

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

TPC8406-H

High Efficiency DC-DC Converter Applications

Notebook PC Applications

Portable Equipment Applications

CCFL Inverter Applications

- Small footprint due to a small and thin package
- High speed switching
- Low drain-source ON-resistance: P-Channel $R_{DS(ON)} = 24 \text{ m}\Omega$ (typ.)
N-Channel $R_{DS(ON)} = 22 \text{ m}\Omega$ (typ.)
- Small gate charge: P-Channel $Q_{SW} = 9.7 \text{ nC}$ (typ.)
N-Channel $Q_{SW} = 3.5 \text{ nC}$ (typ.)
- High forward transfer admittance: P-Channel $|Y_{fs}| = 13 \text{ S}$ (typ.)
N-Channel $|Y_{fs}| = 14 \text{ S}$ (typ.)
- Low leakage current: P-Channel $I_{DSS} = -10 \text{ }\mu\text{A}$ ($V_{DS} = -40 \text{ V}$)
N-Channel $I_{DSS} = 10 \text{ }\mu\text{A}$ ($V_{DS} = 40 \text{ V}$)
- Enhancement mode
: P-Channel $V_{th} = -0.8 \text{ to } -2.0 \text{ V}$ ($V_{DS} = -10 \text{ V}$, $I_D = -1 \text{ mA}$)
: N-Channel $V_{th} = 1.1 \text{ to } 2.3 \text{ V}$ ($V_{DS} = 10 \text{ V}$, $I_D = 1 \text{ mA}$)

Absolute Maximum Ratings ($T_a = 25^\circ\text{C}$)

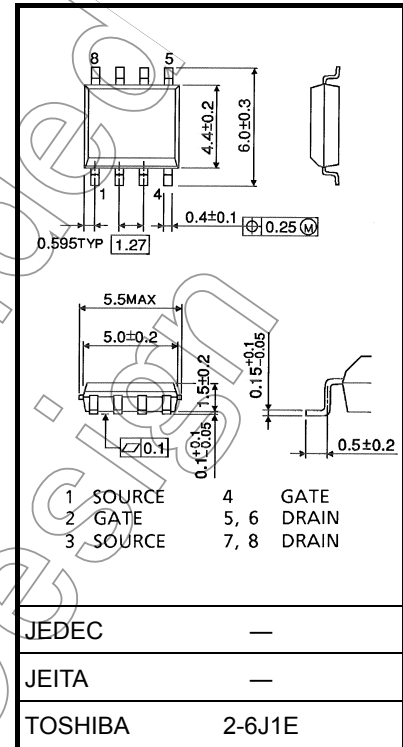
Characteristic		Symbol	Rating		Unit
			P-Channel	N-Channel	
Drain-source voltage		V_{DSS}	-40	40	V
Drain-gate voltage ($R_{GS} = 20 \text{ k}\Omega$)		V_{DGR}	-40	40	V
Gate-source voltage		V_{GSS}	± 20	± 20	V
Drain current	DC (Note 1)	I_D	-6.5	6.5	A
	Pulse (Note 1)	I_{DP}	-26	26	A
Drain power dissipation ($t = 10 \text{ s}$) (Note 2a)	Single-device operation (Note 3a)	$P_{D(1)}$	1.5	1.5	W
	Single-device value at dual operation (Note 3b)	$P_{D(2)}$	1.1	1.1	
Drain power dissipation ($t = 10 \text{ s}$) (Note 2b)	Single-device operation (Note 3a)	$P_{D(1)}$	0.75	0.75	
	Single-device value at dual operation (Note 3b)	$P_{D(2)}$	0.45	0.45	
Single-pulse avalanche energy		E_{AS}	19 (Note 4a)	19 (Note 4b)	mJ
Avalanche current		I_{AR}	-6.5	6.5	A
Repetitive avalanche energy Single-device value at dual operation (Note 2a, 3b, 5)		E_{AR}	0.08		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 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.).

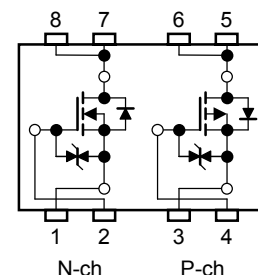
This transistor is an electrostatic-sensitive device. Handle with care.

Unit: mm



Weight: 0.085 g (typ.)

