WNSC2M40120TB

N-Channel Silicon Carbide MOSFET

Rev.02 - 18 March 2025 Product data sheet

1. General description

Silicon Carbide MOSFET in a TSPAK plastic package with top side cooling structure, designed for high frequency, high efficiency systems.

2. Features and benefits

- Top side cooling structure
- Kelvin source configuration
- Low specific on-resistance
- Optimized dynamic performance
- Robust gate design
- 0V turn-off V_{GS} for simple gate driver
- 100% UIS Tested
- Easy to parallel
- RoHS compliant

3. Applications

- Switching mode power supplies
- UPS and energy storage systems
- Battery formation instrument
- PV MPPT and inverters
- EV Chargers
- Welding machines
- Motor Drives

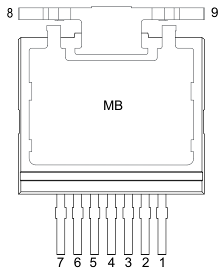
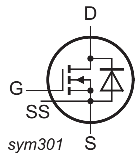
4. Quick reference data

Table 1. Quick reference data

Symbol	Parameter	Conditions	Notes	Values			Unit
Absolute maximum rating							
V_{DS}	drain-source voltage	25 °C ≤ T_j ≤ 175 °C		1200			V
I_D	drain current	V_{GS} = 18 V; T_{mb} = 25 °C		77			A
P_{tot}	total power dissipation	T_{mb} = 25 °C, T_j = 175 °C		393			W
T_j	junction temperature			-55 to 175			°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; di/dt = 500 A/μs; V_{DS} = 400 V; T_j = 25 °C		-	174	-	nC

5. Pinning information

Table 2. Pinning information

<table>
<tr><th>Pin</th><th>Symbol</th><th>Description</th><th>Simplified outline</th><th>Graphic symbol</th></tr>
<tr><td>1</td><td>G</td><td>gate</td><td rowspan="4">
</td><td rowspan="4">
</td></tr>
<tr><td>2</td><td>SS</td><td>source sense</td></tr>
<tr><td>3-7</td><td>S</td><td>source</td></tr>
<tr><td>8-9
mb</td><td>D</td><td>mounting base; connected to drain</td></tr>
</table>

6. Ordering information

Table 3. Ordering information

Type number	Package Name	Orderable part number	Packing method	Small packing quantity	Package version	Package issue date
WNSC2M40120TB	TSPAK	WNSC2M40120TB6J	Reel	600	TSPAKH	06-Dec-2024

7. Marking

Table 4. Marking codes

Type number	Marking codes
WNSC2M40120TB	WNSC2M 40120TB

8. Limiting values

Table 5. Limiting values

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

Symbol	Parameter	Conditions	Notes	Values	Unit
V_{DS}	drain-source voltage	25 °C ≤ T_j ≤ 175 °C		1200	V
$V_{GS,max}$	gate-source voltage			-12 to 24	V
$V_{GS,op}$	gate-source voltage			-4 to 18	V
P_{tot}	total power dissipation	T_{mb} = 25 °C, T_j = 175 °C		393	W
I_D	drain current	V_{GS} = 18 V; T_{mb} = 25 °C		77	A
		V_{GS} = 18 V; T_{mb} = 100 °C		54	A
I_{DM}	peak drain current	pulse width t_p limited by T_{jmax}	Fig.17	150	A
I_S	continuous diode current	V_{GS} = -4 V; T_{mb} = 25 °C		55	A
I_{SM}	pulse diode current	V_{GS} = -4 V; pulse width t_p limited by T_{jmax}		150	A
E_{as}	single pulse drain−to-source avalanche	I_{AS} = 24 A; L = 1 mH; V_{DD} = 100 V; T_j = 25 °C		288	mJ
T_{stg}	storage temperature			-55 to 175	°C
T_j	junction temperature			-55 to 175	°C
$T_{sld(M)}$	peak soldering temperature			245	°C

