FAIRCHILD
SEMICONDUCTOR™

April 1995

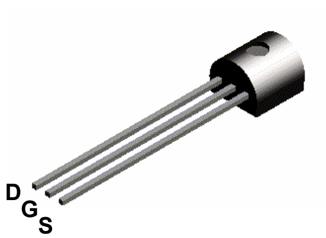
NDF0610 / NDS0610
P-Channel Enhancement Mode Field Effect Transistor

General Description

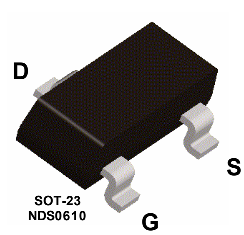
These P-Channel enhancement mode power field effect transistors are produced using Fairchild's proprietary, high cell density, DMOS technology. This very high density process has been designed to minimize on-state resistance, provide rugged and reliable performance and fast switching. They can be used, with a minimum of effort, in most applications requiring up to 180mA DC and can deliver pulsed currents up to 1A. This product is particularly suited to low voltage applications requiring a low current high side switch.

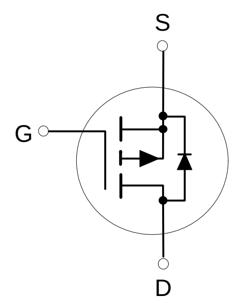
Features

- -0.18 and -0.12A, -60V. $R_{DS(ON)} = 10\Omega$
- Voltage controlled p-channel small signal switch
- High density cell design for low $R_{DS(ON)}$
- TO-92 and SOT-23 packages for both through hole and surface mount applications
- High saturation current



TO-92
NDF0610





Absolute Maximum Ratings

$T_A = 25°C$ unless otherwise noted

Symbol	Parameter	NDF0610	NDS0610	Units
V_{DSS}	Drain-Source Voltage	-60		V
V_{DGR}	Drain-Gate Voltage ($R_{GS} \leq 1\ M\Omega$)	-60		V
V_{GSS}	Gate-Source Voltage - Continuous	±20		V
	- Nonrepetitive ($t_P < 50\ \mu s$)	±30		V
I_D	Drain Current - Continuous	-0.18	-0.12	A
	- Pulsed	-1		
P_D	Maximum Power Dissipation $T_A = 25°C$	0.8	0.36	W
	Derate above 25°C	5	2.9	mW/°C
T_J, T_{STG}	Operating and Storage Temperature Range	-55 to 150		°C
T_L	Maximum lead temperature for soldering purposes, 1/16" from case for 10 seconds	300		°C
THERMAL CHARACTERISTICS				
$R_{\theta JA}$	Thermal Resistance, Junction-to-Ambient	200	350	°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 = -10 µA		-60			V
I_{DSS}	Zero Gate Voltage Drain Current	V_{DS} = -48 V, V_{GS} = 0 V				-1	µA
			T_J = 125°C			-200	µA
I_{GSSF}	Gate - Body Leakage, Forward	V_{GS} = 20 V, V_{DS} = 0 V				10	nA
I_{GSSR}	Gate - Body Leakage, Reverse	V_{GS} = -20 V, V_{DS} = 0 V				-10	nA
ON CHARACTERISTICS (Note 1)							
$V_{GS(th)}$	Gate Threshold Voltage	V_{DS} = V_{GS}, I_D = -1 mA		-1	-2.4	-3.5	V
			T_J = 125°C	-0.6	-2.1	-3.2	
$R_{DS(ON)}$	Static Drain-Source On-Resistance	V_{GS} = -10 V, I_D = -0.5 A			3.6	10	Ω
			T_J = 125°C		5.9	16	
		V_{GS} = -4.5 V, I_D = -0.25 A			5.2	20	
			T_J = 125°C		7.9	30	
$I_{D(on)}$	On-State Drain Current	V_{GS} = -10 V, V_{DS} = -10 V		-0.6	-1.6		A
		V_{GS} = -4.5 V, V_{DS} = -10 V			-0.35		
g_{FS}	Forward Transconductance	V_{DS} = -10 V, I_D = -0.1 A		70	170		mS
DYNAMIC CHARACTERISTICS							
C_{iss}	Input Capacitance	V_{DS} = -25 V, V_{GS} = 0 V, f = 1.0 MHz			40	60	pF
C_{oss}	Output Capacitance				11	25	pF
C_{rss}	Reverse Transfer Capacitance				3.2	5	pF
SWITCHING CHARACTERISTICS (Note 1)							
$t_{D(on)}$	Turn - On Delay Time	V_{DD} = -25 V, I_D = -0.18 A, V_{GS} = -10 V, R_{GEN} = 25 Ω			7	10	nS
t_r	Turn - On Rise Time				5	15	nS
$t_{D(off)}$	Turn - Off Delay Time				13	15	nS
t_f	Turn - Off Fall Time				10	20	nS
Q_g	Total Gate Charge	V_{DS} = -48 V, I_D = -0.5 A, V_{GS} = -10 V			1.43		nC
Q_{gs}	Gate-Source Charge				0.6		nC
Q_{gd}	Gate-Drain Charge				0.25		nC
DRAIN-SOURCE DIODE CHARACTERISTICS							
I_S	Maximum Continuous Source Current					-0.18	A
I_{SM}	Maximum Pulse Source Current (Note 1)					-1	A
V_{SD}	Drain-Source Diode Forward Voltage	V_{GS} = 0 V, I_S = -0.5 A (Note 1)			-1.2	-1.5	V
			T_J = 125°C		-0.98	-1.3	
t_{rr}	Reverse Recovery Time	V_{GS} = 0 V, I_S = -0.5 A, dI_F/dt = 100 A/µs			40		ns
I_{rr}	Reverse Recovery Current				2.8		A

