

## 250V Low Charge Injection 8-Channel High Voltage Analog Switch

### Features

- ▶ HVCMOS® technology for high performance
- ▶ Very low quiescent power dissipation -10µA
- ▶ Low parasitic capacitances
- ▶ DC to 10MHz analog signal frequency
- ▶ -60dB typical output off isolation at 5MHz
- ▶ -60dB typical off-isolation at 5MHz
- ▶ CMOS logic circuitry for low power
- ▶ Excellent noise immunity
- ▶ On-chip shift register, latch and clear logic circuitry
- ▶ Flexible high voltage supplies
- ▶ Surface mount packages

### Applications

- ▶ Medical ultrasound imaging
- ▶ Non-destructive evaluation
- ▶ Inkjet printer heads
- ▶ Optical MEMS modules

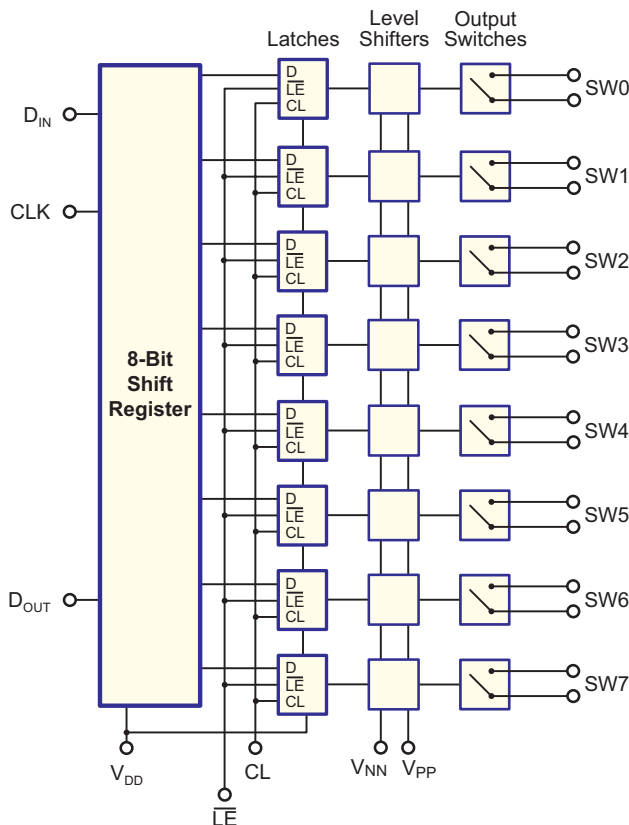
### General Description

The Supertex HV214 is a low charge injection 8-channel high voltage analog switch integrated circuit (IC) intended for use in applications requiring high voltage switching controlled by low voltage control signals, such as medical ultrasound imaging, piezoelectric transducer drivers, inkjet printer heads and optical MEMS modules.

Input data is shifted into an 8-bit shift register that can then be retained in an 8-bit latch. To reduce any possible clock feedthrough noise, the latch enable bar should be left high until all bits are clocked in. Data are clocked in during the rising edge of the clock. Using HVCMOS® technology, this device combines high voltage bilateral DMOS switches and low power CMOS logic to provide efficient control of high voltage analog signals.

The device is suitable for various combinations of high voltage supplies, e.g.,  $V_{PP}/V_{NN}$ : +40V/-210V, +125V/-125V, +210V/-40V.

### Block Diagram



## Ordering Information

Package Options		
Device	28-Lead PLCC	48-Lead LQFP/TQFP(1.4mm)
HV214	HV214PJ	HV214FG
	HV214PJ-G	HV214FG-G

-G indicates the part is RoHS compliant (Green)



