

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

# **TPN11006NL**

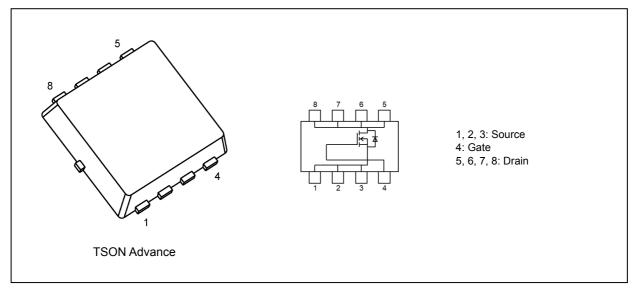
#### 1. Applications

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

#### 2. Features

- (1) High-speed switching
- (2) Small gate charge:  $Q_{SW} = 6.4 \text{ nC (typ.)}$
- (3) Low drain-source on-resistance:  $R_{DS(ON)} = 9.6 \text{ m}\Omega$  (typ.) ( $V_{GS} = 10 \text{ V}$ )
- (4) Low leakage current:  $I_{DSS} = 10 \mu A \text{ (max) (V}_{DS} = 60 \text{ V)}$
- (5) Enhancement mode:  $V_{th} = 1.5 \text{ to } 2.5 \text{ V } (V_{DS} = 10 \text{ V}, I_D = 0.2 \text{ mA})$

### 3. Packaging and Internal Circuit





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

Characteristi	cs		Symbol	Rating	Unit
Drain-source voltage			$V_{DSS}$	60	V
Gate-source voltage	·		$V_{GSS}$	±20	
Drain current (DC)	(Silicon limit)	(Note 1), (Note 2)	I <sub>D</sub>	37	Α
Drain current (DC)	(T <sub>c</sub> = 25 °C)	(Note 1)	I <sub>D</sub>	17	
Drain current (pulsed)	(t = 1 ms)	(Note 1)	I <sub>DP</sub>	81	
Power dissipation	(T <sub>c</sub> = 25 °C)		$P_{D}$	30	W
Power dissipation	(t = 10 s)	(Note 3)	P <sub>D</sub>	1.9	
Power dissipation	(t = 10 s)	(Note 4)	$P_{D}$	0.7	
Single-pulse avalanche energy		(Note 5)	E <sub>AS</sub>	35	mJ
Avalanche current			I <sub>AR</sub>	17	Α
Channel temperature			T <sub>ch</sub>	150	°C
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).

#### 5. Thermal Characteristics

Characteristics			Symbol	Max	Unit
Channel-to-case thermal resistance	(T <sub>c</sub> = 25 °C)		R <sub>th(ch-c)</sub>	4.16	°C/W
Channel-to-ambient thermal resistance	(t = 10 s)	(Note 3)	R <sub>th(ch-a)</sub>	65.7	
Channel-to-ambient thermal resistance	(t = 10 s)	(Note 4)	R <sub>th(ch-a)</sub>	178	

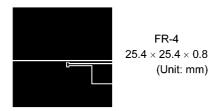
Note 1: Ensure that the channel temperature does not exceed 150 °C.

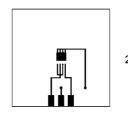
Note 2: Limited by silicon chip capability.

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:  $V_{DD}$  = 48 V,  $T_{ch}$  = 25 °C (initial), L = 95  $\mu$ H,  $I_{AR}$  = 17 A





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

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>	$V_{GS} = \pm 20 \text{ V}, V_{DS} = 0 \text{ V}$	_	_	±0.1	μА
Drain cut-off current	I <sub>DSS</sub>	V <sub>DS</sub> = 60 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	60	_		V
	V <sub>(BR)DSX</sub>	$I_D = 10 \text{ mA}, V_{GS} = -20 \text{ V}$	45	_		
Gate threshold voltage	$V_{th}$	$V_{DS} = 10 \text{ V}, I_D = 0.2 \text{ mA}$	1.5	_	2.5	
Drain-source on-resistance	R <sub>DS(ON)</sub>	$V_{GS} = 4.5 \text{ V}, I_D = 8.5 \text{ A}$	_	12.8	17	mΩ
		$V_{GS}$ = 10 V, $I_D$ = 8.5 A	_	9.6	11.4	

