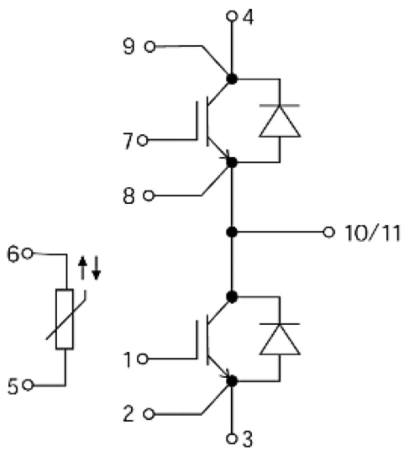
IGBT Modules

V_{CES} 1700V
I_C 450A

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 °C	1700	V
Continuous Collector Current	I_C	T_c = 115 °C, T_{vj} = 175 °C	450	A
Repetitive Peak Collector Current	I_{CRM}	Tp = 1 ms	1200	A
Gate-Emitter Voltage	V_{GES}	T_{vj} = 25 °C	±20	V
Total Power Dissipation	P_{tot}	T_c = 25 °C T_{vjmax} = 175 °C	2500	W

Characteristic values

Parameter	Symbol	Conditions	Value			Unit
			Min.	Typ.	Max.	
Gate-emitter Threshold Voltage	$V_{GE(th)}$	$V_{GE} = V_{CE}$, $I_C = 25$ mA, $T_{vj} = 25$ °C	5	6.10	7.5	V
Collector-Emitter Cut-off Current	I_{CES}	$V_{CE} = 1700$ V, $V_{GE} = 0$ V, $T_{vj} = 25$ °C			1	mA
Collector-Emitter Saturation Voltage	$V_{CE(sat)}$	$I_c = 450$ A, $V_{GE} = 15$ V, $T_{vj} = 25$ °C		1.7	2	V
		$I_c = 450$ A, $V_{GE} = 15$ V, $T_{vj} = 125$ °C		2		
		$I_c = 450$ A, $V_{GE} = 15$ V, $T_{vj} = 175$ °C		2.16		
Gate Charge	Q_G	$I_c = 450$ A, $V_{GE} = 900$ V		3		uC
Internal Gate Resistance	R_{Gint}			2.1		Ω
Input Capacitance	C_{ies}	$V_{CE} = 25$ V, $V_{GE} = 0$ V, f = 100 kHz, $T_{vj} = 25$ °C		30.6		nF
Reverse Transfer Capacitance	C_{res}			0.93		nF
Gate-Emitter leakage current	I_{GES}	$V_{CE} = 0$ V, $V_{GE} = \pm 20$ V, $T_{vj} = 25$ °C	-0.5		0.5	nA
Turn-on Delay Time	$t_{d(on)}$	$I_C = 450$ A, $V_{CC} = 900$ V, $V_{GE} = \pm 15$ V, $R_G = 2$ Ω, $T_{vj} = 25$ °C		142		ns
Rise Time	t_r			48		ns
Turn-off Delay Time	$t_{d(off)}$	$I_C = 450$ A, $V_{CC} = 900$ V, $V_{GE} = \pm 15$ V, $R_G = 2$ Ω, $T_{vj} = 25$ °C		528		ns
Fall Time	t_f			380		ns
Energy Dissipation During Turn-on Time	E_{on}	$I_C = 450$ A, $V_{CC} = 900$ V, $V_{GE} = \pm 15$ V, $R_G = 2$ Ω, $T_{vj} = 25$ °C		111		mJ
Energy Dissipation During Turn-off Time	E_{off}	$I_C = 450$ A, $V_{CC} = 900$ V, $V_{GE} = \pm 15$ V, $R_G = 2$ Ω, $T_{vj} = 25$ °C		95		mJ
Turn-on Delay Time	$t_{d(on)}$	$I_C = 450$ A, $V_{CE} = 900$ V, $V_{GE} = \pm 15$ V, $R_G = 2$ Ω, $T_{vj} = 125$ °C		187		ns
Rise Time	t_r			53		ns
Turn-off Delay Time	$t_{d(off)}$	$I_C = 450$ A, $V_{CE} = 900$ V, $V_{GE} = \pm 15$ V, $R_G = 2$ Ω, $T_{vj} = 125$ °C		644		ns
Fall Time	t_f			557		ns
Energy Dissipation During Turn-on Time	E_{on}	$I_C = 450$ A, $V_{CC} = 900$ V, $V_{GE} = \pm 15$ V, $R_G = 2$ Ω, $T_{vj} = 125$ °C		151		mJ
Energy Dissipation During Turn-off Time	E_{off}	$I_C = 450$ A, $V_{CC} = 900$ V, $V_{GE} = \pm 15$ V, $R_G = 2$ Ω, $T_{vj} = 125$ °C		134		mJ
Turn-on Delay Time	$t_{d(on)}$	$I_C = 450$ A, $V_{CE} = 900$ V, $V_{GE} = \pm 15$ V, $R_G = 2$ Ω, $T_{vj} = 175$ °C		211		ns
Rise Time	t_r			56		ns
Turn-off Delay Time	$t_{d(off)}$	$I_C = 450$ A, $V_{CC} = 900$ V, $V_{GE} = \pm 15$ V, $R_G = 2$ Ω, $T_{vj} = 175$ °C		691		ns
Fall Time	t_f			636		ns
Energy Dissipation During Turn-on Time	E_{on}	$I_C = 450$ A, $V_{CC} = 900$ V, $V_{GE} = \pm 15$ V, $R_G = 2$ Ω, $T_{vj} = 175$ °C		177		mJ
Energy Dissipation During Turn-off Time	E_{off}	$I_C = 450$ A, $V_{CC} = 900$ V, $V_{GE} = \pm 15$ V, $R_G = 2$ Ω, $T_{vj} = 175$ °C		150		mJ
SC Data	I_{sc}	$T_p \leq 10$ us, $V_{GE} = 15$ V, $T_{vj} = 175$ °C, $V_{cc} = 1200$ V, $V_{CEM} \leq 1700$V		1550		A

