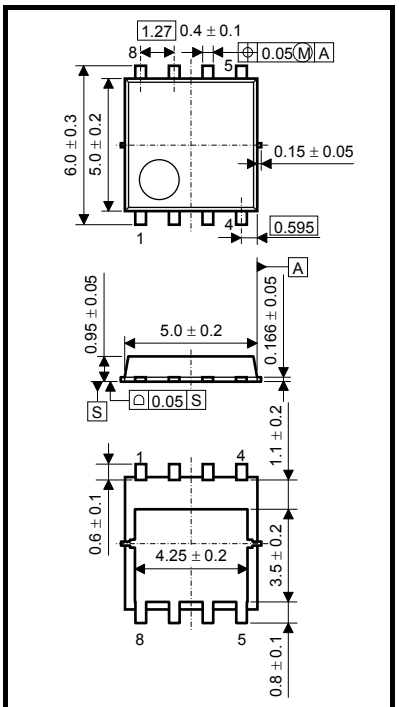
TOSHIBA Field Effect Transistor Silicon N-Channel MOS Type (U-MOSⅥ-H)

TPCA8051-H

Switching Regulator Applications
Motor Drive Applications
DC-DC Converter Applications

Unit: mm



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

JEDEC	—
JEITA	—
TOSHIBA	2-5Q1A

Weight: 0.069 g (typ.)

- Small footprint due to a small and thin package
- High-speed switching
- Small gate charge: Q_{SW} = 18 nC (typ.)
- Low drain-source ON-resistance: $R_{DS\ (ON)}$ = 6.0 mΩ (typ.)
- High forward transfer admittance: $|Y_{fs}|$ = 96 S (typ.)
- Low leakage current: I_{DSS} = 10 μA (max) (V_{DS} = 80 V)
- Enhancement mode: V_{th} = 1.3 to 2.3 V (V_{DS} = 10 V, I_D = 1.0 mA)

Absolute Maximum Ratings (Ta = 25°C)

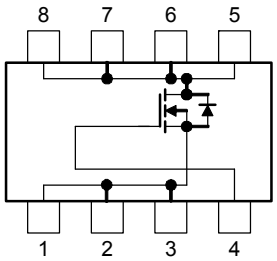
Characteristic		Symbol	Rating	Unit
Drain-source voltage		V_{DSS}	80	V
Drain-gate voltage (R_{GS} = 20 kΩ)		V_{DGR}	80	V
Gate-source voltage		V_{GSS}	±20	V
Drain current	DC (Note 1)	I_D	28	A
	Pulsed (Note 1)	I_{DP}	84	
Drain power dissipation (Tc = 25°C)		P_D	45	W
Drain power dissipation (t = 10 s) (Note 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}	255	mJ
Avalanche current		I_{AR}	28	A
Repetitive avalanche energy (Tc = 25°C) (Note 4)		E_{AR}	2.03	mJ
Channel temperature		T_{ch}	150	°C
Storage temperature range		T_{stg}	−55 to 150	°C

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.

Circuit Configuration

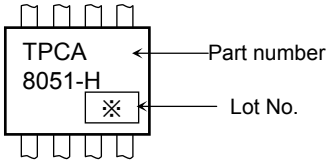


Start of commercial production
2008-10

Thermal Characteristics

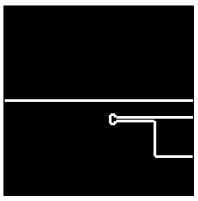
Characteristic	Symbol	Max	Unit
Thermal resistance, channel to case (Tc = 25°C)	$R_{th\ (ch-c)}$	2.78	°C/W
Thermal resistance, channel to ambient (t = 10 s) (Note 2a)	$R_{th\ (ch-a)}$	44.6	°C/W
Thermal resistance, channel to ambient (t = 10 s) (Note 2b)	$R_{th\ (ch-a)}$	78.1	°C/W

Marking (Note 5)



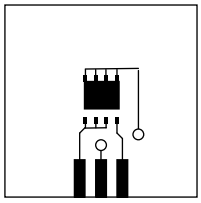
Note 1: Ensure that the channel temperature does not exceed 150°C.