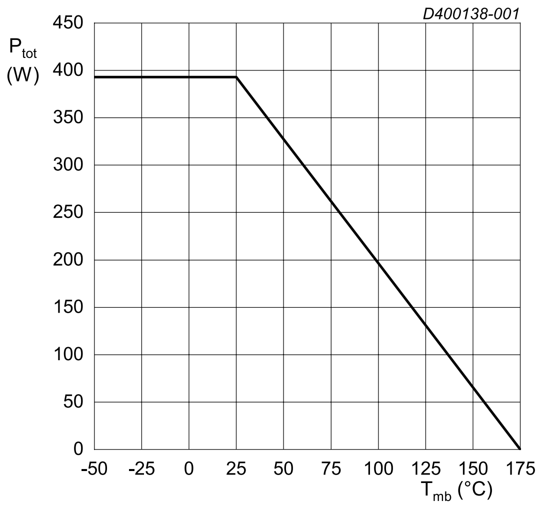


Fig. 1. Total power dissipation as a function of mounting base temperature; maximum values

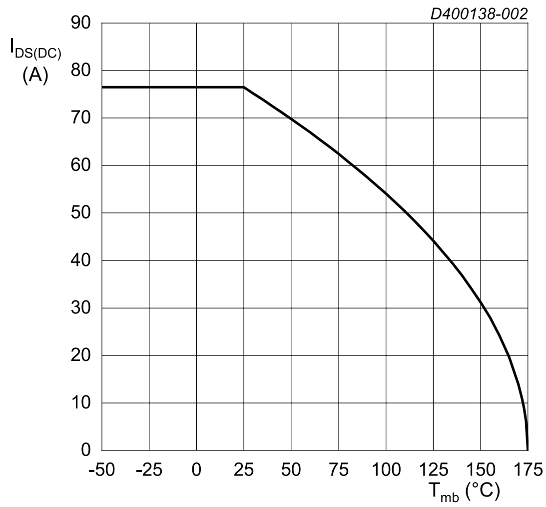


Fig. 2. Continuous Drain Current as a function of mounting base temperature

9. Thermal & Mechanical characteristics

Table 6. Thermal & Mechanical characteristics

Symbol	Parameter	Conditions	Notes	Min	Typ	Max	Unit
$R_{th(j-mb)}$	thermal resistance from junction to mounting base			-	0.38	-	K/W
$R_{th(j-a)}$	thermal resistance from junction to ambient	in free air		-	40	-	K/W

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

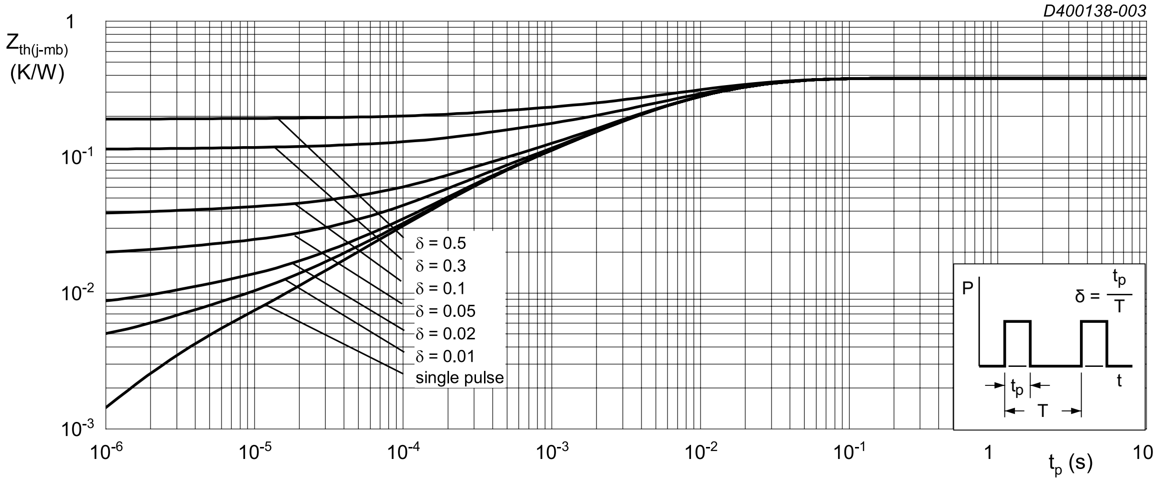
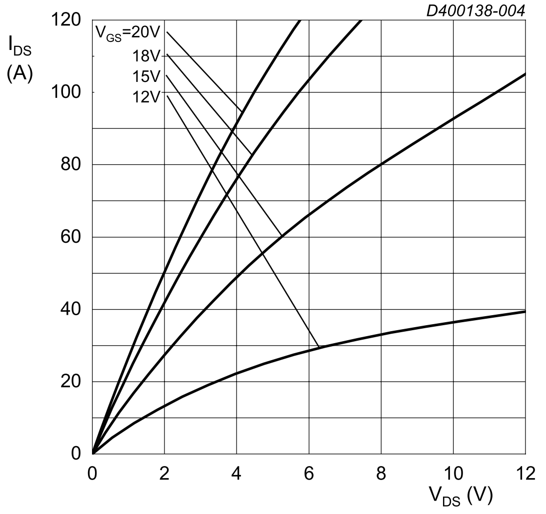