## Absolute Maximum Ratings

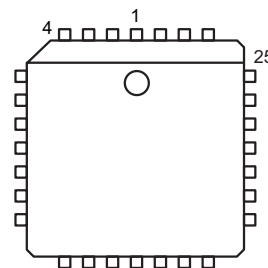
Parameter	Value
$V_{DD}$ logic power supply voltage	-0.5V to +15V
$V_{PP} - V_{NN}$ supply voltage	260V
$V_{PP}$ positive high voltage supply	-0.5V to $V_{NN} + 250V$
$V_{NN}$ negative high voltage supply	+0.5V to -260V
Logic input voltages	-0.5V to $V_{DD} + 0.3V$
Analog signal range	$V_{NN}$ to $V_{PP}$
Peak analog signal current/channel	2.5A
Storage temperature	-65°C to +150°C
Power dissipation:	
28-Lead PLCC	1.2W
48-Lead LQFP/TQFP (1.4mm)	1.0W

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.

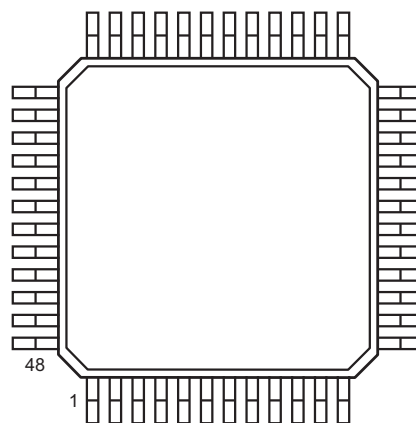
## Operating Conditions

Symbol	Parameter	Value
$V_{DD}$	Logic power supply voltage	4.5V to 13.2V
$V_{PP}$	Positive high voltage supply	40V to $V_{NN} + 250V$
$V_{NN}$	Negative high voltage supply	-40V to -210V
$V_{IH}$	High level input logic voltage	$V_{DD} - 1.5V$ to $V_{DD}$
$V_{IL}$	Low-level input logic voltage	0V to 1.5V
$V_{SIG}$	Analog signal voltage peak-to-peak	$V_{NN} + 10V$ to $V_{PP} - 10V$
$T_A$	Operating free air temperature	0°C to 70°C

## Pin Configurations



28-Lead (J) PLCC (PJ)  
(top view)



48-Lead LQFP (FG)  
(7x7x1.4mm)  
(top view)

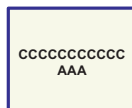
## Product Marking

Top Marking



YY = Year Sealed  
WW = Week Sealed  
L = Lot Number  
C = Country of Origin  
A = Assembler ID\*

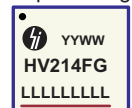
Bottom Marking



— = "Green" Packaging  
\*May be part of top marking

28-Lead PLCC (PJ)

Top Marking



YY = Year Sealed  
WW = Week Sealed  
L = Lot Number  
C = Country of Origin  
A = Assembler ID\*

Bottom Marking



— = "Green" Packaging  
\*May be part of top marking

48-Lead LQFP (FG)

**DC Electrical Characteristics** ( $T_A = 25^\circ\text{C}$ , over recommended operating conditions unless otherwise noted)

