LM96530 PRODUCT BRIEF

PRELIMINARY
September 3, 2010

Ultrasound Transmit/Receive Switch

General Description

The LM96530 is an eight-channel monolithic high-voltage, high-speed T/R (Transmit/Receive) switch for multi-channel medical ultrasound applications. It is well-suited for use with National's LM965XX series chipset which offers a complete medical ultrasound solution targeted towards low-power, portable systems.

The LM96530 contains eight high-voltage T/R switches with integrated clamping diodes. This chip protects the inputs of the receive channel's LNA (Low Noise Amplifier) from the high-voltage pulses of the transmit channel. Advanced features include a diode bridge with internal current sources that are programmable via an external resistor. Low-power operation is enabled via per-channel-selectable switching.

National Semiconductor also offers a development package for sale which includes a driver hardware and software package with a graphical user interface for configuration and monitoring.

Applications

- Ultrasound Imaging

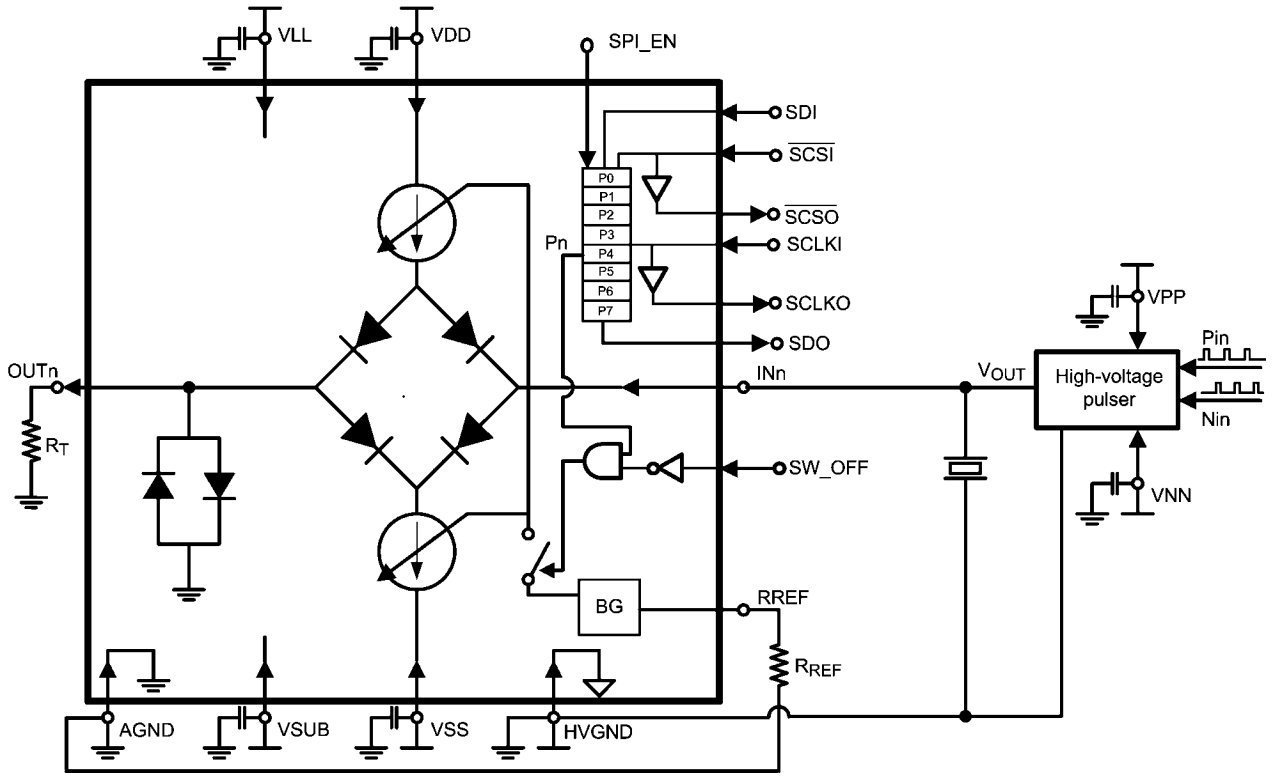
Features

- 8-channel high-voltage receive side switches without charge-injection
- Can be used for receive protection and/or receive multiplexing with SPI™ compatible bus control
- Channel bandwidth supports 1MHz to 15MHz transducers
- Input accepts pulses and continuous-wave signals within ±60V
- Integrated output clamping diodes limit output to ±0.7V
- Low harmonic distortion HD2 at -75dBc at 5MHz
- Continuous-wave operation
- Up to 15MHz carrier frequency operation
- Soft-switcher based on a diode bridge architecture yielding better noise performance and faster turn-on and -off times than competing T-gate switch architectures
- 2.5V to 3.3V CMOS SPI™ compatible logic interface with daisy chain capability
- Bias current source (I_S) can be scaled between 0 and 8mA via an external resistor

