

# SBC-Nano

V1.4 05/31/16



## A Windows/Linux Embedded Single Board Computer with XMC IO Site and 1 GbE Link

### FEATURES

- Combines an industry standard COM Express CPU module with XMC IO module in a compact, stand-alone design
- Powerful performance using Intel-based CPU core via COM Express
- Small form factor: 150 x 75 mm
- Rugged, stand-alone operation
- Able to operate headless
- Runs Windows or Linux applications including RTOS variants
- Configurable IO uses standard XMC IO modules. Add anything from RF receivers to industrial control modules.
- PCI Express IO site (VITA 42.3) delivers >1600 MB/s to CPU memory\*
- Supports Innovative X3, X5 and X6 IO module features for private data channels, triggering and timing
- USB 3.0/2.0 x1, USB 2.0 x2, SATA x2, mini DisplayPort
- Optional connectivity via 1 Gb Ethernet link
- Boots from 32 GB eMMC
- On-board XMC FPGA JTAG programmer
- 6 -14V DC operation\*

### APPLICATIONS

- Embedded instrumentation
- Remote, autonomous IO
- Mobile instrumentation
- Distributed data acquisition

### SOFTWARE

- Windows and Linux compatible
- Runs standard desktop applications
- C++ Developers Kit supporting IO integration and customization
- Device drivers, example software and support applets supplied for all peripherals

\* Data rate and input voltage range depends on the COM Express module capabilities



### DESCRIPTION

The SBC-Nano is a user-customizable, turnkey embedded instrument that includes a full Windows/Linux PC and supports a wide assortment of ultimate-performance XMC modules. With its modular IO, scalable performance, and easy to use PC architecture, the SBC-Nano reduces time-to-market while providing the performance you need.

**Distributed Data Acquisition** – Put the SBC-Nano at the data source and reduce system errors and complexity. Limitless flexibility – simply replace the XMC module and get different functionality.

**Uniquely customizable** - XMC site for IO, user-programmable FPGA for IO interfaces, triggering and timing control, USB ports.

**Remote or Local Operation** - Continuous data streaming up to 500 MB/s (local SSDs) or 1 Gb/s Ethernet.

**Rugged** – Runs from embedded eMMC drive in a compact, rugged 150x75mm footprint that is ready for embedded operation.

**Two Generic Serial Ports** for system extension.

**6 -14V DC Operation** - Perfect for portable or automotive battery operated data loggers or waveform generators.

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06/03/16

PRODUCTION DATA information is current as of publication date. Products conform to specifications per the terms of the Innovative Integration standard warranty. Production processing does not necessarily include testing of all parameters.

# SBC-Nano



This electronics assembly can be damaged by ESD. Innovative Integration recommends that all electronic assemblies and components circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage.

ESD damage can range from subtle performance degradation to complete device failure. Precision integrated circuits may be more susceptible to damage because very small parametric changes could cause the device not to meet its published specifications.

## ORDERING INFORMATION

Product	Part Number	Description
SBC-Nano	80342-<cfg>-<environ>	SBC-Nano - (high-performance) with quad-core Atom CPU with passive heat spreader, 4GB 1333 MHz DDR3L direct-soldered, 2x SATA 3.0Gbps, 1x USB 3.0, 2x USB2.0, 32GB eMMC, 100W 12V DC power supply. 15W w/o XMC modules. <cfg> = 1: x4 PCIe Gen2 connection to XMC, 1 GbE port disabled (80201-36) <cfg> = 2: x2 PCIe Gen2 connection to XMC, 1 GbE port enabled (80201-37) <environ> = L0: Office, controlled lab, L1: Outdoor, stationary, L2: Industrial, L3: Vehicles See <a href="#">online web quote</a> for all available options and accessories
Operating System	54042 54050 54051 54052 54054 54055	Open Suse Linux 32-bit Windows 7 Pro 32-bit Windows 7 Embedded, 32-bit Windows 7 Pro 64-Bit Windows 7 Embedded, 64-Bit OpenSuse Linux 64-bit
I/O Expansion Board	80338-0-<environ>	Expansion board for SBC-Nano providing two mSATA slots and connectors for DIO and secondary USB ports
SSD	36050	256 GB mSATA solid state disk
Chassis	30602-0 30601-0	Chassis and heat spreader for SBC-Nano and optional XMC module Chassis and heat spreader for SBC-Nano and optional Cardsharp SBC+FMC module
Active cooling	61439	Fan and heatsink assembly which attaches to top of chassis to provide active cooling. Audible Noise: 64 dB from 1 meter distance.
Power supply	80200-1 80200-2 80200-3	Power supply for US, Japan, Korea or Taiwan Power supply for UK, Australia, India Power supply for EU
Framework Logic	55014 55015 55016 55018 55019 55020 55021 55022	Framework Logic support for X3-SDF module. Framework Logic support for X5-400M module. Framework Logic support for X3-SD module. Framework Logic support for X5-210M module. Framework Logic support for X3-10M module. Framework Logic support for X3-25M module. Framework Logic support for X3-A4D4 module. Framework Logic support for X3-DIO module.