Sym	Parameter	Min	Typ	Max	Units	Conditions
$R_{\text{ONS}}$	Small signal switch on-resistance	-	-	55	$\Omega$	$I_{\text{SIG}} = 5.0\text{mA}$ $V_{\text{PP}} = +40\text{V}$
		-	-	49		$I_{\text{SIG}} = 200\text{mA}$ $V_{\text{NN}} = -160\text{V}$
		-	-	42		$I_{\text{SIG}} = 5.0\text{mA}$ $V_{\text{PP}} = +125\text{V}$
		-	-	36		$I_{\text{SIG}} = 200\text{mA}$ $V_{\text{NN}} = -100\text{V}$
		-	-	38		$I_{\text{SIG}} = 5.0\text{mA}$ $V_{\text{PP}} = +210\text{V}$
		-	-	32		$I_{\text{SIG}} = 200\text{mA}$ $V_{\text{NN}} = -40\text{V}$
$\Delta R_{\text{ONS}}$	Small signal switch On-resistance matching	-	-	20	%	$I_{\text{SIG}} = 5\text{mA}$ , $V_{\text{PP}} = +125\text{V}$ , $V_{\text{NN}} = -125\text{V}$
$R_{\text{ONL}}$	Large signal switch On-resistance	-	23	-	$\Omega$	$V_{\text{SIG}} = V_{\text{PP}} - 10\text{V}$ , $I_{\text{SIG}} = 1\text{A}$
$I_{\text{SOL}}$	Switch off leakage per switch	-	-	10	$\mu\text{A}$	$V_{\text{SIG}} = V_{\text{PP}} - 10\text{V}$ & $V_{\text{NN}} + 10\text{V}$
	DC offset switch off	-	-	300	mV	$R_{\text{LOAD}} = 100\text{K}\Omega$
	DC offset switch on	-	-	500	mV	$R_{\text{LOAD}} = 100\text{K}\Omega$
$I_{\text{PPQ}}$	Quiescent $V_{\text{PP}}$ supply current	-	-	50	$\mu\text{A}$	All switches off
$I_{\text{NNQ}}$	Quiescent $V_{\text{NN}}$ supply current	-	-	-50	$\mu\text{A}$	All switches off
$I_{\text{PPQ}}$	Quiescent $V_{\text{PP}}$ supply current	-	-	50	$\mu\text{A}$	All switches on, $I_{\text{SW}} = 5.0\text{mA}$
$I_{\text{NNQ}}$	Quiescent $V_{\text{NN}}$ supply current	-	-	-50	$\mu\text{A}$	All switches on, $I_{\text{SW}} = 5.0\text{mA}$
	Switch output peak current	-	-	2.0	A	$V_{\text{SIG}}$ duty cycle 0.1%
$f_{\text{SW}}$	Output switch frequency	-	-	50	kHz	Duty cycle = 50%
$I_{\text{PP}}$	Average $V_{\text{PP}}$ supply current	-	-	7.0	mA	$V_{\text{PP}} = +40\text{V}$ $V_{\text{NN}} = -160\text{V}$
		-	-	5.0		$V_{\text{PP}} = +100\text{V}$ $V_{\text{NN}} = -100\text{V}$
		-	-	5.0		$V_{\text{PP}} = +160\text{V}$ $V_{\text{NN}} = -40\text{V}$
$I_{\text{NN}}$	Average $V_{\text{NN}}$ supply current	-	-	-7.0	mA	$V_{\text{PP}} = +40\text{V}$ $V_{\text{NN}} = -160\text{V}$
		-	-	-5.0		$V_{\text{PP}} = +100\text{V}$ $V_{\text{NN}} = -100\text{V}$
		-	-	-5.0		$V_{\text{PP}} = +160\text{V}$ $V_{\text{NN}} = -40\text{V}$
$I_{\text{DD}}$	Average $V_{\text{DD}}$ supply current	-	-	10	mA	$f_{\text{CLK}} = 5\text{MHz}$ , $V_{\text{DD}} = 5.0\text{V}$
$I_{\text{DDQ}}$	Quiescent $V_{\text{DD}}$ supply current	-	-	4.0	$\mu\text{A}$	---
$I_{\text{SOR}}$	Data out source current	45	-	-	mA	$V_{\text{OUT}} = V_{\text{DD}} - 0.7\text{V}$
$I_{\text{SINK}}$	Data out sink current	45	-	-	mA	$V_{\text{OUT}} = 0.7\text{V}$
$C_{\text{IN}}$	Large input capacitance	-	-	10	pF	---
$T_A$	Ambient temperature range	0	-	70	$^\circ\text{C}$	---

**AC Electrical Characteristics** ( $V_{DD} = 5.0V$ ,  $T_A = 25^\circ C$ , over recommended operating conditions unless otherwise noted)

