# MT3906S5

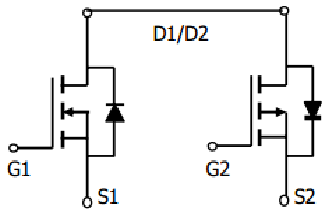
## 60V Complementary Power MOSFET

MT Semiconductor®

http://www.mtsemi.com

### Features

- N-Channel
  60V/8.0A,
  $R_{DS(ON)}$ = 36mΩ @ VGS = 10V
  $R_{DS(ON)}$ = 42mΩ @ VGS = 4.5V
- P-Channel
  -60V/-6.0A,
  $R_{DS(ON)}$ = 65mΩ @ VGS = -10V
  $R_{DS(ON)}$ = 75mΩ @ VGS = -4.5V
- RoHS Compliant




N-channel P-channel

### General Description

This complementary MOSFET device is produced using Mos-tech's advanced PowerTrench process that has been especially tailored to minimize the on-state resistance and yet maintain low gate charge for superior switching performance.

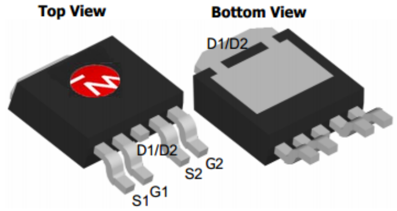
### Applications

- DC-DC converter
- Power management
- LCD backlight inverter
- DC-FAN

**MARKING DIAGRAM & PIN ASSIGNMENT**

TO252-4L
DPAK

Top View Bottom View




### Absolute Maximum Ratings $T_A$ = 25°C unless otherwise noted

| Symbol | Parameter | N-CH | P-CH | Units |
|---|---|---|---|---|
| $V_{DSS}$ | Drain-Source Voltage | 60 | –60 | V |
| $V_{GSS}$ | Gate-Source Voltage | ±20 | ±20 | V |
| $I_D$ | Drain Current - Continuous (Note 1a) | 8.0 | -6.0 | A |
| | - Pulsed | 25 | -25 | |
| $P_D$ | Power Dissipation for Dual Operation | 15 | 10 | W |
| $T_J$, $T_{STG}$ | Operating and Storage Junction Temperature Range | -55 to +150 | | °C |

### Thermal Characteristics

| Symbol | Parameter | Value | Units |
|---|---|---|---|
| $R_{\theta JA}$ | Thermal Resistance, Junction-to-Ambient (Note 1a) | 62.5 | °C/W |
| $R_{\theta JC}$ | Thermal Resistance, Junction-to-Case (Note 1) | 41 | °C/W |

### Package Marking and Ordering Information

| Device Marking | Device | Reel Size | Tape width | Quantity |
|---|---|---|---|---|
| MT3906S5 | MT3906S5 | - | - | 2500 units |

