



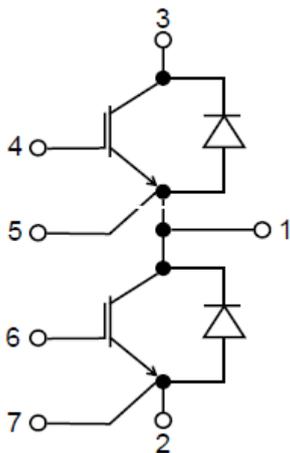
IGBT Modules

V_{CES} 1200V
 I_c 200A

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}	$V_{GE} = 0 V, I_c = 1 mA, T_{vj} = 25 ^\circ C$	1200	V
Continuous Collector Current	I_c	$T_c = 100 ^\circ C$	200	A
Repetitive Peak Collector Current	I_{CRM}	$T_p = 1 ms$	400	A
Gate-Emitter Voltage	V_{GES}	$T_{vj} = 25 ^\circ C$	± 20	V
Total Power Dissipation	P_{tot}	$T_c = 25 ^\circ C$ $T_{vjmax} = 175 ^\circ C$	1115	W

Characteristic values

Parameter	Symbol	Conditions	Value			Unit
			Min.	Typ.	Max.	
Gate-emitter Threshold Voltage	$V_{GE(th)}$	$V_{GE} = V_{CE}, I_C = 22.5 \text{ mA}, T_{vj} = 25 \text{ }^\circ\text{C}$	5	5.9	7.1	V
Collector-Emitter Cut-off Current	I_{CES}	$V_{CE} = 1200 \text{ V}, V_{GE} = 0 \text{ V}, T_{vj} = 25 \text{ }^\circ\text{C}$			1	mA
Collector-Emitter Saturation Voltage	$V_{CE(sat)}$	$I_C = 200 \text{ A}, V_{GE} = 15 \text{ V}, T_{vj} = 25 \text{ }^\circ\text{C}$		1.68	2	V
		$I_C = 200 \text{ A}, V_{GE} = 15 \text{ V}, T_{vj} = 125 \text{ }^\circ\text{C}$		2		
		$I_C = 200 \text{ A}, V_{GE} = 15 \text{ V}, T_{vj} = 175 \text{ }^\circ\text{C}$		2.15		
Gate Charge	Q_G			1.7		uC
Internal Gate Resistance	R_{Gint}			3.45		Ω
Input Capacitance	C_{ies}	$V_{CE} = 25 \text{ V}, V_{GE} = 0 \text{ V}, f = 100 \text{ kHz}, T_{vj} = 25 \text{ }^\circ\text{C}$		11.8		nF
Reverse Transfer Capacitance	C_{res}			0.5		nF
Gate-Emitter leakage current	I_{GES}	$V_{CE} = 0 \text{ V}, V_{GE} = \pm 20 \text{ V}, T_{vj} = 25 \text{ }^\circ\text{C}$			500	nA
Turn-on Delay Time	$t_{d(on)}$	$I_C = 200 \text{ A}, V_{CC} = 600 \text{ V}, V_{GE} = \pm 15 \text{ V}, R_G = 2 \text{ } \Omega, T_{vj} = 25 \text{ }^\circ\text{C}$		140		ns
Rise Time	t_r			33		ns
Turn-off Delay Time	$t_{d(off)}$	$I_C = 200 \text{ A}, V_{CC} = 600 \text{ V}, V_{GE} = \pm 15 \text{ V}, R_G = 2 \text{ } \Omega, T_{vj} = 25 \text{ }^\circ\text{C}$		480		ns
Fall Time	t_f			245		ns
Energy Dissipation During Turn-on Time	E_{on}	$I_C = 200 \text{ A}, V_{CC} = 600 \text{ V}, V_{GE} = \pm 15 \text{ V}, R_G = 2 \text{ } \Omega, T_{vj} = 25 \text{ }^\circ\text{C}$		15		mJ
Energy Dissipation During Turn-off Time	E_{off}	$I_C = 200 \text{ A}, V_{CC} = 600 \text{ V}, V_{GE} = \pm 15 \text{ V}, R_G = 2 \text{ } \Omega, T_{vj} = 25 \text{ }^\circ\text{C}$		21		mJ
Turn-on Delay Time	$t_{d(on)}$	$I_C = 200 \text{ A}, V_{CE} = 600 \text{ V}, V_{GE} = \pm 15 \text{ V}, R_G = 2 \text{ } \Omega, T_{vj} = 125 \text{ }^\circ\text{C}$		150		ns
Rise Time	t_r			36		ns
Turn-off Delay Time	$t_{d(off)}$	$I_C = 200 \text{ A}, V_{CE} = 600 \text{ V}, V_{GE} = \pm 15 \text{ V}, R_G = 2 \text{ } \Omega, T_{vj} = 125 \text{ }^\circ\text{C}$		550		ns
Fall Time	t_f			355		ns
Energy Dissipation During Turn-on Time	E_{on}	$I_C = 200 \text{ A}, V_{CC} = 600 \text{ V}, V_{GE} = \pm 15 \text{ V}, R_G = 2 \text{ } \Omega, T_{vj} = 125 \text{ }^\circ\text{C}$		25		mJ
Energy Dissipation During Turn-off Time	E_{off}	$I_C = 200 \text{ A}, V_{CC} = 600 \text{ V}, V_{GE} = \pm 15 \text{ V}, R_G = 2 \text{ } \Omega, T_{vj} = 125 \text{ }^\circ\text{C}$		28		mJ
Turn-on Delay Time	$t_{d(on)}$	$I_C = 200 \text{ A}, V_{CE} = 600 \text{ V}, V_{GE} = \pm 15 \text{ V}, R_G = 2 \text{ } \Omega, T_{vj} = 175 \text{ }^\circ\text{C}$		155		ns
Rise Time	t_r			41		ns
Turn-off Delay Time	$t_{d(off)}$	$I_C = 200 \text{ A}, V_{CC} = 600 \text{ V}, V_{GE} = \pm 15 \text{ V}, R_G = 2 \text{ } \Omega, T_{vj} = 175 \text{ }^\circ\text{C}$		580		ns
Fall Time	t_f			398		ns
Energy Dissipation During Turn-on Time	E_{on}	$I_C = 200 \text{ A}, V_{CC} = 600 \text{ V}, V_{GE} = \pm 15 \text{ V}, R_G = 2 \text{ } \Omega, T_{vj} = 175 \text{ }^\circ\text{C}$		27		mJ
Energy Dissipation During Turn-off Time	E_{off}	$I_C = 200 \text{ A}, V_{CC} = 600 \text{ V}, V_{GE} = \pm 15 \text{ V}, R_G = 2 \text{ } \Omega, T_{vj} = 175 \text{ }^\circ\text{C}$		31		mJ
SC Data	I_{sc}	$T_p = 10 \text{ } \mu\text{s}, V_{GE} = 15 \text{ V}, T_{vj} = 150 \text{ }^\circ\text{C}, V_{CC} = 900 \text{ V}, V_{CEM} = 1200 \text{ V}$		760		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		200	A
Repetitive Peak Forward Current	I_{FRM}	$t_p = 1\text{ ms}$	400	A
I^2t -value	I^2t	$V_R = 0\text{ V}, t_p = 10\text{ ms}, T_j = 125\text{ °C}$	2550	A^2s
		$V_R = 0\text{ V}, t_p = 10\text{ ms}, T_j = 150\text{ °C}$	2500	

