

FQP11N40C, FQPF11N40C

QFET[®] MOSFET, N-Channel

400 V, 10.5 A, 530 mΩ

Description

This N-Channel enhancement mode power MOSFET is produced using ON Semiconductor 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.

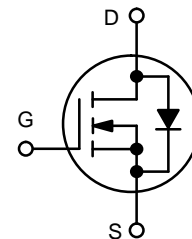
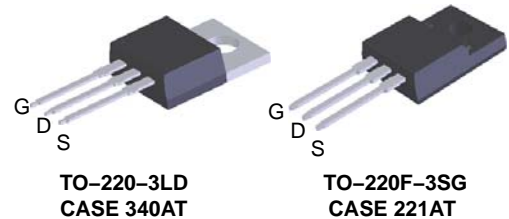
Features

- 10.5 A, 400 V, $R_{DS(on)} = 530 \text{ m}\Omega$ (Max.) @ $V_{GS} = 10 \text{ V}$, $I_D = 5.25 \text{ A}$
- Low Gate Charge (Typ. 28 nC)
- Low Crss (Typ. 85 pF)
- 100% Avalanche Tested
- These Devices are Pb-Free and are RoHS Compliant



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ORDERING INFORMATION

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

FQP11N40C, FQPF11N40C

ORDERING INFORMATION

| Device | Device Marking | Package | Shipping |
|------------|----------------|---|--------------------|
| FQP11N40C | FQP11N40C | TO-220 (Pb-Free) | 1,000 Units / Tube |
| FQPF11N40C | FQPF11N40C | TO-220 Fullpack, TO-220F-3SG (Pb-Free) | 1,000 Units / Tube |

MOSFET MAXIMUM RATINGS ($T_C = 25^\circ\text{C}$ unless otherwise noted)

| Symbol | Parameter | FQP11N40C | FQPF11N40C | Unit |
|----------------|--|------------|------------|---------------------|
| V_{DSS} | Drain to Source Voltage | 400 | | V |
| I_D | Drain Current –Continuous ($T_C = 25^\circ\text{C}$) –Continuous ($T_C = 100^\circ\text{C}$) | 10.5 | 10.5 * | A |
| | | 6.6 | 6.6 * | A |
| I_{DM} | Drain Current – Pulsed (Note 1) | 42 | 42 * | A |
| V_{GSS} | Gate to Source Voltage | ± 30 | | V |
| E_{AS} | Single Pulsed Avalanche Energy (Note 2) | 360 | | mJ |
| I_{AR} | Avalanche Current (Note 1) | 11 | | A |
| E_{AR} | Repetitive Avalanche Energy (Note 1) | 13.5 | | mJ |
| dv/dt | Peak Diode Recovery dv/dt (Note 3) | 4.5 | | V/ns |
| P_D | Power Dissipation ($T_C = 25^\circ\text{C}$) – Derate above 25°C | 135 | 44 | W |
| | | 1.07 | 0.35 | 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, 1/8" from Case for 5 Seconds | 300 | | $^\circ\text{C}$ |

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. $L = 5.7 \text{ mH}$, $I_{AS} = 10.5 \text{ A}$, $V_{DD} = 50 \text{ V}$, $R_G = 25 \Omega$, starting $T_J = 25^\circ\text{C}$.
3. $I_{SD} \leq 10.5 \text{ A}$, $di/dt \leq 200 \text{ A}/\mu\text{s}$, $V_{DD} \leq BV_{DSS}$, starting $T_J = 25^\circ\text{C}$.

THERMAL CHARACTERISTICS

| Symbol | Parameter | FQP11N40C | FQPF11N40C | Unit |
|-----------------|--|-----------|------------|---------------------------|
| $R_{\theta JC}$ | Thermal Resistance, Junction to Case, Max | 0.93 | 2.86 | $^\circ\text{C}/\text{W}$ |
| $R_{\theta JA}$ | Thermal Resistance, Junction to Ambient, Max | 62.5 | 62.5 | $^\circ\text{C}/\text{W}$ |

FQP11N40C, FQPF11N40C

ELECTRICAL CHARACTERISTICS (T_C = 25°C unless otherwise noted)

| Symbol | Parameter | Test Conditions | Min | Typ | Max | Unit |
|--------|-----------|-----------------|-----|-----|-----|------|
|--------|-----------|-----------------|-----|-----|-----|------|

