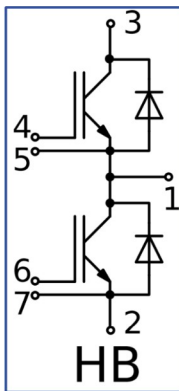
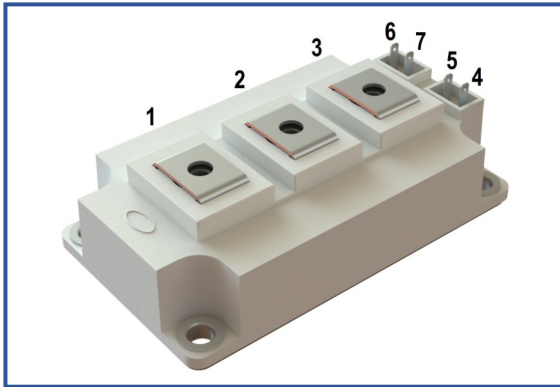


## Industry standard 62mm IGBT module

1200 V 450 A


**Chip features**

- IGBT chip
  - Trench FS
  - low  $V_{CE(sat)}$  value
  - 10  $\mu s$  short circuit of 150°C
  - square RBSOA of 2xlc
  - low EMI
- FRD chip
  - fast and soft reverse recovery
  - low voltage drop

**Design features**

- copper baseplate
- $Al_2O_3$  DBC substrate
- ultrasonically welded power terminals
- Improved thermal cycling
- RoHS compliant

**Typical application**

- AC motor drives
- solar inverter
- air conditioning
- high power converters and UPS

**Maximum rated values**

Definition	Symbol	Conditions	Value	Unit
<b>IGBT</b>				
Collector-Emitter voltage	$V_{CES}$	$V_{GE} = 0$ .	1200	V
Maximum allowable collector current (continuous)	$I_{C 25}$	$T_{vj (max)} = 175^{\circ}C$ ; $T_c = 25^{\circ}C$ .	658	A
	$I_{C 80}$	$T_{vj (max)} = 175^{\circ}C$ ; $T_c = 80^{\circ}C$ .	450	A
Repetitive peak collector current* <sup>1</sup>	$I_{CRM}$	$I_{CRM} = 2 \times I_{C nom}$ ; $t_p = 1$ ms.	900	A
Short-circuit duration	$t_{psc}$	$T_{vj} = 25^{\circ}C$ ; $V_{GE} = \pm 15$ V; $V_{CE} = 500$ V; $R_{G on} = R_{G off} = 2.2 \Omega$ ; $I_{C max} < 1940$ A.	10	$\mu s$
		$T_{vj} = 150^{\circ}C$ ; $V_{GE} = \pm 15$ V; $V_{CE} = 500$ V; $R_{G on} = R_{G off} = 2.2 \Omega$ ; $I_{C max} < 1600$ A.	10	
Gate-Emitter voltage	$V_{GES}$		$\pm 20$	V
Junction operating temperature	$T_{vj (op)}$		-40...+150	°C
<b>Inverse diode \ Freewheeling diode</b>				
Repetitive peak reverse voltage	$V_{RRM}$	$V_{GE} = 0$ V.	1200	V
Maximum allowable forward current (continuous)	$I_{F 25}$	$T_{vj (max)} = 175^{\circ}C$ ; $T_c = 25^{\circ}C$ .	459	A
	$I_{F 80}$	$T_{vj (max)} = 175^{\circ}C$ ; $T_c = 80^{\circ}C$ .	344	A
Repetitive peak forward current* <sup>1</sup>	$I_{FRM}$	$I_{FRM} = 2 \times I_{F nom}$ ; $t_p = 1$ ms.	900	A
Junction operating temperature	$T_{vj (op)}$		-40...+150	°C
<b>Module</b>				
Storage temperature	$T_{stg}$		-40...+50	°C
Isolation voltage	$V_{isol}$	AC sin 50 Hz; t = 1 min.	4000	V

\*<sup>1</sup> Pulse width and repetition rate should be such that device junction temperature does not exceed maximum  $T_{vj}$  rating

