PMN20ENA

40 V, N-channel Trench MOSFET

30 April 2019 **Product data sheet**

1. General description

N-channel enhancement mode Field-Effect Transistor (FET) in a small SOT457 (SC-74) Surface-Mounted Device (SMD) plastic package using Trench MOSFET technology.

2. Features and benefits

- Logic-level compatible
- Extended temperature range T_j = 175 °C
- Trench MOSFET technology
- AEC-Q101 qualified

3. Applications

- Relay driver
- High-speed line driver
- Low-side load switch
- Switching circuits

4. Quick reference data

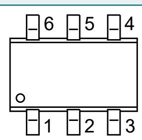
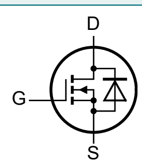
Table 1. Quick reference data

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
V_{DS}	drain-source voltage	T_j = 25 °C		-	-	40	V
V_{GS}	gate-source voltage			-20	-	20	V
I_D	drain current	V_{GS} = 10 V; T_{amb} = 25 °C	[1]	-	-	6.2	A
Static characteristics							
R_{DSon}	drain-source on-state resistance	V_{GS} = 10 V; I_D = 6.2 A; T_j = 25 °C		-	19	23	mΩ

[1] Device mounted on an FR4 Printed-Circuit Board (PCB), single-sided copper, tin-plated, mounting pad for drain 6 cm^2.

5. Pinning information

Table 2. Pinning information

Pin	Symbol	Description	Simplified outline	Graphic symbol
1	D	drain	 **SC-74; TSOP6 (SOT457)**	
2	D	drain		
3	G	gate		
4	S	source		
5	D	drain		
6	D	drain		

6. Ordering information

Table 3. Ordering information

Type number	Package		
	Name	Description	Version
PMN20ENA	SC-74; TSOP6	plastic, surface-mounted package (SC-74; TSOP6); 6 leads	SOT457

