WNSC2M40120TB-A

N-Channel Silicon Carbide MOSFET

Rev.01 - 08 May 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.

AEC - Q101 Qualified

2. Features and benefits

- Automotive Qualified (AEC-Q101)
- Reduced cooling requirements
- Low on-resistance
- Fast switching speed
- 0V turn-off gate voltage for simple gate driver
- 100% UIS Tested
- Easy to parallel
- Controllable dV/dt for optimized EMI
- RoHS compliant

3. Applications

- Automotive on board chargers
- Automotive DC-DC converters
- Automotive electric compressor motor drives
- HV battery management systems

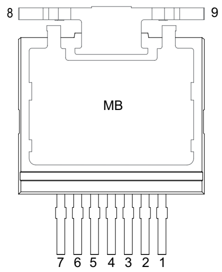
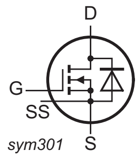
4. Quick reference data

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		76.5			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

Pin	Symbol	Description	Simplified outline	Graphic symbol
1	G	gate		
2	SS	source sense		
3-7	S	source		
8-9 mb	D	mounting base; connected to drain		

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-A	TSPAK	WNSC2M40120TB-A6J	Reel	600	TSPAKH	06-Dec-2024

7. Marking

Table 4. Marking codes

Type number	Marking codes
WNSC2M40120TB-A	WNSC2M 40120TB-A

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	Absolute maximum values		-10 to 22	V
$V_{GS,op}$	gate-source voltage	Recommended operational values		-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		76.5	A
		V_{GS} = 18 V; T_{mb} = 100 °C		54.1	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		54.8	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			260	°C

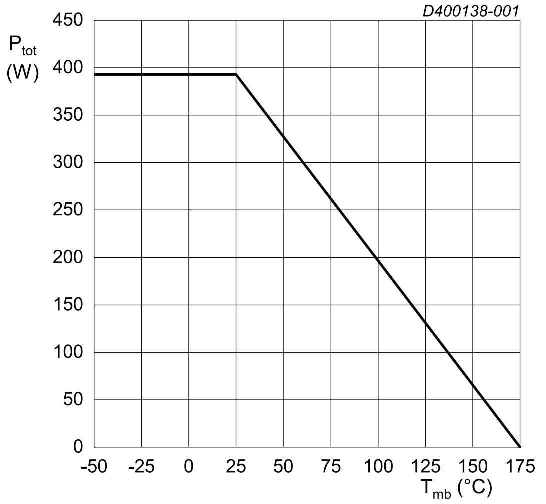


Fig. 1. Total power dissipation as a function of mounting base temperature; maximum values

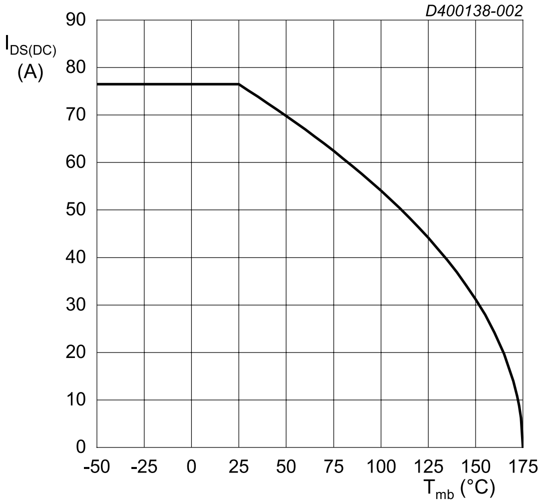


Fig. 2. Continuous Drain Current as a function of mounting base temperature

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.

