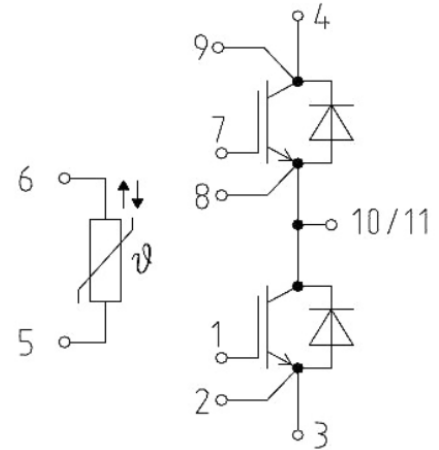


C5 series package: 1200V 450A IGBT module

[Datasheet](#)



Equivalent  
Circuit Schematic

## Features:

- Trenchgate Gen.7 IGBT technology
- $V_{CE(sat)}$  with positive temperature coefficient
- High RBSOA capability
- Low static losses:  $V_{CE(sat)} = 1,5V@25^{\circ}C$
- Low dynamic losses

## Options:

- Pre-applied TIM (option +M01)
- Adoption for parallel connection ( $V_f$  selection)

## Typical Applications:

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

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

Collector-emitter Voltage	$T_{vj} = 25^{\circ}\text{C}$	$V_{CES}$	1200	V
Continuous DC Collector Current		$I_{Cnom}$	450	A
	$T_C = 100^{\circ}\text{C}, T_{vj\ max} \leq 175^{\circ}\text{C}$	$I_C$	540	A
Repetitive Peak Collector Current	$t_p T_{vj\ op}$	$I_{CRM}$	900	A
Total Power Dissipation	$T_C = 25^{\circ}\text{C}, T_{vj\ max} = 175^{\circ}\text{C}$	$P_{tot}$	2344	W
Gate-emitter Peak Voltage		$V_{GES}$	$\pm 20$	V

**Characteristic Values**

		<b>min. typ. max.</b>				
Collector-emitter Saturation Voltage <sup>1)</sup>	$I_C = 450\text{A}, V_{GE} = 15\text{V}$ $T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = 150^{\circ}\text{C}$ $T_{vj} = 175^{\circ}\text{C}$	$V_{CEsat}$	1.40	1.51 1.71 1.79	1.70	V
Gate Threshold Voltage	$V_{CE} = V_{GE}, I_C = 24\text{mA}, T_{vj} = 25^{\circ}\text{C}$	$V_{GEth}$	5.0	6.0	7.0	V
Gate Charge	$V_{GE} = -10\text{V}/15\text{V}, V_{CE} = 600\text{V}$	$Q_G$	-	4.1	-	$\mu\text{C}$
Internal Gate Resistor	$T_{vj} = 25^{\circ}\text{C}$	$R_{Gint}$	-	1.05	-	$\Omega$
Input Capacitance	$f = 100\text{kHz}, T_{vj} = 25^{\circ}\text{C}, V_{CE} = 25\text{V}, V_{GE} = 0\text{V}$	$C_{ies}$	-	106	-	nF
Output Capacitance	$f = 100\text{kHz}, T_{vj} = 25^{\circ}\text{C}, V_{CE} = 25\text{V}, V_{GE} = 0\text{V}$	$C_{oes}$	-	1.96	-	nF
Reverse Transfer Capacitance	$f = 100\text{kHz}, T_{vj} = 25^{\circ}\text{C}, V_{CE} = 25\text{V}, V_{GE} = 0\text{V}$	$C_{res}$	-	0.28	-	nF
Collector-emitter Cutoff Current	$V_{CE} = 1200\text{V}, V_{GE} = 0\text{V}, T_{vj} = 25^{\circ}\text{C}$	$I_{CES}$	-	-	100	$\mu\text{A}$
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	$I_C = 450\text{A}, V_{CE} = 600\text{V}$ $V_{GE} = -8\text{V}/15\text{V}$ $R_{GON} = 1.0\Omega$ $T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = 125^{\circ}\text{C}$ $T_{vj} = 150^{\circ}\text{C}$ $T_{vj} = 175^{\circ}\text{C}$	$t_{don}$	-	206 212 216 240	-	ns
Rise Time, Inductive Load	$I_C = 450\text{A}, V_{CE} = 600\text{V}$ $V_{GE} = -8\text{V}/15\text{V}$ $R_{GON} = 1.0\Omega$ $T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = 125^{\circ}\text{C}$ $T_{vj} = 150^{\circ}\text{C}$ $T_{vj} = 175^{\circ}\text{C}$	$t_r$	-	62 74 77 98	-	ns
Turn-off Delay Time, Inductive Load	$I_C = 450\text{A}, V_{CE} = 600\text{V}$ $V_{GE} = -8\text{V}/15\text{V}$ $R_{GON} = 1.0\Omega$ $T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = 125^{\circ}\text{C}$ $T_{vj} = 150^{\circ}\text{C}$ $T_{vj} = 175^{\circ}\text{C}$	$t_{doff}$	-	389 434 440 495	-	ns
Fall Time, Inductive Load	$I_C = 450\text{A}, V_{CE} = 600\text{V}$ $V_{GE} = -8\text{V}/15\text{V}$ $R_{Goff} = 1\Omega$ $T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = 125^{\circ}\text{C}$ $T_{vj} = 150^{\circ}\text{C}$ $T_{vj} = 175^{\circ}\text{C}$	$t_f$	-	123 191 203 210	-	ns
Turn-on Energy Loss per Pulse	$I_C = 450\text{A}, V_{CE} = 600\text{V}, L_{\sigma} = 30\text{nH}$ $V_{GE} = -8\text{V}/15\text{V}, R_{GON} = 1.0\Omega$ $di/dt = 4200\text{A}/\mu\text{s} (T_{vj} = 175^{\circ}\text{C})$ $T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = 125^{\circ}\text{C}$ $T_{vj} = 150^{\circ}\text{C}$ $T_{vj} = 175^{\circ}\text{C}$	$E_{on}$	-	27.1 38.1 46.4 51.2	-	mJ
Turn-off energy Loss per Pulse	$I_C = 450\text{A}, V_{CE} = 600\text{V}, L_{\sigma} = 30\text{nH}$ $V_{GE} = -8\text{V}/15\text{V}, R_{GON} = 1.0\Omega$ $du/dt = 6300\text{V}/\mu\text{s} (T_{vj} = 175^{\circ}\text{C})$ $T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = 125^{\circ}\text{C}$ $T_{vj} = 150^{\circ}\text{C}$ $T_{vj} = 175^{\circ}\text{C}$	$E_{off}$	-	33.4 46.4 50.4 56.9	-	mJ

