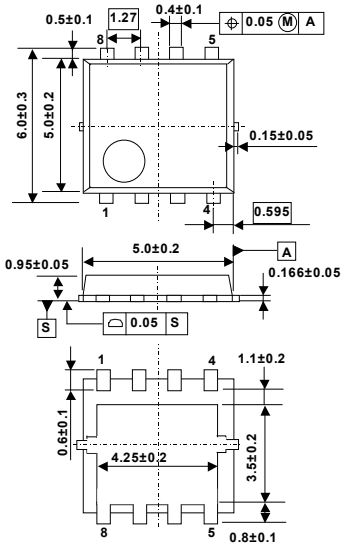
TOSHIBA Field Effect Transistor Silicon N-Channel MOS Type (U-MOSⅤ-H)

TPCA8023-H

High-Efficiency DC/DC Converter Applications
Notebook PC Applications
Portable Equipment Applications

- Small footprint due to a small and thin package
- High-speed switching
- Small gate charge: Q_{SW} = 5.0 nC (typ.)
- Low drain-source ON-resistance: $R_{DS\ (ON)}$ = 9.8 mΩ (typ.)
- High forward transfer admittance: $|Y_{fs}|$ = 47 S (typ.)
- Low leakage current: I_{DSS} = 10 μA (max) (V_{DS} = 30 V)
- Enhancement mode: V_{th} = 1.5 to 2.5 V (V_{DS} = 10 V, I_D = 1 mA)

Unit: mm



1,2,3:SOURCE 4:GATE
5,6,7,8:DRAIN

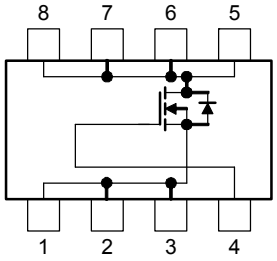
JEDEC	—
JEITA	—
TOSHIBA	2-5Q1A

Weight: 0.069 g (typ.)

Absolute Maximum Ratings (Ta = 25°C)

Characteristic		Symbol	Rating	Unit
Drain-source voltage		V_{DSS}	30	V
Drain-gate voltage (R_{GS} = 20 kΩ)		V_{DGR}	30	V
Gate-source voltage		V_{GSS}	±20	V
Drain current	DC (Note 1)	I_D	21	A
	Pulsed (Note 1)	I_{DP}	63	
Drain power dissipation (Tc=25°C)		P_D	30	W
Drain power dissipation (t = 10 s) (Note 2a)		P_D	2.8	W
Drain power dissipation (t = 10 s) (Note 2b)		P_D	1.6	W
Single-pulse avalanche energy (Note 3)		E_{AS}	57	mJ
Avalanche current		I_{AR}	21	A
Repetitive avalanche energy (Tc=25°C) (Note 4)		E_{AR}	2.9	mJ
Channel temperature		T_{ch}	150	°C
Storage temperature range		T_{stg}	−55 to 150	°C

Circuit Configuration



Note: For Notes 1 to 4, refer to the next page.

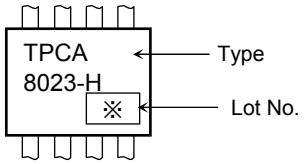
Using continuously under heavy loads (e.g. the application of high temperature/current/voltage and the significant change in temperature, etc.) may cause this product to decrease in the reliability significantly even if the operating conditions (i.e. operating temperature/current/voltage, etc.) are within 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).

This transistor is an electrostatic-sensitive device. Handle with care.

