

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

TPCP8401

○ Switching Regulator Applications

○ Load Switch Applications

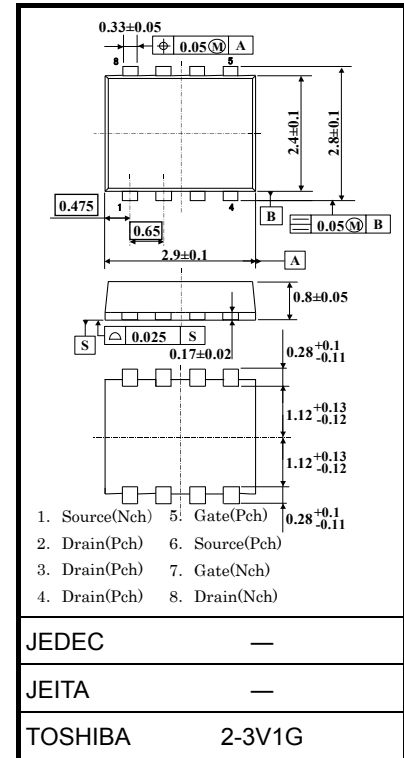
- Lead(Pb)-Free
- Multi-chip discrete device; built-in P channel MOS FET for main switch and N Channel MOS FET for drive
- Small footprint due to small and thin package
- Low drain-source ON resistance
: P Channel $R_{DS(ON)} = 31 \text{ m}\Omega$ (typ.)
- Low drain-source ON resistance
High forward transfer admittance
: P Channel $|Y_{fs}| = 13 \text{ S}$ (typ.)
- Low leakage current
: P Channel $I_{DSS} = -10 \mu\text{A}$ ($V_{DS} = -12 \text{ V}$)
- Enhancement-mode
: P Channel $V_{th} = -0.5 \text{ to } -1.2 \text{ V}$ ($V_{DS} = -10 \text{ V}$, $I_D = -200 \mu\text{A}$)

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

P-ch

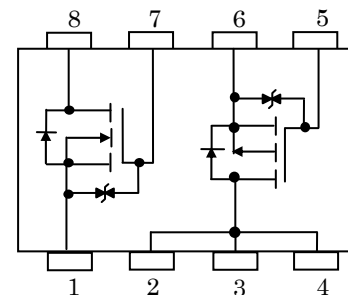
Characteristics		Symbol	Rating	Unit
Drain-source voltage		V_{DSS}	-12	V
Drain-gate voltage ($R_{GS} = 20 \text{ k}\Omega$)		V_{DGR}	-12	V
Gate-source voltage		V_{GSS}	± 8	V
Drain current	DC (Note 1)	I_D	-5.5	A
	Pulse (Note 1)	I_{DP}	-22.0	
Drain power dissipation ($t = 5 \text{ s}$) (Note 2a)		P_D	1.96	W
Drain power dissipation ($t = 5 \text{ s}$) (Note 2b)		P_D	1.0	W
Single pulse avalanche energy (Note 3)		E_{AS}	5.3	mJ
Avalanche current		I_{AR}	-2.8	A
Repetitive avalanche energy (Note 2a) (Note 4)		E_{AR}	0.22	mJ
Channel temperature		T_{ch}	150	$^\circ\text{C}$

Unit: mm

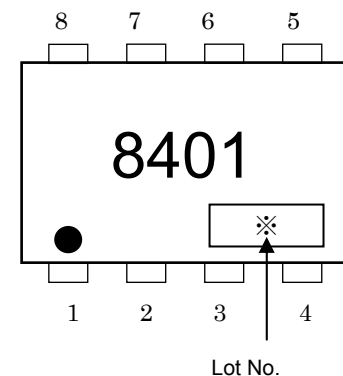


Weight: 0.017 g (typ.)

Circuit Configuration



Marking (Note5)



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Characteristics		Symbol	Rating	Unit
Drain-source voltage		V_{DSS}	20	V
Gate-source voltage		V_{GSS}	± 10	V
Drain current	DC (Note 1)	I_D	0.1	A
	Pulse (Note 1)	I_{DP}	0.2	
Channel temperature		T_{ch}	150	$^{\circ}C$
Repetitive avalanche energy Single-device value at dual operation (Note 2a, 3b, 5)		E_{AR}	0.12	mJ
Channel temperature		T_{ch}	150	$^{\circ}C$

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

Common Absolute Maximum Ratings (Ta=25°C)

Characteristics	Symbol	Rating	Unit
Storage temperature range	T_{stg}	-55~150	$^{\circ}C$

Note: 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).

