

1. General description

TSPM1 module with WeEn 650V Gen2 SiC MOSFET. Integrated with NTC temperature sensor.



2. Features and benefits

- Half bridge topology
- Low $R_{DS(on)}$
- Low Switching Losses
- Low Q_g and C_{rss}
- Low Inductive Design

3. Applications

- Power inverters
- AC-DC converters
- DC-DC converters
- Active power factor correctors
- Compressor drivers
- On board chargers

4. Quick reference data

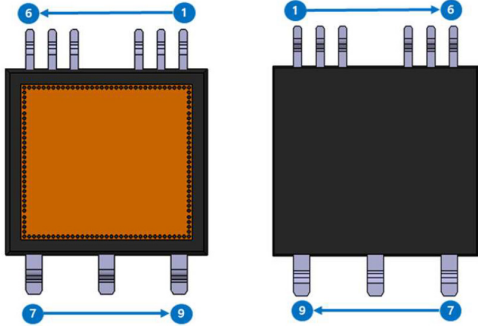
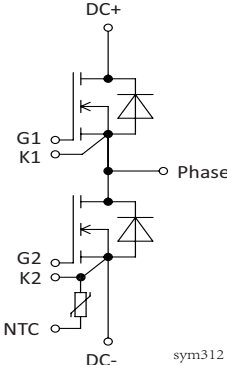
Table 1. Quick reference data

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Symbol	Parameter	Conditions	Notes	Values			Unit
Absolute maximum rating							
V _{DS}	drain-source voltage	25 °C ≤ T _j ≤ 175 °C		650			V
I _D	drain current	V _{GS} = 18 V; T _{mb} = 25 °C		54			A
P _{tot}	total power dissipation	T _{mb} = 25 °C, T _j = 175 °C		170			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 = 25 A; T _j = 25 °C		-	45	58	mΩ
		V _{GS} = 18 V; I _D = 25 A; T _j = 25 °C		-	33	43	mΩ
Dynamic characteristics							
Q _{G(tot)}	total gate charge	I _D = 25 A; V _{DS} = 400 V; V _{GS} = -4 V/18 V; T _j = 25 °C		-	87	-	nC
Q _{GD}	gate-drain charge			-	9	-	nC
Source-drain diode							
Q _r	recovered charge	I _{SD} = 25 A; di/dt = 500 A/μs; V _{DS} = 400 V; T _j = 25 °C		-	94	-	nC

5. Pinning information

Table 2. Pinning information

Pin	Description	Simplified outline	Circuit diagram
1	G1		
2	K1		
3	N/C		
4	NTC		
5	K2		
6	G2		
7	Phase		
8	DC-		
9	DC+		

6. Ordering information

Table 3. Ordering information

Type number	Package Name	Orderable part number	Packing method	Small packing quantity	Package version	Package issue date
WMSC045H06TS1	TSPM1	WMSC045H06TS16Q	Tube	16		

7. Marking

Table 4. Marking codes

Type number	Marking codes
WMSC045H06TS1	WMSC045H06TS1

8. Limiting values

Table 5. Limiting values
In accordance with the Absolute Maximum Rating System (IEC 60134).

Symbol	Parameter	Conditions	Notes	Values	Unit
T _{stg}	storage temperature			-55 to 175	°C
T _j	junction temperature			-55 to 175	°C
MOSFET					
V _{DS}	drain-source voltage	T _j = 25 °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 °C		170	W
I _D	drain current	V _{GS} = 18 V; T _{mb} = 25 °C		54	A
		V _{GS} = 18 V; T _{mb} = 100 °C		38	A
I _{DM}	peak drain current	pulse width t _p limited by T _{jmax}		107	A
E _{as}	single pulse drain-to-source avalanche	I _{AS} = 20 A; L = 1 mH; V _{DD} = 100 V; T _j = 25 °C		200	mJ
Body Diode					
I _{SD}	DC body diode forward current	V _{GS} = -4 V; T _j = 25 °C		63	A
I _{SD,pulse}	Pulse body diode current	V _{GS} = -4 V; pulse width t _p limited by T _{jmax}		107	A

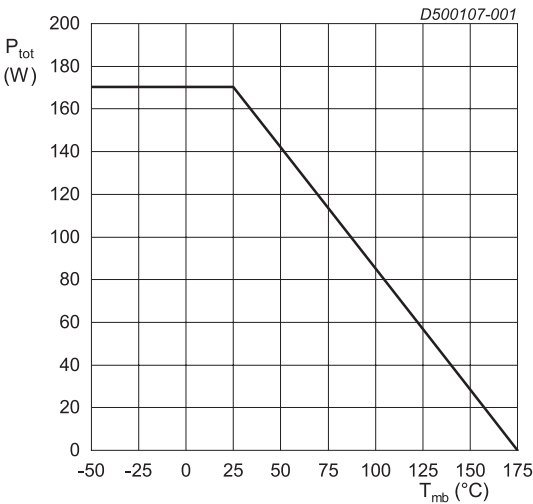


Fig. 1. Total power dissipation as a function of mounting base temperature; maximum values

