
# RMT1 User Guide

## Version 1.1

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# Document Version History

| Version | Date | Author | Comments |
|---|---|---|---|
| 0.0 | 2008/07/19 | P. Ma | Initial DRAFT |
| 0.1 | 2008/07/20 | P. Ma | Minor text edits; corrected web site links |
| 0.2 | 2008/07/25 | P. Ma | Minor text edits throughout<br>Appendix D: added new enclosure example |
| 1.0 | 2008/08/07 | P. Ma | Initial Release<br>2.4: Enhanced warning about **J16** sensitivity to damage<br>2.4: Updated flex cable connection pictures<br>2.4: Added Warning about insulating LCD flex circuitry<br>4.11: Added Note about pushbutton key caps<br>4.12: Warning about **D3** reversed marking on PCB Rev04 |
| 1.1 | 2008/10/07 | P. Ma | 2.3: Specified all four sets of inter-board connections.<br>4.4: Corrected reference: 3.0V regulator is **U5**. |

# Table of Contents

# 1 Overview

The RMT1 is a circuit board designed to extend the functionality of the Atmel NGW100 evaluation board. RMT1 is designed to be used by professional developers, students and advanced hobbyists. The advantage of using RMT1:

- Take advantage of volume manufactured boards (NGW100 and RMT1), while focusing your development efforts on value-added software and product packaging.
- Rapid-prototyping of your complete solution, before committing to a fully customized embedded CPU hardware design.
- Exploring the full functionality of Atmel AVR32, without the up-front cost and effort of designing your own PCB, and handling fine-pitch SMT components.
- Example u-boot bootloader and linux kernel sources and binaries, to kick-start your software developement.

RMT1 offers a wide degree of flexibility in its standard and optional peripheral set. However, RMT1 has been designed especially with the following applications in mind:

- General TFT LCD user interface, with touchscreen
- Portable Wireless Terminal
- Portable Media Player

Noting the above, there RMT1 has an optimized set of standard peripherals (pre-loaded components). Footprints are provided for a wide range of customer-implemented peripherals. This keeps your cost down and minimizes power consumption, while still leaving you the ability to add functions that best match your application.

Note that the main CPU connectivity to RMT1 is a set of standard 0.1” headers. Though the header footprints and pin-out directly match those of the NGW100, they are generic enough for simple interfacing to other CPU host boards.

## 1.1 In the Package

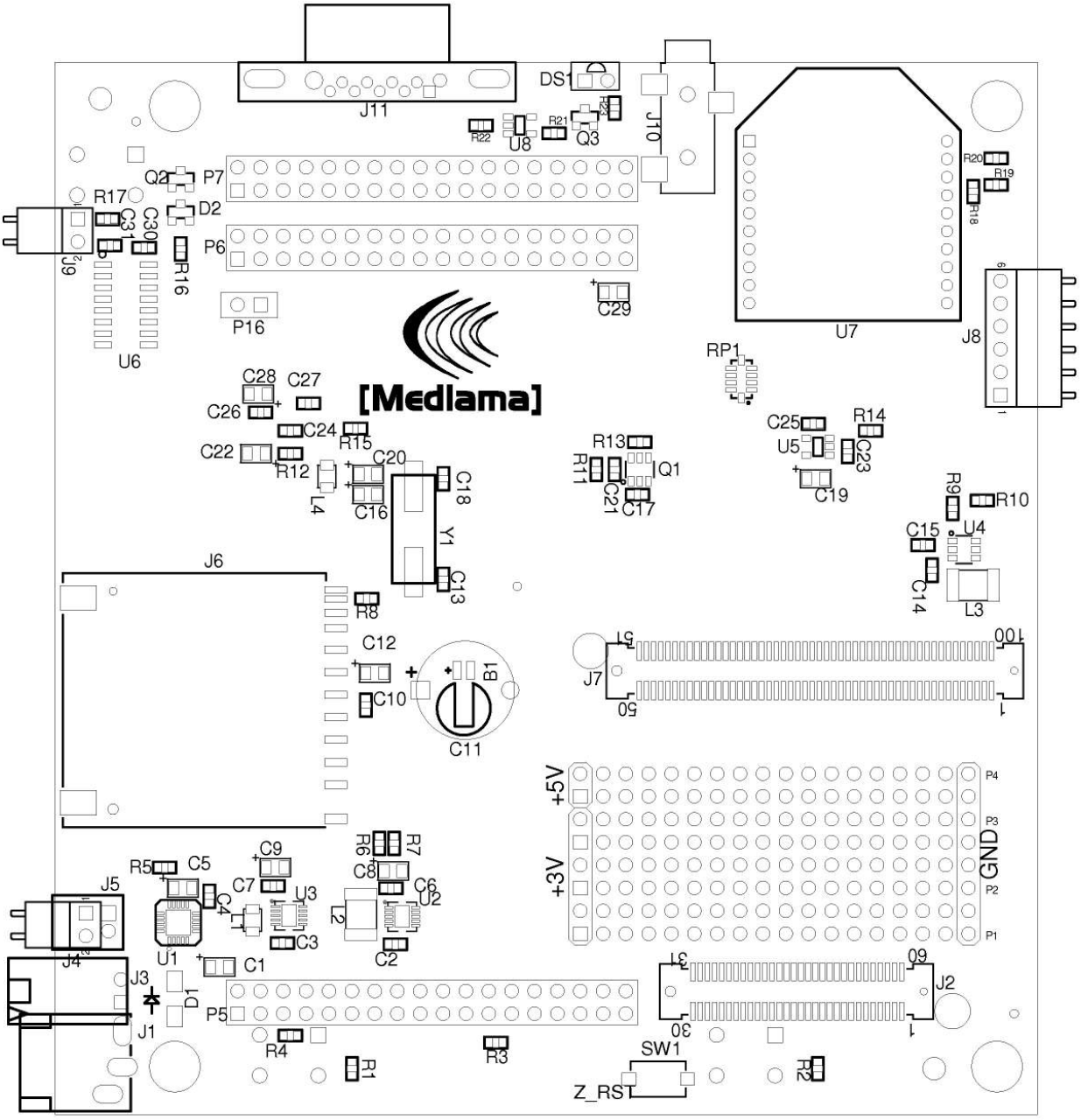
The following items are included in your RMT1 package:

1. RMT1-*x* (where *x* indicates the board variant that was ordered)
2. Extra Components bag (one for each board ordered), containing components that may be used for some of the customer-implemented peripheral options.
3. USB flash drive (one per shipment): documentation, schematics and software patches/binaries.

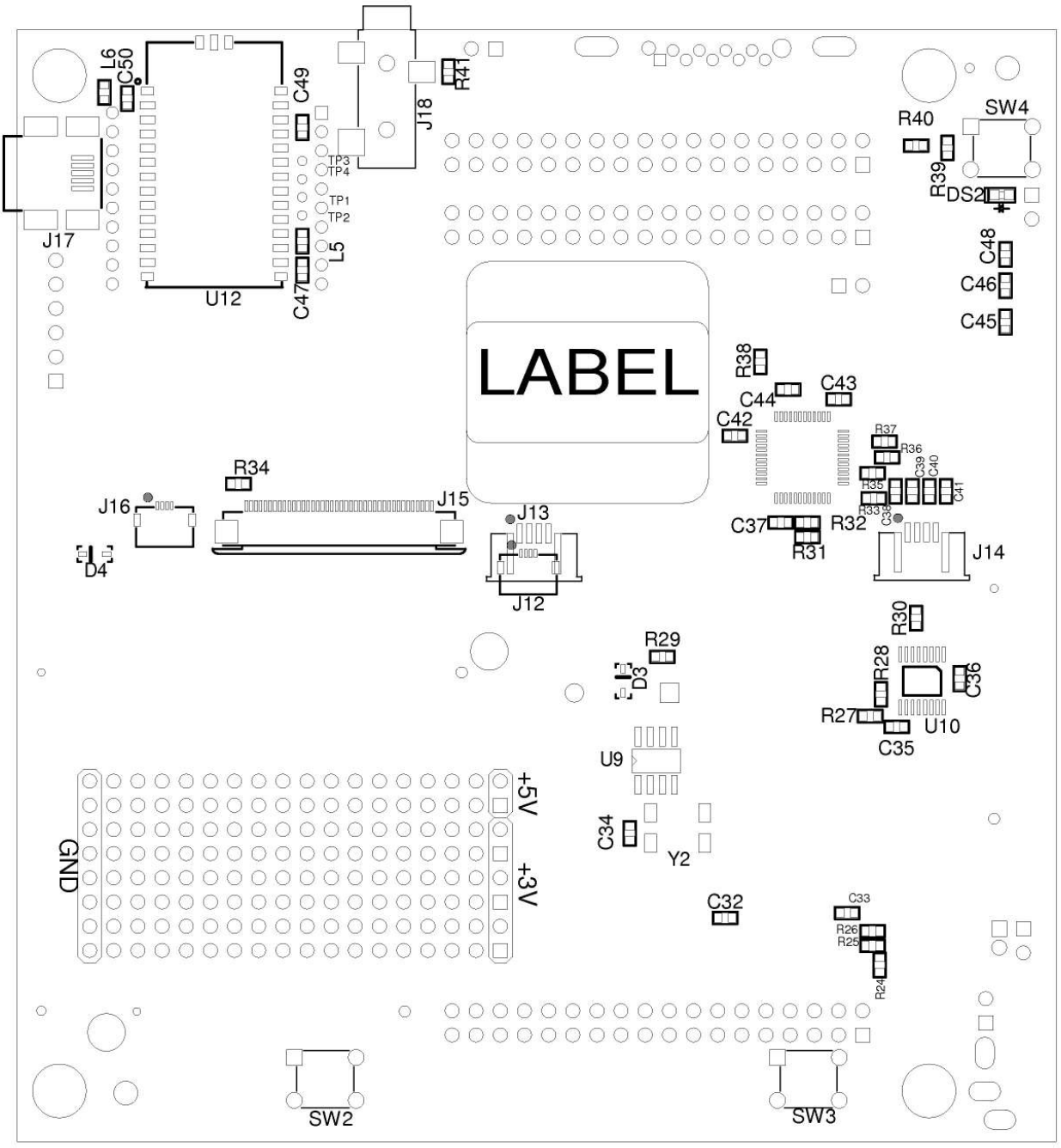
## 1.2 The RMT1 Board

The following images depict the top and bottom of the RMT1 board.

