FAIRCHILD
SEMICONDUCTOR ™

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. $R_{DS(ON)} = 0.0095\ \Omega$ @ $V_{GS} = 10$ V
  $R_{DS(ON)} = 0.011\ \Omega$ @ $V_{GS} = 6$ 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

G
D
S

D

G

S

TO-263AB
FDB Series

D

G

S
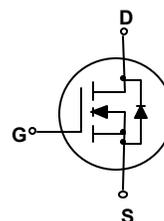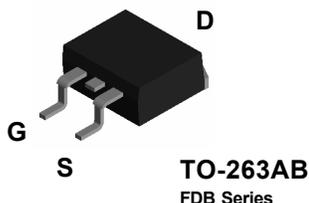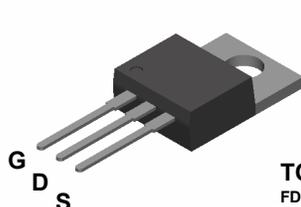
Absolute Maximum Ratings T_A=25°C unless otherwise noted

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,		4468		pF
C_{oss}	Output Capacitance	f = 1.0 MHz		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,		21	30	ns
t_r	Turn–On Rise Time	V_{GS} = 10 V, R_{GEN} = 6 Ω		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,		76	107	nC
Q_{gs}	Gate–Source Charge	V_{GS} = 10 V		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
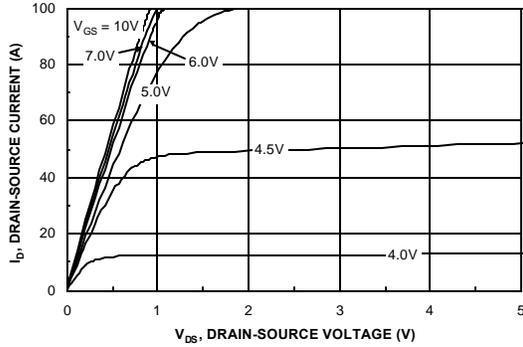
Figure 1. On-Region Characteristics.
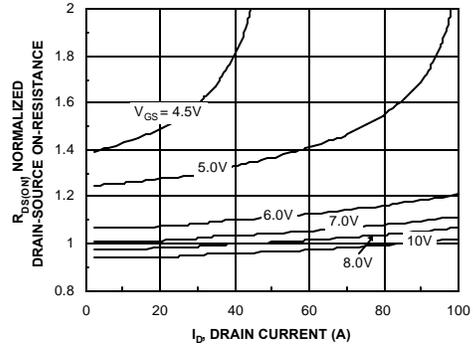
Figure 2. On-Resistance Variation with
Drain Current and Gate Voltage.
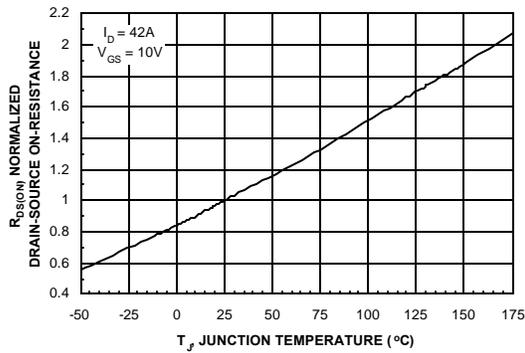
Figure 3. On-Resistance Variation
withTemperature.
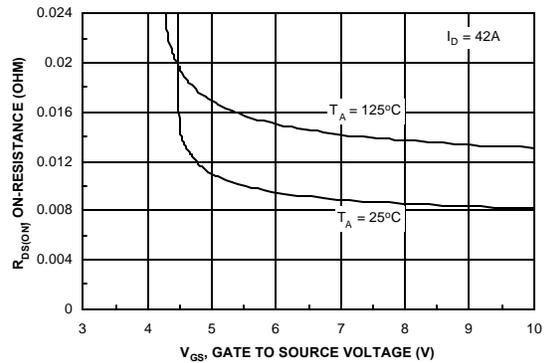
Figure 4. On-Resistance Variation with
Gate-to-Source Voltage.
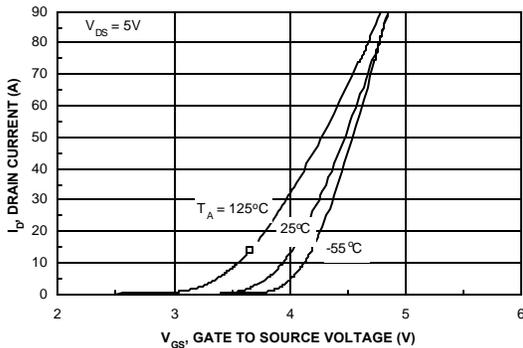
Figure 5. Transfer Characteristics.
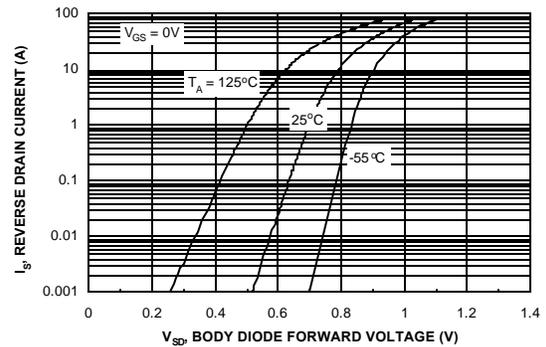
Figure 6. Body Diode Forward Voltage Variation
with Source Current and Temperature.