Thermal Characteristics

Characteristics	Symbol	Max	Unit
Thermal resistance, channel to ambient (t = 5 s) (Note 2a)	$R_{th(ch-a)}$	63.8	$^{\circ}C/W$
Thermal resistance, channel to ambient (t = 5 s) (Note 2b)	$R_{th(ch-a)}$	125	$^{\circ}C/W$

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

Note 2: (a) Mounted on FR4 board (glass epoxy, 0.8mm thick, Cu area: 25.4mm²) (t = 5s)

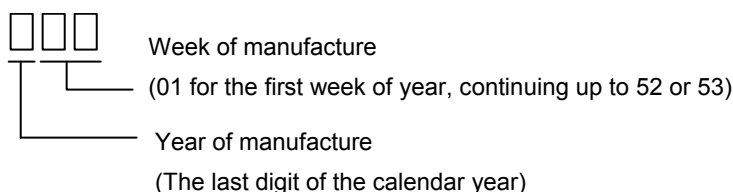
(b) Mounted on FR4 board (glass epoxy, 0.8mm thick, printed minimum pad dimensions: 25.4mm²) (t = 5s)

Note 3: $V_{DD} = -10$ V, $T_{ch} = 25^{\circ}C$ (initial), $L = 0.5$ mH, $R_G = 25 \Omega$, $I_{AR} = -2.75$ A

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

Note 5: "●" on the lower left of the marking indicates pin 1.

"*" shows the lot number, which consists of three digits. The first digit denotes the year of manufacture, expressed as the last digit of the calendar year; the next two digits denote the week of manufacture.



Electrical Characteristics (Ta = 25°C)

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Characteristics		Symbol	Test Condition	Min	Typ.	Max	Unit
Gate leakage current		I_{GSS}	$V_{GS} = \pm 8 \text{ V}, V_{DS} = 0 \text{ V}$	—	—	± 10	μA
Drain cut-off current		I_{DSS}	$V_{DS} = -12 \text{ V}, V_{GS} = 0 \text{ V}$	—	—	-10	μA
Drain-source breakdown voltage		$V_{(BR)DSS}$	$I_D = -10 \text{ mA}, V_{GS} = 0 \text{ V}$	-12	—	—	V
		$V_{(BR)DSX}$	$I_D = -10 \text{ mA}, V_{GS} = 20 \text{ V}$	-4	—	—	
Gate threshold voltage		V_{th}	$V_{DS} = -10 \text{ V}, I_D = -200 \mu\text{A}$	-0.5	—	-1.2	V
Drain-source ON resistance		$R_{DS(ON)}$	$V_{GS} = -1.8 \text{ V}, I_D = -1.4 \text{ A}$	—	66	103	m Ω
			$V_{GS} = -2.5 \text{ V}, I_D = -2.8 \text{ A}$	—	44	58	
			$V_{GS} = -4.5 \text{ V}, I_D = -2.8 \text{ A}$	—	31	38	
Forward transfer admittance		$ Y_{fs} $	$V_{DS} = -10 \text{ V}, I_D = -2.8 \text{ A}$	6.5	13	—	S
Input capacitance		C_{iss}	$V_{DS} = -10 \text{ V}, V_{GS} = 0 \text{ V}, f = 1 \text{ MHz}$	—	1520	—	pF
Reverse transfer capacitance		C_{rss}		—	330	—	
Output capacitance		C_{oss}		—	380	—	
Switching time	Rise time	t_r		—	9.5	—	ns
	Turn-on time	t_{on}		—	16	—	
	Fall time	t_f		—	28	—	
	Turn-off time	t_{off}		Duty $\leq 1\%$, $t_w = 10 \mu\text{s}$	—	74	
Total gate charge (gate-source plus gate-drain)		Q_g	$V_{DD} \approx -10 \text{ V}, V_{GS} = -5 \text{ V}, I_D = -5.5 \text{ A}$	—	20	—	nC
Gate-source charge 1		Q_{gs1}		—	15	—	
Gate-drain ("miller") charge		Q_{gd}		—	5	—	

