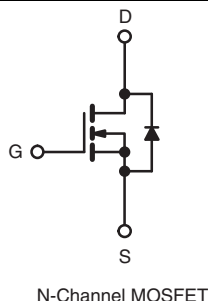
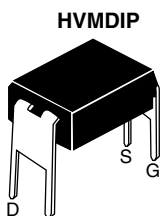


## Power MOSFET

### PRODUCT SUMMARY

|                           |                        |      |
|---------------------------|------------------------|------|
| $V_{DS}$ (V)              | 50                     |      |
| $R_{DS(on)}$ ( $\Omega$ ) | $V_{GS} = 10\text{ V}$ | 0.10 |
| $Q_g$ (Max.) (nC)         | 24                     |      |
| $Q_{gs}$ (nC)             | 7.1                    |      |
| $Q_{gd}$ (nC)             | 7.1                    |      |
| Configuration             | Single                 |      |



### FEATURES

- For Automatic Insertion
- Compact, End Stackable
- Fast Switching
- Ease of Paralleling
- Excellent Temperature Stability
- Compliant to RoHS Directive 2002/95/EC



**RoHS\***  
COMPLIANT

### DESCRIPTION

The HVMDIP technology is the key to Vishay's advanced line of power MOSFET transistors. The efficient geometry and unique processing of the HVMDIP design achieves very low on-state resistance combined with high transconductance and extreme device ruggedness. HVMDIPs feature all of the established advantages of MOSFETs such as voltage control, very fast switching, ease of paralleling, and temperature stability of the electrical parameters.

The HVMDIP 4 pin, dual-in-line package brings the advantages of HVMDIPs to high volume applications where automatic PC board insertion is desirable, such as circuit boards for computers, printers, telecommunications equipment, and consumer products. Their compatibility with automatic insertion equipment, low-profile and end stackable features represent the state-of-the-art in power device packaging.

### ORDERING INFORMATION

|                |                           |
|----------------|---------------------------|
| Package        | HVMDIP                    |
| Lead (Pb)-free | IRFD020PbF<br>SiHFD020-E3 |
| SnPb           | IRFD020<br>SiHFD020       |

### ABSOLUTE MAXIMUM RATINGS ( $T_C = 25\text{ }^\circ\text{C}$ , unless otherwise noted)

| PARAMETER                                                    | SYMBOL           | LIMIT                             | UNIT                |
|--------------------------------------------------------------|------------------|-----------------------------------|---------------------|
| Drain-Source Voltage <sup>a</sup>                            | $V_{DS}$         | 50                                | V                   |
| Gate-Source Voltage                                          | $V_{GS}$         | $\pm 20$                          |                     |
| Continuous Drain Current                                     | $V_{GS}$ at 10 V | $T_C = 25\text{ }^\circ\text{C}$  | A                   |
|                                                              |                  | $T_C = 100\text{ }^\circ\text{C}$ |                     |
| Pulsed Drain Current <sup>b</sup>                            | $I_{DM}$         | 19                                | W/ $^\circ\text{C}$ |
| Linear Derating Factor                                       |                  | 0.0080                            |                     |
| Inductive Current, Clamped                                   | $I_{LM}$         | 19                                | A                   |
| Unclamped Inductive Current (Avalanche Current) <sup>c</sup> | $I_L$            | 2.2                               |                     |
| Maximum Power Dissipation                                    | $P_D$            | 1.0                               | W                   |
| Operating Junction and Storage Temperature Range             | $T_J, T_{stg}$   | - 55 to + 150                     | $^\circ\text{C}$    |
| Soldering Recommendations (Peak Temperature)                 | for 10 s         | 300 <sup>d</sup>                  |                     |

#### Notes

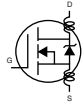
- $T_J = 25\text{ }^\circ\text{C}$  to  $150\text{ }^\circ\text{C}$
- Repetitive rating; pulse width limited by maximum junction temperature.
- $V_{DD} = 25\text{ V}$ , starting  $T_J = 25\text{ }^\circ\text{C}$ ,  $L = 100\text{ }\mu\text{H}$ ,  $R_g = 25\text{ }\Omega$
- 1.6 mm from case.

