# WMSC040F12B1P

## N-Channel Silicon Carbide MOSFET Module

Rev.02 - 01 March 2025 Product data sheet

## 1. General description

WeEnPACK-B1 module with WeEn 1200V Gen2 SiC MOSFET and Pressfit type.
Integrated with NTC temperature sensor.

RoHS Halogen-Free Lead-Free

## 2. Features and benefits

- H Bridge topology
- Press-fit pin type
- Low $R_{DSon}$
- Low Switching Losses
- Low $Q_g$ and $C_{rss}$
- Low Inductive Design

## 3. Applications

- Power inverters
- AC-DC converters
- Active power factor correctors
- Motor drives

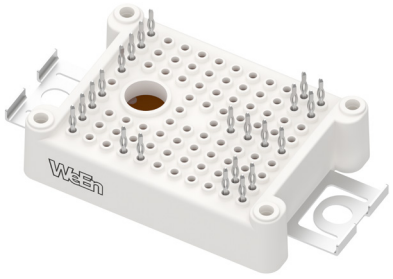
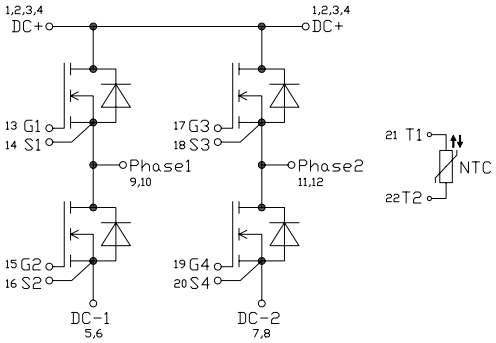
## 4. Quick reference data

**Table 1. Quick reference data**

| Symbol | Parameter | Conditions | Notes | Values | | | Unit |
|---|---|---|---|---|---|---|---|
| **Absolute maximum rating** | | | | | | | |
| $V_{DS}$ | drain-source voltage | $T_j$ = 25 °C | | 1200 | | | V |
| $I_D$ | drain current | $V_{GS}$ = 18 V; $T_h$ = 25 °C | | 38 | | | A |
| $P_{tot}$ | total power dissipation | $T_h$ = 25 °C | | 74 | | | W |
| **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; $V_{GS}$ = -4 V/18 V; $V_R$ = 600 V; di/dt = 3400 A/µs; $R_{G(ext)}$ = 5.1 Ω; $T_j$ = 25 °C | | - | 465 | - | 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 |
|---|---|---|---|---|---|---|
| WMSC040F12B1P | WeEnPACK-B1 | WMSC040F12B1P6T | Tray | 24 | WeEnPACK-B1PFB-A | 28-Jun-2024 |

# 7. Marking

**Table 4. Marking codes**

| Type number | Marking codes |
|---|---|
| WMSC040F12B1P | WMSC040F12B1P |

# 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 | | 74 | W |
| $I_D$ | drain current | $V_{GS}$ = 18 V; $T_h$ = 25 °C | | 38 | A |
| | | $V_{GS}$ = 18 V; $T_h$ = 100 °C | | 24 | A |
| $I_{DM}$ | peak drain current | pulse width tp 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 | $T_h$ = 25 °C; $V_{GS}$ = -4 V | | 18 | A |
| $I_{SD,pulse}$ | Pulse body diode current | verified by design, tp limited by $T_{jmax}$ | | 80 | A |

