

TOSHIBA Field Effect Transistor Silicon N Channel MOS Type (U-MOSIII)

# TPCS8209

Lithium Ion Battery Applications  
 Notebook PC Applications  
 Portable Machines and Tools

- Small footprint due to small and thin package
- Low drain-source ON resistance:  $R_{DS(ON)} = 19\text{ m}\Omega$  (typ.)
- High forward transfer admittance:  $|Y_{fs}| = 9.2\text{ S}$  (typ.)
- Low leakage current:  $I_{DSS} = 10\text{ }\mu\text{A}$  (max) ( $V_{DS} = 20\text{ V}$ )
- Enhancement-mode:  $V_{th} = 0.5\sim 1.2\text{ V}$  ( $V_{DS} = 10\text{ V}$ ,  $I_D = 200\text{ }\mu\text{A}$ )

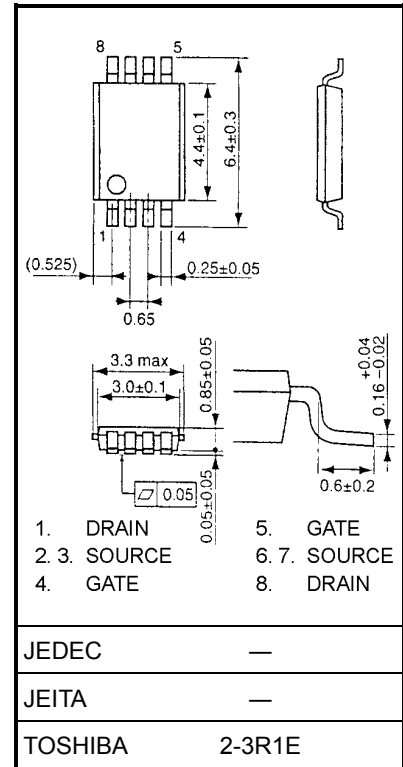
## Maximum Ratings ( $T_a = 25^\circ\text{C}$ )

Characteristics		Symbol	Rating	Unit
Drain-source voltage		$V_{DSS}$	20	V
Drain-gate voltage ( $R_{GS} = 20\text{ k}\Omega$ )		$V_{DGR}$	20	V
Gate-source voltage		$V_{GSS}$	$\pm 12$	V
Drain current	DC (Note 1)	$I_D$	5	A
	Pulse (Note 1)	$I_{DP}$	20	
Drain power dissipation ( $t = 10\text{ s}$ ) (Note 2a)	Single-device operation (Note 3a)	$P_D(1)$	1.1	W
	Single-device value at dual operation (Note 3b)	$P_D(2)$	0.75	
Drain power dissipation ( $t = 10\text{ s}$ ) (Note 2b)	Single-device operation (Note 3a)	$P_D(1)$	0.6	W
	Single-device value at dual operation (Note 3b)	$P_D(2)$	0.35	
Single pulse avalanche energy (Note 4)		$E_{AS}$	32.5	mJ
Avalanche current		$I_{AR}$	5	A
Repetitive avalanche energy Single-device value at dual operation (Note 2a, 3b, 5)		$E_{AR}$	0.075	mJ
Channel temperature		$T_{ch}$	150	$^\circ\text{C}$
Storage temperature range		$T_{stg}$	$-55\sim 150$	$^\circ\text{C}$

Note: (Note 1), (Note 2), (Note 3), (Note 4), (Note 5) Please see next page.

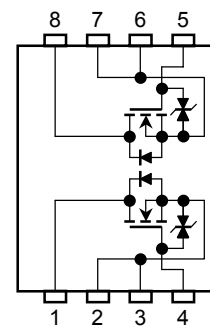
This transistor is an electrostatic sensitive device. Please handle with caution.

Unit: mm



Weight: 0.035 g (typ.)

