March 2000

FDP5645/FDB5645

60V N-Channel PowerTrench® MOSFET

General Description

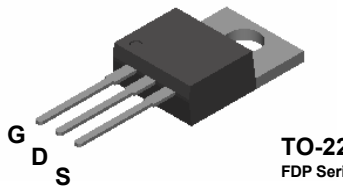
This N-Channel MOSFET has been designed specifically to improve the overall efficiency of DC/DC converters using either synchronous or conventional switching PWM controllers.

These MOSFETs feature faster switching and lower gate charge than other MOSFETs with comparable $R_{DS(ON)}$ specifications.

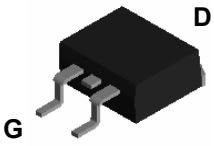
The result is a MOSFET that is easy and safer to drive (even at very high frequencies), and DC/DC power supply designs with higher overall efficiency.

Features

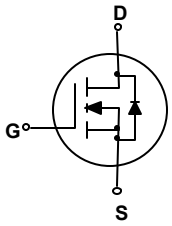
- 80 A, 60 V. $R_{DS(ON)}$ = 0.0095 Ω @ V_{GS} = 10 V
  $R_{DS(ON)}$ = 0.011 Ω @ V_{GS} = 6 V.
- Critical DC electrical parameters specified at elevated temperature.
- Rugged internal source-drain diode can eliminate the need for an external Zener diode transient suppressor.
- High performance trench technology for extremely low $R_{DS(ON)}$.
- 175°C maximum junction temperature rating.



TO-220
FDP Series



TO-263AB
FDB Series



Absolute Maximum Ratings

T_A=25°C unless otherwise noted

Symbol	Parameter		FDP5645 FDB5645	Units
V_{DSS}	Drain-Source Voltage		60	V
V_{GSS}	Gate-Source Voltage		±20	V
I_D	Maximum Drain Current	– Continuous (note 3)	80	A
		– Pulsed	300	
P_D	Total Power Dissipation	@ T_C = 25°C	125	W
		Derate above 25°C	0.83	W/°C
T_J, T_{STG}	Operating and Storage Junction Temperature Range		-65 to +175	°C
T_L	Maximum lead termperature for soldering purposes, 1/8" from case for 5 seconds		+275	°C

Thermal Characteristics

$R_{\theta JC}$	Thermal Resistance, Junction-to-Case	1.2	°C/W
$R_{\theta JA}$	Thermal Resistance, Junction-to-Ambient	62.5	°C/W

Package Marking and Ordering Information

Device Marking	Device	Reel Size	Tape width	Quantity
FDB5645	FDB5645	13"	24mm	800 units
FDP5645	FDP5645	note 2		

Electrical Characteristics

T_A = 25°C unless otherwise noted

Symbol	Parameter	Test Conditions	Min	Typ	Max	Units
Drain-Source Avalanche Ratings (Note 1)						
W_{DSS}	Single Pulse Drain-Source Avalanche Energy	V_{DD} = 40 V, I_D = 80 A			800	mJ
I_{AR}	Maximum Drain-Source Avalanche Current				80	A
Off Characteristics						
BV_{DSS}	Drain–Source Breakdown Voltage	V_{GS} = 0 V, I_D = 250 µA	60			V
$\frac{\Delta BV_{DSS}}{\Delta T_J}$	Breakdown Voltage Temperature Coefficient	I_D = 250 µA, Referenced to 25°C		64		mV/°C
I_{DSS}	Zero Gate Voltage Drain Current	V_{DS} = 48 V, V_{GS} = 0 V			1	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 1)						
$V_{GS(th)}$	Gate Threshold Voltage	V_{DS} = V_{GS}, I_D = 250 µA	2		4	V
$\frac{\Delta V_{GS(th)}}{\Delta T_J}$	Gate Threshold Voltage Temperature Coefficient	I_D = 250 µA, Referenced to 25°C		-7.8		mV/°C
$R_{DS(on)}$	Static Drain–Source On–Resistance	V_{GS} = 10 V, I_D = 40 A V_{GS}=10V, I_D = 40 A, T_J=125°C V_{GS} = 6 V, I_D = 38 A		8 13 9	9.5 18 11	mΩ
$I_{D(on)}$	On–State Drain Current	V_{GS} = 10 V, V_{DS} = 10 V	60			A
g_{FS}	Forward Transconductance	V_{DS} = 5 V, I_D = 40 A		88		S
Dynamic Characteristics						
C_{iss}	Input Capacitance	V_{DS} = 30 V, V_{GS} = 0 V, f = 1.0 MHz		4468		pF
C_{oss}	Output Capacitance			810		pF
C_{rss}	Reverse Transfer Capacitance			198		pF
Switching Characteristics (Note 2)						
$t_{d(on)}$	Turn–On Delay Time	V_{DD} = 30 V, I_D = 1 A, V_{GS} = 10 V, R_{GEN} = 6 Ω		21	30	ns
t_r	Turn–On Rise Time			13	20	ns
$t_{d(off)}$	Turn–Off Delay Time			77	90	ns
t_f	Turn–Off Fall Time			42	50	ns
Q_g	Total Gate Charge	V_{DS} = 30 V, I_D = 80 A, V_{GS} = 10 V		76	107	nC
Q_{gs}	Gate–Source Charge			18		nC
Q_{gd}	Gate–Drain Charge			21		nC
Drain–Source Diode Characteristics and Maximum Ratings						
I_S	Maximum Continuous Drain–Source Diode Forward Current				80	A
I_S	Maximum Pulsed Drain–Source Diode Forward Current				300	A
V_{SD}	Drain–Source Diode Forward Voltage	V_{GS} = 0 V, I_S = 40 A		0.9	1.3	V

