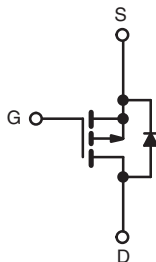
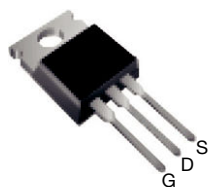


## Power MOSFET

### PRODUCT SUMMARY

|                           |                   |      |
|---------------------------|-------------------|------|
| $V_{DS}$ (V)              | - 50              |      |
| $R_{DS(on)}$ ( $\Omega$ ) | $V_{GS} = - 10$ V | 0.14 |
| $Q_g$ (Max.) (nC)         | 39                |      |
| $Q_{gs}$ (nC)             | 10                |      |
| $Q_{gd}$ (nC)             | 15                |      |
| Configuration             | Single            |      |

**TO-220AB**


P-Channel MOSFET

### FEATURES

- P-Channel Versatility
- Compact Plastic Package
- Fast Switching
- Low Drive Current
- Ease of Paralleling
- Excellent Temperature Stability
- Material categorization: For definitions of compliance please see [www.vishay.com/doc?99912](http://www.vishay.com/doc?99912)

### Note

\* Lead (Pb)-containing terminations are not RoHS-compliant. Exemptions may apply.



**RoHS\***  
COMPLIANT

### DESCRIPTION

The power MOSFET technology is the key to Vishay's advanced line of power MOSFET transistors. The efficient geometry and unique processing of the power MOSFET design achieve very low on-state resistance combined with high transconductance and extreme device ruggedness.

The p-channel power MOSFET's are designed for application which require the convenience of reverse polarity operation. They retain all of the features of the more common n-channel Power MOSFET's such as voltage control, very fast switching, ease of paralleling, and excellent temperature stability.

P-channel power MOSFETs are intended for use in power stages where complementary symmetry with n-channel devices offers circuit simplification. They are also very useful in drive stages because of the circuit versatility offered by the reverse polarity connection. Applications include motor control, audio amplifiers, switched mode converters, control circuits and pulse amplifiers.

### ORDERING INFORMATION

|                |             |
|----------------|-------------|
| Package        | TO-220AB    |
| Lead (Pb)-free | IRF9Z30PbF  |
|                | SiHF9Z30-E3 |
| SnPb           | IRF9Z30     |
|                | SiHF9Z30    |

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

| PARAMETER                                        | SYMBOL         | LIMIT                     | UNIT                |
|--------------------------------------------------|----------------|---------------------------|---------------------|
| Drain-Source Voltage                             | $V_{DS}$       | - 50                      | V                   |
| Gate-Source Voltage                              | $V_{GS}$       | $\pm 20$                  |                     |
| Continuous Drain Current                         | $I_D$          | $T_C = 25^\circ\text{C}$  | A                   |
|                                                  |                | $T_C = 100^\circ\text{C}$ |                     |
| Pulsed Drain Current <sup>a</sup>                | $I_{DM}$       | - 60                      |                     |
| Linear Derating Factor                           |                | 0.59                      | W/ $^\circ\text{C}$ |
| Inductive Current, Clamped                       | $I_{LM}$       | - 60                      | A                   |
| Unclamped Inductive Current (Avalanche Current)  | $I_L$          | - 3.1                     | A                   |
| Maximum Power Dissipation                        | $P_D$          | 74                        | 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>c</sup>          |                     |

### Notes

- Repetitive rating; pulse width limited by maximum junction temperature (see fig. 14).
- $V_{DS} = - 25$  V, starting  $T_J = 25^\circ\text{C}$ ,  $L = 100\ \mu\text{H}$ ,  $R_g = 25\ \Omega$
- 0.063" (1.6 mm) from case.

