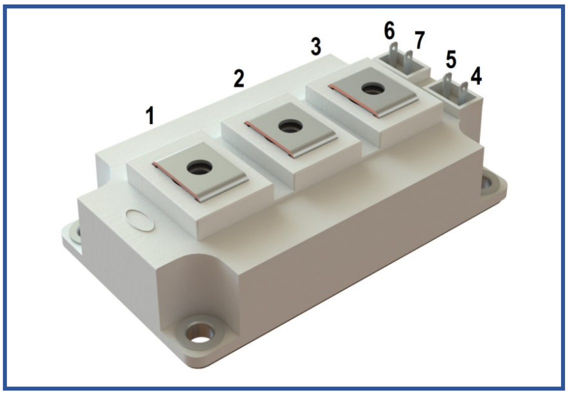
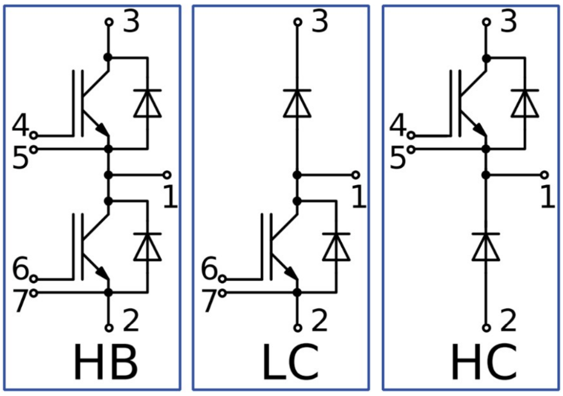
Industry standard 62mm IGBT module — 1200 V 450 A





Chip features

- IGBT chip
  - low $V_{CE(sat)}$ value
  - 10 µs short circuit of 150°C
  - square RBSOA of $2xI_C$
  - 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
IGBT				
Collector-Emitter voltage	V_{CES}	V_{GE} = 0.	1200	V
Maximum allowable collector current (continuous)	$I_{C\ 25}$	$T_{vj\ (max)}$ = 175°C; T_c = 25°C.	663	A
	$I_{C\ 80}$	$T_{vj\ (max)}$ = 175°C; T_c = 80°C.	450	A
Repetitive peak collector current[*1]	I_{CRM}	I_{CRM} = 3 x $I_{C\ nom}$; t_p = 1 ms.	1350	A
Short-circuit duration	t_{psc}	T_{vj} = 25°C; V_{GE} = ±15 V; V_{CE} = 720 V; $R_{G\ on}$ = $R_{G\ off}$ = 2.2 Ω; $I_{C\ max}$ < 2800 A.	10	µs
		T_{vj} = 150°C; V_{GE} = ±15 V; V_{CE} = 720 V; $R_{G\ on}$ = $R_{G\ off}$ = 2.2 Ω; $I_{C\ max}$ < 2300 A.	10	
Gate-Emitter voltage	V_{GES}		±20	V
Junction operating temperature	$T_{vj\ (op)}$		-40…+150	ºC
Inverse diode \ Freewheeling 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°C; T_c = 25°C.	475	A
	$I_{F\ 80}$	$T_{vj\ (max)}$ = 175°C; T_c = 80°C.	353	A
Repetitive peak forward current[*1]	I_{FRM}	I_{FRM} = 3 x $I_{F\ nom}$; t_p = 1 ms.	1350	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

