

# MOSFET – N-Channel, SUPERFET<sup>®</sup>, FRFET<sup>®</sup> 600 V, 47 A, 73 mΩ

## FCH47N60F

### Description

SUPERFET MOSFET is ON Semiconductor's first generation of high voltage super-junction (SJ) MOSFET family that is utilizing charge balance technology for outstanding low on-resistance and lower gate charge performance. This technology is tailored to minimize conduction loss, provide superior switching performance, dv/dt rate and higher avalanche energy. Consequently, SUPERFET MOSFET is very suitable for the switching power applications such as PFC, server / telecom power, FPD TV power, ATX power and industrial power applications. SUPERFET FRFET MOSFET's optimized body diode reverse recovery performance can remove additional component and improve system reliability.

### Features

- 650 V @  $T_J = 150^\circ\text{C}$
- Typ.  $R_{DS(on)} = 58\text{ m}\Omega$
- Ultra Low Gate Charge (Typ.  $Q_g = 210\text{ nC}$ )
- Low Effective Output Capacitance (Typ.  $C_{oss\text{eff.}} = 420\text{ pF}$ )
- 100% Avalanche Tested
- These Devices are Pb-Free and are RoHS Compliant

### Applications

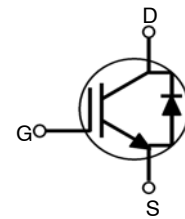
- Solar Inverter
- AC-DC Power Supply



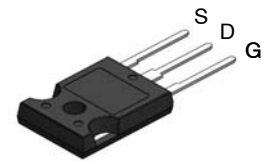
ON Semiconductor<sup>®</sup>

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| $V_{DS}$ | $R_{DS(on)}\text{ MAX}$ | $I_D\text{ MAX}$ |
|----------|-------------------------|------------------|
| 600 V    | 73 mΩ @ 10 V            | 47 A             |

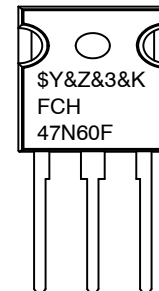


N-CHANNEL MOSFET



TO-247-3LD  
CASE 340CK

### MARKING DIAGRAM



|           |                         |
|-----------|-------------------------|
| \$Y       | = ON Semiconductor Logo |
| &Z        | = Assembly Plant Code   |
| &3        | = Numeric Date Code     |
| &K        | = Lot Code              |
| FCH47N60F | = Specific Device Code  |

### ORDERING INFORMATION

See detailed ordering and shipping information on page 2 of this data sheet.

# FCH47N60F

## ABSOLUTE MAXIMUM RATINGS (T<sub>C</sub> = 25°C unless otherwise noted)

| Symbol                            | Parameter  | FCH47N60F-F133 | Unit      |
|-----------------------------------|--|----------------|-----------|
| V <sub>DSS</sub>                  | Drain to 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) | 47<br>29.7     | A<br>A    |
| I <sub>DM</sub>                   | Drain Current<br>–Pulsed (Note 1)  | 141            | A         |
| V <sub>GSS</sub>                  | Gate–Source Voltage  | ±30            | V         |
| E <sub>AS</sub>                   | Single Pulsed Avalanche Energy (Note 2)  | 1800           | mJ        |
| I <sub>AR</sub>                   | Avalanche Current (Note 1)   | 47             | A         |
| E <sub>AR</sub>                   | Repetitive Avalanche Energy (Note 1)   | 41.7           | mJ        |
| dv/dt                             | Peak Diode Recovery dv/dt (Note 3)   | 50             | V/ns      |
| P <sub>D</sub>                    | Power Dissipation<br>(T <sub>C</sub> = 25°C)<br>–Derate Above 25°C                             | 417<br>3.33    | 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, ¼ from Case for 5 second                       | 300            | °C        |

Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

1. Repetitive Rating: Pulse width limited by maximum junction temperature.
2. I<sub>AS</sub> = 18 A, V<sub>DD</sub> = 50 V, R<sub>G</sub> = 25 Ω, Starting T<sub>J</sub> = 25 °C
3. I<sub>SD</sub> ≤ 47 A, di/dt ≤ 1200 A/μs, V<sub>DD</sub> ≤ BV<sub>DSS</sub>, Starting T<sub>J</sub> = 25 °C.

