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Please note: As part of the Fairchild Semiconductor integration, some of the Fairchild orderable part numbers will need to change in order to meet ON Semiconductor's system requirements. Since the ON Semiconductor product management systems do not have the ability to manage part nomenclature that utilizes an underscore (_), the underscore (_) in the Fairchild part numbers will be changed to a dash (-). This document may contain device numbers with an underscore (_). Please check the ON Semiconductor website to verify the updated device numbers. The most current and up-to-date ordering information can be found at www.onsemi.com. Please email any questions regarding the system integration to Fairchild_questions@onsemi.com.

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NDT014L
N-Channel Logic Level Enhancement Mode Field Effect Transistor

General Description

These N-Channel logic level 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, provide superior switching performance, and withstand high energy pulses in the avalanche and commutation modes.Thesedevices 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

- 2.8 A, 60 V. $R_{DS(ON)} = 0.2 \ \Omega$ @ $V_{GS} = $ 4.5 V
  $R_{DS(ON)} = 0.16 \ \Omega$ @ $V_{GS} = 10$ V.

- 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)
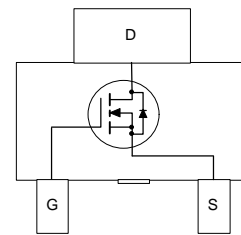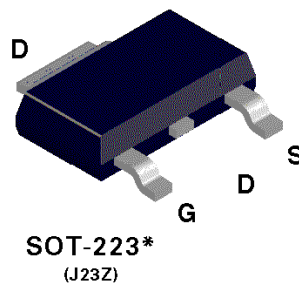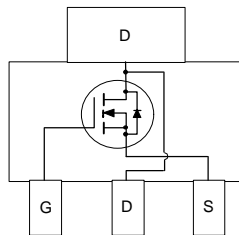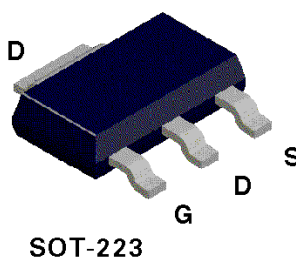
Absolute Maximum Ratings T_A = 25°C unless otherwise noted

Symbol	Parameter			NDT014L	Units
V_{DSS}	Drain-Source Voltage			60	V
V_{GSS}	Gate-Source Voltage			± 20	V
I_D	Drain Current	- Continuous	(Note 1a)	± 2.8	A
		- Pulsed		± 10	
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

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		60			V
I_{DSS}	Zero Gate Voltage Drain Current	V_{DS} = 60 V, V_{GS} = 0 V				25	µA
			T_J = 55°C			250	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	1.5	3	V
			T_J = 125°C	0.8	1.1	2	
$R_{DS(ON)}$	Static Drain-Source On-Resistance	V_{GS}= 4.5 V, I_D = 2.8 A			0.17	0.2	Ω
			T_J = 125°C		0.22	0.36	
		V_{GS} = 10 V, I_D = 3.4 A			0.12	0.16	
$I_{D(on)}$	On-State Drain Current	V_{GS} = 4.5 V , V_{DS} = 5 V		5			A
		V_{GS} = 10 V, V_{DS} = 5 V		10			
G_{FS}	Forward Transconductance	V_{GS} = 5 V, I_D = 2.8 A			4.2		S
DYNAMIC CHARACTERISTICS							
C_{iss}	Input Capacitance	V_{DS} = 30 V, V_{GS} = 0 V, f = 1.0 MHz			214		pF
C_{oss}	Output Capacitance				70		pF
C_{rss}	Reverse Transfer Capacitance				27		pF
SWITCHING CHARACTERISTICS (Note 2)							
$t_{D(on)}$	Turn - On Delay Time	V_{DD} = 30 V, I_D = 3 A, V_{GEN} = 10 V, R_{GEN} = 12 Ω			6	12	ns
t_r	Turn - On Rise Time				14	25	ns
$t_{D(off)}$	Turn - Off Delay Time				15	28	ns
t_f	Turn - Off Fall Time				10	18	ns
Q_g	Total Gate Charge	V_{DS} = 10 V, I_D = 2.8 A, V_{GS} = 4.5 V			3.6	5	nC
Q_{gs}	Gate-Source Charge				0.8		nC
Q_{gd}	Gate-Drain Charge				1.4		nC

