

TOSHIBA Power MOS FET Module Silicon N&P Channel MOS Type (Four L<sup>2</sup>-π-MOSV in One)

## MP4212

### High Power High Speed Switching Applications H-Switch Driver

- 4-V gate drivability
- Small package by full molding (SIP 10 pin)
- High drain power dissipation (4-device operation)  
: P<sub>T</sub> = 4 W (T<sub>a</sub> = 25°C)
- Low drain-source ON resistance: R<sub>DS</sub> (ON) = 120 mΩ (typ.) (N-ch)  
160 mΩ (typ.) (P-ch)
- High forward transfer admittance: |Y<sub>fs</sub>| = 5.0 S (typ.) (Nch)  
4.0 S (typ.) (Pch)
- Low leakage current: I<sub>GSS</sub> = ±10 μA (max) (V<sub>GS</sub> = ±16 V)  
I<sub>DSS</sub> = 100 μA (max) (V<sub>DS</sub> = 60 V)
- Enhancement-mode: V<sub>th</sub> = 0.8 to 2.0 V (V<sub>DS</sub> = 10 V, I<sub>D</sub> = 1 mA)

### Absolute Maximum Ratings (T<sub>a</sub> = 25°C)

Characteristics		Symbol	Rating		Unit
			Nch	Pch	
Drain-source voltage		V <sub>DSS</sub>	60	-60	V
Drain-gate voltage (R <sub>GS</sub> = 20 kΩ)		V <sub>DGR</sub>	60	-60	V
Gate-source voltage		V <sub>GSS</sub>	±20	±20	V
Drain current	DC	I <sub>D</sub>	5	-5	A
	Pulse	I <sub>DP</sub>	20	-20	
Drain power dissipation (1-device operation, Ta = 25°C)		P <sub>D</sub>	2.0		W
Drain power dissipation (4-device operation, Ta = 25°C)		P <sub>DT</sub>	4.0		W
Single pulse avalanche energy (Note 1)		E <sub>AS</sub>	129	273	mJ
Avalanche current		I <sub>AR</sub>	5	-5	A
Repetitive avalanche energy (Note 2)	1-device operation	E <sub>AR</sub>	0.2		mJ
	4-device operation	E <sub>ART</sub>	0.4		
Channel temperature		T <sub>ch</sub>	150		°C
Storage temperature range		T <sub>stg</sub>	-55 to 150		°C

Note 1: Condition fo avalanche energy (single pulse) measurement

Nch: V<sub>DD</sub> = 25 V, starting T<sub>ch</sub> = 25°C, L = 7 mH, R<sub>G</sub> = 25 Ω, I<sub>AR</sub> = 5 A

Pch: V<sub>DD</sub> = -25 V, starting T<sub>ch</sub> = 25°C, L = 14.84 mH, R<sub>G</sub> = 25 Ω, I<sub>AR</sub> = -5 A

Note 2: Repetitive rating; pulse width limited by maximum channel temperature

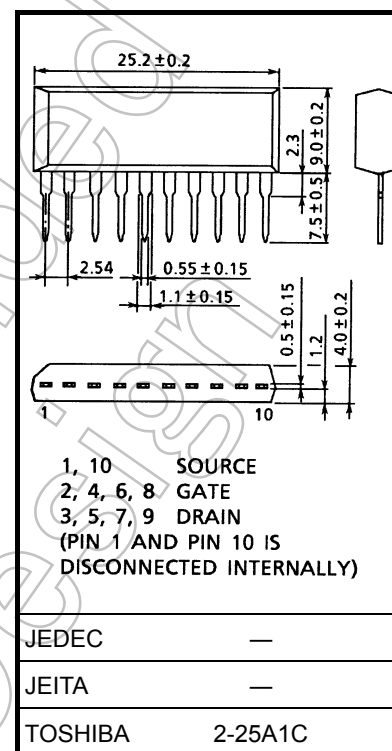
Note 3: Using continuously under heavy loads (e.g. the application of high temperature/current/voltage and the significant change in temperature, etc.) may cause this product to decrease in the reliability significantly even if the operating conditions (i.e. operating temperature/current/voltage, etc.) 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).

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

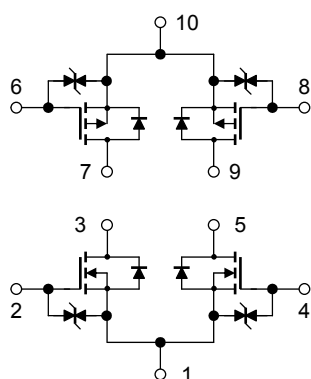
Industrial Applications

Unit: mm



Weight: 2.1 g (typ.)

