



February 1999
PRELIMINARY

FDP4020P/FDB4020P

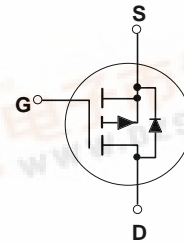
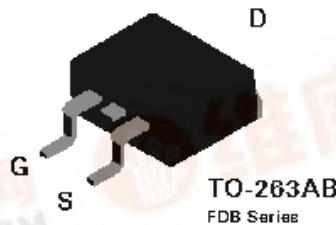
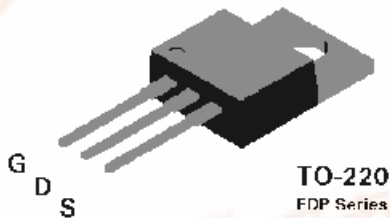
P-Channel 2.5V Specified Enhancement Mode Field Effect Transistor

General Description

This P-Channel low threshold MOSFET has been designed for use as a linear pass element for low voltage outputs. In addition, the part may be used as a low voltage load switch when switching outputs on or off for power management. The part may also be used in conjunction with DC-DC converters requiring P-Channel.

Features

- 16 A, -20 V. $R_{DS(on)} = 0.08 \Omega @ V_{GS} = -4.5 V$
 $R_{DS(on)} = 0.11 \Omega @ V_{GS} = -2.5 V$
- Critical DC electrical parameters specified at elevated temperature.
- High density cell design for extremely low $R_{DS(on)}$.
- TO-220 and TO-263 (D²PAK) package for both through hole and surface mount applications.
- 175°C maximum junction temperature rating.



Absolute Maximum Ratings $T_A = 25^\circ C$ unless otherwise noted

| Symbol | Parameter | FDP4020P | FDB4020P | Units |
|----------------|--|-------------|----------|---------------|
| V_{DSS} | Drain-Source Voltage | -20 | | V |
| V_{GSS} | Gate-Source Voltage | ± 8 | | V |
| I_D | Drain Current - Continuous | -16 | | A |
| | - Pulsed | -48 | | |
| P_D | Total Power Dissipation @ $T_C = 25^\circ C$ | 37.5 | | W |
| | Derate above $25^\circ C$ | 0.25 | | W/ $^\circ C$ |
| T_J, T_{STG} | Operating and Storage Junction Temperature Range | -65 to +175 | | $^\circ C$ |

Thermal Characteristics

| | | | | |
|-----------------|---|------|----|--------------|
| $R_{\theta JC}$ | Thermal Resistance, Junction-to- Case | 4 | | $^\circ C/W$ |
| $R_{\theta JA}$ | Thermal Resistance, Junction-to- Ambient (Note 1) | 62.5 | 40 | $^\circ C/W$ |

Package Outlines and Ordering Information

| Device Marking | Device | Reel Size | Tape Width | Quantity |
|----------------|----------|-----------|------------|------------|
| FDP4020P | FDP4020P | 13" | 12mm | 2500 units |



Electrical Characteristics

$T_A = 25^\circ\text{C}$ unless otherwise noted

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

Off Characteristics

| | | | | | | |
|--------------------------------------|---|--|-----|-----|------|----------------------|
| BV_{DSS} | Drain-Source Breakdown Voltage | $V_{GS} = 0\text{ V}, I_D = -250\ \mu\text{A}$ | -20 | | | V |
| $\frac{\Delta BV_{DSS}}{\Delta T_J}$ | Breakdown Voltage Temperature Coefficient | $I_D = -250\ \mu\text{A}$, Referenced to 25°C | | -28 | | mV/ $^\circ\text{C}$ |
| I_{DSS} | Zero Gate Voltage Drain Current | $V_{DS} = -16\text{ V}, V_{GS} = 0\text{ V}$ | | | -1 | μA |
| I_{GSSF} | Gate-Body Leakage Current, Forward | $V_{GS} = 8\text{ V}, V_{DS} = 0\text{ V}$ | | | 100 | nA |
| I_{GSSR} | Gate-Body Leakage Current, Reverse | $V_{GS} = -8\text{ V}, V_{DS} = 0\text{ V}$ | | | -100 | nA |

