The PicoDigitizer 250-Series is a wideband IQ processor solution which combines the power of a large FPGA with high sampling speeds, while accelerating the development cycle by eliminating the need for hand-coding.

At the core is a Virtex-6 FPGA, which interfaces with a dual channel 250 MSPS A/D and dual channel 1 GSPS D/A. A model-based development environment allows for rapid deployment and testing of algorithms without hand-coding of the FPGA.

To maximize the power and flexibility of this small table top solution, the PicoDigitizer 250-Series is available in a dual channel, dual channel embedded, or quad channel configuration.

**Key Features**

- Choose either one or two high speed dual channel processor nodes, each capable of processing up to 250 MHz of baseband signal
- 2 x 250 MSPS 14-bit A/D per dual channel processor node
- 2 x 1 GSPS 16-bit D/A per dual channel processor node
- One large Virtex-6 FPGA per dual channel processor node
- Optional Intel Quad-Core i7 (Available in the 1 x dual channel embedded configuration)

- 14 x high speed LVDS user I/Os per dual channel processor node
- One trigger input per dual channel processor node for event-based recording/playback
- One PPS input per node for a GPS-disciplined sampling clock
- GigE and PCIe 4x high speed interfaces
## Configurations

<table>
<thead>
<tr>
<th></th>
<th>PicoDigitizer 250-Series 1 x Dual Channel Processor Node</th>
<th>PicoDigitizer 250-Series 1 x Dual Channel Processor Node (Embedded)</th>
<th>PicoDigitizer 250-Series 2 x Dual Channel Processor Node</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>250 MHz Dual Channel Processor Nodes</strong></td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td><strong>A/D Converters</strong></td>
<td>2</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td><strong>Maximum Input Sampling Frequency</strong></td>
<td>250 MSPS</td>
<td>250 MSPS</td>
<td>250 MSPS</td>
</tr>
<tr>
<td><strong>Input Resolution</strong></td>
<td>14 bits</td>
<td>14 bits</td>
<td>14 bits</td>
</tr>
<tr>
<td><strong>D/A Converters</strong></td>
<td>2</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td><strong>Maximum Output Sampling Frequency</strong></td>
<td>1 GSPS</td>
<td>1 GSPS</td>
<td>1 GSPS</td>
</tr>
<tr>
<td><strong>Output Resolution</strong></td>
<td>16 bits</td>
<td>16 bits</td>
<td>16 bits</td>
</tr>
<tr>
<td><strong>FPGA</strong></td>
<td>1 x Virtex-6</td>
<td>1 x Virtex-6</td>
<td>2 x Virtex-6</td>
</tr>
<tr>
<td><strong>Remote Host Interface</strong></td>
<td>1x GigE, 1x PCIe-4x (between embedded Intel Quad-Core i7 and Virtex-6)</td>
<td>1x GigE, 2x PCIe 4x (between embedded Intel Quad-Core i7 and Virtex-6)</td>
<td>1x GigE, 1x PCIe-4x (between embedded Intel Quad-Core i7 and Virtex-6)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Or Single PCIe 4x (between embedded Intel Quad-Core i7 and Virtex-6)</td>
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<tr>
<td></td>
<td></td>
<td>+ Single PCIe 4x external</td>
<td></td>
</tr>
<tr>
<td><strong>Embedded CPU</strong></td>
<td>None</td>
<td>Intel Quad-Core i7-2715QE</td>
<td>None</td>
</tr>
<tr>
<td><strong>Embedded Storage</strong></td>
<td>N.A.</td>
<td>64 GB SSD +1x SATA external +1x 200 GB SATA internal (optional)</td>
<td>N.A.</td>
</tr>
</tbody>
</table>

* Virtex-6 options available: LX240T, LX550T, SX315T or SX475T

** 1x eSATA connection Rear PicoDigitizer panel, 1x SATA for internal 1.8" SSD Drive.
Sample Block Diagram
PicoDigitizer 250-Series: 1 x Dual Channel Processor Node, Embedded Version
Model-Based Design Flow
Rapid System Level FPGA Development in MATLAB and Xilinx System Generator for DSP

Built on top of Nutaq’s board software development kit (BSDK), Nutaq’s model-based design kit (MBDK) enables rapid design, simulation, testing, and deployment of applications from the Simulink graphical environment without requiring hand-coding in either VHDL or C.

