WNSC2M1K0170W-A

N-Channel Silicon Carbide MOSFET

Rev.01 - 10 February 2025 — Product data sheet

1. General description

Silicon Carbide MOSFET in a TO247-3L plastic package, designed for high frequency, high efficiency systems.

AEC - Q101 Qualified

2. Features and benefits

- Low specific on-resistance
- Optimized dynamic performance
- 0V turn-off V_{GS} for simple gate driving
- 100% UIS Tested
- Easy to parallel
- RoHS compliant
- Automotive Qualified (AEC-Q101)

3. Applications

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

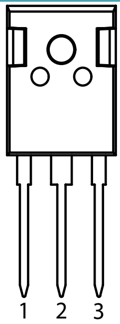
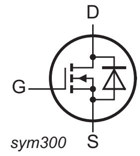
4. Quick reference data

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		1700			V
I_D	drain current	V_{GS} = 18 V; T_{mb} = 25 °C		6.3			A
P_{tot}	total power dissipation	T_{mb} = 25 °C, T_j = 175 °C		64			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 = 1 A; T_j = 25 °C		-	1000	-	mΩ
		V_{GS} = 18 V; I_D = 1 A; T_j = 25 °C		-	750	1200	mΩ
Dynamic characteristics							
$Q_{G(tot)}$	total gate charge	I_D = 2 A; V_{DS} = 1200 V; V_{GS} = 0 V/18 V; T_j = 25 °C		-	12	-	nC
Q_{GD}	gate-drain charge			-	5	-	nC
Source-drain diode							
Q_r	recovered charge	I_{SD} = 1 A; di/dt = 500 A/µs; V_{DS} = 400 V; T_j = 25 °C		-	38	-	nC

5. Pinning information

Table 2. Pinning information

Pin	Symbol	Description	Simplified outline	Graphic symbol
1	G	gate		
2	D	drain		
3	S	source		
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
WNSC2M1K0170W-A	TO247	WNSC2M1K0170W-A6Q	Tube	30	TO247P	09-Mar-2023

7. Marking

Table 4. Marking codes

Type number	Marking codes
WNSC2M1K0170W-A	WNSC2M 1K0170W-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		1700	V
$V_{GS,max}$	gate-source voltage			-10 to 22	V
$V_{GS,op}$	gate-source voltage			-5 to 18	V
P_{tot}	total power dissipation	T_{mb} = 25 °C, T_j = 175 °C		64	W
I_D	drain current	V_{GS} = 18 V; T_{mb} = 25 °C		6.3	A
		V_{GS} = 18 V; T_{mb} = 100 °C		4.5	A
I_{DM}	peak drain current	pulsed; tp ≤ 10 µs; Tmb = 25 °C	Fig.17	13	A
E_{as}	single pulse drain−to-source avalanche	I_{AS} = 7 A; L = 1 mH; V_{DD} = 100 V; T_j = 25 °C		24.5	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

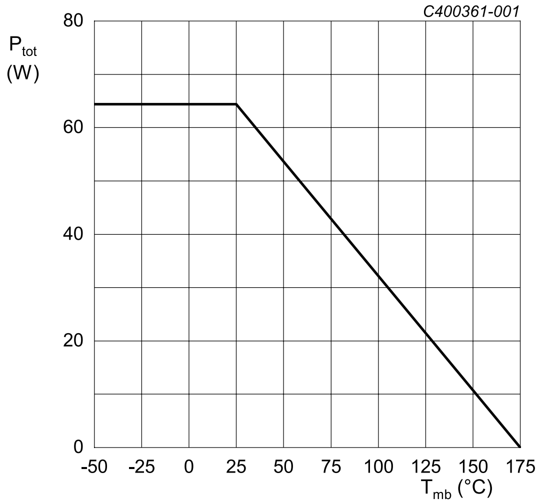


Fig. 1. Total power dissipation as a function of mounting base temperature; maximum values

