Dec 2016

SemiHow
Know-How for Semiconductor

# HRLF53N06H

## 60V N-Channel Trench MOSFET

### Features

- ❑ Optimized for High Speed Switching, Logic Level
- ❑ Enhanced Body diode dv/dt capability
- ❑ Enhanced Avalanche Ruggedness
- ❑ 100% UIS Tested, 100% Rg Tested
- ❑ Lead free, Halogen Free

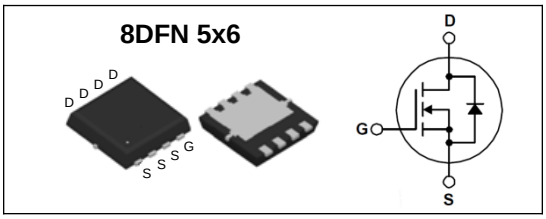
### Application

- ❑ Synchronous Rectification in SMPS
- ❑ Hard Switching and High Speed Circuit
- ❑ DC/DC in Telecoms and Industrial

### Key Parameters

| Parameter | Value | Unit |
|---|---|---|
| $BV_{DSS}$ | 60 | V |
| $I_D$ | 90 | A |
| $R_{DS(on),\ typ\ @10V}$ | 4.1 | mΩ |
| $R_{DS(on),\ typ\ @4.5V}$ | 5.6 | mΩ |

### Package & Internal Circuit




### Absolute Maximum Ratings

$T_J$=25℃ unless otherwise specified

| Symbol | Parameter | | Value | Units |
|---|---|---|---|---|
| $V_{DSS}$ | Drain-Source Voltage | | 60 | V |
| $V_{GS}$ | Gate-Source Voltage | | ±20 | V |
| $I_D$ | Drain Current | $T_C$ = 25℃ | 90 | A |
| | | $T_C$ = 100℃ | 57 | A |
| $I_{DM}$ | Pulsed Drain Current | | 250 | A |
| $E_{AS}$ | Single Pulsed Avalanche Energy | L=1mH | 80 | mJ |
| $P_D$ | Power Dissipation | $T_C$ = 25℃ | 83 | W |
| | | $T_A$ = 25℃ | 2.0 | W |
| $T_J$, $T_{STG}$ | Operating and Storage Temperature Range | | -55 to +150 | ℃ |

### Thermal Resistance Characteristics

| Symbol | Parameter | Typ. | Max. | Units |
|---|---|---|---|---|
| $R_{\theta JC}$ | Junction-to-Case | -- | 1.5 | ℃/W |
| $R_{\theta JA}$ | Junction-to-Ambient (steady state) | -- | 62 | ℃/W |