Typical Characteristics
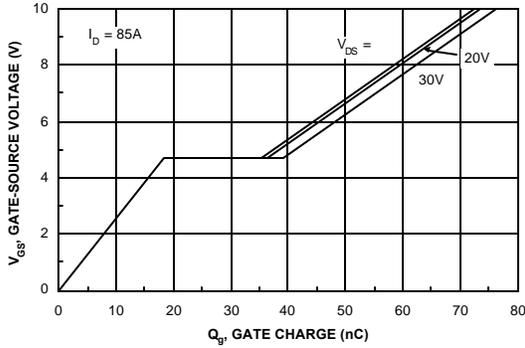
Figure 7. Gate Charge Characteristics.
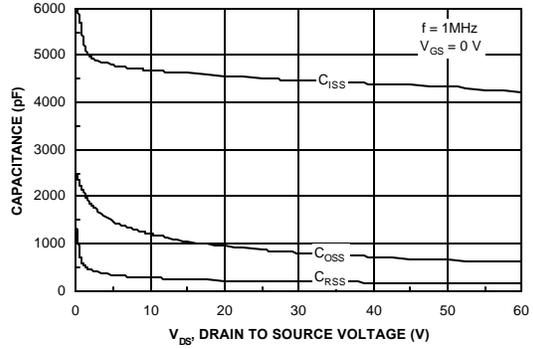
Figure 8. Capacitance Characteristics.
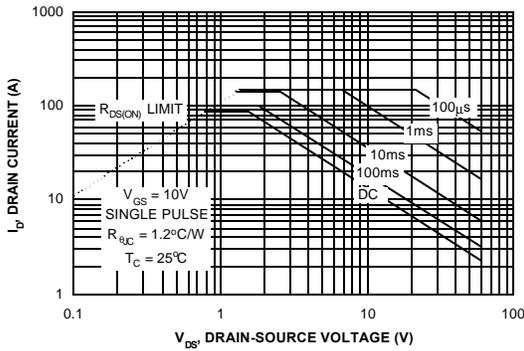
Figure 9. Maximum Safe Operating Area.
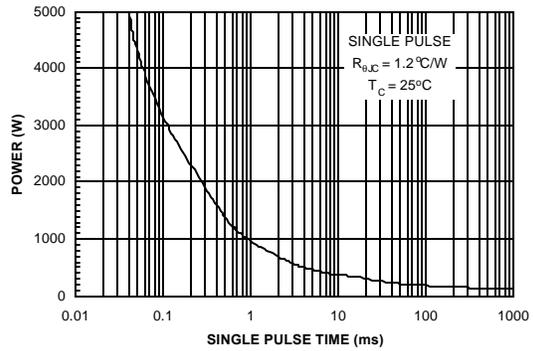
Figure 10. Single Pulse Maximum
Power Dissipation.
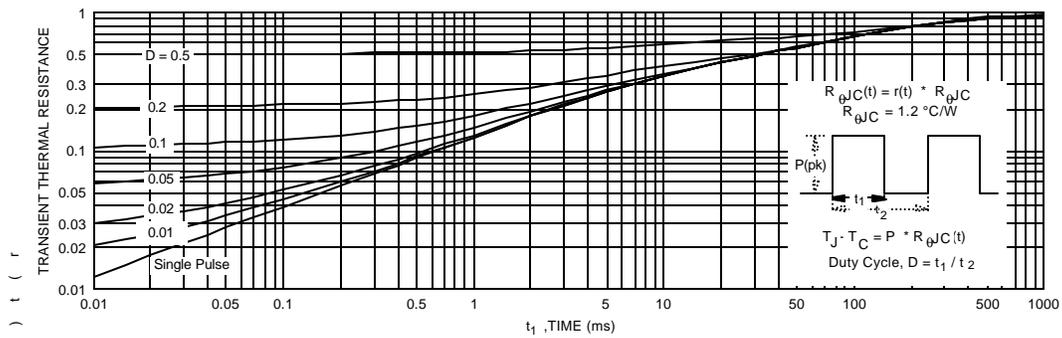
Figure 11. Transient Thermal Response Curve.