**THERMAL RESISTANCE RATINGS**

| PARAMETER                        | SYMBOL     | TYP. | MAX. | UNIT |
|----------------------------------|------------|------|------|------|
| Maximum Junction-to-Ambient      | $R_{thJA}$ | -    | 80   | °C/W |
| Maximum Junction-to-Case (Drain) | $R_{thJC}$ | -    | 1.7  |      |

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

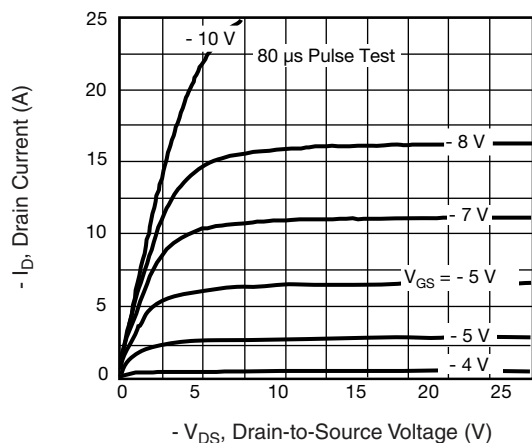
| PARAMETER                                 | SYMBOL       | TEST CONDITIONS                                                                                                                                                                                               |                                                                    | MIN.  | TYP.  | MAX.      | UNIT          |
|-------------------------------------------|--------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------|-------|-------|-----------|---------------|
| Static                                    |              |                                                                                                                                                                                                               |                                                                    |       |       |           |               |
| Drain-Source Breakdown Voltage            | $V_{DS}$     | $V_{GS} = 0\text{ V}$ , $I_D = -250\text{ }\mu\text{A}$                                                                                                                                                       |                                                                    | - 50  | -     | -         | V             |
| Gate-Source Threshold Voltage             | $V_{GS(th)}$ | $V_{DS} = V_{GS}$ , $I_D = -250\text{ }\mu\text{A}$                                                                                                                                                           |                                                                    | - 2.0 | -     | - 4.0     | V             |
| Gate-Source Leakage                       | $I_{GSS}$    | $V_{GS} = \pm 20\text{ V}$                                                                                                                                                                                    |                                                                    | -     | -     | $\pm 500$ | nA            |
| Zero Gate Voltage Drain Current           | $I_{DSS}$    | $V_{DS} = \text{max. rating}$ , $V_{GS} = 0\text{ V}$                                                                                                                                                         |                                                                    | -     | -     | - 250     | $\mu\text{A}$ |
|                                           |              | $V_{DS} = \text{max. rating} \times 0.8$ , $V_{GS} = 0\text{ V}$ ,<br>$T_J = 125\text{ }^\circ\text{C}$                                                                                                       |                                                                    | -     | -     | - 1000    |               |
| Drain-Source On-State Resistance          | $R_{DS(on)}$ | $V_{GS} = -10\text{ V}$                                                                                                                                                                                       | $I_D = -9.3\text{ A}^b$                                            | -     | 0.093 | 0.14      | $\Omega$      |
| Forward Transconductance                  | $g_{fs}$     | $V_{DS} = 2 \times V_{GS}$ , $I_{DS} = -9\text{ A}^b$                                                                                                                                                         |                                                                    | 3.1   | 4.7   | -         | S             |
| Dynamic                                   |              |                                                                                                                                                                                                               |                                                                    |       |       |           |               |
| Input Capacitance                         | $C_{iss}$    | $V_{GS} = 0\text{ V}$ ,<br>$V_{DS} = -25\text{ V}$ ,<br>$f = 1.0\text{ MHz}$ , see fig. 9                                                                                                                     |                                                                    | -     | 900   | -         | pF            |
| Output Capacitance                        | $C_{oss}$    |                                                                                                                                                                                                               |                                                                    | -     | 570   | -         |               |
