

IGBT Modules

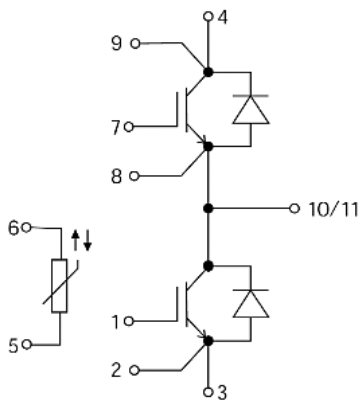


V_{CES}	1200V
I_C	600A

Applications

- Motion/servo control
- High frequency switching application
- UPS (Uninterruptible Power Supplies)
- Welding machine

Circuit



Features

- Low $V_{ce(sat)}$ with Trench technology
- Low switching losses especially E_{off}
- $V_{ce(sat)}$ with positive temperature coefficient
- High short circuit capability(10us)
- Including ultra fast & soft recovery anti-parallel FWD
- Low inductance package
- Maximum junction temperature 175°C

● IGBT

Absolute Maximum Ratings

Parameter	Symbol	Conditions	Value	Unit
Collector-Emitter Voltage	V_{CES}	$V_{GE} = 0\text{ V}$, $I_C = 1\text{ mA}$, $T_{vj} = 25\text{ °C}$	1200	V
Continuous Collector Current	I_C	$T_c = 120\text{ °C}$, $T_{vj} = 175\text{ °C}$	600	A
Repetitive Peak Collector Current	I_{CRM}	$T_p = 1\text{ ms}$	1200	A
Gate-Emitter Voltage	V_{GES}		± 20	V
Total Power Dissipation	P_{tot}	$T_c = 25\text{ °C}$ $T_{vjmax} = 175\text{ °C}$	3260	W

Characteristic values

Parameter	Symbol	Conditions	Value			Unit
			Min.	Typ.	Max.	
Gate-emitter Threshold Voltage	$V_{GE(th)}$	$V_{GE} = V_{CE}$, $I_C = 30 \text{ mA}$, $T_{vj} = 25^\circ\text{C}$	5	6.2	7.5	V
Collector-Emitter Cut-off Current	I_{CES}	$V_{CE} = 1200 \text{ V}$, $V_{GE} = 0 \text{ V}$, $T_{vj} = 25^\circ\text{C}$			1	mA
Collector-Emitter Saturation Voltage	$V_{CE(sat)}$	$I_C = 600 \text{ A}$, $V_{GE} = 15 \text{ V}$, $T_{vj} = 25^\circ\text{C}$		1.5	1.9	V
		$I_C = 600 \text{ A}$, $V_{GE} = 15 \text{ V}$, $T_{vj} = 125^\circ\text{C}$		1.7		
		$I_C = 600 \text{ A}$, $V_{GE} = 15 \text{ V}$, $T_{vj} = 175^\circ\text{C}$		1.8		
Gate Charge	Q_G	$I_C = 600 \text{ A}$, $V_{GE} = 600 \text{ V}$		5.3		uC
Internal Gate Resistance	R_{Gint}			1.2		Ω
Input Capacitance	C_{ies}	$V_{CE} = 25 \text{ V}$, $V_{GE} = 0 \text{ V}$, $f = 100 \text{ kHz}$, $T_{vj} = 25^\circ\text{C}$		44		nF
Reverse Transfer Capacitance	C_{res}			2.1		nF
Gate-Emitter leakage current	I_{GES}	$V_{CE} = 0 \text{ V}$, $V_{GE} = \pm 20 \text{ V}$, $T_{vj} = 25^\circ\text{C}$	-0.5		0.5	nA
Turn-on Delay Time	$t_{d(on)}$	$I_C = 600 \text{ A}$, $V_{CC} = 600 \text{ V}$, $V_{GE} = \pm 15 \text{ V}$, $R_G = 0.47 \Omega$, $T_{vj} = 25^\circ\text{C}$		120		ns
Rise Time	t_r			60		ns
Turn-off Delay Time	$t_{d(off)}$	$I_C = 600 \text{ A}$, $V_{CC} = 600 \text{ V}$, $V_{GE} = \pm 15 \text{ V}$, $R_G = 1.5 \Omega$, $T_{vj} = 25^\circ\text{C}$		575		ns
Fall Time	t_f			165		ns
Energy Dissipation During Turn-on Time	E_{on}	$I_C = 600 \text{ A}$, $V_{CC} = 600 \text{ V}$, $V_{GE} = \pm 15 \text{ V}$, $R_G = 0.47 \Omega$, $T_{vj} = 25^\circ\text{C}$		20		mJ
Energy Dissipation During Turn-off Time	E_{off}	$I_C = 600 \text{ A}$, $V_{CC} = 600 \text{ V}$, $V_{GE} = \pm 15 \text{ V}$, $R_G = 1.5 \Omega$, $T_{vj} = 25^\circ\text{C}$		66		mJ
Turn-on Delay Time	$t_{d(on)}$	$I_C = 600 \text{ A}$, $V_{CE} = 600 \text{ V}$, $V_{GE} = \pm 15 \text{ V}$, $R_G = 0.47 \Omega$, $T_{vj} = 125^\circ\text{C}$		130		ns
Rise Time	t_r			58		ns
Turn-off Delay Time	$t_{d(off)}$	$I_C = 600 \text{ A}$, $V_{CE} = 900 \text{ V}$, $V_{GE} = \pm 15 \text{ V}$, $R_G = 1.5 \Omega$, $T_{vj} = 125^\circ\text{C}$		145		ns
Fall Time	t_f			290		ns
Energy Dissipation During Turn-on Time	E_{on}	$I_C = 600 \text{ A}$, $V_{CC} = 600 \text{ V}$, $V_{GE} = \pm 15 \text{ V}$, $R_G = 0.47 \Omega$, $T_{vj} = 125^\circ\text{C}$		50		mJ
Energy Dissipation During Turn-off Time	E_{off}	$I_C = 600 \text{ A}$, $V_{CC} = 600 \text{ V}$, $V_{GE} = \pm 15 \text{ V}$, $R_G = 1.5 \Omega$, $T_{vj} = 125^\circ\text{C}$		90		mJ
Turn-on Delay Time	$t_{d(on)}$	$I_C = 600 \text{ A}$, $V_{CE} = 900 \text{ V}$, $V_{GE} = \pm 15 \text{ V}$, $R_G = 1.5 \Omega$, $T_{vj} = 175^\circ\text{C}$		150		ns
Rise Time	t_r			62		ns
Turn-off Delay Time	$t_{d(off)}$	$I_C = 600 \text{ A}$, $V_{CC} = 600 \text{ V}$, $V_{GE} = \pm 15 \text{ V}$, $R_G = 0.47 \Omega$, $T_{vj} = 175^\circ\text{C}$		155		ns
Fall Time	t_f			335		ns
Energy Dissipation During Turn-on Time	E_{on}	$I_C = 600 \text{ A}$, $V_{CC} = 600 \text{ V}$, $V_{GE} = \pm 15 \text{ V}$, $R_G = 0.47 \Omega$, $T_{vj} = 175^\circ\text{C}$		73		mJ
Energy Dissipation During Turn-off Time	E_{off}	$I_C = 600 \text{ A}$, $V_{CC} = 600 \text{ V}$, $V_{GE} = \pm 15 \text{ V}$, $R_G = 1.5 \Omega$, $T_{vj} = 175^\circ\text{C}$		100		mJ
SC Data	I_{sc}	$T_p \leq 10 \text{ us}$, $V_{GE} = 15 \text{ V}$, $T_{vj} = 175^\circ\text{C}$, $V_{cc} = 800 \text{ V}$, $V_{CEM} \leq 1200 \text{ V}$		2000		A

