

TOSHIBA Field Effect Transistor with Built-in Schottky Barrier Diode

Silicon N-Channel MOS Type (U-MOS V -H)

# TPC8A07-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: (Q1)  $Q_{SW} = 3.4 \text{ nC (typ.)}$   
(Q2)  $Q_{SW} = 3.6 \text{ nC (typ.)}$
- Low drain-source ON-resistance: (Q1)  $R_{DS(ON)} = 21 \text{ m}\Omega \text{ (typ.)}$   
(Q2)  $R_{DS(ON)} = 14 \text{ m}\Omega \text{ (typ.)}$
- Low leakage current: (Q1)  $I_{DSS} = 10 \text{ }\mu\text{A (max) (}V_{DS} = 30 \text{ V)}$   
(Q2)  $I_{DSS} = 100\text{ }\mu\text{A (max) (}V_{DS} = 30 \text{ V)}$
- Enhancement mode: (Q1)  $V_{th} = 1.5 \text{ to } 2.5 \text{ V (}V_{DS} = 10 \text{ V, } I_D = 1.0 \text{ mA)}$   
(Q2)  $V_{th} = 1.3 \text{ to } 2.3 \text{ V (}V_{DS} = 10 \text{ V, } I_D = 1.0 \text{ mA)}$

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

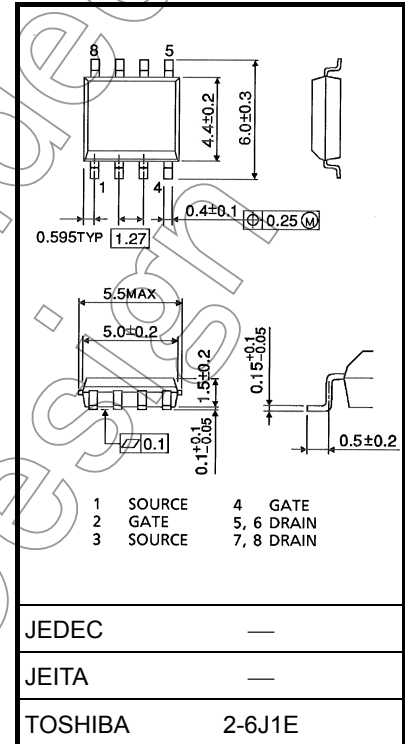
Characteristic		Symbol	Rating		Unit
			(Q1)	(Q2)	
Drain-source voltage		$V_{DSS}$	30	30	V
Drain-gate voltage ( $R_{GS} = 20 \text{ k}\Omega$ )		$V_{DGR}$	30	30	V
Gate-source voltage		$V_{GSS}$	$\pm 20$	$\pm 20$	V
Drain current	D C (Note 1)	$I_D$	6.8	8.5	A
	Pulse (Note 1)	$I_{DP}$	27.2	34	
Drain power dissipation (t = 10 s) (Note 2a)	Single-device operation (Note 3a)	$P_D(1)$	1.5		W
	Single-device value at dual operation (Note 3b)	$P_D(2)$	1.1		
Drain power dissipation (t = 10 s) (Note 2b)	Single-device operation (Note 3a)	$P_D(1)$	0.75		W
	Single-device value at dual operation (Note 3b)	$P_D(2)$	0.45		
Single-pulse avalanche energy (Note 4)		$E_{AS}$	60.1	94	mJ
Avalanche current		$I_{AR}$	6.8	8.5	A
Repetitive avalanche energy (Note 2a, Note 3b, Note 5)		$E_{AR}$	0.11	0.09	mJ
Channel temperature		$T_{ch}$	150		°C
Storage temperature range		$T_{stg}$	-55 to 150		°C

Note: For Notes 1 to 5, 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.).

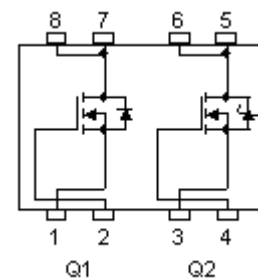
This transistor is an electrostatic-sensitive device. Handle with care.

Unit: mm



Weight: 0.085 g (typ.)

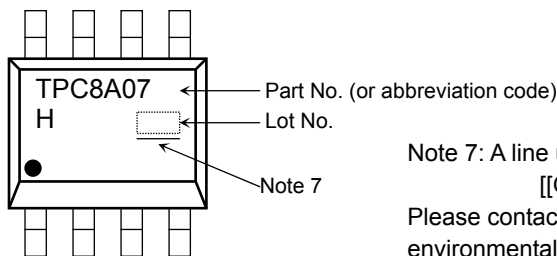
## Circuit Configuration



## Thermal Characteristics

Characteristic		Symbol	Max	Unit
Thermal resistance, channel to ambient (t = 10 s)	Single-device operation (Note 3a)	R <sub>th</sub> (ch-a) (1)	83.3	°C/W
	Single-device value at dual operation (Note 3b)	R <sub>th</sub> (ch-a) (2)	114	
Thermal resistance, channel to ambient (t = 10 s)	Single-device operation (Note 3a)	R <sub>th</sub> (ch-a) (1)	167	
	Single-device value at dual operation (Note 3b)	R <sub>th</sub> (ch-a) (2)	278	

## Marking (Note 6)



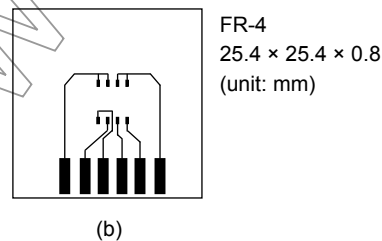
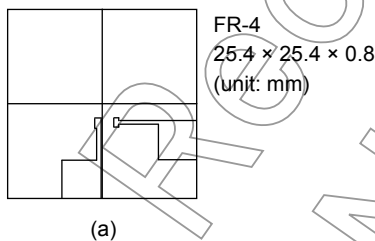
Note 7: A line under a Lot No. identifies the indication of product Labels.

