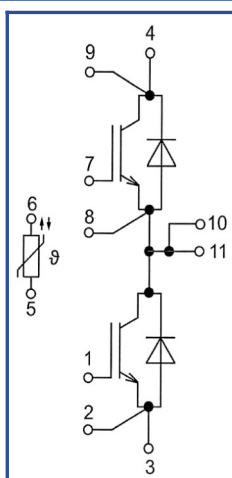
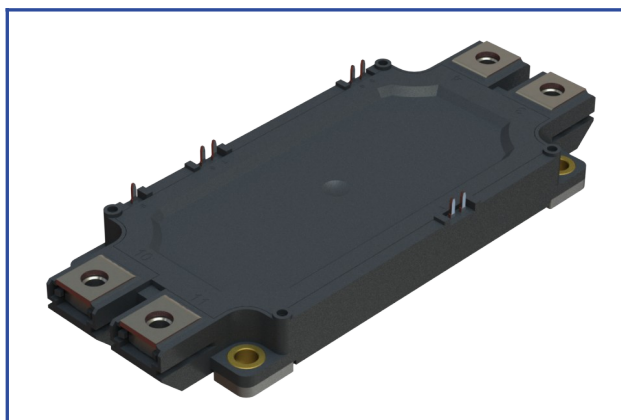


Low Inductance IGBT Module with 17 mm Height Housing
1200 V 600 A

Chip features

- IGBT chip
 - low $V_{CE(sat)}$ value
 - 10 μs short circuit duration at 150°C
 - square RBSOA of 2xI_C
- FRD chip
 - fast and soft reverse recovery
 - low voltage drop

Design features

- copper baseplate
- Al₂O₃ DBC substrate
- ultrasonic welded power terminals
- improved thermal cycling
- RoHS compliant
- low inductance value

Typical application

- AC motor drives
- solar inverters
- air conditioning
- high power converters and UPS
- Inverters for wind energy converters

Maximum rated values

Definition	Symbol	Conditions	Value	Unit
IGBT				
Collector-Emitter voltage	V_{CES}	$V_{GE} = 0$.	1200	V
Maximum allowable collector current (continuous)	$I_{C\ 25}$	$T_{vj\ (max)} = 175^{\circ}C$; $T_c = 25^{\circ}C$.	796	A
	$I_{C\ 80}$	$T_{vj\ (max)} = 175^{\circ}C$; $T_c = 80^{\circ}C$.	600	A
Repetitive peak collector current ^{*1}	I_{CRM}	$I_{CRM} = 3 \times I_{C\ nom}$; $t_p = 1\ ms$.	1800	A
Short-circuit duration	t_{psc}	$T_{vj} = 25^{\circ}C$; $V_{GE} = \pm 15\ V$; $V_{CE} = 720\ V$; $R_{G\ on} = R_{G\ off} = 1.5\ \Omega$.	10	μs
		$T_{vj} = 150^{\circ}C$; $V_{GE} = \pm 15\ V$; $V_{CE} = 720\ V$; $R_{G\ on} = R_{G\ off} = 1.5\ \Omega$.	10	
Gate-Emitter voltage	V_{GES}		± 20	V
Junction operating temperature	$T_{vj\ (op)}$		-40...+150	°C
Inverse diode				
Repetitive peak reverse voltage	V_{RRM}	$V_{GE} = 0\ V$.	1200	V
Maximum allowable forward current (continuous)	$I_{F\ 25}$	$T_{vj\ (max)} = 175^{\circ}C$; $T_c = 25^{\circ}C$.	642	A
	$I_{F\ 80}$	$T_{vj\ (max)} = 175^{\circ}C$; $T_c = 80^{\circ}C$.	490	A
Repetitive peak forward current ^{*1}	I_{FRM}	$I_{FRM} = 3 \times I_{F\ nom}$; $t_p = 1\ ms$.	1800	A
Junction operating temperature	$T_{vj\ (op)}$		-40...+150	°C
Module				
Storage temperature	T_{stg}		-55...+50	°C
Isolation voltage	V_{isol}	AC sin 50 Hz; $t = 1\ min$.	4000	V

^{*1} Pulse width and repetition rate should be such that device junction temperature does not exceed maximum T_{vj} rating



