

## 56A, 100V, 0.025 Ohm, N-Channel UltraFET Power MOSFETs



These N-Channel power MOSFETs are manufactured using the innovative UltraFET™ process.

This advanced process technology achieves the lowest possible on-resistance per silicon area, resulting in outstanding performance. This device is capable of withstanding high energy in the avalanche mode and the diode exhibits very low reverse recovery time and stored charge. It was designed for use in applications where power efficiency is important, such as switching regulators, switching converters, motor drivers, relay drivers, low-voltage bus switches, and power management in portable and battery-operated products.

Formerly developmental type TA75639.

### Ordering Information

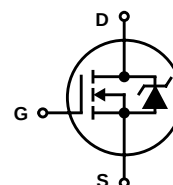
| PART NUMBER | PACKAGE  | BRAND  |
|-------------|----------|--------|
| HUF75639G3  | TO-247   | 75639G |
| HUF75639P3  | TO-220AB | 75639P |
| HUF75639S3S | TO-263AB | 75639S |

NOTE: When ordering, use the entire part number. Add the suffix T to obtain the TO-263AB variant in tape and reel, e.g., HUF75639S3ST.

### Features

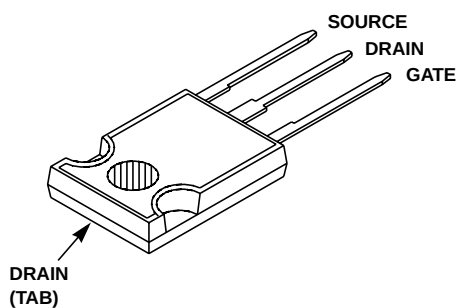
- 56A, 100V
- Simulation Models
  - Temperature Compensated PSPICE® and SABER™ Electrical Models
  - Spice and Saber Thermal Impedance Models
  - www.Intersil.com
- Peak Current vs Pulse Width Curve
- UIS Rating Curve
- Related Literature
  - TB334, "Guidelines for Soldering Surface Mount Components to PC Boards"

### Symbol

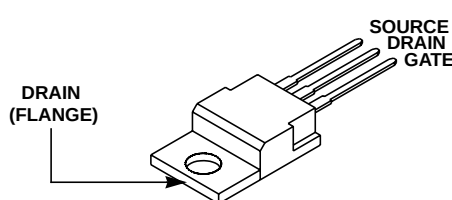


### Packaging

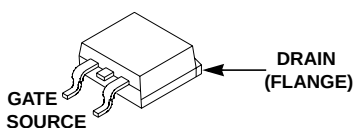
JEDEC STYLE TO-247



JEDEC TO-220AB



JEDEC TO-263AB



# HUF75639G3, HUF75639P3, HUF75639S3S

## Absolute Maximum Ratings $T_C = 25^{\circ}\text{C}$ , Unless Otherwise Specified

|                                                                          |                |                   | UNITS                       |
|--------------------------------------------------------------------------|----------------|-------------------|-----------------------------|
| Drain to Source Voltage (Note 1) . . . . .                               | $V_{DSS}$      | 100               | V                           |
| Drain to Gate Voltage ( $R_{GS} = 20\text{k}\Omega$ ) (Note 1) . . . . . | $V_{DGR}$      | 100               | V                           |
| Gate to Source Voltage . . . . .                                         | $V_{GS}$       | $\pm 20$          | V                           |
| Drain Current                                                            |                |                   |                             |
| Continuous (Figure 2) . . . . .                                          | $I_D$          | 56                | A                           |
| Pulsed Drain Current . . . . .                                           | $I_{DM}$       | Figure 4          |                             |
| Pulsed Avalanche Rating . . . . .                                        | $E_{AS}$       | Figures 6, 14, 15 |                             |
| Power Dissipation . . . . .                                              | $P_D$          | 200               | W                           |
| Derate Above $25^{\circ}\text{C}$ . . . . .                              |                | 1.35              | $\text{W}/^{\circ}\text{C}$ |
| Operating and Storage Temperature . . . . .                              | $T_J, T_{STG}$ | -55 to 175        | $^{\circ}\text{C}$          |
| Maximum Temperature for Soldering                                        |                |                   |                             |
| Leads at 0.063in (1.6mm) from Case for 10s. . . . .                      | $T_L$          | 300               | $^{\circ}\text{C}$          |
| Package Body for 10s, See Techbrief 334 . . . . .                        | $T_{pkg}$      | 260               | $^{\circ}\text{C}$          |

CAUTION: Stresses above those listed in "Absolute Maximum Ratings" may cause permanent damage to the device. This is a stress only rating and operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied.

