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

XPQ1R00AQB

1. Applications

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

2. Features

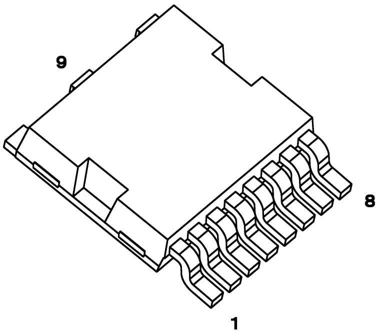
(1) AEC-Q101 qualified

(2) Low drain-source on-resistance: $R_{DS(ON)}$ = 0.84 mΩ (typ.) (V_{GS} = 10 V)

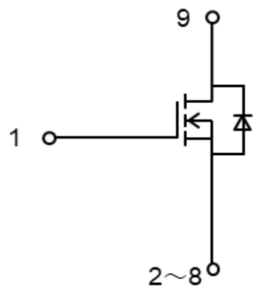
(3) Low leakage current: I_{DSS} = 10 μA (max) (V_{DS} = 100 V)

(4) Enhancement mode: V_{th} = 2.5 to 3.5 V (V_{DS} = 10 V, I_D = 1.5 mA)

3. Packaging and Internal Circuit (Note)



L-TOGL™



1: Gate
9: Drain (heatsink)
2 to 8: Source

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

Start of commercial production
2023-05

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

Characteristics		Symbol	Rating	Unit
Drain-source voltage		V_{DSS}	100	V
Gate-source voltage		V_{GSS}	±20	
Drain current (DC)	(Note 1)	I_D	300	A
Drain current (pulsed)	(Note 1)	I_{DP}	900	
Power dissipation	(T_c = 25 °C)	P_D	750	W
Single-pulse avalanche energy	(Note 2)	E_{AS}	725	mJ
Single-pulse avalanche current		I_{AS}	150	A
Channel temperature	(Note 3)	T_{ch}	175	°C
Storage temperature	(Note 3)	T_{stg}	-55 to 175	°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).

Note: In this product, radiation resistance and cosmic ray resistance are not designed, and these natural environmental factors may affect reliability.
In addition, radiation from the constituent materials of the product also becomes a natural environmental factor which may affect reliability.

5. Thermal Characteristics

Characteristics		Symbol	Max	Unit
Channel-to-case thermal impedance	(T_c = 25 °C)	$z_{th(ch-c)}$	0.2	°C/W

Note 1: Ensure that the channel temperature does not exceed 175 °C.
Note 2: V_{DD} = 80 V, T_{ch} = 25 °C (initial), L = 24.8 μH, R_G = 25 Ω, I_{AS} = 150 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.

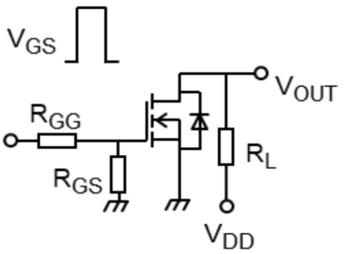
6. Electrical Characteristics

6.1. Static Characteristics (T_a = 25 °C unless otherwise specified)

Characteristics	Symbol	Test Condition	Min	Typ.	Max	Unit
Gate leakage current	I_{GSS}	V_{GS} = ±20 V, V_{DS} = 0 V	—	—	±1	µA
Drain cut-off current	I_{DSS}	V_{DS} = 100 V, V_{GS} = 0 V	—	—	10	
Drain-source breakdown voltage	$V_{(BR)DSS}$	I_D = 10 mA, V_{GS} = 0 V	100	—	—	V
	$V_{(BR)DSX}$	I_D = 10 mA, V_{GS} = -20 V	80	—	—	
Gate threshold voltage (Note 4)	V_{th}	V_{DS} = 10 V, I_D = 1.5 mA	2.5	—	3.5	
Drain-source on-resistance	$R_{DS(ON)}$	V_{GS} = 6 V, I_D = 150 A	—	1.1	1.93	mΩ
		V_{GS} = 10 V, I_D = 150 A	—	0.84	1.03	

