

## 1. General description

Silicon Carbide MOSFET in a TSPAK plastic package with top side cooling structure, designed for high frequency, high efficiency systems.



## 2. Features and benefits

- Top side cooling structure
- Kelvin source configuration
- Low specific on-resistance
- Optimized dynamic performance
- Robust gate design
- 0V turn-off  $V_{GS}$  for simple gate driver
- 100% UIS Tested
- Easy to parallel
- RoHS compliant



## 3. Applications

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

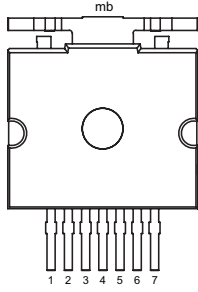
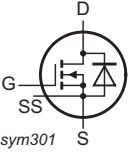
## 4. Quick reference data

Table 1. Quick reference data

Symbol	Parameter	Conditions	Notes	Values			Unit
<b>Absolute maximum rating</b>							
$V_{DS}$	drain-source voltage	$25\text{ °C} \leq T_j \leq 175\text{ °C}$		1200			V
$I_D$	drain current	$V_{GS} = 18\text{ V}; T_{mb} = 25\text{ °C}$		210			A
$P_{tot}$	total power dissipation	$T_{mb} = 25\text{ °C}, T_j = 175\text{ °C}$		1012			W
$T_j$	junction temperature			-55 to 175			°C
Symbol	Parameter	Conditions	Notes	Min	Typ	Max	Unit
<b>Static characteristics</b>							
$R_{DS(on)}$	drain-source on-state resistance	$V_{GS} = 15\text{ V}; I_D = 75\text{ A}; T_j = 25\text{ °C}$		-	12	-	mΩ
		$V_{GS} = 18\text{ V}; I_D = 75\text{ A}; T_j = 25\text{ °C}$		-	9.8	25	mΩ
<b>Dynamic characteristics</b>							
$Q_{G(tot)}$	total gate charge	$I_D = 75\text{ A}; V_{DS} = 800\text{ V}; V_{GS} = -4\text{ V}/18\text{ V}; T_j = 25\text{ °C}$		-	321	-	nC
$Q_{GD}$	gate-drain charge			-	57	-	nC
<b>Source-drain diode</b>							
$Q_r$	recovered charge	$I_{SD} = 50\text{ A}; di/dt = 500\text{ A}/\mu\text{s}; V_{DS} = 400\text{ V}; T_j = 25\text{ °C}$		-	250	-	nC

## 5. Pinning information

Table 2. Pinning information

Pin	Symbol	Description	Simplified outline	Graphic symbol
1	G	gate		
2	SS	source sense		
3-7	S	source		
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
WN2C2M12120TB	TSPAK	WN2C2M12120TB6J	Reel	600	TSPAKH	06-Dec-2024

## 7. Marking

Table 4. Marking codes

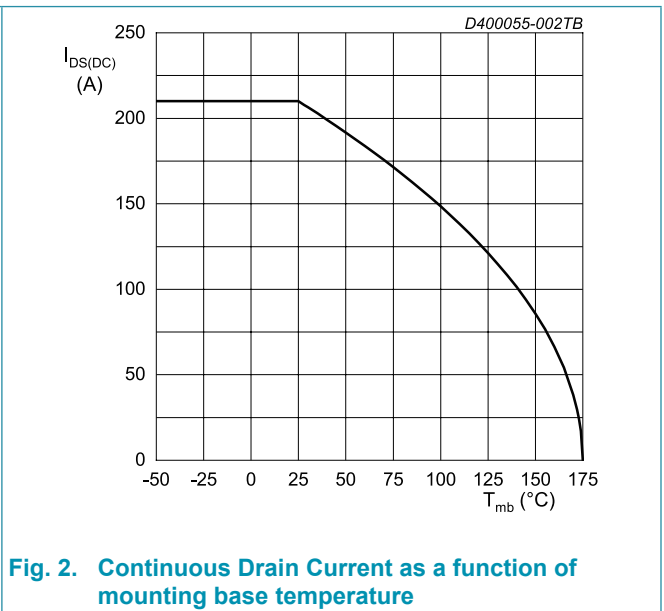
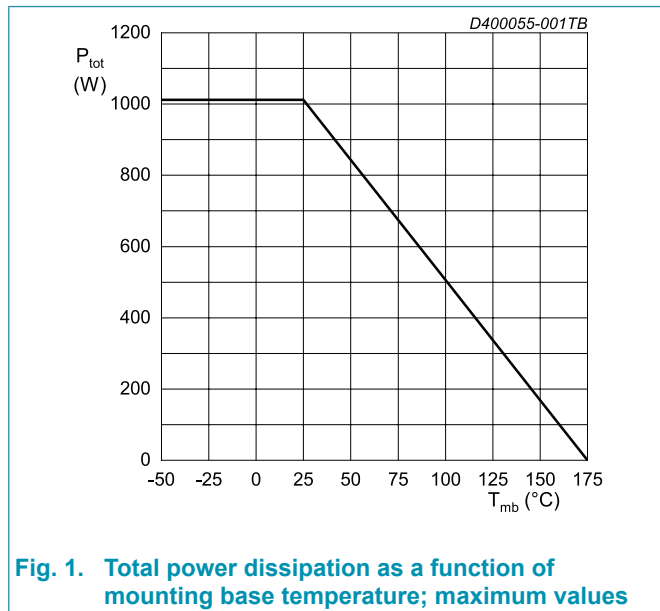
Type number	Marking codes
WN2C2M12120TB	WN2C2M 12120TB

