## N Channel MOSFET

Lead Free Package and Finish

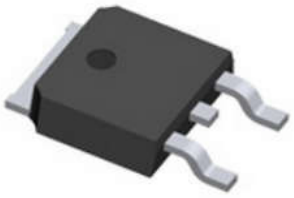
### Applications:

- •PWM applications
- •Load switch
- •Power management

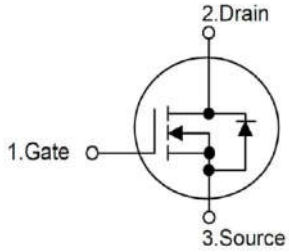
| $I_D$ | $R_{DS(ON)}$(Max.) | $V_{DSS}$ |
|---|---|---|
| 60A | 6.5mΩ | 20V |

### Features:

- •$V_{DS}$=20V; $I_D$=60A
  $R_{DS(ON)}$ < 6.5mΩ @ $V_{GS}$ =4.5V
  Rds(on) < 10mΩ @ VGS =2.5V
- •Ultra Low On-Resistance
- •High UIS and UIS 100% Test
- •RoHS Compliant



TO-252(DPAK) top view




### Ordering Information

| Part Number | Package | Marking |
|---|---|---|
| RS20N60D | TO-252 | RS20N60D |

### Absolute Maximun Ratings Tc=25℃ unless otherwise specified

| Symbol | Parameter | RS20N60D | Units |
|---|---|---|---|
| VDSS | Drain-to-Source Voltage | 20 | V |
| ID | Continuous Drain Current（Tc=25℃） | 60 | A |
| | Continuous Drain Current Tc=100℃ | 39 | |
| IDM | Pulsed Drain Current (Note*1) | 240 | |
| PD | Power Dissipation（Tc=25℃） | 37 | W |
| VGS | Gate-to-Source Voltage | ±20 | V |
| EAS | Single Pulse Avalanche Engergy (Note*2) | 47.6 | mJ |
| TL<br>TPKG | Maximum Temperature for Soldering<br>Leads at 0.063in(1.6mm)from Case for 10 seconds<br>Package Body for 10 seconds | 300<br>260 | ℃ |
| TJ and TSTG | Operating Junction and Storage Temperature Range | -55 to 175 | |

*Drain Current Limited by Maximum Junction Temperature

Caution:Stresses greater than those listed in the“Absolute Maximum Ratings”Table may cause permanent damage to the device.

### Thermal Resistance

| Symbol | Parameter | RS20N60D | Units | Test Conditions |
|---|---|---|---|---|
| RθJC | Junction-to-Case | 4 | ℃/W | Drain lead soldered to water cooled heatsink,PD adjusted for a peak junction temperature of +175℃. |

**OFF Characteristics** TJ=25℃ unless otherwise specified

| Symbol | Parameter | Min. | Typ. | Max. | Units | Test Conditions |
|---|---|---|---|---|---|---|
| BVDSS | Drain-to-source Breakdown Voltage | 20 | -- | -- | V | VGS=0V,ID=250μA |
| IDSS | Drain-to-Source Leakage Current | -- | -- | 1 | μA | VDS=20V,VGS=0V |
| IGSS | Gate-to-Source Forward Leakage | -- | -- | 100 | nA | VGS=+12V VDS=0V |
| | Gate-to-Source Reverse Leakage | -- | -- | -100 | | VGS=-12V VDS=0V |

**ON Characteristics TJ=25℃ unless otherwise specified**

| Symbol | Parameter | Min. | Typ. | Max. | Units | Test Conditions |
|---|---|---|---|---|---|---|
| RDS(on) | Static Drain-to-Source On-Resistance (Note*3) | -- | 4.8 | 6.5 | mΩ | VGS=4.5V,ID=25A |
| | | -- | 6.8 | 10.0 | mΩ | VGS=2.5V,ID=15A |
| VGS(TH) | Gate Threshold Voltage | 0.4 | 0.7 | 1.0 | V | VGS=VDS,ID=250μA |

**Resistive Switching Characteristics** Essentially independent of operating temperature

| Symbol | Parameter | Min. | Typ. | Max. | Units | Test Conditions |
|---|---|---|---|---|---|---|
| td(ON) | Turn-on Delay Time | -- | 15 | -- | nS | VDS=10V<br>VGS=4.5V<br>ID=25A<br>RG=3Ω |
| trise | Rise Time | -- | 37 | -- | | |
| td(OFF) | Turn-OFF Delay Time | -- | 52 | -- | | |
| tfall | Fall Time | -- | 21 | -- | | |

