

TOSHIBA Field Effect Transistor Silicon N Channel MOS Type ( $\pi$ -MOSIV)

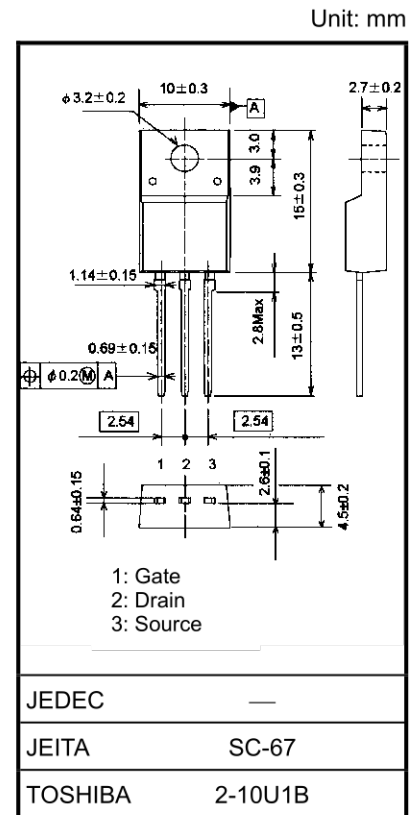
# 2SK4013

## Switching Regulator Applications

- Low drain-source ON resistance:  $R_{DS(ON)} = 1.35 \Omega$  (typ.)
- High forward transfer admittance:  $|Y_{fs}| = 5.0 S$  (typ.)
- Low leakage current:  $I_{DSS} = 100 \mu A$  (max) ( $V_{DS} = 640 V$ )
- Enhancement-model:  $V_{th} = 2.0$  to  $4.0 V$  ( $V_{DS} = 10 V, I_D = 1 mA$ )

## Absolute Maximum Ratings ( $T_a = 25^\circ C$ )

Characteristics		Symbol	Rating	Unit
Drain-source voltage		$V_{DSS}$	800	V
Drain-gate voltage ( $R_{GS} = 20 k\Omega$ )		$V_{DGR}$	800	V
Gate-source voltage		$V_{GSS}$	$\pm 30$	V
Drain current	DC (Note 1)	$I_D$	6	A
	Pulse (Note 1)	$I_{DP}$	18	
Drain power dissipation ( $T_c = 25^\circ C$ )		$P_D$	45	W
Single pulse avalanche energy (Note 2)		$E_{AR}$	317	mJ
Avalanche current		$I_{AR}$	6	A
Repetitive avalanche energy (Note 3)		$E_{AR}$	4.5	mJ
Channel temperature		$T_{ch}$	150	$^\circ C$
Storage temperature range		$T_{stg}$	-55 to 150	$^\circ C$



Weight: 1.7 g (typ.)

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

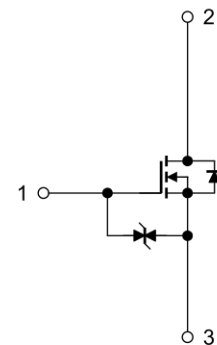
Characteristics	Symbol	Max	Unit
Thermal resistance, channel to case	$R_{th(ch-c)}$	2.78	$^\circ C/W$
Thermal resistance, channel to ambient	$R_{th(ch-a)}$	62.5	$^\circ C/W$

Note 1: Please use devices on condition that the channel temperature is below  $150^\circ C$ .

Note 2:  $V_{DD} = 90 V, T_{ch} = 25^\circ C$  (initial),  $L = 14.5 mH, R_G = 25 \Omega, I_{AR} = 6 A$

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

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



Start of commercial production  
2007-07

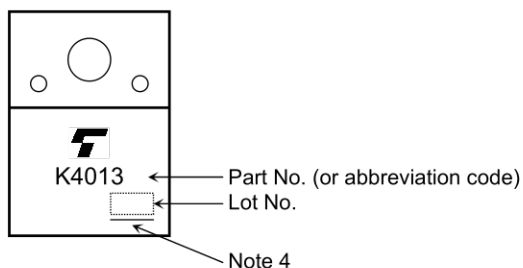
## Electrical Characteristics (Ta = 25°C)