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				2.3	A
V$_{SD}$	Drain-Source Diode Forward Voltage	V$_{GS}$ = 0 V, I$_S$ = 2.3 A (Note 2)		0.85	1.3	V
t$_{rr}$	Reverse Recovery Time	V$_{GS}$ = 0 V, I$_F$ = 2.3 A dI$_F$/dt = 100 A/µs			140	ns

Notes:

1. $P_D(t) = \frac{T_J - T_A}{R_{\theta JA}(t)} = \frac{T_J - T_A}{R_{\theta JC} + R_{\theta CA}(t)} = I_D^2(t) \times R_{DS(ON)@T_J}$ 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 defined by users. For general reference: Applications on 4.5"x5" FR-4 PCB under still air environment, typical R$_{\theta JA}$ is found to be:

   a. 42°C/W with 1 in^2 of 2 oz copper mounting pad.
   b. 95°C/W with 0.066 in^2 of 2 oz copper mounting pad.
   c. 110°C/W with 0.0123 in^2 of 2 oz copper mounting pad.
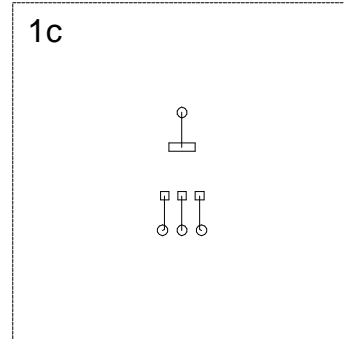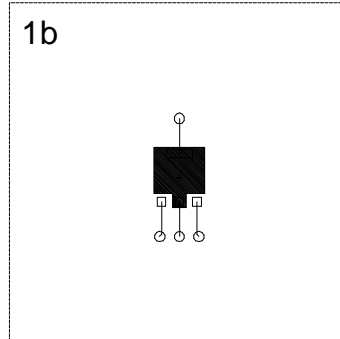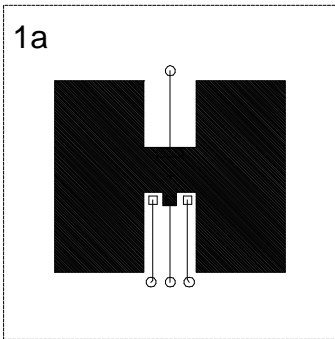
Scale 1 : 1 on letter size paper

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

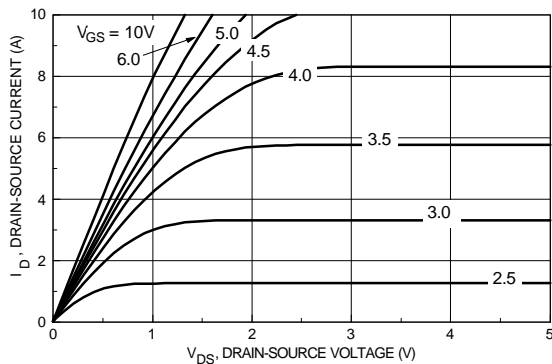## Typical Electrical Characteristics
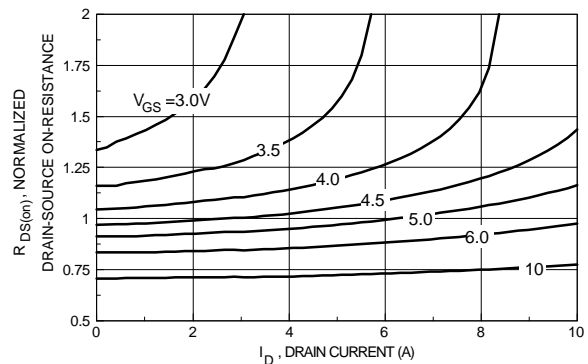

Figure 1. On-Region Characteristics.

