

## Product Summary

- $V_{DS}$  200V
- $I_D$  40A
- $R_{DS(ON)}$  (at  $V_{GS}=10V$ )  $<55m\Omega$
- 100% EAS Tested
- 100%  $\nabla V_{DS}$  Tested

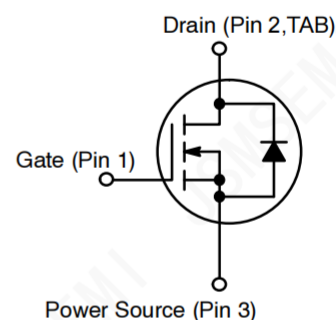


## General Description

- Vertical Double-diffused MOSFET technology
- Excellent package for heat dissipation
- High density cell design for low  $R_{DS(ON)}$
- Moisture Sensitivity Level 1
- Epoxy Meets UL 94 V-0 Flammability Rating
- Halogen Free

## Applications

- Power switching application
- Uninterruptible power supply
- DC-DC convertor
- Motor drivers



| Absolute Maximum Ratings $T_C = 25^\circ\text{C}$ , unless otherwise noted |                |               |                  |
|----------------------------------------------------------------------------|----------------|---------------|------------------|
| Parameter                                                                  | Symbol         | Value         | Unit             |
| Drain-Source Voltage                                                       | $V_{DSS}$      | 200           | V                |
| Continuous Drain Current                                                   | $I_D$          | 40            | A                |
| Pulsed Drain Current (note1)                                               | $I_{DM}$       | 160           | A                |
| Gate-Source Voltage                                                        | $V_{GSS}$      | $\pm 20$      | V                |
| Single Pulse Avalanche Energy (note1)                                      | $E_{AS}$       | 191           | mJ               |
| Avalanche Current (note1)                                                  | $I_{AS}$       | 31            | A                |
| Repetitive Avalanche Energy (note1)                                        | $E_{AR}$       | 124           | mJ               |
| Power Dissipation ( $T_C = 25^\circ\text{C}$ )                             | $P_D$          | 160           | W                |
| Operating Junction and Storage Temperature Range                           | $T_J, T_{stg}$ | $-55\sim+150$ | $^\circ\text{C}$ |

| Thermal Resistance                      |            |       |                    |
|-----------------------------------------|------------|-------|--------------------|
| Parameter                               | Symbol     | Value | Unit               |
| Thermal Resistance, Junction-to-Case    | $R_{thJC}$ | 1.2   | $^\circ\text{C/W}$ |
| Thermal Resistance, Junction-to-Ambient | $R_{thJA}$ | 60    |                    |

