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PowerPC™
755/7400
Single Board Computer

PowerXpress

PPC6 POWER PC PROCESSOR

High Performance Air-Cooled SBC



- Latest PowerPC Processors (755 & 7400 with AltiVec)
- 64 bit 66 MHz PCI bus
- High Bandwidth Main Memory Bus
- CHRP based architecture
- 2 Air-Cooled Ruggedization Levels
- Standard 6U form factor
- Radstone Software Support

Key Features

– PowerPC Processor with up to 2 Mbyte L2 Cache
– Up to 64 Mbytes 64 bit wide User FLASH
– Up to 256 Mbytes SDRAM with EDC
– 10/100 BaseT or 10 Base 5 Ethernet
– Front I/O for accessibility
– 2 PMC slots
– Full Radstone software support including BIT, SilverChip, BSPs and ESPs for VxWorks and LynxOS

Product Overview

The PPC6 is the very latest addition to Radstone's PPCx family of PowerPC based Single Board Computers (SBCs), combining the very latest, high performance, PowerPC processors, with the same rich feature set of previous SBCs in the PPCx family. As the direct successor to the popular PPC1A, the PPC6 is ideal where high performance and competitive cost are required for service in the demanding environments found in many industrial, naval and vetronic applications.

This high performance board features either a Motorola 755 or 7400 processor, with SDRAM (with Error Detection and Correction) offering impressive sustained data transfer rates on a high bandwidth memory bus. The processor's demands for data are fully supported by a 64 bit 66 MHz PCI bus offering high data transfer rates between memory and the two on-board PMC sites.

The PPC6 provides easily accessible front panel I/O and full functional compatibility with the PPC1A, offering an optional audio interface in addition to the standard Radstone PPCx interfaces (SCSI, keyboard, mouse, floppy, parallel, Ethernet, 2 serial channels).

The PPC6 follows Radstone's technology insertion strategy which offers a clear performance upgrade path by maintaining a standard functional envelope for its SBCs, protecting long-term investment in application software. Coupled with Radstone's 35+ years experience supplying rugged electronic systems for deployment in harsh environments, this makes Radstone's PPC6 the clear choice for Systems Integrators and Defense OEMs serving the market for leading edge embedded computing platforms.

RADSTONE
TECHNOLOGY
Why settle for less

Features	Advantages	Benefits
Latest PowerPC Processors (755 and 7400)	Access to the most performant processors currently available including the 7400 with its AltiVec core	Highest possible performance to satisfy high end processing and lower level DSP requirements
100 MHz Main Memory Bus	Facilitates high bandwidth data transfer between processor and main memory	Maximised bus bandwidths support the data rates of the latest Gbit network controllers, and the very latest processors, allowing customers to put together systems without data bottlenecks
200 MHz Cache Bus	Maximises data transfer rate between Cache and processor	
1 or 2 Mbyte L2 Cache (755/7400)	Maximises utilization of fast Cache bus	
Full Snooping supported	Maximises use of Cache and reduces memory bus use	
Up to 64 Mbytes, 64 bit wide FLASH	Extensive range of FLASH capacities	A range of FLASH and SDRAM capacities offer the most cost effective and flexible memory solution
Up to 256 Mbytes SDRAM	High capacity with low access times for high memory bandwidth	
64 bit 66 MHz PCI bus	Allows high data transfer between PMCs and processor / memory	Particularly suitable for applications requiring fast communication channels (Fibre Channel etc)
2 PCI Mezzanine card (PMC) sites	Allows system flexibility, particularly in conjunction with ***PPzero*** (PCI over P0)	Radstone's wide range of PMCs (Comms, Graphics etc.) combined with standard on-board I/O, offers widest range of I/O options
10/100 baseT Ethernet, SCSI, Parallel, 2 serial ports, audio	Range of I/O functions gives system flexibility	
2 Air-Cooled Ruggedization Levels	Designed for industrial and sheltered military applications	Performance upgrade path following technology insertion strategy. PPC1A compatibility, meeting exacting requirements without over-specification
Rear I/O on 5 row VME connectors	Compatible with pin-out of Radstone's PPC1A	
Front I/O	Easily accessible I/O for use in standard front I/O systems	
Radstone Software Support	COTS BIT, SilverChip firmware and BSPs and ESPs for VxWorks, LynxOS	Full hardware and software support for long term programs, satisfying the needs of real-world applications
Radstone Software Maintenance	Automatic SW revision updates and technical support	
Radstone Configuration Control	Unique part number system requiring customer notification or authorization for product changes	

