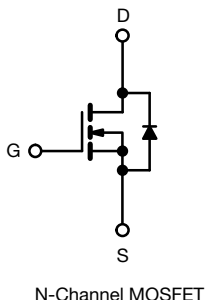
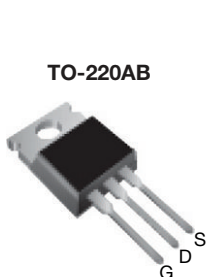


## Power MOSFET

### PRODUCT SUMMARY

|                           |                        |      |
|---------------------------|------------------------|------|
| $V_{DS}$ (V)              | 200                    |      |
| $R_{DS(on)}$ ( $\Omega$ ) | $V_{GS} = 10\text{ V}$ | 0.18 |
| $Q_g$ (Max.) (nC)         | 70                     |      |
| $Q_{gs}$ (nC)             | 13                     |      |
| $Q_{gd}$ (nC)             | 39                     |      |
| Configuration             | Single                 |      |



### FEATURES

- Dynamic dV/dt rating
- Repetitive avalanche rated
- Fast switching
- Ease of paralleling
- Simple drive requirements
- Material categorization: for definitions of compliance please see [www.vishay.com/doc?99912](http://www.vishay.com/doc?99912)



RoHS\*  
Available

### Note

\* This datasheet provides information about parts that are RoHS-compliant and / or parts that are non-RoHS-compliant. For example, parts with lead (Pb) terminations are not RoHS-compliant. Please see the information / tables in this datasheet for details.

### DESCRIPTION

Third generation power MOSFETs from Vishay provide the designer with the best combination of fast switching, ruggedized device design, low on-resistance and cost-effectiveness.

The TO-220AB package is universally preferred for all commercial-industrial applications at power dissipation levels to approximately 50 W. The low thermal resistance and low package cost of the TO-220AB contribute to its wide acceptance throughout the industry.

### ORDERING INFORMATION

|                |            |
|----------------|------------|
| Package        | TO-220AB   |
| Lead (Pb)-free | IRF640PbF  |
|                | SiHF640-E3 |
| SnPb           | IRF640     |
|                | SiHF640    |

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

| PARAMETER                                                 | SYMBOL           | LIMIT                               | UNIT                  |
|-----------------------------------------------------------|------------------|-------------------------------------|-----------------------|
| Drain-Source Voltage                                      | $V_{DS}$         | 200                                 | 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>a</sup>                         | $I_{DM}$         | 72                                  |                       |
| Linear Derating Factor                                    |                  | 1.0                                 | W/ $^{\circ}\text{C}$ |
| Single Pulse Avalanche Energy <sup>b</sup>                | $E_{AS}$         | 580                                 | mJ                    |
| Repetitive Avalanche Current <sup>a</sup>                 | $I_{AR}$         | 18                                  | A                     |
| Repetitive Avalanche Energy <sup>a</sup>                  | $E_{AR}$         | 13                                  | mJ                    |
| Maximum Power Dissipation                                 | $P_D$            | 125                                 | W                     |
| Peak Diode Recovery dV/dt <sup>c</sup>                    | dV/dt            | 5.0                                 | V/ns                  |
| Operating Junction and Storage Temperature Range          | $T_J, T_{stg}$   | -55 to +150                         | $^{\circ}\text{C}$    |
| Soldering Recommendations (Peak temperature) <sup>d</sup> | for 10 s         | 300                                 |                       |
| Mounting Torque                                           | 6-32 or M3 screw | 10                                  |                       |
|                                                           |                  | 1.1                                 | N · m                 |

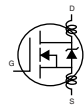
### Notes

- Repetitive rating; pulse width limited by maximum junction temperature (see fig. 11).
- $V_{DS} = 50\text{ V}$ , starting  $T_J = 25\text{ }^{\circ}\text{C}$ ,  $L = 2.7\text{ mH}$ ,  $R_g = 25\text{ }\Omega$ ,  $I_{AS} = 18\text{ A}$  (see fig. 12).
- $I_{SD} \leq 18\text{ A}$ ,  $dI/dt \leq 150\text{ A}/\mu\text{s}$ ,  $V_{DD} \leq V_{DS}$ ,  $T_J \leq 150\text{ }^{\circ}\text{C}$ .
- 1.6 mm from case.