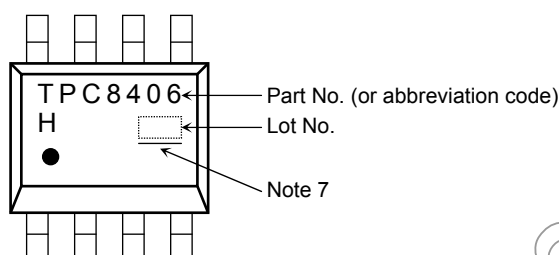
Circuit Configuration



Thermal Characteristics

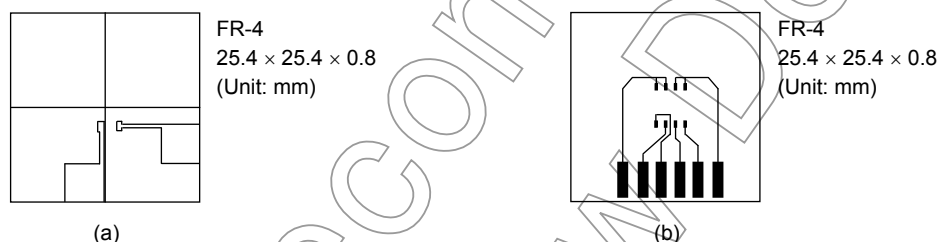
Characteristic		Symbol	Max	Unit
Thermal resistance, channel to ambient ($t = 10\text{s}$)	Single-device operation (Note 3a)	$R_{th}(\text{ch-a})(1)$	83.3	$^{\circ}\text{C/W}$
	Single-device value at dual operation (Note 3b)	$R_{th}(\text{ch-a})(2)$	114	
Thermal resistance, channel to ambient ($t = 10\text{s}$)	Single-device operation (Note 3a)	$R_{th}(\text{ch-a})(1)$	167	
	Single-device value at dual operation (Note 3b)	$R_{th}(\text{ch-a})(2)$	278	

Marking (Note 6)



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)



Note 3: a) The power dissipation and thermal resistance values are shown for a single device (During single-device operation, power is applied to one device only.).

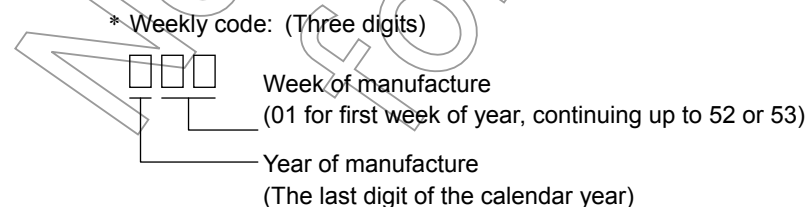
b) The power dissipation and thermal resistance values are shown for a single device (During dual operation, power is evenly applied to both devices.).

Note 4: a) $V_{DD} = -24\text{ V}$, $T_{ch} = 25^{\circ}\text{C}$ (initial), $L = 0.5\text{ mH}$, $R_G = 25\ \Omega$, $I_{AR} = -6.5\text{ A}$

b) $V_{DD} = 24\text{ V}$, $T_{ch} = 25^{\circ}\text{C}$ (initial), $L = 0.5\text{ mH}$, $R_G = 25\ \Omega$, $I_{AR} = 6.5\text{ A}$

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

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



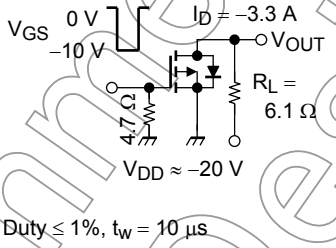
Note 7: A line under a Lot No. identifies the indication of product Labels.

Not underlined: $[[\text{Pb}]]/\text{INCLUDES} > \text{MCV}$

Underlined: $[[\text{G}]]/\text{RoHS COMPATIBLE}$ or $[[\text{G}]]/\text{RoHS } [[\text{Pb}]]$

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.

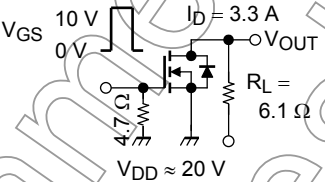
P-Channel Electrical Characteristics (Ta = 25°C)

Characteristic		Symbol	Test Condition	Min	Typ.	Max	Unit
Gate leakage current		I _{GSS}	V _{GS} = ±16 V, V _{DS} = 0 V	—	—	±10	μA
Drain cutoff current		I _{DSS}	V _{DS} = -40 V, V _{GS} = 0 V	—	—	-10	μA
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		V _{th}	V _{DS} = -10 V, I _D = -1 mA	-0.8	—	-2.0	V
Drain-source ON-resistance		R _{DS (ON)}	V _{GS} = -4.5 V, I _D = - 3.3 A	—	29	37	mΩ
			V _{GS} = -10 V, I _D = - 3.3 A	—	24	30	
Forward transfer admittance		Y _{fs}	V _{DS} = -10 V, I _D = - 3.3 A	6.5	13	—	S
Input capacitance		C _{iss}	V _{DS} = -10 V, V _{GS} = 0 V, f = 1 MHz	—	1190	—	pF
Reverse transfer capacitance		C _{rss}		—	170	—	
Output capacitance		C _{oss}		—	250	—	
Switching time	Rise time	t _r		—	5	—	ns
	Turn-on time	t _{on}		—	12	—	
	Fall time	t _f		—	12	—	
	Turn-off time	t _{off}		Duty ≤ 1%, t _w = 10 μs	—	43	
Total gate charge (gate-source plus gate-drain)		Q _g	V _{DD} ≈ -32 V, V _{GS} = -10 V I _D = -6.5 A	—	27	—	nC
			V _{DD} ≈ -32 V, V _{GS} = -5 V I _D = -6.5 A	—	15	—	
Gate-source charge 1		Q _{gs1}	V _{DD} ≈ -32 V, V _{GS} = -10 V I _D = -6.5 A	—	3.2	—	
Gate-drain ("Miller") charge		Q _{gd}		—	8.1	—	
Gate switch charge		Q _{sw}		—	9.7	—	

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

Characteristic		Symbol	Test Condition	Min	Typ.	Max	Unit
Drain reverse current	Pulse (Note 1)	I_{DRP}	—	—	—	-26	A
Forward voltage (diode)		V_{DSF}	$I_{DR} = -6.5 \text{ A}, V_{GS} = 0 \text{ V}$	—	—	1.2	V

