**FAIRCHILD**

SEMICONDUCTOR ™

NDT451N

N-Channel Enhancement Mode Field Effect Transistor

General Description

Power SOT N-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 DC motor control and DC/DC conversion where fast switching, low in-line power loss, and resistance to transients are needed.

Features

- 5.5A, 30V. $R_{DS(ON)} = 0.05\Omega$ @ $V_{GS} = 10V$.
- High density cell design for extremely low $R_{DS(ON)}$.
- High power and current handling capability in a widely used surface mount package.

SOT-223

SOT-223*
(J23Z)
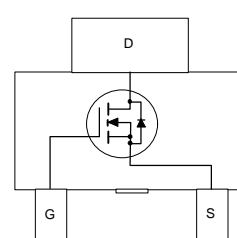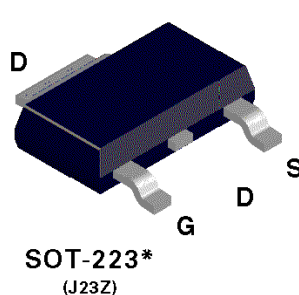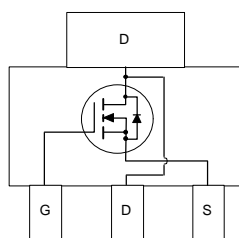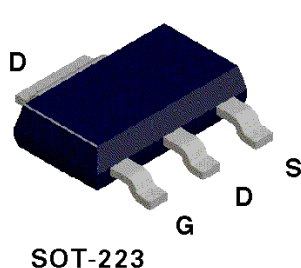
Absolute Maximum Ratings $T_A = 25°C$ unless otherwise noted

Symbol	Parameter			NDT451N	Units
V_{DSS}	Drain-Source Voltage			30	V
V_{GSS}	Gate-Source Voltage			±20	V
I_D	Drain Current	- Continuous	(Note 1a)	±5.5	A
		- Pulsed		±25	
P_D	Maximum Power Dissipation		(Note 1a)	3	W
			(Note 1b)	1.3	
			(Note 1c)	1.1	
T_J, T_{STG}	Operating and Storage Temperature Range			-65 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

* Order option J23Z for cropped center drain lead.

Electrical Characteristics (T$_A$ = 25°C unless otherwise noted)

Symbol	Parameter	Conditions		Min	Typ	Max	Units
OFF CHARACTERISTICS							
BV$_{DSS}$	Drain-Source Breakdown Voltage	V$_{GS}$ = 0 V, I$_D$ = 250 µA		30			V
I$_{DSS}$	Zero Gate Voltage Drain Current	V$_{DS}$ = 24 V, V$_{GS}$ = 0 V				2	µA
			T$_J$ = 55°C			20	µA
I$_{GSSF}$	Gate - Body Leakage, Forward	V$_{GS}$ = 20 V, V$_{DS}$ = 0 V				100	nA
I$_{GSSR}$	Gate - Body Leakage, Reverse	V$_{GS}$ = -20 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	1.6	3	V
			T$_J$ = 125°C	0.7	1.2	2.2	
R$_{DS(ON)}$	Static Drain-Source On-Resistance	V$_{GS}$ = 10 V, I$_D$ = 5.5 A			0.042	0.05	Ω
			T$_J$ = 125°C		0.065	0.1	
		V$_{GS}$ = 4.5 V, I$_D$ = 4.3 A			0.064	0.08	
I$_{D(on)}$	On-State Drain Current	V$_{GS}$ = 10 V, V$_{DS}$ = 5 V		18			A
		V$_{GS}$ = 4.5 V, V$_{DS}$ = 5 V		15			
g$_{FS}$	Forward Transconductance	V$_{DS}$ = 10 V, I$_D$ = 5.5 A			6		S
DYNAMIC CHARACTERISTICS							
C$_{iss}$	Input Capacitance	V$_{DS}$ = 10 V, V$_{GS}$ = 0 V, f = 1.0 MHz			730		pF
C$_{oss}$	Output Capacitance				370		pF
C$_{rss}$	Reverse Transfer Capacitance				140		pF
SWITCHING CHARACTERISTICS (Note 2)							
t$_{D(on)}$	Turn - On Delay Time	V$_{DD}$ = 15 V, I$_D$ = 1.0 A, V$_{GEN}$ = 10 V, R$_{GEN}$ = 6 Ω			20	30	ns
t$_r$	Turn - On Rise Time				15	25	ns
t$_{D(off)}$	Turn - Off Delay Time				19	40	ns
t$_f$	Turn - Off Fall Time				10	30	ns
Q$_g$	Total Gate Charge	V$_{DS}$ = 10 V, I$_D$ = 5.5 A, V$_{GS}$ = 10 V			16	25	nC
Q$_{gs}$	Gate-Source Charge				1.8	3	nC
Q$_{gd}$	Gate-Drain Charge				4.5	7	nC

