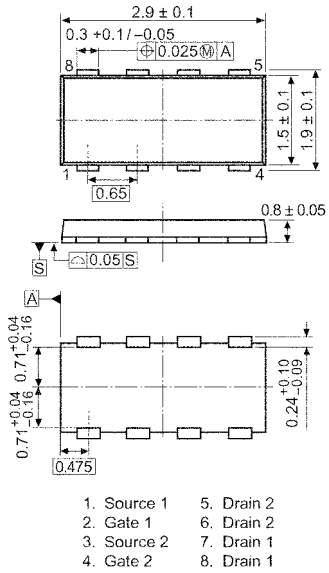
TOSHIBA Field Effect Transistor Silicon P, N Channel MOS Type (U-MOS IV / U-MOS III)

TPCF8402

Portable Equipment Applications
Mortor Drive Applications
DC-DC Converter Applications

- Low drain-source ON resistance
  : P Channel $R_{DS\ (ON)}$ = 60 mΩ (typ.)
  N Channel $R_{DS\ (ON)}$ = 38 mΩ (typ.)
- High forward transfer admittance
  : P Channel $|Y_{fs}|$ = 5.9 S (typ.)
  N Channel $|Y_{fs}|$ = 6.8 S (typ.)
- Low leakage current
  : P Channel I_{DSS} = −10 μA (V_{DS} = −30 V)
  N Channel I_{DSS} = 10 μA (V_{DS} = 30 V)
- Enhancement−mode
  : P Channel V_{th} = −0.8 to −2.0 V (V_{DS} = −10 V, I_D = −1mA)
  N Channel V_{th} = 1.3 to 2.5 V (V_{DS} = 10 V, I_D = 1mA)

Unit: mm



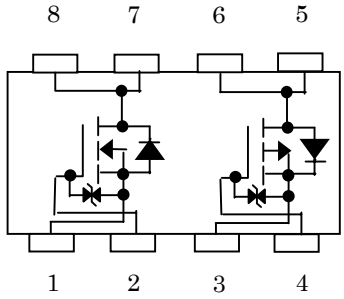
JEDEC	—
JEITA	—
TOSHIBA	2-3U1B

Weight: 0.011 g (typ.)

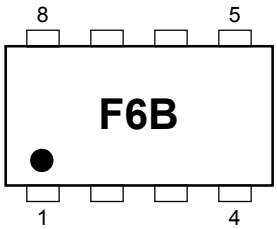
Maximum Ratings (Ta = 25°C)

Characteristics		Symbol	Rating		Unit
Drain-source voltage		V_{DSS}	-30	30	V
Drain-gate voltage (R_{GS} = 20 kΩ)		V_{DGR}	-30	30	V
Gate-source voltage		V_{GSS}	±20	±20	V
Drain current	DC (Note 1)	I_D	-3.2	4.0	A
	Pulse (Note 1)	I_{DP}	-12.8	16.0	
Drain power dissipation (t = 5 s) (Note 2a)	Single-device operation (Note 3a)	$P_{D\ (1)}$	1.35	1.35	W
	Single-device value at dual operation(Note 3b)	$P_{D\ (2)}$	1.12	1.12	
Drain power dissipation (t = 5 s) (Note 2b)	Single-device operation (Note 3a)	$P_{D\ (1)}$	0.53	0.53	
	Single-device value at dual operation(Note 3b)	$P_{D\ (2)}$	0.33	0.33	
Single pulse avalanche energy(Note 4)		E_{AS}	0.67	2.6	mJ
Avalanche current		I_{AR}	-1.6	2.0	A
Repetitive avalanche energy Single-device value at dual operation (Note 2a, 3b, 5)		E_{AR}	0.11		mJ
Channel temperature		T_{ch}	150		°C
Storage temperature range		T_{stg}	−55~150		°C

Circuit Configuration



Marking (Note 6)



Note: For (Note 1), (Note 2), (Note 3), (Note 4), (Note 5) and (Note 6), please refer to the next page.

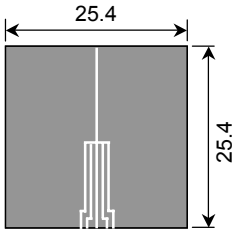
This transistor is an electrostatic sensitive device. Please handle with caution.

Thermal Characteristics

Characteristics		Symbol	Max	Unit
Thermal resistance, channel to ambient (t = 5 s) (Note 2a)	Single-device operation (Note 3a)	$R_{th\ (ch\text{-}a)\ (1)}$	92.6	°C/W
	Single-device value at dual operation (Note 3b)	$R_{th\ (ch\text{-}a)\ (2)}$	111.6	
Thermal resistance, channel to ambient (t = 5 s) (Note 2b)	Single-device operation (Note 3a)	$R_{th\ (ch\text{-}a)\ (1)}$	235.8	°C/W
	Single-device value at dual operation (Note 3b)	$R_{th\ (ch\text{-}a)\ (2)}$	378.8	

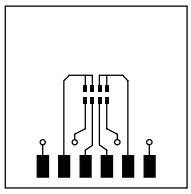
Note 1: Please use devices on condition that the channel temperature is below 150°C.