Thermal Characteristics

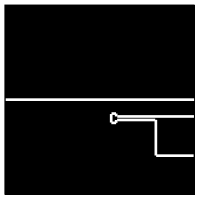
Characteristic	Symbol	Max	Unit
Thermal resistance, channel to case (Tc=25°C)	$R_{th\ (ch-c)}$	4.17	°C/W
Thermal resistance, channel to ambient (t = 10 s) (Note 2a)	$R_{th\ (ch-a)}$	44.6	°C/W
Thermal resistance, channel to ambient (t = 10 s) (Note 2b)	$R_{th\ (ch-a)}$	78.1	°C/W

Marking (Note 5)



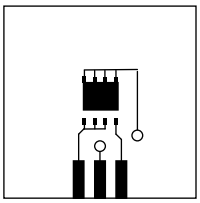
Note 1: The channel temperature should not exceed 150°C during use

Note 2: (a) Device mounted on a glass-epoxy board (a) (b) Device mounted on a glass-epoxy board (b)



FR-4
25.4 × 25.4 × 0.8
(Unit: mm)

(a)



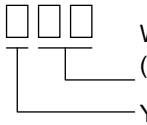
FR-4
25.4 × 25.4 × 0.8
(Unit: mm)

(b)

Note 3: V_{DD} = 24 V, T_{ch} = 25°C (initial), L = 100 μH, R_G = 25 Ω, I_{AR} = 21 A

Note 4: Repetitive rating: pulse width limited by max. channel temperature

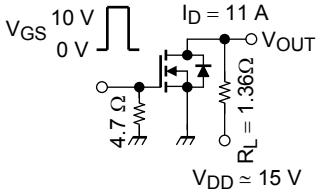
Note 5: * Weekly code: (Three digits)



Week of manufacture
(01 for first week of year, continuing up to 52 or 53)

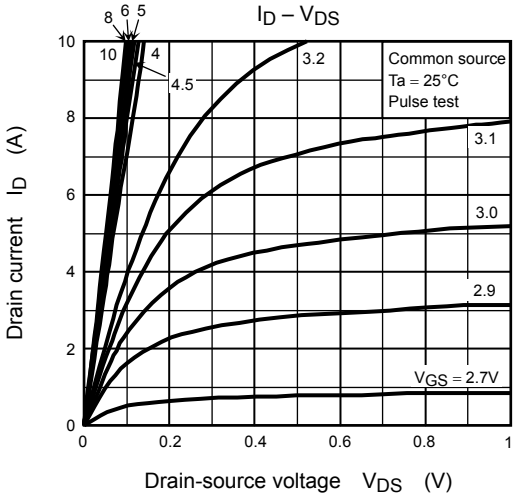
Year of manufacture
(The last digit of the calendar year)

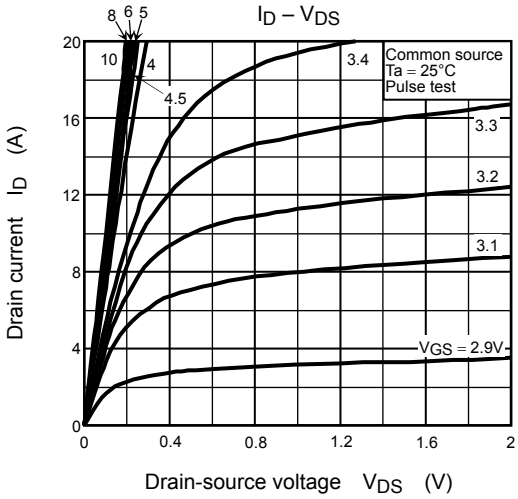
Electrical Characteristics (Ta = 25°C)

