

TOSHIBA POWER MOS FET MODULE SILICON N & P CHANNEL MOS TYPE (L<sup>2</sup>-π-MOSV 4 IN 1)

# MP4212

HIGH POWER HIGH SPEED SWITCHING APPLICATIONS  
H - SWITCH DRIVER

- 4 V Gate Drive
- Small Package by Full Molding (SIP 10 Pin)
- High Drain Power Dissipation (4 Devices Operation)  
:  $P_T = 4 \text{ W}$  ( $T_a = 25^\circ\text{C}$ )
- Low Drain-Source ON Resistance  
:  $R_{DS(ON)} = 120 \text{ m}\Omega$  (typ.) (N-ch)  
160 mΩ (typ.) (P-ch)
- High Forward Transfer Admittance  
:  $|Y_{fs}| = 5.0 \text{ S}$  (typ.) (Nch)  
4.0 S (typ.) (Pch)
- Low Leakage Current:  $I_{GSS} = \pm 10 \mu\text{A}$  (max.) ( $V_{GS} = \pm 16 \text{ V}$ )  
 $I_{DSS} = 100 \mu\text{A}$  (max.) ( $V_{DS} = 60 \text{ V}$ )
- Enhancement-Mode :  $V_{th} = 0.8 \sim 2.0 \text{ V}$  ( $V_{DS} = 10 \text{ V}$ ,  $I_D = 1 \text{ mA}$ )

MAXIMUM RATINGS ( $T_a = 25^\circ\text{C}$ )

| CHARACTERISTIC                                                              | SYMBOL                 | RATING    |          | UNIT             |
|-----------------------------------------------------------------------------|------------------------|-----------|----------|------------------|
|                                                                             |                        | Nch       | Pch      |                  |
| Drain-Source Voltage                                                        | $V_{DSS}$              | 60        | -60      | V                |
| Drain-Gate Voltage ( $R_{GS} = 20 \text{ k}\Omega$ )                        | $V_{DGR}$              | 60        | -60      | V                |
| Gate-Source Voltage                                                         | $V_{GSS}$              | $\pm 20$  | $\pm 20$ | V                |
| Drain Current                                                               | DC                     | $I_D$     | 5 -5     | A                |
|                                                                             | Pulse                  | $I_{DP}$  | 20 -20   |                  |
| Drain Power Dissipation<br>(1 Device Operation, $T_a = 25^\circ\text{C}$ )  | $P_D$                  | 2.0       |          | W                |
| Drain Power Dissipation<br>(4 Devices Operation, $T_a = 25^\circ\text{C}$ ) | $P_{DT}$               | 4.0       |          | W                |
| Single Pulse Avalanche Energy*                                              | $E_{AS}$               | 129       | 273      | mJ               |
| Avalanche Current                                                           | $I_{AR}$               | 5         | -5       | A                |
| Repetitive Avalanche<br>Energy**                                            | 1 Device<br>Operation  | $E_{AR}$  | 0.2      | mJ               |
|                                                                             | 4 Devices<br>Operation | $E_{ART}$ | 0.4      |                  |
| Channel Temperature                                                         | $T_{ch}$               | 150       |          | $^\circ\text{C}$ |
| Storage Temperature Range                                                   | $T_{stg}$              | -55~150   |          | $^\circ\text{C}$ |

Note ;

\* Avalanche energy (single pulse) applied condition

Nch :  $V_{DD} = 25 \text{ V}$ , Starting  $T_{ch} = 25^\circ\text{C}$ ,  $L = 7 \text{ mH}$ ,  $R_G = 25 \Omega$ ,  $I_{AR} = 5 \text{ A}$

Pch :  $V_{DD} = -25 \text{ V}$ , Starting  $T_{ch} = 25^\circ\text{C}$ ,  $L = 14.84 \text{ mH}$ ,  $R_G = 25 \Omega$ ,  $I_{AR} = -5 \text{ A}$

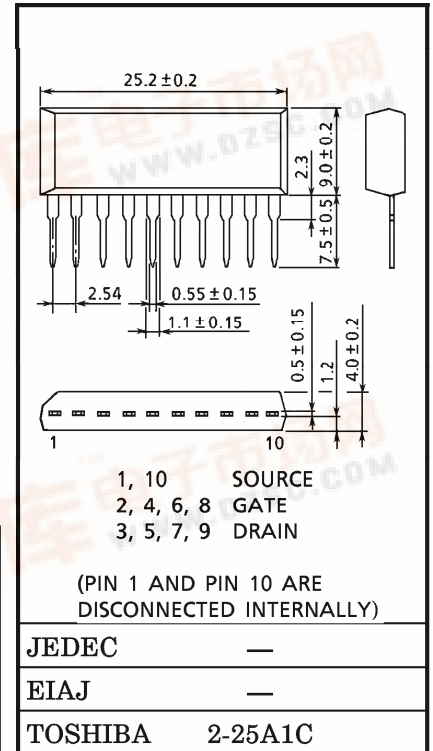
\*\* Repetitive rating; Pulse Width Limited by maximum channel temperature.

This transistor is an electrostatic sensitive device. Please handle with caution.

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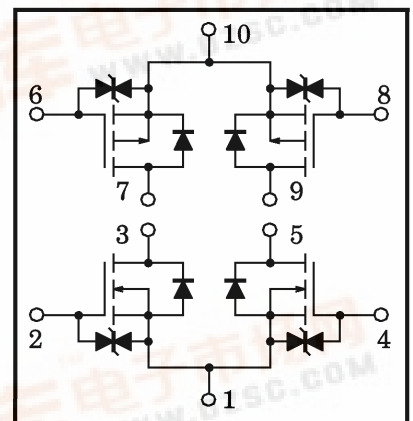
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INDUSTRIAL APPLICATIONS  
Unit in mm



Weight : 2.1 g (typ.)

