

1. General description

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



2. Features and benefits

- Kelvin source configuration
- Low specific on-resistance
- Optimized dynamic performance
- Robust gate design
- 0V turn-off VGS for simple gate driving
- Easy to parallel
- 100% UIS Tested
- Easy to parallel
- RoHS compliant

3. Applications

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

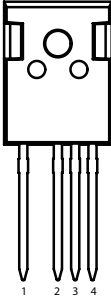
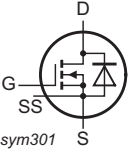
4. Quick reference data

Table 1. Quick reference data

Symbol	Parameter	Conditions	Notes	Values			Unit
Absolute maximum rating							
V_{DS}	drain-source voltage	$25\text{ °C} \leq T_j \leq 175\text{ °C}$		1200			V
I_D	drain current	$V_{GS} = 18\text{ V}; T_{mb} = 25\text{ °C}$		91			A
P_{tot}	total power dissipation	$T_{mb} = 25\text{ °C}, T_j = 175\text{ °C}$		556			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	$V_{GS} = 15\text{ V}; I_D = 33\text{ A}; T_j = 25\text{ °C}$		-	40	-	mΩ
		$V_{GS} = 18\text{ V}; I_D = 33\text{ A}; T_j = 25\text{ °C}$		-	33	45	mΩ
Dynamic characteristics							
$Q_{G(tot)}$	total gate charge	$I_D = 33\text{ A}; V_{DS} = 800\text{ V}; V_{GS} = -4\text{ V}/18\text{ V}; T_j = 25\text{ °C}$		-	115	-	nC
Q_{GD}	gate-drain charge			-	18	-	nC
Source-drain diode							
Q_r	recovered charge	$I_{SD} = 33\text{ A}; V_{GS} = -4\text{ V}/18\text{ V}; di/dt = 2490\text{ A}/\mu\text{s}; V_{DS} = 600\text{ V}; T_j = 25\text{ °C}$		-	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
WN _{SC} 2M40120R	TO247-4L	WN _{SC} 2M40120R6Q	Tube	30	TO247N-4L	17-Dec-2021

7. Marking

Table 4. Marking codes

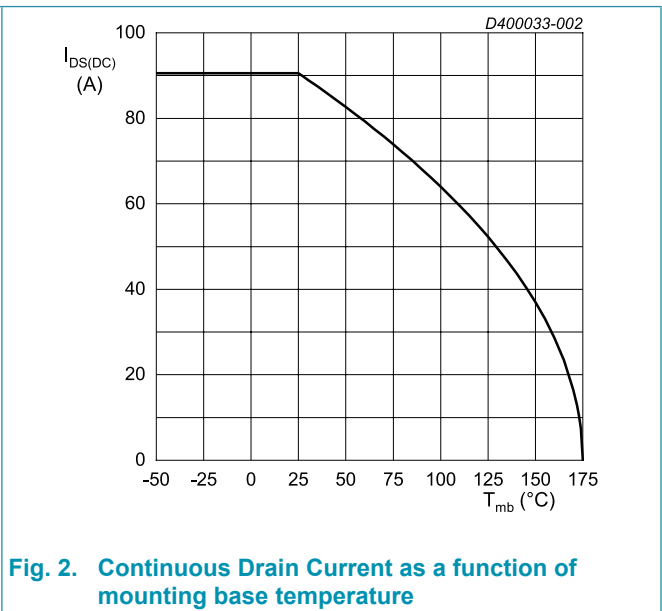
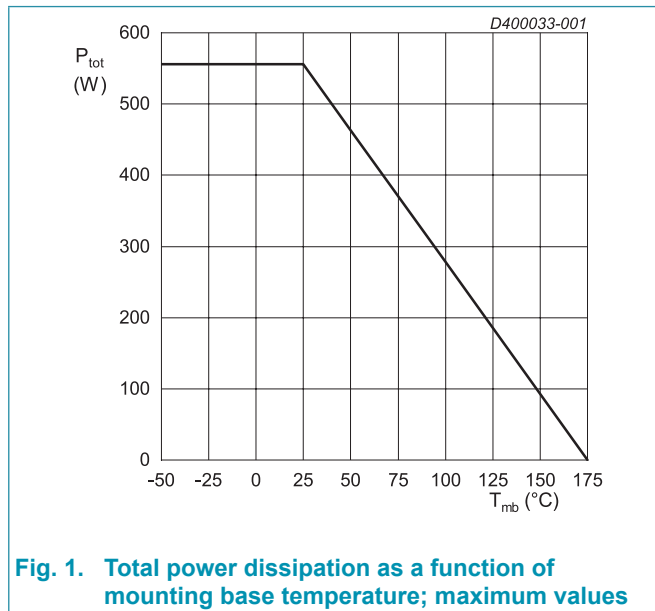
Type number	Marking codes
WN _{SC} 2M40120R	WN _{SC} 2M 40120R

