

MOSFET – N-Channel, UNIFET™

250 V, 51 A, 60 mΩ

FDP51N25, FDPF51N25

Description

UniFET MOSFET is onsemi's high voltage MOSFET family based on planar stripe and DMOS technology. This MOSFET is tailored to reduce on-state resistance, and to provide better switching performance and higher avalanche energy strength. This device family is suitable for switching power converter applications such as power factor correction (PFC), flat panel display (FPD) TV power, ATX and electronic lamp ballasts.

Features

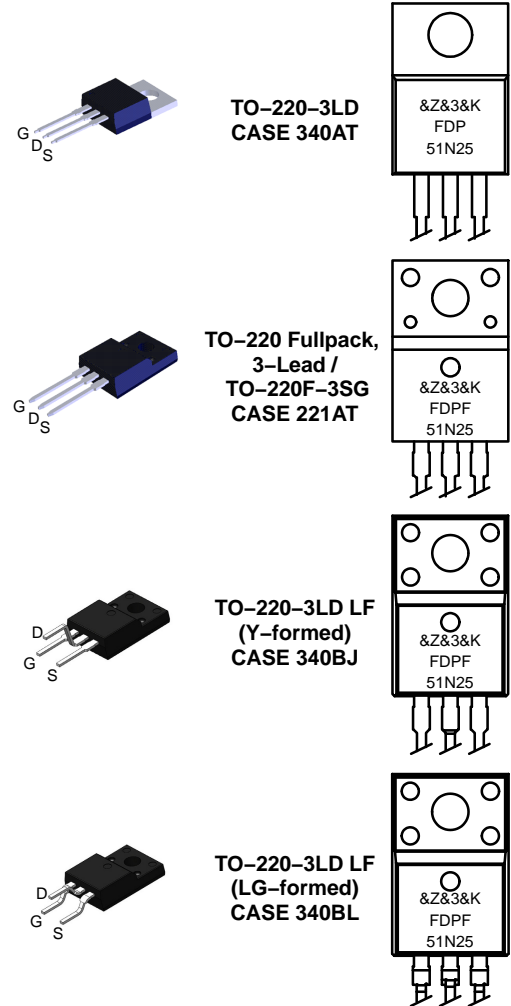
- $R_{DS(on)} = 48 \text{ m}\Omega$ (Typ.) @ $V_{GS} = 10 \text{ V}$, $I_D = 25.5 \text{ A}$
- Low Gate Charge (Typ. 55 nC)
- Low C_{rss} (Typ. 63 pF)

Applications

- PDP TV
- Lighting
- Uninterruptible Power Supply
- AC-DC Power Supply

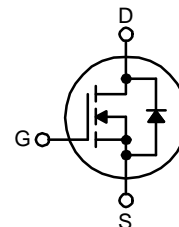
| V_{DSS} | $R_{DS(on)}$ MAX | I_D MAX |
|-----------|------------------|-----------|
| 250 V | 60 mΩ @ 10 V | 51 A |

MARKING DIAGRAM



&Z = Assembly Plant Code
 &3 = 3-Digit Date Code
 &K = 2-Digits Lot Run Code
 FDP51N25, FDPF51N25 = Specific Device Code

N-CHANNEL MOSFET



ORDERING INFORMATION

See detailed ordering and shipping information on page 9 of this data sheet.

FDP51N25, FDPF51N25

ABSOLUTE MAXIMUM RATINGS (T_C = 25°C unless otherwise noted)

| Symbol | Parameter | | FDPF51N25 | | Unit |
|-----------------------------------|--|---------------------------------------|-------------|--------------------------------|------|
| | | | FDP51N25 | FDPF51N25YDTU FDPF51N25RDTU | |
| V _{DSS} | Drain–Source Voltage | | 250 | | V |
| I _D | Drain Current | – Continuous (T _C = 25°C) | 51 | 51* | A |
| | | – Continuous (T _C = 100°C) | 30 | 30* | A |
| I _{DM} | Drain Current | – Pulsed (Note 1) | 204 | 204* | A |
| V _{GSS} | Gate–Source Voltage | | ±30 | | V |
| E _{AS} | Single Pulsed Avalanche Energy (Note 2) | | 1111 | | mJ |
| I _{AR} | Avalanche Current (Note 1) | | 51 | | A |
| E _{AR} | Repetitive Avalanche Energy (Note 1) | | 32 | | mJ |
| V _{ISO} | Insulation Withstand Voltage (RMS) from All Three Leads to External Heat Sink (t = 0.3 s; T _C = 25°C) | | N/A | 2500 | V |
| dv/dt | Peak Diode Recovery dv/dt (Note 3) | | 4.5 | | V/ns |
| P _D | Power Dissipation | (T _C = 25°C) | 320 | 38 | W |
| | | – Derate Above 25°C | 3.7 | 0.3 | W/°C |
| T _J , T _{STG} | Operating and Storage Temperature Range | | –55 to +150 | | °C |
| T _L | Maximum Lead Temperature for Soldering, 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 = 0.68 mH, I_{AS} = 51 A, V_{DD} = 50 V, R_G = 25 Ω, starting T_J = 25°C.

