

MOSFETs Silicon P-Channel MOS (U-MOSVI)

# TPC6130

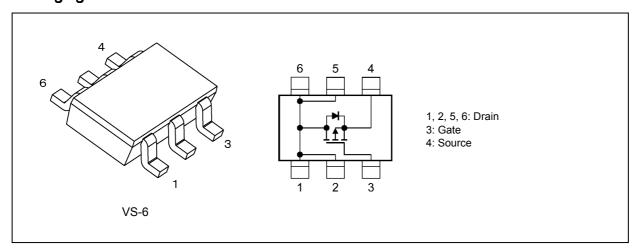
#### 1. Applications

- · Lithium-Ion Secondary Batteries
- · Power Management Switches

#### 2. Features

- (1) Small footprint due to small and thin package
- (2) Low drain-source on-resistance:  $R_{DS(ON)} = 86 \text{ m}\Omega$  (typ.) ( $V_{GS} = -4.5 \text{ V}$ )
- (3) Low leakage current:  $I_{DSS} = -10 \mu A \text{ (max) (V}_{DS} = -20 \text{ V)}$
- (4) Enhancement mode:  $V_{th}$  = -0.5 to -1.2 V ( $V_{DS}$  = -10 V,  $I_D$  = -0.2 mA)

#### 3. Packaging and Internal Circuit



### 4. Absolute Maximum Ratings (Note) (Ta = 25°C unless otherwise specified)

Characteris	Symbol	Rating	Unit		
Drain-source voltage			$V_{DSS}$	-20	V
Gate-source voltage			V <sub>GSS</sub>	±12	
Drain current (DC)		(Note 1)	Ι <sub>D</sub>	-2.8	Α
Drain current (pulsed)		(Note 1)	I <sub>DP</sub>	-11.2	
Power dissipation	(t = 5 s)	(Note 2)	$P_D$	2.2	W
Power dissipation	(t = 5 s)	(Note 3)	$P_D$	0.7	W
Single-pulse avalanche energy		(Note 4)	E <sub>AS</sub>	10.1	mJ
Avalanche current			I <sub>AR</sub>	-2.8	Α
Channel temperature			T <sub>ch</sub>	150	℃
Storage temperature			T <sub>stg</sub>	-55 to 150	

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).

Start of commercial production



#### 5. Thermal Characteristics

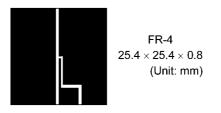
Characteristics				Max	Unit
Channel-to-ambient thermal resistance	(t = 5 s)	(Note 2)	R <sub>th(ch-a)</sub>	56.8	°C/W
Channel-to-ambient thermal resistance	(t = 5 s)	(Note 3)	R <sub>th(ch-a)</sub>	178	°C/W

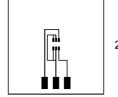
Note 1: Ensure that the channel temperature does not exceed 150°C.

Note 2: Device mounted on a glass-epoxy board (a), Figure 5.1

Note 3: Device mounted on a glass-epoxy board (b), Figure 5.2

Note 4:  $V_{DD}$  = -16 V,  $T_{ch}$  = 25°C (initial), L = 1 mH,  $R_{G}$  = 25  $\Omega,\,I_{AR}$  = -2.8 A





 $\begin{aligned} & \text{FR-4} \\ 25.4 \times 25.4 \times 0.8 \\ & \text{(Unit: mm)} \end{aligned}$ 

Fig. 5.1 Device Mounted on a Glass-Epoxy Board (a)

Fig. 5.2 Device Mounted on a Glass-Epoxy Board (b)

Note: This transistor is sensitive to electrostatic discharge and should be handled with care.



#### 6. Electrical Characteristics

## 6.1. Static Characteristics (T<sub>a</sub> = 25°C unless otherwise specified)

Characteristics	Symbol	Test Condition	Min	Тур.	Max	Unit
Gate leakage current	I <sub>GSS</sub>	$V_{GS} = \pm 12 \text{ V}, V_{DS} = 0 \text{ V}$	_		±0.1	μА
Drain cut-off current	I <sub>DSS</sub>	V <sub>DS</sub> = -20 V, V <sub>GS</sub> = 0 V	-	_	-10	
Drain-source breakdown voltage	V <sub>(BR)DSS</sub>	$I_D = -10 \text{ mA}, V_{GS} = 0 \text{ V}$	-20			V
Drain-source breakdown voltage (Note 5)	V <sub>(BR)DSX</sub>	$I_D = -10 \text{ mA}, V_{GS} = 8 \text{ V}$	-12			
Gate threshold voltage	$V_{th}$	$V_{DS} = -10 \text{ V}, I_{D} = -0.2 \text{ mA}$	-0.5		-1.2	
Drain-source on-resistance	R <sub>DS(ON)</sub>	$V_{GS} = -2.5 \text{ V}, I_D = -1.4 \text{ A}$	1	128	164	mΩ
		$V_{GS}$ = -4.5 V, $I_D$ = -1.4 A	_	86	106	

Note 5: If a forward bias is applied between gate and source, this device enters  $V_{(BR)DSX}$  mode. Note that the drain-source breakdown voltage is lowered in this mode.

