

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

## XPQ1R004PB

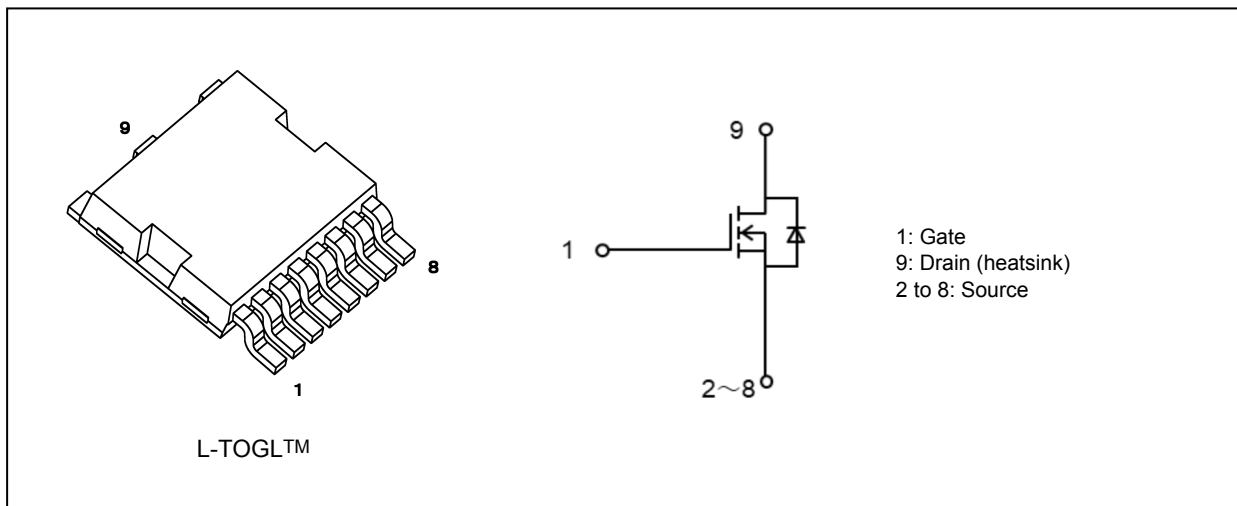
### 1. Applications

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

### 2. Features

- (1) AEC-Q101 qualified
- (2) Low drain-source on-resistance:  $R_{DS(ON)} = 0.8 \text{ m}\Omega$  (typ.) ( $V_{GS} = 10 \text{ V}$ )
- (3) Low leakage current:  $I_{DSS} = 10 \text{ }\mu\text{A}$  (max) ( $V_{DS} = 40 \text{ V}$ )
- (4) Enhancement mode:  $V_{th} = 2.0$  to  $3.0 \text{ V}$  ( $V_{DS} = 10 \text{ V}$ ,  $I_D = 0.5 \text{ mA}$ )

### 3. Packaging and Internal Circuit (Note)



Note: L-TOGL™ is a trademark of Toshiba Electronic Devices & Storage Corporation.

Start of commercial production  
2022-11

## 4. Absolute Maximum Ratings (Note) ( $T_a = 25\text{ °C}$ unless otherwise specified)

Characteristics	Symbol	Rating	Unit
Drain-source voltage	$V_{DSS}$	40	V
Gate-source voltage	$V_{GSS}$	$\pm 20$	
Drain current (DC) (Note 1)	$I_D$	200	A
Drain current (pulsed) (Note 1)	$I_{DP}$	600	
Power dissipation ( $T_c = 25\text{ °C}$ )	$P_D$	230	W
Single-pulse avalanche energy (Note 2)	$E_{AS}$	208	mJ
Single-pulse avalanche current	$I_{AS}$	100	A
Channel temperature (Note 3)	$T_{ch}$	175	$^{\circ}\text{C}$
Storage temperature (Note 3)	$T_{stg}$	-55 to 175	$^{\circ}\text{C}$

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).

## 5. Thermal Characteristics

Characteristics	Symbol	Max	Unit
Channel-to-case thermal impedance ( $T_c = 25\text{ °C}$ )	$Z_{th(ch-c)}$	0.65	$^{\circ}\text{C}/\text{W}$

Note 1: Ensure that the channel temperature does not exceed 175  $^{\circ}\text{C}$ .

