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

XPJ1R004PB

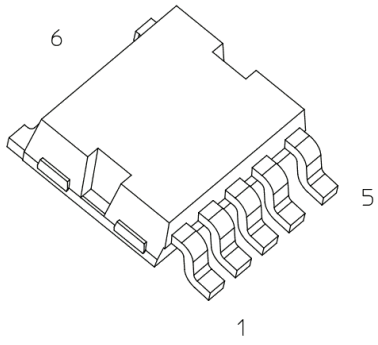
1. Applications

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

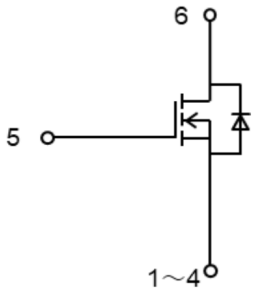
2. Features

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

3. Packaging and Internal Circuit Pin Assignment (Note)



S-TOGL™



5: Gate
6: Drain
1 to 4: Source (heatsink)

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

Start of commercial production
2023-06

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

Characteristics		Symbol	Rating	Unit
Drain-source voltage		V_{DSS}	40	V
Gate-source voltage		V_{GSS}	±20	
Drain current (DC)	(Note 1)	I_D	160	A
Drain current (pulsed)	(Note 1)	I_{DP}	480	
Power dissipation	(T_c = 25 °C)	P_D	223	W
Single-pulse avalanche energy	(Note 2)	E_{AS}	266	mJ
Single-pulse avalanche current		I_{AS}	80	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).

5. Thermal Characteristics

Characteristics		Symbol	Max	Unit
Channel-to-case thermal impedance	(T_c = 25 °C)	$z_{th(ch-c)}$	0.67	°C/W

Note 1: Ensure that the channel temperature does not exceed 175 °C.
Note 2: V_{DD} = 32 V, T_{ch} = 25 °C (initial), L = 32 μH, R_G = 25 Ω, I_{AS} = 80 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.

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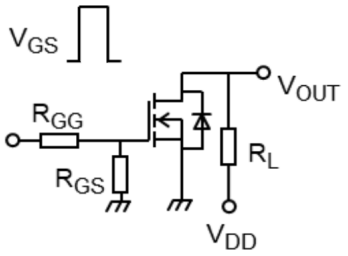
6. Electrical Characteristics

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} = 40 V, V_{GS} = 0 V	—	—	10	
Drain-source breakdown voltage	$V_{(BR)DSS}$	I_D = 10 mA, V_{GS} = 0 V	40	—	—	V
	$V_{(BR)DSX}$	I_D = 10 mA, V_{GS} = -20 V	20	—	—	
Gate threshold voltage (Note 4)	V_{th}	V_{DS} = 10 V, I_D = 0.5 mA	2.0	—	3.0	
Drain-source on-resistance	$R_{DS(ON)}$	V_{GS} = 6 V, I_D = 80 A	—	1.2	1.8	mΩ
		V_{GS} = 10 V, I_D = 80 A	—	0.8	1.0	

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	—	5300	6890	pF
Reverse transfer capacitance	C_{rss}		—	400	680	
Output capacitance	C_{oss}		—	3680	—	
Gate resistance	r_g		—	3.5	7.0	Ω
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	—	



V_{DD} ≈ 20 V
V_{GS} = 10 V/ 0 V
I_D = 80 A
R_L = 0.25 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} ≈ 32 V, V_{GS} = 10 V, I_D = 160 A	—	84	—	nC
Gate-source charge 1	Q_{gs1}		—	29	—	
Gate-drain charge	Q_{gd}		—	19	—	

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}	—	—	—	160	A
Reverse drain current (pulsed) (Note 5)	I_{DRP}	—	—	—	480	
Diode forward voltage	V_{DSF}	I_{DR} = 160 A, V_{GS} = 0 V	—	—	-1.2	V
Reverse recovery time	t_{rr}	I_{DR} = 160 A, V_{GS} = 0 V -dI_{DR}/dt = 100 A/μs	—	73	—	ns
Reverse recovery charge	Q_{rr}		—	113	—	nC

