

TOSHIBA Field Effect Transistor Silicon P Channel MOS Type (L<sup>2</sup>-π-MOSV)

# 2SJ438

DC-DC Converter, Relay Drive and Motor Drive Applications

- 4-V gate drive
- Low drain-source ON resistance :  $R_{DS(ON)} = 0.16 \Omega$  (typ.)
- High forward transfer admittance :  $|Y_{fs}| = 4.0 \text{ S}$  (typ.)
- Low leakage current :  $I_{DSS} = -100 \mu\text{A}$  (max) ( $V_{DS} = -60 \text{ V}$ )
- Enhancement mode :  $V_{th} = -0.8$  to  $-2.0 \text{ V}$  ( $V_{DS} = -10 \text{ V}$ ,  $I_D = -1 \text{ mA}$ )

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

Characteristics	Symbol	Rating	Unit	
Drain-source voltage	$V_{DSS}$	-60	V	
Drain-gate voltage ( $R_{GS} = 20 \text{ k}\Omega$ )	$V_{DGR}$	-60	V	
Gate-source voltage	$V_{GSS}$	$\pm 20$	V	
Drain current	DC (Note 1)	$I_D$	-5	A
	Pulse (Note 1)	$I_{DP}$	-20	A
Drain power dissipation ( $T_c = 25^\circ\text{C}$ )	$P_D$	25	W	
Single pulse avalanche energy (Note 2)	$E_{AS}$	273	mJ	
Avalanche current	$I_{AR}$	-5	A	
Repetitive avalanche energy (Note 3)	$E_{AR}$	2	mJ	
Channel temperature	$T_{ch}$	150	°C	
Storage temperature range	$T_{stg}$	-55~150	°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

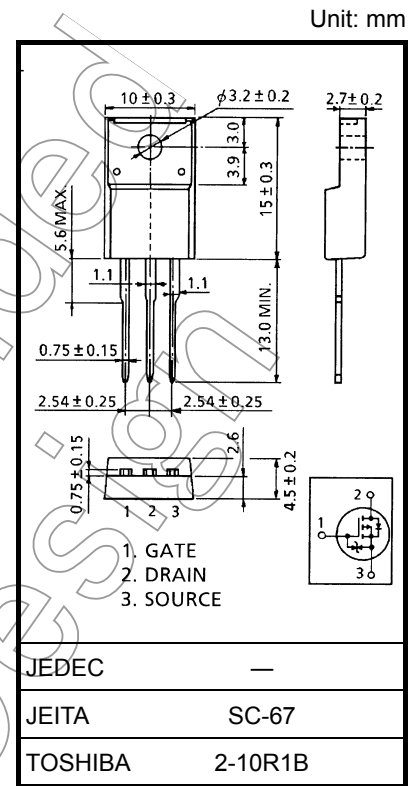
Characteristics	Symbol	Max	Unit
Thermal resistance, channel to case	$R_{th(ch-c)}$	5.0	°C / W
Thermal resistance, channel to ambient	$R_{th(ch-a)}$	62.5	°C / W

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

Note 2:  $V_{DD} = -25 \text{ V}$ ,  $T_{ch} = 25^\circ\text{C}$  (initial),  $L = 14.84 \text{ mH}$ ,  $R_G = 25 \Omega$ ,  $I_{AR} = -5 \text{ A}$

Note 3: Repetitive rating: pulse width limited by maximum channel temperature

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



Weight: 1.9 g (typ.)

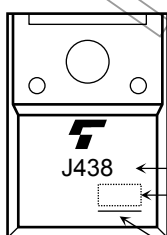
## Electrical Characteristics (Ta = 25°C)