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

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

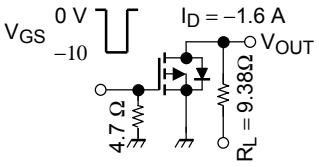
Note 4: P Channel: V_{DD} = −24 V, T_{ch} = 25°C (initial), L = 0.2 mH, R_G = 25 Ω, I_{AR} = −1.6 A
N Channel: V_{DD} = 24 V, T_{ch} = 25°C (initial), L = 0.5 mH, R_G = 25 Ω, I_{AR} = 2.0 A

Note 5: Repetitive rating; Pulse width limited by Max. Channel temperature.

Note 6: Black round marking "● " locates on the left lower side of parts number marking "F6B indicates terminal No. 1.

P-ch

Electrical Characteristics (Ta = 25°C)

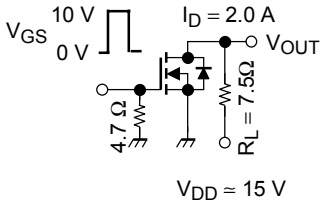
Characteristics		Symbol	Test Condition	Min	Typ.	Max	Unit
Gate leakage current		I_{GSS}	V_{GS} = ±16 V, V_{DS} = 0 V	—	—	±10	μA
Drain cut-off current		I_{DSS}	V_{DS} = −30 V, V_{GS} = 0 V	—	—	−10	μA
Drain-source breakdown voltage		$V_{(BR)\ DSS}$	I_D = −10 mA, V_{GS} = 0 V	−30	—	—	V
		$V_{(BR)\ DSX}$	I_D = −10 mA, V_{GS} = 20 V	−15	—	—	
Gate threshold voltage		V_{th}	V_{DS} = −10 V, I_D = −1 mA	−0.8	—	−2.0	V
Drain-source ON resistance		$R_{DS\ (ON)}$	V_{GS} = −4.5 V, I_D = −1.6A	—	80	105	mΩ
			V_{GS} = −10 V, I_D = −1.6 A	—	60	72	
Forward transfer admittance		$\|Y_{fs}\|$	V_{DS} = −10 V, I_D = −1.6 A	2.9	5.9	—	S
Input capacitance		C_{iss}	V_{DS} = −10 V, V_{GS} = 0 V, f = 1 MHz	—	600	—	pF
Reverse transfer capacitance		C_{rss}		—	60	—	
Output capacitance		C_{oss}		—	70	—	
Switching time	Rise time	t_r	 Duty ≦ 1%, t_w = 10 μs	—	5.3	—	ns
	Turn-on time	t_{on}		—	12	—	
	Fall time	t_f		—	8.4	—	
	Turn-off time	t_{off}		—	34	—	
Total gate charge (gate-source plus gate-drain)		Q_g	V_{DD} ≃ −24 V, V_{GS} = −10 V, I_D = −3.2 A	—	14	—	nC
Gate-source charge 1		Q_{gs1}		—	1.4	—	
Gate-drain (“miller”) charge		Q_{gd}		—	2.7	—	

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

Characteristics		Symbol	Test Condition	Min	Typ.	Max	Unit
Drain reverse current	Pulse (Note 1)	I_{DRP}	—	—	—	−12.8	A
Forward voltage (diode)		V_{DSF}	I_{DR} = −3.2 A, V_{GS} = 0 V	—	—	1.2	V

N-ch

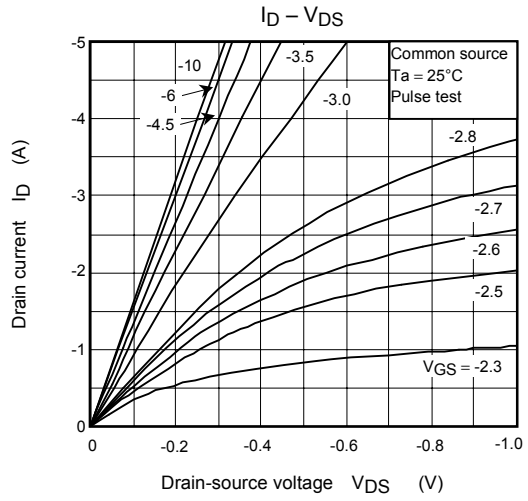
Electrical Characteristics (Ta = 25°C)