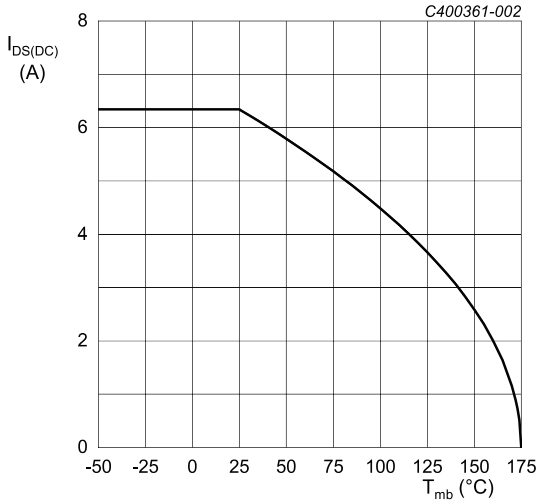


Fig. 2. Continuous Drain Current as a function of mounting base temperature

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			-	2.33	-	K/W
$R_{th(j-a)}$	thermal resistance from junction to ambient	in free air		-	40	-	K/W
M_d	Mounting torque	M3 or 6 - 32 screw		-	-	0.6	Nm

Note: It is recommended that a metal washer is inserted between screw head and mounting tab.
Do not use self-tapping screws.
Device is ESD sensitive. Handling precautions are recommended.

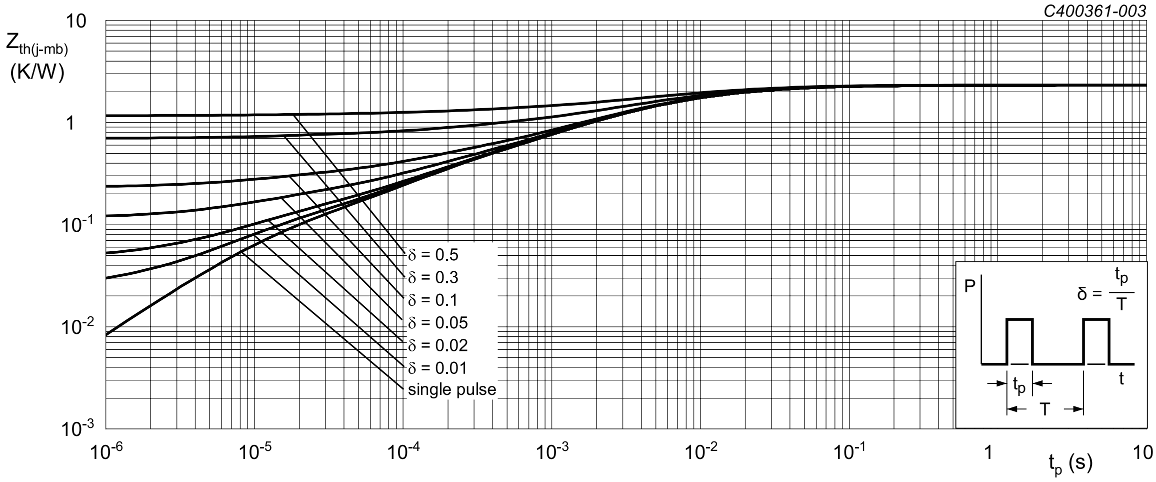
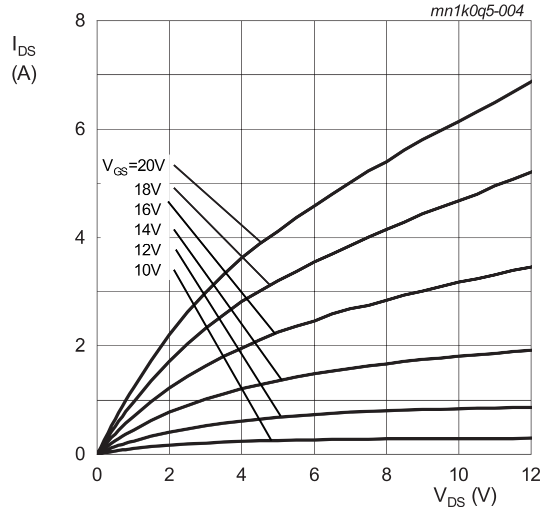


