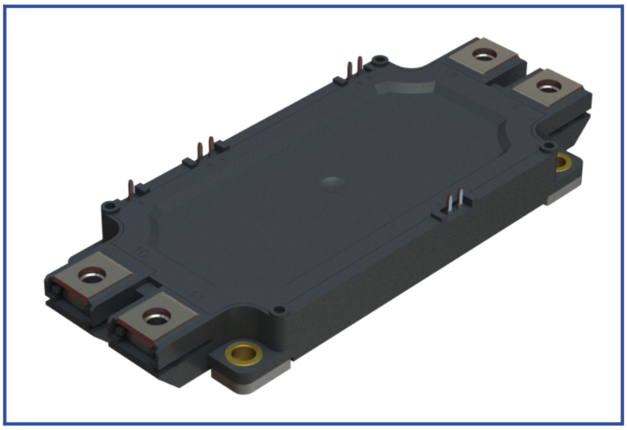
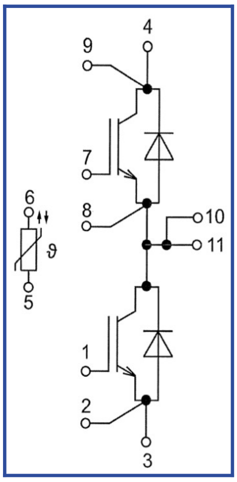
PROTON-ELECTROTEX

MID2-HB12LA-600N

IGBT module datasheet

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
- Al_2O_3 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°C; T_c = 25°C.	796	A
	$I_{C\,80}$	$T_{vj\,(max)}$ = 175°C; T_c = 80°C.	600	A
Repetitive peak collector current*1	I_{CRM}	I_{CRM} = 3 x $I_{C\,nom}$; t_p = 1 ms.	1800	A
Short-circuit duration	t_{psc}	T_{vj} = 25°C; V_{GE} = ±15 V; V_{CE} = 720 V; $R_{G\,on}$ = $R_{G\,off}$ = 1.5 Ω.	10	µs
		T_{vj} = 150°C; V_{GE}= ±15 V; V_{CE}= 720 V; $R_{G\,on}$ = $R_{G\,off}$ = 1.5 Ω.	10	
Gate-Emitter voltage	V_{GES}		±20	V
Junction operating temperature	$T_{vj\,(op)}$		-40…+150	ºC
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°C; T_c = 25°C.	642	A
	$I_{F\,80}$	$T_{vj\,(max)}$ = 175°C; T_c = 80°C.	490	A
Repetitive peak forward current*1	I_{FRM}	I_{FRM} = 3 x $I_{F\,nom}$; 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 min.	Value typ.	Value max.	Unit.
IGBT							
Collector-Emitter saturation voltage	V_{CEsat}	V_{GE} = +15 V; I_C = 600 A; t_u = 1000 µs.	T_{vj} = 25°C	1.65	2.10	2.55	V
			T_{vj} = 150°C	2.00	2.60	3.20	V
Gate-Emitter threshold voltage	$V_{GE(th)}$	I_C = 24 mA; V_{CE} = V_{GE}; T_{vj} = 25°C; t_u = 2 ms.		4.15	5.80	8.10	V
Collector-Emitter cut-off current	I_{CES}	V_{CE} = 1200 V; t_u = 50 ms; V_{GE} = 0.	T_{vj} = 25°C	-	13.00	300	µA
			T_{vj} = 150°C	-	0.20	5.00	mA
Gate-Emitter leakage current	I_{GES}	V_{CE} = 0; V_{GE} = ±20 V; T_{vj} = 25°C; t_u = 30 ms.		-	17.00	200	nA
Input capacitance	C_{ies}	V_{CE} = 25 V; V_{GE} = 0 V; f = 1 MHz; T_{vj} = 25°C.		-	330.00	-	nF
Reverse transfer capacitance	C_{res}			-	2.10	-	nF
Total gate charge	Q_G	I_C = 600 A; V_{CE} = 600 V; V_{GE} = -8...+15 V.		-	-	5500	nC
Internal gate resistance	R_{Gint}	T_{vj} = 25°C.		-	0.50	-	Ω
Turn-on delay time	$t_{d(on)}$	V_{CE} = 600 V; V_{GE} = ±15 V; $I_{C\,max}$ = 600 A; R_G = 1.5 Ω; L_s = 56 nH.	T_{vj} = 25°C	227	253	279	ns
			T_{vj} = 150°C	233	284	335	
Rise time	t_{ri}		T_{vj} = 25°C	110	124	138	ns
			T_{vj} = 150°C	125	141	157	
Turn-on energy	E_{on}		T_{vj} = 25°C	21.0	29.0	37.0	mJ
			T_{vj} = 150°C	41.0	59.5	78.0	
Turn-off delay time	$t_{d(off)}$		T_{vj} = 25°C	612	681	750	ns
			T_{vj} = 150°C	682	783	884	
Fall time	t_{fi}		T_{vj} = 25°C	153	174	195	ns
			T_{vj} = 150°C	286	338	390	
Turn-off energy	E_{off}		T_{vj} = 25°C	71.0	80.0	89.0	mJ
			T_{vj} = 150°C	94.5	108.5	122.5	
Collector-emitter threshold voltage	V_{CE0}	V_{GE} = +15 V; T_{vj} = 150°C; I_{CE1} = 150 A; I_{CE2} = 600 A; t_u = 1000 µs.		0.59	0.66	0.73	V
On-State slope resistance (IGBT)	r_{CE0}			2.59	3.20	3.81	mΩ
Thermal resistance junction to case	$R_{th(j-c)}$	DC; I_{test} = 1.5 A; V_{GE} = +15 V.		-	-	0.050	K/W
Inverse diode							
Forward voltage drop	V_F	I_F = 600 A; V_{GE} = 0; t_u = 1000 µs.	T_{vj} = 25°C	1.85	2.25	2.65	V
			T_{vj} = 150°C	2.05	2.55	3.05	V
Reverse recovery time	t_{rr}	V_{CE} = 600 V; V_{GE} = ±15 V; $I_{C\,max}$ = 600 A; R_G = 1.5 Ω; L_s = 56 nH.	T_{vj} = 25°C	281	313	345	ns
			T_{vj} = 150°C	459	532	605	ns
Peak reverse current	I_{RM}		T_{vj} = 25°C	215	275	335	A
			T_{vj} = 150°C	260	330	400	A
Recovered charge	Q_r		T_{vj} = 25°C	34.0	43.5	53.0	µC
			T_{vj} = 150°C	67.5	87.0	106.5	µC
Reverse recovery energy	E_{rec}		T_{vj} = 25°C	15.5	21.5	27.5	mJ
			T_{vj} = 150°C	28.0	37.5	47.0	mJ
Threshold voltage	$V_{(T0)}$	T_{vj} = 150°C; V_{GE} = 0; I_{F1} = 150 A; I_{F2} = 600 A; t_u = 1000 µs		0.79	0.81	0.83	V
Forward slope resistance	r_T			2.61	2.93	3.25	mΩ
Thermal resistance junction to case	$R_{th(JC-D)}$	DC; I_{test} = 1.5 A; V_{GE} = 0 V.		-	-	0.080	K/W

