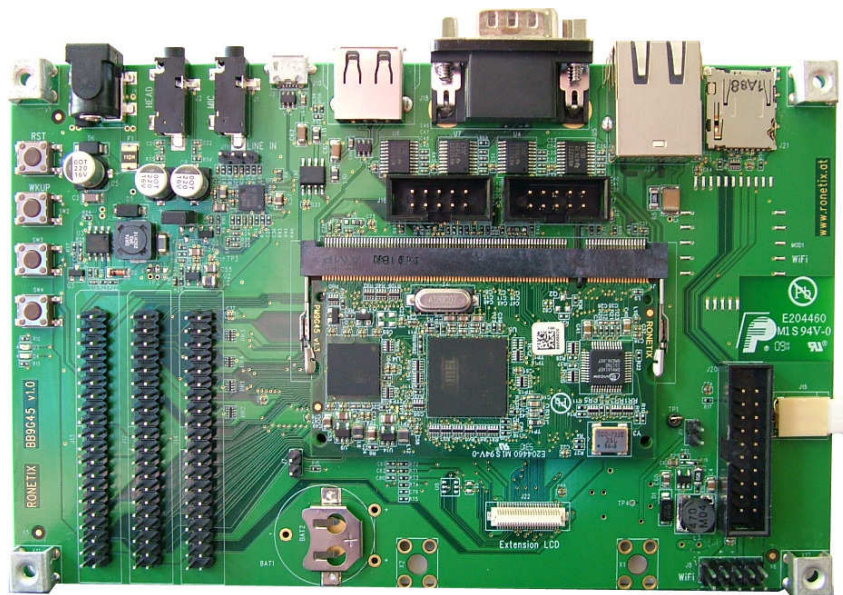


# SK-PM9G45 Starter Kit

Data Sheet



**RONETIX**  
DEVELOPMENT TOOLS

# Acknowledgement

September, 2011

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**Change log**

September 2011	- add changes for BB9G45 v1.1
June 2011	- Initial release.

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# 1 Features

## PM9G45 board

- AT91SAM9G45 Embedded MCU
- 128MiB DDR2 SDRAM for system and video ram
- 256MiB NAND flash
- DS2401 48bits SN on 1-Wire Dallas protocol
- 4MiB or 8MiB DataFlash(optional)
- 10/100 Mbps Ethernet PHY

## BB9G45 board

- Wifi H&D SPB105 or SPB106(Optional)
- Ethernet RJ-45 connector
- LCD with touchscreen 7", 800x480(Optional)
- LCD backlight power
- Expansion LCD connector
- Standard ARM JTAG 20 pin connector
- MicroSD card slot
- UART on Cannon DB-9 male connector
- USART on a header connector
- Two UARTs on a header connector
- RS-485 on PTR connector
- Expansion Header pins
- USB host on type A connector
- USB host/device on Micro-AB connector
- I2S audio codec
- Audio jacks for headphone and microphone
- Audio line-in pin header
- DC power jack
- Reset, wake-up and two user defined buttons
- Two user defined leds
- Two leds for +5V and +3.3V power
- Linear regulator for permanent 3.3V
- Selectable power supply: 5V or 10-24V
- Buzzer
- PCB screw terminals
- SO-DIMM connector for PM9G45

## Embedded Software

- AT91BootStrap 2.13
- U-Boot 2010.09
- Linux Kernel 2.6.30
- OpenEmbedded distribution KaeiIOS
- Windows CE 6.0 R3

## Development Software

- SAM Boot Assistance(SAM-BA)
- OpenEmbedded SDK

## 2 Introduction

SK-PM9G45 starter kit includes PM9G45 and BB9G45 boards. PM9G45 module is based on AT91SAM9G45 microcontroller with additional DDR2 SDRAM, NAND flash and optional DataFlash memories. It mounts to the Base Board (BB9G45) on which are located buttons, leds, connectors and power regulators. The LCD, touchscreen, audio, USB, Ethernet and RS-232 UART port allows to take advantage of using operating systems such as Linux and Windows CE, and to enjoy the graphical user interface. This starter kit is a complete embedded system.

The Starter Kit may also be ordered in combination with PEEDI under the name SK-PD-PM9G45. It is designed to make easy learning, testing and developing software systems, which makes it very suitable for both beginners and professionals.