On Characteristics (Note 2)

| | | | | | | |
|--|--|--|------|-------------------------|-----------------------|----------------------|
| $V_{GS(th)}$ | Gate Threshold Voltage | $V_{DS} = V_{GS}, I_D = -250\ \mu\text{A}$ | -0.4 | -0.58 | -1 | V |
| $\frac{\Delta V_{GS(th)}}{\Delta T_J}$ | Gate Threshold Voltage Temperature Coefficient | $I_D = -250\ \mu\text{A}$, Referenced to 25°C | | 2 | | mV/ $^\circ\text{C}$ |
| $R_{DS(on)}$ | Static Drain-Source On-Resistance | $V_{GS} = -4.5\text{ V}, I_D = -8\text{ A}$, $V_{GS} = -4.5\text{ V}, I_D = -8\text{ A}, T_J = 125^\circ\text{C}$ $V_{GS} = -2.5\text{ V}, I_D = -7\text{ A}$ | | 0.068 0.098 0.096 | 0.08 0.13 0.110 | Ω |
| $I_{D(on)}$ | On-State Drain Current | $V_{GS} = -4.5\text{ V}, V_{DS} = -5\text{ V}$ | -20 | | | A |
| g_{FS} | Forward Transconductance | $V_{DS} = -5\text{ V}, I_D = -8\text{ A}$ | | 14 | | S |

Dynamic Characteristics

| | | | | | | |
|-----------|------------------------------|--|--|-----|--|----|
| C_{iss} | Input Capacitance | $V_{DS} = -10\text{ V}, V_{GS} = 0\text{ V}$, $f = 1.0\text{ MHz}$ | | 665 | | pF |
| C_{oss} | Output Capacitance | | | 270 | | pF |
| C_{rss} | Reverse Transfer Capacitance | | | 70 | | pF |

Switching Characteristics (Note 2)

| | | | | | | |
|--------------|---------------------|--|--|-----|----|----|
| $t_{d(on)}$ | Turn-On Delay Time | $V_{DD} = -5\text{ V}, I_D = -1\text{ A}$, $V_{GS} = -4.5\text{ V}, R_{GEN} = 6\ \Omega$ | | 8 | 16 | ns |
| t_r | Turn-On Rise Time | | | 24 | 38 | ns |
| $t_{d(off)}$ | Turn-Off Delay Time | | | 50 | 80 | ns |
| t_f | Turn-Off Fall Time | | | 29 | 45 | ns |
| Q_g | Total Gate Charge | $V_{DS} = -5\text{ V}$, $I_D = -16\text{ A}, V_{GS} = -4.5\text{ V}$ | | 9.5 | 13 | nC |
| Q_{gs} | Gate-Source Charge | | | 1.3 | | nC |
| Q_{gd} | Gate-Drain Charge | | | 2.2 | | nC |

Drain-Source Diode Characteristics and Maximum Ratings

| | | | | | | |
|----------|--|--|--|--|------|---|
| I_S | Maximum Continuous Drain-Source Diode Forward Current (Note 2) | | | | -16 | A |
| I_{SM} | Maximum Pulsed Drain-Source Diode Forward Current (Note 2) | | | | -48 | |
| V_{SD} | Drain-Source Diode Forward Voltage | $V_{GS} = 0\text{ V}, I_S = -16\text{ A}$ (Note 2) | | | -1.2 | V |

Notes:

- $R_{\theta JA}$ is the sum of the junction-to-case and case-to-ambient thermal resistance. For T0-263 the device is mounted on circuit board with a 1in² pad of 2 oz. copper.
- Pulse Test: Pulse Width $\leq 300\ \mu\text{s}$, Duty Cycle $\leq 2.0\%$

Typical Characteristics

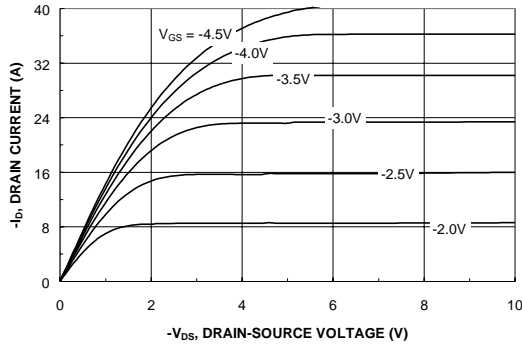


Figure 1. On-Region Characteristics.