## Electrical Characteristics $T_J$=25 °C unless otherwise specified

| Symbol | Parameter | Test Conditions | Min | Typ | Max | Units |
|---|---|---|---|---|---|---|
| **On Characteristics** | | | | | | |
| $V_{GS}$ | Gate Threshold Voltage | $V_{DS}$ = $V_{GS}$, $I_D$ = 250 μA | 1.0 | -- | 3.0 | V |
| $R_{DS(ON)}$ | Static Drain-Source On-Resistance | $V_{GS}$ = 10 V, $I_D$ = 20 A | -- | 4.1 | 5.3 | mΩ |
| | | $V_{GS}$ = 4.5 V, $I_D$ = 20 A | -- | 5.6 | 7.5 | mΩ |
| $g_{FS}$ | Forward Transconductance | $V_{DS}$ = 5 V, $I_D$ = 20 A | -- | 48 | -- | S |
| **Off Characteristics** | | | | | | |
| $BV_{DSS}$ | Drain-Source Breakdown Voltage | $V_{GS}$ = 0 V, $I_D$ = 250 μA | 60 | -- | -- | V |
| $I_{DSS}$ | Zero Gate Voltage Drain Current | $V_{DS}$ = 60 V, $V_{GS}$ = 0 V | -- | -- | 1 | μA |
| | | $V_{DS}$ = 60 V, $T_J$ = 100℃ | -- | -- | 100 | μA |
| $I_{GSS}$ | Gate-Body Leakage Current | $V_{GS}$ = ±20 V, $V_{DS}$ = 0 V | -- | -- | ±100 | nA |
| **Dynamic Characteristics** | | | | | | |
| $C_{iss}$ | Input Capacitance | $V_{DS}$ = 30 V, $V_{GS}$ = 0 V, f = 1.0 MHz | -- | 2274 | -- | pF |
| $C_{oss}$ | Output Capacitance | | -- | 793 | -- | pF |
| $C_{rss}$ | Reverse Transfer Capacitance | | -- | 35 | -- | pF |
| $R_g$ | Gate Resistance | $V_{GS}$ = 0 V, $V_{DS}$ = 0 V, f = 1MHz | -- | 1.5 | -- | Ω |
| **Switching Characteristics** | | | | | | |
| $t_{d(on)}$ | Turn-On Time | $V_{DS}$ = 30 V, $I_D$ = 20 A, $R_G$ = 10 Ω | -- | 11 | -- | ns |
| $t_r$ | Turn-On Rise Time | | -- | 7 | -- | ns |
| $t_{d(off)}$ | Turn-Off Delay Time | | -- | 35 | -- | ns |
| $t_f$ | Turn-Off Fall Time | | -- | 10 | -- | ns |
| $Q_{g\ (10V)}$ | Total Gate Charge | $V_{DS}$ = 30 V, $I_D$ = 20 A, $V_{GS}$ = 10 V | -- | 36 | -- | nC |
| $Q_{g\ (4.5V)}$ | Total Gate Charge | | -- | 18 | -- | nC |
| $Q_{gs}$ | Gate-Source Charge | | -- | 4.5 | -- | nC |
| $Q_{gd}$ | Gate-Drain Charge | | -- | 7.5 | -- | nC |
| **Source-Drain Diode Maximum Ratings and Characteristics** | | | | | | |
| $I_S$ | Continuous Source-Drain Diode Forward Current | | -- | -- | 90 | A |
| $I_{SM}$ | Pulsed Source-Drain Diode Forward Current | | -- | -- | 250 | |
| $V_{SD}$ | Source-Drain Diode Forward Voltage | $I_S$ = 20 A, $V_{GS}$ = 0 V | -- | 0.9 | 1.2 | V |
| trr | Reverse Recovery Time | $I_S$ = 20 A, $V_R$ = 30 V, $di_F/dt$ = 300 A/μs | -- | 30 | -- | ns |
| Qrr | Reverse Recovery Charge | | -- | 53 | -- | nC |

