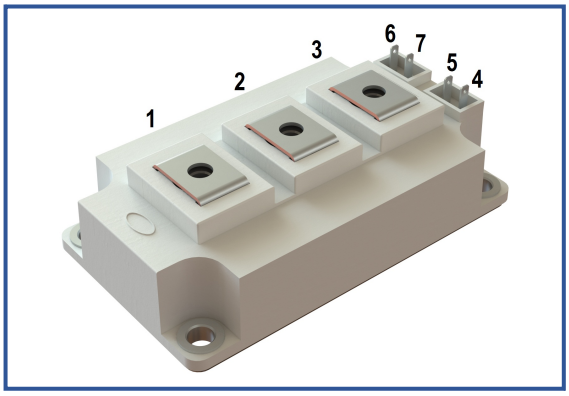
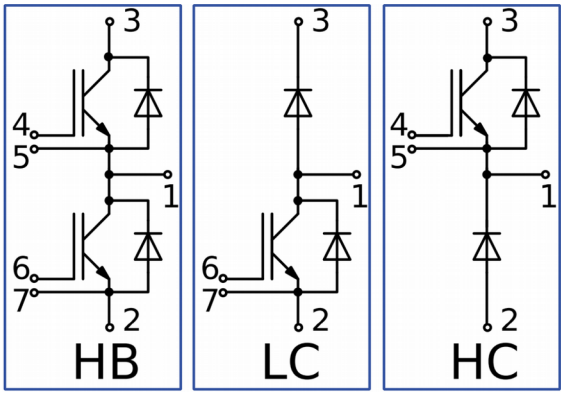
MIAA-HB12FA-400N

IGBT module datasheet

Industry standard 62mm IGBT module

1200 V 400 A





Chip features

- IGBT chip
  - Trench FS — V-Series IGBT (Fuji 6th gen)
  - 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
Collector current (nominal)	$I_{C\ nom}$		400	A
Collector current (maximum continuous)	$I_{C\ 25}$	$T_{vj\ (max)}$ = 175°C; T_c = 25°C.	504	A
	$I_{C\ 80}$	$T_{vj\ (max)}$ = 175°C; T_c = 80°C.	388	A
Repetitive peak collector current*1	I_{CRM}	I_{CRM} = 3 x $I_{C\ nom}$; t_p = 1 ms.	1200	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; $I_{C\ max}$ < 1950 A.	10	µs
		T_{vj} = 150°C; V_{GE} = ±15 V; V_{CE} = 720 V; $R_{G\ on}$ = $R_{G\ off}$ = 2.2 Ω; $I_{C\ max}$ < 1900 A.	10	
Gate-Emitter voltage	V_{GES}		±20	V
Junction operating temperature	$T_{vj\ (op)}$		-40…+150	°C
Inverse diode \ Freewheeling diode				
Repetitive peak reverse voltage	V_{RRM}	V_{GE} = 0 V.	1200	V
Forward current (nominal)	$I_{F\ nom}$		400	A
Forward current (maximum continuous)	$I_{F\ 25}$	$T_{vj\ (max)}$ = 175°C; T_c = 25°C.	444	A
	$I_{F\ 80}$	$T_{vj\ (max)}$ = 175°C; T_c = 80°C.	332	A
Repetitive peak forward current*1	I_{FRM}	I_{FRM} = 3 x $I_{F\ nom}$; t_p = 1 ms.	1200	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