**Specifications**  $T_J = 25^\circ\text{C}$ , unless otherwise noted

| Parameter                               | Symbol        | Test Conditions                                               | Value |      |           | Unit       |
|-----------------------------------------|---------------|---------------------------------------------------------------|-------|------|-----------|------------|
|                                         |               |                                                               | Min.  | Typ. | Max.      |            |
| Static                                  |               |                                                               |       |      |           |            |
| Drain-Source Breakdown Voltage          | $V_{(BR)DSS}$ | $V_{GS} = 0V, I_D = 250\mu A$                                 | 220   | --   | --        | V          |
| Zero Gate Voltage Drain Current         | $I_{DSS}$     | $V_{DS} = 220V, V_{GS} = 0V, T_J = 25^{\circ}C$               | --    | --   | 1         | $\mu A$    |
|                                         |               | $V_{DS} = 220V, V_{GS} = 0V, T_J = 125^{\circ}C$              | --    | --   | 100       |            |
| Gate-Source Leakage                     | $I_{GSS}$     | $V_{GS} = \pm 20V, V_{DS} = 0V$                               | --    | --   | $\pm 100$ | nA         |
| Gate-Source Threshold Voltage           | $V_{GS(th)}$  | $V_{DS} = V_{GS}, I_D = 250\mu A$                             | 2.0   | --   | 4.0       | V          |
| Drain-Source On-Resistance (Note4)      | $R_{DS(on)}$  | $V_{GS} = 10V, I_D = 20A$                                     | --    | 45   | 55        | m $\Omega$ |
| Forward Transconductance (Note4)        | gfs           | $V_{DS} = 25V, I_D = 20A$                                     | --    | 16   | --        | S          |
| Dynamic                                 |               |                                                               |       |      |           |            |
| Input Capacitance                       | $C_{iss}$     | $V_{GS} = 0V,$<br>$V_{DS} = 25V,$<br>$f = 1.0MHz$             | --    | 2800 | --        | pF         |
| Output Capacitance                      | $C_{oss}$     |                                                               | --    | 355  | --        |            |
| Reverse Transfer Capacitance            | $C_{rss}$     |                                                               | --    | 101  | --        |            |
| Total Gate Charge                       | $Q_g$         | $V_{DD} = 160V, I_D = 40A,$                                   | --    | 154  |           | nC         |
| Gate-Source Charge                      | $Q_{gs}$      |                                                               | --    | 13   | --        |            |
| Gate-Drain Charge                       | $Q_{gd}$      |                                                               | --    | 58   | --        |            |
| Turn-on Delay Time                      | $t_{d(on)}$   | $V_{DD} = 160V, I_D = 40A,$<br>$V_{GS} = 15V, R_G = 25\Omega$ | --    | 46   | --        | ns         |
| Turn-on Rise Time                       | $t_r$         |                                                               | --    | 54   | --        |            |
| Turn-off Delay Time                     | $t_{d(off)}$  |                                                               | --    | 360  | --        |            |
| Turn-off Fall Time                      | $t_f$         |                                                               | --    | 96   | --        |            |
| Drain-Source Body Diode Characteristics |               |                                                               |       |      |           |            |
| Continuous Source Current               | $I_{SD}$      | Integral PN-diode in MOSFET                                   | --    | --   | 40        | A          |
| Pulsed Source Current                   | $I_{SM}$      |                                                               | --    | --   | 160       |            |
| Body Forward Voltage                    | $V_{SD}$      | $I_S = 20A, V_{GS} = 0V$                                      | --    | --   | 1.4       | V          |
| Reverse Recovery Time                   | $t_{rr}$      | $V_{GS} = 0V, I_F = 10A,$<br>$di_F/dt = 100A/\mu s$           | --    | 152  | --        | ns         |
| Reverse Recovery Charge                 | $Q_{rr}$      |                                                               | --    | 1    | --        | $\mu C$    |

**Notes:**

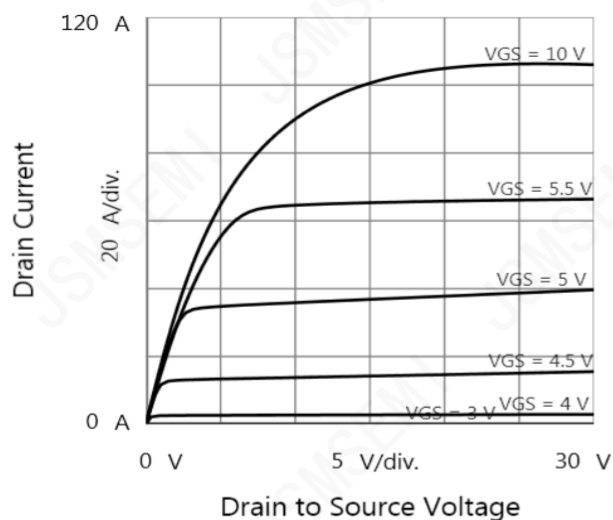
1. Repetitive Rating: Pulse width limited by maximum junction temperature
2.  $L = 1mH, V_{DD} = 30V, R_G = 25\Omega$ , Starting  $T_J = 25^\circ\text{C}$
3. Pulse Test: Pulse width  $\leq 300\mu s$ , Duty Cycle  $\leq 1\%$

