National Semiconductor

# 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

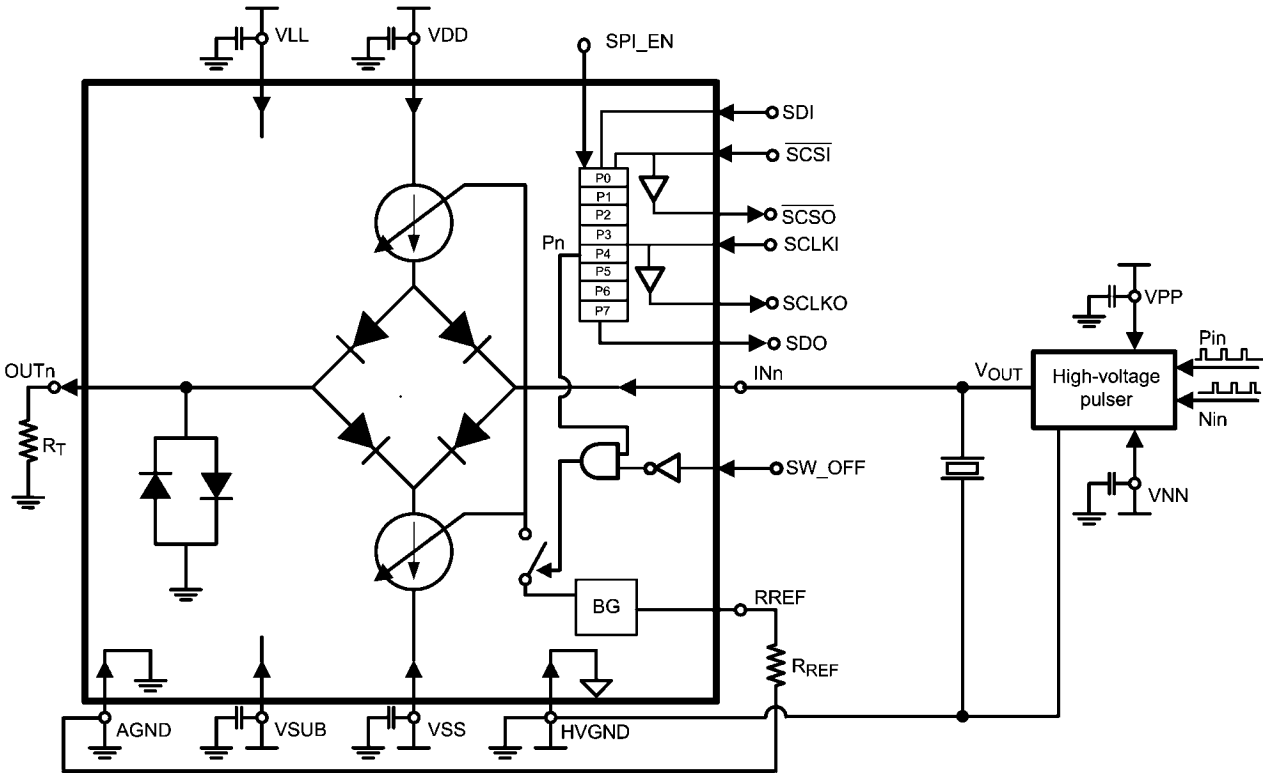
- 8-channel high-voltage receive side switches without charge-injection
- Can be used for receive protection and/or receive multiplexing with SPI™ compatible bus control
- Channel bandwidth supports 1MHz to 15MHz transducers
- Input accepts pulses and continuous-wave signals within ±60V
- Integrated 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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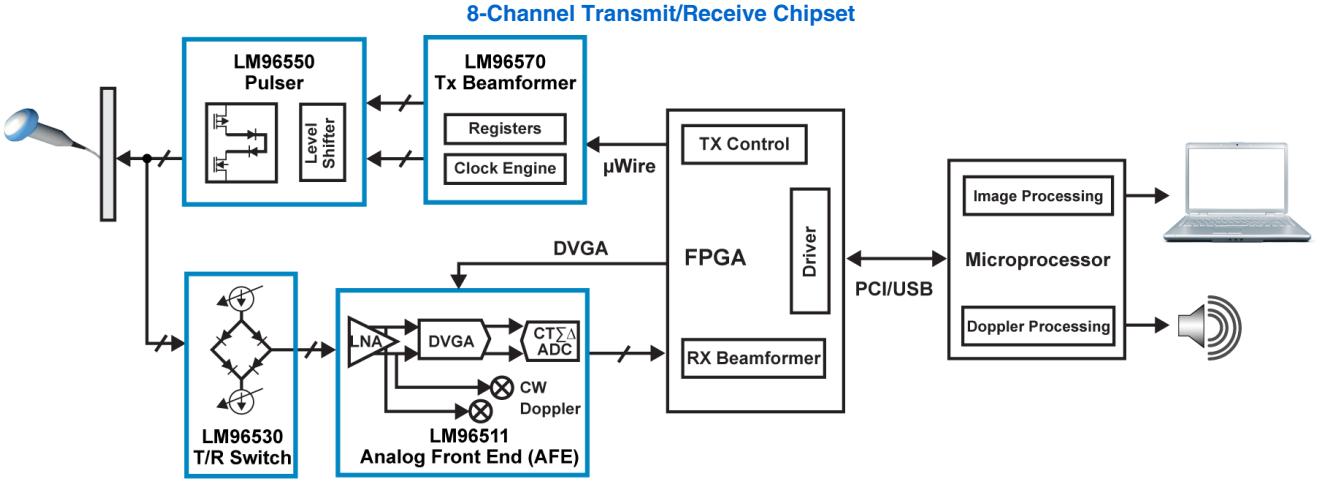
## Typical Application