## 6.2. Dynamic Characteristics (Ta = 25 °C unless otherwise specified)

Characteristics	Symbol	Test Condition	Min	Тур.	Max	Unit
Input capacitance	C <sub>iss</sub>	V <sub>DS</sub> = 30 V, V <sub>GS</sub> = 0 V, f = 1 MHz	_	1500	2000	pF
Reverse transfer capacitance	C <sub>rss</sub>		_	23	50	
Output capacitance	C <sub>oss</sub>		_	350		
Gate resistance	r <sub>g</sub>	_		0.6	1.1	Ω
Switching time (rise time)	t <sub>r</sub>	See Fig. 6.2.1		4.0		ns
Switching time (turn-on time)	t <sub>on</sub>			11.0		
Switching time (fall time)	t <sub>f</sub>		_	7.1	_	
Switching time (turn-off time)	t <sub>off</sub>		_	27	_	

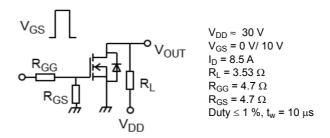


Fig. 6.2.1 Switching Time Test Circuit

## 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	$Q_g$	$V_{DD} \approx 30 \text{ V}, V_{GS} = 10 \text{ V}, I_D = 17 \text{ A}$	_	23		nC
gate-drain)		$V_{DD} \approx 30 \text{ V}, V_{GS} = 4.5 \text{ V}, I_D = 17 \text{ A}$		11.2		
Gate-source charge 1	Q <sub>gs1</sub>	$V_{DD} \approx 30 \text{ V}, V_{GS} = 10 \text{ V}, I_D = 17 \text{ A}$		5.0		
Gate-drain charge	$Q_{gd}$		_	4.1		
Gate switch charge	$Q_SW$			6.4		

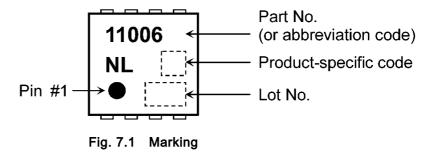
## 6.4. Source-Drain Characteristics (T<sub>a</sub> = 25 °C unless otherwise specified)

Characteristics		Symbol	Test Condition	Min	Тур.	Max	Unit
Reverse drain current (pulsed) (N	Note 6)	$I_{DRP}$		_	_	81	Α
Diode forward voltage		$V_{DSF}$	I <sub>DR</sub> = 17 A, V <sub>GS</sub> = 0 V			-1.2	V

Note 6: Ensure that the channel temperature does not exceed 150  $^{\circ}\text{C}.$ 



## 7. Marking



Rev.3.0



#### 8. Characteristics Curves (Note)

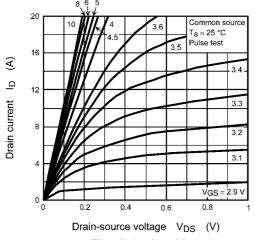
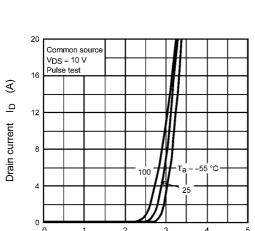


Fig. 8.1  $I_D - V_{DS}$ 



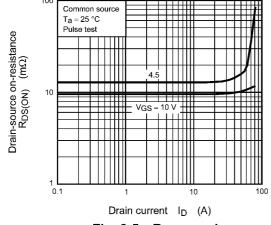


Fig. 8.5 R<sub>DS(ON)</sub> - I<sub>D</sub>

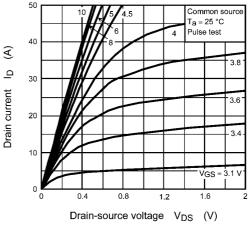


Fig. 8.2 I<sub>D</sub> - V<sub>DS</sub>

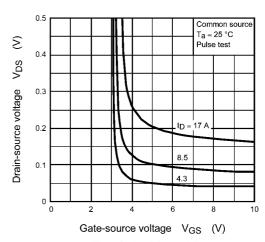


Fig. 8.4 V<sub>DS</sub> - V<sub>GS</sub>

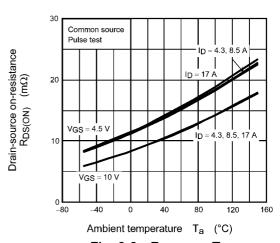
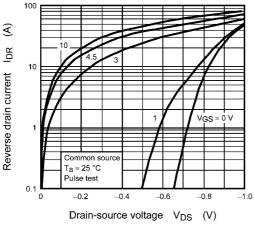
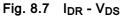