### 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	$T_{mb} = 25\text{ °C}, T_j = 175\text{ °C}$		1012	W
$I_D$	drain current	$V_{GS} = 18\text{ V}; T_{mb} = 25\text{ °C}$		210	A
		$V_{GS} = 18\text{ V}; T_{mb} = 100\text{ °C}$		149	A
$I_{DM}$	peak drain current	pulse width $t_p$ limited by $T_{jmax}$	Fig.17	420	A
$I_S$	continuous diode current	$V_{GS} = -4\text{ V}; T_{mb} = 25\text{ °C}$		142	A
$I_{SM}$	pulse diode current	$V_{GS} = -4\text{ V};$ pulse width $t_p$ limited by $T_{jmax}$		420	A
$E_{as}$	single pulse drain-to-source avalanche	$I_{AS} = 35\text{ A}; L = 1\text{ mH}; V_{DD} = 100\text{ V}; T_j = 25\text{ °C}$		613	mJ
$T_{stg}$	storage temperature			-55 to 175	°C
$T_j$	junction temperature			-55 to 175	°C
$T_{sld(M)}$	peak soldering temperature			245	°C

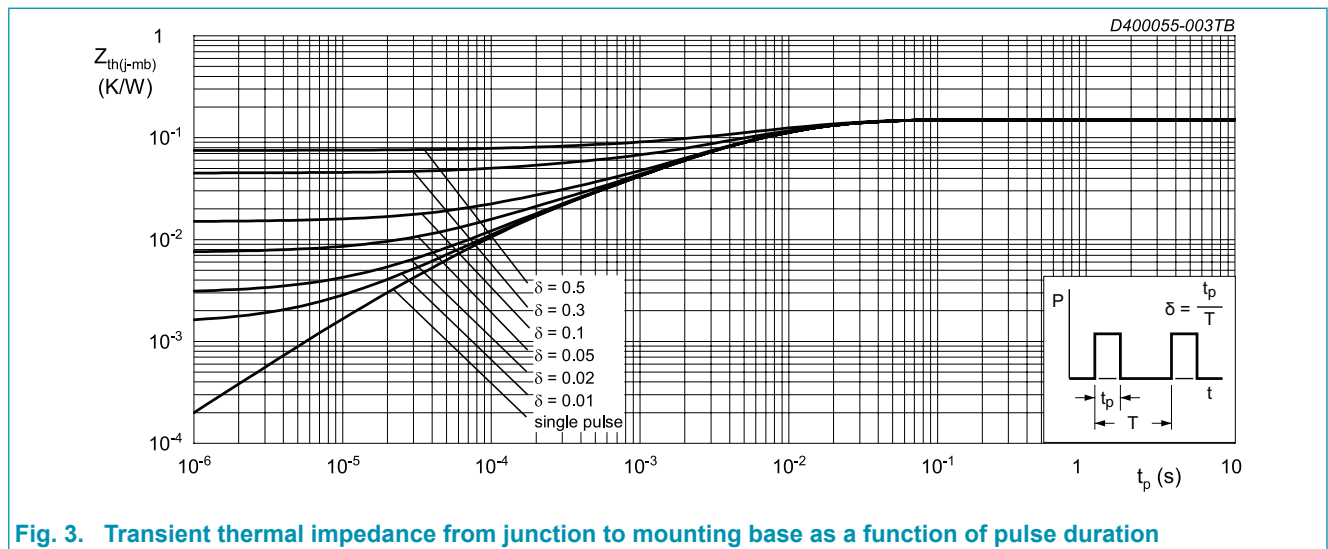


## 9. Thermal & Mechanical characteristics

**Table 6. Thermal & Mechanical characteristics**

Symbol	Parameter	Conditions	Notes	Min	Typ	Max	Unit
$R_{th(j-mb)}$	thermal resistance from junction to mounting base			-	0.15	-	K/W
$R_{th(j-a)}$	thermal resistance from junction to ambient	in free air		-	40	-	K/W

