

Low Charge Injection 16-Channel High Voltage Analog Switch

Features

- ❑ HVCMOS technology for high performance
- ❑ 16 Channels of high voltage analog switch
- ❑ 3.3V input logic level compatible
- ❑ 20MHz data shift clock frequency
- ❑ Very low quiescent power dissipation -10µA
- ❑ Low parasitic capacitance
- ❑ DC to 10MHz analog signal frequency
- ❑ -60dB typical off-isolation at 5MHz
- ❑ CMOS logic circuitry for low power
- ❑ Excellent noise immunity
- ❑ Cascadable serial data register with latches
- ❑ Flexible operating supply voltages

Applications

- ❑ Medical ultrasound imaging
- ❑ NDT metal flaw detection
- ❑ Piezoelectric transducer drivers
- ❑ Optical MEMS modules

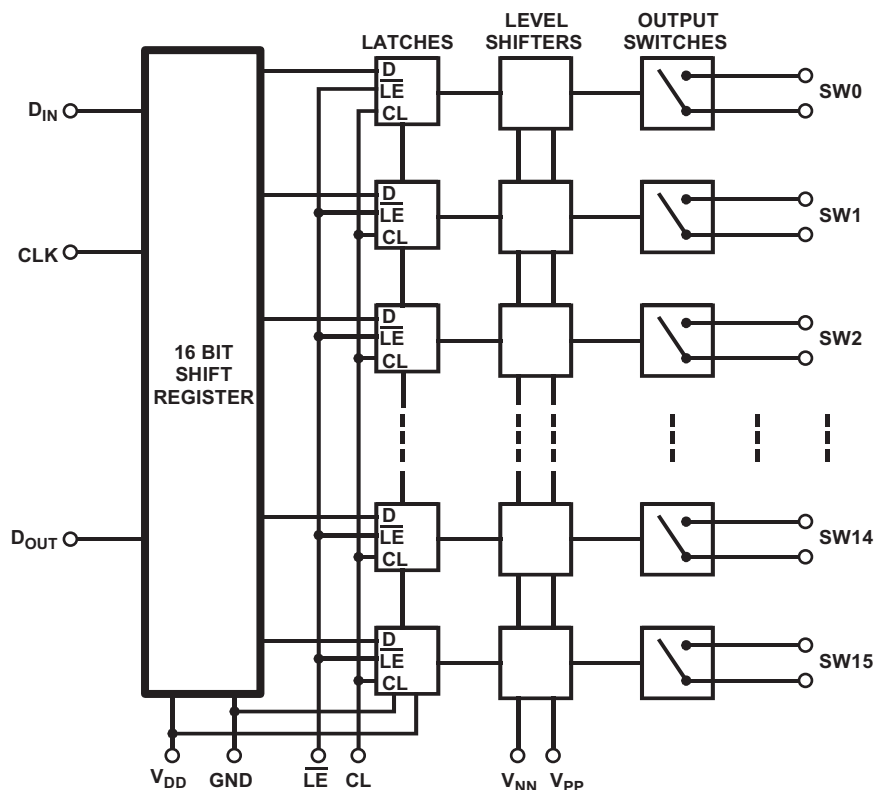
General Description

The Supertex HV2601 is a low charge injection 16-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 and other piezoelectric transducer drivers.

Input data is shifted into a 16-bit shift register that can then be retained in a 16-bit latch. To reduce any possible clock feed through 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/-160V, +100V/-100V, and +160V/-40V.

Block Diagram



Ordering Information

DEVICE	Package Options
	48-Lead TQFP
HV2601	HV2601FG-G



-G indicates package is RoHS compliant ('Green')

Absolute Maximum Ratings

V_{DD} Logic supply	-0.5V to +7V
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/channel	3.0A
Storage temperature	-65°C to 150°C
Power dissipation	48-Lead TQFP 1W

*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.