Off Characteristics

| | | | | | | |
|--------------------------------------|---|---|-----|------|------|------|
| BV _{DSS} | Drain–Source Breakdown Voltage | V _{GS} = 0 V, I _D = 250 μA | 400 | | | V |
| $\frac{\Delta BV_{DSS}}{\Delta T_J}$ | Breakdown Voltage Temperature Coefficient | I _D = 250 μA, Referenced to 25°C | | 0.54 | | V/°C |
| I _{DSS} | Zero Gate Voltage Drain Current | V _{DS} = 400 V, V _{GS} = 0 V | | | 1 | μA |
| | | V _{DS} = 320 V, T _C = 125°C | | | 10 | μA |
| I _{GSSF} | Gate–Body Leakage Current, Forward | V _{GS} = 30 V, V _{DS} = 0 V | | | 100 | nA |
| I _{GSSR} | Gate–Body Leakage Current, Reverse | V _{GS} = –30 V, V _{DS} = 0 V | | | –100 | nA |

On Characteristics

| | | | | | | |
|---------------------|-----------------------------------|---|-----|------|------|---|
| V _{GS(th)} | Gate Threshold Voltage | V _{DS} = V _{GS} , I _D = 250 μA | 2.0 | | 4.0 | V |
| r _{DS(on)} | Static Drain–Source On–Resistance | V _{GS} = 10 V, I _D = 5.25 A | | 0.43 | 0.53 | Ω |
| g _{FS} | Forward Transconductance | V _{DS} = 40 V, I _D = 5.25 A | | 7.1 | | s |

Dynamic Characteristics

| | | | | | | |
|------------------|------------------------------|--|--|-----|------|----|
| C _{iss} | Input Capacitance | V _{DS} = 25 V, V _{GS} = 0 V, f = 1 MHz | | 840 | 1090 | pF |
| C _{oss} | Output Capacitance | | | 250 | 325 | pF |
| C _{rss} | Reverse Transfer Capacitance | | | 85 | 110 | pF |

Switching Characteristics

| | | | | | | |
|---------------------|---------------------|---|--|----|-----|----|
| t _{d(on)} | Turn–On Delay Time | V _{DD} = 200 V, I _D = 10.5 A, R _G = 25 Ω (Note 4) | | 14 | 40 | ns |
| t _r | Turn–On Rise Time | | | 89 | 190 | ns |
| t _{d(off)} | Turn–Off Delay Time | | | 81 | 170 | ns |
| t _f | Turn–Off Fall Time | | | 81 | 170 | ns |
| Q _g | Total Gate Charge | V _{DS} = 320 V, I _D = 10.5 A, R _G = 25 Ω (Note 4) | | 28 | 35 | nC |
| Q _{gs} | Gate–Source Charge | | | 4 | | nC |
| Q _{gd} | Gate–Drain Charge | | | 15 | | nC |

Drain–Source Diode Characteristics and Maximum Ratings

| | | | | | | |
|-----------------|---|---|--|-----|------|----|
| I _S | Maximum Continuous Drain–Source Diode Forward Current | | | | 10.5 | A |
| I _{SM} | Maximum Pulsed Drain–Source Diode Forward Current | | | | 42 | A |
| V _{SD} | Drain–Source Diode Forward Voltage | V _{GS} = 0 V, I _S = 10.5 A | | | 1.4 | V |
| t _{rr} | Reverse Recovery Time | V _{GS} = 0 V, I _S = 10.5 A, dI _F /dt = 100 A/μs | | 290 | | ns |
| Q _{rr} | Reverse Recovery Charge | | | 2.4 | | 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 PERFORMANCE CHARACTERISTICS