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

Characteristics	Symbol	Test Condition	Min	Typ.	Max	Unit
Input capacitance	C_{iss}	V_{DS} = 10 V, V_{GS} = 0 V, f = 300 KHz	—	16500	21450	pF
Reverse transfer capacitance	C_{rss}		—	1000	1700	
Output capacitance	C_{oss}		—	6800	—	
Gate resistance	r_g		—	2.3	4.6	Ω
Switching time (rise time)	t_r	See Fig. 6.2.1	—	85	—	ns
Switching time (turn-on time)	t_{on}		—	160	—	
Switching time (fall time)	t_f		—	85	—	
Switching time (turn-off time)	t_{off}		—	290	—	



V_{DD} ≈ 50 V
V_{GS} = 10 V/ 0 V
I_D = 150 A
R_L = 0.33 Ω
R_{GG} = 4.7 Ω
R_{GS} = 4.7 Ω
Duty ≤ 1 %, t_w = 10 µs

Fig. 6.2.1 Switching Time Test Circuit

6.3. Gate Charge Characteristics (T_a = 25 °C unless otherwise specified)

Characteristics	Symbol	Test Condition	Min	Typ.	Max	Unit
Total gate charge (gate-source plus gate-drain)	Q_g	V_{DD} ≈ 80 V, V_{GS} = 10 V, I_D = 300 A	—	269	—	nC
Gate-source charge 1	Q_{gs1}		—	80	—	
Gate-drain charge	Q_{gd}		—	73	—	

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

Characteristics	Symbol	Test Condition	Min	Typ.	Max	Unit
Reverse drain current (DC) (Note 5)	I_{DR}	—	—	—	300	A
Reverse drain current (pulsed) (Note 5)	I_{DRP}	—	—	—	900	
Diode forward voltage	V_{DSF}	I_{DR} = 300 A, V_{GS} = 0 V	—	—	-1.2	V
Reverse recovery time	t_{rr}	I_{DR} = 300 A, V_{GS} = 0 V $-dI_{DR}/dt$ = 100 A/µs	—	122	—	ns
Reverse recovery charge	Q_{rr}		—	369	—	nC

Note 5: Ensure that the channel temperature does not exceed 175 °C.

7. Marking

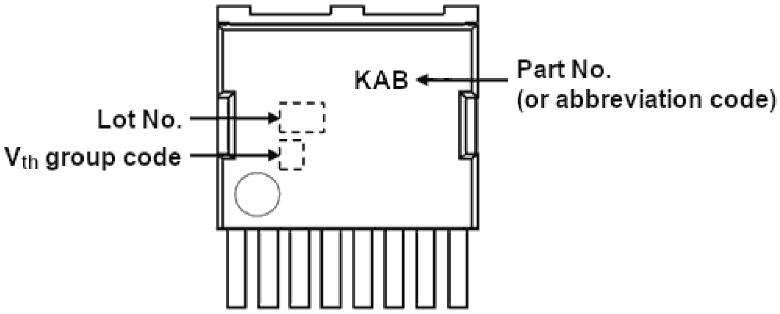


Fig. 7.1 Marking

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)