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

Typical Electrical Characteristics

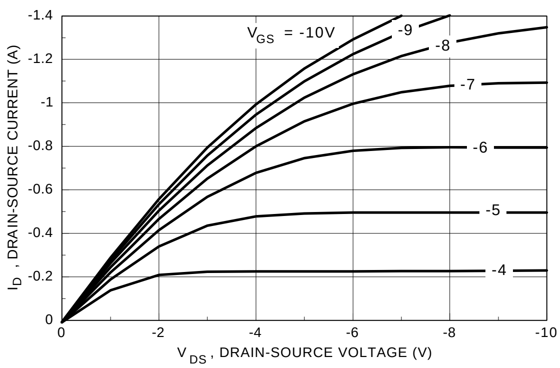


Figure 1. On-Region Characteristics

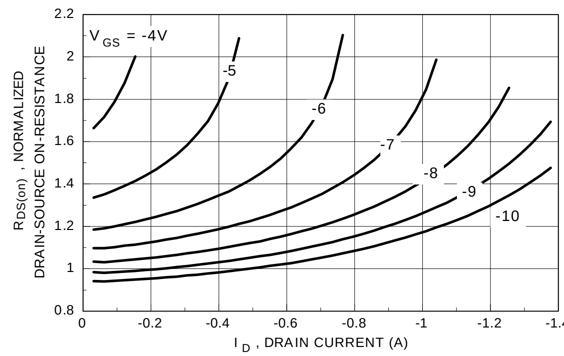


Figure 2. On-Resistance Variation with Gate Voltage and Drain Current

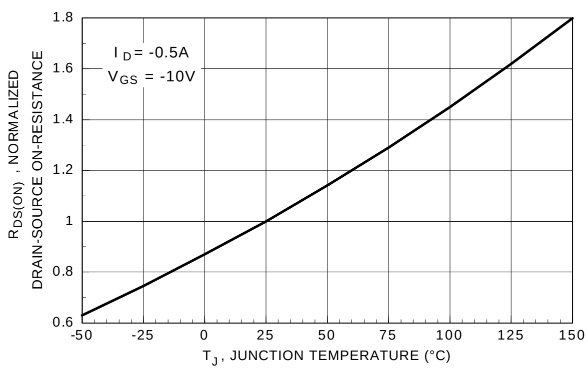


Figure 3. On-Resistance Variation with Temperature

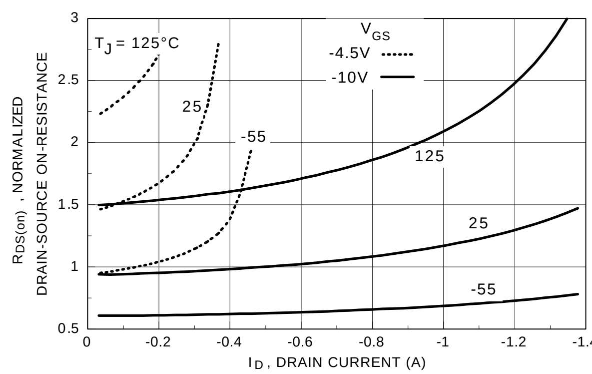


Figure 4. On-Resistance Variation with Drain Current and Temperature

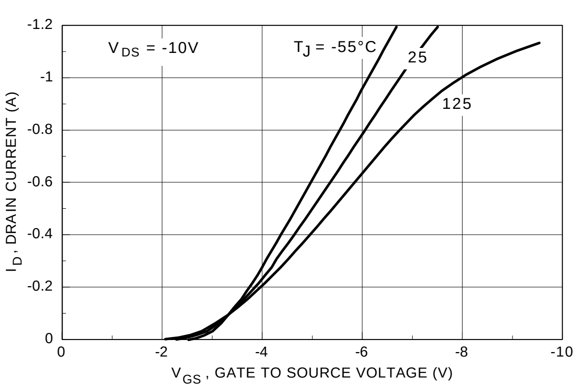


Figure 5. Transfer Characteristics

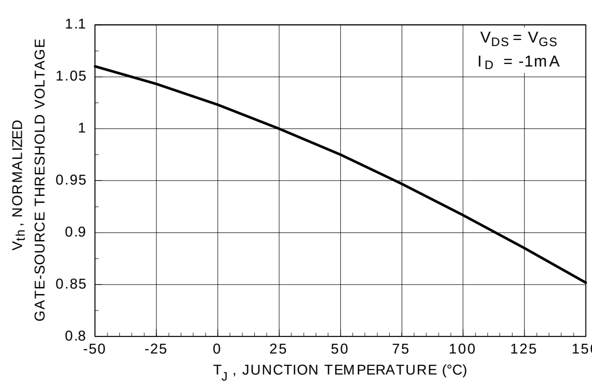


Figure 6. Gate Threshold Variation with Temperature

Typical Electrical Characteristics (continued)

