

TOSHIBA Field Effect Transistor Silicon P Channel MOS Type (U-MOSVI)

# TPC6113

Lithium Ion Battery Applications  
Power Management Switch Applications

- Small footprint due to small and thin package
- Low drain-source ON-resistance:  $R_{DS(ON)} = 38\text{ m}\Omega$  (typ.)  
( $V_{GS} = -4.5\text{V}$ )
- Low leakage current:  $I_{DSS} = -10\text{ }\mu\text{A}$  (max) ( $V_{DS} = -20\text{ V}$ )
- Enhancement mode:  $V_{th} = -0.5\text{ to }-1.2\text{ V}$   
( $V_{DS} = -10\text{ V}$ ,  $I_D = -0.2\text{ mA}$ )

## Absolute 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 = 5 s) (Note 2a)		$P_D$	2.2	W
Drain power dissipation (t = 5 s) (Note 2b)		$P_D$	0.7	W
Single pulse avalanche energy (Note 3)		$E_{AS}$	1.6	mJ
Avalanche current		$I_{AR}$	-2.5	A
Channel temperature		$T_{ch}$	150	$^\circ\text{C}$
Storage temperature range		$T_{stg}$	-55 to 150	$^\circ\text{C}$

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.).

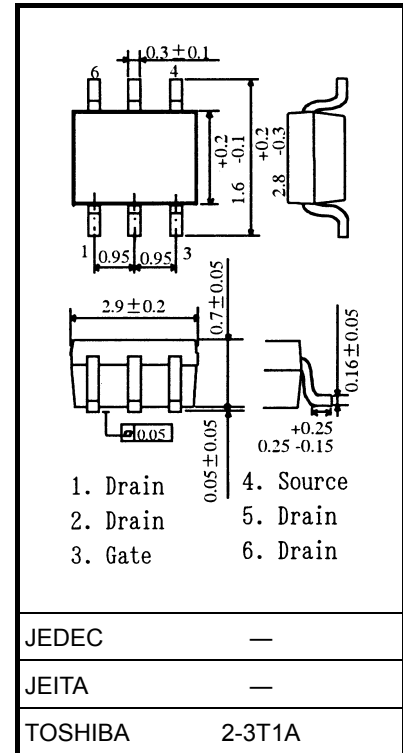
## Thermal Characteristics

Characteristics	Symbol	Max	Unit
Thermal resistance, channel to ambient (t = 5 s) (Note 2a)	$R_{th(ch-a)}$	56.8	$^\circ\text{C/W}$
Thermal resistance, channel to ambient (t = 5 s) (Note 2b)	$R_{th(ch-a)}$	178.5	$^\circ\text{C/W}$

Note: (Note 1), (Note 2), (Note 3) : See other pages.

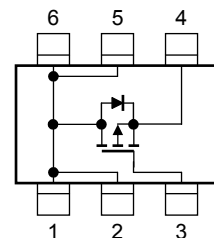
This transistor is an electrostatic-sensitive device. Please handle with caution.

Unit: mm

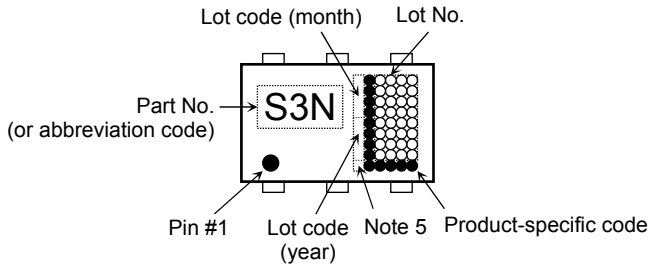


Weight: 0.011 g (typ.)

## Circuit Configuration

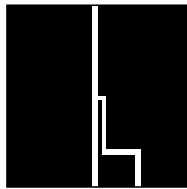


## Marking (Note 4)



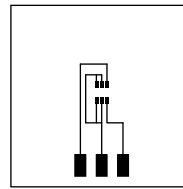
Note 1: Ensure that the channel temperature does not exceed 150°C.