\* Pb containing terminations are not RoHS compliant, exemptions may apply

**THERMAL RESISTANCE RATINGS**

| PARAMETER                   | SYMBOL     | TYP. | MAX. | UNIT |
|-----------------------------|------------|------|------|------|
| Maximum Junction-to-Ambient | $R_{thJA}$ | -    | 120  | °C/W |

**SPECIFICATIONS** ( $T_C = 25\text{ }^{\circ}\text{C}$ , unless otherwise noted)

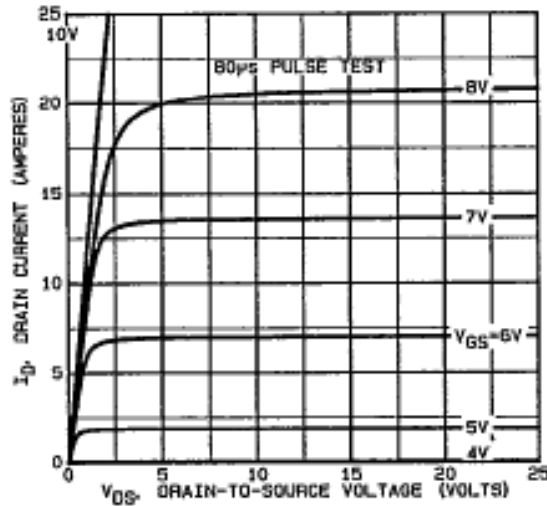
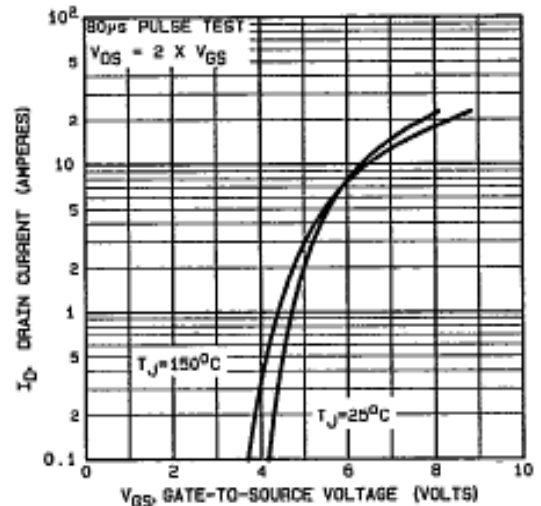
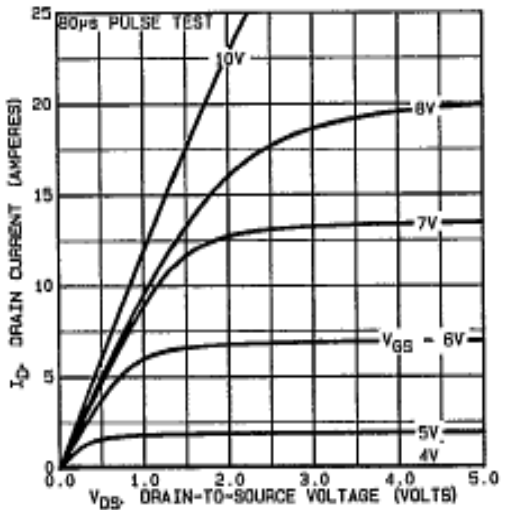
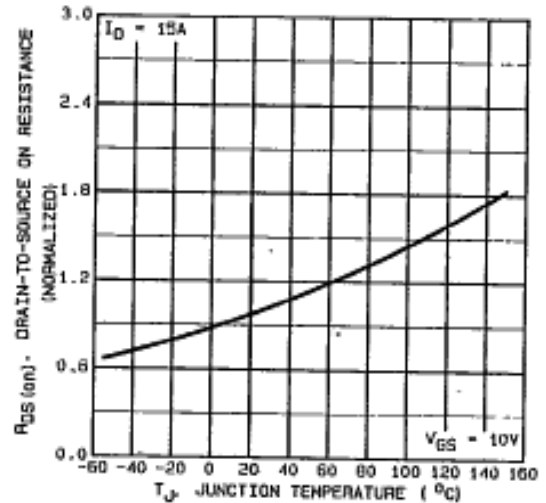
| PARAMETER                                     | SYMBOL              | TEST CONDITIONS                                                                                                                                                    |                                                                 | MIN. | TYP.  | MAX.  | UNIT |
|-----------------------------------------------|---------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------|------|-------|-------|------|
| Static                                        |                     |                                                                                                                                                                    |                                                                 |      |       |       |      |
| Drain-Source Breakdown Voltage                | V <sub>DS</sub>     | V <sub>GS</sub> = 0 V, I <sub>D</sub> = 250 μA                                                                                                                     |                                                                 | 50   | -     | -     | V    |
| Gate-Source Threshold Voltage                 | V <sub>GS(th)</sub> | V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = 250 μA                                                                                                        |                                                                 | 2.0  | -     | 4.0   | V    |
| Gate-Source Leakage                           | I <sub>GSS</sub>    | V <sub>GS</sub> = ± 20 V                                                                                                                                           |                                                                 | -    | -     | ± 500 | nA   |
| Zero Gate Voltage Drain Current               | I <sub>DSS</sub>    | V <sub>DS</sub> = max. rating, V <sub>GS</sub> = 0 V                                                                                                               |                                                                 | -    | -     | 250   | μA   |
|                                               |                     | V <sub>DS</sub> = max. rating x 0.8, V <sub>GS</sub> = 0 V, T <sub>C</sub> = 125                                                                                   |                                                                 | -    | -     | 1000  |      |
| On-State Drain Current <sup>b</sup>           | I <sub>D(on)</sub>  | V <sub>GS</sub> = 10 V                                                                                                                                             | V <sub>DS</sub> > I <sub>D(on)</sub> x R <sub>DS(on)</sub> max. | 2.4  | -     | -     | A    |
