

## 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

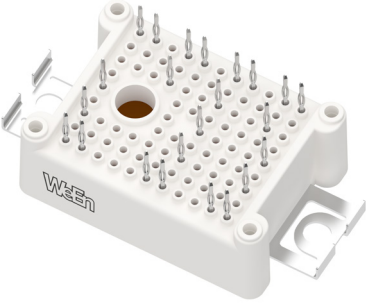
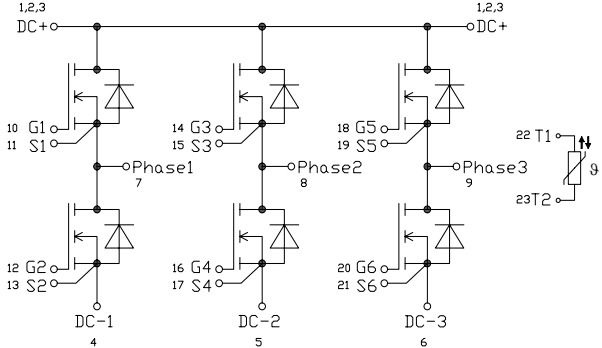
## 4. Quick reference data

Table 1. Quick reference data

Symbol	Parameter	Conditions	Notes	Values			Unit
<b>Absolute maximum rating</b>							
$V_{DS}$	drain-source voltage	$T_j = 25\text{ °C}$		1200			V
$I_D$	drain current	$V_{GS} = 18\text{ V}; T_h = 25\text{ °C}$		37			A
$P_{tot}$	total power dissipation	$T_h = 25\text{ °C}$		74			W
$T_{j,op}$	maximum junction temperature			-40 to 150			°C
Symbol	Parameter	Conditions	Notes	Min	Typ	Max	Unit
<b>Static characteristics</b>							
$R_{DS(on)}$	drain-source on-state resistance	$V_{GS} = 15\text{ V}; I_D = 33\text{ A}; T_j = 25\text{ °C}$		-	40	-	mΩ
		$V_{GS} = 18\text{ V}; I_D = 33\text{ A}; T_j = 25\text{ °C}$		-	33	45	mΩ
<b>Dynamic characteristics</b>							
$Q_{G(tot)}$	total gate charge	$I_D = 33\text{ A}; V_{DS} = 800\text{ V}; V_{GS} = -4\text{ V}/18\text{ V}; T_j = 25\text{ °C}$		-	116	-	nC
$Q_{GD}$	gate-drain charge			-	19	-	nC
<b>Source-drain diode</b>							
$Q_r$	recovered charge	$I_{SD} = 33\text{ A}; V_{GS} = -4\text{ V}/18\text{ V}; V_R = 600\text{ V}; di/dt = 2700\text{ A}/\mu\text{s}; R_{G(ext)} = 5.1\text{ }\Omega; T_j = 25\text{ °C}$		-	707	-	nC

## 5. Pinning information

Table 2. Pinning information

Simplified outline	Graphic symbol
 <p>* 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
WMSC040S12B1P	WeEnPACK-B1	WMSC040S12B1P6T	Tray	24	WeEnPACK-B1PSB-B	13-Jun-2024

## 7. Marking

Table 4. Marking codes

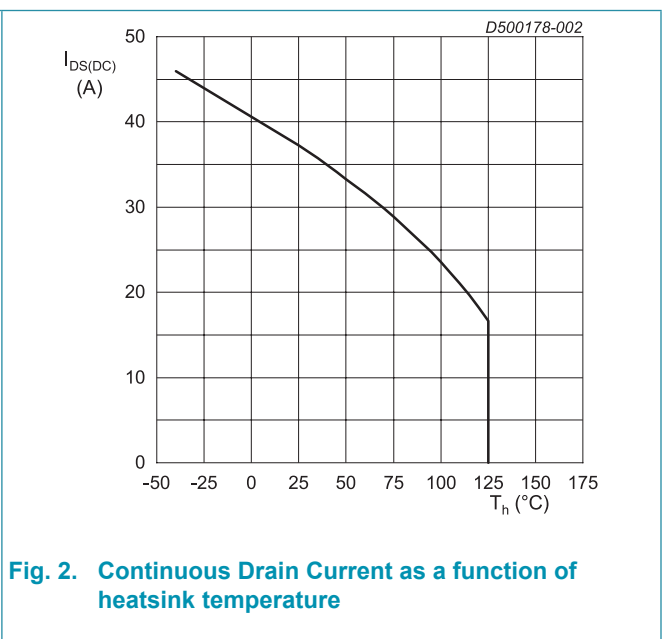
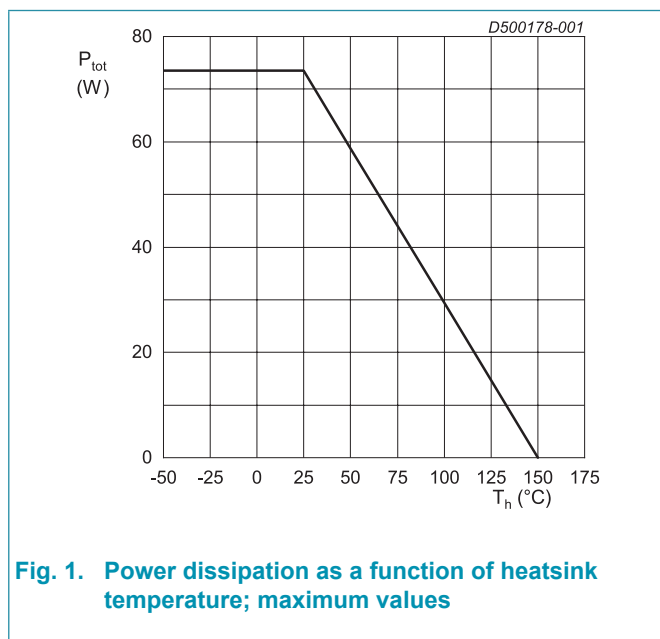
Type number	Marking codes
WMSC040S12B1P	WMSC040S12B1P