Note 2: (a) Device mounted on a glass-epoxy board (a) ( $t = 5$  s)  
 (b) Device mounted on a glass-epoxy board (b) ( $t = 5$  s)



(a)

FR-4  
 $25.4 \times 25.4 \times 0.8$   
 (Unit: mm)



(b)

FR-4  
 $25.4 \times 25.4 \times 0.8$   
 (Unit: mm)

Note 3:  $V_{DD} = -16$  V,  $T_{ch} = 25^\circ\text{C}$  (initial),  $L = 0.2$  mH,  $R_G = 25 \Omega$ ,  $I_{AR} = -2.5$  A

Note 4: • on lower left of the marking indicates Pin 1.

Note 5: A line under a Lot No. identifies the indication of product Labels.

Not underlined: [[Pb]]/INCLUDES > MCV

Underlined: [[G]]/RoHS COMPATIBLE or [[G]]/RoHS [[Pb]]

Please contact your TOSHIBA sales representative for details as to environmental matters such as the RoHS compatibility of Product. The RoHS is the Directive 2002/95/EC of the European Parliament and of the Council of 27 January 2003 on the restriction of the use of certain hazardous substances in electrical and electronic equipment.

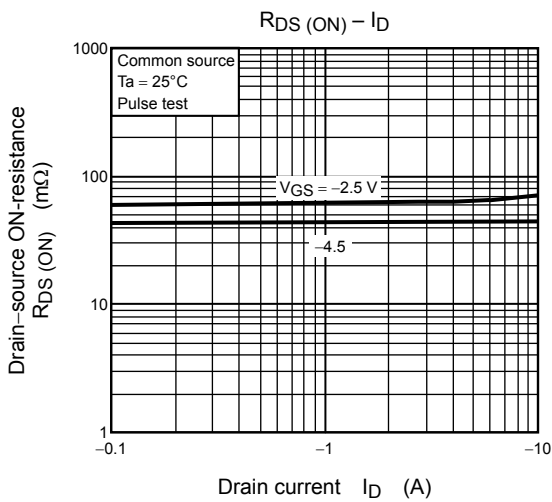
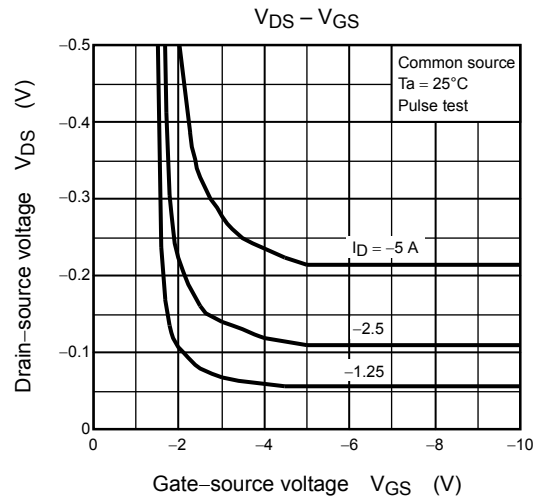
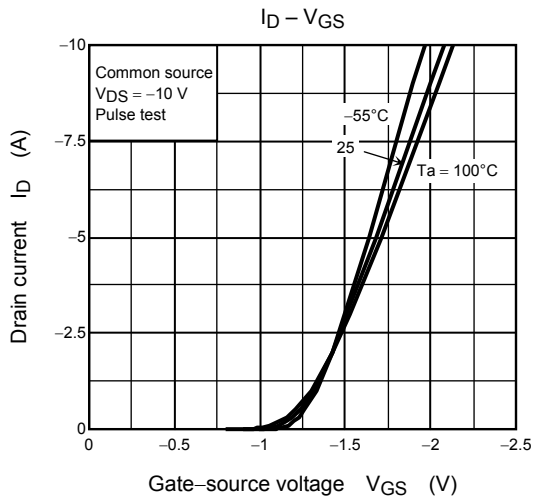
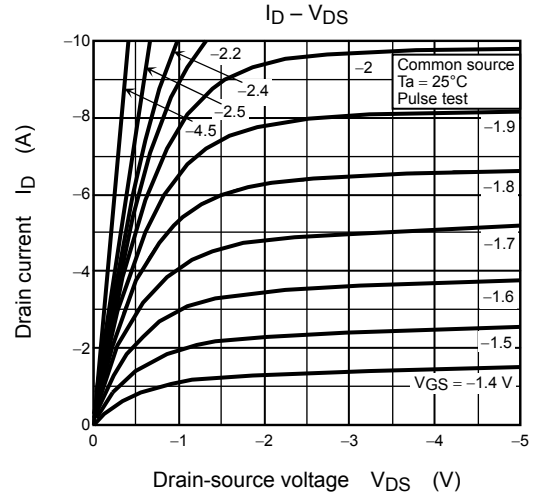
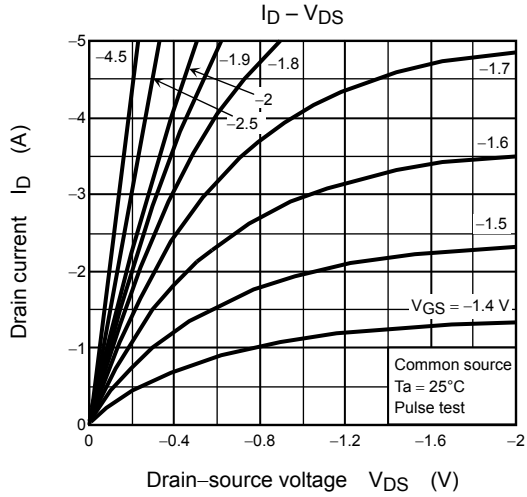
## Electrical Characteristics (Ta = 25°C)