Characteristics

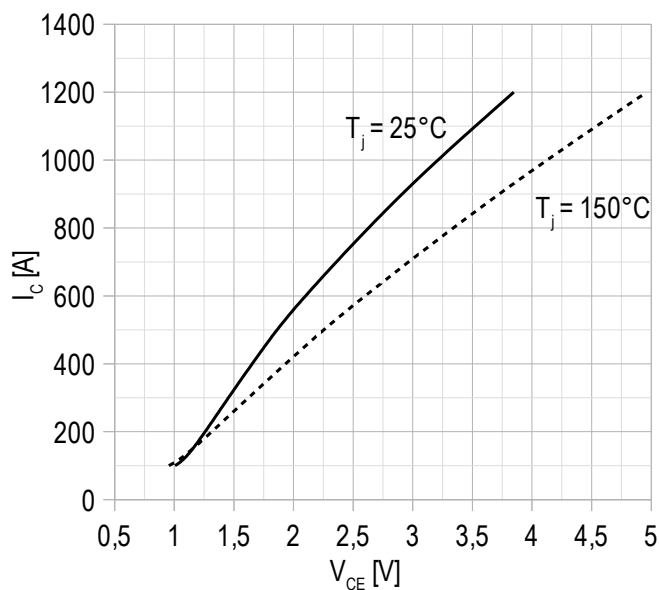
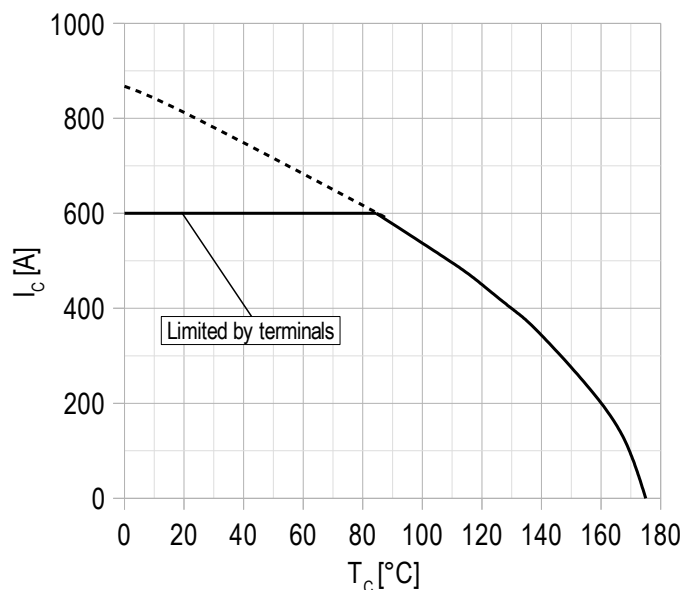
Definition	Symbol	Conditions		Value			Unit.	
				min.	typ.	max.		
IGBT								
Collector-Emitter saturation voltage	V_{CEsat}	$V_{GE} = +15\text{ V}; I_C = 600\text{ A};$ $t_u = 1000\text{ }\mu\text{s}.$	$T_{vj} = 25^\circ\text{C}$ $T_{vj} = 150^\circ\text{C}$	1.65 2.00	2.10 2.60	2.55 3.20	V V	
Gate-Emitter threshold voltage	$V_{GE(th)}$	$I_C = 24\text{ mA}; V_{CE} = V_{GE}; T_{vj} = 25^\circ\text{C};$ $t_u = 2\text{ ms}.$		4.15	5.80	8.10	V	
Collector-Emitter cut-off current	I_{CES}	$V_{CE} = 1200\text{ V};$ $t_u = 50\text{ ms}; V_{GE} = 0.$	$T_{vj} = 25^\circ\text{C}$ $T_{vj} = 150^\circ\text{C}$	- -	13.00 0.20	300 5.00	μA mA	
Gate-Emitter leakage current	I_{GES}	$V_{CE} = 0; V_{GE} = \pm 20\text{ V}; T_{vj} = 25^\circ\text{C};$ $t_u = 30\text{ ms}.$		-	17.00	200	nA	
Input capacitance	C_{ies}	$V_{CE} = 25\text{ V}; V_{GE} = 0\text{ V};$		-	330.00	-	nF	
Reverse transfer capacitance	C_{res}	$f = 1\text{ MHz}; T_{vj} = 25^\circ\text{C}.$		-	2.10	-	nF	
Total gate charge	Q_G	$I_C = 600\text{ A}; V_{CE} = 600\text{ V};$ $V_{GE} = -8...+15\text{ V}.$		-	-	5500	nC	
Internal gate resistance	R_{Gint}	$T_{vj} = 25^\circ\text{C}.$		-	0.50	-	Ω	
Turn-on delay time	$t_{d(on)}$	$V_{CE} = 600\text{ V};$ $V_{GE} = \pm 15\text{ V};$ $I_{C\text{ max}} = 600\text{ A};$ $R_G = 1.5\text{ }\Omega;$ $L_s = 56\text{ nH}.$	$T_{vj} = 25^\circ\text{C}$ $T_{vj} = 150^\circ\text{C}$	227 233	253 284	279 335	ns	
Rise time	t_{ri}		$T_{vj} = 25^\circ\text{C}$ $T_{vj} = 150^\circ\text{C}$	110 125	124 141	138 157	ns	
Turn-on energy	E_{on}		$T_{vj} = 25^\circ\text{C}$ $T_{vj} = 150^\circ\text{C}$	21.0 41.0	29.0 59.5	37.0 78.0	mJ	
Turn-off delay time	$t_{d(off)}$		$T_{vj} = 25^\circ\text{C}$ $T_{vj} = 150^\circ\text{C}$	612 682	681 783	750 884	ns	
Fall time	t_{fi}		$T_{vj} = 25^\circ\text{C}$ $T_{vj} = 150^\circ\text{C}$	153 286	174 338	195 390	ns	
Turn-off energy	E_{off}		$T_{vj} = 25^\circ\text{C}$ $T_{vj} = 150^\circ\text{C}$	71.0 94.5	80.0 108.5	89.0 122.5	mJ	
Collector-emitter threshold voltage	V_{CE0}		$V_{GE} = +15\text{ V}; T_{vj} = 150^\circ\text{C};$		0.59	0.66	0.73	V
On-State slope resistance (IGBT)	r_{CE0}		$I_{CE1} = 150\text{ A}; I_{CE2} = 600\text{ A};$ $t_u = 1000\text{ }\mu\text{s}.$		2.59	3.20	3.81	m Ω
Thermal resistance junction to case	$R_{th(j-c)}$		DC; $I_{test} = 1.5\text{ A};$ $V_{GE} = +15\text{ V}.$		-	-	0.050	K/W
Inverse diode								
Forward voltage drop	V_F		$I_F = 600\text{ A};$ $V_{GE} = 0; t_u = 1000\text{ }\mu\text{s}.$	$T_{vj} = 25^\circ\text{C}$ $T_{vj} = 150^\circ\text{C}$	1.85 2.05	2.25 2.55	2.65 3.05	V V
Reverse recovery time	t_{rr}		$V_{CE} = 600\text{ V};$ $V_{GE} = \pm 15\text{ V};$ $I_{C\text{ max}} = 600\text{ A};$ $R_G = 1.5\text{ }\Omega;$ $L_s = 56\text{ nH}.$	$T_{vj} = 25^\circ\text{C}$ $T_{vj} = 150^\circ\text{C}$	281 459	313 532	345 605	ns ns
Peak reverse current	I_{RM}	$T_{vj} = 25^\circ\text{C}$ $T_{vj} = 150^\circ\text{C}$		215 260	275 330	335 400	A A	
Recovered charge	Q_r	$T_{vj} = 25^\circ\text{C}$ $T_{vj} = 150^\circ\text{C}$		34.0 67.5	43.5 87.0	53.0 106.5	μC μC	
Reverse recovery energy	E_{rec}	$T_{vj} = 25^\circ\text{C}$ $T_{vj} = 150^\circ\text{C}$		15.5 28.0	21.5 37.5	27.5 47.0	mJ mJ	
Threshold voltage	$V_{(T0)}$	$T_{vj} = 150^\circ\text{C}; V_{GE} = 0; I_{F1} = 150\text{ A};$		0.79	0.81	0.83	V	
Forward slope resistance	r_T	$I_{F2} = 600\text{ A}; t_u = 1000\text{ }\mu\text{s}$		2.61	2.93	3.25	m Ω	
Thermal resistance junction to case	$R_{th(JC-D)}$	DC; $I_{test} = 1.5\text{ A};$ $V_{GE} = 0\text{ V}.$		-	-	0.080	K/W	