- ## Diode

Absolute Maximum Ratings

Parameter	Symbol	Conditions	Value	Unit
Repetitive Peak Reverse Voltage	V_{RRM}	T_{vj} = 25 °C	1700	V
Continuous DC Forward Current	I_F		450	A
Repetitive Peak Forward Current	I_{FRM}	t_p = 1 ms	800	A
I^2t-value	I^2t	V_R = 0 V, t_p = 10 ms, T_j=150 °C	16750	A^2s

Characteristic values

Parameter	Symbol	Conditions	Value			Unit
			Min.	Typ.	Max.	
Forward Voltage	V_F	I_F = 450 A, T_{vj} = 25 °C		1.75		V
		I_F = 450 A, T_{vj} = 125 °C		1.95		
		I_F = 450 A, T_{vj} = 175 °C		2.0		
Recovered Charge	Q_{rr}	I_F = 450 A V_R = 900 V -di_F/dt = 8220 A/us T_{vj} = 25 °C		101		uC
Peak Reverse Recovery Current	I_{rr}			408		A
Reverse Recovery Energy	E_{rec}			55		mJ
Recovered Charge	Q_{rr}	I_F = 450 A V_R = 900 V -di_F/dt = 8220 A/us T_{vj} =125 °C		158		uC
Peak Reverse Recovery Current	I_{rr}			408		A
Reverse Recovery Energy	E_{rec}			91		mJ
Recovered Charge	Q_{rr}	I_F = 450 A V_R = 900 V -di_F/dt = 8220 A/us T_{vj} = 175 °C		193		uC
Peak Reverse Recovery Current	I_{rr}			409		A
Reverse Recovery Energy	E_{rec}			113		mJ

