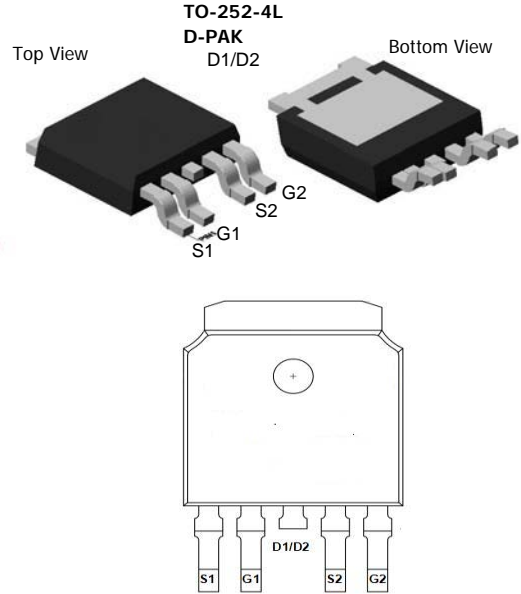


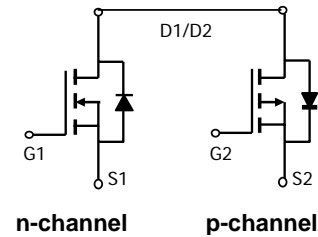
## Features

- 40V, 34A  
 $R_{DS(ON)}$  Typ = 13m $\Omega$  @  $V_{GS} = 10V$   
 $R_{DS(ON)}$  Typ = 16m $\Omega$  @  $V_{GS} = 4.5V$
- -40V, -24A  
 $R_{DS(ON)}$  Typ = 28m $\Omega$  @  $V_{GS} = -10V$   
 $R_{DS(ON)}$  Typ = 40m $\Omega$  @  $V_{GS} = -4.5V$
- Advanced Trench Technology
- Excellent  $R_{DS(ON)}$  and Low Gate Charge



## Application

- Load Switch
- PWM Application
- Power Management



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

| Symbol          | Parameter                                     | N Value                   | P Value  | Units              |
|-----------------|---|---------------------------|----------|--------------------|
| $V_{DS}$        | Drain-to-Source Voltage                       | 40                        | -40      | V                  |
| $V_{GS}$        | Gate-to-Source Voltage                        | $\pm 20$                  | $\pm 20$ | V                  |
| $I_D$           | Continuous Drain Current                      | $T_C = 25^\circ\text{C}$  | 34       | -24                |
|                 |   | $T_C = 100^\circ\text{C}$ | 20.4     | -14.4              |
| $I_{DM}$        | Pulsed Drain Current <sup>(1)</sup>           | 136                       | -96      | A                  |
| $E_{AS}$        | Single Pulsed Avalanche Energy <sup>(2)</sup> | 33                        | 42       | mJ                 |
| $P_D$           | Power Dissipation                             | $T_C = 25^\circ\text{C}$  | 25       | 25                 |
| $R_{\theta JC}$ | Thermal Resistance, Junction to Ambient       | 5                         | 5        | $^\circ\text{C/W}$ |
| $T_J, T_{STG}$  | Junction & Storage Temperature Range          | -55 to 150                |          | $^\circ\text{C}$   |

