

## P-Channel Enhancement-Mode Vertical DMOS FET

### Features

- -2.4V Maximum Low Threshold
- High Input Impedance
- 110 pF Maximum Low Input Capacitance
- Fast Switching Speeds
- Low On-Resistance
- Free from Secondary Breakdown
- Low Input and Output Leakage

### Applications

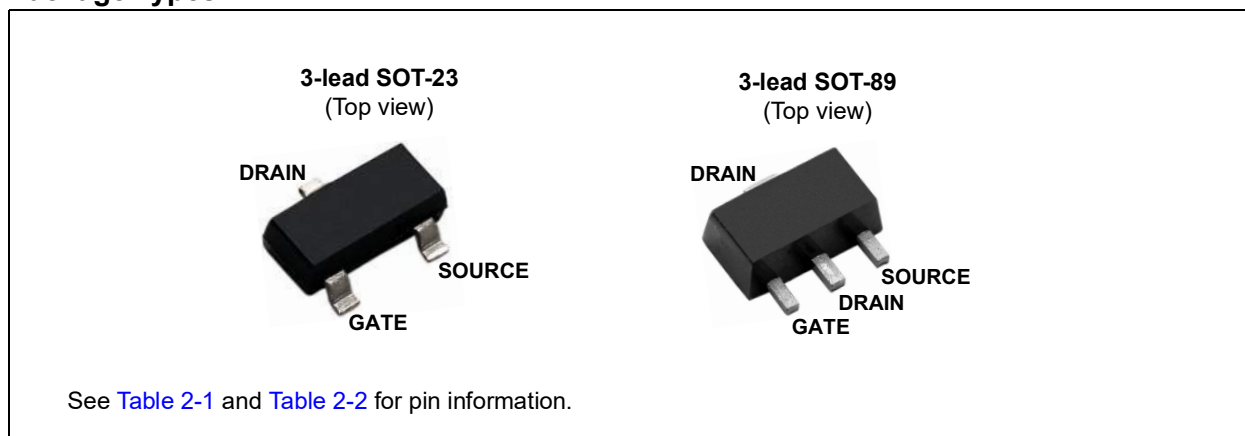
- Logic-Level Interfaces (Ideal for TTL and CMOS)
- Battery-Operated Systems
- Photovoltaic Drives
- Analog Switches
- General Purpose Line Drivers
- Telecommunication Switches

### General Description

The TP5322 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



# TP5322

## 1.0 ELECTRICAL CHARACTERISTICS

### Absolute Maximum Ratings†

Drain-to-Source Voltage .....	$BV_{DSS}$
Drain-to-Gate Voltage .....	$BV_{DGS}$
Gate-to-Source Voltage .....	$\pm 20V$
Operating Ambient Temperature, $T_A$ .....	$-55^{\circ}C$ to $+150^{\circ}C$
Storage Temperature, $T_S$ .....	$-55^{\circ}C$ to $+150^{\circ}C$

† **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:**  $T_A = 25^{\circ}C$  unless otherwise specified. All DC parameters are 100% tested at  $25^{\circ}C$  unless otherwise stated. Pulse test: 300  $\mu s$  pulse, 2% duty cycle

