

# 2SK2401

Chopper Regulator, DC-DC Converter and Motor Drive Applications

- Low drain-source ON resistance :  $R_{DS(ON)} = 0.13 \Omega$  (typ.)
- High forward transfer admittance :  $|Y_{fs}| = 17 S$  (typ.)
- Low leakage current :  $I_{DSS} = 100 \mu A$  (max) ( $V_{DS} = 200 V$ )
- Enhancement mode :  $V_{th} = 1.5$  to  $3.5 V$  ( $V_{DS} = 10 V, I_D = 1 mA$ )

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

| Characteristics                                |                | Symbol    | Rating     | Unit       |
|------------------------------------------------|----------------|-----------|------------|------------|
| Drain-source voltage                           |                | $V_{DSS}$ | 200        | V          |
| Drain-gate voltage ( $R_{GS} = 20 k\Omega$ )   |                | $V_{DGR}$ | 200        | V          |
| Gate-source voltage                            |                | $V_{GSS}$ | $\pm 20$   | V          |
| Drain current                                  | DC (Note 1)    | $I_D$     | 15         | A          |
|                                                | Pulse (Note 1) | $I_{DP}$  | 45         | A          |
| Drain power dissipation ( $T_c = 25^\circ C$ ) |                | $P_D$     | 75         | W          |
| Single pulse avalanche energy (Note 2)         |                | $E_{AS}$  | 166        | mJ         |
| Avalanche current                              |                | $I_{AR}$  | 15         | A          |
| Repetitive avalanche energy (Note 3)           |                | $E_{AR}$  | 7.5        | mJ         |
| Channel temperature                            |                | $T_{ch}$  | 150        | $^\circ C$ |
| Storage temperature range                      |                | $T_{stg}$ | -55 to 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 case    | $R_{th(ch-c)}$ | 1.67 | $^\circ C / W$ |
| Thermal resistance, channel to ambient | $R_{th(ch-a)}$ | 83.3 | $^\circ C / W$ |

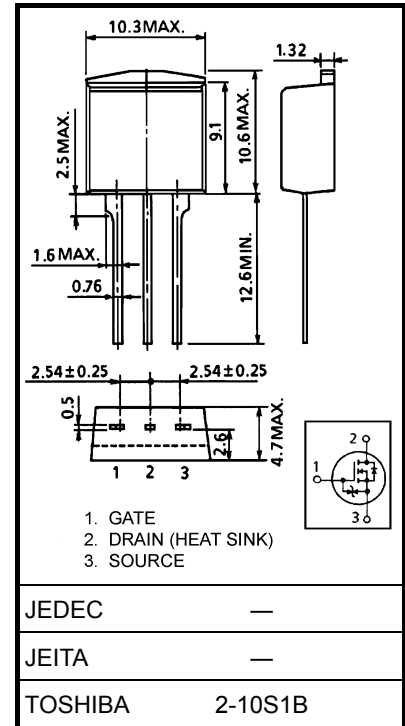
Note 1: Ensure that the channel temperature does not exceed  $150^\circ C$ .

Note 2:  $V_{DD} = 50 V, T_{ch} = 25^\circ C$  (initial),  $L = 1.2 mH, R_G = 25 \Omega, I_{AR} = 15 A$

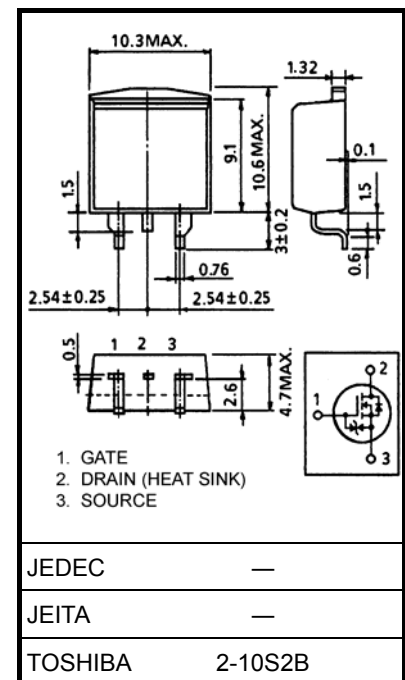
Note 3: Repetitive rating: pulse width limited by maximum channel temperature

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

Unit: mm



Weight: 1.5 g (typ.)



