

# N-Channel Enhancement-Mode Vertical DMOS FETs

## Features

- ▶ Low threshold (2.0V max.)
- ▶ High input impedance
- ▶ 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
- ▶ Solid state relays
- ▶ Battery operated systems
- ▶ Photo voltaic drives
- ▶ Analog switches
- ▶ General purpose line drivers
- ▶ Telecom switches

## Ordering Information

Part Number	Package Option	Packing
TN2640K4-G	TO-252 (D-PAK)	2000/Reel
TN2640LG-G	8-Lead SOIC	2500/Reel
TN2640N3-G	3-Lead TO-92	1000/Bag
TN2640N3-G P002	3-Lead TO-92	2000/Reel
TN2640N3-G P003		
TN2640N3-G P005		
TN2640N3-G P013		
TN2640N3-G P015		

For packaged products, -G indicates package is RoHS compliant ('Green').  
 TO-92 taping specifications and winding styles per EIA-468 Standard.  
 Devices in Wafer / Die form are RoHS compliant ('Green').  
 Refer to Die Specification VF57 for layout and dimensions.

## Absolute Maximum Ratings

Parameter	Value
Drain-to-source voltage	$BV_{DSS}$
Drain-to-gate voltage	$BV_{DGS}$
Gate-to-source voltage	$\pm 20V$
Operating and storage temperature	$-55^{\circ}C$ to $+150^{\circ}C$

Absolute Maximum Ratings are those values beyond which damage to the device may occur. Functional operation under these conditions is not implied. Continuous operation of the device at the absolute rating level may affect device reliability. All voltages are referenced to device ground.

## General Description

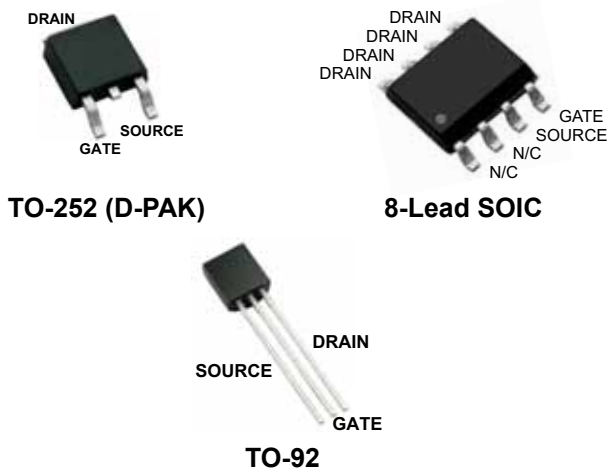
This low threshold enhancement-mode (normally-off) transistor utilizes a vertical DMOS structure and Supertex's well-proven silicon-gate manufacturing process. This combination produces a device with the power handling capabilities of bipolar transistors and with the high input impedance and positive temperature coefficient inherent in MOS devices. Characteristic of all MOS structures, this device is free from thermal runaway and thermally induced secondary breakdown.

Supertex'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.

## Product Summary

$BV_{DSS}/BV_{DGS}$	$R_{DS(ON)}$ (max)	$I_{D(ON)}$ (min)	$V_{GS(th)}$ (max)
400V	5.0Ω	2.0A	2.0V

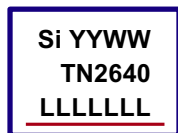
## Pin Configuration



## Typical Thermal Resistance

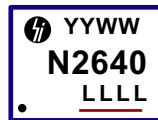
Package	$\theta_{ja}$
TO-252 (D-PAK)	81°C/W
8-Lead SOIC	101°C/W
TO-92	132°C/W

## Product Marking



YY = Year Sealed  
 WW = Week Sealed  
 L = Lot Number  
 \_\_\_\_\_ = "Green" Packaging

Package may or may not include the following marks: Si or **TO-252 (D-PAK)**



YY = Year Sealed  
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Package may or may not include the following marks: Si or **8-Lead SOIC**



