MOSFETs Silicon P-Channel MOS (U-MOSⅥ)

# SSM3J168F

## 1. Applications

- High-Speed Switching
- Analog Switches
- Interfacing

## 2. Features

(1) AEC-Q101 qualified (Please see the orderable part number list)

(2) 4.0 V drive

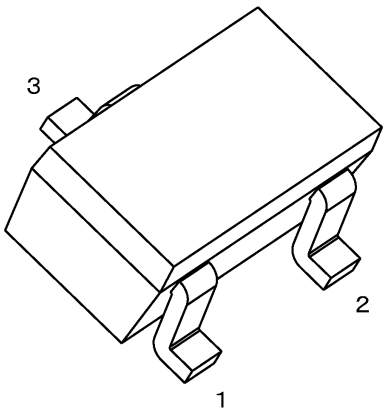
(3) Low drain-source on-resistance

: $R_{DS(ON)}$ = 1.6 Ω (typ.) ($V_{GS}$ = -4.0 V)

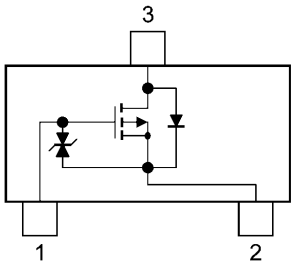
$R_{DS(ON)}$ = 1.4 Ω (typ.) ($V_{GS}$ = -4.5 V)

$R_{DS(ON)}$ = 1.3 Ω (typ.) ($V_{GS}$ = -10 V)

## 3. Packaging and Pin Assignment




S-Mini




1: Gate
2: Source
3: Drain

## 4. Orderable part number

| Orderable part number | AEC-Q101 | Note |
|---|---|---|
| SSM3J168F,LF | — | General Use |
| SSM3J168F,LXGF | YES (Note 1) | Unintended Use (Note 1) |
| SSM3J168F,LXHF | YES | Automotive Use |

Note 1: For more information, please contact our sales or use the inquiry form on our website.

Start of commercial production
2016-11

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## 5. Absolute Maximum Ratings (Note) (Unless otherwise specified, $T_a$ = 25 °C)

| Characteristics | | | Symbol | Rating | Unit |
|---|---|---|---|---|---|
| Drain-source voltage | | | $V_{DSS}$ | -60 | V |
| Gate-source voltage | | | $V_{GSS}$ | -20/+10 | |
| Drain current (DC) | | (Note 1) | $I_D$ | -400 | mA |
| Drain current (pulsed) | | (Note 1) | $I_{DP}$ | -800 | |
| Power dissipation | | (Note 2) | $P_D$ | 600 | mW |
| Power dissipation | t ≤ 1s | (Note 2) | | 1200 | |
| Channel temperature | | | $T_{ch}$ | 150 | °C |
| Storage temperature | | | $T_{stg}$ | -55 to 150 | |

Note: Using continuously under heavy loads (e.g. the application of high temperature/current/voltage and the significant change in temperature, etc.) may cause this product to decrease in the reliability significantly even if the operating conditions (i.e. operating temperature/current/voltage, etc.) are within the absolute maximum ratings.
Please design the appropriate reliability upon reviewing the Toshiba Semiconductor Reliability Handbook ("Handling Precautions"/"Derating Concept and Methods") and individual reliability data (i.e. reliability test report and estimated failure rate, etc).

Note 1: Ensure that the channel temperature does not exceed 150 °C.

Note 2: Device mounted on a 25.4 mm × 25.4 mm × 1.6 mm FR4 glass epoxy board (Cu pad: 645 $mm^2$)

Note: This transistor is sensitive to electrostatic discharge and should be handled with care.

Note: The MOSFETs in this device are sensitive to electrostatic discharge. When handling this device, the worktables, operators, soldering irons and other objects should be protected against anti-static discharge.

Note: The channel-to-ambient thermal resistance, $R_{th(ch-a)}$, and the drain power dissipation, $P_D$, vary according to the board material, board area, board thickness and pad area. When using this device, be sure to take heat dissipation fully into account.

