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FAIRCHILD SEMICONDUCTOR™

June 2001

# FDT458P

## 30V P-Channel PowerTrench® MOSFET

### General Description

This P-Channel MOSFET has been designed specifically to improve the overall efficiency of DC/DC converters using either synchronous or conventional switching PWM controllers, and battery chargers.

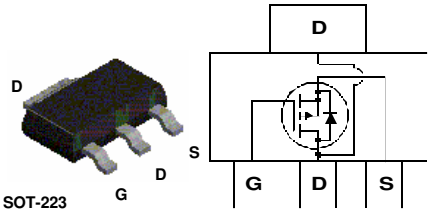
These MOSFETs feature faster switching and lower gate charge than other MOSFETs with comparable $R_{DS(ON)}$ specifications.

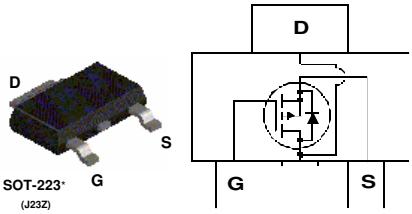
### Applications

- Battery chargers
- Motor drives

### Features

- 3.4 A, –30 V. $R_{DS(ON)}$ = 130 mΩ @ $V_{GS}$ = 10 V
  $R_{DS(ON)}$ = 200 mΩ @ $V_{GS}$ = 4.5 V
- Fast switching speed
- Low gate charge (2.5 nC typical)
- High performance trench technology for extremely low $R_{DS(ON)}$
- High power and current handling capability in a widely used surface mount package




## Absolute Maximum Ratings

$T_A$=25°C unless otherwise noted

| Symbol | Parameter | | Ratings | Units |
|---|---|---|---|---|
| $V_{DSS}$ | Drain-Source Voltage | | – 30 | V |
| $V_{GSS}$ | Gate-Source Voltage | | ±20 | V |
| $I_D$ | Drain Current – Continuous | (Note 1a) | 3.4 | A |
| | – Pulsed | | 10 | |
| $P_D$ | Maximum Power Dissipation | (Note 1a) | 3.0 | W |
| | | (Note 1b) | 1.3 | |
| | | (Note 1c) | 1.1 | |
| $T_J$, $T_{STG}$ | Operating and Storage Junction Temperature Range | | –55 to +150 | °C |

## Thermal Characteristics

| | | | | |
|---|---|---|---|---|
| $R_{\theta JA}$ | Thermal Resistance, Junction-to-Ambient | (Note 1a) | 42 | °C/W |
| $R_{\theta JC}$ | Thermal Resistance, Junction-to-Case | (Note 1) | 12 | °C/W |

## Package Marking and Ordering Information

| Device Marking | Device | Reel Size | Tape width | Quantity |
|---|---|---|---|---|
| 458P | FDT458P | 13” | 12mm | 2500 units |