***Top View***



***Bottom View***




## 1.3 Peripherals

RMT1 board variants consist of a set of standard and optional peripherals. **Standard Peripherals** are already populated on the board.

**Optional Peripherals** allow you to implement them as you see fit, to add needed functionality, or to conform to physical or cost constraints for your particular application. A small prototyping area is also provided for extra circuitry. Instructions are provided on how to add optional functions to a standard RMT1 board. Please see Section 4 for details of the standard and optional peripherals.

## 1.4 Extra Components

A bag of Extra Components is provided with every RMT1 board. These are available to support some (but not all) of the common customer-implemented options.

The following table lists the items in the Extra Components bag, and the RMT1 reference designator they are associated with:

| Reference Des. | Part Number | Description |
|---|---|---|
| **J1** | CUI PJ-003A | Power Barrel Jack, 2.1mm inner-diameter |
| **J3** | Molex 70553-0036 | 2-pin 0.1" header, shrouded with lock |
| **J4** | Molex 22-05-3021 | 2-pin 0.1" header, ramp lock |
| **J5** | JST S2B-PH-K-S | 2-pin 2mm header, shrouded |
| **J8** | Molex 22-28-8060 | 6-pin 0.1" header, right-angle |
| **J9** | Molex 22-28-8020 | 2-pin 0.1" header, right-angle |
| **J11** | Kycon K31X-E9P-NJ | DB-9M (plug), thin profile |
| **SW2/SW3/SW4** | Omron B3F-1050 | 6.5mm push-button switch, vertical |

Please refer to the relevant peripheral descriptions in Section 4 for information on how these components may be used.

## 1.5 Software Support

Example code patches and binaries for bootloader (u-boot) and operating system (Linux) are provided. These may be downloaded from the following web-site:

**http://www.mediamatech.com/shop/downloads/downloads.xml**

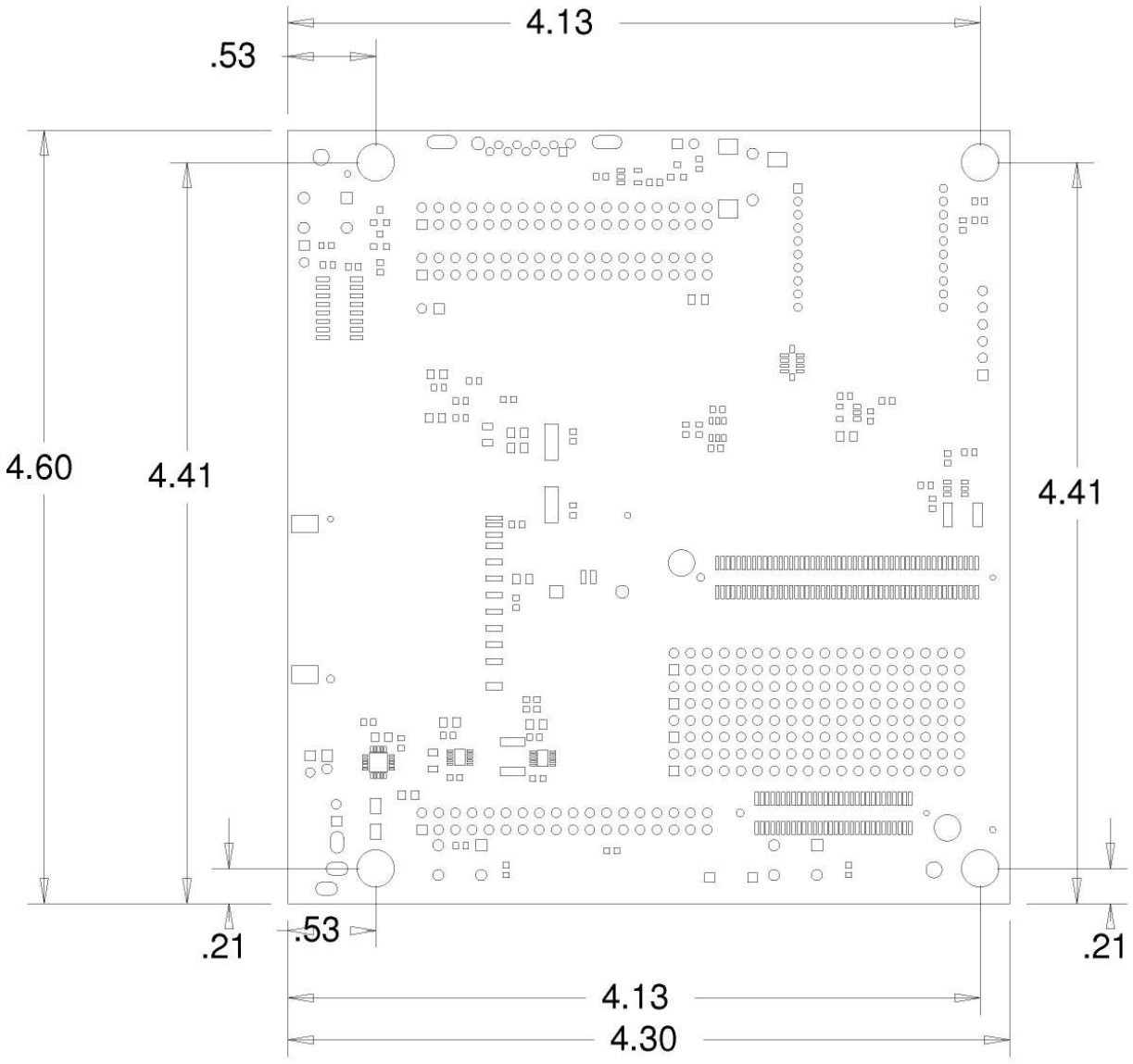
Mediama Technologies is committed to contributing to the AVR32 open source community, and to keep our releases up-to-date with the latest AVR32 u-boot and linux kernel releases. However, these files are provided as-is, with no warranty expressed or implied. They are simply provided as examples to help you start using RMT1 peripherals as quickly as possible, and to help kick-start developers new to u-boot and/or linux.

For software support questions, please contact support@mediamatech.com. You are encouraged to search through and participate in the Mediama Technologies Support Forum:

**http://apps.mediamatech.com/Forum**

# 2 Mechanical Considerations

The following image shows the dimensions of the board and mounting holes.




## 2.1 Mounting Holes

There are four mounting holes on RMT1. They do not align with the NGW100, but instead are located beyond the boundaries of the NGW100 board. This allows for direct mounting schemes to the RMT1 (e.g. a metal faceplate).

The mounting hole specification is as follows:

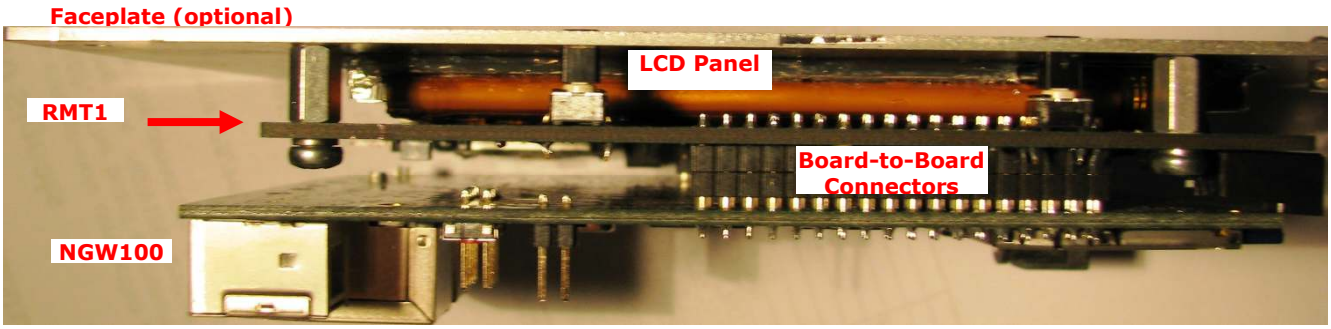
- Plated hole, with no electrical connection to other planes/signals on RMT1 PCB
- Finished Hole Size: 3.2mm (0.126”)
- Plated Pad: 5.7mm (0.224”)

These are designed to support standard M3 screws and 5mm hex standoffs. #4 screws and ¼" hex standoffs will work also.

## 2.2 Board Mounting

The RMT1 is designed to be mounted with its top-side (Mediama silkscreen logo) facing toward the bottom-side of the NGW100.

The following photograph shows a side view of NGW100 and RMT1, plus an optional faceplate (with LCD mounted):




Board-to-board spacing will vary based on the connector system implemented by the customer. It is expected that the board-to-board connectors will provide sufficient strength to hold the NGW100 and RMT1 together; however, additional support may be required depending on your application requirements.