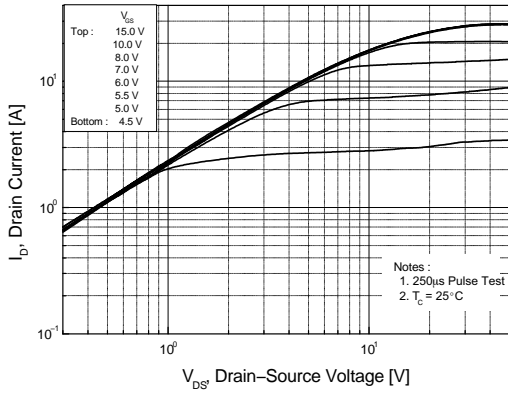


Figure 1. On-Region Characteristics

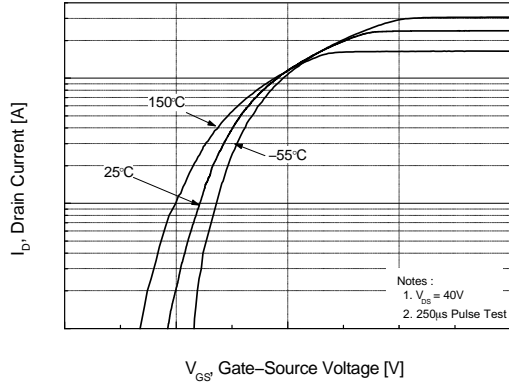


Figure 2. Transfer Characteristics

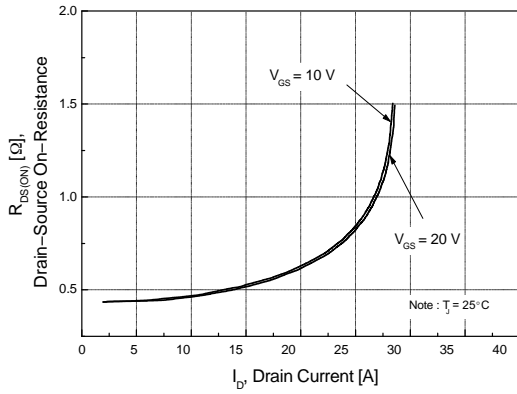


Figure 3. On-Resistance Variation vs Drain Current and Gate Voltage

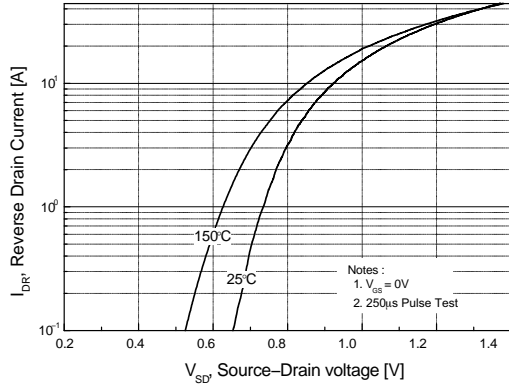


Figure 4. Body Diode Forward Voltage Variation vs. Source Current and Temperature