[[G]]/RoHS COMPATIBLE or [[G]]/RoHS [[Pb]]

Please contact your TOSHIBA sales representative for details as to environmental matters such as the RoHS compatibility of Product. The RoHS is the Directive 2002/95/EC of the European Parliament and of the Council of 27 January 2003 on the restriction of the use of certain hazardous substances in electrical and electronic equipment.

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)



Note 3:

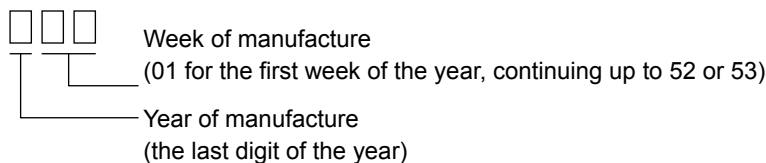
- The power dissipation and thermal resistance values are shown for a single device (During single-device operation, power is only applied to one device.)
- The power dissipation and thermal resistance values are shown for a single device (During dual operation, power is evenly applied to both devices.)

Note 4: (Q1) V<sub>DD</sub> = 24 V, T<sub>ch</sub> = 25°C (Initial), L = 1.0 mH, R<sub>G</sub> = 25 Ω, I<sub>AR</sub> = 6.8 A  
(Q2) V<sub>DD</sub> = 24 V, T<sub>ch</sub> = 25°C (Initial), L = 1.0 mH, R<sub>G</sub> = 25 Ω, I<sub>AR</sub> = 8.5 A

Note 5: Repetitive rating: pulse width limited by maximum channel temperature

Note 6: • on the lower left of the marking indicates Pin 1.

\* Weekly code: (three digits)



## Q1

### Electrical Characteristics (Ta = 25°C)

Characteristic		Symbol	Test Condition	Min	Typ.	Max	Unit
Gate leakage current		$I_{GSS}$	$V_{GS} = \pm 20\text{ V}, V_{DS} = 0\text{ V}$	—	—	$\pm 100$	nA
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	—	—	V
Gate threshold voltage		$V_{th}$	$V_{DS} = 10\text{ V}, I_D = 1.0\text{ mA}$	1.5	—	2.5	V
Drain-source ON-resistance		$R_{DS(ON)}$	$V_{GS} = 4.5\text{ V}, I_D = 3.4\text{ A}$	—	21	28	m $\Omega$
			$V_{GS} = 10\text{ V}, I_D = 3.4\text{ A}$	—	17	23	
Forward transfer admittance		$ Y_{fs} $	$V_{DS} = 10\text{ V}, I_D = 3.4\text{ A}$	11	22	—	S
Input capacitance		$C_{iss}$	$V_{DS} = 10\text{ V}, V_{GS} = 0\text{ V}, f = 1\text{ MHz}$	—	830	1100	pF
Reverse transfer capacitance		$C_{rss}$		—	54	82	
Output capacitance		$C_{oss}$		—	180	—	
Gate resistance		$r_g$	$V_{DS} = 10\text{ V}, V_{GS} = 0\text{ V}, f = 5\text{ MHz}$	—	1.7	2.6	$\Omega$
Switching time	Rise time	$t_r$		—	2.2	—	ns
	Turn-on time	$t_{on}$		—	7.7	—	
	Fall time	$t_f$		—	2.5	—	
	Turn-off time	$t_{off}$		Duty $\leq 1\%$ , $t_w = 10\ \mu\text{s}$	—	18	
Total gate charge (gate-source plus gate-drain)		$Q_g$	$V_{DD} \approx 24\text{ V}, V_{GS} = 10\text{ V}, I_D = 6.8\text{ A}$	—	13	—	nC
			$V_{DD} \approx 24\text{ V}, V_{GS} = 5\text{ V}, I_D = 6.8\text{ A}$	—	6.9	—	
Gate-source charge 1		$Q_{gs1}$	$V_{DD} \approx 24\text{ V}, V_{GS} = 10\text{ V}, I_D = 6.8\text{ A}$	—	2.9	—	
Gate-drain ("Miller") charge		$Q_{gd}$		—	2.3	—	
Gate switch charge		$Q_{sw}$		—	3.4	—	

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

Characteristic		Symbol	Test Condition	Min	Typ.	Max	Unit
Drain reverse current	Pulse (Note 1)	$I_{DRP}$	—	—	—	27.2	A
Forward voltage (diode)		$V_{DSF}$	$I_{DR} = 6.8\text{ A}, V_{GS} = 0\text{ V}$	—	—	-1.2	V

