Data Sheet

RS104

Ultra Small Rugged Computer

The RS104 is an **Ultra Small Form Factor** rugged computer family designed for deployment under harsh ambient conditions.

The miniaturized system bases on **COTS** components and has been optimized for small size, low weight and low power consumption w/o compromising the ruggedness level of the overall system.

The smallest configuration (cooling by "cold plate" - no fins) **has only ~1.2 Litre!**

The **modular stack through design** ensures great flexibility in adding and/or exchanging of modules as requirements or board technology changes. Each housing frame module carries two PC/104 compatible boards.

Based on the rich choice of PC104 modules offered on the market the system can be easily customised/extended by e.g.: Power PC based CPU boards, video solutions, SSD storage, CAN, GPS, etc.

The enclosure offers **IP67** sealing for the internally installed electronics and is protected against aggressive chemical environments by proper surface finish.

Cross cabling is minimized by usage of one dedicated 38999 connector for each board.

The housing is optimized for **conduction cooling** (cold-plate cooling) and **natural convection cooling** (by fins). Critical internal electronics, as Power Supply and CPU modules are always conduction cooled ensuring thus maximum reliability.

Furthermore, the system is equipped with an impressive range of **protection and monitoring** features, like overcurrent, over/under-voltage, over/under-temperature, polarity protection as well as EMI immunity for bursts, spikes and transients including MIL-STD-1275.

Customer's benefit from this is a product with a **superior lifetime**, an **increased reliability** and **improved failure rate**, resulting in **cost savings** on RMA handling and associated processes.

Due to its wide input range the system may be used in applications:

- **12V (cars)**
- **24V (trucks)**
- **28VDC (MIL)**

Beside MIL STD 704 / 1275 protection it covers also the **automobile** load dump requirements as defined in the **ISO 7637**.

Typical applications for the RS104-1 are:

- Industrial computer for harsh environments
- UAV management computer
- Aircraft, car, truck management computer
- Mobile vehicle computer to sea, land or air
- Yacht, boat, ship, underwater computer

I.e. applications where **size**, **weight, reliability**, **performance** and **flexibility** are critical.

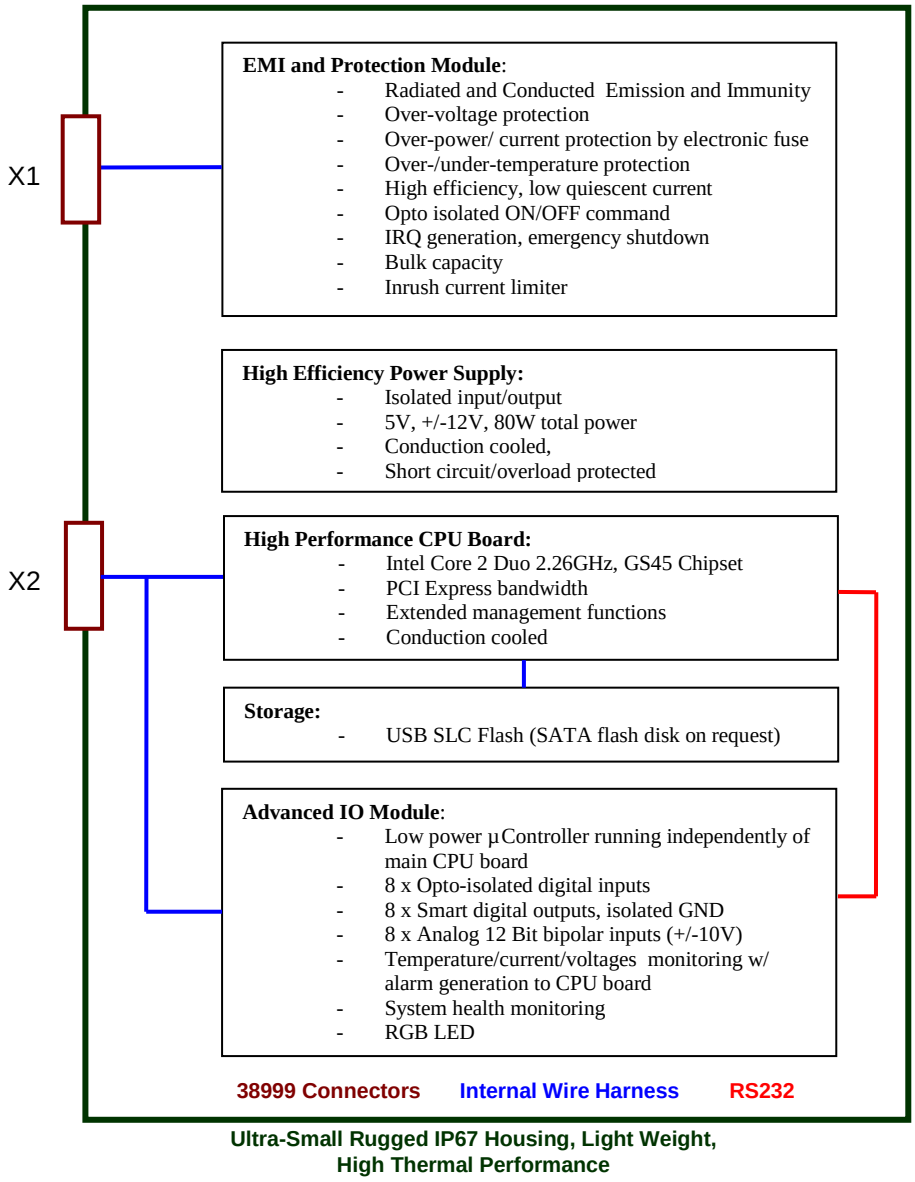
The system can be preloaded with the OS of customer's choice and shipped ready integrated as a turn key solution.