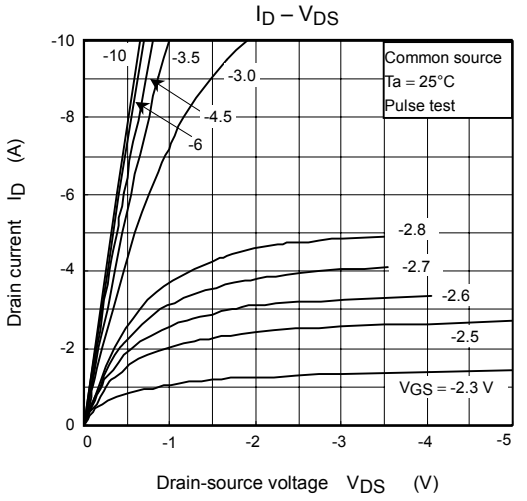
Characteristics		Symbol	Test Condition	Min	Typ.	Max	Unit
Gate leakage current		I_{GSS}	V_{GS} = ±16 V, V_{DS} = 0 V	—	—	±10	μA
Drain cut-off current		I_{DSS}	V_{DS} = 30 V, V_{GS} = 0 V	—	—	10	μA
Drain-source breakdown voltage		$V_{(BR)\ DSS}$	I_D = 10 mA, V_{GS} = 0 V	30	—	—	V
		$V_{(BR)\ DSX}$	I_D = 10 mA, V_{GS} = −20 V	15	—	—	
Gate threshold voltage		V_{th}	V_{DS} = 10 V, I_D = 1 mA	1.3	—	2.5	V
Drain-source ON resistance		$R_{DS\ (ON)}$	V_{GS} = 4.5 V, I_D = 2.0 A	—	58	77	mΩ
			V_{GS} = 10 V, I_D = 2.0 A	—	38	50	
Forward transfer admittance		$\|Y_{fs}\|$	V_{DS} = 10 V, I_D = 2.0 A	3.4	6.8	—	S
Input capacitance		C_{iss}	V_{DS} = 10 V, V_{GS} = 0 V, f = 1 MHz	—	470	—	pF
Reverse transfer capacitance		C_{rss}		—	60	—	
Output capacitance		C_{oss}		—	80	—	
Switching time	Rise time	t_r	 Duty ≦ 1%, t_w = 10 μs	—	5.2	—	ns
	Turn-on time	t_{on}		—	8.3	—	
	Fall time	t_f		—	4.0	—	
	Turn-off time	t_{off}		—	22	—	
Total gate charge (gate-source plus gate-drain)		Q_g	V_{DD} ≈ 24 V, V_{GS} = 10 V, I_D = 6 A	—	10	—	nC
Gate−source charge 1		Q_{gs1}		—	1.7	—	
Gate−drain (“miller”) charge		Q_{gd}		—	2.4	—	

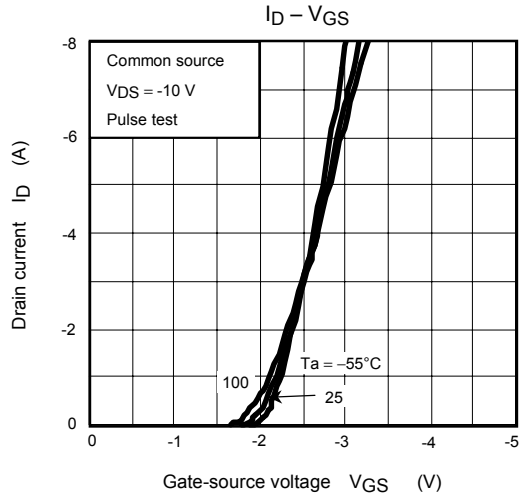
Source−Drain Ratings and Characteristics (Ta = 25°C)

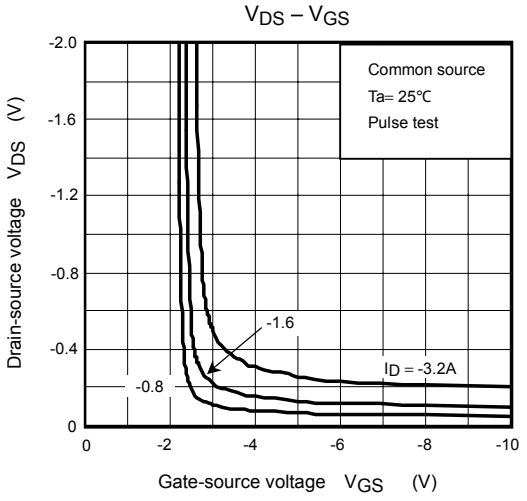
Characteristics		Symbol	Test Condition	Min	Typ.	Max	Unit
Drain reverse current	Pulse (Note 1)	I_{DRP}	—	—	—	16.0	A
Forward voltage (diode)		V_{DSF}	I_{DR} = 4.0 A, V_{GS} = 0 V	—	—	−1.2	V