● Diode

Absolute Maximum Ratings

Parameter	Symbol	Conditions	Value	Unit
Repetitive Peak Reverse Voltage	V_{RRM}	$T_{vj} = 25\text{ °C}$	1200	V
Continuous DC Forward Current	I_F		600	A
Repetitive Peak Forward Current	I_{FRM}	$t_p = 1\text{ ms}$	1200	A
I^2t -value	I^2t	$V_R = 0\text{ V}$, $t_p = 10\text{ ms}$, $T_j = 150\text{ °C}$	37500	A ² s

Characteristic values

Parameter	Symbol	Conditions	Value			Unit
			Min.	Typ.	Max.	
Forward Voltage	V_F	$I_F = 600\text{ A}$, $T_{vj} = 25\text{ °C}$		1.85	2.3	V
		$I_F = 600\text{ A}$, $T_{vj} = 125\text{ °C}$		1.95		
		$I_F = 600\text{ A}$, $T_{vj} = 175\text{ °C}$		2		
Recovered Charge	Q_{rr}	$I_F = 600\text{ A}$ $V_R = 600\text{ V}$ $-di_F/dt = 9000\text{ A/us}$ $T_{vj} = 25\text{ °C}$		53		uC
Peak Reverse Recovery Current	I_{rr}			485		A
Reverse Recovery Energy	E_{rec}			27		mJ
Recovered Charge	Q_{rr}	$I_F = 600\text{ A}$ $V_R = 600\text{ V}$ $-di_F/dt = 9000\text{ A/us}$ $T_{vj} = 125\text{ °C}$		75		uC
Peak Reverse Recovery Current	I_{rr}			570		A
Reverse Recovery Energy	E_{rec}			43		mJ
Recovered Charge	Q_{rr}	$I_F = 600\text{ A}$ $V_R = 600\text{ V}$ $-di_F/dt = 9000\text{ A/us}$ $T_{vj} = 175\text{ °C}$		133		uC
Peak Reverse Recovery Current	I_{rr}			585		A
Reverse Recovery Energy	E_{rec}			55		mJ