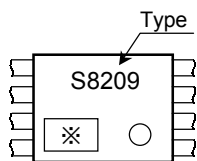
## Circuit Configuration



## Thermal Characteristics

Characteristics		Symbol	Max	Unit
Thermal resistance, channel to ambient (t = 10 s) (Note 2a)	Single-device operation (Note 3a)	$R_{th(ch-a)}(1)$	114	°C/W
	Single-device value at dual operation (Note 3b)	$R_{th(ch-a)}(2)$	167	
Thermal resistance, channel to ambient (t = 10 s) (Note 2b)	Single-device operation (Note 3a)	$R_{th(ch-a)}(1)$	208	°C/W
	Single-device value at dual operation (Note 3b)	$R_{th(ch-a)}(2)$	357	

## Marking (Note 6)

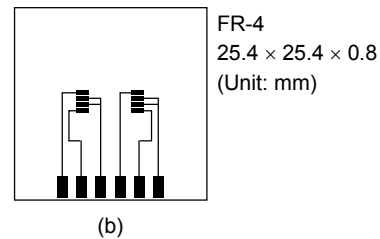
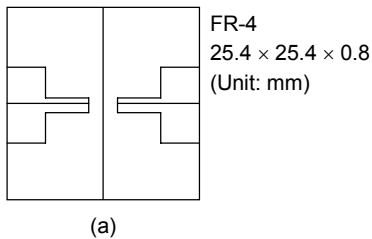


Note 1: Please use devices on condition that the channel temperature is below 150°C.

Note 2:

a) Device mounted on a glass-epoxy board (a)

b) Device mounted on a glass-epoxy board (b)



Note 3:

- a) The power dissipation and thermal resistance values are shown for a single device (During single-device operation, power is only applied to one device.).
- b) The power dissipation and thermal resistance values are shown for a single device (During dual operation, power is evenly applied to both devices.).

Note 4:  $V_{DD} = 16\text{ V}$ ,  $T_{ch} = 25^\circ\text{C}$  (initial),  $L = 1.0\text{ mH}$ ,  $R_G = 25\ \Omega$ ,  $I_{AR} = 5\text{ A}$

Note 5: Repetitive rating; pulse width limited by max channel temperature.

Note 6:  $\circ$  on lower right of the marking indicates Pin 1.