### NOTE:

1.  $T_J = 25^{\circ}\text{C}$  to  $150^{\circ}\text{C}$ .

## Electrical Specifications $T_C = 25^{\circ}\text{C}$ , Unless Otherwise Specified

| PARAMETER                                        | SYMBOL              | TEST CONDITIONS                                                                                                          | MIN                                                                                                                     | TYP   | MAX   | UNITS            |    |
|--------------------------------------------------|---------------------|--------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------|-------|-------|------------------|----|
| OFF STATE SPECIFICATIONS                         |                     |                                                                                                                          |                                                                                                                         |       |       |                  |    |
| Drain to Source Breakdown Voltage                | BV <sub>DSS</sub>   | I <sub>D</sub> = 250μA, V <sub>GS</sub> = 0V (Figure 11)                                                                 | 100                                                                                                                     | -     | -     | V                |    |
| Zero Gate Voltage Drain Current                  | I <sub>DSS</sub>    | V <sub>DS</sub> = 95V, V <sub>GS</sub> = 0V                                                                              | -                                                                                                                       | -     | 1     | μA               |    |
|                                                  |                     | V <sub>DS</sub> = 90V, V <sub>GS</sub> = 0V, T <sub>C</sub> = 150 <sup>0</sup> C                                         | -                                                                                                                       | -     | 250   | μA               |    |
| Gate to Source Leakage Current                   | I <sub>GSS</sub>    | V <sub>GS</sub> = ±20V                                                                                                   | -                                                                                                                       | -     | ±100  | nA               |    |
| ON STATE SPECIFICATIONS                          |                     |                                                                                                                          |                                                                                                                         |       |       |                  |    |
| Gate to Source Threshold Voltage                 | V <sub>GS(TH)</sub> | V <sub>GS</sub> = V <sub>DS</sub> , I <sub>D</sub> = 250μA (Figure 10)                                                   | 2                                                                                                                       | -     | 4     | V                |    |
| Drain to Source On Resistance                    | r <sub>DS(ON)</sub> | I <sub>D</sub> = 56A, V <sub>GS</sub> = 10V (Figure 9)                                                                   | -                                                                                                                       | 0.021 | 0.025 | Ω                |    |
| THERMAL SPECIFICATIONS                           |                     |                                                                                                                          |                                                                                                                         |       |       |                  |    |
| Thermal Resistance Junction to Case              | R <sub>θJC</sub>    | (Figure 3)                                                                                                               | -                                                                                                                       | -     | 0.74  | <sup>0</sup> C/W |    |
| Thermal Resistance Junction to Ambient           | R <sub>θJA</sub>    | TO-247                                                                                                                   | -                                                                                                                       | -     | 30    | <sup>0</sup> C/W |    |
|                                                  |                     | TO-220, TO-263                                                                                                           | -                                                                                                                       | -     | 62    | <sup>0</sup> C/W |    |
| SWITCHING SPECIFICATIONS (V <sub>GS</sub> = 10V) |                     |                                                                                                                          |                                                                                                                         |       |       |                  |    |
| Turn-On Time                                     | t <sub>ON</sub>     | V <sub>DD</sub> = 50V, I <sub>D</sub> ≅ 56A,<br>R <sub>L</sub> = 0.89Ω, V <sub>GS</sub> = 10V,<br>R <sub>GS</sub> = 5.1Ω | -                                                                                                                       | -     | 110   | ns               |    |
| Turn-On Delay Time                               | t <sub>d(ON)</sub>  |                                                                                                                          | -                                                                                                                       | 15    | -     | ns               |    |
| Rise Time                                        | t <sub>r</sub>      |                                                                                                                          | -                                                                                                                       | 60    | -     | ns               |    |
| Turn-Off Delay Time                              | t <sub>d(OFF)</sub> |                                                                                                                          | -                                                                                                                       | 20    | -     | ns               |    |
| Fall Time                                        | t <sub>f</sub>      |                                                                                                                          | -                                                                                                                       | 25    | -     | ns               |    |
| Turn-Off Time                                    | t <sub>OFF</sub>    |                                                                                                                          | -                                                                                                                       | -     | 70    | ns               |    |
| GATE CHARGE SPECIFICATIONS                       |                     |                                                                                                                          |                                                                                                                         |       |       |                  |    |
| Total Gate Charge                                | Q <sub>g(TOT)</sub> | V <sub>GS</sub> = 0V to 20V                                                                                              | V <sub>DD</sub> = 50V,<br>I <sub>D</sub> ≅ 56A,<br>R <sub>L</sub> = 0.89Ω<br>I <sub>g(REF)</sub> = 1.0mA<br>(Figure 13) | -     | 110   | 130              | nC |
| Gate Charge at 10V                               | Q <sub>g(10)</sub>  | V <sub>GS</sub> = 0V to 10V                                                                                              |                                                                                                                         | -     | 57    | 75               | nC |
| Threshold Gate Charge                            | Q <sub>g(TH)</sub>  | V <sub>GS</sub> = 0V to 2V                                                                                               |                                                                                                                         | -     | 3.7   | 4.5              | nC |
| Gate to Source Gate Charge                       | Q <sub>gs</sub>     |                                                                                                                          |                                                                                                                         | -     | 9.8   | -                | nC |
| Gate to Drain “Miller” Charge                    | Q <sub>gd</sub>     |                                                                                                                          |                                                                                                                         | -     | 24    | -                | nC |