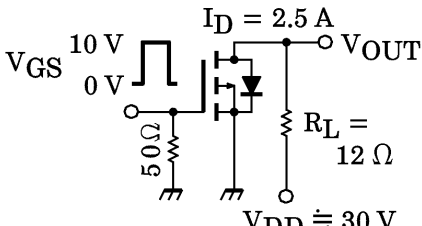
ARRAY CONFIGURATION



**THERMAL CHARACTERISTICS**

| CHARACTERISTIC                                                                     | SYMBOL                | MAX. | UNIT |
|------------------------------------------------------------------------------------|-----------------------|------|------|
| Thermal Resistance of Channel to Ambient<br>(4 Devices Operation, Ta = 25°C)       | $\Sigma R_{th}(ch-a)$ | 31.2 | °C/W |
| Maximum Lead Temperature for Soldering Purposes<br>(3.2 mm from Case for t = 10 s) | T <sub>L</sub>        | 260  | °C   |

**ELECTRICAL CHARACTERISTICS (Ta = 25°C) (Nch MOS FET)**

| CHARACTERISTIC                                     | SYMBOL                | TEST CONDITION                                                          | MIN.                                                                                 | TYP.                                                                                           | MAX. | UNIT |    |
|----------------------------------------------------|-----------------------|-------------------------------------------------------------------------|--------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------|------|------|----|
| Gate Leakage Current                               | I <sub>GSS</sub>      | V <sub>GS</sub> = ±16 V, V <sub>DS</sub> = 0 V                          | —                                                                                    | —                                                                                              | ±10  | μA   |    |
| Drain Cut-off Current                              | I <sub>DSS</sub>      | V <sub>DS</sub> = 60 V, V <sub>GS</sub> = 0 V                           | —                                                                                    | —                                                                                              | 100  | μA   |    |
| Drain-Source Breakdown Voltage                     | V <sub>(BR) DSS</sub> | I <sub>D</sub> = 10 mA, V <sub>GS</sub> = 0 V                           | 60                                                                                   | —                                                                                              | —    | V    |    |
| Gate Threshold Voltage                             | V <sub>th</sub>       | V <sub>DS</sub> = 10 V, I <sub>D</sub> = 1 mA                           | 0.8                                                                                  | —                                                                                              | 2.0  | V    |    |
| Drain-Source ON Resistance                         | R <sub>DS(ON)</sub>   | V <sub>GS</sub> = 4 V, I <sub>D</sub> = 2.5 A                           | —                                                                                    | 0.21                                                                                           | 0.32 | Ω    |    |
|                                                    |                       | V <sub>GS</sub> = 10 V, I <sub>D</sub> = 2.5 A                          | —                                                                                    | 0.12                                                                                           | 0.16 |      |    |
| Forward Transfer Admittance                        | Y <sub>fs</sub>       | V <sub>DS</sub> = 10 V, I <sub>D</sub> = 2.5 A                          | 3.0                                                                                  | 5.0                                                                                            | —    | S    |    |
| Input Capacitance                                  | C <sub>iss</sub>      | V <sub>DS</sub> = 10 V, V <sub>GS</sub> = 0 V,<br>f = 1 MHz             | —                                                                                    | 370                                                                                            | —    | pF   |    |
| Reverse Transfer Capacitance                       | C <sub>rss</sub>      |                                                                         | —                                                                                    | 60                                                                                             | —    |      |    |
| Output Capacitance                                 | C <sub>oss</sub>      |                                                                         | —                                                                                    | 180                                                                                            | —    |      |    |
| Switching Time                                     | Rise Time             | t <sub>r</sub>                                                          |  | —                                                                                              | 18   | —    | ns |
|                                                    | Turn-on Time          | t <sub>on</sub>                                                         |                                                                                      | —                                                                                              | 25   | —    |    |
|                                                    | Fall Time             | t <sub>f</sub>                                                          |                                                                                      | —                                                                                              | 55   | —    |    |
|                                                    | Turn-off Time         | t <sub>off</sub>                                                        |                                                                                      | V <sub>IN</sub> : t <sub>r</sub> , t <sub>f</sub> < 5 ns,<br>Duty ≤ 1%, t <sub>w</sub> = 10 μs | —    | 170  |    |
| Total Gate Charge<br>(Gate-Source Plus Gate-Drain) | Q <sub>g</sub>        | V <sub>DD</sub> ≐ 48 V, V <sub>GS</sub> = 10 V,<br>I <sub>D</sub> = 5 A | —                                                                                    | 12                                                                                             | —    | nC   |    |
| Gate-Source Charge                                 | Q <sub>gs</sub>       |                                                                         | —                                                                                    | 8                                                                                              | —    |      |    |
| Gate-Drain (“Miller”) Charge                       | Q <sub>gd</sub>       |                                                                         | —                                                                                    | 4                                                                                              | —    |      |    |

**SOURCE-DRAIN DIODE RATING AND CHARACTERISTICS (Ta = 25°C)**

| CHARACTERISTIC                   | SYMBOL           | TEST CONDITION                               | MIN. | TYP. | MAX. | UNIT |
|----------------------------------|------------------|----------------------------------------------|------|------|------|------|
| Continuous Drain Reverse Current | I <sub>DR</sub>  | —                                            | —    | —    | 5    | A    |
| Pulse Drain Reverse Current      | I <sub>DRP</sub> | —                                            | —    | —    | 20   | A    |
| Diode Forward Voltage            | V <sub>DSF</sub> | I <sub>DR</sub> = 5 A, V <sub>GS</sub> = 0 V | —    | —    | –1.7 | V    |
| Reverse Recovery Time            | t <sub>rr</sub>  | I <sub>DR</sub> = 5 A, V <sub>GS</sub> = 0 V | —    | 70   | —    | ns   |
| Reverse Recovery Charge          | Q <sub>rr</sub>  | dI <sub>DR</sub> / dt = 50 A / μs            | —    | 0.1  | —    | μC   |

