

1. General description

Silicon Carbide MOSFET in a TO247-4L plastic package, designed for high frequency, high efficiency systems.



AEC - Q101 Qualified



2. Features and benefits

- Kelvin source configuration
- 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

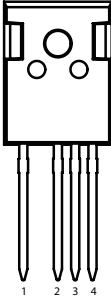
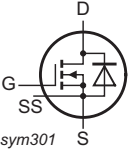
Table 1. Quick reference data

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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		81			A
P _{tot}	total power dissipation	T _{mb} = 25 °C, T _j = 175 °C		375			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 = 33A; 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 = 2490 A/μs; V _{DS} = 600 V; T _j = 25 °C		-	300	-	nC

5. Pinning information

Table 2. Pinning information

Pin	Symbol	Description	Simplified outline	Graphic symbol
1	D	drain		
2	S	source		
3	SS	source sense		
4	G	gate		
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
WNSC2M40120R-A	TO247-4L	WNSC2M40120R-A6Q	Tube	30	TO247N-4L	17-Dec-2021

7. Marking

Table 4. Marking codes

Type number	Marking codes
WNSC2M40120R-A	WNSC2M 40120R-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	$25\text{ °C} \leq T_J \leq 175\text{ °C}$		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	$T_{mb} = 25\text{ °C}$, $T_J = 175\text{ °C}$		375	W
I_D	drain current	$V_{GS} = 18\text{ V}$; $T_{mb} = 25\text{ °C}$		81	A
		$V_{GS} = 18\text{ V}$; $T_{mb} = 100\text{ °C}$		58	A
I_{DM}	peak drain current	pulse width t_p limited by T_{Jmax}	Fig.17	162	A
I_S	continuous diode current	$V_{GS} = -4\text{ V}$; $T_{mb} = 25\text{ °C}$		60	A
I_{SM}	pulse diode current	$V_{GS} = -4\text{ V}$; pulse width t_p limited by T_{Jmax}		162	A
E_{as}	single pulse drain-to-source avalanche	$I_{AS} = 24\text{ A}$; $L = 1\text{ mH}$; $V_{DD} = 100\text{ V}$; $T_J = 25\text{ °C}$		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

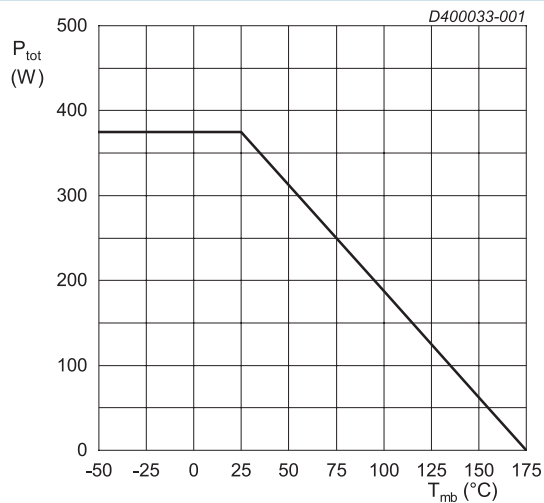


Fig. 1. Total power dissipation as a function of mounting base temperature; maximum values

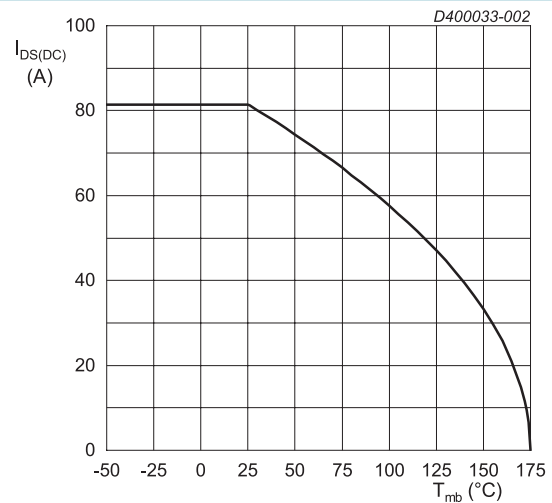


Fig. 2. Continuous Drain Current as a function of mounting base temperature

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			-	0.4	-	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.