A minimum board-to-board spacing of 5.5mm (0.217") is required in order to provide clearance for the standard peripherals. Optional peripherals may require more. For instance, if J1 is mounted, a spacing of 7.3mm (0.288") is required.

One or more rubber feet on the NGW100 may need to be removed in order to accommodate RMT1 standard and/or optional peripherals.

## 2.3 NGW100 Interface

There are four sets of board-to-board connector sets required to mate the RMT1 to the NGW100:

| RMT1 | NGW100 | Pins | Description |
|---|---|---|---|
| **P5** | **J5** | 36 | GPIO Port A: SPI, IIC, USART, etc |
| **P6** | **J6** | 36 | GPIO Port B: USART, etc |
| **P7** | **J7** | 26 | GPIO Port E: LCD Signals, etc |
| **P16** | **J16** | 2 | +5VDC power. In most applications, supplied by RMT1 and used by NGW100. See Section 4.3 for options. |

Low-cost 25mil square-pin 0.1" headers/sockets can certainly be used. However, mounting and unmounting force will be very high. However, this may be desirable for applications in which one board is relying on the other for mechanical stability.

For applications in which the RMT1 must be unmounted with relatively low force, round pin/socket connectors are suggested (as shown in the above side-view photo). The following is a table of possible solutions:

| Interface | NGW100 | RMT1 |
|---|---|---|
| **P5/P6/P7** (2 x 18) | Mill-Max 803-10-036-10-002000 | Mill-Max 802-10-036-10-002000 |
| **P16** (2 x 1) | Mill-Max 801-10-002-10-002000 | Mill-Max 800-10-002-10-002000 |

Mill-Max parts are often cut to order, so larger strips may be more available in distribution. Consult the Mill-Max online catalog for more interface possibilities: **www.millmax.com**

It is highly recommended that pre-fitting of connectors be performed, before soldering:

1. If necessary, mate all pairs of connectors (three 18x2, and one 1x2 pair).
2. Insert connector set solder tails into both the NGW100 and RMT1 boards.
3. Making sure the boards are parallel and the connectors are in nominal positions, solder corner pins on each connector set. Constantly check to make sure connectors maintain alignment and there is no appreciable stress between the boards or along the connectors.
4. Double-check connector alignments and board parallelism, before soldering the remaining pins.

An ill-fitted or misaligned connector system may cause undue stress on the NGW100 and RMT1 boards. This may result in long-term damage to one or both boards.

## 2.4 LCD Panel Mounting

Many applications using RMT1 will take advantage of the LCD panel and touchscreen support. For the sake of example, this section assumes that you are attempting to use a Sharp LQ043T3DX02 or compatible 4.3" LCD panel, pre-mounted with a Hantouch touchscreen. Other LCD panels/touchscreens are supported – see Section 4.4 for more details.

Many 4.3" LCD panels have components mounted on a flex circuit board that also extends to be the LCD data cable. If such a LCD is mounted back-to-back to the RMT1, the LCD flex circuitry must be insulated so as not to short with circuitry on the RMT1. Use insulating tape to completely cover the LCD flex circuitry.

Most LCD panels of this size do not have built-in mounting tabs. RMT1 does not provide any mounting facilities for the LCD panel itself. It is up to the customer to provide a proper mounting to your intended enclosure or panel.

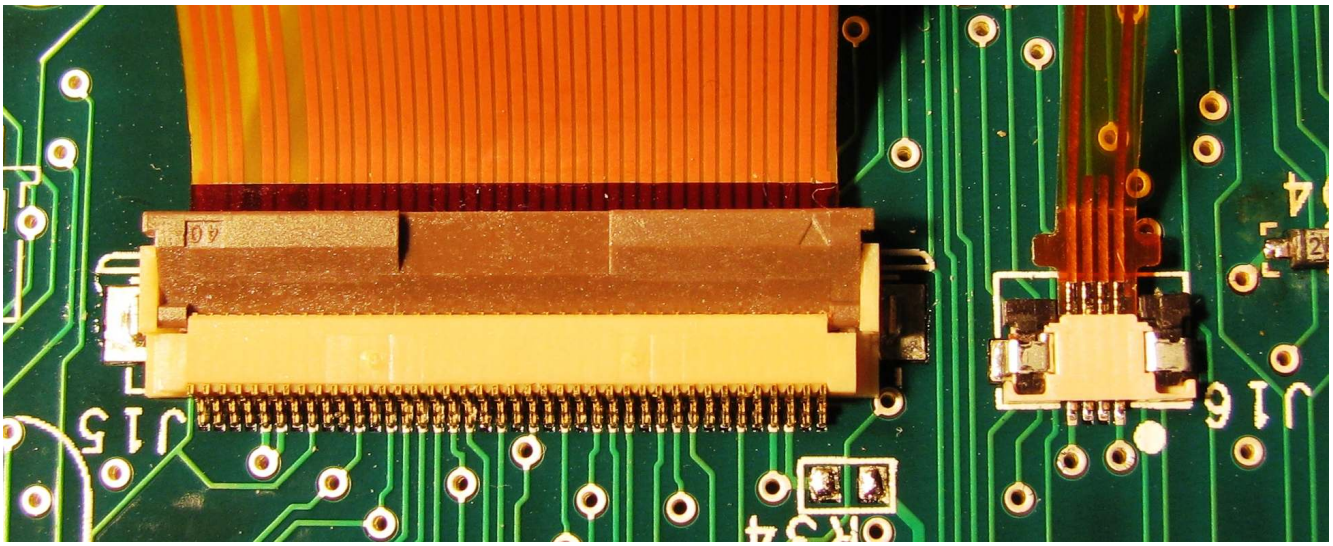
There are three connectors for the various flat-flex cables coming from the LCD panel:

1. 40-pin 0.5mm RGB pixel data (**J15**)
2. 4-pin 0.5mm LED backlight power (**J16**)

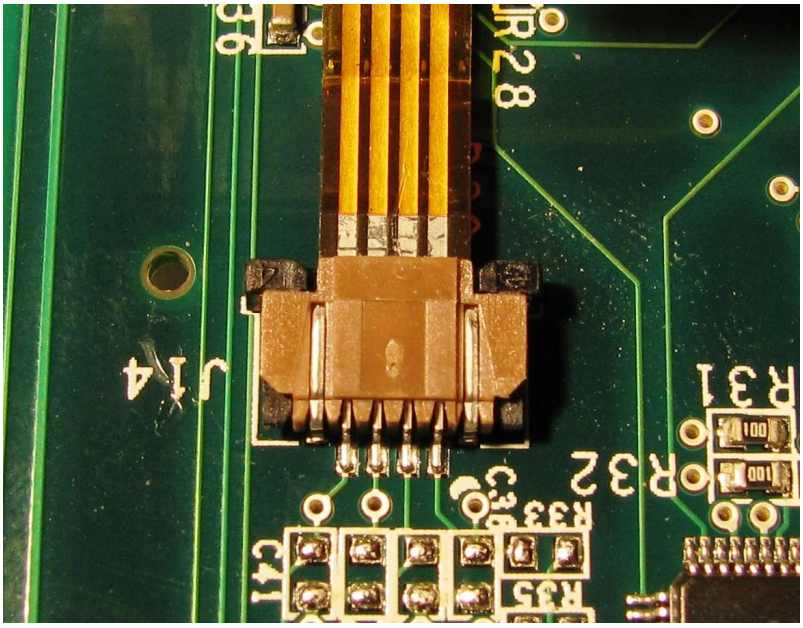
3. 4-pin 1mm resistive touchscreen (**J14**)

Flat-flex cables and connectors are very delicate, so please exercise extreme care. Keep insertion/removal cycles to a minimum.
**J16** is *extremely* sensitive, and thus can be easily damaged.

The flex connectors usually provide very little sense of the depth at which the cable must be inserted for proper contact. Please refer to the following photos to see what a *typically* good engagement might look like. This will vary between LCD panels.




Data connector (**J15**) has a *flip-up* lock, whereas the other connectors have forward *sliding* locks.




## 2.5 System Mounting

The NGW100+RMT1 stack can be mounted inside a customer-specific enclosure or casing in a variety of ways.

See **Appendix D** for examples of prototype enclosure solutions.

# 3 Interface Signals

RMT1 Reference designators **P5**/**P6**/**P7**/**P16** correspond to NGW100 **J5**/**J6**/**J7**/**J16**, respectively.

## 3.1 RMT1 Interface Pin Assignments

The following tables show the assignments from the NGW100 to RMT1 signals. Signal directions are relative to the NGW100.