**Ordering Information**

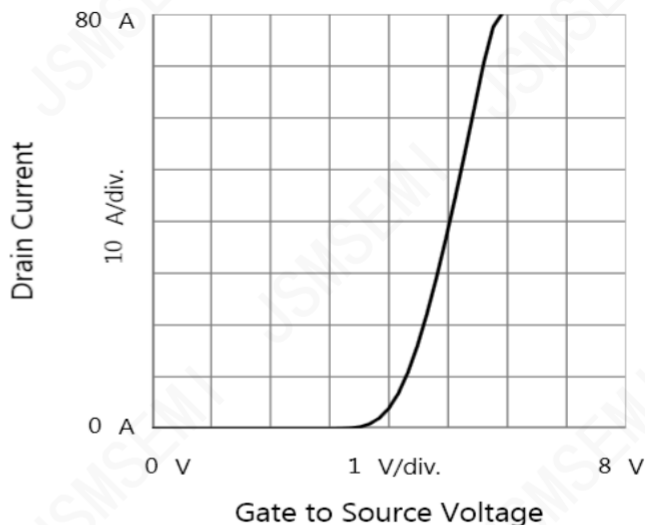
| Ordernumber | Package  | Marking   | Operation Temperature Range | MSL Grade | Ship, Quantity | Green |
|-------------|----------|-----------|-----------------------------|-----------|----------------|-------|
| JSM40N20C   | TO-220-3 | JSM40N20C | -55 to $150^\circ\text{C}$  | 1         | TUBE, 1000     | RoHS  |

**Typical Characteristics**  $T_J = 25^\circ\text{C}$ , unless otherwise noted

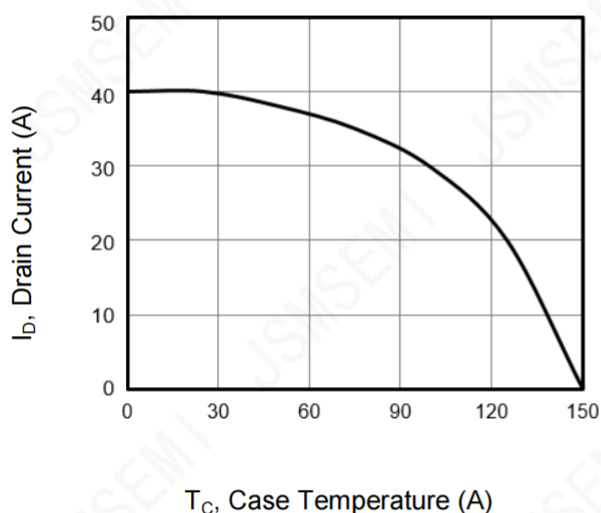
**Figure 1. Output Characteristics ( $T_J = 25^\circ\text{C}$ )**



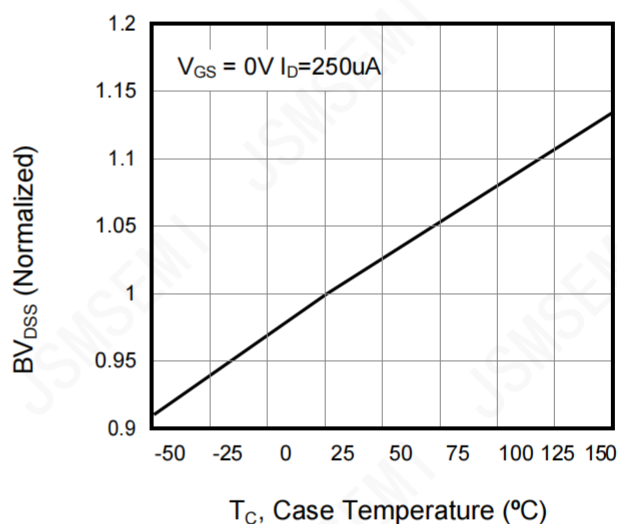
**Figure 2. Transfer Characteristics**



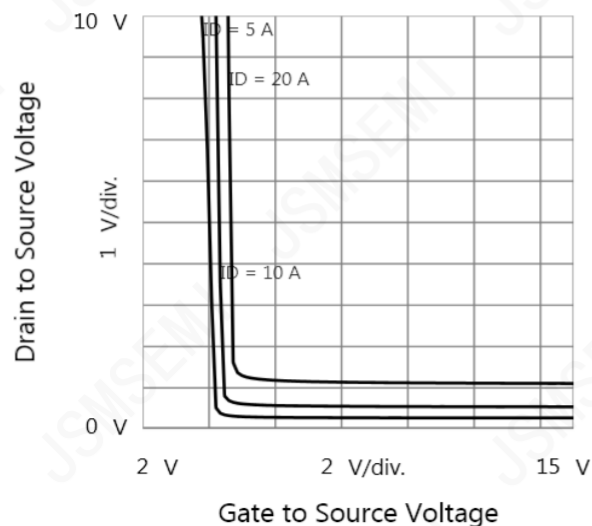
**Figure 3. Drain to Source Resistance vs. Drain Current**