**THERMAL RESISTANCE RATINGS**

| PARAMETER                           | SYMBOL     | TYP. | MAX. | UNIT |
|-------------------------------------|------------|------|------|------|
| Maximum Junction-to-Ambient         | $R_{thJA}$ | -    | 62   | °C/W |
| Case-to-Sink, Flat, Greased Surface | $R_{thCS}$ | 0.50 | -    |      |
| Maximum Junction-to-Case (Drain)    | $R_{thJC}$ | -    | 1.0  |      |

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

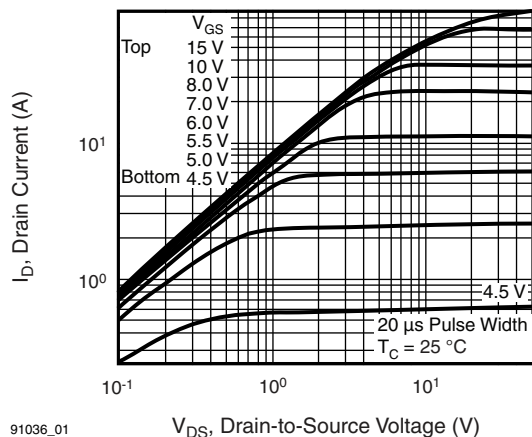
| PARAMETER                                      | SYMBOL              | TEST CONDITIONS                                                                                                                                                     | MIN. | TYP. | MAX.      | UNIT          |
|------------------------------------------------|---------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|------|-----------|---------------|
| <b>Static</b>                                  |                     |                                                                                                                                                                     |      |      |           |               |
| Drain-Source Breakdown Voltage                 | $V_{DS}$            | $V_{GS} = 0\text{ V}$ , $I_D = 250\text{ }\mu\text{A}$                                                                                                              | 200  | -    | -         | V             |
| $V_{DS}$ Temperature Coefficient               | $\Delta V_{DS}/T_J$ | Reference to $25\text{ °C}$ , $I_D = 1\text{ mA}$                                                                                                                   | -    | 0.29 | -         | V/°C          |
| 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                            | $I_{GSS}$           | $V_{GS} = \pm 20\text{ V}$                                                                                                                                          | -    | -    | $\pm 100$ | nA            |
| Zero Gate Voltage Drain Current                | $I_{DSS}$           | $V_{DS} = 200\text{ V}$ , $V_{GS} = 0\text{ V}$                                                                                                                     | -    | -    | 25        | $\mu\text{A}$ |
|                                                |                     | $V_{DS} = 160\text{ V}$ , $V_{GS} = 0\text{ V}$ , $T_J = 125\text{ °C}$                                                                                             | -    | -    | 250       |               |
| Drain-Source On-State Resistance               | $R_{DS(on)}$        | $V_{GS} = 10\text{ V}$ , $I_D = 11\text{ A}^b$                                                                                                                      | -    | -    | 0.18      | $\Omega$      |
| Forward Transconductance                       | $g_{fs}$            | $V_{DS} = 50\text{ V}$ , $I_D = 11\text{ A}^b$                                                                                                                      | 6.7  | -    | -         | S             |
| <b>Dynamic</b>                                 |                     |                                                                                                                                                                     |      |      |           |               |
| Input Capacitance                              | $C_{iss}$           | $V_{GS} = 0\text{ V}$ ,<br>$V_{DS} = 25\text{ V}$ ,<br>$f = 1.0\text{ MHz}$ , see fig. 5                                                                            | -    | 1300 | -         | pF            |
| Output Capacitance                             | $C_{oss}$           |                                                                                                                                                                     | -    | 430  | -         |               |
| Reverse Transfer Capacitance                   | $C_{rss}$           |                                                                                                                                                                     | -    | 130  | -         |               |
