sub>	-	0.033	-	K/W
Temperature under Switching Conditions <sup>2)</sup>		T <sub>vj op</sub>	-40		175	°C

## Diode, Inverter Maximum Rated Values

Repetitive Peak Reverse Voltage	T <sub>vj</sub> = 25°C	V <sub>RRM</sub>		1700		V
Continuous DC Forward Current		I <sub>Fnom</sub>		600		A
Repetitive Peak Forward Current	t <sub>p</sub> = 1ms	I <sub>FRM</sub>		1200		A

## Characteristic Values

				min.	typ.	max.	
Forward Voltage <sup>1)</sup>	I <sub>F</sub> = 600A, V <sub>GE</sub> = 0V	T <sub>vj</sub> = 25°C T <sub>vj</sub> = 125°C T <sub>vj</sub> = 150°C T <sub>vj</sub> = 175°C	V <sub>F</sub>	-	1.65 1.83 1.82 1.80	-	V
Peak Reverse Recovery Current	I <sub>F</sub> = 600A, V <sub>R</sub> = 900V -di <sub>F</sub> /dt = 10300 A/us (T <sub>vj</sub> = 175°C) V <sub>GE</sub> = -15V	T <sub>vj</sub> = 25°C T <sub>vj</sub> = 125°C T <sub>vj</sub> = 150°C T <sub>vj</sub> = 175°C	I <sub>RM</sub>	-	808 816 808 760	-	A
Recovery Charge	I <sub>F</sub> = 600A, V <sub>R</sub> = 900V -di <sub>F</sub> /dt = 10300 A/us (T <sub>vj</sub> = 175°C) V <sub>GE</sub> = -15V	T <sub>vj</sub> = 25°C T <sub>vj</sub> = 125°C T <sub>vj</sub> = 150°C T <sub>vj</sub> = 175°C	Q <sub>R</sub>	-	86 107 111 119	-	μC
Reverse Recovery Energy	I <sub>F</sub> = 600A, V <sub>R</sub> = 900V -di <sub>F</sub> /dt = 10300 A/us (T <sub>vj</sub> = 175°C) V <sub>GE</sub> = -8V	T <sub>vj</sub> = 25°C T <sub>vj</sub> = 125°C T <sub>vj</sub> = 150°C T <sub>vj</sub> = 175°C	E <sub>rec</sub>	-	47.3 89.5 84.0 78.5	-	mJ
Thermal Resistance, Junction to Case	Per FRD		R <sub>thJC</sub>	-	0.064	-	K/W
Thermal Resistance, Case to Heatsink	Per FRD $\lambda_{grease} = 1W/(m \cdot K)$		R <sub>thCH</sub>	-	0.038	-	K/W
Temperature under Switching Conditions <sup>2)</sup>			T <sub>vj op</sub>	-40	-	175	°C

## NTC-Thermistor / NTC Characteristic Values

				min.	typ.	max.	
Rated Resistance	T <sub>NTC</sub> = 25°C		R <sub>25</sub>	-	5	-	KΩ
Deviation of R100 R100	T <sub>NTC</sub> = 100°C, R <sub>100</sub> = 491Ω		ΔR/R	-5	-	5	%
Power Dissipation	T <sub>NTC</sub> = 25°C		P <sub>25</sub>	-	-	20	mW
B-Value B	$R_2 = R_{25} \exp[B_{25/50}(1/T_2 - 1/(298.15K))]$		B <sub>25/50</sub>	-	3375	-	K
	$R_2 = R_{25} \exp[B_{25/80}(1/T_2 - 1/(298.15K))]$		B <sub>25/80</sub>	-	3425	-	K
	$R_2 = R_{25} \exp[B_{25/100}(1/T_2 - 1/(298.15K))]$		B <sub>25/100</sub>	-	3443	-	K

**Module**

Isolation Test Voltage	RMS, f=50Hz, t=3s	V <sub>ISOL</sub>	3.4	kV
Isolation Test Voltage of NTC NTC	RMS, f=50Hz, t=3s	V <sub>ISOL(NTC)</sub>	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 <sup>3)</sup>	