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

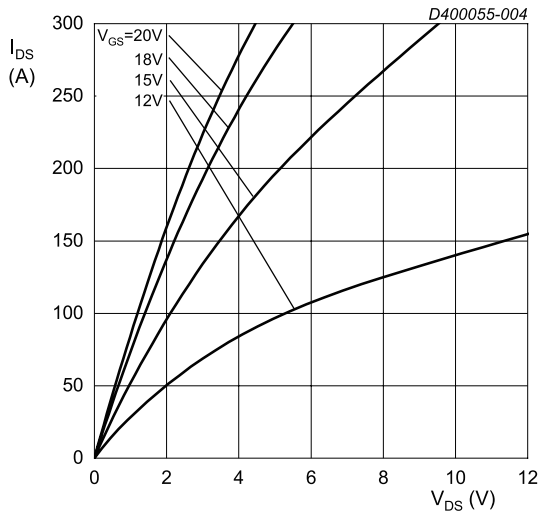


**Fig. 3. Transient thermal impedance from junction to mounting base as a function of pulse duration**

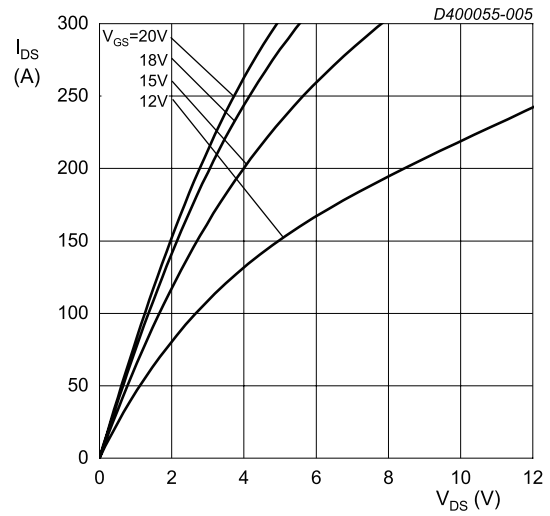
## 10. Characteristics

Table 7. Characteristics

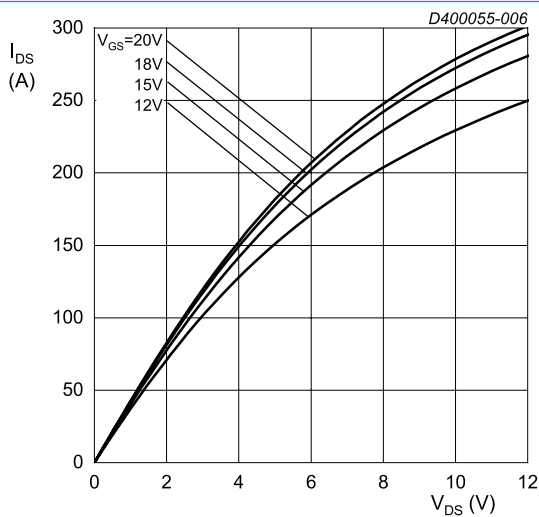
Symbol	Parameter	Conditions	Notes	Min	Typ	Max	Unit
<b>Static characteristics</b>							
$V_{(BR)DSS}$	drain-source breakdown voltage	$I_D = 100 \mu A; V_{GS} = 0 V; T_j = 25 \text{ }^\circ C$		1200	-	-	V
$V_{GS(th)}$	gate-source threshold voltage	$I_D = 28 \text{ mA}; V_{DS} = 10 \text{ V}; T_j = 25 \text{ }^\circ C$		1.9	2.6	3.5	V
		$I_D = 28 \text{ mA}; V_{DS} = 10 \text{ V}; T_j = 175 \text{ }^\circ C$		-	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	$\mu A$
		$V_{DS} = 1200 \text{ V}; V_{GS} = 0 \text{ V}; T_j = 175 \text{ }^\circ C$		-	2	-	$\mu A$
$I_{GSS}$	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	$V_{GS} = 15 \text{ V}; I_D = 75 \text{ A}; T_j = 25 \text{ }^\circ C$		-	12	-	m $\Omega$
		$V_{GS} = 18 \text{ V}; I_D = 75 \text{ A}; T_j = 25 \text{ }^\circ C$		-	9.8	25	m $\Omega$
		$V_{GS} = 18 \text{ V}; I_D = 75 \text{ A}; T_j = 175 \text{ }^\circ C$		-	19.1	-	m $\Omega$
$R_G$	gate resistance	$f = 1 \text{ MHz}; T_j = 25 \text{ }^\circ C$		-	0.53	-	$\Omega$
$g_{fs}$	transconductance	$V_{DS} = 20 \text{ V}; I_D = 75 \text{ A}; T_j = 25 \text{ }^\circ C$		-	56	-	S
<b>Dynamic characteristics</b>							
$Q_{G(tot)}$	total gate charge	$I_D = 75 \text{ A}; V_{DS} = 800 \text{ V}; V_{GS} = -4 \text{ V}/18 \text{ V}; T_j = 25 \text{ }^\circ C$		-	321	-	nC
$Q_{GS}$	gate-source charge			-	115	-	nC
$Q_{GD}$	gate-drain charge			-	57	-	nC
$C_{iss}$	input capacitance	$V_{DS} = 1000 \text{ V}; V_{GS} = 0 \text{ V}; f = 1 \text{ MHz}; T_j = 25 \text{ }^\circ C$		-	6782	-	pF
$C_{oss}$	output capacitance			-	289	-	pF
$C_{rss}$	reverse transfer capacitance			-	23	-	pF
$E_{oss}$	Coss stored energy			-	145	-	$\mu J$
$t_{d(on)}$	turn-on delay time	$V_{DS} = 800 \text{ V}; V_{GS} = -4 \text{ V}/18 \text{ V}; R_{G(ext)} = 5.1 \text{ } \Omega; I_D = 75 \text{ A}; L = 100 \text{ } \mu H; T_j = 25 \text{ }^\circ C$		-	36	-	ns
$t_r$	rise time			-	65	-	ns
$t_{d(off)}$	turn-off delay time			-	86	-	ns
$t_f$	fall time			-	21	-	ns
$E_{on}$	turn-on energy (SiC Diode FWD)		Fig.20	-	1460	-	$\mu J$
$E_{off}$	turn-off energy (SiC Diode FWD)		Fig.20	-	1153	-	$\mu J$
$E_{on}$	turn-on energy (Body Diode FWD)		Fig.20	-	1833	-	$\mu J$
$E_{off}$	turn-off energy (Body Diode FWD)	Fig.20	-	1063	-	$\mu J$	
<b>Source-drain diode</b>							
$V_{SD}$	source-drain voltage	$V_{GS} = 0 \text{ V}; I_{SD} = 37.5 \text{ A}; T_j = 25 \text{ }^\circ C$		-	2.9	-	V
		$V_{GS} = -4 \text{ V}; I_{SD} = 37.5 \text{ A}; T_j = 25 \text{ }^\circ C$		-	4.7	-	V
		$V_{GS} = -4 \text{ V}; I_{SD} = 37.5 \text{ A}; T_j = 175 \text{ }^\circ C$		-	4.1	-	V
$t_{rr}$	reverse recovery time	$I_{SD} = 50 \text{ A}; di/dt = 500 \text{ A}/\mu s; V_{DS} = 400 \text{ V}; T_j = 25 \text{ }^\circ C$		-	45.5	-	ns
$Q_r$	recovered charge			-	250	-	nC
$I_{rrm}$	reverse recovery current			-	10	-	A