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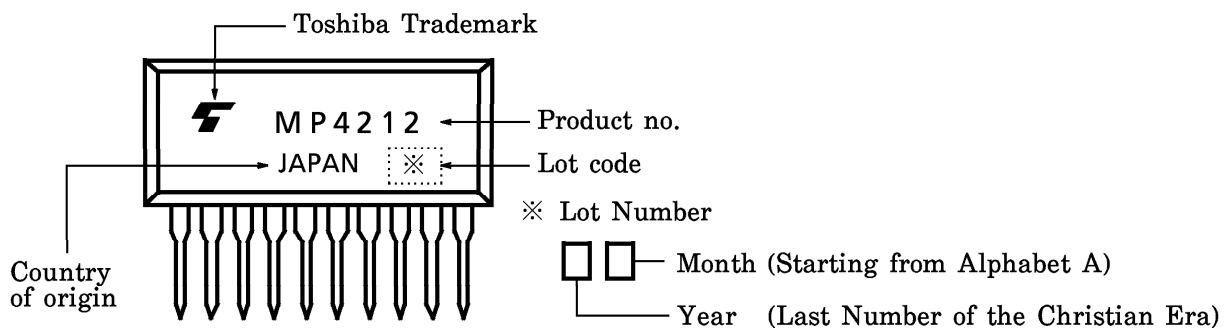
ELECTRICAL CHARACTERISTICS (Ta = 25°C) (Pch MOS FET)

| CHARACTERISTIC                                  |               | SYMBOL               | TEST CONDITION                                                             | MIN.                                                                                          | TYP. | MAX. | UNIT |
|-------------------------------------------------|---------------|----------------------|----------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------|------|------|------|
| Gate Leakage Current                            |               | I <sub>GSS</sub>     | V <sub>GS</sub> = ±16 V, V <sub>DS</sub> = 0 V                             | —                                                                                             | —    | ±10  | μA   |
| Drain Cut-off Current                           |               | I <sub>DSS</sub>     | V <sub>DS</sub> = -60 V, V <sub>GS</sub> = 0 V                             | —                                                                                             | —    | -100 | μA   |
| Drain-Source Breakdown Voltage                  |               | V (BR) DSS           | I <sub>D</sub> = -10 mA, V <sub>GS</sub> = 0 V                             | -60                                                                                           | —    | —    | V    |
| Gate Threshold Voltage                          |               | V <sub>th</sub>      | V <sub>DS</sub> = -10 V, I <sub>D</sub> = -1 mA                            | -0.8                                                                                          | —    | -2.0 | V    |
| Drain-Source ON Resistance                      |               | R <sub>D(S) ON</sub> | V <sub>GS</sub> = -4 V, I <sub>D</sub> = -2.5 A                            | —                                                                                             | 0.24 | 0.28 | Ω    |
|                                                 |               |                      | V <sub>GS</sub> = -10 V, I <sub>D</sub> = -2.5 A                           | —                                                                                             | 0.16 | 0.19 |      |
| Forward Transfer Admittance                     |               | Y <sub>fs</sub>      | V <sub>DS</sub> = -10 V, I <sub>D</sub> = -2.5 A                           | 2.0                                                                                           | 4.0  | —    | S    |
| Input Capacitance                               |               | C <sub>iss</sub>     | V <sub>DS</sub> = -10 V, V <sub>GS</sub> = 0 V,<br>f = 1 MHz               | —                                                                                             | 630  | —    | pF   |
| Reverse Transfer Capacitance                    |               | C <sub>rss</sub>     |                                                                            | —                                                                                             | 95   | —    |      |
| Output Capacitance                              |               | C <sub>oss</sub>     |                                                                            | —                                                                                             | 290  | —    |      |
| Switching Time                                  | Rise Time     | t <sub>r</sub>       |                                                                            | —                                                                                             | 25   | —    | ns   |
|                                                 | Turn-on Time  | t <sub>on</sub>      |                                                                            | —                                                                                             | 45   | —    |      |
|                                                 | Fall Time     | t <sub>f</sub>       |                                                                            | —                                                                                             | 55   | —    |      |
|                                                 | Turn-off Time | t <sub>off</sub>     |                                                                            | V <sub>IN</sub> : t <sub>r</sub> , t <sub>f</sub> < 5 ns<br>Duty ≤ 1%, t <sub>w</sub> = 10 μs | —    | 200  |      |
| Total Gate Charge (Gate-Source Plus Gate-Drain) |               | Q <sub>g</sub>       | V <sub>DD</sub> ≐ -48 V, V <sub>GS</sub> = -10 V,<br>I <sub>D</sub> = -5 A | —                                                                                             | 22   | —    | nC   |
| Gate-Source Charge                              |               | Q <sub>gs</sub>      |                                                                            | —                                                                                             | 16   | —    |      |
| Gate-Drain ("Miller") Charge                    |               | Q <sub>gd</sub>      |                                                                            | —                                                                                             | 6    | —    |      |

