

## 1. General description

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



## 2. Features and benefits

- Separate driver source pin
- Low on-resistance
- Fast switching speed
- 0V turn-off gate voltage for simple gate drive
- 100% UIS Tested
- Easy to parallel
- Controllable dV/dt for optimized EMI
- Reduced cooling requirements
- RoHS compliant

## 3. Applications

- Switch Mode Power Supplies
- UPS
- Solar string inverter and solar optimizer
- EV Charger
- Motor Drives

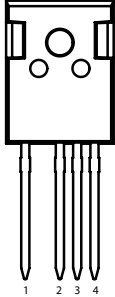
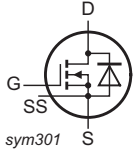
## 4. Quick reference data

Table 1. Quick reference data

Symbol	Parameter	Conditions	Notes	Min	Typ	Max	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> = 20 V; T <sub>mb</sub> = 25 °C		-	-	45	A
P <sub>tot</sub>	total power dissipation	T <sub>mb</sub> = 25 °C		-	-	270	W
T <sub>j</sub>	junction temperature			-55	-	175	°C
Static characteristics							
R <sub>DS(on)</sub>	drain-source on-state resistance	V <sub>GS</sub> = 20 V; I <sub>D</sub> = 20 A; T <sub>j</sub> = 25 °C		-	80	98	mΩ
Dynamic characteristics							
Q <sub>G(tot)</sub>	total gate charge	I <sub>D</sub> = 20 A; V <sub>DS</sub> = 800 V; V <sub>GS</sub> = 0V/20 V; T <sub>j</sub> = 25 °C		-	59	-	nC
Q <sub>GD</sub>	gate-drain charge			-	11	-	nC
Source-drain diode							
Q <sub>r</sub>	recovered charge	I <sub>SD</sub> = 20 A; di/dt = 500 A/μs; V <sub>DS</sub> = 400 V; T <sub>i</sub> = 25 °C		-	108	-	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
WNSCM80120R	TO247-4L	WNSCM80120R6Q	Tube	30	TO247N-4L	17-Dec-2021

## 7. Marking

Table 4. Marking codes

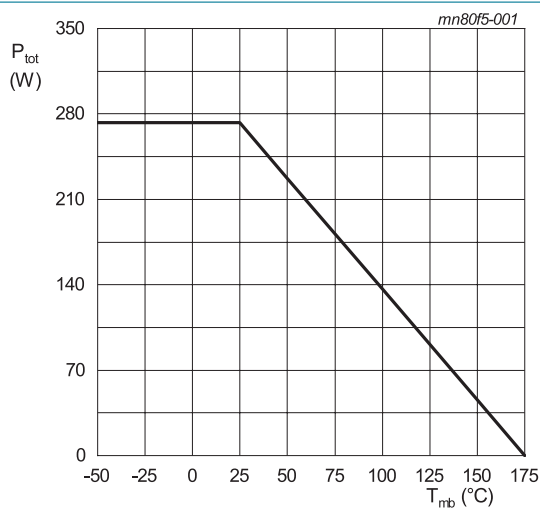
Type number	Marking codes
WNSCM80120R	WNSCM 80120R