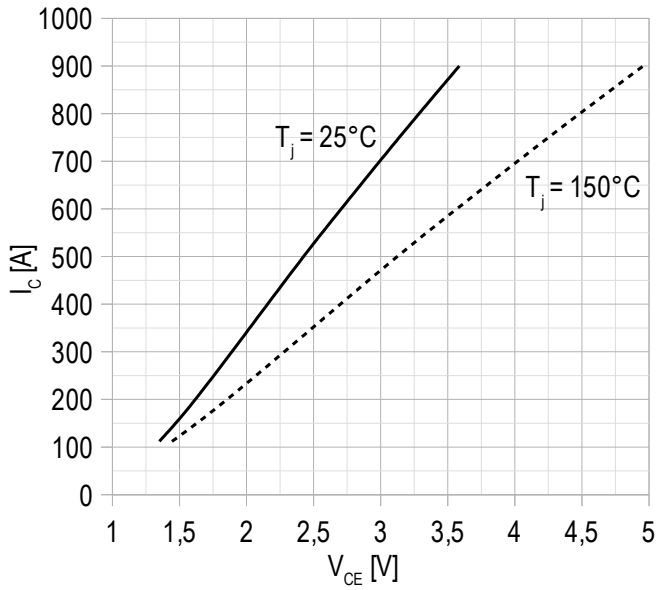
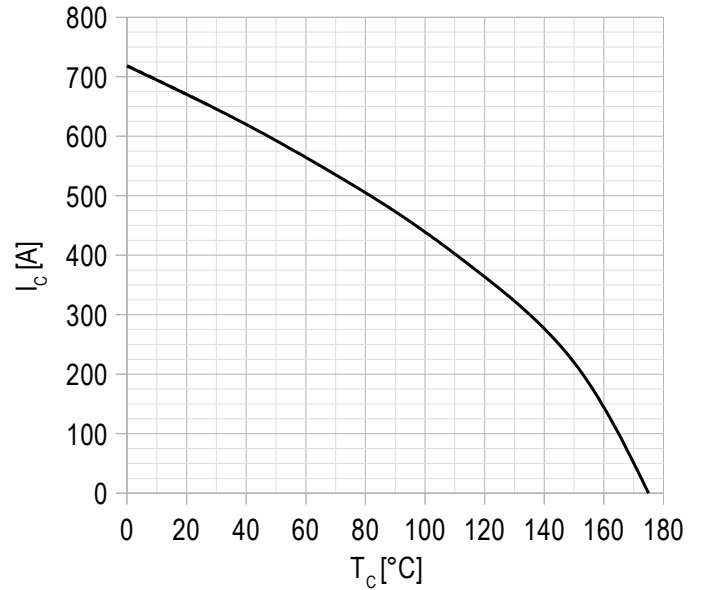
**Characteristics**

Definition	Symbol	Conditions	Value			Unit		
			min.	typ.	max.			
<b>IGBT</b>								
Collector-Emitter saturation voltage	$V_{CEsat}$	$V_{GE} = +15\text{ V}; I_C = 450\text{ A}; t_u = 1000\ \mu\text{s}.$	$T_{vj} = 25^\circ\text{C}$ $T_{vj} = 150^\circ\text{C}$	1.90 2.35	2.30 2.90	2.70 3.45	V V	
Gate-Emitter threshold voltage	$V_{GE(th)}$	$I_C = 18\text{ mA}; V_{CE} = V_{GE}; T_{vj} = 25^\circ\text{C}; t_u = 2\text{ ms}.$		5.20	5.80	6.40	V	
Collector-Emitter cut-off current	$I_{CES}$	$V_{CE} = 1200\text{ V}; t_u = 50\text{ ms}; V_{GE} = 0.$	$T_{vj} = 25^\circ\text{C}$ $T_{vj} = 150^\circ\text{C}$	- -	14.0 7.0	100 20.0	$\mu\text{A}$ mA	
Gate-Emitter leakage current	$I_{GES}$	$V_{CE} = 0; V_{GE} = \pm 20\text{ V}; T_{vj} = 25^\circ\text{C}; t_u = 30\text{ ms}.$		-	12.0	100	nA	
Input capacitance	$C_{ies}$	$V_{CE} = 25\text{ V}; V_{GE} = 0\text{ V}; f = 1\text{ MHz}; T_{vj} = 25^\circ\text{C}.$		-	31.10	-	nF	
Output capacitance	$C_{oes}$			-	2.50	-		
Reverse transfer capacitance	$C_{res}$			-	1.10	-		
Total gate charge	$Q_G$	$I_G = 20\text{ mA}; V_{CE} = 600\text{ V}; V_{GE} = -8\dots+15\text{ V}.$		-	1600	1750	nC	
Internal gate resistance	$R_{Gint}$	$T_{vj} = 25^\circ\text{C}.$		-	-	1.90	$\Omega$	
Turn-on delay time	$t_{d(on)}$	$V_{CE} = 600\text{ V}; V_{GE} = \pm 15\text{ V}; I_{Cmax} = 450\text{ A}; R_G = 2.2\ \Omega; L_s = 56\text{ nH}.$	$T_{vj} = 25^\circ\text{C}$ $T_{vj} = 150^\circ\text{C}$	114 146	176 204	238 262	ns	
Rise time	$t_{ri}$		$T_{vj} = 25^\circ\text{C}$ $T_{vj} = 150^\circ\text{C}$	60 65	71 79	82 93	ns	
Turn-on energy	$E_{on}$		$T_{vj} = 25^\circ\text{C}$ $T_{vj} = 150^\circ\text{C}$	5.0 14.0	12.0 27.0	19.0 40.0	mJ	
Turn-off delay time	$t_{d(off)}$		$T_{vj} = 25^\circ\text{C}$ $T_{vj} = 150^\circ\text{C}$	269 329	313 386	357 443	ns	
Fall time	$t_{fi}$		$T_{vj} = 25^\circ\text{C}$ $T_{vj} = 150^\circ\text{C}$	143 204	166 239	189 274	ns	
Turn-off energy	$E_{off}$		$T_{vj} = 25^\circ\text{C}$ $T_{vj} = 150^\circ\text{C}$	32.5 43.5	38.5 50.5	44.5 57.5	mJ	
Collector-emitter threshold voltage	$V_{CE0}$		$V_{GE} = +15\text{ V}; T_{vj} = 150^\circ\text{C}; I_{CE1} = 112.5\text{ A}; I_{CE2} = 450\text{ A}; t_u = 1000\ \mu\text{s}.$		0.91	0.96	1.01	V
On-State slope resistance (IGBT)	$r_{CE0}$				4.07	4.36	4.65	m $\Omega$
Thermal resistance junction to case	$R_{th(j-c)}$		DC; $I_{CE} = 350 \pm 40\text{ A}; I_{test} = 0.5\text{ A}; V_{GE} = +15\text{ V}.$		-	0.053	0.056	K/W
<b>Inverse diode \ Freewheeling diode</b>								
Forward voltage drop	$V_F$	$I_F = 450\text{ A}; V_{GE} = 0; t_u = 1000\ \mu\text{s}.$	$T_{vj} = 25^\circ\text{C}$ $T_{vj} = 150^\circ\text{C}$	2.10 2.10	2.45 2.50	2.80 2.90	V V	
Reverse recovery time	$t_{rr}$	$V_{GE} = \pm 15\text{ V}; V_{CE} = 600\text{ V}; I_{Cmax} = 450\text{ A}; L_s = 56\text{ nH}; R_{Gon} = 2.2\ \Omega.$	$T_{vj} = 25^\circ\text{C}$ $T_{vj} = 150^\circ\text{C}$	110 125	131 240	152 355	ns ns	
Peak reverse current	$I_{RM}$		$T_{vj} = 25^\circ\text{C}$ $T_{vj} = 150^\circ\text{C}$	170 225	250 320	330 415	A A	
Recovered charge	$Q_r$		$T_{vj} = 25^\circ\text{C}$ $T_{vj} = 150^\circ\text{C}$	13.5 28.0	19.5 42.0	25.5 56.0	$\mu\text{C}$ $\mu\text{C}$	
Reverse recovery energy	$E_{rec}$		$T_{vj} = 25^\circ\text{C}$ $T_{vj} = 150^\circ\text{C}$	7.0 16.5	11.0 26.0	15.0 35.5	mJ mJ	
Threshold voltage	$V_{(T0)}$		$T_{vj} = 150^\circ\text{C}; V_{GE} = 0; I_{CE1} = 112.5\text{ A}; I_{CE2} = 450\text{ A}; t_u = 1000\ \mu\text{s}.$		0.93	0.96	0.99	V
Forward slope resistance	$r_T$				3.25	3.42	3.59	m $\Omega$
Thermal resistance junction to case	$R_{th(jc-D)}$	DC; $I_{CE} = 350 \pm 40\text{ A}; I_{test} = 0.5\text{ A}; V_{GE} = +15\text{ V}.$		-	0.119	0.124	K/W	