Weight: 1.5 g (typ.)

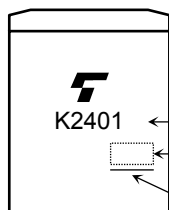
## Electrical Characteristics (Ta = 25°C)

| 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                           |               | $I_{DSS}$     | $V_{DS} = 200\text{ V}, V_{GS} = 0\text{ V}$                                                                                                                                                                            | —   | —    | 100      | $\mu\text{A}$ |
| Drain-source breakdown voltage                  |               | $V_{(BR)DSS}$ | $I_D = 10\text{ mA}, V_{GS} = 0\text{ V}$                                                                                                                                                                               | 200 | —    | —        | V             |
| Gate threshold voltage                          |               | $V_{th}$      | $V_{DS} = 10\text{ V}, I_D = 1\text{ mA}$                                                                                                                                                                               | 1.5 | —    | 3.5      | V             |
| Drain-source ON resistance                      |               | $R_{DS(ON)}$  | $V_{GS} = 10\text{ V}, I_D = 10\text{ A}$                                                                                                                                                                               | —   | 0.13 | 0.18     | $\Omega$      |
| Forward transfer admittance                     |               | $ Y_{fs} $    | $V_{DS} = 10\text{ V}, I_D = 10\text{ A}$                                                                                                                                                                               | 10  | 17   | —        | S             |
| Input capacitance                               |               | $C_{iss}$     | $V_{DS} = 10\text{ V}, V_{GS} = 0\text{ V}, f = 1\text{ MHz}$                                                                                                                                                           | —   | 2000 | —        | pF            |
| Reverse transfer capacitance                    |               | $C_{rss}$     |                                                                                                                                                                                                                         | —   | 200  | —        |               |
| Output capacitance                              |               | $C_{oss}$     |                                                                                                                                                                                                                         | —   | 600  | —        |               |
| Switching time                                  | Rise time     | $t_r$         | <p><math>I_D = 10\text{ A}</math><br/><math>V_{GS} = 10\text{ V}</math><br/><math>V_{DD} = 100\text{ V}</math><br/><math>R_L = 10\ \Omega</math><br/>Duty <math>\leq 1\%</math>, <math>t_w = 10\ \mu\text{s}</math></p> | —   | 35   | —        | ns            |
|                                                 | Turn-on time  | $t_{on}$      |                                                                                                                                                                                                                         | —   | 50   | —        |               |
|                                                 | Fall time     | $t_f$         |                                                                                                                                                                                                                         | —   | 10   | —        |               |
|                                                 | Turn-off time | $t_{off}$     |                                                                                                                                                                                                                         | —   | 66   | —        |               |
| Total gate charge (Gate-source plus gate-drain) |               | $Q_g$         | $V_{DD} \approx 100\text{ V}, V_{GS} = 10\text{ V}, I_D = 15\text{ A}$                                                                                                                                                  | —   | 40   | —        | nC            |
| Gate-source charge                              |               | $Q_{gs}$      |                                                                                                                                                                                                                         | —   | 25   | —        |               |
| Gate-drain ("miller") charge                    |               | $Q_{gd}$      |                                                                                                                                                                                                                         | —   | 15   | —        |               |

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

| Characteristics                           | Symbol    | Test Condition                              | Min | Typ. | Max  | Unit          |
|-------------------------------------------|-----------|---------------------------------------------|-----|------|------|---------------|
| Continuous drain reverse current (Note 1) | $I_{DR}$  | —                                           | —   | —    | 15   | A             |
| Pulse drain reverse current (Note 1)      | $I_{DRP}$ | —                                           | —   | —    | 45   | A             |
| Forward voltage (diode)                   | $V_{DSF}$ | $I_{DR} = 15\text{ A}, V_{GS} = 0\text{ V}$ | —   | —    | -2.0 | V             |
| Reverse recovery time                     | $t_{rr}$  | $I_{DR} = 15\text{ A}, V_{GS} = 0\text{ V}$ | —   | 180  | —    | ns            |
| Reverse recovery charge                   | $Q_{rr}$  | $dI_{DR} / dt = 100\text{ A} / \mu\text{s}$ | —   | 1.13 | —    | $\mu\text{C}$ |

## Marking



Part No. (or abbreviation code)

Lot No.

