

# UEIPAC Cubes and RACKs

Fifth Generation CPU with Quad-Core Zynq® UltraScale+™ SoC

Programmable Automation/Embedded Controllers



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BETA

- Powerful stand-alone embedded controller
- Flexible, compact and rugged
- Powerful Xilinx Zynq® UltraScale+™ SoC chip combines
  - Quad-core ARM Cortex-A53, 64-bit processor
  - User programmable Xilinx FPGA (two sizes available)
- 4 GByte, 64-bit DDR, 8 GByte FLASH
- Up to 10x CPU performance increase over previous UEIPACs and up to 100x real-time performance increase via FPGA
- Three GigE ports including IEEE-1588 support
- Full HD Video Output
- M.2 slot for NVMe SS drives up to 512 GByte
- Standard Linux Operating System (other OS's planned)
- Flexible: Over 90 I/O boards available
- Real-Time Linux kernel-based real-time capability



The UEIPAC is available on all UEI industrial platforms.  
Call for details on Zynq based MIL-series options!

## General Description:

The new Zynq UltraScale+ based UEIPAC CPU offers up to a 10x increase in CPU performance over previous UEIPACs. When utilizing the built-in Xilinx FPGA, an increase in real-time performance up to 100x is possible relative to previous UEIPACs.

The new CPU joins the currently supported Freescale MPC5200/8347 and i.MX6 SoloX based CPUs in the UEIPAC family, and all are covered by UEI's powerful 10-year availability guarantee. The initial release supports the Linux operating systems, while VxWorks and PIKE OS support is expected in the future.

The UEIPAC offers an unprecedented combination of flexibility, high performance, low cost and small controller. The unit is an ideal solution in a wide variety of measurement and control applications. The UEIPAC is also an ideal solution for embedded DAQ applications, allowing systems to operate without the cost or additional space required by an external host computer.

### Enhanced Quad-core CPU performance:

The latest (fifth) Generation CPU uses the Xilinx Zynq® UltraScale+ MPSoCs: EG series devices. A major advantage of the Zynq series is its combination of a multicore CPU and a Xilinx FPGA. In particular, the Zynq SoC provides a modern, quad-core ARM Cortex -A53 MPCore CPU running at up to 1.2GHz with 4 GByte of DDR4, 64-bit RAM. Two CPU options are available based on the Zynq ZU3EG series chip with up to 154k logic cells, or the Zynq ZU4EV chip with 192k cells. (Please contact the factory for more details on the capabilities of the Xilinx FPGA and the availability of higher density UltraScale+ devices.)

The CPU includes three IEEE-1588 compliant GigE Ethernet ports. One is a direct link to the CPU, while the remaining ports are connected to programmable logic that then links to the CPU. A DP (display port) supports full HD graphics (1080p). An 8 GByte eMMC FLASH drive is included on the board. For larger disk drive needs, a PCIe M.2 slot allows for the installation of 2242 or 2260 series NVMe cards, which are currently available in sizes up to 512 GByte. An external Synch port is provided, along with a USB 3.0/2.0 port. A diagnostic port rounds out the I/O connectivity of the CPU board.

### Features of the Zynq UltraScale+ based CPU:

- Three GigE Ethernet ports (fully IEEE-1588 compliant)
- Built-in DP (Display Port) (4k) support
- 4 GByte DDR4 RAM/8 GByte eMMC FLASH
- M.2 series I/O slot for NVMe SSD or other peripheral
- USB 3.0/2.0 interface
- Direct support of DNx series sync port
- Extensive diagnostics including power supply and temperature monitoring
- Serial diagnostic port
- All standard UEI chassis environmental specifications
- 9–36 VDC power (universal AC adaptor also included)
- Low power: 12W typical, <18W in most configurations

The Zynq UltraScale+ version of the UEIPAC supports Linux OS with future support for VxWorks and PIKE OS expected.