## Typical Characteristics

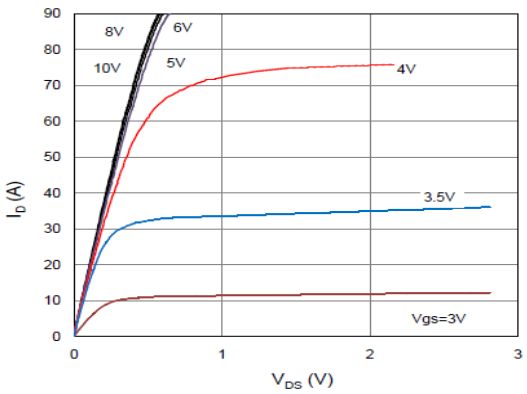



**Figure 1. On Region Characteristics**

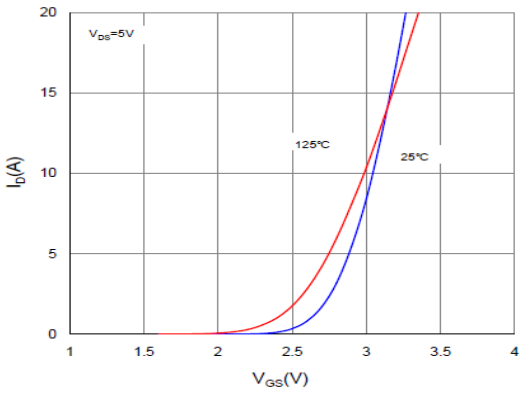



**Figure 2. Transfer Characteristics**

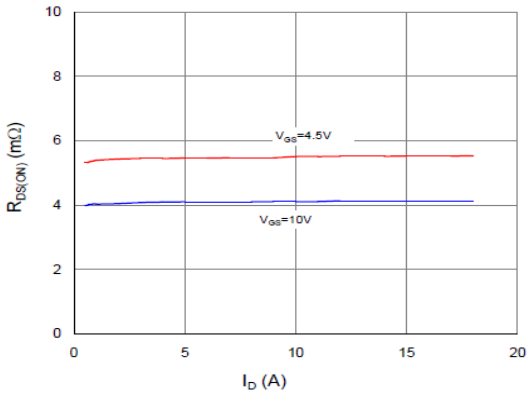



**Figure 3. On Resistance Variation vs Drain Current and Gate Voltage**

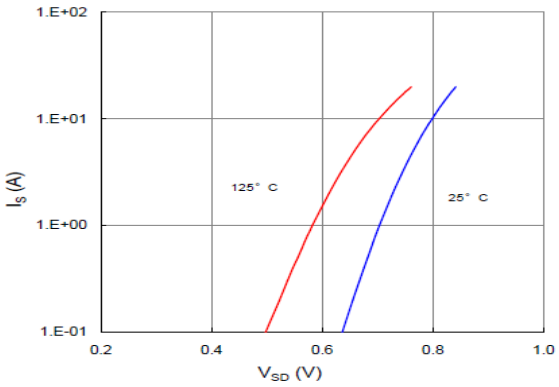



