

1. General description

WeEnPACK-B1 module with WeEn 1200V Gen2 SiC MOSFET and Press-fit pin type. NTC temperature sensor inside.



2. Features and benefits

- 3-phase full bridge 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

- EV chargers
- Energy storage and solar energy systems
- Power Inverters
- AC/DC converters
- Power factor correctors
- Motor drives

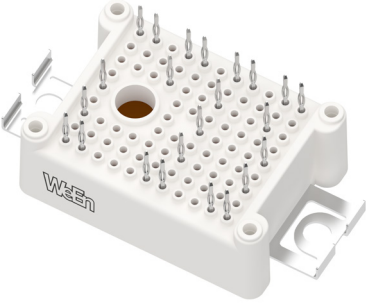
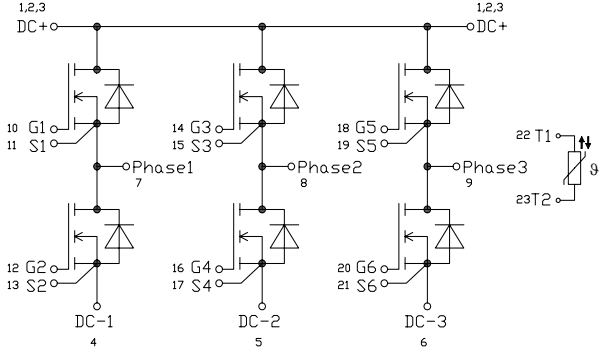
4. Quick reference data

Table 1. Quick reference data

Symbol	Parameter	Conditions	Notes	Values			Unit
Absolute maximum rating							
V_{DS}	drain-source voltage	$T_j = 25\text{ °C}$		1200			V
I_D	drain current	$V_{GS} = 18\text{ V}; T_h = 25\text{ °C}$		59			A
P_{tot}	total power dissipation	$T_h = 25\text{ °C}$		91			W
$T_{j,op}$	maximum junction temperature			-40 to 150			°C
Symbol	Parameter	Conditions	Notes	Min	Typ	Max	Unit
Static characteristics							
$R_{DS(on)}$	drain-source on-state resistance	$V_{GS} = 15\text{ V}; I_D = 50\text{ A}; T_j = 25\text{ °C}$		-	20	-	mΩ
		$V_{GS} = 18\text{ V}; I_D = 50\text{ A}; T_j = 25\text{ °C}$		-	16.3	29	mΩ
Dynamic characteristics							
$Q_{G(tot)}$	total gate charge	$I_D = 50\text{ A}; V_{DS} = 800\text{ V}; V_{GS} = -4\text{ V}/18\text{ V}; T_j = 25\text{ °C}$		-	215	-	nC
Q_{GD}	gate-drain charge			-	32	-	nC
Source-drain diode							
Q_r	recovered charge	$I_{SD} = 50\text{ A}; V_{GS} = -4\text{ V}/18\text{ V}; V_R = 600\text{ V}; di/dt = 2300\text{ A}/\mu\text{s}; R_{G(ext)} = 5.1\text{ }\Omega; T_j = 25\text{ °C}$		-	1072	-	nC

5. Pinning information

Table 2. Pinning information

Simplified outline	Graphic symbol
 <p data-bbox="137 801 598 815">* Please refer to the package outline description for actual pin order.</p>	

6. Ordering information

Table 3. Ordering information

Type number	Package Name	Orderable part number	Packing method	Small packing quantity	Package version	Package issue date
WMSC020S12B1P	WeEnPACK-B1	WMSC020S12B1P6T	Tray	6	WeEnPACK-B1PSB-B	13-Jun-2024

7. Marking

Table 4. Marking codes

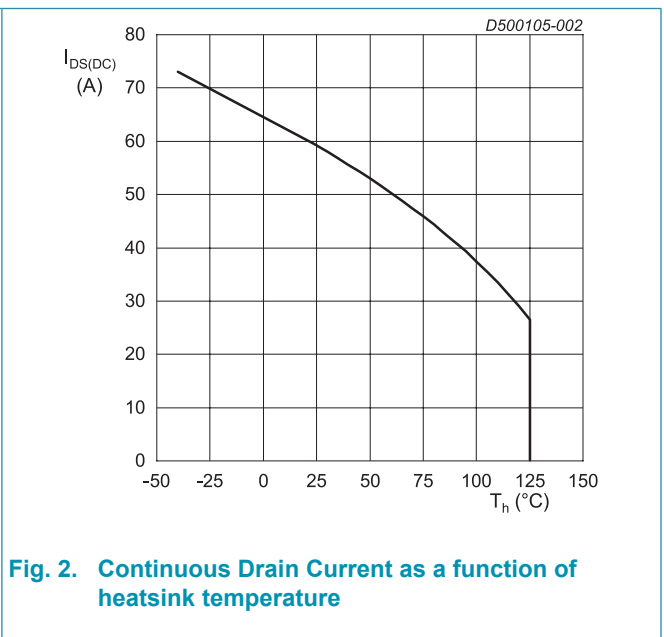
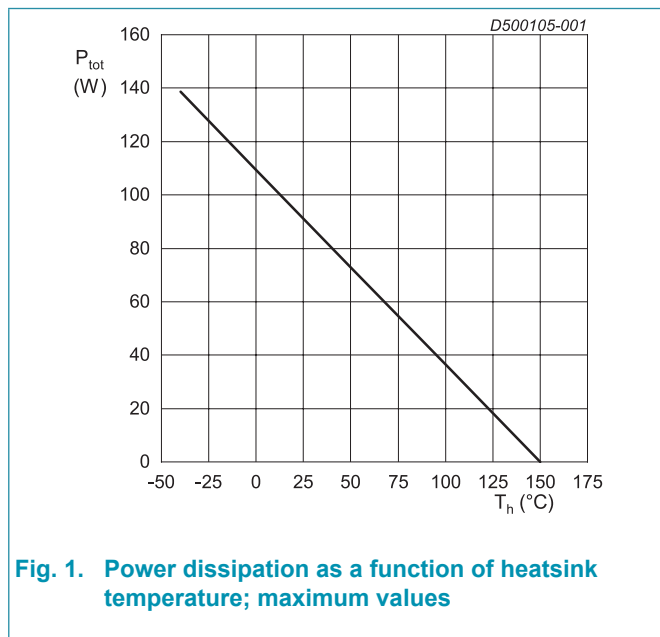
Type number	Marking codes
WMSC020S12B1P	WMSC020S12B1P