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	55023	Framework Logic support for X3-Servo module.
	55024	Framework Logic support for X5-COM module.
	55025	Framework Logic support for X5-GSPS module.
	55027	Framework Logic support for X5-TX module.
	55028	Framework Logic support for X5-RX module.
	55029	Framework Logic support for X5-G12 module.
	55030	Framework Logic support for X6-RX module.
	55031	Framework Logic support for X3-2M module.
	55032	Framework Logic support for X3-SD16 module.
	55034	Framework Logic support for X6-400M module.
	55036	Framework Logic support for X6-GSPS module.
	55037	Framework Logic support for X6-1000M module.
	55038	Framework Logic support for PEX6-COP module.
	55039	Framework Logic support for X6-250M module.
	55046	Framework Logic support for XU-TX module.
	55047	Framework Logic support for XU-RX module.
	55048	Framework Logic support for XU-RT module.
	55206	Framework Logic support for Cardsharp SBC
	80168-0	X3-SD XMCe Module
	80175-0	X3-SDF XMCe Module
	80176-0	X3-25M XMCe Module
	80177-0	X3-A4D4 PCIe XMC MODULE w/ 1.8 MG Spartan 3A FPGA
	80178-0	X3-DIO PCIe XMC MODULE, LVCMOS front I/O
	80178-1	X3-DIO PCIe XMC MODULE with LVDS front-panel DIO
	80178-2	X3-DIO PCIe XMC MODULE, LVCMOS front-panel DIO, Conformal Coated
	80179-0	X3-SERVO PCIe XMC MODULE with 1.8 Mgate FPGA
	80180-1	X5-400M PCIe/XMCe Module w/SX95T1 FPGA, EXT clk mode
	80180-2	X5-400M PCIe/XMCe Module w/SX95T1 FPGA, D/A: PLL mode
	80180-5	X5-400M, WITH SX95T1 FPGA, D/A clk: EXT, AC-coupled inputs
	80180-6	X5-400M, WITH SX95T1 FPGA, D/A clk: EXT, AC-coupled inputs
	80190-0	X5-210M with SX95T1 FPGA, PCIe 8-lane gen1
	80190-0	X5-210M PCIe/XMCe Module w/SX95T1 FPGA
	80190-1	X5-210M PCIe/XMCe Module w/LX155T1 FPGA
	80190-10	X5-210M PCIe/XMCe Module w/LX155T1 FPGA
	80190-11	X5-210M with SX95T2 FPGA, PCIe 8-lane gen1
	80190-9	X5-210M with SX95T1 FPGA, PCIe 8-lane gen1, external clock
	80192-0	X3-10M XMCe Module
	80197-0	X5-GSPS PCIe/XMCe Module w/SX95T1 FPGA DC-coupled, LVCMOS trigger
	80197-1	X5-GSPS PCIe/XMCe Module w/SX95T1 FPGA, AC coupled, LVCMOS trigger
	80197-4	X5-GSPS PCIe/XMCe Module w/SX95T2 FPGA DC-coupled, LVCMOS trigger
	80197-5	X5-GSPS PCIe/XMCe Module w/SX95T1 FPGA DC-coupled, LVPECL trigger
	80197-6	X5-GSPS PCIe/XMCe Module w/SX95T1 FPGA, AC coupled, LVPECL trigger
	80209-0	X5-COM with Virtex5 SX95T1 FGPA
	80209-3	X5-COM with Virtex5 SX95T2 FGPA
	80214-0	X5-TX with SX95T2 FPGA DC Coupled DAC Outputs
	80214-1	X5-TX with SX95T2 FPGA AC Coupled DAC Outputs
	80214-2	X5-TX with LX155T2 DC Coupled DAC Outputs
	80214-4	X5-TX with LX155T2 FPGA DC Coupled, DAC Outputs
	80222-0	X5-RX with SX95T1 FPGA
	80234-0	X3-Timing XMC Module, 1 ppb crystal, no GPS

