WMSC040B12B1P-C

N-Channel Silicon Carbide MOSFET Module

Rev.01 - 09 December 2024 — Product data sheet

1. General description

WeEnPACK-B1 module with WeEn 1200V Gen2 SiC MOSFET and PressFit pin type. Intergrated with NTC temperature sensor.

2. Features and benefits

- Dual-boost topology
- Press-fit pin configuration
- Low on resistance
- Low switching losses
- Reduced Q_g and C_{rss}
- Minimized circuit impedance
- Robust product design

3. Applications

- Solar power MPPT

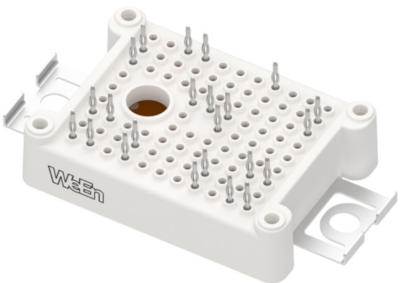
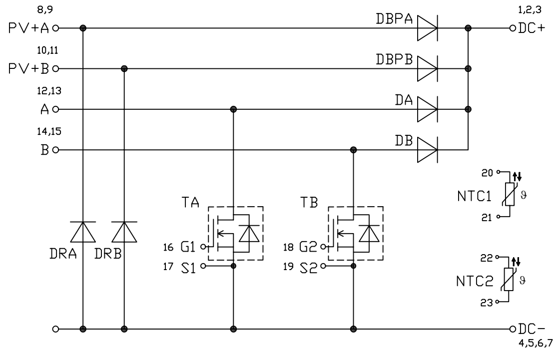
4. Quick reference data

Table 1. Quick reference data

Symbol	Parameter	Conditions	Notes	Values			Unit
Absolute maximum rating							
V_{DS}	drain-source voltage	T_j = 25 °C		1200			V
I_D	drain current	V_{GS} = 18 V; T_h = 25 °C		39			A
P_{tot}	total power dissipation	T_h = 25 °C		77			W
T_j	junction temperature			-40 to 150			°C
Symbol	**Parameter**	**Conditions**	**Notes**	**Min**	**Typ**	**Max**	**Unit**
Static characteristics							
$R_{DS(on)}$	drain-source on-state resistance	V_{GS} = 15 V; I_D = 33 A; T_j = 25 °C		-	40	-	mΩ
		V_{GS} = 18 V; I_D = 33 A; T_j = 25 °C		-	33	45	mΩ
Dynamic characteristics							
$Q_{G(tot)}$	total gate charge	I_D = 33 A; V_{DS} = 800 V; V_{GS} = -4 V/18 V; T_j = 25 °C		-	115	-	nC
Q_{GD}	gate-drain charge			-	18	-	nC
Source-drain diode							
Q_r	recovered charge	I_{SD} = 33 A; V_{DS} = 400 V; di/dt = 500 A/μs; T_j = 25 °C		-	174	-	nC

5. Pinning information

Table 2. Pinning information

Simplified outline	Circuit diagram
 * Please refer to the package outline description for actual pin order.	

6. Ordering information

Table 3. Ordering information

Type number	Package Name	Orderable part number	Packing method	Small packing quantity	Package version	Package issue date
WMSC040B12B1P-C	WeEnPACK-B1	WMSC040B12B1P-C6T	Tray	24	WeEnPACK-B1PBT-B	28-Jun-2024

7. Marking

Table 4. Marking codes

Type number	Marking codes
WMSC040B12B1P-C	WMSC040B12B1P-C

8. Limiting values

Table 5. Limiting values

In accordance with the Absolute Maximum Rating System (IEC 60134).

Symbol	Parameter	Conditions	Notes	Values	Unit
T_{stg}	storage temperature			-40 to 125	°C
$T_{j.op}$	operating junction temperature			-40 to 150	°C
$T_{j.max}$	maximum junction temperature	Intermittent condition with shortened lifetime		-40 to 175	°C
V_{ISOL}	RMS isolation voltage	T_j = 25 °C; all terminals shorted; f = 50 Hz; t = 1 s		3500	V
MOSFET					
V_{DS}	drain-source voltage	T_j = 25 °C		1200	V
$V_{GS,max}$	gate-source voltage	Absolute maximum values		-12 to 24	V
$V_{GS,op}$	gate-source voltage	Recommended operational values		-4 to 18	V
P_{tot}	total power dissipation	T_h = 25 °C		77	W
I_D	drain current	V_{GS} = 18 V; T_h = 25 °C		39	A
		V_{GS} = 18 V; T_h = 100 °C		25	A
I_{DM}	peak drain current	pulse width t_p limited by T_{jmax}		80	A
E_{as}	single pulse drain−to-source avalanche	I_{AS} = 24 A; L = 1 mH; V_{DD} = 100 V; $T_{j(init)}$ = 25 °C; per MOSFET		288	mJ
Body Diode					
I_{SD}	DC body diode forward current	V_{GS} = -4 V; T_h = 25 °C		13	A
$I_{SD,pulse}$	Pulse body diode current	verified by design, t_p limited by T_{jmax}		80	A
By-pass and Inverse-polarity Protection Diode					
V_{RRM}	repetitive peak reverse voltage			1600	V
$I_{F(AV)}$	average forward current	δ = 0.5; square-wave pulse; T_h ≤ 113 °C		45	A
I_{FSM}	non-repetitive peak forward current	t_p = 10 ms; $T_{j(init)}$ = 25 °C; sine-wave pulse		475	A
		t_p = 8.3 ms; $T_{j(init)}$ = 25 °C; sine-wave pulse		523	A
Boost Diode					
V_{RRM}	repetitive peak reverse voltage			1200	V
$I_{F(AV)}$	average forward current	δ = 0.5; square-wave pulse; T_h ≤ 113 °C		25	A
I_{FRM}	repetitive peak forward current	δ = 0.5; t_p = 25 μs; square-wave pulse;		50	A
I_{FSM}	non-repetitive peak forward current	t_p = 10 ms; $T_{j(init)}$ = 25 °C; sine-wave pulse		225	A
		t_p = 10 μs; $T_{j(init)}$ = 25 °C; square-wave pulse		1200	A

