

# FCH20N60 / FCA20N60

## 600V N-Channel MOSFET

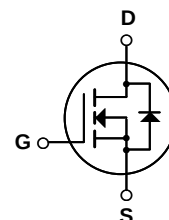
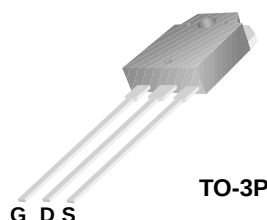
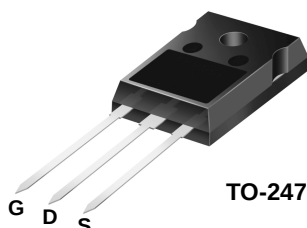
### Features

- 650V @T<sub>J</sub> = 150°C
- Typ. R<sub>DS(on)</sub> = 0.15Ω
- Ultra low gate charge (typ. Q<sub>g</sub> = 75nC)
- Low effective output capacitance (typ. C<sub>oss-eff</sub> = 165pF)
- 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                                                                                      | FCH20N60    | FCA20N60 | Unit      |
|-----------------------------------|------------------------------------------------------------------------------------------------|-------------|----------|-----------|
| V <sub>DSS</sub>                  | Drain-Source Voltage                                                                           | 600         |          | V         |
| I <sub>D</sub>                    | Drain Current<br>- Continuous (T <sub>C</sub> = 25°C)<br>- Continuous (T <sub>C</sub> = 100°C) | 20<br>12.5  |          | A<br>A    |
| I <sub>DM</sub>                   | Drain Current - Pulsed (Note 1)                                                                | 60          |          | A         |
| V <sub>GSS</sub>                  | Gate-Source voltage                                                                            | ± 30        |          | V         |
| E <sub>AS</sub>                   | Single Pulsed Avalanche Energy (Note 2)                                                        | 690         |          | mJ        |
| I <sub>AR</sub>                   | Avalanche Current (Note 1)                                                                     | 20          |          | A         |
| E <sub>AR</sub>                   | Repetitive Avalanche Energy (Note 1)                                                           | 20.8        |          | mJ        |
| dv/dt                             | Peak Diode Recovery dv/dt (Note 3)                                                             | 4.5         |          | V/ns      |
| P <sub>D</sub>                    | Power Dissipation<br>(T <sub>C</sub> = 25°C)<br>- Derate above 25°C                            | 208<br>1.67 |          | W<br>W/°C |
| T <sub>J</sub> , T <sub>STG</sub> | Operating and Storage Temperature Range                                                        | -55 to +150 |          | °C        |
| T <sub>L</sub>                    | Maximum Lead Temperature for Soldering Purpose,<br>1/8" from Case for 5 Seconds                | 300         |          | °C        |

### Thermal Characteristics

| Symbol           | Parameter                               | Typ. | Max. | Unit |
|------------------|-----------------------------------------|------|------|------|
| R <sub>θJC</sub> | Thermal Resistance, Junction-to-Case    | --   | 0.6  | °C/W |
| R <sub>θCS</sub> | Thermal Resistance, Case-to-Sink        | 0.24 | --   |      |
| R <sub>θJA</sub> | Thermal Resistance, Junction-to-Ambient | --   | 41.7 | °C/W |

