PBSM5240PFH

40 V, 2 A PNP low V_{CEsat} (BISS) transistor with N-channel Trench MOSFET

Rev. 1 — 20 June 2012 **Product data sheet**

1. Product profile

1.1 General description

Combination of PNP low V_{CEsat} Breakthrough In Small Signal (BISS) transistor and N-channel Trench Metal-Oxide Semiconductor Field- Effect Transistor (MOSFET). The device is housed in a leadless medium power DFN2020-6 (SOT1118) Surface-Mounted Device (SMD) plastic package.

1.2 Features and benefits

- Very low collector-emitter saturation voltage V_{CEsat}
- High collector current capability I_C and I_{CM}
- High energy efficiency due to less heat generation
- Smaller required Printed-Circuit Board (PCB) area than for conventional transistors

1.3 Applications

- Load switch
- Power management
- Power switches (e.g. motors, fans)
- Battery-driven devices
- Charging circuits

1.4 Quick reference data

Table 1. Quick reference data

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
PNP low V_{CEsat} (BISS) transistor							
V_{CEO}	collector-emitter voltage	open base		-	-	−40	V
I_C	collector current		[1]	-		−1.8	A
I_{CRM}	repetitive peak collector current		[1][5]	-	-	−2	A
I_{CM}	peak collector current	single pulse; $t_p \leq 1$ ms	[1]	-	-	−3	A
R_{CEsat}	collector-emitter saturation resistance	I_C = −500 mA; I_B = −50 mA	[2]	-	240	340	mΩ

Table 1. Quick reference data *...continued*

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
N-channel Trench MOSFET							
V_{DS}	drain-source voltage	T_{amb} = 25 °C		-	-	30	V
V_{GS}	gate-source voltage	T_{amb} = 25 °C		-	-	±8	V
I_D	drain current	T_{amb} = 25 °C; V_{GS} = 10 V	[3]	-	-	0.66	A
R_{DSon}	drain-source on-state resistance	T_j = 25 °C; V_{GS} = 4.5 V; I_D = 0.2 A	[4]	-	370	580	mΩ

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

[2] Pulse test: $t_p \leq 300\ \mu s$; $\delta \leq 0.02$.

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

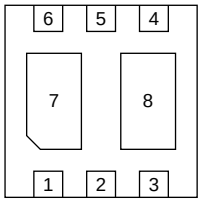
[4] Pulse test: $t_p \leq 300\ \mu s$; $\delta \leq 0.01$.

[5] Pulse test: $t_p \leq 20$ ms; $\delta \leq 0.10$.

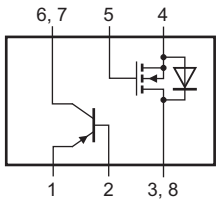
2. Pinning information

Table 2. Pinning

Pin	Description	Simplified outline	Graphic symbol
1	emitter		
2	base		
3	drain		
4	source		
5	gate		
6	collector		
7	collector		
8	drain		



Transparent top view



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3. Ordering information

Table 3. Ordering information

Type number	Package		
	Name	Description	Version
PBSM5240PFH	DFN2020-6	plastic thermal enhanced ultra thin small outline package; no leads; 6 terminals; body 2 × 2 × 0.65 mm	SOT1118

4. Marking

Table 4. Marking code

Type number	Marking code
PBSM5240PFH	1T

5. Limiting values

Table 5. Limiting values

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

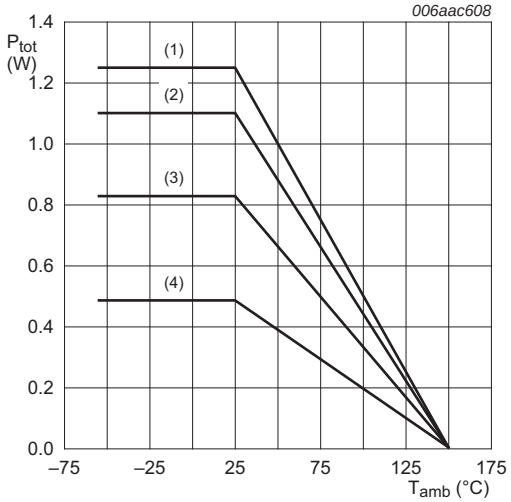
Symbol	Parameter	Conditions		Min	Max	Unit
PNP low V_{CEsat} (BISS) transistor						
V_{CBO}	collector-base voltage	open emitter		-	–40	V
V_{CEO}	collector-emitter voltage	open base		-	–40	V
V_{EBO}	emitter-base voltage	open collector		-	–5	V
I_C	collector current		[1]	-	–1.8	A
I_{CRM}	repetitive peak collector current		[1][4]	-	–2	A
I_{CM}	peak collector current	single pulse; $t_p \leq 1$ ms	[1]	-	–3	A
I_B	base current		[1]	-	–300	mA
I_{BM}	peak base current	single pulse; $t_p \leq 1$ ms	[1]	-	–1	A
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	[1]	-	1.1	W
			[2]	-	1.25	W
N-channel Trench MOSFET						
V_{DS}	drain-source voltage	T_{amb} = 25 °C		-	30	V
V_{DG}	drain-gate voltage	T_{amb} = 25 °C; R_{GS} = 20 kΩ		-	30	V
V_{GS}	gate-source voltage	T_{amb} = 25 °C		-	±8	V
I_D	drain current	V_{GS} = 10 V	[3]			
		T_{amb} = 25 °C		-	660	mA
		T_{amb} = 100 °C		-	420	mA
I_{DM}	peak drain current	T_{amb} = 25 °C; single pulse; $t_p \leq 10$ μs		-	3.56	A
P_{tot}	total power dissipation	T_{amb} = 25 °C	[3]	-	760	mW
Source-drain diode						
I_S	source current	T_{amb} = 25 °C		-	660	mA
Per device						
T_j	junction temperature			-	150	°C
T_{amb}	ambient temperature			–55	+150	°C
T_{stg}	storage temperature			–65	+150	°C

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

[2] Device mounted on an FR4 PCB, 4-layer copper, tin-plated, mounting pad for collector 1 cm^2

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

[4] Pulse test: $t_p \leq 20$ ms; $\delta \leq 0.10$.