**Electrical Specifications**  $T_C = 25^\circ\text{C}$ , Unless Otherwise Specified

| PARAMETER                         | SYMBOL    | TEST CONDITIONS                                                                    | MIN | TYP  | MAX | UNITS |
|-----------------------------------|-----------|------------------------------------------------------------------------------------|-----|------|-----|-------|
| <b>CAPACITANCE SPECIFICATIONS</b> |           |                                                                                    |     |      |     |       |
| Input Capacitance                 | $C_{ISS}$ | $V_{DS} = 25\text{V}$ , $V_{GS} = 0\text{V}$ ,<br>$f = 1\text{MHz}$<br>(Figure 12) | -   | 2000 | -   | pF    |
| Output Capacitance                | $C_{OSS}$ |                                                                                    | -   | 500  | -   | pF    |
| Reverse Transfer Capacitance      | $C_{RSS}$ |                                                                                    | -   | 65   | -   | pF    |

**Source to Drain Diode Specifications**

| PARAMETER                     | SYMBOL   | TEST CONDITIONS                                                | MIN | TYP | MAX  | UNITS |
|-------------------------------|----------|----------------------------------------------------------------|-----|-----|------|-------|
| Source to Drain Diode Voltage | $V_{SD}$ | $I_{SD} = 56\text{A}$                                          | -   | -   | 1.25 | V     |
| Reverse Recovery Time         | $t_{rr}$ | $I_{SD} = 56\text{A}$ , $dI_{SD}/dt = 100\text{A}/\mu\text{s}$ | -   | -   | 110  | ns    |
| Reverse Recovered Charge      | $Q_{RR}$ | $I_{SD} = 56\text{A}$ , $dI_{SD}/dt = 100\text{A}/\mu\text{s}$ | -   | -   | 320  | nC    |