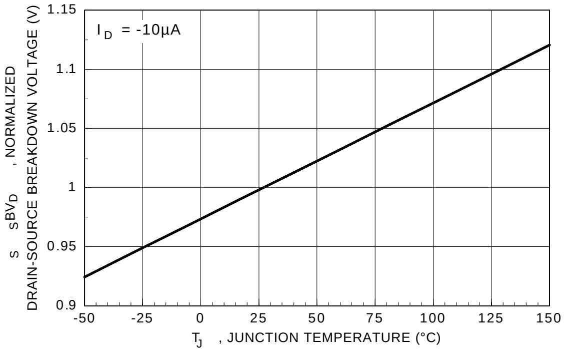


Figure 7. Breakdown Voltage Variation with Temperature

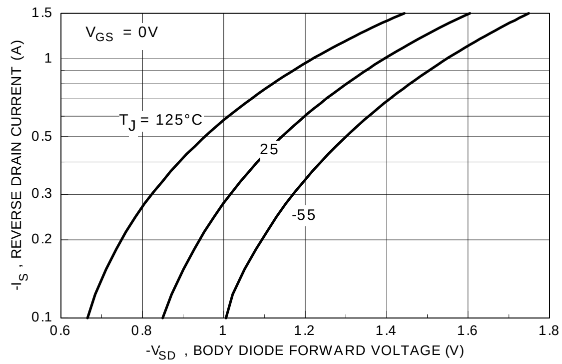


Figure 8. Body Diode Forward Voltage Variation with Current and Temperature

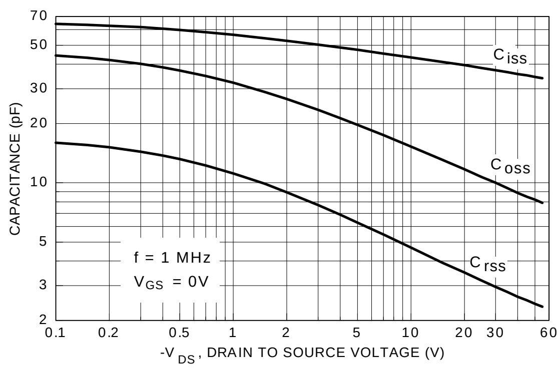


Figure 9. Capacitance Characteristics

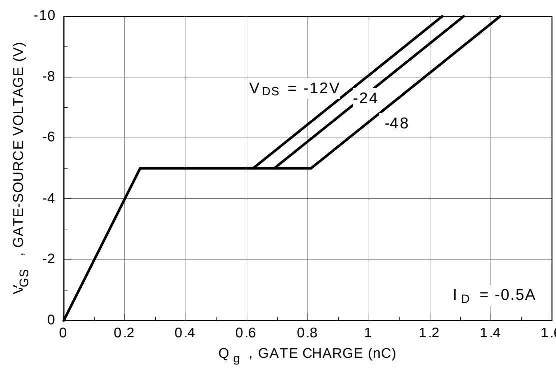


Figure 10. Gate Charge Characteristics

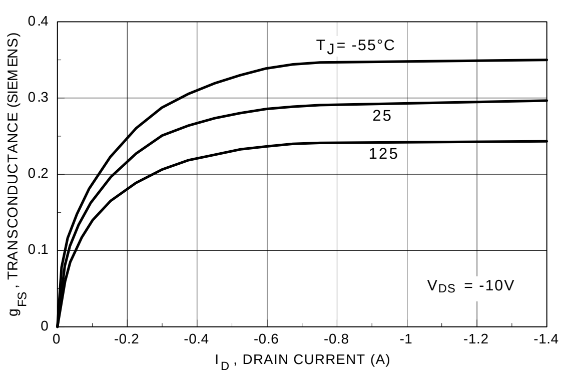


Figure 11. Transconductance Variation with Drain Current and Temperature

Typical Electrical Characteristics (continued)

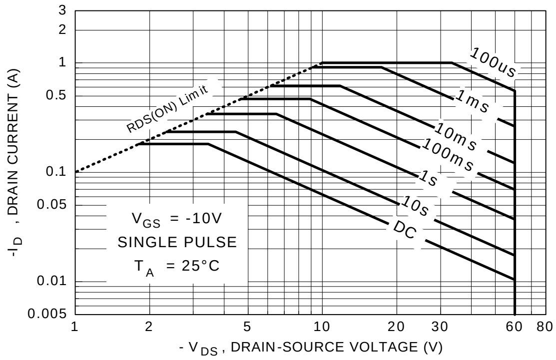


Figure 12. NDF0610 (TO-92) Maximum Safe Operating Area

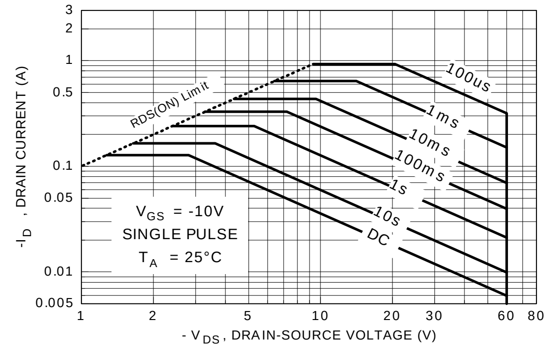


Figure 13. NDS0610 (SOT-23) Maximum Safe Operating Area

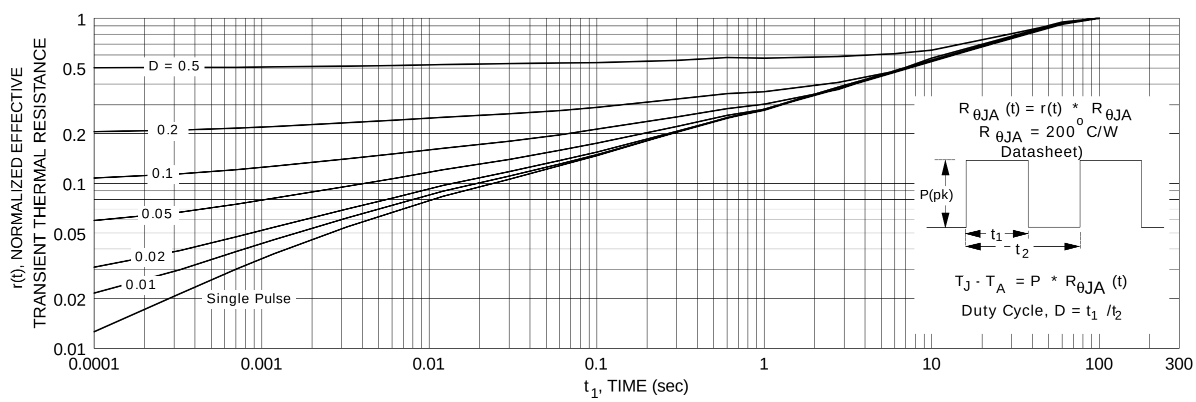


Figure 14. NDF0610 (TO-92) Transient Thermal Response Curve.

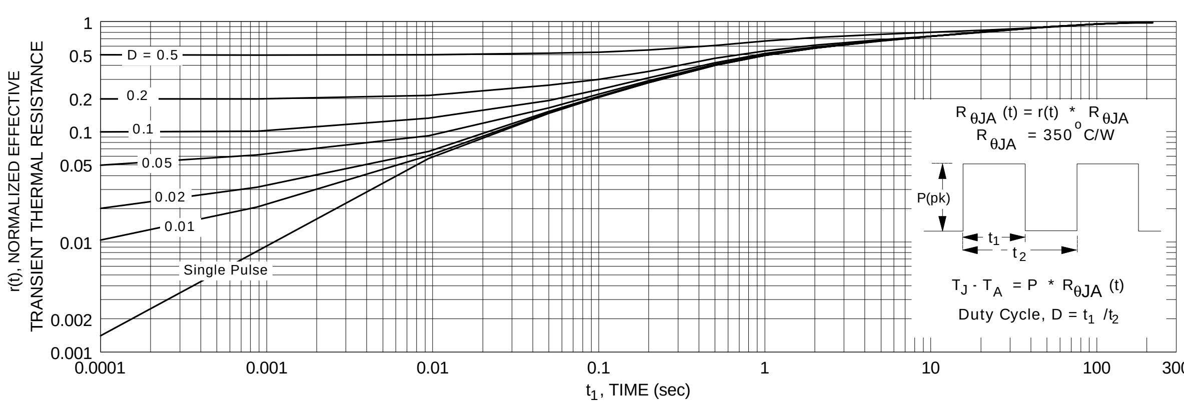


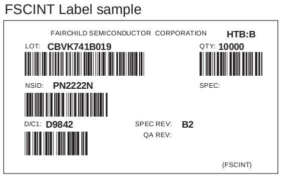
Figure 15. NDS0610 (SOT-23) Transient Thermal Response Curve.

