STAR-Dundee

SpaceWire Engineering Excellence

SpaceWire RTC Development Kit

AT7913E Radiation Hard Processor

The SpaceWire Remote Terminal Controller (RTC) processor (Atmel/Microchip AT7913E) is a Radiation-Hardened SPARC® V8 processor for space applications. This device comprises a powerful processor core, 64KByte EDAC protected on-chip memory, CAN and SpaceWire interfaces, FIFO interface, ADC/DAC interface for analogue acquisition/conversion, and other standard resources (UARTs, timers, general purpose input/output). The range of interfaces it provides and its low power consumption permits its use in a wide range of space applications including instrument control. Inclusion of CAN and SpaceWire interfaces enables bridging of traffic from a sensor network onto a high-speed SpaceWire network.

SpaceWire RTC Development Kit

The SpaceWire RTC Development Kit is designed specifically to support the development of hardware and software based on the SpW-RTC Processor (Microchip AT7913E). The Development Kit consists of a well-engineered development unit and a complete all-in-one software development environment. It provides great flexibility and supports a variety of test and development scenarios in a single instrument. It helps both hardware and software engineers at all stages of SpW-RTC related system development: evaluation, hardware prototyping, software development and debugging. The SpaceWire RTC Development Kit provides a complete package to help reduce development time and cost.

SpaceWire RTC Development Unit

The Development Unit is a complete AT7913E based processing board housed in a custom enclosure with the various interfaces of the AT7913E device available on front or rear panel connectors. The Development Unit is connected to the host PC using a USB 2.0 cable and powered via a 5V power brick.

Principal Features:

- **USB 2.0 interface:** This provides a high-speed communication interface from host PC to the development unit. The host computer is used to configure and control the development unit, and to carry out processor software development & debugging, plus hardware simulation & monitoring.
- **On-chip memory**: The SpW-RTC processor includes a 64KByte EDAC protected on-chip memory. Programmable over a SpaceWire link, the RTC then operates as a single-chip system, for remotely controlled applications.
- **On-board Memory:** The development unit includes 160Mbits of Flash PROM and 160Mbits of SRAM. Software loaded from the local PROM and executed from local SRAM allows the SpW-RTC to operate as a fully-featured system.
- **Hardware control:** The RTC Development Kit provides the RTC software full control of the RTC hardware, including processor watchdog and reset control, external break signal control, programmable system clock and memory bus width setting.
- **On-board ADC and DAC:** The development unit is equipped with on-board ADC and DAC chips, supporting four channel analogue inputs and one channel analogue output. These chips are commercial counterparts of Space Qualified ASICs. Designs based on this on-board ADC or DAC could easily be migrated to a flight design.
- **External hardware in the loop:** The connectors on the front and rear panels permit external hardware to be connected to the unit allowing integration with the SpW-RTC during hardware development, easing the development process.
- **Processor break push-button:** A processor break button is fitted on the front panel for the purpose of halting the processor and putting it into debug mode. Alongside this push button, a multi-colour LED indicates the processor's status.
- **Processor debug interfaces:** Supported interfaces include Debug UART over both USB and serial, and debug over SpaceWire using a STAR-Dundee SpaceWire interface device.
- **Traffic visibility:** The development unit provides multi-colour LEDs on each of the SpaceWire interfaces, CAN interfaces, and UART interface. These provide an immediate indication of the status of the corresponding interfaces.

Hardware Specifications

Size:

- 220mm wide, 30mm high (excl. feet), 115mm deep (approx.).

Power:

- +5V DC, power brick supplied.

USB 2.0:

- High Speed 480 Mbit/s.

SpaceWire Ports:

- ECSS-E50-12A and ECSS-E-ST-50-12C compliant.
- Maximum Speed: 200 Mbit/s.

Trigger input and output ports:

- SMB connectors: +3.3V signal, 5V tolerant.

CAN Ports:

- CAN 2.0B Protocol.
- Configurable Normal End Node or Stub Node modes.

UART RS-232 Port:

- Configurable DSU-UART mode or RTC peripheral UART mode.

On-Board ADC and DAC:

- Four channel Analogue inputs to ADC – AD774B.
- One channel Analogue output from DAC –AD667.

On-Board Memory:

- Up to 160Mbits SRAM (config. as -8bit, -32bit or -40bit bus).
- Up to 160Mbits FLASH (config. as -8bit, -32bit or -40bit bus).

Expansion Connectors:

- ADC and DAC expansion connector.
- FIFO expansion connector.
- LEON PIO & GPIO expansion connector.

SpaceWire RTC Software Development Environment

The Software Development Environment (SDE) provides a comprehensive, fully integrated set of software development tools for the SpW-RTC, including compiler, debugger, and monitor functions. It is based on widely used open-source software development tools, extended by the provision of features specifically designed to aid SpW-RTC software development. Additional software components allow connection to RTC-based hardware systems for software debugging and testing.

