Supertex inc.

HV204

Objective

Low Charge Injection 8-Channel High Voltage Analog Switch

Ordering Information

$V_{PP} - V_{NN}$	Package Options			
	28-pin ceramic*† side-brazed DIP	Die in waffle pack	28-pin plastic DIP	28-lead plastic chip carrier
200V	HV20420C	HV20420X	HV20420P	HV20420PJ

* Consult factory for Cerdip and Ceramic LCC availability.
† Consult factory for MIL-STD-883 processing.

Features

- ☐ HVCMOS® technology for high performance
- ☐ Low charge injection
- ☐ Very low quiescent power dissipation – 10μA
- ☐ Output On-resistance typically 22 ohms
- ☐ Low parasitic capacitances
- ☐ DC to 10MHz analog signal frequency
- ☐ 60dB typical output off isolation at 5 MHz
- ☐ CMOS logic circuitry for low power
- ☐ Excellent noise immunity
- ☐ On-chip shift register, latch and clear logic circuitry
- ☐ Flexible high voltage supplies
- ☐ Surface mount package available

General Description

This device 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 ultrasound imaging and printers. Input data is shifted into an 8-bit shift register which can then be retained in an 8-bit latch. To reduce any possible clock feed-through noise, Latch Enable Bar ($\overline{LE}$) should be left high until all bits are clocked in. Using HVCMOS technology, this switch combines high voltage bi-lateral DMOS switches and low power CMOS logic to provide efficient control of high voltage analog signals.

This IC is suitable for various combinations of high voltage supplies, e.g., V_{PP}/V_{NN} : +50V/–150V, or +100V/–100V.

Absolute Maximum Ratings*

V_{DD} Logic power supply voltage	-0.5V to +18V
V_{PP} - V_{NN} Supply voltage	220V
V_{PP} Positive high voltage supply	-0.5V to V_{NN} +200V
V_{NN} Negative high voltage supply	+0.5V to -200V
Logic input voltages	-0.5V to V_{DD} +0.3V
Analog Signal Range	V_{NN} to V_{PP}
Peak analog signal current/channel	3.0A
Storage temperature	-65°C to +150°C
Power dissipation	Plastic Package 0.8W Ceramic Package 2.0W

* 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.

Electrical Characteristics

DC Characteristics (over recommended operating conditions unless otherwise noted)

Characteristics	Sym	0°C		+25°C			+70°C		Units	Test Conditions	
		min	max	min	typ	max	min	max			
Small Signal Switch (ON) Resistance	R_{ONS}		30		26	32		35	ohms	I_{SIG} = 5mA	V_{PP} = +50V,
			25		22	27		32		I_{SIG} = 200mA	V_{NN} = -150V
			25		22	27		30		I_{SIG} = 5mA	V_{PP} = +100V,
			18		18	20		23		I_{SIG} = 200mA	V_{NN} = -100V
Small Signal Switch (ON) Resistance Matching	ΔR_{ONS}		20		5.0	20		20	%	I_{SW} = 5mA, V_{PP} = +100V, V_{NN} = -100V	
Large Signal Switch (ON) Resistance	R_{ONL}				15				ohms	V_{SIG} = V_{PP} -10V, I_{SIG} = 1.0A	
Switch Off Leakage Per Switch	I_{SOL}		5.0		1.0	10		15	µA	V_{SIG} = V_{PP}–10V to V_{NN} +10V	
DC Offset Switch Off			300		100	300		300	mV	R_L = 100KΩ	
DC Offset Switch On			500		100	500		500	mV	R_L = 100KΩ	
Pos. HV Supply Current	I_{PPQ}				10	50			µA	ALL SWS OFF	
Neg. HV Supply Current	I_{NNQ}				-10	-50			µA	ALL SWS OFF	
Pos. HV Supply Current	I_{PPQ}				10	50			µA	ALL SWS ON I_{SW} = 5mA	
Neg. HV Supply Current	I_{NNQ}				-10	-50			µA	ALL SWS ON I_{SW} = 5mA	
Switch Output Peak Current			3.0		3.0	2.0		2.0	A	V_{SIG} duty cycle ≤ 0.1%	
Output Switch Frequency	f_{SW}					50			KHz	Duty Cycle = 50%	
I_{PP} Supply Current	I_{PP}		8.1			8.8		10.0	mA	V_{PP} = +50V, V_{NN} = -150V	50KHz Output Switching Frequency with no load
			5.0			6.3		6.9		V_{PP} = +100V, V_{NN} = -100V	
I_{NN} Supply Current	I_{NN}		8.1			8.8		10.0	mA	V_{PP} = +50V, V_{NN} = -150V	
			5.0			6.3		6.9		V_{PP} = +100V, V_{NN} = -100V	
Logic Supply Average Current	I_{DD}		6.0		4.0	6.0		6.0	mA	f_{CLK} = 3MHz	
Logic Supply Quiescent Current	I_{DDQ}		10			10		10	µA		
Data Out Source Current	I_{SOR}	0.45		0.45	0.70		0.40		mA	V_{OUT} = V_{DD} - 0.7V	
Data Out Sink Current	I_{SINK}	0.45		0.45	0.70		0.40		mA	V_{OUT} = 0.7V	