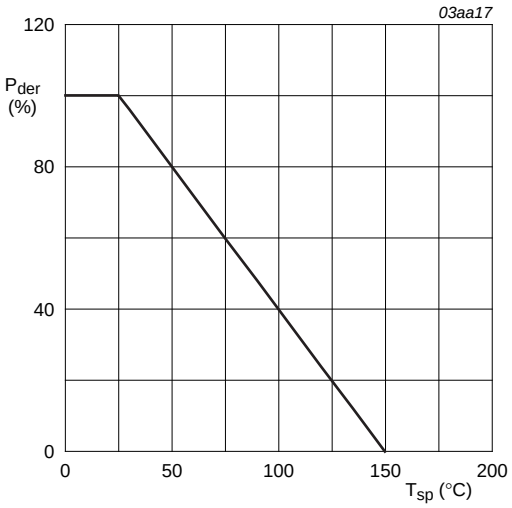
(1) FR4 PCB, 4-layer copper, mounting pad for collector 1 cm^2

(2) FR4 PCB, single-sided copper, mounting pad for collector 6 cm^2

(3) FR4 PCB, single-sided copper, mounting pad for collector 1 cm^2

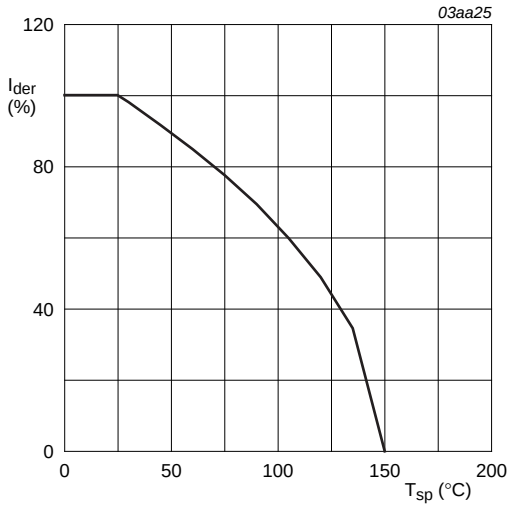
(4) FR4 PCB, single-sided copper, standard footprint

Fig 1. BISS transistor: Power derating curves



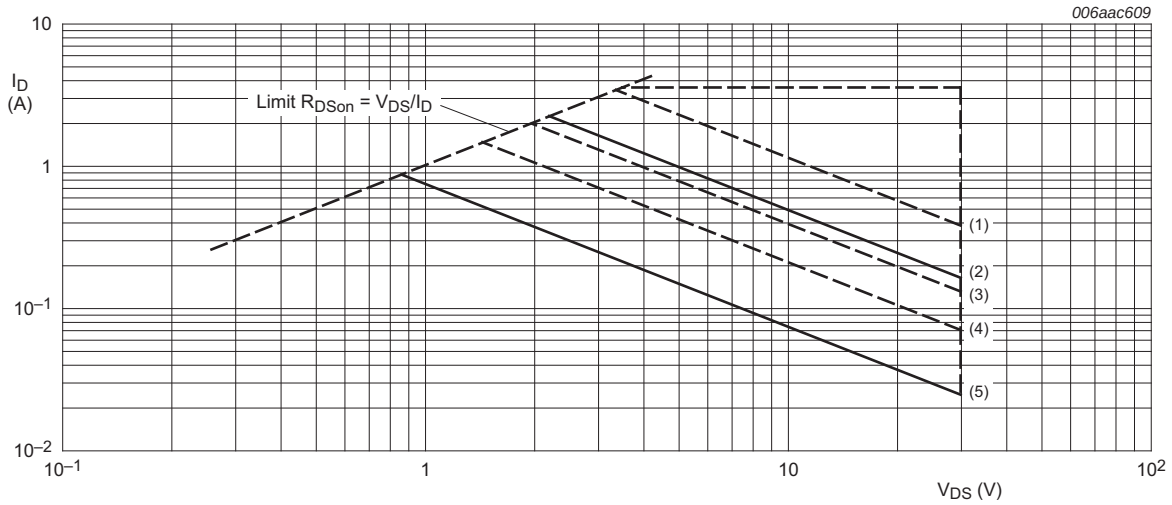
$$P_{der} = \frac{P_{tot}}{P_{tot(25°C)}} \times 100\ \%$$

Fig 2. MOSFET: Normalized total power dissipation as a function of solder point temperature



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

Fig 3. MOSFET: Normalized continuous drain current as a function of solder point temperature



I_{DM} = single pulse

(1) t_p = 1 ms

(2) DC; T_{sp} = 25 °C

(3) t_p = 10 ms

(4) t_p = 100 ms

(5) DC; T_{amb} = 25 °C; drain mounting pad 1 cm^2

Fig 4. MOSFET: Safe operating area; junction to ambient; continuous and peak drain currents as a function of drain-source voltage