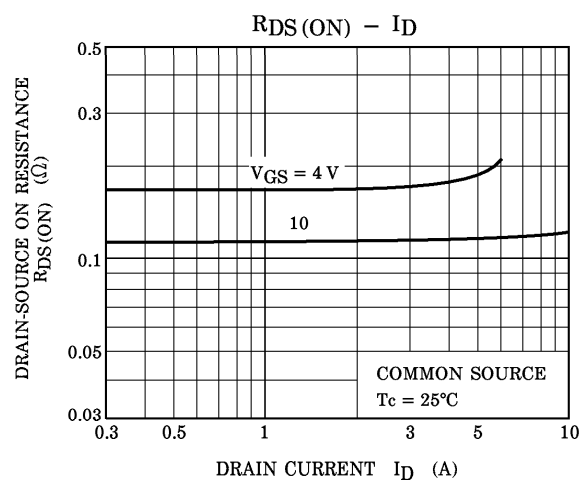
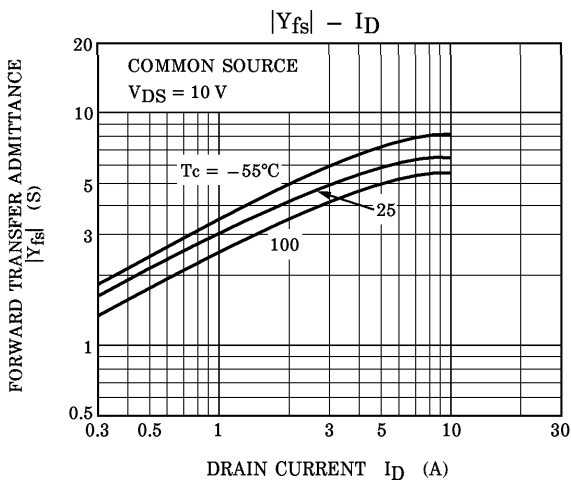
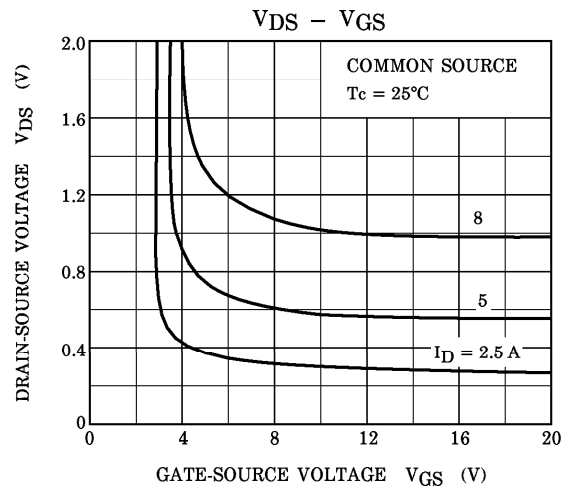
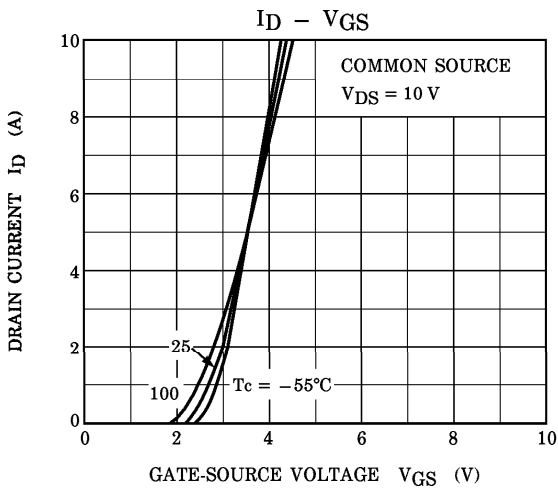
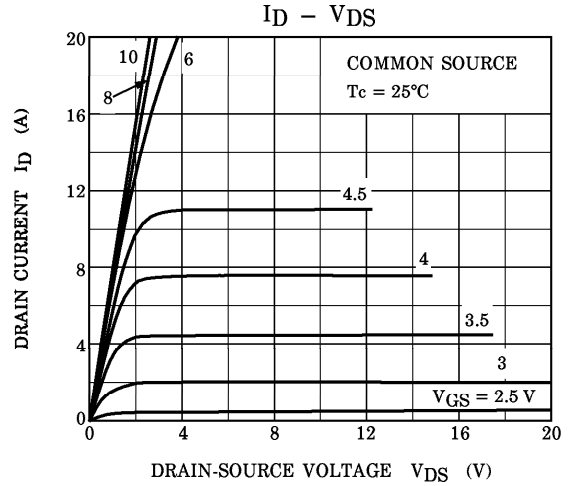
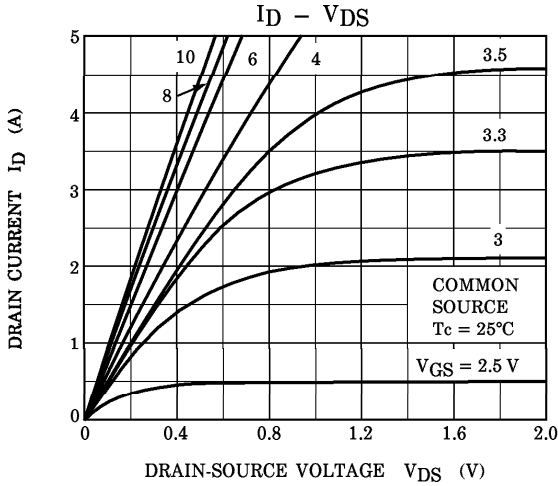
SOURCE-DRAIN DIODE RATING AND CHARACTERISTICS (Ta = 25°C)

|                                  | SYMBOL           | TEST CONDITION                                | MIN. | TYP. | MAX. | UNIT |
|----------------------------------|------------------|-----------------------------------------------|------|------|------|------|
| Continuous Drain Reverse Current | I <sub>DR</sub>  | —                                             | —    | —    | -5   | A    |
| Pulse Drain Reverse Current      | I <sub>DRP</sub> | —                                             | —    | —    | -20  | A    |
| Diode Forward Voltage            | V <sub>DSF</sub> | I <sub>DR</sub> = -5 A, V <sub>GS</sub> = 0 V | —    | —    | 1.7  | V    |
| Reverse Recovery Time            | t <sub>rr</sub>  | I <sub>DR</sub> = -5 A, V <sub>GS</sub> = 0 V | —    | 80   | —    | ns   |
| Reverse Recovery Charge          | Q <sub>rr</sub>  | dI <sub>DR</sub> / dt = 50 A / μs             | —    | 0.1  | —    | μC   |