#### 6.2. Dynamic Characteristics (T<sub>a</sub> = 25°C unless otherwise specified)

Characteristics	Symbol	Test Condition	Min	Тур.	Max	Unit
Input capacitance	C <sub>iss</sub>	V <sub>DS</sub> = -10 V, V <sub>GS</sub> = 0 V, f = 1 MHz	_	360	_	pF
Reverse transfer capacitance	C <sub>rss</sub>		_	47	_	
Output capacitance	C <sub>oss</sub>		_	63	_	
Switching time (rise time)	t <sub>r</sub>	See Figure 6.2.1.	_	4	_	ns
Switching time (turn-on time)	t <sub>on</sub>		_	13	_	
Switching time (fall time)	t <sub>f</sub>		_	9	_	
Switching time (turn-off time)	t <sub>off</sub>		_	40	_	

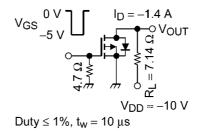


Fig. 6.2.1 Switching Time Test Circuit

### 6.3. Gate Charge Characteristics (T<sub>a</sub> = 25°C unless otherwise specified)

Characteristics	Symbol	ol Test Condition		Тур.	Max	Unit
Total gate charge (gate-source plus gate-drain)	Qg	$V_{DD} \approx -16 \text{ V}, V_{GS} = -5 \text{ V}, I_{D} = -2.8 \text{ A}$		5.1		nC
Gate-source charge 1	Q <sub>gs1</sub>		_	0.8		
Gate-drain charge	$Q_{gd}$		_	1.8		

### 6.4. Source-Drain Characteristics (T<sub>a</sub> = 25°C unless otherwise specified)

Characteristics		Symbol	Test Condition	Min	Тур.	Max	Unit
Reverse drain current (pulsed)	(Note 6)	I <sub>DRP</sub>	_	_	_	-11.2	Α
Diode forward voltage		$V_{DSF}$	I <sub>DR</sub> = -2.8 A, V <sub>GS</sub> = 0 V	_	_	1.2	V

Note 6: Ensure that the channel temperature does not exceed 150°C.



## 7. Marking

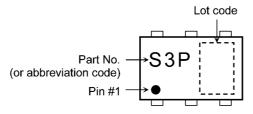


Fig. 7.1 Marking

#### 8. Characteristics Curves (Note)

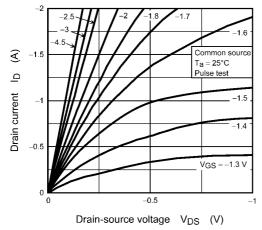
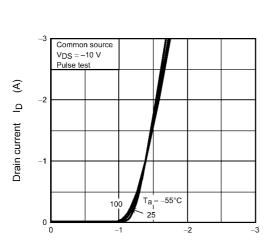