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

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7. Marking

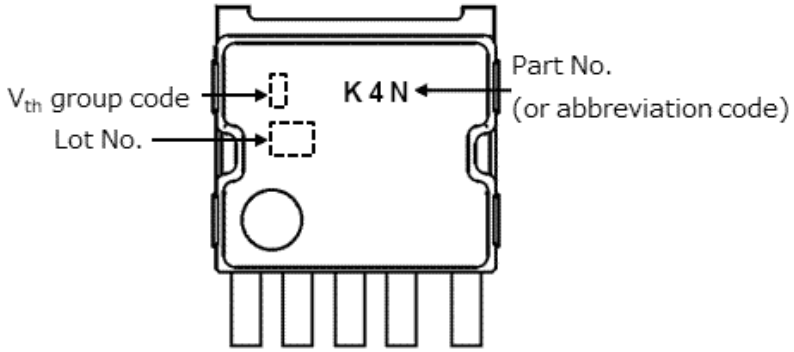

Fig. 7.1 Marking

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)

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8. Characteristics Curves (Note)

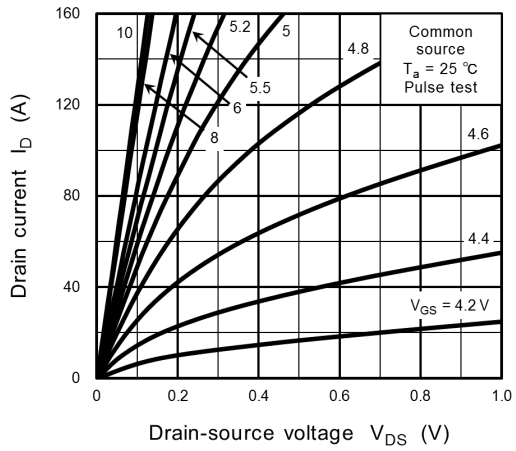

Fig. 8.1 I_D - V_{DS}

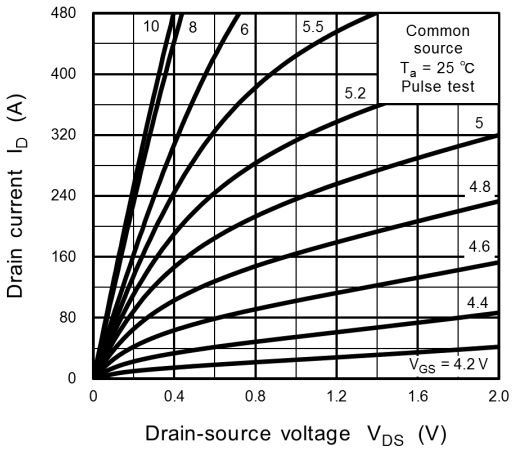

