

TOSHIBA Field Effect Transistor Silicon N-Channel MOS Type (Ultra-High-Speed U-MOSIII)

# TPCA8004-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:  $Q_{SW} = 12.7 \text{ nC (typ.)}$
- Low drain-source ON-resistance:  $R_{DS(ON)} = 3.5 \text{ m}\Omega \text{ (typ.)}$
- High forward transfer admittance:  $|Y_{fs}| = 80 \text{ S (typ.)}$
- Low leakage current:  $I_{DSS} = 10 \text{ }\mu\text{A (max)} \text{ (} V_{DS} = 30 \text{ V)}$
- Enhancement mode:  $V_{th} = 1.1 \text{ to } 2.3 \text{ V (} V_{DS} = 10 \text{ V, } I_D = 1 \text{ mA)}$

## Absolute Maximum Ratings (Ta = 25°C)

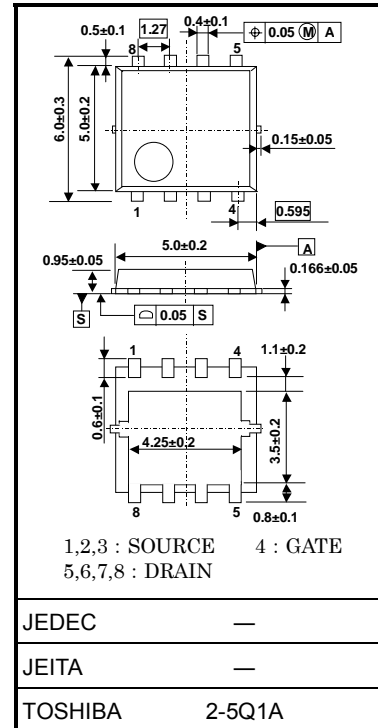
Characteristic		Symbol	Rating	Unit
Drain-source voltage		$V_{DSS}$	30	V
Drain-gate voltage ( $R_{GS} = 20 \text{ k}\Omega$ )		$V_{DGR}$	30	V
Gate-source voltage		$V_{GSS}$	$\pm 20$	V
Drain current	DC (Note 1)	$I_D$	40	A
	Pulsed (Note 1)	$I_{DP}$	120	
Drain power dissipation	( $T_c = 25^\circ\text{C}$ )	$P_D$	45	W
Drain power dissipation	( $t = 10 \text{ s}$ ) (Note 2a)	$P_D$	2.8	W
Drain power dissipation	( $t = 10 \text{ s}$ ) (Note 2b)	$P_D$	1.6	W
Single-pulse avalanche energy (Note 3)		$E_{AS}$	208	mJ
Avalanche current		$I_{AR}$	40	A
Repetitive avalanche energy ( $T_c = 25^\circ\text{C}$ ) (Note 4)		$E_{AR}$	4.5	mJ
Channel temperature		$T_{ch}$	150	$^\circ\text{C}$
Storage temperature range		$T_{stg}$	-55 to 150	$^\circ\text{C}$

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).

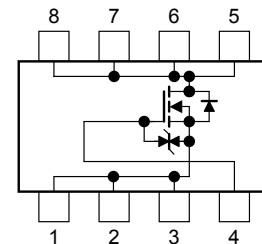
This transistor is an electrostatic-sensitive device. Handle with care.

Unit: mm



Weight: 0.069 g (typ.)

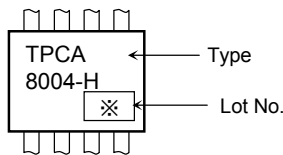
## Circuit Configuration



## Thermal Characteristics

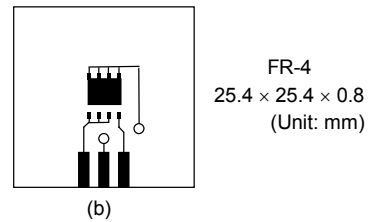
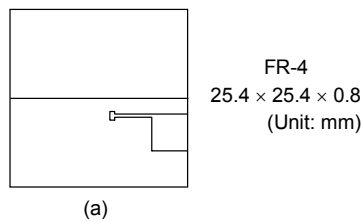
Characteristic	Symbol	Max	Unit
Thermal resistance, channel to case ( $T_c=25^\circ\text{C}$ )	$R_{th(ch-c)}$	2.78	$^\circ\text{C/W}$
Thermal resistance, channel to ambient ( $t = 10\text{ s}$ ) (Note 2a)	$R_{th(ch-a)}$	44.6	$^\circ\text{C/W}$
Thermal resistance, channel to ambient ( $t = 10\text{ s}$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

## Marking (Note 5)



Note 1: The channel temperature should not exceed  $150^\circ\text{C}$  during use.