## 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
<b>MOSFET</b>					
$V_{DS}$	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	$T_h = 25\text{ °C}$		74	W
$I_D$	drain current	$V_{GS} = 18\text{ V}$ ; $T_h = 25\text{ °C}$		37	A
		$V_{GS} = 18\text{ V}$ ; $T_h = 100\text{ °C}$		23	A
$I_{DM}$	peak drain current	pulse width $t_p$ limited by $T_{j,max}$		74	A
$E_{as}$	single pulse drain-to-source avalanche	$I_{AS} = 24\text{ A}$ ; $L = 1\text{ mH}$ ; $V_{DD} = 100\text{ V}$ ; $T_{j(init)} = 25\text{ °C}$ ; per MOSFET		288	mJ
<b>Body Diode</b>					
$I_{SD}$	DC body diode forward current	$V_{GS} = -4\text{ V}$ ; $T_h = 25\text{ °C}$		15	A
$I_{SD,pulse}$	Pulse body diode current	verified by design, $t_p$ limited by $T_{j,max}$		74	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		-	0.7	-	K/W
$R_{th(j-h)}$	thermal resistance from junction to heatsink	per MOSFET, $\lambda_{grease} = 1 \text{ W/(m}\cdot\text{K)}$ , $thick_{grease} = 50 \text{ }\mu\text{m}$		-	1.7	-	K/W
<b>Internal Isolation</b>		basic insulation (class 1, IEC 61140)		Al <sub>2</sub> O <sub>3</sub>			
$d_{Creep}$	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.