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

45 units per Tube

12 Tubes per Bag

Conductive Plastic Bag

2 bags per Box

530mm x 130mm x 83mm
Intermediate box
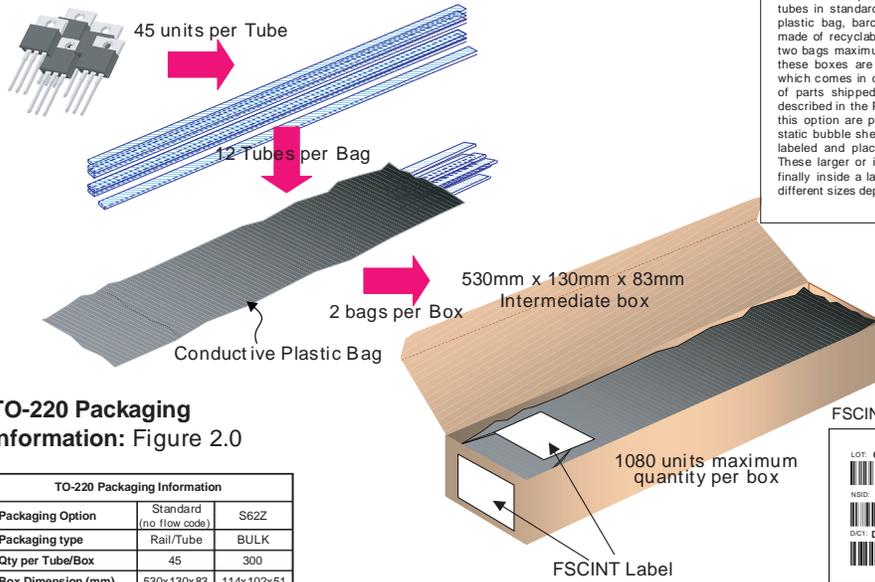
Packaging Description:

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.