## 8. Limiting values

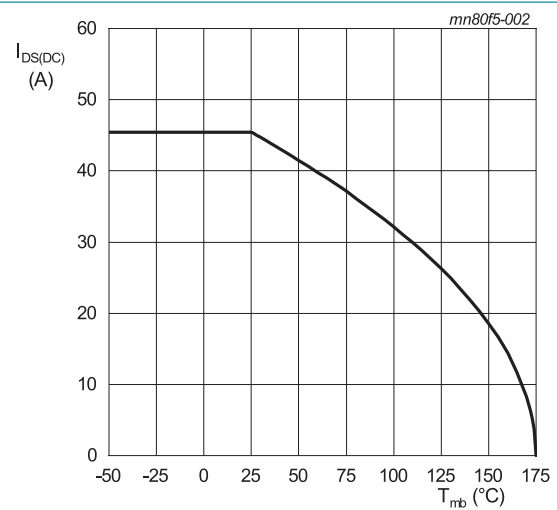
**Table 5. Limiting values**

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

Symbol	Parameter	Conditions	Notes	Min	Max	Unit
$V_{DS}$	drain-source voltage	$25\text{ °C} \leq T_J \leq 175\text{ °C}$		-	1200	V
$V_{GS,max}$	gate-source voltage			-10	25	V
$V_{GS,op}$	gate-source voltage			-5	20	V
$P_{tot}$	total power dissipation	$T_{mb} = 25\text{ °C}$		-	270	W
$I_D$	drain current	$V_{GS} = 20\text{ V}; T_{mb} = 25\text{ °C}$		-	45	A
		$V_{GS} = 20\text{ V}; T_{mb} = 100\text{ °C}$		-	32	A
$I_{DM}$	peak drain current	pulsed; $t_p \leq 10\text{ }\mu\text{s}; T_{mb} = 25\text{ °C}$		-	81	A
$E_{as}$	single pulse drain-to-source avalanche	$I_{AS} = 18\text{ A}; L = 1\text{ mH}; V_{DD} = 100\text{ V}, T_{j(init)} = 25\text{ °C}$		162	-	mJ
$T_{stg}$	storage temperature			-55	175	°C
$T_J$	junction temperature			-55	175	°C
$T_{sld(M)}$	peak soldering temperature			-	260	°C



**Fig. 1. Normalized 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			-	-	0.55	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.

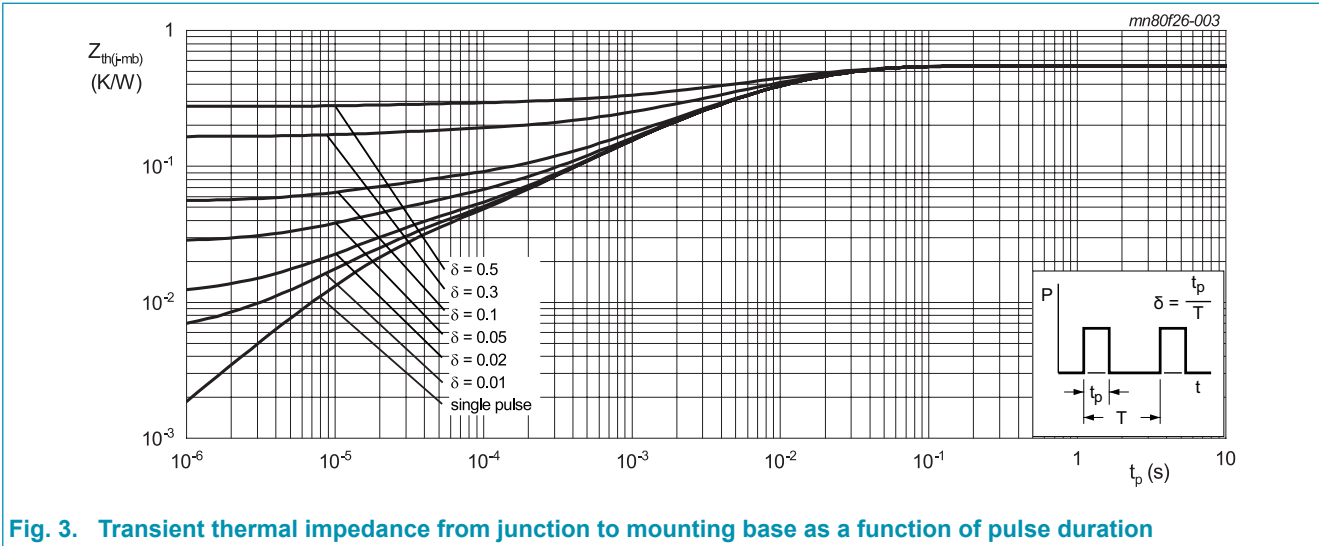
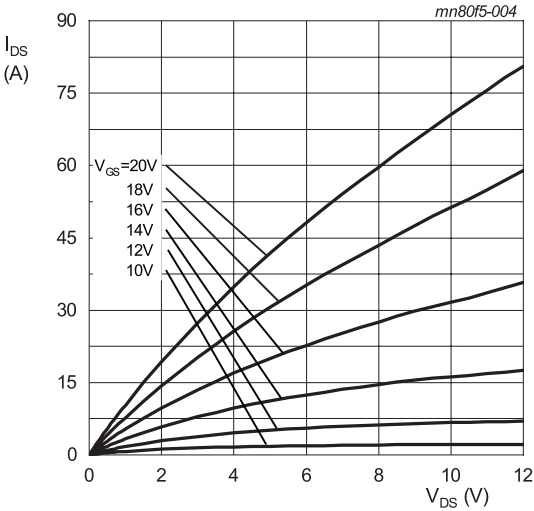


Fig. 3. Transient thermal impedance from junction to mounting base as a function of pulse duration