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

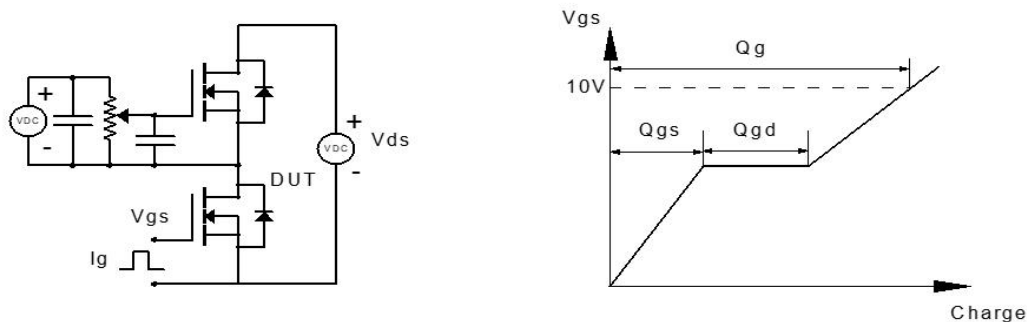
| Symbol   | Parameter  | Conditions  | Min. | Typ. | Max. | Unit |
|--|--|---|------|------|------|------|
| Off Characteristics                                |  |   |      |      |      |      |
| V <sub>(BR)DSS</sub>                               | Drain-Source Breakdown Voltage                           | 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    | 1.5  | 2.2  | V    |
| R <sub>DS(ON)</sub>                                | Static Drain-Source ON-Resistance <sup>(3)</sup>         | V <sub>GS</sub> = 10V, I <sub>D</sub> = 10A   | -    | 13   | 15   | mΩ   |
|  |  | V <sub>GS</sub> = 4.5V, I <sub>D</sub> = 5A   | -    | 16   | 18   | mΩ   |
| Dynamic Characteristics                            |  |   |      |      |      |      |
| C <sub>iss</sub>                                   | Input Capacitance  | V <sub>GS</sub> = 0V, V <sub>DS</sub> = 20V, f = 1MHz                                       | -    | 956  | -    | pF   |
| C <sub>oss</sub>                                   | Output Capacitance                                       |   | -    | 78   | -    | pF   |
| C <sub>rss</sub>                                   | Reverse Transfer Capacitance                             |   | -    | 65   | -    | 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> = 10A                   | -    | 27   | -    | nC   |
| Q <sub>gs</sub>                                    | Gate Source Charge                                       |   | -    | 7    | -    | nC   |
| Q <sub>gd</sub>                                    | Gate Drain("Miller") Charge                              |   | -    | 6    | -    | 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> = 10A, R <sub>GEN</sub> = 3Ω | -    | 7.5  | -    | ns   |
| t <sub>r</sub>                                     | Turn-On Rise Time  |   | -    | 12   | -    | ns   |
| t <sub>d(off)</sub>                                | Turn-Off DelayTime                                       |   | -    | 27   | -    | ns   |
| t <sub>f</sub>                                     | Turn-Off Fall Time                                       |   | -    | 7    | -    | ns   |
| Drain-Source Diode Characteristics and Max Ratings |  |   |      |      |      |      |
| I <sub>S</sub>                                     | Maximum Continuous Drain to Source Diode Forward Current |   | -    | -    | 34   | A    |
| I <sub>SM</sub>                                    | Maximum Pulsed Drain to Source Diode Forward Current     |   | -    | -    | 136  | A    |
| V <sub>SD</sub>                                    | Drain to Source Diode Forward Voltage                    | V <sub>GS</sub> = 0V, I <sub>S</sub> = 10A  | -    | -    | 1.2  | V    |
| trr  | Body Diode Reverse Recovery Time                         | I <sub>F</sub> = 10A, di/dt = 100A/us   | -    | 11   | -    | ns   |
| Qrr  | Body Diode Reverse Recovery Charge                       |   | -    | 7    | -    | nC   |

