

## Power MOSFET

**TO-220AB**


N-Channel MOSFET

### FEATURES

- Ultra low gate charge
- Reduced gate drive requirement
- Enhanced 30 V  $V_{GS}$  rating
- Reduced  $C_{iss}$ ,  $C_{oss}$ ,  $C_{rss}$
- Extremely high frequency operation
- Repetitive avalanche rated
- 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

This new series of low charge Power MOSFETs achieve significantly lower gate charge over conventional MOSFETs. Utilizing the new LCDMOS technology, the device improvements are achieved without added product cost, allowing for reduced gate drive requirements and total system savings. In addition, reduced switching losses and improved efficiency are achievable in a variety of high frequency applications. Frequencies of a few MHz at high current are possible using the new Low Charge MOSFETs.

These device improvements combined with the proven ruggedness and reliability that are characteristic of Power MOSFETs offer the designer a new standard in power transistors for switching applications.

| PRODUCT SUMMARY           |                      |
|---------------------------|----------------------|
| $V_{DS}$ (V)              | 400                  |
| $R_{DS(on)}$ ( $\Omega$ ) | $V_{GS} = 10$ V 0.55 |
| $Q_g$ (Max.) (nC)         | 39                   |
| $Q_{gs}$ (nC)             | 10                   |
| $Q_{gd}$ (nC)             | 19                   |
| Configuration             | Single               |

| ORDERING INFORMATION            |                 |
|---------------------------------|-----------------|
| Package                         | TO-220AB        |
| Lead (Pb)-free                  | IRF740LCPbF     |
| Lead (Pb)-free and halogen-free | IRF740LCPbF-BE3 |

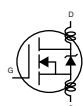
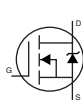
| ABSOLUTE MAXIMUM RATINGS ( $T_C = 25^\circ\text{C}$ , unless otherwise noted) |                          |                           |                  |                     |   |
|---|--------------------------|---------------------------|------------------|---------------------|---|
| PARAMETER   | SYMBOL                   |                           | LIMIT            | UNIT                |   |
| Drain-source voltage  | $V_{DS}$                 |                           | 400              | V                   |   |
| Gate-source voltage   | $V_{GS}$                 |                           | $\pm 30$         |                     |   |
| Continuous drain current  | $V_{GS}$ at 10 V         | $T_C = 25^\circ\text{C}$  | 10               | A                   |   |
|   |                          | $T_C = 100^\circ\text{C}$ | 6.3              |                     |   |
| Pulsed drain current <sup>a</sup>   | $I_{DM}$                 |                           | 32               |                     |   |
| Linear derating factor  |                          |                           | 1.0              | W/ $^\circ\text{C}$ |   |
| Single pulse avalanche energy <sup>b</sup>                                    | $E_{AS}$                 |                           | 520              | mJ                  |   |
| Repetitive avalanche current <sup>a</sup>                                     | $I_{AR}$                 |                           | 10               | A                   |   |
| Repetitive avalanche energy <sup>a</sup>                                      | $E_{AR}$                 |                           | 13               | mJ                  |   |
| Maximum power dissipation   | $T_C = 25^\circ\text{C}$ |                           | $P_D$            | 125                 | W |
| Peak diode recovery $dV/dt$ <sup>c</sup>                                      | $dV/dt$                  |                           | 4.0              | 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 <sup>d</sup> |                     |   |
| Mounting torque   | 6-32 or M3 screw         |                           | 10               | lbf · in            |   |
|   |                          |                           | 1.1              | N · m               |   |