Fig. 3. Transient thermal impedance from junction to mounting base as a function of pulse duration

10. Characteristics

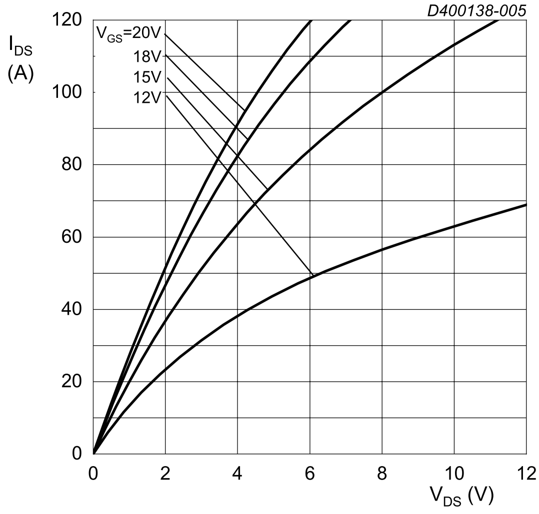
Table 7. Characteristics

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} = 10 V; T_j = 25 °C		1.9	2.6	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
		V_{DS} = 1200 V; V_{GS} = 0 V; T_j = 175 °C		-	2	-	µA
I_{GSS}	gate leakage current	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 = 175 °C		-	56	-	mΩ
R_G	gate resistance	f = 1 MHz; T_j = 25 °C		-	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 = 1 MHz; 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; $R_{G(ext)}$ = 5.1 Ω; I_D = 33 A; L = 100 µH; T_j = 25 °C		-	23	-	ns
t_r	rise time			-	30	-	ns
$t_{d(off)}$	turn-off delay time			-	42	-	ns
t_f	fall time			-	13	-	ns
E_{on}	turn-on energy (Sic Diode FWD)		Fig.20	-	386	-	µJ
E_{off}	turn-off energy (Sic Diode FWD)		Fig.20	-	115	-	µJ
E_{on}	turn-on energy (Body Diode FWD)		Fig.20	-	487	-	µJ
E_{off}	turn-off energy (Body Diode FWD)		Fig.20	-	143	-	µJ
Source-drain diode							
V_{SD}	source-drain voltage	V_{GS} = 0 V; I_{SD} = 16.5 A; T_j = 25 °C		-	3.5	-	V
		V_{GS} = -4 V; I_{SD} = 16.5 A; T_j = 25 °C		-	5.0	-	V
		V_{GS} = -4 V; I_{SD} = 16.5 A; T_j = 175 °C		-	4.3	-	V
t_{rr}	reverse recovery time	I_{SD} = 33 A; di/dt = 500 A/µs; V_{DS} = 400 V; T_j = 25 °C		-	52	-	ns
Q_r	recovered charge			-	174	-	nC
I_{rrm}	reverse recovery current			-	6.8	-	A