Parameter	Sym.	Min.	Typ.	Max.	Unit	Conditions
Drain-to-Source Breakdown Voltage	$BV_{DSS}$	-220	—	—	V	$V_{GS} = 0V, I_D = -2\text{ mA}$
Gate Threshold Voltage	$V_{GS(th)}$	-1	—	-2.4	V	$V_{GS} = V_{DS}, I_D = -1\text{ mA}$
Change in $V_{GS(th)}$ with Temperature	$\Delta V_{GS(th)}$	—	—	4.5	mV/ $^{\circ}C$	$V_{GS} = V_{DS}, I_D = -1\text{ mA}$ ( <b>Note 1</b> )
Gate Body Leakage Current	$I_{GSS}$	—	—	-100	nA	$V_{GS} = \pm 20V, V_{DS} = 0V$
Zero-Gate Voltage Drain Current	$I_{DSS}$	—	—	-10	$\mu A$	$V_{DS} = \text{Maximum rating}, V_{GS} = 0V$
		—	—	-1	mA	$V_{DS} = 0.8\text{ Maximum rating}, V_{GS} = 0V, T_A = 125^{\circ}C$ ( <b>Note 1</b> )
On-State Drain Current	$I_{D(ON)}$	-0.7	-0.95	—	A	$V_{GS} = -10V, V_{DS} = -25V$
Static Drain-to-Source On-State Resistance	$R_{DS(ON)}$	—	10	15	$\Omega$	$V_{GS} = -4.5V, I_D = -100\text{ mA}$
		—	8	12	$\Omega$	$V_{GS} = -10V, I_D = -200\text{ mA}$
Change in $R_{DS(ON)}$ with Temperature	$\Delta R_{DS(ON)}$	—	—	1.7	%/ $^{\circ}C$	$V_{GS} = -10V, I_D = -200\text{ mA}$ ( <b>Note 1</b> )

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

## AC ELECTRICAL CHARACTERISTICS

**Electrical Specifications:**  $T_A = 25^\circ\text{C}$  unless otherwise specified. Specification is obtained by characterization and is not 100% tested.

Parameter	Sym.	Min.	Typ.	Max.	Unit	Conditions
Forward Transconductance	$G_{FS}$	100	250	—	mmho	$V_{GS} = -10\text{V}$ , $I_D = -200\text{ mA}$
Input Capacitance	$C_{ISS}$	—	—	110	pF	$V_{GS} = 0\text{V}$ , $V_{DS} = -25\text{V}$ , $f = 1\text{ MHz}$
Common Source Output Capacitance	$C_{OSS}$	—	—	45	pF	
Reverse Transfer Capacitance	$C_{RSS}$	—	—	20	pF	
Turn-On Delay Time	$t_{d(ON)}$	—	—	10	ns	$V_{DD} = -25\text{V}$ , $I_D = -700\text{ mA}$ , $R_{GEN} = 25\Omega$ ,
Rise Time	$t_r$	—	—	15	ns	
Turn-Off Delay Time	$t_{d(OFF)}$	—	—	20	ns	
Fall Time	$t_f$	—	—	15	ns	
<b>DIODE PARAMETER</b>						
Diode Forward Voltage Drop	$V_{SD}$	—	—	-1.8	V	$V_{GS} = 0\text{V}$ , $I_{SD} = -500\text{ mA}$ (Note 1)
Reverse Recovery Time	$t_{rr}$	—	300	—	ns	$V_{GS} = 0\text{V}$ , $I_{SD} = -500\text{ mA}$

**Note 1:** Unless otherwise stated, all DC parameters are 100% tested at  $25^\circ\text{C}$ . Pulse test: 300  $\mu\text{s}$  pulse, 2% duty cycle

## TEMPERATURE SPECIFICATIONS

Parameter	Sym.	Min.	Typ.	Max.	Unit	Conditions
<b>TEMPERATURE RANGE</b>						
Operating Ambient Temperature	$T_A$	-55	—	+150	$^\circ\text{C}$	
Storage Temperature	$T_S$	-55	—	+150	$^\circ\text{C}$	
<b>PACKAGE THERMAL RESISTANCE</b>						
3-lead SOT-23	$\theta_{JA}$	—	203	—	$^\circ\text{C/W}$	
3-lead SOT-89	$\theta_{JA}$	—	133	—	$^\circ\text{C/W}$	

## THERMAL CHARACTERISTICS

Package	$I_D$ (Note 1) (Continuous) (mA)	$I_D$ (Pulsed) (mA)	Power Dissipation at $T_A = 25^\circ\text{C}$ (W)	$I_{DR}$ (Note 1) (mA)	$I_{DRM}$ (mA)
3-lead SOT-23	-120	-700	0.36	-120	-700
3-lead SOT-89	-260	-0.90	1.6 (Note 2)	-260	-0.90

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

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

# TP5322

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## 2.0 PIN DESCRIPTION

The details on the pins of TP5322 3-lead SOT-23 and 3-lead SOT-89 packages are listed in [Table 2-1](#) and [Table 2-2](#), respectively. Refer to [Package Types](#) for the location of pins.

