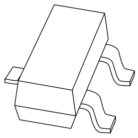


2N7002E

N-channel TrenchMOS™ FET

Rev. 02 — 26 April 2005 **Product data sheet**

1. Product profile

1.1 General description

N-channel enhancement mode Field-Effect Transistor (FET) in a plastic package using TrenchMOS™ technology.

1.2 Features

- Logic level threshold compatible
- Surface-mounted package
- Very fast switching
- TrenchMOS™ technology

1.3 Applications

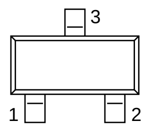
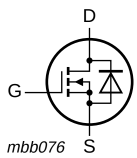
- Logic level translator
- High speed line driver

1.4 Quick reference data

- $V_{DS} \leq 60$ V
- $R_{DSon} \leq 3\ \Omega$
- $I_D \leq 385$ mA
- $P_{tot} = 0.83$ W

2. Pinning information

Table 1: Pinning

Pin	Description	Simplified outline	Symbol
1	gate (G)	 SOT23	
2	source (S)		
3	drain (D)		

PHILIPS

3. Ordering information

Table 2: Ordering information

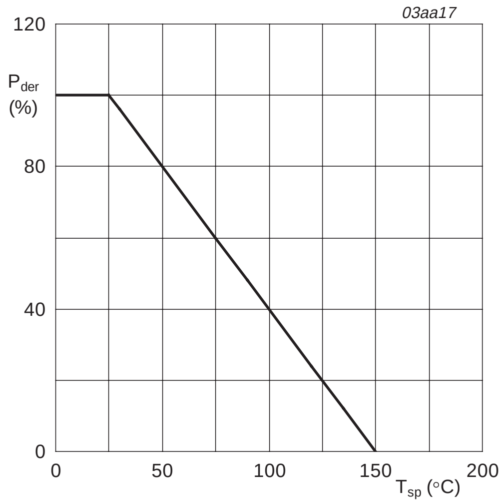
Type number	Package		
	Name	Description	Version
2N7002E	TO-236AB	plastic surface mounted package; 3 leads	SOT23

4. Limiting values

Table 3: Limiting values

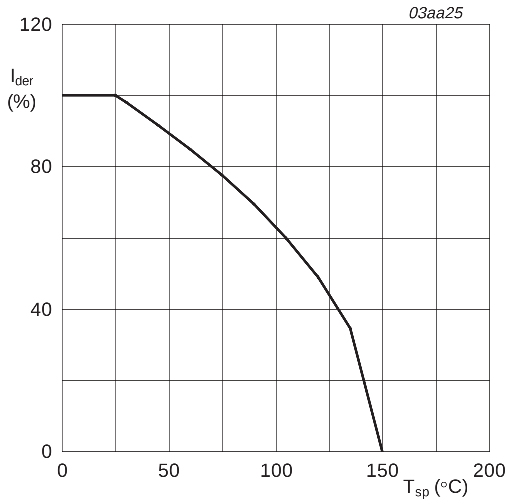
In accordance with the Absolute Maximum Rating System (IEC 60134).

Symbol	Parameter	Conditions	Min	Max	Unit
V_{DS}	drain-source voltage (DC)	25 °C ≤ T_j ≤ 150 °C	-	60	V
V_{DGR}	drain-gate voltage (DC)	25 °C ≤ T_j ≤ 150 °C; R_{GS} = 20 kΩ	-	60	V
V_{GS}	gate-source voltage (DC)		-	±30	V
V_{GSM}	peak gate-source voltage	t_p ≤ 50 µs; pulsed; duty cycle = 25 %	-	±40	V
I_D	drain current (DC)	T_{sp} = 25 °C; V_{GS} = 10 V; Figure 2 and 3	-	385	mA
		T_{sp} = 100 °C; V_{GS} = 10 V; Figure 2	-	245	mA
I_{DM}	peak drain current	T_{sp} = 25 °C; pulsed; t_p ≤ 10 µs; Figure 3	-	1.5	A
P_{tot}	total power dissipation	T_{sp} = 25 °C; Figure 1	-	0.83	W
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–65	+150	°C
Source-drain diode					
I_S	source (diode forward) current (DC)	T_{sp} = 25 °C	-	385	mA
I_{SM}	peak source (diode forward) current	T_{sp} = 25 °C; pulsed; t_p ≤ 10 µs	-	1.5	A