Fig. 3. Transient thermal impedance from junction to mounting base as a function of pulse duration

10. Characteristics

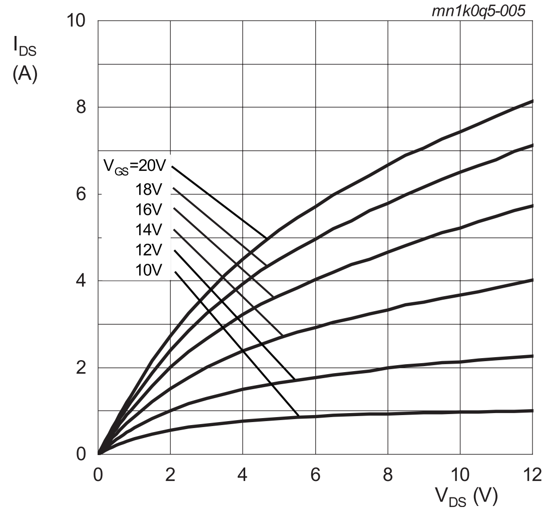
Table 7. Characteristics

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		1700	-	-	V
$V_{GS(th)}$	gate-source threshold voltage	I_D = 0.8 mA; V_{DS} = 10 V; T_j = 25 °C		2.3	3.2	4.2	V
		I_D = 0.8 mA; V_{DS} = 10 V; T_j = 150 °C		-	2.4	-	V
I_{DSS}	drain leakage current	V_{DS} = 1700 V; V_{GS} = 0 V; T_j = 25 °C		-	0.1	100	µA
		V_{DS} = 1700 V; V_{GS} = 0 V; T_j = 150 °C		-	1	-	µA
I_{GSS}	gate leakage current (absolute value)	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 = 1 A; T_j = 25 °C		-	1000	-	mΩ
		V_{GS} = 18 V; I_D = 1 A; T_j = 25 °C		-	750	1200	mΩ
		V_{GS} = 18 V; I_D = 1 A; T_j = 150 °C		-	1050	-	mΩ
R_G	gate resistance	f = 1 MHz; T_j = 25 °C		-	16	-	Ω
g_{fs}	transconductance	V_{DS} = 10 V; I_D = 1 A; T_j = 25 °C		-	0.5	-	S
Dynamic characteristics							
$Q_{G(tot)}$	total gate charge	I_D = 2 A; V_{DS} = 1200 V; V_{GS} = 0 V/18 V; T_j = 25 °C		-	12	-	nC
Q_{GS}	gate-source charge			-	3.8	-	nC
Q_{GD}	gate-drain charge			-	5	-	nC
C_{iss}	input capacitance	V_{DS} = 1000 V; V_{GS} = 0 V; f = 1 MHz; T_j = 25 °C		-	225	-	pF
C_{oss}	output capacitance			-	15	-	pF
C_{rss}	reverse transfer capacitance			-	2.8	-	pF
E_{oss}	Coss stored energy			-	7.5	-	µJ
$t_{d(on)}$	turn-on delay time	V_{DS} = 1000 V; V_{GS} = -3/18 V; $R_{G(ext)}$ = 5.1 Ω; I_D = 2 A; L = 4.8 mH; T_j = 25 °C		-	5.6	-	ns
t_r	rise time			-	18	-	ns
$t_{d(off)}$	turn-off delay time			-	7.8	-	ns
t_f	fall time			-	60	-	ns
E_{on}	turn-on energy (Body Diode FWD)			-	57	-	µJ
E_{off}	turn-off energy (Body Diode FWD)			-	11	-	µJ
Source-drain diode							
V_{SD}	source-drain voltage	V_{GS} = 0 V; I_F = 1 A; T_j = 25 °C		-	3.9	-	V
		V_{GS} = 0 V; I_F = 1 A; T_j = 150 °C		-	3.4	-	V
t_{rr}	reverse recovery time	I_{SD} = 1 A; di/dt = 500 A/µs; V_{DS} = 400 V; T_j = 25 °C		-	36	-	ns
Q_r	recovered charge			-	38	-	nC
I_{rrm}	reverse recovery current			-	1.8	-	A