## Package Marking and Ordering Information

| Device Marking | Device   | Package | Reel Size | Tape Width | Quantity |
|----------------|----------|---------|-----------|------------|----------|
| FCH20N60       | FCH20N60 | TO-247  | -         | -          | 30       |
| FCA20N60       | FCA20N60 | TO-3P   | -         | -          | 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> = 20A                                               | --  | 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> = 10A                                              | --  | 0.15 | 0.19 | Ω     |
| g <sub>FS</sub>                                        | Forward Transconductance                              | V <sub>DS</sub> = 40V, I <sub>D</sub> = 10A (Note 4)                                     | --  | 17   | --   | S     |
| Dynamic Characteristics                                |                                                       |                                                                                          |     |      |      |       |
| C <sub>iSS</sub>                                       | Input Capacitance                                     | V <sub>DS</sub> = 25V, V <sub>GS</sub> = 0V, f = 1.0MHz                                  | --  | 2370 | 3080 | pF    |
| C <sub>oSS</sub>                                       | Output Capacitance                                    |                                                                                          | --  | 1280 | 1665 | pF    |
| C <sub>rSS</sub>                                       | Reverse Transfer Capacitance                          |                                                                                          | --  | 95   | --   | pF    |
| C <sub>oSS</sub>                                       | Output Capacitance                                    | V <sub>DS</sub> = 480V, V <sub>GS</sub> = 0V, f = 1.0MHz                                 | --  | 65   | 85   | pF    |
| C <sub>oSS</sub> eff.                                  | Effective Output Capacitance                          | V <sub>DS</sub> = 0V to 400V, V <sub>GS</sub> = 0V                                       | --  | 165  | --   | pF    |
| Switching Characteristics                              |                                                       |                                                                                          |     |      |      |       |
| t <sub>d(on)</sub>                                     | Turn-On Delay Time                                    | V <sub>DD</sub> = 300V, I <sub>D</sub> = 20A<br>R <sub>G</sub> = 25Ω<br><br>(Note 4, 5)  | --  | 62   | 135  | ns    |
| t <sub>r</sub>                                         | Turn-On Rise Time                                     |                                                                                          | --  | 140  | 290  | ns    |
| t <sub>d(off)</sub>                                    | Turn-Off Delay Time                                   |                                                                                          | --  | 230  | 470  | ns    |
| t <sub>f</sub>                                         | Turn-Off Fall Time                                    |                                                                                          | --  | 65   | 140  | ns    |
| Q <sub>g</sub>                                         | Total Gate Charge                                     | V <sub>DS</sub> = 480V, I <sub>D</sub> = 20A<br>V <sub>GS</sub> = 10V<br><br>(Note 4, 5) | --  | 75   | 98   | nC    |
| Q <sub>gs</sub>                                        | Gate-Source Charge                                    |                                                                                          | --  | 13.5 | 18   | nC    |
| Q <sub>gd</sub>                                        | Gate-Drain Charge                                     |                                                                                          | --  | 36   | --   | nC    |
| Drain-Source Diode Characteristics and Maximum Ratings |                                                       |                                                                                          |     |      |      |       |
| I <sub>S</sub>                                         | Maximum Continuous Drain-Source Diode Forward Current |                                                                                          | --  | --   | 20   | A     |
| I <sub>SM</sub>                                        | Maximum Pulsed Drain-Source Diode Forward Current     |                                                                                          | --  | --   | 60   | A     |
| V <sub>SD</sub>                                        | Drain-Source Diode Forward Voltage                    | V <sub>GS</sub> = 0V, I <sub>S</sub> = 20A                                               | --  | --   | 1.4  | V     |
| t <sub>rr</sub>                                        | Reverse Recovery Time                                 | V <sub>GS</sub> = 0V, I <sub>S</sub> = 20A<br>dI <sub>F</sub> /dt = 100A/μs (Note 4)     | --  | 530  | --   | ns    |
| Q <sub>rr</sub>                                        | Reverse Recovery Charge                               |                                                                                          | --  | 10.5 | --   | μC    |

### Notes:

1. Repetitive Rating: Pulse width limited by maximum junction temperature
2. I<sub>AS</sub> = 20A, V<sub>DD</sub> = 50V, R<sub>G</sub> = 25Ω, Starting T<sub>J</sub> = 25°C
3. I<sub>SD</sub> ≤ 20A, 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