## PACKAGE MARKING AND ORDERING INFORMATION

| Device Marking | Device         | Package  | Reel Size | Tape Width | Quantity |
|----------------|----------------|----------|-----------|------------|----------|
| FCH47N60F      | FCH47N60F-F133 | TO-247-3 | –         | –          | 30 Units |

## THERMAL CHARACTERISTICS

| Symbol           | Parameter   | Value | Unit |
|------------------|---|-------|------|
| R <sub>θJC</sub> | Thermal Resistance, Junction to Case, Max.              | 0.3   | °C/W |
| R <sub>θJA</sub> | Thermal Resistance, Junction to Ambient, Max. (Note 34) | 41.7  |      |

# FCH47N60F

## ELECTRICAL CHARACTERISTICS (T<sub>C</sub> = 25°C unless otherwise noted)

| Symbol | Parameter | Test Condition | Min. | Typ. | Max. | Unit |
|--------|-----------|----------------|------|------|------|------|
|--------|-----------|----------------|------|------|------|------|

### OFF CHARACTERISTICS

|                                      |   |  |     |     |      |      |
|--------------------------------------|---|--|-----|-----|------|------|
| BV <sub>DSS</sub>                    | Drain to Source Breakdown Voltage         | I <sub>D</sub> = 250 μA, V <sub>GS</sub> = 0 V, T <sub>J</sub> = 25°C  | 600 | –   | –    | V    |
|                                      |   | I <sub>D</sub> = 250 μA, V <sub>GS</sub> = 0 V, T <sub>J</sub> = 150°C | –   | 650 | –    | V    |
| ΔBV <sub>DSS</sub> / ΔT <sub>J</sub> | Breakdown Voltage Temperature Coefficient | I <sub>D</sub> = 250 μA, Referenced to 25°C                            | –   | 0.6 | –    | V/°C |
| BV <sub>DS</sub>                     | Drain–Source Avalanche Breakdown Voltage  | I <sub>D</sub> = 47 A, V <sub>GS</sub> = 0 V                           | –   | 700 | –    | V    |
| I <sub>DSS</sub>                     | Zero Gate Voltage Drain Current           | V <sub>DS</sub> = 600 V, V <sub>GS</sub> = 0 V                         | –   | –   | 10   | μA   |
|                                      |   | V <sub>DS</sub> = 480 V, T <sub>C</sub> = 125°C                        | –   | –   | 100  | μA   |
| I <sub>GSSF</sub>                    | Gate–Body Leakage Current, Forward        | V <sub>GS</sub> = 30 V, V <sub>DS</sub> = 0 V                          | –   | –   | 100  | nA   |
| I <sub>GSSR</sub>                    | Gate–Body Leakage Current, Reverse        | V <sub>GS</sub> = –30 V, V <sub>DS</sub> = 0 V                         | –   | –   | –100 | nA   |

### ON CHARACTERISTICS

|                     |                                   |   |   |       |       |   |
|---------------------|-----------------------------------|---|---|-------|-------|---|
| V <sub>GS(th)</sub> | Gate Threshold Voltage            | V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = 250 μA | 3 | –     | 5     | V |
| R <sub>DS(on)</sub> | Static Drain–Source On–Resistance | V <sub>GS</sub> = 10 V, I <sub>D</sub> = 23.5 A             | – | 0.062 | 0.073 | Ω |
| g <sub>FS</sub>     | Forward Transconductance          | V <sub>DS</sub> = 40 V, I <sub>D</sub> = 23.5 A             | – | 40    | –     | S |

### DYNAMIC CHARACTERISTICS

|                       |                              |  |   |      |      |    |
|-----------------------|------------------------------|--|---|------|------|----|
| C <sub>iss</sub>      | Input Capacitance            | V <sub>DS</sub> = 25 V, V <sub>GS</sub> = 0 V,<br>f = 1 MHz  | – | 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> = 480 V, V <sub>GS</sub> = 0 V,<br>f = 1 MHz | – | 160  | –    | pF |
| C <sub>oss</sub> eff. | Effective Output Capacitance | V <sub>DS</sub> = 0 V to 400 V, V <sub>GS</sub> = 0 V        | – | 420  | –    | pF |