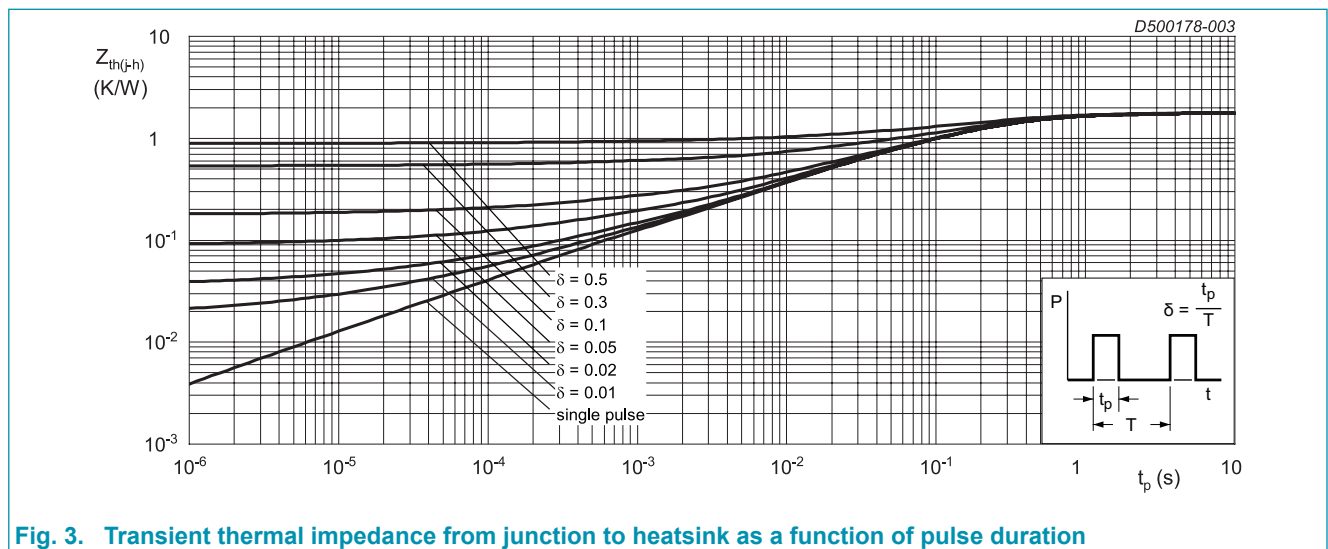


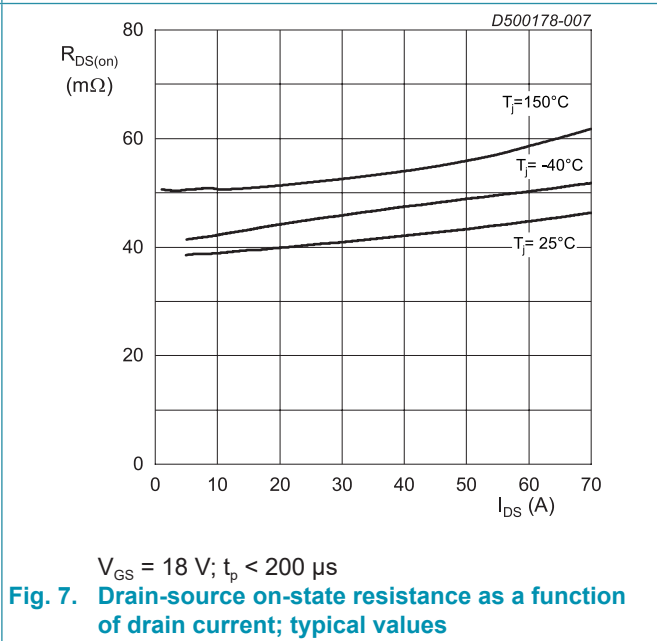
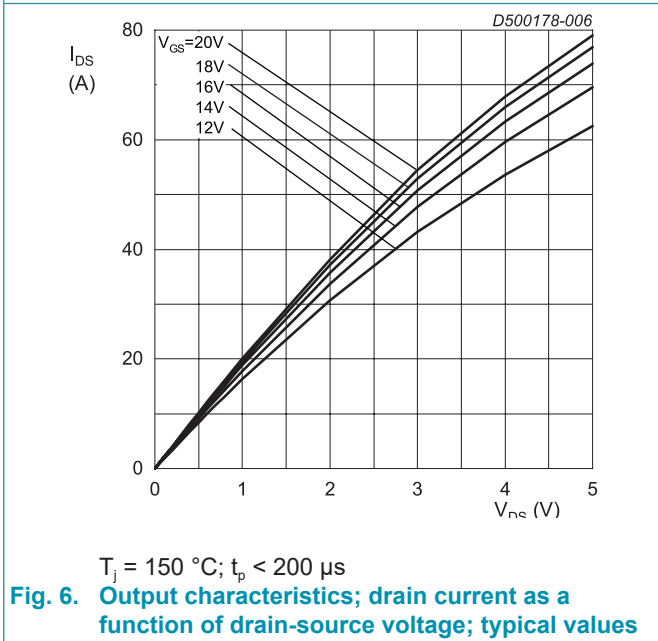
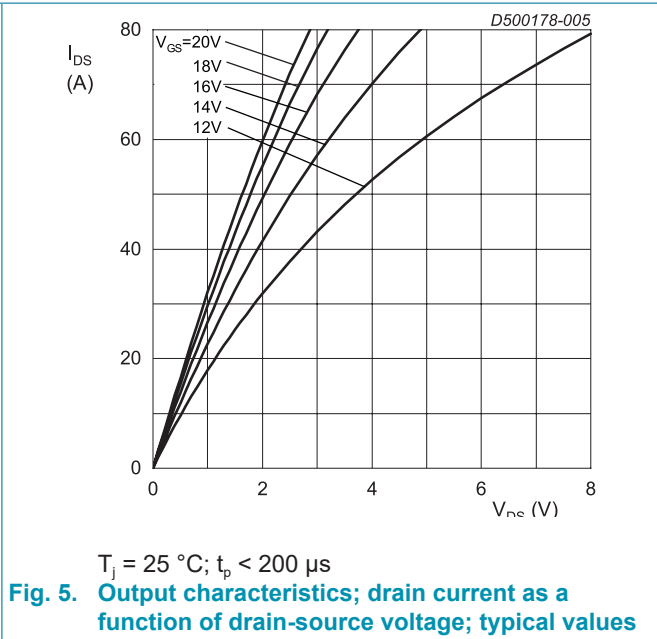
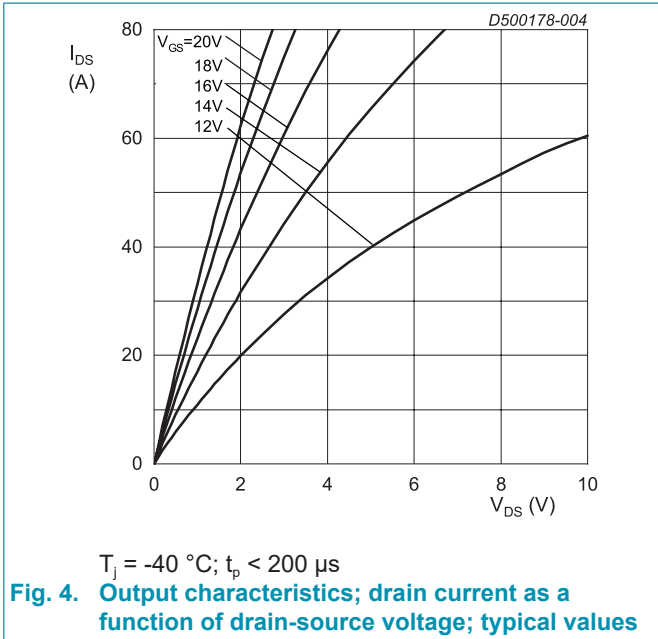
Fig. 3. Transient thermal impedance from junction to heatsink as a function of pulse duration