Module							
Pin resistance	R _{Pxy}	T _{vj} = 25°C.	R _{P10/11-3}	-	0.95	1.00	mΩ
			R _{P10/11-4}	-	0.68	1.00	
Parasitic inductance between terminals	L _{Pce}			-	22.00	-	nH
Thermistor resistance	R _t	T _{vj} = 25°C		4850	-	6225	Ω
		T _{vj} = 150°C		160	-	195	
Coefficient of temperature sensitivity	B _{25/50}	R ₂ = R ₂₅ exp [B _{25/50} (1/T ₂ - 1/T ₁)], T ₁ = 298,15 K		-	3375	-	κ
Thermal resistance case to heatsink	R _{thCH}	per module		-	0.009	0.014	K/W
Mounting torque for screws to heatsink	M _s	to heatsink M5		3	-	6	N*m
Mounting torque for terminal screws	M _t	to terminals M6		3	-	6	N*m
Weight	W			-	-	360	g

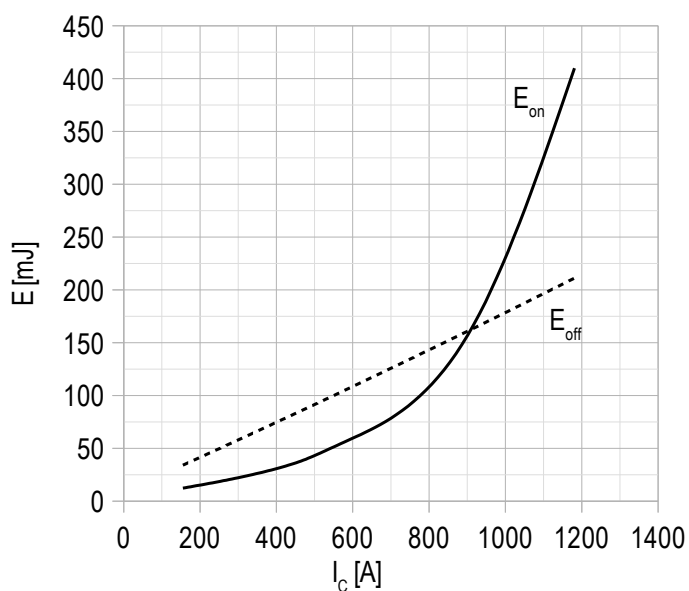
" - " — data will be refined as additional tests are conducted and statistics are collected.

Notes:

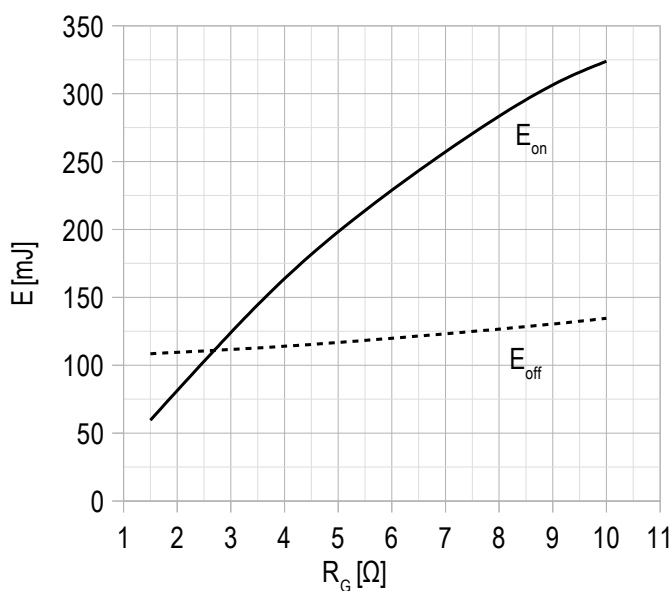
- Insulating material operating temperature 125°C max;
- Case temperature 125°C max;
- The recommended operating junction temperature $T_{vj \text{ op}} = -40...+150^{\circ}\text{C}$.