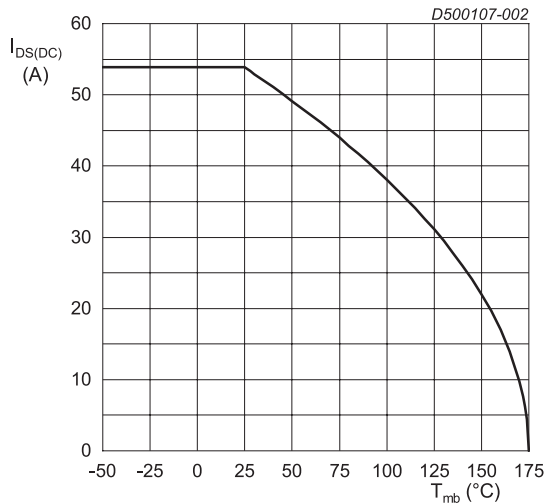


Fig. 2. Continuous Drain Current as a function of mounting base temperature

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			-	0.88	-	K/W

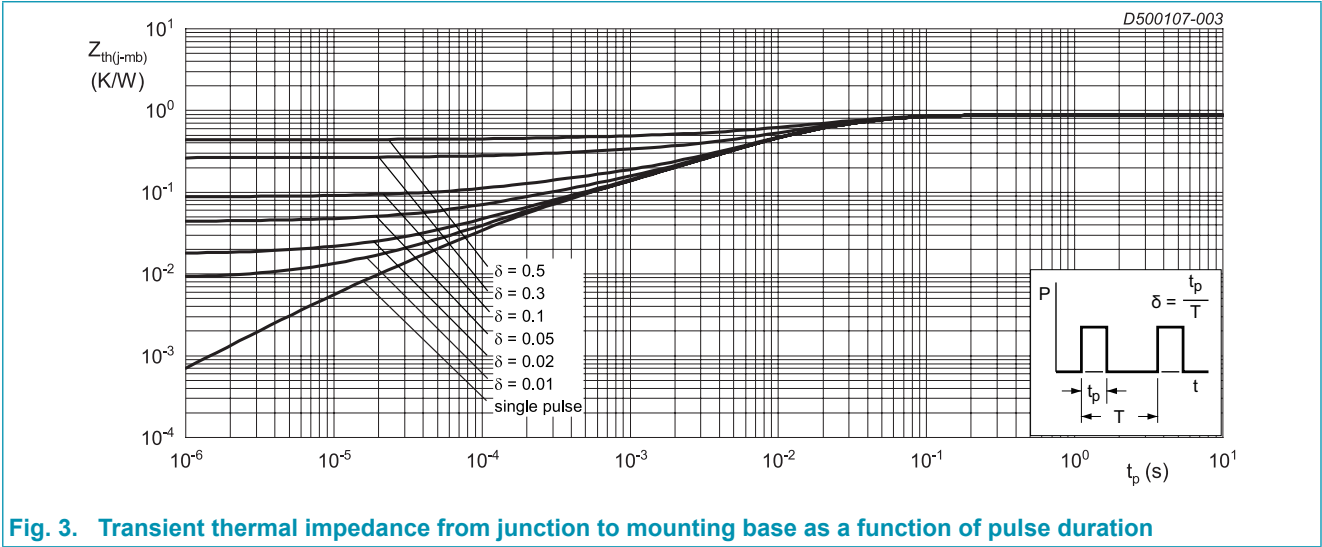
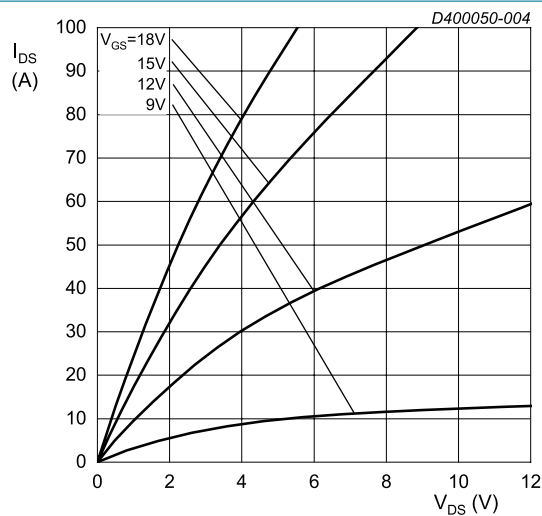