YY = Year Sealed  
 WW = Week Sealed  
 \_\_\_\_\_ = "Green" Packaging

Package may or may not include the following marks: Si or **TO-92**

## Thermal Characteristics

Package	$I_D$ (continuous) <sup>†</sup>	$I_D$ (pulsed)	Power Dissipation @ $T_A = 25^\circ\text{C}$	$I_{DR}$ <sup>†</sup>	$I_{DRM}$
TO-252 (D-PAK)	500mA	3.0A	2.5W <sup>‡</sup>	500mA	3.0A
8-Lead SOIC	260mA	2.0A	1.3W <sup>‡</sup>	260mA	2.0A
TO-92	220mA	2.0A	0.74W	220mA	2.0A

**Notes:**

- <sup>†</sup>  $I_D$  (continuous) is limited by max rated  $T_J$
- <sup>‡</sup> Mounted on FR4 board, 25mm x 25mm x 1.57mm

## Electrical Characteristics ( $T_A = 25^\circ\text{C}$ unless otherwise specified)

Sym	Parameter	Min	Typ	Max	Units	Conditions
$BV_{DSS}$	Drain-to-source breakdown voltage	400	-	-	V	$V_{GS} = 0V, I_D = 1.0mA$
$V_{GS(th)}$	Gate threshold voltage	0.8	-	2.0	V	$V_{GS} = V_{DS}, I_D = 2.0mA$
$\Delta V_{GS(th)}$	Change in $V_{GS(th)}$ with temperature	-	-2.5	-4.0	mV/ $^\circ\text{C}$	$V_{GS} = V_{DS}, I_D = 2.0mA$
$I_{GSS}$	Gate body leakage	-	-	100	nA	$V_{GS} = \pm 20V, V_{DS} = 0V$
$I_{DSS}$	Zero gate voltage drain current	-	-	10	$\mu\text{A}$	$V_{GS} = 0V, V_{DS} = \text{Max rating}$
		-	-	1.0	mA	$V_{DS} = 0.8 \text{ Max Rating}, V_{GS} = 0V, T_A = 125^\circ\text{C}$
$I_{D(ON)}$	On-state drain current	1.5	3.5	-	A	$V_{GS} = 5.0V, V_{DS} = 25V$
		2.0	4.0	-		$V_{GS} = 10V, V_{DS} = 25V$
$R_{DS(ON)}$	Static drain-to-source on-state resistance	-	3.2	5.0	$\Omega$	$V_{GS} = 4.5V, I_D = 500mA$
		-	3.0	5.0		$V_{GS} = 10V, I_D = 500mA$
$\Delta R_{DS(ON)}$	Change in $R_{DS(ON)}$ with temperature	-	-	0.75	%/ $^\circ\text{C}$	$V_{GS} = 10V, I_D = 500mA$
$G_{FS}$	Forward transconductance	200	330	-	mmho	$V_{DS} = 25V, I_D = 100mA$
$C_{ISS}$	Input capacitance	-	210	225	pF	$V_{GS} = 0V, V_{DS} = 25V, f = 1.0MHz$
$C_{OSS}$	Common source output capacitance	-	30	50		
$C_{RSS}$	Reverse transfer capacitance	-	8.0	15		