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

Characteristics	Symbol	Test Condition	Min	Typ.	Max	Unit
Drain reverse current (pulse) (Note 1)	I_{DRP}	—	—	—	-22	A
Forward voltage (diode)	V_{DSF}	$I_{DR} = -5.5 \text{ A}, V_{GS} = 0 \text{ V}$	—	—	1.2	V

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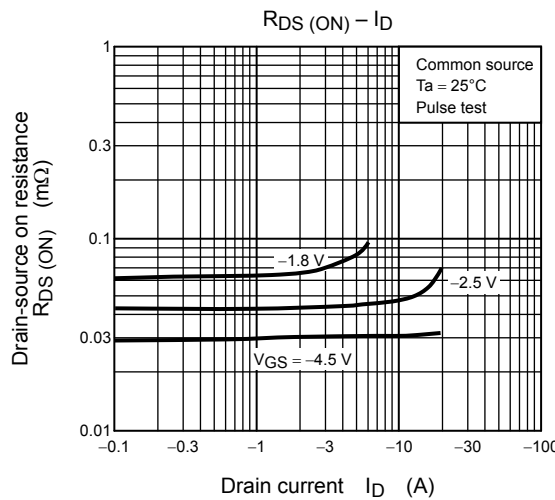
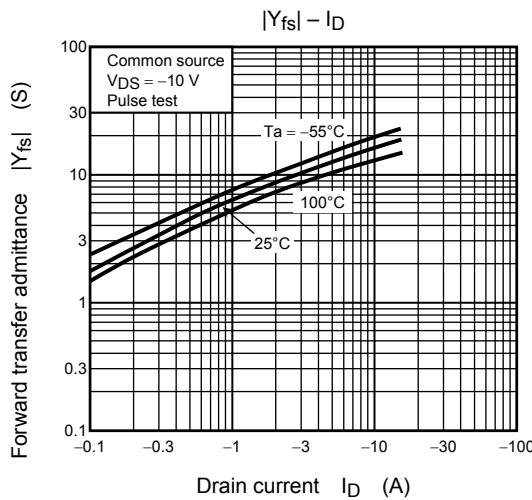
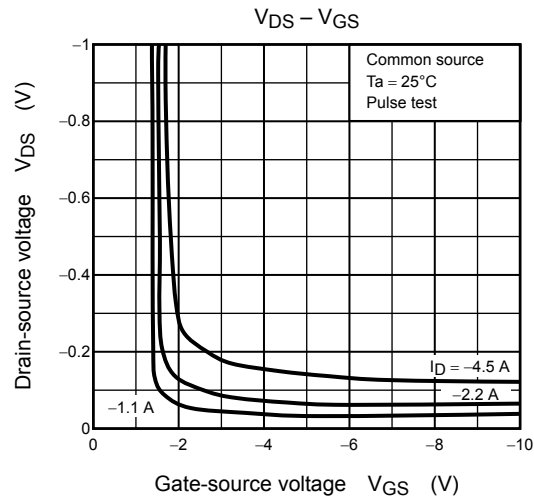
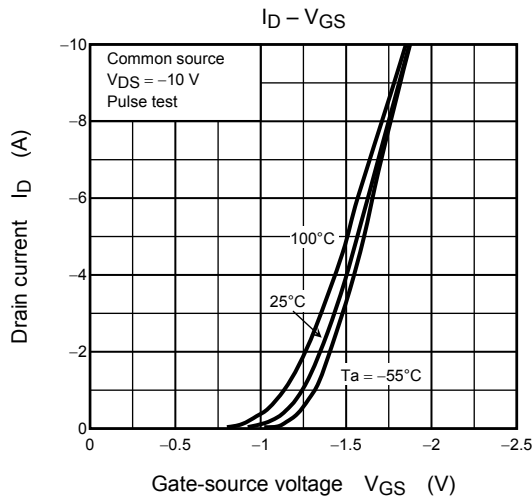
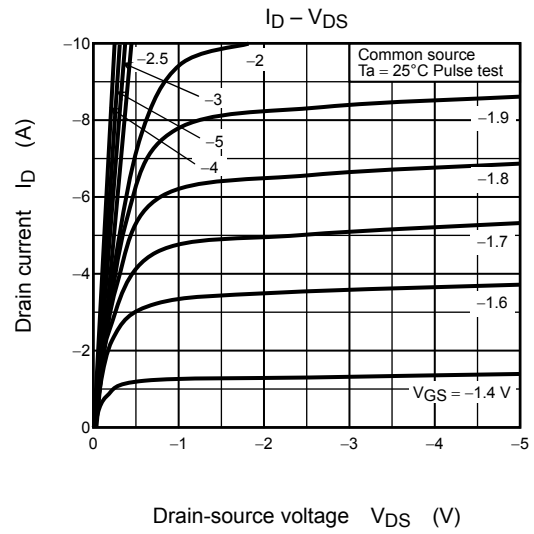
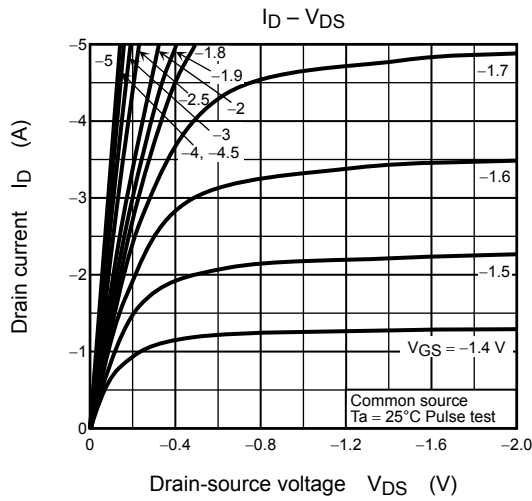
Characteristics		Symbol	Test Condition	Min	Typ.	Max	Unit
Gate leakage current		I_{GSS}	$V_{GS} = \pm 10\text{ V}, V_{DS} = 0\text{ V}$	—	—	± 1	μA
Drain cut-off current		I_{DSS}	$V_{DS} = 20\text{ V}, V_{GS} = 0\text{ V}$	—	—	1	μA
Drain-source breakdown voltage		$V_{(BR) DSS}$	$I_D = 0.1\text{ mA}, V_{GS} = 0\text{ V}$	20	—	—	V
