

# MOSFET – N-Channel, QFET

**200 V, 19 A, 170 mΩ**

## FQP19N20C, FQPF19N20C

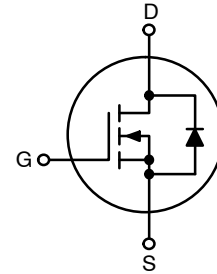
### Description

This N-Channel enhancement mode power MOSFET is produced using onsemi's proprietary planar stripe and DMOS technology. This advanced MOSFET technology has been especially tailored to reduce on-state resistance, and to provide superior switching performance and high avalanche energy strength. These devices are suitable for switched mode power supplies, active power factor correction (PFC), and electronic lamp ballasts.

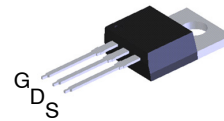
### Features

- 19 A, 200 V,  $R_{DS(on)} = 170 \text{ m}\Omega$  (Max) @  $V_{GS} = 10 \text{ V}$ ,  $I_D = 9.5 \text{ A}$
- Low Gate Charge (Typ. 40.5 nC)
- Low  $C_{RSS}$  (Typ. 85 pF)
- 100% Avalanche Tested
- These Devices are Pb-Free and are RoHS Compliant

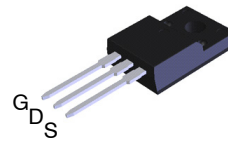
| $V_{DS}$ | $R_{DS(on)}$ MAX | $I_D$ MAX |
|----------|------------------|-----------|
| 200 V    | 170 mΩ @ 10 V    | 19 A      |



N-Channel MOSFET

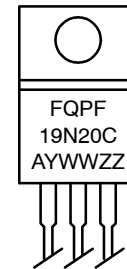


TO-220-3LD  
CASE 340AT



TO-220 Fullpack, 3-Lead  
/ TO-220F-3SG  
CASE 221AT

### MARKING DIAGRAM



FQP19N20C  
 FQPF19N20C = Device Code  
 A = Assembly Location  
 YWW = Date Code (Year & Week)  
 ZZ = Assembly Lot

### ORDERING INFORMATION

| Device     | Package | Shipping          |
|------------|---------|-------------------|
| FQP19N20C  | TO-220  | 1000 Units / Tube |
| FQPF19N20C | TO-200F | 1000 Units / Tube |

# FQP19N20C, FQPF19N20C

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

| Symbol                            | Parameter                                                               |                                       | FQP19N20C   | FQPF19N20C | Unit |
|-----------------------------------|-------------------------------------------------------------------------|---------------------------------------|-------------|------------|------|
| V <sub>DSS</sub>                  | Drain to Source Voltage                                                 |                                       | 200         |            | V    |
| I <sub>D</sub>                    | Drain Current                                                           | – Continuous (T <sub>C</sub> = 25°C)  | 19.0        | 19.0*      | A    |
|                                   |                                                                         | – Continuous (T <sub>C</sub> = 100°C) | 12.1        | 12.1*      |      |
| I <sub>DM</sub>                   | Drain Current                                                           | – Pulsed (Note 1)                     | 76.0        | 76.0*      | A    |
| V <sub>GSS</sub>                  | Gate to Source Voltage                                                  |                                       | ±30         |            | V    |
| E <sub>AS</sub>                   | Single Pulsed Avalanche Energy (Note 2)                                 |                                       | 433         |            | mJ   |
| I <sub>AR</sub>                   | Avalanche Current (Note 1)                                              |                                       | 19.0        |            | A    |
| E <sub>AR</sub>                   | Repetitive Avalanche Energy (Note 1)                                    |                                       | 13.9        |            | mJ   |
| dv/dt                             | Peak Diode Recovery dv/dt (Note 3)                                      |                                       | 5.5         |            | V/ns |
| P <sub>D</sub>                    | Power Dissipation                                                       | (T <sub>C</sub> = 25°C)               | 139         | 43         | W    |
|                                   |                                                                         | –Derate above 25°C                    | 1.11        | 0.34       | 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,<br>1/8" from Case for 5 Seconds |                                       | 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.

\*Drain current limited by maximum junction temperature.

1. Repetitive rating: pulse-width limited by maximum junction temperature.
2. L = 1.8 mH, I<sub>AS</sub> = 19.0 V, V<sub>DD</sub> = 50 V, R<sub>G</sub> = 25 Ω, starting T<sub>J</sub> = 25°C.
3. I<sub>SD</sub> ≤ 19.0 A, di/dt ≤ 300 A/μs, V<sub>DD</sub> ≤ BV<sub>DSS</sub>, starting T<sub>J</sub> = 25°C.

## THERMAL CHARACTERISTICS

| Symbol           | Parameter                                     | FCP190N60 | FCPF190N60 | Unit |
|------------------|-----------------------------------------------|-----------|------------|------|
| R <sub>θJC</sub> | Thermal Resistance, Junction to Case, Max.    | 0.9       | 2.89       | °C/W |
| R <sub>θJA</sub> | Thermal Resistance, Junction to Ambient, Max. | 62.5      | 62.5       |      |