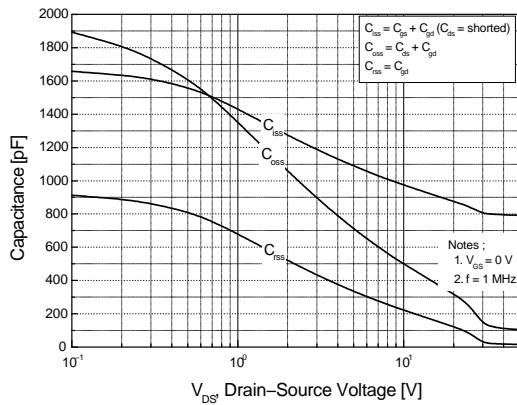


Figure 5. Capacitance Characteristics

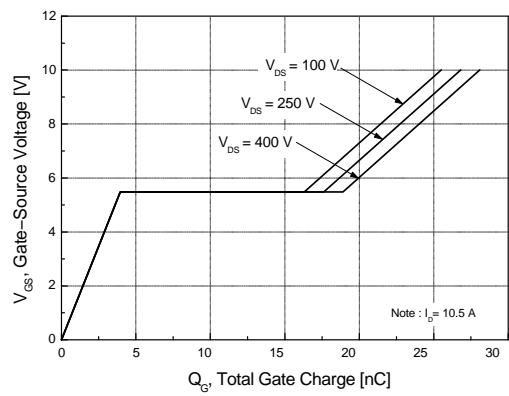


Figure 6. Gate Charge Characteristics

FQP11N40C, FQPF11N40C

TYPICAL PERFORMANCE CHARACTERISTICS

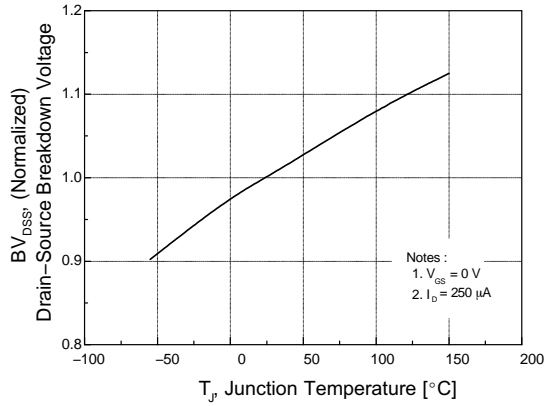


Figure 7. Breakdown Voltage Variation vs. Temperature

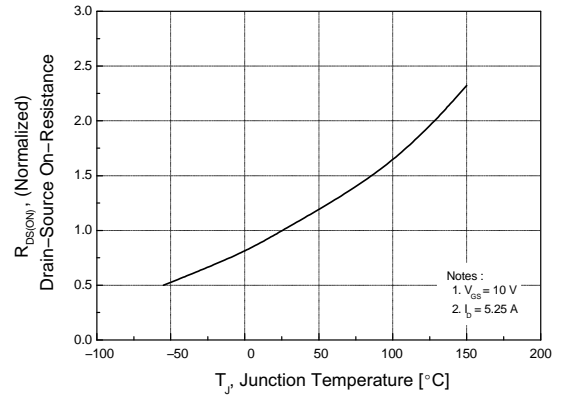


Figure 8. On-Resistance Variation vs. Temperature

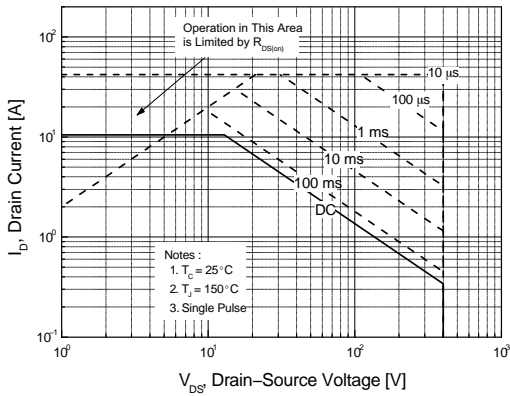