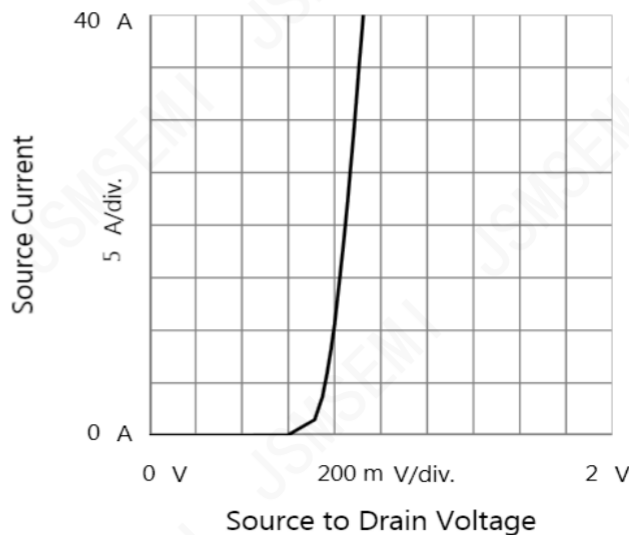
**Figure 4.  $BV_{DSS}$  Variation vs. Temperature**



**Figure 5. Drain to Source Voltage vs. Gate to Source Voltage**

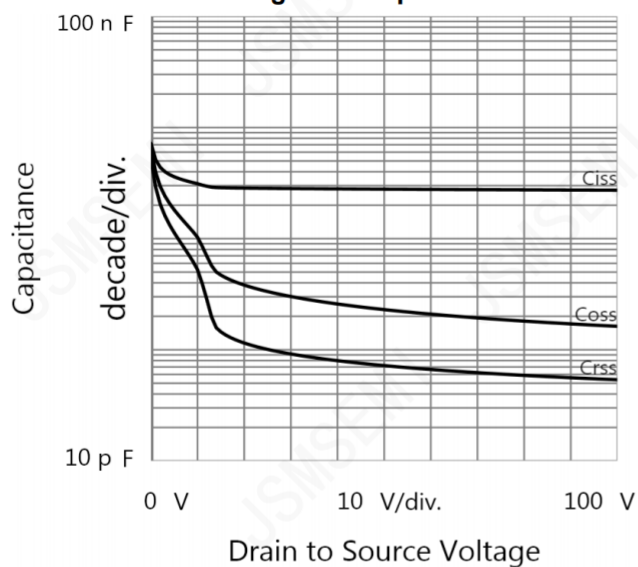


**Figure 6. Body Diode Forward Characteristics**