3. I_{SD} ≤ 51 A, di/dt ≤ 200 A/μs, V_{DD} ≤ BV_{DSS}, starting T_J = 25°C.

THERMAL CHARACTERISTICS

| Symbol | Parameter | | FDPF51N25 | | Unit |
|------------------|---|--|-----------|--------------------------------|------|
| | | | FDP51N25 | FDPF51N25YDTU FDPF51N25RDTU | |
| R _{θJC} | Thermal Resistance, Junction–to–Case, Max. | | 0.39 | 3.3 | °C/W |
| R _{θJA} | Thermal Resistance, Junction–to–Ambient, Max. | | 62.5 | 62.5 | °C/W |

FDP51N25, FDPF51N25

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

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

OFF CHARACTERISTICS

| | | | | | | |
|--------------------------------------|---|---|-----|------|---------|----------|
| BV _{DSS} | Drain–Source Breakdown Voltage | V _{GS} = 0 V, I _D = 250 μA, T _J = 25°C | 250 | – | – | V |
| ΔBV _{DSS} / ΔT _J | Breakdown Voltage Temperature Coefficient | I _D = 250 μA, Referenced to 25°C | – | 0.25 | – | V/°C |
| I _{DSS} | Zero Gate Voltage Drain Current | V _{DS} = 250 V, V _{GS} = 0 V V _{DS} = 200 V, T _C = 125°C | – | – | 1 10 | μA 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} = 0V | – | – | –100 | nA |

ON CHARACTERISTICS

| | | | | | | |
|---------------------|-----------------------------------|---|-----|-------|-------|---|
| V _{GS(th)} | Gate Threshold Voltage | V _{DS} = V _{GS} , I _D = 250 μA | 3.0 | – | 5.0 | V |
| R _{DS(on)} | Static Drain–Source On–Resistance | V _{GS} = 10 V, I _D = 25.5 A | – | 0.048 | 0.060 | Ω |
| g _{FS} | Forward Transconductance | V _{DS} = 40 V, I _D = 25.5 A | – | 43 | – | S |

DYNAMIC CHARACTERISTICS

| | | | | | | |
|------------------|------------------------------|--|---|------|------|----|
| C _{iss} | Input Capacitance | V _{DS} = 25 V, V _{GS} = 0 V, f = 1 MHz | – | 2620 | 3410 | pF |
| C _{oss} | Output Capacitance | | – | 530 | 690 | pF |
| C _{rss} | Reverse Transfer Capacitance | | – | 63 | 90 | pF |

SWITCHING CHARACTERISTICS

| | | | | | | |
|---------------------|---------------------|---|---|-----|-----|----|
| t _{d(on)} | Turn–On Delay Time | V _{DD} = 125 V, I _D = 51 A, V _{GS} = 10 V, R _G = 25 Ω (Note 4) | – | 62 | 135 | ns |
| t _r | Turn–On Rise Time | | – | 465 | 940 | ns |
| t _{d(off)} | Turn–Off Delay Time | | – | 98 | 205 | ns |
| t _f | Turn–Off Fall Time | | – | 130 | 270 | ns |
| Q _g | Total Gate Charge | V _{DS} = 200 V, I _D = 51 A, V _{GS} = 10 V (Note 4) | – | 55 | 70 | nC |
| Q _{gs} | Gate–Source Charge | | – | 16 | – | nC |
| Q _{gd} | Gate–Drain Charge | | – | 27 | – | nC |

DRAIN–SOURCE DIODE CHARACTERISTICS AND MAXIMUM RATINGS

| | | | | | | |
|-----------------|---|---|---|-----|-----|----|
| I _S | Maximum Continuous Drain–Source Diode Forward Current | – | – | 51 | A | |
| I _{SM} | Maximum Pulsed Drain–Source Diode Forward Current | – | – | 204 | A | |
| V _{SD} | Drain–Source Diode Forward Voltage | V _{GS} = 0 V, I _S = 51 A | – | – | 1.4 | V |
| t _{rr} | Reverse Recovery Time | V _{GS} = 0 V, I _S = 51 A, di/dt = 100 A/μs | – | 178 | – | ns |
| Q _{rr} | Reverse Recovery Charge | | – | 4.0 | – | 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.

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TYPICAL PERFORMANCE CHARACTERISTICS

