

# 2.5V Drive Nch+Pch MOSFET

## QS6M3

●Structure

Silicon N-channel / P-channel MOSFET

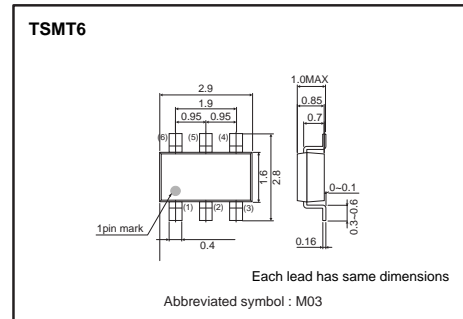
●Features

- 1) Low on-resistance.
- 2) Built-in G-S Protection Diode.
- 3) Small Surface Mount Package (TSMT6).

●Application

Power switching, DC / DC converter.

●Dimensions (Unit : mm)



●Packaging specifications

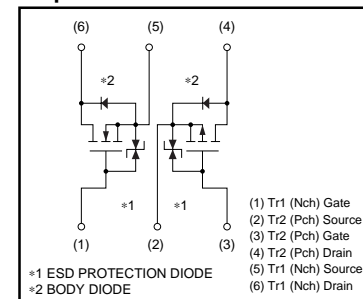
| Type  | Package                      | Taping |
|-------|------------------------------|--------|
|       | Code                         | TR     |
|       | Basic ordering unit (pieces) | 3000   |
| QS6M3 |                              | ○      |

●Absolute maximum ratings (Ta=25°C)

| Parameter                   | Symbol     | Limits      |           | Unit        |
|-----------------------------|------------|-------------|-----------|-------------|
|                             |            | Tr1 : Nch   | Tr2 : Pch |             |
| Drain-source voltage        | $V_{DSS}$  | 30          | -20       | V           |
| Gate-source voltage         | $V_{GSS}$  | ±12         | ±12       | V           |
| Drain current               | Continuous | $I_D$       | ±1.5      | A           |
|                             | Pulsed     | $I_{DP}$ *1 | ±6.0      | A           |
| Source current (Body diode) | Continuous | $I_S$       | 0.8       | A           |
|                             | Pulsed     | $I_{SP}$ *1 | 6.0       | A           |
| Total power dissipation     | $P_D$ *2   | 1.25        |           | W / TOTAL   |
|                             |            | 0.9         |           | W / ELEMENT |
| Channel temperature         | $T_{ch}$   | 150         |           | °C          |
| Storage temperature         | $T_{stg}$  | -55 to +150 |           | °C          |

\*1  $P_w \leq 10\mu s$ , Duty cycle  $\leq 1\%$   
 \*2 Mounted on a ceramic board

●Equivalent circuit



●Thermal resistance

| Parameter          | Symbol           | Limits | Unit             |
|--------------------|------------------|--------|------------------|
| Channel to ambient | $R_{th}(ch-a)$ * | 100    | °C / W / TOTAL   |
|                    |                  | 139    | °C / W / ELEMENT |

\* Mounted on a ceramic board

Transistors

N-ch

●Electrical characteristics (Ta=25°C)