6. Thermal characteristics

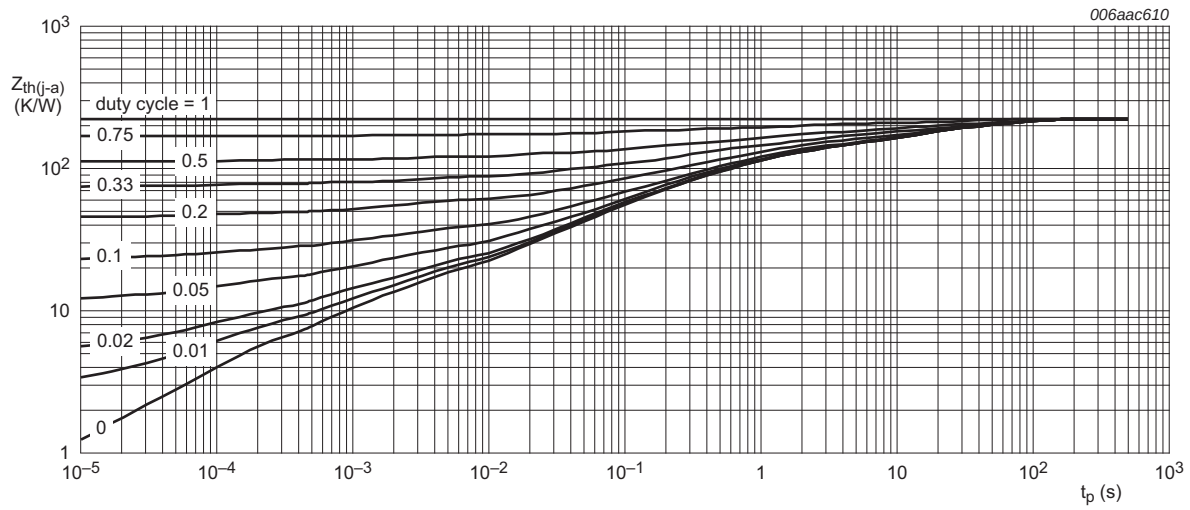
Table 6. Thermal characteristics

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
PNP low V_{CEsat} (BISS) transistor							
$R_{th(j-a)}$	thermal resistance from junction to ambient	in free air	[1]	-	-	115	K/W
			[2]	-	-	100	K/W
N-channel Trench MOSFET							
$R_{th(j-a)}$	thermal resistance from junction to ambient	in free air	[3]	-	-	165	K/W

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

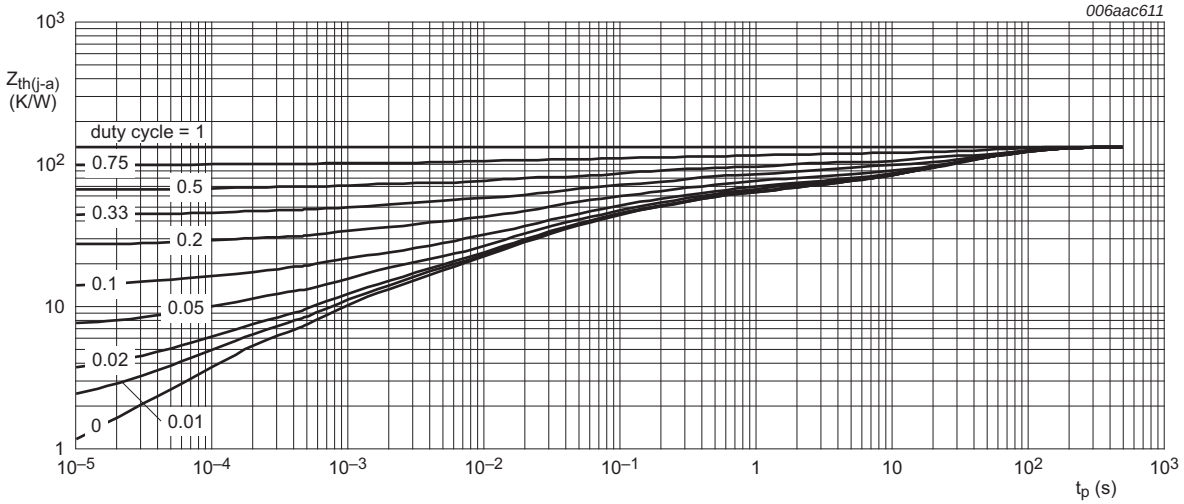
[2] Device mounted on an FR4 PCB, 4-layer copper, tin-plated, mounting pad for collector 1 cm^2.

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



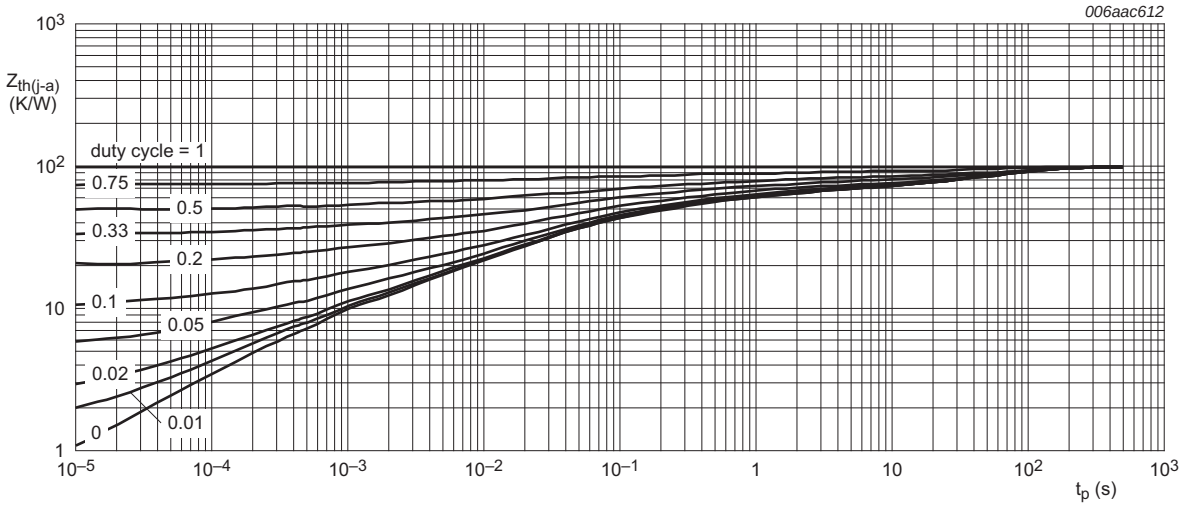
FR4 PCB, single-sided copper, standard footprint