Processors

The PPC6 supports the PowerPC 755 and 7400 microprocessors using the standard Radstone architecture, which provides a stable platform for system integrators, allowing development of high performance solutions today, while anticipating introduction of the very latest technology upgrades as soon as they enter production.

The 755 is the latest in Motorola's 75x series of processors and features a range of embedded architectural enhancements, further augmenting its already impressive performance. The 7400 features Motorola's new AltiVec technology with it's 128bit wide vector unit, demonstrating a new level of capability in handling the ultra-high bandwidth and computational requirements of today's - and tomorrow's – demanding applications. AltiVec technology, as embodied on the PPC6, allows customers to develop systems offering unprecedented levels of performance.

Memory

The CPU is interfaced to the main memory via a 64 bit data bus running at up to 100 MHz, supporting up to 256 Mbytes of SDRAM with EDC, up to 64 Mbytes of 64 bit wide User FLASH and 16 Mbytes of Boot FLASH. A 64 bit 66 MHz PCI bus interfaces the processor to the PMC expansion slots, with a 32 bit 33 MHz PCI bus interfacing to the remaining I/O functions and utilities including the VMEbus, via the Universe II bridge device.

Table 1: CPU Selection

CPU	Frequency (MHz)	SPECint95 *	SPECfp95 *	CPU Typical (Watts) Consumption *	Power SBC Typical Power (Watts) Consumption †
755	400	18.8	12.3	4.5	18
7400 AltiVec	500	22.8	17.0	5.5	19

Note: Estimates of CPU performance & dissipation provided by PowerPC vendors. These figures are presented as a guide to illustrate relative CPU performance only. Radstone SBC performance may vary from these figures. † Actual power consumption may vary depending on the application and resource usage of the configured system.

Table 2: Memory Summary

Memory Type	Capacity	Comments	Memory bandwidth
SDRAM Options	128 Mbytes 256 Mbytes	64 bits wide (all on-board)	457 Mbytes/sec Non EDC 355 Mbytes/sec With EDC
FLASH Options	BOOT: 16 Mbytes	8 bits wide	5 Mbytes/sec
	USER: 32 Mbytes OR: 64 Mbytes	32 bits wide 64 bits wide	20 Mbytes/sec 40 Mbytes/sec
Level 2 Cache	1 Mbyte for 755 2 Mbytes for 7400	Backside L2 Cache bus at up to 200MHz	1.6 Gbytes/sec Pipelined Cache 1.1 Gbytes/sec Non-Pipelined Cache
NVRAM	8 kBytes Battery Backed		