Chart 1 – typ. output characteristic, IGBT.

 $V_{GE} = +15 \text{ V.}$
Chart 2 – max. rated current vs temperature.


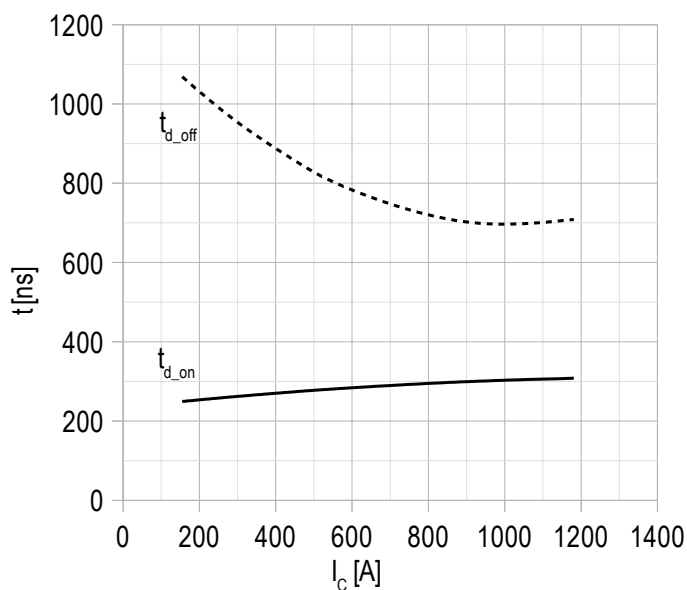
DC;
 $V_{GE} = +15 \text{ V};$
 $T_{vj(max)} = 150^\circ\text{C}.$

Chart 3 – typ. turn-on/off energy vs rated current, IGBT.


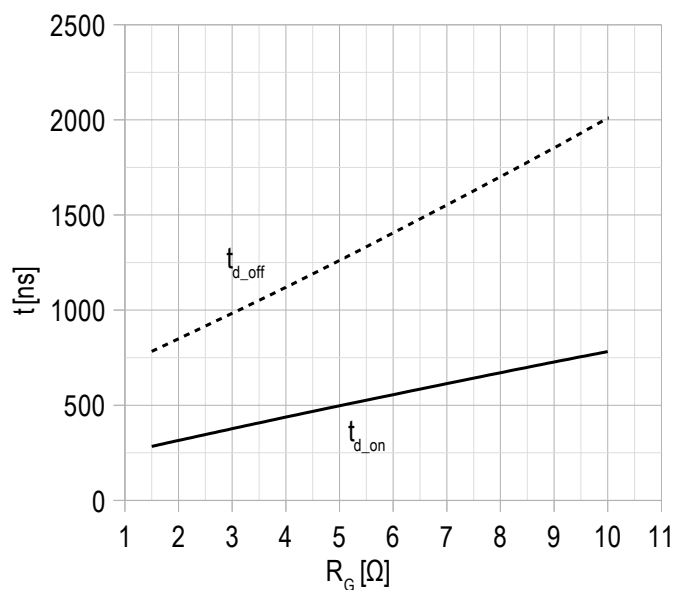
$V_{CE} = 600 \text{ V};$
 $V_{GE} = \pm 15 \text{ V};$
 $R_G = 1.5 \Omega;$
 $L_s = 56 \text{ nH};$
 $T_{vj(max)} = 150^\circ\text{C}.$

Chart 4 – typ. turn-on/off energy vs gate resistance, IGBT.


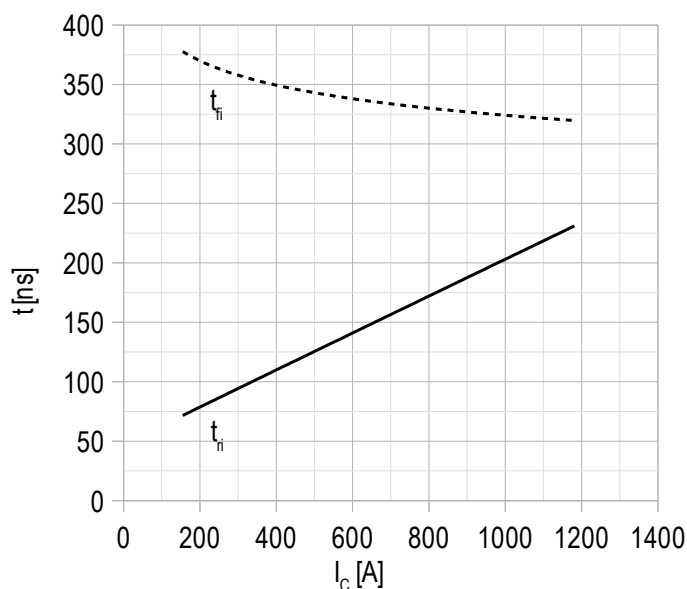
$V_{CE} = 600 \text{ V};$
 $V_{GE} = \pm 15 \text{ V};$
 $I_{Cmax} = 600 \text{ A};$
 $L_s = 56 \text{ nH};$
 $T_{vj(max)} = 150^\circ\text{C}.$

Chart 5 – typ. switching times vs rated current, IGBT.


