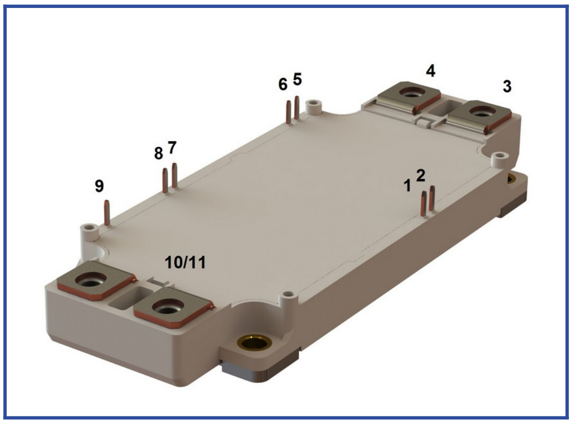
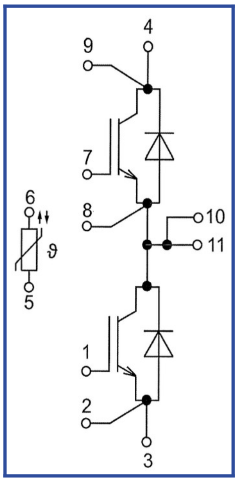
Low Inductance IGBT Module with 17 mm Height Housing — 1200 V 300 A





Chip features

- IGBT chip
  - Trench FS
  - low $V_{CE(sat)}$ value
  - 10 µs short circuit duration at 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
- ultrasonic welded power terminals
- improved thermal cycling
- RoHS compliant

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
Collector current (nominal)	$I_{C\ nom}$		300	A
Collector current (maximum continuous)	$I_{C\ 25}$	$T_{vj\ (max)}$ = 175°C; T_c = 25°C.	442	A
	$I_{C\ 80}$	$T_{vj\ (max)}$ = 175°C; T_c = 80°C.	300	A
Repetitive peak collector current[*1]	I_{CRM}	I_{CRM} = 3 x $I_{C\ nom}$; t_p = 1 ms.	900	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
Forward current (nominal)	$I_{F\ nom}$		300	A
Forward current (maximum continuous)	$I_{F\ 25}$	$T_{vj\ (max)}$ = 175°C; T_c = 25°C.	402	A
	$I_{F\ 80}$	$T_{vj\ (max)}$ = 175°C; T_c = 80°C.	304	A
Repetitive peak forward current[*1]	I_{FRM}	I_{FRM} = 3 x $I_{F\ nom}$; t_p = 1 ms.	900	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