● Module Characteristics

$T_c=25^{\circ}\text{C}$ unless otherwise specified

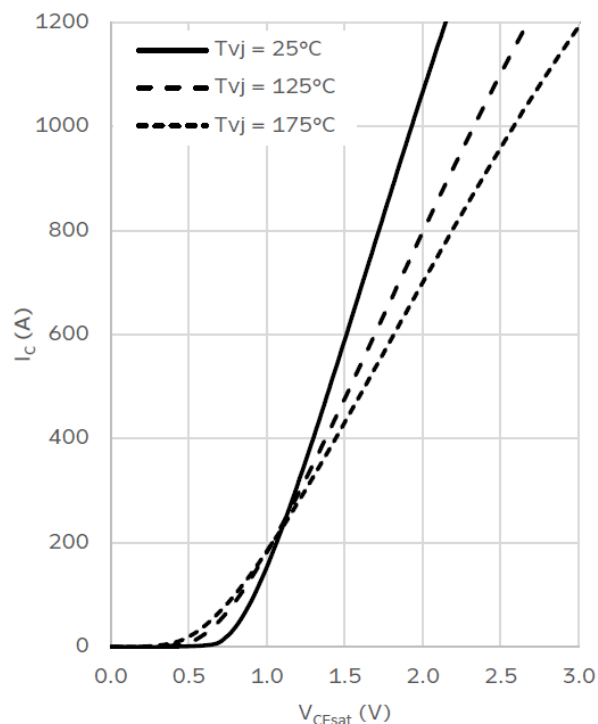
Parameter	Symbol	Conditions	Value			Unit
			Min.	Typ.	Max.	
Isolation voltage	V_{isol}	$t=1\text{ min, }f=50\text{ Hz}$			3400	V
Maximum Junction Temperature	T_{jmax}				175	$^{\circ}\text{C}$
Operating Junction Temperature	$T_{\text{vj(op)}}$		-40		175	$^{\circ}\text{C}$
Storage Temperature	T_{stg}		-40		125	$^{\circ}\text{C}$
Thermal Resistance Junction-to Case	$R_{\theta\text{JC}}$	per IGBT			0.046	K/W
		per Diode			0.077	
Comparative Tracking Index	CTI		200			
Thermal Resistance Case-to Sink	$R_{\theta\text{CS}}$	Conductive grease applied		0.030		K/W
Module Electrodes Torque	M_t	Recommended(M6)	3		6	N·m
Module-to-Sink Torque	M_s	Recommended(M5)	3		6	N·m
Mass	m			350		g

Characteristics

IGBT on-state characteristics (typical)

$$I_C = f(V_{CE})$$

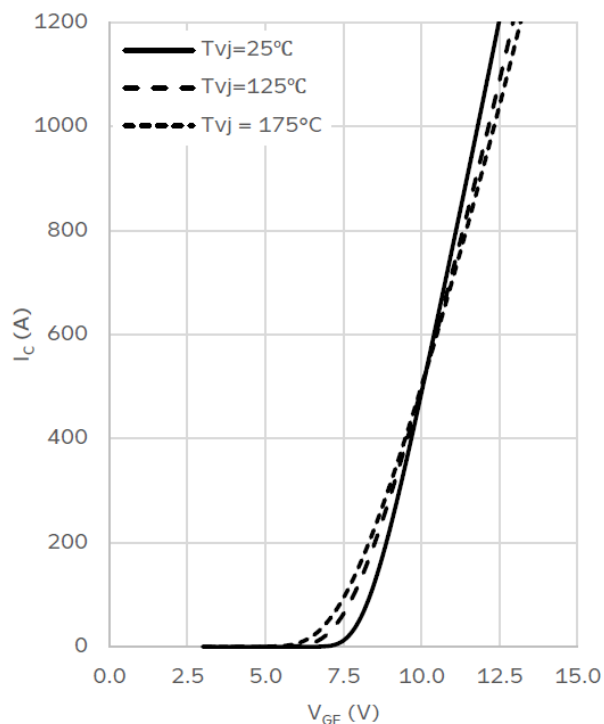
$$V_{GE} = 15 \text{ V}$$



IGBT transfer characteristics (typical)

$$I_C = f(V_{GE})$$

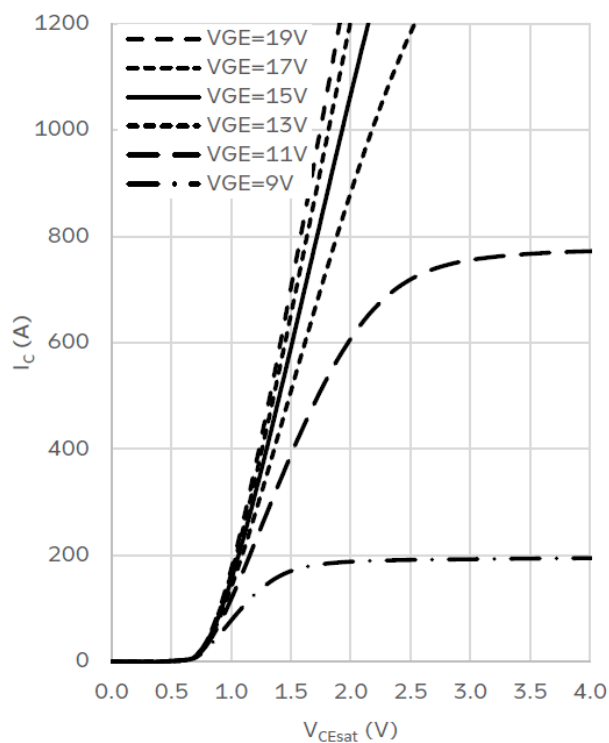
$$V_{CE} = 20 \text{ V}$$



IGBT output characteristics (typical)