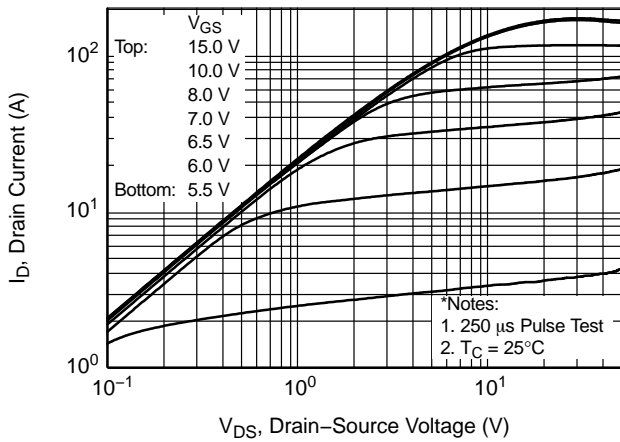


Figure 1. On-Region Characteristics

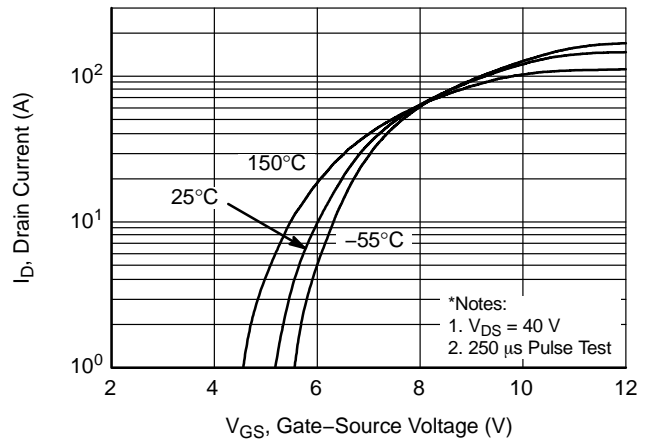


Figure 2. Transfer Characteristics

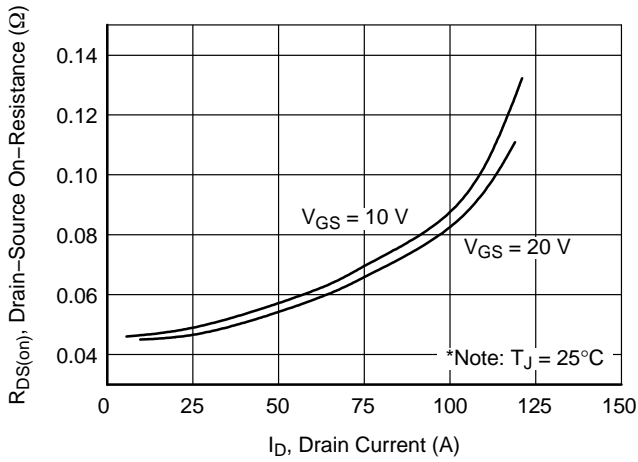


Figure 3. On-Resistance Variation vs. Drain Current and Gate Voltage

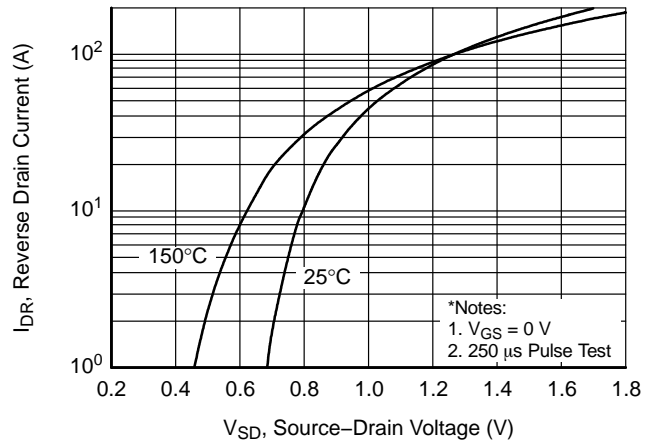


Figure 4. Body Diode Forward Voltage Variation vs. Source Current and Temperature

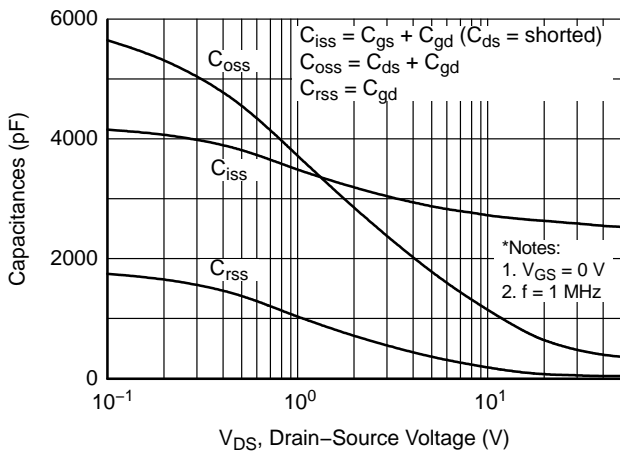


Figure 5. Capacitance Characteristics

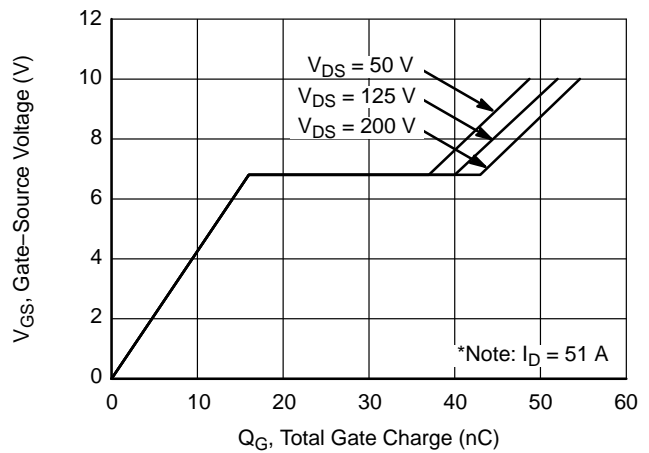


Figure 6. Gate Charge Characteristics

FDP51N25, FDPF51N25

TYPICAL PERFORMANCE CHARACTERISTICS (CONTINUED)