Characteristics		Symbol	Test Condition	Min	Typ.	Max	Unit
Gate leakage current		$I_{GSS}$	$V_{GS} = \pm 16\text{ V}, V_{DS} = 0\text{ V}$	—	—	$\pm 10$	$\mu\text{A}$
Drain cut-off current		$I_{DSS}$	$V_{DS} = -60\text{ V}, V_{GS} = 0\text{ V}$	—	—	-100	$\mu\text{A}$
Drain-source breakdown voltage		$V_{(BR)DSS}$	$I_D = -10\text{ mA}, V_{GS} = 0\text{ V}$	-60	—	—	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		$R_{DS(ON)}$	$V_{GS} = -4\text{ V}, I_D = -2.5\text{ A}$	—	0.24	0.28	$\Omega$
			$V_{GS} = -10\text{ V}, I_D = -2.5\text{ A}$	—	0.16	0.19	
Forward transfer admittance		$ Y_{fs} $	$V_{DS} = -10\text{ V}, I_D = -2.5\text{ A}$	2.0	4.0	—	S
Input capacitance		$C_{iss}$	$V_{DS} = -10\text{ V}, V_{GS} = 0\text{ V}, f = 1\text{ MHz}$	—	630	—	pF
Reverse transfer capacitance		$C_{rss}$		—	95	—	
Output capacitance		$C_{oss}$		—	290	—	
Switching time	Rise time	$t_r$		—	25	—	ns
	Turn-on time	$t_{on}$		—	45	—	
	Fall time	$t_f$		—	55	—	
	Turn-off time	$t_{off}$		—	200	—	
Total gate charge (Gate-source plus gate-drain)		$Q_g$	$V_{DD} \approx -48\text{ V}, V_{GS} = -10\text{ V}, I_D = -5\text{ A}$	—	22	—	nC
Gate-source charge		$Q_{gs}$		—	16	—	
Gate-drain ("miller") charge		$Q_{gd}$		—	6	—	

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

Characteristics	Symbol	Test Condition	Min	Typ.	Max	Unit
Continuous drain reverse current (Note 1)	$I_{DR}$	—	—	—	-5	A
Pulse drain reverse current (Note 1)	$I_{DRP}$	—	—	—	-20	A
Forward voltage (diode)	$V_{DSF}$	$I_{DR} = -5\text{ A}, V_{GS} = 0\text{ V}$	—	—	1.7	V
Reverse recovery time	$t_{rr}$	$I_{DR} = -5\text{ A}, V_{GS} = 0\text{ V}, dI_{DR}/dt = 50\text{ A}/\mu\text{s}$	—	80	—	ns
Reverse recovery charge	$Q_{rr}$		—	0.1	—	$\mu\text{C}$

## Marking



J438 ← Part No. (or abbreviation code)

← Lot No.