## Array Configuration



## Thermal Characteristics

Characteristics	Symbol	Max	Unit
Thermal resistance from channel to ambient (4-device operation, $T_a = 25^\circ\text{C}$ )	$\Sigma R_{th}(\text{ch-a})$	31.2	$^\circ\text{C/W}$
Maximum lead temperature for soldering purposes (3.2 mm from case for $t = 10\text{ s}$ )	$T_L$	260	$^\circ\text{C}$

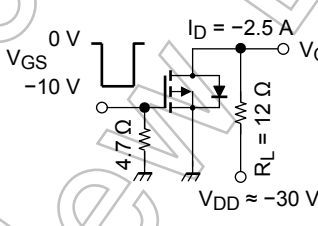
Electrical Characteristics ( $T_a = 25^\circ\text{C}$ ) (Nch MOS FET)

Characteristics	Symbol	Test Condition	Min	Typ.	Max	Unit
Gate leakage current	$I_{GSS}$	$V_{GS} = \pm 16\text{ V}$ , $V_{DS} = 0\text{ V}$	—	—	$\pm 10$	$\mu\text{A}$
Drain cut-off current	$I_{DSS}$	$V_{DS} = 60\text{ V}$ , $V_{GS} = 0\text{ V}$	—	—	100	$\mu\text{A}$
Drain-source breakdown voltage	$V_{(BR)DSS}$	$I_D = 10\text{ mA}$ , $V_{GS} = 0\text{ V}$	60	—	—	V
Gate threshold voltage	$V_{th}$	$V_{DS} = 10\text{ V}$ , $I_D = 1\text{ mA}$	0.8	—	2.0	V
Drain-source ON resistance	$R_{DS(ON)}$	$V_{GS} = 4\text{ V}$ , $I_D = 2.5\text{ A}$	—	0.21	0.32	$\Omega$
		$V_{GS} = 10\text{ V}$ , $I_D = 2.5\text{ A}$	—	0.12	0.16	
Forward transfer admittance	$ Y_{fs} $	$V_{DS} = 10\text{ V}$ , $I_D = 2.5\text{ A}$	3.0	5.0	—	S
Input capacitance	$C_{iss}$	$V_{DS} = 10\text{ V}$ , $V_{GS} = 0\text{ V}$ , $f = 1\text{ MHz}$	—	370	—	pF
Reverse transfer capacitance	$C_{rss}$		—	60	—	pF
Output capacitance	$C_{oss}$		—	180	—	pF
Switching time	Rise time		—	18	—	ns
	Turn-on time		—	25	—	
	Fall time		—	55	—	
	Turn-off time		—	170	—	
Total gate charge (Gate-source plus gate-drain)	$Q_g$	$V_{DD} \approx 48\text{ V}$ , $V_{GS} = 10\text{ V}$ , $I_D = 5\text{ A}$	—	12	—	nC
Gate-source charge	$Q_{gs}$		—	8	—	nC
Gate-drain ("miller") charge	$Q_{gd}$		—	4	—	nC

## Source-Drain Diode Ratings and Characteristics (Ta = 25°C)

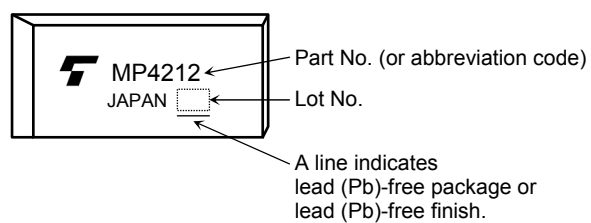
Characteristics	Symbol	Test Condition	Min	Typ.	Max	Unit
Continuous drain reverse current	$I_{DR}$	—	—	—	5	A
Pulse drain reverse current	$I_{DRP}$	—	—	—	20	A
Diode forward voltage	$V_{DSF}$	$I_{DR} = 5 \text{ A}$ , $V_{GS} = 0 \text{ V}$	—	—	-1.7	V
Reverse recovery time	$t_{rr}$	$I_{DR} = 5 \text{ A}$ , $V_{GS} = 0 \text{ V}$	—	70	—	ns
Reverse recovery charge	$Q_{rr}$	$dI_{DR}/dt = 50 \text{ A}/\mu\text{s}$	—	0.1	—	$\mu\text{C}$