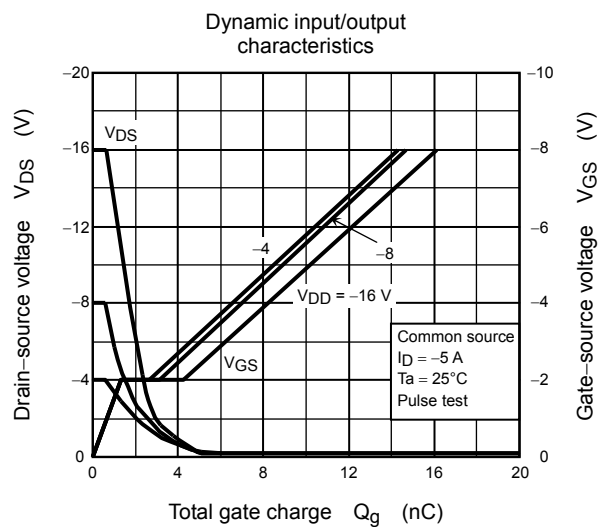
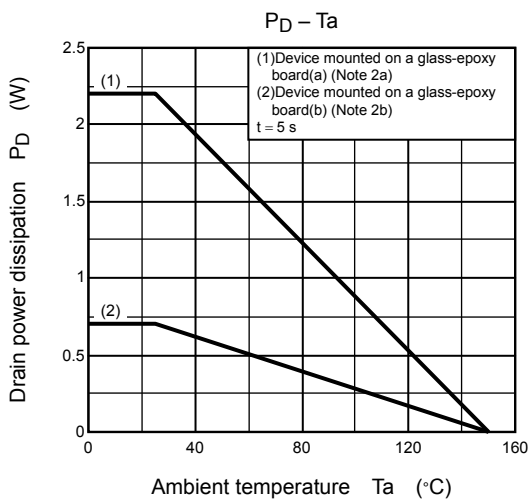
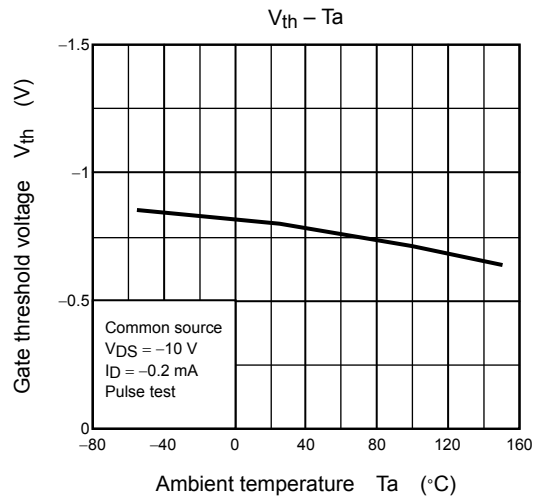
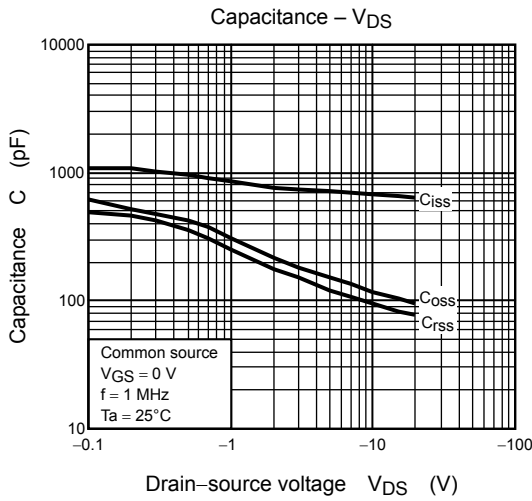
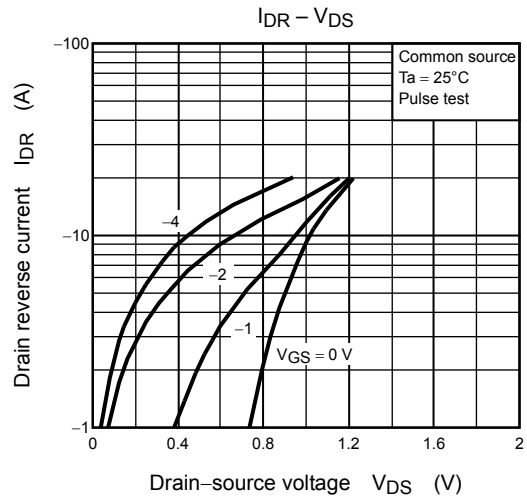
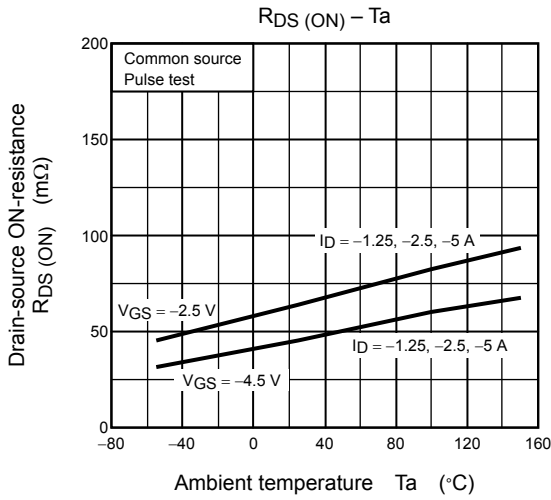
Characteristics		Symbol	Test Condition	Min	Typ.	Max	Unit
Gate leakage current		$I_{GSS}$	$V_{GS} = \pm 12\text{ V}, V_{DS} = 0\text{ V}$	—	—	$\pm 100$	nA
Drain cut-off current		$I_{DSS}$	$V_{DS} = -20\text{ V}, V_{GS} = 0\text{ V}$	—	—	-10	$\mu\text{A}$
Drain-source breakdown voltage		$V_{(BR)DSS}$	$I_D = -10\text{ mA}, V_{GS} = 0\text{ V}$	-20	—	—	V
		$V_{(BR)DSX}$	$I_D = -10\text{ mA}, V_{GS} = 8\text{ V}$ (Note 6)	-12	—	—	
Gate threshold voltage		$V_{th}$	$V_{DS} = -10\text{ V}, I_D = -0.2\text{ mA}$	-0.5	—	-1.2	V
Drain-source ON-resistance		$R_{DS(ON)}$	$V_{GS} = -2.5\text{ V}, I_D = -2.5\text{ A}$	—	56	85	m $\Omega$