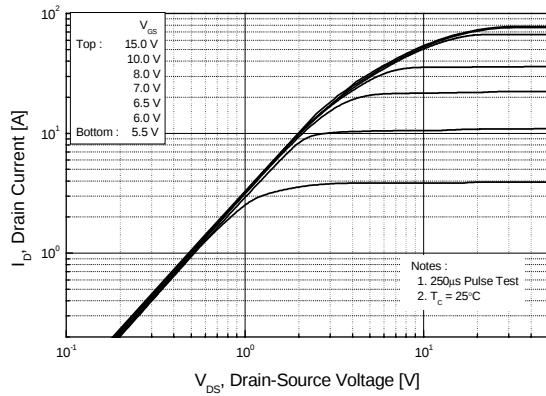


Figure 2. Transfer Characteristics

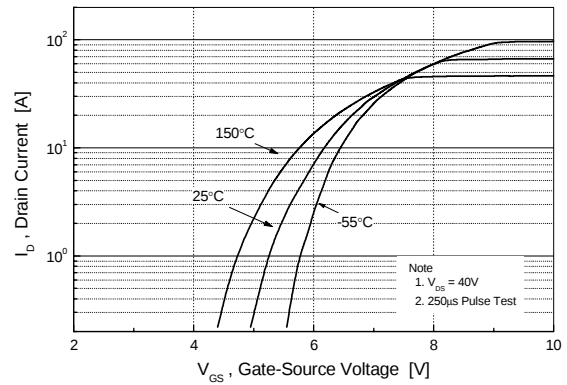


Figure 3. On-Resistance Variation vs. Drain Current and Gate Voltage

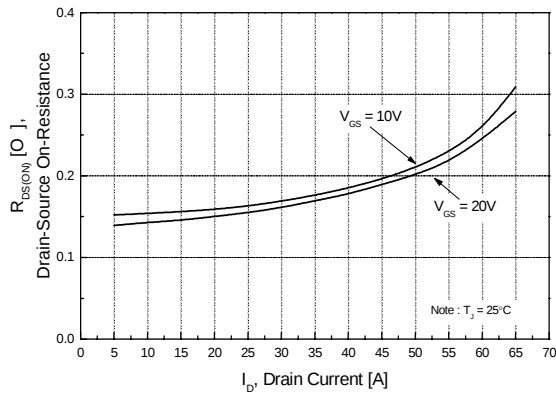


Figure 4. Body Diode Forward Voltage Variation vs. Source Current and Temperature