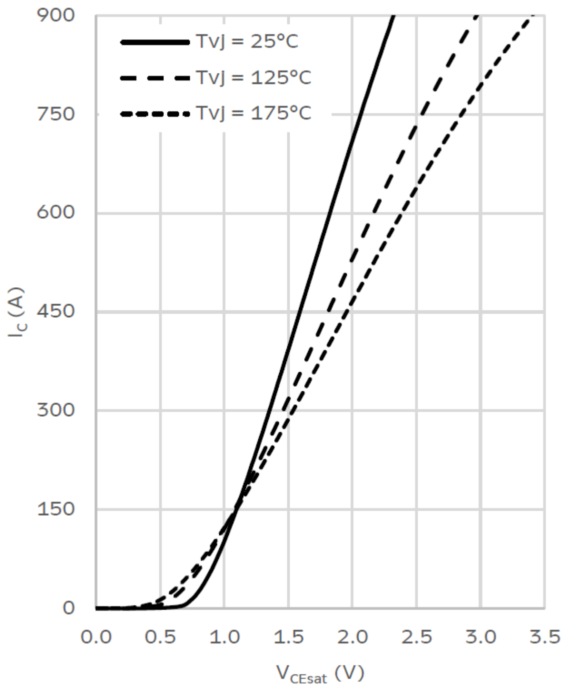
Module Characteristics

T_c=25°C unless otherwise specified

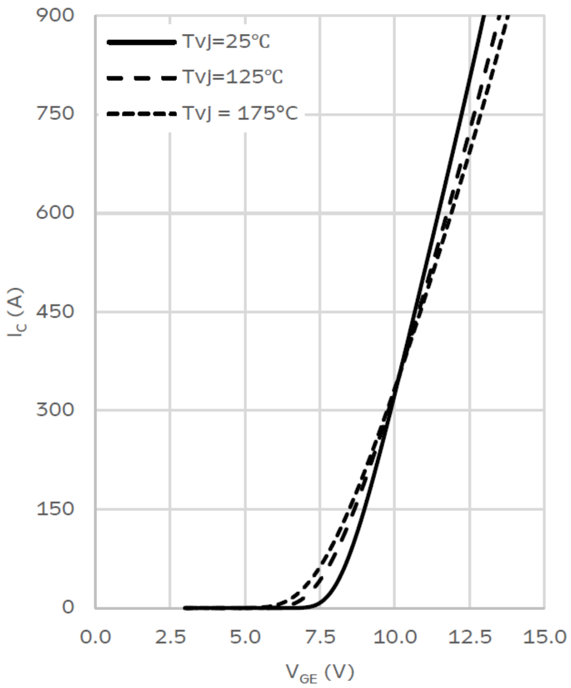
Parameter	Symbol	Conditions	Value			Unit
			Min.	Typ.	Max.	
Isolation voltage	V_{isol}	t =1 min, f = 50 Hz			3400	V
Maximum Junction Temperature	T_{jmax}				175	°C
Operating Junction Temperature	$T_{vj(op)}$		-40		175	°C
Storage Temperature	T_{stg}		-40		125	°C
Thermal Resistance Junction-to Case	$R_{\theta JC}$	per IGBT			0.060	K/W
		per Diode			0.106	
Comparative Tracking Index	CTI		200			
Thermal Resistance Case-to Sink	$R_{\theta CS}$	Conductive grease applied		0.032		K/W
Module ElectrodesTorque	M_t	Recommended(M6)	3		6	N·m
Module-to-SinkTorque	M_s	Recommended(M5)	3		6	N·m
Mass	m			350		g

Characteristics

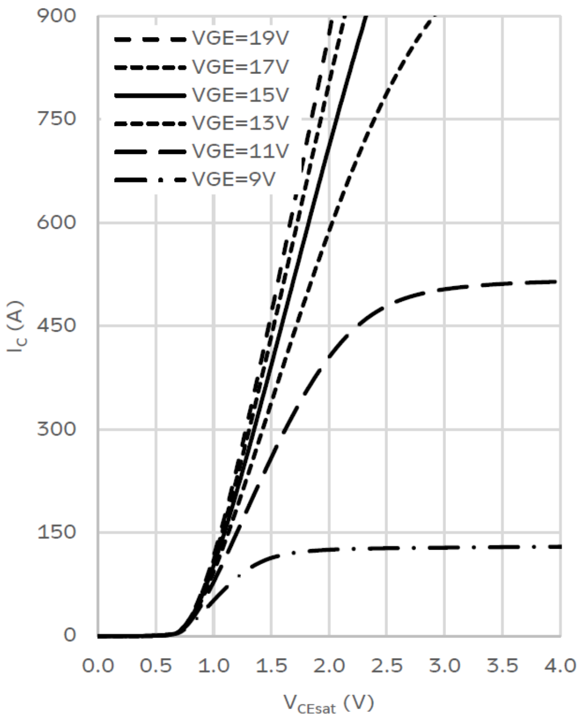
IGBT on-state characteristics (typical)
$I_C = f(V_{CE})$
V_{GE} = 15 V



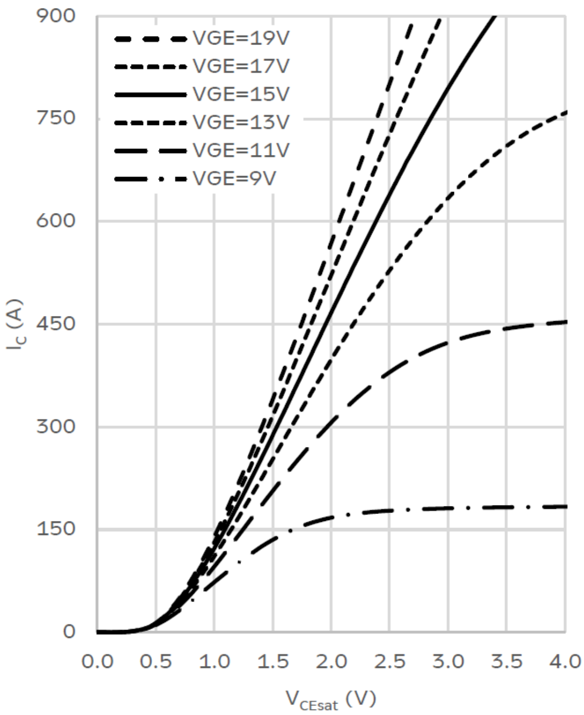
IGBT transfer characteristics (typical)
$I_C = f(V_{GE})$
V_{CE} = 20V



