

# FCH47N60 / FCA47N60

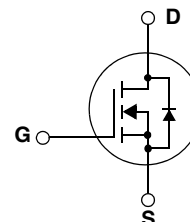
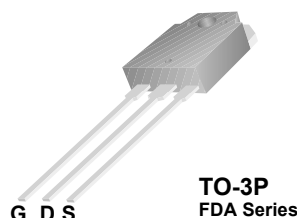
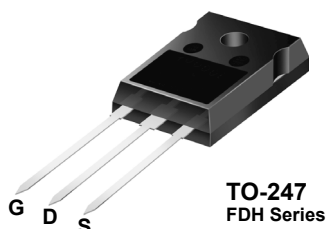
## Features

- 650V @ $T_J = 150^{\circ}\text{C}$
- Typ.  $R_{ds(on)} = 0.058\Omega$
- Ultra low gate charge (typ.  $Q_g = 210\text{nC}$ )
- Low effective output capacitance (typ.  $C_{oss,eff} = 420\text{pF}$ )
- 100% avalanche tested

## Description

SuperFET™ is, Fairchild's proprietary, new generation of high voltage MOSFET family that is utilizing an advanced charge balance mechanism for outstanding low on-resistance and lower gate charge performance.

This advanced technology has been tailored to minimize conduction loss, provide superior switching performance, and withstand extreme  $dv/dt$  rate and higher avalanche energy. Consequently, SuperFET is very suitable for various AC/DC power conversion in switching mode operation for system miniaturization and higher efficiency.



## Absolute Maximum Ratings

| Symbol         | Parameter                                                                                                    | FCH47N60    | FCA47N60 | Unit                  |
|----------------|--------------------------------------------------------------------------------------------------------------|-------------|----------|-----------------------|
| $V_{DSS}$      | Drain-Source Voltage                                                                                         | 600         |          | V                     |
| $I_D$          | Drain Current<br>- Continuous ( $T_C = 25^{\circ}\text{C}$ )<br>- Continuous ( $T_C = 100^{\circ}\text{C}$ ) | 47          |          | A                     |
|                |                                                                                                              | 29.7        |          | A                     |
| $I_{DM}$       | Drain Current - Pulsed (Note 1)                                                                              | 141         |          | A                     |
| $V_{GSS}$      | Gate-Source voltage                                                                                          | $\pm 30$    |          | V                     |
| $E_{AS}$       | Single Pulsed Avalanche Energy (Note 2)                                                                      | 1800        |          | mJ                    |
| $I_{AR}$       | Avalanche Current (Note 1)                                                                                   | 47          |          | A                     |
| $E_{AR}$       | Repetitive Avalanche Energy (Note 1)                                                                         | 41.7        |          | mJ                    |
| $dv/dt$        | Peak Diode Recovery $dv/dt$ (Note 3)                                                                         | 4.5         |          | V/ns                  |
| $P_D$          | Power Dissipation<br>( $T_C = 25^{\circ}\text{C}$ )<br>- Derate above $25^{\circ}\text{C}$                   | 417         |          | W                     |
|                |                                                                                                              | 3.33        |          | W/ $^{\circ}\text{C}$ |
| $T_J, T_{STG}$ | Operating and Storage Temperature Range                                                                      | -55 to +150 |          | $^{\circ}\text{C}$    |
| $T_L$          | Maximum Lead Temperature for Soldering Purpose,<br>1/8" from Case for 5 Seconds                              | 300         |          | $^{\circ}\text{C}$    |

## Thermal Characteristics

| Symbol          | Parameter                               | Typ. | Max. | Unit                 |
|-----------------|-----------------------------------------|------|------|----------------------|
| $R_{\theta JC}$ | Thermal Resistance, Junction-to-Case    | --   | 0.3  | $^{\circ}\text{C/W}$ |
| $R_{\theta CS}$ | Thermal Resistance, Case-to-Sink        | 0.24 | --   | $^{\circ}\text{C/W}$ |
| $R_{\theta JA}$ | Thermal Resistance, Junction-to-Ambient | --   | 41.7 | $^{\circ}\text{C/W}$ |

## Package Marking and Ordering Information

| Device Marking | Device        | Package | Reel Size | Tape Width | Quantity |
|----------------|---------------|---------|-----------|------------|----------|
| FCH47N60       | FCH47N60      | TO-247  | -         | -          | 30       |
| FCA47N60       | FCA47N60      | TO-3P   | -         | -          | 30       |
| FCA47N60       | FCA47N60_F109 | TO-3PN  | -         | -          | 30       |