SC Data	V <sub>GE</sub> = -8V/15V V <sub>CC</sub> = 600V	t <sub>p</sub> ≤ 10μs, T <sub>vj</sub> = 25°C t <sub>p</sub> ≤ 10μs, T <sub>vj</sub> = 150°C t <sub>p</sub> ≤ 10μs, T <sub>vj</sub> = 175°C	I <sub>sc</sub>	-	2700 2100 2000	-	A
Thermal Resistance, Junction to Case	Per IGBT		R <sub>thJC</sub>	-	0.064	-	K/W
Thermal Resistance, Case to Heatsink	Per IGBT λ <sub>grease</sub> = 1W/(m·K)		R <sub>thCH</sub>	-	0.030	-	K/W
Temperature under Switching Conditions			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>	1200	V
Continuous DC Forward Current		I <sub>Fnom</sub>	450	A
Repetitive Peak Forward Current	t <sub>p</sub> T <sub>vj op</sub>	I <sub>FRM</sub>	900	A

## Characteristic Values

			min. typ. max.				
Forward Voltage <sup>1)</sup>	I <sub>F</sub> = 450A, V <sub>GE</sub> = 0V	T <sub>vj</sub> = 25°C T <sub>vj</sub> = 150°C T <sub>vj</sub> = 175°C	V <sub>F</sub>	1.50	2.01 1.94 1.84	2.40	V
Peak Reverse Recovery Current	I <sub>F</sub> = 450A, V <sub>R</sub> = 600V -di <sub>F</sub> /dt = 5600A/μs (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	I <sub>RM</sub>	-	302 358 374 390	-	A
Recovery Charge	I <sub>F</sub> = 450A, V <sub>R</sub> = 600V -di <sub>F</sub> /dt = 5600A/μs (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	Q <sub>R</sub>	-	21.3 42.1 50.0 56.0	-	μC
Reverse Recovery Energy	I <sub>F</sub> = 450A, V <sub>R</sub> = 600V -di <sub>F</sub> /dt = 5600A/μs (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>	-	11.3 22.5 27.7 33.0	-	mJ
Thermal Resistance, Junction to Case	Per FRD		R <sub>thJC</sub>	-	0.092	-	K/W
Thermal Resistance, Case to Heatsink	Per FRD λ <sub>grease</sub> = 1W/(m·K)		R <sub>thCH</sub>	-	0.039	-	K/W
Temperature under Switching Conditions <sup>2)</sup>			T <sub>vj op</sub>	-40	-	175	°C

**NTC-Thermistor / NTC  
Maximum Rated Values**

		<b>min. typ. max.</b>				
Rated Resistance	TNTC = 25°C	R25	–	5	–	KΩ
Deviation of R100 R100	TNTC = 100°C, R100 = 465Ω	ΔR/R	-7.3	–	7.3	%
Power Dissipation	TNTC = 25°C	P25	–	–	10	mW
B-Value B	$R_2 = R_{25} \exp[B_{25/50}(1/T_2 - 1/(298.15K))]$	B25/50	–	3380	–	K
	$R_2 = R_{25} \exp[B_{25/80}(1/T_2 - 1/(298.15K))]$	B25/80	–	3470	–	K
	$R_2 = R_{25} \exp[B_{25/100}(1/T_2 - 1/(298.15K))]$	B25/100	–	3520	–	K

**Module**

Isolation Test Voltage	RMS, f=50Hz	V <sub>ISOL</sub>		3.0		kV
Isolation Test Voltage of NTC NTC	RMS, f=50Hz	V <sub>ISOL</sub> (NTC)		3.0		kV
Material of Module Baseplate				Cu		
Internal Isolation				ZTA		
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.**

