

## P-Channel Enhancement-Mode Lateral MOSFET

### Features

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

### Applications

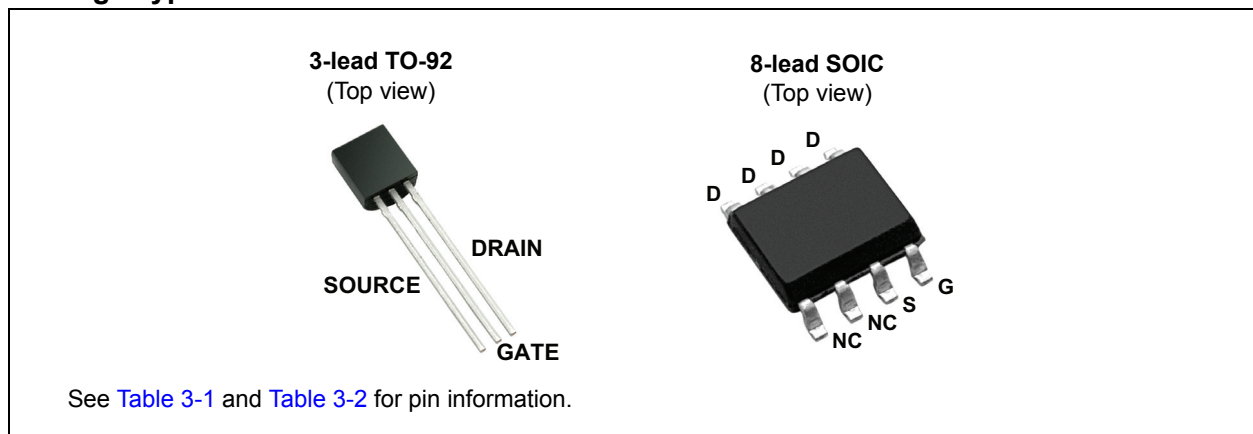
- Logic-Level Interfaces
- Solid-State Relays
- Battery-Operated Systems
- Photovoltaic Drives
- Analog Switches
- General Purpose Line Drivers

### General Description

The LP0701 Enhancement-mode (normally-off) transistor uses a lateral MOS 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.

The low threshold voltage and low on-resistance characteristics are ideally suited for handheld and battery-operated applications.

### Package Types



# LP0701

## 1.0 ELECTRICAL CHARACTERISTICS

### Absolute Maximum Ratings†

Drain-to-Source Voltage .....	$BV_{DSS}$
Drain-to-Gate Voltage .....	$BV_{DGS}$
Gate-to-Source Voltage .....	$\pm 10V$
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	$BV_{DSS}$	-16.5	—	—	V	$V_{GS} = 0V, I_D = -1\text{ mA}$
Gate Threshold Voltage	$V_{GS(th)}$	-0.5	-0.7	-1	V	$V_{GS} = V_{DS}, I_D = -1\text{ mA}$
Change in $V_{GS(th)}$ with Temperature	$\Delta V_{GS(th)}$	—	—	-4	mV/ $^{\circ}C$	$V_{GS} = V_{DS}, I_D = -1\text{ mA}$ (Note 1)
Gate Body Leakage Current	$I_{GSS}$	—	—	-100	nA	$V_{GS} = \pm 10V, V_{DS} = 0V$
Zero-Gate Voltage Drain Current	$I_{DSS}$	—	—	-100	nA	$V_{DS} = -15V, V_{GS} = 0V$
		—	—	-1	mA	$V_{DS} = 0.8$ Maximum rating, $V_{GS} = 0V, T_A = 125^{\circ}C$ (Note 1)
On-State Drain Current	$I_{D(ON)}$	—	-0.4	—	A	$V_{GS} = V_{DS} = -2V$
		-0.6	-1	—	A	$V_{GS} = V_{DS} = -3V$
		-1.25	-2.3	—	A	$V_{GS} = V_{DS} = -5V$
Static Drain-to-Source On-State Resistance	$R_{DS(ON)}$	—	2	4	$\Omega$	$V_{GS} = -2V, I_D = -50\text{ mA}$
		—	1.7	2	$\Omega$	$V_{GS} = -3V, I_D = -150\text{ mA}$
		—	1.3	1.5	$\Omega$	$V_{GS} = -5V, I_D = -300\text{ mA}$
Change in $R_{DS(ON)}$ with Temperature	$\Delta R_{DS(ON)}$	—	—	0.75	%/ $^{\circ}C$	$V_{GS} = -5V, I_D = -300\text{ mA}$ (Note 1)

