Matching Components for your KU060 FPGA Design

The XQRKU060 brings high performance machine learning (ML) to space, and Protec GmbH can help you to make your KU060 design even better.

1. Power for your KU060

Intersil offers a wide Variety of components to power the KU060 FPGA. The Intersil / Renesas team in the US is working on a Power Solution Evaluation Board at the moment, to provide customers with a fully validated rad hard power solution they can use in their designs, reducing development time.

If you click on the individual Building Blocks below - the Datasheets will open.
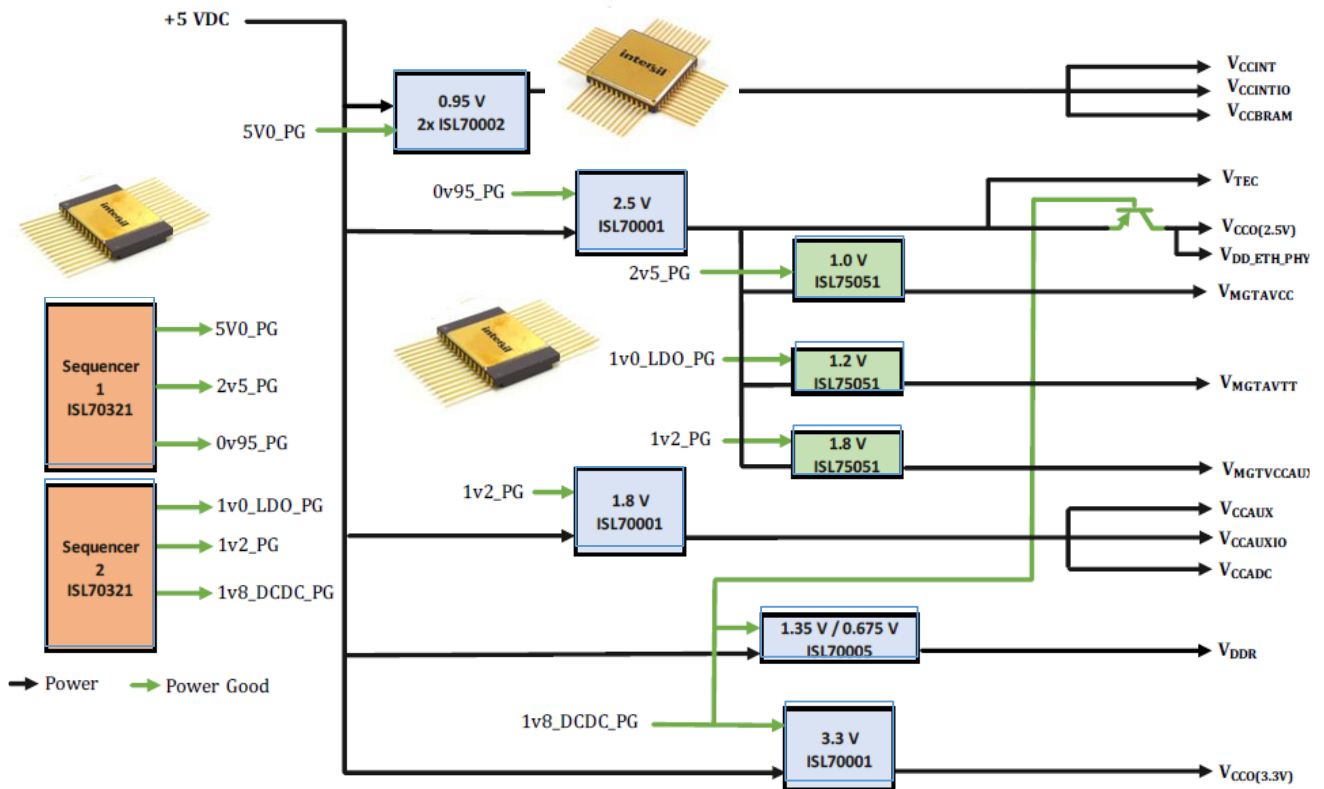
Schedule