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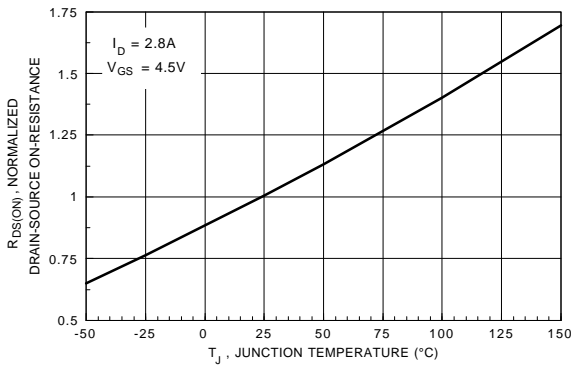

Figure 3. On-Resistance Variation with Temperature.
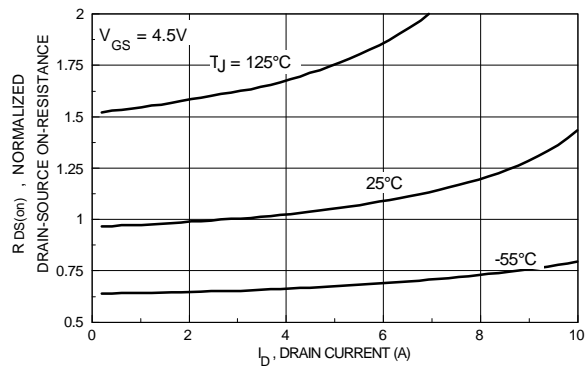

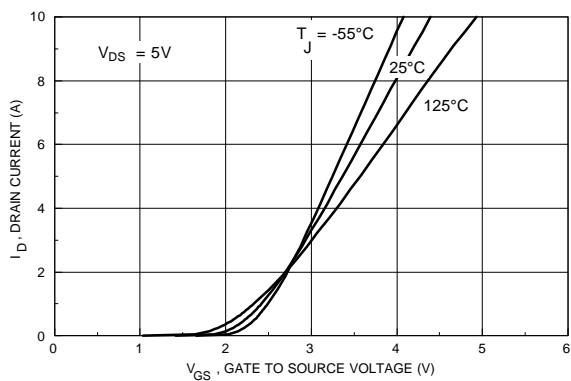Figure 4. On-Resistance Variation with Drain Current and Temperature.
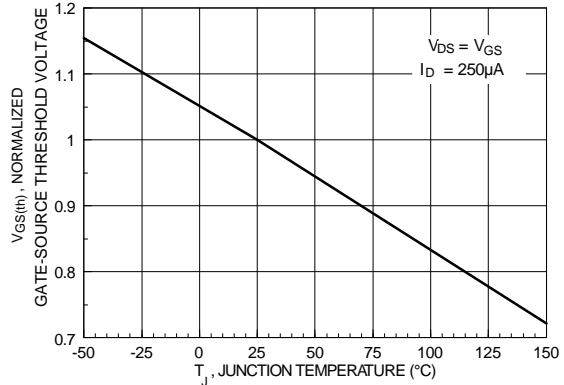

Figure 5. Transfer Characteristics.

Figure 6. Gate Threshold Variation with Temperature.

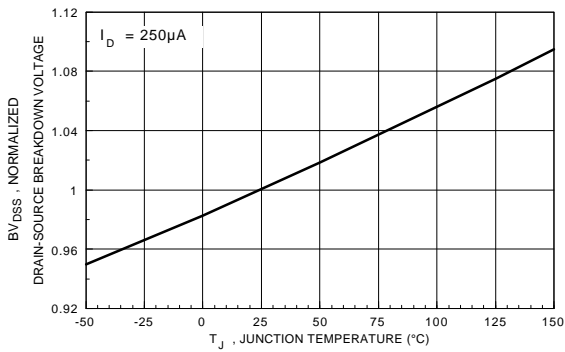NDT014L Rev.D

Typical Electrical Characteristics

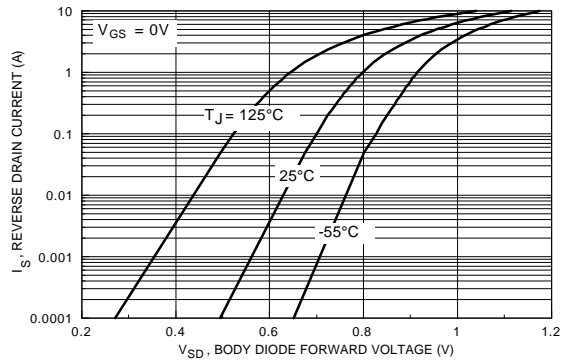Figure 7. Breakdown Voltage Variation with Temperature.