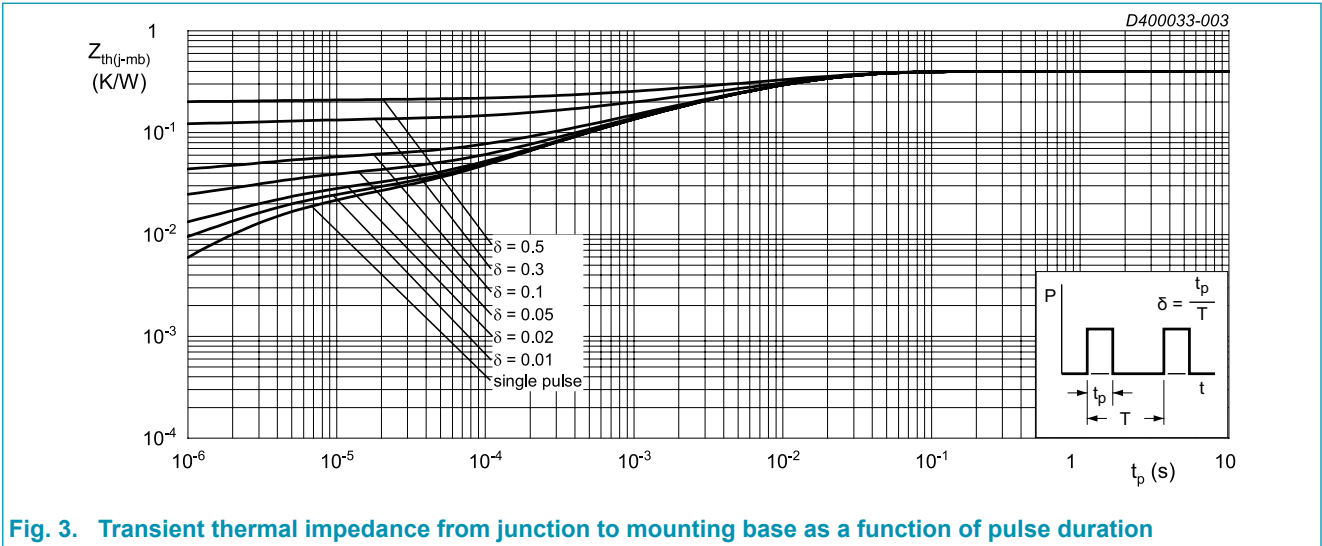


Fig. 3. Transient thermal impedance from junction to mounting base as a function of pulse duration

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		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 = 300 μH; T _J = 25 °C		-	8	-	ns
t _r	rise time			-	22	-	ns
t _{d(off)}	turn-off delay time			-	30	-	ns
t _f	fall time			-	11	-	ns
E _{on}	turn-on energy <small>(SiC Diode FWD)</small>		Fig.20	-	353	-	μJ
E _{off}	turn-off energy <small>(SiC Diode FWD)</small>		Fig.20	-	90	-	μJ
E _{on}	turn-on energy <small>(Body Diode FWD)</small>		Fig.20	-	397	-	μJ
E _{off}	turn-off energy <small>(Body Diode FWD)</small>		Fig.20	-	116	-	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 = 2490 A/μs; V _{DS} = 600 V; T _J = 25 °C		-	17	-	ns
Q _r	recovered charge			-	300	-	nC
I _{rrm}	reverse recovery current			-	33	-	A

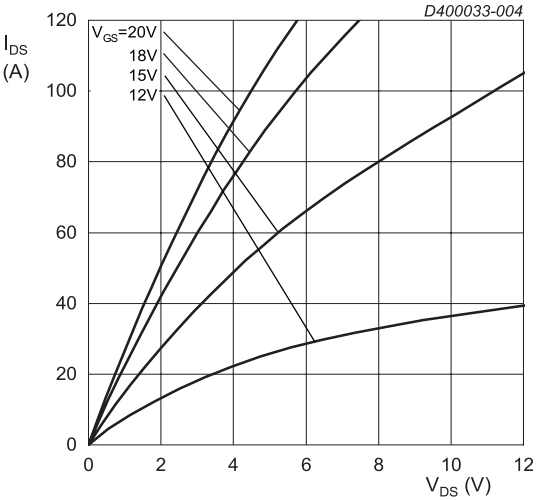


Fig. 4. Output characteristics; drain current as a function of drain-source voltage; typical values