### Notes

- Repetitive rating; pulse width limited by maximum junction temperature (see fig. 11)
- $V_{DD} = 50$  V, starting  $T_J = 25^\circ\text{C}$ ,  $L = 9.1$  mH,  $R_g = 25$   $\Omega$ ,  $I_{AS} = 10$  A (see fig. 12)
- $I_{SD} \leq 10$  A,  $dI/dt \leq 120$  A/ $\mu\text{s}$ ,  $V_{DD} \leq V_{DS}$ ,  $T_J \leq 150^\circ\text{C}$
- 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 ( $T_J = 25\text{ }^\circ\text{C}$ , unless otherwise noted) |                     |   |  |      |      |           |               |
|---|---------------------|---|--|------|------|-----------|---------------|
| PARAMETER   | SYMBOL              | TEST CONDITIONS   |  | MIN. | TYP. | MAX.      | UNIT          |
| <b>Static</b>   |                     |   |  |      |      |           |               |
| Drain-source breakdown voltage  | $V_{DS}$            | $V_{GS} = 0\text{ V}, I_D = 250\text{ }\mu\text{A}$   |  | 400  | -    | -         | V             |
| $V_{DS}$ temperature coefficient  | $\Delta V_{DS}/T_J$ | Reference to $25\text{ }^\circ\text{C}$ , $I_D = 1\text{ mA}$   |  | -    | 0.76 | -         | 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   | $I_{DSS}$           | $V_{DS} = 400\text{ V}, V_{GS} = 0\text{ V}$  |  | -    | -    | 25        | $\mu\text{A}$ |
|   |                     | $V_{DS} = 320\text{ V}, V_{GS} = 0\text{ V}, T_J = 125\text{ }^\circ\text{C}$   |  | -    | -    | 250       |               |
| Drain-source on-state resistance  | $R_{DS(on)}$        | $V_{GS} = 10\text{ V}$  | $I_D = 6.0\text{ A}^b$   | -    | -    | 0.55      | $\Omega$      |
| Forward transconductance  | $g_{fs}$            | $V_{DS} = 50\text{ V}, I_D = 6.0\text{ A}^b$  |  | 3.0  | -    | -         | S             |
| <b>Dynamic</b>  |                     |   |  |      |      |           |               |
| Input capacitance   | $C_{iss}$           | $V_{GS} = 0\text{ V}, V_{DS} = 25\text{ V}, f = 1.0\text{ MHz}$ , see fig. 5  |  | -    | 1100 | -         | pF            |
| Output capacitance  | $C_{oss}$           |   |  | -    | 190  | -         |               |
| Reverse transfer capacitance  | $C_{rss}$           |   |  | -    | 18   | -         |               |
| Total gate charge   | $Q_g$               | $V_{GS} = 10\text{ V}$  | $I_D = 10\text{ A}, V_{DS} = 320\text{ V}$<br>see fig. 6 and 13 <sup>b</sup> | -    | -    | 39        | nC            |
| Gate-source charge  | $Q_{gs}$            |   |  | -    | -    | 10        |               |
| Gate-drain charge   | $Q_{gd}$            |   |  | -    | -    | 19        |               |
| Turn-on delay time  | $t_{d(on)}$         | $V_{DD} = 200\text{ V}, I_D = 10\text{ A}, R_g = 9.1\text{ }\Omega, R_D = 20\text{ }\Omega$ , see fig. 10 <sup>b</sup>                                  |  | -    | 11   | -         | ns            |
| Rise time   | $t_r$               |   |  | -    | 31   | -         |               |
| Turn-off delay time   | $t_{d(off)}$        |   |  | -    | 25   | -         |               |
| Fall time   | $t_f$               |   |  | -    | 20   | -         |               |
| Internal drain inductance   | $L_D$               | Between lead, 6 mm (0.25") from package and center of die contact  |  | -    | 4.5  | -         | nH            |
| Internal source inductance  | $L_S$               |   |  | -    | 7.5  | -         |               |
| <b>Drain-Source Body Diode Characteristics</b>                              |                     |   |  |      |      |           |               |
| Continuous source-drain diode current                                       | $I_S$               | MOSFET symbol showing the integral reverse p - n junction diode    |  | -    | -    | 10        | A             |
| Pulsed diode forward current <sup>a</sup>                                   | $I_{SM}$            |   |  | -    | -    | 32        |               |
| Body diode voltage  | $V_{SD}$            | $T_J = 25\text{ }^\circ\text{C}, I_S = 10\text{ A}, V_{GS} = 0\text{ V}^b$  |  | -    | -    | 2.0       | V             |
| Body diode reverse recovery time  | $t_{rr}$            | $T_J = 25\text{ }^\circ\text{C}, I_F = 10\text{ A}, dI/dt = 100\text{ A}/\mu\text{s}^b$   |  | -    | 380  | 570       | ns            |
| Body diode reverse recovery charge  | $Q_{rr}$            |   |  | -    | 2.8  | 4.2       | $\mu\text{C}$ |
| 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)