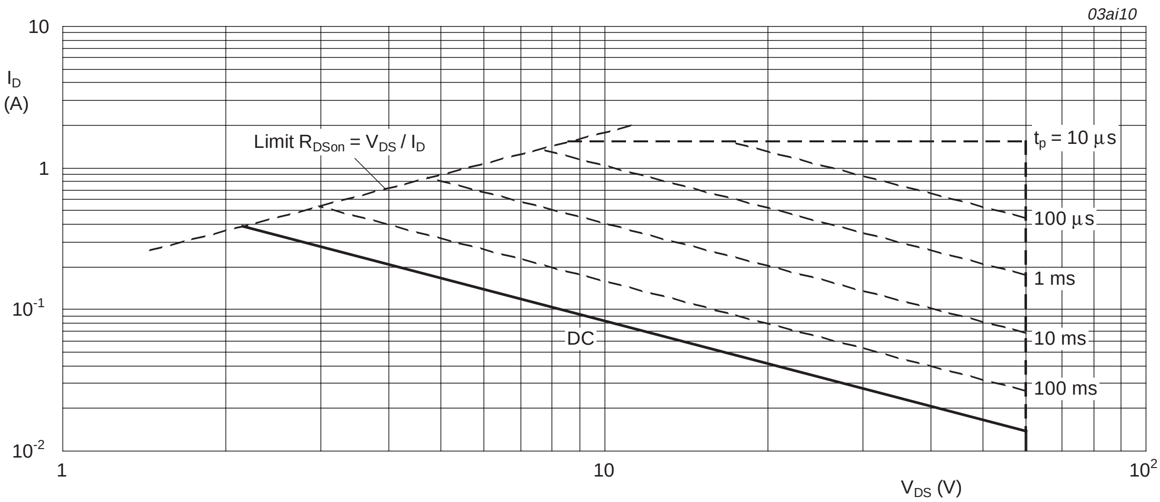
$$P_{der} = \frac{P_{tot}}{P_{tot(25\ ^{\circ}C)}} \times 100\ \%$$

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



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

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



T_{sp} = 25 °C; I_{DM} is single pulse

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

5. Thermal characteristics

Table 4: Thermal characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$R_{th(j-sp)}$	thermal resistance from junction to solder point	Figure 4	-	-	150	K/W
$R_{th(j-a)}$	thermal resistance from junction to ambient	mounted on a printed-circuit board; minimum footprint; vertical in still air	-	-	350	K/W