| Drain-Source On-State Resistance <sup>b</sup> | R <sub>DS(on)</sub> | V <sub>GS</sub> = 10 V                                                                                                                                             | I <sub>D</sub> = 1.4 A                                          | -    | 0.080 | 0.10  | Ω    |
| Forward Transconductance <sup>b</sup>         | g <sub>fs</sub>     | V <sub>DS</sub> = 20 V, I <sub>D</sub> = 7.5 A                                                                                                                     |                                                                 | 4.9  | 7.3   | -     | S    |
| Dynamic                                       |                     |                                                                                                                                                                    |                                                                 |      |       |       |      |
| Input Capacitance                             | C <sub>ISS</sub>    | V <sub>GS</sub> = 0 V,<br>V <sub>DS</sub> = 25 V,<br>f = 1.0 MHz                                                                                                   |                                                                 | -    | 400   | -     | pF   |
| Output Capacitance                            | C <sub>OSS</sub>    |                                                                                                                                                                    |                                                                 | -    | 260   | -     |      |
| Reverse Transfer Capacitance                  | C <sub>RSS</sub>    |                                                                                                                                                                    |                                                                 | -    | 44    | -     |      |
| Total Gate Charge                             | Q <sub>g</sub>      | V <sub>GS</sub> = 10 V                                                                                                                                             | I <sub>D</sub> = 15 A,<br>V <sub>DS</sub> = max. rating x 0.8   | -    | 16    | 24    | nC   |
| Gate-Source Charge                            | Q <sub>gs</sub>     |                                                                                                                                                                    |                                                                 | -    | 4.7   | 7.1   |      |
| Gate-Drain Charge                             | Q <sub>gd</sub>     |                                                                                                                                                                    |                                                                 | -    | 4.7   | 7.1   |      |
| Turn-On Delay Time                            | t <sub>d(on)</sub>  | V <sub>DD</sub> = 25 V, I <sub>D</sub> = 15 A,<br>R <sub>g</sub> = 18 Ω, R <sub>D</sub> = 1.7 Ω                                                                    |                                                                 | -    | 8.7   | 13    | ns   |
| Rise Time                                     | t <sub>r</sub>      |                                                                                                                                                                    |                                                                 | -    | 55    | 83    |      |