Figure 9. Maximum Safe Operating Area of FQP11N40C

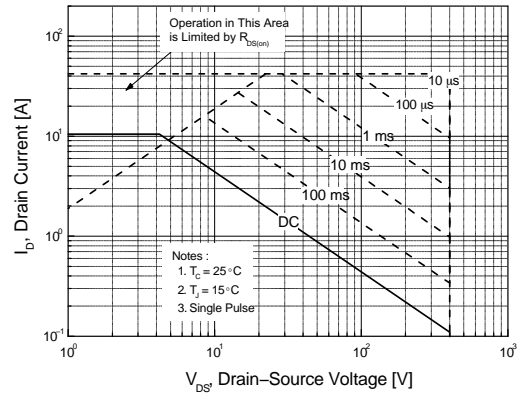


Figure 10. Maximum Safe Operating Area of FQPF11N40C

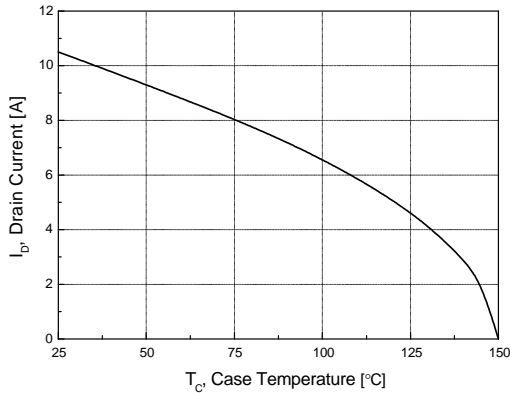


Figure 11. Maximum Drain Current

FQP11N40C, FQPF11N40C

TYPICAL PERFORMANCE CHARACTERISTICS

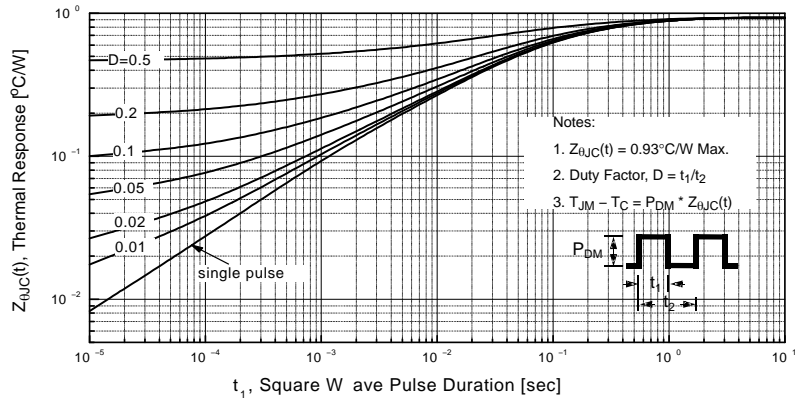


Figure 12. Transient Thermal Response Curve of FQP11N40C

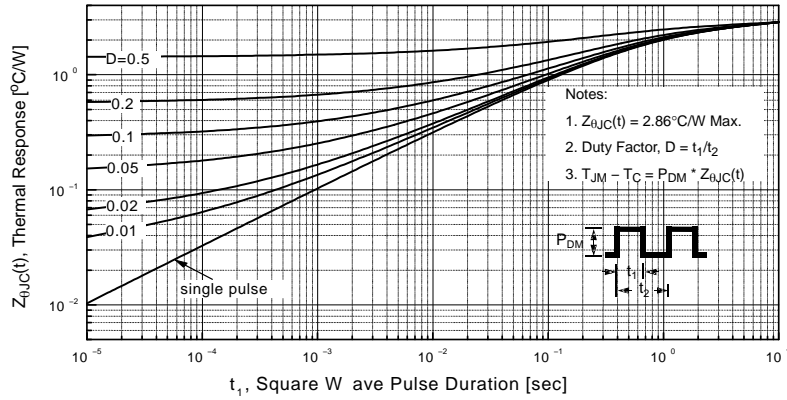