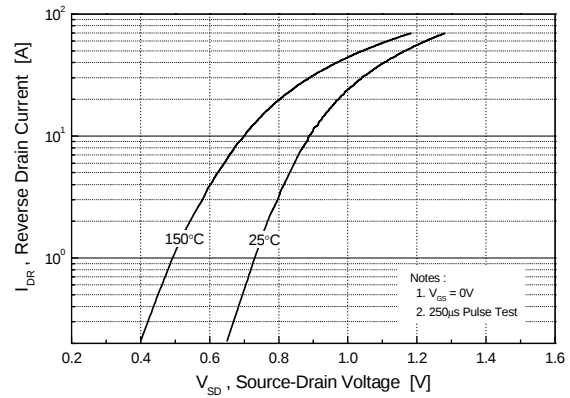


Figure 5. Capacitance Characteristics

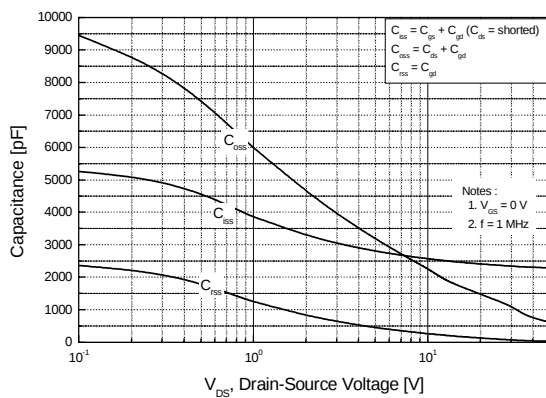
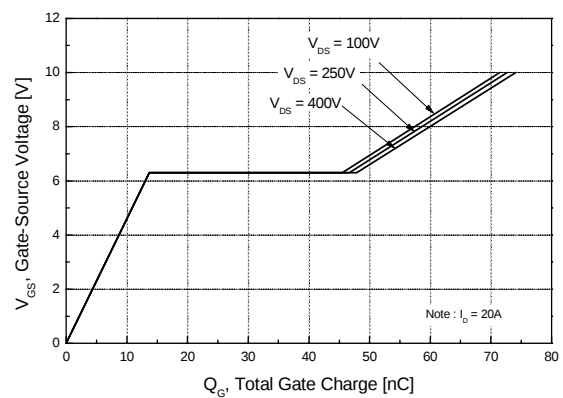
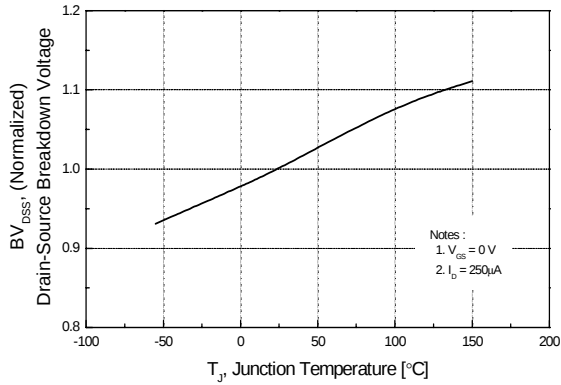


Figure 6. Gate Charge Characteristics

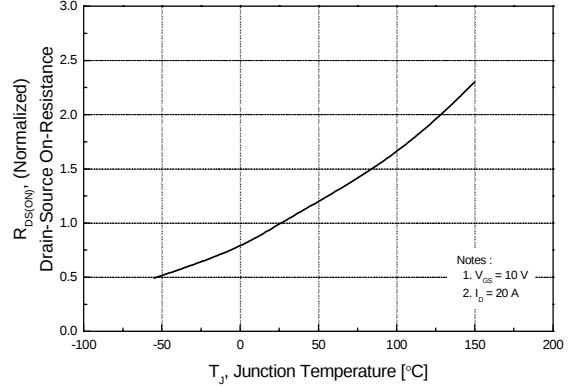


## Typical Performance Characteristics (Continued)

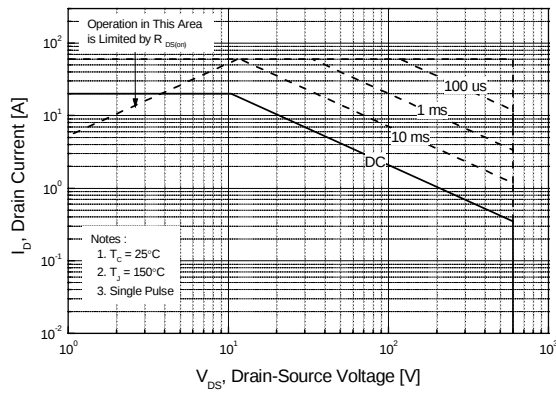
**Figure 7. Breakdown Voltage Variation vs. Temperature**



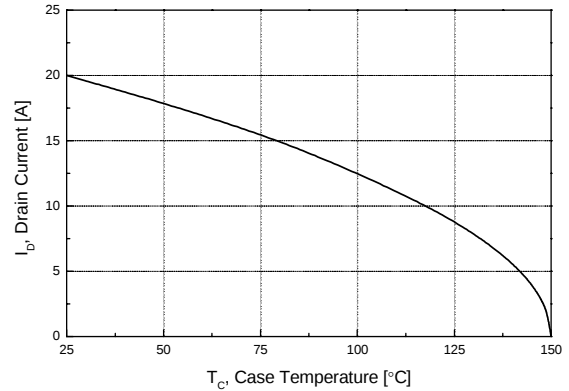
**Figure 8. On-Resistance Variation vs. Temperature**