Characteristic values

Parameter	Symbol	Conditions	Value			Unit
			Min.	Typ.	Max.	
Forward Voltage	V_F	$I_F = 200\text{ A}, T_{vj} = 25\text{ °C}$		1.75	2.5	V
		$I_F = 200\text{ A}, T_{vj} = 125\text{ °C}$		1.85		
		$I_F = 200\text{ A}, T_{vj} = 175\text{ °C}$		1.85		
Recovered Charge	Q_{rr}	$I_F = 200\text{ A}$ $V_R = 600\text{ V}$		16		μC
Peak Reverse Recovery Current	I_{rr}	$-di_F/dt = 6600\text{ A/us}$ $T_{vj} = 25\text{ °C}$		200		A
Reverse Recovery Energy	E_{rec}			5		mJ
Recovered Charge	Q_{rr}	$I_F = 200\text{ A}$ $V_R = 600\text{ V}$		30		μC
Peak Reverse Recovery Current	I_{rr}	$-di_F/dt = 6600\text{ A/us}$ $T_{vj} = 125\text{ °C}$		230		A
Reverse Recovery Energy	E_{rec}			10		mJ
Recovered Charge	Q_{rr}	$I_F = 200\text{ A}$ $V_R = 600\text{ V}$		36		μC
Peak Reverse Recovery Current	I_{rr}	$-di_F/dt = 6600\text{ A/us}$ $T_{vj} = 175\text{ °C}$		238		A
Reverse Recovery Energy	E_{rec}			12		mJ

