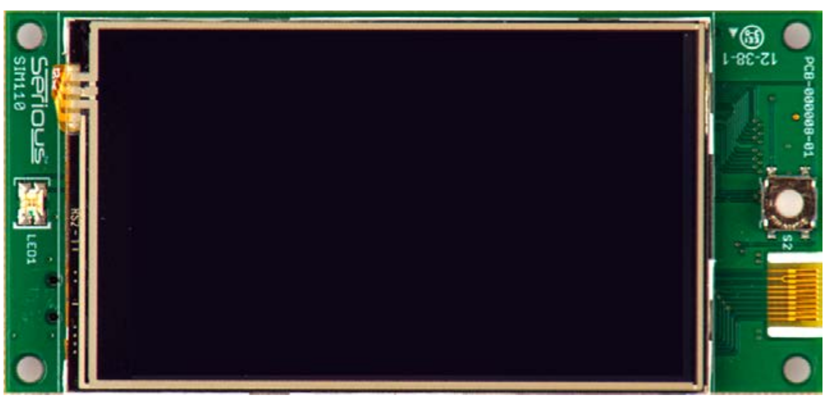
SIM110 TECHNICAL REFERENCE MANUAL



PRELIMINARY ADVANCE INFORMATION

SIM110_TRM_A4ENUS
Revision A4

IMPORTANT LEGAL NOTICE

Yes, our attorneys made us put this in. But you really should read and understand this.

Information herein is provided in connection with Serious Integrated, Inc. ("SERIOUS") products.

The products may comprise components designed and manufactured by SERIOUS as well as other vendors. This information may refer to a variety of specifications related to those non-SERIOUS components for informational purposes only, and the user is strongly urged to consult the original manufacturers' data sheets and other documentation for authoritative specifications.

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TRADEMARKS AND COPYRIGHTS

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DOCUMENT INFORMATION AND APPLICABLE PRODUCTS

CHANGE HISTORY AND APPLICABLE PRODUCTS

The following table summarizes major changes to this document and the applicable versions of the product corresponding to this document:

Doc Version	Date	For HW Versions	Major Changes
A0	07 Nov 12	1.0	• Initial prerelease version
A1	28 Nov 12	1.0	• Cosmetic and readability
A2	03 Dec 12	1.0	• Fixed PCB Edge Connector: pins 4 and 6 were reversed • Piezo beeper renamed "piezo sounder" • MCU temperature sensor calibration note added • Clarified up to 768KB FLASH on MCU
A3	26 Jan 13	2.0	• Added LCD Backlight lifetime spec • Added typical power table • Revised Maximum Input Voltage to 5.80V
A4	07 Feb 13	3.0 (production)	• Added maximum power requirements • Clarified mechanical dimensions

DOCUMENT CONVENTIONS

This symbol indicates an advanced tip for hardware or software designers to extract interesting or unique value from the Serious Integrated Module.

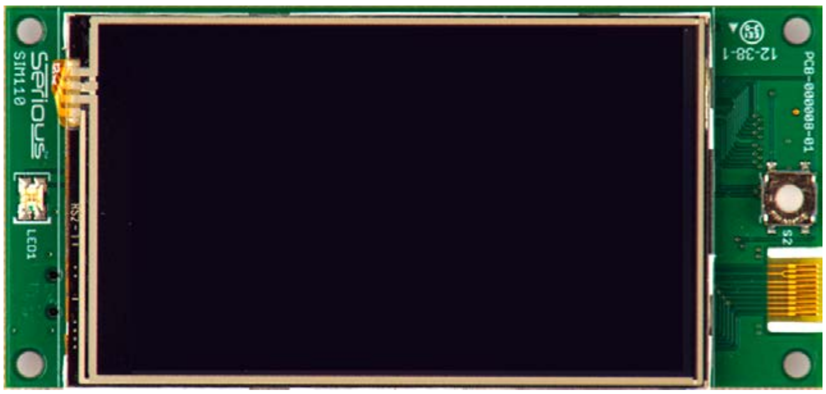
WARNING: You can damage your board, damage attached systems, overheat or cause things to catch fire if you do not heed these warnings.

Notes with this symbol are related to license and associated legal issues you need to understand to use this software. We're big believers in honoring license agreements, so please help the industry by respecting intellectual property ownership.

Some hardware features may be preconfigured or permanently reserved for use by the SHIPEngine software (the GUI management engine component of the Serious Human Interface™ Platform). Notes with this symbol indicate where the module comes pre-configured or uses these resources.

INTRODUCTION

The SIM110 family of Serious Integrated Modules is a series of complete intelligent 3.0" WQVGA graphic front panels, some with touch capability. These cost-effective modules are designed for use by Original Equipment Manufacturers (OEMs), custom design shops, and hobbyists to add sophisticated and user-friendly graphical user interfaces to their products.



HARDWARE

All SIM110 family members feature:

- 3.0" WQVGA 400x240 16-bit color TFT display 320-400 NITs
  - Various touch panel options
- 100MHz 32-bit Renesas RX63N/RX631
  - 128KB RAM, up to 768KB FLASH
  - Floating Point Unit
  - Temperature Monitor and Real Time Clock
- On-module memory
  - Up to 1MB (512KBx16) external SRAM
  - 192KB RAM-on-LCD Frame Buffer
  - 8MB Serial FLASH + 2Kbit EEPROM
- Flexible I/O
  - 24-Pin FFC (GPIO, power, RESET#, UART)
  - RMII on 63N-based units
  - 7-pin system-to-system connector
  - PCB edge connector (E1 debug, USB device)
- 98 x 46 mm
- 3.0V to 5.8V, -20 to +70°C Operating Range

Consult the latest SIM110 Product Brief for a listing of current family members and options. As of the time of this document's publish date, the family members/options are:

Options	A00	A01	A02	A03	A04
MCU RX Family	63N	631	631	631	631
MCU FLASH (KBytes)	768	512	512	512	512
SRAM/Serial FLASH (MBytes)	1/8	1/8	1/8	1/8	1/8
Touch	R4	R4		R4	
USB2.0 FS device connector	✓	✓	✓		
Piezo Sounder	✓	✓	✓		
Battery Backed Clock	✓	✓	✓		
24-Pin FFC (GPIO, +5V, GPIO, UART)	✓	✓	✓		
RMII on 24-Pin FFC	✓				

This is a preliminary table prior to product release and is subject to change.
See www.seriousintegrated.com/SIM110 for latest options.