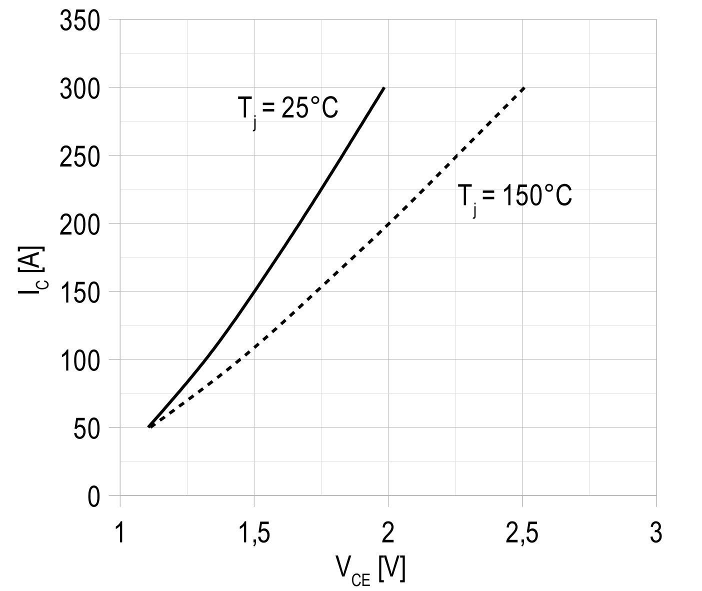
Definition	Symbol	Conditions		Value min.	Value typ.	Value max.	Unit
IGBT							
Collector-Emitter saturation voltage	V_{CEsat}	V_{GE} = +15 V; I_C = 300 A; t_u = 1000 µs.	T_{vj} = 25°C	1.92	1.94	2.08	V
			T_{vj} = 150°C	2.42	2.47	2.65	V
Gate-Emitter threshold voltage	$V_{GE(th)}$	I_C =12 mA; V_{CE} = V_{GE}; T_{vj} = 25°C; t_u = 2 ms.		5.50	5.82	6.20	V
Collector-Emitter cut-off current	I_{CES}	V_{CE} = 1200 V; t_u = 50 ms; V_{GE} = 0.	T_{vj} = 25°C	1.76	2.31	300	µA
			T_{vj} = 150°C	1.19	1.30	5.00	mA
Gate-Emitter leakage current	I_{GES}	V_{CE} = 0; V_{GE} = ±20 V; T_{vj} = 25°C; t_u = 30 ms.		10.4	13.8	400	nA
Input capacitance	C_{ies}	V_{CE} = 10 V; V_{GE} = 0 V; f = 1 MHz; T_{vj} = 25°C.		-	27.3	-	nF
Output capacipance	C_{oes}			-	2.1	-	nF
Reverse transfer capacitance	C_{res}			-	2.4	-	nF
Total gate charge	Q_G	I_C = 300 A; V_{CE} = 600 V; V_{GE} = - 8÷15 V.		-	2880	3000	nC
Internal gate resistance	R_{Gint}	T_{vj} = 25°C.		-	2.5	-	Ω
Turn-on delay time	$t_{d(on)}$	V_{CE} = 600 V; V_{GE} = ±15 V; $I_{C\,max}$ = 300 A; R_G = 1.5 Ω; L = 56 nH.	T_{vj} = 25°C	376	384	430	ns
			T_{vj} = 150°C	416	420	460	
Rise time	t_{ri}		T_{vj} = 25°C	60	60	70	ns
			T_{vj} = 150°C	66	66	75	
Turn-on energy	E_{on}		T_{vj} = 25°C	7	8	11	mJ
			T_{vj} = 150°C	15	16	19.5	
Turn-off delay time	$t_{d(off)}$		T_{vj} = 25°C	490	510	570	ns
			T_{vj} = 150°C	580	600	680	
Fall time	t_{fi}		T_{vj} = 25°C	224	232	260	ns
			T_{vj} = 150°C	300	308	350	
Turn-off energy	E_{off}		T_{vj} = 25°C	27	29	34	mJ
			T_{vj} = 150°C	36	38	45	
Collector-emitter threshold voltage	V_{CE0}	V_{GE} = +15 V; T_{vj} = 150°C; I_{CE1} = 75 A; I_{CE2} = 300 A; t_u = 1000 µs.		0.859	0.866	0.900	V
On-State slope resistance (IGBT)	r_{CE0}			5.16	5.33	5.63	mΩ
Thermal resistance junction to case	$R_{th(j-c)}$	DC; I_{test} = 1.5 A; V_{GE} = +15 V.		-	0.0927	0.100	K/W
Inverse diode							
Forward voltage drop	V_F	I_F = 300 A; V_{GE} = 0; t_u = 1000 µs.	T_{vj} = 25°C	1.90	1.96	2.14	V
			T_{vj} = 150°C	2.06	2.13	2.34	V
Reverse recovery time	t_{rr}	V_{GE} = ±15 V; V_{CE} = 600 V; $I_{C\,max}$ = 300 A; $R_{G\,on}$ = 1.5 Ω; L = 56 nH.	T_{vj} = 25°C	122	128	150	ns
			T_{vj} = 150°C	179	188	220	ns
Repetitive peak reverse current	I_{rrm}		T_{vj} = 25°C	235	243	270	A
			T_{vj} = 150°C	292	299	330	A
Reverse recovered charge	Q_{rr}		T_{vj} = 25°C	17	18	21	µC
			T_{vj} = 150°C	31	32	36	µC
Reverse recovery energy	E_{rec}		T_{vj} = 25°C	10	10	13	mJ
			T_{vj} = 150°C	24	25	29	mJ
Threshold voltage	$V_{(T0)}$	T_{vj} = 150°C; V_{GE} = 0; t_u = 1000 µs		0.831	0.843	0.890	V
Forward slope resistance	r_T			4.09	4.30	4.67	mΩ
Thermal resistance junction to case	$R_{th(JC-D)}$	DC; I_{test} = 1.5 A; V_{GE} = +15 V.		-	0.128	0.135	K/W

Module							
Pin resistance	R_{Pxy}	T_{vj} = 25°C.	$R_{P10/11-3}$	-	0.92	1.00	mΩ
			$R_{P10/11-4}$	-	0.59	1.00	
Parasitic inductance between terminals	L_{Pce}			-	22	-	nH
Thermistor resistance	R_{t25}	T_{vj} = 25°C		-	5000	-	Ω
		T_{vj} = 100°C		-	495	-	
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

Notes:

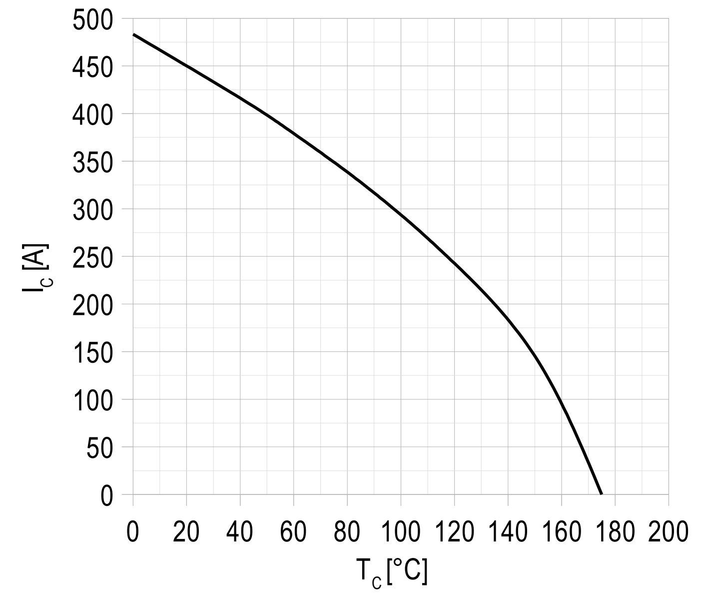
- Insulating material operating temperature 125°C max;
- Case temperature 125°C max;
- The recommended operating junction temperature $T_{vj\ op}$ = - 40 ÷ +150°C.

Chart 1 – typ. output characteristic, IGBT.



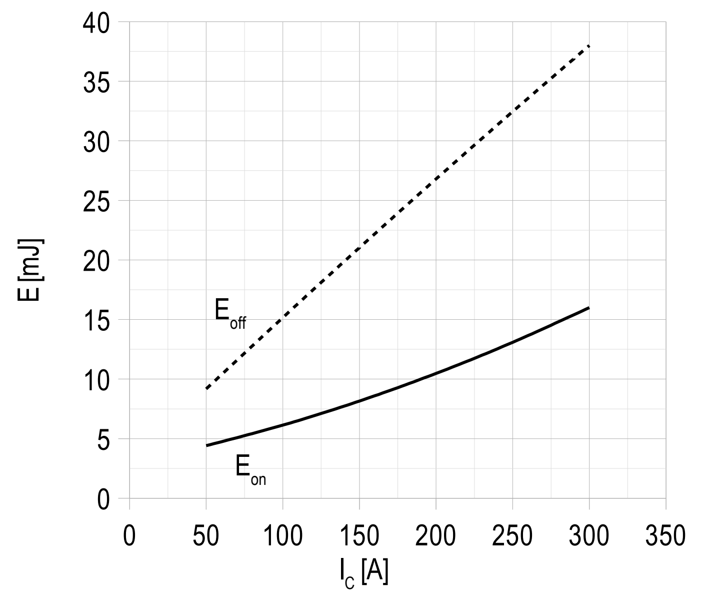
V_{GE} = +15 V.

Chart 2 – max. rated current vs temperature.



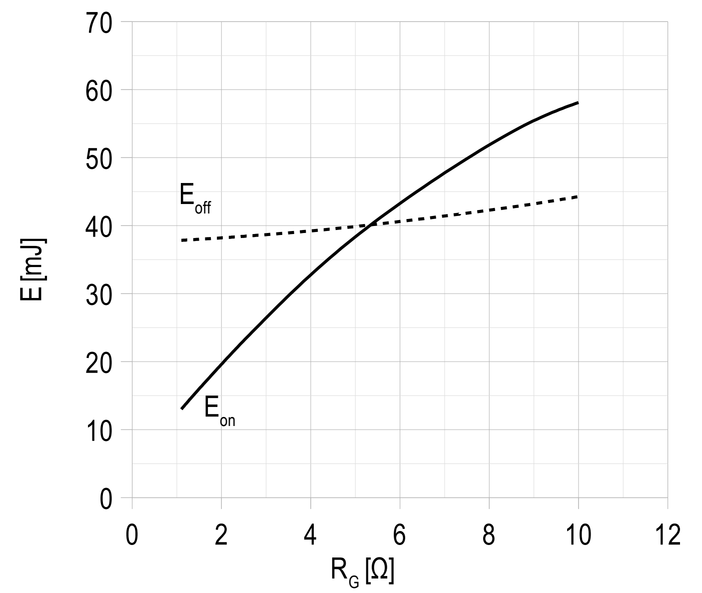
DC;
V_{GE} = +15 V;
$T_{vj\,(max)}$ = 150°C.