TO-220 Packaging
Information: Figure 2.0

1080 units maximum
quantity per box

FSCINT Label

FSCINT Label sample

FAIRCHILD SEMICONDUCTOR CORPORATION		HTB: B	
LOT: **CBVK741B019**		QTY: **1080**	
NSID: **FDP7060**		SPEC:	
D/C1: **D9842**	SPEC REV: **B2**		
	QA REV:		
			(FSCINT)

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

FSCINT Label

Anti-static
Bubble Sheets

530mm x 130mm x 83mm
Intermediate box

300 units per
EO70 box

5 EO70 boxes per per
Intermediate Box

1500 units maximum
quantity per intermediate box

114mm x 102mm x 51mm
EO70 Immediate Box

FSCINT Label
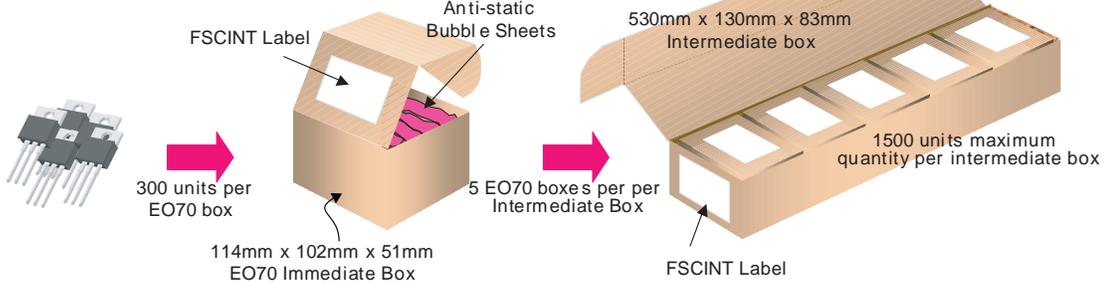
TO-220 Tube
Configuration: Figure 4.0

Note: All dimensions are in inches

0.123
+0.001
-0.003

0.450
±030

1.300
±.015

0.165

0.080

0.275

0.032
±.003

0.160

20.000
+0.031
-0.065

0.800

0.275

TO-220 (FS PKG Code 37)

1:1

Scale 1:1 on letter size paper

Dimensions shown below are in:
inches [millimeters]

Part Weight per unit (gram): 1.4378

$\phi \begin{array}{c} 0.1610 \\ 0.1390 \end{array}$ $\phi \begin{array}{c} 4.09 \\ 3.53 \end{array}$

TYP. $\begin{array}{c} 0.0700 \\ 0.0450 \end{array}$ $\begin{bmatrix} 1.78 \\ 1.14 \end{bmatrix}$

TYP. $\begin{array}{c} 0.0400 \\ 0.0150 \end{array}$ $\begin{bmatrix} 1.02 \\ 0.38 \end{bmatrix}$

$\begin{array}{c} 0.1350 \\ 0.1000 \end{array}$ $\begin{bmatrix} 3.43 \\ 2.54 \end{bmatrix}$

$\begin{array}{c} 0.1100 \\ 0.0900 \end{array}$ $\begin{bmatrix} 2.79 \\ 2.29 \end{bmatrix}$

$\begin{array}{c} 0.2100 \\ 0.1900 \end{array}$ $\begin{bmatrix} 5.33 \\ 4.83 \end{bmatrix}$

$\begin{array}{c} 0.4200 \\ 0.3800 \end{array}$ $\begin{bmatrix} 10.67 \\ 9.65 \end{bmatrix}$

$\begin{array}{c} 0.1100 \\ 0.0900 \end{array}$ $\begin{bmatrix} 2.79 \\ 2.29 \end{bmatrix}$

PIN#1 ID

$\begin{array}{c} 0.6500 \\ 0.5600 \end{array}$ $\begin{bmatrix} 16.51 \\ 14.22 \end{bmatrix}$

TYP. $\begin{array}{c} 0.2500 \\ 0.1430 \end{array}$ $\begin{bmatrix} 6.35 \\ 3.63 \end{bmatrix}$