## Electrical Characteristics T<sub>C</sub> = 25°C unless otherwise noted

| Symbol                                                 | Parameter                                             | Conditions                                                                               | Min | Typ   | Max  | Units |
|--------------------------------------------------------|-------------------------------------------------------|------------------------------------------------------------------------------------------|-----|-------|------|-------|
| Off Characteristics                                    |                                                       |                                                                                          |     |       |      |       |
| BV <sub>DSS</sub>                                      | Drain-Source Breakdown Voltage                        | V <sub>GS</sub> = 0V, I <sub>D</sub> = 250μA, T <sub>J</sub> = 25°C                      | 600 | --    | --   | V     |
|                                                        |                                                       | V <sub>GS</sub> = 0V, I <sub>D</sub> = 250μA, T <sub>J</sub> = 150°C                     | --  | 650   | --   | V     |
| ΔBV <sub>DSS</sub> / ΔT <sub>J</sub>                   | Breakdown Voltage Temperature Coefficient             | I <sub>D</sub> = 250μA, Referenced to 25°C                                               | --  | 0.6   | --   | V/°C  |
| BV <sub>DS</sub>                                       | Drain-Source Avalanche Breakdown Voltage              | V <sub>GS</sub> = 0V, I <sub>D</sub> = 47A                                               | --  | 700   | --   | V     |
| I <sub>DSS</sub>                                       | Zero Gate Voltage Drain Current                       | V <sub>DS</sub> = 600V, V <sub>GS</sub> = 0V                                             | --  | --    | 1    | μA    |
|                                                        |                                                       | V <sub>DS</sub> = 480V, T <sub>C</sub> = 125°C                                           | --  | --    | 10   | μA    |
| I <sub>GSSF</sub>                                      | Gate-Body Leakage Current, Forward                    | V <sub>GS</sub> = 30V, V <sub>DS</sub> = 0V                                              | --  | --    | 100  | nA    |
| I <sub>GSSR</sub>                                      | Gate-Body Leakage Current, Reverse                    | V <sub>GS</sub> = -30V, V <sub>DS</sub> = 0V                                             | --  | --    | -100 | nA    |
| On Characteristics                                     |                                                       |                                                                                          |     |       |      |       |
| V <sub>GS(th)</sub>                                    | Gate Threshold Voltage                                | V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = 250μA                               | 3.0 | --    | 5.0  | V     |
| R <sub>DS(on)</sub>                                    | Static Drain-Source On-Resistance                     | V <sub>GS</sub> = 10V, I <sub>D</sub> = 23.5A                                            | --  | 0.058 | 0.07 | Ω     |
| g <sub>FS</sub>                                        | Forward Transconductance                              | V <sub>DS</sub> = 40V, I <sub>D</sub> = 23.5A (Note 4)                                   | --  | 40    | --   | S     |
| Dynamic Characteristics                                |                                                       |                                                                                          |     |       |      |       |
| C <sub>iss</sub>                                       | Input Capacitance                                     | V <sub>DS</sub> = 25V, V <sub>GS</sub> = 0V, f = 1.0MHz                                  | --  | 5900  | 8000 | pF    |
| C <sub>oss</sub>                                       | Output Capacitance                                    |                                                                                          | --  | 3200  | 4200 | pF    |
| C <sub>rss</sub>                                       | Reverse Transfer Capacitance                          |                                                                                          | --  | 250   | --   | pF    |
| C <sub>oss</sub>                                       | Output Capacitance                                    | V <sub>DS</sub> = 480V, V <sub>GS</sub> = 0V, f = 1.0MHz                                 | --  | 160   | --   | pF    |
| C <sub>oss eff.</sub>                                  | Effective Output Capacitance                          | V <sub>DS</sub> = 0V to 400V, V <sub>GS</sub> = 0V                                       | --  | 420   | --   | pF    |
| Switching Characteristics                              |                                                       |                                                                                          |     |       |      |       |
| t <sub>d(on)</sub>                                     | Turn-On Delay Time                                    | V <sub>DD</sub> = 300V, I <sub>D</sub> = 47A<br>R <sub>G</sub> = 25Ω<br><br>(Note 4, 5)  | --  | 185   | 430  | ns    |
| t <sub>r</sub>                                         | Turn-On Rise Time                                     |                                                                                          | --  | 210   | 450  | ns    |
| t <sub>d(off)</sub>                                    | Turn-Off Delay Time                                   |                                                                                          | --  | 520   | 1100 | ns    |
| t <sub>f</sub>                                         | Turn-Off Fall Time                                    |                                                                                          | --  | 75    | 160  | ns    |
| Q <sub>g</sub>                                         | Total Gate Charge                                     | V <sub>DS</sub> = 480V, I <sub>D</sub> = 47A<br>V <sub>GS</sub> = 10V<br><br>(Note 4, 5) | --  | 210   | 270  | nC    |
| Q <sub>gs</sub>                                        | Gate-Source Charge                                    |                                                                                          | --  | 38    | --   | nC    |
| Q <sub>gd</sub>                                        | Gate-Drain Charge                                     |                                                                                          | --  | 110   | --   | nC    |
| Drain-Source Diode Characteristics and Maximum Ratings |                                                       |                                                                                          |     |       |      |       |
| I <sub>S</sub>                                         | Maximum Continuous Drain-Source Diode Forward Current |                                                                                          | --  | --    | 47   | A     |
| I <sub>SM</sub>                                        | Maximum Pulsed Drain-Source Diode Forward Current     |                                                                                          | --  | --    | 141  | A     |
| V <sub>SD</sub>                                        | Drain-Source Diode Forward Voltage                    | V <sub>GS</sub> = 0V, I <sub>S</sub> = 47A                                               | --  | --    | 1.4  | V     |
| t <sub>rr</sub>                                        | Reverse Recovery Time                                 | V <sub>GS</sub> = 0V, I <sub>S</sub> = 47A                                               | --  | 590   | --   | ns    |
| Q <sub>rr</sub>                                        | Reverse Recovery Charge                               | dI <sub>F</sub> /dt = 100A/μs (Note 4)                                                   | --  | 25    | --   | μC    |