$$I_C = f(V_{CE})$$

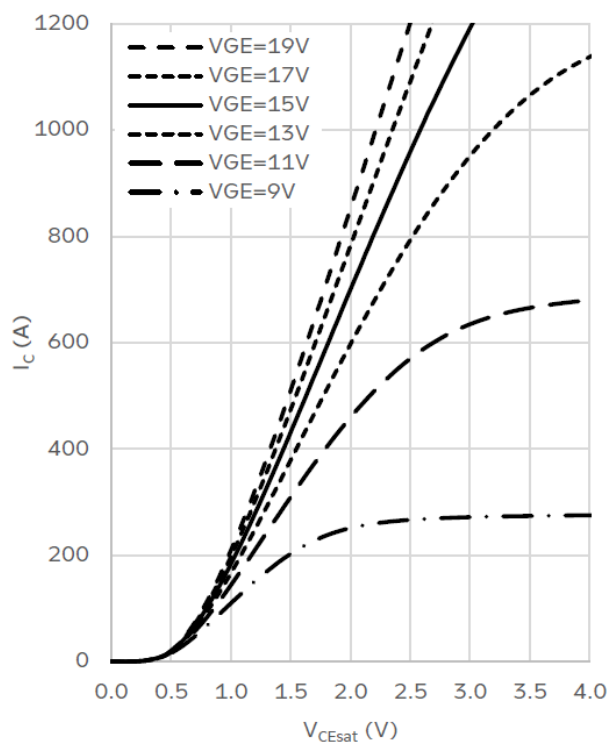
$$T_{vj} = 25^\circ\text{C}$$



IGBT output characteristics (typical)

$$I_C = f(V_{CE})$$

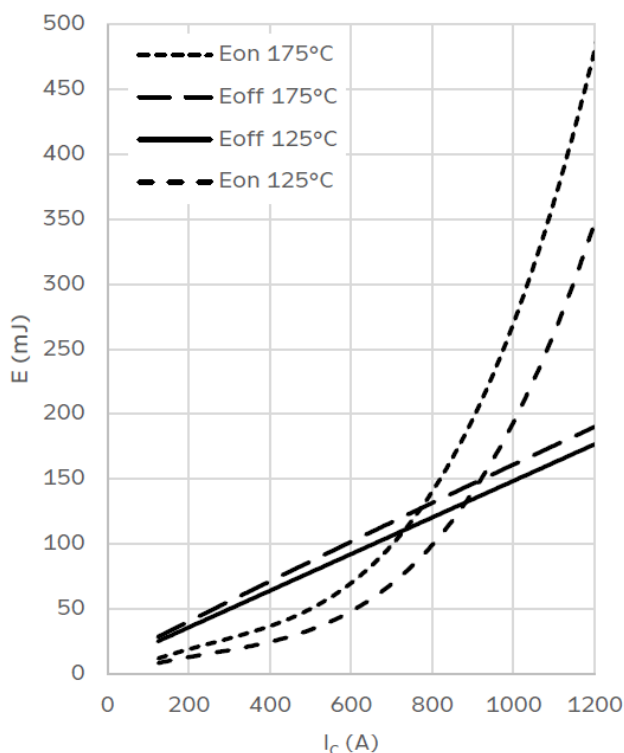
$$T_{vj} = 175^\circ\text{C}$$



IGBT switching losses (typical)

$E = f(I_{CE})$

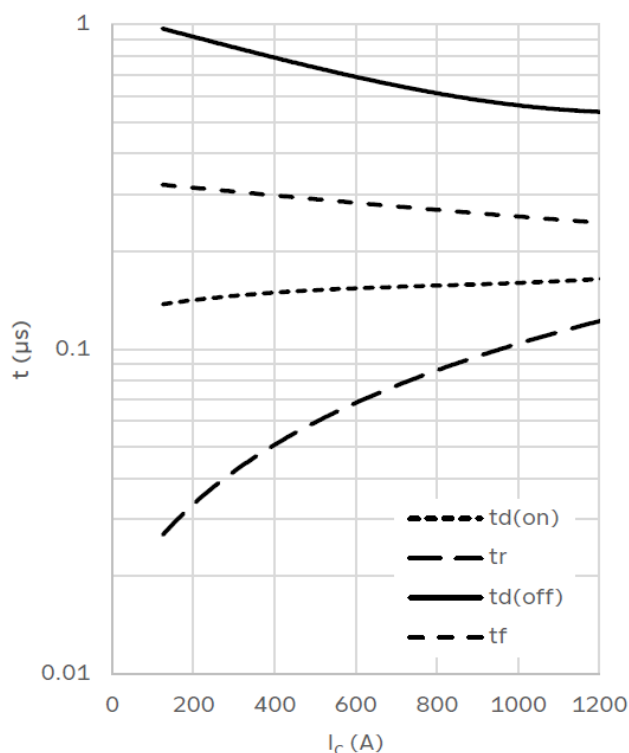
$V_{CE} = 600 \text{ V}$, $R_{Gon} = 0.47 \text{ } \Omega$, $R_{Goff} = 1.5 \text{ } \Omega$, $V_{GE} = -15/+15 \text{ V}$



