United Electronic Industries / AMETEK

UEIPAC FlatTop I/O System

PowerDNA® Gigabit Ethernet I/O Cubes Include Fifth Generation CPU with Quad-Core Zynq UltraScale+ SoC

Programmable Automation/Embedded Controllers

- Powerful stand-alone embedded controller
- Flexible, compact and rugged
- Heat sink eliminates the need for rotary cooling fan
- Powerful Xilinx Zynq® UltraScale+™ SoC chip combines
  - Quad-core ARM Cortex-A53, 64-bit processor
  - User programmable Xilinx FPGA (two sizes available)
- 4 GB, 64-bit DDR, 8 GB 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 SSD pSLC up to 480 GB, TLC up to 4 TB
- 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's industrial platforms. Call for details on Zynq based MIL-series options.

GENERAL DESCRIPTION

The PowerDNA® (**D**istributed **N**etworked **A**utomation) Cube is a compact, rugged, Ethernet based DAQ interface. Its flexibility allows you to configure one or more cubes to match the specific I/O requirements of your application. The PowerDNA Cube is ideally suited for a wide variety of industrial, aerospace and laboratory data acquisition and control applications.

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 GB of DDR4, 64-bit RAM. Two CPU options are available: one based on the Zynq ZU3EG series chip, with up to 154k logic cells, and the other based on 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 GB 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. An external sync port is provided, along with a USB 3.0/2.0 port. An RS-232 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) support
- 4 GB DDR4 RAM/8 GB 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 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 DNx compatible, which means it 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 processor, 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 (**E**xperimental **P**hysics and **I**ndustrial **C**ontrol **S**ystem) **C**hannel **A**ccess **S**erver (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.

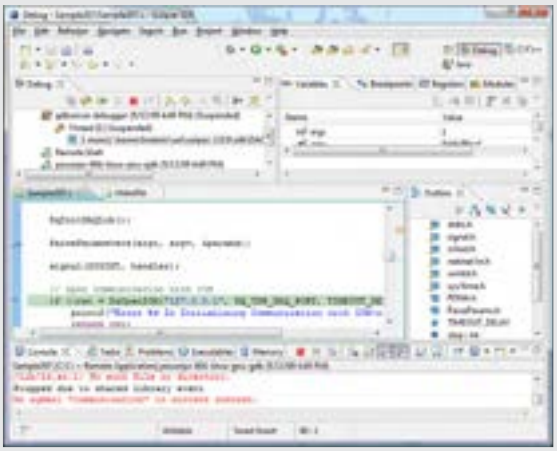
After the UEIPAC power-up, you have a ready-to-go Linux OS with FTP and web servers as well as a command line shell accessible from the serial port or SSH over the network.

EPICS

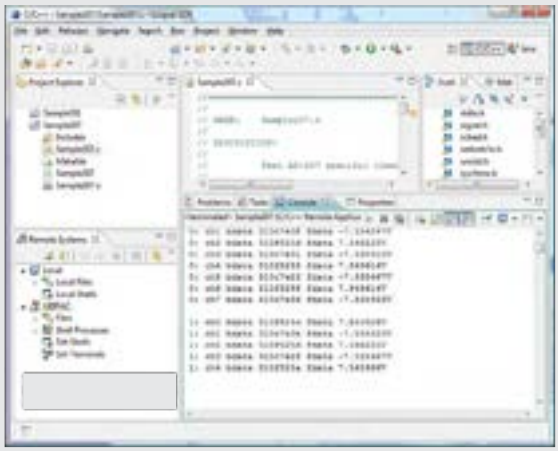
EPICS (**E**xperimental **P**hysics and **I**ndustrial **C**ontrol **S**ystem) is a popular standard in high-energy physics laboratories. Our new EPICS server provides the source code to set up the UEIPAC as an EPICS CAS (Channel Access Server), allowing you to configure any I/O input or output as a PV (Process Variable).

Eclipse IDE plug-in support

The UEIPAC is supported by the Eclipse IDE plug-in for EPICS. 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.

Internet of Things

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 SampleDMAP_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 analog outputs and digital outputs.