| Reverse Transfer Capacitance              | $C_{rss}$    |                                                                                                                                                                                                               |                                                                    | -     | 140   | -         |               |
| Total Gate Charge                         | $Q_g$        | $V_{GS} = -10\text{ V}$                                                                                                                                                                                       | $I_D = -18\text{ A}$ , $V_{DS} = -0.8$<br>max. rating, see fig. 17 | -     | 26    | 39        | nC            |
| Gate-Source Charge                        | $Q_{gs}$     |                                                                                                                                                                                                               |                                                                    | -     | 6.9   | 10        |               |
| Gate-Drain Charge                         | $Q_{gd}$     |                                                                                                                                                                                                               |                                                                    | -     | 9.7   | 15        |               |
| Turn-On Delay Time                        | $t_{d(on)}$  | $V_{DD} = -25\text{ V}$ , $I_D = -18\text{ A}$ ,<br>$R_g = 13\text{ }\Omega$ , $R_D = 1.3\text{ }\Omega$ , see fig. 16<br>(MOSFET switching times are<br>essentially independent of operating<br>temperature) |                                                                    | -     | 12    | 18        | ns            |
| Rise Time                                 | $t_r$        |                                                                                                                                                                                                               |                                                                    | -     | 110   | 170       |               |
| Turn-Off Delay Time                       | $t_{d(off)}$ |                                                                                                                                                                                                               |                                                                    | -     | 21    | 32        |               |
| Fall Time                                 | $t_f$        |                                                                                                                                                                                                               |                                                                    | -     | 64    | 96        |               |
| Drain-Source Body Diode Characteristics   |              |                                                                                                                                                                                                               |                                                                    |       |       |           |               |
| Continuous Source-Drain Diode Current     | $I_S$        | MOSFET symbol<br>showing the<br>integral reverse<br>p - n junction diode<br>                                              |                                                                    | -     | -     | - 18      | A             |
| Pulsed Diode Forward Current <sup>a</sup> | $I_{SM}$     |                                                                                                                                                                                                               |                                                                    | -     | -     | - 60      |               |
| Body Diode Voltage                        | $V_{SD}$     | $T_J = 25\text{ }^\circ\text{C}$ , $I_S = -18\text{ A}$ , $V_{GS} = 0\text{ V}^b$                                                                                                                             |                                                                    | -     | -     | - 6.3     | V             |
| Body Diode Reverse Recovery Time          | $t_{rr}$     | $T_J = 25\text{ }^\circ\text{C}$ , $I_F = -18\text{ A}$ , $dI/dt = 100\text{ A}/\mu\text{s}^b$                                                                                                                |                                                                    | 54    | 120   | 250       | ns            |
| Body Diode Reverse Recovery Charge        | $Q_{rr}$     |                                                                                                                                                                                                               |                                                                    | 0.20  | 0.47  | 1.1       | $\mu\text{C}$ |

