C5 series package: 1700V 600A IGBT module
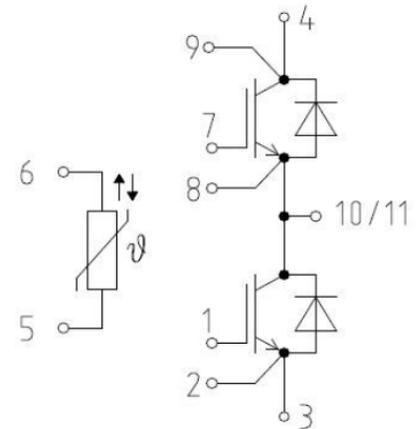

Equivalent
Circuit Schematic

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	$T_{vj} = 25°C$	V_{CES}		1700		V
Implemented Collector Curren		I_{Cnom}		600		A
Continuous DC Collector Current	$T_C = 85°C$, $T_{vj\ max} = 175°C$	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]	$I_C = 600A$, $V_{GE} = 15V$ $T_{vj} = 25°C$ / $T_{vj} = 125°C$ / $T_{vj} = 150°C$ / $T_{vj} = 175°C$	V_{CEsat}	–	1.60 / 1.78 / 1.86 / 1.90	–	V
Gate Threshold Voltage	$V_{CE} = V_{GE}$, $I_C = 12mA$, $T_{vj} = 25°C$	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	$T_{vj} = 25°C$	R_{Gint}	–	0.46	–	Ω
Input Capacitance	$f = 100kHz$, $T_{vj} = 25°C$, $V_{CE} = 25V$, $V_{GE} = 0V$	C_{ies}	–	102	–	nF
Reverse Transfer Capacitance	$f = 100kHz$, $T_{vj} = 25°C$, $V_{CE} = 25V$, $V_{GE} = 0V$	C_{res}	–	0.27	–	nF
Collector-emitter Cutoff Current	$V_{CE} = 1700V$, $V_{GE} = 0V$, $T_{vj} = 25°C$	I_{CES}	–	–	1	mA
Gate-emitter Leakage Current	$V_{CE} = 0V$, $V_{GE} = 20V$, $T_{vj} = 25°C$	I_{GES}	–	–	100	nA
Turn-on Delay Time, Inductive Load	$I_C = 600A$, $V_{CE} = 900V$ $V_{GE} = ±15V$ $R_{GON} = 1Ω$ $T_{vj} = 25°C$ / $T_{vj} = 125°C$ / $T_{vj} = 150°C$ / $T_{vj} = 175°C$	t_{don}	–	94 / 101 / 102 / 110	–	ns
Rise Time, Inductive Load	$I_C = 600A$, $V_{CE} = 900V$ $V_{GE} = ±15V$ $R_{GON} = 1Ω$ $T_{vj} = 25°C$ / $T_{vj} = 125°C$ / $T_{vj} = 150°C$ / $T_{vj} = 175°C$	t_r	–	47 / 55 / 58 / 60	–	ns
Turn-off Delay Time, Inductive Load	$I_C = 600A$, $V_{CE} = 900V$ $V_{GE} = ±15V$ $R_{Goff} = 1Ω$ $T_{vj} = 25°C$ / $T_{vj} = 125°C$ / $T_{vj} = 150°C$ / $T_{vj} = 175°C$	t_{doff}	–	394 / 470 / 490 / 500	–	ns
Fall Time, Inductive Load	$I_C = 600A$, $V_{CE} = 900V$ $V_{GE} = ±15V$ $R_{Goff} = 1Ω$ $T_{vj} = 25°C$ / $T_{vj} = 125°C$ / $T_{vj} = 150°C$ / $T_{vj} = 175°C$	t_f	–	404 / 716 / 786 / 850	–	ns
Turn-on Energy Loss per Pulse	$I_C = 600A$, $V_{CE} = 900V$, $L_σ = 30nH$ $V_{GE} = ±15V$, $R_{GON} = 1Ω$ $di/dt = 7800\ A/µs$ ($T_{vj} = 175°C$) $T_{vj} = 25°C$ / $T_{vj} = 125°C$ / $T_{vj} = 150°C$ / $T_{vj} = 175°C$	E_{on}	–	97 / 132 / 142 / 165	–	mJ
Turn-off energy Loss per Pulse	$I_C = 600A$, $V_{CE} = 900V$, $L_σ = 30nH$ $V_{GE} = ±15V$, $R_{Goff} = 1Ω$ $du/dt = 3800\ A/µs$ ($T_{vj} = 175°C$) $T_{vj} = 25°C$ / $T_{vj} = 125°C$ / $T_{vj} = 150°C$ / $T_{vj} = 175°C$	E_{off}	–	141 / 209 / 226 / 242	–	mJ
SC Data	$V_{GE} ≤ 15V$ $V_{CC} = 1000V$ $V_{CEmax} = V_{CES} - L_{sCE}*di/dt$ $t_P ≤ 10µs$, $T_{vj} = 25°C$ / $t_P ≤ 6µs$, $T_{vj} = 175°C$	I_{sc}	–	3000 / 2400	–	A