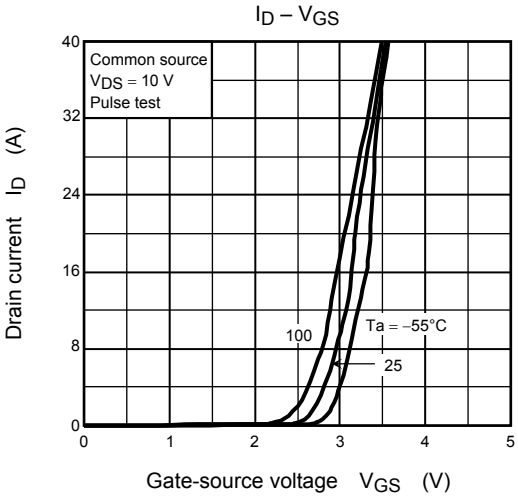
Characteristic		Symbol	Test Condition	Min	Typ.	Max	Unit
Gate leakage current		I_{GSS}	V_{GS} = ±20 V, V_{DS} = 0 V	—	—	±100	nA
Drain cutoff current		I_{DSS}	V_{DS} = 30 V, V_{GS} = 0 V	—	—	10	μA
Drain-source breakdown voltage		$V_{(BR)\ DSS}$	I_D = 10 mA, V_{GS} = 0 V	30	—	—	V
		$V_{(BR)\ DSX}$	I_D = 10 mA, V_{GS} = −20 V	15	—	—	
Gate threshold voltage		V_{th}	V_{DS} = 10 V, I_D = 1 mA	1.5	—	2.5	V
Drain-source ON-resistance		$R_{DS\ (ON)}$	V_{GS} = 4.5 V, I_D = 11 A	—	12.1	15.7	mΩ
			V_{GS} = 10 V, I_D = 11 A	—	9.8	12.9	
Forward transfer admittance		$\|Y_{fs}\|$	V_{DS} = 10 V, I_D = 11 A	23.5	47	—	S
Input capacitance		C_{iss}	V_{DS} = 10 V, V_{GS} = 0 V, f = 1 MHz	—	1433	2150	pF
Reverse transfer capacitance		C_{rss}		—	83	125	
Output capacitance		C_{oss}		—	303	—	
Gate resistance		Rg	V_{DS} = 10 V, V_{GS} = 0 V, f = 5 MHz	—	1.0	1.5	Ω
Switching time	Rise time	t_r	 Duty ≦ 1%, t_w = 10 μs	—	2.8	—	ns
	Turn-on time	t_{on}		—	9.3	—	
	Fall time	t_f		—	3.4	—	
	Turn-off time	t_{off}		—	21	—	
Total gate charge (gate-source plus gate-drain)		Q_g	V_{DD} ≃ 24 V, V_{GS} = 10 V, I_D = 21 A	—	21	—	nC
			V_{DD} ≃ 24 V, V_{GS} = 5 V, I_D = 21 A	—	11	—	
Gate-source charge 1		Q_{gs1}	V_{DD} ≃ 24 V, V_{GS} = 10 V, I_D = 21 A	—	4.7	—	
Gate-drain (“Miller”) charge		Q_{gd}		—	3.0	—	
Gate switch charge		Q_{SW}		—	5.0	—	

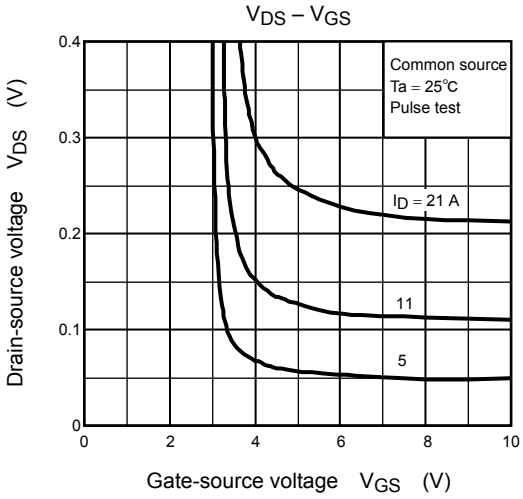
Source-Drain Ratings and Characteristics (Ta = 25°C)

