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August 2015

FCPF650N80Z

N-Channel SuperFET[®] II MOSFET

800 V, 10 A, 650 mΩ

Features

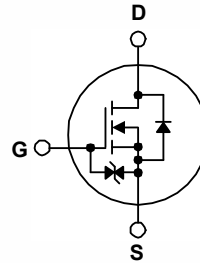
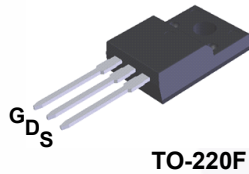
- $R_{DS(on)} = 530 \text{ m}\Omega$ (Typ.)
- Ultra Low Gate Charge (Typ. $Q_g = 27 \text{ nC}$)
- Low E_{oss} (Typ. 2.8 uJ @ 400V)
- Low Effective Output Capacitance (Typ. $C_{oss(eff.)} = 124 \text{ pF}$)
- 100% Avalanche Tested
- RoHS Compliant
- ESD Improved Capability

Applications

- AC - DC Power Supply
- LED Lighting

Description

SuperFET[®] II MOSFET is Fairchild Semiconductor's brand-new 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. In addition, internal gate-source ESD diode allows to withstand over 2kV HBM surge stress. Consequently, SuperFET II MOSFET is very suitable for the switching power applications such as Audio, Laptop adapter, Lighting, ATX power and industrial power applications.



Absolute Maximum Ratings $T_C = 25^\circ\text{C}$ unless otherwise noted.

| Symbol | Parameter | FCPF650N80Z | Unit |
|----------------|--|--|------------------|
| V_{DSS} | Drain to Source Voltage | 800 | V |
| V_{GSS} | Gate to Source Voltage | - DC | ± 20 |
| | | - AC (f > 1 Hz) | ± 30 |
| I_D | Drain Current | - Continuous ($T_C = 25^\circ\text{C}$) | 10* |
| | | - Continuous ($T_C = 100^\circ\text{C}$) | 6.3* |
| I_{DM} | Drain Current | - Pulsed (Note 1) | 24* |
| E_{AS} | Single Pulsed Avalanche Energy (Note 2) | 204 | mJ |
| I_{AR} | Avalanche Current (Note 1) | 1.6 | A |
| E_{AR} | Repetitive Avalanche Energy (Note 1) | 0.305 | mJ |
| dv/dt | MOSFET dv/dt | 100 | V/ns |
| | Peak Diode Recovery dv/dt (Note 3) | 20 | |
| P_D | Power Dissipation ($T_C = 25^\circ\text{C}$) | | 30.5 |
| | | - Derate Above 25°C | 0.24 |
| T_J, T_{STG} | Operating and Storage Temperature Range | -55 to +150 | $^\circ\text{C}$ |
| T_L | Maximum Lead Temperature for Soldering, 1/8" from Case for 5 Seconds | 300 | $^\circ\text{C}$ |

*Drain current limited by maximum junction temperature, with heatsink.

Thermal Characteristics

| Symbol | Parameter | FCPF650N80Z | Unit |
|-----------------|---|-------------|--------------------|
| $R_{\theta JC}$ | Thermal Resistance, Junction to Case, Max. | 4.1 | $^\circ\text{C/W}$ |
| $R_{\theta JA}$ | Thermal Resistance, Junction to Ambient, Max. | 62.5 | |

Package Marking and Ordering Information

| Part Number | Top Mark | Package | Packing Method | Reel Size | Tape Width | Quantity |
|-------------|-------------|---------|----------------|-----------|------------|----------|
| FCPF650N80Z | FCPF650N80Z | TO-220F | Tube | N/A | N/A | 50 units |

Electrical Characteristics $T_C = 25^\circ\text{C}$ unless otherwise noted.