**Dynamic Characteristics** Essentially independent of operating temperature

| Symbol | Parameter | Min. | Typ. | Max. | Units | Test Conditions |
|---|---|---|---|---|---|---|
| Ciss | Input Capacitance | -- | 1799 | -- | pF | VGS=0V<br>VDS=10V<br>f=1.0MHz |
| Coss | Output Capacitance | -- | 298 | -- | | |
| Crss | Reverse Transfer Capacitance | -- | 283 | -- | | |
| Qg | Total Gate Charge | -- | 23 | -- | nC | VDS=10V<br>ID=25A<br>VGS=4.5V |
| Qgs | Gate-to-Source Charge | -- | 5 | -- | | |
| Qgd | Gate-to-Drain("Miller"）Charge | -- | 7 | -- | | |

## Source-Drain Diode Characteristics

| Symbol | Parameter | Min. | Typ. | Max. | Units | Test Conditions |
|---|---|---|---|---|---|---|
| $I_{SD}$ | Source-Drain Current(Body Diode) | -- | -- | 60 | A | |
| $I_{SDM}$ | Pulsed Source-Drain Current(Body Diode) | -- | -- | 240 | A | Maximum Pulsed Drain to Source Diode Forward Current |
| $V_{SD}$ | Diode Forward Voltage | -- | -- | 1.3 | V | IS=30A,VGS=0V |
| trr | Reverse Recovery Time | -- | 25 | -- | nS | VGS=0V $I_F$=25A,di/dt=100A/μs |
| Qrr | Reverse Recovery Charge | -- | 21 | -- | nC | |

**Notes:**

*1. Repetitive Rating: Pulse Width Limited by Maximum Junction Temperature
*2. EAS condition: TJ=25℃, VDD=10V, VG=4.5V, L=0.5mH, RG=25Ω, IAS=13.8A
*3. Pulse Test: Pulse Width≤300μs, Duty Cycle≤0.5%