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



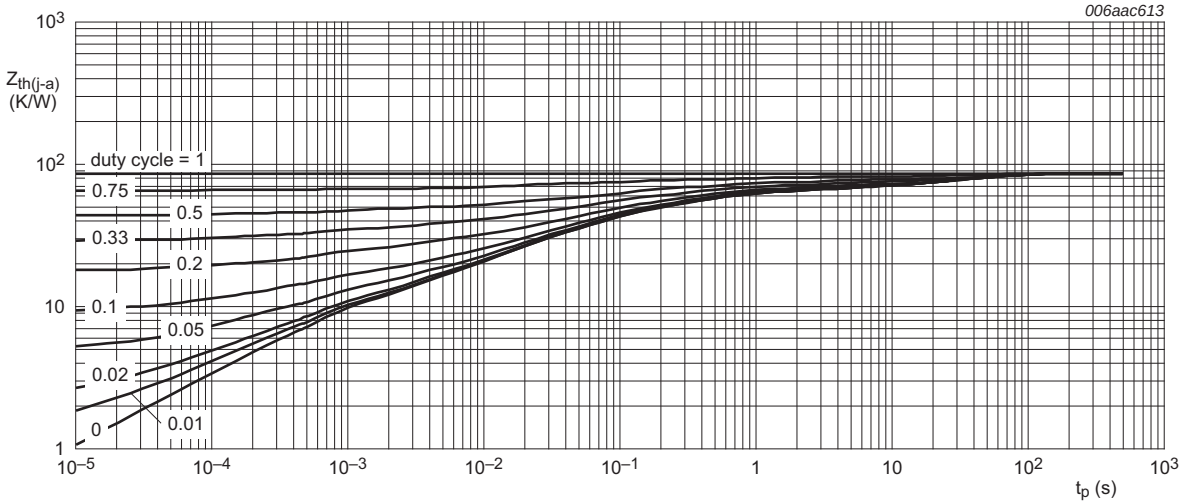
FR4 PCB, single-sided copper, mounting pad for collector 1 cm^2

Fig 6. PNP transistor: Transient thermal impedance from junction to ambient as a function of pulse duration; typical values



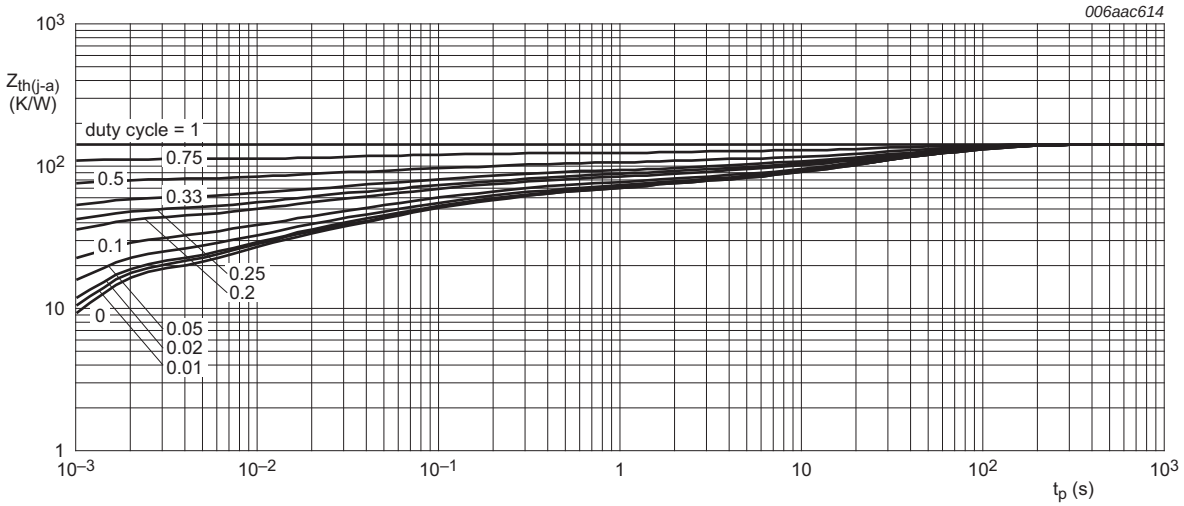
FR4 PCB, single-sided copper, mounting pad for collector 6 cm^2

Fig 7. PNP transistor: Transient thermal impedance from junction to ambient as a function of pulse duration; typical values



FR4 PCB, 4-layer copper, mounting pad for collector 1 cm^2

Fig 8. PNP transistor: Transient thermal impedance from junction to ambient as a function of pulse duration; typical values



FR4 PCB, single-sided copper, mounting pad for drain 1 cm^2

Fig 9. MOSFET: Transient thermal impedance from junction to ambient as a function of pulse duration; typical values

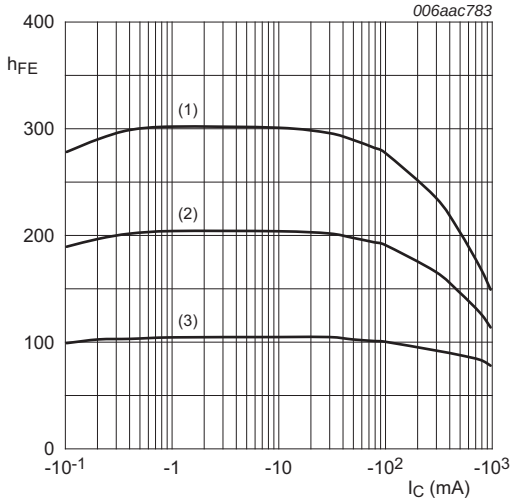
7. Characteristics

Table 7. Characteristics for PNP low V_{CEsat} transistor

T_{amb} = 25 °C unless otherwise specified.

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
I_{CBO}	collector-base cut-off current	V_{CB} = –30 V; I_E = 0 A		-	-	–100	nA
		V_{CB} = –30 V; I_E = 0 A; T_j = 150 °C		-	-	–50	μA
I_{CES}	collector-emitter cut-off current	V_{CE} = –30 V; I_B = 0 A		-	-	–100	nA
I_{EBO}	emitter-base cut-off current	V_{EB} = –5 V; I_C = 0 A		-	-	–100	nA
h_{FE}	DC current gain	V_{CE} = –5 V	[1]				
		I_C = –1 mA		100	-	-	
		I_C = –100 mA		100	-	-	
		I_C = –1 A		75	-	-	
V_{CEsat}	collector-emitter saturation voltage	I_C = –100 mA; I_B = –1 mA	[1]	-	–85	–140	mV
		I_C = –500 mA; I_B = –50 mA	[1]	-	–120	–170	mV
		I_C = –1 A; I_B = –100 mA	[1]	-	–200	–310	mV
R_{CEsat}	collector-emitter saturation resistance	I_C = –500 mA; I_B = –50 mA	[1]	-	240	340	mΩ
V_{BEsat}	base-emitter saturation voltage	I_C = –1 A; I_B = –100 mA	[1]	-	-	–1.1	V
V_{BEon}	base-emitter turn-on voltage	V_{CE} = –5 V; I_C = –1 A	[1]	-	-	–1	V
f_T	transition frequency	V_{CE} = –10 V; I_C = –50 mA; f = 100 MHz		100	-	-	MHz
C_c	collector capacitance	V_{CB} = –10 V; I_E = i_e = 0 A; f = 1 MHz		-	-	15	pF

[1] Pulse test: $t_p \leq 300$ μs; $\delta \leq 0.02$.