PM9G45 board can also be used as a separate module for other hardware applications.

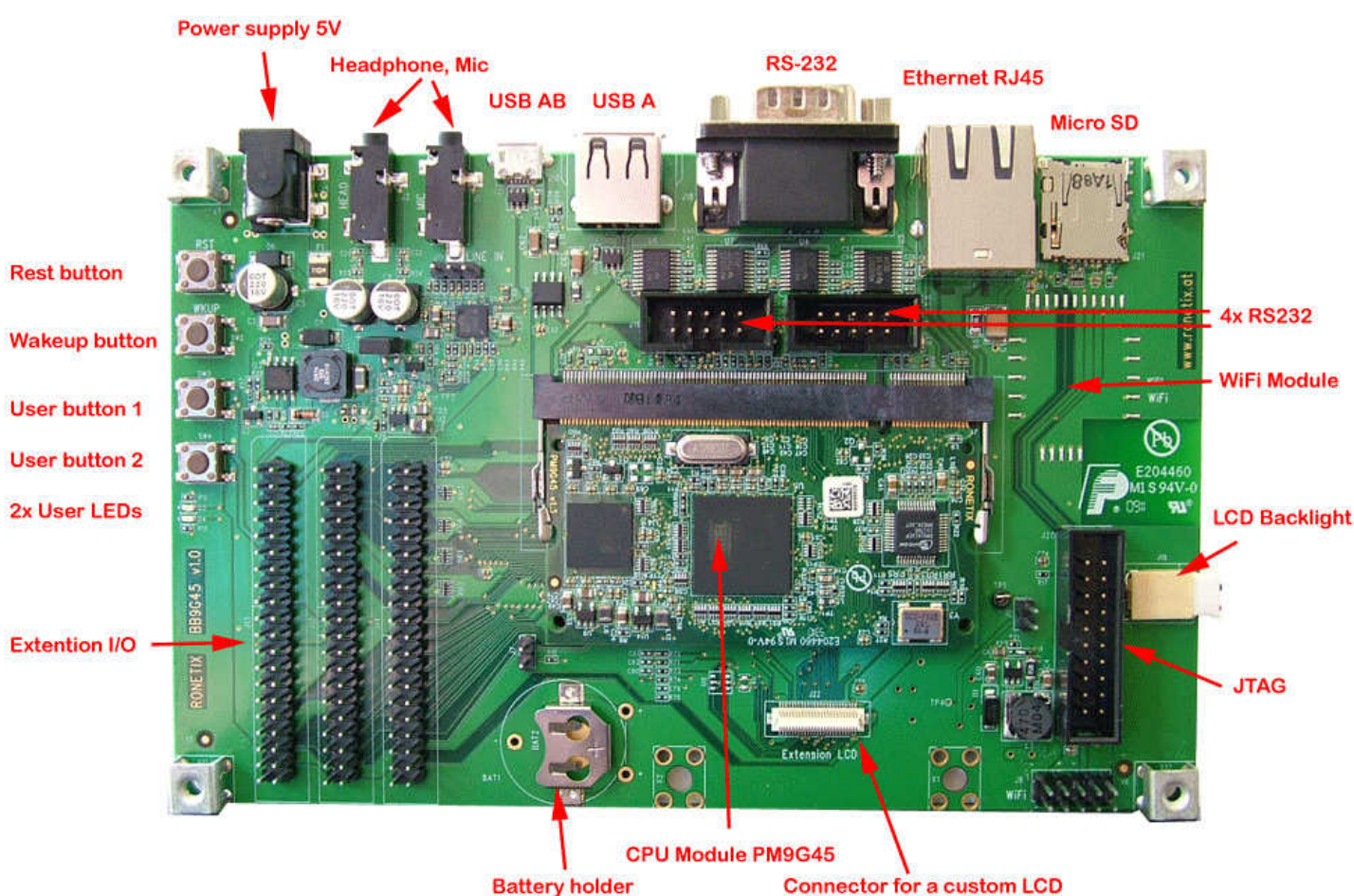


Figure 1: SK-PM9G45 layout

## 3 Getting Started

### Step 1:

First of all, available tftp or dhcp server have to be ensured either on your host machine or on a remote one, reachable over the network. It is necessary to use telnet client and RS-232 terminal as well.

### Step 2:

Check the package list after opening the box, then begin to assemble the starter kit.

