Initial Release

Low Charge Injection 8-Channel High Voltage Analog Switch

Features

- HVCMOS technology for high performance
- Very low quiescent power dissipation-10µA
- Output On-resistance typically 11Ω
- Low parasitic capacitance
- DC to 10MHz analog signal frequency
- -60dB typical off-isolation at 5MHz
- CMOS logic circuitry for low power
- Excellent noise immunity
- Serial shift register logic control with latches
- Flexible operating supply voltages
- Surface mount packages

Applications

- Medical Ultrasound Imaging
- Non-Destructive Evaluation

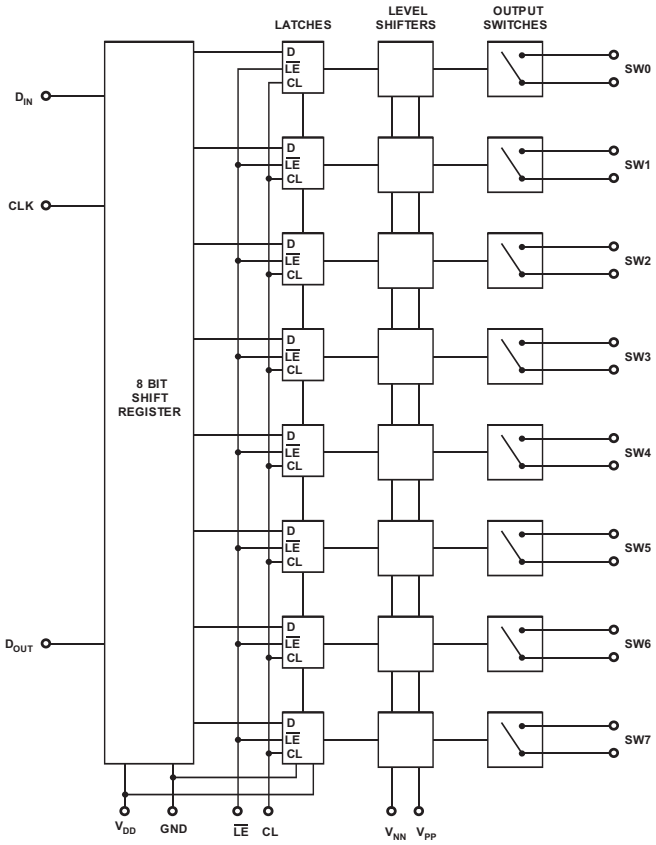
General Description

The Supertex HV219 is a low switch resistance, low charge injection 8-channel 200V analog switch integrated circuit (IC) intended primarily for medical ultrasound imaging. The device can also be used for NDE, non-destructive evaluation applications. The HV219 is a lower switch resistance, 11ohms versus 22ohms, version of the Supertex HV20220 device. The lower switch resistance will help reduce insertion loss. It has the same pin configuration as that of the Supertex HV20220PJ and the HV20220FG.

The device is manufactured using Supertex's HVCMOS (high voltage CMOS) technology with high voltage bilateral DMOS structures for the outputs and low voltage CMOS logic for the input control. The outputs are configured as eight independent single pole single throw 11 ohms analog switches. The input logic is an 8-bit serial to parallel shift register followed by an 8-bit parallel latch. The switch states are determined by the data in the latch. Logic high will correspond to a closed switch and logic low as an opened switch.

The HV219 is designed to operate on various combinations of high voltage supplies. For example the V_{PP} and V_{NN} supplies can be: +40V/-160V, +100V/-100V, or +160V/-40V. This allows the user to maximize the signal voltage for uni-polar negative, bi-polar, or uni-polar positive.

