TN5325

N-Channel Enhancement-Mode Vertical DMOS FET

Features

- Low Threshold (2V Maximum)
- High Input Impedance and High Gain
- Free from Secondary Breakdown
- Low CISS and Fast Switching Speeds

Applications

- Logic-level Interfaces (Ideal for TTL and CMOS)
- Solid State Relays
- Battery-operated Systems
- Photo-voltaic Drives
- Analog Switches
- General Purpose Line Drivers
- Telecommunication Switches

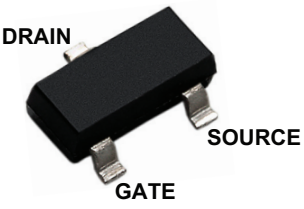
General Description

The TN5325 is a low-threshold, Enhancement-mode (normally-off) transistor that utilizes a vertical 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 MOS devices. Characteristic of all MOS structures, this device is free from thermal runaway and thermally induced secondary breakdown.

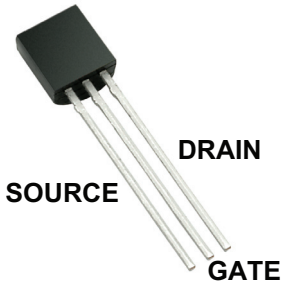
Microchip's vertical DMOS FETs are ideally suited to a wide range of switching and amplifying applications where very low threshold voltage, high breakdown voltage, high input impedance, low input capacitance and fast switching speeds are desired.

Package Types

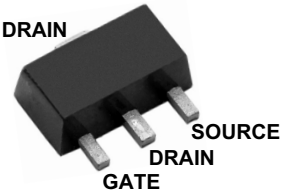
3-lead SOT-23 (TO-236AB)
(Top view)



3-lead TO-92
(Top view)



3-lead SOT-89 (243AA)
(Top view)



See Table 2-1, Table 2-2 and Table 2-3 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 “Absolute 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 sections of this specification is not intended. Exposure to maximum rating conditions for extended periods may affect device reliability.

DC ELECTRICAL CHARACTERISTICS [1]

Electrical Specifications: Unless otherwise specified, for all specifications $T_A = T_J = +25°C$.

Parameter	Sym.	Min.	Typ.	Max.	Unit	Conditions
Drain-to-source Breakdown Voltage	BV_{DSS}	250	—	—	V	V_{GS} = 0V, I_D = 100 µA
Gate Threshold Voltage	$V_{GS(th)}$	0.6	—	2	V	$V_{GS} = V_{DS}$, I_D = 1 mA
Change in $V_{GS(th)}$ with Temperature	$\Delta V_{GS(th)}$	—	—	–4.5	mV/°C	$V_{GS} = V_{DS}$, I_D = 1 mA (**Note 2**)
Gate Body Leakage	I_{GSS}	—	—	100	nA	V_{GS} = ± 20V, V_{DS} = 0V
Zero-gate Voltage Drain Current	I_{DSS}	—	—	1	µA	V_{GS} = 0V, V_{DS} = 100V
		—	—	10		V_{GS} = 0V, V_{DS} = Maximum Rating
		—	—	1	mA	V_{DS} = 0.8 Maximum Rating, V_{GS} = 0V, T_A = 125°C (**Note 2**)
On-state Drain Current	$I_{D(ON)}$	0.6	—	—	A	V_{GS} = 4.5V, V_{DS} = 25V
		1.2	—	—		V_{GS} = 10V, V_{DS} = 25V
Static Drain-to-source On-state Resistance	$R_{DS(ON)}$	—	—	8	Ω	V_{GS} = 4.5V, I_D = 150 mA
		—	—	7		V_{GS} = 10V, I_D = 1A
Change in $R_{DS(ON)}$ with Temperature	$\Delta_{RDS(ON)}$	—	—	1	%/°C	V_{GS} = 4.5V, I_D = 150 mA (**Note 2**)

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

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

AC ELECTRICAL CHARACTERISTICS [2]