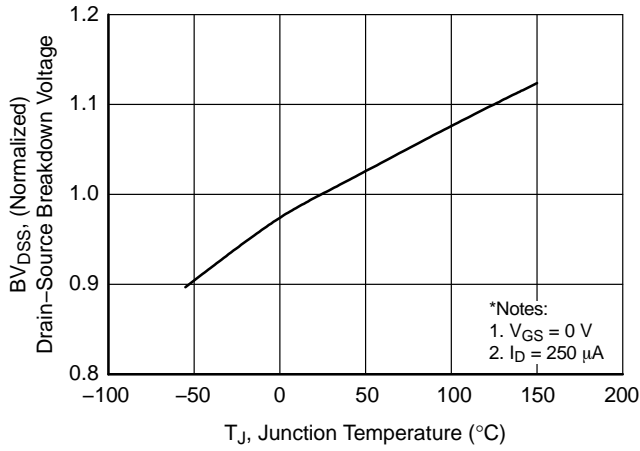


Figure 7. Breakdown Voltage Variation vs. Temperature

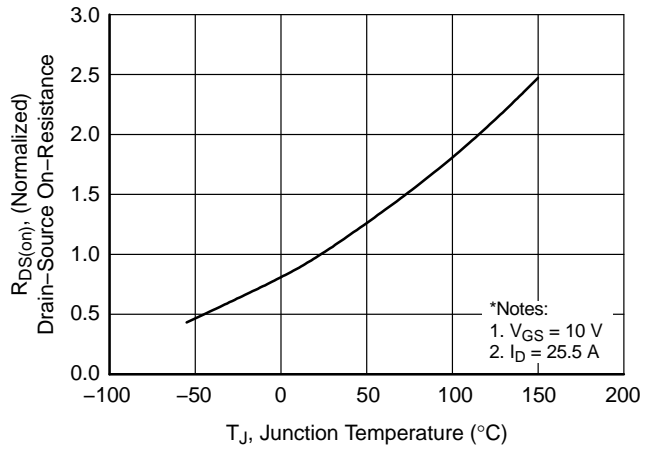


Figure 8. On-Resistance Variation vs. Temperature

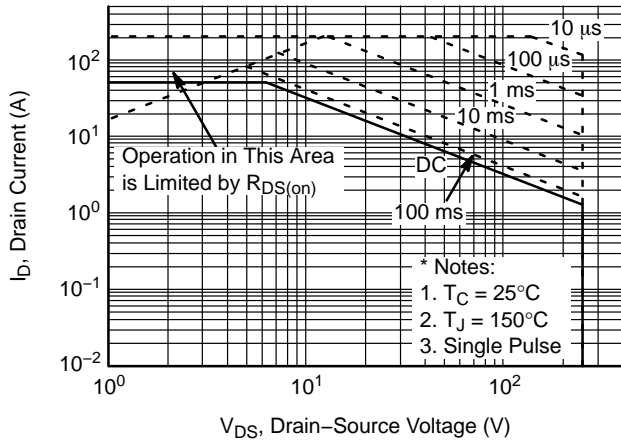


Figure 9-1. Maximum Safe Operating Area for FDP51N25

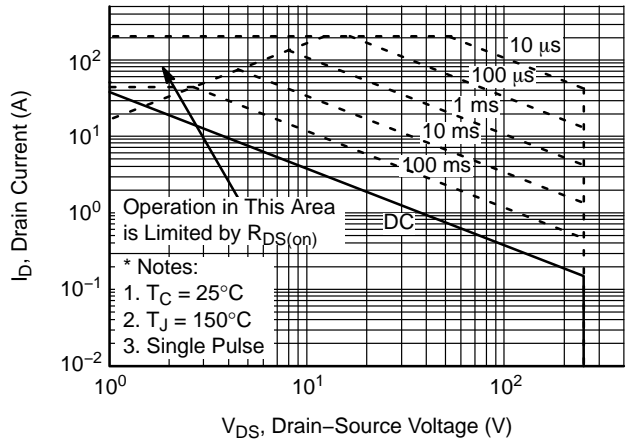


Figure 9-2. Maximum Safe Operating Area for FDPF51N25 / FDPF51N25YDTU

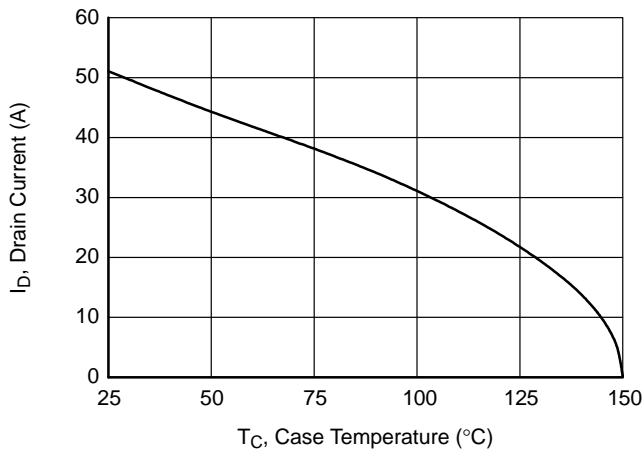


Figure 10. Maximum Drain Current vs. Case Temperature

FDP51N25, FDPF51N25

TYPICAL PERFORMANCE CHARACTERISTICS (CONTINUED)