### Linux Systems:

- Uses Yocto Linux distribution: Petalinux 2020.2 Yocto (Zeus), Linux kernel 5.4.0, PREEMPT\_RT patch for real-time support
- Program in standard C/C++ or Python
- Eclipse IDE support
- Develop on Linux PC or Windows PC environment

The UEIPAC is supported by all UEI DNA/DNR/DNF series chassis. There are currently over 90 different I/O boards available, including analog input (with up to 24 bit resolution), analog output, digital I/O, MIL-STD-1553, ARINC-664, ARINC 429/453/708, Serial and CAN communications, counter/timer, quadrature encoder input and more. With this many different I/O boards available, there is sure to be a configuration perfect for your application.

The Zynq UltraScale+ based UEIPAC is an ideal high performance embedded controller where high-speed real-time analysis and decisions are required. The unit's UEISIM deployment is also an ideal hardware target for Simulink based I/O applications where high speed, ruggedness and high reliability are required.

## Linux Programming

Your application runs as a regular Linux process, giving you access to the standard POSIX API provided by the GNU C runtime library (glibc) as well as any other library that can be compiled for Linux (for example: libxml, libaudio file...).

New software provided with the UEIPAC includes an EPICS (Experimental Physics and Industrial Control System) Channel Access Server (CAS). Our new LibSharedData software allows easy connection of the UEIPAC to HTML/HTML5 browsers via Web Sockets or other PCs via TCP/IP Sockets.

Whether your application requires a few I/O channels or a few thousand, the UEIPAC is an ideal solution. The UEIPAC's unique combination of Linux operating system, real-time support, I/O flexibility, compact size, mechanical and electrical ruggedness, and ease of use is unparalleled.

## UEIPAC Linux TK Programmer's Toolkit

The programmer's toolkit provides the software tools necessary to create an embedded application targeting Linux on the UEIPAC's ARM processor. This includes most popular versions of Linux, such as Fedora and Suse. The development environment runs on a Linux PC or in the WSL 2 environment on a Windows PC. Applications requiring hard real-time functionality are possible with the Real-Time Linux capability included in the 5.4.0 series kernel.

The UEIPAC development environment includes:

- GCC 9.2.0 based cross-compiler for applications targeting the UEIPAC ARM module
- GNU toolchain tools such as Make
- Standard Linux libraries such as glibc
- UEIPAC library for the various I/O boards/devices

The UEIPAC Linux TK is not included with the UEIPAC and must be purchased as a separate item. *Only one Linux toolkit must be purchased, regardless of the number of UEIPAC deployed.*

The toolkit uses the same API as our popular PowerDNA Cubes, allowing you to reuse existing programs that were designed to run with a PowerDNA Cube over the network. This allows you to develop your application on your desktop, working directly with a "slaved" PowerDNA Cube. Once you are satisfied with your system, you may port the programs to run directly on the UEIPAC Cube with few modifications.

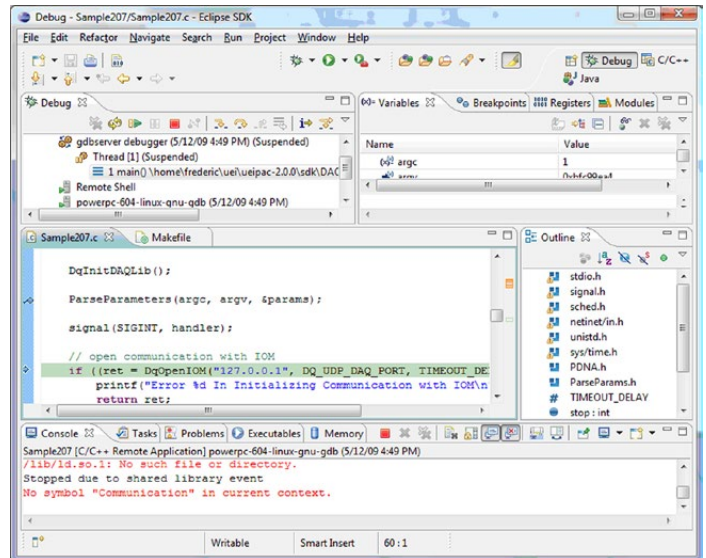
After the UEIPAC power-up, you have a ready to go Linux OS with FTP and web servers as well as a command line shell accessible from the serial port or SSH over the network.