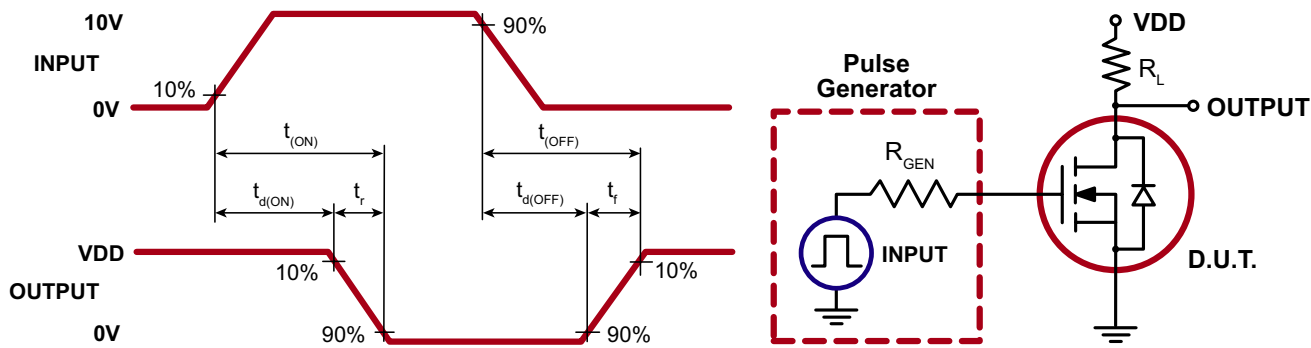
**Electrical Characteristics** ( $T_A = 25^\circ\text{C}$  unless otherwise specified)

Sym	Parameter	Min	Typ	Max	Units	Conditions
$t_{d(ON)}$	Turn-on delay time	-	4.0	15	ns	$V_{DD} = 25\text{V}$ , $I_D = 2.0\text{A}$ , $R_{GEN} = 25\Omega$
$t_r$	Rise time	-	15	20		
$t_{d(OFF)}$	Turn-off delay time	-	20	25		
$t_f$	Fall time	-	22	27		
$V_{SD}$	Diode forward voltage drop	-	-	0.9	V	$V_{GS} = 0\text{V}$ , $I_{SD} = 200\text{mA}$
$t_{rr}$	Reverse recovery time	-	300	-	ns	$V_{GS} = 0\text{V}$ , $I_{SD} = 1.0\text{A}$

**Notes:**

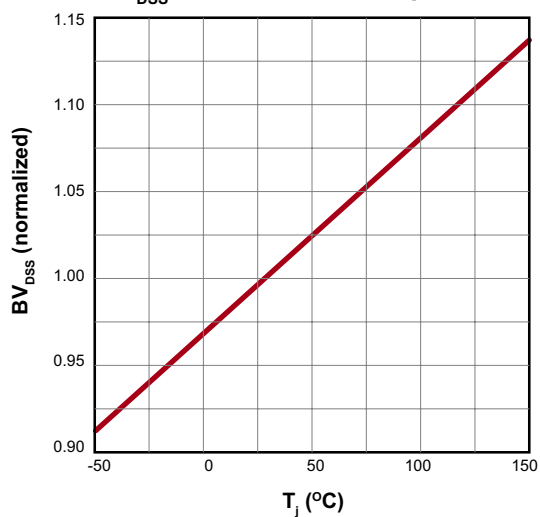
1. All D.C. parameters 100% tested at  $25^\circ\text{C}$  unless otherwise stated. (Pulse test:  $300\mu\text{s}$  pulse, 2% duty cycle.)
2. All A.C. parameters sample tested.

