

1. General description

Silicon Carbide MOSFET in a TO3PF plastic package, designed for high frequency, high efficiency systems.



2. Features and benefits

- Optimized for fly-back topologies
- 15V/0V gate-source voltage compatible with fly-back controllers
- 100% UIS Tested
- Controllable dV/dt for optimized EMI
- Reduced cooling requirements
- Enlarge creepage distance
- RoHS compliant

3. Applications

- Auxiliary Power Supplies
- Switch Mode Power Supplies
- Solar Inverter
- Frequency converter
- Industrial power supply

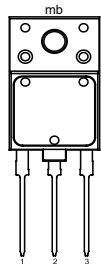
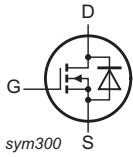
4. Quick reference data

Table 1. Quick reference data

Symbol	Parameter	Conditions	Notes	Values			Unit
Absolute maximum rating							
V_{DS}	drain-source voltage	$25\text{ °C} \leq T_j \leq 175\text{ °C}$		1700			V
I_D	drain current	$V_{GS} = 18\text{ V}; T_{mb} = 25\text{ °C}$		4.6			A
P_{tot}	total power dissipation	$T_{mb} = 25\text{ °C}$		34			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	$V_{GS} = 15\text{ V}; I_D = 1\text{ A}; T_j = 25\text{ °C}$		-	1000	-	mΩ
Dynamic characteristics							
$Q_{G(tot)}$	total gate charge	$I_D = 2\text{ A}; V_{DS} = 1200\text{ V}; V_{GS} = 0\text{ V}/18\text{ V}; T_j = 25\text{ °C}$		-	12	-	nC
Q_{GD}	gate-drain charge			-	5	-	nC
Source-drain diode							
Q_r	recovered charge	$I_{SD} = 1\text{ A}; di/dt = 500\text{ A}/\mu\text{s}; V_{DS} = 400\text{ V}; T_j = 25\text{ °C}$		-	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	n.c.	mounting base; isolated		

6. Ordering information

Table 3. Ordering information

Type number	Package Name	Orderable part number	Packing method	Small packing quantity	Package version	Package issue date
WNSC2M1K0170J	TO3PF	WNSC2M1K0170JQ	Tube	30	SOT1293	16-Mar-2006

