

## N-Ch 40V Fast Switching MOSFETs

- ★ Green Device Available
- ★ Super Low Gate Charge
- ★ Excellent  $CdV/dt$  effect decline
- ★ Advanced high cell density Trench technology

## Product Summary

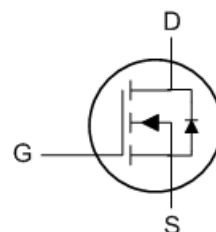
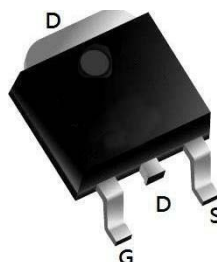


| BVDSS | RDSON  | ID  |
|-------|--------|-----|
| 40V   | 4.5 mΩ | 90A |

## Description

The XR90N04 is the high cell density trenched N-ch MOSFETs, which provide excellent RDSON and gate charge for most of the synchronous buck converter applications. The XR90N04 meet the RoHS and Green Product requirement, 100% EAS guaranteed with full function reliability approved.

## TO252-3L Pin Configuration

Absolute Maximum Ratings (@  $T_C = 25^\circ\text{C}$  unless otherwise specified)

| Symbol          | Parameter                                              | Value                     | Units              |
|-----------------|--------------------------------------------------------|---------------------------|--------------------|
| $V_{DS}$        | Drain-to-Source Voltage                                | 40                        | V                  |
| $V_{GS}$        | Gate-to-Source Voltage                                 | $\pm 20$                  | V                  |
| $I_D$           | Continuous Drain Current                               | $T_C = 25^\circ\text{C}$  | A                  |
|                 |                                                        | $T_C = 100^\circ\text{C}$ |                    |
| $I_{DM}$        | Pulsed Drain Current <sup>(1)</sup>                    | 280                       | A                  |
| $E_{AS}$        | Single Pulsed Avalanche Energy <sup>(2)</sup>          | 121                       | mJ                 |
| $P_D$           | Power Dissipation                                      | $T_C = 25^\circ\text{C}$  | W                  |
| $R_{\theta JA}$ | Thermal Resistance, Junction to Ambient <sup>(3)</sup> | 34                        | $^\circ\text{C/W}$ |
| $R_{\theta JC}$ | Thermal Resistance, Junction to Case                   | 2.1                       |                    |
| $T_J, T_{STG}$  | Junction & Storage Temperature Range                   | -55 to 150                | $^\circ\text{C}$   |