Overview

The SpaceWire RTC Software Development Environment consists of a number of components integrated together to provide a complete system for the editing, compiling, debugging and testing of software.

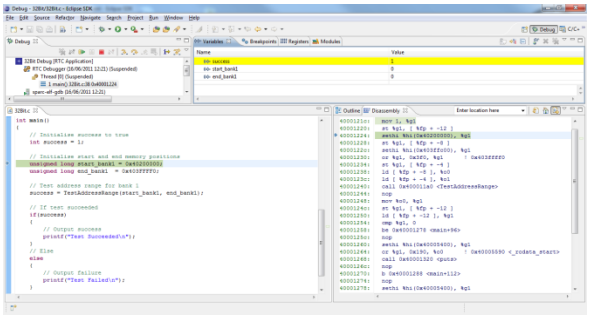
The components of the Software Development Environment are:

- **Code Rocket**: an abstract pictorial and descriptive input tool.
- **Eclipse IDE**: widely adopted Integrated Development Environment.
- **Custom plugins to Eclipse IDE**: provide seamless access to the peripherals and other components of the RTC, allowing reading and writing of data and control information.
- **GNU Compiler Collection:** fully integrated toolchain.
- **Hardware interface module**: manages communications between the Eclipse IDE and the SpW-RTC based system, using RS-232 or USB to connect to the Development Unit.

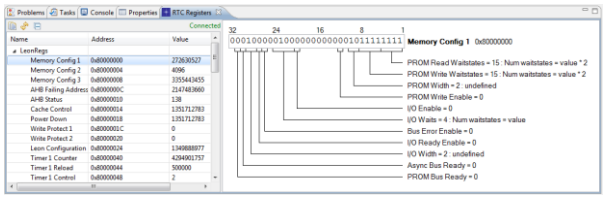
Fully Featured IDE

The Eclipse IDE is used for the RTC Software Development Environment front end. Its wide adoption for software development of embedded systems and its extensible nature make it an ideal choice.

Using a fast USB connection between the host computer and the development board ensures a smooth, highly responsive debugging experience. While debugging, Eclipse provides familiar views to allow inspection of code, variables and register values.

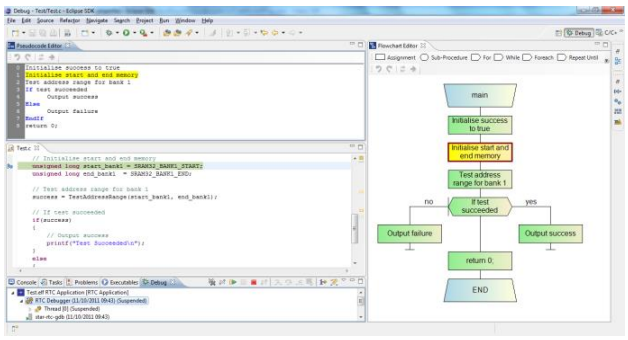


Custom views added to the Eclipse environment also provide access to other aspects of the hardware, such as the device internal register view.



Code Rocket

Code Rocket, from Rapid Quality Systems Ltd., is a software design tool that provides abstract pseudocode and flowchart visualisations of algorithms. A plugin for the Eclipse IDE allows the developer to design and visualise methods on demand.



When changes are made in the code, the design views are automatically synchronised. Similarly, when changes are made in the pseudocode or flowchart editors, the method can be re-populated with the associated forward-engineered code. The synchronisation between code and design ensures that neither gets out of date, and the ad-hoc nature of the tool means that it unobtrusively fits into the developer's working process. The Debug Stepping feature brings the design to life; as you step through code in the debugger, statements are highlighted in the pseudocode and flowchart views.

GNU Compiler Collection

The industry standard GNU Compiler Collection (GCC) provides a fully integrated toolchain, including compilers, linkers and debuggers, as well as a number of other tools. The RTC Software Development Environment uses a version of GCC, tailored for use with the SpW-RTC processor, and supports all RTC features.

A Board Support Package (BSP) is provided to support development of C and C++ programs.

Applications

The RTC Software Development Environment can be used to develop a wide range of applications based on the RTC hardware, such as instrument data processing and control software.

It allows development and integration of software and hardware for spacecraft instruments or payloads:

- In early stages when there is little or no access to hardware.
- When actual hardware (flight or test) becomes available.

The RTC Software Development Environment is designed to resolve problems much earlier in the development process and provides for extensive system testing prior to flight platform integration.

Specifications

Software:

- Operates under Windows (Windows 10, 8, 7, Vista, XP).

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