

MOSFETs Silicon N-Channel MOS

# SSM3K345R

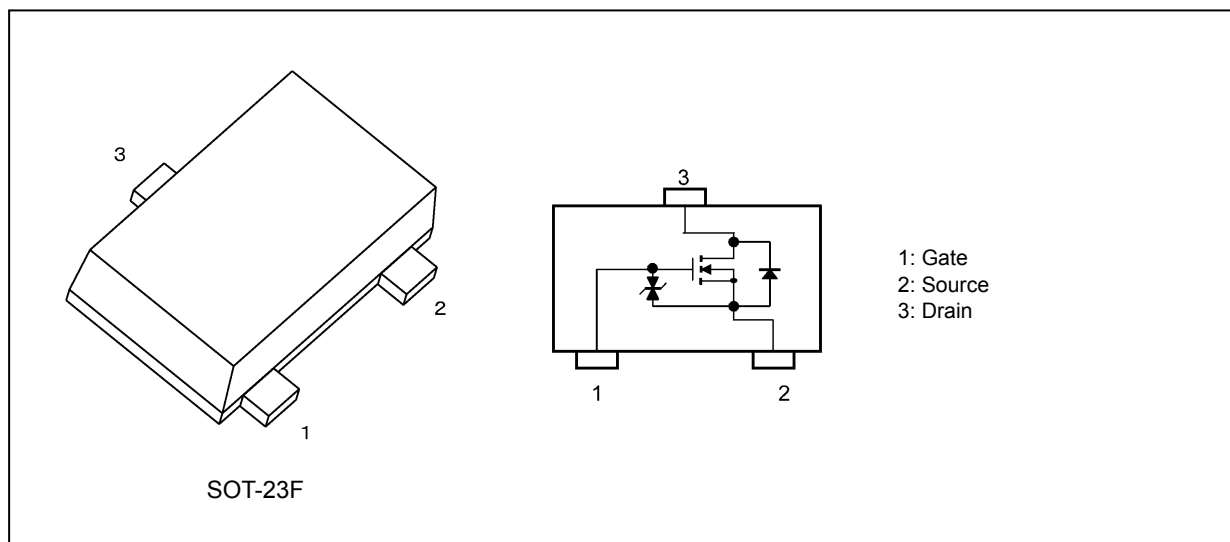
## 1. Applications

- Power Management Switches
- DC-DC Converters

## 2. Features

- (1) 1.5 V drive
- (2) Low drain-source on-resistance
  - :  $R_{DS(ON)} = 33 \text{ m}\Omega$  (max) (@ $V_{GS} = 4.5 \text{ V}$ )
  - $R_{DS(ON)} = 45 \text{ m}\Omega$  (max) (@ $V_{GS} = 2.5 \text{ V}$ )
  - $R_{DS(ON)} = 74 \text{ m}\Omega$  (max) (@ $V_{GS} = 1.8 \text{ V}$ )
  - $R_{DS(ON)} = 108 \text{ m}\Omega$  (max) (@ $V_{GS} = 1.5 \text{ V}$ )

## 3. Packaging and Pin Assignment



Start of commercial production  
2016-11

### 4. Absolute Maximum Ratings (Note) (Unless otherwise specified, $T_a = 25\text{ }^\circ\text{C}$ )

| Characteristics                               | Symbol    | Rating     | Unit             |
|---|-----------|------------|------------------|
| Drain-source voltage                          | $V_{DSS}$ | 20         | V                |
| Gate-source voltage                           | $V_{GSS}$ | $\pm 8$    |                  |
| Drain current (Note 1)                        | $I_D$     | 4          | A                |
| Drain current (pulsed) (Note 1), (Note 2)     | $I_{DP}$  | 16         |                  |
| Power dissipation (Note 3)                    | $P_D$     | 1          | W                |
| Power dissipation $t = 0.5\text{ s}$ (Note 3) | $P_D$     | 2          |                  |
| Channel temperature                           | $T_{ch}$  | 150        | $^\circ\text{C}$ |
| 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  $150\text{ }^\circ\text{C}$ .

Note 2: Pulse width  $\leq 10\text{ ms}$ , Duty  $\leq 1\%$

Note 3: Device mounted on a  $25.4\text{ mm} \times 25.4\text{ mm} \times 1.6\text{ mm}$  FR4 glass epoxy board (Cu pad:  $645\text{ mm}^2$ )

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.