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Electrical Characteristics $(T_A = 25°C$ unless otherwise noted)

Symbol	Parameter	Conditions	Min	Typ	Max	Units
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, $I_S = 5.5$ 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.
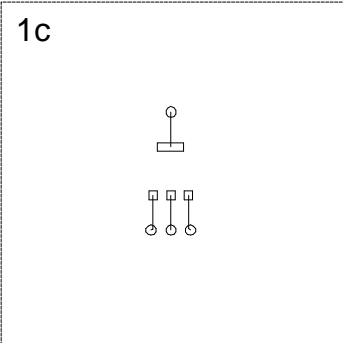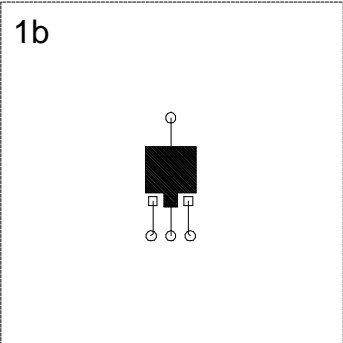
$$P_D(t) = \frac{T_J - T_A}{R_{\theta JA}(t)} = \frac{T_J - T_A}{R_{\theta JC} + R_{\theta CA}(t)} = I_D^2(t) \times R_{DS(ON)@T_J}$$

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

   a. 42°C/W when mounted on a 1 in^2 pad of 2oz copper.

   b. 95°C/W when mounted on a 0.066 in^2 pad of 2oz copper.

   c. 110°C/W when mounted on a 0.0123 in^2 pad of 2oz copper.
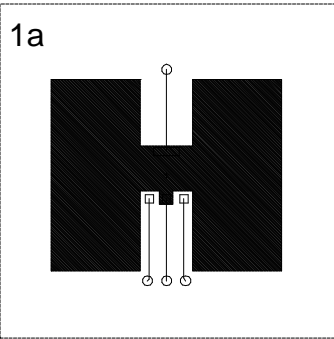
Scale 1 : 1 on letter size paper

2. Pulse Test: Pulse Width $\leq$ 300µs, Duty Cycle $\leq$ 2.0%.

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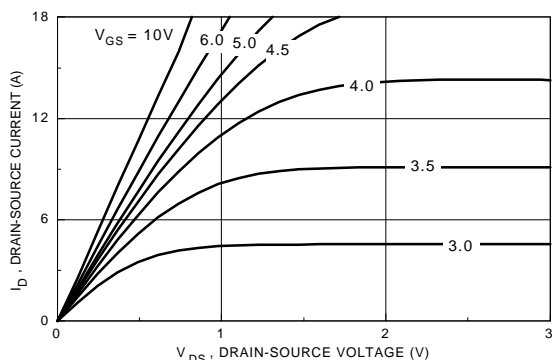
Typical Electrical Characteristics
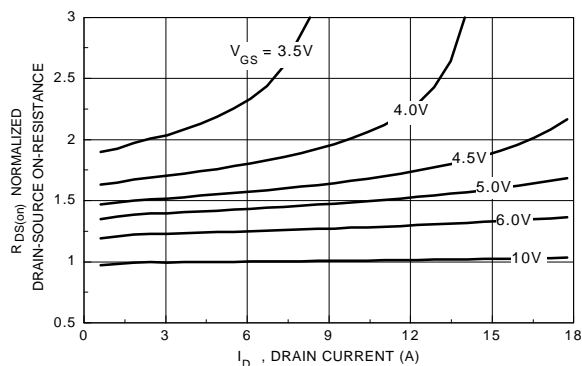

Figure 1. On-Region Characteristics.

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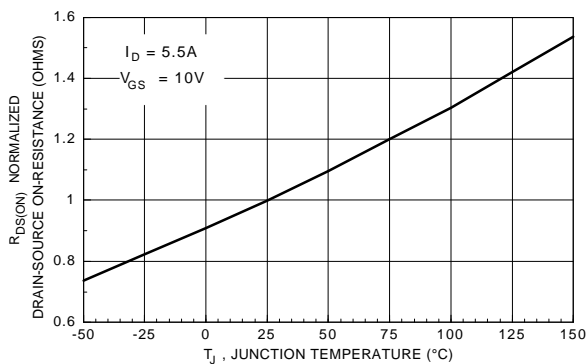and Drain Current.