Sym	Parameter	Min	Typ	Max	Units	Conditions
$t_{SD}$	Set-up time before $\overline{LE}$ rises	150	-	-	ns	---
$t_{WLE}$	Time width of $\overline{LE}$	150	-	-	ns	---
$t_{DO}$	Clock delay time to data out	-	-	150	ns	---
$t_{WCL}$	Time width of CL	150	-	-	ns	---
$t_{SU}$	Set-up time data to clock	15	8.0	-	ns	---
$t_H$	Hold time data from clock	35	-	-	ns	---
$f_{CLK}$	Clock frequency	-	-	5.0	MHz	50% duty cycle, $f_{DATA} = f_{CLK}/2$
$t_R, t_F$	Clock rise and fall times	-	-	50	ns	---
$T_{ON}$	Turn-on time	-	-	5.0	$\mu s$	$V_{SIG} = V_{PP} - 10V, R_{LOAD} = 10K\Omega$
$T_{OFF}$	Turn-off time	-	-	5.0	$\mu s$	$V_{SIG} = V_{PP} - 10V, R_{LOAD} = 10K\Omega$
dv/dt	Maximum $V_{SIG}$ slew rate	-	-	20	V/ns	$V_{PP} = +40V, V_{NN} = -160V$
		-	-	20		$V_{PP} = +125V, V_{NN} = -100V$
		-	-	20		$V_{PP} = +210V, V_{NN} = -40V$
KO	Off isolation	-30	-	-	dB	F = 5MHz, 1K $\Omega$ /15pF load
		-58	-	-		F = 5MHz, 50 $\Omega$ load
$K_{CR}$	Switch crosstalk	-60	-	-	dB	F = 5MHz, 50 $\Omega$ load
$I_{ID}$	Output switch isolation diode current	-	-	300	mA	300ns pulse width, 2% duty cycle
$C_{SG(OFF)}$	Off capacitance SW to GND	5.0	12	17	pF	0V, f = 1MHz
$C_{SG(ON)}$	On capacitance SW to GND	25	38	50	pF	0V, f = 1MHz
$+V_{SPK}$	Output voltage spike	-	-	200	mV	$V_{PP} = +40V, V_{NN} = -210V, R_{LOAD} = 50\Omega$
$-V_{SPK}$		-	-	200		
$+V_{SPK}$		-	-	200		$V_{PP} = +100V, V_{NN} = -125V, R_{LOAD} = 50\Omega$
$-V_{SPK}$		-	-	200		
$+V_{SPK}$		-	-	200		$V_{PP} = +160V, V_{NN} = -40V, R_{LOAD} = 50\Omega$
$-V_{SPK}$		-	-	200		