Gate threshold voltage		V_{th}	$V_{DS} = 3\text{ V}, I_D = 0.1\text{ mA}$	0.6	—	1.1	V
Drain-source ON resistance		$R_{DS(ON)}$	$V_{GS} = 1.5\text{ V}, I_D = 1\text{ mA}$	—	5.2	15	Ω
			$V_{GS} = 2.5\text{ V}, I_D = 10\text{ mA}$	—	2.2	4	
			$V_{GS} = 4\text{ V}, I_D = 10\text{ mA}$	—	1.5	3	
Forward transfer admittance		$ Y_{fs} $	$V_{DS} = 3\text{ V}, I_D = 10\text{ mA}$	40	—	—	mS
Switching time	Turn-on time	t_{on}	<p> $I_D = 10\text{ mA}$ $V_{GS} = 2.5\text{ V}$ 0 V $50\ \Omega$ $R_L = 300\ \Omega$ V_{OUT} $V_{DD} \approx 3\text{ V}$ $Duty \leq 1\%, t_w = 10\ \mu\text{s}$ </p>	—	70	—	ns
	Turn-off time	t_{off}		—	125	—	
Input capacitance		C_{iss}	$V_{DS} = 3\text{ V}, V_{GS} = 0\text{ V}, f = 1\text{ MHz}$	—	9.3	—	pF
Reverse transfer capacitance		C_{rss}		—	4.5	—	
Output capacitance		C_{oss}		—	9.8	—	