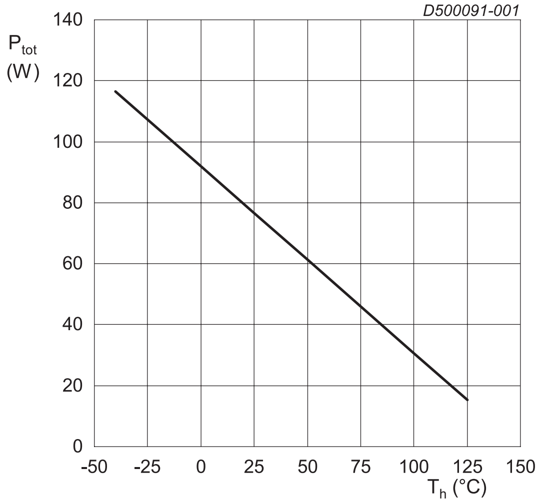


Fig. 1. Power dissipation as a function of heatsink temperature; maximum values

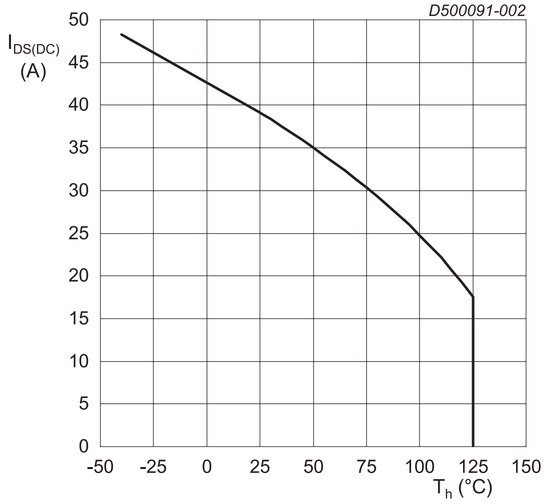


Fig. 2. Continuous Drain Current as a function of heatsink temperature

9. Thermal characteristics

Table 6. Thermal characteristics

Symbol	Parameter	Conditions	Notes	Min	Typ	Max	Unit
$R_{th(j-c)}$	thermal resistance from junction to case	per MOSFET		-	0.75	-	K/W
$R_{th(j-h)}$	thermal resistance from junction to heatsink	per MOSFET, λ_{grease} = 1 W/(m·K) thick$_{grease}$= 50 um		-	1.63	-	K/W
Internal Isolation		basic insulation (class 1, IEC 61140)			Al_2O_3		
d_{Creep}	Creepage distance	terminal to heatsink		-	11.5	-	mm
		terminal to terminal		-	6.3	-	mm
d_{Clear}	Clearance	terminal to heatsink		-	10	-	mm
		terminal to terminal		-	5	-	mm
CTI	Comperative tracking index				>200		
F	Mounting force per clamp			20	-	50	N
G	Approximate Weight			-	20	-	g

Note: Module is ESD sensitive. Handling precautions are recommended.