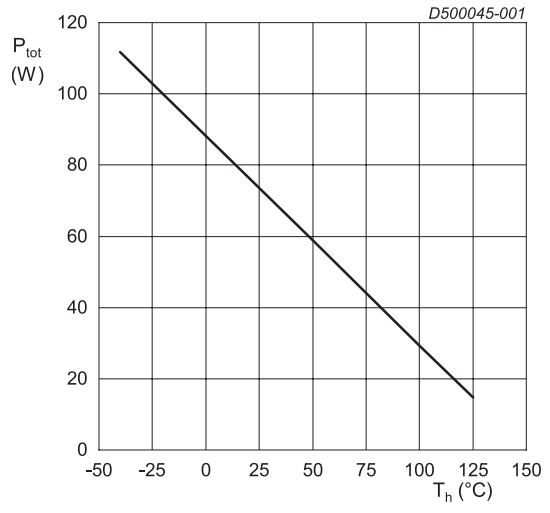



**Fig. 1. Power dissipation as a function of heatsink temperature; maximum values**

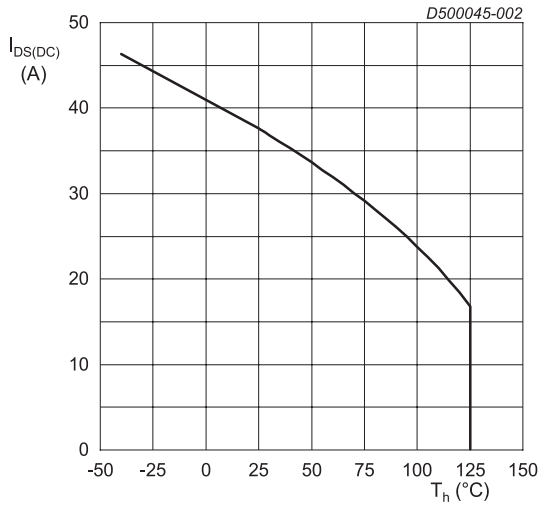



**Fig. 2. Continuous Drain Current as a function of heatsink temperature**

# 9. Thermal & Mechanical characteristics

**Table 6. Thermal & Mechanical 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, $\lambda_{grease}$ = 3 W/(m·K) $thick_{grease}$ = 50 um | | - | 1.7 | - | 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 recommanded.