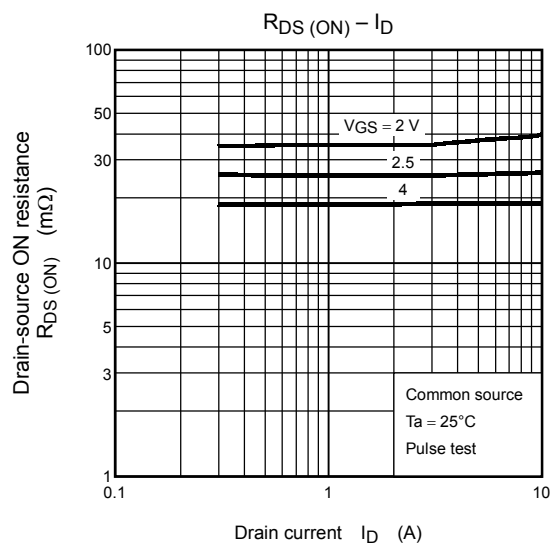
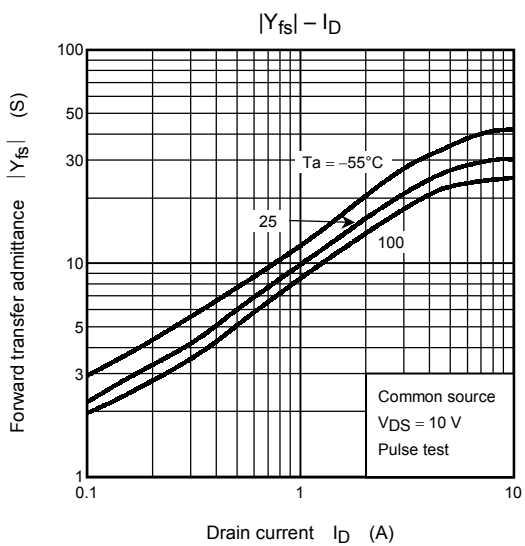
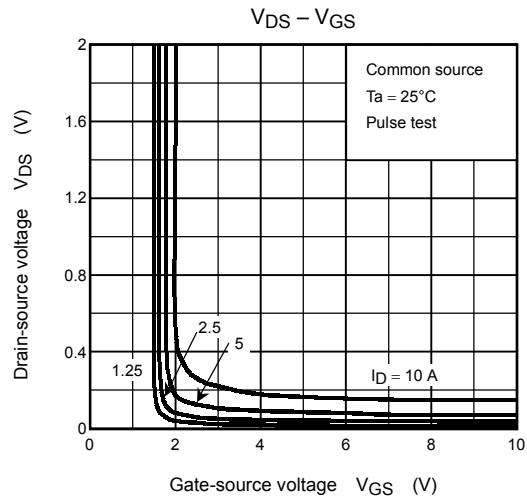
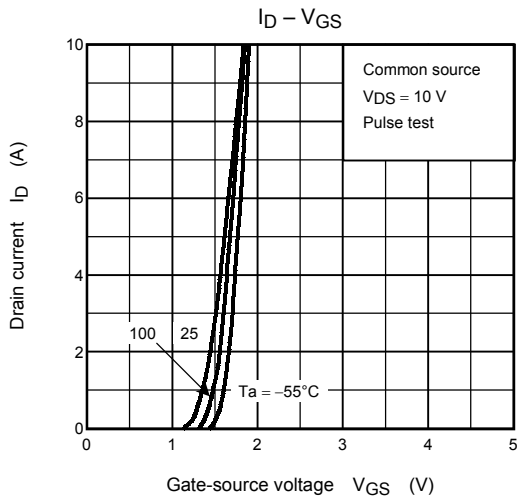
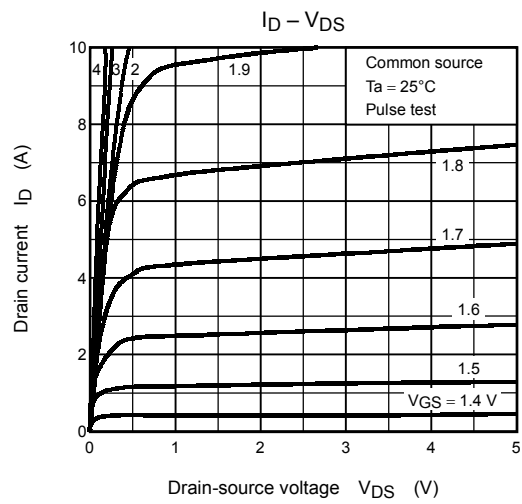
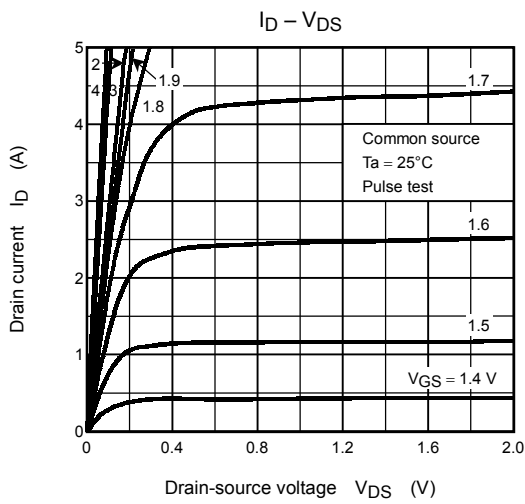
\* shows lot number. (year of manufacture: last decimal digit of the year of manufacture, month of manufacture: January to December are denoted by letters A to L respectively)