SOFTWARE

The SIM110 is supported by a growing collection of Renesas, open source, as well as *Serious* proprietary software allowing designers to gain confidence that their essential software can not only get it done, but perform to the needed end result. Available at mySerious.com for download, SIM110 programmers can obtain an out-of-the-box experience with a pre-ported version of the Renesas GAPI library on Micrium µCOS-III, Segger embOS and FreeRTOS operating systems. The SIM110 includes full single-unit production licenses of the Micrium and Segger kernels for use with each module.

For even faster development, the Serious Human Interface™ Platform offers PC-based GUI design tools and rapid GUI prototyping, development, and deployment. With minimal coding, you can create attractive and functional GUIs in a fraction of the time of traditional C-based development. See www.seriousintegrated.com/SHIP for details.

It is very difficult to know, as a designer selecting the hardware for a graphic/touch interface, if the result after many months of software and graphic design will have acceptable performance. Will the system be responsive? Will it be visually attractive? Will the look-and-feel be consistent with the company's brand image? *Serious* addresses these OEM designer challenges by providing video best-of-class GUI examples, fostering community demos and solutions, and through its proprietary software, tools, and consulting services.

USAGE MODELS

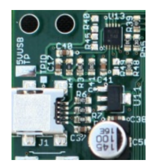
The SIM110 can be used as a stand-alone controller for a whole system – where all the intelligence and control is in the SIM110 with few external components – or can act just as a front-panel touch/graphic human interface, a sort of "super-interface", to an attached intelligent system. In reality, there are many usage models in between these extremes.

There is often additional software and hardware functionality in the user's system beyond the SIM110; for example, a machine control system. The SIM110 is equipped with several connectors allowing simple communications to an external hardware system.

Often a designer has an existing product with a traditional button-and-segment-LCD user interface and is seeking to give the product an "extreme makeover" with a new front graphic/touch panel. The existing design may already be an intelligent system, such as a pool control system including motor controllers, valve relays, sensors, and power supply circuits as well as its own microcontroller on a "baseboard" PCB. In some designs, this baseboard has a wire harness to a simple front panel interface. In others, the baseboard is combined with front panel buttons and indicators. All user configuration and operation is managed by the existing baseboard and its software. Rather than completely redesigning the hardware and software of the existing OEM system, the old front panel can be replaced by a simple UART + Power connection to one of the SIM110's connectors. The designer can then architect inter-board messages such as "pump is on" which could be sent over the UART causing visual indicators to appear or change on the display. A GUI on the SIM110 could change user preferences, for instance, sending back messages such as "pump on days: MWF" which the baseboard may store in its configuration EEPROM.

The possibilities are endless: the SIM110 module contains not only a powerful MCU but also a suite of hardware features that are commonly needed in many designs. A high-end thermostat or alarm panel, for example, could be as simple as a SIM110 connected to another PCB with a few relays and a battery.

GETTING STARTED



The SIM110 comes pre-configured with a demo program loaded in the system FLASH. To startup the system, plug a USB cable from your PC or USB supply into the USB device Mini-B connector. The system will use a maximum of 250mA of current from the USB connection when in operation, not including any external power draw from the module you may add.

Several connectors may be used to power the SIM110. See the Power Supplies section of this guide.

The demo should start running and displaying info on the LCD screen.

For more getting started information and out-of-the-box tips, see www.seriousintegrated.com/oob.

SPECIFICATIONS

VOLTAGE INPUT LIMITS

Source	Permissible Range			
	Min	Typ	Max	Units
On +5V_USBF	4.75	5.00	5.25	V
On +5V_EXT	3.60	5.00	5.80	V

SUPPLY CURRENT

The following table outlines maximums based on the SIM110 design and supplied information from component data sheets. Any additional external power requirements (for example, on the +3V3 signal on the 7-pin connector) are in addition to these totals.

	Max mA On 3.3V Internal	External Max mA From +5V_EXT			Notes
		@3.6V	@5.0V	@5.8V	
External→Internal Power Conversion Efficiency		80%	82%	82%	Estimated worst case from datasheet
RX63N MCU					
Digital supply current	100.00	114.58	80.49	69.39	High Speed mode (0.87 x f +13)
Analog supply current	5.85	6.70	4.71	4.06	Converting (All DACs + ADCs)
Analog reference	0.70	0.80	0.56	0.49	Converting
R1LV0816ASD SRAM	35.00	40.10	28.17	24.29	
SST25VF064C SFLASH	25.00	28.65	20.12	17.35	
CAT34C02HU4 EEPROM	1.00	1.15	0.80	0.69	SCL = 100KHz
12MHz Oscillation	2.20	2.52	1.77	1.53	
LCD Display (Logic)	15.00	17.19	12.07	10.41	LCD on/enabled and writing
LCD Display (Backlight)	100.00	114.58	80.49	69.39	4 LED up to 25mA each
Misc (LED, Resistors, Logic)	10.00	11.46	8.05	6.94	
Total (No Piezo, No Touch)	294.77	337.75	237.25	204.53	
TFT LCD Touch Screen	14.85	17.02	11.95	10.30	When pressed/energized, continuous
Piezo	10.00	11.46	8.05	6.94	LM2766 boost enabled
Total (With Piezo, Touch)	319.62	366.23	257.25	221.77	

Many I/O signals on the SIM110 are directly and exclusively connect to the RX MCU pins. Consult the RX63N/RX631 data sheet for complete specifications of each pin.

There are specific power limitations on the RX MCU pins. Consult the RX63N/RX631 data sheet for more information. **Exceeding these limits may damage your board, damage attached systems, overheat or cause things to catch fire.**

MEASURED SUPPLY CURRENT

The following table summarizes typical measured input current characteristics of the SIM110. These figures are **not design maximums**, and are for informational purposes only:

+5V_EXT Input Power Condition	Typical Measured Values			
	@5.80V	@5.00V	@3.60V	Units
Total Input Current Backlight, Sounder, Touch OFF MCU idle delay loop	39	47	61	mA
Total Input Current Backlight 100%, Sounder, Touch OFF MCU drawing on screen	116	135	167	mA
Incremental Input Current When touch screen pressed (avg)	1	1	1	mA
Incremental Input Current When piezo sounder 100% volume	11	7	7	mA
Total Input Current Backlight, Sounder, Touch ON MCU drawing on screen	128	143	175	mA

AC TIMING

The AC timing characteristics at the module level are governed by the underlying AC timing characteristics of the individual components. Consult the component data sheets for more information.

