IPC/RSL81xxx-XxxxE

Document Ordercode: DOC/IPC_RSL81-E

Revision	Date	Author	Modification
1.0	17.12.2018	U. Müller	First release
1.1	11.02.2019	U. Müller	Intel errata information added
1.2	29.04.2019	U. Müller	updated interface isolation data, removed obsolete safety restrictions
1.3	11.05.2020	D. Scheiwiller	added reliability prediction
1.4	18.11.2020	U. Müller	Added new system version with solved "DP_PWR" errata

Contents

List of Tables

List of Figures

1 Introduction

1.1. General remarks

The content and presentation of this document has been carefully checked. No responsibility is accepted for any errors or omissions in the documentation.

Note that the documentation for the products is constantly revised and improved. The right to change this documentation at any time without notice is therefore reserved.

Syslogic is grateful for any help referring to errors or for suggestions for improvements.

The following registered trademarks are used:

IBM-PC, PC/AT, PS/2	trademarks of IBM Corporation
I^2C	trademark of Philips Corporation
CFast	trademark of CompactFlash Association
PCIe	trademark of PCI-SIG

1.2. Contents of this Documentation

This document addresses to system integrators, programmers and instructed installation and maintenance personal working with the industrial PC system. It provides all information needed to configure, setup and program the IPC/RSL81 systems. For complete information also the documentation of the mounted communications and I/O boards must be consulted.

1.3. Naming conventions

In the following paragraphs all descriptions referenced to "RSL81" apply to all IPC/RSL81xxx-XxxxE products, if not declared otherwise.

1.4. Documents and references

1.4.1. Documents
The following additional documents are *required* for correct installation and operation of the RSL81 system:
- Expansion card with GPS, and socket for WAN Modem
  DOC/IPC_WLBPGE

1.4.2. Datasheets
For additional and more detailed information on the Intel Atom processor and chipset the following documents are of interest:
- Datasheet Intel Atom Processor E39xx Series
https://www.intel.com/content/www/us/en/embedded/products/apollo-lake/overview.html

- Datasheet Intel I210 GbE Controller Family
http://www.intel.com/content/www/us/en/embedded/products/networking/ethernet-controller-i210-i211-family.html

- Different documents and Datasheets on u-Blox MCPI-L210 LTE/UMTS/GPRS modem
https://www.u-blox.com/de/product-resources?f[0]=property_file_product_filter%3A2457

- Different documents and datasheets on u-Blox NEO-M8U GPS module
https://www.u-blox.com/de/product-resources?f[0]=property_file_product_filter%3A11098

- Datasheet and resources ST Microelectronics iNEMO inertial modul ISM330DLC
http://www.st.com/en/mems-and-sensors/ism330dlc.html

1.5. Items delivered
The RSL81 comes without external cabling and power supply. These additional items must be ordered separately and installed according to the respective user documentations.

1.6. Installation
The installation of the RSL81 system is described in chapter 5 of this documentation.

Important Note

Before applying power to the RSL81 system, all installed boards must be correctly configured and mounted.

1.7. Safety Recommendations and Warnings

1.7.1. General safety recommendations

The products are intended for measurement, control and communications applications in railway applications. The products must be assembled and installed by specially trained people. The strict observation of the assembly and installation guidelines is mandatory.

The use of the products in systems in which life or health of persons is directly dependent (e.g. life support systems, patient monitoring systems, etc.) is not allowed.

The use of the products in potentially explosive atmospheres requires additional external protection circuitry which is not provided with the products.

In case of uncertainty or of believed errors in the documentation please immediately contact the manufacturer (address see chapter 10). Do not use or install the products if you are in doubt. In any case of misuse of the products, the user is solely liable for the consequences.

1.7.2. Safety warnings and requirements

Do not operate this product outside of the recommended operating conditions according to the technical data specified in paragraph 6.

Strictly observe the installation instructions listed in paragraph **Fehler! Verweisquelle konnte nicht gefunden werden.**.

Do not touch the surface of this product without precaution, it may be hot and burn your skin. Cool it down before touching.

Do not touch any connector unless you have verified that no dangerous voltage is around. Disconnect cabling first.

Do not open any part of the enclosure while power is applied.

Do not try to repair any defective product by yourself. There is no replaceable service part inside.

Do not open the service cover unless you are instructed and entitled to do this. The service cover is intended for inserting the CFast software storage and SIM card on initial operation of the product by an instructed person only.

Do not operate the system without certified matching antennas connected to all antenna ports.

The antenna for UMTS/LTE may be harmful if people are exposed to the radiation for too long. Therefore place the antenna way that there is always a distance of 45cm to places people stay

1.8. Electro-static discharge

Electronic boards are sensitive to Electro-Static Discharge (ESD). Please ensure that the product is handled with care and only in a ESD protected environment. Otherwise a proper operation is not guaranteed and the warranty is not applicable.

1.9. Life Cycle Information

1.9.1. Transportation and Storage

During transportation and storage the products must be in their original packing. It is recommended, to keep the original packing in case of return of the product to the factory for repair. Note that the packing is recyclable.

1.9.2. Assembly and Installation

Observe the EMI-precautions against static discharge. Carefully read the assembly and installation documentation (see chapter 5) before unpacking the products. Make sure that you have all the necessary items ready (including all the small parts). Follow the assembly guidelines in chapter 5 strictly.

The installation procedures must be observed strictly. Note that deviations from the installation guidelines may result in degraded operational reliability or in unfavorable EM-radiation or EM-susceptibility.

1.9.3. Operation

The operating environment must guarantee the environmental parameters (temperature, power supply, etc.) specified in the technical specification section of the product manuals.

The main functionality of the RSL81 system is defined by the application programs running on the processor board. The application programs are not part of the delivery by Syslogic but are defined, developed and tested by the customer or a system-integrator for each specific application. Refer to the respective documentation for more information.

1.9.4. Maintenance and Repair

The RSL81 system features error- and malfunction-detection circuitry. Diagnostic information gathered is transferred to the applications software where it can be used. In the rare case of a module hardware-failure or malfunction, the complete system should be exchanged. The faulty system must be returned to the factory for repair.

For best maintenance and repair service it is recommended to use the Syslogic RMA Service. Refer to Chapter 10.1.1 .

Please use whenever possible the original packing for return of the product (EMI and mechanical protection).

1.9.5. Warranty

Our products are covered by a world-wide manufacturer's warranty. The warranty period starts at the delivery time from our official distributor to the customer. The duration of the warranty period is specified in the respective product catalogs and the offers. All products carry a job number for identification. The manufacturing data and deliveries are registered in a high level Quality Management System.

The warranty covers material and manufacturing defects. All products must be returned via the official distributor to the factory for repair or replacement. The warranty expires immediately if the products are damaged of operation outside of the specified recommended operating conditions. The warranty also expires if the date code or job number listed on the product is altered or rendered unintelligible. The warranty does not include damage due to errors in firmware or software delivered with the products.

For best warranty service it is recommended to use the Syslogic RMA Service. Refer to Chapter 10.1.1 .

1.9.6. RoHS

The products of the RSL81 family are designed and produced according to the Restriction of Hazardous Substances (RoHS) Directive (2011/65/EU)

1.9.7. Disposal

At the end of the lifespan the RSL81 products must be properly disposed. RSL81 products contain a multitude of elements and must be disposed like computer parts.
The RSL81 products of the are not designed ready for operation for the end-user and are not intended for consumer applications.

1.9.8. EMI/EMC

This product fulfills all EMI/EMC requirements for railway applications (rolling stock). This is a Class A product and not intended to be used in domestic environments. The product may cause electromagnetic interference. Appropriate measures must be taken.

WARNING

This equipment is compliant with Class A of EN55032/EN55022. In a residential environment this equipment may cause radio interference.

Attention: Be aware of the local laws and standards while using wireless communication. Compliance to a certain standard normally does not comply operating or importing the device into a country. Always check local laws. If required register the device at its destination.

2 Product Description

2.1 Features

The IPC/RSL81 system is a x86 based industrial PC designed for use in railway applications (rolling stock).

The RSL81 offers the following main features:

− low power industrial processor board eliminating the need for enforced cooling
− high performance 64-bit Intel Atom x7-E3950 based quad core processor with integrated floating point unit
− up to 2 GHz processor clock
− up to 8 Gbyte DRAM on board
− 64-bit graphics controller with partial backwards compatibility to VGA and SVGA standards
− graphics controller supporting up to 4096x2160 dots resolution on DisplayPort port
− SATA interface supporting one CFast card socket
− integrated peripheral controller (IPC) with PC/AT compatible DMA controllers (2 x 8237), interrupt controllers (2 x 8259) and timer/counter channels (8254)
− one USB V3.0/ V2.0 port (XHCI/EHCI-Hostcontroller) with Super-, High-, Full- and Low-Speed support
− one USB V2.0 port (OHCI/EHCI-Hostcontroller) with High-, Full- and Low-Speed support
− two 10/100Mbit Ethernet LAN interfaces
− Year 2000 compliant Real Time Clock (PC/AT compatible)
− hardware watchdog configurable for 100 ms to 256 s timeout and hardware reset activation
− temperature supervisor for software controlled power management
− Flash for BIOS and BIOS extensions
− supervised GoldCap backup for Real Time Clock
− onboard isolated power supply with 24/36V wide input range (16.8Vdc … 45Vdc) and Class S2 interruption support
− onboard buzzer
− GPS positioning system
− Motion Sensor with 3 axis accelerometer and gyroscope
− UMTS/LTE connectivity
− WLAN connectivity (optional)
− two high speed CAN interfaces, galvanically isolated, normal or Listen only mode (Silent Mode)
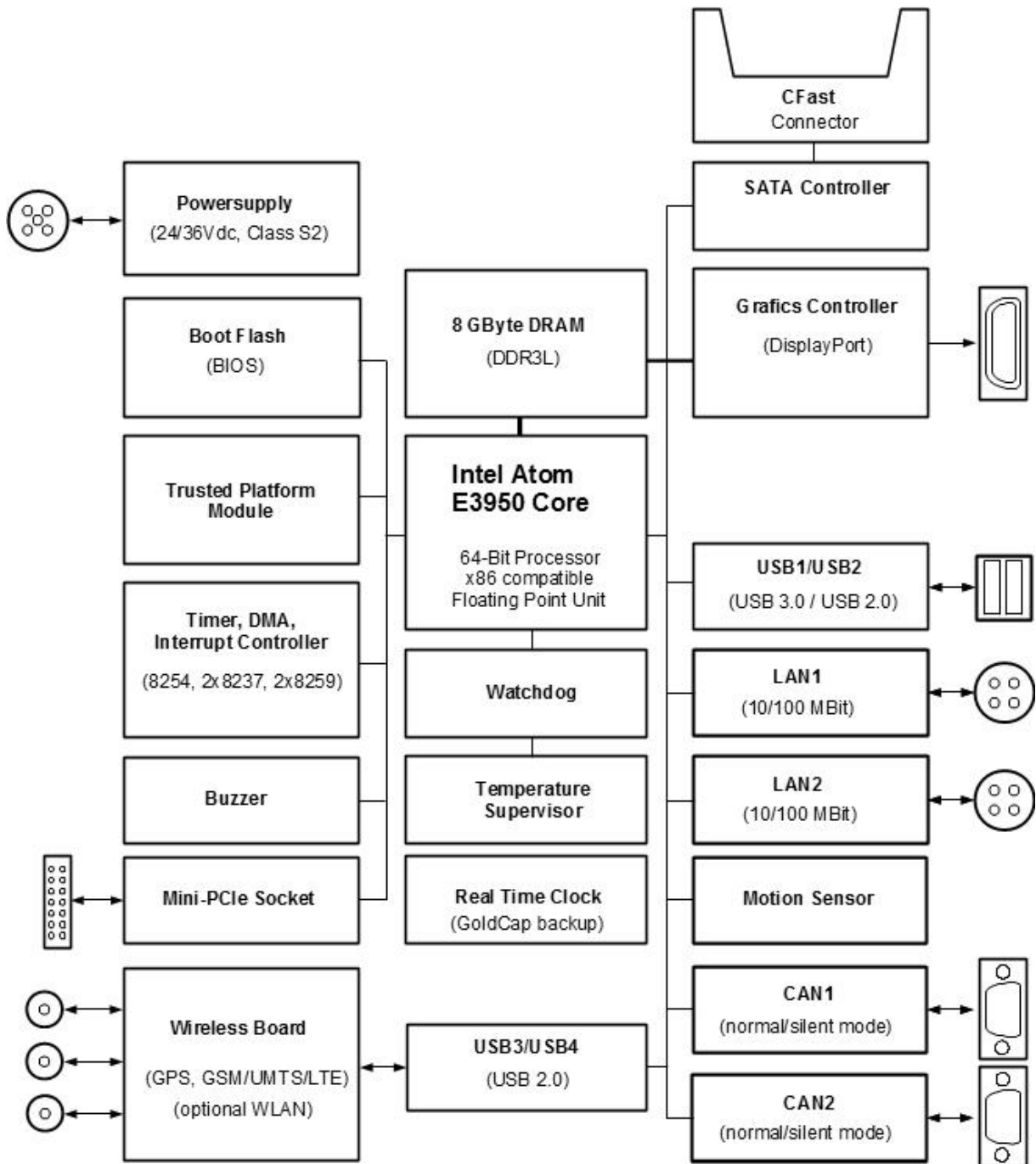
Fig. 1   Block Diagram RSL81 (all functions)

Important Note

Check the product variant carefully for the supported functions.