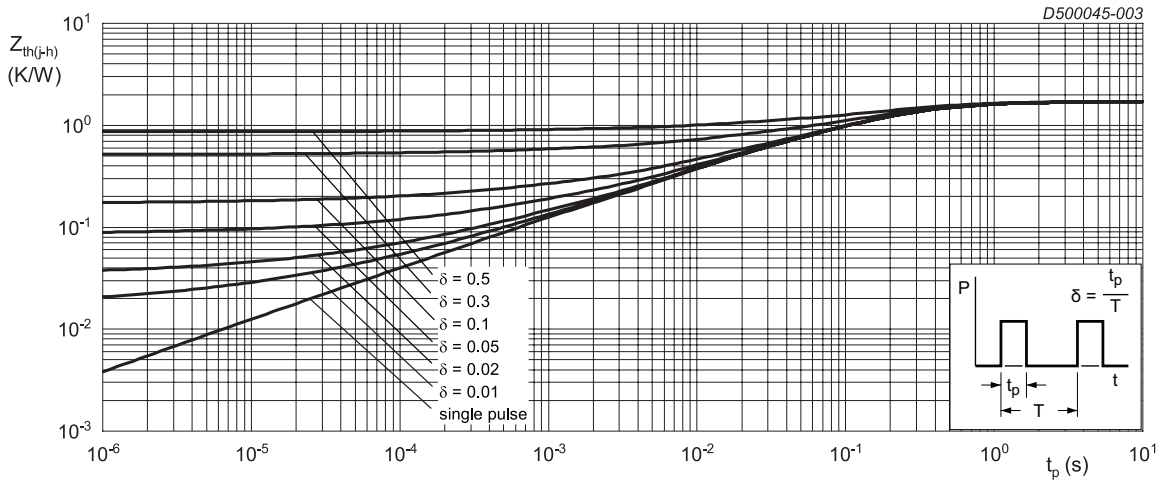


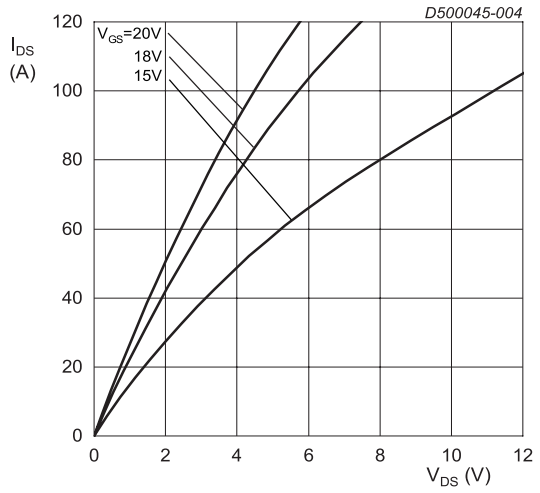

**Fig. 3. Transient thermal impedance from junction to heatsink as a function of pulse duration**

# 10. Characteristics

**Table 7. Characteristics**

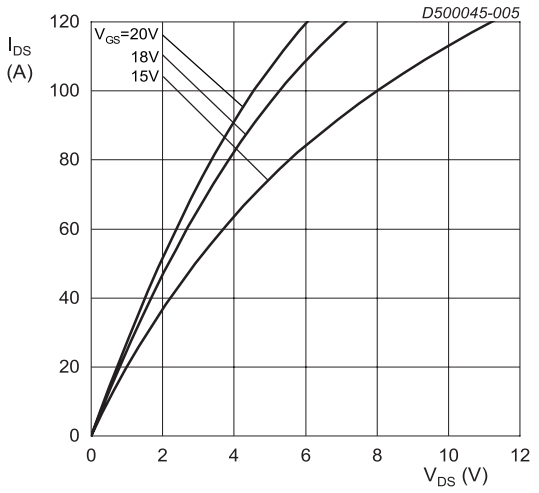
| MOSFET | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Symbol** | **Parameter** | **Conditions** | **Notes** | **Min** | **Typ** | **Max** | **Unit** |
| **Static characteristics** | | | | | | | |
| $V_{(BR)DSS}$ | drain-source breakdown voltage | $I_D$ = 100 µA; $V_{GS}$ = 0 V; $T_j$ = 25 °C | | 1200 | - | - | V |
| $V_{GS(th)}$ | gate-source threshold voltage | $I_D$ = 10 mA; $V_{DS}$ = $V_{GS}$; $T_j$ = 25 °C | | 1.9 | 2.6 | 3.5 | V |
| | | $I_D$ = 10 mA; $V_{DS}$ = $V_{GS}$; $T_j$ = 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 | | - | 46 | - | 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 | | - | 54 | - | mΩ |
| $R_G$ | gate resistance | f = 1 MHz; $T_j$ = 25 °C; per MOSFET | | - | 1 | - | 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 | | - | 2.45 | - | nF |
| $C_{oss}$ | 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; $R_{G(ext)}$ = 5.1 Ω; $I_D$ = 33 A; L = 300 µH; $T_j$ = 25 °C | | - | 27 | - | ns |
| $t_r$ | rise time | | | - | 30 | - | ns |
| $t_{d(off)}$ | turn-off delay time | | | - | 42 | - | ns |
| $t_f$ | fall time | | | - | 11 | - | ns |
| $E_{on}$ | turn-on energy | | | - | 612 | - | µJ |
| $E_{off}$ | turn-off energy | | | - | 90 | - | 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; $V_{GS}$ = -4 V/18 V; $V_R$ = 600 V; di/dt = 3400 A/µs; $R_{G(ext)}$ = 5.1 Ω; $T_j$ = 25 °C | | - | 44 | - | A |
| $t_{rr}$ | reverse recovery time | | | - | 19 | - | ns |
| $Q_r$ | recovered charge | | | - | 465 | - | nC |
| $E_{rec}$ | reverse recovery energy | | | - | 117 | - | 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 costant | | | - | 2 | - | mW/K |
| | Thermal time constant | | | - | ≤10 | - | s |