Note 2:  $V_{DD} = 32\text{ V}$ ,  $T_{ch} = 25\text{ °C}$  (initial),  $L = 16\text{ }\mu\text{H}$ ,  $R_G = 25\text{ }\Omega$ ,  $I_{AS} = 100\text{ A}$

Note 3: The definitions of the absolute maximum channel and storage temperatures are based on AEC-Q101.

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

### 6. Electrical Characteristics

#### 6.1. Static Characteristics ( $T_a = 25\text{ }^\circ\text{C}$ unless otherwise specified)

Characteristics	Symbol	Test Condition	Min	Typ.	Max	Unit
Gate leakage current	$I_{GSS}$	$V_{GS} = \pm 20\text{ V}, V_{DS} = 0\text{ V}$	—	—	$\pm 1$	$\mu\text{A}$
Drain cut-off current	$I_{DSS}$	$V_{DS} = 40\text{ V}, V_{GS} = 0\text{ V}$	—	—	10	
Drain-source breakdown voltage	$V_{(BR)DSS}$	$I_D = 10\text{ mA}, V_{GS} = 0\text{ V}$	40	—	—	V
	$V_{(BR)DSX}$	$I_D = 10\text{ mA}, V_{GS} = -20\text{ V}$	20	—	—	
Gate threshold voltage	$V_{th}$	$V_{DS} = 10\text{ V}, I_D = 0.5\text{ mA}$	2.0	—	3.0	
Drain-source on-resistance	$R_{DS(ON)}$	$V_{GS} = 6\text{ V}, I_D = 100\text{ A}$	—	1.2	1.8	$\text{m}\Omega$
		$V_{GS} = 10\text{ V}, I_D = 100\text{ A}$	—	0.8	1.0	

#### 6.2. Dynamic Characteristics ( $T_a = 25\text{ }^\circ\text{C}$ unless otherwise specified)

Characteristics	Symbol	Test Condition	Min	Typ.	Max	Unit
Input capacitance	$C_{iss}$	$V_{DS} = 10\text{ V}, V_{GS} = 0\text{ V}, f = 300\text{ KHz}$	—	5300	6890	$\text{pF}$
Reverse transfer capacitance	$C_{rss}$		—	400	680	
Output capacitance	$C_{oss}$		—	3680	—	
Gate resistance	$r_g$		—	3.2	6.4	$\Omega$
Switching time (rise time)	$t_r$	See Fig. 6.2.1	—	33	—	ns
Switching time (turn-on time)	$t_{on}$		—	57	—	
Switching time (fall time)	$t_f$		—	39	—	
Switching time (turn-off time)	$t_{off}$		—	113	—	

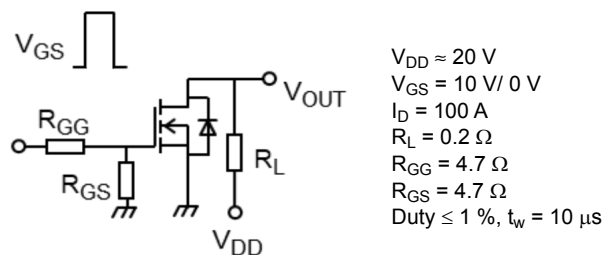


Fig. 6.2.1 Switching Time Test Circuit

#### 6.3. Gate Charge Characteristics ( $T_a = 25\text{ }^\circ\text{C}$ unless otherwise specified)

Characteristics	Symbol	Test Condition	Min	Typ.	Max	Unit
Total gate charge (gate-source plus gate-drain)	$Q_g$	$V_{DD} \approx 32\text{ V}, V_{GS} = 10\text{ V}, I_D = 200\text{ A}$	—	84	—	nC
Gate-source charge 1	$Q_{gs1}$		—	29	—	
Gate-drain charge	$Q_{gd}$		—	19	—	

#### 6.4. Source-Drain Characteristics ( $T_a = 25\text{ }^\circ\text{C}$ unless otherwise specified)

Characteristics	Symbol	Test Condition	Min	Typ.	Max	Unit
Reverse drain current (DC) (Note 5)	$I_{DR}$	—	—	—	200	A
Reverse drain current (pulsed) (Note 5)	$I_{DRP}$	—	—	—	600	
Diode forward voltage	$V_{DSF}$	$I_{DR} = 200\text{ A}, V_{GS} = 0\text{ V}$	—	—	-1.2	V
Reverse recovery time	$t_{rr}$	$I_{DR} = 200\text{ A}, V_{GS} = 0\text{ V}$ $-di_{DR}/dt = 100\text{ A}/\mu\text{s}$	—	85	—	ns
Reverse recovery charge	$Q_{rr}$		—	136	—	nC

Note 5: Ensure that the channel temperature does not exceed  $175\text{ }^\circ\text{C}$ .

