

MOSFETs Silicon N-channel MOS (U-MOSIX-H)

# TPH3R70APL1

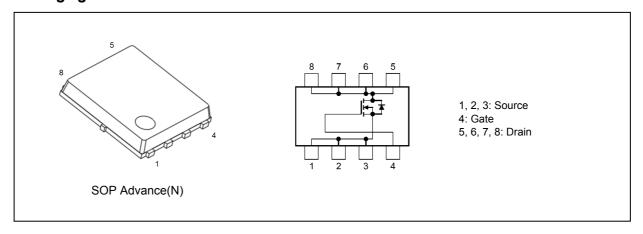
#### 1. Applications

- · High-Efficiency DC-DC Converters
- · Switching Voltage Regulators
- · Motor Drivers

#### 2. Features

- (1) High-speed switching
- (2) Small gate charge:  $Q_{SW} = 21 \text{ nC (typ.)}$
- (3) Small output charge:  $Q_{oss} = 74 \text{ nC (typ.)}$
- (4) Low drain-source on-resistance:  $R_{DS(ON)} = 3.1 \text{ m}\Omega$  (typ.) ( $V_{GS} = 10 \text{ V}$ )
- (5) Low leakage current:  $I_{DSS} = 10 \mu A \text{ (max) (V}_{DS} = 100 \text{ V)}$
- (6) Enhancement mode:  $V_{th} = 1.5$  to 2.5 V ( $V_{DS} = 10$  V,  $I_D = 1$  mA)

#### 3. Packaging and Internal Circuit





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

Characteristics	3		Symbol	Rating	Unit
Drain-source voltage			$V_{DSS}$	100	V
Gate-source voltage	,		$V_{GSS}$	±20	
Drain current (DC)	(T <sub>c</sub> = 25 °C)	(Note 1)	I <sub>D</sub>	90	Α
Drain current (DC)	(Silicon limit)	(Note 1), (Note 2)	I <sub>D</sub>	170	
Drain current (pulsed)	(t = 100 μs)	(Note 1)	I <sub>DP</sub>	500	
Power dissipation	(T <sub>c</sub> = 25 °C)		$P_{D}$	210	W
Power dissipation		(Note 3)	P <sub>D</sub>	3	
Power dissipation	,	(Note 4)	$P_{D}$	0.96	
Single-pulse avalanche energy		(Note 5)	E <sub>AS</sub>	157	mJ
Single-pulse avalanche current		(Note 5)	I <sub>AS</sub>	90	Α
Channel temperature			T <sub>ch</sub>	175	°C
Storage temperature			T <sub>stg</sub>	-55 to 175	

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).

#### 5. Thermal Characteristics

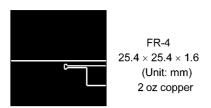
Characteristics			Symbol	Max	Unit
Channel-to-case thermal resistance	(T <sub>c</sub> = 25 °C)		R <sub>th(ch-c)</sub>	0.71	°C/W
Channel-to-ambient thermal resistance	(T <sub>a</sub> = 25 °C)	(Note 3)	R <sub>th(ch-a)</sub>	50	
Channel-to-ambient thermal resistance	(T <sub>a</sub> = 25 °C)	(Note 4)	R <sub>th(ch-a)</sub>	156	

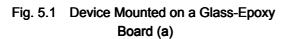
Note 1: Ensure that the channel temperature does not exceed 175 °C.

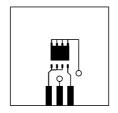
Note 2: Limited by silicon chip capability.

Note 3: Device mounted on a glass-epoxy board (a), Figure 5.1 Note 4: Device mounted on a glass-epoxy board (b), Figure 5.2

Note 5:  $V_{DD}$  = 60 V,  $T_{ch}$  = 25 °C (initial), L = 21  $\mu$ H,  $I_{AS}$  =90 A







FR-4  $25.4 \times 25.4 \times 1.6$  (Unit: mm) 2 oz copper

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>	$V_{GS} = \pm 20 \text{ V}, V_{DS} = 0 \text{ V}$	_	_	±0.1	μА
Drain cut-off current	I <sub>DSS</sub>	V <sub>DS</sub> = 100 V, V <sub>GS</sub> = 0 V	_	_	10	
Drain-source breakdown voltage	V <sub>(BR)DSS</sub>	I <sub>D</sub> = 10 mA, V <sub>GS</sub> = 0 V	100	_		V
Drain-source breakdown voltage (Note 6)	V <sub>(BR)DSX</sub>	I <sub>D</sub> = 10 mA, V <sub>GS</sub> = -20 V	65	_	_	
Gate threshold voltage	$V_{th}$	V <sub>DS</sub> = 10 V, I <sub>D</sub> = 1 mA	1.5	_	2.5	
Drain-source on-resistance	R <sub>DS(ON)</sub>	V <sub>GS</sub> = 4.5 V, I <sub>D</sub> = 20 A	_	4.1	6.2	mΩ
		V <sub>GS</sub> = 10 V, I <sub>D</sub> = 45 A	_	3.1	3.7	