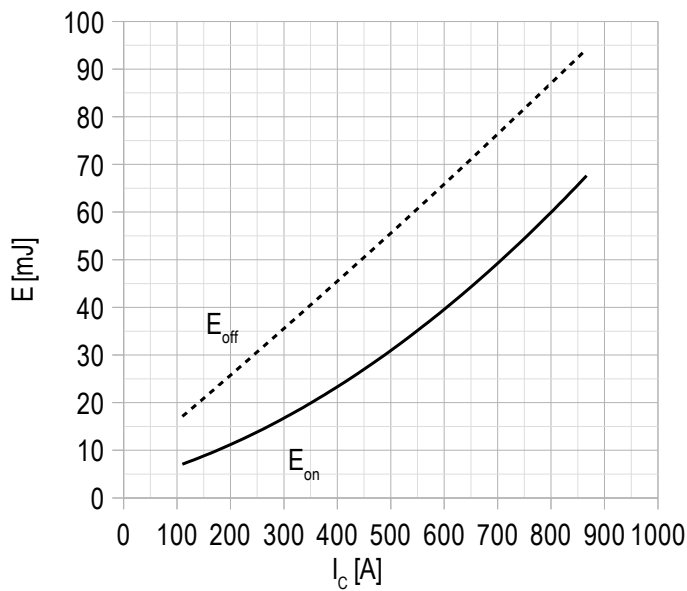
Module							
Pin resistance	$R_{Pxy}$	$T_{vj} = 25^{\circ}\text{C}.$	$R_{P12}$	-	0.28	0.50	m $\Omega$
			$R_{P13}$	-	0.38	0.50	
Parasitic inductance between terminals	$L_{Pce}$			-	22	-	nH
Thermal resistance case to heatsink	$R_{thCH}$	per module			0.02	0.04	K/W
Mounting torque for screws to heatsink	$M_s$	to heatsink M6		3.00	-	5.00	N*m
Mounting torque for terminal screws	$M_t$	to terminals M6		2.25	2.50	2.75	N*m
Weight	$W$			-	320	340	g