### Step 3:



**WARNING:**

*Be aware with the J19 rotary backlock connector or a gender plug. To operate with J19, module PM9G45 must be removed! Get familiar with the FPC connectors construction and operation! A brief operation with the rotary backlock connector is described below.*

The LCD module should be connected first. Locate J19 on the Base Board, it could be a rotary backlock connector or a gender plug, and locate J23 (gender plug) connector.

*Do the following to operate with the rotary backlock connector:*

*Opening the lever:*

*Opening the lever must be done with fingers on each side of the lever, pushing firmly up vertically to lift and rotate the lever.*

*Cable insertion:*

*Insert the cable with its contacts toward the PCB and perpendicular and horizontal to the connector.*

*Closing the lever:*

*Closing the lever must be done with fingers on each side of the lever, pushing firmly down vertically. Do not press too hard.*

The LCD can be fixed to BB9G45 so to prevent movement between the modules. Also they can be attached to a pad in a way to produce more comfortable development setup.

*The LCD could be mounted on the bottom side of the BB9G45 like this:*

*Put a adhesive transfer tape on the short edges on the bottom side of the board. Apply adhesive transfer tape to lift the LCD to at least 3mm above the PCB.*

*Firmly push the LCD the BB9G45 to join them with the adhesive transfer tape.*

### Step 4:



**WARNING:**

*Get familiar with the SO-DIMM socket construction and operation! A brief operation with the SO-DIMM socket is presented below.*

It is time to connect the PM9G45 module. Get the module, match the mechanical keys and inset the board into the slot with around 20 to 30 degrees slope. Hold with two fingers the two stick up edges of PM9G45 and push them vertically down until the SO-DIMM latches locks.

### Step 5:

Then connect straight Ethernet cable to the RJ-45 socket and connect a DB-9 null modem cable(two female connectors on a crossover cable) to J18.

### **Step 6:**

Run the COM port terminal program and attach to the null modem cable inserted COM port. Set the terminal settings to 115200bps, 8 data bits, No parity check, 1 stop bit.

### **Step 7:**

Get the DC 5V power supply(check your country line voltage) and connect it the line power then to the Power Jack. A boot messages should appear on the terminal screen and the Ronetix logo should appear on the screen.

### **Step 8:**

After the GNU/Linux login prompt is printed on the terminal screen, use account root and no password will be required.

### **Step 9:**

Play with the GUI and the board.

### **Step 10:**

The board stop with command "halt", then wait for message "Power down" to safely remove the power and disconnect cables.

## **3.1 Restoring installation images**

In case of NAND corruption or erasing by mistake there is a way to restore. Get the SK-PM9G4 files from the Ronetix download web site and program them as mentioned in the README-pm9g45.ronetix. If you do not have a JTAG programmer you may use SAM-BA(available on the download web site).

The pre-built files are listed at README-pre-built\_images.ronetix.

## 4 Hardware description

### 4.1 Memories

The memories are on the PM9G45 CPU modules.

#### 4.1.1 DDR2 SDRAM

Two DDR2 SDRAM chips with total capacity of 128MiB extend the main MCU memory.

#### 4.1.2 NAND

The NAND flash, with capacity of 256MiB, provides nonvolatile memory storage. Its memory capacity allows storage of completely functional embedded operating system with GUI, like GNU/Linux and Windows CE. The NAND can be divided into partitions for custom data storage or use the operating system file system to write/read and change files.

#### 4.1.3 DataFlash

This is an optional component and could have 4MiB or 8MiB capacity. DataFlash succeed the EEPROM providing reliable and easy to use memory interface. It is intended for special storage like a calibration data or parameter tables.

Please contact Ronetix for this option.

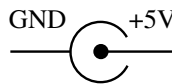
## 4.2 Power supply

The board is supplied with selectable 5V or 10-24V range on the DC power jack. Select the in power through R1 or J29, for both of them close 1,2 if power supply is 5V or close 2,3 if the power supply is in the range of 10-24V. There is a fuse for holding current limit 1.5A and tripping current 3A. The input is reverse power and above 26V protected with unidirectional transient voltage suppressor.