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



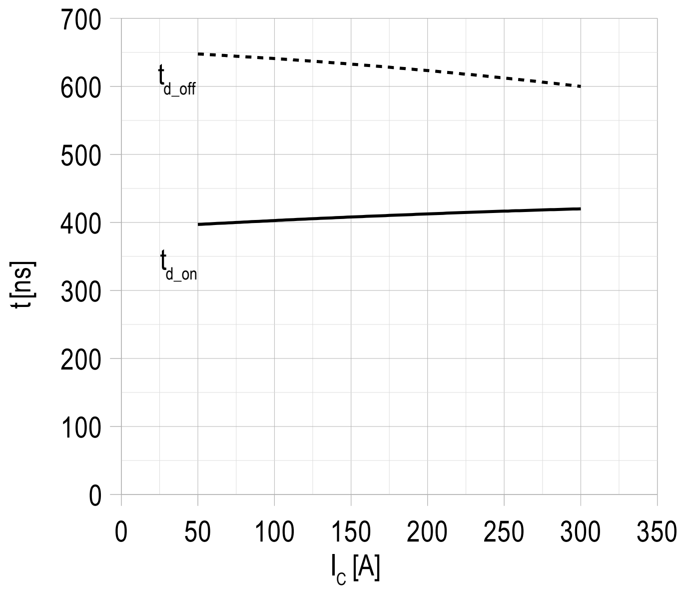
V_{CE} = 600 V;
V_{GE} = ±15 V;
R_G = 1.5 Ω;
L = 56 nH;
$T_{vj\,(max)}$ = 150°C.

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



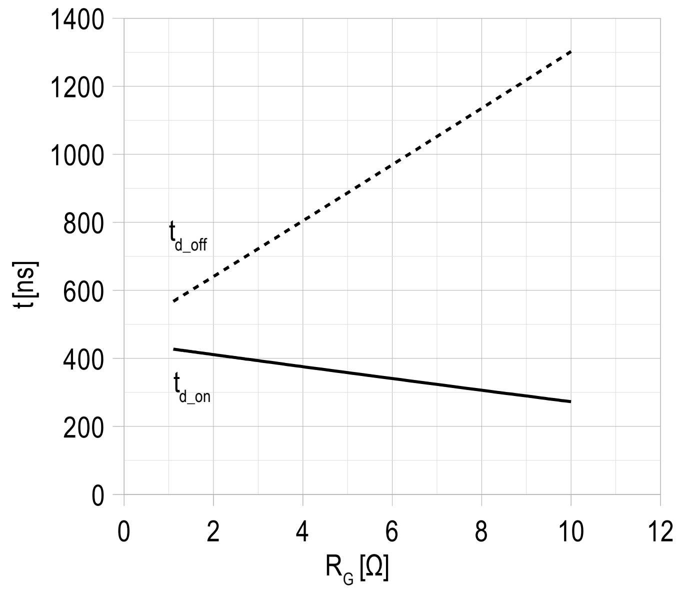
V_{CE} = 600 V;
V_{GE} = ±15 V;
$I_{C\,max}$ = 300 A;
L = 56 nH;
$T_{vj\,(max)}$ = 150°C.

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



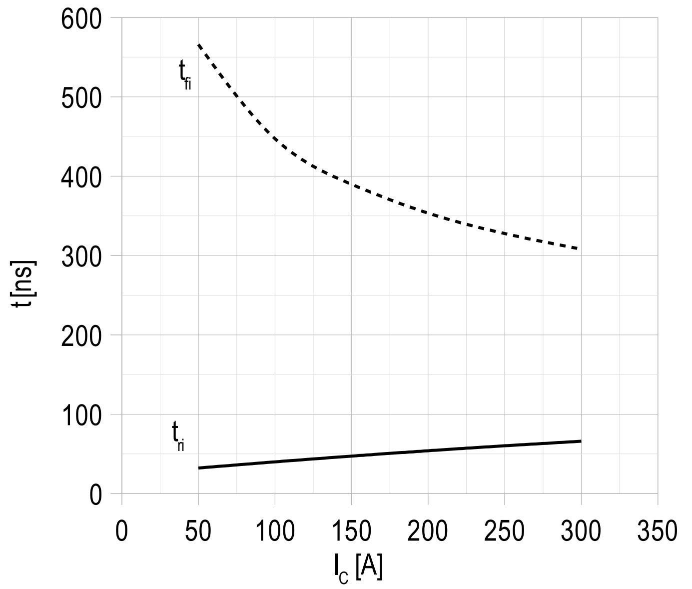
V_{CE} = 600 V;
V_{GE} = ±15 V;
R_G = 1.5 Ω;
L = 56 nH;
$T_{vj\,(max)}$ = 150°C.

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



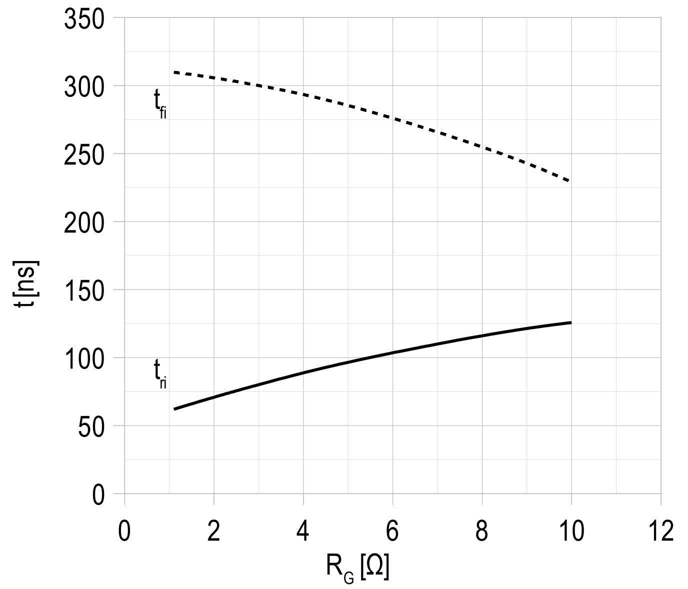
V_{CE} = 600 V;
V_{GE} = ±15 V;
$I_{C\,max}$ = 300 A;
L = 56 nH;
$T_{vj\,(max)}$ = 150°C.