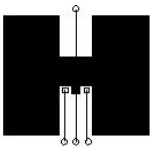
## Electrical Characteristics

$T_A$ = 25°C unless otherwise noted

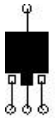
| Symbol | Parameter | Test Conditions | Min | Typ | Max | Units |
|---|---|---|---|---|---|---|
| **Off Characteristics** | | | | | | |
| $BV_{DSS}$ | Drain–Source Breakdown Voltage | $V_{GS}$ = 0 V, $I_D$ = –250 µA | –30 | | | V |
| $\frac{\Delta BV_{DSS}}{\Delta T_J}$ | Breakdown Voltage Temperature Coefficient | $I_D$ = –250 µA, Referenced to 25°C | | –23 | | mV/°C |
| $I_{DSS}$ | Zero Gate Voltage Drain Current | $V_{DS}$ = –24 V, $V_{GS}$ = 0 V | | | –1 | µA |
| $I_{GSSF}$ | Gate–Body Leakage, Forward | $V_{GS}$ = –25 V, $V_{DS}$ = 0 V | | | 100 | nA |
| $I_{GSSR}$ | Gate–Body Leakage, Reverse | $V_{GS}$ = –25 V, $V_{DS}$ = 0 V | | | –100 | nA |
| **On Characteristics** (Note 2) | | | | | | |
| $V_{GS(th)}$ | Gate Threshold Voltage | $V_{DS}$ = $V_{GS}$, $I_D$ = –250 µA | –1 | –1.8 | –3 | V |
| $\frac{\Delta V_{GS(th)}}{\Delta T_J}$ | Gate Threshold Voltage Temperature Coefficient | $I_D$ = –250 µA, Referenced to 25°C | | 4 | | mV/°C |
| $R_{DS(on)}$ | Static Drain–Source On–Resistance | $V_{GS}$ = –10 V, $I_D$ = –3.4 A<br>$V_{GS}$ = –4.5 V, $I_D$ = –2.7 A<br>$V_{GS}$=–10 V, $I_D$ =–3.4 A, $T_J$=125°C | | 105<br>157<br>147 | 130<br>200<br>210 | mΩ |
| $I_{D(on)}$ | On–State Drain Current | $V_{GS}$ = –10 V, $V_{DS}$ = –5 V | –5 | | | A |
| $g_{FS}$ | Forward Transconductance | $V_{DS}$ = –5 V, $I_D$ = –3.4 A | | 3 | | S |
| **Dynamic Characteristics** | | | | | | |
| $C_{iss}$ | Input Capacitance | $V_{DS}$ = –15 V, $V_{GS}$ = 0 V, f = 1.0 MHz | | 205 | | pF |
| $C_{oss}$ | Output Capacitance | | | 55 | | pF |
| $C_{rss}$ | Reverse Transfer Capacitance | | | 26 | | pF |
| **Switching Characteristics** (Note 2) | | | | | | |
| $t_{d(on)}$ | Turn–On Delay Time | $V_{DD}$ = –15 V, $I_D$ = –1 A, $V_{GS}$ = –10 V, $R_{GEN}$ = 6 Ω | | 4.5 | 9 | ns |
| $t_r$ | Turn–On Rise Time | | | 12.5 | 23 | ns |
| $t_{d(off)}$ | Turn–Off Delay Time | | | 11 | 20 | ns |
| $t_f$ | Turn–Off Fall Time | | | 2 | 4 | ns |
| $Q_g$ | Total Gate Charge | $V_{DS}$ = –15 V, $I_D$ = –3.4 A, $V_{GS}$ = –10 V | | 2.5 | 3.5 | nC |
| $Q_{gs}$ | Gate–Source Charge | | | 0.7 | | nC |
| $Q_{gd}$ | Gate–Drain Charge | | | 1 | | nC |
| **Drain–Source Diode Characteristics and Maximum Ratings** | | | | | | |
| $I_S$ | Maximum Continuous Drain–Source Diode Forward Current | | | | –2.5 | A |
| $V_{SD}$ | Drain–Source Diode Forward Voltage | $V_{GS}$ = 0 V, $I_S$ = –2.5 A (Note 2) | | –0.8 | –1.2 | V |

**Notes:**

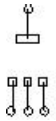
**1.** $R_{\theta JA}$ is the sum of the junction-to-case and case-to-ambient thermal resistance where the case thermal reference is defined as the solder mounting surface of the drain pins. $R_{\theta JC}$ is guaranteed by design while $R_{\theta CA}$ is determined by the user's board design.



a) 42°C/W when mounted on a 1in² pad of 2 oz copper



b) 95°C/W when mounted on a .0066 in² pad of 2 oz copper



c) 110°C/W when mounted on a minimum pad.