## Typical Feature curve

**Figure 1. Output Characteristics (TJ = 25ºC)**

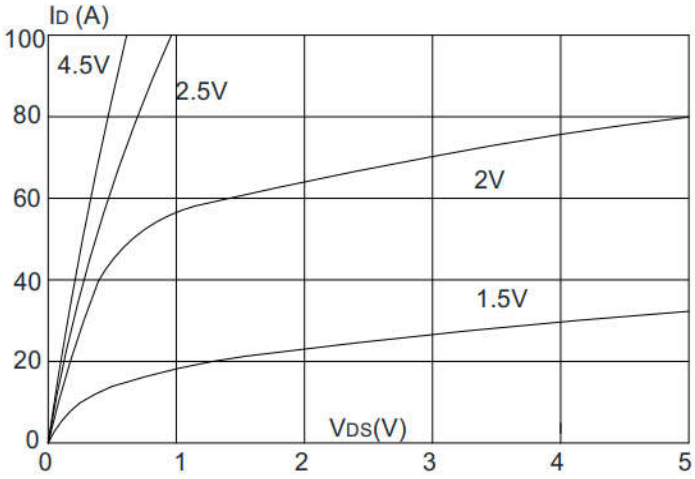



**Figure 2. Transfer Characteristics**

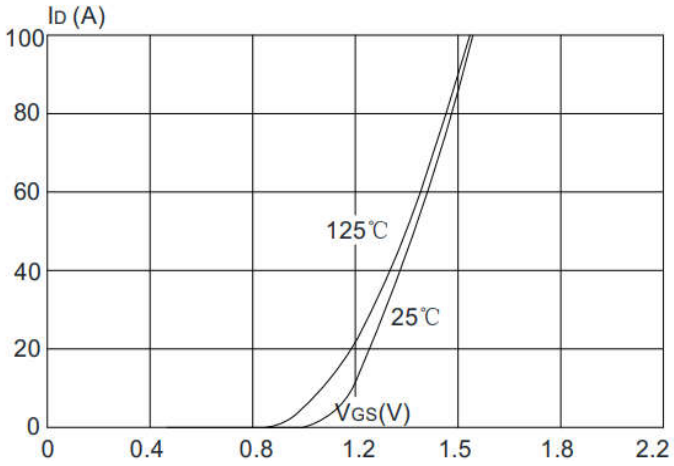


**Figure 3. On-Resistance vs. Drain Current**

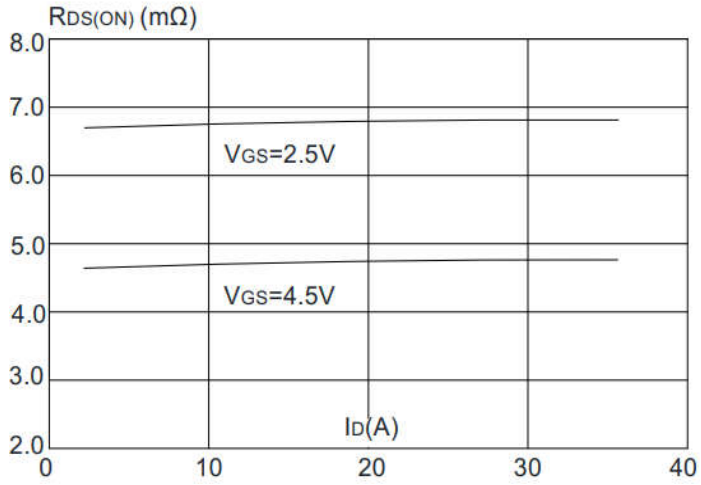