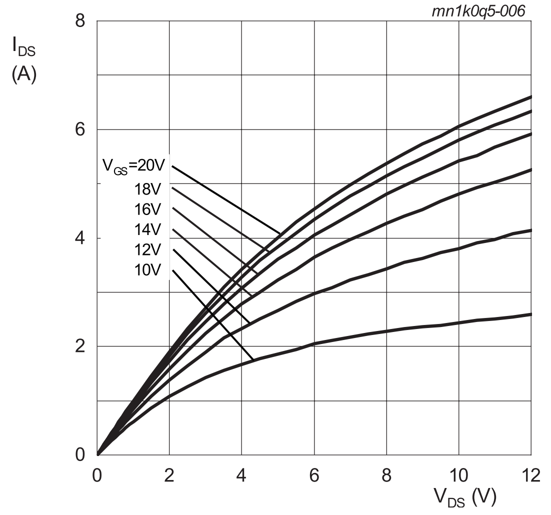
T_j = -55 °C; t_p < 200 µs

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



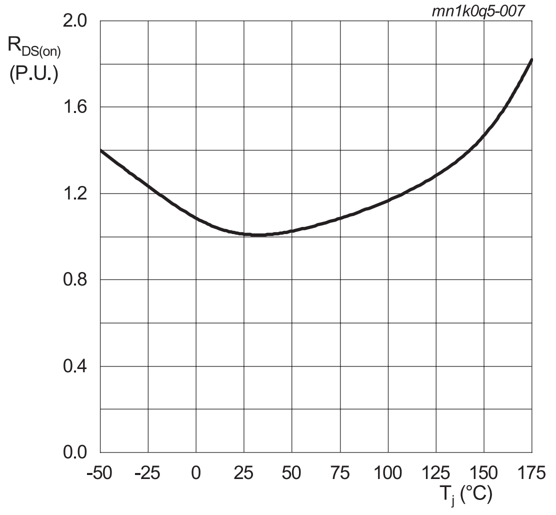
T_j = 25 °C; t_p < 200 µs

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



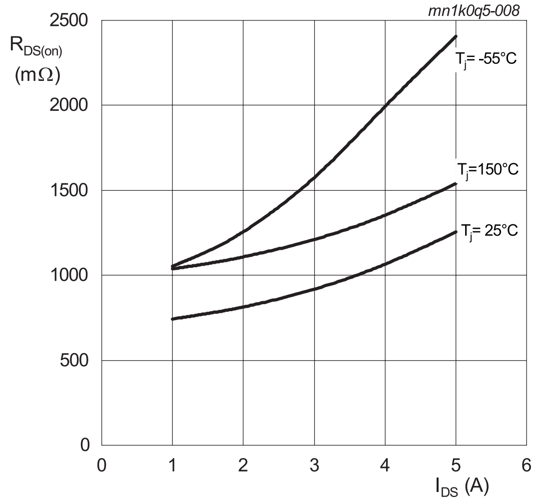
T_j = 150 °C; t_p < 200 µs

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



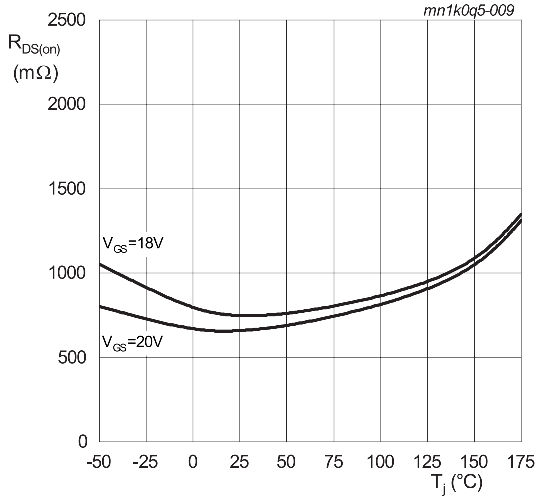
I_{DS} = 1 A; V_{GS} = 18 V; t_p < 200 µs