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

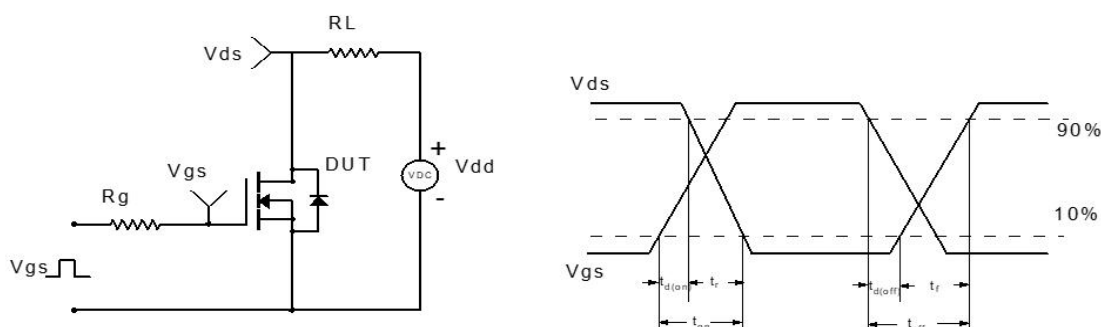
| Symbol   | Parameter  | Conditions   | Min.                                   | Typ. | Max. | Unit |    |
|--|--|--|--|------|------|------|----|
| Off Characteristics                                |  |  |  |      |      |      |    |
| V <sub>(BR)DSS</sub>                               | Drain-Source 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                                     | -1.7 | -2.5 | V    |    |
| R <sub>DS(ON)</sub>                                | Static Drain-Source ON-Resistance <sup>(3)</sup>         | V <sub>GS</sub> = -10V, I <sub>D</sub> = -5A   | -                                      | 28   | 32   | mΩ   |    |
|  |  | V <sub>GS</sub> = -4.5V, I <sub>D</sub> = -4A  | -                                      | 40   | 45   | mΩ   |    |
| Dynamic Characteristics                            |  |  |  |      |      |      |    |
| C <sub>iss</sub>                                   | Input Capacitance  | V <sub>GS</sub> = 0V, V <sub>DS</sub> = -20V, f = 1MHz   | -                                      | 1078 | -    | pF   |    |
| C <sub>oss</sub>                                   | Output Capacitance                                       |  | -                                      | 111  | -    | pF   |    |
| C <sub>rss</sub>                                   | Reverse Transfer Capacitance                             |  | -                                      | 95   | -    | 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> = -10A                   | -                                      | 28   | -    | nC   |    |
| Q <sub>gs</sub>                                    | Gate Source Charge                                       |  | -                                      | 7    | -    | nC   |    |
| Q <sub>gd</sub>                                    | Gate Drain("Miller") Charge                              |  | -                                      | 5.3  | -    | 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> = -10A, R <sub>GEN</sub> = 3Ω | -                                      | 7.8  | -    | ns   |    |
| t <sub>r</sub>                                     | Turn-On Rise Time  |  | -                                      | 29   | -    | ns   |    |
| t <sub>d(off)</sub>                                | Turn-Off DelayTime                                       |  | -                                      | 36   | -    | ns   |    |
| t <sub>f</sub>                                     | Turn-Off Fall Time                                       |  | -                                      | 47   | -    | ns   |    |
| Drain-Source Diode Characteristics and Max Ratings |  |  |  |      |      |      |    |
| I <sub>S</sub>                                     | Maximum Continuous Drain to Source Diode Forward Current | V <sub>GS</sub> = 0V, I <sub>S</sub> = -10A  | -                                      | -    | -24  | A    |    |
| I <sub>SM</sub>                                    | Maximum Pulsed Drain to Source Diode Forward Current     |  | -                                      | -    | -96  | A    |    |
| V <sub>SD</sub>                                    | Drain to Source Diode Forward Voltage                    |  | -                                      | -    | -1.2 | V    |    |
| trr  | Body Diode Reverse Recovery Time                         |  | I <sub>F</sub> = -10A, di/dt = 100A/us | -    | 14   | -    | 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  $T_J = 25^\circ\text{C}$ ,  $V_{DD} = 20\text{V}$ ,  $V_G = 10\text{V}$ ,  $R_G = 25\Omega$ ,  $L = 0.5\text{mH}$ ,  $I_{AS} = 11.5\text{A}$   
 $E_{AS}$  condition: Starting  $T_J = 25^\circ\text{C}$ ,  $V_{DD} = -20\text{V}$ ,  $V_G = -10\text{V}$ ,  $R_G = 25\Omega$ ,  $L = 0.5\text{mH}$ ,  $I_{AS} = -13\text{A}$
  3. Pulse Test: Pulse Width  $\leq 300\mu\text{s}$ , Duty Cycle  $\leq 0.5\%$ .