**2.** Pulse Test: Pulse Width < 300µs, Duty Cycle < 2.0%

## Typical Characteristics

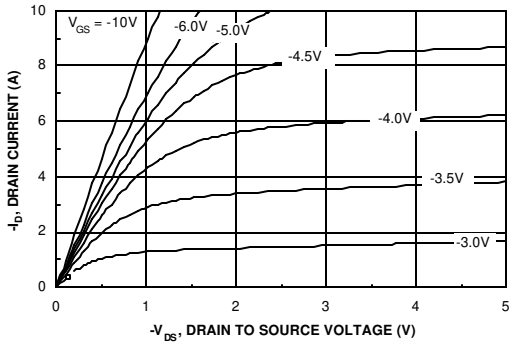



**Figure 1. On-Region Characteristics.**

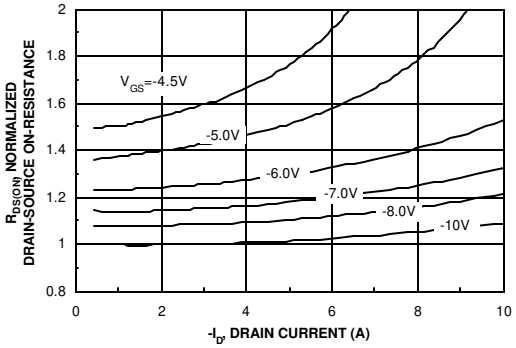



**Figure 2. On-Resistance Variation with Drain Current and Gate Voltage.**

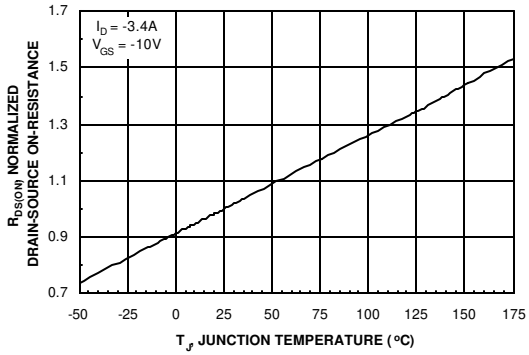



**Figure 3. On-Resistance Variation with Temperature.**

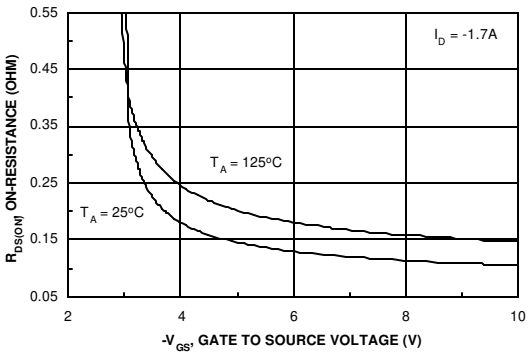



**Figure 4. On-Resistance Variation with Gate-to-Source Voltage.**

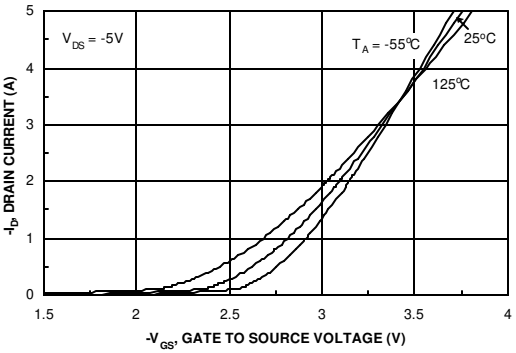



**Figure 5. Transfer Characteristics.**

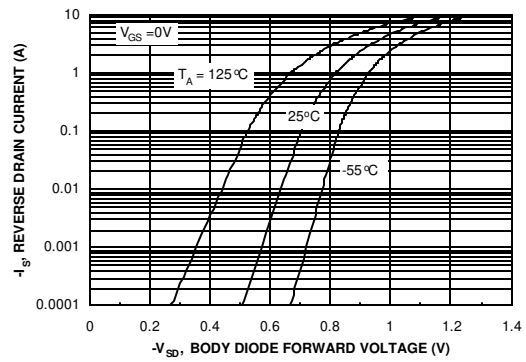