Fig. 3. Transient thermal impedance from junction to mounting base as a function of pulse duration

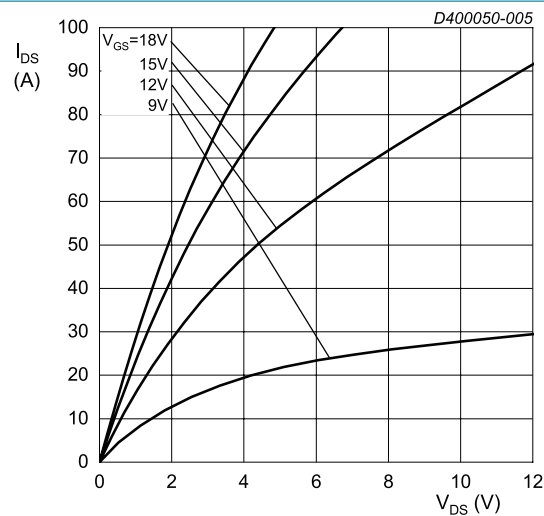
10. Characteristics

Table 7. Characteristics

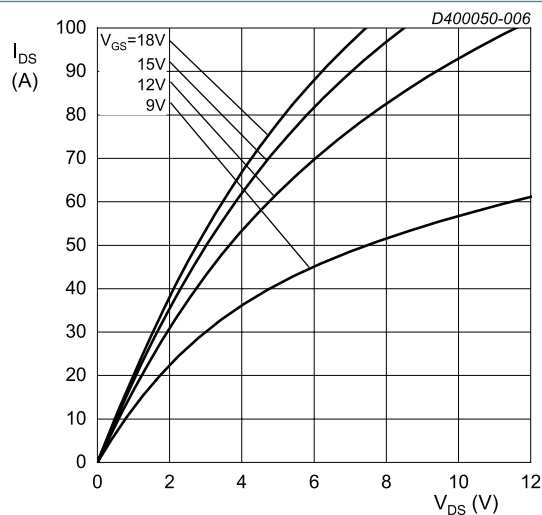
MOSFET							
Symbol	Parameter	Conditions	Notes	Min	Typ	Max	Unit
Static characteristics							
$V_{(BR)DSS}$	drain-source breakdown voltage	$I_D = 100 \mu A$; $V_{GS} = 0 V$; $T_J = 25^\circ C$		650	-	-	V
$V_{GS(th)}$	gate-source threshold voltage	$I_D = 6 mA$; $V_{DS} = V_{GS}$; $T_J = 25^\circ C$		1.9	2.6	3.5	V
		$I_D = 6 mA$; $V_{DS} = V_{GS}$; $T_J = 175^\circ C$		-	1.9	-	V
I_{DSS}	drain leakage current	$V_{DS} = 650 V$; $V_{GS} = 0 V$; $T_J = 25^\circ C$		-	0.1	50	μA
		$V_{DS} = 650 V$; $V_{GS} = 0 V$; $T_J = 175^\circ C$		-	5	-	μA
I_{GSS}	gate leakage current	$V_{GS} = 22 V$; $V_{DS} = 0 V$; $T_J = 25^\circ C$		-	5	100	nA
		$V_{GS} = -10 V$; $V_{DS} = 0 V$; $T_J = 25^\circ C$		-	5	100	nA
$R_{DS(on)}$	drain-source on-state resistance	$V_{GS} = 15 V$; $I_D = 25 A$; $T_J = 25^\circ C$		-	45	58	m Ω
		$V_{GS} = 18 V$; $I_D = 25 A$; $T_J = 25^\circ C$		-	33	43	m Ω
		$V_{GS} = 18 V$; $I_D = 25 A$; $T_J = 175^\circ C$		-	49	-	m Ω
R_G	gate resistance	$f = 1 MHz$; $T_J = 25^\circ C$		-	3.1	-	Ω
g_{fs}	transconductance	$V_{DS} = 20 V$; $I_D = 25 A$; $T_J = 25^\circ C$		-	15	-	S
Dynamic characteristics							
$Q_{G(tot)}$	total gate charge	$I_D = 25 A$; $V_{DS} = 400 V$; $V_{GS} = -4 V/18 V$; $T_J = 25^\circ C$		-	87	-	nC
Q_{GS}	gate-source charge			-	35	-	nC
Q_{GD}	gate-drain charge			-	9	-	nC
C_{iss}	input capacitance	$V_{DS} = 400 V$; $V_{GS} = 0 V$; $f = 1 MHz$; $T_J = 25^\circ C$		-	2167	-	pF
C_{oss}	output capacitance			-	191	-	pF
C_{rss}	reverse transfer capacitance			-	8	-	pF
E_{oss}	Coss stored energy			-	95.5	-	μJ
$t_{d(on)}$	turn-on delay time	$V_{DS} = 400 V$; $V_{GS} = -4 V/18 V$; $R_{G(ext)} = 5.1 \Omega$; $I_D = 12.5 A$; $L = 100 \mu H$; $T_J = 25^\circ C$		-	11	-	ns
t_r	rise time			-	8	-	ns
$t_{d(off)}$	turn-off delay time			-	30	-	ns
t_f	fall time			-	22	-	ns
E_{on}	turn-on energy (Body Diode FWD)		Fig.19	-	50	-	μJ
E_{off}	turn-off energy (Body Diode FWD)		Fig.19	-	24	-	μJ
Body diode							
Symbol	Parameter	Conditions	Notes	Min	Typ	Max	Unit
V_{SD}	source-drain voltage	$V_{GS} = 0 V$; $I_{SD} = 25 A$; $T_J = 25^\circ C$		-	3.4	-	V
		$V_{GS} = -4 V$; $I_{SD} = 25 A$; $T_J = 25^\circ C$		-	3.9	-	V
		$V_{GS} = -4 V$; $I_{SD} = 25 A$; $T_J = 175^\circ C$		-	3.4	-	V
t_{rr}	reverse recovery time	$I_{SD} = 25 A$; $di/dt = 500 A/\mu s$; $V_{DS} = 400 V$; $T_J = 25^\circ C$		-	32	-	ns
Q_r	recovered charge			-	94	-	nC
I_{rrm}	reverse recovery current			-	28.8	-	A