Electrical Characteristics

AC Characteristics (over operating conditions V_{DD} = 15V, unless otherwise noted)

Characteristics	Sym	0°C		+25°C			+70°C		Units	Test Conditions
		min	max	min	typ	max	min	max		
Time to Turn Off V_{SIG}*	$t_{SIG(OFF)}$			0					ns	
Set Up Time Before $\overline{LE}$ Rises	t_{SD}	150		150			150		ns	
Time Width of $\overline{LE}$	t_{WLE}	150		150			150		ns	
Clock Delay Time to Data Out	t_{DO}		175			175		190	ns	
Time Width of CL	t_{WCL}	150		150			150		ns	
Set Up Time Data to Clock	t_{SU}	15		15	8.0		20		ns	
Hold Time Data from Clock	t_h	35		35			35		ns	
Clock Freq	f_{CLK}		5.0			5.0		5.0	MHz	50% duty cycle $f_{DATA} = f_{CLK}/2$
Turn On Time			5.0			5.0		5.0	µs	$V_{SIG} = V_{PP}$ -10V
Turn Off Time			5.0			5.0		5.0	µs	$V_{SIG} = V_{PP}$ -10V
Maximum V_{SIG} Slew Rate	dv/dt					13			V/ns	V_{PP} = +50V, V_{NN} = -150V
						13				V_{PP} = +100V, V_{NN} = -100V
Off Isolation	KO	-30		-30	-33		-30		dB	f = 5.0MHz, 1KΩ//15pF load
		-45		-45	-60		-45		dB	f = 5.0MHz, 50Ω load
Switch Crosstalk	K_{CR}	-60		-60	-70		-60		dB	f = 5.0MHz, 50Ω load
Output Switch Isolation Diode Current	I_{ID}		300			300		300	mA	300ns pulse width, 2.0% duty cycle
Off Capacitance SW to GND	$C_{SG(OFF)}$	5.0	17	5.0	12	17	5.0	17	pF	0V, 1MHz
On Capacitance SW to GND	$C_{SG(ON)}$	25	50	25	38	50	25	50	pF	0V, 1MHz
Output Voltage Spike	$+V_{SPK}$				150				mV	V_{PP} = +100V V_{NN} = -100V R_L = 50Ω
	$-V_{SPK}$				150					

*Time required for analog signal to turn off before output switch turns off.