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

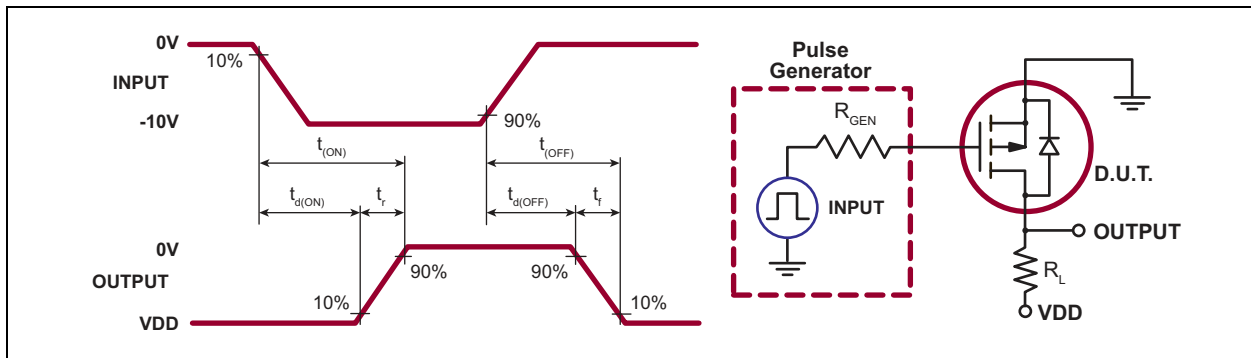
Pin Number	Pin Name	Description
1	Gate	Gate
2	Source	Source
3	Drain	Drain

**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 TP5322.



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

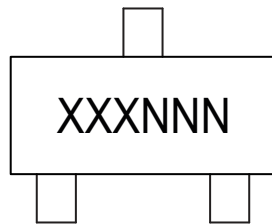
**TABLE 3-1: PRODUCT SUMMARY**

$BV_{DSS}/BV_{DGS}$ (V)	$R_{DS(ON)}$ (Maximum) ( $\Omega$ )	$V_{GS(TH)}$ (Maximum) (V)	$I_{D(ON)}$ (Minimum) (mA)
-220	12	-2.4	-700