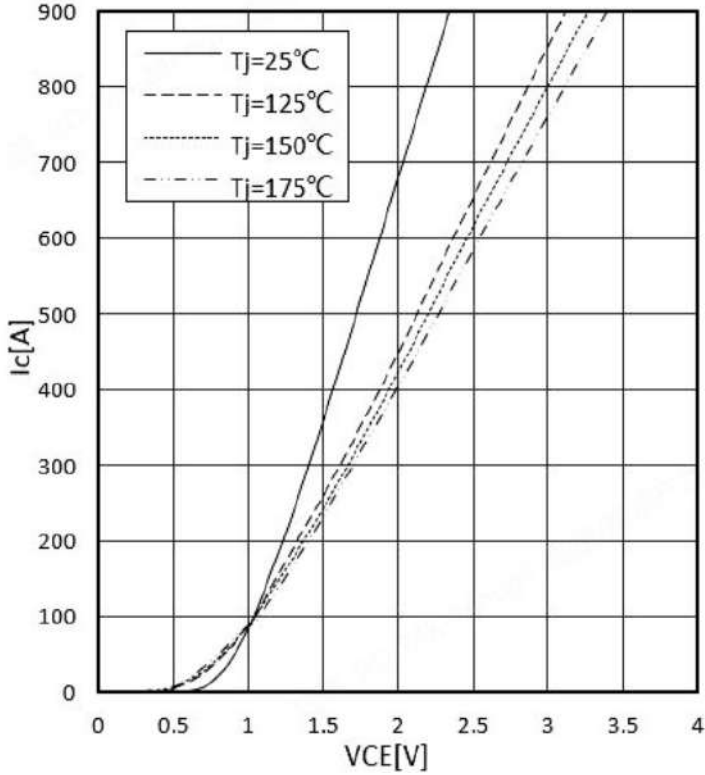
Stray Inductance Module		L <sub>sCE</sub>	–	20	–	nH
Module Lead Resistance, Terminals-Chip	T <sub>C</sub> = 25°C, Per Switch	R <sub>CC'+EE'</sub>	–	0.8	–	mΩ
Thermal Resistance, Case to Heatsink	including thermal coupling, T <sub>s</sub> underneath module (λ <sub>grease</sub> =0.81 W/(m*K))	R <sub>thCH</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	–	6.0	Nm
Mounting Torque for Terminal Mounting	Screw M5 / M5	M	4.0	–	6.0	Nm
Weight		G	–	345	–	g

1) Terminal impedance is not included.

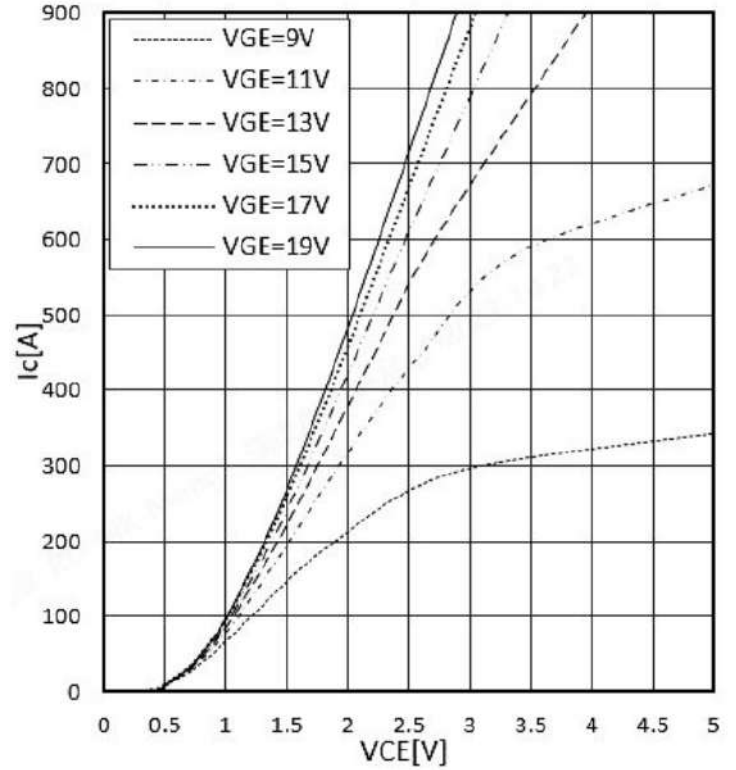
2) T<sub>vj op</sub> > 150°C is allowed for operation at overload conditions.  
T<sub>vj op</sub> > 150°C.

### Circuit Diagram

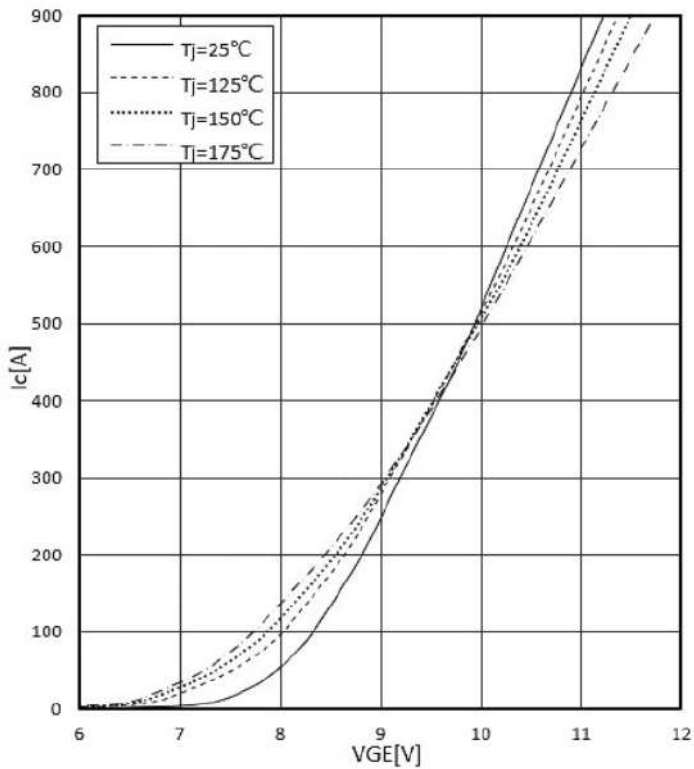
Output characteristic IGBT, Inverter (typical), IGBT  
 $I_c = f(V_{CE})$ ,  $V_{GE} = 15V$