# FQP19N20C, FQPF19N20C

## 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-Source Breakdown Voltage            | V <sub>GS</sub> = 0 V, I <sub>D</sub> = 250 μA  | 200 | –    | –    | V    |
| ΔBV <sub>DSS</sub> / ΔT <sub>J</sub> | Breakdown Voltage Temperature Coefficient | I <sub>D</sub> = 250 μA, Referenced to 25°C     | –   | 0.24 | –    | V/°C |
| I <sub>DSS</sub>                     | Zero Gate Voltage Drain Current           | V <sub>DS</sub> = 200 V, V <sub>GS</sub> = 0 V  | –   | –    | 10   | μA   |
|                                      |                                           | V <sub>DS</sub> = 160 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 | 2.0 | –    | 4.0  | V |
| R <sub>DS(on)</sub> | Static Drain-Source On-Resistance | V <sub>GS</sub> = 10 V, I <sub>D</sub> = 9.5 A              | –   | 0.14 | 0.17 | Ω |
| g <sub>FS</sub>     | Forward Transconductance          | V <sub>DS</sub> = 40 V, I <sub>D</sub> = 9.5 A              | –   | 10.8 | –    | S |

### DYNAMIC CHARACTERISTICS

|                  |                              |                                                            |   |     |      |    |
|------------------|------------------------------|------------------------------------------------------------|---|-----|------|----|
| C <sub>iss</sub> | Input Capacitance            | V <sub>DS</sub> = 25 V, V <sub>GS</sub> = 0 V, f = 1.0 MHz | – | 830 | 1080 | pF |
| C <sub>oss</sub> | Output Capacitance           |                                                            | – | 195 | 255  | pF |
| C <sub>rss</sub> | Reverse Transfer Capacitance |                                                            | – | 85  | 110  | pF |

### SWITCHING CHARACTERISTICS

|                     |                     |                                                                                         |   |      |      |    |
|---------------------|---------------------|-----------------------------------------------------------------------------------------|---|------|------|----|
| t <sub>d(on)</sub>  | Turn-On Delay Time  | V <sub>DD</sub> = 100 V, I <sub>D</sub> = 19.0 A,<br>R <sub>G</sub> = 25 Ω<br>(Note 4)  | – | 15   | 40   | ns |
| t <sub>r</sub>      | Turn-On Rise Time   |                                                                                         | – | 150  | 310  | ns |
| t <sub>d(off)</sub> | Turn-Off Delay Time |                                                                                         | – | 135  | 280  | ns |
| t <sub>f</sub>      | Turn-Off Fall Time  |                                                                                         | – | 115  | 240  | ns |
| Q <sub>g</sub>      | Total Gate Charge   | V <sub>DS</sub> = 160 V, I <sub>D</sub> = 19.0 A,<br>V <sub>GS</sub> = 10 V<br>(Note 4) | – | 40.5 | 53.0 | nC |
| Q <sub>gs</sub>     | Gate-Source Charge  |                                                                                         | – | 6.0  | –    | nC |
| Q <sub>gd</sub>     | Gate-Drain Charge   |                                                                                         | – | 22.5 | –    | nC |

### DRAIN-SOURCE DIODE CHARACTERISTICS AND MAXIMUM RATINGS

|                 |                                                       |                                                                                   |   |      |      |    |
|-----------------|-------------------------------------------------------|-----------------------------------------------------------------------------------|---|------|------|----|
| I <sub>S</sub>  | Maximum Continuous Drain–Source Diode Forward Current |                                                                                   | – | –    | 19.0 | A  |
| I <sub>SM</sub> | Maximum Pulsed Drain–Source Diode Forward Current     |                                                                                   | – | –    | 76.0 | A  |
| V <sub>SD</sub> | Drain–Source Diode Forward Voltage                    | V <sub>GS</sub> = 0 V, I <sub>S</sub> = 19.0 A                                    | – | –    | 1.5  | V  |
| t <sub>rr</sub> | Reverse Recovery Time                                 | V <sub>GS</sub> = 0 V, I <sub>S</sub> = 19.0 A,<br>dI <sub>F</sub> /dt = 100 A/μs | – | 208  | –    | ns |
| Q <sub>rr</sub> | Reverse Recovery Charge                               |                                                                                   | – | 1.63 | –    | 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.