Fig. 7. Normalized drain-source on-state resistance as a function of junction temperature



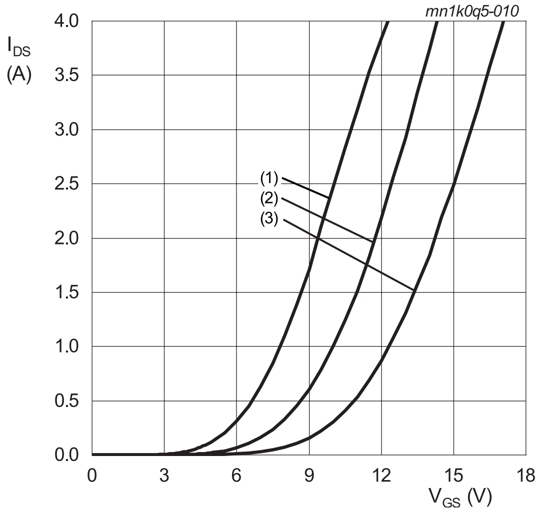
V_{GS} = 18 V; t_p < 200 µs

Fig. 8. Drain-source on-state resistance as a function of drain current; typical values



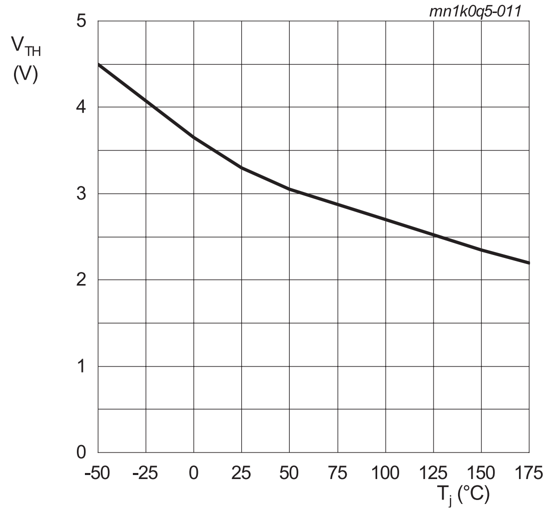
I_{DS} = 1 A; t_p < 200 µs

Fig. 9. Drain-source on-state resistance as a function of junction temperature



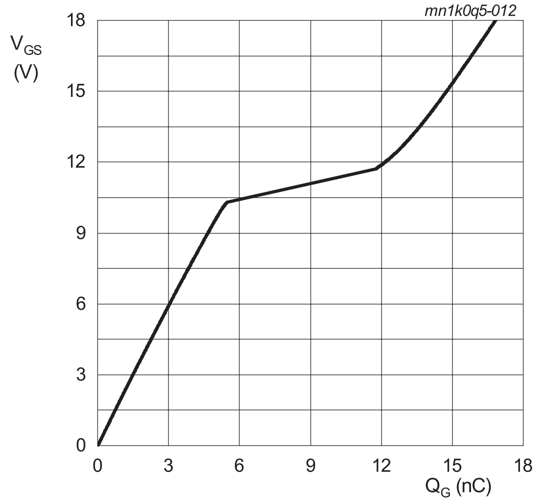
V_{DS} = 10 V; t_p < 200 µs
(1) T_j = 150 °C
(2) T_j = 25 °C
(3) T_j = -55 °C

Fig. 10. Transfer characteristics; drain current as a function of gate-source voltage; typical values