## EPICS:

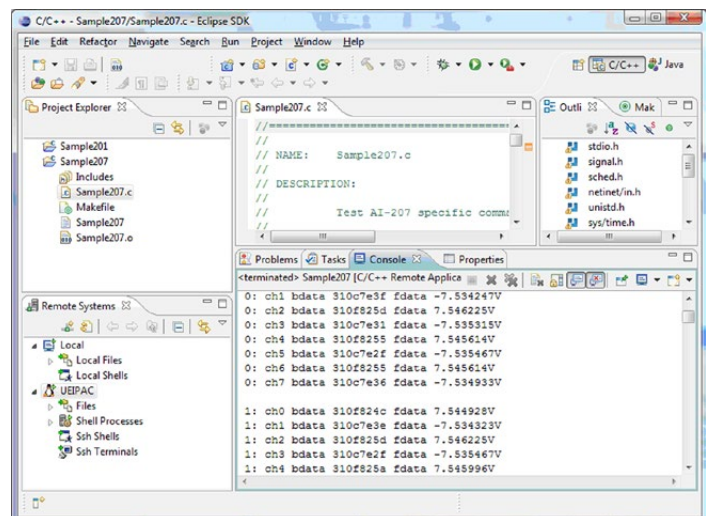
EPICS (Experimental Physics and Industrial Control System) is a popular standard in high-energy physics laboratories. Our new EPICS server provides the source code to set up the UEIPAC as an EPICS CAS (Channel Access Server), allowing you to configure any I/O input or output as a PV (Process Variable).

## Eclipse IDE support

The UEIPAC is supported by the Eclipse IDE. Programmers may now take advantage of the many powerful Eclipse tools to build their UEIPAC applications.



The Eclipse IDE debug screen.



A typical Eclipse IDE run-time screen.

## New Software Support

### Web Browser Interface:

Our new LibSharedData API/library allows easy connection of the UEIPAC to HTML/HTML5 browsers via Web Sockets or other PCs via TCP/IP Sockets. The HTML5 interface is fully compatible with many mobile browsers, including Safari for iOS and iPhones and iPads and the Android web browser. Of course, the standard HTML interface is provided to interface to more general purpose web browsers.

### IOT

The UEIPAC comes with Mosquitto pre-installed. Mosquitto implements a broker and a C library to publish/subscribe MQTT messages. Examples and API documentation can be found at <http://mosquitto.org>. UEIPAC comes with the SampleDMPAQ\_MQTT example that can acquire and publish data from AI, DI or counter/timer layers. The example can also subscribe to external data and write it on AO and DO outputs.