# FQP19N20C, FQPF19N20C

## TYPICAL CHARACTERISTICS

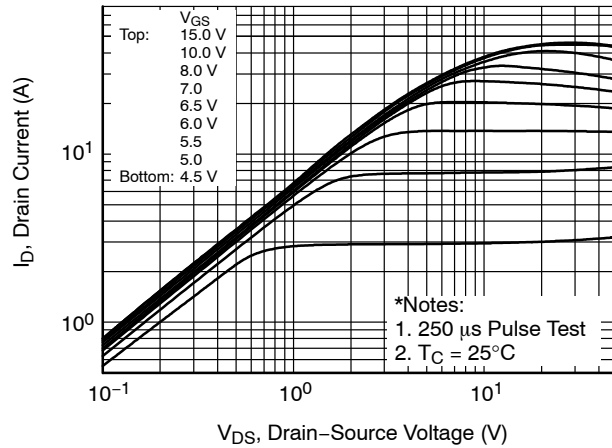


Figure 1. On-Region Characteristics

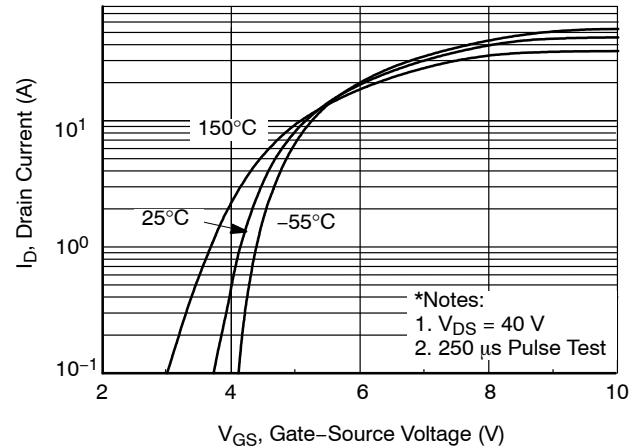


Figure 2. Transfer Characteristics

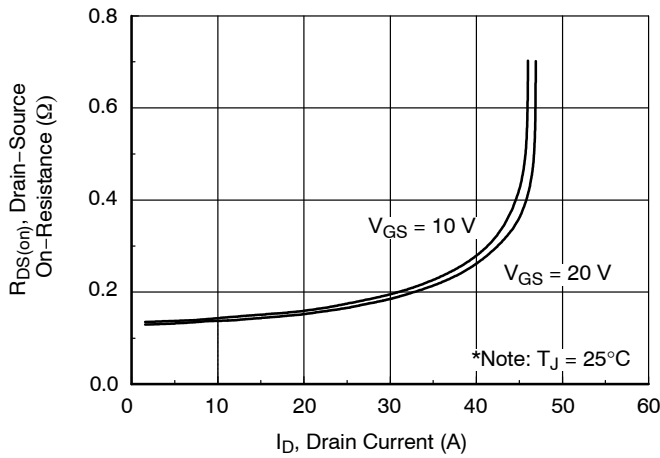


Figure 3. On-Resistance Variation vs Drain Current and Gate Voltage

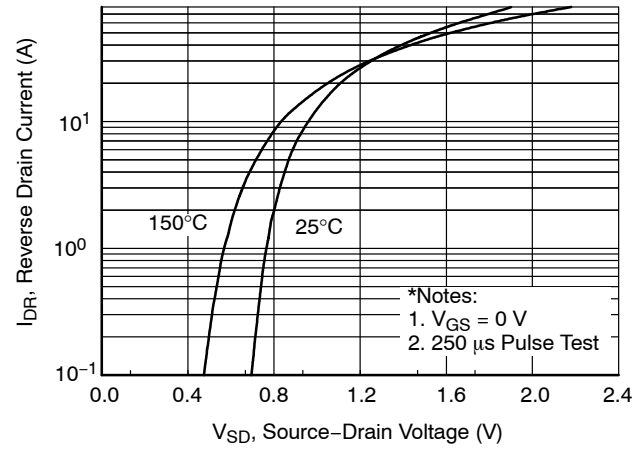


Figure 4. Body Diode Forward Voltage Variation with Source Current and Temperature

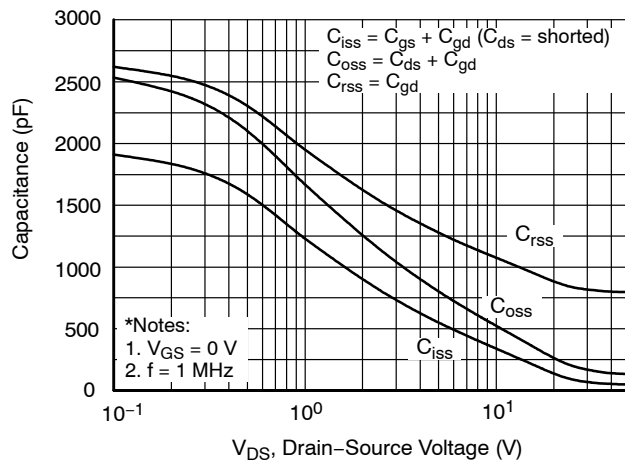


Figure 5. Capacitance Characteristics

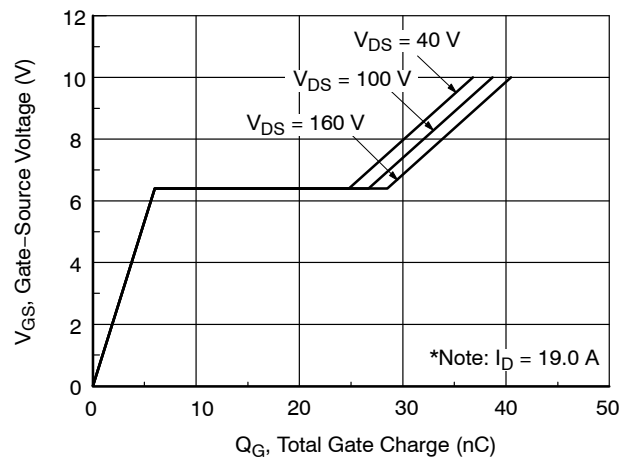
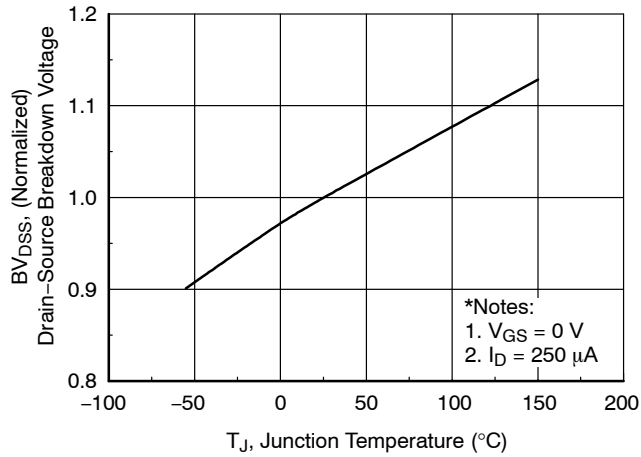