$\begin{array}{c} 0.5800 \\ 0.5000 \end{array}$ $\begin{bmatrix} 14.73 \\ 12.70 \end{bmatrix}$

$\begin{array}{c} 0.0220 \\ 0.0140 \end{array}$ $\begin{bmatrix} 0.56 \\ 0.36 \end{bmatrix}$

$\begin{array}{c} 0.2700 \\ 0.2300 \end{array}$ $\begin{bmatrix} 6.86 \\ 5.84 \end{bmatrix}$

$\begin{array}{c} 0.4200 \\ 0.3800 \end{array}$ $\begin{bmatrix} 10.67 \\ 9.65 \end{bmatrix}$

5.0°

7.0°

5.0°

$\begin{array}{c} 0.1150 \\ 0.0800 \end{array}$ $\begin{bmatrix} 2.92 \\ 2.03 \end{bmatrix}$

$\begin{array}{c} 0.4140 \\ 0.3740 \end{array}$ $\begin{bmatrix} 10.52 \\ 9.50 \end{bmatrix}$

$\begin{array}{c} 0.1900 \\ 0.1400 \end{array}$ $\begin{bmatrix} 4.83 \\ 3.56 \end{bmatrix}$

$\begin{array}{c} 1.1340 \\ 1.1140 \end{array}$ $\begin{bmatrix} 28.80 \\ 28.30 \end{bmatrix}$

$\begin{array}{c} 0.0550 \\ 0.0450 \end{array}$ $\begin{bmatrix} 1.40 \\ 1.14 \end{bmatrix}$

NOTE : UNLESS OTHERWISE SPECIFIED

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 220 3 LEAD

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

TO-263AB/D²PAK Packaging
Configuration: Figure 1.0

ESD Label

Antistatic Cover Tape

Static Dissipative
Embossed Carrier Tape

Moisture Sensitive
Label

F63TNR
Label

Customized
Label
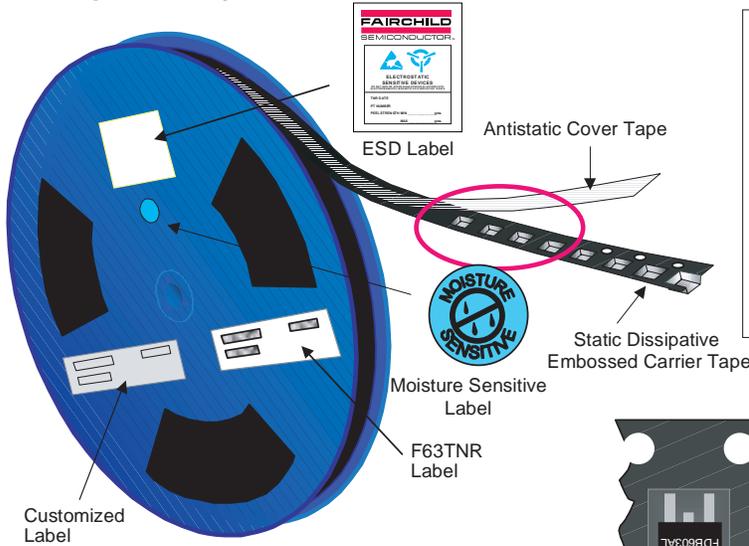
Packaging Description:

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		
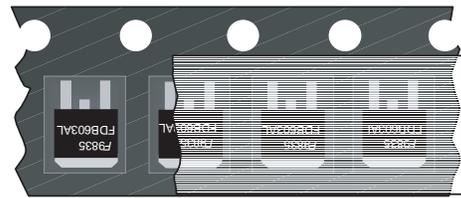
TO-263AB/D²PAK Unit Orientation

359mm x 359mm x 57mm
Standard Intermediate box

ESD Label

Moisture Sensitive
Label

F63TNR Label

DRYPACK Bag

F63TNR Label sample

LOT: CBVK741B019   QTY: 800

FSID: FDB6320L   SPEC:

D/C1: D9842   QTY1:   SPEC REV:
D/C2:   QTY2:   CPN:
                 N/F: F   (F63TNR)3
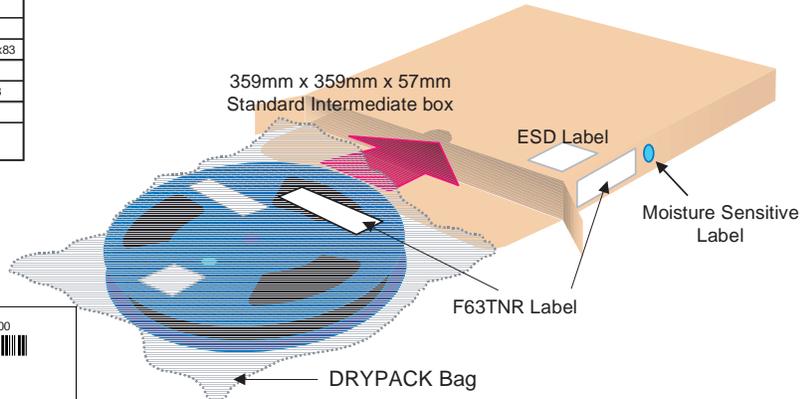
TO-263AB/D²PAK Tape Leader and Trailer
Configuration: Figure 2.0

Carrier Tape

Cover Tape

Trailer Tape
400mm minimum or
25 empty pockets

Components

Leader Tape
1520mm minimum or
95 empty pockets
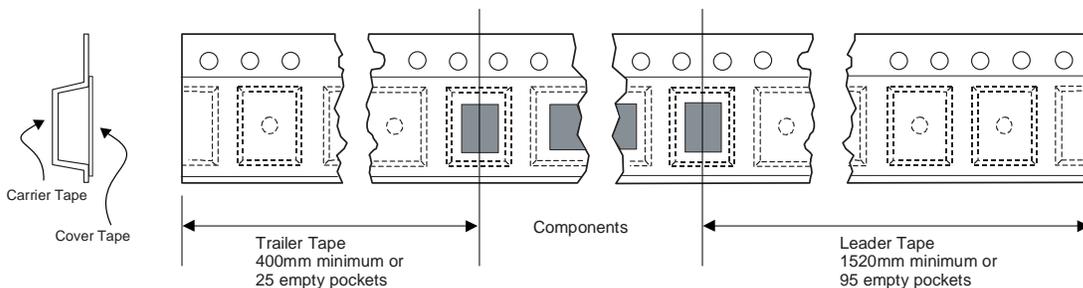
TO-263AB/D²PAK Tape and Reel Data and Package Dimensions, continued

TO-263AB/D²PAK Embossed Carrier Tape
Configuration: Figure 3.0

User Direction of Feed
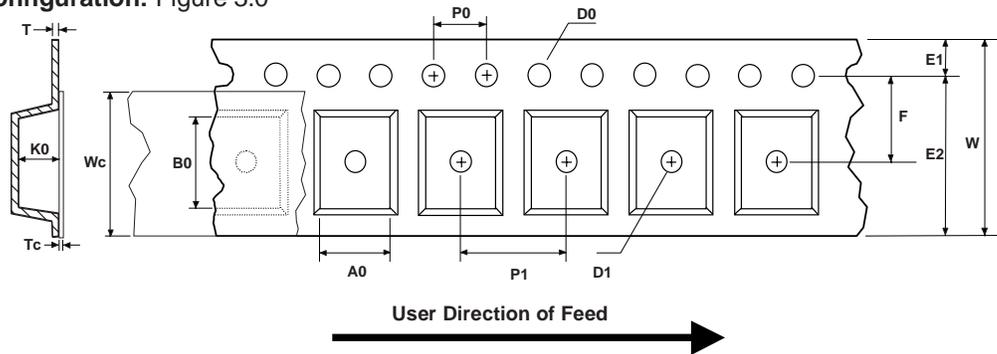
						Dimensions are in millimeter							
Pkg type	A0	B0	W	D0	D1	E1	E2	F	P1	P0	K0	T	Wc	Tc
TO263AB/ D²PAK (24mm)	10.60 +/-0.10	15.80 +/-0.10	24.0 +/-0.3	1.55 +/-0.05	1.60 +/-0.10	1.75 +/-0.10	22.25 min	11.50 +/-0.10	16.0 +/-0.1	4.0 +/-0.1	4.90 +/-0.10	0.450 +/-0.150	21.0 +/-0.3	0.06 +/-0.02