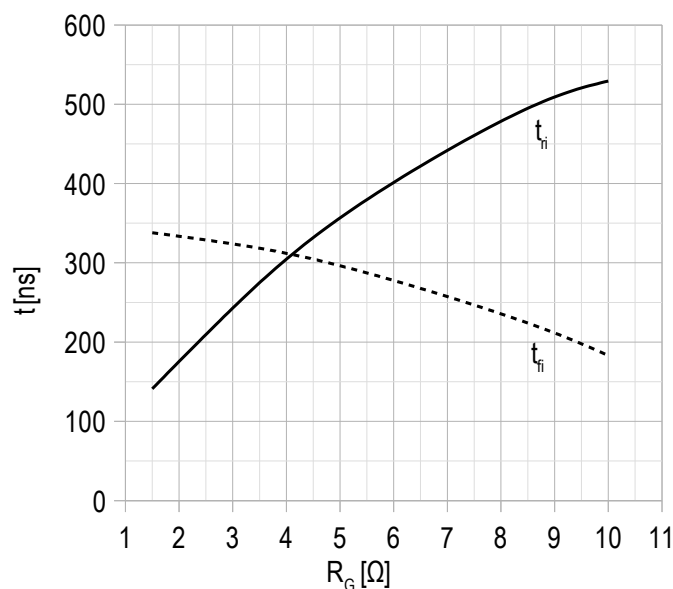
$V_{CE} = 600 \text{ V};$
 $V_{GE} = \pm 15 \text{ V};$
 $R_G = 1.5 \Omega;$
 $L_s = 56 \text{ nH};$
 $T_{vj(max)} = 150^\circ\text{C}.$

Chart 6 – typ. switching times vs gate resistance, IGBT.


$V_{CE} = 600 \text{ V};$
 $V_{GE} = \pm 15 \text{ V};$
 $I_{Cmax} = 600 \text{ A};$
 $L_s = 56 \text{ nH};$
 $T_{vj(max)} = 150^\circ\text{C}.$

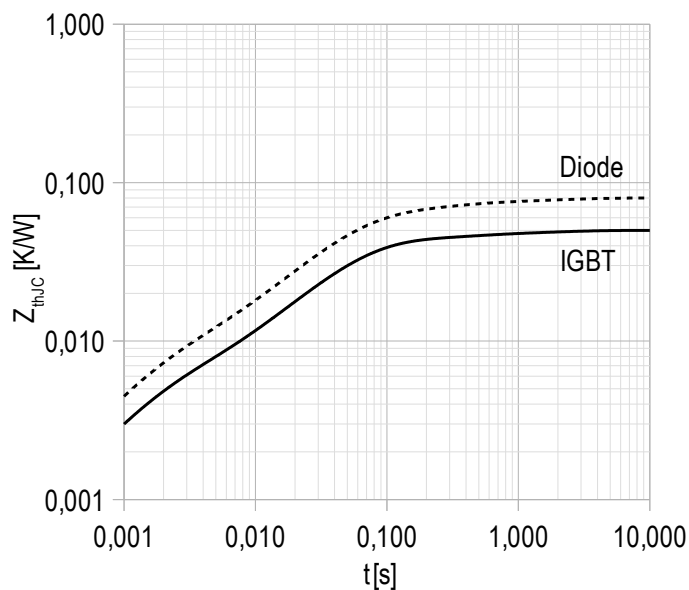
Chart 7 – typ. switching times vs rated current, IGBT.


$V_{CE} = 600 \text{ V};$
 $V_{GE} = \pm 15 \text{ V};$
 $R_G = 1.5 \Omega;$
 $L_s = 56 \text{ nH};$
 $T_{vj(max)} = 150^\circ\text{C}.$

Chart 8 – typ. switching times vs gate resistance, IGBT.


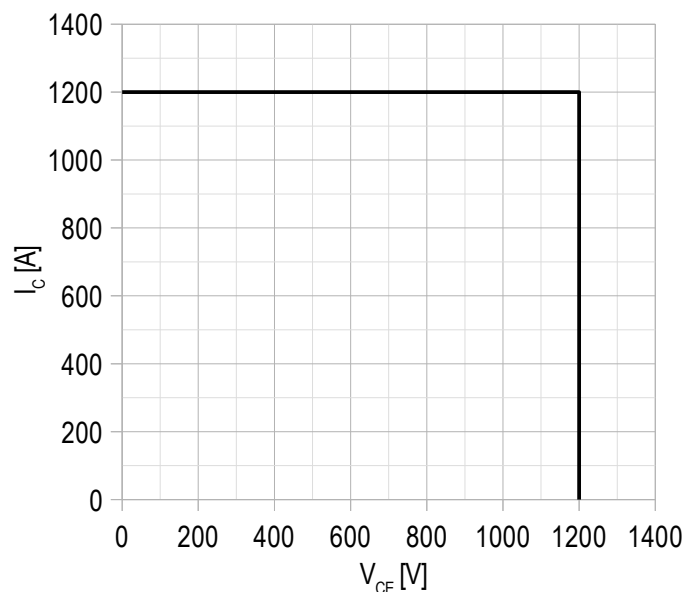
$V_{CE} = 600 \text{ V};$
 $V_{GE} = \pm 15 \text{ V};$
 $I_{Cmax} = 600 \text{ A};$
 $L_s = 56 \text{ nH};$
 $T_{vj(max)} = 150^\circ\text{C}.$

Chart 9 – max. transient thermal impedance.