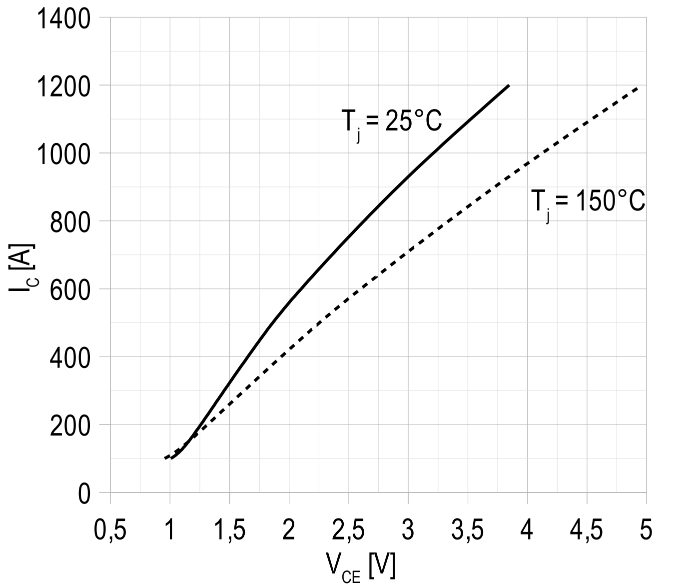
Module							
Pin resistance	R_{Pxy}	T_{vj} = 25°C.	$R_{P10/11-3}$	-	0.95	1.00	mΩ
			$R_{P10/11-4}$	-	0.68	1.00	
Parasitic inductance between terminals	L_{Pce}			-	22.00	-	nH
Thermistor resistance	R_t	T_{vj} = 25°C		4850	-	6225	Ω
		T_{vj} = 150°C		160	-	195	
Coefficient of temperature sensitivity	$B_{25/50}$	$R_2 = R_{25}\exp[B_{25/50}(1/T_2 - 1/T_1)]$, T_1 = 298,15 K		-	3375	-	K
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:

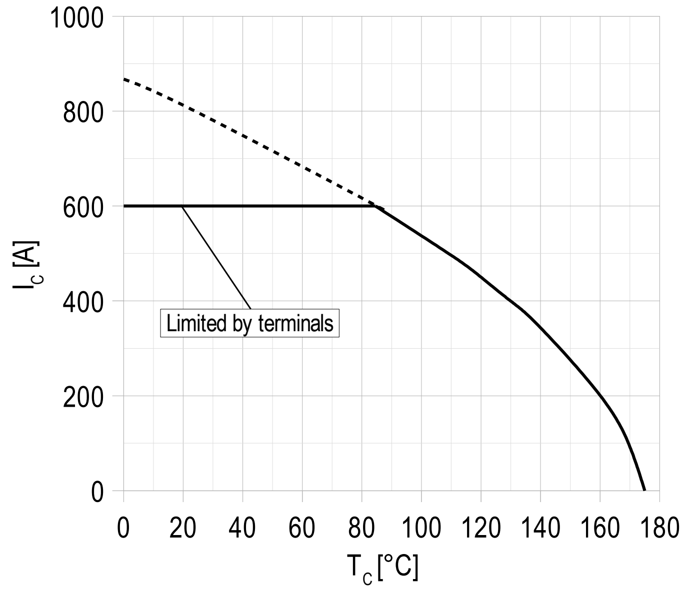
- Insulating material operating temperature 125°C max;
- Case temperature 125°C max;
- The recommended operating junction temperature $T_{vj\ op}$ = -40...+150°C.

Chart 1 – typ. output characteristic, IGBT.



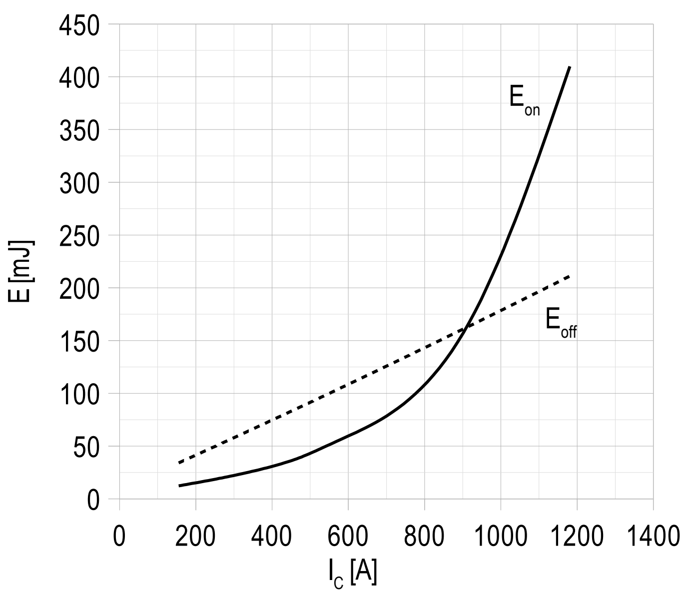
V_{GE} = +15 V.

Chart 2 – max. rated current vs temperature.



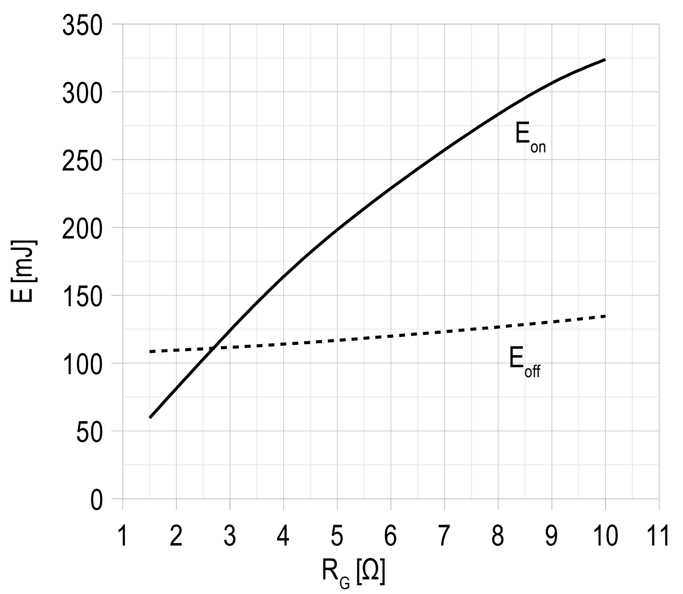
DC;
V_{GE} = +15 V;
$T_{vj\,(max)}$ = 150°C.