Note 6: If a reverse 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> = 50 V, V <sub>GS</sub> = 0 V, f = 1 MHz	_	4850	6300	pF
Reverse transfer capacitance	C <sub>rss</sub>		_	29	59	
Output capacitance	C <sub>oss</sub>		_	640	_	
Gate resistance	r <sub>g</sub>	_	_	2.1	3.2	Ω
Switching time (rise time)	t <sub>r</sub>	See Fig. 6.2.1	_	10	_	ns
Switching time (turn-on time)	t <sub>on</sub>		_	21	_	
Switching time (fall time)	t <sub>f</sub>		_	19	_	
Switching time (turn-off time)	t <sub>off</sub>		_	68	_	

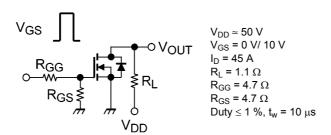


Fig. 6.2.1 Switching Time Test Circuit

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

Characteristics	Symbol	Test Condition	Min	Тур.	Max	Unit
Total gate charge (gate-source plus	$Q_g$	$V_{DD} \approx 50 \text{ V}, V_{GS} = 10 \text{ V}, I_D = 45 \text{ A}$	_	67	1	nC
gate-drain)		$V_{DD} \approx 50 \text{ V}, V_{GS} = 4.5 \text{ V}, I_D = 20 \text{ A}$	_	33		
Gate-source charge 1	Q <sub>gs1</sub>	$V_{DD} \approx 50 \text{ V}, V_{GS} = 10 \text{ V}, I_D = 45 \text{ A}$	_	16		
Gate-drain charge	$Q_{gd}$		_	14		
Gate switch charge	$Q_{SW}$		_	21		
Output charge	$Q_{oss}$	V <sub>DS</sub> = 50 V, V <sub>GS</sub> = 0 V, f = 1 MHz	_	74		



## 6.4. Source-Drain Characteristics ( $T_a = 25$ °C unless otherwise specified)

Characteristics	Symbol	Test Condition	Min	Тур.	Max	Unit
Reverse drain current (pulsed) (Note 7)	I <sub>DRP</sub>	(t = 100 μs)	_	_	500	Α
Diode forward voltage	V <sub>DSF</sub>	I <sub>DR</sub> = 90 A, V <sub>GS</sub> = 0 V		_	-1.2	V
Reverse recovery time	t <sub>rr</sub>	I <sub>DR</sub> = 22.5 A, V <sub>GS</sub> = 0 V,		53		ns
Reverse recovery charge	$Q_{rr}$	-dI <sub>DR</sub> /dt = 100 A/μs		74		nC

Note 7: Ensure that the channel temperature does not exceed 175  $^{\circ}\text{C}$ .