Key Specifications

Input voltage	±60	V
Output voltage clamp (I_S= 1mA)	±0.6	V
On-resistance	16	Ω
Off-isolation @ 5MHz	-58	dB
Noise spectral density @ 5MHz	0.5	nV/√Hz
Harmonic distortion		
HD2	-75	dB
HD3	-78	dB
Channel crosstalk @ 5MHz	-73	dB
Operating Temp.	0 to +70	°C

Block Diagram



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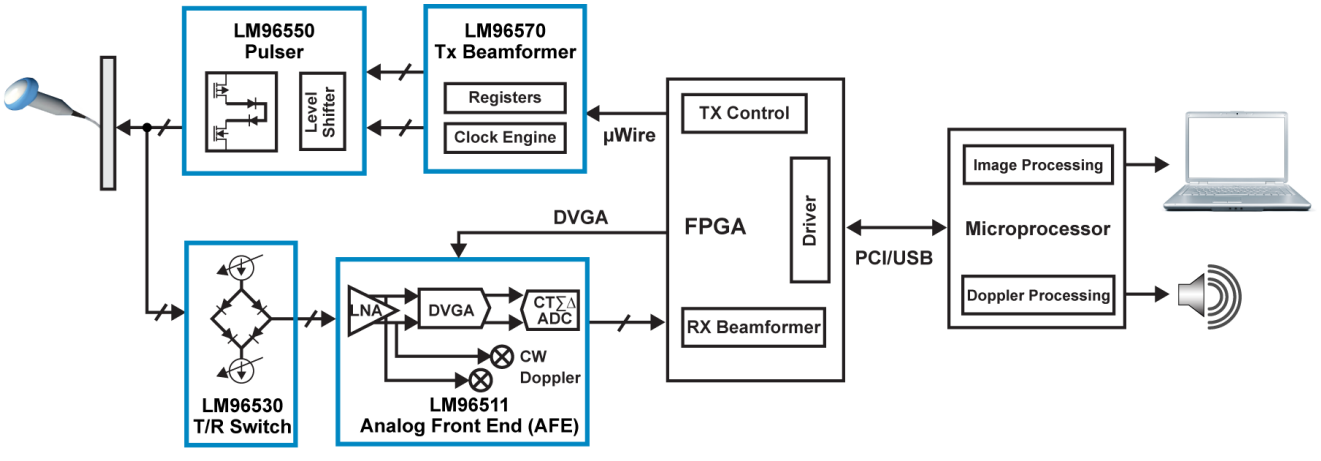
Typical Application

