

TOSHIBA Field Effect Transistor Silicon N-Channel MOS Type ( $L^2$ - $\pi$ -MOSV)

## 2SK2399

Chopper Regulator, DC/DC Converter and Motor Drive Applications

Unit: mm

- 4 V gate drive
- Low drain-source ON-resistance :  $R_{DS(ON)} = 0.17 \Omega$  (typ.)
- High forward transfer admittance :  $|Y_{fs}| = 4.5 S$  (typ.)
- Low leakage current :  $I_{DSS} = 100 \mu A$  (max) ( $V_{DS} = 100 V$ )
- Enhancement mode :  $V_{th} = 0.8$  to  $2.0 V$  ( $V_{DS} = 10 V$ ,  $I_D = 1 mA$ )

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

| Characteristic                                 |                | Symbol    | Rating     | Unit       |
|------------------------------------------------|----------------|-----------|------------|------------|
| Drain-source voltage                           |                | $V_{DSS}$ | 100        | V          |
| Drain-gate voltage ( $R_{GS} = 20 k\Omega$ )   |                | $V_{DGR}$ | 100        | 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 ( $T_c = 25^\circ C$ ) |                | $P_D$     | 20         | W          |
| Single-pulse avalanche energy (Note 2)         |                | $E_{AS}$  | 180        | mJ         |
| Avalanche current                              |                | $I_{AR}$  | 5          | A          |
| Repetitive avalanche energy (Note 3)           |                | $E_{AR}$  | 2          | 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

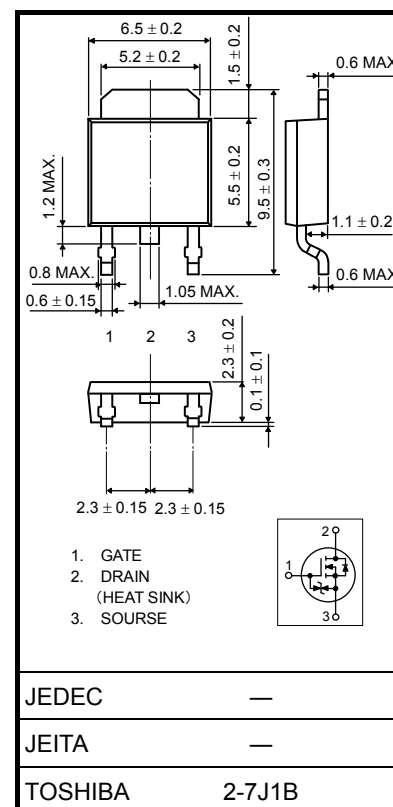
| Characteristic                         | Symbol         | Max  | Unit           |
|----------------------------------------|----------------|------|----------------|
| Thermal resistance, channel to case    | $R_{th(ch-c)}$ | 6.25 | $^\circ C / W$ |
| Thermal resistance, channel to ambient | $R_{th(ch-a)}$ | 125  | $^\circ C / W$ |

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

Note 2:  $V_{DD} = 25 V$ ,  $T_{ch} = 25^\circ C$  (initial),  $L = 11.6 mH$ ,  $R_G = 25 \Omega$ ,  $I_{AR} = 5 A$

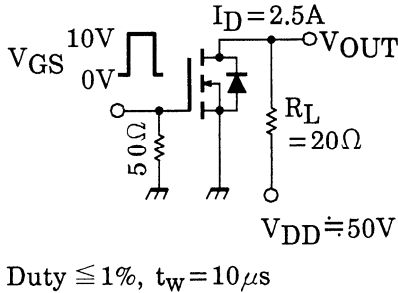
Note 3: Repetitive rating: pulse width limited by maximum channel temperature

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



Weight: 0.36 g (typ.)