Phase 1: Schematic & BoM Completion –July 17, 2020
Phase 2: PCB Design Completion –July 31, 2020
Phase 3: Evaluation Boards Available –September 18, 2020

2. Teledyne e2v Radiation-Tolerant Quad Core ARM Cortex A72 companion Processor to load your FPGA image into the Xilinx KU060 & Processing Data to save FPGA resources

The LS1046A is a cost-effective, power-efficient, and highly integrated system-on-chip (SoC) design that extends the reach of the TELEDYNE-E2V value-performance line of QorIQ communications processors. Featuring power-efficient 64-bit Arm® Cortex®-A72 cores with ECC-protected L1 and L2 cache memories for high reliability, running up to 1.8 GHz.

The LS1046A and LS1026A processors are perfectly suited for a range of embedded applications such as enterprise routers and switches, linecard controllers, network attached storage, security appliances, virtual customer premise equipment (vCPE), service providers gateways, and single board computers.

This stand alone processor enables you to do in-Orbit reconfiguration of your Xilinx FPGA and safely load your image into the FPGA. It also saves Resources in your FPGA since most Processing could be done by the external Processor.

LS1046-Space - Radiation Tolerant Quad ARM® Cortex® A72

Performances, Ecosystem & Reduced Power
- Quad 64-bit Arm® Cortex® A72 cores, Up to 1.6GHz
- NXP LS1046 based
- 2MB total L2 cache, 1-10GbE, PCIe 3.0, UARTs, SPI, I2C, …

Radiation tolerance
- TID (target):   100 krad(Si)
- SEL :   > 60 MeV.cm²/mg
- SEU/SEFI :   Data available at 60 MeV.cm²/mg
- LS1046 Space

Applications
- Image processing / Data crunching and compression
- Telecommunications with ultra-low latency
- On-Board decision making, including AI
- KU060 Companion Chip

Sampling now with Teledyne e2v Space Specifics
- Reduced lead time – EMs available
- NASA Level 1 (NASA EEE-INST-002–Section M4–PEMs) & ECSS Class 1 (ECSS-Q-ST-60-13C)

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3. Teledyne e2v Radiation-Tolerant DDR4 Memory for the Companion Processor a combination to push your KU060 design extreme performance

Teledyne e2v has announced the DDR4T04G72M – the first radiation-tolerant DDR4 memory chip, featuring a total 4GB capacity. Currently validated at 2133MT/s, and targeting to offer 2400MT/s in the near future, this next-generation solution offers ultra-responsive low latency operation, while fitting into a highly compact form factor. Furthermore, high-reliability manufacturing and radiation-tolerant robustness makes it highly suitable for dealing with the rigors of space environments.
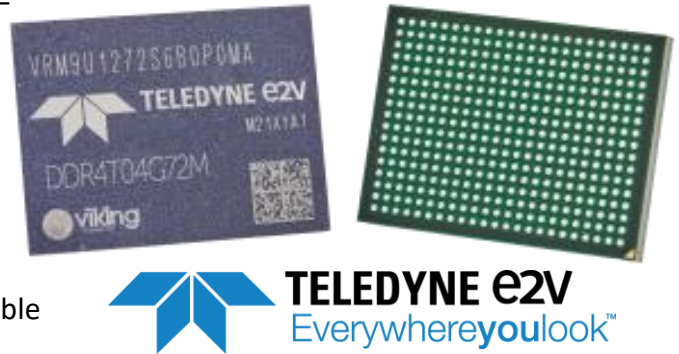
With 15mm x 20mm x 1.92mm dimensions, this new space-grade device comprises an array of Micron based memory chips, integrated in a single package. It features a 72bit bus, where 64bits are dedicated to data and 8bits to error correction code (ECC).

Radiation tests have been performed on these memory chips and a single event effects (SEE) report is available from Teledyne e2v. In particular, the memory has been demonstrated to be single event latch-up (SEL) free up to 60+MeV.cm2/mg.