Block Diagram



A042705

Ordering Information

V_{PP}-V_{NN}	Maximum Analog Switch Voltage	Package Options		
		28-lead plastic chip carrier PLCC	48-lead TQFP	Die
200V	$180V_{P-P}$	HV219PJ	HV219FG	HV219X

Absolute Maximum Ratings*

V_{DD} Logic supply		-0.5V to +15V
V_{PP}-V_{NN} differential supply		220V
V_{PP} Positive supply		-0.5V to V_{NN}+200V
V_{NN} Negative supply		+0.5V to –200V
Logic input voltage		-0.5V to V_{DD}+0.3V
Analog signal range		V_{NN} to V_{PP}
Peak analog signal current		3.0A
Storage temperature		-65°C to +125°C
Power dissipation	28-Lead PLCC	1.2W
	48 Lead TQFP	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	4.5V to 13.2V
V_{PP}	Positive high voltage supply	40V to V_{NN}+200V
V_{NN}	Negative high voltage supply	-40V to -160V
V_{IH}	Input logic voltage high	V_{DD}-1.5V to V_{DD}
V_{IL}	Input logic voltage low	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

Electrical Characteristics

DC Characteristics *(over recommended operating conditions unless otherwise noted)*

Sym	Parameter	0°C		+25°C			+70°C		Units	Conditions	
		Min	Max	Min	Typ	Max	Min	Max			
R_{ONS}	Small Signal Switch On-Resistance		15		13	19		24	Ohms	I_{SIG} = 5mA	V_{PP} = +40V
			13		11	14		16		I_{SIG} = 200mA	V_{NN} = -160V
			13		11	14		15		I_{SIG} = 5mA	V_{PP} = +100V
			9		9	12		14		I_{SIG} = 200mA	V_{NN} = -100V
			12		10	13		15		I_{SIG} = 5mA	V_{PP} = +160V
			11		8	13		14		I_{SIG} = 200mA	V_{NN} = -40V
ΔR_{ONS}	Small Signal Switch On-Resistance Matching		20		5.0	20		20	%	I_{SIG} = 5mA, V_{PP} = +100V, V_{NN} = -100V	
R_{ONL}	Large Signal Switch On-Resistance				8				Ohms	V_{SIG} = V_{PP}-10V, I_{SIG} = 1A	
I_{SOL}	Switch Off Leakage per Switch		5.0		1.0	10		15	µA	V_{SIG} = V_{PP}-10V and V_{NN}+10V	
	DC offset Switch off		300		100	300		300	mV	R_{LOAD} = 100KΩ	
	DC offset Switch on		500		100	500		500	mV	R_{LOAD} = 100KΩ	
I_{PPQ}	Quiescent V_{PP} supply current				10	50			µA	All switches off	
I_{NNQ}	Quiescent V_{NN} supply current				-10	-50			µA	All switches off	
I_{PPQ}	Quiescent V_{PP} supply current				10	50			µA	All switches on, I_{SW} = 5mA	
I_{NNQ}	Quiescent V_{NN} supply current				-10	-50			µA	All switches on, I_{SW} = 5mA	
	Switch output peak current		3.0		3.0	2.0		2.0	A	V_{SIG} duty cycle < 0.1%	
f_{SW}	Output switch frequency					50			kHz	Duty cycle = 50%	
I_{PP}	Average V_{PP} supply current		6.5			7.0		8.0	mA	V_{PP} = +40V V_{NN} = -160V	All output switches are turning On and Off at 50KHz with no load.
			4.0			5.0		5.5		V_{PP} = +100V V_{NN} = -100V	
			4.0			5.0		5.5		V_{PP} = +160V V_{NN} = -40V	
I_{NN}	Average V_{NN} supply current		6.5			7.0		8.0	mA	V_{PP} = +40V V_{NN} = -160V	
			4.0			5.0		5.5		V_{PP} = +100V V_{NN} = -100V	
			4.0			5.0		5.5		V_{PP} = +160V V_{NN} = -40V	
I_{DD}	Average V_{DD} supply current		4.0			4.0		4.0	mA	f_{CLK} = 5MHz, V_{DD} = 5.0V	
I_{DDQ}	Quiescent V_{DD} supply current		10			10		10	µA	All logic inputs are static	
I_{SOR}	Data out source current	0.45		0.45	0.70		0.40		mA	V_{OUT} = V_{DD}-0.7V	
I_{SINK}	Data out sink current	0.45		0.45	0.70		0.40		mA	V_{OUT} = 0.7V	
C_{IN}	Logic input capacitance		10			10		10	pF		