A comprehensive software package is offered too. The BSP package comprises all drivers and interfaces needed for common OS like Windows and Linux.

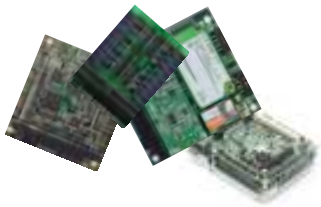
PBIT for power supply and IO modules is included in the standard configuration. IBIT/CBIT, VxWorks BSP and DO 178 solutions are offered on request.

The configuration RS104-1V211S11111E-0 (single middle module) is described on the following pages:

Block Diagram



Boards and Modules	Comments
CPU High Performance SBC Cool Xpress Runner 	PCI/104-Express **Intel® Core™2 Duo 2,26GHz (SP93000)**, ▪ Chipset Intel® GS45 with integrated graphics and ICH9M ▪ 1/2/more GB soldered DDR3 1066 MHz memory ▪ VGA/LCD (LVDS) 18/24Bit (dual pixel) ▪ 2 x serial RS232/RS485 ▪ 1 x LAN 10/100/1000 ▪ Two SATA 2 channels (300MB/s), raid capable ▪ 8 x USB 2.0 ▪ keyboard, mouse, LPT, ACPI, watchdog ▪ HDA compatible sound controller with SPDIF in and out ▪ PCI + PCI Express interface connectors
Storage (Flash) 	The chassis offers the possibility to integrate SATA/USB DOMs; an 8 GB module is already integrated in the basic system configuration. For application with higher storage demand a SATA SSD disc can be integrated in a second middle module.
PSU	Please refer to table “Power Supply”
Protection	Please refer to table “Protection Module”
Advanced IO Module	Please refer to table “Advanced IO Module”
EMI	Please refer to table “Environmental”

Customisation 	Easy integration of different/more boards, the chassis accepts 2xPC104 compliant boards per housing frame: SSD disc, 1553, ARINC 429, AFDX, video, discrete IO, serial, analog, CAN, GPS, analog IO, FPGA, removable CF etc. Please contact us.

Different CPU? Video solutions?
More storage needed? Other configuration?

Please contact us for customisation of your product!