This new space-grade DDR4 memory enables elevated levels of performance, while taking up minimal board real estate – something that is certain to be of value in highly space-constrained, densely-packed satellite designs.

The thermally-enhanced packaging technology accelerates heat dissipation, in order to maintain continued operational reliability. Flight Models will be available up to an extended temperature range of -55°C to 125°C. It is compliant with NASA Level 1 (NASA EEE-INST-002 – Section M4 – PEMs) and ECSS Class 1 (ECSS-Q-ST-60-13C).

"The combination of radiation tolerance, rugged construction and small form factor, make this Radiation Tolerant 4GB DDR4 memory a very appealing solution for integration into space-oriented systems," states Thomas Guillemain, Marketing & Business Development Manager at Teledyne e2V Semiconductors. "This space-grade DDR4 offers the transition path to newer generations of processing devices required by compute intensive space applications".

Product Name	Radiation Performance	DDR Size	Bus width	Temperature Range	Package Type	Speed (MT/s)	Rev	Space Grade
DDR4	T : Rad Tol	04G : 4 GByte 08G : 8 Gbyte	72 : 72 bits	M : -55/125C A : -40/105C C : 0/70C	ZR : PBGA Stacked Wire Bond (C5 Leaded) ZS : PBGA Stacked Wire Bond (C5 RoHS)	T : 1866 1 : 2133 2 : 2400	A	-N1 : Nasa Level 1 -N2 : Nasa Level 2 -N3 : Nasa Level 3 EM : Engineering Models EQM : Engineering Qualified Models -E1 : ECSS Class 1 -E2 : ECSS Class 2 -E3 : ECSS Class 3

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4. Teledyne e2v - Ka-Band digital-to-analog converters (DACs) such EV12DD700
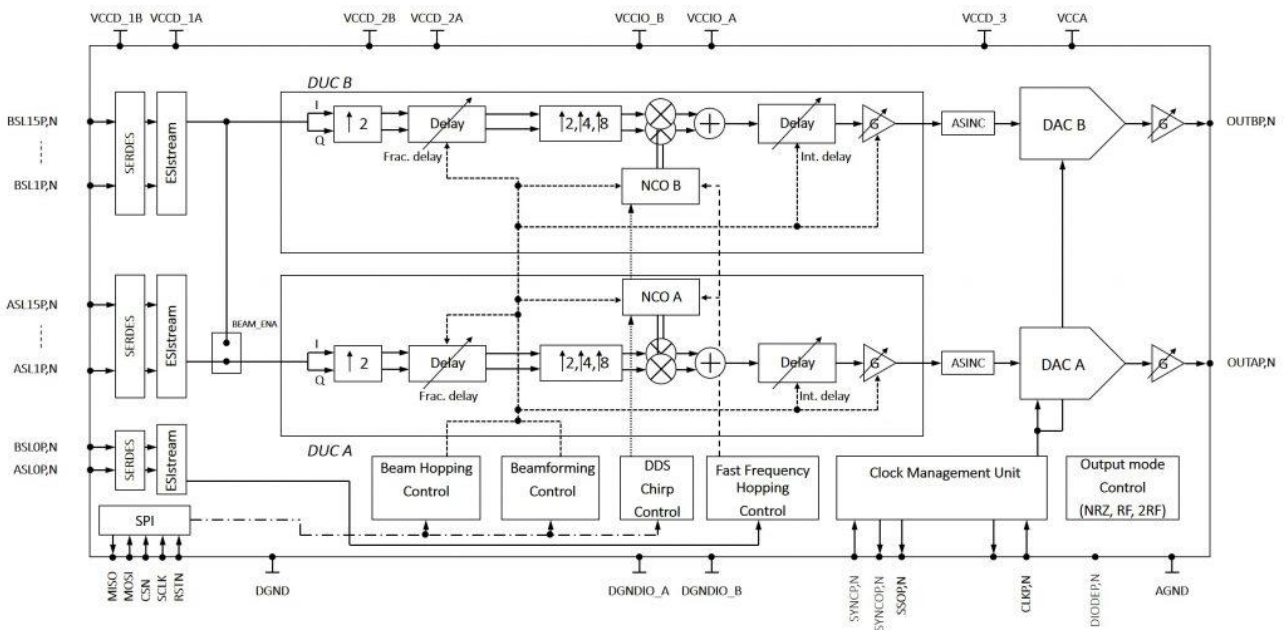
This new DAC provides a significant leap forward for RF Softwarization. At any band up to Ka, System designers can now migrate more RF hardware to digital code than ever before. Enabling unprecedented levels of dynamic RF system reconfiguration on the fly.