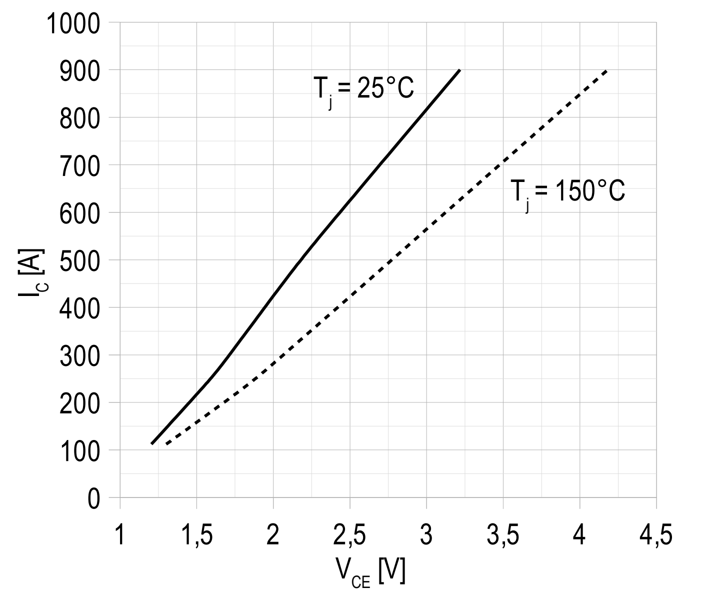
Definition	Symbol	Conditions		Value min.	Value typ.	Value max.	Unit
IGBT							
Collector-Emitter saturation voltage	V_{CEsat}	V_{GE} = +15 V; I_C = 450 A; t_u = 1000 μs.	T_{vj} = 25°C	1.75	2.05	2.25	V
			T_{vj} = 150°C	2.25	2.60	2.95	V
Gate-Emitter threshold voltage	$V_{GE(th)}$	I_C = 18 mA; V_{CE} = V_{GE}; T_{vj} = 25°C; t_u = 2 ms.		5.20	5.85	6.45	V
Collector-Emitter cut-off current	I_{CES}	V_{CE} = 1200 V; t_u = 50 ms; V_{GE} = 0.	T_{vj} = 25°C	-	1.00	100	μA
			T_{vj} = 150°C	-	1.00	3.00	mA
Gate-Emitter leakage current	I_{GES}	V_{CE} = 0; V_{GE} = ±20 V; T_{vj} = 25°C; t_u = 30 ms.		-	33.00	100	nA
Input capacitance	C_{ies}	V_{CE} = 25 V; V_{GE} = 0 V; f = 1 MHz; T_{vj} = 25°C.		-	85.4	-	nF
Output capacipance	C_{oes}			-	-	-	
Reverse transfer capacitance	C_{res}			-	0.98	-	
Total gate charge	Q_G	I_C = 450 A; V_{CE} = 600 V; V_{GE} = -8...+15 V.		-	3550	3750	nC
Internal gate resistance	R_{Gint}	T_{vj} = 25°C.		-	1.80	-	Ω
Turn-on delay time	$t_{d(on)}$	V_{CE} = 600 V; V_{GE} = ±15 V; $I_{C\,max}$ = 450 A; R_G = 0.5 Ω; L_s = 56 nH.	T_{vj} = 25°C	256	413	493	ns
			T_{vj} = 150°C	318	440	557	
Rise time	t_{ri}		T_{vj} = 25°C	52	72	86	ns
			T_{vj} = 150°C	63	93	125	
Turn-on energy	E_{on}		T_{vj} = 25°C	10.5	21.0	35.5	mJ
			T_{vj} = 150°C	25.0	51.5	82.0	
Turn-off delay time	$t_{d(off)}$		T_{vj} = 25°C	301	388	437	ns
			T_{vj} = 150°C	319	424	537	
Fall time	t_{fi}		T_{vj} = 25°C	130	166	190	ns
			T_{vj} = 150°C	224	292	374	
Turn-off energy	E_{off}		T_{vj} = 25°C	29.0	37.5	43.0	mJ
			T_{vj} = 150°C	39.0	51.5	65.0	
Collector-emitter threshold voltage	V_{CE0}	V_{GE} = +15 V; T_{vj} = 150°C; I_{CE1} = 112 A; I_{CE2} = 450 A; t_u = 1000 μs.		0.83	0.87	0.91	V
On-State slope resistance (IGBT)	r_{CE0}			3.56	3.84	4.12	mΩ
Thermal resistance junction to case	$R_{th(j-c)}$	DC; I_{CE} = 350±40 A; I_{test} = 0.5 A; V_{GE} = +15 V.		-	0.050	0.062	K/W
Inverse diode \ Freewheeling diode							
Forward voltage drop	V_F	I_F = 450 A; V_{GE} = 0; t_u = 1000 μs.	T_{vj} = 25°C	1.55	1.85	2.10	V
			T_{vj} = 150°C	1.70	1.95	2.30	V
Reverse recovery time	t_{rr}	V_{GE} = ±15 V; V_{CE} = 600 V; $I_{C\,max}$ = 450 A; L_s = 56 nH; $R_{G\,on}$ = 0.5 Ω.	T_{vj} = 25°C	151	197	229	ns
			T_{vj} = 150°C	212	334	478	ns
Peak reverse current	I_{RM}		T_{vj} = 25°C	315	460	660	A
			T_{vj} = 150°C	264	410	635	A
Recovered charge	Q_r		T_{vj} = 25°C	39.0	54.0	75.5	μC
			T_{vj} = 150°C	60.0	79.0	102.0	μC
Reverse recovery energy	E_{rec}		T_{vj} = 25°C	16.0	27.5	47.0	mJ
			T_{vj} = 150°C	20.0	32.5	52.0	mJ
Threshold voltage	$V_{(T0)}$	T_{vj} = 150°C; V_{GE} = 0; I_{F1} = 112 A; I_{F2} = 450 A; t_u = 1000 μs.		0.89	0.91	0.93	V
Forward slope resistance	r_T			2.13	2.34	2.55	mΩ
Thermal resistance junction to case	$R_{th(JC-D)}$	DC; I_{CE} = 350±40 A; I_{test} = 0.5 A; V_{GE} = +15 V.		-	0.125	0.147	K/W

Module							
Pin resistance	R_{Pxy}	T_{vj} = 25°C.	R_{P12}	-	0.28	0.50	mΩ
			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			-	318	340	g

Notes:

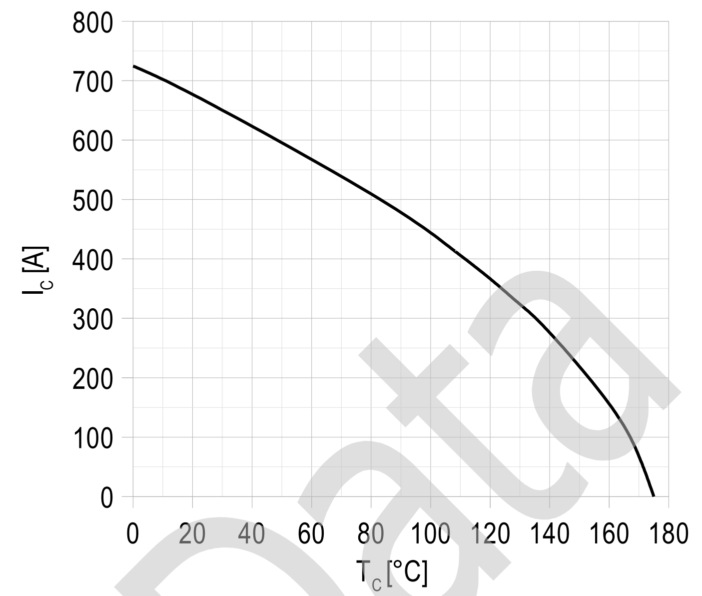
- Insulating material operating temperature 125°C max;
- Case temperature 125°C max;
- The recommended operating junction temperature $T_{vj\ op}$ = -40...+150°C.

Chart 1 – typ. output characteristic, IGBT.



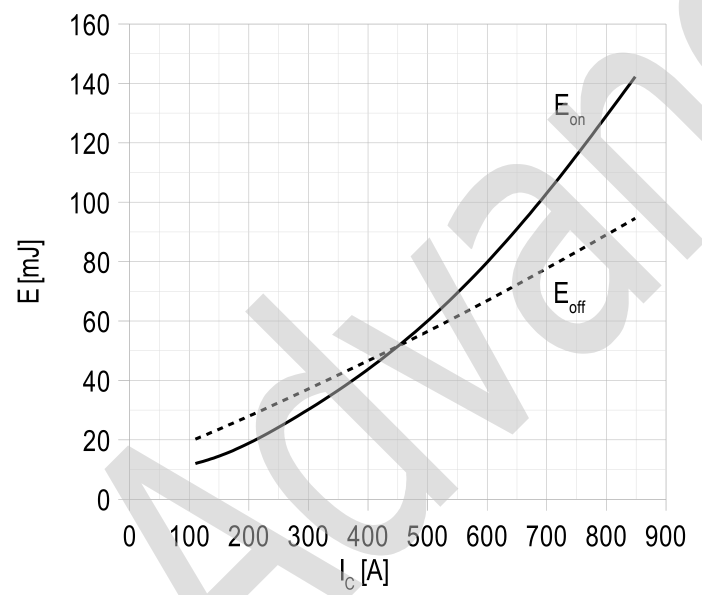
V_{GE} = +15 V.

Chart 2 – max. rated current vs temperature.



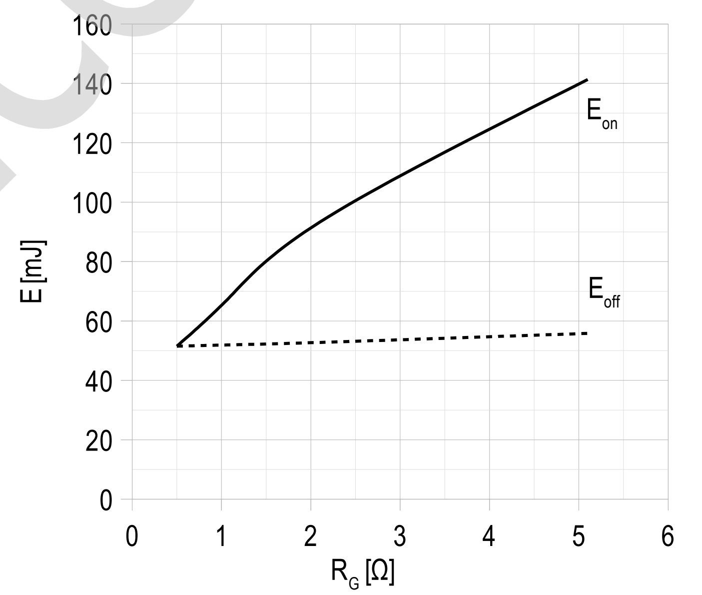
DC;
V_{GE} = +15 V;
$T_{vj\ (max)}$ = 175°C.