Fig. 8.2 I_D - V_{DS}

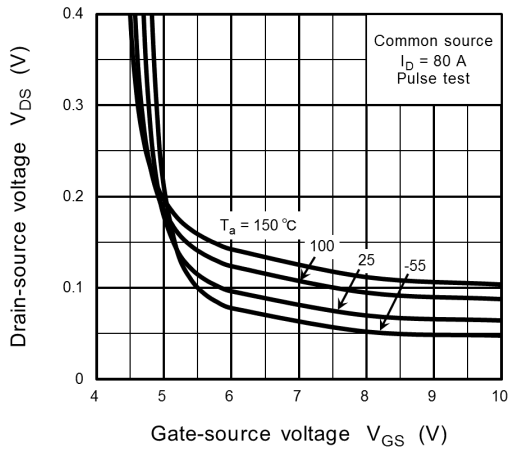

Fig. 8.3 V_{DS} - V_{GS}

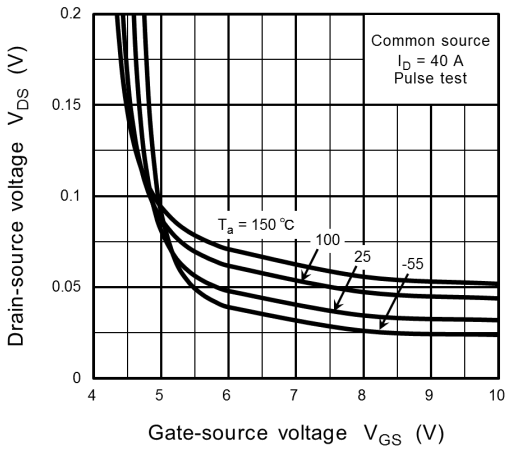

Fig. 8.4 V_{DS} - V_{GS}

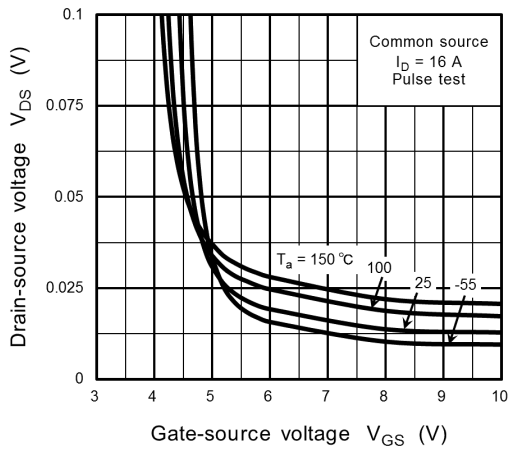

Fig. 8.5 V_{DS} - V_{GS}

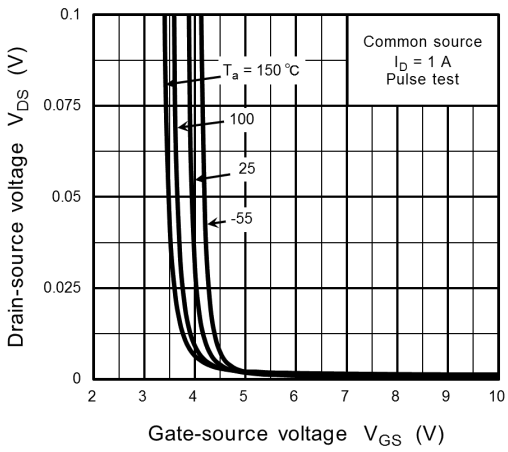

Fig. 8.6 V_{DS} - V_{GS}

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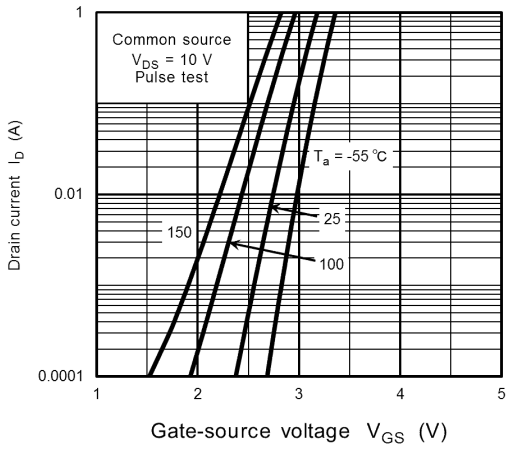