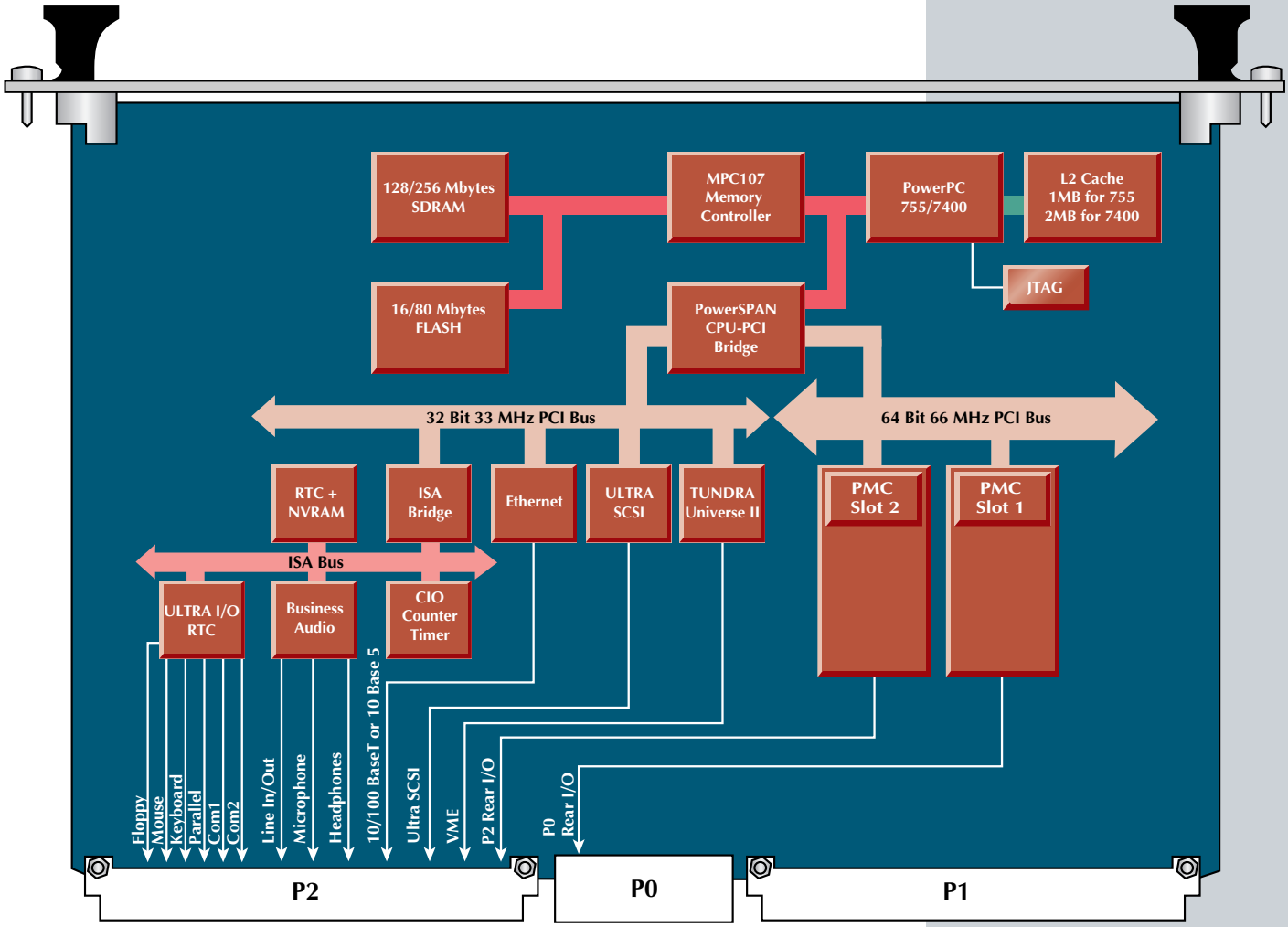


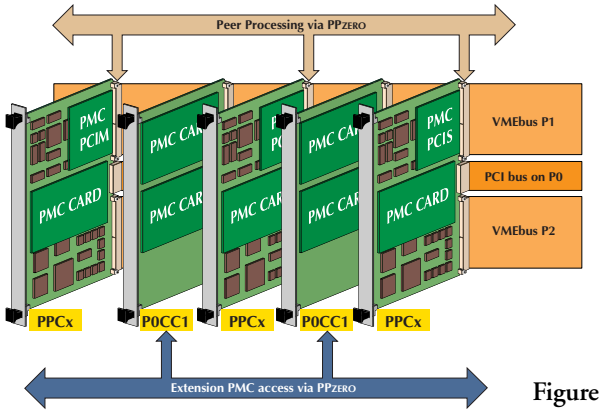
Figure 1: PPC6 Functional Block Diagram

PCI Sub-System

The PPC6 supports two air cooled PCI Mezzanine Cards (PMCs) with its on-board PMC slots. In addition, the PPC6 also supports ***PPzero***, a Radstone solution providing for both high bandwidth peer multi-processing and extension PMCs, using a PCIbus routed over standard P0 capable VME backplanes.