Electrical Characteristics

AC Characteristics *(over recommended operating conditions, V_{DD}=5.0V, unless otherwise noted)*

Sym	Parameter	0°C		+25°C			+70°C		Units	Conditions
		Min	Max	Min	Typ	Max	Min	Max		
t_{SD}	Set Up Time Before $\overline{LE}$ Rises	150		150			150		ns	
t_{WLE}	Time Width of $\overline{LE}$	150		150			150		ns	
t_{DO}	Clock Delay Time to Data out		150			150		150	ns	
tw_{CL}	Time Width of CL	150		150			150		ns	
t_{SU}	Set Up Time Data to Clock	15		15	8.0		20		ns	
t_H	Hold Time Data from Clock	35		35			35		ns	
f_{CLK}	Clock Frequency		5.0			5.0		5.0	MHz	50% duty cycle, $f_{DATA} = f_{CLK}/2$
tr,tf	Clock rise and fall Times		50			50		50	ns	
Ton	Turn on Time		5.0			5.0		5.0	µs	$V_{SIG} = V_{PP}$-10V, R_{LOAD} = 10KΩ
Toff	Turn off Time		5.0			5.0		5.0	µs	$V_{SIG} = V_{PP}$-10V, R_{LOAD} = 10KΩ
dv/dt	Maximum V_{SIG} Slew Rate		20			20		20	V/ns	V_{PP} = +40V, V_{NN} = -160V
			20			20		20		V_{PP} = +100V, V_{NN} = -100V
			20			20		20		V_{PP} = +160V, V_{NN} = -40V
KO	Off Isolation	-30		-30	-33		-30		dB	F = 5MHz, 1KΩ//15pF load
		-58		-58			-58			F = 5.0MHz, 50Ω load
Kcr	Switch Crosstalk			-60					dB	F = 5.0MHz, 50Ω load
Iid	Output Switch Isolation Diode Current		300			300		300	mA	300ns pulse width, 2.0% duty cycle
C_{SG}(off)	Off Capacitance SW to Gnd	14	25	14	20	25	14	25	pF	0V, f = 1MHz
C_{SG}(on)	On Capacitance SW to Gnd	40	60	40	50	60	40	60	pF	0V, f = 1MHz
$+V_{SPK}$	Output Voltage Spike					150			mV	V_{PP} = +40V, V_{NN} = -160V, R_{LOAD} = 50ohm
$-V_{SPK}$						200				
$+V_{SPK}$						150			mV	V_{PP} = +100V, V_{NN} = -100V, R_{LOAD} = 50ohm
$-V_{SPK}$						200				
$+V_{SPK}$						150			mV	V_{PP} = +160V, V_{NN} = -40V, R_{LOAD} = 50ohm
$-V_{SPK}$						200				
Q	Charge Injection				1450				pC	V_{PP} = +40V, V_{NN} = -160V, V_{SIG} = 0V
					1050					V_{PP} = +100V, V_{NN} = -100V, V_{SIG} = 0V
					550					V_{PP} = +160V, V_{NN} = -40V, V_{SIG} = 0V

Power Up/Down Sequence

1) Power up/down sequence is arbitrary except GND must be powered up first and powered down last. This applies for applications powering GND of the IC with different voltages.
2) Vsig must always be at or in between V_{PP} and V_{NN} or floating during power up/down transition.
3) Rise and fall times of the power supplies V_{DD}, V_{PP}, and V_{NN} should not be less than 1.0ms.