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# 6. Electrical Characteristics

## 6.1. Static Characteristics (Unless otherwise specified, $T_a$ = 25 °C)

| Characteristics | | Symbol | Test Condition | Min | Typ. | Max | Unit |
|---|---|---|---|---|---|---|---|
| Gate leakage current | | $I_{GSS}$ | $V_{DS}$ = 0 V, $V_{GS}$ = -16 V/+10 V | — | — | ±10 | μA |
| Drain cut-off current | | $I_{DSS}$ | $V_{DS}$ = -60 V, $V_{GS}$ = 0 V | — | — | -10 | |
| Drain-source breakdown voltage | | $V_{(BR)DSS}$ | $I_D$ = -1 mA, $V_{GS}$ = 0 V | -60 | — | — | V |
| Drain-source breakdown voltage | (Note 1) | $V_{(BR)DSX}$ | $I_D$ = -1 mA, $V_{GS}$ = 10 V | -50 | — | — | |
| Gate threshold voltage | (Note 2) | $V_{th}$ | $V_{DS}$ = -10 V, $I_D$ = -1 mA | -0.8 | — | -2.0 | |
| Drain-source on-resistance | (Note 3) | $R_{DS(ON)}$ | $I_D$ = -100 mA, $V_{GS}$ = -4.0 V | — | 1.6 | 2.0 | Ω |
| | | | $I_D$ = -100 mA, $V_{GS}$ = -4.5 V | — | 1.4 | 1.9 | |
| | | | $I_D$ = -200 mA, $V_{GS}$ = -10 V | — | 1.3 | 1.55 | |

Note 1: If a reverse bias is applied between gate and source, this device enters $V_{(BR)DSX}$ mode. Note that the drain-source breakdown voltage is lowered in this mode.

Note 2: Let $V_{th}$ be the voltage applied between gate and source that causes the drain current ($I_D$) to below (-1 mA for this device). Then, for normal switching operation, $V_{GS(ON)}$ must be higher than $V_{th}$, and $V_{GS(OFF)}$ must be lower than $V_{th}$. This relationship can be expressed as: $V_{GS(OFF)} < V_{th} < V_{GS(ON)}$.
Take this into consideration when using the device.

Note 3: Pulse measurement.

## 6.2. Dynamic Characteristics (Unless otherwise specified, $T_a$ = 25 °C)

| Characteristics | Symbol | Test Condition | Min | Typ. | Max | Unit |
|---|---|---|---|---|---|---|
| Input capacitance | $C_{iss}$ | $V_{DS}$ = -10 V , $V_{GS}$ = 0 V, f = 1 MHz | — | 82 | — | pF |
| Reverse transfer capacitance | $C_{rss}$ | | — | 5.5 | — | |
| Output capacitance | $C_{oss}$ | | — | 13 | — | |
| Switching time (turn-on time) | $t_{on}$ | $V_{DD}$ = -30 V, $I_D$ = -0.1 A, $V_{GS}$ = 0 to -10 V, $R_G$ = 50 Ω Duty ≤ 1 %, $V_{IN}$: $t_r$, $t_f$ < 5 ns, Common source | — | 4.3 | — | ns |
| Switching time (turn-off time) | $t_{off}$ | | — | 31.7 | — | |

## 6.3. Switching Time Test Circuit

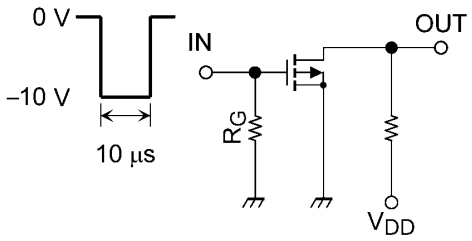



Fig. 6.3.1 Switching Time Test Circuit

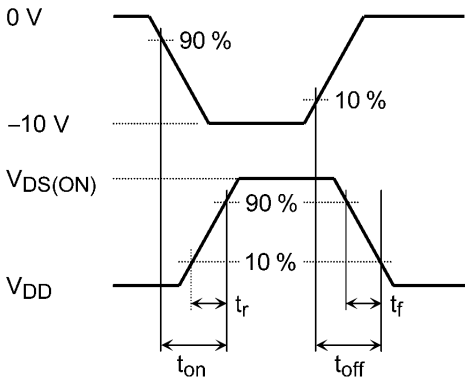



Fig. 6.3.2 Input Waveform/Output Waveform

## 6.4. Gate Charge Characteristics (Unless otherwise specified, $T_a$ = 25 °C)

| Characteristics | Symbol | Test Condition | Min | Typ. | Max | Unit |
|---|---|---|---|---|---|---|
| Total gate charge (gate-source plus gate-drain) | $Q_g$ | $V_{DD}$ = -48 V, $I_D$ = -0.4 A, $V_{GS}$ = -10 V | — | 3.0 | — | nC |
| Gate-source charge 1 | $Q_{gs1}$ | | — | 0.4 | — | |
| Gate-drain charge | $Q_{gd}$ | | — | 1.1 | — | |