**Figure 4. Body Diode Forward Voltage Variation with Source Current and Temperature**

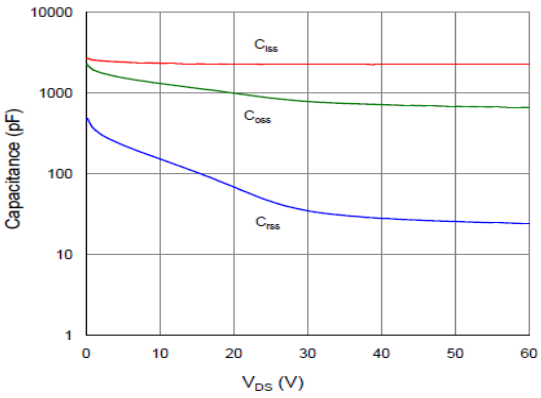



**Figure 5. Capacitance Characteristics**

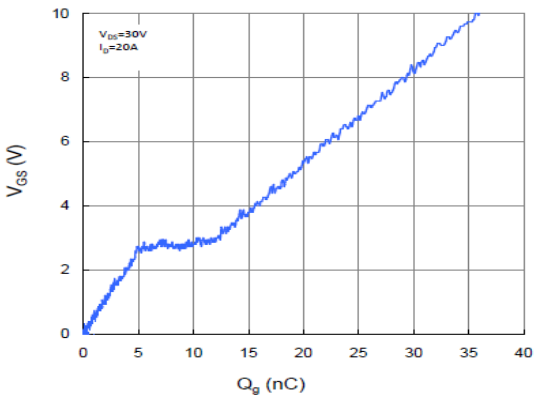



**Figure 6. Gate Charge Characteristics**

## Typical Characteristics (continued)

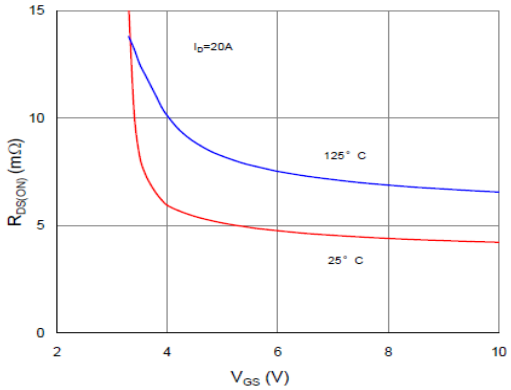



**Figure 7. On-Resistance Variation vs Gate-Source Voltage**

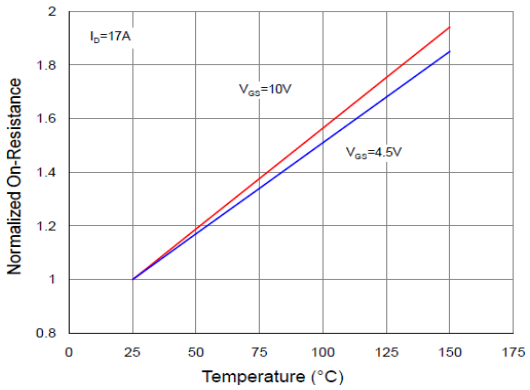