## Electrical Characteristics (Ta = 25°C) (Pch MOS FET)

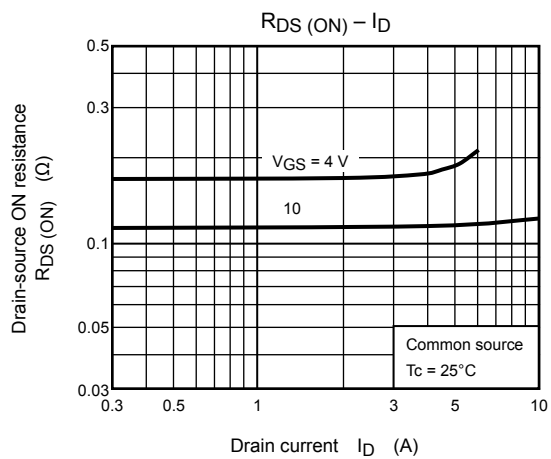
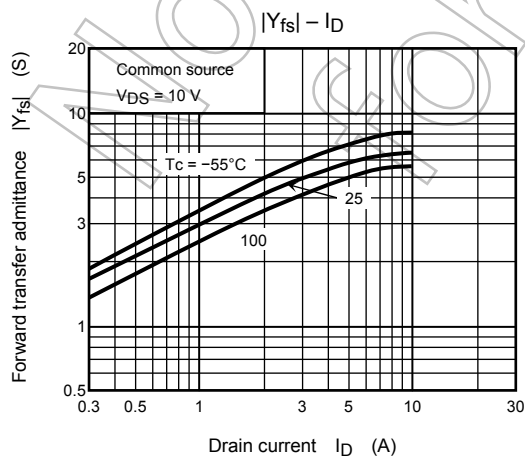
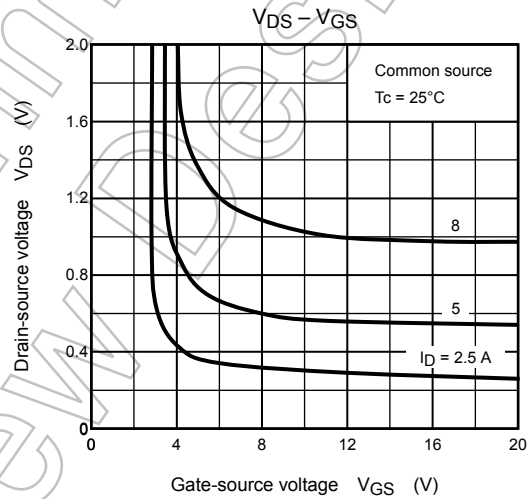
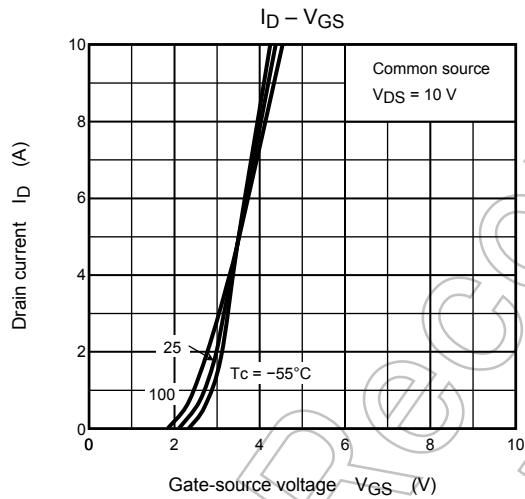
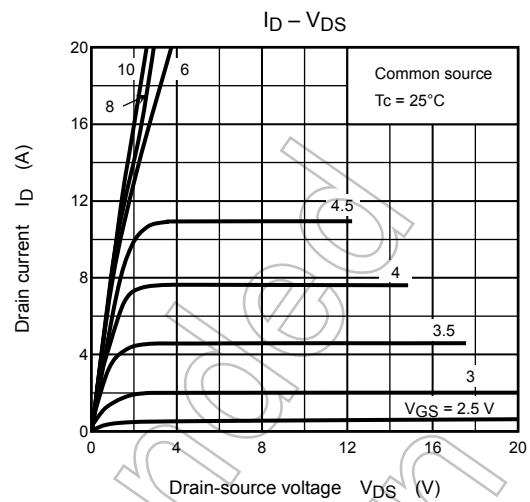
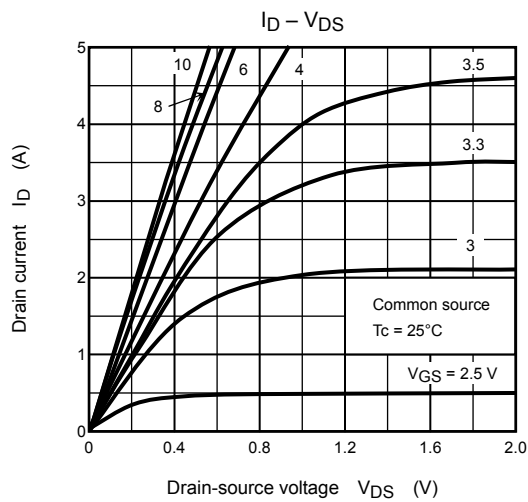
Characteristics		Symbol	Test Condition	Min	Typ.	Max	Unit		
Gate leakage current		$I_{GSS}$	$V_{GS} = \pm 16 \text{ V}$ , $V_{DS} = 0 \text{ V}$	—	—	$\pm 10$	$\mu\text{A}$		
Drain cut-off current		$I_{DSS}$	$V_{DS} = -60 \text{ V}$ , $V_{GS} = 0 \text{ V}$	—	—	-100	$\mu\text{A}$		
Drain-source breakdown voltage		$V_{(BR)DSS}$	$I_D = -10 \text{ mA}$ , $V_{GS} = 0 \text{ V}$	-60	—	—	V		
Gate threshold voltage		$V_{th}$	$V_{DS} = -10 \text{ V}$ , $I_D = -1 \text{ mA}$	-0.8	—	-2.0	V		
Drain-source ON resistance		$R_{DS(ON)}$	$V_{GS} = -4 \text{ V}$ , $I_D = -2.5 \text{ A}$	—	0.24	0.28	$\Omega$		
			$V_{GS} = -10 \text{ V}$ , $I_D = -2.5 \text{ A}$	—	0.16	0.19			
Forward transfer admittance		$ Y_{fs} $	$V_{DS} = -10 \text{ V}$ , $I_D = -2.5 \text{ A}$	2.0	4.0	—	S		
Input capacitance		$C_{iss}$	$V_{DS} = -10 \text{ V}$ , $V_{GS} = 0 \text{ V}$ , $f = 1 \text{ MHz}$	—	630	—	pF		
Reverse transfer capacitance		$C_{rss}$		—	95	—	pF		
Output capacitance		$C_{oss}$		—	290	—	pF		
Switching time	Rise time	$t_r$		—	25	—	ns		
	Turn-on time	$t_{on}$		—	45	—			
	Fall time	$t_f$		—	55	—			
	Turn-off time	$t_{off}$		—	200	—			
Total gate charge (gate-source plus gate-drain)			$Q_g$	$V_{DD} \approx -48 \text{ V}$ , $V_{GS} = -10 \text{ V}$ , $I_D = -5 \text{ A}$		—	22	—	nC
Gate-source charge			$Q_{gs}$			—	16	—	nC
Gate-drain ("miller") charge			$Q_{gd}$			—	6	—	nC

