DN3545

N-Channel Depletion-Mode Vertical DMOS FET

Features

- High Input Impedance
- Low Input Capacitance
- Fast Switching Speeds
- Low On-Resistance
- Free from Secondary Breakdown
- Low Input and Output Leakage

Applications

- Normally-On Switches
- Solid-State Relays
- Converters
- Linear Amplifiers
- Constant-Current Sources
- Power Supply Circuits
- Telecommunications

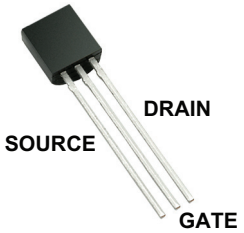
General Description

The DN3545 Depletion-mode normally-on transistor uses an advanced vertical Diffusion Metal Oxide Semiconductor (DMOS) structure and a well-proven silicon-gate manufacturing process. This combination produces a device with the power-handling capabilities of bipolar transistors and the high-input impedance and positive-temperature coefficient inherent in Metal-Oxide Semiconductor (MOS) devices. Characteristic of all MOS structures, this device is free from thermal runaway and thermally induced secondary breakdown.

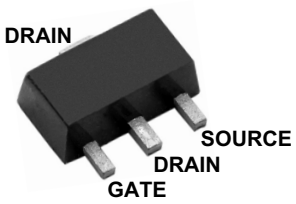
Vertical DMOS Field-Effect Transistors (FETs) are ideally suited to a wide range of switching and amplifying applications where very low threshold voltage, high breakdown voltage, high input impedance, low input capacitance and fast switching speeds are desired.

Package Types

3-lead TO-92
(Top view)



3-lead SOT-89
(Top view)



See Table 3-1 and Table 3-2 for pin information.

1.0 ELECTRICAL CHARACTERISTICS

ABSOLUTE MAXIMUM RATINGS†

Drain-to-Source Voltage ..... BV_{DSX}
Drain-to-Gate Voltage ..... BV_{DGX}
Gate-to-Source Voltage ..... ±20V
Operating Ambient Temperature, T_A ..... –55°C to +150°C
Storage Temperature, T_S ..... –55°C to +150°C

† Notice: Stresses above those listed under “Maximum Ratings” may cause permanent damage to the device. This is a stress rating only and functional operation of the device at those or any other conditions above those indicated in the operational listings of this specification is not implied. Exposure to maximum rating conditions for extended periods may affect device reliability.

DC ELECTRICAL CHARACTERISTICS

Electrical Specifications: T_A = 25°C unless otherwise specified. All DC parameters are 100% tested at 25°C unless otherwise stated. Pulse test: 300 µs pulse, 2% duty cycle.

Parameter	Sym.	Min.	Typ.	Max.	Unit	Conditions
Drain-to-Source Breakdown Voltage	BV_{DSX}	450	—	—	V	V_{GS} = –5V, I_D = 100 µA
Gate-to-Source Off Voltage	$V_{GS(OFF)}$	–1.5	—	–3.5	V	V_{DS} = 25V, I_D = 10 µA
$V_{GS(OFF)}$ Change with Temperature	$\Delta V_{GS(OFF)}$	—	—	–4.5	mV/°C	V_{DS} = 25V, I_D = 10 µA (**Note 1**)
Gate Body Leakage Current	I_{GSS}	—	—	100	nA	V_{GS} = ±20V, V_{DS} = 0V
Drain-to-Source Leakage Current	$I_{D(OFF)}$	—	—	1	µA	V_{DS} = Maximum rating, V_{GS} = –5V
		—	—	1	mA	V_{DS} = 0.8 Maximum rating, V_{GS} = –5V, T_A = 125°C (**Note 1**)
Saturated Drain-to-Source Current	I_{DSS}	200	—	—	mA	V_{GS} = 0V, V_{DS} = 15V
Static Drain-to-Source On-State Resistance	$R_{DS(ON)}$	—	—	20	Ω	V_{GS} = 0V, I_D = 150 mA
Change in $R_{DS(ON)}$ with Temperature	$\Delta R_{DS(ON)}$	—	—	1.1	%/°C	V_{GS} = 0V, I_D = 150 mA (**Note 1**)

Note 1: Specification is obtained by characterization and is not 100% tested.