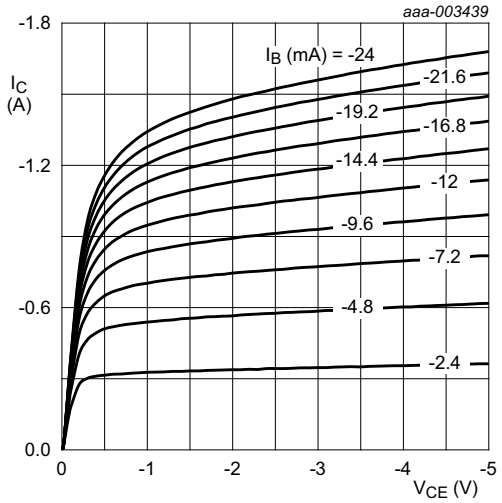
V_{CE} = −5 V

(1) T_{amb} = 100 °C

(2) T_{amb} = 25 °C

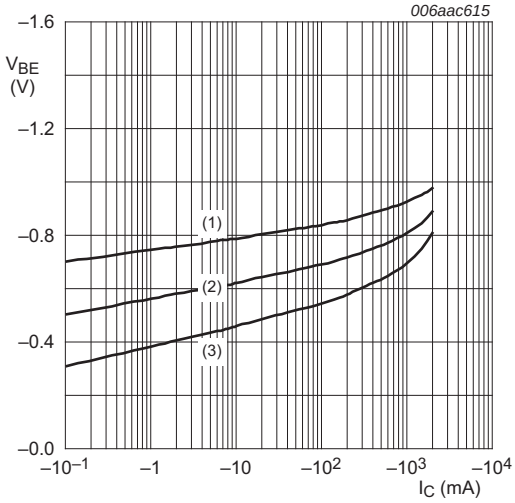
(3) T_{amb} = −55 °C

Fig 10. PNP transistor: DC current gain as a function of collector current; typical values



T_{amb} = 25 °C

Fig 11. PNP transistor: Collector current as a function of collector-emitter voltage; typical values



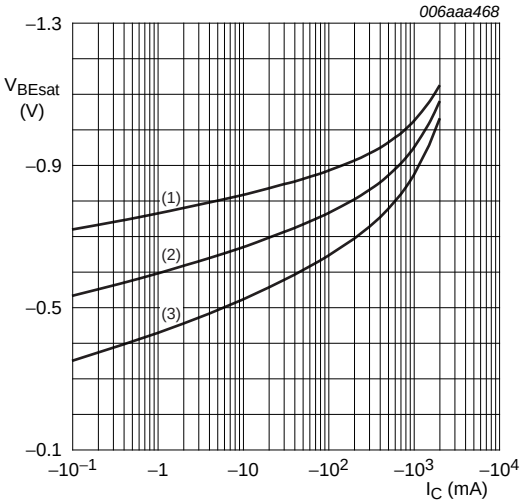
V_{CE} = −5 V

(1) T_{amb} = −55 °C

(2) T_{amb} = 25 °C

(3) T_{amb} = 100 °C

Fig 12. PNP transistor: Base-emitter voltage as a function of collector current; typical values



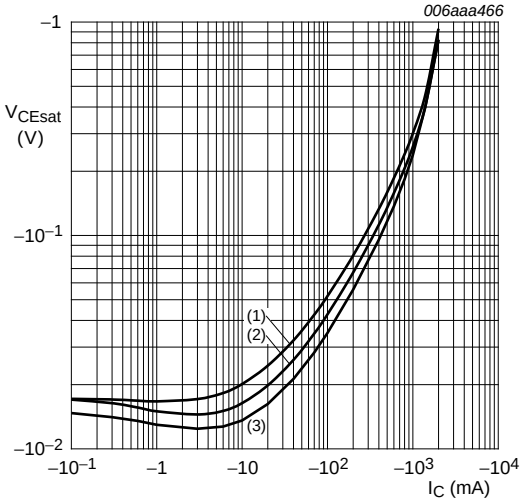
I_C/I_B = 20

(1) T_{amb} = −55 °C

(2) T_{amb} = 25 °C

(3) T_{amb} = 100 °C

Fig 13. PNP transistor: Base-emitter saturation voltage as a function of collector current; typical values



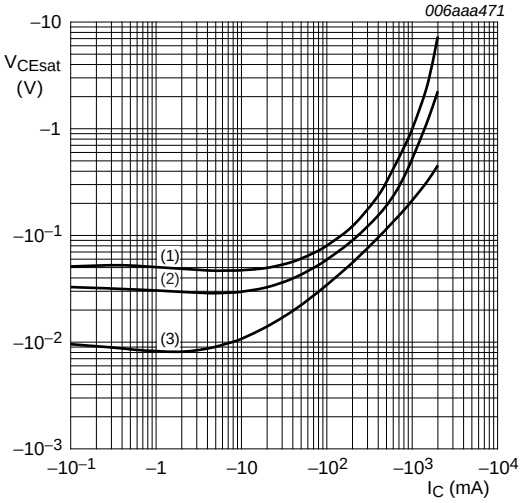
I_C/I_B = 20

(1) T_{amb} = 100 °C

(2) T_{amb} = 25 °C

(3) T_{amb} = −55 °C

Fig 14. PNP transistor: Collector-emitter saturation voltage as a function of collector current; typical values