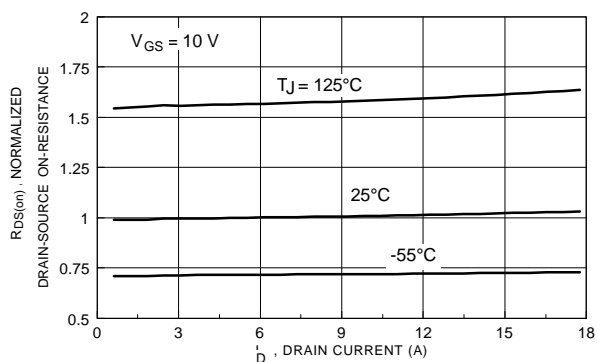Figure 3. On-Resistance Variation
with Temperature.

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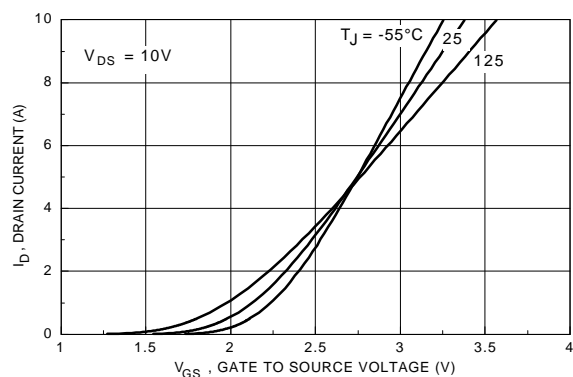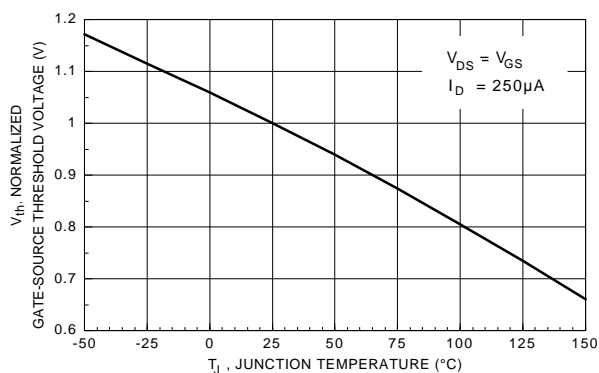Current and Temperature.

Figure 5. Transfer Characteristics.

Figure 6. Gate Threshold Variation with
Temperature.

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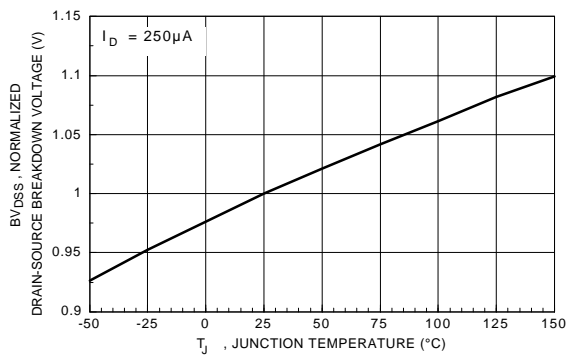
Typical Electrical Characteristics (continued)

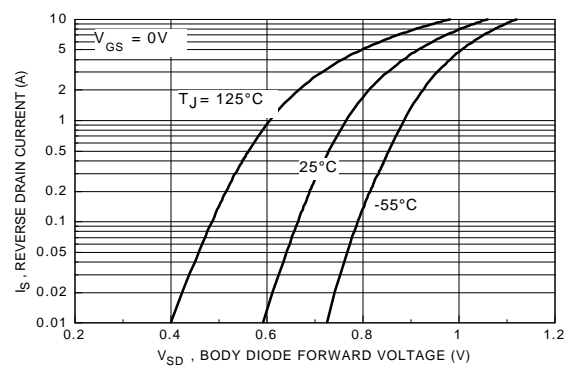**Figure 7. Breakdown Voltage Variation with Temperature.**

