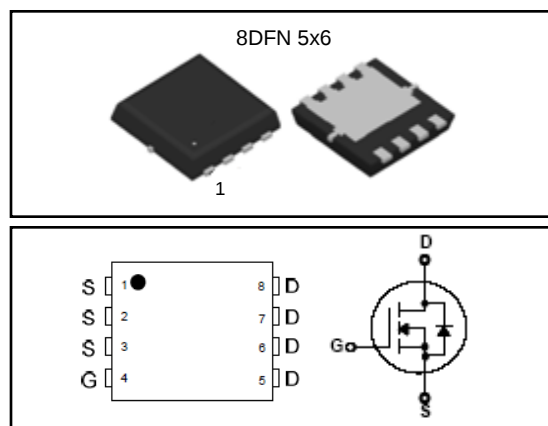


# HRF140N06K

## 60V N-Channel Trench MOSFET

### FEATURES

- ❑  $BV_{DSS} = 60\text{ V}$
- ❑  $I_D = 40\text{ A}$
- ❑ Unrivalled Gate Charge : 40 nC (Typ.)
- ❑ Lower  $R_{DS(ON)}$  : 11.5 mΩ (Typ.) @  $V_{GS}=10\text{V}$
- ❑ 100% Avalanche Tested



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

| Symbol         | Parameter                                                                     | Value       | Units            |
|----------------|-------------------------------------------------------------------------------|-------------|------------------|
| $V_{DSS}$      | Drain-Source Voltage                                                          | 60          | V                |
| $I_D$          | Drain Current – Continuous ( $T_C = 25^\circ\text{C}$ )                       | 40 *        | A                |
|                | Drain Current – Continuous ( $T_C = 100^\circ\text{C}$ )                      | 28 *        | A                |
| $I_{DM}$       | Drain Current – Pulsed (Note 1)                                               | 140 *       | A                |
| $V_{GS}$       | Gate-Source Voltage                                                           | $\pm 20$    | V                |
| $E_{AS}$       | Single Pulsed Avalanche Energy (Note 2)                                       | 145         | mJ               |
| $E_{AR}$       | Repetitive Avalanche Energy (Note 1)                                          | 3.3         | mJ               |
| $P_D$          | Power Dissipation ( $T_C = 25^\circ\text{C}$ )                                | 33          | W                |
|                | Power Dissipation ( $T_A = 25^\circ\text{C}$ )                                | 2.4         | W                |
| $T_J, T_{STG}$ | Operating and Storage Temperature Range                                       | -55 to +175 | $^\circ\text{C}$ |
| $T_L$          | Maximum lead temperature for soldering purposes, 1/8" from case for 5 seconds | 300         | $^\circ\text{C}$ |

\* Drain current limited by maximum junction temperature

### Thermal Resistance Characteristics

| Symbol          | Parameter           | Typ. | Max. | Units              |
|-----------------|---------------------|------|------|--------------------|
| $R_{\theta JA}$ | Junction-to-Ambient | --   | 62   | $^\circ\text{C/W}$ |
| $R_{\theta JC}$ | Junction-to-Case    | --   | 4.5  |                    |

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

| Symbol                    | Parameter                         | Test Conditions                             | Min | Typ  | Max | Units      |
|---------------------------|-----------------------------------|---------------------------------------------|-----|------|-----|------------|
| <b>On Characteristics</b> |                                   |                                             |     |      |     |            |
| $V_{GS}$                  | Gate Threshold Voltage            | $V_{DS} = V_{GS}, I_D = 250\ \mu\text{A}$   | 2.2 | --   | 3.8 | V          |
| $R_{DS(ON)}$              | Static Drain-Source On-Resistance | $V_{GS} = 10\ \text{V}, I_D = 15\ \text{A}$ | --  | 11.5 | 14  | m $\Omega$ |
| $g_{FS}$                  | Forward Transconductance          | $V_{DS} = 20, I_D = 15\ \text{A}$           | --  | 60   | --  | S          |