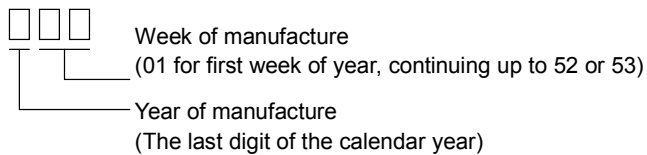
Note 2: (a) Device mounted on a glass-epoxy board (a) (b) Device mounted on a glass-epoxy board (b)



Note 3:  $V_{DD} = 24\text{ V}$ ,  $T_{ch} = 25^\circ\text{C}$  (initial),  $L = 0.1\text{ mH}$ ,  $R_G = 25\ \Omega$ ,  $I_{AR} = 40\text{ A}$

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

Note 5: \* Weekly code: (Three digits)

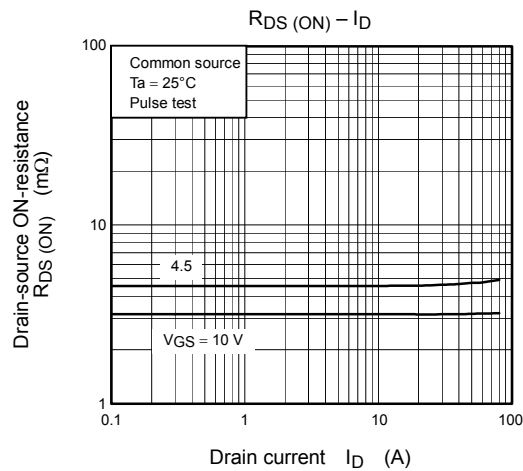
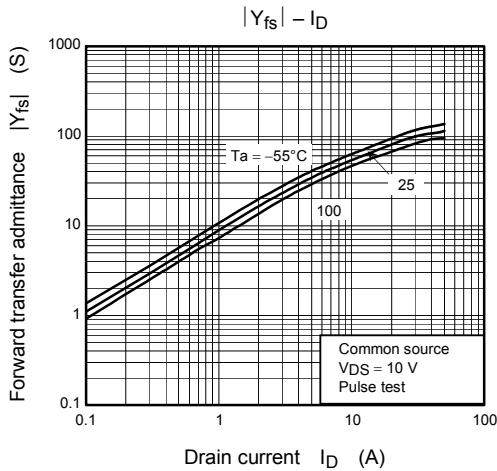
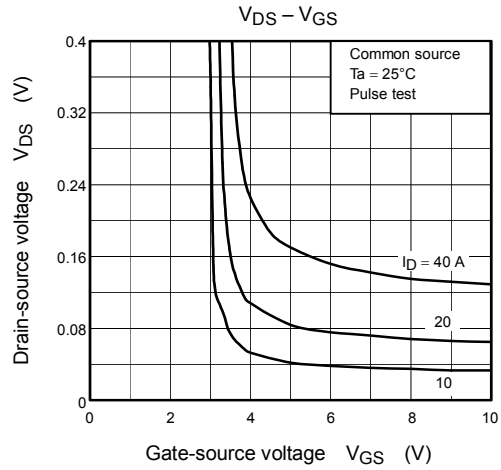
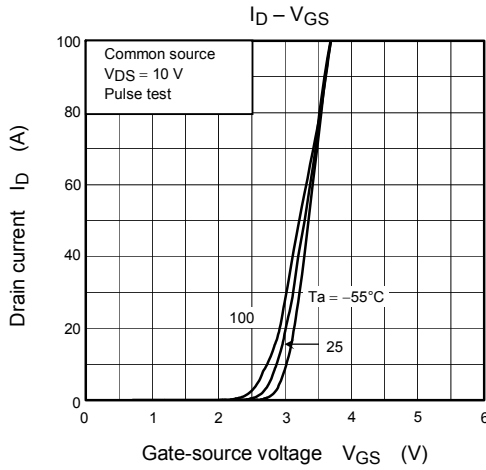
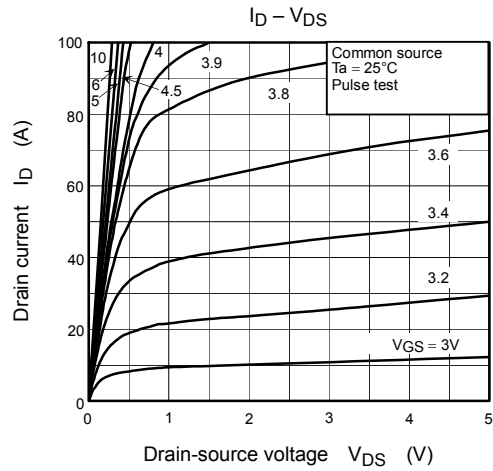
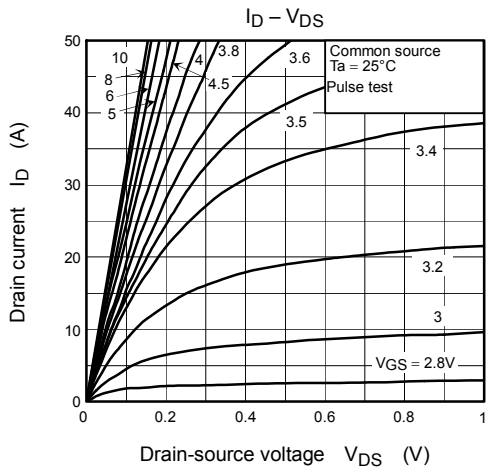