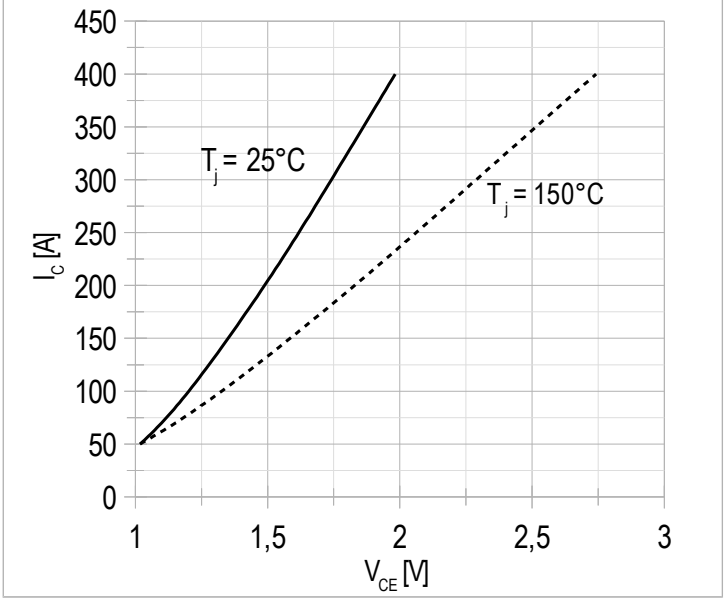
Definition	Symbol	Conditions		Value min.	Value typ.	Value max.	Unit
IGBT							
Collector-Emitter saturation voltage	V_{CEsat}	V_{GE} = +15 V; I_C = 400 A; t_u = 1000 µs.	T_{vj} = 25°C	1.93	1.97	2.12	V
			T_{vj} = 150°C	2.54	2.72	3.00	V
Gate-Emitter threshold voltage	$V_{GE(th)}$	I_C = 16 mA; V_{CE} = V_{GE}; T_{vj} = 25°C; t_u = 2 ms.		5.45	6.04	6.40	V
Collector-Emitter cut-off current	I_{CES}	V_{CE} = 1200 V; t_u = 10 ms; V_{GE} = 0.	T_{vj} = 25°C	45.5	63.2	150	µA
			T_{vj} = 150°C	1.99	2.11	2.5	mA
Gate-Emitter leakage current	I_{GES}	V_{CE} = 0; V_{GE} = ±20 V; T_{vj} = 25°C; t_u = 30 ms.		9.92	11.9	200	nA
Input capacitance	C_{ies}	V_{CE} = 10 V; V_{GE} = 0 V; f = 1 MHz; T_{vj} = 25°C.		-	33.2	-	nF
Output capacitance	C_{oes}			-	2.40	-	nF
Reverse transfer capacitance	C_{res}			-	2.80	-	nF
Total gate charge	Q_G	I_C = 400 A; V_{CE} = 600 V; V_{GE} = - 8÷15 V.		-	3416	3654	nC
Internal gate resistance	R_{Gint}	T_{vj} = 25°C.		-	1.88	-	Ω
Turn-on delay time	$t_{d(on)}$	V_{CE} = 600 V; V_{GE} = ±15 V; $I_{C\,max}$ = 400 A; R_G = 2.2 Ω; L = 100 µH.	T_{vj} = 25°C	348	387	472	ns
			T_{vj} = 150°C	440	457	570	ns
Rise time	t_{ri}		T_{vj} = 25°C	78	83	100	ns
			T_{vj} = 150°C	71	74	102	ns
Turn-on energy	E_{on}		T_{vj} = 25°C	16.8	21.0	28.0	mJ
			T_{vj} = 150°C	23.2	27.9	47.0	mJ
Turn-off delay time	$t_{d(off)}$		T_{vj} = 25°C	650	666	725	ns
			T_{vj} = 150°C	640	650	800	ns
Fall time	t_{fi}		T_{vj} = 25°C	181	194	225	ns
			T_{vj} = 150°C	287	314	360	ns
Turn-off energy	E_{off}		T_{vj} = 25°C	40.8	41.3	46.0	mJ
			T_{vj} = 150°C	52.1	53.9	60.0	mJ
Collector-emitter threshold voltage	V_{CE0}	V_{GE} = +15 V; T_{vj} = 150°C; I_{CE1} = 100 A; I_{CE2} = 400 A; t_u = 1000 µs.		0.82	0.84	0.86	V
On-State slope resistance (IGBT)	r_{CE0}			4.27	4.69	5.30	mΩ
Thermal resistance junction to case	$R_{th(j-c)}$	DC; I_{CE} = 400±20 A; I_{test} = 1.0 A; V_{GE} = +15 V.		-	0.073	0.084	K/W
Inverse diode \ Freewheeling diode							
Forward voltage drop	V_F	I_F = 400 A; V_{GE} = 0; t_u = 500 µs.	T_{vj} = 25°C	1.94	1.98	2.15	V
			T_{vj} = 150°C	2.17	2.31	2.59	V
Reverse recovery time	t_{rr}	V_{GE} = ±15 V; V_{CE} = 600 V; $I_{C\,max}$ = 400 A; L = 100 µH; $R_{G\,on}$ = 2.2 Ω.	T_{vj} = 25°C	136	142	170	ns
			T_{vj} = 150°C	207	221	270	ns
Repetitive peak reverse current	I_{RRM}		T_{vj} = 25°C	260	276	310	A
			T_{vj} = 150°C	320	340	390	A
Reverse recovered charge	Q_{rr}		T_{vj} = 25°C	21.0	23.0	27.0	µC
			T_{vj} = 150°C	40.0	43.0	49.0	µC
Reverse recovery energy	E_{rec}		T_{vj} = 25°C	11.0	13.0	17.0	mJ
			T_{vj} = 150°C	29.0	31.0	36.0	mJ
Threshold voltage	$V_{(T0)}$	T_{vj} = 150°C; V_{GE} = 0; I_{CE1} = 100 A; I_{CE2} = 400 A; t_u = 1000 µs.		0.81	0.82	0.85	V
Forward slope resistance	r_T			2.60	2.67	3.00	mΩ
Thermal resistance junction to case	$R_{th(JC-D)}$	DC; I_{CE} = 330±20 A; I_{test} = 1.0 A; V_{GE} = +15 V.		-	0.131	0.155	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_{Pxy}	T_{vj} = 25°C; f = 1 MHz.	L_{P12}	-	33.4	35.0	nH
			L_{P13}	-	56.0	60.0	
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 M5		2.25	2.50	2.75	N*m
Weight	W			-	320	340	g