**Notes:**

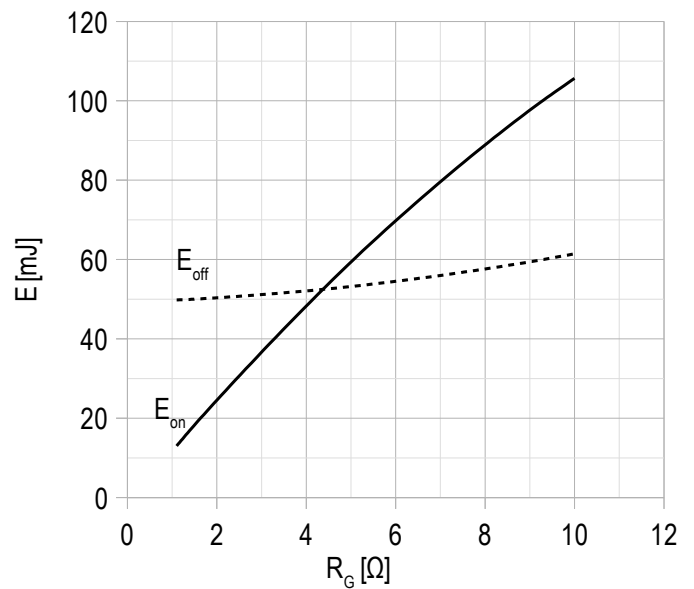
- Insulating material operating temperature 125°C max;
- Case temperature 125°C max;
- The recommended operating junction temperature  $T_{vj\ op} = -40\dots+150^{\circ}\text{C}.$

**Chart 1 – typ. output characteristic, IGBT.**

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


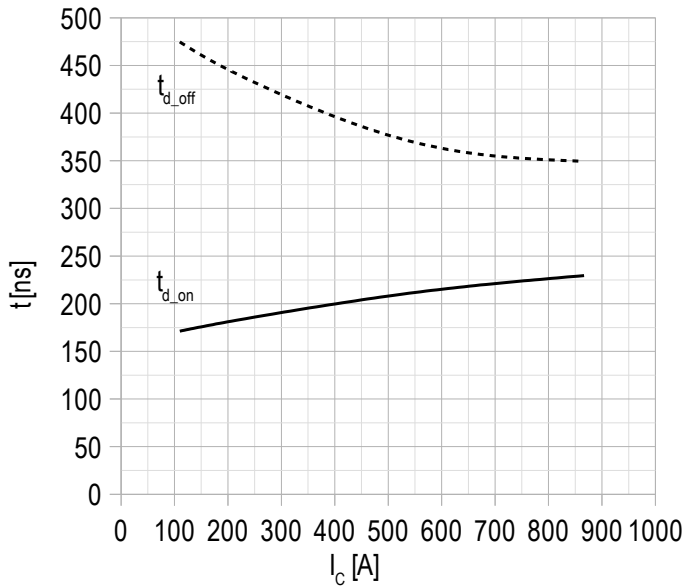
DC;  
 $V_{GE} = +15 \text{ V;}$   
 $T_{vj(max)} = 175^\circ\text{C.}$

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


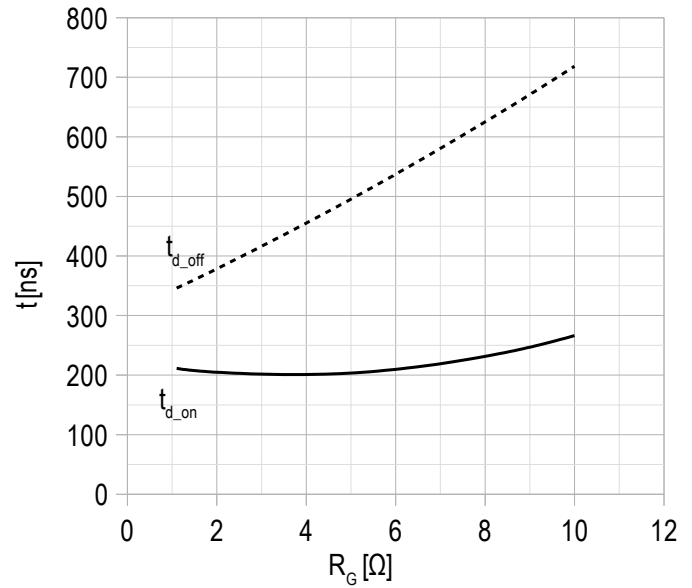
$V_{CE} = 600 \text{ V;}$   
 $V_{GE} = \pm 15 \text{ V;}$   
 $R_G = 2.2 \Omega;$   
 $L_s = 56 \text{ nH;}$   
 $T_{vj(max)} = 150^\circ\text{C.}$

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


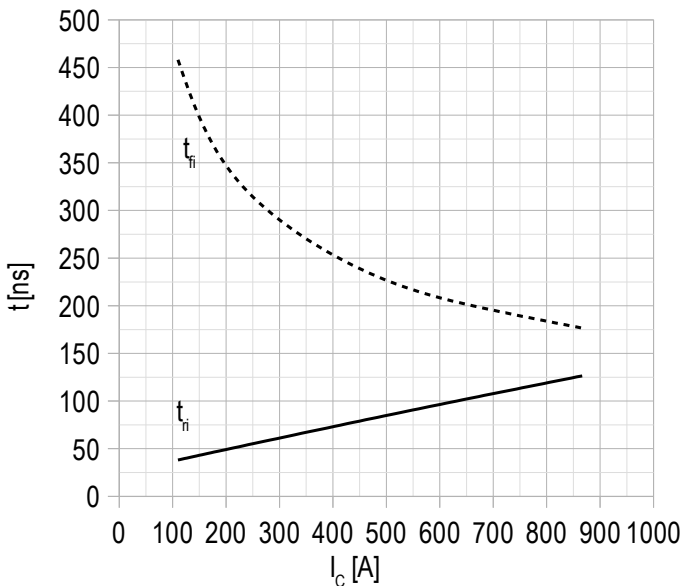
$V_{CE} = 600 \text{ V;}$   
 $V_{GE} = \pm 15 \text{ V;}$   
 $I_{Cmax} = 450 \text{ A;}$   
 $L_s = 56 \text{ nH;}$   
 $T_{vj(max)} = 150^\circ\text{C.}$