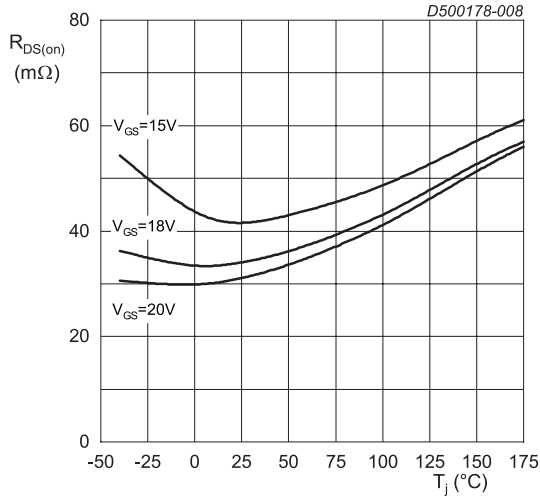
## 10. Characteristics

Table 7. Characteristics

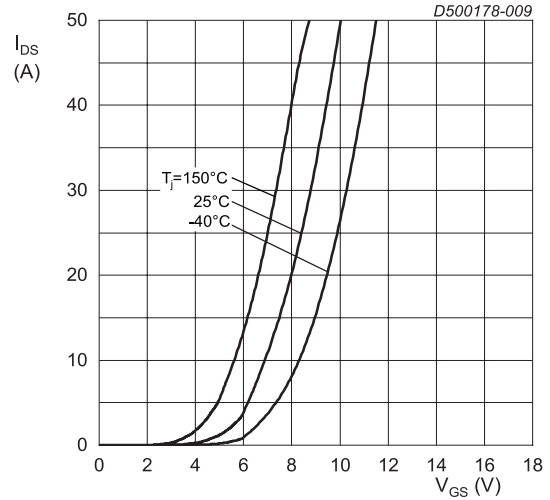
MOSFET							
Symbol	Parameter	Conditions	Notes	Min	Typ	Max	Unit
<b>Static characteristics</b>							
$V_{(BR)DSS}$	drain-source breakdown voltage	$I_D = 100 \mu A; V_{GS} = 0 V; T_j = 25 \text{ }^\circ C$		1200	-	-	V
$V_{GS(th)}$	gate-source threshold voltage	$I_D = 10 \text{ mA}; V_{DS} = V_{GS}; T_j = 25 \text{ }^\circ C$		1.9	2.5	3.5	V
		$I_D = 10 \text{ mA}; V_{DS} = V_{GS}; T_j = 175 \text{ }^\circ C$		-	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	$\mu A$
$I_{GSS}$	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	$V_{GS} = 15 \text{ V}; I_D = 33 \text{ A}; T_j = 25 \text{ }^\circ C$		-	40	-	m $\Omega$
		$V_{GS} = 18 \text{ V}; I_D = 33 \text{ A}; T_j = 25 \text{ }^\circ C$		-	33	45	m $\Omega$
		$V_{GS} = 18 \text{ V}; I_D = 33 \text{ A}; T_j = 125 \text{ }^\circ C$		-	45	-	m $\Omega$
		$V_{GS} = 18 \text{ V}; I_D = 33 \text{ A}; T_j = 150 \text{ }^\circ C$		-	53	-	m $\Omega$
		$V_{GS} = 18 \text{ V}; I_D = 33 \text{ A}; T_j = 175 \text{ }^\circ C$		-	55.7	-	m $\Omega$
$R_G$	gate resistance	$f = 1 \text{ MHz}; T_j = 25 \text{ }^\circ C; \text{ per MOSFET}$		-	0.8	-	$\Omega$
$g_{fs}$	transconductance	$V_{DS} = 20 \text{ V}; I_D = 33 \text{ A}; T_j = 25 \text{ }^\circ C$		-	27	-	S
<b>Dynamic characteristics</b>							
$Q_{G(tot)}$	total gate charge	$I_D = 33 \text{ A}; V_{DS} = 800 \text{ V}; V_{GS} = -4 \text{ V}/18 \text{ V}; T_j = 25 \text{ }^\circ C$		-	116	-	nC
$Q_{GS}$	gate-source charge			-	42	-	nC
$Q_{GD}$	gate-drain charge			-	19	-	nC
$C_{iss}$	input capacitance	$V_{DS} = 1000 \text{ V}; V_{GS} = 0 \text{ V}; f = 1 \text{ MHz}; T_j = 25 \text{ }^\circ C$		-	2450	-	pF
$C_{oss}$	output capacitance			-	108	-	pF
$C_{riss}$	reverse transfer capacitance			-	11	-	pF
$E_{oss}$	Coss stored energy			-	54	-	$\mu J$
$t_{d(on)}$	turn-on delay time		$V_{DS} = 800 \text{ V}; V_{GS} = -4 \text{ V}/18 \text{ V}; R_{G(off)} = 5.1 \text{ } \Omega; R_{G(on)} = 5.1 \text{ } \Omega; I_D = 33 \text{ A}; L = 300 \text{ } \mu H; T_j = 25 \text{ }^\circ C$		-	17	-
$t_r$	rise time			-	10	-	ns
$t_{d(off)}$	turn-off delay time			-	42	-	ns
$t_f$	fall time			-	14	-	ns
$E_{on}$	turn-on energy			-	492	-	$\mu J$
$E_{off}$	turn-off energy			-	124	-	$\mu J$

Body diode							
Symbol	Parameter	Conditions	Notes	Min	Typ	Max	Unit
<b>Static characteristics</b>							
V <sub>SD</sub>	source-drain voltage	V <sub>GS</sub> = -4 V; I <sub>SD</sub> = 33 A; T <sub>j</sub> = 25 °C		-	5.5	-	V
		V <sub>GS</sub> = -4 V; I <sub>SD</sub> = 33 A; T <sub>j</sub> = 150 °C		-	5.0	-	V
<b>Dynamic characteristics</b>							
I <sub>rrm</sub>	reverse recovery current	I <sub>SD</sub> = 33 A; V <sub>GS</sub> = -4 V/18 V; V <sub>R</sub> = 600 V; di/dt = 2700 A/μs; R <sub>G(ext)</sub> = 5.1 Ω; T <sub>j</sub> = 25 °C		-	50	-	A
t <sub>rr</sub>	reverse recovery time			-	24	-	ns
Q <sub>r</sub>	recovered charge			-	707	-	nC
E <sub>rec</sub>	reverse recovery energy			-	91	-	μJ
I <sub>rrm</sub>	reverse recovery current	I <sub>SD</sub> = 33 A; V <sub>GS</sub> = -4 V/18 V; V <sub>R</sub> = 600 V; di/dt = 3600 A/μs; R <sub>G(ext)</sub> = 5.1 Ω; T <sub>j</sub> = 150 °C		-	66	-	A
t <sub>rr</sub>	reverse recovery time			-	25	-	ns
Q <sub>r</sub>	recovered charge			-	1032	-	nC
E <sub>rec</sub>	reverse recovery energy			-	138	-	μJ
<b>NTC thermistor</b>							
Symbol	Parameter	Conditions	Notes	Min	Typ	Max	Unit
R <sub>25</sub>	Rated resistance	T <sub>NTC</sub> = 25 °C		-	5000	-	Ω
R <sub>100</sub>		T <sub>NTC</sub> = 100 °C			493±5%		Ω
B <sub>25/50</sub>	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