**N- Channel Switching Waveforms and Test Circuit**

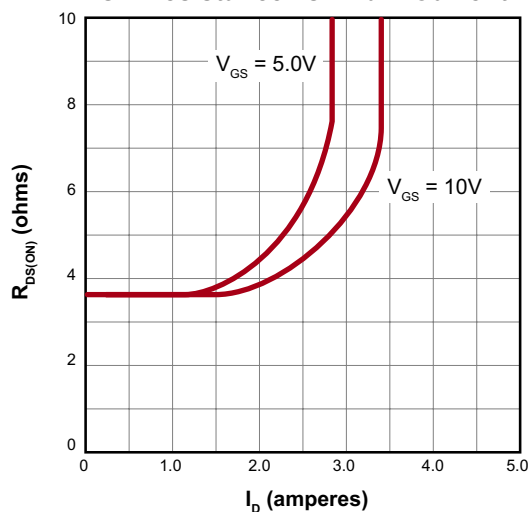


# Typical Performance Curves

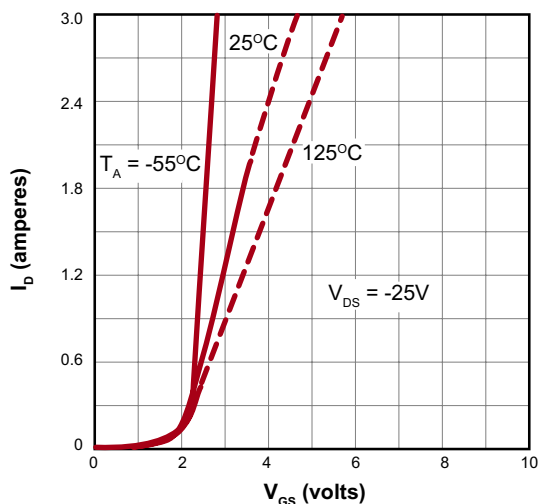
**BV<sub>DSS</sub> Variation with Temperature**



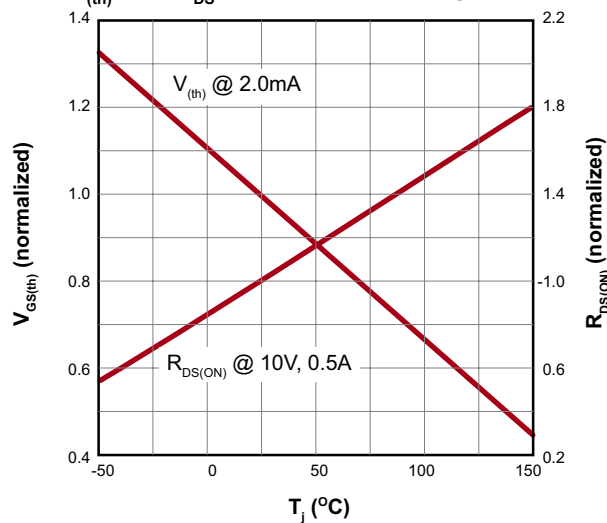
**On-Resistance vs. Drain Current**



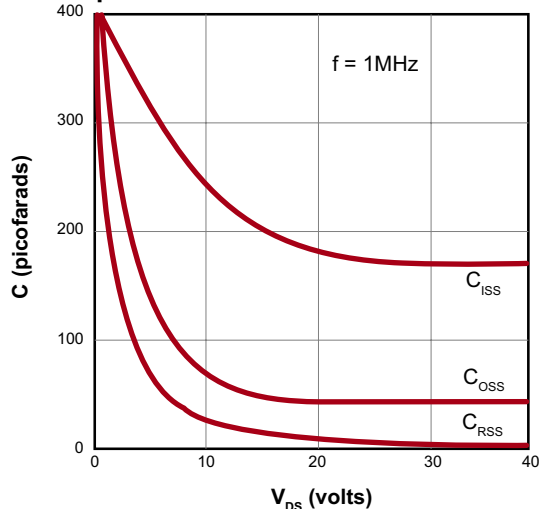
**Transfer Characteristics**



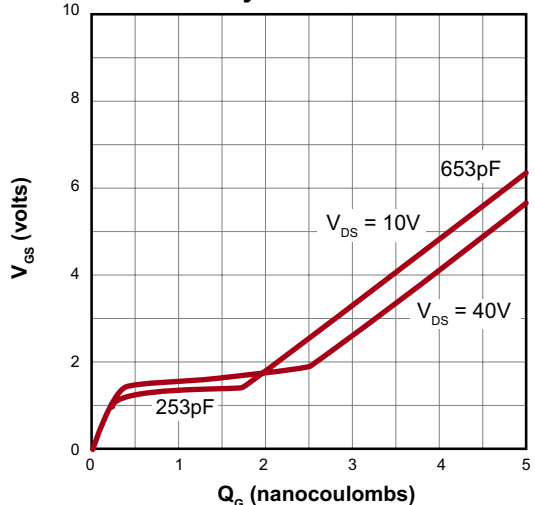
**V<sub>(th)</sub> and R<sub>DS</sub> Variation with Temperature**



