

## 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

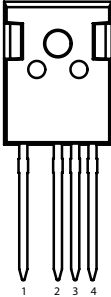
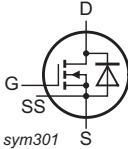
## 4. Quick reference data

Table 1. Quick reference data

Symbol	Parameter	Conditions	Notes	Values			Unit
Absolute maximum rating							
V <sub>DS</sub>	drain-source voltage	25 °C ≤ T <sub>j</sub> ≤ 175 °C		1200			V
I <sub>D</sub>	drain current	V <sub>GS</sub> = 18 V; T <sub>mb</sub> = 25 °C		93			A
P <sub>tot</sub>	total power dissipation	T <sub>mb</sub> = 25 °C, T <sub>j</sub> = 175 °C		417			W
T <sub>j</sub>	junction temperature			-55 to 175			°C
Symbol	Parameter	Conditions	Notes	Min	Typ	Max	Unit
Static characteristics							
R <sub>DS(on)</sub>	drain-source on-state resistance	V <sub>GS</sub> = 15 V; I <sub>D</sub> = 40 A; T <sub>j</sub> = 25 °C		-	30	-	mΩ
		V <sub>GS</sub> = 18 V; I <sub>D</sub> = 40 A; T <sub>j</sub> = 25 °C		-	24	40	mΩ
Dynamic characteristics							
Q <sub>G(tot)</sub>	total gate charge	I <sub>D</sub> = 40 A; V <sub>DS</sub> = 800 V; V <sub>GS</sub> = -4 V/18 V; T <sub>j</sub> = 25 °C		-	151	-	nC
Q <sub>GD</sub>	gate-drain charge			-	21	-	nC
Source-drain diode							
Q <sub>r</sub>	recovered charge	I <sub>SD</sub> = 40 A; di/dt = 500 A/μs; V <sub>DS</sub> = 400 V; T <sub>j</sub> = 25 °C		-	129	-	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
WNSC2M30120R-A	TO247-4L	WNSC2M30120R-A6Q	Tube	30	TO247N-4L	17-Dec-2021

7. Marking

Table 4. Marking codes

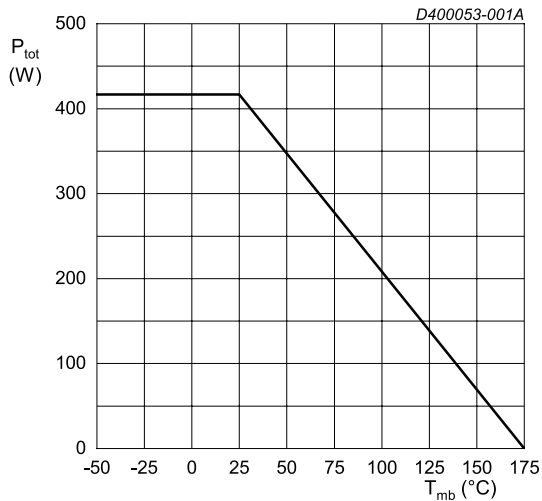
Type number	Marking codes
WNSC2M30120R-A	WNSC2M 30120R-A

## 8. Limiting values

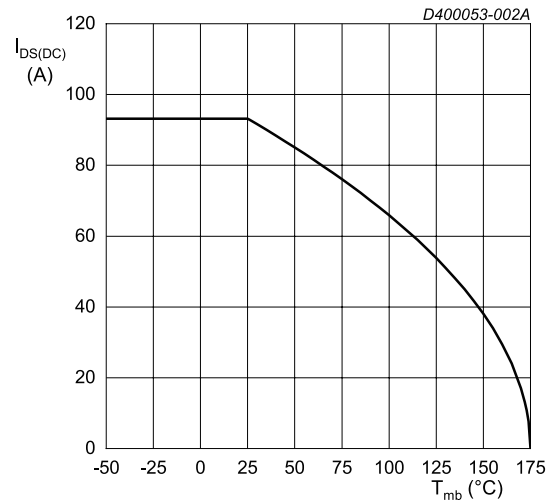
**Table 5. Limiting values**

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	$T_{mb} = 25\text{ °C}$ ; $T_j = 175\text{ °C}$		417	W
$I_D$	drain current	$V_{GS} = 18\text{ V}$ ; $T_{mb} = 25\text{ °C}$		93	A
		$V_{GS} = 18\text{ V}$ ; $T_{mb} = 100\text{ °C}$		65	A
$I_{DM}$	peak drain current	pulse width $t_p$ limited by $T_{jmax}$	Fig.17	186	A
$I_S$	continuous diode current	$V_{GS} = -4\text{ V}$ ; $T_{mb} = 25\text{ °C}$		70	A
$I_{SM}$	pulse diode current	$V_{GS} = -4\text{ V}$ ; pulse width $t_p$ limited by $T_{jmax}$		186	A
$E_{as}$	single pulse drain-to-source avalanche	$I_{AS} = 20\text{ A}$ ; $L = 1\text{ mH}$ ; $V_{DD} = 100\text{ V}$ ; $T_j = 25\text{ °C}$		200	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			-	0.36	-	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.