Many I/O signals on the SIM110 are directly and exclusively connect to the RX MCU pins. Consult the RX63N/RX631 data sheet for complete specifications of each pin.

The no-cost SHIPWare source code as well as the full-featured Serious Human Interface™ Platform software initializes many of these signals for correct operation between the various module components.

ENVIRONMENTAL

Specification	Permissible Range			Notes
	Min	Max	Units	
Operating Temperature	-20	+70	C	
Storage Temperature	-30	+80	C	
Humidity		90%	RH	@60C, non-condensing

DIMENSIONS

The outer dimensions of the SIM110 are 98 x 46 mm. The SIM has 4 mounting holes, one in each corner, as well as 2 alignment positioning holes. The alignment holes are non-plated and are the foundation of all positioning on the module, especially the LCD display mounting position. These holes should be used if possible during installation of the SIM110 into an enclosure to align the active display area of the LCD with any front bezel. Typically, precision alignment pegs, for example PennEngineering # MPP-2mm-10, will be used in the front bezel assembly. The SIM110 would be aligned on these pegs, and then fastened by a pressure clamp (covering the 4 corners where the mounting holes are) or screws using the mounting holes.

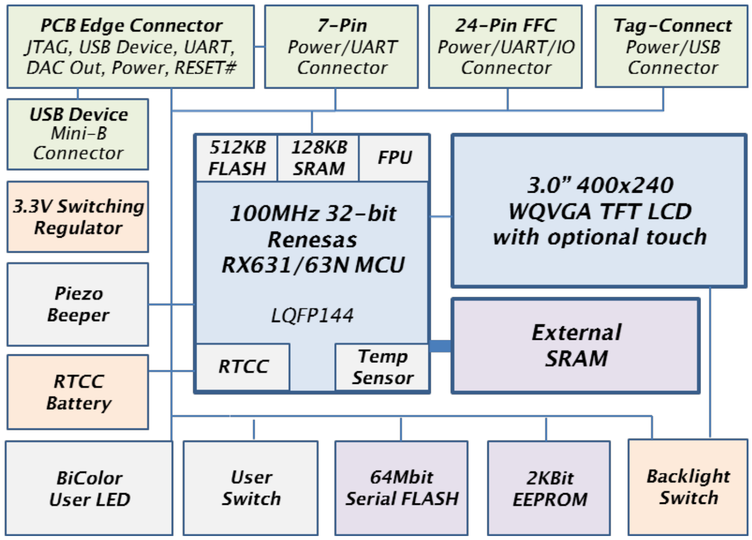
Serious will endeavor, across all future SIM110 revisions, to maintain the dimensions and positioning of:

- the outline of the module,
- mounting hole positions,
- alignment hole positions,
- TFT LCD visible area positioning, and,
- external connectors.

Positioning and selection of components are subject to change across SIM revisions to optimize manufacturability, reliability, quality, and cost. Ensure that related system mechanical designs do not rely on the specific positioning and height of components other than external connectors.

Mechanical drawings and SolidWorks/STEP models are available for most SIMs. Visit www.seriousintegrated.com/docs for more information.

HARDWARE ARCHITECTURAL OVERVIEW



SIM110 Hardware Block Diagram

Not all features are available on all SIM110 family members.

HIGH PERFORMANCE RENESAS RX MCU

The heart of the SIM110 is the 32-bit Renesas RX63N/RX631 microcontroller (MCU) with up to 768KB of zero wait state FLASH, 128KB RAM, and FPU. This powerful MCU is equipped with extensive analog and digital peripherals and, with software, can deliver an excellent user interface experience. On the SIM110, the MCU should be operated at 96MHz to ensure usable timing sources for peripherals such as USB.

GRAPHIC COLOR LCD DISPLAY WITH TOUCH OPTION

The SIM110's Liquid Crystal Display ("LCD" or "glass") has a simple graphics display chip, the ORISE OTM4001A, which includes a built-in frame buffer and all power supplies and timing necessary to display the frame buffer on the LCD panel. The MCU communicates with the OTM4001A via a 16-bit SRAM-type bus, including sending and receiving commands as well as pixel data.

Some SIM110 family members ("variants") include an integrated 4-wire resistive touch feature: a resistive film over the LCD returns an analog voltage in two dimensions which can be read by the MCU's analog-to-digital converters and translated with a simple algorithm into a pixel hit position.

ON-MODULE PERIPHERALS

The SIM110 contains numerous on-module peripherals – many common to a vast and diverse set of OEM applications, including a Real Time Clock/Calendar (RTCC) (battery-backed on some modules), temperature sensor, USB, serial FLASH, a high speed UART, EEPROM, a bi-color LED, a user "select" switch, and more.

ON-MODULE MEMORY

The SIM110 module has a variety of memory for storage of program, data, images, parameters, etc.:

FLASH Memory:

- Up to 768KB zero wait state FLASH program memory within the RX63N/RX631
- 8Mbytes (64 Mbits) serial FLASH memory attached via dedicated SPI

EEPROM

- 2Kbits EEPROM

RAM

- 128KBytes RAM within the RX63N/RX631
- 192KBytes Frame Buffer RAM (400x240x16bits) in the ORISE OTM4001A LCD controller
- Up to 1MB of external SRAM

COMMUNICATIONS

The SIM110 has numerous off-module communication ports. Some may or may not be available on specific SIM110 family members.