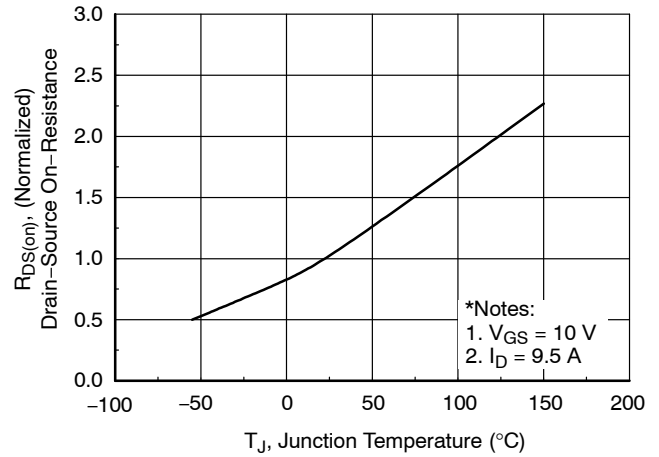
Figure 6. Gate Charge Characteristics

# FQP19N20C, FQPF19N20C

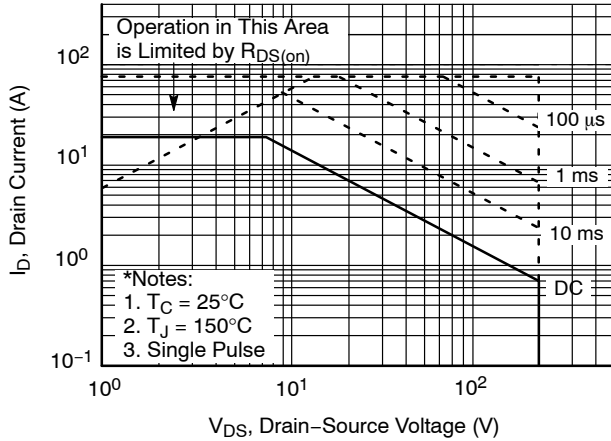
## TYPICAL CHARACTERISTICS (continued)



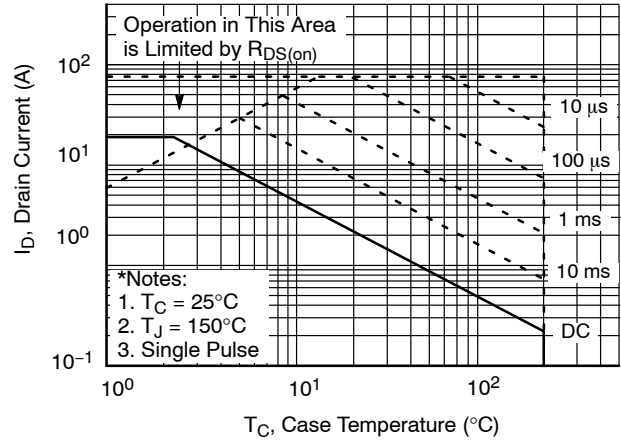
**Figure 7. Breakdown Voltage Variation vs Temperature**



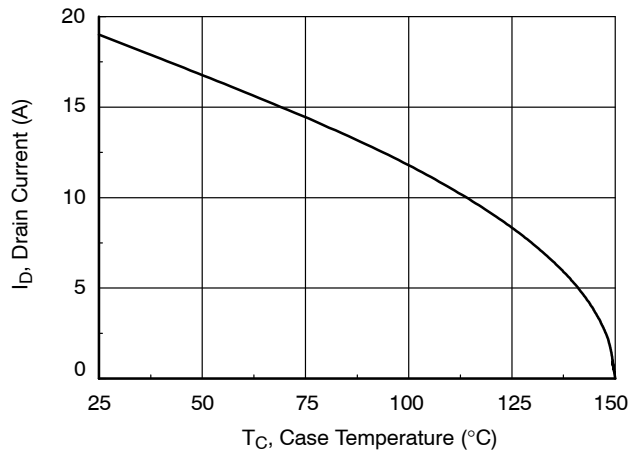
**Figure 8. On-Resistance Variation vs Temperature**