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



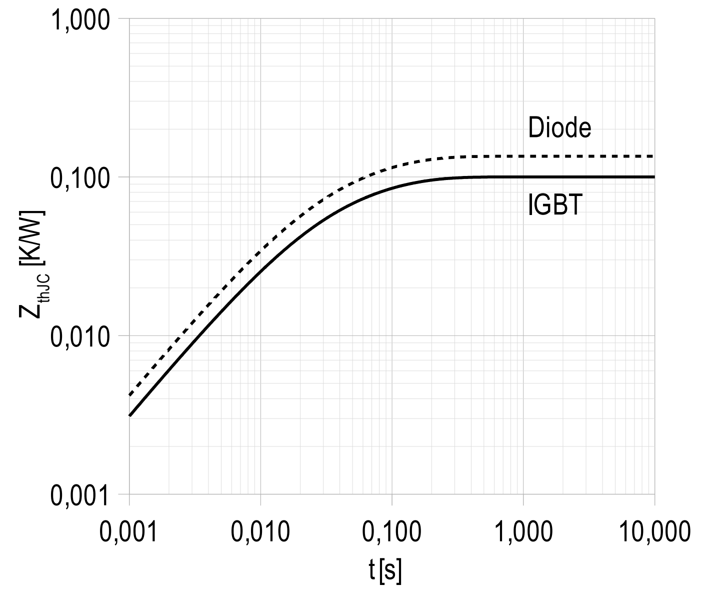
V_{CE} = 600 V;
V_{GE} = ±15 V;
R_G = 1.5 Ω;
L = 56 nH.
$T_{vj\,(max)}$ = 150°C.

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



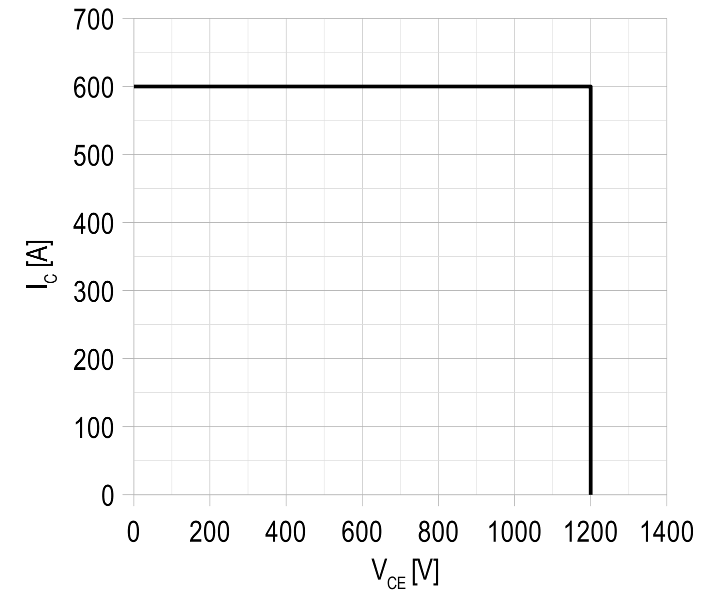
V_{CE} = 600 V;
V_{GE} = ±15 V;
$I_{C\,max}$ = 300 A;
L = 56 nH.
$T_{vj\,(max)}$ = 150°C.

Chart 9 – max. transient thermal impedance.