- PCB Edge Connector for high speed programming and MCU-level debugging, including:
  - SPI and high-speed UART ports
  - JTAG for connection (with adapter) to 14-pin Renesas E1, Segger J-Link and equivalent devices
  - USB 2.0 device port (shared with USB mini-B connector if present)
- USB Mini-B Device Port
  - USB 2.0 full speed device port
- 24-Pin Flex Cable Connector with extensive I/O including:
  - Reduced MII (RMII) Ethernet connection (if the SIM110 is equipped with an RX63N MCU)
  - SPI, I2C, and high-speed UART ports
- 7-pin JST Communications and Power Connector
  - Suitable for an inexpensive wire harness with latching plug connection
  - UART, +5V in, +3V3 out, and RESET#
- Tag-Connect port for a convenient in-service programming capability

POWER

The SIM110 module can be powered from either of two mechanisms:

- USB Device Power signal (+5V_USBF) available on the USB Mini-B connector, PCB Edge Connector, and Tag-Connect port
- External 5VDC signal (+5V_EXT) available on the 7 pin JST connector and 24-pin FFC connector.

For development, it is common to power the module via the USB port attached to the PC via a powered USB hub. The complete module may require as much as 250mA from the USB power supply, so ensure that the USB hub or USB power supply can deliver enough power.

The SIM110 can support concurrent connection to +5V_USBF and +5V_EXT power; however, only the higher of the two sources will supply the module. See the Power Supplies for details.

MODULE FEATURE DETAIL

RENESAS RX63N/RX631 MCU

At the heart of the SIM110 is a 100MHz 32-bit Renesas RX63N/RX631 MCU equipped with extensive analog and digital peripherals. Features include:

MCU Core & Memory

- 100MHz 32-bit core
- Up to 768KBytes FLASH – zero wait state at up to 100MHz
- 128KBytes RAM – zero wait state at 100MHz
- Single cycle multiply and hardware divide unit
- Single precision hardware Floating Point Unit (FPU)
- 16 32-bit registers
- Fast context switching/interrupt response, including a dedicated "fast interrupt"

Peripherals include:

- USB 2.0 port
- SRAM external bus controller with 8/16/32-bit bus and chip selects
- Four-channel general hardware DMA controller plus Data Transfer Controller
- A/D Converters: 4 channels x 2 units 10-bit or 8 channels x 1 unit 12-bit
- Hardware real time clock calendar (RTCC) with battery backup capability
- D/A Converter: 10-bit x 2 channels
- Watchdog timer
- Numerous SPI, I2C, CAN, and high-speed-capable serial ports

Some SIM110 family members feature the RX63N MCU, which has the Ethernet peripheral, and others the RX631 MCU without Ethernet. Renesas provides extensive documentation of the RX63N/RX631 MCU family as well as example software: consult their website. In addition, many community resources are available for RX family developers, including the **Error! Hyperlink reference not valid.**.

Note that on the SIM110, the MCU should normally be operated at 96MHz to ensure the clocking system can generate the appropriate clocks for SRAM, USB, and other peripherals.

MCU BOOT MODES, SWITCH S1, AND THE USB BOOT FLASH

Three separate FLASH memory areas are available inside the RX MCU: Program FLASH, Data FLASH, and USB Boot Mode FLASH as well as one Boot Mode ROM. Three "boot modes" are available on the RX631/RX63N MCU family based on the state of the MD and PC7 pins when the RESET# signal is released. Depending on which of the three boot modes is determined at reset, the MCU jumps to a corresponding start address for code execution. The following table summarizes this information:

MD	PC7	Boot Mode	Execution start on the release of RESET#
High	X	Normal Program Boot Mode	Program FLASH reset vector
Low	Low	ROM Boot Mode	Start of Boot Mode ROM
Low	High	USB Boot Mode	Start of USB Boot Mode FLASH

In normal Program boot mode, the PC7 signal is completely available for program and system use. However, in the two special boot modes, PC7 must remain fixed throughout the operation of the mode until the subsequent RESET# and is not available for general program and system use during these special modes.

The MD1 and PC7 signals are weakly pulled high on the SIM110, ensuring that for normal operation the MCU will boot in Normal Program Boot Mode, starting execution at the main RX MCU Program FLASH reset vector. The Program FLASH can be (re)programmed in a variety of ways, including the JTAG port exposed on the PCB Edge Connector as well as under user program control.

Because the MD1 signal is available on the PCB Edge Connector, it can be pulled low externally to the SIM forcing the SIM to go into one of the two special boot modes.

Some SIM110 variants have a DIP switch S1 on the PCB. MD1 is connected to this switch. For normal execution, ensure S1.1 is in the OFF position. When S1.1 is set ON, and because PC7 is weakly pulled high on the SIM110, the MCU will enter USB Boot Mode on release of RESET#.

S1.1, when ON, is connected directly to GND. **Do not externally drive the MD1 signal high while S1.1 is ON or you may damage the SIM and/or attached equipment**.

For those variants without S1 populated, the SPA100 adapter has this switch.

During RESET#, PC7 can only be set low externally to the SIM and is made available on PCB Edge Connector. ROM Boot Mode is a complex mode and beyond the scope of this document. Consult the Renesas RX63N/RX631 MCU Hardware Manual for details.

In USB Boot Mode, the processor begins execution in the 16KB USB Boot FLASH rather than the normal Program FLASH. ***Serious*** programs the USB boot area with special firmware designed to function with the Serious Human Interface™ Platform tools, enabling reprogramming of the SHIPEngine and Serial FLASH with new GUI cargo files. The algorithm in this firmware is proprietary, and when the SIM110 boots in USB Boot mode the USB port will identify itself as requiring up to 500mA of bus power and having USB Vendor ID 0x25D8 (registered exclusively to *Serious*) and USB Product ID in the 0x0001 to 0x0099 range depending on the version of the protocol contained in the area.

Renesas supplies a standard load for this FLASH area. With the standard Renesas load installed and USB Boot Mode selected, the Renesas firmware reads P35 (NMI#) and finds it pulled high, causing the USB device port to tell a connected USB host (such as a PC) that the SIM110 is bus powered and requires up to 500mA of power from the USB port. The USB VID will be 0x045B (registered exclusively to Renesas) and USB PID of 0x0025.

To use the full features of the Serious Human Interface™ Platform, you need to preserve the ***Serious*** firmware in this area. Overwriting and/or re-installing this firmware can only be accomplished with Renesas tools and a JTAG debugger.

GRAPHIC LCD DISPLAY

The LCD display (or "glass") on the SIM110 is a 3" diagonal active area 400x240 TFT with optional 4-wire resistive touch layer.

