

## NDH8321C

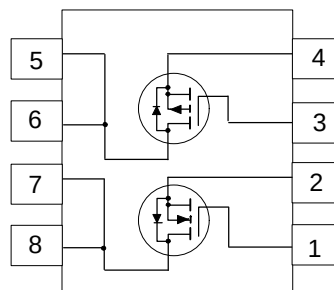
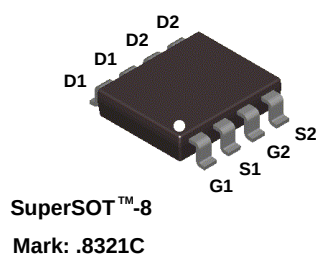
### Dual N & P-Channel Enhancement Mode Field Effect Transistor

#### General Description

These dual N- and P-Channel enhancement mode power field effect transistors are produced using Fairchild's proprietary, high cell density, DMOS technology. This very high density process is especially tailored to minimize on-state resistance and provide superior switching performance. These devices are particularly suited for low voltage applications such as notebook computer power management and other battery powered circuits where fast switching, low in-line power loss, and resistance to transients are needed.

#### Features

- N-Ch 3.8 A, 20 V,  $R_{DS(ON)}=0.035\ \Omega$  @  $V_{GS}=4.5\text{ V}$   
 $R_{DS(ON)}=0.045\ \Omega$  @  $V_{GS}=2.7\text{ V}$   
P-Ch -2.7 A, -20V,  $R_{DS(ON)}=0.07\ \Omega$  @  $V_{GS}=-4.5\text{ V}$   
 $R_{DS(ON)}=0.095\ \Omega$  @  $V_{GS}=-2.7\text{ V}$ .
- Proprietary SuperSOT™-8 package design using copper lead frame for superior thermal and electrical capabilities.
- High density cell design for extremely low  $R_{DS(ON)}$ .
- Exceptional on-resistance and maximum DC current capability.



#### Absolute Maximum Ratings

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

| Symbol         | Parameter                                       | N-Channel  | P-Channel | Units            |
|----------------|-------------------------------------------------|------------|-----------|------------------|
| $V_{DSS}$      | Drain-Source Voltage                            | 20         | -20       | V                |
| $V_{GSS}$      | Gate-Source Voltage                             | $\pm 8$    | $\pm 8$   | V                |
| $I_D$          | Drain Current - Continuous (Note 1)             | 3.8        | -2.7      | A                |
|                | - Pulsed                                        | 15         | -10       |                  |
| $P_D$          | Power Dissipation for Single Operation (Note 1) | 0.8        |           | W                |
| $T_J, T_{STG}$ | Operating and Storage Temperature Range         | -55 to 150 |           | $^\circ\text{C}$ |

#### THERMAL CHARACTERISTICS

|                 |                                                  |     |                    |
|-----------------|--------------------------------------------------|-----|--------------------|
| $R_{\theta JA}$ | Thermal Resistance, Junction-to-Ambient (Note 1) | 156 | $^\circ\text{C/W}$ |
| $R_{\theta JC}$ | Thermal Resistance, Junction-to-Case (Note 1)    | 40  | $^\circ\text{C/W}$ |

# Electrical Characteristics (T<sub>A</sub> = 25°C unless otherwise noted)

| Symbol                      | Parameter                         | Conditions                                                                                       | Type | Min  | Typ   | Max   | Units |
|-----------------------------|-----------------------------------|--------------------------------------------------------------------------------------------------|------|------|-------|-------|-------|
| OFF CHARACTERISTICS         |                                   |                                                                                                  |      |      |       |       |       |
| BV <sub>DSS</sub>           | Drain-Source Breakdown Voltage    | V <sub>GS</sub> = 0 V, I <sub>D</sub> = 250 μA                                                   | N-Ch | 20   |       |       | V     |
|                             |                                   | V <sub>GS</sub> = 0 V, I <sub>D</sub> = -250 μA                                                  | P-Ch | -20  |       |       | V     |
| I <sub>DSS</sub>            | Zero Gate Voltage Drain Current   | V <sub>DS</sub> = 16 V, V <sub>GS</sub> = 0 V<br><div>T<sub>J</sub> = 55°C</div>                 | N-Ch |      |       | 1     | μA    |
|                             |                                   |                                                                                                  |      |      |       | 10    | μA    |
|                             |                                   | V <sub>DS</sub> = -16 V, V <sub>GS</sub> = 0 V<br><div>T<sub>J</sub> = 55°C</div>                | P-Ch |      |       | -1    | μA    |
|                             |                                   |                                                                                                  |      |      |       | -10   | μA    |
| I <sub>GSSF</sub>           | Gate - Body Leakage, Forward      | V <sub>GS</sub> = 8 V, V <sub>DS</sub> = 0 V                                                     | All  |      |       | 100   | nA    |
| I <sub>GSSR</sub>           | Gate - Body Leakage, Reverse      | V <sub>GS</sub> = -8 V, V <sub>DS</sub> = 0 V                                                    | All  |      |       | -100  | nA    |
| ON CHARACTERISTICS (Note 2) |                                   |                                                                                                  |      |      |       |       |       |
| V <sub>GS(th)</sub>         | Gate Threshold Voltage            | V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = 250 μA<br><div>T<sub>J</sub> = 125°C</div>  | N-Ch | 0.4  | 0.7   | 1     | V     |
|                             |                                   |                                                                                                  |      | 0.3  | 0.45  | 0.8   |       |
|                             |                                   | V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = -250 μA<br><div>T<sub>J</sub> = 125°C</div> | P-Ch | -0.4 | -0.7  | -1    |       |
|                             |                                   |                                                                                                  |      | -0.3 | -0.5  | -0.8  |       |
| R <sub>DS(on)</sub>         | Static Drain-Source On-Resistance | V <sub>GS</sub> = 4.5 V, I <sub>D</sub> = 3.8 A<br><div>T<sub>J</sub> = 125°C</div>              | N-Ch |      | 0.029 | 0.035 | Ω     |
|                             |                                   |                                                                                                  |      |      | 0.043 | 0.063 |       |
|                             |                                   |                                                                                                  |      |      | 0.036 | 0.045 |       |
|                             |                                   | V <sub>GS</sub> = -4.5 V, I <sub>D</sub> = -2.7 A<br><div>T<sub>J</sub> = 125°C</div>            | P-Ch |      | 0.061 | 0.07  |       |
|                             |                                   |                                                                                                  |      |      | 0.087 | 0.125 |       |
|                             |                                   |                                                                                                  |      |      | 0.082 | 0.095 |       |
| I <sub>D(on)</sub>          | On-State Drain Current            | V <sub>GS</sub> = 4.5 V, V <sub>DS</sub> = 5 V                                                   | N-Ch | 15   |       |       | A     |
|                             |                                   | V <sub>GS</sub> = 2.7 V, V <sub>DS</sub> = 5 V                                                   |      | 5    |       |       |       |
|                             |                                   | V <sub>GS</sub> = -4.5 V, V <sub>DS</sub> = -5 V                                                 | P-Ch | -10  |       |       |       |
|                             |                                   | V <sub>GS</sub> = -2.7 V, V <sub>DS</sub> = -5 V                                                 |      | -3   |       |       |       |
| g <sub>FS</sub>             | Forward Transconductance          | V <sub>DS</sub> = 5 V, I <sub>D</sub> = 3.8 A                                                    | N-Ch |      | 15    |       | S     |
|                             |                                   | V <sub>DS</sub> = -5 V, I <sub>D</sub> = -2.7 A                                                  | P-Ch |      | 8     |       |       |
| DYNAMIC CHARACTERISTICS     |                                   |                                                                                                  |      |      |       |       |       |
| C <sub>iss</sub>            | Input Capacitance                 | N-Channel<br>V <sub>DS</sub> = 10 V, V <sub>GS</sub> = 0 V,<br>f = 1.0 MHz                       | N-Ch |      | 700   |       | pF    |
|                             |                                   |                                                                                                  | P-Ch |      | 865   |       |       |
| C <sub>oss</sub>            | Output Capacitance                | P-Channel<br>V <sub>DS</sub> = -10 V, V <sub>GS</sub> = 0 V,<br>f = 1.0 MHz                      | N-Ch |      | 370   |       | pF    |
|                             |                                   |                                                                                                  | P-Ch |      | 415   |       |       |
| C <sub>rss</sub>            | Reverse Transfer Capacitance      |                                                                                                  | N-Ch |      | 145   |       | pF    |
|                             |                                   |                                                                                                  | P-Ch |      | 150   |       |       |