● Module Characteristics

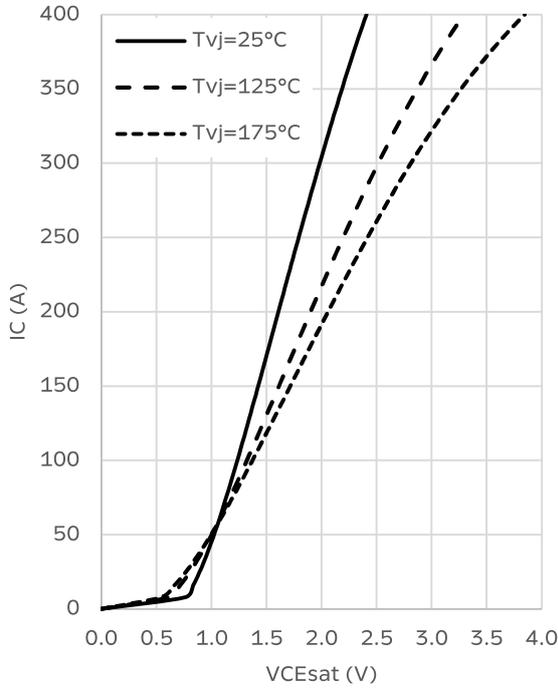
$T_c=25^{\circ}\text{C}$ unless otherwise specified

Parameter	Symbol	Conditions	Value			Unit
			Min.	Typ.	Max.	
Isolation voltage	V_{isol}	$t = 1 \text{ min}, f = 50 \text{ Hz}$			4000	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_{JC}	per IGBT			0.138	K/W
		per Diode			0.207	
Comparative Tracking Index	CTI		>400			
Thermal Resistance Case-to Sink	R_{CS}	Conductive grease applied		0.045		K/W
Module Electrodes Torque	M_t	Recommended(M6)	2.5		5.0	N·m
Module-to-Sink Torque	M_s	Recommended(M5)	3.0		6.0	N·m
Mass	m			310		g

Characteristics

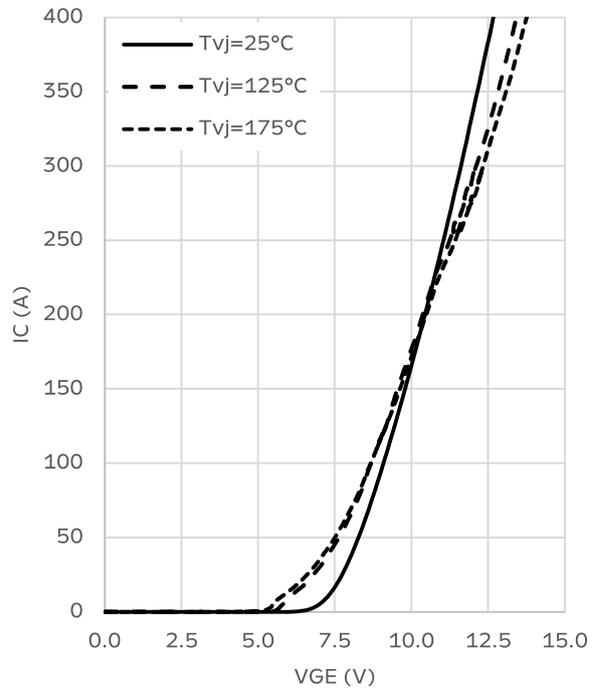
IGBT on-state characteristics (typical)