Characteristics		Symbol	Test Condition	Min	Typ.	Max	Unit
Gate leakage current		$I_{GSS}$	$V_{GS} = \pm 25\text{ V}, V_{DS} = 0\text{ V}$	—	—	$\pm 10$	$\mu\text{A}$
Drain-source breakdown voltage		$V_{(BR)GSS}$	$I_G = \pm 10\ \mu\text{A}, V_{DS} = 0\text{ V}$	$\pm 30$	—	—	V
Drain cut-OFF current		$I_{DSS}$	$V_{DS} = 640\text{ V}, V_{GS} = 0\text{ V}$	—	—	100	$\mu\text{A}$
Drain-source breakdown voltage		$V_{(BR)DSS}$	$I_D = 10\text{ mA}, V_{GS} = 0\text{ V}$	800	—	—	V
Gate threshold voltage		$V_{th}$	$V_{DS} = 10\text{ V}, I_D = 1\text{ mA}$	2.0	—	4.0	V
Drain-source ON resistance		$R_{DS(ON)}$	$V_{GS} = 10\text{ V}, I_D = 3\text{ A}$	—	1.35	1.7	$\Omega$
Forward transfer admittance		$ Y_{fs} $	$V_{DS} = 20\text{ V}, I_D = 3\text{ A}$	2.5	5.0	—	S
Input capacitance		$C_{iss}$	$V_{DS} = 25\text{ V}, V_{GS} = 0\text{ V}, f = 1\text{ MHz}$	—	1400	—	pF
Reverse transfer capacitance		$C_{rss}$		—	30	—	
Output capacitance		$C_{oss}$		—	130	—	
Switching time	Rise time	$t_r$	<p>Duty <math>\leq 1\%</math>, <math>t_w = 10\ \mu\text{s}</math></p>	—	25	—	ns
	Turn-ON time	$t_{on}$		—	80	—	
	Fall time	$t_f$		—	65	—	
	Turn-OFF time	$t_{off}$		—	220	—	
Total gate charge (gate-source plus gate-drain)		$Q_g$	$V_{DD} \approx 400\text{ V}, V_{GS} = 10\text{ V}, I_D = 6\text{ A}$	—	45	—	nC
Gate-source charge		$Q_{gs}$		—	25	—	
Gate-drain ("miller") charge		$Q_{gd}$		—	20	—	

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

Characteristics	Symbol	Test Condition	Min	Typ.	Max	Unit
Continuous drain reverse current (Note 1)	$I_{DR}$	—	—	—	6	A
Pulse drain reverse current (Note 1)	$I_{DRP}$	—	—	—	18	A
Forward voltage (diode)	$V_{DSF}$	$I_{DR} = 6\text{ A}, V_{GS} = 0\text{ V}$	—	—	-1.7	V
Reverse recovery time	$t_{rr}$	$I_{DR} = 6\text{ A}, V_{GS} = 0\text{ V},$	—	1100	—	ns
Reverse recovery charge	$Q_{rr}$	$dI_{DR}/dt = 100\text{ A}/\mu\text{s}$	—	10	—	$\mu\text{C}$