## Source-Drain Diode Ratings and Characteristics (Ta = 25°C)

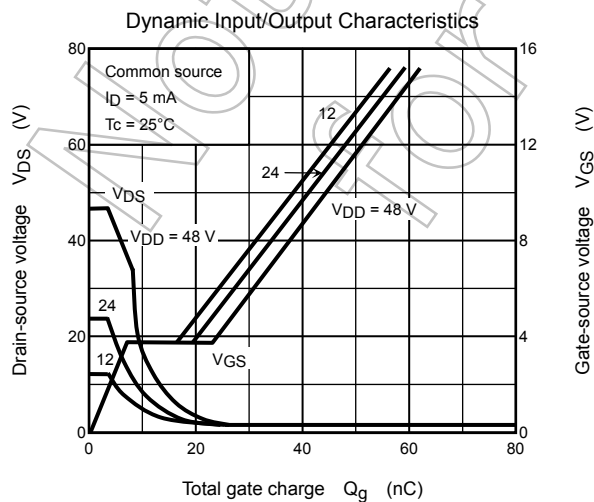
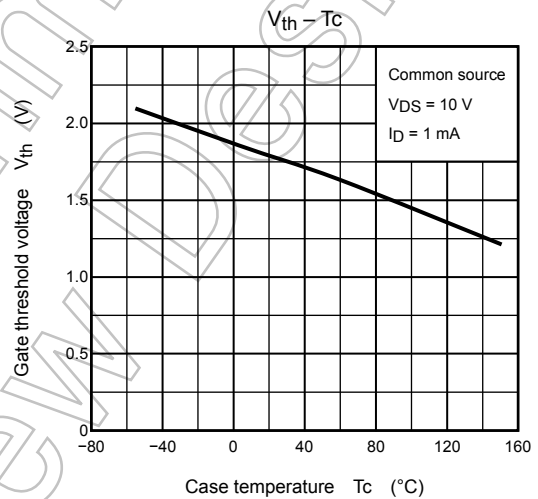
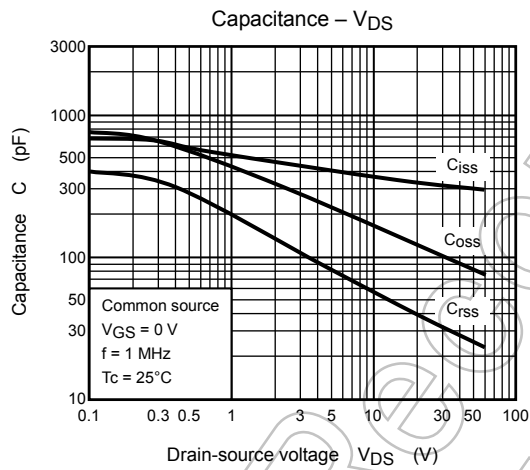
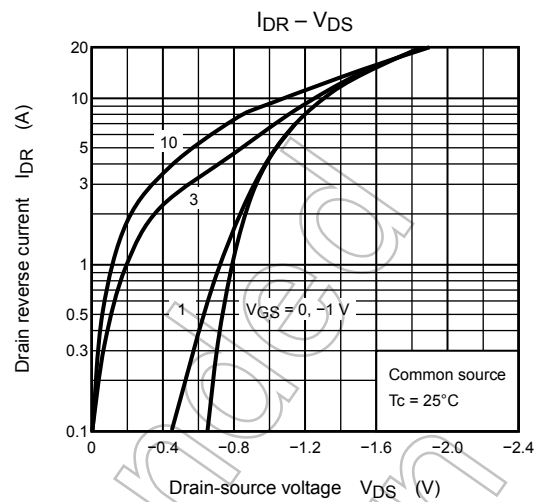
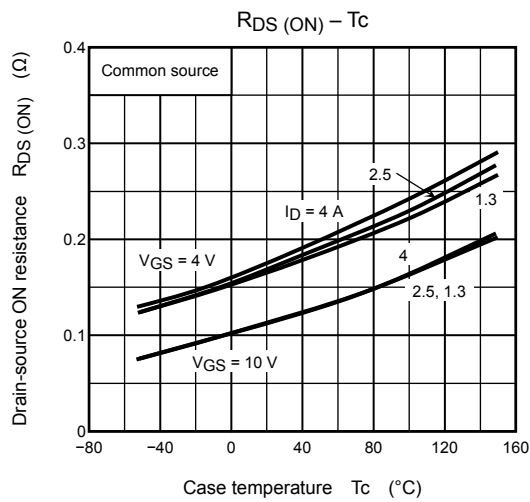
Characteristics	Symbol	Test Condition	Min	Typ.	Max	Unit
Continuous drain reverse current	$I_{DR}$	—	—	—	-5	A
Pulse drain reverse current	$I_{DRP}$	—	—	—	-20	A
Diode forward voltage	$V_{DSF}$	$I_{DR} = -5 \text{ A}$ , $V_{GS} = 0 \text{ V}$	—	—	1.7	V
Reverse recovery time	$t_{rr}$	$I_{DR} = -5 \text{ A}$ , $V_{GS} = 0 \text{ V}$	—	80	—	ns
Reverse recovery charge	$Q_{rr}$	$dI_{DR}/dt = 50 \text{ A}/\mu\text{s}$	—	0.1	—	$\mu\text{C}$