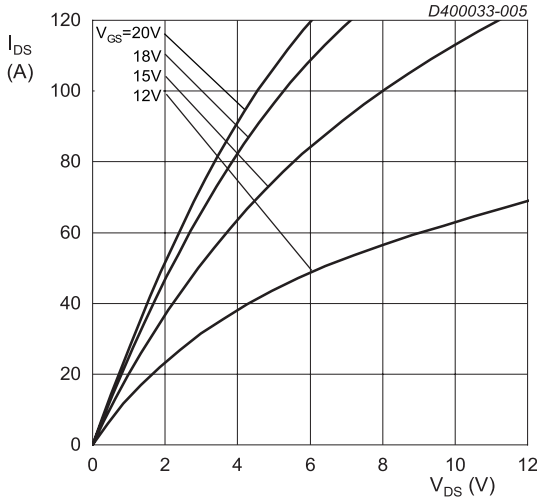


Fig. 5. Output characteristics; drain current as a function of drain-source voltage; typical values

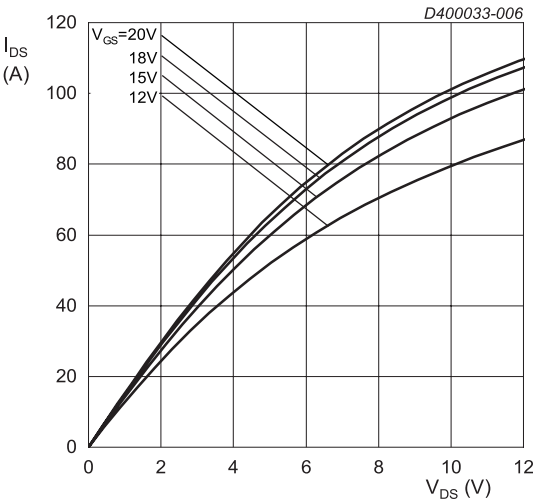


Fig. 6. Output characteristics; drain current as a function of drain-source voltage; typical values

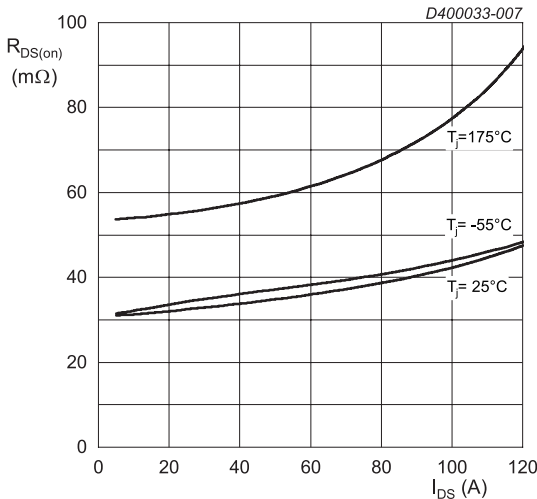
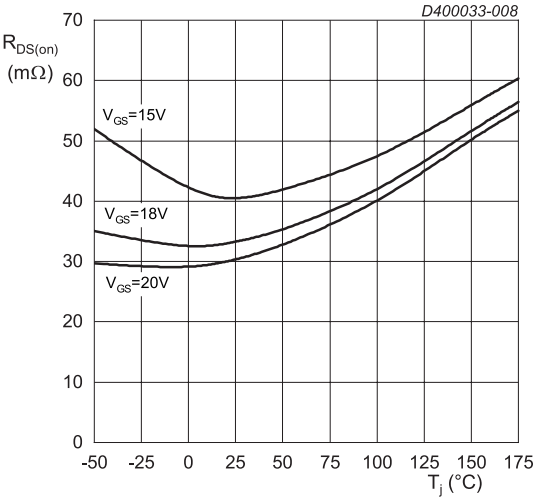
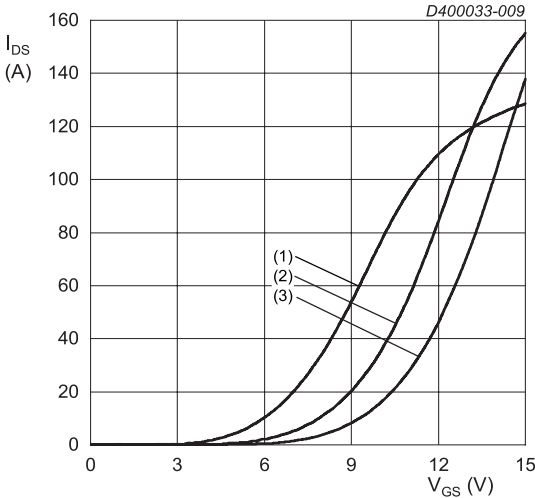