UEIPAC TECHNICAL SPECIFICATIONS

Board Type	
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	Full HD resolution
M.2 PCIe slot	1 slot for 2280, 2260 or 2242
Configuration port/serial port	DIAG port
USB port	USB 3.0 fully supported
Synchronization options	1. IEEE-1588 synchronization on primary Ethernet port 2. DNA-SYNC-1G series cables and boards provide both clock and trigger sync signals 3. DNA-IRIG-650 for IRIG and GPS synch 4. Redundant TSN
I/O Board Support	
Series supported	DNA Cube series boards
Software / Operating System	
Software	PetaLinux 2020.2 Yocto Zeus, kernel 5.4.0
Development language	C/C++, C++11/14/17, Eclipse IDE support
Development environments	Linux PC or Windows environment
Processor/System	
CPU option -33	Xilinx Zynq® UltraScale+™ MPSoCs: ZU3EG. Includes quad-core ARM Cortex -A53 MPCore CPU plus a Xilinx FPGA with 154k logic cells, 141k; CLB Flip-Flops and 71k CLB LUTs 1.2 gigahertz clock speed
CPU option -3A	Xilinx Zynq® UltraScale+™ MPSoCs: ZU4EV. Includes quad-core ARM Processor/system; CLB Flip-Flops and 88k CLB LUTs 1.2 gigahertz clock speed
CPU option -34	Xilinx Zynq® UltraScale+™ MPSoCs: ZU4EG. Includes quad-core ARM Cortex -A53 MPCore CPU plus a Xilinx FPGA with 154k logic cells, 141k; CLB Flip-Flops and 71k CLB LUTs 1.2 gigahertz clock speed
Memory	4 GB DDR4 RAM
eMMC FLASH	8 GB
Optional M.2 SSD*	2242, 2260 and 2280 NVMe M.2 cards*
USB drive interface	Standard USB 3.0 port
Physical Dimensions	
3 I/O slots	4.1" W x 5.5" D x 5.2" H (4 lbs.)
6 I/O slots	4.1" W x 5.5" D x 7" H (5.9 lbs.)
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, 3 g (rms), Broad-band random
Vibration (IEC 60068-2-6)	10–500 Hz, 3 g, Sinusoidal
Shock (IEC 60068-2-27)	30 g, 11 ms half sine, 18 shocks at 6 orientations
Altitude	70,000 feet maximum
Reliability	
MTBF	450,000 hours
Power Requirements	
Voltage	9-36 VDC (115/220 VAC adaptor included)
Power	12 W (not including I/O boards)

*The SD cards and 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
- Flange kit for mounting to wall/flat surface
- DIN rail and rack mount kits
- Standard "Off-the-shelf" products and delivery

Rugged and Industrial

- Operation tested from -40 °C to 70 °C
- Vibration tested to 3 g
- Shock tested to 100 g (operating)

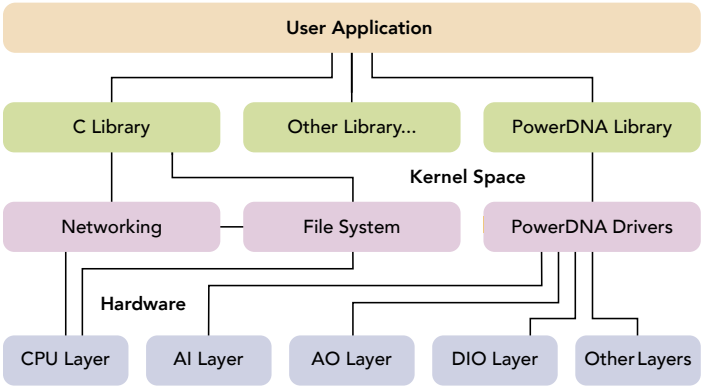
Compact Size and High Channel Density

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

TYPICAL APPLICATIONS

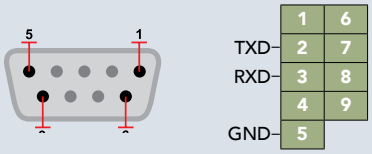
- Simulink hardware target
- Embedded Controller
- Hardware-in-the-loop controller
- Unmanned vehicle controller
- Wind energy and turbine controller
- Smart, flexible data loggers
- Slaved controller with fail-safe local control and/or shut-down if communication is lost
- HVAC / Environmental controller
- 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



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)

Please See Ordering Guide on Page 6

FLATTOP INTERFACES

A Heat Sink
Cooling fins eliminate the need for a fan.