### SWITCHING CHARACTERISTICS

|                     |                     |   |   |     |      |    |
|---------------------|---------------------|---|---|-----|------|----|
| t <sub>d(on)</sub>  | Turn-On Delay Time  | V <sub>DD</sub> = 300 V, I <sub>D</sub> = 47 A,<br>R <sub>G</sub> = 25 Ω<br>(Note 4)  | – | 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> = 480 V, I <sub>D</sub> = 47 A,<br>V <sub>GS</sub> = 10 V<br>(Note 4) | – | 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> | Source to Drain Diode Voltage                         | V <sub>GS</sub> = 0 V, I <sub>S</sub> = 47 A                                    | – | –    | 1.4 | V  |
| t <sub>rr</sub> | Reverse Recovery Time                                 | V <sub>GS</sub> = 0 V, I <sub>S</sub> = 47 A,<br>dI <sub>F</sub> /dt = 100 A/μs | – | 240  | –   | ns |
| Q <sub>rr</sub> | Reverse Recovery Charge                               |   | – | 2.04 | –   | μC |

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

4. Essentially Independent of Operating Temperature Typical Characteristics.

TYPICAL CHARACTERISTICS

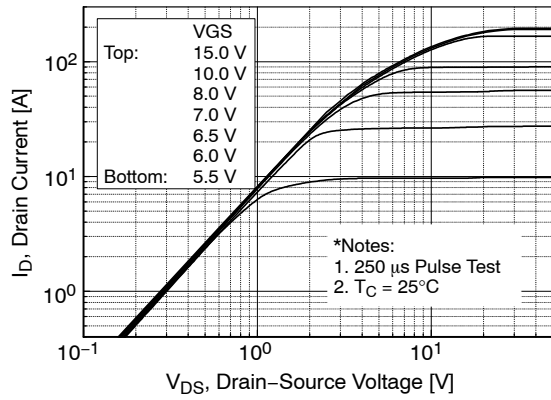


Figure 1. On-Region Characteristics

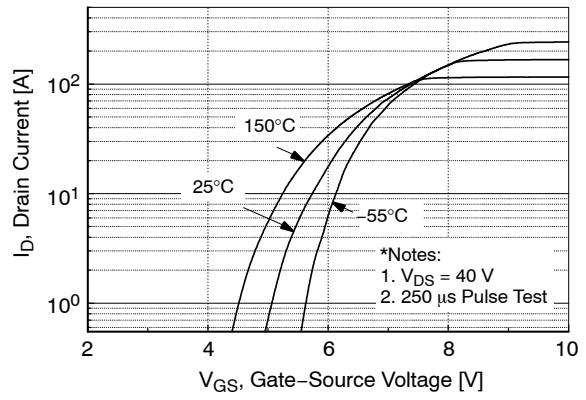


Figure 2. Transfer Characteristics

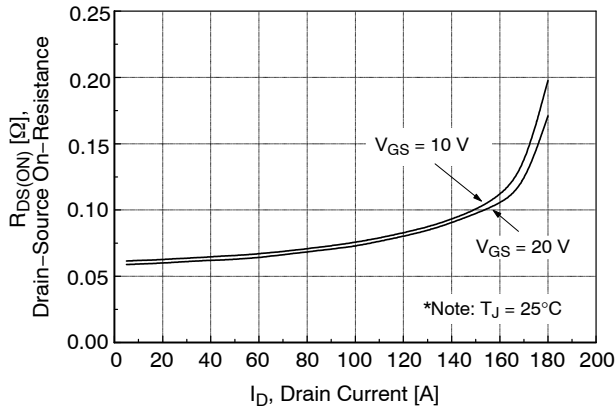


Figure 3. On-Resistance Variation vs. Drain Current and Gate voltage

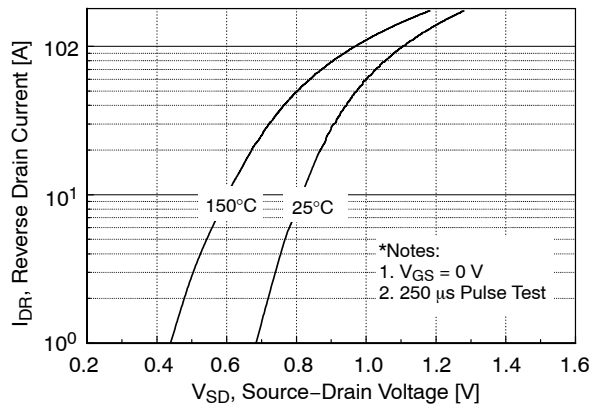


Figure 4. Body Diode Forward Voltage Variation vs. Source Current and Temperature