**J5(NGW100) / P5(RMT1)**

| RMT1 Signal | Dir | Peripheral B | Peripheral A | Port | | | Port | Peripheral A | Peripheral B | Dir | RMT1 Signal |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 3.3V | 1 | 2 | GND | | | | |
| SPI_MISO | → | SSC1 - RX_FRAME | SPI0 - MISO | PA00 | 3 | 4 | PA01 | SPI0 - MOSI | SSC1 - TX_ FRAME | → | SPI_MOSI |
| SPI_SCLK | ← | SSC1 - TX_CLOCK | SPI0 - SCK | PA02 | 5 | 6 | PA03 | SPI0 - NPCS0 | SSC1 - RX_CLOCK | | |
| SPI_TS_CS_N | ← | SSC1 - TX_DATA | SPI0 - NPCS1 | PA04 | 7 | 8 | PA05 | SPI0 - NPCS2 | SSC1 - RX_DATA | | |
| | | USART0 - RTS | TWI - SDA | PA06 | 9 | 10 | PA07 | TWI - SCL | USART0 - CTS | | |
| | | USART0 - RXD | PSIF - CLOCK0 | PA08 | 11 | 12 | PA09 | PSIF - DATA0 | USART0 - TXD | | |
| ZB_RST_N | ← | PWM - PWM2 | SSC0 - RX_FRAME | PA21 | 13 | 14 | PA22 | SSC0 - RX_CLOCK | PWM - PWM3 | → | BT_RST |
| PCM_CLK | ← | TIMER1 - A0 | SSC0 - TX_CLOCK | PA23 | 15 | 16 | PA24 | SSC0 - TX_FRAME | TIMER1 - A1 | → | PCM_SYNC |
| PCM_TXD | ← | TIMER1 - B0 | SSC0 - TX_DATA | PA25 | 17 | 18 | PA26 | SSC0 - RX_DATA | TIMER1 - B1 | ← | PCM_RXD |
| IR_DATA | ← | TIMER1 - CLK0 | SPI1 - NPCS3 | PA27 | 19 | 20 | PA28 | PWM - PWM0 | TIMER1 - A2 | → | LCD_BL_ON |
| IR_FC | ← | TIMER1 - B2 | PWM -PWM1 | PA29 | 21 | 22 | PA30 | SM - GCLK0 | TIMER1 - CLK1 | → | AC97_RST_N |
| LCD_DISP | ← | TIMER1 - CLK2 | SM - GCLK1 | PA31 | 23 | 24 | PB00 | ISI - D0 | SPI1 - MISO | | |
| | | SPI1 - MOSI | ISI - D1 | PB01 | 25 | 26 | PB02 | ISI - D2 | SPI1 - NPCS0 | | |
| | | SPI1 - NPCS1 | ISI - D3 | PB03 | 27 | 28 | PB04 | ISI - D4 | SPI1 - NPCS2 | | |
| | | SPI1 - SCK | ISI - D5 | PB05 | 29 | 30 | PB06 | ISI - D6 | MMCI - CMD1 | | |
| | | USART1 - CTS | SPI0 - NPCS3 | PA20 | 31 | 32 | | N.C. | | | |
| | | | 3.3V | | 33 | 34 | | GND | | | |
| | | | 3.3V | | 35 | 36 | | GND | | | |

**J6(NGW100) / P6(RMT1)**

| RMT1 Signal | Dir | Peripheral B | Peripheral A | Port | | | Port | Peripheral A | Peripheral B | Dir | RMT1 Signal |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 3.3V | 1 | 2 | GND | | | | |
| | | | | 3.3V | 3 | 4 | GND | | | | |
| | | | | N.C. | 5 | 6 | N.C. | | | | |
| | | MMCI - D4 | ISI - D7 | PB07 | 7 | 8 | PB08 | ISI - HSYNC | MMCI - D5 | | |
| | | MMCI - D6 | ISI - VSYNC | PB09 | 9 | 10 | PB10 | ISI - PCLK | MMCI - D7 | | |
| PB_L | → | ISI - D8 | PSIF - CLOCK1 | PB11 | 11 | 12 | PB12 | PSIF - DATA1 | ISI - D9 | ← | PB_R |
| PWR_ON | ← | ISI - D10 | SSC2 - TX_DATA | PB13 | 13 | 14 | PB14 | SSC2 - RX_DATA | ISI - D11 | ← | PWR_SW_N |
| BT_CTS | → | USART3 - CTS | SSC2 - TX_CLOCK | PB15 | 15 | 16 | PB16 | SSC2 - TX_FRAME | USART3 - RTS | → | BT_RTS |
| BT_TXD | ← | USART3 - TXD | SSC2 - RX_FRAME | PB17 | 17 | 18 | PB18 | SSC2 - RX_CLOCK | USART3 - RXD | ← | BT_RXD |
| | | USART3 - CLK | SM - GCLK2 | PB19 | 19 | 20 | PB20 | DAC - DATA1 | AUDIOC - SDO | → | AC97_SDO |
| AC97_SYNC | ← | AUDIOC - SYNC | DAC - DATA0 | PB21 | 21 | 22 | PB22 | DAC - DATAN1 | AUDIOC - SCLK | ← | AC97_SCLK |
| AC97_SDI | → | AUDIOC - SDI | DAC - DATAN0 | PB23 | 23 | 24 | PB24 | DMAC - DMARQ0 | NMI - NMI_N | | |
| TS_INT | → | IRQ - EXTINT0 | DMAC - DMARQ1 | PB25 | 25 | 26 | PB26 | USART2 - RXD | IRQ - EXTINT1 | ← | SER_RXD |
| SER_TXD | ← | IRQ - EXTINT2 | USART2 - TXD | PB27 | 27 | 28 | | WAKE_N | | | |
| | | | N.C. | | 29 | 30 | | N.C. | | | |
| | | | N.C. | | 31 | 32 | | N.C. | | | |
| | | | 3.3V | | 33 | 34 | | GND | | | |
| | | | 3.3V | | 35 | 36 | | GND | | | |

**J7(NGW100) / P7(RMT1)**

| RMT1 Signal | Dir | Peripheral B | Peripheral A | Port | | | Port | Peripheral A | Peripheral B | Dir | RMT1 Signal |
|---|---|---|---|---|---|---|---|---|---|---|---|
| LCD_D[0] | ← | LCD - D0 | EBI - D19 | PE03 | 1 | 2 | PE04 | EBI - D20 | LCD - D1 | → | LCD_D[1] |
| LCD_D[2] | ← | LCD - D2 | EBI - D21 | PE05 | 3 | 4 | PE06 | EBI - D22 | LCD - D3 | → | LCD_D[3] |
| LCD_D[4] | ← | LCD - D4 | EBI - D23 | PE07 | 5 | 6 | PC31 | | LCD - D5 | → | LCD_D[5] |
| LCD_D[6] | ← | LCD - D6 | | PD00 | 7 | 8 | PD01 | | LCD - D7 | → | LCD_D[7] |
| LCD_D[8] | ← | LCD - D8 | EBI - D24 | PE08 | 9 | 10 | PE09 | EBI - D25 | LCD - D9 | → | LCD_D[9] |
| LCD_D[10] | ← | LCD - D10 | EBI - D26 | PE10 | 11 | 12 | PE11 | EBI - D27 | LCD - D11 | → | LCD_D[11] |
| LCD_D[12] | ← | LCD - D12 | EBI - D28 | PE12 | 13 | 14 | PD07 | | LCD - D13 | → | LCD_D[13] |
| LCD_D[14] | ← | LCD - D14 | | PD08 | 15 | 16 | PD09 | | LCD - D15 | → | LCD_D[15] |
| LCD_D[16] | ← | LCD - D16 | EBI - D29 | PE13 | 17 | 18 | PE14 | EBI - D30 | LCD - D17 | → | LCD_D[17] |
| LCD_D[18] | ← | LCD - D18 | EBI - D31 | PE15 | 19 | 20 | PE16 | EBI - A23 | LCD - D19 | → | LCD_D[19] |
| LCD_D[20] | ← | LCD - D20 | EBI - A24 | PE17 | 21 | 22 | PE18 | EBI - A25 | LCD - D21 | → | LCD_D[21] |
| LCD_D[22] | ← | LCD - D22 | | PD16 | 23 | 24 | PD17 | | LCD - D23 | → | LCD_D[23] |
| | | LCD - DVAL | EBI - D17 | PE01 | 25 | 26 | PE02 | EBI - D18 | LCD - MODE | | |
| LCD_HSYNC | ← | | LCD - HSYNC | PC20 | 27 | 28 | PC21 | LCD - PCLK | | → | LCD_PCLK |
| LCD_VSYNC | ← | | LCD - VSYNC | PC22 | 29 | 30 | N.C. | | | | |
| | | | | N.C. | 31 | 32 | N.C. | | | | |
| | | | | 3.3V | 33 | 34 | GND | | | | |
| | | | | 3.3V | 35 | 36 | GND | | | | |

**J16(NGW100) / P16(RMT1)**

GND | 2 | 1 | +5VDC (from RMT1)

## 3.2 RMT1 Signal Definitions

The following table defines the RMT1 interface signals. Digital signal levels are outlined in **Appendix A**. All signal directions stated are relative to the NGW100 (or other host CPU board).