**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	$G_{FS}$	500	700	—	mmho	$V_{GS} = -15\text{V}, I_D = -1\text{A}$
Input Capacitance	$C_{ISS}$	—	120	250	pF	$V_{GS} = 0\text{V},$ $V_{DS} = -15\text{V},$ $f = 1\text{ MHz}$
Common Source Output Capacitance	$C_{OSS}$	—	100	125	pF	
Reverse Transfer Capacitance	$C_{RSS}$	—	40	60	pF	
Turn-On Delay Time	$t_{d(ON)}$	—	—	20	ns	$V_{DD} = -15\text{V},$ $I_D = -1.25\text{A},$ $R_{GEN} = 25\Omega$
Rise Time	$t_r$	—	—	20	ns	
Turn-Off Delay Time	$t_{d(OFF)}$	—	—	30	ns	
Fall Time	$t_f$	—	—	30	ns	
<b>DIODE PARAMETER</b>						
Diode Forward Voltage Drop	$V_{SD}$	—	-1.2	-1.5	V	$V_{GS} = 0\text{V}, I_{SD} = -500\text{ mA}$ ( <b>Note 1</b> )

**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 TO-92	$\theta_{JA}$	—	132	—	$^\circ\text{C/W}$	
8-lead SOIC	$\theta_{JA}$	—	101	—	$^\circ\text{C/W}$	<b>Note 1</b>

**Note 1:** Mounted on an FR4 board, 25 mm x 25 mm x 1.57 mm

## THERMAL CHARACTERISTICS

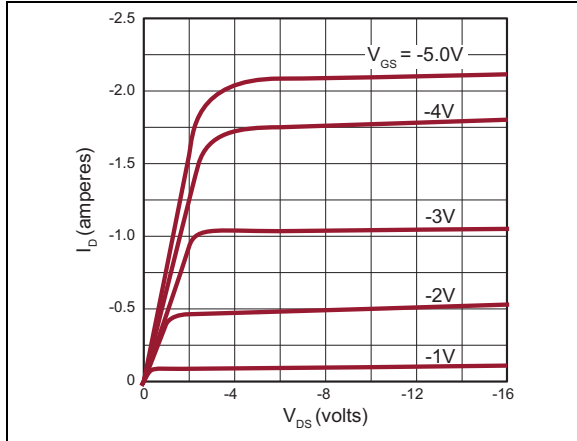
Package	$I_D$ ( <b>Note 1</b> ) (Continuous) (mA)	$I_D$ (Pulsed) (A)	Power Dissipation at $T_A = 25^\circ\text{C}$ (W)	$I_{DR}$ ( <b>Note 1</b> ) (mA)	$I_{DRM}$ (mA)
3-lead TO-92	-500	-1.25	1	-500	-1.25
8-lead SOIC	-700	-1.25	1.5 ( <b>Note 2</b> )	-700	-1.25