AC ELECTRICAL CHARACTERISTICS

Electrical Specifications: Unless otherwise specified, for all specifications T_A = 25°C. Specification is obtained by characterization and is not 100% tested.

Parameter	Sym.	Min.	Typ.	Max.	Unit	Conditions
Forward Transconductance	G_{FS}	150	—	—	mmho	V_{DS} = 10V, I_D = 100 mA
Input Capacitance	C_{ISS}	—	—	360	pF	V_{GS} = –5V, V_{DS} = 25V, f = 1 MHz
Common Source Output Capacitance	C_{OSS}	—	—	40	pF	
Reverse Transfer Capacitance	C_{RSS}	—	—	15	pF	
Turn-On Delay Time	$t_{d(ON)}$	—	—	20	ns	V_{DD} = 25V, I_D = 150 mA, R_{GEN} = 25Ω, V_{GS} = 0V to –10V
Rise Time	t_r	—	—	30	ns	
Turn-Off Delay Time	$t_{d(OFF)}$	—	—	30	ns	
Fall Time	t_f	—	—	40	ns	
DIODE PARAMETER						
Diode Forward Voltage Drop	V_{SD}	—	—	1.8	V	V_{GS} = –5V, I_{SD} = 150 mA (**Note 1**)
Reverse Recovery Time	t_{rr}	—	800	—	ns	V_{GS} = –5V, I_{SD} = 150 mA

Note 1: All DC parameters are 100% tested at 25°C unless otherwise stated. Pulse test: 300 µs pulse, 2% duty cycle.

TEMPERATURE SPECIFICATIONS

Electrical Specifications: Unless otherwise specified, for all specifications $T_A = T_J = +25°C$.						
Parameter	**Sym.**	**Min.**	**Typ.**	**Max.**	**Unit**	**Conditions**
TEMPERATURE RANGE						
Operating Ambient Temperature	T_A	–55	—	150	°C	
Storage Temperature	T_S	–55	—	150	°C	
PACKAGE THERMAL RESISTANCE						
3-lead TO-92	θ_{JA}	—	132	—	°C/W	
3-lead SOT-89	θ_{JA}	—	133	—	°C/W	

THERMAL CHARACTERISTICS

Package	**I_D (Note 1) Continuous (mA)**	**I_D Pulsed (mA)**	**Power Dissipation at T_C = 25°C (W)**	**I_{DR} (Note 1) (mA)**	**I_{DRM} (mA)**
3-lead TO-92	136	1600	0.74	136	1600
3-lead SOT-89	200	300	1.6 (Note 2)	200	300

Note 1: I_D continuous is limited by the maximum rated T_J.

2: Mounted on an FR4 board, 25 mm x 25 mm x 1.57 mm

2.0 TYPICAL PERFORMANCE CURVES

Note: The graphs and tables provided following this note are a statistical summary based on a limited number of samples and are provided for informational purposes only. The performance characteristics listed herein are not tested or guaranteed. In some graphs or tables, the data presented may be outside the specified operating range (e.g. outside specified power supply range) and therefore outside the warranted range.