7. Marking

Table 4. Marking codes

Type number	Marking codes
WNSC2M1K0170J	WNSC2M 1K0170J

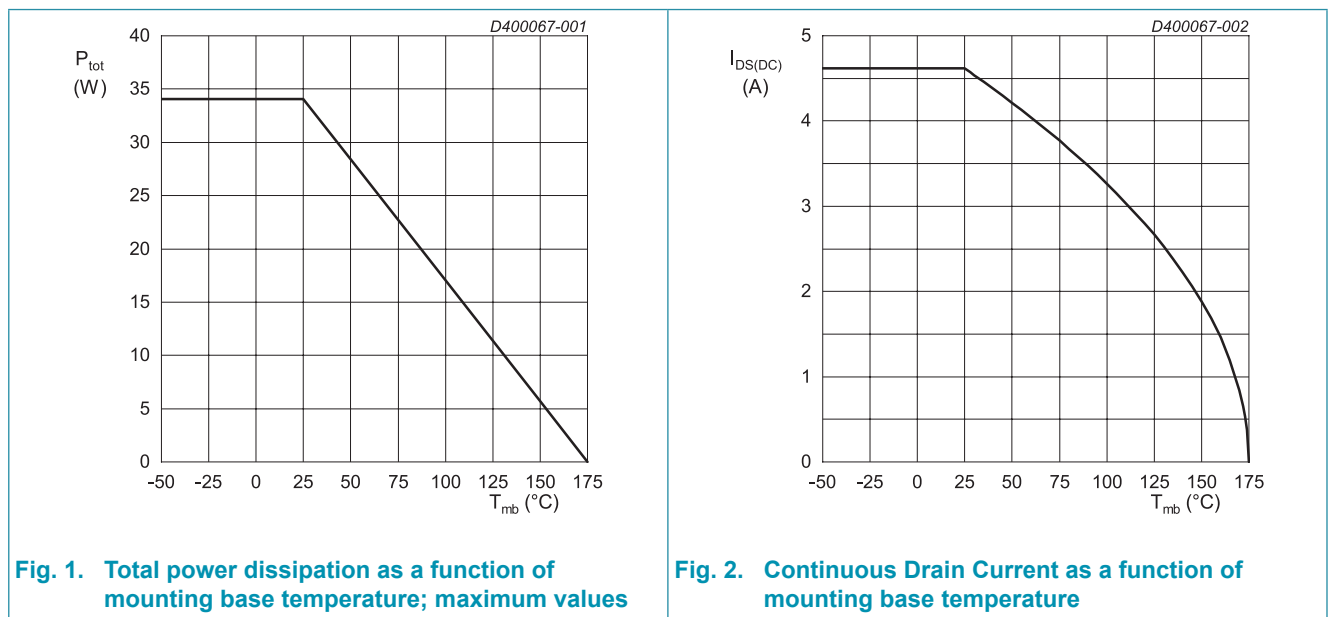
8. Limiting values

Table 5. Limiting values

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

Symbol	Parameter	Conditions	Notes	Vaules	Unit
V_{DS}	drain-source voltage	$25\text{ °C} \leq T_j \leq 175\text{ °C}$		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	$T_{mb} = 25\text{ °C}$		34	W
I_D	drain current	$V_{GS} = 18\text{ V}; T_{mb} = 25\text{ °C}$		4.6	A
		$V_{GS} = 18\text{ V}; T_{mb} = 100\text{ °C}$		3.3	A
I_{DM}	peak drain current	pulsed; $t_p \leq 10\text{ }\mu\text{s}; T_{mb} = 25\text{ °C}$		10	A
E_{as}	single pulse drain-to-source avalanche	$I_{AS} = 7\text{ A}; L = 1\text{ mH}; V_{DD} = 100\text{ V}; T_{j(init)} = 25\text{ °C}$		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

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



9. Thermal characteristics

Table 6. Thermal characteristics

Symbol	Parameter	Conditions	Notes	Min	Typ	Max	Unit
$R_{th(j-mb)}$	thermal resistance from junction to mounting base			-	4.4	-	K/W
$R_{th(j-a)}$	thermal resistance from junction to ambient	in free air		-	50	-	K/W

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

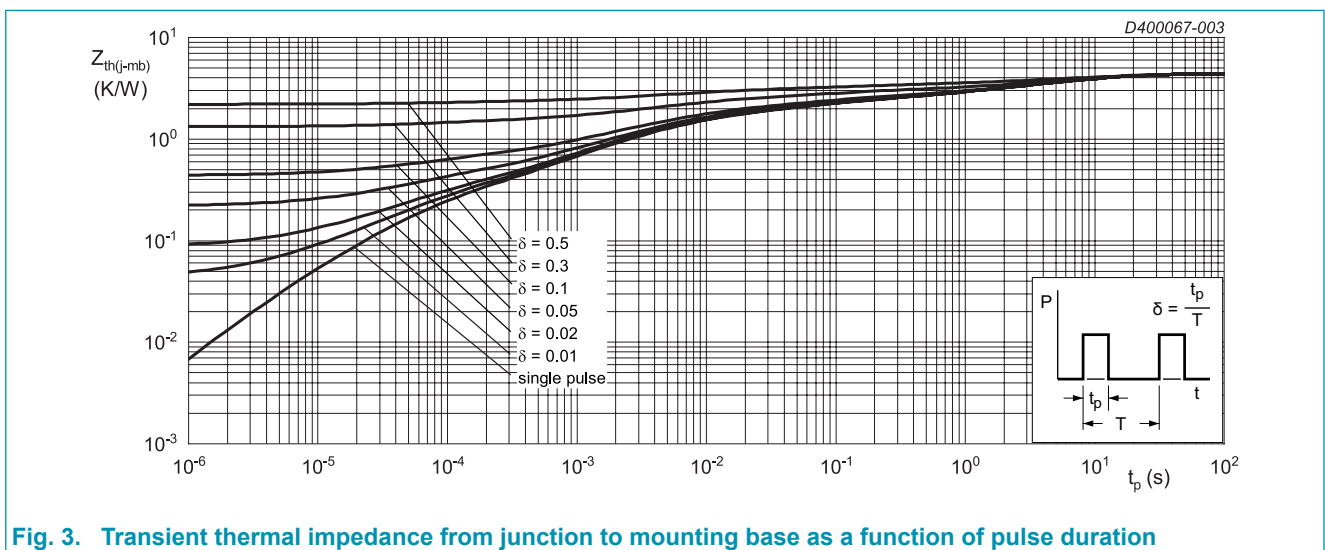
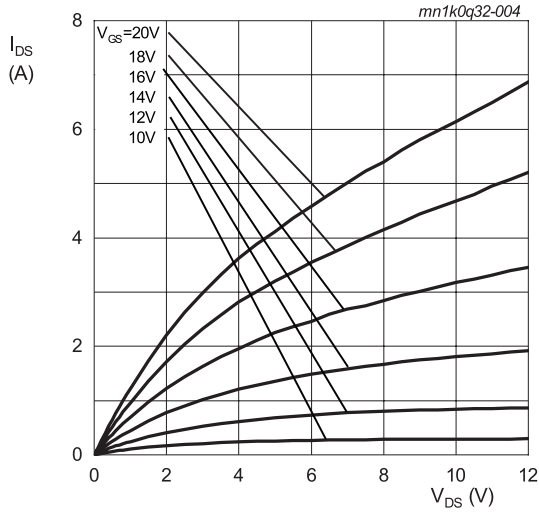