Notes:

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

2. TO-220 package is supplied in tube / rail @ 45 pieces per rail.

3. Calculated continuous current based on maximum allowable junction temperature. Actual maximum continuous current limited by package constraints to 75A

Typical Characteristics

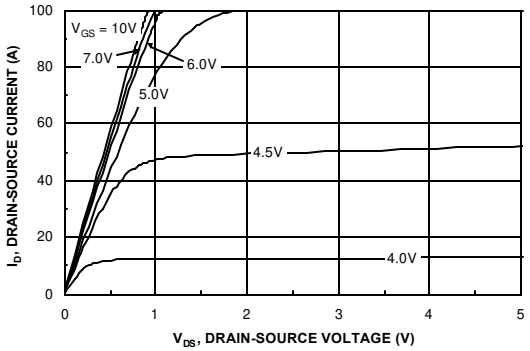


Figure 1. On-Region Characteristics.

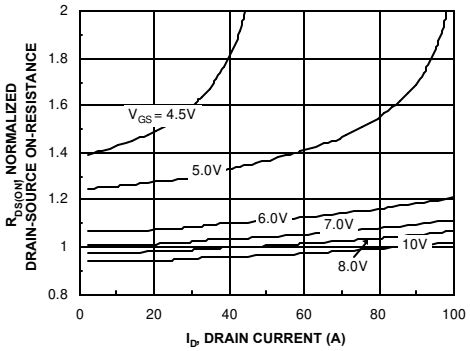


Figure 2. On-Resistance Variation with Drain Current and Gate Voltage.

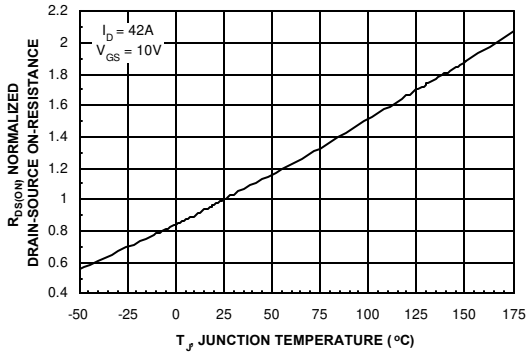


Figure 3. On-Resistance Variation withTemperature.

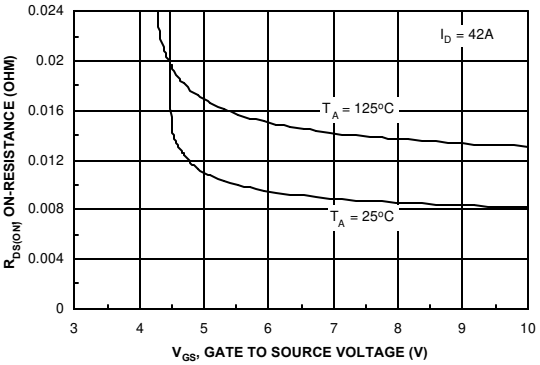


Figure 4. On-Resistance Variation with Gate-to-Source Voltage.

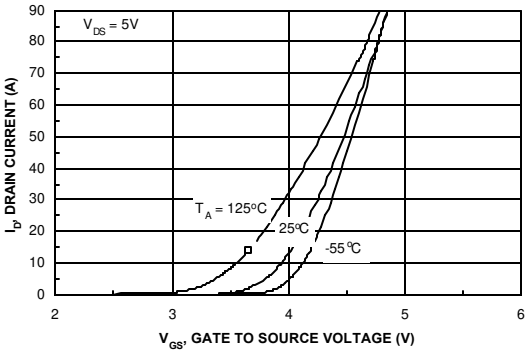


Figure 5. Transfer Characteristics.