Extension PMCs - a half size PMC board, the PMCPCI, can be used to extend the on-board PCIbus from any Radstone PowerPC, to be picked up by P0CC1 carrier cards, each of which support 2 PMCs. Radstone can offer a wide range of PMCs for applications including Graphics, additional asynchronous and fast synchronous serial channels, ATM, Fibre Channel, MIL-STD-1553, FLASH and Compact FLASH Memory.

Peer multi-processing – two half PMC boards, the PMCPCIM and PMCPCIS can be used to extend the on-board PCIbus from any Radstone PowerPC, to be picked up by further Radstone processor boards, facilitating multi-processing over PCI for maximum system flexibility. Each system requires one PMCPCIM (master) and one PMCPCIS (slave) per additional processor. See the ***PPzero*** and P0CC1 data sheets for more details.



PPzero

- Provides high bandwidth access to peer main processor cards across PCI
- Genuine multi-processing, peers see the other's main memory
- Standard O/S backplane driver models supported for VxWorks and LynxOS
- Also provides access for up to nine standard PMC cards within five VME slots
- Easy expansion at low incremental cost

Figure 2: *PPzero* Diagram

Input/Output

The PPC6 is designed to provide both high-density Rear I/O and easily accessible Front I/O.

In order to maximise Rear I/O density, the PPC6 features 5 row VME64 P1 and P2 connectors as well as a standard P0 connector for rear access to the on-board PMC Slot 1. Type A 80 way P0 connectors with guide pin and keying or type B 95 way P0 connectors may be fitted (specify type when ordering).

Front I/O is available from each of the two PMC sites and from three micro-D connectors mounted on the front panel. The PPC6 also supports Radstone's FPX600-S front panel adapter which provides front I/O via industry standard connectors but occupies two VME slots. (see the Radstone X600 manual for further details)

Optional Features

Audio - The PPC6 can provide an optional audio interface including Line In / Line Out, Microphone and Headphone, available via Front I/O. Order POPPPC6-90 for this option.

Standard I/O

The PPC6 provides a range of standard I/O features which are compatible with Radstone's PPCx range of SBC's.

Table 3: Standard I/O

Port	Description	I/O Location
Parallel port	Centronics style printer port	Rear I/O
COM 1	RS232	Front or Rear I/O
COM 2	RS232 /422 / 485 software selectable	Front or Rear I/O
Ethernet	10/100 BaseT or 10 Base5	Front or Rear I/O
Keyboard and mouse	PS/2 compatible	Front or Rear I/O
SCSI	8 bits, 20 Mbytes / second	Rear I/O
Floppy	Floppy disk controller	Via on-board header

Note: The PPC6 provides a range of standard I/O features which are compatible with Radstone's PPCx range of SBCs