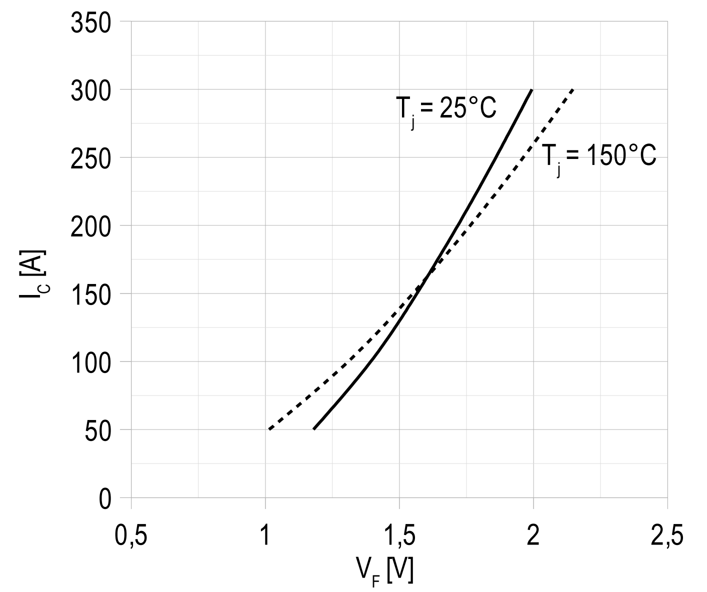
Single pulse;
V_{GE} = +15 V.

Chart 10 – RBSOA.



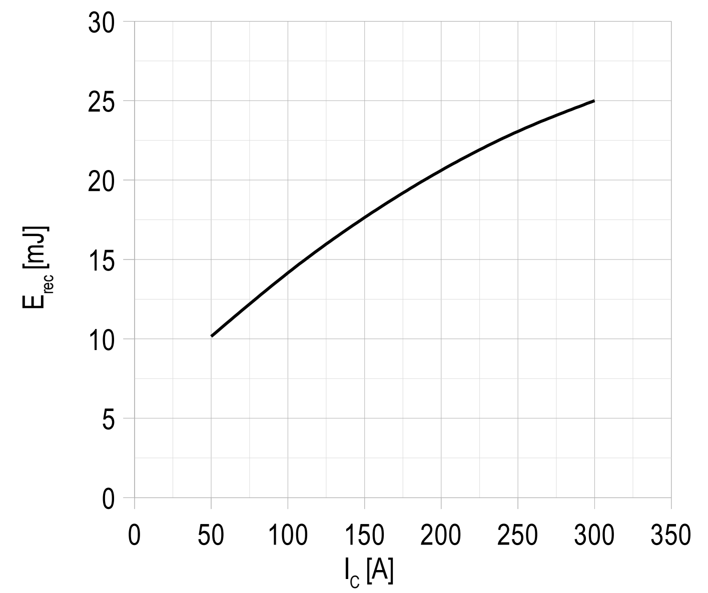
$V_{CE\ max}$ = 1200 V;
V_{GE} = ±15 V;
$I_{C\ max}$ = 2*$I_{C\ nom}$;
R_G = 1.5 Ω;
L = 56 nH.

Chart 11 – typ. output characteristic, FRD.



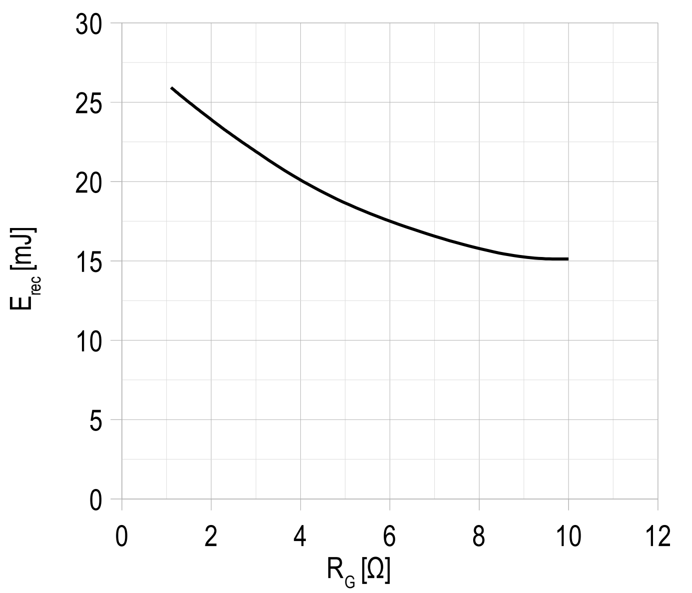
V_{GE} = 0 V.

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



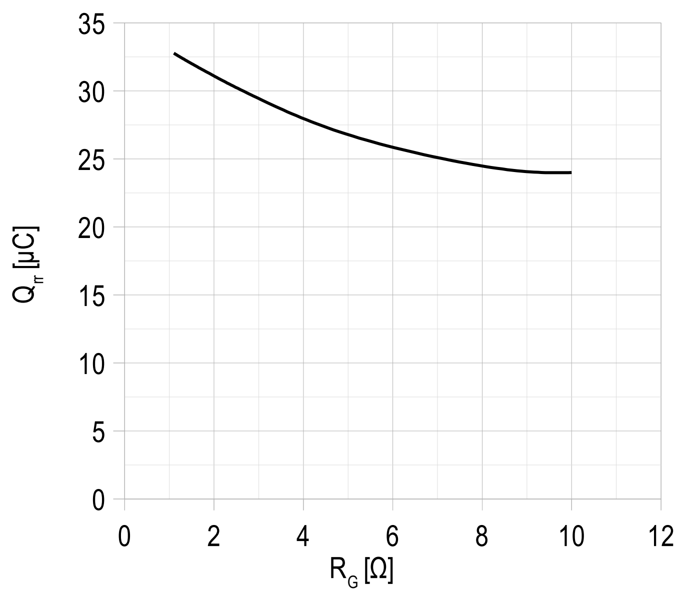
V_{GE} = ±15 V;
V_{CE} = 600 V;
L = 56 nH;
$R_{G\ on}$ = 1.5 Ω;
$T_{vj\ (max)}$ = 150°C.