The on-glass graphics display chip, the ORISE OTM4001A, includes a built-in 192KB frame buffer and all the power supplies and timing necessary to display the frame buffer on the LCD. The MCU communicates with the OTM4001A via a 16-bit SRAM-type bus, including sending and receiving commands as well as pixel data. In some software systems, the pixel data can be written directly to this frame buffer without any additional frame memory. In more complex GUIs, a separate frame buffer in SRAM can be used, with the changed portions of the frame "pushed" to the frame buffer on the OTM4001A using DMA.

LCD features include:

Parameter	Typical Value
Type	TFT TRANSMISSIVE
Active Area	38.88 × 64.80 mm
Pixel Dimensions/Depth	400 x 240 as 16 bit RBG565
On Board Frame Buffer	192KB RAM
Backlight Type	LED
Backlight Luminance (with touch)	330cd/m^2
Backlight Luminance (without touch)	430cd/m^2
Backlight Lifetime at full power to 50% original brightness	30,000 hours typical

The ORISE OTM4001A address/data/read/write lines are directly connected to the RX `An/Dn/RD#/WR#` signals in a 16-bit bus topology. The RX MCU's `CS1#` chip select signal enables access to the LCD chip.

The no-cost SHIPWare software at mySerious.com includes all initialization code and basic pixel get/set routines for the ORISE OTM4001A, including timing of the chip select registers.

The full-featured Serious Human Interface™ Platform software system has integrated high-performance rendering and GUI management software and drivers for the ORISE OTM4001A.

The backlight is enabled when RX `P22/BLEN` is driven high, which turns on the backlight power switch allowing 3.3V to flow to the backlight LEDs on the LCD. This signal has a weak pull-down, so the backlight is off until the MCU pin is initialized, including during and directly after system `RESET#`. This RX port pin also supports a pulse width modulated output which can be helpful in backlight dimming. A PWM driving the backlight power circuit should run at or less than 10KHz with high-level duty cycles of 0 to 100%.

TOUCH

Some SIM110 family members include a resistive touch layer bonded to the LCD display. The layer can return an analog voltage in two dimensions to be read by the MCU's analog-to-digital converters and translated with a software algorithm into a pixel hit position.

These four input signals are as follows:

Signal	Description	MCU Port
TOUCH_XL	X-/XL	AN000/P40/IRQ8-DS
TOUCH_YU	Y+/YU	AN001/P41
TOUCH_XR	X+/XR	AN002/P42
TOUCH_YD	Y-/YD	AN003/P43

Resistive touch layers are made from a highly resilient Polyethylene Terephthalate (PET) film, and have the advantage of being robust and usable with a stylus, finger, or any blunt object. Unlike typical capacitive touch screens, resistive touch screens do not require the bare finger and can be used with gloves on – important for certain medical, industrial, and automotive applications. They also work well in wet conditions, although appropriate caution must be taken to ensure liquids do not flow onto the SIM110 or other circuitry. ***Serious*** application note AN0201: Resistive Touch Bezel Guidelines is a good resource for understanding how to mount a touch screen behind a bezel.

Some chemicals, harsh cleansers, and abrasive cleaning products can discolor and/or damage the PET film. Use caution in end-product guidelines and instructions to ensure long lifetime is ensured.

One challenge with resistive touch layers is power: applying power through the resistive layer is normally required to sense the change in resistance created when touched. There are two very different modes where power is applied to the panel: (1) basic "is the panel touched?" and (2) actual sensing of the touched position.

BASIC TOUCH TESTING AND WAKE-UP

Two common places where a simple detection of panel hit is required are: during CPU sleep modes where a panel touch needs to wake up the CPU and the system, and as a quick simple test to see if further panel reading for the actual touched coordinates.

Basic touch testing requires only the ADC pins. The ADC pins, connected through current-limiting resistors to the touch panel, can be configured dynamically by software to be low current outputs or ADC inputs. To do a basic "are we touched?" test on the SIM110, the pins can be configured as follows:

Signal	Mode	State
TOUCH_YT	Output	Strongly pulled low
TOUCH_XL	ADC Input	Weakly pulled high

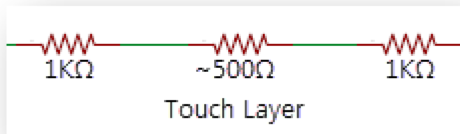
When not touched, the XL analog input will read at-or-near the maximum ADC value. The ADC on the RX631/RX63N has 12-bit resolution, so the reading will be at-or-near 0x0FFF. When the panel is touched, the two layers connect, and the weak pullup on XL is overwhelmed by the strong low on YT, causing the ADC value to drop significantly.

In sleep modes, setting an interrupt on IRQ8-DS can wake the system when the panel is touched. In this mode the standby power is extremely low – the resistance across the panel planes when not touched is typically 10MΩ.

This simple test can be used in a timer-driven software event to determine if/when a more precise and rigorous full reading of the XY location of the touch screen is required.

TOUCH PANEL COORDINATE READING

Because of current limitations on the MCU pins, 1KΩ resistors are placed in series with the four ADC pins such that when they are used as outputs the current is limited to approximately 1mA. As well, the ADC reading is then limited to the center of the range – the two 1KΩ resistors with the ~500Ω touch plane in between form a voltage divider.



Full reading of the touch coordinates is a more complex task and benefits from a full voltage applied across the planes. Since the touch planes can have resistance as low as 200Ω, up to 16mA is required to drive them – beyond the capability of the RX digital outputs. Therefore the SIM110 has a set of four higher-current output drivers with the following signals directly wired through the drivers from the MCU to the touch panel:

Signal	**MCU** Name	**Enabled** State	**Touch Signal**
DRIVE_XR#	P54	HI	TOUCH_XR
DRIVE_XL#	P87	LO	TOUCH_XL
DRIVE_YB#	P56	HI	TOUCH_YB
DRIVE_YT#	P55	LO	TOUCH_YT

When a signal (e.g. `DRIVE_XR#`) is activated, the corresponding touch signal is strongly driven to the state indicated. This allows a full voltage range across the panel, so 12-bit ADC values from `0x0000` to `0x0FFF` can be read and mapped to the screen coordinates. Touch panel algorithms are beyond the scope of this document, but an Internet search can yield numerous resources in this area.