Electrical Specifications: Unless otherwise specified, for all specifications $T_A = T_J = +25°C$.						
Parameter	**Sym.**	**Min.**	**Typ.**	**Max.**	**Unit**	**Conditions**
Forward Transconductance	G_{FS}	150	—	—	mmho	V_{DS} = 25V, I_D = 200 mA
Input Capacitance	C_{ISS}	—	—	110	pF	V_{GS} = 0V, V_{DS} = 25V, f = 1 MHz
Common Source Output Capacitance	C_{OSS}	—	—	60		
Reverse Transfer Capacitance	C_{RSS}	—	—	23		
Turn-on Delay Time	$t_{d(ON)}$	—	—	20	ns	V_{DD} = 25V, I_D = 150 mA, R_{GEN} = 25Ω
Rise Time	t_r	—	—	15		
Turn-off Delay Time	$t_{d(OFF)}$	—	—	25		
Fall Time	t_f	—	—	25		
DIODE PARAMETER						
Diode Forward Voltage Drop	V_{SD}	—	—	1.8	V	V_{GS} = 0V, I_{SD} = 200 mA (**Note 1**)
Reverse Recovery Time	t_{rr}	—	300	—	ns	V_{GS} = 0V, I_{SD} = 200 mA (**Note 2**)

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

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

TEMPERATURE SPECIFICATIONS

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 SOT-23	θ_{JA}	—	350	—	°C/W	
	θ_{JC}	—	200	—	°C/W	
3-lead TO-92	θ_{JA}	—	170	—	°C/W	
	θ_{JC}	—	125	—	°C/W	
3-lead SOT-89	θ_{JA}	—	78	—	°C/W	**Note 1**
	θ_{JC}	—	15	—	°C/W	

Note 1: Mounted on FR5 25 mm x 25 mm x 1.57 mm

THERMAL CHARACTERISTICS

Package	**I_D [1] (Continuous) (mA)**	**I_D (Pulsed) (A)**	**Power Dissipation at T_A = 25°C (W)**	**I_{DR} [1] (mA)**	**I_{DRM} (A)**
3-lead SOT-23	150	0.4	0.36	150	0.4
3-lead TO-92	215	0.8	0.74	215	0.8
3-lead SOT-89	316	1.5	1.6 [2]	316	1.5

Note 1: I_D (continuous) is limited by maximum T_J.

2: Mounted on FR5 board, 25 mm x 25 mm x 1.57 mm

2.0 PIN DESCRIPTION

Table 2-1, Table 2-2 and Table 2-3 show the description of pins in TN5325 3-lead SOT-23, 3-lead TO-92 and 3-lead SOT-89, respectively. Refer to **Package Types** for the location of pins.

TABLE 2-1: SOT-23 PIN FUNCTION TABLE

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

TABLE 2-2: TO-92 PIN FUNCTION TABLE

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

TABLE 2-3: SOT-89 PIN FUNCTION TABLE

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

3.0 FUNCTIONAL DESCRIPTION

Figure 3-1 illustrates the switching waveforms and test circuit for TN5325.