**Capacitance vs. Drain-to-Source Voltage**

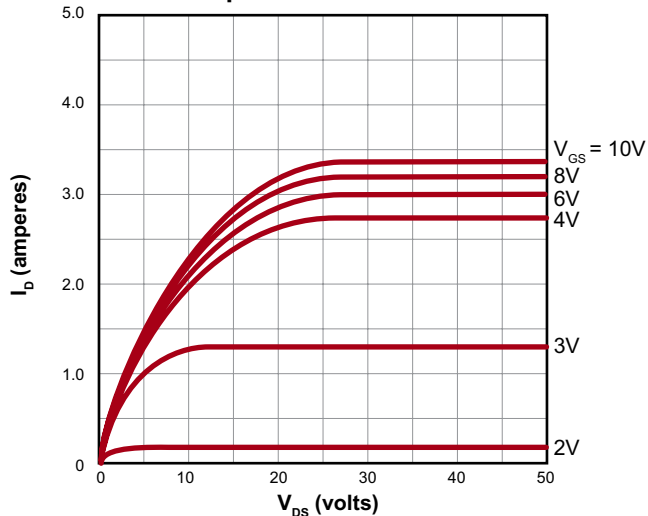


**Gate Drive Dynamic Characteristics**

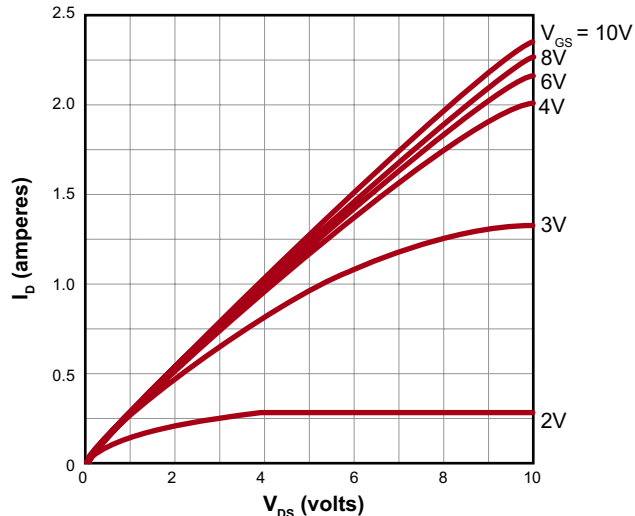


Typical Performance Curves (cont.)