| Total Gate Charge                              | $Q_g$               | $V_{GS} = 10\text{ V}$ , $I_D = 18\text{ A}$ , $V_{DS} = 160\text{ V}$ ,<br>see fig. 6 and 13 <sup>b</sup>                                                          | -    | -    | 70        | nC            |
| Gate-Source Charge                             | $Q_{gs}$            |                                                                                                                                                                     | -    | -    | 13        |               |
| Gate-Drain Charge                              | $Q_{gd}$            |                                                                                                                                                                     | -    | -    | 39        |               |
| Turn-On Delay Time                             | $t_{d(on)}$         | $V_{DD} = 100\text{ V}$ , $I_D = 18\text{ A}$ ,<br>$R_g = 9.1\text{ }\Omega$ , $R_D = 5.4\text{ }\Omega$ , see fig. 10 <sup>b</sup>                                 | -    | 14   | -         | ns            |
| Rise Time                                      | $t_r$               |                                                                                                                                                                     | -    | 51   | -         |               |
| Turn-Off Delay Time                            | $t_{d(off)}$        |                                                                                                                                                                     | -    | 45   | -         |               |
| Fall Time                                      | $t_f$               |                                                                                                                                                                     | -    | 36   | -         |               |
| Internal Drain Inductance                      | $L_D$               | Between lead,<br>6 mm (0.25") from<br>package and center of<br>die contact<br> | -    | 4.5  | -         | nH            |
| Internal Source Inductance                     | $L_S$               |                                                                                                                                                                     | -    | 7.5  | -         |               |
| Gate Input Resistance                          | $R_g$               | $f = 1\text{ MHz}$ , open drain                                                                                                                                     | 0.5  | -    | 3.6       | $\Omega$      |
| <b>Drain-Source Body Diode Characteristics</b> |                     |                                                                                                                                                                     |      |      |           |               |
| 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>      | $I_{SM}$            |                                                                                                                                                                     | -    | -    | 72        |               |
| Body Diode Voltage                             | $V_{SD}$            | $T_J = 25\text{ °C}$ , $I_S = 18\text{ A}$ , $V_{GS} = 0\text{ V}^b$                                                                                                | -    | -    | 2.0       | V             |
| Body Diode Reverse Recovery Time               | $t_{rr}$            | $T_J = 25\text{ °C}$ , $I_F = 18\text{ A}$ , $dI/dt = 100\text{ A}/\mu\text{s}^b$                                                                                   | -    | 300  | 610       | ns            |
| Body Diode Reverse Recovery Charge             | $Q_{rr}$            |                                                                                                                                                                     | -    | 3.4  | 7.1       | $\mu\text{C}$ |
| Forward Turn-On Time                           | $t_{on}$            | Intrinsic turn-on time is negligible (turn-on is dominated by $L_S$ and $L_D$ )                                                                                     |      |      |           |               |