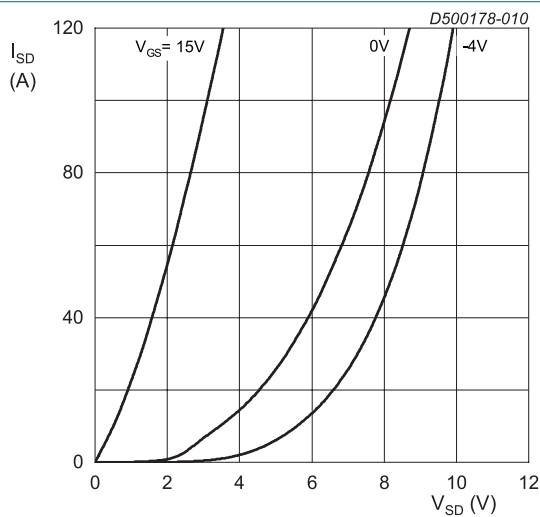




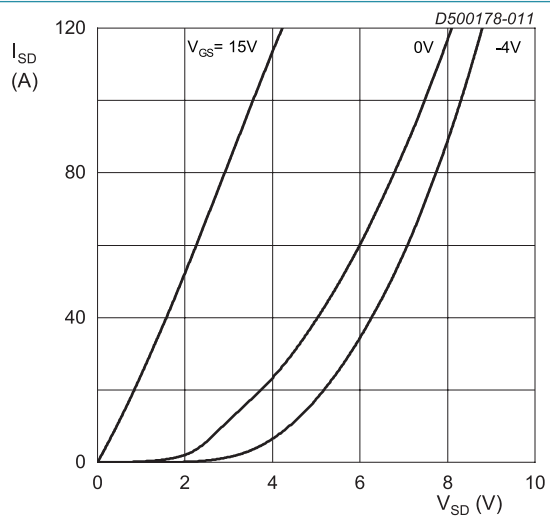
$I_{DS} = 33 A; t_p < 200 \mu s$   
**Fig. 8. Drain-source on-state resistance as a function of junction temperature**



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

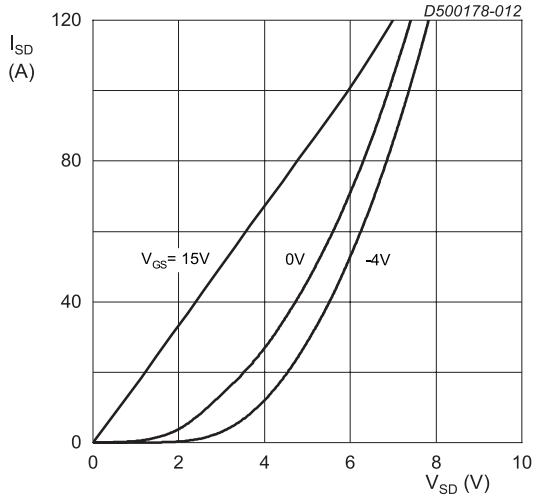


$T_j = -40^{\circ}C; t_p < 200 \mu s$   
**Fig. 10. Body diode forward characteristics; typical values**



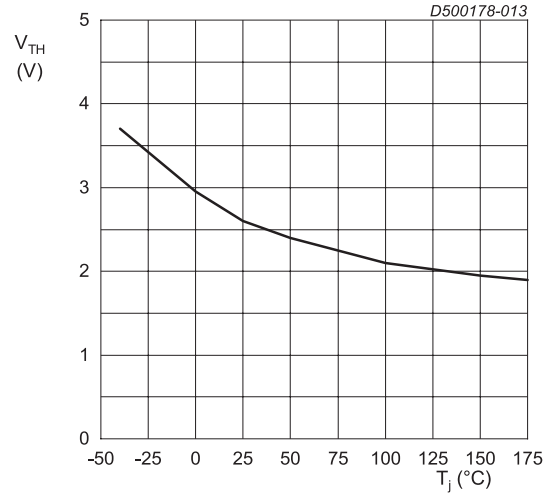
$T_j = 25^{\circ}C; t_p < 200 \mu s$   
**Fig. 11. Body diode forward characteristics; typical values**