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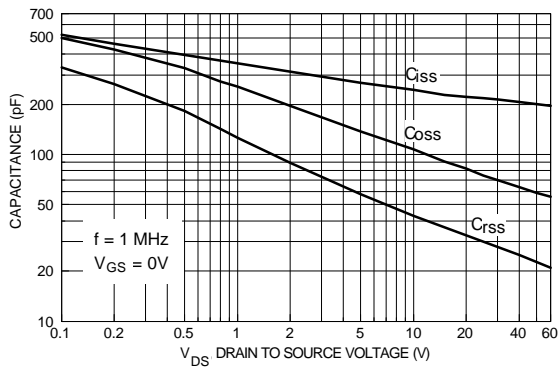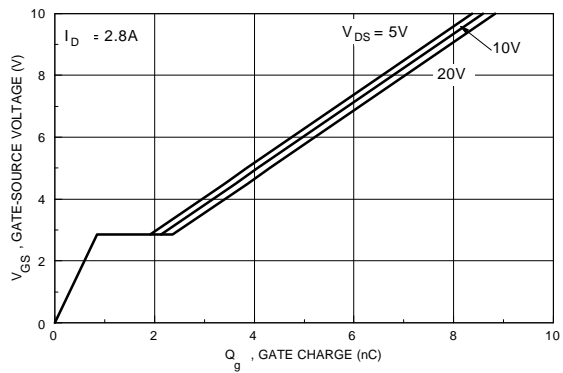

Figure 9. Capacitance Characteristics.
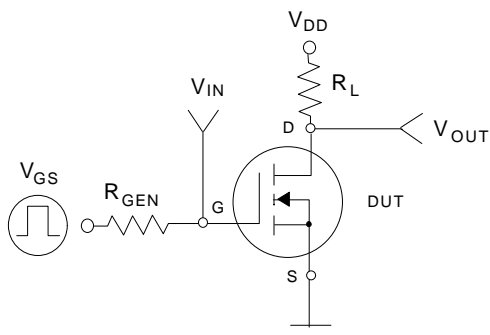

Figure 10. Gate Charge Characteristics.

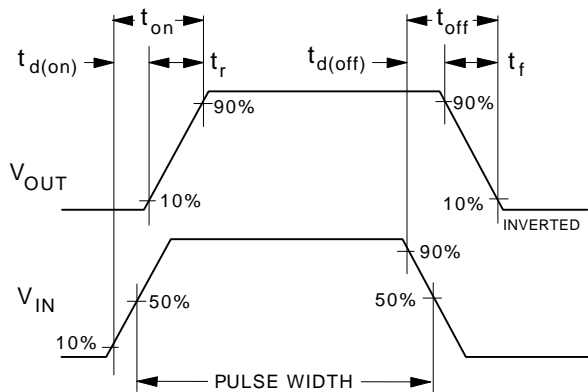Figure 11. Switching Test Circuit.

Figure 12. Switching Waveforms.

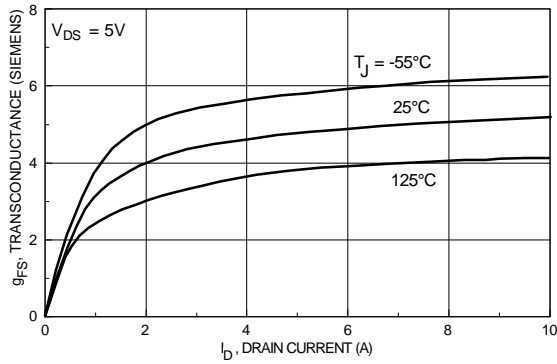NDT014L Rev.D

Typical Thermal Characteristics

Figure 13. Transconductance Variation with Drain Current and Temperature.
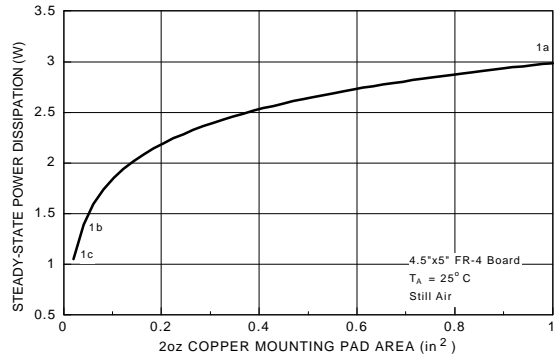