V_{DS} = 10 V; I_{DS} = 0.8 mA

Fig. 11. Threshold voltage as a function of junction temperature



I_{DS} = 2 A; I_{GS} = 0.1 mA; V_{DS} = 1200 V; T_j = 25 °C

Fig. 12. Gate-source voltage as a function of gate charge; typical values

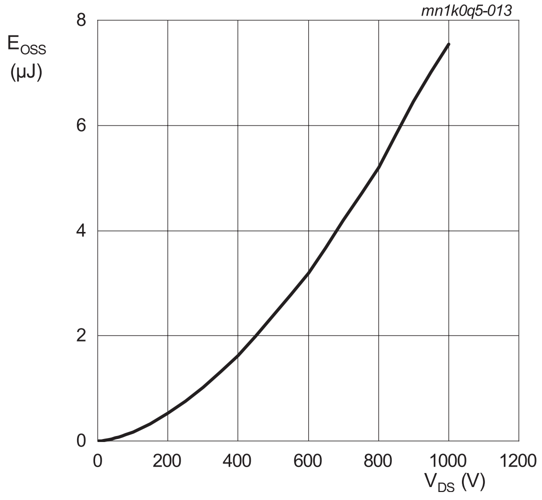
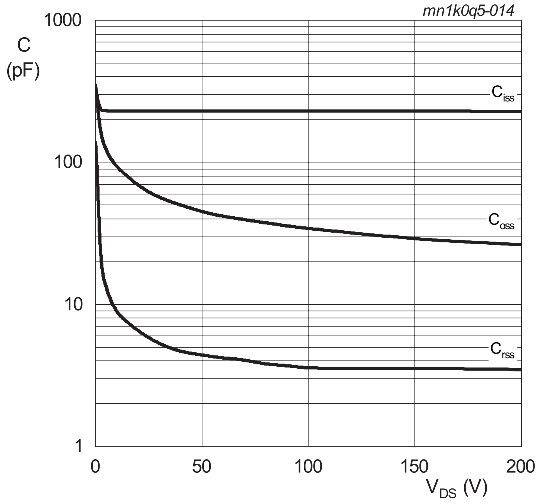


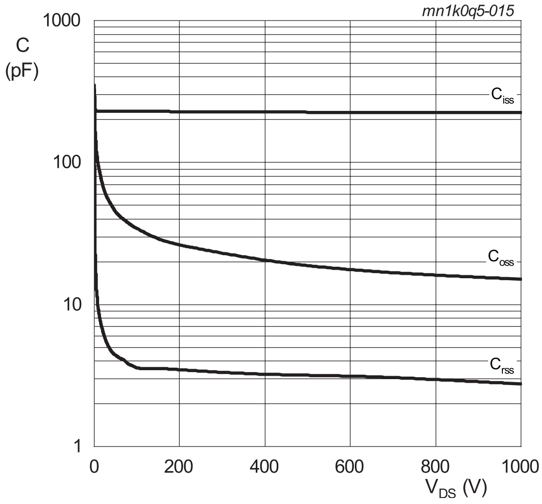
Fig. 13. Output capacitor stored energy as a function of drain-source voltage



V_{DS} = 0 - 200 V

T_j = 25 °C; V_{AC} = 25 mV; f = 1 MHz

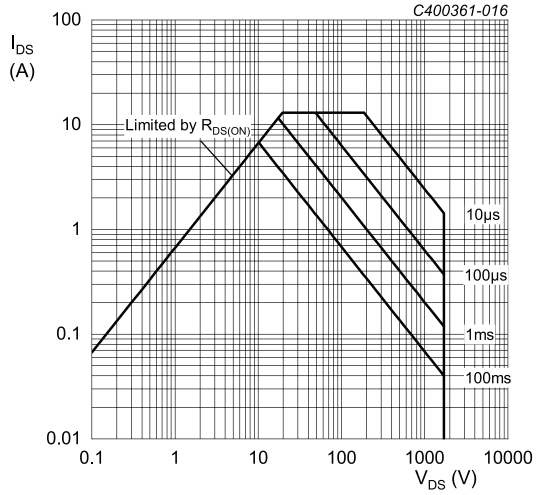
Fig. 14. Input, output and reverse transfer capacitances as a function of drain-source voltage; typical values