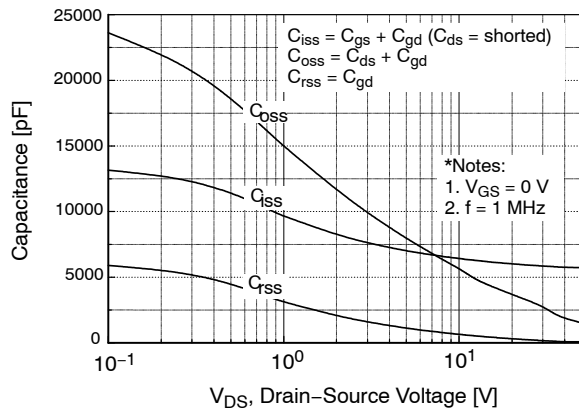


Figure 5. Capacitance Characteristics

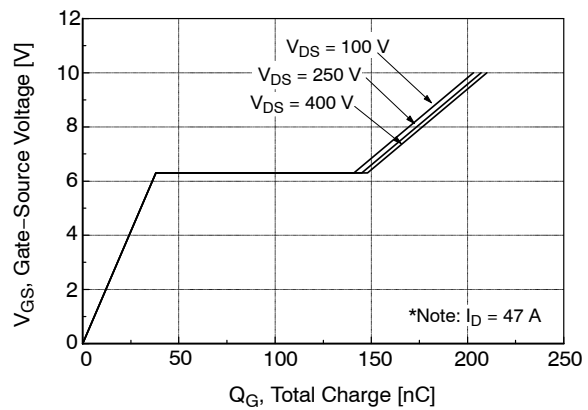
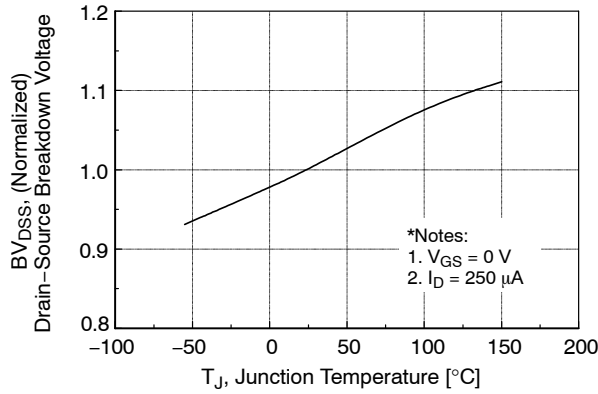


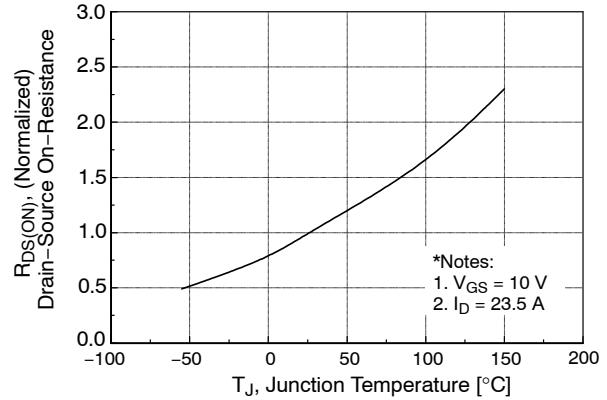
Figure 6. Gate Charge Characteristics

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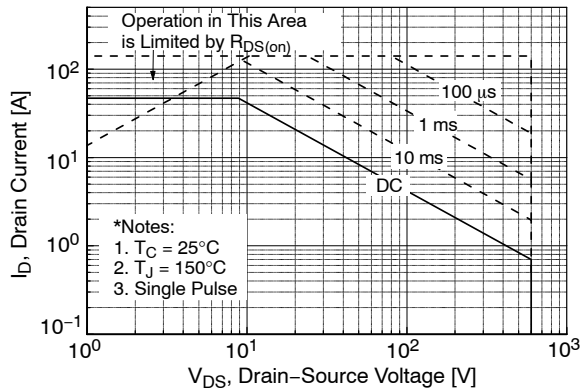
## TYPICAL CHARACTERISTICS