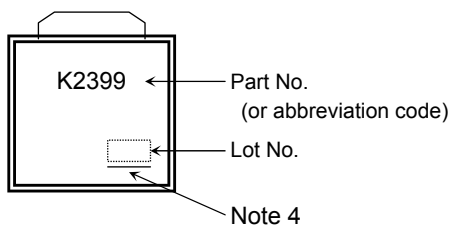
## Electrical Characteristics (Ta = 25°C)

| 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 cutoff current                            |               | $I_{DSS}$     | $V_{DS} = 100 \text{ V}, V_{GS} = 0 \text{ V}$                                      | —   | —    | 100      | $\mu\text{A}$ |
| Drain-source breakdown voltage                  |               | $V_{(BR)DSS}$ | $I_D = 10 \text{ mA}, V_{GS} = 0 \text{ V}$                                         | 100 | —    | —        | 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                      |               | $R_{DS(ON)}$  | $V_{GS} = 4 \text{ V}, I_D = 2.5 \text{ A}$                                         | —   | 0.22 | 0.30     | $\Omega$      |
|                                                 |               |               | $V_{GS} = 10 \text{ V}, I_D = 2.5 \text{ A}$                                        | —   | 0.17 | 0.23     |               |
| Forward transfer admittance                     |               | $ Y_{fs} $    | $V_{DS} = 10 \text{ V}, I_D = 2.5 \text{ A}$                                        | 2.0 | 4.5  | —        | S             |
| Input capacitance                               |               | $C_{iss}$     | $V_{DS} = 10 \text{ V}, V_{GS} = 0 \text{ V}, f = 1 \text{ MHz}$                    | —   | 500  | —        | pF            |
| Reverse transfer capacitance                    |               | $C_{rss}$     |                                                                                     | —   | 80   | —        |               |
| Output capacitance                              |               | $C_{oss}$     |                                                                                     | —   | 190  | —        |               |
| Switching time                                  | Rise time     | $t_r$         |  | —   | 17   | —        | ns            |
|                                                 | Turn-on time  | $t_{on}$      |                                                                                     | —   | 25   | —        |               |
|                                                 | Fall time     | $t_f$         |                                                                                     | —   | 50   | —        |               |
|                                                 | Turn-off time | $t_{off}$     |                                                                                     | —   | 195  | —        |               |
| Total gate charge (gate-source plus gate-drain) |               | $Q_g$         | $V_{DD} \approx 80 \text{ V}, V_{GS} = 10 \text{ V}, I_D = 5 \text{ A}$             | —   | 22   | —        | nC            |
| Gate-source charge                              |               | $Q_{gs}$      |                                                                                     | —   | 15   | —        |               |
| Gate-drain ("Miller") charge                    |               | $Q_{gd}$      |                                                                                     | —   | 7    | —        |               |