V_{DS} = 0 - 1000 V

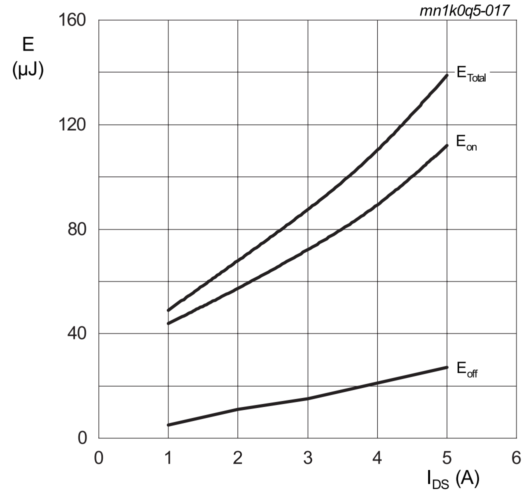
T_j = 25 °C; V_{AC} = 25 mV; f = 1 MHz

Fig. 15. Input, output and reverse transfer capacitances as a function of drain-source voltage; typical values



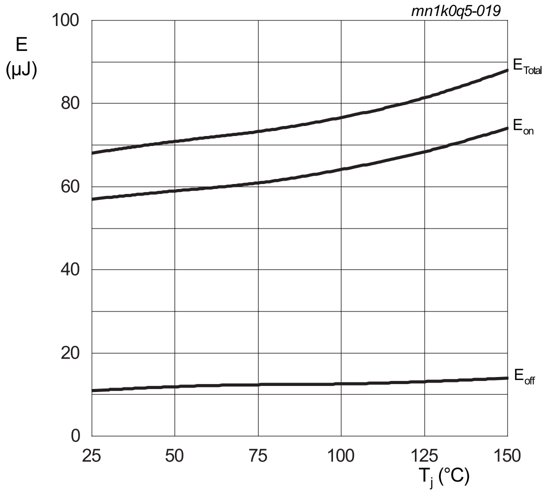
T_c = 25 °C; D = 0
Parameter: t_p

Fig. 16. Forward bias safe operating area



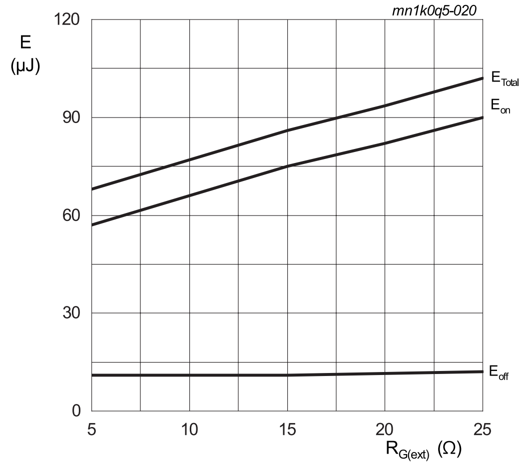
T_j = 25 °C; V_{DD} = 1000 V; $R_{G(ext)}$ = 5.1 Ω;
V_{GS} = -3V/18 V; L = 4.8 mH;
FWD = WNSC2M1K0170W-A

Fig. 17. Clamped Inductive Switching Energy as a function of drain current



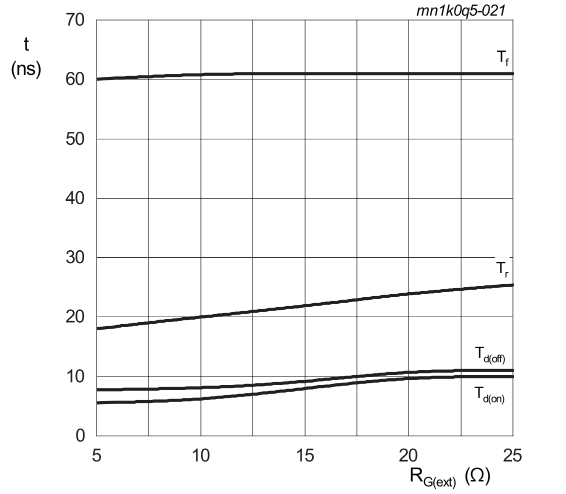
I_{DS} = 2 A; V_{DD} = 1000 V; $R_{G(ext)}$ = 5.1 Ω;
V_{GS} = -3V/18 V; L = 4.8 mH;
FWD = WNSC2M1K0170W-A

Fig. 18. Clamped Inductive Switching Energy as a function of junction temperature