Fig. 3. Transient thermal impedance from junction to mounting base as a function of pulse duration

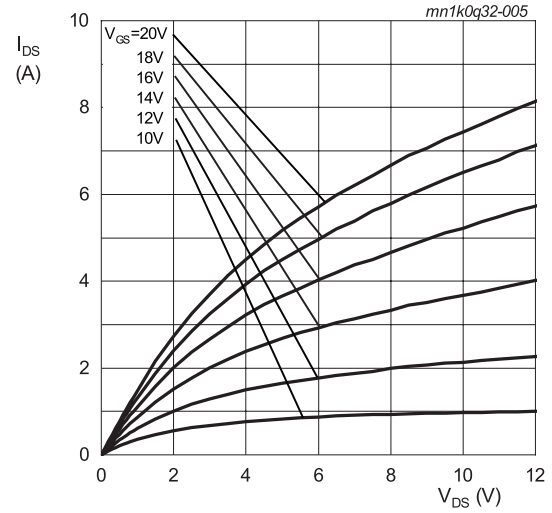
10. Characteristics

Table 7. Characteristics

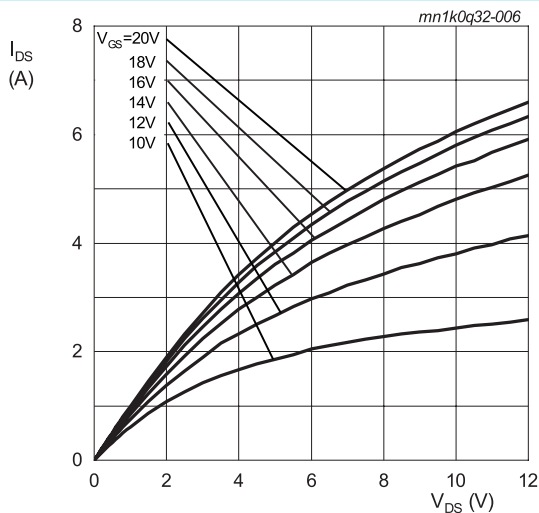
Symbol	Parameter	Conditions	Notes	Min	Typ	Max	Unit
Static characteristics							
$V_{(BR)DSS}$	drain-source breakdown voltage	$I_D = 100 \mu A; V_{GS} = 0 V; T_J = 25 \text{ }^\circ C$		1700	-	-	V
$V_{GS(th)}$	gate-source threshold voltage	$I_D = 0.8 \text{ mA}; V_{DS} = 10 \text{ V}; T_J = 25 \text{ }^\circ C$		2.3	3.2	4.2	V
		$I_D = 0.8 \text{ mA}; V_{DS} = 10 \text{ V}; T_J = 150 \text{ }^\circ C$		-	2.4	-	V
I_{DSS}	drain leakage current	$V_{DS} = 1700 \text{ V}; V_{GS} = 0 \text{ V}; T_J = 25 \text{ }^\circ C$		-	0.1	10	μA
		$V_{DS} = 1700 \text{ V}; V_{GS} = 0 \text{ V}; T_J = 150 \text{ }^\circ C$		-	1	-	μA
I_{GSS}	gate leakage current	$V_{GS} = 18 \text{ V}; V_{DS} = 0 \text{ V}; T_J = 25 \text{ }^\circ C$		-	10	100	nA
		$V_{GS} = -10 \text{ V}; V_{DS} = 0 \text{ V}; T_J = 25 \text{ }^\circ C$		-	10	100	nA
$R_{DS(on)}$	drain-source on-state resistance	$V_{GS} = 15 \text{ V}; I_D = 1 \text{ A}; T_J = 25 \text{ }^\circ C$		-	1000	-	m Ω
		$V_{GS} = 18 \text{ V}; I_D = 1 \text{ A}; T_J = 25 \text{ }^\circ C$		-	750	1000	m Ω
		$V_{GS} = 18 \text{ V}; I_D = 1 \text{ A}; T_J = 150 \text{ }^\circ C$		-	1050	-	m Ω
R_G	gate resistance	$f = 1 \text{ MHz}; T_J = 25 \text{ }^\circ C$		-	16	-	Ω
g_{fs}	transconductance	$V_{DS} = 10 \text{ V}; I_D = 1 \text{ A}; T_J = 25 \text{ }^\circ C$		-	0.5	-	S
Dynamic characteristics							
$Q_{G(tot)}$	total gate charge	$I_D = 2 \text{ A}; V_{DS} = 1200 \text{ V}; V_{GS} = 0 \text{ V}/18 \text{ V}; T_J = 25 \text{ }^\circ C$		-	12	-	nC
Q_{GS}	gate-source charge			-	3.8	-	nC
Q_{GD}	gate-drain charge			-	5	-	nC
C_{iss}	input capacitance	$V_{DS} = 1000 \text{ V}; V_{GS} = 0 \text{ V}; f = 1 \text{ MHz}; T_J = 25 \text{ }^\circ C$		-	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		$V_{DS} = 1000 \text{ V}; V_{GS} = -3 \text{ V}/18 \text{ V}; R_{G(ext)} = 5.1 \text{ } \Omega; I_D = 2 \text{ A}; L = 4.8 \text{ mH}; T_J = 25 \text{ }^\circ C$		-	5.6	-
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 <small>(Body Diode FWD)</small>			-	57	-	μJ
E_{off}	turn-off energy <small>(Body Diode FWD)</small>			-	11	-	μJ
Source-drain diode							
V_{SD}	source-drain voltage	$V_{GS} = 0 \text{ V}; I_{SD} = 1 \text{ A}; T_J = 25 \text{ }^\circ C$		-	3.9	-	V
		$V_{GS} = 0 \text{ V}; I_{SD} = 1 \text{ A}; T_J = 150 \text{ }^\circ C$		-	3.4	-	V
t_{rr}	reverse recovery time	$I_{SD} = 1 \text{ A}; di/dt = 500 \text{ A}/\mu s; V_{DS} = 400 \text{ V}; T_J = 25 \text{ }^\circ C$		-	36	-	ns
Q_r	recovered charge			-	38	-	nC
I_{rrm}	reverse recovery current			-	1.8	-	A