## 7. Marking

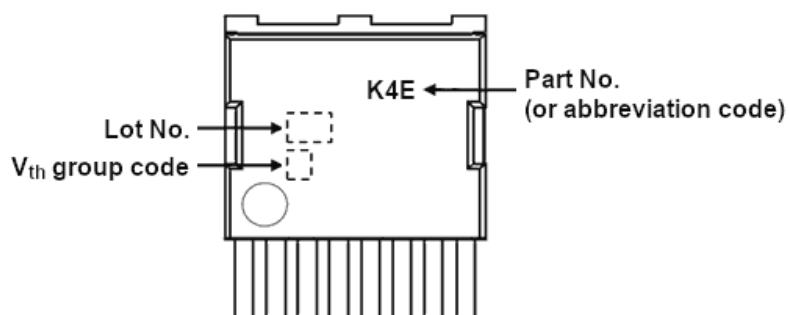


Fig. 7.1 Marking

Note 4: If requested,  $V_{th}$  grouping is possible for each reel. ( $V_{th}$  width is 0.4 V)  
However, we do not accept specifications in specific groups.  
If there is no request, the group-free reel will be applied. ( $V_{th}$  width is 1.0 V, no  $V_{th}$  group code is printed on marking)

## 8. Characteristics Curves (Note)

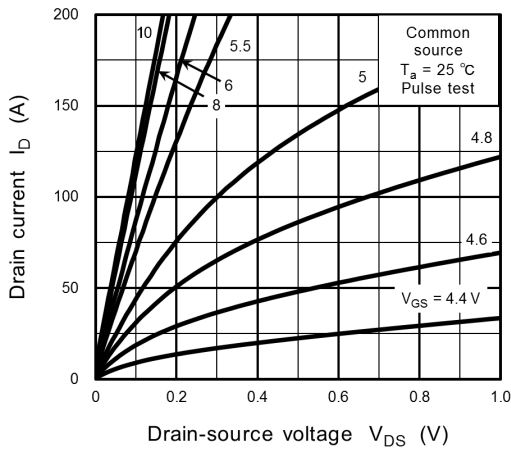


