



## Description

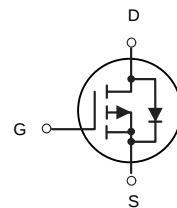
The NP36P04SDG uses advanced trench technology to provide excellent  $R_{DS(ON)}$ , low gate charge and operation with gate voltages as low as 4.5V. This device is suitable for use as a Battery protection or in other Switching application.



## General Features

$V_{DS} = -40V$   $I_D = -40A$

$R_{DS(ON)} < 19\text{ m}\Omega$  @  $V_{GS}=10V$



P-Channel MOSFET

## Application

Battery protection

Load switch

Uninterruptible power supply

## Package Marking and Ordering Information

| Product ID | Pack     | Brand      | Qty(PCS) |
|------------|----------|------------|----------|
| NP36P04SDG | TO252-2L | HXY MOSFET | 2500     |

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

| Symbol                      | Parameter                                             | Rating     | Units              |
|-----------------------------|-------------------------------------------------------|------------|--------------------|
| $V_{DS}$                    | Drain-Source Voltage                                  | -40        | V                  |
| $V_{GS}$                    | Gate-Source Voltage                                   | $\pm 20$   | V                  |
| $I_D@T_C=25^\circ\text{C}$  | Continuous Drain Current, $V_{GS}$ @ 10V <sup>1</sup> | -40        | A                  |
| $I_D@T_C=100^\circ\text{C}$ | Continuous Drain Current, $V_{GS}$ @ 10V <sup>1</sup> | -22        | A                  |
| $I_{DM}$                    | Pulsed Drain Current <sup>2</sup>                     | -140       | A                  |
| $P_D@T_C=25^\circ\text{C}$  | Total Power Dissipation <sup>4</sup>                  | 40.3       | W                  |
| $T_{STG}$                   | Storage Temperature Range                             | -55 to 150 | $^\circ\text{C}$   |
| $T_J$                       | Operating Junction Temperature Range                  | -55 to 150 | $^\circ\text{C}$   |
| $R_{\theta JA}$             | Thermal Resistance Junction-ambient <sup>1</sup>      | 66         | $^\circ\text{C/W}$ |
| $R_{\theta JC}$             | Thermal Resistance Junction-Case <sup>1</sup>         | 3.1        | $^\circ\text{C/W}$ |