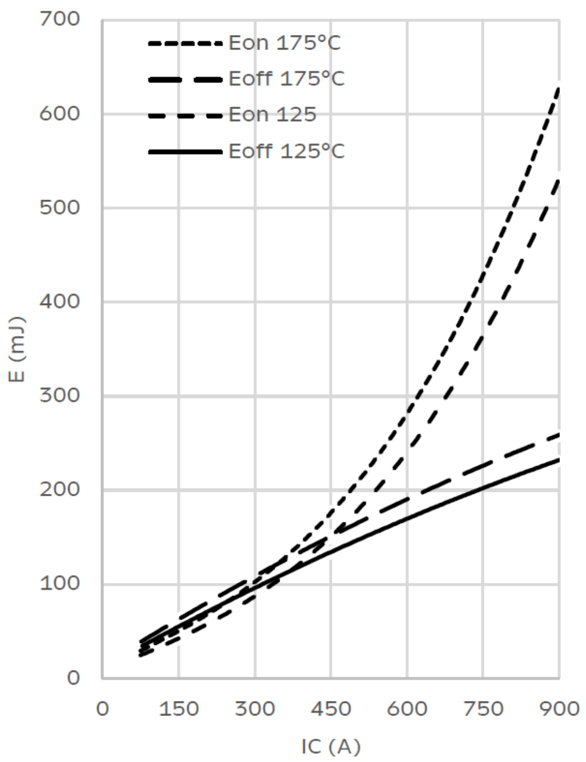
IGBT output characteristics (typical)
$I_C = f(V_{CE})$
T_{vj} = 25 °C



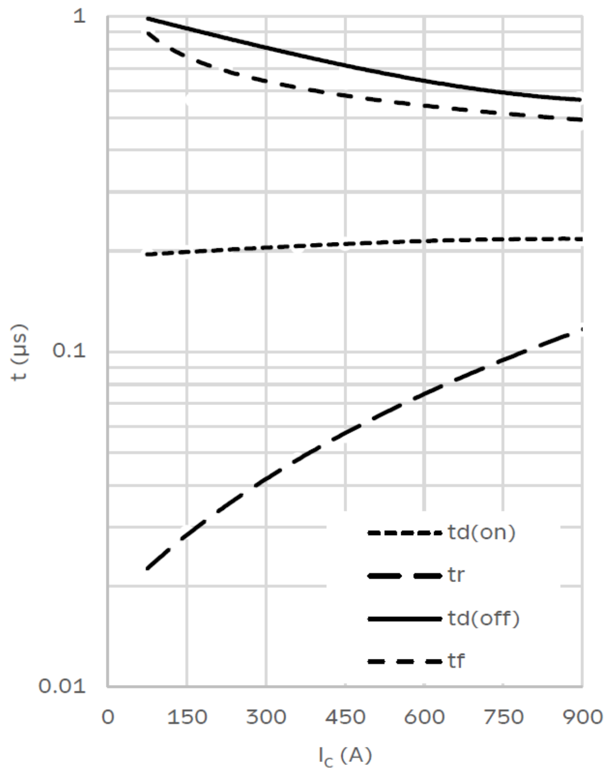
IGBT output characteristics (typical)
$I_C = f(V_{CE})$
T_{vj} = 175 °C