7. Marking

Table 4. Marking codes

Type number	Marking code
PMN20ENA	3M

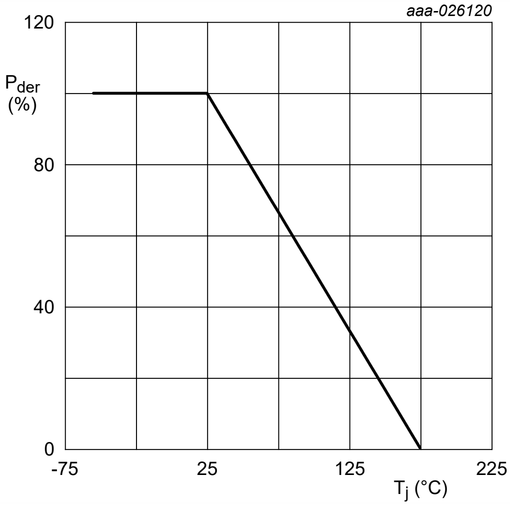
8. Limiting values

Table 5. Limiting values

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

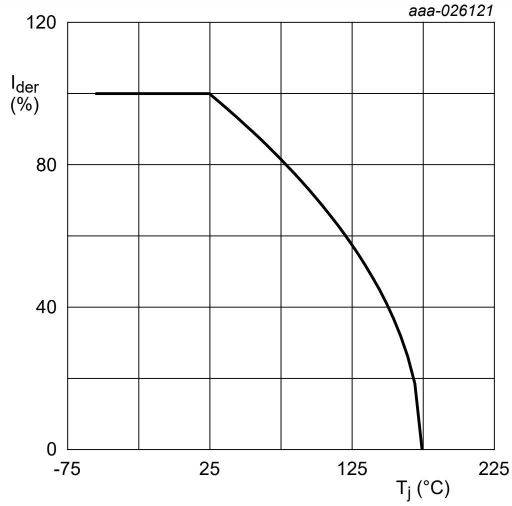
Symbol	Parameter	Conditions		Min	Max	Unit
V_{DS}	drain-source voltage	T_j = 25 °C		-	40	V
V_{GS}	gate-source voltage			-20	20	V
I_D	drain current	V_{GS} = 10 V; T_{amb} = 25 °C	[1]	-	6.2	A
		V_{GS} = 10 V; T_{amb} = 100 °C	[1]	-	4.4	A
I_{DM}	peak drain current	T_{amb} = 25 °C; single pulse; $t_p \leq$ 10 µs		-	25	A
P_{tot}	total power dissipation	T_{amb} = 25 °C	[2]	-	652	mW
			[1]	-	1.7	W
		T_{sp} = 25 °C		-	7.5	W
T_j	junction temperature			-55	175	°C
T_{amb}	ambient temperature			-55	175	°C
T_{stg}	storage temperature			-65	175	°C
Source-drain diode						
I_S	source current	T_{amb} = 25 °C	[1]	-	1.7	A
ESD maximum rating						
V_{ESD}	electrostatic discharge voltage	HBM	[3]	-	500	V
Avalanche ruggedness						
$E_{DS(AL)S}$	non-repetitive drain-source avalanche energy	$T_{j(init)}$ = 25 °C; I_D = 1.35 A; DUT in avalanche (unclamped)		-	28.4	mJ

[1] Device mounted on an FR4 Printed-Circuit Board (PCB), single-sided copper, tin-plated, mounting pad for drain 6 cm^2.
[2] Device mounted on an FR4 PCB, single-sided copper, tin-plated and standard footprint.
[3] Measured between all pins.



$$P_{der} = \frac{P_{tot}}{P_{tot(25°C)}} \times 100 \ \%$$

Fig. 1. Normalized total power dissipation as a function of junction temperature



$$I_{der} = \frac{I_D}{I_{D(25°C)}} \times 100 \ \%$$

Fig. 2. Normalized continuous drain current as a function of junction temperature