**Electrical Characteristics** ( $T_A = 25^\circ\text{C}$  unless otherwise noted)

| Symbol                                                 | Parameter                                             | Conditions                                                                                                                                                                                                                            | Type | Min | Typ  | Max   | Units |
|--------------------------------------------------------|-------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|-----|------|-------|-------|
| SWITCHING CHARACTERISTICS (Note 2)                     |                                                       |                                                                                                                                                                                                                                       |      |     |      |       |       |
| t <sub>D(on)</sub>                                     | Turn - On Delay Time                                  | N-Channel<br>V <sub>DD</sub> = 5 V, I <sub>D</sub> = 1 A,<br>V <sub>GEN</sub> = 4.5 V, R <sub>GEN</sub> = 6 Ω<br><br>P-Channel<br>V <sub>DD</sub> = -5 V, I <sub>D</sub> = -1 A,<br>V <sub>GEN</sub> = -4.5 V, R <sub>GEN</sub> = 6 Ω | N-Ch |     | 8    | 15    | ns    |
|                                                        |                                                       |                                                                                                                                                                                                                                       | P-Ch |     | 11   | 22    |       |
| t <sub>r</sub>                                         | Turn - On Rise Time                                   |                                                                                                                                                                                                                                       | N-Ch |     | 22   | 40    | ns    |
|                                                        |                                                       |                                                                                                                                                                                                                                       | P-Ch |     | 25   | 50    |       |
| t <sub>D(off)</sub>                                    | Turn - Off Delay Time                                 |                                                                                                                                                                                                                                       | N-Ch |     | 48   | 90    | ns    |
|                                                        |                                                       |                                                                                                                                                                                                                                       | P-Ch |     | 78   | 150   |       |
| t <sub>f</sub>                                         | Turn - Off Fall Time                                  | N-Ch                                                                                                                                                                                                                                  |      | 23  | 40   | ns    |       |
|                                                        |                                                       | P-Ch                                                                                                                                                                                                                                  |      | 55  | 100  |       |       |
| Q <sub>g</sub>                                         | Total Gate Charge                                     | N-Channel<br>V <sub>DS</sub> = 10 V,<br>I <sub>D</sub> = 3.8 A, V <sub>GS</sub> = 4.5 V                                                                                                                                               | N-Ch |     | 19.6 | 28    | nC    |
|                                                        |                                                       |                                                                                                                                                                                                                                       | P-Ch |     | 16   | 23    |       |
| Q <sub>gs</sub>                                        | Gate-Source Charge                                    | P-Channel<br>V <sub>DS</sub> = -10 V,<br>I <sub>D</sub> = -2.7 A, V <sub>GS</sub> = -4.5 V                                                                                                                                            | N-Ch |     | 2.5  |       | nC    |
|                                                        |                                                       |                                                                                                                                                                                                                                       | P-Ch |     | 2.4  |       |       |
| Q <sub>gd</sub>                                        | Gate-Drain Charge                                     |                                                                                                                                                                                                                                       | N-Ch |     | 6.5  |       | nC    |
|                                                        |                                                       |                                                                                                                                                                                                                                       | P-Ch |     | 5.1  |       |       |
| DRAIN-SOURCE DIODE CHARACTERISTICS AND MAXIMUM RATINGS |                                                       |                                                                                                                                                                                                                                       |      |     |      |       |       |
| I <sub>S</sub>                                         | Maximum Continuous Drain-Source Diode Forward Current |                                                                                                                                                                                                                                       | N-Ch |     |      | 0.67  | A     |
|                                                        |                                                       |                                                                                                                                                                                                                                       | P-Ch |     |      | -0.67 |       |
| V <sub>SD</sub>                                        | Drain-Source Diode Forward Voltage                    | V <sub>GS</sub> = 0 V, I <sub>S</sub> = 0.67 A (Note2)                                                                                                                                                                                | N-Ch |     | 0.65 | 1.2   | V     |
|                                                        |                                                       | V <sub>GS</sub> = 0 V, I <sub>S</sub> = -0.67 A (Note2)                                                                                                                                                                               | P-Ch |     | -0.7 | -1.2  |       |

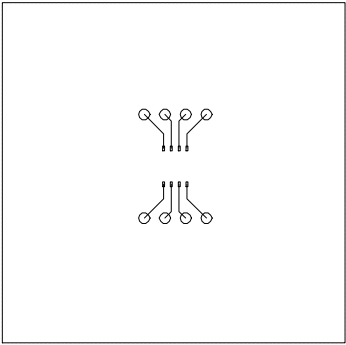
Notes:

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.

$$P_D(t) = \frac{T_J - T_A}{R_{\theta JA}(t)} = \frac{T_J - T_A}{R_{\theta JC} + R_{\theta CA}(t)} = I_D^2(t) \times R_{DS(ON)}@T_J$$

Typical  $R_{\theta JA}$  for single device operation using the board layout shown below on 4.5"x5" FR-4 PCB in a still air environment:

156°C/W when mounted on a 0.0025 in<sup>2</sup> pad of 2oz copper.