**Typical Performance Curves**

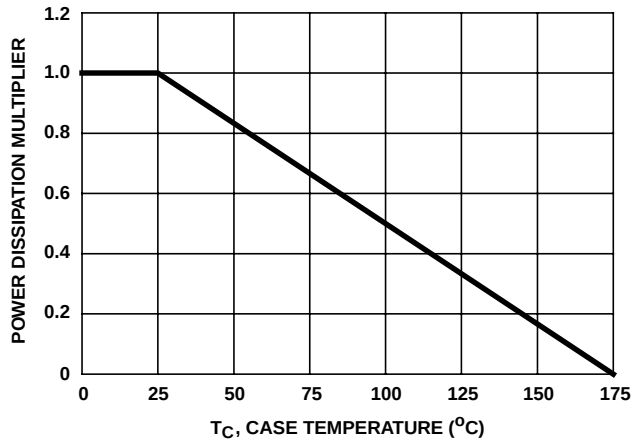


FIGURE 1. NORMALIZED POWER DISSIPATION vs CASE TEMPERATURE

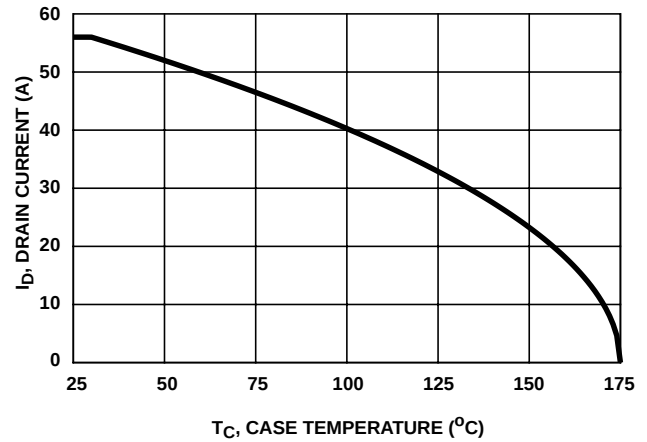


FIGURE 2. MAXIMUM CONTINUOUS DRAIN CURRENT vs CASE TEMPERATURE