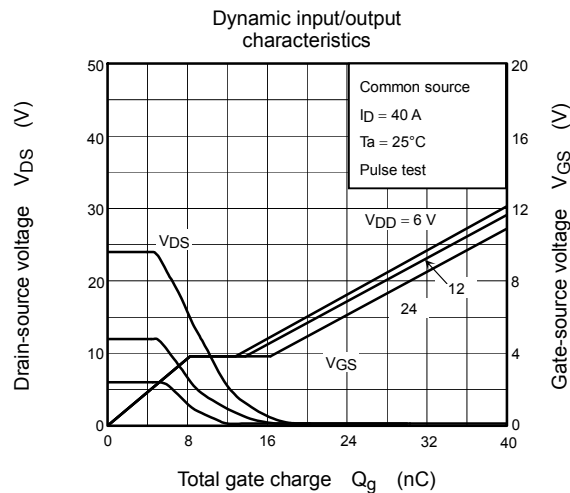
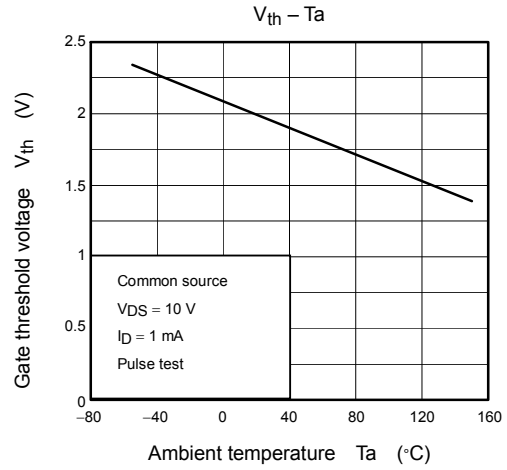
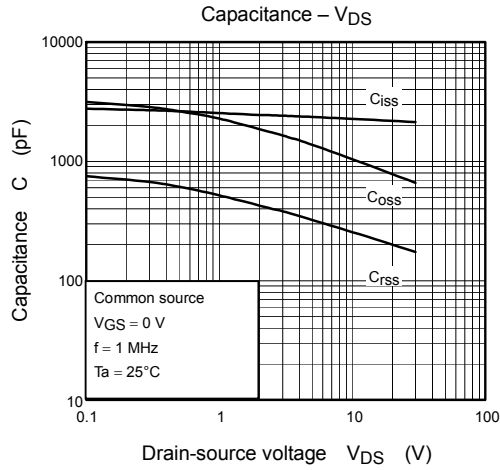
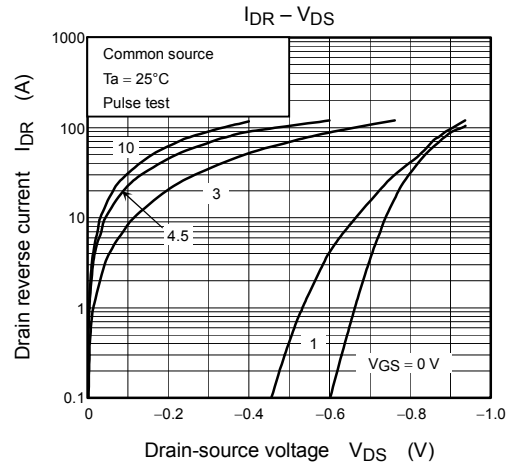
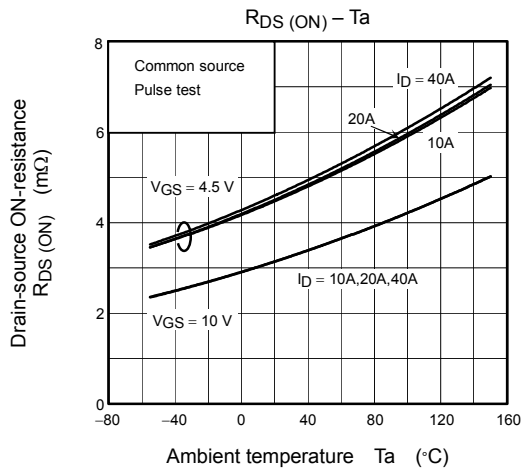
## Electrical Characteristics (Ta = 25°C)