| Turn-Off Delay Time                           | t <sub>d(off)</sub> |                                                                                                                                                                    |                                                                 | -    | 16    | 24    |      |
| Fall Time                                     | t <sub>f</sub>      |                                                                                                                                                                    |                                                                 | -    | 26    | 39    |      |
| Internal Drain Inductance                     | L <sub>D</sub>      | Between lead,<br>6 mm (0.25") from<br>package and center of<br>die contact<br> |                                                                 | -    | 4.0   | -     | nH   |
| Internal Source Inductance                    | L <sub>S</sub>      |                                                                                                                                                                    |                                                                 | -    | 6.0   | -     |      |
| Drain-Source Body Diode Characteristics       |                     |                                                                                                                                                                    |                                                                 |      |       |       |      |
| Continuous Source-Drain Diode Current         | I <sub>S</sub>      | MOSFET symbol<br>showing the<br>integral reverse<br>p - n junction diode<br>   |                                                                 | -    | -     | 2.4   | A    |
| Pulsed Diode Forward Current <sup>c</sup>     | I <sub>SM</sub>     |                                                                                                                                                                    |                                                                 | -    | -     | 19    |      |
| Body Diode Voltage <sup>a</sup>               | V <sub>SD</sub>     | T <sub>C</sub> = 25 °C, I <sub>S</sub> = 2.4 A, V <sub>GS</sub> = 0 V                                                                                              |                                                                 | -    | -     | 1.4   | V    |
| Body Diode Reverse Recovery Time              | t <sub>rr</sub>     | T <sub>J</sub> = 25 °C, I <sub>F</sub> = 15 A, dI/dt = 100 A/μs                                                                                                    |                                                                 | 57   | 130   | 310   | ns   |
| Body Diode Reverse Recovery Charge            | Q <sub>rr</sub>     |                                                                                                                                                                    |                                                                 | 0.17 | 0.34  | 0.85  | μC   |
| Forward Turn-On Time                          | t <sub>on</sub>     | Intrinsic turn-on time is negligible (turn-on is dominated by L <sub>S</sub> and L <sub>D</sub> )                                                                  |                                                                 |      |       |       |      |