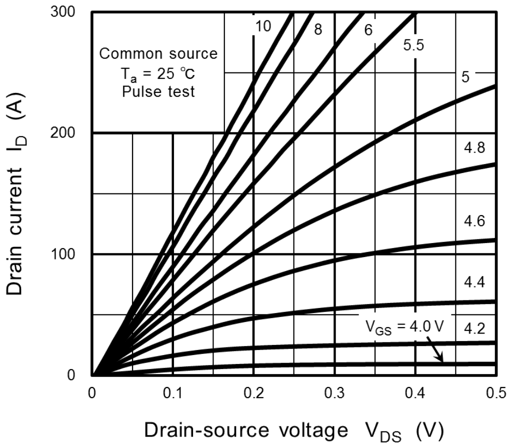


Fig. 8.1 I_D - V_{DS}

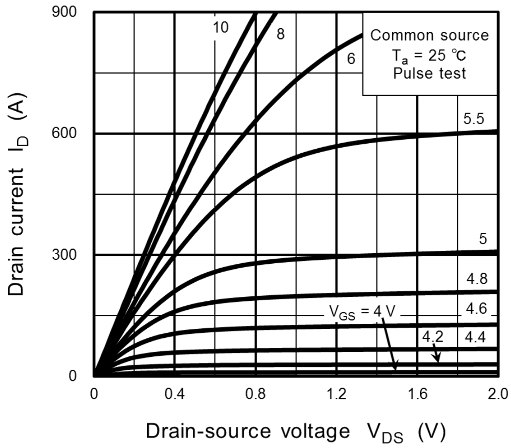


Fig. 8.2 I_D - V_{DS}

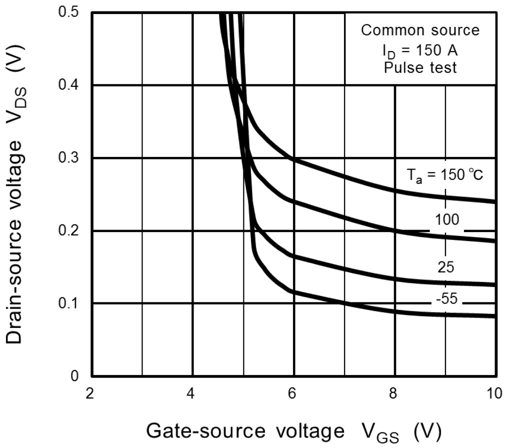


Fig. 8.3 V_{DS} - V_{GS}

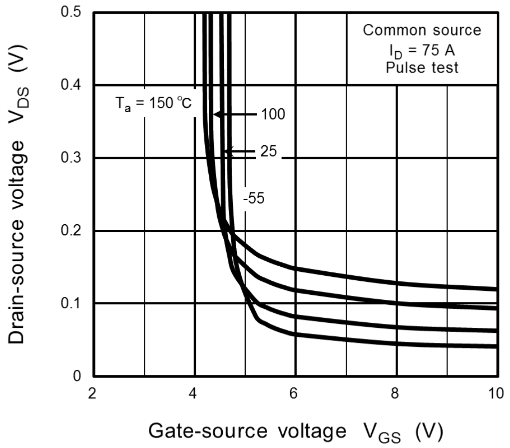


Fig. 8.4 V_{DS} - V_{GS}

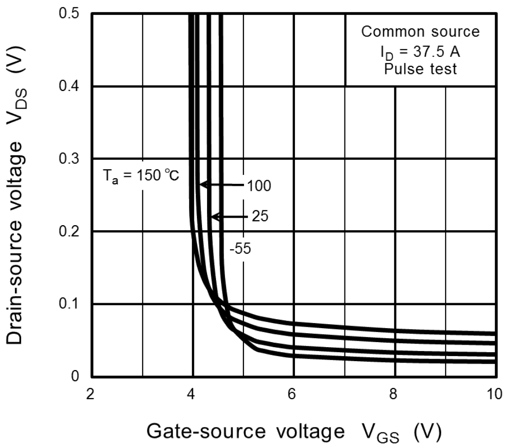


Fig. 8.5 V_{DS} - V_{GS}

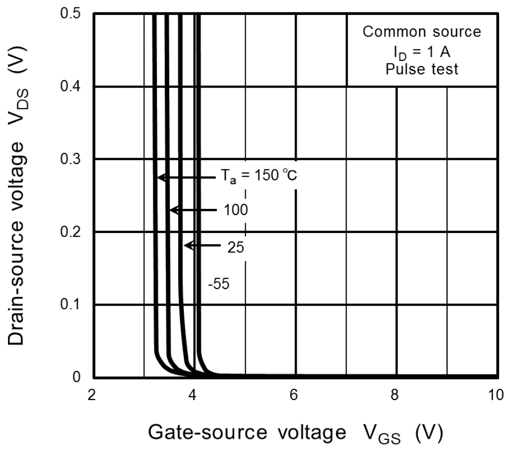


Fig. 8.6 V_{DS} - V_{GS}

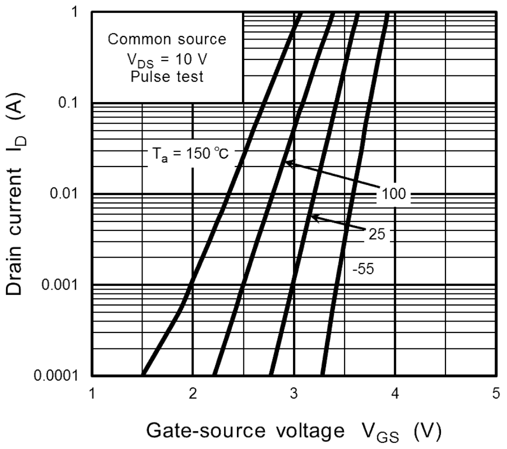


Fig. 8.7 I_D - V_{GS}