**Marking**

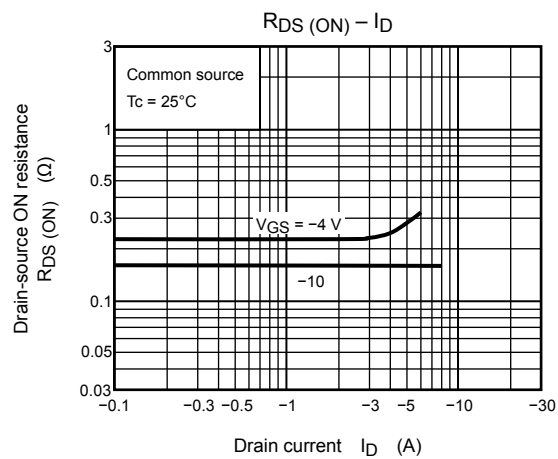
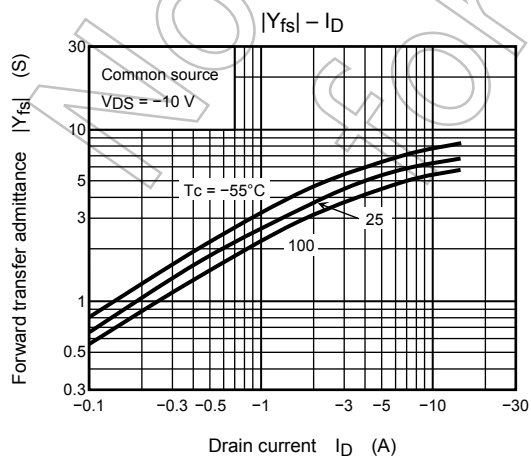
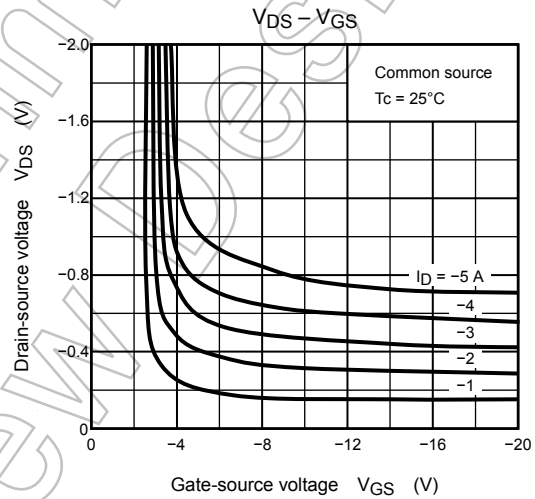
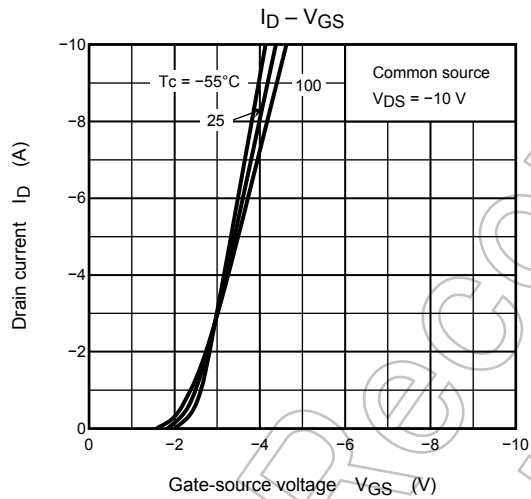
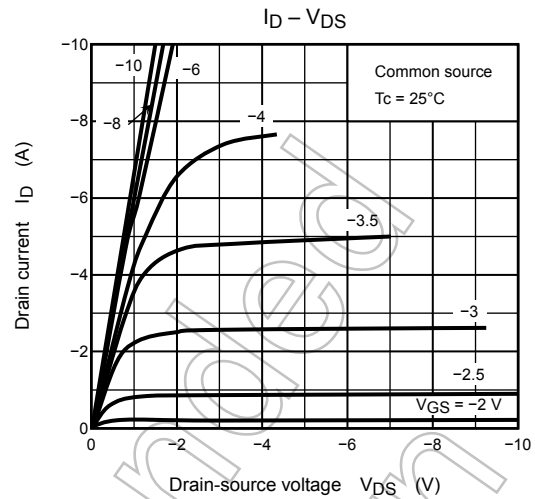
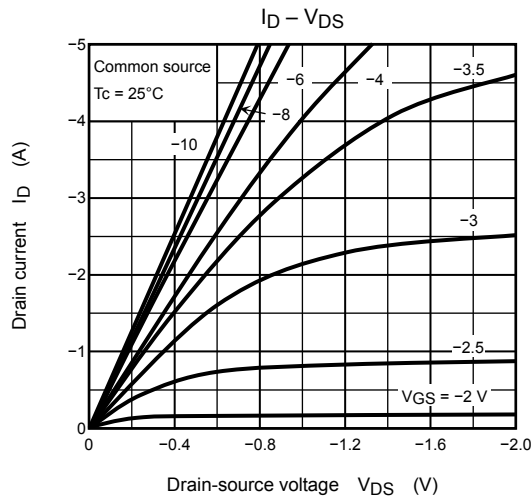
## Nch MOS FET