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



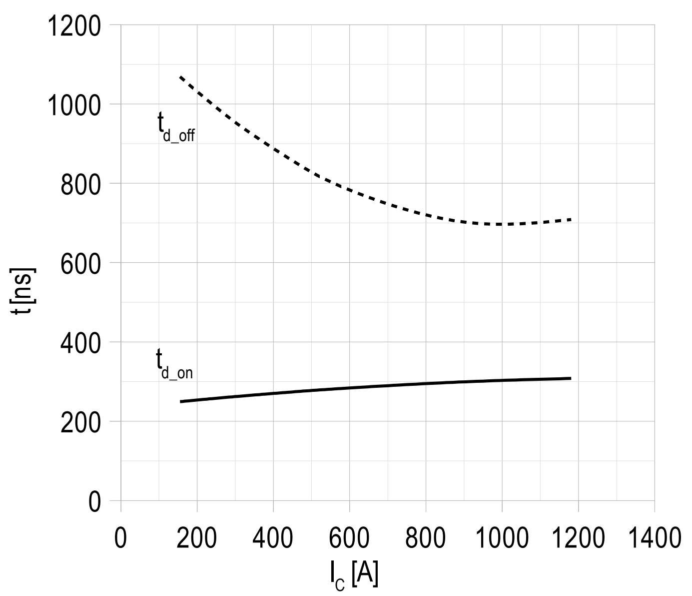
V_{CE} = 600 V;
V_{GE} = ±15 V;
R_G = 1.5 Ω;
L_s = 56 nH;
$T_{vj\,(max)}$ = 150°C.

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



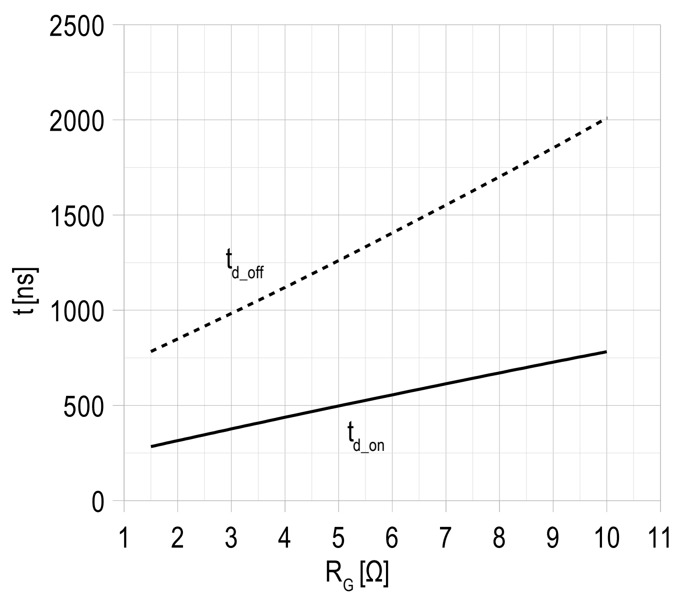
V_{CE} = 600 V;
V_{GE} = ±15 V;
$I_{C\,max}$ = 600 A;
L_s = 56 nH;
$T_{vj\,(max)}$ = 150°C.

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



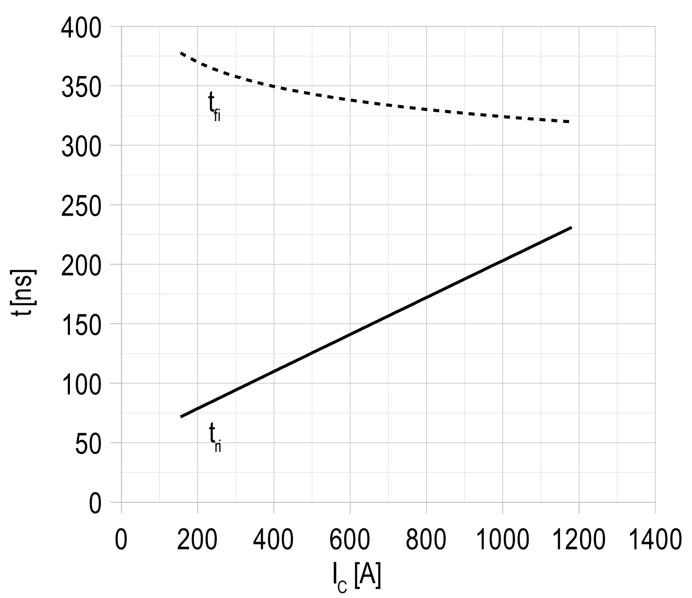
V_{CE} = 600 V;
V_{GE} = ±15 V;
R_G = 1.5 Ω;
L_s = 56 nH;
$T_{vj\ (max)}$ = 150°C.