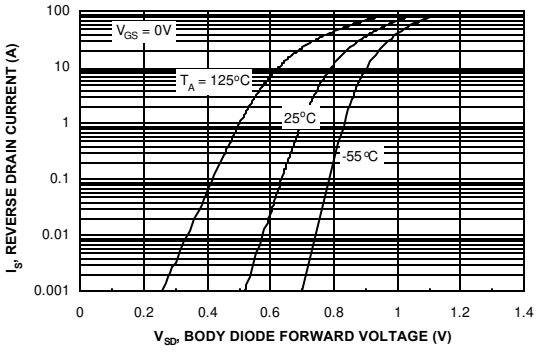


Figure 6. Body Diode Forward Voltage Variation with Source Current and Temperature.

Typical Characteristics

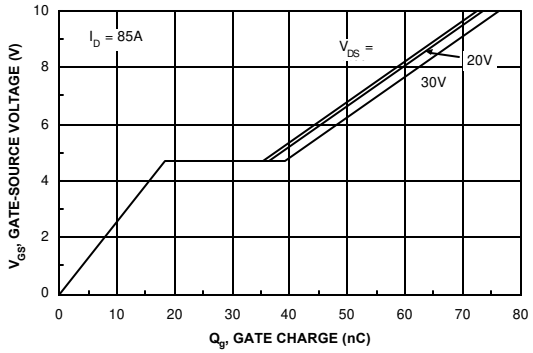


Figure 7. Gate Charge Characteristics.

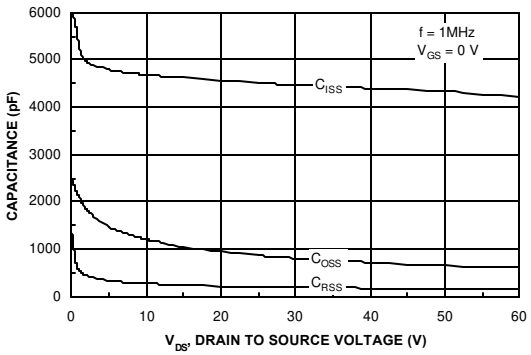


Figure 8. Capacitance Characteristics.

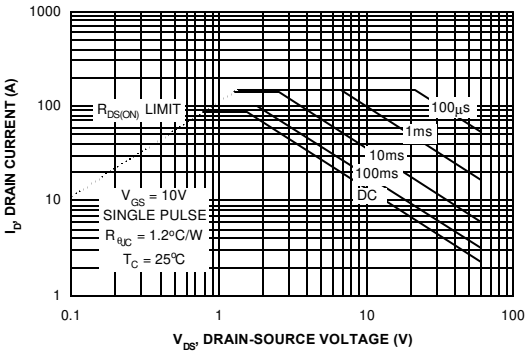


Figure 9. Maximum Safe Operating Area.

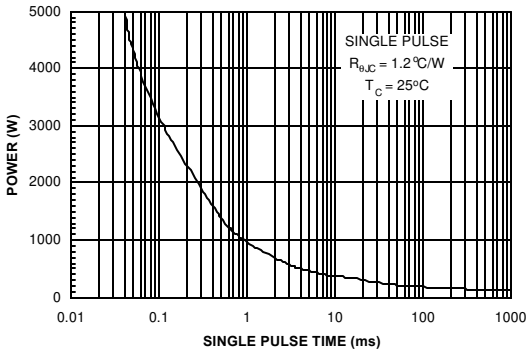


Figure 10. Single Pulse Maximum Power Dissipation.

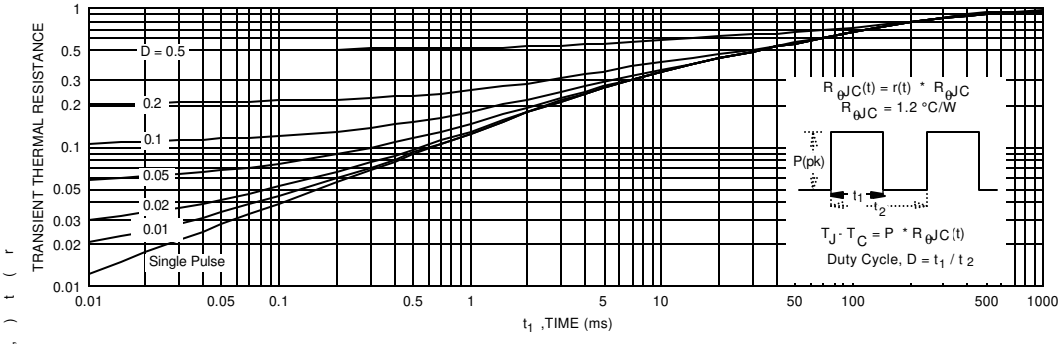


Figure 11. Transient Thermal Response Curve.