**min. typ. max.**

			min.	typ.	max.	
Stray Inductance Module		L <sub>sCE</sub>	-	20	-	nH
Module Lead Resistance, Terminals-Chip	T <sub>C</sub> = 25°C, Per Switch	R <sub>CC'+EE'</sub>	-	0.8	-	mΩ
Thermal Resistance, Case to Heatsink	including thermal coupling, T <sub>s</sub> underneath module (λgrease=0.81 W/(m*K))	R <sub>thCH</sub>	-	0.014	-	K/W
Storage Temperature		T <sub>stg</sub>	-40	-	125	°C
Mounting Torque for Module Mounting	Screw M5 / M5	M	4.0	-	5.0	Nm
Power terminal installation torque	Screw M6 / M6	M	4.0	-	5.0	Nm
Weight		G	-	345	-	g

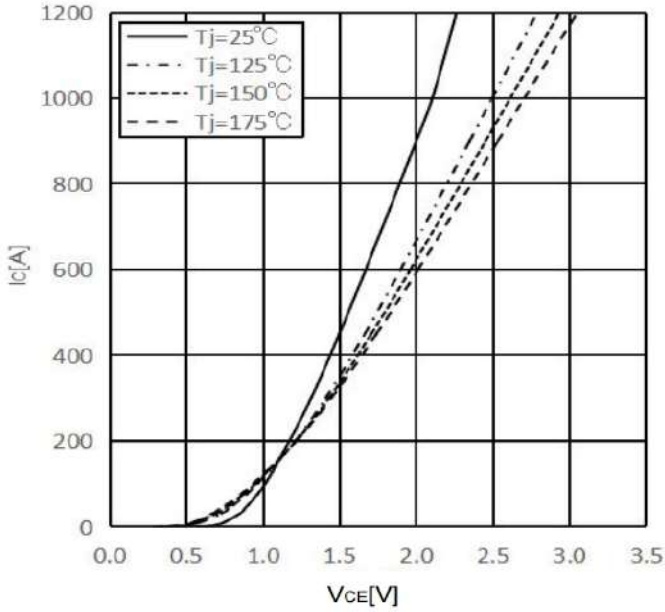
1) Terminal impedance is not included.

2) T<sub>vj op</sub> > 150°C is allowed for operation at overload conditions.