### 5. Electrical Characteristics

#### 5.1. Static Characteristics (Unless otherwise specified, $T_a = 25\text{ }^\circ\text{C}$ )

| Characteristics                         | Symbol        | Test Condition                                 | Min  | Typ. | Max     | Unit             |
|---|---------------|--|------|------|---------|------------------|
| Drain-source breakdown voltage          | $V_{(BR)DSS}$ | $I_D = 1\text{ mA}, V_{GS} = 0\text{ V}$       | 20   | —    | —       | V                |
| Drain-source breakdown voltage (Note 1) | $V_{(BR)DSX}$ | $I_D = 1\text{ mA}, V_{GS} = -5\text{ V}$      | 15   | —    | —       | V                |
| Drain cut-off current                   | $I_{DSS}$     | $V_{DS} = 16\text{ V}, V_{GS} = 0\text{ V}$    | —    | —    | 1       | $\mu\text{A}$    |
| Gate leakage current                    | $I_{GSS}$     | $V_{DS} = 0\text{ V}, V_{GS} = \pm 6\text{ V}$ | —    | —    | $\pm 1$ | $\mu\text{A}$    |
| Gate threshold voltage (Note 2)         | $V_{th}$      | $V_{DS} = 3\text{ V}, I_D = 1\text{ mA}$       | 0.40 | —    | 1.00    | V                |
| Drain-source on-resistance (Note 3)     | $R_{DS(ON)}$  | $I_D = 0.5\text{ A}, V_{GS} = 1.5\text{ V}$    | —    | 54   | 108     | $\text{m}\Omega$ |
|   |               | $I_D = 0.5\text{ A}, V_{GS} = 1.8\text{ V}$    | —    | 40   | 74      |                  |
|   |               | $I_D = 1.0\text{ A}, V_{GS} = 2.5\text{ V}$    | —    | 31   | 45      |                  |
|   |               | $I_D = 4.0\text{ A}, V_{GS} = 4.5\text{ V}$    | —    | 25   | 33      |                  |

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.

#### 5.2. Dynamic Characteristics (Unless otherwise specified, $T_a = 25\text{ }^\circ\text{C}$ )

| Characteristics                | Symbol    | Test Condition   | Min | Typ. | Max | Unit        |
|--------------------------------|-----------|--|-----|------|-----|-------------|
| Input capacitance              | $C_{iss}$ | $V_{DS} = 10\text{ V}, V_{GS} = 0\text{ V},$<br>$f = 1\text{ MHz}$   | —   | 410  | —   | $\text{pF}$ |
| Reverse transfer capacitance   | $C_{rss}$ |  | —   | 40   | —   |             |
| Output capacitance             | $C_{oss}$ |  | —   | 85   | —   |             |
| Switching time (turn-on time)  | $t_{on}$  | $V_{DD} = 10\text{ V}, I_D = 0.5\text{ A},$<br>$V_{GS} = 0\text{ to }4.5\text{ V}, R_G = 10\text{ }\Omega$ | —   | 25   | —   | ns          |
| Switching time (turn-off time) | $t_{off}$ |  | —   | 45   | —   |             |

#### 5.3. Switching Time Test Circuit

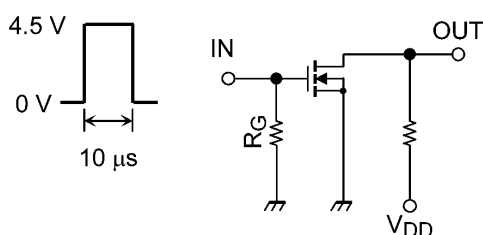


Fig. 5.3.1 Switching Time Test Circuit

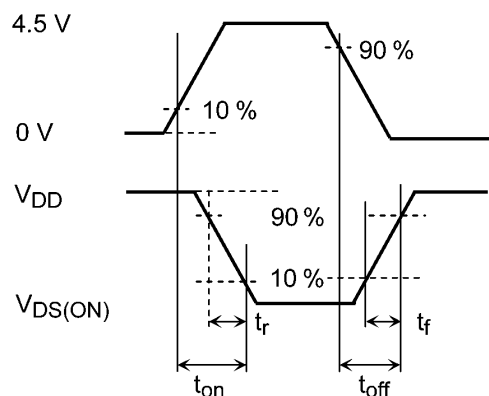


Fig. 5.3.2 Input Waveform/Output Waveform

#### 5.4. Gate Charge Characteristics (Unless otherwise specified, $T_a = 25\text{ }^\circ\text{C}$ )

| Characteristics                                 | Symbol    | Test Condition  | Min | Typ. | Max | Unit |
|---|-----------|---|-----|------|-----|------|
| Total gate charge (gate-source plus gate-drain) | $Q_g$     | $V_{DD} = 8\text{ V}, I_D = 4\text{ A},$<br>$V_{GS} = 4.5\text{ V}$ | —   | 3.6  | —   | nC   |
| Gate-source charge 1                            | $Q_{gs1}$ |   | —   | 0.62 | —   |      |
| Gate-drain charge                               | $Q_{gd}$  |   | —   | 0.79 | —   |      |

