



T1042-based Single Board Computer

High Performance/Low Power DO-254 Certifiable SBC IP



Features and Benefits

- Part of the COTS-D family of safety certifiable modules
- Single conduction-cooled rugged module - 3U VITA-65 (OpenVPX™) solution
- A complete HW solution with data package to support certification to RTCA DO-254/EUROCAE ED-80
- Board Support Packages (BSP) available, as well as data packages to support certification to RTCA DO-178C/EUROCAE ED-12C
- The provision of all IP and data to enable manufacture, support, and repair of the module
- Integrated graphics supported with CoreAVI’s Certifiable OpenGL software renderer, T1042 DIU, and DVI output

Introduction

The T1042-based Single Board Computer (SBC) is ideal for avionics and defense applications requiring the best performance per watt from a safety certifiable Power Architecture®-based processor including a built-in graphics interface and an XMC expansion site to maximize the functionality in a single-slot of a 3U VPX system.

The T1042 SBC design comes with all the data needed for support, manufacturing and repair of the module, as well as data to support DO-254/ED-80 hardware certification. The SBC also comes with off-the-shelf certifiable BSPs for most certifiable O/S’s, complete with data to support DO-178C/ED-12C software certification. The available data kits support both FAA and EASA certification authority needs.

Processing

The Central Processing Unit (CPU) is the NXP® T1042 Power Architecture processor from the QorIQ® Advanced Multiprocessing (AMP) series. The T1042 embedded processor was architected to provide maximum performance per watt, and enable small form factor conduction-cooled solutions with high performance and functionality. The advanced features include four e5500 64-bit Power Architecture cores operating at 1400 MHz along with low latency, large caches, advanced interconnect and memory hierarchy.

NXP QorIQ AMP processors are ideal for the aerospace and defense market, providing integrated features such as ECC, parity, support for hardware assisted virtualization and partitioning enforcement, along with safety and security blocks that make them suitable for robust applications. In addition, these processors are manufactured in large volume, providing confidence for “in-service experience”.

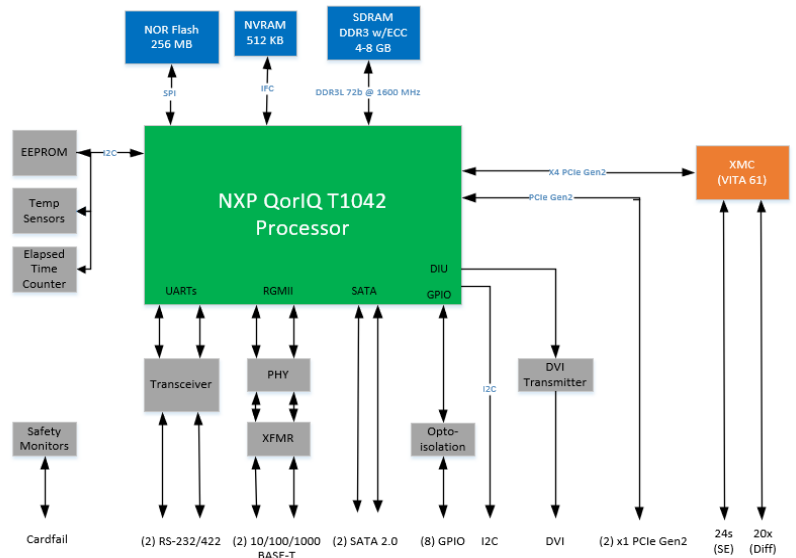


Figure 1: T1042 SBC Block Diagram



Memory

The following table summarizes the available memory:

Memory	Size	Interface	Typical Use
SDRAM – DDR3	4-8 GB	DDR3L 72b @ 1600 MHz	Main application memory
NOR Flash	256 MB	Quad SPI	Application program storage
NVRAM	512 KB	LPC	Application non-volatile data storage
EEPROM	256B	I2C	Product information (product identification, serial number, MAC address etc.)

Integrated Graphics Support

The T1042 Display Interface Unit (DIU) is supported with CoreAVI’s IGL OpenGL SC 1 DO-178C/ED-12C certifiable driver library suite which performs OpenGL graphics software rendering to SDRAM which is then sent out to the DVI transmitter by the DIU. IGL is one of the highest Technology Readiness Level (TRL) software renderer solutions available. It is a proven solution deployed on various platforms and provides deterministic execution in a small footprint driver library.