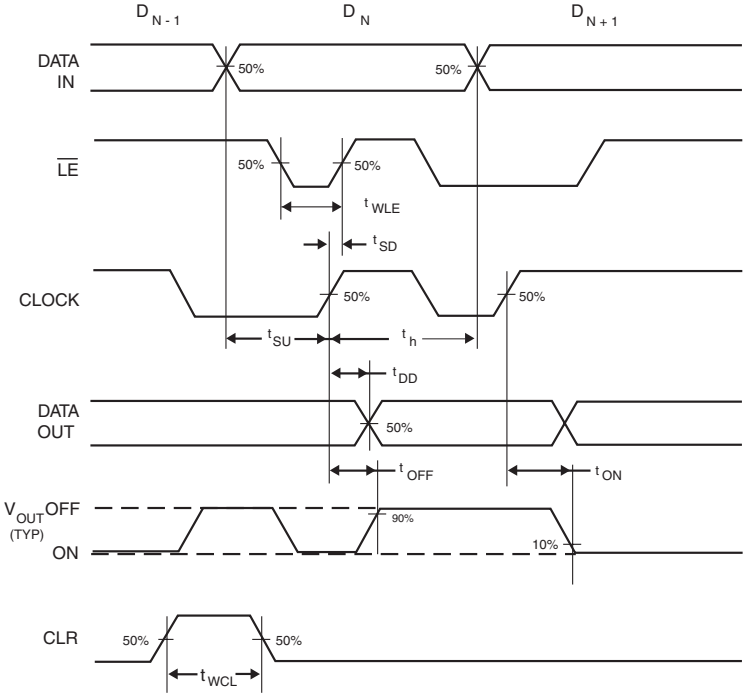
Logic Truth Table

Data in the 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

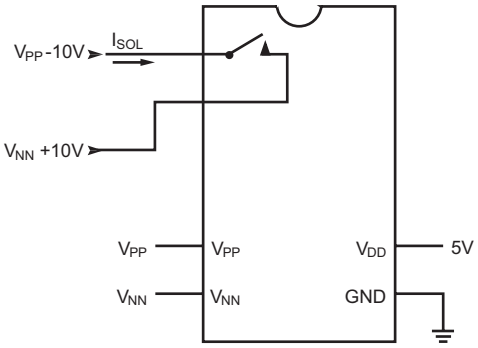
Notes:

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

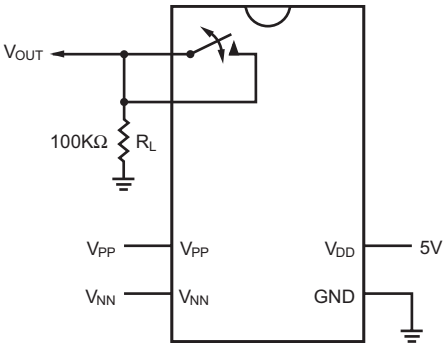
Logic Timing Waveform



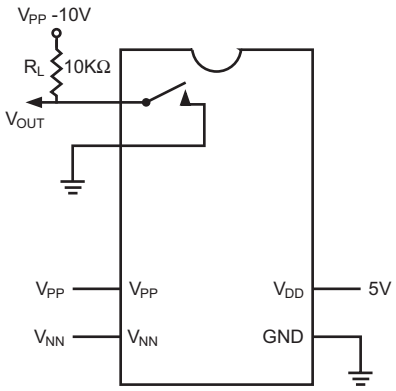
Test Circuits



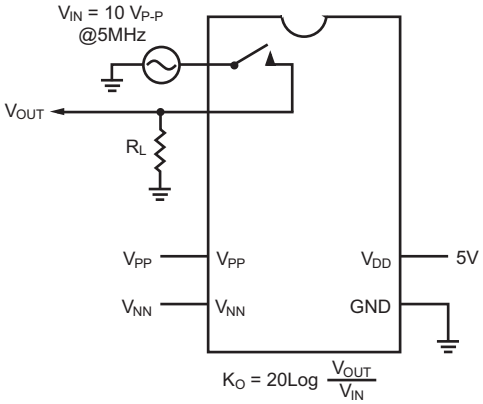
Switch OFF Leakage



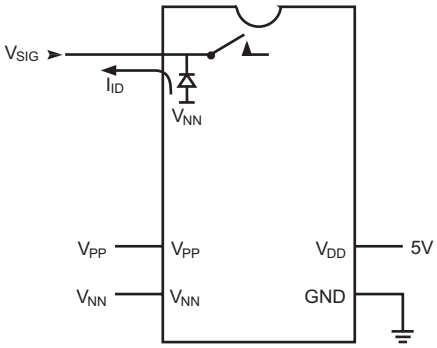
DC Offset ON/OFF



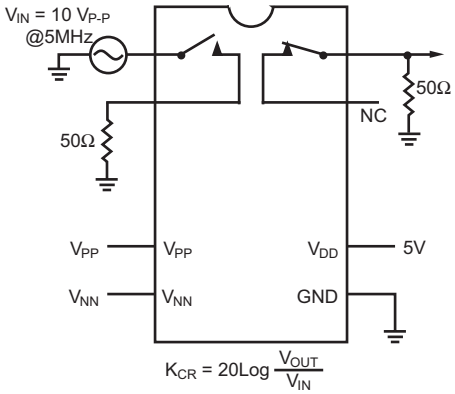
T_{ON}/T_{OFF} Test Circuit



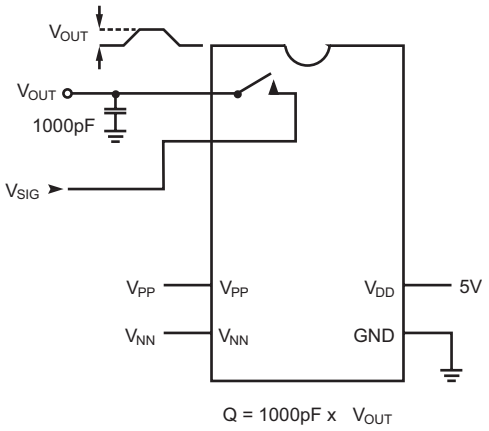
OFF Isolation



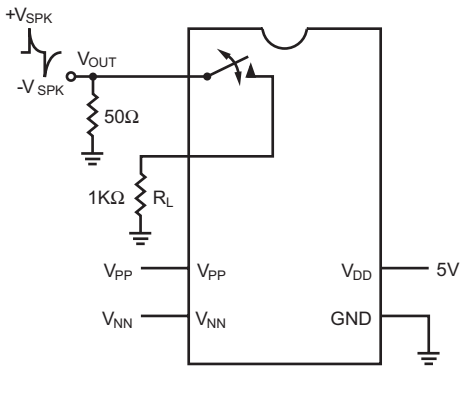
Isolation Diode Current



Crosstalk

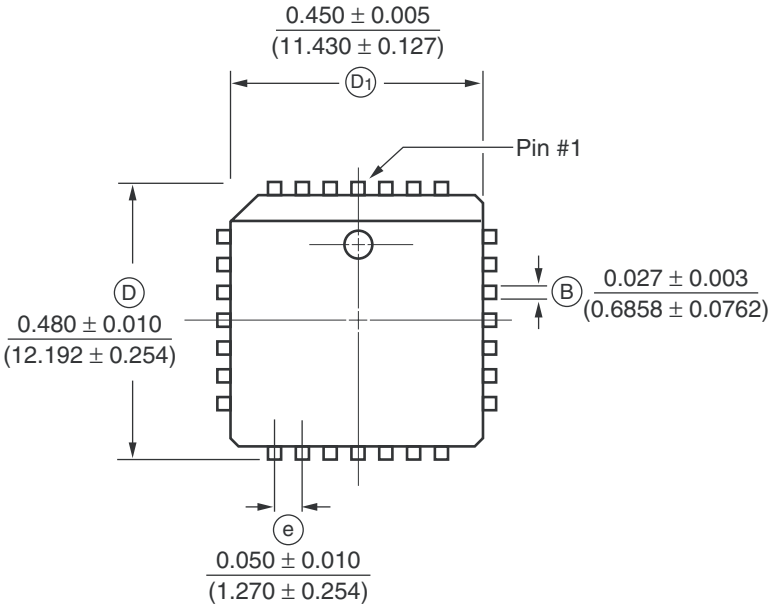


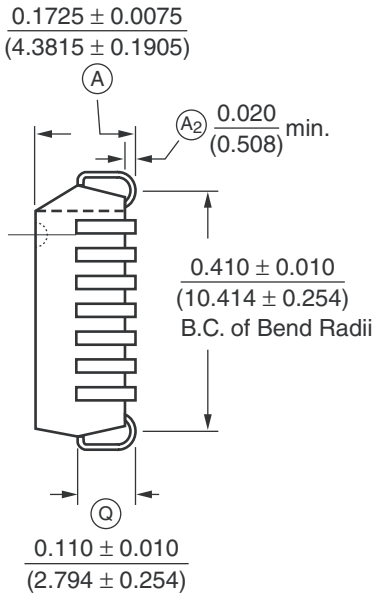
Charge Injection

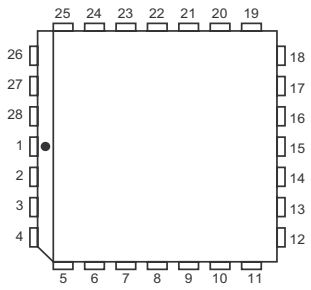


Output Voltage Spike