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

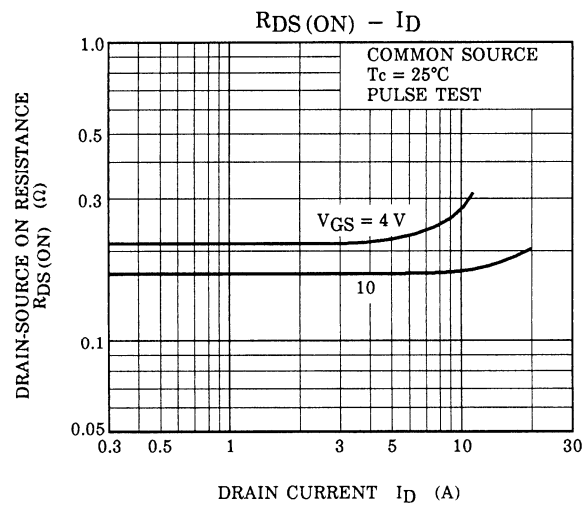
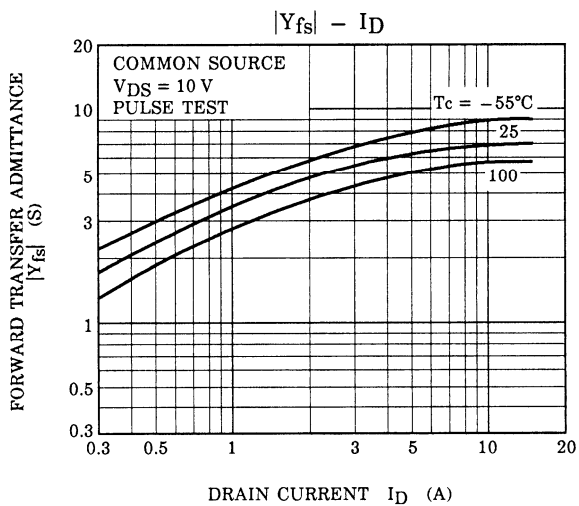
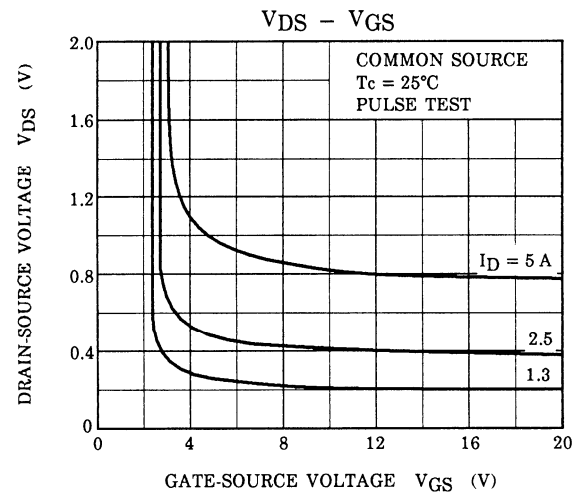
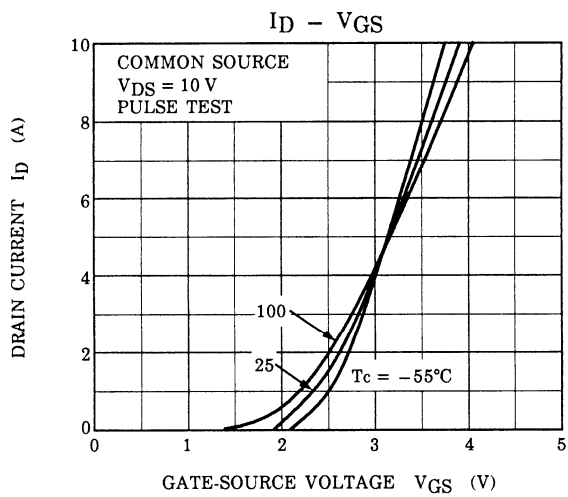
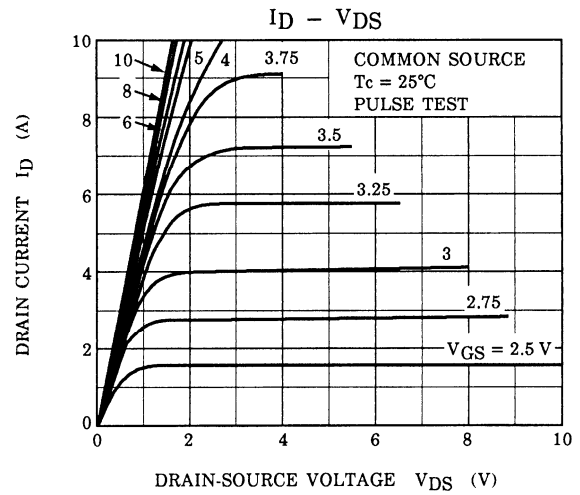
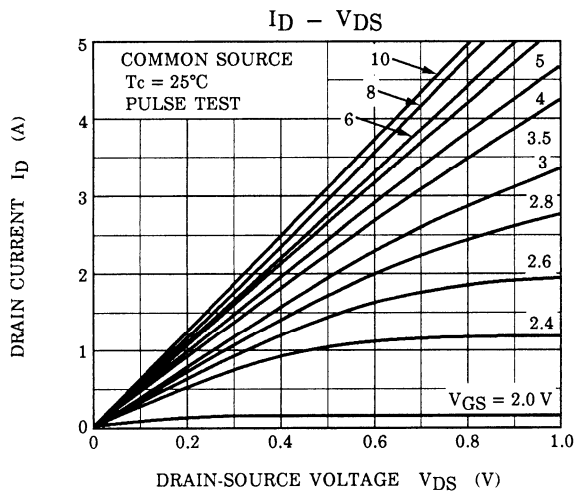
| Characteristic                            | Symbol    | Test Condition                                                                          | Min | Typ. | Max  | Unit          |
|-------------------------------------------|-----------|-----------------------------------------------------------------------------------------|-----|------|------|---------------|
| 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                     | $t_{rr}$  | $I_{DR} = 5 \text{ A}, V_{GS} = 0 \text{ V}, dI_{DR} / dt = 50 \text{ A} / \mu\text{s}$ | —   | 160  | —    | ns            |
| Reverse recovery charge                   | $Q_{rr}$  |                                                                                         | —   | 0.28 | —    | $\mu\text{C}$ |