Thermal Resistance, Junction to Case	Per IGBT	R_{thJC}	–	0.049	–	K/W
Thermal Resistance, Case to Heatsink	Per 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		R_{thJC}	–	0.064	–	K/W
Thermal Resistance, Case to Heatsink	Per FRD 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	$\triangle R/R$	-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℃, Per Switch	$R_{CC'+EE'}$	–	0.8	–	mΩ
Storage Temperature		T_{stg}	-40	–	125	℃
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) $T_{vj\ op}$ > 150°C is allowed for operation at overload conditions.
3) CTI is greater than 200

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Circuit Diagram

Output characteristic IGBT, Inverter (typical)
Inclusive $R_{CC'+EE'}$
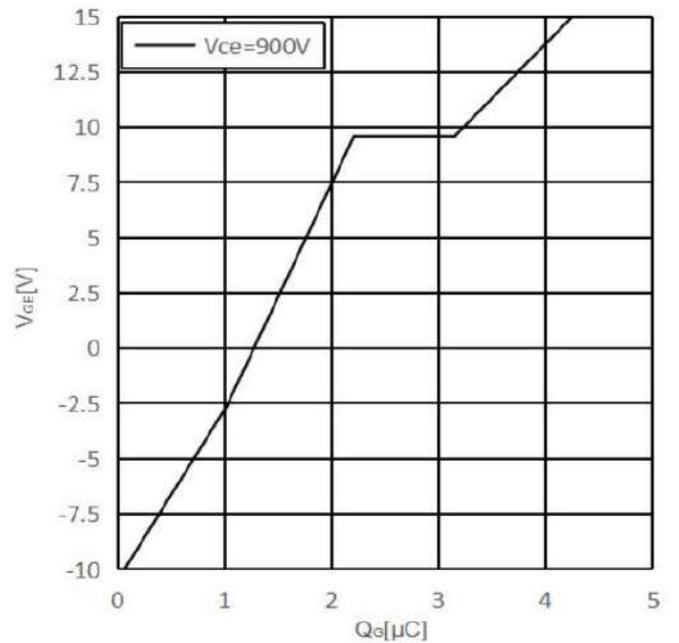$I_C = f(V_{CE})$, $V_{GE} = 15V$
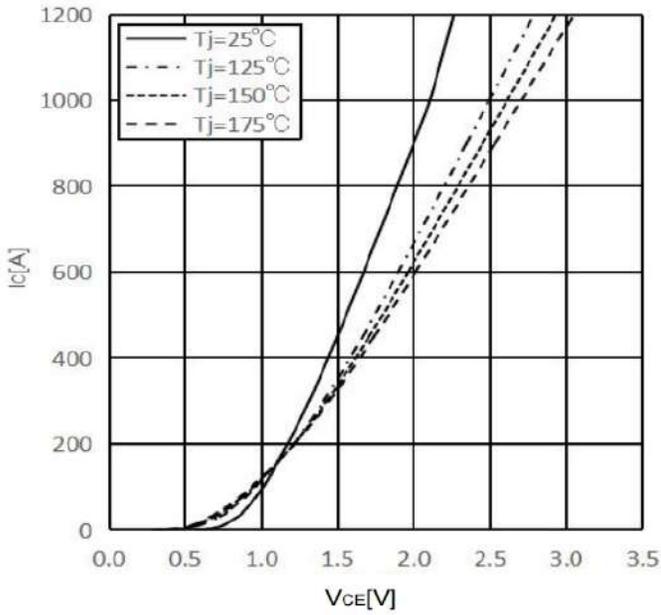
Output characteristic IGBT, Inverter (typical)
Inclusive $R_{CC'+EE'}$
$I_C = f(V_{CE})$, $T_j = 175°C$
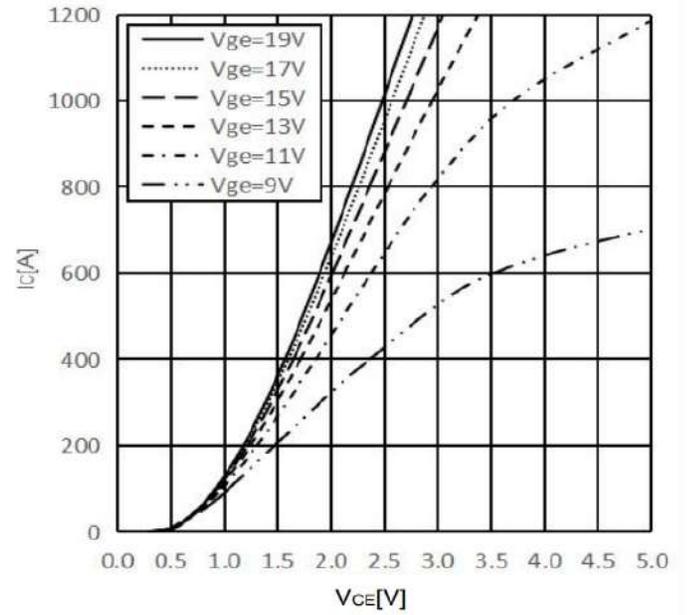
Transfer characteristic IGBT, Inverter(typical),
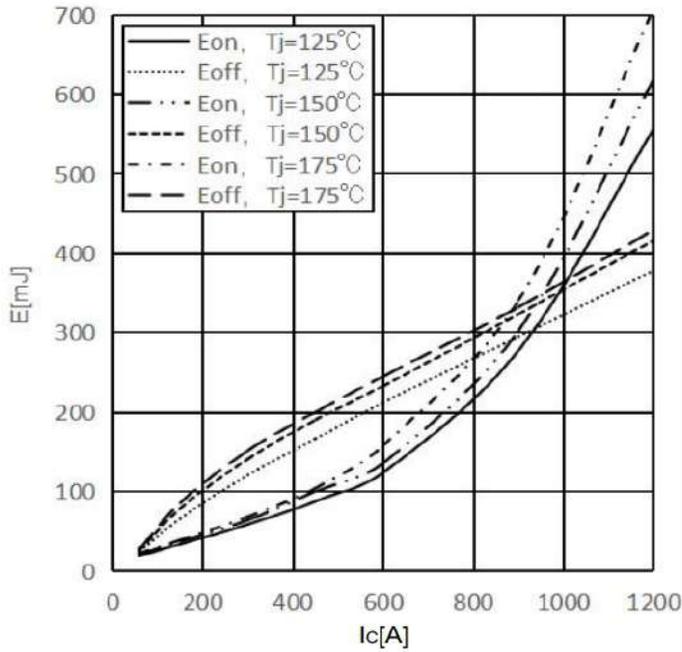Inclusive $R_{CC'+EE'}$
$I_C = f(V_{GE})$, $V_{CE} = 20V$
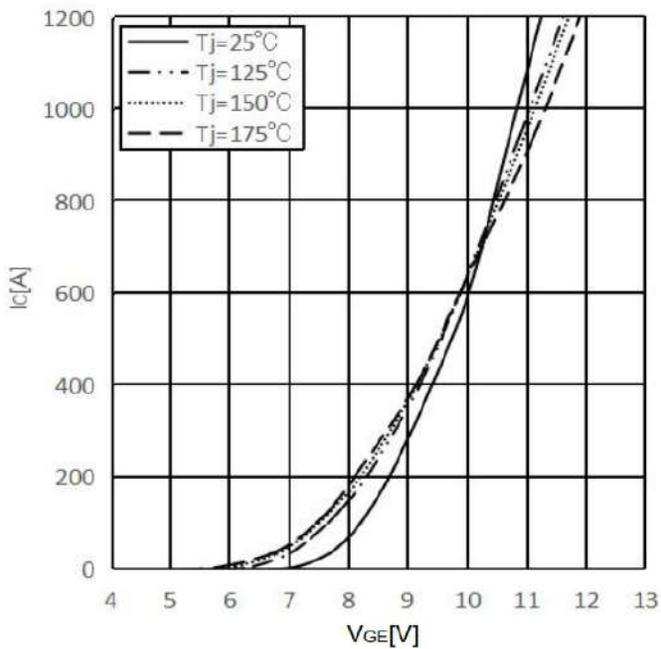
Gate Charge characteristic IGBT,Inverter
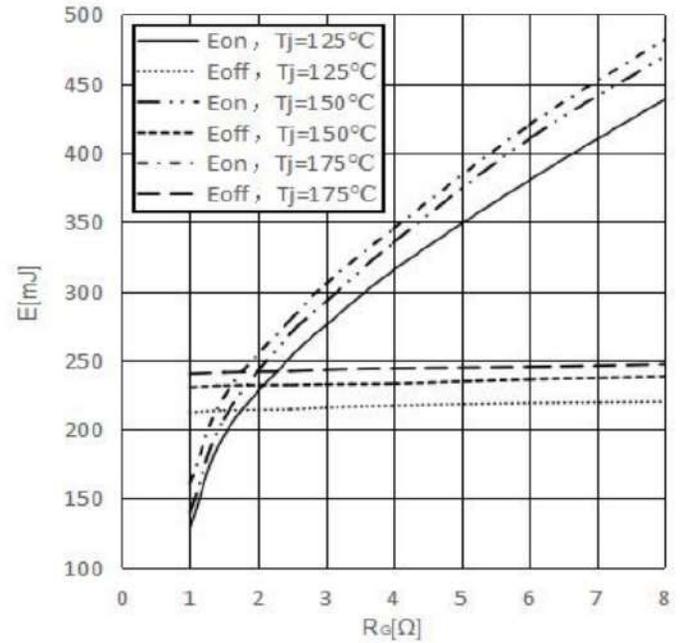$V_{GE} = f(Q_G)$
$I_C = 600A$, $T_{vj} = 25°C$