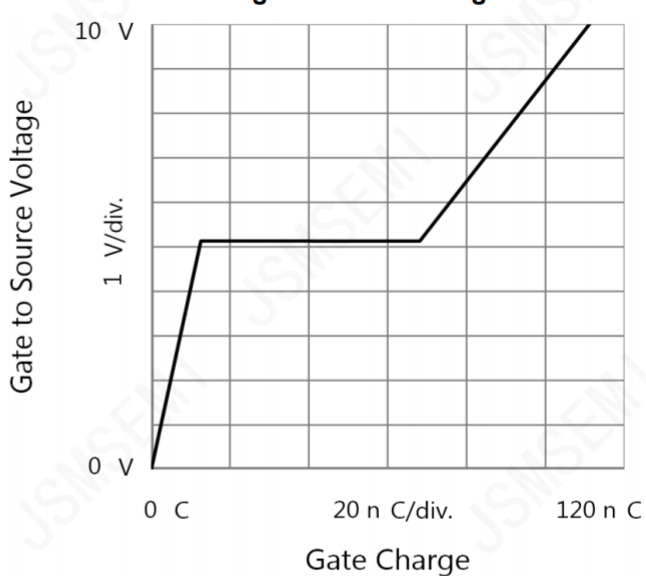


Typical Characteristics  $T_J = 25^\circ\text{C}$ , unless otherwise noted

**Figure 7. Capacitance**



**Figure 8. Gate Charge**



**Figure 9. Transient Thermal Impedance**

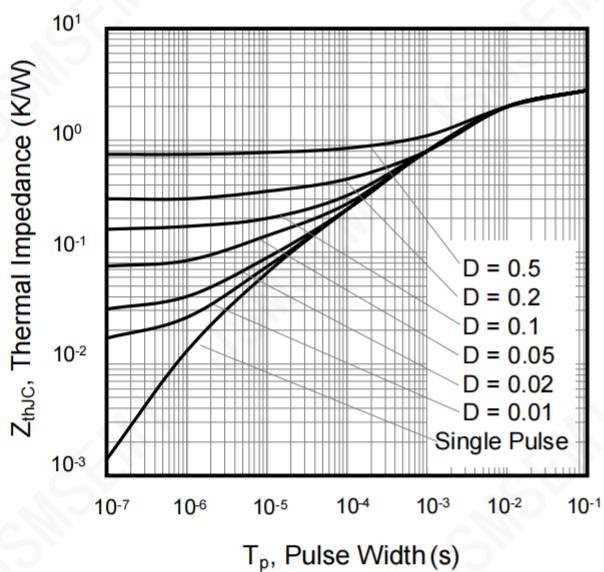