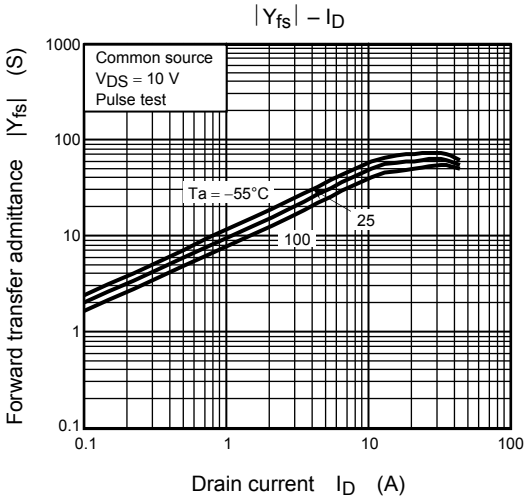
Characteristic		Symbol	Test Condition	Min	Typ.	Max	Unit
Drain reverse current	Pulse (Note 1)	I_{DRP}	—	—	—	63	A
Forward voltage (diode)		V_{DSF}	I_{DR} = 21 A, V_{GS} = 0 V	—	—	−1.2	V

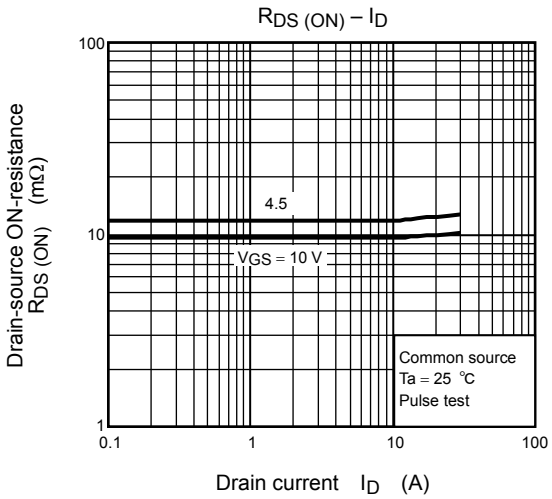

$I_D - V_{DS}$
Common source
Ta = 25°C
Pulse test
8 6 5 10 4 4.5 3.2 3.1 3.0 2.9 V_{GS} = 2.7V
Drain current I_D (A)
Drain-source voltage V_{DS} (V)


$I_D - V_{DS}$
Common source
Ta = 25°C
Pulse test
8 6 5 10 4 4.5 3.4 3.3 3.2 3.1 V_{GS} = 2.9V
Drain current I_D (A)
Drain-source voltage V_{DS} (V)

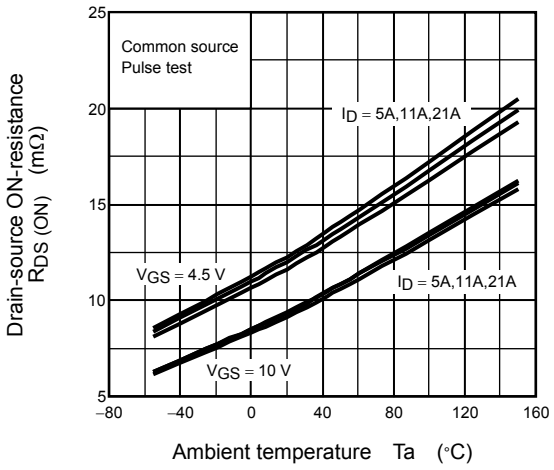

$I_D - V_{GS}$
Common source
V_{DS} = 10 V
Pulse test
100 Ta = −55°C 25
Drain current I_D (A)
Gate-source voltage V_{GS} (V)


$V_{DS} - V_{GS}$
Common source
Ta = 25°C
Pulse test
I_D = 21 A 11 5
Drain-source voltage V_{DS} (V)
Gate-source voltage V_{GS} (V)