## Electrical Characteristics $T_A$ = 25°C unless otherwise noted

| Symbol | Parameter | Test Conditions | Type | Min | Typ | Max | Units |
|---|---|---|---|---|---|---|---|
| **Drain-Source Avalanche Ratings (Note 1)** | | | | | | | |
| $W_{DSS}$ | Single Pulse Drain-Source Avalanche Energy | $V_{DD}$ = 30 V, $I_D$ = 4.5 A | N-CH | - | - | 93 | mJ |
| $I_{AR}$ | Maximum Drain-Source Avalanche Current | | N-CH | - | - | 7.0 | A |
| **Off Characteristics** | | | | | | | |
| $BV_{DSS}$ | Drain-Source Breakdown Voltage | $V_{GS}$ = 0 V, $I_D$ = 250 μA<br>$V_{GS}$ = 0 V, $I_D$ = –250 μA | N-CH<br>P-CH | 60<br>–60 | - | - | V |
| $\frac{\Delta BV_{DSS}}{\Delta T_J}$ | Breakdown Voltage Temperature Coefficient | $I_D$ = 250 μA, Referenced to 25°C<br>$I_D$ = –250 μA, Referenced to 25°C | N-CH<br>P-CH | - | 59<br>–47 | - | mV/°C |
| $I_{DSS}$ | Zero Gate Voltage Drain Current | $V_{DS}$ = 48 V, $V_{GS}$ = 0 V<br>$V_{DS}$ = –48 V, $V_{GS}$ = 0 V | N-CH<br>P-CH | - | - | 1<br>–1 | μA |
| $I_{GSS}$ | Gate-Body Leakage | $V_{GS}$ = ±20 V, $V_{DS}$ = 0 V<br>$V_{GS}$ = ±20 V, $V_{DS}$ = 0 V | N-CH<br>P-CH | - | - | ±100<br>±100 | nA |
| **On Characteristics (Note 2)** | | | | | | | |
| $V_{GS(th)}$ | Gate Threshold Voltage | $V_{DS}$ = $V_{GS}$, $I_D$ = 250 μA<br>$V_{DS}$ = $V_{GS}$, $I_D$ = –250 μA | N-CH<br>P-CH | 1<br>–1 | 2.0<br>–2.0 | 3<br>–3 | V |
| $\frac{\Delta V_{GS(th)}}{\Delta T_J}$ | Gate Threshold Voltage Temperature Coefficient | $I_D$ = 250 μA, Referenced to 25°C<br>$I_D$ = –250 μA, Referenced to 25°C | N-CH<br>P-CH | - | –5.6<br>4 | - | mV/°C |
| $R_{DS(on)}$ | Static Drain-Source On-Resistance | $V_{GS}$ = 10 V, $I_D$ = 5.3A<br>$V_{GS}$ = 10 V, $I_D$ = 5.3A , $T_J$ = 125°C<br>$V_{GS}$ = 4.5 V, $I_D$ = 4.7A | N-CH | - | 36<br>52<br>42 | 40<br>64<br>45 | mΩ |
| | | $V_{GS}$ = –10 V, $I_D$ = -5.3A<br>$V_{GS}$ = –10 V, $I_D$ = -5.3A , $T_J$ = 125°C<br>$V_{GS}$ = –4.5 V, $I_D$ = -4.7A | P-CH | - | 65<br>90<br>75 | 70<br>100<br>80 | |
| $I_{D(on)}$ | On-State Drain Current | $V_{GS}$ = 10 V, $V_{DS}$ = 5 V<br>$V_{GS}$ = –10 V, $V_{DS}$ = –5 V | N-CH<br>P-CH | 20<br>–20 | - | - | A |
| $g_{FS}$ | Forward Transconductance | $V_{DS}$ = 10 V, $I_D$ = 5.3A<br>$V_{DS}$ = –5 V, $I_D$ = 5.3A | N-CH<br>P-CH | - | 4<br>6 | - | S |
| **Dynamic Characteristics** | | | | | | | |
| $C_{iss}$ | Input Capacitance | N-CH<br>$V_{DS}$ = 25 V, $V_{GS}$ = 0 V,<br>f = 1.0 MHz<br>P-CH<br>$V_{DS}$ = –30 V, $V_{GS}$ = 0 V,<br>f = 1.0 MHz | N-CH<br>P-CH | - | 680<br>770 | - | pF |
| $C_{oss}$ | Output Capacitance | | N-CH<br>P-CH | - | 86<br>94 | - | pF |
| $C_{rss}$ | Reverse Transfer Capacitance | | N-CH<br>P-CH | - | 37<br>39 | - | pF |
| **Switching Characteristics (Note 2)** | | | | | | | |
| $t_{d(on)}$ | Turn-On Delay Time | N-CH<br>$V_{DD}$ = 30 V, $I_D$ = 1 A,<br>$V_{GS}$ = 10V, $R_{GEN}$ = 6 Ω<br>P-CH<br>$V_{DD}$ = –30 V, $I_D$ = –1 A,<br>$V_{GS}$ = –10 V, $R_{GEN}$ = 6 Ω | N-CH<br>P-CH | - | 13<br>7 | 23<br>17 | ns |
| $t_r$ | Turn-On Rise Time | | N-CH<br>P-CH | - | 8<br>12 | 19<br>23 | ns |
| $t_{d(off)}$ | Turn-Off Delay Time | | N-CH<br>P-CH | - | 19<br>19 | 39<br>37 | ns |
| $t_f$ | Turn-Off Fall Time | | N-CH<br>P-CH | - | 6<br>12 | 17<br>25 | ns |
| $Q_g$ | Total Gate Charge | N-CH<br>$V_{DS}$ = 30 V, $I_D$= 5.3A , $V_{GS}$ = 10 V<br>P-CH<br>$V_{DS}$ = –30 V, $I_D$ = -5.3A , $V_{GS}$ = –10V | N-CH<br>P-CH | - | 15.5<br>18 | 19<br>24 | nC |
| $Q_{gs}$ | Gate-Source Charge | | N-CH<br>P-CH | - | 2.6<br>2.7 | - | nC |
| $Q_{gd}$ | Gate-Drain Charge | | N-CH<br>P-CH | - | 2.7<br>3.3 | - | nC |