Fig. 8.1  $I_D - V_{DS}$

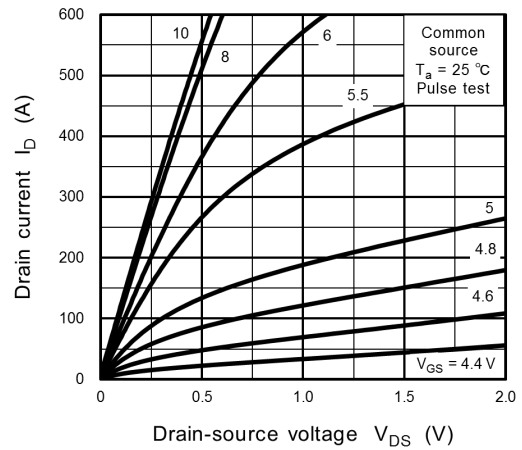


Fig. 8.2  $I_D - V_{DS}$

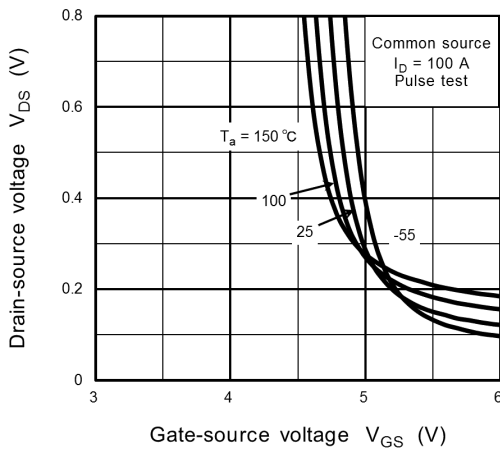


Fig. 8.3  $V_{DS} - V_{GS}$

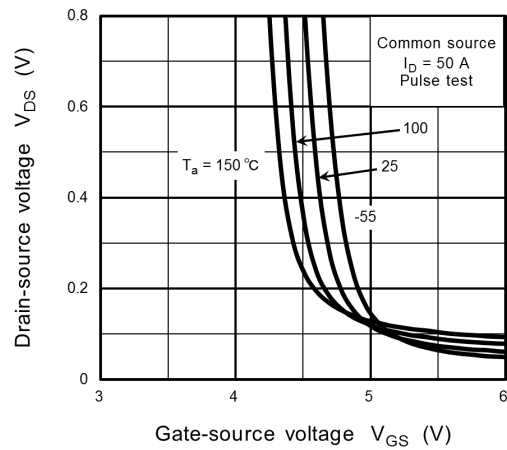


Fig. 8.4  $V_{DS} - V_{GS}$

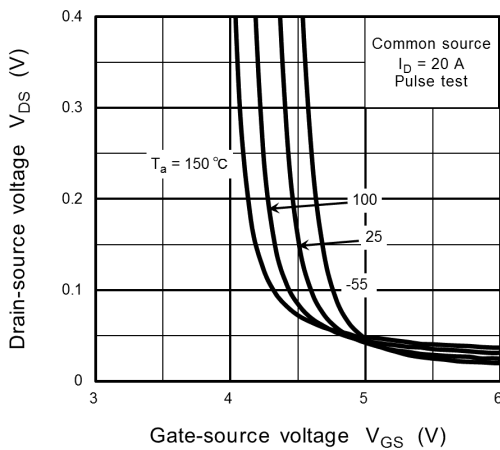


Fig. 8.5  $V_{DS} - V_{GS}$

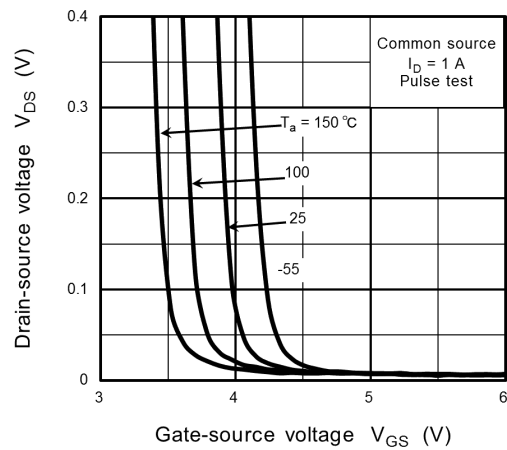
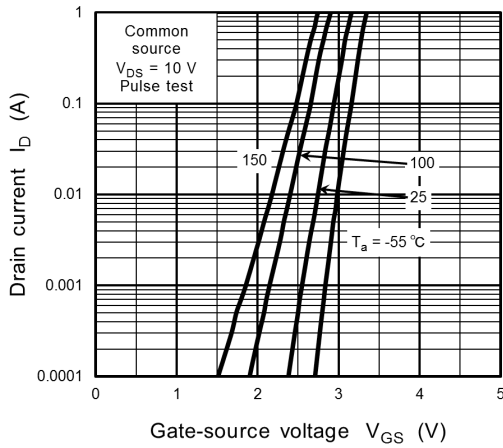
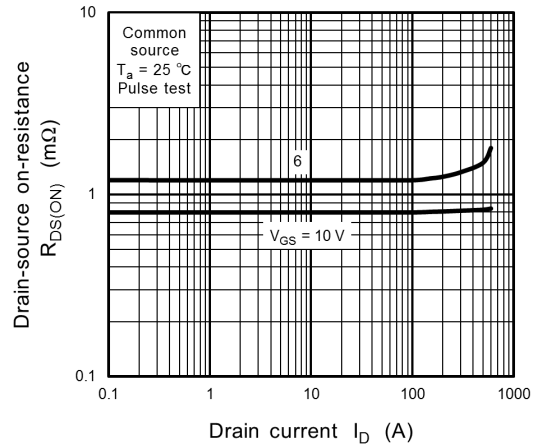