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).

10 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
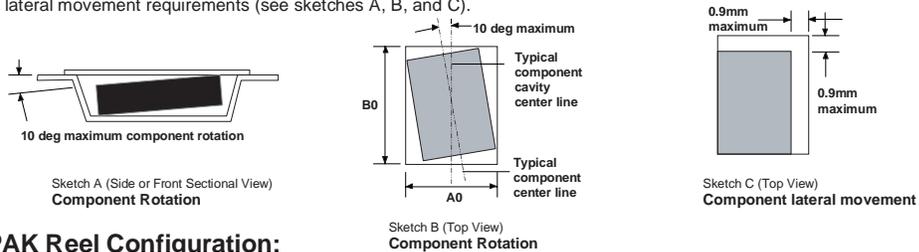
TO-263AB/D²PAK Reel Configuration:
Figure 4.0

13" Diameter Option
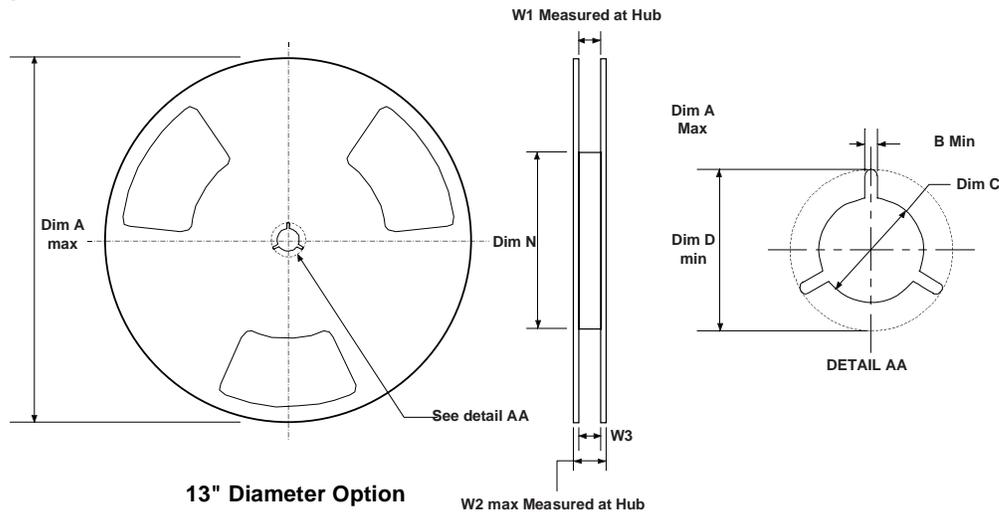
				Dimensions are in inches and millimeters				
Tape Size	Reel Option	Dim A	Dim B	Dim C	Dim D	Dim N	Dim W1	Dim W2	Dim W3 (LSL-USL)
24mm	13" Dia	13.00 330	0.059 1.5	512 +0.020/-0.008 13 +0.5/-0.2	0.795 20.2	4.00 100	0.961 +0.078/-0.000 24.4 +2/0	1.197 30.4	0.941 – 0.1079 23.9 – 27.4