**Electrical Characteristics** ( $T_J = 25^\circ\text{C}$  unless otherwise specified)

| Symbol                                             | Parameter                                                | Conditions                                                                                  | Min. | Typ. | Max. | Unit |
|----------------------------------------------------|----------------------------------------------------------|---------------------------------------------------------------------------------------------|------|------|------|------|
| Off Characteristics                                |                                                          |                                                                                             |      |      |      |      |
| V <sub>(BR)DSS</sub>                               | Drain-Source Breakdown Voltage                           | I <sub>D</sub> = 250μA, V <sub>GS</sub> = 0V                                                | 40   | -    | -    | V    |
| I <sub>DSS</sub>                                   | Zero Gate Voltage Drain Current                          | V <sub>DS</sub> = 40V, V <sub>GS</sub> = 0V                                                 | -    | -    | 1.0  | μA   |
| I <sub>GSS</sub>                                   | Gate-Body Leakage Current                                | V <sub>DS</sub> = 0V, V <sub>GS</sub> = ±20V                                                | -    | -    | ±100 | nA   |
| On Characteristics                                 |                                                          |                                                                                             |      |      |      |      |
| V <sub>GS(th)</sub>                                | Gate Threshold Voltage                                   | V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = 250μA                                  | 1.3  | 1.8  | 2.3  | V    |
| R <sub>DS(ON)</sub>                                | Static Drain-Source ON-Resistance <sup>(4)</sup>         | V <sub>GS</sub> = 10V, I <sub>D</sub> = 30A                                                 | -    | 4.5  | 5.9  | mΩ   |
|                                                    |                                                          | V <sub>GS</sub> = 4.5V, I <sub>D</sub> = 20A                                                | -    | 6.6  | 8.6  | mΩ   |
| Dynamic Characteristics                            |                                                          |                                                                                             |      |      |      |      |
| C <sub>iss</sub>                                   | Input Capacitance                                        | V <sub>GS</sub> = 0V, V <sub>DS</sub> = 20V, f = 1MHz                                       | -    | 3031 | -    | pF   |
| C <sub>oss</sub>                                   | Output Capacitance                                       |                                                                                             | -    | 213  | -    | pF   |
| C <sub>rss</sub>                                   | Reverse Transfer Capacitance                             |                                                                                             | -    | 179  | -    | pF   |
| Q <sub>g</sub>                                     | Total Gate Charge                                        | V <sub>GS</sub> = 0 to 10V<br>V <sub>DS</sub> = 20V, I <sub>D</sub> = 30A                   | -    | 59   | -    | nC   |
| Q <sub>gs</sub>                                    | Gate Source Charge                                       |                                                                                             | -    | 12   | -    | nC   |
| Q <sub>gd</sub>                                    | Gate Drain("Miller") Charge                              |                                                                                             | -    | 12   | -    | nC   |
|                                                    |                                                          |                                                                                             |      |      |      |      |
| Switching Characteristics                          |                                                          |                                                                                             |      |      |      |      |
| t <sub>d(on)</sub>                                 | Turn-On DelayTime                                        | V <sub>GS</sub> = 10V, V <sub>DD</sub> = 20V<br>I <sub>D</sub> = 30A, R <sub>GEN</sub> = 3Ω | -    | 11   | -    | ns   |
| t <sub>r</sub>                                     | Turn-On Rise Time                                        |                                                                                             | -    | 32   | -    | ns   |
| t <sub>d(off)</sub>                                | Turn-Off DelayTime                                       |                                                                                             | -    | 52   | -    | ns   |
| t <sub>f</sub>                                     | Turn-Off Fall Time                                       |                                                                                             | -    | 13   | -    | ns   |
| Drain-Source Diode Characteristics and Max Ratings |                                                          |                                                                                             |      |      |      |      |
| I <sub>S</sub>                                     | Maximum Continuous Drain to Source Diode Forward Current |                                                                                             | -    | -    | 90   | A    |
| I <sub>SM</sub>                                    | Maximum Pulsed Drain to Source Diode Forward Current     |                                                                                             | -    | -    | 280  | A    |
| V <sub>SD</sub>                                    | Drain to Source Diode Forward Voltage                    | V <sub>GS</sub> = 0V, I <sub>S</sub> = 30A                                                  | -    | -    | 1.2  | V    |
| trr                                                | Body Diode Reverse Recovery Time                         | I <sub>F</sub> = 20A, di/dt = 100A/us                                                       | -    | 13   | -    | ns   |
| Qrr                                                | Body Diode Reverse Recovery Charge                       |                                                                                             | -    | 7    | -    | nC   |

- Notes:
1. Repetitive Rating: Pulse Width Limited by Maximum Junction Temperature.
  2.  $E_{AS}$  condition: Starting  $T_J = 25^\circ\text{C}$ ,  $V_{DD} = 20\text{V}$ ,  $V_G = 10\text{V}$ ,  $R_G = 25\text{ohm}$ ,  $L = 0.5\text{mH}$ ,  $I_{AS} = 22\text{A}$
  3.  $R_{\theta JA}$  is measured with the device mounted on a  $1\text{inch}^2$  pad of 2oz copper FR4 PCB
  4. Pulse Test: Pulse Width  $\leq 300\mu\text{s}$ , Duty Cycle  $\leq 0.5\%$ .