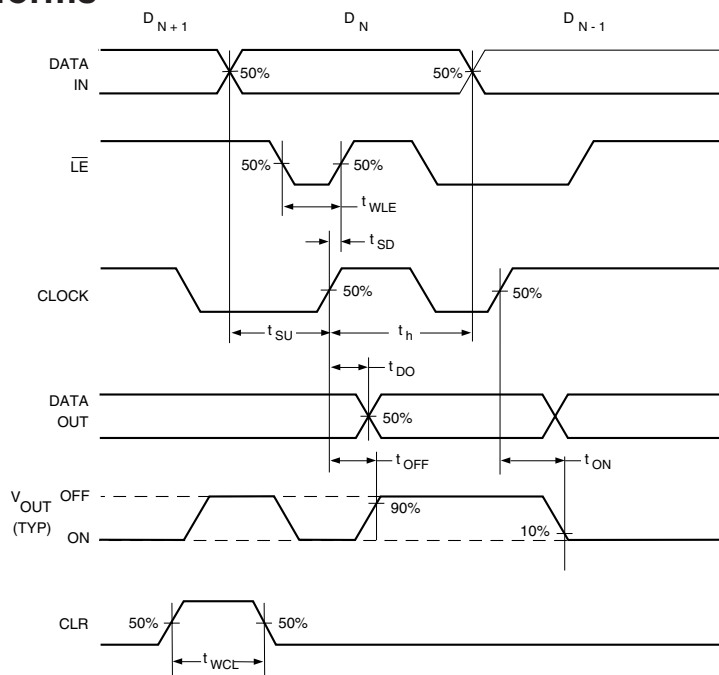
Truth Table

Data in 8-Bit Shift Register								$\overline{LE}$	CL	Output Switch State							
D0	D1	D2	D3	D4	D5	D6	D7			SW0	SW1	SW2	SW3	SW4	SW5	SW6	SW7
L								L	L	OFF							
H								L	L	ON							
	L							L	L		OFF						
	H							L	L		ON						
		L						L	L			OFF					
		H						L	L			ON					
			L					L	L				OFF				
			H					L	L				ON				
				L				L	L					OFF			
				H				L	L					ON			
					L			L	L						OFF		
					H			L	L						ON		
						L		L	L							OFF	
						H		L	L							ON	
							L	L	L								OFF
							H	L	L								ON
X	X	X	X	X	X	X	X	H	L	Hold Previous State							
X	X	X	X	X	X	X	X	X	H	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF

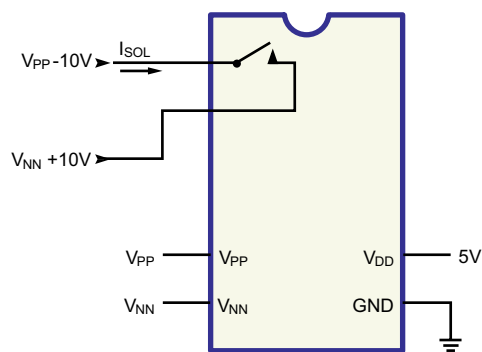
Notes:

1. The eight switches operate independently.
2. Serial data is clocked in on the L→H transition CLK.
3. The switches go to a state retaining their present condition at the rising edge of  $\overline{LE}$ . When  $\overline{LE}$  is low the shift register data flows through the latch.
4.  $D_{OUT}$  is high when switch 7 is on.
5. Shift register clocking has no effect on the switch states if  $\overline{LE}$  is H.
6. The clear input overrides all other inputs.