Fig. 7. Drain-source on-state resistance as a function of drain current; typical values



$I_{DS} = 33\text{ A}$; $t_p < 200\text{ }\mu\text{s}$

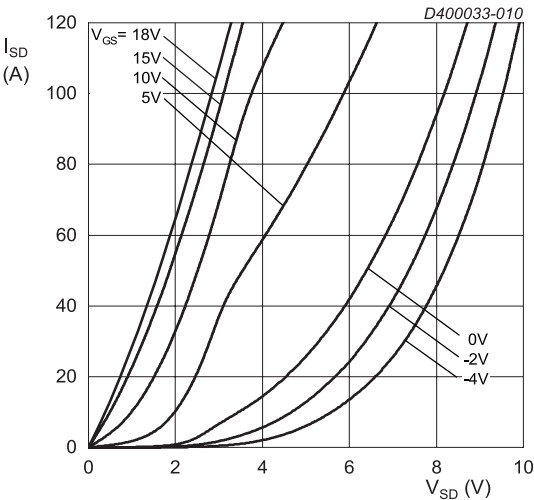
Fig. 8. Drain-source on-state resistance as a function of junction temperature



$V_{DS} = 20\text{ V}$; $t_p < 200\text{ }\mu\text{s}$

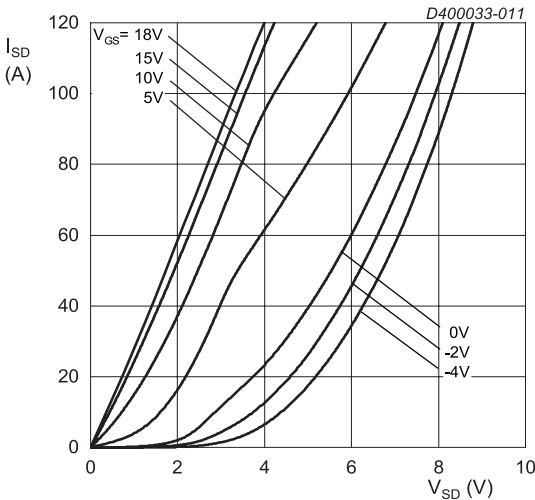
- (1) $T_j = 175\text{ }^\circ\text{C}$
- (2) $T_j = 25\text{ }^\circ\text{C}$
- (3) $T_j = -55\text{ }^\circ\text{C}$

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



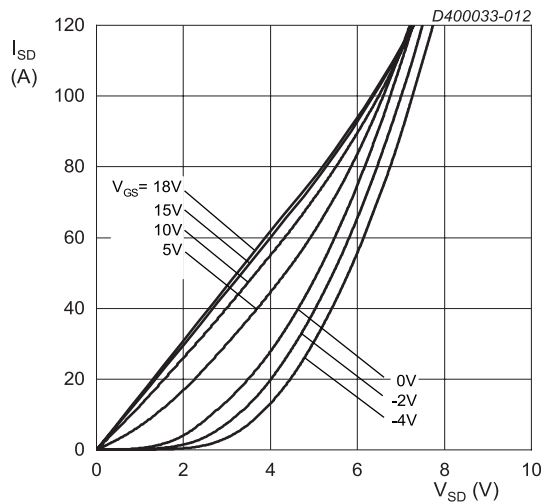
$T_j = -55\text{ }^\circ\text{C}$; $t_p < 200\text{ }\mu\text{s}$