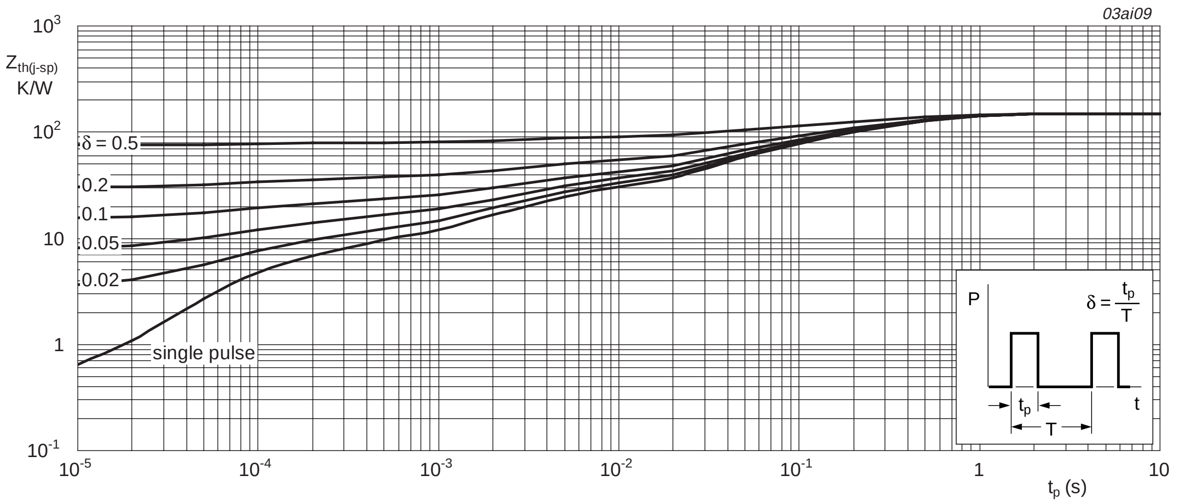


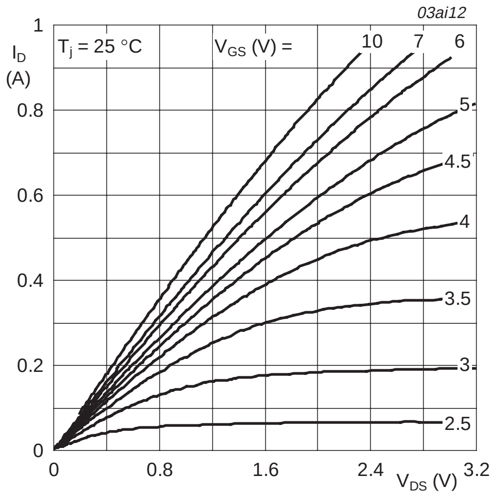
Fig 4. Transient thermal impedance from junction to solder point as a function of pulse duration

6. Characteristics

Table 5: Characteristics

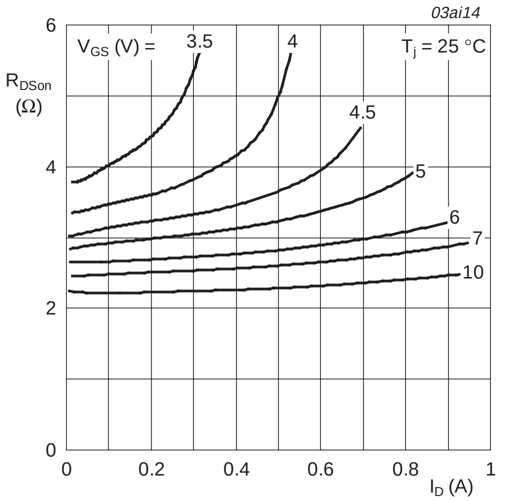
T_j = 25 °C unless otherwise specified.

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	60	-	-	V
		T_j = –55 °C	55	-	-	V
$V_{GS(th)}$	gate-source threshold voltage	I_D = 1 mA; V_{DS} = V_{GS}; Figure 9 and 10				
		T_j = 25 °C	1	2	3	V
		T_j = 150 °C	0.6	-	-	V
		T_j = –55 °C	-	-	3.5	V
I_{DSS}	drain-source leakage current	V_{DS} = 48 V; V_{GS} = 0 V				
		T_j = 25 °C	-	0.01	1	µA
		T_j = 150 °C	-	-	10	µA
I_{GSS}	gate-source leakage current	V_{GS} = ±15 V; V_{DS} = 0 V	-	10	100	nA
R_{DSon}	drain-source on-state resistance	V_{GS} = 10 V; I_D = 500 mA; Figure 6 and 8				
		T_j = 25 °C	-	2.3	3	Ω
		T_j = 150 °C	-	4.2	5.55	Ω
		V_{GS} = 4.5 V; I_D = 75 mA; Figure 6 and 8	-	3.1	4	Ω
Dynamic characteristics						
g_{fs}	forward transconductance	V_{DS} = 10 V; I_D = 200 mA	100	300	-	mS
C_{iss}	input capacitance	V_{GS} = 0 V; V_{DS} = 10 V; f = 1 MHz; Figure 11	-	25	40	pF
C_{oss}	output capacitance		-	18	30	pF
C_{rss}	reverse transfer capacitance		-	7.5	10	pF
t_{on}	turn-on delay time	V_{DD} = 50 V; R_L = 250 Ω; V_{GS} = 10 V; R_G = 50 Ω; R_{GS} = 50 Ω	-	3	10	ns
t_{off}	turn-off delay time		-	12	15	ns
Source-drain diode						
V_{SD}	source-drain (diode forward) voltage	I_S = 300 mA; V_{GS} = 0 V; Figure 12	-	0.85	1.5	V
t_{rr}	reverse recovery time	I_S = 300 mA; dI_S/dt = –100 A/µs; V_{GS} = 0 V	-	30	-	ns
Q_r	recovered charge		-	30	-	nC