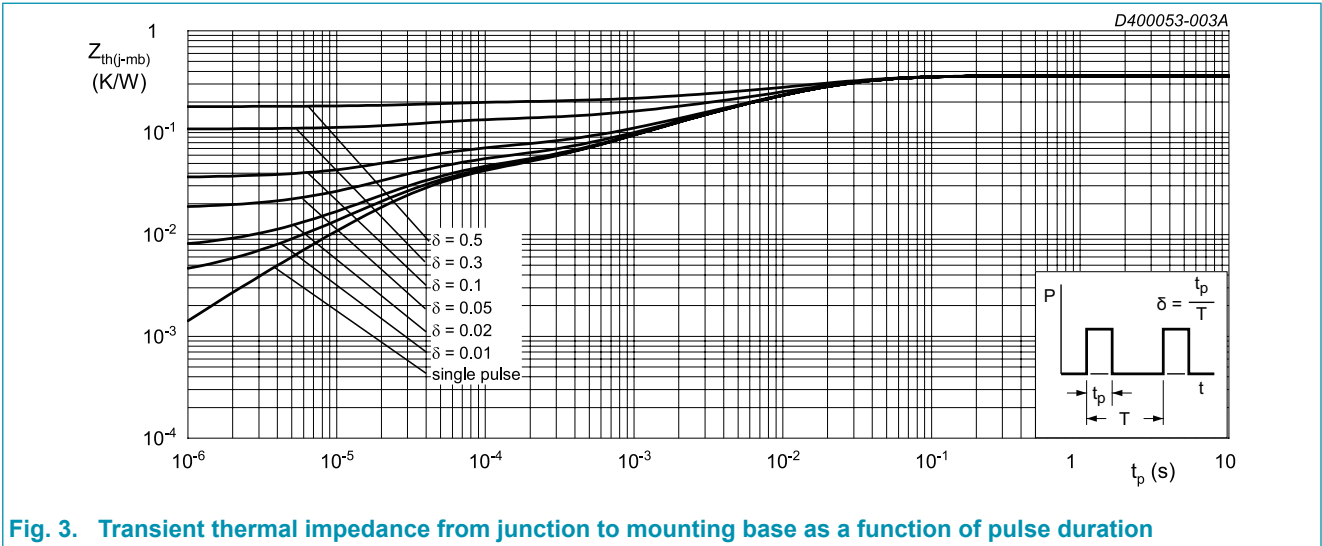
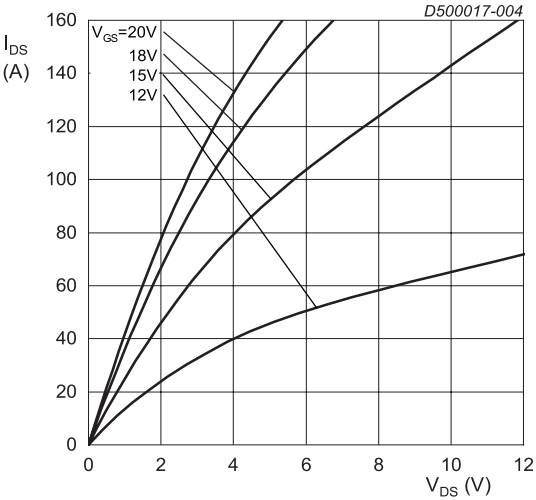


Fig. 3. Transient thermal impedance from junction to mounting base as a function of pulse duration