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80234-3	X3-Timing XMC Module, 1 ppm crystal, w/GPS
80234-5	X3-Timing XMC Module, LVCMOS trigger outputs, 1 ppm crystal, with GPS
80243-1	X5-G12 with SX95T2 FPGA
80243-1-L1	X5-G12 with SX95T FPGA dual coupled A/D inputs
80243-4	X5-G12 with SX95T FPGA dual coupled A/D inputs, 1 GB DRAM
80245-10	X6-RX with SX475T2 FPGA, PCIe 8-lane gen2, AC-coupled, without DDC ASIC
80245-13	X6-RX with LX240T2 FPGA, PCIe 8-lane gen2, AC-coupled, no DDC ASIC
80245-6	X6-RX with SX315T2 FPGA, PCIe 8-lane gen2, AC-coupled, without DDC ASIC
80248-0	X3-2M XMCE Module
80255-0	X3-SD16 XMCE Module
80255-1	X3-SD16 XMCE Module, conformal coating
80264-1	X6-GSPS with LX240T2 FPGA, PCIe 8-lane gen2, AC-Coupled
80264-4	X6-GSPS with SX475T2 FPGA, PCIe 8-lane gen2, AC-coupled
80264-5	X6-GSPS with SX315T2 FPGA, PCIe 8-lane gen2, AC-coupled
80270-10	X6-400M with SX475T2 FPGA, PCIe 8-lane gen2, AC coupled
80270-11	X6-400M with SX315T2 FPGA, PCIe 8-lane gen2, AC coupled
80270-12	X6-400M with SX315T2 FPGA, PCIe 8-lane gen2, DC coupled
80270-14	X6-400M with SX315T2 FPGA, PCIe 8-lane gen2, AC-Coupled, 12-bit 500 MSPS ADC
80270-2	X6-400M with LX240T2 FPGA, PCIe 8-lane gen2, AC coupled
80270-3	X6-400M with LX240T2 FPGA, PCIe 8-lane gen2, AC-Coupled, 12-bit 500 MSPS ADC
80270-6	X6-400M with LX240T2 FPGA, PCIe 8-lane gen2, DC coupled
80270-8	X6-400M with SX475T2 FPGA, PCIe 8-lane gen2, DC coupled
80279-10	X6-250M with SX315T2 FPGA, PCIe 8-lane gen2, DC-coupled
80279-11	X6-250M with SX475T2 FPGA, PCIe 8-lane gen2, AC-coupled
80279-12	X6-250M with SX475T2 FPGA, PCIe 8-lane gen2, DC-coupled
80279-7	X6-250M with LX240T2 FPGA, PCIe 8-lane gen2, DC-coupled
80279-8	X6-250M with LX240T2 FPGA, PCIe 8-lane gen2, AC-coupled
80279-9	X6-250M with SX315T2 FPGA, PCIe 8-lane gen2, AC-coupled
80280-10	X6-1000M with SX315T2 FPGA, PCIe 8-lane gen2, DC Coupled
80280-11	X6-1000M with LX240T2 FPGA, PCIe 8-lane gen2, AC Coupled
80280-12	X6-1000M with LX240T2 FPGA, PCIe 8-lane gen2, DC Coupled
80280-13	X6-1000M with SX315T2 FPGA, PCIe 8-lane gen2, AC coupled in DC coupled out
80280-14	X6-1000M with SX475T2 FPGA, PCIe 8-lane gen2, AC coupled in DC coupled out
80280-5	X6-1000M with SX475T2 FPGA, PCIe 8-lane gen2, DC Coupled
80280-6	X6-1000M with SX315T2 FPGA, PCIe 8-lane gen2, AC Coupled
80280-8	X6-1000M with SX475T2 FPGA, PCIe 8-lane gen2, AC Coupled
80335-0	XU-TX - 4 ch, 2.8 GSPS XMC, XUCV0x5 FPGA, AC coupled
80336-0	XU-RX - 2 ch, 4.0 GSPS XMC, XUCV0x5 FPGA, AC coupled
80337-0	XU-RT - 4 ch, 2.8 GSPS XMC, XUCV0x5 FPGA, AC coupled
80340-0	Atropos XMC Module, Precision Timing Card, Single Ended
80340-1	Atropos XMC Module, Precision Timing Card, Differential Output
-<environ>	