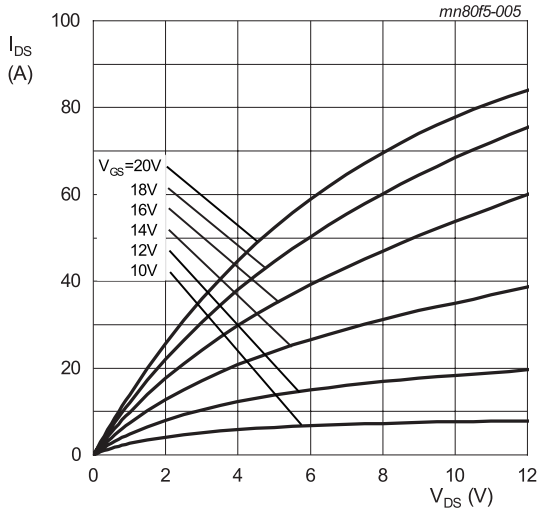
## 10. Characteristics

Table 7. Characteristics

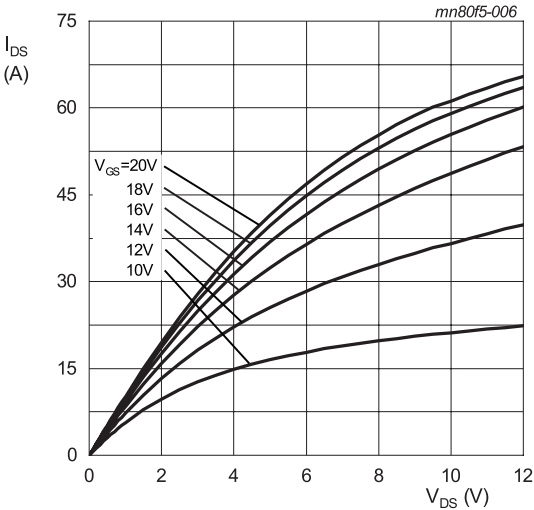
Symbol	Parameter	Conditions	Notes	Min	Typ	Max	Unit
Static characteristics							
V <sub>(BR)DSS</sub>	drain-source breakdown voltage	I <sub>D</sub> = 100 μA; V <sub>GS</sub> = 0 V; T <sub>J</sub> = 25 °C		1200	-	-	V
V <sub>GS(th)</sub>	gate-source threshold voltage	I <sub>D</sub> = 6 mA; V <sub>DS</sub> = 10 V; T <sub>J</sub> = 25 °C		2.5	3.5	4.5	V
		I <sub>D</sub> = 6 mA; V <sub>DS</sub> = 10 V; T <sub>J</sub> = 150 °C		-	2.5	-	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		-	0.1	100	μA
		V <sub>DS</sub> = 1200 V; V <sub>GS</sub> = 0 V; T <sub>J</sub> = 150 °C		-	1	-	μA
I <sub>GSS</sub>	gate leakage current	V <sub>GS</sub> = 25 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> = 20 V; I <sub>D</sub> = 20 A; T <sub>J</sub> = 25 °C		-	80	98	mΩ
		V <sub>GS</sub> = 20 V; I <sub>D</sub> = 20 A; T <sub>J</sub> = 150 °C		-	110	-	mΩ
R <sub>G</sub>	gate resistance	f = 1 MHz; T <sub>J</sub> = 25 °C		-	2.6	-	Ω
g <sub>fs</sub>	transconductance	V <sub>DS</sub> = 20 V; I <sub>D</sub> = 20 A; T <sub>J</sub> = 25 °C		-	8.8	-	S
Dynamic characteristics							
Q <sub>G(tot)</sub>	total gate charge	I <sub>D</sub> = 20 A; V <sub>DS</sub> = 800 V; V <sub>GS</sub> = 0 V/20 V; T <sub>J</sub> = 25 °C		-	59	-	nC
Q <sub>GS</sub>	gate-source charge			-	23	-	nC
Q <sub>GD</sub>	gate-drain charge			-	11	-	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		-	1350	-	pF
C <sub>oss</sub>	output capacitance			-	68	-	pF
C <sub>rss</sub>	reverse transfer capacitance			-	5.5	-	pF
E <sub>oss</sub>	Coss stored energy			-	34	-	μJ
t <sub>d(on)</sub>	turn-on delay time	V <sub>DS</sub> = 800 V; V <sub>GS</sub> = -5/20 V; R <sub>G(ext)</sub> = 0 Ω; I <sub>D</sub> = 20 A; L = 360 μH; T <sub>J</sub> = 25 °C		-	7	-	ns
t <sub>r</sub>	rise time			-	17	-	ns
t <sub>d(off)</sub>	turn-off delay time			-	18	-	ns
t <sub>f</sub>	fall time			-	8	-	ns
E <sub>on</sub>	turn-on energy (SiC Diode FWD)			-	208	-	μJ
E <sub>off</sub>	turn-off energy (SiC Diode FWD)			-	38	-	μJ
E <sub>on</sub>	turn-on energy (Body Diode FWD)			-	393	-	μJ
E <sub>off</sub>	turn-off energy (Body Diode FWD)			-	42	-	μJ
Source-drain diode							
V <sub>SD</sub>	source-drain voltage	V <sub>GS</sub> = 0 V; I <sub>F</sub> = 10 A; T <sub>J</sub> = 25 °C		-	4.1	-	V
		V <sub>GS</sub> = 0 V; I <sub>F</sub> = 10 A; T <sub>J</sub> = 150 °C		-	3.5	-	V
t <sub>rr</sub>	reverse recovery time	I <sub>SD</sub> = 20 A; di/dt = 500 A/μs; V <sub>DS</sub> = 400 V; T <sub>J</sub> = 25 °C		-	36	-	ns
Q <sub>r</sub>	recovered charge			-	108	-	nC
I <sub>rrm</sub>	reverse recovery current			-	5.1	-	A