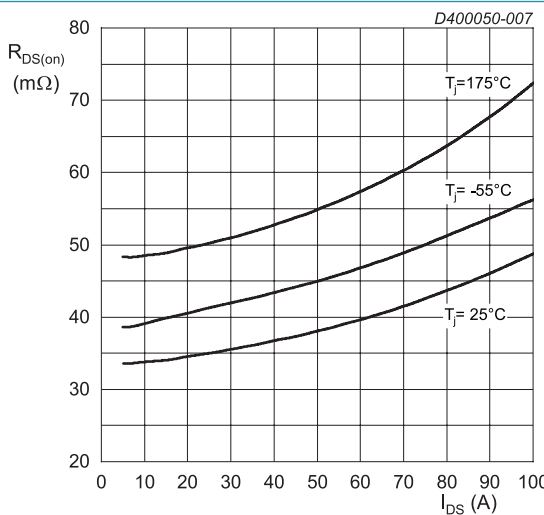
$T_j = -55\text{ }^{\circ}\text{C}; t_p < 200\text{ }\mu\text{s}$
Fig. 4. Output characteristics; drain current as a function of drain-source voltage; typical values



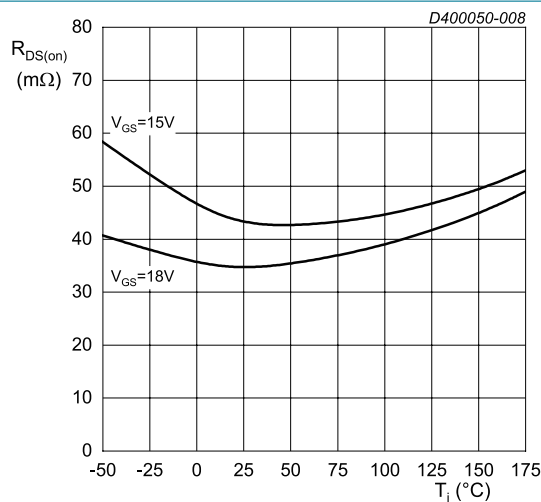
$T_j = 25\text{ }^{\circ}\text{C}; t_p < 200\text{ }\mu\text{s}$
Fig. 5. Output characteristics; drain current as a function of drain-source voltage; typical values