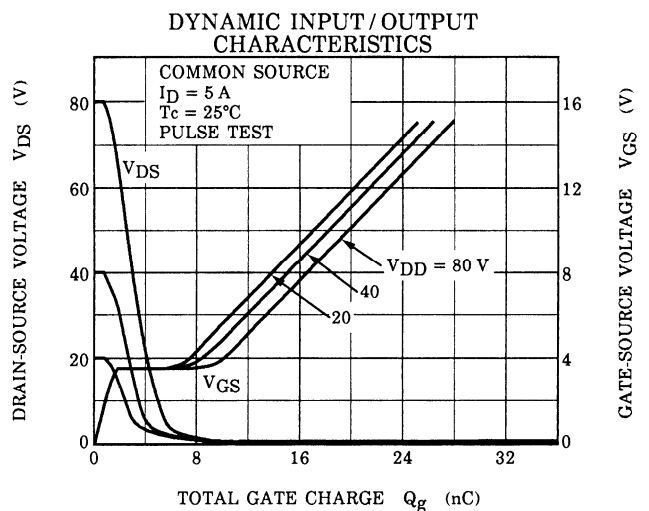
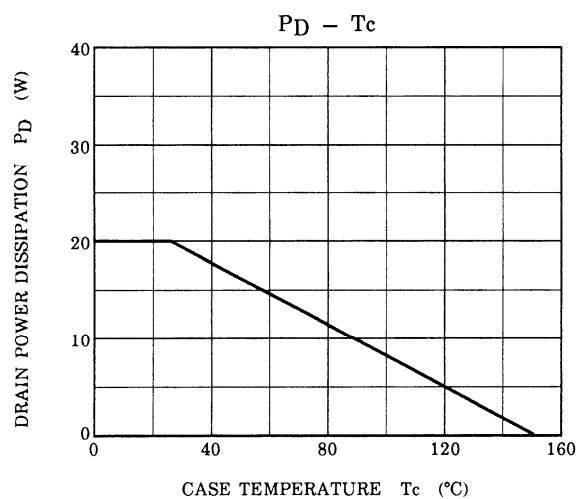
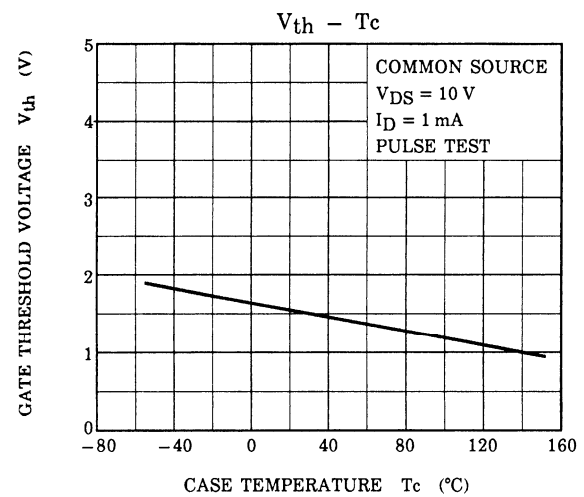
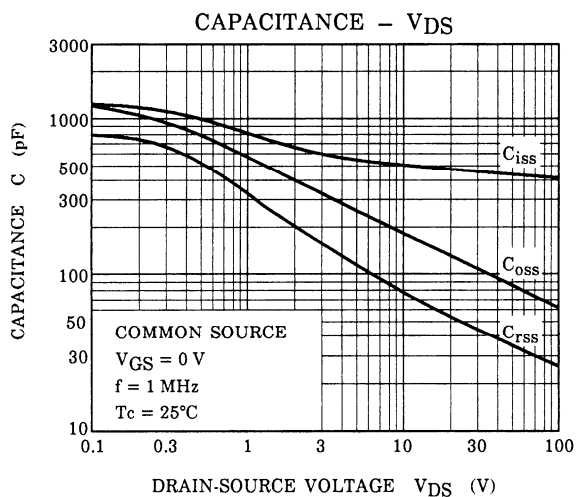
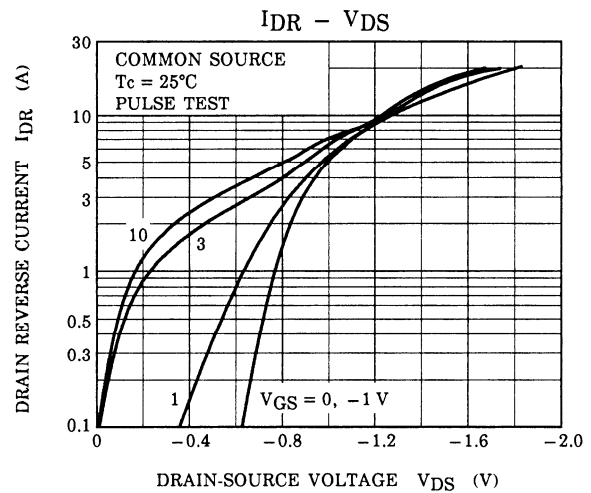
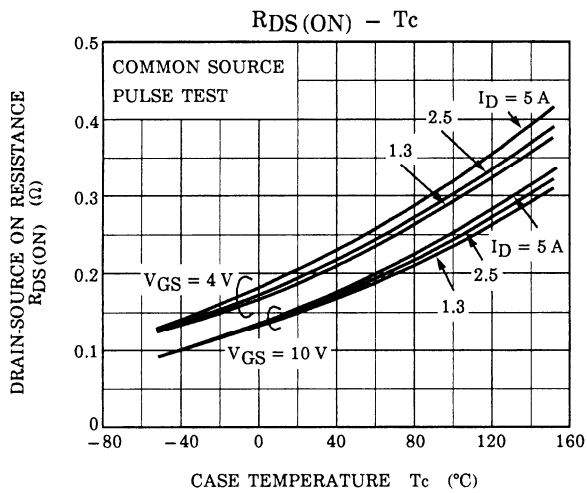
## Marking