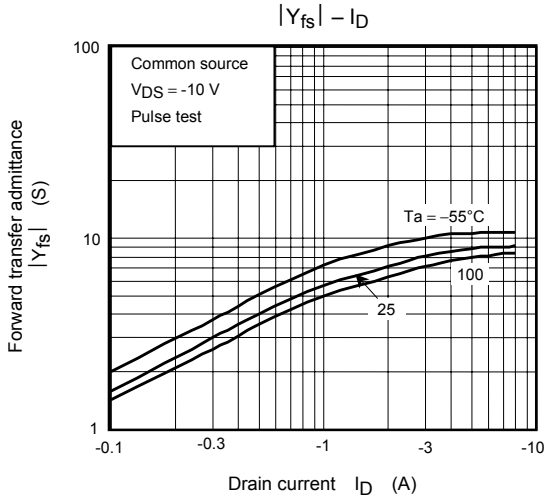
P-ch

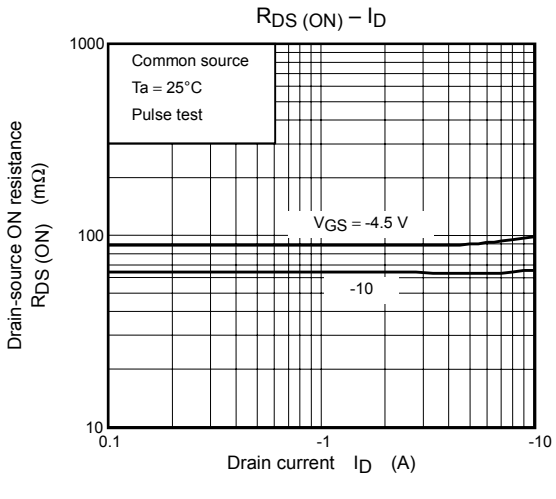

$I_D - V_{DS}$
Common source
Ta = 25°C
Pulse test
-10
-6
-4.5
-3.5
-3.0
-2.8
-2.7
-2.6
-2.5
V_{GS} = -2.3
Drain current I_D (A)
Drain-source voltage V_{DS} (V)


$I_D - V_{DS}$
Common source
Ta = 25°C
Pulse test
-10
-3.5
-3.0
-4.5
-6
-2.8
-2.7
-2.6
-2.5
V_{GS} = -2.3 V
Drain current I_D (A)
Drain-source voltage V_{DS} (V)


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

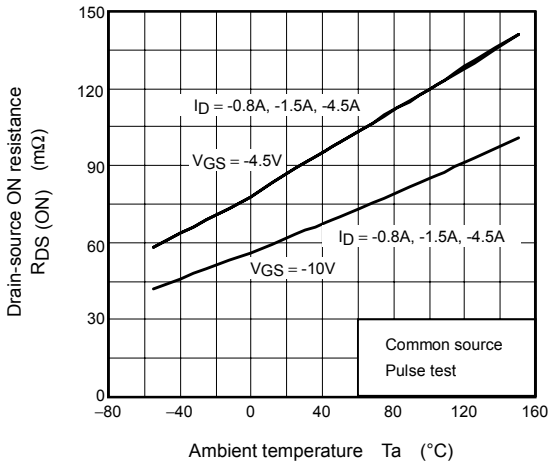

$V_{DS} - V_{GS}$
Common source
Ta= 25°C
Pulse test
-1.6
-0.8
I_D = -3.2A
Drain-source voltage V_{DS} (V)
Gate-source voltage V_{GS} (V)


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

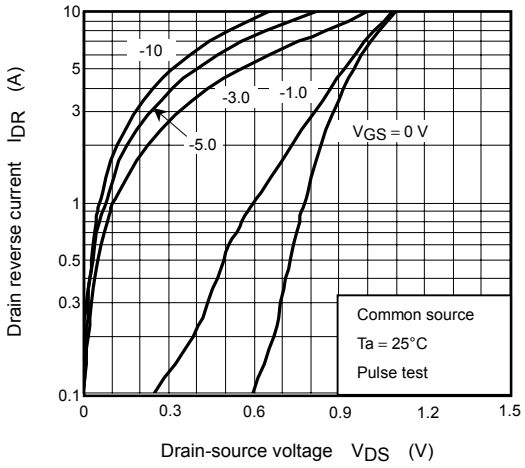

$R_{DS\ (ON)} - I_D$
Common source
Ta = 25°C
Pulse test
V_{GS} = -4.5 V
-10
Drain-source ON resistance $R_{DS\ (ON)}$ (mΩ)
Drain current I_D (A)