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

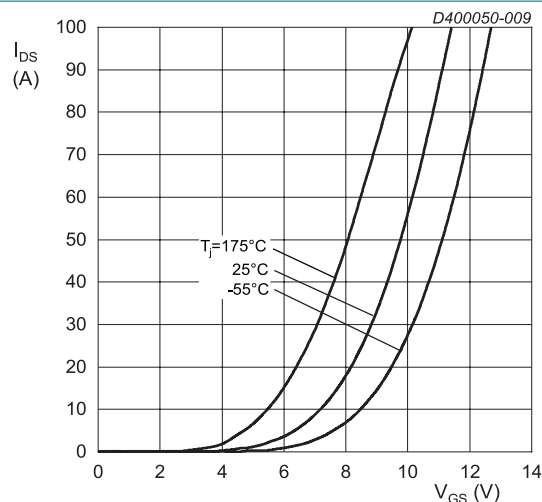


$V_{GS} = 18\text{ V}; t_p < 200\text{ }\mu\text{s}$
Fig. 7. Drain-source on-state resistance as a function of drain current; typical values



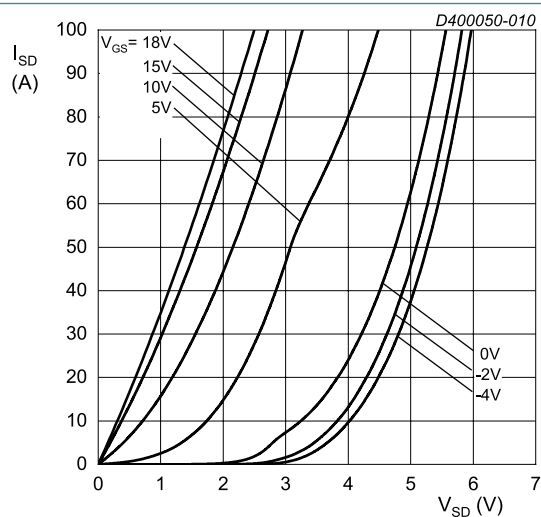
$I_{DS} = 25\text{ A}; t_p < 200\text{ }\mu s$

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



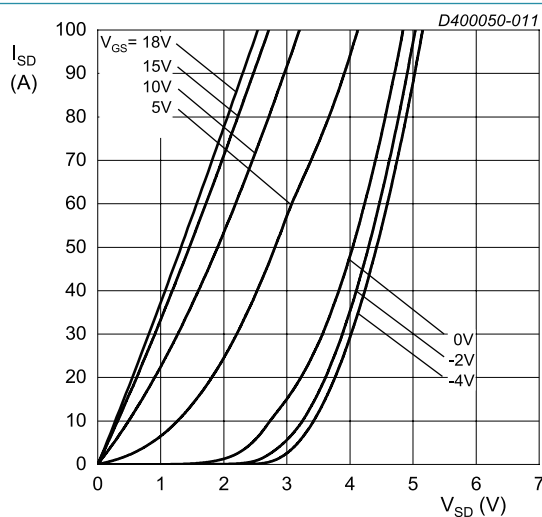
$V_{DS} = 20\text{ V}; t_p < 200\text{ }\mu s$

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



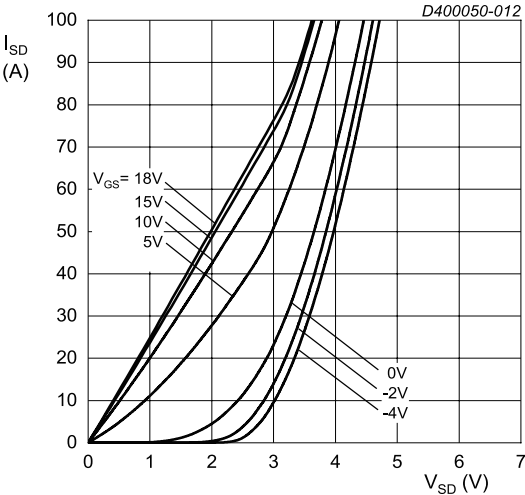
$T_j = -55\text{ }^{\circ}C; t_p < 200\text{ }\mu s$

Fig. 10. Body diode forward characteristics; typical values



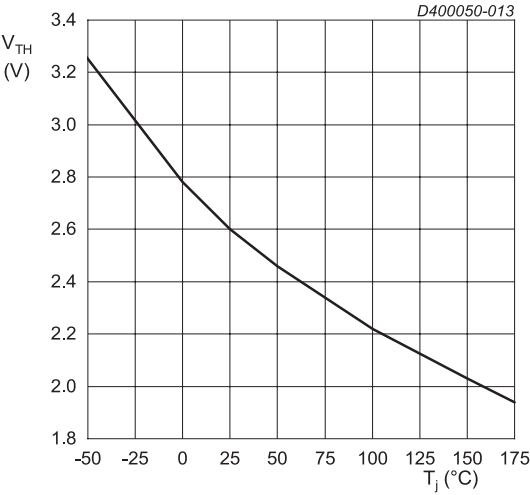
$T_j = 25\text{ }^{\circ}C; t_p < 200\text{ }\mu s$