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

Off Characteristics

| | | | | | | |
|--------------------------------|---|---|-----|-----|----------|--------------------|
| BV_{DSS} | Drain to Source Breakdown Voltage | $V_{GS} = 0\text{ V}, I_D = 1\text{ mA}, T_J = 25^\circ\text{C}$ | 800 | - | - | V |
| $\Delta BV_{DSS} / \Delta T_J$ | Breakdown Voltage Temperature Coefficient | $I_D = 1\text{ mA}$, Referenced to 25°C | - | 0.8 | - | $V/^\circ\text{C}$ |
| I_{DSS} | Zero Gate Voltage Drain Current | $V_{DS} = 800\text{ V}, V_{GS} = 0\text{ V}$ | - | - | 25 | μA |
| | | $V_{DS} = 640\text{ V}, V_{GS} = 0\text{ V}, T_C = 125^\circ\text{C}$ | - | - | 250 | |
| I_{GSS} | Gate to Body Leakage Current | $V_{GS} = \pm 20\text{ V}, V_{DS} = 0\text{ V}$ | - | - | ± 10 | μA |

On Characteristics

| | | | | | | |
|--------------|--------------------------------------|--|-----|-----|-----|------------------|
| $V_{GS(th)}$ | Gate Threshold Voltage | $V_{GS} = V_{DS}, I_D = 0.8\text{ mA}$ | 2.5 | - | 4.5 | V |
| $R_{DS(on)}$ | Static Drain to Source On Resistance | $V_{GS} = 10\text{ V}, I_D = 4\text{ A}$ | - | 530 | 650 | $\text{m}\Omega$ |
| g_{FS} | Forward Transconductance | $V_{DS} = 20\text{ V}, I_D = 4\text{ A}$ | - | 7.8 | - | S |

Dynamic Characteristics

| | | | | | | |
|-----------------|-------------------------------|---|--------------------|------|------|-------------|
| C_{iss} | Input Capacitance | $V_{DS} = 100\text{ V}, V_{GS} = 0\text{ V}, f = 1\text{ MHz}$ | - | 1178 | 1565 | pF |
| C_{oss} | Output Capacitance | | - | 36 | 48 | pF |
| C_{rss} | Reverse Transfer Capacitance | | - | 0.84 | - | pF |
| C_{oss} | Output Capacitance | $V_{DS} = 480\text{ V}, V_{GS} = 0\text{ V}, f = 1\text{ MHz}$ | - | 18 | - | pF |
| $C_{oss(eff.)}$ | Effective Output Capacitance | $V_{DS} = 0\text{ V to } 480\text{ V}, V_{GS} = 0\text{ V}$ | - | 124 | - | pF |
| $Q_{g(tot)}$ | Total Gate Charge at 10V | $V_{DS} = 640\text{ V}, I_D = 8\text{ A}, V_{GS} = 10\text{ V}$ | - | 27 | 35 | nC |
| Q_{gs} | Gate to Source Gate Charge | (Note 4) | - | 6 | - | nC |
| Q_{gd} | Gate to Drain "Miller" Charge | | - | 11 | - | nC |
| ESR | Equivalent Series Resistance | | $f = 1\text{ MHz}$ | - | 1.9 | - |

Switching Characteristics

| | | | | | | |
|--------------|---------------------|--|----------|----|-----|----|
| $t_{d(on)}$ | Turn-On Delay Time | $V_{DD} = 400\text{ V}, I_D = 8\text{ A}, V_{GS} = 10\text{ V}, R_G = 4.7\ \Omega$ | - | 17 | 44 | ns |
| t_r | Turn-On Rise Time | | - | 11 | 32 | ns |
| $t_{d(off)}$ | Turn-Off Delay Time | | - | 40 | 90 | ns |
| t_f | Turn-Off Fall Time | | (Note 4) | - | 3.4 | 17 |

Drain-Source Diode Characteristics

| | | | | | | |
|----------|--|--|---|-----|-----|---------------|
| I_S | Maximum Continuous Drain to Source Diode Forward Current | - | - | 10 | A | |
| I_{SM} | Maximum Pulsed Drain to Source Diode Forward Current | - | - | 24 | A | |
| V_{SD} | Drain to Source Diode Forward Voltage | $V_{GS} = 0\text{ V}, I_{SD} = 8\text{ A}$ | - | - | 1.2 | V |
| t_{rr} | Reverse Recovery Time | $V_{GS} = 0\text{ V}, I_{SD} = 8\text{ A}, di_F/dt = 100\text{ A}/\mu\text{s}$ | - | 365 | - | ns |
| Q_{rr} | Reverse Recovery Charge | | - | 5.9 | - | μC |

Notes:

1. Repetitive rating: pulse width limited by maximum junction temperature.
2. $I_{AS} = 1.6\text{ A}, R_G = 25\ \Omega$, Starting $T_J = 25^\circ\text{C}$
3. $I_{SD} \leq 10\text{ A}, di/dt \leq 200\text{ A}/\mu\text{s}, V_{DD} \leq BV_{DSS}$, Starting $T_J = 25^\circ\text{C}$
4. Essentially independent of operating temperature typical characteristics.