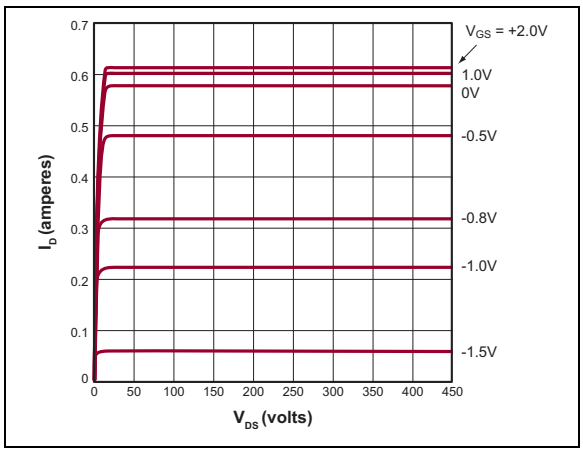


FIGURE 2-1: *OutputCharacteristics.*

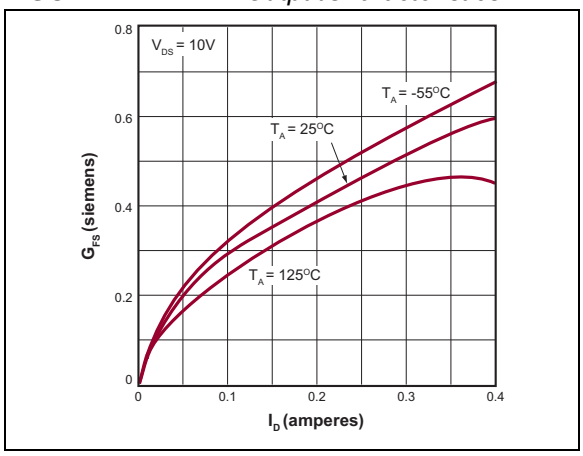


FIGURE 2-2: *Transconductance vs. Drain Current.*

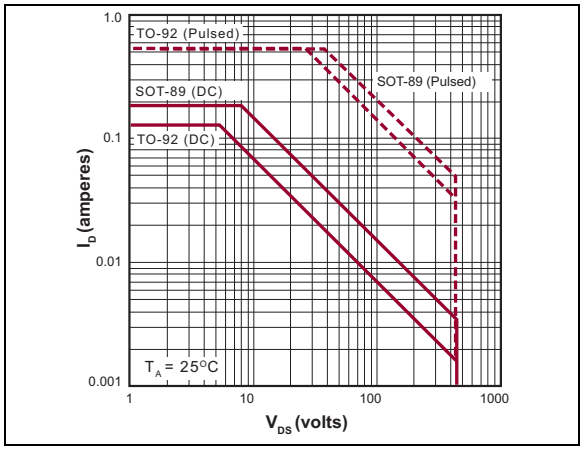


FIGURE 2-3: *Maximum Rated Safe Operating Area.*

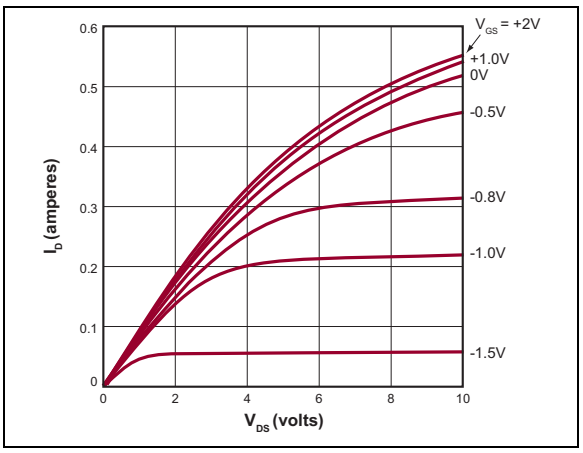


FIGURE 2-4: *Saturation Characteristics.*

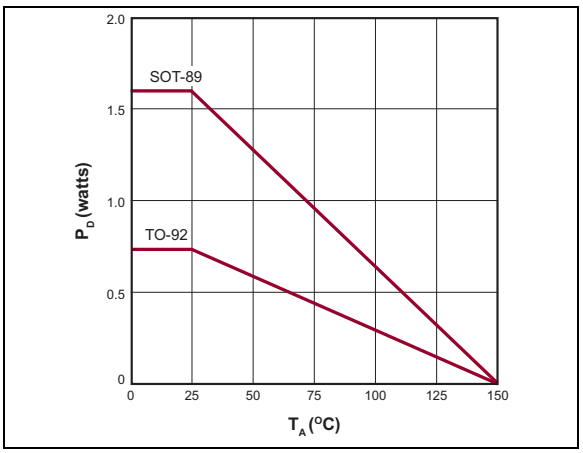


FIGURE 2-5: *Power Dissipation vs. Ambient Temperature.*

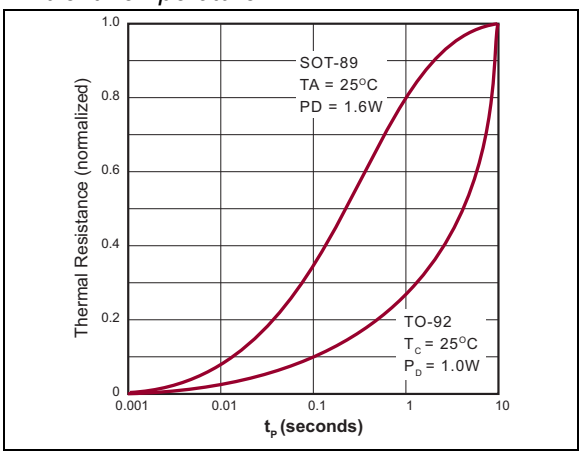


FIGURE 2-6: *Thermal Response Characteristics.*