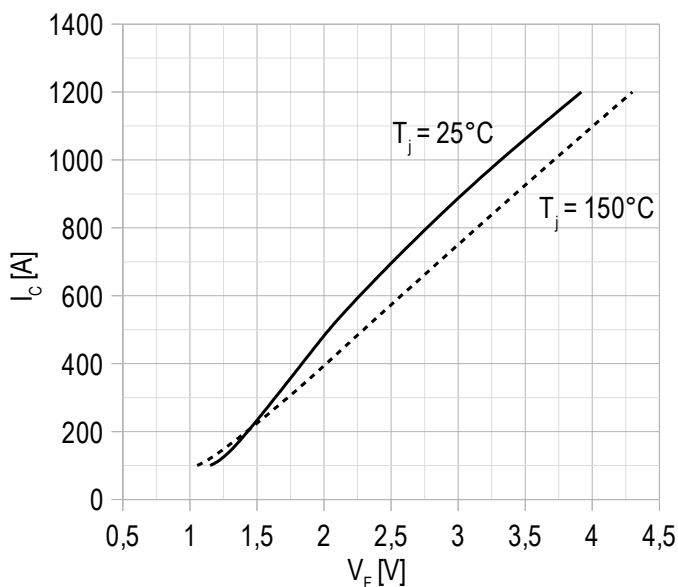
Single pulse;
 $V_{GE} = +15 \text{ V}$.

Chart 10 – RBSOA.



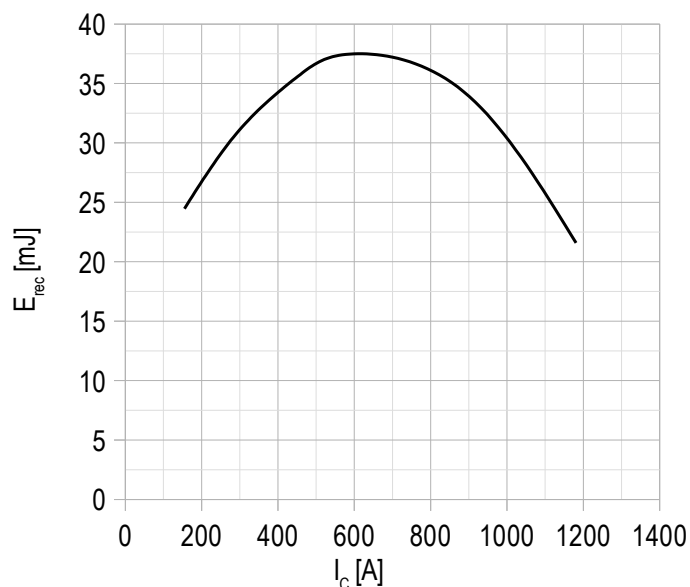
$V_{CE \text{ max}} = 1200 \text{ V}$;
 $V_{GE} = \pm 15 \text{ V}$;
 $I_{C \text{ max}} = 2 \cdot I_{C \text{ nom}}$;
 $R_G = 1.5 \Omega$;
 $L_s = 56 \text{ nH}$.

Chart 11 – typ. output characteristic, FRD.

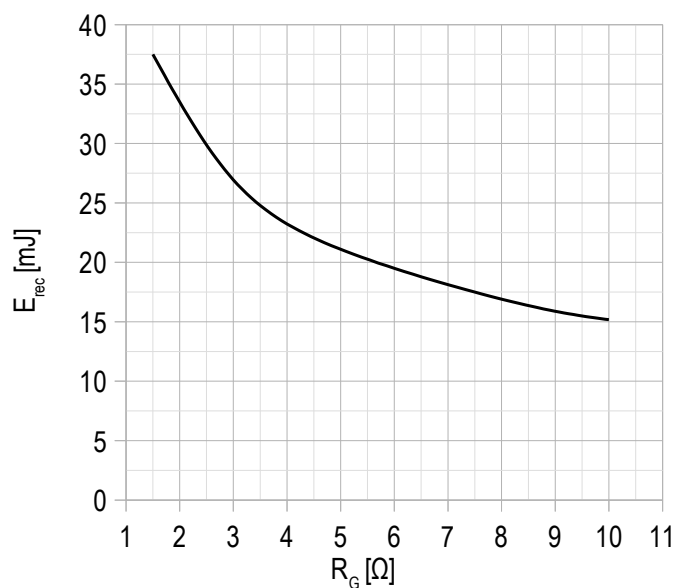


$V_{GE} = 0 \text{ V}$.