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)



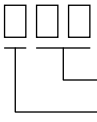
FR-4
25.4 × 25.4 × 0.8
(Unit: mm)

(b)

Note 3: V_{DD} = 24 V, T_{ch} = 25°C (initial), L = 100 μH, R_G = 25 Ω, I_{AR} = 28 A

Note 4: Repetitive rating: pulse width limited by maximum channel temperature

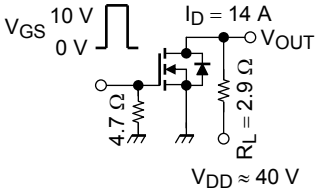
Note 5: * Weekly code: (Three digits)



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

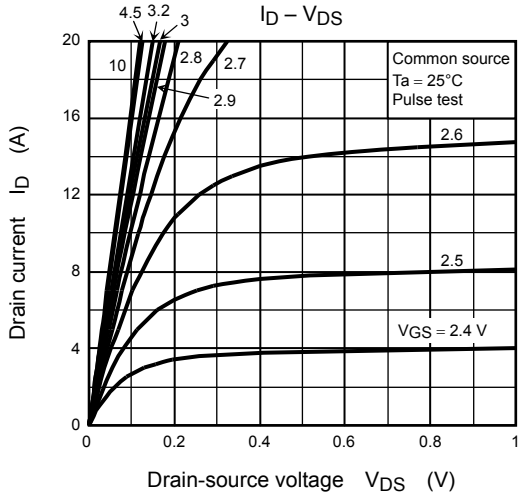
Year of manufacture
(The last digit of the year)

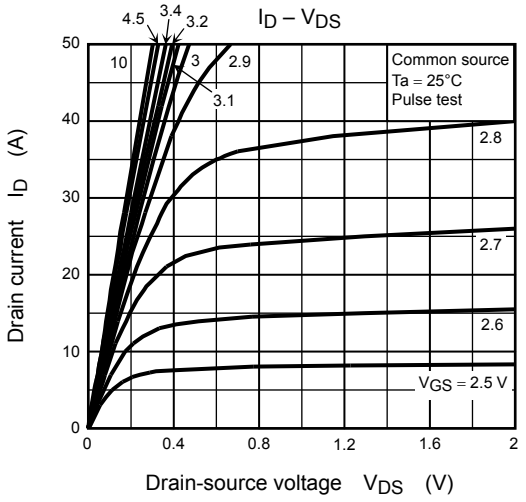
Electrical Characteristics (Ta = 25°C)