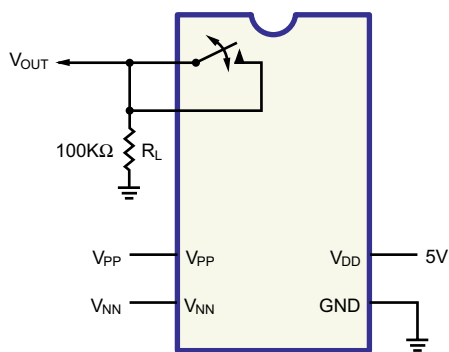
Logic Timing Waveforms



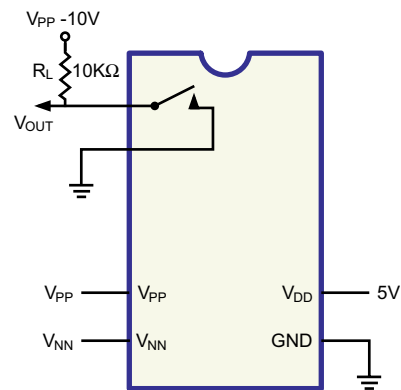
Test Circuits



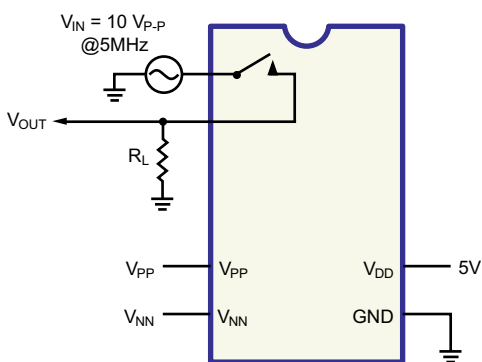
Switch OFF Leakage



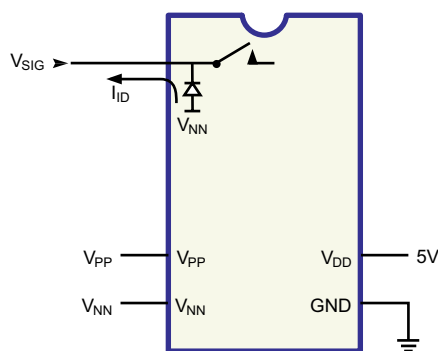
DC Offset ON/OFF



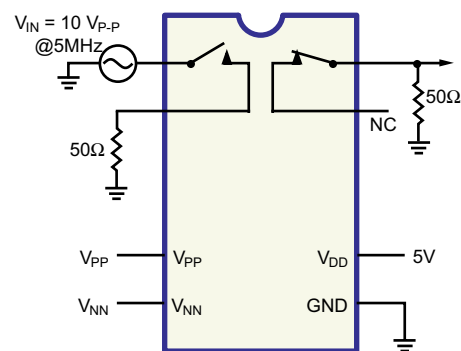
T<sub>ON</sub>/T<sub>OFF</sub> Test Circuit



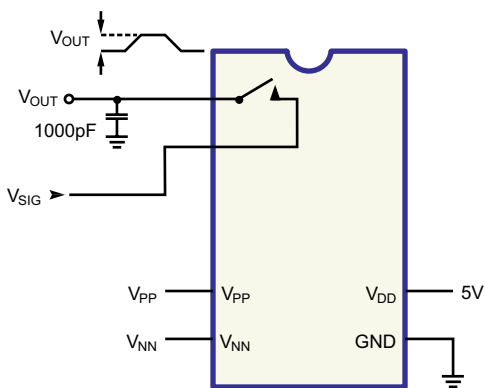
$K_O = 20 \text{Log} \frac{V_{OUT}}{V_{IN}}$   
OFF Isolation



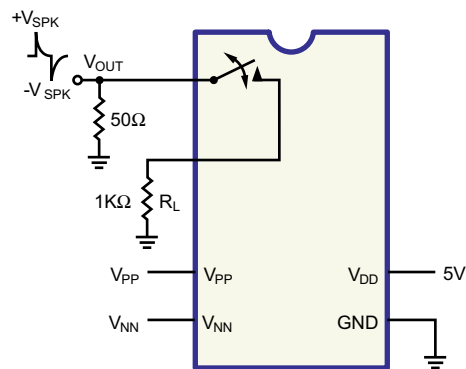
Isolation Diode Current



$K_{CR} = 20 \text{Log} \frac{V_{OUT}}{V_{IN}}$   
Crosstalk



$Q = 1000 \text{pF} \times V_{OUT}$   
Charge Injection



Output Voltage Spike

## 28-Lead (J-Lead) PLCC (PJ) Pin Description

Pin	Function	Pin	Function	Pin	Function	Pin	Function
1	SW3	8	SW0	15	NC	22	SW7
2	SW3	9	NC	16	D <sub>IN</sub>	23	SW6
3	SW2	10	V <sub>PP</sub>	17	CLK	24	SW6
4	SW2	11	NC	18	$\overline{\text{LE}}$	25	SW5
5	SW1	12	V <sub>NN</sub>	19	CL	26	SW5
6	SW1	13	GND	20	D <sub>OUT</sub>	27	SW4
7	SW0	14	V <sub>DD</sub>	21	SW7	28	SW4

