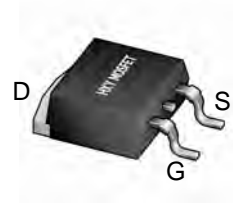




## Description

The IPD50N04S410ATMA1 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.



TO252-2L

## General Features

$V_{DS} = 40V$   $I_D = 60A$

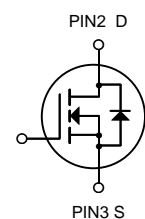
$R_{DS(ON)} < 10m\Omega$  @  $V_{GS}=10V$

## Application

Battery protection

Load switch

Uninterruptible power supply



N-Channel MOSFET

## Package Marking and Ordering Information

| Product ID        | Pack     | Brand      | Qty(PCS) |
|-------------------|----------|------------|----------|
| IPD50N04S410ATMA1 | TO252-2L | HXY MOSFET | 2500     |

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

| Symbol                | Parameter   | Rating     | Units        |
|-----------------------|---|------------|--------------|
| $V_{DS}$              | Drain-Source Voltage  | 40         | V            |
| $V_{GS}$              | Gate-Source Voltage   | $\pm 20$   | V            |
| $I_D@T_C=25^\circ C$  | Continuous Drain Current, $V_{GS}$ @ 10V <sup>1</sup>           | 60         | A            |
| $I_D@T_C=100^\circ C$ | Continuous Drain Current, $V_{GS}$ @ 10V <sup>1</sup>           | 40         | A            |
| $I_{DM}$              | Pulsed Drain Current <sup>2</sup>                               | 160        | A            |
| EAS                   | Single Pulse Avalanche Energy <sup>3</sup>                      | 46.1       | mJ           |
| $I_{AS}$              | Avalanche Current   | 28         | A            |
| $P_D@T_C=25^\circ C$  | Total Power Dissipation <sup>4</sup>                            | 34.6       | W            |
| $T_{STG}$             | Storage Temperature Range                                       | -55 to 150 | $^\circ C$   |
| $T_J$                 | Operating Junction Temperature Range                            | -55 to 150 | $^\circ C$   |
| $R_{\theta JA}$       | Thermal Resistance Junction-ambient (Steady State) <sup>1</sup> | 62         | $^\circ C/W$ |
| $R_{\theta JC}$       | Thermal Resistance Junction-Case <sup>1</sup>                   | 3.8        | $^\circ C/W$ |



**Electrical Characteristics (T<sub>J</sub>=25°C unless otherwise specified)**

| Symbol   | Parameter   | Test Condition   | Min. | Typ. | Max. | Units |
|--|---|--|------|------|------|-------|
| Off Characteristic                                     |   |  |      |      |      |       |
| V <sub>(BR)DSS</sub>                                   | Drain-Source Breakdown Voltage                            | V <sub>GS</sub> =0V, I <sub>D</sub> =250μA   | 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 to 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                                 | 1.0  | 1.5  | 2.5  | V     |
| R <sub>DS(on)</sub>                                    | Static Drain-Source on-Resistance<br><small>note3</small> | V <sub>GS</sub> =10V, I <sub>D</sub> =30A  | -    | 7.7  | 10   | mΩ    |
|  |   | V <sub>GS</sub> =4.5V, I <sub>D</sub> =20A   | -    | 10   | 14   |       |
| Dynamic Characteristics                                |   |  |      |      |      |       |
| C <sub>iss</sub>                                       | Input Capacitance   | V <sub>DS</sub> =20V, V <sub>GS</sub> =0V,<br>f=1.0MHz                                   | -    | 1639 | -    | pF    |
| C <sub>oss</sub>                                       | Output Capacitance  |  | -    | 148  | -    | pF    |
| C <sub>rss</sub>                                       | Reverse Transfer Capacitance                              |  | -    | 122  | -    | pF    |
| Q <sub>g</sub>   | Total Gate Charge   | V <sub>DS</sub> =20V, I <sub>D</sub> =15A,<br>V <sub>GS</sub> =4.5V                      | -    | 16   | -    | nC    |
| Q <sub>gs</sub>  | Gate-Source Charge  |  | -    | 5    | -    | nC    |
| Q <sub>gd</sub>  | Gate-Drain(“Miller”) Charge                               |  | -    | 7    | -    | nC    |
| Switching Characteristics                              |   |  |      |      |      |       |
| t <sub>d(on)</sub>                                     | Turn-on Delay Time  | V <sub>DS</sub> =20V,I <sub>D</sub> =1A,<br>R <sub>GEN</sub> =6.2Ω, V <sub>GS</sub> =10V | -    | 10   | -    | ns    |
| t <sub>r</sub>   | Turn-on Rise Time   |  | -    | 6    | -    | ns    |
| t <sub>d(off)</sub>                                    | Turn-off Delay Time                                       |  | -    | 50   | -    | ns    |
| t <sub>f</sub>   | Turn-off Fall Time  |  | -    | 26   | -    | ns    |
| Drain-Source Diode Characteristics and Maximum Ratings |   |  |      |      |      |       |
| I <sub>S</sub>   | Maximum Continuous Drain to Source Diode Forward Current  |  | -    | -    | 60   | A     |
| I <sub>SM</sub>  | Maximum Pulsed Drain to Source Diode Forward Current      |  | -    | -    | 160  | A     |
| V <sub>SD</sub>  | Drain to Source Diode Forward Voltage                     | V <sub>GS</sub> =0V, I <sub>S</sub> =30A   | -    | -    | 1.2  | V     |
| t <sub>rr</sub>  | Body Diode Reverse Recovery Time                          | I <sub>F</sub> =5A,dI/dt=100A/μs   | -    | 13   | -    | ns    |
| Q <sub>rr</sub>  | Body Diode Reverse Recovery Charge                        |  | -    | 7    | -    | nC    |