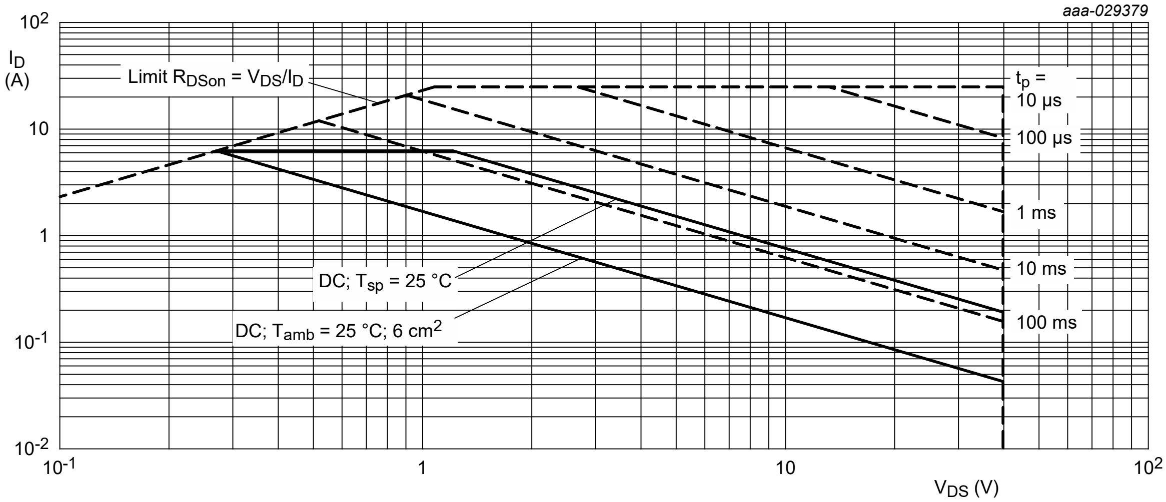


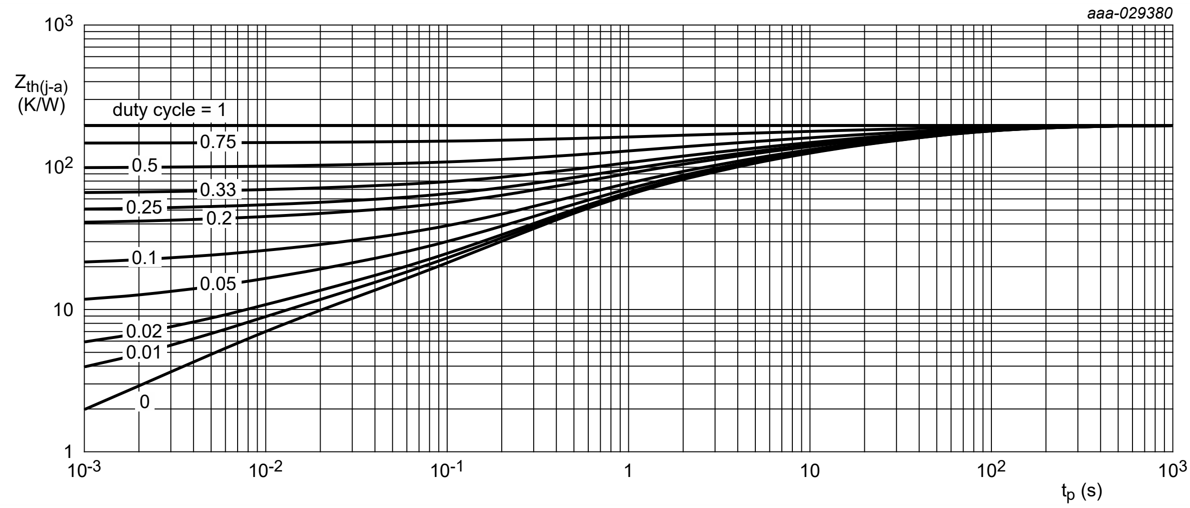
Fig. 3. Safe operating area; junction to ambient; continuous and peak drain currents as a function of drain-source voltage

9. Thermal characteristics

Table 6. Thermal characteristics

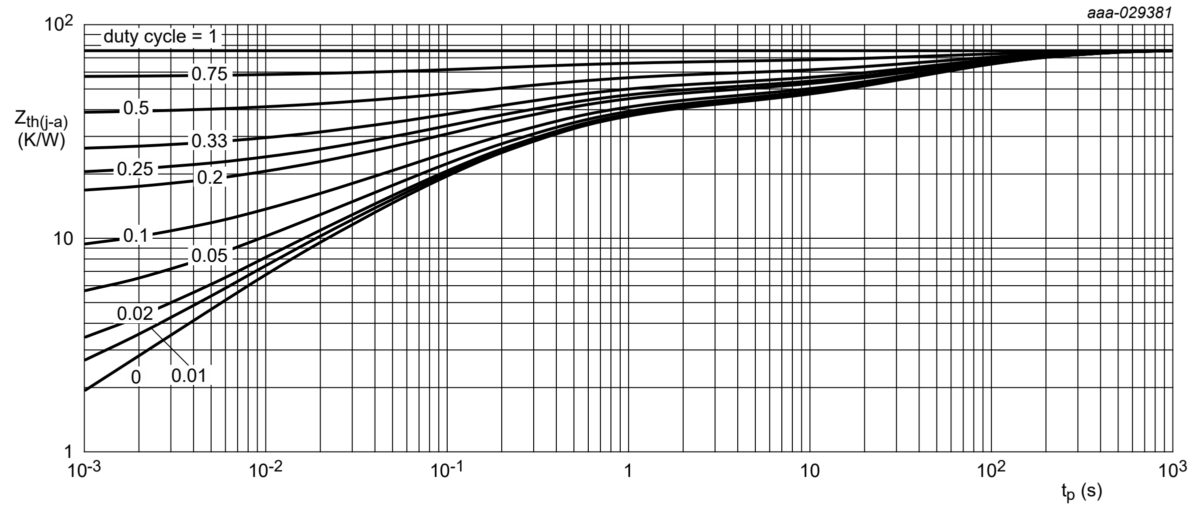
Symbol	Parameter	Conditions		Min	Typ	Max	Unit
$R_{th(j-a)}$	thermal resistance from junction to ambient	in free air	[1]	-	200	230	K/W
			[2]	-	78	90	K/W
$R_{th(j-sp)}$	thermal resistance from junction to solder point			-	15	20	K/W