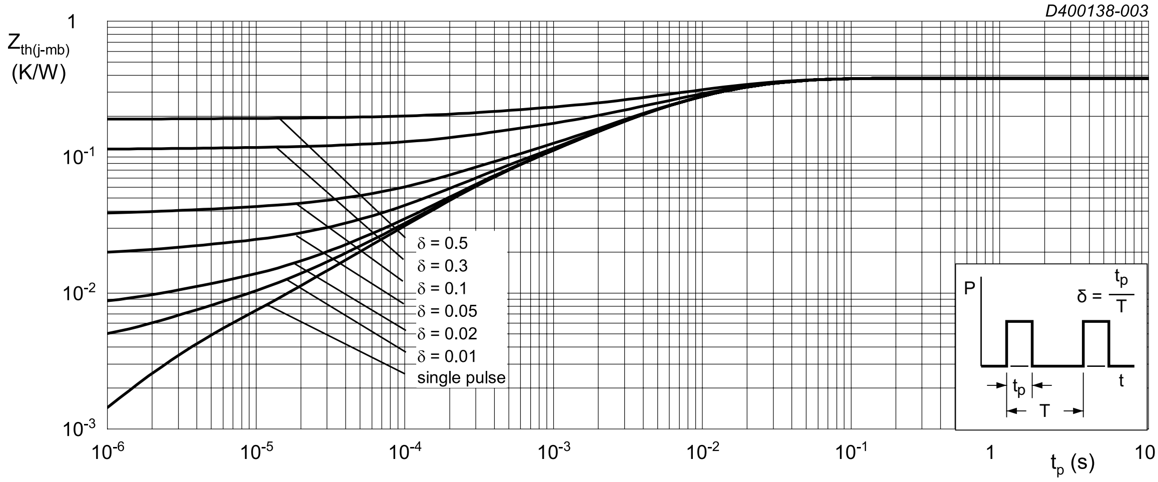
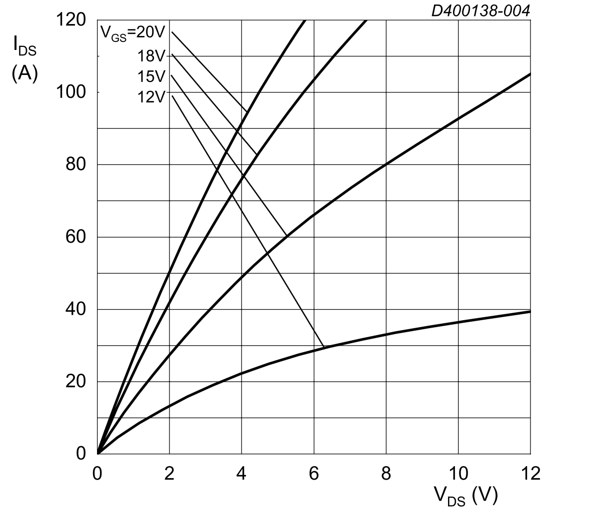


Fig. 3. Transient thermal impedance from junction to mounting base as a function of pulse duration

10. Characteristics

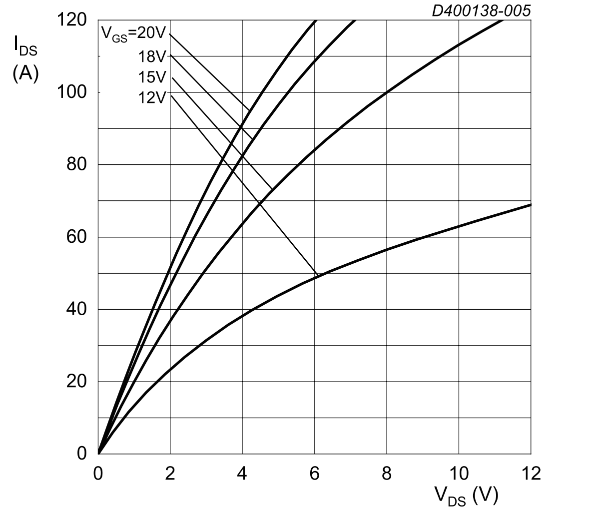
Table 7. Characteristics

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} = 22 V; V_{DS} = 0 V; T_j = 25 °C		-	10	100	nA
		V_{GS} = -10 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		-	3.2	-	V
		V_{GS} = -4 V; I_{SD} = 16.5 A; T_j = 25 °C		-	4.8	-	V
		V_{GS} = -4 V; I_{SD} = 16.5 A; T_j = 175 °C		-	4.2	-	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