The no-cost SHIPWare software at mySerious.com includes a full source-code implementation of a touch driver for the SIM110.

The full-featured Serious Human Interface™ Platform software system has integrated top driver and algorithms that automatically map touch coordinates to GUI objects.

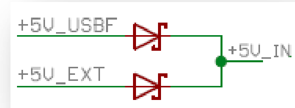
POWER SUPPLIES

The SIM110 requires 5V +/- 10% input power which can be supplied via:

- +5V_EXT on the 7-pin JST connector and 24-pin FFC connector (if present), or,

- +5V_USBF on the USB Mini-B connector (if present) or the PCB Edge Connector.

Both +5V_EXT and +5V_USBF can be supplied simultaneously. Diode routed, the higher of the two will supply the SIM110's power needs into the +5_IN main power rail. This allows a SIM110 powered in a device via +5V_EXT to simultaneously have a PC USB port or USB hub connected to the SIM.



These diodes are low-forward-drop Schottky type capable of a full 1A continuous current; nevertheless, the +5_VIN signal will typically be 0.3V below the higher of the two input voltages.

MAIN 3.3V REGULATION

Major power consumers, such as the LCD backlight, MCU, and SRAM are all attached to the 3.3V power supply +3V3. Therefore, a switching regulator with typical conversion efficiency of 85 to 90% is used to convert between the +5_IN supply and the +3V3 main voltage rail.

This 3.3V regulation system is always enabled when +5_IN is available.

Assuming sufficient input current on +5_IN is available, the +3V3 rail is capable of supplying up to 500mA total current to the SIM and any other loads attached to the external +3V3 outputs on the 24-pin FFC Connector and/or the 7-pin JST Connector.

LCD PANEL BACKLIGHT POWER

The LCD Panel has an LED backlight array driven by a 3.3V supply. Therefore, unlike some displays, no special voltage boost circuit is required. See the LCD Panel section for how the +3V3 signal is routed to the backlight pins of the LCD Panel.

USB DEVICE ("FUNCTION") POWER

The SIM110 can be powered, as mentioned, from the USB Device connector as long as the PC or hub can supply sufficient current. The +5V_USBF signal represents this power source. This input is also available on the PCB Edge Connector as well as the Tag-Connect port. For more information, see the USB Mini-B Device Connector section.

CLOCK/CALENDAR BATTERY POWER

The SIM110 has a 12mm coin cell holder designed to accommodate a common CR1220-type 3V battery. This is not designed to be a rechargeable battery, nor does any circuit on the SIM110 supply power to charge this battery. The only purpose and connection of this coin cell battery is to provide backup power to the RX MCU's Real Time Clock peripheral to keep the clock/calendar running in the event that all other power sources are removed. Consult the RX63N/RX631 datasheet for exact specifications, but this battery can potentially keep the clock keeping time for several years without replacement. The

RTCC chip automatically switches to use the coin cell power only when main power is not available, so in a system that normally has main power applied, the coin cell battery is used infrequently. See the Clock/Calendar section for more information.

SERIAL FLASH, SERIALIZATION, AND FAMILY MEMBER IDENTIFICATION

All SIM110 family members include the SST SST25VF064C serial FLASH, a 64 megabit (8 megabyte) device with 2048 4KByte erasable blocks as well as a built-in 64-bit unique serial ID and 192 bits of OTP ID space. It is connected via a dedicated SPI port to the MCU to optimize data transfers, especially when images need to be retrieved and delivered directly to the display memory.

The serial FLASH connected to the `RSPI0` port of the RX MCU:

Description	FLASH Pin	FLASH Name	MCU/Signal Name
SPI data MCU→FLASH	5	SDI	PC6/MOSIA
SPI data FLASH→MCU	2	SDO	PC7/MISOA
SPI FLASH clock	6	SCK	PC5/RSPCKA
SPI FLASH slave select	1	CS#	PC4/SSLA0

See the SST25VF064C data sheet for hardware specifications and programming details and the Renesas RX data sheet for information on the SPI master port configuration.

THE OTP REGION: SERIALIZATION AND FAMILY MEMBER ID

Beyond the 8MBytes of FLASH, the SST25VF064C also has a 256 bit (32 byte) one-time programmable (OTP) region.

Do not write to the SST25VF064C's OTP region.
This region is reserved for manufacturing and configuration information by *Serious*.
Writing to this area may **void your warranty** with Serious and render the module unusable.

Several key pieces of information stored in this region which you may find useful to read in your software:

Location	Size (Bytes)	Contents
0x00..0x07	8	Unique Microchip SST25V064 Serial Number
0x08..0x09	2	0x0110 indicates SIM110
0x0A	1	Version of hardware: high nibble is major; low nibble is minor. For example, "0x14" is v1.4
0x0B	1	Variant of hardware: see chart below
0x0C..0x0F	4	Unique sequence number of this model/variant
0x10..0x17	8	Reserved for OEM Serial Number
0x18..0x1F	8	Reserved by *Serious* for manufacturing information

Locations 0x08…0x0F, when combined, form the unique ***Serious*** serial number for the module. All values are stored in Big Endian order. Note that the MCU on the SIM is normally operated in Little Endian mode, so byte/word swapping will be required to correctly interpret the data.

SHIPWare and SHIPEngine have software routines included to read this information on boot and load a data structure for you to easily access these fields from your software. In the case of SHIPWare, this is available from mySerious.com in full source code format.

SIM110 FAMILY MEMBERS AND THE VARIANT ID MAP

The following table maps the Variant ID byte found in the SIM25VF064C's OTP area at location 0x0B to the SIM110 family member. See the SIM110 Family Option Table for specific features per member.

Variant ID Byte	SIM110 Family Member
0x00	-A00
0x01	-A01
0x02	-A02
0x03..0xFE	Reserved
0xFF	Invalid/Unknown

SHIPWare and SHIPEngine read the values in the OTP area and load data structures you can access: the initialization routines also load a complete data structure with the variant features so your software can be written to adapt at runtime to the features of the specific family member (variant) it is operating on.

SRAM

An external SRAM is available on some SIM110 family members. With the RX MCU operating at 96MHz, the SRAM bus can operate at up to 48MHz. The RX's built-in SRAM controller can be configured to access this memory with the appropriate timing.