Fig. 10. Body diode forward characteristics; typical values



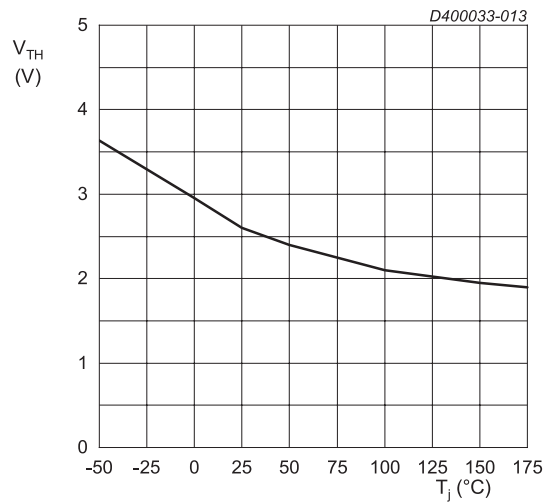
$T_j = 25\text{ }^\circ\text{C}$; $t_p < 200\text{ }\mu\text{s}$

Fig. 11. Body diode forward characteristics; typical values



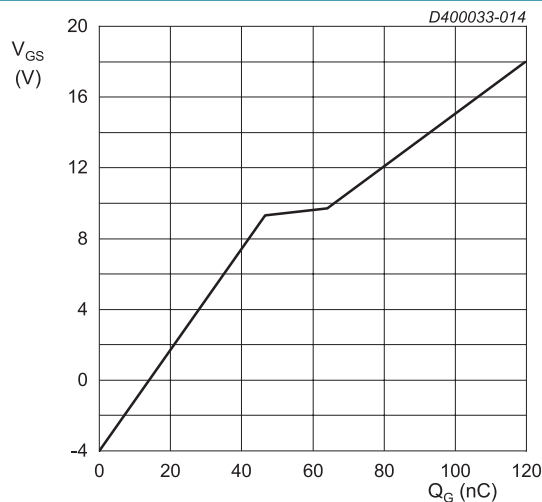
$T_j = 175\text{ }^{\circ}\text{C}; t_p < 200\text{ }\mu\text{s}$

Fig. 12. Body diode forward characteristics; typical values



$V_{DS} = 10\text{ V}; I_{DS} = 10\text{ mA}$

Fig. 13. Threshold voltage as a function of junction temperature



$I_{DS} = 33\text{ A}; I_{GS} = 0.1\text{ mA}; V_{DS} = 800\text{ V}; T_j = 25\text{ }^{\circ}\text{C}$

Fig. 14. Gate-source voltage as a function of gate charge; typical values

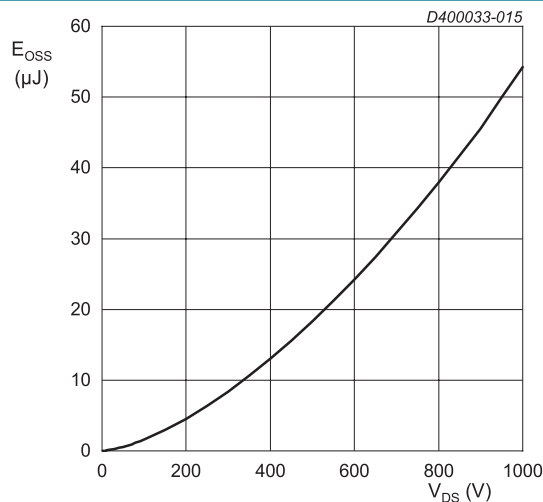
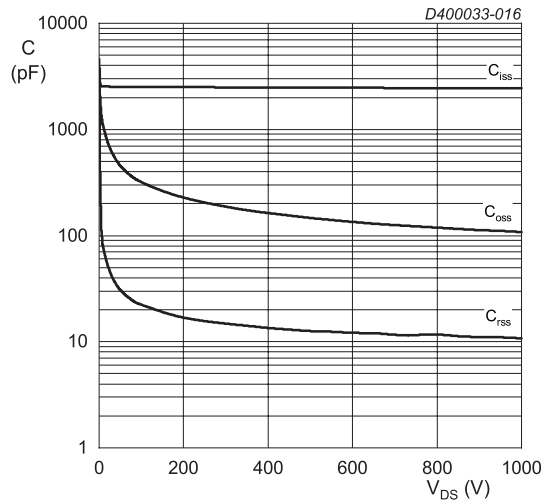
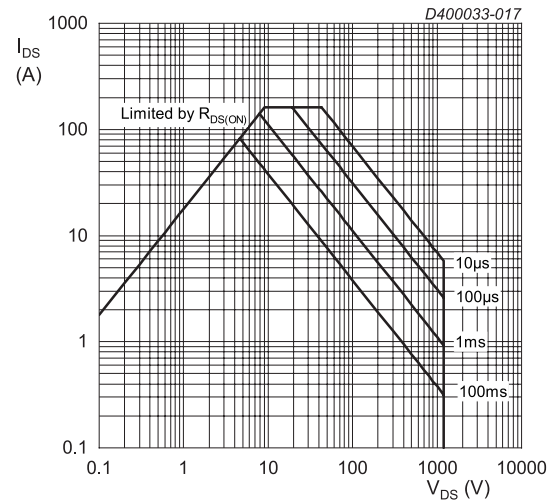