Software shut-down option is provided by the AT91SAM9G45's built-in Shutdown Controller. A write to dedicated register activates the SHDN (shutdown) output pin to switch off the power sources. The back-up power must remain in case of wake up signal is going to be used. The backup power is supplied by a linear 3.3V power regulator. The battery (if mounted) or external +3.3V backup power (if connected on J27) are additional abilities to support the Backup Section of the MCU. These additional backup power sources are enabled with closing J7. Base board provides wake up button that can switch the system to running state by enabling the power regulators.

To force the power regulator of the power supply close J6, used for test or diagnostic cases.

Figure 2: Power Jack layout



## 4.3 Network

The RJ-45 is for Ethernet cable connection and its pin out is wired according TIA/EIA-568 standard. It is MDI interface as on the PC, workstations and routers in contrast with switches and hubs which have the MDIX interface.

## 4.4 USARTs

Four USARTs are available on the J16 and J17 header connectors, as USART0 to USART3 are like two-pins UART and USART1 and USART2 are with four pins(TX, RX, RTS, CTS).

The RS-232 driver(MAX3222CPW) and so the starter kit meets the requirements of TIA/EIA-232-F and ITU v.28 Standards.

The USART1 is driven by ISL83078EIBZA to form the RS-485 interface. RS-485 is the default state of USART1.

Figure 3: Header connector pin out

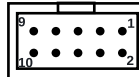


Table 1: J16 header signals

Pin	Description
1	TxD0
2	DUART shutdown
3	TxD3
4	USART1 shutdown
5	RxD0
6	USART2 shutdown
7	RxD3
8	USARTs 0 and 3 shutdown
9	Ground
10	Ground

Table 2: J17 header signals

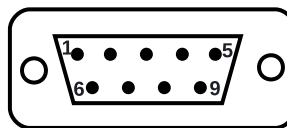
Pin	Description
1	TxD1
2	TxD2
3	RTS1
4	RTS2
5	RxD1
6	RxD2
7	CTS1
8	CTS2
9	Ground
10	Ground

The shutdown signals are low level active and the maximum applied voltage must not exceed 3.3V. The on board 100K ohm pull-up enables the driver if the shutdown pins are left floating.

## 4.5 UART

The UART implemented features have full compatibility with the Atmel USART standard.

Figure 4: UART DB-9 male connector



UART connector J18	
Pin	Description
1	Not connected
2	Rx
3	Tx
4	Not connected
5	Ground
6	Not connected
7	RTS
8	CTS
9	Not connected

The two synchronization signals are always active.

## 4.6 USB

USB host port is on type A J10 connector. Multiplexing Host and Device through UTMI allows to create an USB On-The-Go device. The USB micro AB J3 connector is for Host/Device. To determine the mode of the

device one of the pins PD28 or PD17 must be chosen to act as ID pin. This is defined by R6 resistor, placed at the bottom side on the Base Board. Grounded ID pin sets initially MCU to be a host. Pin PD7 is used as VBUS detected signal.

## 4.7 I/O extension headers

The signals on the SO-DIMM pins are multiplexed, hence some devices can not be used at the same time. For more detailed information take a look at PM9G45 datasheet of the multiplexed signals and devices.

The signals available on J12, J13 and J14 header pins are listed in tables [Table 3 I/O extension header J12](#) [Table 4 I/O extension header J13](#) [Table 5 I/O extension header J14](#) .

Table 3: I/O extension header J12

+3.3V	1	2	+3.3V
P_B0	3	4	P_B1
P_B2	5	6	P_B3
P_B4	7	8	P_B5
P_B6	9	10	P_B7
P_B8	11	12	P_B9
P_B10	13	14	P_B11
P_B12	15	16	P_B13
P_B14	17	18	P_B15
P_B16	19	20	P_B17
P_B18	21	22	P_B19
P_B20	23	24	P_B21
P_B22	25	26	P_B23
P_B24	27	28	P_B25
P_B26	29	30	P_B27
P_B28	31	32	P_B29
P_B30	33	34	P_B31
NC	35	36	P_E31
NC	37	38	P_D31
GND	39	40	GND

Table 4: I/O extension header J13

+3.3V	1	2	+3.3V
P_A8	3	4	P_A9
P_A20	5	6	P_A21
P_A23	7	8	P_A24
P_A25	9	10	P_A28
P_C6	11	12	P_C8
P_C9	13	14	P_C10
P_C11	15	16	P_C12
P_C13	17	18	P_C15
P_D1	19	20	P_D0
P_D9	21	22	P_D8
P_D17	23	24	P_D16
P_D19	25	26	P_D18
P_D21	27	28	P_D20
P_D23	29	30	P_D22
P_D25	31	32	P_D24
P_D28	33	34	P_D27
P_D30	35	36	P_D29
+5V	37	38	+5V
GND	39	40	GND