Environmental	Specification/Comments
Random vibration	▪ MIL810F, 514.5, Procedure 1, Figure 514.5C-17, 1 hour/axis
Shock	▪ MIL810F, 516.5, Proc. 1. with 20g, 11ms, saw tooth, +/- 3hits/axis
EMC	▪ MIL-STD-461F [1] : CE101, CE102, CS101 CS114, CS115, CS116 RE101, RE102, RS101 RS103, RS105 ▪ MIL-STD-704E, Test Method: Part 8 ▪ MIL-STD-1275E, Test Method: 28V Electrical Systems ▪ Automotive load dumps ISO7637, 12V, 24V [1]
Temperature	▪ MIL STD 810F, Test Method: Low Temperature Procedure: 502.4-1 - 502.4-10 High Temperature Procedure: 501.4-1 - 501.4-12 Temperature Shock [1] Procedure: 503.4-1 - 503.4-10 Low Pressure/Altitude [1] Procedure: 500.4-1 - 500.4-8
OP temperature natural convection at 30W power consumption	-40℃ … +60℃; mounted to a thermal non conductive structure -40℃ … +66℃; mounted to a thermal conductive stru cture [2] Derating of upper limits: -1℃ per additional 1W po wer dissipation
OP temperature conduction cooling [3]	-40℃ … +70℃ at its thermal interfaces with housin g mounted to a thermal conductive structure, e.g. a cold plate
Power Consumption at 60℃ ambient temperature [4]	2.5Wall IO Module functions available (see p. 7), CPU=OFF 12Win Windows idle mode 30Wwith PassMark BurnInPro software at 50% CPU+RAM 35Wwith PassMark BurnInPro software at 100% CPU+RAM
Altitude	20.000ft, (70.000 on request)
Dimensions (one housing module)	Conduction cooled (finless) version: 50 x 148 x151 (mm, WxHxL) (w/o fixation foots and connectors) Only 1.15 Litres Air/conduction cooled (finned) version: 100 x 149 x186 (mm, WxHxL) (w/o fixation foots and connectors) Only 2.75 Litres
Water proof	IP67, 1m one hour
Weight	< 2.15kg, finned system, one middle module, fully equipped
MTBF [5]	103.000 hrs, Ground Benign, 30℃

1) The system is designed to meet listed requirements
2) R_{th} structure <= 0.33 ℃K/W
3) Conduction cooling style of housing, i.e. finless version RS104-1Hx-xx, at 30W power consumption
4) About 5W less below 50℃ ambient temperature
5) Per MIL-HDBK-217, Parts Count method for the system w/ CPU and USB flash mass storage

Power Supply		Comments
Wide DC input voltage		Min. 15V to max. 33V (24V and MIL version) Min. 10V to max. 18V (automotive version)
Output voltages		5V/15A, +12V/0.3A, -12V/0.3A
Output power		80W cumulated output power
Galvanic isolation		Power input lines to chassis: 100VDC The ground of the secondary side, i.e. 5V RTN is connected to the housing
Inrush current		Max. 16A/150us
PROTECTION	**Polarity**	Up to -120V DC, w/o damage
	Overvoltage	Steady state: +65V DC; (for 10 seconds up to +120V w/o damage) System switches OFF after a predefined duration of overvoltage A pre-warning IRQ is generated to allow user SW to save critical data before system is switched OFF
	Undervoltage	System automatically switches OFF on undervoltage *Software programmable pre-warning threshold*
	Overpower	Software programmable electronic circuit breaker *Software programmable pre-warning threshold* Standard melting fuse 15A for additional safety in failure case
	Temperatures	System switches off when temperatures of PCB, mosfet or uC are out of range; Monitoring/logging of temperatures *Software programmable pre-warning high and low thresholds*
ON/OFF command		Opto isolated input, 5V…32V/10mA or Auto-on (standard configuration)
Quiescent current		2.1mA (typ.) when OFF at 28V input voltage
Efficiency		85% at 28V input, 25W power
Power Interruptions		Board with high back-up capacity on request
RGB LED		On front panel for status indication