### NOTES:

1. Repetitive Rating: Pulse width limited by maximum junction temperature
2. I<sub>AS</sub> = 18A, V<sub>DD</sub> = 50V, R<sub>G</sub> = 25Ω, Starting T<sub>J</sub> = 25°C
3. I<sub>SD</sub> ≤ 47A, di/dt ≤ 200A/μs, V<sub>DD</sub> ≤ BV<sub>DSS</sub>, Starting T<sub>J</sub> = 25°C
4. Pulse Test: Pulse width ≤ 300μs, Duty Cycle ≤ 2%
5. Essentially Independent of Operating Temperature Typical Characteristics

## Typical Performance Characteristics

Figure 1. On-Region Characteristics

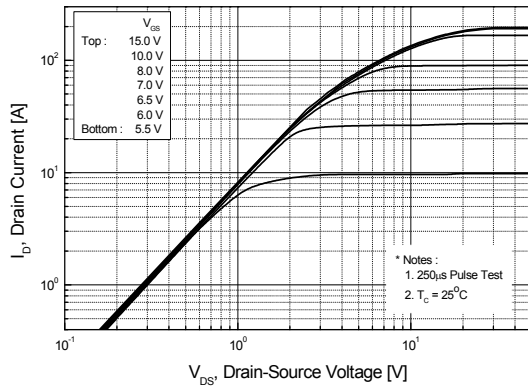


Figure 2. Transfer Characteristics

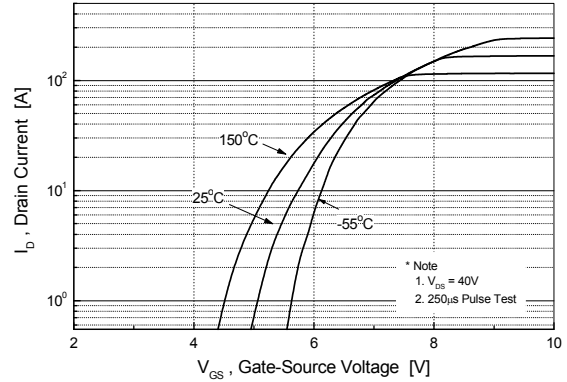


Figure 3. On-Resistance Variation vs. Drain Current and Gate Voltage

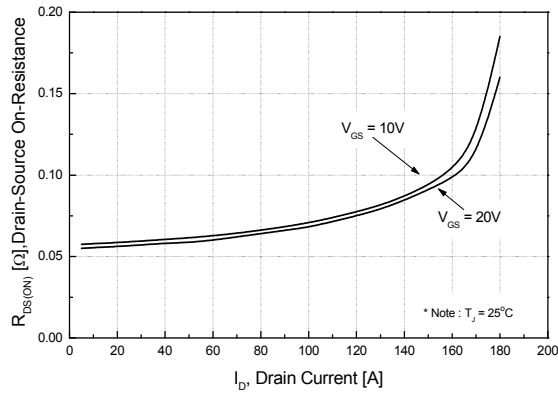


Figure 4. Body Diode Forward Voltage Variation vs. Source Current and Temperature