## Marking

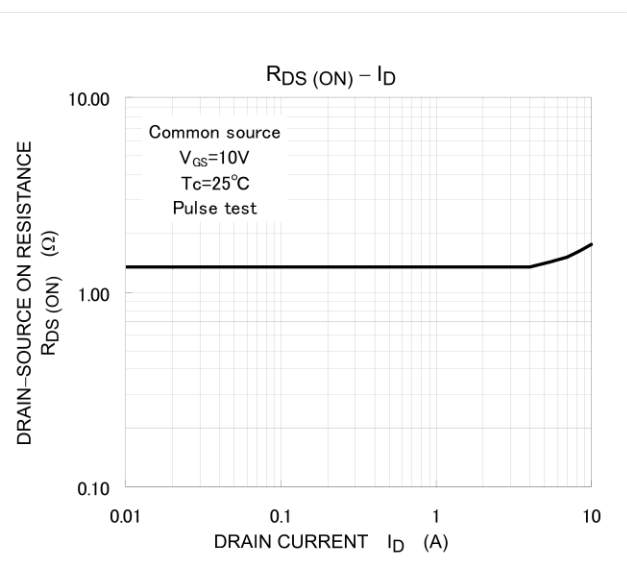
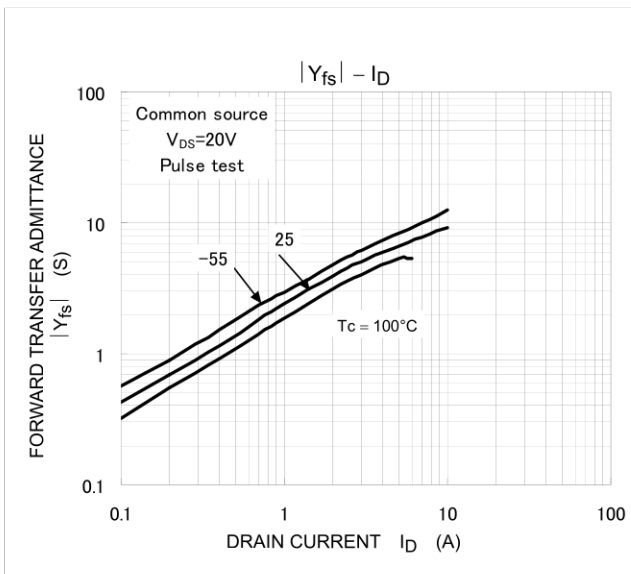
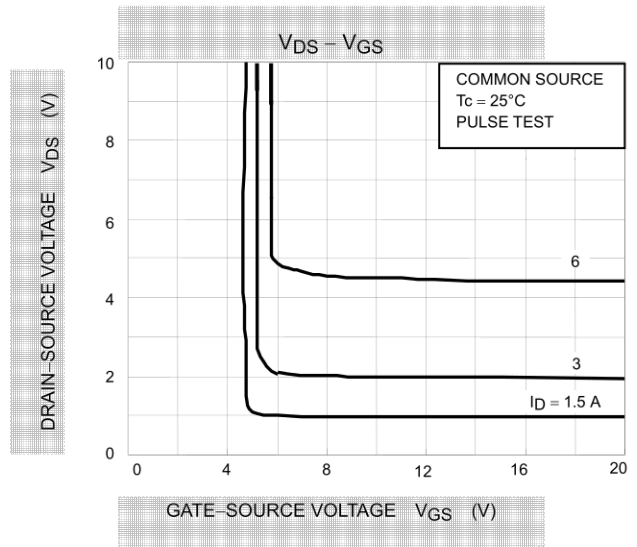
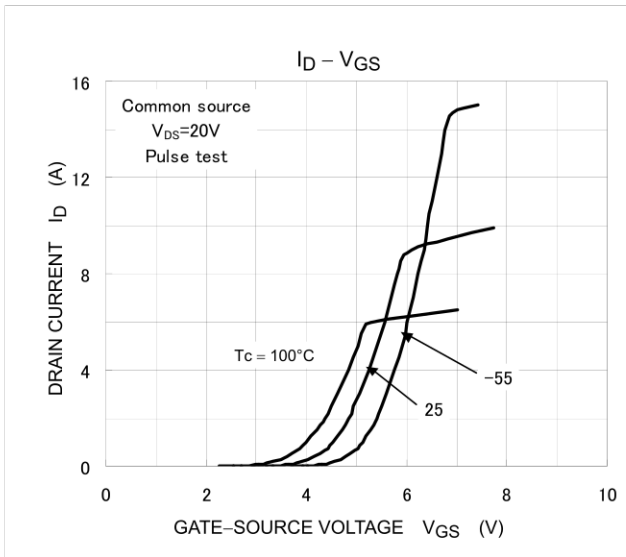
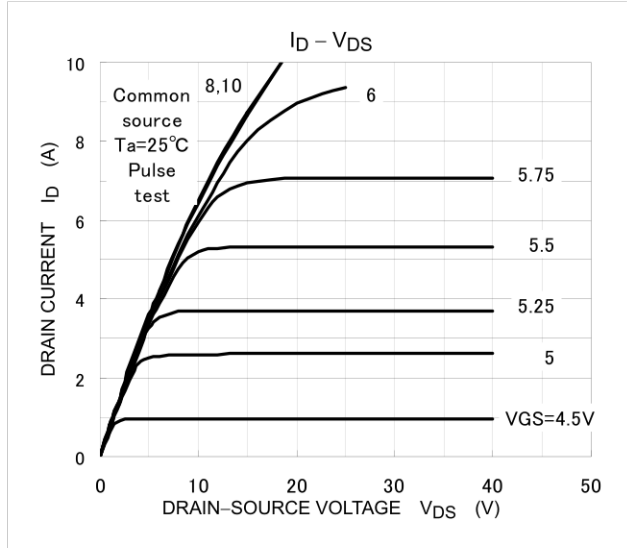
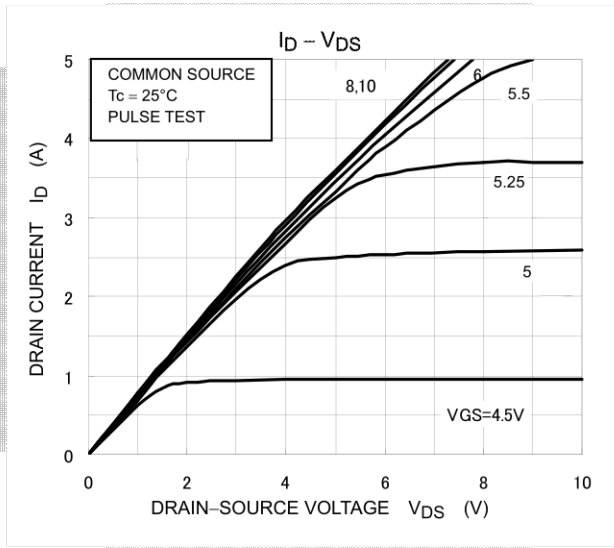