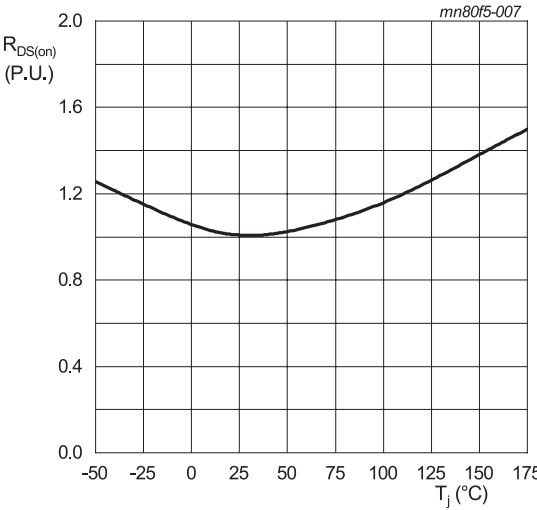
$T_j = -55\text{ °C}$ ;  $t_p < 200\text{ }\mu\text{s}$   
**Fig. 4. Output characteristics; drain current as a function of drain-source voltage; typical values**



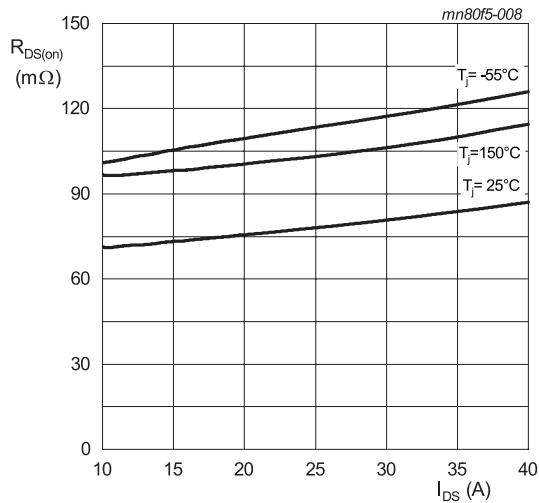
$T_j = 25\text{ °C}$ ;  $t_p < 200\text{ }\mu\text{s}$   
**Fig. 5. Output characteristics; drain current as a function of drain-source voltage; typical values**



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

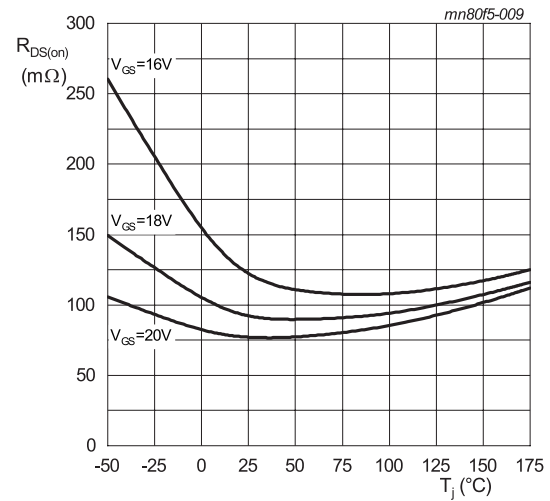


$I_{DS} = 20\text{ A}$ ;  $V_{GS} = 20\text{ V}$ ;  $t_p < 200\text{ }\mu\text{s}$   
**Fig. 7. Normalized drain-source on-state resistance as a function of junction temperature**