Table 5: I/O extension header J14

+3.3V	1	2	+3.3V
P_D15	3	4	P_D14
P_D13	5	6	P_D12
P_D11	7	8	P_D10
P_D9	9	10	P_D8
P_D7	11	12	P_D6
P_D5	13	14	P_D4
P_D3	15	16	P_D2
P_D1	17	18	P_D0
P_A1	19	20	P_A0
P_A3	21	22	P_A2
P_A5	23	24	P_A4
P_A7	25	26	P_A6
P_A9	27	28	P_A8
nCS1	29	30	A10
nWE/nWR0	31	32	nBS/nWR1
nRD	33	34	nBS3/nWR3
nRST	35	36	VBAT
nWKUP	37	38	nPWR_EN
GND	39	40	GND

## 4.8 LCD and touchscreen

There is a LCD controller embedded in AT91SAM9G45 that supports single and dual scan color and monochrome passive STN LCD panels and single scan active TFT LCD panels. The maximal supported resolution is up to 2048 x 2048.

The touchscreen support four-wire resistive touchscreen device, which kind of devices are durable, accurate enough and frequently met.

The backlight driver allow light intensity control. The maximum power for led strings, connected on J15, is 6W and up to 36V.

Combining Touch Screen ADC Controller and the LCD Controller finds place in the design of virtual graphic keyboard systems applications.

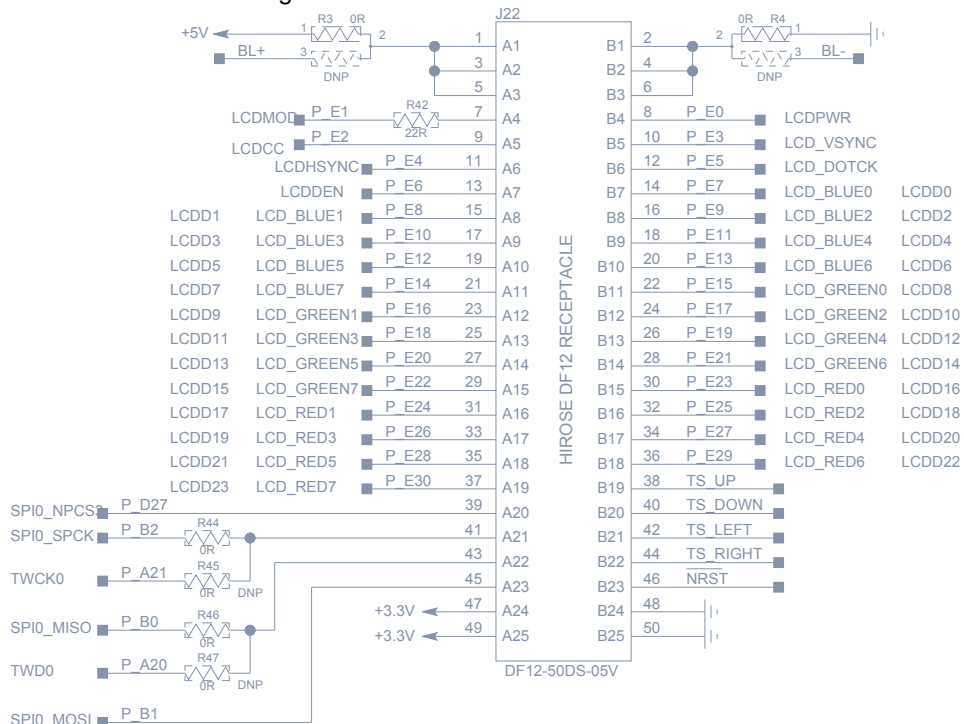
Table 6: J23 - touchscreen connector

1	Up
2	Right
3	Down
4	Left

The connector J19 is designed to be used for GATW70SP8H1R0 7", 800x480, 256k colors display. The extension LCD connector J22, with the help of an adapter board can be used with other LCDs. The PCB mounting screw holes X1 and X2 are placed to support the LCD extension board.