Figure 13. Transient Thermal Response Curve of FQPF11N40C

FQP11N40C, FQPF11N40C

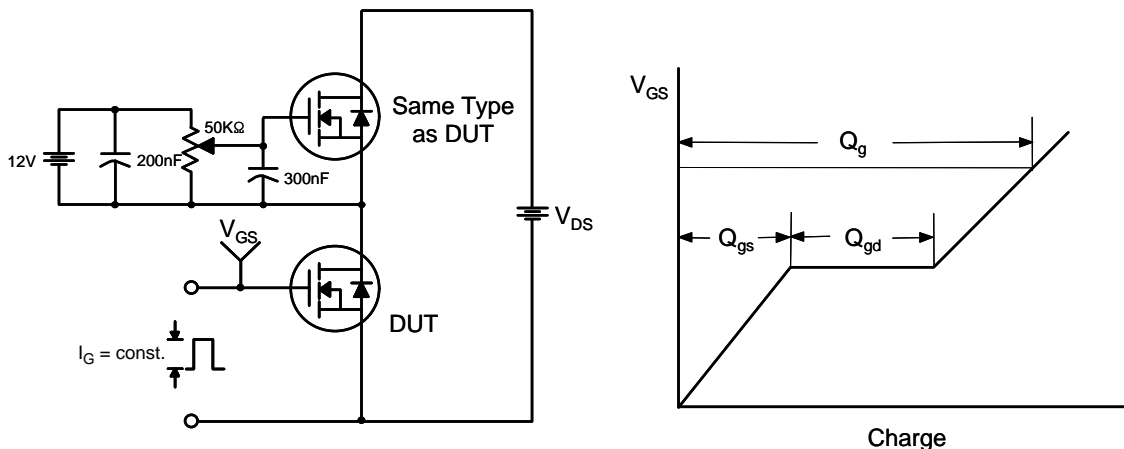


Figure 14. Gate Charge Test Circuit & Waveform

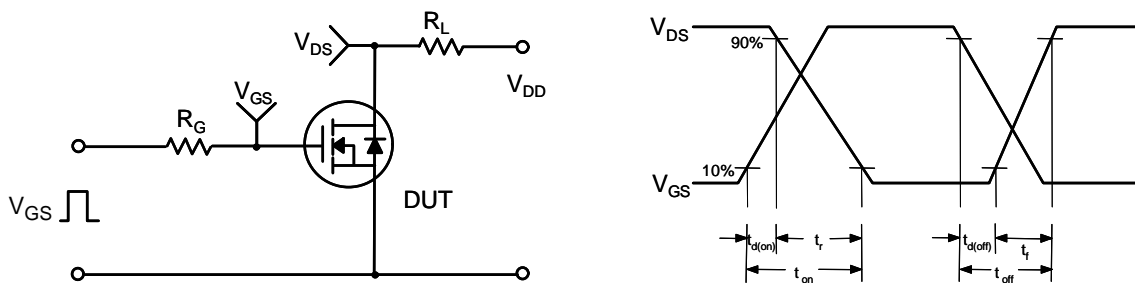


Figure 15. Resistive Switching Test Circuit & Waveforms

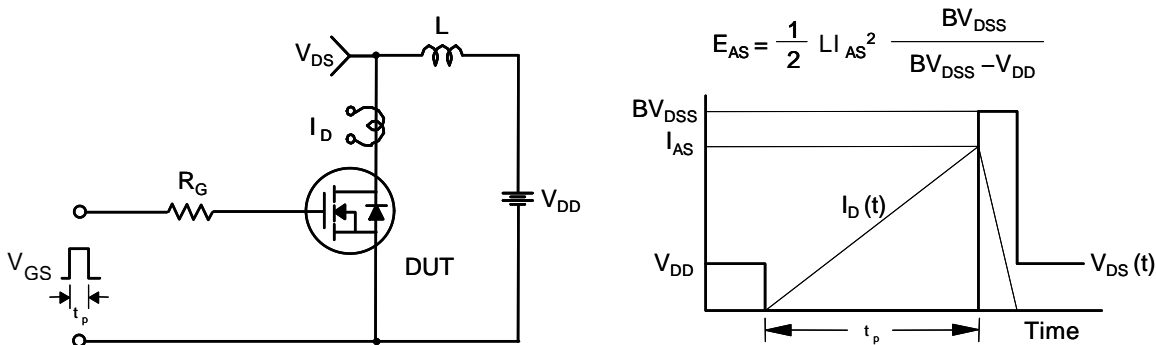


Figure 16. Unclamped Inductive Switching Test Circuit & Waveforms

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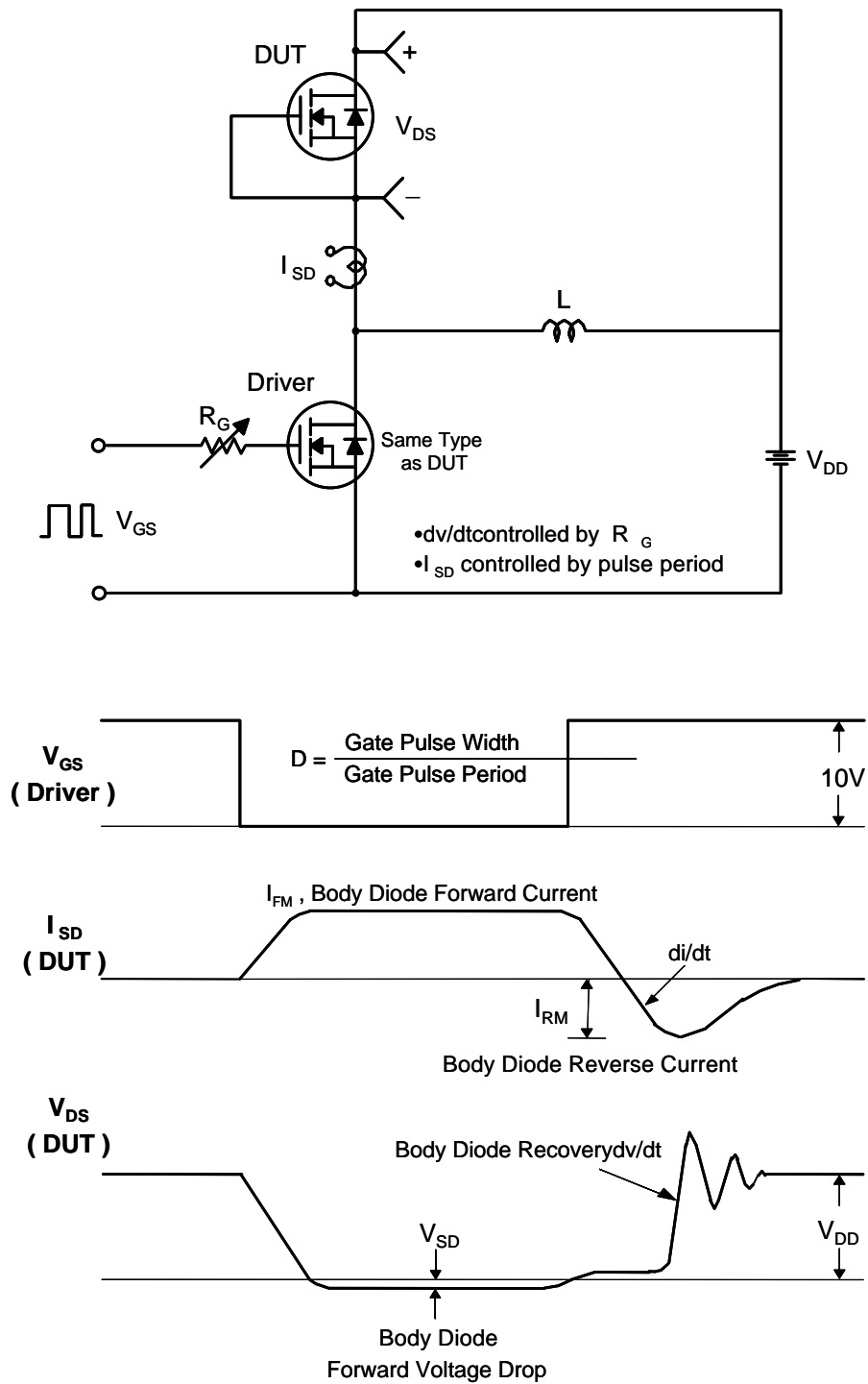