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			-12 to 24	V
$V_{GS,op}$	gate-source voltage			-4 to 18	V
P_{tot}	total power dissipation	$T_{mb} = 25\text{ °C}, T_j = 175\text{ °C}$		556	W
I_D	drain current	$V_{GS} = 18\text{ V}; T_{mb} = 25\text{ °C}$		91	A
		$V_{GS} = 18\text{ V}; T_{mb} = 100\text{ °C}$		64	A
I_{DM}	peak drain current	pulse width t_p limited by T_{jmax}	Fig.17	180	A
I_S	continuous diode current	$V_{GS} = -4\text{ V}; T_{mb} = 25\text{ °C}$		71	A
I_{SM}	pulse diode current	$V_{GS} = -4\text{ V}$; pulse width t_p limited by T_{jmax}		180	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 150	°C
T_j	junction temperature			-55 to 175	°C
$T_{sld(M)}$	peak soldering temperature			260	°C



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			-	0.27	-	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.

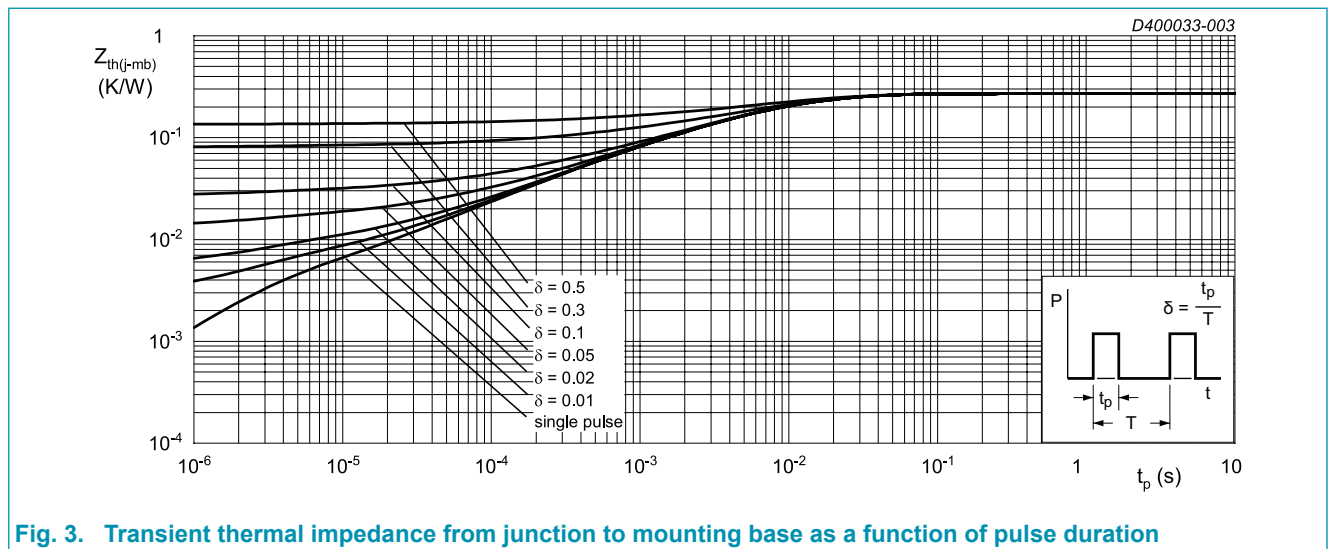
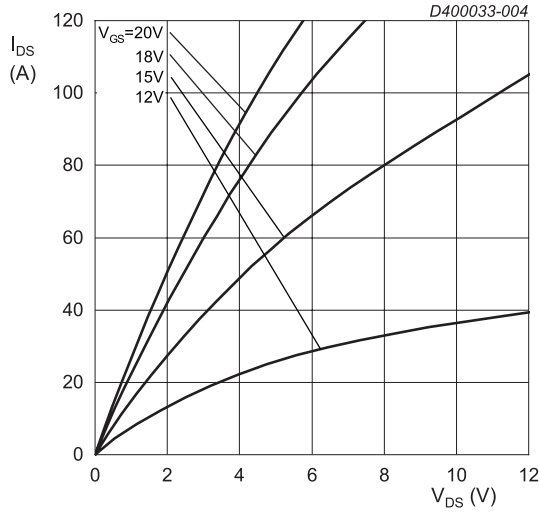


Fig. 3. Transient thermal impedance from junction to mounting base as a function of pulse duration