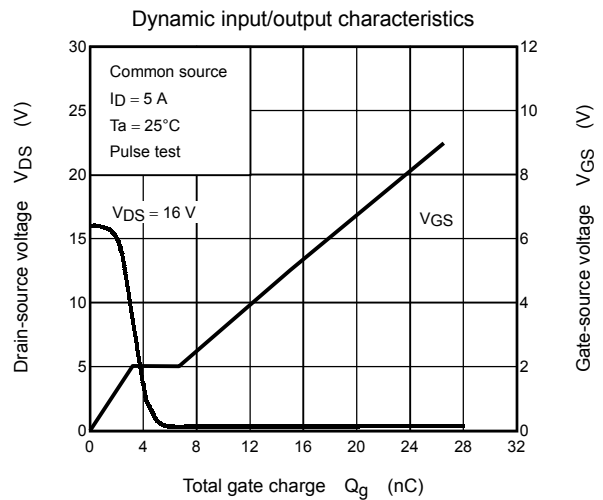
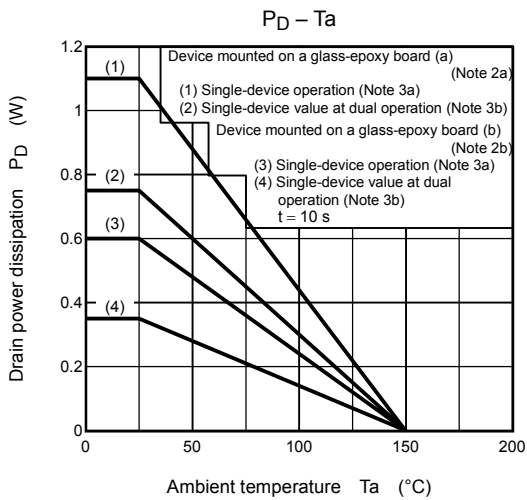
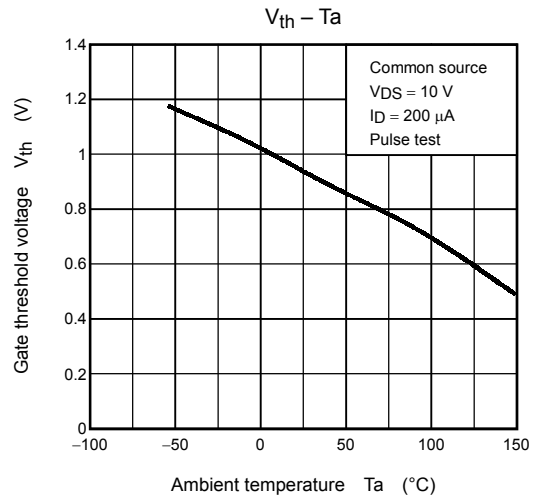
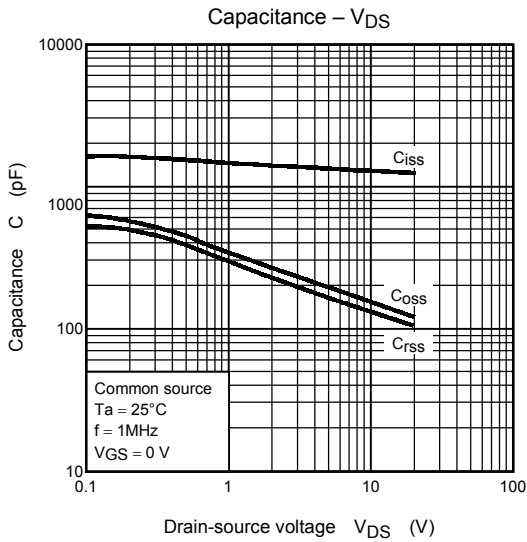
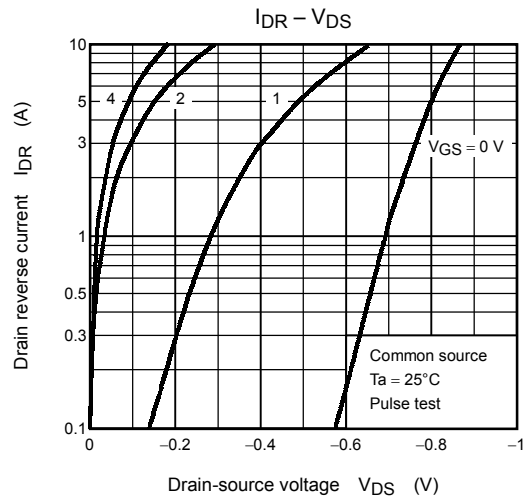
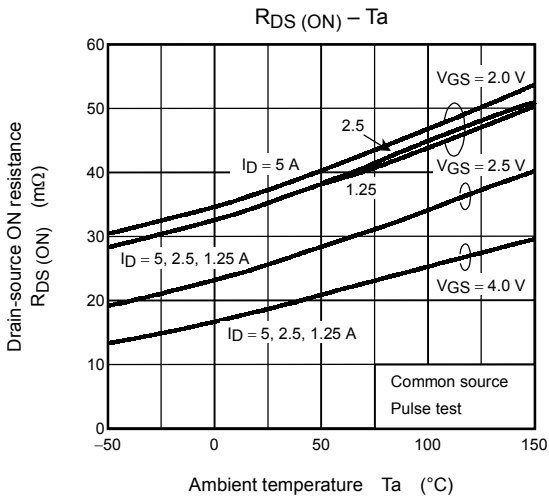
## Electrical Characteristics (Ta = 25°C)