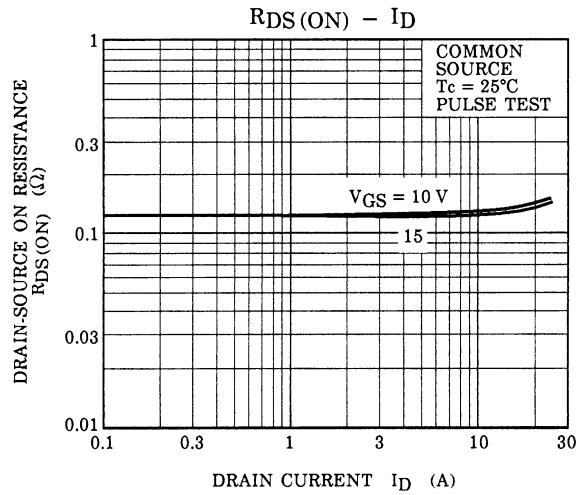
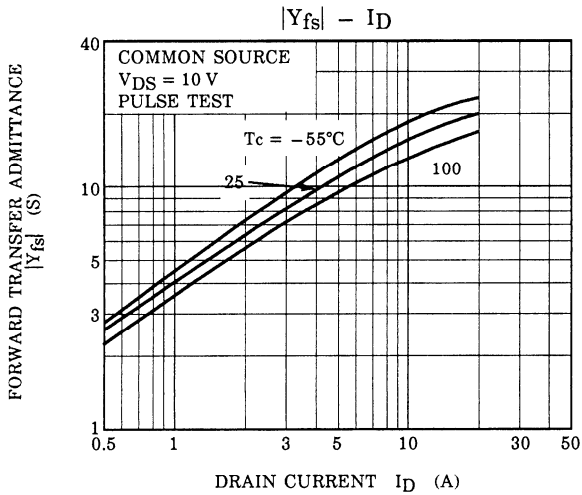
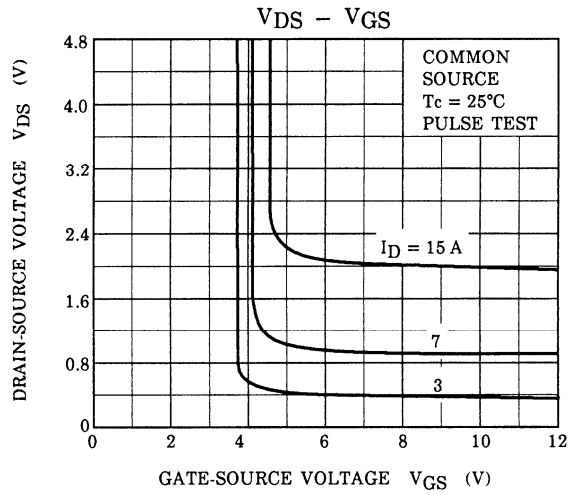
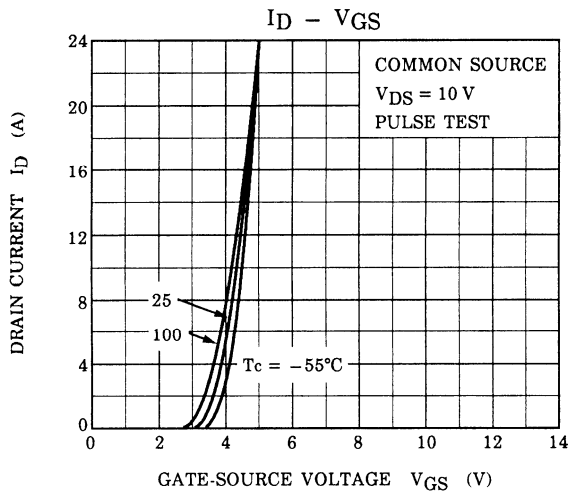
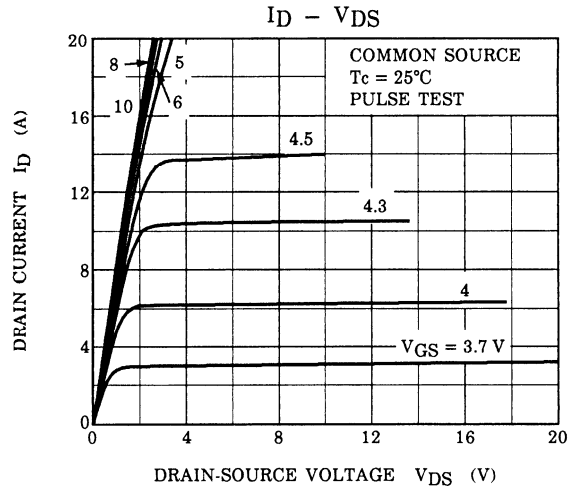
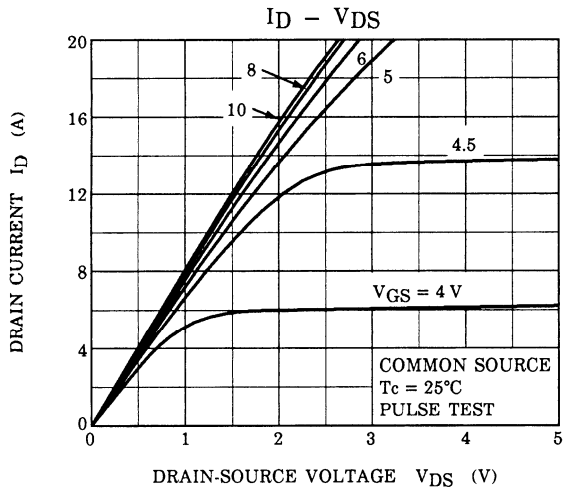
Note 4