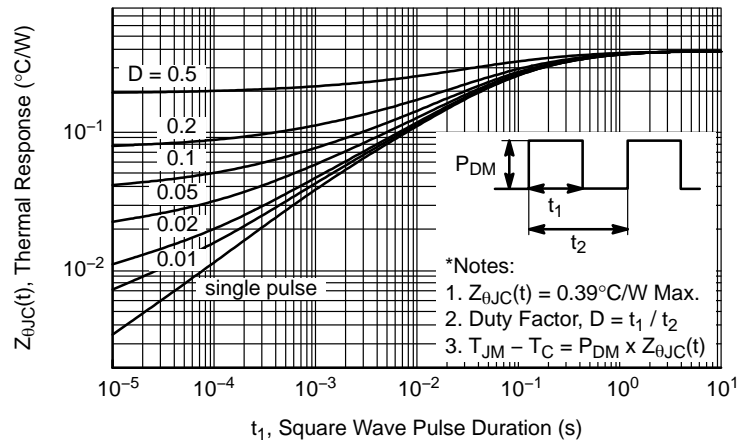


Figure 11-1. Transient Thermal Response Curve for FDP51N25

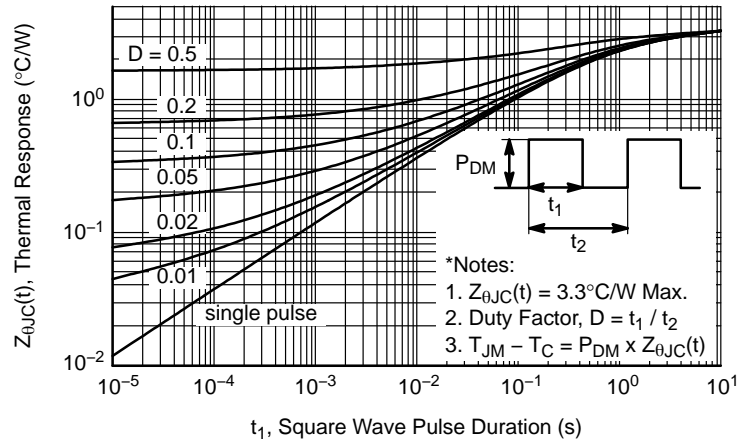


Figure 11-2. Transient Thermal Response Curve for FDPF51N25 / FDPF51N25YDTU

FDP51N25, FDPF51N25

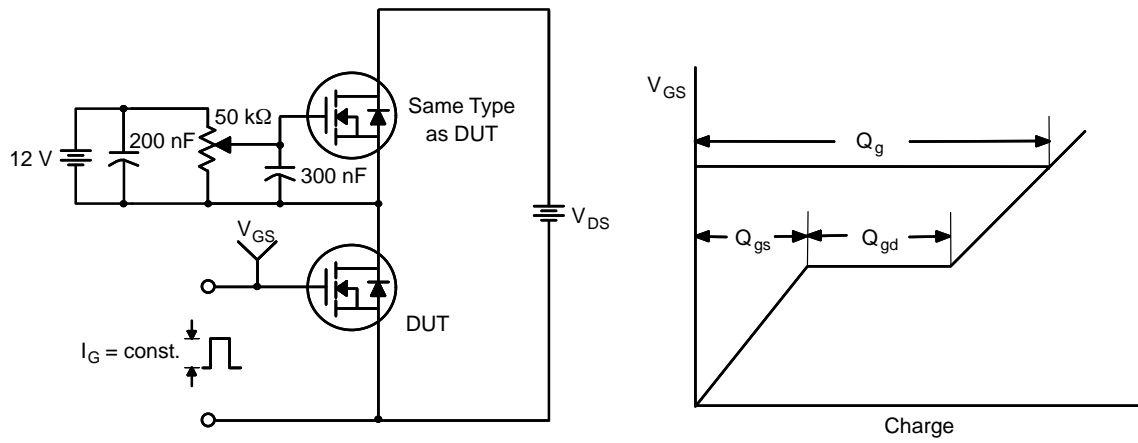


Figure 11. Gate Charge Test Circuit & Waveform

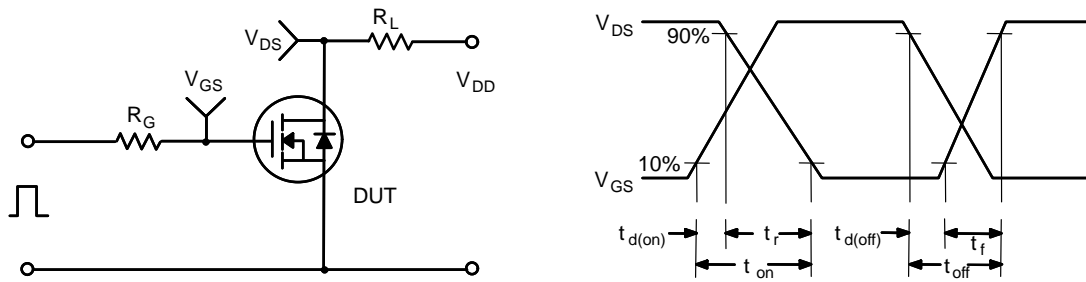


Figure 12. Resistive Switching Test Circuit & Waveforms

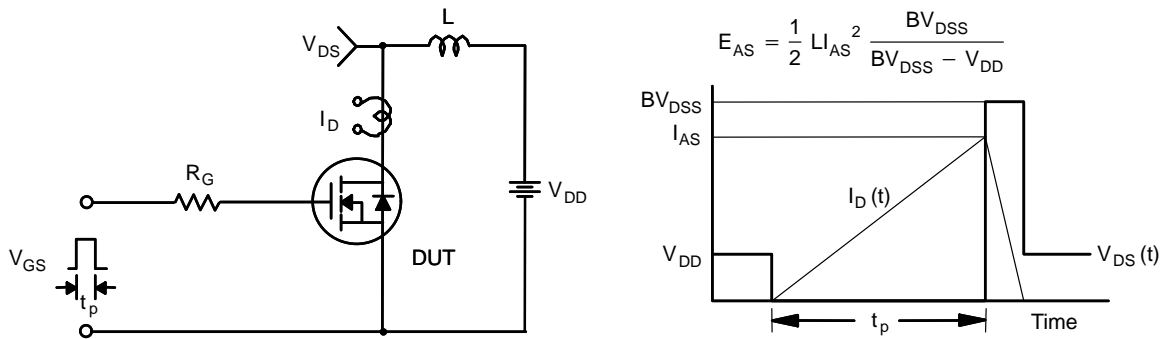
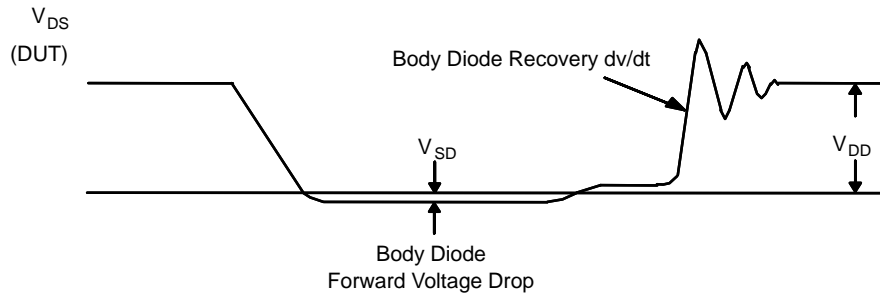
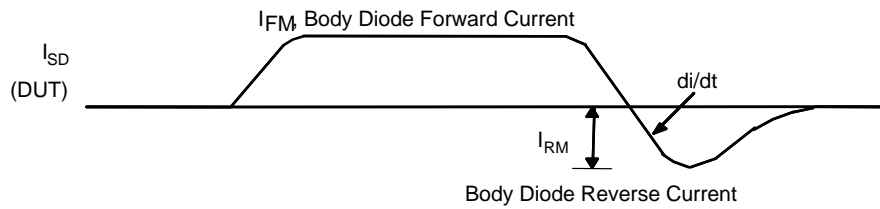
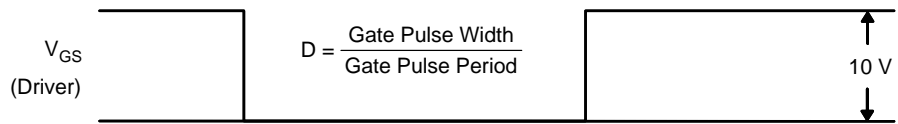