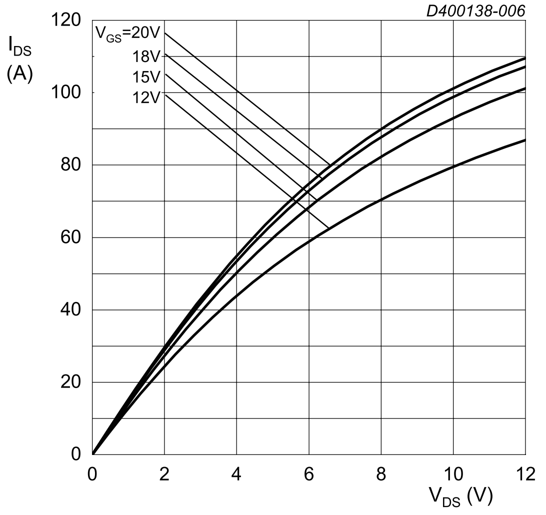
T_j = -55 °C; t_p < 200 µs

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



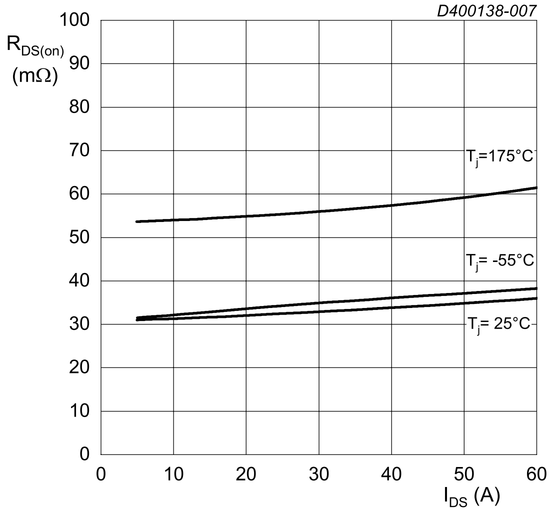
T_j = 25 °C; t_p < 200 µs

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



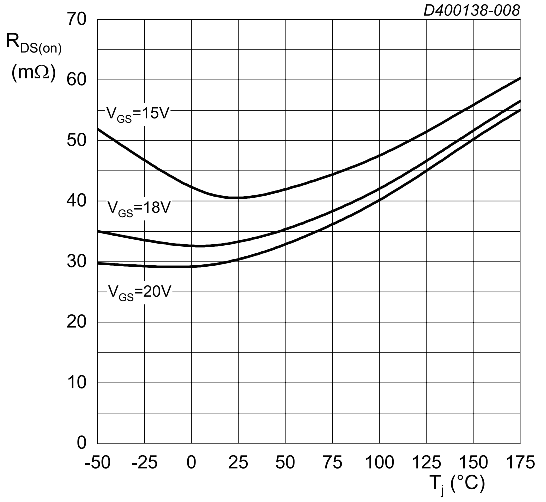
T_j = 175 °C; t_p < 200 µs

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



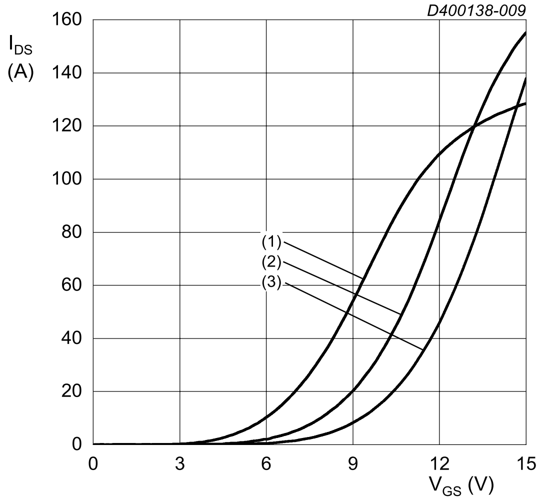
V_{GS} = 18 V; t_p < 200 µs

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



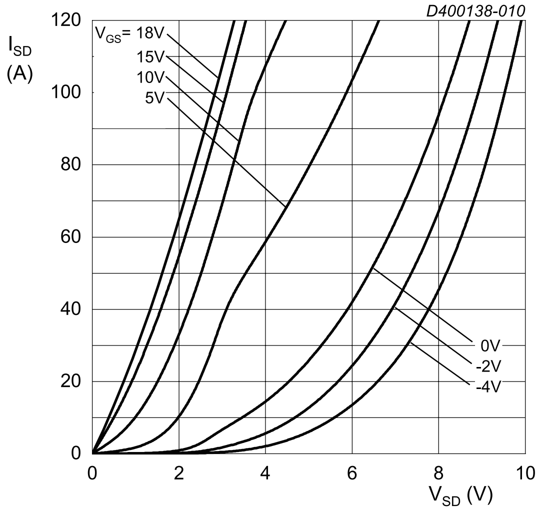
I_{DS} = 33 A; t_p < 200 µs

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



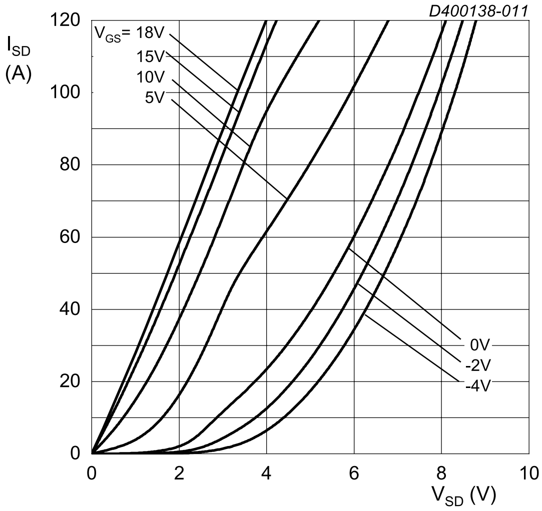
V_{DS} = 20 V; t_p < 200 µs
(1) T_j = 175 °C
(2) T_j = 25 °C
(3) T_j = -55 °C