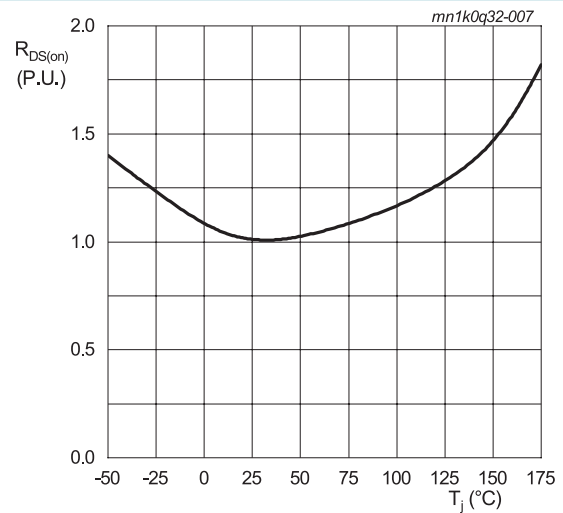
$T_j = -55\text{ °C}; t_p < 200\ \mu\text{s}$
Fig. 4. Output characteristics; drain current as a function of drain-source voltage; typical values



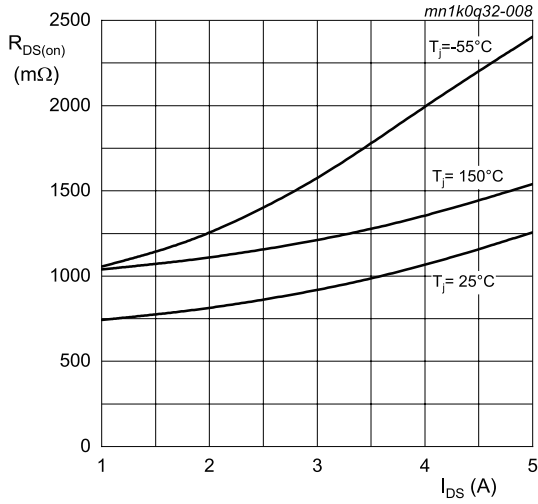
$T_j = 25\text{ °C}; t_p < 200\ \mu\text{s}$
Fig. 5. Output characteristics; drain current as a function of drain-source voltage; typical values



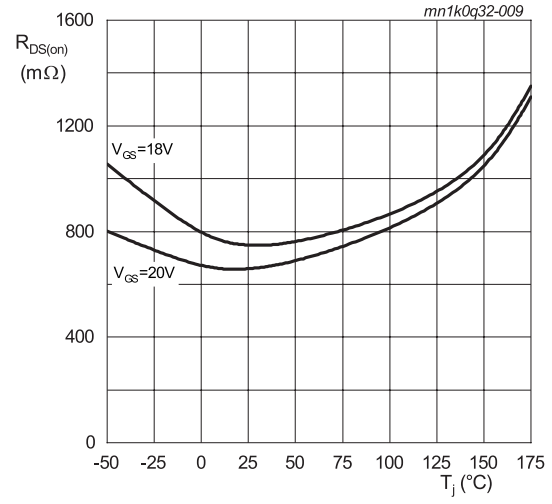
$T_j = 150\text{ °C}; t_p < 200\ \mu\text{s}$
Fig. 6. Output characteristics; drain current as a function of drain-source voltage; typical values



