

## 1.Description

Features of this design are a 150°C junction operating temperature, fast switching speed and improved repetitive avalanche rating.

## 2.2Features

- Advanced Process Technology
- Ultra Low On-Resistance
- 50°C Operating Temperature
- Fast Switching

## 2.1Features

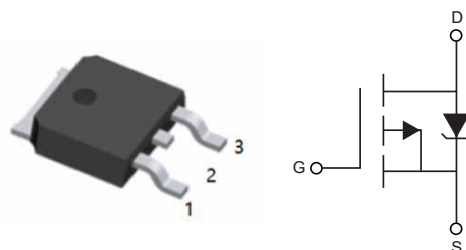
- $V_{DS(V)} = -55V$
- $I_D = -42A (V_{GS} = -10V)$
- $R_{DS(ON)} < 20m\Omega (V_{GS} = -10V)$

- Repetitive Avalanche Allowed up to  $T_{jmax}$
- Some Parameters Are Different from IRF4905S

## 3.Pinning information

| Pin | Symbol | Description |
|-----|--------|-------------|
| 1   | G      | GATE        |
| 2   | D      | DRAIN       |
| 3   | S      | SOURCE      |

TO-252(DPAK)  
top view



## 4.Absolute Maximum Ratings

| Parameter                                                    |                     | Symbol                       | Rating | Units |
|--------------------------------------------------------------|---------------------|------------------------------|--------|-------|
| Continuous Drain Current, $V_{GS} @ 10V$ (Silicon Limited)   | $T_c = 25^\circ C$  | $I_D$                        | -70    | A     |
| Continuous Drain Current, $V_{GS} @ 10V$ (Silicon Limited)   | $T_c = 100^\circ C$ |                              | -44    | A     |
| Continuous Drain Current, $V_{GS} @ 10V$ (Wire Bond Limited) | $T_c = 25^\circ C$  |                              | -42    | A     |
| Pulsed Drain Current <sup>1</sup>                            |                     | $I_{DM}$                     | -280   | A     |
| Power Dissipation                                            | $T_c = 25^\circ C$  | $P_D$                        | 170    | W     |
| Linear Derating Factor                                       |                     |                              | 1.3    | W/°C  |
| Gate-to-Source Voltage                                       |                     | $V_{GS}$                     | ±20    | V     |
| Single Pulse Avalanche Energy <sup>2</sup>                   |                     | $E_{AS}$ (Thermally limited) | 140    | mJ    |
| Single Pulse Avalanche Energy Tested Value <sup>6</sup>      |                     | $E_{AS}$ (Tested )           | 790    | mJ    |



|                                                          |                |                    |    |
|----------------------------------------------------------|----------------|--------------------|----|
| Avalanche Current <sup>1</sup>                           | $I_{AR}$       | See Fig.16a,       | A  |
| Repetitive Avalanche Energy <sup>5</sup>                 | $E_{AR}$       | 16b, 15, 13        | mJ |
| Storage Temperature Range                                | $T_J, T_{STG}$ | -55 to 150         | °C |
| Soldering Temperature, for 10 seconds (1.6mm from case ) |                | 300                | °C |
| Mounting Torque, 6-32 or M3 screw <sup>7</sup>           |                | 10 lbf•in (1.1N•m) |    |

## 5. Thermal resistance rating

| Parameter                                                    | Symbol     | Typ | Max  | Units |
|--------------------------------------------------------------|------------|-----|------|-------|
| Junction-to-Case <sup>8</sup>                                | $R_{thJC}$ |     | 0.75 | °C/W  |
| Junction-to-Ambient (PCB Mount, steady state) <sup>7,8</sup> | $R_{thJA}$ |     | 40   | °C/W  |