Figure 14. SOT-223 Maximum Steady- State Power Dissipation versus Copper Mounting Pad Area.
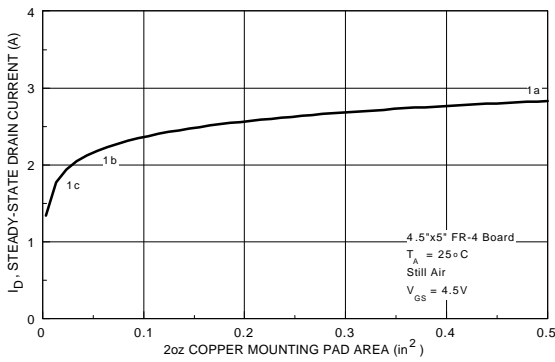

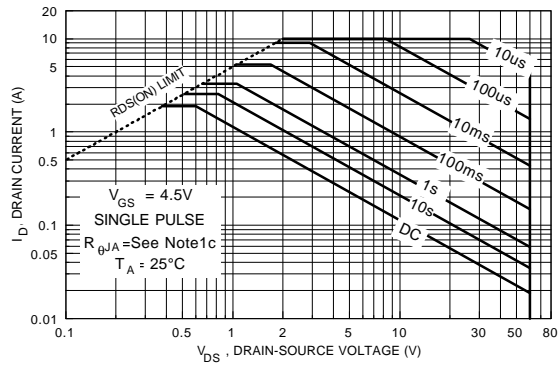Figure 15. Maximum Steady- State Drain Current versus Copper Mounting Pad Area.

Figure 16. Maximum Safe Operating Area.

$$R_{\theta JA}(t) = r(t) * R_{\theta JA}$$
$$R_{\theta JA} = \text{See Note 1 c}$$

$$T_J - T_A = P * R_{\theta JA}(t)$$
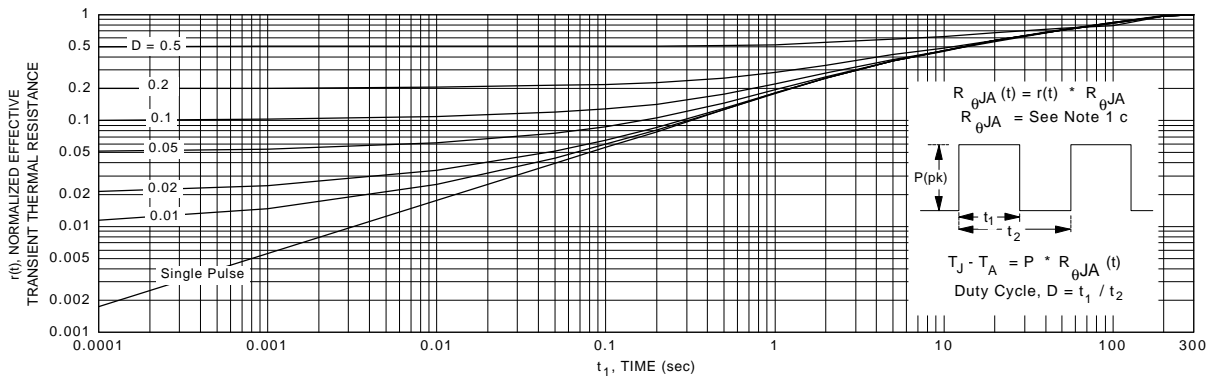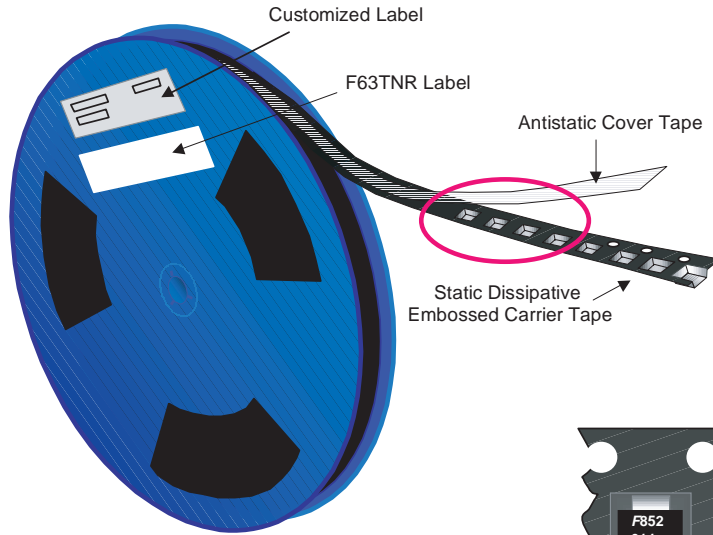$$\text{Duty Cycle, } D = t_1 / t_2$$