[1] Device mounted on an FR4 PCB, single-sided copper, tin-plated and standard footprint.
[2] Device mounted on an FR4 PCB, single-sided copper, tin-plated, mounting pad for drain 6 cm^2.



FR4 PCB, standard footprint

Fig. 4. Transient thermal impedance from junction to ambient as a function of pulse duration; typical values



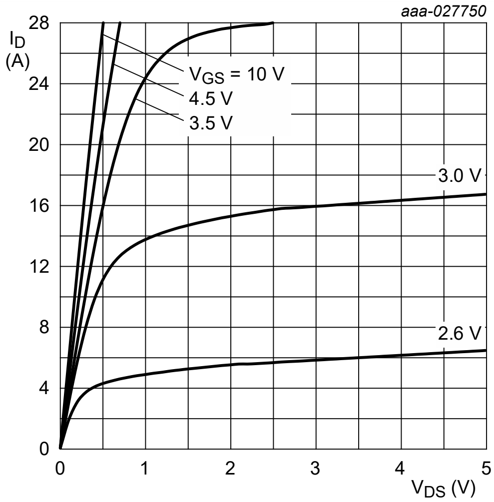
FR4 PCB, mounting pad for drain 6 cm^2

Fig. 5. Transient thermal impedance from junction to ambient as a function of pulse duration; typical values