**Figure 9.1. Maximum Safe Operating Area for FQP19N20C**



**Figure 9.2. Maximum Safe Operating Area for FQPF19N20C**



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

# FQP19N20C, FQPF19N20C

## TYPICAL CHARACTERISTICS (continued)

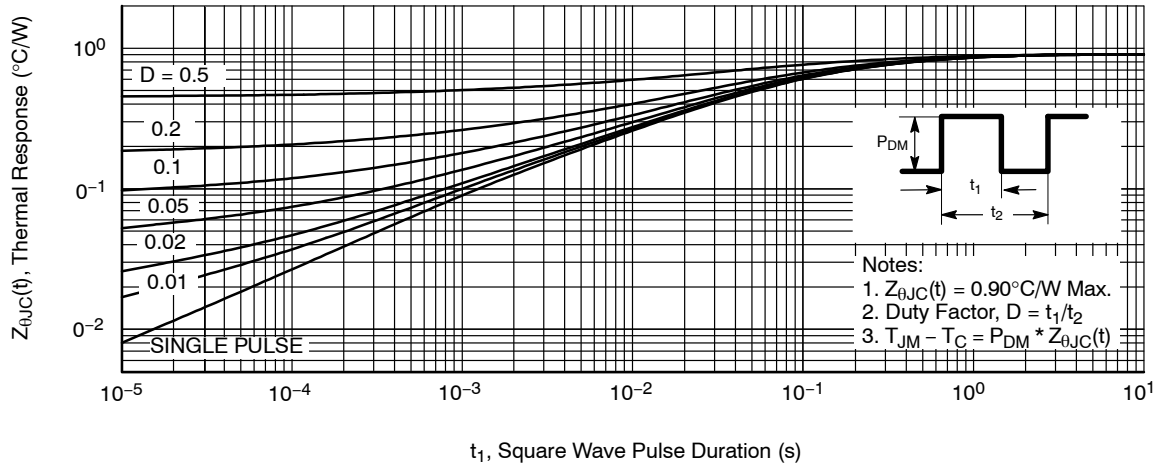


Figure 11.1. Transient Thermal Response Curve for FQP19N20C

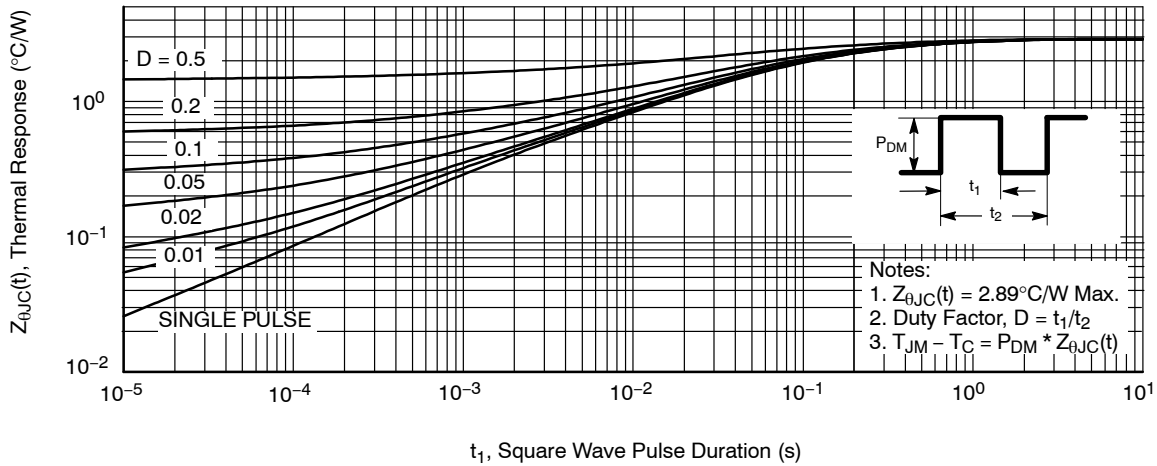


Figure 11.2. Transient Thermal Response Curve for FQPF19N20C