**Figure 4: Body Diode Characteristics**

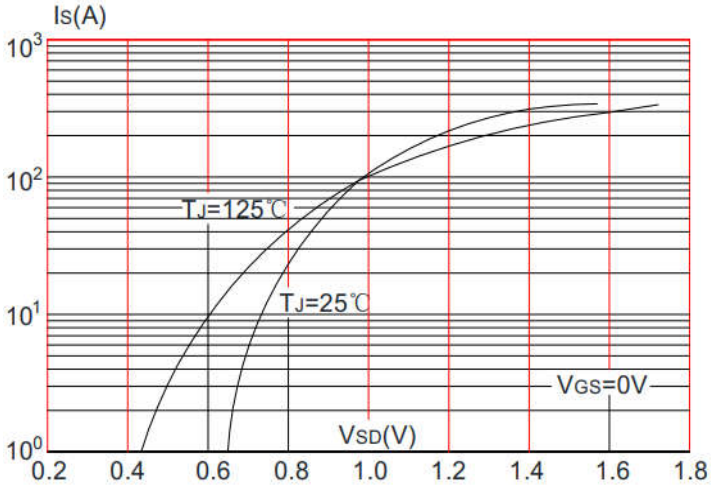



**Figure 5. Gate Charge Characteristics**

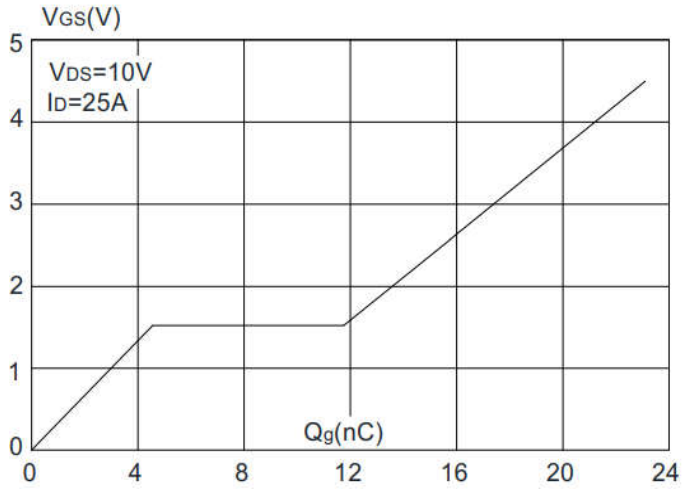



**Figure 6. Capacitance Characteristics**

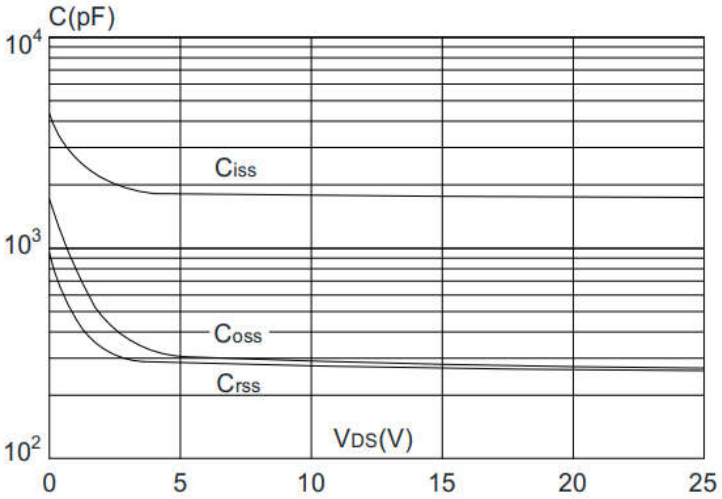



**Figure 7: Normalized Breakdown Voltage vs. Junction Temperature**

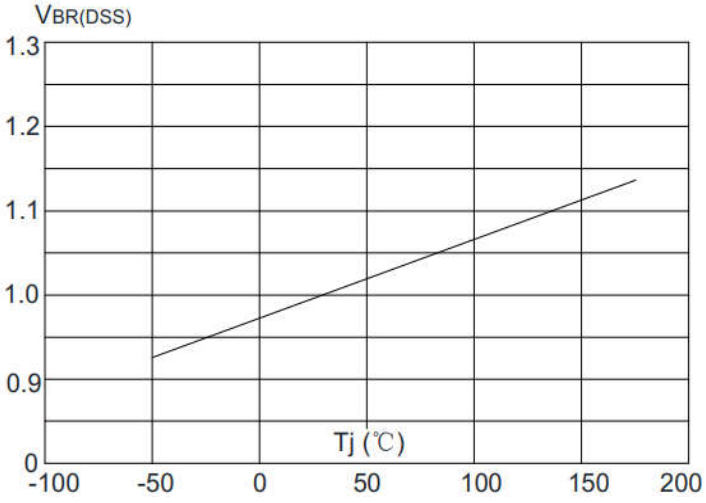