2.2 Product Variants

The RSL81 is available in different functional variants and enclosures.
The following tables show the functional differences of the IPC/RSL81 variants. Bold printed functions are available on a front or rear connector. See figure Fig. 4 for location of the internal interfaces.

Function	IPC/RSL81I20-A245E	Remarks
CPU	*Atom E3950 2GHz*	internal component
Memory	*8 GByte*	internal components
LAN1	**LAN1**	
LAN2	**LAN2**	
WLAN	**-**	
GPS	**GPS**	
UMTS/LTE	**LTE**	
COM1	**-**	
COM2	**-**	
CAN1	**CAN1**	Configurable normal or silent mode
CAN2	**CAN2**	configurable normal or silent mode
USB1/2	**USB3.0/2.0**	
Display	**DisplayPort**	
Audio	Buzzer	
CFast	*P8*	socket behind service cover
Motion Sensor	ISM330DLC	3 axis acceleration and gyro sensor
TPM	SLB9665	Trusted Platform Module 2.0
RTC Backup	GoldCap	

Tab. 1 Product Variants RSL81

2.3 Operating Modes

The RSL81 is based on the standard PC/AT architecture and therefore operates in DOS-compatible mode (real mode) on start up. The configurable BIOS initializes all onboard peripherals to their default values, executes the BIOS extensions programmed into the onboard BIOS-Flash and BIOS extensions found on installed expansion boards prior to booting the operating system from a user-selectable drive (boot sector). The operating system (or eventually a BIOS extension) may switch to protected mode to execute high performance 32-bit or 64-bit program code.

2.4 Startup Modes

The RSL81 may startup either in normal operating mode or in BIOS recovery mode:

– BIOS recovery mode is invoked when rotary switch S1 is set to position '8'.

In BIOS recovery mode is intended to reprogram a corrupt main BIOS. Before starting the reprogram process, switch S1 must be reset to position '0', otherwise the recovery BIOS will be overwritten.

– Normal operating mode is invoked when rotary switch S1 is set to position '0'.

Other parameters like backlight control and watchdog base timeout are also dependent on S1 setting:

Switch S1	Startup Mode	Watchdog Base Timeout	Remark
0	normal operating modes	1 s	Factory Setting
1		100ms	
2		1 s	
3		100ms	
4		1 s	
5		100ms	
6		1 s	
7		100ms	
8	BIOS recovery mode	1 s	
9	factory modes	1 s	
A	(do not use)	1 s	
B		1 s	
C	factory modes	1 s	
D	(do not use)	1 s	
E		1 s	
F		1 s	

Tab. 2   Startup Modes

◈ **syslogic**

3 Hardware Description

3.1 Overview

The RSL81 hardware may be configured by software (CMOS setup) and by switch settings. Custom BIOS configuration can be programmed into the BIOS flash on request (ask Syslogic technical support for custom BIOS configuration).

The switch and connector locations are shown in the board layout drawing (Fig. 4).

Important Note

Always check the switch configuration of a freshly received board to comply with your system requirements before applying power, otherwise the system may get damaged or may fail to operate.
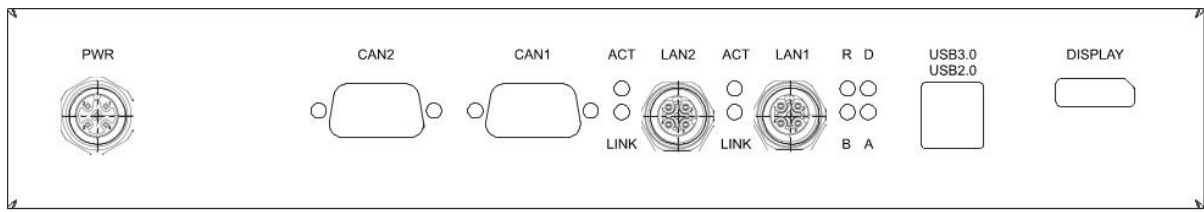
Fig. 2   Front Connections
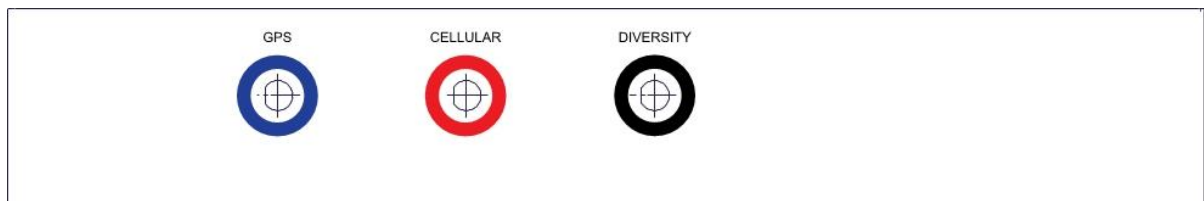
Fig. 3   Backside Connections

◆ **syslogic**
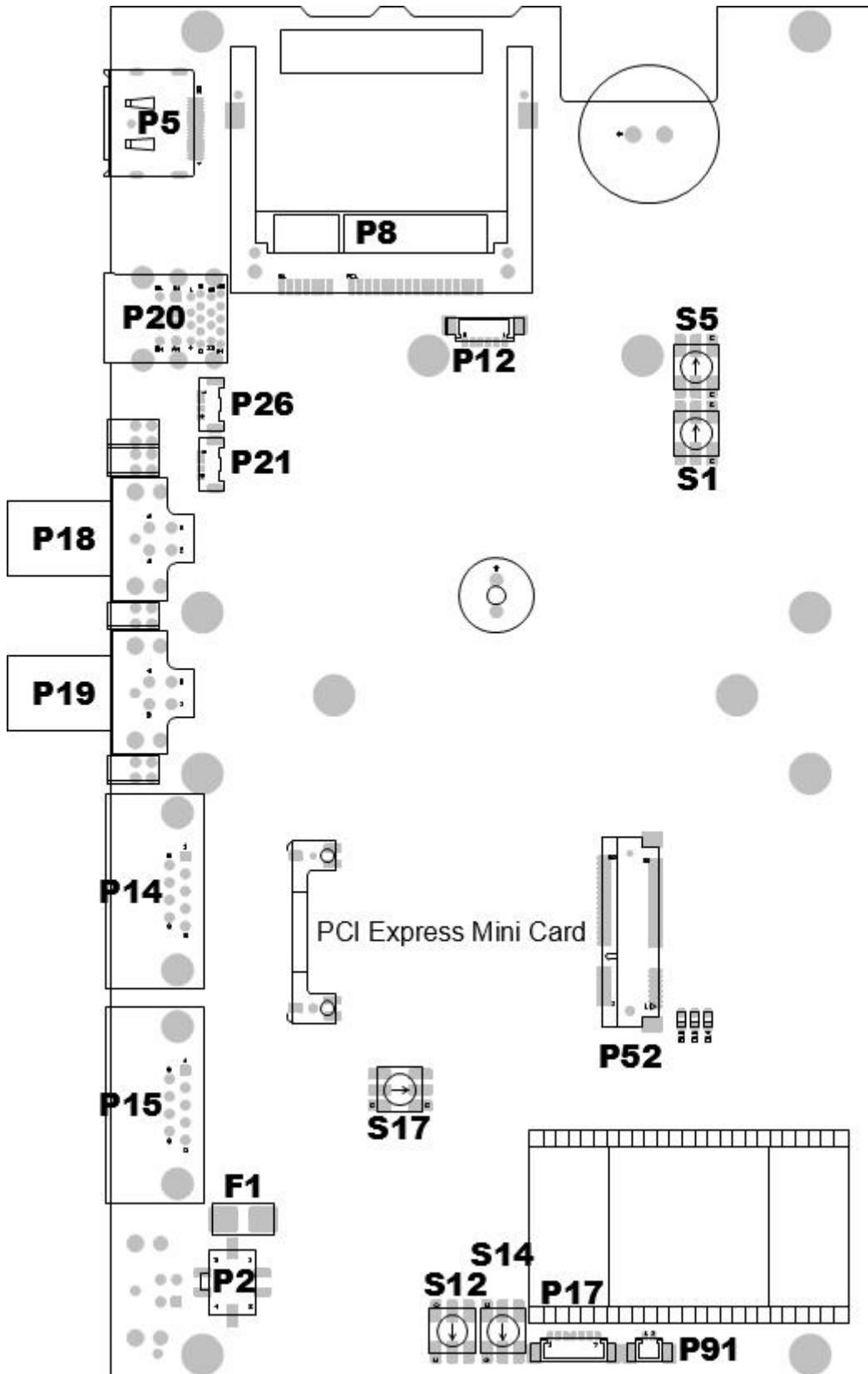
Fig. 4   Board Layout RSL81 Baseboard

Fig. 5   Open System View

Fig. 6   Closed System View

3.2 Memory and I/O Resources

3.2.1 General Memory Layout and Configuration

The RSL81 uses the same memory layout as a standard desktop PC. Three onboard devices, DRAM, graphics controller, and BIOS, make use of the 4 Gbyte (32-bit mode) / 64Gbyte (64-bit mode) adressable memory space.