X-axis: T_J, JUNCTION TEMPERATURE (°C)
Y-axis: BV_{DSS}, NORMALIZED DRAIN-SOURCE BREAKDOWN VOLTAGE (V)
$I_D = 250\mu A$

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

X-axis: V_{SD}, BODY DIODE FORWARD VOLTAGE (V)
Y-axis: I_S, REVERSE DRAIN CURRENT (A)
$V_{GS} = 0V$
$T_J = 125°C$
25°C
-55°C
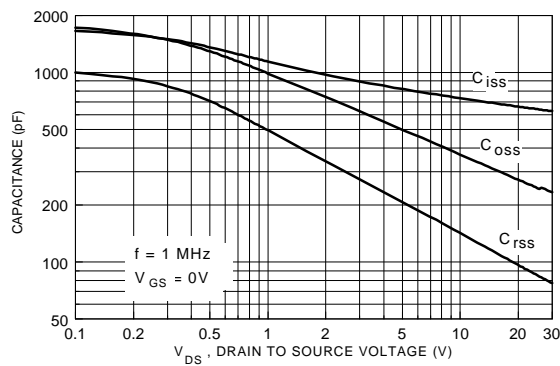
Figure 9. Capacitance Characteristics.

X-axis: V_{DS}, DRAIN TO SOURCE VOLTAGE (V)
Y-axis: CAPACITANCE (pF)
C_{iss}
C_{oss}
C_{rss}
f = 1 MHz
$V_{GS} = 0V$
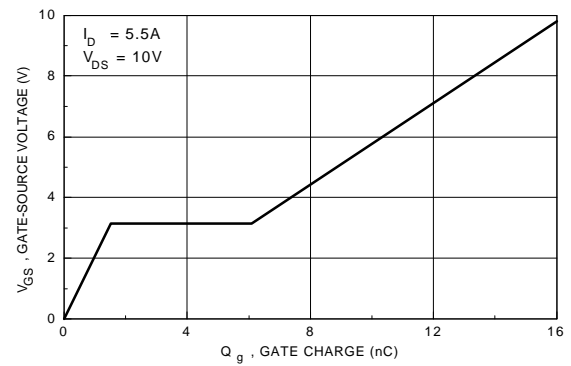
Figure 10. Gate Charge Characteristics.

X-axis: Q_g, GATE CHARGE (nC)
Y-axis: V_{GS}, GATE-SOURCE VOLTAGE (V)
$I_D = 5.5A$
$V_{DS} = 10V$
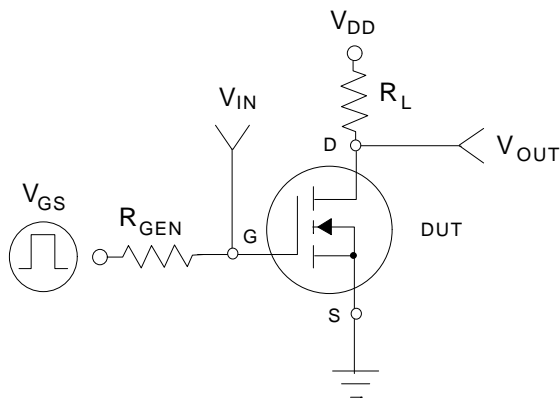
Figure 11. Switching Test Circuit.

V_{DD}
V_{IN}
R_L
D
V_{OUT}
V_{GS}
R_{GEN}
G
DUT
S

Figure 12. Switching Waveforms.

t_{on}
$t_{d(on)}$
t_r
$t_{d(off)}$
t_{off}
t_f
V_{OUT}
90%
10%
90%
10%
INVERTED
V_{IN}
50%
90%
50%
10%
PULSE WIDTH

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Typical Electrical Characteristics (continued)

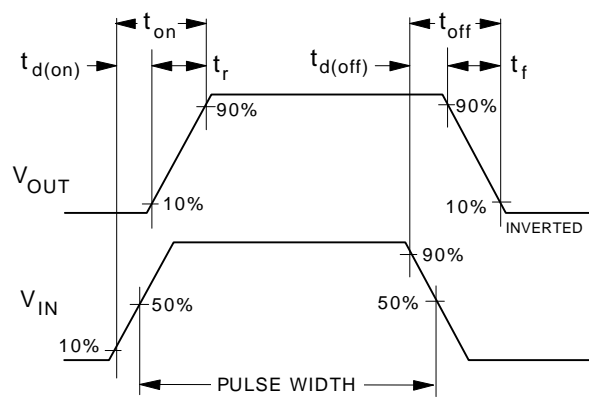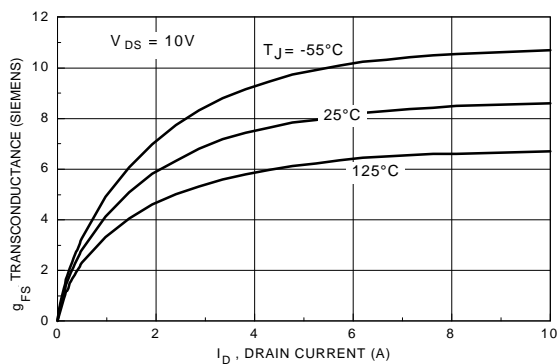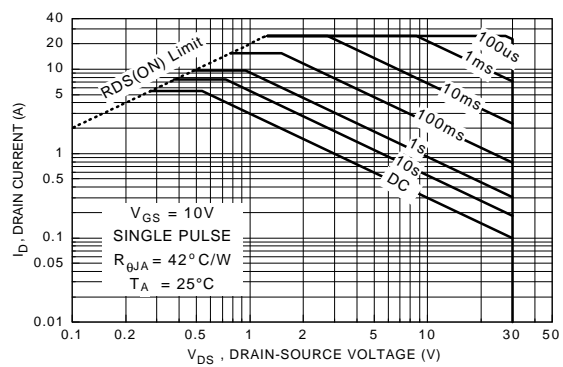Figure 13. Transconductance Variation with Drain Current and Temperature.