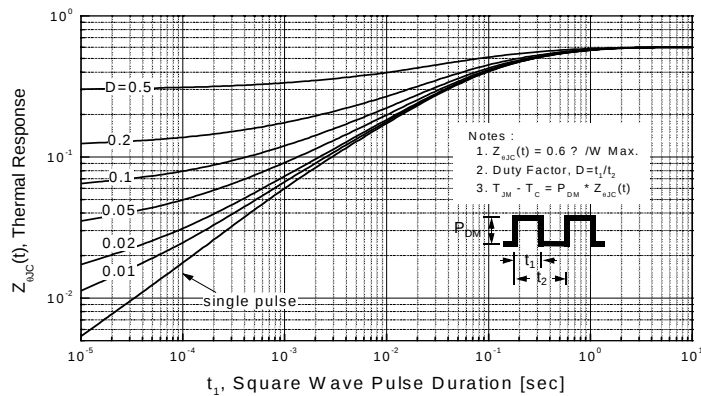
**Figure 9. Maximum Safe Operating Area**



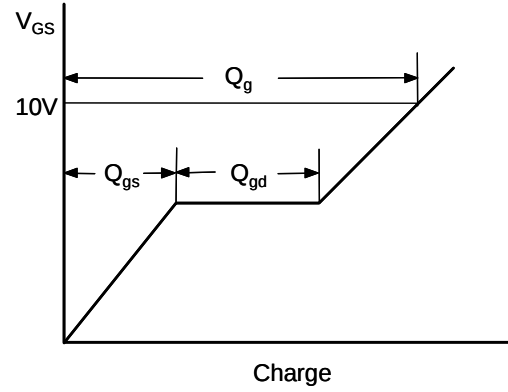
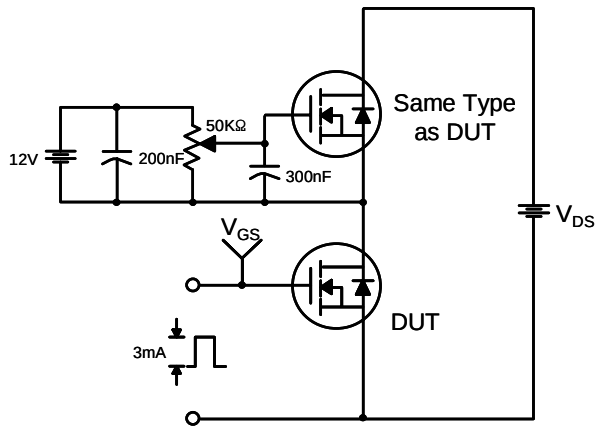
**Figure 10. Maximum Drain Current vs. Case Temperature**



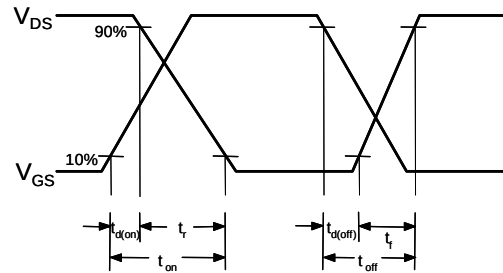
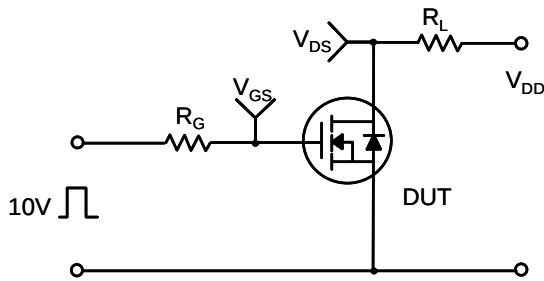
**Figure 11. Transient Thermal Response Curve**