TO-92 Tape and Reel Data and Package Dimensions

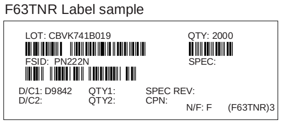
FAIRCHILD SEMICONDUCTOR TM

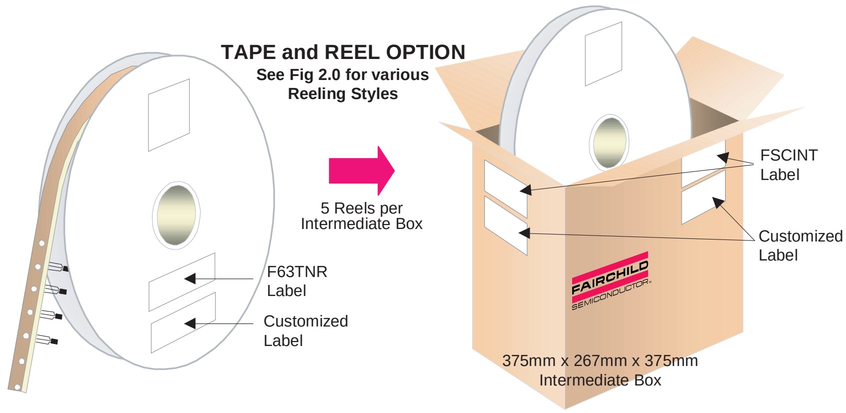
TO-92 Packaging Configuration: Figure 1.0

FSCINT Label sample



F63TNR Label sample

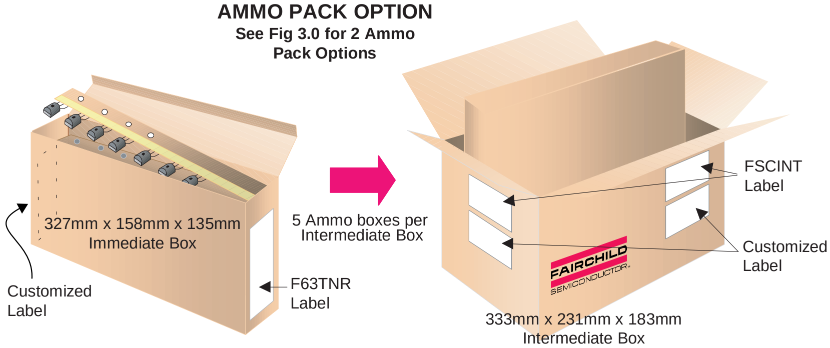




TO-92 TNR/AMMO PACKING INFROMATION

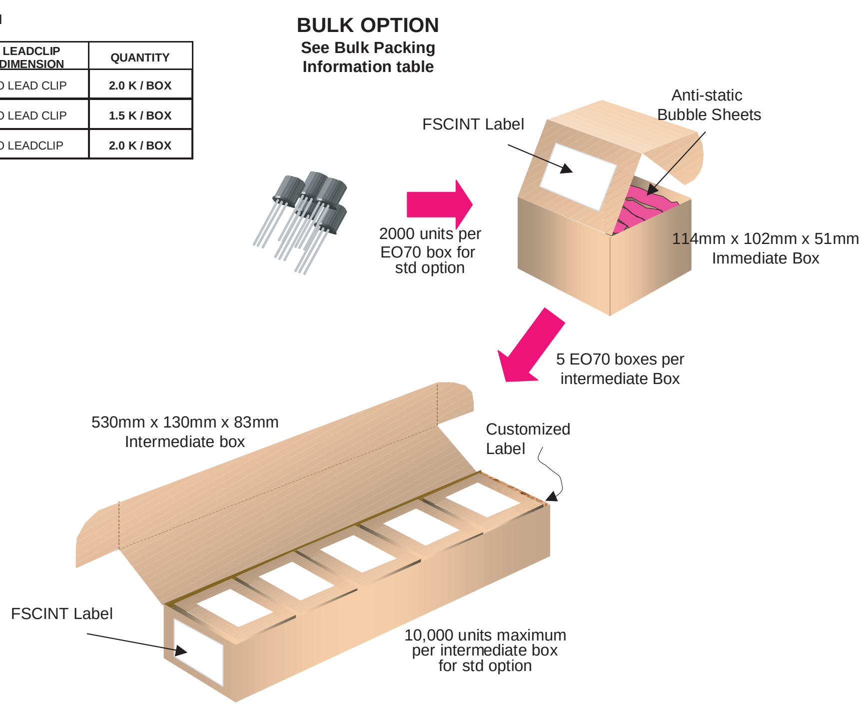
Packing	Style	Quantity	EOL code
Reel	A	2,000	D26Z
	E	2,000	D27Z
Ammo	M	2,000	D74Z
	P	2,000	D75Z

Unit weight = 0.22 gm
Reel weight with components = 1.04 kg
Ammo weight with components = 1.02 kg
Max quantity per intermediate box = 10,000 units



(TO-92) BULK PACKING INFORMATION

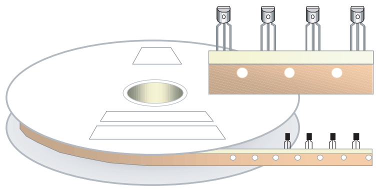
EOL CODE	DESCRIPTION	LEADCLIP DIMENSION	QUANTITY
J18Z	TO-18 OPTION STD	NO LEAD CLIP	2.0 K / BOX
J05Z	TO-5 OPTION STD	NO LEAD CLIP	1.5 K / BOX
NO EOL CODE	TO-92 STANDARD STRAIGHT	NO LEADCLIP	2.0 K / BOX