## Q2

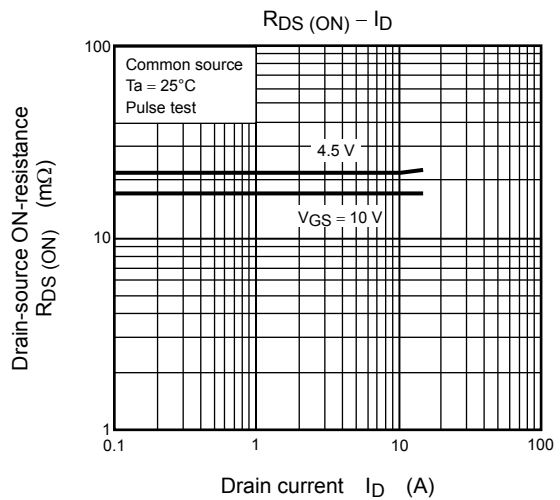
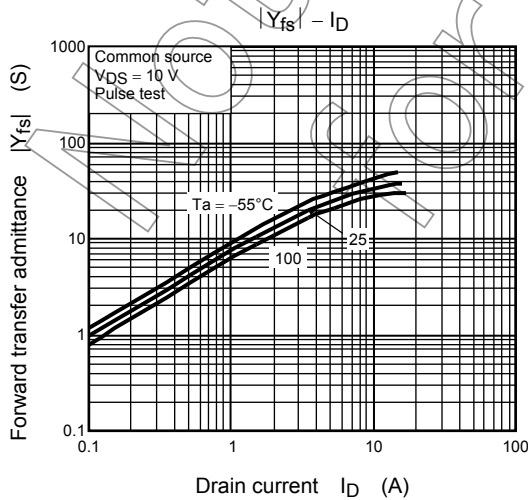
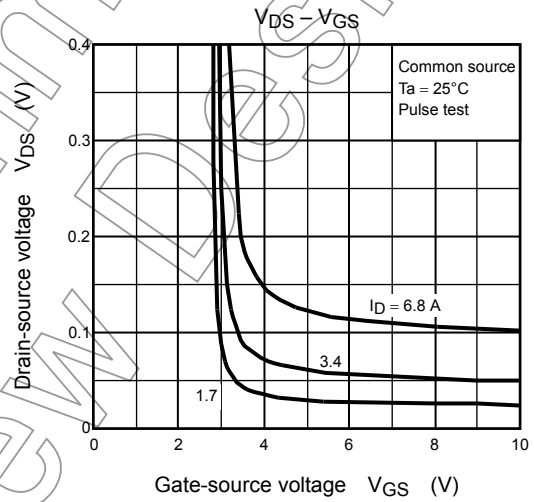
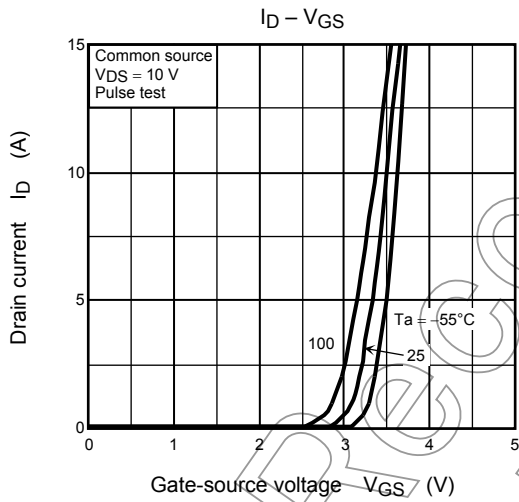
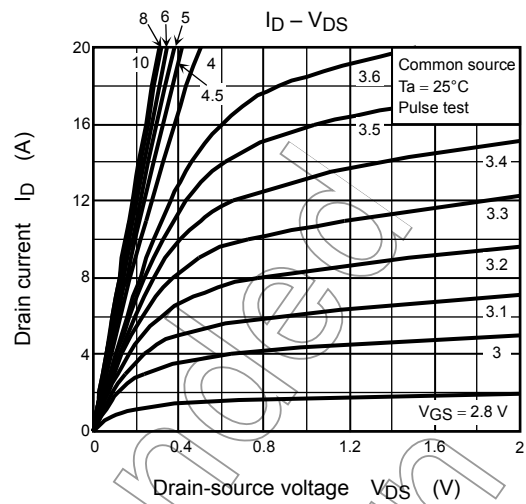
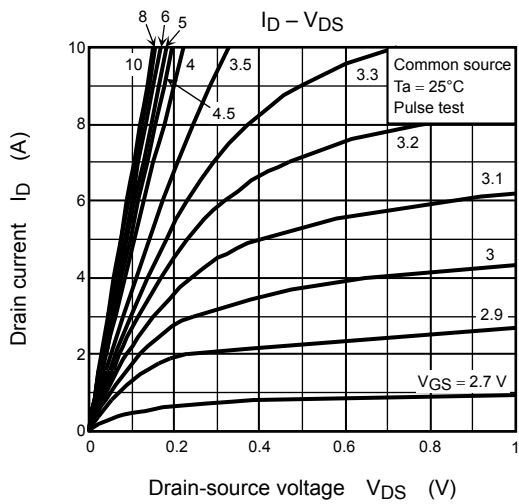
### Electrical Characteristics (Ta = 25°C)