8-Channel Transmit/Receive Chipset



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Pin Diagram

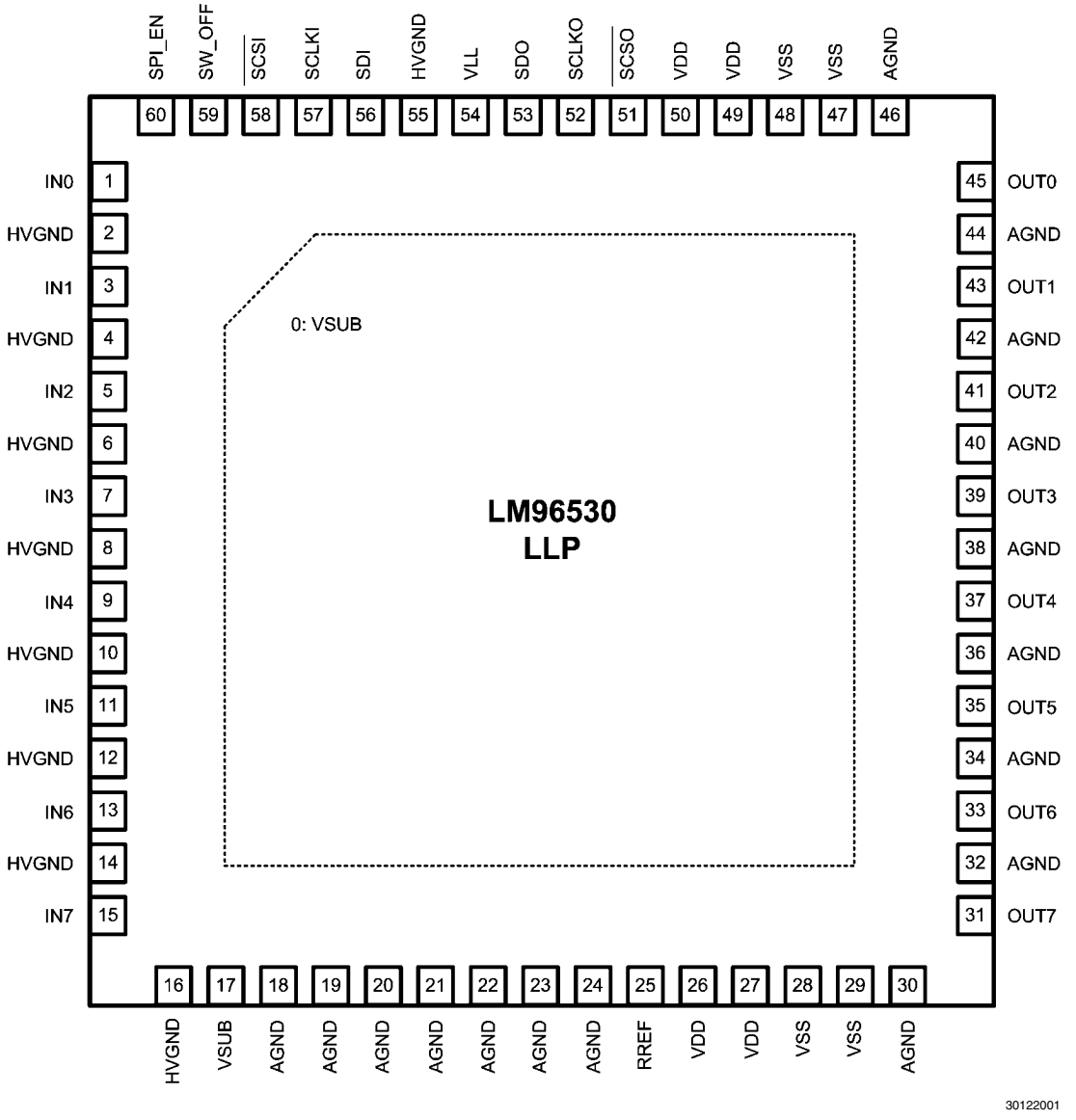

FIGURE 1. Pin Diagram of LM96530

TABLE 1. Pin Descriptions

Pin No.	Name	Type	Function and Connection
1, 3, 5, 7, 9, 11, 13, 15	INn n=0,...,7	Input	High-voltage input
45, 43, 41, 39, 37, 35, 33, 31	OUTn n=0,...	Output	Low-voltage output
25	RREF	Output	External resistor to AGND. Used to set internal current sources. R_{REF} = 6.25 kΩ → I_S = 8mA; R_{REF} = 12.5 kΩ → I_S = 4mA; R_{REF} = 25 kΩ → I_S = 2mA; R_{REF} = 50 kΩ → I_S = 1mA
59	SW_OFF	Input	1 = Switch all channels OFF 0 = Use SPI™ to control switch
60	SPI_EN	Input	1 = Enable the SPI™ Interface 0 = Disable the SP™I Interface and presets SPI™ registers for all switches ON.
58	$\overline{SCSI}$	Input	SPI™ chip select input, 0 = Chip Select
57	SCKI	Input	SPI™ compatible clock input
56	SDI	Input	SPI™ compatible data input
53	SDO	Output	SPI™ compatible data buffered output
52	SCKO	Output	SPI™ compatible clock buffered output
51	$\overline{SCSO}$	Output	SPI™ chip select buffered output
26, 27, 49, 50	VDD	Power	Positive analog supply voltage (+5V)
28, 29, 47, 48	VSS	Power	Negative analog supply voltage (-5V)
54	VLL	Power	Logic voltage supply (+2.5 to 3.3V)
0, 17	VSUB	Power	Negative high voltage supply (-65V)
2, 4, 6, 8, 10, 12, 14, 16, 55	HVGND	Ground	High voltage reference potential (0V)
All others	AGND	Ground	Analog and logic low voltage reference input, logic ground (0V)