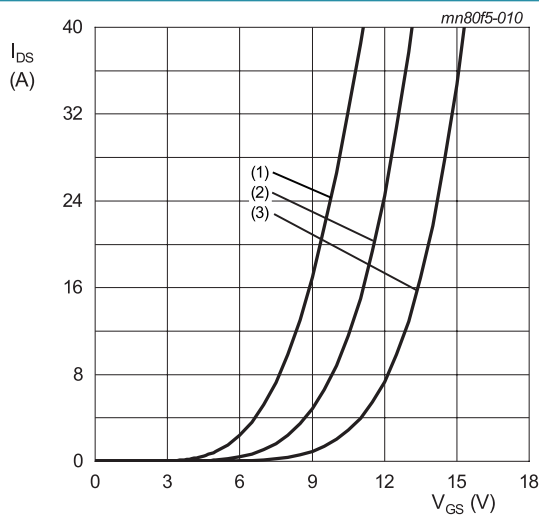
$V_{GS} = 20\text{ V}$ ;  $t_p < 200\text{ }\mu\text{s}$

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



$I_{DS} = 20\text{ A}$ ;  $t_p < 200\text{ }\mu\text{s}$

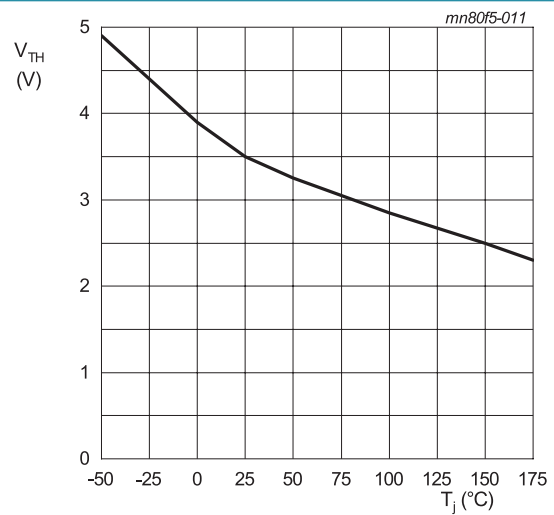
**Fig. 9. Drain-source on-state resistance as a function of junction temperature**



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

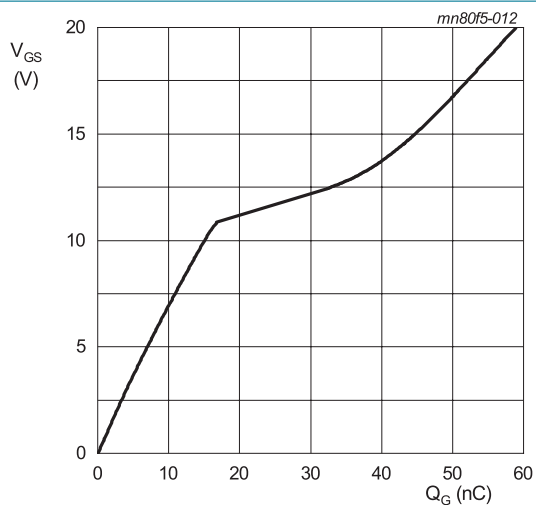
- (1)  $T_J = 150^\circ\text{C}$   
 (2)  $T_J = 25^\circ\text{C}$   
 (3)  $T_J = -55^\circ\text{C}$

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



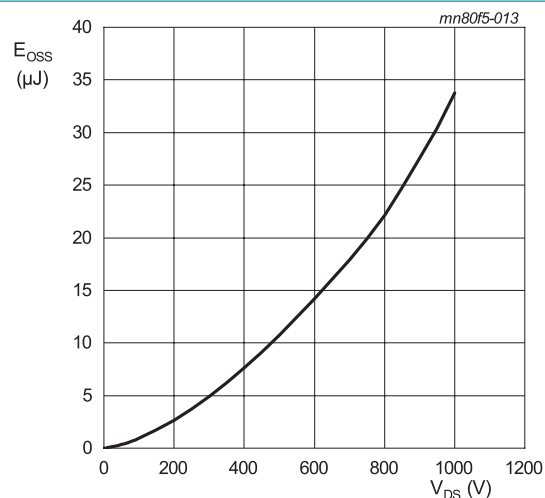
$V_{DS} = 20\text{ V}$ ;  $I_{DS} = 6\text{ mA}$