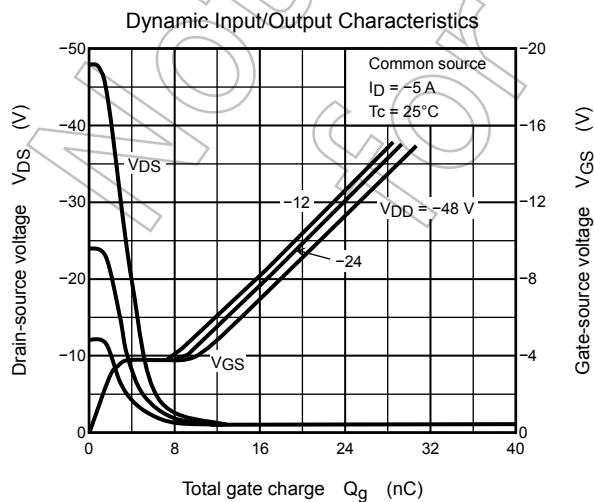
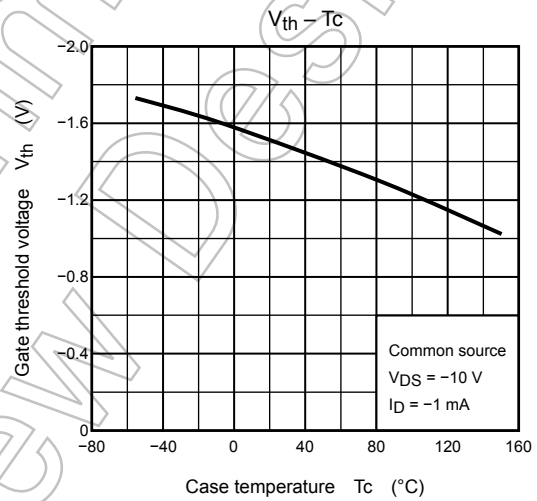
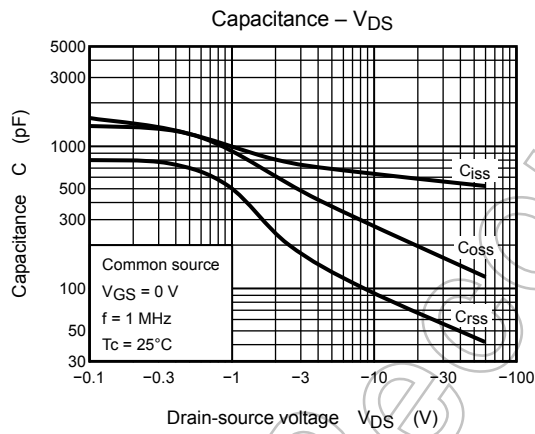
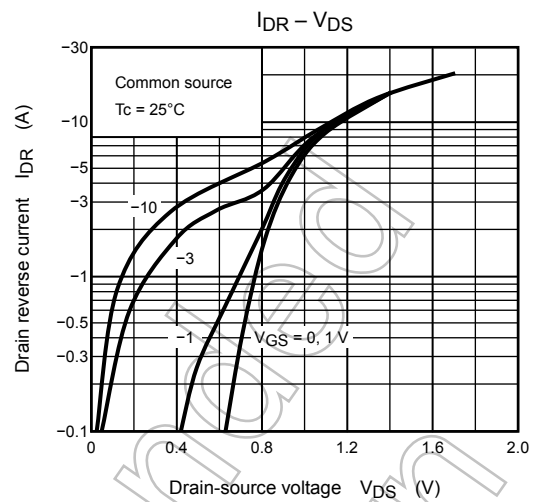
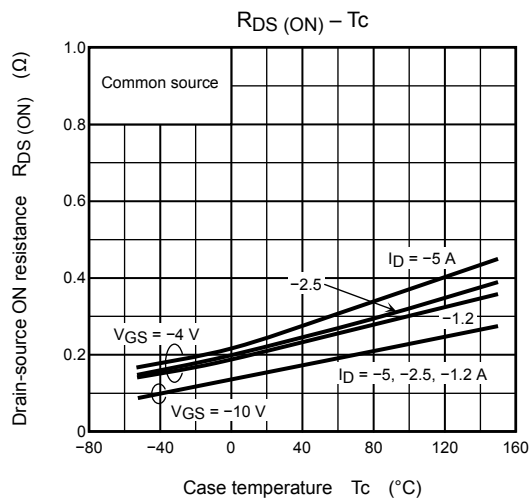
Nch MOS FET



