TN5335

N-Channel Enhancement-Mode Vertical DMOS FET

Features

- Low Threshold
- High Input Impedance
- Low Input Capacitance
- Fast Switching Speeds
- Low On-Resistance
- Free from Secondary Breakdown
- Low Input and Output Leakage
- Complementary N-Channel and P-Channel Devices

Applications

- Logic-Level Interfaces (Ideal for TTL and CMOS)
- Solid-State Relays
- Battery-Operated Systems
- Photovoltaic Drives
- Analog Switches
- General Purpose Line Drivers
- Telecommunication Switches

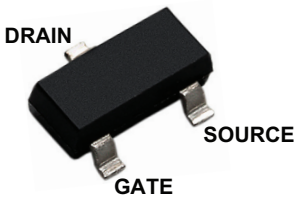
General Description

The TN5335 low-threshold Enhancement-mode (normally-off) transistor uses 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.

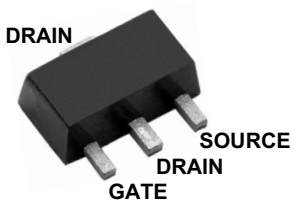
Microchip's vertical DMOS FETs are ideally suited for a wide range of switching and amplifying applications where very low threshold voltage, high breakdown voltage, high input impedance, low input capacitance and fast switching speeds are desired.

Package Types

3-lead SOT-23
(Top view)



3-lead SOT-89
(Top view)



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

1.0 ELECTRICAL CHARACTERISTICS

Absolute Maximum Ratings†

Drain-to-Source Voltage ..... BV_{DSS}
Drain-to-Gate Voltage ..... BV_{DGS}
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

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_{DSS}	350	—	—	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 1**)
Gate Body Leakage Current	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	µA	V_{GS} = 0V, V_{DS} = Maximum rating
		—	—	1	mA	V_{DS} = 0.8 Maximum rating, V_{GS} = 0V, T_A = 125°C (**Note 1**)
On-State Drain Current	$I_{D(ON)}$	300	—	—	mA	V_{GS} = 4.5V, V_{DS} = 25V
		750	—	—	mA	V_{GS} = 10V, V_{DS} = 25V
Static Drain-to-Source On-state Resistance	$R_{DS(ON)}$	—	—	15	Ω	V_{GS} = 3V, I_D = 20 mA
		—	—	15	Ω	V_{GS} = 4.5V, I_D = 150 mA
		—	—	15	Ω	V_{GS} = 10V, I_D = 200 mA
Change in $R_{DS(ON)}$ with Temperature	$\Delta R_{DS(ON)}$	—	—	1	%/°C	V_{GS} = 4.5V, I_D = 150 mA (**Note 1**)

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

AC ELECTRICAL CHARACTERISTICS

Electrical Specifications: T_A = 25°C unless otherwise specified. All AC parameters are not 100% sample tested.						
Parameter	**Sym.**	**Min.**	**Typ.**	**Max.**	**Unit**	**Conditions**
Forward Transconductance	G_{FS}	125	—	—	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	pF	
Reverse Transfer Capacitance	C_{RSS}	—	—	22	pF	
Turn-On Delay Time	$t_{d(ON)}$	—	—	20	ns	V_{DD} = 25V, I_D = 150 mA, R_{GEN} = 25Ω
Rise Time	t_r	—	—	15	ns	
Turn-Off Delay Time	$t_{d(OFF)}$	—	—	25	ns	
Fall Time	t_f	—	—	25	ns	
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}	—	800	—	ns	V_{GS} = 0V, I_{SD} = 200 mA

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

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}	—	203	—	°C/W	
3-lead SOT-89	θ_{JA}	—	173	—	°C/W	

THERMAL CHARACTERISTICS

Package	**I_D (Note 1) (Continuous) (mA)**	**I_D (Pulsed) (A)**	**Power Dissipation at T_A = 25°C (W)**	**I_{DR} (Note 1) (mA)**	**I_{DRM} (A)**
3-lead SOT-23	110	0.8	0.36	110	0.8
3-lead SOT-89	230	1.3	1.6 (**Note 2**)	230	1.3

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

2: T_A = 25°C. Mounted on an FR5 Board, 25 mm x 25 mm x 1.57 mm.