B Network Connectors
Three GigE Ethernet ports (fully IEEE-1588 compliant)—NIC 2 is a direct link to the CPU, while NIC 1 and NIC 3 are connected to programmable logic that then links to the CPU.

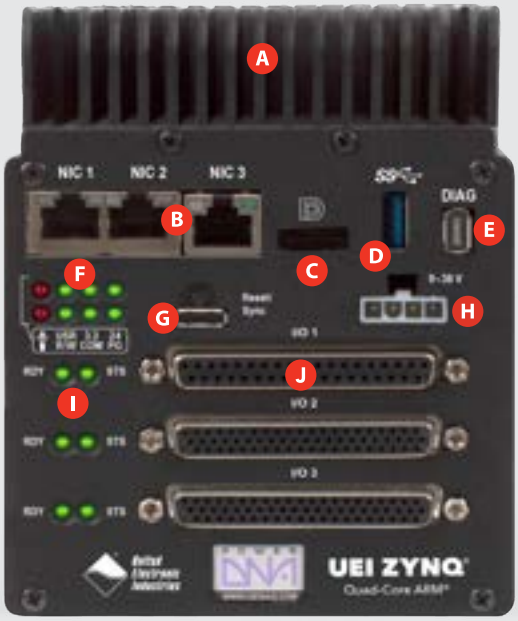
C Display Port
Video display supports full HD graphics (1080p).

D USB Port
USB 3.0/2.0 fully supported.

E Diagnostic Port
Communications port.

F Cube Status LEDs
These LEDs monitor power supplies, internal temperature, fan operation, CPU heartbeat and input current.

G Sync Connector & Reset Button
High-speed Cube-to-Cube synchronization connector allows multiple cubes to be synchronized. The reset button is recessed to prevent accidental activation, this button resets the CPU layer for activities such as downloading and installing new firmware for the Cube.



H Power Connector
Power-In, 9-36V DC either from the DNA-PSU-24 (included with the Cube), or a user-supplied source.

I I/O Layer Status LEDs
These two green lights give a visual indication of the status of each I/O layer.
RDY - Ready • **STS** - Status.

J I/O Board Slots
Cubes provide 3 or 6 I/O slots. Boards installed in the I/O slots perform the various analog, digital and communications functions you need for your specific application. Your signals may be connected directly to the I/O boards via your custom cabling or take advantage of our wide variety of easy-to-use, external screw terminal panels. Boards ordered with your cube are factory installed. It is also a simple task to add boards or reconfigure a cube in the field.

FLATTOP CONFIGURATIONS

3 SLOTS

6 SLOTS

REAR

The UEIPAC FlatTop is also available in 1 and 7-slot Cube configurations. Contact uei.sales@ametek.com

PINOUT DIAGRAMS

Power In[1] (molex)