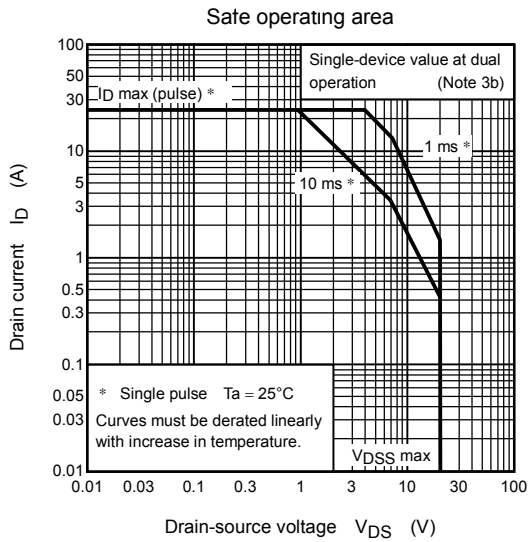
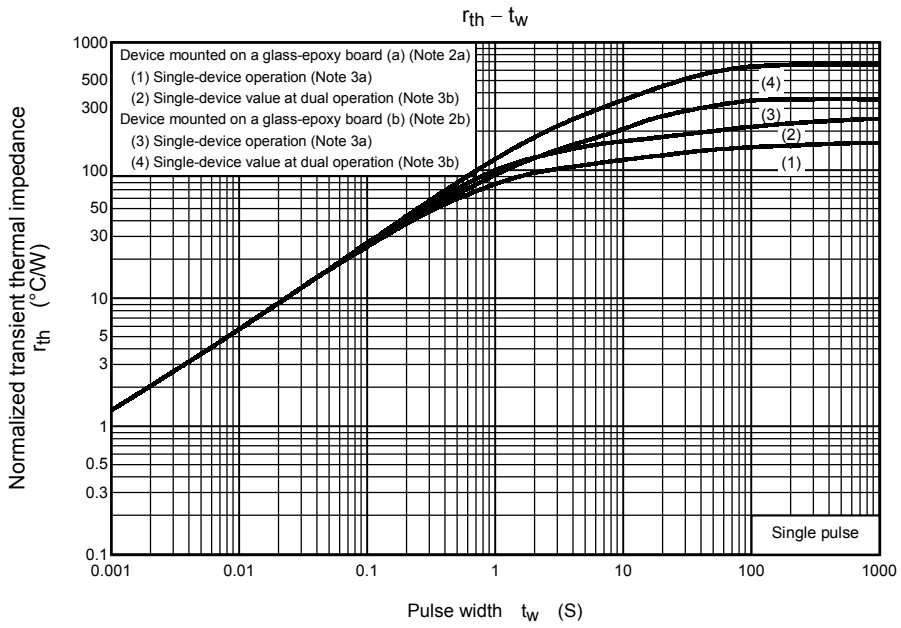
Characteristics		Symbol	Test Condition	Min	Typ.	Max	Unit
Gate leakage current		$I_{GSS}$	$V_{GS} = \pm 10\text{ V}, V_{DS} = 0\text{ V}$	—	—	$\pm 10$	$\mu\text{A}$
Drain cut-OFF current		$I_{DSS}$	$V_{DS} = 20\text{ V}, V_{GS} = 0\text{ V}$	—	—	10	$\mu\text{A}$
Drain-source breakdown voltage		$V_{(BR)DSS}$	$I_D = 10\text{ mA}, V_{GS} = 0\text{ V}$	20	—	—	V
		$V_{(BR)DSX}$	$I_D = 10\text{ mA}, V_{GS} = -12\text{ V}$	8	—	—	
Gate threshold voltage		$V_{th}$	$V_{DS} = 10\text{ V}, I_D = 200\ \mu\text{A}$	0.5	—	1.2	V
Drain-source ON resistance		$R_{DS(ON)}$	$V_{GS} = 2.0\text{ V}, I_D = 3.5\text{ A}$	—	34	60	m $\Omega$
			$V_{GS} = 2.5\text{ V}, I_D = 3.5\text{ A}$	—	26	40	
			$V_{GS} = 4.0\text{ V}, I_D = 4.0\text{ A}$	—	19	30	
Forward transfer admittance		$ Y_{fs} $	$V_{DS} = 10\text{ V}, I_D = 2.5\text{ A}$	4.6	9.2	—	S
Input capacitance		$C_{iss}$	$V_{DS} = 10\text{ V}, V_{GS} = 0\text{ V}, f = 1\text{ MHz}$	—	1280	—	pF
Reverse transfer capacitance		$C_{rss}$		—	130	—	