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	$T_j = 25\text{ °C}$; all terminals shorted; $f = 50\text{ Hz}$; $t = 1\text{ s}$		3500	V
MOSFET					
V_{DS}	drain-source voltage	$T_j = 25\text{ °C}$		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	$T_h = 25\text{ °C}$		91	W
I_D	drain current	$V_{GS} = 18\text{ V}$; $T_h = 25\text{ °C}$		59	A
		$V_{GS} = 18\text{ V}$; $T_h = 100\text{ °C}$		37	A
I_{DM}	peak drain current	pulse width t_p limited by $T_{j,max}$		118	A
E_{as}	single pulse drain-to-source avalanche	$I_{AS} = 30\text{ A}$; $L = 1\text{ mH}$; $V_{DD} = 100\text{ V}$; $T_{j(init)} = 25\text{ °C}$; per MOSFET		450	mJ
Body Diode					
I_{SD}	DC body diode forward current	$V_{GS} = -4\text{ V}$; $T_h = 25\text{ °C}$		30	A
$I_{SD,pulse}$	Pulse body diode current	verified by design, t_p limited by $T_{j,max}$		118	A



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		-	0.59	-	K/W
$R_{th(j-h)}$	thermal resistance from junction to heatsink	per MOSFET, $\lambda_{grease} = 1 \text{ W/(m}\cdot\text{K)}$, $thick_{grease} = 50 \text{ }\mu\text{m}$		-	1.37	-	K/W
Internal Isolation		basic insulation (class 1, IEC 61140)		Al ₂ O 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.

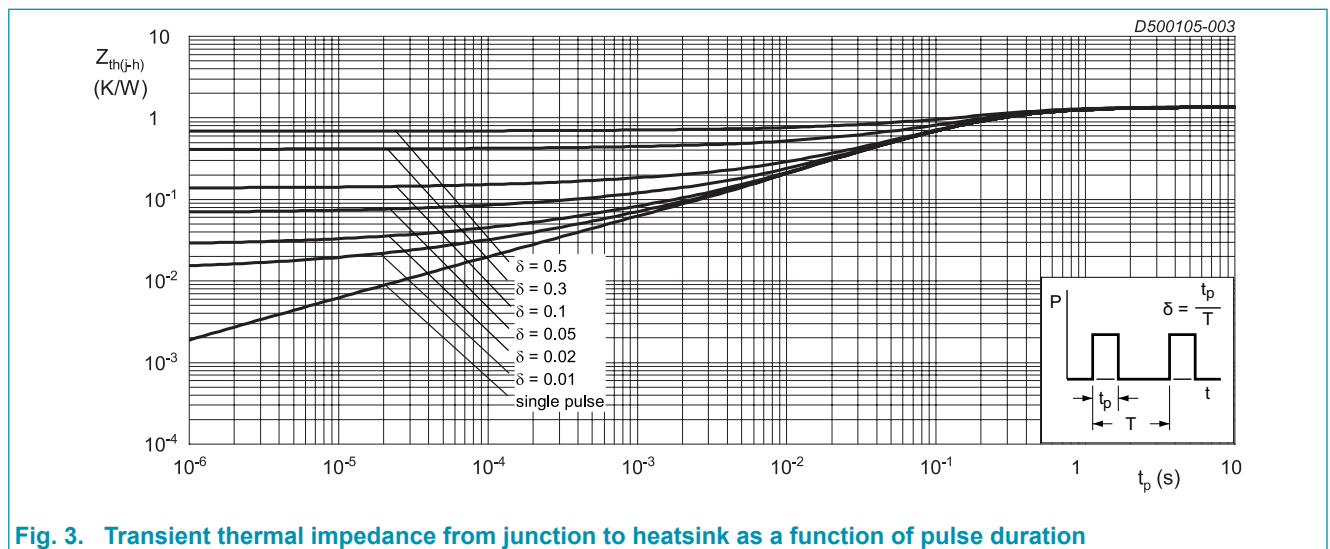


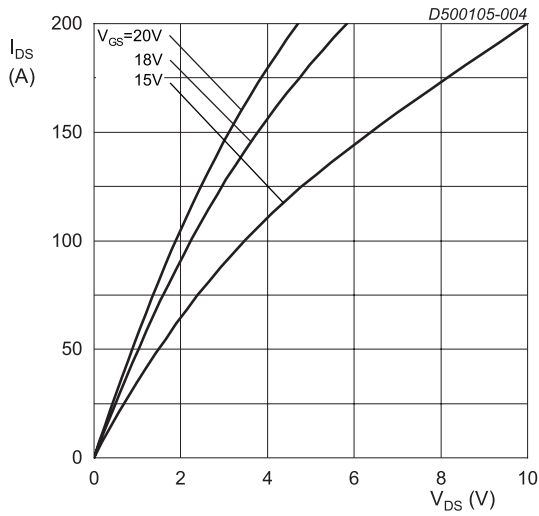
Fig. 3. Transient thermal impedance from junction to heatsink as a function of pulse duration