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



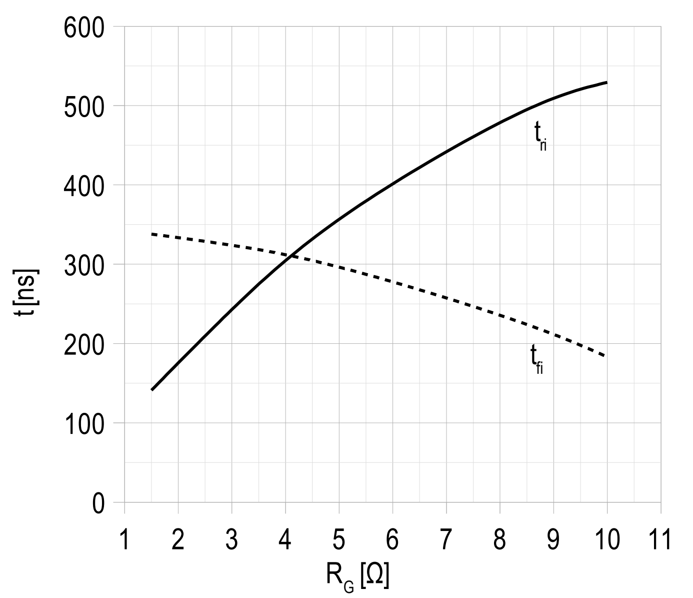
V_{CE} = 600 V;
V_{GE} = ±15 V;
$I_{C\ max}$ = 600 A;
L_s = 56 nH;
$T_{vj\ (max)}$ = 150°C.

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



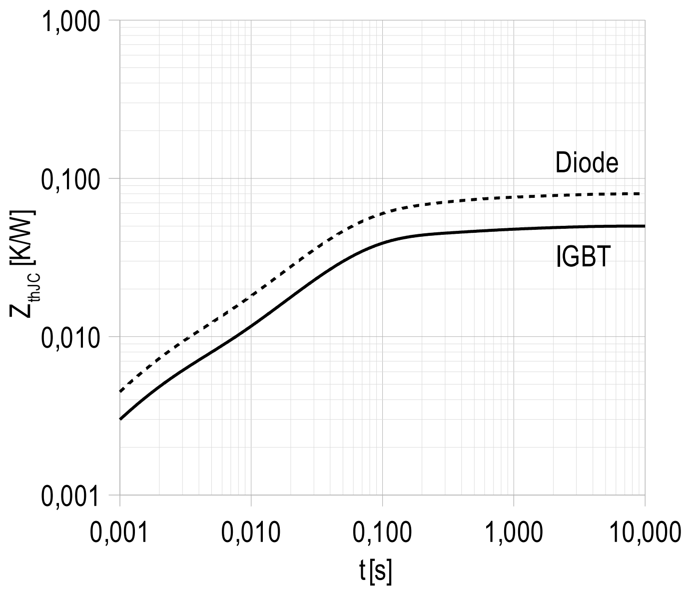
V_{CE} = 600 V;
V_{GE} = ±15 V;
R_G = 1.5 Ω;
L_s = 56 nH;
$T_{vj\ (max)}$ = 150°C.

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



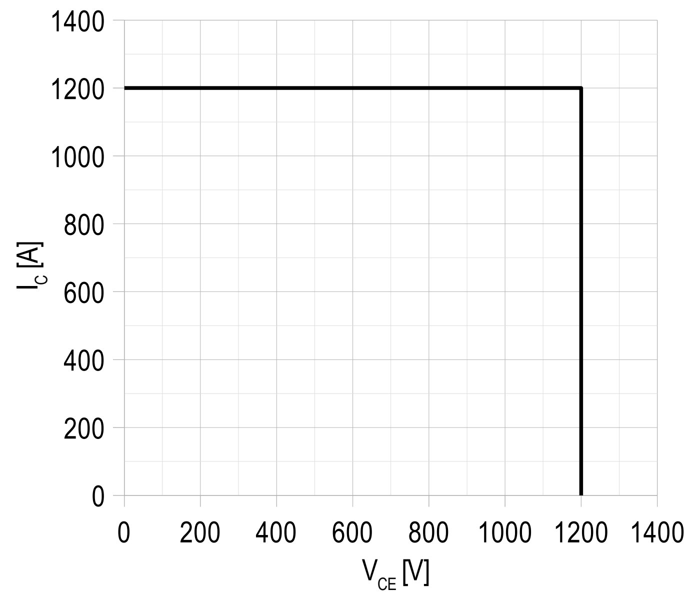
V_{CE} = 600 V;
V_{GE} = ±15 V;
$I_{C\ max}$ = 600 A;
L_s = 56 nH;
$T_{vj\ (max)}$ = 150°C.

Chart 9 – max. transient thermal impedance.