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Switching losses IGBT, Inverter(typical)

E = f(Ic), 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(Ic), V$_{GE}$ = ±15V, V$_{CE}$ = 900V, T$_j$ = 175°C
R$_{Gon}$ = 1Ω, R$_{Goff}$ = 1Ω
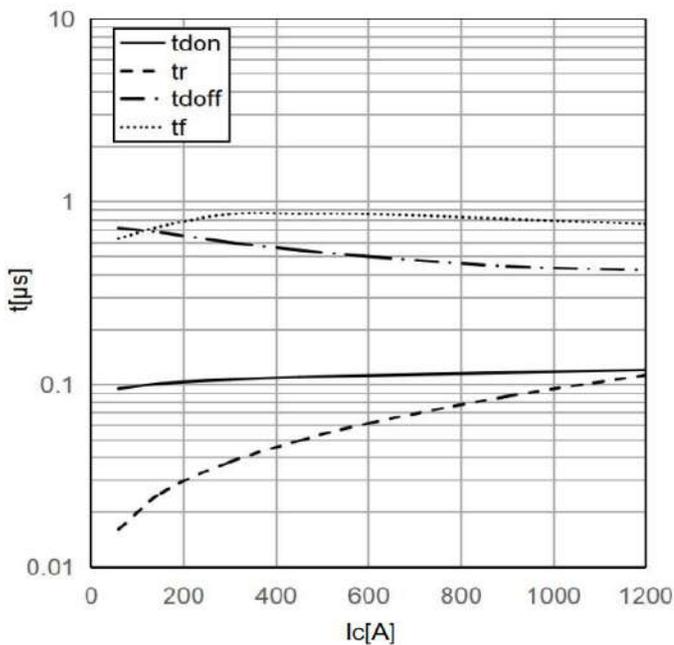