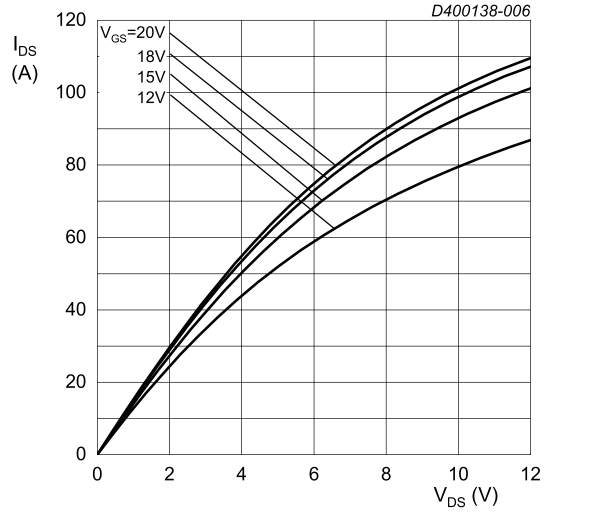
T_j = -55 °C; t_p < 200 µs

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



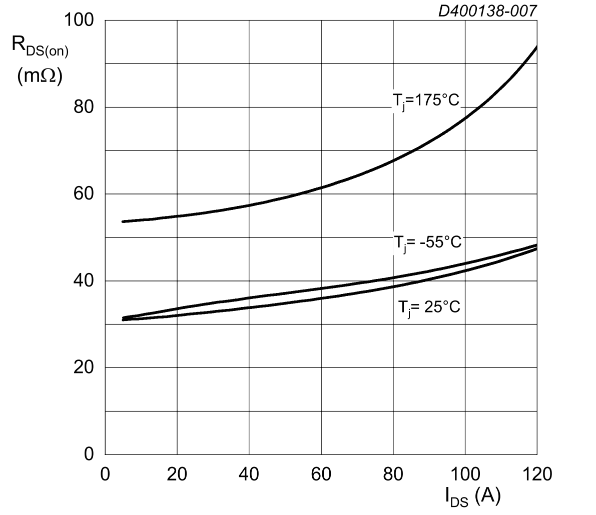
T_j = 25 °C; t_p < 200 µs

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



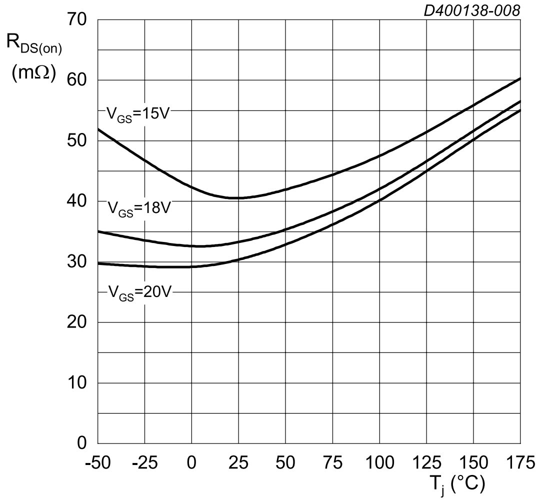
T_j = 175 °C; t_p < 200 µs

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



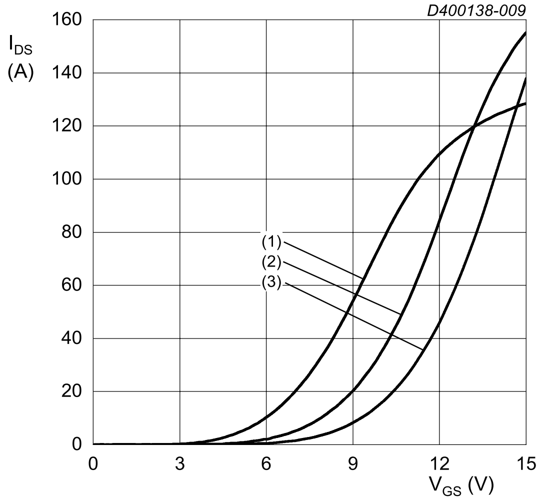
V_{GS} = 18 V; t_p < 200 µs

