

TOSHIBA FIELD EFFECT TRANSISTOR SILICON N, P CHANNEL MOS TYPE (π -MOSVI / U-MOS II)

TPC8402

LITHIUM ION SECONDARY BATTERY
NOTE BOOK PC
PORTABLE DEVICES

INDUSTRIAL APPLICATIONS

Unit in mm

- Low Drain-Source ON Resistance
: P CHANNEL $R_{DS(ON)} = 27 \text{ m}\Omega$ (Typ.)
N CHANNEL $R_{DS(ON)} = 37 \text{ m}\Omega$ (Typ.)
- High Forward Transfer Admittance
: P CHANNEL $|Y_{fs}| = 7 \text{ S}$ (Typ.)
N CHANNEL $|Y_{fs}| = 6 \text{ S}$ (Typ.)
- Low Leakage Current
: P CHANNEL $I_{DSS} = -10 \mu\text{A}$ ($V_{DS} = -30 \text{ V}$)
N CHANNEL $I_{DSS} = 10 \mu\text{A}$ ($V_{DS} = 30 \text{ V}$)
- Enhancement-Mode
: P CHANNEL $V_{th} = -0.8 \sim -2.0 \text{ V}$ ($V_{DS} = -10 \text{ V}$, $I_D = -1 \text{ mA}$)
N CHANNEL $V_{th} = 0.8 \sim 2.0 \text{ V}$ ($V_{DS} = 10 \text{ V}$, $I_D = 1 \text{ mA}$)

MAXIMUM RATINGS ($T_a = 25^\circ\text{C}$)

CHARACTERISTIC	SYMBOL	RATING		UNIT	
		P CHANNEL	N CHANNEL		
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}	± 20	± 20	V	
Drain Current	DC	I_D	-4.5	5	A
	Pulse	I_{DP}	-18	20	A
Drain Power Dissipation**** ($T_a = 25^\circ\text{C}$)	P_D	2.0		W	
Single Pulse Avalanche Energy	E_{AS}	26**	32.5***	W	
Avalanche Current	I_{AR}	-4.5	5	W	
Repetitive Avalanche Energy*	E_{AR}	0.2		W	
Channel Temperature	T_{ch}	150		$^\circ\text{C}$	
Storage Temperature Range	T_{stg}	-55~150		$^\circ\text{C}$	

THERMAL CHARACTERISTICS

CHARACTERISTIC	SYMBOL	MAX.	UNIT
Thermal Resistance, Channel to Ambient****	$R_{th(ch-a)}$	62.5	$^\circ\text{C}/\text{W}$

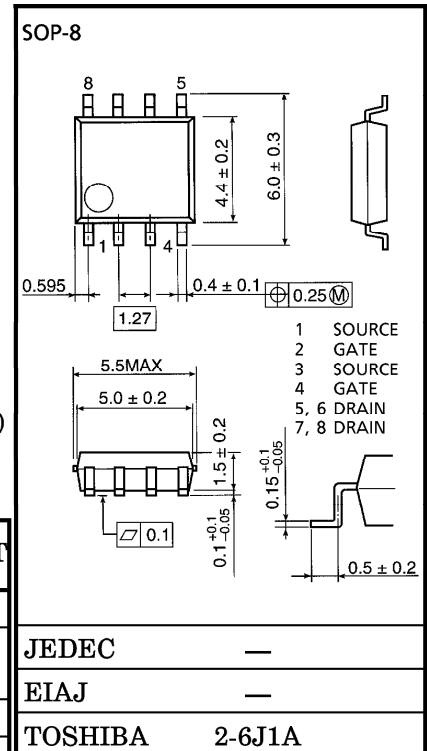
Note ;

- * Repetitive rating ; Pulse Width Limited by Max. Junction temperature.
- ** $V_{DD} = -24 \text{ V}$, $T_{ch} = 25^\circ\text{C}$ (initial), $L = 1.0 \text{ mH}$, $R_G = 25 \Omega$, $I_{AR} = -4.5 \text{ A}$
- *** $V_{DD} = 24 \text{ V}$, $T_{ch} = 25^\circ\text{C}$ (initial), $L = 1.0 \text{ mH}$, $R_G = 25 \Omega$, $I_{AR} = 5.0 \text{ A}$
- **** Drive operation ; Mount on glass epoxy board [1 inch² × 0.8 t] in the two devices driving (t = 10 s)

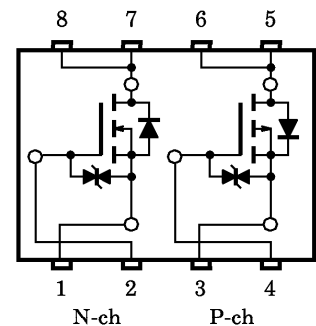
This transistor is an electrostatic sensitive device. Please handle with caution.