Scale 1 : 1 on letter size paper.

2. Pulse Test: Pulse Width  $\leq 300\mu\text{s}$ , Duty Cycle  $\leq 2.0\%$ .

## Typical Electrical Characteristics: N-Channel

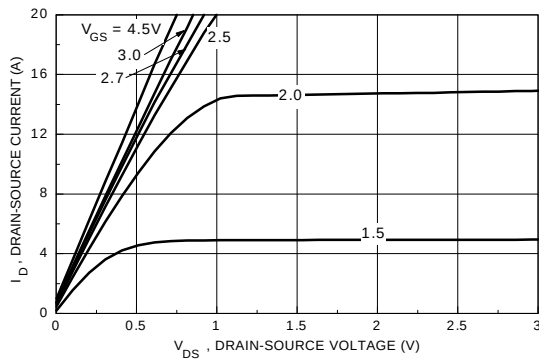


Figure 1. N-Channel On-Region Characteristics.

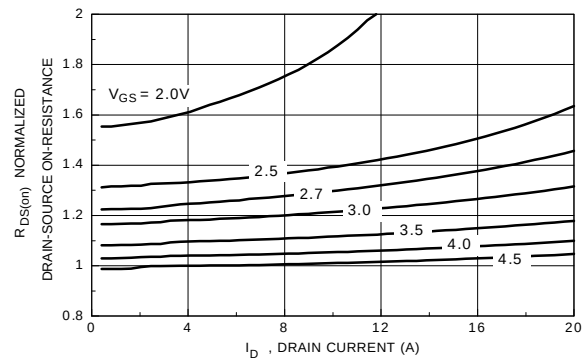


Figure 2. N-Channel On-Resistance Variation with Gate Voltage and Drain Current.

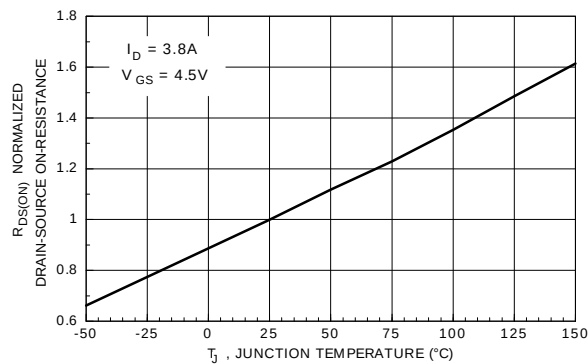


Figure 3. N-Channel On-Resistance Variation with Temperature.

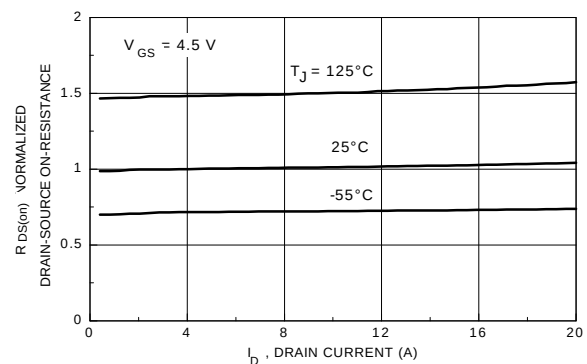


Figure 4. N-Channel On-Resistance Variation with Drain Current and Temperature.

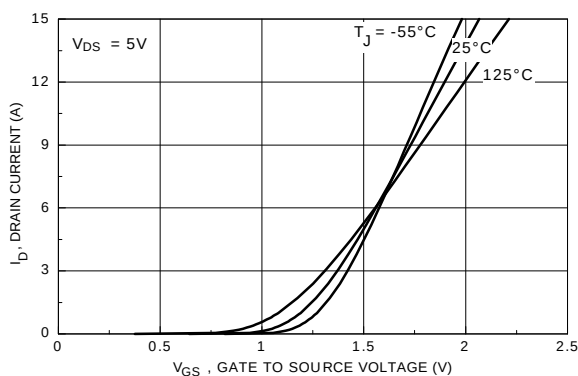


Figure 5. N-Channel Transfer Characteristics.

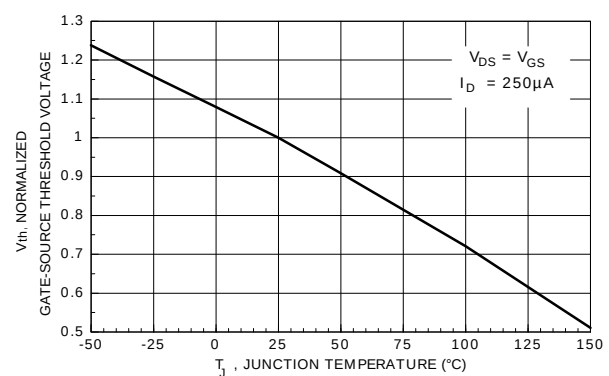


Figure 6. N-Channel Gate Threshold Variation with Temperature.

## Typical Electrical Characteristics: N-Channel (continued)

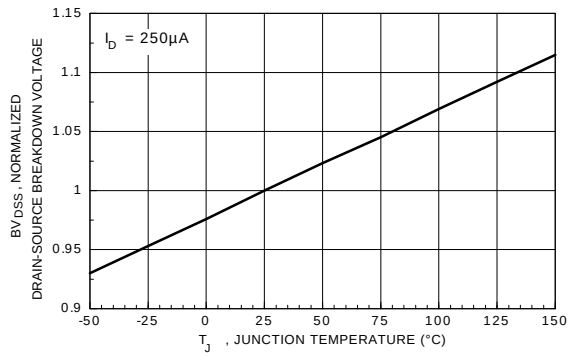


Figure 7. N-Channel Breakdown Voltage Variation with Temperature.

