

## Ultrasound Configurable Transmit Beamformer

### General Description

The LM96570 is an eight-channel monolithic beamformer for pulse generators in 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 LM96570 offers eight P and N output channels with individual delays of up to 102.4  $\mu$ s operating at pulse rates of up to 80 MHz. A pulse sequence is launched on all channels simultaneously through a single firing signal. Advanced features include delay resolution down to 1/1280  $\mu$ s and programmable patterns of up to 64 pulses. Pulse patterns and delay settings are pre-programmed through a serial interface, thereby simplifying the timing requirements on the driving circuitry.

The LM96570 is packaged in a 32-pin LLP.

### Applications

- Ultrasound Imaging

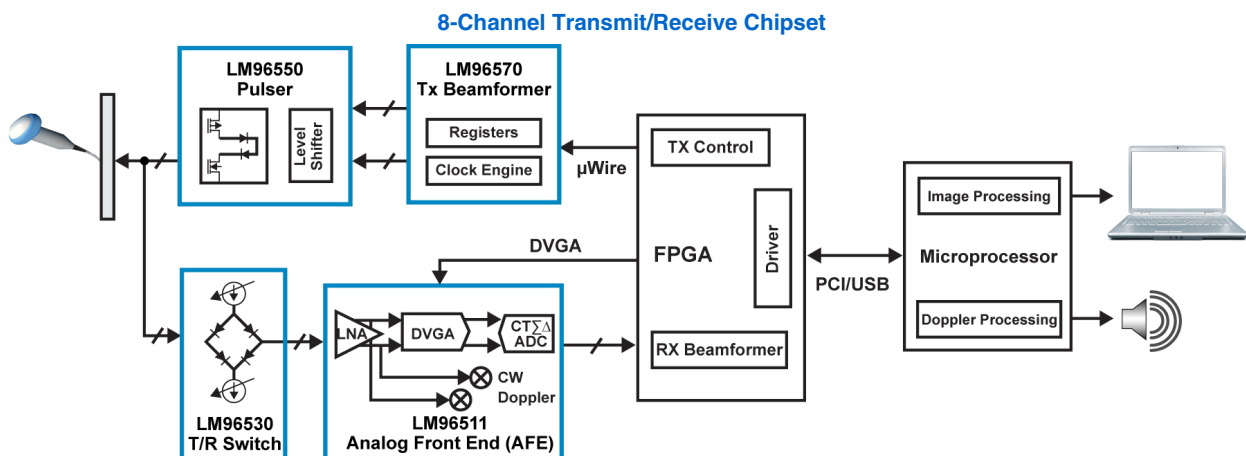
### Features

- Full control over selecting beam directions and pulse patterns by programming individual channel parameters
- Outputs interface seamlessly with positive and negative inputs on octal high-voltage pulser ICs
- Beamformer timing provides:
  - Delay resolution of 1/1280  $\mu$ s
  - Delay range of up to 100  $\mu$ s
- Pulse patterns are locally generated with:
  - Sequences of up to 64 pulses
  - Pulse width modulation at 80 MHz
- 2.5V to 3.3V CMOS logic interface

