# DATA SHEET

# PN4416; PN4416A

## N-channel field-effect transistor

Product specification
File under Discrete Semiconductors, SC07

December 1997

Philips
Semiconductors

PHILIPS

# N-channel field-effect transistor PN4416; PN4416A

## FEATURES

- Low noise
- Interchangeability of drain and source connections
- High gain.

## DESCRIPTION

N-channel symmetrical silicon junction FETs in a SOT54 envelope. These devices are intended for use in VHF/UHF amplifiers, oscillators and mixers.

## PINNING - SOT54 (TO-92).

| PIN | DESCRIPTION |
|---|---|
| 1 | gate |
| 2 | source |
| 3 | drain |

## QUICK REFERENCE DATA

| SYMBOL | PARAMETER | CONDITIONS | MIN. | MAX. | UNIT |
|---|---|---|---|---|---|
| $V_{DS}$ | drain-source voltage | | | | |
| | PN4416 | | – | 30 | V |
| | PN4416A | | – | 35 | V |
| $I_{DSS}$ | drain current | $V_{DS}$ = 15 V; $V_{GS}$ = 0 | 5 | 15 | mA |
| $P_{tot}$ | total power dissipation | up to $T_{amb}$ = 25 °C | – | 400 | mW |
| $V_{GS(off)}$ | gate-source cut-off voltage | $V_{DS}$ = 15 V; $I_D$ = 1 nA | | | |
| | PN4416 | | – | –6 | V |
| | PN4416A | | –2.5 | –6 | V |
| $\|Y_{fs}\|$ | common-source transfer admittance | $V_{DS}$ = 15 V; $V_{GS}$ = 0; f = 1 kHz | 4.5 | 7.5 | mS |

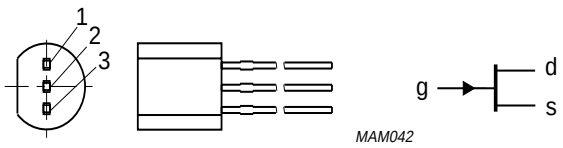



Fig.1 Simplified outline and symbol.

## LIMITING VALUES

In accordance with the Absolute Maximum Rating System (IEC 134).

| SYMBOL | PARAMETER | CONDITIONS | MIN. | MAX. | UNIT |
|---|---|---|---|---|---|
| $V_{DS}$ | drain-source voltage | | | | |
| | PN4416 | | – | 30 | V |
| | PN4416A | | – | 35 | V |
| $V_{GSO}$ | gate-source voltage | | | | |
| | PN4416 | | – | –30 | V |
| | PN4416A | | – | –35 | V |
| $V_{GDO}$ | gate-drain voltage | | | | |
| | PN4416 | | – | –30 | V |
| | PN4416A | | – | –35 | V |
| $I_G$ | DC forward gate current | | – | 10 | mA |
| $P_{tot}$ | total power dissipation | up to $T_{amb}$ = 25 °C (note 1) | – | 400 | mW |
| $T_{stg}$ | storage temperature | | –65 | +150 | °C |
| $T_j$ | junction temperature | | – | 150 | °C |

## THERMAL RESISTANCE

| SYMBOL | PARAMETER | THERMAL RESISTANCE |
|---|---|---|
| $R_{th\ j\text{-}a}$ | from junction to ambient (note 1) | 350 K/W |

**Note**

1. Mounted on a printed-circuit board, maximum lead length 4 mm, mounting pad for drain leads 10 $mm^2$.

## STATIC CHARACTERISTICS

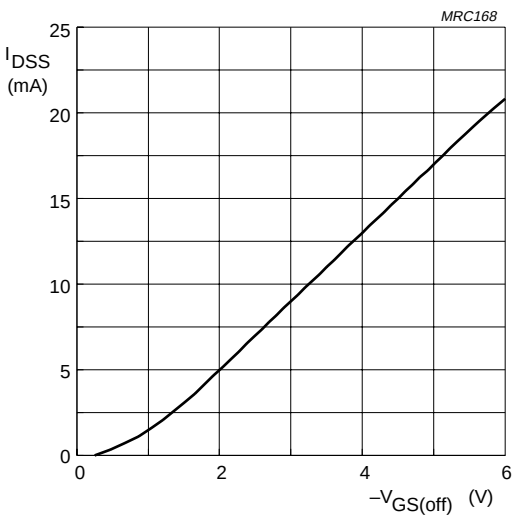
$T_j$ = 25 °C unless otherwise specified.