| Signal | Description | Levels |
|---|---|---|
| **SPI_MISO** | Serial Peripheral Interface: Data – Master In, Slave Out | LVC33 |
| **SPI_MOSI** | Serial Peripheral Interface: Data – Master Out, Slave In | LVC33 |
| **SPI_SCLK** | Serial Peripheral Interface: Data Clock | LVC33 |
| **SPI_TS_CS_N** | Serial Peripheral Interface: Touchscreen Controller Chip Select | LVC33 |
| **ZB_RST_N** | ZigBee/802.15.4 Module: Reset (active low) | LVC33 |
| **BT_RST_N** | Bluetooth Module: Reset (active high) | LVC33 |
| **PCM_CLK** | SSC (to Bluetooth Module): Clock Output | LVC33 |
| **PCM_SYNC** | SSC (to Bluetooth Module): Sync Output | LVC33 |
| **PCM_TXD** | SSC (to Bluetooth Module): Transmit Data Output | LVC33 |
| **PCM_RXD** | SSC (to Bluetooth Module): Receive Data Input | LVC33 |
| **IR_DATA** | Infrared Transmitter: Transmit Data | LVC33 |
| **IR_FC** | Infrared Transmitter: Carrier Frequency Clock | LVC33 |
| **AC97_SYNC** | AC97 Codec: Sync Output | LVC33 |
| **AC97_SCLK** | AC97 Codec: Sync Clock Input | LVC33 |
| **AC97_SDO** | AC97 Codec: Data Output | LVC33 |
| **AC97_SDI** | AC97 Codec: Data Input | LVC33 |
| **AC97_RST_N** | AC97 Codec: Reset (active low) | LVC33 |
| **TS_INT** | Touchscreen Controller Interrupt Input | LVC33 |
| **LCD_BL_ON** | LCD: Backlight On (active high, or PWM) | LVC33 |
| **LCD_DISP** | LCD: Display On (active high) | LVC33 |
| **LCD_PCLK** | LCD: Pixel Clock Output | LVC33 |
| **LCD_D[23:0]** | LCD: Data Output | LVC33 |

| | | |
|---|---|---|
| **LCD_HSYNC** | LCD: Horizontal Sync Output | LVC33 |
| **LCD_VSYNC** | LCD: Vertical Sync Output | LVC33 |
| **PB_L** | Pushbutton: Left Button press (active low) | LVC33 |
| **PB_R** | Pushbutton: Right Button press (active low) | LVC33 |
| **PWR_ON** | Main Power Control: Power On Output (active high) | LVC33 |
| **PWR_SW_N** | Main Power Control: Power Pushbutton sense (active low) | LVC33 |
| **BT_TXD** | Zigbee/Bluetooth UART: Transmit Data Output | LVC33 |
| **BT_CTS** | Zigbee/Bluetooth UART: Clear To Send Input | LVC33 |
| **BT_RXD** | Zigbee/Bluetooth UART: Receive Data Input | LVC33 |
| **BT_RTS** | Zigbee/Bluetooth UART: Request To Send Output | LVC33 |
| **SER_TXD** | DB9M DTE UART: Transmit Data Output | LVC33 |
| **SER_RXD** | DB9M DTE UART: Receive Data Input | LVC33 |
| **+5VDC** | +5VDC ±5%: Supplied by RMT1 to NGW100* | - |
| **GND** | Common for all power supplies and signals. | - |

Please refer to the corresponding peripheral descriptions in Section 4 for relevant details on these signals.

* See Section 4.3 for specific system power options with this signal.

# 4 Peripherals

The RMT1 has many optional peripherals, which would require customer mounting and/or soldering. A few of these options are supported by extra components provided with the RMT1 board.

For most options, you are required to purchase components. See **Appendix B** for a complete Bill of Materials to assist in your purchasing task.

**Appendix C** describes other optional peripherals that are currently not supported.

The following table states the standard and optional peripherals, based on the Product Number of the RMT1 board. The Product Number can be found on the white label on the bottom-side of the board.

| Product Number: | RMT1-A | | |
|---|---|---|---|
| **Peripheral Name** | **Standard** | **Optional** | **Skill/Effort** |
| **Battery Charger / DC Input** | Yes | | |
| **Main Power Control** | Yes | Partial | **THL** |
| **Main Supply** | Yes | | |
| **LCD Panel Support** | Yes | Partial | **SMTM** |
| **Touchscreen Controller** | Yes | Partial | **SMTM** |
| **AC97 Codec** | Yes | Partial | **SMTL** |
| **DTE RS-232 Serial Port** | | Yes | **THM** |
| **LVTTL UART Port** | | Yes | **THL** |
| **ZigBee 802.15.4 Wireless** | | Yes | **THM** |
| **Bluetooth Wireless** | | Yes | **SMTH** |
| **General Pushbuttons** | | Yes | **THL** |
| **External Real-Time Clock** | | Yes | **SMTL** |
| **Prototyping Area** | | Yes | **THL** |

**Standard** peripherals components are already mounted and soldered on the RMT1 board. **Partial** indicates that some standard peripherals have extra options – please see the corresponding sub-section for more details.

**Skill/Effort** represents the estimated soldering skill and effort required in adding an optional peripheral to the RMT1 board:

**THL** Through-hole components. Recommend using a soldering iron with a ≤2mm tip.

**THM** Through-hole components with pitch ≤2mm (0.079”). Recommend using a soldering iron with a ≤1mm tip.

**SMTL** Surface-mount components, with pitch ≥50mil (1.27mm). Recommend using a soldering iron with a ≤0.5mm tip.

**SMTM** Surface-mount components, with pitch ≤0.65mm (25mil). Recommend using a soldering iron with a ≤0.15mm conical tip. Hot-air gun will also be helpful.

**SMTH** Surface-mount components, leadless. Recommend using a hot-air gun. Unloaded pads should have sufficient solder for proper reflow.

The following sub-sections describe each peripheral. Note that references are made to RMT1 signals, as defined in Section 3.2.

## 4.1 Battery Charger / DC Input

The Battery Charger and DC Input circuit provides the following functionality:

- Intelligent DC input or battery switching for the RMT1 main power. When a DC source is connected, the battery can be charged, while main power is still supplied to the RMT1.
- Standard lithium and lithium polymer battery charger (4.2V maximum charge voltage).

Two connectors are provided as options for the Battery connection (supplied in Extra Components bag). Only **one** connector may be mounted, since the footprints overlap.

- **J4**: Molex 22-05-3021 (2-pin 0.1")
- **J5**: JST S2P-PHK-S (2-pin 2mm)

Two connectors are provided as options for the DC Input connection (supplied in the Extra Components bag). Only **one** connector may be mounted, since the footprints overlap.

- **J1**: CUI PJ-003A (power barrel jack, 2.1mm inner-diameter)
- **J3**: Molex 70553-0036 (2-pin 0.1")

The battery charger circuit has DC input range of **4.5VDC** to **6.0VDC**. It is recommended that a 5VDC or 5.5VDC **regulated** power adapter is used to guarantee that the maximum specification is never exceeded.

## 4.2 Main Power Control

The Main Power Control circuit sits between the Battery Charger and the Main Supply. This circuit allows push-button (on-board or external) power on and off control. It is centred around a MOSFET (**Q2**) that controls the enable to the Main Supply.

There is an optional pushbutton (**SW4**, supplied in the Extra Components bag). This can be mounted on the RMT1 (bottom-side). Also, an optional 2-pin 0.1" header (**J9**, supplied in the Extra Components bag) can be mounted to allow connection to a cable of an external switch.

Whenever **SW4**/**J9** is pressed/shorted, the MOSFET is turned on. It is expected that the boot loader (u-boot) will then assert the GPIO for signal **PWR_ON**, which will force the MOSFET to remain enabled.

Once booted to linux, drivers may sense a subsequent press/short on **SW4**/**J9** via GPIO input signal **PWR_SW_N** (active low). This could indicate a power-down request. Following proper linux shutdown (i.e. `poweroff` signal to PID 0), **PWR_ON** would be de-asserted, thus shutting off the Main Supply.

## 4.3 Main Supply

The Main Supply consists of a high efficiency DC/DC boost converter, capable of supplying +5.0VDC to the RMT1 board peripherals, and to the attached NGW100 over interface connectors **P16**/**J16**. Circuitry on the RMT1 and NGW100 would then derive other voltages (typically lower). In this configuration, the NGW100 (or other host CPU board) is expected to supply +3.3VDC to the RMT1, over assigned pins on the other interface connectors.

The Main Supply is enabled or disabled by the Main Power Control circuit.

There may be some customer applications in which the NGW100 is to provide the Main Supply. Note that the only peripheral that requires +5.0VDC is the LCD panel and its supporting power supplies. Two scenarios are possible:

- NGW100 supplies regulated +5.0VDC over **J16**/**P16**. Note that the NGW100 has a full-wave bridge rectifier (**D6**) between the DC input jack and **J16**. The two diode drops need to be compensated for, or the rectifier must be bypassed.
- NGW100 supplies ≤ +6VDC over **J16**/**P16**. In this case, the LCD **must not** be connected. The DC/DC must be isolated by removing SMT resistors **R6** and **R7**. Care must be taken to never enable the LCD backlight supply: always de-assert GPIO to signal **LCD_BL_ON**.
- NGW100 supplies > +6VDC over **J16**/**P16**. More components from +5V path will need to be removed.

Mediama Technologies does not warranty such deviations. Please engage Mediama technical support (support@mediamatech.com), before making modifications of this nature.

## 4.4 LCD Panel Support

The following table describes the degree of support for various LCD panels (at time of publication):

| Mfg Part Number | Support Status | Touchscreen Connector |
|---|---|---|
| **Sharp LQ043T3DX01**<br>**Sharp LQ043T3DX02** | LCD: Tested<br>Backlight: Tested<br>Touchscreen: Hantouch HT043A-NCOFD52 Tested | **J14** |
| **Hantronix HDA430T** | LCD: Tested<br>Backlight: Tested<br>Touchscreen: Designed for, but Not Tested | **J12** |
| **Sharp LQ043T1DG01** | LCD: Not Tested<br>Backlight: Not Tested<br>Touchscreen: Designed for, but Not Tested | **J13** |

**J15** provides the 24-bit pixel data and analog/digital power supplies to the LCD panel.

A 3.0VDC regulator is provided to feed the LCD panel's logic supply. Some LCDs have a supply that can tolerate only 3.3VDC maximum; thus, 3.0VDC ensures that there is some margin. This can be bypassed, allowing +3.3VDC to supply the panel: Remove **U5**, and install **R34**.

The analog supply (+5VDC) is only enabled to the LCD panel when the logic supply is valid. This matches the supply sequencing requirements of the supported TFT LCD panels.