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

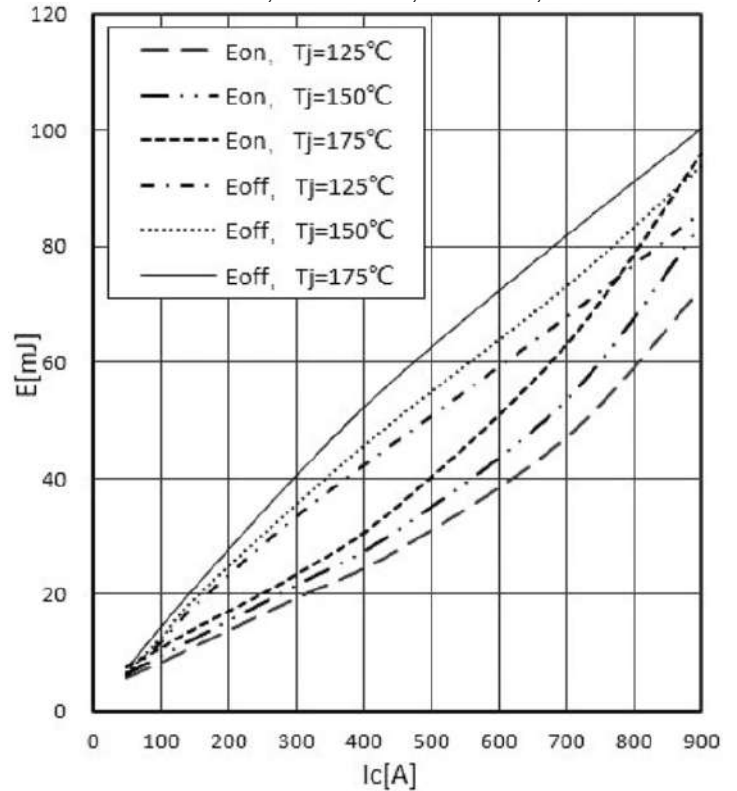


Transfer characteristic IGBT, Inverter (typical), IGBT  
 $I_c = f(V_{GE})$ ,  $V_{CE} = 20V$



Switching losses IGBT, Inverter (Typical), IGBT

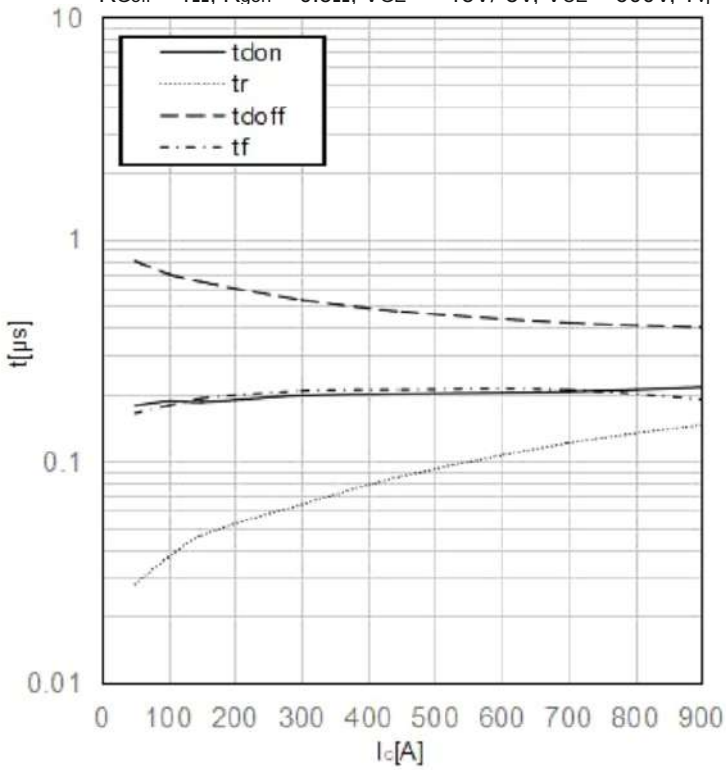
$E_{on} = f(I_c)$ ,  $E_{off} = f(I_c)$   
 $V_{GE} = +15V/-8V$ ,  $R_{Gon} = 0.5\Omega$ ,  $R_{Goff} = 1\Omega$ ,  $V_{CC} = 600V$