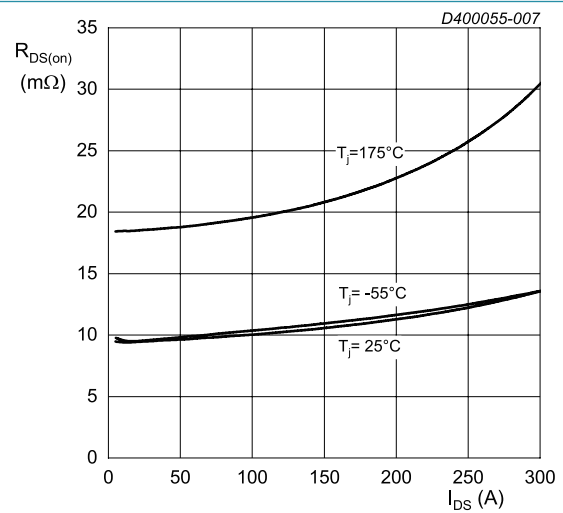
$T_j = -55\text{ °C}; t_p < 200\ \mu\text{s}$   
**Fig. 4. Output characteristics; drain current as a function of drain-source voltage; typical values**



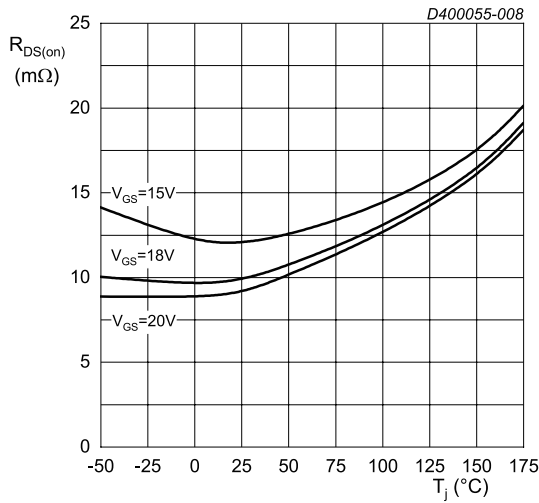
$T_j = 25\text{ °C}; t_p < 200\ \mu\text{s}$   
**Fig. 5. Output characteristics; drain current as a function of drain-source voltage; typical values**



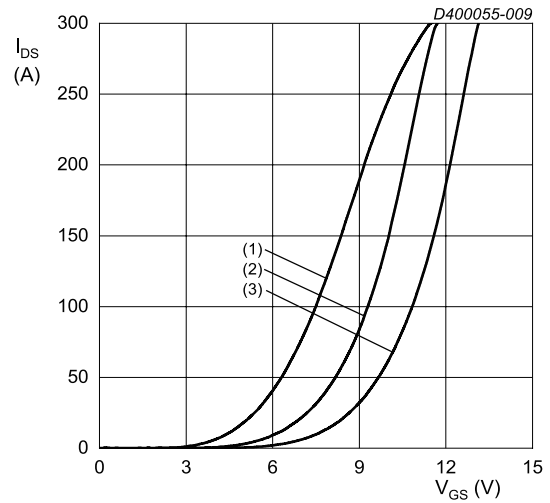
$T_j = 175\text{ °C}; t_p < 200\ \mu\text{s}$   
**Fig. 6. Output characteristics; drain current as a function of drain-source voltage; typical values**