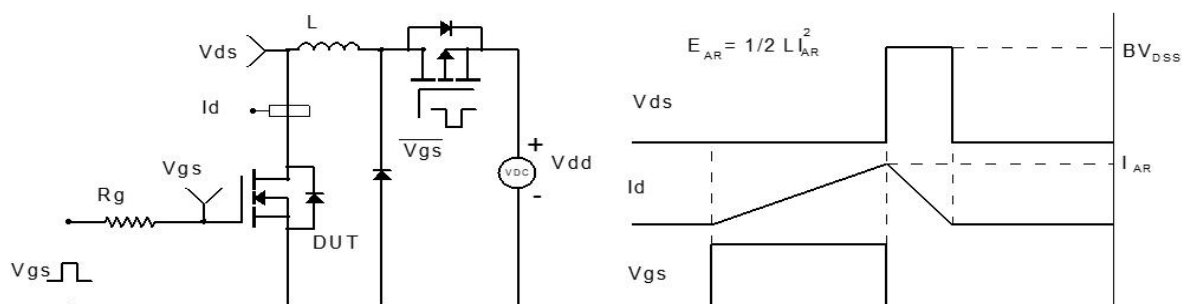
## Test Circuit



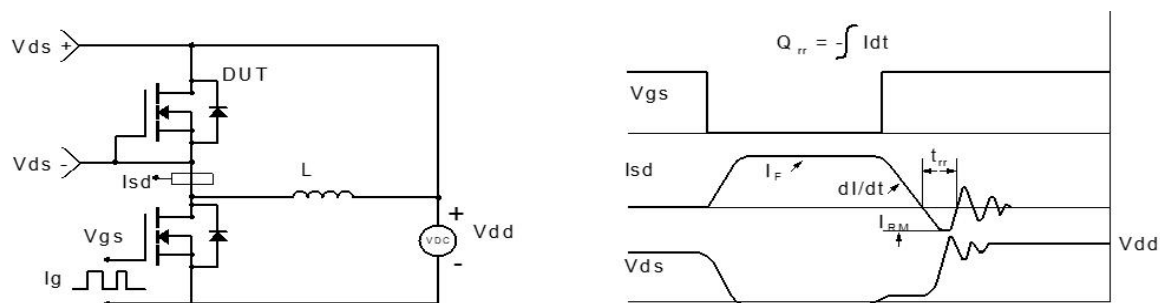
**Figure 1: Gate Charge Test Circuit & Waveform**



**Figure 2: Resistive Switching Test Circuit & Waveform**

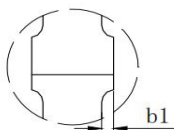
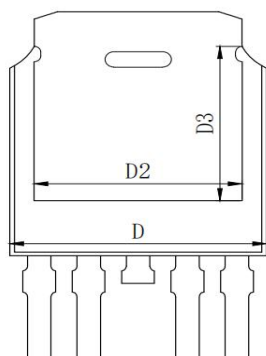
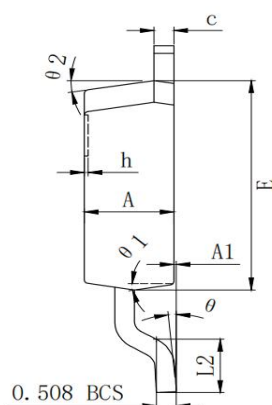
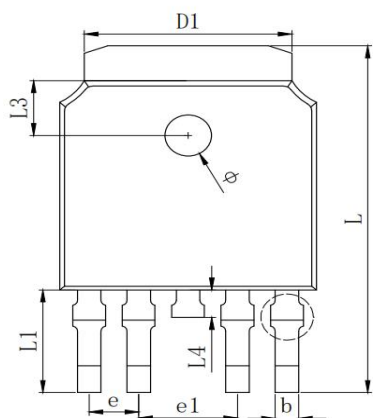


**Figure 3: Unclamped Inductive Switching Test Circuit & Waveform**



**Figure 4: Diode Recovery Test Circuit & Waveform**

## Package Mechanical Data(TO-252-4L)



| SYMBOL     | MILLIMETER |        |        |
|------------|------------|--------|--------|
|            | MIN        | Typ.   | MAX    |
| A          | 2.200      | 2.300  | 2.400  |
| A1         | 0.000      |        | 0.127  |
| b          | 0.550      | 0.600  | 0.650  |
| b1         | 0.000      |        | 0.120  |
| c (电镀后)    | 0.460      | 0.520  | 0.580  |
| D          | 6.500      | 6.600  | 6.700  |
| D1         | 5.334 REF  |        |        |
| D2         | 5.346 REF  |        |        |
| D3         | 4.490 REF  |        |        |
| E          | 6.000      | 6.100  | 6.200  |
| e          | 1.270 TYP  |        |        |
| e1         | 2.540 TYP  |        |        |
| h          | 0.000      | 0.100  | 0.200  |
| L          | 9.900      | 10.100 | 10.300 |
| L1         | 2.988 REF  |        |        |
| L2         | 1.400      | 1.550  | 1.700  |
| L3         | 1.600 REF  |        |        |
| L4         | 0.700      | 0.800  | 0.900  |
| $\phi$     | 1.100      | 1.200  | 1.300  |
| $\theta$   | 0°         |        | 8°     |
| $\theta_1$ | 9° TYP     |        |        |
| $\theta_2$ | 9° TYP     |        |        |