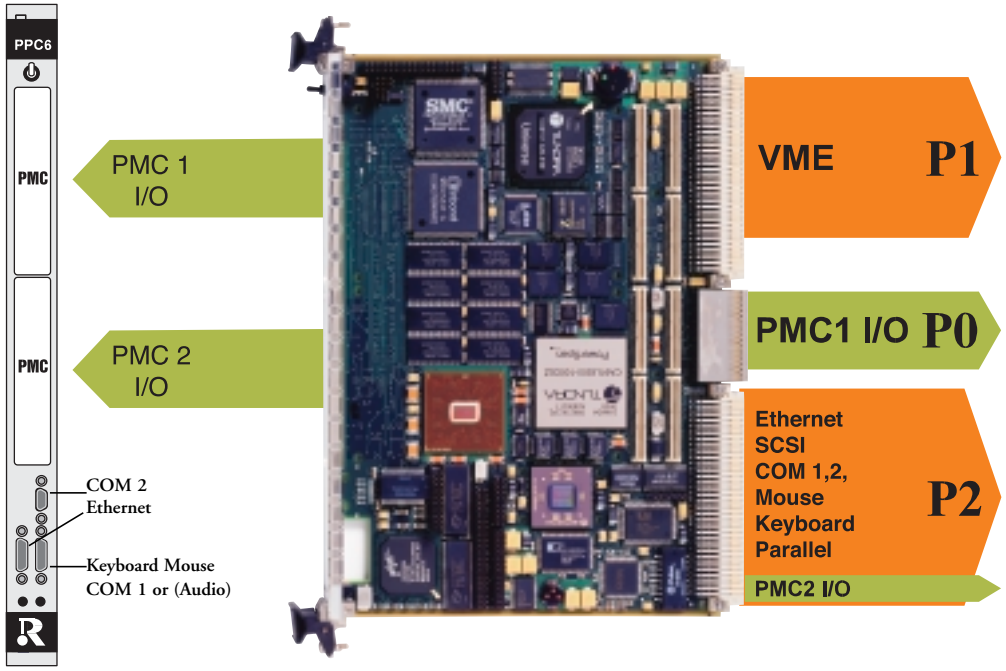


Figure 3: PPC6 I/O Diagram

Ruggediztion Levels for the PPC6

Available in 2 air-cooled ruggedization levels which offer options for extended temperature range and conformal coating. Designed to meet environmental requirements ranging from industrial to 'sheltered' military, which typically include many naval and vetronic programs.

Radstone have used advanced thermal and mechanical design techniques in the printed circuit board, metal work and assembly processes to achieve the required levels of ruggedization, while at the same time minimising costs. This has resulted in a cost effective solution for real-world applications in the target market place.

Table 4: Ruggedization Levels

Ruggedization Levels	1	2
Conformal Coat	Optional	Standard
Low Pressure Operational	15,000ft	15,000ft
Low Pressure Storage	50,000ft	50,000ft
High Temp Operational	55°C @ 300ft/min	65°C @ 300ft/min
Low Temp Operational	0°C	-20°C
High Temp Storage	85°C	85°C
Low Temp Storage	-40°C	-40°C
Temperature Shock	10°C/min over Ts	10°C/min over Ts
Humidity	95% non-condensing	95% 10cycles 240hrs
Vibration Sine	5-500Hz 2g	5-500Hz 2g
Vibration Random	$0.002g^2$/Hz from 10 2000Hz	$0.002g^2$/Hz from 10-2000Hz
Shock	20g Peak Sawtooth, 11mSec Duration	20g Peak Sawtooth, 11mSec Duration