Switching times IGBT, Inverter (typical)
t = f(R$_G$), V$_{GE}$ = ±15V, V$_{CE}$ = 900V, T$_j$ = 175°C
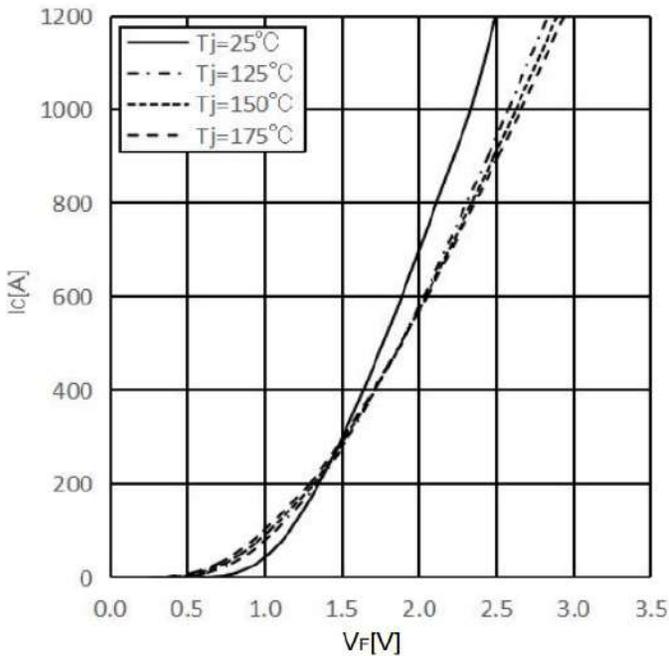I$_C$ = 600A
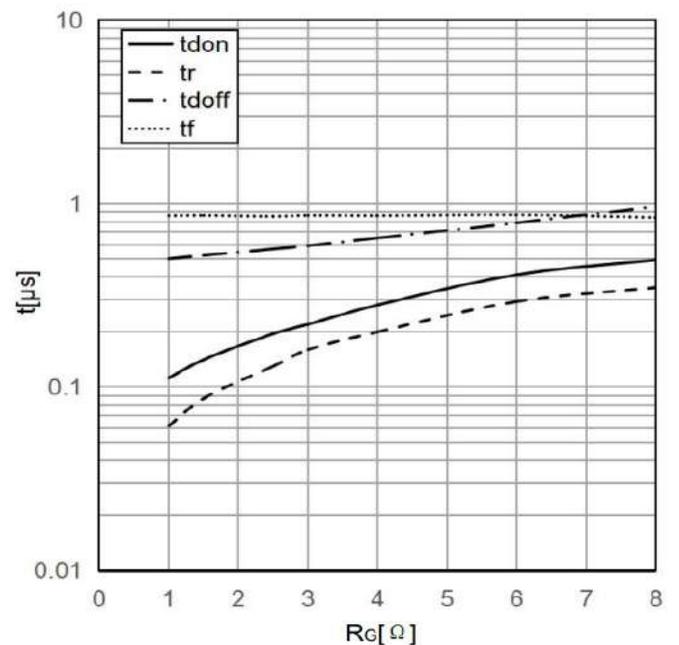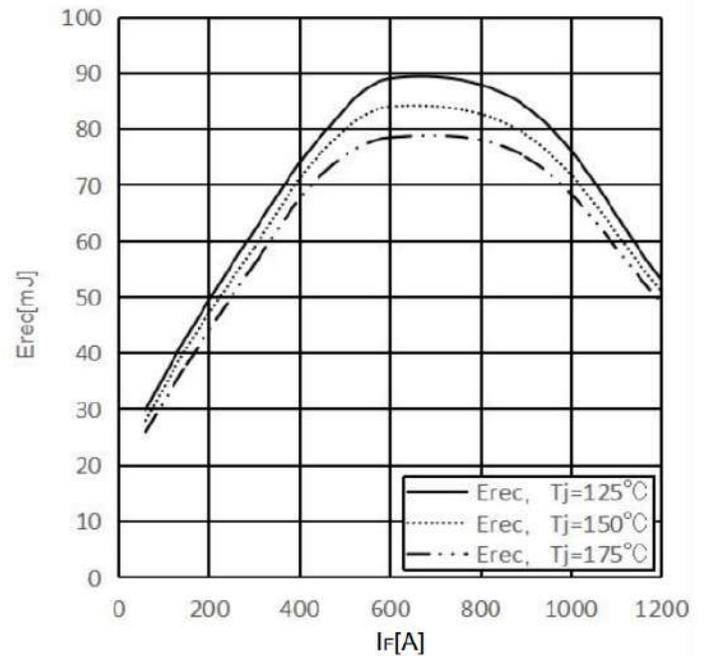
Transient thermal impedance IGBT, Inverter
$Z_{thJC}=f(t)$
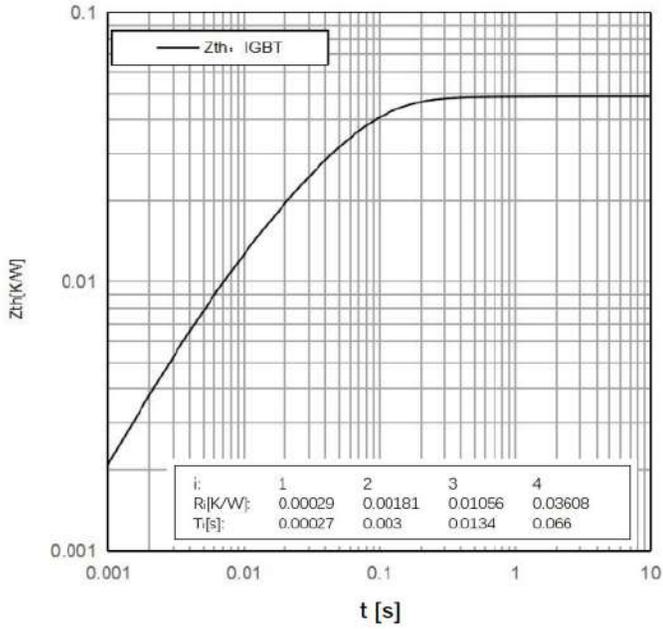