Switching time IGBT, Inverter (typical), IGBT

$t = f(I_c)$

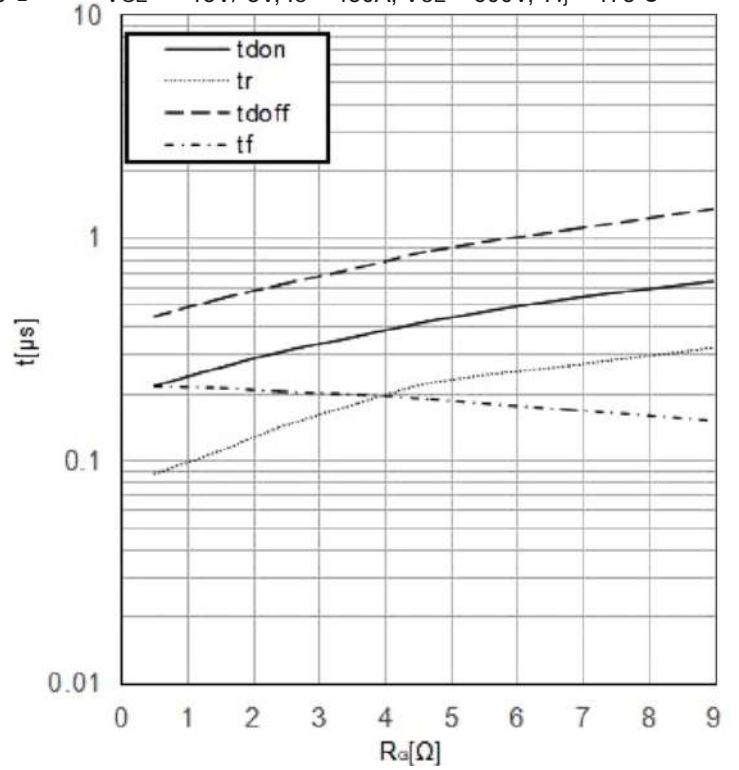
$R_{Goff} = 1\Omega, R_{Gon} = 0.5\Omega, V_{GE} = +15V/-8V, V_{CE} = 600V, T_{vj} = 175^\circ C$



Switching time IGBT, Inverter (typical), IGBT

$t = f(R_G)$

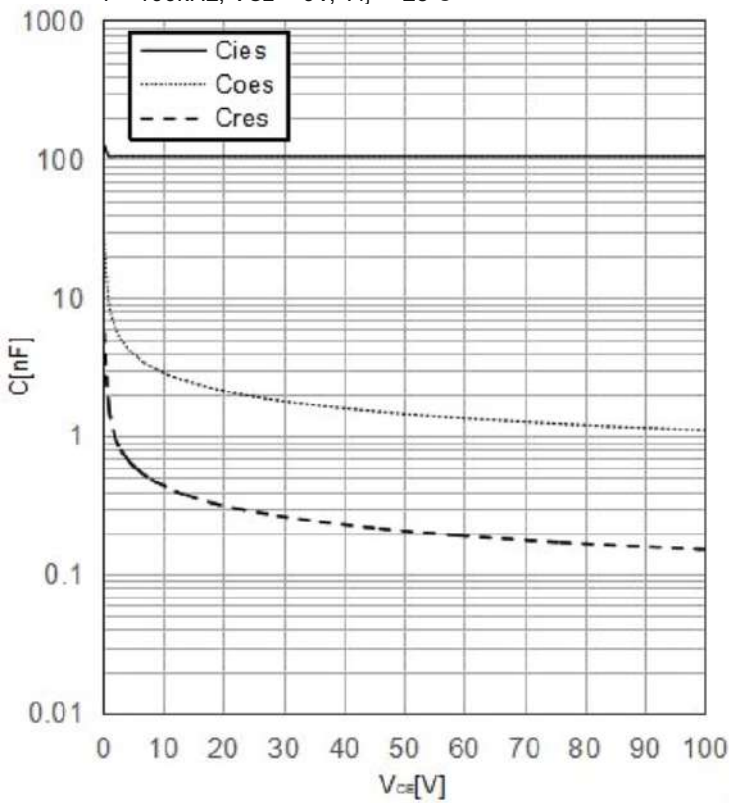
$V_{GE} = +15V/-8V, I_c = 450A, V_{CE} = 600V, T_{vj} = 175^\circ C$



Capacitance characteristic IGBT, Inverter, IGBT

$C = f(V_{CE})$

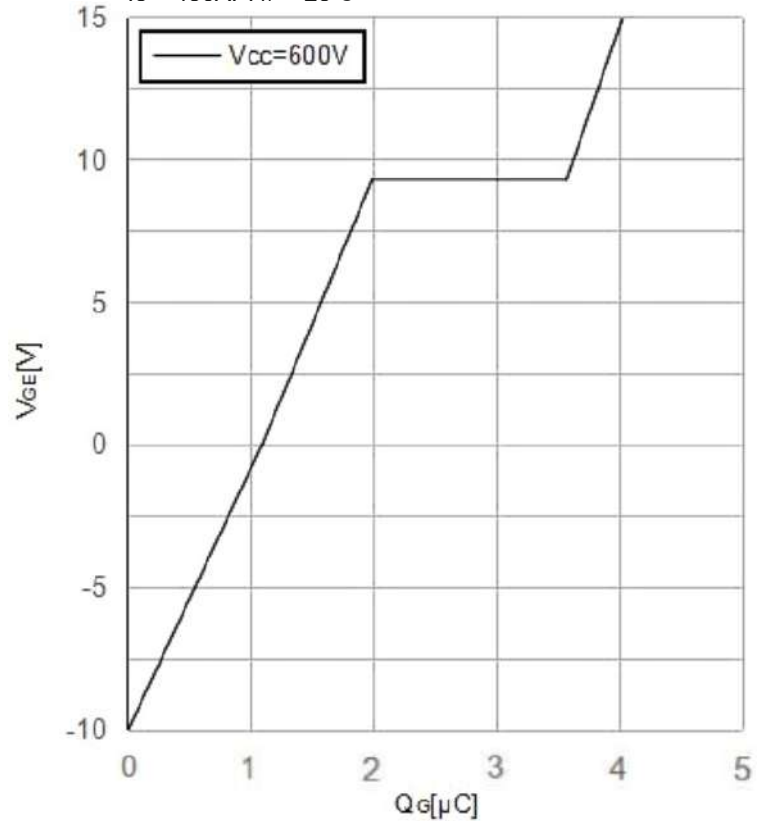
$f = 100kHz, V_{GE} = 0V, T_{vj} = 25^\circ C$