Operating Conditions*

Symbol	Parameter	Value
V_{DD}	Logic power supply voltage	10.0 V to 15.5 V
V_{PP}	Positive high voltage supply	50V to V_{NN}+ 200V
V_{NN}	Negative high voltage supply	-100V to -150V
V_{IH}	High-level input voltage	V_{DD} -2V to V_{DD}
V_{IL}	Low-level input voltage	0V to 2.0V
V_{SIG}	Analog signal voltage peak to peak	V_{NN} +10V to V_{PP} -10
T_A	Operating free air-temperature	0°C to 70°C

Note:

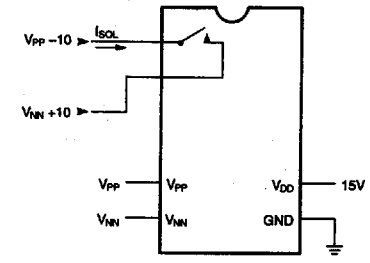
* Power up/down sequence is arbitrary except GND must be powered-up first and powered-down last.
V_{SIG} must be $V_{NN} \le V_{SIG} \le V_{PP}$ or floating during power up/down transistion.
Rise and fall times of power supplies V_{DD}, V_{PP} and V_{NN} should not be less than 1.0msec.

Truth Table

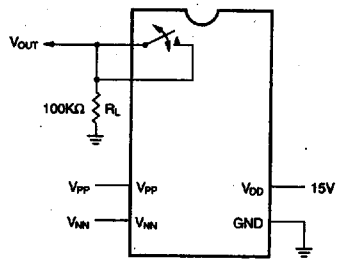
D0	D1	D2	D3	D4	D5	D6	D7	$\overline{LE}$	CL	SW0	SW1	SW2	SW3	SW4	SW5	SW6	SW7
L								L	L	OFF							
H								L	L	ON							
	L							L	L		OFF						
	H							L	L		ON						
		L						L	L			OFF					
		H						L	L			ON					
			L					L	L				OFF				
			H					L	L				ON				
				L				L	L					OFF			
				H				L	L					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.