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

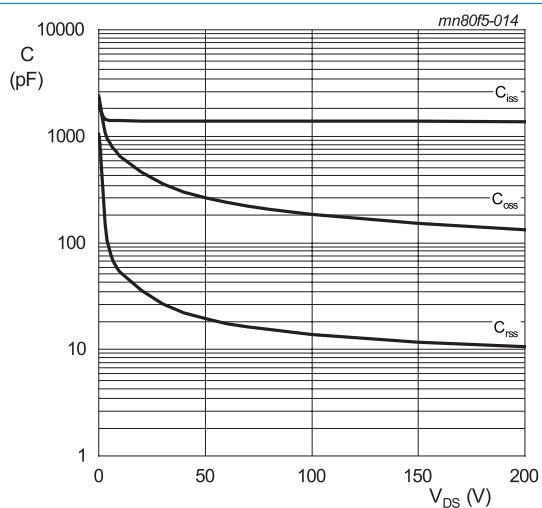


$I_{DS} = 20 \text{ A}$ ;  $I_{GS} = 1 \text{ mA}$ ;  $V_{DS} = 800 \text{ V}$ ;  $T_j = 25^\circ \text{C}$

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

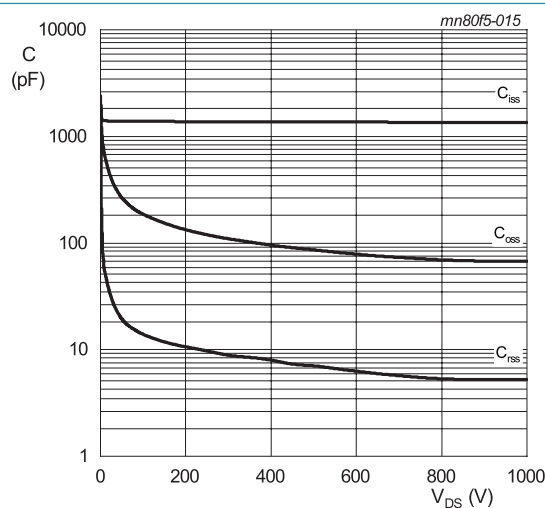


**Fig. 13. Output capacitor stored energy as a function of drain-source voltage**



$V_{DS} = 0 - 200 \text{ V}$   
 $T_j = 25^\circ \text{C}$ ;  $V_{AC} = 25 \text{ mV}$ ;  $f = 1 \text{ MHz}$

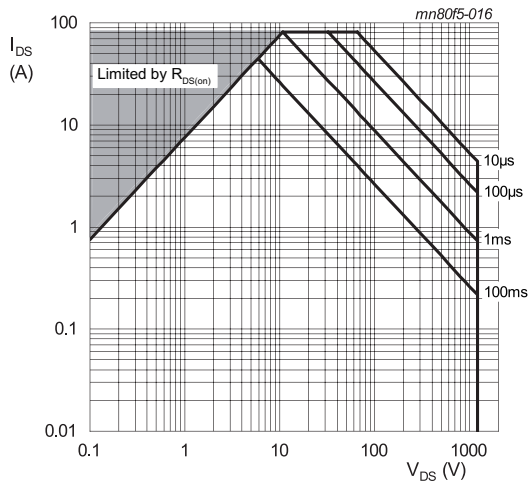
**Fig. 14. Input, output and reverse transfer capacitances as a function of drain-source voltage; typical values**



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

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

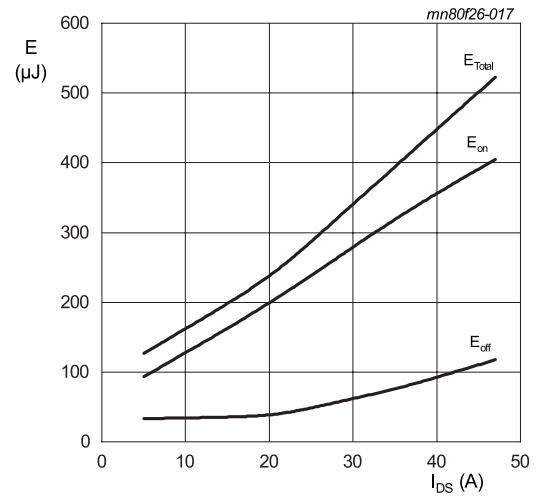




$T_c = 25\text{ }^\circ\text{C}$ ;  $D = 0$

Parameter:  $t_p$

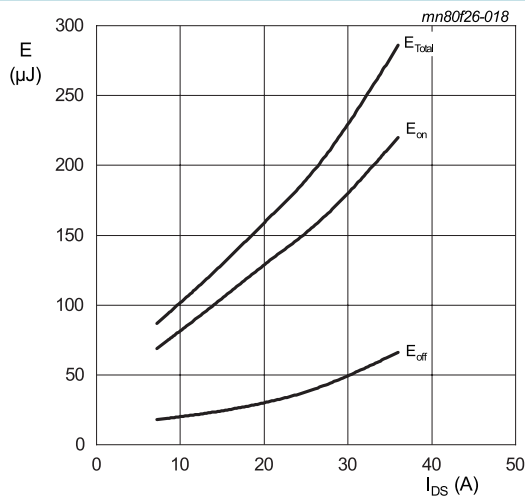
**Fig. 16. Forward bias safe operating area**