Fig. 11. Body diode forward characteristics; typical values



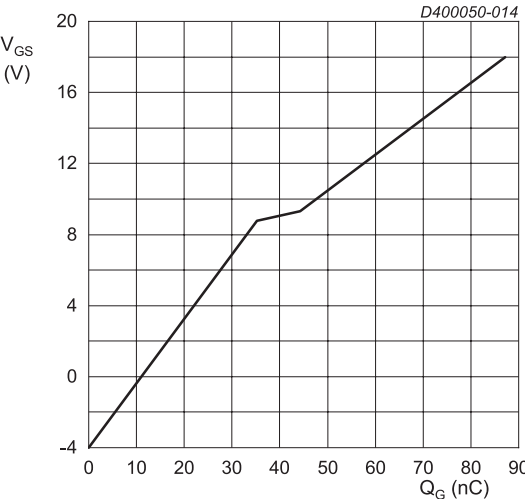
$T_j = 175\text{ }^{\circ}\text{C}$; $t_p < 200\text{ }\mu\text{s}$

Fig. 12. Body diode forward characteristics; typical values



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

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



$I_{DS} = 25\text{ A}$; $I_{GS} = 0.1\text{ mA}$; $V_{DS} = 400\text{ V}$; $T_j = 25\text{ }^{\circ}\text{C}$

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

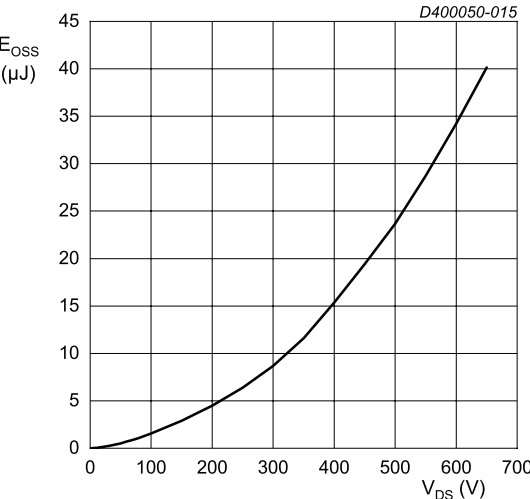
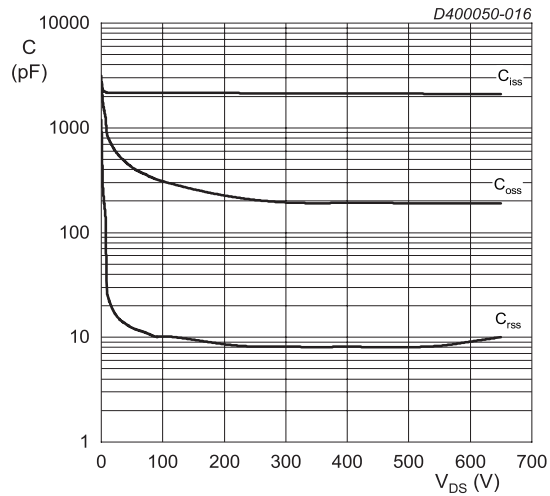
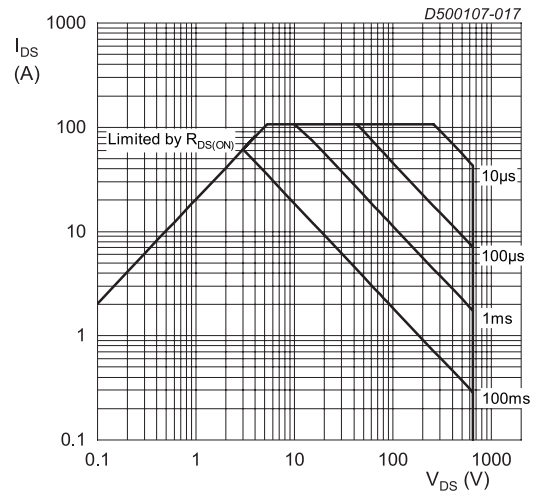