Address	Device / Register	Remarks
0000'0000..0009'FFFFH	640 kbyte Main Memory (DRAM)	
000A'0000..000B'FFFFH	VGA Video Memory	
000C'0000..000F'FFFFH	Configurable memory range (BIOS, BIOS Extensions, DRAM or redirected to PC/104 bus)	
0010'0000.. FFFF'FFFFH	2-4 Gbyte Main Memory (DRAM)	including graphics memory (UMA)
0000'0001'0000'0000.. 0000'000F'FFFF'FFFFH	up to top	64-bit mode only

Tab. 3   Physical Memory Address Space Layout

Fig. 7   Memory Map

◇ **syslogic**
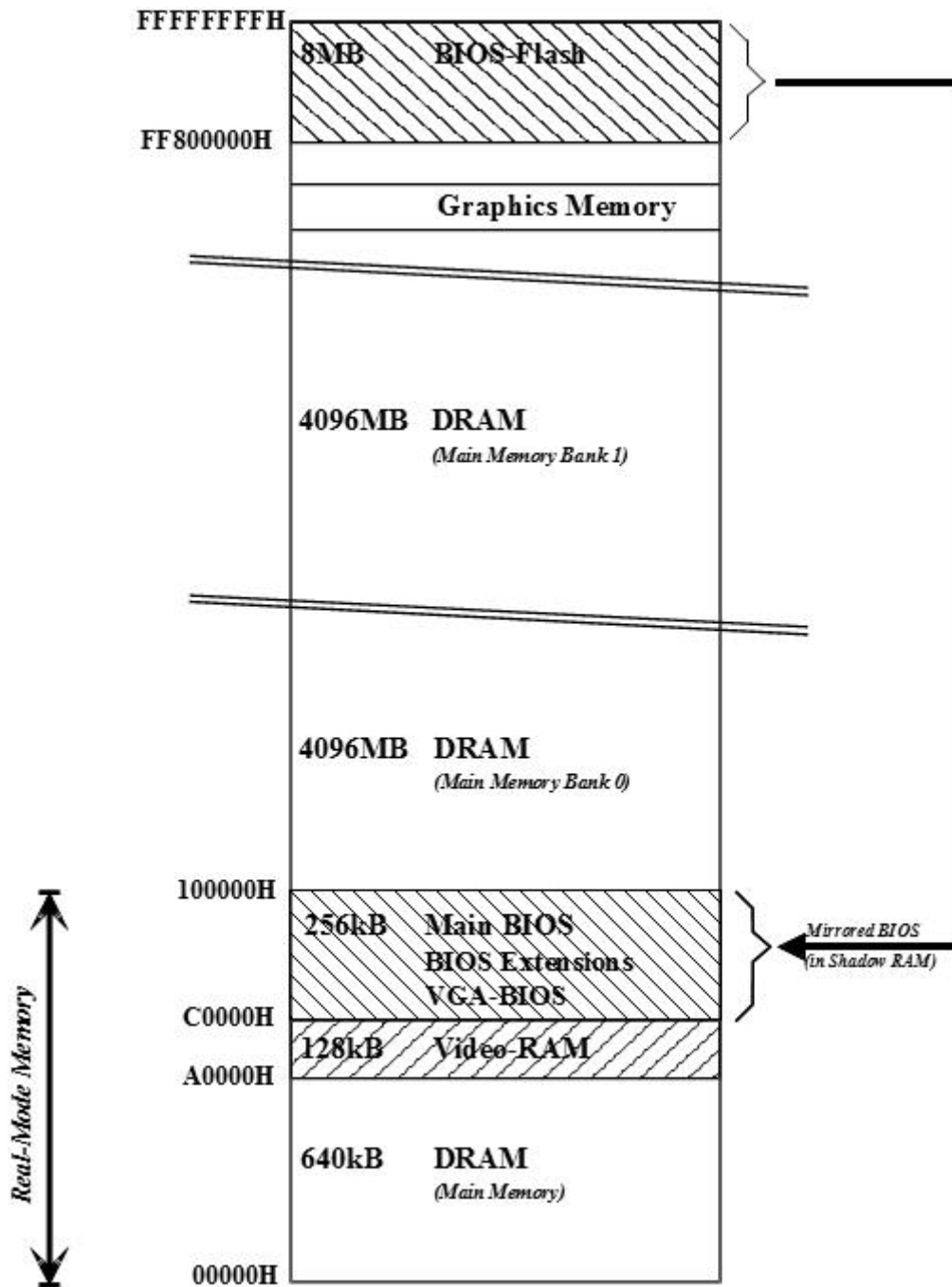
General I/O Layout and Configuration

The RSL81 64 kbyte I/O address space is mapped to peripheral devices as indicated in the table below.

Address	Device / Register	Remarks
0000..001FH	DMA Controller 1	
0020..0021H	Master Interrupt Controller	
0022H	Configuration Address Register	
0023H	Configuration Data Register	
0024..003FH	reserved	
0040..0043H	Timer/Counter	
0044..005FH	reserved	
0060H	Keyboard/Mouse Controller	
0061H	Port B Register	
0062..0063H	reserved	
0064H	Keyboard/Mouse Controller	
0065..006FH	reserved	
0070H	Bit 6..0 = RealTimeClock/CMOS-RAM Address Register Bit 7 = Non Maskable Interrupt (NMI) Mask (write only)	
0071H	RealTimeClock/CMOS-RAM Data Register	
0072..007FH	reserved	
0080..0091H	DMA Page Registers / reserved	
0092H	Port 92h System Control Register	
0093..009FH	reserved	
00A0..00A1H	Slave Interrupt Controller	
00A2..00BFH	reserved	
00C0..00DFH	DMA Controller 2	
00E0..010FH	reserved	
0110..016FH	reserved	
0170..0177H	Secondary IDE Channel	
0178..01EFH	reserved	
01F0..01F7H	Primary IDE Channel	
01F8..01FFH	reserved	
0200..0207H	reserved for Serial Ports (COM3)	
0208..020FH	reserved for Serial Ports (COM4)	
0210..026FH	not used	
0278..027FH	reserved for Parallel Port (LPT2) and Plug'n Play	
0280..02E7H	reserved	
02E8..02EFH	reserved for Serial Port (COM4)	
02F0..02F7H	reserved	
02F8..02FFH	reserved for Serial Port (COM2)	
0300..036FH	not used	
0370..0377H	reserved for external Secondary Floppy Controller	
0376..0377H	reserved for external Secondary IDE Channel	
0378..037FH	Parallel Port (LPT1)	

0380..03AFH	reserved	
03B0..03BBH	VGA registers (MDA)	
03BC..03BFH	reserved for Parallel Port (LPT3)	
03C0..03CFH	VGA registers (EGA)	
03D0..03DFH	VGA registers (CGA)	
03E0..03E7H	reserved	
03E8..03EFH	reserved for Serial Port (COM3)	
03F0..03F7H	reserved for external Primary Floppy Controller	
03F6..03F7H	Primary IDE Channel	
03F8..03FFH	reserved for Serial Port (COM1)	
0400..042FH	reserved	
0430..04EFH	reserved	
0480..048FH	DMA High Page Registers / reserved	
0490..049FH	Instruction Counter Registers / reserved	
04A0..04CFH	reserved	
04D0..04D1H	IRQ Edge/Level Control	
04D2..04FFH	reserved	
0500..08FFH	reserved	
0900..0A77H	reserved	
0A78H	Plug'n Play configuration port	
0A79..0BFFH	reserved	
0C00..0CF7H	reserved	
0CF8..0CFFH	PCI configuration registers	
0D00..0FFFH	reserved	
1000..3FFFH	reserved	
4000.. 46E7H	reserved	
46E8H	reserved	
46E9..47FFH	reserved	
4800..6FFFH	reserved	
7000..7FFFH	not used	
8000..81FFH	reserved	
8200..821FH	RSL8 system registers	
8220..83FFH	reserved for Syslogic IPC add-on boards	
8400..BFFFH	reserved	
C000..FFFFH	reserved for PCI devices (VGA, Ethernet, USB, SATA)	

Tab. 4   I/O Address Space Layout

The programmable logic device on the RSL81 board is factory programmed using some pins of the internal header P12. These pins **must not** be connected by the user.

Pin Number	Signal	Remarks
1	TCK (do not connect)	
2	TDO (do not connect)	
3	TMS (do not connect)	
4	TDI (do not connect)	
5	JTAG_VCC (do not connect)	
6	JTAG_GND (do not connect)	

Tab. 5   Factory Programming Header P12 (1x4 pin)

The power management controller on the RSL81 board is factory programmed using the internal header P17. This header **must not** be connected by the user.

Pin Number	Signal	Remarks
1	VPP/MCLR# (do not connect)	PICkit3 pin 1
2	VCC (do not connect)	PICkit3 pin 2
3	GND (do not connect)	PICkit3 pin 3
4	PGD (ICSPDAT, do not connect)	PICkit3 pin 4
5	PGC (ICSPCLK, do not connect)	PICkit3 pin 5
6	PGM LVP (SCL, do not connect)	PICkit3 pin 6
7	-- (SDA, do not connect)	--

Tab. 6   Factory Programming Header P17 (1x7 pin)

3.3   Peripheral Devices

3.3.1   DisplayPort Interface

The DisplayPort signals are available on the DisplayPort connector P5 for direct connection of DisplayPort compatible monitors. The controller uses the standard VGA register interface. All configuration is done by software (BIOS, VGA-BIOS, OS driver).

Device Connection

Pin Number	Signal	Remarks
1	ML Lane 0 +	Lane 0 (positive)
2	GND	Ground
3	ML Lane 0 -	Lane 0 (negative)
4	ML Lane 1 +	Lane 1 (positive)
5	GND	Ground
6	ML Lane 1 -	Lane 1 (negative)
7	ML Lane 2 +	Lane 2 (positive)
8	GND	Ground
9	ML Lane 2 -	Lane 2 (negative)
10	ML Lane 3 +	Lane 3 (positive)
11	GND	Ground
12	ML Lane 3 -	Lane 3 (negative)
13	CONFIG1	Configuration input 1
14	CONFIG2	Configuration input 2
15	AUX CH +	Auxiliary channel (positive)
16	GND	Ground
17	AUX CH -	Auxiliary channel (negative)
18	Hot plug	Hot plug dectect
19	Return	Return for power
20	DP_PWR	Power for connector (3.3V, 500mA)

Tab. 7   DisplayPort connector P5

Important Note

Maximum cable length for DisplayPort connection is dependent on pixel clock frequency (about 3 m for full bandwidth transmission, up to 15m for reduced bandwidth transmission1920x1080 resolution with a refresh rate of 60Hz).
For EMI conformance cable length is restricted to maximum 3m. If longer cables are used, special overvoltage and filtering elements have to be installed to comply with the requirements of EMI/RFI ''CE''-certification.
Use high quality shielded DisplayPort cables for maximum EMI protection.
Do not feed any voltage into pin 20 (DP_PWR), it is a supply output only for an optional external DisplayPort adapter.

3.3.2 Buzzer

A buzzer is available driven by the standard PC timer 1.

Use 2.4kHz for maximum volume.

3.3.3 CFast-Interface

The RSL81 features a SATA generation 3 hostcontroller having assigned the base address and IRQ at boot time by the PCI-BIOS.

Channel 0 of the SATA controller serves the CFast socket P8. The CFast card behaves like a standard SATA disk.

Tested CFast cards are:

- Cactus Technologies KC-series

Device Connection (CFast)

Pin Number	Signal	Pin Number	Signal
S1	SGND	PC1	CDI
S2	RxP	PC2	GND
S3	RxN	PC3	nc
S4	SGND	PC4	nc
S5	TxN	PC5	nc
S6	TxP	PC6	nc
S7	SGND	PC7	GND
		PC8	LED1
		PC9	LED2
		PC10	IO1
		PC11	IO2
		PC12	IO3
		PC13	PWR
		PC14	PWR
		PC15	PGND
		PC16	PGND
		PC17	CDO

Tab. 8 CFast Connector P8 (SATA Channel 0)

Important Note

Do not insert or remove the CFast card when power supply is on. This interface does not support hot-plugging.

syslogic

3.3.4   USB Interface

The RSL81 features an OHCI/EHCI and a XHCI compatible USB host controller having assigned the base address and IRQ at boot time by the PCI-BIOS. All ports support USB 2.0 devices and port 1 supports USB 3.0 devices with Superspeed.

Device Connection

The USB interface uses a standard A type double USB connector on the front for USB ports 1 and 2. Ports 3 and 4 are located on two internal 4 pin connectors.

P20 bottom Pin Number	USB port 1 Signal	P20 top Pin Number	USB port 2 Signal
1	VBUS	1	VBUS
2	D-	2	D-
3	D+	3	D+
4	GND	4	GND
5	SSRX-	5	-
6	SSRX+	6	-
7	SSGND	7	-
8	SSTX-	8	-
9	SSTX+	9	-

Tab. 9   USB1/2 Interface Connector P20 (Dual Type A)

syslogic

Pin Number	Signal	Remarks
1	VBUS	
2	D-	
3	D+	
4	GND	

Tab. 10 USB3, 4 Interface Connector P21, P26 (1x4pin)

Mating connector type for P21, P26: Housing Molex Micro-Lock Plus 505565-0401, Crimp contacts Molex 505431-1100. Recommended wire type: 26-28AWG, max insulation diameter 1.02mm. Twisted D+/D- wires.

Important Note

Maximum cable length allowed for USB connection is 3 m. If longer cables are used, special overvoltage and filtering elements have to be installed to comply with the requirements of EMI/RFI "CE"-certification. Only use high quality industrial USB devices with sufficient EMI compatibility.
Use shielded cables for maximum EMI protection.
Drawing excessively power might disturb operation.