Operation Conditions

Symbol	Parameter	Value
V_{DD}	Logic power supply voltage	3.0V to 5.5V
V_{PP}	Positive high voltage supply	40V to V_{NN} +200V
V_{NN}	Negative high voltage supply	-40V to -160V
V_{IH}	High level input voltage	$0.9V_{DD}$ to V_{DD}
V_{IL}	Low level input voltage	0V to $0.1V_{DD}$
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

Notes:

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

DC Electrical 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		30		26	38		48	Ω	I _{SIG} = 5mA	V _{PP} = +40V
			25		22	27		32		I _{SIG} = 200mA	V _{NN} = -160V
			25		22	27		30		I _{SIG} = 5mA	V _{PP} = +100V
			18		18	24		27		I _{SIG} = 200mA	V _{NN} = -100V
			23		20	25		30		I _{SIG} = 5mA	V _{PP} = +160V
			22		16	25		27		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				15				Ω	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	
V _{OS}	DC offset Switch off*		300		100	300		300	mV	100KΩ Load	
	DC offset Switch on*		500		100	500		500	mV		
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	
I _{SW}	Switch output peak current		3.0		3.0	2.0		2.0	A	V _{SIG} duty cycle < 0.1%	
f _{SW}	Output switching frequency					50			kHz	Duty cycle = 50%	
I _{PP}	Average V _{PP} supply current		6.5			7.0		8.0	mA	V _{PP} = +40V	All output switches are turning On and Off at 50KHz with no load.
			4.0			5.5		5.5		V _{NN} = -160V	
			4.0			5.0		5.5		V _{PP} = +100V V _{NN} = -100V	
I _{NN}	Average V _{NN} supply current		6.5			7.0		8.0	mA	V _{PP} = +160V V _{NN} = -40V	
			4.0			5.0		5.5		V _{PP} = +40V V _{NN} = -160V	
			4.0			5.0		5.5		V _{PP} = +100V V _{NN} = -100V	
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		

* See Test Circuits on page 5

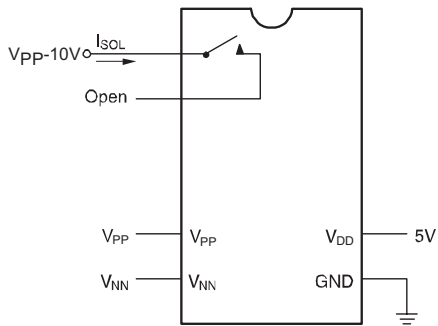
AC Electrical Characteristics

(over recommended operating conditions, $V_{DD} = 5.0V$, $t_R = t_F \leq 5ns$, 50% duty cycle, $C_{LOAD} = 20pF$ unless otherwise noted)

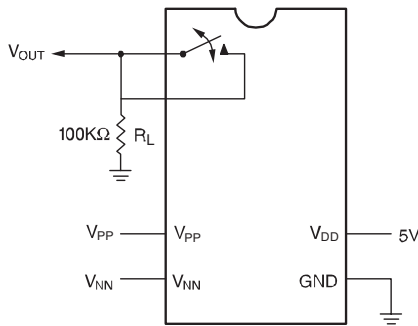
Sym	Parameter	0°C		+25°C			+70°C		Units	Conditions	
		Min	Max	Min	Typ	Max	Min	Max			
t_{SD}	Set Up Time Before LE Rises	25		25			25		ns		
t_{WLE}	Time Width of LE	56			56		56		ns	$V_{DD} = 3.0V$	
		12			12		12			$V_{DD} = 5.0V$	
t_{DO}	Clock Delay Time to Data out	50	100	50	78	100	50	100	ns	$V_{DD} = 3.0V$	
		15	40	15	30	40	15	40		$V_{DD} = 5.0V$	
t_{WCL}	Time Width of CL	55		55			55		ns		
t_{SU}	Set Up Time Data to Clock	21			21		21		ns	$V_{DD} = 3.0V$	
		7			7		7			$V_{DD} = 5.0V$	
t_H	Hold Time Data from Clock	2		2			2		ns	$V_{DD} = 3.0$ or $5.0V$	
f_{CLK}	Clock Frequency		8			8		8	MHz	$V_{DD} = 3.0V$	
			20			20		20		$V_{DD} = 5.0V$	
t_R, t_F	Clock rise and fall Times		50			50		50	ns		
T_{ON}	Turn on Time*		5.0			5.0		5.0	μs	$V_{SIG} = V_{PP} - 10V, R_{LOAD} = 10K\Omega$	
T_{OFF}	Turn off Time*		5.0			5.0		5.0	μs	$V_{SIG} = V_{PP} - 10V, R_{LOAD} = 10K\Omega$	
dv/dt	Maximum V_{SIG} Slew Rate		20			20		20		$V_{PP} = +40V, V_{NN} = -160V$	
			20			20		20		$V_{PP} = +100V, V_{NN} = -100V$	
			20			20		20		$V_{PP} = +160V, V_{NN} = -40V$	
K_O	Off Isolation*	-30		-30	-33		-30		dB	$f = 5.0MHz, 1K\Omega//15pF$ load	
		-58		-58			-58			$f = 5.0MHz, 50\Omega$ load	
K_{CR}	Switch Crosstalk*	-60		-60	-70		-60		dB	$f = 5.0MHz, 50\Omega$ load	
I_{ID}	Output Switch Isolation Diode Current		300			300		300	mA	300ns pulse width, 2.0% duty cycle	
$C_{SG(OFF)}$	Off Capacitance SW to GND	5.0	17	5.0	12	17	5.0	17	pF	0V, $f = 1.0MHz$	
$C_{SG(ON)}$	On Capacitance SW to GND	25	50	25	38	50	25	50	pF	0V, $f = 1.0MHz$	
$+V_{SPK}$	Output Voltage Spike*					150			mV	$V_{PP} = +40V, V_{NN} = -160V, R_{LOAD} = 50ohm$	
$-V_{SPK}$						150				$V_{PP} = +100V, V_{NN} = -100V, R_{LOAD} = 50ohm$	
$+V_{SPK}$						150				$V_{PP} = +160V, V_{NN} = -40V, R_{LOAD} = 50ohm$	
$-V_{SPK}$						150					
$+V_{SPK}$						820					$V_{PP} = +40V, V_{NN} = -160V, V_{SIG} = 0V$
$-V_{SPK}$						600					$V_{PP} = +100V, V_{NN} = -100V, V_{SIG} = 0V$
QC	Charge Injection*								pC	$V_{PP} = +160V, V_{NN} = -40V, V_{SIG} = 0V$	
										$V_{PP} = +100V, V_{NN} = -100V, V_{SIG} = 0V$	
										$V_{PP} = +160V, V_{NN} = -40V, V_{SIG} = 0V$	