**Notes**

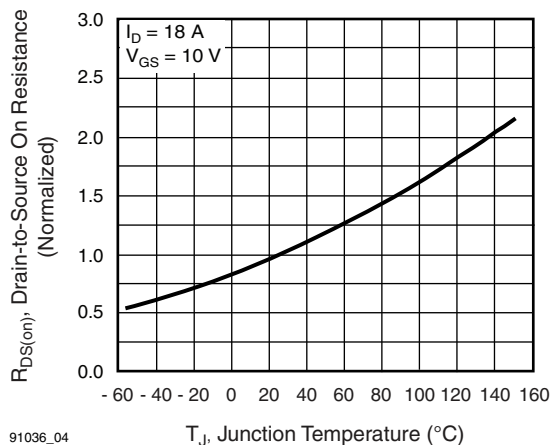
- a. Repetitive rating; pulse width limited by maximum junction temperature (see fig. 11).  
b. Pulse width  $\leq 300\text{ }\mu\text{s}$ ; duty cycle  $\leq 2\%$ .



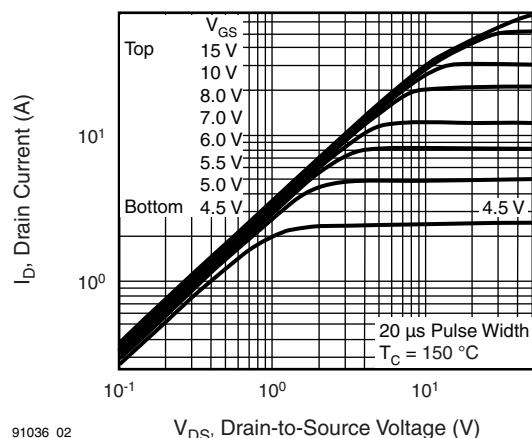
**TYPICAL CHARACTERISTICS** (25 °C, unless otherwise noted)



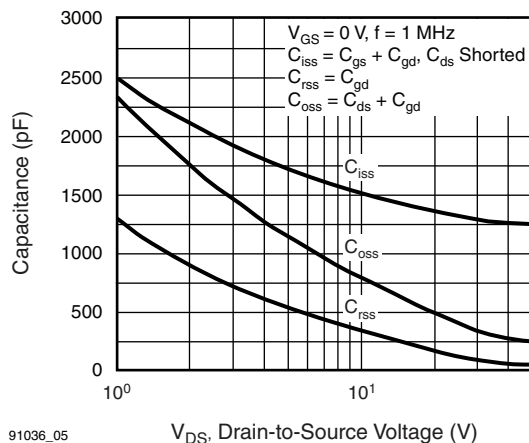
**Fig. 1 - Typical Output Characteristics,  $T_C = 25\text{ °C}$**



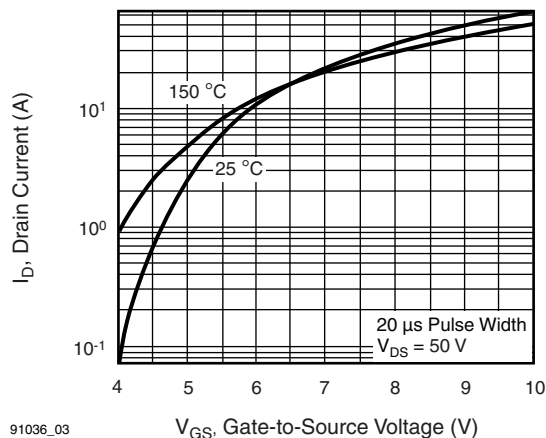
**Fig. 4 - Normalized On-Resistance vs. Temperature**



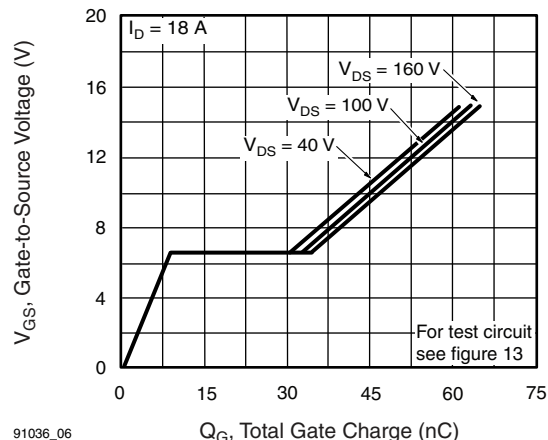
**Fig. 2 - Typical Output Characteristics,  $T_C = 150\text{ °C}$**