Fig. 8.6 R<sub>DS(ON)</sub> - T<sub>a</sub>







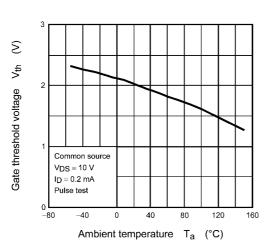


Fig. 8.9 V<sub>th</sub> - T<sub>a</sub>

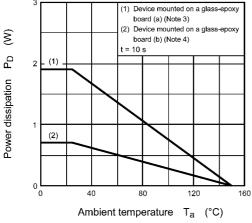


Fig. 8.11 P<sub>D</sub> - T<sub>a</sub> (Guaranteed Maximum)

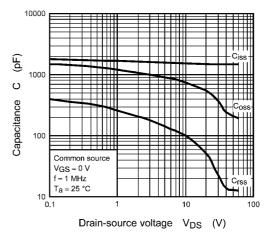


Fig. 8.8 Capacitance - V<sub>DS</sub>

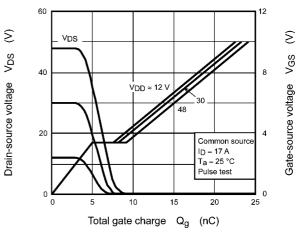


Fig. 8.10 Dynamic Input/Output Characteristics

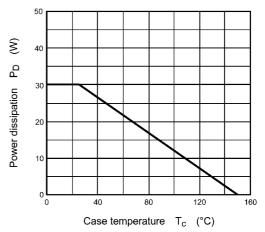


Fig. 8.12 P<sub>D</sub> - T<sub>c</sub> (Guaranteed Maximum)



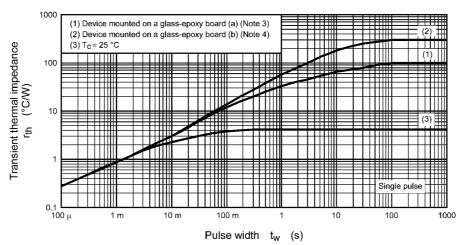


Fig. 8.13 r<sub>th</sub> - t<sub>w</sub> (Guaranteed Maximum)

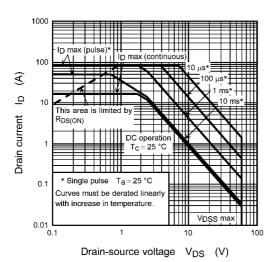


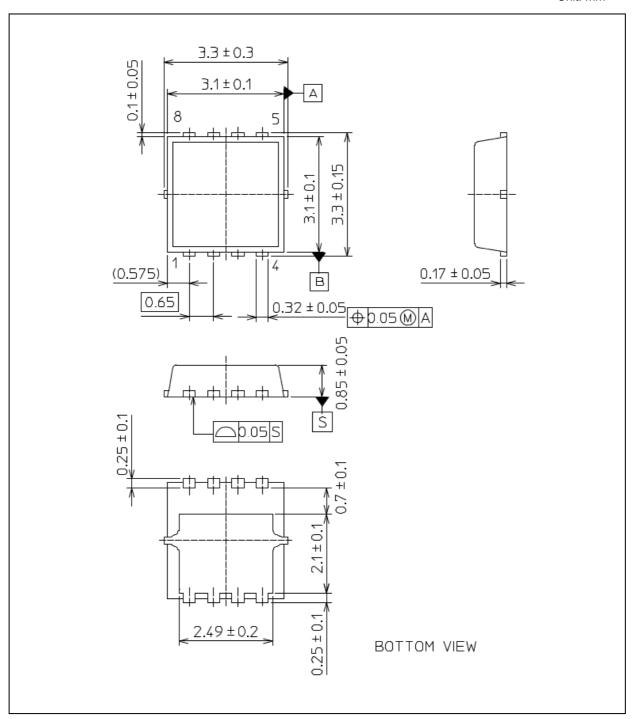
Fig. 8.14 Safe Operating Area (Guaranteed Maximum)

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



## **Package Dimensions**

Unit: mm



Weight: 0.02 g (typ.)

Package Name(s)
TOSHIBA: 2-3X1S
Nickname: TSON Advance

Rev.3.0



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