$I_c = f(V_{CE})$
 $V_{GE} = 15\text{ V}$



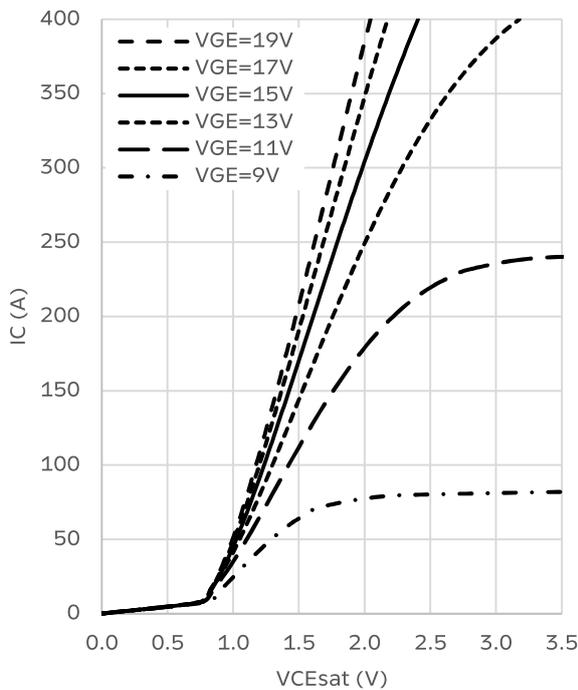
IGBT transfer characteristics (typical)

$I_c = f(V_{GE})$
 $V_{CE} = 20\text{ V}$



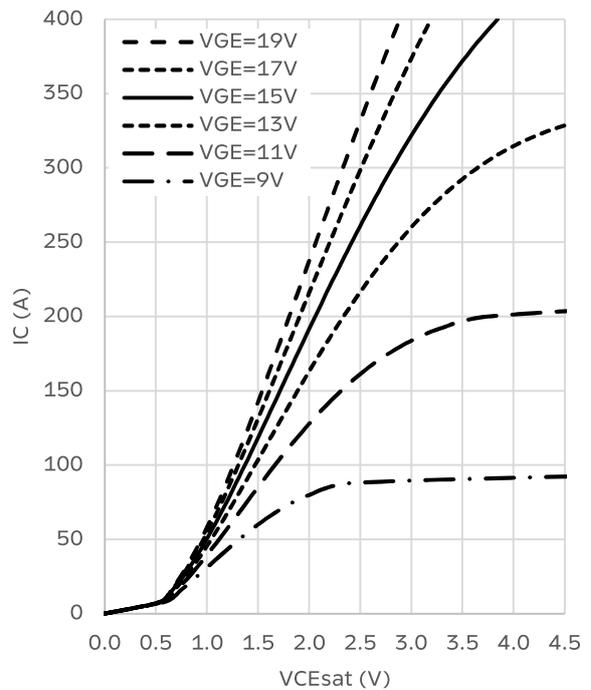
IGBT output characteristics (typical)

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



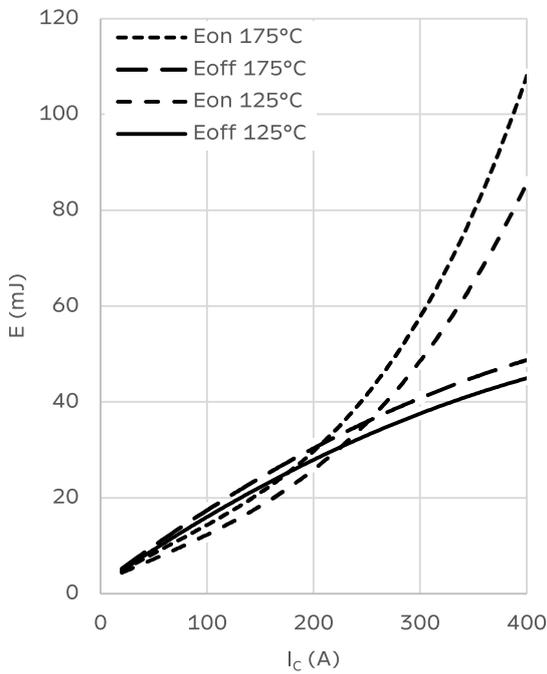
IGBT output characteristics (typical)