10. Characteristics

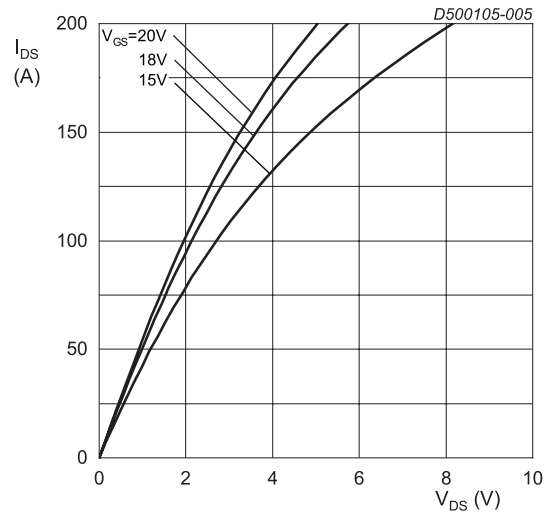
Table 7. Characteristics

MOSFET							
Symbol	Parameter	Conditions	Notes	Min	Typ	Max	Unit
Static characteristics							
$V_{(BR)DSS}$	drain-source breakdown voltage	$I_D = 100 \mu A; V_{GS} = 0 V; T_j = 25 \text{ }^\circ C$		1200	-	-	V
$V_{GS(th)}$	gate-source threshold voltage	$I_D = 20 \text{ mA}; V_{DS} = V_{GS}; T_j = 25 \text{ }^\circ C$		1.9	2.6	3.5	V
		$I_D = 20 \text{ mA}; V_{DS} = V_{GS}; T_j = 175 \text{ }^\circ C$		-	1.9	-	V
I_{DSS}	drain leakage current	$V_{DS} = 1200 \text{ V}; V_{GS} = 0 \text{ V}; T_j = 25 \text{ }^\circ C$		-	0.2	100	μA
I_{GSS}	gate leakage current (absolute value)	$V_{GS} = 24 \text{ V}; V_{DS} = 0 \text{ V}; T_j = 25 \text{ }^\circ C$		-	10	100	nA
		$V_{GS} = -12 \text{ V}; V_{DS} = 0 \text{ V}; T_j = 25 \text{ }^\circ C$		-	10	100	nA
$R_{DS(on)}$	drain-source on-state resistance	$V_{GS} = 15 \text{ V}; I_D = 50 \text{ A}; T_j = 25 \text{ }^\circ C$		-	20	-	m Ω
		$V_{GS} = 18 \text{ V}; I_D = 50 \text{ A}; T_j = 25 \text{ }^\circ C$		-	16.3	29	m Ω
		$V_{GS} = 18 \text{ V}; I_D = 50 \text{ A}; T_j = 125 \text{ }^\circ C$		-	24	-	m Ω
		$V_{GS} = 18 \text{ V}; I_D = 50 \text{ A}; T_j = 150 \text{ }^\circ C$		-	26	-	m Ω
		$V_{GS} = 18 \text{ V}; I_D = 50 \text{ A}; T_j = 175 \text{ }^\circ C$		-	27.3	-	m Ω
R_G	gate resistance	$f = 1 \text{ MHz}; T_j = 25 \text{ }^\circ C; \text{ per MOSFET}$		-	0.6	-	Ω
g_{fs}	transconductance	$V_{DS} = 20 \text{ V}; I_D = 50 \text{ A}; T_j = 25 \text{ }^\circ C$		-	32	-	S
Dynamic characteristics							
$Q_{G(tot)}$	total gate charge	$I_D = 50 \text{ A}; V_{DS} = 800 \text{ V}; V_{GS} = -4 \text{ V}/18 \text{ V}; T_j = 25 \text{ }^\circ C$		-	215	-	nC
Q_{GS}	gate-source charge			-	83	-	nC
Q_{GD}	gate-drain charge			-	32	-	nC
C_{iss}	input capacitance	$V_{DS} = 1000 \text{ V}; V_{GS} = 0 \text{ V}; f = 1 \text{ MHz}; T_j = 25 \text{ }^\circ C$		-	4701	-	pF
C_{oss}	output capacitance			-	199	-	pF
C_{riss}	reverse transfer capacitance			-	20	-	pF
E_{oss}	Coss stored energy			-	100	-	μJ
$t_{d(on)}$	turn-on delay time		$V_{DS} = 800 \text{ V}; V_{GS} = -4 \text{ V}/18 \text{ V}; R_{G(off)} = 5.1 \text{ } \Omega; R_{G(on)} = 5.1 \text{ } \Omega; I_D = 50 \text{ A}; L = 300 \text{ } \mu H; T_j = 25 \text{ }^\circ C$		-	23	-
t_r	rise time			-	16	-	ns
$t_{d(off)}$	turn-off delay time			-	64	-	ns
t_f	fall time			-	19	-	ns
E_{on}	turn-on energy			-	877	-	μJ
E_{off}	turn-off energy			-	237	-	μJ