Notes:1. Repetitive Rating: Pulse Width Limited by Maximum Junction Temperature

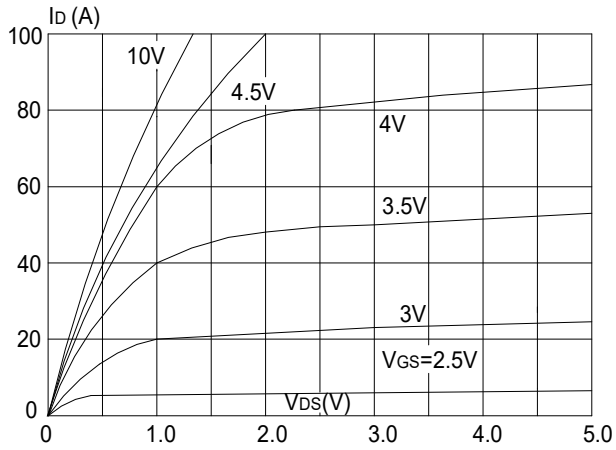
2. EAS condition: T<sub>J</sub>=25°C, V<sub>GS</sub>=20V, R<sub>G</sub>=25Ω, L=0.5mH, I<sub>AS</sub>=13A

3. Pulse Test: Pulse Width≤300μs, Duty Cycle≤0.5%

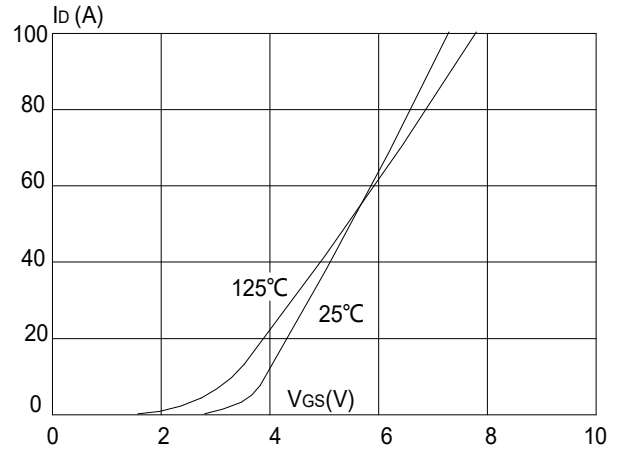