Characteristic		Symbol	Test Condition	Min	Typ.	Max	Unit
Gate leakage current		$I_{GSS}$	$V_{GS} = \pm 20\text{ V}, V_{DS} = 0\text{ V}$	—	—	$\pm 100$	nA
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	—	—	V
Gate threshold voltage		$V_{th}$	$V_{DS} = 10\text{ V}, I_D = 1.0\text{ mA}$	1.3	—	2.3	V
Drain-source ON-resistance		$R_{DS(ON)}$	$V_{GS} = 4.5\text{ V}, I_D = 4.3\text{ A}$	—	14	19	m $\Omega$
			$V_{GS} = 10\text{ V}, I_D = 4.3\text{ A}$	—	11	15	
Forward transfer admittance		$ Y_{fs} $	$V_{DS} = 10\text{ V}, I_D = 4.3\text{ A}$	13	26	—	S
Input capacitance		$C_{iss}$	$V_{DS} = 10\text{ V}, V_{GS} = 0\text{ V}, f = 1\text{ MHz}$	—	1100	1400	pF
Reverse transfer capacitance		$C_{rss}$		—	50	75	
Output capacitance		$C_{oss}$		—	320	—	
Gate resistance		$r_g$	$V_{DS} = 10\text{ V}, V_{GS} = 0\text{ V}, f = 5\text{ MHz}$	—	1.9	2.9	$\Omega$
Switching time	Rise time	$t_r$		—	2.1	—	ns
	Turn-on time	$t_{on}$		—	7.8	—	
	Fall time	$t_f$		—	3.1	—	
	Turn-off time	$t_{off}$		Duty $\leq 1\%$ , $t_w = 10\ \mu\text{s}$	—	22	
Total gate charge (gate-source plus gate-drain) (Note 7)		$Q_g$	$V_{DD} \approx 24\text{ V}, V_{GS} = 10\text{ V}, I_D = 8.5\text{ A}$	—	16	—	nC
			$V_{DD} \approx 24\text{ V}, V_{GS} = 5\text{ V}, I_D = 8.5\text{ A}$	—	8.1	—	
Gate-source charge 1		$Q_{gs1}$	$V_{DD} \approx 24\text{ V}, V_{GS} = 10\text{ V}, I_D = 8.5\text{ A}$	—	3.4	—	
Gate-drain ("Miller") charge		$Q_{gd}$		—	2.2	—	
Gate switch charge		$Q_{sw}$		—	3.6	—	

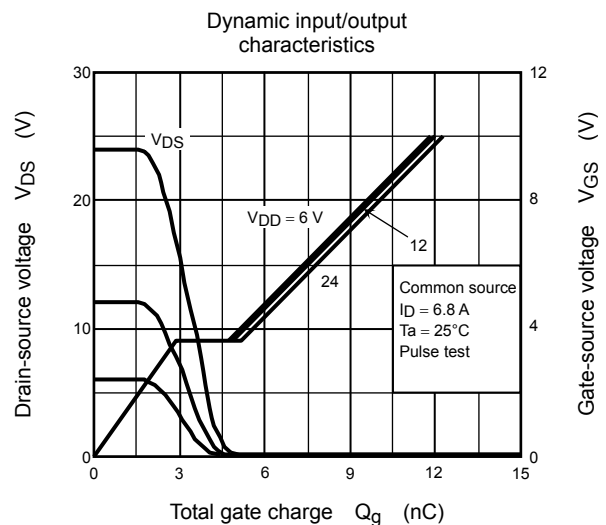
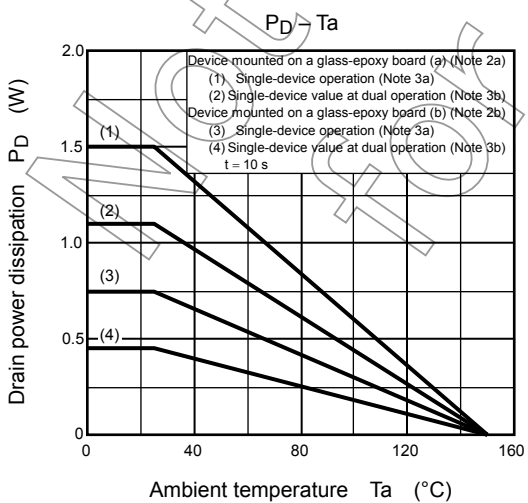
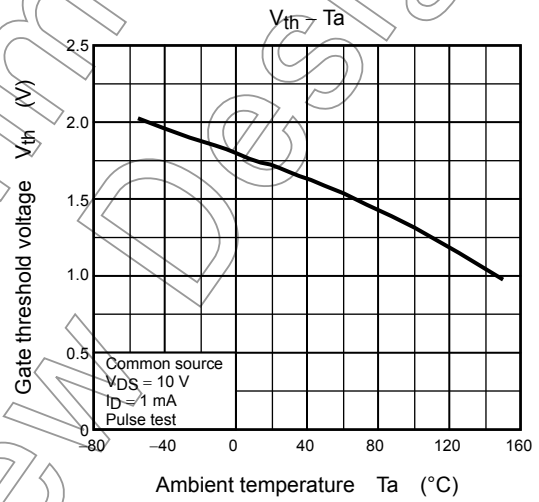
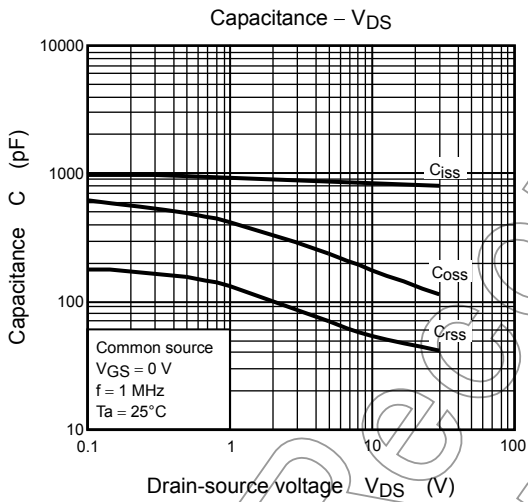
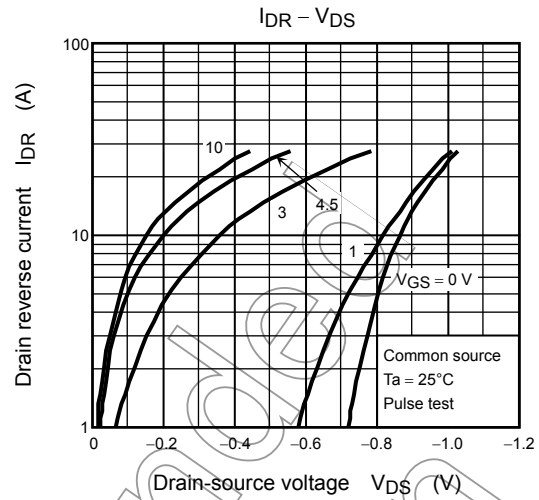
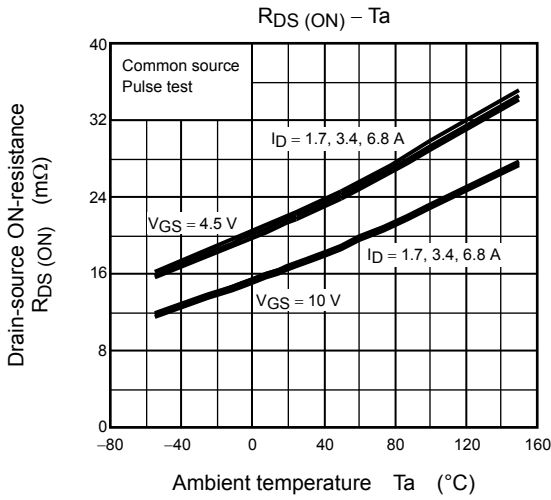
### Source-Drain Ratings and Characteristics (Ta = 25°C)