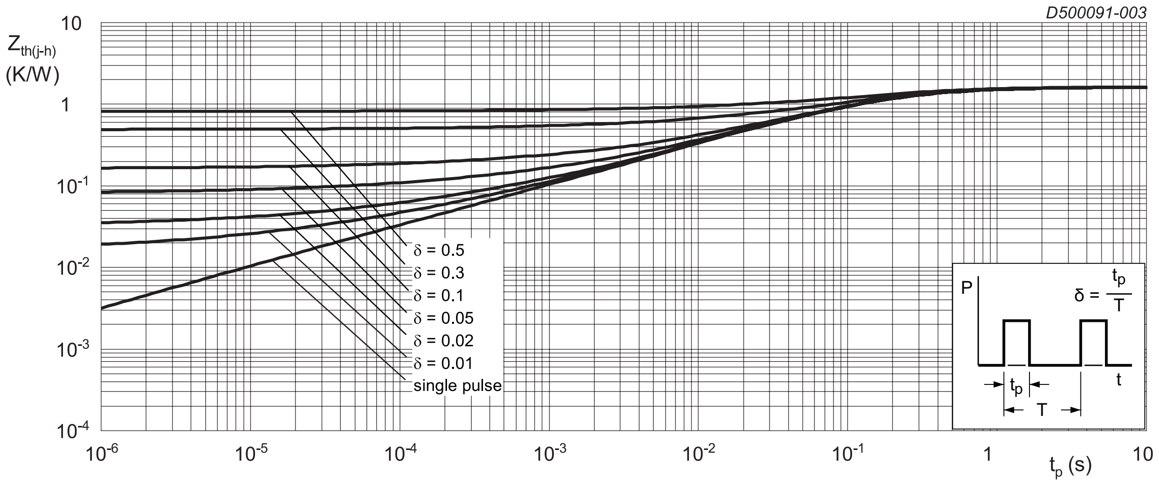


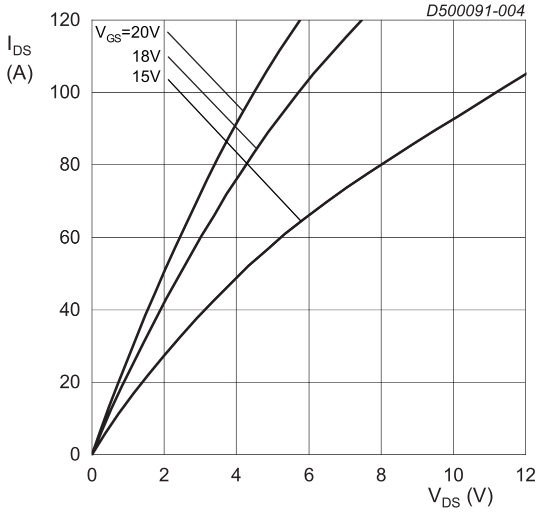
Fig. 3. Transient thermal impedance from junction to heatsink as a function of pulse duration

10. Characteristics

Table 7. Characteristics

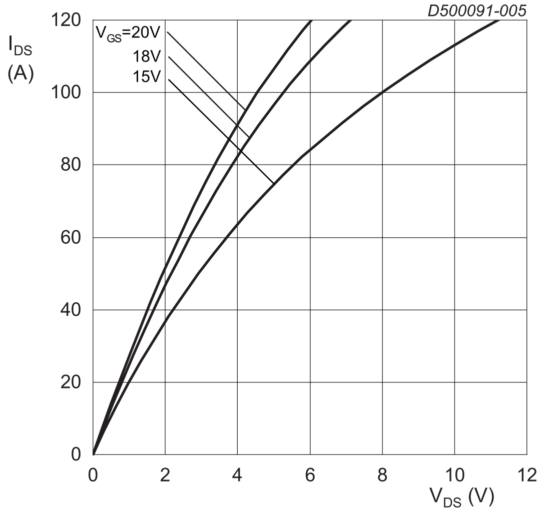
Symbol	Parameter	Conditions	Notes	Min	Typ	Max	Unit
MOSFET							
Static characteristics							
$V_{(BR)DSS}$	drain-source breakdown voltage	I_D = 100 µA; V_{GS} = 0 V; T_j = 25 °C		1200	-	-	V
$V_{GS(th)}$	gate-source threshold voltage	I_D = 10 mA; V_{DS} = 10 V; T_j = 25 °C		1.9	2.5	3.5	V
		I_D = 10 mA; V_{DS} = 10 V; T_j = 175 °C		-	1.9	-	V
I_{DSS}	drain leakage current	V_{DS} = 1200 V; V_{GS} = 0 V; T_j = 25 °C		-	0.2	100	µA
I_{GSS}	gate leakage current (absolute value)	V_{GS} = 24 V; V_{DS} = 0 V; T_j = 25 °C		-	10	100	nA
		V_{GS} = -12 V; V_{DS} = 0 V; T_j = 25 °C		-	10	100	nA
$R_{DS(on)}$	drain-source on-state resistance	V_{GS} = 15 V; I_D = 33 A; T_j = 25 °C		-	40	-	mΩ
		V_{GS} = 18 V; I_D = 33 A; T_j = 25 °C		-	33	45	mΩ
		V_{GS} = 18 V; I_D = 33 A; T_j = 125 °C		-	45	-	mΩ
		V_{GS} = 18 V; I_D = 33 A; T_j = 150 °C		-	51	-	mΩ
		V_{GS} = 18 V; I_D = 33 A; T_j = 175 °C		-	56	-	mΩ
R_G	gate resistance, each side	f = 1 MHz; T_j = 25 °C, per MOSFET		-	1.0	-	Ω
g_{fs}	transconductance	V_{DS} = 20 V; I_D = 33 A; T_j = 25 °C		-	20	-	S
Dynamic characteristics							
$Q_{G(tot)}$	total gate charge	I_D = 33 A; V_{DS} = 800 V; V_{GS} = -4 V/18 V; T_j = 25 °C		-	115	-	nC
Q_{GS}	gate-source charge			-	47	-	nC
Q_{GD}	gate-drain charge			-	18	-	nC
C_{iss}	input capacitance	V_{DS} = 1000 V; V_{GS} = 0 V; f = 100 KHz; T_j = 25 °C		-	2450	-	pF
C_{oss}	output capacitance			-	108	-	pF
C_{rss}	reverse transfer capacitance			-	11	-	pF
E_{oss}	Coss stored energy			-	54	-	µJ
$t_{d(on)}$	turn-on delay time	V_{DS} = 800 V; V_{GS} = -4 V/18 V; $R_{G(ext)}$ = 2.4 Ω; I_D = 33 A; L = 100 µH; T_j = 25 °C		-	17	-	ns
t_r	rise time			-	15	-	ns
$t_{d(off)}$	turn-off delay time			-	23	-	ns
t_f	fall time			-	8	-	ns
E_{on}	turn-on energy			-	250	-	µJ
E_{off}	turn-off energy			-	100	-	µJ