| SYMBOL | PARAMETER | CONDITIONS | MIN. | MAX. | UNIT |
|---|---|---|---|---|---|
| $V_{(BR)GSS}$ | gate-source breakdown voltage | $V_{DS}$ = 0; $I_G$ = –1 μA | | | |
| | PN4416 | | –30 | – | V |
| | PN4416A | | –35 | – | V |
| $I_{GSS}$ | reverse gate leakage current | $V_{DS}$ = 0; $V_{GS}$ = –15 V | – | –1 | nA |
| $I_{DSS}$ | drain current | $V_{DS}$ = 15 V; $V_{GS}$ = 0 | 5 | 15 | mA |
| $V_{GSS}$ | gate-source forward voltage | $V_{DS}$ = 0; $I_G$ = 1 mA | – | 1 | V |
| $V_{GS(off)}$ | gate-source cut-off voltage | $V_{DS}$ = 15 V; $I_D$ = 1 nA | | | |
| | PN4416 | | – | –6 | V |
| | PN4416A | | –2.5 | –6 | V |
| $\|Y_{fs}\|$ | common source transfer admittance | $V_{DS}$ = 15 V; $V_{GS}$ = 0 | 4.5 | 7.5 | mS |
| $\|Y_{os}\|$ | common source output admittance | $V_{DS}$ = 15 V; $V_{GS}$ = 0 | | | |
| | PN4416 | | – | 50 | μS |
| | PN4416A | | – | 50 | μS |

**DYNAMIC CHARACTERISTICS**

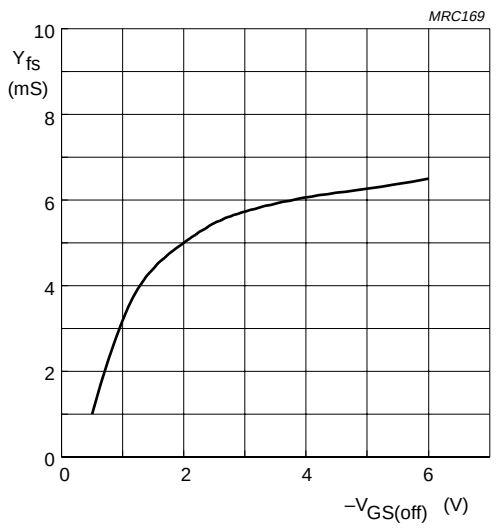
$T_j$ = 25 °C; $V_{DS}$ = 15 V; $V_{GS}$ = 0.

| SYMBOL | PARAMETER | CONDITIONS | MIN. | TYP. | MAX. | UNIT |
|---|---|---|---|---|---|---|
| $C_{is}$ | input capacitance | f = 1 MHz | – | – | 4 | pF |
| $C_{os}$ | output capacitance | f = 1 MHz | – | – | 2 | pF |
| $C_{rs}$ | feedback capacitance | f = 1 MHz | – | – | 0.8 | pF |
| $g_{is}$ | common source input conductance | f = 100 MHz | – | – | 100 | µS |
| | | f = 400 MHz | – | – | 1 | mS |
| $g_{fs}$ | common source transfer conductance | f = 100 MHz | – | 5.2 | – | mS |
| | | f = 400 MHz | 4 | 5 | – | mS |
| $g_{rs}$ | common source feedback conductance | f = 100 MHz | – | –8 | – | µS |
| | | f = 400 MHz | – | –100 | – | µS |
| $g_{os}$ | common source output conductance | f = 100 MHz | – | – | 75 | µS |
| | | f = 400 MHz | – | – | 100 | µS |
| $V_n$ | equivalent input noise voltage | f = 100 Hz | – | 5 | – | nV/√Hz |



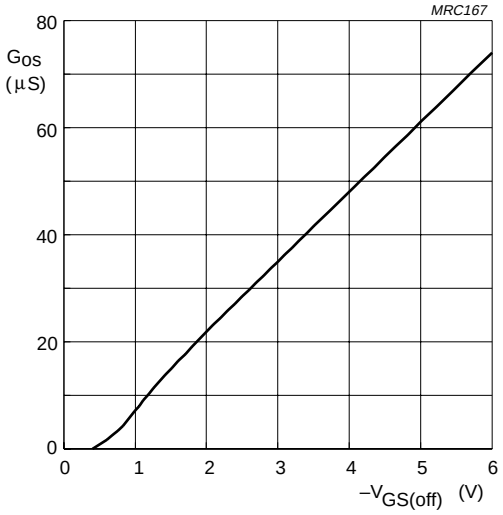

$V_{DS}$ = 15 V; $T_j$ = 25 °C.