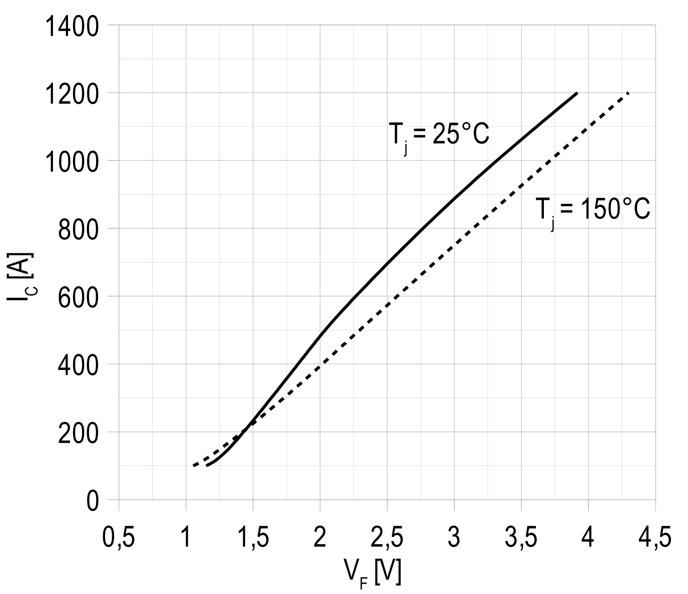
Single pulse;
V_{GE} = +15 V.

Chart 10 – RBSOA.



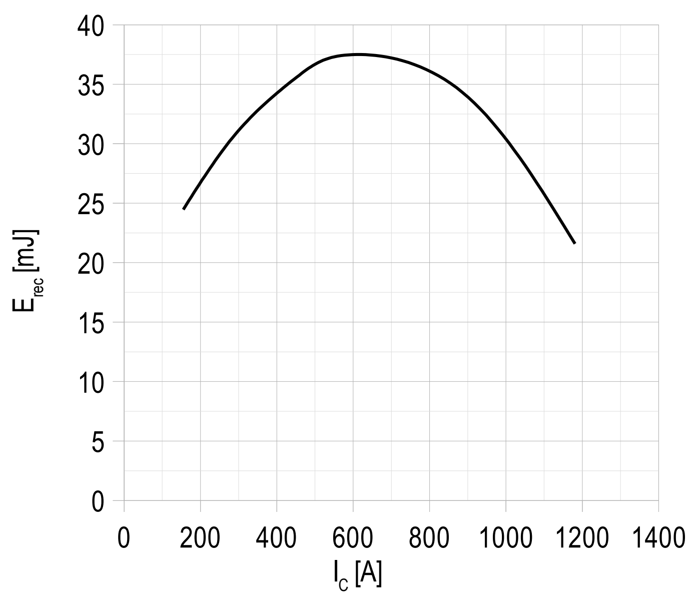
$V_{CE\ max}$ = 1200 V;
V_{GE} = ±15 V;
$I_{C\ max}$ = 2*$I_{C\ nom}$;
R_G = 1.5 Ω;
L_s = 56 nH.

Chart 11 – typ. output characteristic, FRD.



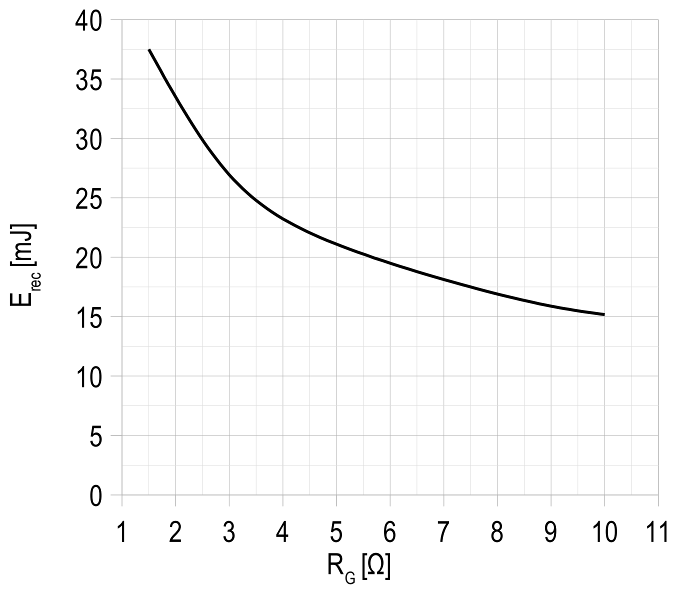
V_{GE} = 0 V.