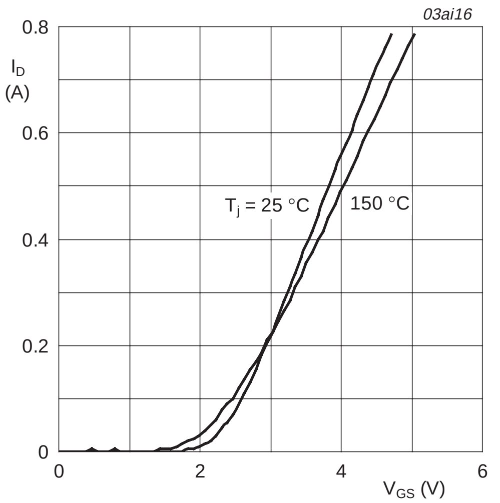
T_j = 25 °C

Fig 5. Output characteristics: drain current as a function of drain-source voltage; typical values



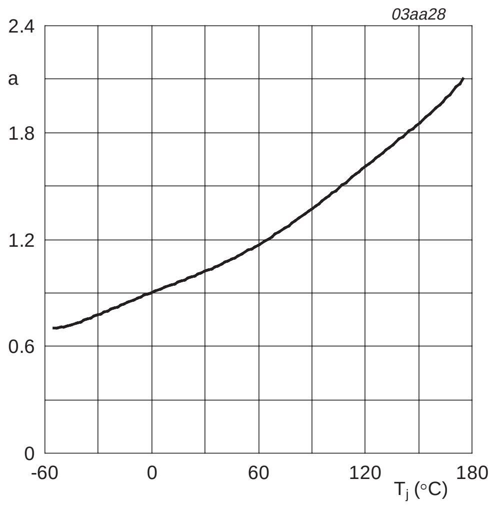
T_j = 25 °C

Fig 6. Drain-source on-state resistance as a function of drain current; typical values



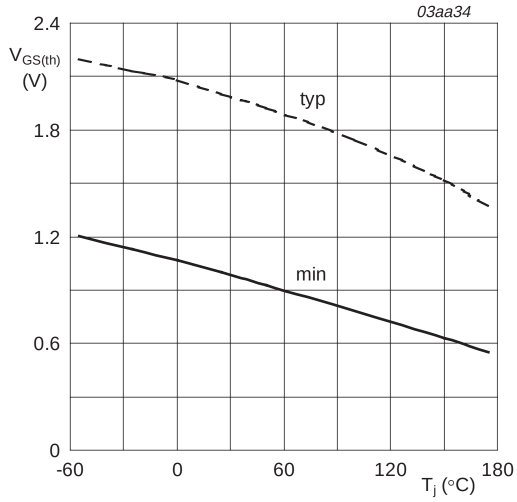
T_j = 25 °C and 150 °C; $V_{DS} > I_D \times R_{DSon}$

Fig 7. Transfer characteristics: drain current as a function of gate-source voltage; typical values



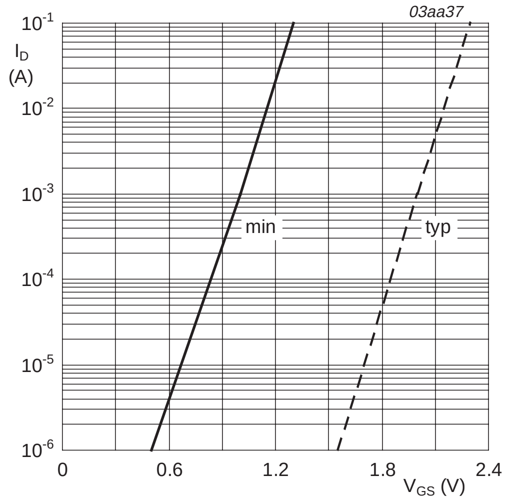
$$a = \frac{R_{DSon}}{R_{DSon(25\ ^\circ C)}}$$