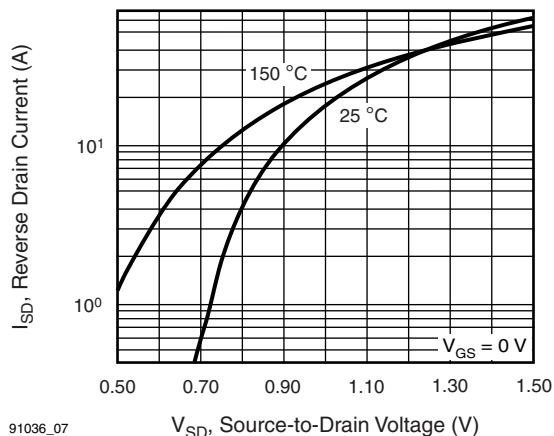
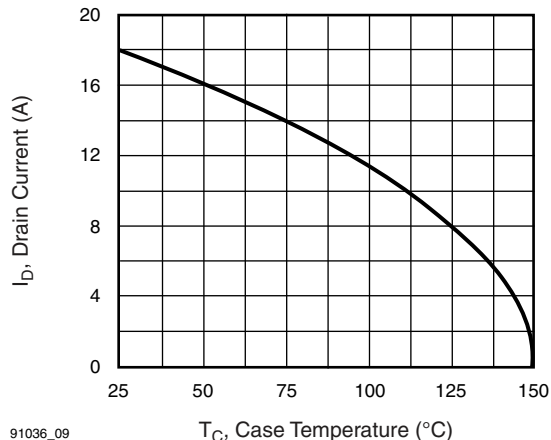
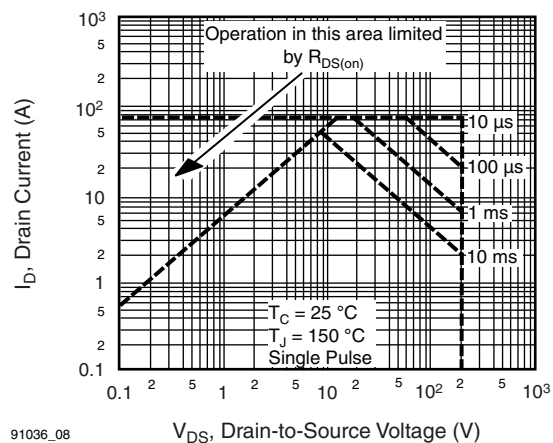
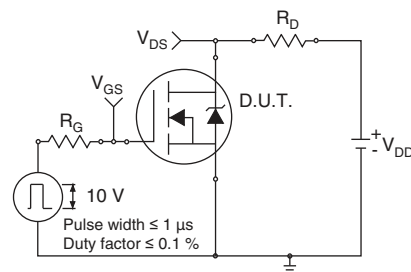
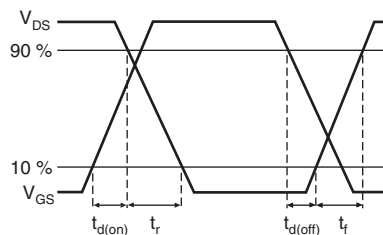
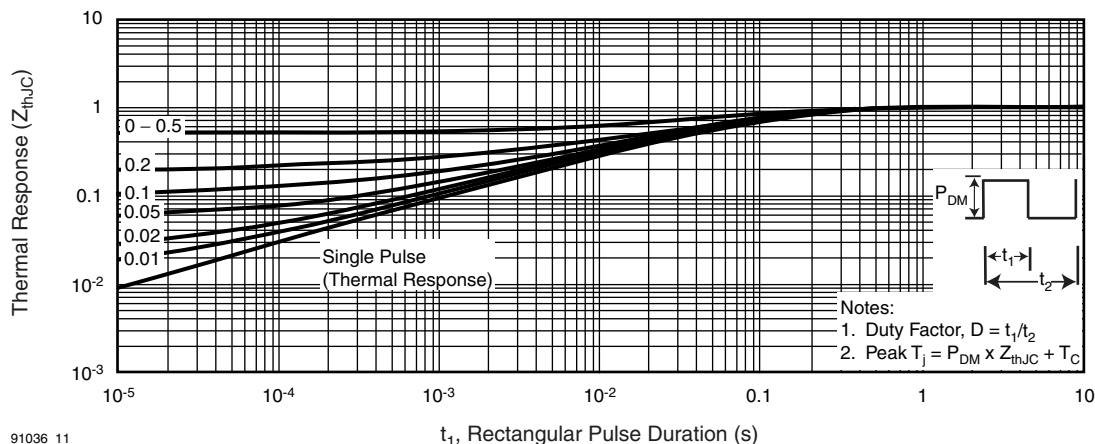
**Fig. 5 - Typical Capacitance vs. Drain-to-Source Voltage**