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## Pin Diagram

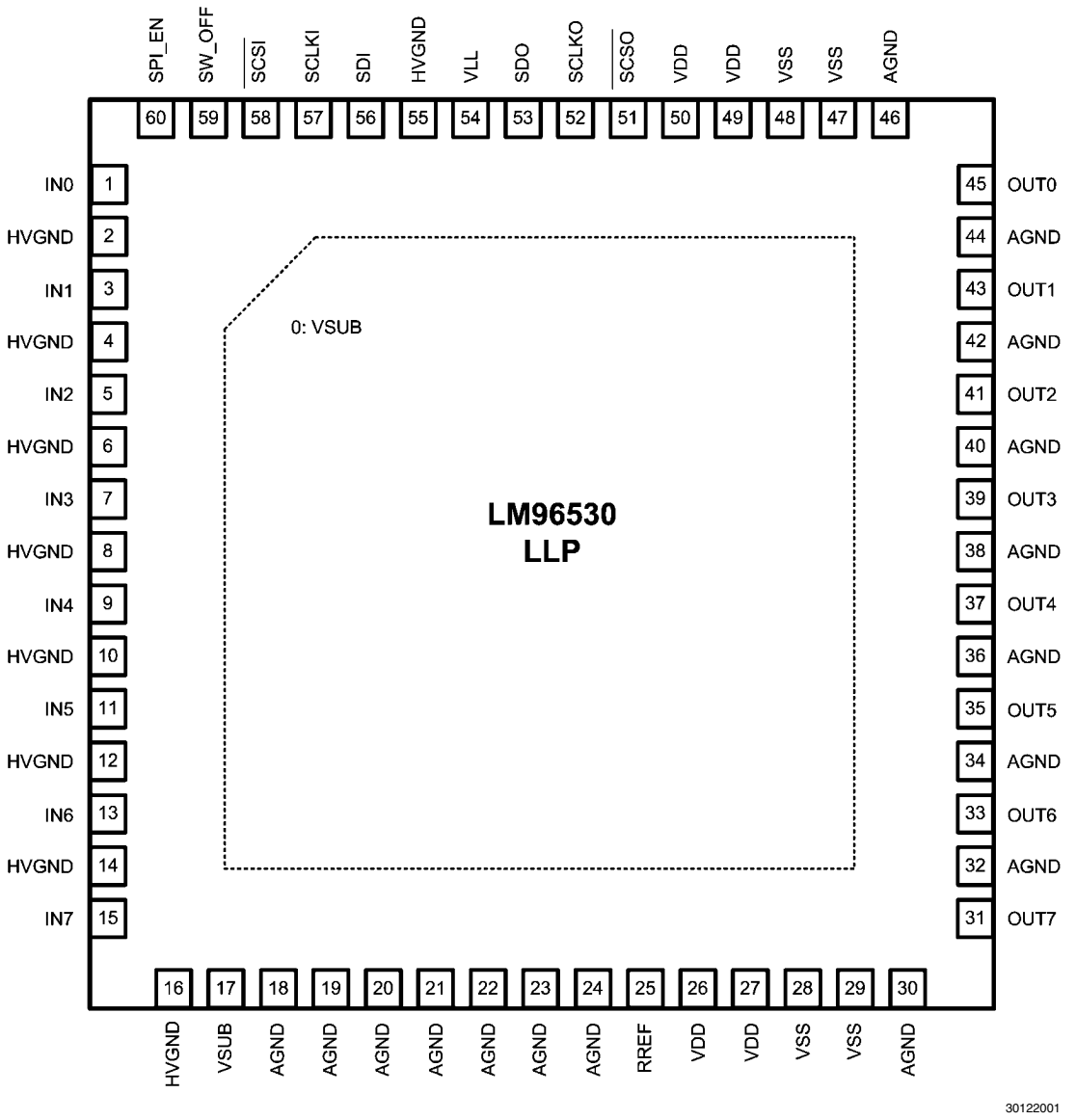


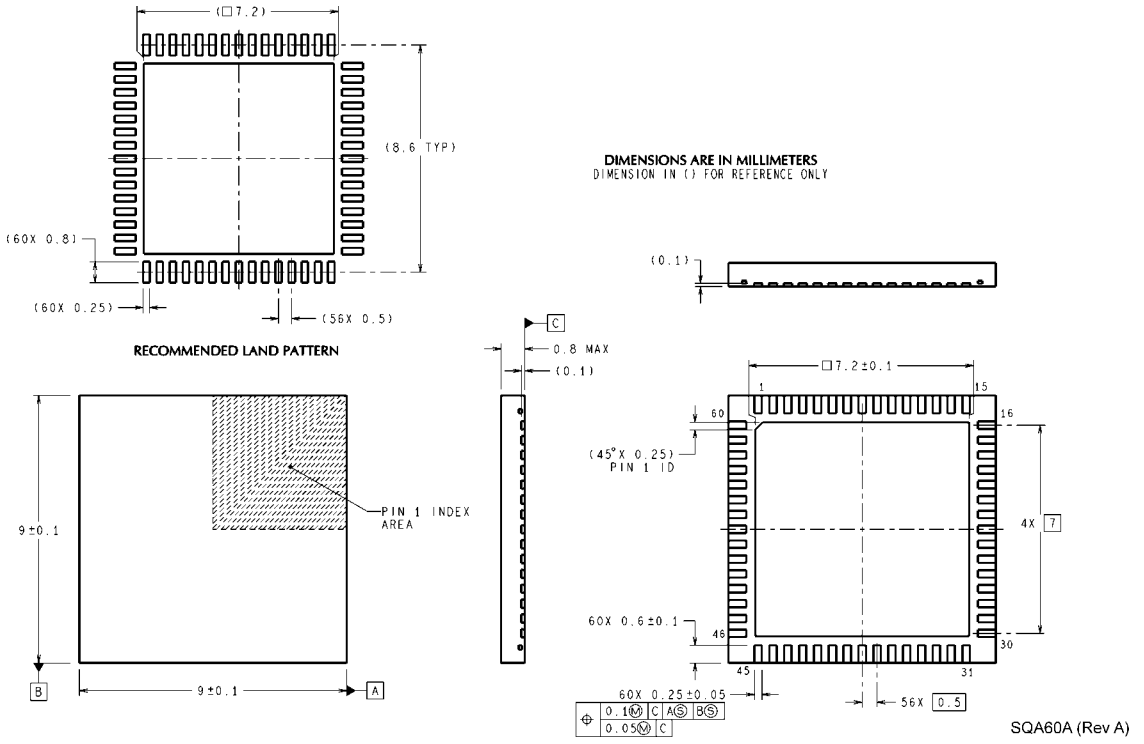

**FIGURE 1. Pin Diagram of LM96530**

## TABLE 1. Pin Descriptions

| Pin No. | Name | Type | Function and Connection |
|---|---|---|---|
| 1, 3, 5, 7, 9, 11, 13, 15 | INn<br>n=0,...,7 | Input | High-voltage input |
| 45, 43, 41, 39, 37, 35, 33, 31 | OUTn<br>n=0,... | Output | Low-voltage output |
| 25 | RREF | Output | External resistor to AGND. Used to set internal current sources.<br>$R_{REF}$ = 6.25 kΩ → $I_S$ = 8mA;<br>$R_{REF}$ = 12.5 kΩ → $I_S$ = 4mA;<br>$R_{REF}$ = 25 kΩ → $I_S$ = 2mA;<br>$R_{REF}$ = 50 kΩ → $I_S$ = 1mA |
| 59 | SW_OFF | Input | 1 = Switch all channels OFF<br>0 = Use SPI™ to control switch |
| 60 | SPI_EN | Input | 1 = Enable the SPI™ Interface<br>0 = Disable the SP™I Interface and presets SPI™ registers for all switches ON. |
| 58 | $\overline{SCSI}$ | Input | SPI™ chip select input,<br>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) |

SPI™ is a trademark of Motorola, Inc.

## Physical Dimensions inches (millimeters) unless otherwise noted




**60-Lead LLP Package**
**NS Package Number SQA60A**

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