**Figure 8: Normalized on Resistance vs. Junction Temperature**

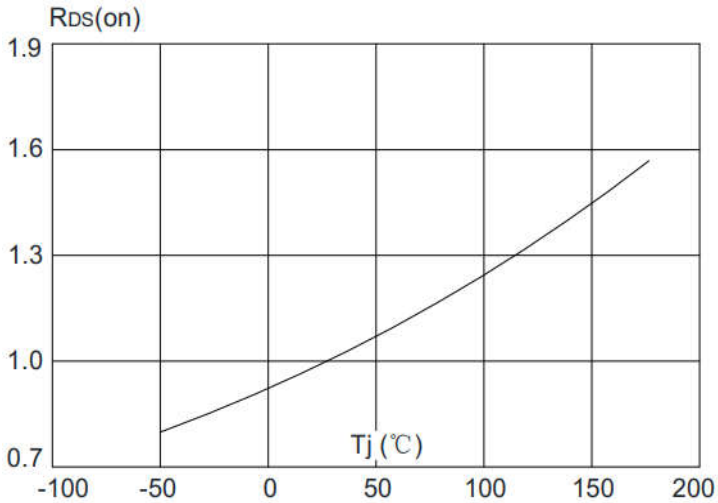


**Figure 9: Maximum Safe Operating Area**

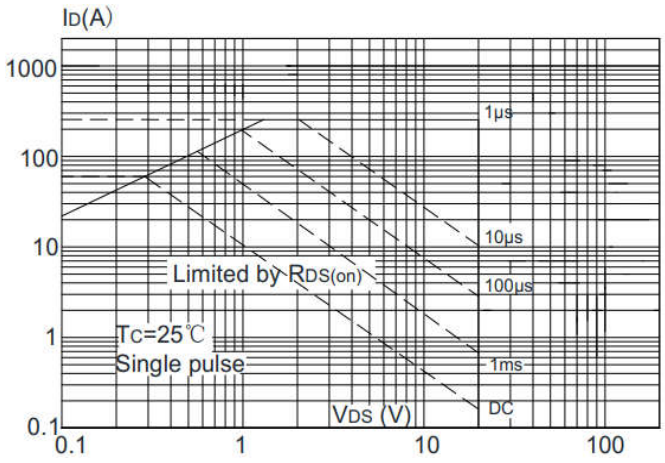



**Figure 9: Maximum Safe Operating Area**

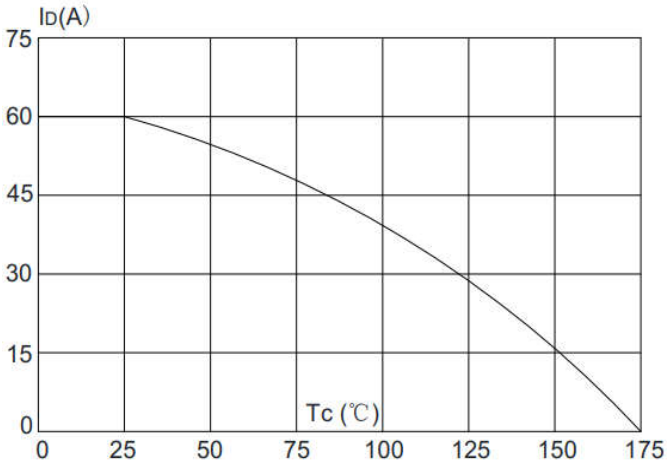
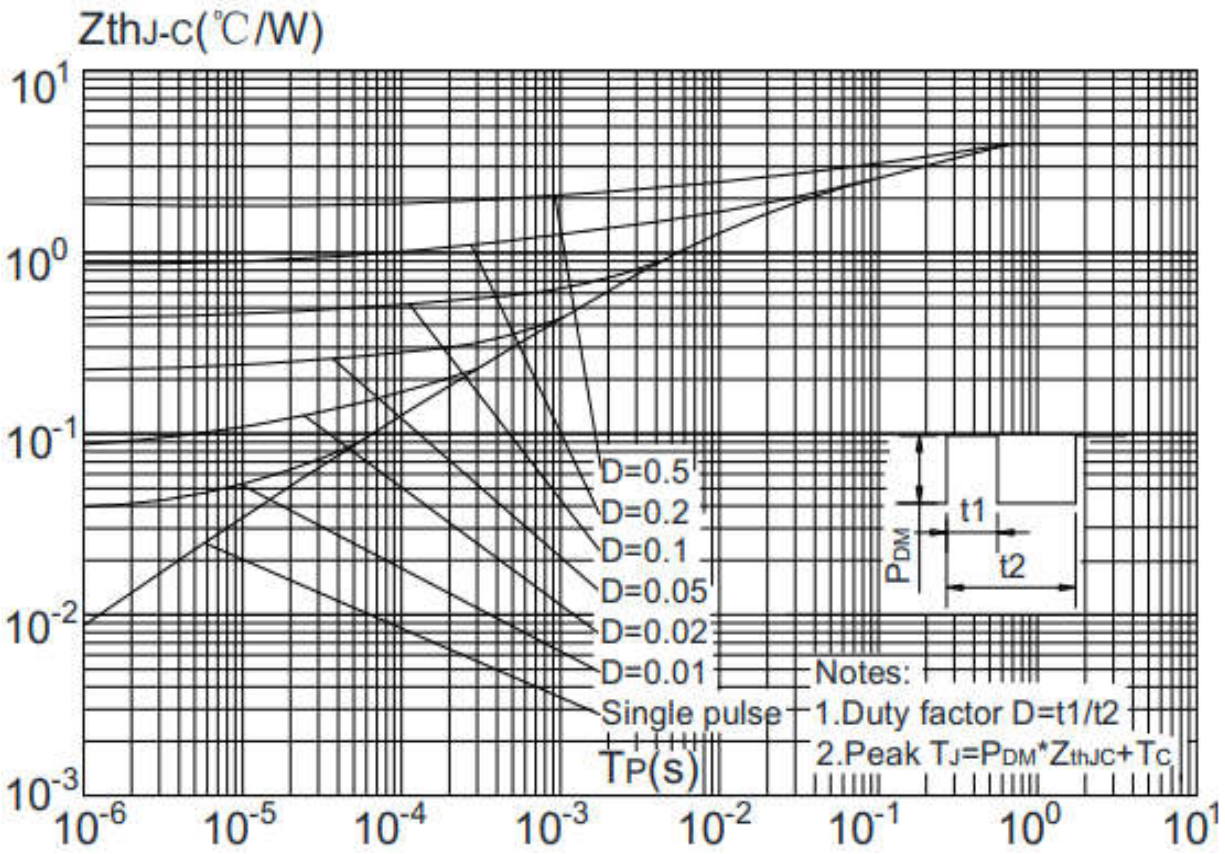