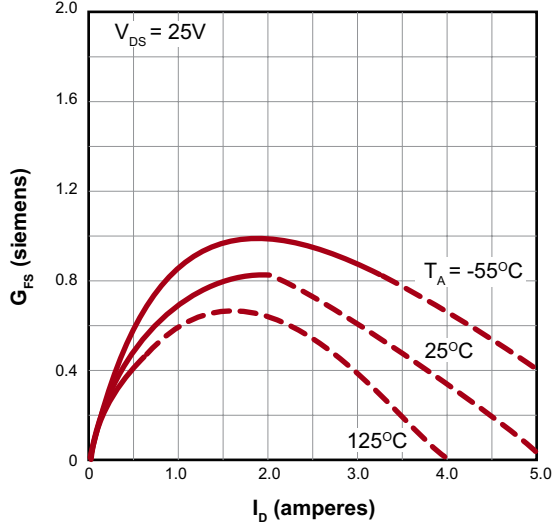
Output Characteristics



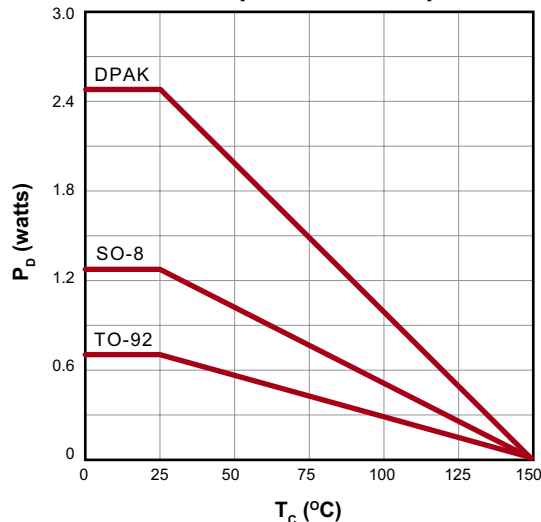
Saturation Characteristics



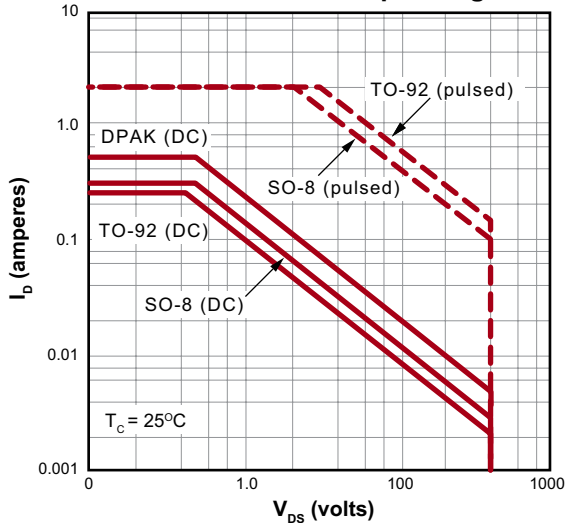
Transconductance vs. Drain Current



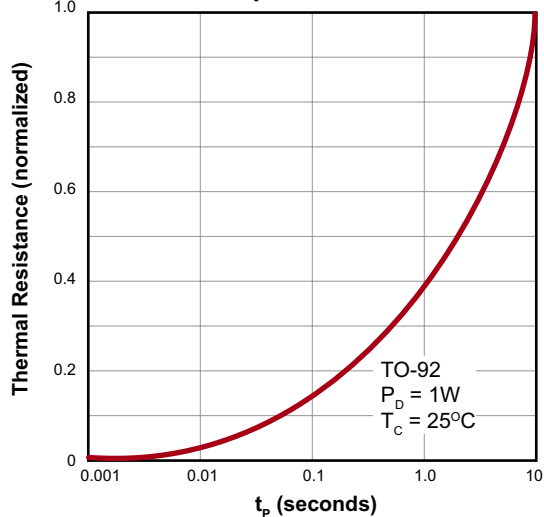
Power Dissipation vs. Temperature



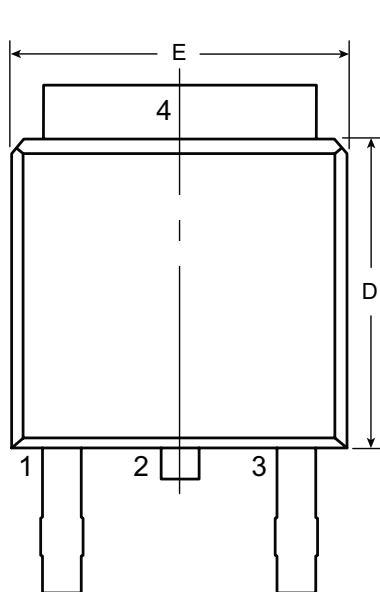
Maximum Rated Safe Operating Area



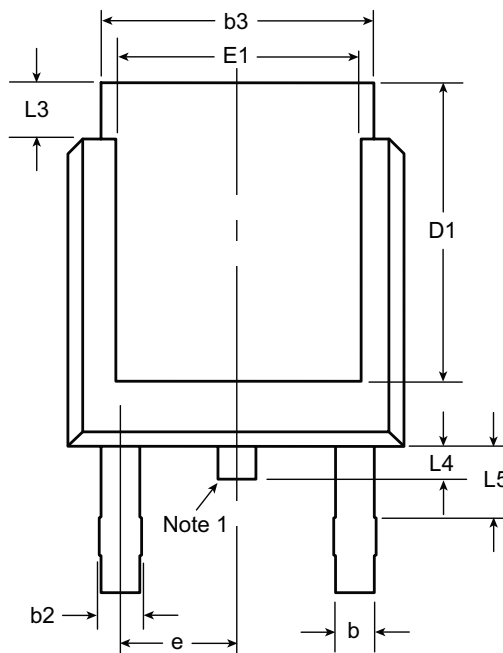
Thermal Response Characteristics



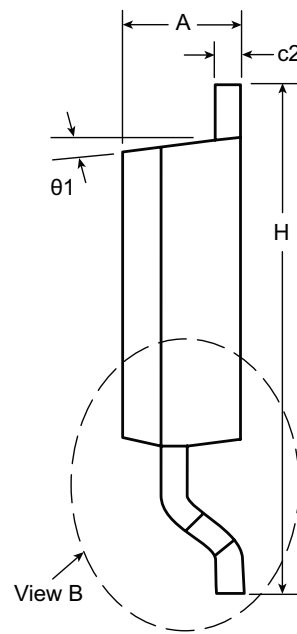
### 3-Lead TO-252 D-PAK Package Outline (K4)



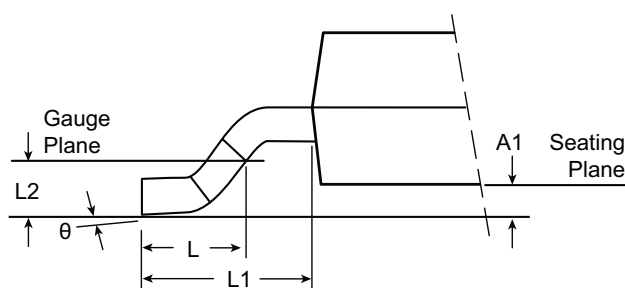