## Electrical Characteristics (continued)

$T_A$ = 25°C unless otherwise noted

| Symbol | Parameter | Test Conditions | Type | Min | Typ | Max | Units |
|---|---|---|---|---|---|---|---|
| **Drain-Source Diode Characteristics and Maximum Ratings** | | | | | | | |
| $I_S$ | Maximum Continuous Drain-Source Diode Forward Current | | N-CH<br>P-CH | | | 1.4<br>–1.4 | A |
| $V_{SD}$ | Drain-Source Diode Forward Voltage | $V_{GS}$ = 0 V, $I_S$ = 2.0A (Note 2)<br>$V_{GS}$ = 0 V, $I_S$ = 2.0A (Note 2) | N-CH<br>P-CH | | 0.8<br>–0.8 | 1.2<br>-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.

Scale 1 : 1 on letter size paper

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

## Typical Characteristics: P-CH

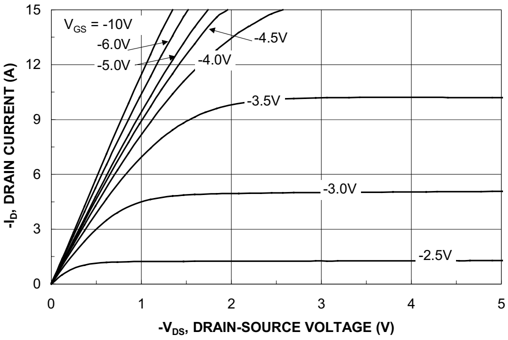