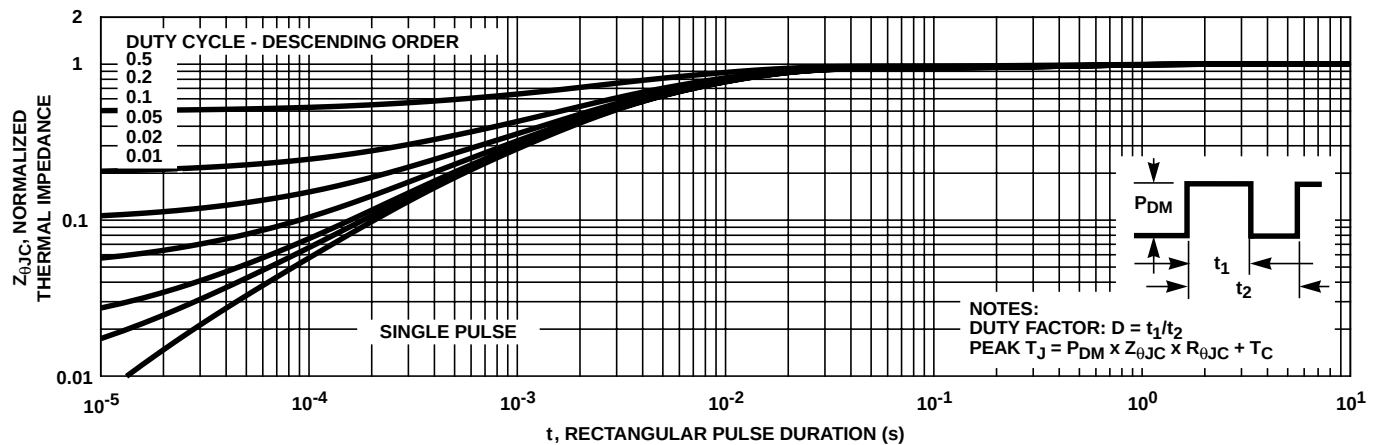
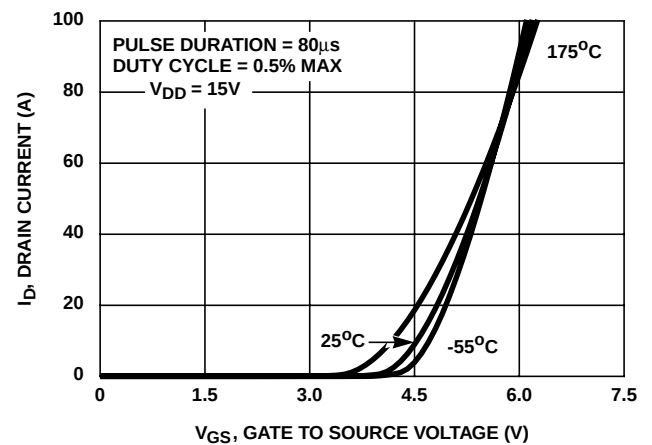
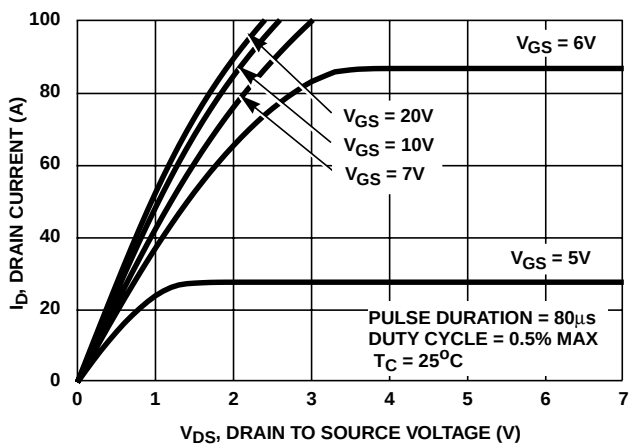
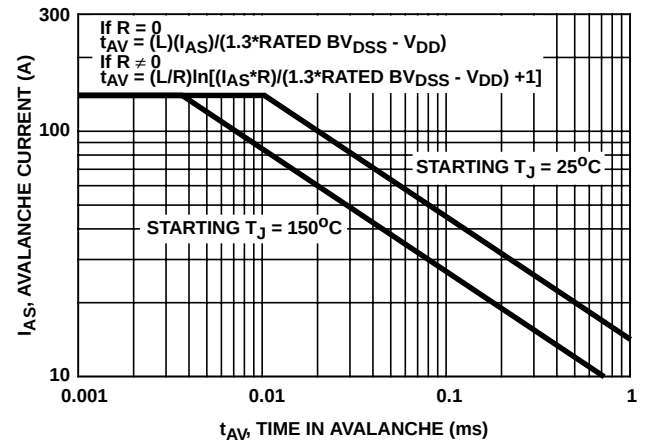
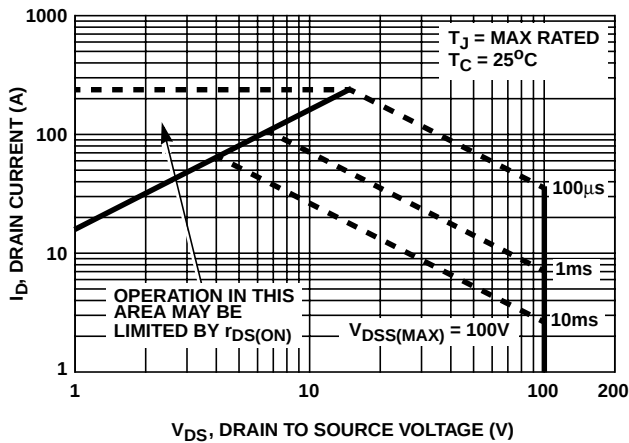
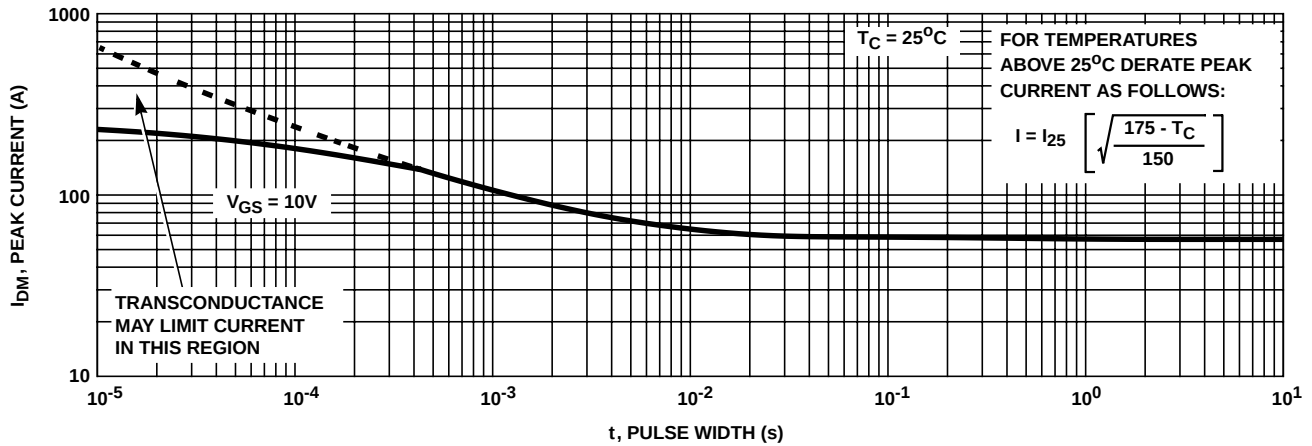