TO-92 Tape and Reel Data and Package Dimensions, continued

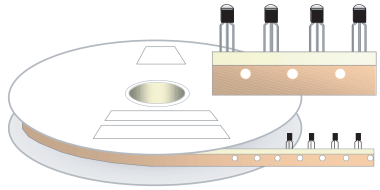
TO-92 Reeling Style
Configuration: Figure 2.0

Machine Option "A" (H)



Style "A", D26Z, D70Z (s/h)

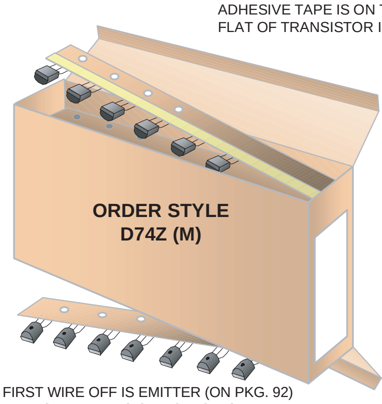
Machine Option "E" (J)



Style "E", D27Z, D71Z (s/h)

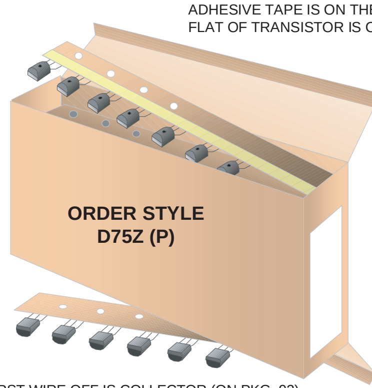
TO-92 Radial Ammo Packaging
Configuration: Figure 3.0

FIRST WIRE OFF IS COLLECTOR
ADHESIVE TAPE IS ON THE TOP SIDE
FLAT OF TRANSISTOR IS ON TOP



FIRST WIRE OFF IS EMITTER (ON PKG. 92)
ADHESIVE TAPE IS ON BOTTOM SIDE
FLAT OF TRANSISTOR IS ON BOTTOM

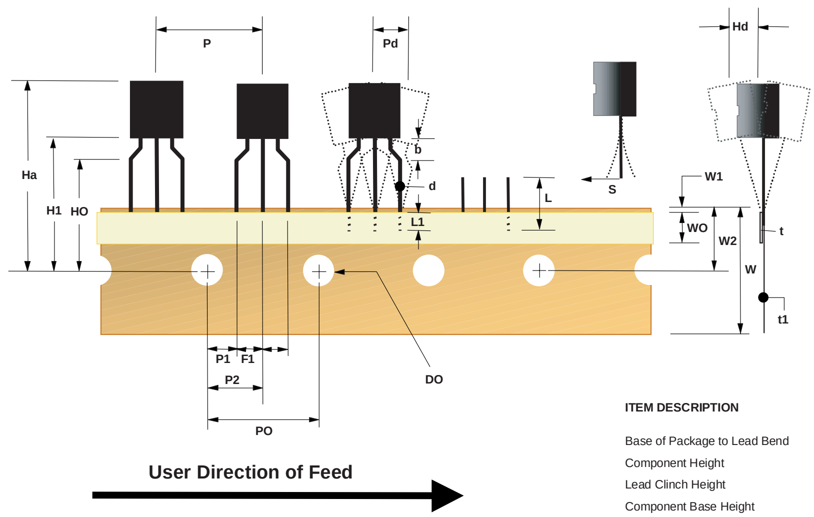
FIRST WIRE OFF IS EMITTER
ADHESIVE TAPE IS ON THE TOP SIDE
FLAT OF TRANSISTOR IS ON BOTTOM



FIRST WIRE OFF IS COLLECTOR (ON PKG. 92)
ADHESIVE TAPE IS ON BOTTOM SIDE
FLAT OF TRANSISTOR IS ON TOP

TO-92 Tape and Reel Data and Package Dimensions, continued

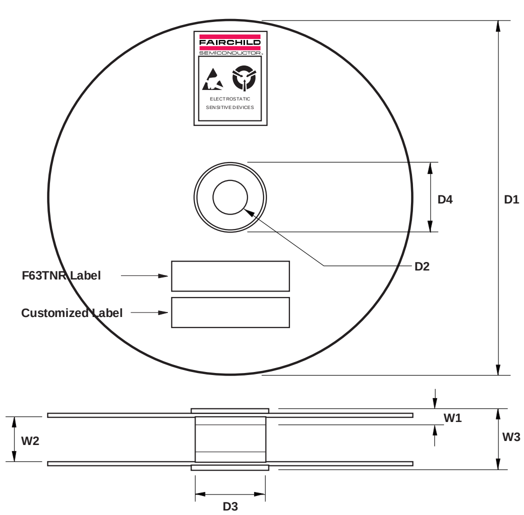
TO-92 Tape and Reel Taping
Dimension Configuration: Figure 4.0



ITEM DESCRIPTION	SYMBOL	DIMENSION
Base of Package to Lead Bend	b	0.098 (max)
Component Height	Ha	0.928 (+/- 0.025)
Lead Clinch Height	HO	0.630 (+/- 0.020)
Component Base Height	H1	0.748 (+/- 0.020)
Component Alignment (side/side)	Pd	0.040 (max)
Component Alignment (front/back)	Hd	0.031 (max)
Component Pitch	P	0.500 (+/- 0.020)
Feed Hole Pitch	PO	0.500 (+/- 0.008)
Hole Center to First Lead	P1	0.150 (+0.009, -0.010)
Hole Center to Component Center	P2	0.247 (+/- 0.007)
Lead Spread	F1/F2	0.104 (+/- 0 .010)
Lead Thickness	d	0.018 (+0.002, -0.003)
Cut Lead Length	L	0.429 (max)
Taped Lead Length	L1	0.209 (+0.051, -0.052)
Taped Lead Thickness	t	0.032 (+/- 0.006)
Carrier Tape Thickness	t1	0.021 (+/- 0.006)
Carrier Tape Width	W	0.708 (+0.020, -0.019)
Hold - down Tape Width	WO	0.236 (+/- 0.012)
Hold - down Tape position	W1	0.035 (max)
Feed Hole Position	W2	0.360 (+/- 0.025)
Sprocket Hole Diameter	DO	0.157 (+0.008, -0.007)
Lead Spring Out	S	0.004 (max)

Note : All dimensions are in inches.