Characteristic		Symbol	Test Condition	Min	Typ.	Max	Unit
Peak forward current	Pulse (Note 1)	$I_{FP}$	—	—	—	34	A
Forward voltage (diode)		$V_{DSF}$	$I_{DR} = 1\text{ A}, V_{GS} = 0\text{ V}$	—	-0.4	-0.6	V
			$I_{DR} = 8.5\text{ A}, V_{GS} = 0\text{ V}$	—	—	-1.2	V

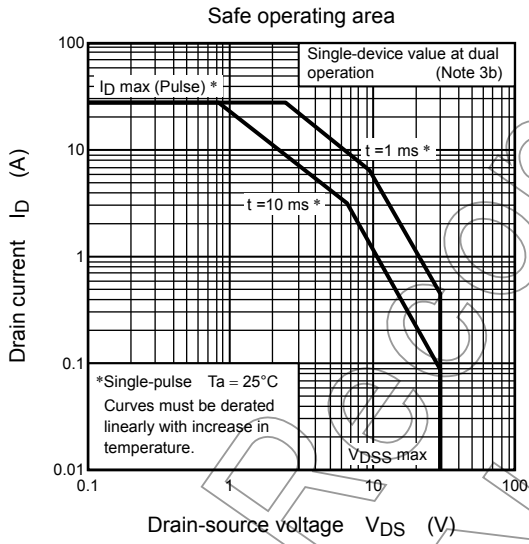
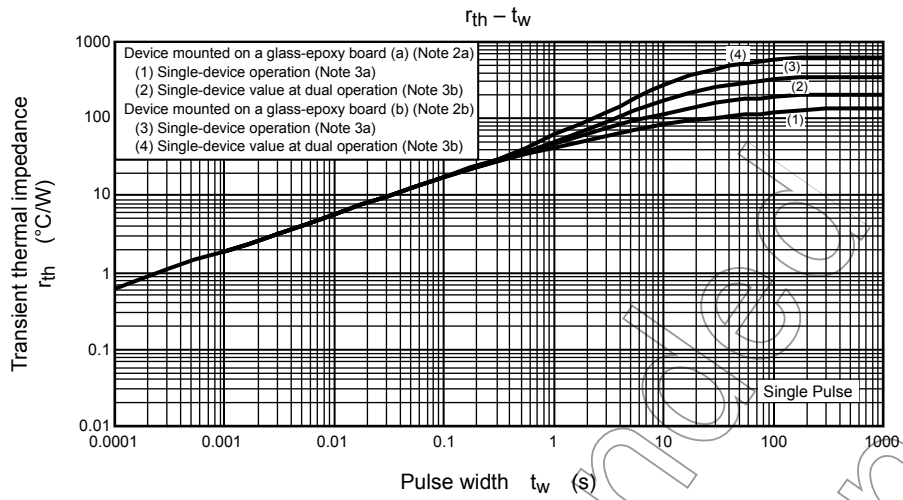
**Q1**