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



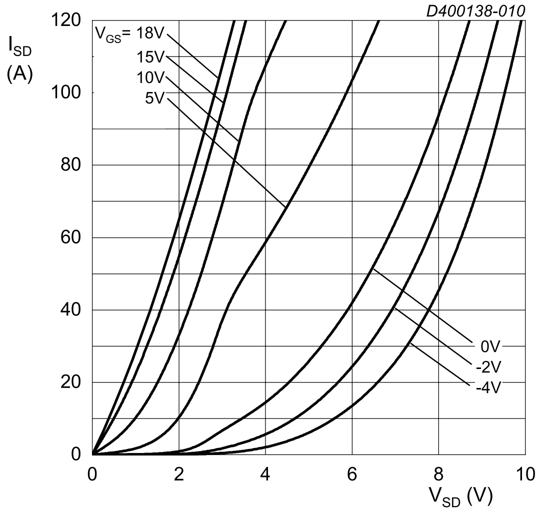
V_{DS} = 20 V; t_p < 200 µs

(1) T_j = 175 °C

(2) T_j = 25 °C

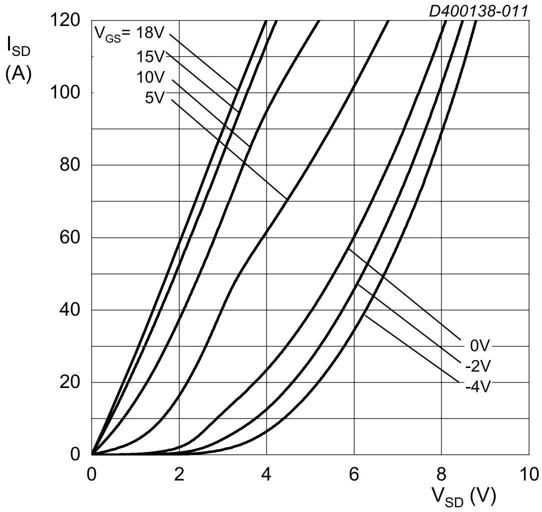
(3) T_j = -55 °C

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



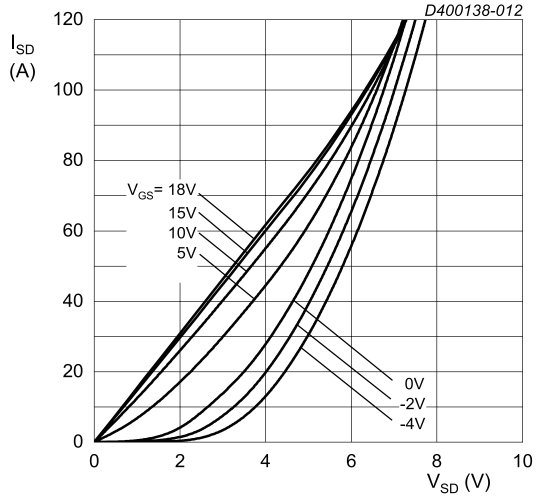
T_j = -55 °C; t_p < 200 µs

Fig. 10. Body diode forward characteristics; typical values



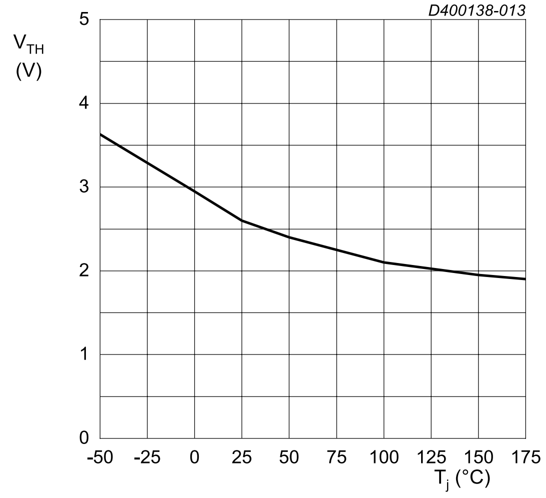
T_j = 25 °C; t_p < 200 µs