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CIRCUIT CONFIGURATION



P-ch

ELECTRICAL CHARACTERISTICS (Ta = 25°C)

CHARACTERISTIC		SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Gate Leakage Current		I_{GSS}	$V_{GS} = \pm 16\text{ V}, V_{DS} = 0\text{ V}$	—	—	± 10	μA
Drain Cut-Off Current		I_{DSS}	$V_{DS} = -30\text{ V}, V_{GS} = 0\text{ V}$	—	—	-10	μA
Drain-Source Breakdown Voltage		$V_{(BR)DSS}$	$I_D = -10\text{ mA}, V_{GS} = 0\text{ V}$	-30	—	—	V
		$V_{(BR)DSX}$	$I_D = -10\text{ mA}, V_{GS} = 20\text{ V}$	-15	—	—	
Gate Threshold Voltage		V_{th}	$V_{DS} = -10\text{ V}, I_D = -1\text{ mA}$	-0.8	—	-2.0	V
Drain-Source ON Resistance		$R_{DS(ON)}$	$V_{GS} = -4\text{ V}, I_D = -2.2\text{ A}$	—	55	65	m Ω
		$R_{DS(ON)}$	$V_{GS} = -10\text{ V}, I_D = -2.2\text{ A}$	—	27	35	
Forward Transfer Admittance		$ Y_{fs} $	$V_{DS} = -10\text{ V}, I_D = -2.2\text{ A}$	3.5	7	—	S
Input Capacitance		C_{iss}	$V_{DS} = -10\text{ V}, V_{GS} = 0\text{ V},$ $f = 1\text{ MHz}$	—	970	—	pF
Reverse Transfer Capacitance		C_{rss}		—	180	—	
Output Capacitance		C_{oss}		—	370	—	
Switching Time	Rise Time	t_r	<p>$V_{IN} : t_r, t_f < 5\text{ ns},$ $Duty \leq 1\%, t_w = 10\ \mu\text{s}$</p>	—	17	—	ns
	Turn-On Time	t_{on}		—	20	—	
	Fall Time	t_f		—	75	—	
	Turn-Off Time	t_{off}		—	160	—	
Total Gate Charge (Gate-Source Plus Gate-Drain)		Q_g	$V_{DD} \doteq -24\text{ V}, V_{GS} = -10\text{ V}$	—	28	—	nC
Gate-Source Charge		Q_{gs}	$I_D = -4.5\text{ A}$	—	16	—	
Gate-Drain (“Miller”) Charge		Q_{gd}		—	12	—	

SOURCE-DRAIN DIODE RATINGS AND CHARACTERISTICS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Continuous Drain Reverse Current	I_{DR}	—	—	—	-4.5	A
Pulse Drain Reverse Current	I_{DRP}	—	—	—	-18	A
Diode Forward Voltage	V_{DSF}	$I_{DR} = -4.5\text{ A}, V_{GS} = 0\text{ V}$	—	—	1.2	V

N-ch

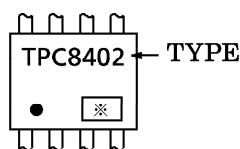
ELECTRICAL CHARACTERISTICS (Ta = 25°C)

CHARACTERISTIC		SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Gate Leakage Current		I_{GSS}	$V_{GS} = \pm 16\text{ V}, V_{DS} = 0\text{ V}$	—	—	± 10	μA
Drain Cut-Off Current		I_{DSS}	$V_{DS} = 30\text{ V}, V_{GS} = 0\text{ V}$	—	—	10	μA
Drain-Source Breakdown Voltage		$V_{(BR)DSS}$	$I_D = 10\text{ mA}, V_{GS} = 0\text{ V}$	30	—	—	V
Gate Threshold Voltage		V_{th}	$V_{DS} = 10\text{ V}, I_D = 1\text{ mA}$	0.8	—	2.0	V
Drain-Source ON Resistance		$R_{DS(ON)}$	$V_{GS} = 4\text{ V}, I_D = 2.5\text{ A}$	—	58	80	$\text{m}\Omega$
		$R_{DS(ON)}$	$V_{GS} = 10\text{ V}, I_D = 2.5\text{ A}$	—	37	50	$\text{m}\Omega$
Forward Transfer Admittance		$ Y_{fs} $	$V_{DS} = 10\text{ V}, I_D = 2.5\text{ A}$	3	6	—	S
Input Capacitance		C_{iss}	$V_{DS} = 10\text{ V}, V_{GS} = 0\text{ V},$ $f = 1\text{ MHz}$	—	475	—	pF
Reverse Transfer Capacitance		C_{rss}		—	85	—	
Output Capacitance		C_{oss}		—	270	—	
Switching Time	Rise Time	t_r		—	10	—	ns
	Turn-On Time	t_{on}		—	16	—	
	Fall Time	t_f		—	13	—	
	Turn-Off Time	t_{off}		—	70	—	
Total Gate Charge (Gate-Source Plus Gate-Drain)		Q_g	$V_{DD} \doteq 24\text{ V}, V_{GS} = 10\text{ V}$ $I_D = 5\text{ A}$	—	16	—	nC
Gate-Source Charge		Q_{gs}		—	11	—	
Gate-Drain ("Miller") Charge		Q_{gd}		—	5	—	

SOURCE-DRAIN DIODE RATINGS AND CHARACTERISTICS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Continuous Drain Reverse Current	I_{DR}	—	—	—	5	A
Pulse Drain Reverse Current	I_{DRP}	—	—	—	20	A
Diode Forward Voltage	V_{DSF}	$I_{DR} = 5\text{ A}, V_{GS} = 0\text{ V}$	—	—	-1.2	V