**J16** provides the LED backlight power supply. The power supply is current-controlled to supply a constant 18.2mA. The LED voltage can be up to 36VDC, which is sufficient to drive a backlight with up to 10 white LEDs in series. The backlight is enabled by GPIO signal **LCD_BL_ON**.

If the backlight cable is not connected, the backlight regulator will go into over-voltage protection (+37VDC), and emit an audible high-frequency tone. To avoid this, please check that the backlight cable is securely attached. For applications that do not require the LCD backlight, please disable the backlight (de-assert **LCD_BL_ON**).

## 4.5 AC97 Codec

A NXP UCB1400BE provides AC97 Rev2.1 compliant audio headphone/line output and microphone input. A 24.576MHz crystal is provided for the codec.

**J10** is a 3.5mm (1/8") stereo jack, which can drive a headphone (25mW into 32Ω), or a general line output ($1V_{PP}$ into 10KΩ).

By default, the output jack has a pseudo-ground that is +1.65VDC relative to RMT1 digital common. For line-out applications it may be desirable to have the jack common ring connected to RMT1 ground, especially in situations where there is a common system ground. This can be accomplished with the following modification:

1. Remove **R38**.
2. Install (or short) **R41**.

Microphone input is also possible by loading jack **J18**. Only passive microphones are supported.

## 4.6 Touchscreen Controller

RMT1 provides a Texas Instruments ADS7846 (or TSC2046) controller for handling 4-wire resistive touchscreens. This controller has 12-bit sampling precision. The CPU communicates with the controller over the SPI interface.

To support various touchscreens, the following connectors footprints are provided. The following table lists the connector pin-outs, based on touchscreen axis.

| Pin: | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| **J14** (1mm) | Lower X | Upper Y | Upper X | Lower Y |
| **J13** (1mm) | Lower X | Upper Y | Upper X | Lower Y |
| **J12** (0.5mm) | Upper Y | Upper X | Lower Y | Lower X |

Only **J14** is loaded on a standard RMT1.

The touchscreen controller operates with best linearity when the X and Y axis resistances are equal. Some panels have a Y resistance that is significantly lower than the X. To compensate for this, RMT1 has a resistor in series with the Lower-Y connection: **R30** is currently set to 470Ω, to match the Hantronix HT043A panel.

Some developers may want to use the touchscreen digitizer on the UCB1400BE. This can be accomplished with the following modifications:

1. Remove **U10**
2. Install **R33**, **R25**, **R36** and **R37**. If necessary, tune **R36** value to provide X/Y axis resistance matching.
3. Install **R15**

## 4.7 DTE RS-232 Serial Port

A RS-232 level translator is attached to NGW100's **USART2** port.

Only the RXD and TXD ports are routed.

Connector **J11** (DB9 male connector, available from the Extra Components) may be mounted to provide a standard 9-pin DTE serial port.

## 4.8 LVTTL UART Port

A 6-pin header can be mounted (**J8**, available in the Extra Components) to provide 3.3V LVCMOS compatible UART port.

The pin-out for **J8** is as follows:

| Pin | Signal | Description |
|---|---|---|
| 1 | **GND** | Digital Common |
| 2 | **CTS** | Clear-to-Send Output |
| 3 | **NC** | Not Connected |
| 4 | **TXD** | Transmit Data Output |
| 5 | **RXD** | Receive Data Input |
| 6 | **RTS** | Request-to-Send Input |

This port is shares NGW100 **USART3** with other functions. Care must be taken to avoid contention on any signals.

RMT1 does not provide any protection on these signals for ESD or overvoltage transients.

## 4.9 ZigBee/802.15.4 Wireless

Support is provided for a Digi/MaxStream XBee wireless module, both Series I (IEEE 802.15.4) and Series II (ZigBee). Hardware-wise, all that is needed is to solder a compatible module into footprint **U7**.

The physically larger XBee Pro modules are not supported.

Main communication between the CPU and the module is over NGW100 **USART3**. The current generations of XBee modules operate at baud rates up to 115200bps, with hardware flow-control (RTS/CTS).

To allow external module configuration using the Digi X-CTU software, **J8** can be used with an external cable. With this method, the **J8** pin-out is compatible with the FTDI TTL-232R-3V3 cable. In order for this to be possible, the NGW100 **USART3** port must be disabled or not initialized (e.g. outputs tri-stated).

The reset line to the module (**ZB_RST_N**) is an active-low signal that is controlled by CPU GPIO. When this signal is asserted, the module is put into low-power mode, with all signals tri-stated.

The ZigBee/802.15.4 module shares NGW100 **USART3** with other functions. Care must be taken to avoid contention on any signals.
It is recommended that only **one** wireless module be mounted on an RMT1.

Wireless performance and range is dependent on many factors, including the shape and type of enclosure. As such, there are no guaranteed performance specifications for RMT1 with ZigBee or 802.15.4 support.

## 4.10 Bluetooth Wireless

The RMT1 supports the Bluegiga WT12-A-HCI module, which may be mounted on footprint **U12**.

The WT12-A only has underside SMT pads. The use of a hot-air gun or reflow station is highly recommended. While the RMT1 pads will be pre-tinned, it is highly recommended that the WT12-A pads also be pre-tinned with solder, before hot-air reflow.

Main communication between the CPU and the module is over NGW100 **USART3**, with hardware flow-control (RTS/CTS).

The WT12-A-HCI module is factory-configured to enable its **USB interface** only. Before mounting, a module must be pre-configured to use the UART interface, or custom configured modules can be ordered from Bluegiga. If neither method is possible, you can still re-configure the module in-system using the procedure given in Error! Reference source not found..

The reset line to the module (**BT_RST**) is an active-high signal that is controlled by CPU GPIO. When this signal is asserted, the module is put into low-power mode, with all signals tri-stated.

The Bluetooth module shares NGW100 **USART3** with other functions. Care must be taken to avoid contention on any signals.
It is recommended that only **one** wireless module be mounted on an RMT1.

Wireless performance and range is dependent on many factors, including the shape and type of enclosure. As such, there are no guaranteed performance specifications for RMT1 with Bluetooth support.

## 4.11 General Pushbuttons

Two pushbutton switches are provided. The switches are supplied in the Extra Components (Omron B3F-1050), and are intended to be mounted on the bottom-side of the RMT1 board (same side as LCD connectors). That way, they are able to provide user-input buttons through the same mounting panel/plate as the LCD panel.

These switches drive **PB_L** and **PB_R**, which are active-low signals routed to CPU GPIO. Note that no hardware de-bouncing is provided.

Matching plastic key caps are Omron B32-10xx series.

## 4.12 External Real-Time Clock

The Atmel AT32AP7000 on the NGW100 has an internal real-time clock (RTC). However, the internal RTC does not retain its count over through a main power outage, nor does it have a battery input for retention.

RMT1 provides footprints for a Seiko Instruments S-35390A real-time clock circuit. This device is accessed over the NGW100 IIC bus. Either a rechargeable lithium battery or a super-capacitor may be selected for clock retention.

If the lithium battery is chosen, the following components must be installed:

**U9**, **D3**, **Y2**, **C34**, **R29**, **B1**

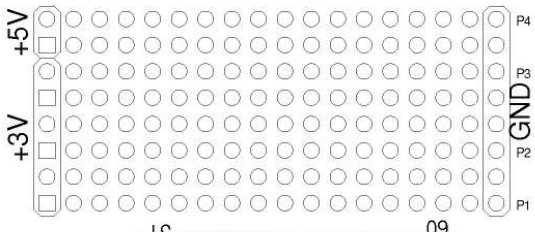
If the super-capacitor is chosen, the following components must be installed:

**U9**, **D3**, **Y2**, **C34**, **C11**

On revision 04 PCBs (marked on top-side as "**RMT1 Rev 04**"), the silkscreen orientation mark for **D3** is reversed. The cathode (line on the diode package) should be connected to **B1**. This is correctly depicted in the schematics.

## 4.13 Prototyping Area

A 0.1" grid prototyping area is provided, consisting of 18x6 plated holes.




As depicted in the above image, pins are provided to various power supplies: +5VDC and +3.3VDC. The current available on each supply for prototyping is TBD.

One use of this area would be to mount a horizontal DIP-based module. An interesting use for this would be the FPGA DIP modules from Enterpoint:

http://www.enterpoint.co.uk/component_replacements/craignell.html

The "+5V" may not truly be +5VDC if a deviant main supply scheme is implement, as discussed in Section 4.3.

There are traces running between the holes in the prototype area. Please take care to not damage traces while using the prototype area. Also, please take these traces into considering when using the prototype area for RFI-sensitive application.