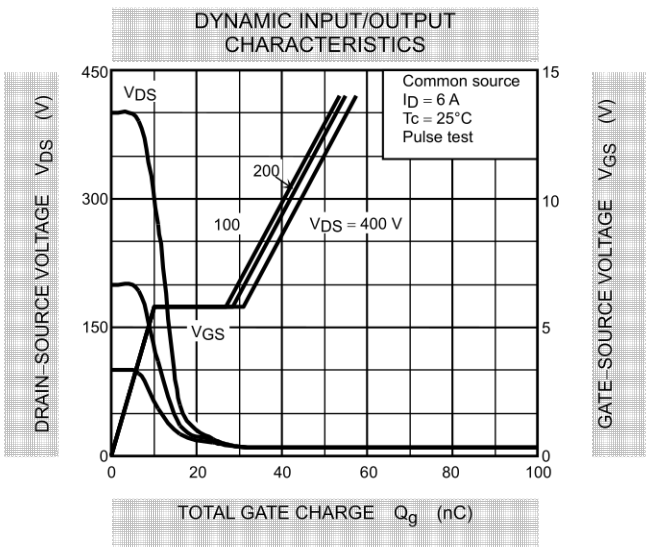
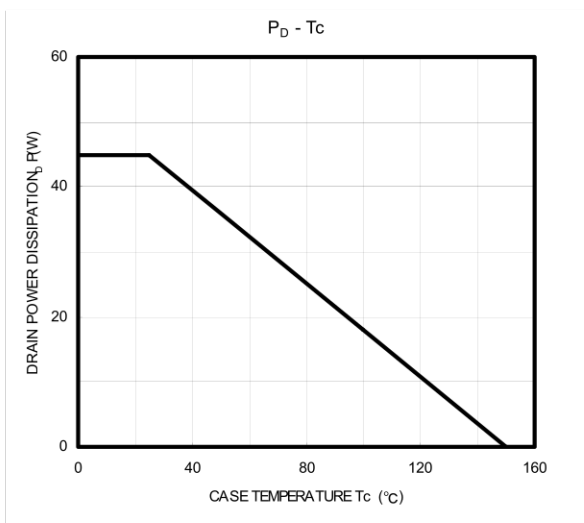
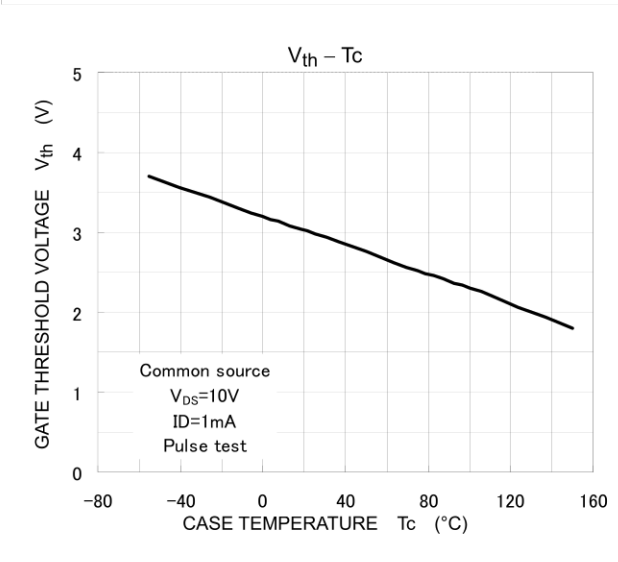
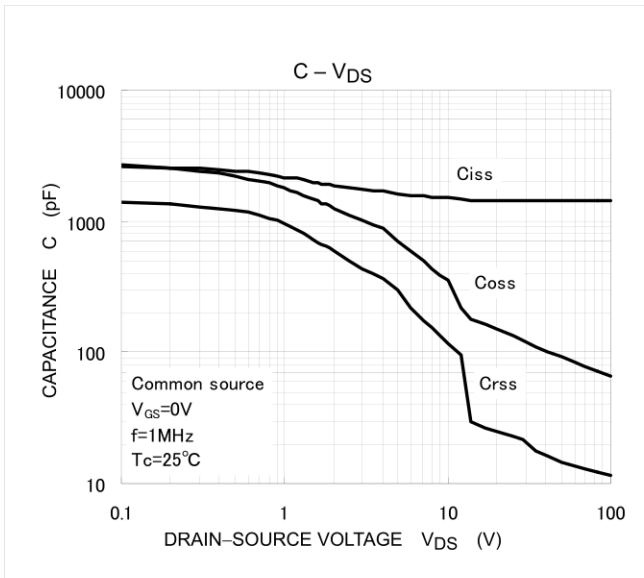