MARKING

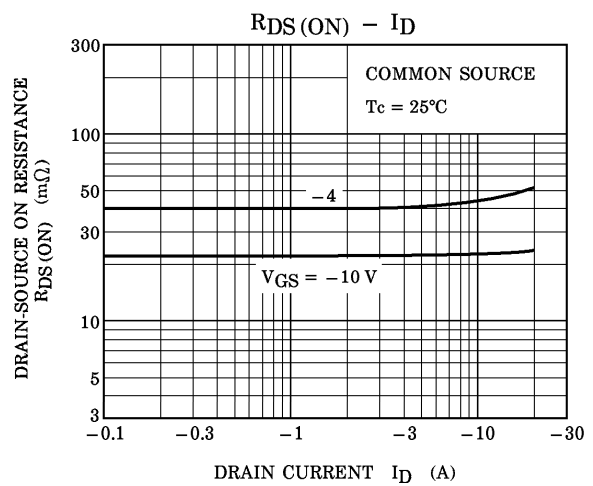
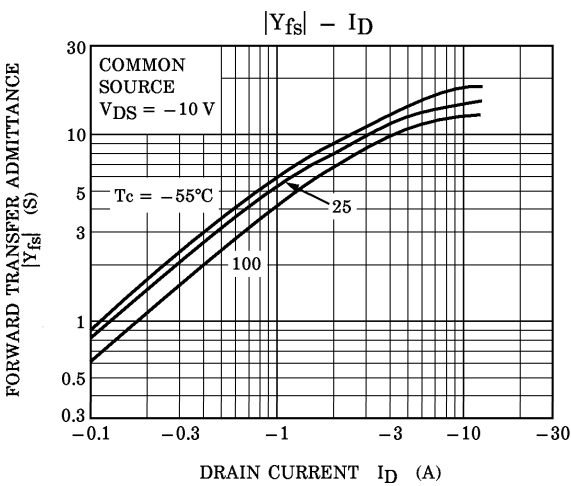
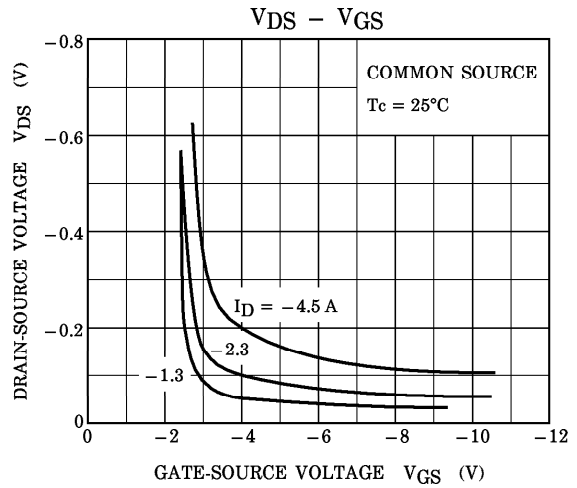
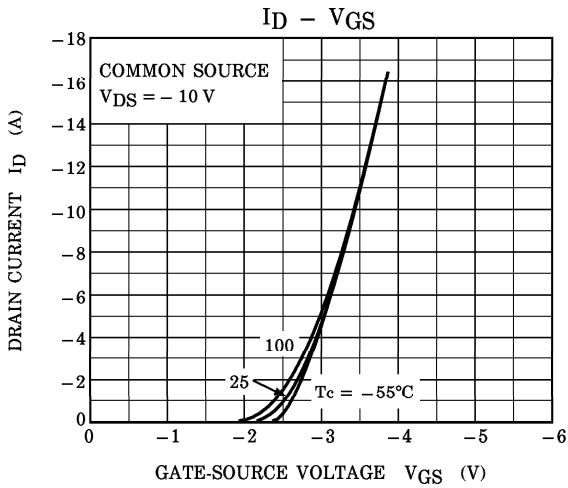
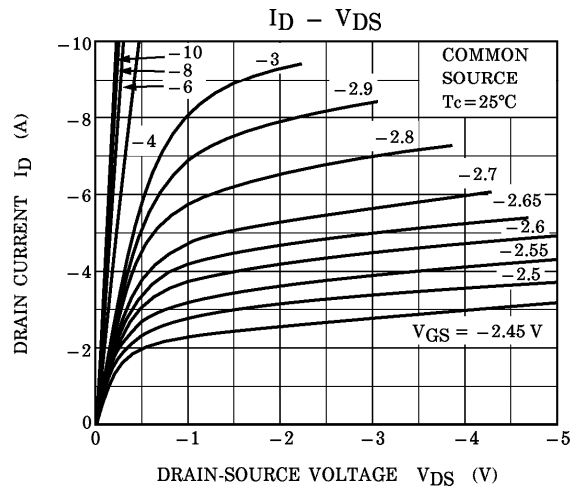
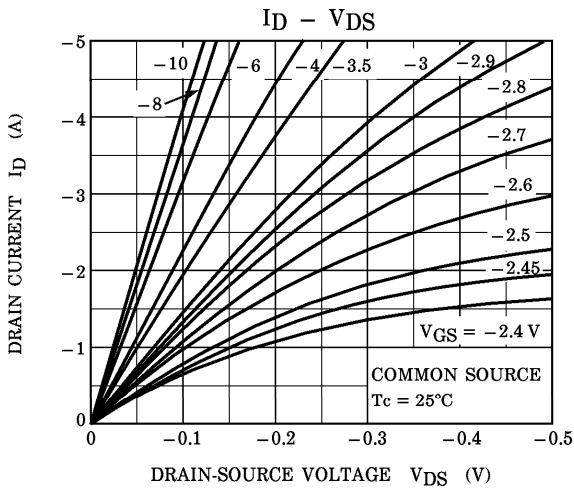