**Figure.11: Maximum Effective Transient Thermal Impedance, Junction-to-Case**



## Test Circuits and Waveforms

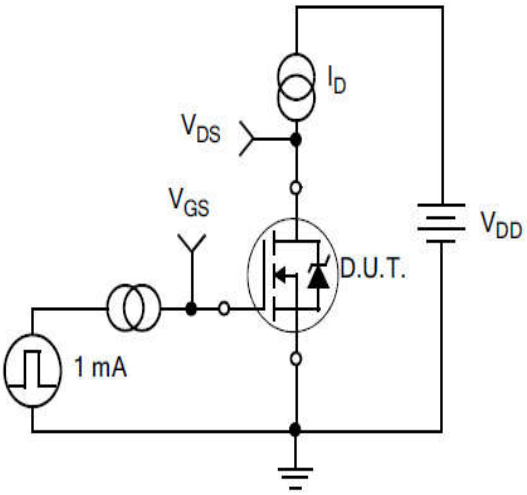



Figure A.
Gate Charge Test Circuit

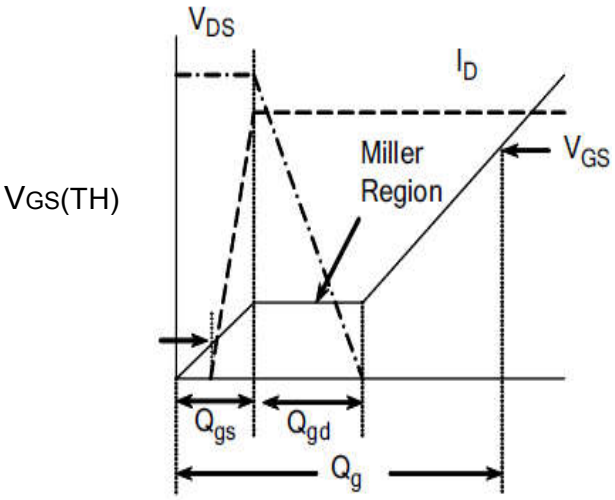



Figure B.
Gate Charge Waveform

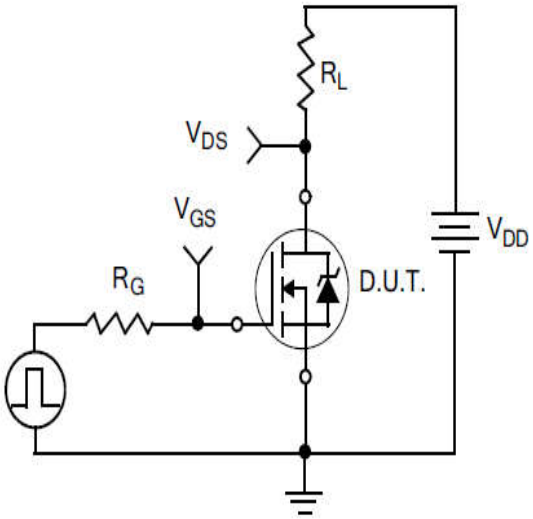



Figure C.
Resistive Switching Test Circuit