Some of the benefits presented by Nutaq’s model-based design approach include:

- A significant reduction in the time spent on low value-add tasks such as programming I/O interfaces, adjusting FPGA constraints, debugging drivers etc.
- Providing host co-simulation tools which enables:
  - I/O integration within simulations
  - Step-by-step FPGA fabric design migration
  - Easy FPGA-to-host interaction
  - Data logging
- Tools such as record/playback, host IO control and data streaming libraries.

FPGA Recording/Playback IP Core

The FPGA SDRAM recording/playback IP core enables storage and playback of very high speed multichannel bursts of data in the FPGA-attached SDRAM.

This data can then be transferred to a host device for storage and/or real-time analysis. It can also be loaded in memory for looped playback transmission over the high speed D/A converters.

The FPGA recording/playback IP core comes with standard trigger mechanisms (single shot, normal, and software defined). The trigger sources can either come from the host processor, a user-defined FPGA signal, or from the PicoDigitizer 250-Series trigger front panel input.

The user can define the number of channels to record/playback, as well as the acquisition rate, so that the available recording memory bandwidth is efficiently used. Note that FPGA pre/post-processing on the channels can be performed before recording or after playback, to potentially reduce recording/playback bandwidth needs.

- DDR3 FPGA memory size = 4 GB
- Maximum data throughput = 5.7 GBps
- Recorded/playback time at full rate = 720 msecs

Application Example:

FPGA-based filtering on 2 channels sampled at 250 MSPS on the FPGA (decimation by 16), then recording of both channels. Each channel can be recorded for 64 seconds.

RTDEEx (Real Time Data Exchange)

Nutaq’s RTDEEx IP core provides users with a framework to exchange data with a host device through either the GigE or PCIe links, yielding the highest bandwidth and lowest possible latency.

Built to complement our “snapshot” FPGA recording/playback capabilities, the RTDEEx IP core provides a continuous data flow from the acquisition/transmission to the host computer, for further real-time computing or real-time PC recording/playback.

<table>
<thead>
<tr>
<th>HOST - FPGA Streaming</th>
<th>GigE</th>
<th>PCIe 1x</th>
<th>PCIe 4x</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data BW</td>
<td>1 Gbps</td>
<td>2.5 Gbps</td>
<td>10 Gbps</td>
</tr>
<tr>
<td>Sustained Data Throughput</td>
<td>900 Mbps</td>
<td>1.5 Gbps</td>
<td>6 Gbps</td>
</tr>
</tbody>
</table>
## Specifications

### FPGA
- Supports LX240T, LX550T, SX315T and SX475T FPGA devices
- Supports GigE interface; Supports single PCIe (4x) non-embedded;
- Supports up to 2 PCIe (4x) embedded;
- 4 GB SODIMM DDR3
- 18 MB QDR2 SRAM
- 64 MB NOR Flash
- 128 MB DDR3 SRAM (Dedicated to Nutaq Central Communication Engine and Microblaze Embedded Linux OS)

### Embedded CPU Section
- Intel Quad-Core i7 Gen2 CPU, 2.1 GHz processor
- 8 GB DDR3 SDRAM
- 64 GB SSD + 1 x SATA external + 1 x 200 GB internal (optional)
- GigE & Dual PCIe 4x support
- SATA -II/III support
- Embedded throughput (FPGA-CPU) : 1x PCIe 4x - 6 Gbps