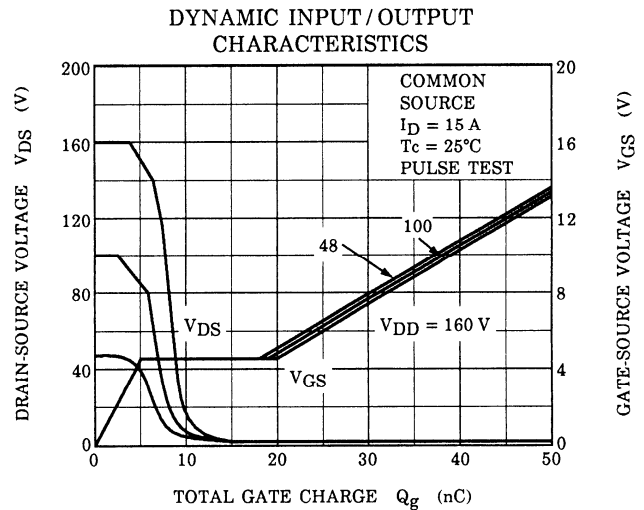
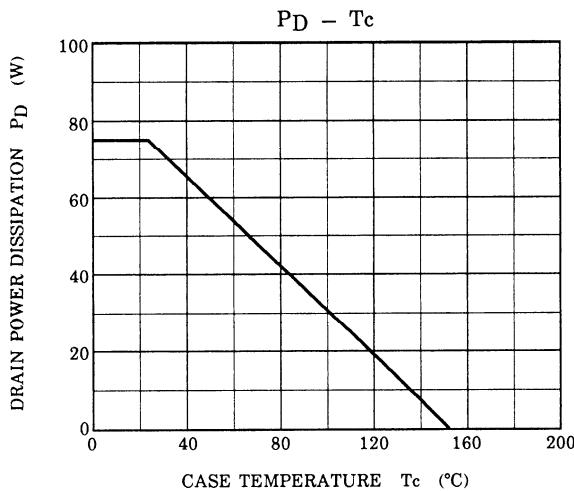
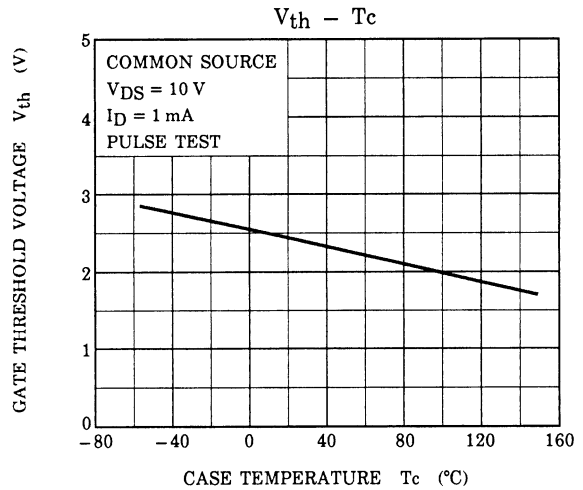
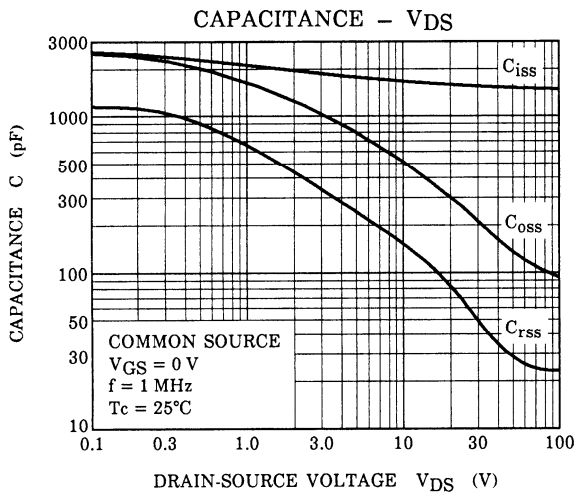