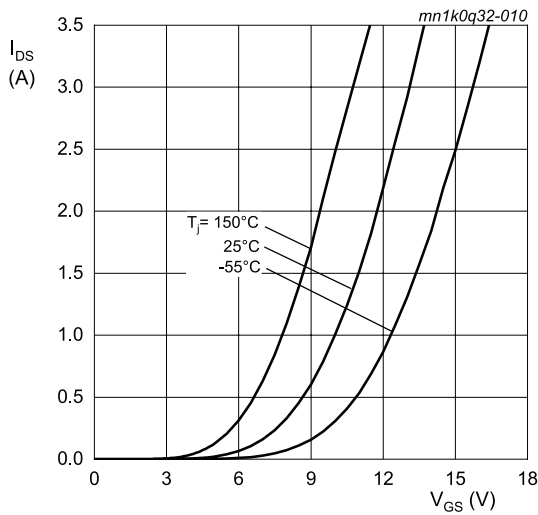
$I_{DS} = 1\text{ A}; V_{GS} = 18\text{ V}; t_p < 200\ \mu\text{s}$
Fig. 7. Normalized drain-source on-state resistance as a function of junction temperature



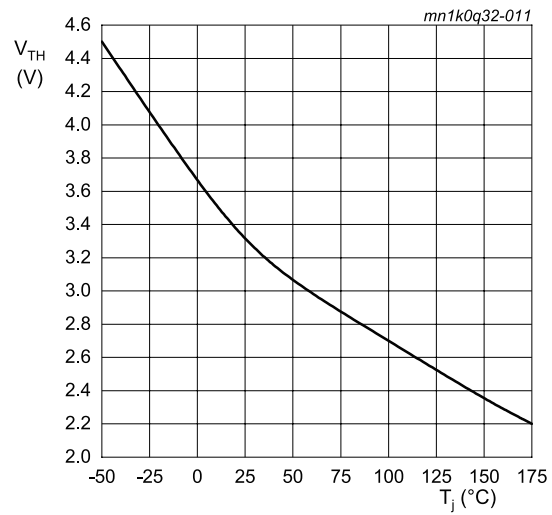
$V_{GS} = 18\text{ V}; t_p < 200\ \mu\text{s}$
Fig. 8. Drain-source on-state resistance as a function of drain current; typical values



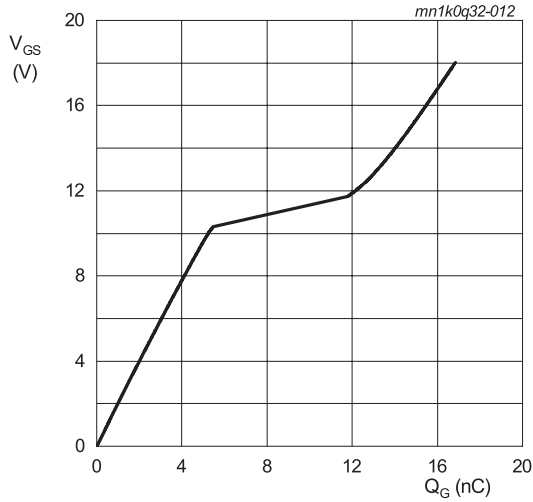
$I_{DS} = 1\text{ A}; t_p < 200\ \mu\text{s}$
Fig. 9. Drain-source on-state resistance as a function of junction temperature



$V_{DS} = 10\text{ V}; t_p < 200\ \mu\text{s}$
Fig. 10. Transfer characteristics; drain current as a function of gate-source voltage; typical values



$V_{DS} = 10\text{ V}; I_{DS} = 0.8\text{ mA}$
Fig. 11. Threshold voltage as a function of junction temperature



$I_{DS} = 2\text{ A}; I_{GS} = 0.1\text{ mA}; V_{DS} = 1200\text{ V}; T_j = 25\text{ }^\circ\text{C}$
Fig. 12. Gate-source voltage as a function of gate charge; typical values