Figure A: Gate Charge Test Circuit and Waveform

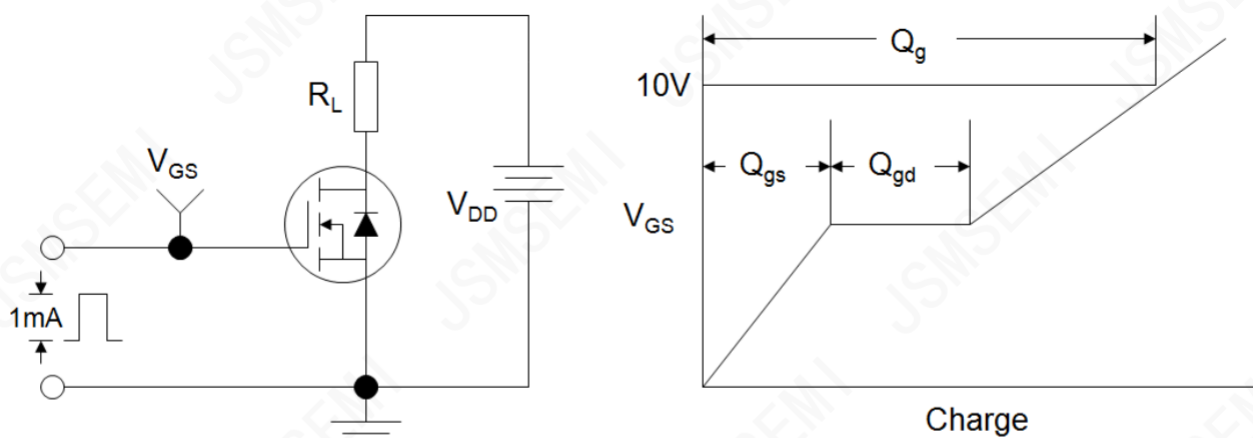


Figure B: Resistive Switching Test Circuit and Waveform

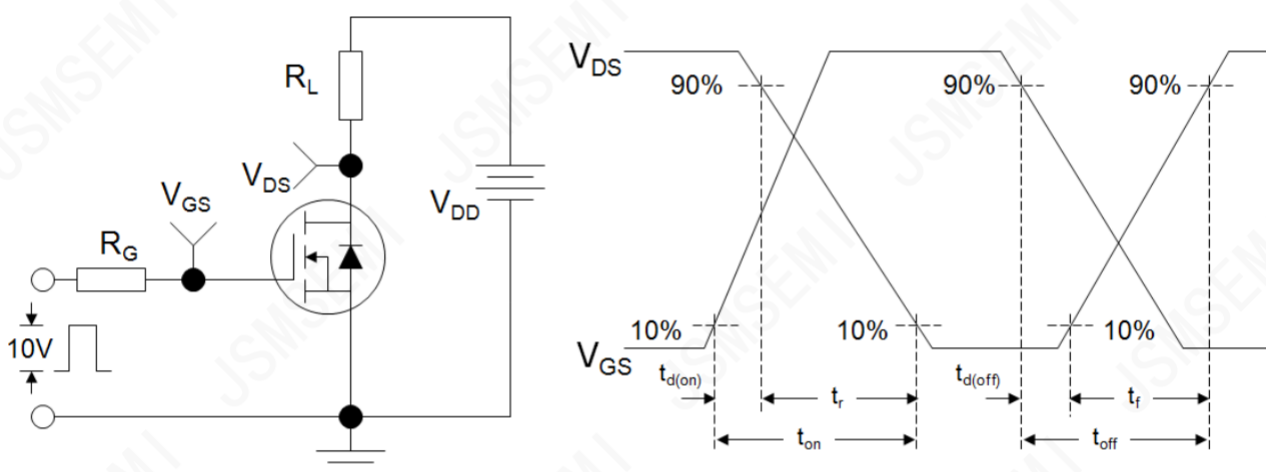
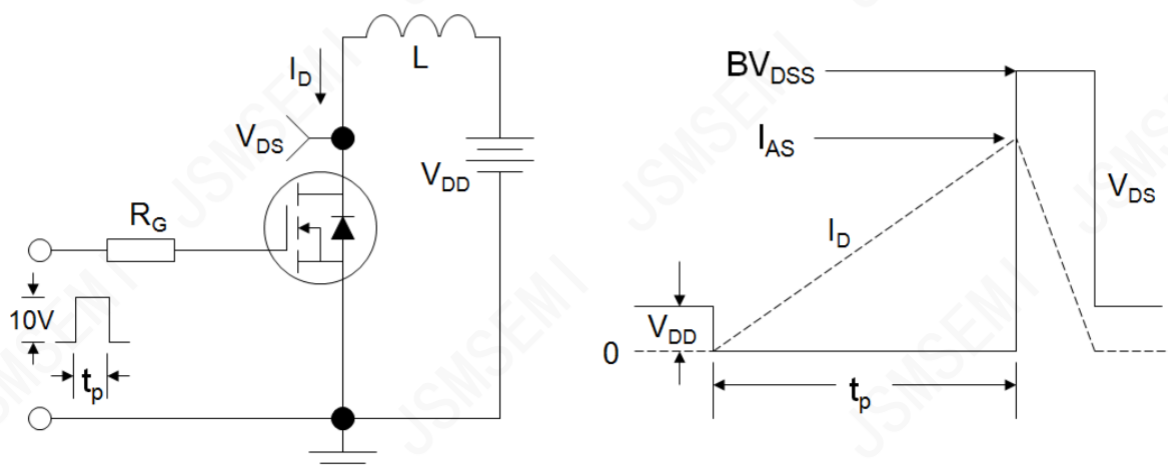