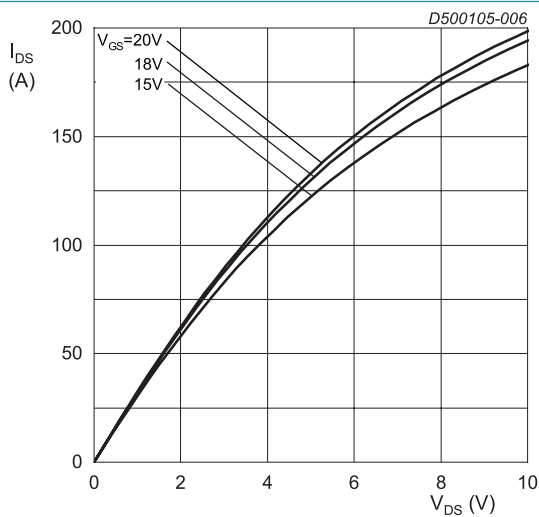
Body diode							
Symbol	Parameter	Conditions	Notes	Min	Typ	Max	Unit
Static characteristics							
V _{SD}	source-drain voltage	V _{GS} = -4 V; I _{SD} = 50 A; T _j = 25 °C		-	5.5	-	V
		V _{GS} = -4 V; I _{SD} = 50 A; T _j = 150 °C		-	5.0	-	V
Dynamic characteristics							
I _{rrm}	reverse recovery current	I _{SD} = 50 A; V _{GS} = -4 V/18 V; V _R = 600 V; di/dt = 2300 A/μs; R _{G(ext)} = 5.1 Ω; T _j = 25 °C		-	67	-	A
t _{rr}	reverse recovery time			-	27	-	ns
Q _r	recovered charge			-	1072	-	nC
E _{rec}	reverse recovery energy			-	178	-	μJ
I _{rrm}	reverse recovery current	I _{SD} = 50 A; V _{GS} = -4 V/18 V; V _R = 600 V; di/dt = 3000 A/μs; R _{G(ext)} = 5.1 Ω; T _j = 150 °C		-	74	-	A
t _{rr}	reverse recovery time			-	29	-	ns
Q _r	recovered charge			-	1368	-	nC
E _{rec}	reverse recovery energy			-	207	-	μJ
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			465±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 constant			-	2	-	mW/K
	Thermal time constant			-	≤10	-	s



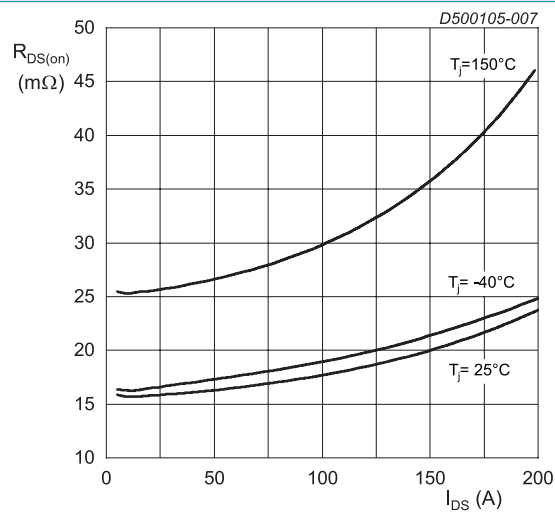
$T_j = -40\text{ °C}; t_p < 200\text{ }\mu\text{s}$
Fig. 4. Output characteristics; drain current as a function of drain-source voltage; typical values



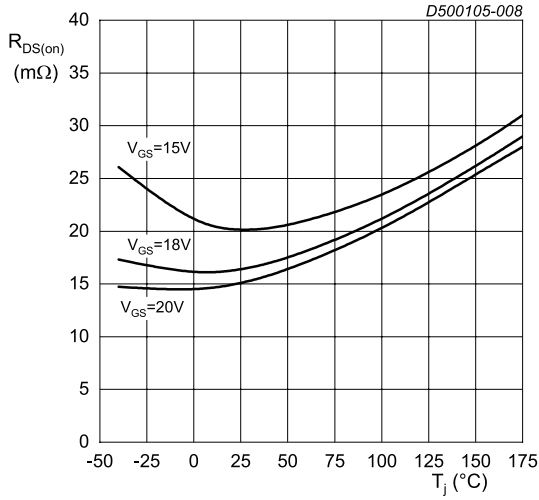
$T_j = 25\text{ °C}; t_p < 200\text{ }\mu\text{s}$
Fig. 5. Output characteristics; drain current as a function of drain-source voltage; typical values