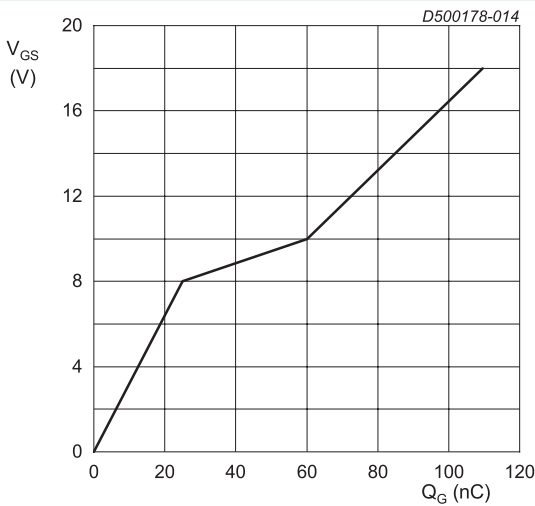
$T_j = 150\text{ }^\circ\text{C}$ ;  $t_p < 200\text{ }\mu\text{s}$

**Fig. 12. Body diode forward characteristics; typical values**



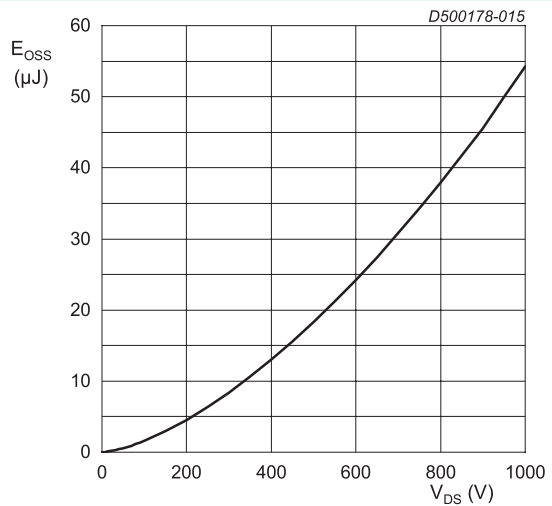
$V_{DS} = V_{GS}$ ;  $I_{DS} = 10\text{ mA}$

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

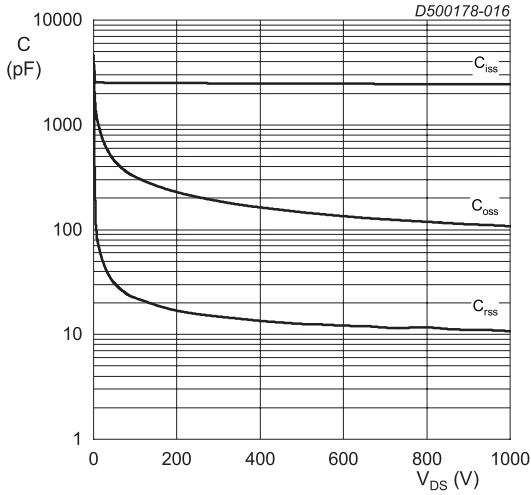


$I_{DS} = 33\text{ A}$ ;  $I_{GS} = 0.1\text{ mA}$ ;  $V_{DS} = 800\text{ V}$ ;  $T_j = 25\text{ }^\circ\text{C}$

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

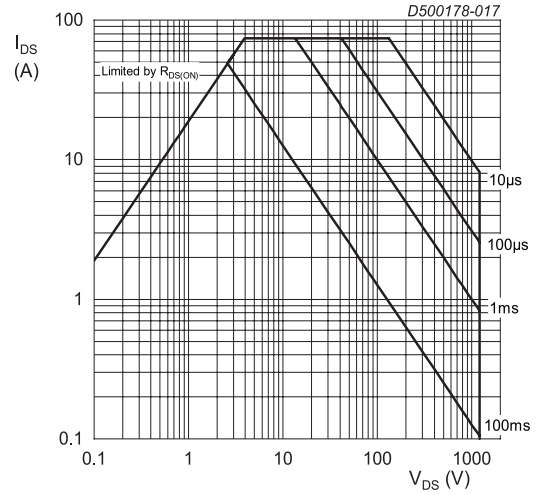


**Fig. 15. Output capacitor stored energy as a function of drain-source voltage**



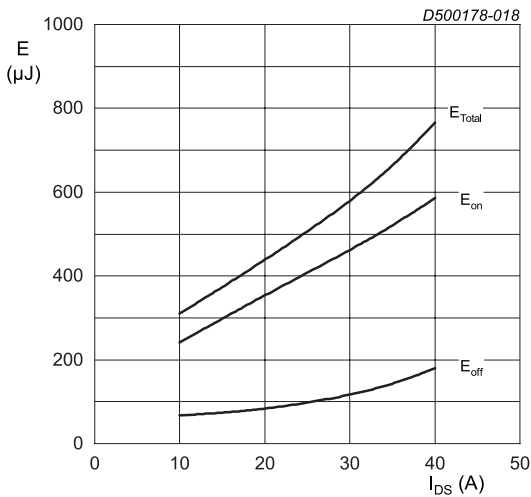
$V_{DS} = 0 - 1000\text{ V}$   
 $T_j = 25\text{ }^\circ\text{C}; V_{AC} = 25\text{ mV}; f = 1\text{ MHz}$

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



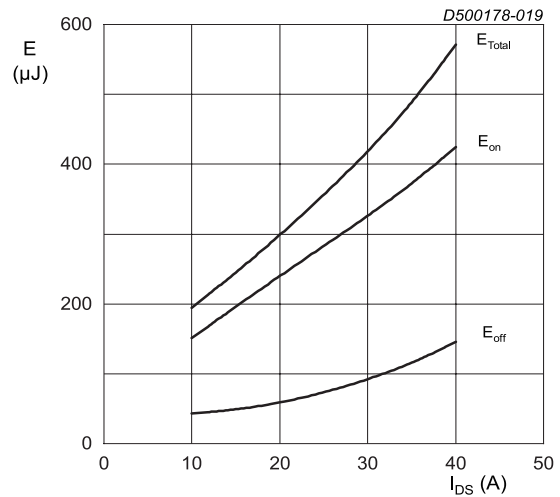
$T_j = 25\text{ }^\circ\text{C}; D = 0$   
 Parameter:  $t_p$