Typical Performance Characteristics

Figure 1. On-Region Characteristics

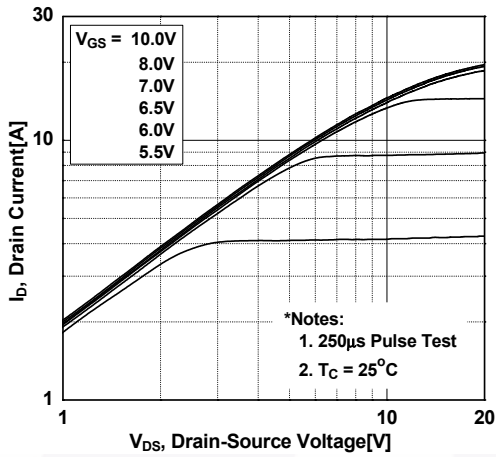


Figure 2. Transfer Characteristics

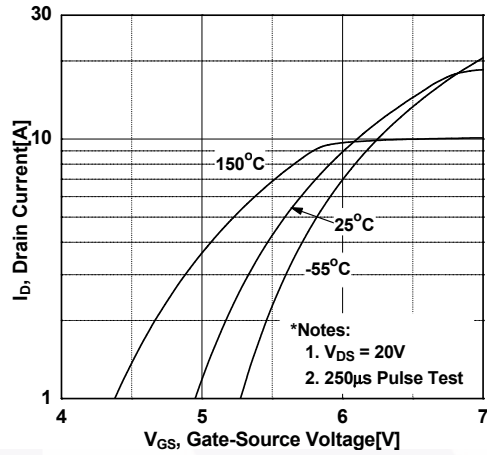


Figure 3. On-Resistance Variation vs. Drain Current and Gate Voltage

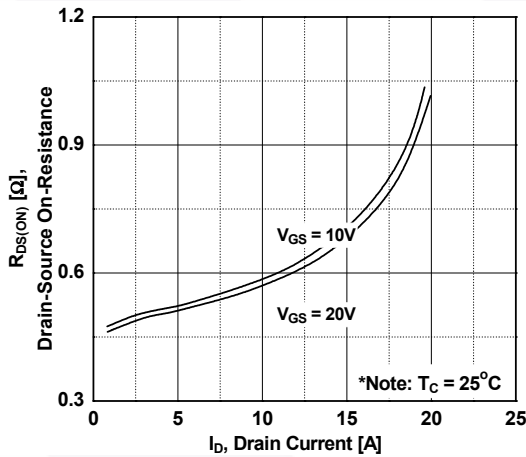


Figure 4. Body Diode Forward Voltage Variation vs. Source Current and Temperature