| Parameter                               | Symbol                 | Min. | Typ. | Max. | Unit | Conditions                                  |
|---|------------------------|------|------|------|------|---|
| Gate-source leakage                     | I <sub>GSS</sub>       | –    | –    | ±10  | μA   | V <sub>GS</sub> =±12V, V <sub>DS</sub> =0V  |
| Drain-source breakdown voltage          | V <sub>(BR) DSS</sub>  | 30   | –    | –    | V    | I <sub>D</sub> =1mA, V <sub>GS</sub> =0V    |
| Zero gate voltage drain current         | I <sub>DSS</sub>       | –    | –    | 1    | μA   | V <sub>DS</sub> =30V, V <sub>GS</sub> =0V   |
| Gate threshold voltage                  | V <sub>GS (th)</sub>   | 0.5  | –    | 1.5  | V    | V <sub>DS</sub> =10V, I <sub>D</sub> =1mA   |
| Static drain-source on-state resistance | R <sub>DS (on)</sub> * | –    | 170  | 230  | mΩ   | I <sub>D</sub> =1.5A, V <sub>GS</sub> =4.5V |
|   |                        | –    | 180  | 245  |      | I <sub>D</sub> =1.5A, V <sub>GS</sub> =4.0V |
|   |                        | –    | 260  | 360  |      | I <sub>D</sub> =1.0A, V <sub>GS</sub> =2.5V |
| Forward transfer admittance             | Y <sub>fs</sub>   *    | 1.0  | –    | –    | S    | I <sub>D</sub> =1.0A, V <sub>DS</sub> =10V  |
| Input capacitance                       | C <sub>iss</sub>       | –    | 80   | –    | pF   | V <sub>DS</sub> =10V                        |
| Output capacitance                      | C <sub>oss</sub>       | –    | 25   | –    | pF   | V <sub>GS</sub> =0V                         |
| Reverse transfer capacitance            | C <sub>rss</sub>       | –    | 15   | –    | pF   | f=1MHz                                      |
| Turn-on delay time                      | t <sub>d (on)</sub> *  | –    | 7    | –    | ns   | I <sub>D</sub> =1A, V <sub>DD</sub> ≐15V    |
| Rise time                               | t <sub>r</sub> *       | –    | 18   | –    | ns   | V <sub>GS</sub> =4.5V                       |
| Turn-off delay time                     | t <sub>d (off)</sub> * | –    | 15   | –    | ns   | R <sub>L</sub> =15Ω                         |
| Fall time                               | t <sub>f</sub> *       | –    | 15   | –    | ns   | R <sub>G</sub> =10Ω                         |
| Total gate charge                       | Q <sub>g</sub> *       | –    | 1.6  | –    | nC   | V <sub>DD</sub> ≐15V R <sub>L</sub> =10Ω    |
| Gate-source charge                      | Q <sub>gs</sub> *      | –    | 0.5  | –    | nC   | V <sub>GS</sub> =4.5V R <sub>G</sub> =10Ω   |
| Gate-drain charge                       | Q <sub>gd</sub> *      | –    | 0.9  | –    | nC   | I <sub>D</sub> =1.5A                        |

\*Pulsed

●Body diode characteristics (Source-Drain) (Ta=25°C)

| Parameter       | Symbol            | Min. | Typ. | Max. | Unit | Conditions                                |
|-----------------|-------------------|------|------|------|------|---|
| Forward voltage | V <sub>SD</sub> * | –    | –    | 1.2  | V    | I <sub>S</sub> =3.2A, V <sub>GS</sub> =0V |

\*Pulsed

Transistors

P-ch

●Electrical characteristics (Ta=25°C)

| Parameter                               | Symbol                 | Min. | Typ. | Max. | Unit | Conditions                                       |
|---|------------------------|------|------|------|------|--|
| Gate-source leakage                     | I <sub>GSS</sub>       | -    | -    | ±10  | μA   | V <sub>GS</sub> = ±12V, V <sub>DS</sub> =0V      |
| Drain-source breakdown voltage          | V <sub>(BR) DSS</sub>  | -20  | -    | -    | V    | I <sub>D</sub> = -1mA, V <sub>GS</sub> =0V       |
| Zero gate voltage drain current         | I <sub>DSS</sub>       | -    | -    | -1   | μA   | V <sub>DS</sub> = -20V, V <sub>GS</sub> =0V      |
| Gate threshold voltage                  | V <sub>GS (th)</sub>   | -0.7 | -    | -2.0 | V    | V <sub>DS</sub> = -10V, I <sub>D</sub> =1mA      |
| Static drain-source on-state resistance | R <sub>DS (on)</sub> * | -    | 155  | 215  | mΩ   | I <sub>D</sub> = -1.5A, V <sub>GS</sub> = -4.5V  |
|   |                        | -    | 170  | 235  |      | I <sub>D</sub> = -1.5A, V <sub>GS</sub> = -4.0V  |
|   |                        | -    | 310  | 430  |      | I <sub>D</sub> = -0.75A, V <sub>GS</sub> = -2.5V |
| Forward transfer admittance             | Y <sub>fs</sub>   *    | 1.0  | -    | -    | S    | I <sub>D</sub> = -0.75A, V <sub>DS</sub> = -10V  |
| Input capacitance                       | C <sub>iss</sub>       | -    | 270  | -    | pF   | V <sub>DS</sub> = -10V                           |
| Output capacitance                      | C <sub>oss</sub>       | -    | 40   | -    | pF   | V <sub>GS</sub> =0V                              |
| Reverse transfer capacitance            | C <sub>riss</sub>      | -    | 35   | -    | pF   | f=1MHz   |
| Turn-on delay time                      | t <sub>d (on)</sub> *  | -    | 10   | -    | ns   | I <sub>D</sub> = -0.75A, V <sub>DD</sub> = -15V  |
| Rise time                               | t <sub>r</sub> *       | -    | 12   | -    | ns   | V <sub>GS</sub> = -4.5V                          |
| Turn-off delay time                     | t <sub>d (off)</sub> * | -    | 45   | -    | ns   | R <sub>L</sub> =20Ω                              |
| Fall time                               | t <sub>f</sub> *       | -    | 20   | -    | ns   | R <sub>G</sub> =10Ω                              |
| Total gate charge                       | Q <sub>g</sub> *       | -    | 3.0  | -    | nC   | V <sub>DD</sub> = -15V R <sub>L</sub> =10Ω       |
| Gate-source charge                      | Q <sub>gs</sub> *      | -    | 0.8  | -    | nC   | V <sub>GS</sub> = -4.5V R <sub>G</sub> =10Ω      |
| Gate-drain charge                       | Q <sub>gd</sub> *      | -    | 0.85 | -    | nC   | I <sub>D</sub> = -1.5A                           |