Fig.2 Drain current as a function of gate-source cut-off voltage; typical values.



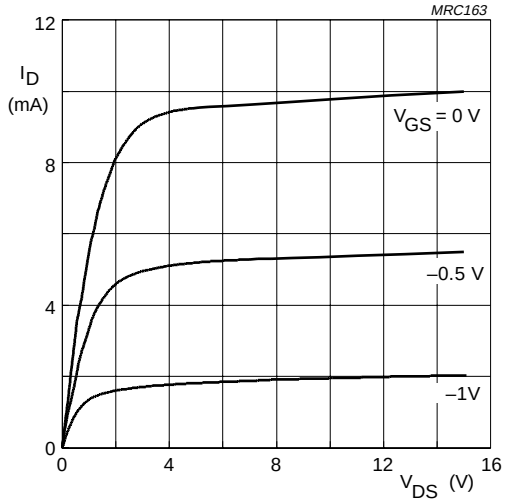

$V_{DS}$ = 15 V; $T_j$ = 25 °C.

Fig.3 Common source transfer admittance as a function of gate-source cut-off voltage; typical values.



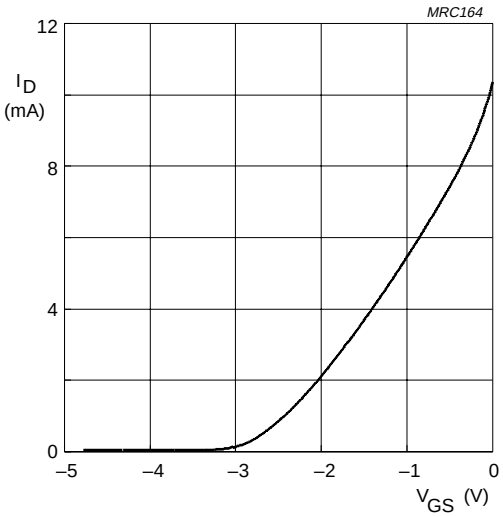

$V_{DS}$ = 15 V; $T_j$ = 25 °C.

Fig.4 Common source output conductance as a function of gate-source cut-off voltage; typical values.



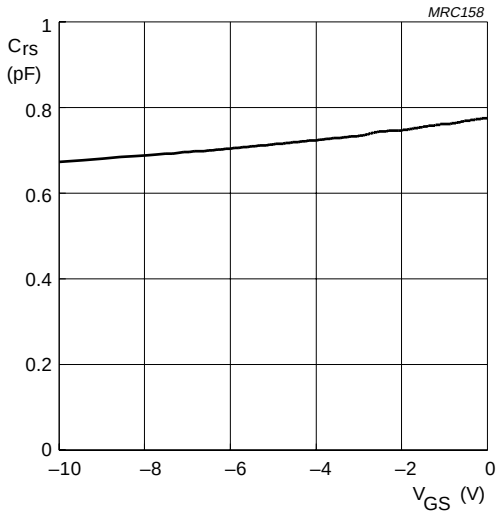

$T_j$ = 25 °C.

Fig.5 Typical output characteristics.



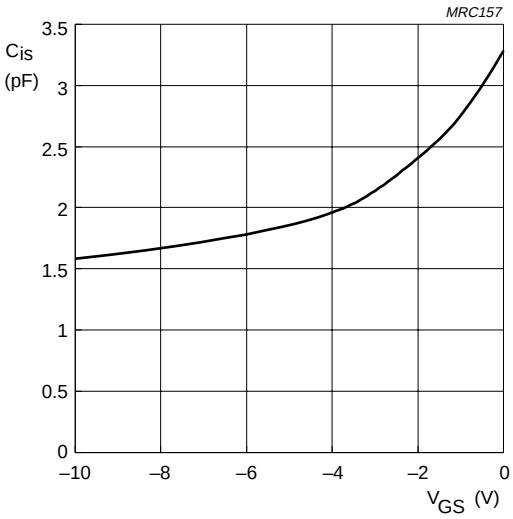

$V_{DS}$ = 15 V; $T_j$ = 25 °C.