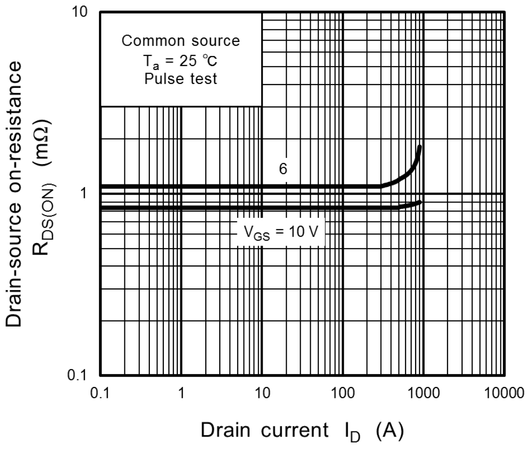


Fig. 8.8 $R_{DS(ON)}$ - I_D

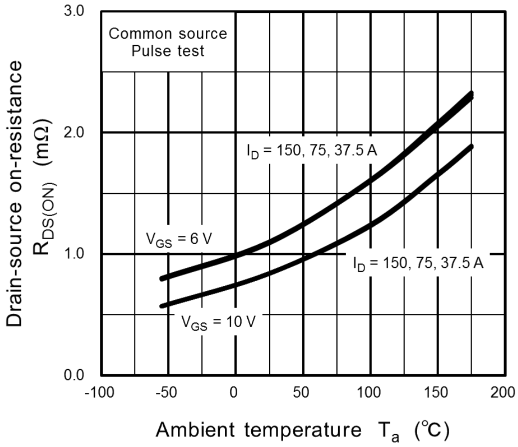


Fig. 8.9 $R_{DS(ON)}$ - T_a

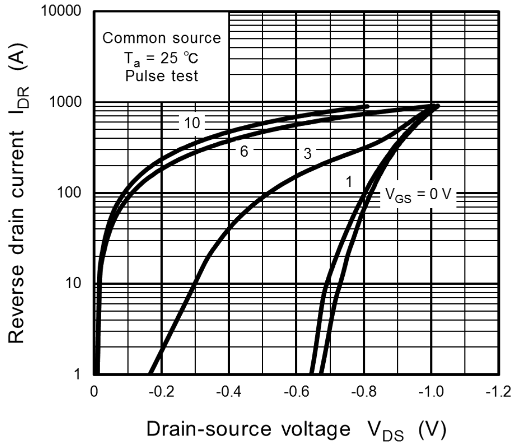


Fig. 8.10 I_{DR} - V_{DS}

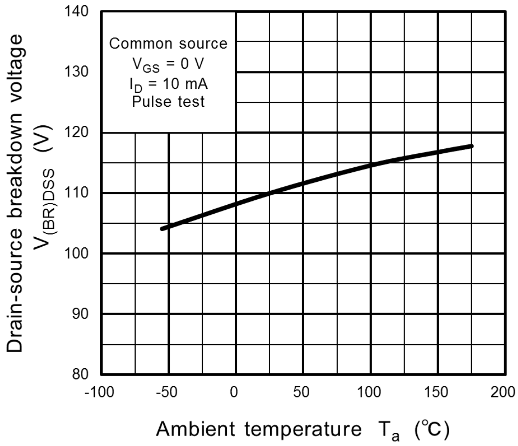


Fig. 8.11 $V_{(BR)DSS}$ - T_a

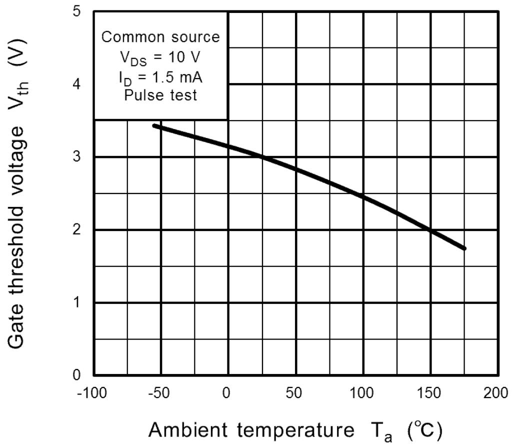


Fig. 8.12 V_{th} - T_a

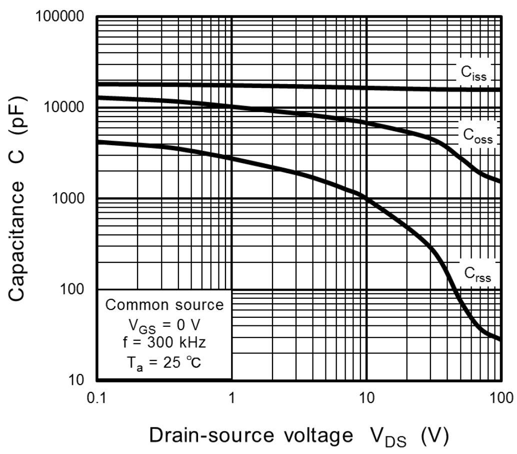


Fig. 8.13 Capacitance - V_{DS}

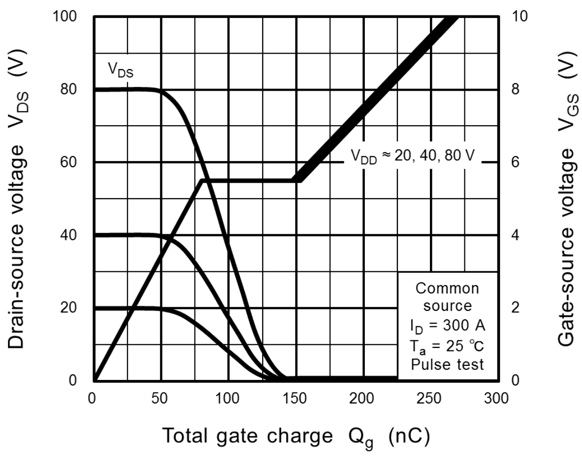