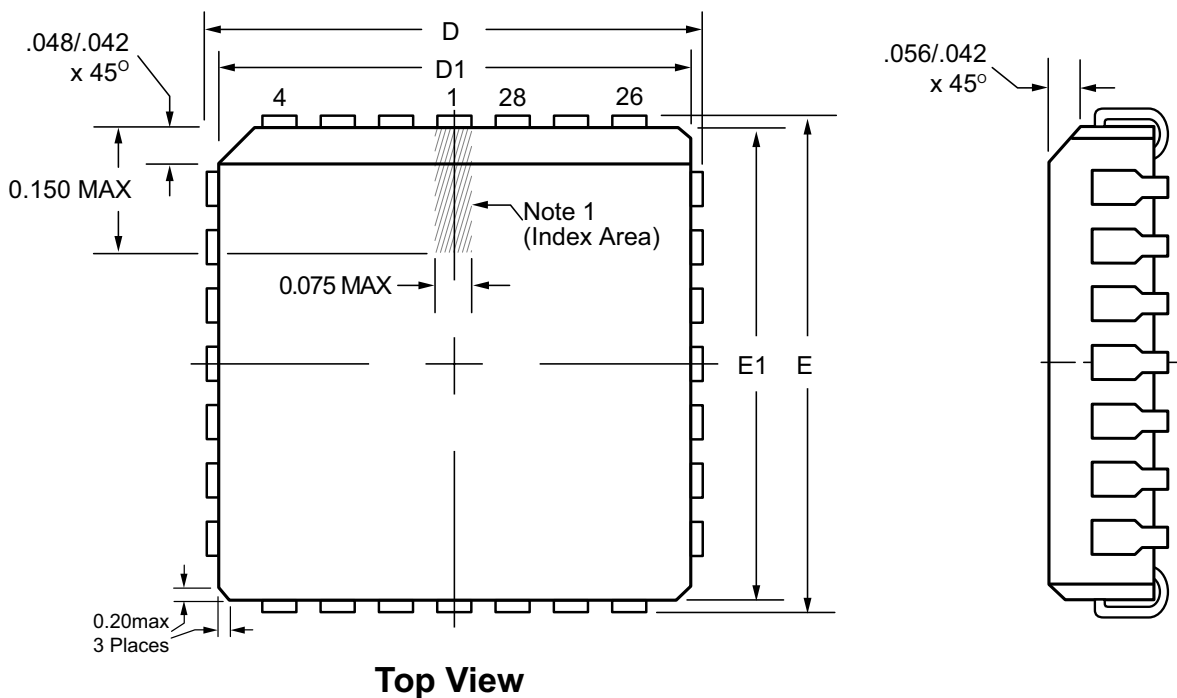
## 48-Lead LQFP/TQFP (FG) Pin Description

Pin	Function	Pin	Function	Pin	Function	Pin	Function
1	SW5	13	NC	25	V <sub>NN</sub>	37	D <sub>OUT</sub>
2	NC	14	SW2	26	NC	38	NC
3	SW4	15	NC	27	NC	39	SW7
4	NC	16	SW1	28	GND	40	NC
5	SW4	17	NC	29	V <sub>DD</sub>	41	SW7
6	NC	18	SW1	30	NC	42	NC
7	NC	19	NC	31	NC	43	SW6
8	SW3	20	SW0	32	NC	44	NC
9	NC	21	NC	33	D <sub>IN</sub>	45	SW6
10	SW3	22	SW0	34	CLK	46	NC
11	NC	23	NC	35	$\overline{\text{LE}}$	47	SW5
12	SW2	24	V <sub>PP</sub>	36	CLR	48	NC

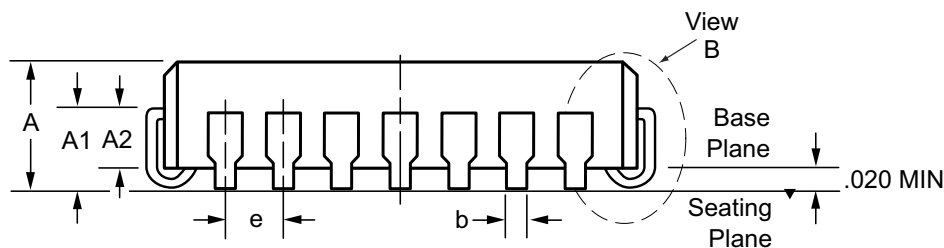
### Power Up/Down Sequence:

1. Power up/down sequence is arbitrary except GND must be powered-up first and powered-down last.
2.  $V_{\text{SIG}}$  must be  $V_{\text{NN}} \leq V_{\text{SIG}} \leq V_{\text{PP}}$  or floating during power up/down transition.
3. Rise and fall times of power supplies  $V_{\text{DD}}$ ,  $V_{\text{PP}}$ , and  $V_{\text{NN}}$  should not be less than 1.0msec.