## FQP19N20C, FQPF19N20C

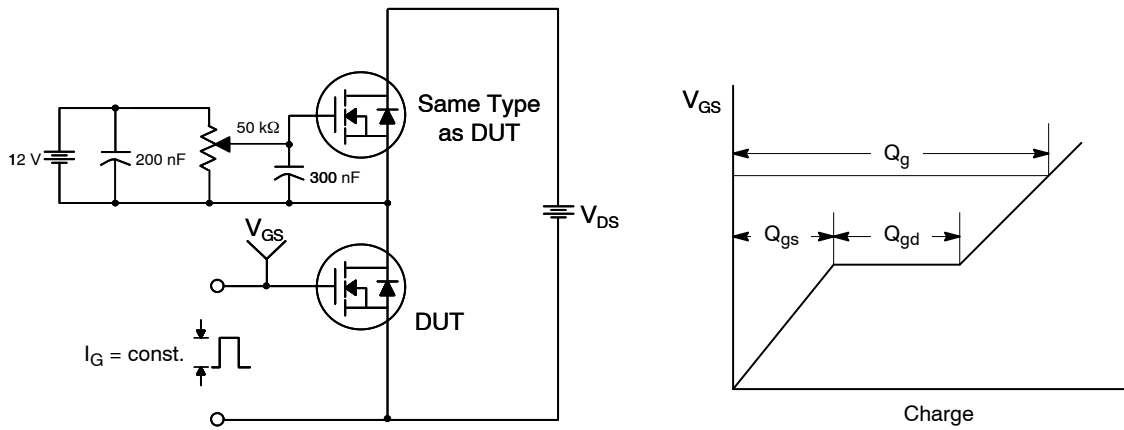


Figure 12. Gate Charge Test Circuit & Waveform

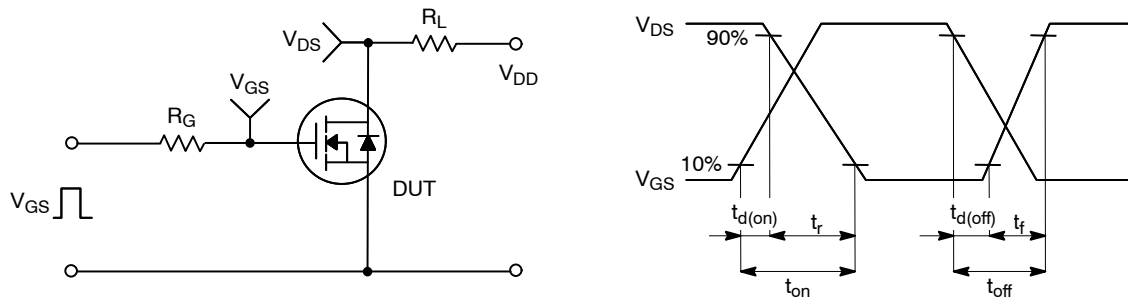


Figure 13. Resistive Switching Test Circuit & Waveforms

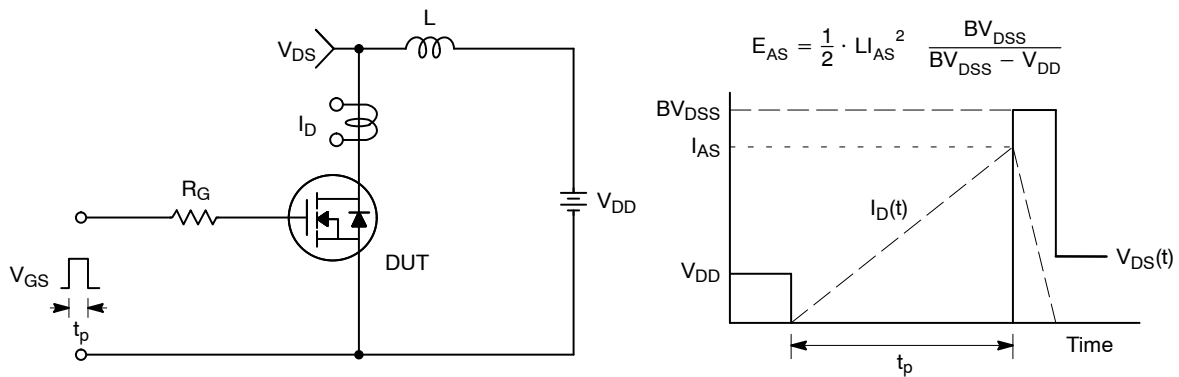


Figure 14. Unclamped Inductive Switching Test Circuit & Waveforms

# FQP19N20C, FQPF19N20C

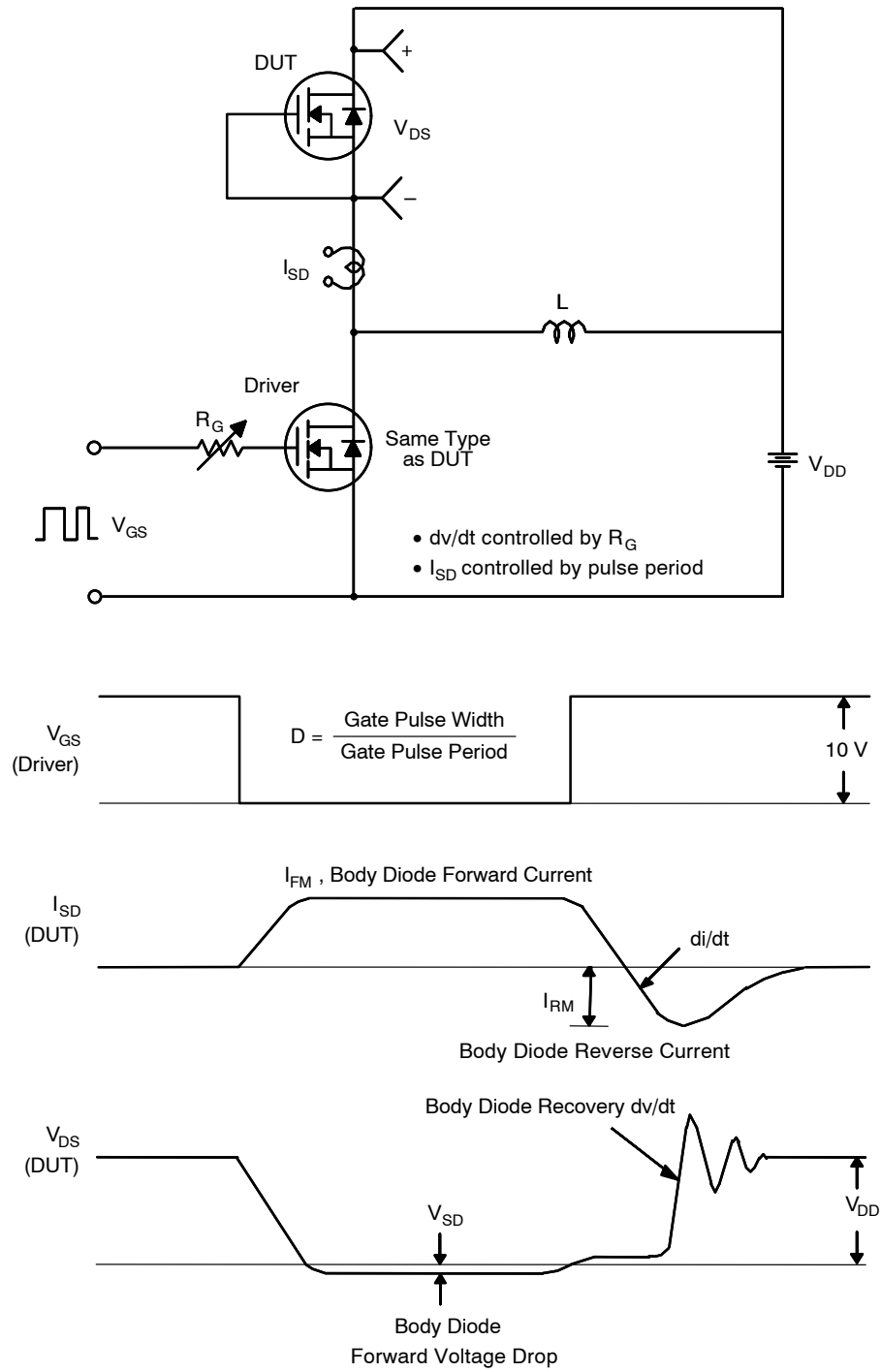
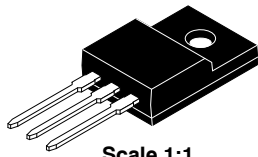