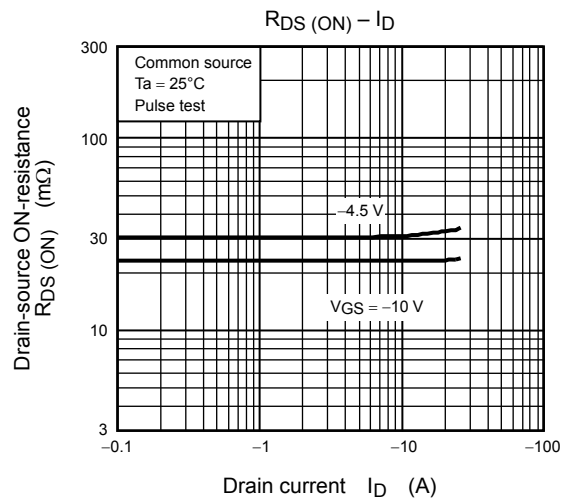
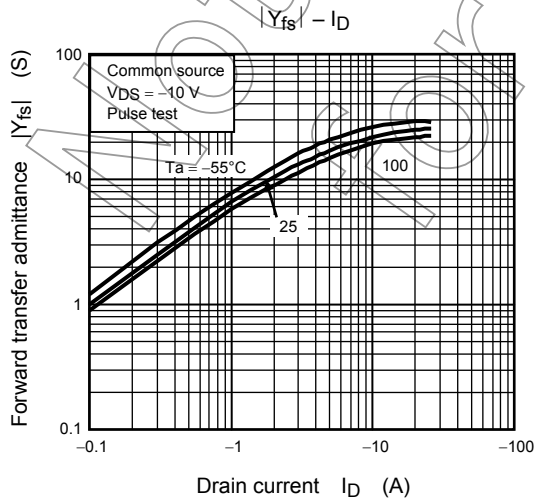
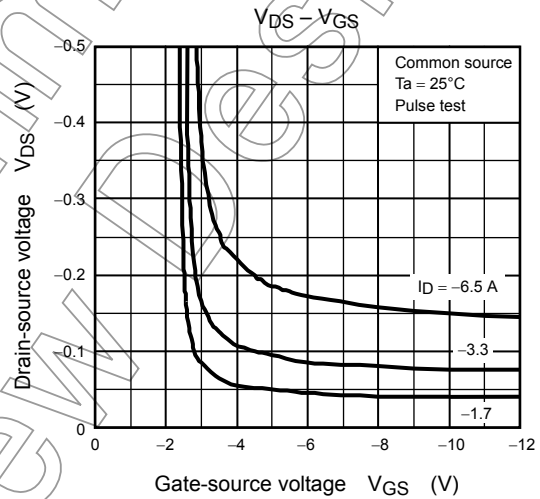
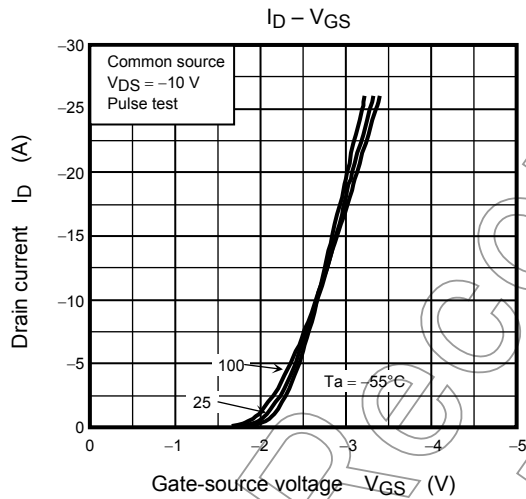
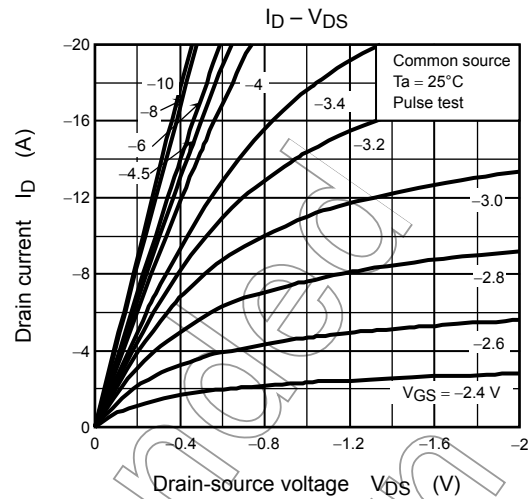
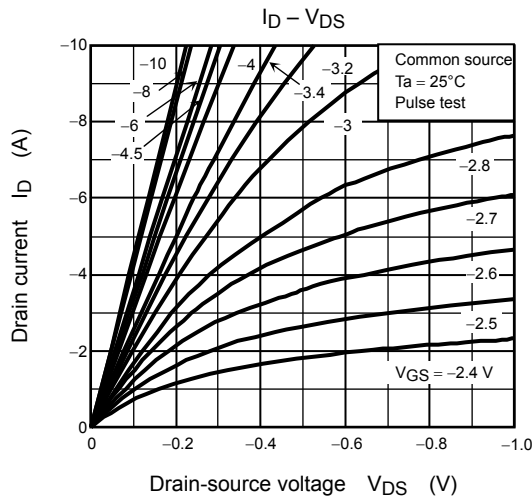
N-channel Electrical Characteristics (Ta = 25°C)