$I_c = f(V_{CE})$
 $T_{vj} = 175\text{ °C}$



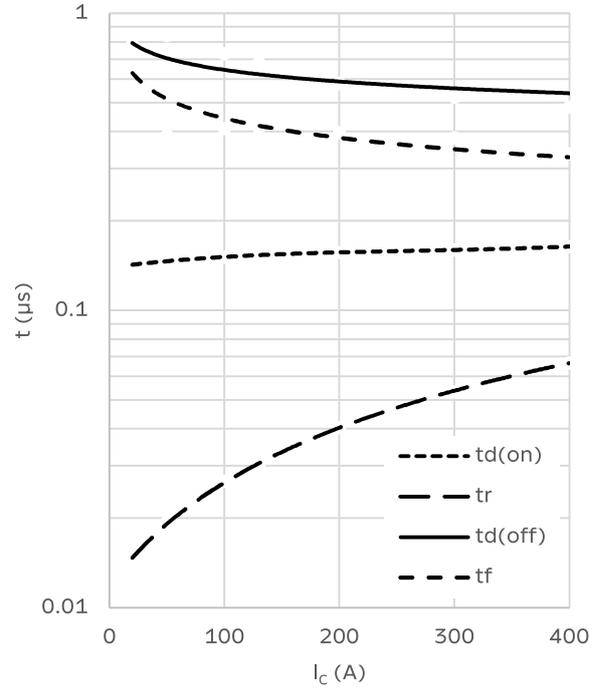
IGBT switching losses (typical)

$E = f(I_{CE})$
 $V_{CE} = 600 \text{ V}, R_{Gon} = 2 \Omega, R_{Goff} = 5.5 \Omega, V_{GE} = -15/+15 \text{ V}$



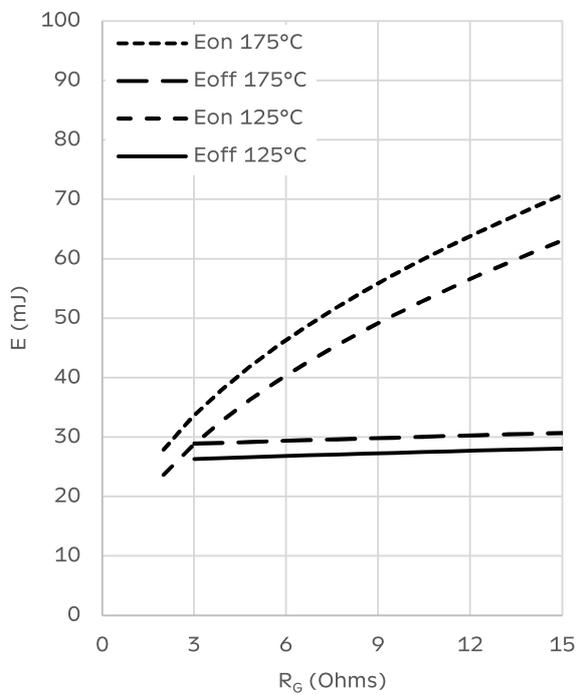
IGBT switching times (typical)

$t = f(I_{CE}), T_{vj} = 175 \text{ °C}$
 $V_{CE} = 600 \text{ V}, R_{Gon} = 2 \Omega, R_{Goff} = 5.5 \Omega, V_{GE} = -15/+15 \text{ V}$



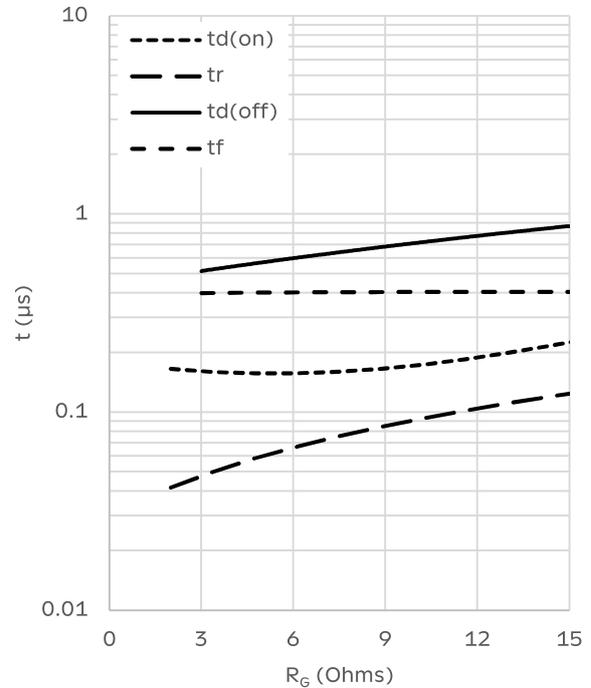
IGBT switching losses (typical)

$E = f(R_G)$
 $V_{CE} = 600 \text{ V}, I_C = 200 \text{ A}, V_{GE} = -15/+15 \text{ V}$