All values are typical values except where otherwise indicated

Advanced IO Module	Comments
Digital In **)	▪ 3 x opto isolated inputs ▪ ON: 3V to 32V/6mA, OFF: <0.8V; no jumper settings needed ▪ *Pattern (level/edge triggering) with IRQ generation capability*
Digital Out **)	▪ 4 x low side driver 500mA / 40V ▪ Isolated GND for low side drivers, max 100V *) ▪ Especially designed for driving inductive loads (relays) ▪ Load dump, short circuit and thermally protected ▪ *Monitoring functions for open load, short to GND over-temperature and over-load conditions*
Analog In **)	▪ 3 bipolar channels, +/-5V, +/- 10V, 1mV resolution ▪ Simultaneous sampling ▪ Option: Auto-validation of channels 1…4 ▪ *Windows discriminator with IRQ generation capability*
Analog Out	▪ 1 bipolar channel, +/- 10V
Supervision Functions	For superior reliability and protection against unsafe conditions a dedicated microcontroller continuously monitors: ▪ System max. and average input voltage and input power ▪ Temperatures PCB, mosfet, microcontroller ▪ Voltages: 12V, 5V and 3.3V ▪ System health status In case of anomalies the user application will be informed in order to take necessary action. Anomalies/failures are logged and can be processed (later) in order to determine system status, environmental conditions, system life time, exchange of potentially breaking parts, etc. *Dual redundant DC/DC power and input voltage monitoring functions.* *Triple redundant input current monitoring functions.*
IRQ capability	The µController generates an IR in case of emergency situations, e.g. over-/under-voltage, over-power, over-/under-temperature. Furthermore pre-warning thresholds are software programmable by user for early notification about potential unsafe conditions.
Advanced management	As the microcontroller works completely independent from the CPU board and has it's own power supply various powerful functions could be implemented, e.g.: ▪ Advanced sleep and power saving combinations while all functionality of the IO Module remain active ▪ Event driven wake up of main CPU board, for example based on changes of the IO lines, time, temperature, voltages, etc. ▪ Watchdog with reset / cold start option ▪ Continuous health check of system with various free programmable alarm thresholds

All values are typical values.

*) The outputs are not isolated between each other but the GND of the digital output is isolated vs. the GND of the system.

) In order to route out **all 8 signals a second middle frame is needed, i.e. the system must be at least of type RS104-**2**; see also Standard Pinout on page 10.

Specification CPU Board Cool Express Runner *

CPU Board	Comments
Processor	Intel Core 2 Duo SP9300, 6 MB cache, SP9300 at 2.26 GHz
FSB	1066 MHz
Core logic	Mobile Intel® GS45 Express Chipset
RAM	1 GB soldered DDR3, more on request
Graphics	up to 256 MB RAM, up to 2048 x 1536 pixel at 75 Hz, supports 3D, DirectX and OpenGL
CRT	Analog VGA
LVDS	Dual channel
USB	8 USB 2.0 host ports, of which one is connected to the external 38999 connector boot device support
Ethernet	1x 1000 BaseT with i82567
Serial	1x RS232 or RS485 ports, selectable in BIOS, COM2 internally used
SATA	2 SATA ports
Audio	High definition audio, 5+1
RTC Backup	Yes
Watchdog	Yes
PCI Bus	5 V compliant.
PCI Express Bus	4 x1 lanes, configurable as x4 1 x16 lane, usable for graphics, Also configurable as x8, x4, x2 lanes
Power Consumption	Typical 11 watts Maximum 33 watts
Power Management	BIOS supports ACPI power saving
BIOS	Phoenix FirstBIOS BIOS parameters are also saved in FEPROM
Supported OS by board manufacturer	Windows, Linux VxWorks BSP, BIT and DO-178 software on request

* Link: http://www.adlinktech.com/PD/web/PD_detail.php?cKind=&pid=1149&seq=&id=&sid=&source=

Supported Management Functions of CPU Board Cool Express Runner

Function name	Description
Total operating hours counter	Counts the number of hours the module has been run in minutes
On-time minutes counter	Indicates the amount of time since last power on in minutes
Power cycles counter	Counts how often the module has been powered on
Watchdog timer	Set / reset / disable / trigger watchdog timer
System restart reason	Power loss / watchdog / external Reset
Flash area	1024 bytes of flash area for customer data
Protected flash area	128 Bytes. Keys, ID's, etc. can be stored in a write- and clear-protectable region
Board identity	Vendor ID / board ID / serial number
Temperature Monitor	Read the actual temperatures of the CPU and board. Stores temperatures at power-up.
Temperature Logger	Stores min-/max-temperature of the CPU and board
Voltage Monitor	Read onboard-voltages