Characteristic		Symbol	Test Condition	Min	Typ.	Max	Unit
Gate leakage current		I _{GSS}	V _{GS} = ±16 V, V _{DS} = 0 V	—	—	±10	μA
Drain cutoff current		I _{DSS}	V _{DS} = 40 V, V _{GS} = 0 V	—	—	10	μA
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	25	—	—	
Gate threshold voltage		V _{th}	V _{DS} = 10 V, I _D = 1 mA	1.1	—	2.3	V
Drain-source ON-resistance		R _{DS (ON)}	V _{GS} = 4.5 V, I _D = 3.3 A	—	27	35	mΩ
			V _{GS} = 10 V, I _D = 3.3 A	—	22	27	
Forward transfer admittance		Y _{fs}	V _{DS} = 10 V, I _D = 3.3 A	7	14	—	S
Input capacitance		C _{iss}	V _{DS} = 10 V, V _{GS} = 0 V, f = 1 MHz	—	650	—	pF
Reverse transfer capacitance		C _{rss}		—	55	—	
Output capacitance		C _{oss}		—	240	—	
Switching time	Rise time	t _r	 V _{GS} 10 V 0 V I _D = 3.3 A V _{OUT} R _L = 6.1 Ω 4.7 Ω V _{DD} ≈ 20 V	—	3	—	ns
	Turn-on time	t _{on}		—	9	—	
	Fall time	t _f		—	2	—	
	Turn-off time	t _{off}		Duty ≤ 1%, t _w = 10 μs	—	18	
Total gate charge (gate-source plus gate-drain)		Q _g	V _{DD} ≈ 32 V, V _{GS} = 10V, I _D = 6.5A	—	11	—	nC
			V _{DD} ≈ 32 V, V _{GS} = 5 V, I _D = 6.5A	—	6.2	—	
Gate-source charge 1		Q _{gs1}	V _{DD} ≈ 32 V, V _{GS} = 10 V, I _D = 6.5A	—	2.1	—	
Gate-drain (“Miller”) charge		Q _{gd}		—	2.7	—	
Gate switch charge		Q _{SW}		—	3.5	—	

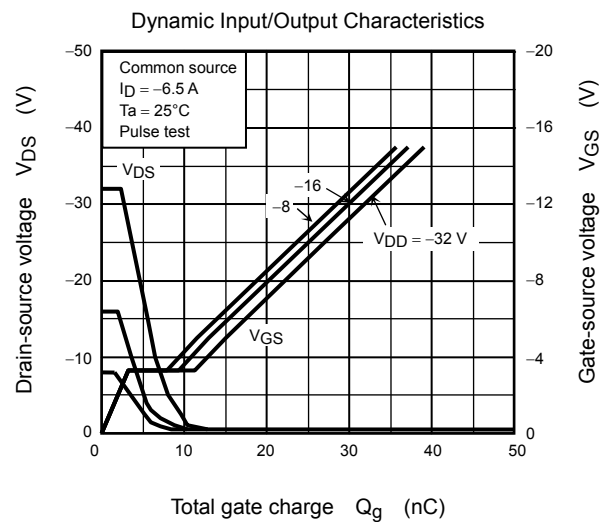
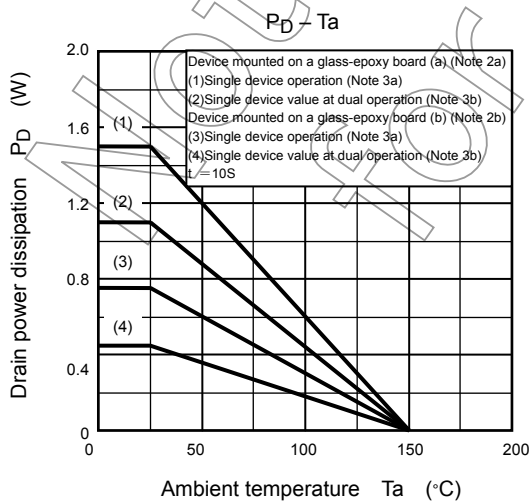
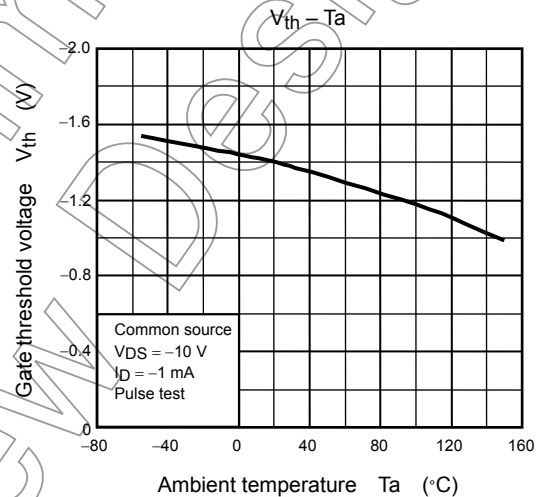
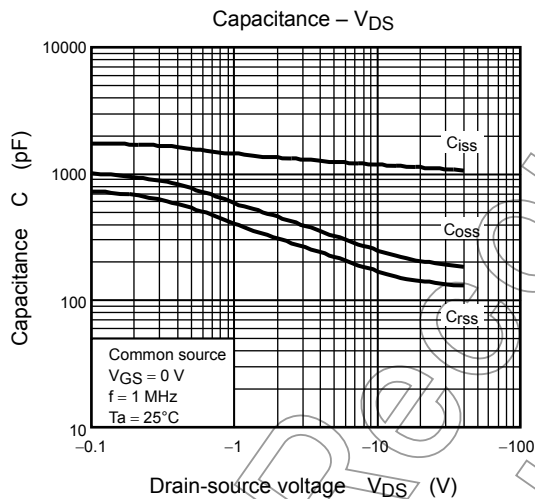
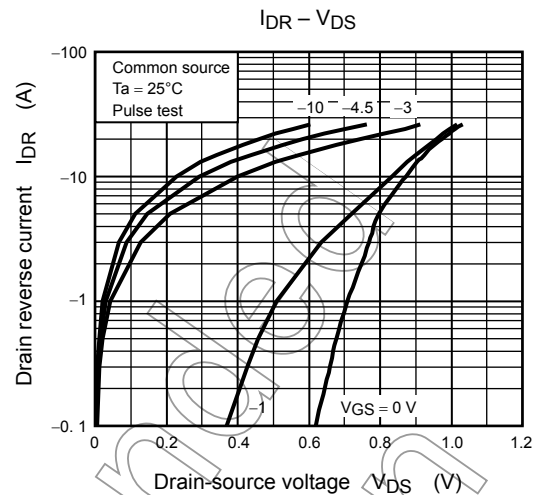
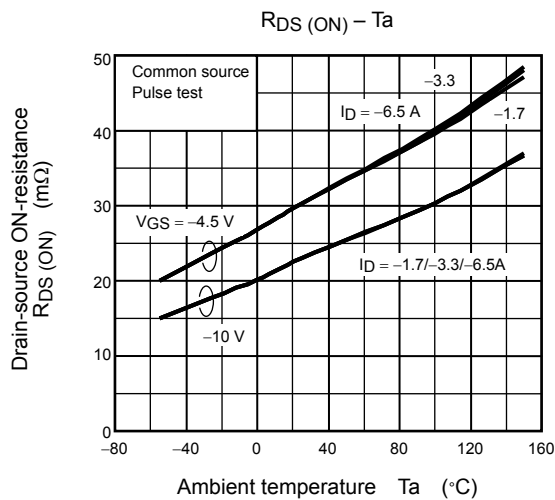
Source-Drain Ratings and Characteristics (Ta = 25°C)