TO-92 Reel
Configuration: Figure 5.0

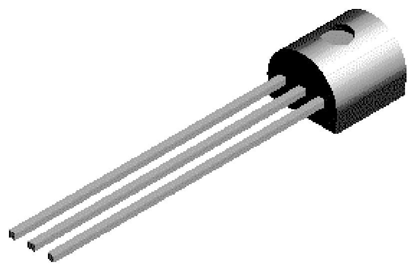


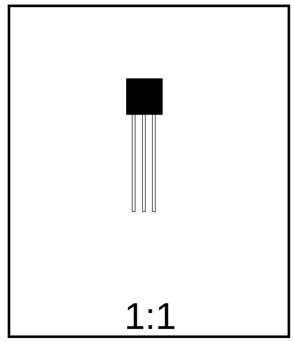
ITEM DESCRIPTION	SYSMBOL	MINIMUM	MAXIMUM
Reel Diameter	D1	13.975	14.025
Arbor Hole Diameter (Standard)	D2	1.160	1.200
(Small Hole)	D2	0.650	0.700
Core Diameter	D3	3.100	3.300
Hub Recess Inner Diameter	D4	2.700	3.100
Hub Recess Depth	W1	0.370	0.570
Flange to Flange Inner Width	W2	1.630	1.690
Hub to Hub Center Width	W3		2.090

Note: All dimensions are inches

TO-92 Tape and Reel Data and Package Dimensions

TO-92 (FS PKG Code 92, 94, 96)





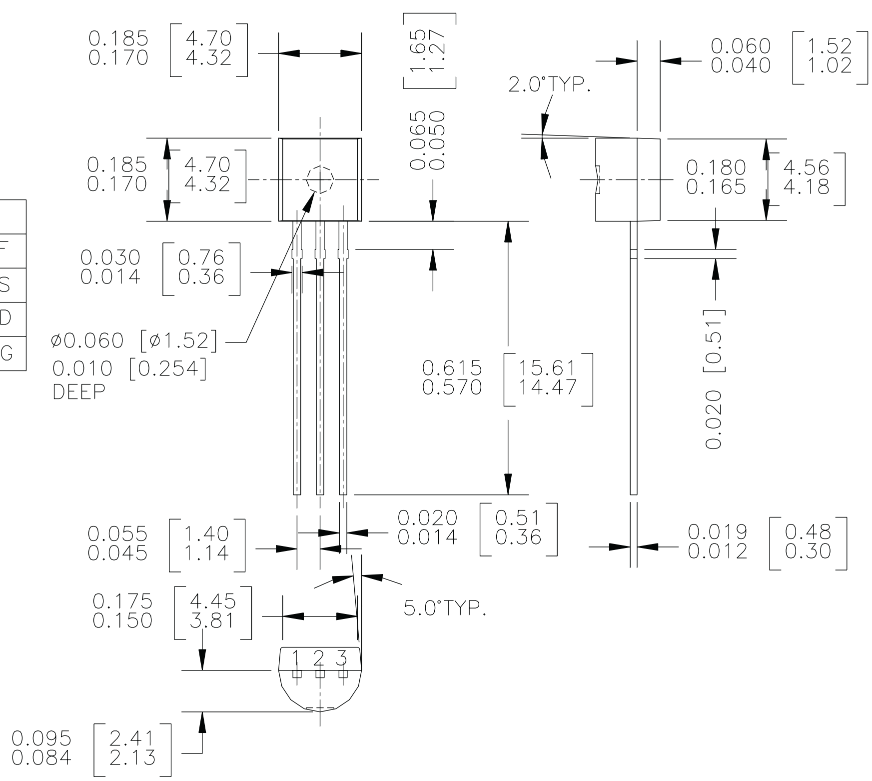
Scale 1:1 on letter size paper

Dimensions shown below are in:
inches [millimeters]

Part Weight per unit (gram): 0.1977

TO−92 (92,94,96)

PIN	92		94		96	
	B	F	B	F	B	F
1	E	D	E	D	B	S
2	B	S	C	G	E	D
3	C	G	B	S	C	G

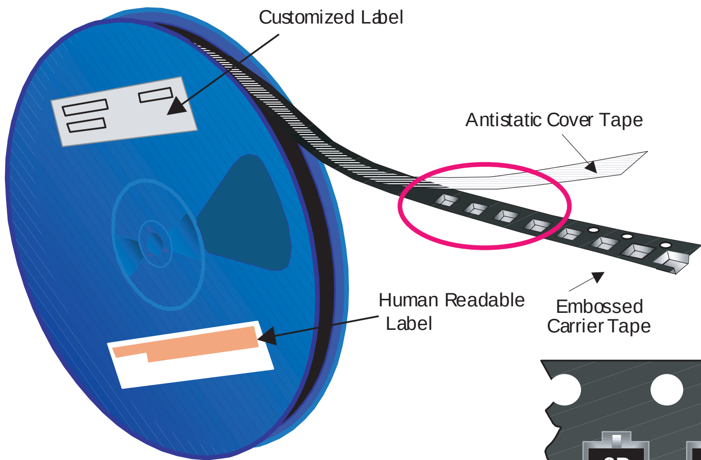


January 2000, Rev. B

SOT-23 Tape and Reel Data and Package Dimensions

SOT-23 Packaging

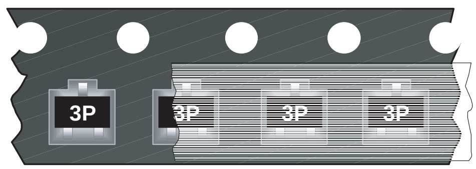
Configuration: Figure 1.0



Packaging Description:

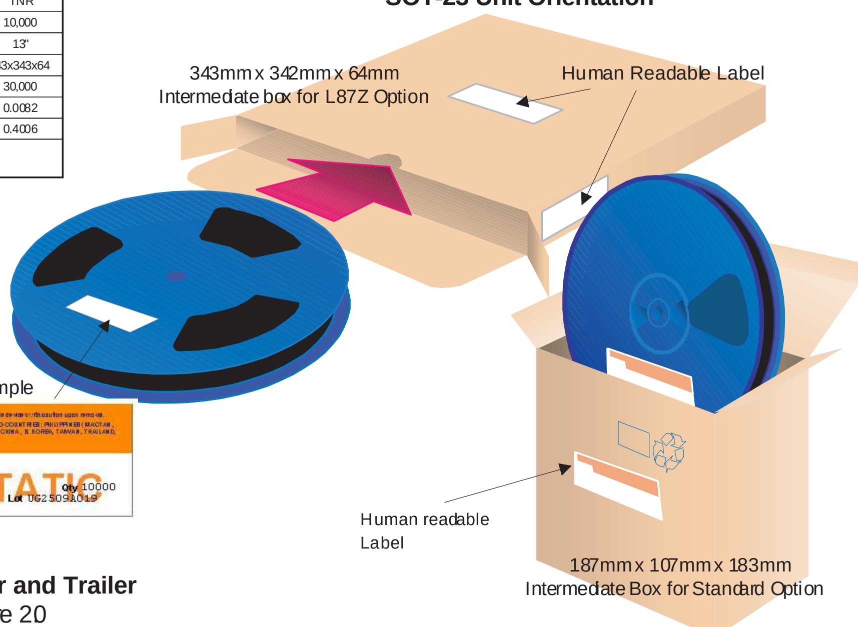
SOT-23 parts are shipped in tape. The carrier tape is made from a dissipative (carbon filled) polycarbonate resin. The cover tape is a multilayer film (Heat Activated Adhesive in nature) primarily composed of polyester film, adhesive layer, sealant, and anti-static sprayed agent. These reeled parts in standard option are shipped with 3,000 units per 7" or 177cm diameter reel. The reels are dark blue in color and is made of polystyrene plastic (anti-static coated). Other option comes in 10,000 units per 13" or 330cm diameter reel. This and some other options are described in the Packaging Information table.

These full reels are individually labeled and placed inside a standard intermediate made of recyclable corrugated brown paper with a Fairchild logo printing. One pizza box contains eight reels maximum. And these intermediate boxes are placed inside a labeled shipping box which comes in different sizes depending on the number of parts shipped.



SOT-23 Unit Orientation

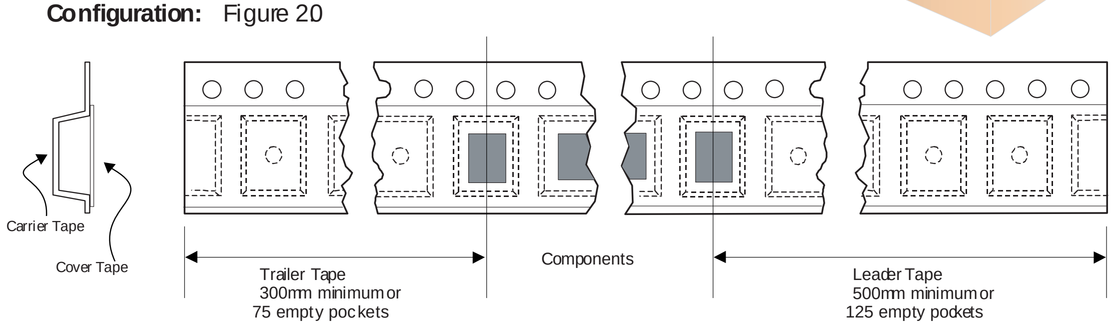
SOT-23 Packaging Information		
Packaging Option	Standard (no flow code)	D87Z
Packaging type	TNR	TNR
Qty per Reel/Tube/Bag	3,000	10,000
Reel Size	7" Dia	13"
Box Dimension (mm)	187x107x183	343x343x64
Max qty per Box	24,000	30,000
Weight per unit (gm)	0.0082	0.0082
Weight per Reel (kg)	0.1175	0.4006
Note/Comments		



Human Readable Label sample

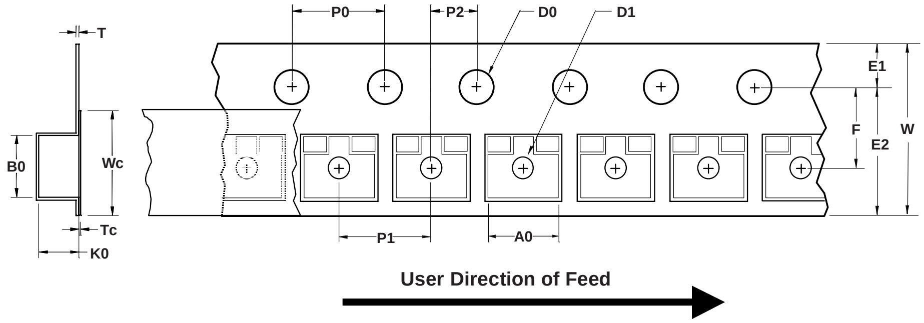
SOT-23 Tape Leader and Trailer

Configuration: Figure 2.0



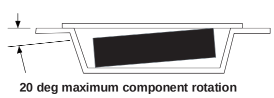
SOT-23 Tape and Reel Data and Package Dimensions, continued

SOT-23 Embossed Carrier Tape Configuration: Figure 3.0

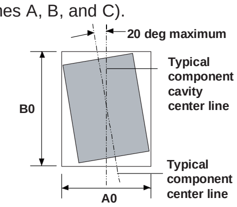


Dimensions are in millimeter													
Pkg type	**A0**	**B0**	**W**	**D0**	**D1**	**E1**	**E2**	**F**	**P1**	**P0**	**K0**	**T**	**Wc**	**Tc**
SOT-23 (8mm)	3.15 +/-0.10	2.77 +/-0.10	8.0 +/-0.3	1.55 +/-0.05	1.125 +/-0.125	1.75 +/-0.10	6.25 min	3.50 +/-0.05	4.0 +/-0.1	4.0 +/-0.1	1.30 +/-0.10	0.228 +/-0.013	5.2 +/-0.3	0.06 +/-0.02

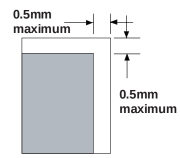
Notes: A0, B0, and K0 dimensions are determined with respect to the EIA/Jedec RS-481 rotational and lateral movement requirements (see sketches A, B, and C).