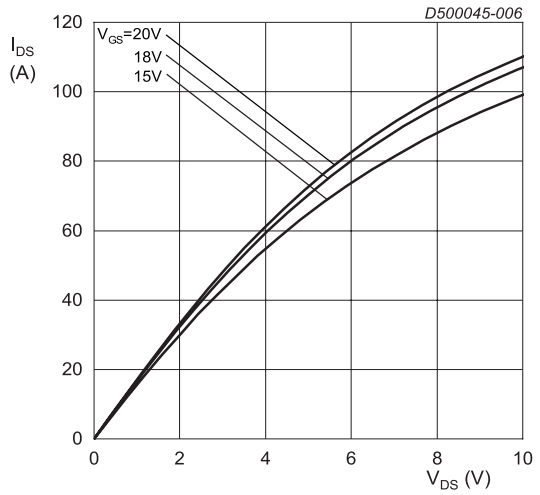

$T_j$ = -40 °C; $t_p$ < 200 µs

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



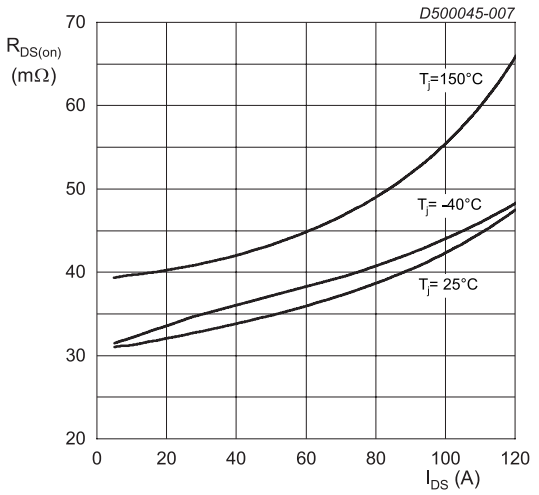

$T_j$ = 25 °C; $t_p$ < 200 µs

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



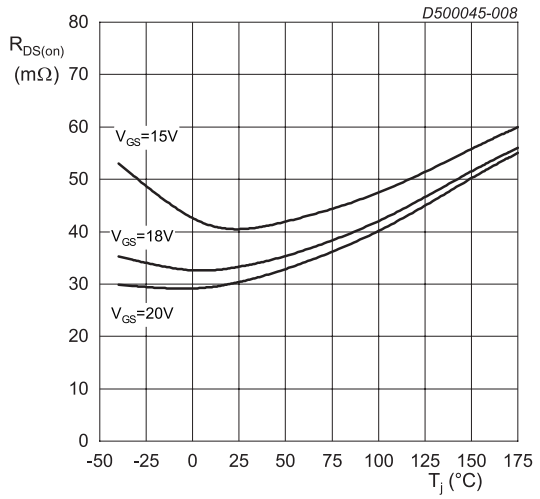

$T_j$ = 150 °C; $t_p$ < 200 µs

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



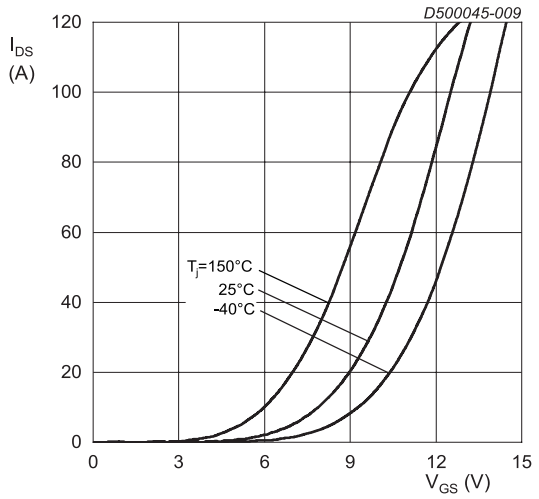