Fig. 11. Body diode forward characteristics; typical values



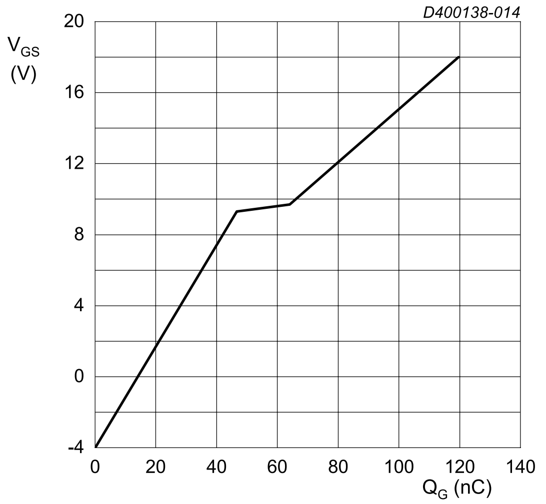
T_j = 175 °C; t_p < 200 μs

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

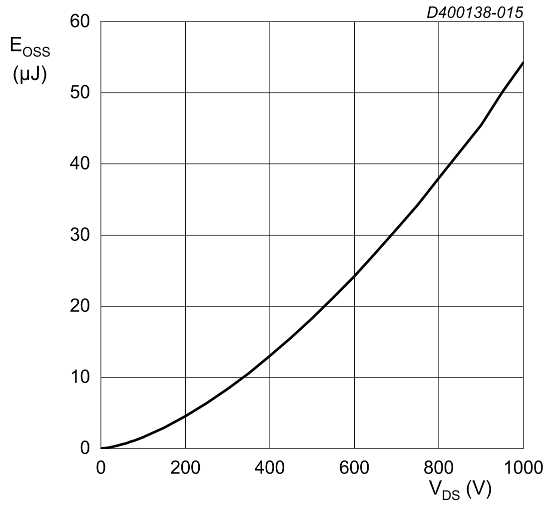
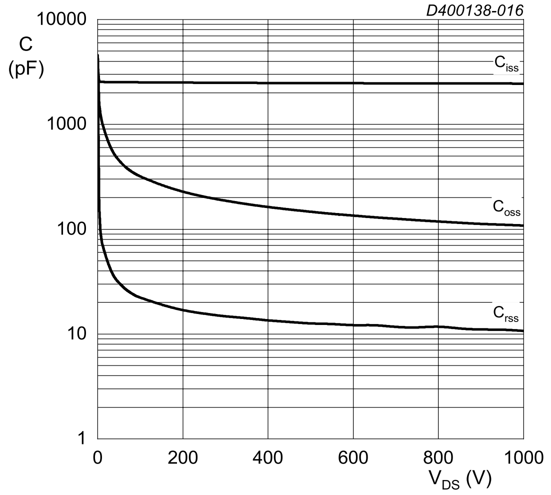
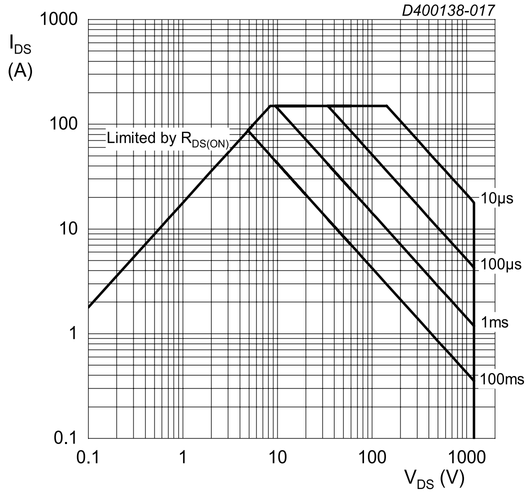


Fig. 15. Output capacitor stored energy as a function of drain-source voltage



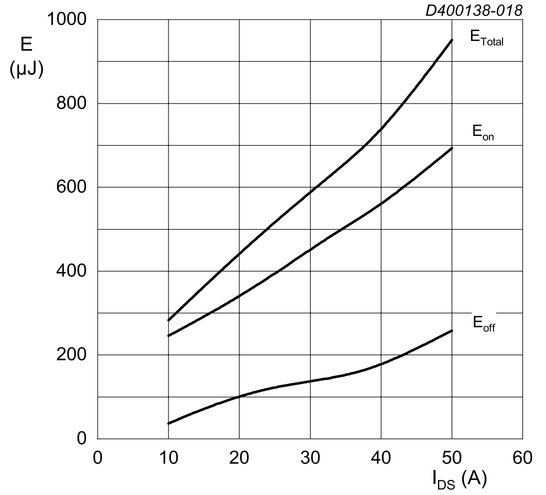
V_{DS} = 0 - 1000 V
T_j = 25 °C; V_{AC} = 25 mV; f = 1 MHz