**Fig. 17. Forward bias safe operating area**



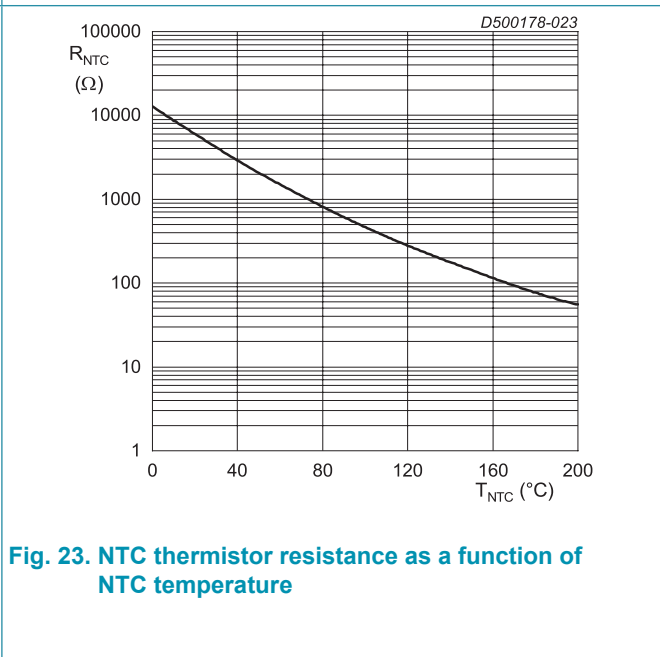
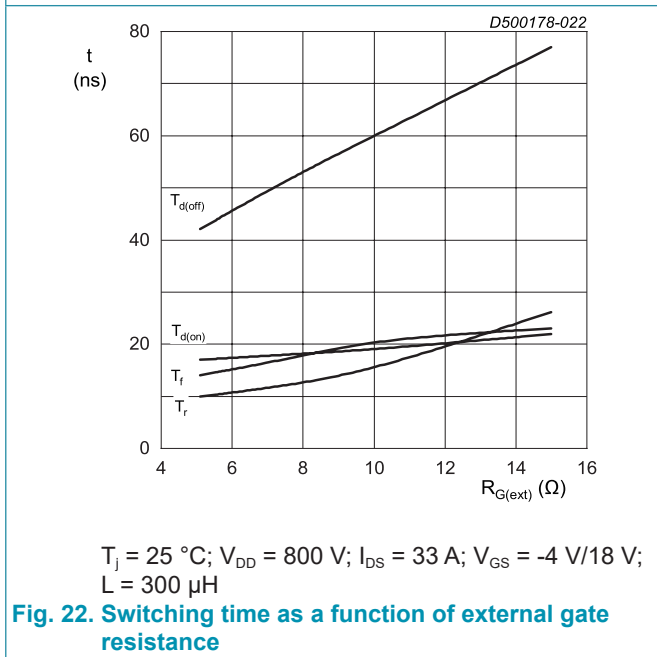
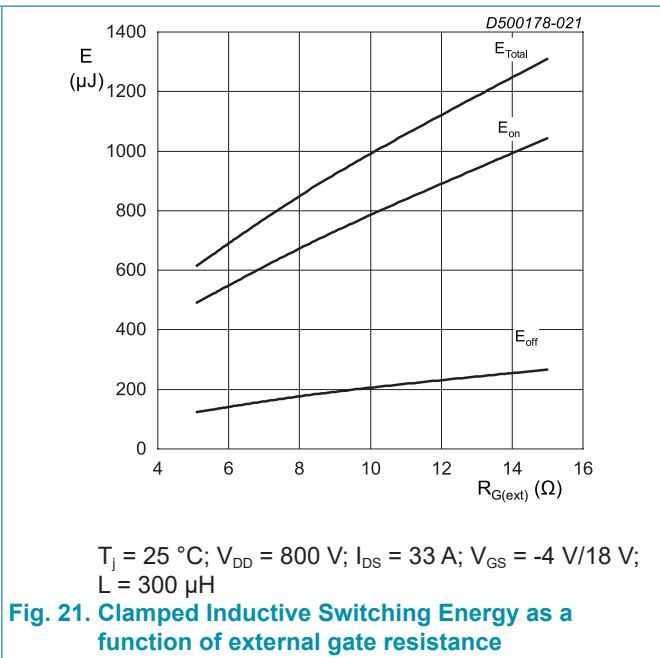
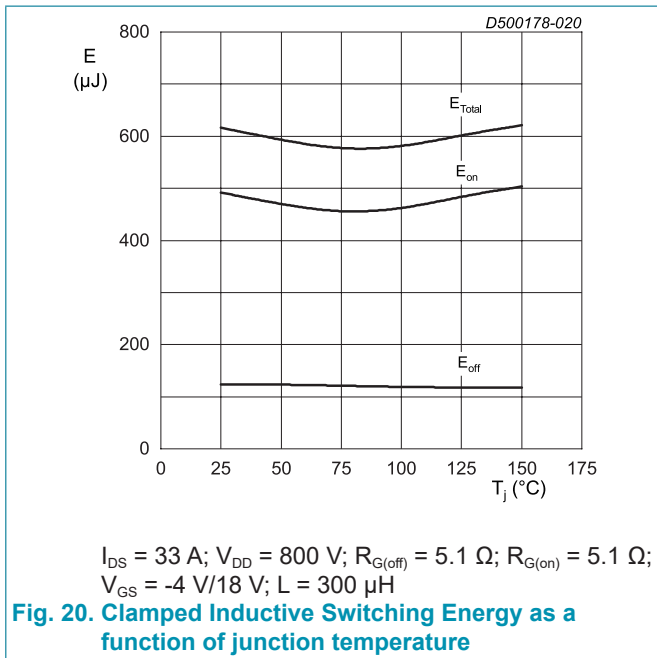
$T_j = 25\text{ }^\circ\text{C}; V_{DD} = 800\text{ V}; R_{G(off)} = 5.1\text{ }\Omega; R_{G(on)} = 5.1\text{ }\Omega;$   
 $V_{GS} = -4\text{ V}/18\text{ V}; L = 300\text{ }\mu\text{H}$