Characteristic		Symbol	Test Condition	Min	Typ.	Max	Unit
Drain reverse current	Pulse (Note 1)	I_{DRP}	—	—	—	26	A
Forward voltage (diode)		V_{DSF}	$I_{DR} = 6.5 \text{ A}, V_{GS} = 0 \text{ V}$	—	—	-1.2	V

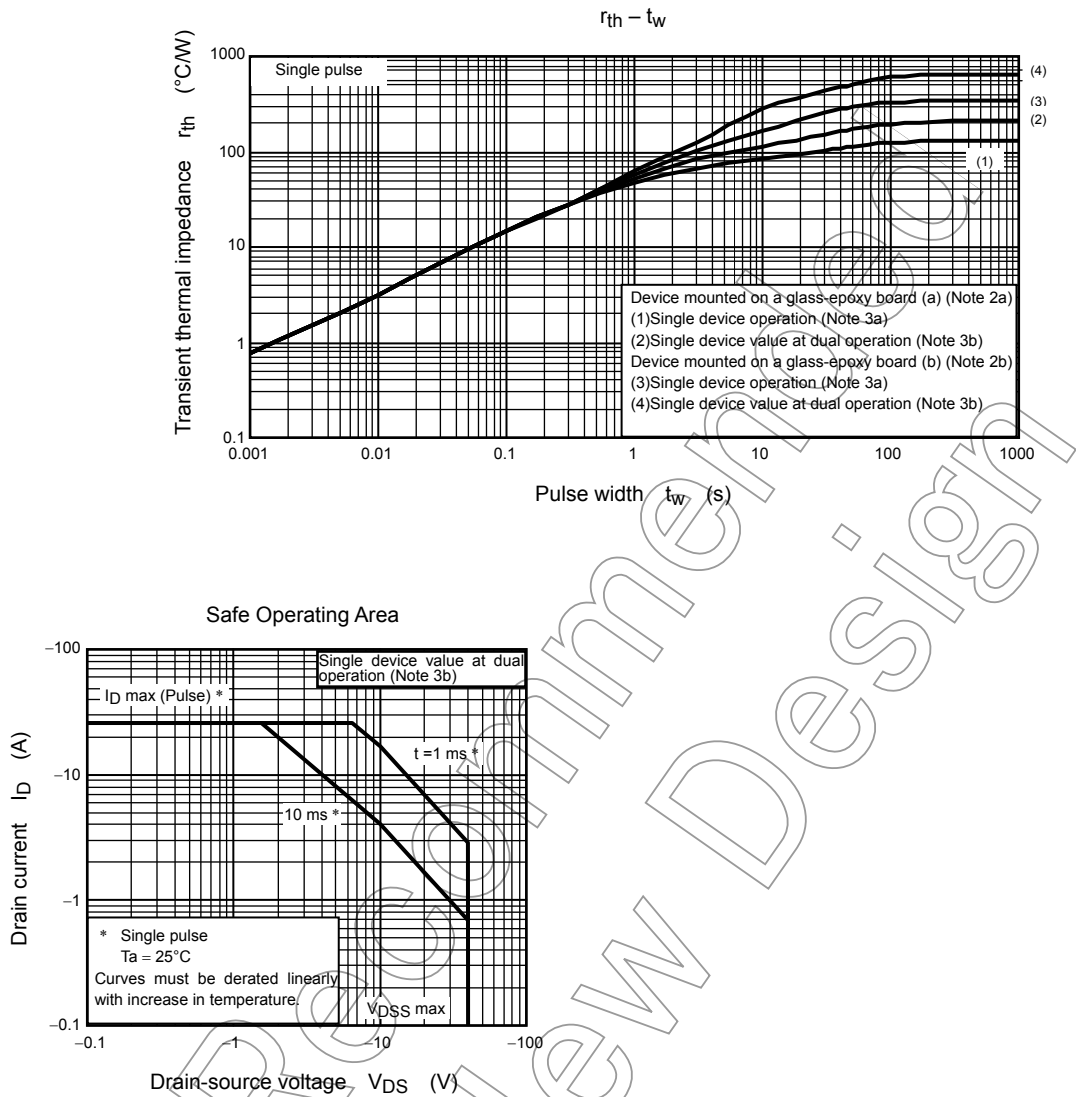
P-Channel