### Typical Performance Characteristics

Figure 1: Output Characteristics

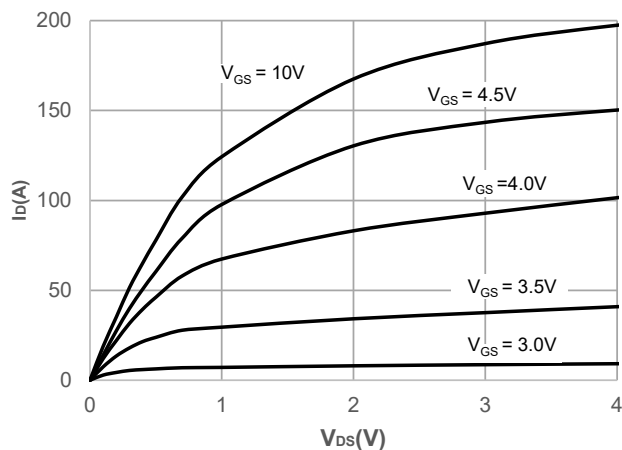


Figure 2: Typical Transfer Characteristics

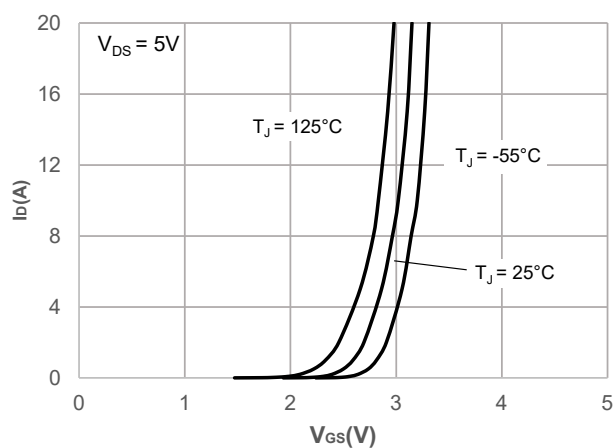


Figure 3: On-resistance vs. Drain Current