10. Characteristics

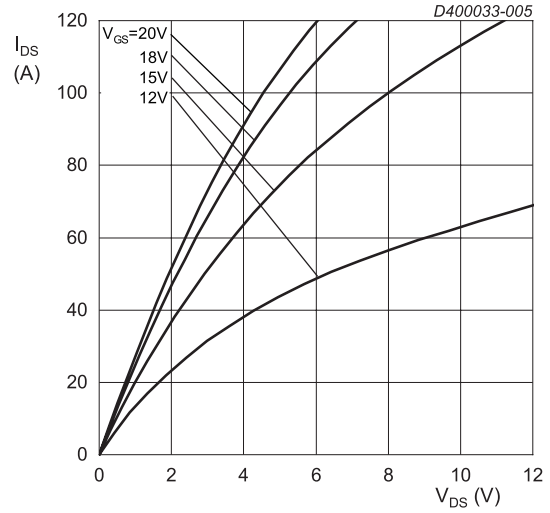
Table 7. Characteristics

Symbol	Parameter	Conditions	Notes	Min	Typ	Max	Unit
Static characteristics							
$V_{(BR)DSS}$	drain-source breakdown voltage	$I_D = 100 \mu A; V_{GS} = 0 V; T_J = 25 \text{ }^\circ C$		1200	-	-	V
$V_{GS(th)}$	gate-source threshold voltage	$I_D = 10 \text{ mA}; V_{DS} = 10 \text{ V}; T_J = 25 \text{ }^\circ C$		1.9	2.6	3.5	V
		$I_D = 10 \text{ mA}; V_{DS} = 10 \text{ V}; T_J = 175 \text{ }^\circ C$		-	1.9	-	V
I_{DSS}	drain leakage current	$V_{DS} = 1200 \text{ V}; V_{GS} = 0 \text{ V}; T_J = 25 \text{ }^\circ C$		-	0.2	100	μA
		$V_{DS} = 1200 \text{ V}; V_{GS} = 0 \text{ V}; T_J = 175 \text{ }^\circ C$		-	2	-	μA
I_{GSS}	gate leakage current	$V_{GS} = 24 \text{ V}; V_{DS} = 0 \text{ V}; T_J = 25 \text{ }^\circ C$		-	10	100	nA
		$V_{GS} = -12 \text{ V}; V_{DS} = 0 \text{ V}; T_J = 25 \text{ }^\circ C$		-	10	100	nA
$R_{DS(on)}$	drain-source on-state resistance	$V_{GS} = 15 \text{ V}; I_D = 33 \text{ A}; T_J = 25 \text{ }^\circ C$		-	40	-	m Ω
		$V_{GS} = 18 \text{ V}; I_D = 33 \text{ A}; T_J = 25 \text{ }^\circ C$		-	33	45	m Ω
		$V_{GS} = 18 \text{ V}; I_D = 33 \text{ A}; T_J = 175 \text{ }^\circ C$		-	56	-	m Ω
R_G	gate resistance	$f = 1 \text{ MHz}; T_J = 25 \text{ }^\circ C$		-	1	-	Ω
g_{fs}	transconductance	$V_{DS} = 20 \text{ V}; I_D = 33 \text{ A}; T_J = 25 \text{ }^\circ C$		-	20	-	S
Dynamic characteristics							
$Q_{G(tot)}$	total gate charge	$I_D = 33 \text{ A}; V_{DS} = 800 \text{ V}; V_{GS} = -4 \text{ V}/18 \text{ V}; T_J = 25 \text{ }^\circ C$		-	115	-	nC
Q_{GS}	gate-source charge			-	47	-	nC
Q_{GD}	gate-drain charge			-	18	-	nC
C_{iss}	input capacitance	$V_{DS} = 1000 \text{ V}; V_{GS} = 0 \text{ V}; f = 1 \text{ MHz}; T_J = 25 \text{ }^\circ C$		-	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	$V_{DS} = 800 \text{ V}; V_{GS} = -4 \text{ V}/18 \text{ V}; R_{G(ext)} = 5.1 \Omega; I_D = 33 \text{ A}; L = 300 \mu H; T_J = 25 \text{ }^\circ C$		-	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 (SiC Diode FWD)		Fig.20	-	353	-	μJ
E_{off}	turn-off energy (SiC Diode FWD)		Fig.20	-	90	-	μJ
E_{on}	turn-on energy (Body Diode FWD)		Fig.20	-	397	-	μJ
E_{off}	turn-off energy (Body Diode FWD)	Fig.20	-	116	-	μJ	
Source-drain diode							
V_{SD}	source-drain voltage	$V_{GS} = 0 \text{ V}; I_{SD} = 16.5 \text{ A}; T_J = 25 \text{ }^\circ C$		-	3.5	-	V
		$V_{GS} = -4 \text{ V}; I_{SD} = 16.5 \text{ A}; T_J = 25 \text{ }^\circ C$		-	5.0	-	V
		$V_{GS} = -4 \text{ V}; I_{SD} = 16.5 \text{ A}; T_J = 175 \text{ }^\circ C$		-	4.3	-	V
t_{rr}	reverse recovery time	$I_{SD} = 33 \text{ A}; V_{GS} = -4 \text{ V}/18 \text{ V}; di/dt = 2490 \text{ A}/\mu s; V_{DS} = 600 \text{ V}; T_J = 25 \text{ }^\circ C$		-	17	-	ns
Q_r	recovered charge			-	300	-	nC
I_{rrm}	reverse recovery current			-	33	-	A