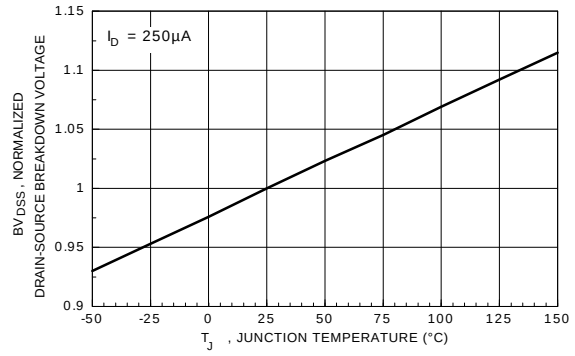


Figure 8. N-Channel Body Diode Forward Voltage Variation with Current and Temperature.

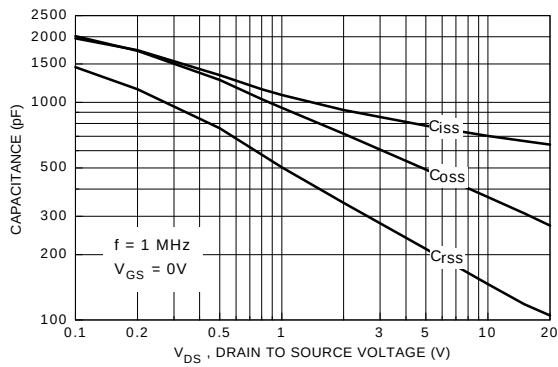


Figure 9. N-Channel Capacitance Characteristics.

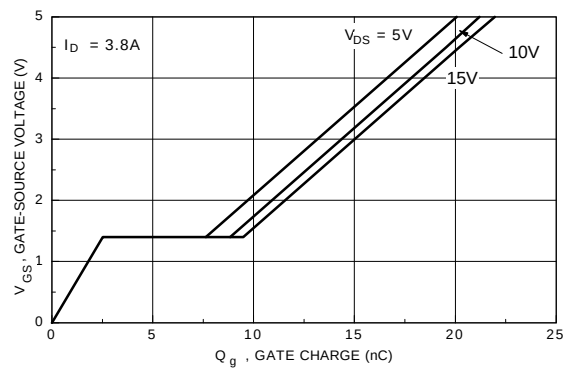


Figure 10. N-Channel Gate Charge Characteristics.

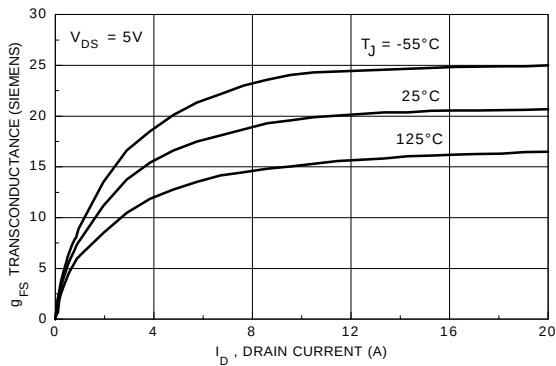


Figure 11. N-Channel Transconductance Variation with Drain Current and Temperature.

## Typical Electrical Characteristics: P-Channel (continued)

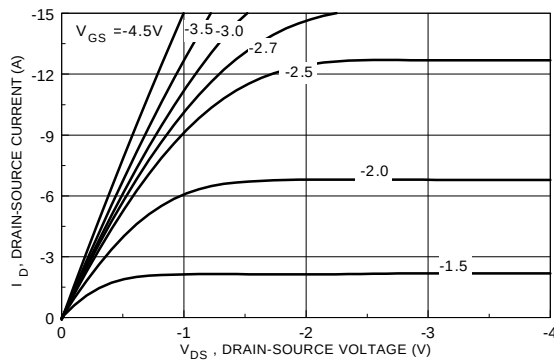


Figure 12. P-Channel On-Region Characteristics.

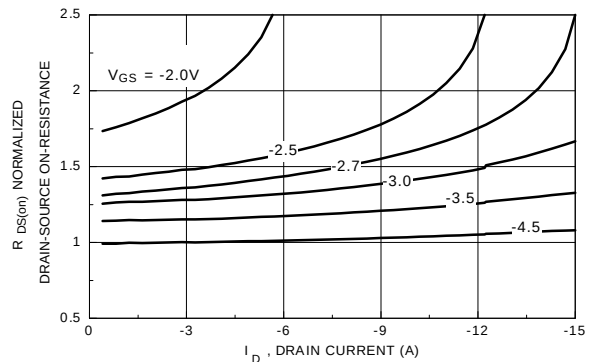


Figure 13. P-Channel On-Resistance Variation with Gate Voltage and Drain Current.

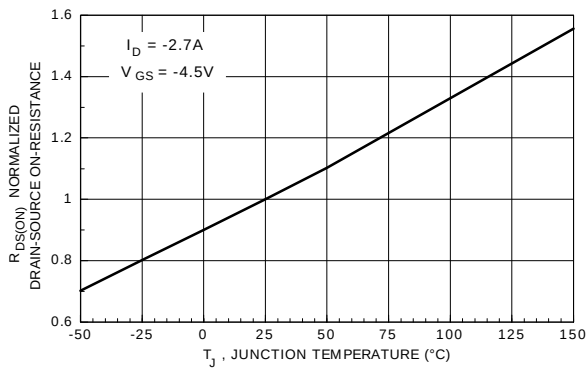


Figure 14. P-Channel On-Resistance Variation with Temperature.

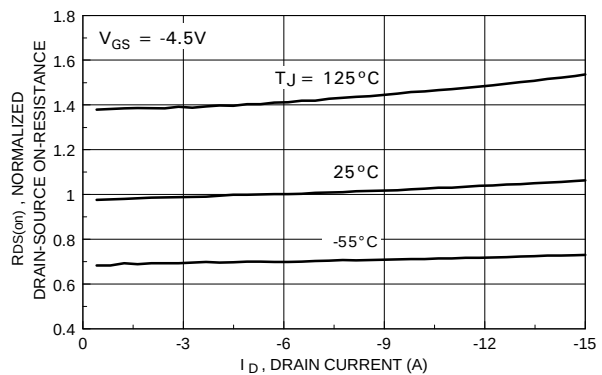


Figure 15. P-Channel On-Resistance Variation with Drain Current and Temperature.