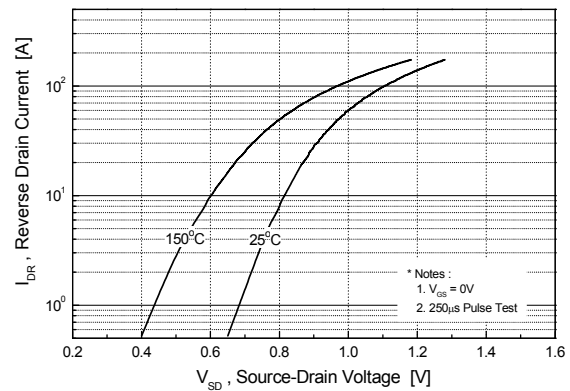


Figure 5. Capacitance Characteristics

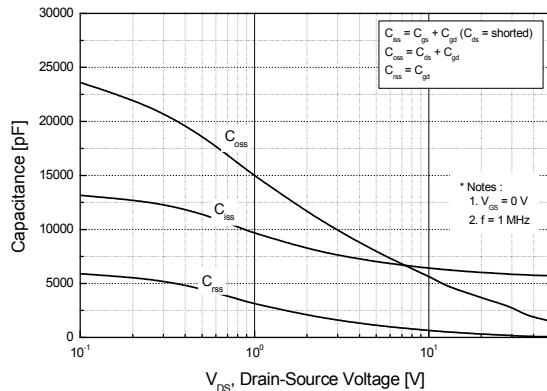
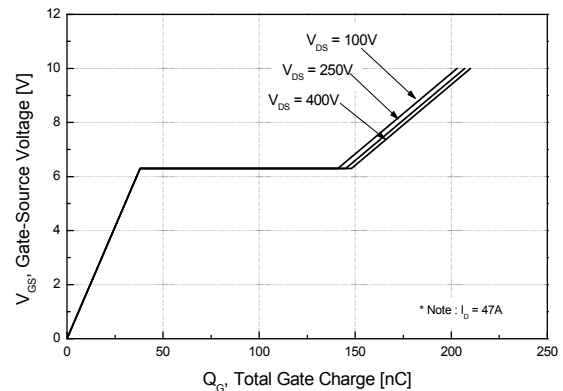
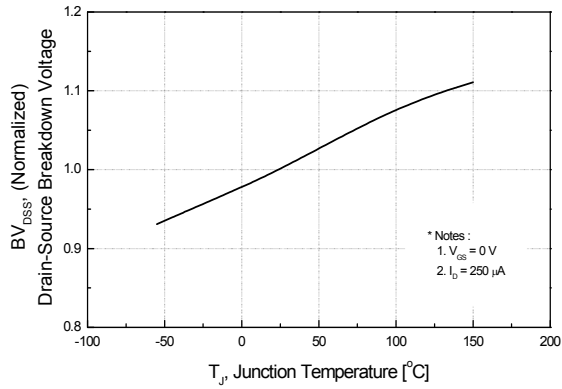