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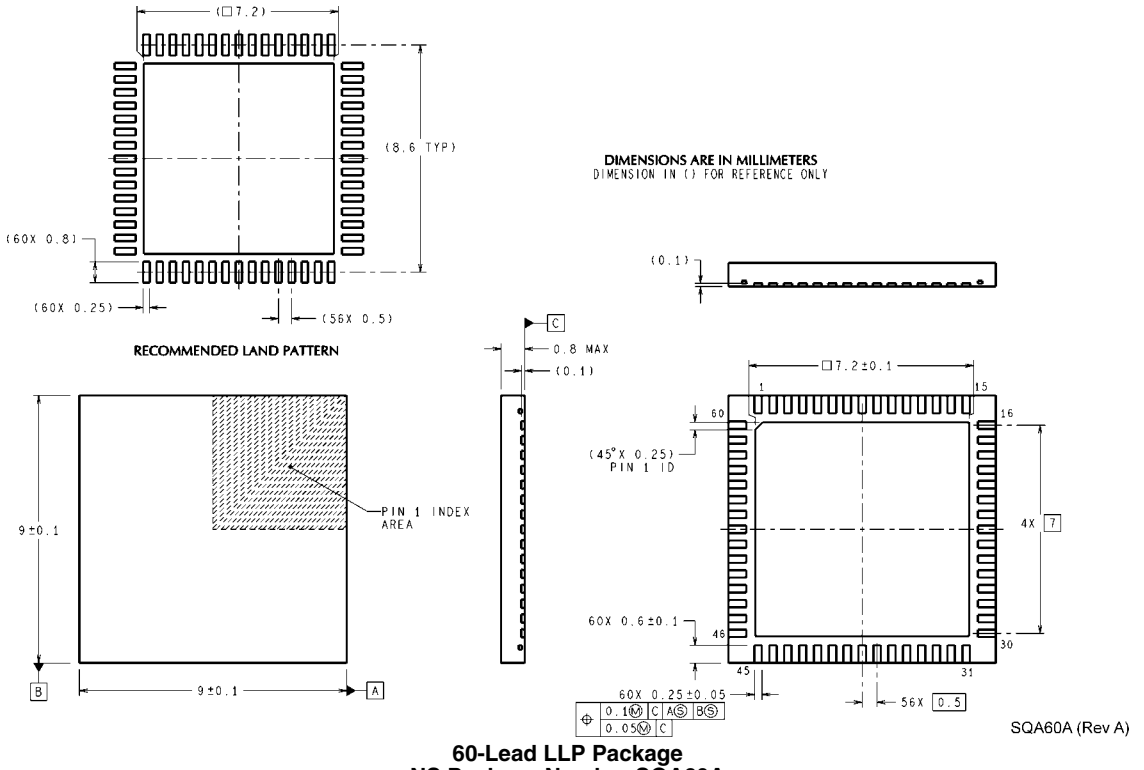
Physical Dimensions inches (millimeters) unless otherwise noted



60-Lead LLP Package
NS Package Number SQA60A

Notes

For more National Semiconductor product information and proven design tools, visit the following Web sites at: www.national.com

Products		Design Support	
Amplifiers	www.national.com/amplifiers	WEBENCH® Tools	www.national.com/webench
Audio	www.national.com/audio	App Notes	www.national.com/appnotes
Clock and Timing	www.national.com/timing	Reference Designs	www.national.com/refdesigns
Data Converters	www.national.com/adc	Samples	www.national.com/samples
Interface	www.national.com/interface	Eval Boards	www.national.com/evalboards
LVDS	www.national.com/lvds	Packaging	www.national.com/packaging
Power Management	www.national.com/power	Green Compliance	www.national.com/quality/green
Switching Regulators	www.national.com/switchers	Distributors	www.national.com/contacts
LDOs	www.national.com/ldo	Quality and Reliability	www.national.com/quality
LED Lighting	www.national.com/led	Feedback/Support	www.national.com/feedback
Voltage References	www.national.com/vref	Design Made Easy	www.national.com/easy
PowerWise® Solutions	www.national.com/powerwise	Applications & Markets	www.national.com/solutions
Serial Digital Interface (SDI)	www.national.com/sdi	Mil/Aero	www.national.com/milaero
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