Body diode							
Symbol	**Parameter**	**Conditions**	**Notes**	**Min**	**Typ**	**Max**	**Unit**
Static characteristics							
V_{SD}	source-drain voltage	V_{GS} = -4 V; I_{SD} = 33 A; T_j = 25 °C		-	5.5	-	V
		V_{GS} = -4 V; I_{SD} = 33 A; T_j = 150 °C		-	5.0	-	V
Dynamic characteristics							
I_{rrm}	reverse recovery current	I_{SD} = 33 A; di/dt = 500 A/μs; V_{DS} = 400 V; T_j = 25 °C		-	6.8	-	A
t_{rr}	reverse recovery time			-	52	-	ns
Q_r	recovered charge			-	174	-	nC
By-pass and Inverse-polarity Protection Diode							
Symbol	**Parameter**	**Conditions**	**Notes**	**Min**	**Typ**	**Max**	**Unit**
V_F	forward voltage	I_F = 45 A; T_j = 25 °C		-	1.20	1.40	V
		I_F = 45 A; T_j = 150 °C		-	1.10	1.30	V
I_R	reverse current	V_R = 1600 V; T_j = 25 °C		-	-	10	μA
		V_R = 1600 V; T_j = 150 °C		-	-	1.5	mA
V_R	reverse voltage	DC		-	1600	-	V
Boost Diode							
Symbol	**Parameter**	**Conditions**	**Notes**	**Min**	**Typ**	**Max**	**Unit**
V_F	forward voltage	I_F = 25 A; T_j = 25 °C		-	1.42	1.60	V
		I_F = 25 A; T_j = 150 °C		-	1.90	2.30	V
I_R	reverse current	V_R = 1200 V; T_j = 25 °C		-	1	125	μA
V_R	reverse voltage	DC		-	1200	-	V
Q_r	recovered charge	I_F = 25 A; V_R = 400 V; dI_F/dt = 500 A/μs; T_j = 25 °C		-	54	-	nC
NTC thermistor							
Symbol	**Parameter**	**Conditions**	**Notes**	**Min**	**Typ**	**Max**	**Unit**
R_{25}	Rated resistance	T_{NTC} = 25 °C		-	5000	-	Ω
R_{100}		T_{NTC} = 100 °C			493±5%		Ω
$B_{25/50}$	B-value	$R_2 = R_{25} \exp[B_{25/50}(1/T_2 - 1/(298.15K))]$			3380		K
	Maximum operating temperature			-	200	-	°C
	Dissipation costant			-	2	-	mW/K
	Thermal time constant			-	≤10	-	s



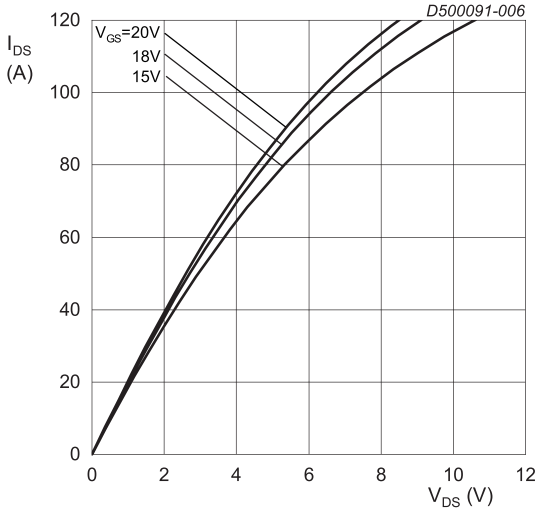
T_j = -40 °C; t_p < 200 µs

Fig. 4. Output characteristics; drain current as a function of drain-source voltage; typical values



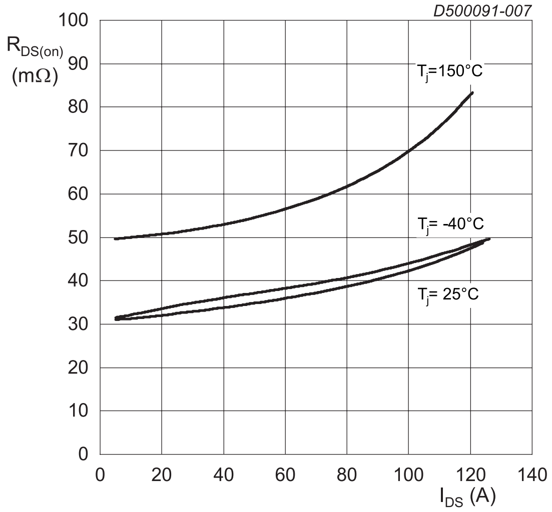
T_j = 25 °C; t_p < 200 µs

Fig. 5. Output characteristics; drain current as a function of drain-source voltage; typical values



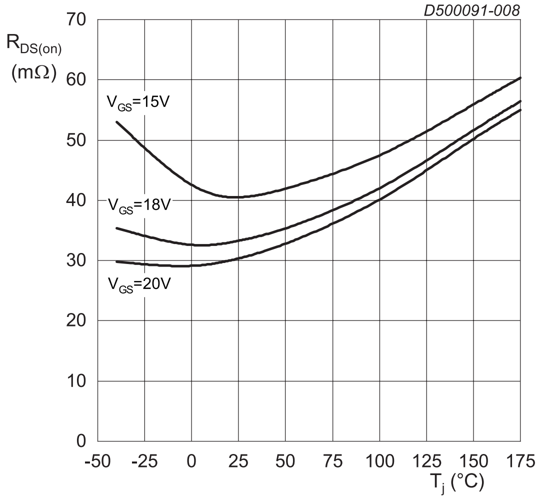
T_j = 150 °C; t_p < 200 µs

Fig. 6. Output characteristics; drain current as a function of drain-source voltage; typical values