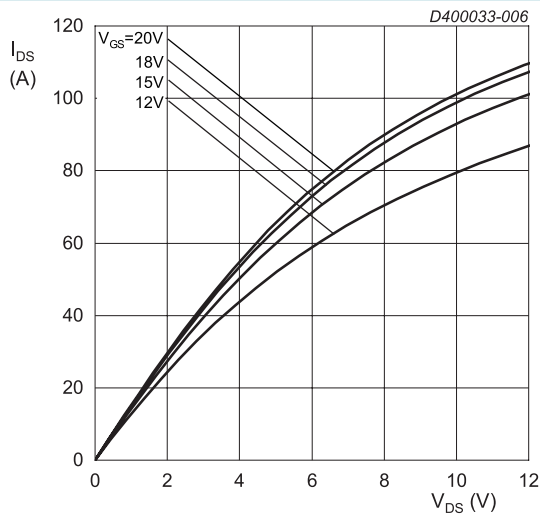
$T_j = -55\text{ }^\circ\text{C}; t_p < 200\text{ }\mu\text{s}$

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



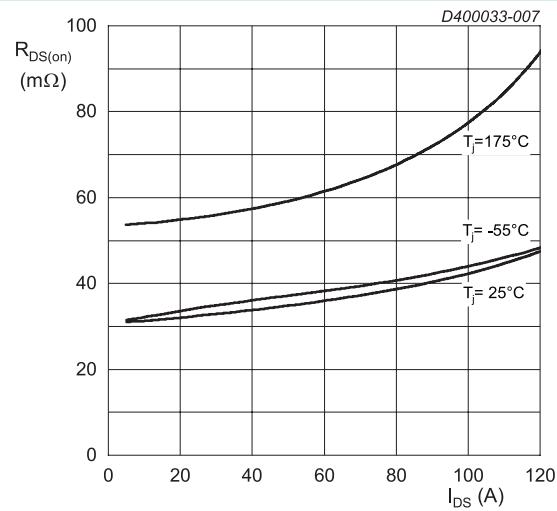
$T_j = 25\text{ }^\circ\text{C}; t_p < 200\text{ }\mu\text{s}$

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



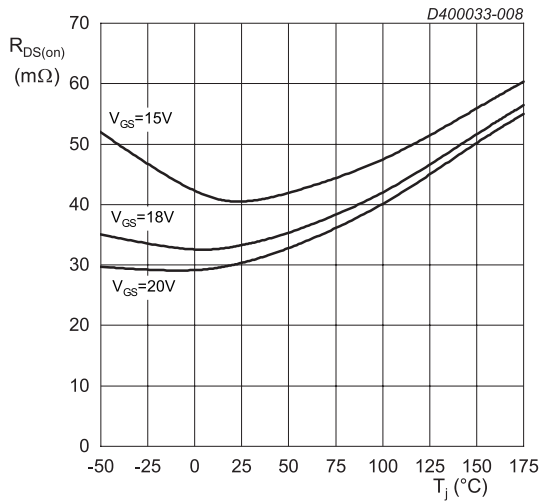
$T_j = 175\text{ }^\circ\text{C}; t_p < 200\text{ }\mu\text{s}$

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

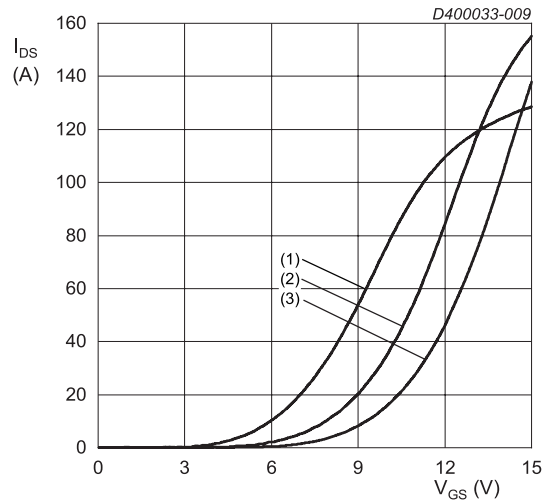


$V_{GS} = 18\text{ V}; t_p < 200\text{ }\mu\text{s}$

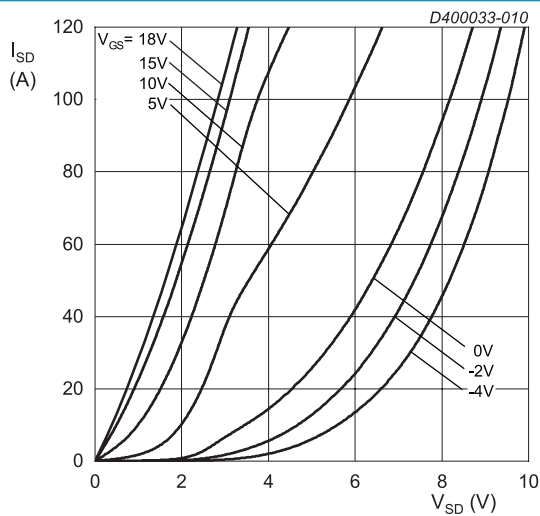
Fig. 7. Drain-source on-state resistance as a function of drain current; typical values