IGBT switching times (typical)

$t = f(I_{CE})$, $T_{vj} = 175 \text{ } ^\circ\text{C}$

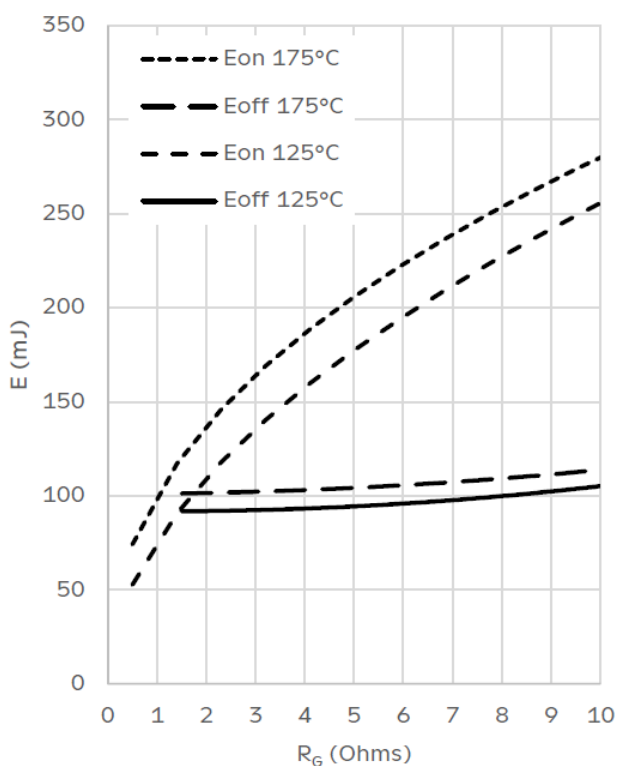
$V_{CE} = 600 \text{ V}$, $R_{Gon} = 0.47 \text{ } \Omega$, $R_{Goff} = 1.5 \text{ } \Omega$, $V_{GE} = -15/+15 \text{ V}$



IGBT switching losses (typical)

$E = f(R_G)$

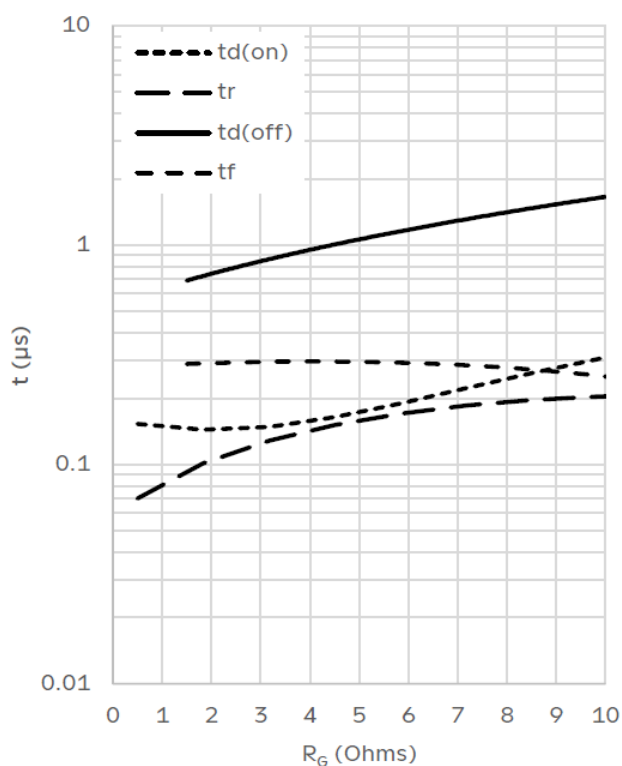
$V_{CE} = 600 \text{ V}$, $I_C = 600 \text{ A}$, $V_{GE} = -15/+15 \text{ V}$



IGBT switching times (typical)