Figure 17. Typical Transient Thermal Impedance Curve.

Remark: Thermal characterization performed under the conditions of Note 1c. Should better thermal design employs, $R_{\theta JA}$ will be lower and reach thermal equivalent sooner.
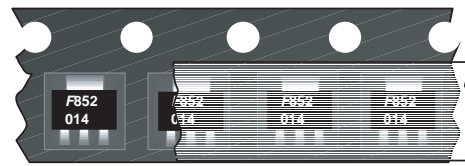
SOT-223 Tape and Reel Data and Package Dimensions

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SOT-223 Packaging
Configuration: Figure 1.0

Customized Label

F63TNR Label
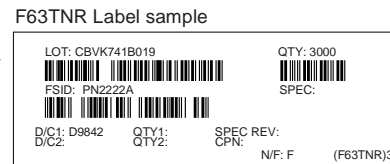
Antistatic Cover Tape

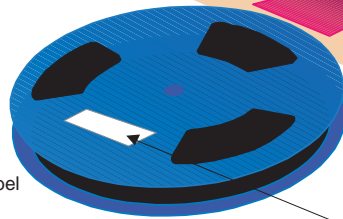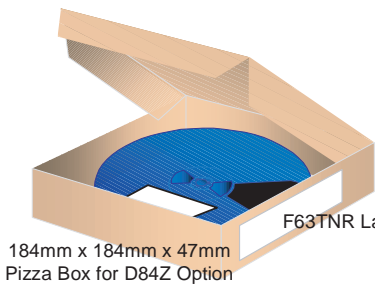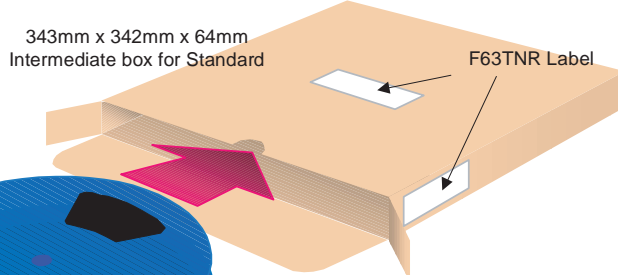Static Dissipative
Embossed Carrier Tape

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.
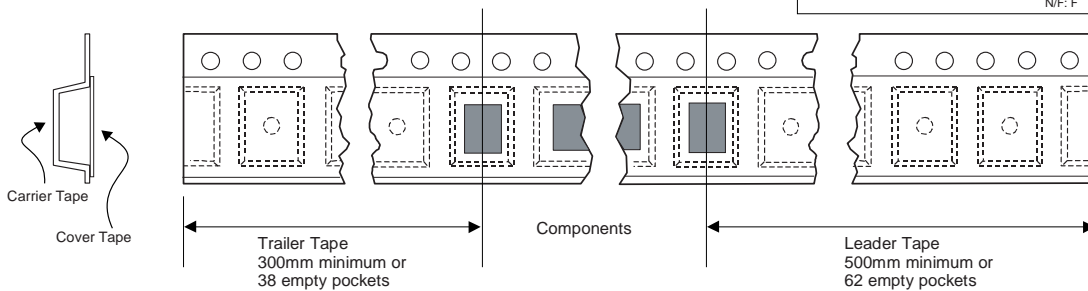
SOT-223 Unit Orientation