Connector J22 is "DF12-50DS-05V" and its mating part is "DF12#(4.0)-50DP-0.5V" and stacking height is 4.0mm.

Figure 5: LCD extension connector - J22



## 4.9 Micro SD Card slot

The High Speed Multimedia Card Interfaces (HSMCI) supports the the SD Memory Card Specification V2.0, the SDIO V1.1 specification.

## 4.10 Audio

There are two 3.5mm stereo audio jacks, for headphone and for microphone. The microphone jack is with shorted left and right channels.

The Line-in interface is on J11 tree pin header, as pin one is the R line-in channel and pin 3 is the L line-in channel. Pin two(the middle) is the GND.

## 4.11 JTAG interface for debug and memory programming

JTAG uses standard 2x10-pin connector, J20. It is suitable for debugging and memory programming with emulators like PEEDI.

## 4.12 Wifi

There are slots for WiFi modules to be attached to the starter kit. These wifi modules are H&D SPB105 on J8 connector and SPB106 on MOD1 footprint. SPB105 is for evaluation purpose only and SPB106 is meant for the end product.

Wifi modules are not shipped with the starter kit and can be purchased from a distributor of electronic components like Farnell.

## 4.13 Leds

On board two of the five leds are custom defined. The D7 is reserved for the Ethernet full duplex monitoring. Leds D3 and D4 are wired to the PD30 and PD31 currently used for GNU/Linux heart beat and NAND access monitoring.

Leds D8 and D9 indicates respectively 5V and 3.3V.

## 4.14 Buttons

To reset the board without power cycle use RST button. The next one WKUP is for bringing the system up when the system is halted under GNU/Linux.

The rest two buttons are defined in the Linux kernel PM9G45 module board files.

## **5 Embedded software description**

The starter kits boots on two steps. Initially the MCU internal RomCode loads AT91BootStrap from NAND and runs it, which one then loads and runs U-Boot. U-Boot is powerful enough to run the GNU/Linux system.

AT91BootStrap makes the basic settings of the starter kit, it should not be necessary to modify it. It is sufficient to prepare the board for upper software layer.

The work for cooking the software is described at the README's. They covers AT91BootStrap, U-Boot, Linux kernel and root file system build by OpenEmbedded.

## 6 Technical specifications

### 6.1 Temperature

PM9G45 is available in two temperature ranges:

- Standard temperature range 0°C +70°C
- Industrial temperature range -40°C +85°C

### 6.2 Electrostatic Warning

The PM9G45 Module and BB9G45 are shipped in protective anti-static packaging. The board must not be subjected to high electrostatic potentials. A grounding strap or similar protective device should be worn when handling the board. Avoid touching the component pins or any other metallic element.

### 6.3 RoHS Compliance Statement

The product is fully RoHS Compliant.

A RoHS signed declaration for use of RoHS processes and materials is available.

### 6.4 Assembly and mechanical

The LCD is mounted on the bottom site.