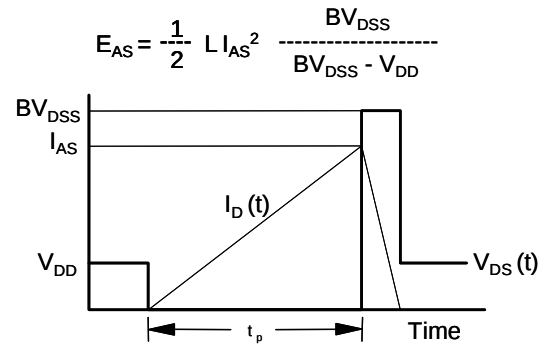
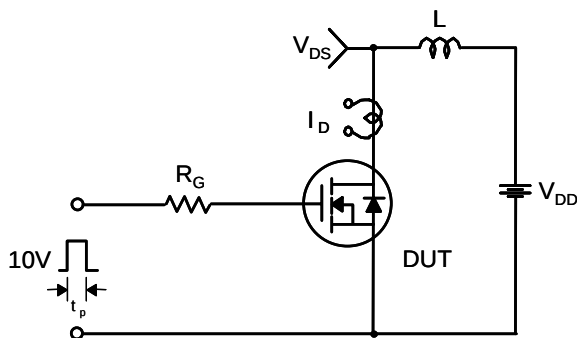
### Gate Charge Test Circuit & Waveform



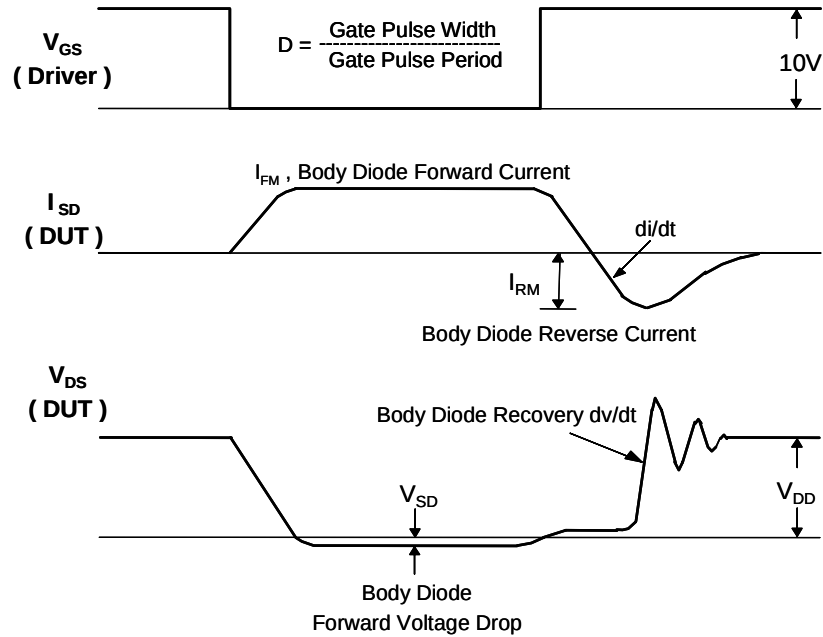
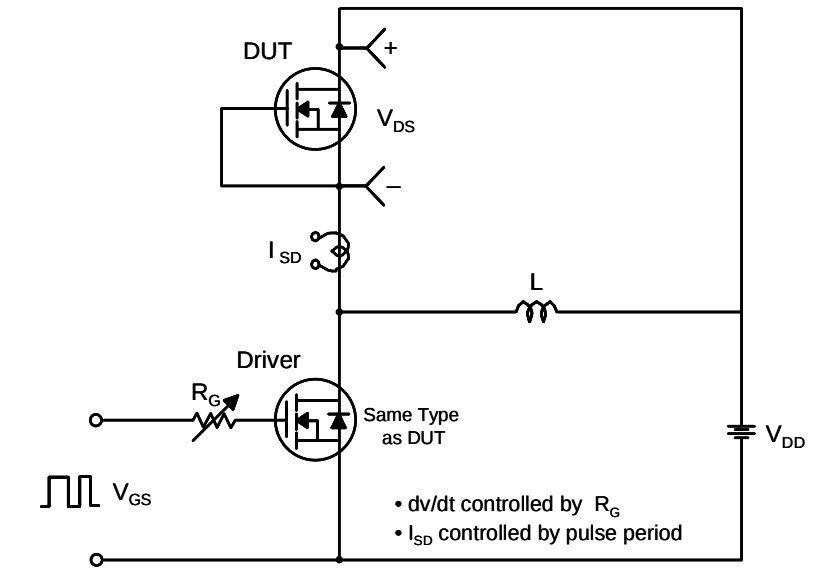
### Resistive Switching Test Circuit & Waveforms