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

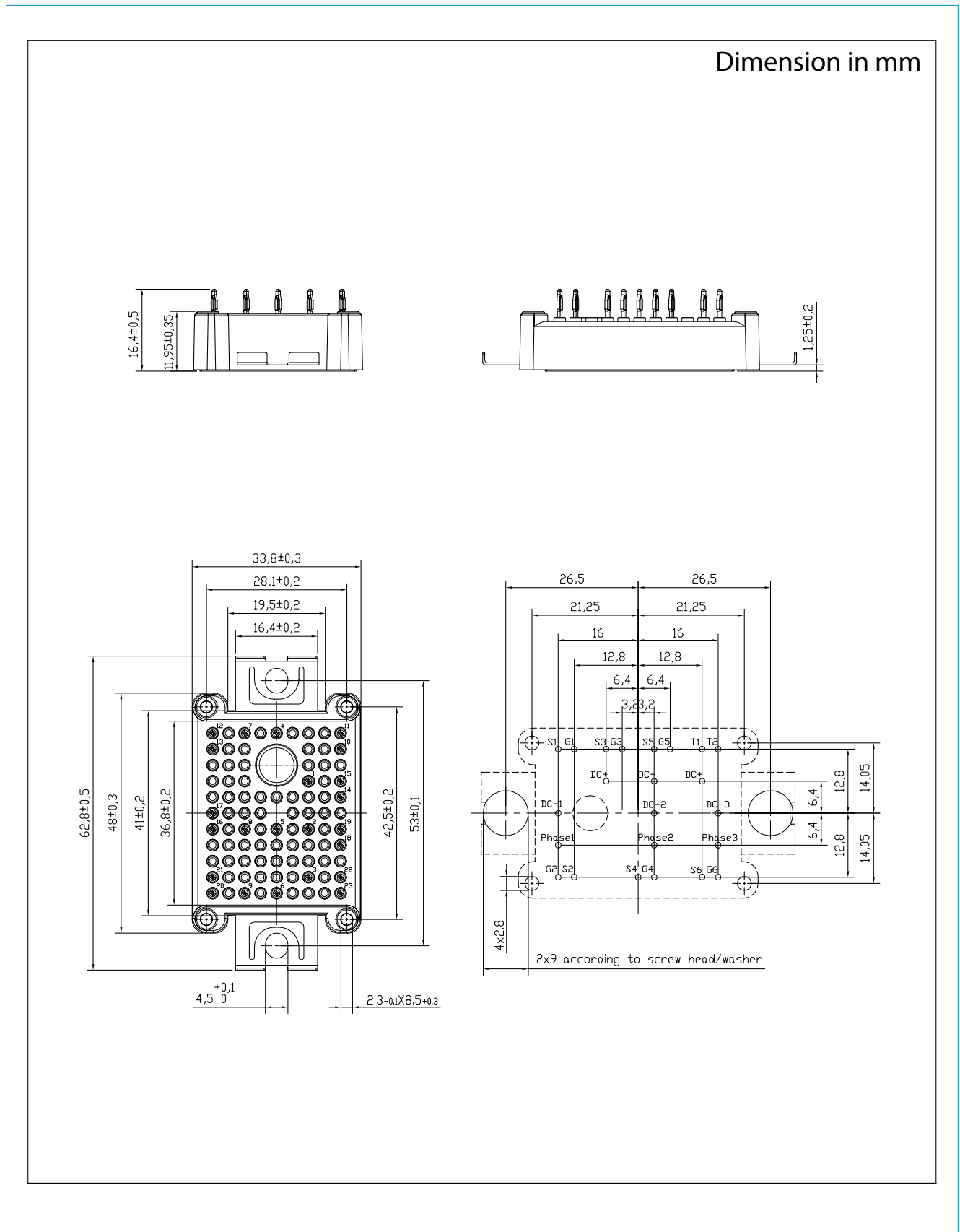


$T_j = 25\text{ }^\circ\text{C}; V_{DD} = 600\text{ V}; R_{G(off)} = 5.1\text{ }\Omega; R_{G(on)} = 5.1\text{ }\Omega;$   
 $V_{GS} = -4\text{ V}/18\text{ V}; L = 300\text{ }\mu\text{H}$

**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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For more information, please visit: <http://www.ween-semi.com>  
For sales office addresses, please send an email to: [salesaddresses@ween-semi.com](mailto:salesaddresses@ween-semi.com)  
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