**Off Characteristics**

|            |                                 |                                                   |    |    |           |               |
|------------|---------------------------------|---------------------------------------------------|----|----|-----------|---------------|
| $BV_{DSS}$ | Drain-Source Breakdown Voltage  | $V_{GS} = 0\ \text{V}, I_D = 250\ \mu\text{A}$    | 60 | -- | --        | V             |
| $I_{DSS}$  | Zero Gate Voltage Drain Current | $V_{DS} = 48\ \text{V}, V_{GS} = 0\ \text{V}$     | -- | -- | 1         | $\mu\text{A}$ |
|            |                                 | $V_{DS} = 48\ \text{V}, T_J = 125^\circ\text{C}$  | -- | -- | 100       | $\mu\text{A}$ |
| $I_{GSS}$  | Gate-Body Leakage Current       | $V_{GS} = \pm 20\ \text{V}, V_{DS} = 0\ \text{V}$ | -- | -- | $\pm 100$ | nA            |

**Dynamic Characteristics**

|           |                              |                                                                         |    |      |    |          |
|-----------|------------------------------|-------------------------------------------------------------------------|----|------|----|----------|
| $C_{iss}$ | Input Capacitance            | $V_{DS} = 25\ \text{V}, V_{GS} = 0\ \text{V},$<br>$f = 1.0\ \text{MHz}$ | -- | 2150 | -- | pF       |
| $C_{oss}$ | Output Capacitance           |                                                                         | -- | 200  | -- | pF       |
| $C_{rss}$ | Reverse Transfer Capacitance |                                                                         | -- | 130  | -- | pF       |
| $R_g$     | Gate Resistance              | $V_{GS} = 0\ \text{V}, V_{DS} = 0\ \text{V}, f = 1\text{MHz}$           | -- | 1.6  | -- | $\Omega$ |

**Switching Characteristics**

|              |                     |                                                                         |    |     |    |    |
|--------------|---------------------|-------------------------------------------------------------------------|----|-----|----|----|
| $t_{d(on)}$  | Turn-On Time        | $V_{DS} = 30\ \text{V}, I_D = 15\ \text{A},$<br>$R_G = 6\ \Omega$       | -- | 30  | -- | ns |
| $t_r$        | Turn-On Rise Time   |                                                                         | -- | 20  | -- | ns |
| $t_{d(off)}$ | Turn-Off Delay Time |                                                                         | -- | 120 | -- | ns |
| $t_f$        | Turn-Off Fall Time  |                                                                         | -- | 25  | -- | ns |
| $Q_g$        | Total Gate Charge   | $V_{DS} = 48\ \text{V}, I_D = 15\ \text{A},$<br>$V_{GS} = 10\ \text{V}$ | -- | 40  | -- | nC |
| $Q_{gs}$     | Gate-Source Charge  |                                                                         | -- | 10  | -- | nC |
| $Q_{gd}$     | Gate-Drain Charge   |                                                                         | -- | 13  | -- | nC |

**Source-Drain Diode Maximum Ratings and Characteristics**

|                 |                                               |                                                                                |    |    |     |    |
|-----------------|-----------------------------------------------|--------------------------------------------------------------------------------|----|----|-----|----|
| I <sub>S</sub>  | Continuous Source-Drain Diode Forward Current |                                                                                | -- | -- | 40  | A  |
| I <sub>SM</sub> | Pulsed Source-Drain Diode Forward Current     |                                                                                | -- | -- | 140 |    |
| V <sub>SD</sub> | Source-Drain Diode Forward Voltage            | I <sub>S</sub> = 15 A, V <sub>GS</sub> = 0 V                                   | -- | -- | 1.3 | V  |
| t <sub>rr</sub> | Reverse Recovery Time                         | I <sub>S</sub> = 15 A, V <sub>GS</sub> = 0 V<br>di <sub>F</sub> /dt = 100 A/μs | -- | 60 | --  | ns |
| Q <sub>rr</sub> | Reverse Recovery Charge                       |                                                                                | -- | 90 | --  | nC |

**Notes :**

1. Repetitive Rating : Pulse width limited by maximum junction temperature
2.  $L=1\text{mH}, I_{AS}=13\text{A}, V_{DD}=25\text{V}, R_G=25\Omega$ , Starting  $T_J=25^\circ\text{C}$