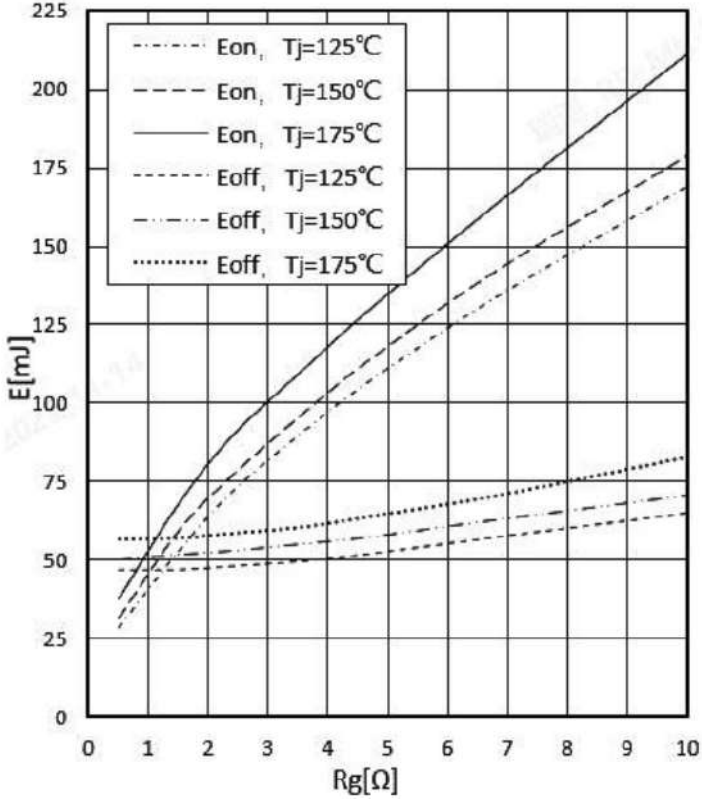
Gate Charge characteristic IGBT, Inverter, IGBT

$V_{GE} = f(Q_G)$

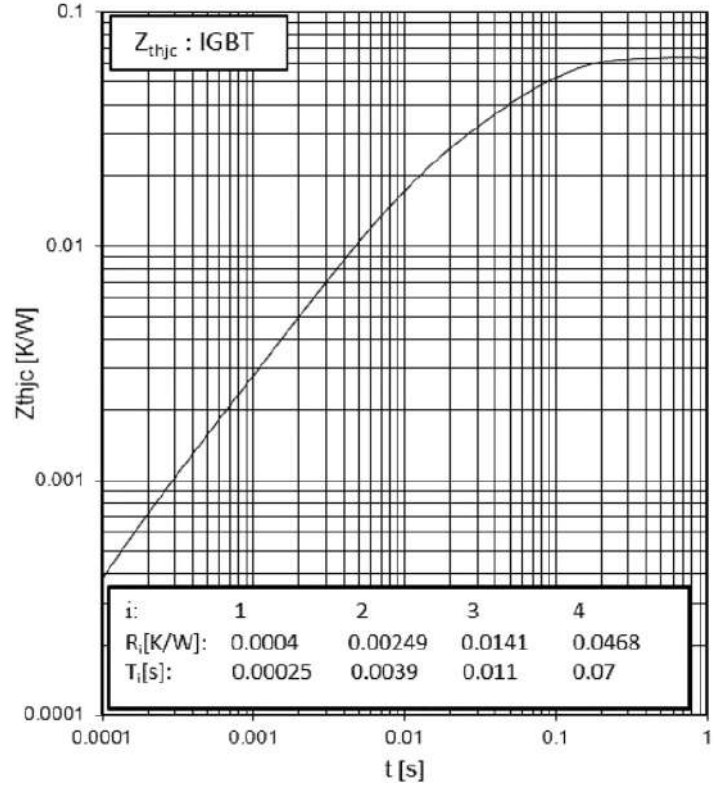
$I_c = 450A, T_{vj} = 25^\circ C$



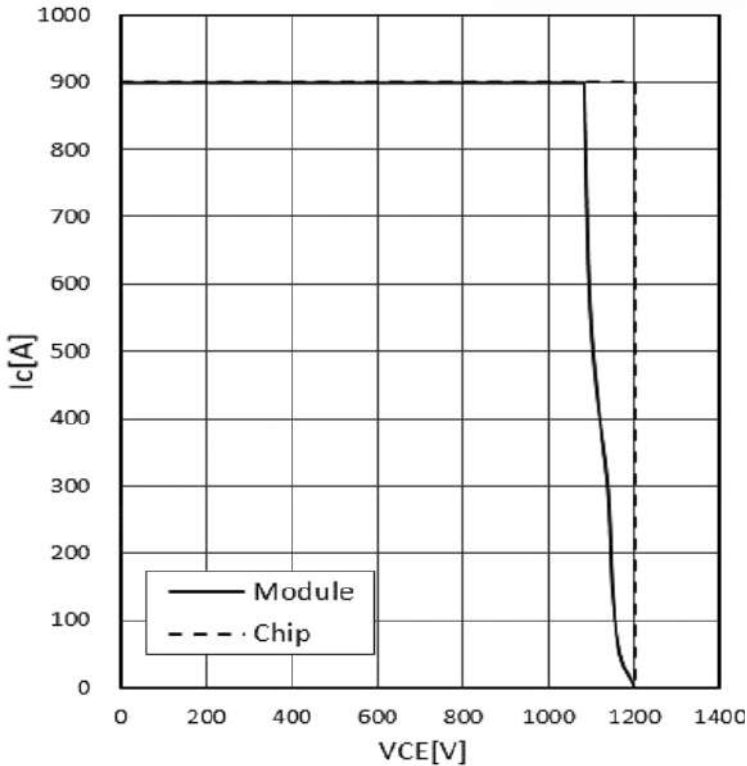
Switching losses IGBT, Inverter (Typical), IGBT  
 $E_{on} = f(R_G)1\Omega$ ,  $E_{off} = f(R_G)$ ,  
 $V_{GE} = +15V/-8V$ ,  $I_C = 450A$ ,  $V_{CE} = 600V$