## 6. Electrical Characteristics @ $T_J = 25^\circ\text{C}$ (unless otherwise specified)

| Parameter                            | Symbol                            | Conditions                                                                                   | Min  | Typ    | Max  | Units               |
|--------------------------------------|-----------------------------------|----------------------------------------------------------------------------------------------|------|--------|------|---------------------|
| Drain-to-Source Breakdown Voltage    | $V_{(BR)DSS}$                     | $I_D = -250\mu\text{A}$ , $V_{GS} = 0\text{V}$                                               | -55  |        |      | V                   |
| Breakdown Voltage Temp. Coefficient  | $\Delta V_{(BR)DSS} / \Delta T_J$ | Reference to $25^\circ\text{C}$ , $I_D = -1\text{mA}$                                        |      | -0.054 |      | V/ $^\circ\text{C}$ |
| Static Drain-to-Source On-Resistance | $R_{DS(ON)}$                      | $V_{GS} = -10\text{V}$ , $I_D = -42\text{A}^3$                                               |      |        | 20   | m $\Omega$          |
| Gate Threshold Voltage               | $V_{GS(th)}$                      | $V_{DS} = V_{GS}$ , $I_D = -250\mu\text{A}$                                                  | -1.1 | -1.8   | -2.5 | V                   |
| Forward Transconductance             | $g_{FS}$                          | $V_{DS} = -25\text{V}$ , $I_D = -42\text{A}$                                                 |      | 19     |      | S                   |
| Drain-to-Source Leakage Current      | $I_{DSS}$                         | $V_{DS} = -55\text{V}$ , $V_{GS} = 0\text{V}$                                                |      |        | -25  | $\mu\text{A}$       |
|                                      |                                   | $V_{DS} = -44\text{V}$ , $V_{GS} = 0\text{V}$ , $T_J = 125^\circ\text{C}$                    |      |        | -200 | $\mu\text{A}$       |
| Gate-to-Source Forward Leakage       | $I_{GSS}$                         | $V_{GS} = -20\text{V}$                                                                       |      |        | 100  | nA                  |
| Gate-to-Source Reverse Leakage       |                                   | $V_{GS} = 20\text{V}$                                                                        |      |        | -100 | nA                  |
| Total Gate Charge                    | $Q_g$                             | $I_D = -42\text{A}$ , $V_{DS} = -44\text{V}$ , $V_{GS} = -10\text{V}^3$                      |      | 120    | 180  | nC                  |
| Gate-to-Source Charge                | $Q_{gs}$                          |                                                                                              |      | 32     |      | nC                  |
| Gate-to-Drain ("Miller") Charge      | $Q_{gd}$                          |                                                                                              |      | 53     |      | nC                  |
| Turn-On Delay Time                   | $t_{D(on)}$                       | $V_{DD} = -28\text{V}$ , $I_D = -42\text{A}$<br>$R_G = 2.6\Omega$ , $V_{GS} = -10\text{V}^3$ |      | 20     |      | ns                  |
| Rise Time                            | $t_r$                             |                                                                                              |      | 99     |      | ns                  |
| Turn-Off Delay Time                  | $t_{D(off)}$                      |                                                                                              |      | 51     |      | ns                  |
| Fall Time                            | $t_f$                             |                                                                                              |      | 64     |      | ns                  |
| Internal Source Inductance           | $L_S$                             | Between lead,<br>and center of die contact                                                   |      | 7.5    |      | nH                  |
| Input Capacitance                    | $C_{iss}$                         | $V_{GS} = 0\text{V}$ , $V_{DS} = -25\text{V}$<br>$f = 1\text{MHz}$                           |      | 3500   |      | pF                  |
| Output Capacitance                   | $C_{oss}$                         |                                                                                              |      | 1250   |      | pF                  |
| Reverse Transfer Capacitance         | $C_{rss}$                         |                                                                                              |      | 450    |      | pF                  |
| Output Capacitance                   | $C_{oss}$                         | $V_{GS} = 0\text{V}$ , $V_{DS} = -1\text{V}$ , $f = 1\text{MHz}$                             |      | 4620   |      | pF                  |
| Output Capacitance                   | $C_{oss}$                         | $V_{GS} = 0\text{V}$ , $V_{DS} = -44\text{V}$ , $f = 1\text{MHz}$                            |      | 940    |      | pF                  |
| Effective Output Capacitance         | $C_{oss\text{eff.}}$              | $V_{GS} = 0\text{V}$ , $V_{DS} = 0\text{V}$ to $-44\text{V}^4$                               |      | 1530   |      | pF                  |