⬦ **syslogic**

3.3.5 Ethernet LAN Interface

The RSL81 features up to two PCI Ethernet controllers having assigned the base address and IRQ at boot time by the BIOS. The Ethernet interface drives two LED's (yellow and green) beside the LAN connector for status information. The meaning of the LED activity is programmable (normally set by the low level driver).

LAN1 and LAN2 feature Intel I210 Ethernet controllers supporting 10/100Mb/s. Both interfaces support Auto Negotiation and Auto MDIX functions. Check manufacturer's datasheets for detailed information.

No configuration options are available for the Ethernet device.

Device Connection

The Ethernet interfaces use the standard D-coded M12 CAT5 connector P18 and P19 on the front for 100Ω shielded Twisted Pair cabling.

Mating connector type for P18, P19: any standard D-coded male M12 CAT5 conformal connector.

Pin Number	Signal	Remarks
1	TX+	
2	RX+	
3	TX-	
4	RX-	

Tab. 11 Ethernet Twisted Pair Interface Connector P18 and P19 (M12 D)
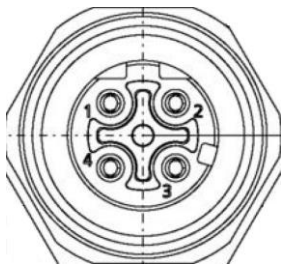
Fig. 8 M12 D-coded Female Pinout (front view)

Important Note

Do not apply any supply voltage to this port.

3.3.6 Watchdog

The watchdog timer is hardware configurable for 100ms or 1s shortest timeout. Longer timeouts may be achieved by programming the Watchdog Configuration Register.

Once timed out, it may activate the RSL81 hardware reset.

Configuration Options

Switch	Configuration	Remarks
S1	even positions '0', '2', '4', '6', '8' = 1 s	see Tab. 2.
	odd positions '1', '3', '5', '7' = 100 ms	see Tab. 2.

Tab. 12 Watchdog Configuration Options

3.3.7 GPS

The GPS function is supported by use of a complete and certified GPS module NEO-M8U manufactured by u-Blox.

GPS Feature is part of the IPC/WLB-PG Extension board. Refer to the dedicated user documentation DOC/IPC_WLBPG-E and u-Blox web page for detailed information.

The Module is connected to USB internal interface directly and appears as a virtual serial interface.

The GPS module may be turned off by the IPC/WLB-PG controller. This allows to safe power or to hard reboot the module. Refer to 3.3.10 .

GPS antenna connector	
Connector	**Description**
Connector Type Assembled	SMA
LNA Supply Voltage	3.3V+/-10% with internal 10Ohm series resistor
LNA maximum Supply current	20mA
Required frequency range of Antenna	1575MHz GPS
	1598 ... 1606MHz Glonass
	1561MHz BeiDou
	1560MHz ... 1591MHz Galileo
Required antenna impedance	50Ohms
Required antenna ESD Rating	4kV contact discharge, 8kV air discharge
Pin description	
Pin 1	Antenna
Shield	GND

Tab. 13 GPS Antenna requirement

Important Note

Do not shortcut the antenna.

GPS with Dead Rekoning

The GPS module supports dead reckoning to provide position data even if there are no accurate satellite visibility available. Dead reckoning is available after an initialization phase where the internal sensors are calibrated. Refer to u-Blox documentation to get best performance.
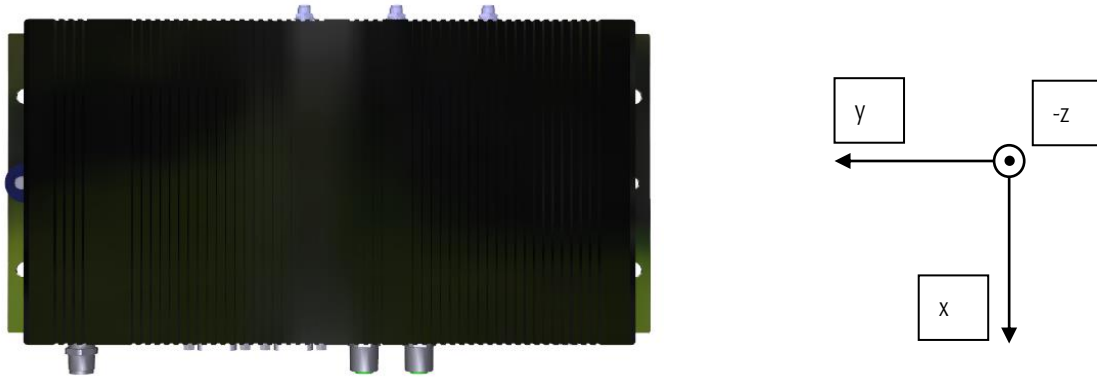
Fig. 9   G-Sensors of GPS ADR modul

Important Note

After a power cycle the GPS module is required to get the current position before being able to calculate the current position according to its internal sensors.

3.3.8   Motion Sensor

The integrated motion sensor ISM330DLC provides a 3D accelerometer and a 3D gyroscope. The sensor can be configured and data can be read over the CPUs I2C interface. See ST Microelectronics ISM330DLC datasheet for details.
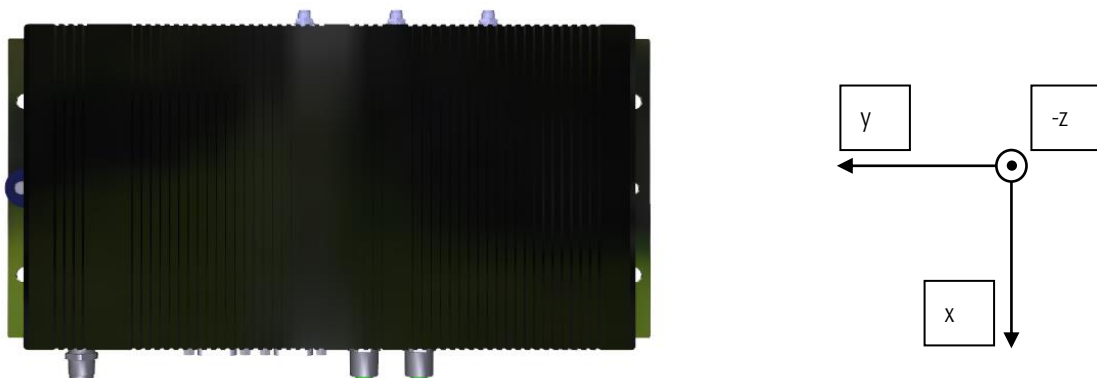
Fig. 10   Motion Sensor

3.3.9 LTE

LTE Interface is provided by u-Blox MPCI-L210 (MPCI-L210-02S-00 or MPCI-L210-03S) modem connected to an internal USB Port and is inserted in the expansion interface board IPC/WLB-PG. For detailed information refer to DOC/IPC_WLBPG and u-Blox documentation.

The UMTS/LTE antenna input is available on a designated SMA connector. The antenna must match the requirements according to the u-Blox documentation.

The modem is connected to USB and appears as a virtual serial interface and as a virtual network interface.

The LTE modem may be turned off by the IPC/WLB-PG controller. This allows to safe power or to hard reboot the module. Refer to 3.3.10 .

Important Note

The antenna for LTE may be harmful if people are exposed to the radiation for too long. Therefore place the antenna that way that there is always a distance of 45cm to places people stay.

Important Note

LTE Antenna must meet the requirements of u-Blox documentation. Especially check SWR, gain, maximum Power and impedance.

Important Note

The LTE Modem provides a diversity antenna input. It is required to disable the RX-Diversity antenna using AT-commands if this input is not connected to an antenna.

The expansion board IPC/WLB-PG provides two SIM Card interfaces (ID-000, 25mm x 15mm). Only one card may be connected to the modem at the same time. The configuration is done using the controller of the IPC/WLB-PG board.

To change the SIM Card follow the procedure given below:
1. Disable WAN connection using AT+CFUN=2
2. Select the desired SIM Card by sending USB-HID command to the board controller
3. Enable the WAN connection using AT+CFUN=16 or AT+CFUN=1,1

More details on how to change SIM-Card are provided in u-Blox System Integration manual of MPCI-L210 Modem chapter SIM interface.

Important Note

At the place where the SIM-Cards are installed it may get up to +85°C. Make sure the inserted SIM Card fulfills this requirement to avoid errors.
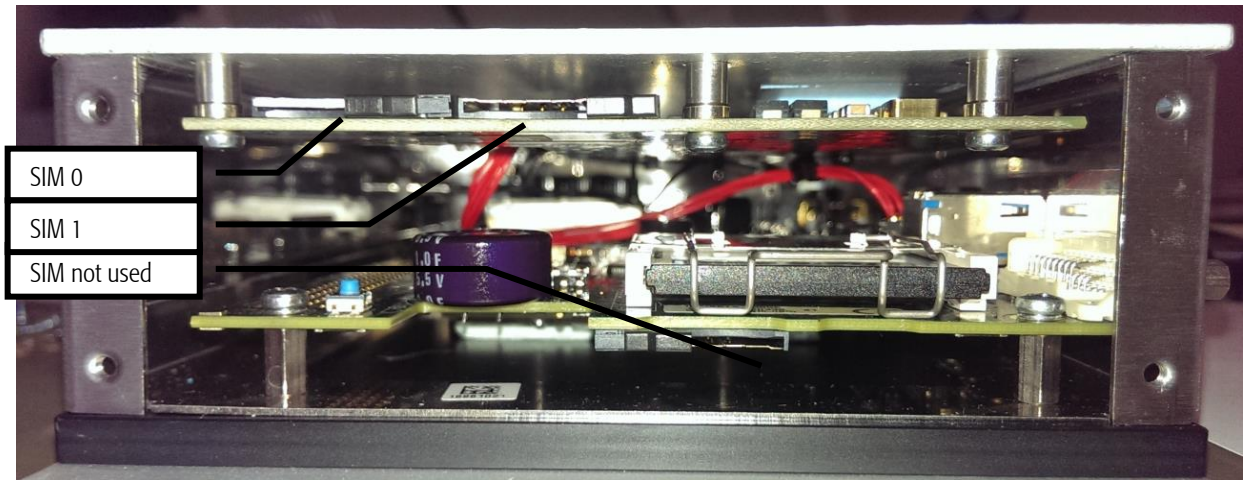
Fig. 11   Location of SIM Card holder

3.3.10   IPC/WLB-PG Controller

IPC/WLB-PG expansion board provides some configuration and status information about the GPS and LTE Interface. The controller is connected to an internal USB Port and provides the following features:

- Selection of SIM Card for LTE modem
- Enable and disable power of LTE and GPS module
- Disable LTE connection (air plane mode)
- Check if SIM0 and SIM1 are inserted
- Check if lid of SIM0 and SIM1 are closed
- Read LTE status flag.

For detailed documentation refer to DOC/IPC_WLBPG-E documentation.

syslogic

3.3.11 CAN interface

RSL81 features up to two CAN Ethernet controllers having assigned the base address and IRQ at boot time by the BIOS.

Both CAN interfaces are factory configured for normal mode. It can be changed to Silent Mode (Listen only), preventing the interface to transmit on or disturb the connected CAN lines.

Device Connection

The CAN interfaces are available on two 9-pin male DSUB connectors.

Pin Number	Signal	Pin Number	Signal
1	-	6	-
2	CANL	7	CANH
3	CAN Ground	8	-
4	-	9	-
5	-		

Tab. 14 CAN Ports CAN1, CAN2 (DSUB9)

Device Configuration

The CAN transceiver operating mode can be configured with switch S17.

Switch S17	CAN1 transceiver operating mode	CAN2 transceiver operating mode
0	normal mode (receiver and transmitter enabled)	normal mode (receiver and transmitter enabled)
1	silent mode (receiver enabled, transmitter disabled)	normal mode (receiver and transmitter enabled)
2	normal mode (receiver and transmitter enabled)	silent mode (receiver enabled, transmitter disabled)
3	silent mode (receiver enabled, transmitter disabled)	silent mode (receiver enabled, transmitter disabled)
4-F	reserved	do not use

Tab. 15 CAN transceiver operating mode configuration

3.3.12 Power supply

The processor and its peripherals are powered by an isolated, integrated power supply which generates all the necessary voltages. The main power must be supplied to a 4 pole A-coded male M12 connector.