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



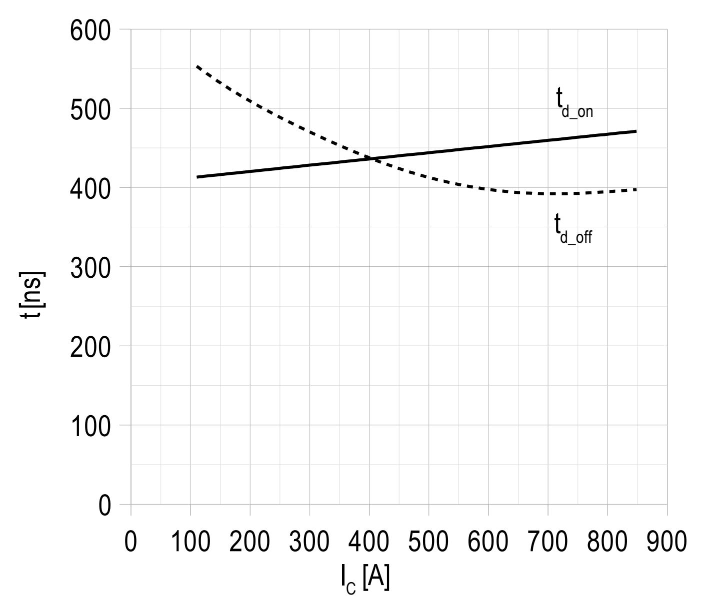
V_{CE} = 600 V;
V_{GE} = ±15 V;
R_G = 0.5 Ω;
L_s = 56 nH;
$T_{vj\ (max)}$ = 150°C.

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



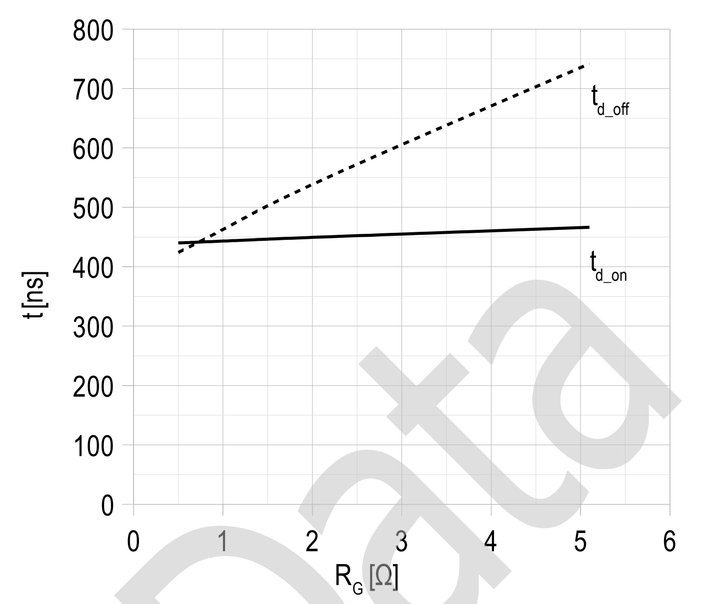
V_{CE} = 600 V;
V_{GE} = ±15 V;
$I_{C\ max}$ = 450 A;
L_s = 56 nH;
$T_{vj\ (max)}$ = 150°C.

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



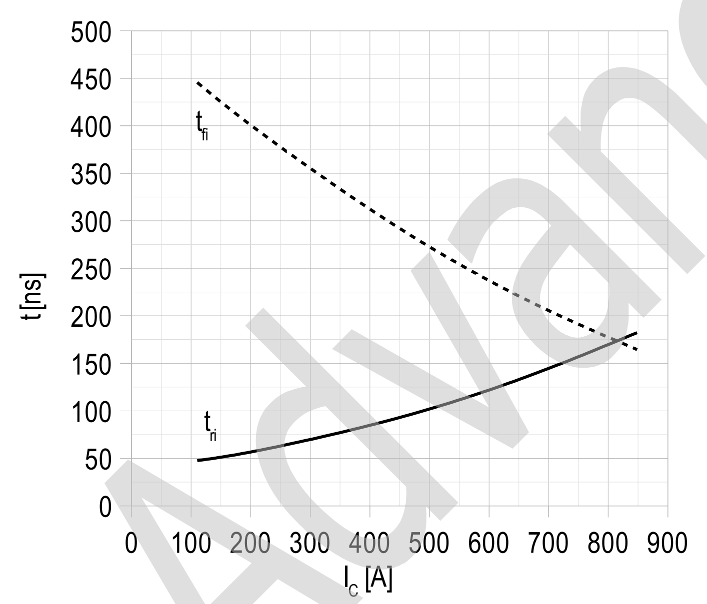
V_{CE} = 600 V;
V_{GE} = ±15 V;
R_G = 0.5 Ω;
L_s = 56 nH;
$T_{vj\,(max)}$ = 150°C.