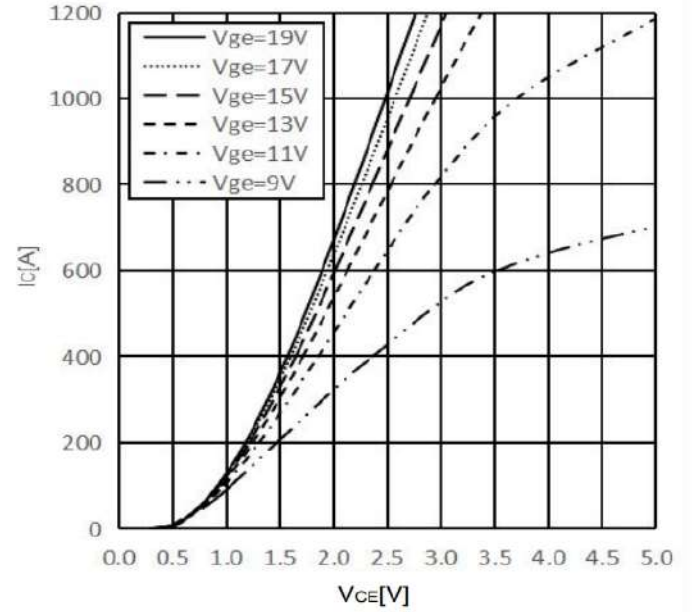
3) CTI is greater than 200

### Circuit Diagram

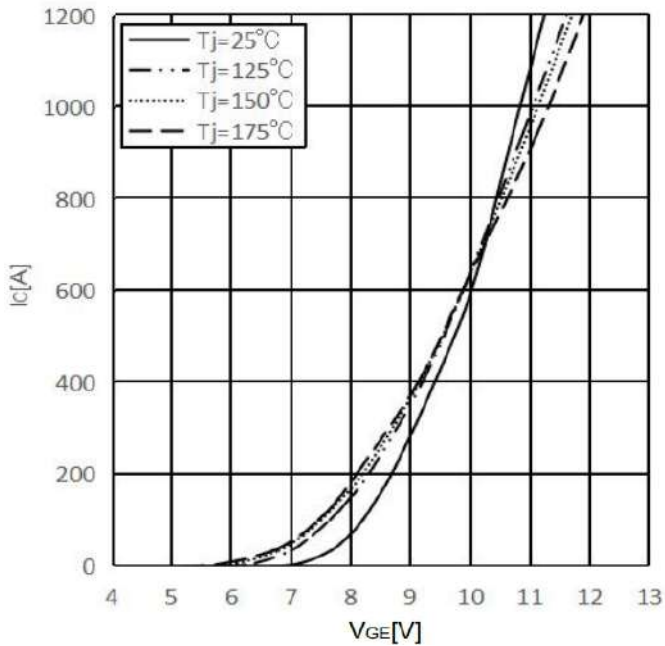
Output characteristic IGBT, Inverter (typical)  
 Inclusive RCC+EE'  
 $I_c = f(V_{CE}), V_{GE} = 15V$



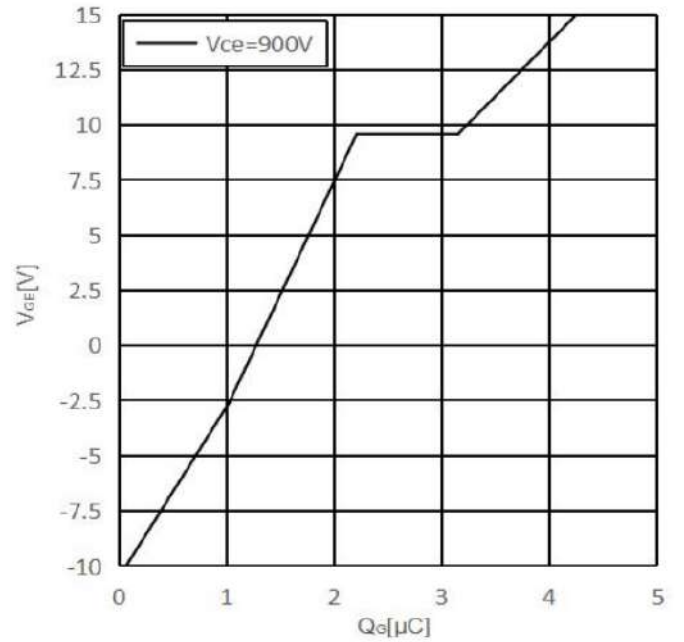
Output characteristic IGBT, Inverter (typical)  
 Inclusive RCC+EE'  
 $I_c = f(V_{CE}), T_j = 175^\circ C$



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

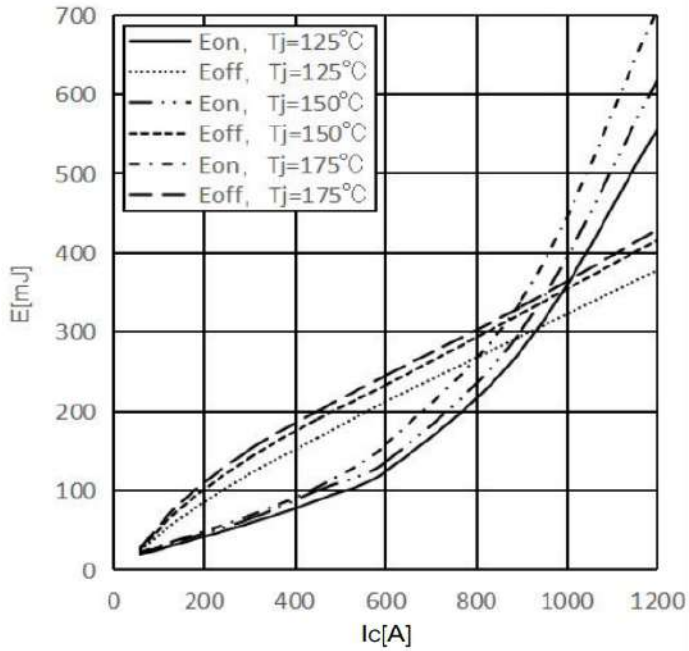


Gate Charge characteristic IGBT, Inverter  
 $V_{GE} = f(Q_g)$   
 $I_c = 600A, T_j = 25^\circ C$