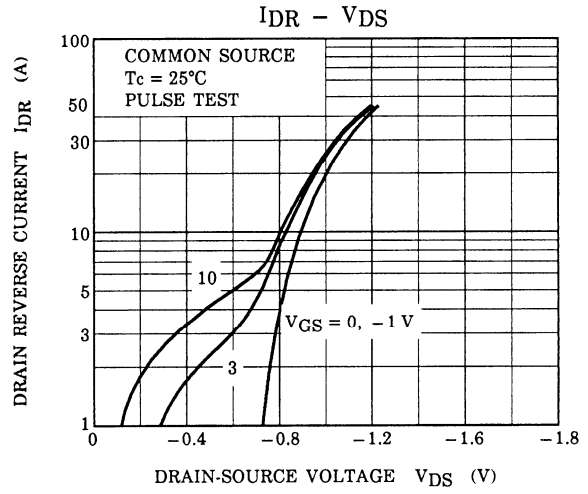
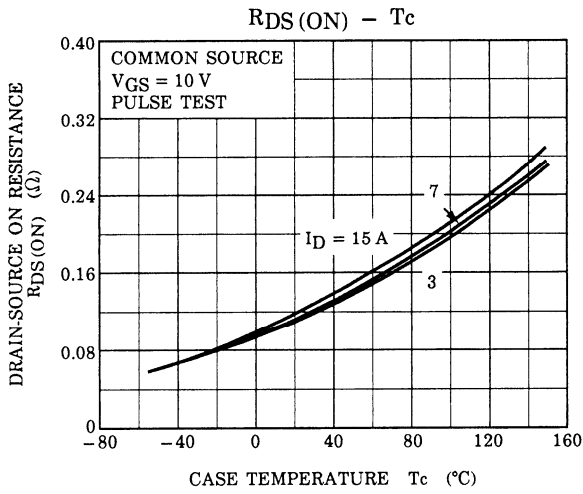
Note 4: A line under a Lot No. identifies the indication of product Labels.