## Typical Performance Characteristics

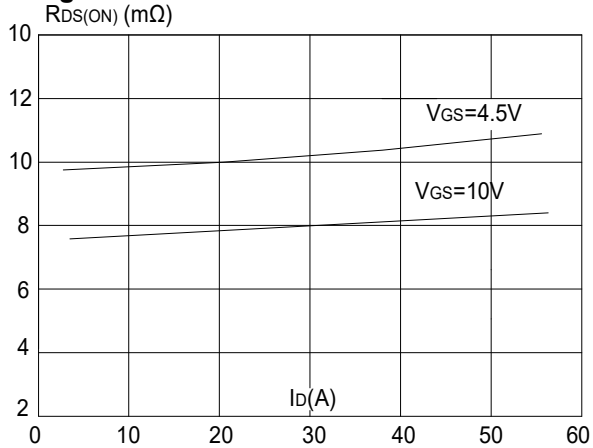
**Figure1: Output Characteristics**



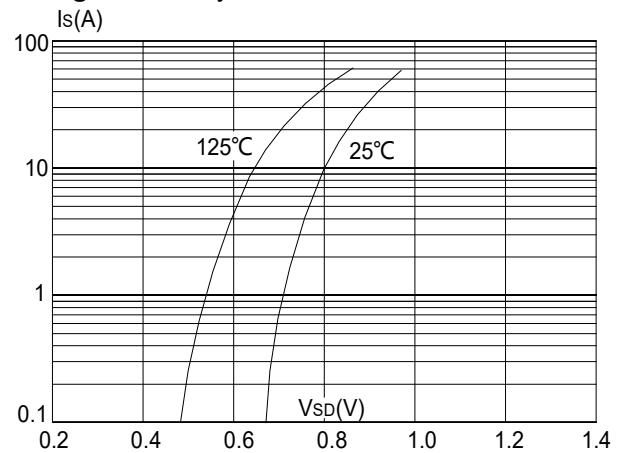
**Figure 2: Typical Transfer Characteristics**



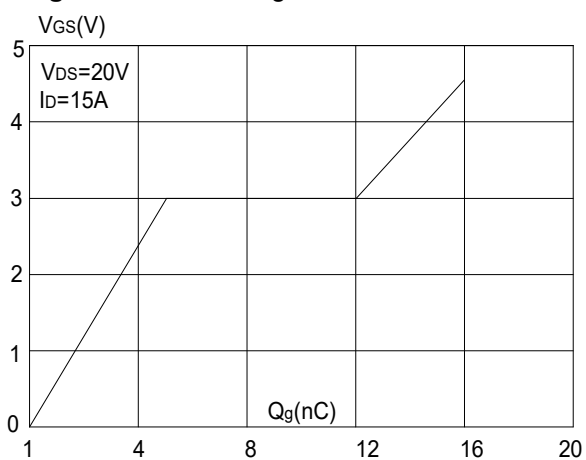
**Figure 3: On-resistance vs. Drain Current**



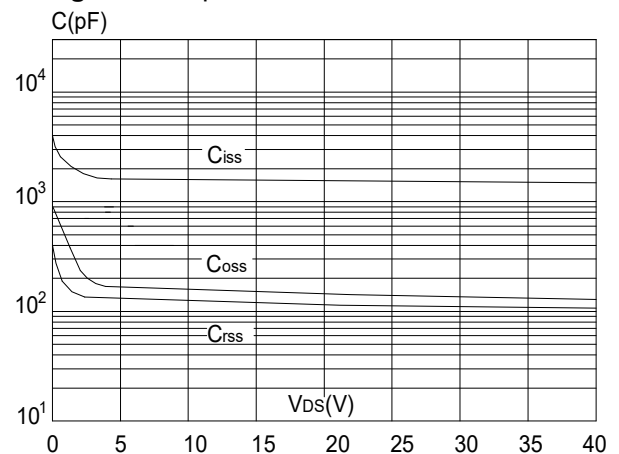
**Figure 4: Body Diode Characteristics**