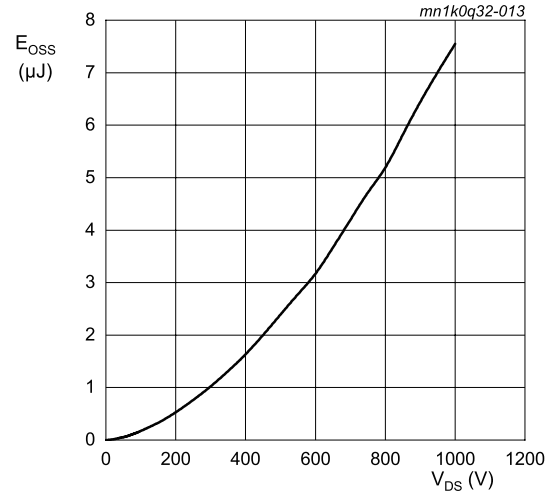
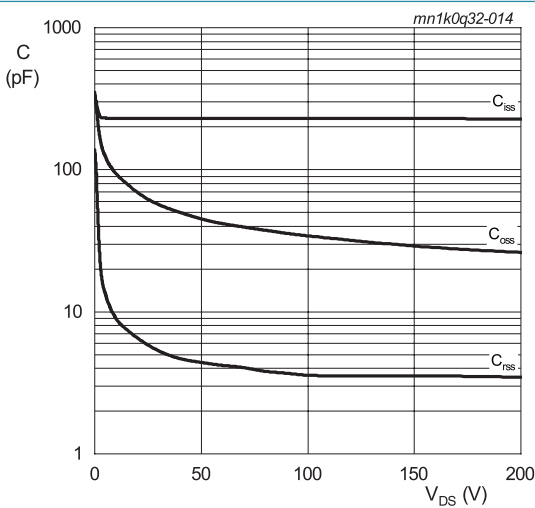
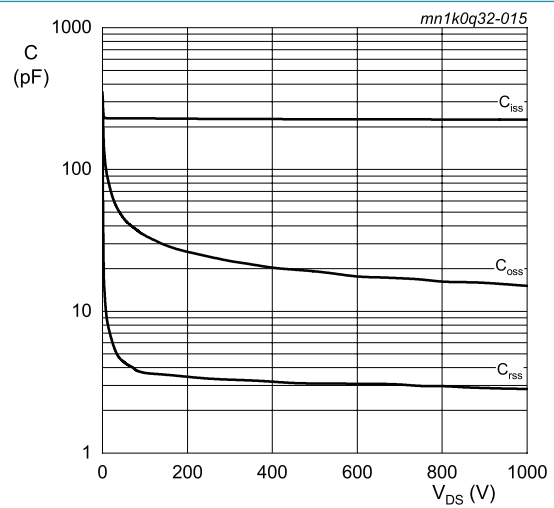


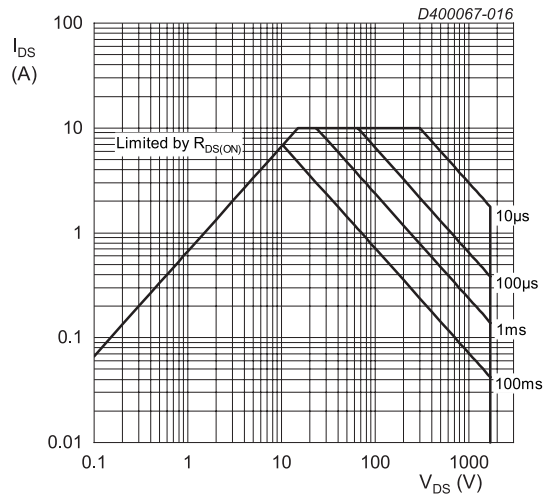
Fig. 13. Output capacitor stored energy as a function of drain-source voltage



$V_{DS} = 0 - 200\text{ V}$
 $T_j = 25\text{ }^\circ\text{C}; V_{AC} = 25\text{ mV}; f = 1\text{ MHz}$
Fig. 14. Input, output and reverse transfer capacitances as a function of drain-source voltage; typical values

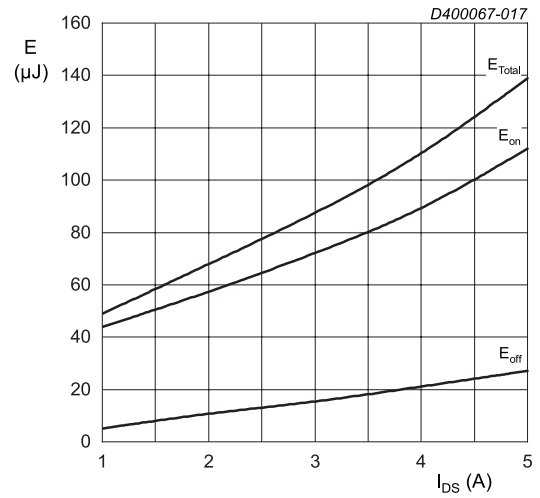


$V_{DS} = 0 - 1000\text{ V}$
 $T_j = 25\text{ }^\circ\text{C}; V_{AC} = 25\text{ mV}; f = 1\text{ MHz}$
Fig. 15. Input, output and reverse transfer capacitances as a function of drain-source voltage; typical values



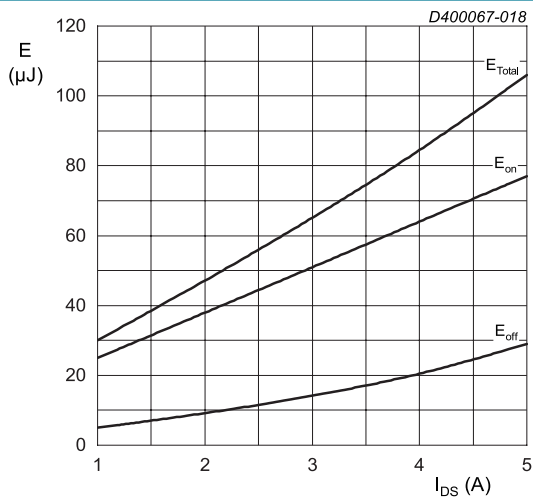
$T_j = 25\text{ }^\circ\text{C}$; $D = 0$
Parameter: t_p