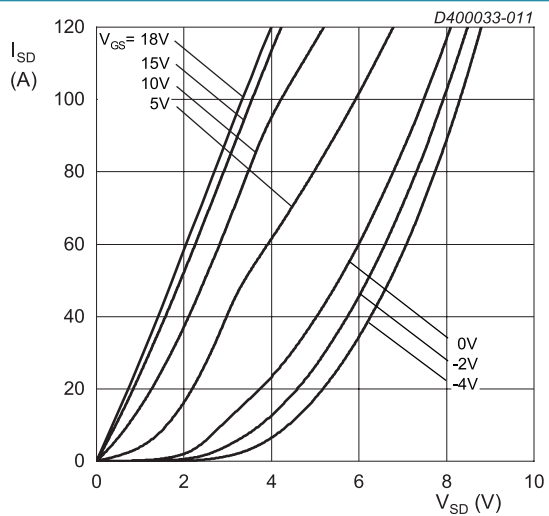
$I_{DS} = 33 \text{ A}; t_p < 200 \mu\text{s}$
Fig. 8. Drain-source on-state resistance as a function of junction temperature



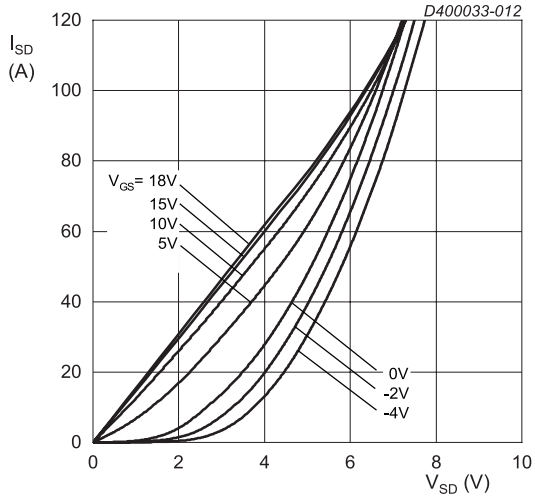
$V_{DS} = 20 \text{ V}; t_p < 200 \mu\text{s}$
 (1) $T_j = 175 \text{ }^\circ\text{C}$
 (2) $T_j = 25 \text{ }^\circ\text{C}$
 (3) $T_j = -55 \text{ }^\circ\text{C}$
Fig. 9. Transfer characteristics; drain current as a function of gate-source voltage; typical values



$T_j = -55 \text{ }^\circ\text{C}; t_p < 200 \mu\text{s}$
Fig. 10. Body diode forward characteristics; typical values

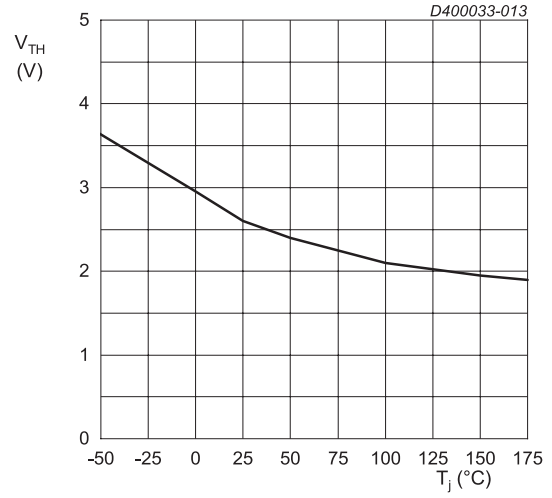


$T_j = 25 \text{ }^\circ\text{C}; t_p < 200 \mu\text{s}$
Fig. 11. Body diode forward characteristics; typical values



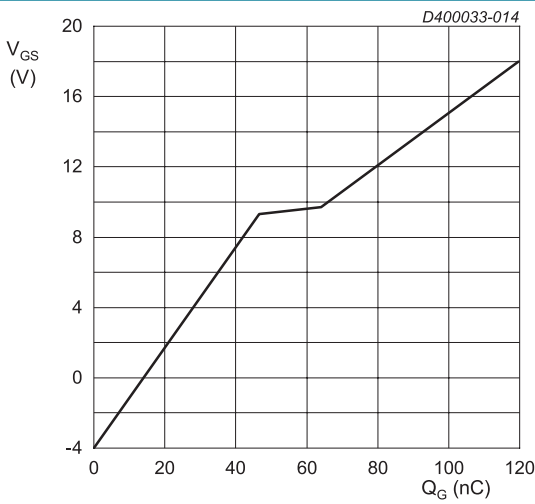
$T_j = 175\text{ }^\circ\text{C}$; $t_p < 200\text{ }\mu\text{s}$