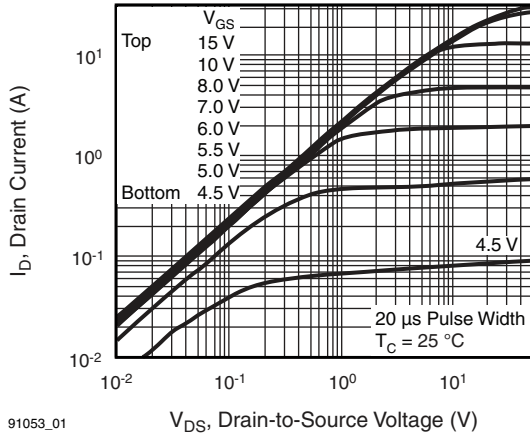


Fig. 1 - Typical Output Characteristics,  $T_C = 25\text{ }^\circ\text{C}$

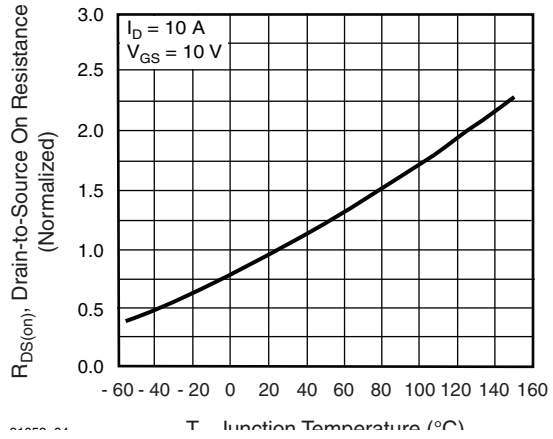


Fig. 3 - Normalized On-Resistance vs. Temperature

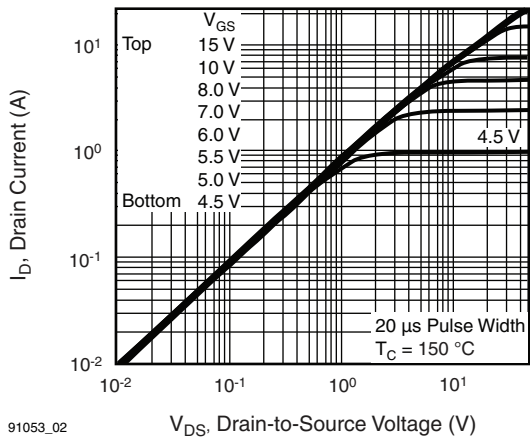


Fig. 1 - Typical Output Characteristics,  $T_C = 150\text{ }^\circ\text{C}$

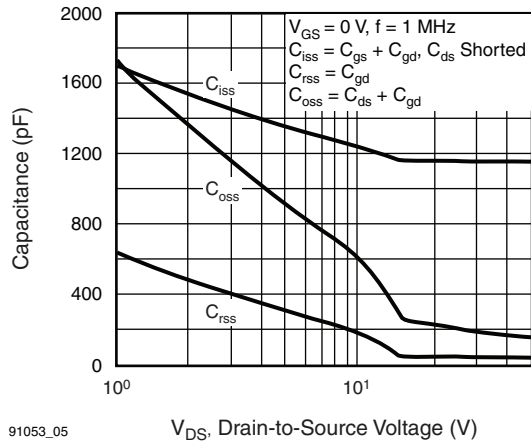