Others

Chassis	Comments
LED	RGB LED on middle frame front, blinking, dimming
External connectors	2x38999, series 3, shell size 15, uniquely keyed
Conduction cooling of internal boards	Conduction cooling of the CPU board and power supply by special means
PC104 slots	Basic configuration of RS104-1: two slots, both are used Note: adding additional middle module(s) enables usage of two more PC104 compliant cards per frame.
Fan cooling	One or two fans can be installed on the outer sides if needed.
Material	Aluminium
Surface finish	Chromated, optionally painted, Ni plated, custom varnish

Standard pinout for RS104-1VX (one middle module)

X1	Function	Pin	Recommended AWG for ext. wire harness
Input Power	+ In - IN	1 3	> 5A, AWG16, Twisted Pair

X2	Function	Pin	Recommended AWG for ext. wire harness
VGA	Red GND Green Blue Hsync Vsync	1 30 2 18 17 16	AWG26
LAN	MX1- MX1+ MX2- MX2+ MX3- MX3+ MX4- MX4+	22 6 23 7 8 24 10 9	AWG26, Twisted Pair
USB	VCC USB 0 USB 0- USB 0+ USB GND	3 20 31 19	AWG26, Twisted Pair
Analog In	AN IN0 AN IN0 RTN AN IN1 AN IN1 RTN AN IN2 AN IN2 RTN Mode RTN	12 11 13 26 14 27	AWG26, Twisted Pair
Digital In	DIG IN0 DIG IN0 RTN DIG IN1 DIG IN1 RTN DIG IN2 DIG IN2 RTN	29 15 34 28 35 36	AWG26, Twisted Pair
Digital Out	DIG OUT0 DIG OUT1 DIG OUT2 DIG OUT3 DIG OUT RTN	4 5 32 33 21	AWG26 AWG22 180℃
Mode	Mode	25	AWG26

Note: customization possible

Order Codes (System)

RS104-	X	X	X	X	X	X	X	X	X	X	X	X	-	X	Remarks
RS104-															Rugged system PC104
	1														**Qty of Middle Frames**
	2														1x Middle module: 2 PC104 boards in total
	3														2x Middle module: 4 PC104 boards in total
															3x Middle module: 6 PC104 boards in total
		V													**Cooling**
		H													Vertical, air and conduction cooling
															Horizontal, conduction cooling only
			1												**IP Level**
			2												IP60
															IP67
				1											**Chassis surface finish**
				2											Chromated, yellow (ROHS compliant)
				3											Chromated + black powder coated
				4											Electroless Nickel plated (Note 1)
															Electroless Nickel plated + black painted (Note 1)
					1										**Mass Storage Size**
					2										USB Module Flash 8GB
					3										USB Module Flash 16GB
					4										SATA SSD Flash 32GB (Note 2)
					5										SATA SSD Flash 64GB (Note 2)
					6										SATA SSD Flash 128GB (Note 2)
					7										SATA SSD Flash 256GB (Note 2)
						S									**SATA Mass Storage Type**
						M									SLC
															MLC
							1								**CPU**
															Intel Core 2Duo 2.26GHz
								1							**RAM**
								2							1GB
															2GB
									1						**Input Voltage**
									2						24/28V
															12V
										1					**ON/OFF**
										2					Auto On
															Opto isolated
											1				**IO**
															3xDig In, 3xDig Out, 3xAn In, 1xUSB, 1xLAN, 1xVGA
											2				8xDig In, 8xDig Out, 8xAn In, 1xAn Out (+/-10V) 2xUSB, 1xLAN, 1xVGA (Note 3)

(continued on next page)