# Typical Characteristics

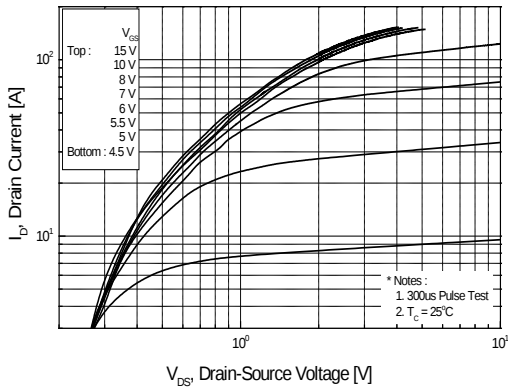


Figure 1. On Region Characteristics

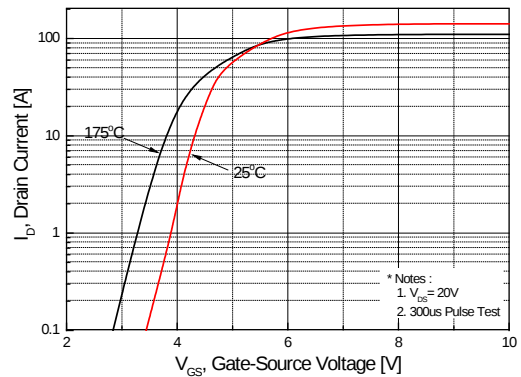


Figure 2. Transfer Characteristics

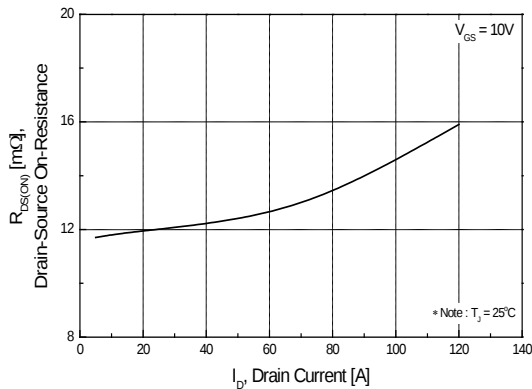


Figure 3. On Resistance Variation vs Drain Current and Gate Voltage

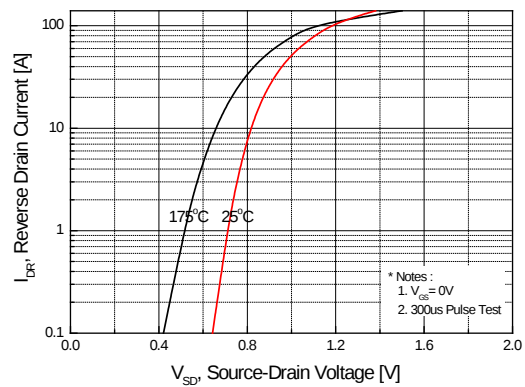


Figure 4. Body Diode Forward Voltage Variation with Source Current and Temperature