## 5.5. Source-Drain Characteristics (Unless otherwise specified, $T_a = 25\text{ °C}$ )

| Characteristics                | Symbol    | Test Condition                           | Min | Typ. | Max  | Unit |
|--------------------------------|-----------|--|-----|------|------|------|
| Diode forward voltage (Note 1) | $V_{DSF}$ | $I_D = -4\text{ A}, V_{GS} = 0\text{ V}$ | —   | -0.8 | -1.2 | V    |

Note 1: Pulse measurement.

## 6. Marking

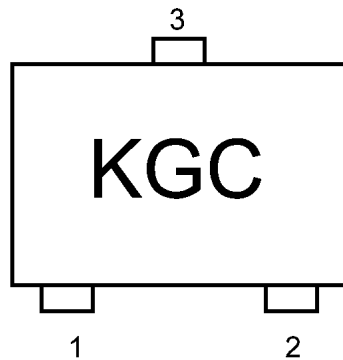


Fig. 6.1 Marking

### 7. Characteristics Curves (Note)

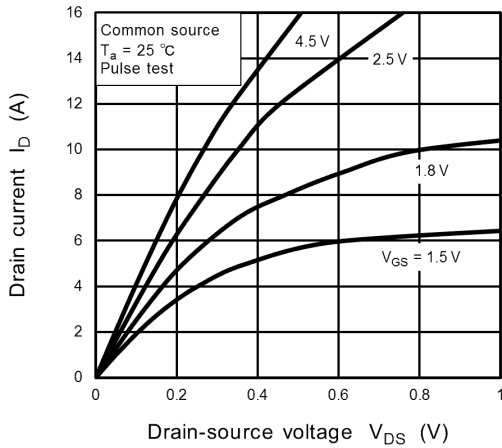


Fig. 7.1  $I_D - V_{DS}$

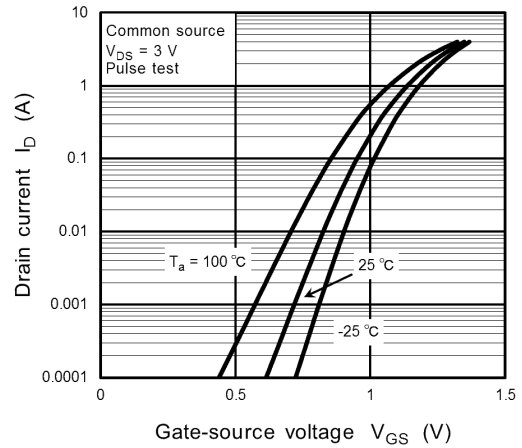


Fig. 7.2  $I_D - V_{GS}$

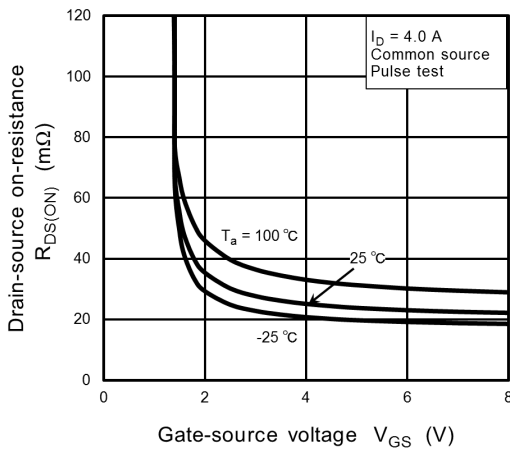


Fig. 7.3  $R_{DS(ON)} - V_{GS}$

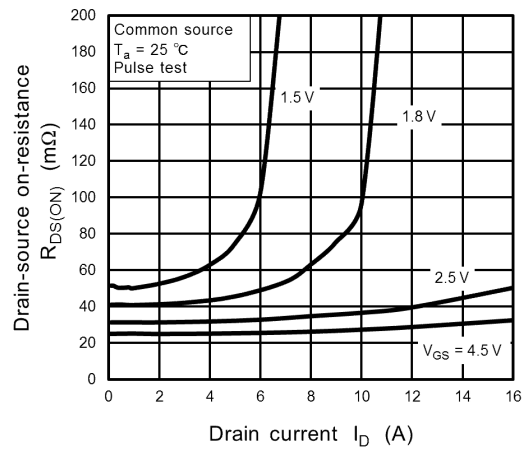


Fig. 7.4  $R_{DS(ON)} - I_D$

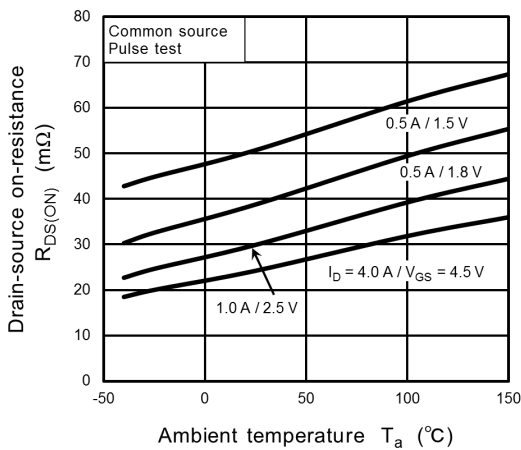


Fig. 7.5  $R_{DS(ON)} - T_a$

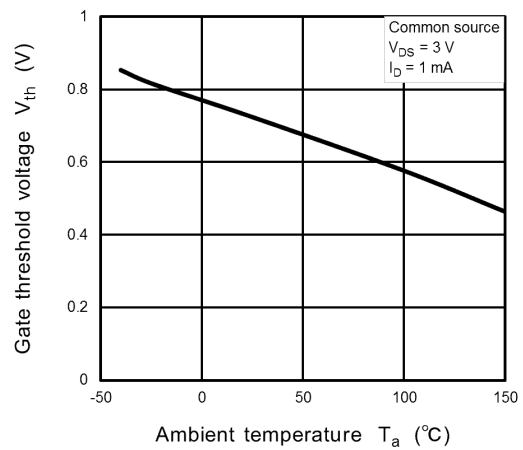
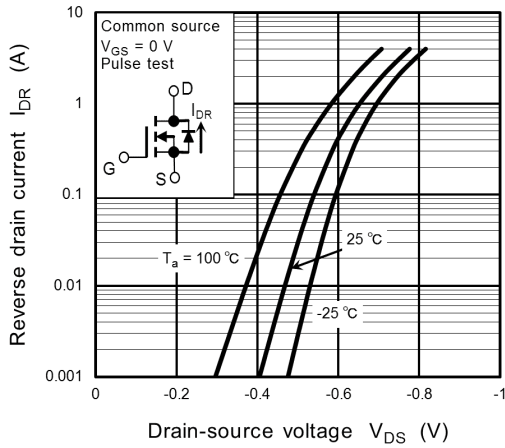
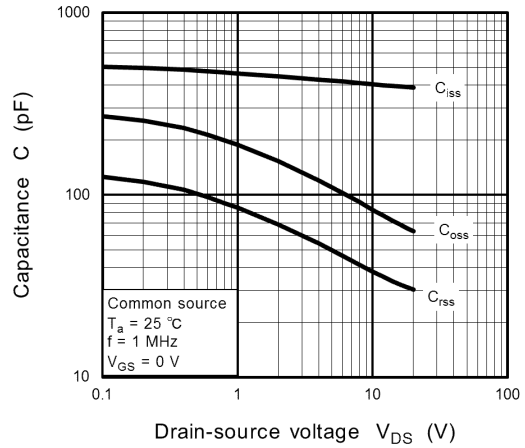