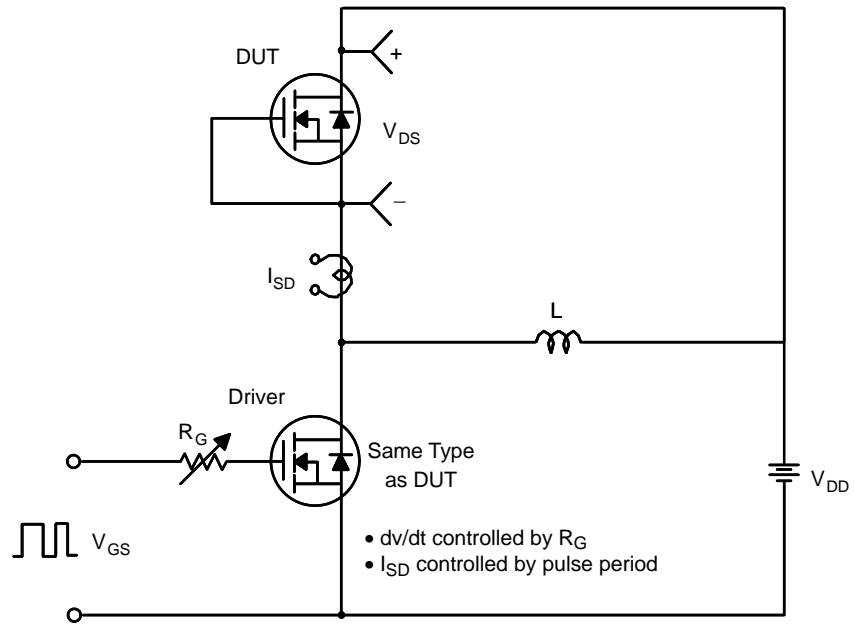


Figure 13. Unclamped Inductive Switching Test Circuit & Waveforms

FDP51N25, FDPF51N25



FDP51N25, FDPF51N25

PACKAGE MARKING AND ORDERING INFORMATION

| Part Number | Top Mark | Package | Shipping |
|---------------|-----------|---|-----------------|
| FDP51N25 | FDP51N25 | TO-220-3LD CASE 340AT | 50 Units / Tube |
| FDPF51N25 | FDPF51N25 | TO-220 Fullpack, 3-Lead / TO-220F-3SG CASE 221AT | 50 Units / Tube |
| FDPF51N25YDTU | FDPF51N25 | TO-220-3LD LF (Y-formed) CASE 340BJ | 50 Units / Tube |
| FDPF51N25RDTU | FDPF51N25 | TO-220-3LD LF (LG-formed) CASE 340BL | 50 Units / Tube |