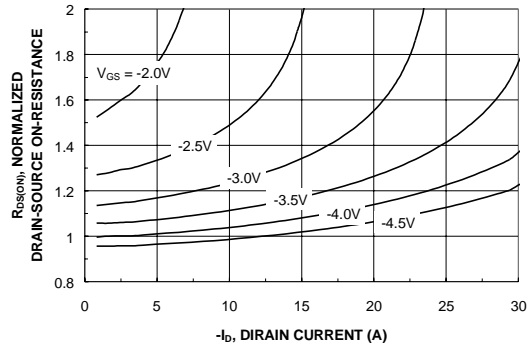


Figure 2. On-Resistance Variation with Drain Current and Gate Voltage.

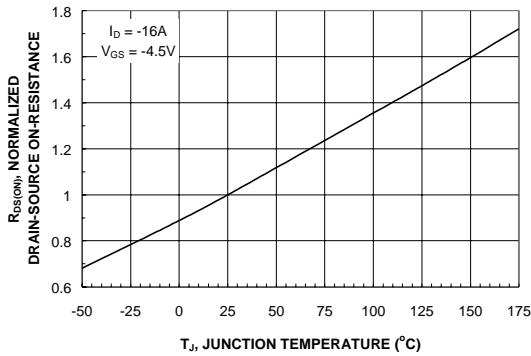


Figure 3. On-Resistance Variation with Temperature.

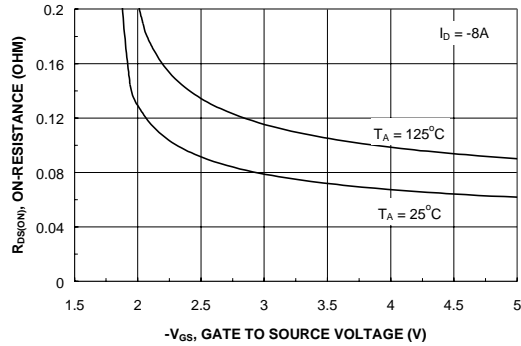


Figure 4. On-Resistance Variation with Gate-to-Source Voltage.

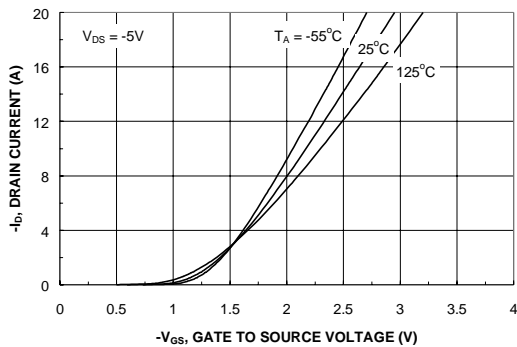


Figure 5. Transfer Characteristics.

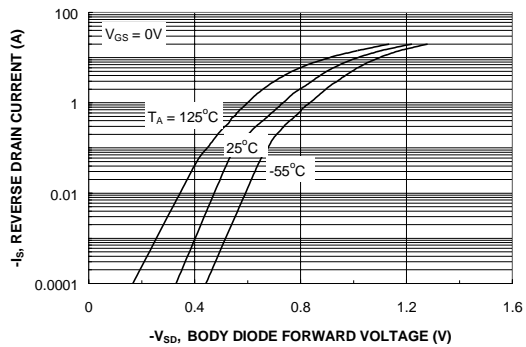


Figure 6. Body Diode Forward Voltage Variation with Source Current and Temperature.

Typical Characteristics (continued)

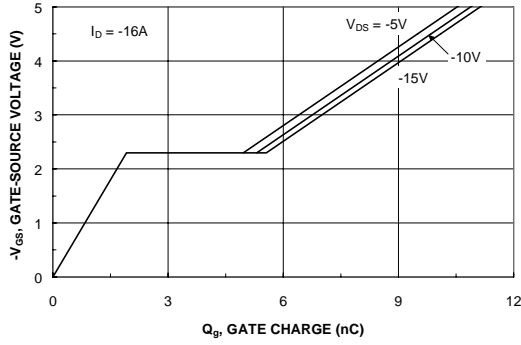


Figure 7. Gate-Charge Characteristics.