Fig. 8.7 I_D - V_{GS}

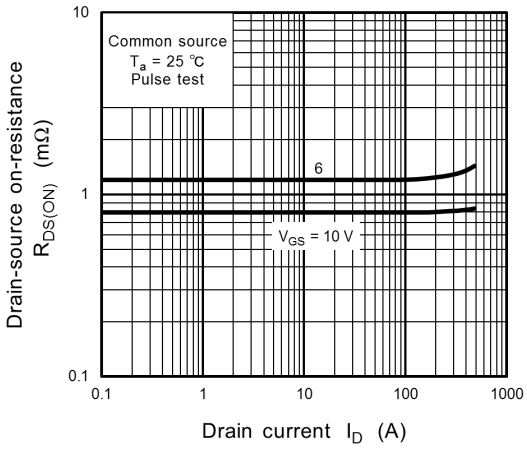

Fig. 8.8 $R_{DS(ON)}$ - I_D

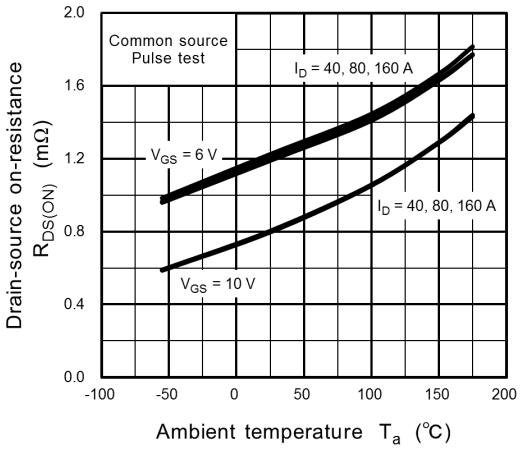

Fig. 8.9 $R_{DS(ON)}$ - T_a

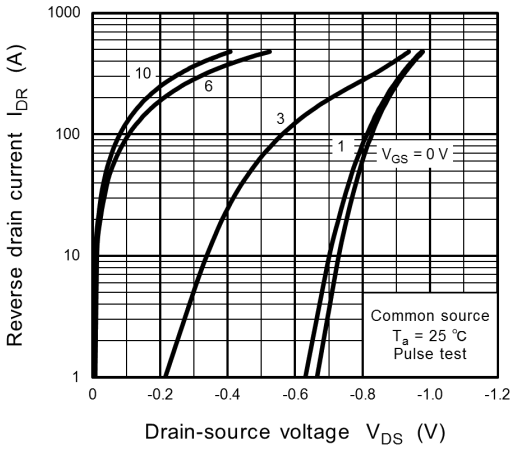

Fig. 8.10 I_{DR} - V_{DS}

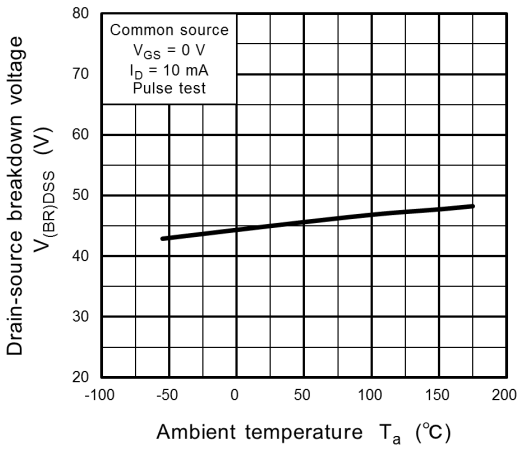

Fig. 8.11 $V_{(BR)DSS}$ - T_a

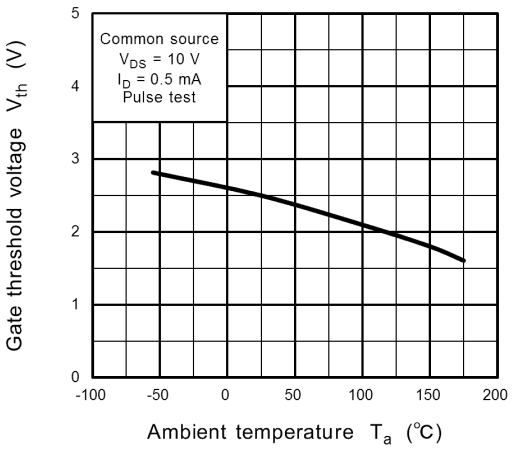

Fig. 8.12 V_{th} - T_a

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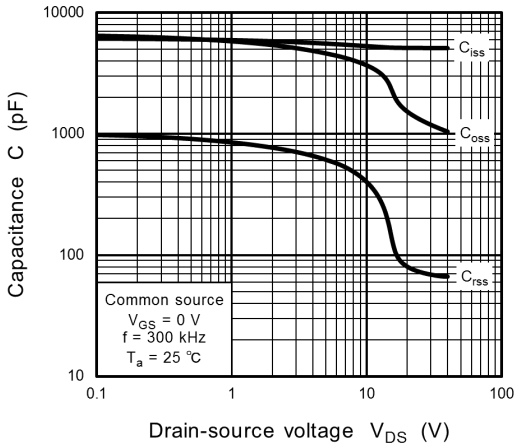