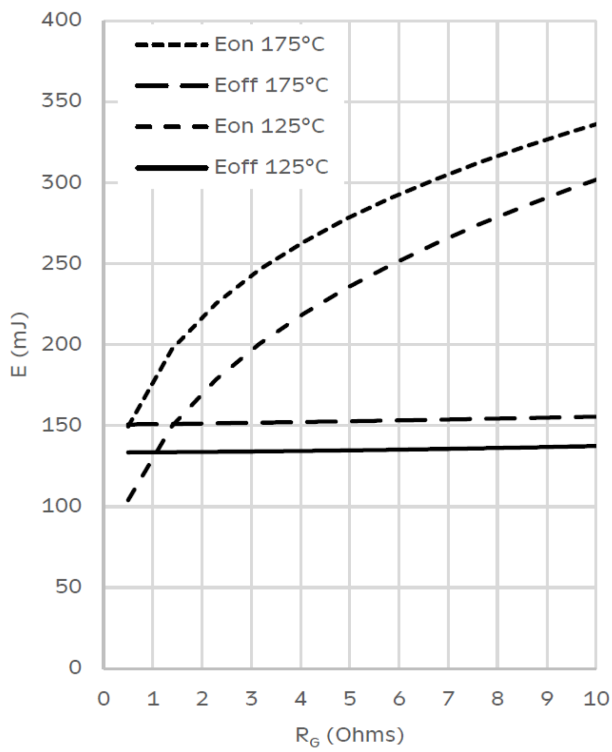
IGBT switching losses (typical)
E = f(I_{CE})
V_{CE} = 9000 V, R_{Gon} = 2 Ω, R_{Goff} = 2 Ω, V_{GE} = -15/+15 V



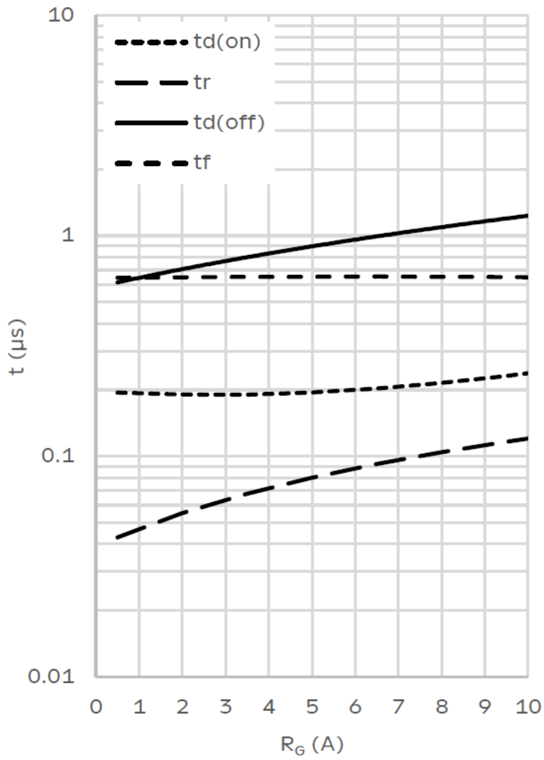
IGBT switching times (typical)
t = f(I_{CE}), T_{vj} = 175 °C
V_{CE} = 900 V, R_{Gon} = 2 Ω, R_{Goff} = 2 Ω, V_{GE} =-15/+15 V



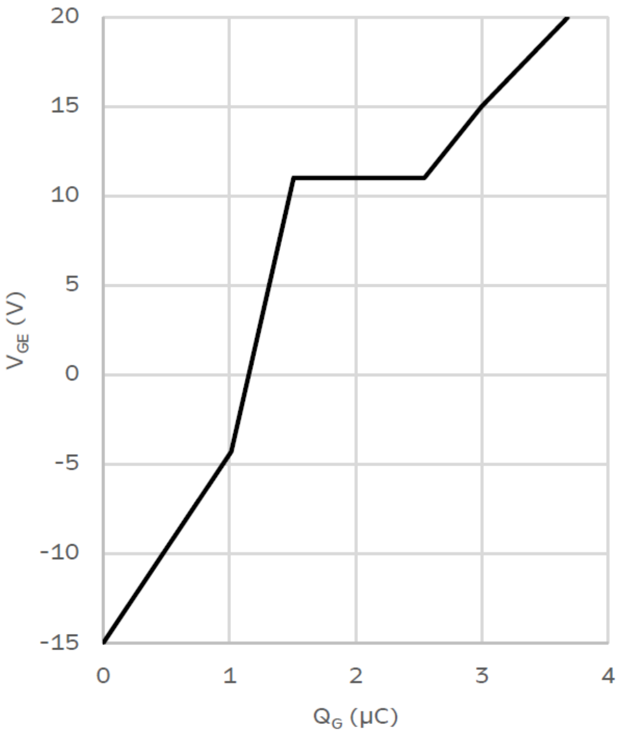
IGBT switching losses (typical)
E = f(R_G)
V_{CE} = 900 V, I_C = 450 A, V_{GE} = -15/+15 V