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

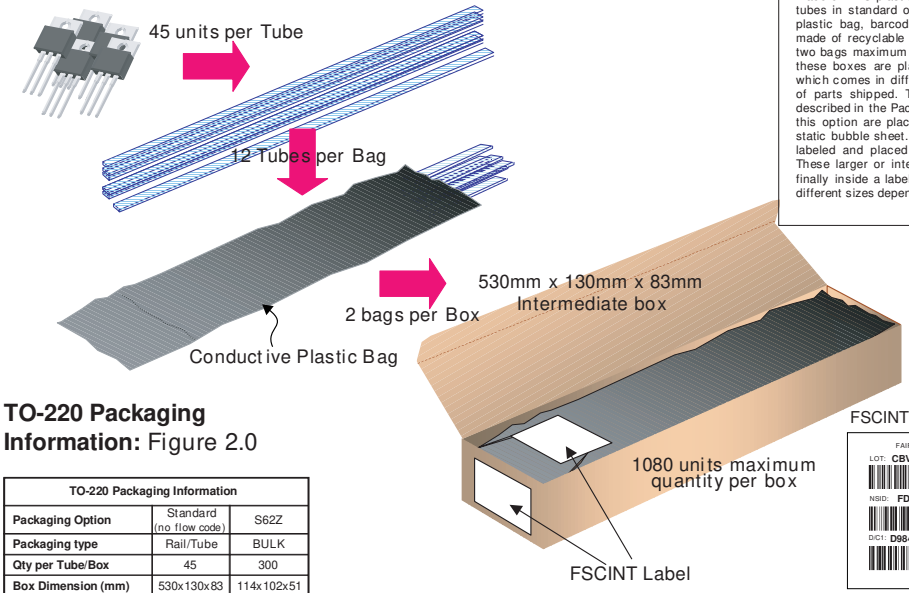
TO-220 Tape and Reel Data and Package Dimensions

FAIRCHILD SEMICONDUCTOR™

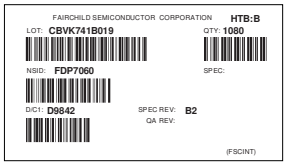
TO-220 Tube Packing
Configuration: Figure 1.0

Packaging Description:

TO-220 parts are shipped normally in tube. The tube is made of PVC plastic treated with anti-static agent.These tubes in standard option are placed inside a dissipative plastic bag, barcode labeled, and placed inside a box made of recyclable corrugated paper. One box contains two bags maximum (see fig. 1.0). And one or several of these boxes are placed inside a labeled shipping box which comes in different sizes depending on the number of parts shipped. The other option comes in bulk as described in the Packaging Information table. The units in this option are placed inside a small box laid with anti-static bubble sheet. These smaller boxes are individually labeled and placed inside a larger box (see fig. 3.0). These larger or intermediate boxes then will be placed finally inside a labeled shipping box which still comes in different sizes depending on the number of units shipped.