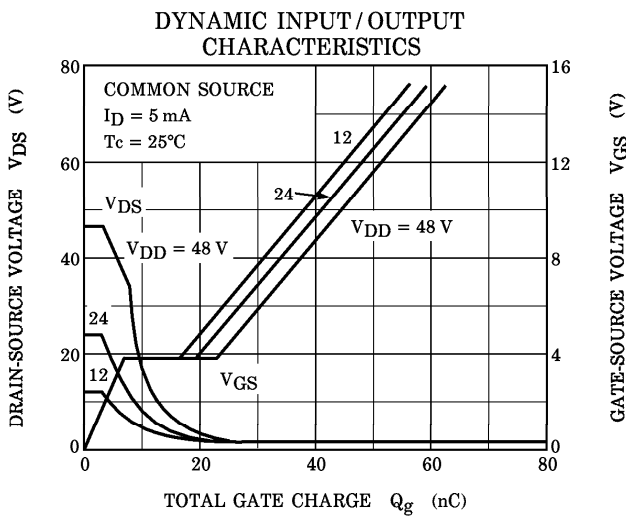
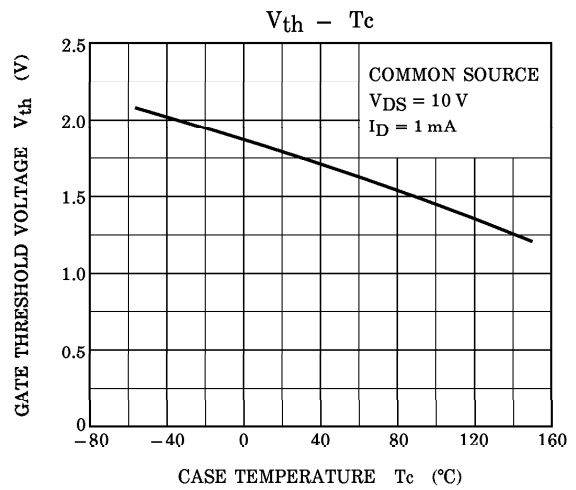
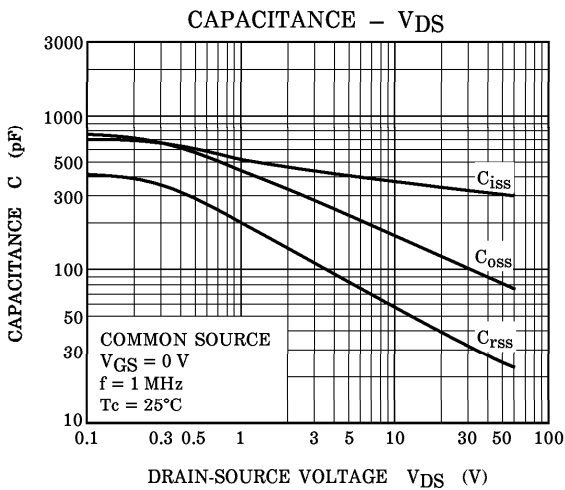
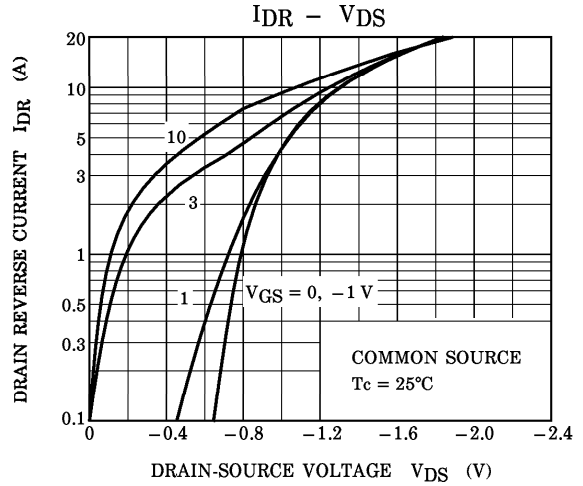
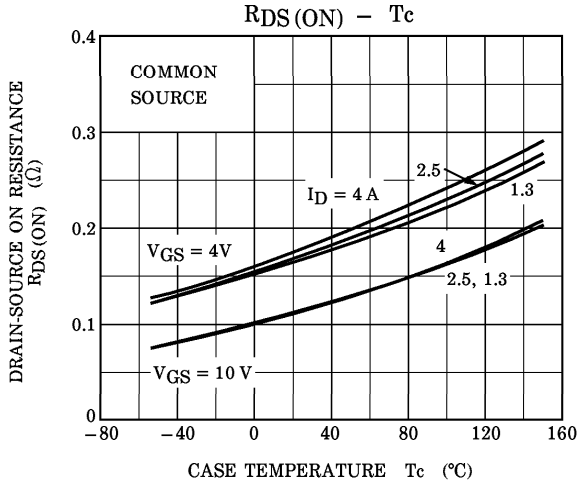
MARKING