# SBC-Nano

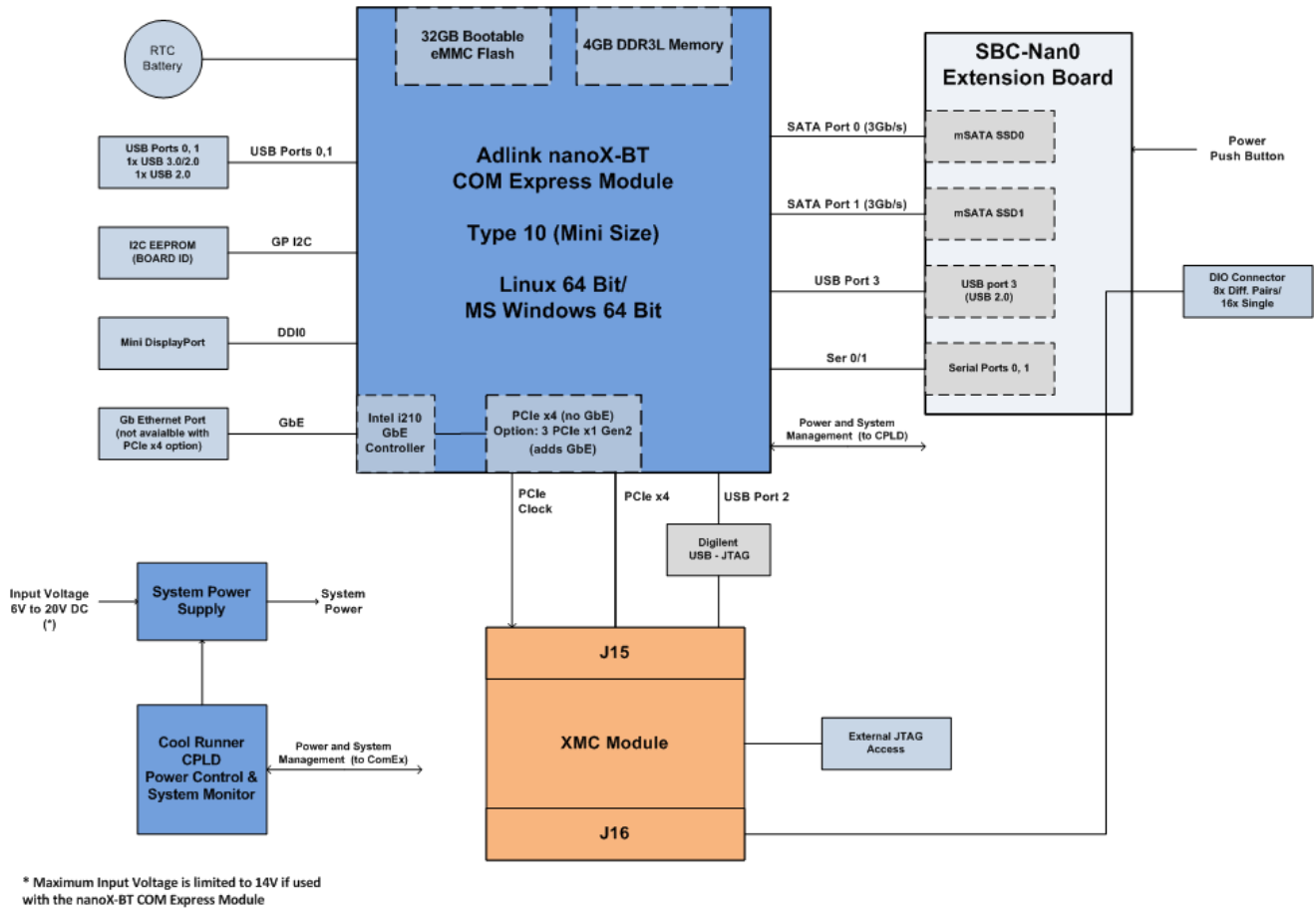


Figure 1. SBC-Nano Block Diagram

Supported Operating Systems (eMMC)	OS Image size (GB)	Residual space (GB)	
		16 GB eMMC	32 GB eMMC (default)
Windows 10 Pro 64-bit	14	0.7	15.4
OpenSUSE Leap 42.1 64-bit	14.5	0.2	14.9