P-ch

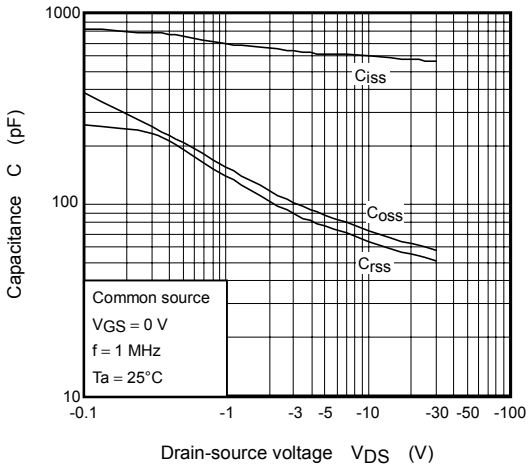
$R_{DS\ (ON)}$ – Ta



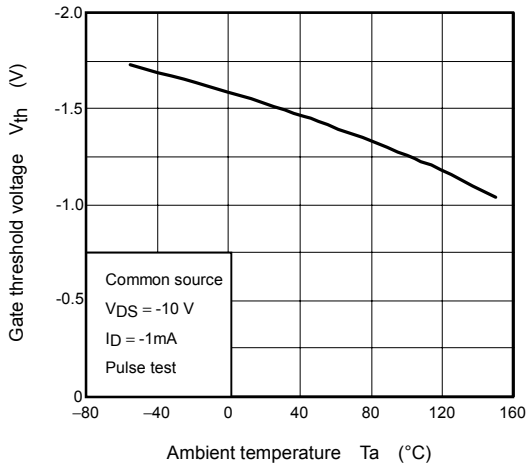
I_{DR} – V_{DS}



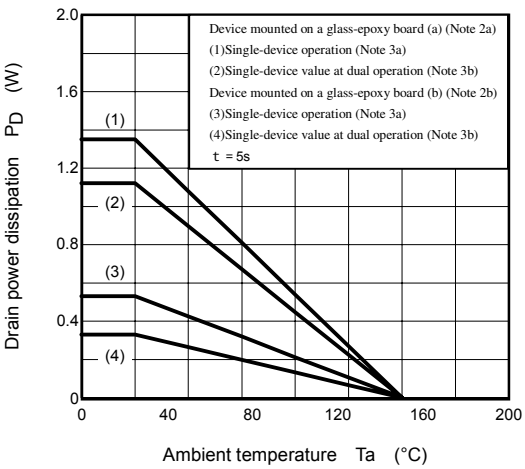
Capacitance – V_{DS}



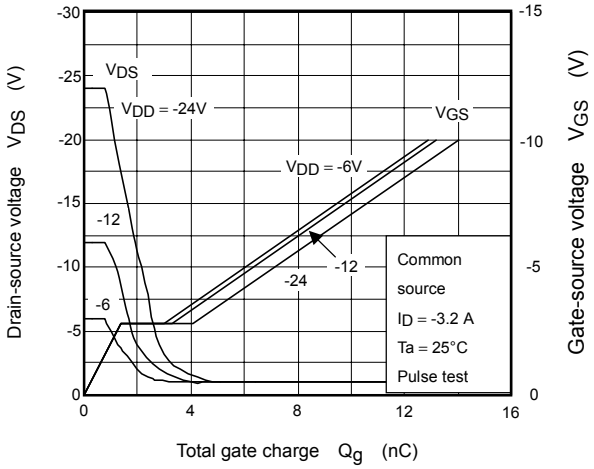
V_{th} – Ta



P_D – Ta

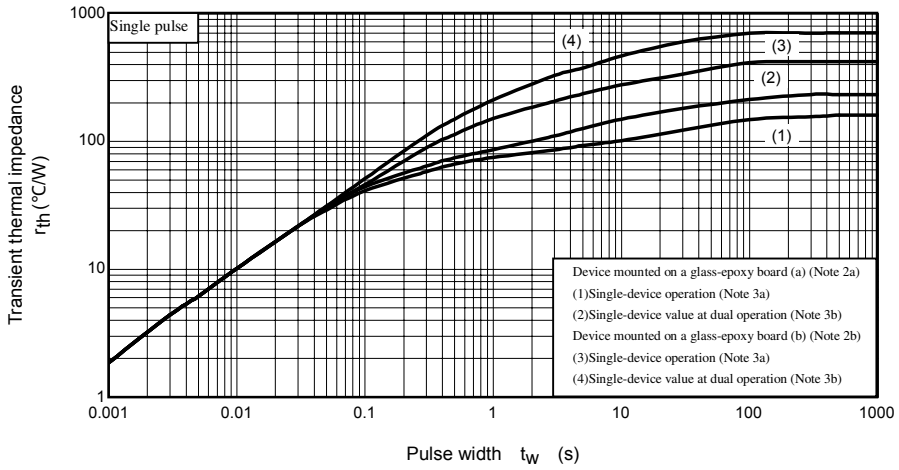


Dynamic input/output characteristics

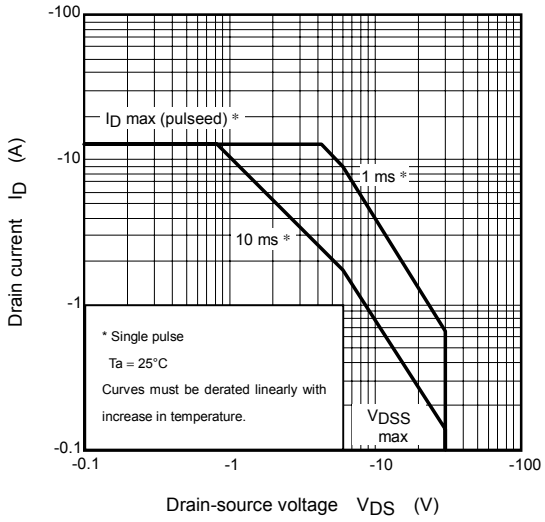


P-ch

$r_{th} - t_w$

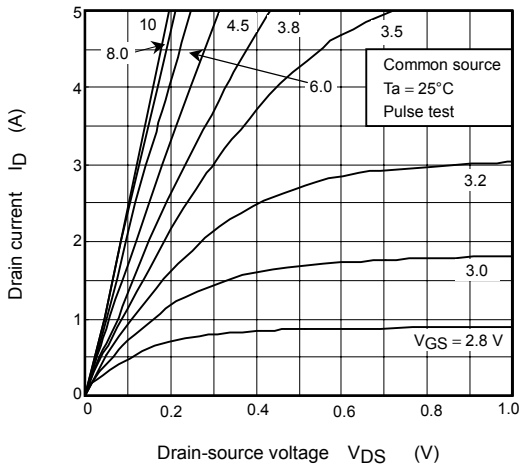


Safe operating area

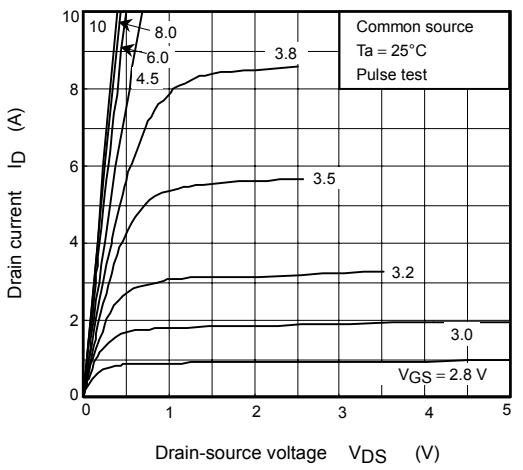