28-Pin J-lead Package Outline







Top View
28-Pin J-Lead Package

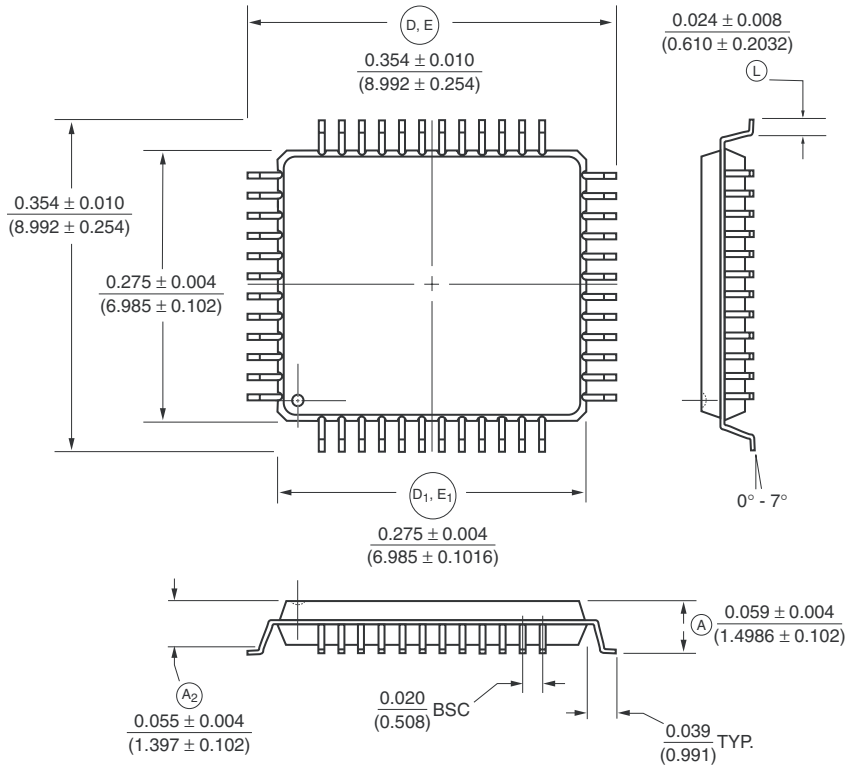
Pin Configuration

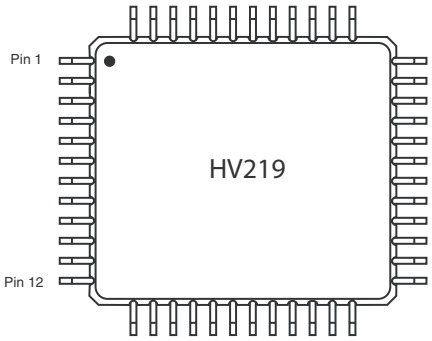
28 Pin J-Lead

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

$$\text{Measurement Legend} = \frac{\text{Dimensions in Inches}}{\text{(Dimensions in Millimeters)}}$$

48-Pin TQFP





top view

48-pin TQFP

Pin Configuration

48-Pin TQFP

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

$$\text{Measurement Legend} = \frac{\text{Dimensions in Inches}}{\text{(Dimensions in Millimeters)}}$$

Supertex inc.
1235 Bordeaux Drive, Sunnyvale, CA 94089
TEL: (408) 222-8888 / FAX: (408) 222-4895
www.supertex.com