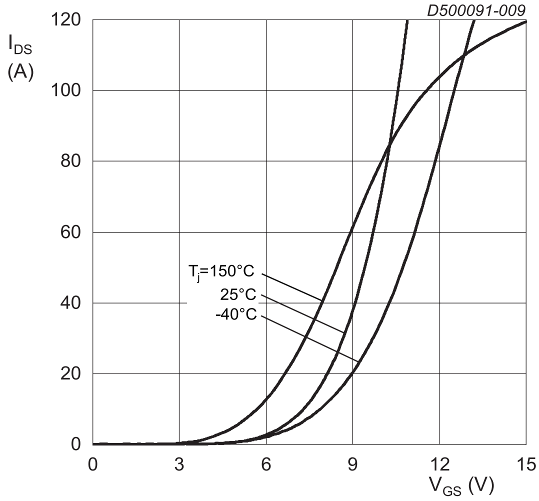
V_{GS} = 18 V; t_p < 200 µs

Fig. 7. Drain-source on-state resistance as a function of drain current; typical values



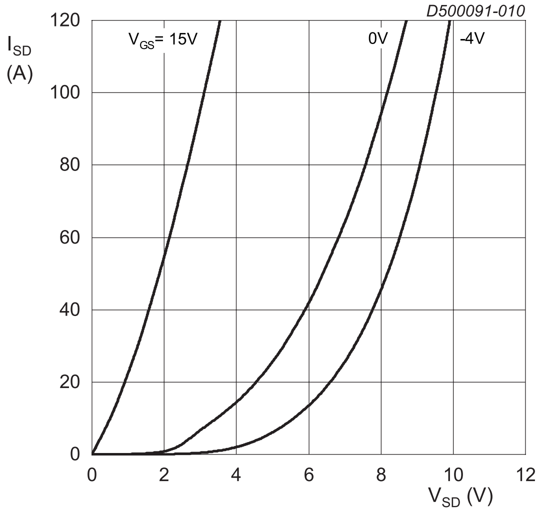
I_{DS} = 33 A; t_p < 200 µs

Fig. 8. Drain-source on-state resistance as a function of junction temperature



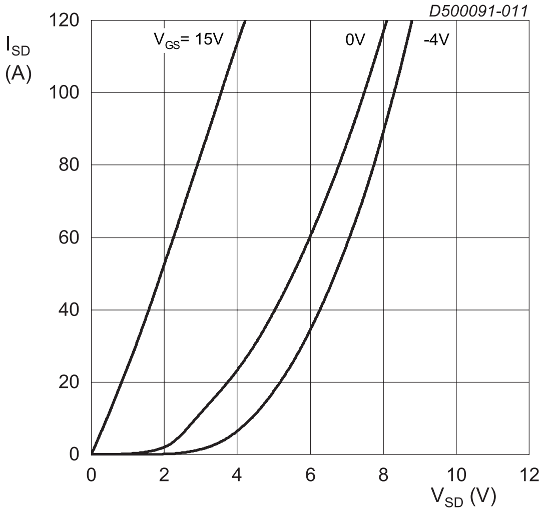
V_{DS} = 20 V; t_p < 200 µs

Fig. 9. Transfer characteristics; drain current as a function of gate-source voltage; typical values