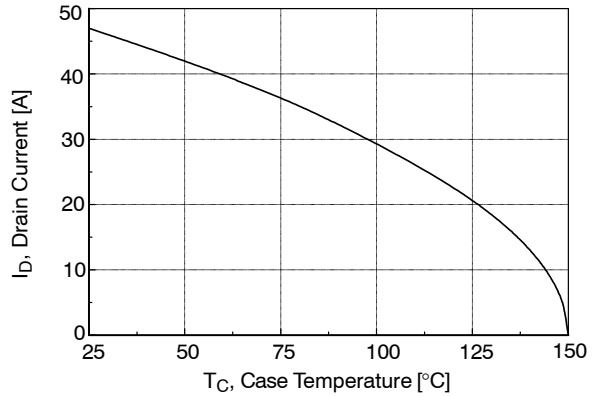
**Figure 7. Breakdown Voltage Variation vs. Temperature**



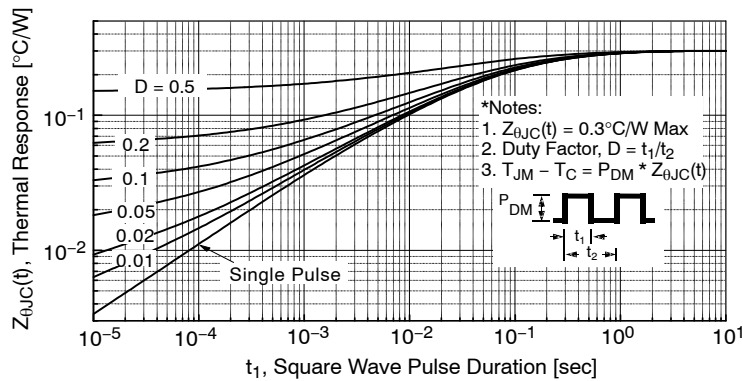
**Figure 8. On-Resistance Variation vs. Temperature**