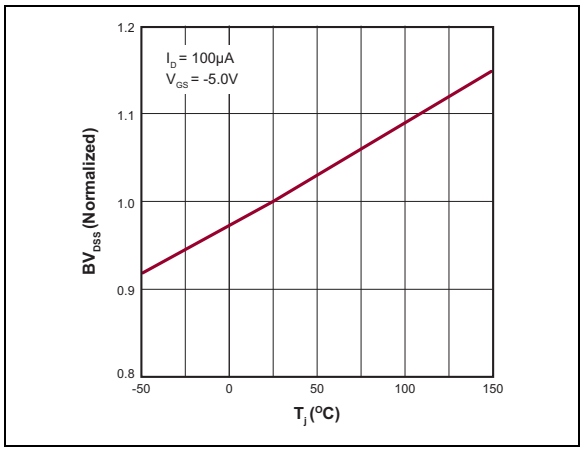


FIGURE 2-7: *BV_{DSS} Variation with Temperature.*

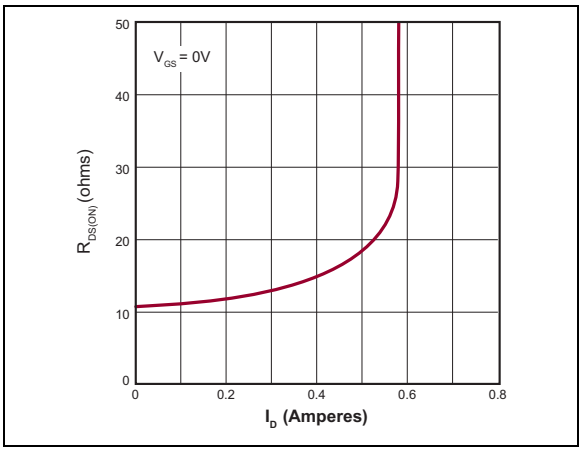


FIGURE 2-10: *On-Resistance vs. Drain Current.*

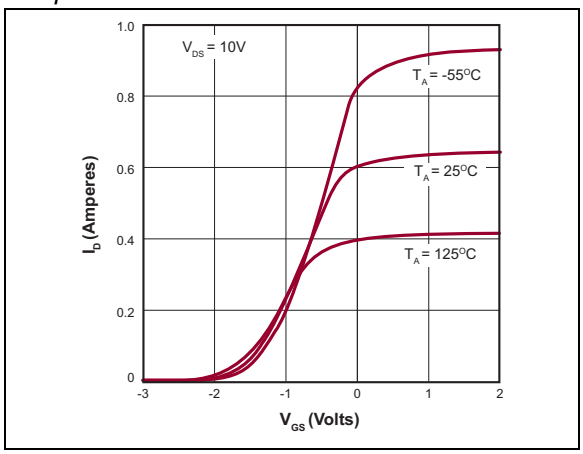


FIGURE 2-8: *Transfer Characteristics.*

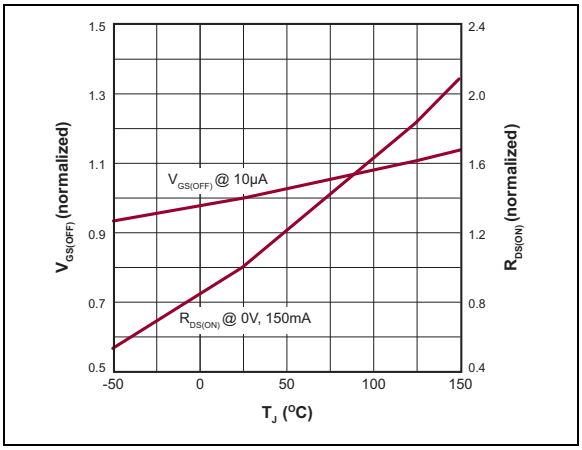


FIGURE 2-11: *$V_{GS(th)}$ and $R_{DS(ON)}$ Variation with Temperature.*

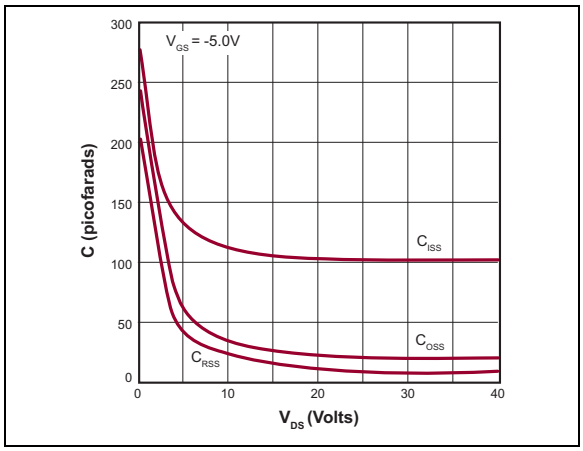


FIGURE 2-9: *Capacitance vs. Drain-to-Source Voltage.*

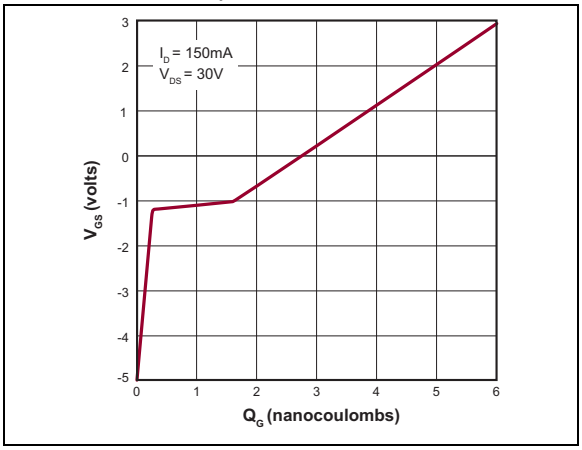


FIGURE 2-12: *Gate Drive Dynamic Characteristics.*

3.0 PIN DESCRIPTION

The details on the pins of 3-lead TO-92 and 3-lead SOT-89 packages are listed on Table 3-1 and Table 3-2, respectively. The locations of pins are indicated in **Package Types**.

TABLE 3-1: 3-LEAD TO-92 PIN FUNCTION TABLE

Pin Number	Pin Name	Description
1	Source	Source
2	Gate	Gate
3	Drain	Drain

TABLE 3-2: 3-LEAD SOT-89 PIN FUNCTION TABLE

Pin Number	Pin Name	Description
1	Gate	Gate
2, 4	Drain	Drain
3	Source	Source

4.0 FUNCTIONAL DESCRIPTION

Figure 4-1 illustrates the switching waveforms and test circuit for DN3545.