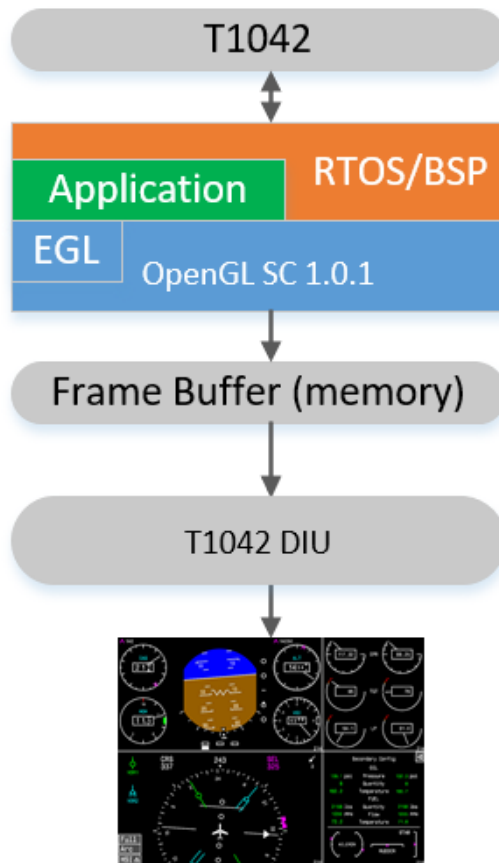


Figure 2: IGL Workflow



Inputs and Outputs

The following table summarizes the available input and output interfaces:

Interface	Quantity	Typical Use
RS-232/RS-485	2	Asynchronous communication with one transmit and one receive signal for development and maintenance
Ethernet 10/100/1000 BASE-T (certifiable UDP/IP interface)	2	High speed data transfer with other systems, sensors and central storage
LVTTL Discrete I/O	8	Single-ended discrete signal monitoring and driving (5V tolerant)
I2C	1	Interface to custom functions on the backplane or system level I/O panel
DVI display driver	1	Graphics display which can be driven by CoreAVI's OpenGL SC 1.0 software renderer.
PCIe x4 Gen 2	1	High speed bus interconnect to communicate with other modules within a system
SATA 2.0	2	Interface to recorder, removable storage to provide mission data and recording

Local Functions

Local functions include an Elapsed Time Counter (ETC) to track module up-time to assist with maintenance activities.

The T1042 provides two four channel DMA engines that are available for general purpose use, which may be used for transferring data between the SDRAM, Flash memory, device bus peripherals, Gigabit Ethernet and the PCIe bus. The DMA controllers have bandwidth management to control the distribution of bandwidth between the DMA channels.

Expansion

Within a 3U VPX system, the capabilities of the module can be expanded. The processor may be configured to have two x1 PCIe Gen 2 communication/data links with up to two independent modules without the need for an addition PCIe switch.

Local card expansion is supported by a standard XMC 2.0 (VITA-61) expansion interface with a 4-lane PCIe Gen 2 interface. The Pn6 I/O is mapped per VITA 46.9 P2W1-X24S+X8D+X12D (24 single ended and 20 differential I/O interfaces) to the backplane. VITA-61 is based on the VITA-42 XMC replacing the connectors with alternative pin and footprint-compatible ruggedized high speed mezzanine interconnectors. The XMC site supports industry standard XMC modules including the CoreAVI E9171 COTS-D Graphics Controller which is available to provide high performance graphics capability.

Safety and Security Features

In addition, the module provides a suite of safety monitors to support safety requirements. These include temperature, voltage and clock. The temperature monitors, two for monitoring module temperature and one for monitoring the T1042 die temperature, are under application control while voltage and clock out of range would result in the module being shut down. A failure of any of the monitor, or a software failure indicator, results in the assertion of a Card Fail indicator to the backplane. In addition to the monitors, there is an independent watch dog timer that will time out and cause a module reset if not "kicked" by the application before timing out.