Figure 6: BB9G45 v1.0 top

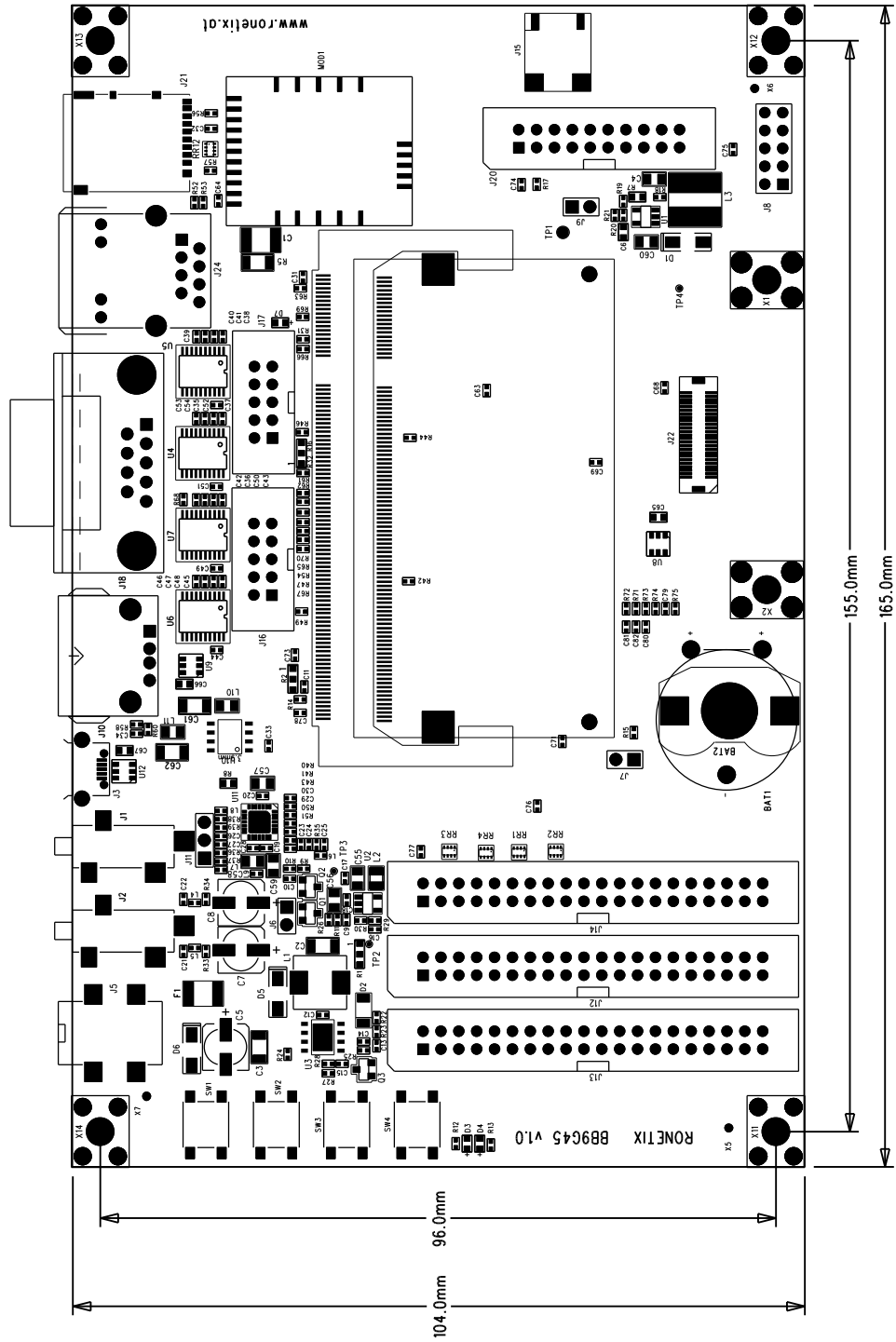
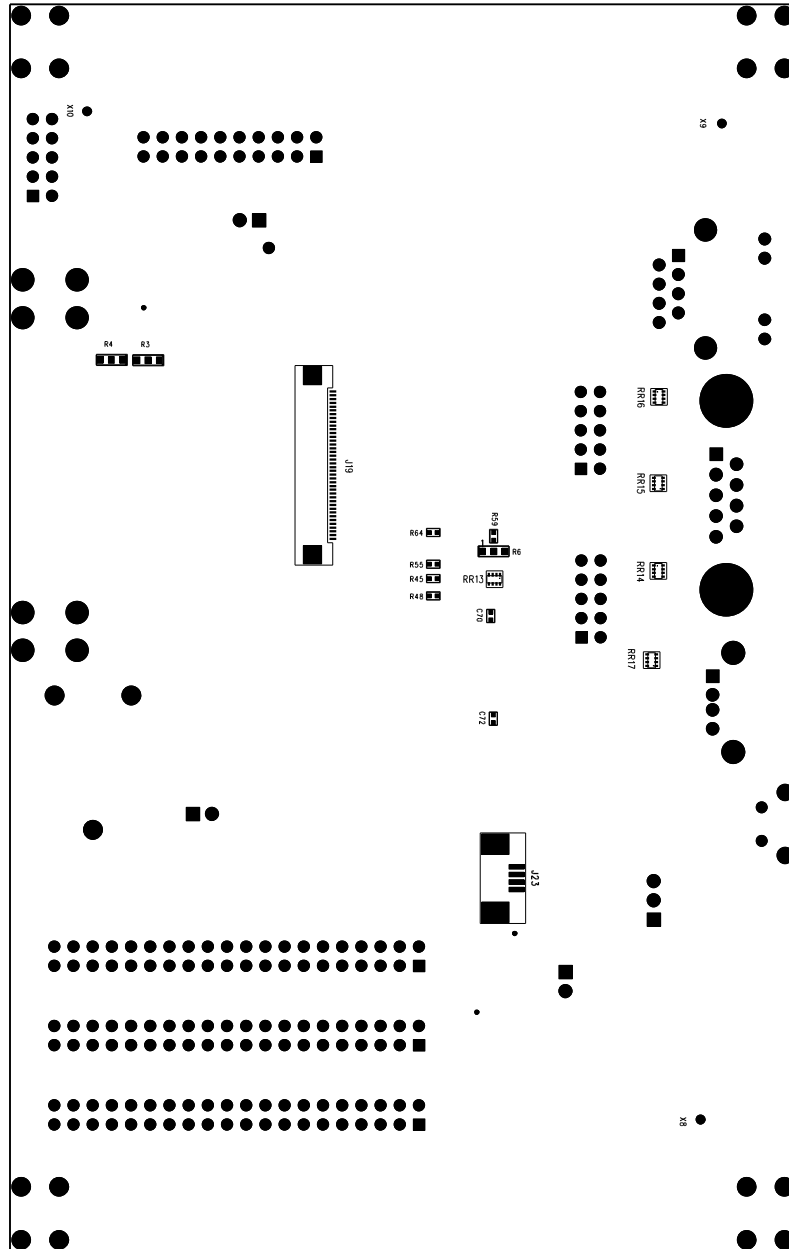