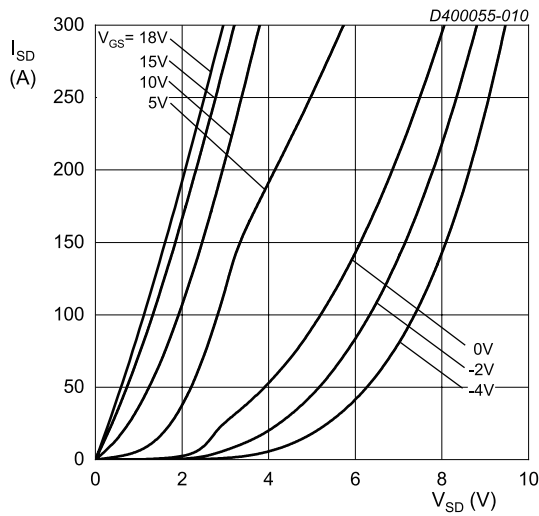
$V_{GS} = 18\text{ V}; t_p < 200\ \mu\text{s}$   
**Fig. 7. Drain-source on-state resistance as a function of drain current; typical values**



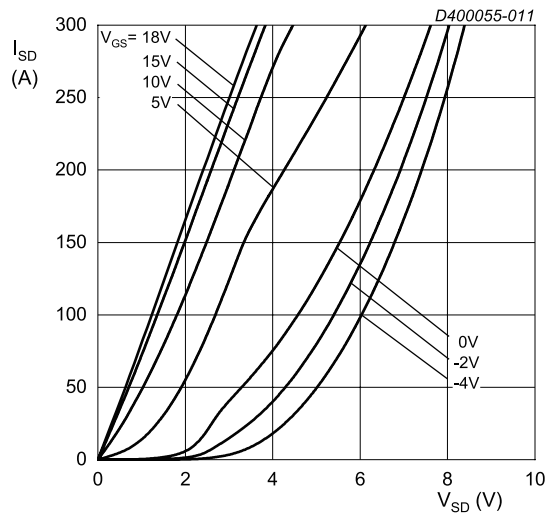
$I_{DS} = 75 \text{ A}; t_p < 200 \mu\text{s}$   
**Fig. 8. Drain-source on-state resistance as a function of junction temperature**



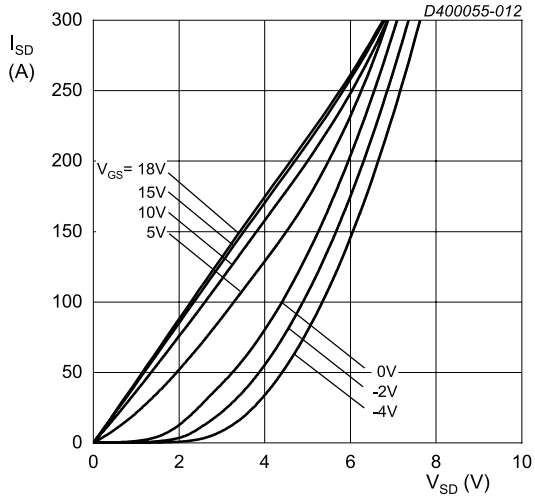
$V_{DS} = 20 \text{ V}; t_p < 200 \mu\text{s}$   
 (1)  $T_j = 175 \text{ }^\circ\text{C}$   
 (2)  $T_j = 25 \text{ }^\circ\text{C}$   
 (3)  $T_j = -55 \text{ }^\circ\text{C}$   
**Fig. 9. Transfer characteristics; drain current as a function of gate-source voltage; typical values**



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

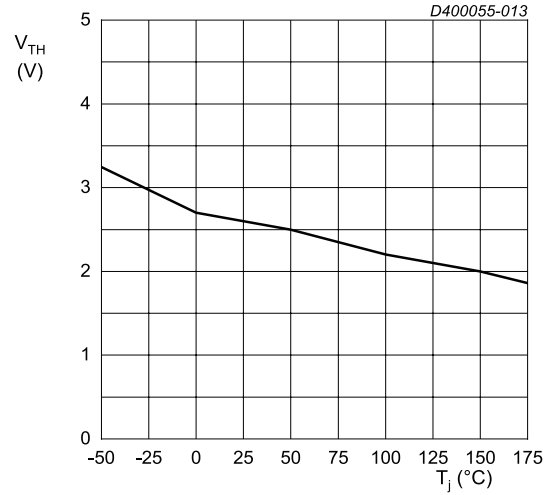


$T_j = 25 \text{ }^\circ\text{C}; t_p < 200 \mu\text{s}$   
**Fig. 11. Body diode forward characteristics; typical values**