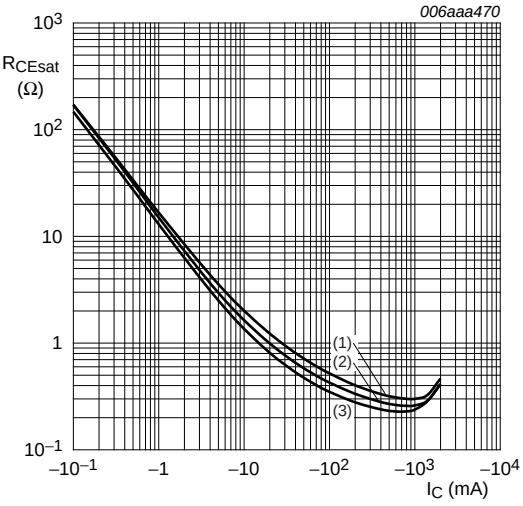
T_{amb} = 25 °C

(1) I_C/I_B = 100

(2) I_C/I_B = 50

(3) I_C/I_B = 10

Fig 15. PNP transistor: Collector-emitter saturation voltage as a function of collector current; typical values



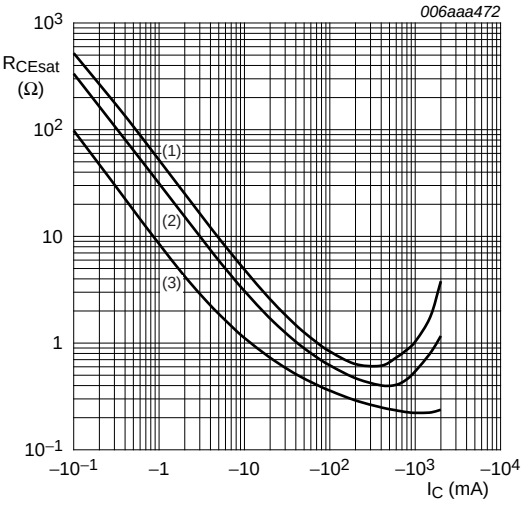
I_C/I_B = 20

(1) T_{amb} = 100 °C

(2) T_{amb} = 25 °C

(3) T_{amb} = −55 °C

Fig 16. PNP transistor: Collector-emitter saturation resistance as a function of collector current; typical values



T_{amb} = 25 °C

(1) I_C/I_B = 100

(2) I_C/I_B = 50

(3) I_C/I_B = 10

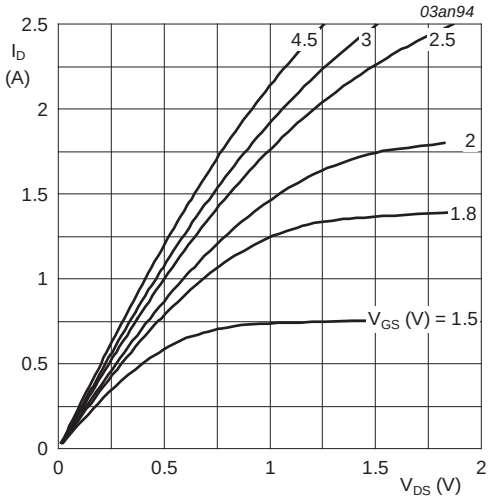
Fig 17. PNP transistor: Collector-emitter saturation resistance as a function of collector current; typical values

Table 8. Characteristics for N-channel Trench MOSFET

T_j = 25 °C unless otherwise specified.

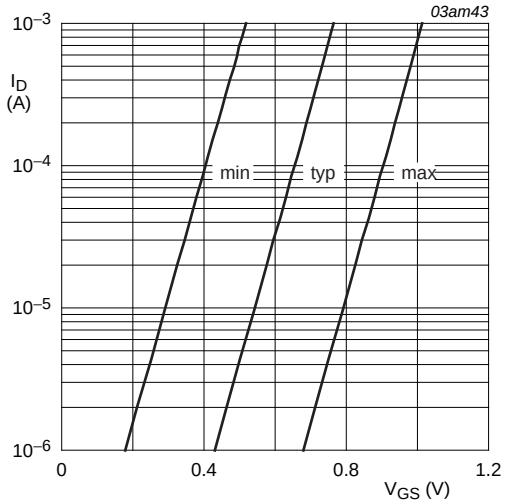
Symbol	Parameter	Conditions		Min	Typ	Max	Unit
Static characteristics							
$V_{(BR)DSS}$	drain-source breakdown voltage	I_D = 10 μA; V_{GS} = 0 V					
		T_j = 25 °C		30	-	-	V
		T_j = −55 °C		27	-	-	V
$V_{GS(th)}$	gate-source threshold voltage	I_D = 250 μA; V_{DS} = V_{GS}					
		T_j = 25 °C		0.45	0.7	0.95	V
		T_j = 150 °C		0.25	-	-	V
		T_j = −55 °C		-	-	1.15	V
I_{DSS}	drain leakage current	V_{DS} = 30 V; V_{GS} = 0 V					
		T_j = 25 °C		-	-	1	μA
		T_j = 150 °C		-	-	100	μA
I_{GSS}	gate leakage current	V_{GS} = ±8 V; V_{DS} = 0 V		-	10	±100	nA
R_{DSon}	drain-source on-state resistance	V_{GS} = 4.5 V; I_D = 0.2 A	[1]				
		T_j = 25 °C		-	370	580	mΩ
		T_j = 150 °C		-	663	985	mΩ
		V_{GS} = 2.5 V; I_D = 0.1 A		-	440	690	mΩ
		V_{GS} = 1.8 V; I_D = 75 mA		-	540	920	mΩ
Dynamic characteristics							
$Q_{G(tot)}$	total gate charge	I_D = 1 A; V_{DS} = 15 V; V_{GS} = 4.5 V		-	0.89	-	nC
Q_{GS}	gate-source charge			-	0.1	-	nC
Q_{GD}	gate-drain charge			-	0.2	-	nC
C_{iss}	input capacitance	V_{GS} = 0 V; V_{DS} = 25 V; f = 1 MHz		-	43	-	pF
C_{oss}	output capacitance			-	7.7	-	pF
C_{rss}	reverse transfer capacitance			-	4.8	-	pF
$t_{d(on)}$	turn-on delay time	V_{DS} = 15 V; R_L = 15 Ω; V_{GS} = 10 V; R_G = 6 Ω		-	4.0	-	ns
t_r	rise time			-	7.5	-	ns
$t_{d(off)}$	turn-off delay time			-	18	-	ns
t_f	fall time			-	4.5	-	ns
Source-drain diode							
V_{SD}	source-drain voltage	I_S = 0.3 A; V_{GS} = 0 V		-	0.76	1.2	V

[1] Pulse test: $t_p \leq 300$ μs; $\delta \leq 0.01$.