Fig.6 Typical input characteristics.




$V_{DS}$ = 15 V; $T_j$ = 25 °C.

Fig.7 Typical feedback capacitance.




$V_{DS}$ = 15 V; $T_j$ = 25 °C.

Fig.8 Typical input capacitance.

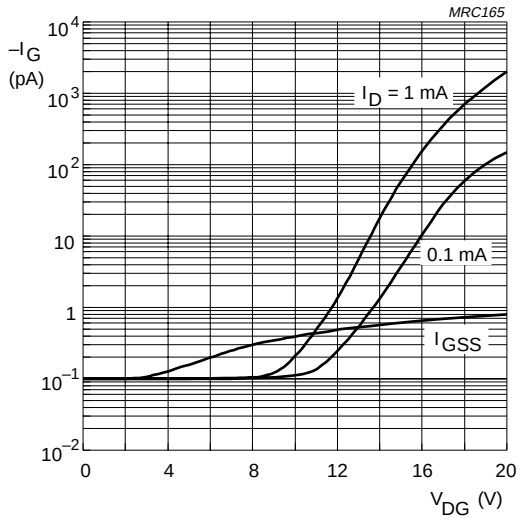



Fig.9 Gate current as a function of drain-gate voltage, typical values.

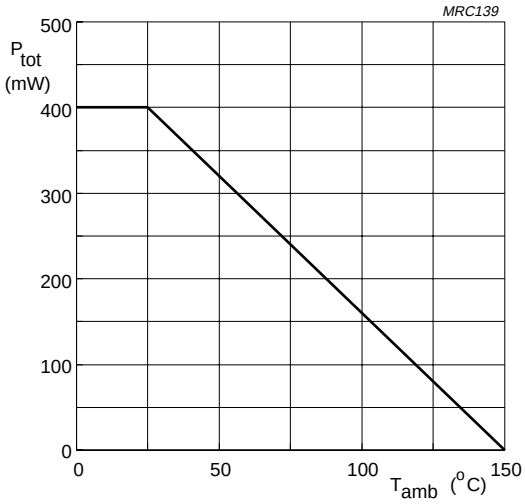
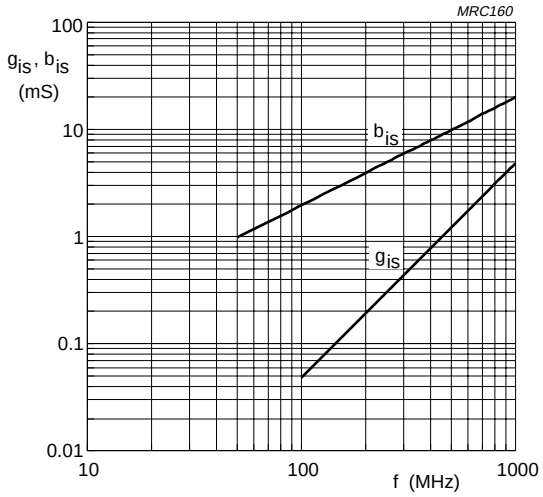
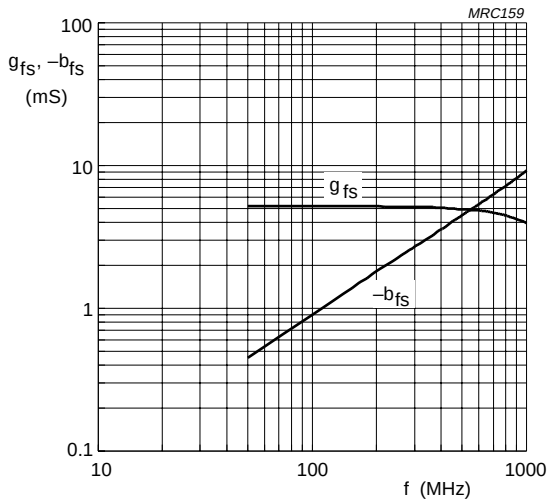



Fig.10 Power derating curve.