**Figure 9. Safe Operating Area**



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



**Figure 11. Transient Thermal Response Curve**

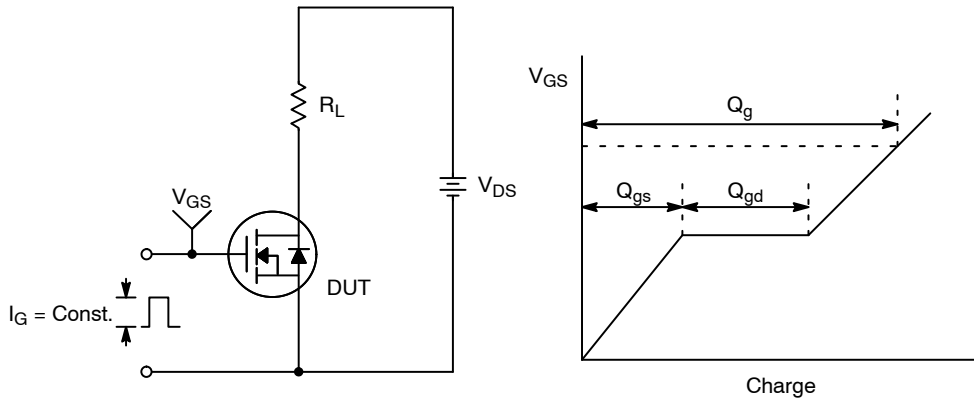


Figure 12. Gate Charge Test Circuit & Waveform

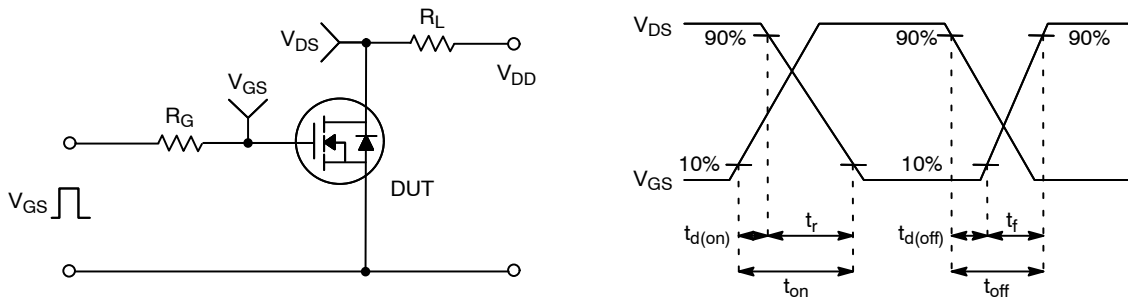


Figure 13. Resistive Switching Test Circuit & Waveforms

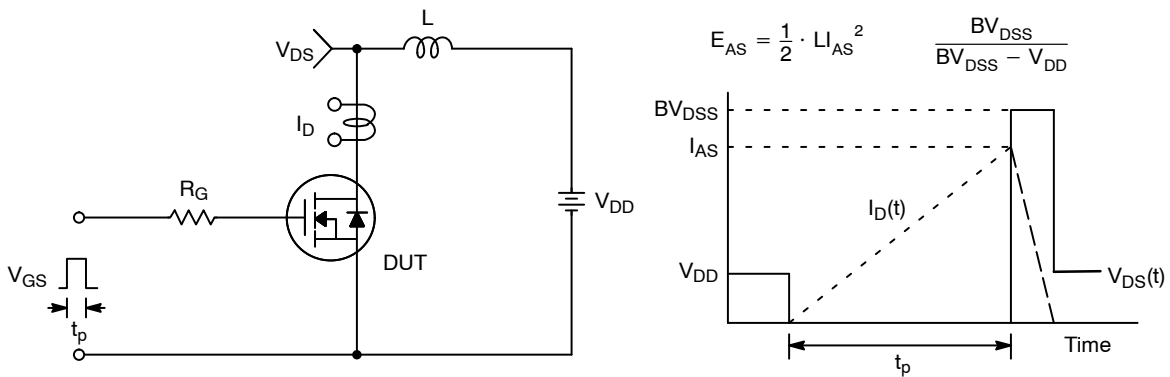
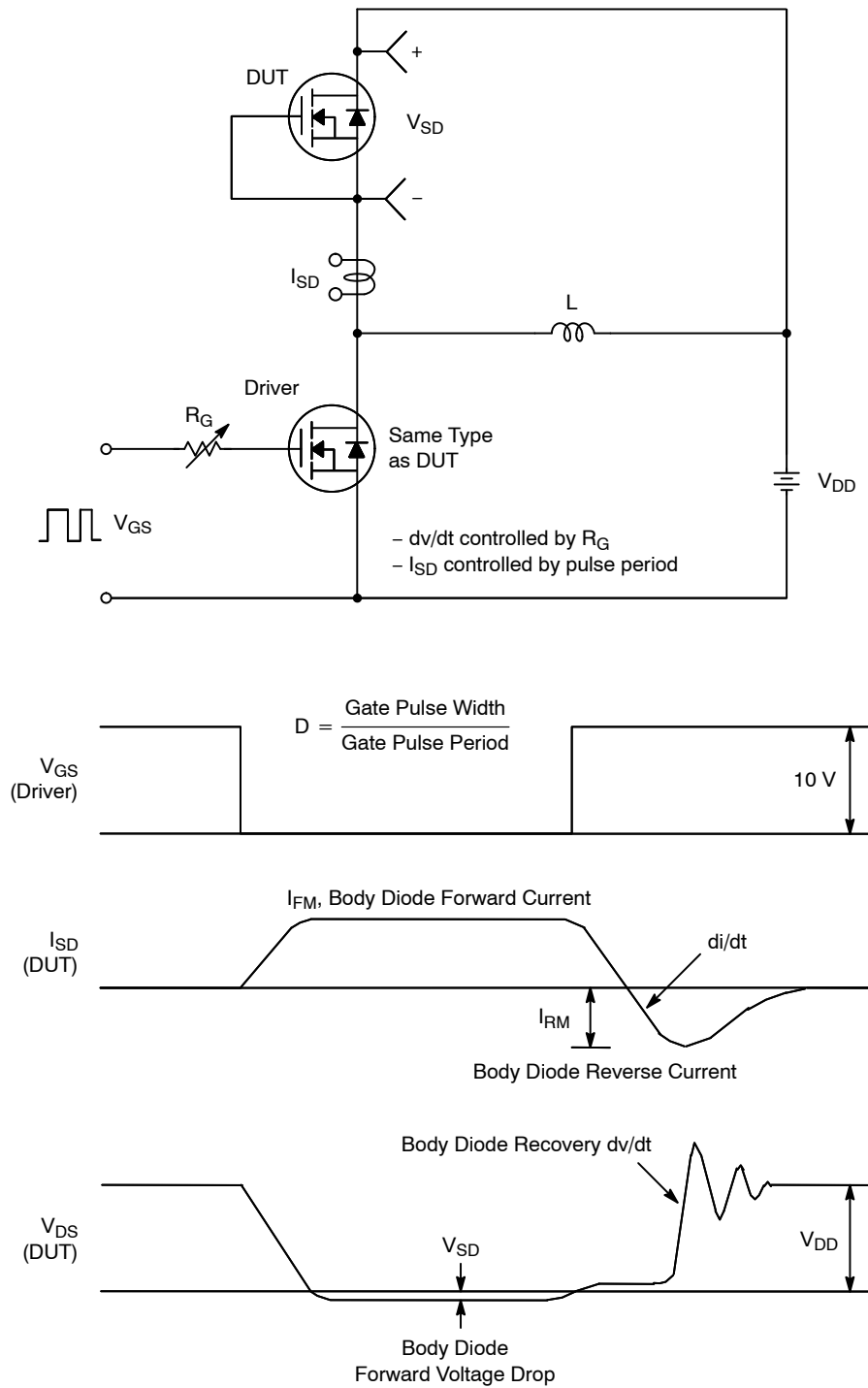