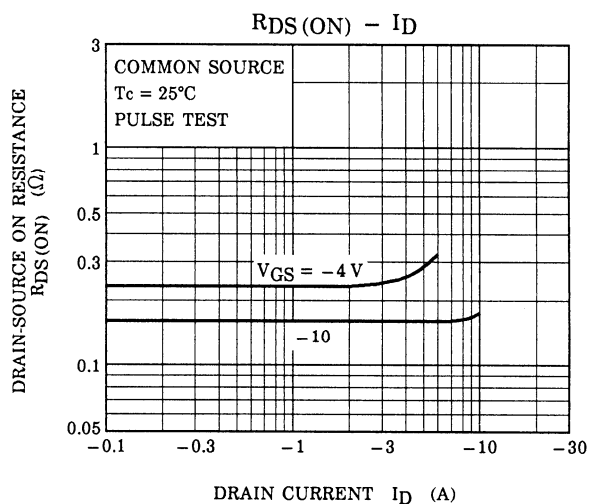
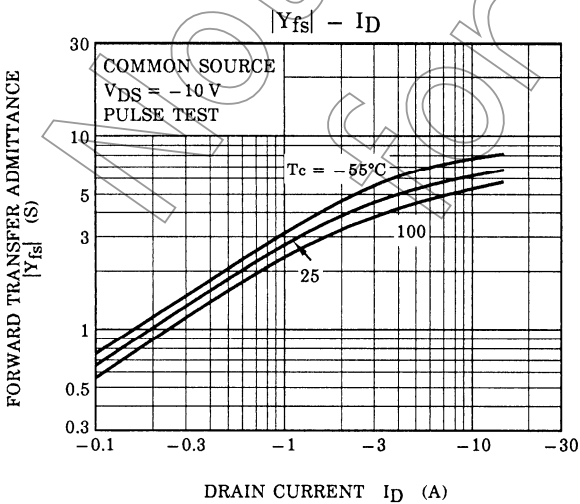
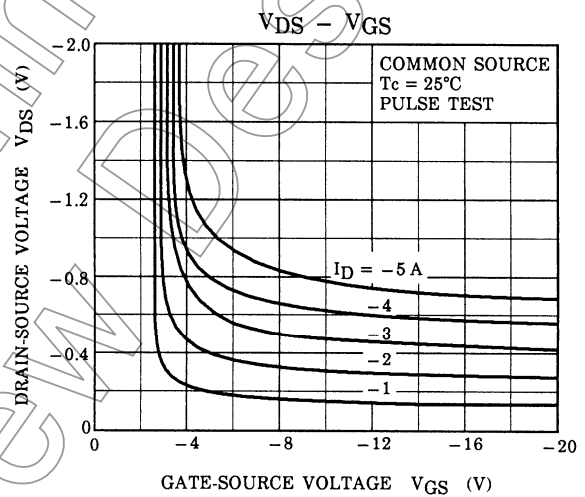
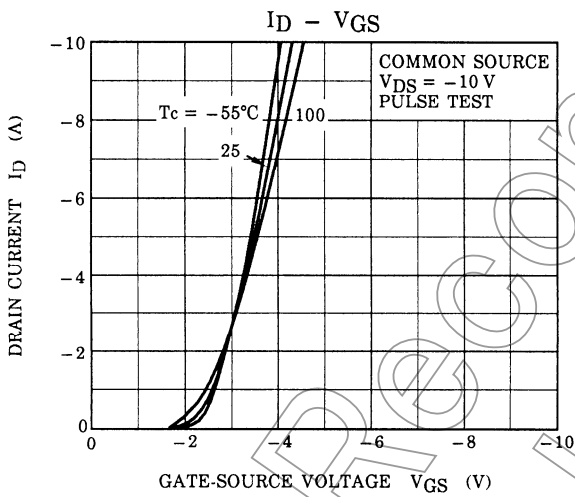
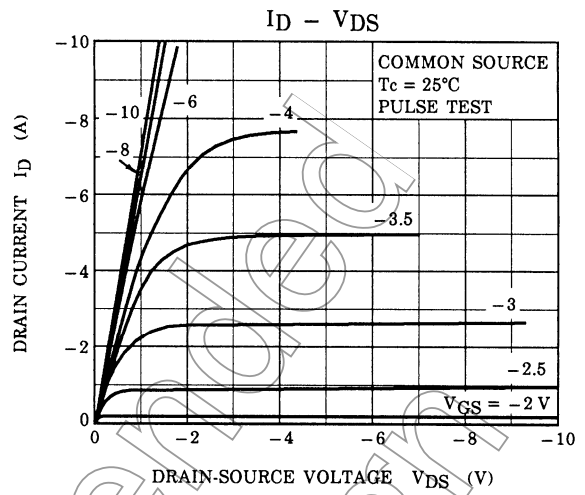
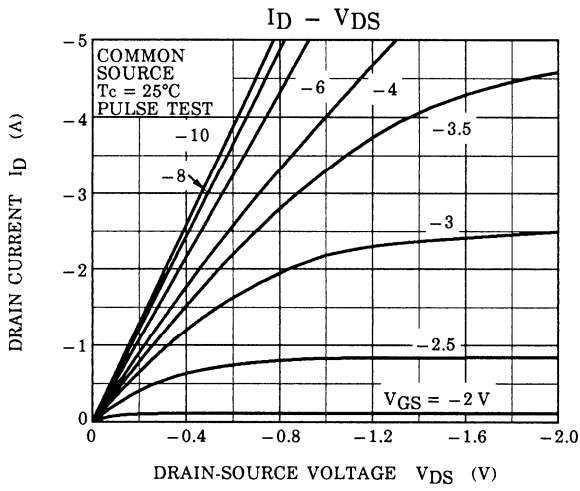
← Note 4