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


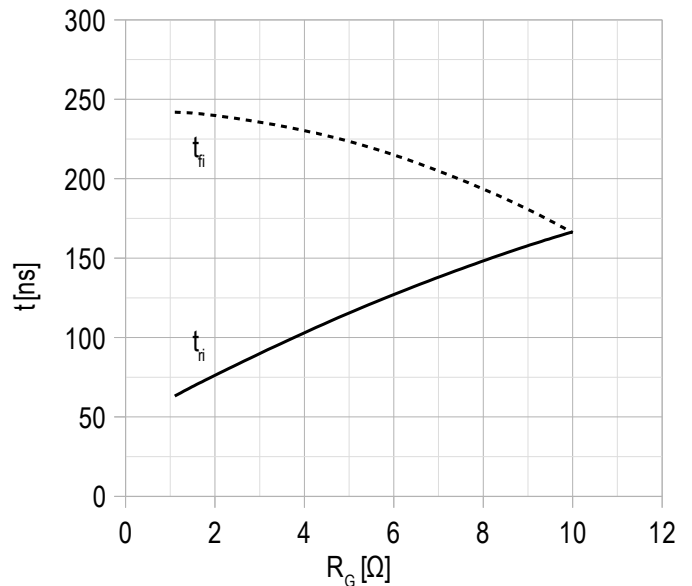
$V_{CE} = 600 \text{ V};$   
 $V_{GE} = \pm 15 \text{ V};$   
 $R_G = 2.2 \Omega;$   
 $L_s = 56 \text{ nH};$   
 $T_{vj(max)} = 150^\circ\text{C}.$

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


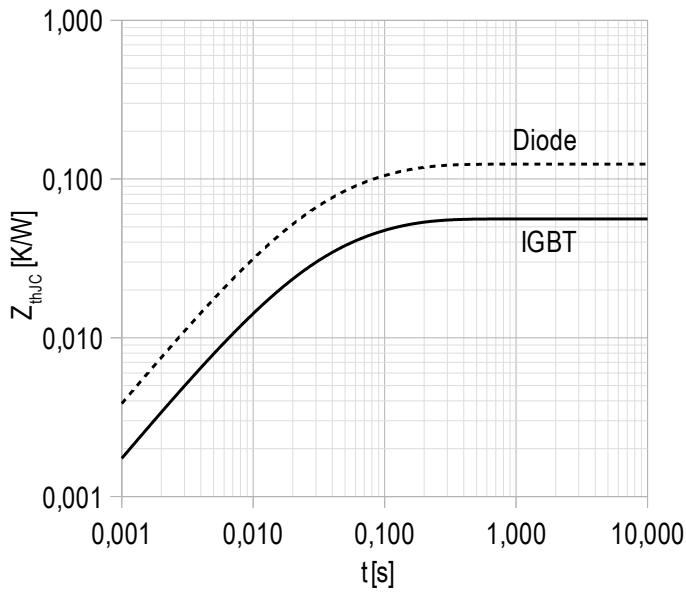
$V_{CE} = 600 \text{ V};$   
 $V_{GE} = \pm 15 \text{ V};$   
 $I_{Cmax} = 450 \text{ A};$   
 $L_s = 56 \text{ nH};$   
 $T_{vj(max)} = 150^\circ\text{C}.$

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


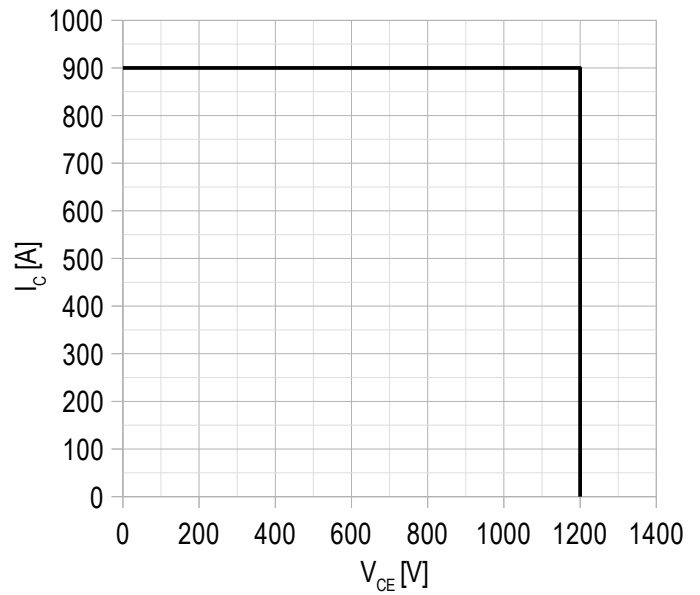
$V_{CE} = 600 \text{ V};$   
 $V_{GE} = \pm 15 \text{ V};$   
 $R_G = 2.2 \Omega;$   
 $L_s = 56 \text{ nH};$   
 $T_{vj(max)} = 150^\circ\text{C}.$