Fig 8. Normalized drain-source on-state resistance factor as a function of junction temperature



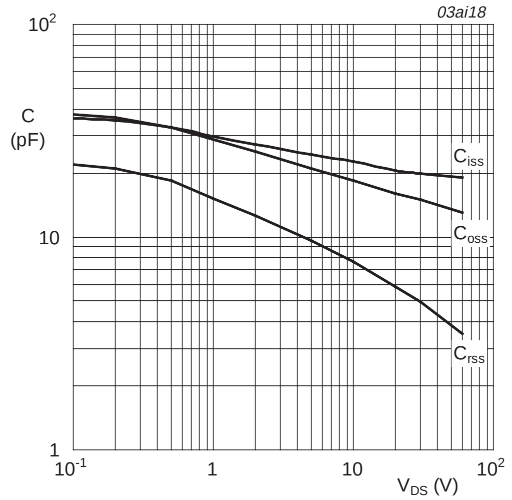
I_D = 1 mA; V_{DS} = V_{GS}

Fig 9. Gate-source threshold voltage as a function of junction temperature



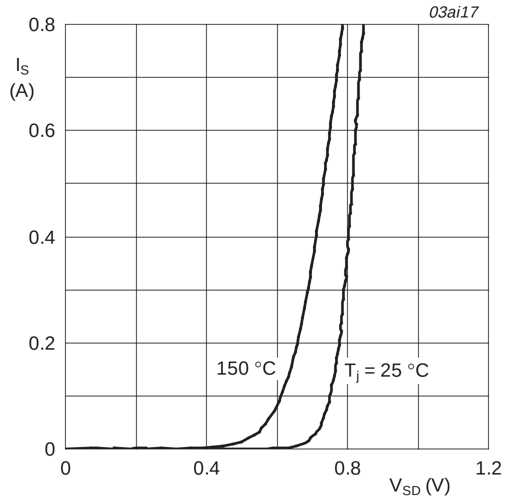
T_j = 25 °C; V_{DS} = 5 V

Fig 10. Sub-threshold drain current as a function of gate-source voltage



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

Fig 11. Input, output and reverse transfer capacitances as a function of drain-source voltage; typical values