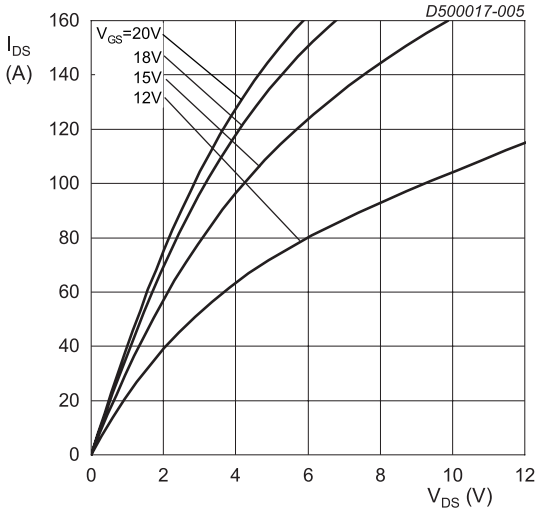
## 10. Characteristics

Table 7. Characteristics

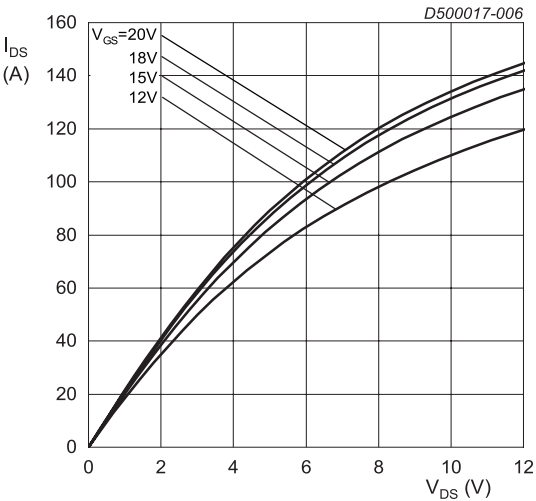
Symbol	Parameter	Conditions	Notes	Min	Typ	Max	Unit
Static characteristics							
V <sub>(BR)DSS</sub>	drain-source breakdown voltage	I <sub>D</sub> = 100 μA; V <sub>GS</sub> = 0 V; T <sub>J</sub> = 25 °C		1200	-	-	V
V <sub>GS(th)</sub>	gate-source threshold voltage	I <sub>D</sub> = 12 mA; V <sub>DS</sub> = 10 V; T <sub>J</sub> = 25 °C		1.9	2.6	3.5	V
		I <sub>D</sub> = 12 mA; V <sub>DS</sub> = 10 V; T <sub>J</sub> = 175 °C		-	1.9	-	V
I <sub>DSS</sub>	drain leakage current	V <sub>DS</sub> = 1200 V; V <sub>GS</sub> = 0 V; T <sub>J</sub> = 25 °C		-	0.2	100	μA
		V <sub>DS</sub> = 1200 V; V <sub>GS</sub> = 0 V; T <sub>J</sub> = 175 °C		-	2	-	μA
I <sub>GSS</sub>	gate leakage current	V <sub>GS</sub> = 22 V; V <sub>DS</sub> = 0 V; T <sub>J</sub> = 25 °C		-	10	100	nA
		V <sub>GS</sub> = -10 V; V <sub>DS</sub> = 0 V; T <sub>J</sub> = 25 °C		-	10	100	nA
R <sub>DS(on)</sub>	drain-source on-state resistance	V <sub>GS</sub> = 15 V; I <sub>D</sub> = 40 A; T <sub>J</sub> = 25 °C		-	30	-	mΩ
		V <sub>GS</sub> = 18 V; I <sub>D</sub> = 40 A; T <sub>J</sub> = 25 °C		-	24	40	mΩ
		V <sub>GS</sub> = 18 V; I <sub>D</sub> = 40 A; T <sub>J</sub> = 175 °C		-	48	-	mΩ
R <sub>G</sub>	gate resistance	f = 1 MHz; T <sub>J</sub> = 25 °C		-	0.8	-	Ω
g <sub>fs</sub>	transconductance	V <sub>DS</sub> = 20 V; I <sub>D</sub> = 40 A; T <sub>J</sub> = 25 °C		-	27	-	S
Dynamic characteristics							
Q <sub>G(tot)</sub>	total gate charge	I <sub>D</sub> = 40 A; V <sub>DS</sub> = 800 V; V <sub>GS</sub> = -4 V/18 V; T <sub>J</sub> = 25 °C		-	151	-	nC
Q <sub>GS</sub>	gate-source charge			-	63	-	nC
Q <sub>GD</sub>	gate-drain charge			-	21	-	nC
C <sub>iss</sub>	input capacitance	V <sub>DS</sub> = 1000 V; V <sub>GS</sub> = 0 V; f = 1 MHz; T <sub>J</sub> = 25 °C		-	3305	-	pF
C <sub>oss</sub>	output capacitance			-	139	-	pF
C <sub>rss</sub>	reverse transfer capacitance			-	12	-	pF
E <sub>oss</sub>	Coss stored energy			-	70	-	μJ
t <sub>d(on)</sub>	turn-on delay time	V <sub>DS</sub> = 800 V; V <sub>GS</sub> = -4 V/18 V; R <sub>G(ext)</sub> = 2.4 Ω; I <sub>D</sub> = 40 A; L = 100 μH; T <sub>J</sub> = 25 °C		-	23	-	ns
t <sub>r</sub>	rise time			-	22	-	ns
t <sub>d(off)</sub>	turn-off delay time			-	40	-	ns
t <sub>f</sub>	fall time			-	8	-	ns
E <sub>on</sub>	turn-on energy <small>(SiC Diode FWD)</small>		Fig.20	-	257	-	μJ
E <sub>off</sub>	turn-off energy <small>(SiC Diode FWD)</small>		Fig.20	-	137	-	μJ
E <sub>on</sub>	turn-on energy <small>(Body Diode FWD)</small>		Fig.20	-	479	-	μJ
E <sub>off</sub>	turn-off energy <small>(Body Diode FWD)</small>		Fig.20	-	175	-	μJ
Source-drain diode							
V <sub>SD</sub>	source-drain voltage	V <sub>GS</sub> = 0 V; I <sub>SD</sub> = 20 A; T <sub>J</sub> = 25 °C		-	3.2	-	V
		V <sub>GS</sub> = -4 V; I <sub>SD</sub> = 20 A; T <sub>J</sub> = 25 °C		-	4.8	-	V
		V <sub>GS</sub> = -4 V; I <sub>SD</sub> = 20 A; T <sub>J</sub> = 175 °C		-	4.2	-	V
t <sub>rr</sub>	reverse recovery time	I <sub>SD</sub> = 40 A; di/dt = 500 A/μs; V <sub>DS</sub> = 400 V; T <sub>J</sub> = 25 °C		-	34	-	ns
Q <sub>r</sub>	recovered charge			-	129	-	nC
I <sub>rrm</sub>	reverse recovery current			-	6.9	-	A