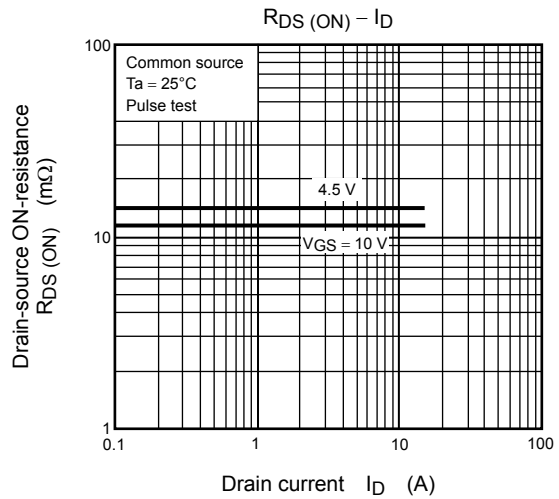
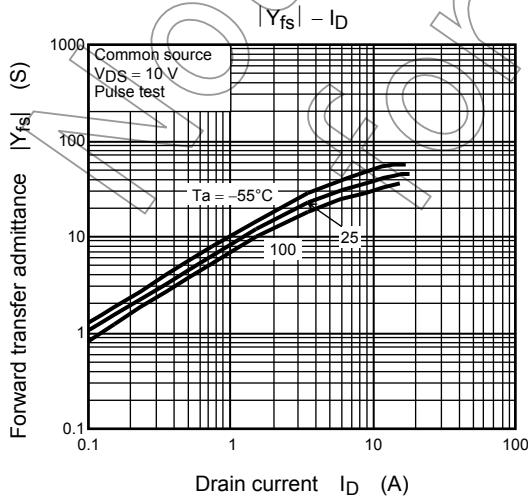
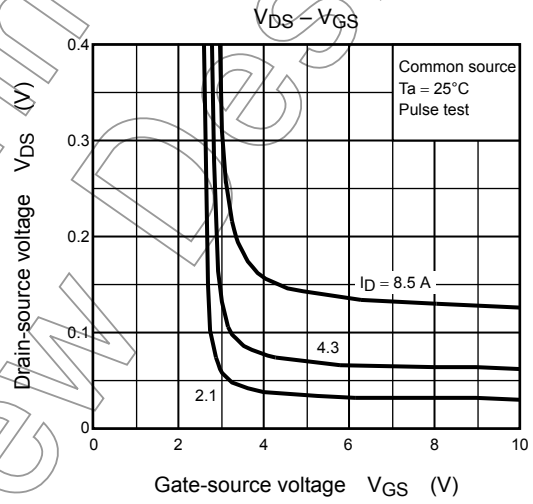
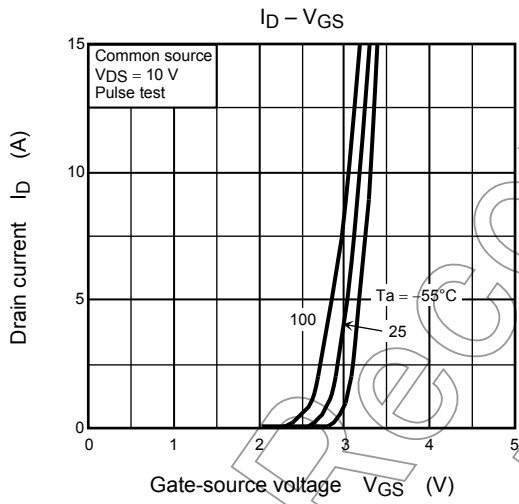
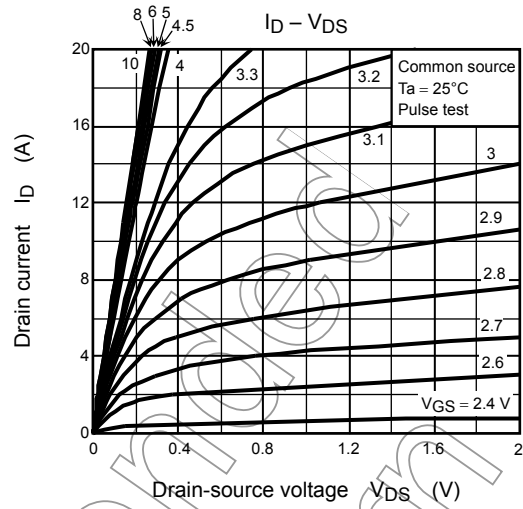
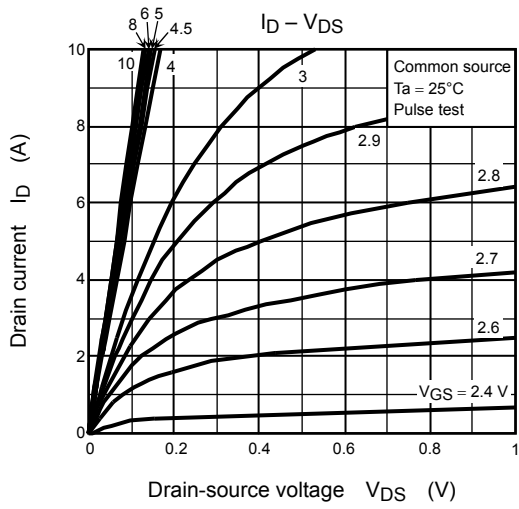
## Q1