Fig. 8.13 Capacitance - V_{DS}

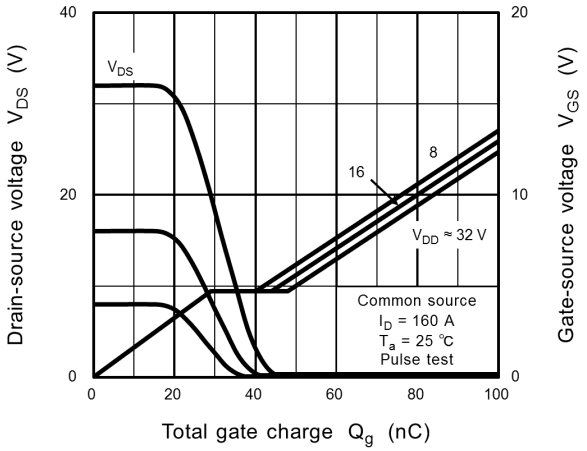

Fig. 8.14 Dynamic Input/Output Characteristics

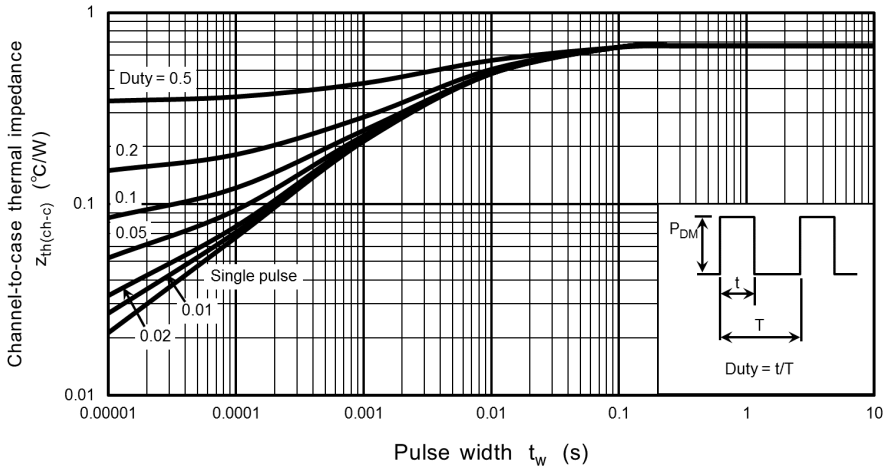

Fig. 8.15 $z_{th(ch-c)}$ - t_w (Guaranteed Maximum)

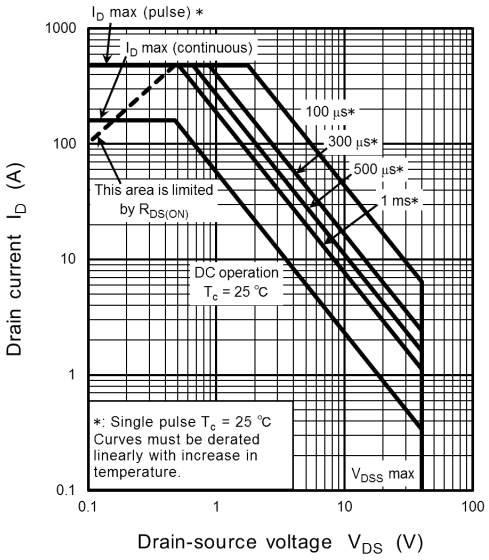

Fig. 8.16 Safe Operating Area (Guaranteed Maximum)