Figure 6. Gate Charge Characteristics

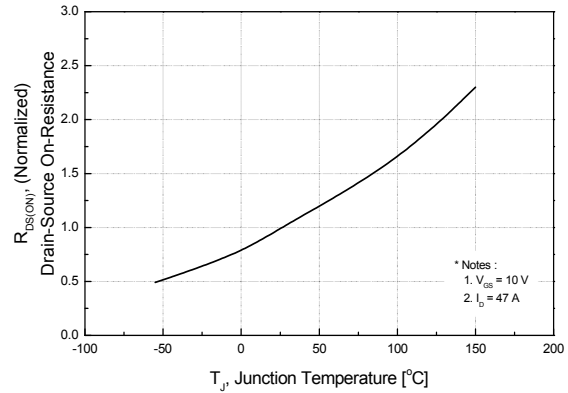


## Typical Performance Characteristics (Continued)

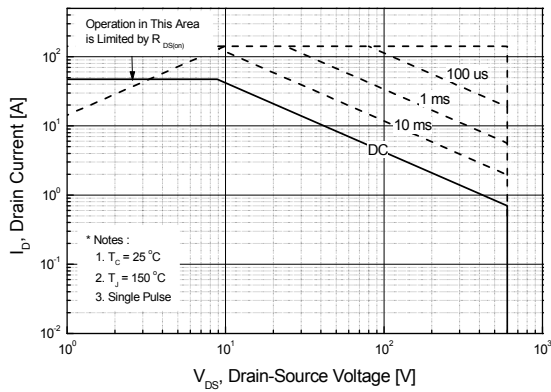
**Figure 7. Breakdown Voltage Variation vs. Temperature**



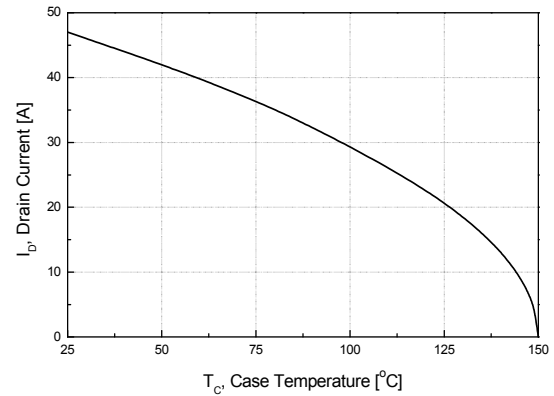
**Figure 8. On-Resistance Variation vs. Temperature**



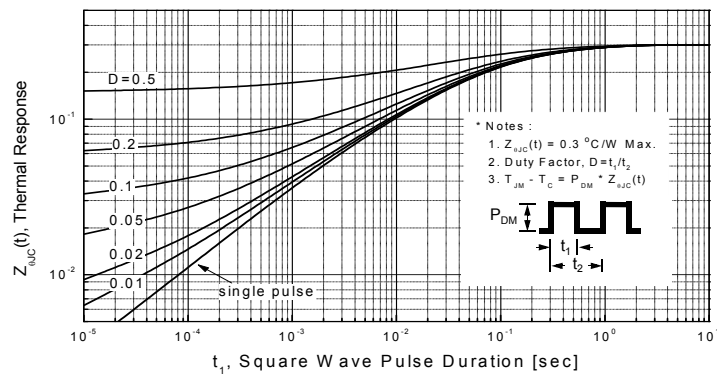
**Figure 9. Safe Operating Area**



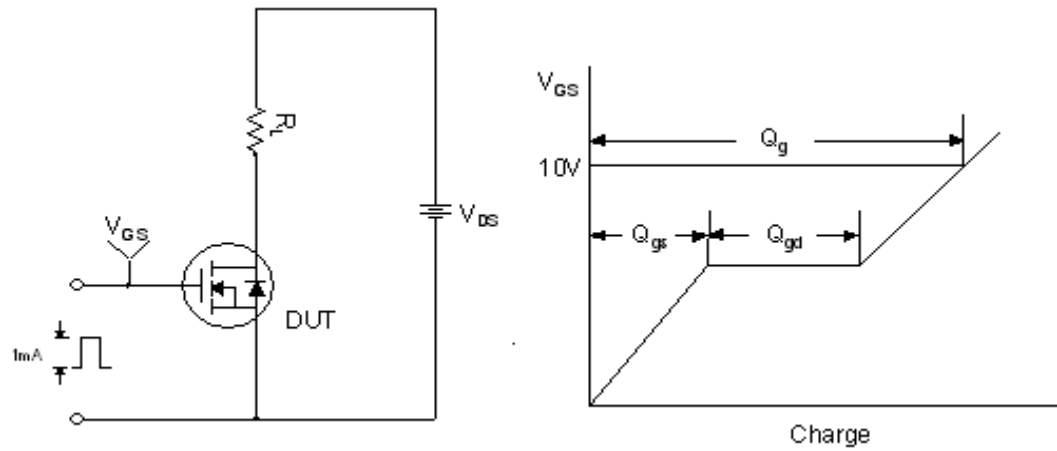
**Figure 10. Maximum Drain Current vs. Case Temperature**