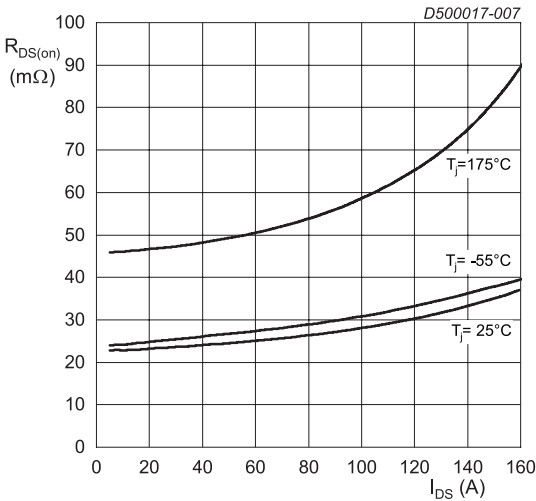
$T_j = -55\text{ }^{\circ}\text{C}$ ;  $t_p < 200\text{ }\mu\text{s}$   
**Fig. 4. Output characteristics; drain current as a function of drain-source voltage; typical values**



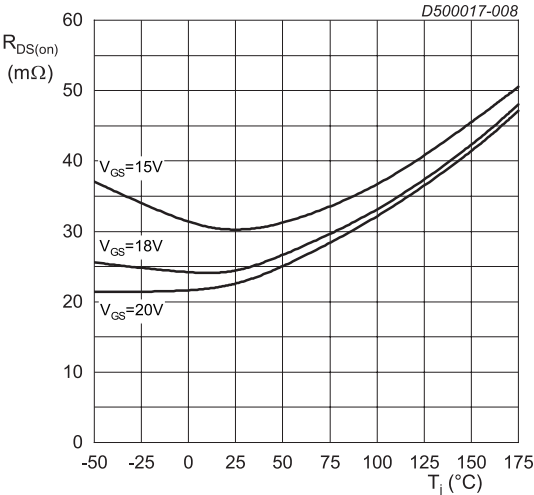
$T_j = 25\text{ }^{\circ}\text{C}$ ;  $t_p < 200\text{ }\mu\text{s}$   
**Fig. 5. Output characteristics; drain current as a function of drain-source voltage; typical values**



$T_j = 175\text{ }^{\circ}\text{C}$ ;  $t_p < 200\text{ }\mu\text{s}$   
**Fig. 6. Output characteristics; drain current as a function of drain-source voltage; typical values**

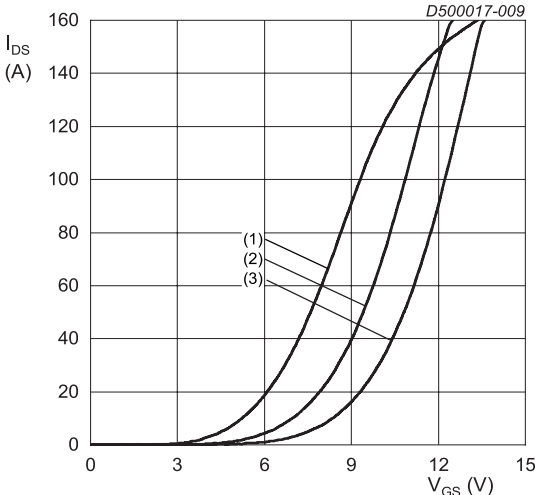


$V_{GS} = 18\text{ V}$ ;  $t_p < 200\text{ }\mu\text{s}$   
**Fig. 7. Drain-source on-state resistance as a function of drain current; typical values**