### Electrical Characteristics (T<sub>J</sub> = 25°C, unless otherwise noted)

| Parameter                               |                       | Symbol               | Test Conditions                                                                            | Min. | Typ. | Max. | Unit |
|-----------------------------------------|-----------------------|----------------------|--------------------------------------------------------------------------------------------|------|------|------|------|
| Static Characteristics                  |                       |                      |                                                                                            |      |      |      |      |
| Drain-Source Breakdown Voltage          |                       | V <sub>(BR)DSS</sub> | V <sub>GS</sub> = 0V, I <sub>D</sub> = -250μA                                              | -40  | -    | -    | V    |
| Gate-body Leakage current               |                       | I <sub>GSS</sub>     | V <sub>DS</sub> = 0V, V <sub>GS</sub> = ±20V                                               | -    | -    | ±100 | nA   |
| Zero Gate Voltage Drain Current         | T <sub>J</sub> =25°C  | I <sub>DSS</sub>     | V <sub>DS</sub> = -40V, V <sub>GS</sub> = 0V                                               | -    | -    | -1   | μA   |
|                                         | T <sub>J</sub> =100°C |                      |                                                                                            | -    | -    | -100 |      |
| Gate-Threshold Voltage                  |                       | V <sub>GS(th)</sub>  | V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = -250μA                                | -1.0 | -1.5 | -2.2 | V    |
| Drain-Source On-Resistance <sup>4</sup> |                       | R <sub>DS(on)</sub>  | V <sub>GS</sub> = -10V, I <sub>D</sub> = -20A                                              | -    | 13.5 | 19   | mΩ   |
|                                         |                       |                      | V <sub>GS</sub> = -4.5V, I <sub>D</sub> = -15A                                             | -    | 19.5 | 25   |      |
| Forward Transconductance <sup>4</sup>   |                       | g <sub>fs</sub>      | V <sub>DS</sub> = -10V, I <sub>D</sub> = -20A                                              | -    | 44   | -    | S    |
| Dynamic Characteristics <sup>5</sup>    |                       |                      |                                                                                            |      |      |      |      |
| Input Capacitance                       |                       | C <sub>iss</sub>     | V <sub>DS</sub> = -20V, V <sub>GS</sub> =0V, f =1MHz                                       | -    | 2525 | -    | pF   |
| Output Capacitance                      |                       | C <sub>oss</sub>     |                                                                                            | -    | 190  | -    |      |
| Reverse Transfer Capacitance            |                       | C <sub>rss</sub>     |                                                                                            | -    | 172  | -    |      |
| Gate Resistance                         |                       | R <sub>g</sub>       | f =1MHz                                                                                    | -    | 10   | -    | Ω    |
| Switching Characteristics <sup>5</sup>  |                       |                      |                                                                                            |      |      |      |      |
| Total Gate Charge                       |                       | Q <sub>g</sub>       | V <sub>GS</sub> = -10V, V <sub>DS</sub> = -20V, I <sub>D</sub> = -20A                      | -    | 35   | -    | nC   |
| Gate-Source Charge                      |                       | Q <sub>gs</sub>      |                                                                                            | -    | 5.5  | -    |      |
| Gate-Drain Charge                       |                       | Q <sub>gd</sub>      |                                                                                            | -    | 8    | -    |      |
| Turn-On Delay Time                      |                       | t <sub>d(on)</sub>   | V <sub>GS</sub> = -10V, V <sub>DD</sub> = -20V, R <sub>G</sub> = 3Ω, I <sub>D</sub> = -20A | -    | 14.5 | -    | ns   |
| Rise Time                               |                       | t <sub>r</sub>       |                                                                                            | -    | 20.2 | -    |      |
| Turn-Off Delay Time                     |                       | t <sub>d(off)</sub>  |                                                                                            | -    | 32   | -    |      |
| Fall Time                               |                       | t <sub>f</sub>       |                                                                                            | -    | 10   | -    |      |
| Drain-Source Body Diode Characteristics |                       |                      |                                                                                            |      |      |      |      |
| Diode Forward Voltage <sup>4</sup>      |                       | V <sub>SD</sub>      | I <sub>S</sub> = -20A, V <sub>GS</sub> = 0V                                                | -    | -    | -1.2 | V    |
| Continuous Source Current               | T <sub>C</sub> =25°C  | I <sub>S</sub>       | -                                                                                          | -    | -    | -40  | A    |

Note :

1. Repetitive rating, pulse width limited by junction temperature T<sub>J(MAX)</sub>=150°C.
2. The EAS data shows Max. rating . The test condition is V<sub>DD</sub>= -25V, V<sub>GS</sub>= -10V, L= 0.1mH, I<sub>AS</sub>= -34A.
3. The data tested by surface mounted on a 1 inch<sup>2</sup> FR-4 board with 20Z copper, The value in any given application depends on the user's specific board design.
4. The data tested by pulsed , pulse width ≤ 300us , duty cycle ≤ 2%.
5. This value is guaranteed by design hence it is not included in the production test.