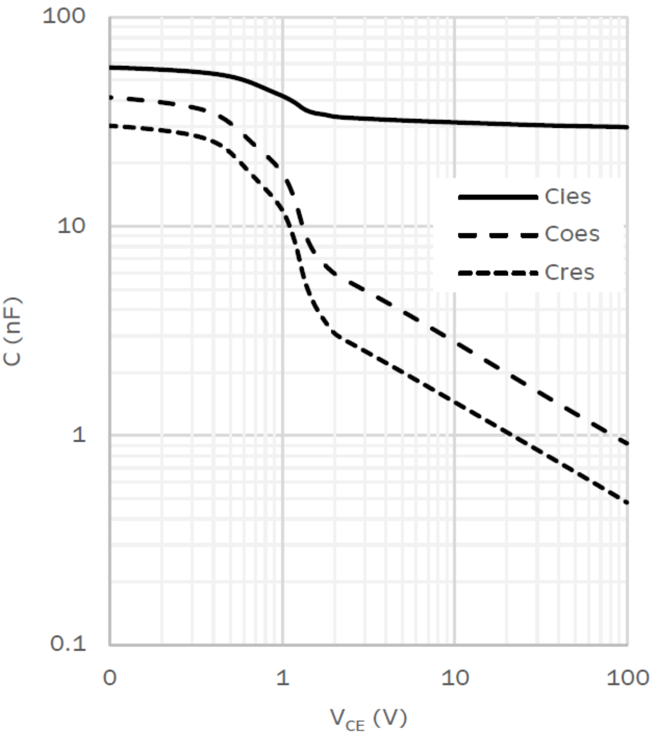
IGBT switching times (typical)
t = f(R_G), T_{vj} = 175 °C
V_{CE} = 900 V, I_C = 450 A, V_{GE} = -15/+15 V V



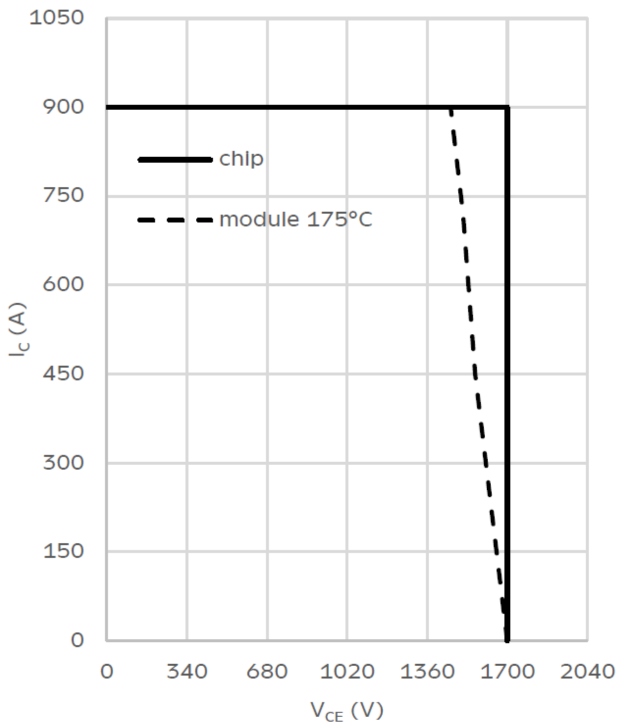
IGBT gate charge (typical)
$V_{GE} = f(Q_G)$, $T_{vj} = 25$ °C
$V_{CE} = 900$ V, $I_C = 600$ A



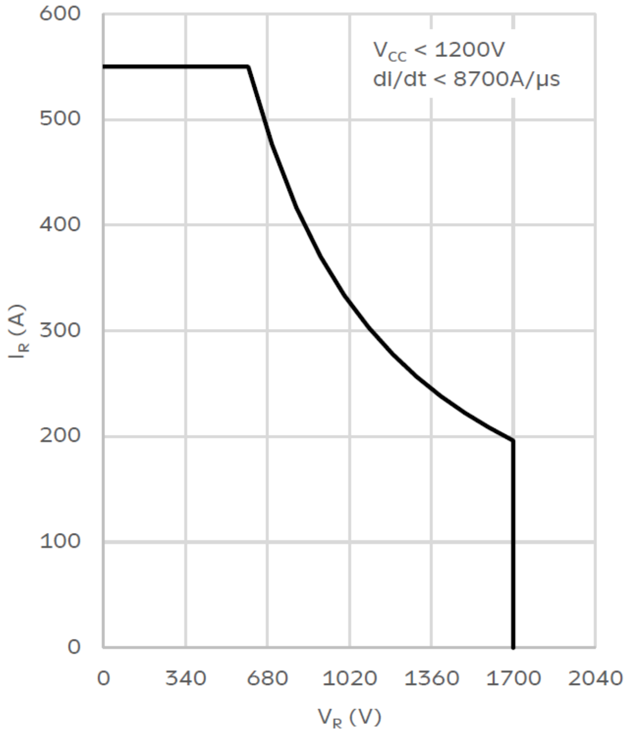
Capacitance characteristics (typical)
$C = f(V_{CE})$, $T_{vj} = 25$ °C
$f = 100$ kHz, $V_{GE} = 0$ V