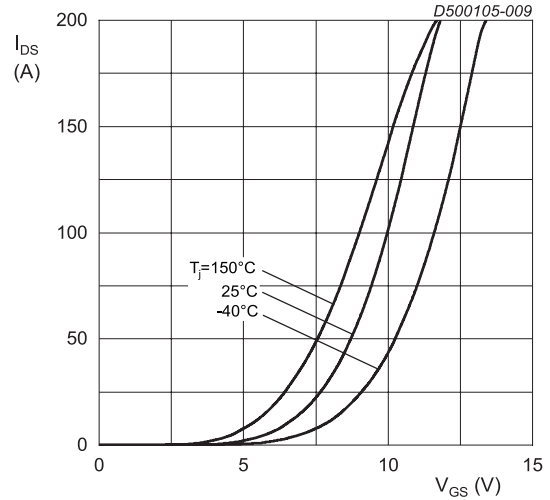
$T_j = 150\text{ °C}; t_p < 200\text{ }\mu\text{s}$
Fig. 6. Output characteristics; drain current as a function of drain-source voltage; typical values



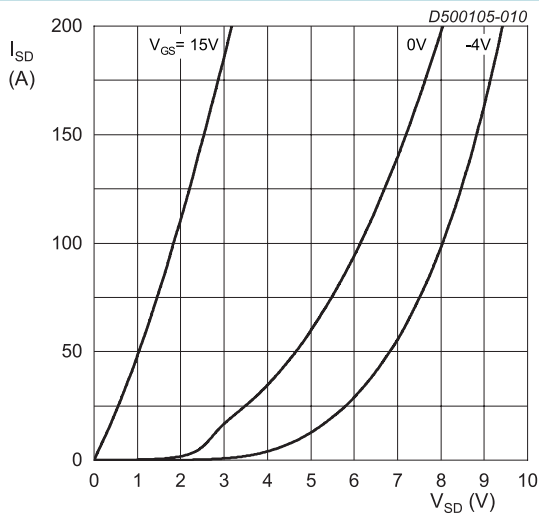
$V_{GS} = 18\text{ V}; t_p < 200\text{ }\mu\text{s}$
Fig. 7. Drain-source on-state resistance as a function of drain current; typical values



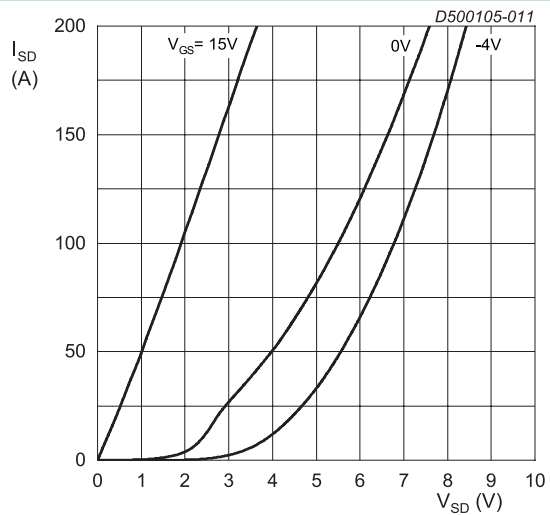
$I_{DS} = 50 A; t_p < 200 \mu s$
Fig. 8. Drain-source on-state resistance as a function of junction temperature



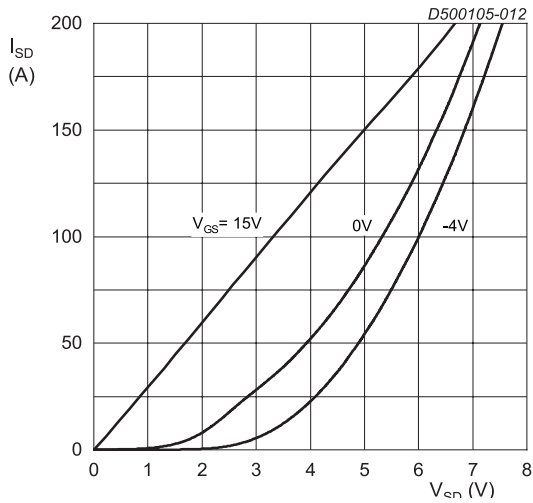
$V_{DS} = 20 V; t_p < 200 \mu s$
Fig. 9. Transfer characteristics; drain current as a function of gate-source voltage; typical values



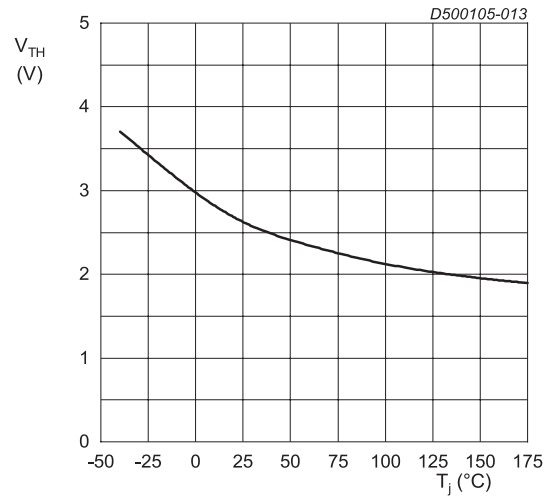
$T_j = -40^{\circ}C; t_p < 200 \mu s$
Fig. 10. Body diode forward characteristics; typical values