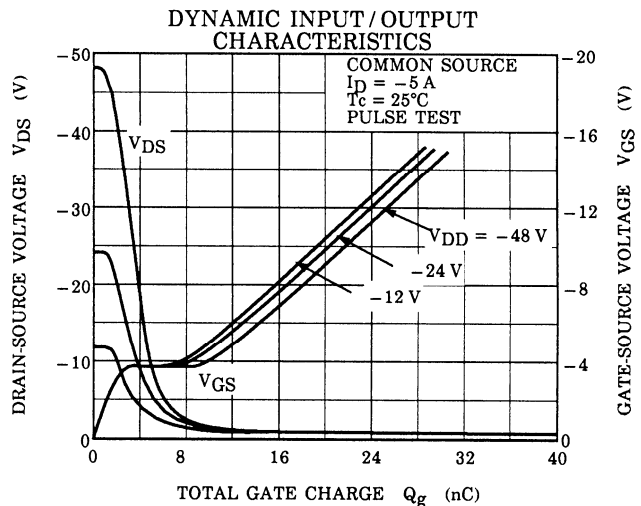
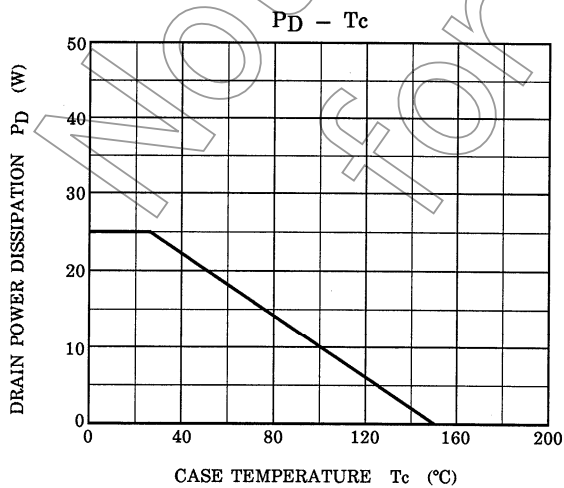
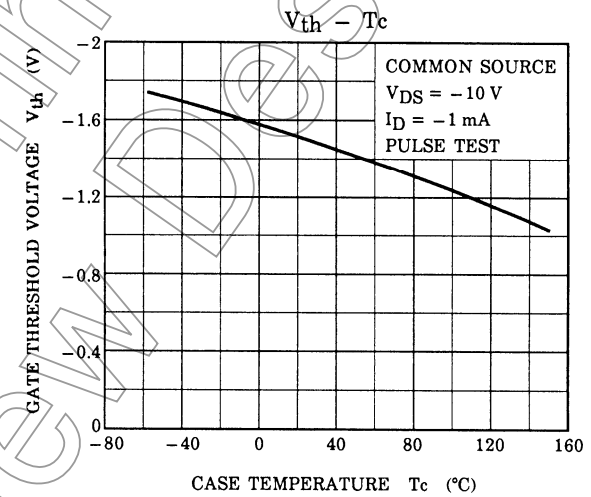
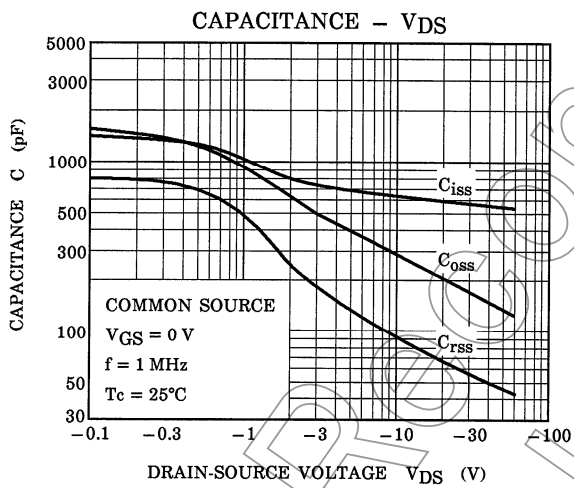
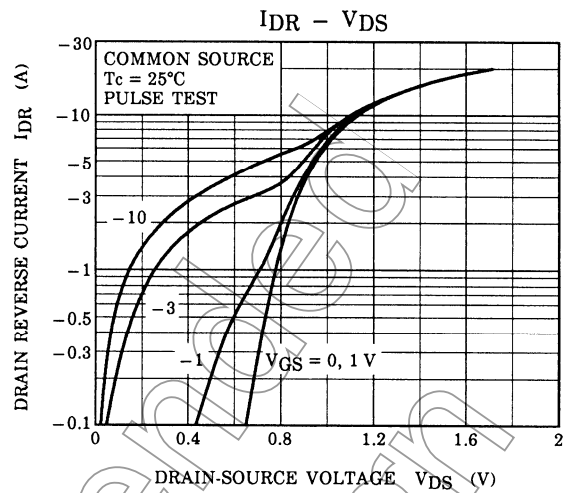
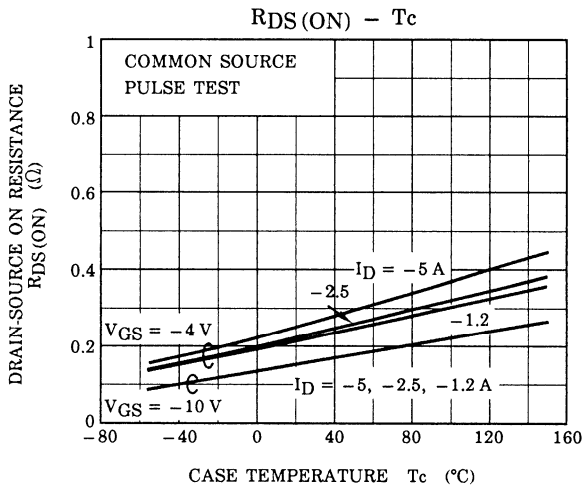
Note 4: A line under a Lot No. identifies the indication of product Labels.