EV12DD700 dual-channel DACs are capable of operating up into Ka-band frequencies and support beamforming applications. They have a 25GHz output bandwidth with only 3dB attenuation being witnessed, and can go way beyond this with just a little over 3dB attenuation. Built into each DAC is an array of sophisticated signal processing functionality.

TELEDYNE e2v
Everywhere**you**look™

This encompasses a programmable anti-sinc filter and direct digital synthesis (DDS) capabilities, as well as a programmable complex mixer. Also included is a digital up-converter (with four interpolation stages, plus sinc compensation).

Digital Processing Functions:	Main features:	Feature rich digital signal path:
• Interpolation ratios • Digital Up Conversion (DUC) • Numerically Controlled Oscillator (32-bit NCO) • Direct Digital Synthesis (DDS) • Digital beamforming and beam-hopping (amplitude and) • Very-fast frequency hopping	• Programmable output mode (NRZ, RF, 2RF) • Gain adjust • Programmable SINC compensation function • Multi-device synchronization	• Digital beamforming • Programmable anti-sinc filter • Programmable complex mixer • Digital up conversion (DUC) • Direct digital synthesis (DDS)

5. Teledyne e2v - Multi-channel Analog-to-digital converters (ADCs) such as EV12AQ600

The first 12-bit ADC to feature a Cross Point Switch (CPS), the EV12AQ600 can operate its four cores simultaneously, independently or paired, to assign its 6.4 GSps sampling speed across the user's desired channel count:

- Quad-channel at 1.6 GSps
- Dual-channel at 3.2 GSps
- Single-channel at 6.4 GSps

SFDR in 4 channels mode without H2 and H3 harmonics is better than 70 dBFS at -1 dBFS up to 5980MHz.

This device is offered in different grade classes from commercial and industrial grades, up to a radiation-tolerant space version.

EV12AQ600 is fit for various applications, such as:

- Earth observation SAR payload,
- Telecommunication MIMO satellite payload,
- High-Speed Data Acquisition,
- High-Speed Test Instrumentation,
- C-band Direct RF Down Conversion,
- Software Defined Radio/Microwave,
- Ultra Wideband Satellite Digital Receiver,
- Point-to-Point Microwave Receivers,
- Time of Flight Mass-Spectrometry,
- LiDAR (Light Detection and Ranging),
- High Energy Physics