| Diode Characteristics                              |          |                                                                              |  |     |      |    |
|----------------------------------------------------|----------|------------------------------------------------------------------------------|--|-----|------|----|
| Continuous Source Current<br>(Body Diode)          | $I_S$    | MOSFET symbol<br>showing the<br>integral reverse<br>p-n junction diode.      |  |     | -42  | A  |
| Pulsed Source Current<br>(Body Diode) <sup>1</sup> | $I_{SM}$ |                                                                              |  |     | -280 | A  |
| Diode Forward Voltage                              | $V_{SD}$ | $T_J=25^{\circ}\text{C}, I_S=-42\text{A}, V_{GS}=0\text{V}$ <sup>3</sup>     |  |     | -1.3 | V  |
| Reverse Recovery Time                              | $t_{rr}$ | $T_J=25^{\circ}\text{C}, I_F=-42\text{A}, V_{DD}=-28\text{V}$                |  | 61  | 92   | ns |
| Reverse Recovery Charge                            | $Q_{rr}$ | $di/dt=100\text{A}/\mu\text{s}$ <sup>3</sup>                                 |  | 150 | 220  | nC |
| Forward Turn-On Time                               | $t_{on}$ | Intrinsic turn-on time is negligible<br>(turn-on is dominated by $L_S+L_D$ ) |  |     |      |    |

## Notes:

1. Repetitive rating; pulse width limited by max. junction temperature.
2. Limited by  $T_{Jmax}$ , starting  $T_J=25^{\circ}\text{C}$ ,  $L=0.16\text{mH}$ ,  $R_G=25\Omega$ ,  $I_{AS}=-42\text{A}$ ,  $V_{GS}=-10\text{V}$ . Part not recommended for use above this value.
3. Pulse width  $\leq 1\text{ms}$ ; duty cycle  $\leq 2\%$ .
4.  $C_{oss}$  eff. is a fixed capacitance that gives the same charging time as  $C_{oss}$  while  $V_{DS}$  is rising from 0 to 80%  $V_{DSS}$ .
5. Limited by  $T_{Jmax}$ , see Fig.12a, 12b, 15, 16 for typical repetitive avalanche performance.
6. This value determined from sample failure population. 100% tested to this value in production.
7. This is applied to D<sup>2</sup>Pak, when mounted on 1" square PCB (FR-4 or G-10 Material).
8.  $R_{\theta}$  is measured at  $T_J$  approximately  $90^{\circ}\text{C}$ .