Figure 15. Peak Diode Recovery  $dv/dt$  Test Circuit & Waveforms

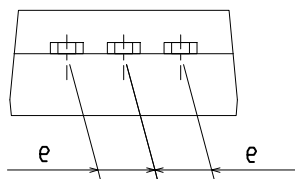
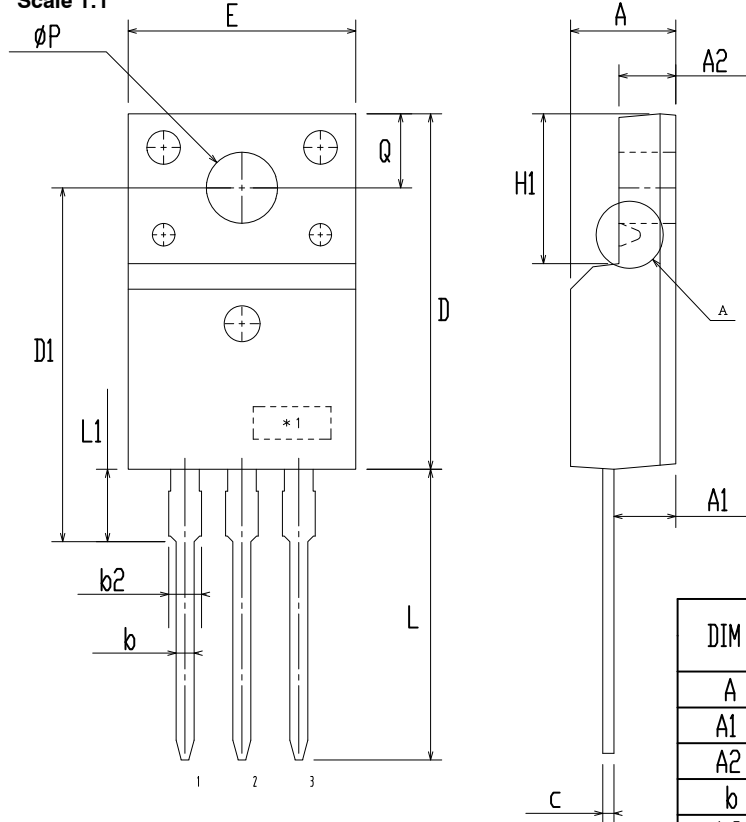


**TO-220 Fullpack, 3-Lead / TO-220F-3SG**  
**CASE 221AT**  
**ISSUE B**

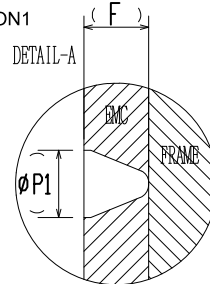
DATE 19 JAN 2021



Scale 1:1



OPTION1



| DIM  | MILLIMETERS |       |       |
|------|-------------|-------|-------|
|      | MIN         | NOM   | MAX   |
| A    | 4.50        | 4.70  | 4.90  |
| A1   | 2.56        | 2.76  | 2.96  |
| A2   | 2.34        | 2.54  | 2.74  |
| b    | 0.70        | 0.80  | 0.90  |
| b2   | ~           | ~     | 1.47  |
| c    | 0.45        | 0.50  | 0.60  |
| D    | 15.67       | 15.87 | 16.07 |
| D1   | 15.60       | 15.80 | 16.00 |
| E    | 9.96        | 10.16 | 10.36 |
| e    | 2.34        | 2.54  | 2.74  |
| F    | ~           | 0.84  | ~     |
| H1   | 6.48        | 6.68  | 6.88  |
| L    | 12.78       | 12.98 | 13.18 |
| L1   | 3.03        | 3.23  | 3.43  |
| Ø P  | 2.98        | 3.18  | 3.38  |
| Ø P1 | ~           | 1.00  | ~     |
| Q    | 3.20        | 3.30  | 3.40  |

**NOTES:**

A. DIMENSION AND TOLERANCE AS ASME Y14.5-2009

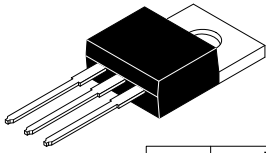
B. DIMENSIONS ARE EXCLUSIVE OF BURRS, MOLD FLASH AND TIE BAR PROTRUCTIONS.

C. OPTION 1 - WITH SUPPORT PIN HOLE

OPTION 2 - NO SUPPORT PIN HOLE

|                         |                                              |                                                                                                                                                                                     |
|-------------------------|----------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
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| <b>DESCRIPTION:</b>     | <b>TO-220 FULLPACK, 3-LEAD / TO-220F-3SG</b> | <b>PAGE 1 OF 1</b>                                                                                                                                                                  |

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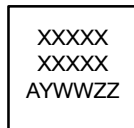
TO-220-3LD  
CASE 340AT  
ISSUE B

DATE 08 AUG 2022

| DIM | MILLIMETERS  |      |       |
|-----|--------------|------|-------|
|     | MIN.         | NOM. | MAX.  |
| A   | 4.00         | --   | 4.70  |
| A1  | SEE NOTE "F" |      |       |
| A2  | 2.10         | --   | 2.85  |
| b   | 0.55         | --   | 1.00  |
| b2  | 1.10         | --   | 1.62  |
| b4  | 1.42         | --   | 1.62  |
| c   | 0.36         | --   | 0.60  |
| D   | 13.90        | --   | 16.30 |
| D1  | 8.13         | --   | 9.40  |
| D2  | 11.50        | --   | 14.30 |
| D3  | 15.42        | --   | 16.51 |
| E   | 9.65         | --   | 10.67 |
| E1  | 7.59         | --   | 8.65  |
| e   | 2.40         | --   | 2.67  |
| H1  | 6.06         | --   | 6.69  |
| L   | 12.70        | --   | 14.04 |
| L1  | 2.70         | --   | 4.10  |
| P   | 3.50         | --   | 4.00  |
| Q   | 2.50         | --   | 3.40  |
| z   | 2.13 REF     |      |       |
| z1  | 2.06 REF     |      |       |
| θ   | 3°           | --   | 5°    |