Sketch A (Side or Front Sectional View)
Component Rotation

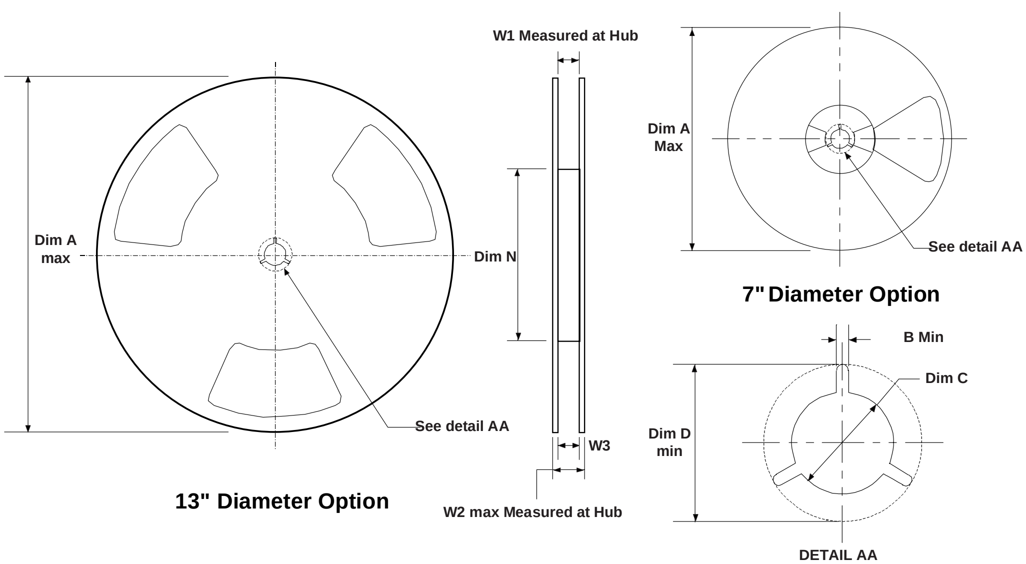


Sketch B (Top View)
Component Rotation



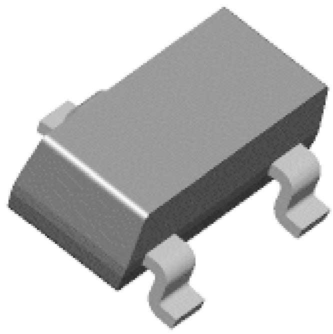
Sketch C (Top View)
Component lateral movement

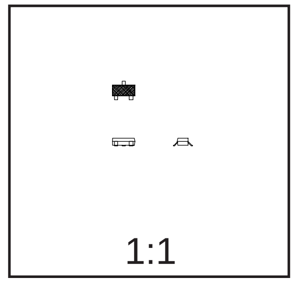
SOT-23 Reel Configuration: Figure 4.0



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)**
8mm	7" Dia	7.00 177.8	0.059 1.5	512 +0.020/-0.008 13 +0.5/-0.2	0.795 20.2	2.165 55	0.331 +0.059/-0.000 8.4 +1.5/0	0.567 14.4	0.311 – 0.429 7.9 – 10.9
8mm	13" Dia	13.00 330	0.059 1.5	512 +0.020/-0.008 13 +0.5/-0.2	0.795 20.2	4.00 100	0.331 +0.059/-0.000 8.4 +1.5/0	0.567 14.4	0.311 – 0.429 7.9 – 10.9

SOT-23 (FS PKG Code 49)

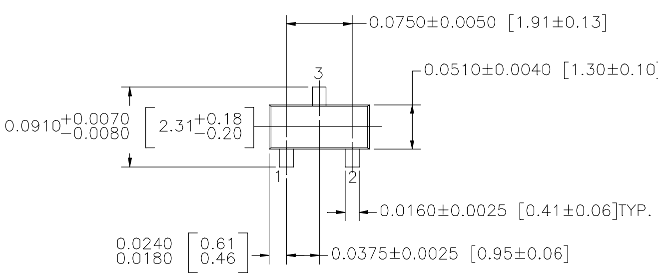


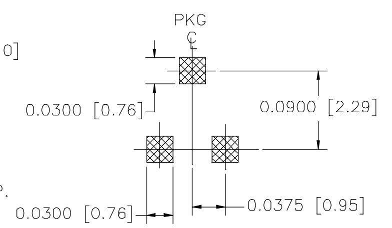


Scale 1:1 on letter size paper

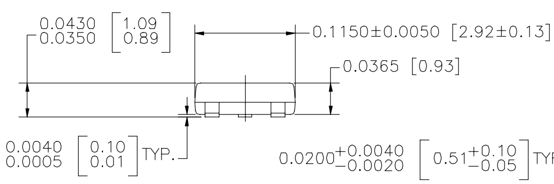
Dimensions shown below are in:
inches [millimeters]

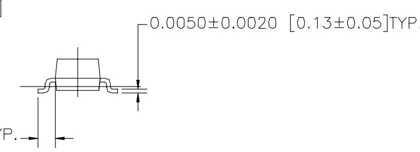
Part Weight per unit (gram): 0.0082





LAND PATTERN RECOMMENDATION





SOT 23, 3 LEADS LOW PROFILE

CONTROLLING DIMENSION IS INCH
VALUES IN [ ] ARE MILLIMETERS

NOTE : UNLESS OTHERWISE SPECIFIED

1. STANDARD LEAD FINISH 150 MICROINCHES / 3.81 MICROMETERS MINIMUM TIN / LEAD (SOLDER) ON ALLOY 42
2. REFERENCE JEDEC REGISTRATION TO-236, VARIATION AB, ISSUE G, DATED JUL 1993

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FACT Quiet Series™	QS™	
FAST®	Quiet Series™	
FASTr™	SuperSOT™-3	
GTO™	SuperSOT™-6	
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