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

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

SOT-223 Embossed Carrier Tape
Configuration: Figure 3.0

P0   D0

T

E1

F
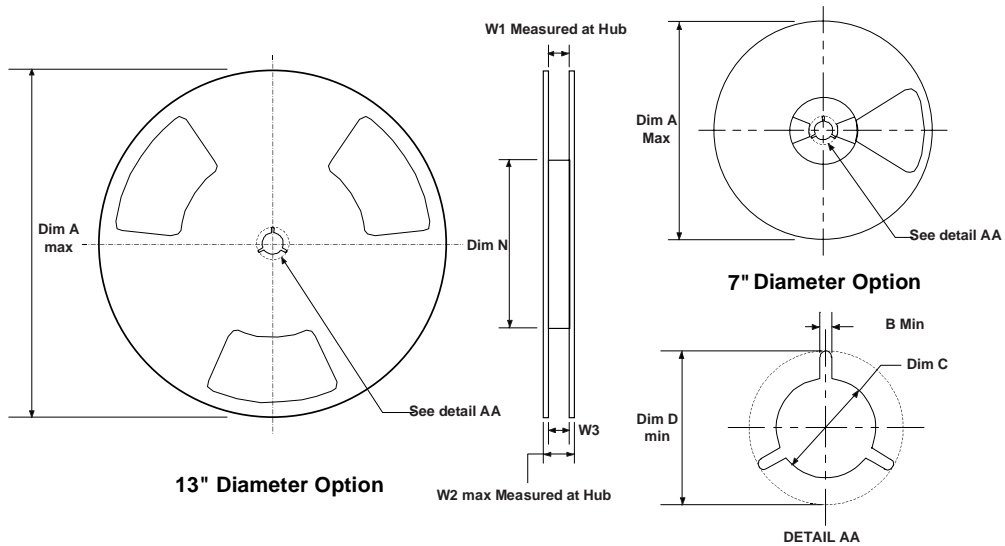
E2

W

K0

Wc

B0

Tc

A0   P1   D1

User Direction of Feed
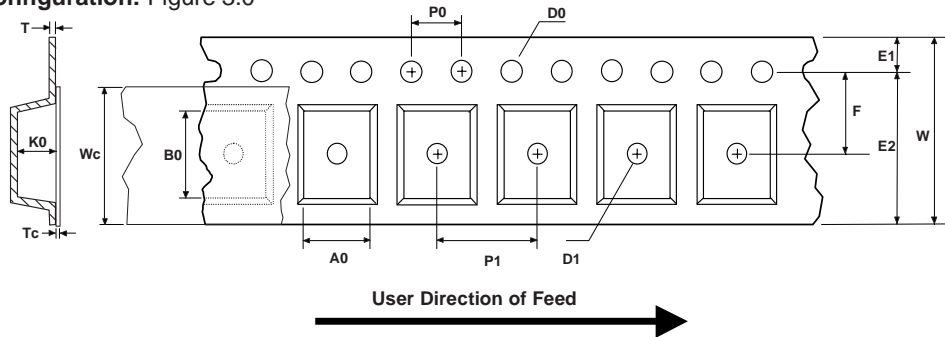
Dimensions are in millimeter													
Pkg type	A0	B0	W	D0	D1	E1	E2	F	P1	P0	K0	T	Wc	Tc
SOT-223 (12mm)	6.83 +/-0.10	7.42 +/-0.10	12.0 +/-0.3	1.55 +/-0.05	1.50 +/-0.10	1.75 +/-0.10	10.25 min	5.50 +/-0.05	8.0 +/-0.1	4.0 +/-0.1	1.88 +/-0.10	0.292 +/-0.0130	9.5 +/-0.025	0.06 +/-0.02