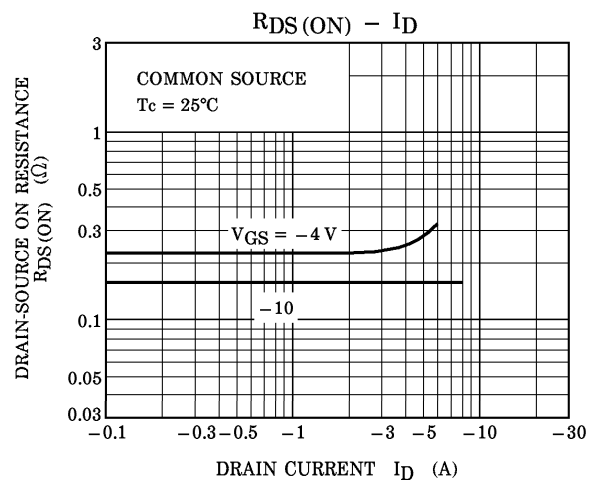
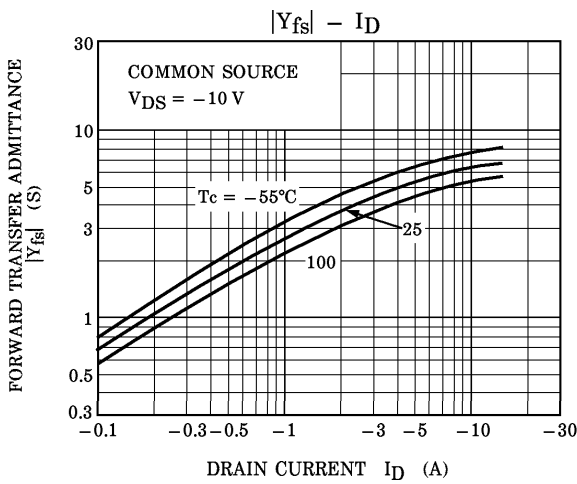
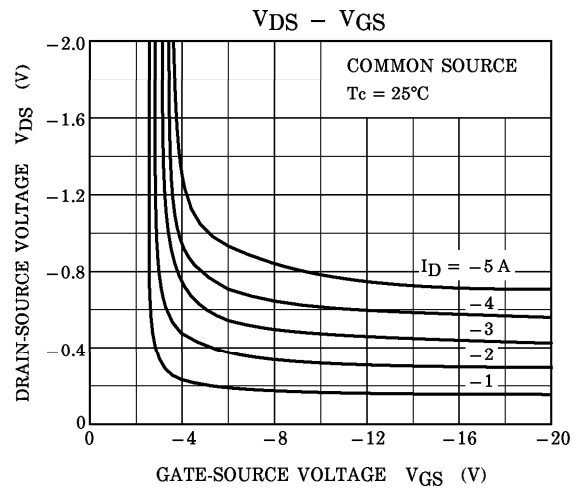
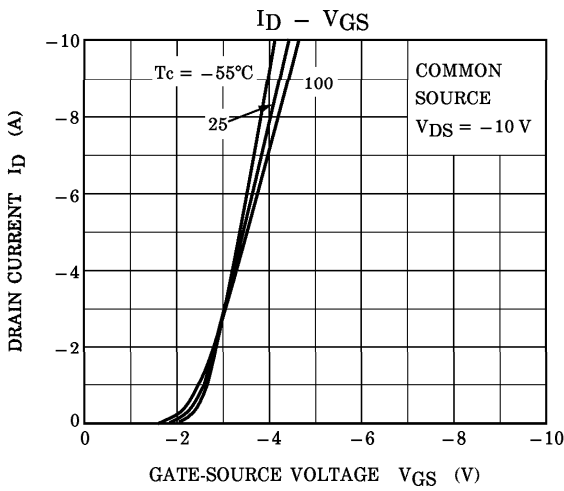
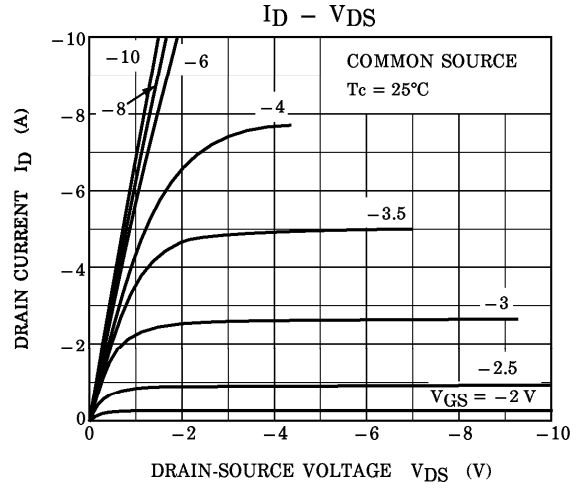
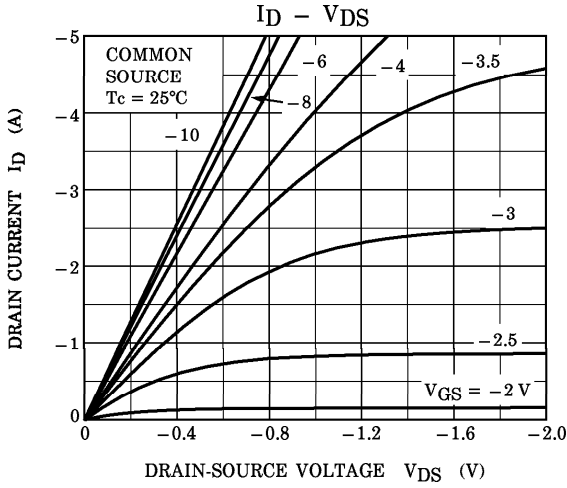
Nch MOS FET