Notes:

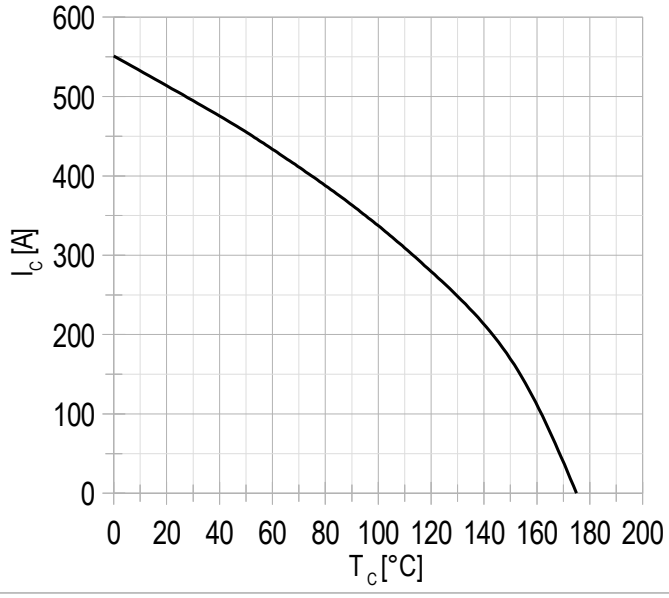
- Insulating material operating temperature 125°C max;
- Case temperature 125°C max;
- The recommended operating junction temperature $T_{vj\ op}$ = - 40 ÷ +150°C.

Chart 1 – typ. output characteristic, IGBT.



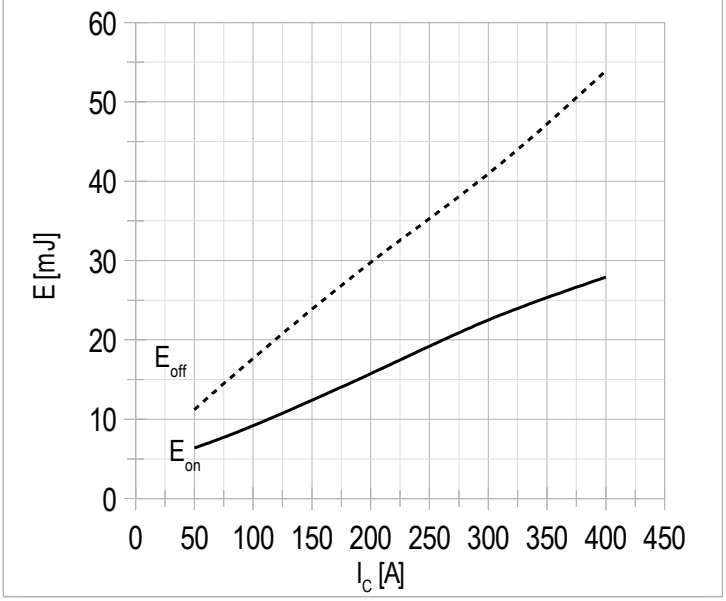
V_{GE} = +15 V.

Chart 2 – max. rated current vs temperature.



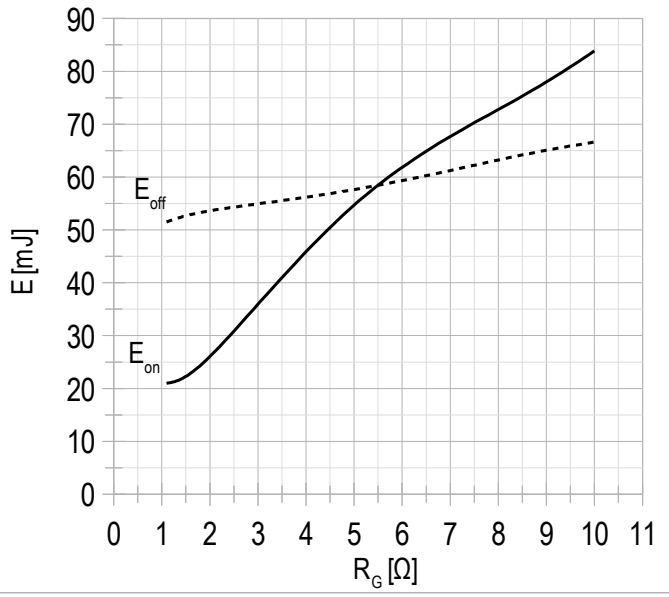
DC;
V_{GE} = +15 V;
$T_{vj\ (max)}$ = 150°C.