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



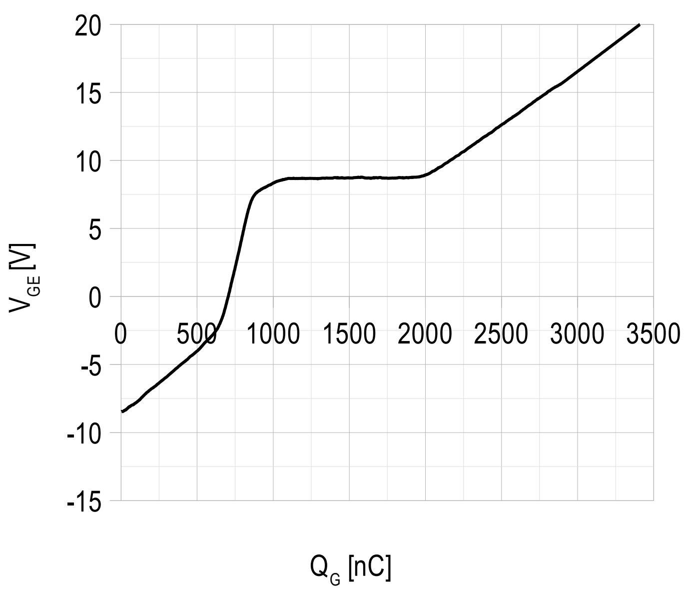
V_{GE} = ±15 V;
V_{CE} = 600 V;
$I_{C\ max}$ = 300 A;
L = 56 nH;
$T_{vj\ (max)}$ = 150°C.

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



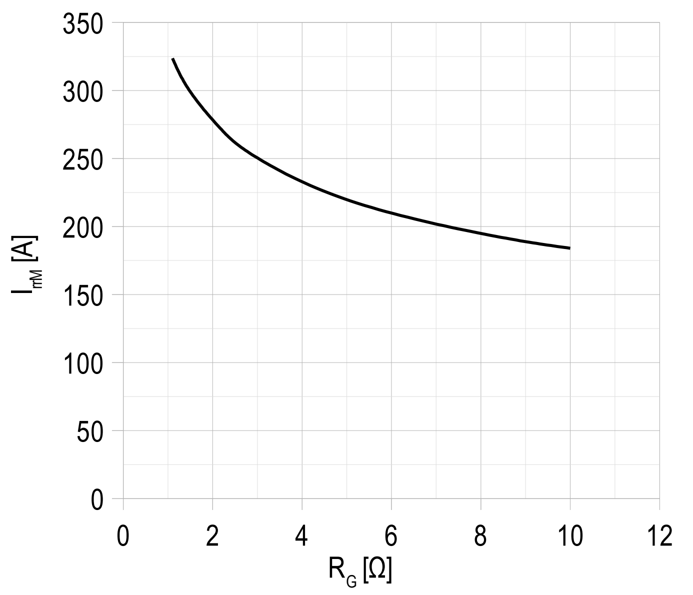
V_{GE} = ±15 V;
V_{CE} = 600 V;
$I_{C\ max}$ = 300 A;
L = 56 nH;
$T_{vj\ (max)}$ = 150°C.

Chart 15 – typ. gate charge characteristic.



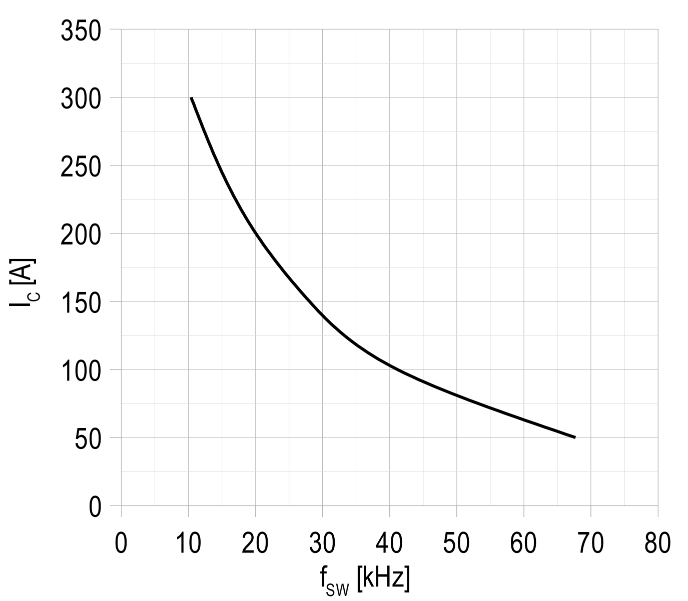
I_C = 300 A;
V_{CE} = 600 V;
V_{GE} = - 8÷15 V.