**Figure 1. On-Region Characteristics.**

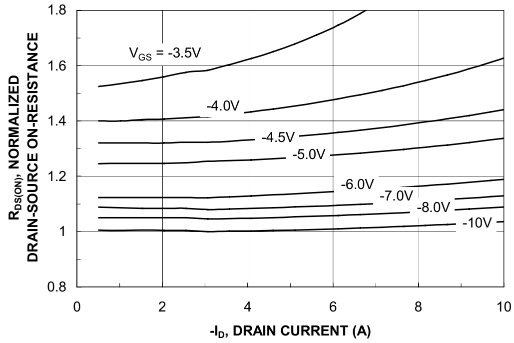



**Figure 2. On-Resistance Variation with Drain Current and Gate Voltage.**

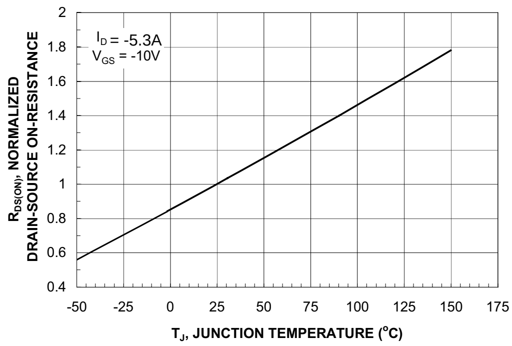



**Figure 3. On-Resistance Variation with Temperature.**

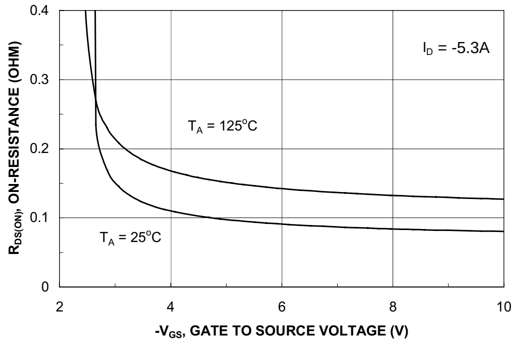



**Figure 4. On-Resistance Variation with Gate-to-Source Voltage.**

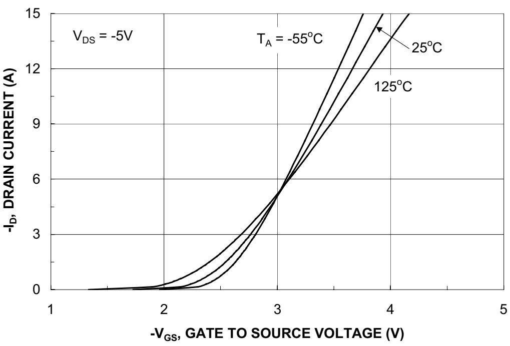



**Figure 5. Transfer Characteristics.**

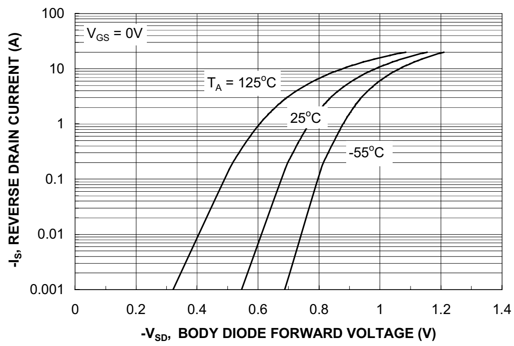



**Figure 6. Body Diode Forward Voltage Variation with Source Current and Temperature.**

# Typical Characteristics: P-CH

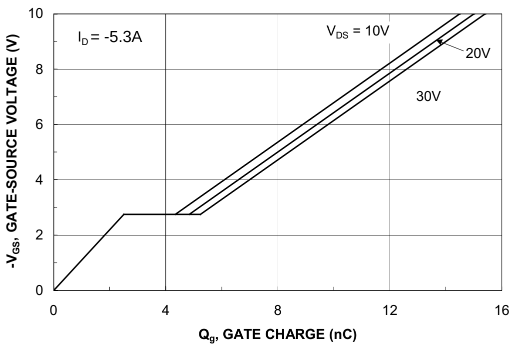