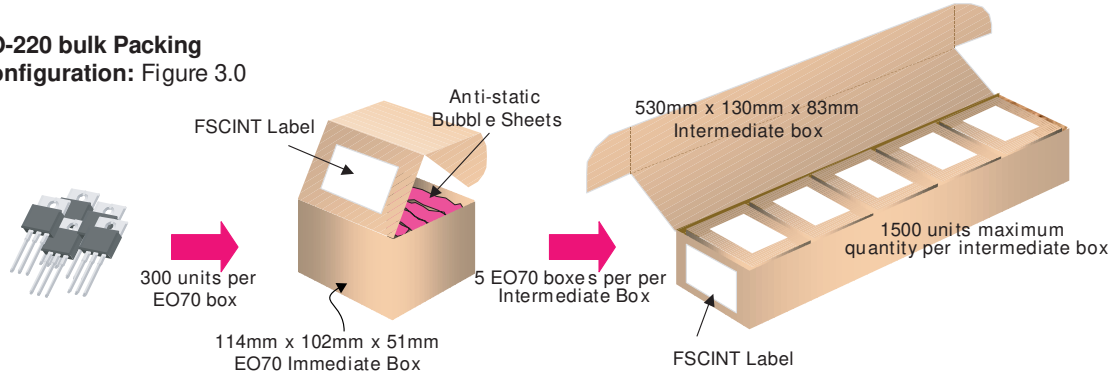
FSCINT Label sample



TO-220 Packaging
Information: Figure 2.0

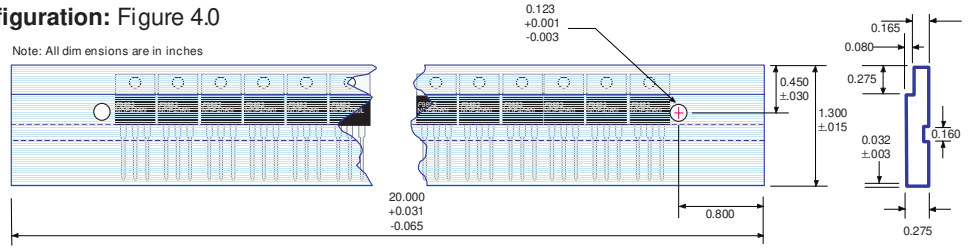
TO-220 Packaging Information		
Packaging Option	Standard (no flow code)	S62Z
Packaging type	Rail/Tube	BULK
Qty per Tube/Box	45	300
Box Dimension (mm)	530x130x83	114x102x51
Max qty per Box	1,080	1,500
Weight per unit (gm)	1.4378	1.4378
Note/Comments		

TO-220 bulk Packing
Configuration: Figure 3.0



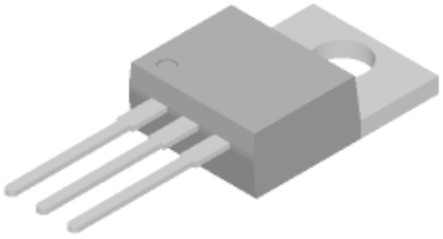
TO-220 Tube
Configuration: Figure 4.0

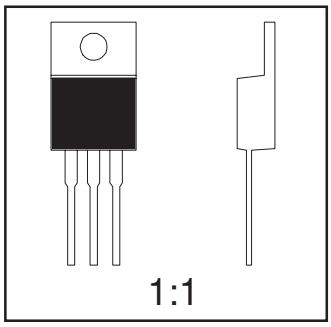
Note: All dimensions are in inches



TO-220 Tape and Reel Data and Package Dimensions, continued

TO-220 (FS PKG Code 37)

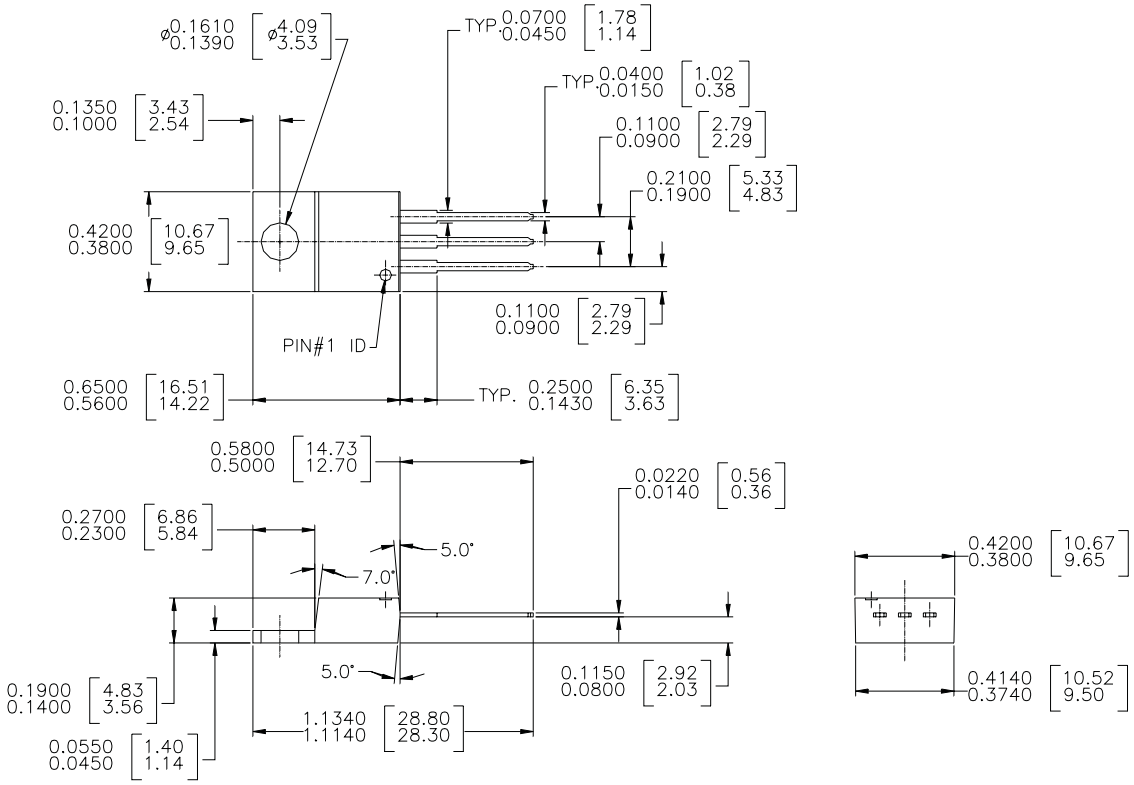




Scale 1:1 on letter size paper

Dimensions shown below are in:
inches [millimeters]