$T_j = 25\text{ }^\circ\text{C}$ ;  $V_{DD} = 800\text{ V}$ ;  $R_{G(ext)} = 0\text{ }\Omega$ ;  $V_{GS} = -5\text{V}/20\text{ V}$

FWD = WNSC2D101200W;  $L = 360\text{ }\mu\text{H}$

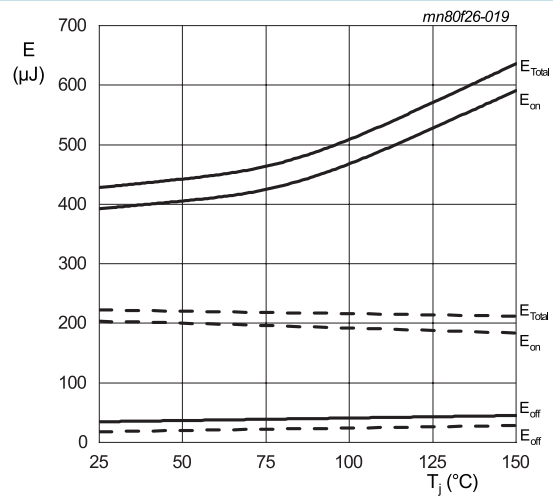
**Fig. 17. Clamped Inductive Switching Energy as a function of drain current**



$T_j = 25\text{ }^\circ\text{C}$ ;  $V_{DD} = 600\text{ V}$ ;  $R_{G(ext)} = 0\text{ }\Omega$ ;  $V_{GS} = -5\text{V}/20\text{ V}$

FWD = WNSC2D101200W;  $L = 360\text{ }\mu\text{H}$

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



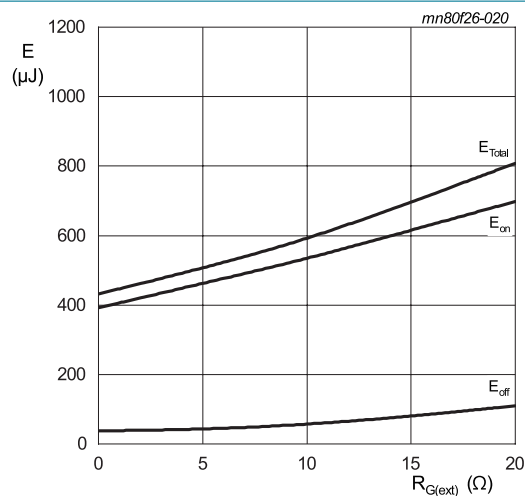
$I_{DS} = 20\text{ A}$ ;  $V_{DD} = 800\text{ V}$ ;  $R_{G(ext)} = 0\text{ }\Omega$ ;  $V_{GS} = -5\text{V}/20\text{ V}$

$L = 360\text{ }\mu\text{H}$

FWD = WNSCM80120R

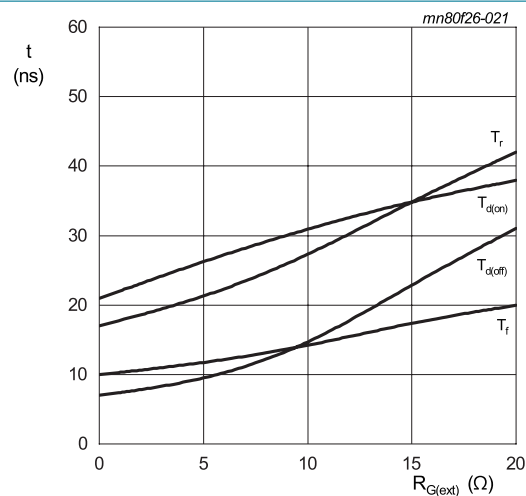
FWD = WNSC2D101200W(- - -)

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



$T_j = 25\text{ }^\circ\text{C}$ ;  $V_{DD} = 800\text{ V}$ ;  $I_{DS} = 20\text{ A}$ ;  $V_{GS} = -5\text{V}/20\text{ V}$   
FWD = WNSCM80120R;  $L = 360\text{ }\mu\text{H}$

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



$T_j = 25\text{ }^\circ\text{C}$ ;  $V_{DD} = 800\text{ V}$ ;  $I_{DS} = 20\text{ A}$ ;  $V_{GS} = -5\text{V}/20\text{ V}$   
FWD = WNSCM80120R;  $L = 360\text{ }\mu\text{H}$