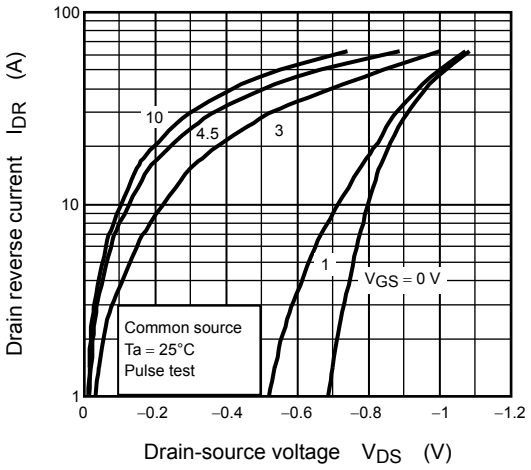

$|Y_{fs}| - I_D$
Common source
V_{DS} = 10 V
Pulse test
Ta = −55°C 25 100
Forward transfer admittance $|Y_{fs}|$ (S)
Drain current I_D (A)


$R_{DS\ (ON)} - I_D$
Common source
Ta = 25 °C
Pulse test
4.5
V_{GS} = 10 V
Drain-source ON-resistance $R_{DS\ (ON)}$ (mΩ)
Drain current I_D (A)