Fig. 15. Output capacitor stored energy as a function of drain-source voltage



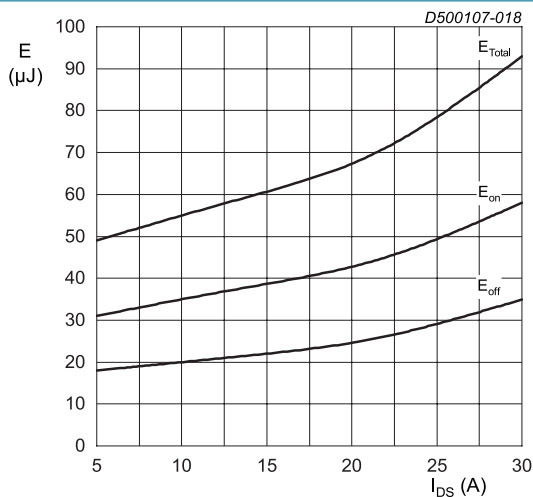
$V_{DS} = 0 - 650$ V
 $T_j = 25$ °C; $V_{AC} = 25$ mV; $f = 1$ MHz

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



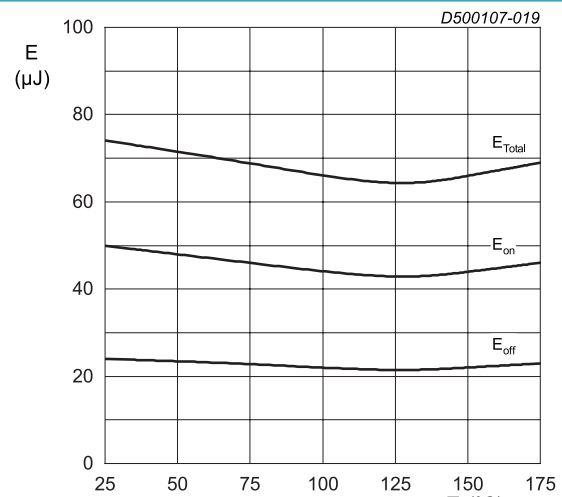
$T_j = 25$ °C; $D = 0$
 Parameter: t_p

Fig. 17. Forward bias safe operating area



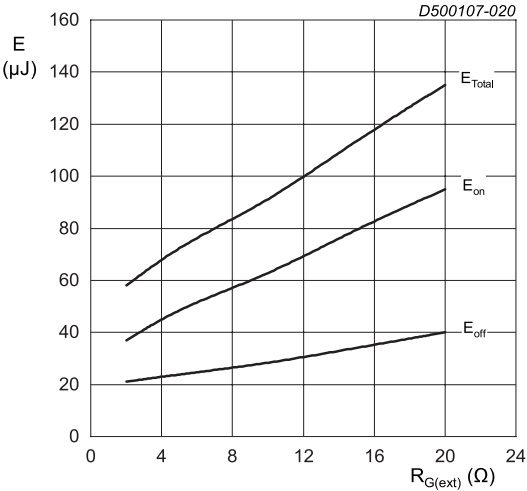
$T_j = 25$ °C; $V_{DD} = 400$ V; $R_{G(ext)} = 2.0$ Ω ;
 $V_{GS} = -4$ V/18 V; $L = 100$ μ H
 FWD = WNSC2M45065B7

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



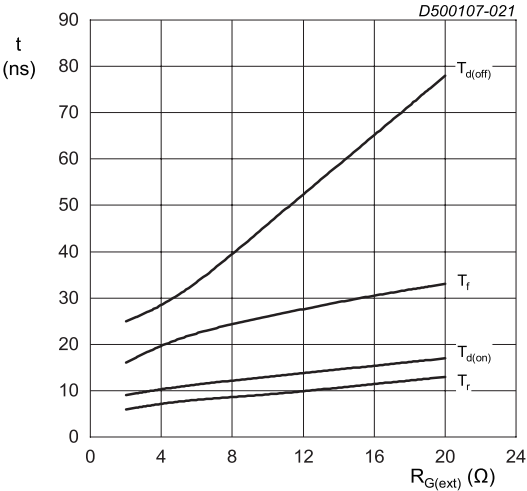
$I_{DS} = 12.5$ A; $V_{DD} = 400$ V; $R_{G(ext)} = 5.1$ Ω ;
 $V_{GS} = -4$ V/18 V; $L = 100$ μ H
 FWD = WNSC2M45065B7

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



$T_j = 25\text{ }^\circ\text{C}$; $V_{DD} = 400\text{ V}$; $I_{DS} = 12.5\text{ A}$; $V_{GS} = -4\text{ V}/18\text{ V}$
FWD = WNSC2M45065B7; $L = 100\text{ }\mu\text{H}$

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



$T_j = 25\text{ }^\circ\text{C}$; $V_{DD} = 400\text{ V}$; $I_{DS} = 12.5\text{ A}$; $V_{GS} = -4\text{ V}/18\text{ V}$
FWD = WNSC2M45065B7; $L = 100\text{ }\mu\text{H}$