2.0 PIN DESCRIPTION

The details on the pins of TN5335 are listed in Table 2-1 and Table 2-2. Refer to **Package Types** for the location of the pins.

TABLE 2-1: 3-LEAD SOT-23 PIN FUNCTION TABLE

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

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

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

3.0 FUNCTIONAL DESCRIPTION

Figure 3-1 illustrates the switching waveforms and test circuit for TN5335.

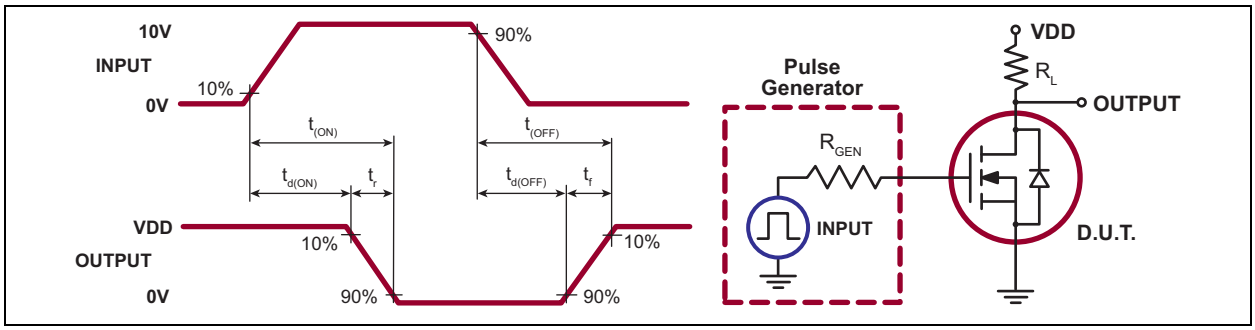


FIGURE 3-1: *Switching Waveforms and Test Circuit.*

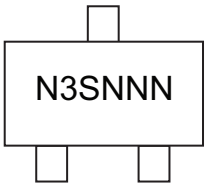
TABLE 3-1: PRODUCT SUMMARY

BV_{DSS}/BV_{DGS} (V)	$R_{DS(ON)}$ (Maximum) (Ω)	$I_{D(ON)}$ (Minimum) (mA)	$V_{GS(TH)}$ (Maximum) (V)
350	15	750	2