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).
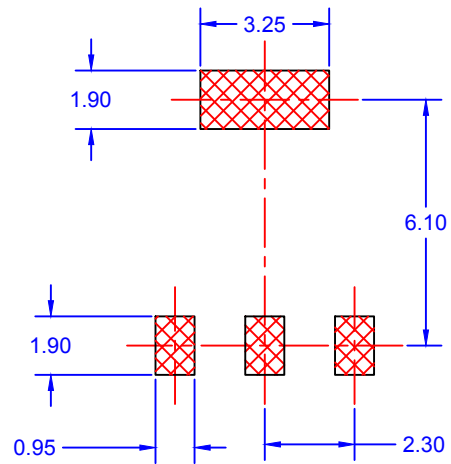
20 deg maximum component rotation

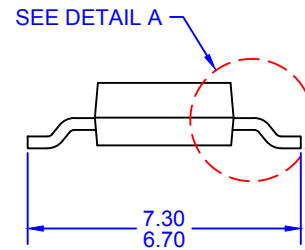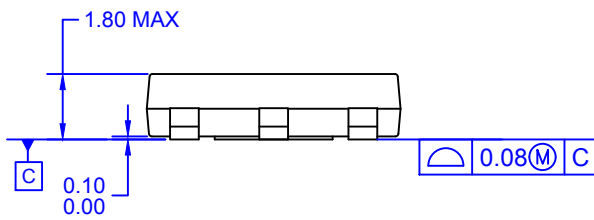Sketch A (Side or Front Sectional View)
Component Rotation

20 deg maximum

B0

Typical component cavity center line

Typical component center line

A0

Sketch B (Top View)
Component Rotation

0.5mm maximum

0.5mm maximum

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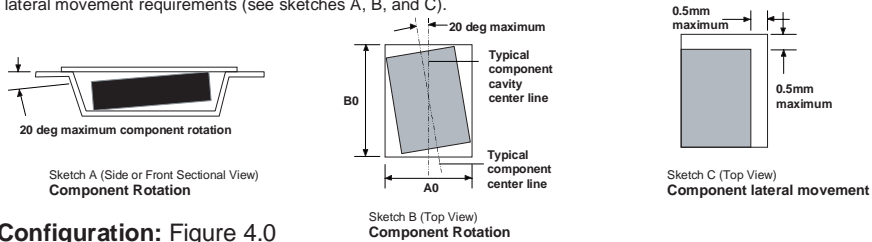
SOT-223 Reel Configuration: Figure 4.0

W1 Measured at Hub

Dim A max

Dim N

See detail AA

13" Diameter Option

W3

W2 max Measured at Hub

Dim A Max

See detail AA

7" Diameter Option

B Min

Dim C

Dim D min

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

6.70
6.20

⌖ 0.10Ⓜ C B

3.10
2.90

4

A

3.70
3.30

1   3

0.84
0.60

2.30

4.60

⌖ 0.10Ⓜ C B

3.25

1.90

6.10

1.90

0.95   2.30

LAND PATTERN RECOMMENDATION

1.80 MAX

⌓ 0.08Ⓜ C

C

0.10
0.00

SEE DETAIL A

7.30
6.70

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

GAGE
PLANE

10°
5°

R0.15±0.05

R0.15±0.05

10°
0° TYP

0.35
0.20

0.25

10°
5°

0.60 MIN

SEATING
PLANE

1.70

FAIRCHILD™

DETAIL A
SCALE: 2:1

PUBLICATION ORDERING INFORMATION
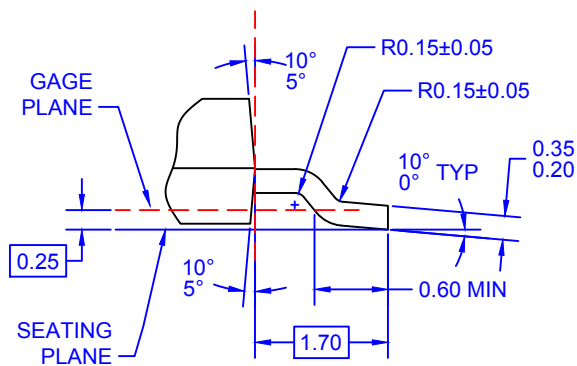
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