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

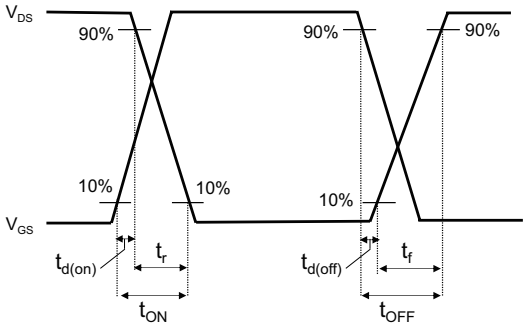
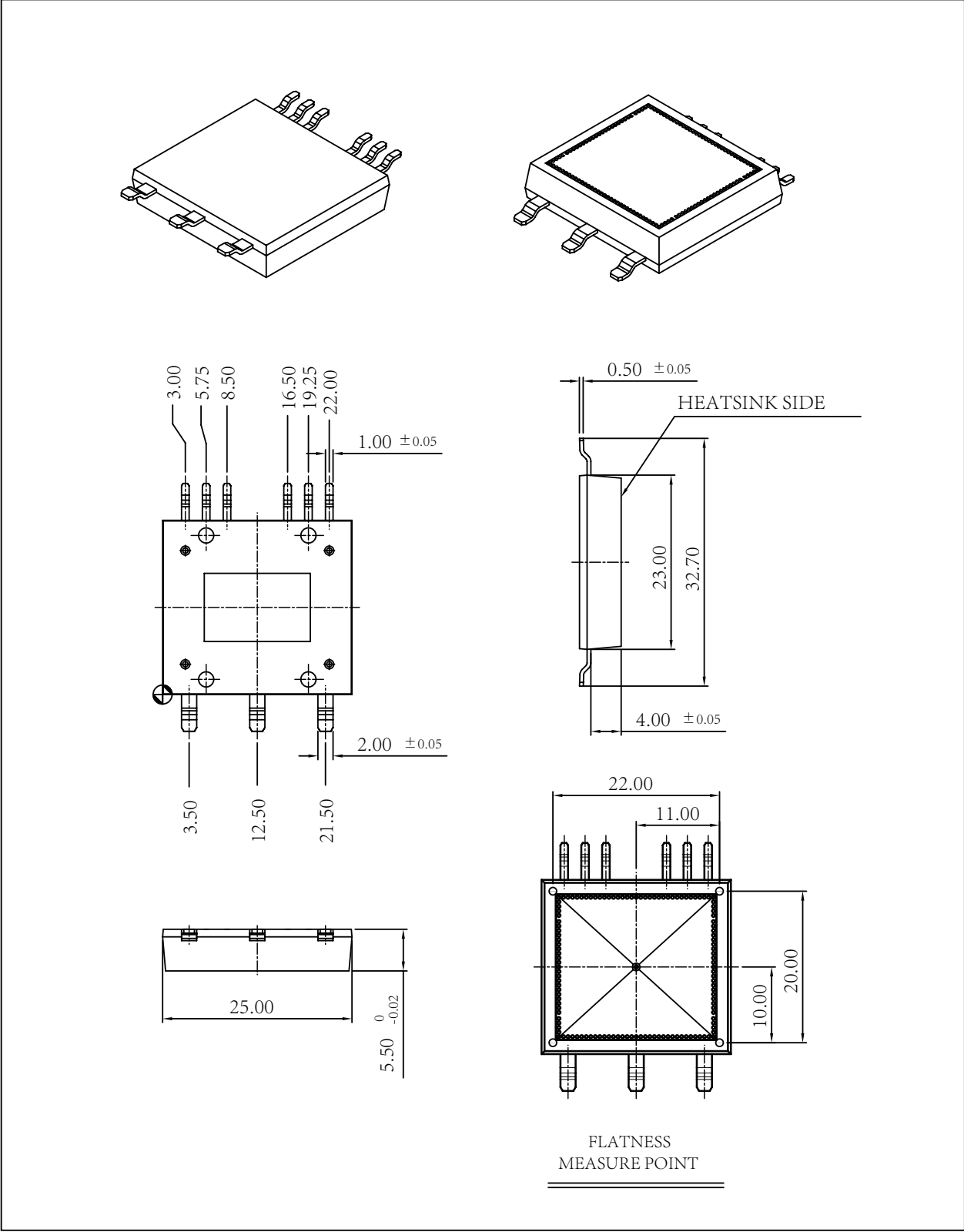


Fig. 22. Switching time definition

11. Package outline

TSPM1



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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