# UEIPAC: Technical Specifications

| Processor/System            |   | -33 & -3A processors are available for Cube and Rack Chassis.   |                    |
|-----------------------------|---|---|--------------------|
|                             | -33   | -3A   |                    |
| CPU                         | <ul style="list-style-type: none"> <li>Xilinx Zynq® UltraScale+™ MPSoCs: ZU3EG.</li> <li>Includes quad-core ARM Cortex -A53 MPCore CPU.</li> <li>Xilinx FPGA with 154k logic cells, 141k CLB Flip-Flops, 71k CLB LUTs.</li> <li>1.2 GHz clock speed.</li> </ul> | <ul style="list-style-type: none"> <li>Xilinx Zynq® UltraScale+™ MPSoCs: ZU4EV.</li> <li>Includes quad-core ARM Cortex -A53 MPCore CPU.</li> <li>Xilinx FPGA with 192k logic cells, 176k CLB Flip-Flops, 88k CLB LUTs.</li> <li>1.2 GHz clock speed.</li> </ul> |                    |
| Memory                      | 4 GByte DDR4 RAM  | 2 GByte DDR4 RAM  |                    |
| eMMC FLASH                  | 8 GByte   |   |                    |
| Optional M.2 SSD*           | 2242, 2260 and 2280 NVMe M.2 cards up to 512 GB*  |   |                    |
| USB drive interface         | Standard USB 3.0 port   |   |                    |
| Primary Ethernet port       | 10/100/1000Base-T, RJ-45 connector  |   |                    |
| Secondary NIC ports         | 2x 10/100/1000Base-T, RJ-45 connector   |   |                    |
| Other port functions        | Ports may optionally be bonded/teamed   |   |                    |
| Video                       | Display Port: Full HD resolution  |   |                    |
| Config/serial port          | DIAG port   |   |                    |
| Synchronization options     | <ol style="list-style-type: none"> <li>IEEE-1588 synchronization on all ports.</li> <li>DNA-SYNC-1G series cables and boards provide both clock and trigger sync signals.</li> <li>DNA-IRIG-650 for IRIG and GPS synchronization.</li> </ol>                    |   |                    |
| Software / Operating System |   |   |                    |
|                             | PetaLinux 2020.2 Yocto Zeus, kernel 5.4.0   |   |                    |
| Dev language                | C/C++, C++11/14/17, Eclipse IDE support   |   |                    |
| Dev environments            | Linux PC or Windows environment   |   |                    |
| I/O Board Support           |   |   |                    |
| Series supported            | All DNA-series boards   | All DNR-series boards (DNF for FLATrack)  |                    |
| Physical Dimensions         |   | UEIPAC Cubes  | RACKtangle Chassis |
| 3 I/O slots                 | UEIPAC 300-1G: 4.1" x 5.0" x 4.0"   | n/a   |                    |
| 4 I/O slots                 | n/a   | UEIPAC 400R: 1.75" x 7.8" x 16" (1U)  |                    |
| 6 I/O slots                 | UEIPAC 600-1G: 4.1" x 5.0" x 5.8"   | UEIPAC 600R: 5.25" x 6.2" x 10.5" (5U)  |                    |
| 7 I/O slots                 | UEIPAC 700-1G: 4.1" x 5.0" x 6.6"   | n/a   |                    |
| 12 I/O slots                | n/a   | UEIPAC 1200R: 5.25" x 6.2" x 17.5" (3U)   |                    |
| Environmental               |   |   |                    |
| Electrical isolation        | 350 Vrms  |   |                    |
| Temperature (operating)     | -40 °C to 70 °C   |   |                    |
| Temperature (storage)       | -40 °C to 85 °C   |   |                    |
| Humidity                    | 0 to 95%, non-condensing  |   |                    |
| Vibration                   |   |   |                    |
| (IEC 60068-2-64)            | 10–500 Hz, 3g (rms), Broad-band random  |   |                    |
| (IEC 60068-2-6)             | 10–500 Hz, 3g sinusoidal  |   |                    |
| Shock                       |   |   |                    |
| (IEC 60068-2-27)            | 100g, 3 ms half sine, 18 shocks at 6 orientations<br>30g, 11 ms half sine, 18 shocks at 6 orientations  |   |                    |
| Altitude                    | 70,000 feet, maximum  |   |                    |
| Power Requirements          |   |   |                    |
| Voltage                     | 9-36 VDC (115/220 VAC adaptor included)   |   |                    |
| Power                       | 12 Watts (not including I/O boards)   |   |                    |

\*The SSD devices used are not built by UEI. As we do not control the source, we cannot offer our 10-year availability guarantee on these devices.

## Extended Features:

### Easy to configure and deploy

- Standard Linux operating system (other operating systems planned)
- Eclipse IDE support
- Full HD Video
- IOT ready with pre-installed MQTT support
- Supports DDS packages including ZeroMQ, OpenSplice and CoreDX
- EPICS CAS provided
- Web server
- Web Browser (Web Socket) interface included
- FTP server included
- Over 90 different I/O boards available
- Optional M.2 Solid-State hard drives up to 512 GByte
- Flange kit for mounting to wall/flat surface
- DIN rail and Rack Mount kits
- Standard "Off-the-shelf" products and delivery