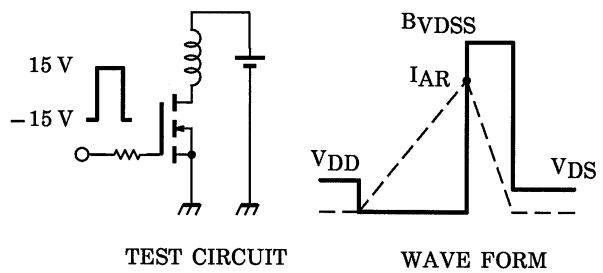
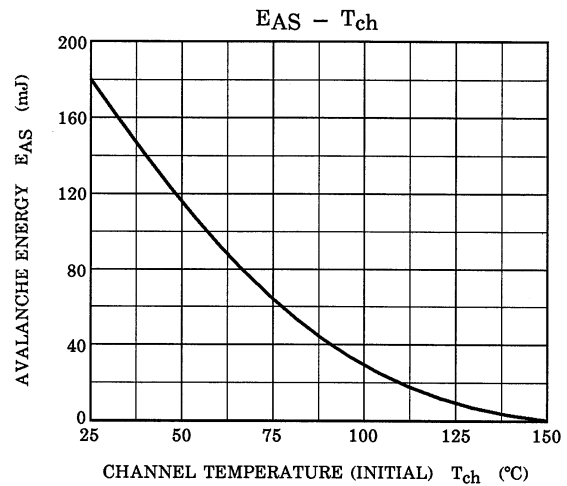
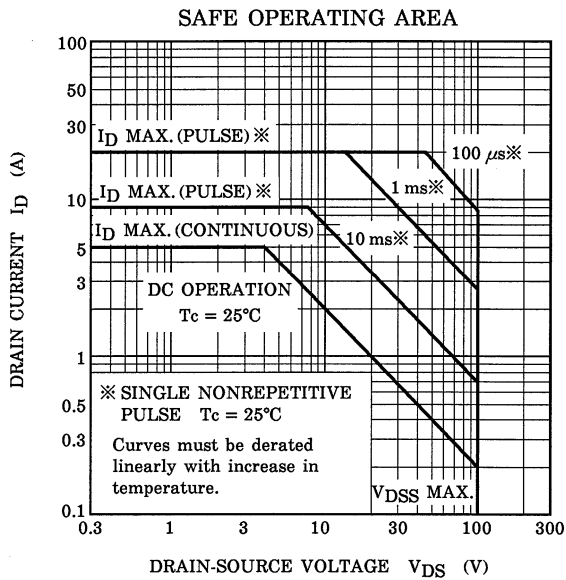
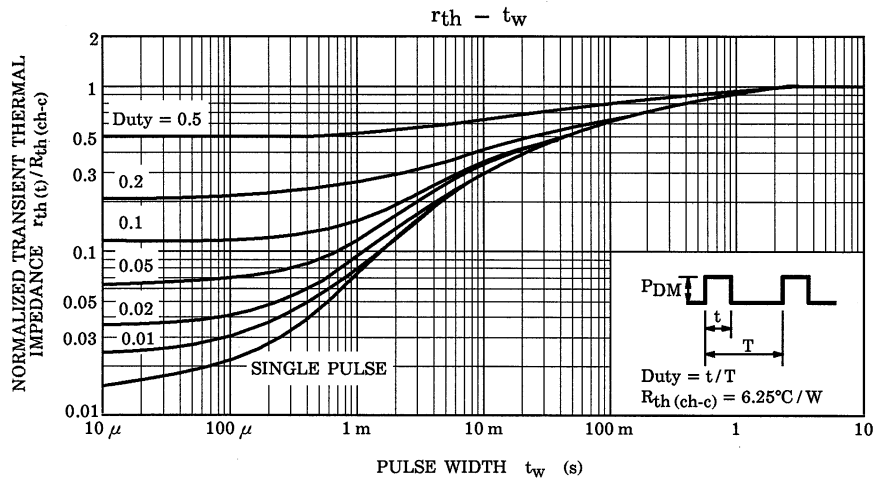


Note 4 : A line under a Lot No. identifies the indication of product Labels [[G]]/RoHS COMPATIBLE or [[G]]/RoHS [[Pb]]

Please contact your TOSHIBA sales representative for details as to environmental matters such as the RoHS compatibility of Product. The RoHS is Directive 2002/95/EC of the European Parliament and of the Council of 27 January 2003 on the restriction of the use of certain hazardous substances in electrical and electronic equipment.







$$R_G = 25 \, \Omega$$

$$V_{DD} = 25 \, \text{V}, L = 11.6 \, \text{mH}$$

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

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