**Figure 7. Gate Charge Characteristics.**

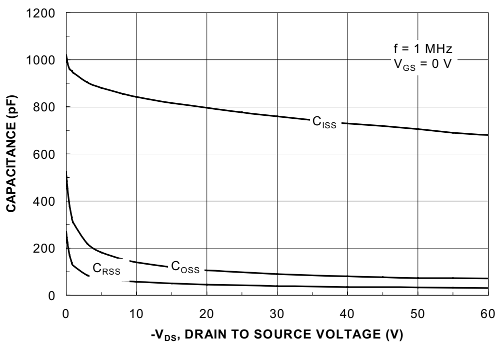



**Figure 8. Capacitance Characteristics.**

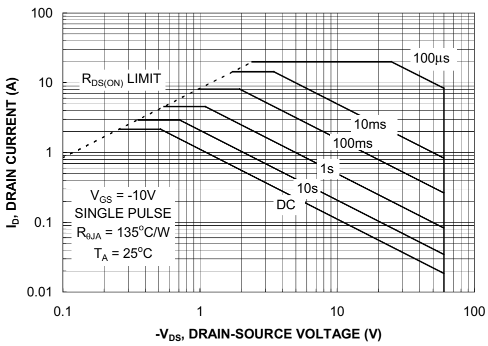



**Figure 9. Maximum Safe Operating Area.**

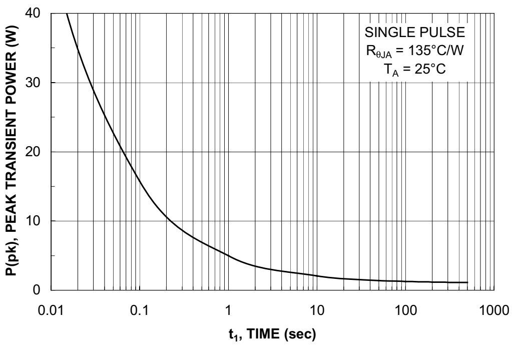



**Figure 10. Single Pulse Maximum Power Dissipation.**

# Typical Characteristics: N-CH

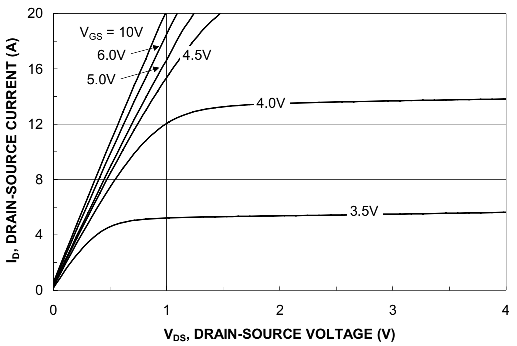



Figure 11. On-Region Characteristics.

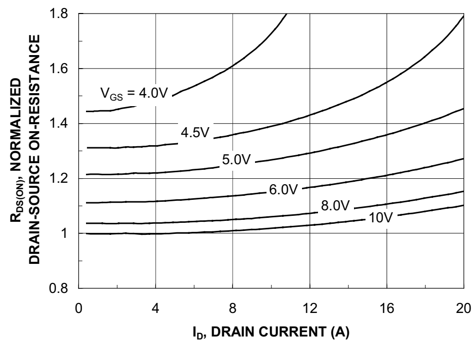



Figure 12. On-Resistance Variation with Drain Current and Gate Voltage.

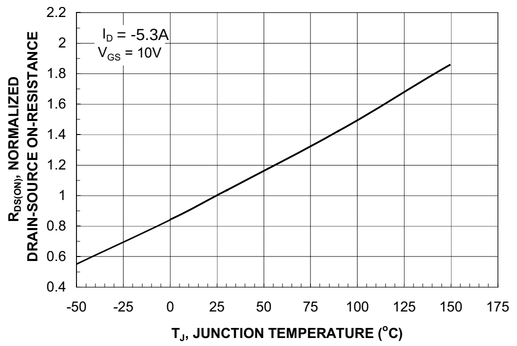



Figure 13. On-Resistance Variation with Temperature.

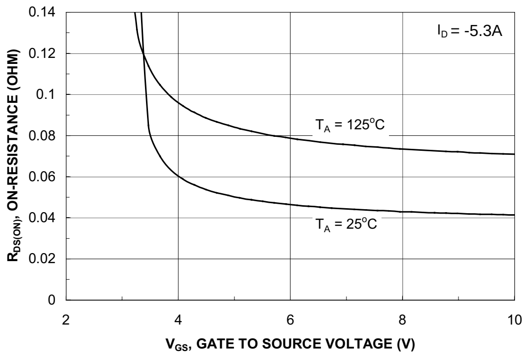



Figure 14. On-Resistance Variation with Gate-to-Source Voltage.