Figure 14. Unclamped Inductive Switching Test Circuit & Waveforms

# FCH47N60F



**Figure 15. Peak Diode Recovery  $dv/dt$  Test Circuit & Waveforms**

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**TO-247-3LD SHORT LEAD**  
**CASE 340CK**  
**ISSUE A**

DATE 31 JAN 2019



NOTES: UNLESS OTHERWISE SPECIFIED.

- A. DIMENSIONS ARE EXCLUSIVE OF BURRS, MOLD FLASH, AND TIE BAR EXTRUSIONS.
- B. ALL DIMENSIONS ARE IN MILLIMETERS.
- C. DRAWING CONFORMS TO ASME Y14.5 - 2009.
- D. DIMENSION A1 TO BE MEASURED IN THE REGION DEFINED BY L1.
- E. LEAD FINISH IS UNCONTROLLED IN THE REGION DEFINED BY L1.

**GENERIC MARKING DIAGRAM\***



- XXXX = Specific Device Code
- A = Assembly Location
- Y = Year
- WW = Work Week
- ZZ = Assembly Lot Code

\*This information is generic. Please refer to device data sheet for actual part marking. Pb-Free indicator, "G" or microdot "•", may or may not be present. Some products may not follow the Generic Marking.

| DIM | MILLIMETERS |       |       |
|-----|-------------|-------|-------|
|     | MIN         | NOM   | MAX   |
| A   | 4.58        | 4.70  | 4.82  |
| A1  | 2.20        | 2.40  | 2.60  |
| A2  | 1.40        | 1.50  | 1.60  |
| b   | 1.17        | 1.26  | 1.35  |
| b2  | 1.53        | 1.65  | 1.77  |
| b4  | 2.42        | 2.54  | 2.66  |
| c   | 0.51        | 0.61  | 0.71  |
| D   | 20.32       | 20.57 | 20.82 |
| D1  | 13.08       | ~     | ~     |
| D2  | 0.51        | 0.93  | 1.35  |
| E   | 15.37       | 15.62 | 15.87 |
| E1  | 12.81       | ~     | ~     |
| E2  | 4.96        | 5.08  | 5.20  |
| e   | ~           | 5.56  | ~     |
| L   | 15.75       | 16.00 | 16.25 |
| L1  | 3.69        | 3.81  | 3.93  |
| ØP  | 3.51        | 3.58  | 3.65  |
| ØP1 | 6.60        | 6.80  | 7.00  |
| Q   | 5.34        | 5.46  | 5.58  |
| S   | 5.34        | 5.46  | 5.58  |

|                         |                              |  |
|-------------------------|------------------------------|--|
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