## 7.1 Typical Characteristics

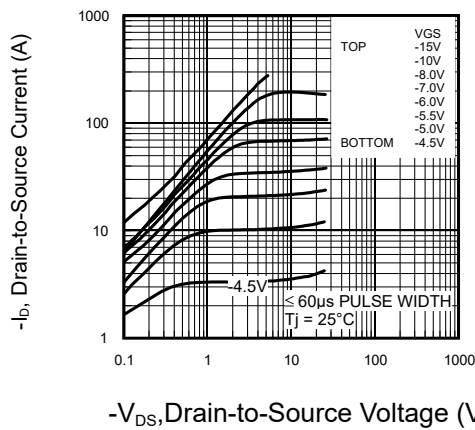


Figure 1: Typical On-Resistance vs. Gate Voltage

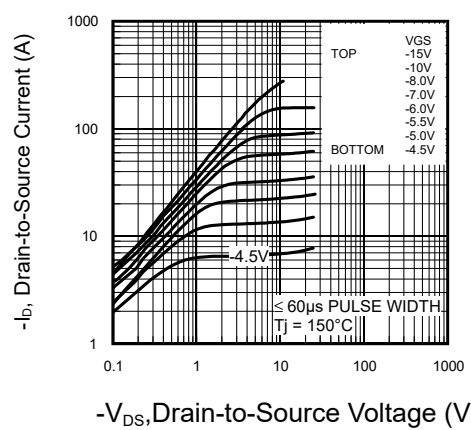


Figure 2: Typical Output Characteristics

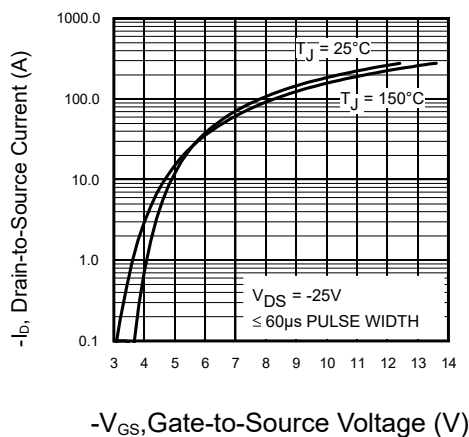


Figure 3: Typical Output Characteristics

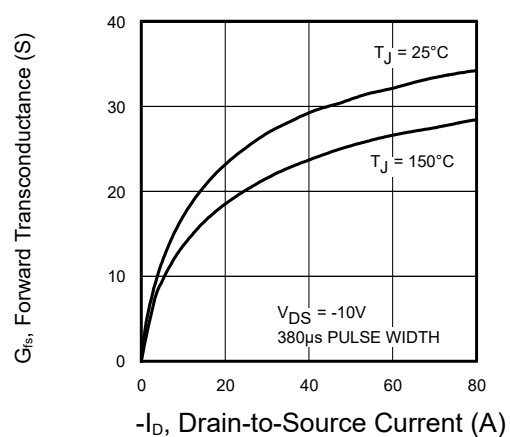


Figure 4: Typical Forward Transconductance Vs. Drain Current

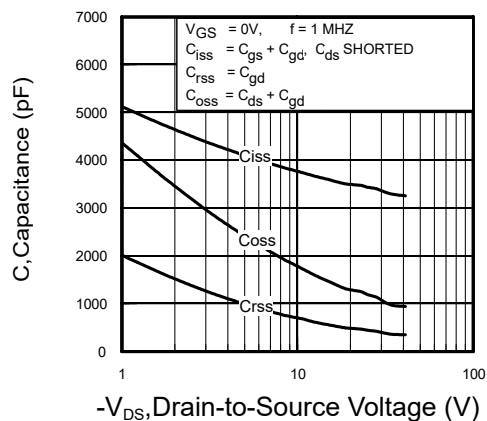


Figure 5: Typical Capacitance vs. Drain-to-Source Voltage

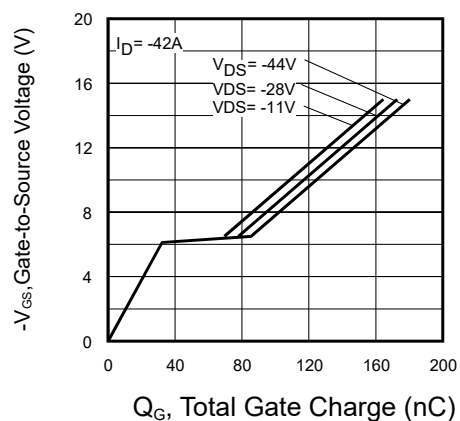


Figure 6: Typical Gate Charge Vs. Gate-to-Source Voltage