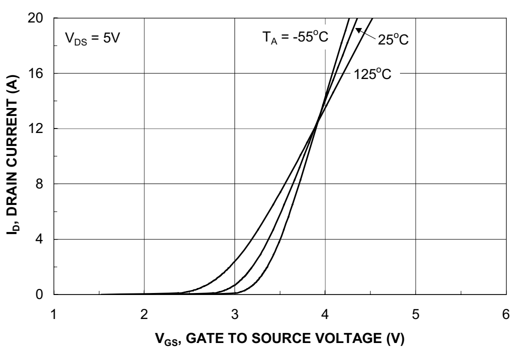



Figure 15. Transfer Characteristics.

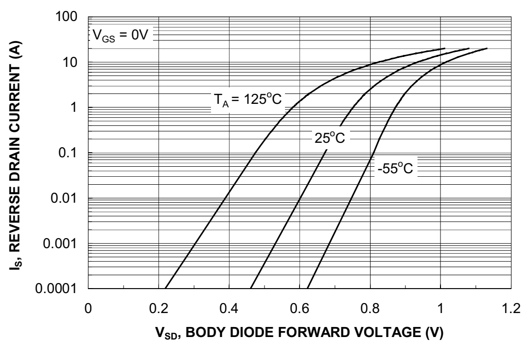



Figure 16. Body Diode Forward Voltage Variation with Source Current and Temperature.

# Typical Characteristics: N-CH

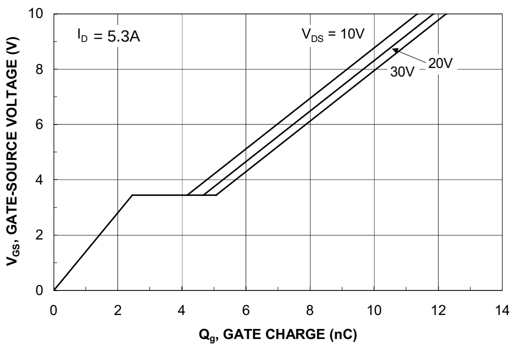



Figure 17. Gate Charge Characteristics.

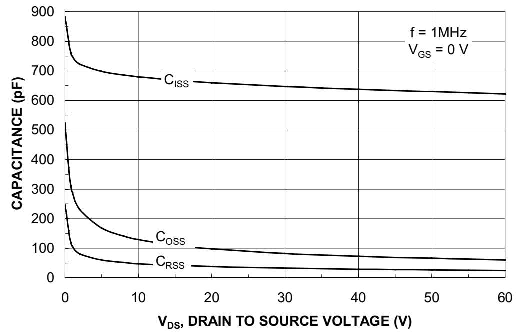



Figure 18. Capacitance Characteristics.

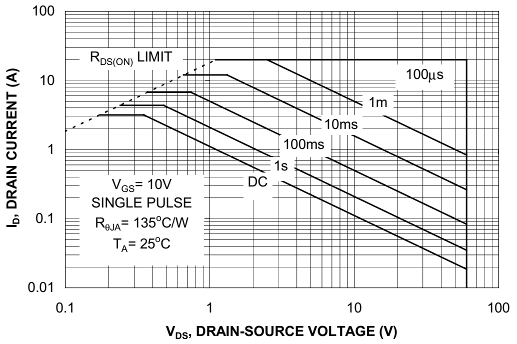



Figure 19. Maximum Safe Operating Area.

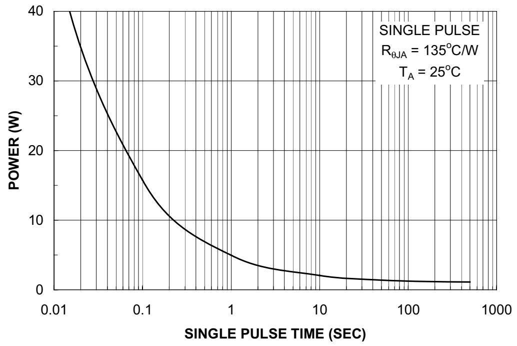



Figure 20. Single Pulse Maximum Power Dissipation.