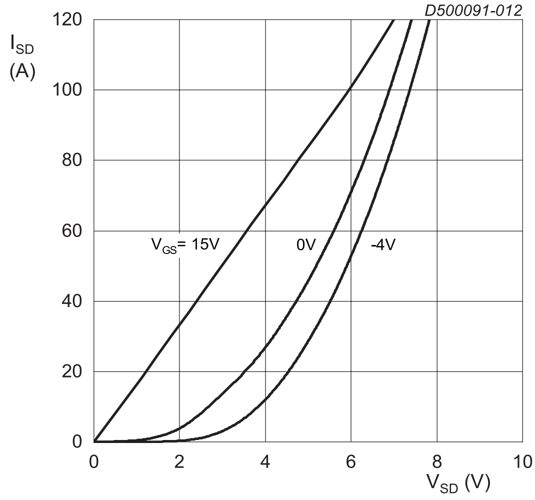
T_j = -40 °C; t_p < 200 µs

Fig. 10. Body diode forward characteristics; typical values



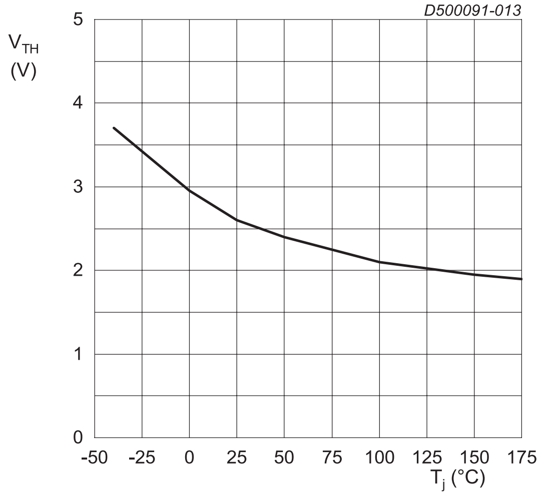
T_j = 25 °C; t_p < 200 µs

Fig. 11. Body diode forward characteristics; typical values



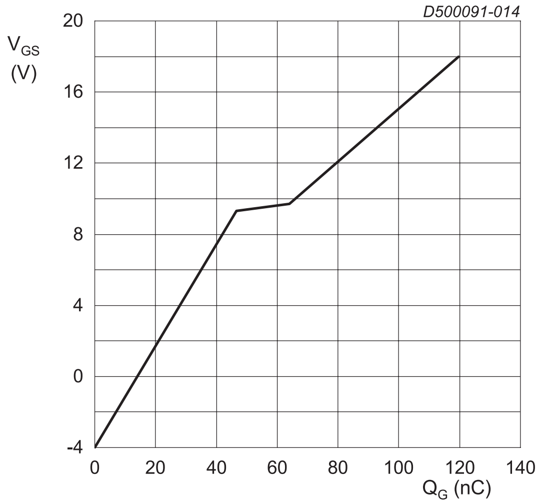
T_j = 150 °C; t_p < 200 µs

Fig. 12. Body diode forward characteristics; typical values



V_{DS} = 10 V; I_{DS} = 10 mA

Fig. 13. Threshold voltage as a function of junction temperature



I_{DS} = 33 A; I_{GS} = 0.1 mA; V_{DS} = 800 V; T_j = 25 °C

Fig. 14. Gate-source voltage as a function of gate charge; typical values

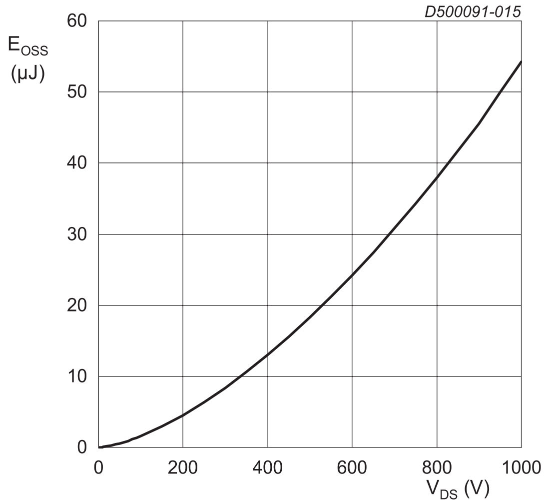
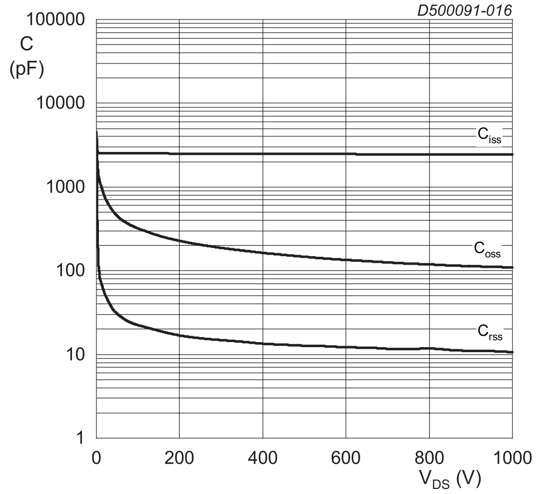
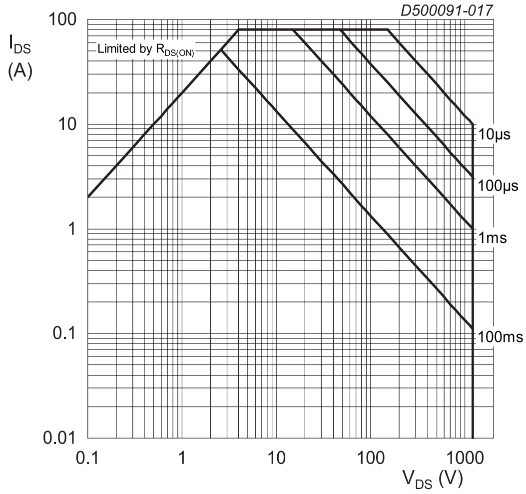


Fig. 15. Output capacitor stored energy as a function of drain-source voltage



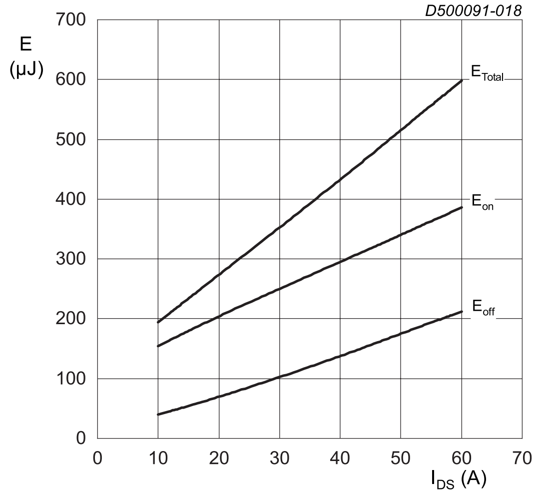
V_{DS} = 0 - 1000 V
T_j = 25 °C; V_{AC} = 25 mV; f = 100 KHz

Fig. 16. Input, output and reverse transfer capacitances as a function of drain-source voltage; typical values



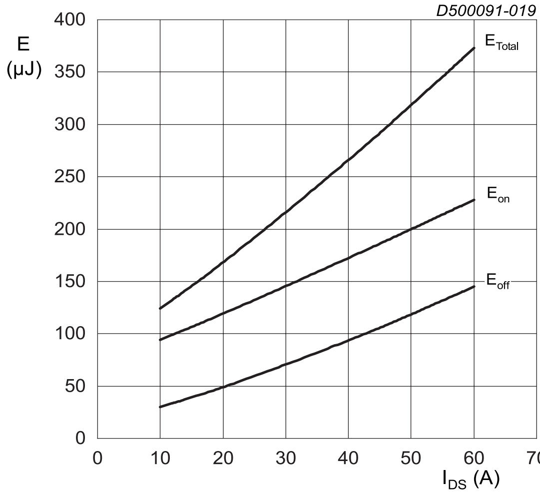
T_j = 25 °C; D = 0
Parameter: t_p

Fig. 17. Forward bias safe operating area



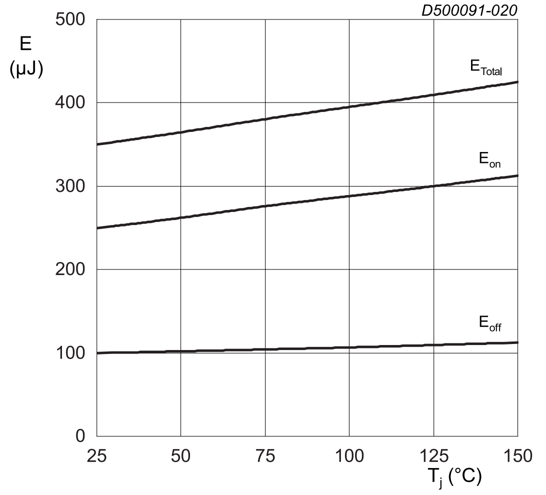
T_j = 25 °C; V_{DD} = 800 V; $R_{G(off)}$ = 2.4 Ω; $R_{G(on)}$ = 2.4 Ω;
V_{GS} = -4 V/18 V V; L = 100 µH