Fig. 8.1  $I_D - V_{DS}$ 



Gate-source voltage V<sub>GS</sub> (V) Fig. 8.3 I<sub>D</sub> - V<sub>GS</sub>

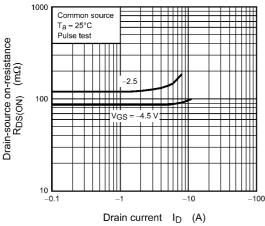


Fig. 8.5 R<sub>DS(ON)</sub> - I<sub>D</sub>

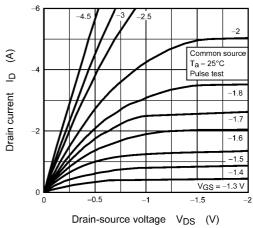


Fig. 8.2 I<sub>D</sub> - V<sub>DS</sub>

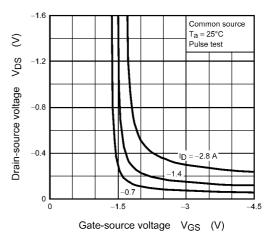


Fig. 8.4 V<sub>DS</sub> - V<sub>GS</sub>

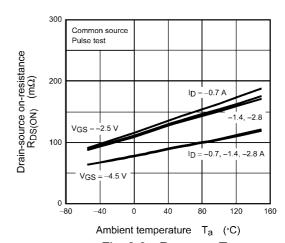


Fig. 8.6 R<sub>DS(ON)</sub> - T<sub>a</sub>

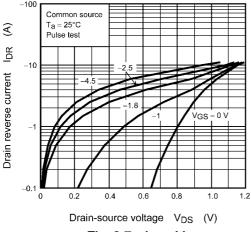


Fig. 8.7  $I_{DR}$  -  $V_{DS}$ 

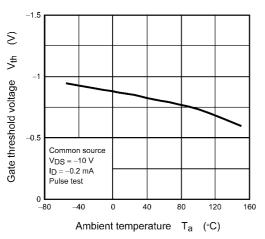


Fig. 8.9 V<sub>th</sub> - T<sub>a</sub>

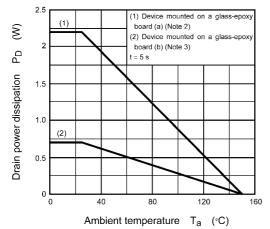


Fig. 8.11 P<sub>D</sub> - T<sub>a</sub> (Guaranteed Maximum)

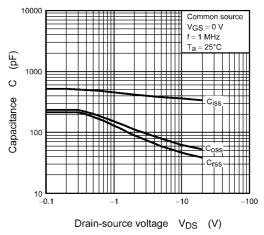


Fig. 8.8 Capacitance - V<sub>DS</sub>

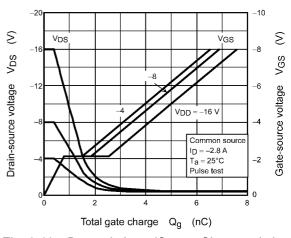


Fig. 8.10 Dynamic Input/Output Characteristics

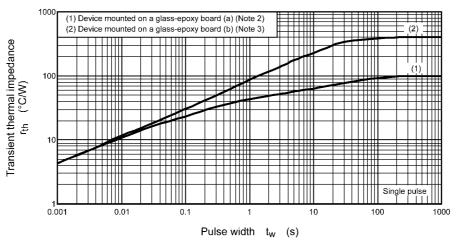


Fig. 8.12 r<sub>th</sub> - t<sub>w</sub> (Guaranteed Maximum)

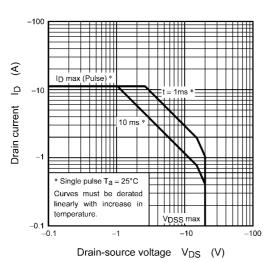


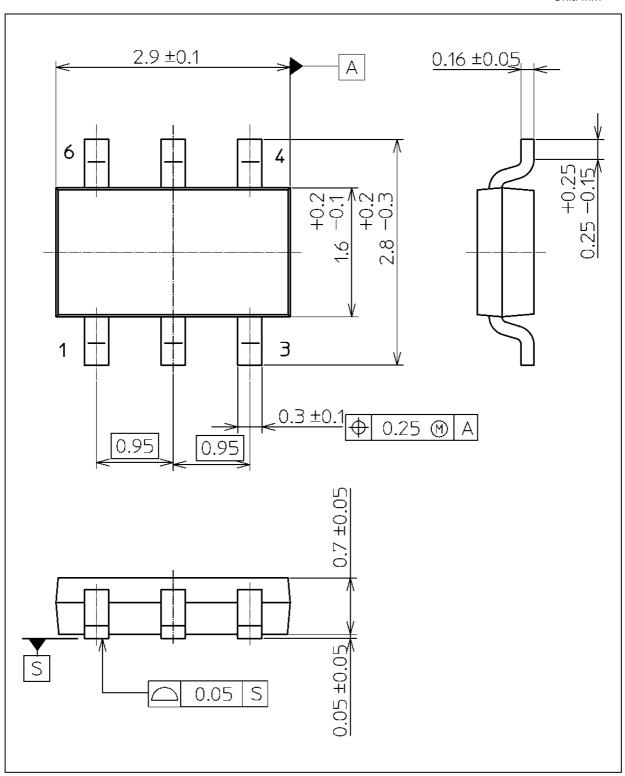
Fig. 8.13 Safe Operating Area (Guaranteed Maximum)

Note: The above characteristics curves are presented for reference only and not guaranteed by production test, unless otherwise noted.



## **Package Dimensions**

Unit: mm



Weight: 0.011 g (typ.)

Package Name(s)
TOSHIBA: 2-3T1S
Nickname: VS-6



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