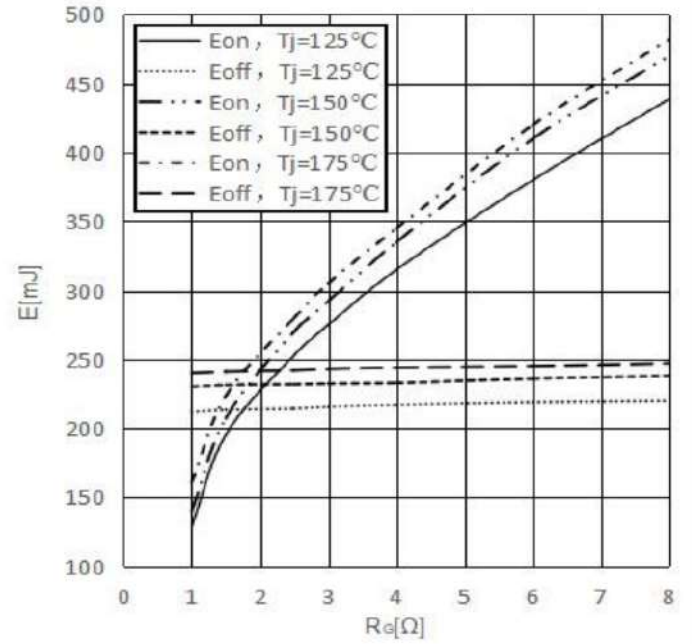
Switching losses IGBT, Inverter(typical)

$E = f(I_c)$ ,  $V_{GE} = +15V$ ,  $R_{Gon} = 1\Omega$ ,  $R_{Goff} = 1\Omega$ ,  $V_{CE} = 900V$



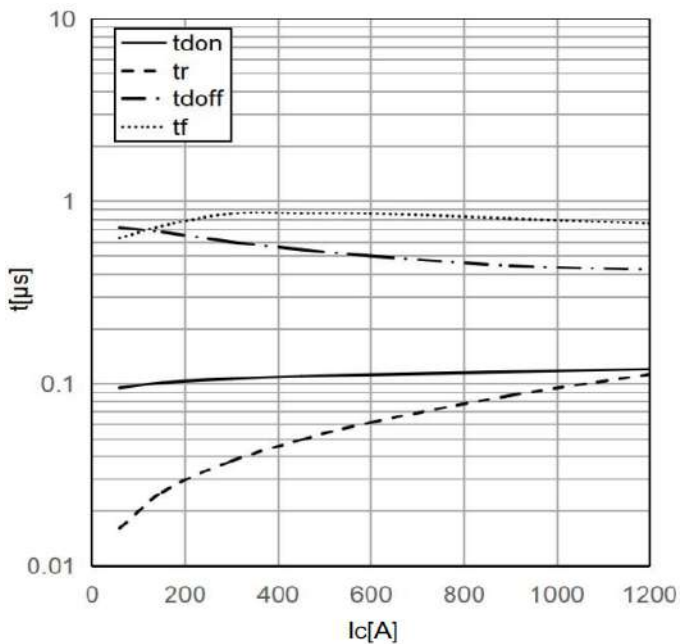
Switching losses IGBT, Inverter(typical)

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



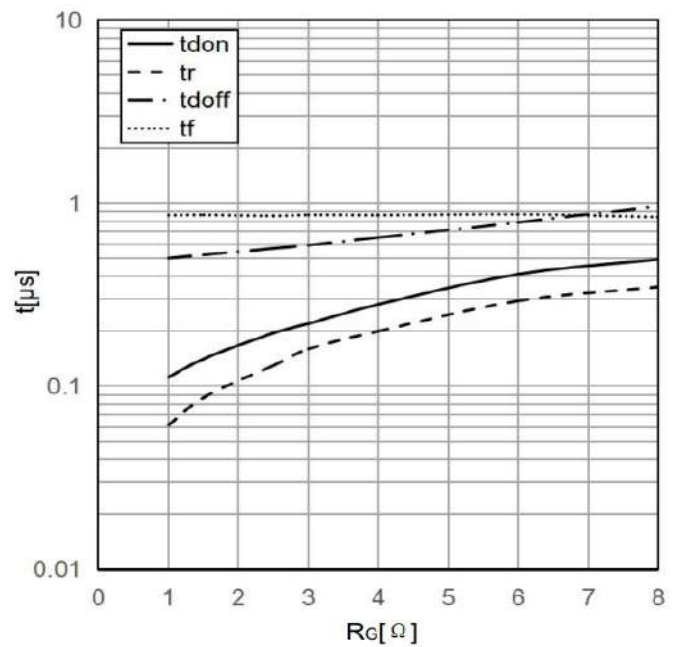
Switching times IGBT, Inverter (typical)