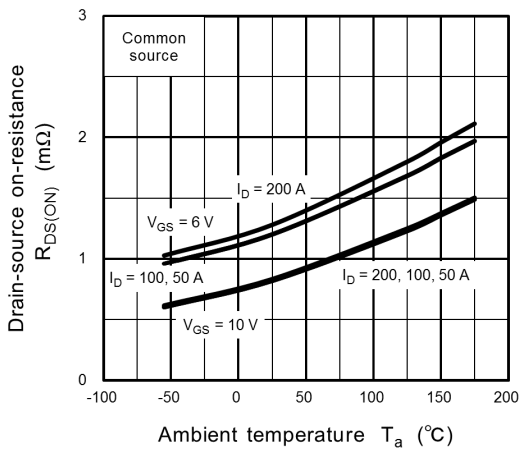
Fig. 8.6  $V_{DS} - V_{GS}$



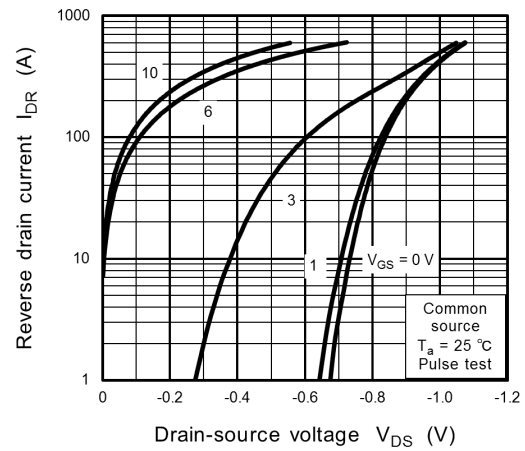
**Fig. 8.7  $I_D - V_{GS}$**



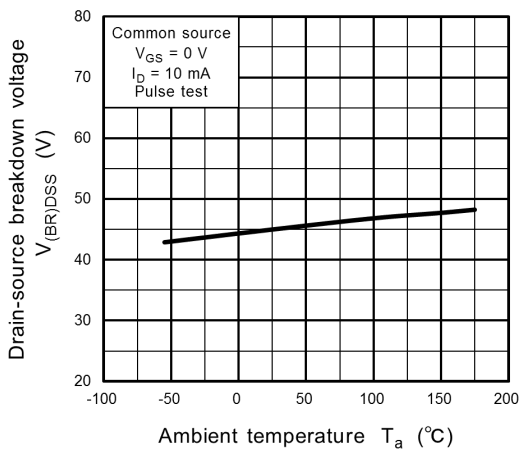
**Fig. 8.8  $R_{DS(ON)} - I_D$**



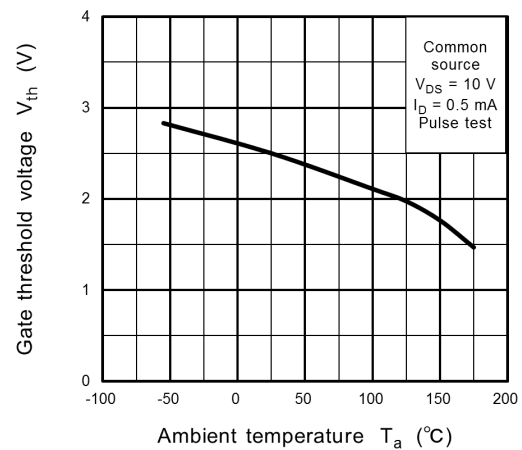
**Fig. 8.9  $R_{DS(ON)} - T_a$**



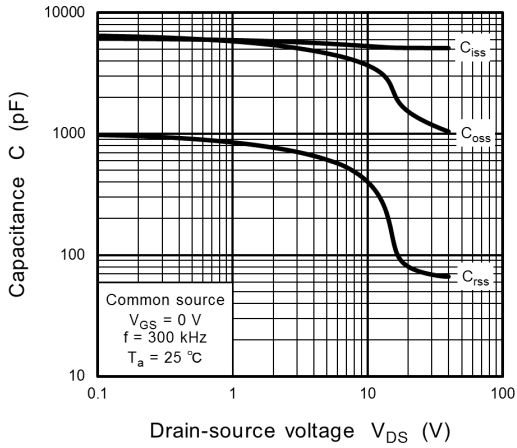
**Fig. 8.10  $I_{DR} - V_{DS}$**



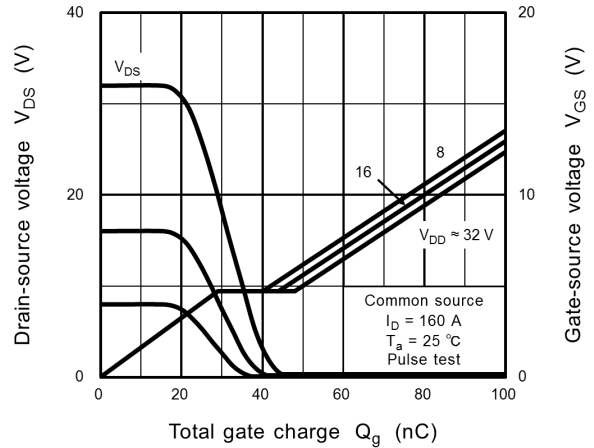