Output capacitance		$C_{oss}$		—	150	—	
Switching time	Rise time	$t_r$	<p> <math>V_{GS} = 5\text{ V}</math>  <math>0\text{ V}</math>  <math>I_D = 2.5\text{ A}</math>  <math>V_{DD} \approx 10\text{ V}</math>  <math>R_L = 4\ \Omega</math>  <math>4.7\ \Omega</math>  <math>V_{OUT}</math>                      Duty <math>\leq 1\%</math>, <math>t_w = 10\ \mu\text{s}</math> </p>	—	4.5	—	ns
	Turn-ON time	$t_{on}$		—	11	—	
	Fall time	$t_f$		—	7.3	—	
	Turn-OFF time	$t_{off}$		—	33	—	
Total gate charge (gate-source plus gate-drain)		$Q_g$	$V_{DD} \approx 16\text{ V}, V_{GS} = 5\text{ V}, I_D = 5\text{ A}$	—	15	—	nC
Gate-source charge 1		$Q_{gs1}$		—	3.3	—	
Gate-drain ("miller") charge		$Q_{gd}$		—	3.5	—	

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

Characteristics		Symbol	Test Condition	Min	Typ.	Max	Unit
Drain reverse current	Pulse (Note 1)	$I_{DRP}$	—	—	—	20	A
Forward voltage (diode)		$V_{DSF}$	$I_{DR} = 5\text{ A}, V_{GS} = 0\text{ V}$	—	—	-1.2	V







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