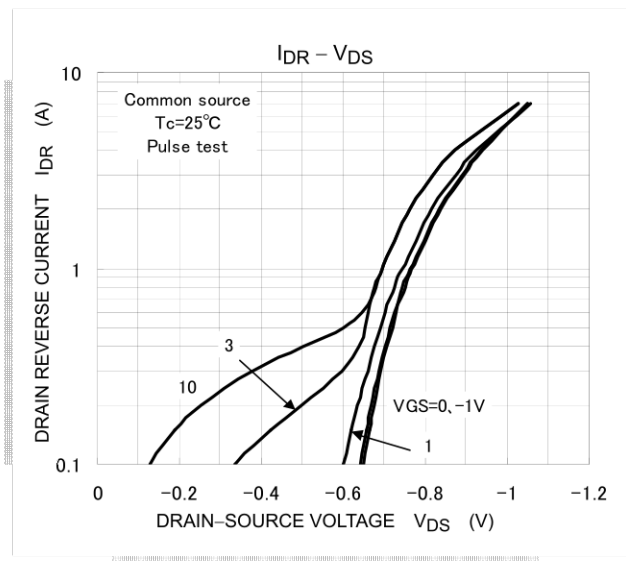
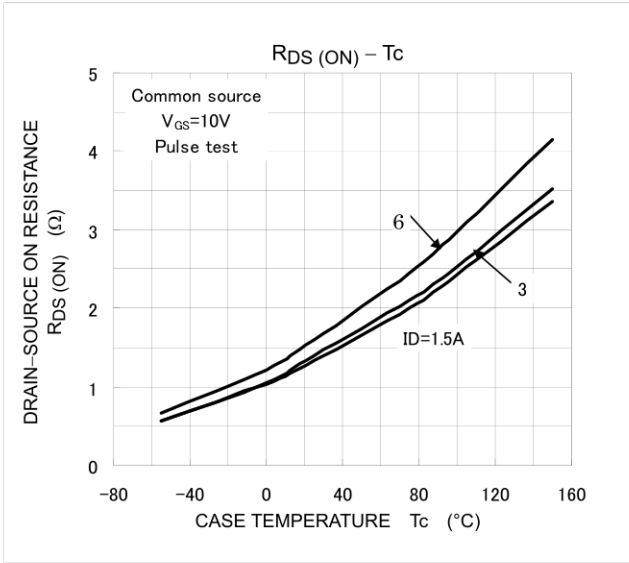
Note 4: A line under a Lot No. identifies the indication of product Labels.