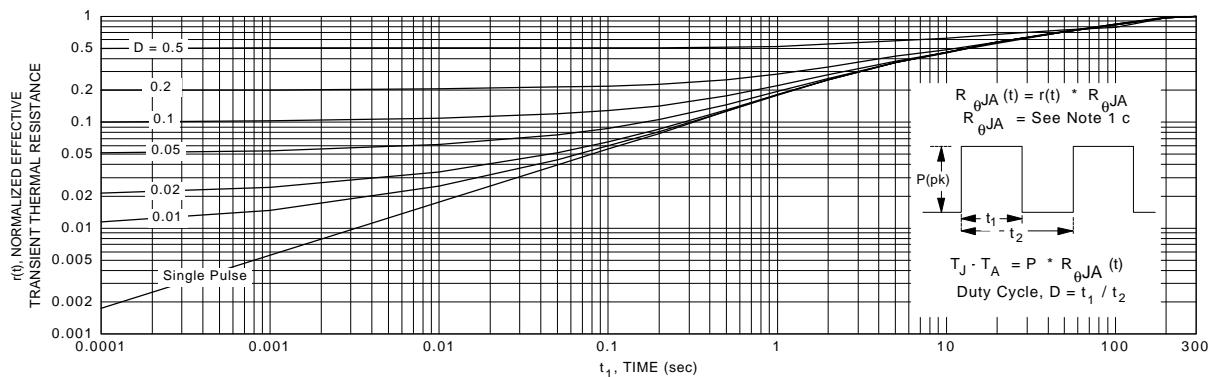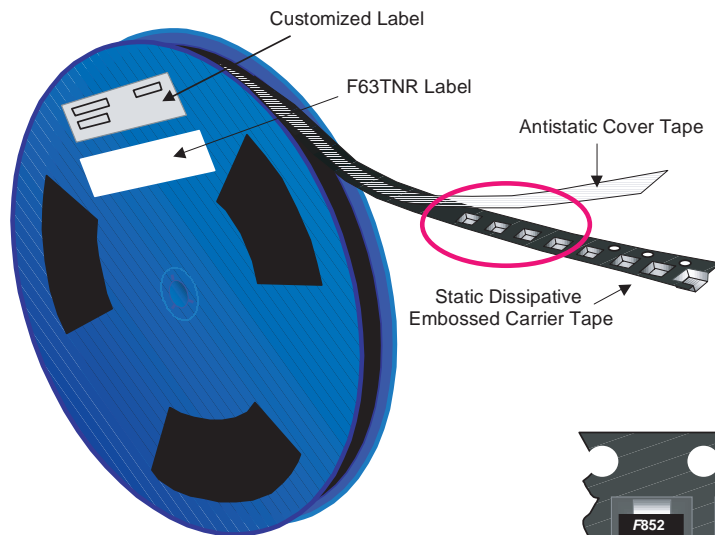Figure 14. Maximum Safe Operating Area.

Figure 15. Transient Thermal Response Curve.

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

SOT-223 Tape and Reel Data and Package Dimensions

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SOT-223 Packaging
Configuration: Figure 1.0

Customized Label

F63TNR Label

Antistatic Cover Tape

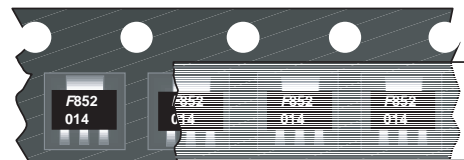Static Dissipative
Embossed Carrier Tape
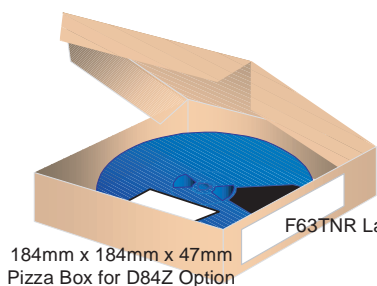
Packaging Description:

SOT-223 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 2,500 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.