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



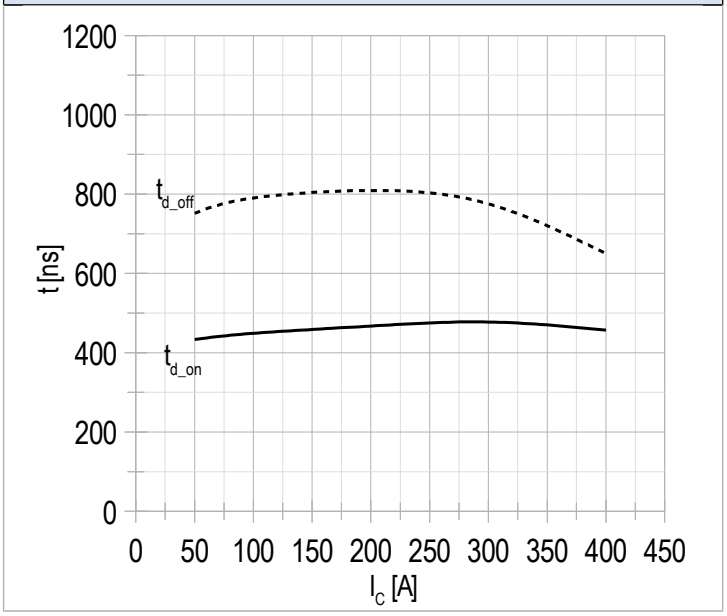
V_{CE} = 600 V;
V_{GE} = ±15 V;
R_G = 2.2 Ω;
L = 100 µH;
$T_{vj\ (max)}$ = 150°C.

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



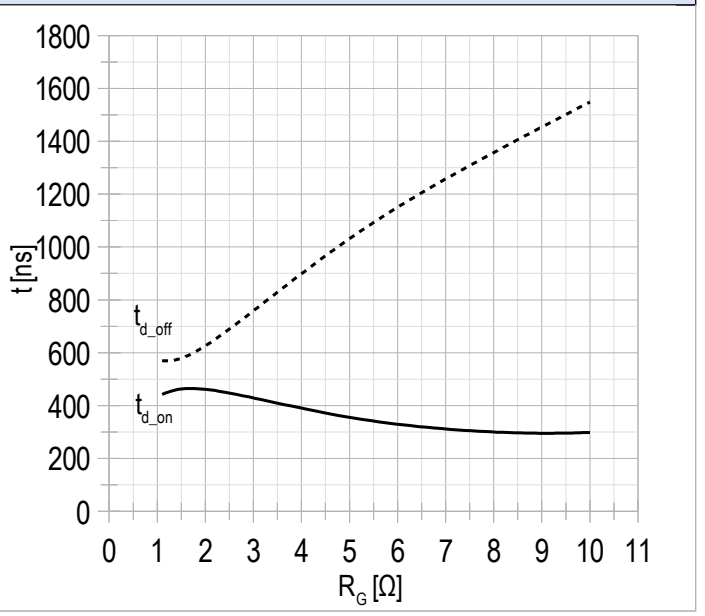
V_{CE} = 600 V;
V_{GE} = ±15 V;
$I_{C\ max}$ = 400 A;
L = 100 µH;
$T_{vj\ (max)}$ = 150°C.

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



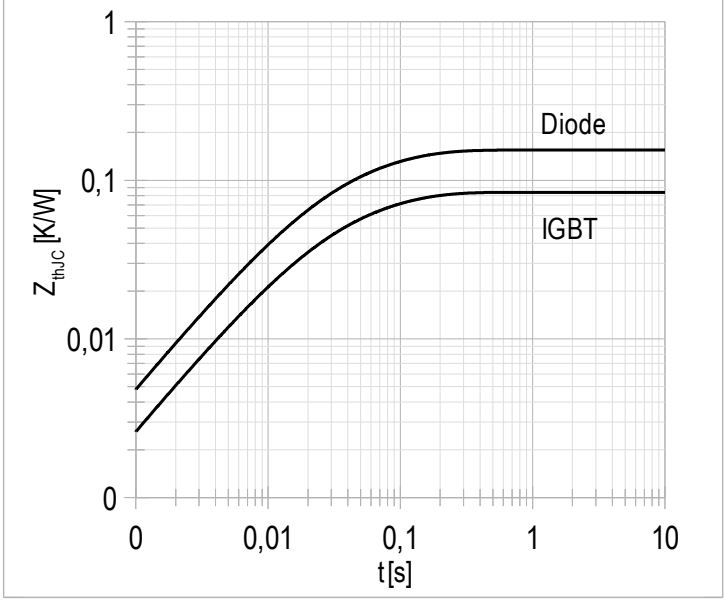
V_{CE} = 600 V;
V_{GE} = ±15 V;
R_G = 2.2 Ω;
L = 100 µH;
$T_{vj\ (max)}$ = 150°C.