**Notes**

a. Repetitive rating; pulse width limited by maximum junction temperature (see fig. 11).

b. Pulse width  $\leq 300\text{ }\mu\text{s}$ ; duty cycle  $\leq 2\%$ .

c.  $V_{DD} = 25\text{ V}$ , starting  $T_J = 25\text{ }^{\circ}\text{C}$ ,  $L = 100\text{ }\mu\text{H}$ ,  $R_g = 25\text{ }\Omega$

**TYPICAL CHARACTERISTICS** (25 °C, unless otherwise noted)

**Fig. 1 - Typical Output Characteristics**

**Fig. 3 - Typical Transfer Characteristics**

**Fig. 2 - Typical Output Characteristics**

**Fig. 4 - Normalized On-Resistance vs. Temperature**

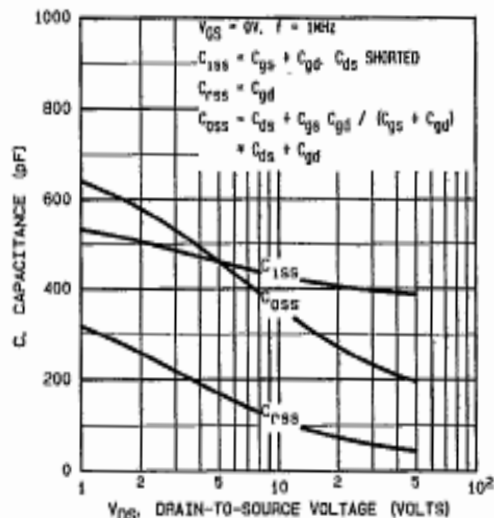