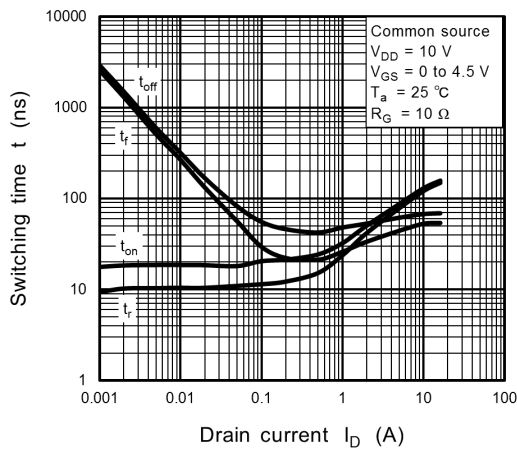
Fig. 7.6  $V_{th} - T_a$



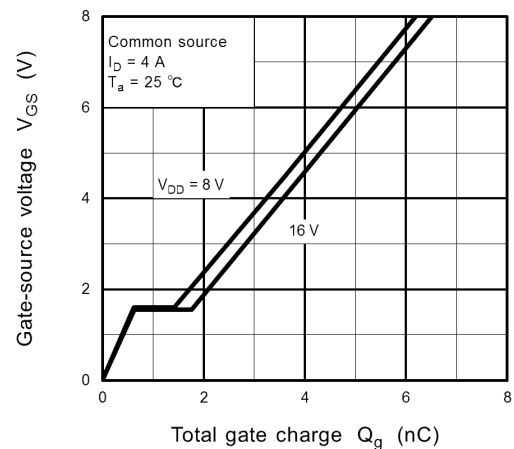
**Fig. 7.7  $I_{DR} - V_{DS}$**



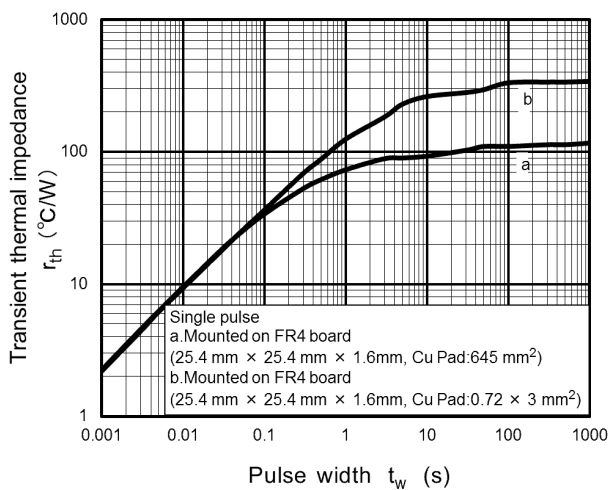
**Fig. 7.8  $C - V_{DS}$**



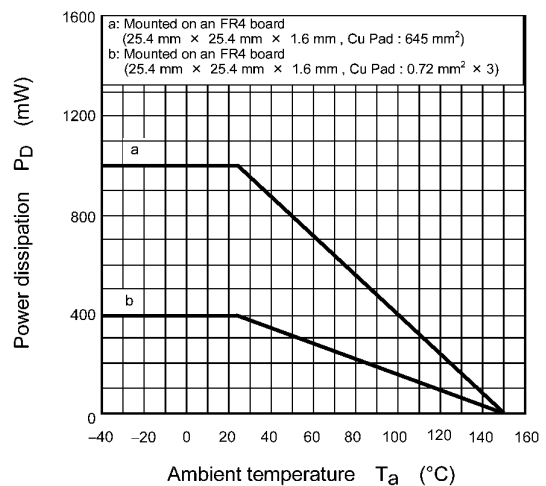
**Fig. 7.9  $t - I_D$**



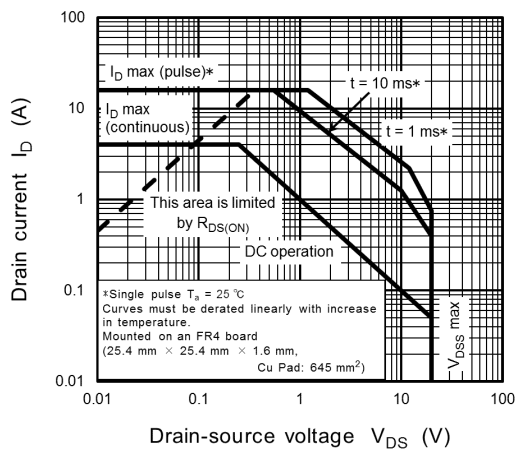
**Fig. 7.10 Dynamic Input Characteristics**



**Fig. 7.11  $r_{th} - t_w$**



**Fig. 7.12  $P_D - T_a$**



**Fig. 7.13 Safe Operating Area**

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

## Package Dimensions

Unit: mm



Weight: 0.011 g (typ.)

|                   |
|-------------------|
| Package Name(s)   |
| Nickname: SOT-23F |



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