IGBT RBSOA
$I_C = f(V_{CEm})$
$R_{Goff} = 2\ \Omega$, $V_{GE} = \pm 15$ V

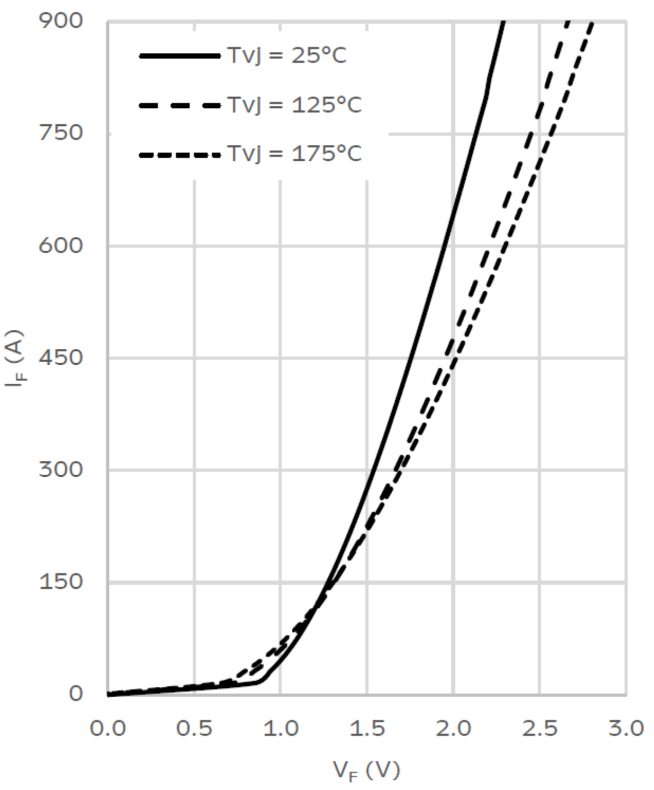


Diode SOA
$T_{vj} \leq 175$ °C



Diode forward characteristic (typical)

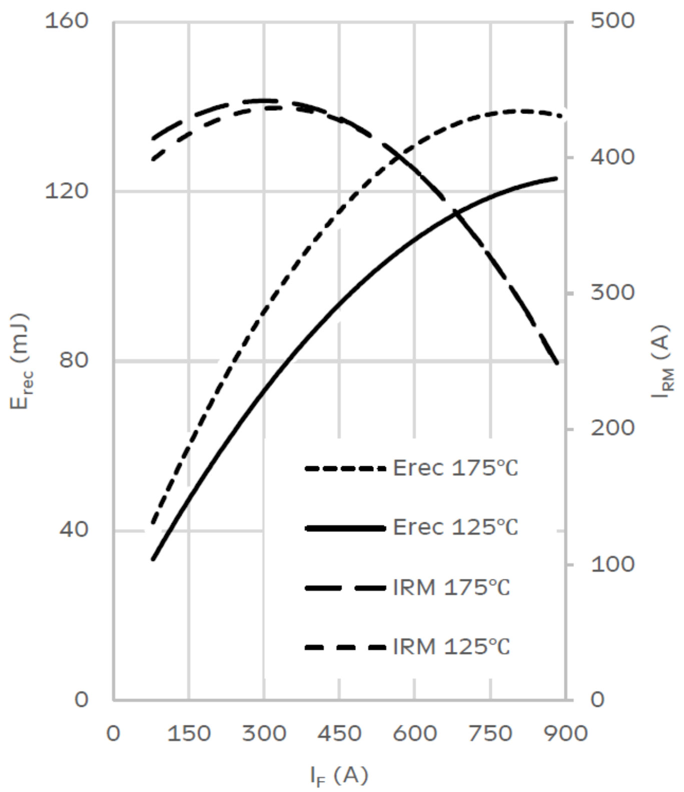
$I_F = f(V_F)$



Diode switching characteristics (typical)