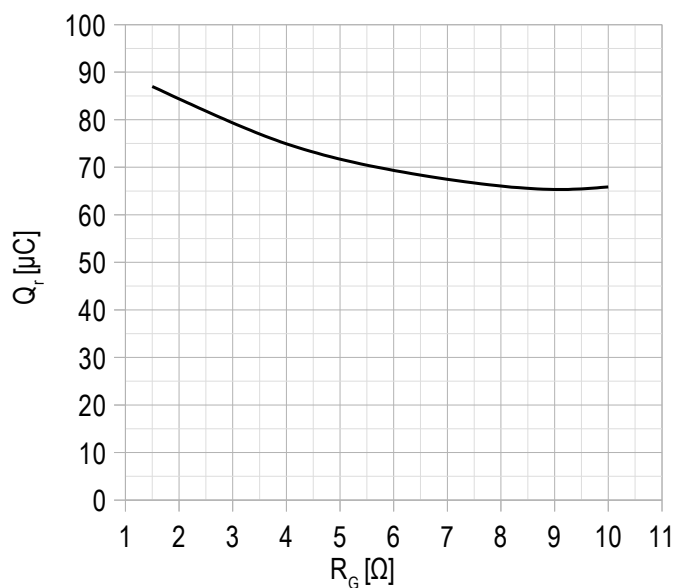
Chart 12 – typ. switching losses vs rated current, FRD.



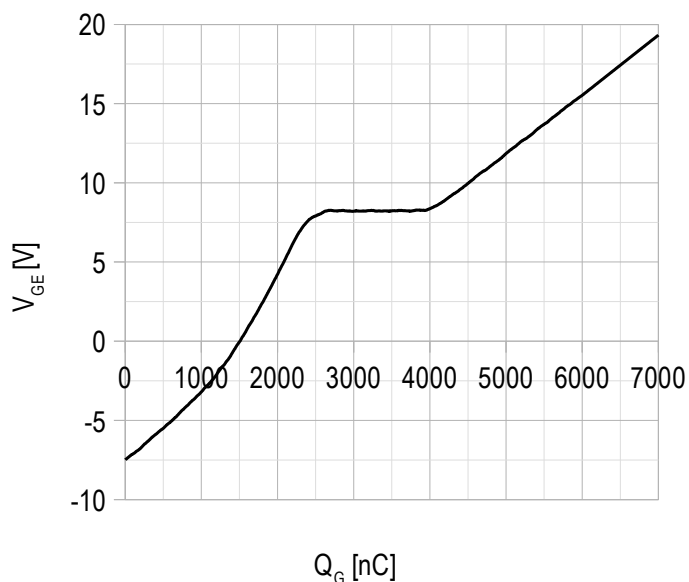
$V_{GE} = \pm 15 \text{ V}$;
 $V_{CE} = 600 \text{ V}$;
 $L_s = 56 \text{ nH}$;
 $R_{G \text{ on}} = 1.5 \Omega$;
 $T_{vj \text{ (max)}} = 150^\circ\text{C}$.

Chart 13 – typ. switching losses vs gate resistance, FRD.


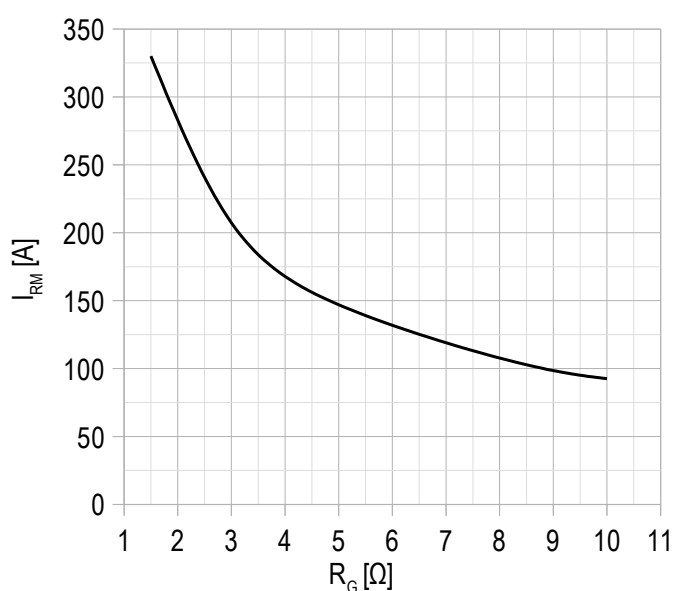
$V_{GE} = \pm 15$ V;
 $V_{CE} = 600$ V;
 $I_{C\ max} = 600$ A;
 $L_s = 56$ nH;
 $T_{vj\ (max)} = 150^\circ\text{C}$.

Chart 14 – typ. reverse recovered charge vs gate resistance, FRD.


$V_{GE} = \pm 15$ V;
 $V_{CE} = 600$ V;
 $I_{C\ max} = 600$ A;
 $L_s = 56$ nH;
 $T_{vj\ (max)} = 150^\circ\text{C}$.

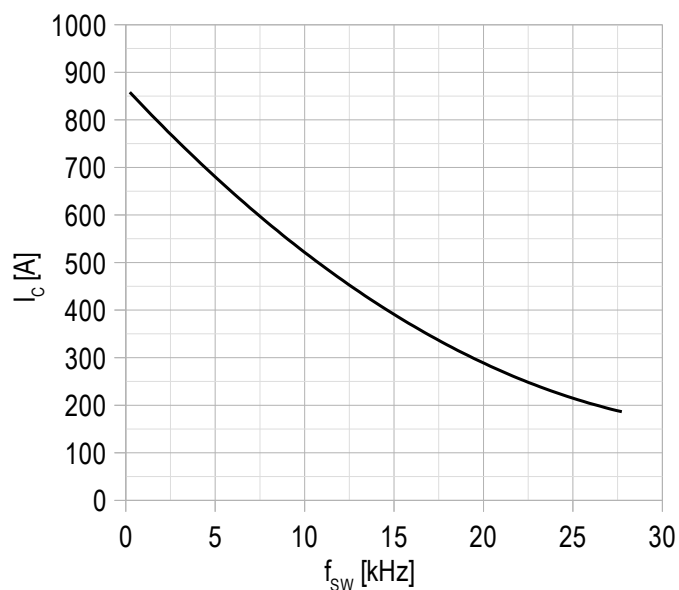
Chart 15 – typ. gate charge characteristic.