The SHIPWare source code has SRAM initialization routines you can examine and use with the SIM110. SHIPWare is available at no cost for registered hardware users on mySerious.com.

The following table summarizes the size, speed, and configuration of each family member:

SIM110 Family Member	Size	SRAM Configuration	Access Time
-A00	1Megabyte	512KBx16	55nS
-A01	1Megabyte	512KBx16	55nS
-A02	1Megabyte	512KBx16	55nS
-A03	1Megabyte	512KBx16	55nS
-A04	1Megabyte	512KBx16	55nS

USB DEVICE PORT

The RX63N/RX631 MCU used on the SIM110 has a USB 2.0 Full Speed (12Mbit/s) device (or "function") port. All SIM110 family members (aka "variants") have the USB device port circuitry connected to this port (USB0). From a data-connectivity perspective, this port is commonly plugged into a PC and, depending on user-supplied software, can act like any number of PC peripherals such as a serial port.

USB MINI-B CONNECTOR

Only some variants have the actual USB Mini-B connector; however, the PCB Edge connector has these signals and can be accessed there. An SPA100 programming adapter from Serious is an inexpensive small hardware adapter that can connect to the PCB edge connector and expose the USB port via a Mini-B connector. For more information see USB Mini-B Device Connector.

SOFTWARE

Renesas provides extensive documentation of the RX63N/RX631 MCU as well as example software: consult the Renesas USB Driver software website.

Vendors such as Micrium and Segger provide complete USB stacks pre-ported to the RX MCU.

SHIPEngine contains built-in USB device stacks and protocols that allow the SIM110 to communicate directly with SHIPTide (the rapid GUI development IDE).

USB DEVICE IDS

USB devices are uniquely identified by a Vendor ID ("VID") and Product ID ("PID"). VIDs are assigned under license by the USB Implementers Forum (USB-IF). The *Serious* VID is 0x25D8.

You may use the *Serious* VID **only in conjunction with the Serious Human Interface™ Platform by using SHIPEngine on the module.** If you wish to program your own software for the SIM, you **must** obtain your own VID from the USB-IF.

SHIPEngine identifies the board as **VID 0x25D8, PID 0x0110**.
All Serious Integrated Modules (SIMs) starting in late 2012 will come with a factory-installed boot loader program. This boot loader, when entering boot loader mode, will identify all SIMs with **VID 0x25D8** and **PIDs** in the **0x0001…0x00FF** range.

USB POWER

The power supplied to the USB device port (say, from a powered hub or USB power adapter) can power the SIM110 if and only if the source supplies approximately 250mA. Most PCs (including modern laptops) as well as powered hubs can supply this power. Be sure to check the power capability of the host device you are attempting to use.

⚠ The power pin of the USB Mini-B connector is directly connected to the power pin on the PCB Edge connector. **Do not simultaneously connect power to both pins.**

The USB device power in is source protected from the external power input (+5_EXT signal), so both the USB port and the external power port can be simultaneously connected. Whichever source has a higher voltage will power the module. See the Power Supplies section for more details.

EEPROM

The SIM110 features a 2Kbit (256 byte) EEPROM with software write protection features. Consult the On Semiconductor CAT34C02 Data Sheet for programming and hardware information.

PIEZO SOUNDER

Some SIM110 family members include a piezoelectric sounder. The signal `P86/BUZ` must be driven at a given frequency to excite the sounder. The RX MCU has a PWM peripheral able to drive this signal, so software will typically be written to drive the sounder at a given frequency with 50% duty cycle for full volume output. The duty cycle can be reduced to lower the volume.

The sounder's resonant frequency is centered at 2400 Hz. Waveforms at this frequency will generate the loudest perceived sound.

END-USER PUSHBUTTON SWITCH AND LED

Some SIM110 variants have a single end-user-friendly pushbutton switch on the display-side of the module near the LCD panel. The switch is connected to an MCU input that is both a general purpose input and also an interrupt input that can wake the MCU from various sleep modes. A front panel captive button or plunger can be positioned to actuate this switch. There is no requirement for an end-system to use this switch; the enclosure may cover it completely and render it inaccessible if desired.

Some SIM110 variants have a bi-color red-green LED placed on front of the display-side of the module. A bi-color LED is actually two independent LEDs in one package: the LED on the SIM110 has red and green LEDs that, when both are on, have an amber hue. Typically, a plastic or metal front panel enclosure will expose this LED through a plastic light pipe; for example, the BiVar PLP1-125-F. There is no requirement for an end-system to expose this LED. The enclosure may cover it completely and render it un-viewable if desired.

Signal	Description	MCU Signal Name
SW1#	Switch Input (active low)	P07
LED1R	LEDR(R) – Right Red	P91
LED1G	LEDR(G) – Right Green	P92

DAC AUDIO

The RX MCU has dual 10-bit DACs that can be used to generate a 3.3V P-P signal suitable for further amplification, scaling, and filtering as an audio output source.

The SIM110 exposes one of these DACs, DA0, on the 7-pin JST Connector as well as the 24-pin FFC Connector.

Vendors such as Micrium and Segger provide software solutions that can deliver audio waveforms to this output. Renesas also has example code for this feature.

SHIPEngine has built-in audio support. With only a few lines of code you can, for instance, deliver an ADPCM .wav file to the DA0 output.

MCU ON-CHIP TEMPERATURE SENSOR

The SIM110's MCU contains an on-chip temperature sensor, readable by the on-chip 12 bit ADC with a typical accuracy of +/- 1%. This sensor may be suitable for keeping track of general system temperature, but is not an accurate ambient air temperature sensor. Air temperature sensors generally require separation from the circuit board to isolate them from heating sources on the PCB, especially the LCD backlight. As a result, the RX MCU's temperature sensor will often read a few degrees above that of the ambient temperature. In addition, software-managed calibration may be required before use.

See the RX63N/RX631 datasheet for more hardware specifications and programming information.

CPU AND PERIPHERAL CLOCKS

The SIM110 uses the external 12MHz oscillator module attached to the MCU's input clock circuit as the primary source for all non-timekeeping clocks in the system.