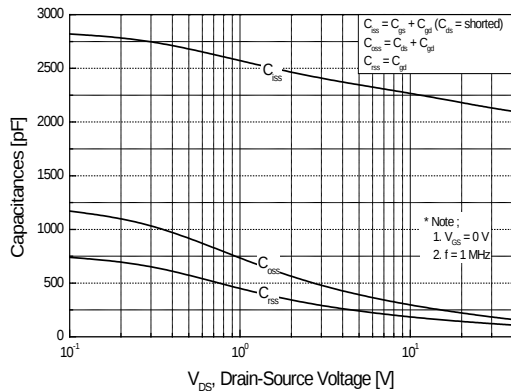


Figure 5. Capacitance Characteristics

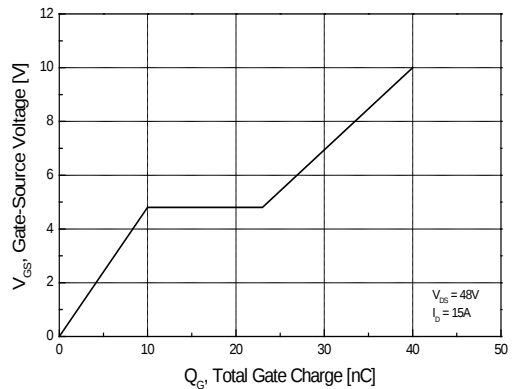
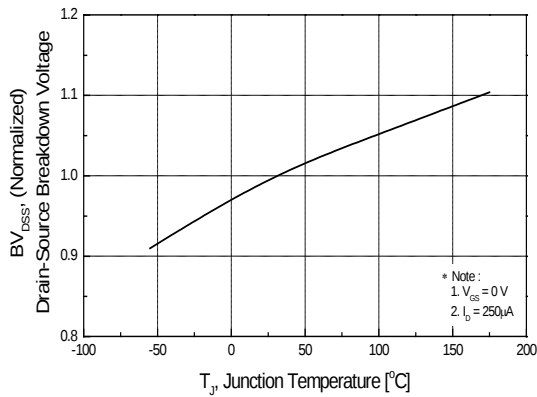
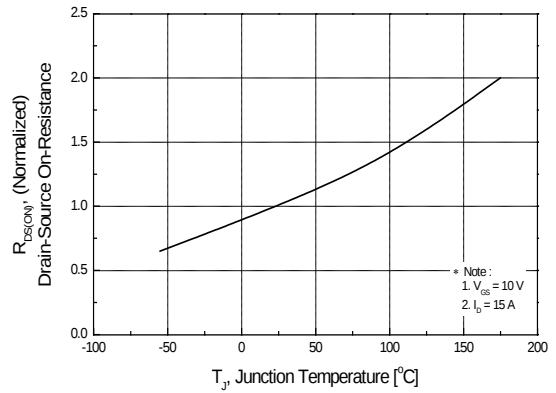


Figure 6. Gate Charge Characteristics

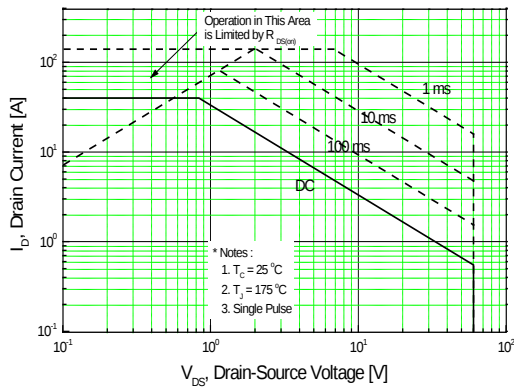
# Typical Characteristics (continued)



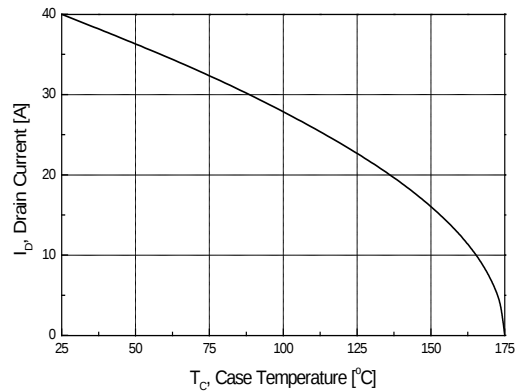
**Figure 7. Breakdown Voltage Variation vs Temperature**



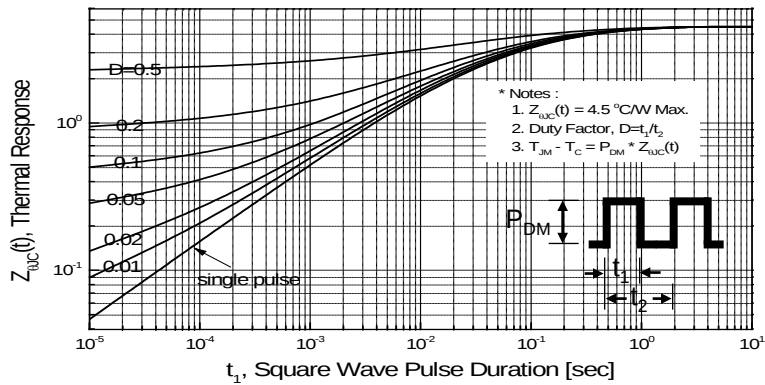
**Figure 8. On-Resistance Variation vs Temperature**