Fig. 4 - Typical Capacitance vs. Drain-to-Source Voltage

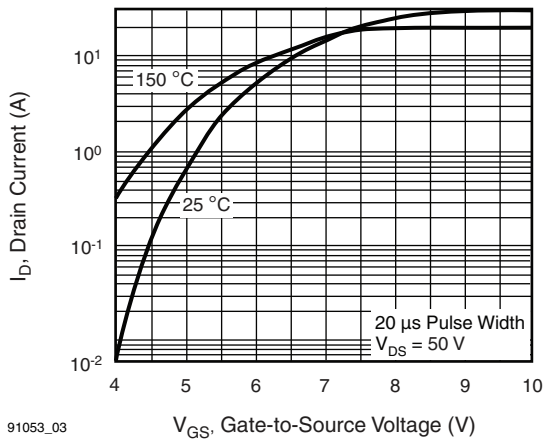


Fig. 2 - Typical Transfer Characteristics

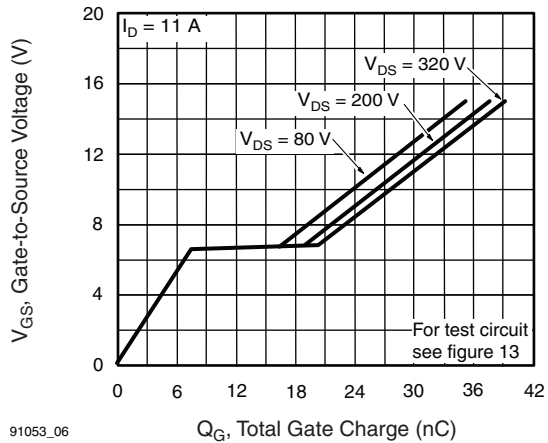
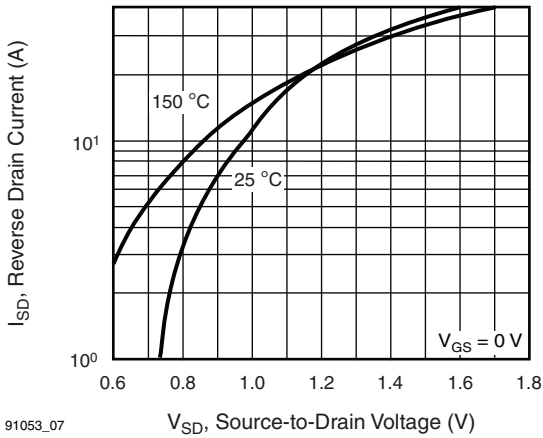
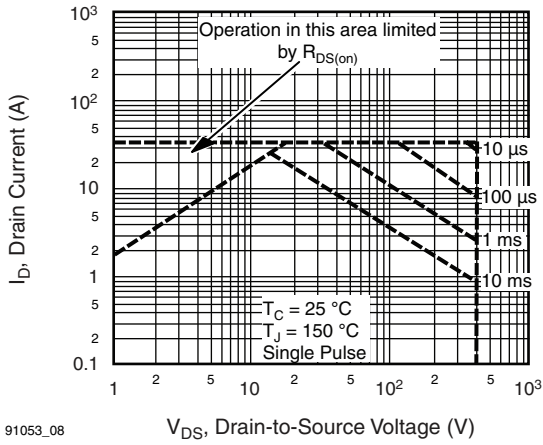


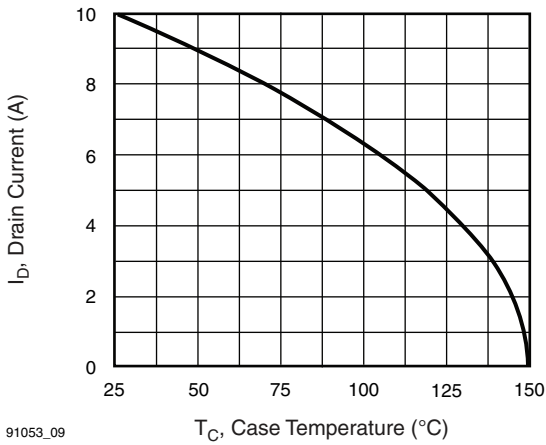
Fig. 5 - Typical Gate Charge vs. Gate-to-Source Voltage