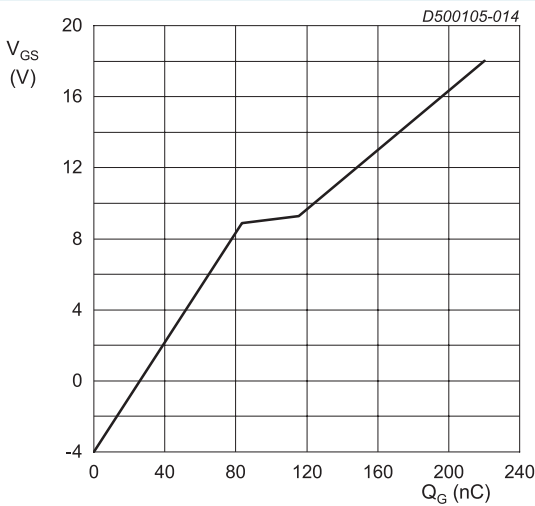
$T_j = 25^{\circ}C; t_p < 200 \mu s$
Fig. 11. Body diode forward characteristics; typical values



$T_j = 150\text{ }^\circ\text{C}$; $t_p < 200\text{ }\mu\text{s}$
Fig. 12. Body diode forward characteristics; typical values



$V_{DS} = V_{GS}$; $I_{DS} = 20\text{ mA}$
Fig. 13. Threshold voltage as a function of junction temperature



$I_{DS} = 50\text{ A}$; $I_{GS} = 0.1\text{ mA}$; $V_{DS} = 800\text{ V}$; $T_j = 25\text{ }^\circ\text{C}$
Fig. 14. Gate-source voltage as a function of gate charge; typical values

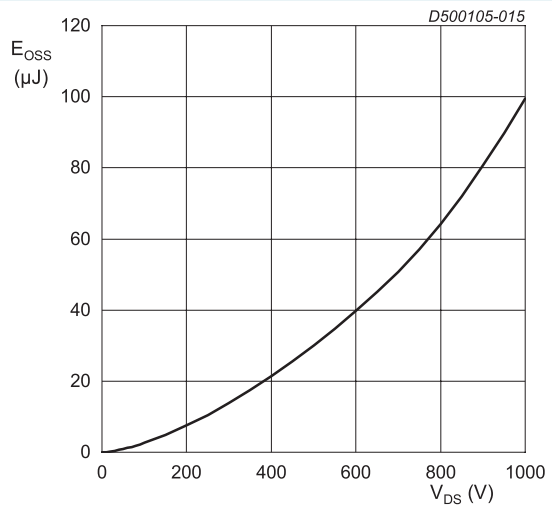
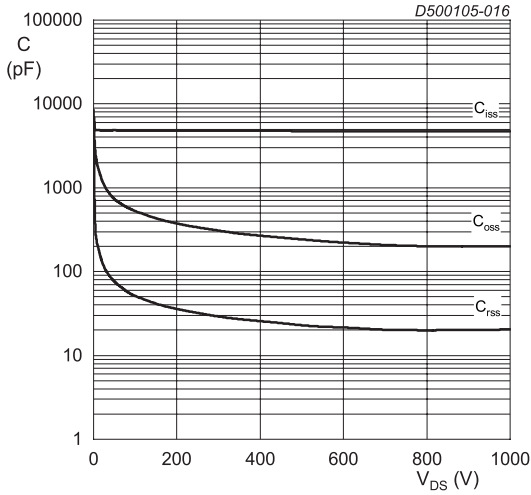
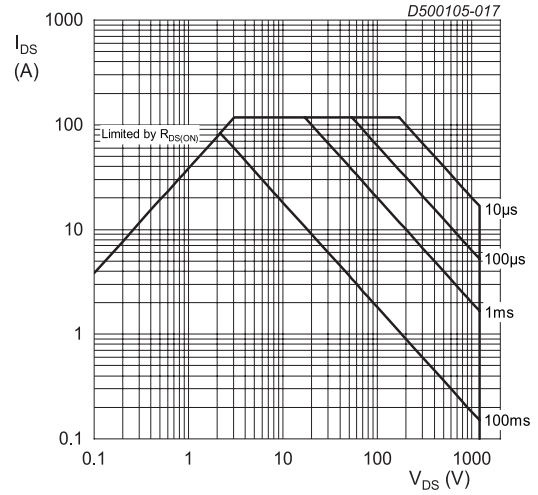


Fig. 15. Output capacitor stored energy as a function of drain-source voltage



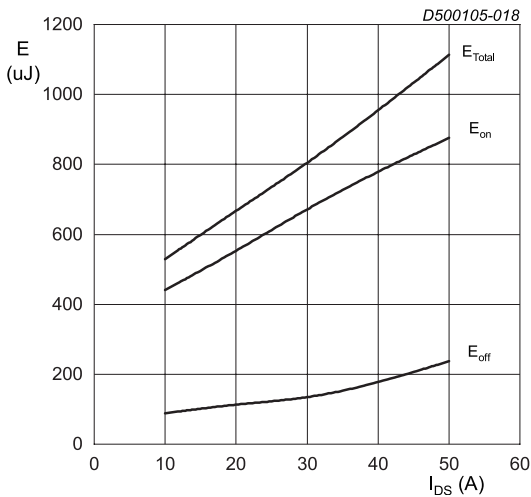
V_{DS} = 0 - 1000 V
 T_j = 25 °C; V_{AC} = 25 mV; f = 1 MHz