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

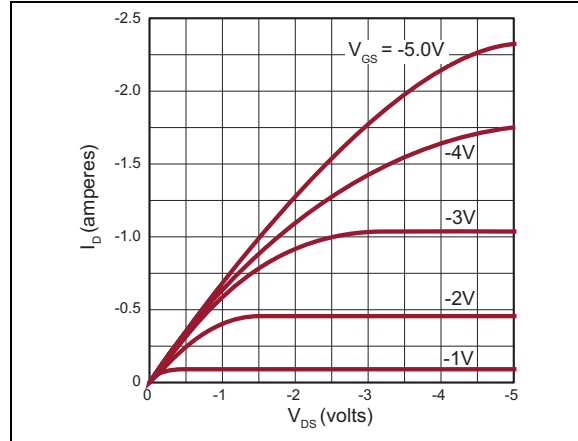
**2:** Mounted on an FR4 board 25 mm x 25 mm x 1.57 mm

## 2.0 TYPICAL PERFORMANCE CURVES

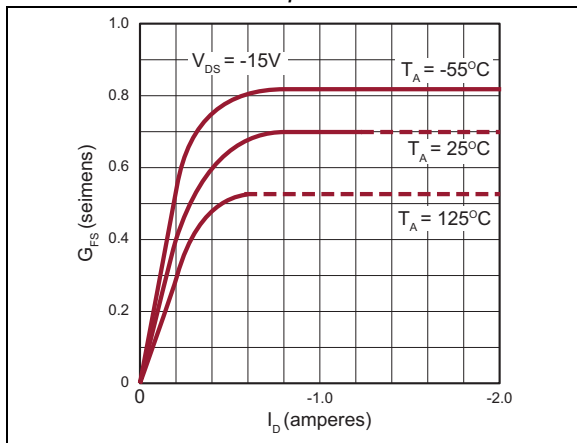
**Note:** The graphs and tables provided following this note are a statistical summary based on a limited number of samples and are provided for informational purposes only. The performance characteristics listed herein are not tested or guaranteed. In some graphs or tables, the data presented may be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



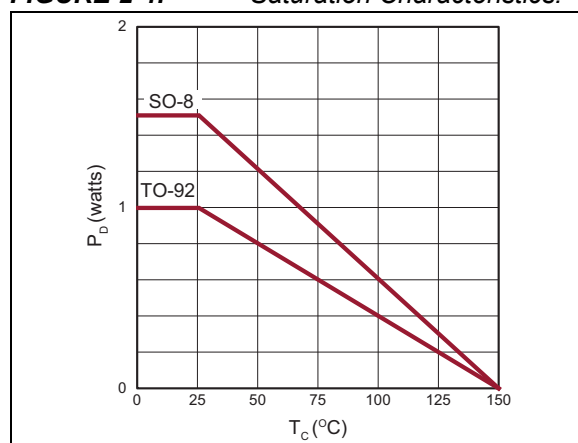
**FIGURE 2-1:** Output Characteristics.



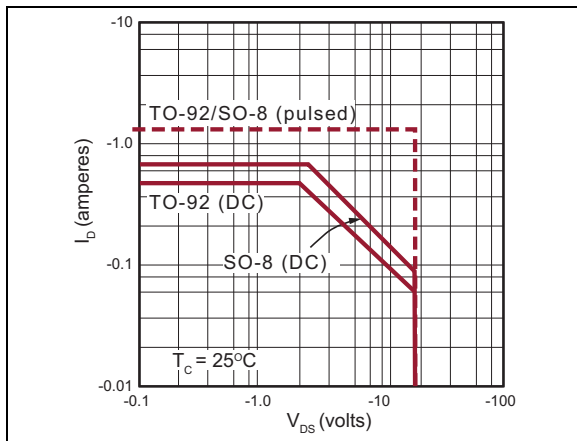
**FIGURE 2-4:** Saturation Characteristics.