$V_{GS}$ = 18 V; $t_p$ < 200 µs

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



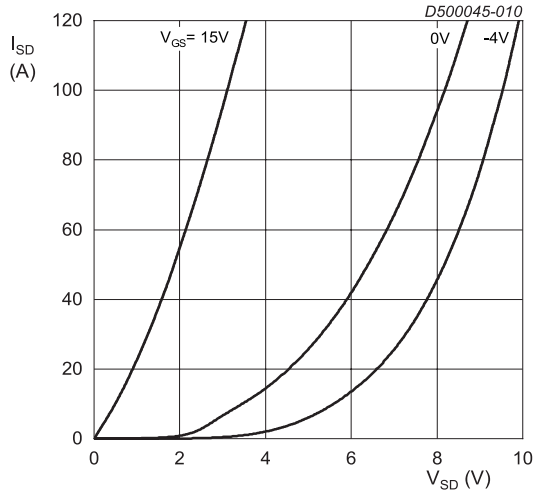

$I_{DS}$ = 33 A; $t_p$ < 200 µs

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



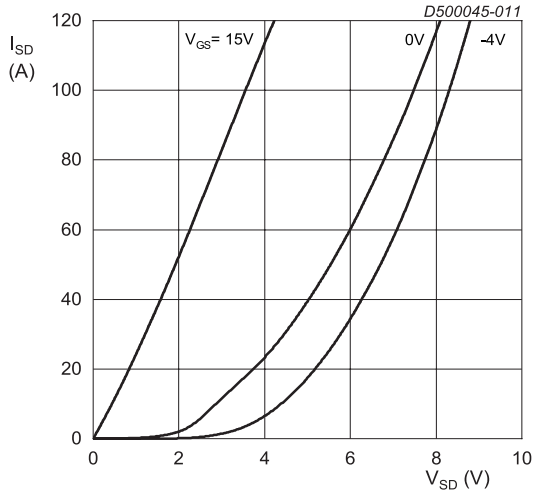

$V_{DS}$ = 20 V; $t_p$ < 200 µs

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



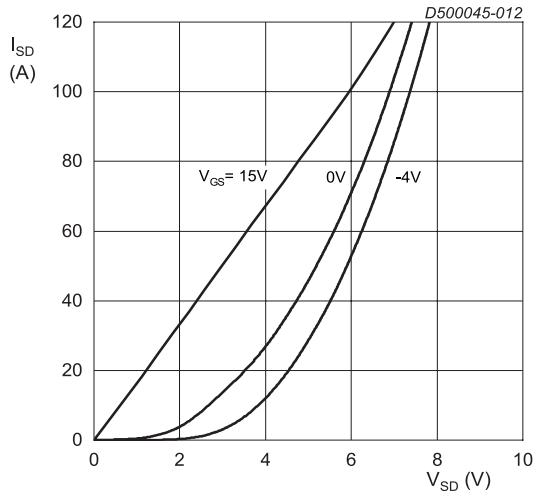

$T_j$ = -40 °C; $t_p$ < 200 µs