Reverse bias safe operating area IGBT,
Inverter(RBSOA)
$I_C = f(V_{CE}), V_{GE} = +15V, R_{Goff} = 1\Omega, T_j = 175°C$
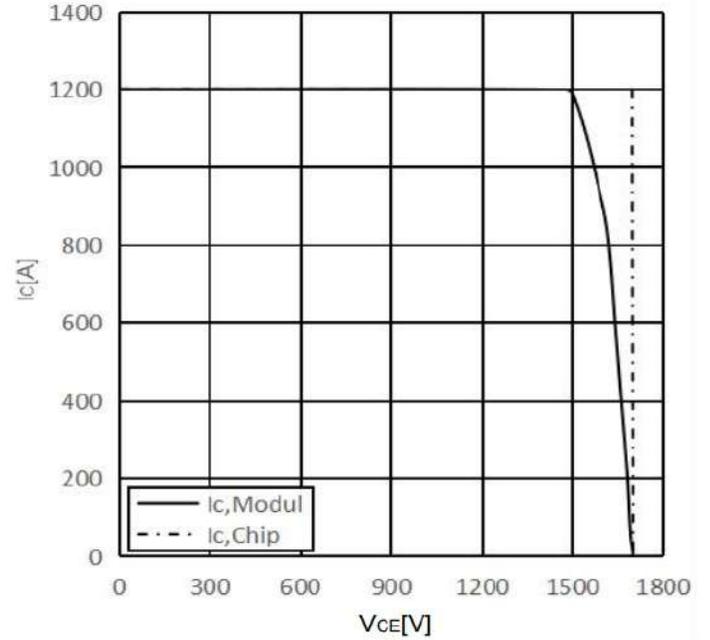
Forward characteristic FRD, Inverter(typical),
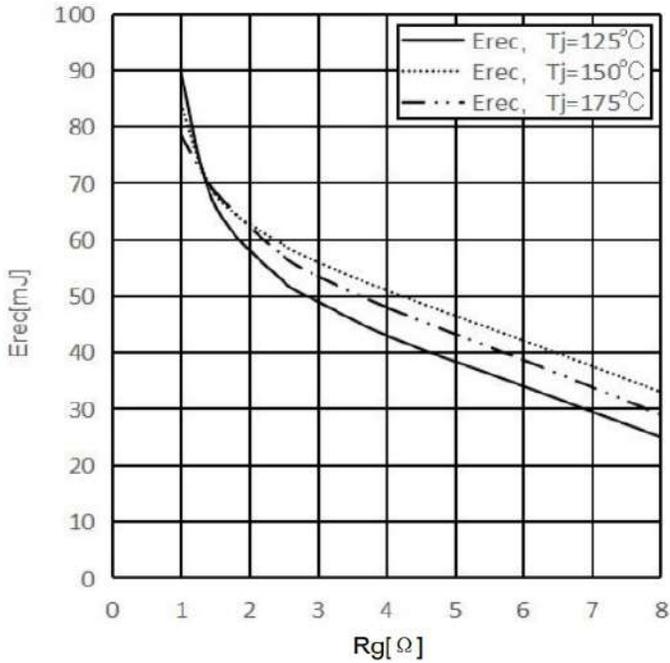Inclusiver $R_{CC'+EE'}$
$I_F = f(V_F)$