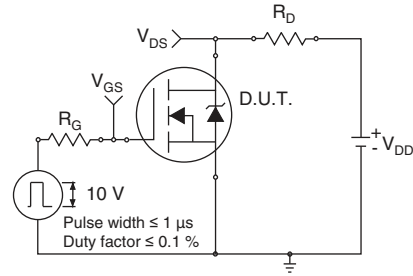
**Fig. 6 - Typical Source-Drain Diode Forward Voltage**



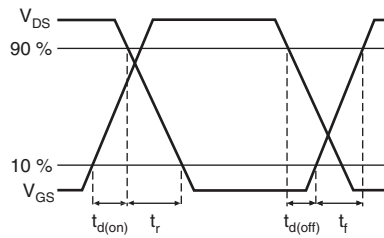
**Fig. 7 - Maximum Safe Operating Area**



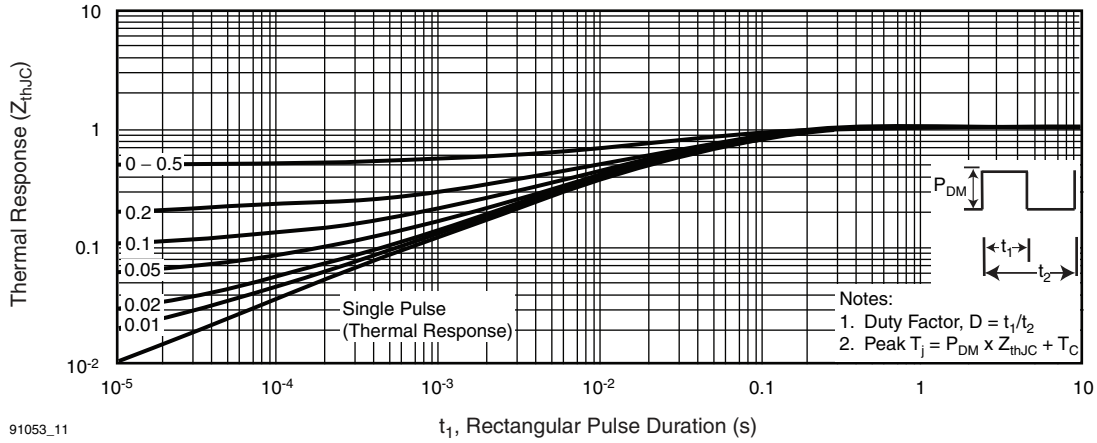
**Fig. 9 - Maximum Drain Current vs. Case Temperature**



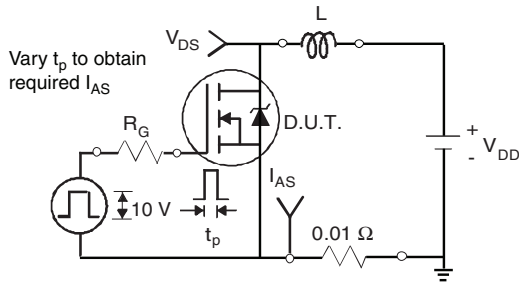
**Fig. 10a - Switching Time Test Circuit**



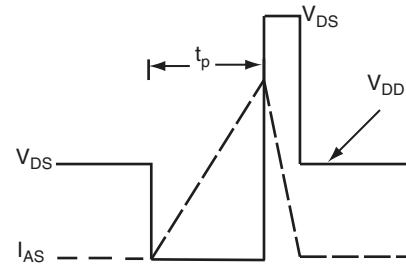
**Fig. 10b - Switching Time Waveforms**



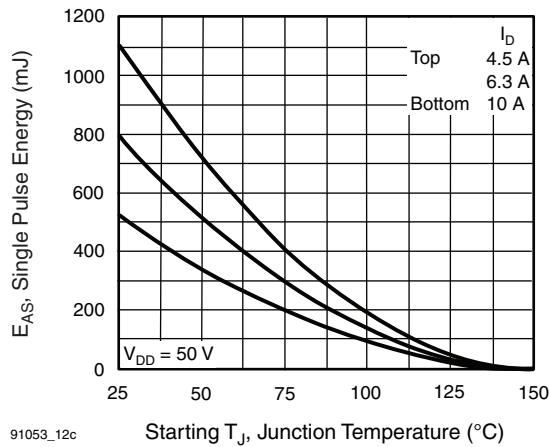
**Fig. 11 - Maximum Effective Transient Thermal Impedance, Junction-to-Case**