**Figure 6. Body Diode Forward Voltage Variation with Source Current and Temperature.**

## Typical Characteristics

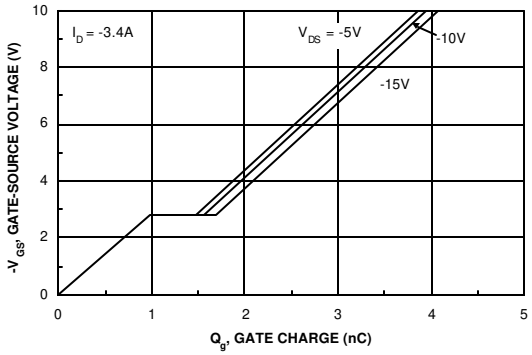



**Figure 7. Gate Charge Characteristics.**

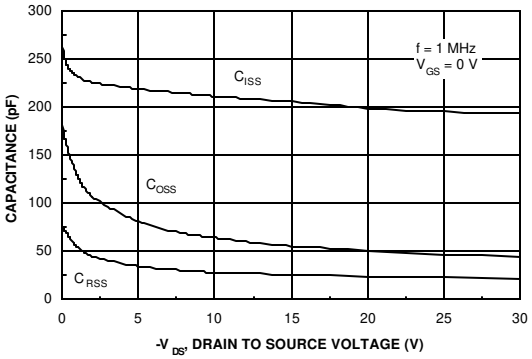



**Figure 8. Capacitance Characteristics.**

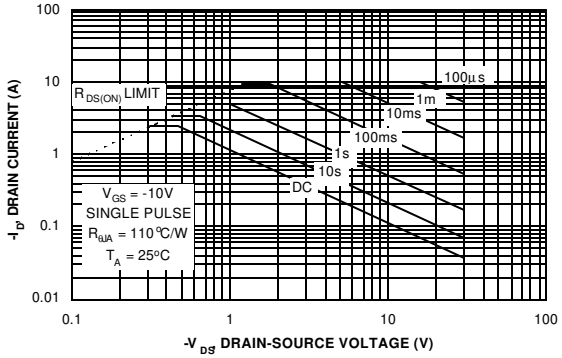



**Figure 9. Maximum Safe Operating Area.**

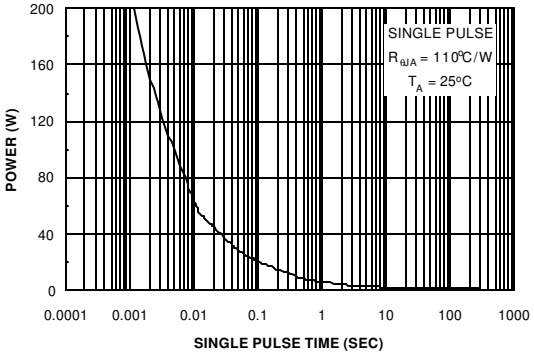



**Figure 10. Single Pulse Maximum Power Dissipation.**

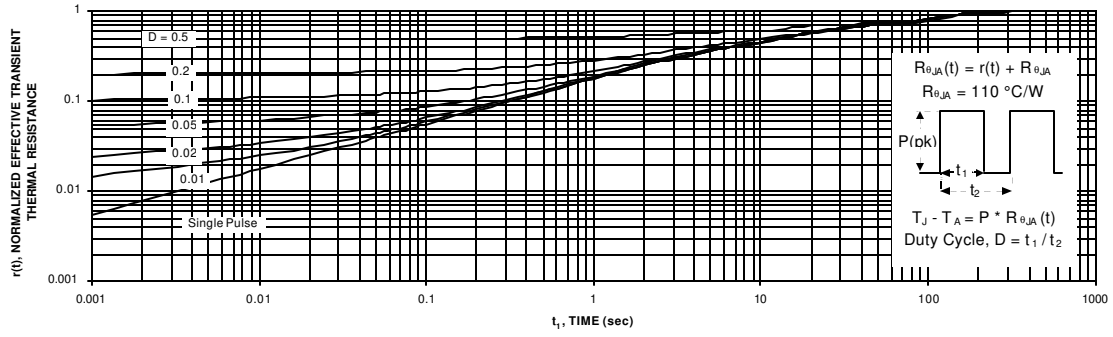
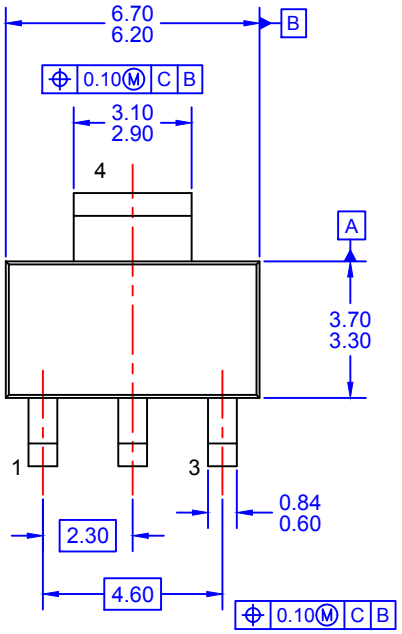
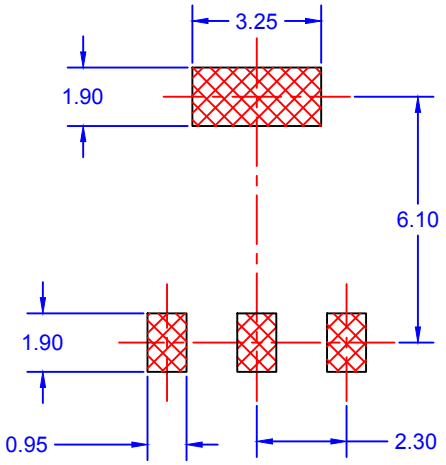


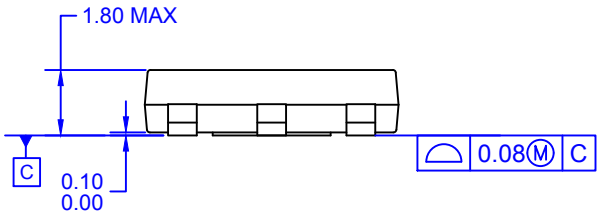

**Figure 11. Transient Thermal Response Curve.**

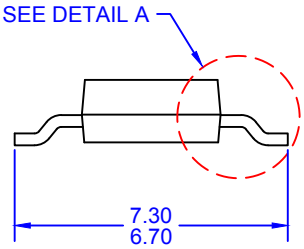