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


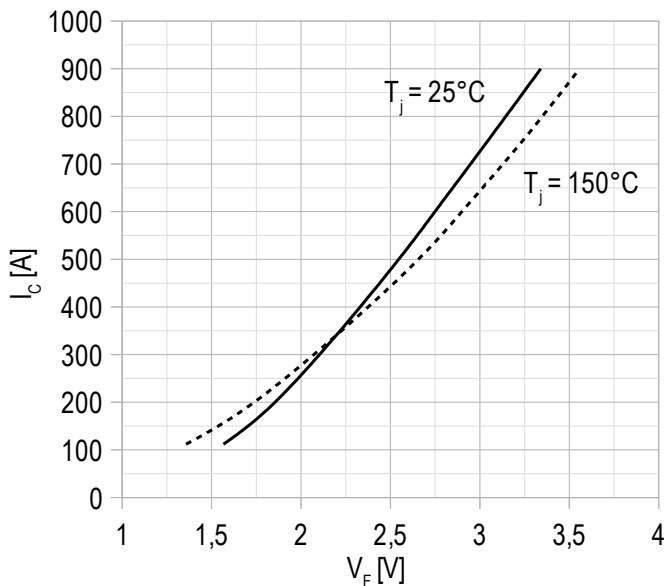
$V_{CE} = 600 \text{ V};$   
 $V_{GE} = \pm 15 \text{ V};$   
 $I_{Cmax} = 450 \text{ A};$   
 $L_s = 56 \text{ nH};$   
 $T_{vj(max)} = 150^\circ\text{C}.$

**Chart 9 – max. transient thermal impedance .**


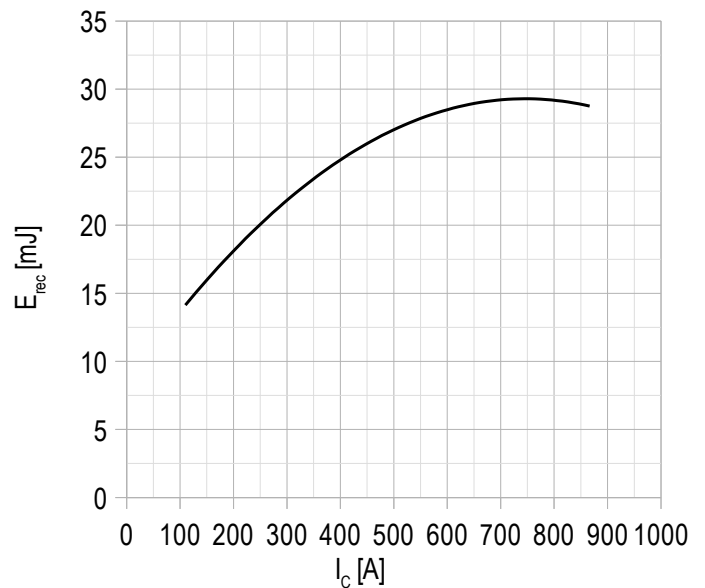
Single pulse;  
 $V_{GE} = +15\text{ V}$ .

**Chart 10 – RBSOA.**


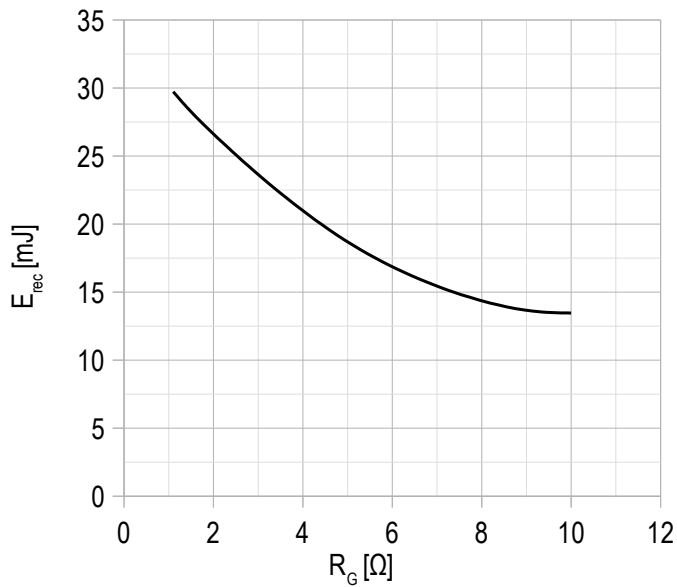
$V_{CE\text{ max}} = 1200\text{ V}$ ;  
 $V_{GE} = \pm 15\text{ V}$ ;  
 $I_{C\text{ max}} = 2 \cdot I_{C\text{ nom}}$ ;  
 $R_G = 2.2\ \Omega$ ;  
 $L_s = 56\text{ nH}$ .