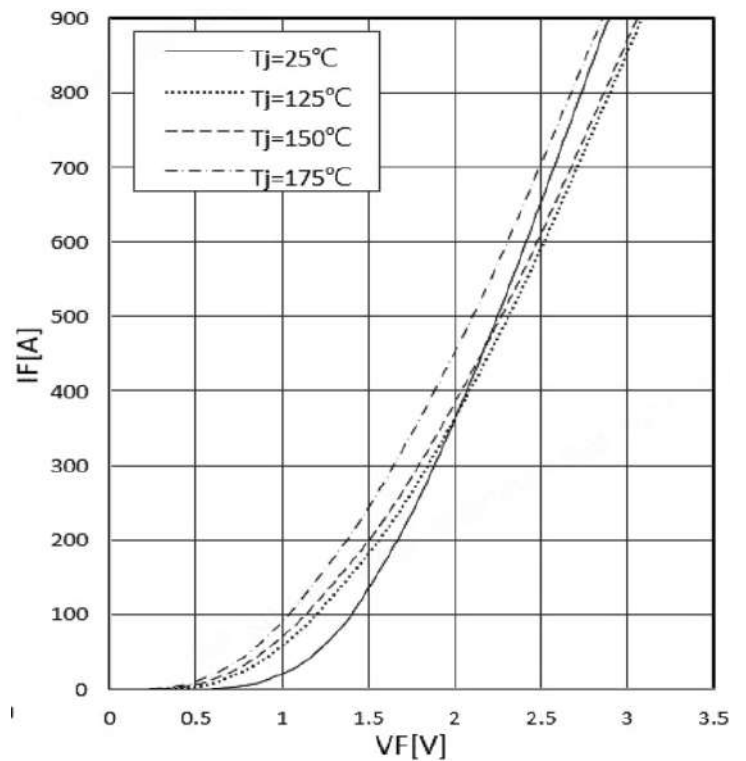
Transient thermal impedance IGBT, Inerter, IGBT  
 $E_{thjc} = f(t)$



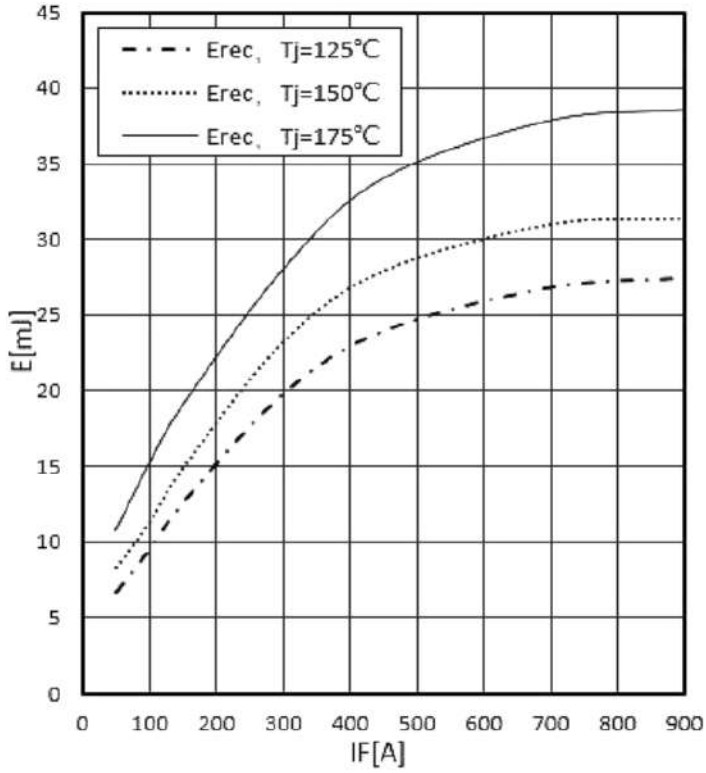
Reverse bias safe operating area IGBT, Inverter (RBSOA)  
 IGBT (RBSOA)  
 $I_C = f(V_{CE})$   
 $V_{GE} = +15V/-8V$ ,  $R_{\theta off} = 1\Omega$ ,  $T_{vj} = 175^\circ C$