Fig. 8.14 Dynamic Input/Output Characteristics

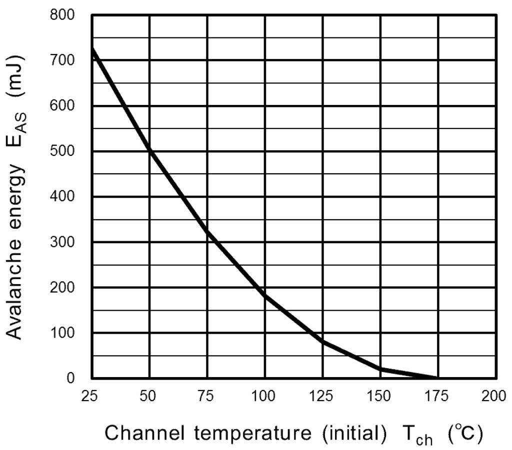
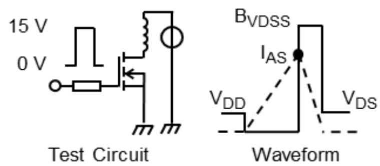


Fig. 8.15 E_{AS} - T_{ch}(Guaranteed Maximum)



R_G = 25 Ω
V_{DD} = 80 V, L = 24.8 μH

$$E_{AS} = \frac{1}{2} \cdot L \cdot I_{AS}^2 \cdot \left(\frac{B_{VDSS}}{B_{VDSS} - V_{DD}} \right)$$

Fig. 8.16 Test Circuit/Waveform

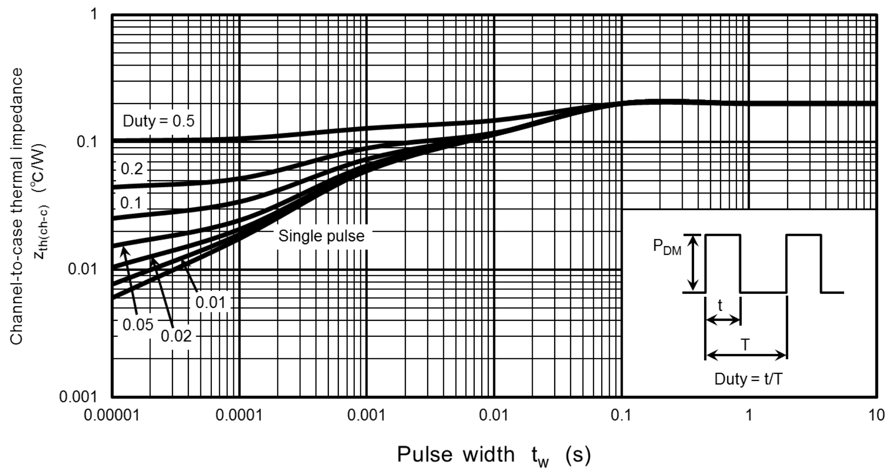


Fig. 8.17 $z_{th(ch-c)}$ - t_w
(Guaranteed Maximum)