### 7. Marking

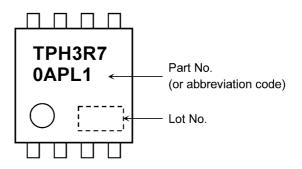


Fig. 7.1 Marking



#### 8. Characteristics Curves (Note)

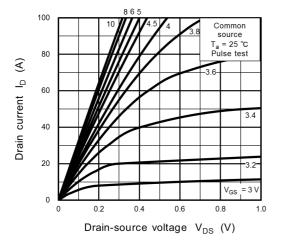


Fig. 8.1 I<sub>D</sub> - V<sub>DS</sub>

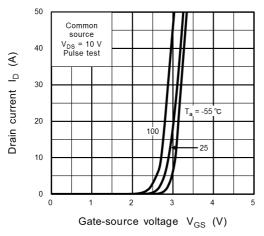


Fig. 8.3  $I_D - V_{GS}$ 

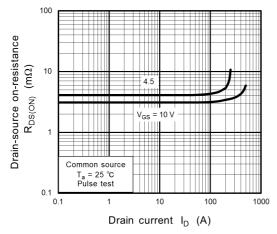


Fig. 8.5 R<sub>DS(ON)</sub> - I<sub>D</sub>

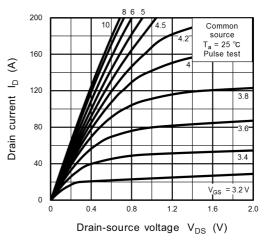


Fig. 8.2 I<sub>D</sub> - V<sub>DS</sub>

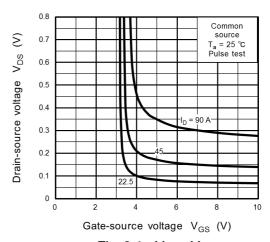


Fig. 8.4 V<sub>DS</sub> - V<sub>GS</sub>

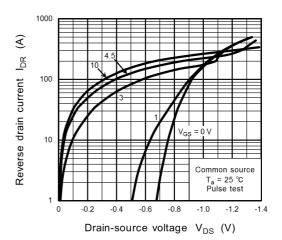


Fig. 8.6  $I_{DR}$  -  $V_{DS}$ 



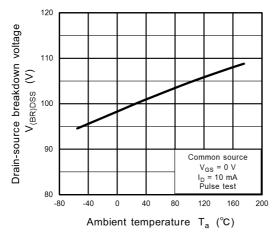


Fig. 8.7 V<sub>(BR)DSS</sub> - T<sub>a</sub>

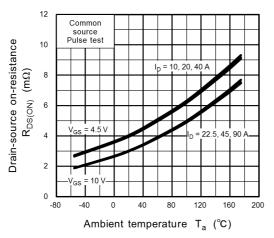


Fig. 8.9 R<sub>DS(ON)</sub> - T<sub>a</sub>

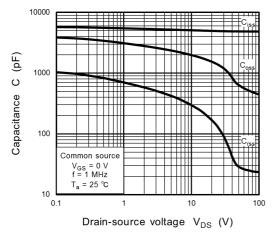


Fig. 8.11 Capacitance - V<sub>DS</sub>

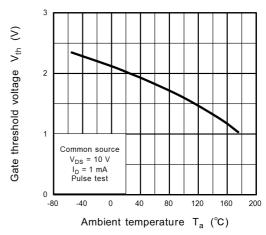


Fig. 8.8 V<sub>th</sub> - T<sub>a</sub>

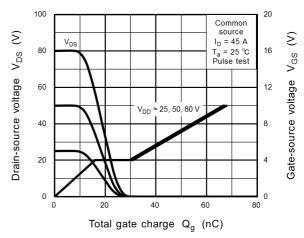


Fig. 8.10 Dynamic Input/Output Characteristics

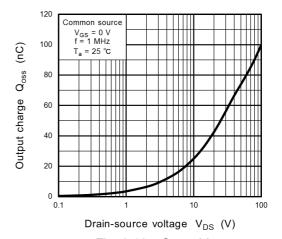


Fig. 8.12 Qoss - VDS

Rev.2.0



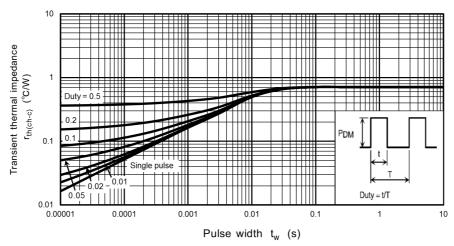


Fig. 8.13 r<sub>th</sub> - t<sub>w</sub> (Guaranteed Maximum)

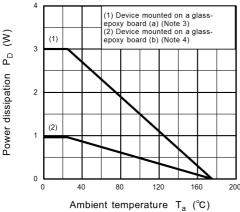


Fig. 8.14 P<sub>D</sub> - T<sub>a</sub> (Guaranteed Maximum)

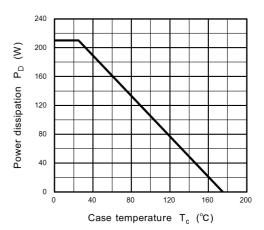


Fig. 8.15 P<sub>D</sub> - T<sub>c</sub> (Guaranteed Maximum)

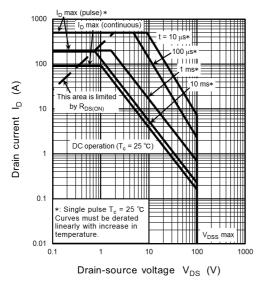


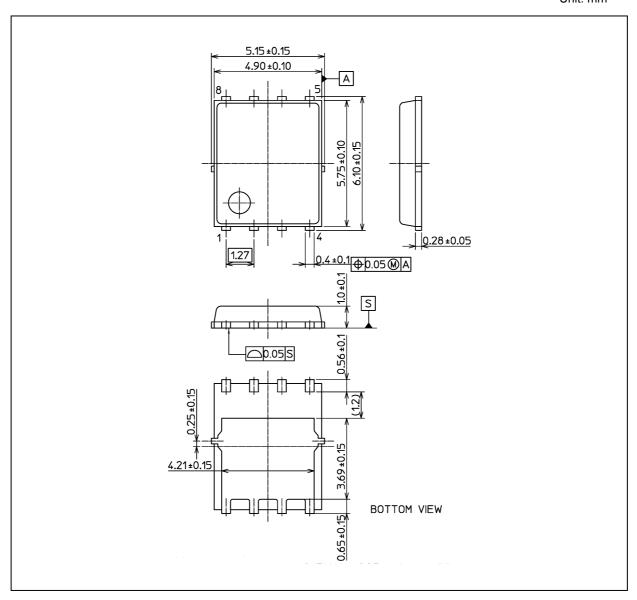
Fig. 8.16 Safe Operating Area (Guaranteed Maximum)

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



### **Package Dimensions**

Unit: mm



Weight: 0.111 g (typ.)

Package Name(s)
TOSHIBA: 2-5W1A
Nickname: SOP Advance(N)



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