### Rugged and Industrial

- RACKS and GigE Cubes operation tested from -40 °C to 70 °C
- RACKs and GigE Cubes Vibration tested to 3 g
- Shock tested to 100 g (operating)

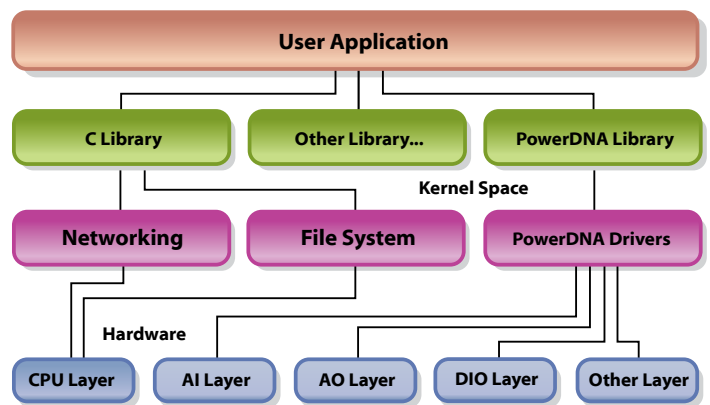
### Compact Size and High Channel Density

- Analog Inputs: up to 175/300 channels per Cube/RACKtangle
- CP/IEPE: up to 28/48 channels per Cube/RACKtangle
- Analog Outputs: up to 224/384 channels per Cube/RACKtangle
- Digital I/O: up to 336/576 DIO per Cube/RACKtangle
- ARINC 429: up to 112/192 channels per Cube/RACKtangle
- Counter/Timer: up to 56/96 counter channels per Cube/RACKtangle
- CAN-bus: up to 28/48 ports per Cube/RACKtangle
- RVDT/LVDT: up to 28/48 channels per Cube/RACKtangle
- RS-232/422/485: up to 56/96 ports per Cube/RACKtangle
- Synchro: up to 28/48 channels per Cube/RACKtangle
- MIL-1553: up to 14/24 redundant ports per Cube/RACKtangle

## Typical Applications:

- Simulink hardware target
- Embedded Controller
- Hardware-in-the-loop controller
- Unmanned vehicle controller
- Wind energy and turbine controller
- Smart, flexible data loggers
- Slaved controller with fail-safe local control and/or shut-down if communication is lost
- HVAC / Environmental controller
- Modern replacement for obsolete VME systems
- Solar Energy system controller
- Machine Health Monitor
- DUT simulator
- In-vehicle test systems
- Avionics simulator
- Single and multiple PID loop controller
- Rugged and remote DAQ

## System Block Diagram:



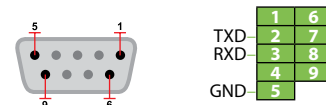
Please See Ordering Guide on the Following Page ►

## CBL-SX6-DIAG (Optional Diagnostic Serial Port Cable)

This cable brings the diagnostic RS-232 port on the CPU board out to a standard female DB-9 connector. Though the diagnostic port provides access to a wealth of boot-time information and configuration/set-up tools, most customers will never need to use it. For this reason, we have made the cable an optional purchase. However, though you certainly will not need a cable per chassis, we do recommend users purchase one or two of these cables for the development lab. Note that we do keep these cables in stock so should you need one in the future, it could be overnighted to you. Note also that the information displayed on the diagnostic port is also available on the DP video display port.