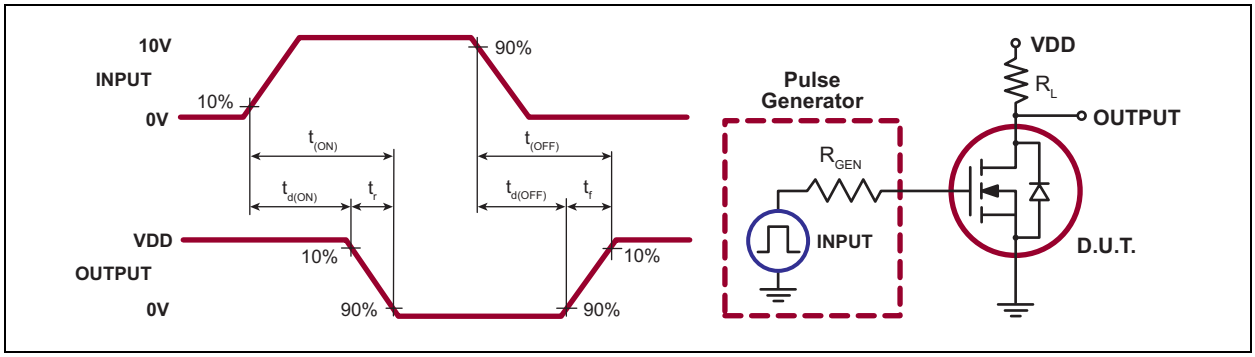


FIGURE 3-1: *Switching Waveforms and Test Circuit.*

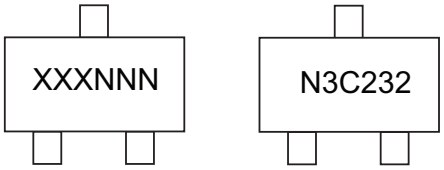
PRODUCT SUMMARY

BV_{DSS}/BV_{DGS} (V)	$R_{DS(ON)}$ (Maximum) (Ω)	$I_{D(ON)}$ (Minimum) (A)	$V_{GS(th)}$ (Maximum) (V)
250V	7	1.2	2

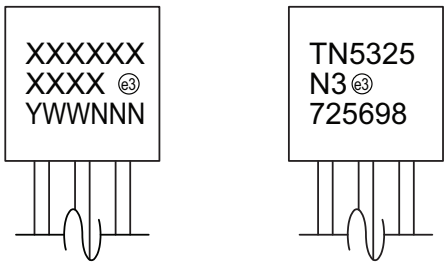
4.0 PACKAGING INFORMATION

4.1 Package Marking Information

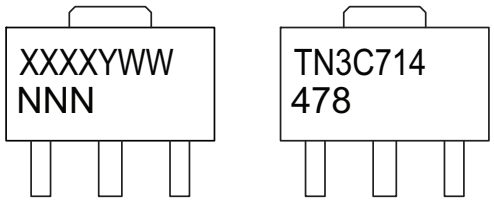
3-lead SOT-23 Example



3-lead TO-92 Example



3-lead SOT-89 Example

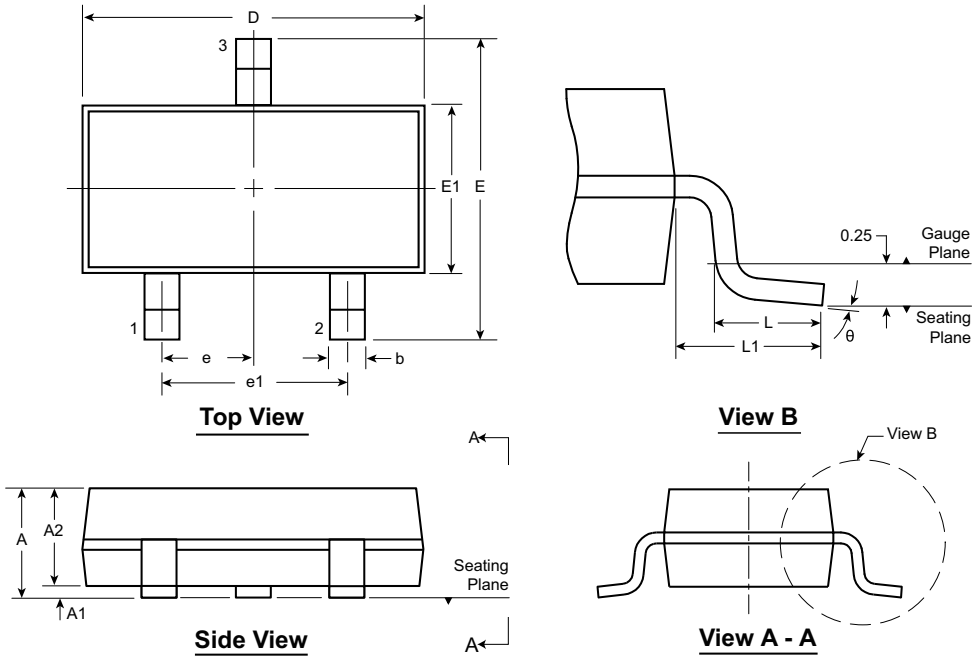


Legend:	XX...X	Product Code or Customer-specific information
	Y	Year code (last digit of calendar year)
	YY	Year code (last 2 digits of calendar year)
	WW	Week code (week of January 1 is week ‘01’)
	NNN	Alphanumeric traceability code
	(e3)	Pb-free JEDEC® designator for Matte Tin (Sn)
	*	This package 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-236AB (SOT-23) Package Outline (K1/T)