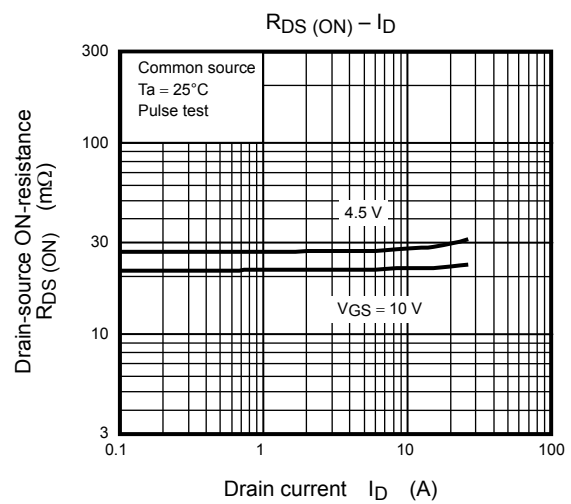
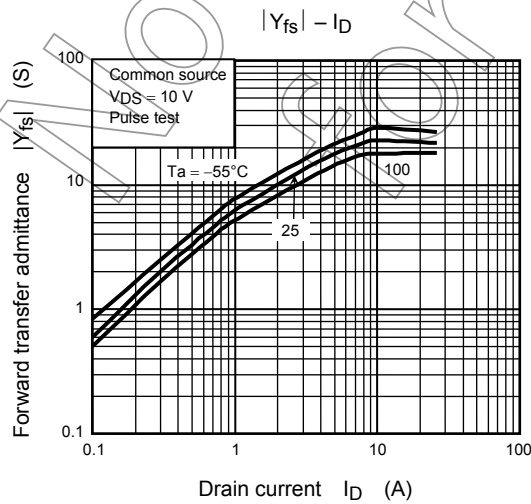
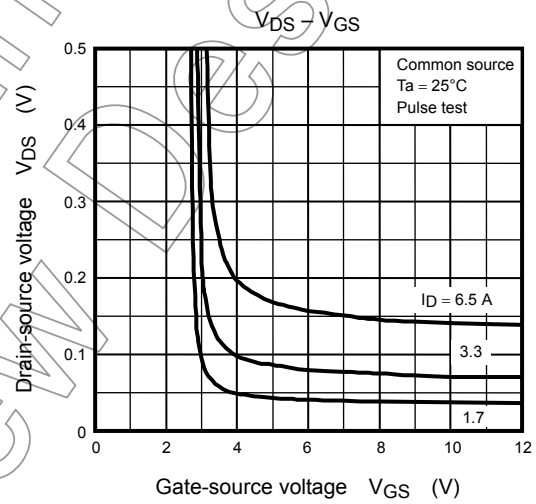
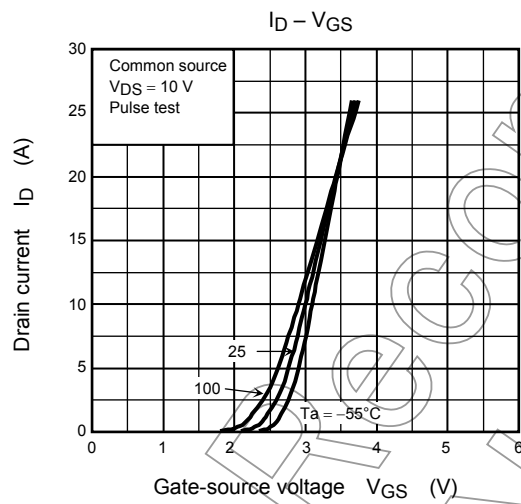
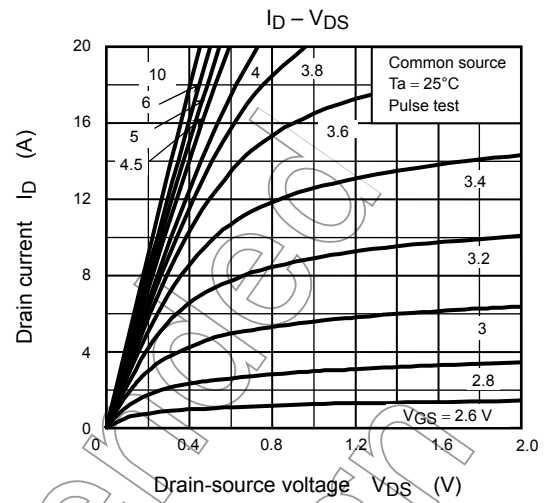
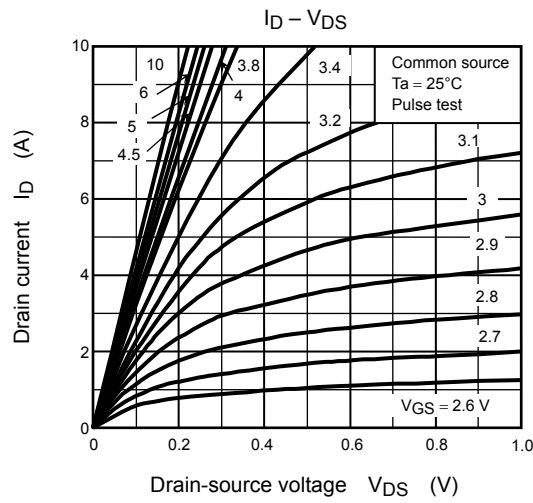
P-Channel