### A/D Sampler Coupling
- AC coupled
- Single-ended

### A/D Sampler Characteristics
- 14 bit
- 250 MSPS maximum
- 2 or 4 channels

### A/D Sampler Coupling
- AC coupled
- Single-ended

### A/D Sampler Characteristics
- 16 bit
- 1000 MSPS maximum
- 2 or 4 channels

### Sampling Clock
- Equipped with an onboard, low-jitter reference clock and synchronization PLL (AD9511)
- Input PPS signal for GPS-disciplined on-board reference clock
- Input External CLK or External Reference
- Output CLK or Reference

### A/D Performance
- Analog input bandwidth: 470 MHz (-3dB)
- SNR (dB): 70.5 (@ 30 MHz), 70 (@ 70 MHz), 65 (@ 150 MHz)
- SFDR (dBc): 75 (@ 30 MHz), 85 (@ 70 MHz), 74 (@ 150 MHz)
- THD (dBc): 74 (@ 30 MHz), 84 (@ 70 MHz), 74 (@ 150 MHz)

### A/D Performance
- Analog output bandwidth : 500 MHz (1 GSps DAC)
- Phase Noise (MHz; dBc/Hz): 125 (@ 30 MHz), 122 (@ 70 MHz), 121 (@ 150 MHz)
- 2nd harmonic (dBc): 63 (@ 30 MHz), 57 (@ 70 MHz), 54 (@ 150 MHz)
- 3rd harmonic (dBc): 69 (@ 30 MHz), 61 (@ 70 MHz), 52 (@ 150 MHz)
**Front Panel Connectors**

**Analog Inputs, CLK & Triggers**
*(All PicoDigitizer 250-Series Models)*

Each IQ Processor Node
- 2 x A/D MMCX inputs
- 2 x D/A MMCX outputs
- 1 x external trigger/PPS input
- 1 x external sampling or reference CLK input
- 1 x sampling or reference CLK output

**Digital Inputs & Outputs**
*(All PicoDigitizer 250-Series Models)*

Each IQ Processor Node
- 1x VHDCI connector

**VHDCI Connector Signal Map**
- 14 x user LVDS I/O data
- 1 x LVDS clock

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**Additional Front Panel Connectors**
*(PicoDigitizer 250-Series 1x Dual Channel Processor Node, Embedded Version Only)*

- 1 x HDMI
- 2 x GigE
- 1 x Mini USB port
- 1 x COM-port
- 1 x USB 2.0 ports

**Rear Panel Connectors**

- 2 x GigE ports
- 1 x USB UART FPGA console port
- 1 x external universal power supply
- 1 x SATA (Embedded models only)
- 1 x PCIe 4x cable interface connector

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**Ordering Information**

**PicoDigitizer250-A-B-C-D-E**

<table>
<thead>
<tr>
<th>A (Dual Channel Processors)</th>
<th>0 = No Embedded CPU, 1 x Virtex-6 Dual Channel Processor</th>
<th>1 = Embedded CPU, 1 x Virtex-6 Dual Channel Processor</th>
<th>2 = No Embedded CPU, 2 x Virtex-6 Dual Channel Processors</th>
</tr>
</thead>
<tbody>
<tr>
<td>B (FPGA Option)</td>
<td>0 = LX240T</td>
<td>1 = LX550T</td>
<td>2 = SX315T</td>
</tr>
<tr>
<td>C (Additional Embedded Storage)</td>
<td>0 = None</td>
<td>1 = 200 GB SSD (172 MBytes/s)</td>
<td></td>
</tr>
<tr>
<td>D (External PCIe)</td>
<td>0 = No external PCIe</td>
<td>1 = PCIe 4x external link to FPGA</td>
<td></td>
</tr>
<tr>
<td>E (Model-Based Design Software License)</td>
<td>0 = No external license</td>
<td>1 = 1x MBDK Workstation License)</td>
<td></td>
</tr>
</tbody>
</table>