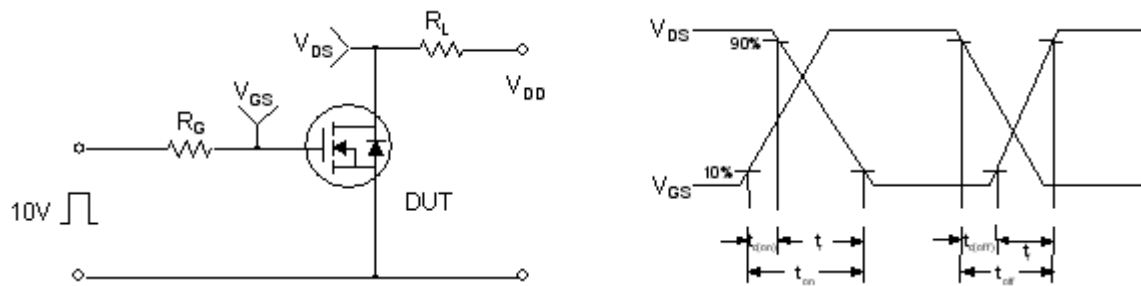
**Figure 10. Transient Thermal Response Curve**



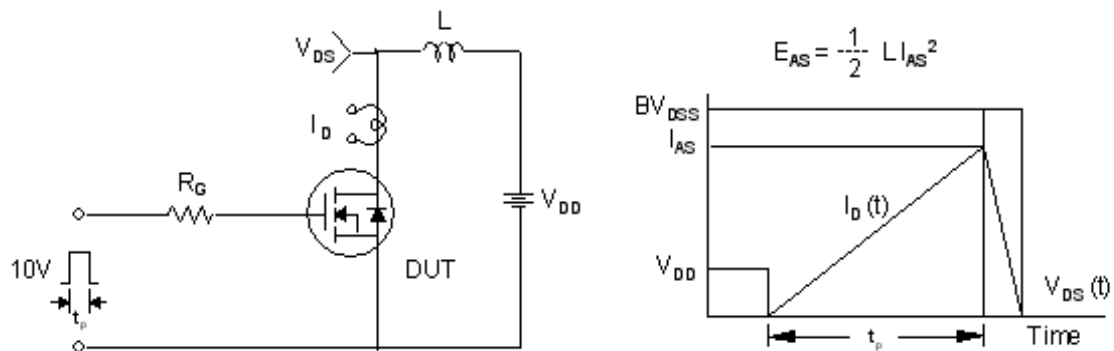
## Gate Charge Test Circuit &amp; Waveform



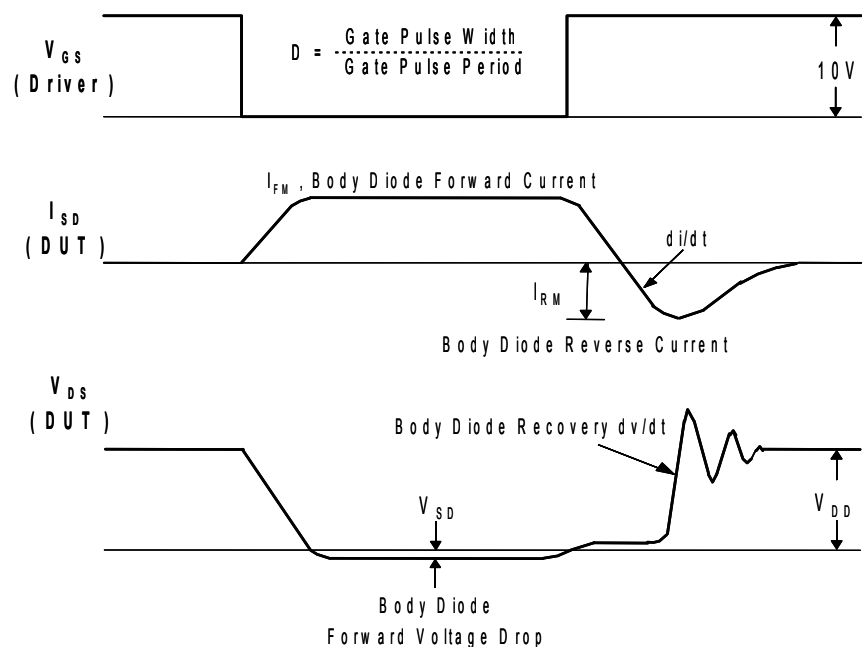
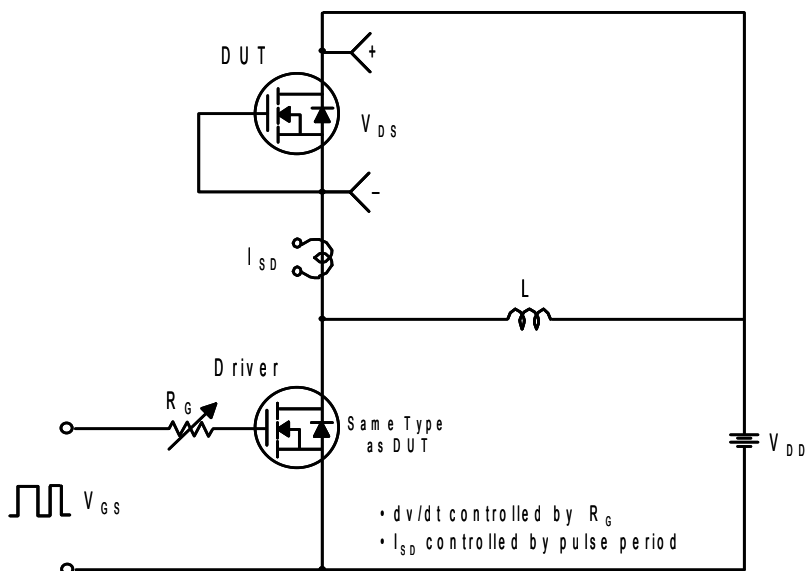
## Resistive Switching Test Circuit &amp; Waveforms