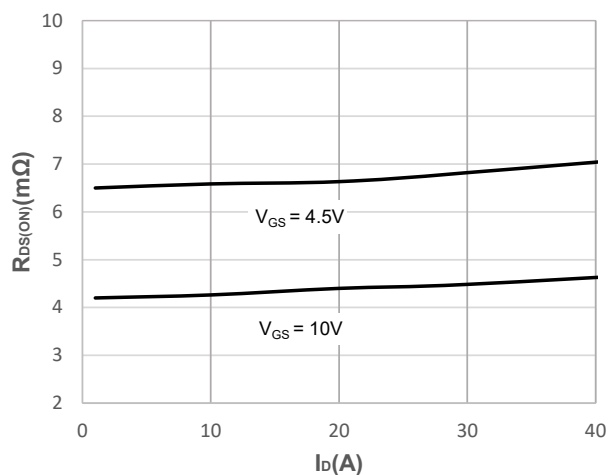


Figure 4: Body Diode Characteristics

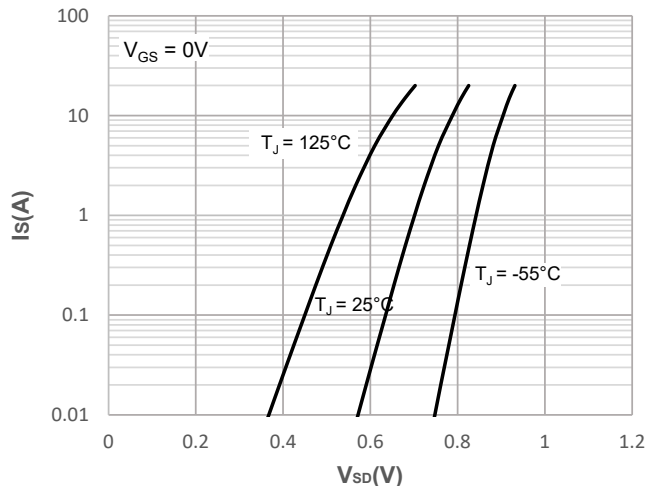


Figure 5: Gate Charge Characteristics

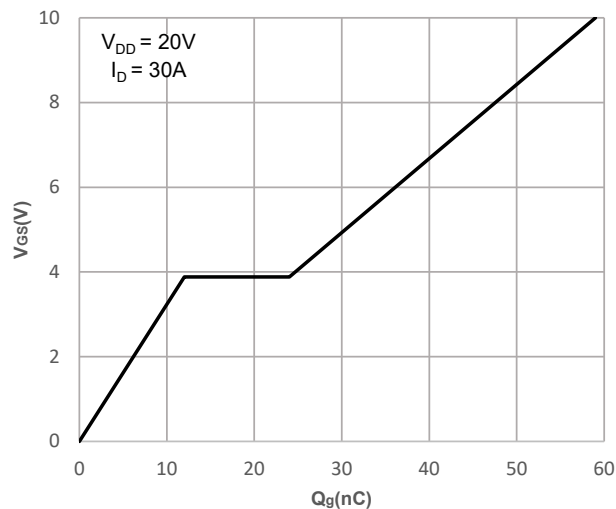
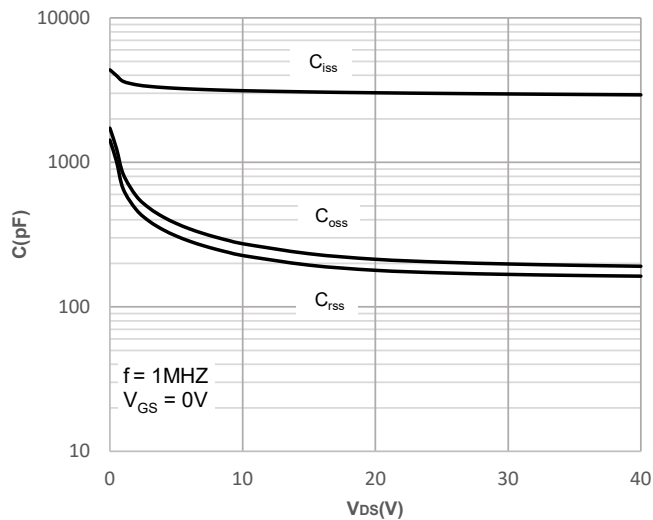