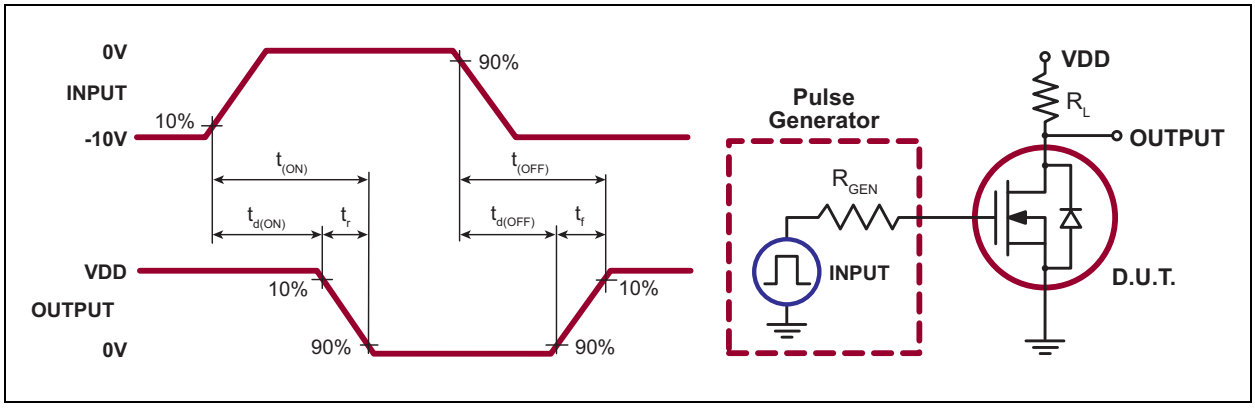


FIGURE 4-1: *Switching Waveforms and Test Circuit.*

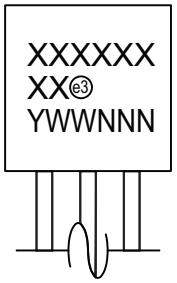
TABLE 4-1: PRODUCT SUMMARY

BV_{DSX}/BV_{DGX} (V)	$R_{DS(ON)}$ (Maximum) (Ω)	I_{DSS} (Minimum) (mA)
450	20	200

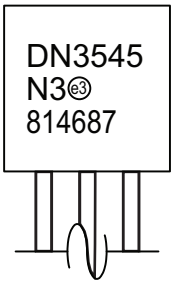
5.0 PACKAGING INFORMATION

5.1 Package Marking Information

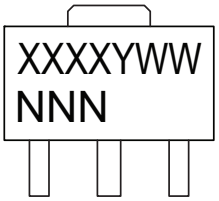
3-lead TO-92



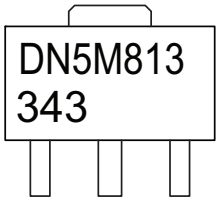
Example



3-lead TO-243AA

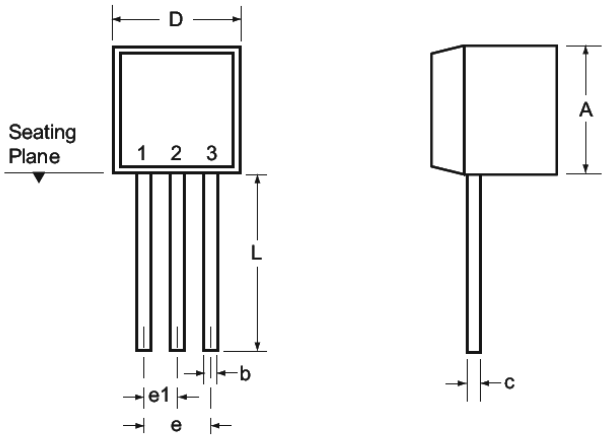


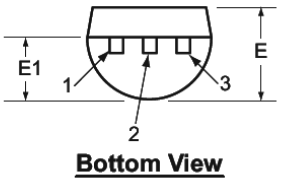
Example



Legend:	XX...X	Product Code or Customer-specific information
	Y	Year code (last digit of calendar year)
	YY	Year code (last 2 digits of calendar year)
	WW	Week code (week of January 1 is week ‘01’)
	NNN	Alphanumeric traceability code
	(e3)	Pb-free JEDEC® designator for Matte Tin (Sn)
	*	This package is Pb-free. The Pb-free JEDEC designator ((e3)) can be found on the outer packaging for this package.
Note:	In the event the full Microchip part number cannot be marked on one line, it will be carried over to the next line, thus limiting the number of available characters for product code or customer-specific information. Package may or not include the corporate logo.	