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



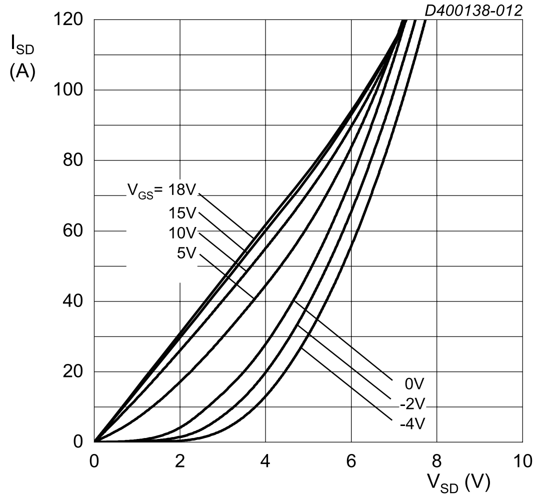
T_j = -55 °C; t_p < 200 µs

Fig. 10. Body diode forward characteristics; typical values



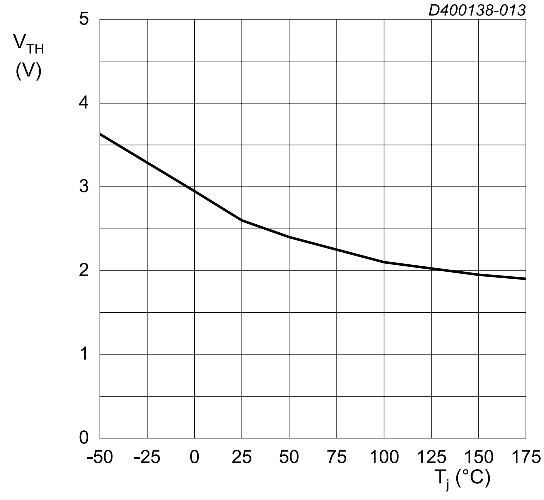
T_j = 25 °C; t_p < 200 µs

Fig. 11. Body diode forward characteristics; typical values



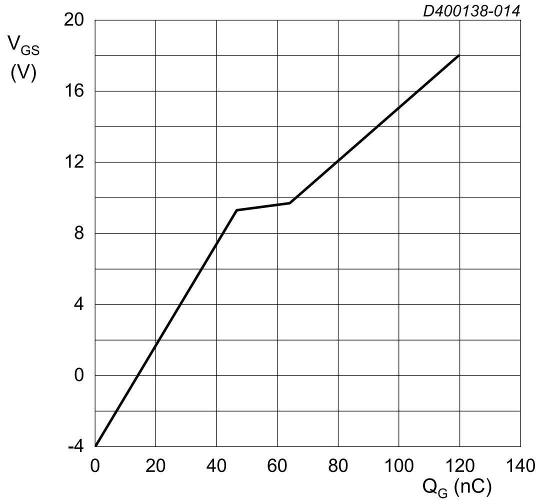
T_j = 175 °C; t_p < 200 µs