※ Lot Number

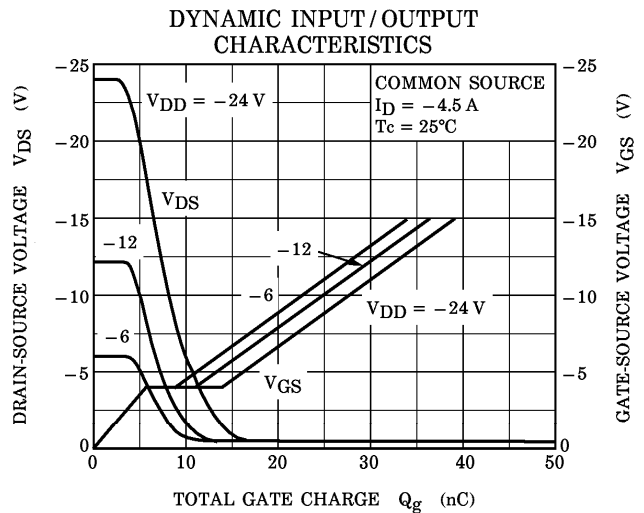
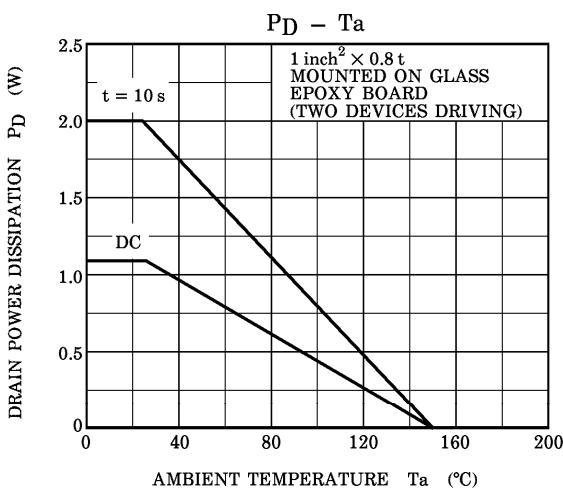
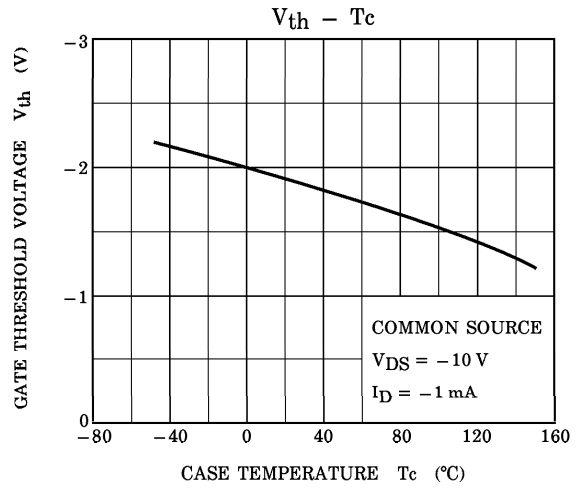
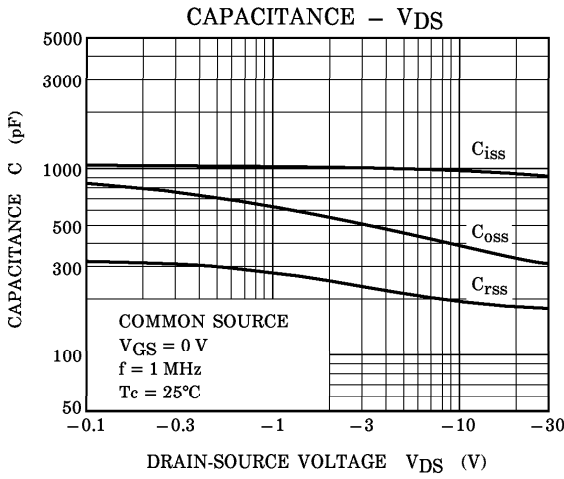
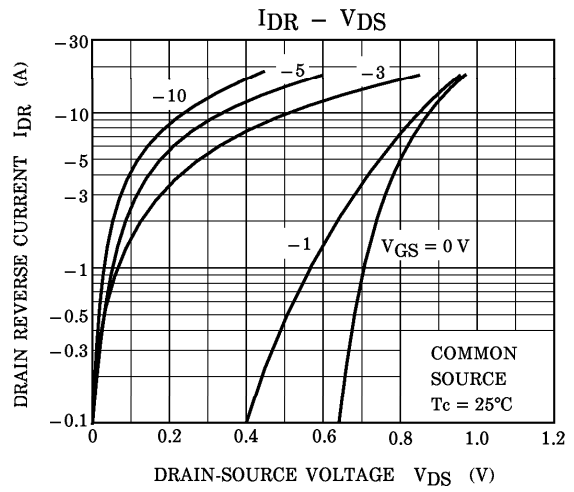
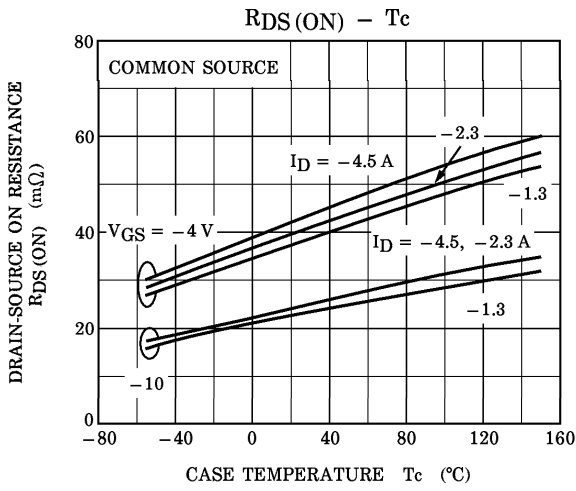
□ □ — Month (Starting from Alphabet A)