**Fig. 8.11  $V_{(BR)DSS} - T_a$**



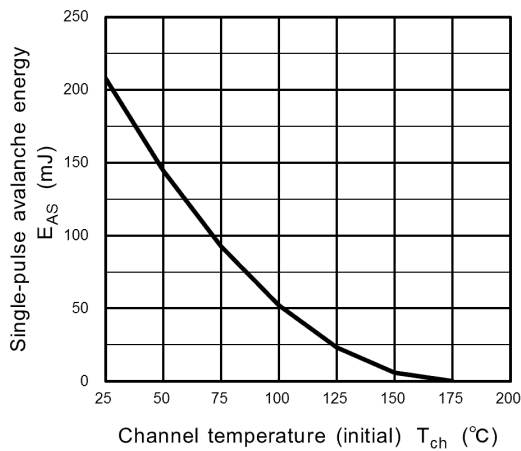
**Fig. 8.12  $V_{th} - T_a$**



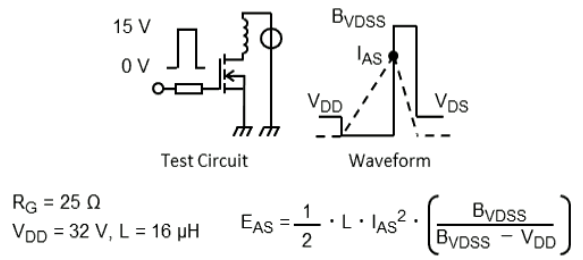
**Fig. 8.13 Capacitance -  $V_{DS}$**



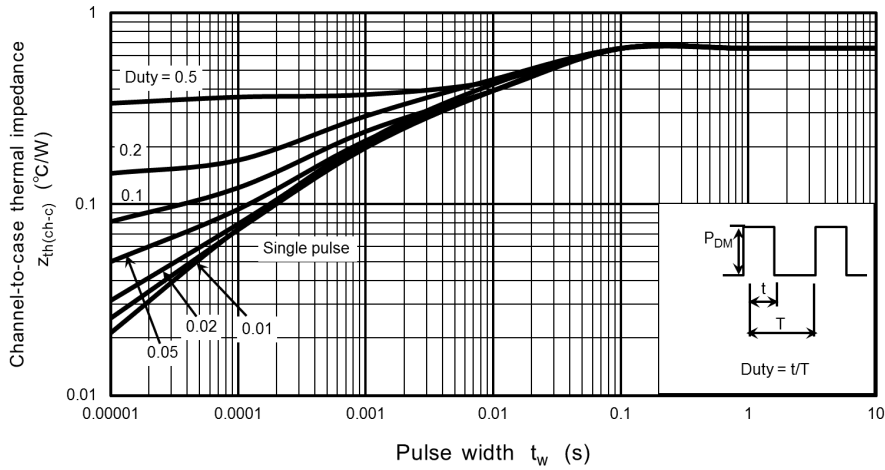
**Fig. 8.14 Dynamic Input/Output Characteristics**



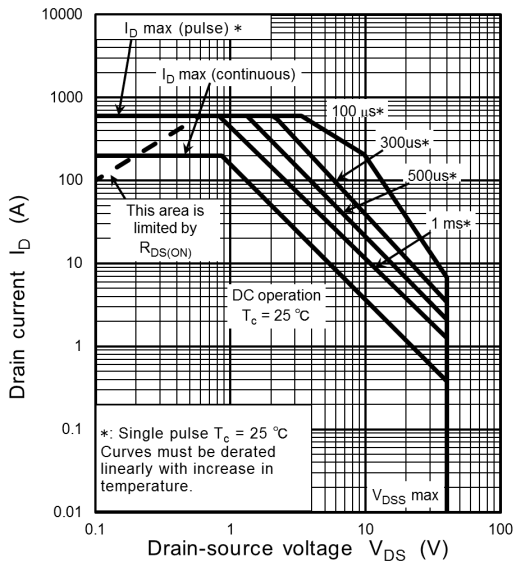
**Fig. 8.15  $E_{AS}$  -  $T_{ch}$ (Guaranteed Maximum)**