Figure 6: Capacitance Characteristics



### Typical Performance Characteristics

Figure 7: Normalized Breakdown voltage vs. Junction Temperature

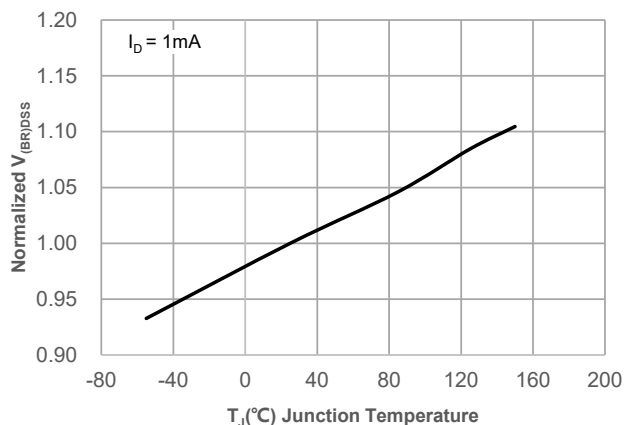


Figure 8: Normalized on Resistance vs. Junction Temperature

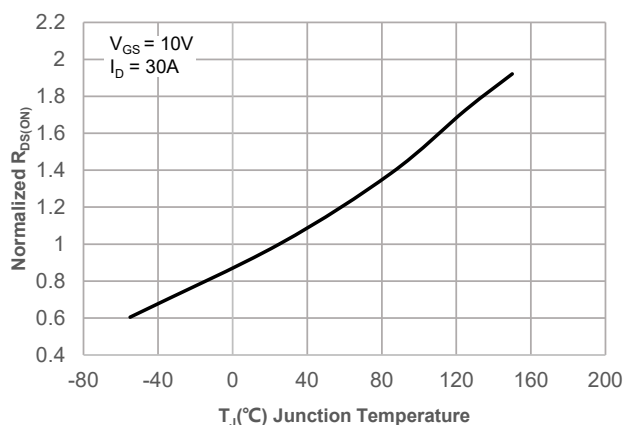


Figure 9: Maximum Safe Operating Area

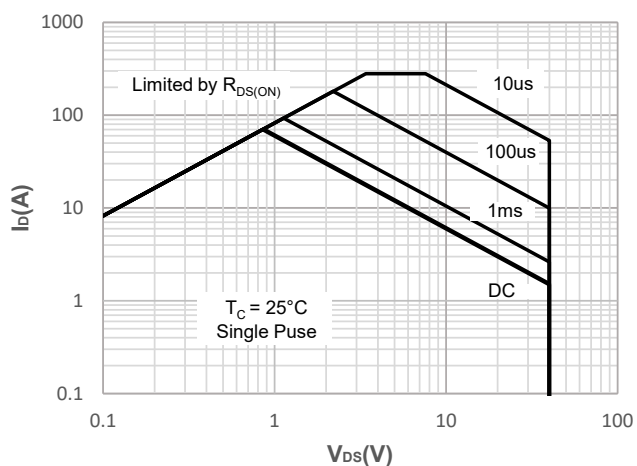


Figure 10: Maximum Continuous Driain Current vs. Case Temperature

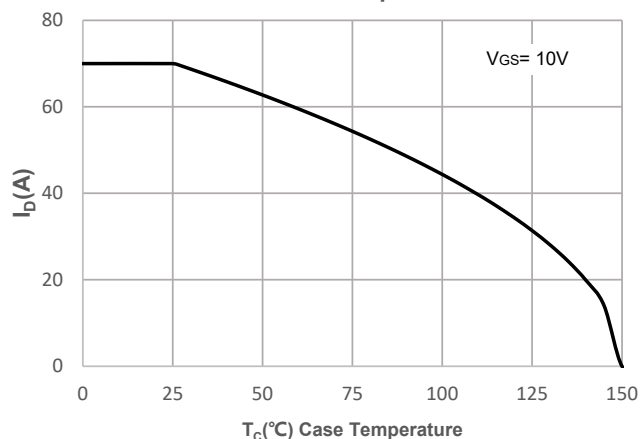


Figure 11: Normalized Maximum Transient Thermal Impedance

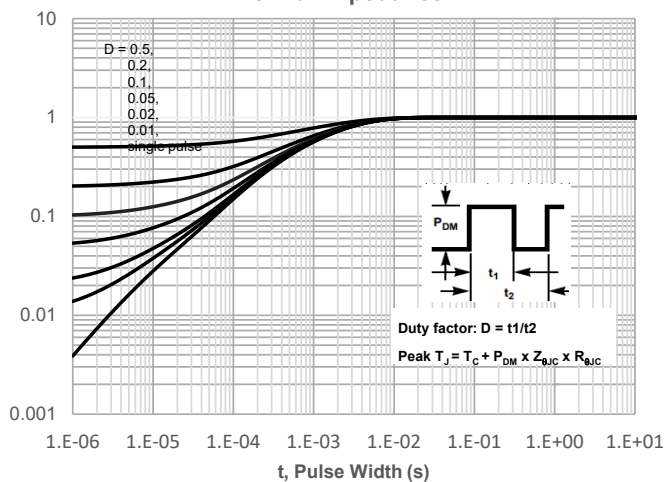
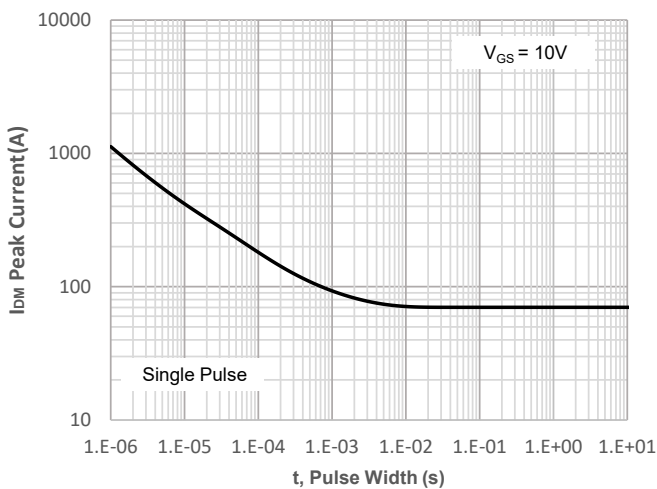