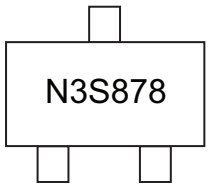
4.0 PACKAGING INFORMATION

4.1 Package Marking Information

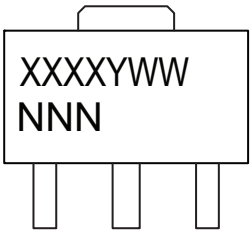
3-lead SOT-23



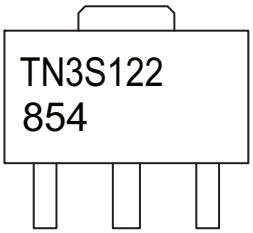
Example



3-lead SOT-89



Example

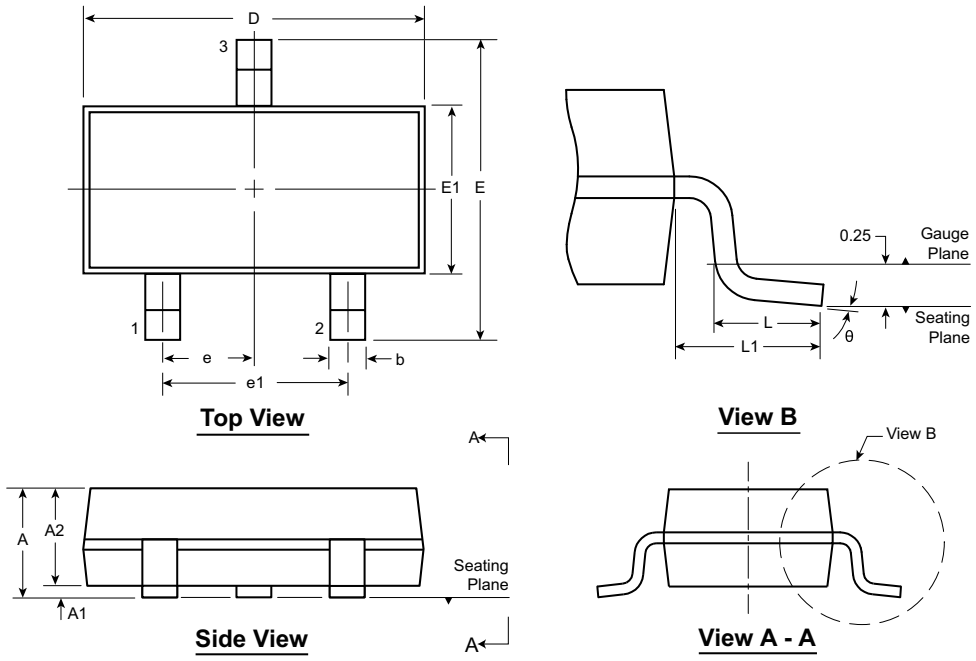


Legend:	XX...X	Product Code or Customer-specific information
	Y	Year code (last digit of calendar year)
	YY	Year code (last 2 digits of calendar year)
	WW	Week code (week of January 1 is week ‘01’)
	NNN	Alphanumeric traceability code
	(e3)	Pb-free JEDEC® designator for Matte Tin (Sn)
	*	This package 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

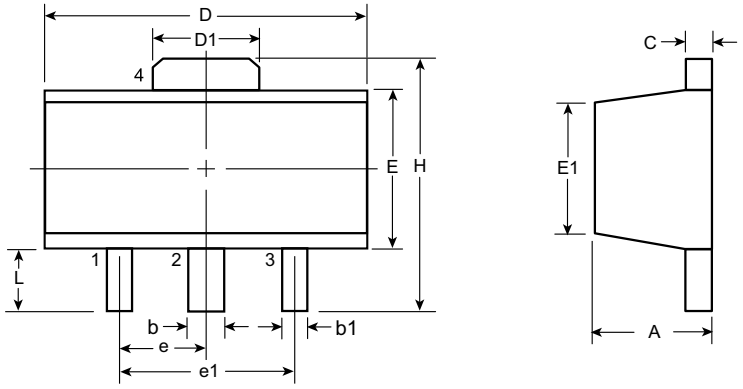


Note: For the most current package drawings, see the Microchip Packaging Specification at www.microchip.com/packaging.

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-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 (September 2021)

- Converted Supertex Doc# DSFP-TN5335 to Microchip DS20005955A
- Changed the package marking format
- 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:	TN5335	=	N-Channel Enhancement-Mode Vertical DMOS FET
Packages:	K1	=	3-lead SOT-23
	N8	=	3-lead SOT-89
Environmental:	G	=	Lead (Pb)-free/RoHS-compliant Package
Media Types:	(blank)	=	3000/Reel for a K1 Package
		=	2000/Reel for an N8 Package

Examples:

a) TN5335K1-G:	N-Channel Enhancement-Mode, Vertical DMOS FET, 3-lead SOT-23, 3000/Reel
b) TN5335N8-G:	N-Channel Enhancement-Mode, Vertical DMOS FET, 3-lead SOT-89, 2000/Reel

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