## Typical Characteristics

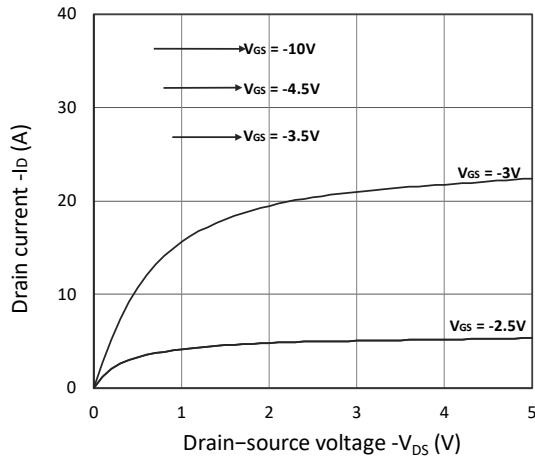


Figure 1. Output Characteristics

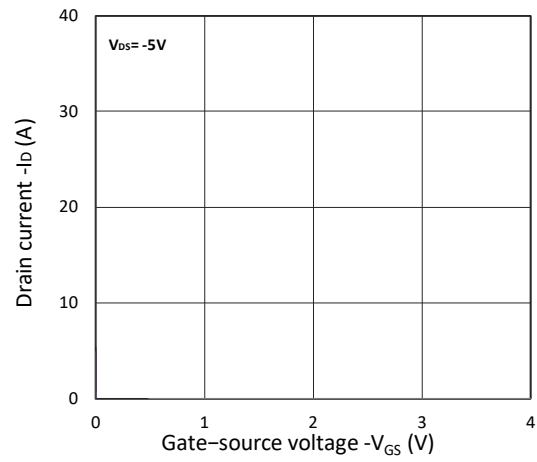


Figure 2. Transfer Characteristics

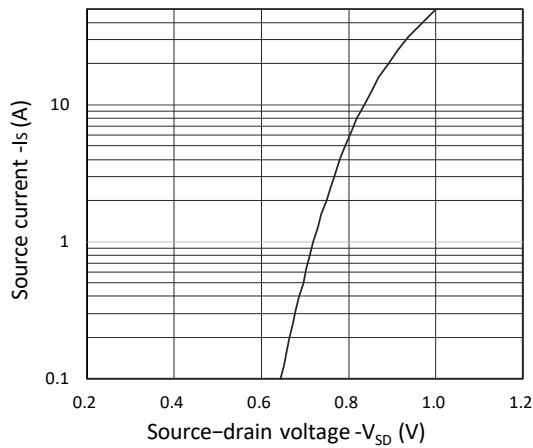


Figure 3. Forward Characteristics of Reverse

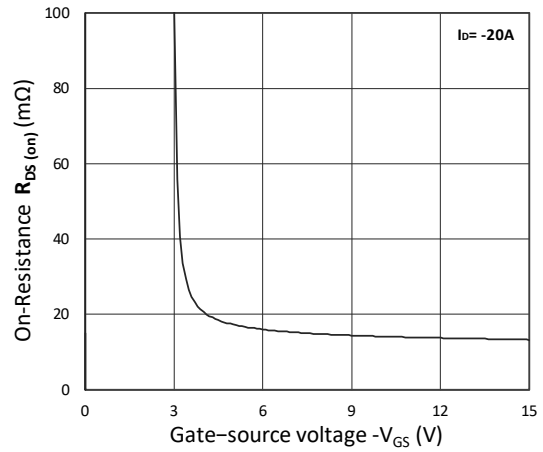


Figure 4.  $R_{DS(on)}$  vs.  $V_{GS}$

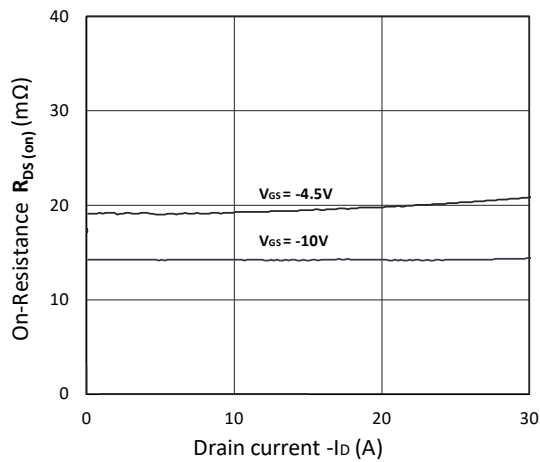


Figure 5.  $R_{DS(on)}$  vs.  $I_D$

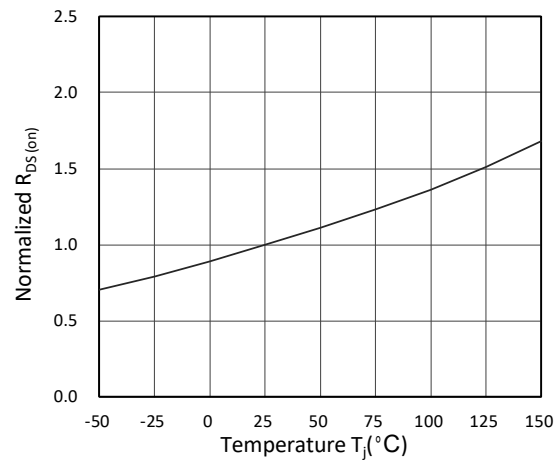


Figure 6. Normalized  $R_{DS(on)}$  vs. Temperature

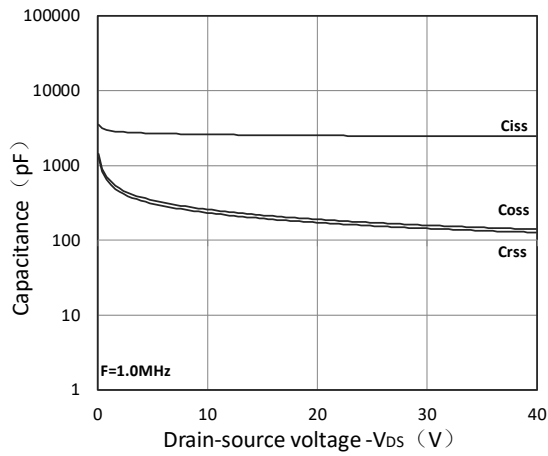


Figure 7. Capacitance Characteristics