**Chart 11 – typ. output characteristic, FRD.**


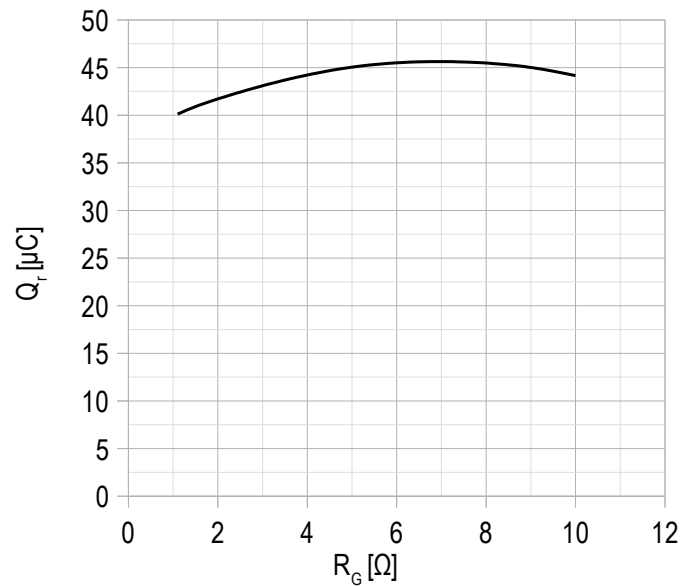
$V_{GE} = 0\text{ V}$ .

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


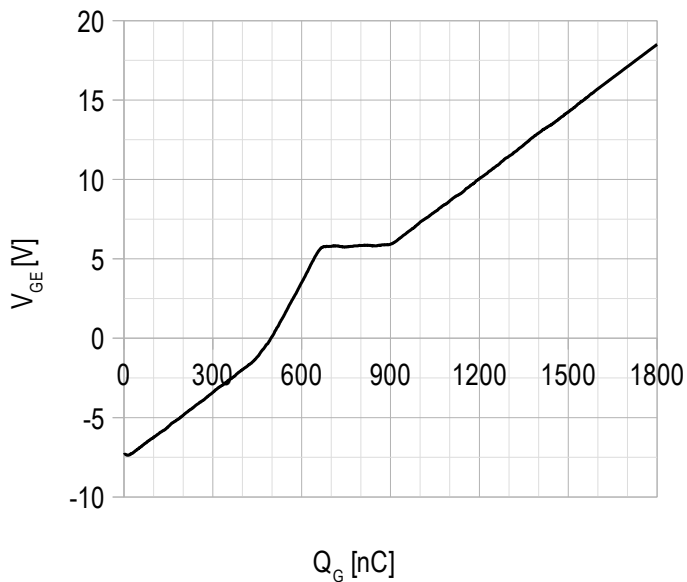
$V_{GE} = \pm 15\text{ V}$ ;  
 $V_{CE} = 600\text{ V}$ ;  
 $L_s = 56\text{ nH}$ ;  
 $R_{G\text{ on}} = 2.2\ \Omega$ ;  
 $T_{vj\text{ (max)}} = 150^\circ\text{C}$ .

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


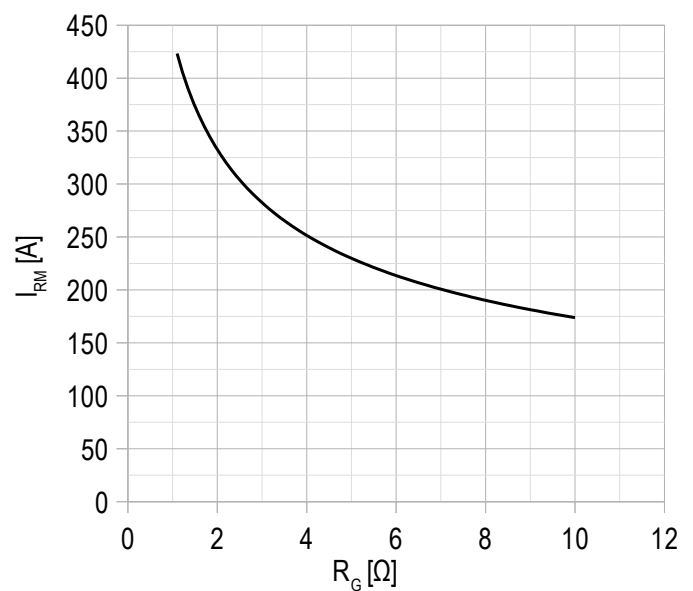
$V_{GE} = \pm 15$  V;  
 $V_{CE} = 600$  V;  
 $I_{Cmax} = 450$  A;  
 $L_s = 56$  nH;  
 $T_{vj(max)} = 150^\circ\text{C}$ .

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


$V_{GE} = \pm 15$  V;  
 $V_{CE} = 600$  V;  
 $I_{Cmax} = 450$  A;  
 $L_s = 56$  nH;  
 $T_{vj(max)} = 150^\circ\text{C}$ .