3-Lead TO-92 Package Outline (L/LL/N3)



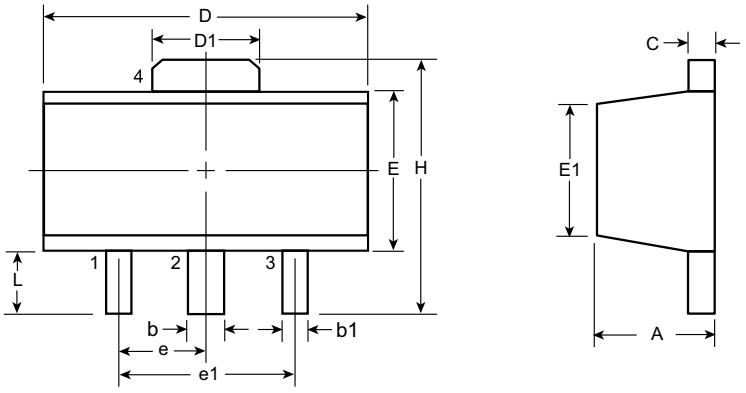


Note: For the most current package drawings, see the Microchip Packaging Specification at www.microchip.com/packaging.

Symbol		A	b	c	D	E	E1	e	e1	L
Dimensions (inches)	MIN	.170	.014†	.014†	.175	.125	.080	.095	.045	.500
	NOM	-	-	-	-	-	-	-	-	-
	MAX	.210	.022†	.022†	.205	.165	.105	.105	.055	.610*

JEDEC Registration TO-92.
** This dimension is not specified in the JEDEC drawing.*
† This dimension differs from the JEDEC drawing.
Drawings not to scale.

3-Lead TO-243AA (SOT-89) Package Outline (N8)



Top View **Side View**

Note: For the most current package drawings, see the Microchip Packaging Specification at www.microchip.com/packaging.

Symbol		A	b	b1	C	D	D1	E	E1	e	e1	H	L
Dimensions (mm)	MIN	1.40	0.44	0.36	0.35	4.40	1.62	2.29	2.00†	1.50 BSC	3.00 BSC	3.94	0.73†
	NOM	-	-	-	-	-	-	-	-			-	-
	MAX	1.60	0.56	0.48	0.44	4.60	1.83	2.60	2.29			4.25	1.20

JEDEC Registration TO-243, Variation AA, Issue C, July 1986.
† This dimension differs from the JEDEC drawing
***Drawings not to scale**.*

APPENDIX A: REVISION HISTORY

Revision A (April 2018)

- Converted Supertex doc #DSFP-DN3545 to Microchip DS20005438A
- Added sections to comply with the standard Microchip format
- Changed the package marking format
- Removed the 3-lead TO-92 N3 P002, P003, P005, P013 and P014 media types
- Made minor text changes throughout the document

PRODUCT IDENTIFICATION SYSTEM

To order or obtain information, e.g., on pricing or delivery, contact your local Microchip representative or sales office.

PART NO.	XX	-	X	-	X
Device	Package Options		Environmental		Media Type

Device:	DN3545	=	N-Channel Depletion-Mode Vertical DMOS FET
Packages:	N3	=	3-lead TO-92
	N8	=	3-lead SOT-89
Environmental:	G	=	Lead (Pb)-free/RoHS-compliant Package
Media Types:	(blank)	=	1000/Bag for an N3 Package
	(blank)	=	2000/Reel for an N8 Package

Examples:

a) DN3545N3-G:	N-Channel Depletion-Mode Vertical DMOS FET, 3-lead TO-92, 1000/Bag
b) DN3545N8-G:	N-Channel Depletion-Mode Vertical DMOS FET, 3-lead SOT-89, 2000/Reel

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