**Notes**

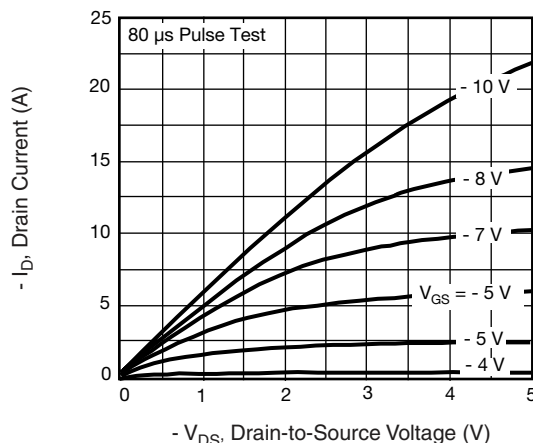
- a. Repetitive rating; pulse width limited by maximum junction temperature (see fig. 14).  
b. Pulse width  $\leq 300\text{ }\mu\text{s}$ ; duty cycle  $\leq 2\%$ .



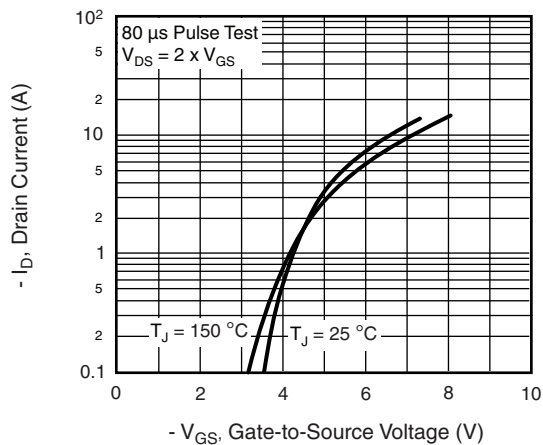
**TYPICAL CHARACTERISTICS** (25 °C, unless otherwise noted)



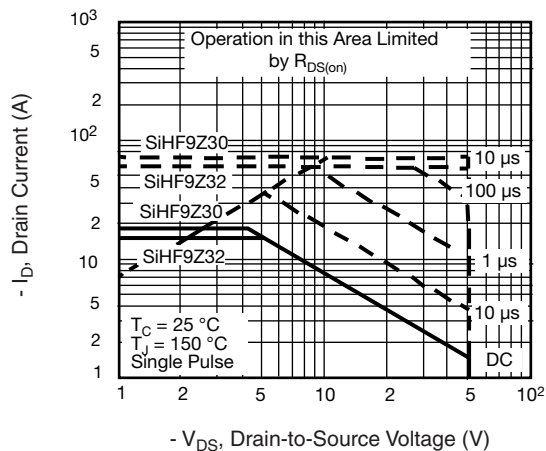
**Fig. 1 - Typical Output Characteristics**



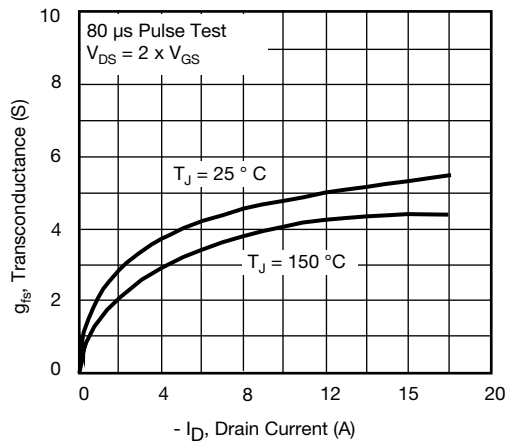
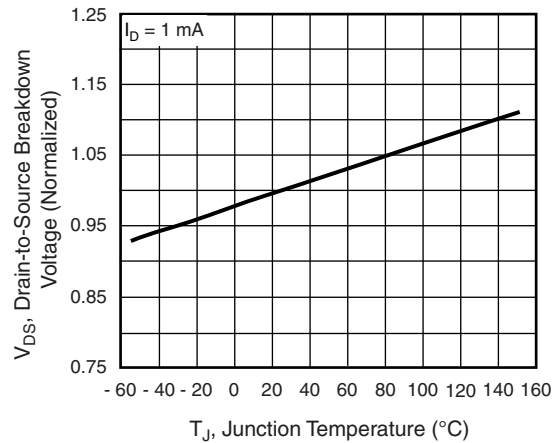
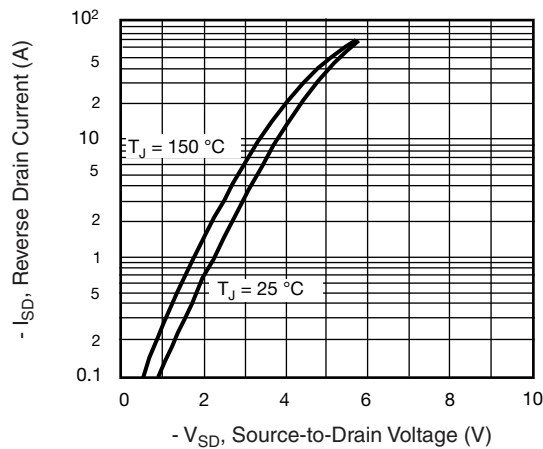
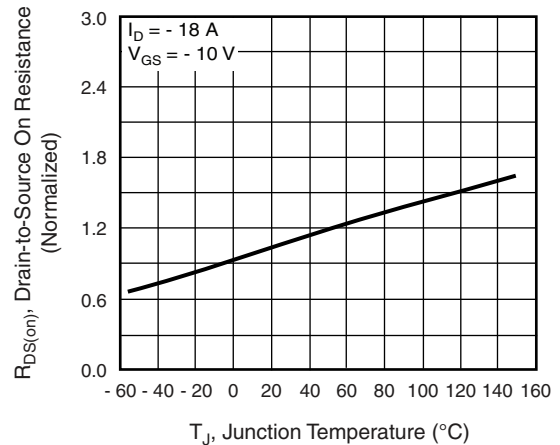
**Fig. 3 - Typical Saturation Characteristics**