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



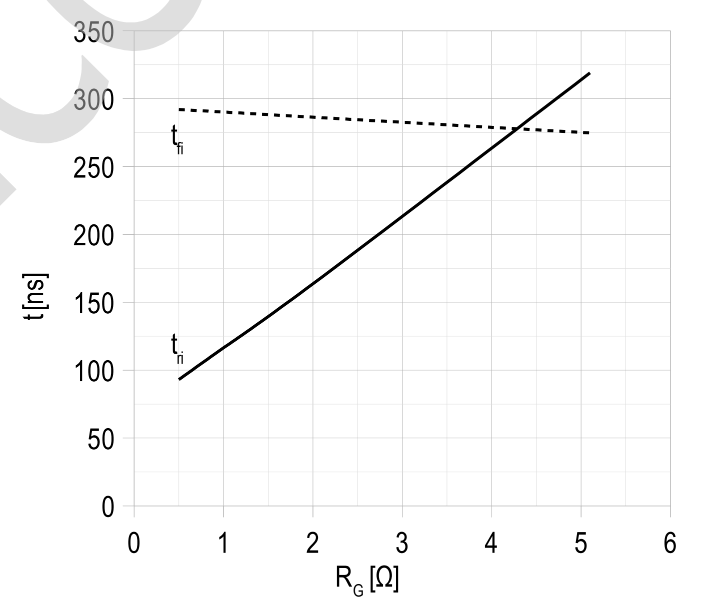
V_{CE} = 600 V;
V_{GE} = ±15 V;
$I_{C\,max}$ = 450 A;
L_s = 56 nH;
$T_{vj\,(max)}$ = 150°C.

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



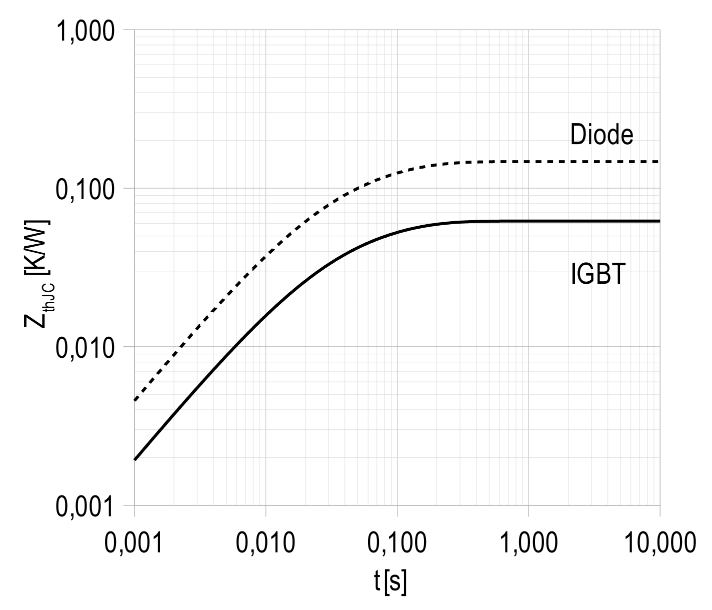
V_{CE} = 600 V;
V_{GE} = ±15 V;
R_G = 0.5 Ω;
L_s = 56 nH;
$T_{vj\,(max)}$ = 150°C.

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



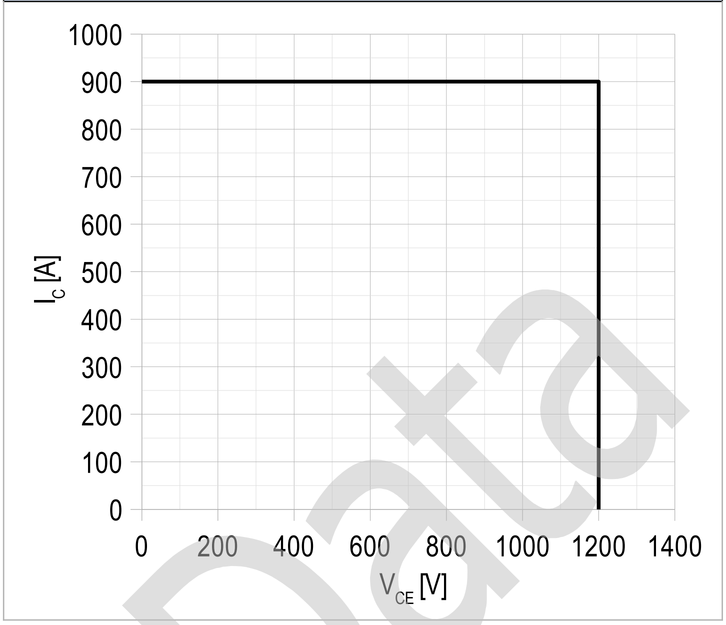
V_{CE} = 600 V;
V_{GE} = ±15 V;
$I_{C\,max}$ = 450 A;
L_s = 56 nH;
$T_{vj\,(max)}$ = 150°C.

Chart 9 – max. transient thermal impedance.