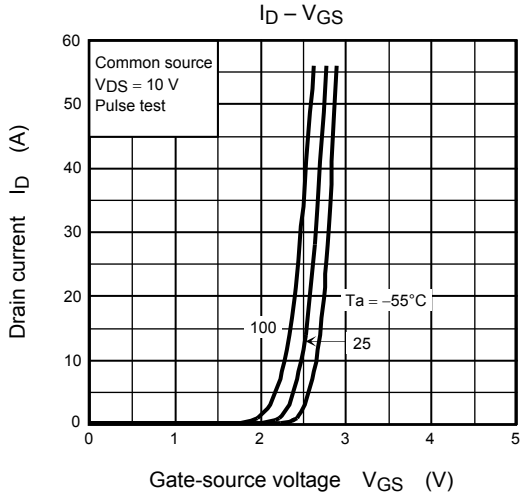
Characteristic		Symbol	Test Condition	Min	Typ.	Max	Unit
Gate leakage current		I_{GSS}	V_{GS} = ±20 V, V_{DS} = 0 V	—	—	±100	nA
Drain cutoff current		I_{DSS}	V_{DS} = 80 V, V_{GS} = 0 V	—	—	10	μA
Drain-source breakdown voltage		$V_{(BR)\ DSS}$	I_D = 10 mA, V_{GS} = 0 V	80	—	—	V
		$V_{(BR)\ DSX}$	I_D = 10 mA, V_{GS} = −20 V	60	—	—	
Gate threshold voltage		V_{th}	V_{DS} = 10 V, I_D = 1.0 mA	1.3	—	2.3	V
Drain-source ON-resistance		$R_{DS\ (ON)}$	V_{GS} = 4.5 V, I_D = 14 A	—	6.4	9.8	mΩ
			V_{GS} = 10 V, I_D = 14 A	—	6.0	9.4	
Forward transfer admittance		$\|Y_{fs}\|$	V_{DS} = 10 V, I_D = 14 A	48	96	—	S
Input capacitance		C_{iss}	V_{DS} = 10 V, V_{GS} = 0 V, f = 1 MHz	—	5800	7540	pF
Reverse transfer capacitance		C_{rss}		—	150	210	
Output capacitance		C_{oss}		—	520	—	
Gate resistance		rg	V_{DS} = 10 V, V_{GS} = 0 V, f = 1 MHz	—	1.0	1.5	Ω
Switching time	Rise time	t_r	 Duty ≤ 1%, t_w = 10 μs	—	3.4	—	ns
	Turn-on time	t_{on}		—	13	—	
	Fall time	t_f		—	6.3	—	
	Turn-off time	t_{off}		—	66	—	
Total gate charge (gate-source plus gate-drain)		Q_g	V_{DD} ≈ 64 V, V_{GS} = 10 V, I_D = 28 A	—	91	—	nC
			V_{DD} ≈ 64 V, V_{GS} = 5 V, I_D = 28 A	—	47	—	
Gate-source charge 1		Q_{gs1}	V_{DD} ≈ 64 V, V_{GS} = 10 V, I_D = 28 A	—	16	—	
Gate-drain ("Miller") charge		Q_{gd}		—	11	—	
Gate switch charge		Q_{SW}		—	18	—	

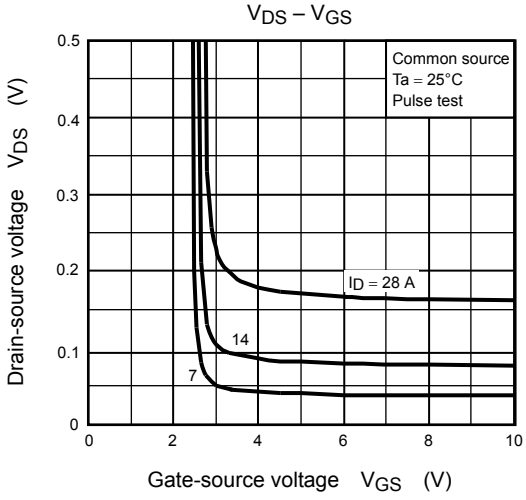
Source-Drain Ratings and Characteristics (Ta = 25°C)

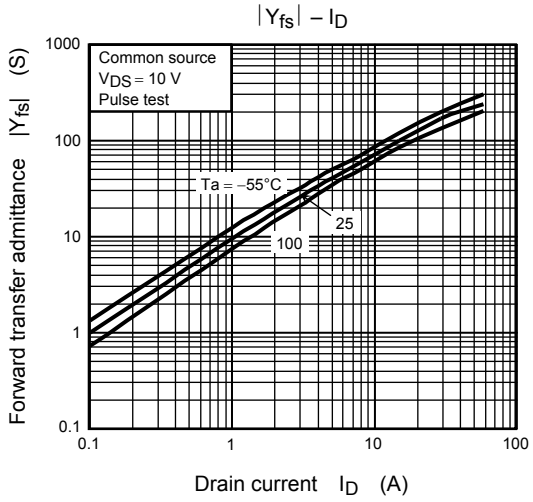
Characteristic		Symbol	Test Condition	Min	Typ.	Max	Unit
Drain reverse current	Pulse (Note 1)	I_{DRP}	—	—	—	84	A
Forward voltage (diode)		V_{DSF}	I_{DR} = 28 A, V_{GS} = 0 V	—	—	−1.2	V