Table 5: Hardware Technical Summary

Feature	Component	Comments
Processor Options	MPC755	400 MHz
	MPC7400	500 MHz
Memory Controller	MPC107	64 bit Memory bus clocked at up to 100 MHz supporting EDC
PCI Bridge	PowerSpan	64 bit 66 MHz PCI bus and secondary 32 bit 33 MHz PCIbus
SDRAM		128 or 256 Mbytes (all on-board)
FLASH ROM	EEPROM	Boot Flash : 16 Mbytes, 8 bits wide User Flash : 32 Mbytes, 32 bit wide as standard (extendible up to 64 Mbytes, 64 bits wide). SW & HW write enable/disable.
NVRAM	M48T18	8 Kbytes battery backed SRAM
Real Time Clock		T.O.D/Calendar battery backed
Level 2 Cache	SRAM	1 or 2 Mbytes on backside L2 bus
Audio (Optional)	CS4231	16 Bit CODEC, stereo headphone, microphone, line-in, line-out
Ethernet	DEC 21143	10/100 BaseT or 10 Base5 (10 Base2 with 3U transceiver)
Ultra SCSI	Symbios 53C860	8 bit 20 Mbytes/s synchronous
ISA Bridge	Winbond 83C553	7 Channel DMA, Timer & Interrupt Controller
Watch Dog Timer	MAX706	1.6 second interval
Parallel Port	SMC FDC37C93X Ultra I/O	IEEE P1284 compatible
Keyboard & Mouse		PS/2 compatible with Phoenix BIOS
Floppy Disk Controller		Available via on-board header
COM 1 (RS232)		INS8250N-B, PC16550A & PC16450 compatible
COM 2 (RS232/422/485)		
Timer Counters	MPC107	4 independent 32 bit timers with 96ns resolution.
	Zilog 85C36 CIO	3 independent 16 bit timers with 333ns resolution. 2 of them may be linked to form a 32 bit counter/timer
VME64 to PCI Bridge		Tundra UNIVERSE' 64 bit VME, 32 bit 33 MHz PCI bus interface, Integral FIFOs, Programmable DMA controller, 70 Mbytes/s burst data transfer
VME Compliance:	Master / Slave	A16, A24, A32, ADO, ADOH A16:LCK, A24:LCK, A32:LCK D08(EO), D08(EO):RMW, D08(EO):BLT D16, D16:RMW, D16:BLT, D32, D32:RMW, D32:BLT, D64:MBLT, D32:UAT
	Interrupt Handler	D08(O), IH(1-7), I(1-7)
	Interrupter	SGL, RRS, PRI, BCLR* generation
	VMEBus Arbiter	ROR, RWD, early BSY* release, Bus capture & hold
	VMEBus Requester	IACK* daisy chain driver, SYSCLK driver
	Auto Slot ID	Slot 1 detector and Auto ID
Power Requirements		+5V (+5%, -2.5%), ±12V and +3.3V for PMC feed, +12V for Ethernet feed only on P2
Weight		Approximately 400 grams

Software support

Radstone's software strategy for PowerPC is designed to allow fully integrated system level solutions to be realised easily and with confidence. Off-the-shelf, layered software modules deliver the most from low-level hardware features while exploiting the best high-level debug and run-time functionality of the COTS Operating Systems.

Radstone's extensive software capabilities have been heavily invested into the PowerPC architecture so that customers can develop market leading product using the O/S and development environment best suited to their long term requirement.

COTS Software Products for PPC SBCs

The following software products are available for the entire PPCx family, including the PPC6, providing a common look, feel and interface for technology inserts:

Built-In-Test for PowerPC

PPC BIT probes from the lowest on-card hardware up to Line Replaceable Unit (LRU) level within a system, ensuring the highest degree of confidence in system integrity. BIT includes comprehensive configuration facilities, allowing automatic power-up tests to be defined, for the desired mix of system functionality and options. Further tests can be invoked interactively, also giving BIT a valuable role as a field service tool. Both Object and Source code products are available. For more details see the "BIT for the Radstone PowerPC family" data sheet.

SilverChip firmware

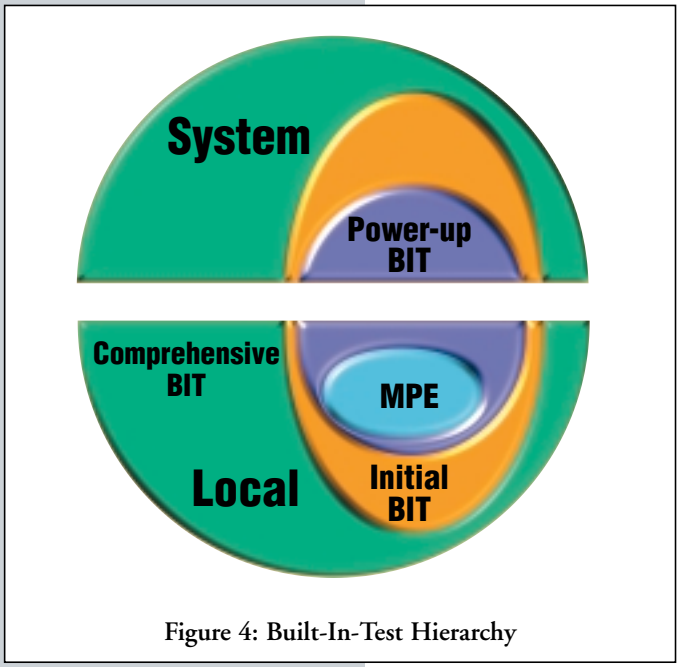


Figure 4: Built-In-Test Hierarchy

Developed as an integral part of the Radstone PowerPC strategy, SilverChip firmware provides a foundation layer to interface between the raw PowerPC board hardware, with it's highly programmable device set-ups and flexibility, and the supported Operating Systems (O/S's) which require a straight-forward booting and device interface model. (Figure 5)