Fig. 5 - Typical Capacitance vs. Drain-to-Source Voltage

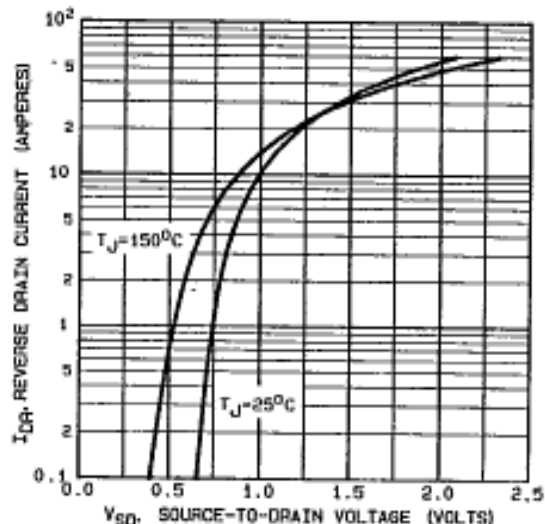


Fig. 7 - Typical Source-Drain Diode Forward Voltage

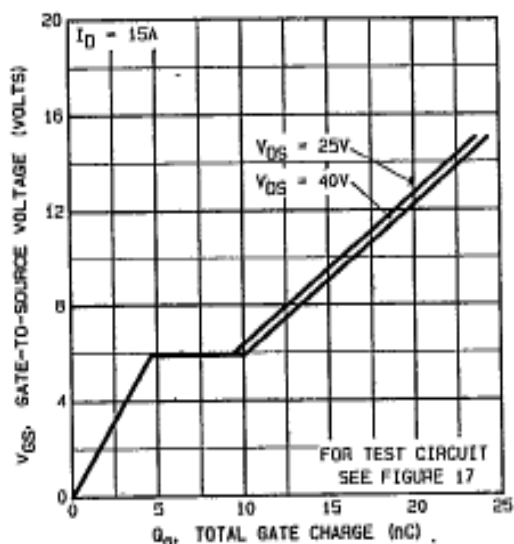


Fig. 6 - Typical Gate Charge vs. Gate-to-Source Voltage

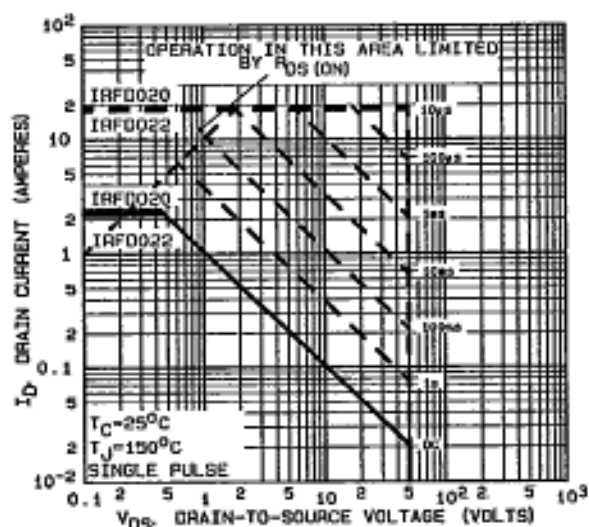


Fig. 8 - Maximum Safe Operating Area

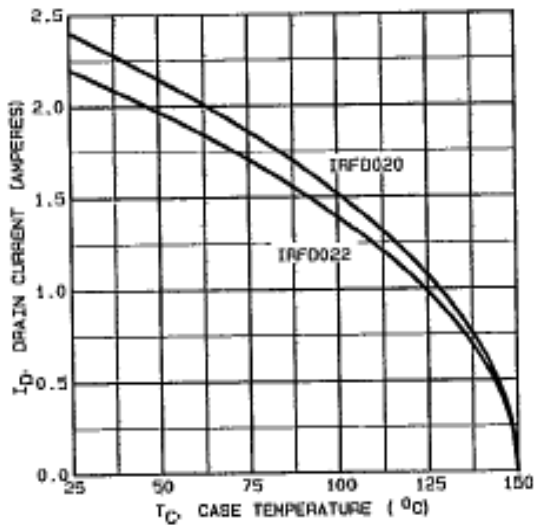


Fig. 9 - Maximum Drain Current vs. Ambient Temperature

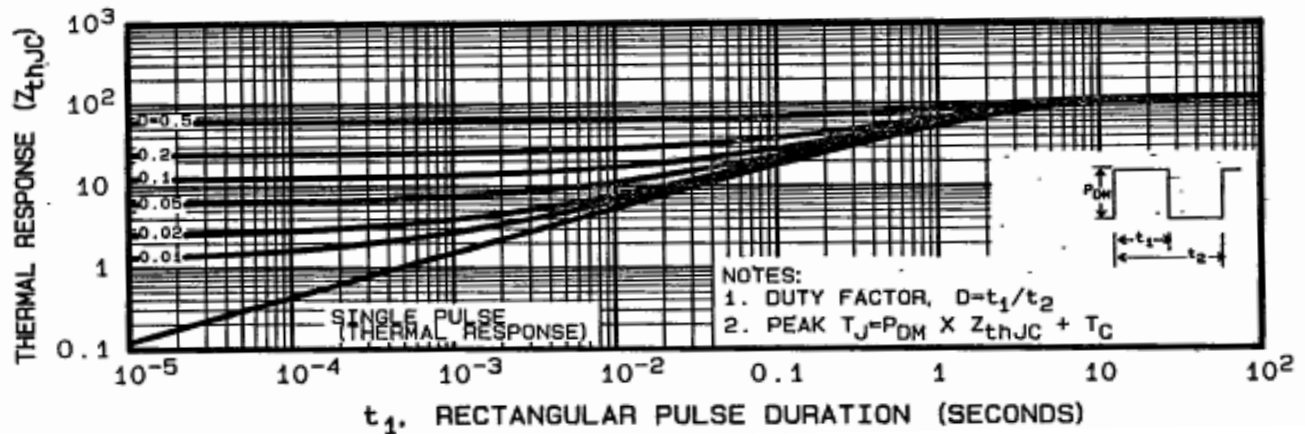