— Year (Last Number of the Christian Era)

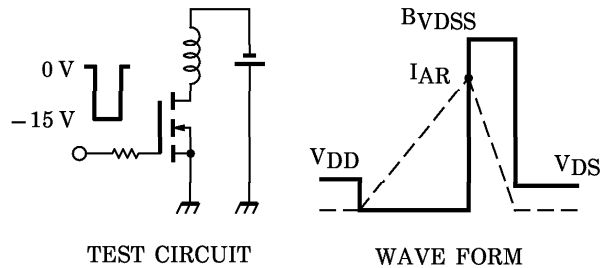
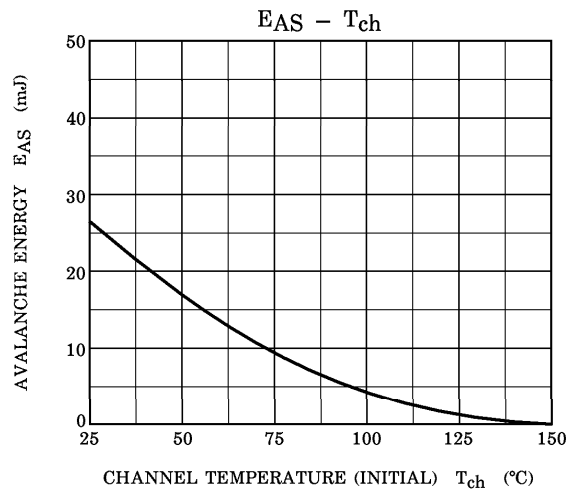
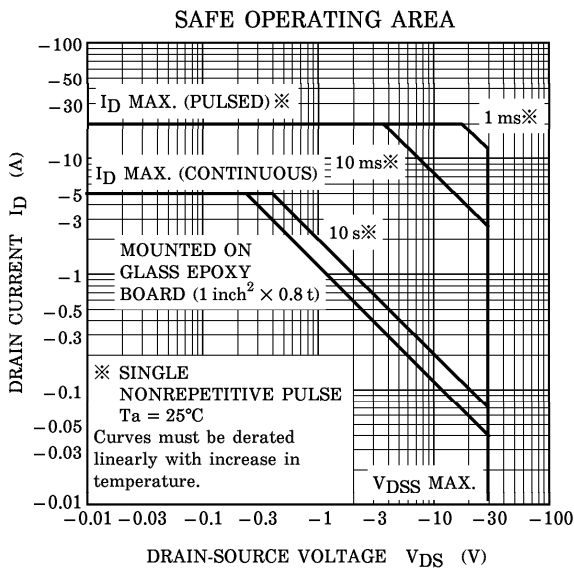
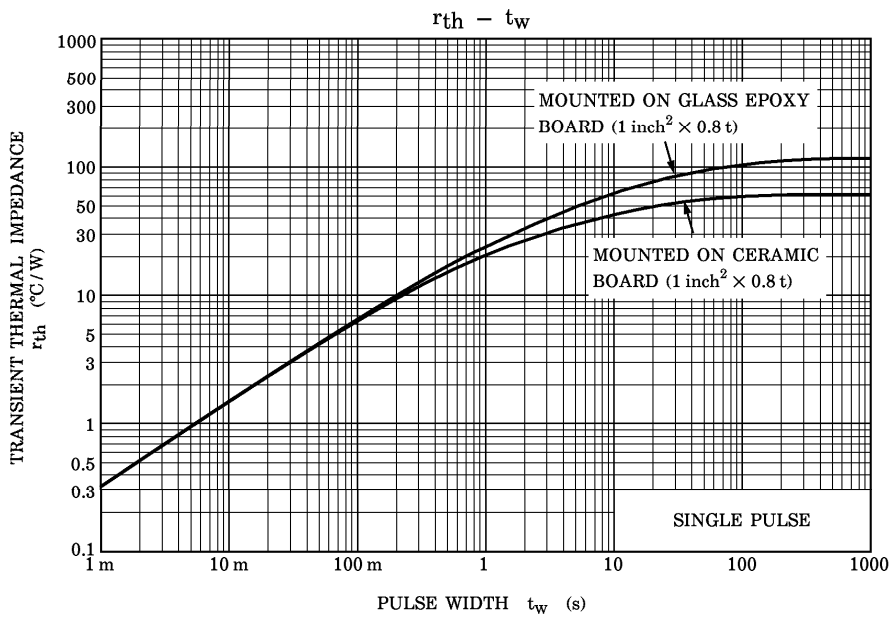
P-ch