* See Test Circuits on page 5

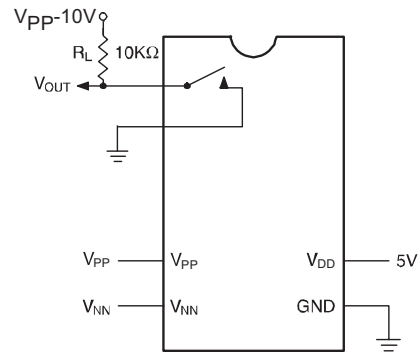
Test Circuits



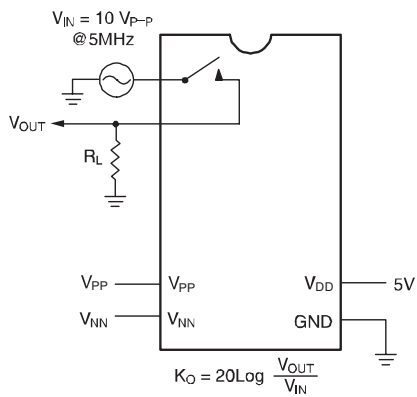
Switch Off Leakage per Switch



DC Offset Switch ON/OFF

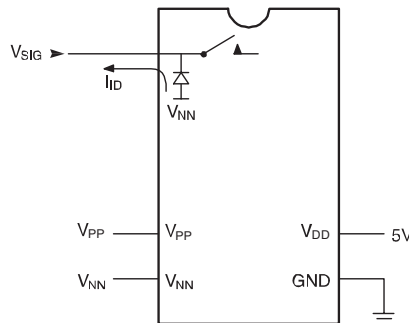


TURN (TON/TOFF) ON/OFF TIME

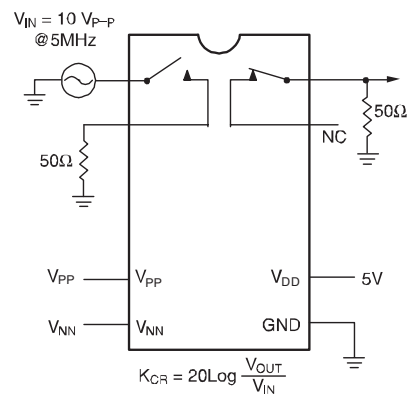


$$K_O = 20 \text{Log} \frac{V_{OUT}}{V_{IN}}$$

OFF Isolation

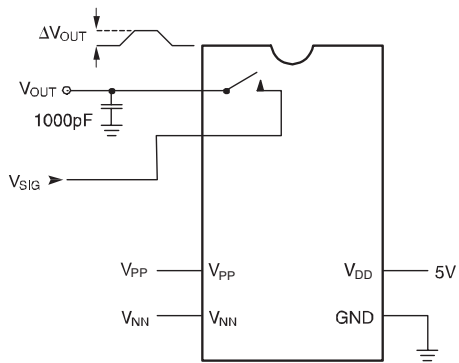


Output Switch Isolation Diode Current

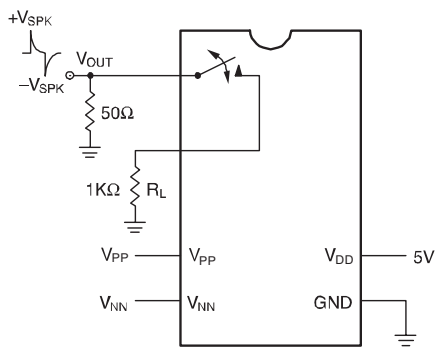


$$K_{CR} = 20 \text{Log} \frac{V_{OUT}}{V_{IN}}$$

Switch Crosstalk



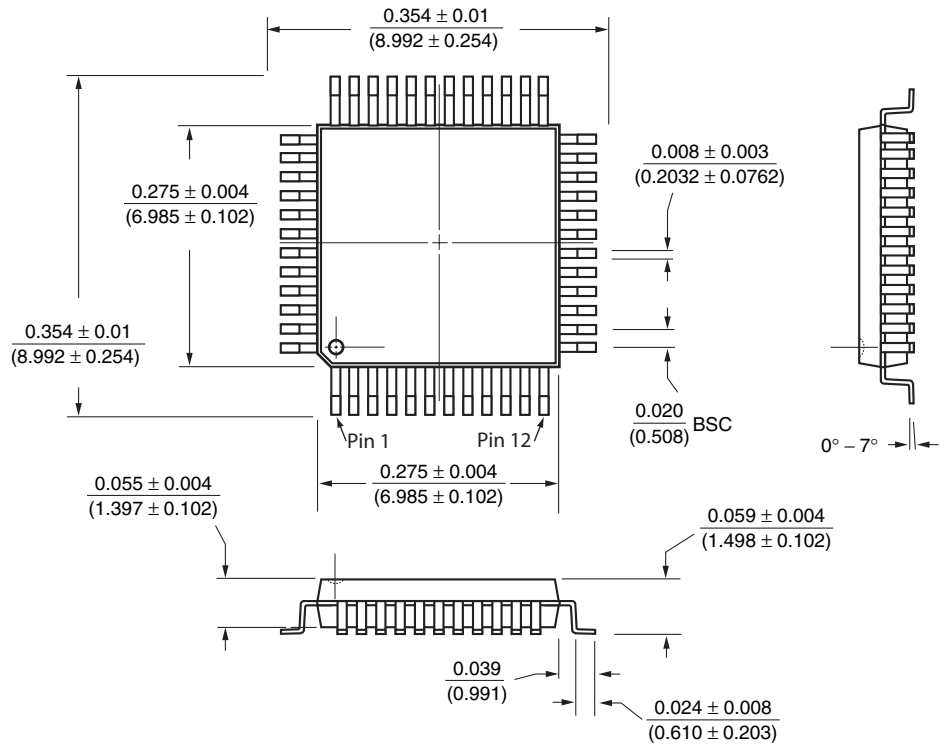
Charge Injection



Output Voltage Spike

Pin Configuration and Package Outline - 48-Lead TQFP (1.4mm) (FG)

Pin Name	TQFP-48
SW4B	3
SW4A	4
SW3B	5
SW3A	6
SW2B	7
SW2A	8
SW1B	9
SW1A	10
SW0B	11
SW0A	12
V _{NN}	13
V _{PP}	15
GND	17
V _{DD}	18
D _{IN}	19
CLK	20
LE	21
CLR	22
D _{OUT}	23
NC	24
SW15B	25
SW15A	26
SW14B	27
SW14A	28
SW13B	29
SW13A	30
SW12B	31
SW12A	32
SW11B	33
SW11A	34
SW10B	37
SW10A	38
SW9B	39
SW9A	40
SW8B	41
SW8A	42
SW7B	43
SW7A	44
SW6B	45
SW6A	46
SW5B	47
SW5A	48
NC	1,2,14,16, 35,36



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

NC = No Internal Connection.

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