# SBC-Nano

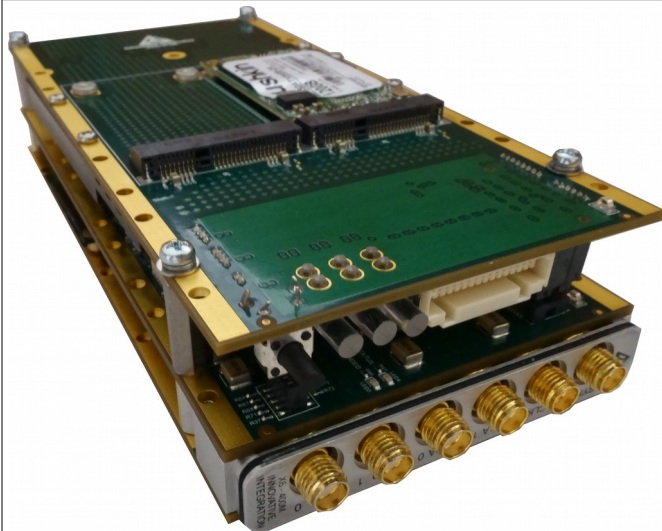


Illustration 1: SBC-Nano Carrier Board with mSATA Extension Board and XMC module installed



Illustration 2: SBC-Nano and XMC module within enclosure with optional fansink. Substitute cold-plate for fan-sink in conduction-cooled applications.



Illustration 3: Bottom view of XMC module, SBC-Nano and mSATA expansion boards.



Illustration 4: Rear view of SBC-Nano aluminum chassis, shown with optional fansink installed. Substitute cold-plate for fan-sink in conduction-cooled applications.



# SBC-Nano



Illustration 5: AC-DC Power Adapter, 12V, 8.33A, 90-264VAC @ 50 or 60 Hz, 136 x 58.5 x 33.7mm, 500g (1.10 lbs), with additional Power Cord:

- 1=USA/Japan/Korea/Taiwan
- 2=UK/Australia/India
- 3=EU



Illustration 6: Fansink, PN 61439, 149 x 74 x 14.8mm, 181g (0.4 lbs), configured for VPWR input.

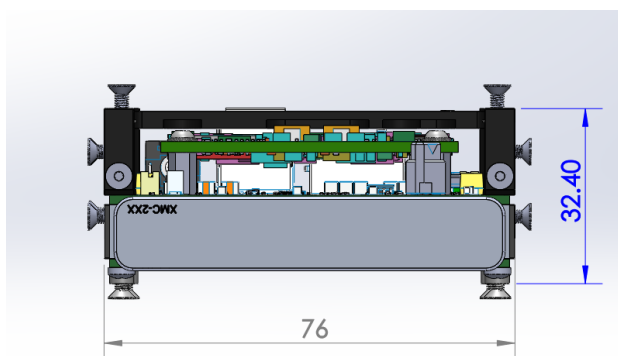


Illustration 7: Minimal dimensions of electronics stack (SBC-Nano+XMC module)