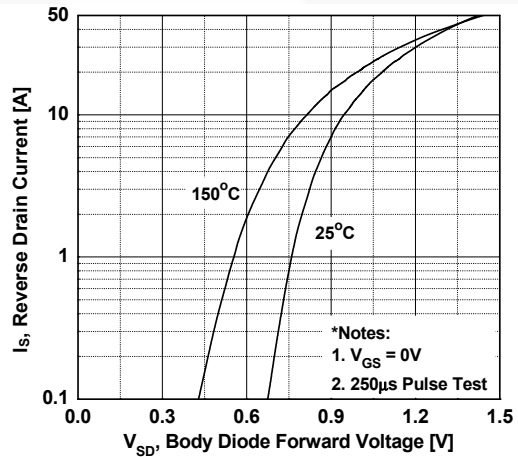


Figure 5. Capacitance Characteristics

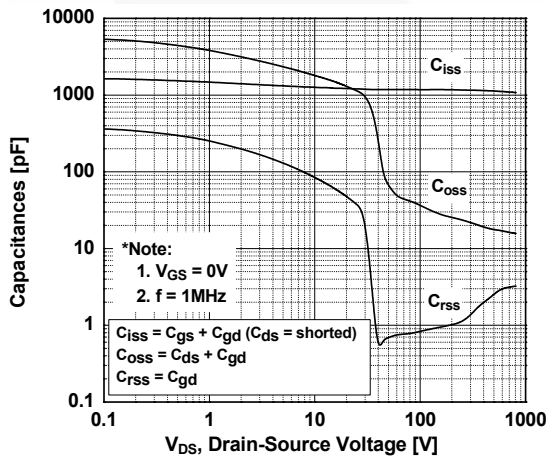
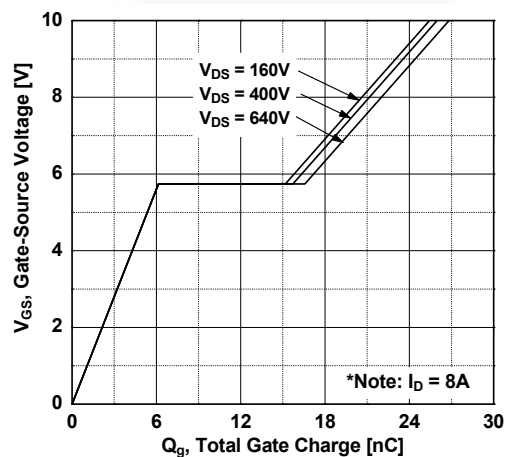


Figure 6. Gate Charge Characteristics



Typical Performance Characteristics (Continued)