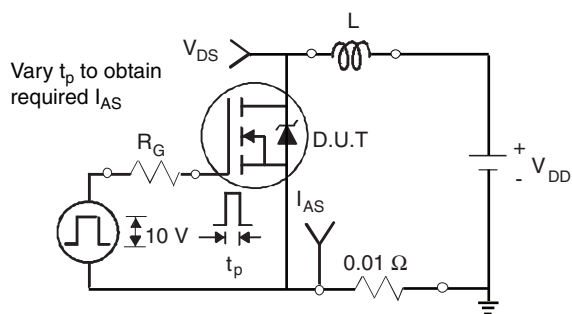
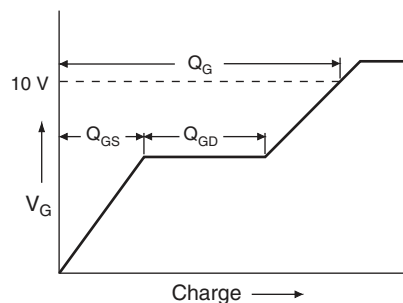
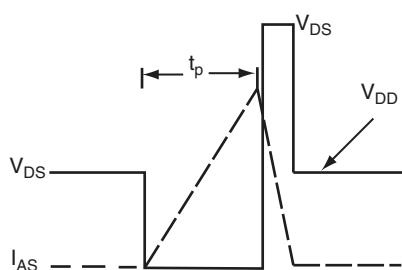
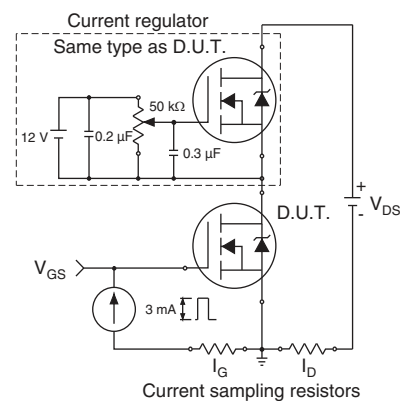
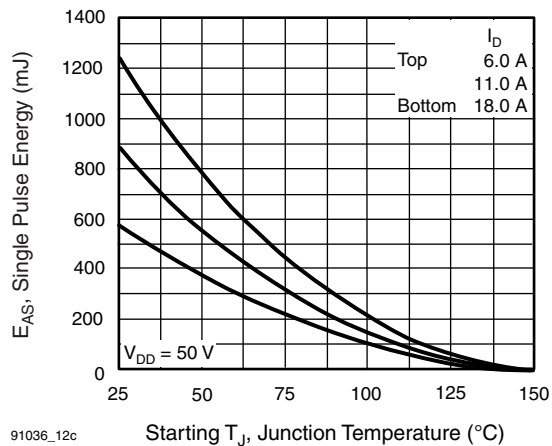