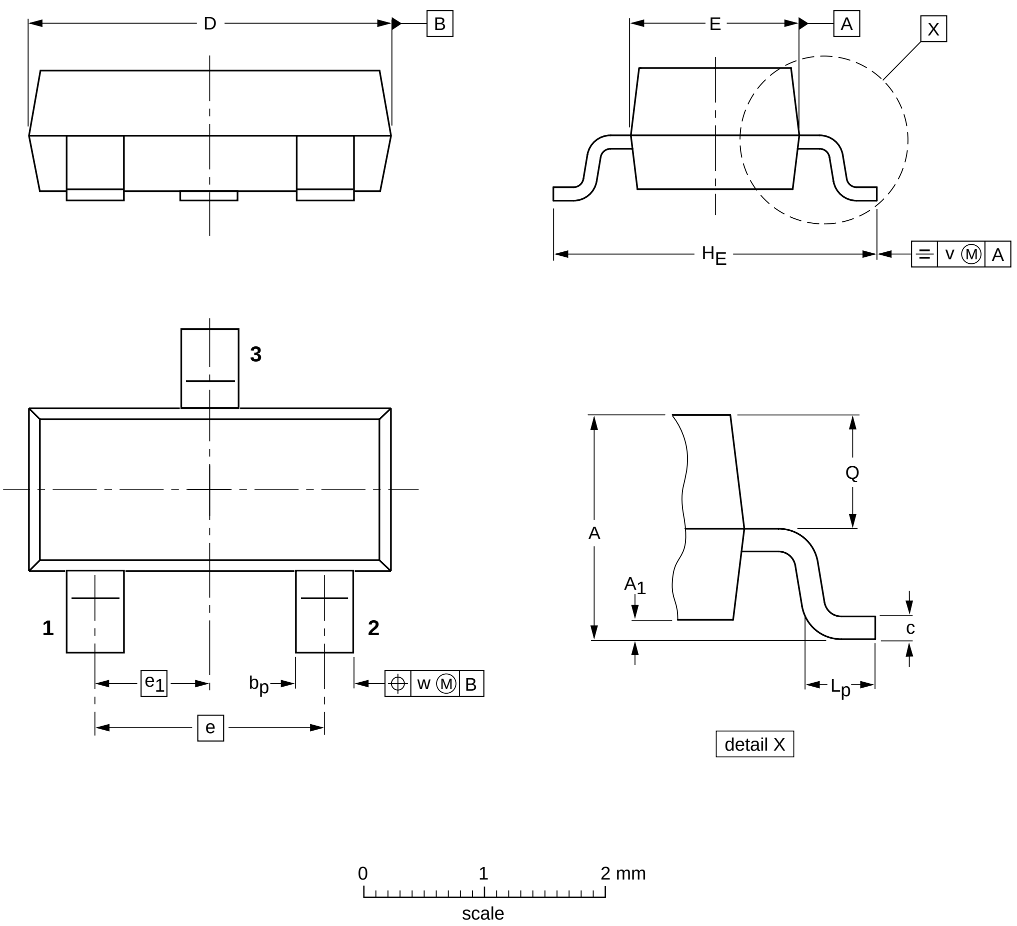


T_j = 25 °C and 150 °C; V_{GS} = 0 V

Fig 12. Source (diode forward) current as a function of source-drain (diode forward) voltage; typical values

7. Package outline

Plastic surface mounted package; 3 leads **SOT23**



DIMENSIONS (mm are the original dimensions)

UNIT	A	A_1 max.	b_p	c	D	E	e	e_1	H_E	L_p	Q	v	w
mm	1.1 0.9	0.1	0.48 0.38	0.15 0.09	3.0 2.8	1.4 1.2	1.9	0.95	2.5 2.1	0.45 0.15	0.55 0.45	0.2	0.1

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	JEITA			
SOT23		TO-236AB				~~99-09-13~~ 04-11-04

Fig 13. Package outline SOT23

8. Revision history

Table 6: Revision history

Document ID	Release date	Data sheet status	Change notice	Doc. number	Supersedes
2N7002E_2	20050426	Product data sheet	-	9397 750 14944	2N7002E-01
Modifications:	• The format of this data sheet has been redesigned to comply with the new presentation and information standard of Philips Semiconductors. • Table 5 “Characteristics” Addition of upper limit for $V_{GS(th)}$.				
2N7002E-01	20020211	Product data	-	9397 750 09095	-

9. Data sheet status

Level	Data sheet status [1]	Product status [2] [3]	Definition
I	Objective data	Development	This data sheet contains data from the objective specification for product development. Philips Semiconductors reserves the right to change the specification in any manner without notice.
II	Preliminary data	Qualification	This data sheet contains data from the preliminary specification. Supplementary data will be published at a later date. Philips Semiconductors reserves the right to change the specification without notice, in order to improve the design and supply the best possible product.
III	Product data	Production	This data sheet contains data from the product specification. Philips Semiconductors reserves the right to make changes at any time in order to improve the design, manufacturing and supply. Relevant changes will be communicated via a Customer Product/Process Change Notification (CPCN).

[1] Please consult the most recently issued data sheet before initiating or completing a design.

[2] The product status of the device(s) described in this data sheet may have changed since this data sheet was published. The latest information is available on the Internet at URL http://www.semiconductors.philips.com.

[3] For data sheets describing multiple type numbers, the highest-level product status determines the data sheet status.

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Short-form specification — The data in a short-form specification is extracted from a full data sheet with the same type number and title. For detailed information see the relevant data sheet or data handbook.

Limiting values definition — Limiting values given are in accordance with the Absolute Maximum Rating System (IEC 60134). Stress above one or more of the limiting values may cause permanent damage to the device. These are stress ratings only and operation of the device at these or at any other conditions above those given in the Characteristics sections of the specification is not implied. Exposure to limiting values for extended periods may affect device reliability.

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14. Contents

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