# Appendix A Signal Levels

## A.1 LVC33

LVCMOS 3.3V Input and Output Specifications:

| Symbol | Parameter | Minimum | Maximum | Units |
|---|---|---|---|---|
| $V_{il}$ | Input Logic Level "0" (LOW) | -0.3 | +0.8 | VDC |
| $V_{ih}$ | Input Logic Level "1" (HIGH) | +2.0 | +3.6 | VDC |
| $V_{ol}$ | Output Logic Level "0" (LOW) | 0.0 | +0.4 | VDC |
| $V_{oh}$ | Output Logic Level "1" (HIGH) | +2.9 | +3.3 | VDC |

# Appendix B Bill of Materials

The RMT1 Bill of Materials (BoM) allows you to find the manufacturer's part number for a given board Reference Designator. A "Yes" in the **Standard** column means that the component is mounted and soldered on to standard RMT1-A board, as shipped.

| Qty | Reference Designator | Standard | Manufacturer | Part Number |
|---|---|---|---|---|
| 1 | B1 | | Seiko Instruments | MS518S-FL35E |
| 6 | C1,C16,C20,C22,C28,C29 | Yes | Rohm | TCTP0J336M8R |
| 3 | C2,C6,C14 | Yes | Panasonic | ECJ-1VB0J106M |
| 2 | C3,C7 | | Panasonic | ECJ-1VB0J106M |
| 19 | C4,C10,C15,C24,C26,C27,C30,C31,C32,C35,C37, C42,C43,C44,C45,C46,C47,C48,C50 | Yes | TDK | C1608Y5V1H104Z |
| 4 | C5,C8,C12,C19 | Yes | Rohm | TCP0J106M8R |
| 1 | C9 | | Rohm | TCP0J106M8R |
| 1 | C11 | | Panasonic | EEC-S0HD334H |
| 1 | C13 | Yes | MuRata | GRM1885C1H220JA01D |
| 5 | C17,C21,C23,C36,C49 | Yes | Taiyo-Yuden | EMK107F105ZA-T |
| 1 | C18 | Yes | MuRata | GRM1885C1H390JA01D |
| 1 | C25 | Yes | Panasonic | GRM188R71H471KA01D |
| 1 | C33 | | TDK | C1608Y5V1H104Z |
| 1 | C34 | | MuRata | GRM1885C1H4R7CZ01D |
| 4 | C38,C39,C40,C41 | | Taiyo-Yuden | EMK107F105ZA-T |
| 1 | DS1 | | Fairchild | QEE113 |
| 1 | DS2 | Yes | Kingbright | APT1608EC |
| 1 | D1 | Yes | On Semi | MBRA210LT3G |
| 1 | D2 | Yes | On Semi | BAT54CLT1G |
| 1 | D3 | | Panasonic | MA2ZD1800L |
| 1 | D4 | Yes | Panasonic | MA2ZD1800L |
| 1 | J1 | | CUI | PJ-003A |
| 1 | J2 | | FCI | 61083-061402LF |
| 1 | J3 | | Molex | 70553-0036 |
| 1 | J4 | | Molex | 22-05-3021 |
| 1 | J5 | | JST | S2B-PH-K-S |
| 1 | J6 | | Yamaichi | FPS009-2405-0 |
| 1 | J7 | | FCI | 61083-101402LF |
| 1 | J8 | | Molex | 22-28-8060 |
| 1 | J9 | | Molex | 22-28-8020 |
| 1 | J10 | Yes | CUI | SJ-3523-SMT |
| 1 | J11 | | Kycon | K31X-E9P-N |
| 1 | J12 | | Molex | 0513790473 |
| 1 | J13 | | FCI | SFW4R-2STE1LF |
| 1 | J14 | Yes | FCI | SFW4R-2STE1LF |
| 1 | J15 | Yes | Hirose | FH12S-40S-0.5SH(55) |
| 1 | J16 | Yes | Molex | 0513790473 |
| 1 | J17 | | Molex | 54819-0572 |
| 1 | J18 | | CUI | SJ-3523-SMT |

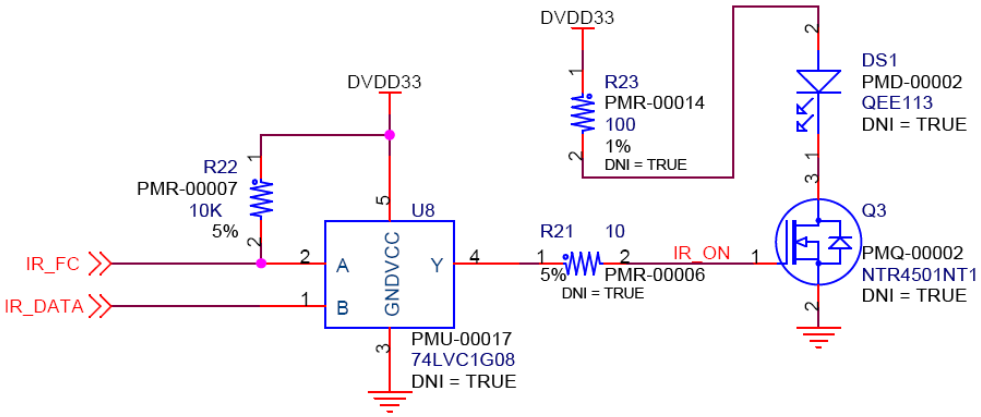
| | | | | |
|---|---|---|---|---|
| 1 | L1 | | TDK | NLCV25T-2R2M-PF |
| 1 | L2 | Yes | EPCOS | B82432T1222K |
| 1 | L3 | Yes | EPCOS | B82432T1223K |
| 1 | L4 | Yes | TDK | NLCV25T-220K-PF |
| 2 | L5,L6 | Yes | TDK | MLG1608B10NJ |
| 4 | P1,P2,P3,P4 | | Samtec | TSW-118-05-T-D |
| 3 | P5,P6,P7 | | Mill-Max | 464-40-236-00-58000 |
| 1 | P16 | | Mill-Max | 464-40-202-00-58000 |
| 1 | Q1 | Yes | Fairchild | FDC6331L |
| 1 | Q2 | Yes | On Semi | NTR4501NT1G |
| 1 | Q3 | | On Semi | NTR4501NT1G |
| 1 | RP1 | | Panasonic | EXB-E10C103J |
| 12 | R1,R2,R3,R8,R9,R13,R14,R16,R22,R28,R39,R40 | Yes | Panasonic | ERJ-3GEYJ103V |
| 7 | R4,R15,R33,R34,R35,R37,R41 | | Panasonic | ERJ-3GEY0R00V |
| 4 | R5,R12,R31,R32 | Yes | Panasonic | ERJ-3GEYJ100V |
| 4 | R6,R7,R27,R38 | Yes | Panasonic | ERJ-3GEY0R00V |
| 1 | R10 | Yes | Panasonic | ERJ-3EKF16R5V |
| 1 | R11 | Yes | Panasonic | ERJ-3GEYJ102V |
| 1 | R17 | Yes | Panasonic | ERJ-3GEYJ221V |
| 1 | R18 | Yes | Panasonic | ERJ-3EKF1501V |
| 1 | R19 | Yes | Panasonic | ERJ-3EKF4702V |
| 1 | R20 | Yes | Panasonic | ERJ-3EKF2702V |
| 1 | R21 | | Panasonic | ERJ-3GEYJ100V |
| 1 | R23 | | Panasonic | ERJ-3GEYJ101V |
| 1 | R24 | Yes | Panasonic | ERJ-3GEYJ242V |
| 1 | R25 | Yes | Panasonic | ERJ-3GEYJ274V |
| 1 | R26 | Yes | Panasonic | ERJ-3GEYJ753V |
| 1 | R29 | Yes | Panasonic | ERJ-3GEYJ470V |
| 1 | R30 | Yes | Panasonic | ERJ-3GEYJ471V |
| 1 | R36 | | Panasonic | ERJ-3GEYJ471V |
| 1 | SW1 | | ITTCannon | KSR211GLFS |
| 3 | SW2,SW3,SW4 | | Omron | B3F-1050 |
| 1 | U1 | Yes | Microsemi | LX2202CLQ |
| 1 | U2 | Yes | TI | TPS61202DSC |
| 1 | U3 | | TI | TPS61201DSC |
| 1 | U4 | Yes | Toshiba | TB62752AFUG |
| 1 | U5 | Yes | Microchip | TC1015-3.0VCT713 |
| 1 | U6 | Yes | TI | MAX3232ECDR |
| 1 | U7 | | Digi | XB24-ACI-001 |
| 1 | U8 | | TI | SN74LVC1G08DBV |
| 1 | U9 | | Seiko Instruments | S-35390A-J8T1G |
| 1 | U10 | Yes | TI | TSC2046IPWR |
| 1 | U11 | Yes | NXP | UCB1400BE-S |
| 1 | U12 | | Bluegiga | WT12-A-HCI |
| 1 | Y1 | Yes | Abracon | ABLS-24.576MHZ-B2F |
| 1 | Y2 | | Seiko Instruments | SPT2AF-6PF20PPM |

# Appendix C Unsupported Peripherals

This appendix describes some peripherals that have footprints available on the RMT1, but are not currently supported. Mediama Technologies reserves the right to remove these peripherals (e.g. PCB footprints) without further notice.

## C.1 Infrared Transmitter

RMT1 provides footprints for an infrared transmitter circuit:




This circuit is an attempt to produce signals that are compliant with Philips RC5 (36kHz) and Sony SIRC (40kHz) remote control transmission standards. LED **DS1** transmits at a wavelength of 940nm.

The CPU generates a constant IR carrier clock on signal **IR_FC**, and output synchronous IR data on signal **IR_DATA**. The mixed (logical AND) signal would then drive an infrared LED. Carrier frequency accuracy would be dependent on the PWM clock source, etc.

At time of publication, hardware has not been tested, and no linux driver support has been implemented.

## C.2 VirtualCogs® VCMX212 Base Connector

The RMT1 has footprints for the VirtualCogs VCMX212 CPU module. Only the following items were tested in early RMT1 prototypes:

1. Mechanical form and connector fit verified (**J2** and **J7**).
2. Power Supply (+5VDC) valid, and VCMX212 booting consistently.
3. Booting linux, with root filesystem stored on SDCard (**J6**).
4. LCD interface functioning at 18bpp (with **RP1** installed, to pull-down unused bits).

The connector footprints and mounting holes remain on production RMT1 boards. However, Mediama Technologies does not officially support the VirtualCogs VCMX212, and reserves the right to remove these footprints without notice. Please contact Mediama Technical Support (support@mediamatech.com) for further assistance.