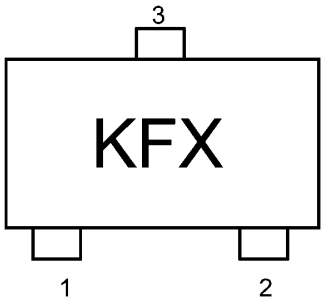
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### 6.5. Source-Drain Characteristics (Unless otherwise specified, $T_a$ = 25 °C)

| Characteristics | Symbol | Test Condition | Min | Typ. | Max | Unit |
|---|---|---|---|---|---|---|
| Diode forward voltage (Note 1) | $V_{DSF}$ | $I_D$ = 400 mA, $V_{GS}$ = 0 V | — | 0.87 | 1.2 | V |

Note 1: Pulse measurement.

## 7. Marking




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## 8. Characteristics Curves (Note)

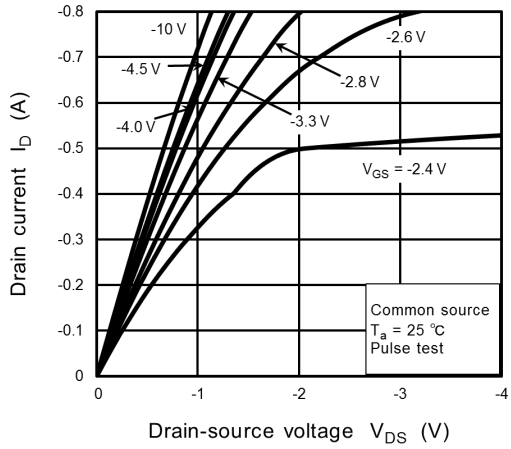



Fig. 8.1 $I_D$ - $V_{DS}$

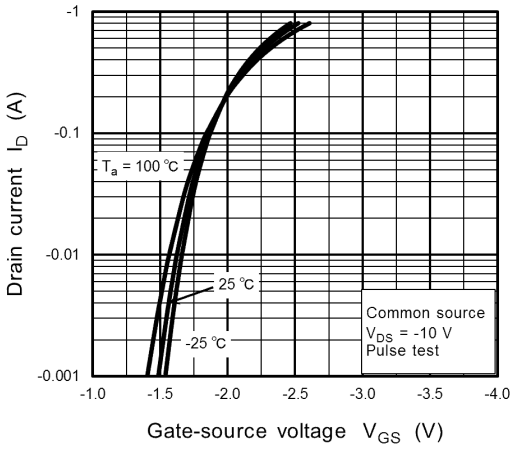



Fig. 8.2 $I_D$ - $V_{GS}$

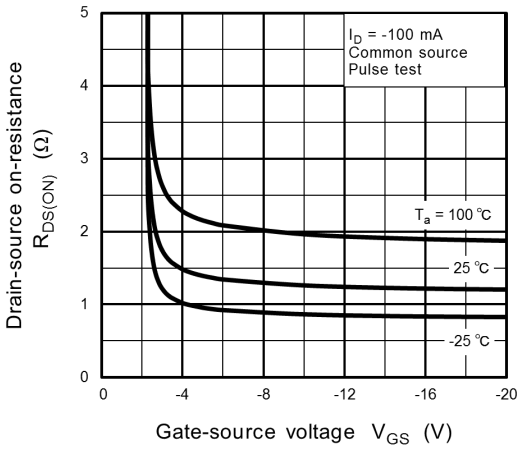



Fig. 8.3 $R_{DS(ON)}$ - $V_{GS}$

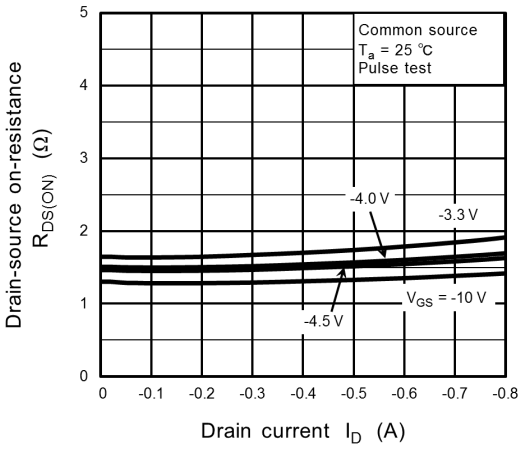



Fig. 8.4 $R_{DS(ON)}$ - $I_D$

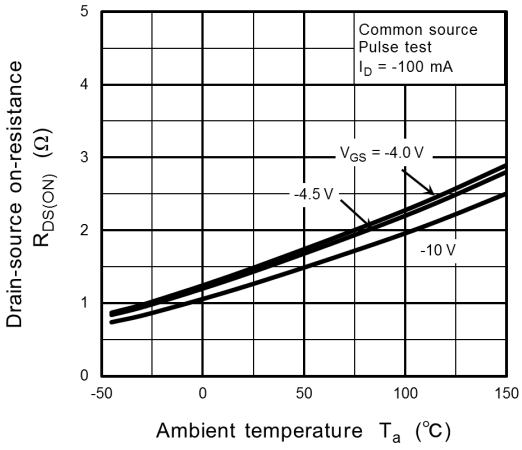



Fig. 8.5 $R_{DS(ON)}$ - $T_a$

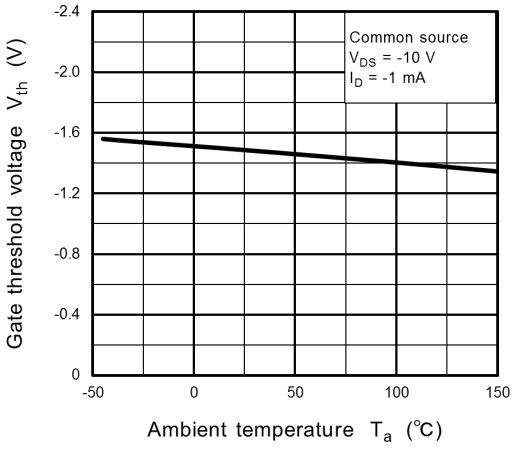



Fig. 8.6 $V_{th}$ - $T_a$

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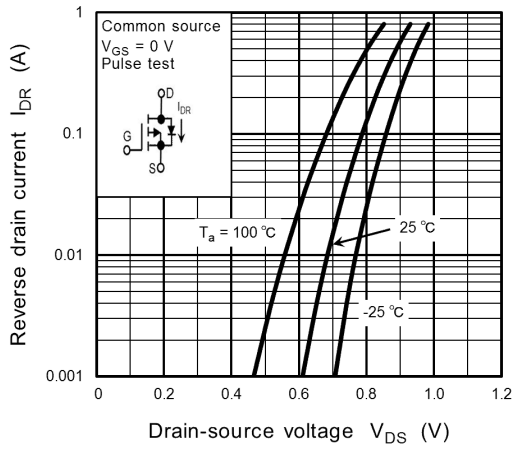