$I_{DS} = 40\text{ A}; t_p < 200\text{ }\mu\text{s}$

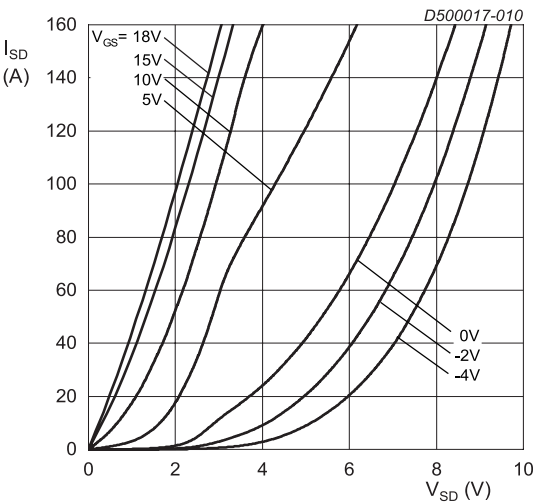
Fig. 8. Drain-source on-state resistance as a function of junction temperature



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

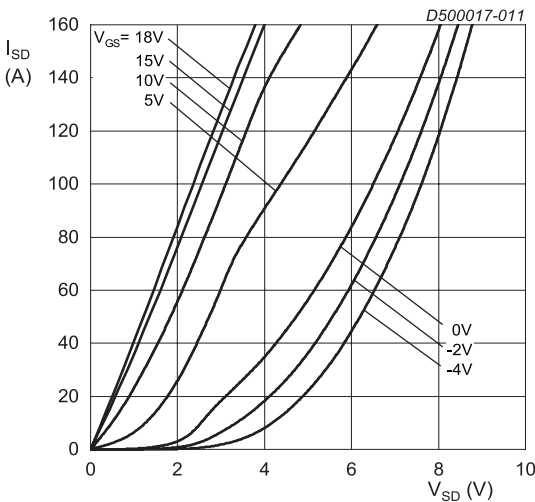
- (1)  $T_j = 175\text{ }^\circ\text{C}$
- (2)  $T_j = 25\text{ }^\circ\text{C}$
- (3)  $T_j = -55\text{ }^\circ\text{C}$

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



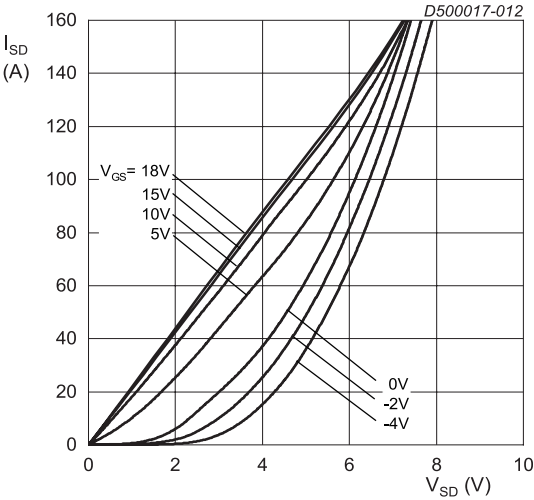
$T_j = -55\text{ }^\circ\text{C}; t_p < 200\text{ }\mu\text{s}$

Fig. 10. Body diode forward characteristics; typical values



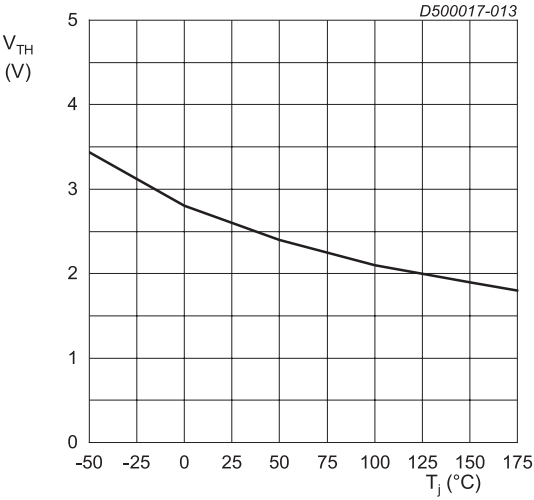
$T_j = 25\text{ }^\circ\text{C}; t_p < 200\text{ }\mu\text{s}$

Fig. 11. Body diode forward characteristics; typical values



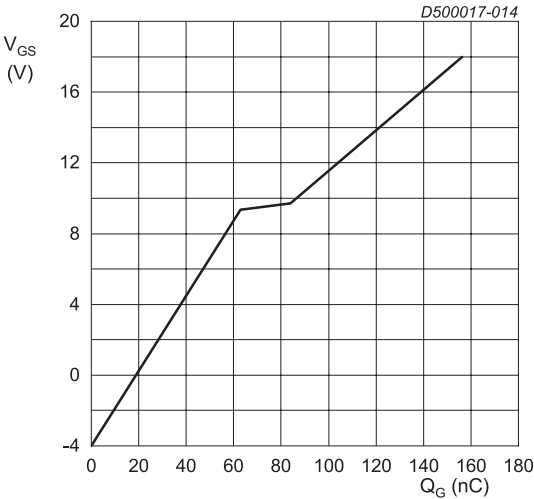
$T_j = 175\text{ }^{\circ}\text{C}$ ;  $t_p < 200\text{ }\mu\text{s}$