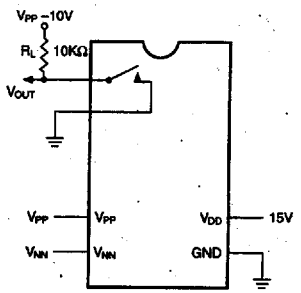
Test Circuits



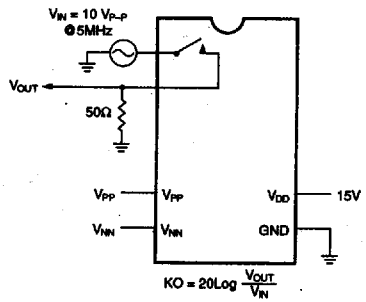
Switch OFF Leakage



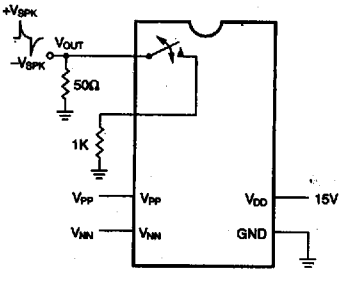
DC Offset ON/OFF



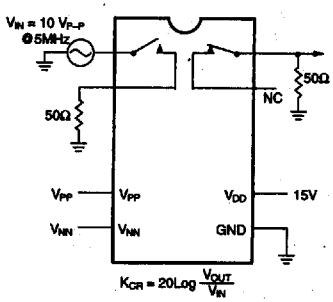
T_{ON} / T_{OFF}



OFF Isolation

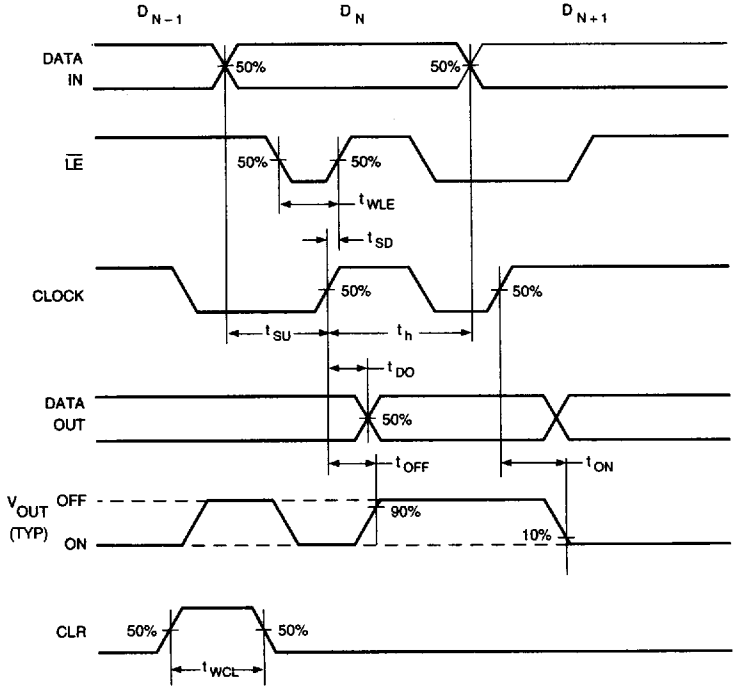


Output Voltage Spike

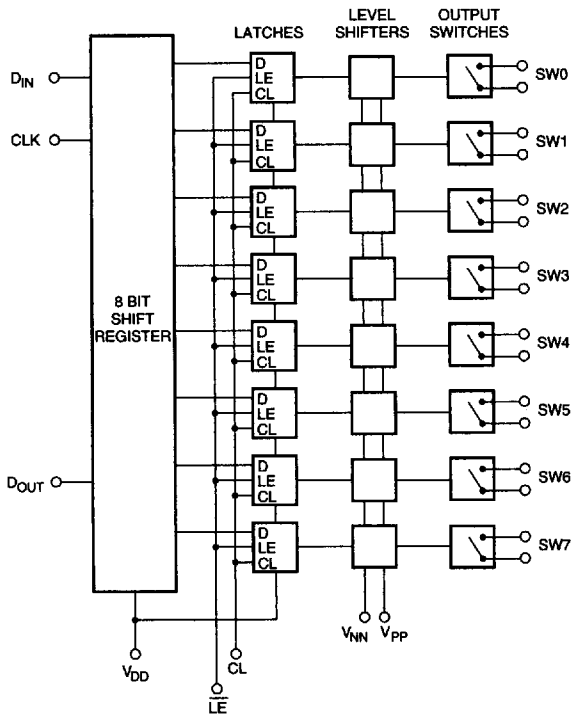


Crosstalk

Logic Timing Waveforms



Logic Diagram



Pin Configurations

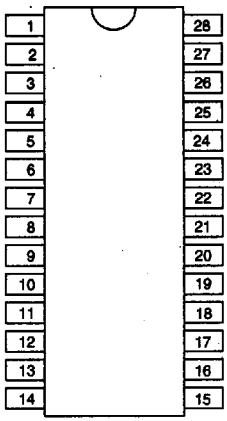
28-Pin DIP

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

28-Pin J-Lead

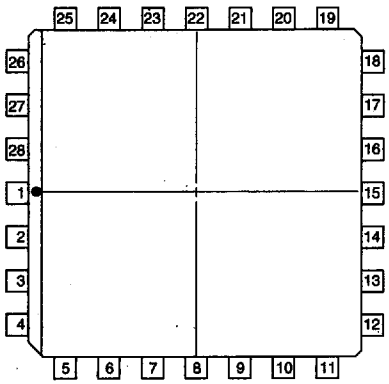
Pin	Function	Pin	Function
1	SW3	15	N/C
2	SW3	16	D_{IN}
3	SW2	17	CLK
4	SW2	18	$\overline{LE}$
5	SW1	19	CL
6	SW1	20	D_{OUT}
7	SW0	21	SW7
8	SW0	22	SW7
9	N/C	23	SW6
10	V_{PP}	24	SW6
11	N/C	25	SW5
12	V_{NN}	26	SW5
13	GND	27	SW4
14	V_{DD}	28	SW4

Package Outlines



top view

28-pin DIP



top view

28-pin J-lead Package