Mating connector type for P1: any standard A-coded male M12 connector with conformal electrical specification (voltage and current). Use AWG18/0.75mm² wires at minimum to comply with the safety requirements and follow the connector manufacturers instruction guide.

Pin Number	Signal	Remarks
1	GND	main ground (0V) connection
2	+24/36VDC	main power +16.8V to +45V DC (24/36V nominal)
3	Power Fail/Remote on/off	Power fail input
4	AUX Power	reserved, leave open

Tab. 16 Power supply connector P1

For normal operation the external power supply has to be connected to the pins 2 (+24/36VDC) and 1 (GND) of the connector.

Pin 4 (AUX Power) is reserved, leave open.

Pin 3 is used as an input for either a power fail or remote on/off signal.
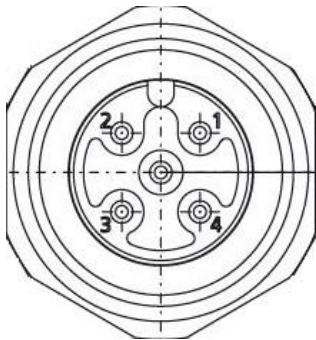
Fig. 12 M12 A-coded Male Pinout (front view)

Important Notes

Input current may vary significantly during operation. Make sure wire diameter are designed properly to remain within the specified operating voltage range.

3.3.13 Power supervision

The power management control unit (PCU) can be operated in two modes: power fail mode or remote on/off mode. The following two chapters describe their functionality in detail.

Switch S12	Configuration	Remarks
0	test mode (powerfail active)	
1	internal pulldown (remote on/off mode)	
2	internal pullup (power fail mode)	Factory setting
3-F	reserved	do not use

Tab. 17 Power fail input configuration

Switch S14	Configuration	Remarks
0	bypass mode (for power fail mode)	Factory Setting
1 to F	remote on/off mode.	Refer to Tab. 19

Tab. 18 Power fail mode configuration

3.3.14 Power Fail

In power fail mode the microcontroller monitors the external power fail signal. The state of power fail signal can be access through a status register, see programming section in chapter 4.

Application example
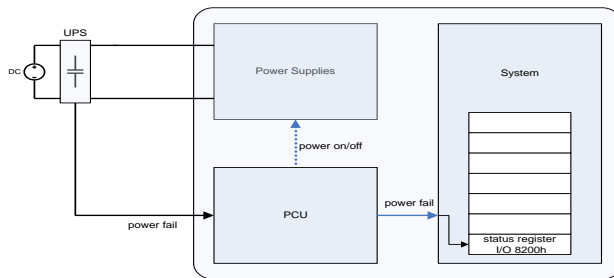
Fig. 13 Typical power fail application

The application has to poll the power fail flag and call different functions according to the state of the flag.
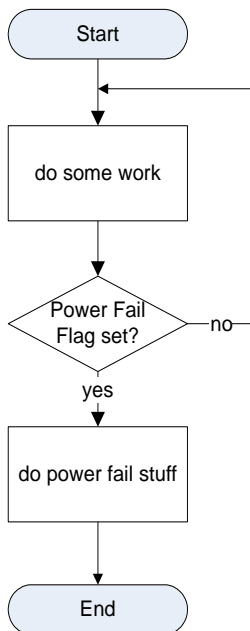
Fig. 14 Typical power fail flow

3.3.15   Remote On/Off

With the remote on/off function the system can be switched on and off through an external control signal. When active, the internal software goes from the run state into the shutdown state. After a predefined timeout the PCU switches the main power supply off. The timeout can be configured through S14. Mode 6-9 are controlled by a 250ms Impulse of the external control signal. Mode 6 and Mode 8 start up, when the power supply is supported. Mode 8 and 9 have the feature to do a hard power off when the Impulse is longer than 5 seconds.

For Mode A (user programmable), a special adapter from Syslogic is necessary which allows to program different timings via an internal serial interface (requires opening the enclosure).

Config switch S14 position	$t_{debounce\_on}$ On debouncing (setup)	$t_{debounce\_off}$ Off debouncing (hold)	$t_{startup}$ Hold time until switch off signal is routed to processor, if system is still booting	t_{hard_off} Timeout until switch off signal is generated from processor (after that hard off)
0	-	-	-	-
1	2 s	60 s	5 s	60 s
2	2 s	60 s	60 s	300 s
3	2 s	60 s	60 s	120 s
4	1 s	5 s	5 s	60 s
5	5 s	5 s	60 s	60 s
6	0 s	0 s	60 s	60 s
7	0 s	0 s	60 s	60 s
8	0 s	0 s	60 s	60 s
9	0 s	0 s	60 s	0 s
A (user mode)	n/a	n/a	n/a	n/a
B – F (reserved)	n/a	n/a	n/a	n/a

Tab. 19 PCU timing configuration through S14

When switch S14 is in position 0 the PCU is in bypass mode.

Please check the separate documentation and sample code for details about the programming of the power management control unit.

Important Notes

The operating system must support the remote on/off function.

---

syslogic

Application example
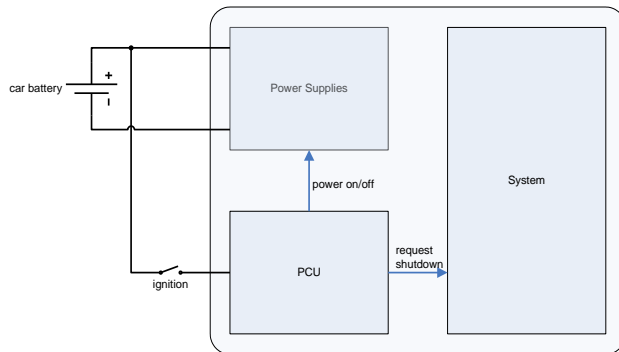
Fig. 15   Application example: CAR PC

Startup sequence
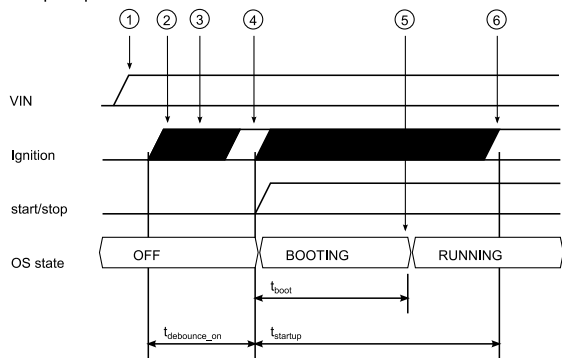
Notes:

1) VIN supply must be present

2) Ignition on starts debouncing sequence

3) glitches/bounces are ignored during $t_{debounce\_on}$

4) if ignition signal is stable after $t_{debounce\_on}$, supply is switched on and the system starts

5) during $t_{startup}$, ignition switch is ignored
Note: system might have finished booting well in advance before startup phase is over

6) after $t_{startup}$, the power management circuit resumes tracking of the ignition switch signal

Fig. 16   Startup timing diagram

Forced shutdown sequence

Ignition off starts debouncing sequence glitches/bounces are ignored during $t_{debounce\_off}$

if ignition signal is stable after $t_{debounce\_off}$, powerfail is indicated to the system

if the operating system ignores the powerfail signal or is not able to shut down within t_{hard_off}, a stop signal is sent from the power management unit to the power supply which cuts off power to the system

VIN supply may be removed now

Fig. 17   Shutdown timing diagram

3.3.16   Frontside Status LEDs

The four colored LEDs on the left part of the front side show the following states:

Label	Color	Signal	Remarks
B	Red	STOP signal	for programming refer to Control register in chapter 4
R	Green	Board ready	for programming refer to Setup register in chapter 4
A	Green	Aux LED	for programming refer to Setup register in chapter 4
D	Yellow	Disk activity	SATA/CFast only

The LEDs beside the LAN connectors show status information of the corresponding LAN interface which is dependent on the driver used.

4 Programming Information

4.1 Overview

The programming of the RSL81 board is done with standard memory and I/O read and write operations. Most configuration options are handled by the BIOS. For detailed information refer to the NETIPC firmware documentation and other related documents as listed in paragraph 1.4.

Please contact Syslogic technical support if you need special BIOS configuration.

4.2 Interrupt, Memory and I/O Resources

4.2.1 Interrupt Resources

The following table shows the usage of the interrupt resources. Interrupts marked 'free' are not used by onboard devices if they are not assigned to a PCI device in the BIOS configuration.

Interrupt	Interrupt Source	Remarks
Master		
IRQ0	Timer Channel 0	
IRQ1	reserved for PS/2-Controller (Keyboard)	SIO, check CMOS setup
IRQ2	Slave Interrupt Controller Cascading	
IRQ3	available for PCI or COM2	SIO, check CMOS setup
IRQ4	available for PCI or COM1	SIO, check CMOS setup
IRQ5	available for PCI or COM4	SIO, check CMOS setup
IRQ6	available for PCI	check CMOS setup
IRQ7	available for PCI or LPT1	SIO, check CMOS setup
Slave		
IRQ8	Real Time Clock	
IRQ9	ACPI/PCI	do not connect
IRQ10	available for PCI or COM3	SIO, check CMOS setup
IRQ11	available for PCI	check CMOS setup
IRQ12	available for PCI or PS/2-Controller	SIO, check CMOS setup
IRQ13	Floating Point Unit	
IRQ14	Primary IDE/SATA Channel in legacy mode	do not connect
IRQ15	available for PCI	check CMOS setup
Special		
NMI	Watchdog	

Tab. 20 Interrupt Usage

Memory Resources

The general memory layout is shown in paragraph 3.2.1 . The configuration of the memory layout is done by programming processors internal configuration registers and board configuration registers (see paragraph 4.2.2). This is done completely by the BIOS on system startup and must not be changed during operation. For operating systems requiring memory configuration (e.g. Windows CE) the memory layout shown in paragraph 3.2.1 must be considered.

4.2.2　　　　I/O Resources

This paragraph describes only the RSL81 system register and support functions not directly related to a specific peripheral device. The general I/O layout is shown in paragraph 0. Peripheral devices are discussed in paragraph 3.3.

Address	Device / Register	Remarks
8200H	Status Register	
8201H	Control Register	Reset state = 05H
8202H	Function ID Register	
8203H	Watchdog Configuration Register	Reset state = 80H
8204H	Option ID Register	
8205H	Setup Register	Reset state = 00H
8206H	Revision ID Register	
8207H	Socket Memory Configuration Register	not supported
8208H	Socket Memory Window Mapping Register	not supported
8209H	Socket Memory Window Base Address Register	not supported
820AH	Boot Mode Input Register	
820BH	I2C Register for Temp Sensor	
820CH	Configuration Switch Input register	
820DH	PWM-Register for LCD Inverter Brightness Control	not supported
820E..821FH	reserved	do not access

Tab. 21 RSL81 System Registers

Status Register 8200h

D7	D6	D5	D4	D3	D2	D1	D0	Access
OVRTMP#	LOBAT#	1	WDG#	ERRFLG#	ATTFLG#	ERRINT#	PWRFAIL#	Read
reserved								Write
1111'1111 (0xFF)								Reset

Description:

OVRTMP#   Temperature Sensor Status Flag

Read	Write
0 = programmed temp. limit reached 1 = temperature ok (below limit)	

LOBAT#   Battery Status Flag

Read	Write
0 = Battery voltage low 1 = Battery voltage ok	

WDG#   Watchdog Status Flag

Read	Write
0 = Watchdog has timed out 1 = Watchdog running or disabled Reset by issuing a hardware reset (see register 8204hex)	

ERRFLG#   Error Status Flag (for polled applications)

Read	Write
not used, returns 1	

ATTFLG#   Attention Status Flag (for polled applications)

Read	Write
not used, returns 1	

ERRINT#   Error Interrupt Status

Read	Write
0 = Error Interrupt pending 1 = No error interrupt pending	

PWRFAIL#   Power Fail Status Flag

Read	Write
0 = Power fail occurred 1 = No power fail occurred	

Reserved   Reserved, always write 0

syslogic

Control Register 8201h

D7	D6	D5	D4	D3	D2	D1	D0	Access
TRIG#	WDTRIG	WDNMI	STOP	TRGSRC	FREEZE	ERREN#	ATTEN#	Read
TRIG#	WDTRIG	WDNMI	STOP	TRGSRC	FREEZE	ERREN#	ATTEN#	Write
0000'0101 (05h)								Reset

Description:

TRIG#   Bus Trigger (currently not supported)

Read	Write
readback of written value	

WDTRIG   Watchdog Trigger

Read	Write
readback of written value	Any state change triggers the watchdog.