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

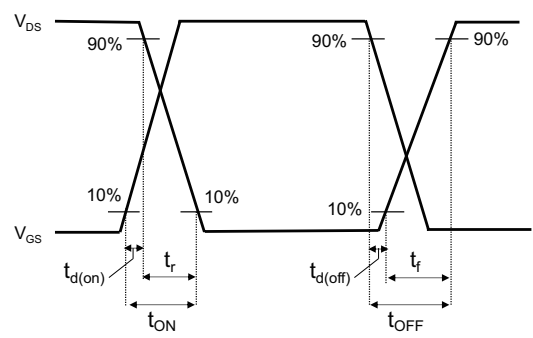
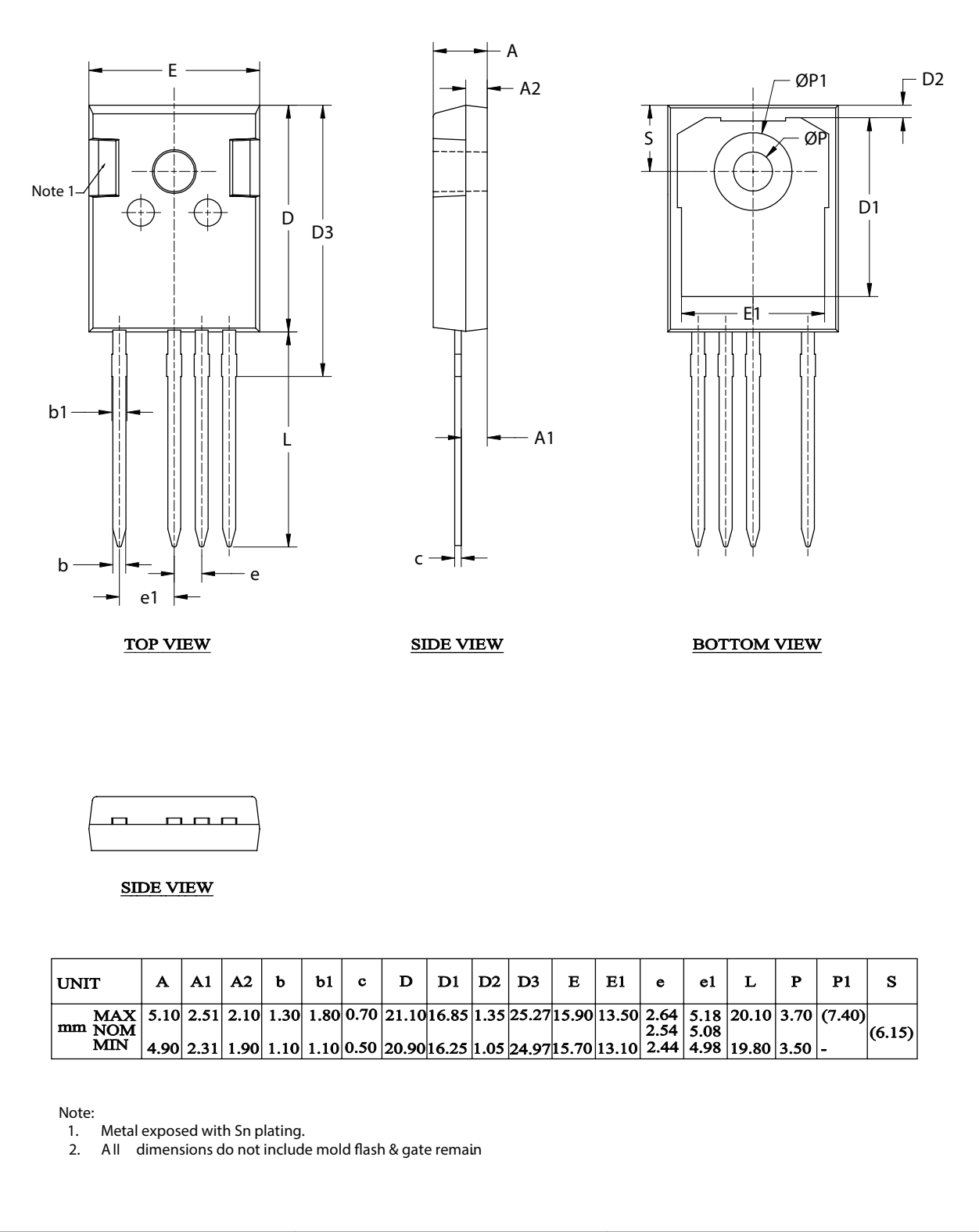


Fig. 22. Switching time definition

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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