N-ch

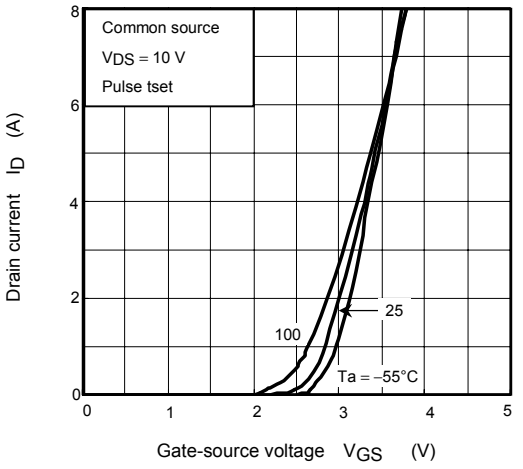
$I_D - V_{DS}$



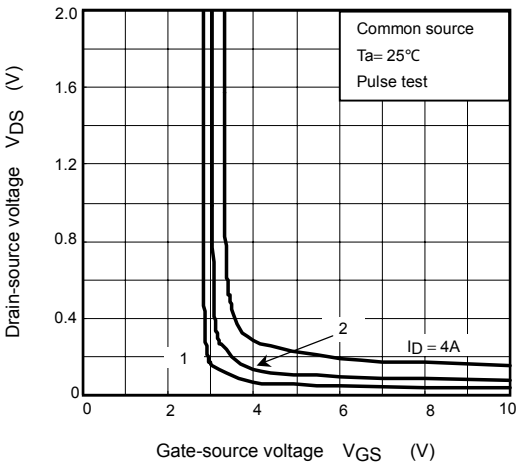
$I_D - V_{DS}$



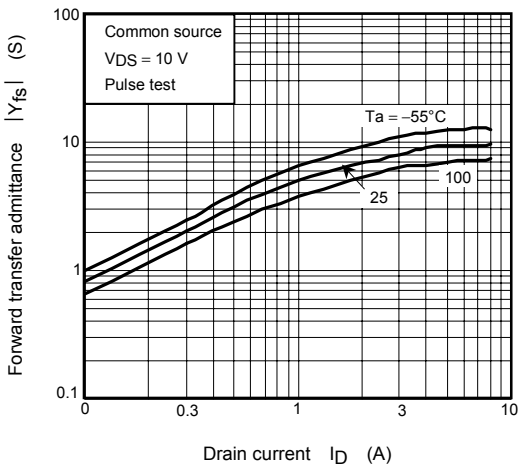
$I_D - V_{GS}$



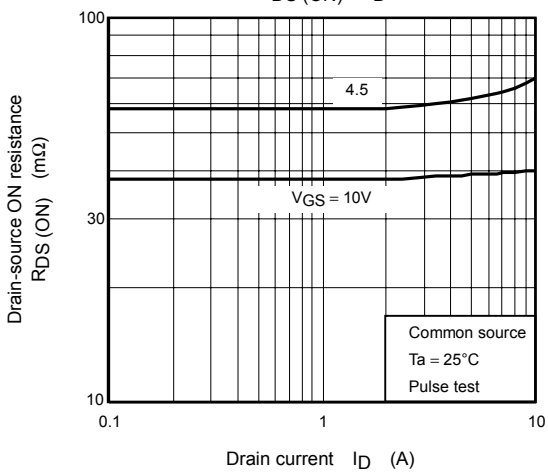
$V_{DS} - V_{GS}$



$|Y_{fs}| - I_D$

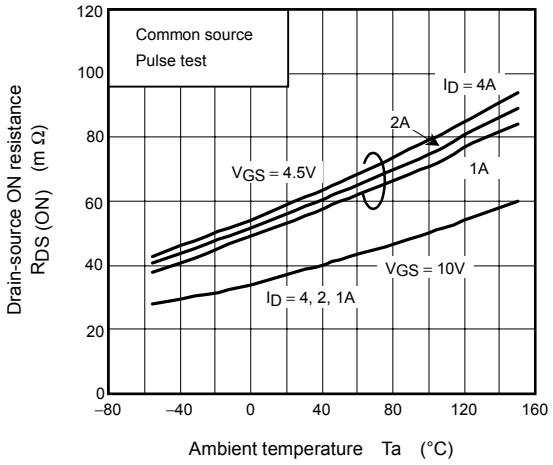


$R_{DS\ (ON)} - I_D$

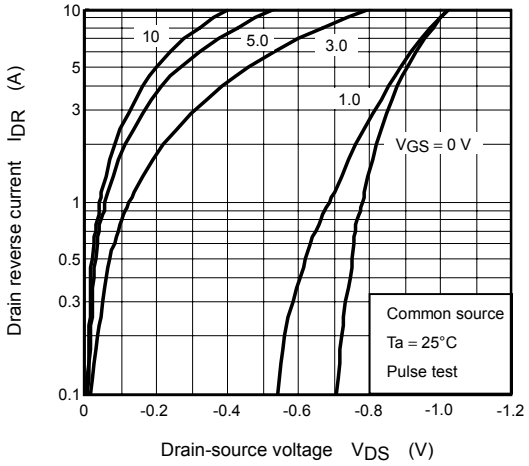


N-ch

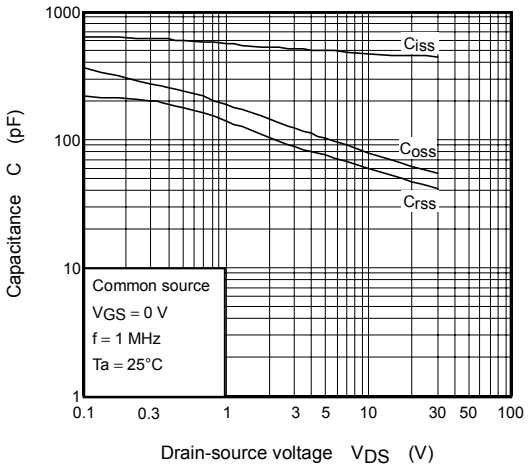
$R_{DS\ (ON)}$ – Ta



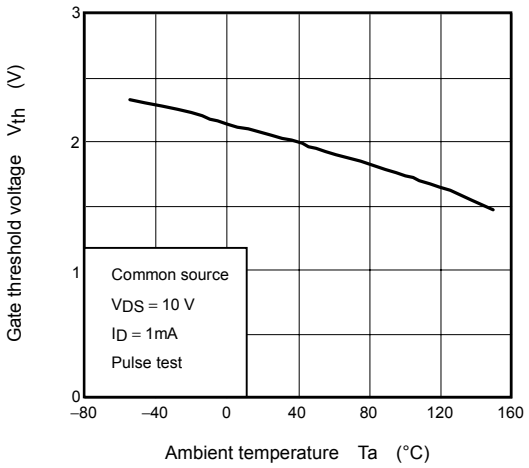
I_{DR} – V_{DS}