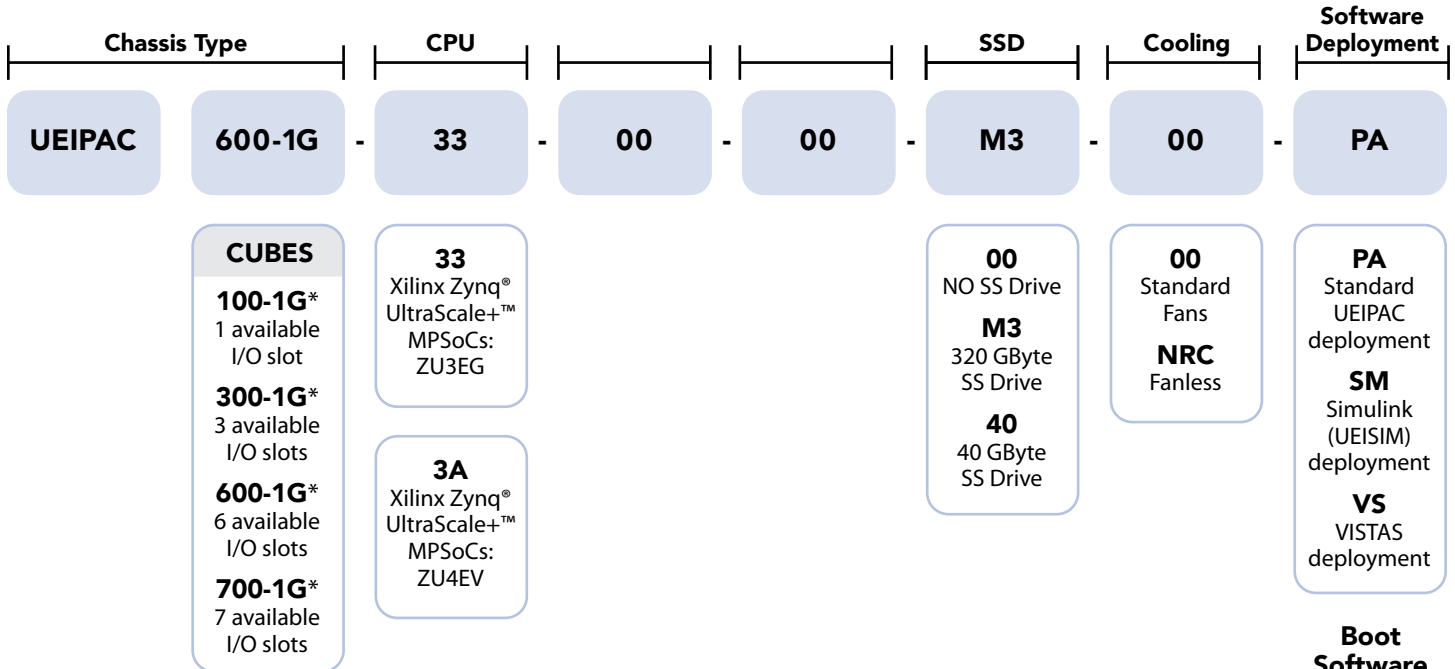
Serial/RS-232 (female dB9, cable is 1 m long)





**Ordering Guide:** (All chassis include: Universal AC power supply, Ethernet cable and pre-installed Linux OS.)

## UEIPAC Gigbit Ethernet Programmable Automation Controllers



\*Fanless (NRC) option of this Cube is available.

**RACKS**

**1200R**  
12 available I/O slots

**600R**  
6 available I/O slots

**400F-AC**  
FlatRACK, 1U rack mountable 4 slot chassis, 100-240 VAC power

**400F-DC**  
FlatRACK, 1U rack mountable 4 slot chassis, 9-36 VDC power

**Boot Software Location**  
The unit is designed to boot directly from on-board QSPI memory, and mount RFS from the 8 GByte FLASH.

### FOR EXAMPLE

A 3-slot, fanless, GigE Cube with a ZU3EG CPU, 40 GByte M.2 SSD, in standard PAC mode would be:

**UEIPAC 300-1G - 33 - 00 - 00 - 40 - NRC - PA**

## Ordering Information

**Accessories & Software including SDK/Board Support Packages** (Only one toolkit is required, regardless of the number of UEIPACs deployed)

| Product                            | Description   |
|------------------------------------|---|
| UEIPAC-Linux TK-ZQ (Software Only) | UEIPAC Linux Programmer's Toolkit   |
| CBL-SX6-DIAG                       | Diagnostic cable. Connects diagnostic connector to standard DB9 RS232 Connector |
| Extended Warranty                  | Option to purchase UEI's extended 5 year warranty is available                  |