**Fig. 8.7 $I_{DR}$ - $V_{DS}$**

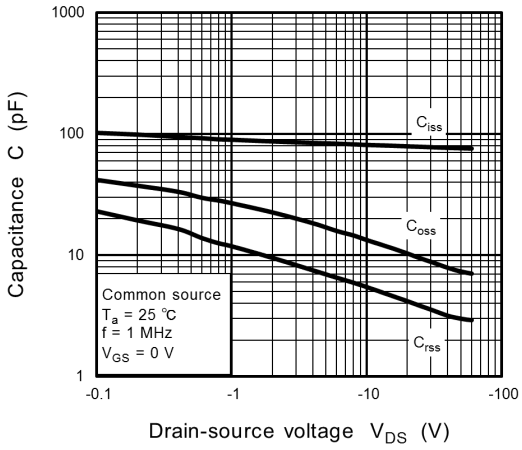



**Fig. 8.8 C - $V_{DS}$**

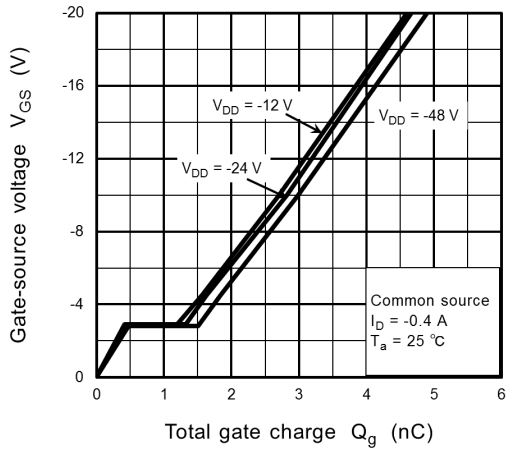



**Fig. 8.9 Dynamic Input Characteristics**

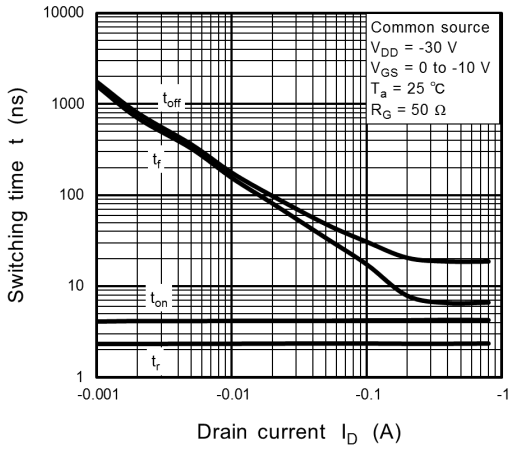



**Fig. 8.10 t - $I_D$**

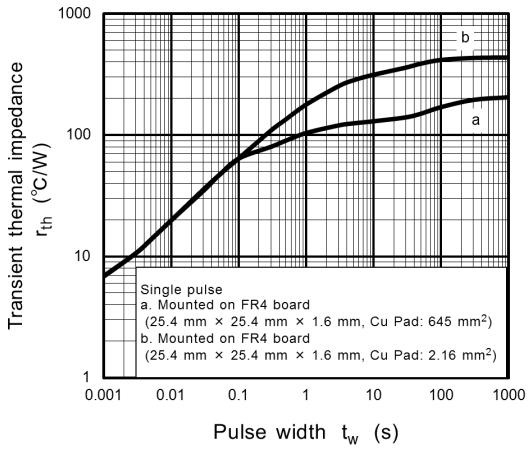



**Fig. 8.11 $r_{th}$ - $t_w$**

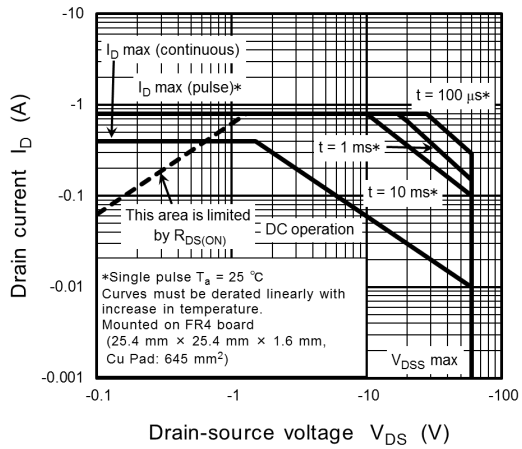



**Fig. 8.12 Safe Operating Area**

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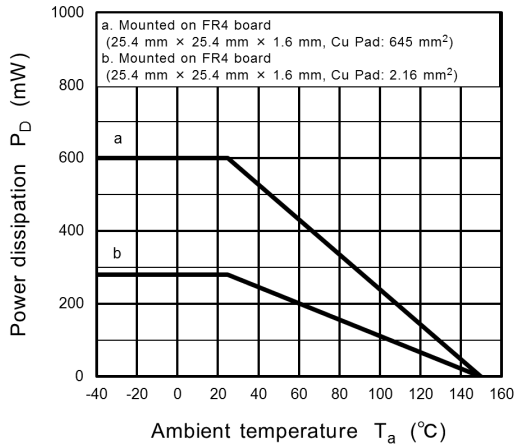