## Unclamped Inductive Switching Test Circuit &amp; Waveforms



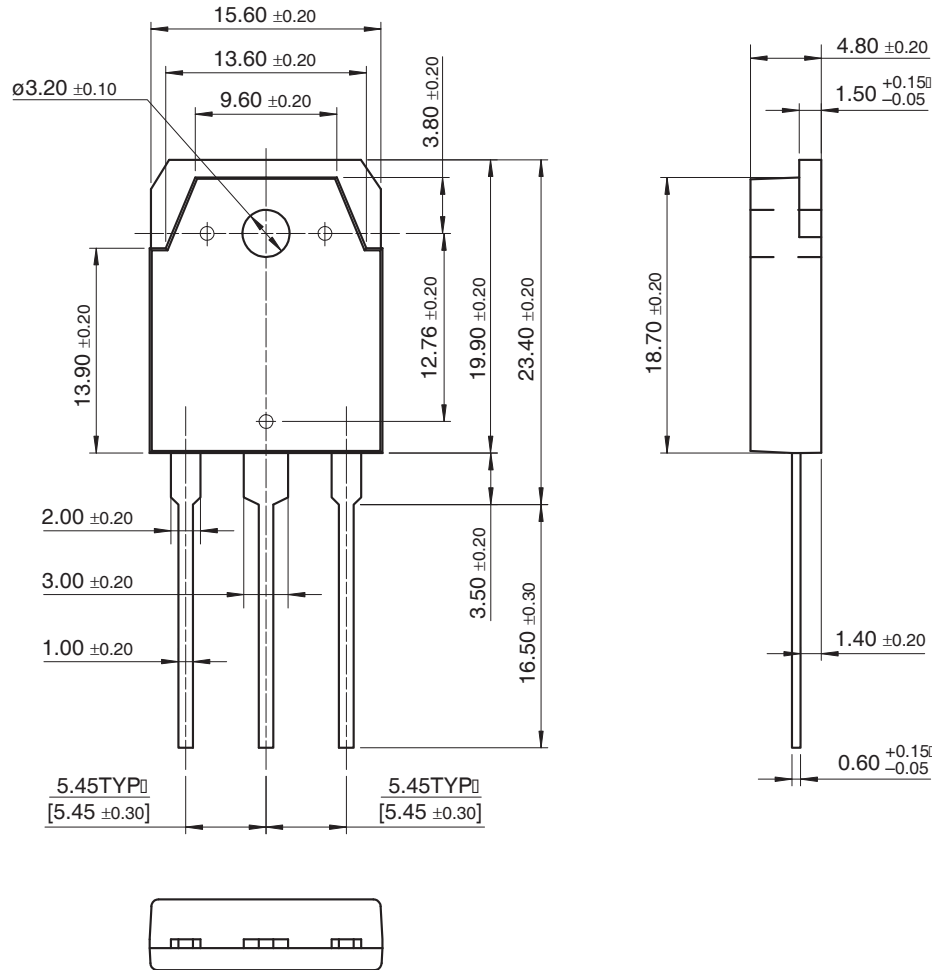
### Peak Diode Recovery dv/dt Test Circuit & Waveforms