**Figure 5: Gate Charge Characteristics**

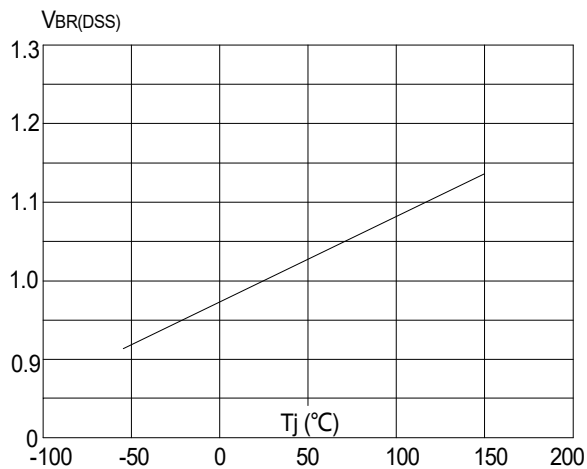


**Figure 6: Capacitance Characteristics**

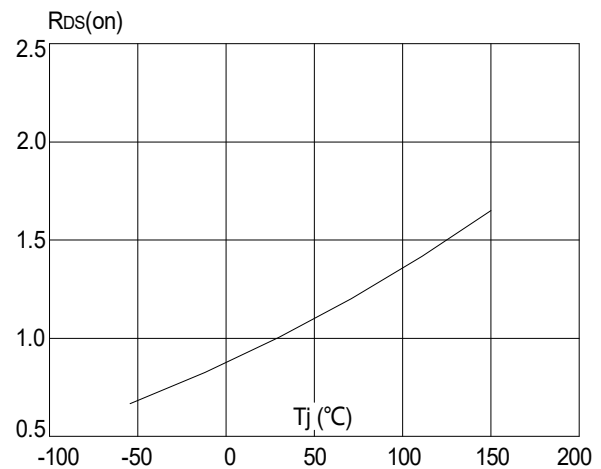




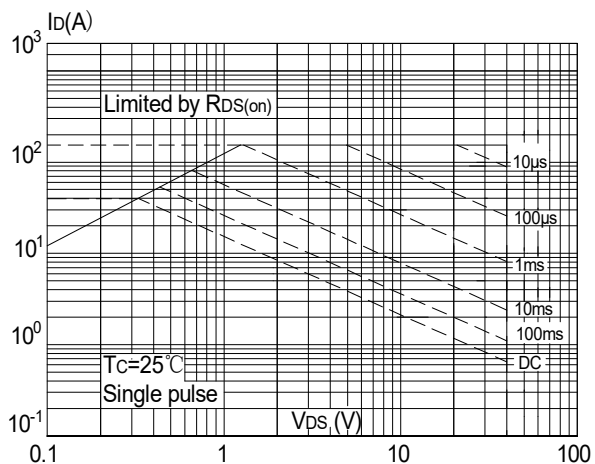
**Figure 7:** Normalized Breakdown Voltage vs. Junction Temperature



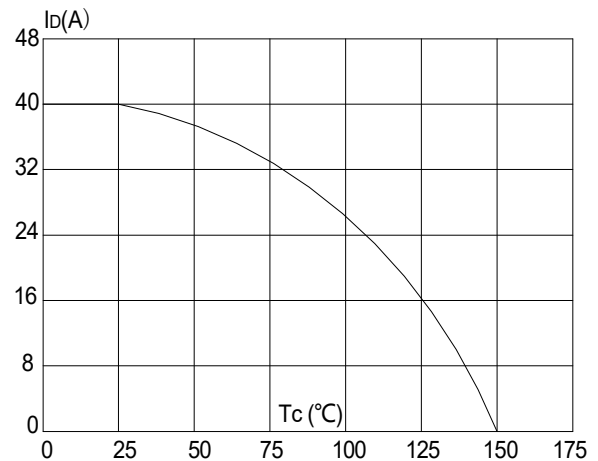
**Figure 8:** Normalized on Resistance vs. Junction Temperature



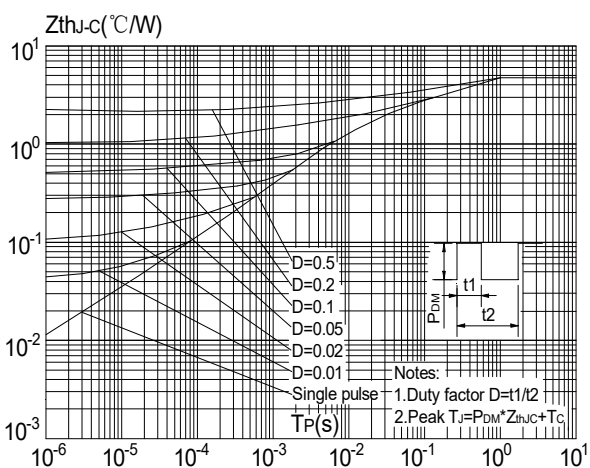
**Figure 9:** Maximum Safe Operating Area