# Appendix D Prototype Enclosure Ideas

This Section describes an ideas for an enclosure methods, and thus is purely informative.

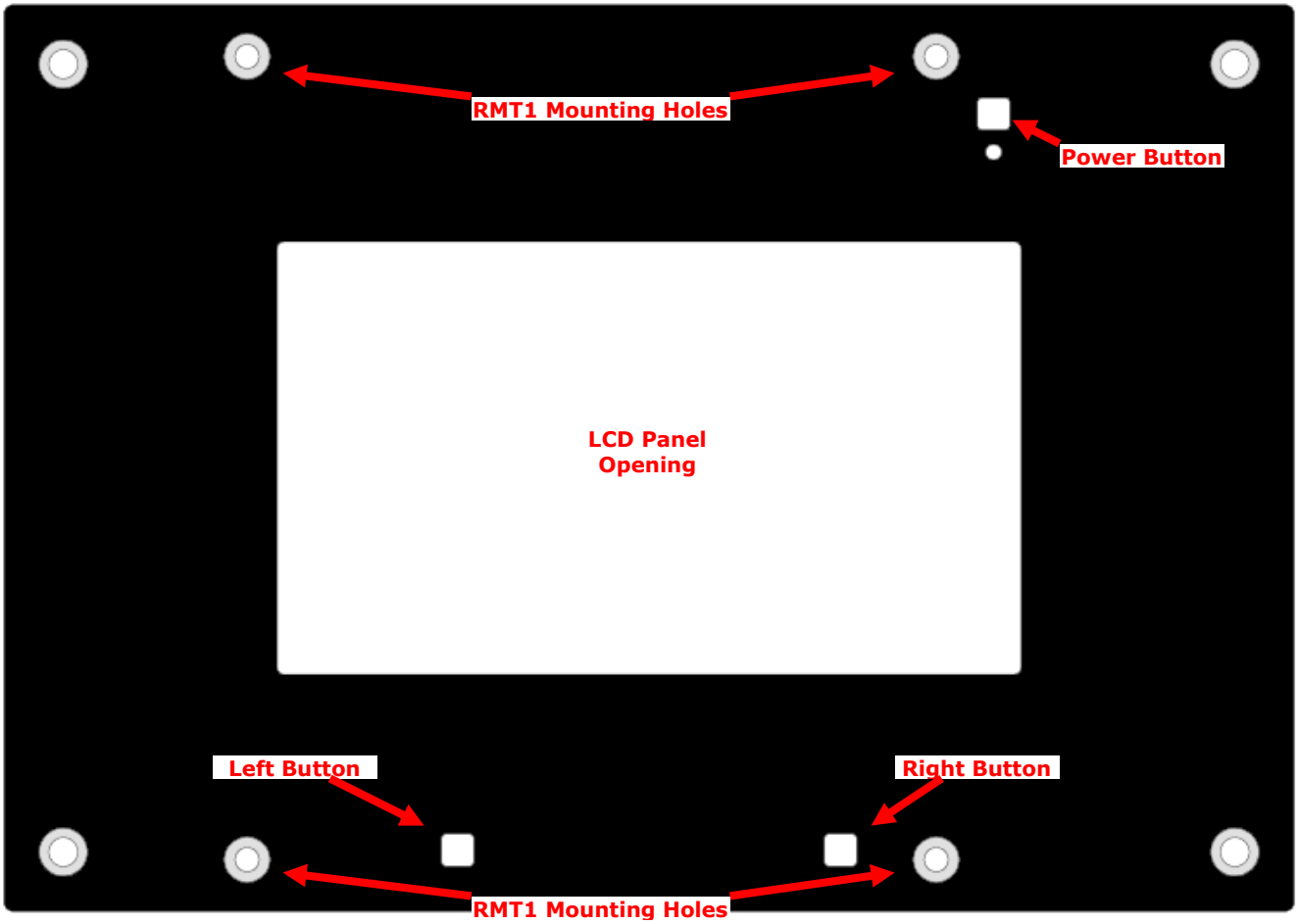
## D.1 Serpac Case

The RMT1 board was dimensioned to fit into the width of a Serpac 173 case:

http://www.serpac.com/products_s-173-173-i.htm

This case consist of two halves. The deeper half contains six mounting standoffs, and has a dual-level lip that is useful for holding a panel. Of the six standoffs, the middle two will have to be removed, as flush as possible to the case bottom. This is required, as the RMT1 board fits the entire width (short axis) of the case.

A front-panel can be designed for the RMT1+NGW100 can be mounted to, with openings for the LCD and pushbuttons. An example aluminum front-panel design is shown below (black finish):



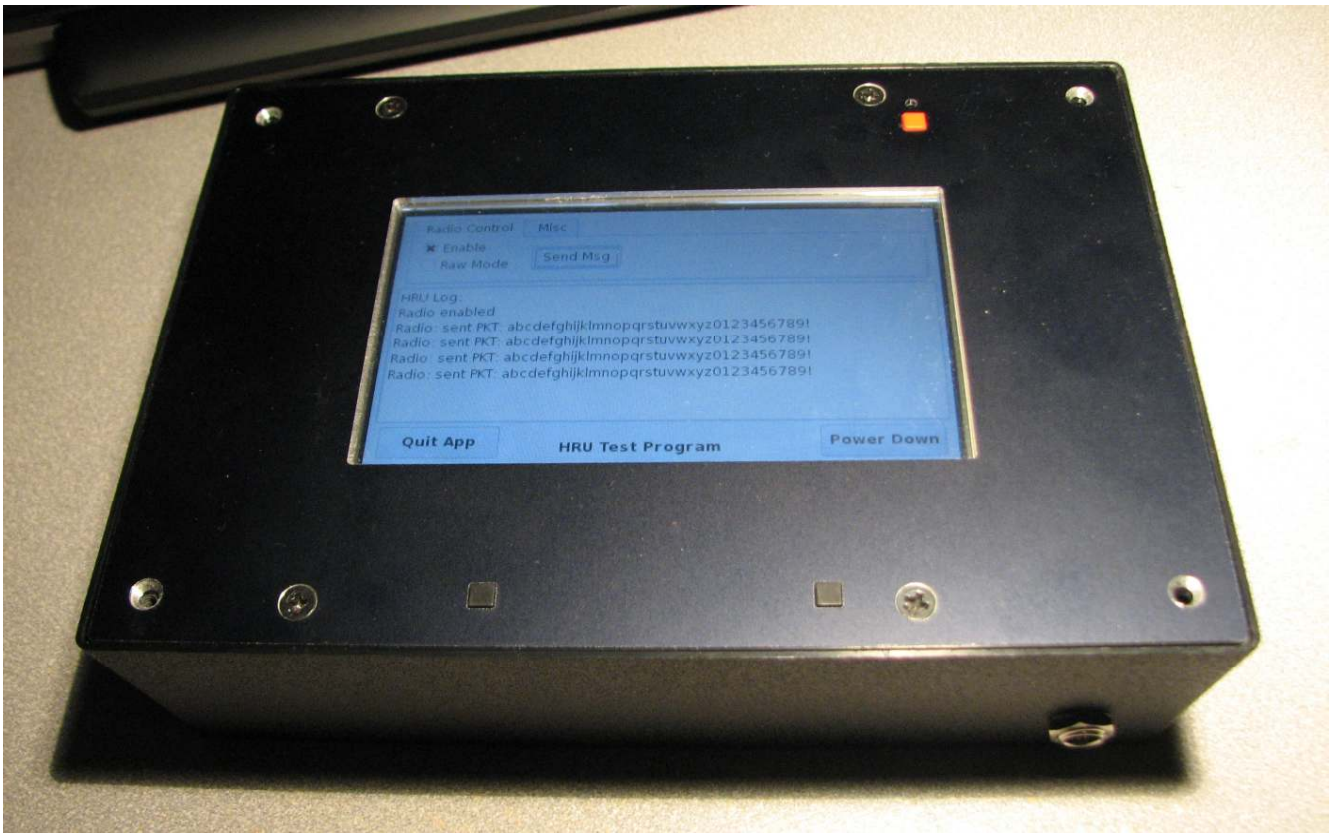

An example design file for Front Panel Express (http://www.frontpanelexpress.com) and Schaeffer AG (http://www.schaeffer-ag.de) may be found at:

http://www.mediamatech.com/files/rmt_example.fpd

The RMT1 (and thus NGW100) is mounted to the front-panel with four 8mm M3 threaded spacers, and M3 countersunk machine screws. The front-panel is then mounted into the case standoffs with #4 countersunk self-tapping screws.

If RMT1 edge connectors that need to be accessible from outside the case (e.g. UART DB9M, audio jacks, etc) require cut-outs in the plastic case. This could be done using a rotary cutting tool.

The following is a photo of an RMT1+NGW100 mounted inside this example case:




## D.2 U-Shaped Case

The RMT1 was designed to have one edge roughly aligned with the NGW100 board edge with the SDCard slot.

On the aligned edge, the RMT1 overhangs the NGW100 by ~0.3mm. Thus, the total distance from edge-to-edge of the stack is 120.3mm (4.74”). This will vary slightly depending on inter-board connector placement alignment.

It is possible to custom design a U-shaped case that could encompass the NGW100+RMT1 stack and expose the connectors on both edges: on one side the NGW100 Serial/Ethernets/USB connectors; and on the other side, the RMT1 DC Input (**J1** or **J3**) connectors, and the NGW100 SDCard slot.