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



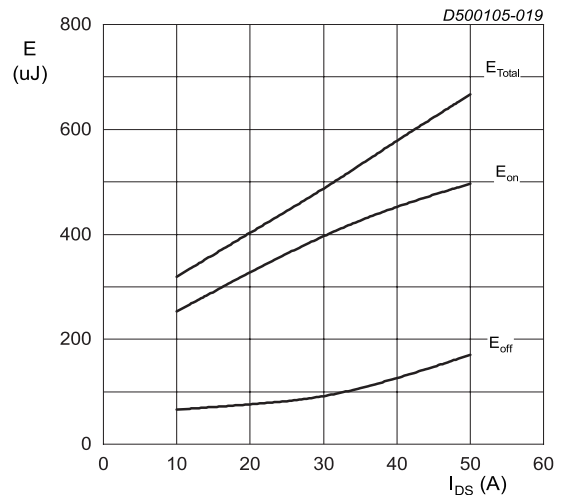
T_j = 25 °C; D = 0
 Parameter: t_p

Fig. 17. Forward bias safe operating area



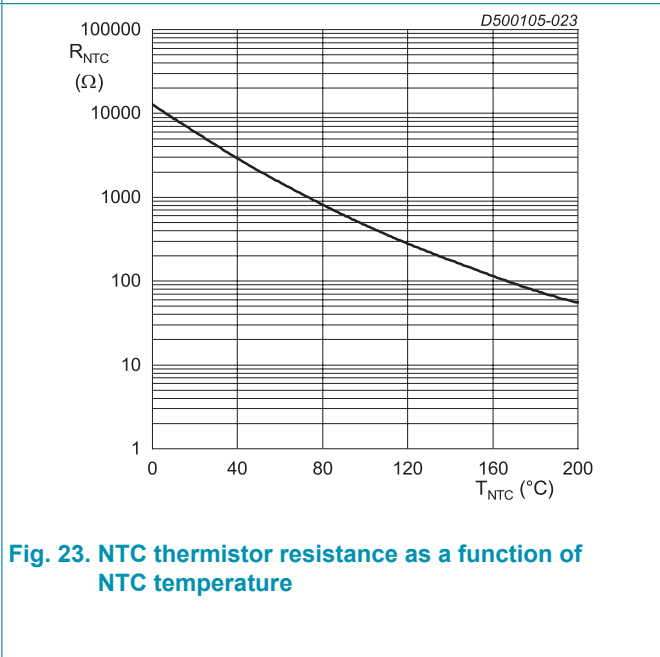
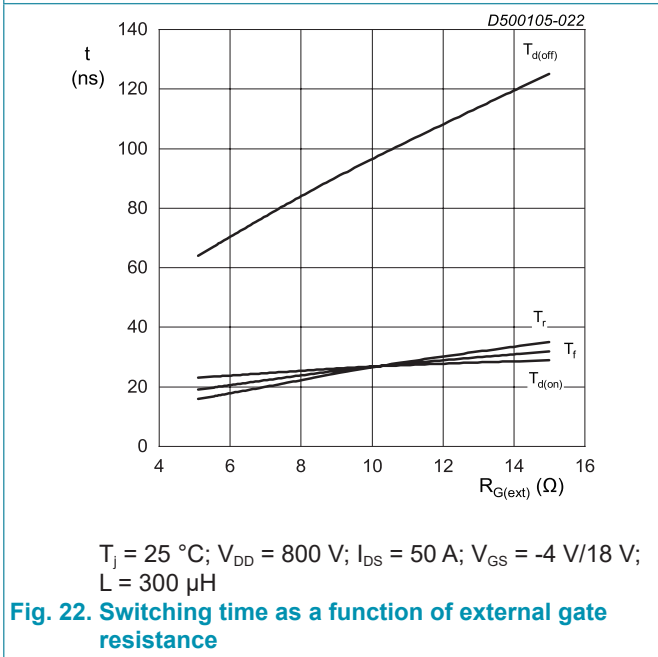
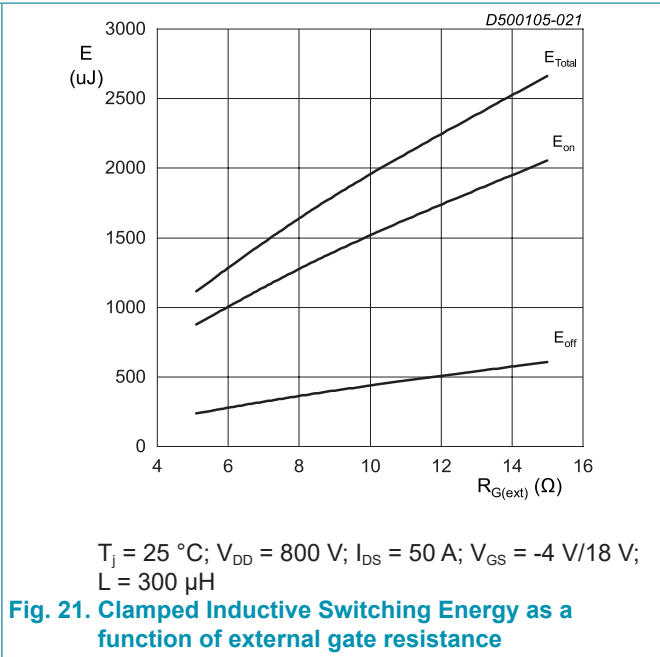
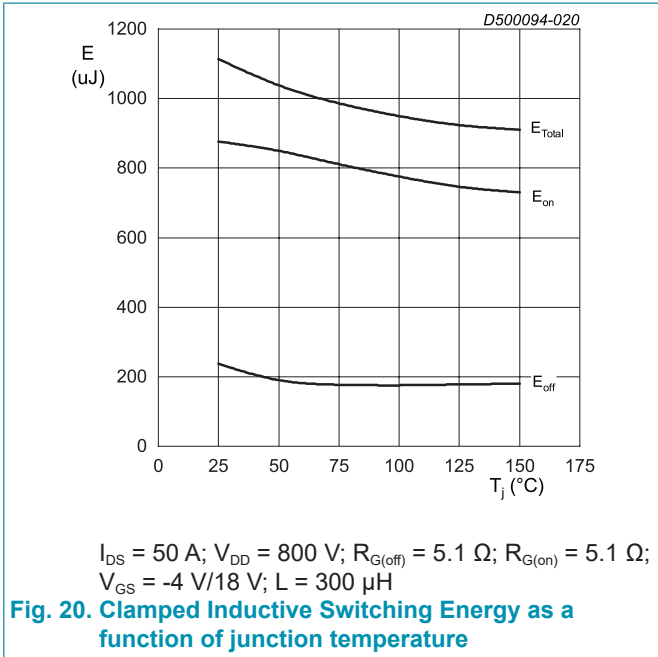
T_j = 25 °C; V_{DD} = 800 V; R_{G(off)} = 5.1 Ω; R_{G(on)} = 5.1 Ω;
 V_{GS} = -4 V/18 V; L = 300 µH