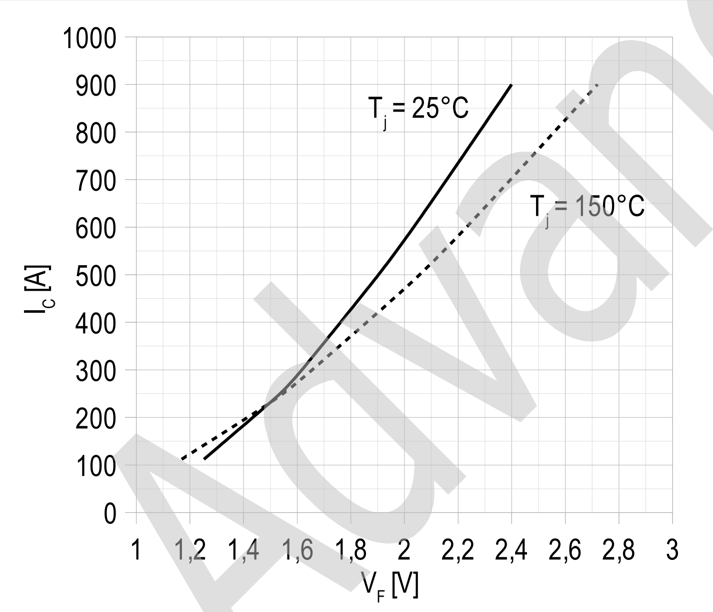
Single pulse;
V_{GE} = +15 V.

Chart 10 – RBSOA.



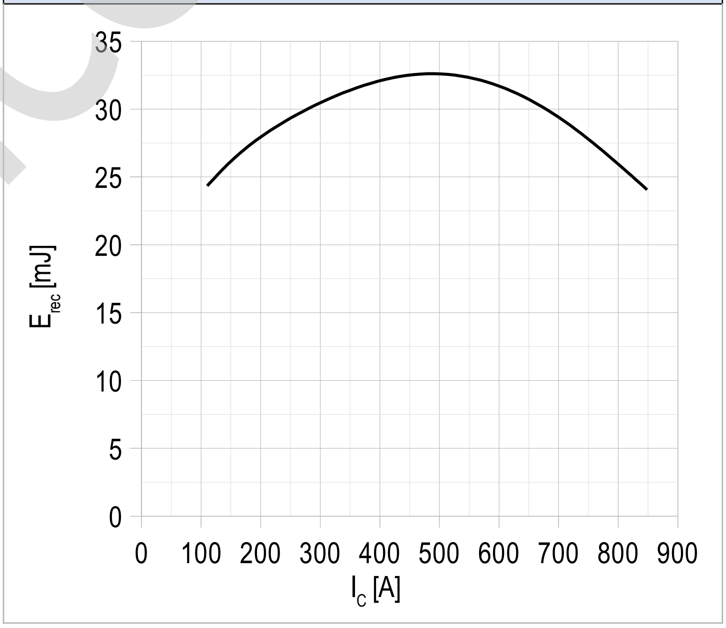
$V_{CE\ max}$ = 1200 V;
V_{GE} = ±15 V;
$I_{C\ max}$ = 2*$I_{C\ nom}$;
R_G = 0.5 Ω;
L_s = 56 nH.

Chart 11 – typ. output characteristic, FRD.



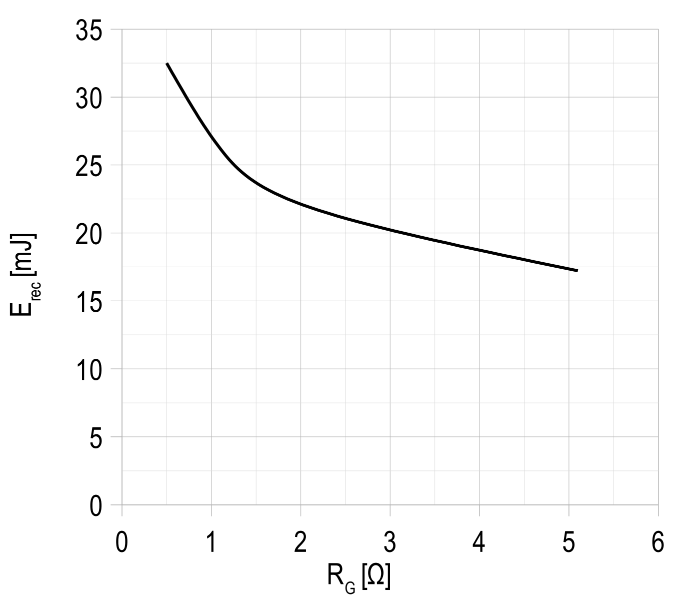
V_{GE} = 0 V.

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



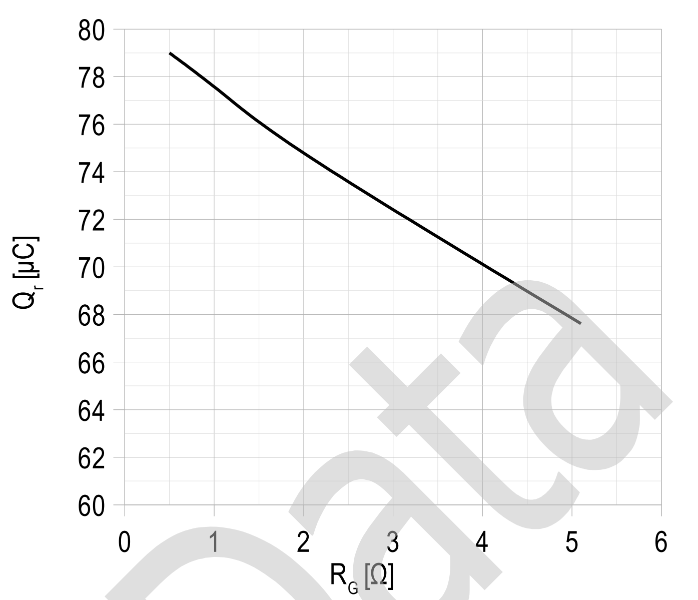
V_{GE} = ±15 V;
V_{CE} = 600 V;
L_s = 56 nH;
$R_{G\ on}$ = 0.5 Ω;
$T_{vj\ (max)}$ = 150°C.