$t = f(R_G)$, $T_{vj} = 175 \text{ } ^\circ\text{C}$

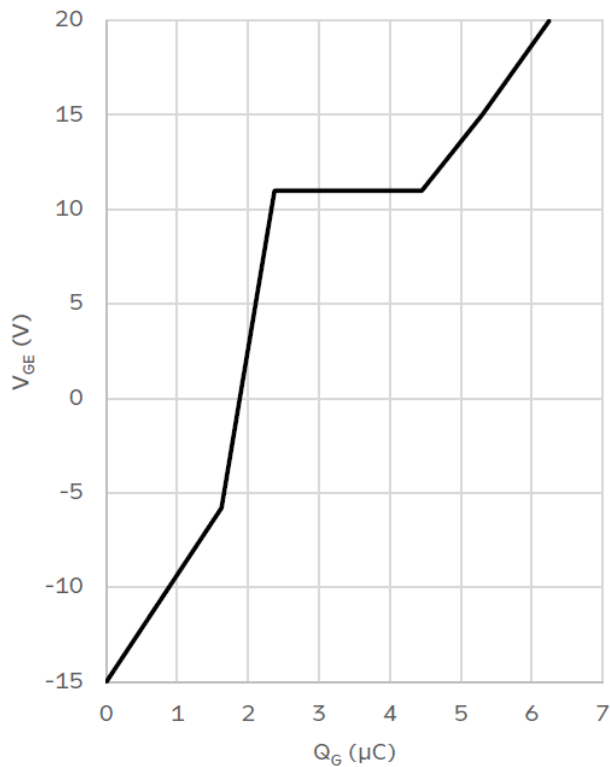
$V_{CE} = 600 \text{ V}$, $I_C = 600 \text{ A}$, $V_{GE} = -15/+15 \text{ V}$



IGBT gate charge (typical)

$V_{GE} = f(Q_G)$, $T_{vj} = 25\text{ °C}$

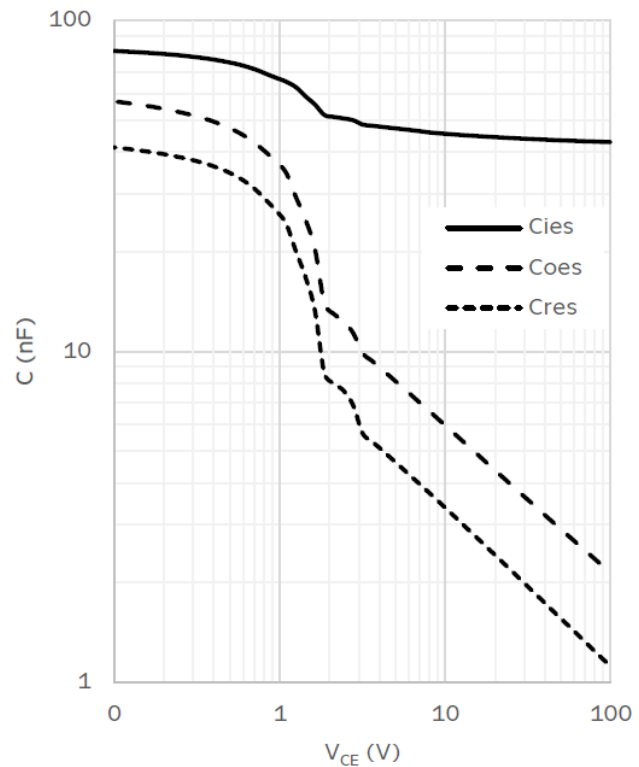
$V_{CE} = 600\text{ V}$, $I_C = 600\text{ A}$



Capacitance characteristics (typical)

$C = f(V_{CE})$, $T_{vj} = 25\text{ °C}$

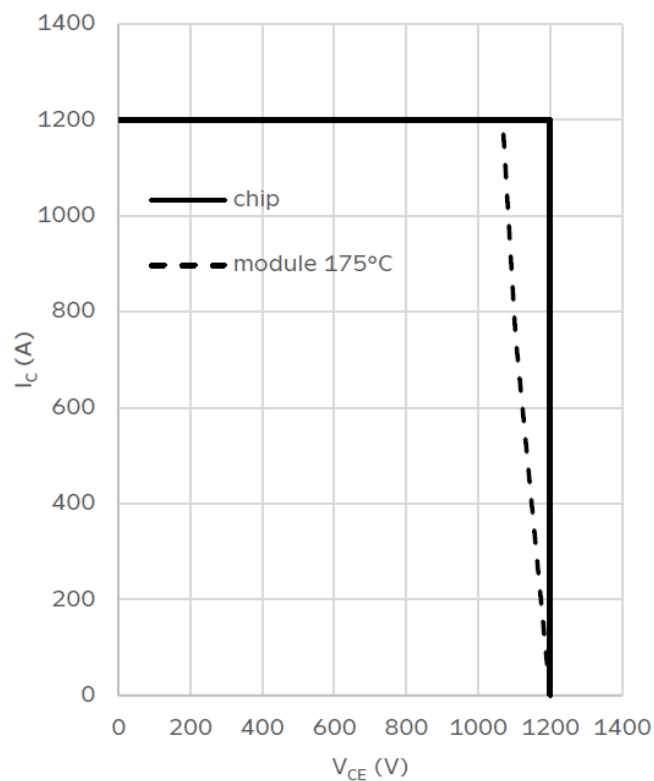
$f = 100\text{ kHz}$, $V_{GE} = 0\text{ V}$