TO-263AB/D²PAK (FS PKG Code 45)
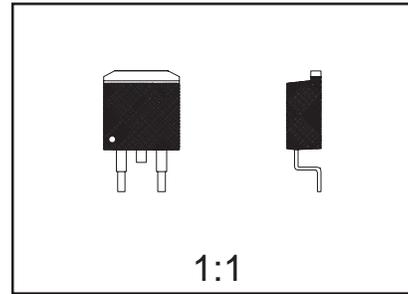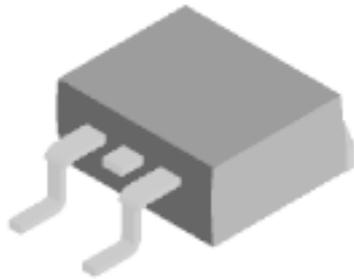
1:1

Scale 1:1 on letter size paper

Dimensions shown below are in:
inches [millimeters]

Part Weight per unit (gram): 1.4378

−A−

10.67
9.65

1.32
1.02

8.84
8.53

1.56
1.25

1.78
1.14

1.02
0.38

5.08

Ø0.25 Ⓜ B AⓂ

9.50

9.00

10.00

4.00

5.08

1.50

LAND PATTERN RECOMMENDATION

8.37
7.77

4.00

6.75
6.15

10.00

−B−

4.83
3.56

1.40
1.14

15.39
15.09

SEATING
PLANE

0.25

GAGE
PLANE

2.79
2.29

0.56
0.36

8°
0°

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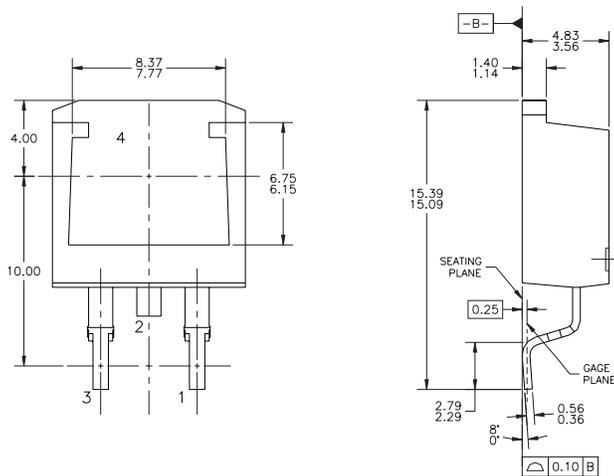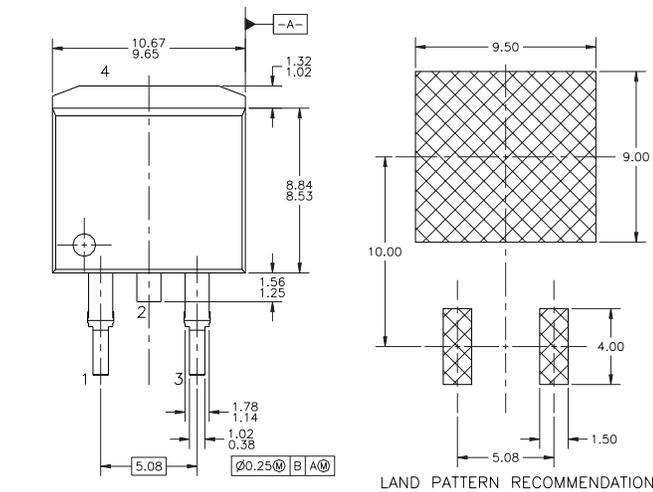
NOTES: UNLESS OTHERWISE SPECIFIED
A)   ALL DIMENSIONS ARE IN MILLIMETERS.
B)   STANDARD LEAD FINISH:
         200 MICROINCHES / 5.08 MICROMETERS MIN.
         LEAD/TIN 15/85 ON OLIN 194 COPPER OR
         EQUIVALENT.
C)   MAXIMUM VERTICAL BURR ON HEATSINK NOT
         TO EXCEED 0.003 INCH / 0.05mm.
D)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