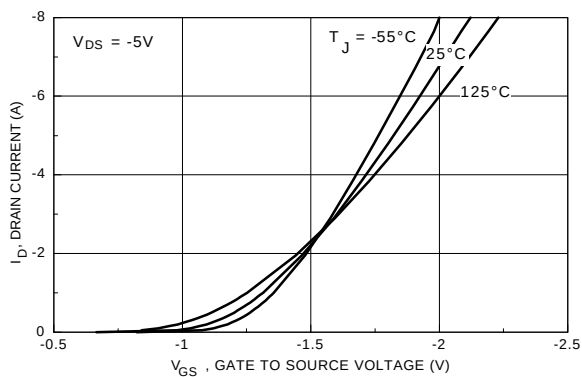


Figure 16. P-Channel Transfer Characteristics.

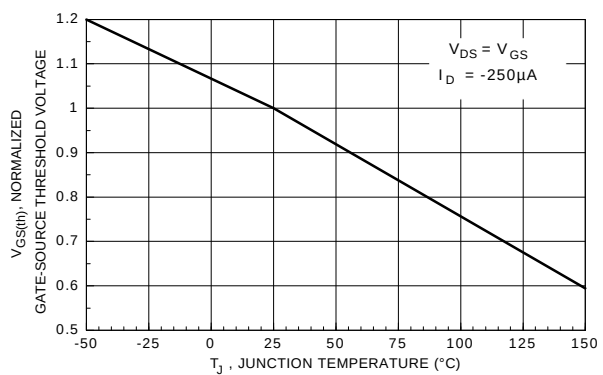
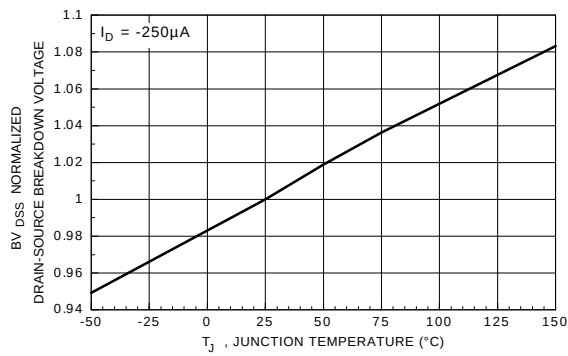
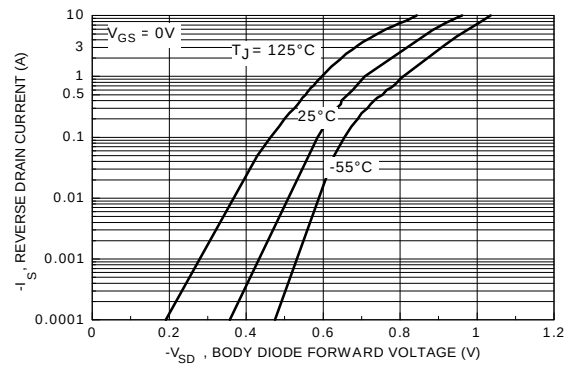


Figure 17. P-Channel Gate Threshold Variation with Temperature.

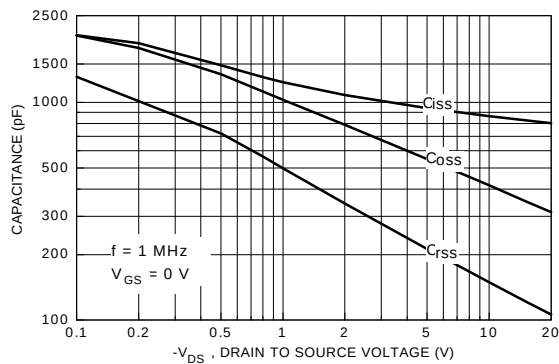
## Typical Electrical Characteristics: P-Channel (continued)



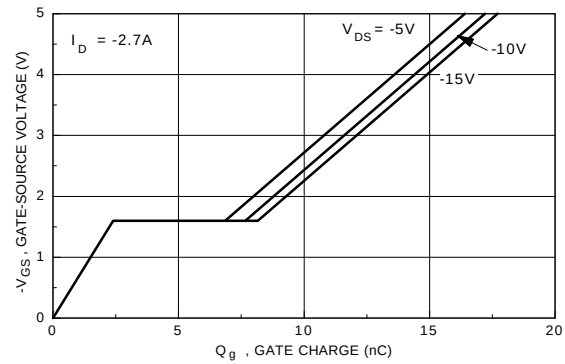
**Figure 18. P-Channel Breakdown Voltage Variation with Temperature.**



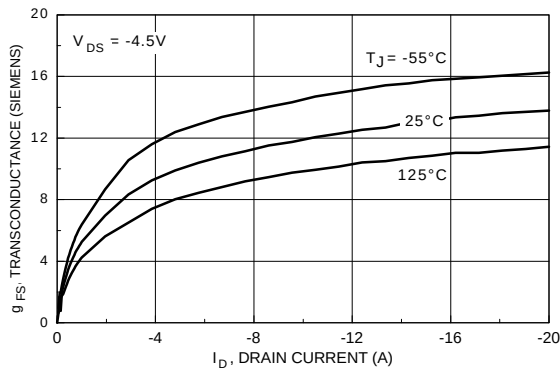
**Figure 19. P-Channel Body Diode Forward Voltage Variation with Current and Temperature.**