10. Characteristics

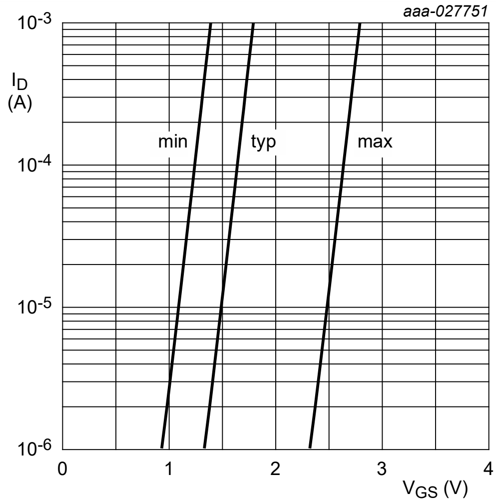
Table 7. Characteristics

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
Static characteristics							
$V_{(BR)DSS}$	drain-source breakdown voltage	I_D = 250 µA; V_{GS} = 0 V; T_j = 25 °C		40	-	-	V
V_{GSth}	gate-source threshold voltage	I_D = 250 µA; V_{DS} = V_{GS}; T_j = 25 °C		1.3	1.7	2.7	V
I_{DSS}	drain leakage current	V_{DS} = 40 V; V_{GS} = 0 V; T_j = 25 °C		-	-	1	µA
I_{GSS}	gate leakage current	V_{GS} = 20 V; V_{DS} = 0 V; T_j = 25 °C		-	-	100	nA
		V_{GS} = -20 V; V_{DS} = 0 V; T_j = 25 °C		-	-	-100	nA
R_{DSon}	drain-source on-state resistance	V_{GS} = 10 V; I_D = 6.2 A; T_j = 25 °C		-	19	23	mΩ
		V_{GS} = 10 V; I_D = 6.2 A; T_j = 175 °C		-	36	44	mΩ
		V_{GS} = 4.5 V; I_D = 5.4 A; T_j = 25 °C		-	23	30	mΩ
g_{fs}	forward transconductance	V_{DS} = 10 V; I_D = 6.2 A; T_j = 25 °C		-	33	-	S
R_G	gate resistance	f = 1 MHz		-	1.8	-	Ω
Dynamic characteristics							
$Q_{G(tot)}$	total gate charge	V_{DS} = 20 V; I_D = 6.2 A; V_{GS} = 10 V; T_j = 25 °C		-	11	17	nC
Q_{GS}	gate-source charge			-	2	-	nC
Q_{GD}	gate-drain charge			-	2.4	-	nC
C_{iss}	input capacitance	V_{DS} = 20 V; f = 1 MHz; V_{GS} = 0 V; T_j = 25 °C		-	582	-	pF
C_{oss}	output capacitance			-	101	-	pF
C_{rss}	reverse transfer capacitance			-	58	-	pF
$t_{d(on)}$	turn-on delay time	V_{DS} = 20 V; I_D = 6.2 A; V_{GS} = 10 V; $R_{G(ext)}$ = 6 Ω; T_j = 25 °C		-	2	-	ns
t_r	rise time			-	5	-	ns
$t_{d(off)}$	turn-off delay time			-	12	-	ns
t_f	fall time			-	5	-	ns
Source-drain diode							
V_{SD}	source-drain voltage	I_S = 1.7 A; V_{GS} = 0 V; T_j = 25 °C		-	0.8	1.2	V
t_{rr}	reverse recovery time	I_S = 2.3 A; dI_S/dt = -100 A/µs; V_{GS} = 0 V; V_{DS} = 20 V; T_j = 25 °C		-	12.8	-	ns
Q_r	recovered charge			-	5.4	-	nC