Fig. 12. Body diode forward characteristics; typical values



$V_{DS} = 10\text{ V}$ ;  $I_{DS} = 12\text{ mA}$

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



$I_{DS} = 40\text{ A}$ ;  $I_{GS} = 0.1\text{ mA}$ ;  $V_{DS} = 800\text{ V}$ ;  $T_j = 25\text{ }^{\circ}\text{C}$

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

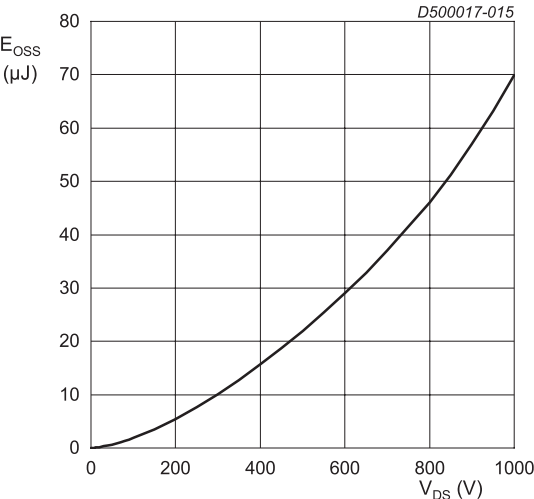
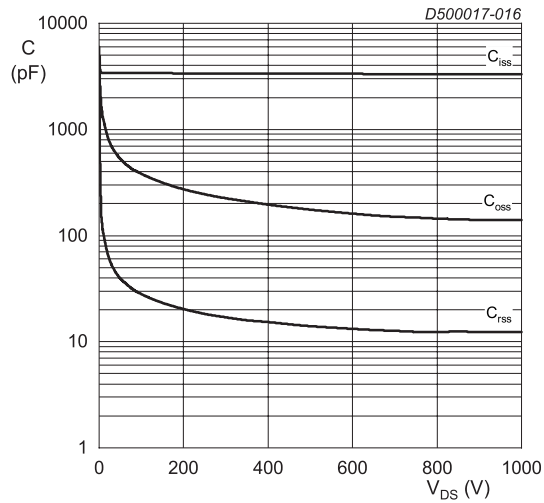


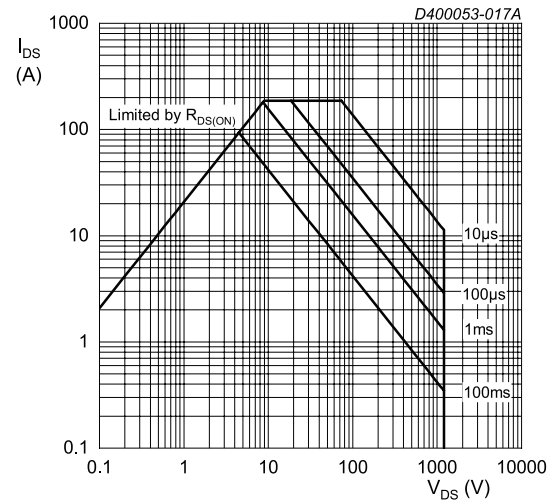
Fig. 15. Output capacitor stored energy as a function of drain-source voltage





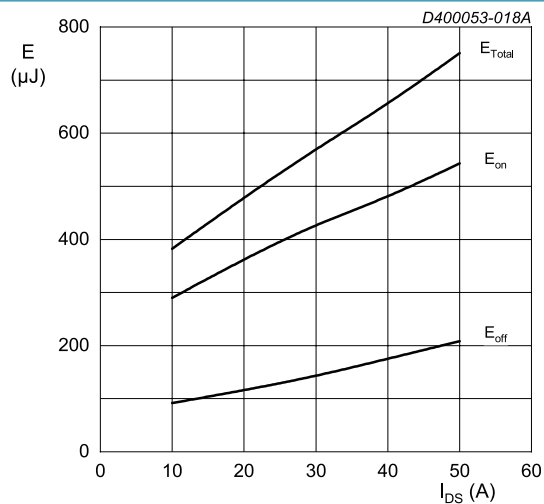
$V_{DS} = 0 - 1000$  V  
 $T_j = 25$  °C;  $V_{AC} = 25$  mV;  $f = 1$  MHz