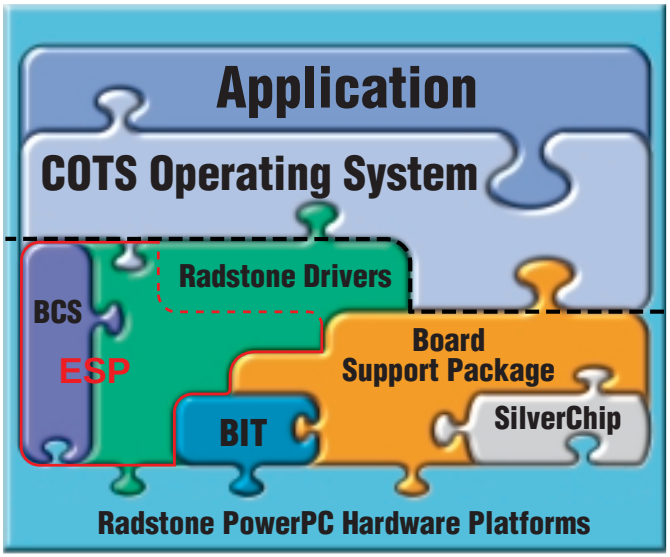


Figure 5: Software Support Model

SilverChip includes: comprehensive configuration facilities, interactive or auto-boot sequencing from a range of device types, automatic PCI resource allocation at initialisation, PCI display/interrogation utilities plus other valuable features for system integrators. Memory or other speed and feature enhancements are seamlessly absorbed by SilverChip giving the same look and feel to the O/S and the user application as the Radstone PowerPC hardware advances.

Board Support Packages (BSP)

n-house porting expertise for PPCx boards is focused on key Operating Systems, including VxWorks/Tornado from WindRiver Systems and LynxOS from LynuxWorks. Other O/S ports, drivers for third-party hardware, and layered products are provided through strategic partnerships with dedicated third party vendors, who are able to offer high quality products and services complementary to the Radstone range. State-of-the-art development environments and debug tools, available with the above software products, are thus leveraged for use on Radstone's performant and flexible hardware architectures.

Enhanced Support Package (ESP)

Enhanced Support Packages (ESPs) offer comprehensive hardware support additional to that defined by O/S vendors for BSP's. This allows users to implement a verifiable BSP standard and yet not be locked out of using valuable extra features, which will adapt the BSP but shorten development times. ESP features may be added or removed as desired in development.

Typical features include VME DMA for VxWorks (not included in WindRiver's BSP definition), and VME enhancements like dynamic windowing and interrupt generation for LynxOS (not included in LynuxWorks BSP definition). Background Condition Screening (BCS) is also part of the ESP.

Background Condition Screening (BCS)

Available initially under VxWorks, BCS supplements the high test coverage obtained at initialization by BIT (see above) with further health screening that is able to co-exist with a standard COTS Operating System. Whilst the intensity and coverage of a true traditional BIT style test makes it destructive to O/S's, the configurable BCS package allows functions such as periodic checksumming, memory scrubbing, and others to be tailored for operation alongside the application in on-line conditions. Results are stored in FLASH in the same format as BIT results. Code is available for reading out BIT/BCS results under LynxOS and VxWorks.

ADA™

Several ADA vendors now offer comprehensive environments layered over standard O/S's such as VxWorks/Tornado and LynxOS. These environments run on any Radstone SBC for which the O/S is supported, without any alteration to the board's regular Board Support Package for the O/S.