### Unclamped Inductive Switching Test Circuit & Waveforms



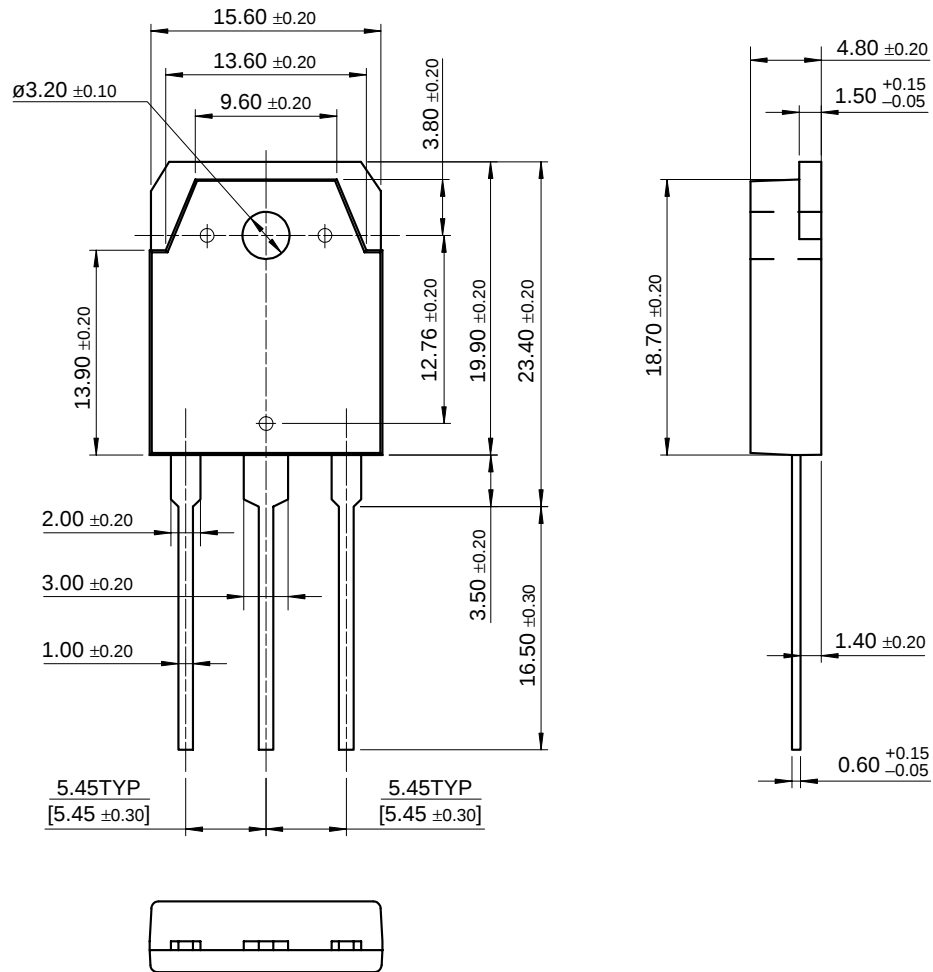
## Peak Diode Recovery dv/dt Test Circuit &amp; Waveforms





## Mechanical Dimensions (Continued)

## TO-3P



Dimensions in Millimeters

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## PRODUCT STATUS DEFINITIONS

### Definition of Terms

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Rev. 115

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