$t = f(I_c)$ ,  $V_{GE} = \pm 15V$ ,  $V_{CE} = 900V$ ,  $T_j = 175^\circ C$   
 $R_{Gon} = 1\Omega$ ,  $R_{Goff} = 1\Omega$

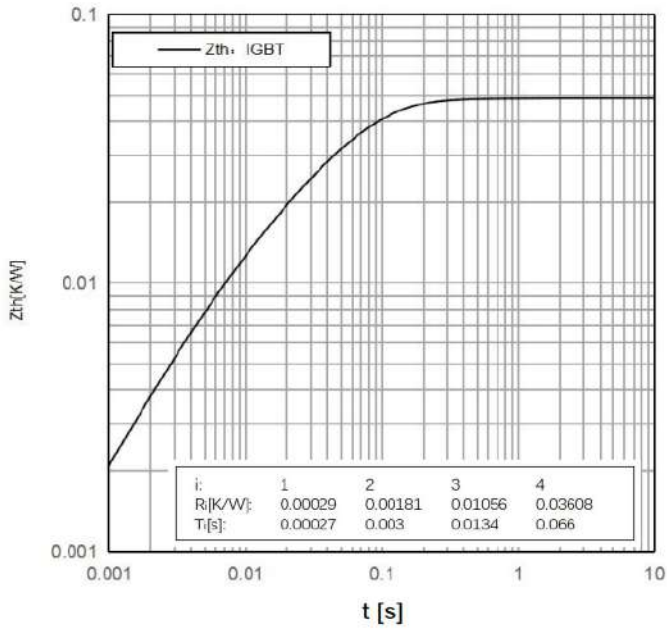


Switching times IGBT, Inverter (typical)

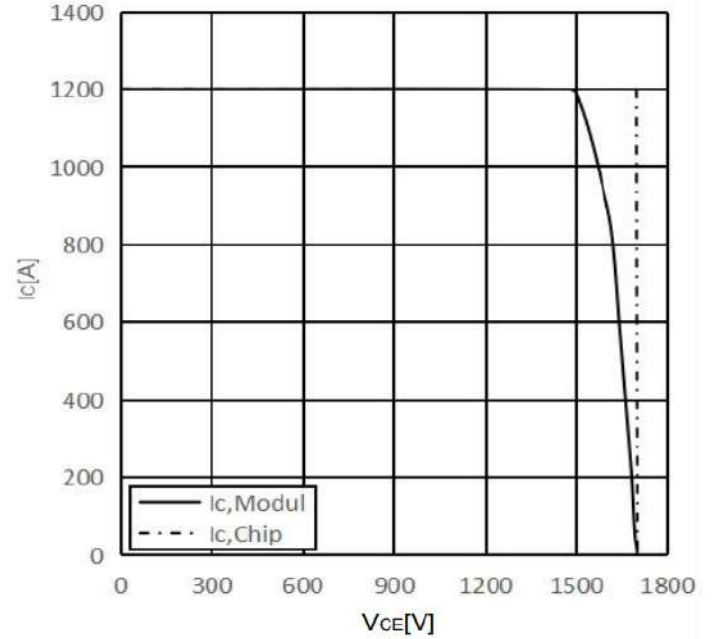
$t = f(R_G)$ ,  $V_{GE} = \pm 15V$ ,  $V_{CE} = 900V$ ,  $T_j = 175^\circ C$   
 $I_c = 600A$