SOT-223 Unit Orientation

F852
014

SOT-223 Packaging Information		
Packaging Option	Standard (no flow code)	D84Z
Packaging type	TNR	TNR
Qty per Reel/Tube/Bag	2,500	500
Reel Size	13" Dia	7" Dia
Box Dimension (mm)	343x64x343	184x187x47
Max qty per Box	5,000	1,000
Weight per unit (gm)	0.1246	0.1246
Weight per Reel (kg)	0.7250	0.1532
Note/Comments		

343mm x 342mm x 64mm
Intermediate box for Standard

F63TNR Label

184mm x 184mm x 47mm
Pizza Box for D84Z Option
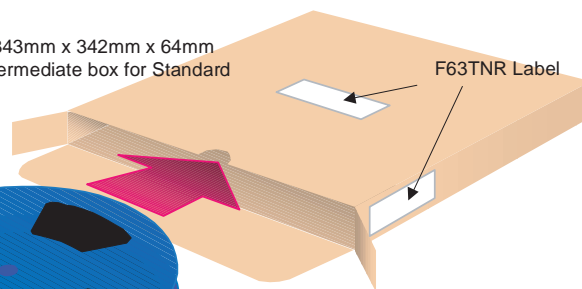
F63TNR Label

F63TNR Label sample

LOT: CBVK741B019   QTY: 3000

FSID: PN2222A   SPEC:

D/C1: D9842   QTY1:   SPEC REV:
D/C2:   QTY2:   CPN:
                       N/F: F   (F63TNR)3

SOT-223 Tape Leader and Trailer
Configuration: Figure 2.0

Carrier Tape

Cover Tape

Trailer Tape
300mm minimum or
38 empty pockets

Components

Leader Tape
500mm minimum or
62 empty pockets
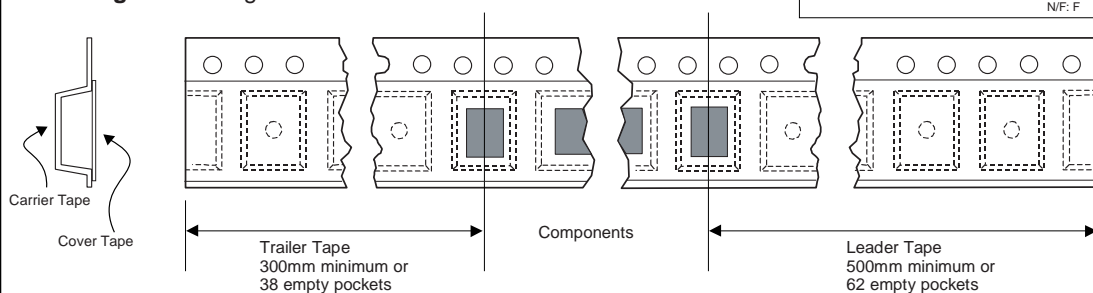
September 1999, Rev. B