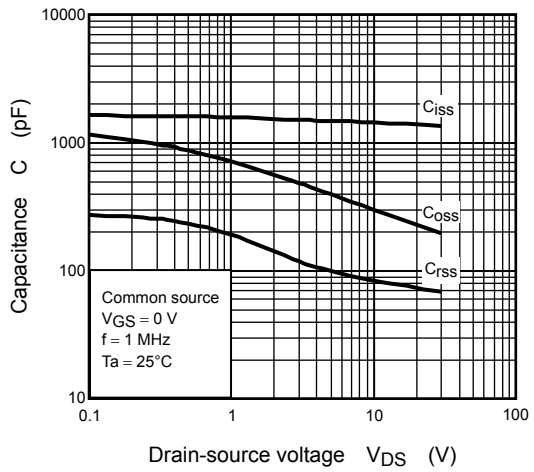
$R_{DS\ (ON)}$ – Ta



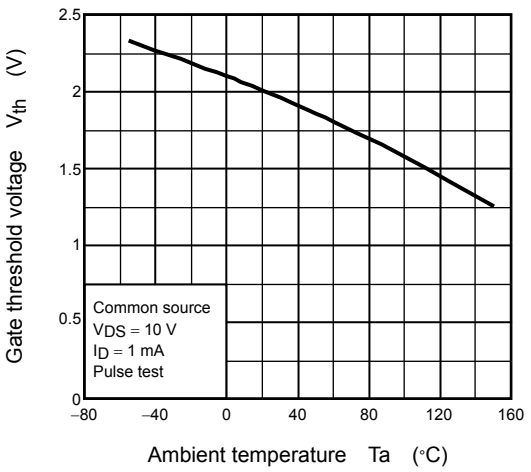
I_{DR} – V_{DS}



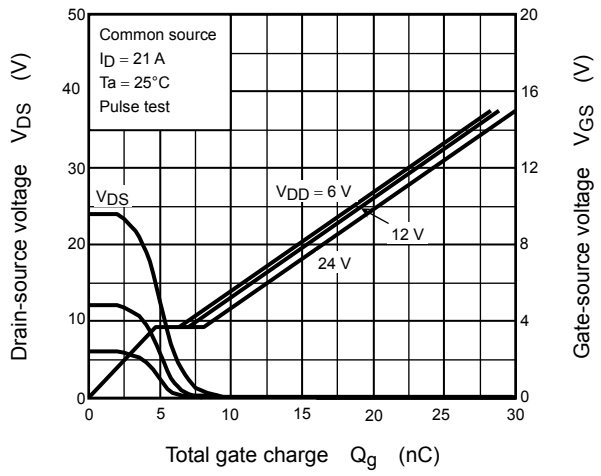
Capacitance – V_{DS}



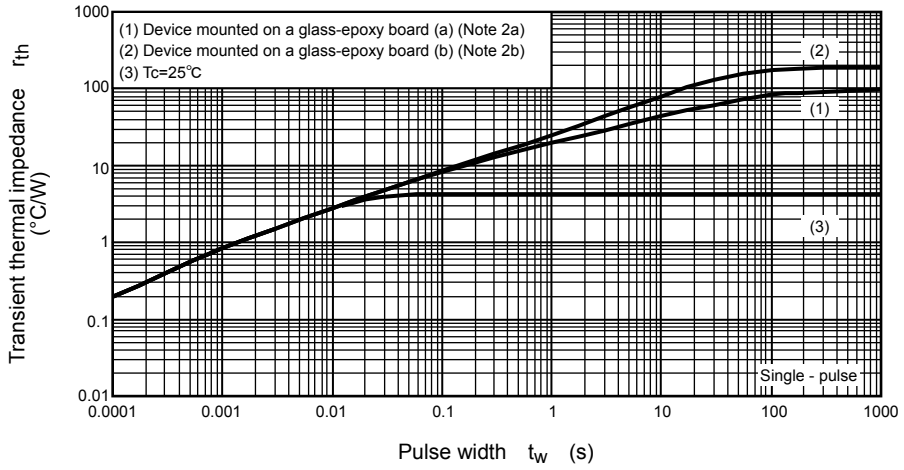
V_{th} – Ta



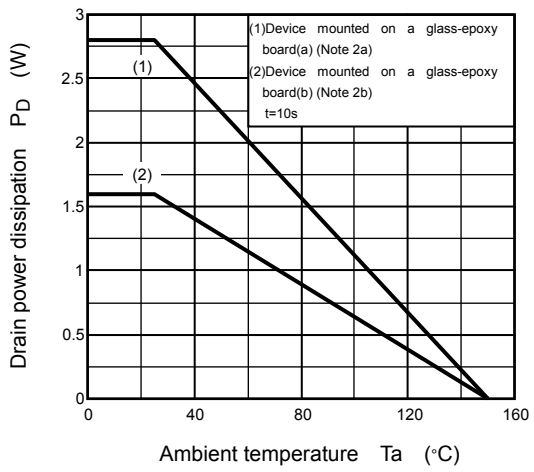
Dynamic input/output characteristics



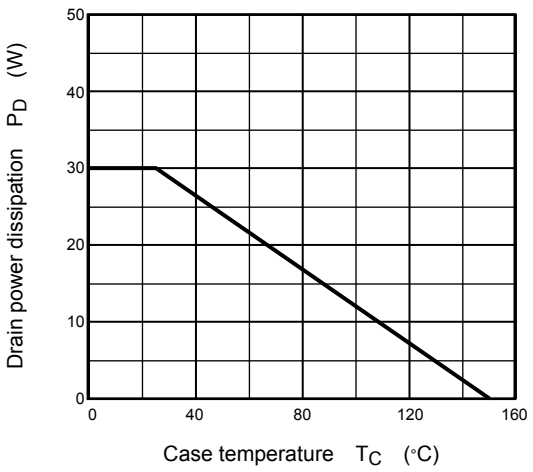
$r_{th} - t_w$



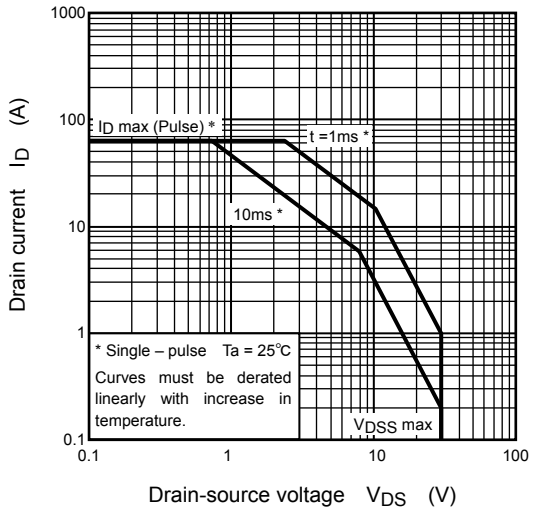
$P_D - Ta$



$P_D - Tc$



Safe operating area



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