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



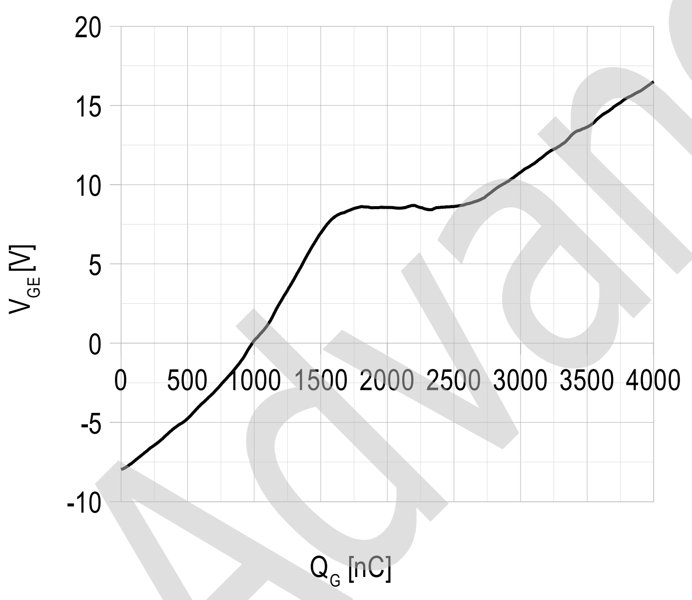
V_{CE} = 600 V;
V_{GE} = ±15 V;
$I_{C\ max}$ = 450 A;
L_s = 56 nH;
$T_{vj\ (max)}$ = 150°C.

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



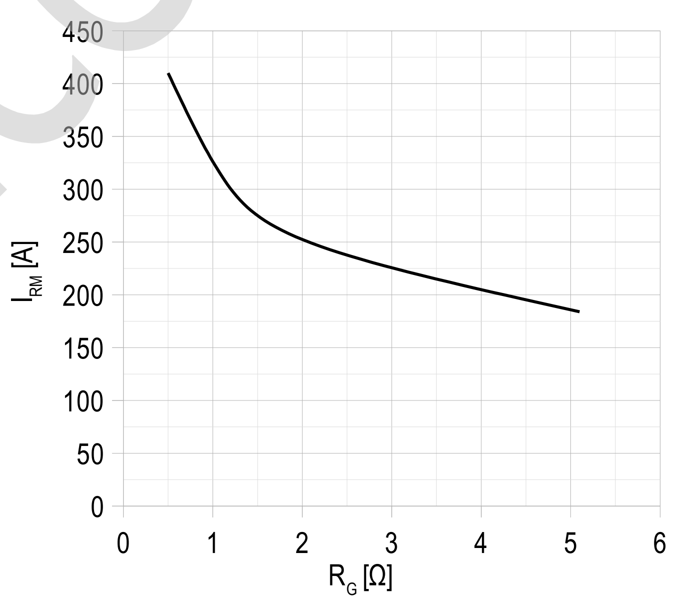
V_{CE} = 600 V;
V_{GE} = ±15 V;
$I_{C\ max}$ = 450 A;
L_s = 56 nH;
$T_{vj\ (max)}$ = 150°C.

Chart 15 – typ. gate charge characteristic.



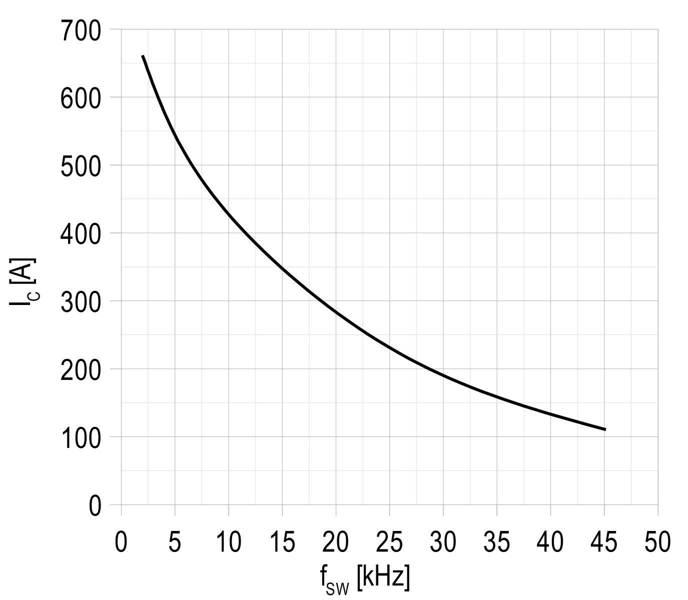
I_C = 450 A;
V_{CE} = 600 V;
V_{GE} = -8...+15 V.