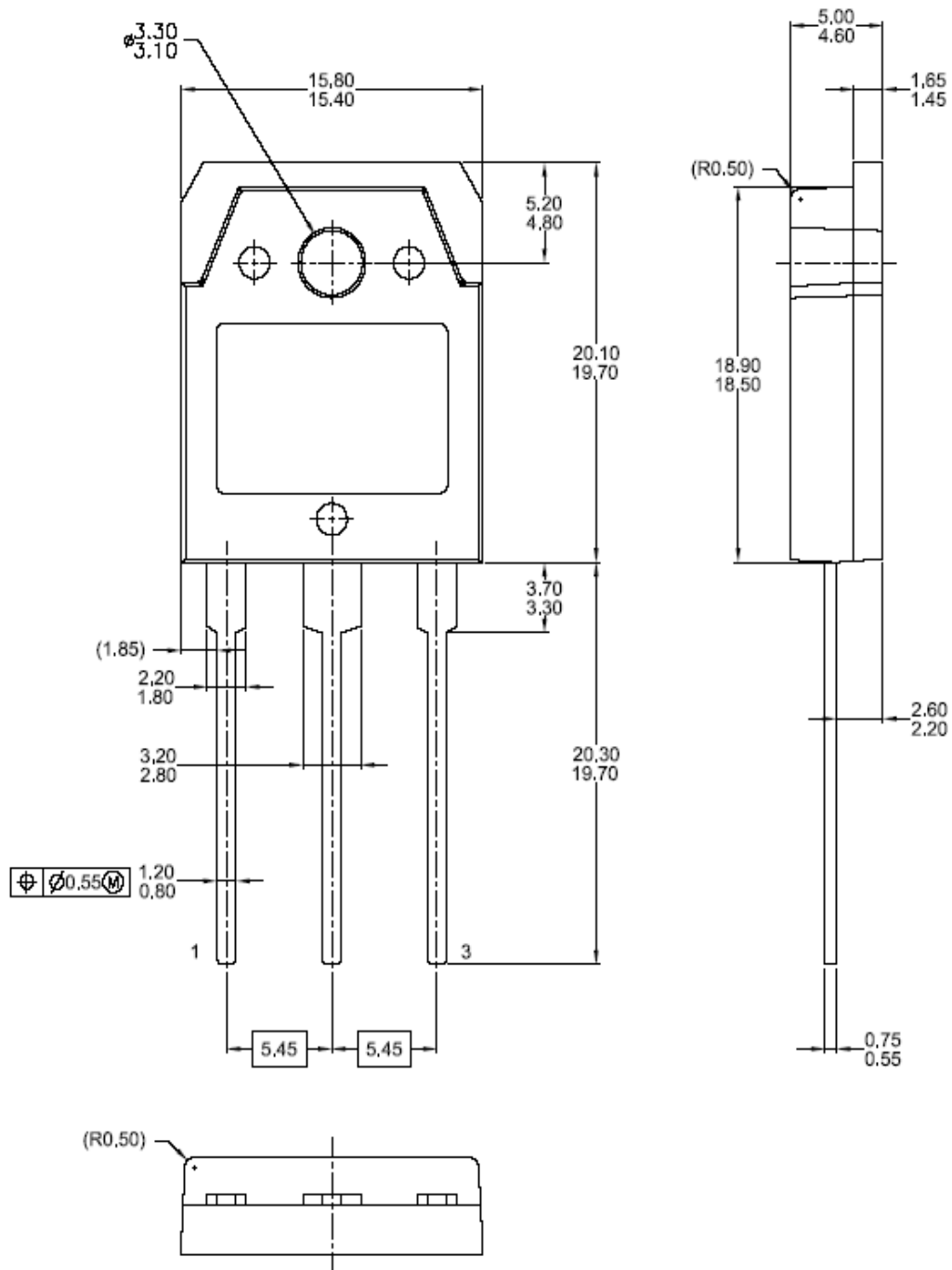


## Mechanical Dimensions (Continued)

## TO-3P



Dimensions in Millimeters

**Mechanical Dimensions** (Continued)**TO-3PN**

Dimensions in Millimeters

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| Datasheet Identification | Product Status         | Definition                                                                                                                                                                                                            |
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