### Key Specifications

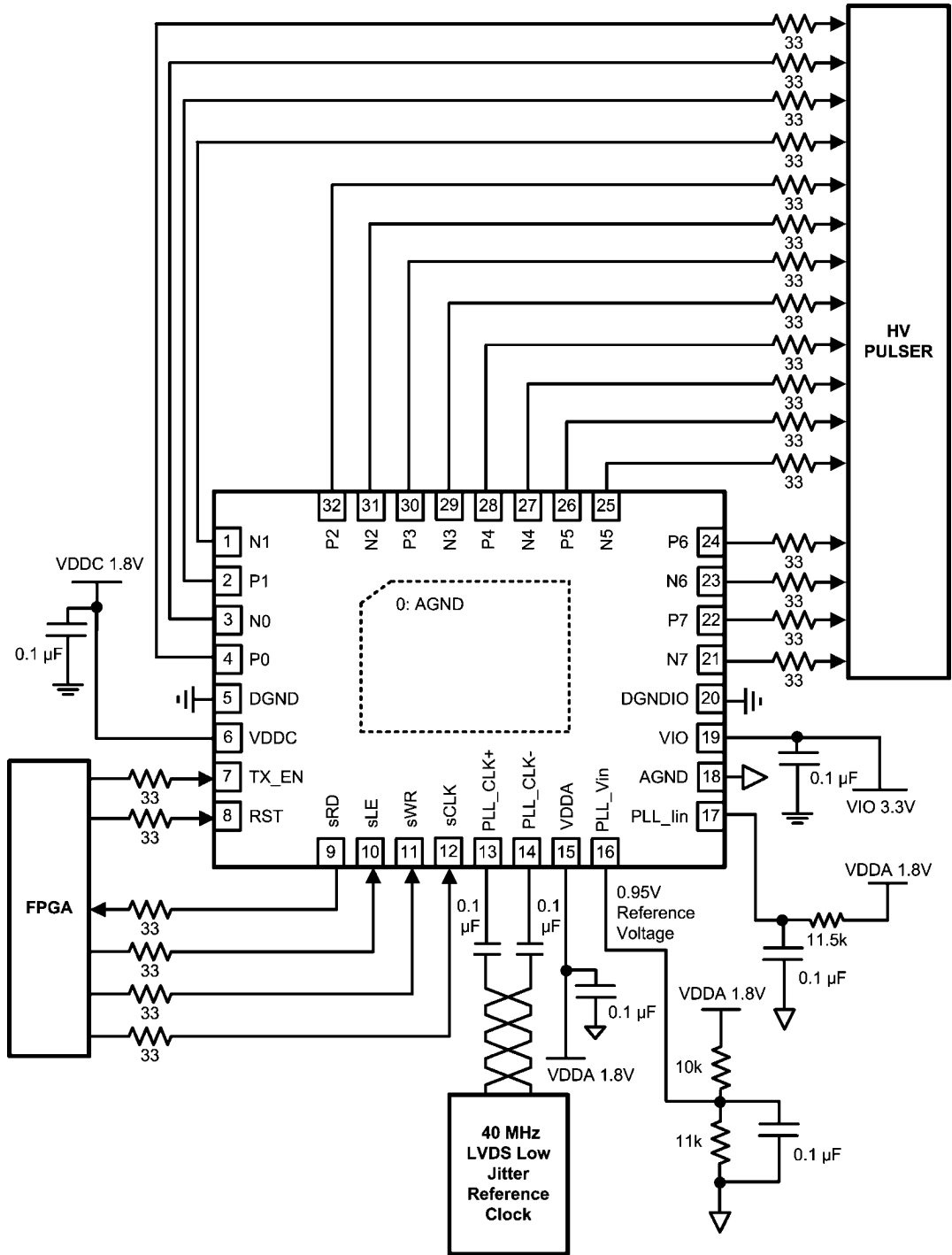
I/O voltage	2.5 to 3.3	V
Core supply voltage	1.8	V
Output pulse rate	80	MHz
Reference frequency	40 ( $\pm$ 5%)	MHz
1 $\sigma$ Output Jitter (@ 5MHz)	25	ps
Output Phase Noise (@ 5MHz, 1kHz offset)	-116	dBc/Hz
Delay resolution	1/1280	$\mu$ s
Delay range	102.4	$\mu$ s
Max. pattern length	64	pulses
Serial interface speed	2	Mbps
Total Power	0.063	Watts
Operating Temp.	0 to +70	$^{\circ}$ C