**Figure 20. P-Channel Capacitance Characteristics.**

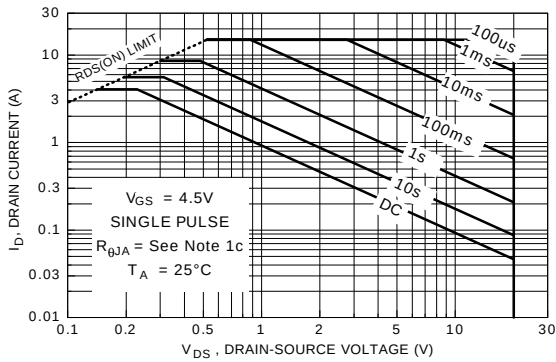


**Figure 21. P-Channel Gate Charge Characteristics.**

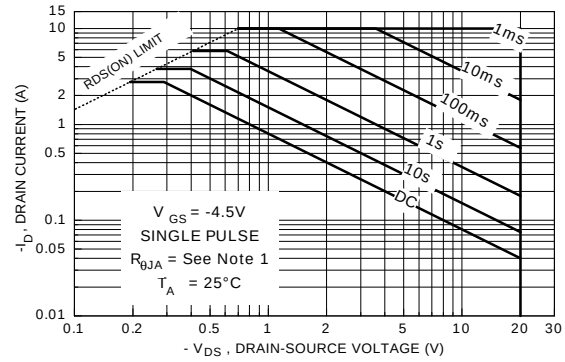


**Figure 22. P-Channel Transconductance Variation with Drain Current and Temperature.**

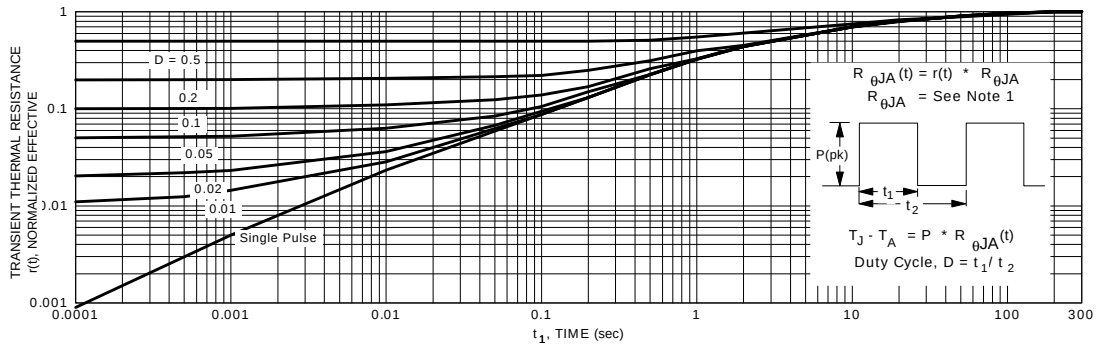
## Typical Thermal Characteristics: N & P-Channel



**Figure 23. N-Channel Maximum Safe Operating Area.**

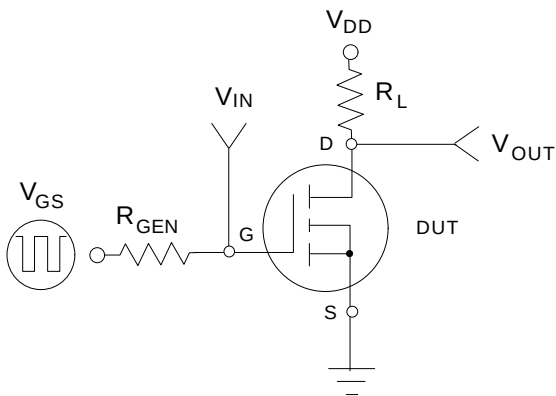


**Figure 24. P-Channel Maximum Safe Operating Area.**

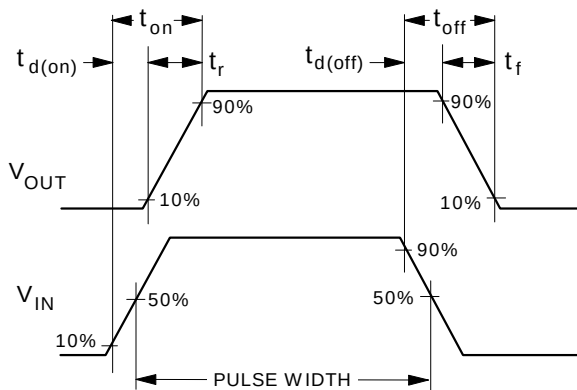


**Figure 25. Transient Thermal Response Curve.**

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



**Figure 26. N or P-Channel Switching Test Circuit.**



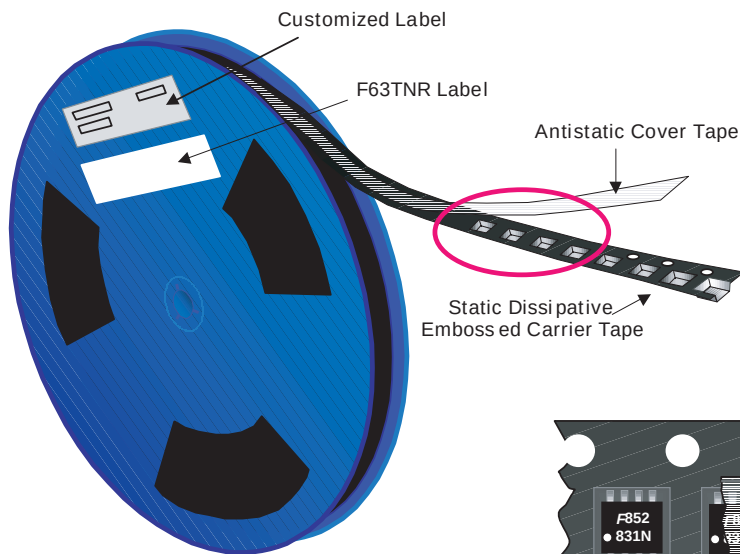
**Figure 27. N or P-Channel Switching Waveforms.**



# SuperSOT™-8 Tape and Reel Data and Package Dimensions



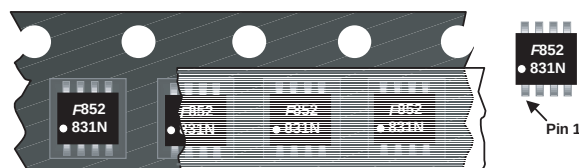
## SSOT-8 Packaging Configuration: Figure 1.0



### Packaging Description:

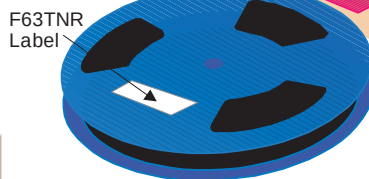
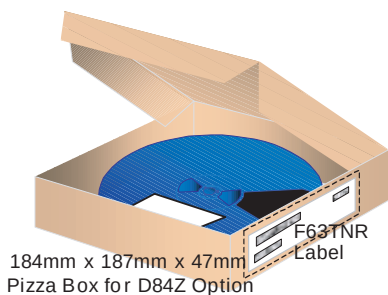
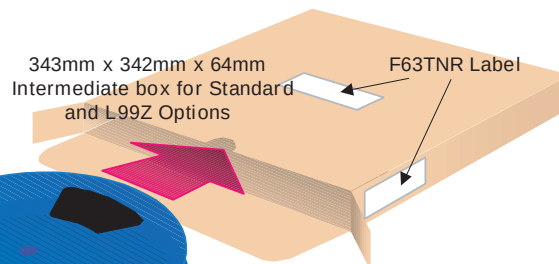
SSOT-8 parts are shipped in tape. The carrier tape is made from a dissipative (carbon filled) polycarbonate resin. The cover tape is a multilayer film (Heat Activated Adhesive in nature) primarily composed of polyester film, adhesive layer, sealant, and anti-static sprayed agent. These reeled parts in standard option are shipped with 3,000 units per 13" or 330cm diameter reel. The reels are dark blue in color and is made of polystyrene plastic (anti-static coated). Other option comes in 500 units per 7" or 177cm diameter reel. This and some other options are further described in the Packaging Information table.