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



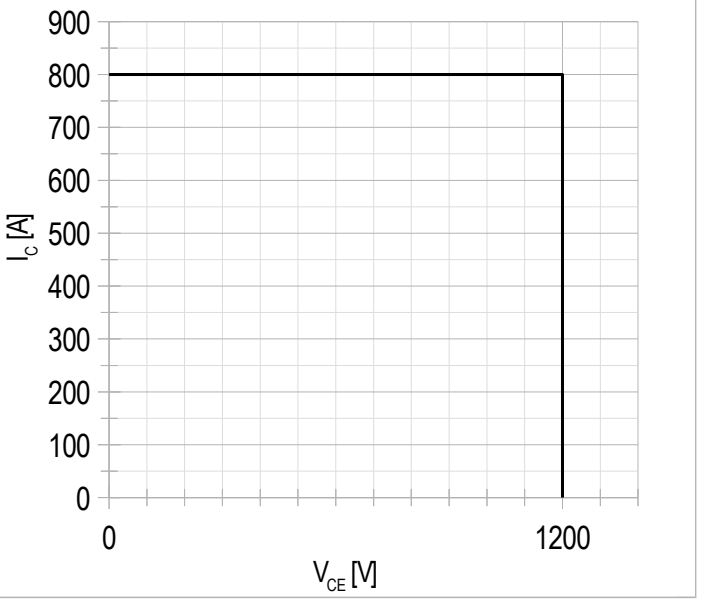
V_{CE} = 600 V;
V_{GE} = ±15 V;
$I_{C\ max}$ = 400 A;
L = 100 µH;
$T_{vj\ (max)}$ = 150°C.

Chart 7 – max. transient thermal impedance.



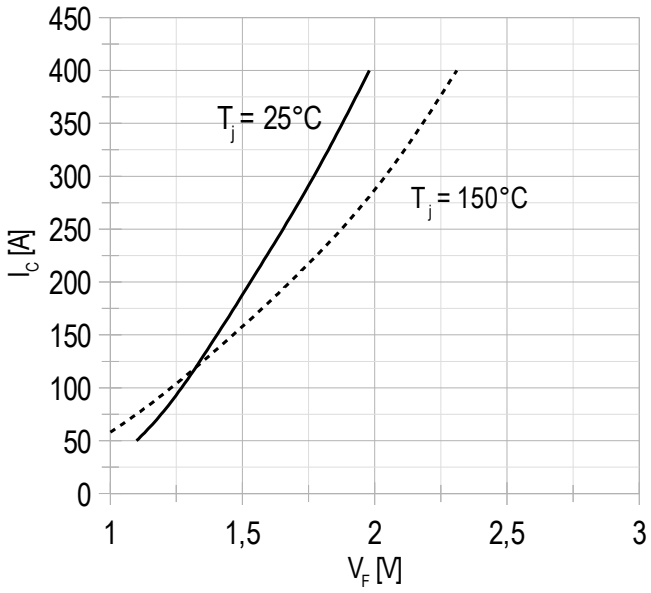
Single pulse;
V_{GE} = +15 V.

Chart 8 – RBSOA.



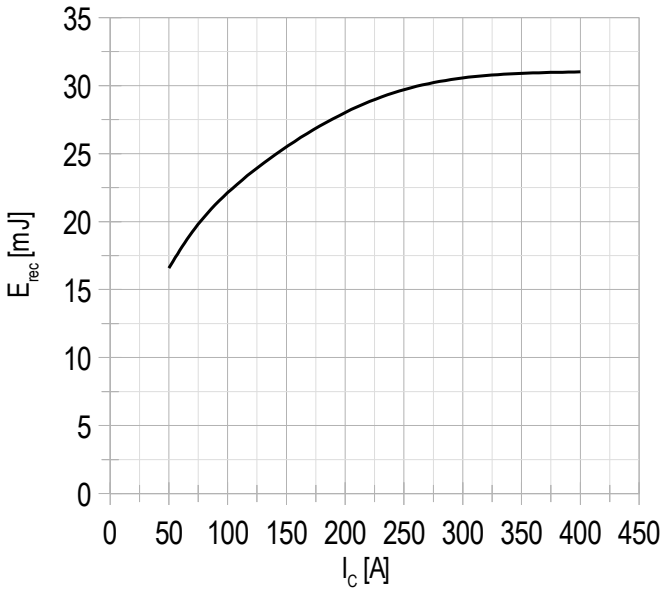
$V_{CE\ max}$ = 1200 V;
V_{GE} = ±15 V;
$I_{C\ max}$ = 2*$I_{C\ nom}$;
R_G = 2.2 Ω;
L = 30 µH.

Chart 9 – typ. output characteristic, FRD.



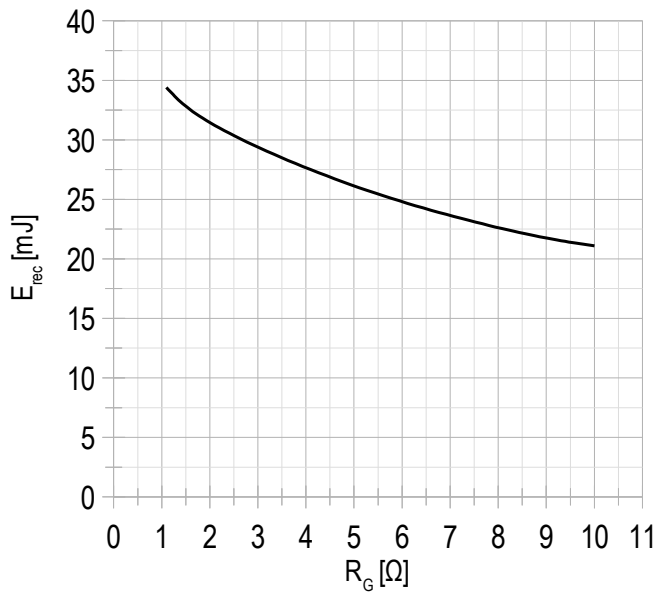
V_{GE} = +15 V.