Part Weight per unit (gram): 1.4378



NOTE : UNLESS OTHERWISE SPECIFIED

TO 220 3 LEAD

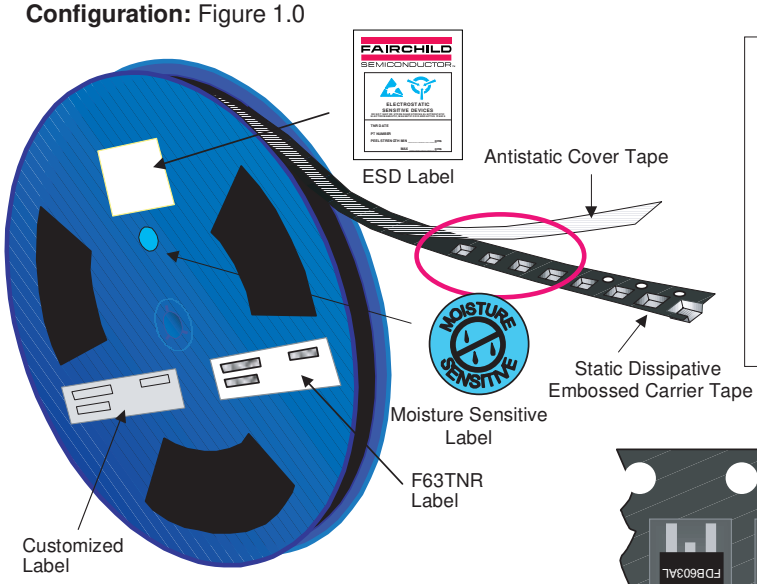
1. STANDARD LEAD FINISH :
200 MICROINCHES / 5.08 MICRON MINIMUM
LEAD / TIN 15/85 ON OLIN 194 COPPER OR EQUIVALENT

2. DIMENSION BASED ON JEDEC STANDARD TO-220
VARIATION AB, ISSUE J, DATED 3/24/87

TO-263AB/D²PAK Tape and Reel Data and Package Dimensions

FAIRCHILD SEMICONDUCTOR™

TO-263AB/D²PAK Packaging Configuration: Figure 1.0

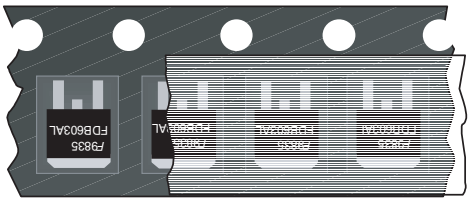


Packaging Description:

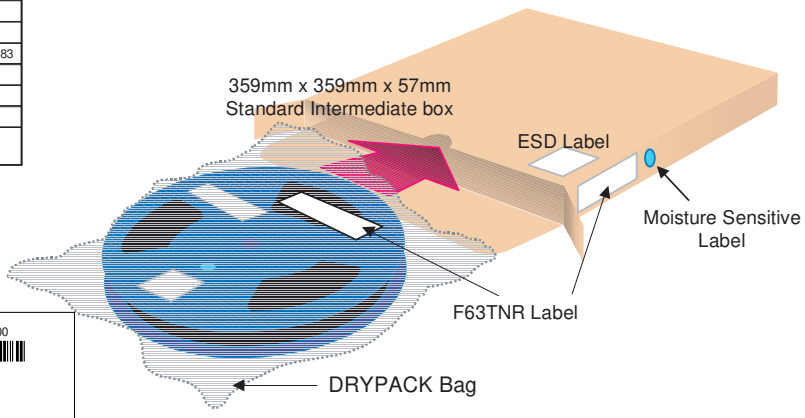
TO-263/D²PAK parts are shipped in tape. The carrier tape is made from a dissipative (carbon filled) polycarbonate resin. The cover tape is a multilayer film (Heat Activated Adhesive in nature) primarily composed of polyester film, adhesive layer, sealant, and anti-static sprayed agent. These reeled parts in standard option are shipped with 800 units per 13" or 330cm diameter reel. The reels are dark blue in color and is made of polystyrene plastic (anti-static coated). This and some other options are further described in the Packaging Information table.