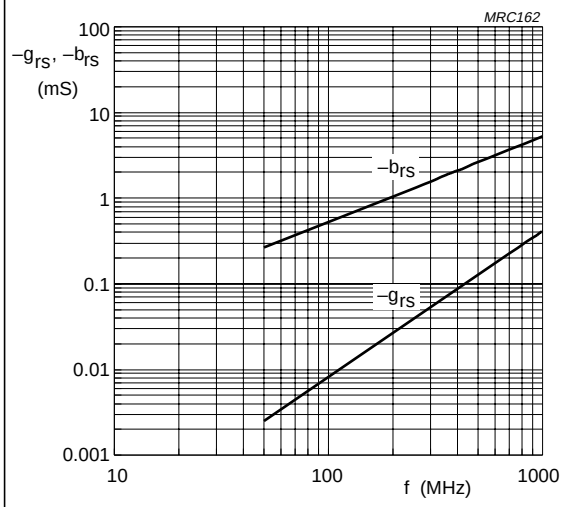

$V_{DS}$ = 15 V; $V_{GS}$ = 0; $T_{amb}$ = 25 °C.

Fig.11 Common source input conductance; typical values.



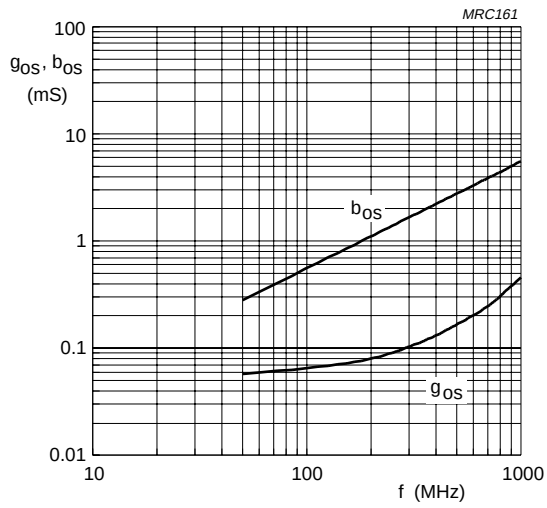

$V_{DS}$ = 15 V; $V_{GS}$ = 0; $T_{amb}$ = 25 °C.

Fig.12 Common source transfer conductance; typical values.




$V_{DS}$ = 15 V; $V_{GS}$ = 0; $T_{amb}$ = 25 °C.

Fig.13 Common source feedback conductance; typical values.




$V_{DS}$ = 15 V; $V_{GS}$ = 0; $T_{amb}$ = 25 °C.

Fig.14 Common source output conductance; typical values.

**SPICE parameters for PN4416**

September 1992; version 1.0.