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



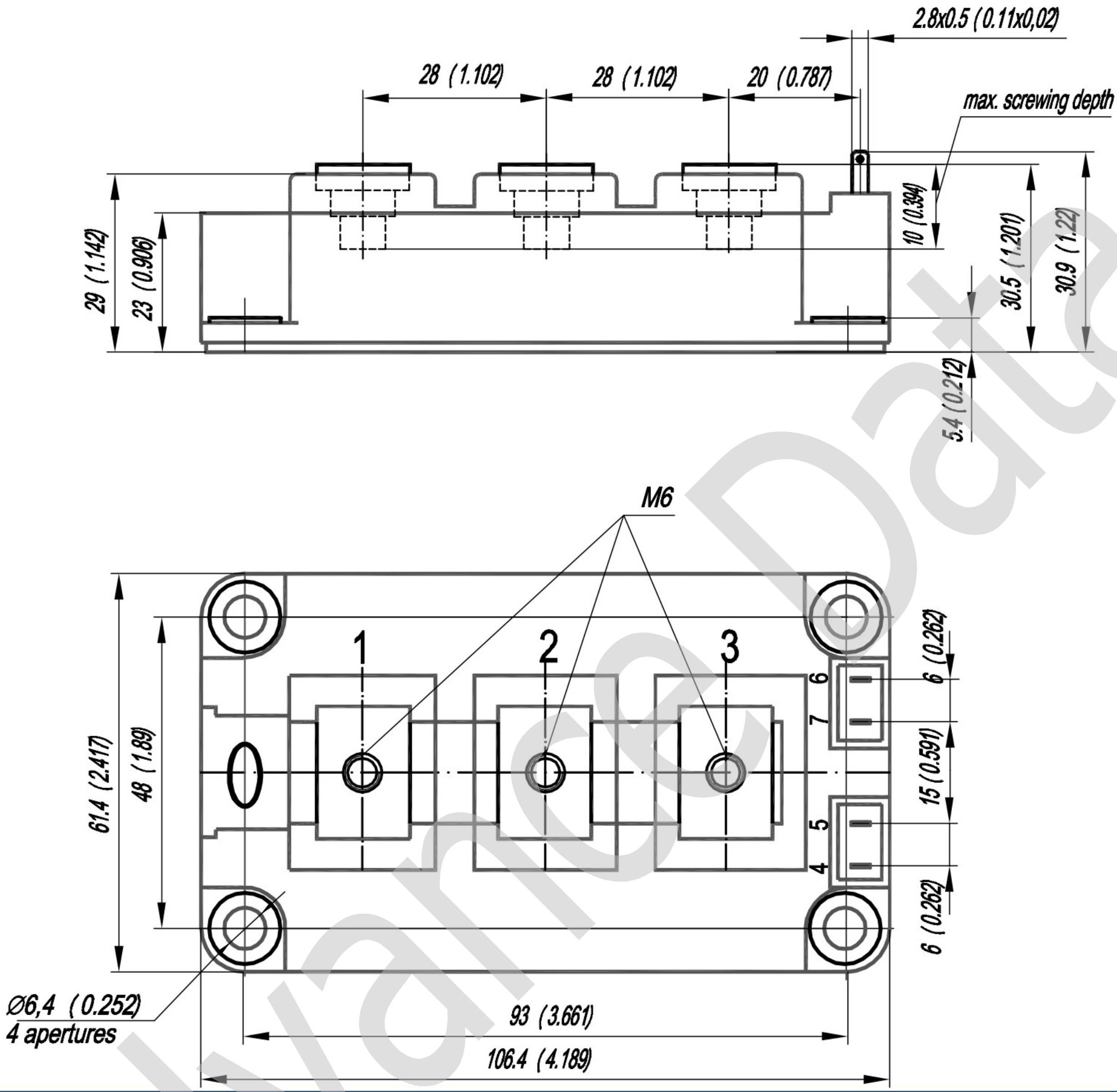
V_{CE} = 600 V;
V_{GE} = ±15 V;
L_s = 56 nH;
$T_{vj\ (max)}$ = 150°C.

Chart 17 – max. rated current vs frequency.



Duty cycle 50%;
V_{CE} = 600 V;
T_c = 80 °C;
$T_{vj\ (max)}$ = 175 °C.

Overall dimensions: Package type – AA



Part numbering guide

MIAA	-	HB	12	SG	-	450	N	
MIAA								IGBT module package type: AA
		HB						2 switches as Half-Bridge
		HC						1 switch as High-Side chopper
		LC						1 switch as Low-Side chopper
			12					Voltage rating (V_{CES}/100)
				SG				IGBT+FRD chipset modification
						450		Current Rating
							N	Climatic version: normal climate