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



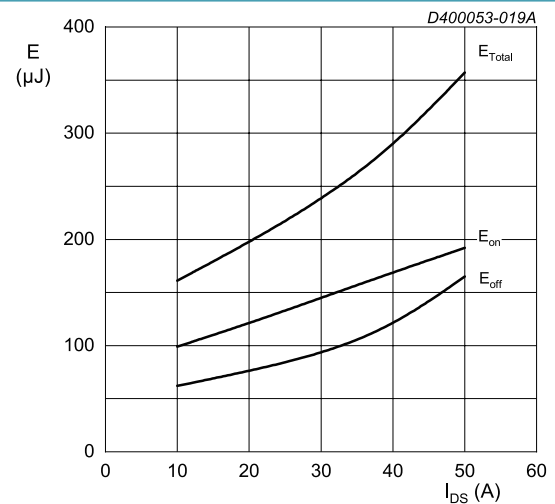
$T_j = 25$  °C;  $D = 0$   
 Parameter:  $t_p$

**Fig. 17. Forward bias safe operating area**



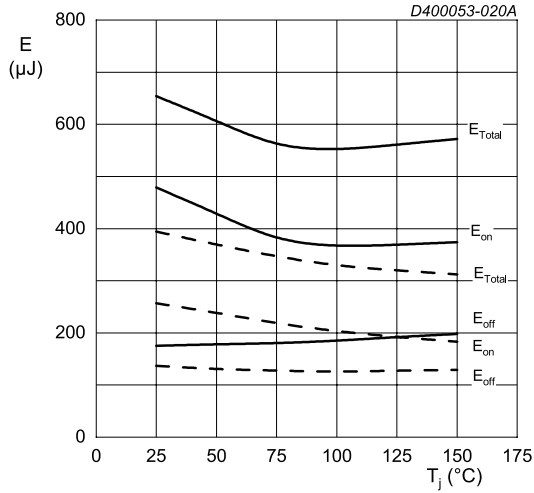
$T_j = 25$  °C;  $V_{DD} = 800$  V;  $R_{G(ext)} = 2.4$  Ω;  
 $V_{GS} = -4$  V/18 V;  $L = 100$  μH  
 FWD = WNSC2M30120R-A

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



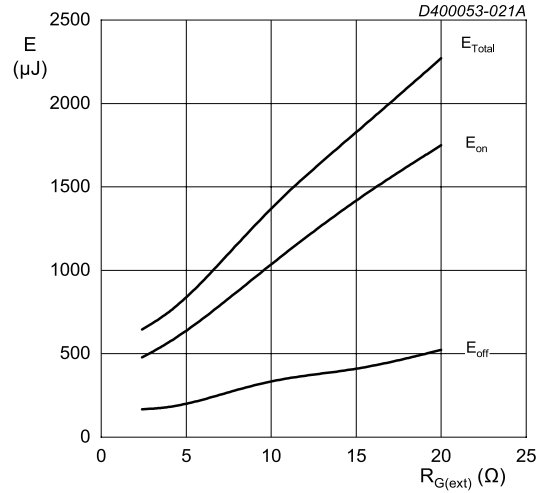
$T_j = 25$  °C;  $V_{DD} = 600$  V;  $R_{G(ext)} = 2.4$  Ω;  
 $V_{GS} = -4$  V/18 V;  $L = 100$  μH  
 FWD = WNSC2M30120R-A

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



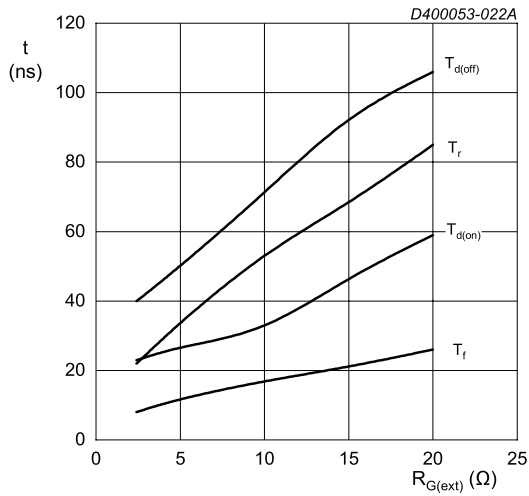
$I_{DS} = 40 \text{ A}$ ;  $V_{DD} = 800 \text{ V}$ ;  $R_{G(ext)} = 2.4 \Omega$ ;  
 $V_{GS} = -4 \text{ V/18 V}$ ;  $L = 100 \mu\text{H}$   
 FWD = WNSC2M30120R-A  
 FWD = WNSC2D201200(---)