Q1

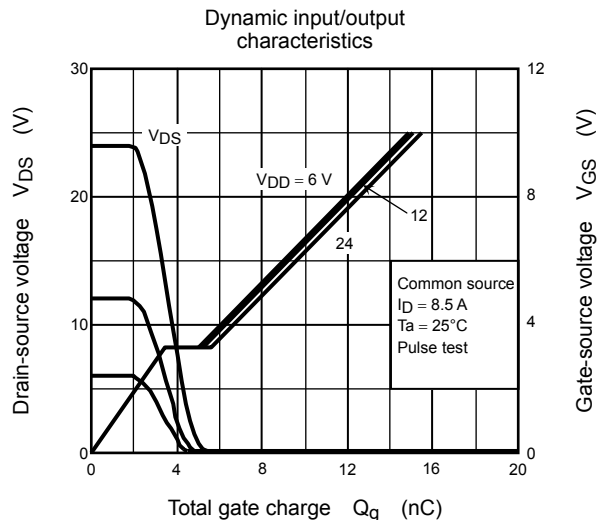
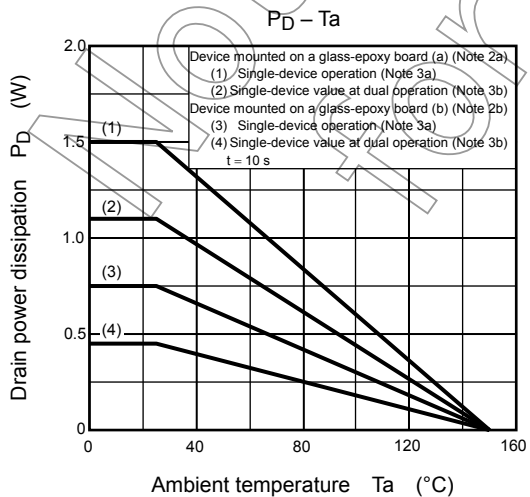
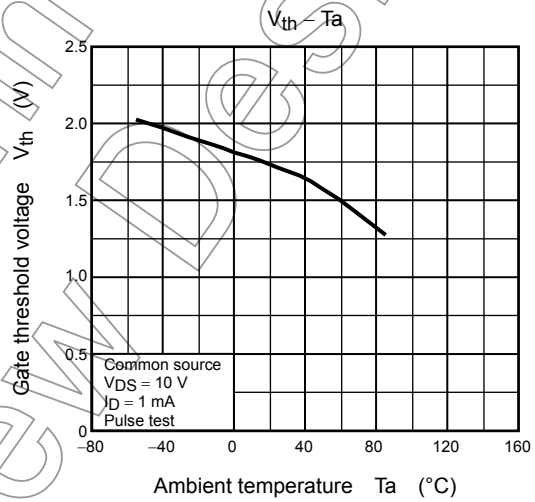
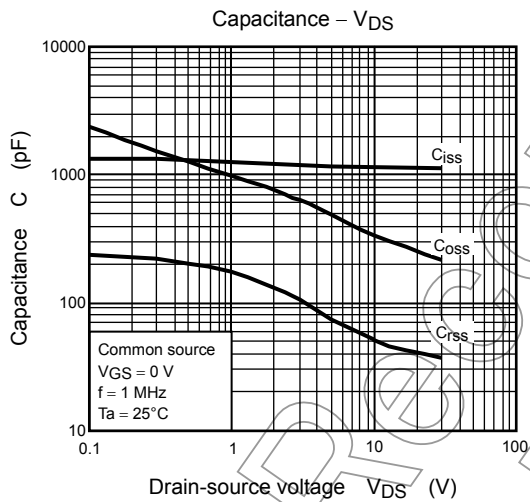
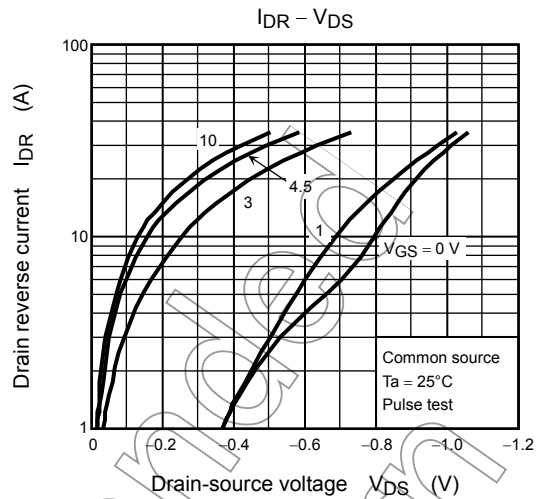
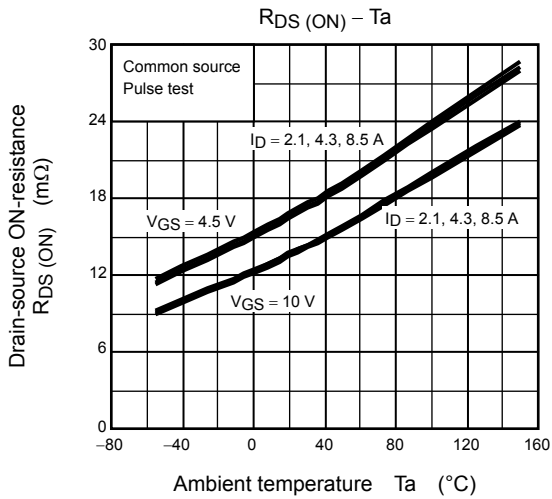