SOT-223 Tape and Reel Data and Package Dimensions, continued

SOT-223 Embossed Carrier Tape
Configuration: Figure 3.0

User Direction of Feed

						Dimensions are in millimeter							
Pkg type	A0	B0	W	D0	D1	E1	E2	F	P1	P0	K0	T	Wc	Tc
SOT-223 (12mm)	6.83 +/-0.10	7.42 +/-0.10	12.0 +/-0.3	1.55 +/-0.05	1.50 +/-0.10	1.75 +/-0.10	10.25 min	5.50 +/-0.05	8.0 +/-0.1	4.0 +/-0.1	1.88 +/-0.10	0.292 +/-0.0130	9.5 +/-0.025	0.06 +/-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).
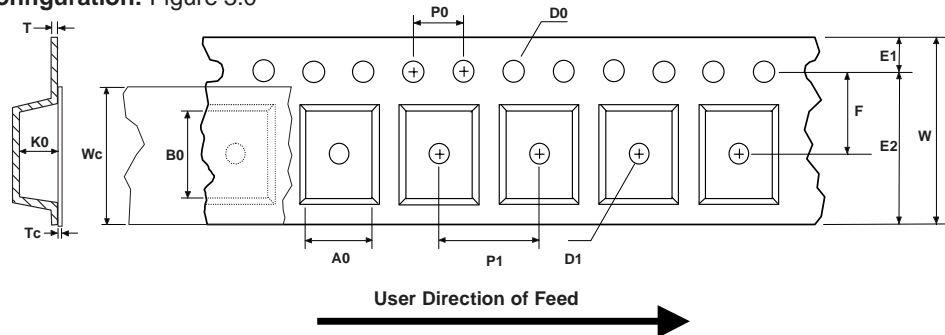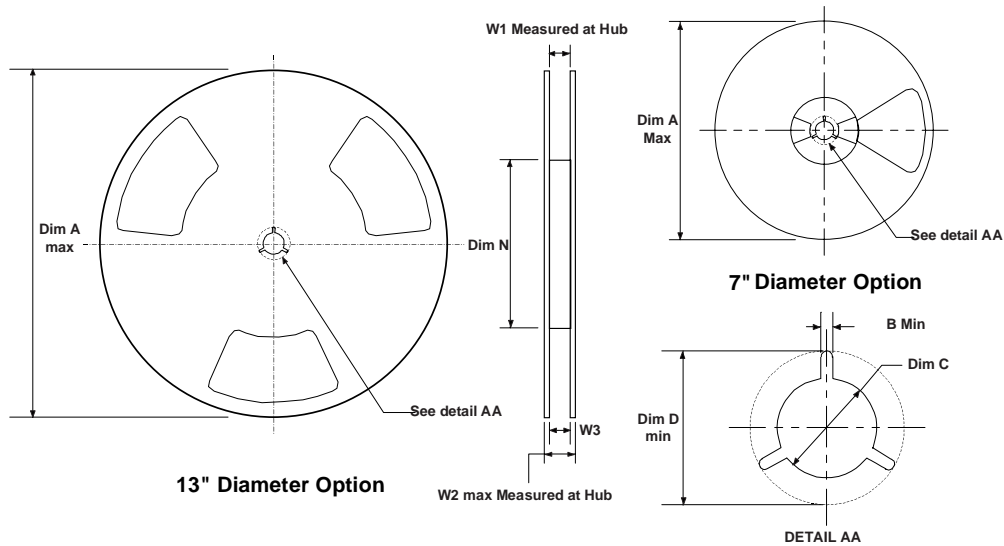

20 deg maximum component rotation

Sketch A (Side or Front Sectional View)
Component Rotation

Sketch B (Top View)
Component Rotation

Sketch C (Top View)
Component lateral movement
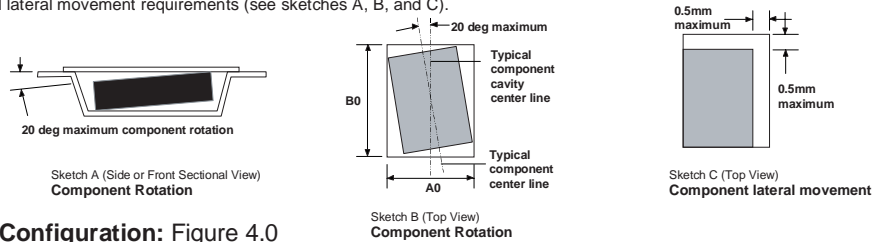
SOT-223 Reel Configuration: Figure 4.0

13" Diameter Option

7" Diameter Option

DETAIL AA

					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	7.00 177.8	0.059 1.5	512 +0.020/-0.008 13 +0.5/-0.2	0.795 20.2	5.906 150	0.488 +0.078/-0.000 12.4 +2/0	0.724 18.4	0.469 – 0.606 11.9 – 15.4
12mm	13" Dia	13.00 330	0.059 1.5	512 +0.020/-0.008 13 +0.5/-0.2	0.795 20.2	7.00 178	0.488 +0.078/-0.000 12.4 +2/0	0.724 18.4	0.469 – 0.606 11.9 – 15.4

July 1999, Rev. B

SOT-223 (FS PKG Code 47)

1 : 1

Scale 1:1 on letter size paper

Part Weight per unit (gram): 0.1246

0.256±0.008 [6.50±0.20]

0.122 [3.10]
0.114 [2.90]

⊕ 0.004 [0.1 Ⓜ CA Ⓢ B Ⓢ]

─A─

0.1400 +0.0060 −0.0100 [3.56 +0.15 −0.25]

0.274 +0.013 −0.010 [6.96 +0.33 −0.25]

─B─

0.0900TYP. [2.29]

0.129MAX. [3.28]

Ⓒ

0.059MAX. [1.50]

0.059MAX. [1.50]

0.248 [6.30]

0.039 [0.99]TYP.