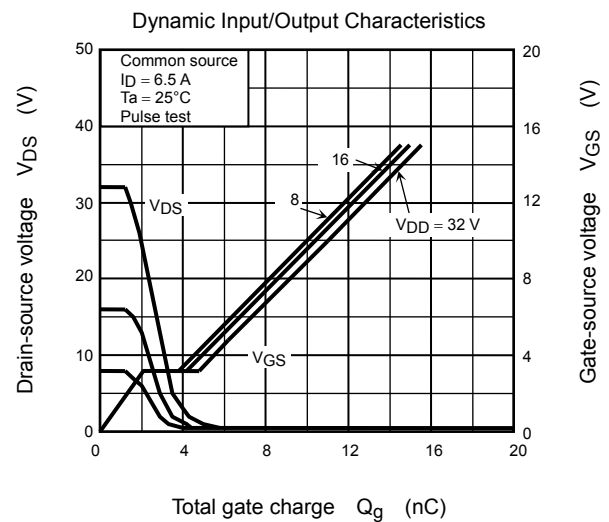
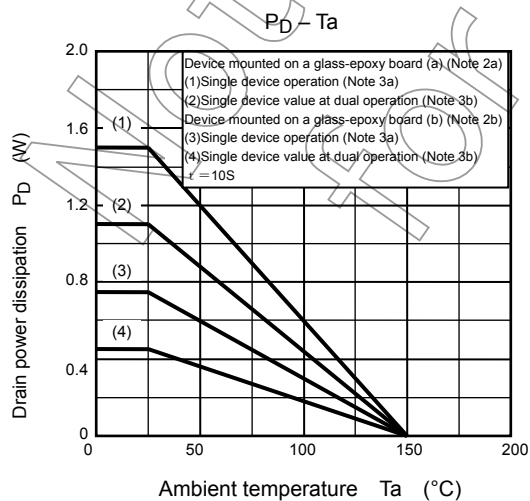
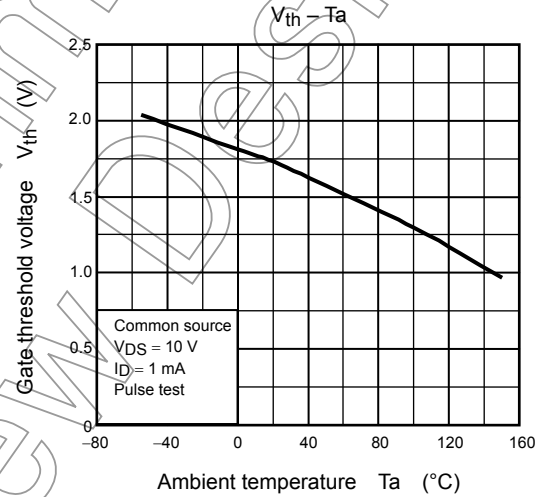
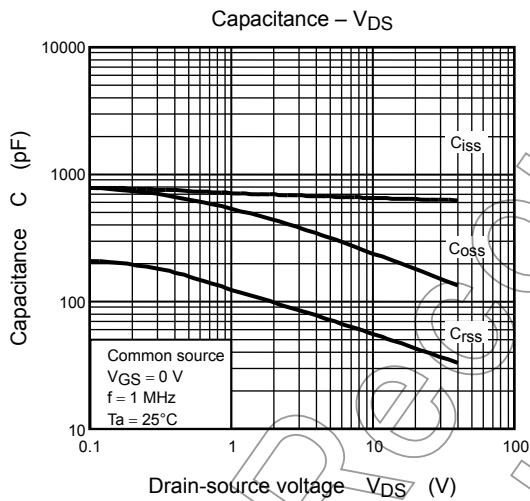
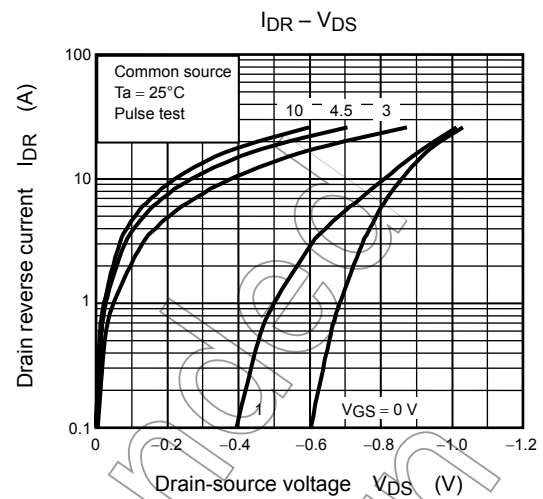