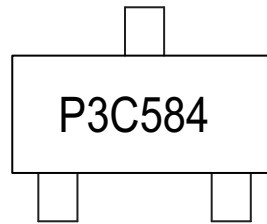
## 4.0 PACKAGING INFORMATION

### 4.1 Package Marking Information

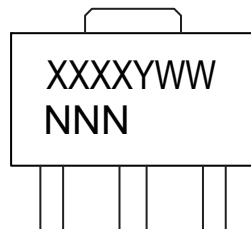
3-lead SOT-23



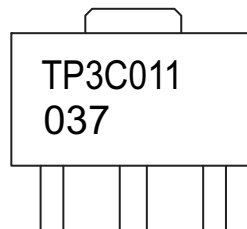
Example



3-lead SOT-89

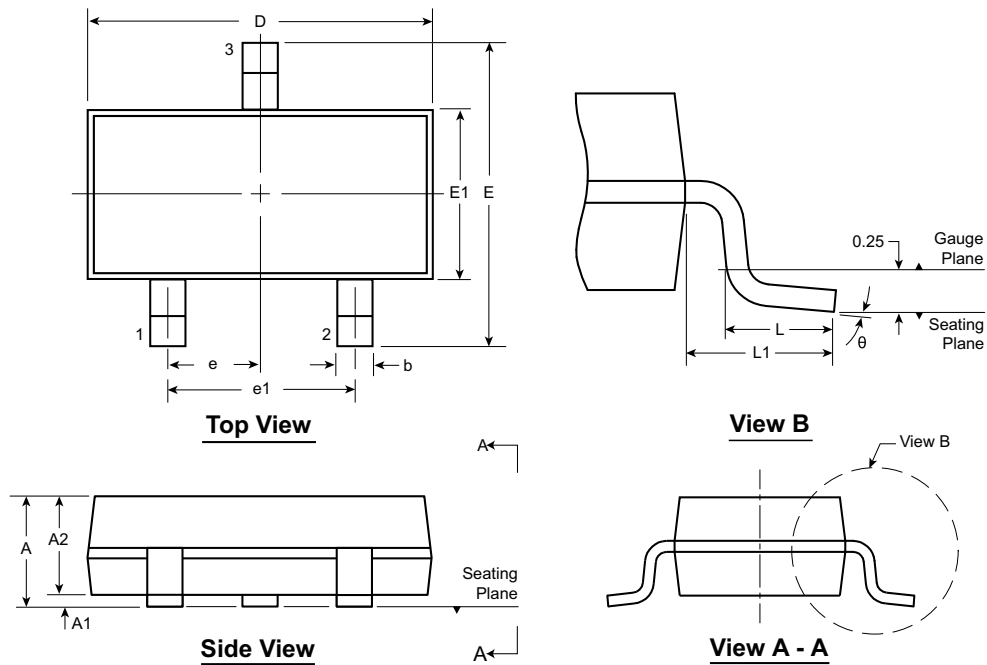


Example



<b>Legend:</b>	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.
<b>Note:</b>	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](http://www.microchip.com/packaging).

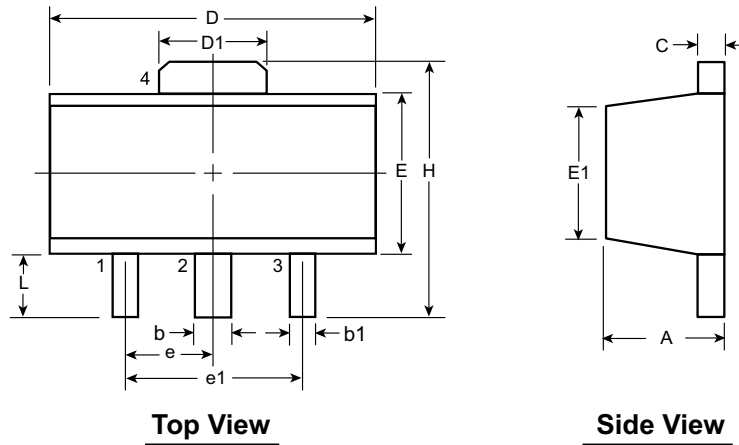
Symbol	A	A1	A2	b	D	E	E1	e	e1	L	L1	$\theta$	
Dimension (mm)	MIN	0.89	0.01	0.88	0.30	2.80	2.10	1.20	0.95 BSC	1.90 BSC	0.20 <sup>†</sup> 0.50 0.60	0.54 REF	0°
	NOM	-	-	0.95	-	2.90	-	1.30					-
	MAX	1.12	0.10	1.02	0.50	3.04	2.64	1.40					8°

JEDEC Registration TO-236, Variation AB, Issue H, Jan. 1999.

<sup>†</sup> This dimension differs from the JEDEC drawing.

Drawings not to scale.

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



Note: For the most current package drawings, see the Microchip Packaging Specification at [www.microchip.com/packaging](http://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 (June 2020)

- Converted Supertex Doc# DSFP-TP5322 to Microchip DS20005973A
- Added a pin function table
- Changed the package marking format
- Made minor text changes throughout the document

# TP5322

## PRODUCT IDENTIFICATION SYSTEM

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

<u>PART NO.</u>		<u>XX</u>	-	<u>X</u>	-	<u>X</u>
Device	Package Options			Environmental		Media Type
Device:	TP5322	=		P-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		
	(blank)	=		2000/Reel for an N8 Package		

**Examples:**

a) TP5322K1-G: P-Channel Enhancement-Mode, Vertical DMOS FET, 3-lead SOT-23, 3000/Reel

b) TP5322N8-G: P-Channel Enhancement-Mode, Vertical DMOS FET, 3-lead SOT-89, 2000/Reel

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ISBN: 978-1-5224-6175-3

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