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

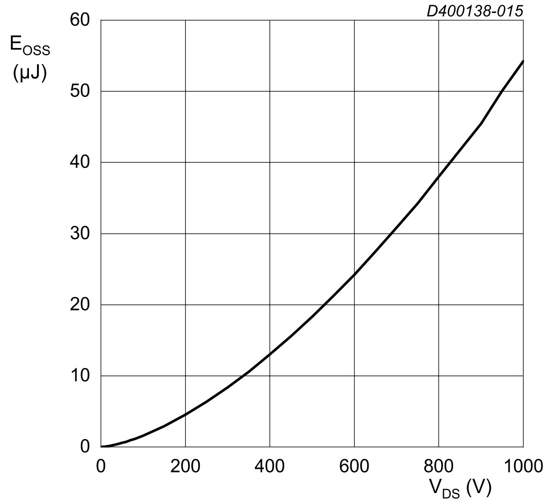
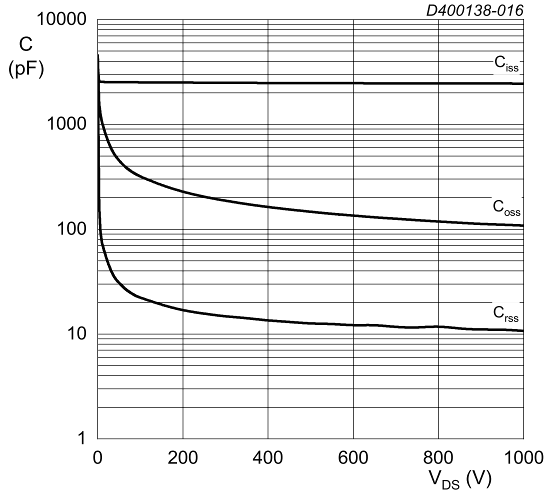
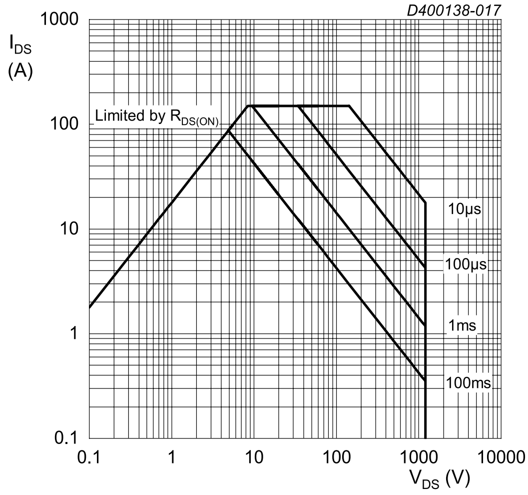


Fig. 15. Output capacitor stored energy as a function of drain-source voltage



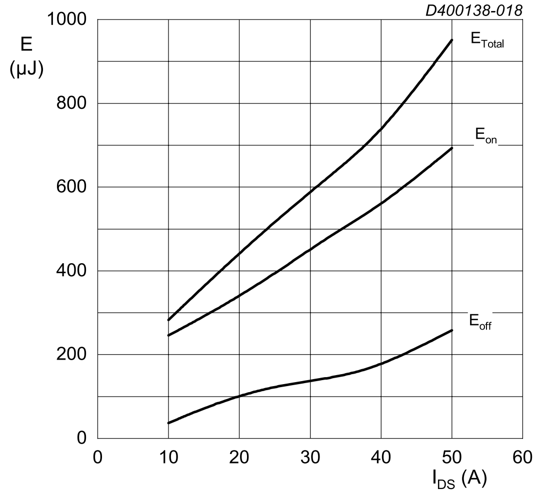
V_{DS} = 0 - 1000 V
T_j = 25 °C; V_{AC} = 25 mV; f = 1 MHz