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

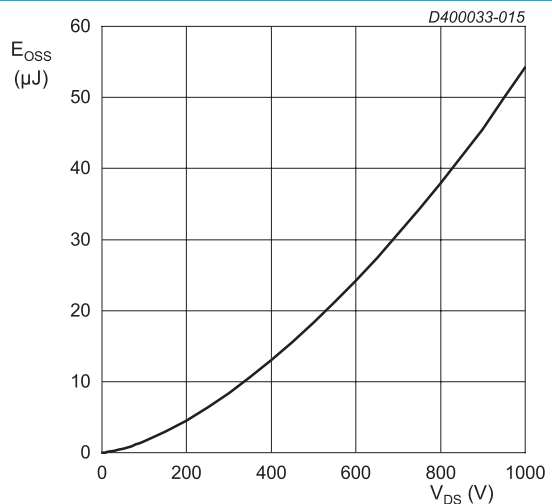
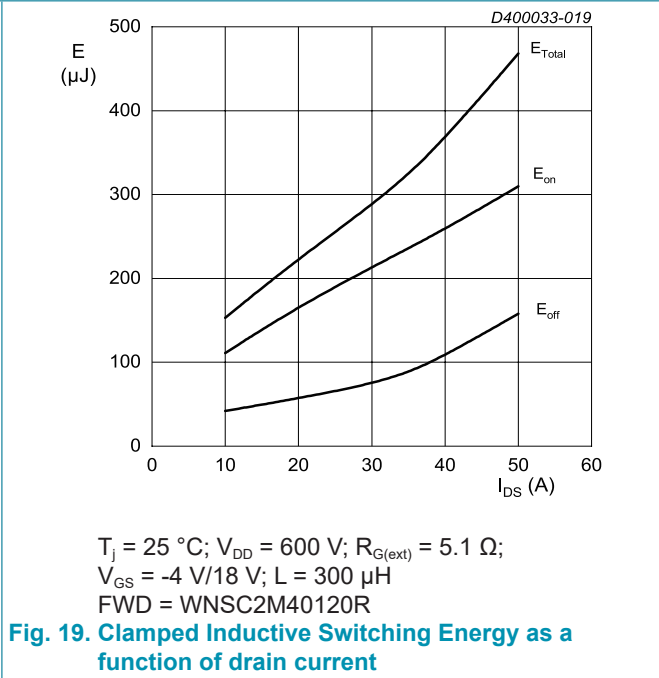
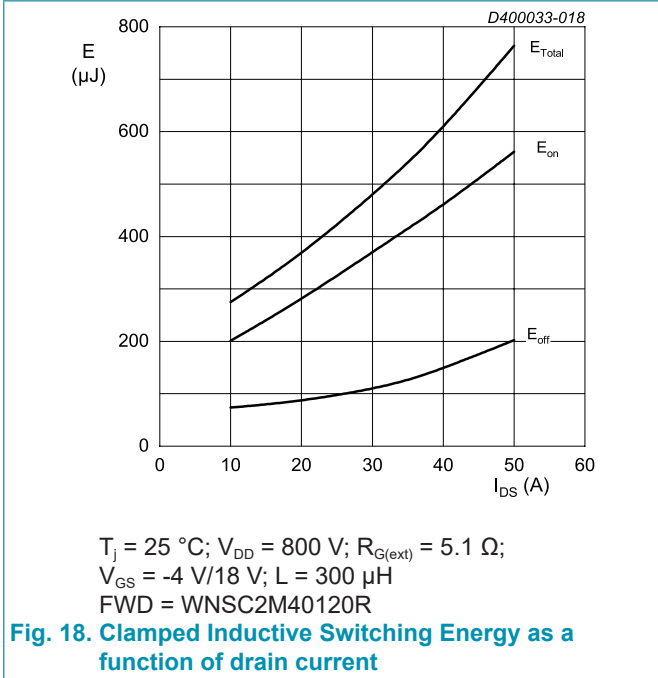
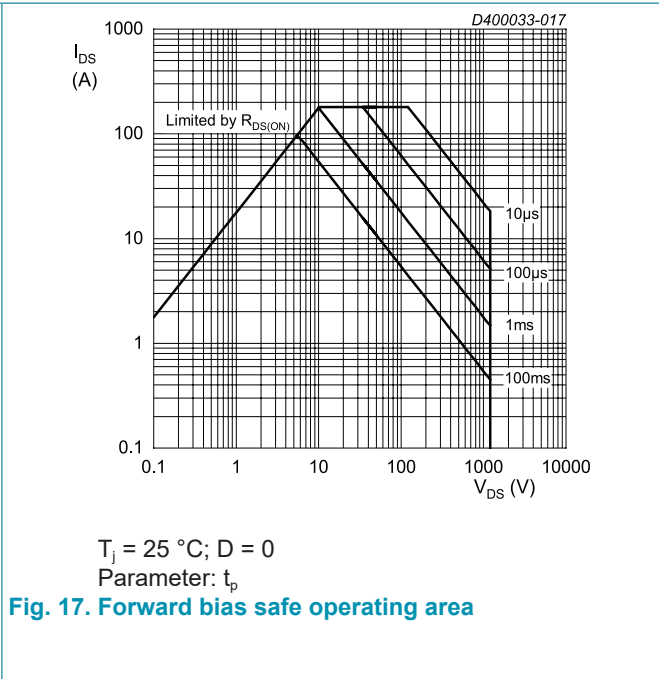
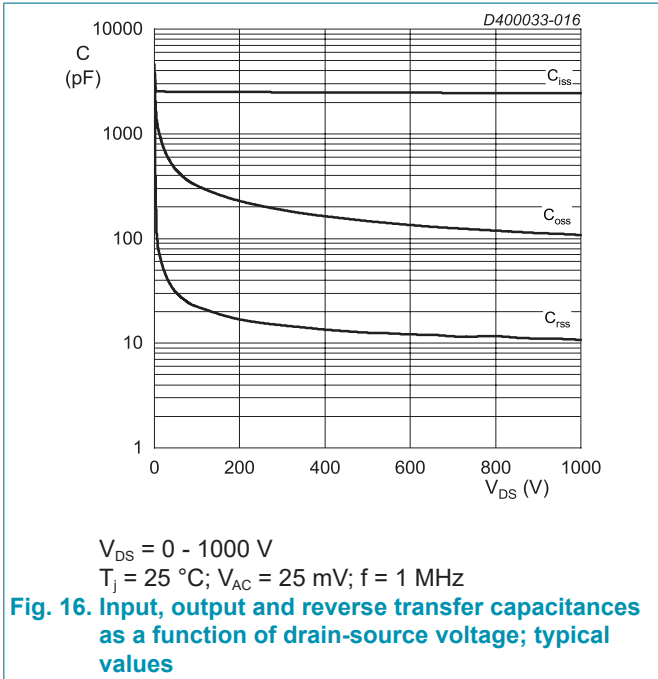
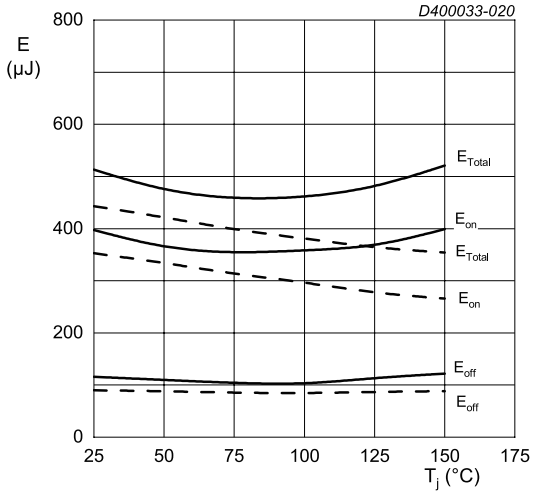