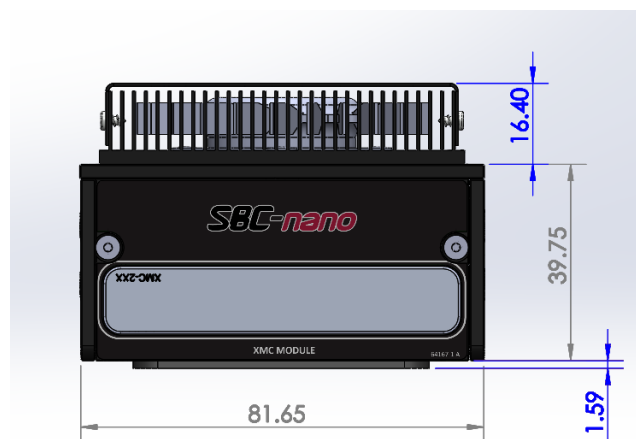


Illustration 8: Minimal dimensions of chassis

# SBC-Nano

## Standard Features

COM Express Site	
Standards	PCIMG COM.0 COM Express Base Specification R2.1 Compliant
Type	10
Size	Supports 84 x 55 mm modules
Verified Modules	Adlink nanoX-BT
CPU Types	Quad core Atom™ E3845 1.91 GHz 542/792 Gfx (Turbo) 10W (4C/1333)
COM Express Memory	Single channel non-ECC 1333 MHz soldered DDR3L memory, 4GB
eMMC	Soldered on module bootable eMMC flash storage, 32 GB
IO Ports	
USB	USB 3.0: Type A rear panel port (USB 0) USB 2.0: Type A rear panel port (USB 1) internal header (USB 3)
Ethernet	<cfg 2>: Single 10/100/1000 GbE port
Video	Mini DisplayPort
SATA	2x SATA 3Gb/s ports (mSATA)
Serial	2 UART ports COM 0/1
XMC Sites	
Module Sites	1
Standards	VITA 42.3 XMC for PCI Express VITA 20 Conduction cooling
Size	75 x 150 mm, 10mm mezzanine height
PCI Express Connections	<cfg 1>: XMC Site (4 lanes, PCIe gen2) <cfg 2>: XMC Site (2 lanes, PCIe gen2)
J16 Support	16 single/8 differential direct connections to Molex I/O connector

Timing and Triggering Support Features	
Clock and Trigger	XMC Module dependent
Power Management	
Power States	Low power states supported including wake features from PCI Express and LAN
Temperature Monitors	2 total : COM Express module and XMC module each have a temperature sensor
Alarms	Software programmable warning and failure levels
Over-temp Monitor	Disables power supplies
Conduction Cooling	Cooling supported for SBC-Nano assembly uses VITA20 XMC thermal rails and VITA 57.1 (mech. only) mezzanine cards.
Power Requirements	
Input	8 to 18V DC
Consumption	<i>Varies according to XMC and COM Express module requirements</i> 15W: SBC-Nano with quad Atom 1.91 GHz COM Express module, 4GB memory and NO XMC
Physicals	
Form Factor	150x75 mm, ~75 mm height (depends on options)
Weight	941g typical: SBC-Nano+Nano Extension+1 mSATA+X6-1000M.
Hazardous Materials	Lead-free and RoHS compliant
MTBF	17021 Hours



# SBC-Nano

## ABSOLUTE MAXIMUM RATINGS

!Exposure to conditions exceeding these ratings may cause damage!

Parameter	Min	Max	Units	Conditions
Supply Voltage	6	14	V	
Operating Temperature	-40	60	C	Non-condensing, cold plate required.
Storage Temperature	-55	130	C	
ESD Rating	-	1k	V	Human Body Model
Vibration	-	5	g	9-200 Hz, Class 3.3 per ETSI EN 300 019-1-3 V2.1.2 (2003-04)
Shock	-	40	g peak	Class 3.3 per ETSI EN 300 019-1-3 V2.1.2 (2003-04)

# SBC-Nano

## Architecture and Features

The SBC-Nano combines a Windows/Linux compatible embedded PC with XMC IO module and supporting peripherals to create a customizable instrument for a wide variety of applications.

### Embedded PC

The embedded PC architecture is Windows/Linux compatible – it runs the same applications as a desktop computer. The COM Express CPU module is a PC on a module and provides the computing engine, available with four low power Atom cores for ultimate computing power.

The COM Express module provides the PCI Express bus that links the XMC module to the CPU. The XMC module behaves identically to PCI Express add-in cards within a PC and are software compatible with PC applications. The PCI Express bus tightly couples the CPU to the XMC modules and outperforms previous generation systems by 2 to 4 times. Data transfer rates between the XMC module and CPU memory occur at speed up 1600 MB/s.

SBC-Nano provides familiar PC interfaces for expansion and connectivity: Ethernet, USB ports, and SATA SSD. Multiple SBC-Nano's may be connected into a mesh using the optional 1 Gb ethernet port for high performance IO supporting up to ~100 MB/s transfer rates to external devices such as other eInstruments.