Fig. 16. Forward bias safe operating area



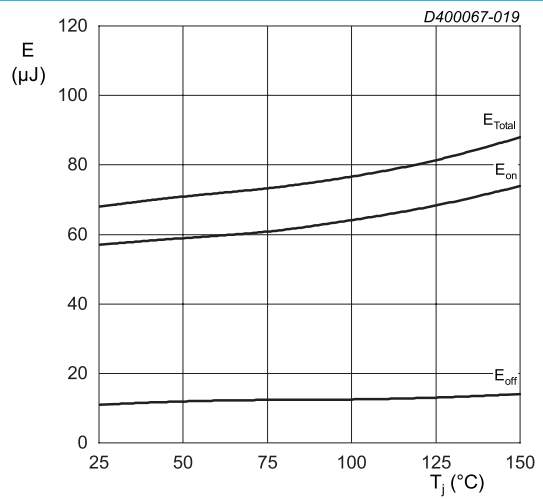
$T_j = 25\text{ }^\circ\text{C}$; $V_{DD} = 1000\text{ V}$; $R_{G(ext)} = 5.1\text{ }\Omega$;
 $V_{GS} = -3\text{ V}/18\text{ V}$; FWD = WN2M1K0170B7
 $L = 4.8\text{ mH}$

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



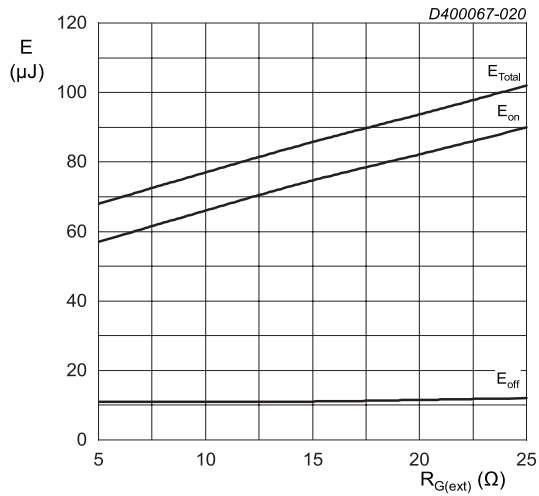
$T_j = 25\text{ }^\circ\text{C}$; $V_{DD} = 1200\text{ V}$; $R_{G(ext)} = 5.1\text{ }\Omega$;
 $V_{GS} = -3\text{ V}/18\text{ V}$; FWD = WN2M1K0170J
 $L = 4.8\text{ mH}$

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



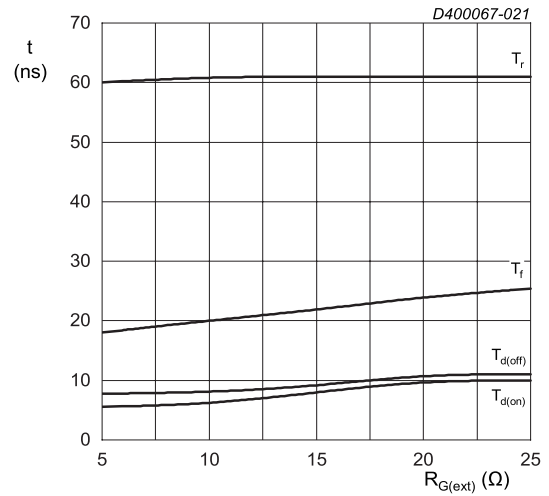
$I_{DS} = 2\text{ A}$; $V_{DD} = 1000\text{ V}$; $R_{G(ext)} = 5.1\text{ }\Omega$;
 $V_{GS} = -3\text{ V}/18\text{ V}$; FWD = WN2M1K0170J
 $L = 4.8\text{ mH}$

Fig. 19. Clamped Inductive Switching Energy as a function of junction temperature



$T_j = 25\text{ }^\circ\text{C}$; $V_{DD} = 1000\text{ V}$; $I_{DS} = 2\text{ A}$; $V_{GS} = -3\text{ V}/18\text{ V}$
 FWD = WNSC2M1K0170J; $L = 4.8\text{ mH}$

Fig. 20. Clamped Inductive Switching Energy as a function of external gate resistance



$T_j = 25\text{ }^\circ\text{C}$; $V_{DD} = 1000\text{ V}$; $I_{DS} = 2\text{ A}$; $V_{GS} = -3\text{ V}/18\text{ V}$
 FWD = WNSC2M1K0170J; $L = 4.8\text{ mH}$