## 7.2 Typical Characteristics

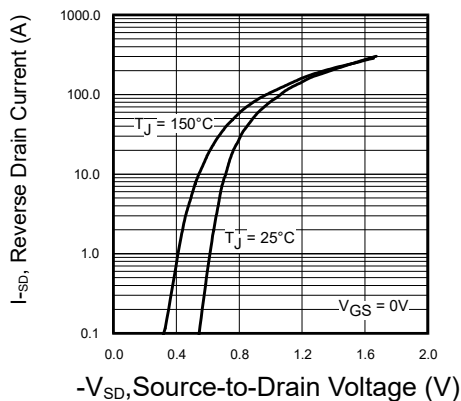


Figure 7: Typical Capacitance vs. Drain-to-Source Voltage

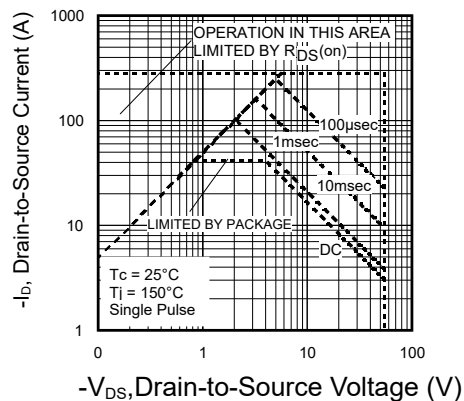


Figure 8: Maximum Safe Operating Area

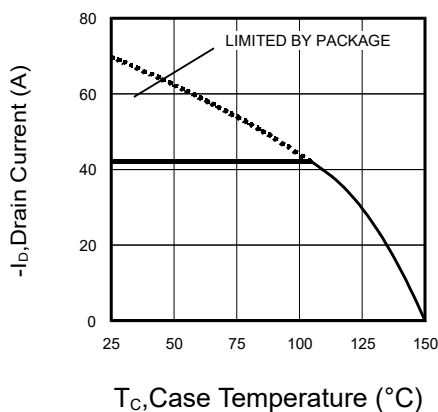


Figure 9: Maximum Drain Current Vs. Case Temperature

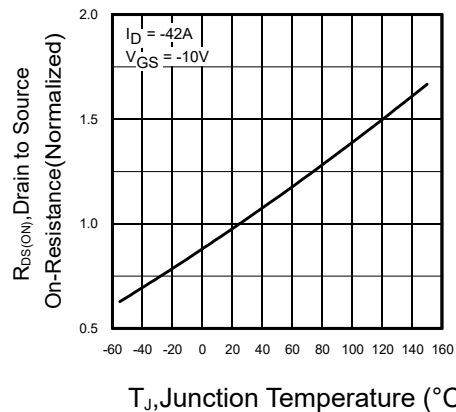


Figure 10: Normalized On-Resistance Vs. Temperature

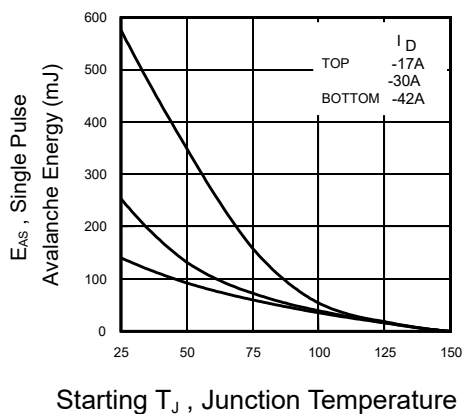


Figure 11: Typical On-Resistance vs. Drain Current

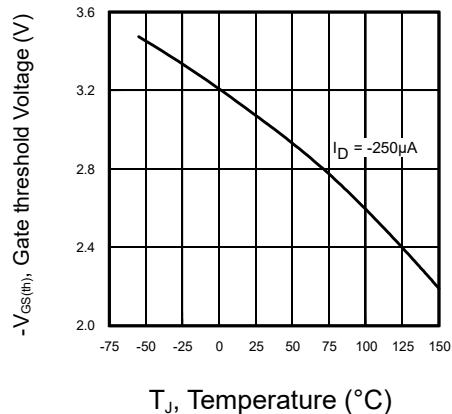
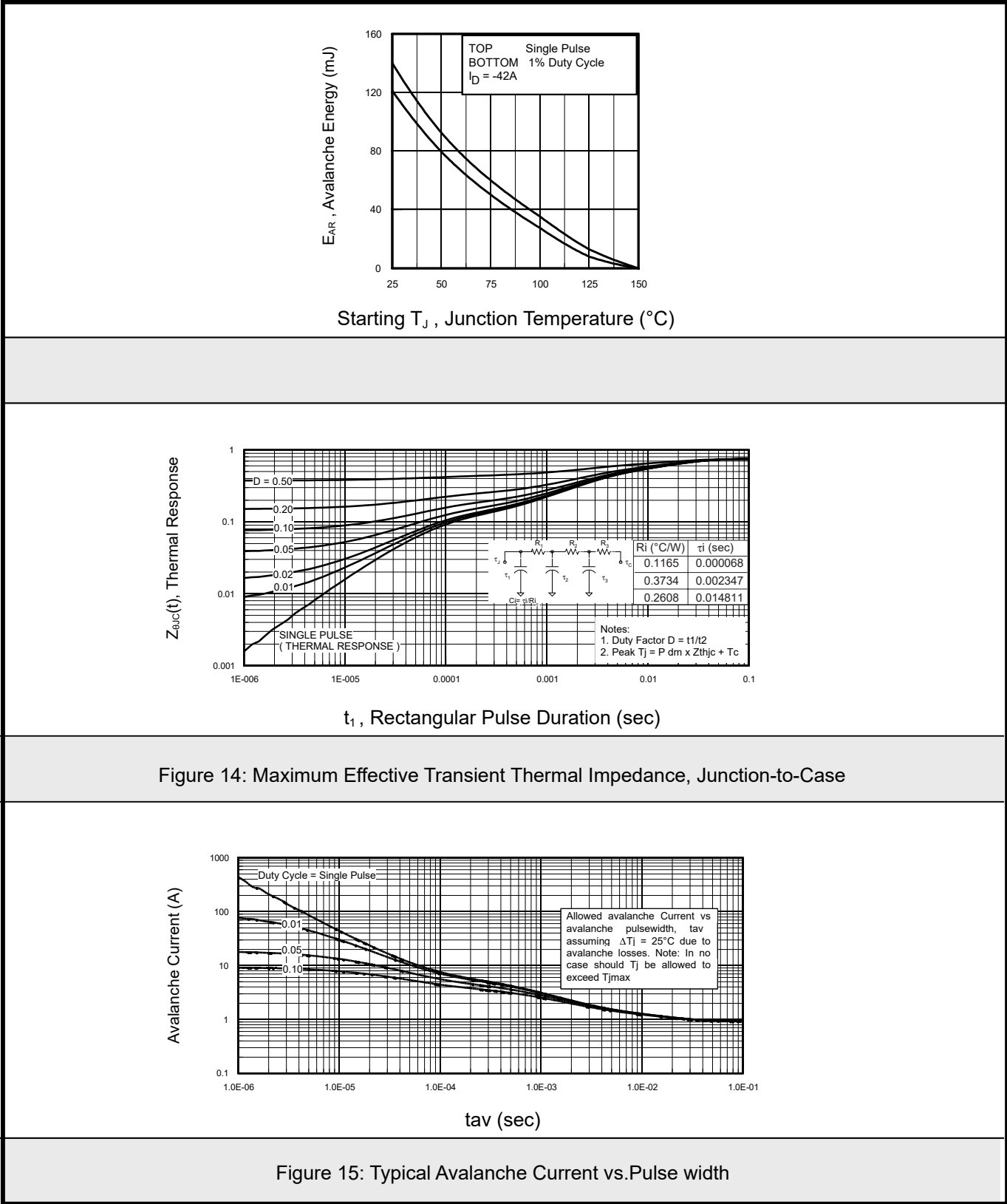