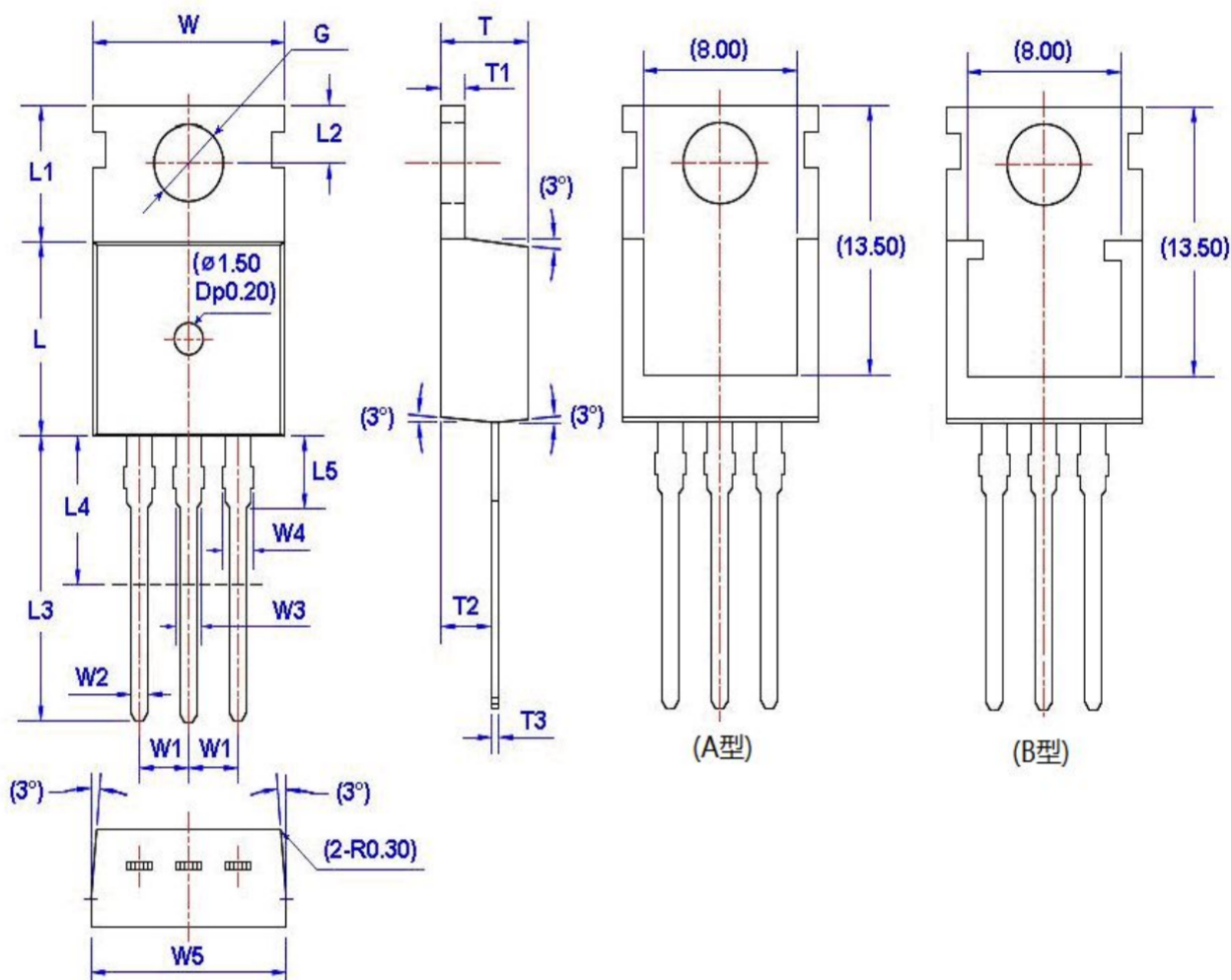
Figure C: Unclamped Inductive Switching Test Circuit and Waveform





## Package Information

### TO-220-3



| Symbol | Size       |       | Symbol | Size  |       | Symbol | Size |      | Symbol      | Size |      |
|--------|------------|-------|--------|-------|-------|--------|------|------|-------------|------|------|
|        | Min        | Max   |        | Min   | Max   |        | Min  | Max  |             | Min  | Max  |
| W      | 9.66       | 10.28 | W5     | 9.80  | 10.20 | L4**   | 6.20 | 6.60 | T3          | 0.45 | 0.60 |
| W1     | 2.54 (TYP) |       | L      | 9.00  | 9.40  | L5     | 2.79 | 3.30 | G( $\Phi$ ) | 3.50 | 3.70 |
| W2     | 0.70       | 0.95  | L1     | 6.40  | 6.80  | T      | 4.30 | 4.70 |             |      |      |
| W3     | 1.17       | 1.37  | L2     | 2.70  | 2.90  | T1     | 1.15 | 1.40 |             |      |      |
| W4*    | 1.32       | 1.72  | L3     | 12.70 | 14.27 | T2     | 2.20 | 2.60 |             |      |      |

## Revision History

| Rev. | Change          | Date      |
|------|-----------------|-----------|
| V1.0 | Initial version | 6/27/2021 |
|      |                 |           |

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