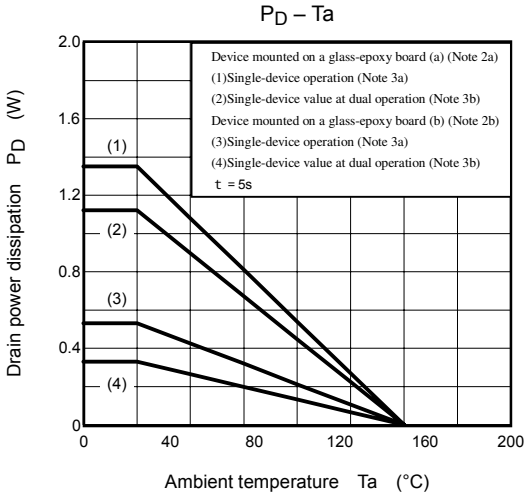
Capacitance – V_{DS}



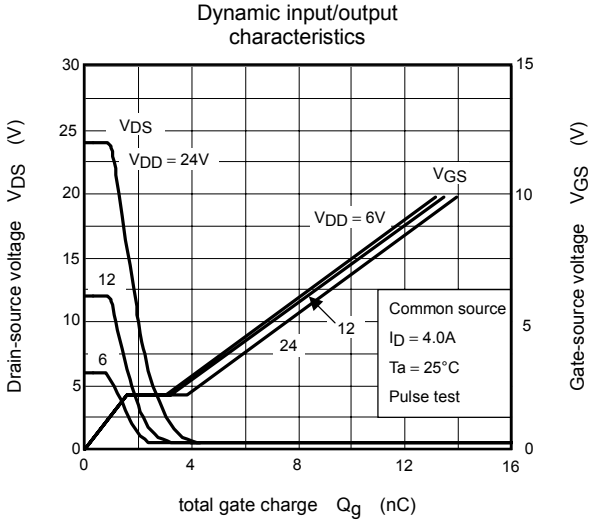
V_{th} – Ta



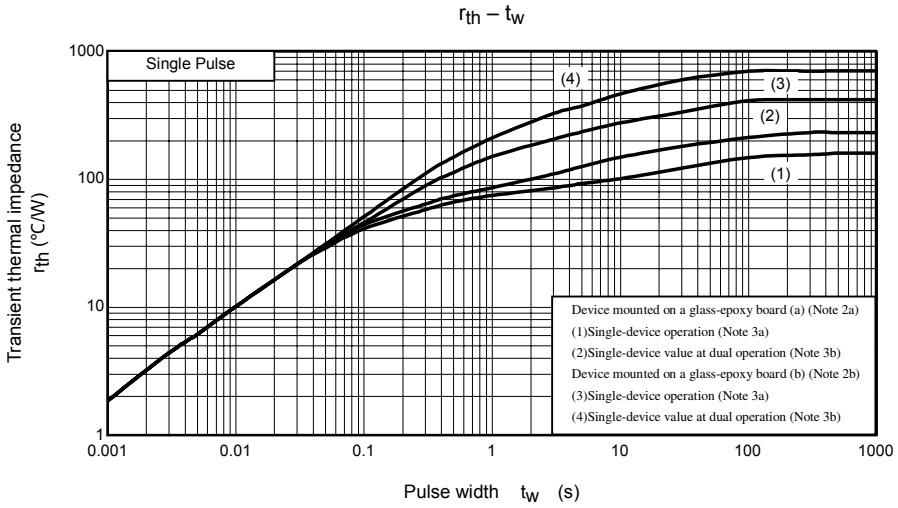
P_D – Ta

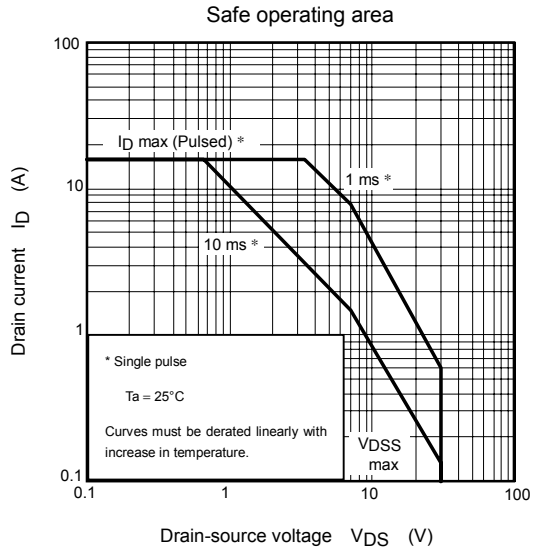


Dynamic input/output characteristics



N-ch


$r_{th} - t_w$
Single Pulse
(4)
(3)
(2)
(1)
Transient thermal impedance r_{th} (°C/W)
1000
100
10
1
0.001
0.01
0.1
1
10
100
1000
Pulse width t_w (s)
Device mounted on a glass-epoxy board (a) (Note 2a)
(1)Single-device operation (Note 3a)
(2)Single-device value at dual operation (Note 3b)
Device mounted on a glass-epoxy board (b) (Note 2b)
(3)Single-device operation (Note 3a)
(4)Single-device value at dual operation (Note 3b)


Safe operating area
I_D max (Pulsed) *
1 ms *
10 ms *
Drain current I_D (A)
100
10
1
0.1
* Single pulse
Ta = 25°C
Curves must be derated linearly with increase in temperature.
V_{DSS} max
0.1
1
10
100
Drain-source voltage V_{DS} (V)

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000707EAA

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