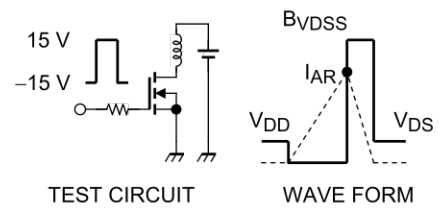
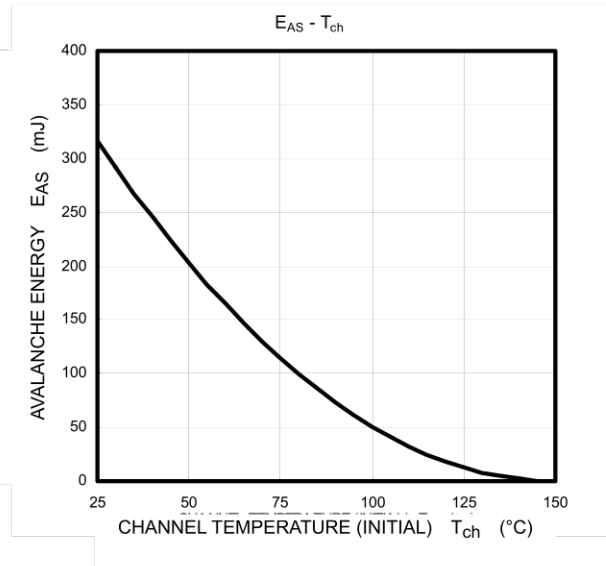
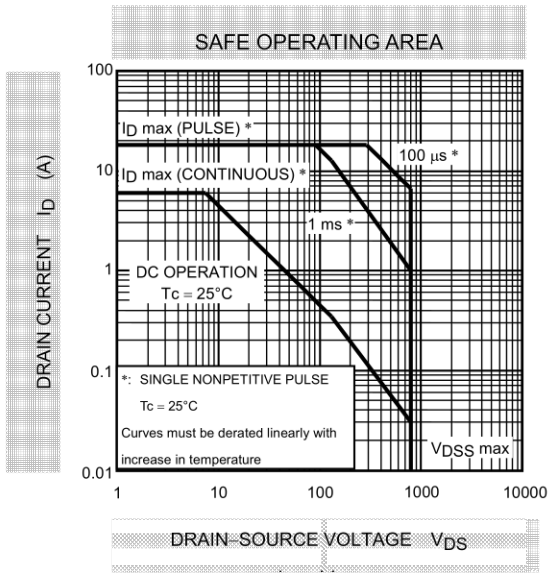
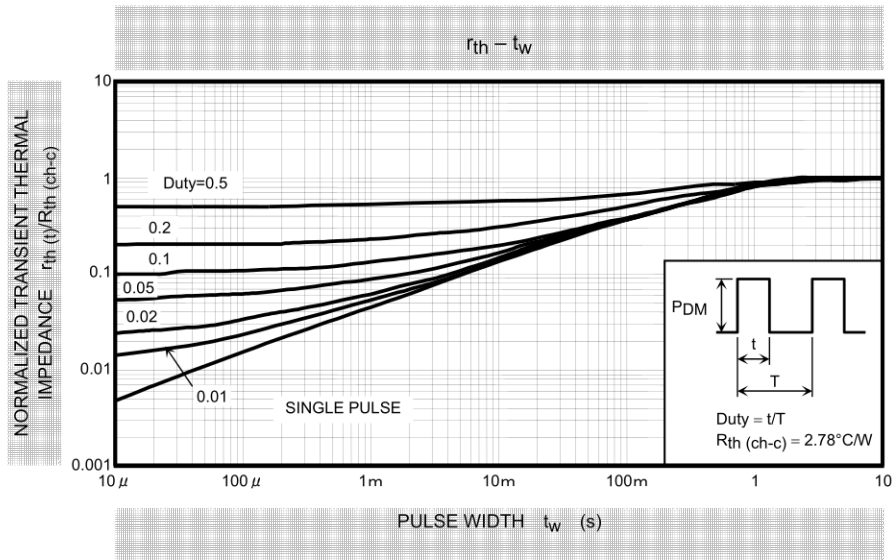
Not underlined:  $[[\text{Pb}]]/\text{INCLUDES} > \text{MCV}$

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

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$R_G = 25 \Omega$   
 $V_{DD} = 90 \text{ V}, L = 14.5 \text{ mH}$

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

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