Chart 10 – typ. switching losses vs rated current, FRD.



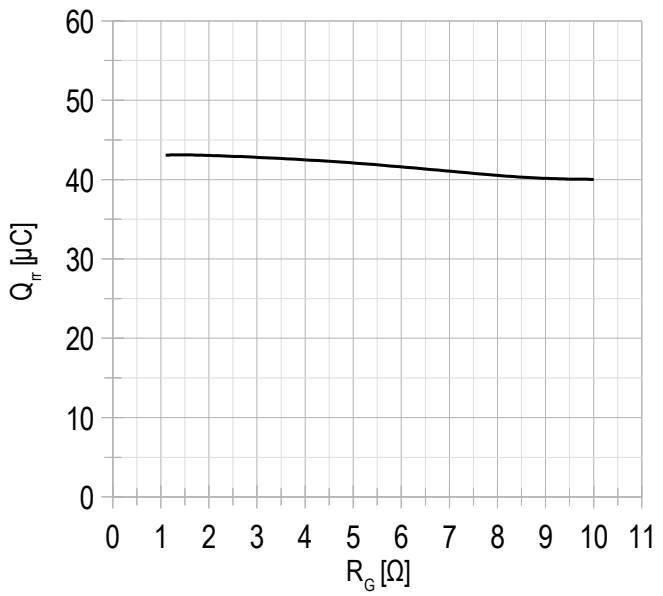
V_{GE} = ±15 V;
V_{CE} = 600 V;
L = 100 µH;
$R_{G\ on}$ = 2.2 Ω;
$T_{vj\ (max)}$ = 150°C.

Chart 11 – typ. switching losses vs gate resistance, FRD.



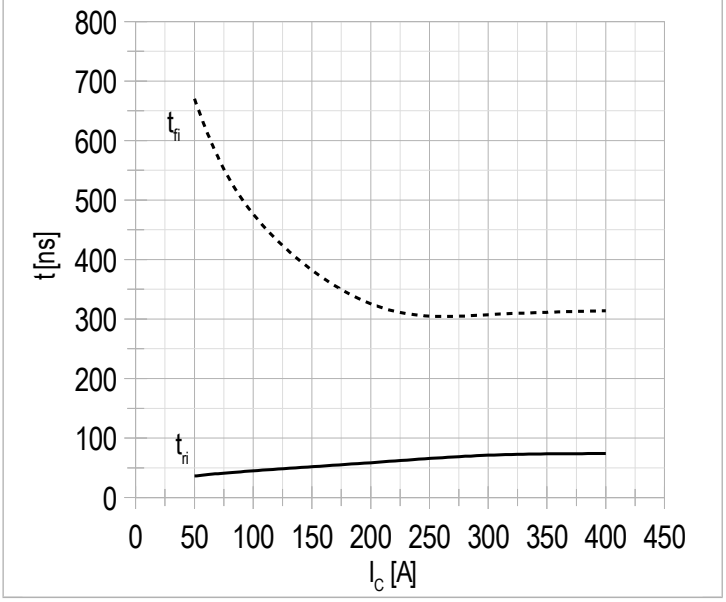
V_{GE} = ±15 V;
V_{CE} = 600 V;
$I_{C\ max}$ = 400 A;
L = 100 µH;
$T_{vj\ (max)}$ = 150°C.

Chart 12 – typ. reverse recovered charge vs gate resistance, FRD.



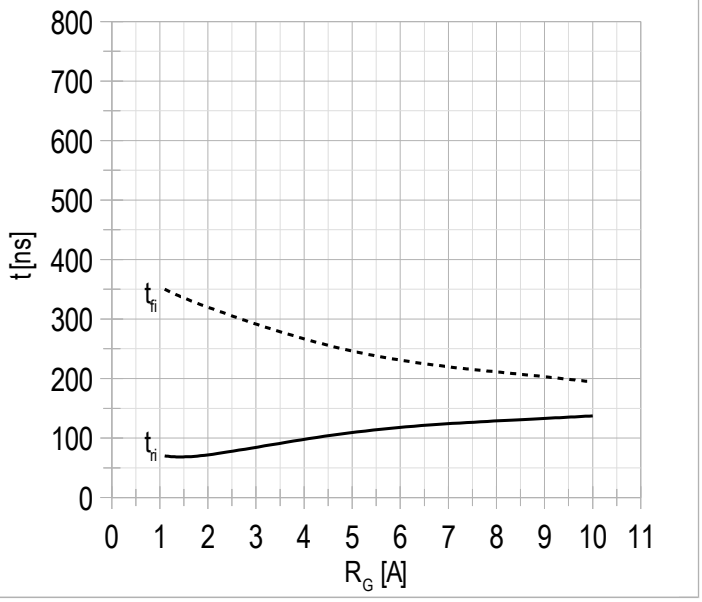
V_{GE} = ±15 V;
V_{CE} = 600 V;
$I_{C\ max}$ = 400 A;
L = 100 µH;
$T_{vj\ (max)}$ = 150°C.