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MECHANICAL CASE OUTLINE

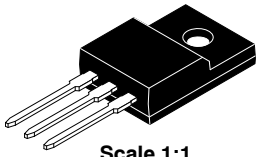
PACKAGE DIMENSIONS

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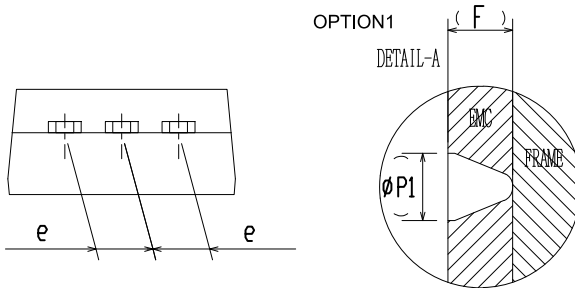
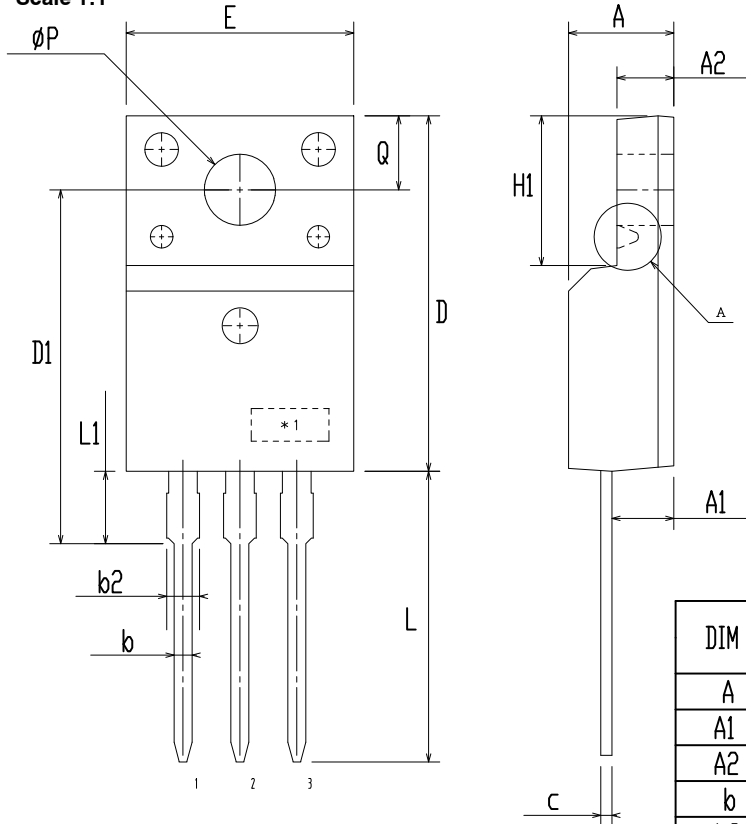


TO-220 Fullpack, 3-Lead / TO-220F-3SG CASE 221AT ISSUE B

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

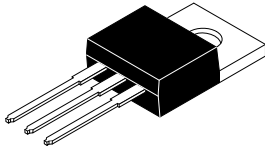
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MECHANICAL CASE OUTLINE

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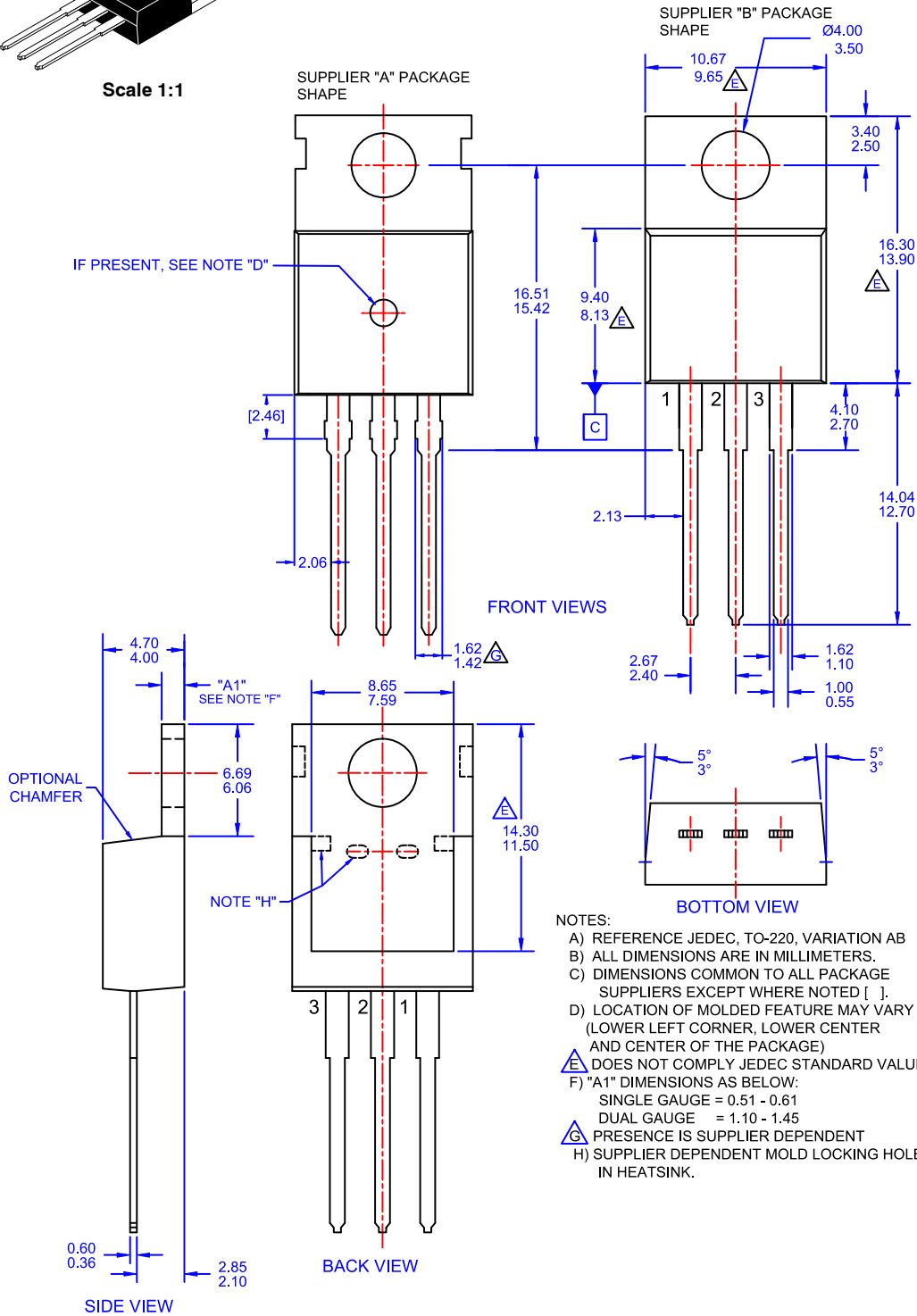
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Scale 1:1