**Fig. 10. Body diode forward characteristics; typical values**



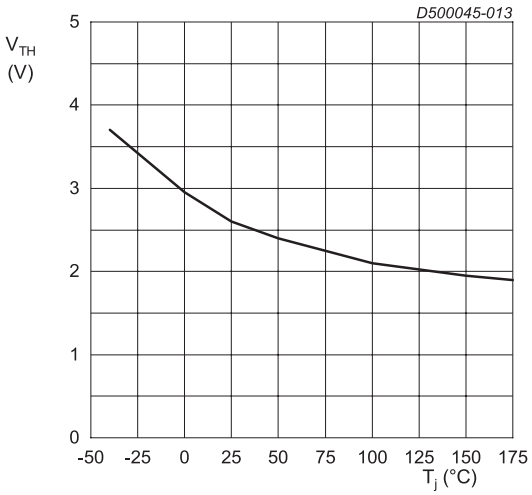

$T_j$ = 25 °C; $t_p$ < 200 µs

**Fig. 11. Body diode forward characteristics; typical values**



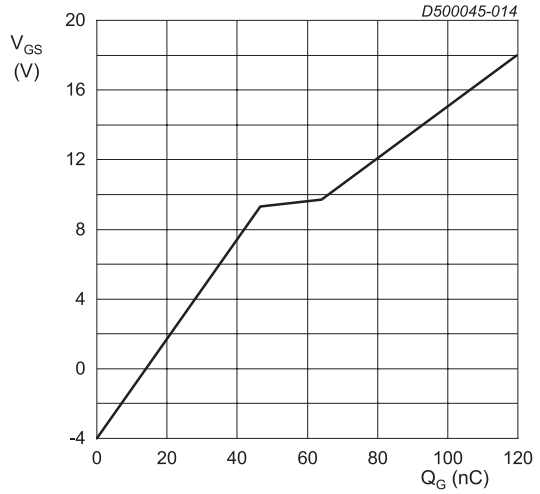

$T_j$ = 150 °C; $t_p$ < 200 µs

**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**

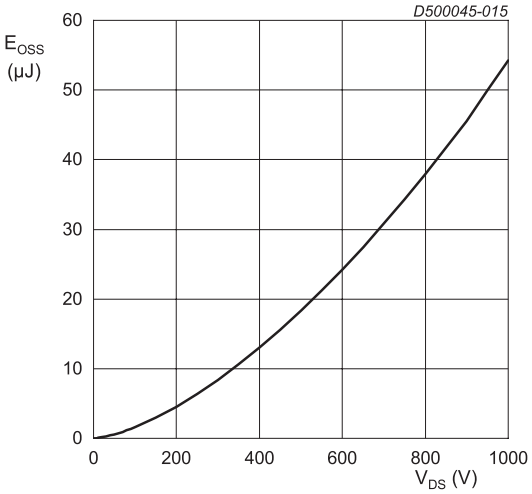
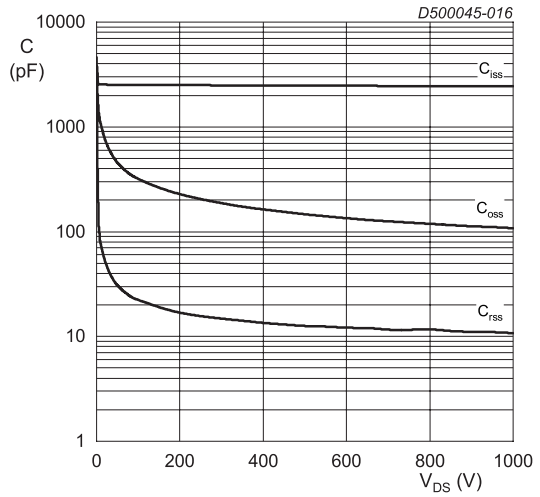
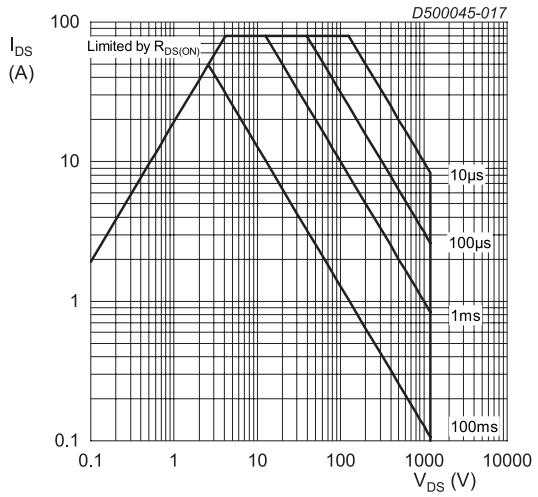