Fig. 15. Output capacitor stored energy as a function of drain-source voltage



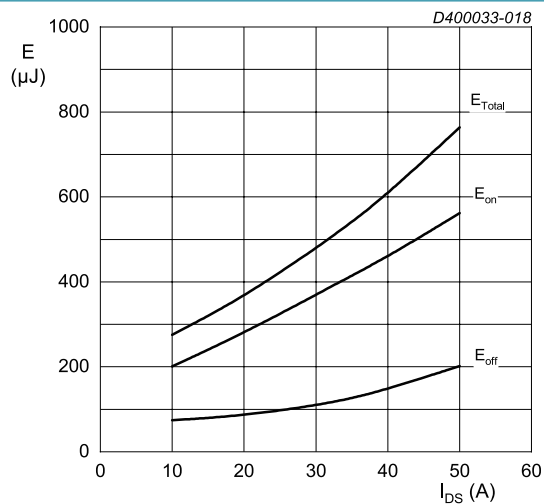
$V_{DS} = 0 - 1000 \text{ V}$
 $T_j = 25^\circ\text{C}$; $V_{AC} = 25 \text{ mV}$; $f = 1 \text{ MHz}$

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



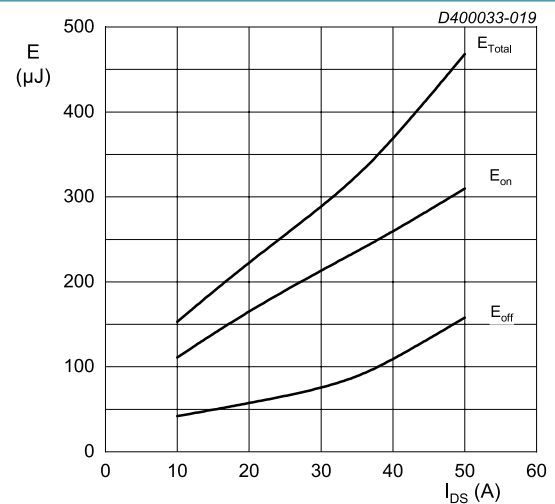
$T_j = 25^\circ\text{C}$; $D = 0$
 Parameter: t_p

Fig. 17. Forward bias safe operating area



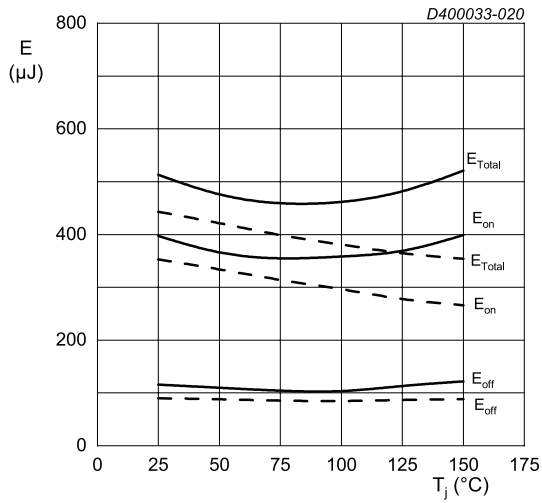
$T_j = 25^\circ\text{C}$; $V_{DD} = 800 \text{ V}$; $R_{G(ext)} = 5.1 \Omega$;
 $V_{GS} = -4 \text{ V}/18 \text{ V}$; $L = 300 \mu\text{H}$
 FWD = WNSC2M40120R-A