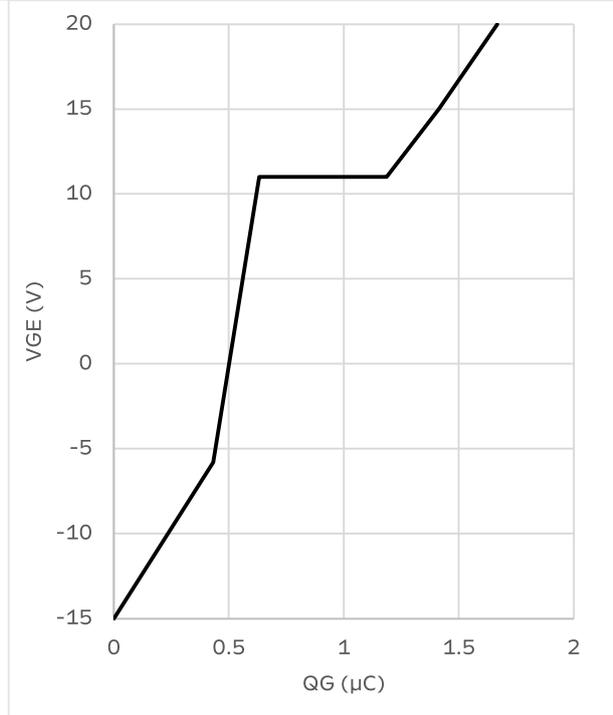
IGBT switching times (typical)

$t = f(R_G), T_{vj} = 175 \text{ °C}$
 $V_{CE} = 600 \text{ V}, I_C = 200 \text{ A}, V_{GE} = -15/+15 \text{ V}$



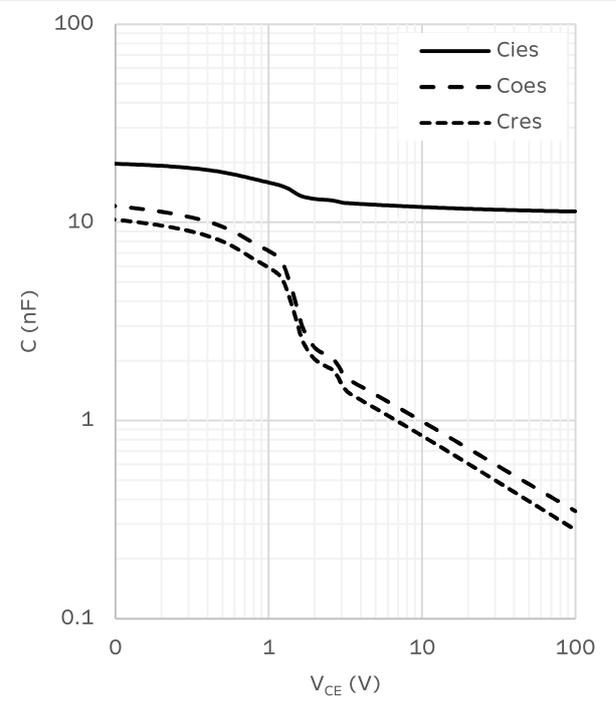
IGBT gate charge (typical)

$V_{GE} = f(Q_G)$, $T_{vj} = 25\text{ }^\circ\text{C}$
 $V_{CE} = 600\text{ V}$, $I_C = 200\text{ A}$



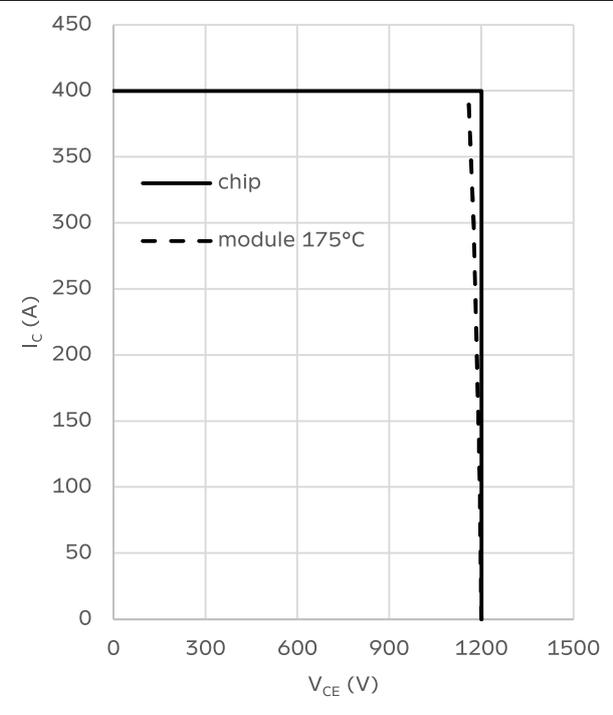
Capacitance characteristics (typical)