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

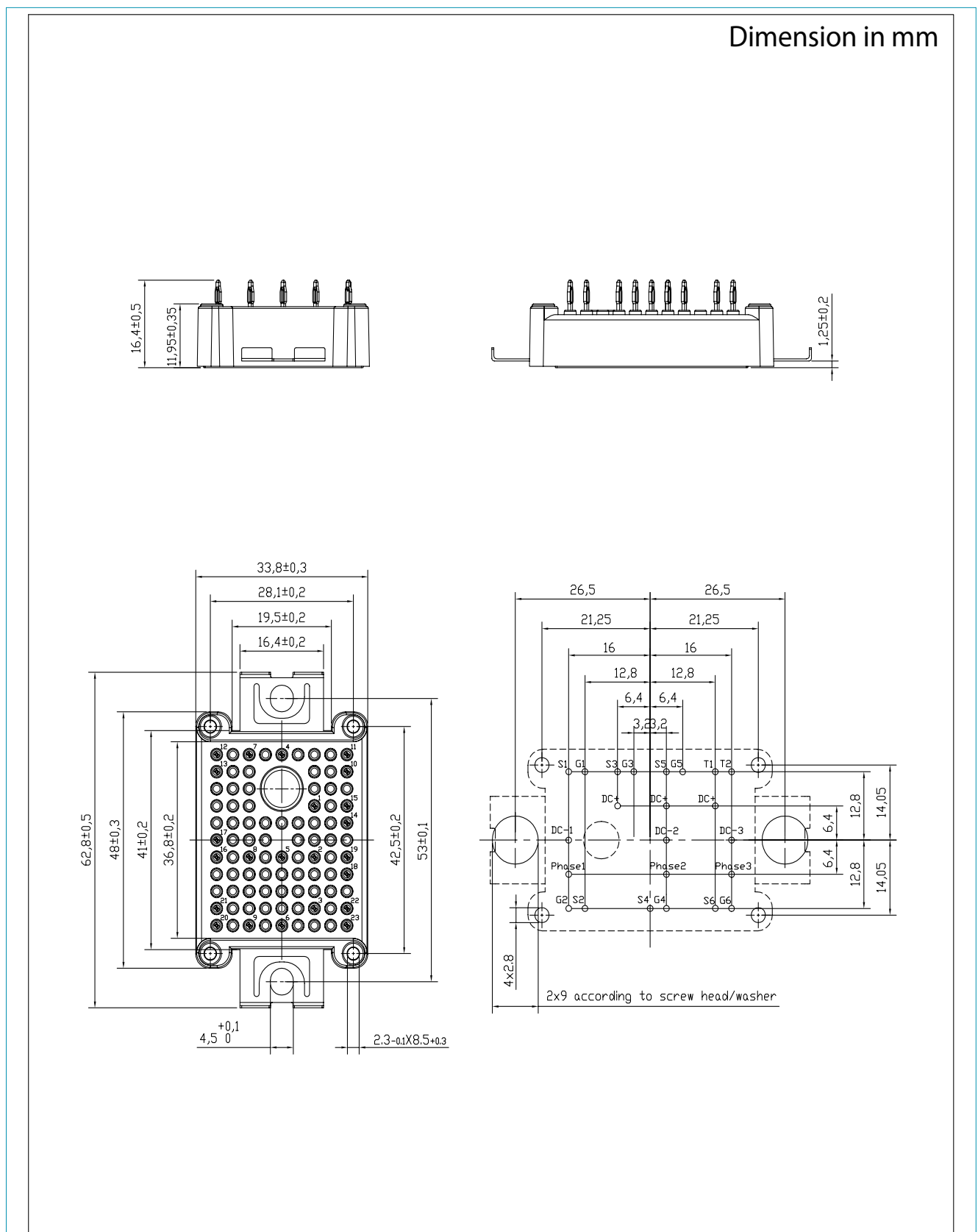


T_j = 25 °C; V_{DD} = 600 V; R_{G(off)} = 5.1 Ω; R_{G(on)} = 5.1 Ω;
 V_{GS} = -4 V/18 V; L = 300 µH

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



11. Package outline



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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