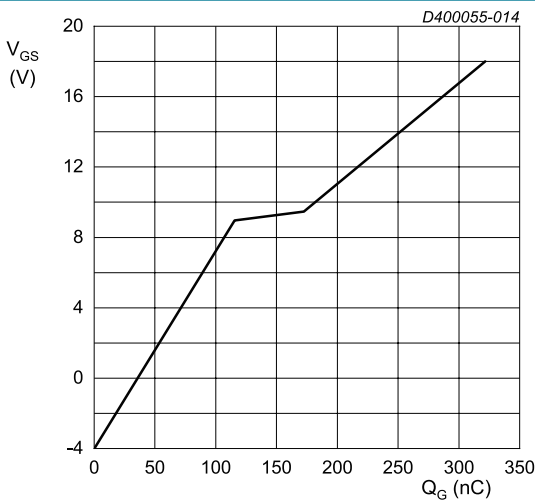
$T_j = 175\text{ }^\circ\text{C}$ ;  $t_p < 200\text{ }\mu\text{s}$

**Fig. 12. Body diode forward characteristics; typical values**



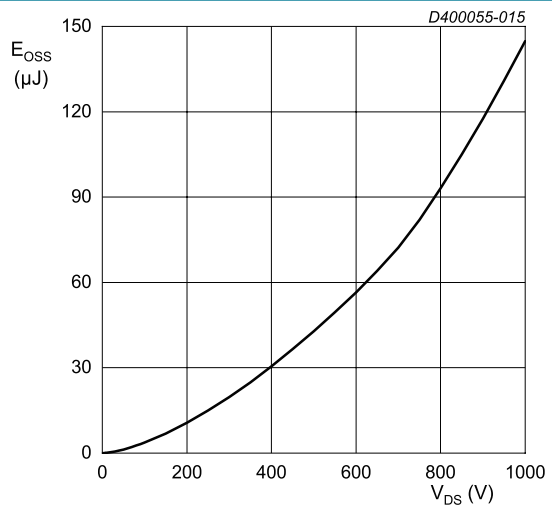
$V_{DS} = 10\text{ V}$ ;  $I_{DS} = 28\text{ mA}$

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



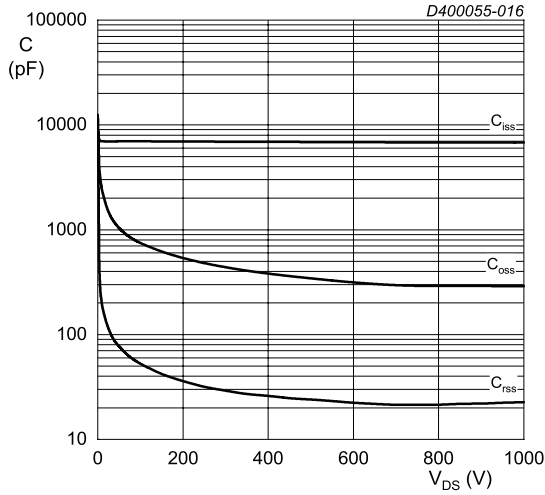
$I_{DS} = 75\text{ A}$ ;  $I_{GS} = 0.1\text{ mA}$ ;  $V_{DS} = 800\text{ V}$ ;  $T_j = 25\text{ }^\circ\text{C}$

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



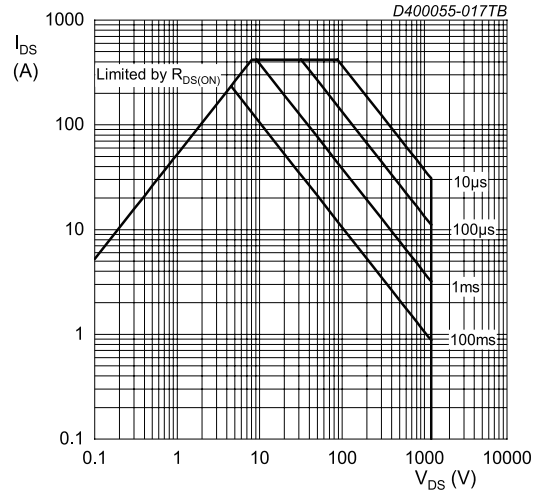
**Fig. 15. Output capacitor stored energy as a function of drain-source voltage**





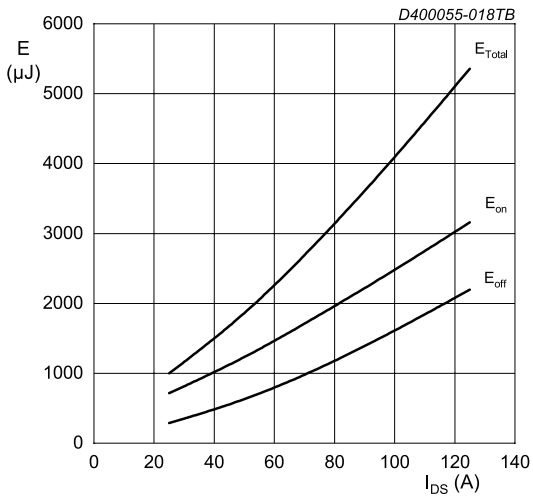
$V_{DS} = 0 - 1000 \text{ V}$   
 $T_j = 25 \text{ }^\circ\text{C}; V_{AC} = 25 \text{ mV}; f = 1 \text{ MHz}$