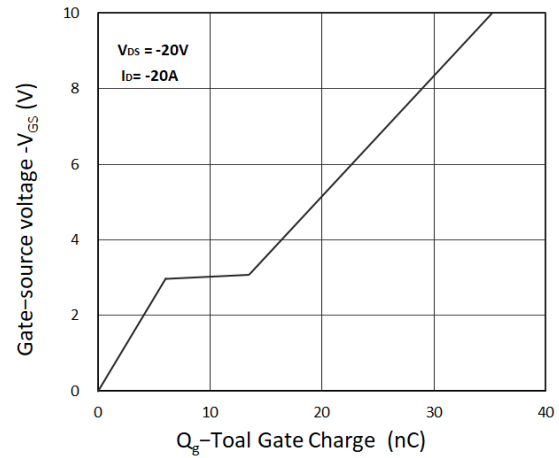


Figure 8. Gate Charge Characteristics

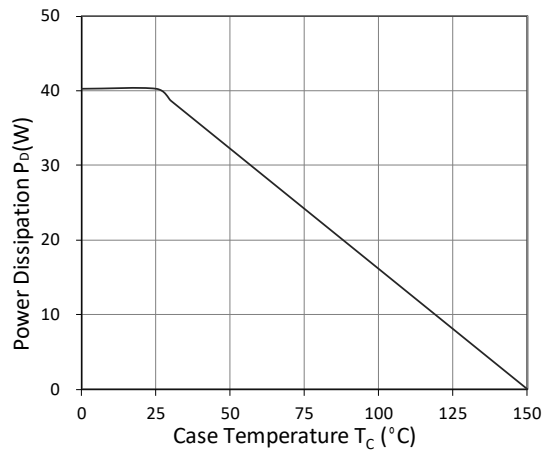


Figure 9. Power Dissipation

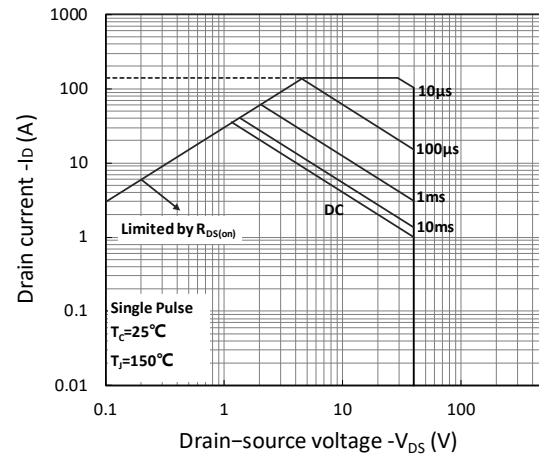


Figure 10. Safe Operating Area

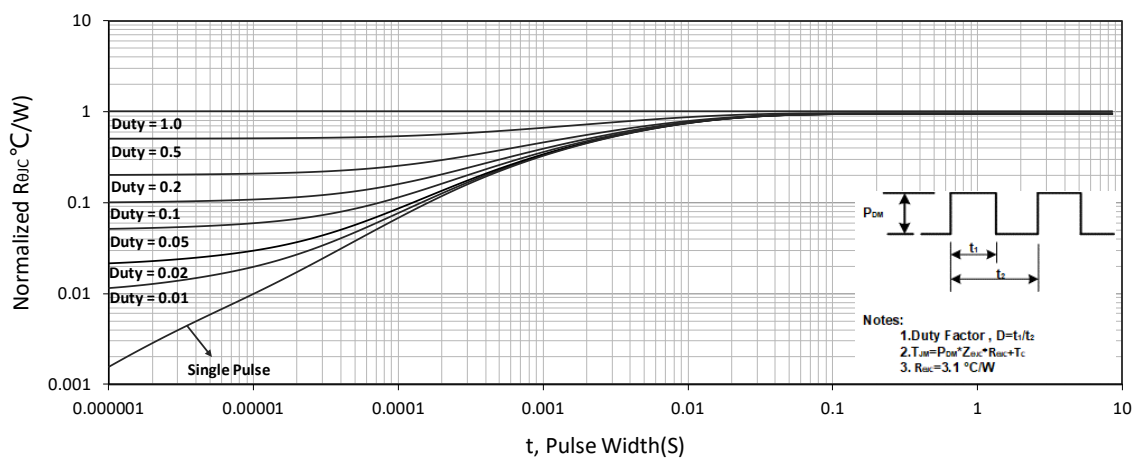


Figure 11. Normalized Maximum Transient Thermal Impedance



## Test Circuit

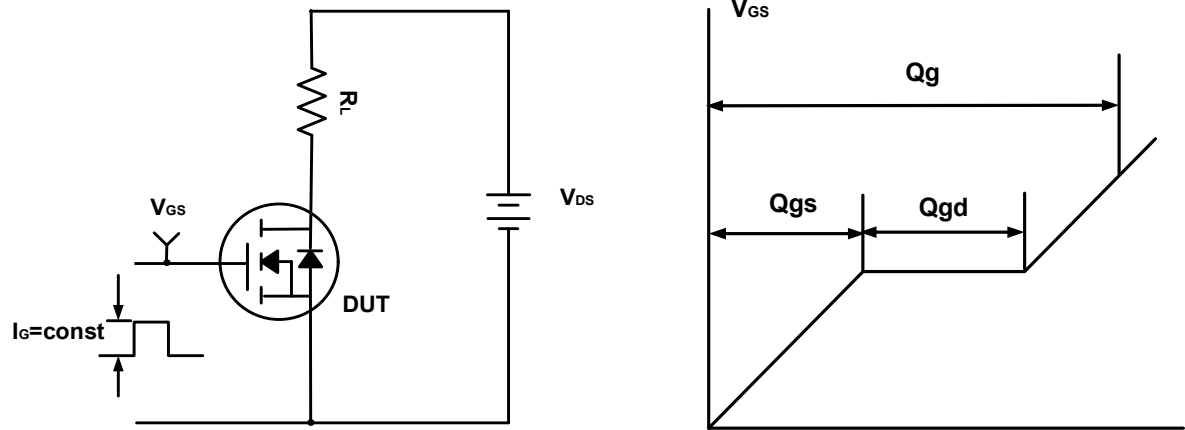


Figure A. Gate Charge Test Circuit & Waveforms

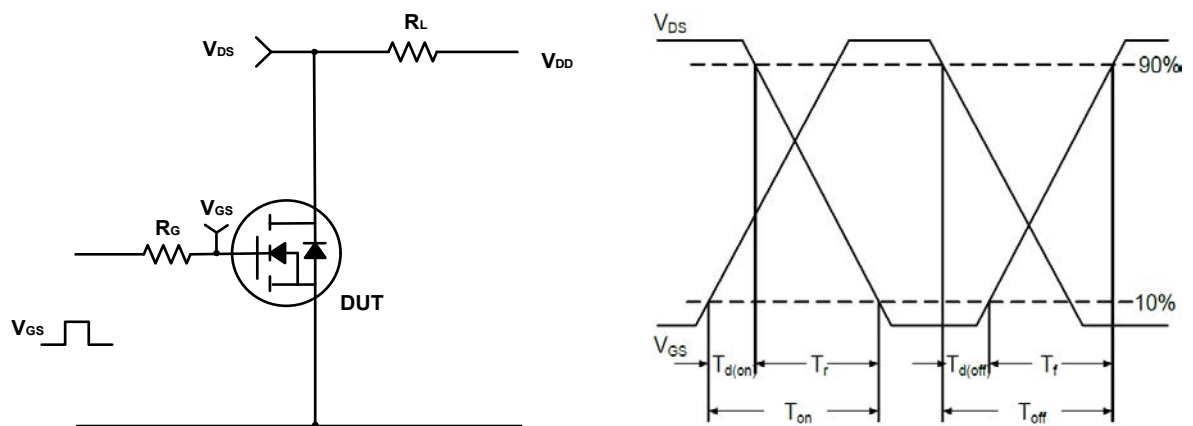


Figure B. Switching Test Circuit & Waveforms

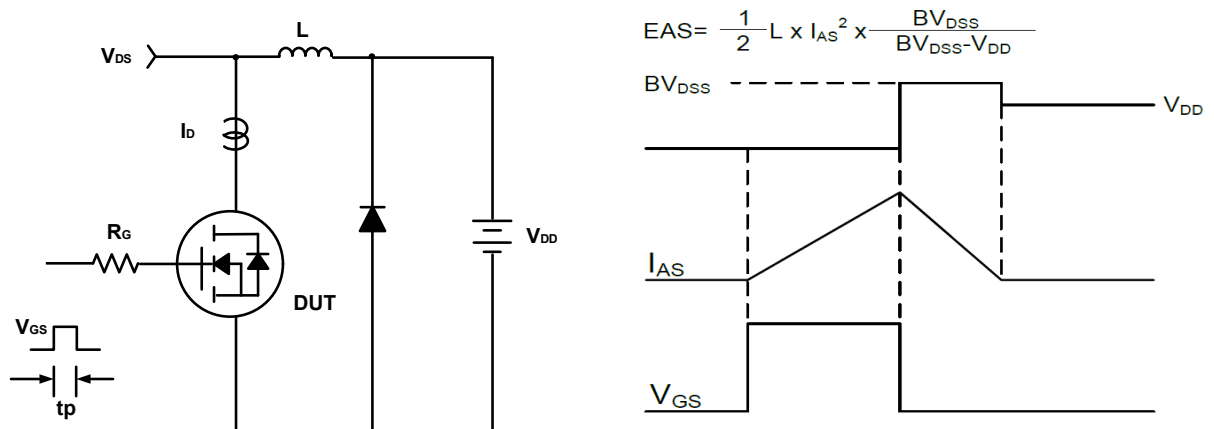
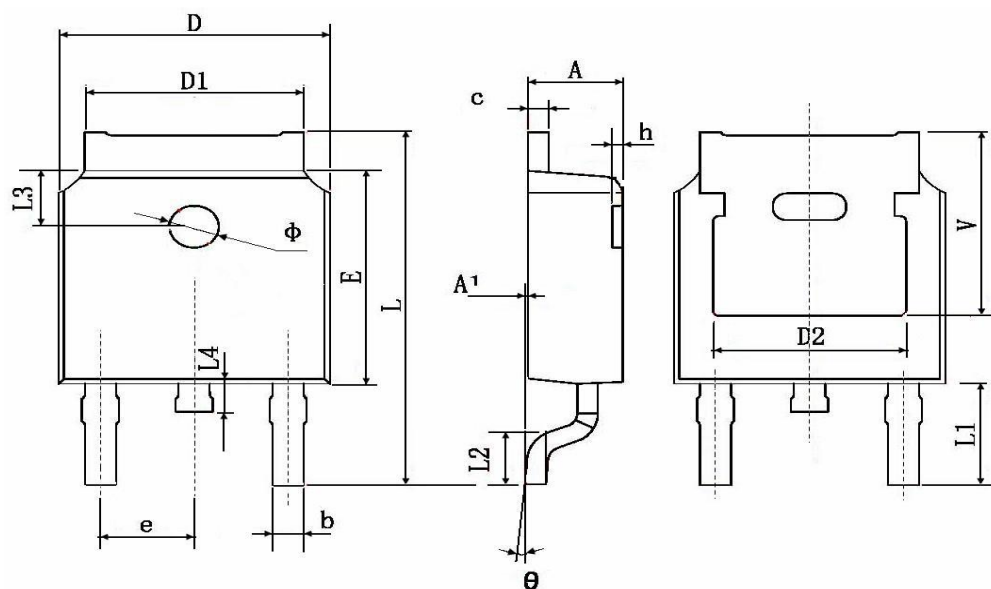