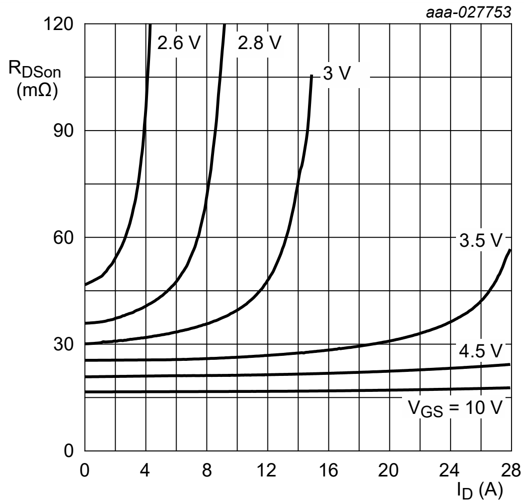
T_j = 25 °C

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



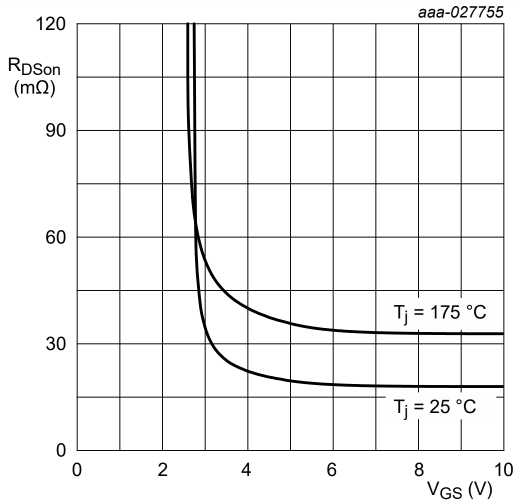
T_j = 25 °C; V_{DS} = 5 V

Fig. 7. Sub-threshold drain current as a function of gate-source voltage



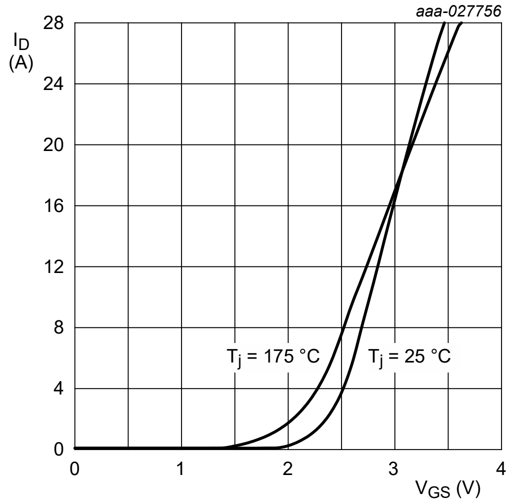
T_j = 25 °C

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



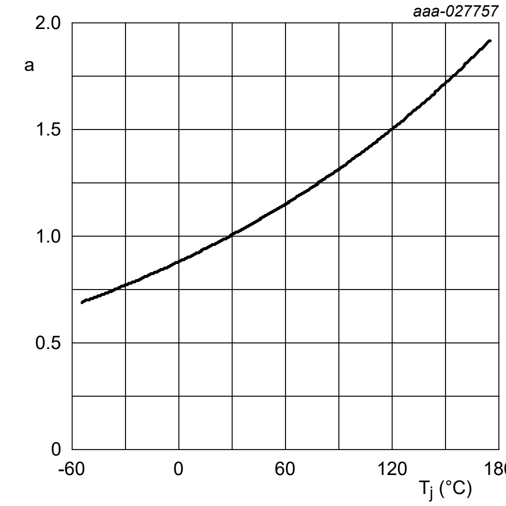
I_D = 7 A

Fig. 9. Drain-source on-state resistance as a function of gate-source voltage; typical values



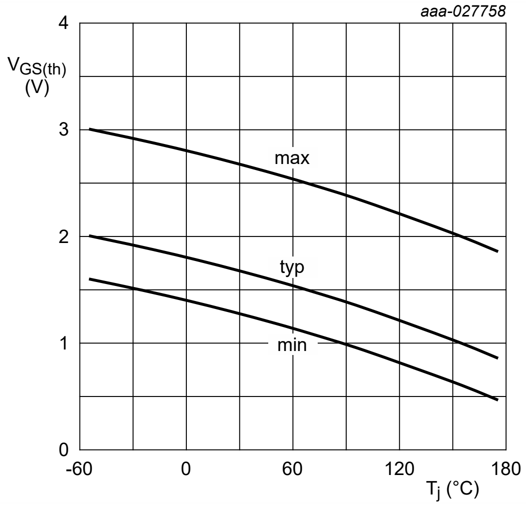
$V_{DS} > I_D \times R_{DSon}$

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



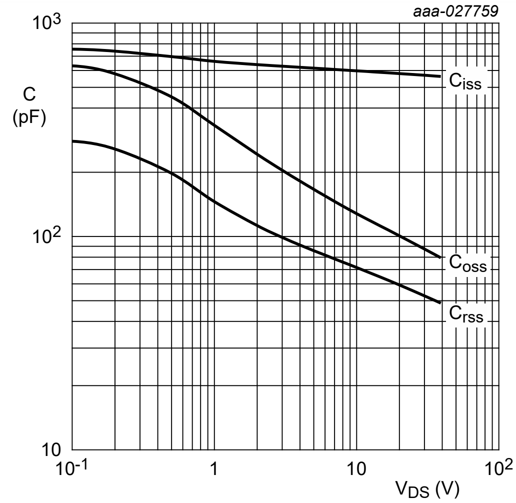
$$a = \frac{R_{DSon}}{R_{DSon(25°C)}}$$

Fig. 11. Normalized drain-source on-state resistance as a function of junction temperature; typical values