FIGURE 3. NORMALIZED MAXIMUM TRANSIENT THERMAL IMPEDANCE

# Typical Performance Curves (Continued)



# Typical Performance Curves (Continued)

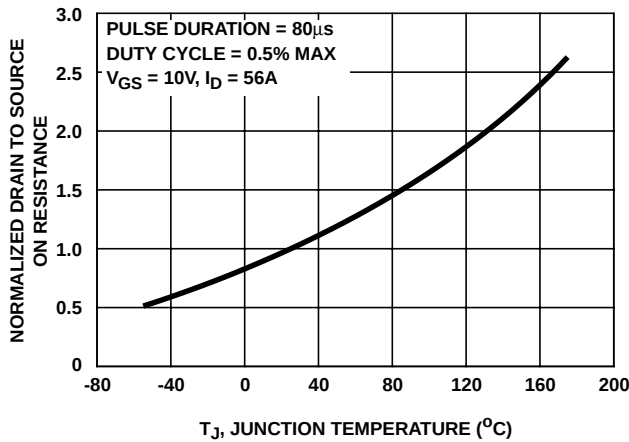


FIGURE 9. NORMALIZED DRAIN TO SOURCE ON RESISTANCE vs JUNCTION TEMPERATURE

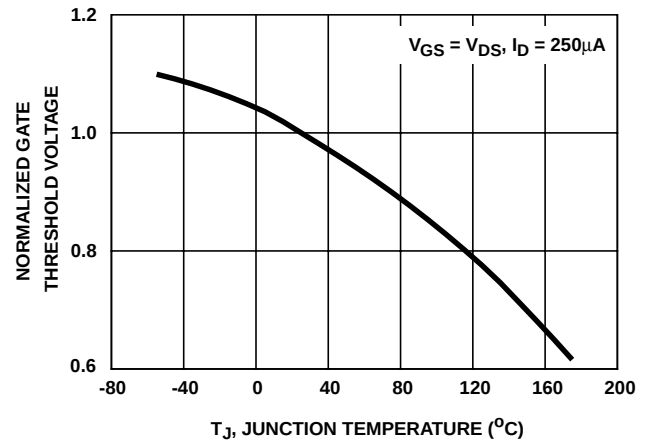


FIGURE 10. NORMALIZED GATE THRESHOLD VOLTAGE vs JUNCTION TEMPERATURE

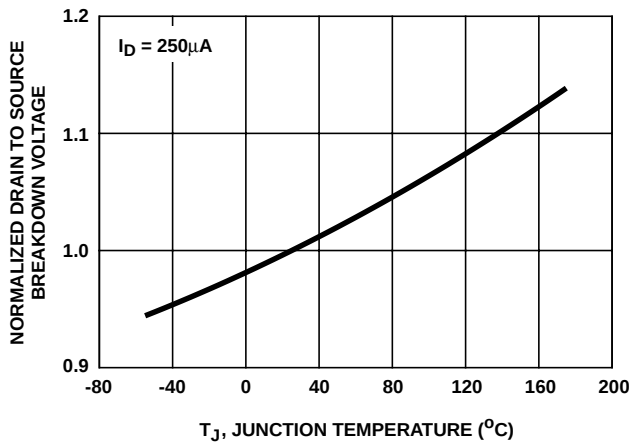


FIGURE 11. NORMALIZED DRAIN TO SOURCE BREAKDOWN VOLTAGE vs JUNCTION TEMPERATURE

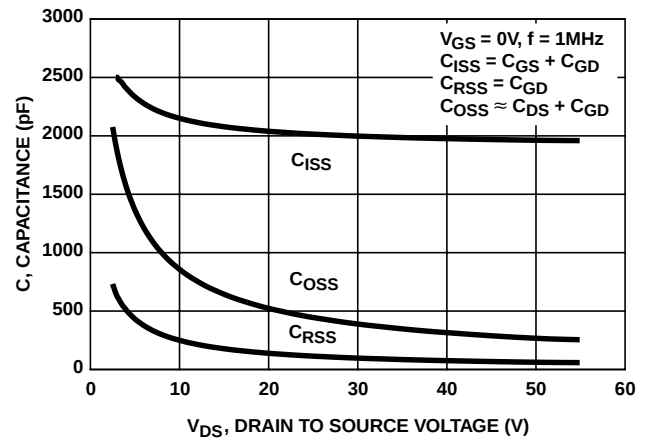
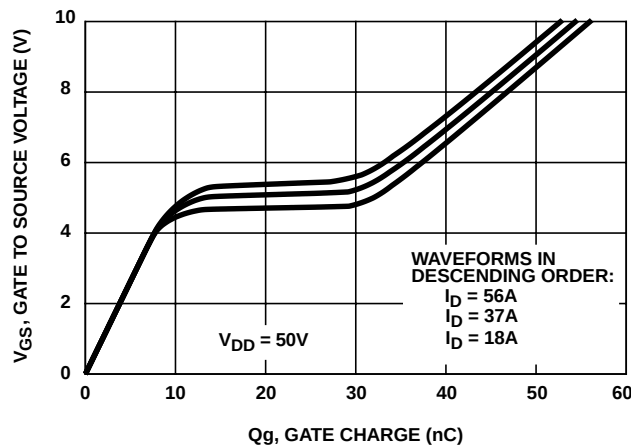


FIGURE 12. CAPACITANCE vs DRAIN TO SOURCE VOLTAGE



NOTE: Refer to Intersil Application Notes AN7254 and AN7260.