## 28-Lead PLCC Package Outline (PJ)



**Top View**



**Side View**

**Note 1:**

A Pin 1 identifier must be located in the index area indicated. The Pin 1 identifier may be either a mold, or an embedded metal or marked feature.

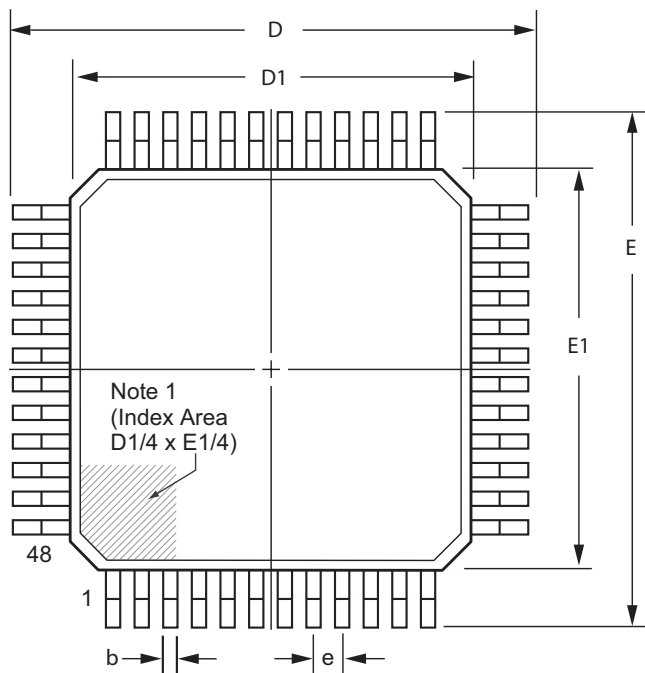
Symbol	A	A1	A2	b	D	D1	E	E1	e	
Dimension (inches)	MIN	.165	.090	.062	.013	.485	.450	.485	.450	.050 BSC
	NOM	.172	.105	-	-	.490	.453	.490	.453	
	MAX	.180	.120	.083	.021	.495	.456	.495	.456	

JEDEC Registration MS-018, Variation AB, Issue A, June, 1993.

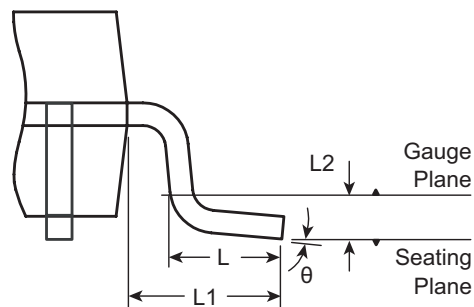
Drawings not to scale.



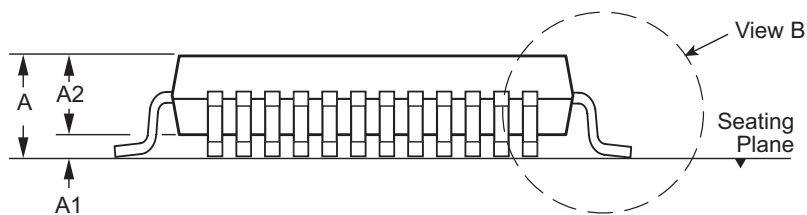
# 48-Lead LQFP/TQFP (1.4mm) Package Outline (FG)



**Top View**



**View B**



**Side View**

**Note 1:**

A Pin 1 identifier must be located in the index area indicated. The Pin 1 identifier may be either a mold, or an embedded metal or marked feature.

Symbol	A	A1	A2	b	D	D1	E	E1	e	L	L1	L2	$\theta$	
Dimension (mm)	MIN	1.40	0.05	1.35	0.17	9.00 BSC	7.00 BSC	9.00 BSC	7.00 BSC	0.50 BSC	1.00 REF	0.25 BSC	0°	
	NOM	-	-	1.40	0.22								0.60	3.5°
	MAX	1.60	0.15	1.45	0.27								0.75	7°

JEDEC Registration MS-026, Variation BBC, Issue D, Jan. 2001.

**Drawings not to scale.**

(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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