RTEMS™

Free Operating System - RTEMS

Developed by OAR Corp., Huntsville, AL for the US Army Missile Command, RTEMS provides all the power and flexibility of real-time executives available on the commercial market today, but without the cost of source code and royalties. RTEMS is freely available from the Internet with no royalties attached. RTEMS is a high performance, object-oriented, multiprocessing executive that forms the cornerstone of re-usable software solutions for today's embedded systems development.

Licensing, Maintenance and Support

Radstone supplies the BSPs and drivers necessary to support its hardware for the selected Operating Systems noted above, under license RT5088. Embedded firmwares such as BIT and SilverChip are supplied under license RT5087. Standard Maintenance Contracts are also available for these modules under Agreement RT5090. Please contact your local sales channel for details.

VxWorks Tornado™

WindRiver SYSTEMS

TORNADO

VxWorks/Tornado Distributed Real-Time Operating System

- Fully integrated Workstation or PC Development Environment
- Performant, deterministic, highly scaleable run-time system
- FDDI, Ethernet and backplane networking
- Comprehensive debug/analysis tools

Tornado represents the latest generation of development and execution environments for embedded and real–time applications. The Tornado suite, which includes the VxWorks operating system, brings a superior development and deployment platform to the embedded developer, based on solid core technology yet adding an evolutionary development interface.

The VxWorks distributed real-time operating system features integrated networking facilities, a fast multitasking kernel with pre-emptive scheduling, intertask communications, backplane multiprocessor support, symbolic and source level debugging, performance monitoring and an I/O file system.

The VxWorks/Tornado package extends the long-standing partnership of WindRiver's software components and Radstone's system solutions. Many of Radstone's I/O and graphics products are also supported by VxWorks libraries and drivers. Please see the Radstone/VxWorks data sheet for more details.

LynxOS Real-time

LYNUXWORKS

LynxOS FROM LYNUXWORKS

LynxOS Real-time Operating System

- Conforms to POSIX standards
- Self-hosted, SunOS, or BlueCat Linux development environments
- Designed for hard real-time
- Full MMU support

LynxOS is a UNIX-compatible, POSIX-compliant, multi-process, and multi-threaded operating system designed for complex real-time applications that require fast, deterministic response. The LynxOS kernel was specifically designed for hard real-time applications. Since its first release in 1988, LynxOS has been fully pre-emptible, re-entrant, and compact. The powerful PosixWorks environment complementing LynxOS provides high specification development tools including source debug, real-time analysis, code control, and other rich features. Support is available for Radstone's leading edge family of COTS PowerPC platforms spanning a wide environmental range with drivers/libraries for various compatible I/O products. Please see the "Radstone/LynxOS"data sheet for more details.

PPC6 Standard Ordering Information

Sales Code	500 MHz PowerPC 7400 - 128 Mbytes DRAM
PPC6-7400-1312B	500 MHz PowerPC 7400 6U VME SBC, Level 1; 128 Mbytes SDRAM, 2 Mbytes L2 Cache, 16 Mbytes Boot Flash; 32 Mbytes User Flash; RTC, 10/100 BaseT, ULTRA SCSI, Mouse & Keyboard I/F, Floppy, Parallel, RS232 port, RS232/422/485 port, 2 PMC slots, 5 row P1 & P2 (no P0)
PPC6-7400-2312B	Level 2 : as above with conformal coating
	400 MHz PowerPC 755 - 128 Mbytes DRAM
PPC6-755-1112B	400 MHz PowerPC 755 6U VME SBC, Level 1; 128 Mbytes SDRAM, 1 Mbytes L2 Cache, 16 Mbytes Boot Flash; 32 Mbytes User Flash; RTC, 10/100 BaseT, ULTRA SCSI, Mouse & Keyboard I/F, Floppy, Parallel, RS232 port, RS232/422/485 port, 2 PMC slots, 5 row P1 & P2 (no P0)
PPC6-755-2112B	Level 2 : as above with conformal coating

Note: For ordering information on further options and accessories please contact your local Radstone Sales Office.

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