0.090 [2.29]

LAND PATTERN RECOMMENDATION
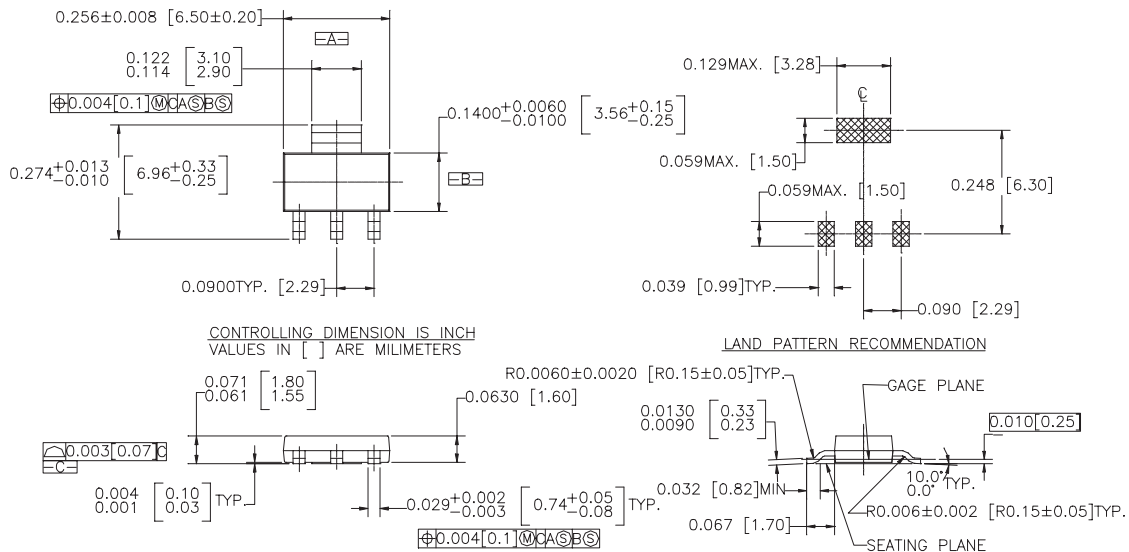
CONTROLLING DIMENSION IS INCH
VALUES IN [ ] ARE MILIMETERS

0.071 [1.80]
0.061 [1.55]

0.0630 [1.60]

⌒ 0.003 [0.07] Ⓒ
─C─

0.004 [0.10] TYP.
0.001 [0.03]

0.029 +0.002 −0.003 [0.74 +0.05 −0.08] TYP.

⊕ 0.004 [0.1 Ⓜ CA Ⓢ B Ⓢ]

R0.0060±0.0020 [R0.15±0.05]TYP.

0.0130 [0.33]
0.0090 [0.23]

0.032 [0.82]MIN.

0.067 [1.70]

GAGE PLANE

0.010 [0.25]

10.0° TYP.
0.0°

R0.006±0.002 [R0.15±0.05]TYP.

SEATING PLANE

SOT223, 4 LEADS

NOTES : UNLESS OTHERWISE SPECIFIED
1. STANDARD LEAD FINISH TO BE 150 MICROINCHES/ 3.81 MICROMETERS
MINIMUM TIN/LEAD (SOLDER) ON COPPER.
2. REFERENCE JEDEC REGISTRATION TO-261, VARIATION AA, ISSUE A, DATED JAN 1990

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CoolFET™	MICROWIRE™	UHC™
CROSSVOLT™	POP™	VCX™
E²CMOS™	PowerTrench™	
FACT™	QFET™	
FACT Quiet Series™	QS™	
FAST®	Quiet Series™	
FASTr™	SuperSOT™-3	
GTO™	SuperSOT™-6	
HiSeC™	SuperSOT™-8	

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2. A critical component is any component of a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.

PRODUCT STATUS DEFINITIONS

Definition of Terms

Datasheet Identification	Product Status	Definition
Advance Information	Formative or In Design	This datasheet contains the design specifications for product development. Specifications may change in any manner without notice.
Preliminary	First Production	This datasheet contains preliminary data, and supplementary data will be published at a later date. Fairchild Semiconductor reserves the right to make changes at any time without notice in order to improve design.
No Identification Needed	Full Production	This datasheet contains final specifications. Fairchild Semiconductor reserves the right to make changes at any time without notice in order to improve design.
Obsolete	Not In Production	This datasheet contains specifications on a product that has been discontinued by Fairchild semiconductor. The datasheet is printed for reference information only.