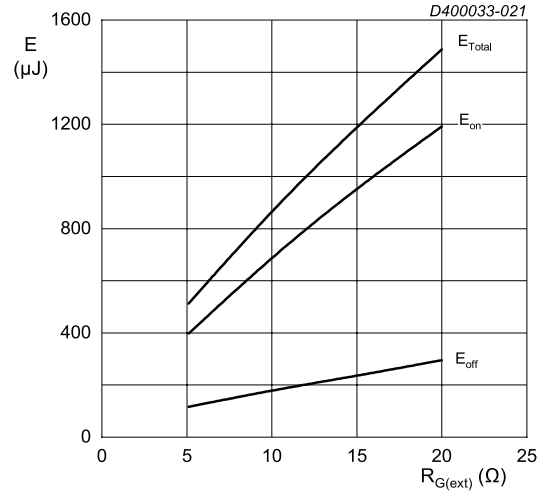
Fig. 15. Output capacitor stored energy as a function of drain-source voltage





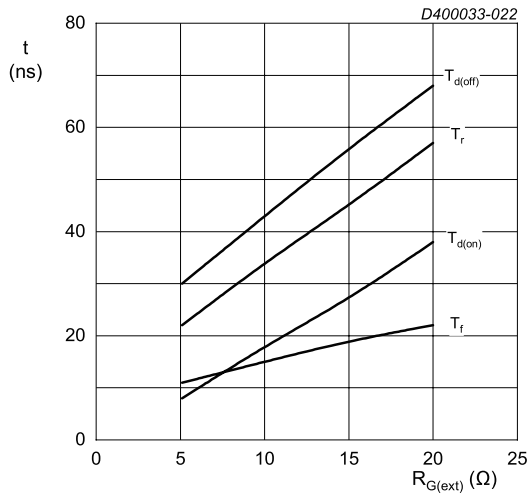
$I_{DS} = 33 \text{ A}; V_{DD} = 800 \text{ V}; R_{G(ext)} = 5.1 \text{ } \Omega;$
 $V_{GS} = -4 \text{ V}/18 \text{ V}; L = 300 \text{ } \mu\text{H}$
 FWD = WNSC2M40120R
 FWD = WNSC2D501200W(---)