Figure C. Unclamped Inductive Switching Circuit & Waveforms



## TO252-2L Package Information



| Symbol | Dimensions In Millimeters |        | Dimensions In Inches |       |
|--------|---------------------------|--------|----------------------|-------|
|        | Min.                      | Max.   | Min.                 | Max.  |
| A      | 2.200                     | 2.400  | 0.087                | 0.094 |
| A1     | 0.000                     | 0.127  | 0.000                | 0.005 |
| b      | 0.660                     | 0.860  | 0.026                | 0.034 |
| c      | 0.460                     | 0.580  | 0.018                | 0.023 |
| D      | 6.500                     | 6.700  | 0.256                | 0.264 |
| D1     | 5.100                     | 5.460  | 0.201                | 0.215 |
| D2     | 4.830 TYP.                |        | 0.190 TYP.           |       |
| E      | 6.000                     | 6.200  | 0.236                | 0.244 |
| e      | 2.186                     | 2.386  | 0.086                | 0.094 |
| L      | 9.800                     | 10.400 | 0.386                | 0.409 |
| L1     | 2.900 TYP.                |        | 0.114 TYP.           |       |
| L2     | 1.400                     | 1.700  | 0.055                | 0.067 |
| L3     | 1.600 TYP.                |        | 0.063 TYP.           |       |
| L4     | 0.600                     | 1.000  | 0.024                | 0.039 |
| Φ      | 1.100                     | 1.300  | 0.043                | 0.051 |
| θ      | 0°                        | 8°     | 0°                   | 8°    |
| h      | 0.000                     | 0.300  | 0.000                | 0.012 |
| V      | 5.350 TYP.                |        | 0.211 TYP.           |       |



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