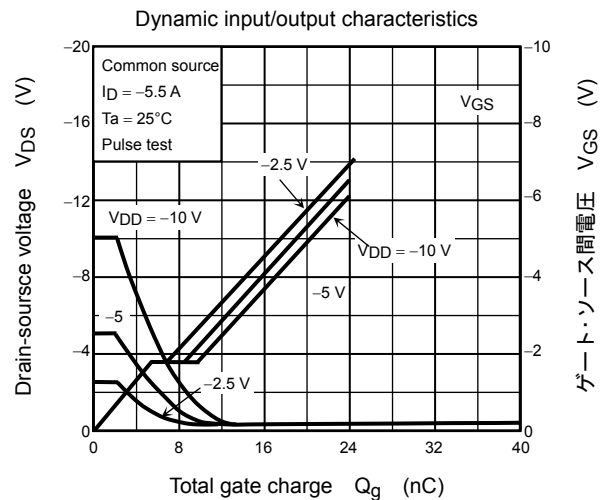
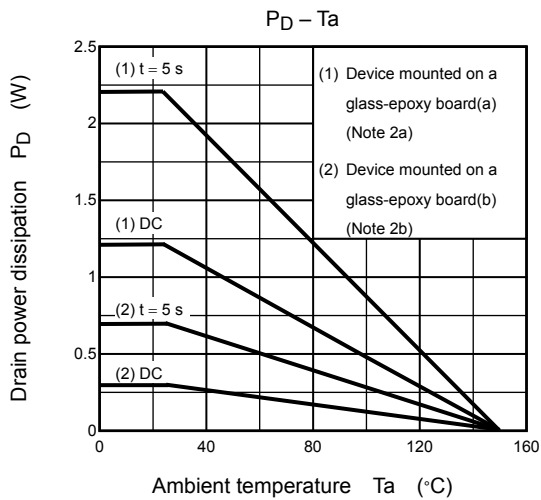
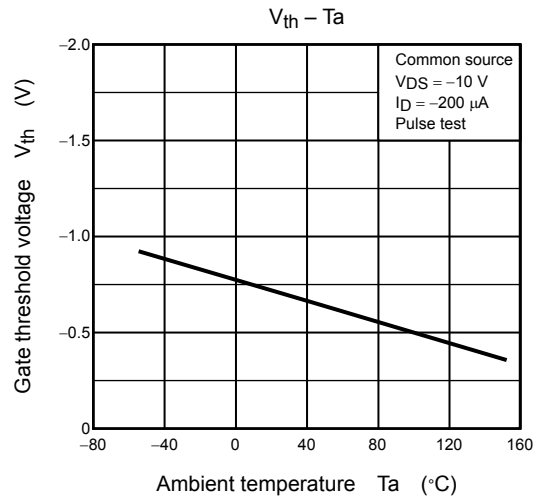
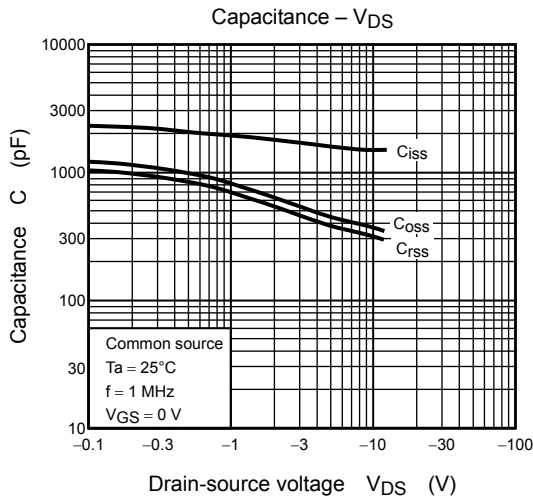
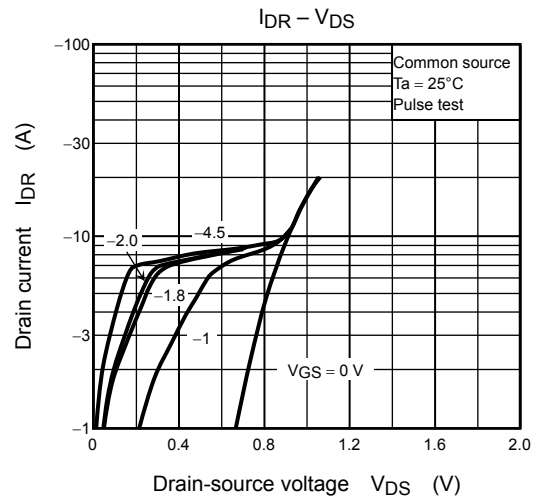
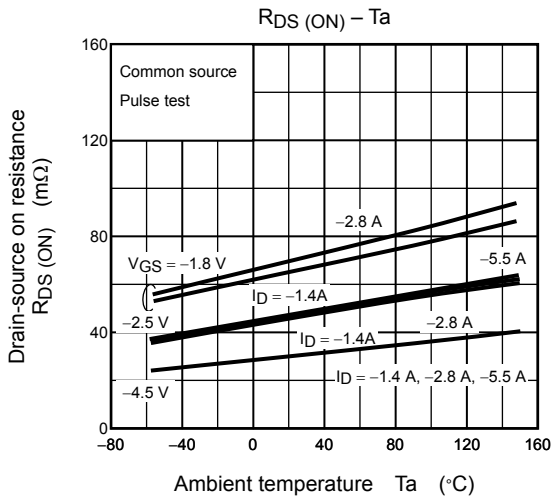
Precaution