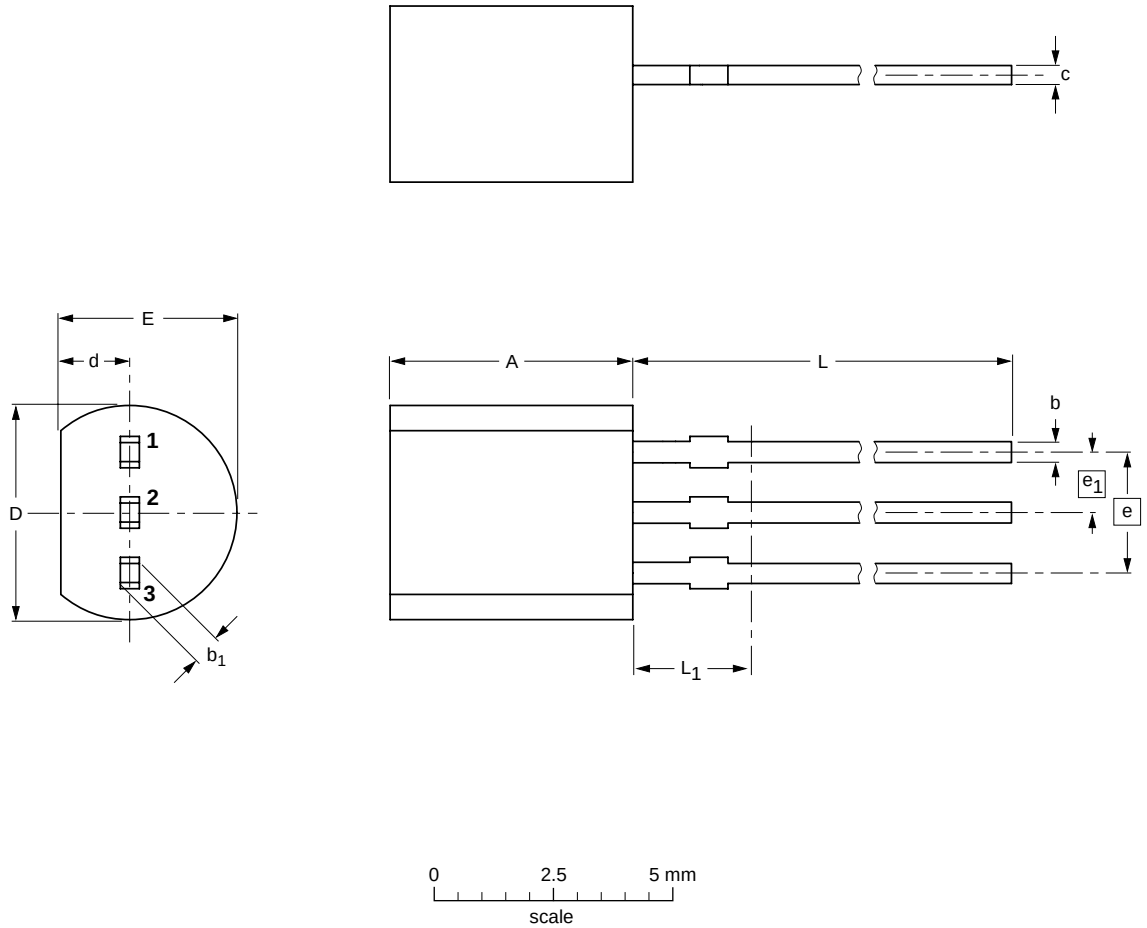
| | | |
|---|---|---|
| 1 | VTO = –3.553 | V |
| 2 | BETA = 792.6 | $\mu A/V^2$ |
| 3 | LAMBDA = 18.46 | m/V |
| 4 | RD = 7.671 | Ω |
| 5 | RS = 7.671 | Ω |
| 6 | IS = 333.4 | aA |
| 7 | CGSO = 2.920 | pF |
| 8 | CGDO = 2.261 | pF |
| 9 | PB = 1.090 | V |
| 10 (note 1) | FC = 500.0 | m |

**Note**

1. Parameter not extracted; default value.

## PACKAGE OUTLINE

**Plastic single-ended leaded (through hole) package; 3 leads** **SOT54**




**DIMENSIONS (mm are the original dimensions)**

| UNIT | A | b | $b_1$ | c | D | d | E | e | $e_1$ | L | $L_1$(1) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| mm | 5.2<br>5.0 | 0.48<br>0.40 | 0.66<br>0.56 | 0.45<br>0.40 | 4.8<br>4.4 | 1.7<br>1.4 | 4.2<br>3.6 | 2.54 | 1.27 | 14.5<br>12.7 | 2.5 |

**Note**

1. Terminal dimensions within this zone are uncontrolled to allow for flow of plastic and terminal irregularities.

| OUTLINE VERSION | REFERENCES | | | | EUROPEAN PROJECTION | ISSUE DATE |
|---|---|---|---|---|---|---|
| | IEC | JEDEC | EIAJ | | | |
| SOT54 | | TO-92 | SC-43 | | | 97-02-28 |

## DEFINITIONS

| **Data sheet status** | |
|---|---|
| Objective specification | This data sheet contains target or goal specifications for product development. |
| Preliminary specification | This data sheet contains preliminary data; supplementary data may be published later. |
| Product specification | This data sheet contains final product specifications. |
| Short-form specification | The data in this 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** | |
| Limiting values given are in accordance with the Absolute Maximum Rating System (IEC 134). 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. | |
| **Application information** | |
| Where application information is given, it is advisory and does not form part of the specification. | |

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