**Fig. 3 - Typical Transfer Characteristics**

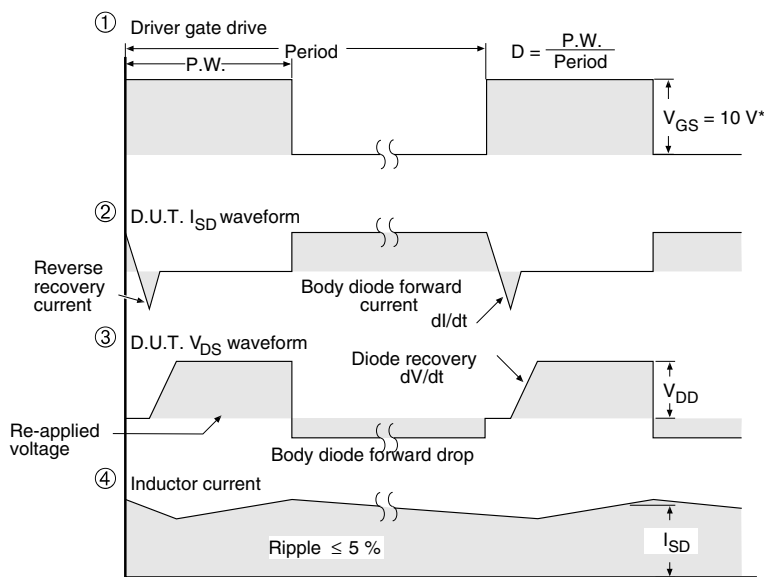
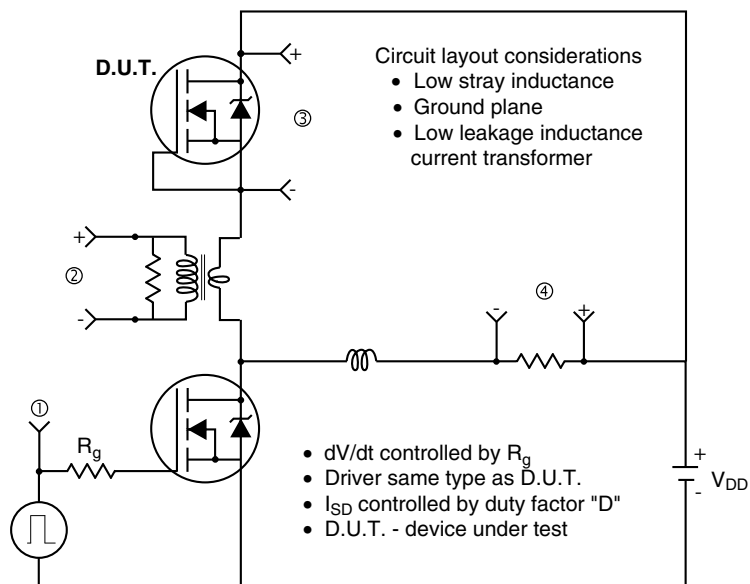