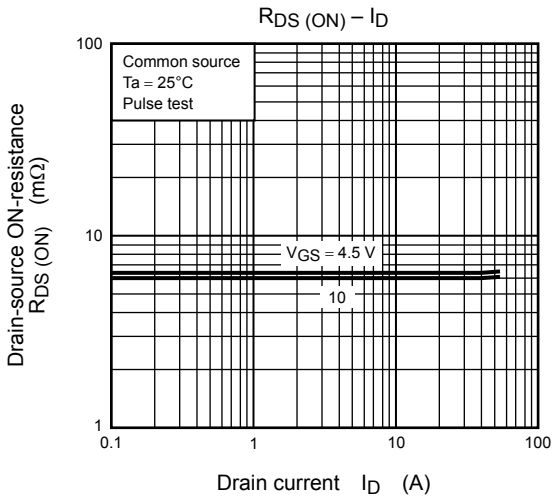

ID – VDS
Common source
Ta = 25°C
Pulse test
4.5
3.2
3
10
2.8
2.7
2.9
2.6
2.5
VGS = 2.4 V
Drain current ID (A)
Drain-source voltage VDS (V)


ID – VDS
Common source
Ta = 25°C
Pulse test
4.5
3.4
3.2
10
3
2.9
3.1
2.8
2.7
2.6
VGS = 2.5 V
Drain current ID (A)
Drain-source voltage VDS (V)

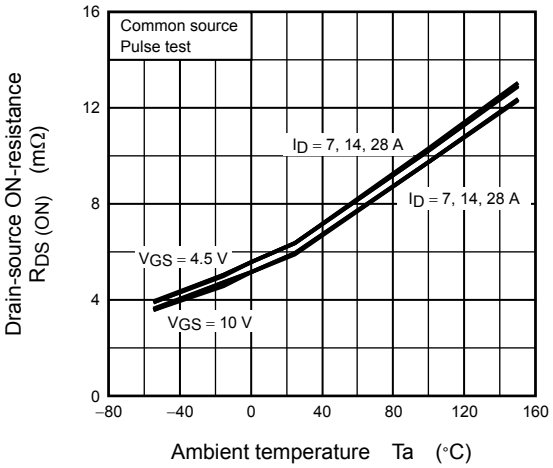

ID – VGS
Common source
VDS = 10 V
Pulse test
Ta = –55°C
100
25
Drain current ID (A)
Gate-source voltage VGS (V)


VDS – VGS
Common source
Ta = 25°C
Pulse test
ID = 28 A
14
7
Drain-source voltage VDS (V)
Gate-source voltage VGS (V)

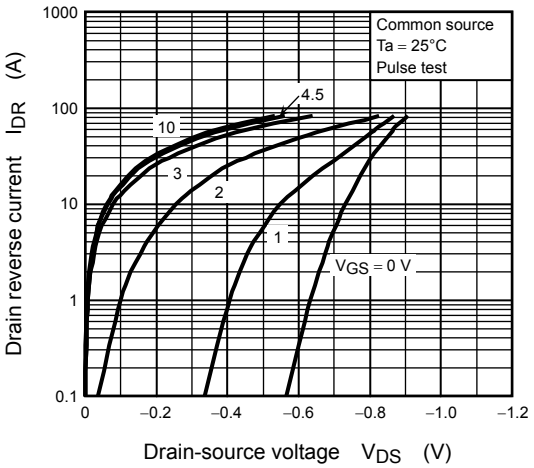

|Yfs| – ID
Common source
VDS = 10 V
Pulse test
Ta = –55°C
25
100
Forward transfer admittance |Yfs| (S)
Drain current ID (A)


RDS (ON) – ID
Common source
Ta = 25°C
Pulse test
VGS = 4.5 V
10
Drain-source ON-resistance RDS (ON) (mΩ)
Drain current ID (A)