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



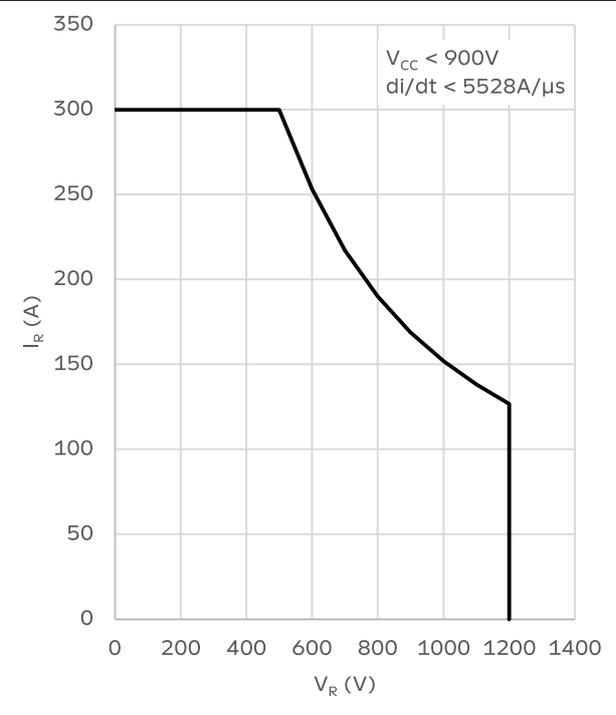
IGBT RBSOA

$I_C = f(V_{CEm})$
 $R_{Goff} = 5.5\text{ }\Omega$, $V_{GE} = \pm 15\text{ V}$



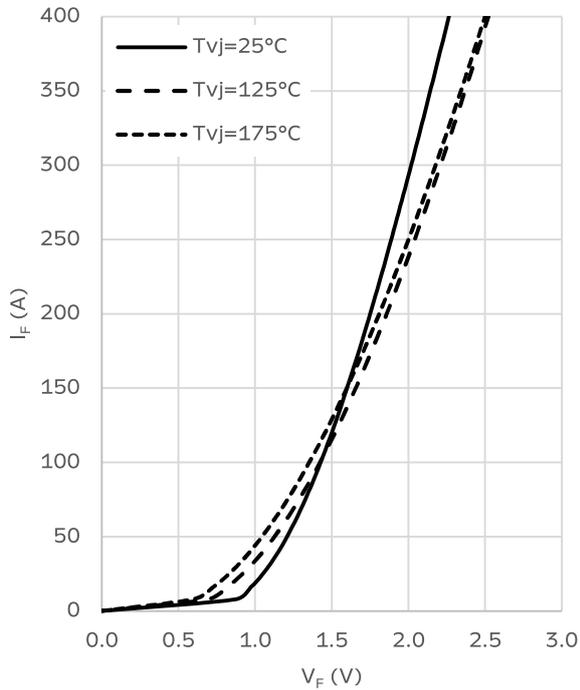
Diode SOA

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



Diode forward characteristic (typical)

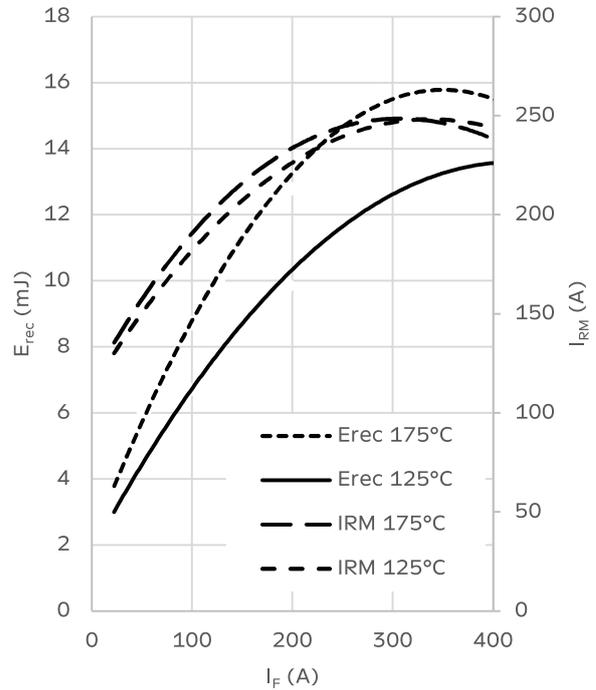
$I_F = f(V_F)$



Diode switching characteristics (typical)