T_j = 25 °C; V_{DD} = 1000 V; I_{DS} = 2 A; V_{GS} = -3V/18 V
FWD = WNSC2M1K0170W-A; L = 4.8 mH

Fig. 19. Clamped Inductive Switching Energy as a function of external gate resistance



T_j = 25 °C; V_{DD} = 1000 V; I_{DS} = 2 A; V_{GS} = -3V/18 V
FWD = WNSC2M1K0170W-A; L = 4.8 mH

Fig. 20. Switching time as a function of external gate resistance

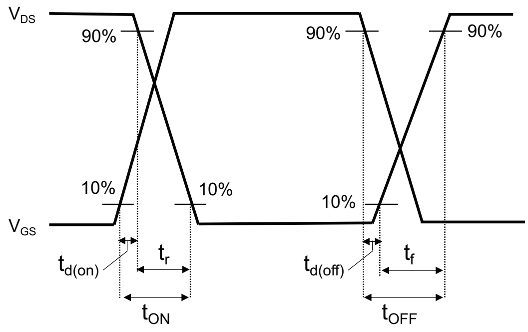
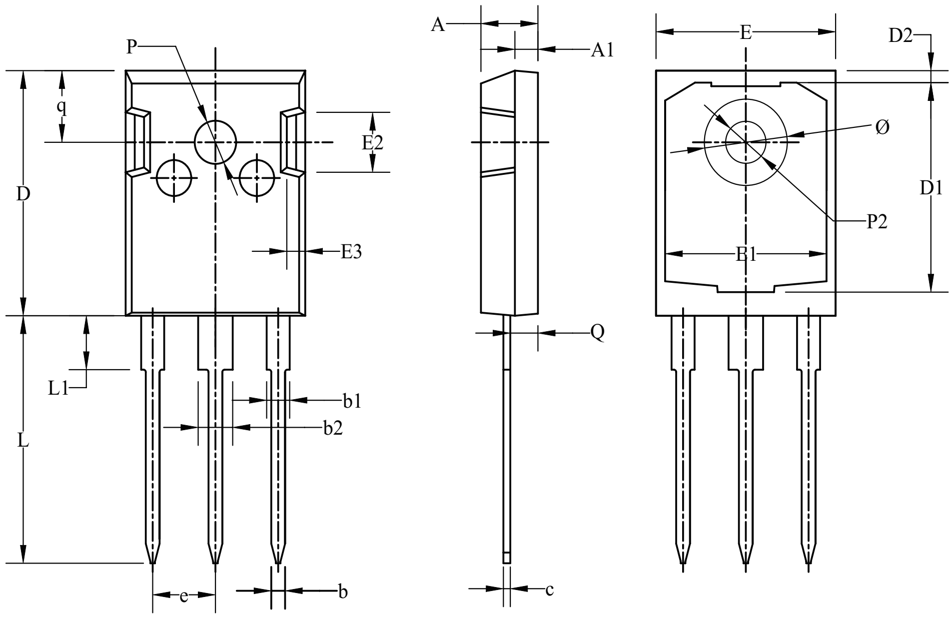


Fig. 21. Switching time definition

11. Package outline

Plastic single-ended through-hole package; headsink mounted; 1 mounting hole; 3 leads TO-247 TO247



Dim	All Dimensions in Millimeters		
	Min	Typ	Max
A	4.70	4.95	5.20
A1	1.90	2.00	2.10
b	1.00	1.20	1.40
b1	1.80	2.00	2.20
b2	2.80	3.00	3.20
c	0.50	0.60	0.70
D	20.30	20.45	20.60
D1	17.28	17.48	17.68
D2	0.80	1.00	1.20
E	15.45	15.60	15.75
E1	13.82	14.02	14.22
E2	4.80	5.00	5.20
E3	1.40	1.60	1.80
e	5.45 BSC		
L	20.40	20.65	20.90
L1	4.25	4.50	4.75
P2	3.40	3.50	3.60
P	3.50	3.60	3.70
Q	2.20	2.40	2.60
q	5.78	5.98	6.18
Ø	7.10	7.19	7.30

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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Date of release: 10 February 2025