**Figure 8. On-Resistance Variation vs Temperature**

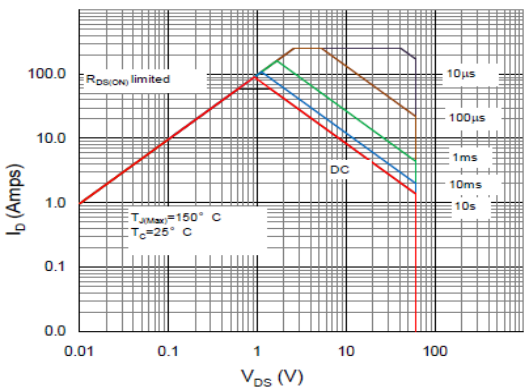



**Figure 9. Maximum Safe Operating Area**

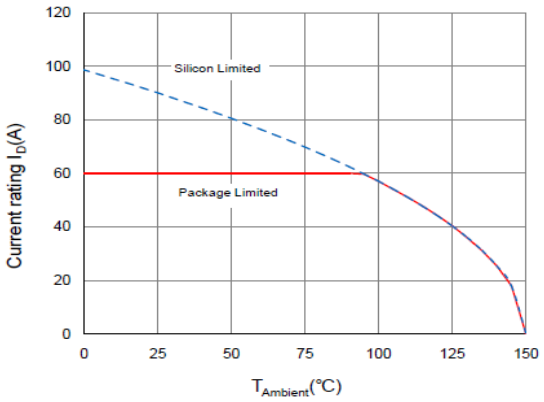



**Figure 10. Maximum Drain Current vs Case Temperature**

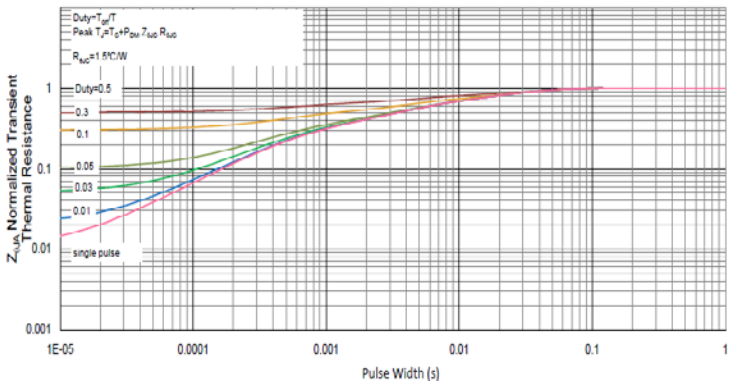