Swiching Losses FRD, Inverter (typical),

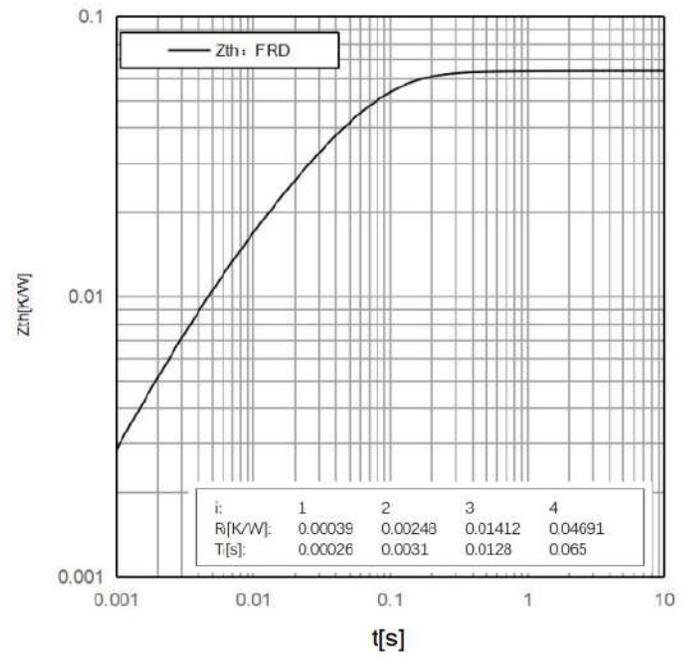$E_{rec} = f(I_F), R_{Gon} = 1\Omega, V_{CE} = 900V$

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Swiching Losses FRD, Inverter (typical),

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

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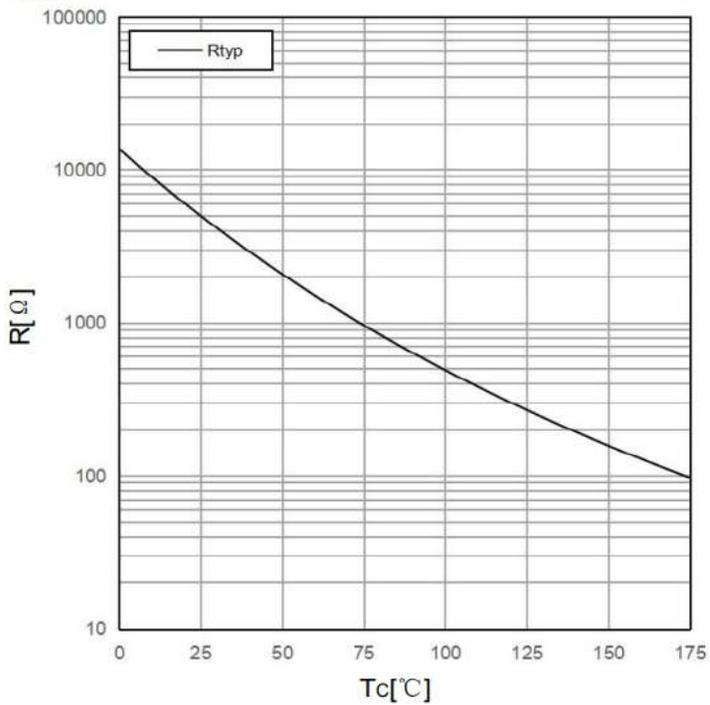$Z_{thJC} = f(t)$