WDNMI   Watchdog NMI Configuration

Read	Write
0 = Watchdog activates hardware reset 1 = Watchdog timeout activates Non Maskable Interrupt (NMI)	0 = Watchdog activates hardware reset 1 = Watchdog timeout activates Non Maskable Interrupt (NMI)

STOP   Stop# Signal/LED State

Read	Write
0 = STOP# inactive (high), red LED off 1 = STOP# active (low), red LED on	0 = STOP# inactive (high), red LED off 1 = STOP# active (low), red LED on

TRGSRC   Trigger source selection

Read	Write
not used, returns 0	

FREEZE   Freeze bit

Read	Write
not used, returns 1	

ERREN#   Error Interrupt Enable (PC/104 bus IOCHCK# routed to NMI)

Read	Write
always 0 = Error Interrupt on NMI always enabled	

ATTEN#   Attention Interrupt Enable

Read	Write
not used, returns 1	

The STOP# signal directly drives the red LED on the front (STOP# low = LED on).
Upon startup STOP# is active (LED on) until the BIOS has initialized the main peripherals, it is set inactive (LED off) before booting the operating system. STOP# is also active (LED on) while operating in Bootloader mode.

Function ID Register 8202h

D7	D6	D5	D4	D3	D2	D1	D0	Access
FID[7:0] Function ID								Read
reserved, always write 0								Write
same as Read value								Reset

Description:

FID   Function ID

Read	Write
51h = general IPC processor board	reserved, always write 0

Watchdog Configuration Register 8203h

D7	D6	D5	D4	D3	D2	D1	D0	Access
WDLOCK	0	0	0	WDTOUT[3:0] Watchdog Timeout Selection				Read
WDLOCK	reserved	reserved	reserved	WDTOUT[3:0] Watchdog Timeout Selection				Write
1000'0000 (80h)								Reset

Description:

WDLOCK   Watchdog Lock Flag (prevents disabling running Watchdog)

Read	Write
0 = Inactive, not locked	0 = do not lock
1 = Active, locked	1 = lock WDEN

WDTOUT   Watchdog Timeout Selection

Read	Write
0 = 1s if S1=even, 100ms if S1=odd	0 = 1s if S1=even, 100ms if S1=odd
1 = 4s	1 = 4s
2 = 8s	2 = 8s
3 = 16s	3 = 16s
4 = 32s	4 = 32s
5 = 64s	5 = 64s
6 = 128s	6 = 128s
7 = 256s	7 = 256s

reserved   Reserved, always write 0

Note

Watchdog timeout selection values > 0 are independent of switch S1 setting.

Option ID Register 8204h

D7	D6	D5	D4	D3	D2	D1	D0	Access
OID[7:0] Option ID								Read
reserved, always write 0								Write
same as Read value								Reset

Description:

OID   Option ID

Read	Write
D4h = RSL8/RSL81	A5h = Writing data A5h invokes a complete hardware reset (also clearing the Watchdog timeout status bit) 5Ah = Writing data 5Ah invokes a complete power off or power reset (also clearing the Watchdog timeout status bit), system restarts depending on configuration of power management controller.

Setup Register 8205h

D7	D6	D5	D4	D3	D2	D1	D0	Access
READY	WDEN	AUX	0	0	USBEN2	USBEN1	USBEN0	Read
READY	WDEN	AUX	0	0	USBEN2	USBEN1	USBEN0	Write
0000'0111 (07h)								Reset

Description:

READY   Ready bit, green LED

Read	Write
0 = Inactive, green LED off	0 = Deactivate green LED
1 = Active, green LED on	1 = Activate green LED

WDEN   Watchdog enable

Read	Write
0 = Watchdog disabled	0 = Disable watchdog
1 = Watchdog enabled (running)	1 = Enable watchdog

AUX   Auxiliary LED, green LED

Read	Write
0 = Inactive, green AUX LED off	0 = Deactivate green AUX LED
1 = Active, green AUX LED on	1 = Activate green AUX LED

USBEN2   USB4/5 Power enable

Read	Write
0 = USB5/6 power off	0 = disable USB5/6 power
1 = USB5/6 power on	1 = enable USB5/6 power

USBEN1   USB2/3 Power enable

Read	Write
0 = USB3/4 power off	0 = disable USB3/4 power
1 = USB3/4 power on	1 = enable USB3/4 power

USBEN0   USB0/1 Power enable

Read	Write
0 = USB1/2 power off	0 = disable USB1/2 power
1 = USB1/2 power on	1 = enable USB1/2 power

The READY signal directly drives the green LED on the front (READY high = LED on).
Upon startup READY is inactive (LED off) until the BIOS has initialized the main peripherals, it is set active (LED on) before booting the operating system.
Always read back the current state before programming this setup register for enabling the watchdog!

Important Note

Be careful when disabling USB power by setting USBENx=0 since this will disable any all devices connected to the two related USB ports. Always use a program sequence which automatically reenables USB power some seconds later.

Revision ID Register 8206h

D7	D6	D5	D4	D3	D2	D1	D0	Access
RID[7:0] Revision ID								Read
reserved, always write 0								Write
same as Read value								Reset

Description:

RID   Logic Design Revision ID

Read	Write
see Product Revision History	

reserved   Reserved, always write 0

Status Register 820Ah

D7	D6	D5	D4	D3	D2	D1	D0	Access
0	0	0	0	0	0	BM1	BM0	Read
reserved								Write
0000'0011 (0x03)								Reset

Description:

BM1..0   Boot Mode Inputs

Read	Write
0 = reserved	
1 = reserved	
2 = boot from backup BIOS	
3 = normal Operating Mode	

Reserved   reserved, do not write

syslogic

I2C Register 820Bh for temperature sensor control

D7	D6	D5	D4	D3	D2	D1	D0	Access
SCLO	SDAO	SCL	SDA	1	1	1	1	Read
SCLO	SDAO	Reserved, always write 1						Write
FFh								Reset

Description:

SCLO   Clock Port Output State

Read	Write
0 = Pin state = low 1 = Pin state = high	0 = Output latch state = low 1 = Output latch state = high (open collector)

SDAO   Data Port Output Port Latch State

Read	Write
0 = Pin state = low 1 = Pin state = high	0 = Output latch state = low 1 = Output latch state = high (open collector)

SCL   Clock Port Pin State

Read	Write
0 = Pin state = low 1 = Pin state = high	

SDA   Data Port Pin State

Read	Write
0 = Pin state = low 1 = Pin state = high	

Configuration Switch Input Register 820Ch

D7	D6	D5	D4	D3	D2	D1	D0	Access
0	0	0	0	S1-D3	S1-D2	S1-D1	S1-D0	Read
reserved								Write
xxxx'xxxx (0xXX)								Reset

Description:

D3-0   Configuration Switch S1 Inputs

Read	Write
S1 state (0-F)	

D7-4   Configuration Switch Inputs

Read	Write
0 (reserved)	

Reserved   reserved, do not write

4.3 Peripheral Devices

4.3.1 DisplayPort-Interface

The DisplayPort interface uses the standard PC/AT VGA register set. For detailed programming information please refer to the IBM PC/AT Technical Reference or similar documentation.

Low level programming is handled by the VESA compatible VGA-BIOS.

For detailed programming information please refer to the Intel Atom E39xx technical reference or similar documentation. Legacy support and low level programming is handled by the BIOS and standard OS drivers.

4.3.2 SATA/CFast-Interface

For detailed programming information please refer to the Intel Atom E39xx technical reference or similar documentation. Legacy support and low level programming is handled by the BIOS and standard OS drivers.

4.3.3 Ethernet Interface

The Ethernet interfaces use the Intel I210IT Gigabit Ethernet Controller. Because of the use of D-coded M12 connector, only 10/100Mbit modes can be used. For detailed programming information and drivers check www.intel.com .

4.3.4 USB Interface

The USB interfaces use the standard OHCI/EHCI/XHCI register set. Legacy support and low level programming is handled by the BIOS and standard OS drivers.

4.3.5 Temperature Sensor

The Temperature Sensor is built up using an LM75 compatible temperature sensor programmable through an I2C interface. The I2C interface programming is done through the I2C Register of the RSL8. For detailed programming information please refer to the National Semiconductor LM75 datasheet or similar documentation.

Poweron default setting for OVERTMP* is 80°C chip temperature.

4.3.6 Watchdog

The watchdog is disabled by default on poweron and must be enabled by the application program.

Before enabling the watchdog by setting the WDEN bit in the RSL81 Setup Register, the watchdog action (RESET or NMI) must be programmed in the RSL81 Control Register (bit WDNMI) and the timeout value must be configured using switch S1 and/or the SL8 Watchdog Configuration Register.

If RESET activation is selected, the watchdog generates a hardware reset if it is not triggered within the configured timeout window by writing the WDTRIG bit in the RSL81 Control Register. The application must check the WDG* bit in the RSL81 Status Register uppon startup to identify the Watchdog as the source of the reset, and it must issue a hardware reset (by writing the value 0a5h to the RSL81 Option ID Register) to clear the WDG* flag. Otherwise the system resets again as soon as the Watchdog is started.

If NMI activation is selected, the watchdog generates a Non Maskable Interrupt to the processor if it is not triggered within the configured timeout window by writing the WDTRIG bit in the RSL81 Control Register. Note that enabling the NMI input of the processor also requires setting bit 7 of I/O port 70h (NMI mask) and clearing bit 3 of I/O port 61h (Port B IOCHK# enable). The NMI routine must check the WDG* bit in the RSL81 Status Register to identify the watchdog as the source of the NMI, and it must issue a hardware reset (by writing the value 0a5h to the RSL81 Option ID Register) to clear the WDG* flag. Otherwise the NMI routine is entered again as soon as the watchdog is started.

Sample code showing the initialization and triggering of the watchdog is available for RESET and NMI mode in the free IPC/IOCOMSW-1A package.

Note

The NMI mask bit (bit 7 of I/O port 70h) is write only. Typically it is enabled by the BIOS and should not be disabled by application software.

4.3.7 Motion Sensor

The integrated motion sensor ISM330DLC provides a 3D accelerometer and a 3D gyroscope. The sensor can be configured and data can be read over the CPUs I2C interface (slave address 1101010b). See ST Microelectronics ISM330DLC datasheet and Syslogic sample code for details.

5 Installation and cabling

5.1 Introduction

Installation and cabling of the RSL81 system has to be done with great care; the correct cabling is essential for high operational reliability and the correct grounding is necessary for protection. To meet the requirements of "CE"-certification all cables have to be shielded. The enclosure has to be connected to ground via the mounting kit.

Important notes

To meet the requirements of EMI/RFI "CE"-certification, correct mounting, installation and cabling of the RSL81 system according to these guidelines is absolutely necessary.

5.2 Protective Earth

Also not required for safety reason because of the low supply voltage, it is highly recommended to connect the earth bolt on the base plate to protective earth with at least 2.5 mm² wire gauge.

Fig. 18   Earth connection

5.3 Powering the RSL81 System

The "logic supply voltage", i.e. the power driving the electronic circuits (CPU and base board) is internally generated from the 24/36VDC power supply input. Remember that the power supply is isolated. For a non-isolated version please contact the manufacturer.

The power supply has to be connected according to paragraph 3.3.12 . Maximum allowed cable length between ac/dc power supply and system power input is 30 m. If the cable is longer than 30 m or routed outside the building, special overvoltage and filtering elements have to be installed to comply with the requirements of EMI/RFI "CE"-certification. Use AWG18/0.75mm^2 wires at minimum to comply with the safety requirements and follow the connector manufacturers instruction guide.