**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

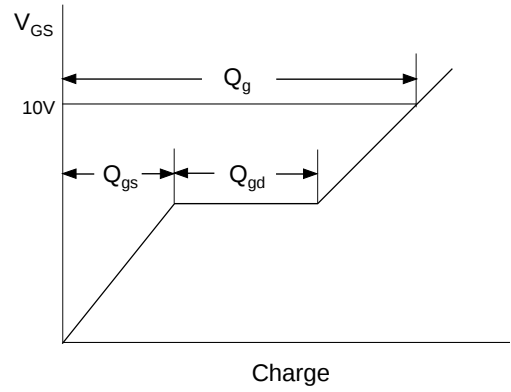
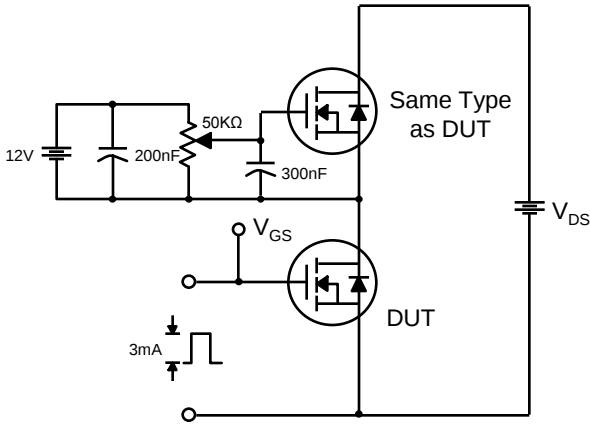


Fig 13. Resistive Switching Test Circuit & Waveforms

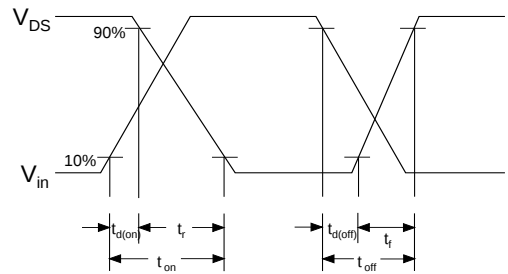
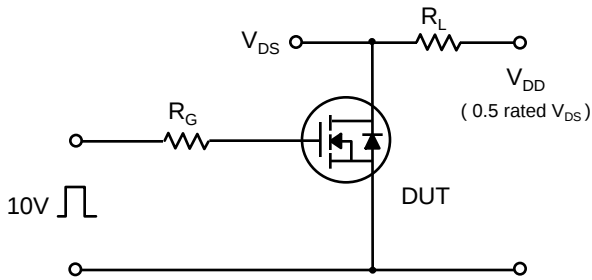