### Typical Application



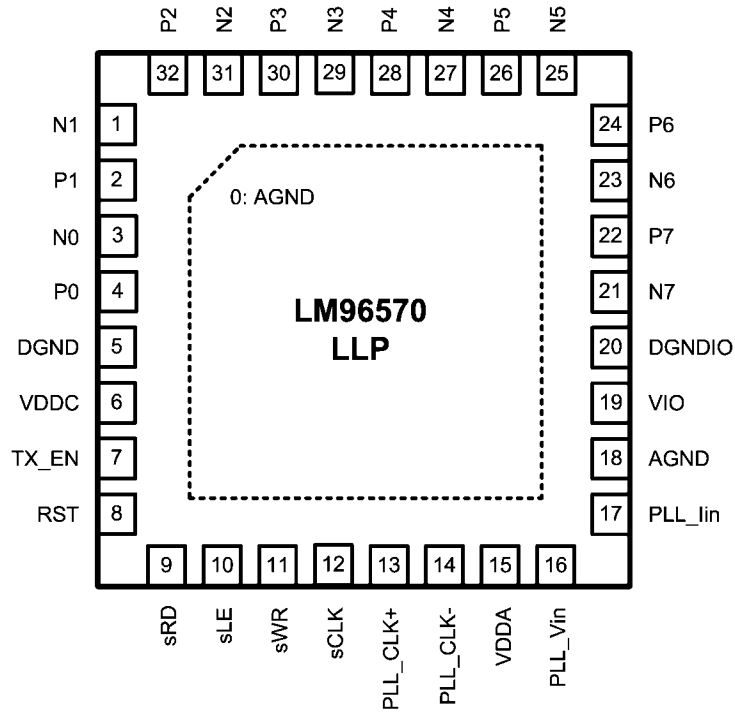
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# Block Diagram



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# Connection Diagram



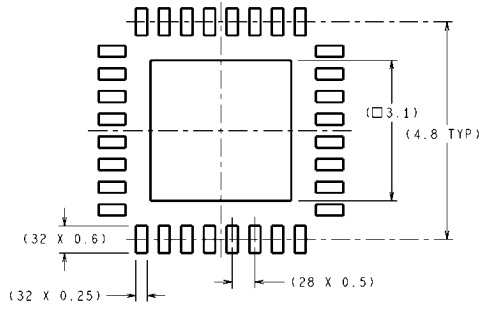
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FIGURE 1. Pin Diagram of LM96570

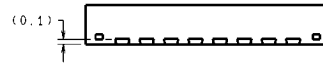
## Pin Descriptions

Pin No.	Name	Type	Function and Connection
1 – 4, 21 – 32	P0-7, N0-7	Output	Control signals for pulser. P outputs control positive pulses and N outputs control negative pulses.
13	PLL_CLK+	Input	PLL Reference Clock PLUS Input, LVDS compatible or Single-Ended LV CMOS input, programmable through 4-Wire Serial Interface (Register 0x1Bh[0])
14	PLL_CLK-	Input	PLL Reference Clock MINUS input, LVDS compatible. For Single-Ended PLL Reference Clock operation, tie this pin to AGND or VDDA.
7	TX_EN	Input	1 = Beamformer starts firing 0 = Beamformer ceases firing
16	PLL_Vin	Input	Voltage range 0.8-1.2V for tuning internal PLL noise performance. Under normal conditions, 0.94V is recommended.
17	PLL_Iin	Input	100 $\mu$ A current input
8	RST	Input	Asynchronous Chip Reset 1 = Reset 0 = No Reset
12	sCLK	Input	4-Wire Serial Interface Clock
10	sLE	Input	4-Wire Serial Interface Latch Enable
11	sWR	Input	4-Wire Serial Interface Data Input for writing data registers
9	sRD	Output	4-Wire Serial Interface Data Output for reading data registers
15	VDDA	Power	Analog supply voltage (1.8V)
6	VDDC	Power	Digital core supply voltage (1.8V)
19	VIO	Power	Digital I/O supply voltage (2.5 to 3.3V)
0, 18	AGND	Ground	PLL Analog ground
5	DGND	Ground	Digital core ground
20	DGNDIO	Ground	Digital I/O ground