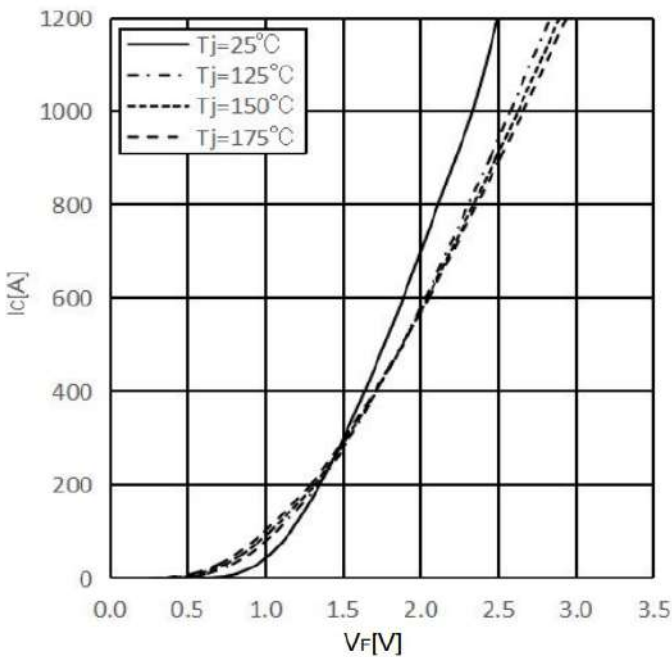
Transient thermal impedance IGBT, Inverter  
 $Z_{thJC}=f(t)$



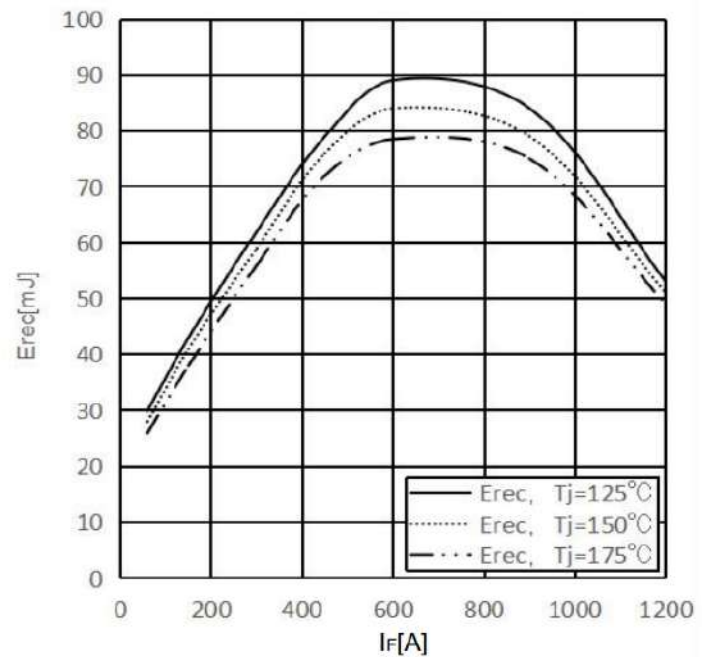
Reverse bias safe operating area IGBT,  
 Inverter(RBSOA)  
 $I_C = f(V_{CE}), V_{GE} = +15V, R_{Goff} = 1\Omega, T_j = 175^\circ C$