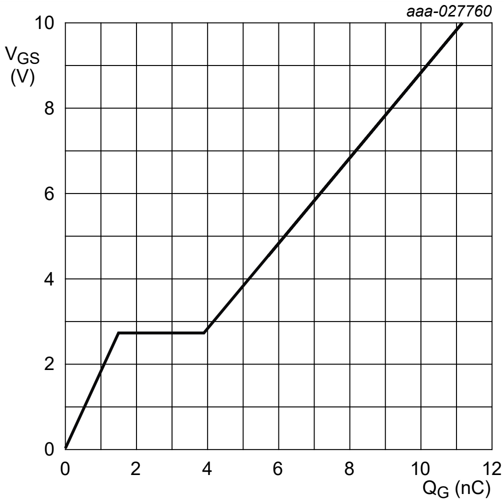
I_D = 250 μA; $V_{DS} = V_{GS}$

Fig. 12. Gate-source threshold voltage as a function of junction temperature



f = 1 MHz; V_{GS} = 0 V

Fig. 13. Input, output and reverse transfer capacitances as a function of drain-source voltage; typical values



I_D = 7 A; V_{DS} = 20 V; T_{amb} = 25 °C

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

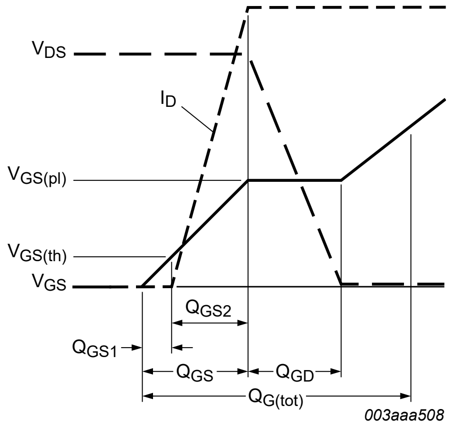
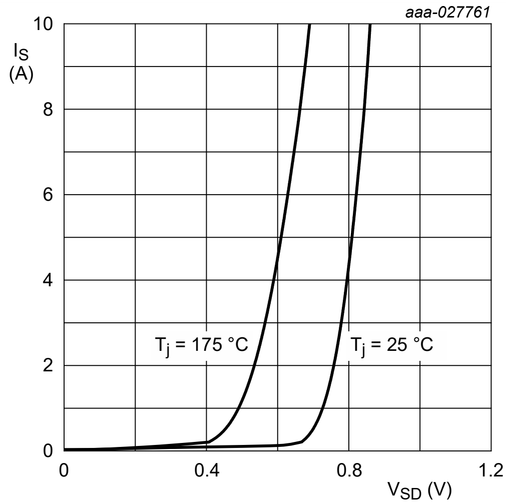


Fig. 15. Gate charge waveform definitions



V_{GS} = 0 V

Fig. 16. Source current as a function of source-drain voltage; typical values

11. Test information

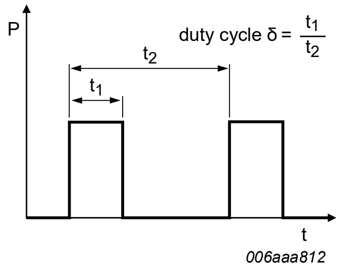


Fig. 17. Duty cycle definition

Quality information

This product has been qualified in accordance with the Automotive Electronics Council (AEC) standard *Q101 - Stress test qualification for discrete semiconductors*, and is suitable for use in automotive applications.

12. Package outline

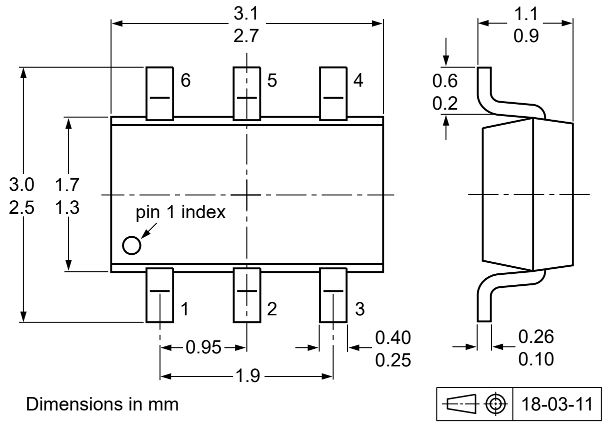


Fig. 18. Package outline SC-74; TSOP6 (SOT457)