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



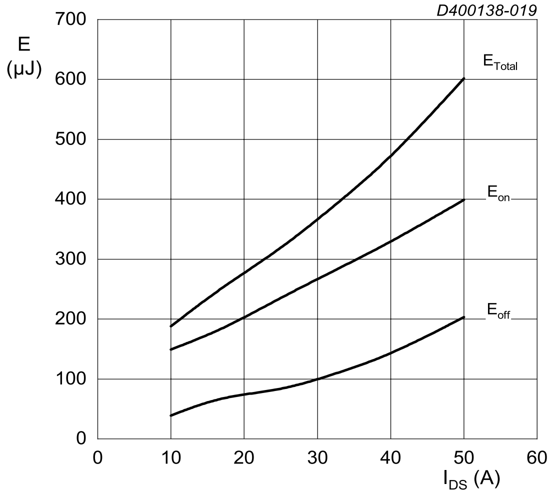
T_j = 25 °C; D = 0
Parameter: t_p

Fig. 17. Forward bias safe operating area



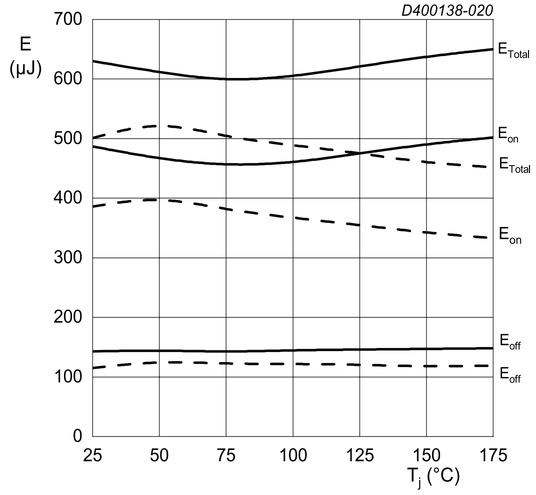
T_j = 25 °C; V_{DD} = 800 V; $R_{G(ext)}$ = 5.1 Ω;
V_{GS} = -4 V/18 V; L = 100 μH
FWD = WNSC2M40120TB-A

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



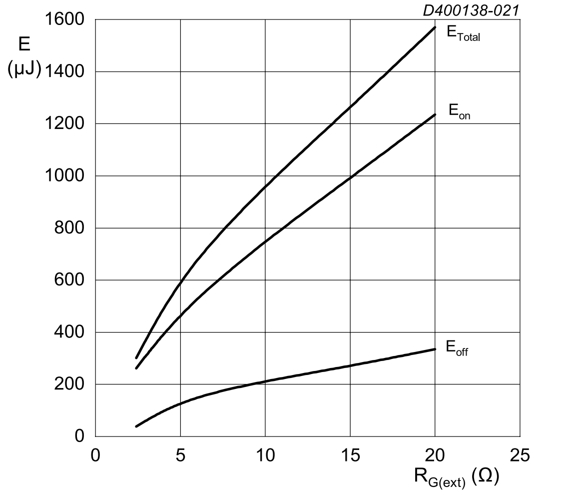
T_j = 25 °C; V_{DD} = 600 V; $R_{G(ext)}$ = 5.1 Ω;
V_{GS} = -4 V/18 V; L = 100 μH
FWD = WNSC2M40120TB-A

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



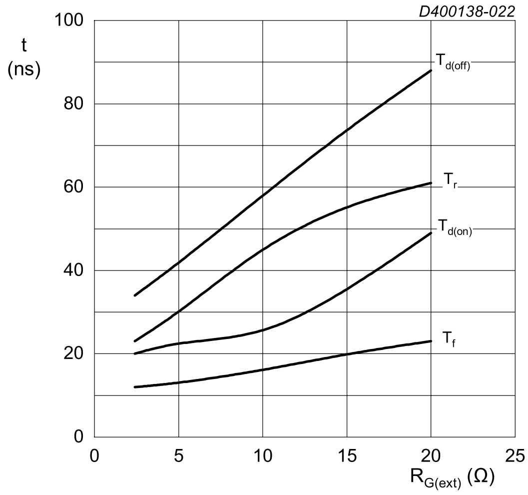
I_{DS} = 33 A; V_{DD} = 800 V; $R_{G(ext)}$ = 5.1 Ω;
V_{GS} = -4 V/18 V; L = 100 μH
FWD = WNSC2M40120TB-A
FWD = WNSC2D301200TB(---)