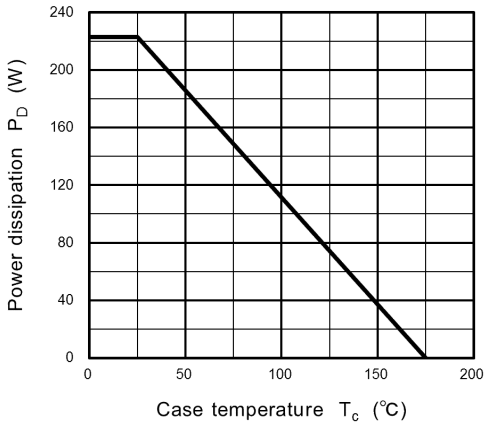

Fig. 8.17 P_D - T_c (Guaranteed Maximum)

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

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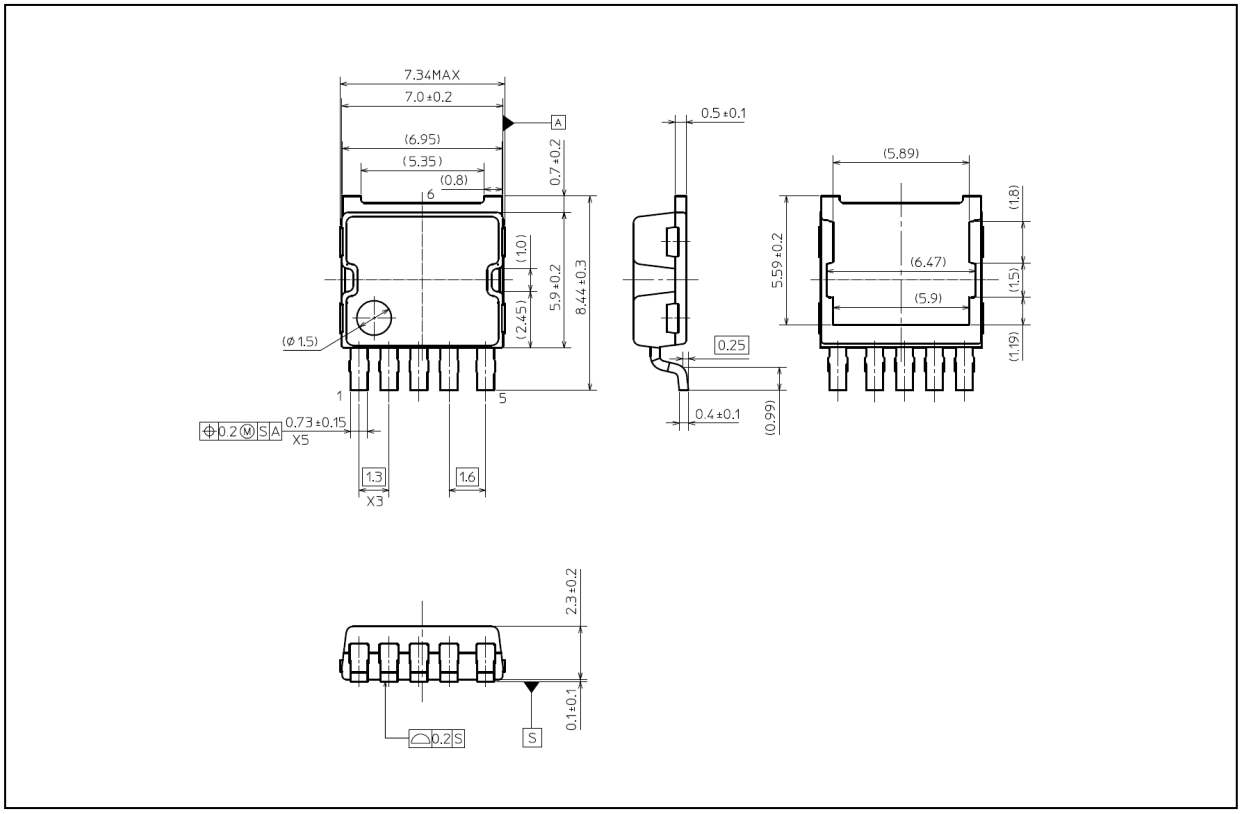
Package Dimensions

Unit: mm



Weight: 0.377 g (typ.)

Package Name(s)
TOSHIBA: 2-7P1A
Nickname: S-TOGL™

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