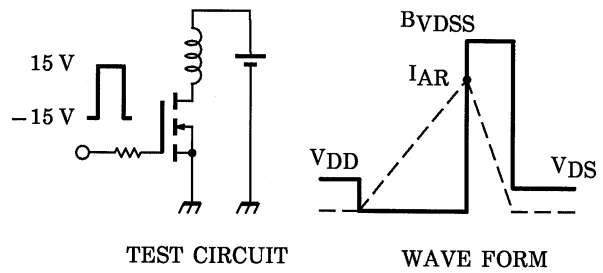
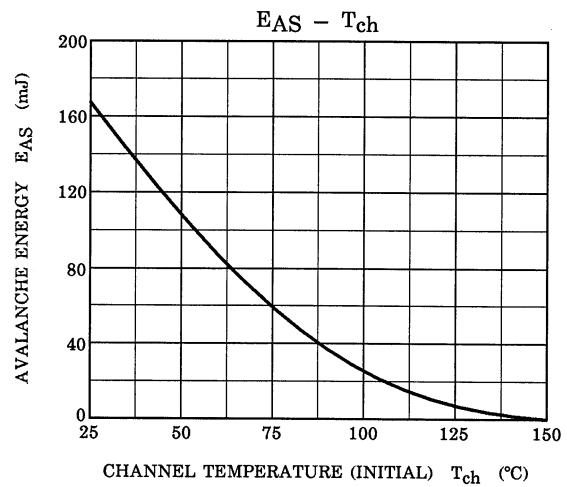
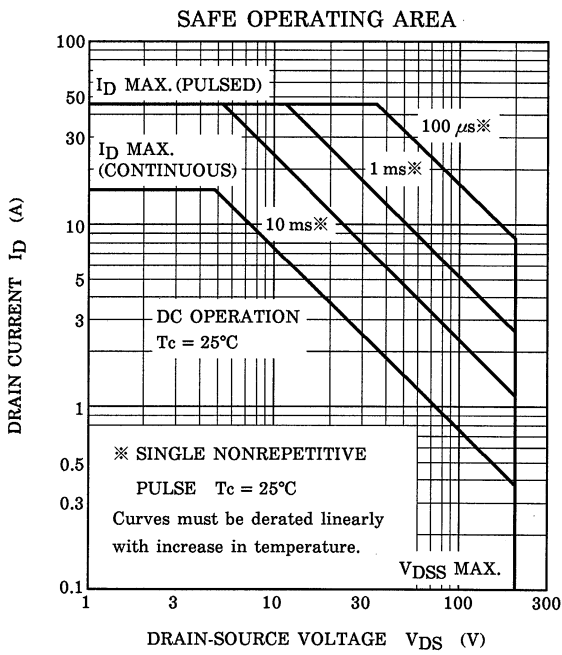
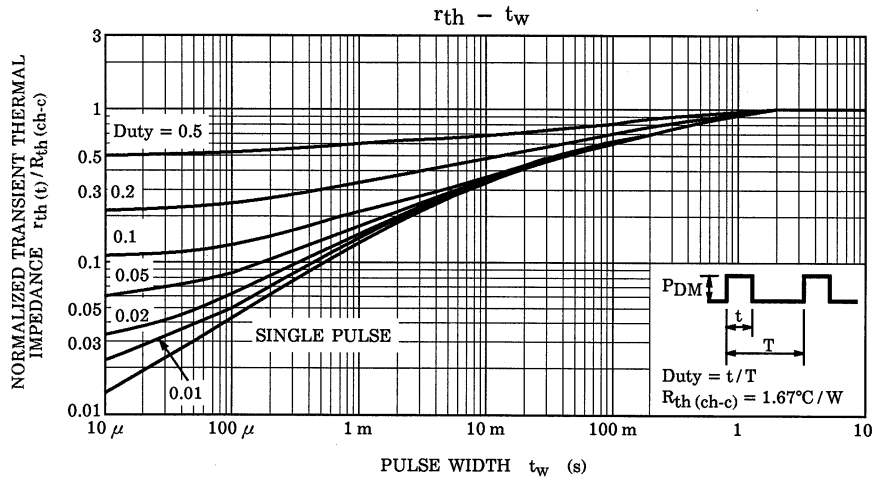
Not underlined:  $[[Pb]]/INCLUDES > MCV$

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

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$R_G = 25 \Omega$   
 $V_{DD} = 50 \text{ V}, L = 1.2 \text{ mH}$

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

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