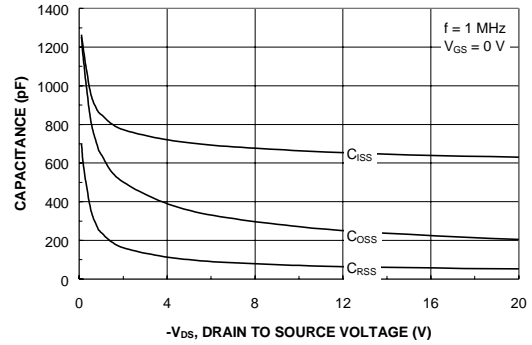


Figure 8. Capacitance Characteristics.

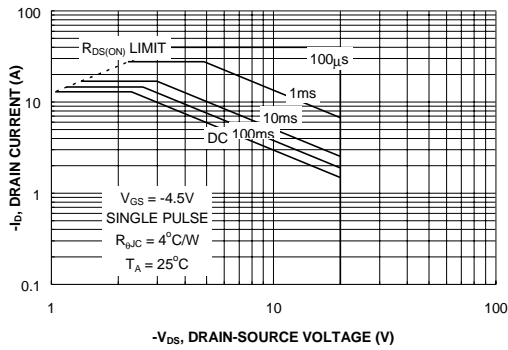


Figure 9. Maximum Safe Operating Area.

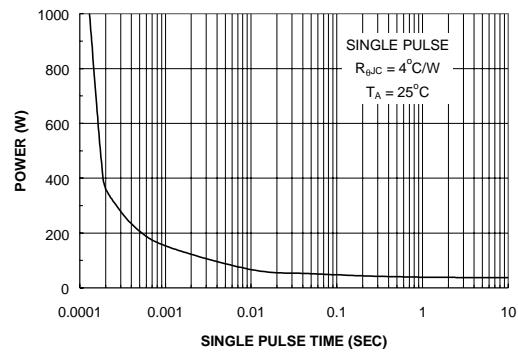


Figure 10. Single Pulse Maximum Power Dissipation.

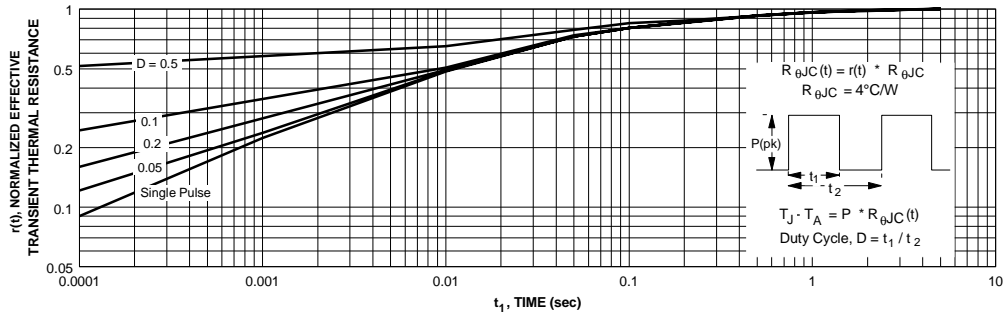


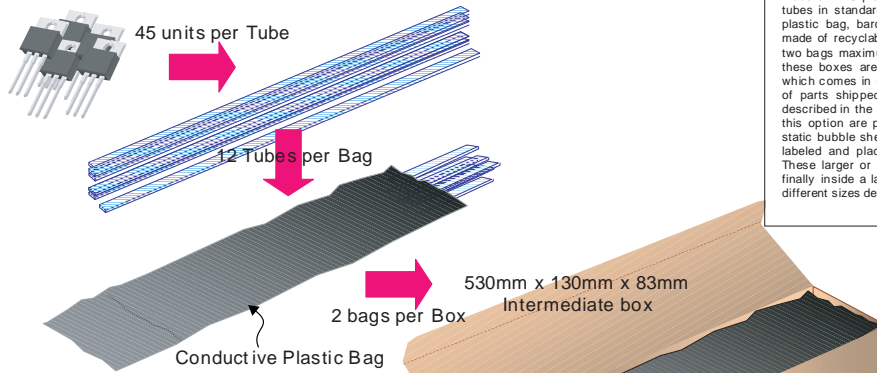
Figure 11. Transient Thermal Response Curve.