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



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

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



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

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

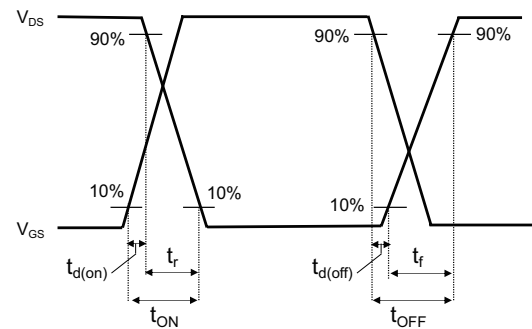
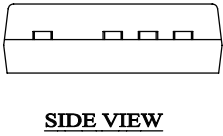
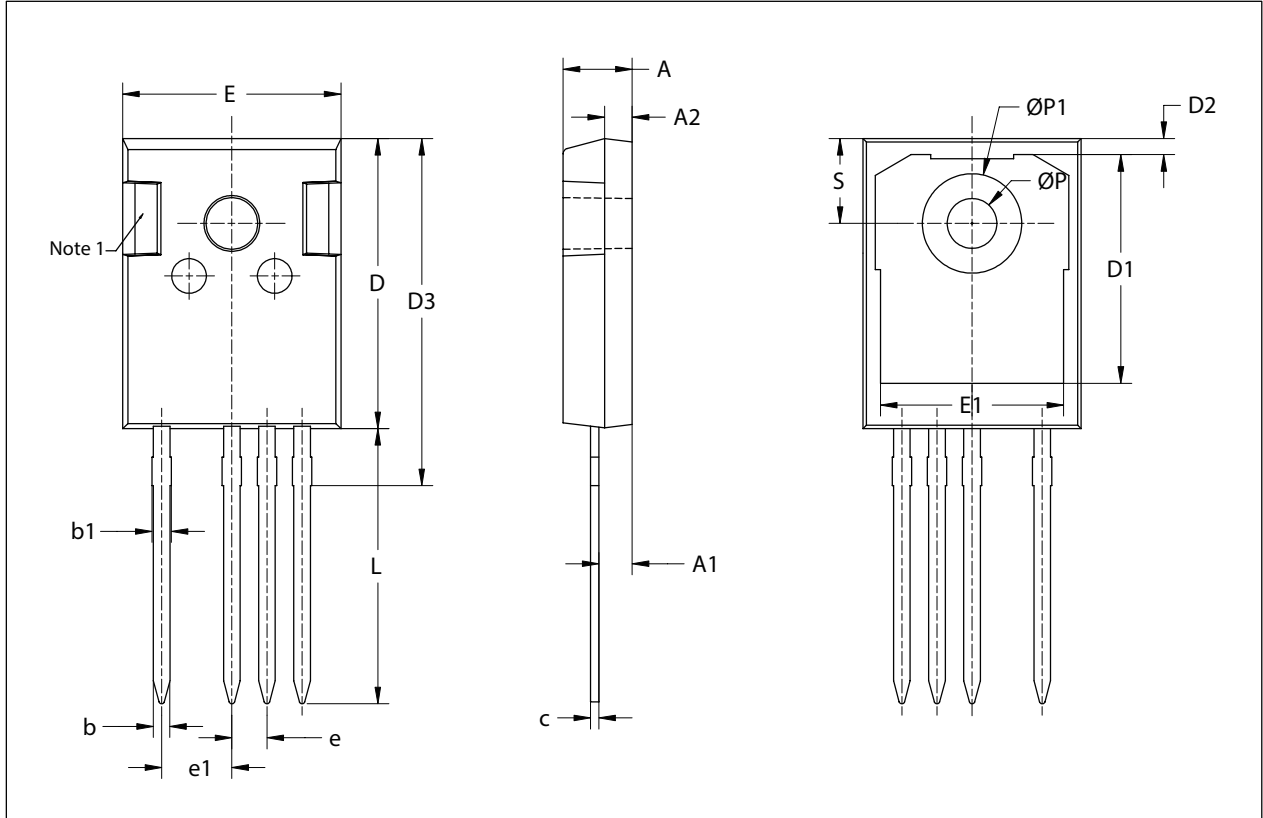


Fig. 23. Switching time definition

11. Package outline

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

TO247-4L



UNIT	A	A1	A2	b	b1	c	D	D1	D2	D3	E	E1	e	e1	L	P	P1	S	
mm	MAX	5.10	2.51	2.10	1.30	1.80	0.70	21.10	16.85	1.35	25.27	15.90	13.50	2.64	5.18	20.10	3.70	(7.40)	(6.15)
	NOM													2.54	5.08				
	MIN	4.90	2.31	1.90	1.10	0.50	20.90	16.25	1.05	24.97	15.70	13.10	2.44	4.98	19.80	3.50	-		

- Note:
1. Metal exposed with Sn plating.
 2. All dimensions do not include mold flash & gate remain

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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Date of release: 04 November 2024