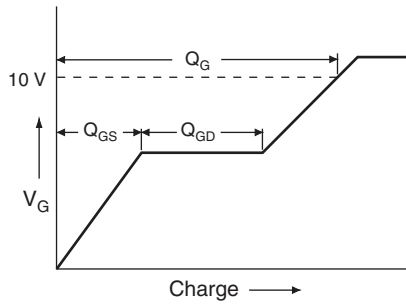
**Fig. 12a - Unclamped Inductive Test Circuit**



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



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

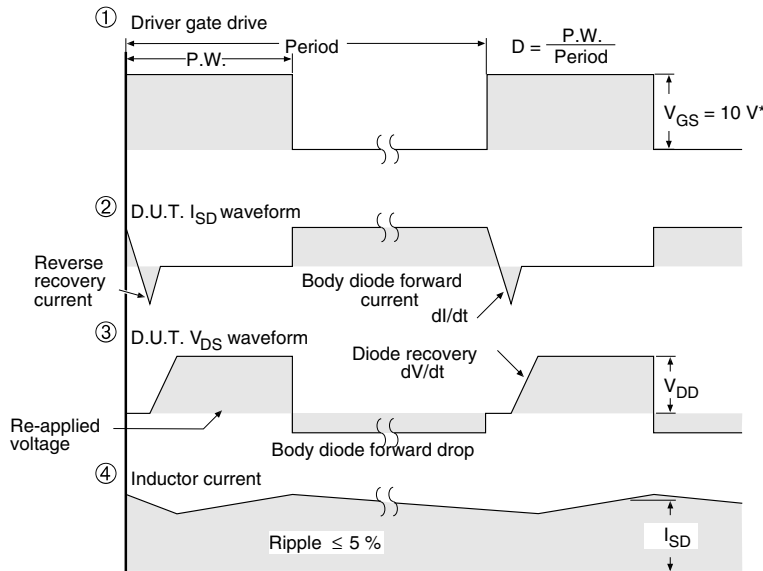
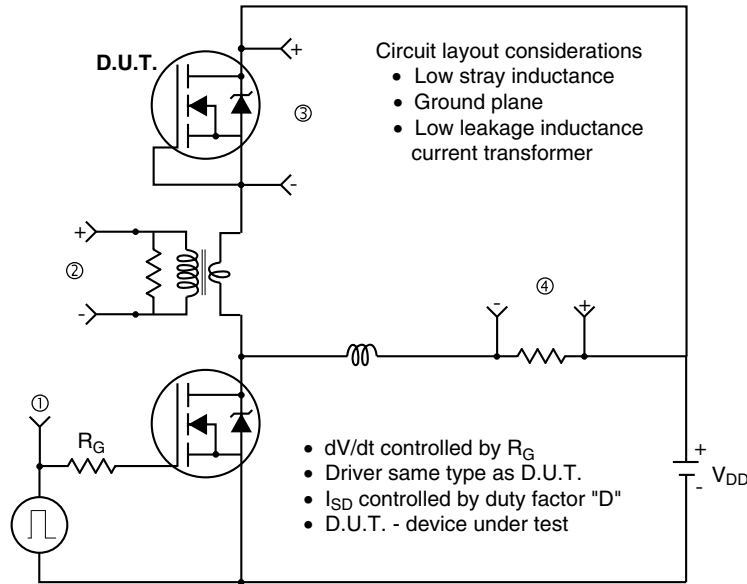


**Fig. 13a - Basic Gate Charge Waveform**



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

**Peak Diode Recovery dV/dt Test Circuit**



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

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

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# 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: 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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