Figure 12: Threshold Voltage Vs. Temperature



7.3Typical Characteristics



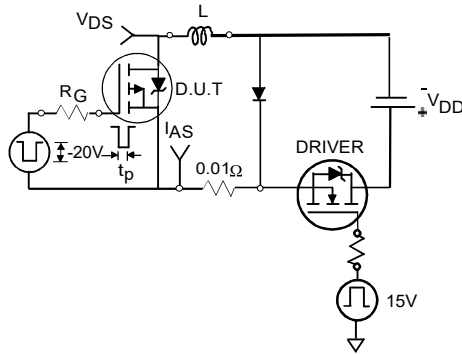


Figure 16a: Unclamped Inductive Test Circuit

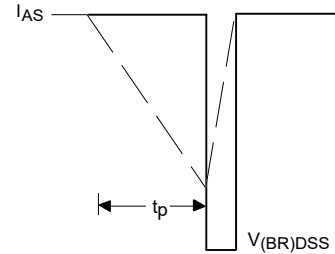


Figure 16b: Unclamped Inductive Waveforms

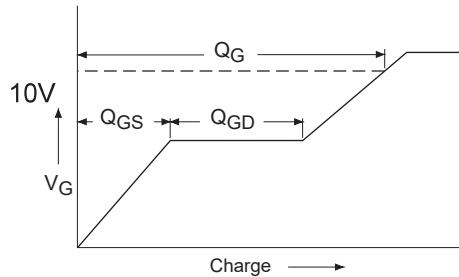


Figure 17a: Gate Charge Test Circuit

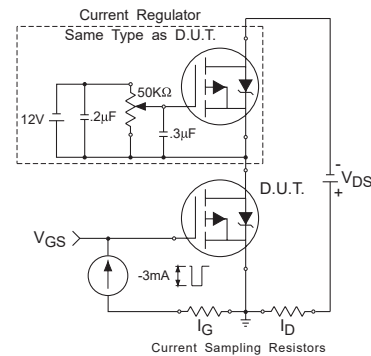


Figure 17b: Threshold Voltage Vs. Temperature

Notes on Repetitive Avalanche Curves , Figures 13, 15:

1. Avalanche failures assumption: Purely a thermal phenomenon and failure occurs at a temperature far in excess of  $T_{jmax}$ . This is validated for every part type.

2. Safe operation in Avalanche is allowed as long as  $T_{jmax}$  is not exceeded.

3. Equation below based on circuit and waveforms shown in Figures 16a, 16b.

4.  $P_{D(ave)}$  = Average power dissipation per single avalanche pulse.

5. BV = Rated breakdown voltage (1.3 factor accounts for voltage increase during avalanche).

6.  $I_{av}$  = Allowable avalanche current.