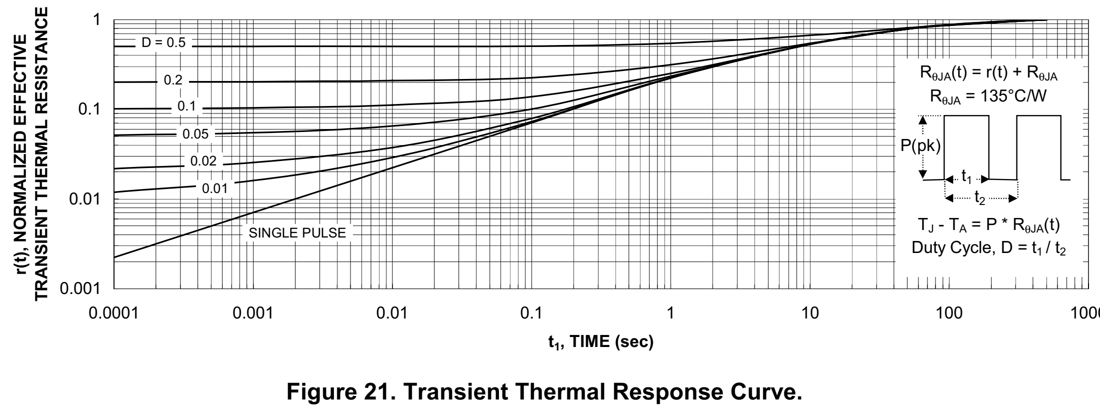
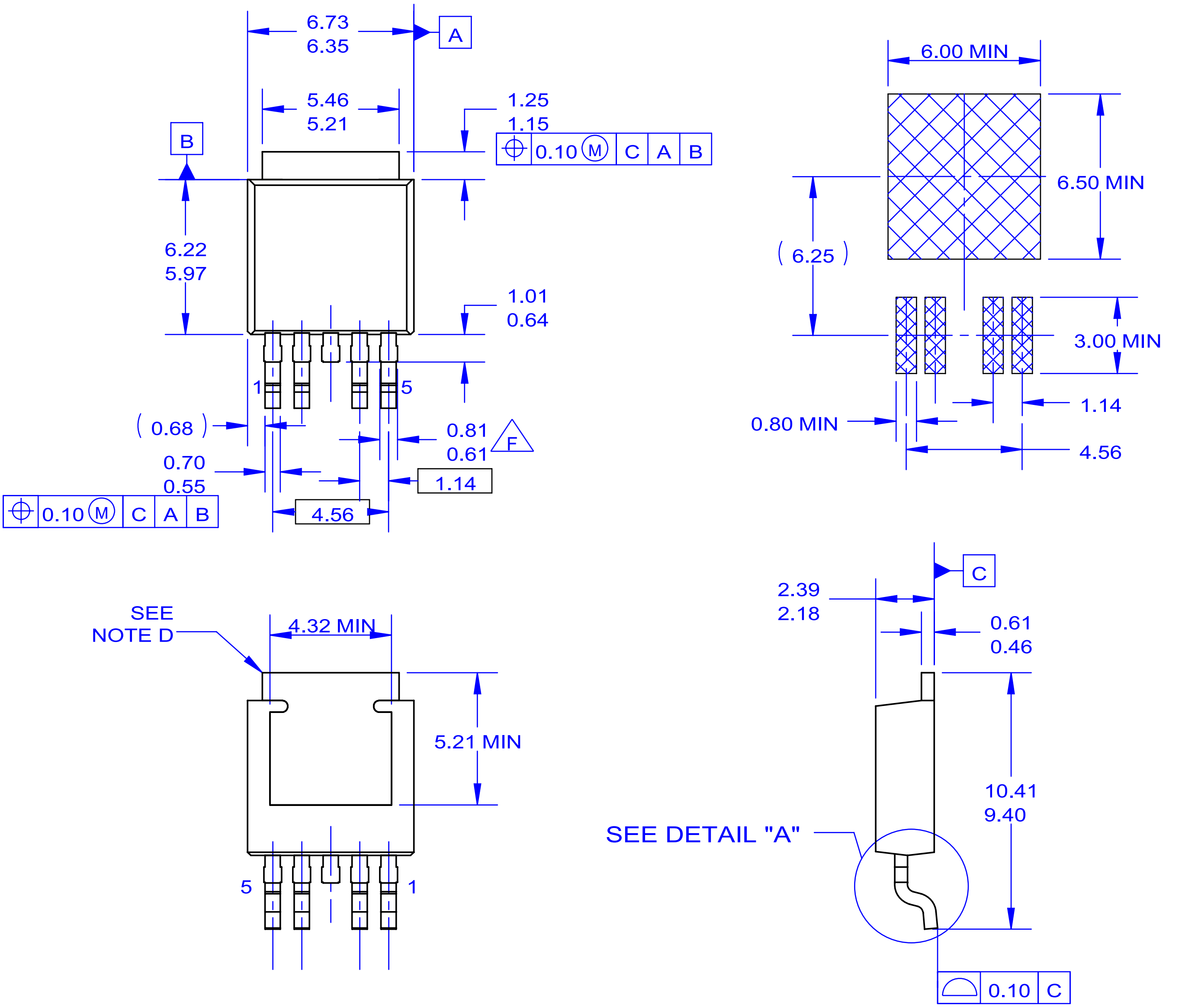
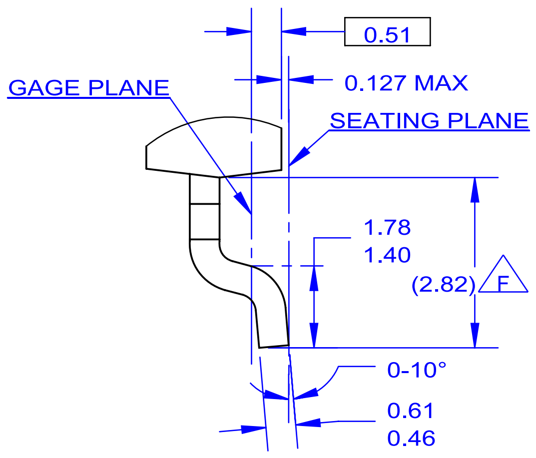