Software

RTOS Board Support

DO-178C/ED-12C certifiable Board Support Packages (BSP) are available off-the-shelf for the following operating systems. Please contact CoreAVI for other RTOS BSP support. In addition to the Board Support Package, CoreAVI is able to provide a complete DO-178C/ED-12C certifiable software package including the Real Time Operating System and its artifacts, certifiable Built-In-Test (BIT) Software, certifiable graphics drivers – all pre-integrated and ready to go. As the single provider of the entire software suite, support is easy to obtain and CoreAVI's expertise in software certification ensures the lowest risk.

- Wind River® VxWorks® 653
- DDC-I Deos™
- Lynx Software LynxOS®-178

Firmware

The T1042 SBC includes boot loader firmware to perform basic initialization of the module prior to loading and starting the application. Two versions of the boot loader are provided, a development boot loader with which you can develop, load and debug the application, and a DO-178C/ED-12C certifiable boot loader, included with the RTOS BSP, which is needed to start the application once it's developed.

Application Development Support

The T1042 COP probe signals are made available to the backplane and Rear Transition Module (RTM) where they are provided in a standard Test Access Port (TAP) to assist with application development and debug.

Rear Transition Module (RTM)

For development purposes a RTM is available that plugs into the backside of the backplane in the same slot as the T1042 SBC. The RTM provides access to the T1042 SBC I/O through commercial industry standard connectors, headers and cables.

Lifecycle

The T1042 is part of NXP's Product Longevity program which ensures stable supply for 15 years from product launch (October 2012) making it one of the longest available Power Architecture processors available today.

Specifications

The T1042 SBC is designed to run from the +5V rail (VS3) with maximum typical current per the following table based on the execution of a representative application at the highest rated operating temperature.

Voltage	Typical Current (Amps)
+12V	Only if required by XMC module
-12V	Only if required by XMC module
+5V	3
+12V Auxiliary	Not used
-12V Auxiliary	Not used
+3.3V Auxiliary	0.1



The T1042 SBC dimensions are per VITA 46/IEEE 1101.2 for a 0.8" pitch conduction-cooled module, without solder-side cover. The weight is less than 400 grams.

The environmental specifications are per the following table:

Environment	Specification
Operating Temperature	-40 to +85°C at module edge
Storage Temperature	-55 to +105°C
Vibration	0.1 g ² /Hz (max), 5 to 2000 Hz
Shock	40 g. 11ms sawtooth
Humidity	0% to 95% non-condensing (dependent on conformal coating used)

The T1042 SBC is compatible with the following VITA-65 slot profiles:

- MOD3-PAY-2F2T-16.2.5-3
- MOD3-PAY-2F2U-16.2.3-3

COTS-D Data Kit

The COTS-D Data Kit provides all the data to enable support, manufacturing and repair of the T1042 SBC. Key elements of the data package include:

- Manufacturing data
- Theory of Operations
- Bill of Materials including full manufacturers part numbers
- Schematics
- PLD design files
- Mechanical drawings and assembly diagrams
- Printed Circuit Board (PCB) drawings and data
- Qualification data

Please request the COTS-D application note which provides further details on the data items and support provided for the technical transfer. The technical transfer also includes training and support as you introduce the product to your manufacturing facility or that of your chosen contract manufacturer.

DO-254/ED-80/ARP-4761 Data Kit

The DO-254/ED-80/ARP-4761 data kit provides documentation and evidence to support FAA and EASA certification needs of the hardware elements as well as Failure Modes and Effects Analysis (FMEA) and other documentation to support ARP-4761 safety assessments for the T1042 SBC. Specifically, data for the T1042 and PLDs support Design Assurance Level (DAL) A.

DO-178C/ED-12C Data Kit

The DO-178C/ED-12C data kit provides documentation and evidence to support FAA and EASA certification needs of the software elements. There are two data kits, one for BSP including initialization firmware and the second for the OpenGL SC 1 driver library suite (IGL) up to and including Level A.



Ordering

The following T1042 SBC products can be ordered from CoreAVI:

- T1042 SBC module for development purposes
- T1042 SBC RTM for development purposes
- COTS-D Design/Manufacturing Data Kit & license to use
- Safety Critical Data Kit supporting DO-254/ED-80/ARP-4761
- BSP
- DO-178C/ED-12C Level A Data Kit for the BSP
- RenderCore OpenGL SC 1.0 Software Renderer driver library suite
- DO-178C/ED-12C level A Data Kit for IGL

Contact CoreAVI to discuss your requirements and obtain a quote.