7.  $\Delta T$  = Allowable rise in junction temperature, not to exceed  $T_{jmax}$  (assumed as 25°C in Figure 15, 13).

$t_{av}$  = Average time in avalanche.

D = Duty cycle in avalanche =  $t_{av} \cdot f$

$Z_{thJC}(D, t_{av})$  = Transient thermal resistance.

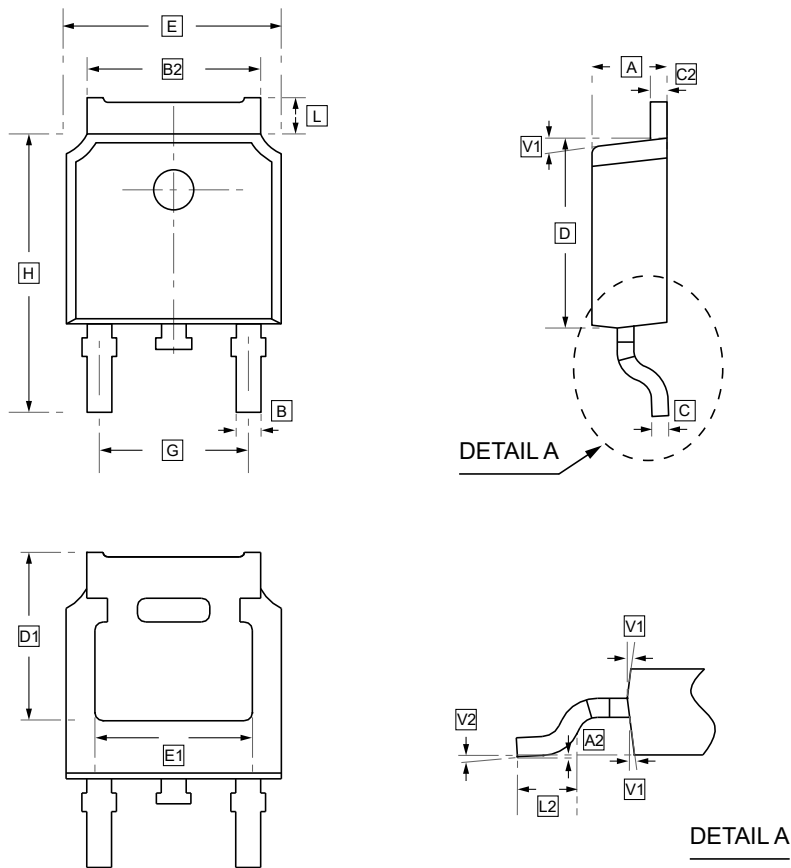
$P_{D(ave)} = 1/2 (1.3 \cdot BV \cdot I_{av}) = \Delta T / Z_{thJC}$

$I_{av} = 2\Delta T / [1.3 \cdot BV \cdot Z_{th}]$

$E_{AS(AR)} = P_{D(ave)} \cdot t_{av}$



8.TO-252 Package Outline Dimensions

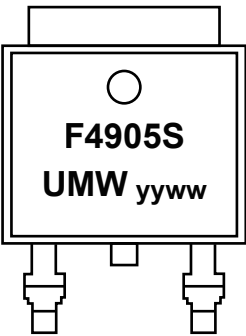


DIMENSIONS (mm are the original dimensions)

| Symbol | A    | A2   | B    | B2   | C    | C2   | D    | D1   | E    | E1   | G    | H     | L    | L2   | V1 | V2 |
|--------|------|------|------|------|------|------|------|------|------|------|------|-------|------|------|----|----|
| Min    | 2.10 | 0    | 0.66 | 5.18 | 0.40 | 0.44 | 5.90 | 5.30 | 6.40 | 4.63 | 4.47 | 9.50  | 1.09 | 1.35 |    | 0° |
| Max    | 2.50 | 0.10 | 0.86 | 5.48 | 0.60 | 0.58 | 6.30 | REF  | 6.80 |      | 4.67 | 10.70 | 1.21 | 1.65 |    | 6° |



9.Ordering information



yy: Year Code  
ww: Week Code

| Order Code      | Package | Base QTY | Delivery Mode |
|-----------------|---------|----------|---------------|
| UMW IRF4905STRL | TO-252  | 2500     | Tape and reel |



## 10.Disclaimer

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