Fig. 10 - Maximum Effective Transient Thermal Impedance, Junction-to-Ambient

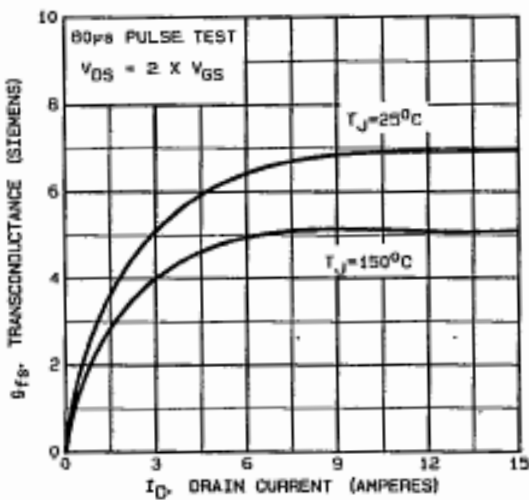


Fig. 11 - Typical Transconductance vs. Drain Current

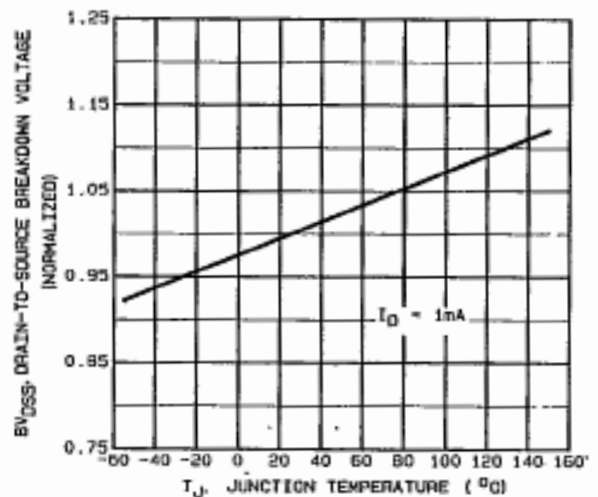


Fig. 12 - Breakdown Voltage vs. Temperature

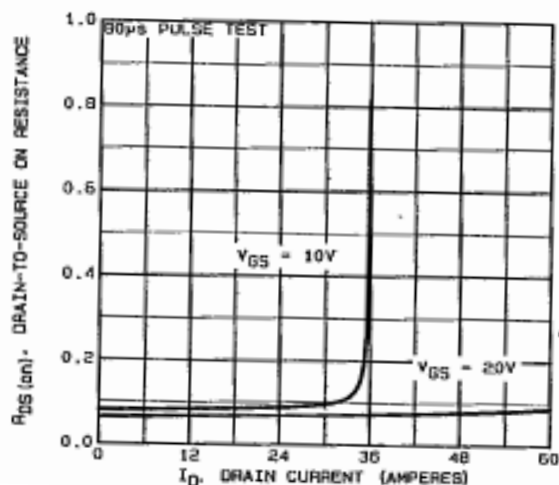


Fig. 13 - Typical on-Resistance vs. Drain Current

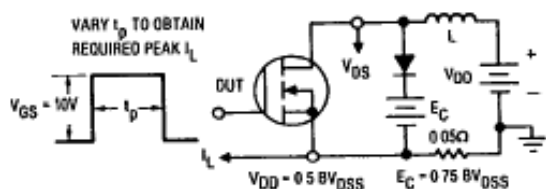


Fig. 14a - Clamped Inductive Test Circuit

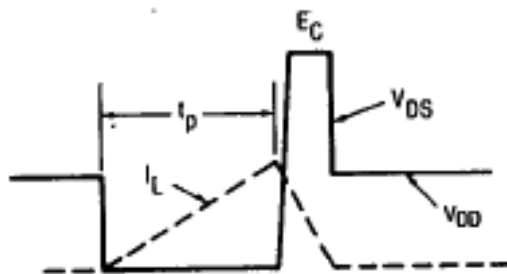


Fig. 14b - Clamped Inductive Waveforms

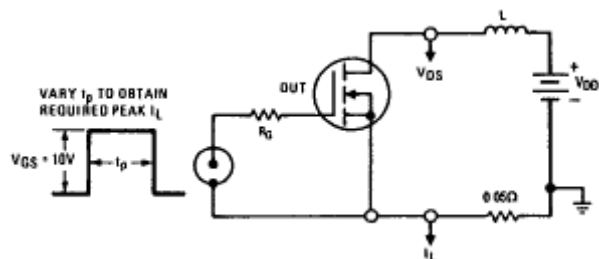