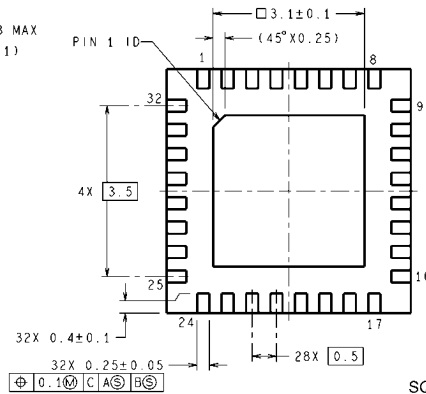
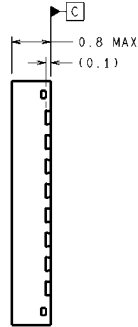
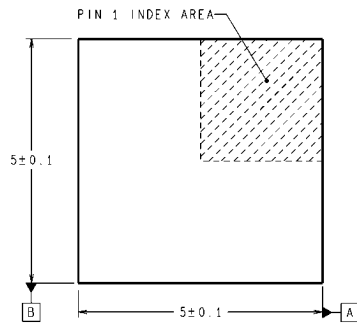
**Physical Dimensions** inches (millimeters) unless otherwise noted



**DIMENSIONS ARE IN MILLIMETERS**  
DIMENSIONS IN ( ) FOR REFERENCE ONLY



**RECOMMENDED LAND PATTERN**



SQA32A (Rev B)

**32-Lead LLP Package**  
**NS Package Number SQA32A**

## Notes

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Data Converters	<a href="http://www.national.com/adc">www.national.com/adc</a>	Samples	<a href="http://www.national.com/samples">www.national.com/samples</a>
Interface	<a href="http://www.national.com/interface">www.national.com/interface</a>	Eval Boards	<a href="http://www.national.com/evalboards">www.national.com/evalboards</a>
LVDS	<a href="http://www.national.com/lvds">www.national.com/lvds</a>	Packaging	<a href="http://www.national.com/packaging">www.national.com/packaging</a>
Power Management	<a href="http://www.national.com/power">www.national.com/power</a>	Green Compliance	<a href="http://www.national.com/quality/green">www.national.com/quality/green</a>
Switching Regulators	<a href="http://www.national.com/switchers">www.national.com/switchers</a>	Distributors	<a href="http://www.national.com/contacts">www.national.com/contacts</a>
LDOs	<a href="http://www.national.com/ldo">www.national.com/ldo</a>	Quality and Reliability	<a href="http://www.national.com/quality">www.national.com/quality</a>
LED Lighting	<a href="http://www.national.com/led">www.national.com/led</a>	Feedback/Support	<a href="http://www.national.com/feedback">www.national.com/feedback</a>
Voltage References	<a href="http://www.national.com/vref">www.national.com/vref</a>	Design Made Easy	<a href="http://www.national.com/easy">www.national.com/easy</a>
PowerWise® Solutions	<a href="http://www.national.com/powerwise">www.national.com/powerwise</a>	Applications & Markets	<a href="http://www.national.com/solutions">www.national.com/solutions</a>
Serial Digital Interface (SDI)	<a href="http://www.national.com/sdi">www.national.com/sdi</a>	Mil/Aero	<a href="http://www.national.com/milaero">www.national.com/milaero</a>
Temperature Sensors	<a href="http://www.national.com/tempensors">www.national.com/tempensors</a>	SolarMagic™	<a href="http://www.national.com/solarmagic">www.national.com/solarmagic</a>
PLL/VCO	<a href="http://www.national.com/wireless">www.national.com/wireless</a>	PowerWise® Design University	<a href="http://www.national.com/training">www.national.com/training</a>

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