**Figure 10:** Maximum Continuous Drain Current vs. Case Temperature



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





## Test Circuit

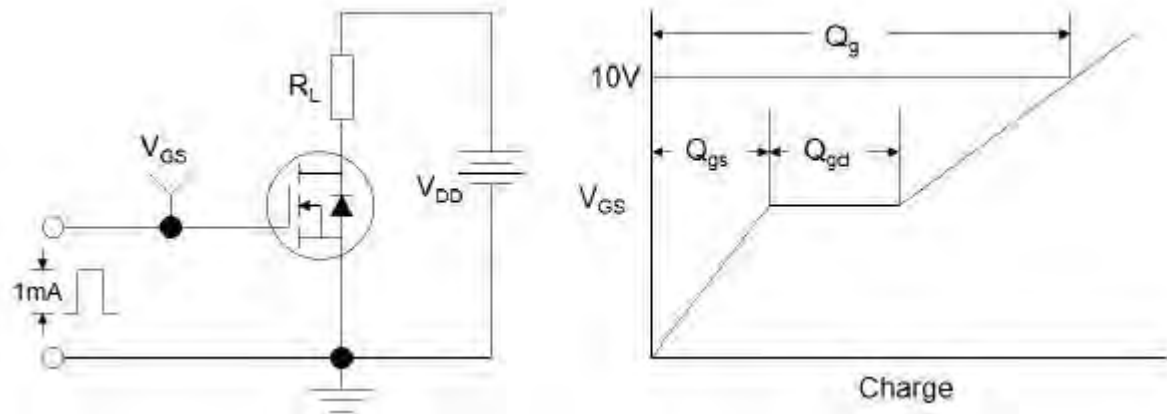


Figure1:Gate Charge Test Circuit & Waveform

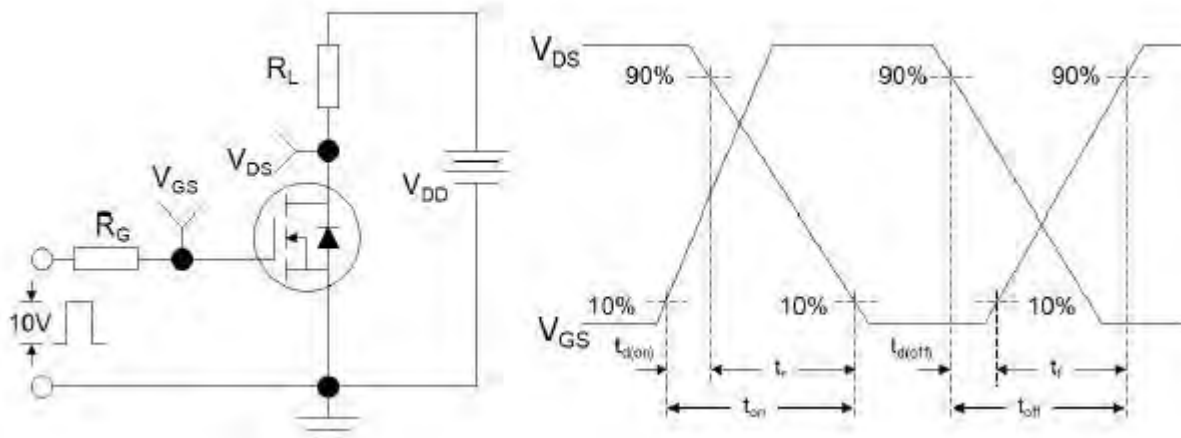


Figure 2: Resistive Switching Test Circuit & Waveforms