**Figure 11. Transient Thermal Response Curve**

**Fig 12. Gate Charge Test Circuit & Waveform**

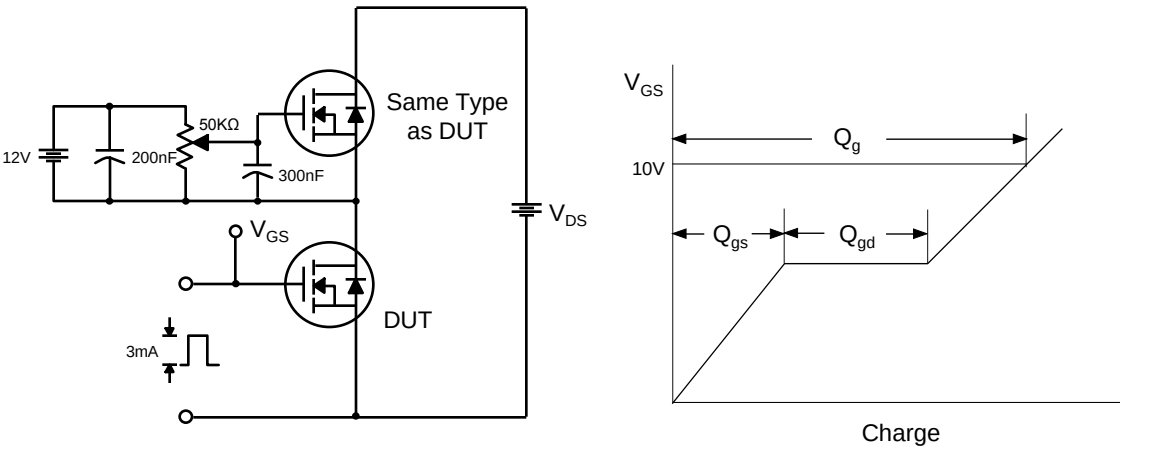



**Fig 13. Resistive Switching Test Circuit & Waveforms**

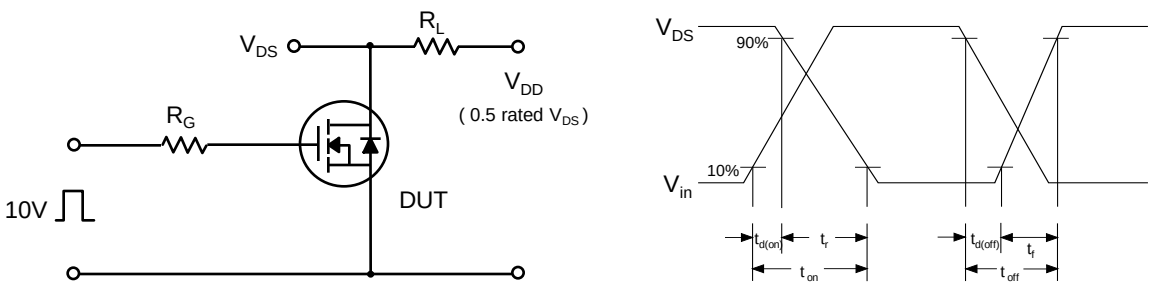



**Fig 14. Unclamped Inductive Switching Test Circuit & Waveforms**

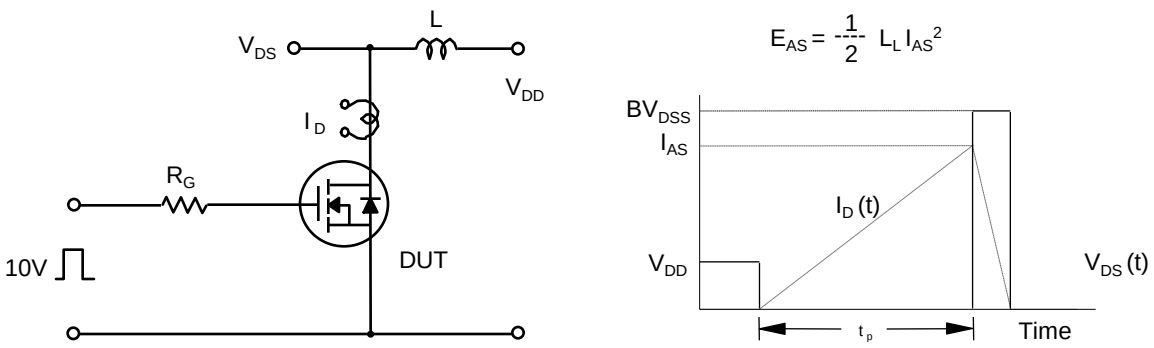
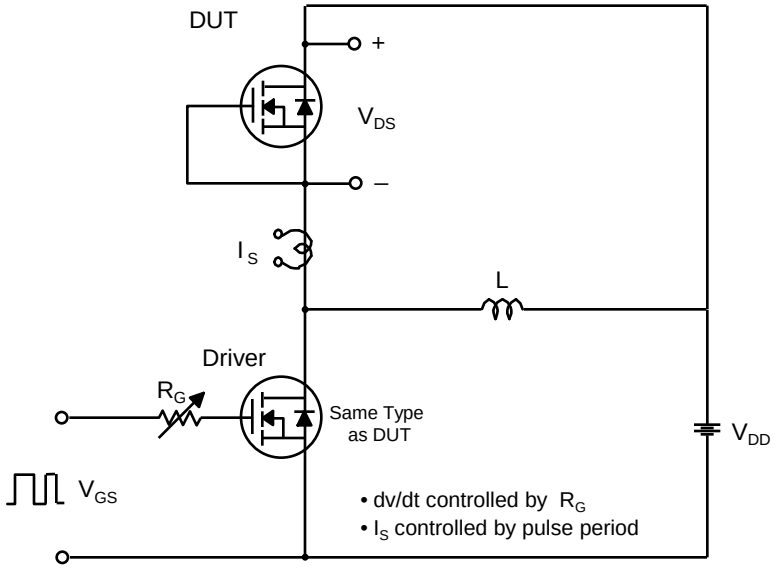
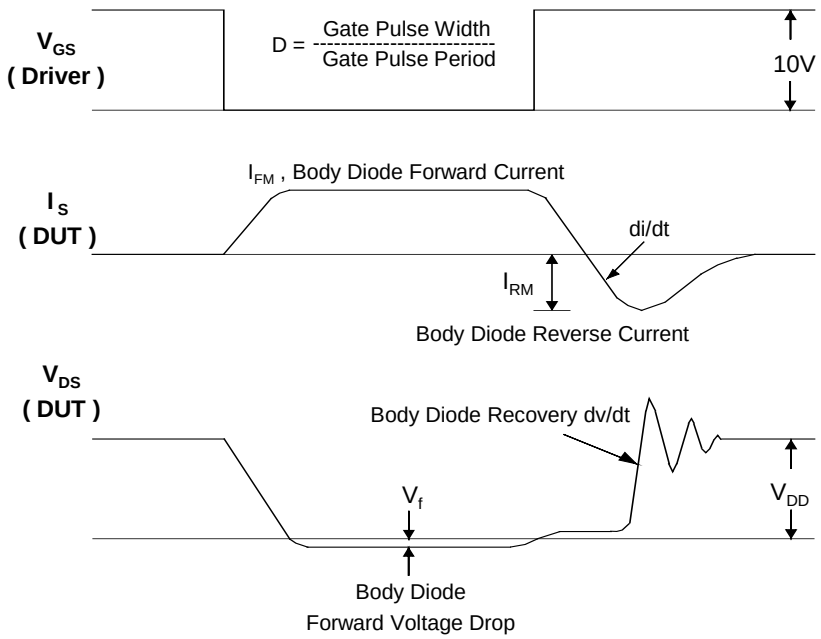