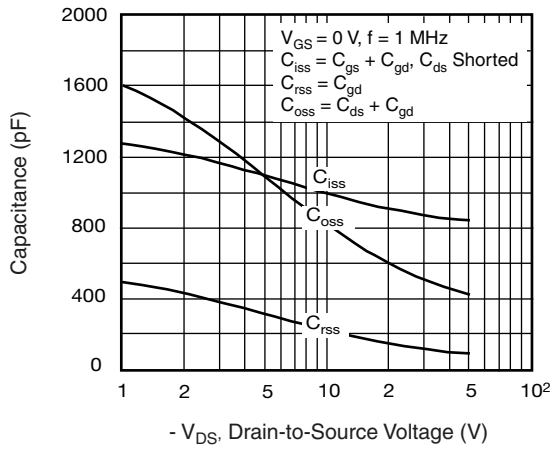
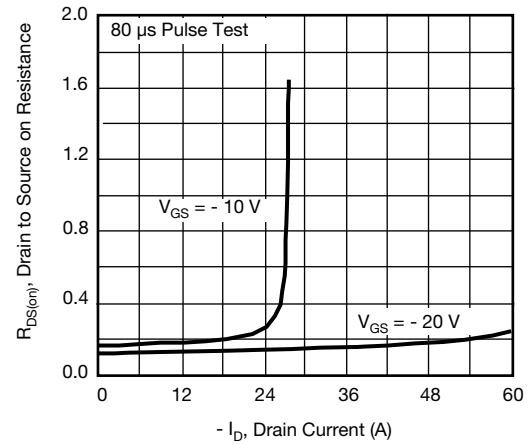
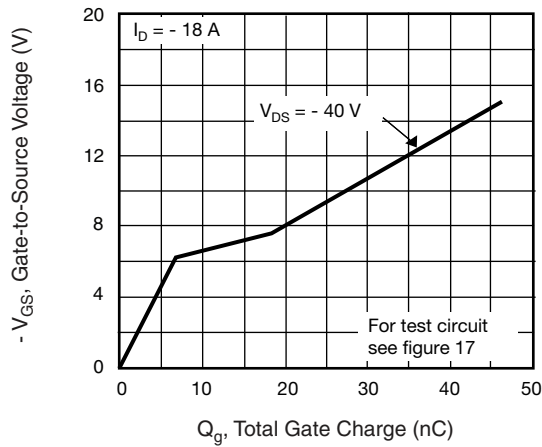
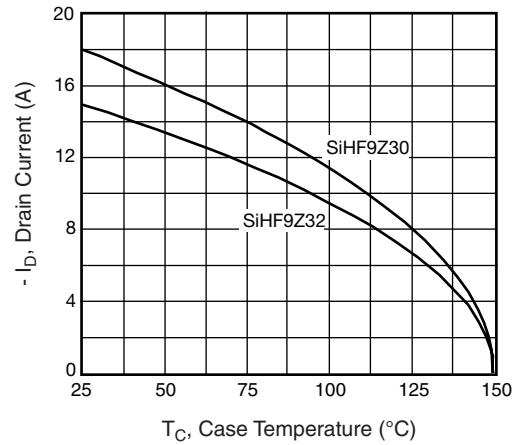


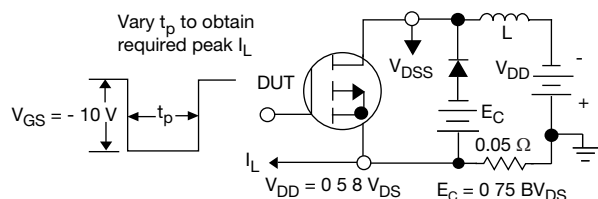
**Fig. 2 - Typical Transfer Characteristics**