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

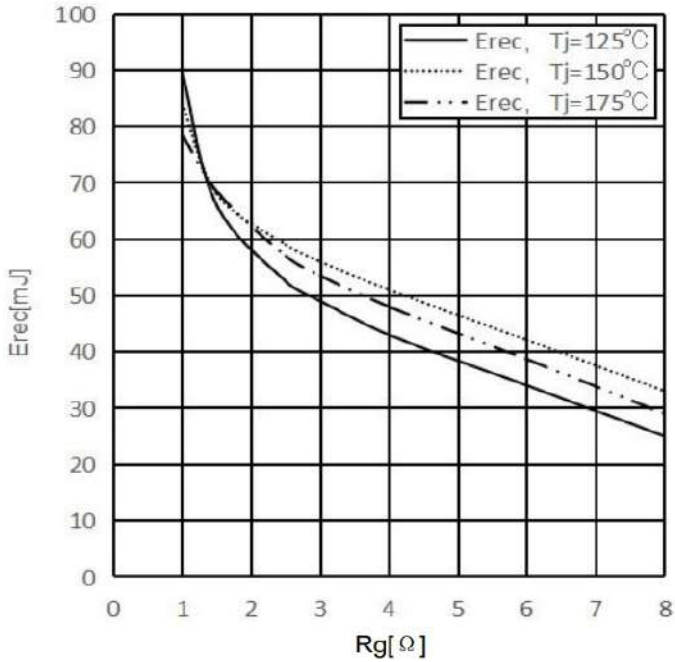


Switching Losses FRD, Inverter (typical),  
 $E_{rec} = f(I_F), R_{Gon} = 1\Omega, V_{CE} = 900V$



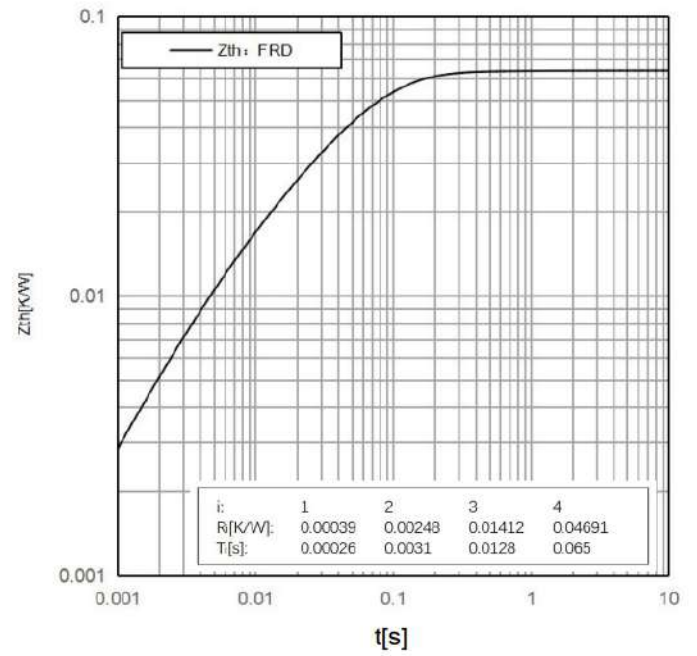
Switching Losses FRD, Inverter (typical),