		$R_{DS(ON)}$	$V_{GS} = -4.5\text{ V}, I_D = -2.5\text{ A}$	—	38	55	
Input capacitance		$C_{iss}$	$V_{DS} = -10\text{ V}, V_{GS} = 0\text{ V}, f = 1\text{ MHz}$	—	690	—	pF
Reverse transfer capacitance		$C_{rss}$		—	93	—	
Output capacitance		$C_{oss}$		—	117	—	
Switching time	Rise time	$t_r$	<p><math>V_{GS}</math> 0 V, -5 V, <math>I_D = -2.5\text{ A}</math>, <math>V_{DD} \approx -10\text{ V}</math>            4.7 nF, <math>R_L = 4\ \Omega</math>, <math>V_{OUT}</math>, Duty <math>\leq 1\%</math>, <math>t_w = 10\ \mu\text{s}</math></p>	—	6	—	ns
	Turn-on time	$t_{on}$		—	13	—	
	Fall time	$t_f$		—	25	—	
	Turn-off time	$t_{off}$		—	81	—	
Total gate charge (gate-source plus gate-drain)		$Q_g$	$V_{DD} \approx -16\text{ V}, V_{GS} = -5\text{ V}, I_D = -5\text{ A}$	—	10	—	nC
Gate-source charge 1		$Q_{gs1}$		—	1.3	—	
Gate-drain ("miller") charge		$Q_{gd}$		—	2.8	—	