Figure 17. Peak Diode Recovery dv/dt Test Circuit & Waveforms

MECHANICAL CASE OUTLINE

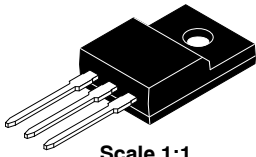
PACKAGE DIMENSIONS

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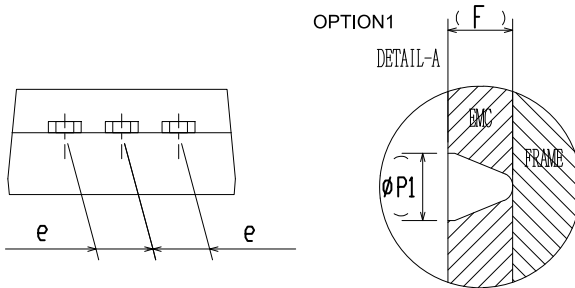
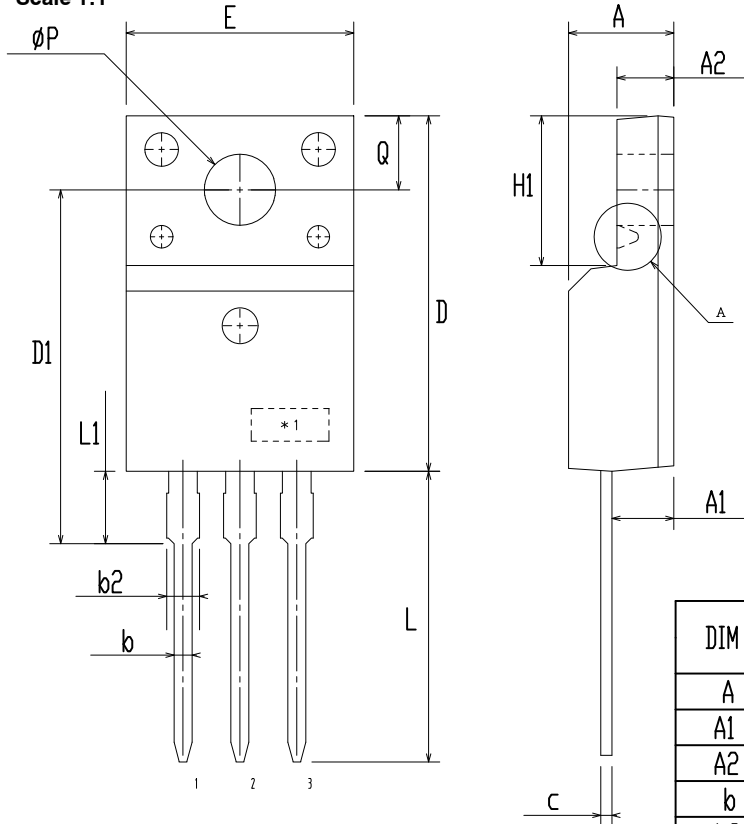


TO-220 Fullpack, 3-Lead / TO-220F-3SG CASE 221AT ISSUE B

DATE 19 JAN 2021



Scale 1:1



| 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 |
| phi P | 2.98 | 3.18 | 3.38 |
| phi 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

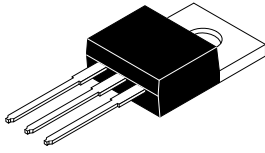
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MECHANICAL CASE OUTLINE