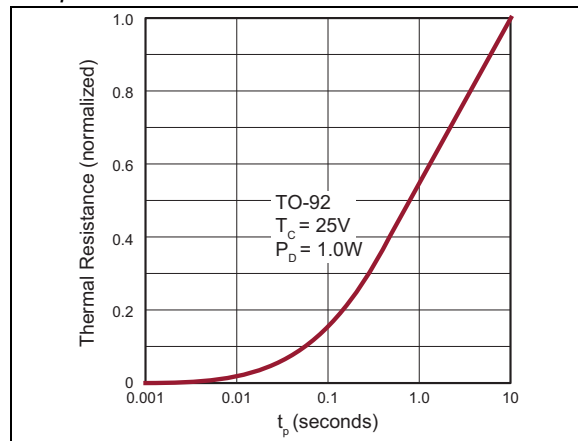
**FIGURE 2-2:** Transconductance vs. Drain Current.



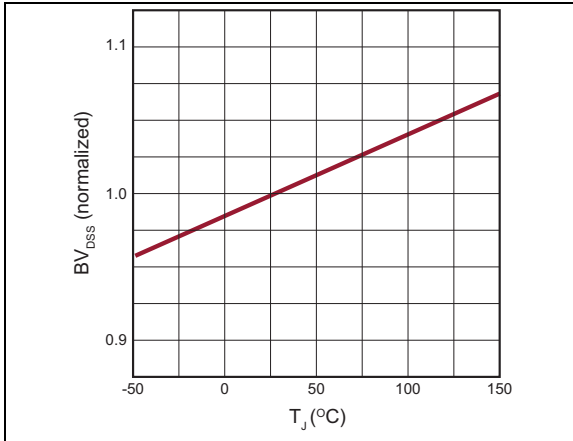
**FIGURE 2-5:** Power Dissipation vs. Case Temperature.



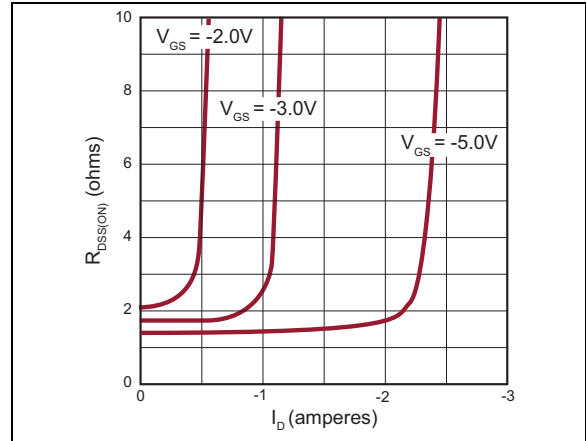
**FIGURE 2-3:** Maximum Rated Safe Operating Area.



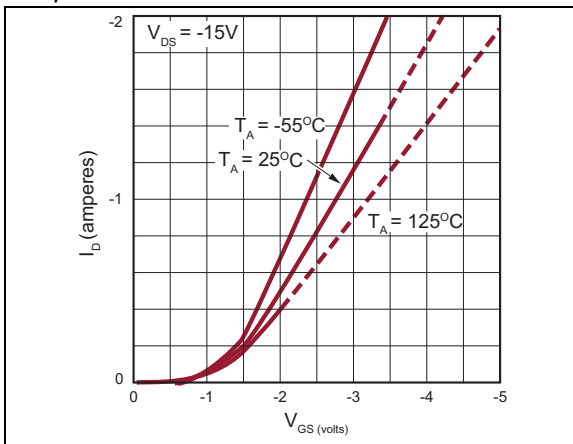
**FIGURE 2-6:** Thermal Response Characteristics.



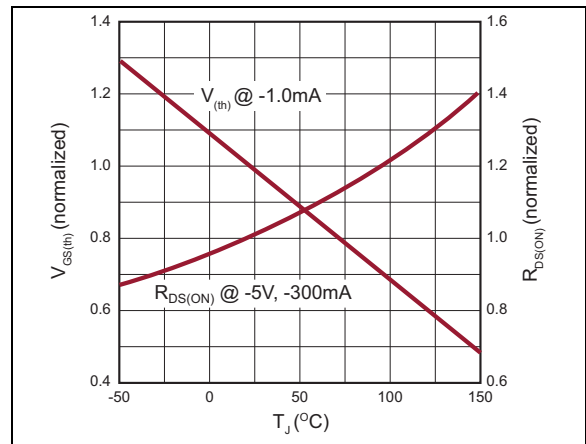
**FIGURE 2-7:**  $BV_{DSS}$  Variation with Temperature.