**Fig. 6 - Typical Gate Charge vs. Gate-to-Source Voltage**


**Fig. 7 - Typical Source-Drain Diode Forward Voltage**

**Fig. 9 - Maximum Drain Current vs. Case Temperature**

**Fig. 8 - Maximum Safe Operating Area**

**Fig. 10a - Switching Time Test Circuit**

**Fig. 10b - Switching Time Waveforms**

**Fig. 11 - Maximum Effective Transient Thermal Impedance, Junction-to-Case**


**Fig. 12a - Unclamped Inductive Test Circuit**

**Fig. 13a - Basic Gate Charge Waveform**

**Fig. 12b - Unclamped Inductive Waveforms**

**Fig. 13b - Gate Charge Test Circuit**

**Fig. 12c - Maximum Avalanche Energy vs. Drain Current**

## Peak Diode Recovery dV/dt Test Circuit

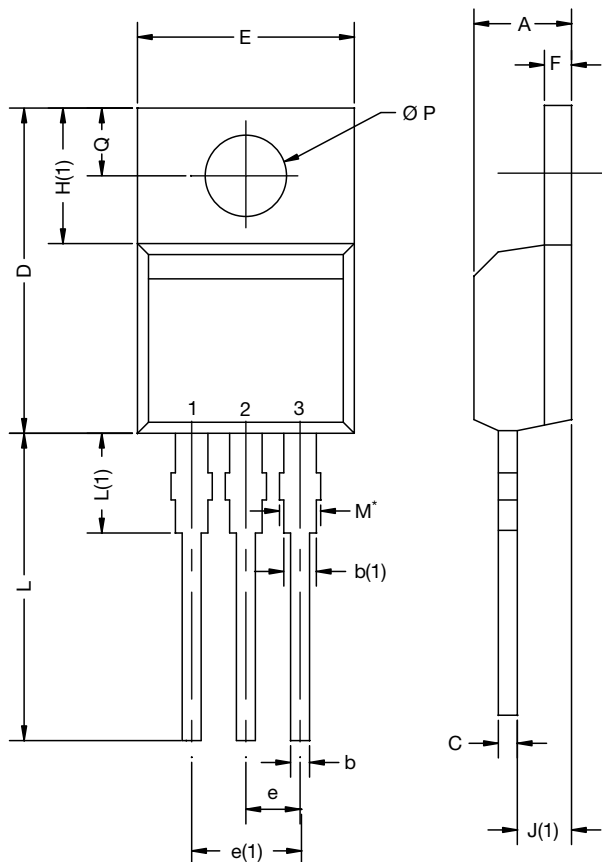


\*  $V_{GS} = 5\text{ V}$  for logic level devices

**Fig. 14 - For N-Channel**

*Vishay Silconix 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 <http://www.vishay.com/ppg?91036>.*

## TO-220-1



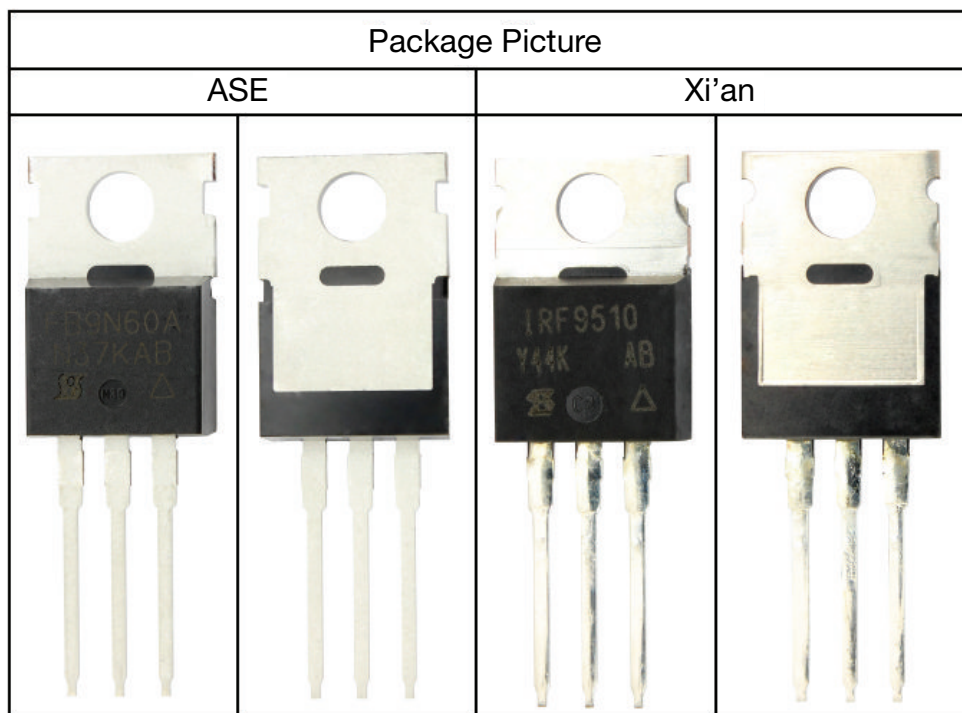
| DIM. | MILLIMETERS |       | INCHES |       |
|------|-------------|-------|--------|-------|
|      | MIN.        | MAX.  | MIN.   | MAX.  |
| A    | 4.24        | 4.65  | 0.167  | 0.183 |
| b    | 0.69        | 1.02  | 0.027  | 0.040 |
| b(1) | 1.14        | 1.78  | 0.045  | 0.070 |
| c    | 0.36        | 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 |
| Ø P  | 3.53        | 3.94  | 0.139  | 0.155 |
| Q    | 2.54        | 3.00  | 0.100  | 0.118 |

ECN: X15-0364-Rev. C, 14-Dec-15  
DWG: 6031

### Note

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

## Package Picture





## Disclaimer

ALL PRODUCT, PRODUCT SPECIFICATIONS AND DATA ARE SUBJECT TO CHANGE WITHOUT NOTICE TO IMPROVE RELIABILITY, FUNCTION OR DESIGN OR OTHERWISE.

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