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



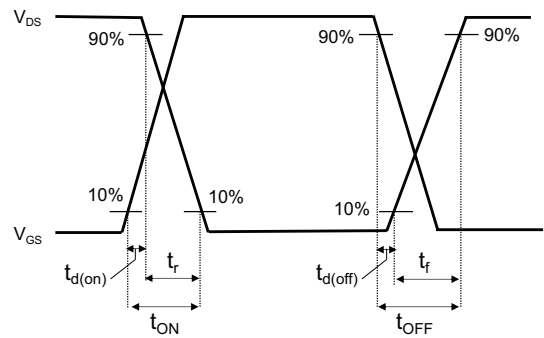
$T_j = 25 \text{ °C}$ ;  $V_{DD} = 800 \text{ V}$ ;  $I_{DS} = 40 \text{ A}$ ;  $V_{GS} = -4 \text{ V/18 V}$   
 FWD = WNSC2M30120R-A;  $L = 100 \mu\text{H}$

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



$T_j = 25 \text{ °C}$ ;  $V_{DD} = 800 \text{ V}$ ;  $I_{DS} = 40 \text{ A}$ ;  $V_{GS} = -4 \text{ V/18 V}$   
 FWD = WNSC2M30120R-A;  $L = 100 \mu\text{H}$

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

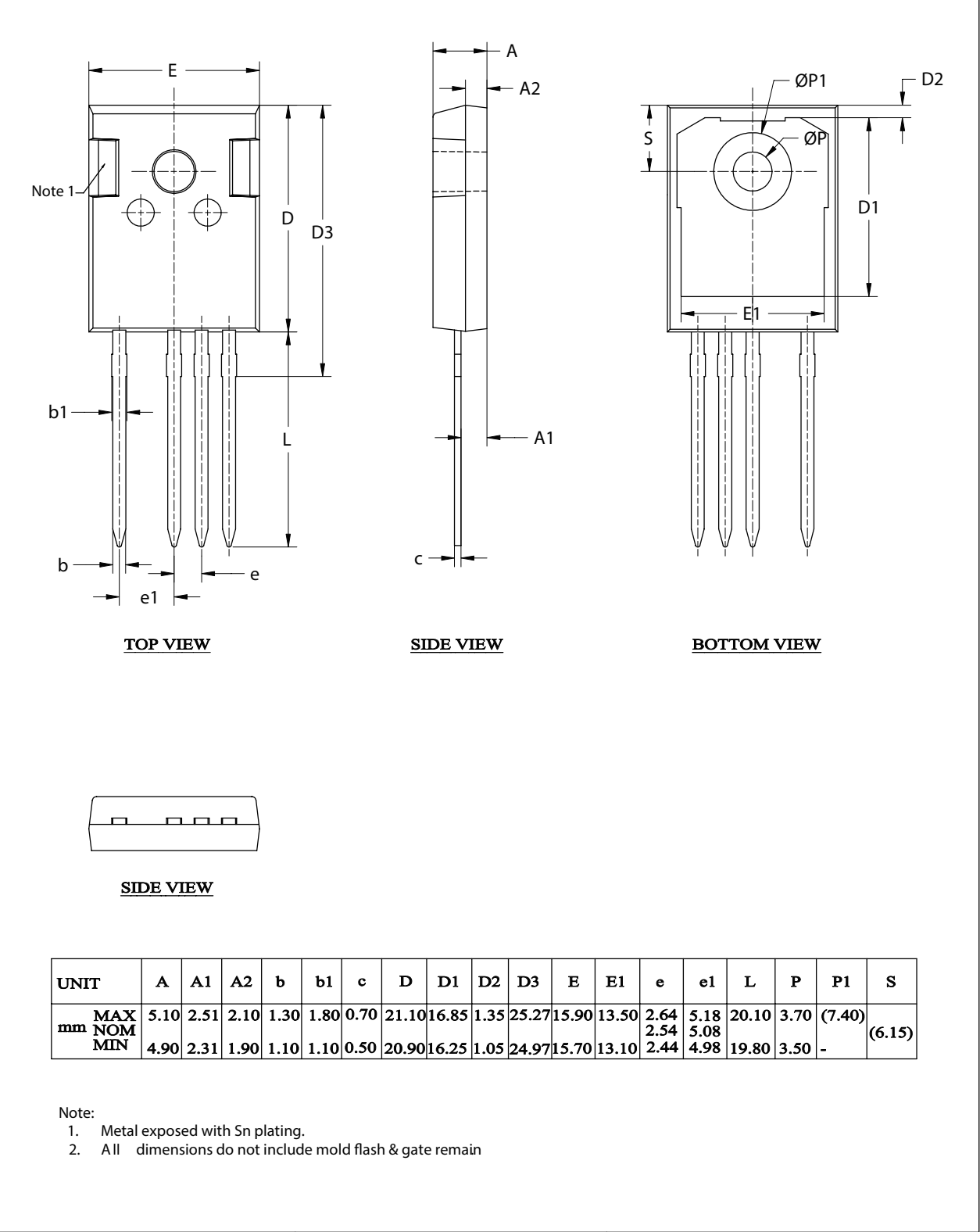


**Fig. 23. Switching time definition**

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.

- [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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