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



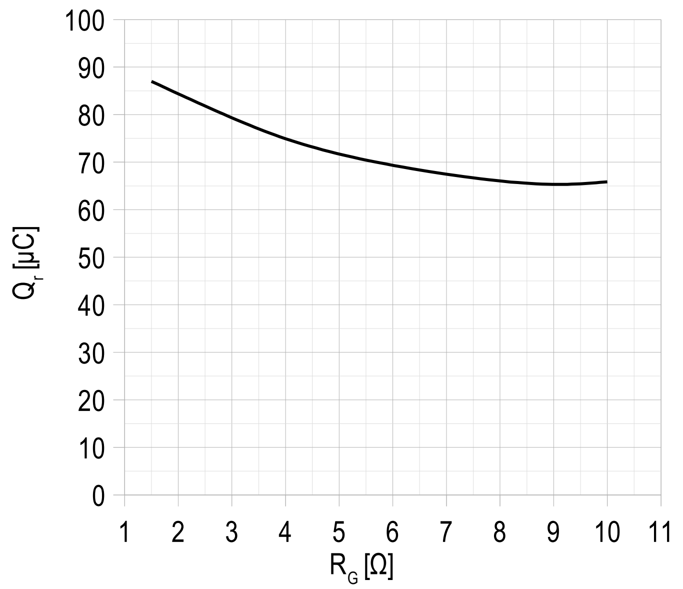
V_{GE} = ±15 V;
V_{CE} = 600 V;
L_s = 56 nH;
$R_{G\ on}$ = 1.5 Ω;
$T_{vj\ (max)}$ = 150°C.

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



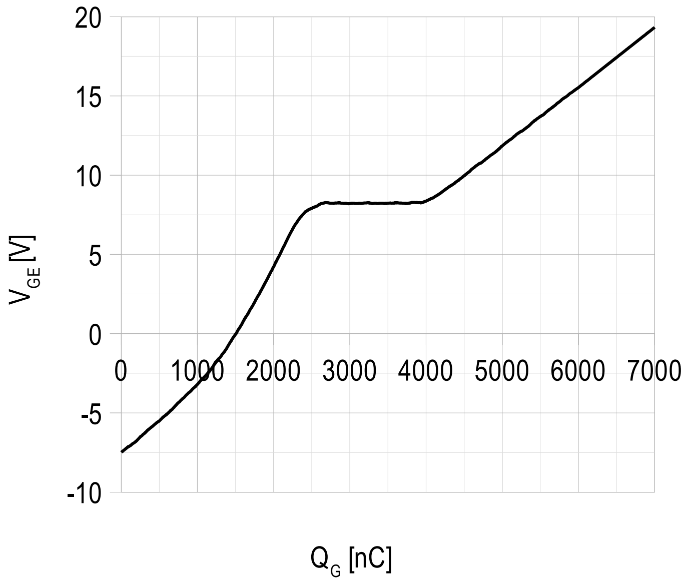
V_{GE} = ±15 V;
V_{CE} = 600 V;
$I_{C\ max}$ = 600 A;
L_s = 56 nH;
$T_{vj\ (max)}$ = 150°C.

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



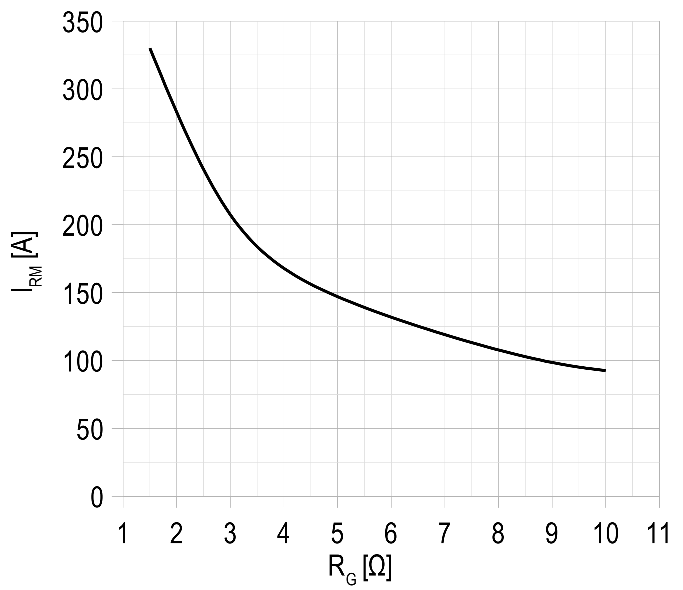
V_{GE} = ±15 V;
V_{CE} = 600 V;
$I_{C\ max}$ = 600 A;
L_s = 56 nH;
$T_{vj\ (max)}$ = 150°C.

Chart 15 – typ. gate charge characteristic.



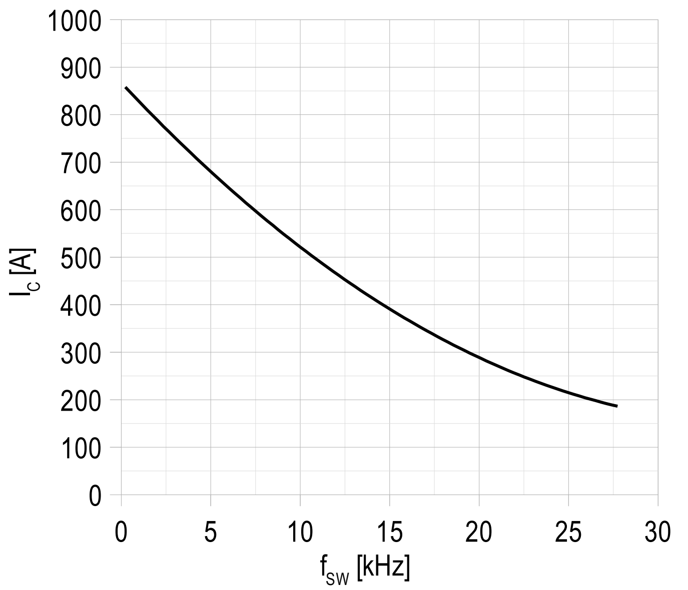
I_C = 600 A;
V_{CE} = 600 V;
V_{GE} = -8...+15 V.