13. Soldering

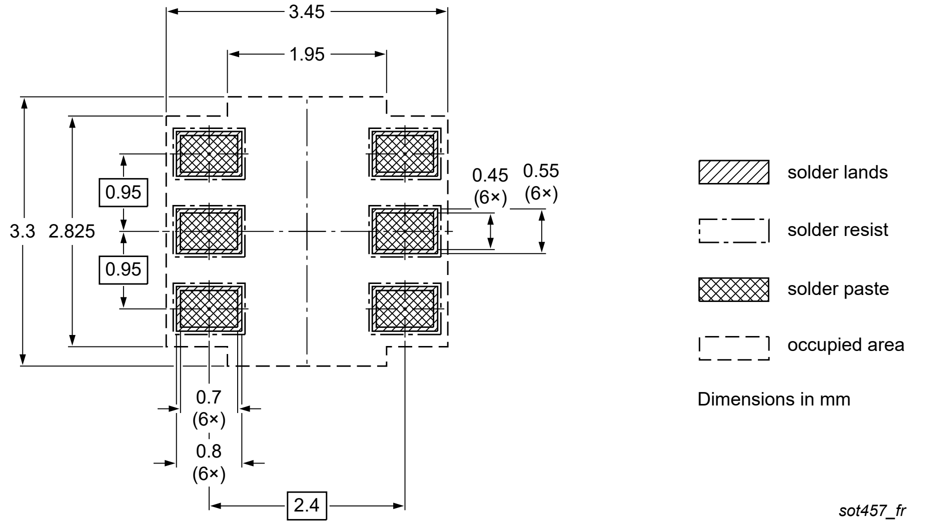


Fig. 19. Reflow soldering footprint for SC-74; TSOP6 (SOT457)

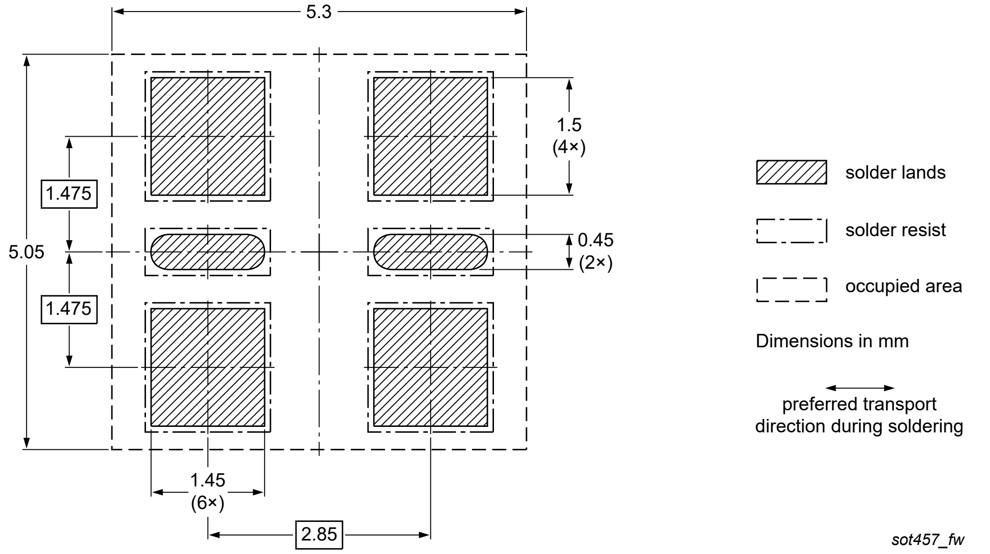


Fig. 20. Wave soldering footprint for SC-74; TSOP6 (SOT457)

14. Revision history

Table 8. Revision history

Data sheet ID	Release date	Data sheet status	Change notice	Supersedes
PMN20ENA v.1	20190430	Product data sheet	-	-

15. 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: 30 April 2019

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