**Thermal characterization performed using the conditions described in Note 1c.**
**Transient thermal response will change depending on the circuit board design.**



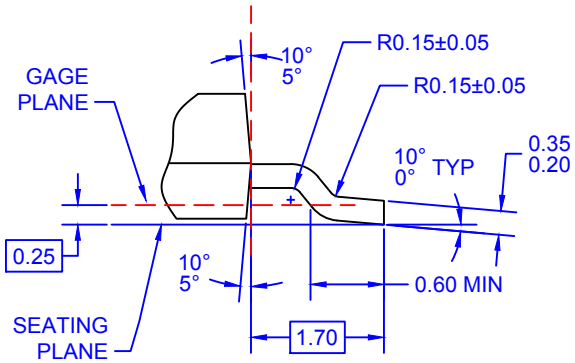




LAND PATTERN RECOMMENDATION




NOTES: UNLESS OTHERWISE SPECIFIED
A) DRAWING BASED ON JEDEC REGISTRATION TO-261C, VARIATION AA.
B) ALL DIMENSIONS ARE IN MILLIMETERS.
C) DIMENSIONS DO NOT INCLUDE BURRS OR MOLD FLASH. MOLD FLASH OR BURRS DOES NOT EXCEED 0.10MM.
D) DIMENSIONING AND TOLERANCING PER ASME Y14.5M-2009.
E) LANDPATTERN NAME: SOT230P700X180-4BN
F) DRAWING FILENAME: MKT-MA04AREV3




DETAIL A
SCALE: 2:1

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