Figure 7. Breakdown Voltage Variation vs. Temperature

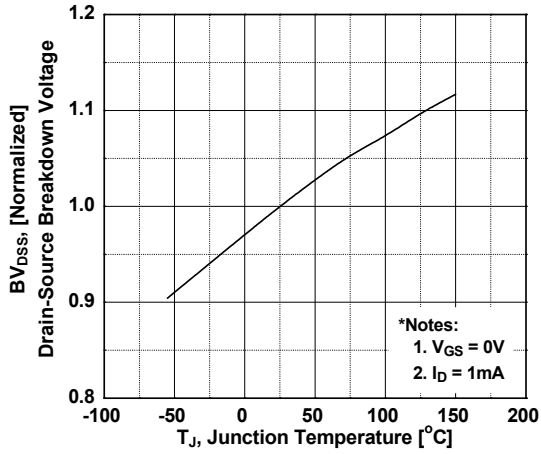


Figure 8. On-Resistance Variation vs. Temperature

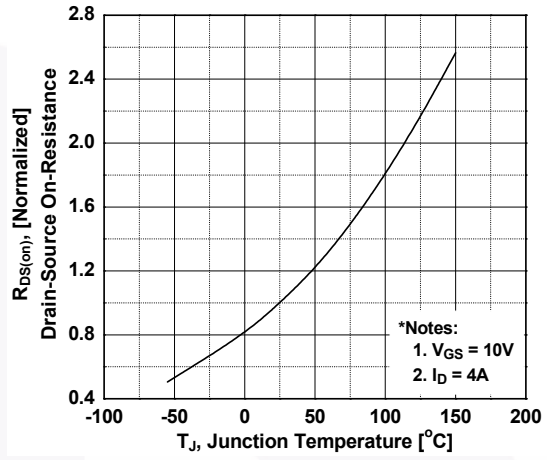


Figure 9. Maximum Safe Operating Area

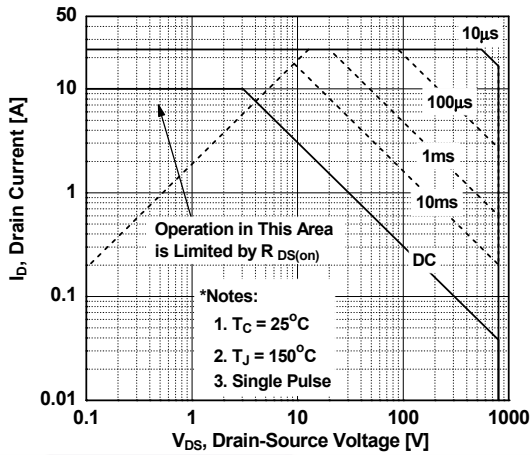


Figure 10. Maximum Drain Current vs. Case Temperature

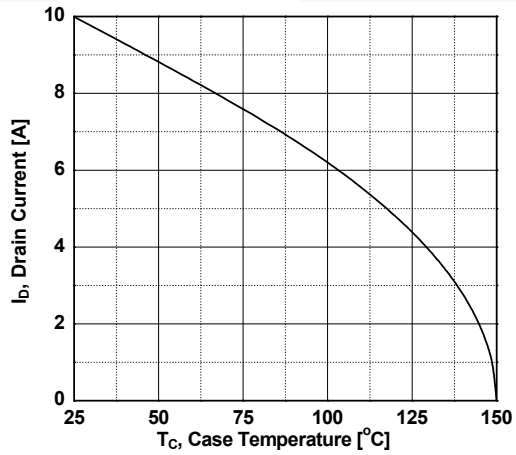
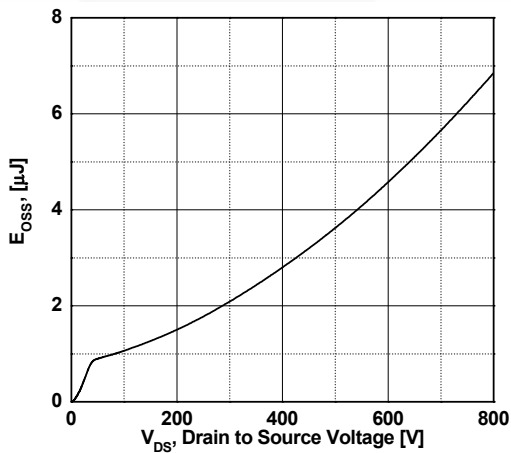


Figure 11. Eoss vs. Drain to Source Voltage



Typical Performance Characteristics (Continued)