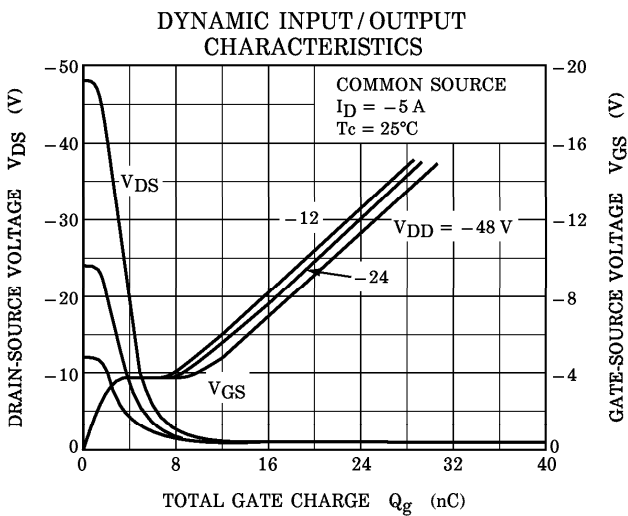
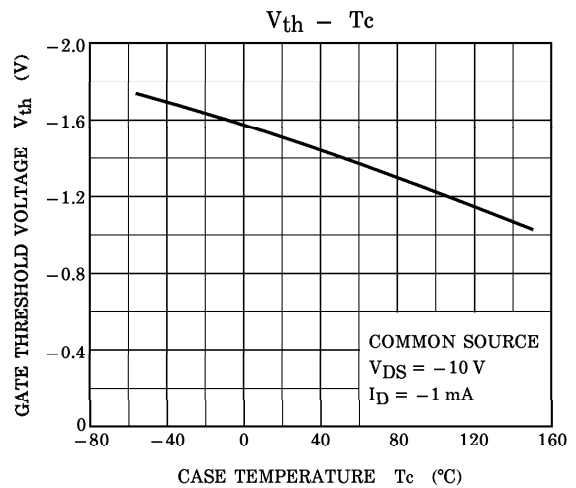
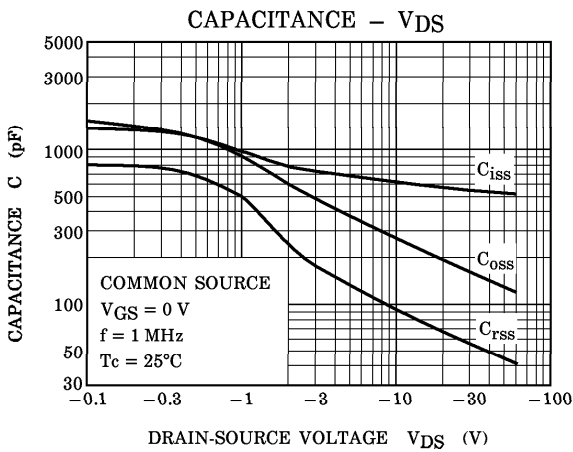
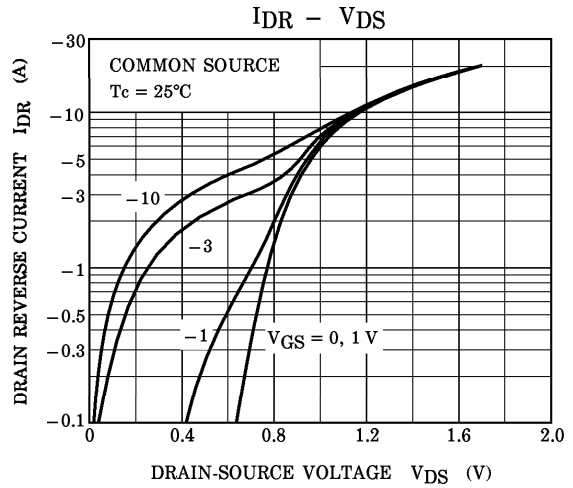
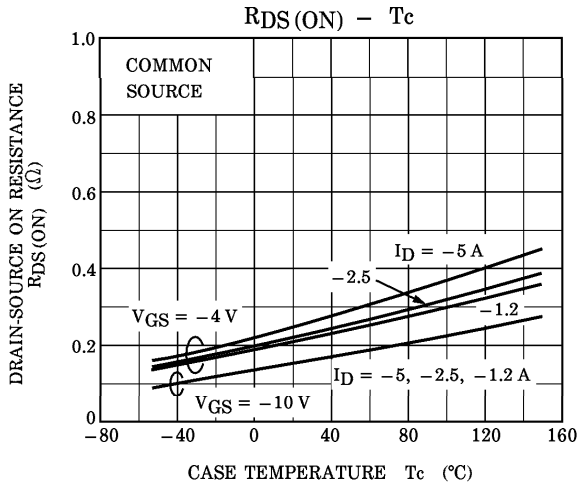
Nch MOS FET

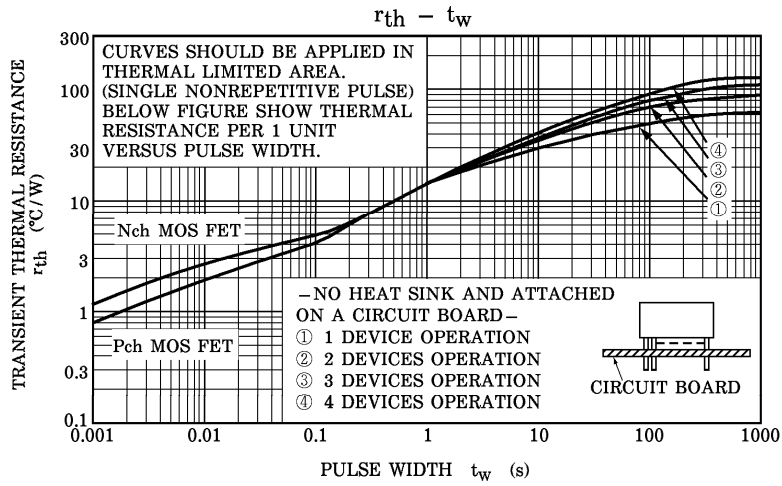
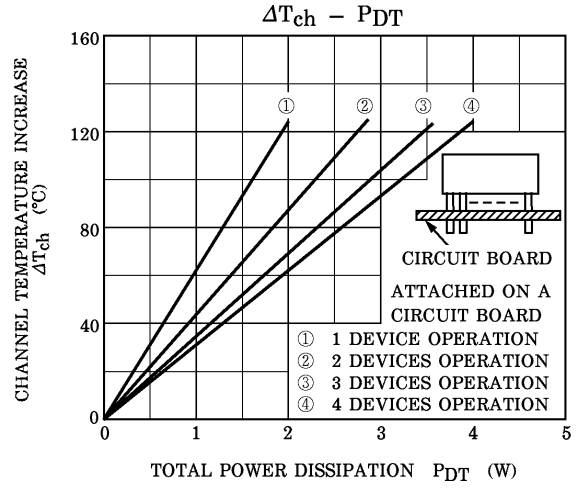
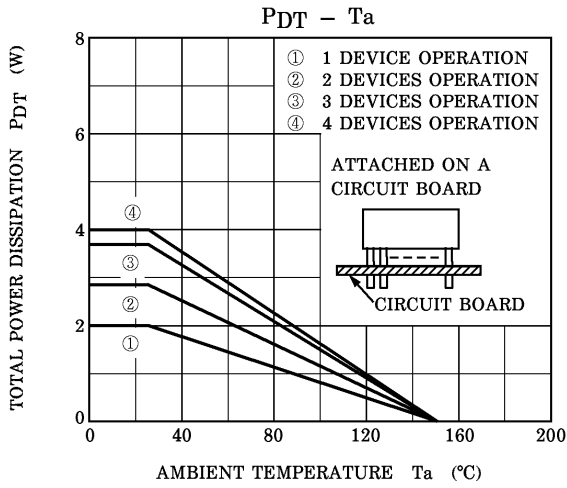