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



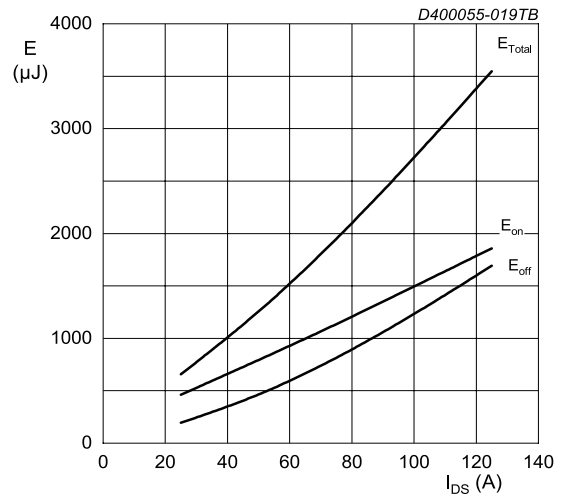
$T_j = 25 \text{ }^\circ\text{C}; D = 0$   
 Parameter:  $t_p$

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



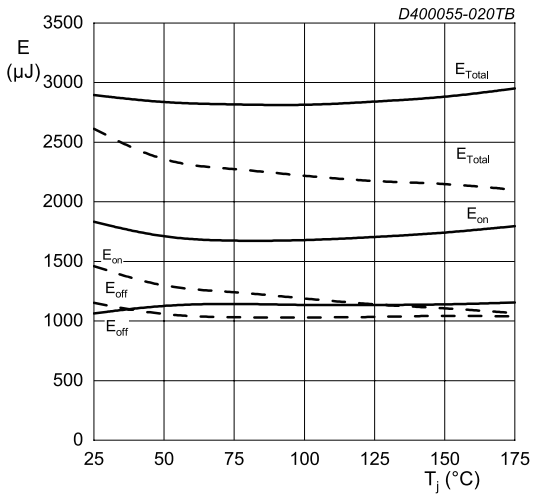
$T_j = 25 \text{ }^\circ\text{C}; V_{DD} = 800 \text{ V}; R_{G(ext)} = 5.1 \text{ } \Omega;$   
 $V_{GS} = -4 \text{ V}/18 \text{ V}; L = 100 \text{ } \mu\text{H}$   
 FWD = WNSC2M12120TB

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



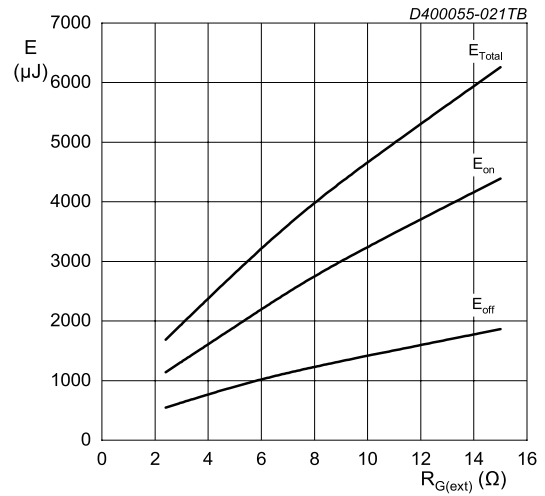
$T_j = 25 \text{ }^\circ\text{C}; V_{DD} = 600 \text{ V}; R_{G(ext)} = 5.1 \text{ } \Omega;$   
 $V_{GS} = -4 \text{ V}/18 \text{ V}; L = 100 \text{ } \mu\text{H}$   
 FWD = WNSC2M12120TB

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



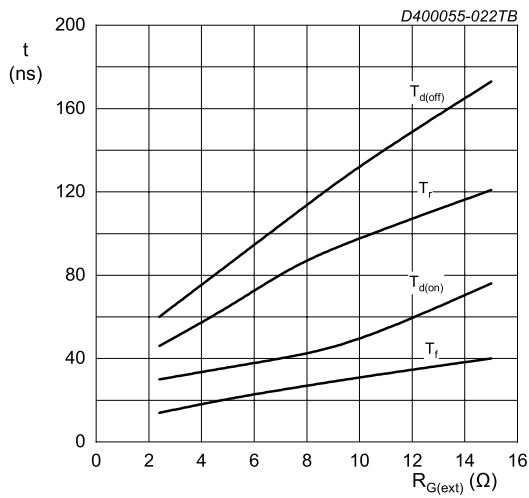
$I_{DS} = 75 \text{ A}; V_{DD} = 800 \text{ V}; R_{G(ext)} = 5.1 \Omega;$   
 $V_{GS} = -4 \text{ V}/18 \text{ V}; L = 100 \mu\text{H}$   
 FWD = WNSC2M12120TB  
 FWD = WNSC2D401200TB(---)