IGBT RBSOA

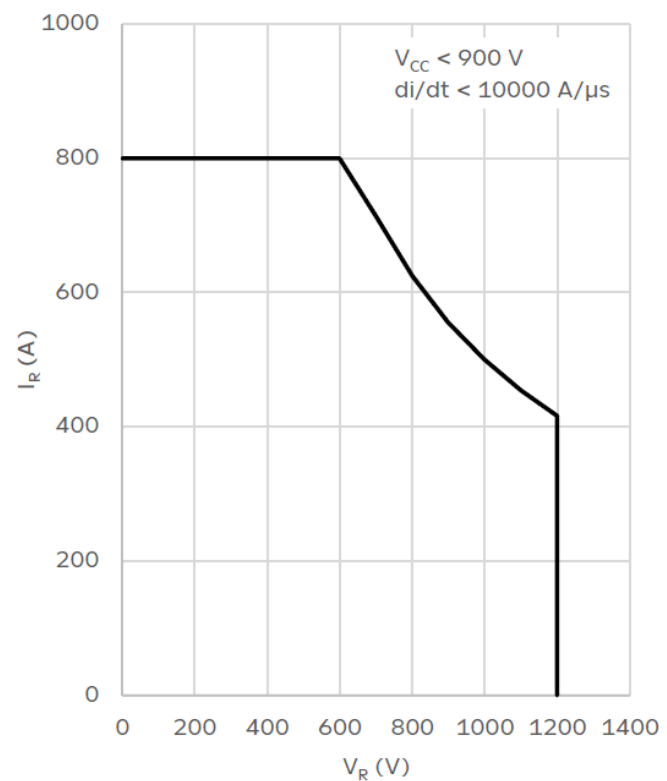
$I_C = f(V_{CEM})$

$R_{Goff} = 1.5\text{ }\Omega$, $V_{GE} = \pm 15\text{ V}$



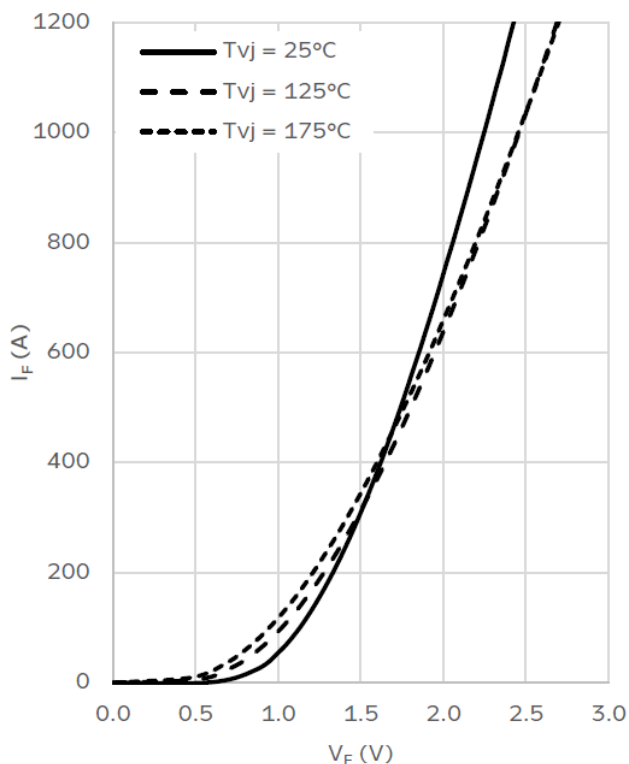
Diode SOA

$T_{vj} \leq 175\text{ °C}$



Diode forward characteristic (typical)

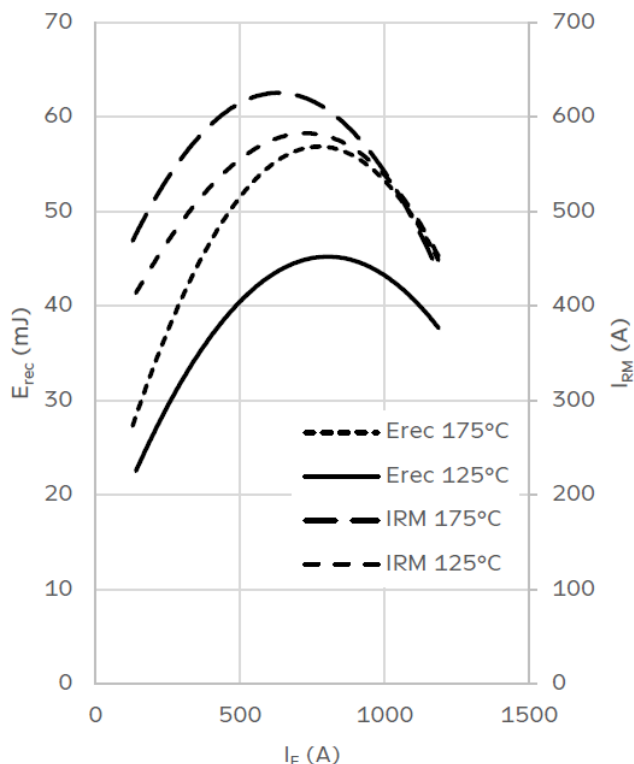
$$I_F = f(V_F)$$



Diode switching characteristics (typical)