Figure 7: BB9G45 v1.0 bottom



## 7 Package contents

Base contents:

- PM9G45 board
- BB9G45 board
- Power source

Optional contents:

- LCD GATW70SP8H1R0 7", 800x480
- Battery

Optional contents which have to be ordered from a distributor of electronic components like Farnel:

- WiFi - H&D SPB106
- WiFi - H&D SPB105(only for evaluation)

## 8 Requirements

### 8.1 Cabels

The USB, Network and RS-232 cables do not come with the starter kit, you should provide them yourself.

- RS-232C femele-female, DB-9 crossover cable(null modem)
- CAT-5e UTP or STP cable with 8P8C modular plugs(known as RJ-45) on each end in straight configuration
- USB A to micro AB cabel for software recovery using SAM-BA

### 8.2 Host software

The starter kit get its network IP from the DHCP server. U-Boot is capable of transferring files over network through tftp protocol. It is useful to move files between starter kit and the host, so network infrastructure as telnet client, DHCP and tftp server are required.

### 8.3 Misc

- Adhesive transfer tape to mount the LCD to the BB9G45

## 9 Order and information

The BB9G45 schematics are available at <http://download.ronetix.info/boards/doc/PM9G45/>. The PM9G45 schematics are available on request and after signing NDA.

For order and information requests please write an e-mail to [sales@ronetix.at](mailto:sales@ronetix.at) or [info@ronetix.at](mailto:info@ronetix.at).

## 10 Reference

Country line voltage reference

<http://www.controlledpwr.com/help-international-voltages.php>

LCD and touchscreen connectors references

<http://www.omron.com/ecb/products/pdf/xf2m.pdf>

[http://www.molex.com/pdm\\_docs/sd/541324097\\_sd.pdf](http://www.molex.com/pdm_docs/sd/541324097_sd.pdf)

<http://www.te.com/catalog/pn/en/84952-4?RQPN=84952-4>

Base board schematics

<http://download.ronetix.info/boards/doc/PM9G45/>

Instructions to prepare software

<http://download.ronetix.info/boards/README/>

Ronetix download site

<http://download.ronetix.info/>

SAM-BA

[http://download.ronetix.info/boards/tools/windows/sam-ba\\_v2.10/](http://download.ronetix.info/boards/tools/windows/sam-ba_v2.10/)

[http://download.ronetix.info/boards/tools/linux/sam-ba\\_v2.10/](http://download.ronetix.info/boards/tools/linux/sam-ba_v2.10/)

FPC connectors construction and operation

<http://www.omron.com/ecb/products/pdf/fpc.pdf>

SO-DIMM socket construction and operation

<http://www.foxconn.com/NWInG/catalog/UserGuide/User%20Guide%20for%20DDR.pdf>