4	3	2	1
T+VIN	GND	GND	+VIN

[1] Mating connector available from Digikey, Molex PN 39-01-4040

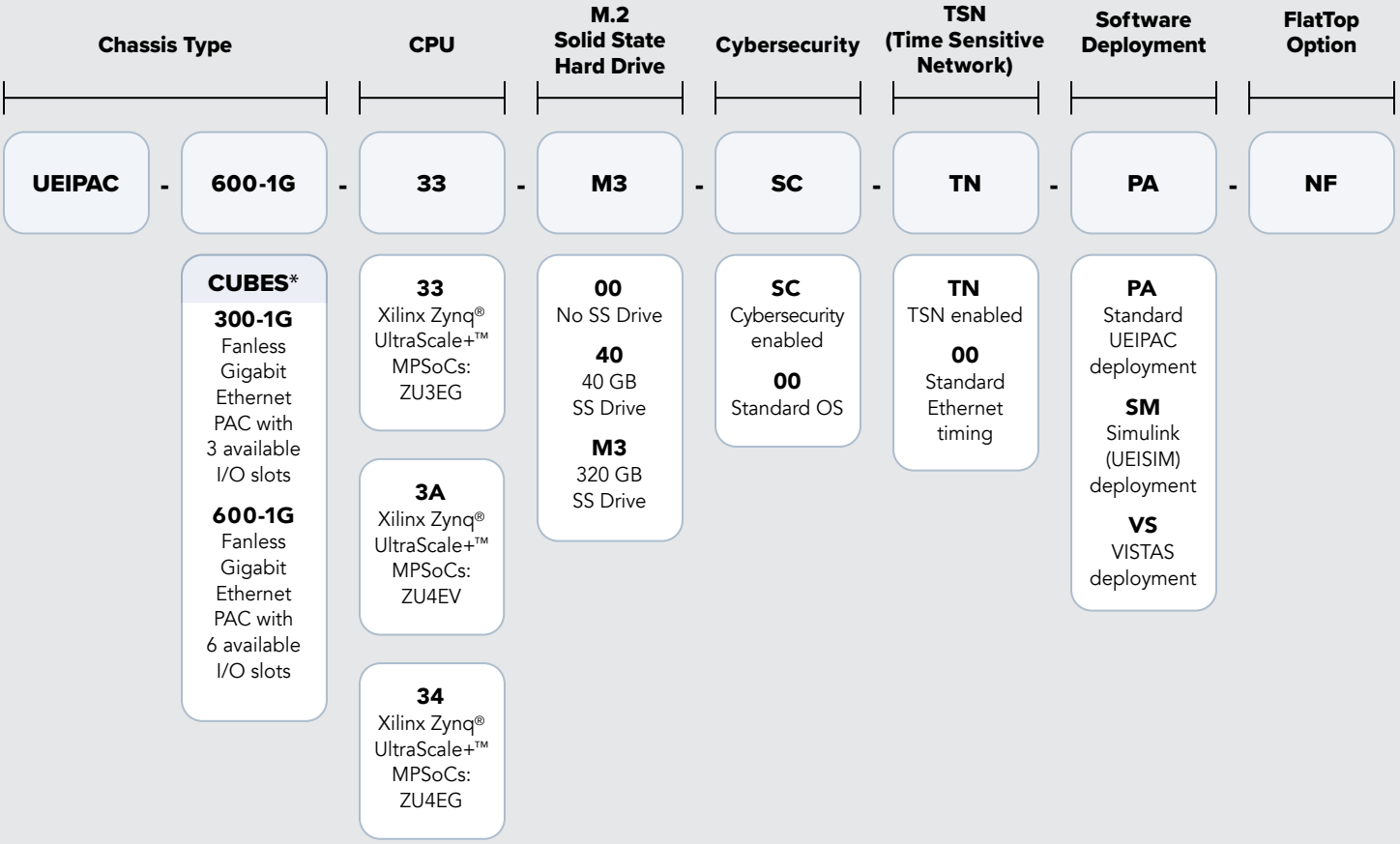
Synchronization

1	+5 V
2	+5 V
3	Gnd
4	Trigger Out
5	Gnd
6	Trigger In
7	Gnd
8	Clock Out
9	Gnd
10	Clock In

ORDERING GUIDE

(All chassis include: Universal AC power supply (except 400F-series), Ethernet cable and pre-installed Linux OS.)

UEIPAC CHASSIS CONFIGURATION



FOR EXAMPLE

6-slot GigE Ice Cube with a ZU3EG CPU, 320 GByte M.2 SSD, with the Cybersecurity and TSN networking enabled, in standard PAC mode would be:

UEIPAC 600-1G - 33 - M3 - SC - TN - PA - FL

Boot Software Location

The unit is designed to boot directly from on-board QSPI memory, and mount RFS from the 8 GB FLASH.

*The FlatTop is also available in 1-slot and 7-slot configurations. Please contact uei.sales@ametek.com.

ORDERING INFORMATION

To place an order, you can build an estimate online at www.ueidaq.com, or contact us at 508-921-4600 or uei.sales@ametek.com.

UEIPAC 300-1G FlatTop*	Fanless Gigabit Ethernet, Programmable Automation Controller with 3 available I/O slot
UEIPAC 600-1G FlatTop*	Fanless Gigabit Ethernet, Programmable Automation Controller with 6 available I/O slots

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

Product	Product
EIPAC-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 warranty (up to 10 years) is available

*The FlatTop is also available in 1-slot and 7-slot configurations. Please contact uei.sales@ametek.com.