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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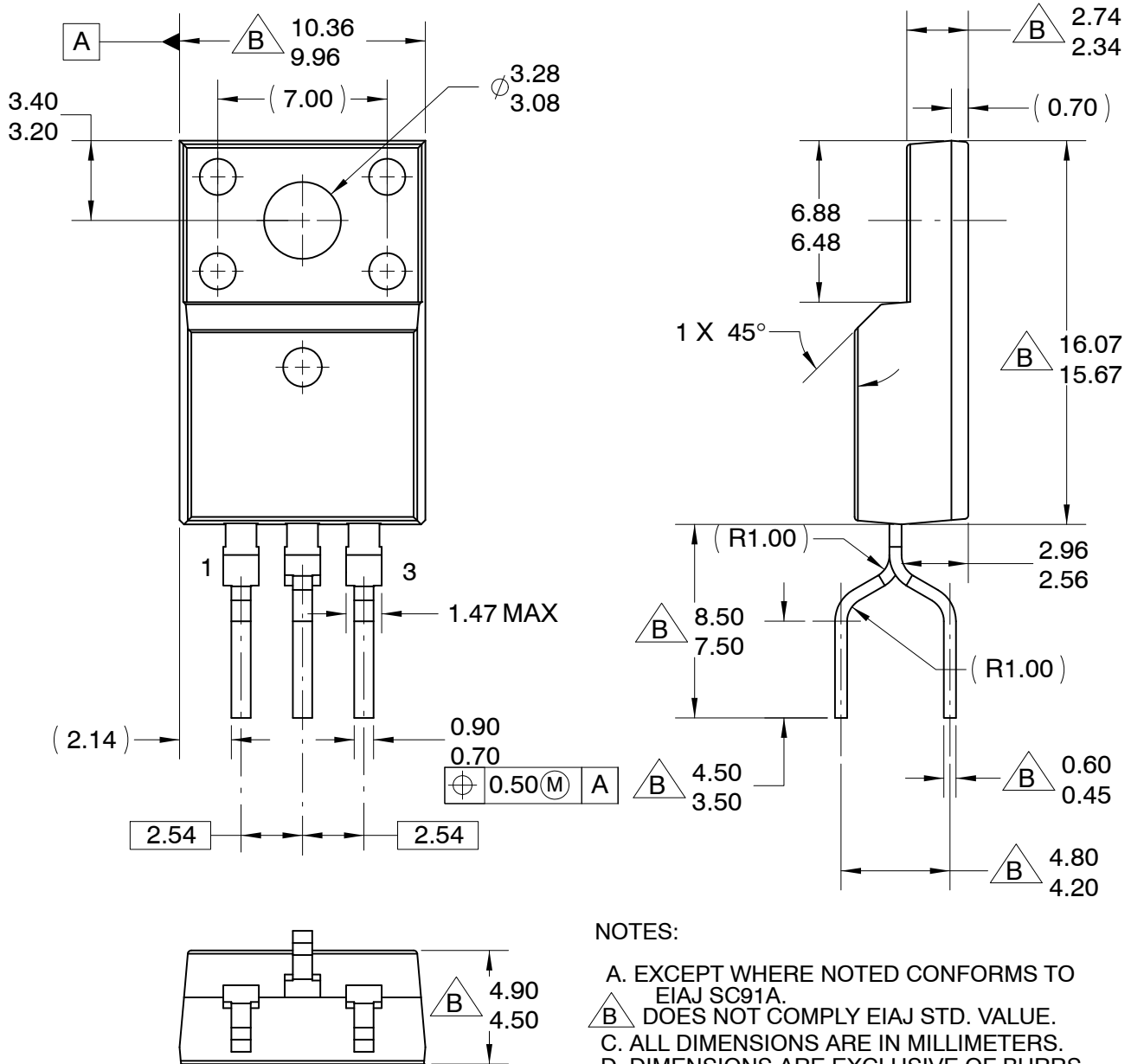
PACKAGE DIMENSIONS

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TO-220-3LD LF
CASE 340BL
ISSUE O

DATE 31 AUG 2016



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.

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