These full reels are individually barcode labeled and placed inside a standard intermediate box (illustrated in figure 1.0) made of recyclable corrugated brown paper. One box contains two reels maximum. And these boxes are placed inside a barcode labeled shipping box which comes in different sizes depending on the number of parts shipped.



### SSOT-8 Unit Orientation

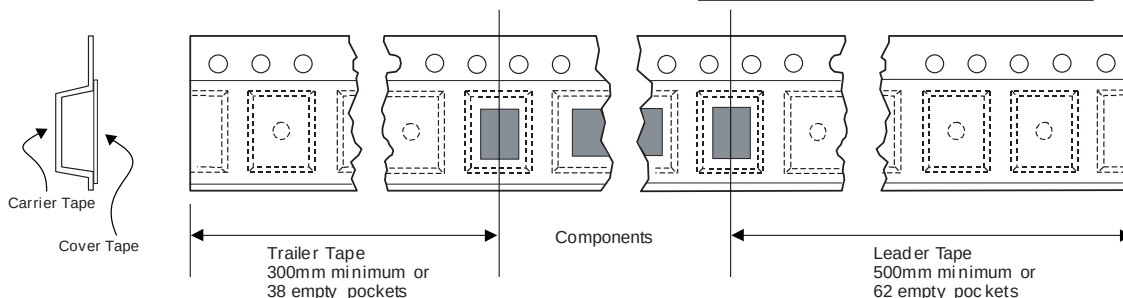
| SSOT-8 Packaging Information |                         |            |
|------------------------------|-------------------------|------------|
| Packaging Option             | Standard (no flow code) | D84Z       |
| Packaging type               | TNR                     | TNR        |
| Qty per Reel/Tube/Bag        | 3,000                   | 500        |
| Reel Size                    | 13" Dia                 | 7" Dia     |
| Box Dimension (mm)           | 343x64x343              | 184x187x47 |
| Max qty per Box              | 6,000                   | 1,000      |
| Weight per unit (gm)         | 0.0416                  | 0.0416     |
| Weight per Reel (kg)         | 0.5615                  | 0.0980     |
| Note/Comments                |                         |            |



### F63TNR Label sample

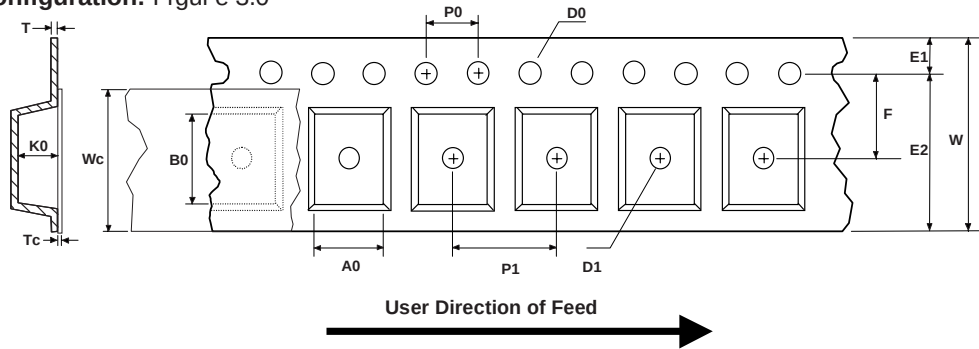
|                  |           |
|------------------|-----------|
| LOT: CBVK741B019 | QTY: 3000 |
| FSID: FDR835N    | SPEC:     |
| D/C1: D9842      | QTY1:     |
| D/C2:            | QTY2:     |
| SPEC REV:        | CPN:      |
| N/F: F           | (F63TNR)3 |

## SSOT-8 Tape Leader and Trailer Configuration: Figure 2.0



## SuperSOT™-8 Tape and Reel Data and Package Dimensions, continued

### SSOT-8 Embossed Carrier Tape Configuration: Figure 3.0

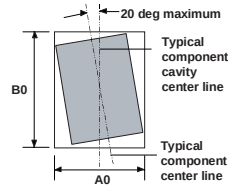


| Dimensions are in millimeter |                 |                 |                |                 |                 |                 |              |                 |               |               |                 |                   |                 |                 |
|------------------------------|-----------------|-----------------|----------------|-----------------|-----------------|-----------------|--------------|-----------------|---------------|---------------|-----------------|-------------------|-----------------|-----------------|
| Pkg type                     | A0              | B0              | W              | D0              | D1              | E1              | E2           | F               | P1            | P0            | K0              | T                 | Wc              | Tc              |
| SSOT-8 (12mm)                | 4.47<br>+/-0.10 | 5.00<br>+/-0.10 | 12.0<br>+/-0.3 | 1.55<br>+/-0.05 | 1.50<br>+/-0.10 | 1.75<br>+/-0.10 | 10.25<br>min | 5.50<br>+/-0.05 | 8.0<br>+/-0.1 | 4.0<br>+/-0.1 | 1.37<br>+/-0.10 | 0.280<br>+/-0.150 | 9.5<br>+/-0.025 | 0.06<br>+/-0.02 |

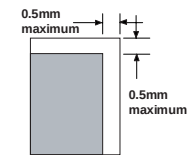
Notes: A0, B0, and K0 dimensions are determined with respect to the EIA/Jedec RS-481 rotational and lateral movement requirements (see sketches A, B, and C).