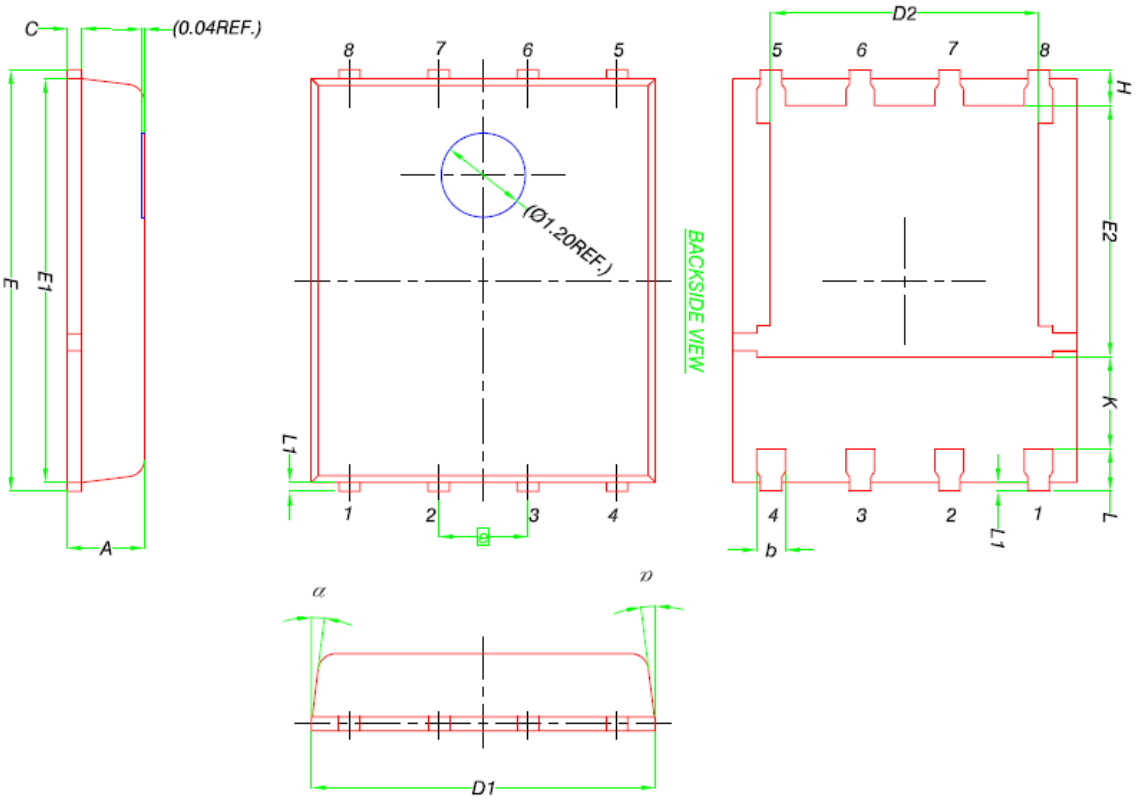
**Fig 15. Peak Diode Recovery dv/dt Test Circuit & Waveforms**



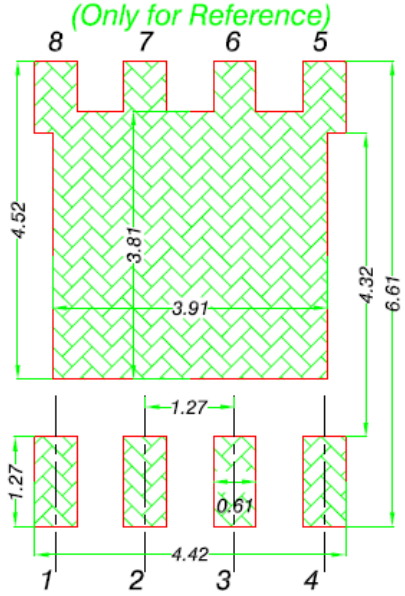
## Package Dimension

# 8DFN 5x6




| DIM. | MILLIMETERS | | |
|---|---|---|---|
| | MIN. | NOM. | MAX. |
| A | 0.90 | 1.00 | 1.10 |
| b | 0.33 | 0.41 | 0.51 |
| C | 0.20 | 0.25 | 0.30 |
| D1 | 4.80 | 4.90 | 5.00 |
| D2 | 3.61 | 3.81 | 3.96 |
| E | 5.90 | 6.00 | 6.10 |
| E1 | 5.70 | 5.75 | 5.80 |
| E2 | 3.38 | 3.58 | 3.78 |
| e | 1.27 BSC | | |
| H | 0.41 | 0.51 | 0.61 |
| K | 1.10 | - | - |
| L | 0.51 | 0.61 | 0.71 |
| L1 | 0.06 | 0.13 | 0.20 |
| α | 0° | - | 12° |

Land Pattern
(Only for Reference)



## Revision History

| VERSION | DESCRIPTION | DATE | APPROVED |
|---|---|---|---|
| 0 | Initiate specification | 20161208 | YGCHO |
| 1 | | | |
| 2 | | | |
| 3 | | | |
| 4 | | | |
| 5 | | | |
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