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



Transient thermal impedance FRD, Inverter

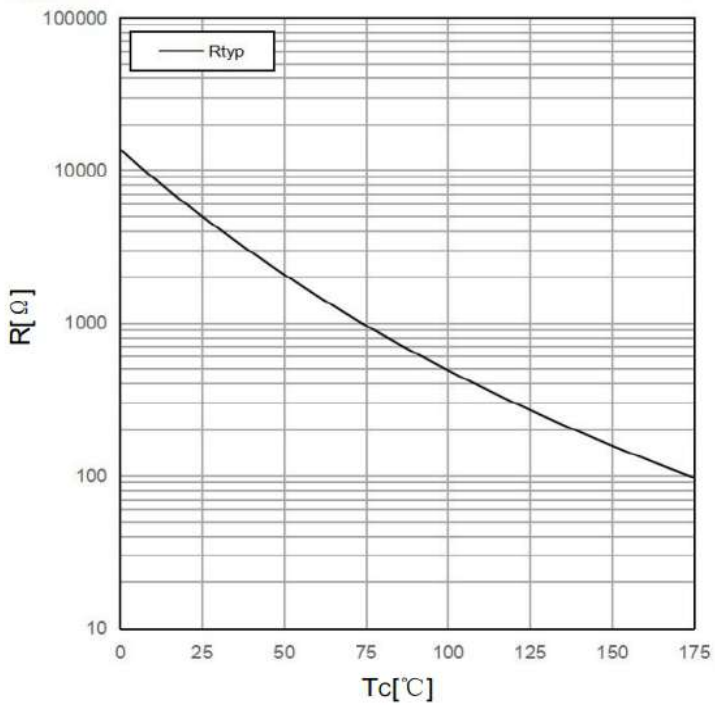
FRD  
 $Z_{thJC} = f(t)$



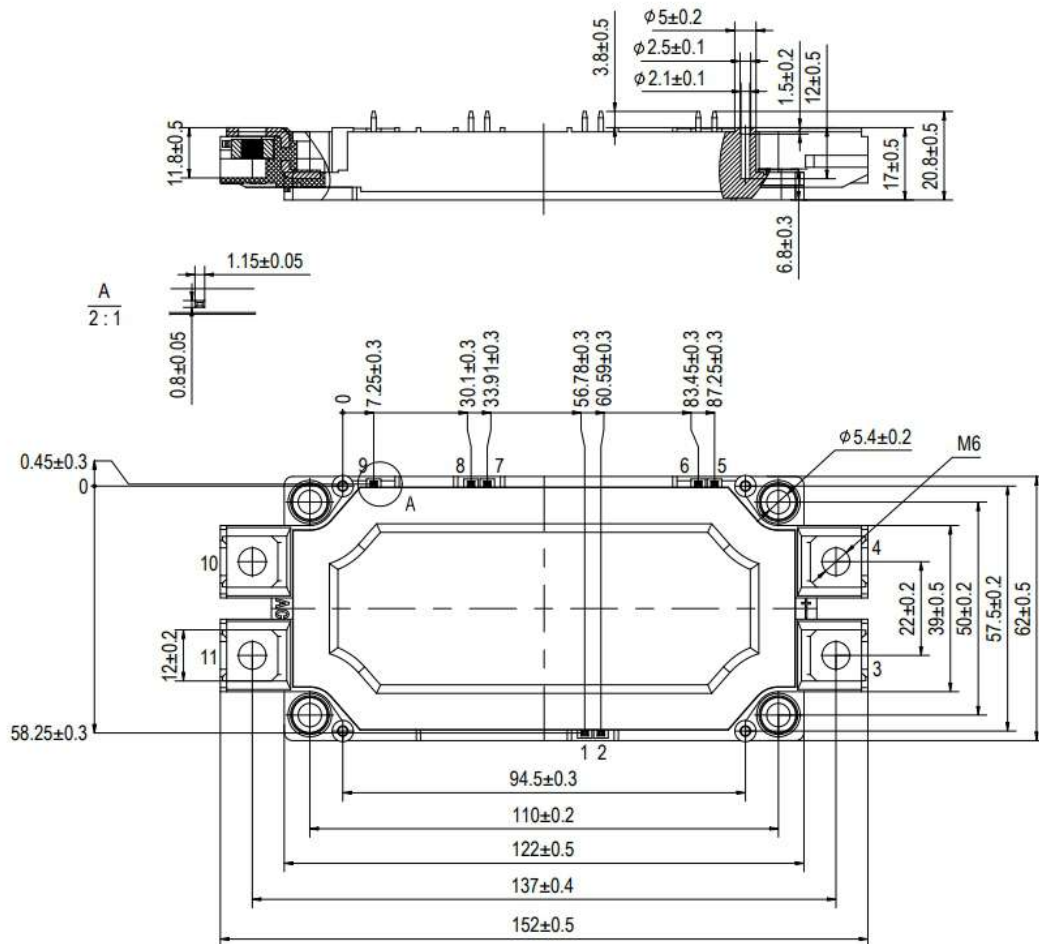
NTC Thermistor temperature characteristic

(typical)

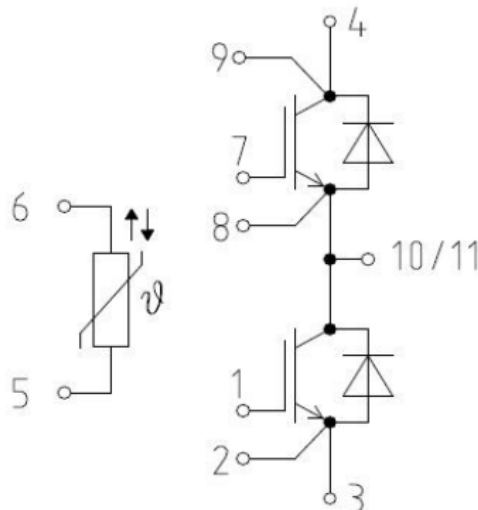
$R = f(T)$



Package Dimension/  
Dimensions in Millimeters



Internal Circuit



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