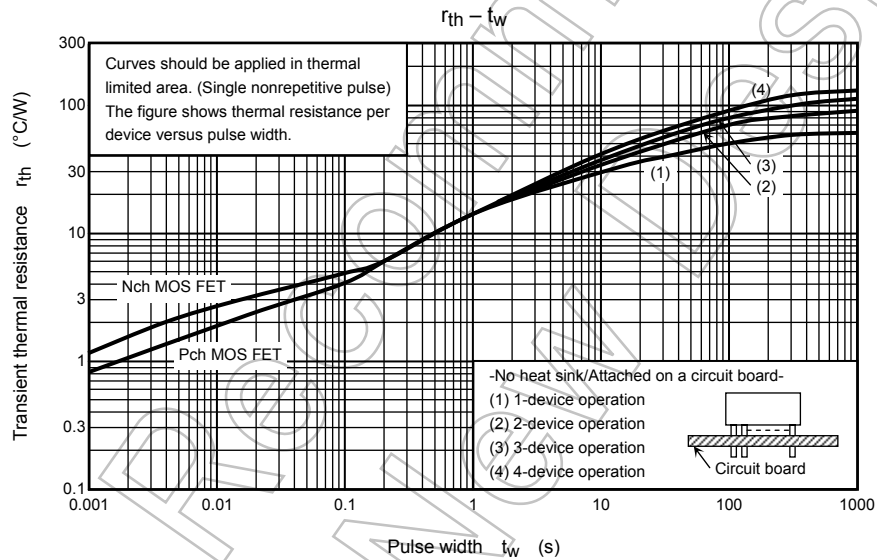
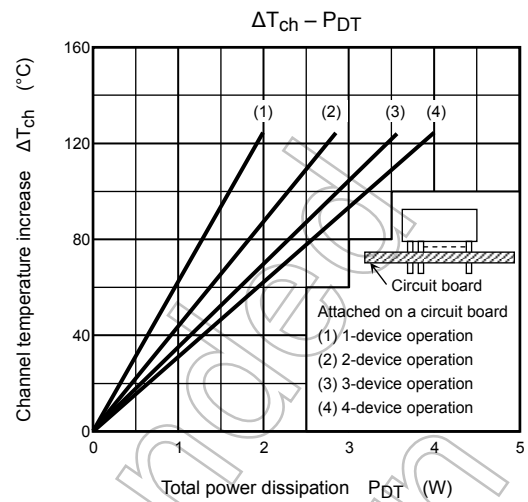
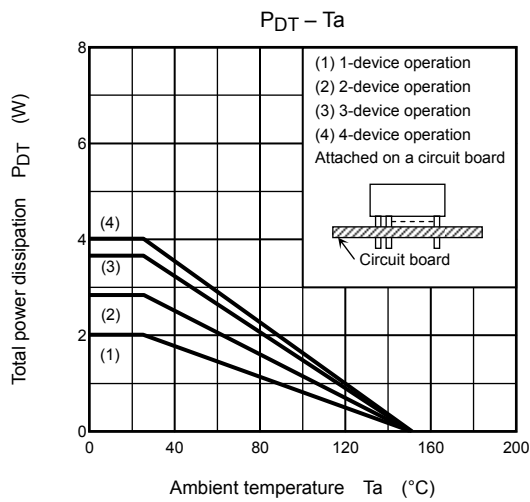
Pch MOS FET