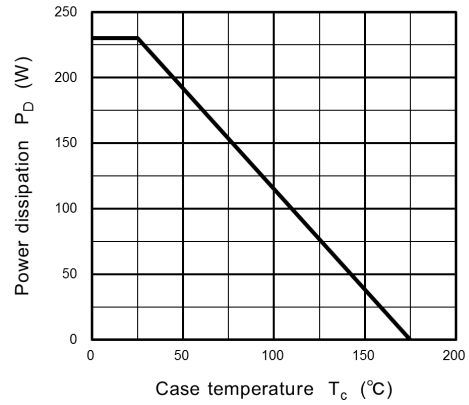
**Fig. 8.16 Test Circuit/Waveform**



**Fig. 8.17  $z_{th(ch-c)} - t_w$   
(Guaranteed Maximum)**



**Fig. 8.18 Safe Operating Area  
(Guaranteed Maximum)**

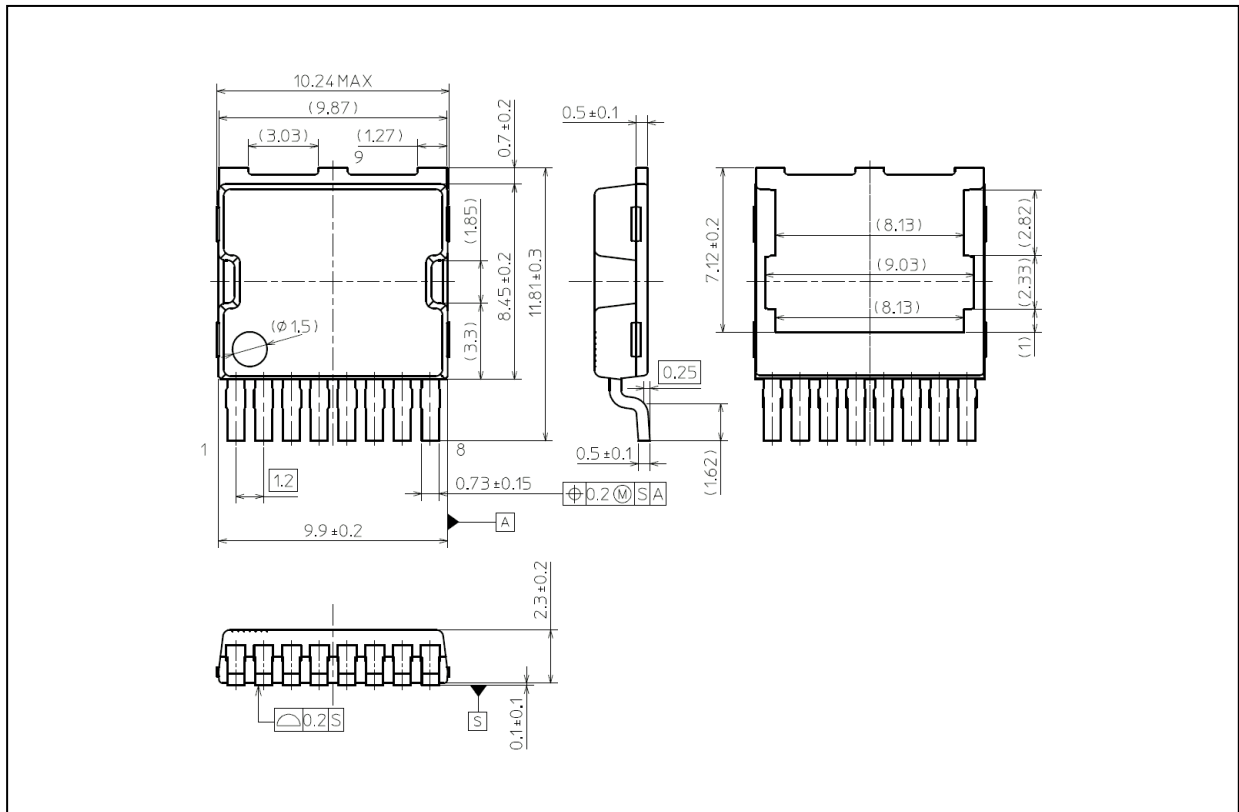


**Fig. 8.19  $P_D - T_c$   
(Guaranteed Maximum)**

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

## Package Dimensions

Unit: mm



Weight: 0.745 g (typ.)

Package Name(s)
TOSHIBA: 2-10AG1A
Nickname: L-TOGL™

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