Order Codes continued

RS104-	X	X	X	X	X	X	X	X	X	X	X	X	-	X	Remarks
												C			**OP Temperature**
												I			Commercial: 0℃ … +40℃
												E			Industrial: -20℃ … +50℃
															Extended: -40℃ … +60/65/70℃ (Note 4)
													-		
														0	**Placeholder for customisations**
															No customisation, contact factory if needed

Notes:

1. For environments containing salt spray.
2. For SATA SSD more as one middle module is needed
3. For IO type 2 more as one middle module is needed.
4. Max OP temperature at 30W:
   60℃ if system is mounted to a thermally non - conductive structure,
   65℃ if system is mounted to a thermally condu ctive structure,
   70℃ only for conduction cooling style.
   Please note derating above 30W total power dissipation as indicated in the Environmental part of the Data Sheet.

Order Codes (spare parts)

RC104-	M	X	X	X	-	X	Remarks
RC104-							bare metal work w/ expansion kit
	M						**Slots** Middle module expansion kit
		V					**Cooling** Vertical, air cooling and conduction cooling
		H					Horizontal, conduction cooling only
			1				**Surface finish** Chromated, yellow (ROHS compliant)
			2				Chromated + black powder coated
			3				Electroless Nickel plated
			4				Electroless Nickel plated + black painted (Note 3)
				1			Kit for extension from 1 middle modules to 2 middle frames
				2			Kit for extension from 2 middle modules to 3 middle frames
				-	-		
						0	**Customisation** No customization
						X	Contact factory for customisation key

Example:

RC104-MV11-0

Expansion kit consisting of:

1 x Middle Module, chromated, vertical style
1 x O Ring gasket
2 x Gaskets for 38999 connectors
4 x M6, 80mm screws, hexagon socket
8 x Screws M3, 12mm, Torx
8 x Nuts, M3 self locking
8 x Screws, M3, 12mm, IP67 screws for the 38999 connectors
1 x 5mm LED housing, no LED
Please note: 38999 connectors are not part of kit.

Vertical style with fins for natural convection cooling

vertical
convection and conduction cooling

99,7x148,7x186 mm *
(WxHxL)

RS104-1Vxx

2.75 Litres, ca. 2.1kg

vertical
convection and conduction cooling

133,4x148,7x186 mm *
(WxHxL)

RS104-2Vxx

3.69 Litres

vertical
convection and conduction cooling

167,1x148,7x186 mm *
(WxHxL)

RS104-3Vxx

4.62 Litres

* Dimensions w/o paint, w/o fixation foots, w/o connectors

Horizontal style without fins for improved conduction cooling

horizontal
improved conduction cooling

51,7x148,7x151 mm *
(HxWxL)

RS104-1Hxx
1.12 Litres, ca. 1.5kg

horizontal
improved conduction cooling

83,4x148,7x151 mm *
(HxWxL)

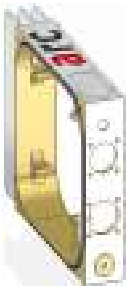
RS104-2Hxx
1.87 Litres

horizontal
improved conduction cooling

117,1x148,7x151 mm *
(HxWxL)

RS104-3Hxx
2.63 Litres

* Dimensions w/o paint, w/o fixation foots, w/o connectors



Expansion kit for RS104-1V

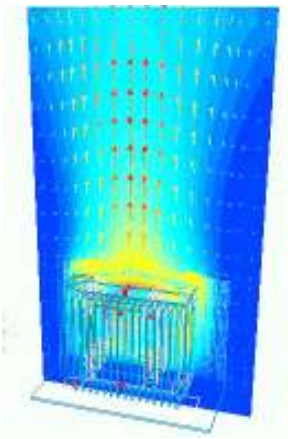
includes one frame, screws and gaskets

RC104-MVxx

The modular design allows great flexibility and **customization**, e.g.:

- Different board selection (CPU, IO)
- Storage and video solutions
- Switch solutions
- CF with access door
- Extending max. OP temp. to 85℃ by advanced conduction cooling
- LED's, breakers
- UPS (battery pack)

Please contact us to determine your appropriate system.



www.advanced-rugged-computers.com