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-A; 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-A; L = 100 μH

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

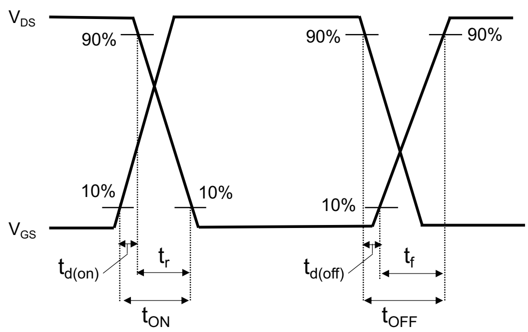
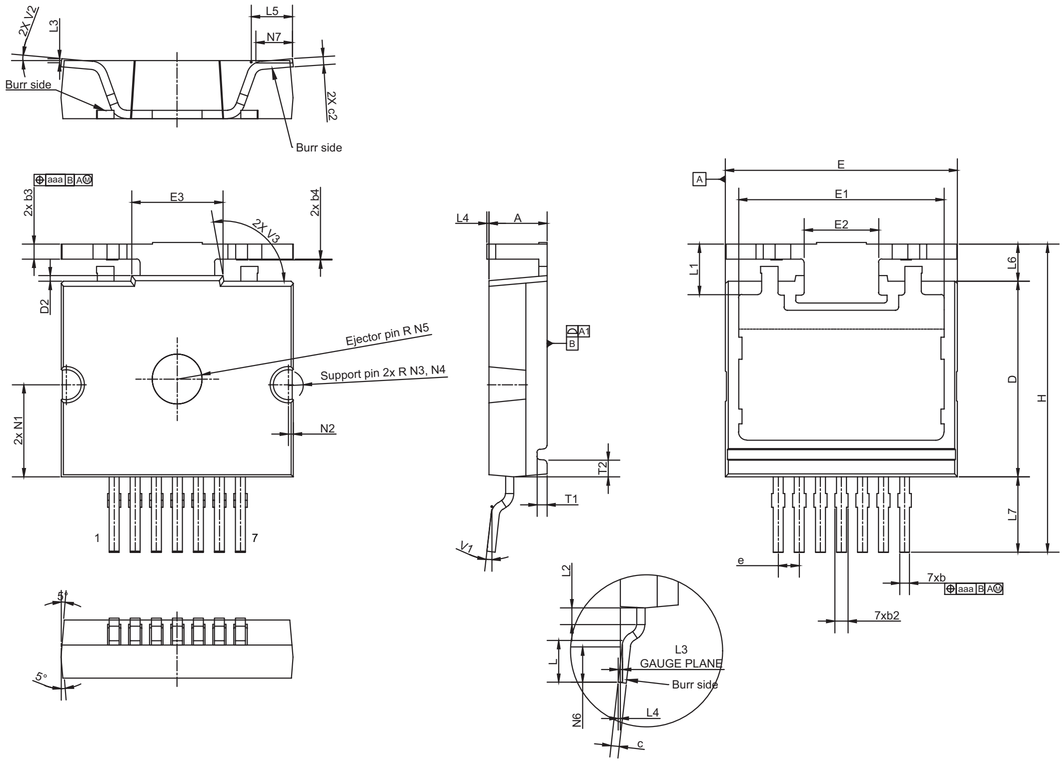
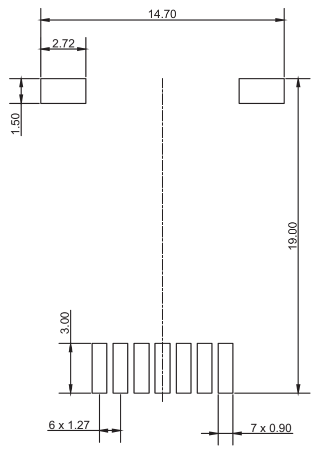


Fig. 23. Switching time definition

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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