**Fig. 15. Output capacitor stored energy as a function of drain-source voltage**



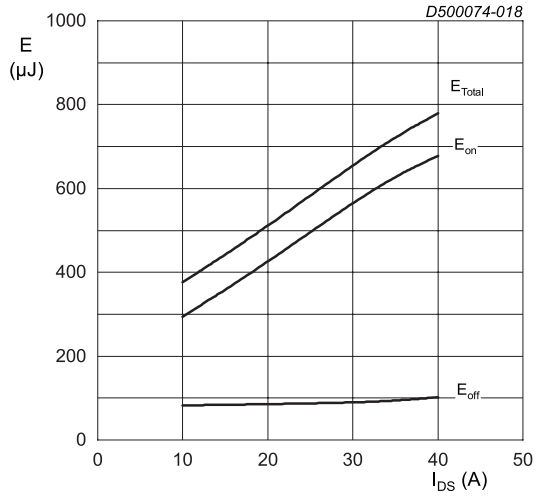

$V_{DS}$ = 0 - 1000 V
$T_j$ = 25 °C; $V_{AC}$ = 25 mV; f = 100 KHz

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



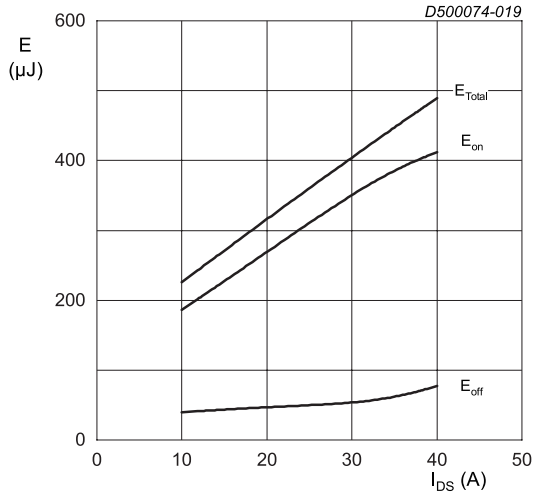

$T_j$ = 25 °C; D = 0
Parameter: $t_p$

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



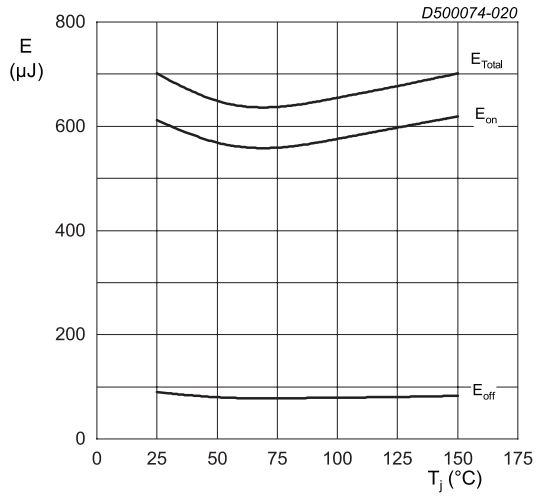

$T_j$ = 25 °C; $V_{DD}$ = 800 V; $R_{G(ext)}$ = 5.1 Ω; $R_{G(on)}$ = 5.1 Ω; $V_{GS}$ = -4 V/18 V; L = 300 µH

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



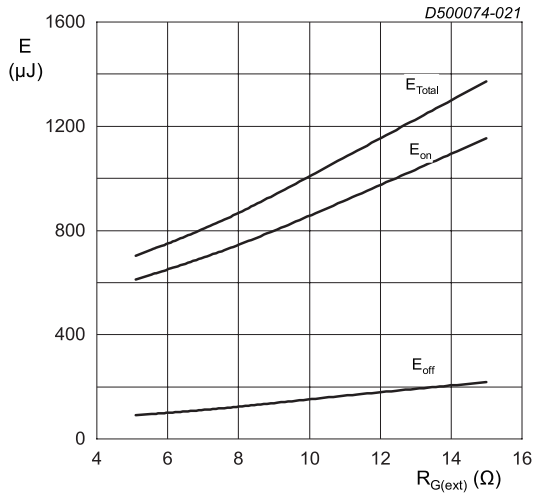

$T_j$ = 25 °C; $V_{DD}$ = 600 V; $R_{G(off)}$ = 5.1 Ω; $R_{G(on)}$ = 5.1 Ω; $V_{GS}$ = -4 V/18 V; L = 300 µH

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



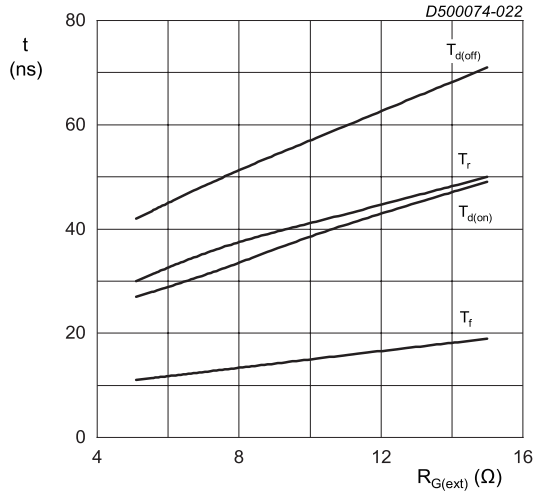

$I_{DS}$ = 33 A; $V_{DD}$ = 800 V; $R_{G(off)}$ = 5.1 Ω; $R_{G(on)}$ = 5.1 Ω; $V_{GS}$ = -4 V/18 V; L = 300 μH

**Fig. 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 = 300 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 = 300 μH