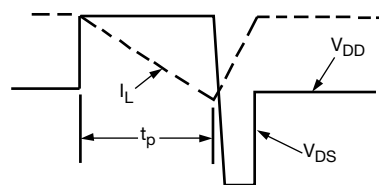
**Fig. 4 - Maximum Safe Operating Area**


**Fig. 5 - Typical Transconductance vs. Drain Current**

**Fig. 7 - Breakdown Voltage vs. Temperature**

**Fig. 6 - Typical Source-Drain Diode Forward Voltage**

**Fig. 8 - Normalized On-Resistance vs. Temperature**

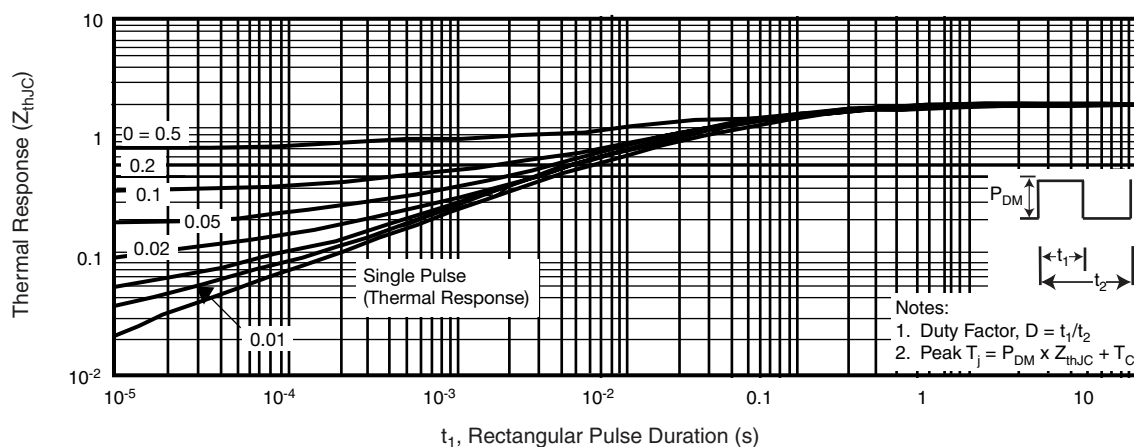

**Fig. 9 - Typical Capacitance vs. Drain-to-Source Voltage**

**Fig. 11 - Typical On-Resistance vs. Drain Current**

**Fig. 10 - Typical Gate Charge vs. Gate-to-Source Voltage**

**Fig. 12 - Maximum Drain Current vs. Case Temperature**



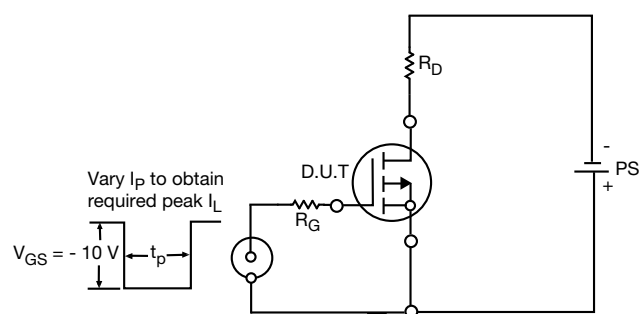
**Fig. 13a - Unclamped Inductive Test Circuit**



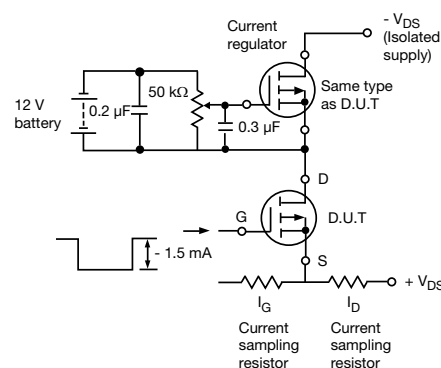
**Fig. 13b - Unclamped Inductive Load Test Waveforms**