P-ch



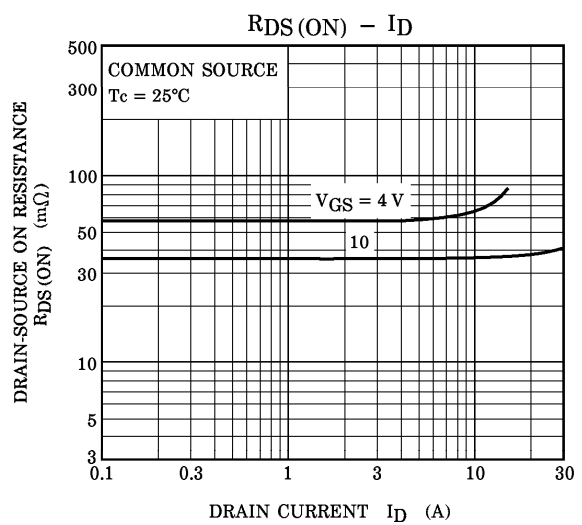
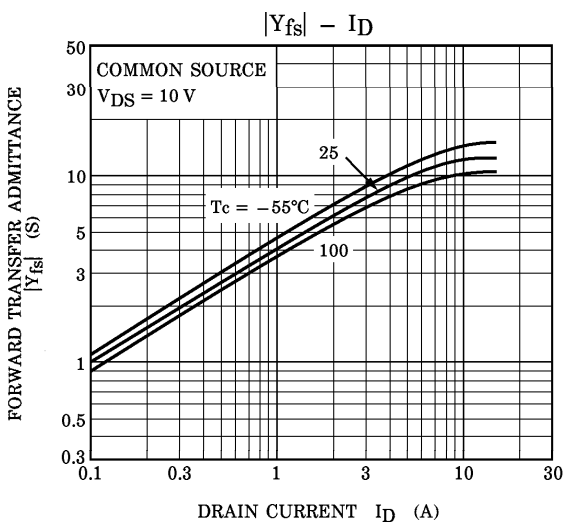
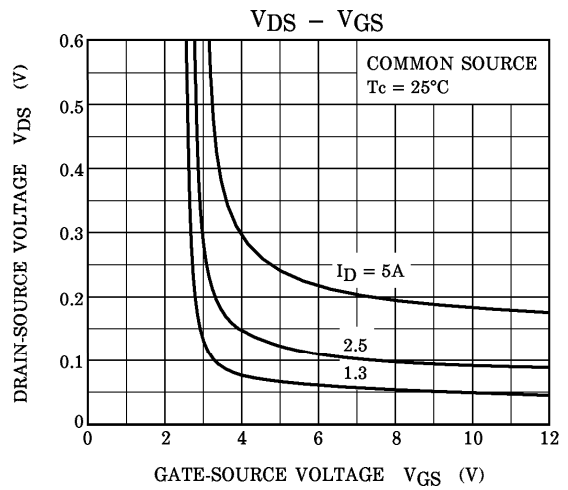
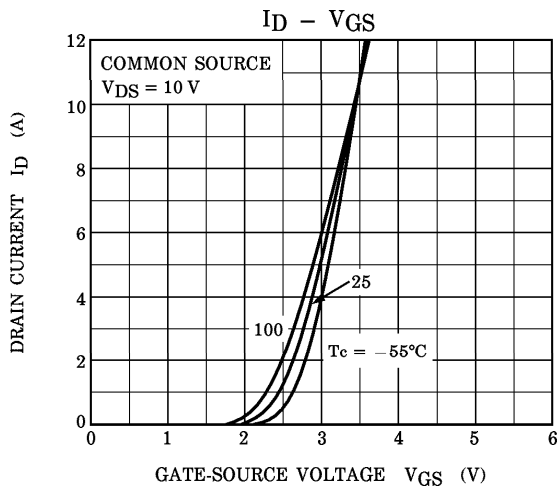
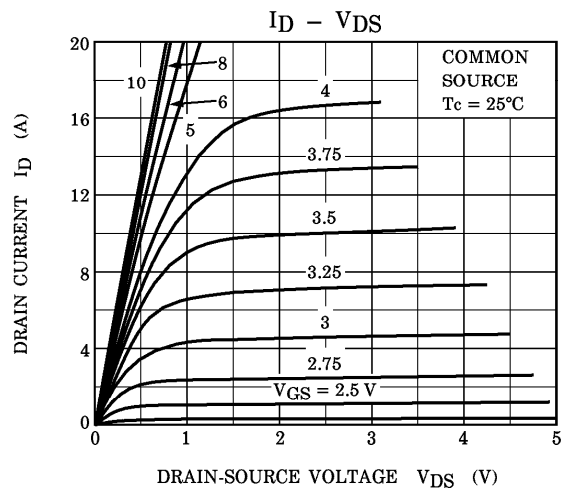
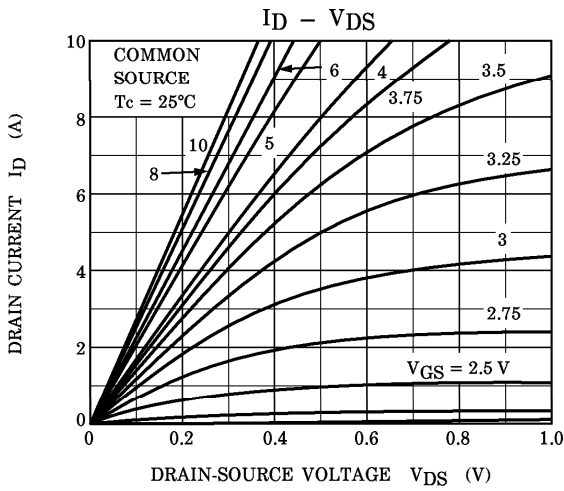
P-ch