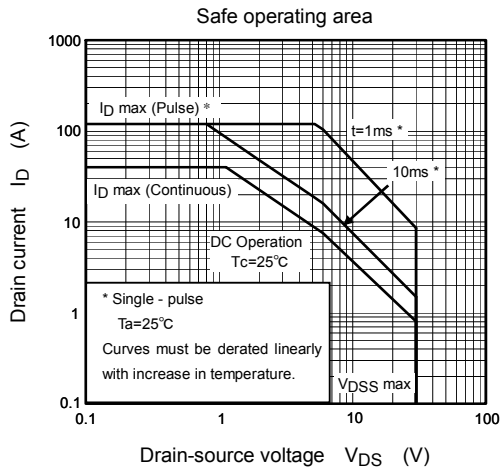
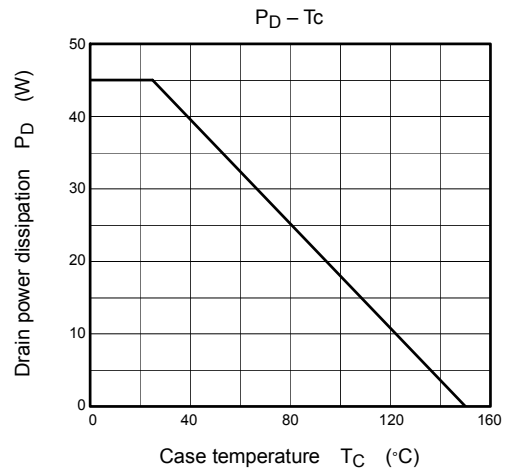
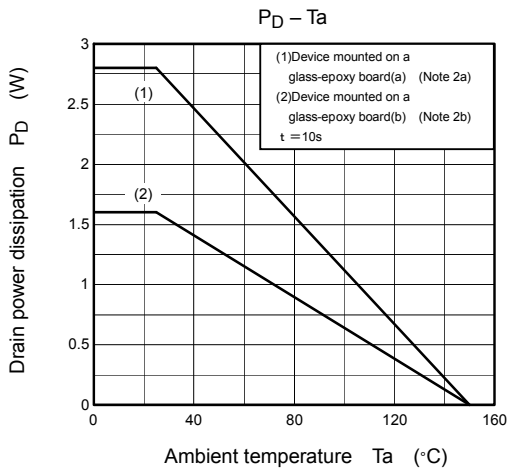
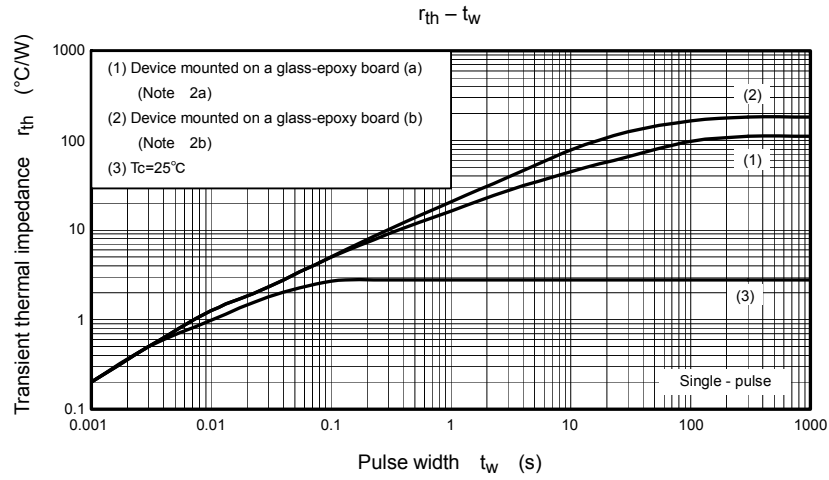
Characteristic		Symbol	Test Condition	Min	Typ.	Max	Unit
Gate leakage current		$I_{GSS}$	$V_{GS} = \pm 16\text{ V}, V_{DS} = 0\text{ V}$	—	—	$\pm 10$	$\mu\text{A}$
Drain cutoff current		$I_{DSS}$	$V_{DS} = 30\text{ V}, V_{GS} = 0\text{ V}$	—	—	10	$\mu\text{A}$
Drain-source breakdown voltage		$V_{(BR)DSS}$	$I_D = 10\text{ mA}, V_{GS} = 0\text{ V}$	30	—	—	V
		$V_{(BR)DSX}$	$I_D = 10\text{ mA}, V_{GS} = -20\text{ V}$	15	—	—	
Gate threshold voltage		$V_{th}$	$V_{DS} = 10\text{ V}, I_D = 1\text{ mA}$	1.1	—	2.3	V
Drain-source ON-resistance		$R_{DS(ON)}$	$V_{GS} = 4.5\text{ V}, I_D = 20\text{ A}$	—	4.8	6.2	$\text{m}\Omega$
			$V_{GS} = 10\text{ V}, I_D = 20\text{ A}$	—	3.5	4.6	
Forward transfer admittance		$ Y_{fs} $	$V_{DS} = 10\text{ V}, I_D = 20\text{ A}$	40	80	—	S
Input capacitance		$C_{iss}$	$V_{DS} = 10\text{ V}, V_{GS} = 0\text{ V}, f = 1\text{ MHz}$	—	2265	—	pF
Reverse transfer capacitance		$C_{riss}$		—	255	—	
Output capacitance		$C_{oss}$		—	1045	—	