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



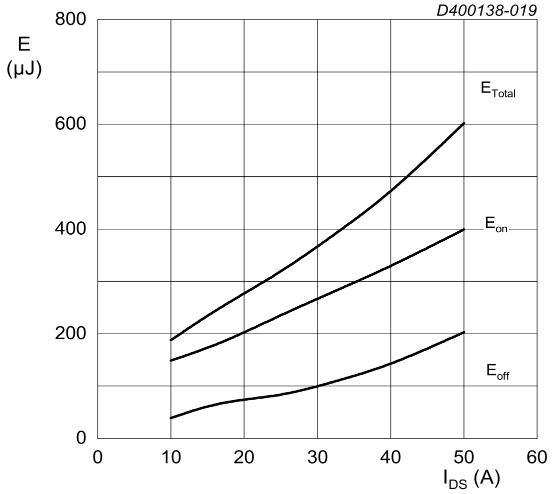
T_j = 25 °C; D = 0
Parameter: t_p

Fig. 17. Forward bias safe operating area



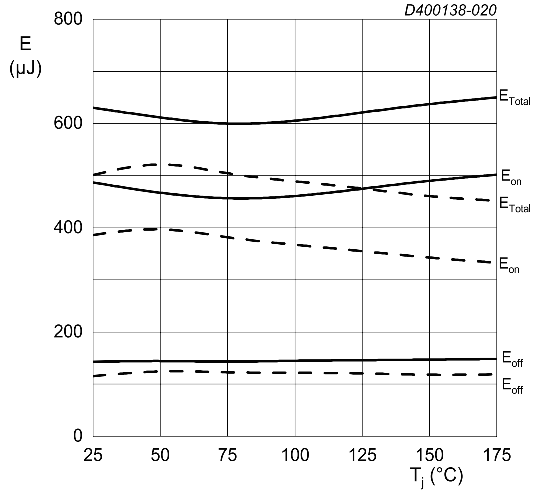
T_j = 25 °C; V_{DD} = 800 V; $R_{G(ext)}$ = 5.1 Ω;
V_{GS} = -4 V/18 V; L = 100 µH
FWD = WNSC2M40120TB

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



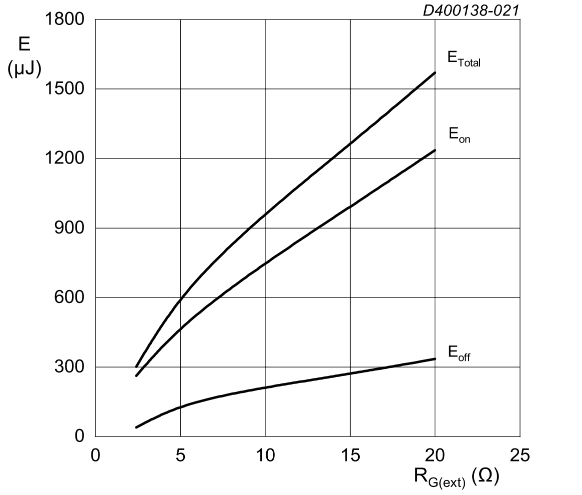
T_j = 25 °C; V_{DD} = 600 V; $R_{G(ext)}$ = 5.1 Ω;
V_{GS} = -4 V/18 V; L = 100 µH
FWD = WNSC2M40120TB

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



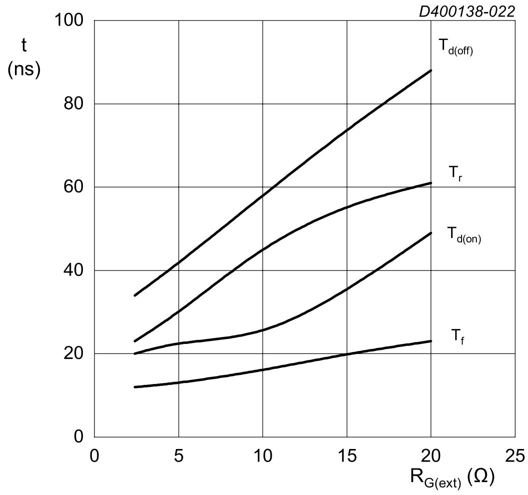
I_{DS} = 33 A; V_{DD} = 800 V; $R_{G(ext)}$ = 5.1 Ω;
V_{GS} = -4 V/18 V; L = 100 µH
FWD = WNSC2M40120TB
FWD = WNSC2D301200TB(- - -)

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
FWD = WNSC2M40120TB; 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
FWD = WNSC2M40120TB; L = 100 µH