When selecting the external power supply the maximum power dissipation of the system has to be considered.

Important notes

Please make sure that the input voltage does not exceed the recommended operating range otherwise the electronics board could get damaged and correct operation cannot be guaranteed.
Use an overload protected power supply to prevent damage in case of a short inside the system.
The ac/dc power supply must fulfill the requirements for EMI/RFI "CE"-certification.

5.4 Cabling the interfaces

Use appropriate cabling for all interfaces. Shielded cabling is required to meet the EMI/EMC limits.

5.5   SIM Card Installation

For SIM Card installation the service cover on the left side of the system must be removed completely. It is highly recommended to shut down the system and remove power before removing the service cover.

After having pushed the locking slider downside, the SIM card must be pushed in completely and secured by pulling the locking slider back up.

To remove the SIM card, the locking slider has to be pushed down. Then a short push on the SIM card will activate an ejection mechanism, making the card accessible for pulling it out of the card holder.
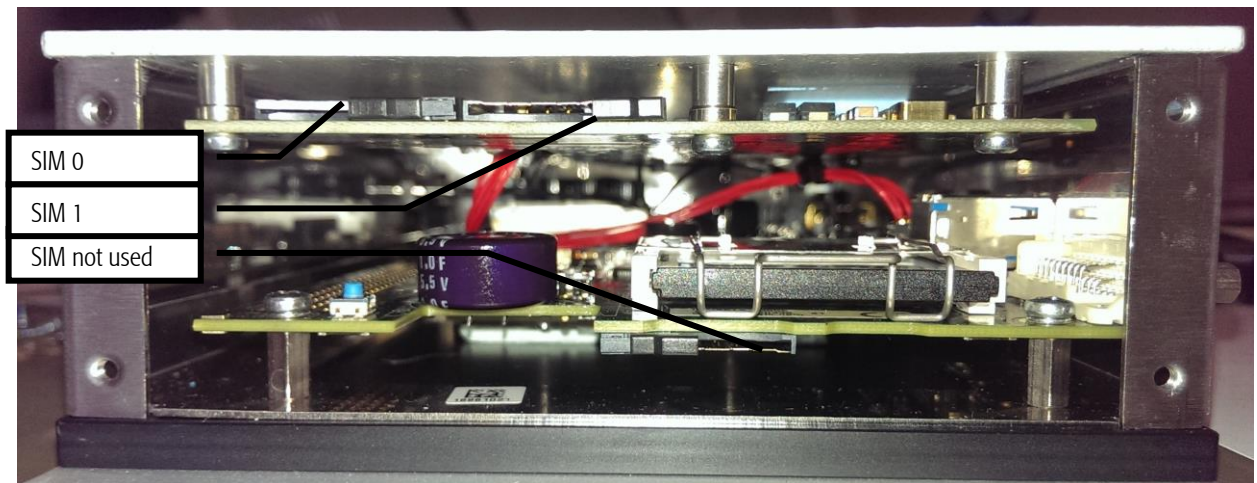

Fig. 19   SIM card installation

Please mount the service cover before reapplying power and restarting the system.

5.6 Grounding

In some cases it is recommended to connect the shields of the cables to chassis potential at the entry point into the housing cabinet as shown in Fig. 20. If the cables enter a hermetically closed cabinet, use special 360 degree metal clamps (EMI/RFI protected types which contact to the cable shield).

Important notes

Grounding of the cables shields using "pig-tail wires" are not recommended because of their high impedance at high frequencies. It is better to clamp the shields onto a grounded copper rail.
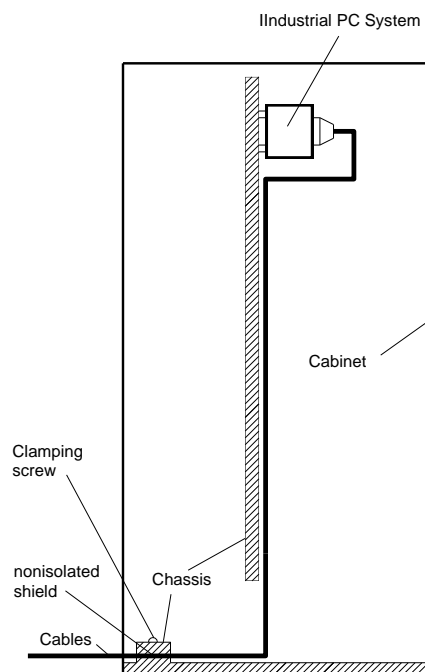

Fig. 20   Additional grounding of the cable shields at the entry point of a cabinet.

5.7 Cabling of communication links

If the communication ports are unisolated ports, cable shields have to be connected to chassis potential on both sides of the interconnection cable. If the cable is very long, a thick copper wire (10 mm²) for potential adjustment is highly recommended. Fig. 21 shows a non-isolated system with common chassis ground.

Some of the communication ports are galvanically isolated ports. In such cases the shield of the interconnection cable must be wired to chassis potential only on one side of the cable.

Fig. 22 shows an isolated system with independent grounds.

Important notes

Grounding of cable shields using "pig-tails wires" are not recommended because of their high impedance at high frequencies. It is recommended to clamp the shields onto a grounded copper-rail.
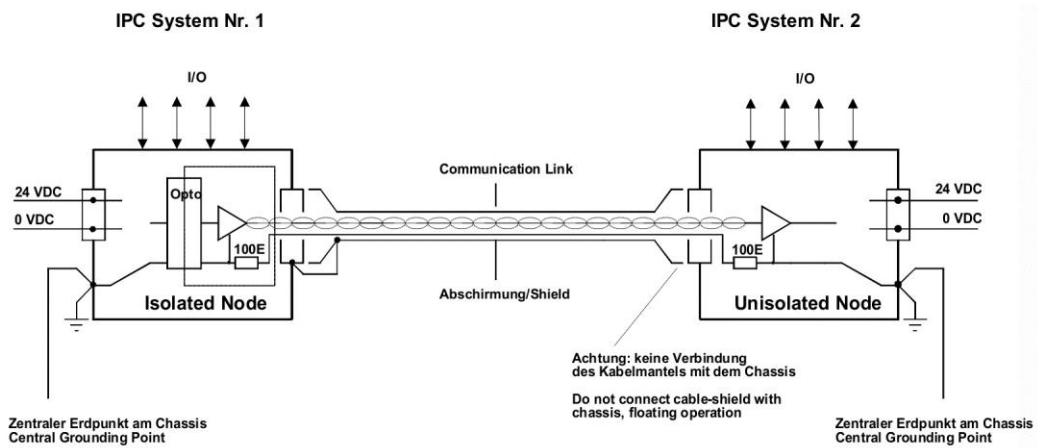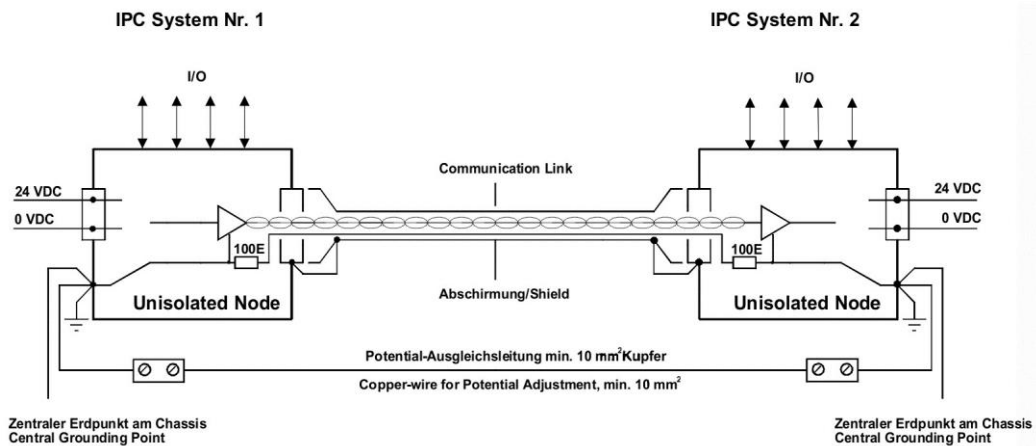
Fig. 21   Isolated communication link

Fig. 22   Non isolated communication link with common chassis potential

syslogic

6 Service

6.1 Replaceable Parts

This RSL81 system contains the following replaceable parts:

- CFast flash card
- Main fuse

To replace the flash card power off the system and remove the service cover. After having unlocked the clip, the flash card may be removed. When inserting a new flash card be sure that it is fully compliant with the CFast standard. Syslogic highly recommends CFast flash cards specified for industrial use by the card manufacturer. Check temperature range and durability to comply with your requirements.

The main fuse protects the system against destruction in case of high energy distortions on the power line. For replacement, the system must be opened in an ESD protected environment. Only an entitled instructed person is allowed for this operation. Replacement fuse type is Littlefuse 0452004.MRL (4A slow-blow).

Safety warnings and installation guidelines must be followed according to paragraphs 1.7, 1.9 and 5.

7 Technical Data

7.1 Electrical Data

Important Note

Do not operate the RSL81 system outside of the recommended operating conditions. Otherwise lifetime and performance will degrade. Operating the board outside of the absolute maximum ratings may damage the hardware.

Absolute Maximum Ratings (over free-air temperature range)

Parameter	Symbol	min	nom	max	Unit
general parameters					
power supply voltage	Vcc	-0.5		45.0	Vdc
power supply voltage (<1s)	Vcc	-0.5		50.4	Vdc
isolations					
power supply to chassis (AC, 60s, 500m a.s.l., Ta=25°C) [1]		1000			Vrms
power supply to logic (AC, 60s, 500m a.s.l., Ta=25°C) [1]		1000			Vrms
isolation Ethernet to chassis (AC, 60s, 500m a.s.l., Ta=25°C) [1]		1000			Vrms
isolation Ethernet to logic (AC, 60s, 500m a.s.l., Ta=25°C) [1]		1000			Vrms
isolation LAN1 to LAN2 (AC, 60s, 500m a.s.l., Ta=25°C) [1]		1000			Vrms
isolation CAN to chassis (AC, 60s, 500m a.s.l., Ta=25°C) [1]		500			Vrms
isolation CAN to logic (AC, 60s, 500m a.s.l., Ta=25°C) [1]		500			Vrms
isolation CAN1 to CAN2 (AC, 60s, 500m a.s.l., Ta=25°C) [1]		500			Vrms
isolation resistance CAN to chassis (500Vdc, Ta=25°C) [1]		0.9	1.0		MOhm
isolation resistance all others to chassis (500Vdc, Ta=25°C) [1]		20			MOhm
creepage distances:					
power supply to chassis/logic [1]		1.0			mm
(1) note: chassis and logic ground are connected					
temperature range					
operating free-air temperature (Ambient)	Ta	-40		70	°C
storage temperature range	Tst	-40		85	°C

Tab. 22 General Absolute Maximum Ratings

syslogic

Recommended Operating Conditions

Parameter	Symbol	min	nom	max	
general parameters					
power supply voltage (isolated)	Vcc	16.8	24/36	45.0	Vdc
power supply short term (<1s)	Vp	14.4		50.4	Vdc
power supply interruption class (EN50155)			S2		
temperature range					
operating free-air temperature (Component Level)	Ta	-40		85	°C
operating free-air temperature (Ambient) 50% CPU load, low GPU load [1]	Ta	-40		70	°C
operating temperature class (EN50155)	Ta		TX/OT4		

> (1) this parameter is highly dependent on mounting, air flow and GPU load; with the Intel SpeedStep technology the processor automatically reduces the internal cpu clock down to 500MHz when the critical thermal trip points are reached to prevent damage.