$$E_{rec} = f(I_F), I_{RM} = f(I_F)$$

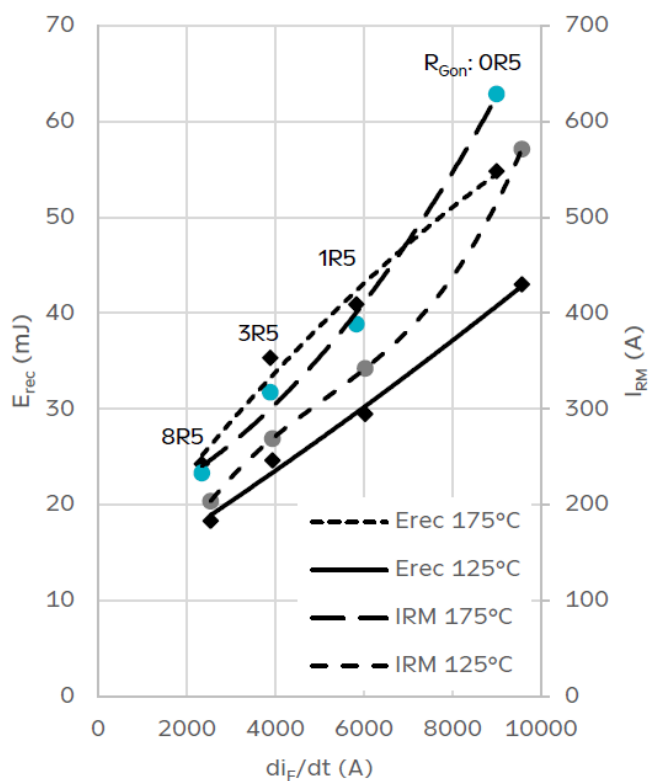
$$V_{DC} = 600 \text{ V}, R_{Gon} = 0.47 \Omega \text{ (IGBT)}, V_{GE} = -15/+15 \text{ V (IGBT)}$$



Diode switching characteristics (typical)

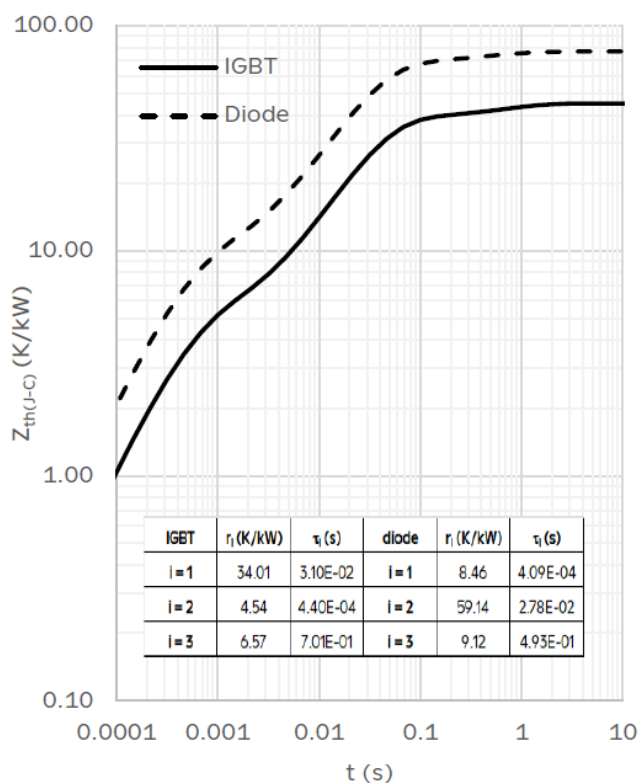
$$E_{rec} = f(di/dt), I_{RM} = f(di/dt)$$

$$V_{DC} = 600 \text{ V}, I_F = 600 \text{ A}, V_{GE} = -15/+15 \text{ V (IGBT)}$$

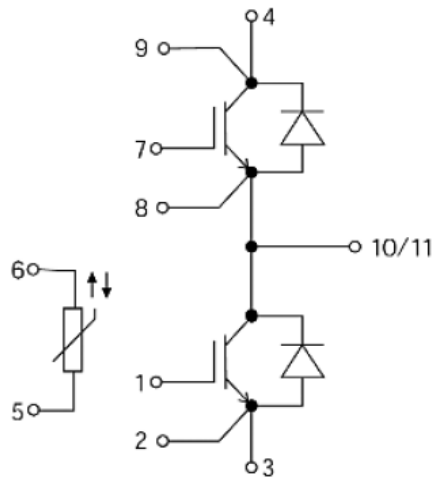


Thermal Impedance

$$Z_{th(j-c)} = f(t)$$



● Circuit Diagram



● Package Outline Information