Thermal characterization performed using the conditions described in Note 1. Transient thermal response will change depending on the circuit board design.

TO-220 Tape and Reel Data and Package Dimensions



TO-220 Tube Packing Configuration: Figure 1.0



Packaging Description:

TO-220 parts are shipped normally in tube. The tube is made of PVC plastic treated with anti-static agent. These tubes in standard option are placed inside a dissipative plastic bag, barcode labeled, and placed inside a box made of recyclable corrugated paper. One box contains two bags maximum (see fig. 1.0). And one or several of these boxes are placed inside a labeled shipping box which comes in different sizes depending on the number of parts shipped. The other option comes in bulk as described in the Packaging information table. The units in this option are placed inside a small box laid with anti-static bubble sheet. These smaller boxes are individually labeled and placed inside a larger box (see fig. 3.0). These larger or intermediate boxes then will be placed finally inside a labeled shipping box which still comes in different sizes depending on the number of units shipped.

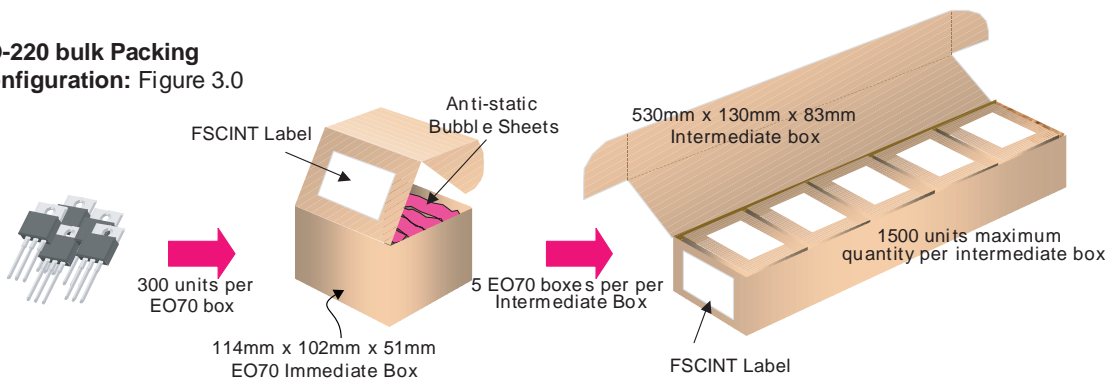
TO-220 Packaging Information: Figure 2.0

| TO-220 Packaging Information | | |
|------------------------------|-------------------------|------------|
| Packaging Option | Standard (no flow code) | S62Z |
| Packaging type | Rail/Tube | BULK |
| Qty per Tube/Box | 45 | 300 |
| Box Dimension (mm) | 530x130x83 | 114x102x51 |
| Max qty per Box | 1,080 | 1,500 |
| Weight per unit (gm) | 1.4378 | 1.4378 |
| Note/Comments | | |

FSCINT Label sample

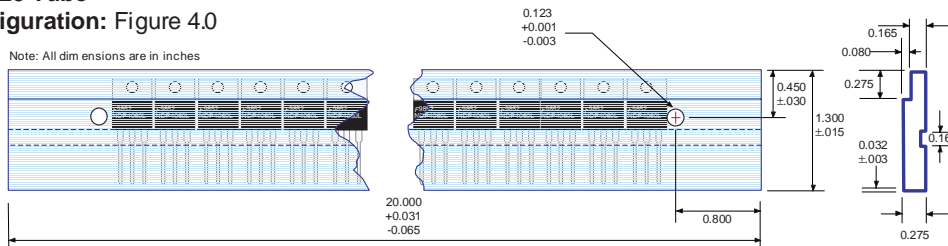


TO-220 bulk Packing Configuration: Figure 3.0



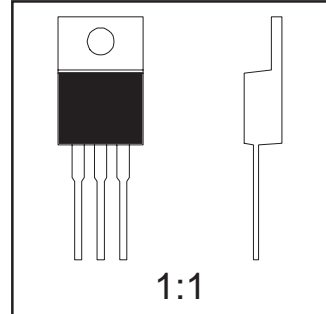
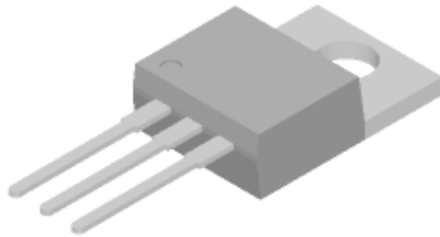
TO-220 Tube Configuration: Figure 4.0