Switching time	Rise time	$t_r$	<p> <math>V_{GS} = 10\text{ V}</math>  <math>0\text{ V}</math>  <math>I_D = 20\text{ A}</math>  <math>V_{OUT}</math>  <math>4.7\Omega</math>  <math>R_L = 0.75\Omega</math>  <math>V_{DD} \approx 15\text{ V}</math>                      Duty <math>\leq 1\%</math>, <math>t_w = 10\mu\text{s}</math> </p>	—	5	—	ns
	Turn-on time	$t_{on}$		—	14	—	
	Fall time	$t_f$		—	11	—	
	Turn-off time	$t_{off}$		—	50	—	
Total gate charge (gate-source plus gate-drain)		$Q_g$	$V_{DD} \approx 24\text{ V}, V_{GS} = 10\text{ V}, I_D = 40\text{ A}$	—	37	—	nC
			$V_{DD} \approx 24\text{ V}, V_{GS} = 5\text{ V}, I_D = 40\text{ A}$	—	20	—	
Gate-source charge 1		$Q_{gs1}$	$V_{DD} \approx 24\text{ V}, V_{GS} = 10\text{ V}, I_D = 40\text{ A}$	—	8.2	—	
Gate-drain ("Miller") charge		$Q_{gd}$	$V_{DD} \approx 24\text{ V}, V_{GS} = 10\text{ V}, I_D = 40\text{ A}$	—	8.7	—	
Gate switch charge		$Q_{SW}$	$V_{DD} \approx 24\text{ V}, V_{GS} = 10\text{ V}, I_D = 40\text{ A}$	—	12.7	—	

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

Characteristic		Symbol	Test Condition	Min	Typ.	Max	Unit
Drain reverse current	Pulse (Note 1)	$I_{DRP}$	—	—	—	120	A
Forward voltage (diode)		$V_{DSF}$	$I_{DR} = 40\text{ A}, V_{GS} = 0\text{ V}$	—	—	-1.2	V







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