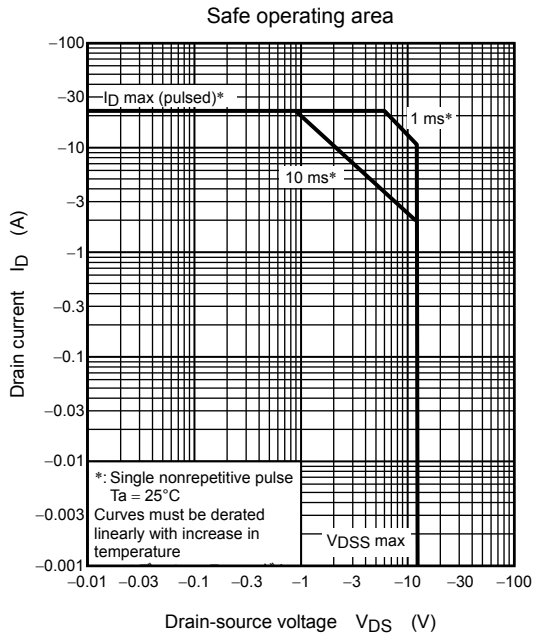
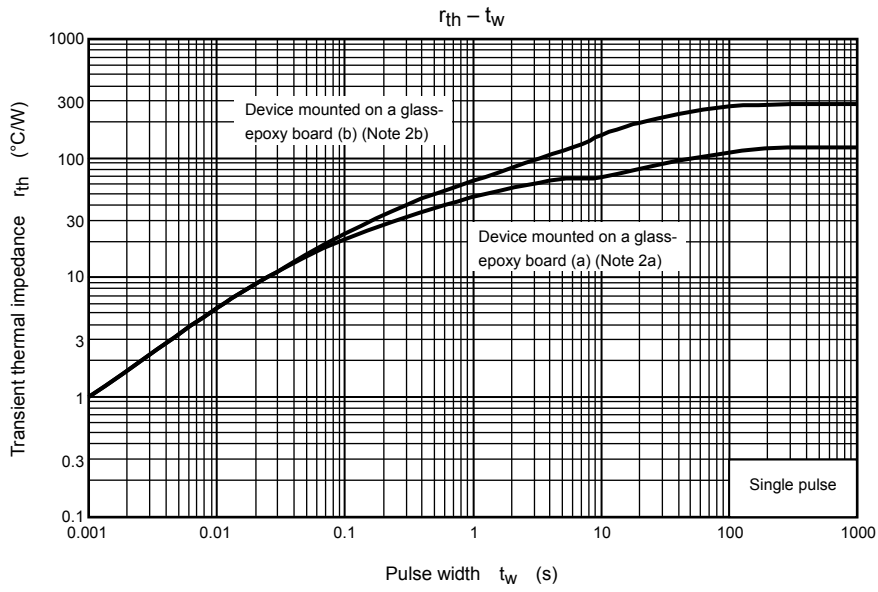
V_{th} can be expressed as the voltage between the gate and source when the low operating current value is $I_D = 100\ \mu\text{A}$ for this product. For normal switching operation, $V_{GS(ON)}$ requires a higher voltage than V_{th} and $V_{GS(OFF)}$ requires a lower voltage than V_{th} . (The relationship can be established as follows: $V_{GS(OFF)} < V_{th} < V_{GS(ON)}$.)