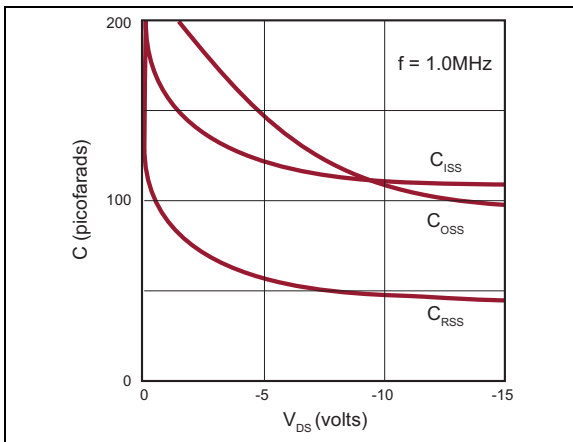
**FIGURE 2-10:** On-Resistance vs. Drain Current.



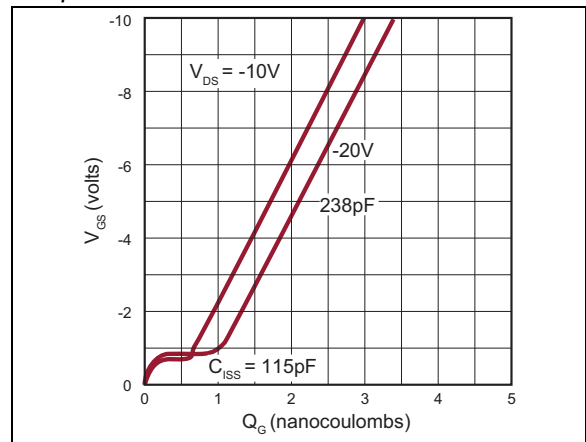
**FIGURE 2-8:** Transfer Characteristics.



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



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



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

# LP0701

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## 3.0 PIN DESCRIPTION

The details on the pins of LP0701 3-lead TO-92 and 8-lead SOIC are listed in [Table 3-1](#) and [Table 3-2](#), respectively. Refer to [Package Types](#) for the location of pins.

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

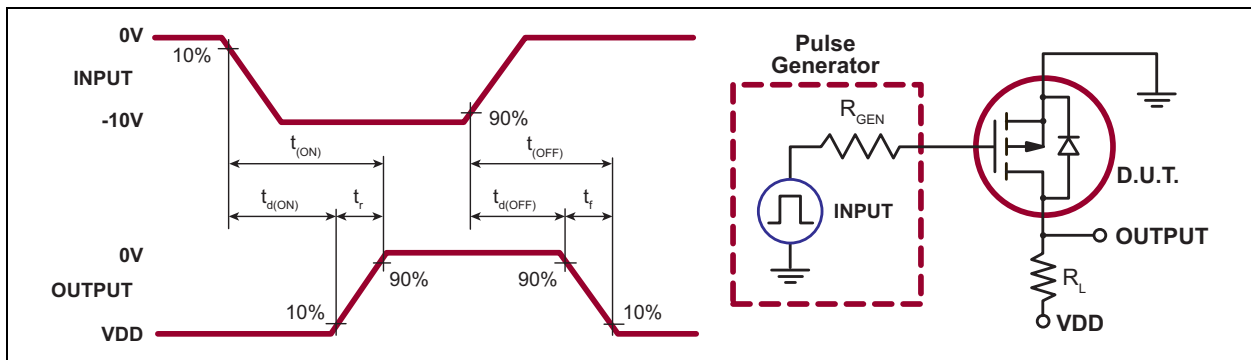
Pin Number	Pin Name	Description
1	Source	Source
2	Gate	Gate
3	Drain	Drain

**TABLE 3-2: 8-LEAD SOIC PIN FUNCTION TABLE**

Pin Number	Pin Name	Description
1	NC	No connection
2	NC	No connection
3	Source	Source
4	Gate	Gate
5	Drain	Drain
6	Drain	Drain
7	Drain	Drain
8	Drain	Drain

## 4.0 FUNCTIONAL DESCRIPTION

Figure 4-1 illustrates the switching waveforms and test circuit for LP0701.