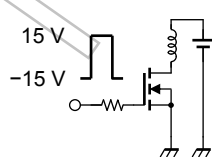
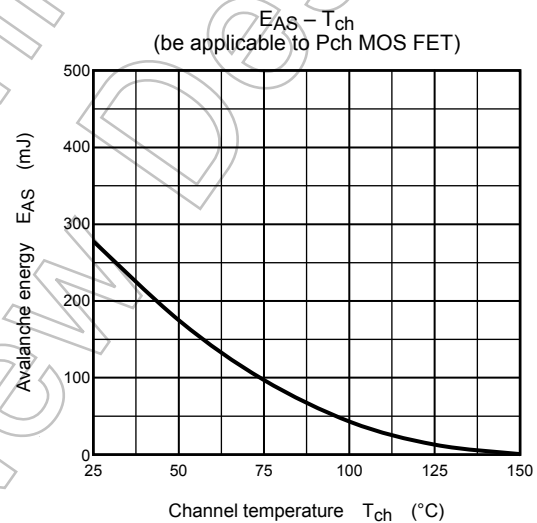
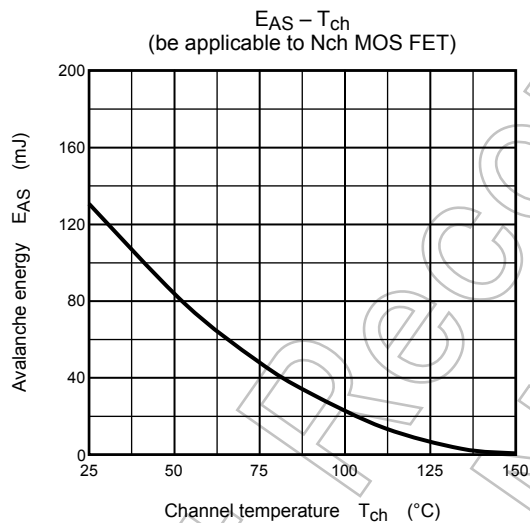
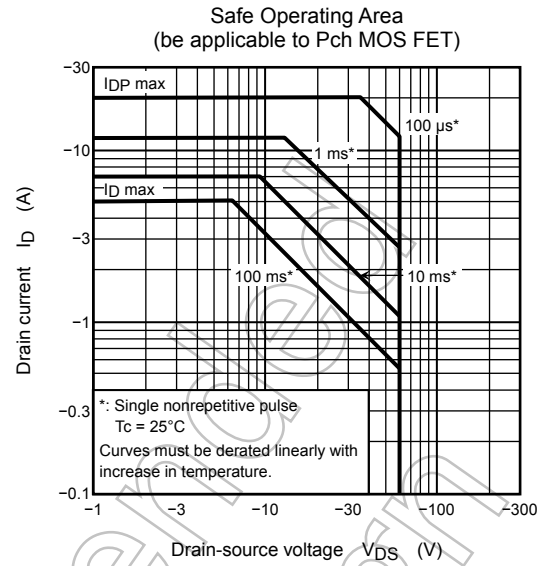
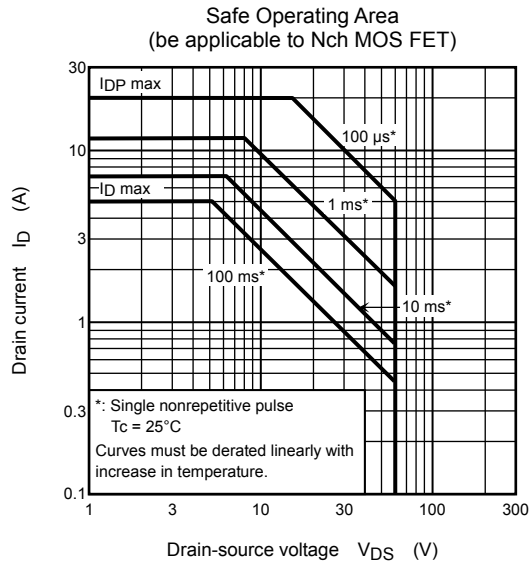


## Pch MOS FET

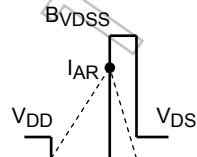








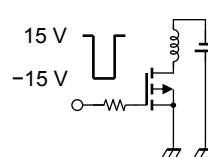
TEST CIRCUIT



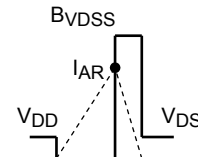
TEST WAVE FORM

Peak  $I_{AR} = 5\text{ A}$ ,  $R_G = 25\ \Omega$   
 $V_{DD} = 25\text{ V}$ ,  $L = 7\text{ mH}$

$$E_{AS} = \frac{1}{2} L \cdot I^2 \cdot \left( \frac{B_{VDSS}}{B_{VDSS} - V_{DD}} \right)$$



TEST CIRCUIT



TEST WAVE FORM

Peak  $I_{AR} = -5\text{ A}$ ,  $R_G = 25\ \Omega$   
 $V_{DD} = -25\text{ V}$ ,  $L = 14.84\text{ mH}$

$$E_{AS} = \frac{1}{2} L \cdot I^2 \cdot \left( \frac{B_{VDSS}}{B_{VDSS} - V_{DD}} \right)$$

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20070701-EN

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