Chart 13 – typ. switching times vs rated current, FRD.



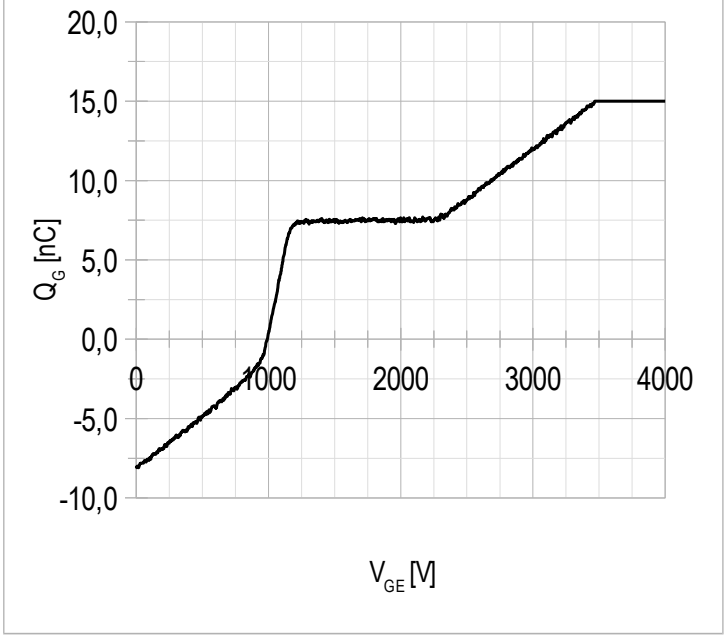
V_{CE} = 600 V;
V_{GE} = ±15 V;
R_G = 2.2 Ω;
L = 100 µH.
$T_{vj\ (max)}$ = 150°C.

Chart 14 – typ. switching times vs gate resistance, FRD.



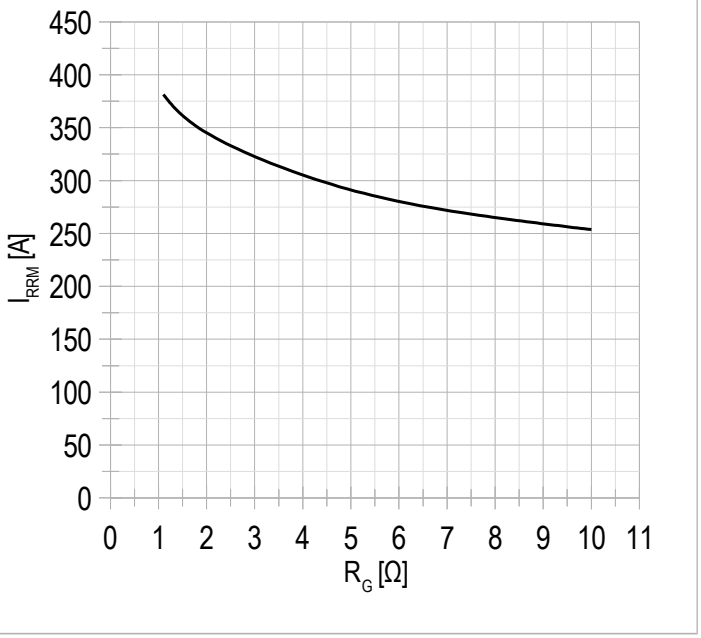
V_{CE} = 600 V;
V_{GE} = ±15 V;
$I_{C\ max}$ = 400 A;
L = 100 µH.
$T_{vj\ (max)}$ = 150°C.

Chart 15 – typ. gate charge characteristic.



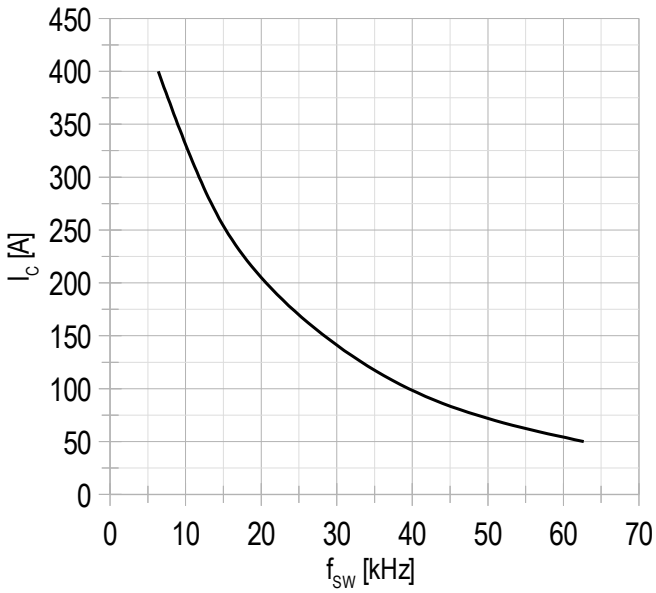
I_C = 400 A;
V_{CE} = 600 V;
V_{GE} = - 8÷15 V.