\*Pulsed

●Body diode characteristics (Source-Drain) (Ta=25°C)

| Parameter       | Symbol          | Min. | Typ. | Max. | Unit | Conditions                                   |
|-----------------|-----------------|------|------|------|------|--|
| Forward voltage | V <sub>SD</sub> | -    | -    | -1.2 | V    | I <sub>S</sub> = -0.75A, V <sub>GS</sub> =0V |

Transistors

N-ch

● Electrical characteristic curves

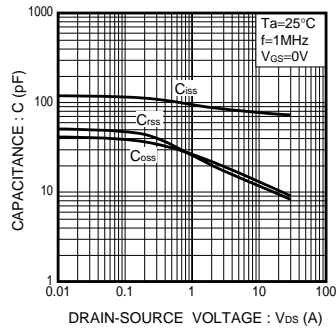


Fig.1 Typical Capacitance vs. Drain-Source Voltage

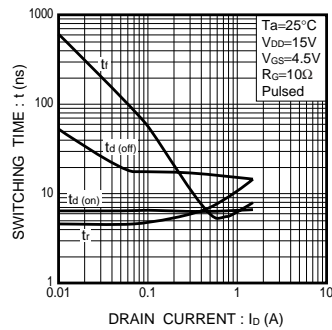


Fig.2 Switching Characteristics

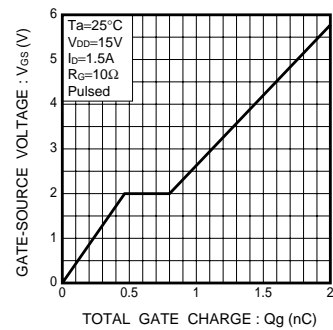


Fig.3 Dynamic Input Characteristics

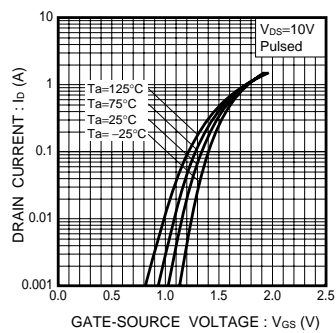


Fig.4 Typical Transfer Characteristics

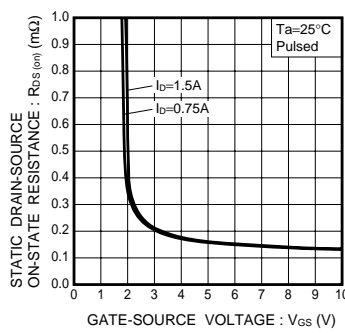


Fig.5 Static Drain-Source On-State Resistance vs. Gate-Source Voltage

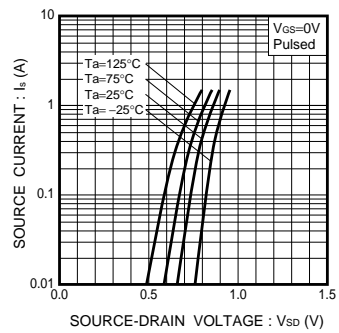


Fig.6 Source Current vs. Source-Drain Voltage

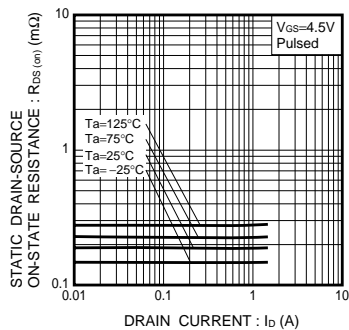