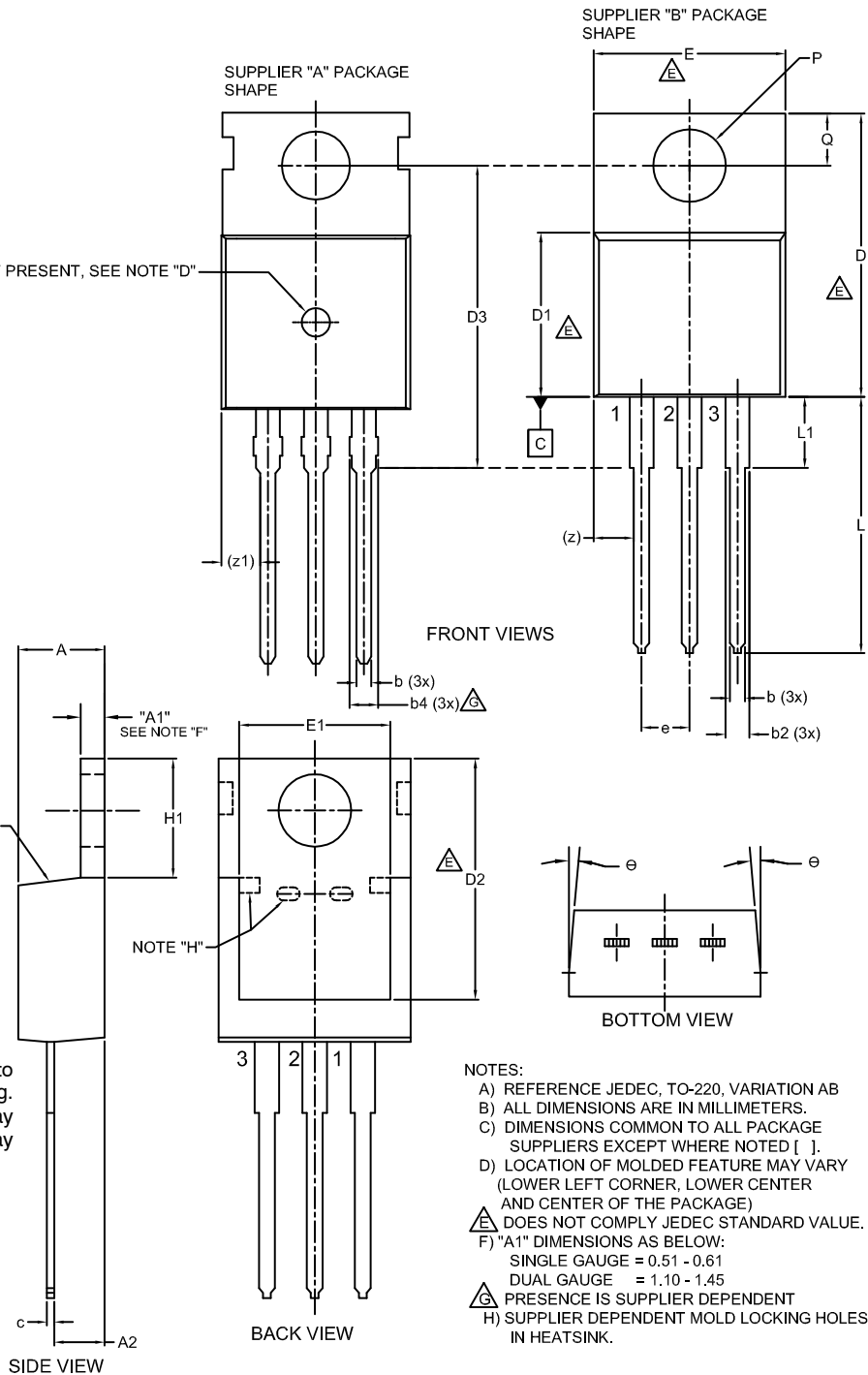
IF PRESENT, SEE NOTE "D"

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.



NOTES:

- A) REFERENCE JEDEC, TO-220, VARIATION AB
- B) ALL DIMENSIONS ARE IN MILLIMETERS.
- C) DIMENSIONS COMMON TO ALL PACKAGE SUPPLIERS EXCEPT WHERE NOTED [ ].
- D) LOCATION OF MOLDED FEATURE MAY VARY (LOWER LEFT CORNER, LOWER CENTER AND CENTER OF THE PACKAGE)
- △ DOES NOT COMPLY JEDEC STANDARD VALUE.
- F) "A1" DIMENSIONS AS BELOW:  
SINGLE GAUGE = 0.51 - 0.61  
DUAL GAUGE = 1.10 - 1.45
- △ PRESENCE IS SUPPLIER DEPENDENT
- H) SUPPLIER DEPENDENT MOLD LOCKING HOLES IN HEATSINK.

|                  |             |                                                                                                                                                                                     |
|------------------|-------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
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| DESCRIPTION:     | TO-220-3LD  | PAGE 1 OF 1                                                                                                                                                                         |

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