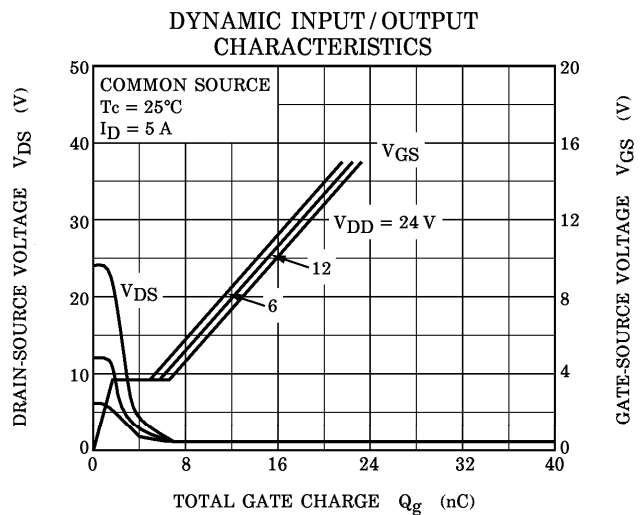
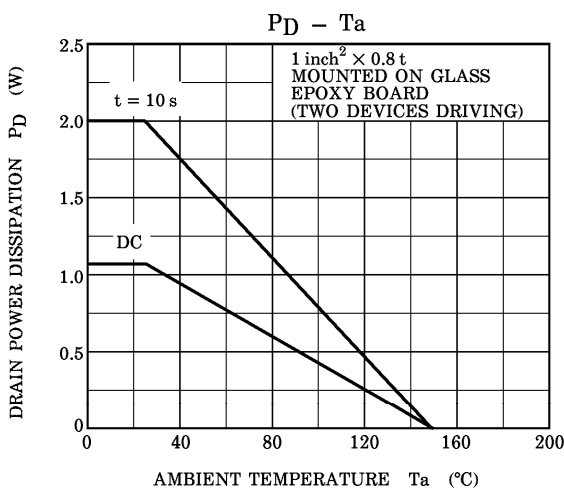
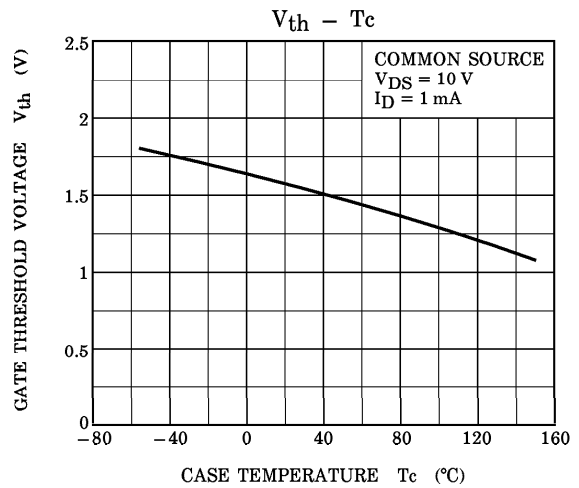
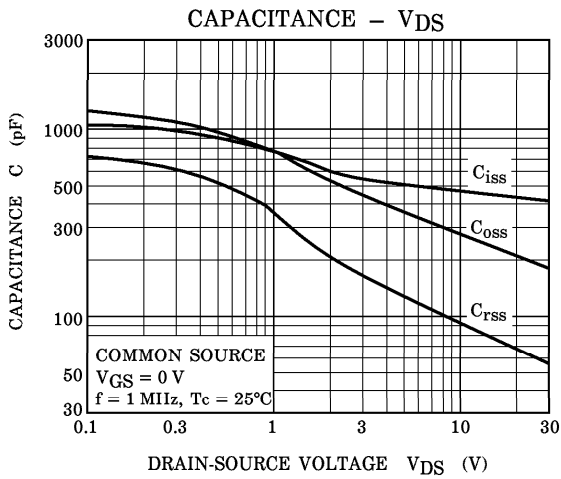
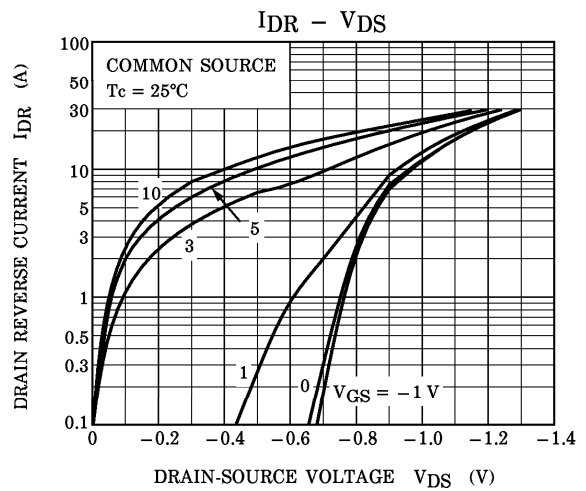
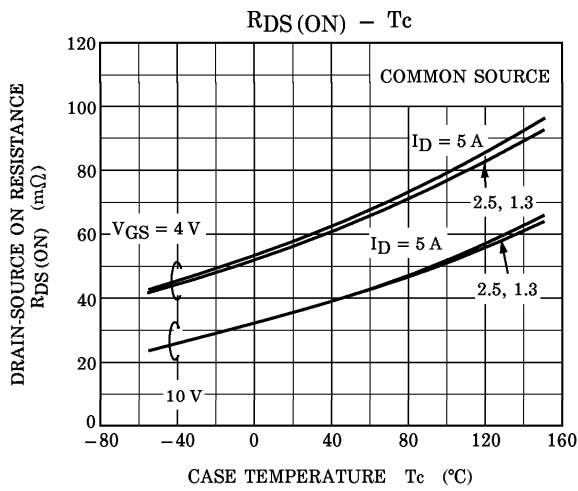
Peak $I_{AR} = -4.5 \text{ A}$, $R_G = 25 \Omega$, $V_{DD} = -24 \text{ V}$, $L = 1.0 \text{ mH}$

$$E_{AS} = \frac{1}{2} \cdot L \cdot I^2 \cdot \left(\frac{BVDSS}{BVDSS - V_{DD}} \right)$$