**Fig. 14 - Maximum Effective Transient Thermal Impedance, Junction-to-Case vs. Pulse Duration**



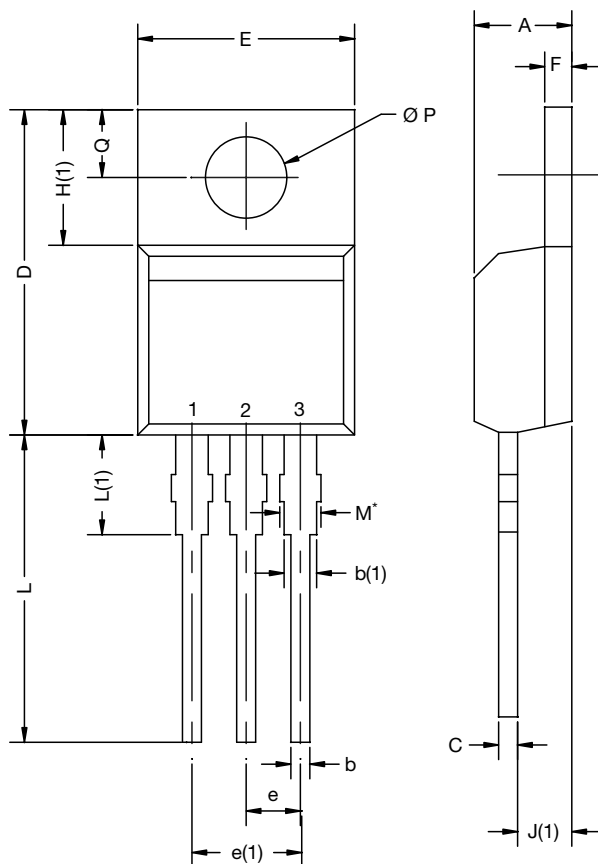
**Fig. 15 - Switching Time Test Circuit**



**Fig. 16 - Gate Charge Test Circuit**

*Vishay Siliconix maintains worldwide manufacturing capability. Products may be manufactured at one of several qualified locations. Reliability data for Silicon Technology and Package Reliability represent a composite of all qualified locations. For related documents such as package/tape drawings, part marking, and reliability data, see [www.vishay.com/ppg?91459](http://www.vishay.com/ppg?91459).*

## TO-220-1



| DIM.            | MILLIMETERS |       | INCHES |       |
|-----------------|-------------|-------|--------|-------|
|                 | MIN.        | MAX.  | MIN.   | MAX.  |
| A               | 4.24        | 4.65  | 0.167  | 0.183 |
| b               | 0.69        | 1.02  | 0.027  | 0.040 |
| b(1)            | 1.14        | 1.78  | 0.045  | 0.070 |
| c               | 0.36        | 0.61  | 0.014  | 0.024 |
| D               | 14.33       | 15.85 | 0.564  | 0.624 |
| E               | 9.96        | 10.52 | 0.392  | 0.414 |
| e               | 2.41        | 2.67  | 0.095  | 0.105 |
| e(1)            | 4.88        | 5.28  | 0.192  | 0.208 |
| F               | 1.14        | 1.40  | 0.045  | 0.055 |
| H(1)            | 6.10        | 6.71  | 0.240  | 0.264 |
| J(1)            | 2.41        | 2.92  | 0.095  | 0.115 |
| L               | 13.36       | 14.40 | 0.526  | 0.567 |
| L(1)            | 3.33        | 4.04  | 0.131  | 0.159 |
| $\varnothing P$ | 3.53        | 3.94  | 0.139  | 0.155 |
| Q               | 2.54        | 3.00  | 0.100  | 0.118 |

ECN: E21-0621-Rev. D, 04-Nov-2021  
DWG: 6031

### Note

- $M^*$  = 0.052 inches to 0.064 inches (dimension including protrusion), heatsink hole for HVM



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