2.90x1.30mm body, 1.12mm height (max), 1.90mm pitch

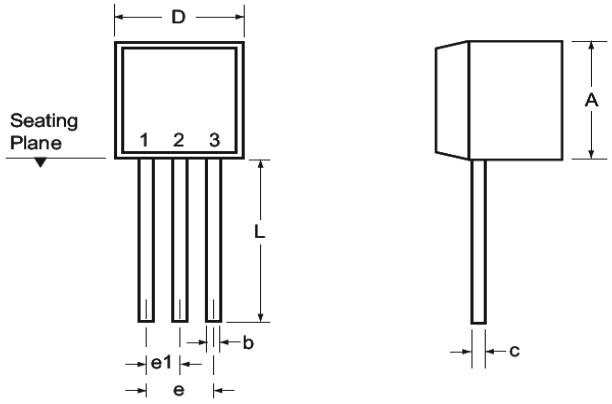


Note: For the most current package drawings, see the Microchip Packaging Specification at www.microchip.com/packaging.

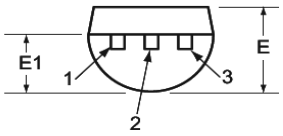
Symbol		A	A1	A2	b	D	E	E1	e	e1	L	L1	θ
Dimension (mm)	MIN	0.89	0.01	0.88	0.30	2.80	2.10	1.20	0.95 BSC	1.90 BSC	0.20†	0.54 REF	0°
	NOM	-	-	0.95	-	2.90	-	1.30			0.50		-
	MAX	1.12	0.10	1.02	0.50	3.04	2.64	1.40			0.60		8°

JEDEC Registration TO-236, Variation AB, Issue H, Jan. 1999.
† This dimension differs from the JEDEC drawing.
Drawings not to scale.

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



Front View **Side View**



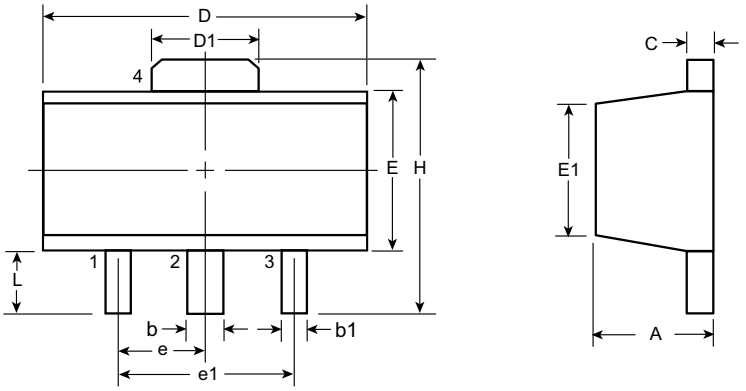
Bottom View

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.

NOTES:

APPENDIX A: REVISION HISTORY

Revision A (April 2017)

- Converted Supertex Doc# DSFP-TN5325 to Microchip DS20005709A
- Changed the part marking format
- Removed the N3 P003, N3 P005, N3 P013 and N3 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:	TN5325	=	N-Channel Enhancement-Mode Vertical DMOS FET
Packages:	K1	=	3-lead SOT-23
	N3	=	3-lead TO-92
	N8	=	3-lead SOT-89
Environmental:	G	=	Lead (Pb)-free/RoHS-compliant Package
Media Types:	(blank)	=	3000/Reel for a K1 Package
		=	1000/Bag for an N3 Package
		=	2000/Reel for an N8 Package
	P002	=	2000/Reel for an N3 Package

Examples:

a) TN5325K1-G: N-Channel Enhancement-Mode Vertical DMOS FET, 3-lead SOT-23, 3000/Reel

b) TN5325N3-G: N-Channel Enhancement-Mode Ver-tical DMOS FET, 3-lead TO-92, 1000/Bag

c) TN5325N3-G-P002: N-Channel Enhancement-Mode Vertical DMOS FET, 3-lead TO-92, 2000/Reel

d) TN5325N8-G: N-Channel Enhancement-Mode Vertical DMOS FET, 3-lead SOT-89, 2000/Reel

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