Pch MOS FET



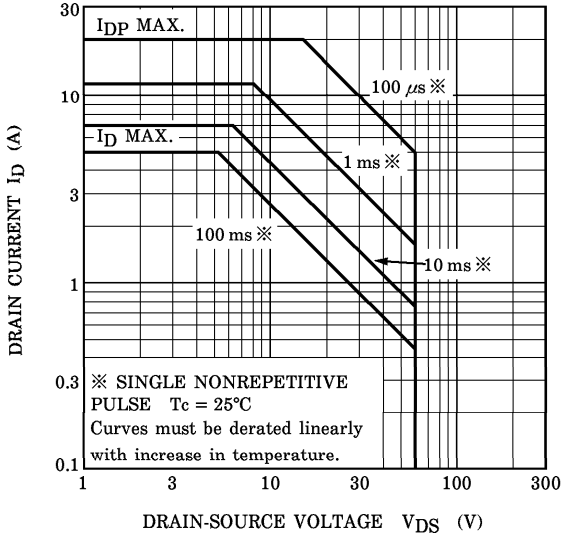
**Pch MOS FET**



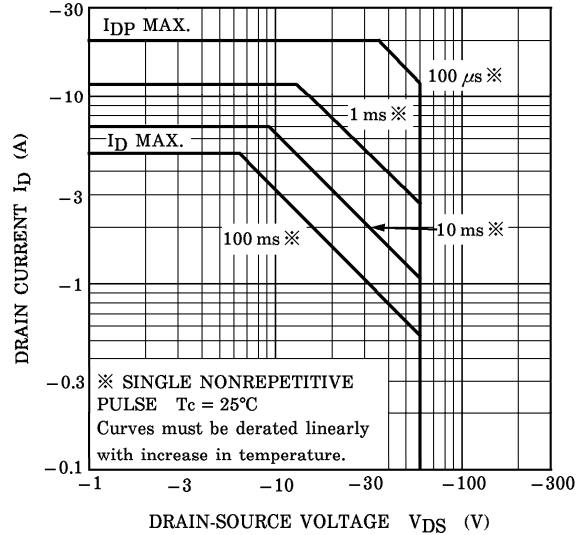




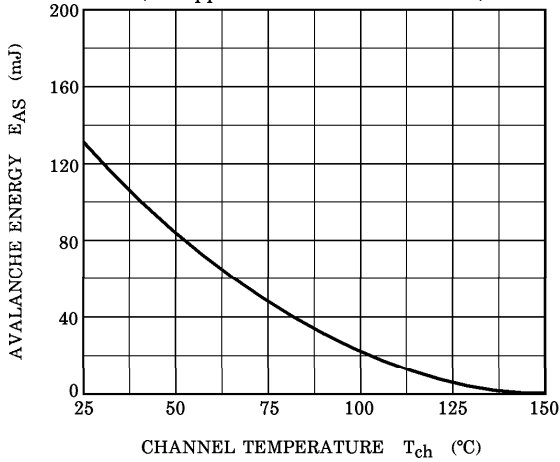
SAFE OPERATING AREA  
(Be applicable to Nch MOS FET)



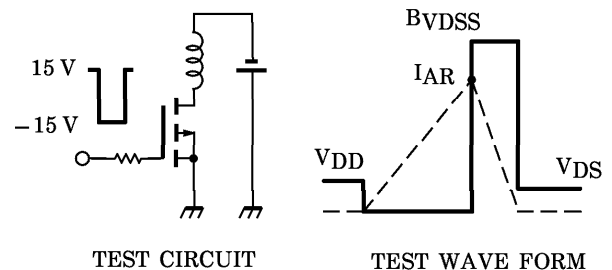
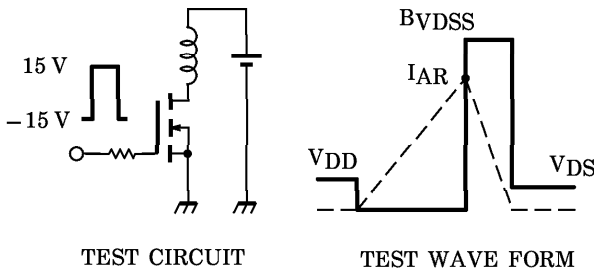
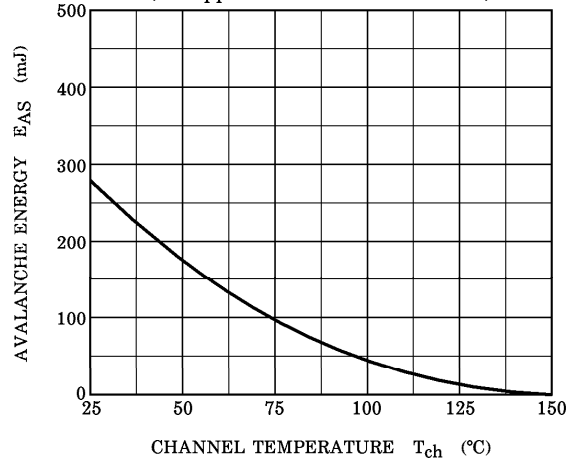
SAFE OPERATING AREA  
(Be applicable to Pch MOS FET)



EAS - T<sub>ch</sub>  
(Be applicable to Nch MOS FET)



EAS - T<sub>ch</sub>  
(Be applicable to Pch MOS FET)



Peak I<sub>AR</sub> = 5 A, R<sub>G</sub> = 25 Ω  
V<sub>DD</sub> = 25 V, L = 7 mH

Peak I<sub>AR</sub> = -5 A, R<sub>G</sub> = 25 Ω  
V<sub>DD</sub> = -25 V, L = 14.84 mH

$$EAS = \frac{1}{2} \cdot L \cdot I^2 \cdot \left( \frac{BVDSS}{BVDSS - VDD} \right)$$

$$EAS = \frac{1}{2} \cdot L \cdot I^2 \cdot \left( \frac{BVDSS}{BVDSS - VDD} \right)$$