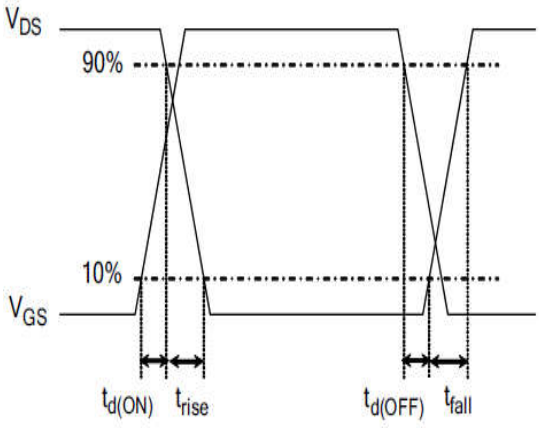



Figure D.
Resistive Switching Waveforms

## Test Circuits and Waveforms

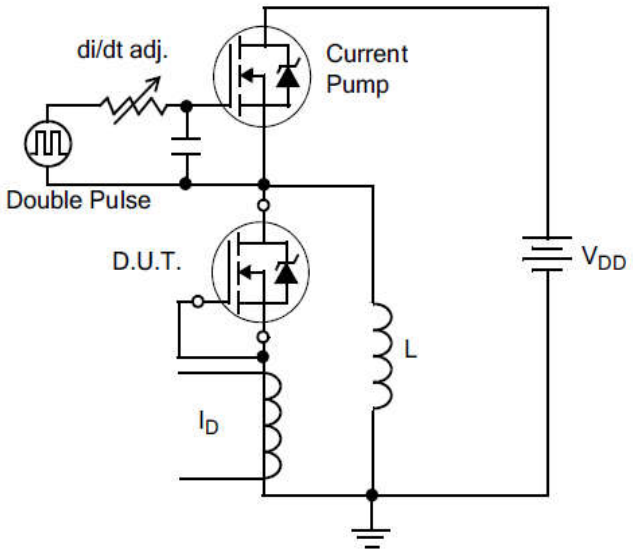



Figure E.Diode Reverse Recovery Test Circuit

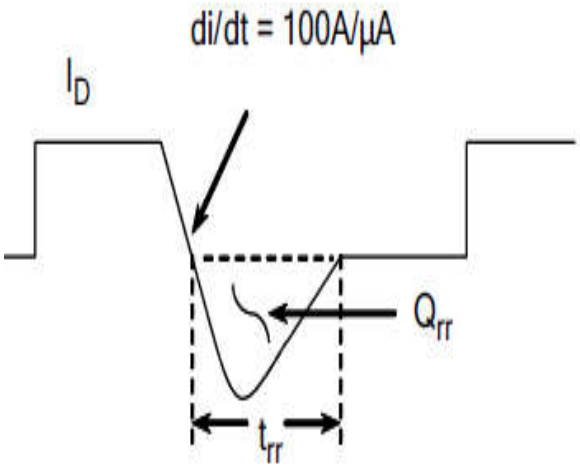



Figure F.Diode Reverse Recovery Waveform

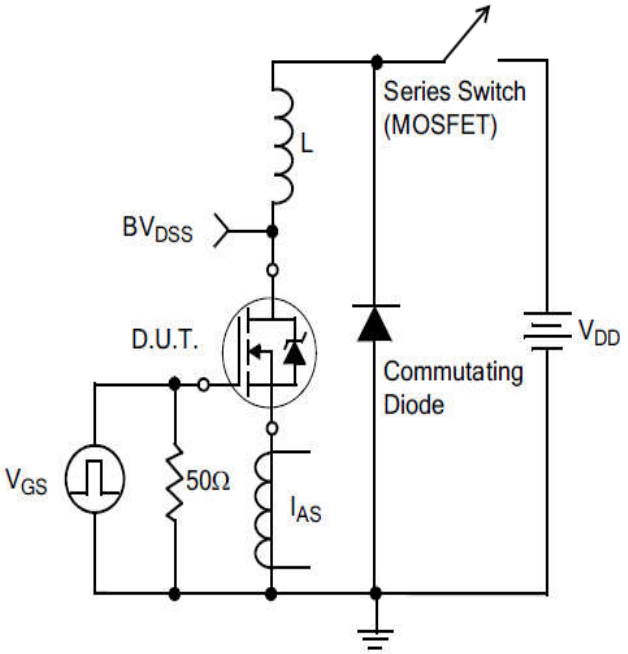
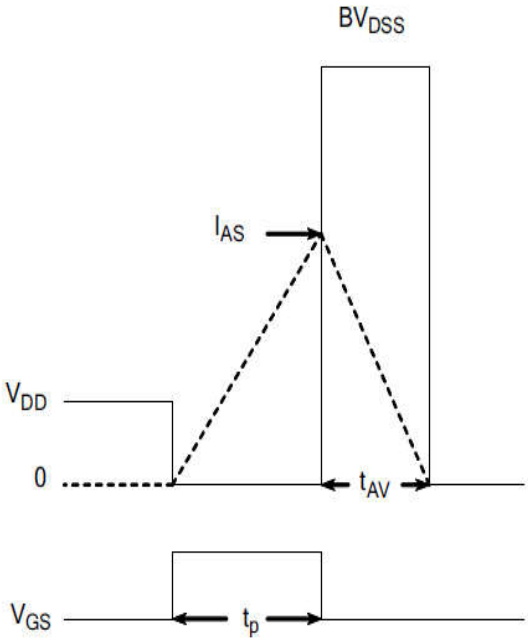