Figure 12. Transient Thermal Response Curve

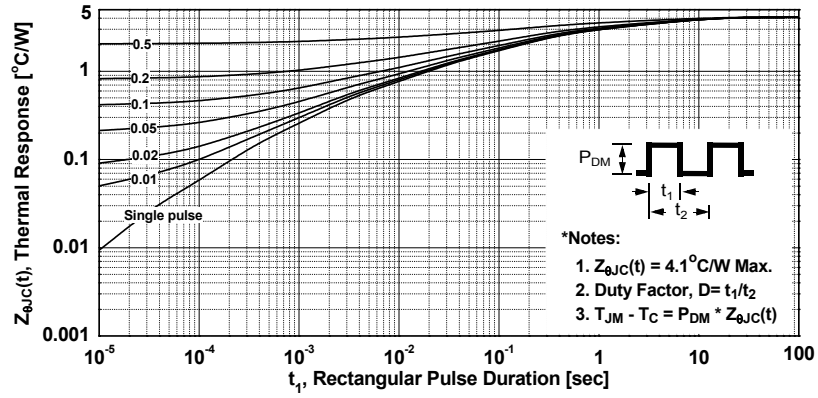




Figure 13. Gate Charge Test Circuit & Waveform



Figure 14. Resistive Switching Test Circuit & Waveforms



Figure 15. Unclamped Inductive Switching Test Circuit & Waveforms

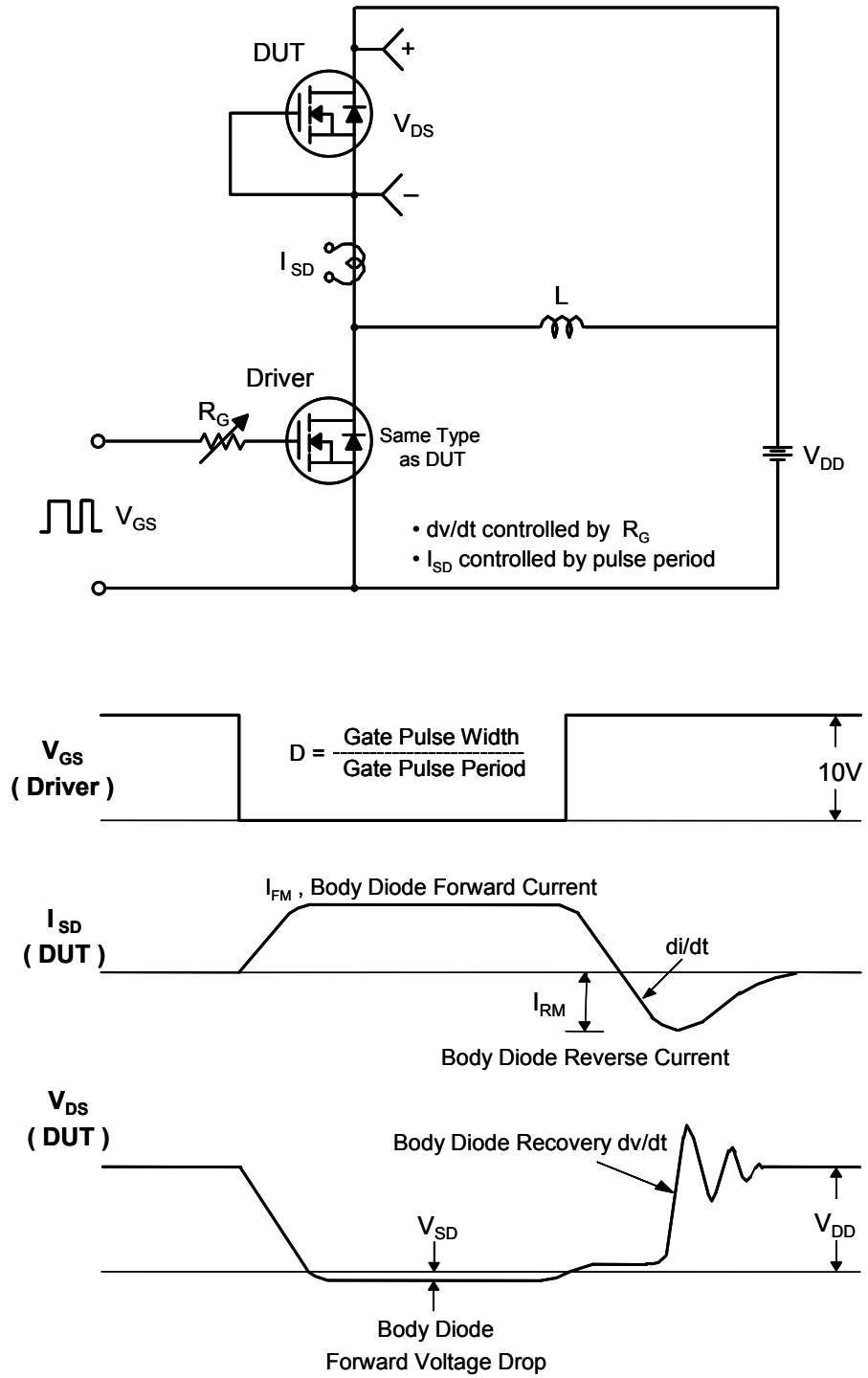
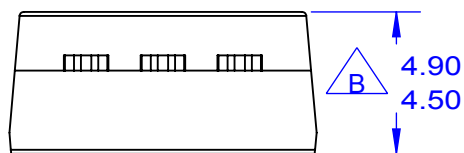


Figure 16. Peak Diode Recovery dv/dt Test Circuit & Waveforms



| | | | |
|----------|------|---|---|
| \oplus | 0.50 | M | A |
|----------|------|---|---|



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NOTES:

- A. EXCEPT WHERE NOTED CONFORMS TO EIAJ SC91A.
- B. DOES NOT COMPLY EIAJ STD. VALUE.
- C. ALL DIMENSIONS ARE IN MILLIMETERS.
- D. DIMENSIONS ARE EXCLUSIVE OF BURRS, MOLD FLASH AND TIE BAR PROTRUSIONS.
- E. DIMENSION AND TOLERANCE AS PER ASME Y14.5-1994.
- F. OPTION 1 - WITH SUPPORT PIN HOLE.
OPTION 2 - NO SUPPORT PIN HOLE.
- G. DRAWING FILE NAME: TO220M03REV5

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