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



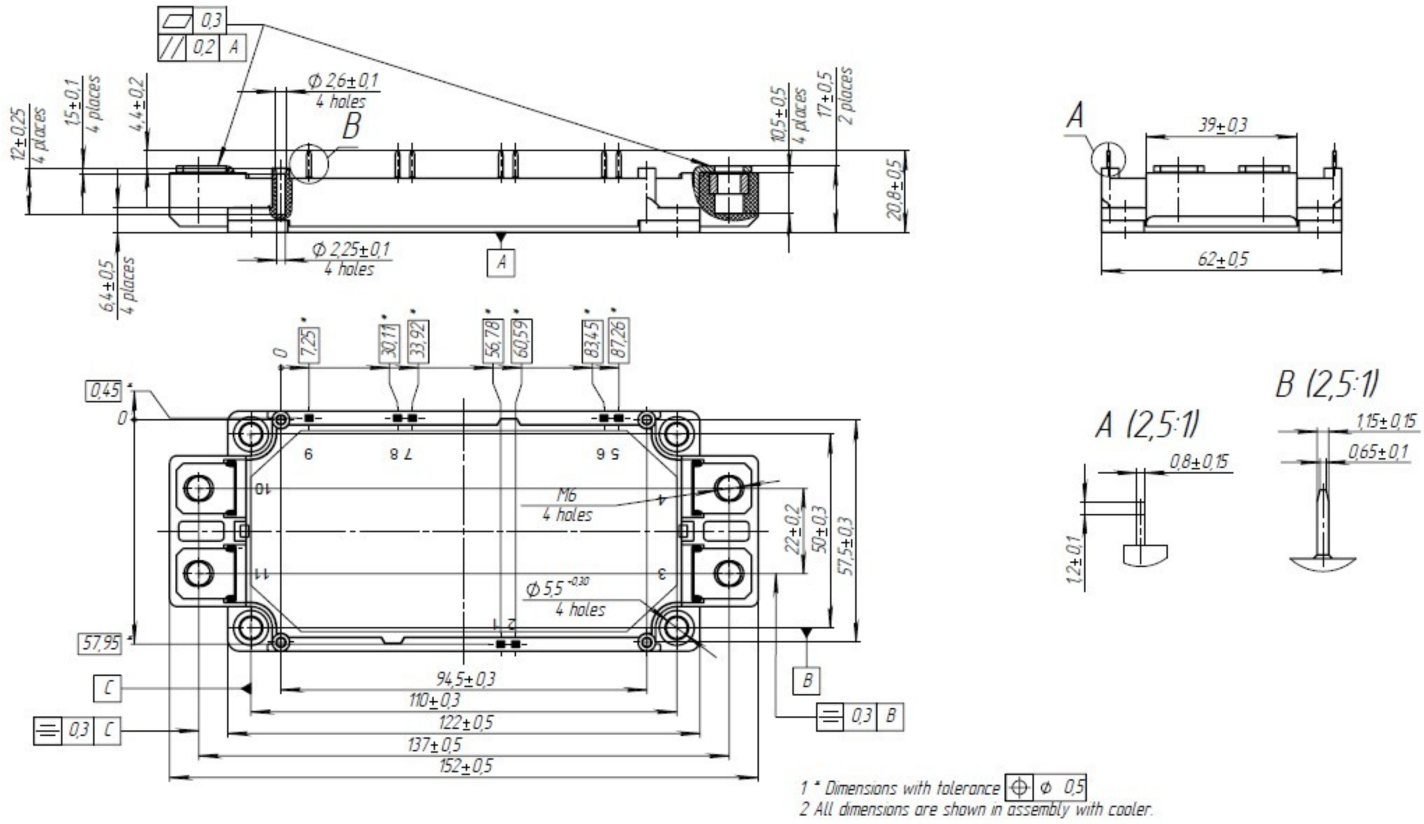
V_{CE} = 600 V;
V_{GE} = ±15 V;
L = 56 nH.
$T_{vj\ (max)}$ = 150°C.

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 – DA



Part numbering guide

MIDA	-	HB	12	FA	-	300	N	
MIDA								IGBT module package type: DA
		HB						Half-Bridge
			12					Voltage rating (V_{CES}/100)
				FA				IGBT+FRD chipset modification
						300		Current Rating
							N	Climatic version: normal climate