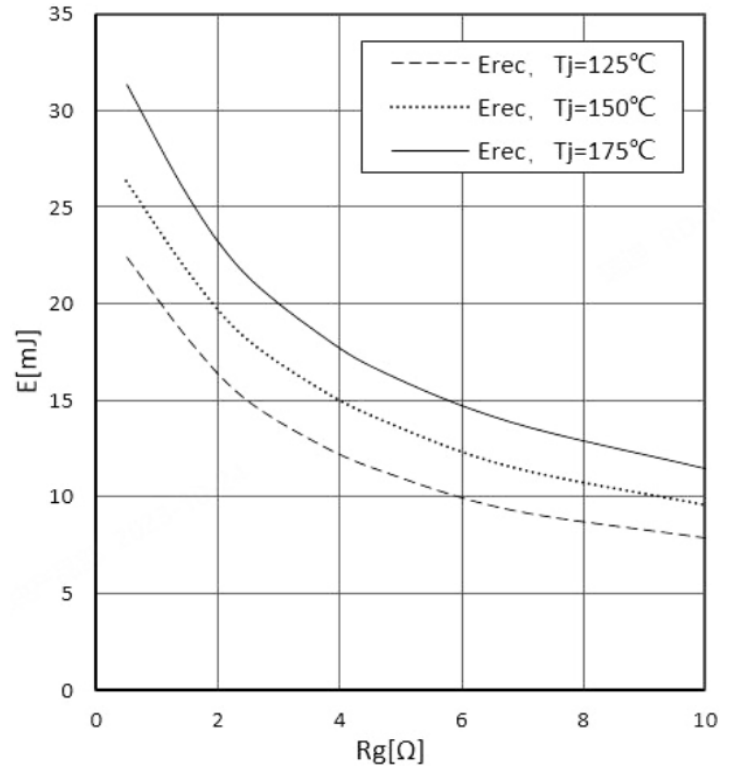
Forward characteristic of Diode, Inverter (typical)  
 $I_F = f(V_F)$



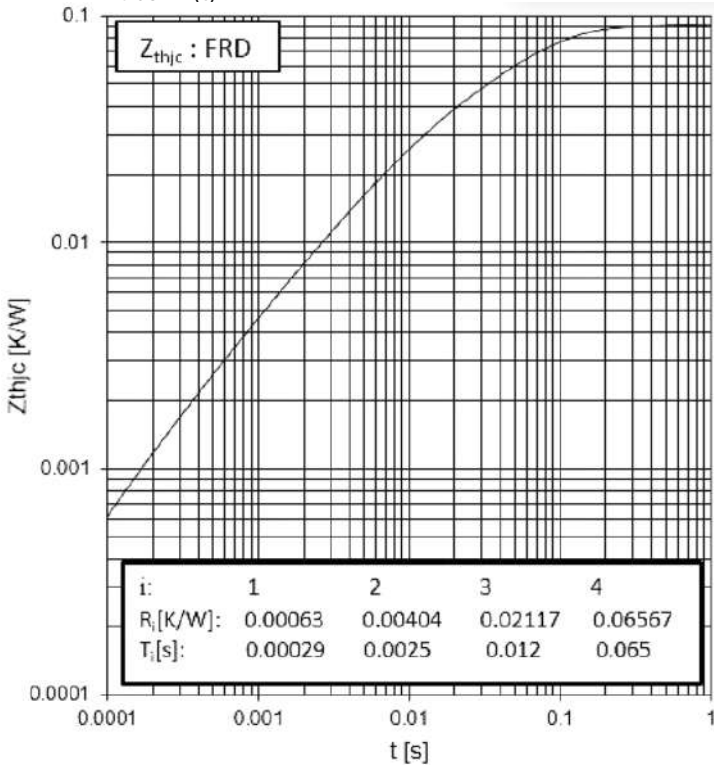
Switching losses Diode, Inverter (typical)  
 $E_{rec} = f(I_F)$ ,  $R_{gon} = 0.5\Omega$ ,  $V_{CE} = 600V$



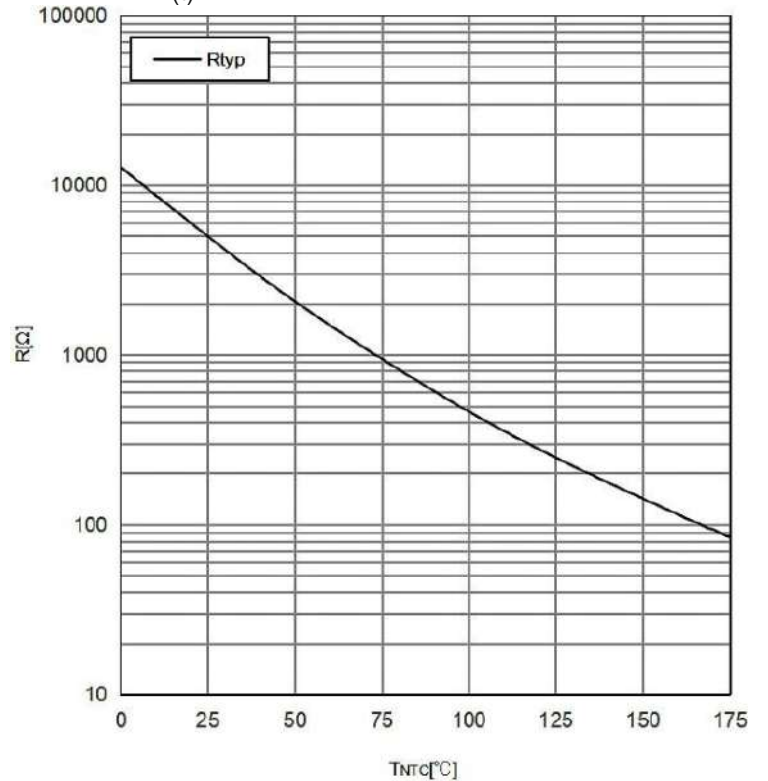
Switching losses Diode, Inverter (typical)  
 $E_{rec} = f(R_g)$ ,  $I_F = 450A$ ,  $V_{CE} = 600V$



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



NTC-Thermistor-temperature characteristic (typical)  
 $R = f(t)$





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