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

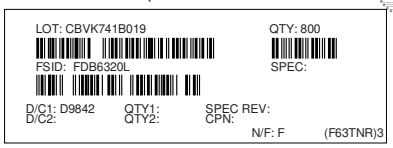
TO-263AB/D²PAK Packaging Information		
Packaging Option	Standard (no flow code)	L86Z
Packaging type	TNR	Rail/Tube
Qty per Reel/Tube/Bag	800	45
Reel Size	13" Dia	-
Box Dimension (mm)	359x359x57	530x130x83
Max qty per Box	800	1,080
Weight per unit (gm)	1.4378	1.4378
Weight per Reel	1.6050	-
Note/Comments		



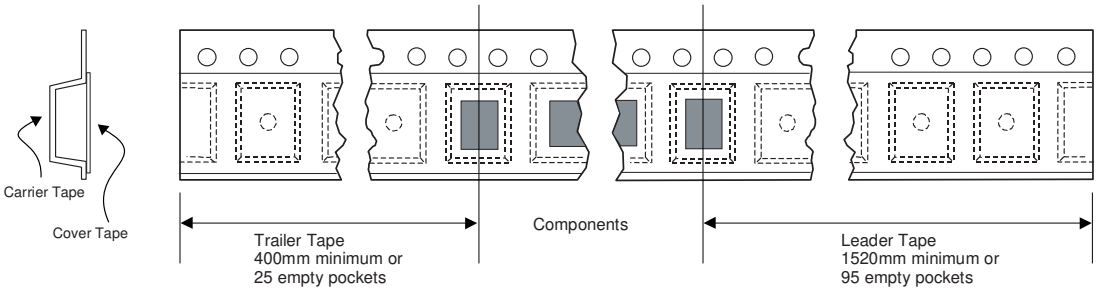
TO-263AB/D²PAK Unit Orientation



F63TNR Label sample



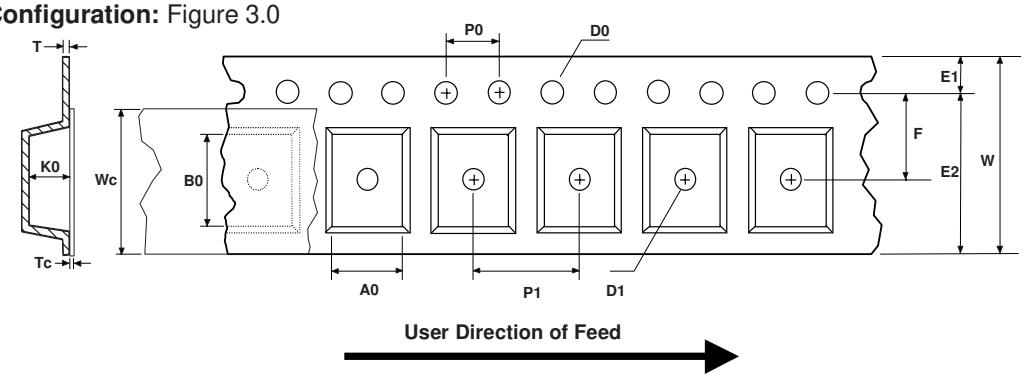
TO-263AB/D²PAK Tape Leader and Trailer Configuration: Figure 2.0



TO-263AB/D²PAK Tape and Reel Data and Package Dimensions, continued

TO-263AB/D²PAK Embossed Carrier Tape

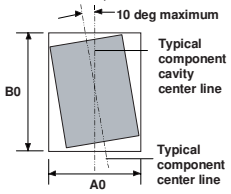
Configuration: Figure 3.0



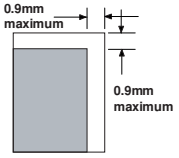
Dimensions are in millimeter														
Pkg type	**A0**	**B0**	**W**	**D0**	**D1**	**E1**	**E2**	**F**	**P1**	**P0**	**K0**	**T**	**Wc**	**Tc**
TO263AB/ D²PAK (24mm)	10.60 +/-0.10	15.80 +/-0.10	24.0 +/-0.3	1.55 +/-0.05	1.60 +/-0.10	1.75 +/-0.10	22.25 min	11.50 +/-0.10	16.0 +/-0.1	4.0 +/-0.1	4.90 +/-0.10	0.450 +/-0.150	21.0 +/-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