Fig. 15a - Unclamped Inductive Test Circuit

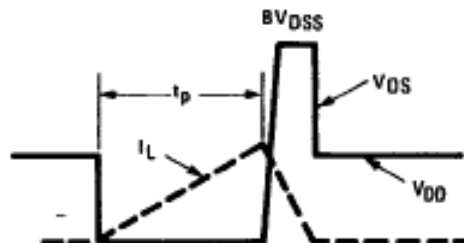


Fig. 15a - Unclamped Inductive Load Test Waveforms

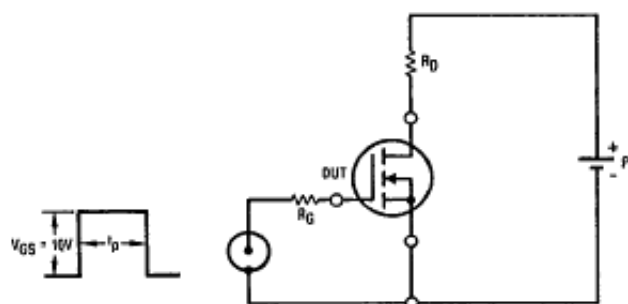


Fig. 16 - Switching Time Test Circuit

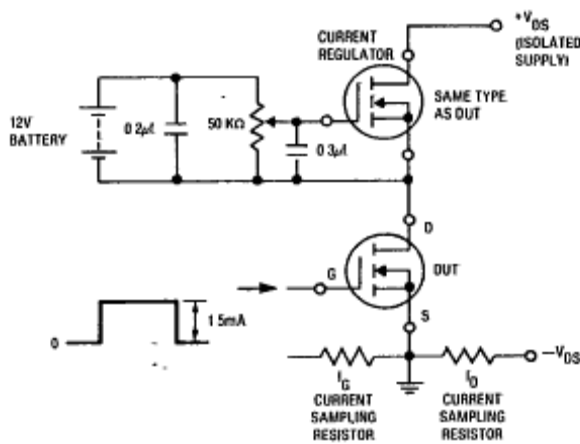


Fig. 17 - Gate Charge Test Circuit

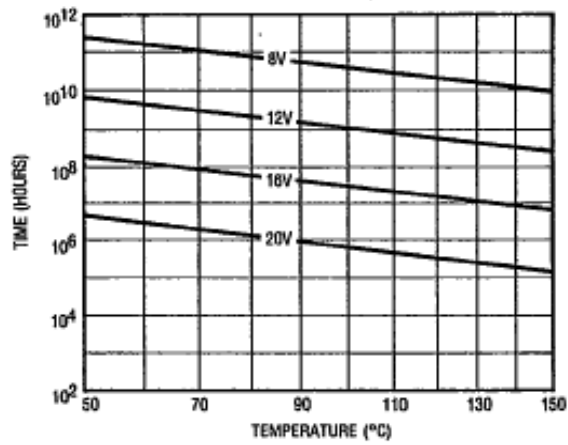


Fig. 18 - Typical Time to Accumulated 1 % Gate Failure

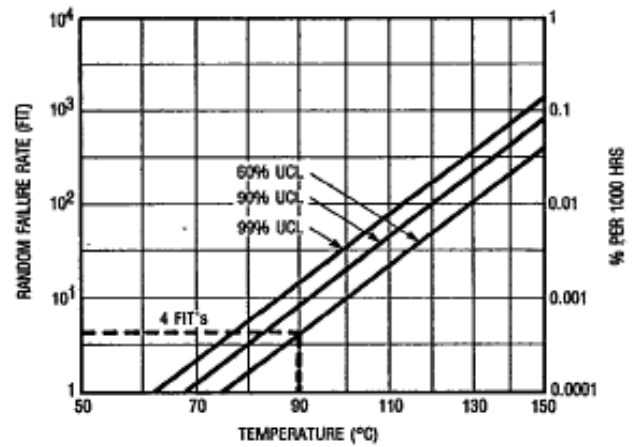


Fig. 19 - Typical High Temperature Reverse Bias (HTRB) Failure Rate

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