$I_C = 600$ A;
 $V_{CE} = 600$ V;
 $V_{GE} = -8...+15$ V.

Chart 16 – typ. reverse recovery current vs gate resistance FRD.


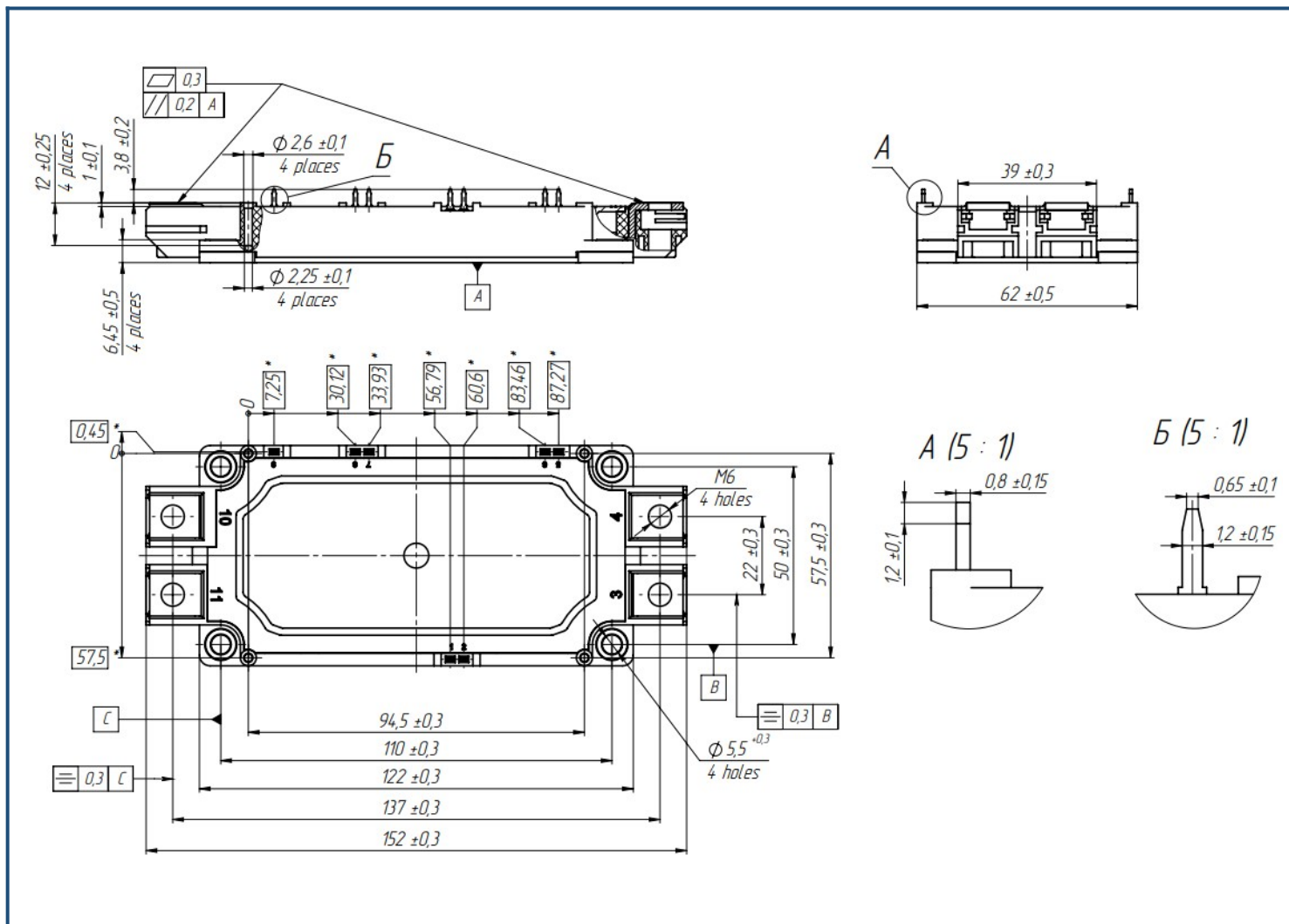
$V_{CE} = 600$ V;
 $V_{GE} = \pm 15$ V;
 $L_s = 56$ nH;
 $T_{vj\ (max)} = 150^\circ\text{C}$.

Chart 17 – max. rated current vs frequency.



Duty cycle 50%;

 $V_{CE} = 600 \text{ V}$; $T_c = 80 \text{ }^\circ\text{C}$; $T_{vj(max)} = 175 \text{ }^\circ\text{C}$.

Overall dimensions: Package type – D2

Part numbering guide

MID2	-	HB	12	SM	-	600	N	
MID2								IGBT module package type: D2
		HB						2 switches as Half-Bridge
			12					Voltage rating ($V_{CES}/100$)
				SM				IGBT+FRD chipset modification
						600		Current Rating
							N	Climatic version: normal climate

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