Fig. 18. Clamped Inductive Switching Energy as a function of drain current



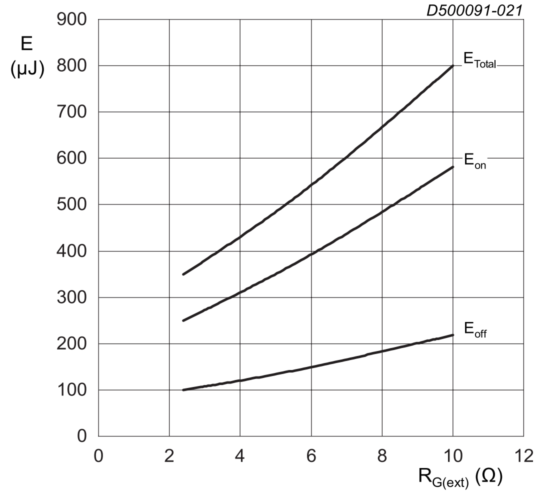
T_j = 25 °C; V_{DD} = 600 V; $R_{G(off)}$ = 2.4 Ω; $R_{G(on)}$ = 2.4 Ω;
V_{GS} = -4 V/18 V; L = 100 µH

Fig. 19. Clamped Inductive Switching Energy as a function of drain current



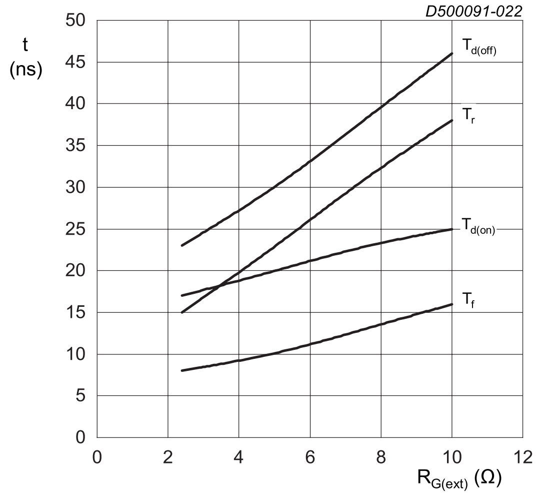
I_{DS} = 33 A; V_{DD} = 800 V; $R_{G(off)}$ = 2.4 Ω; $R_{G(on)}$ = 2.4 Ω; V_{GS} = -4 V/18 V; L = 100 µH

Fig. 20. Clamped Inductive Switching Energy as a function of junction temperature



T_j = 25 °C; V_{DD} = 800 V; I_{DS} = 33 A; V_{GS} = -4 V/18 V; L = 100 µH

Fig. 21. Clamped Inductive Switching Energy as a function of external gate resistance



T_j = 25 °C; V_{DD} = 800 V; I_{DS} = 33 A; V_{GS} = -4 V/18 V; L = 100 µH

Fig. 22. Switching time as a function of external gate resistance

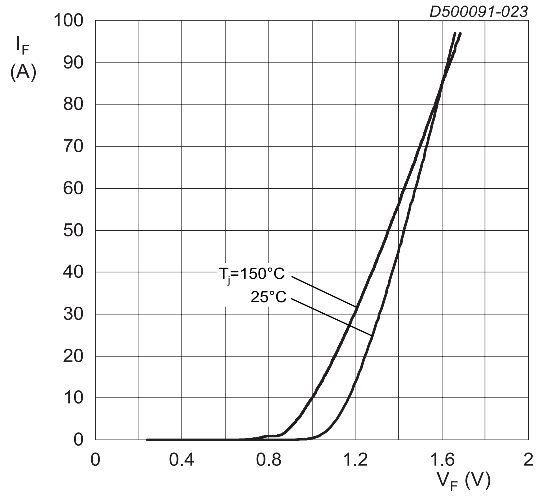


Fig. 23. By-pass and inverse-polarity protection diode forward characteristic; typical values