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



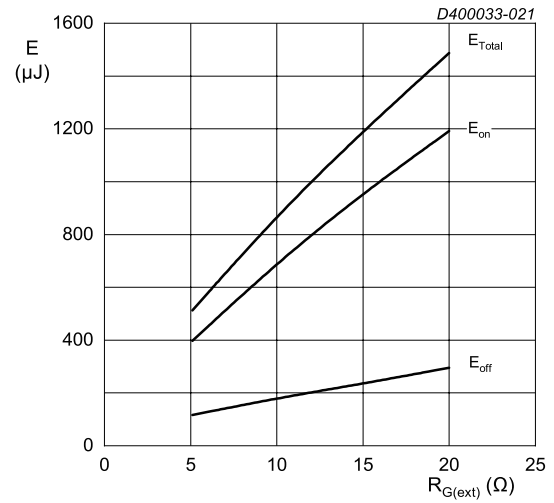
$T_j = 25^\circ\text{C}$; $V_{DD} = 600 \text{ V}$; $R_{G(ext)} = 5.1 \Omega$;
 $V_{GS} = -4 \text{ V}/18 \text{ V}$; $L = 300 \mu\text{H}$
 FWD = WNSC2M40120R-A

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



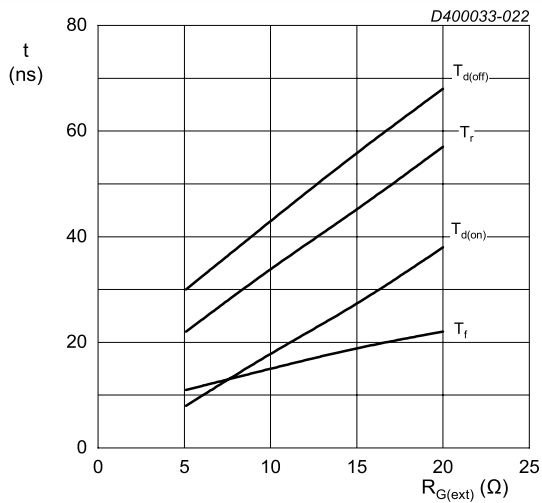
$I_{DS} = 33 \text{ A}$; $V_{DD} = 800 \text{ V}$; $R_{G(ext)} = 5.1 \text{ } \Omega$;
 $V_{GS} = -4 \text{ V/18 V}$; $L = 300 \text{ } \mu\text{H}$
 FWD = WNSC2M40120R-A
 FWD = WNSC2D501200W(- - -)

Fig. 20. Clamped Inductive Switching Energy as a function of junction temperature



$T_j = 25 \text{ } ^\circ\text{C}$; $V_{DD} = 800 \text{ V}$; $I_{DS} = 33 \text{ A}$; $V_{GS} = -4 \text{ V/18 V}$
 FWD = WNSC2M40120R-A; $L = 300 \text{ } \mu\text{H}$

Fig. 21. Clamped Inductive Switching Energy as a function of external gate resistance



$T_j = 25 \text{ } ^\circ\text{C}$; $V_{DD} = 800 \text{ V}$; $I_{DS} = 33 \text{ A}$; $V_{GS} = -4 \text{ V/18 V}$
 FWD = WNSC2M40120R-A; $L = 300 \text{ } \mu\text{H}$