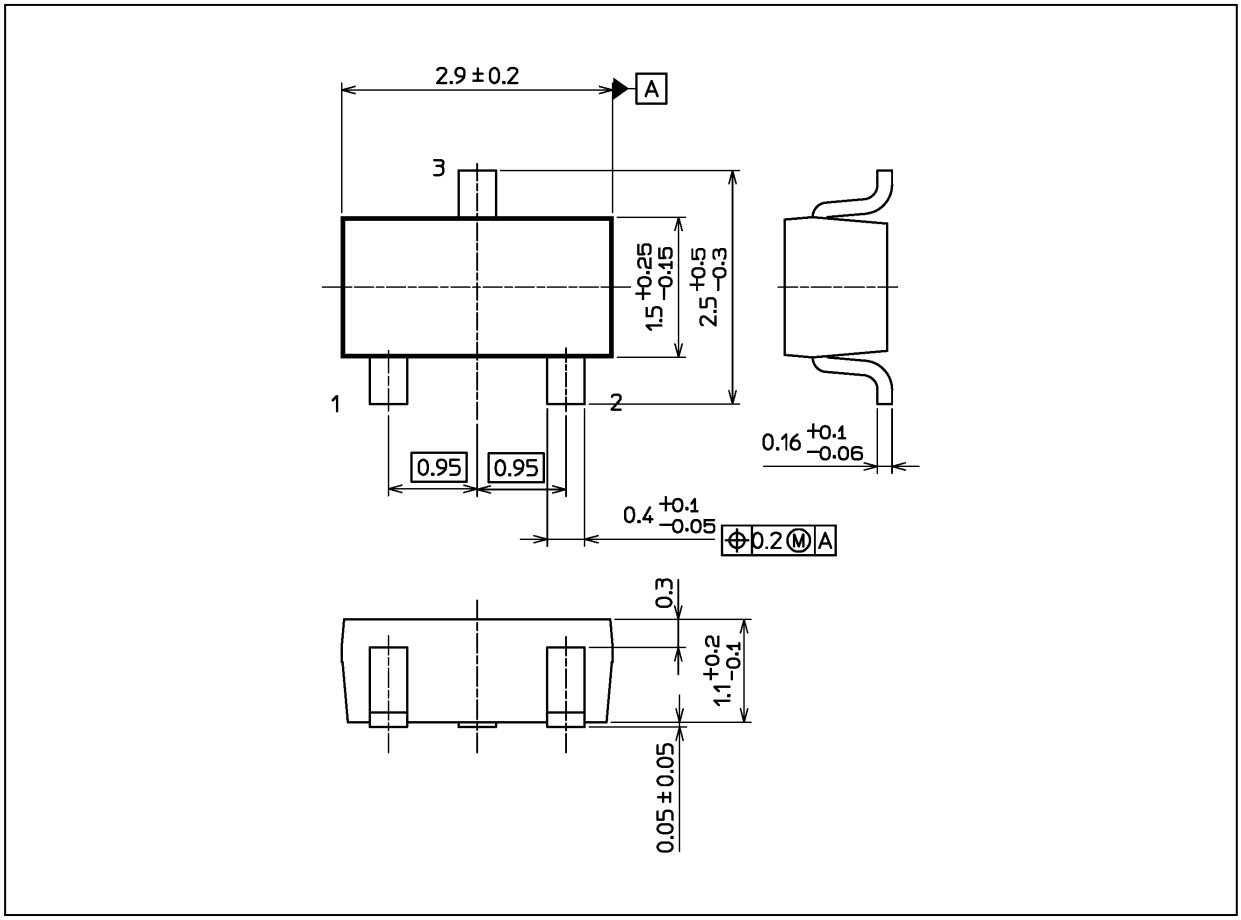

**Fig. 8.13 $P_D$ - $T_a$**

Note: The above characteristics curves are presented for reference only and not guaranteed by production test, unless otherwise noted.

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## Package Dimensions

Unit: mm




Weight: 12 mg (typ.)

| Package Name(s) |
|---|
| JEDEC: SOT-346 |
| Nickname: S-Mini |

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