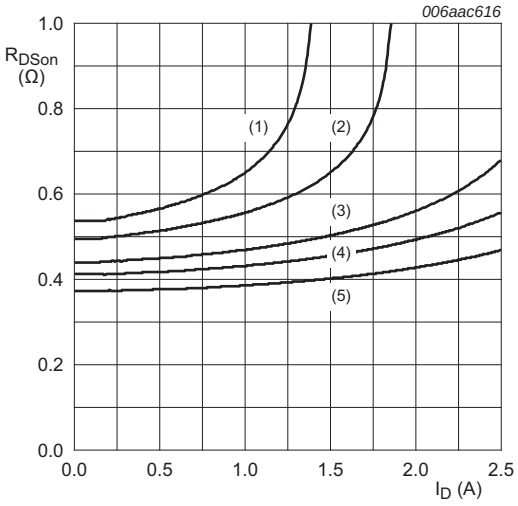
T_j = 25 °C

Fig 18. MOSFET: Output characteristics: drain current as a function of drain-source voltage; typical values



T_j = 25 °C; V_{DS} = 5 V

Fig 19. MOSFET: Subthreshold drain current as a function of gate-source voltage



T_j = 25 °C

(1) V_{GS} = 1.8 V

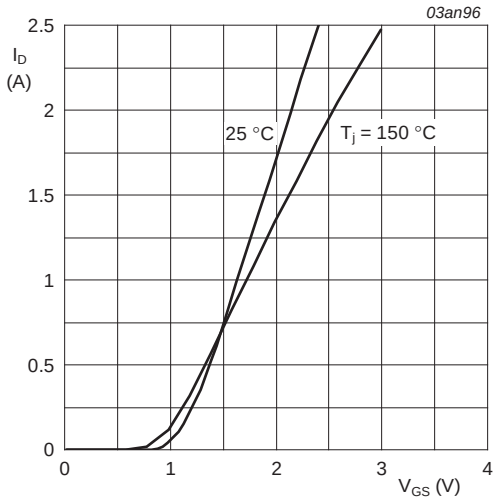
(2) V_{GS} = 2.0 V

(3) V_{GS} = 2.5 V

(4) V_{GS} = 3.0 V

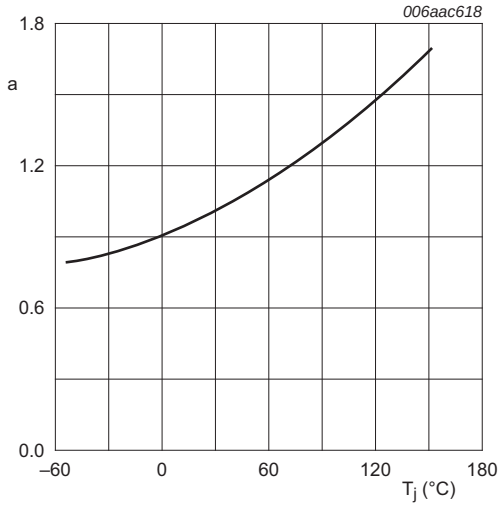
(5) V_{GS} = 4.5 V

Fig 20. MOSFET: Drain-source on-state resistance as a function of drain current; typical values



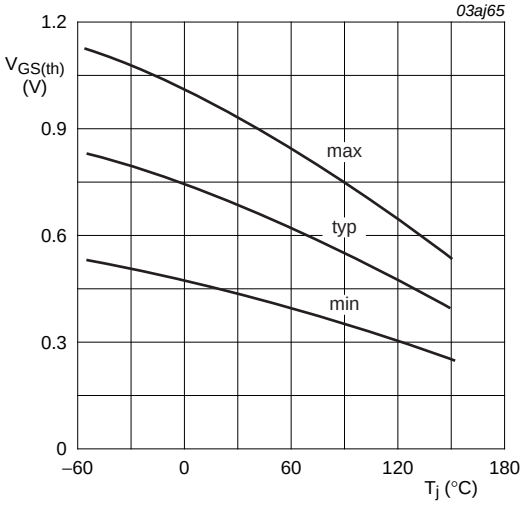
$V_{DS} > I_D \times R_{DSon}$

Fig 21. MOSFET: Transfer characteristics: drain current as a function of gate-source voltage; typical values



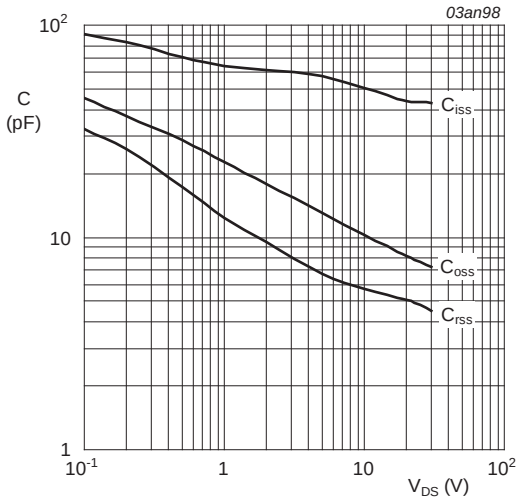
$$a = \frac{R_{DSon}}{R_{DSon(25°C)}}$$

Fig 22. MOSFET: Normalized drain-source on-state resistance as a function of junction temperature; typical values



I_D = 1 mA; V_{DS} = V_{GS}

Fig 23. MOSFET: Gate-source threshold voltage as a function of junction temperature



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

Fig 24. MOSFET: Input, output and reverse transfer capacitances as a function of drain-source voltage; typical values

