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Mil-aero: Battling design constraints
Sosa, Swap and security – Caroline Hayes looks at some of the drivers for embedded board design used in military equipment.

The Quartz Model 5550 has been designed by Pentek, a member of the Sosa Consortium, for the Sosa reference architecture

Effective, reliable communications are vital for electronic warfare, radar and signals intelligence, but the principles of size, weight and power (Swap) still apply for military land and air vehicles.

A recent introduction from Pentek, the Quartz Model 5550, is an eight-channel ADC and DAC, 3U OpenVPX board for communications, electro-optical applications, electronic warfare, radar and signals intelligence.

Based on the Xilinx Zynq UltraScale+ RFSoC, it incorporates the Ansi/Vita 67.3D VPX Backplane Interconnect standard for coaxial RF and optical I/O, to meet the Sosa reference architecture requirement for backplane-only I/O.

The Sensor Open Systems Architecture (Sosa) is an open system reference architecture for military and commercial sensor systems. Its aim is for all sensor systems to be quickly configurable and reusable despite their increasing size and complexity.

The front end accepts analogue IF or RF inputs on eight coax connectors within a Vita 67.3D backplane connector. The signals are routed to eight 4Gsample/s 12-bit ADCs, each with an integral digital down converter with programmable decimation and independent tuning. The AD digital outputs are sent to the RFSoC programmable logic and processor system for signal processing, data capture or to be routed to other resources.

There is a second Vita 67.3D coaxial backplane connector which receives balun-coupled signals from eight 14-bit DACs and there are four additional 67.3D coaxial backplane connections for clocks and timing signals.

Interoperability

The Sosa architecture is based on modular design and non-proprietary standards for interfaces to reduce development time, to ease integration, increase reuse and reduce the cost of modernising a system.

Pentek says that its modular approach to both hardware and software allows for quick adaptions to meet changing requirements. At the heart of this board is a Model 6001 QuartzXM eXpress module which includes the RFSoC FPGA and supporting circuitry. There is also a 40GbE interface and a shelf-management subsystem, as required by Sosa.

The board is preloaded with data capture and processing IP modules for common applications, such as DMA engines, DDR4 memory controller, test signal and metadata generators. There is also pre-installed IP for triggered waveform and radar chirp generation, triggered radar range gate selection, wideband real-time transient capture, multi-mode data acquisition and extended decimation.

For Gigabit communications independent of the PCIe interface there are two built-in 100GbE user datagram protocol (UDP) interfaces or a user-installed serial protocol in the RFSoC in the VITA-67.3D backplane interface.

The board is supported with the Navigator FPGA design kit for custom IP and Navigator board support package.

Swap considerations

Mobility relies on small size and weight and Pentek has also reduced the size of recorders based on its Talon signal recording and playback systems.

Its latest release is the RTX 2684 26GHz RF Sentinel Intelligent Signal Scanning small form factor recorder. It weighs 10.4kg (23lbs) and is sealed for operation in extreme operating environments.

The recorder is used for signal intelligence gathering, scanning the RF spectrum and monitoring or recording bandwidths up to 500MHz. The spectral scan allows the engineer to scan the spectrum and threshold detection is used to automatically lock onto and record signal bands. The real-time recorder can capture signals of interest and store to disk.

The half ATR (analogue tape recorder) has up to 61Tbytes of removable SSD storage. The chassis' small size and weight make it particularly suitable for military, security and government intelligence applications which need to be mobile or are in confined spaces. It is also sealed and engineered to operate at high levels of shock and vibration.

Military standard circular I/O connectors control RF emissions and protect the recorder from humidity, water, dust, sand and salt fog. Further protection is afforded by heat extraction through conduction to an air-cooled inner plenum to seal the internal electronics. Only the fan is exposed.

Operating temperatures of between -40°C and +50°C mean the recorders can operate in most thermal environments, from unmanned aerial vehicles (UAVs) to aircraft pods, and from equipment bays to military vehicles as well as outdoor environments.

RF signals are down-converted directly to the ADC for antenna-to-disk recording. Roger Hosking, vice-president of Pentek, said it achieves a five-fold reduction in packaging compared to the rackmount equivalent.

The data acquisition engine is a Model 78141A Jade transceiver module. This has dual 3.2Gsample/s 12-bit ADCs, operating at 2.8Gsamples/s. The transceiver module is coupled to the 500MHz bandwidth analogue IF output signal of a 26GHz RF tuner front end for dynamic range and a digital down converter provides frequency zooming for recording 125-, 250- and 500MHz signals.

The recorder is based on the Intel Core i7 7700K quad core 4.2GHz processor, which has 8Gbyte DDR4 DRAM, expandable to 16- or 32Gbytes.

Data storage

Large volumes of data storage can be removed and replaced using the QuickPac drive pack. This holds up to 61Tbytes of solid state drive data and supports RAID levels 0, 5 or 6. It is held in place on the front panel by captive thumb screws and is sealed with environmental gasketing. It allows data storage to be moved with minimal downtime.

There is also a companion drive pack so that the recorder can be used while the recorded data is reviewed at another location. For secure

applications, a separate operating system can be removed, to extract non-volatile memory in seconds, says the company.

Its SystemFlow software supports system control and operation. The enhanced version of the software has intelligent scanning and integrated RF control. A graphical user interface (GUI) has point-and-click configuration and can store custom configurations for a single-click set up.

The software also includes a virtual oscilloscope, spectrum analyser and spectrogram.

Post-processing and analysis software, like MatLab tools, can be installed. Data files are recorded to the Windows native new technology file system (NTFS) for immediate access without file format conversion.

There is also an optional GPS receiver for time and position stamping and additional QuickPac drive packs with 3.8Tbyte to 61Tbyte capacities.

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https://www.electronicsweekly.com/news/mil-aero-battling-design-constraints-2020-03/