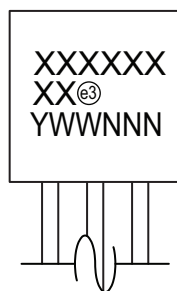
**FIGURE 4-1:** Switching Waveforms and Test Circuit.

# LP0701

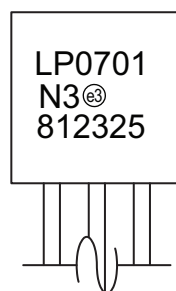
## 5.0 PACKAGING INFORMATION

### 5.1 Package Marking Information

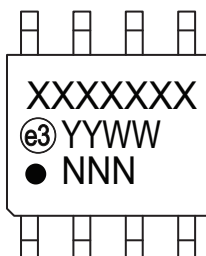
3-lead TO-92



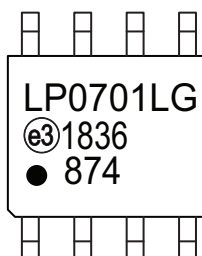
Example



8-lead SOIC



Example

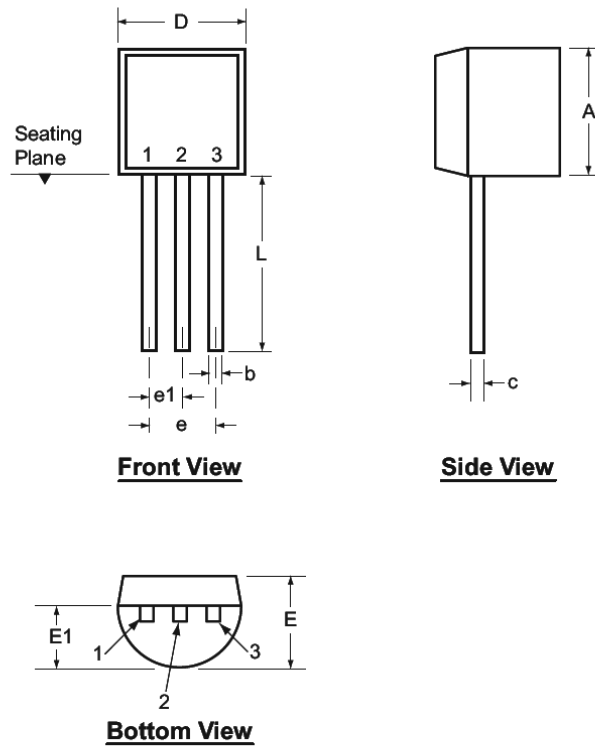


<b>Legend:</b>	XX...X	Product Code or Customer-specific information
	Y	Year code (last digit of calendar year)
	YY	Year code (last 2 digits of calendar year)
	WW	Week code (week of January 1 is week '01')
	NNN	Alphanumeric traceability code
	<sup>(e3)</sup>	Pb-free JEDEC <sup>®</sup> designator for Matte Tin (Sn)
	*	This package is Pb-free. The Pb-free JEDEC designator ( <sup>(e3)</sup> ) 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](http://www.microchip.com/packaging).

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

JEDEC Registration TO-92.