Fig 14. Unclamped Inductive Switching Test Circuit & Waveforms

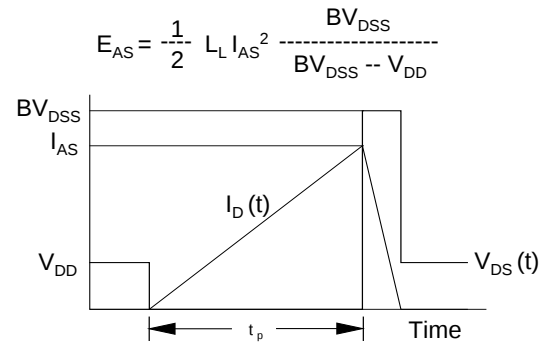
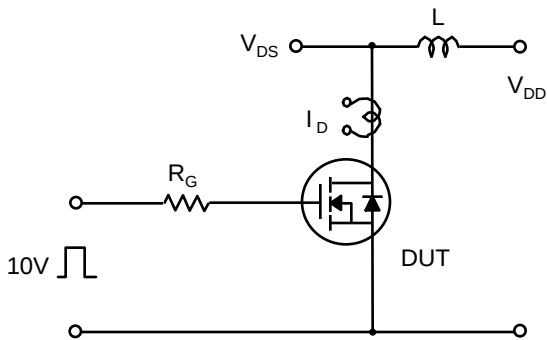
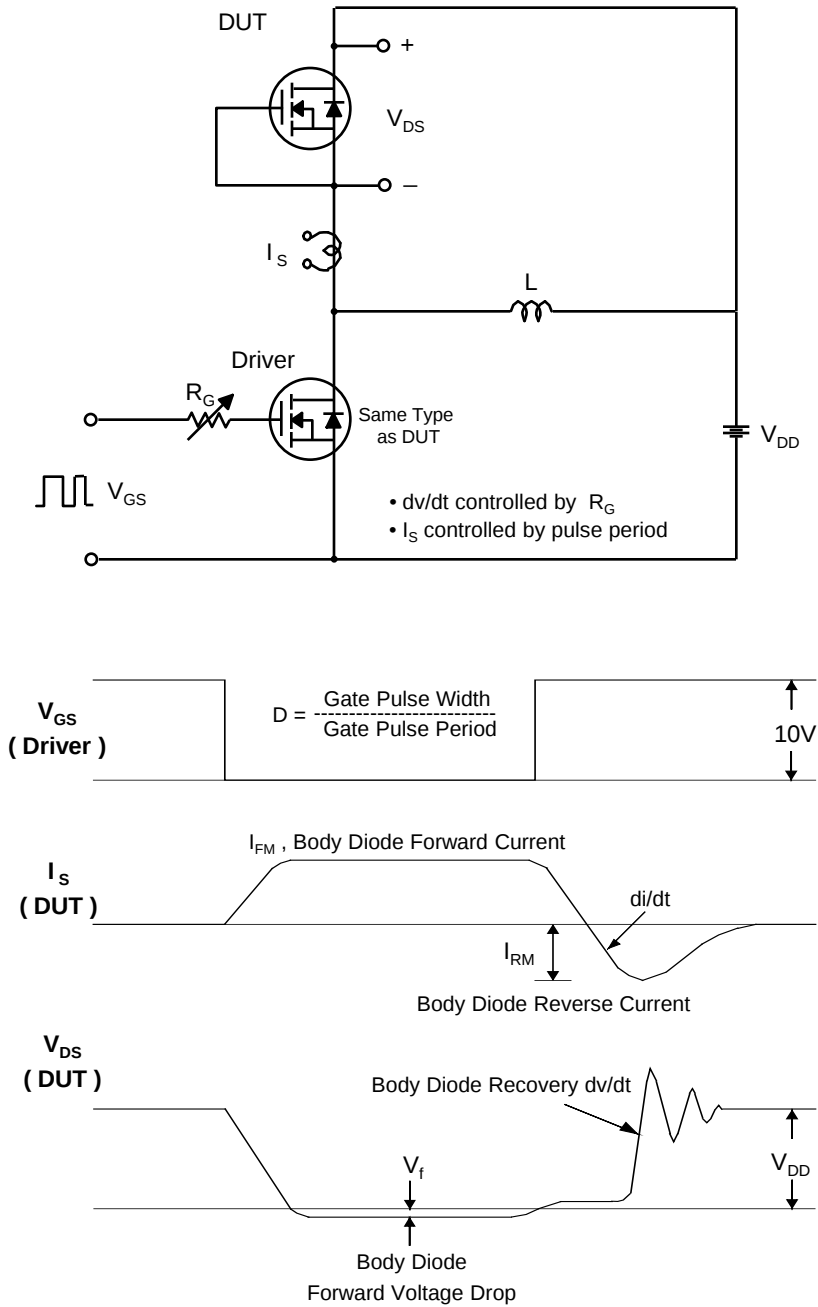


Fig 15. Peak Diode Recovery dv/dt Test Circuit & Waveforms



Package Dimension

8DFN 5x6