Figure 12: Peak Current Capacity



### Test Circuit

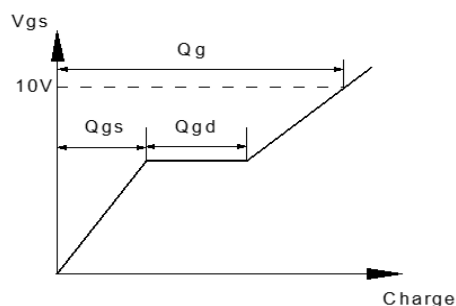
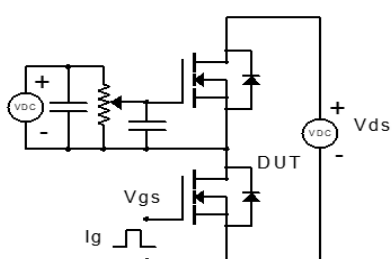


Figure 1: Gate Charge Test Circuit & Waveform

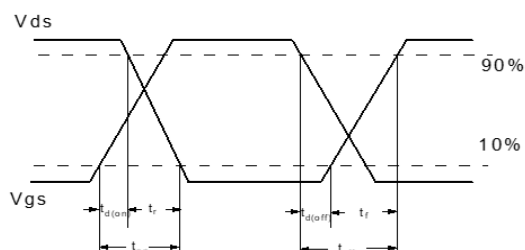
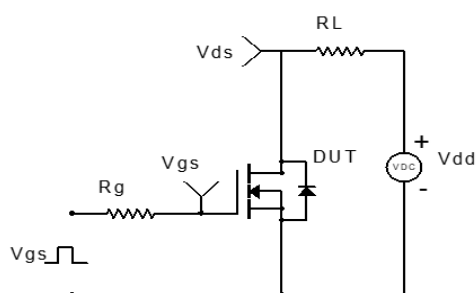


Figure 2: Resistive Switching Test Circuit & Waveform

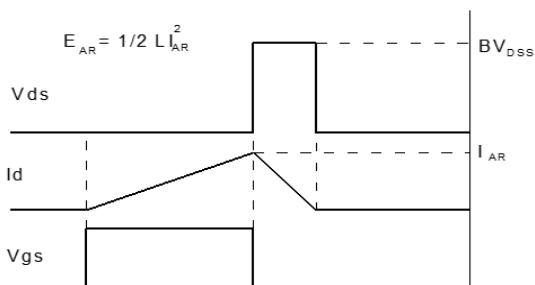
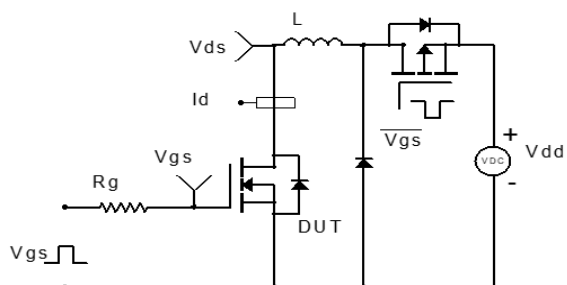