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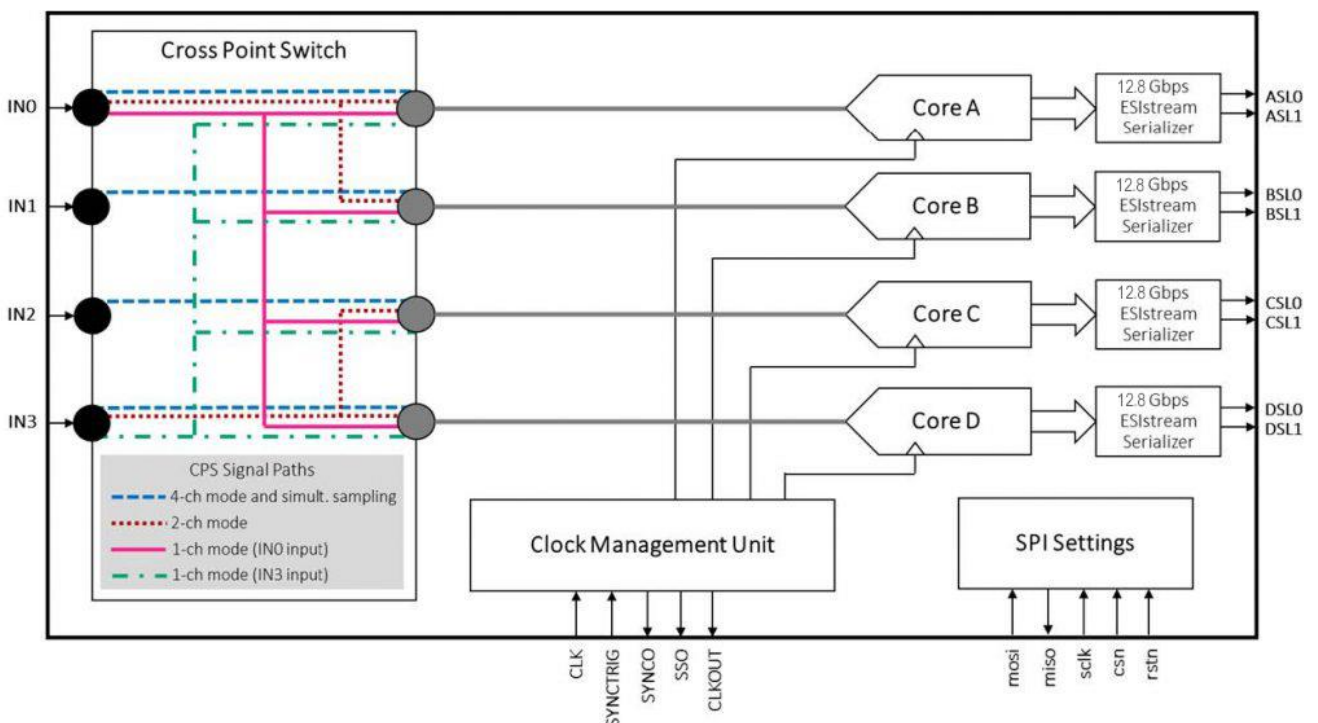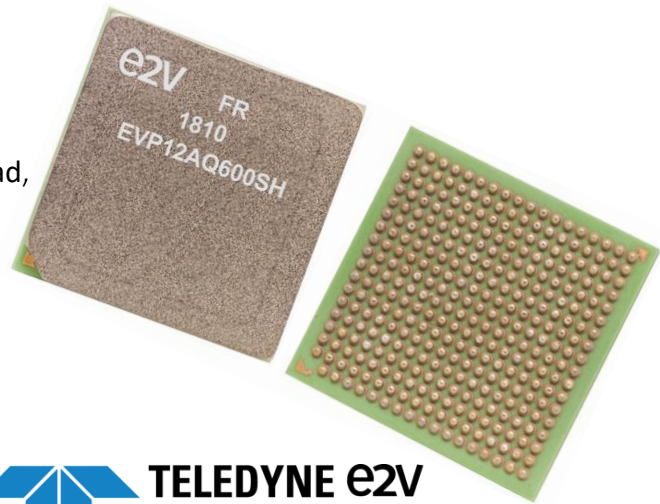
6. Reflex Optical Transceivers - High Speed Data Interfaces for your KU060 directly interfacing to the HSSL of the FPGA achieving data rates of 12,5GBps or even higher 28GBps for board to Board or Box to Box connections

Reflex Photonics Demonstrated the possibility to user their Optical Transceiver directly connected to the RTG4 SerDes 3.125Gbps in October 2019 at the MicroChip Space Forum. The Reflex Photonics Modules are available as Transceivers with 4TRx channels in a very small package 20 x 14 x 5mm where no soldering is needed (Interposer).