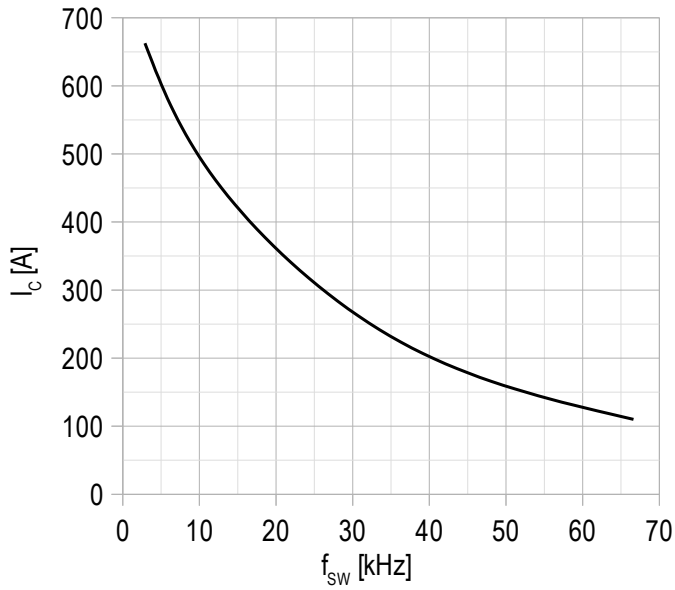
**Chart 15 – typ. gate charge characteristic.**


$I_C = 450$  A;  
 $V_{CE} = 600$  V;  
 $V_{GE} = -8 \div 15$  V.

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


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

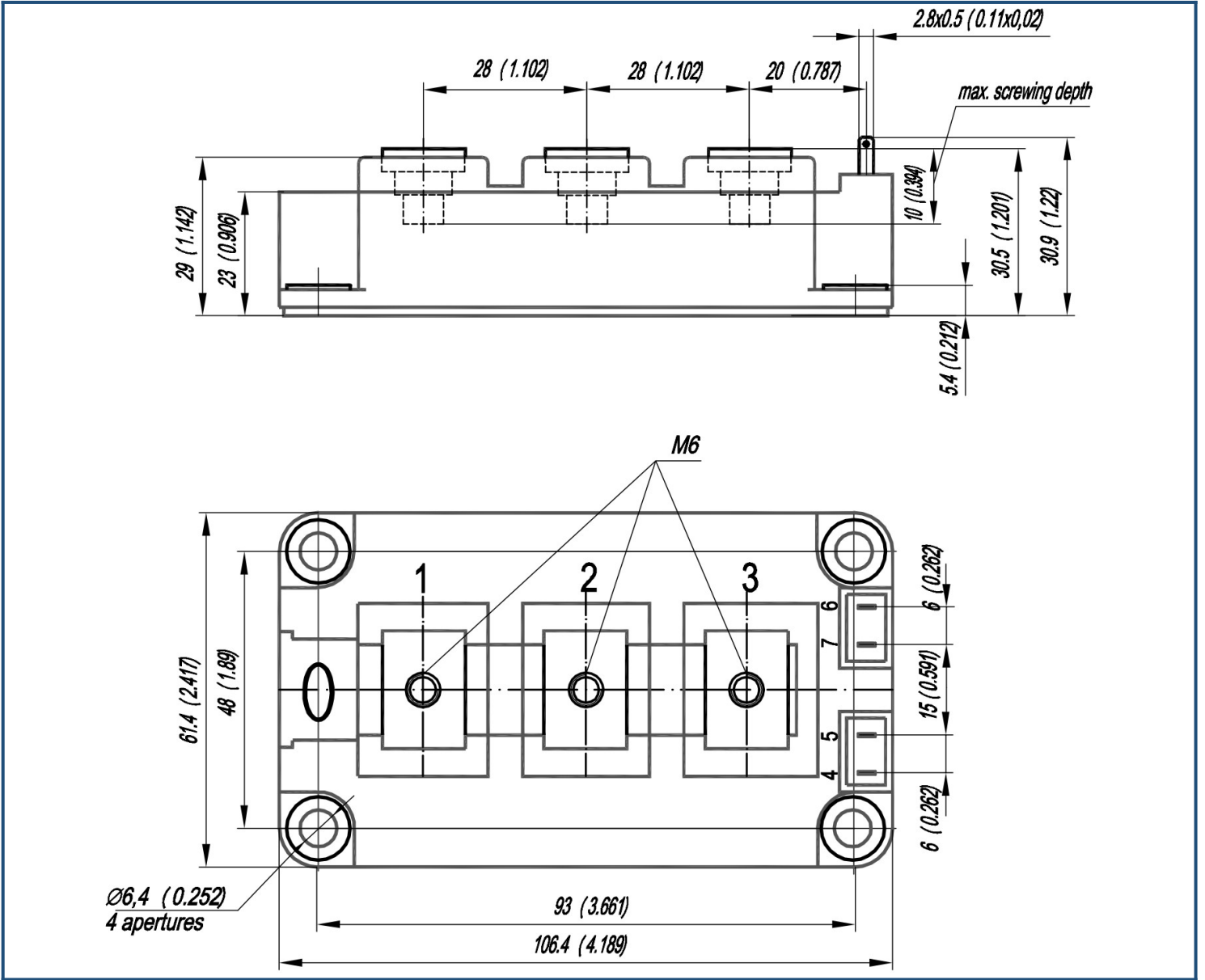
Chart 17 – max. rated current vs frequency.



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 – AA



Part numbering guide

MIAA	-	HB	12	SA	-	450	N	
MIAA								IGBT module package type: AA
		HB						2 switches as Half-Bridge
			12					Voltage rating ( $V_{CES}/100$ )
				SA				IGBT+FRD chipset modification
						450		Current Rating
							N	Climatic version: normal climate

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