**Front View**



**Rear View**



**Side View**



**View B**

**Note:**  
 1. Although 4 terminal locations are shown, only 3 are functional. Lead number 2 was removed.

Symbol	A	A1	b	b2	b3	c2	D	D1	E	E1	e	H	L	L1	L2	L3	L4	L5	θ	θ1			
Dimension (inches)	MIN	.086	.000*	.025	.030	.195	.018	.235	.205	.250	.170	.090 BSC	.370	.055	.108 REF	.020 BSC	.035	.025*	.045	0°	0°		
	NOM	-	-	-	-	-	-	.240	-	-	-		-	.060			-	-	-	-	-	-	-
	MAX	.094	.005	.035	.045	.215	.035	.245	.217*	.265	.182*		.410	.070			.050	.040	.060	10°	15°		

JEDEC Registration TO-252, Variation AA, Issue E, June 2004.

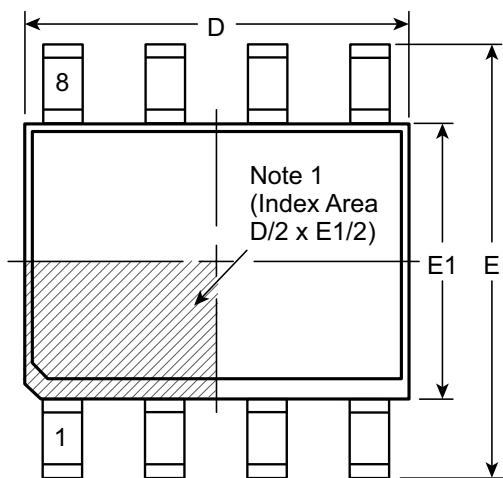
\* This dimension is not specified in the JEDEC drawing.