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

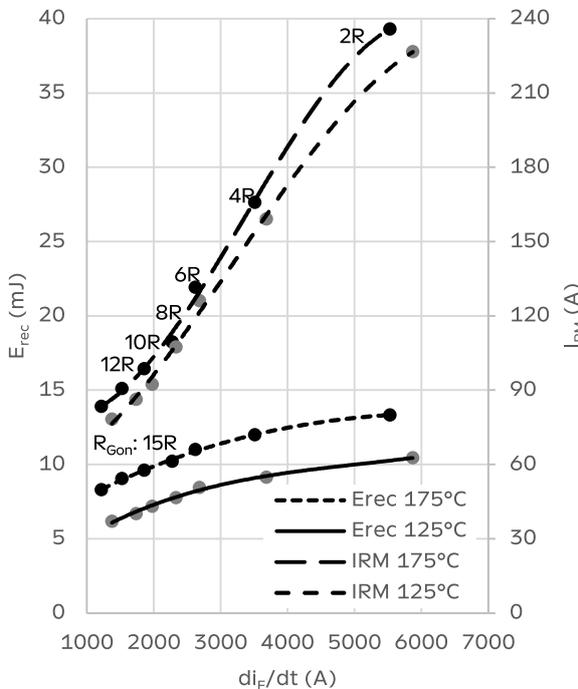
$V_{DC} = 600\text{ V}, R_{Gon} = 2\ \Omega$ (IGBT), $V_{GE} = -15/+15\text{ V}$ (IGBT)



Diode switching characteristics (typical)

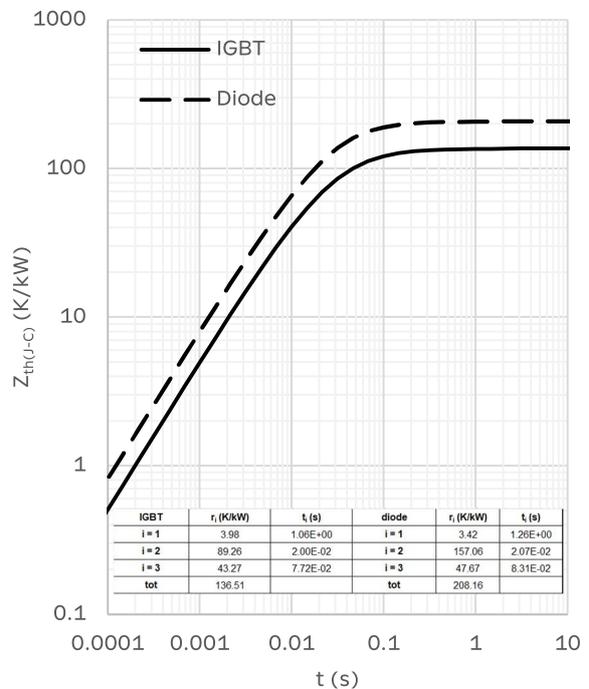
$E_{rec} = f(di/dt), I_{RM} = f(di/dt)$

$V_{DC} = 600\text{ V}, I_F = 200\text{ A}, V_{GE} = -15/+15\text{ V}$ (IGBT)

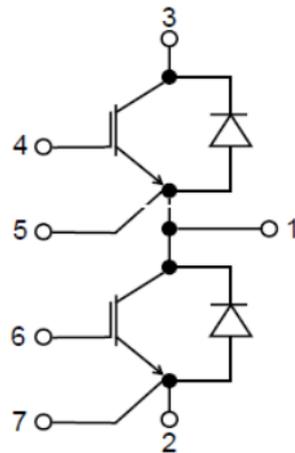


Thermal impedance (typical)

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



● **Circuit Diagram**



● **Package Outline Information**