**Figure 21. Transient Thermal Response Curve.**

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




DETAIL A
SCALE 2:1

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E. DIMENSIONS AND TOLERANCES AS PER ASME Y14.5-2009.
F. EXCEPTION TO TO-252 STANDARD.
G. FILE NAME: TO252B05REV3
H. FAIRCHILDSEMICONDUCTOR

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8. 除上述第7项内容外，不能将本资料中记载的产品用于以下用途。如果用于以下用途而造成的损失，本公司概不负责。
   1）生命维持装置。
   2）植埋于人体使用的装置。
   3）用于治疗（切除患部、给药等）的装置。
   4）其他直接影响到人的生命的装置。
9. 在使用本资料所记载的产品时，对于最大额定值、工作电源电压的范围、放热特性、安装条件及其他条件请在本公司规定的保证范围内使用。如果超出了本公司规定的保证范围使用时，对于由此而造成的故障和出现的事故，本公司将不承担任何责任。
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### Keep safety first in your circuit designs!

1. MOS-TECH Semiconductor Corp. puts the maximum effort into making semiconductor products better and more reliable, but there is always the possibility that trouble may occur with them. Trouble with semiconductors may lead to personal injury, fire or property damage.
   Remember to give due consideration to safety when making your circuit designs, with appropriate measures such as (i) placement of substitutive, auxiliary circuits, (ii) use of nonflammable material or (iii) prevention against any malfunction or mishap.