Sketch A (Side or Front Sectional View)  
Component Rotation

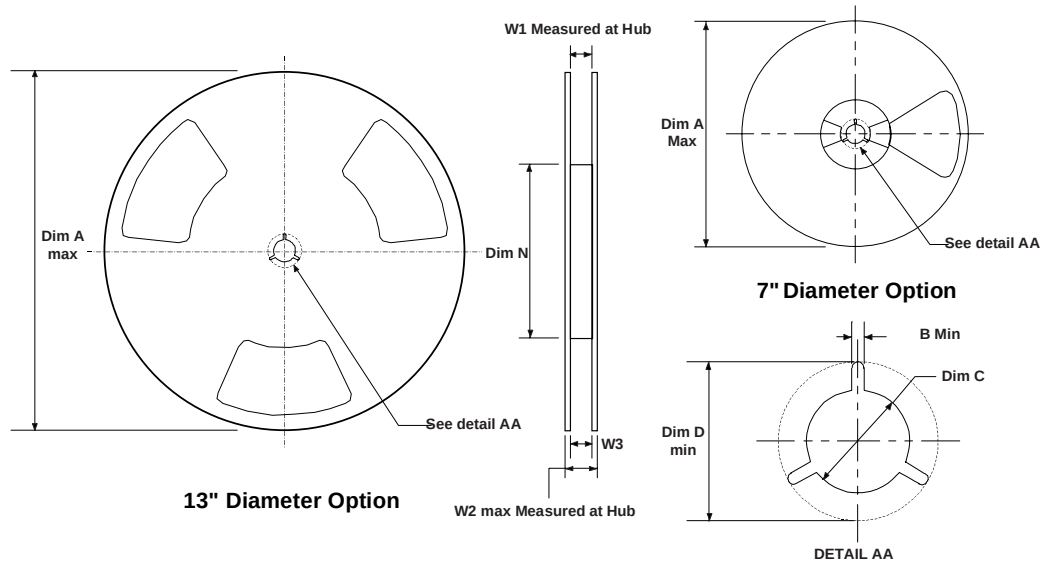


Sketch B (Top View)  
Component Rotation



Sketch C (Top View)  
Component lateral movement

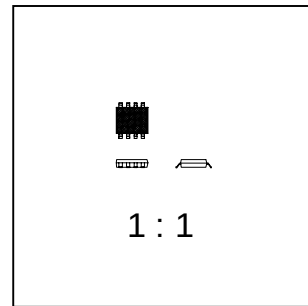
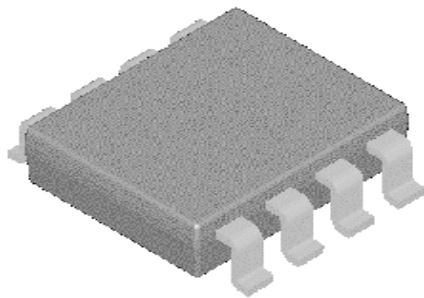
### SSOT-8 Reel Configuration: Figure 4.0



| Dimensions are in inches and millimeters |             |               |              |                                    |               |              |                                  |               |                              |
|------------------------------------------|-------------|---------------|--------------|------------------------------------|---------------|--------------|----------------------------------|---------------|------------------------------|
| Tape Size                                | Reel Option | Dim A         | Dim B        | Dim C                              | Dim D         | Dim N        | Dim W1                           | Dim W2        | Dim W3 (LSL-USL)             |
| 12mm                                     | 7" Dia      | 7.00<br>177.8 | 0.059<br>1.5 | 51.2 +0.020/-0.008<br>13 +0.5/-0.2 | 0.795<br>20.2 | 5.906<br>150 | 0.488 +0.078/-0.000<br>12.4 +2/0 | 0.724<br>18.4 | 0.469 – 0.606<br>11.9 – 15.4 |
| 12mm                                     | 13" Dia     | 13.00<br>330  | 0.059<br>1.5 | 51.2 +0.020/-0.008<br>13 +0.5/-0.2 | 0.795<br>20.2 | 7.00<br>178  | 0.488 +0.078/-0.000<br>12.4 +2/0 | 0.724<br>18.4 | 0.469 – 0.606<br>11.9 – 15.4 |

## SuperSOT™-8 Tape and Reel Data and Package Dimensions, continued

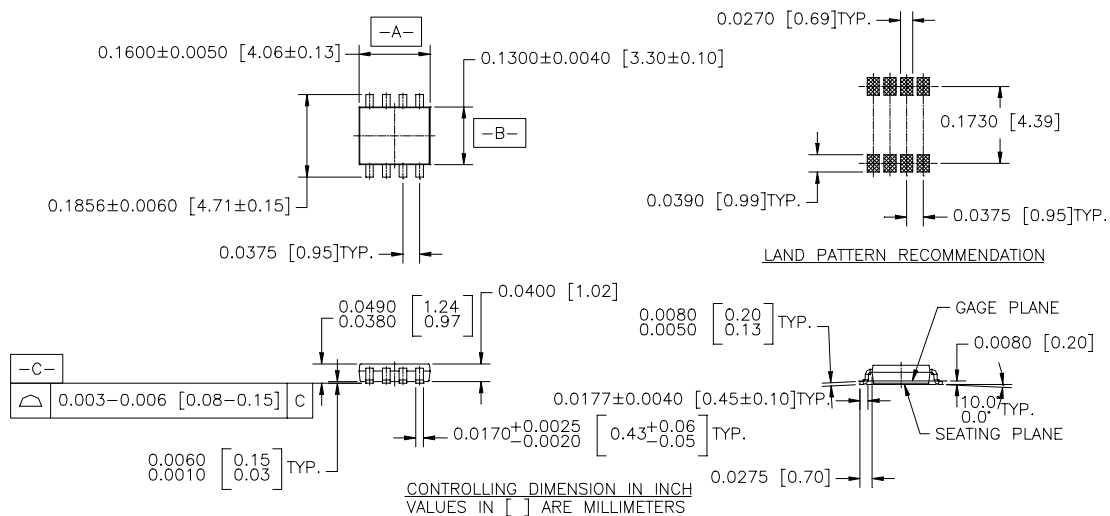
### SuperSOT™-8 (FS PKG Code 34, 35)



Scale 1:1 on letter size paper

Dimensions shown below are in:  
inches [millimeters]

Part Weight per unit (gram): 0.0416



NOTES : UNLESS OTHERWISE SPECIFIED

1. STANDARD LEAD FINISH TO BE 200 MICROINCHES / 5.08 MICROMETERS MINIMUM TIN/LEAD (SOLDER) ON COPPER.
2. NO JEDEC REGISTRATION AS JAN. 1996

SUPER SOT, 8 LEADS

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