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

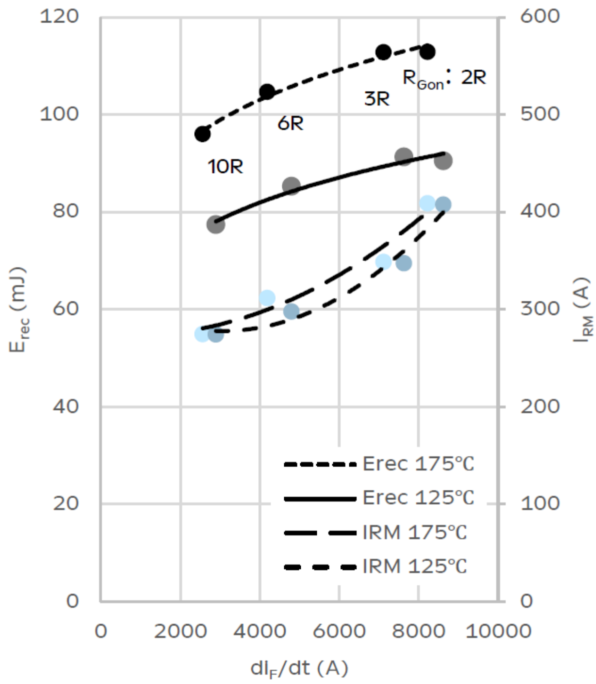
V_{DC} = 900 V, R_{Gon} = 2 Ω (IGBT), V_{GE} =-15/+15 V (IGBT)



Diode switching characteristics (typical)

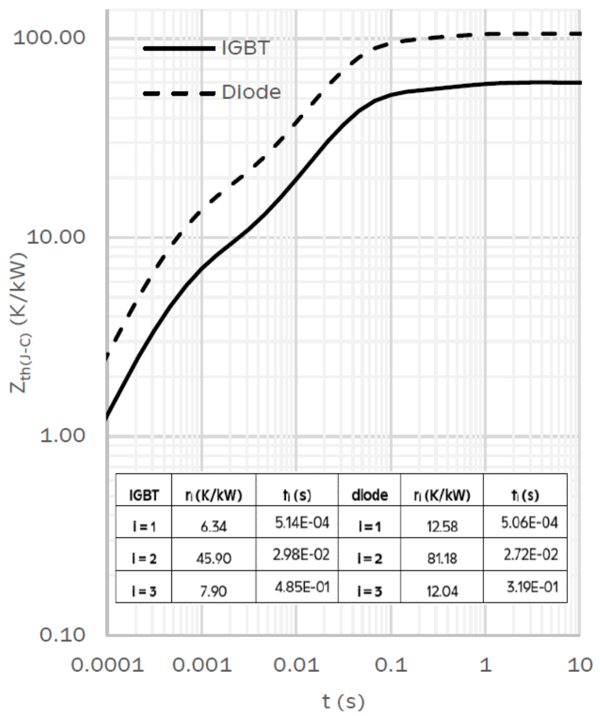
$E_{rec} = f(dI/dt)$, $I_{RM} = f(dI/dt)$

V_{DC} = 900 V, I_F = 450 A, V_{GE} =-15/+15 V (IGBT)



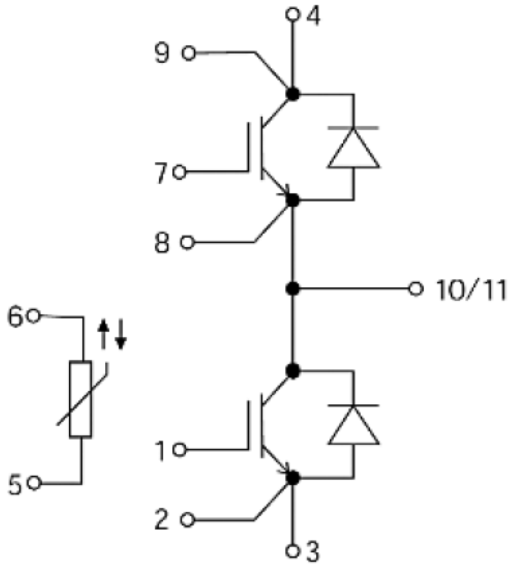
Thermal impedance (typical)

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



IGBT	r_i (K/kW)	τ_i (s)	diode	r_i (K/kW)	τ_i (s)
i = 1	6.34	5.14E-04	i = 1	12.58	5.06E-04
i = 2	45.90	2.98E-02	i = 2	81.18	2.72E-02
i = 3	7.90	4.85E-01	i = 3	12.04	3.19E-01

- **Circuit Diagram**



- **Package Outline Information**