Tab. 23 General Recommended Operating Conditions

Electrical Characteristics
(over recommended operating range, unless otherwise noted)

Parameter	Symbol	min	typ	max	Unit
general parameters					
full load power dissipation (worst case, no external loads) [1]	Pmax		15	19	W
power supply current (Vcc=16.8V, no external loads) [2]	Ip		0.6		A
power supply current (Vcc=36V, no external loads) [2]	Ip		0.4		A
power supply current (shutdown state)	Ip(off)		6	10	mA
under-voltage lockout	Vuvlo		14		V
power fail / remote on/off					
inactive state	PFhigh	10		Vp	V
active state	PFlow	-0.5		1.5	V
Real Time Clock backup					
Backup time with fully charged GoldCaps	t(rtcbup)		36		h
Powered time required for charging the GoldCaps to 90%			15		min
Powered time required for charging the GoldCaps to 95%			1		h
USB Overcurrent Limit					
USB6 on internal connector P21	Ilimit			2.8	A
USB1/2 on connector P20	Ilimit	1.0		2.7	A
all other USB connectors	Ilimit	1.0		2.7	A

> (1) this parameter is highly dependent on mounting, air flow and GPU load; with the Intel SpeedStep technology the processor automatically reduces the internal cpu clock down to 0.8GHz when the critical thermal trip points are reached to prevent damage
>
> (2) 50% CPU load, low GPU load

Tab. 24 General Electrical Characteristics

syslogic

**Switching Characteristics
(over recommended operating range, unless otherwise noted)**

Parameter	Symbol	min	nom	max	
processor characteristics					
processor clock (IPC/RSL81I20-xxx)	fcpu		1.6	2	GHz
communication interface characteristics					
LAN1/LAN2 baud rate			10/100		Mbit/s
timer/clock characteristics					
Watchdog timeout (short period)	Tw	70	100	140	ms
Watchdog timeout (long period)	Tw	0.7	1	1.3	s
Watchdog timeout (programmable)	Tw	1		256	s
Timer base clock	ftimer		1.19318		MHz
Timer base clock accuracy				+/-100	ppm
Timer base clock aging				+/-5	ppm/year
Real Time Clock base clock	frtc		32.768		kHz
Real Time Clock accuracy (25°C)				+/-20	ppm
Real Time Clock temperature coefficient				-0.04	ppm/(°C)^2
Real Time Clock aging				+/-3	ppm/year

Tab. 25 General Switching Characteristics

**Wireless operating conditions and characteristics
(over recommended operating range, unless otherwise noted)**

Please check module manufacturer documentation for detailed operating conditions and characteristics (www.ublox.com).

7.2 EMI/EMC Data

Important Note

The RSL81 system is a class A system for railway and industrial applications. It is not indented for use in residential or home applications.

The RSL81 has been designed to comply with the following EMC standards:

- EN 50121-3-2   Railway applications - Electromagnetic compatibility - Rolling stock - Apparatus

- EN 55032   Electromagnetic compatibility of multimedia equipment - Emission Requirements Limits and methods of measurement

- EN 55035   Electromagnetic compatibility of multimedia equipment - Immunity requirements

- EN 301 489-1 V2.1   Electromagnetic compatibility and Radio spectrum Matters (ERM); ElectroMagnetic Compatibility - (EMC) standard for radio equipment and services

7.3 Environmental specification

The RSL81 has been designed to meet the the following standards:

- EN 61373   Railway application – Rolling stock equipment: Shock and vibration tests

- EN 60068-2-27   Basic environmental testing procedures – Part 2-27: Test Ea and guidance: Shock and guidance

- EN 60068-2-64   Environmental testing – Part 2-6: Test Fh: Vibration, broadband random and guidance

7.4 Reliability (MTBF)[1]

MTBF in hours, according to Telcordia SR-332 Issue 4 (Parts count method), Ambient temperature 25°C, excluding maintenance parts (e.g. battery)

Device	GB	GF	GM
IPC/RSL81I20-245E	~456'300	~284'234	~175'337

Tab. 26 MTBF values

---

[1] A reliability prediction is a theoretical estimation based on the bill of materials of the device and the component reliability data provided by suppliers (if available). Though these prediction methods are widely utilized and accepted, they have several limitations that must be known and accepted. The prediction is based on the component's reliability only, other elements like board and solder joints are not considered.

MTBF rates are dramatically affected by the use case. Do not make assumptions about the reliability of the product without considering the specific use case.

7.5   Mechanical Data

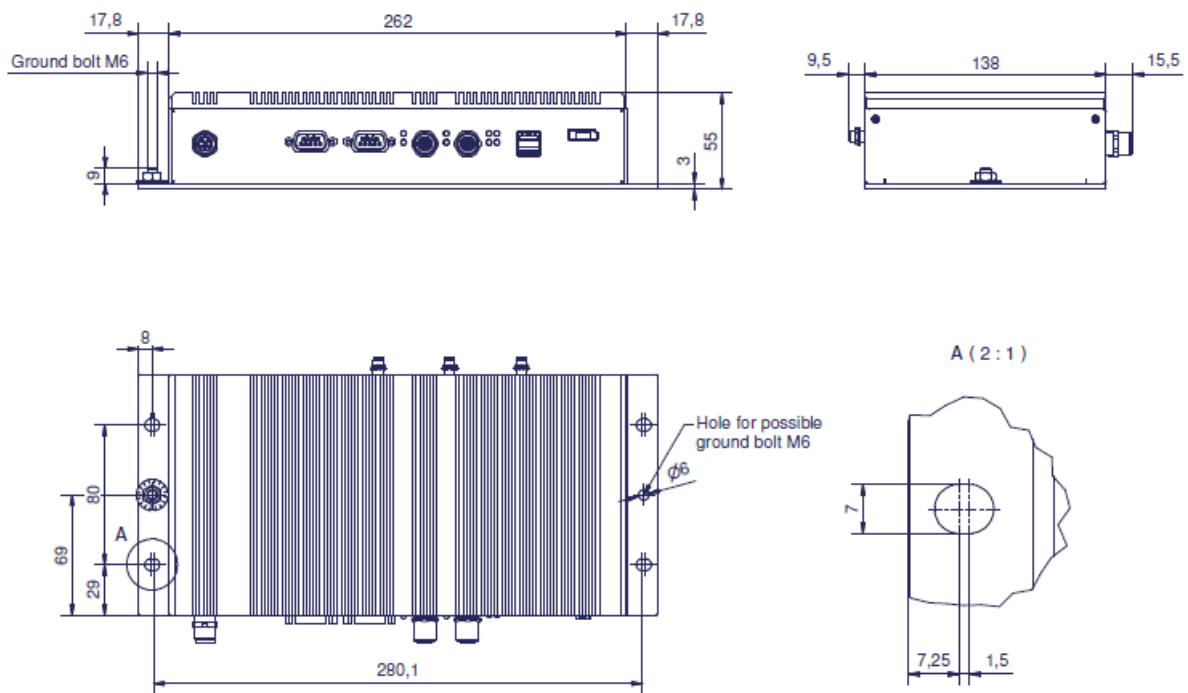| Parameter	Symbol	min	nom	max	
Device width	W		298		mm
Device height	H		55		mm
Device depth (without connectors)			138		mm
Weight	Mtot		2.2		kg

Tab. 27   Mechanical specification

Fig. 23   Mechanical Outline Enclosure RSL81

8 Firmware

8.1 Software Structure

The x86 CPU board based system is based on the following software structure:

BIOS (Basic Input/Output System)

- Power On Self Test (POST)
- Initialization of standard peripheral devices
- Boot procedure for the Operating System

Note : Refer to the BIOS documentation for detailed information

OS (Operating System)

- Initialization of additional peripheral devices
- Start procedure for the Application Programs

Note : Refer to the OS documentation for detailed information

Application Programs

- Initialization of RSL81 system, communications and external devices
- Start procedure for the Control Tasks

Note : Refer to the Application Programs documentation for detailed information

8.2 Firmware Functions

The RSL81 board is setup with BIOS firmware. Some standard PC/AT peripheral devices (e.g. DisplayPort, Keyboard/Mouse, Serial Ports, SATA interface) are directly supported by the BIOS, BIOS extensions and Operating Systems. Some peripheral devices (e.g. Ethernet) are directly supported by standard communication software (e.g. TCP/IP stacks, TCP packet drivers) others need special programming according to the freely available sample software (e.g. Watchdog). Please refer to the appropriate documentation for detailed information.

8.3 Application Programming Interface (API)

The RSL81 system does not contain any special API beside the installed BIOS. Refer to the BIOS and Operating System documentation for API specifications.

9 Product Revision History

9.1 Hardware

This paragraph lists the different hardware revisions of the RSL81 systems delivered beginning with the first production lot. Note that prototyping boards are not included and must be returned to factory for upgrade or replacement. All information listed in this document relies on definitive state hardware. Therefore this information may be incompatible with the prototyping board hardware.

Board Identification (see product label)	Product Revision	Revision ID Register	Remarks
IPC/ RSL81I20-A245E #1.0	1.0	03H	Series Release
IPC/ RSL81I20-A245E #1.1	1.1	03H	New Intel BayTrail processor mask F-1
IPC/ RSL81I20-A245E #1.2	1.2	03H	DisplayPort errata corrected

Tab. 28 Hardware Revision State

9.2 Firmware

This paragraph lists the different firmware versions of the RSL81 systems delivered beginning with the first production lot. Note that prototyping boards are not included and must be returned to factory for upgrade or replacement. All information listed in this document relies on definitive state hardware. Therefore this information may be incompatible with the prototyping board hardware.

Board Identification (see product label)	BIOS Version	Build Date	Remarks
IPC/ RSL81I20-A245E #1.0	D2R003A		Original Release
IPC/ RSL81I20-A245E #1.1	D2R004B		Updated BIOS for Intel BayTrail processor mask F-1
IPC/ RSL81I20-A245E #1.2	D2R004B		Updated BIOS for Intel BayTrail processor mask F-1

Tab. 29 Firmware Revision State

9.3 Erratas

This paragraph lists some important erratas of the current RSL81 boards to enable workarounds in user software. Additional erratas might be present but a workaround already implemented in the BIOS. It is important therefore that neither the application software nor the operating systems reprograms the processor chipset's configuration registers.

Note that prototype board erratas (boards with revision #0) are not listed here. Contact Syslogic technical support for prototype board information.

Additional erratas of the processor chipsets can be found at:

https://www.intel.com/content/dam/www/public/us/en/documents/specification-updates/atom-e3800-family-spec-update.pdf

https://www.intel.com/content/www/us/en/embedded/products/apollo-lake/technical-library.html

IOCHCK#/Watchdog-NMI errata (not working)	
Problem	When Watchdog is configured to activate an NMI, the NMI service routine is not called.
Implication	Watchdog-NMI not usable.
Workaround	none.
Correction	This issue might be a BIOS problem and will be corrected in a future BIOS release.
SDCard Interface erata (not working with some SDCard types)	
Problem	The Intel processor chipset contains several issues in SD and SDIO Hostcontroller which can disturb normal operation of the SDCard interface.
Implication	Some SDCard types will not work reliable.
Workaround	Some of the issues have already been solved by a BIOS workaround, some are dependent on OS drivers and some are not fixable. Check with Syslogic for a list of working SDCard types.
Correction	Some of the issues might be solved by new BIOS and/or OS driver releases, but some are not fixable.
DisplayPort DP_PWR errata (not working with some external DisplayPort to HDMI or VGA adapters)	
Problem	When the external adapter draws much current out of DP_PWR, the voltage drop may be high.
Implication	External adapter not working.
Workaround	Use external adapter with very low power demand or with separate power supply.
Correction	This issue is corrected in systems version 1.2 or higher.

Tab. 30 Known Erratas

syslogic

Important Note

This document always covers the latest product revision listed in 9.1.
Please contact the manufacturers technical support for upgrade options.

10   Manufacturer Information

10.1 Contact

Our distributors and system integrators will gladly give you any information about our products and their use. If you want to contact the manufacturer directly, please send a fax or email message containing a short description of your application and your request to the following address or use one of the information or technical support request forms on our internet homepage:

Syslogic Datentechnik AG, Switzerland

Web:	http://www.syslogic.com
Email:	info@syslogic.com
Technical support:	support@syslogic.com

10.1.1   RMA Service

Syslogic offers a Return Material Authorization process to simplify handling of devices that needs to be returned to the manufacturer. Please follow the instructions on our web page: https://www.syslogic.com/deu/rma.shtml to get best service.