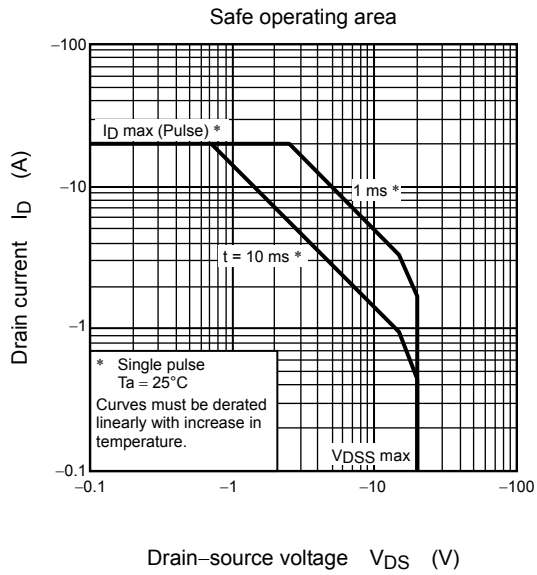
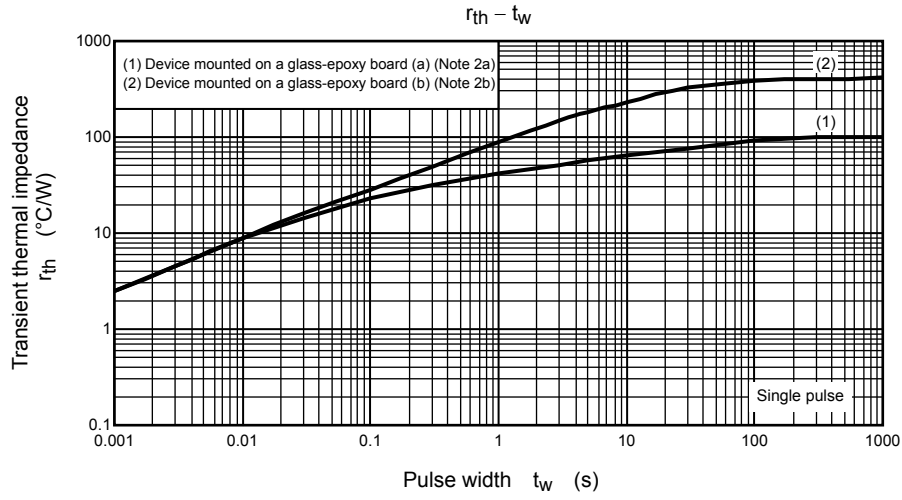
## Source-Drain Ratings and Characteristics (Ta = 25°C)

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

Note 6: VDSX mode (the application of a plus voltage between gate and source) may cause decrease in maximum rating of drain-source voltage.







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