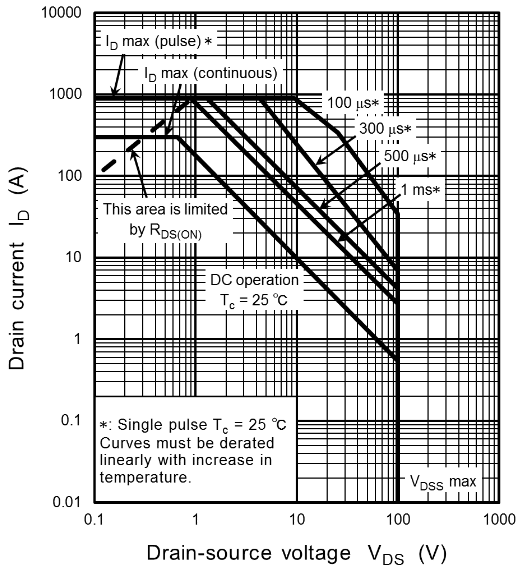


Fig. 8.18 Safe Operating Area
(Guaranteed Maximum)

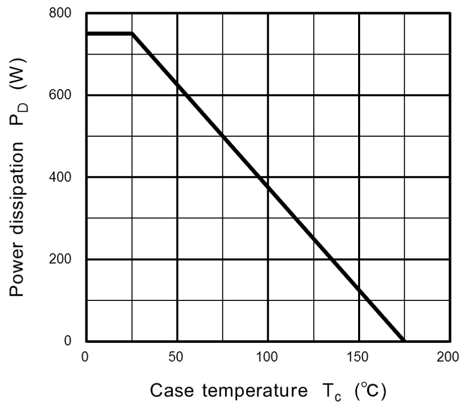
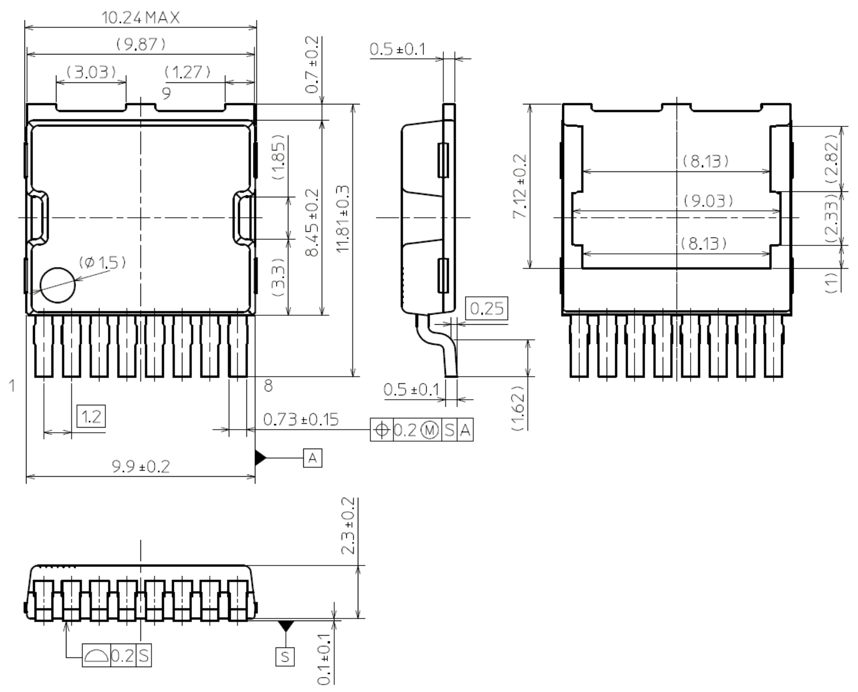


Fig. 8.19 P_D - T_c
(Guaranteed Maximum)

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

Package Dimensions

Unit: mm



Weight: 0.803 g (typ.)

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

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