**Q2 (Includes Schottky Barrier Diode)**

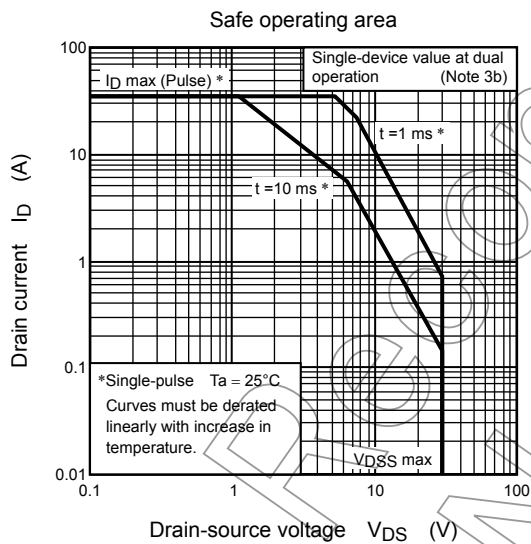
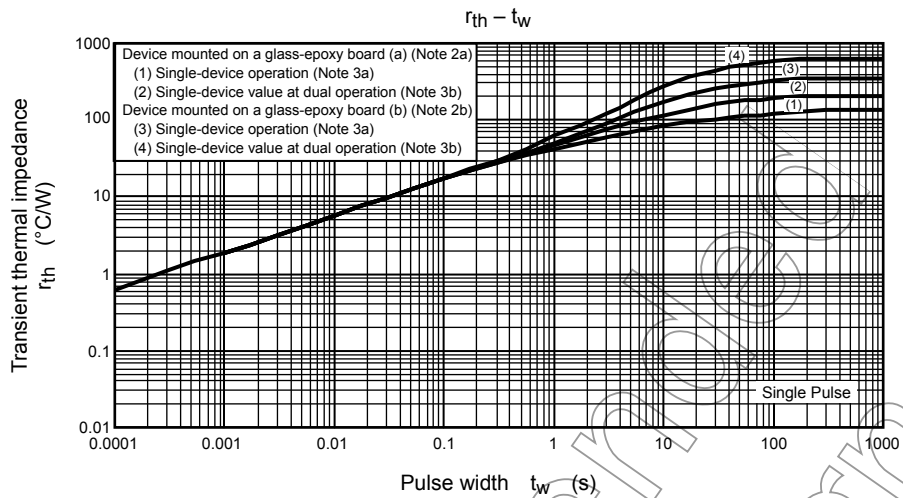




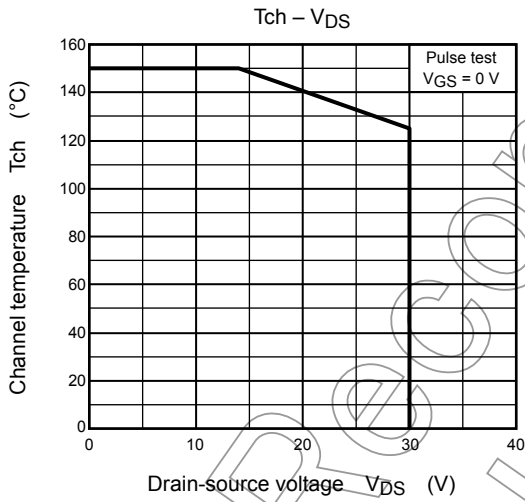
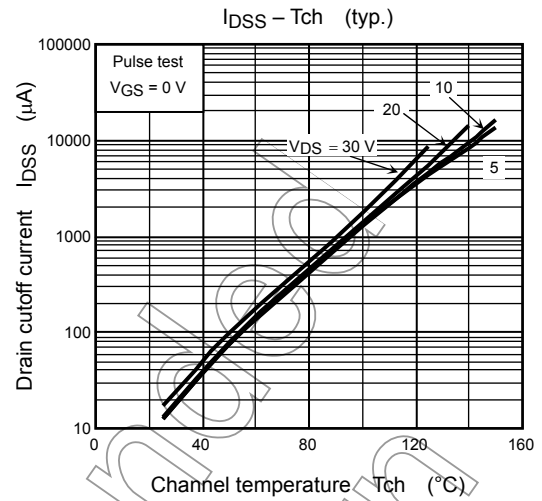
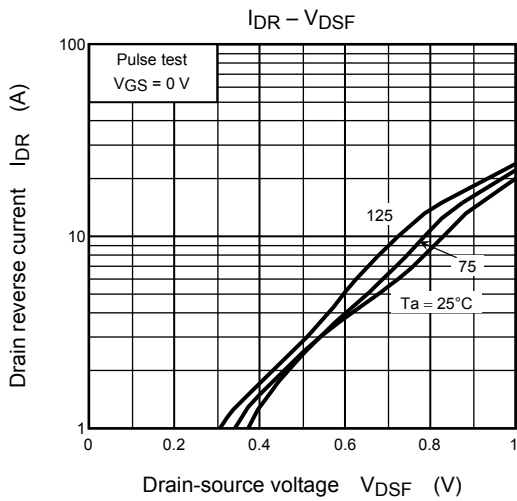
## Q2 (Includes Schottky Barrier Diode)



## Q2 (Includes Schottky Barrier Diode)



**Q2 ( $V_{GS} = 0V$ )**



Not for New Design

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