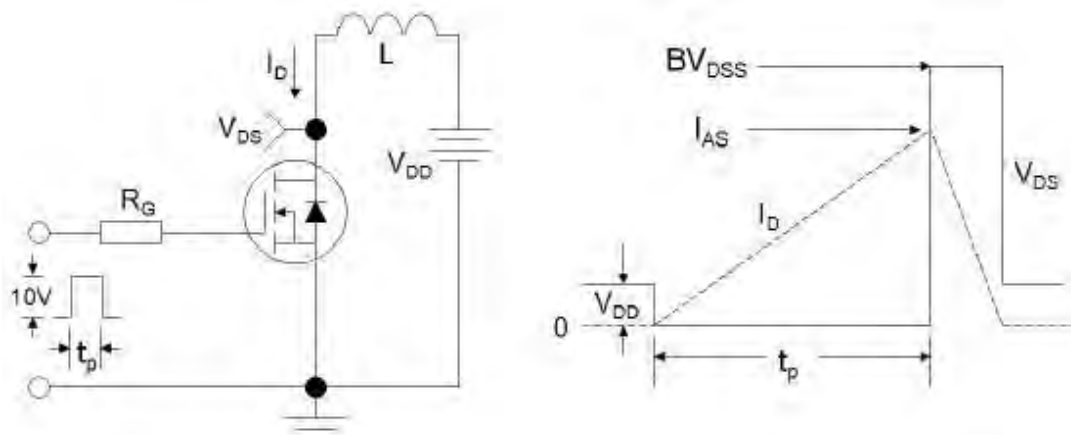
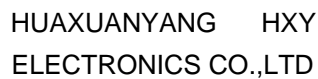
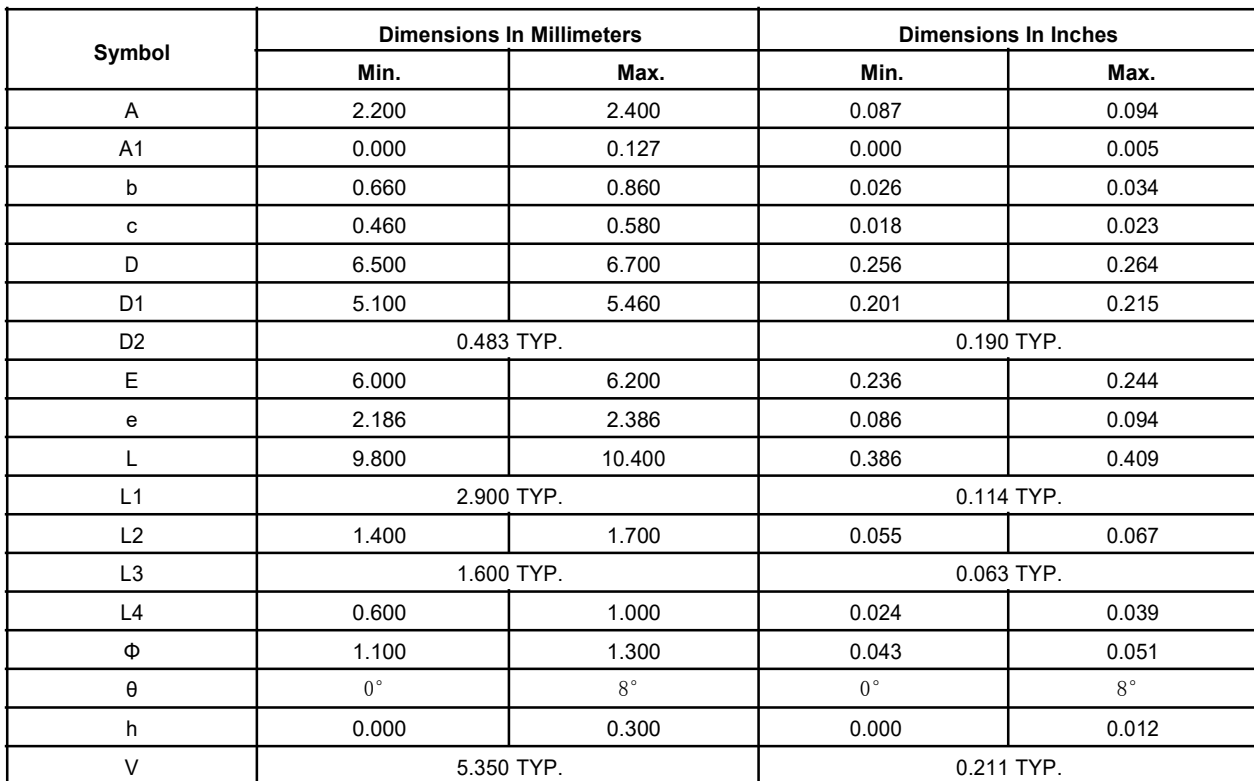


Figure 3:Unclamped Inductive Switching Test Circuit & Waveforms



**IPD50N04S410ATMA1**  
N-Channel Enhancement Mode MOSFET

## TO-252 Package Information





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