FIGURE 13. GATE CHARGE WAVEFORMS FOR CONSTANT GATE CURRENT

## Test Circuits and Waveforms

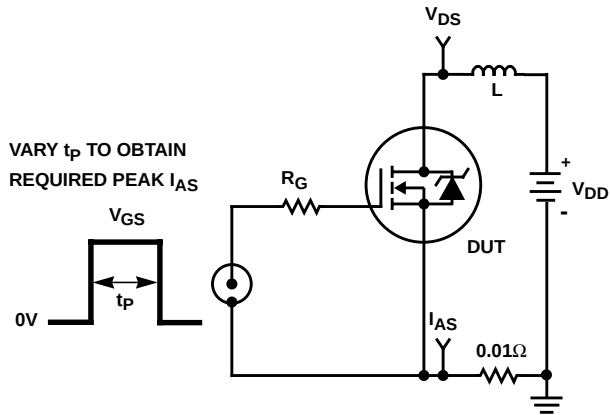


FIGURE 14. UNCLAMPED ENERGY TEST CIRCUIT

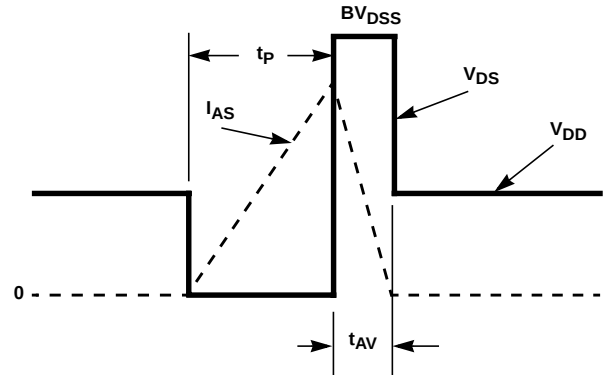


FIGURE 15. UNCLAMPED ENERGY WAVEFORMS

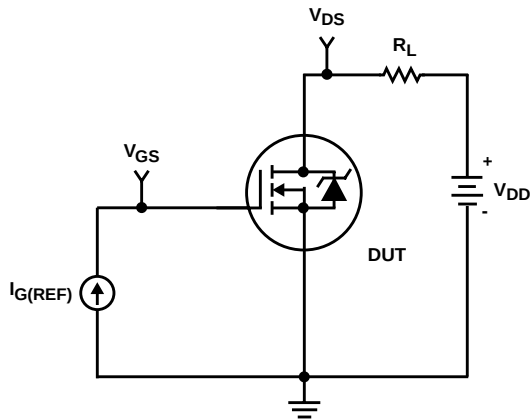


FIGURE 16. GATE CHARGE TEST CIRCUIT

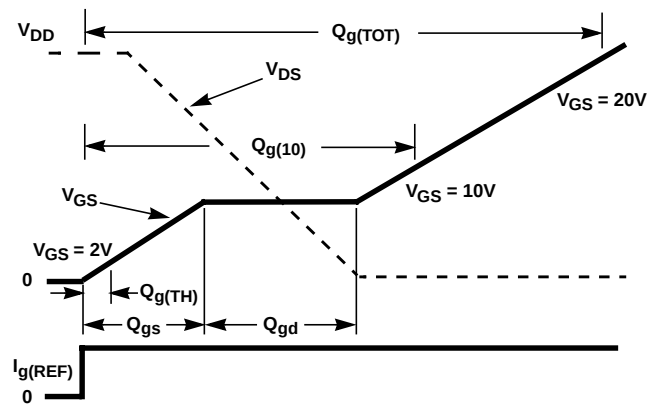


FIGURE 17. GATE CHARGE WAVEFORM

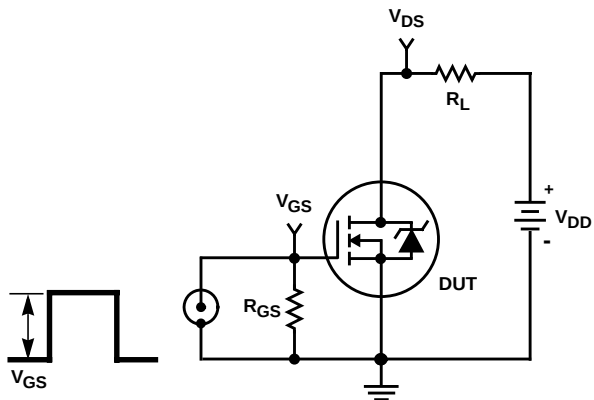


FIGURE 18. SWITCHING TIME TEST CIRCUIT

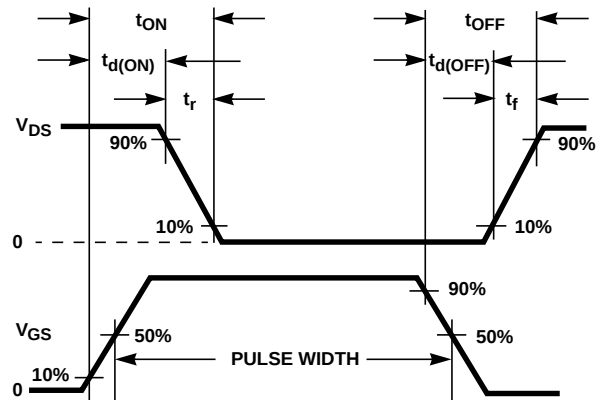


FIGURE 19. RESISTIVE SWITCHING WAVEFORMS





## Spice Thermal Model

REV APRIL 1998

HUF75639

CTHERM1 TH 6 2.8e-3  
CTHERM2 6 5 4.6e-3  
CTHERM3 5 4 5.5e-3  
CTHERM4 4 3 9.2e-3  