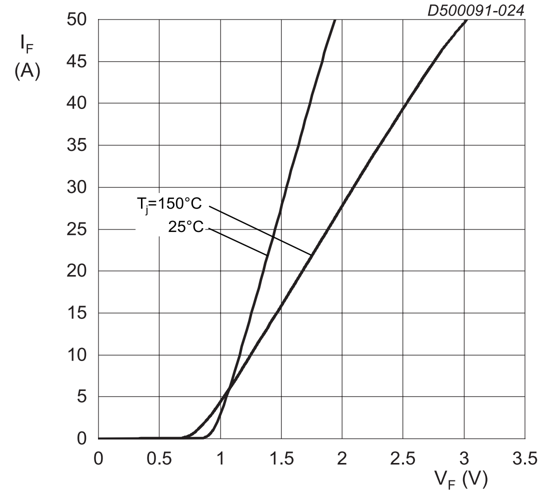


Fig. 24. Boost diode forward characteristic; typical values

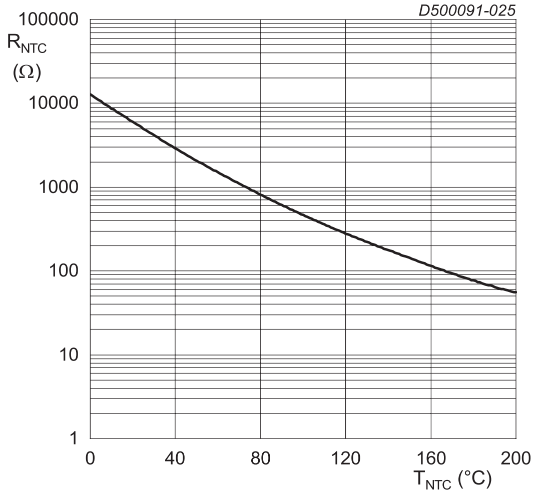
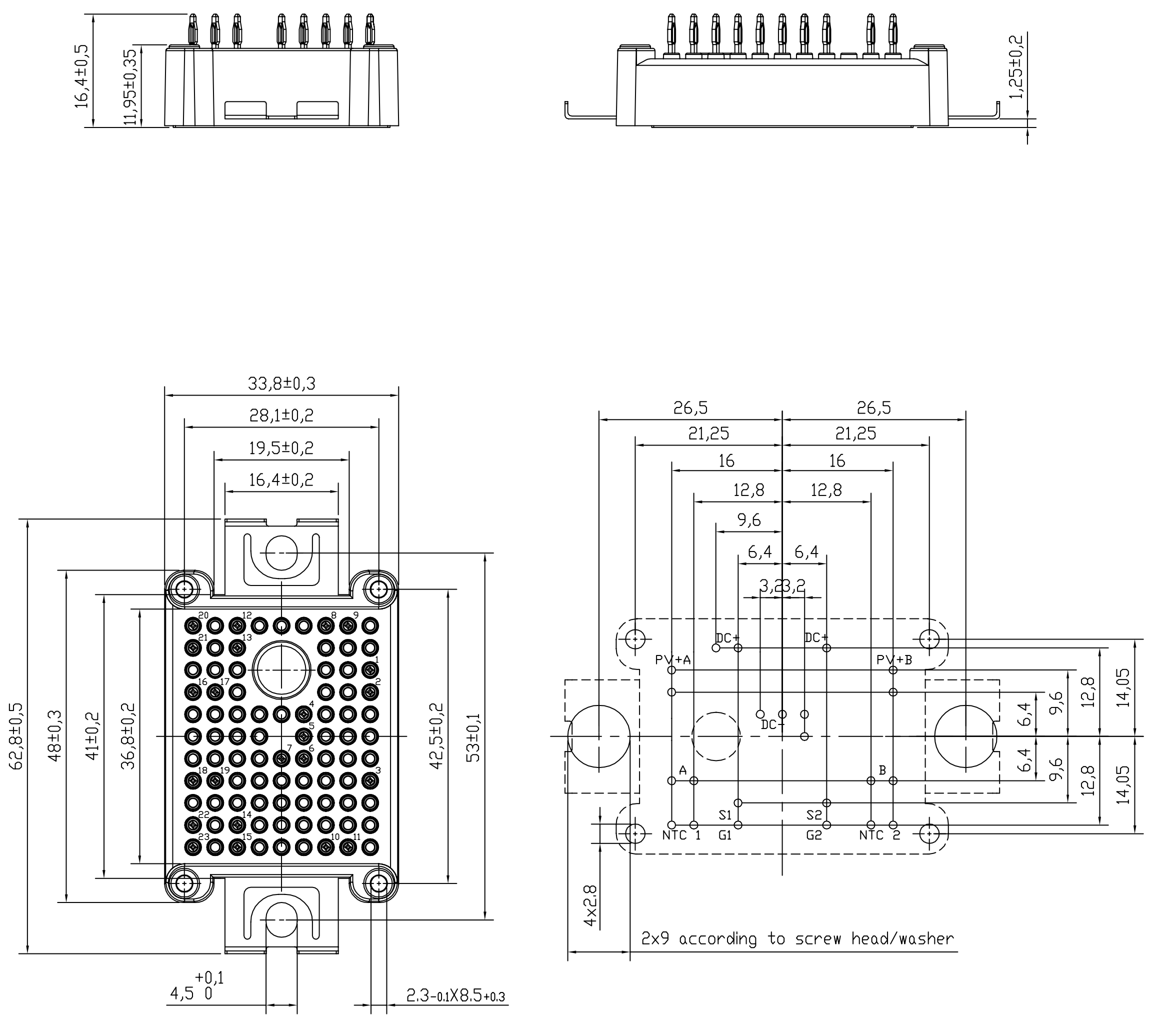


Fig. 25. NTC thermistor resistance as a function of NTC temperature

11. Package outline

Package Outline

Dimensions in mm



12. Legal information

Data sheet status

Document status [1][2]	Product status [3]	Definition
Objective [short] data sheet	Development	This document contains data from the objective specification for product development.
Preliminary [short] data sheet	Qualification	This document contains data from the preliminary specification.
Product [short] data sheet	Production	This document contains the product specification.

[1] Please consult the most recently issued document before initiating or completing a design.
[2] The term 'short data sheet' is explained in section "Definitions".
[3] The product status of device(s) described in this document may have changed since this document was published and may differ in case of multiple devices. The latest product status information is available on the Internet at URL http://www.ween-semi.com.

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13. Contents

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