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



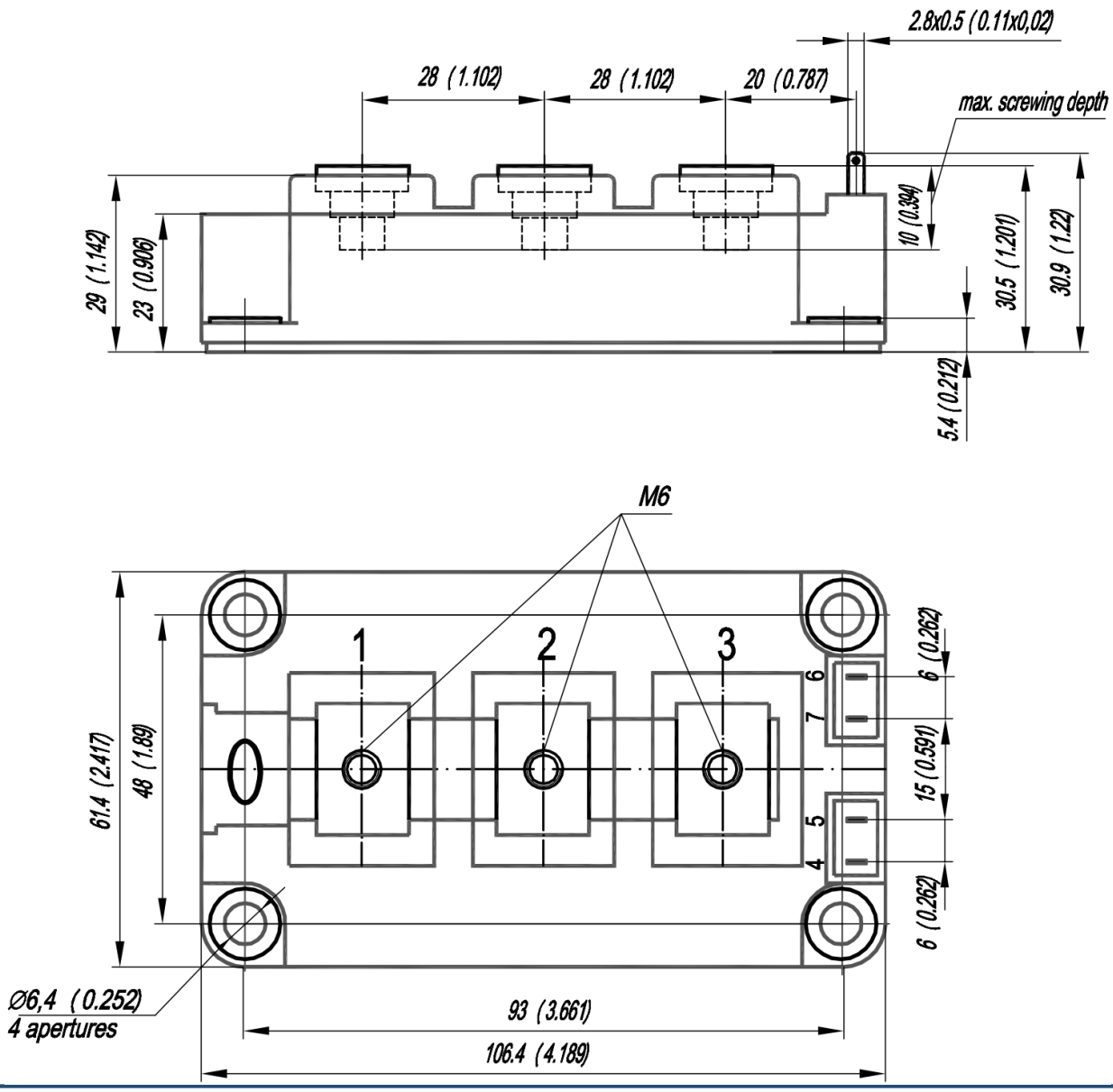
V_{CE} = 600 V;
V_{GE} = ±15 V;
L = 100 µH.
$T_{vj\ (max)}$ = 150°C.

Chart 17 – typ. rated current vs frequency.



Duty cycle 50%

Overall dimensions: Package type – AA



Part numbering guide

MIAA	-	HB	12	FA	-	400	N	
MIAA								IGBT module package type: FA
		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)
				FA				IGBT+FRD chipset modification
						400		Current Rating
							N	Climatic version: normal climate