PACKAGE DIMENSIONS

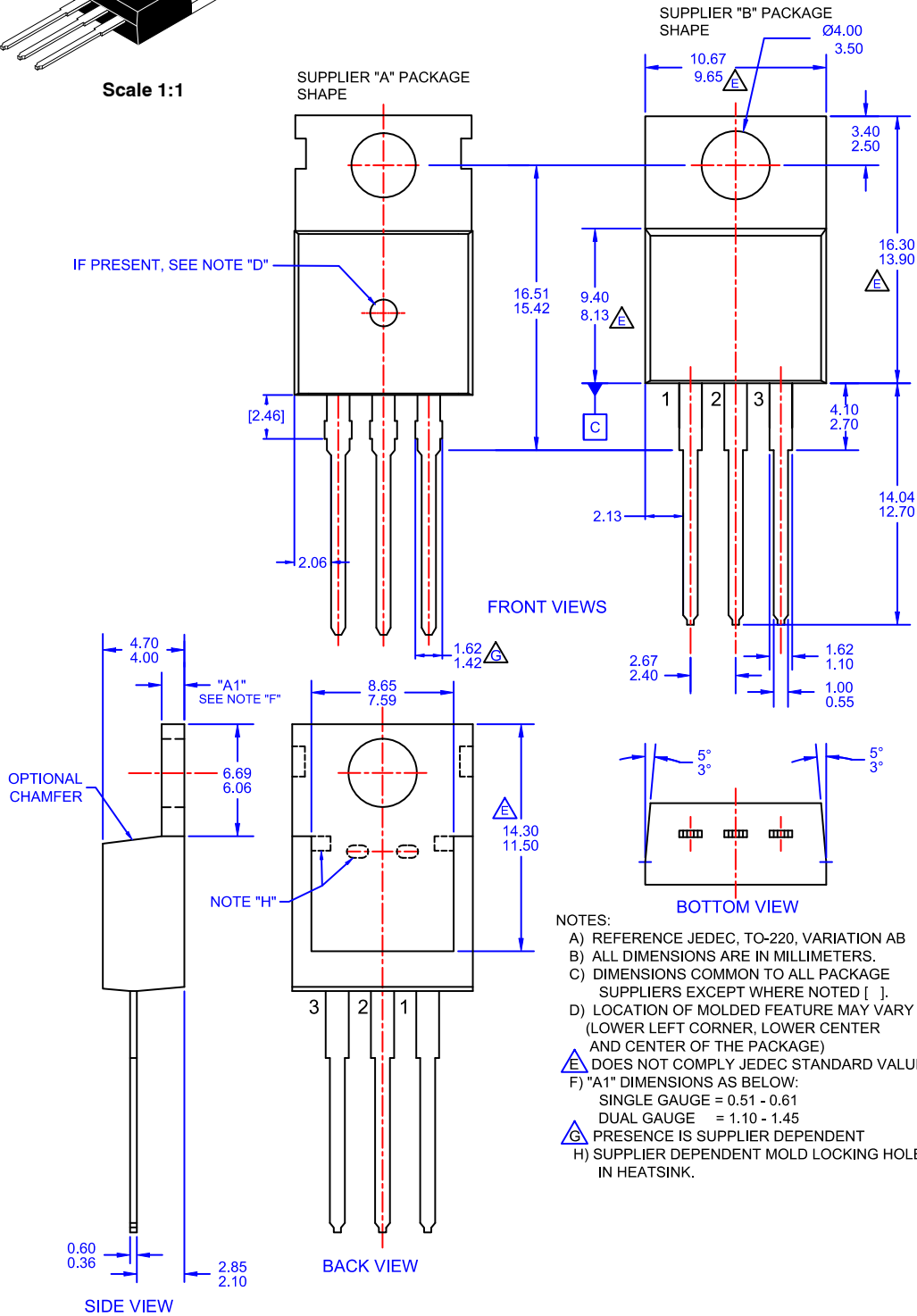
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Scale 1:1

TO-220-3LD CASE 340AT ISSUE A

DATE 03 OCT 2017



- 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)
 - E) DOES NOT COMPLY JEDEC STANDARD VALUE.
 - F) "A1" DIMENSIONS AS BELOW:
 SINGLE GAUGE = 0.51 - 0.61
 DUAL GAUGE = 1.10 - 1.45
 - G) PRESENCE IS SUPPLIER DEPENDENT
 - H) SUPPLIER DEPENDENT MOLD LOCKING HOLES IN HEATSINK.

| | | |
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