Fig. 21. Switching time as a function of external gate resistance

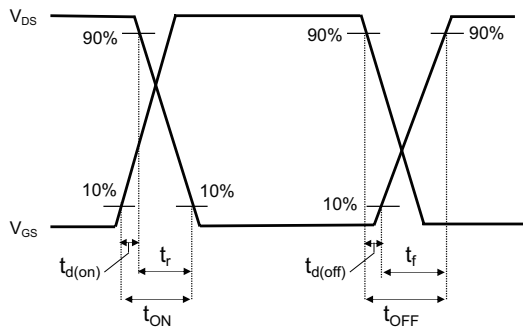
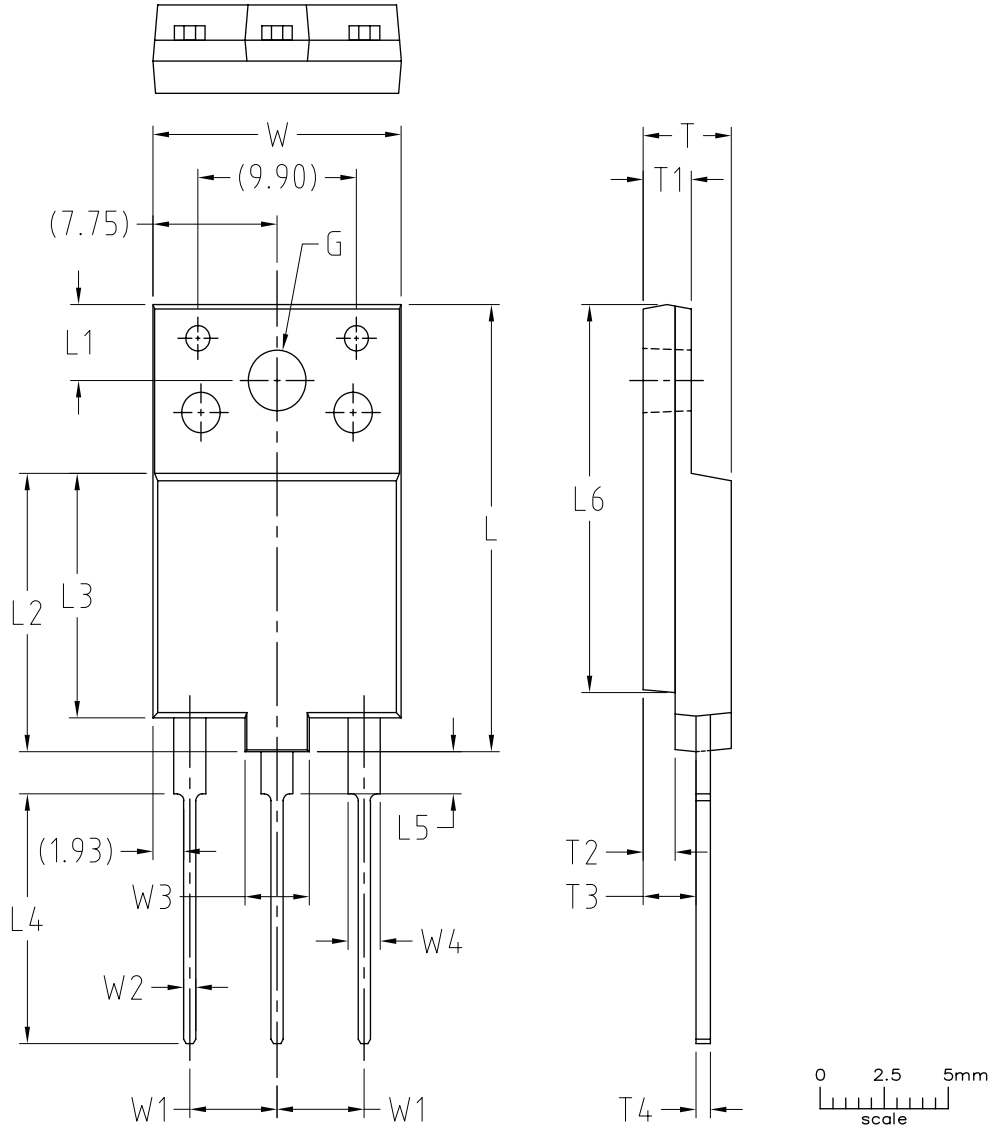


Fig. 22. Switching time definition

11. Package outline

Plastic single-ended package; isolated heatsink mounted; 1 mounting hole; 3-lead TO-3P 'full pack' TO3PF



Remark : (X) the dimension X in blackets is for reference

UNIT	W	W1	W2	W3	W4	L	L1	L2	L3	L4	L5	L6	T	T1	T2	T3	T4	G(φ)
mm	15.7	5.75	0.95	4.20	2.20	26.7	4.6	16.7	14.7	15.0	2.7	23.2	5.7	3.2	2.2	3.5	1.1	3.8
	15.3	5.15	0.65	3.80	1.80	26.3	4.4	16.3	14.3	14.6	2.3	22.8	5.3	2.8	1.8	3.1	0.8	3.4

OUTLINE VERSION	REFERENCES			EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ		
		TO-3PF			

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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