**Drawings not to scale.**

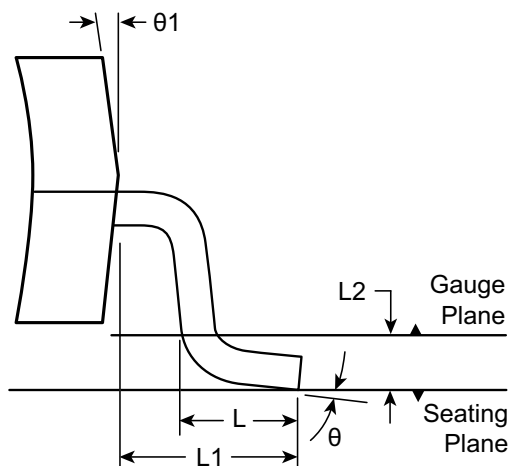
**Supertex Doc. #: DSPD-3TO252K4, Version E041309.**

# 8-Lead SOIC (Narrow Body) Package Outline (LG)

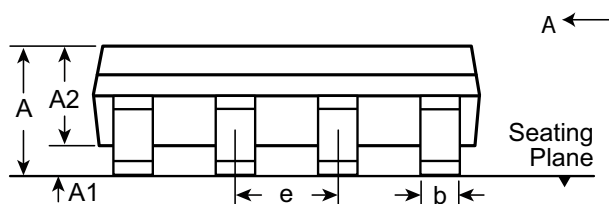
4.90x3.90mm body, 1.75mm height (max), 1.27mm pitch



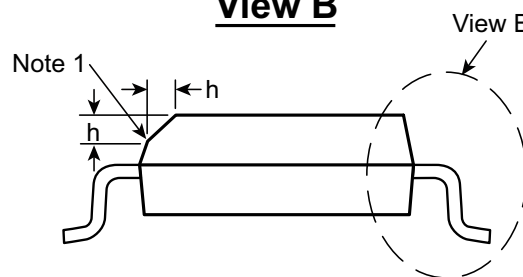
**Top View**



**View B**



**Side View**



**View A-A**

**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°

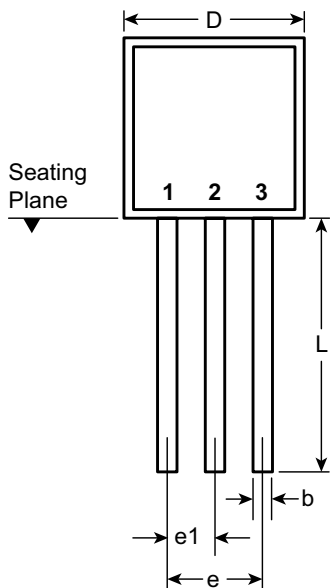
JEDEC Registration MS-012, Variation AA, Issue E, Sept. 2005.

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

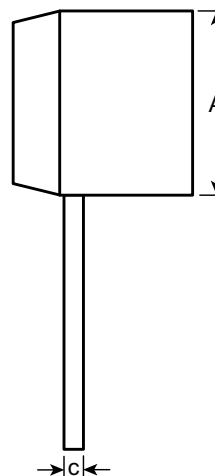
Drawings are not to scale.

Supertex Doc. #: DSPD-8SOLGTG, Version I041309.

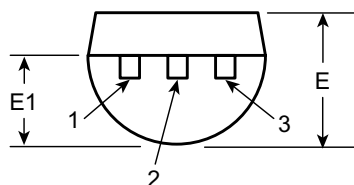
### 3-Lead TO-92 Package Outline (N3)



**Front View**



**Side View**



**Bottom View**

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.**

**Supertex Doc.#:** DSPD-3TO92N3, Version E041009.

(The package drawing(s) in this data sheet may not reflect the most current specifications. For the latest package outline information go to <http://www.supertex.com/packaging.html>.)

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