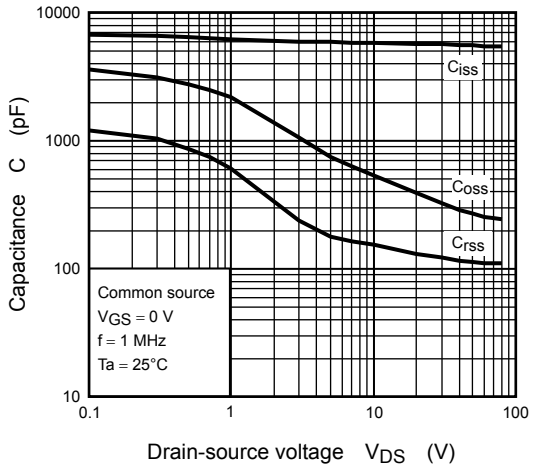
$R_{DS\ (ON)}$ – Ta



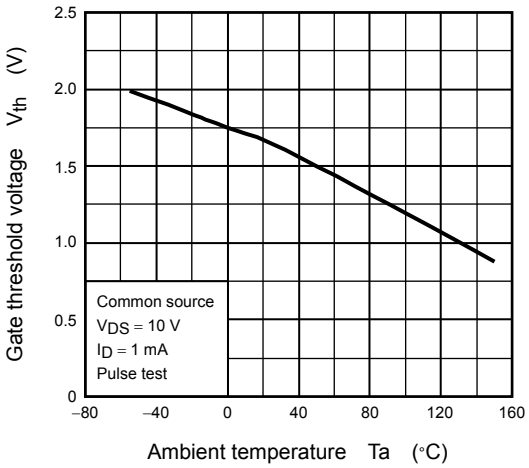
I_{DR} – V_{DS}



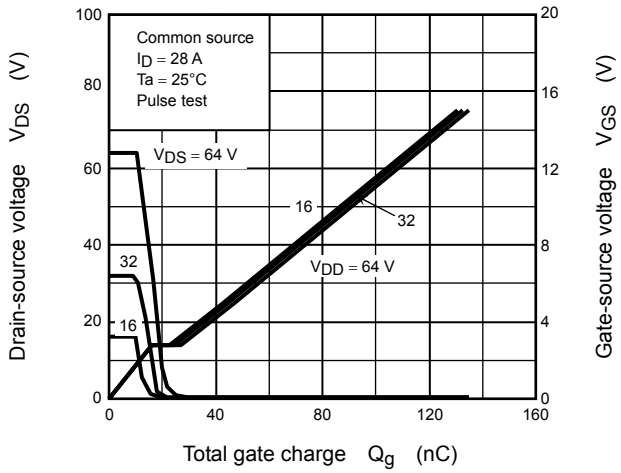
Capacitance – V_{DS}

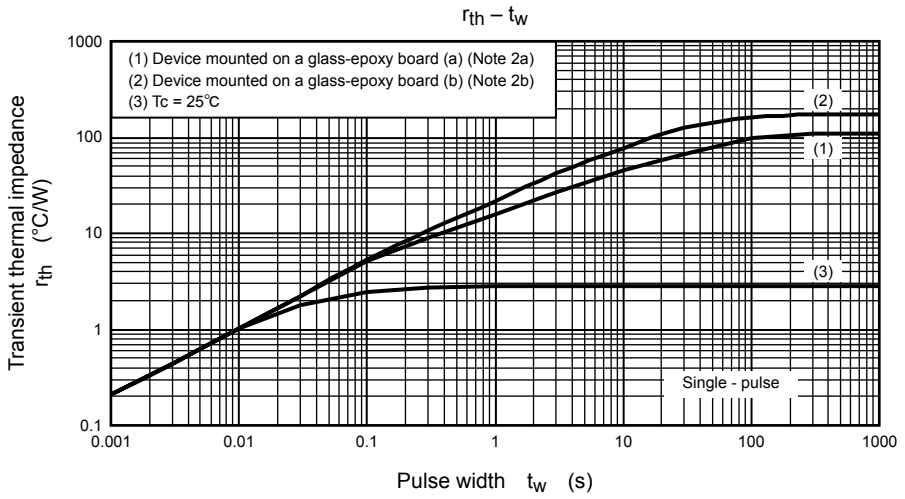


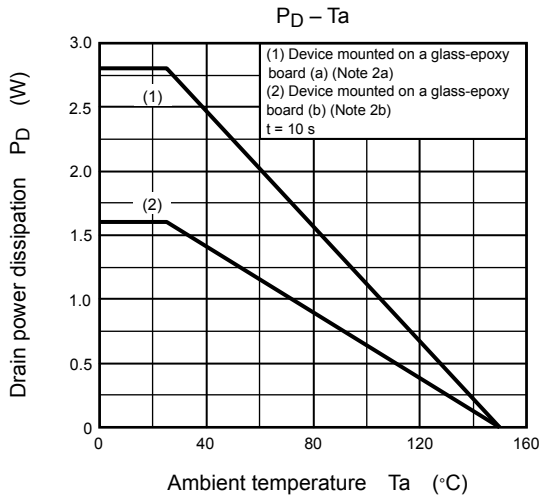
V_{th} – Ta

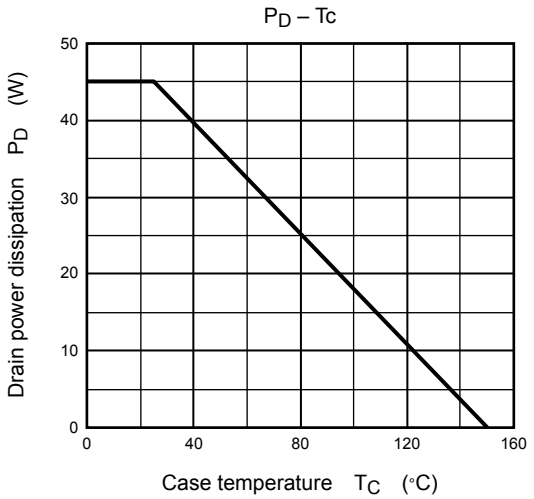


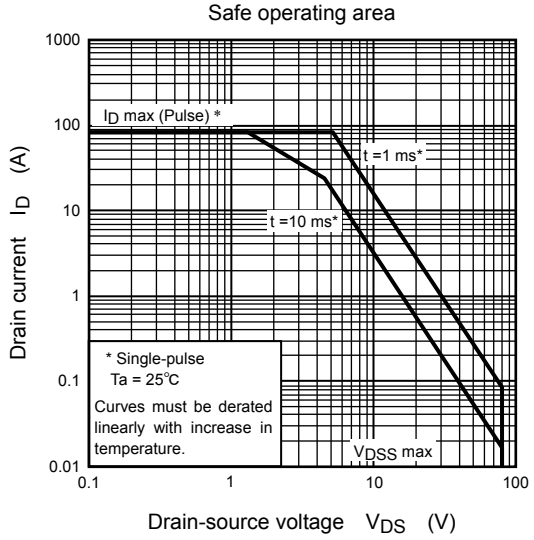
Dynamic input/output characteristics




rth – tw
(1) Device mounted on a glass-epoxy board (a) (Note 2a)
(2) Device mounted on a glass-epoxy board (b) (Note 2b)
(3) Tc = 25°C
(1)
(2)
(3)
Single - pulse
Transient thermal impedance rth (°C/W)
Pulse width tw (s)
1000
100
10
1
0.1
0.001
0.01
0.1
1
10
100
1000


PD – Ta
(1) Device mounted on a glass-epoxy board (a) (Note 2a)
(2) Device mounted on a glass-epoxy board (b) (Note 2b)
t = 10 s
(1)
(2)
Drain power dissipation PD (W)
Ambient temperature Ta (°C)
3.0
2.5
2.0
1.5
1.0
0.5
0
0
40
80
120
160


PD – Tc
Drain power dissipation PD (W)
Case temperature TC (°C)
50
40
30
20
10
0
0
40
80
120
160


Safe operating area
ID max (Pulse) *
t =1 ms*
t =10 ms*
* Single-pulse
Ta = 25°C
Curves must be derated linearly with increase in temperature.
VDSS max
Drain current ID (A)
Drain-source voltage VDS (V)
1000
100
10
1
0.1
0.01
0.1
1
10
100

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