CTHERM5 3 2 1.7e-2  
CTHERM6 2 TL 4.3e-2

RTHERM1 TH 6 5.0e-4  
RTHERM2 6 5 1.5e-3  
RTHERM3 5 4 2.0e-2  
RTHERM4 4 3 9.0e-2  
RTHERM5 3 2 1.9e-1  
RTHERM6 2 TL 2.9e-1

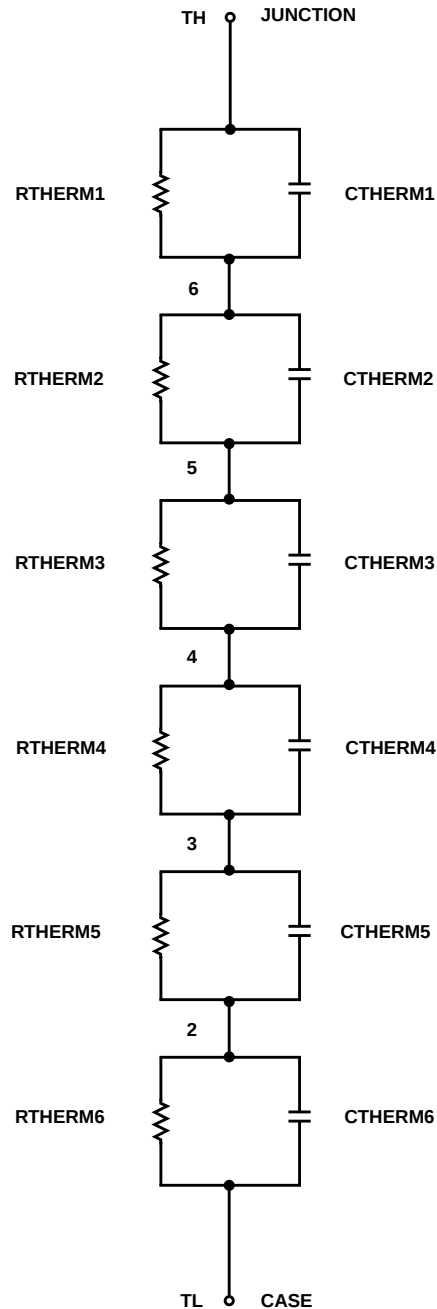
## Saber Thermal Model

Saber thermal model HUF75639

template thermal\_model th tl  
thermal\_c th, tl

```
{
ctherm.ctherm1 th 6 = 2.8e-3
ctherm.ctherm2 6 5 = 4.6e-3
ctherm.ctherm3 5 4 = 5.5e-3
ctherm.ctherm4 4 3 = 9.2e-3
ctherm.ctherm5 3 2 = 1.7e-2
ctherm.ctherm6 2 tl = 4.3e-2
```

```
rtherm.rtherm1 th 6 = 5.0e-4
rtherm.rtherm2 6 5 = 1.5e-3
rtherm.rtherm3 5 4 = 2.0e-2
rtherm.rtherm4 4 3 = 9.0e-2
rtherm.rtherm5 3 2 = 1.9e-1
rtherm.rtherm6 2 tl = 2.9e-1
}
```



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