If more channels are needed Reflex also offers 12Rx or 12Tx Modules.

These optical Transceivers are used more and more in Traditional Space applications as well as in New Space Constellation Applications. Reflex offers very competitive pricing compared to traditional copper based data transfer solutions. In addition to that the optical data transfer offers much more advantages for your design. Your harness will be much lighter and smaller in diameter, lower power, electrical isolation, very high data transfer rate in a very small PCB area.

6.1. Fiber Cable Assemblies

Protec also offers Fiber Cable assemblies, for Space applications. We work with multiple partners in Europe and US for Fiber Cable Assemblies. The cables will be manufactured acc. to your Specs.

With your Choice of Connectors, Termini's, Fibers and length also depending on your Application you might have additional requirements to Protect the fibers, we can offer many different solutions from PTFE or PFA Tubes to ribbonising or even Radiation Testing of the Fibers. All cables can be ordered with test protocols acc. to your specifications.
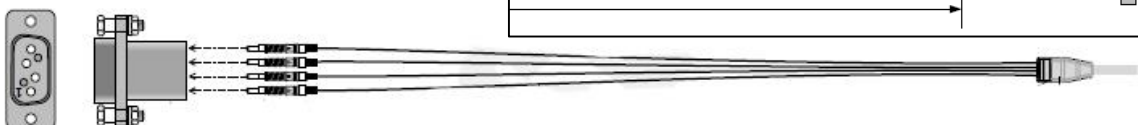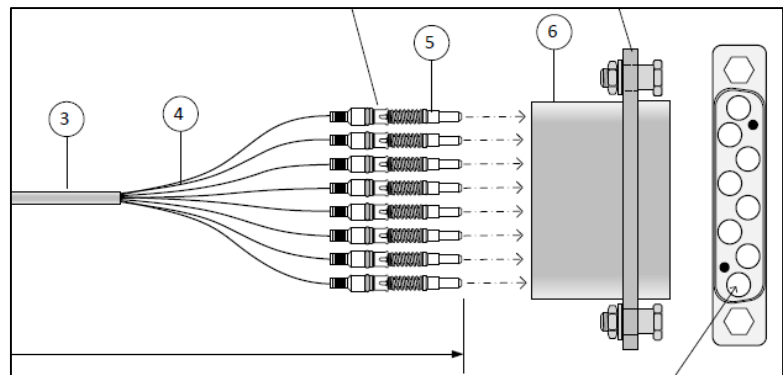
7. Oscillators from Q-Tech for the KU060

- Class B+
- Multi-Output LVDS
- QT626L CMOS XOs
- MCXOs
- OCXOs
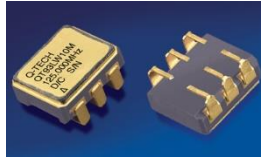
7. SpW IP for your KU060 Design from 4Links

4Links' SpaceWire IP is based on a version of the CoDec (Coder / Decoder) used in its test equipment for SpaceWire. And the best part of it is it is for free.

Thousands of SpaceWire ports of this test equipment have proved to be interoperable with all the SpaceWire designs to which they have been connected. The IP is free and flight proven as the fundamental interconnect on a satellite. It also complements the test solutions and cabling on offer by 4Links.

The IP is implemented in VHDL, but is designed to be instantiated in Verilog with minimal effort. The IP is Supplied as a complete package:

- Standard, easy to use FIFO-style interface to user logic (Data Flow Channel, DFC)
- HDL simulation test bench
- Traffic generator
- Traffic logger (logging all the received traffic)

The simulation test bench (picture on the right) enables you to easily see how the IP operates and how to integrate it into your design. A traffic generator and logger are included in the test-bench connecting to the 4Links standard Data Flow Channels (used to connect to all 4Links IP). The generator and logger use a simple text based file allowing easy modification and checking of the vectors, so you can customize it to model the actual data in the design.