Fig.7 Static Drain-Source On-State Resistance vs. Drain Current (I)

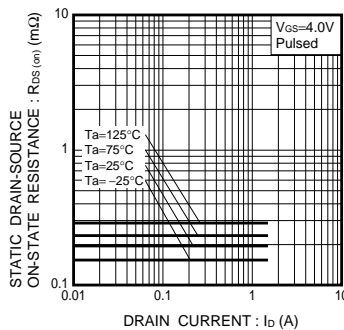


Fig.8 Static Drain-Source On-State Resistance vs. Drain Current (II)

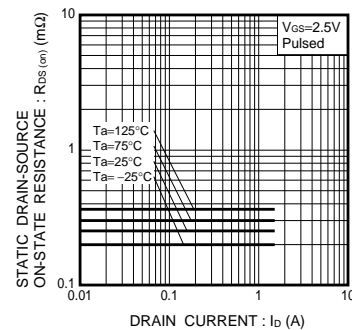


Fig.9 Static Drain-Source On-State Resistance vs. Drain Current (III)

Transistors

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●Electrical characteristic curves

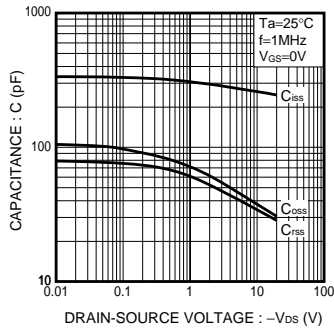


Fig.1 Typical Capacitance vs. Drain-Source Voltage

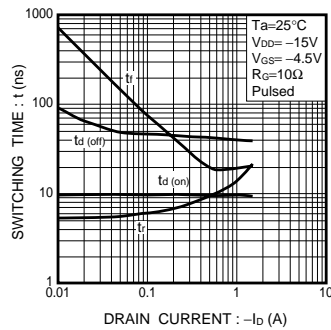


Fig.2 Switching Characteristics

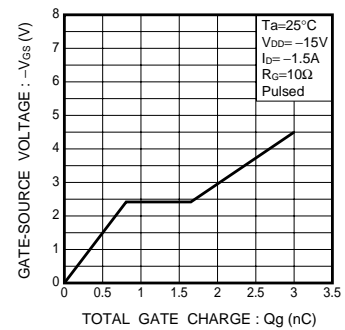


Fig.3 Dynamic Input Characteristics

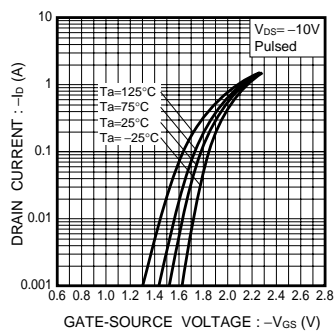


Fig.4 Typical Transfer Characteristics

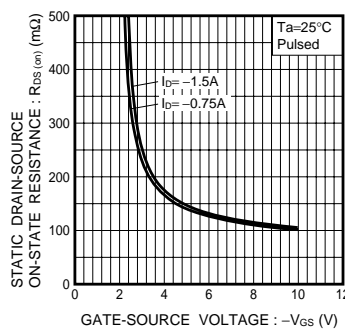


Fig.5 Static Drain-Source On-State Resistance vs. Gate-Source Voltage

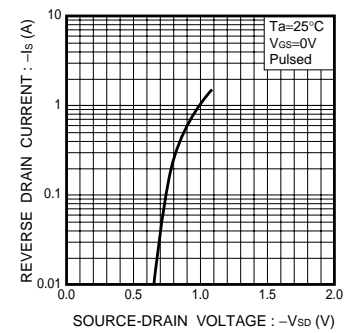


Fig.6 Source Current vs. Source-Drain Voltage

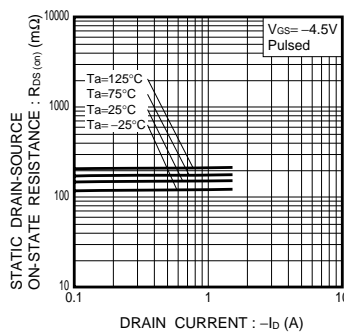


Fig.7 Static Drain-Source On-State Resistance vs. Drain Current (I)