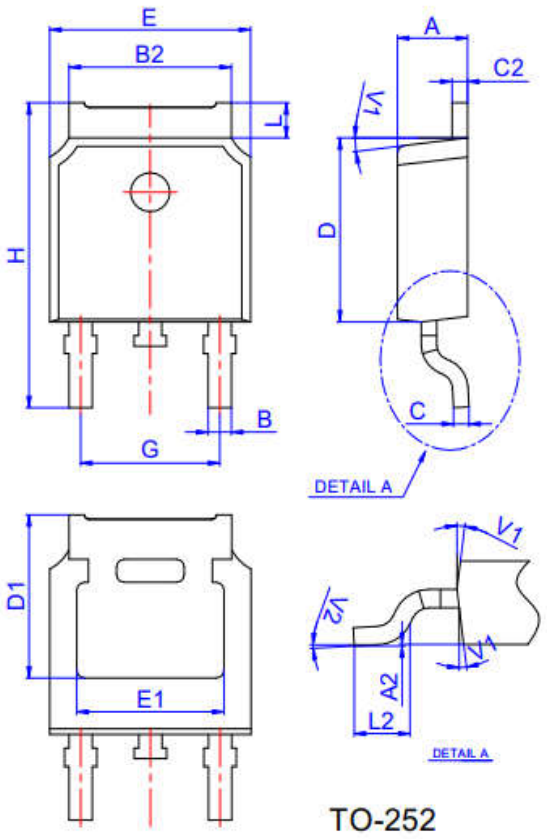

Figure G.Unclamped Inductive Switching Test Circuit




$$E_{AS}= \frac{I_{AS}^2 L}{2}$$

Figure H.Unclamped Inductive Switching Waveforms

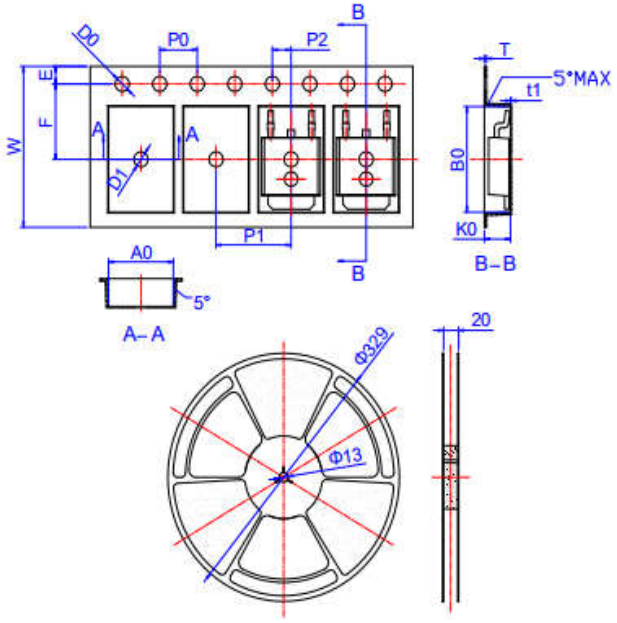
## Package outline drawing




TO-252

| Ref. | Dimensions | | | | | |
|---|---|---|---|---|---|---|
| | Millimeters | | | Inches | | |
| | Min. | Typ. | Max. | Min. | Typ. | Max. |
| A | 2.10 | | 2.50 | 0.083 | | 0.098 |
| A2 | 0 | | 0.10 | 0 | | 0.004 |
| B | 0.66 | | 0.86 | 0.026 | | 0.034 |
| B2 | 5.18 | | 5.48 | 0.202 | | 0.216 |
| C | 0.40 | | 0.60 | 0.016 | | 0.024 |
| C2 | 0.44 | | 0.58 | 0.017 | | 0.023 |
| D | 5.90 | | 6.30 | 0.232 | | 0.248 |
| D1 | 5.30REF | | | 0.209REF | | |
| E | 6.40 | | 6.80 | 0.252 | | 0.268 |
| E1 | 4.63 | | | 0.182 | | |
| G | 4.47 | | 4.67 | 0.176 | | 0.184 |
| H | 9.50 | | 10.70 | 0.374 | | 0.421 |
| L | 1.09 | | 1.21 | 0.043 | | 0.048 |
| L2 | 1.35 | | 1.65 | 0.053 | | 0.065 |
| V1 | | 7° | | | 7° | |
| V2 | 0° | | 6° | 0° | | 6° |

## Reel Specification-TO-252




| Ref. | Dimensions | | | | | |
|---|---|---|---|---|---|---|
| | Millimeters | | | Inches | | |
| | Min. | Typ. | Max. | Min. | Typ. | Max. |
| W | 15.90 | 16.00 | 16.10 | 0.626 | 0.630 | 0.634 |
| E | 1.65 | 1.75 | 1.85 | 0.065 | 0.069 | 0.073 |
| F | 7.40 | 7.50 | 7.60 | 0.291 | 0.295 | 0.299 |
| D0 | 1.40 | 1.50 | 1.60 | 0.055 | 0.059 | 0.063 |
| D1 | 1.40 | 1.50 | 1.60 | 0.055 | 0.059 | 0.063 |
| P0 | 3.90 | 4.00 | 4.10 | 0.154 | 0.157 | 0.161 |
| P1 | 7.90 | 8.00 | 8.10 | 0.311 | 0.315 | 0.319 |
| P2 | 1.90 | 2.00 | 2.10 | 0.075 | 0.079 | 0.083 |
| A0 | 6.85 | 6.90 | 7.00 | 0.270 | 0.271 | 0.276 |
| B0 | 10.45 | 10.50 | 10.60 | 0.411 | 0.413 | 0.417 |
| K0 | 2.68 | 2.78 | 2.88 | 0.105 | 0.109 | 0.113 |
| T | 0.24 | | 0.27 | 0.009 | | 0.011 |
| t1 | 0.10 | | | 0.004 | | |
| 10P0 | 39.80 | 40.00 | 40.20 | 1.567 | 1.575 | 1.583 |

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- b.support or sustain life,
- c.whose failuer to when properly used in accordance with instructions for used provided in the laeling,can be reasonably expected to result in significant injury to the user.

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