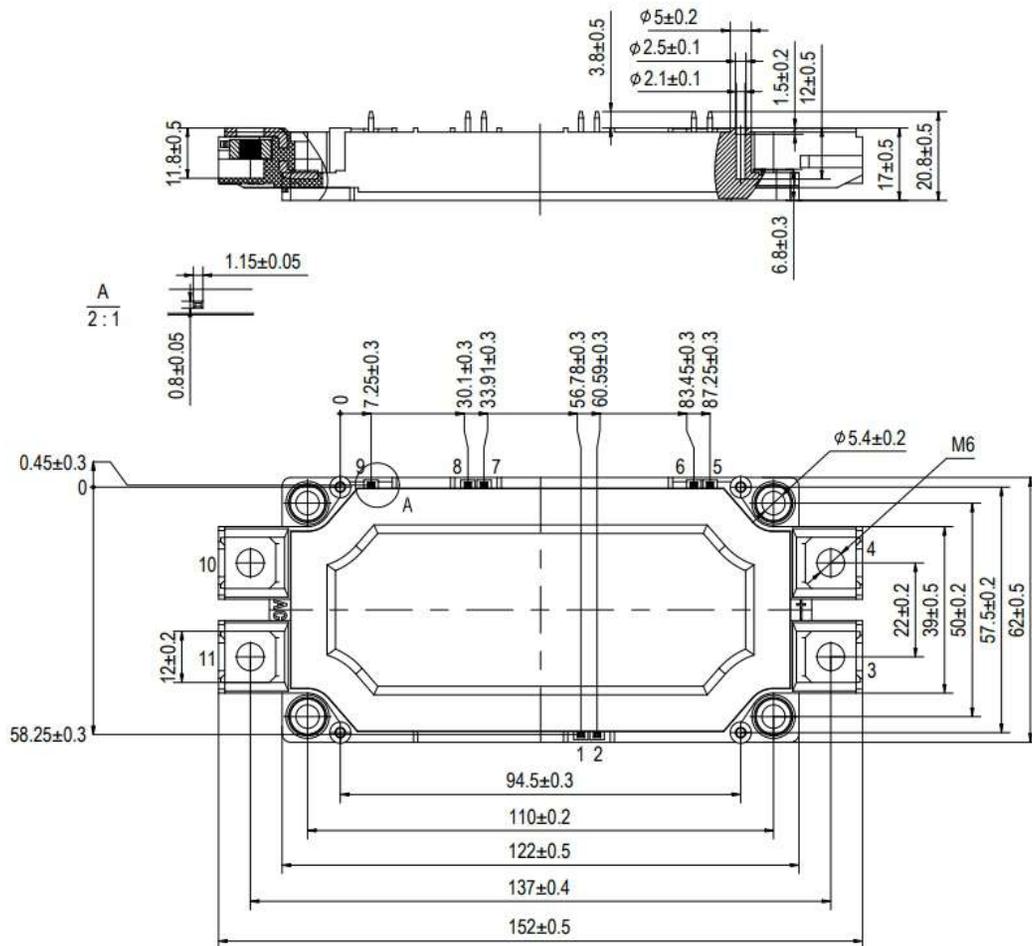| i:	1	2	3	4
R[K/W]:	0.00039	0.00248	0.01412	0.04691
T[s]:	0.00026	0.0031	0.0128	0.065

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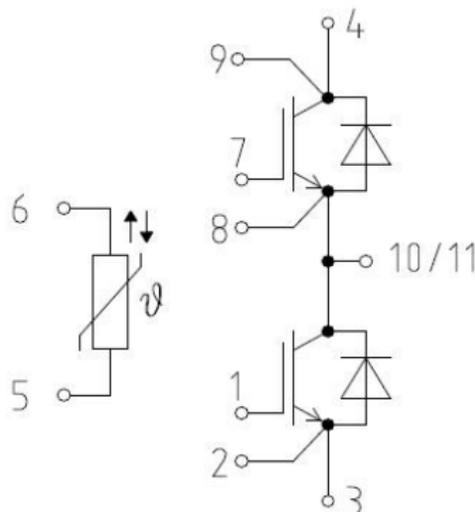(typical)
$R = f(T)$

Package Dimension/
Dimensions in Millimeters

Internal Circuit

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