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



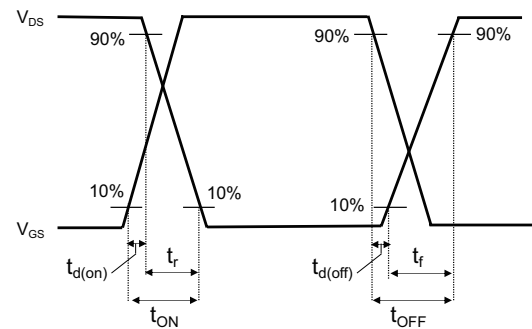
$T_j = 25 \text{ }^\circ\text{C}; V_{DD} = 800 \text{ V}; I_{DS} = 75 \text{ A}; V_{GS} = -4 \text{ V}/18 \text{ V}$   
 FWD = WNSC2M12120TB;  $L = 100 \mu\text{H}$

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



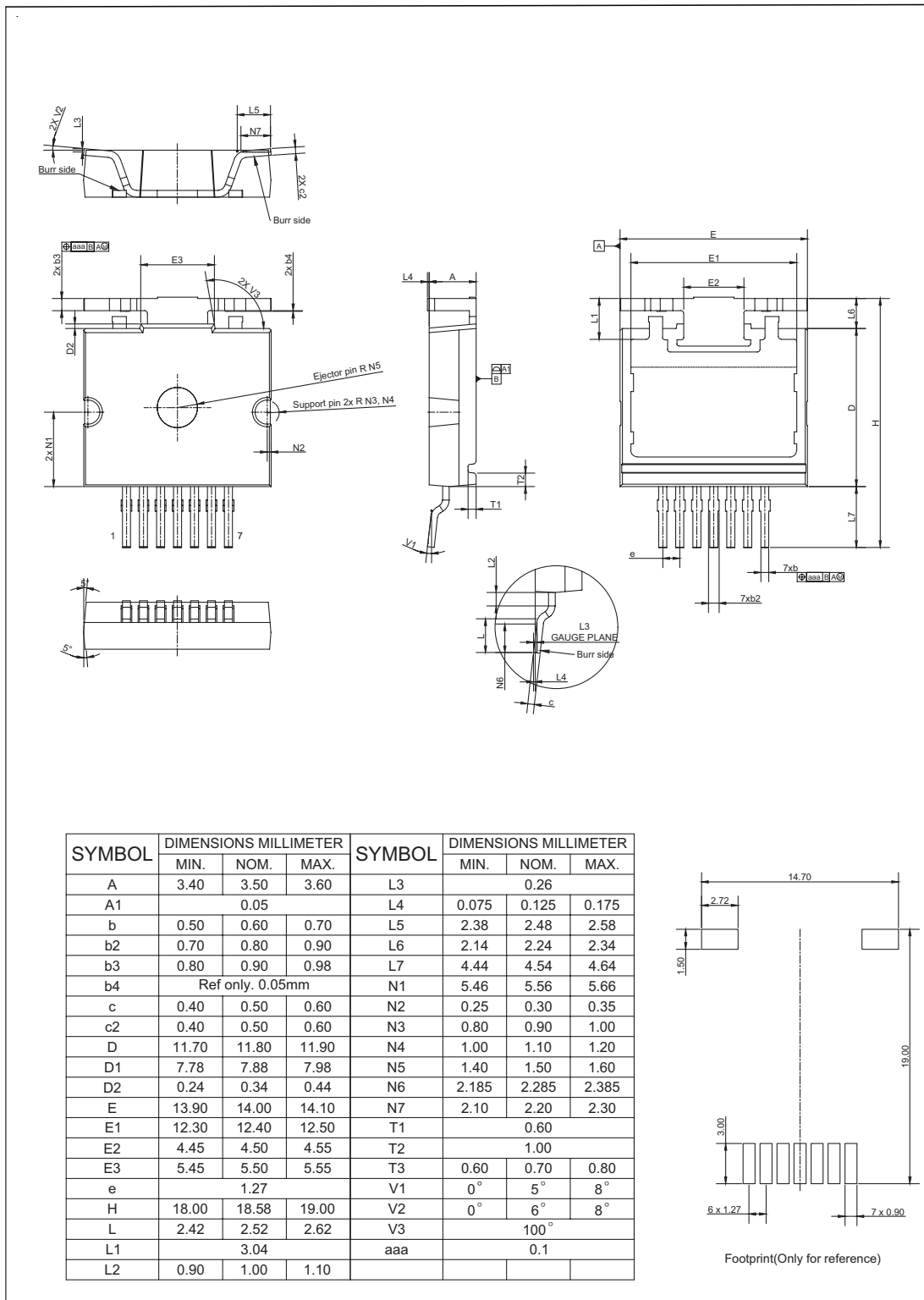
$T_j = 25 \text{ }^\circ\text{C}; V_{DD} = 800 \text{ V}; I_{DS} = 75 \text{ A}; V_{GS} = -4 \text{ V}/18 \text{ V}$   
 FWD = WNSC2M12120TB;  $L = 100 \mu\text{H}$

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



**Fig. 23. Switching time definition**

### 11. Package outline



## 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".
- [3] The product status of device(s) described in this document may have changed since this document was published and may differ in case of multiple devices. The latest product status information is available on the Internet at URL <http://www.ween-semi.com>.

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