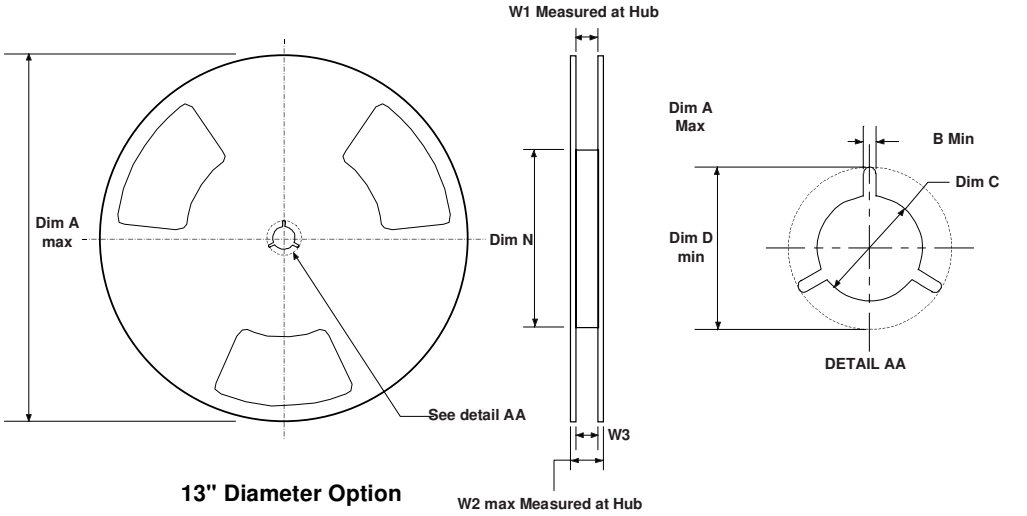
Sketch B (Top View)
Component Rotation



Sketch C (Top View)
Component lateral movement

TO-263AB/D²PAK Reel Configuration:

Figure 4.0

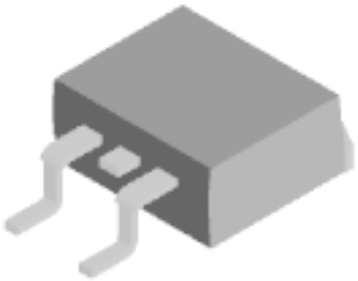


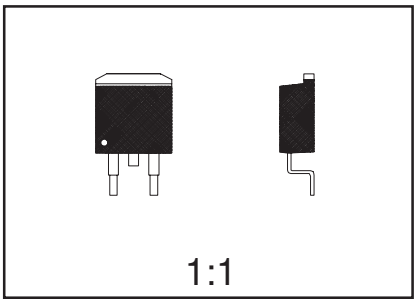
13" Diameter Option

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)**
24mm	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	0.961 +0.078/-0.000 24.4 +2/0	1.197 30.4	0.941 – 0.1.079 23.9 – 27.4

TO-263AB/D²PAK Tape and Reel Data and Package Dimensions, continued

TO-263AB/D²PAK (FS PKG Code 45)

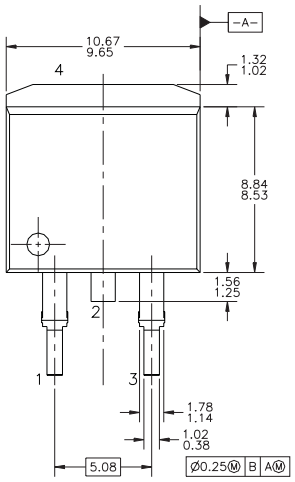


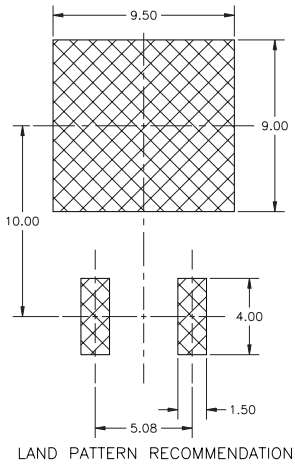


Scale 1:1 on letter size paper

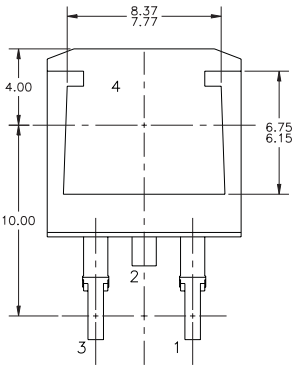
Dimensions shown below are in:
inches [millimeters]

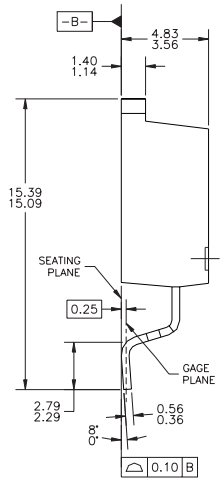
Part Weight per unit (gram): 1.4378





LAND PATTERN RECOMMENDATION





NOTES: UNLESS OTHERWISE SPECIFIED
A) ALL DIMENSIONS ARE IN MILLIMETERS.
B) STANDARD LEAD FINISH:
200 MICROINCHES / 5.08 MICROMETERS MIN.
LEAD/TIN 15/85 ON OLIN 194 COPPER OR EQUIVALENT.
C) MAXIMUM VERTICAL BURR ON HEATSINK NOT TO EXCEED 0.003 INCH / 0.05mm.
D) NO PACKAGE CHIPS, CRACKS OR SURFACE IDENTIFICATION ALLOWED AFTER FORMING.
E) REFERENCE JEDEC, TO-263, ISSUE C, VARIATION AB, DATED 2/92.

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PRODUCT STATUS DEFINITIONS

Definition of Terms

Datasheet Identification	Product Status	Definition
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