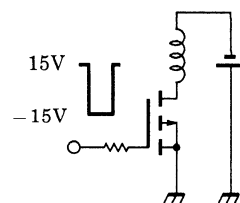
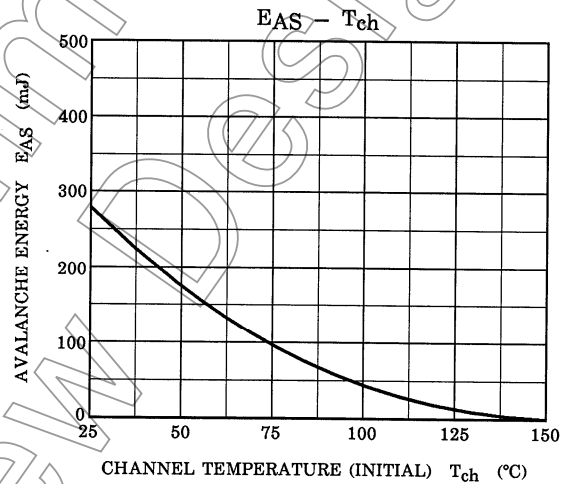
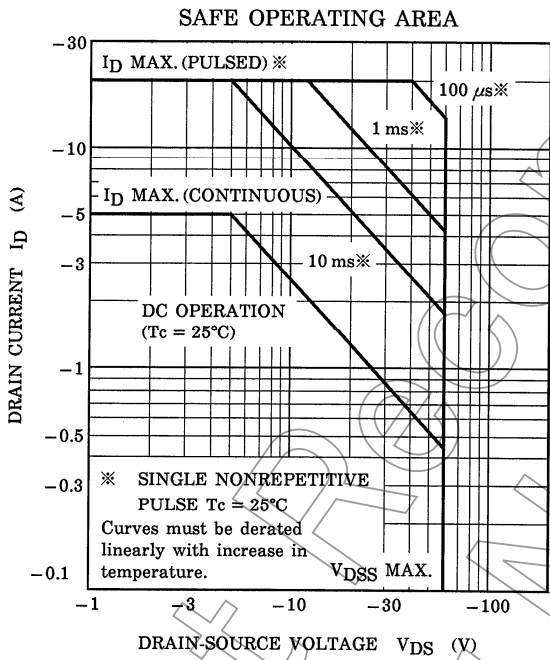
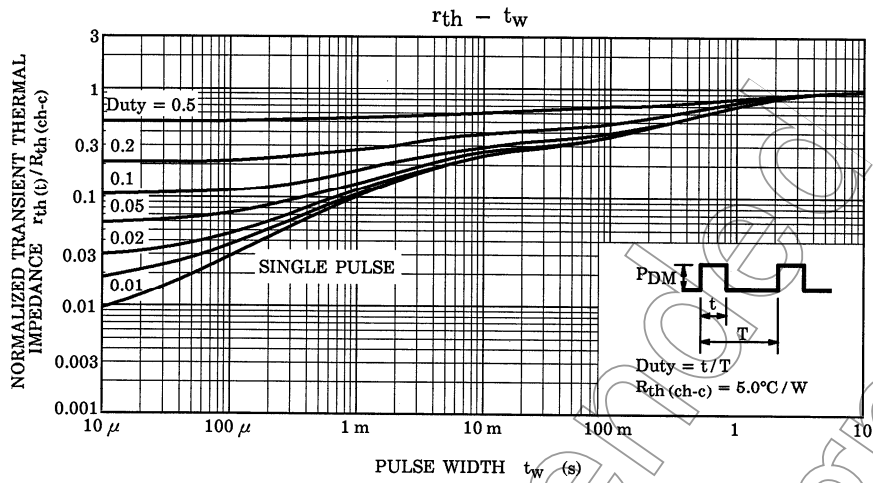
Not underlined: [[Pb]]/INCLUDES > MCV

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

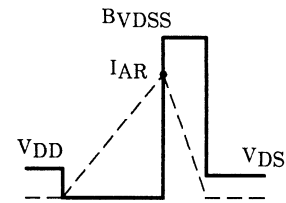
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TEST CIRCUIT



WAVE FORM

$R_G = 25\Omega$

$V_{DD} = -25V, L = 14.84mH$

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

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