Figure 3: Unclamped Inductive Switching Test Circuit & Waveform

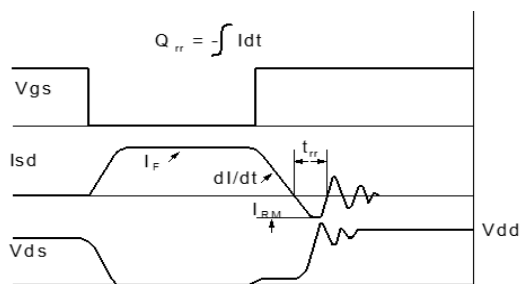
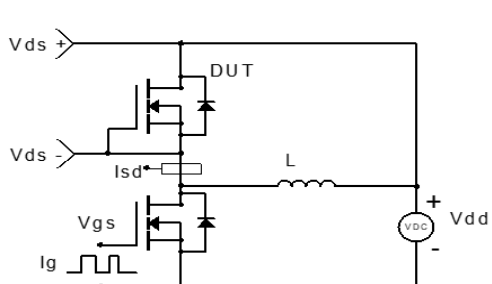
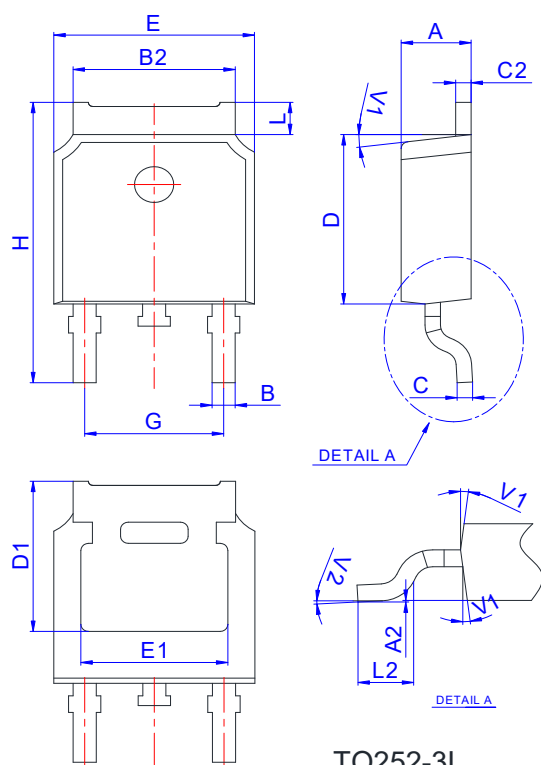


Figure 4: Diode Recovery Test Circuit & Waveform

## N-Ch 40V Fast Switching MOSFETs

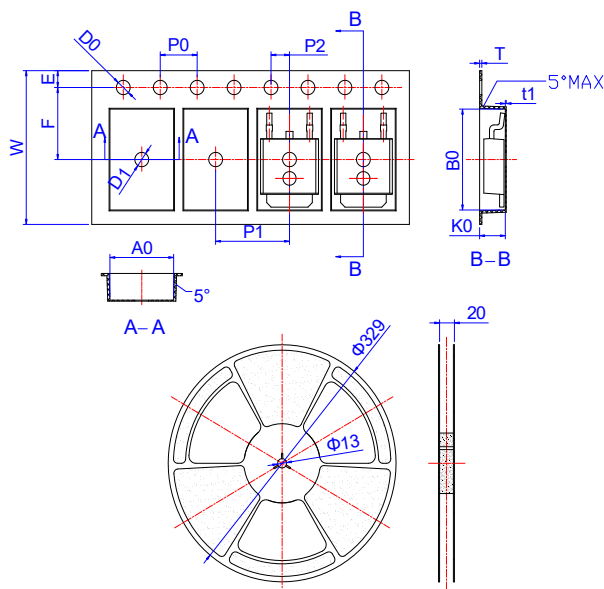
### Package Mechanical Data-TO252-3L



TO252-3L

| 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-TO252-3L



| 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 |