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

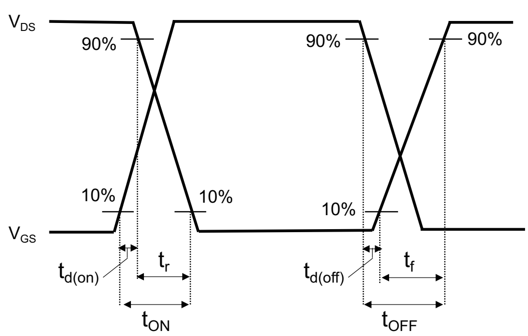
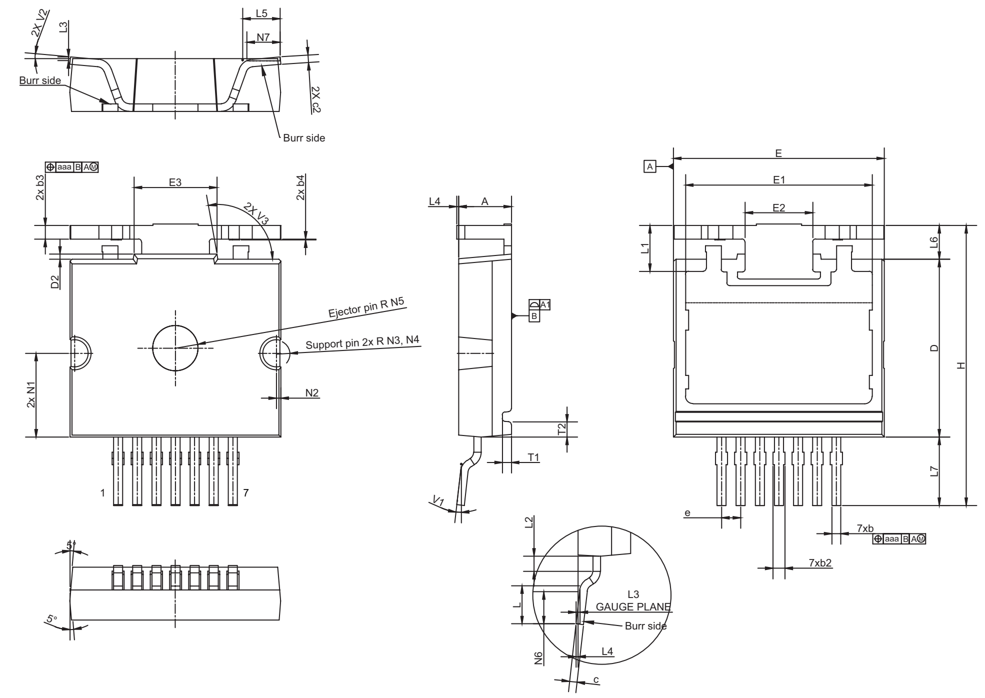
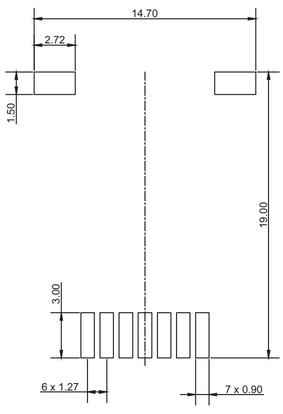


Fig. 23. Switching time definition

11. Package outline



SYMBOL	DIMENSIONS MILLIMETER			SYMBOL	DIMENSIONS MILLIMETER		
	MIN.	NOM.	MAX.		MIN.	NOM.	MAX.
A	3.40	3.50	3.60	L3		0.26	
A1		0.05		L4	0.075	0.125	0.175
b	0.50	0.60	0.70	L5	2.38	2.48	2.58
b2	0.70	0.80	0.90	L6	2.14	2.24	2.34
b3	0.80	0.90	0.98	L7	4.44	4.54	4.64
b4		Ref only. 0.05mm		N1	5.46	5.56	5.66
c	0.40	0.50	0.60	N2	0.25	0.30	0.35
c2	0.40	0.50	0.60	N3	0.80	0.90	1.00
D	11.70	11.80	11.90	N4	1.00	1.10	1.20
D1	7.78	7.88	7.98	N5	1.40	1.50	1.60
D2	0.24	0.34	0.44	N6	2.185	2.285	2.385
E	13.90	14.00	14.10	N7	2.10	2.20	2.30
E1	12.30	12.40	12.50	T1		0.60	
E2	4.45	4.50	4.55	T2		1.00	
E3	5.45	5.50	5.55	T3	0.60	0.70	0.80
e		1.27		V1	0°	5°	8°
H	18.00	18.58	19.00	V2	0°	6°	8°
L	2.42	2.52	2.62	V3		100°	
L1		3.04		aaa		0.1	
L2	0.90	1.00	1.10				



Footprint(Only for reference)

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".
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13. Contents

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