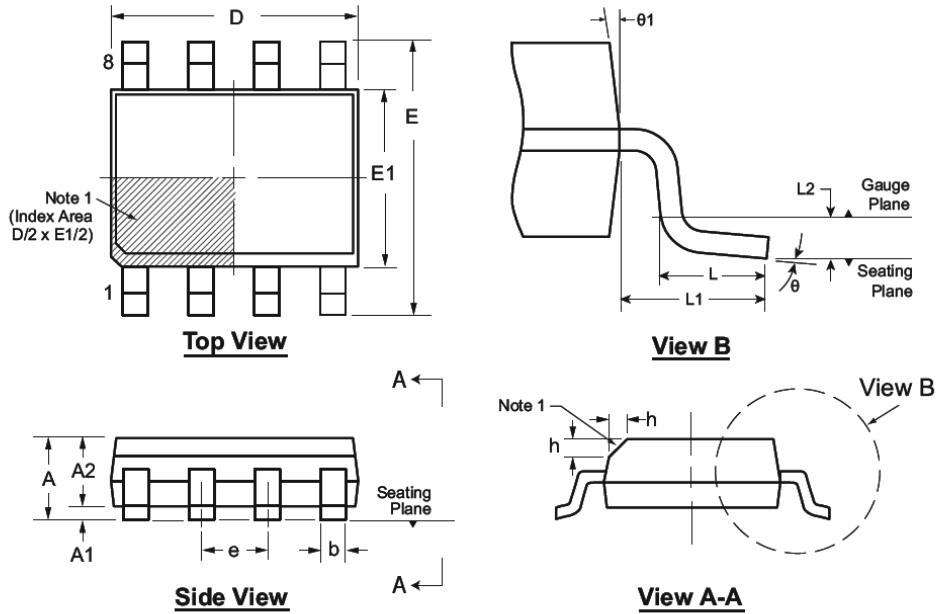
\* This dimension is not specified in the JEDEC drawing.

† This dimension differs from the JEDEC drawing.

**Drawings not to scale.**

# LP0701

## 8-Lead SOIC (Narrow Body) Package Outline (LG/TG) 4.90x3.90mm body, 1.75mm height (max), 1.27mm pitch



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

**Note:**

1. This chamfer feature is optional. A Pin 1 identifier must be located in the index area indicated. The Pin 1 identifier can be: a molded mark/identifier; an embedded metal marker; or a printed indicator.

Symbol	A	A1	A2	b	D	E	E1	e	h	L	L1	L2	$\theta$	$\theta_1$	
Dimension (mm)	MIN	1.35*	0.10	1.25	0.31	4.80*	5.80*	3.80*	1.27 BSC	0.25	0.40	1.04 REF	0.25 BSC	0°	5°
	NOM	-	-	-	-	4.90	6.00	3.90		-	-		-	-	
	MAX	1.75	0.25	1.65*	0.51	5.00*	6.20*	4.00*		0.50	1.27		8°	15°	

JEDEC Registration MS-012, Variation AA, Issue E, Sept. 2005.

\* This dimension is not specified in the JEDEC drawing.

Drawings are not to scale.

## APPENDIX A: REVISION HISTORY

### Revision A (October 2018)

- Converted Supertex Doc# DSFP-LP0701 to Microchip DS20005447A
- Changed the package marking format
- Removed the 3-lead TO-92 N3 P002, P003, P005, P013 and P014 media types
- Added some sections to comply with the standard Microchip format
- Made minor text changes throughout the document

# LP0701

## 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:	LP0701	=	P-Channel Enhancement-Mode Lateral MOSFET		
Packages:	N3	=	3-lead TO-92		
	LG	=	8-lead SOIC		
Environmental:	G	=	Lead (Pb)-free/RoHS-compliant Package		
Media Types:	(blank)	=	1000/Bag for an N3 Package		
	(blank)	=	3300/Reel for an LG Package		

**Examples:**

a) LP0701N3-G: P-Channel Enhancement-Mode Lateral MOSFET, 3-lead TO-92, 1000/Bag

b) LP0701LG-G: P-Channel Enhancement-Mode Lateral MOSFET, 8-lead SOIC, 3300/Reel

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