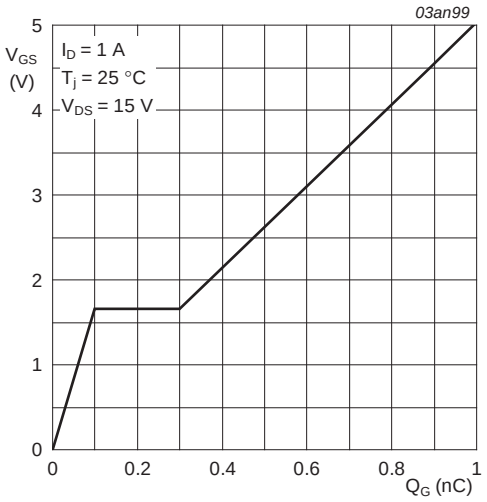


Fig 25. MOSFET: Gate-source voltage as a function of gate charge; typical values

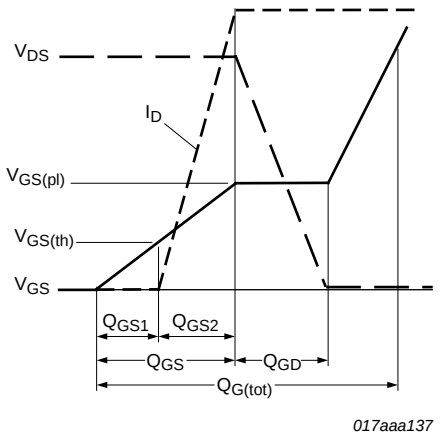


Fig 26. MOSFET: Gate charge waveform definitions

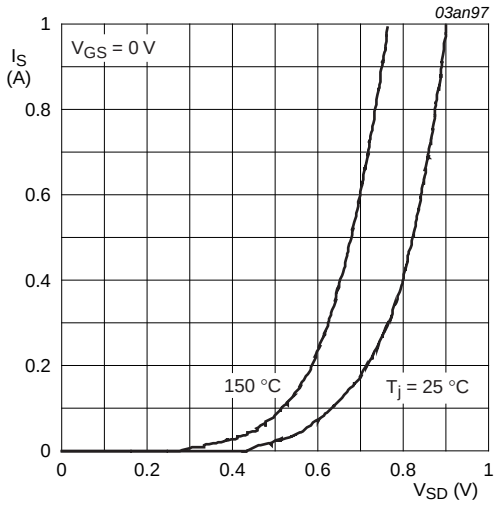


Fig 27. MOSFET: Source current as a function of source-drain voltage; typical values

8. Package outline

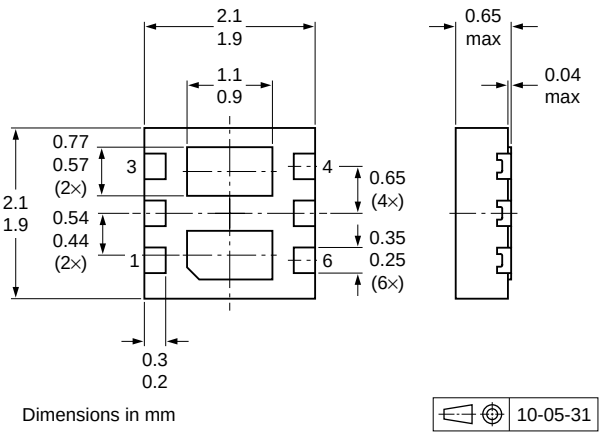


Fig 28. Package outline DFN2020-6 (SOT1118)

9. Packing information

Table 9. Packing methods

The indicated -xxx are the last three digits of the 12NC ordering code.[1]

Type number	Package	Description	Packing quantity
			3000
PBSM5240PFH	DFN2020-6 (SOT1118)	4 mm pitch, 8 mm tape and reel	-115

[1] For further information and the availability of packing methods, see Section 13.

10. Soldering

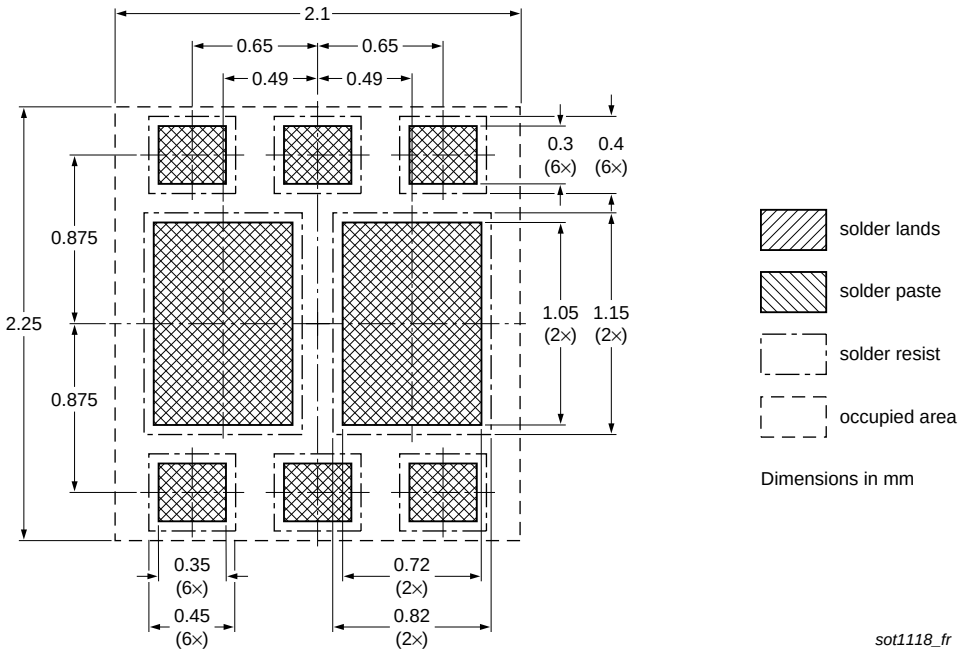


Fig 29. Reflow soldering footprint DFN2020-6 (SOT1118)

11. Revision history

Table 10. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
PBSM5240PFH v.1	20120620	Product data sheet	-	-

12. Legal information

12.1 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.nxp.com.

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14. Contents

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