Note: All dimensions are in inches



TO-220 Tape and Reel Data and Package Dimensions, continued

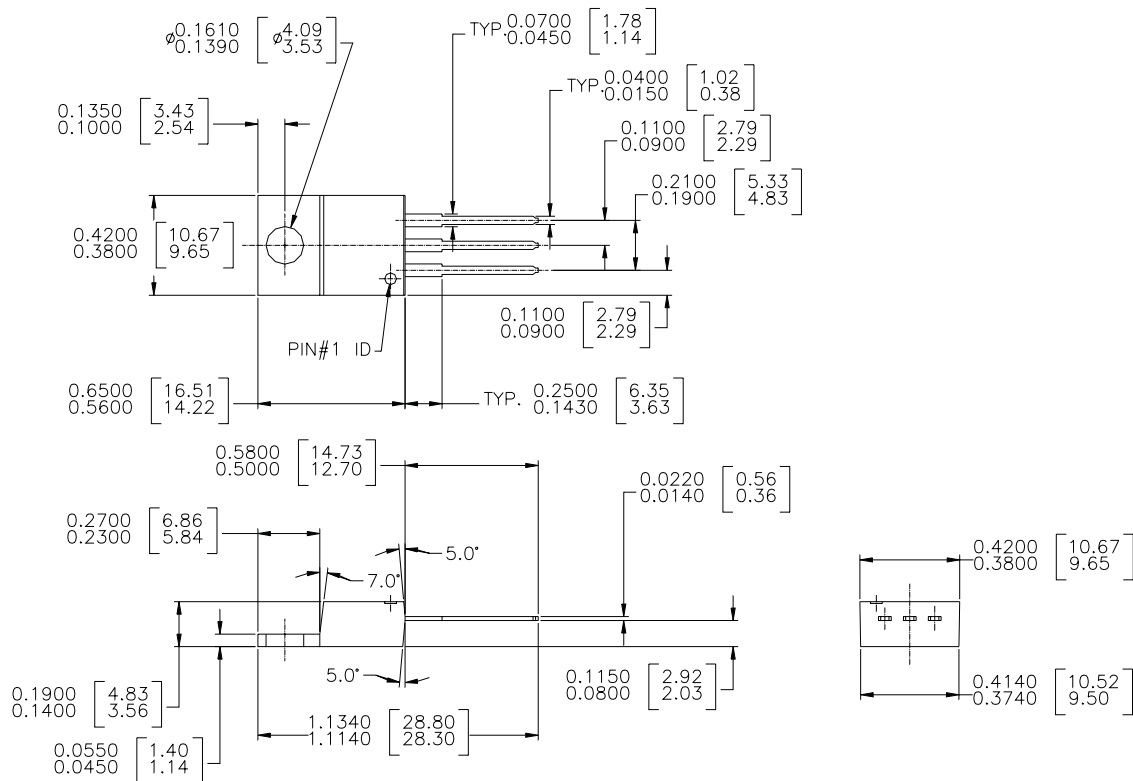
TO-220 (FS PKG Code 37)



Scale 1:1 on letter size paper

Dimensions shown below are in:
inches [millimeters]

Part Weight per unit (gram): 1.4378



NOTE : UNLESS OTHERWISE SPECIFIED

1. STANDARD LEAD FINISH :
200 MICROINCHES / 5.08 MICRON MINIMUM
LEAD / TIN 15/85 ON OLIN 194 COPPER OR EQUIVALENT

2. DIMENSION BASED ON JEDEC STANDARD TO-220
VARIATION AB, ISSUE J, DATED 3/24/87

TO 220 3 LEAD

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