The mini DisplayPort video port and USB keyboard/mouse make operating the SBC-Nano to operate just like any PC. Standard PC screens supporting resolutions up to 1280x780 are supported. “Headless” operation is also supported for truly embedded applications without keyboard/monitor/mouse attached. In the headless mode, the SBC-Nano can be remotely controlled and accessed over Ethernet or via remote protocols such as RDP or VNC.

### XMC IO Site

A single XMC IO module site enables the SBC-Nano to be configured with a wide variety of IO modules. The XMC site is for PCI Express mezzanine cards conforming to VITA 42.3 standard, which are 75 x 150 mm modules (IEEE 1386). Each installed module must employ a suitable heat spreader to conduct heat to the thermal rails running the long edge of the SBC-Nano connected to a cold-plate within the system.

Innovative offers three lines of XMC IO modules: the X3, X5 and the X6 families. These module families offer a range of analog performance mated to high performance FPGA computing cores, with the X6 family featuring the Xilinx Virtex 6 and the X3 using the Xilinx Spartan 3 family. Innovative's Velocia architecture data packet system allows these modules to stream data continuously to system memory at rates up to 1.6 GB/s – making the SBC-Nano well suited for data logging and playback functions. When configured with a two SSD RAID0 array, sustained rates to 500 MB/s are achievable (limited by the SATA 2 links provided by the COM Express module).

### COM Express Advantages

- Intel compatible PC runs Windows and Linux software
- Scalable performance
- Latest technologies: PCIe gen2, Gb Ethernet, USB 3.0
- Upgradeable as requirements change and evolve
- Tech refresh every 18 months
- Compact 95 x 125 mm form-factor
- Industry-standard, multi-vendor

### XMC Modules for IO

- Flexible, modular IO
- Industry-standard VITA 42.3
- PCI Express with up to 1.6 GB/s transfer rates
- X6 modules: IF Rx, Tx, GSPS A/D with Virtex6 FPGA
- X3 modules: Analog and digital IO with FPGA
- Industry-standard, multi-vendor

# SBC-Nano

SBC-Nano supports XMC module families special features for sampling, triggering, and controls. Each XMC module's J16 interface also routes 8 differential/16 single ended connections to a high-speed Molex I/O connector for custom applications.

## Triggering and Sample Clocks

Sample clocks for the XMC modules can be generated using an XMC module's on-card PLL or from an external clock input. The PLL can use the external clock input as a reference.

Triggering on XMC modules can be done via the software or by using the external trigger signal. More details on the clock and triggering features can be found in used XMC modules specifications.

## Remote Operation

SBC-Nano can be operated using Ethernet as a remote computer or embedded instrument. For pure embedded operation, the SBC-Nano can operate “headless” without monitor, keyboard or mouse. The system boots from a 32 GB eMMC drive located on the COM Express module itself. Thus, the two SATA 2 links and bandwidth can be dedicated to storage of application-specific data.

## Software Tools

Software development tools for the SBC-Nano provide comprehensive support application development including device drivers, peripheral configuration and control, and utilities that allow developers to be productive from the start. Software classes provide C++ developers a powerful, high-level interface to the system devices that makes system integration and achieving real-time, high speed data acquisition easier.

Software for data logging and analysis are provided with every Innovative XMC module. Data can be logged to system memory at full rate or to disk drives at rates supported by the drive and controller. Triggering and sample rate controls are provided to support data acquisition applications without writing code. Innovative software applets include *Binview* which provides data viewing, analysis and import to MATLAB for large data files.

Support for MS Visual C++ is provided. Supported OS include Windows and Linux. For more information, the software tools User Guide and on-line help may be downloaded.

# SBC-Nano

## XMC Modules

Plug XMC modules into the SBC-Nano to build your custom, turnkey embedded instrument. Innovative Integration offers an array of ultra-performance PCI Express XMC modules to create your solution.

Innovative XMC module families feature analog and digital IO with FPGA computing cores on high performance PCI Express modules. The FrameWork Logic development tools allow you to design in MATLAB and VHDL and rapidly implement high speed signal processing on the XMC. A list of all currently available XMC modules is available on the website [here](#).

# SBC-Nano

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