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

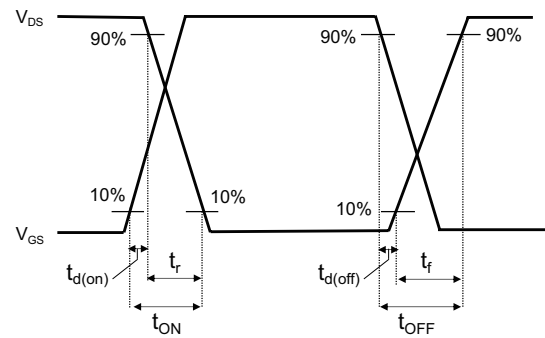
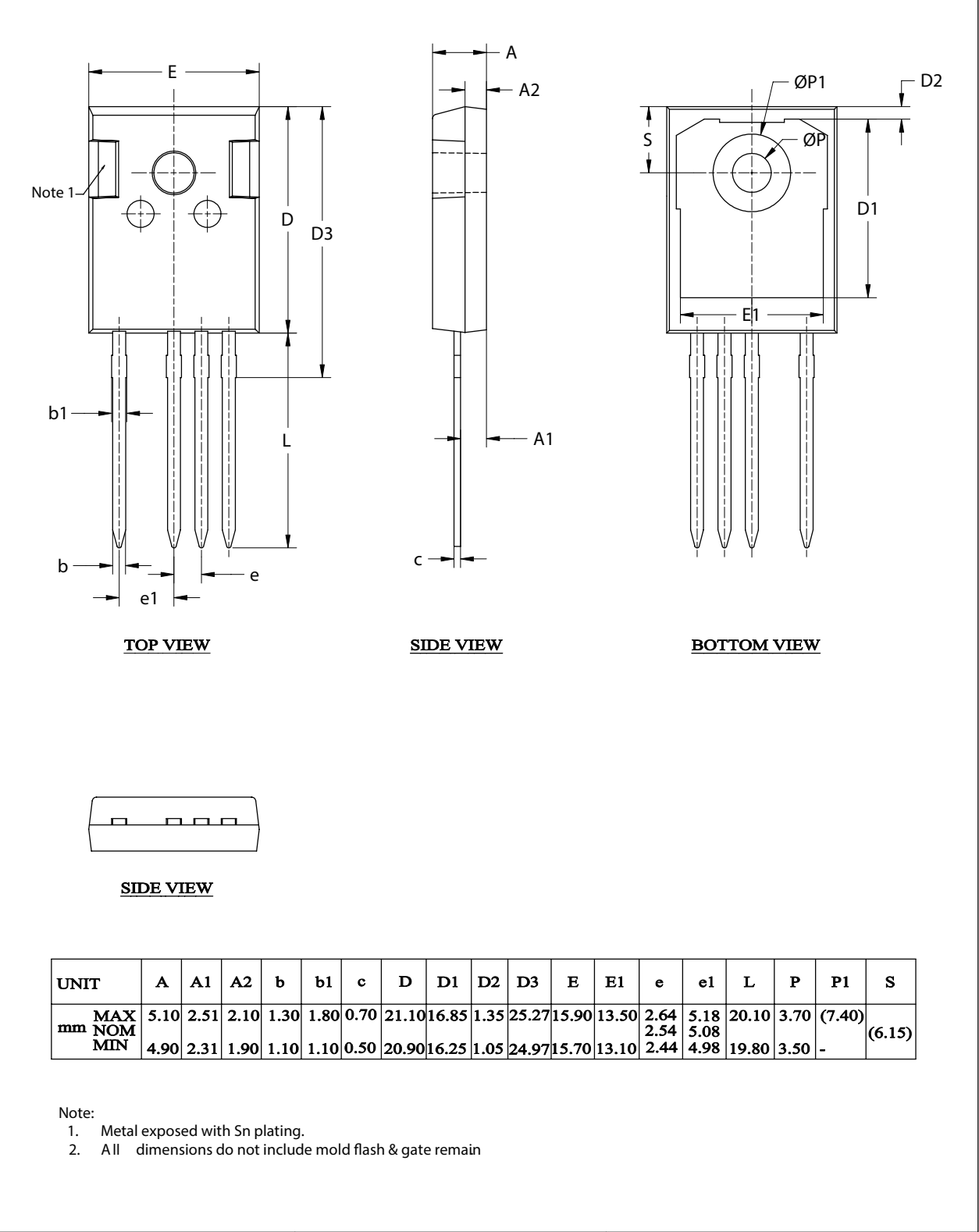


Fig. 23. Switching time definition

11. Package outline

Plastic single-ended through-hole package; heatsink mounted; 1 mounting hole; 4 leads TO-247

TO247-4L



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.

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- [2] The term 'short data sheet' is explained in section "Definitions".
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