Be sure to take this into consideration when using the device. The V_{GS} recommended voltage for turning on this product is 1.5 V or higher.

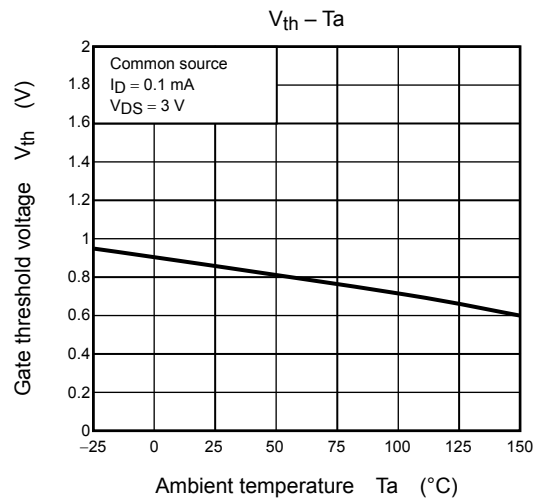
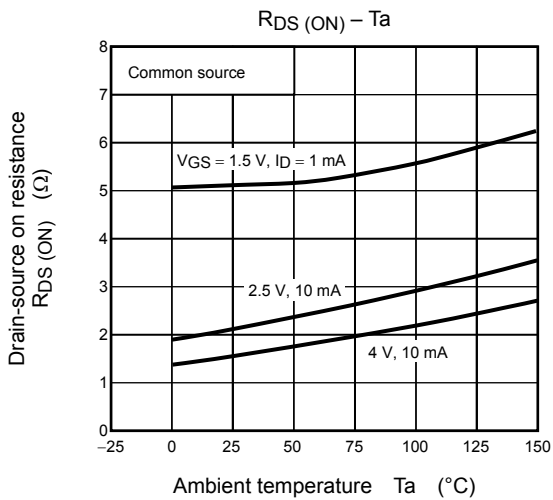
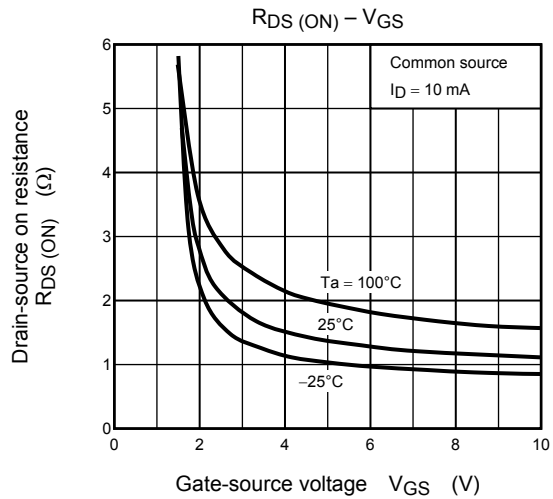
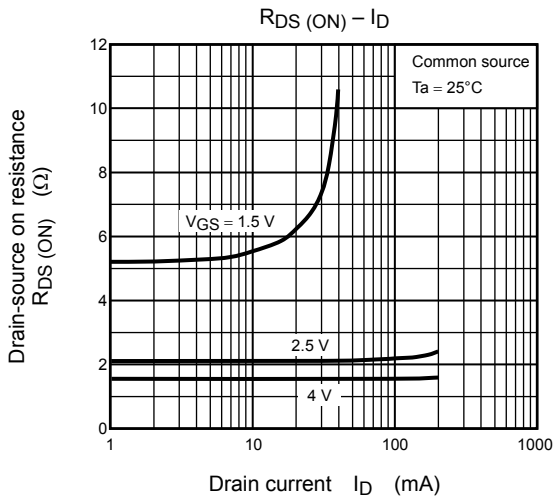
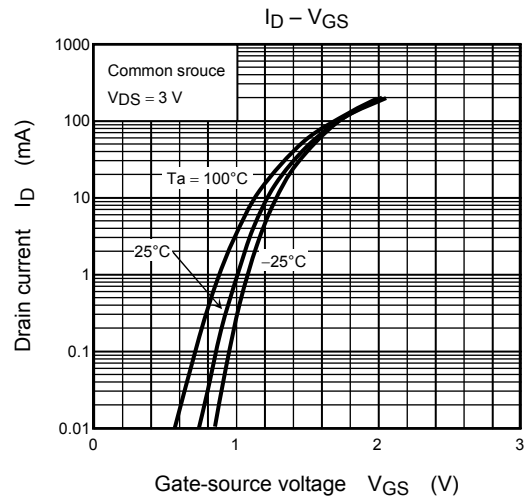