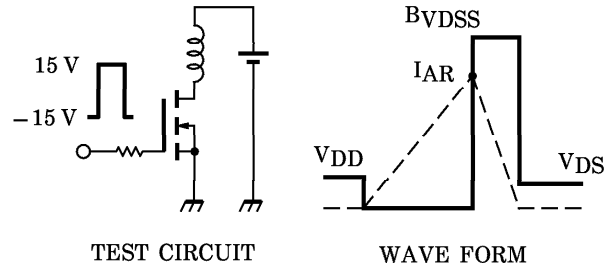
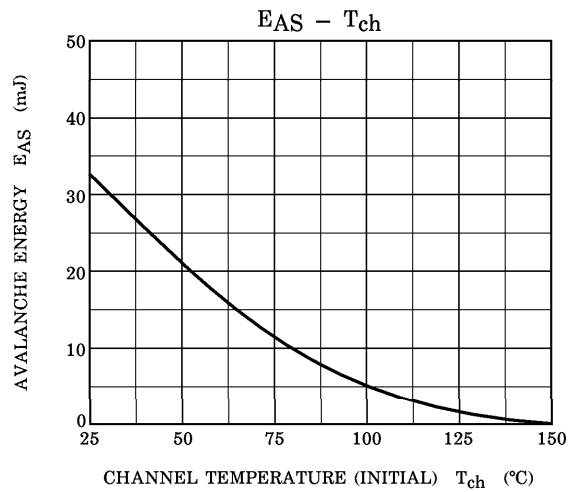
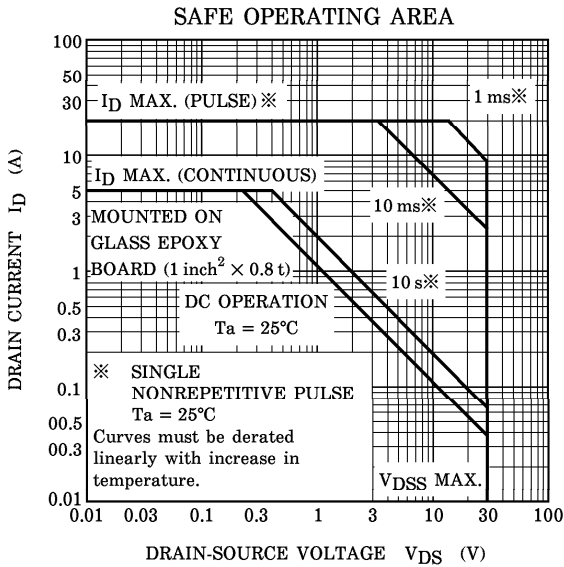
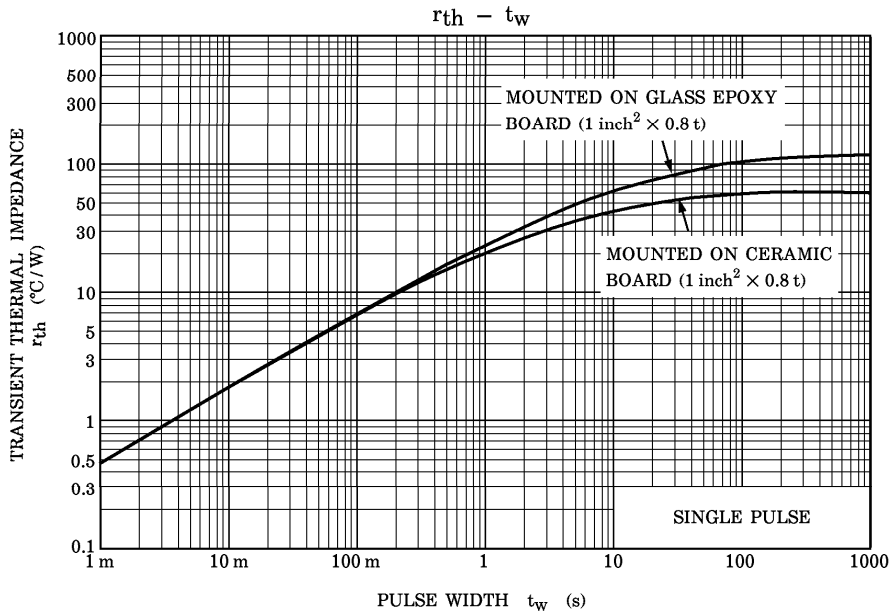
N-ch



N-ch



N-ch



Peak $I_{AR} = 5 \text{ A}$, $R_G = 25 \Omega$
 $V_{DD} = 24 \text{ V}$, $L = 1.0 \text{ mH}$

$$E_{AS} = \frac{1}{2} \cdot L \cdot I^2 \cdot \left(\frac{BV_{DSS}}{BV_{DSS} - V_{DD}} \right)$$