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



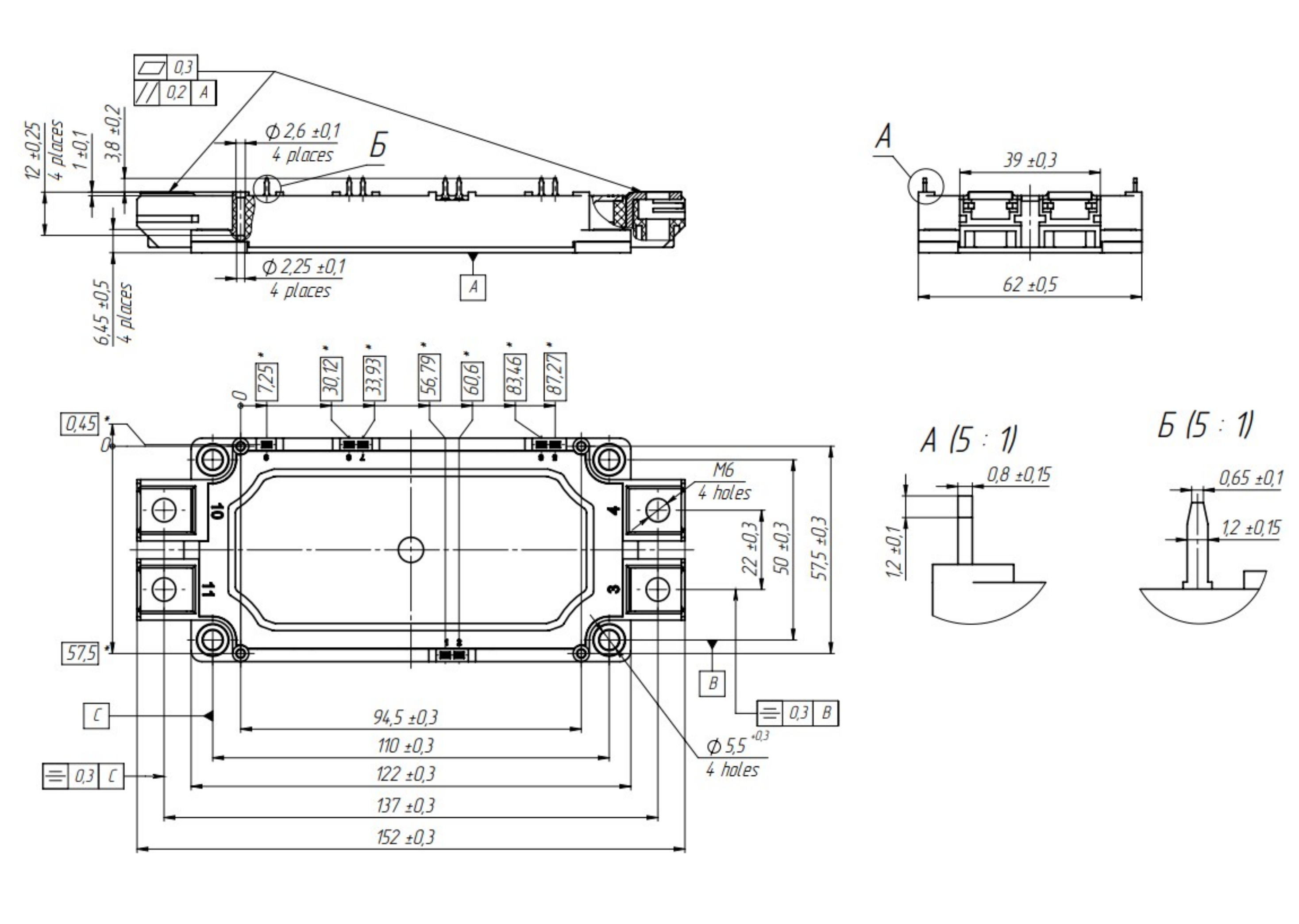
V_{CE} = 600 V;
V_{GE} = ±15 V;
L_s = 56 nH;
$T_{vj\ (max)}$ = 150°C.

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 – D2



Part numbering guide

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