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

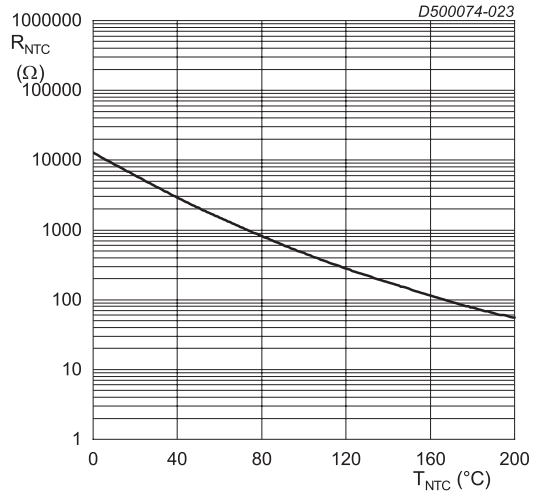
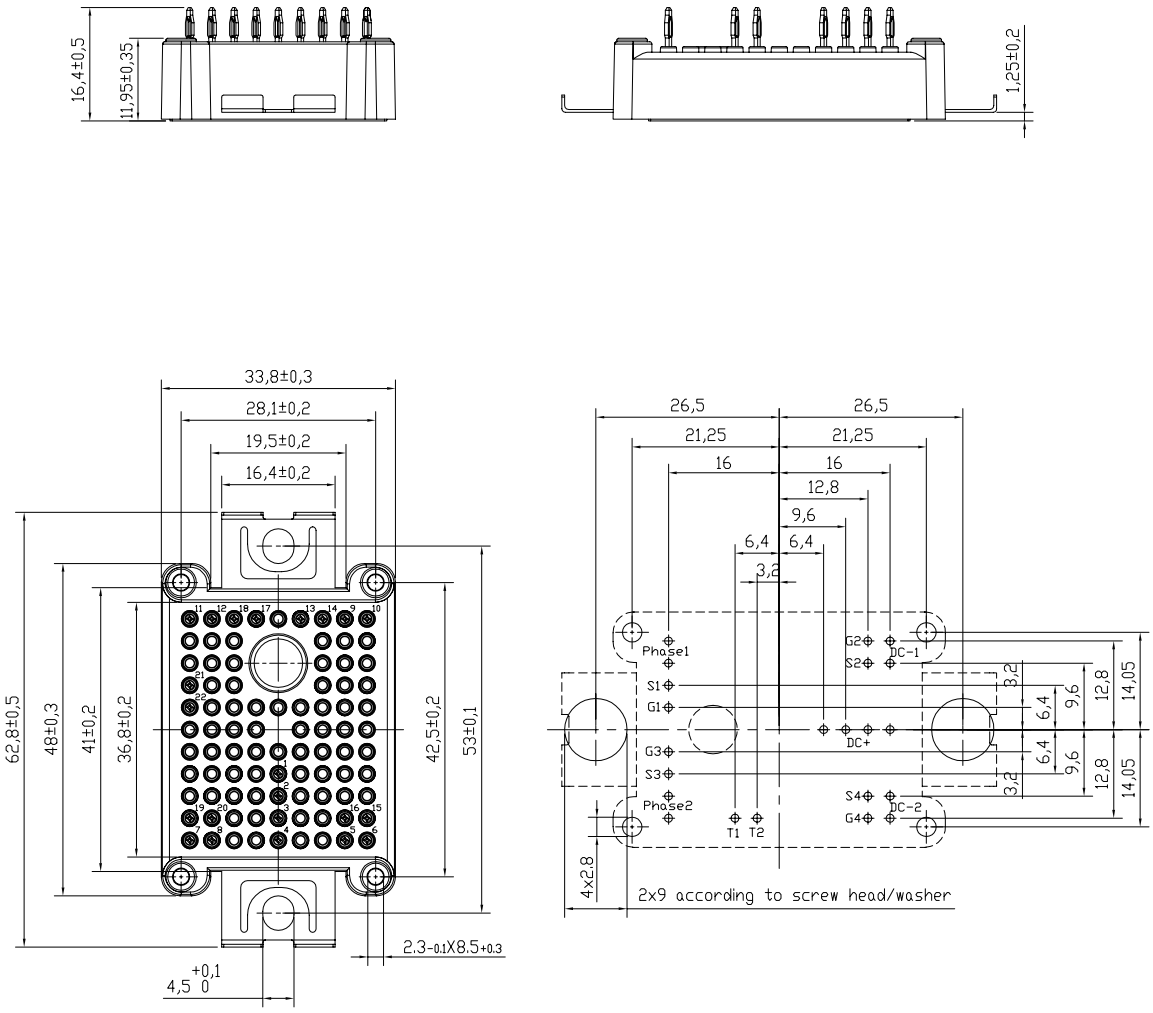



**Fig. 23. NTC thermistor resistance as a function of NTC temperature**

## 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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For more information, please visit: http://www.ween-semi.com
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