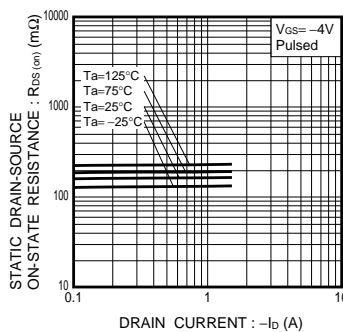


Fig.8 Static Drain-Source On-State Resistance vs. Drain Current (II)

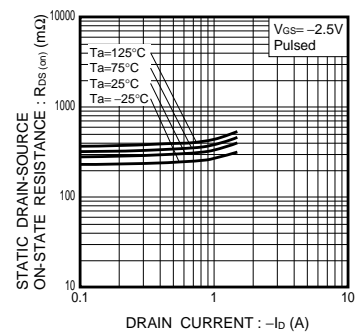


Fig.9 Static Drain-Source On-State Resistance vs. Drain Current (III)

Transistors

N-ch

●Measurement circuit

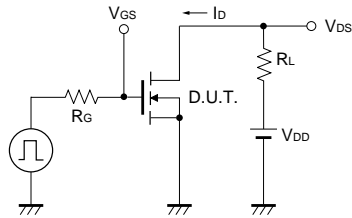


Fig.1-1 Switching Time Measurement Circuit

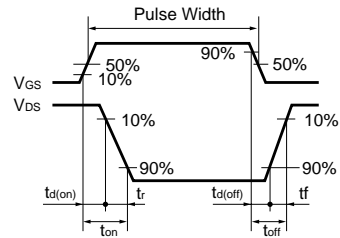


Fig.1-2 Switching Waveforms

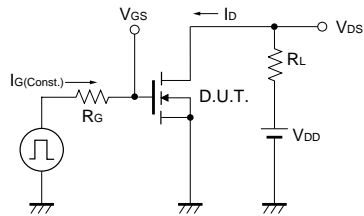


Fig.2-1 Gate Charge Measurement Circuit

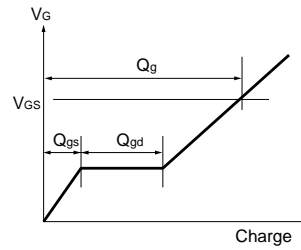


Fig.2-2 Gate Charge Waveform

Transistors

P-ch

●Measurement circuit

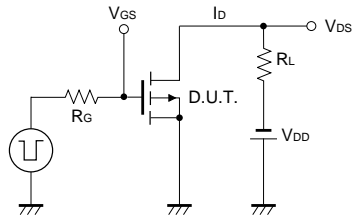


Fig.3-1 Switching Time Measurement Circuit

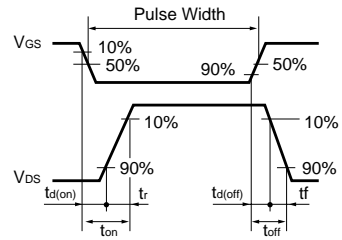


Fig.3-2 Switching Waveforms

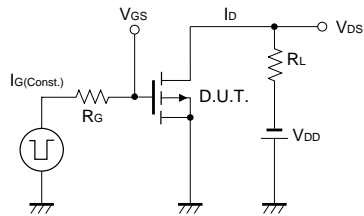


Fig.4-1 Gate Charge Measurement Circuit

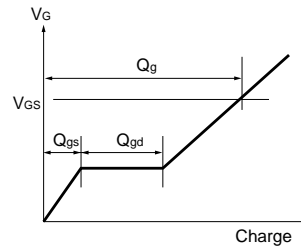


Fig.4-2 Gate Charge Waveform

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