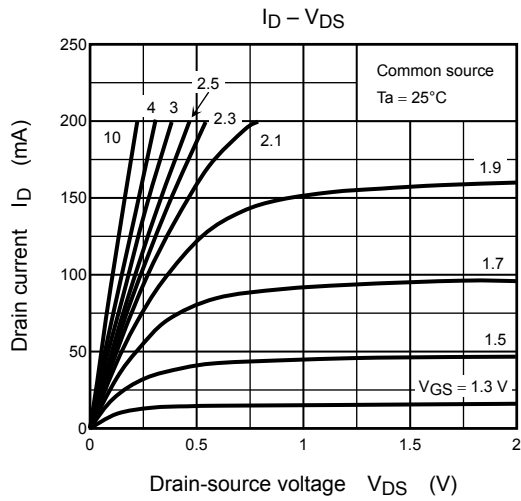
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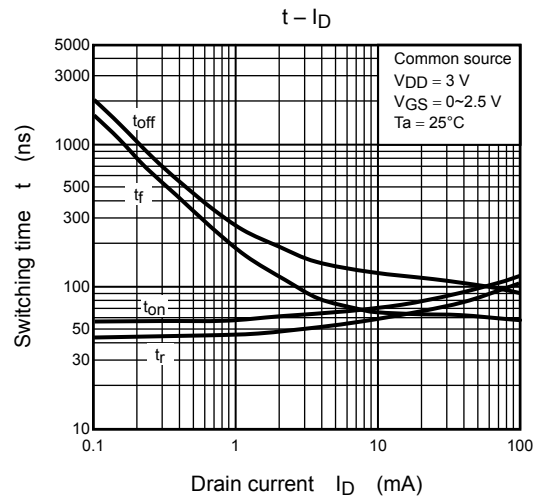
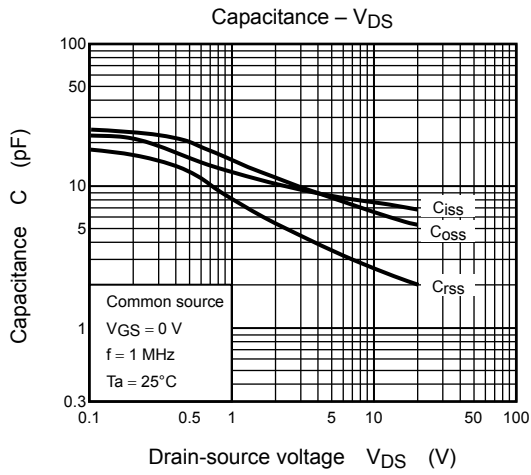
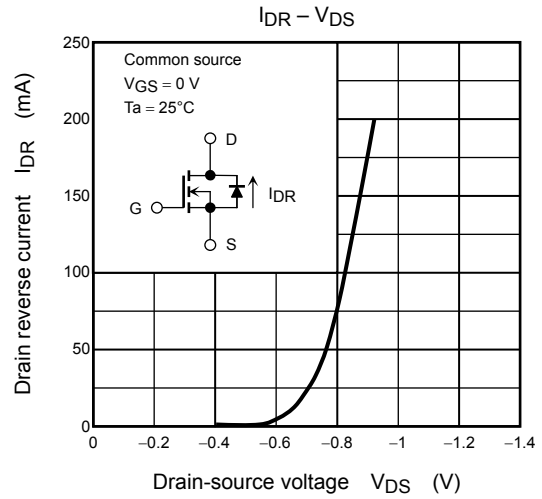
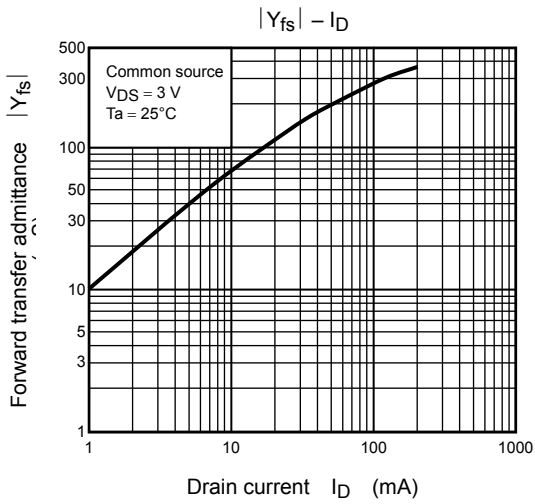






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