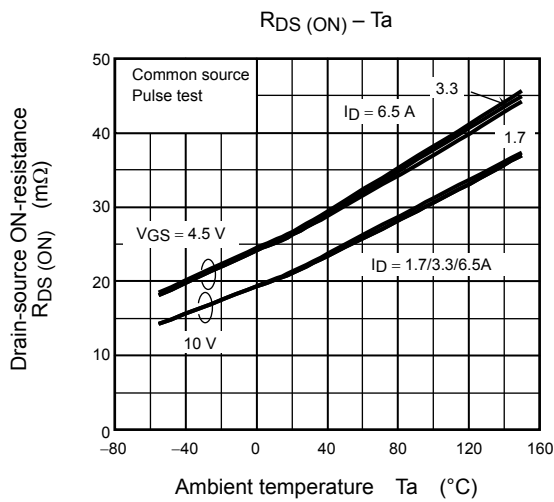
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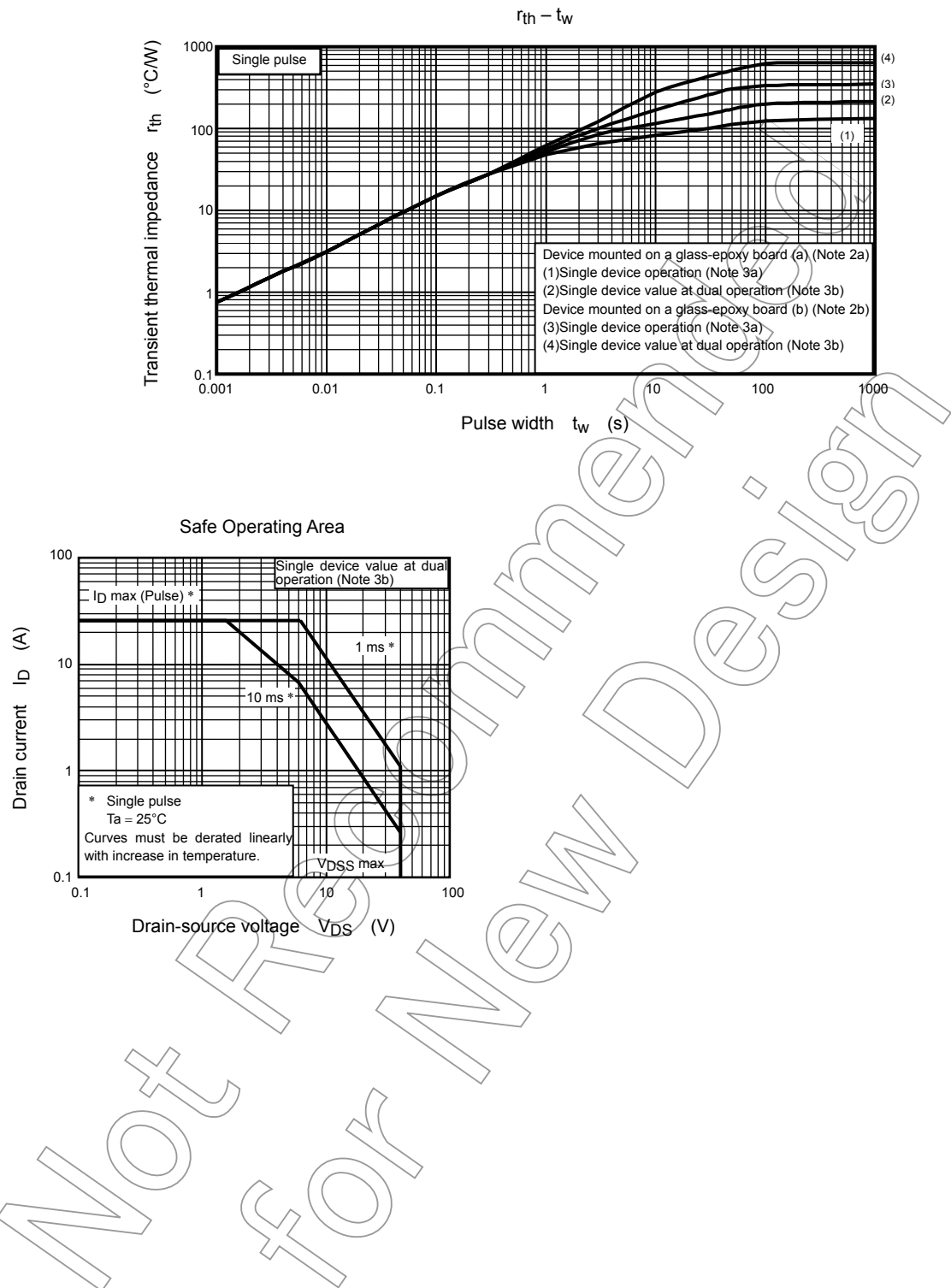
N-Channel



N-Channel



N-Channel



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