The RX MCU, like all modern MCUs, has sophisticated internal clock management circuitry which takes a few input clock frequencies and delivers a plethora of derivative clocks; some higher frequency, some lower. For instance, the RX MCU can take a single 12MHz input clock and create derivative clocks such as the core 96MHz CPU clock as well as various peripheral clocks including 48MHz required for the 12mbps USB ports, 9600 baud for a UART serial port, 48MHz for the SRAM bus, etc. While the RX63x MCU family used on the SIM110 can operate up to 100MHz, on the SIM110 it should typically be programmed to operate at 96MHz so that all the other peripherals can divide down properly from that top frequency. The complexity and capabilities of the RX family clock system are beyond the scope of this guide: consult the Renesas documentation for a complete description.

TIME KEEPING, CLOCK CIRCUITS AND OSCILLATORS

The following terms are important to understand theory of operation described herein:

Clock: A square-wave logic-level periodic signal (not a clock as in a timekeeping clock of time/date/minutes/hours, etc.)

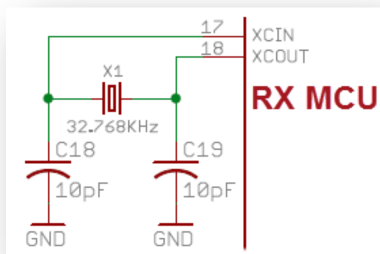
Oscillator: A crystal or resonating oscillator circuit that creates a fixed-frequency sine wave used in a specific circuit to create a clock signal

RTCC: A real time clock/calendar which keeps track of the correct time/date as set by the end user or some other means.

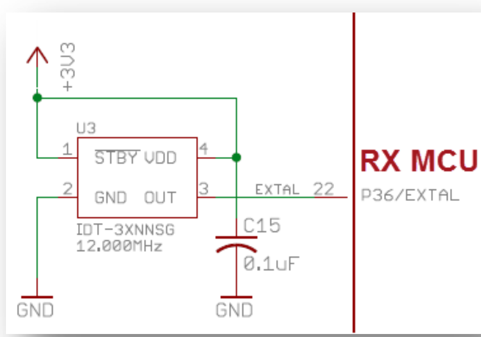
There are many producers and consumers of stable clock signals (or “clocks”) on the SIM110.

All clocks – including, for instance, the 96MHz CPU core clock, the 12MHz USB clock, and a 9,600baud serial port clock – can be traced back to an originating oscillator source somewhere. The two main oscillators/clocks in the SIM110 are:

1) The relatively accurate 32.768 KHz crystal oscillator attached to the RTCC input on the MCU. For modules with battery-backed RTCC capability, this oscillator can continue to operate without module main power applied.



2) The relatively accurate 12MHz clock to the MCU, which is multiplied and divided in a variety of ways inside the MCU to generate the 96MHz the MCU runs at as well as all the different peripheral clocks.



MCU ON-CHIP BATTERY BACKED REAL-TIME CLOCK/CALENDAR

Time keeping (i.e. year/month/day/hour/etc.) can be performed using the RX MCU's internal Real Time Clock/Calendar peripheral if the family member has the 32.768 KHz crystal populated on the module.

The RTCC peripheral must be configured (via software and registers) to be enabled and use that clock input correctly.

RTCC BATTERY BACKUP

The RX63x MCU has several power inputs, including a "main" 3.3V power input connected to the main module power along with a backup battery power input pin. The RTCC is normally powered from the main module power. When main power fails it automatically switches to battery power (if available).

Some family members of the SIM110 have an on-module battery holder designed to accommodate an industry standard CR1220 coin cell battery. This coin cell battery is connected to the RTCC battery backup voltage input on the RX63x MCU.

With a good quality battery, the clock/calendar could run for up to several years without replacement. Consult the RX62N/RX621 data sheet or Contact Renesas for detailed assistance in calculating battery life expectations in your specific end-usage model.

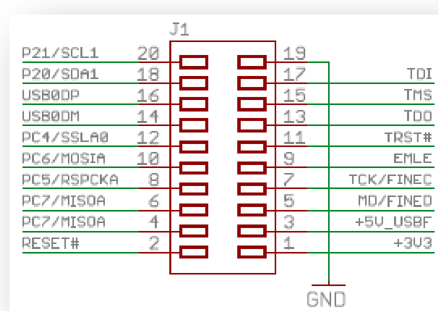
RTCC REAL TIME CLOCK TEMPERATURE COMPENSATION

Like all timekeeping devices, the RTCC will drift over time. Few timepieces are perfectly accurate! The drift and resulting inaccuracy are determined by the accuracy of the 32.768 KHz oscillator. Temperature variance is the most common culprit: crystals have slight variations in frequency over temperature.

The RX63x MCU Family RTC peripheral has a Time Error Adjustment Register (RADJ) which, when combined with the SIM110's on-chip temperature sensor, could be used with custom software to improve the accuracy over temperature of the RTCC. Contact Renesas for assistance if your application requires this level of precision in your specific end-usage model.

J1: PCB EDGE CONNECTOR

The SIM110 and many other new Serious Integrated Modules contain a special PCB Edge Connector primarily used for software development, SIM manufacturing, and volume (re)programming. It features the full signals of the JTAG port, USB device port, primary UART, as well as power in/out connections. The mating connector is the Samtec MEC6-110-02-L-D-RA1-TR.



J1 is not polarized or keyed. **Connecting J1 backwards can damage your SIM.**

The PCB Edge Connector is designed as a unified connector across a variety of SIM families, including those based on the Renesas RX62N/RX621 as well as RX63N/RX631 MCUs. These MCUs have a variety of I/O multiplexers allowing one of numerous different peripheral functions to map to a given I/O pin. Consult the respective hardware manuals for the complete list of options. The following chart shows the intended primary usage of each pin on the PCB Edge Connector, rather than every possible usage:

Signal Name	Description	J1 Pin	RX631/63N MCU Name	RX621/62N MCU Name
+3V3	Regulated 3.3V output from module; see Power Supplies for more current limitations and more information.	1		
RESET#	System RESET# input and/or output; weakly pulled high on the module.	2	RES#	
+5V_USBF	Same as the +5V incoming power pin on USB Device Connector. Do not connect power simultaneously to both of these pins. See USB Device ("Function") Power.	3		
PC7/MISOA	PC7 has special a special boot-mode function when RESET# is released on the RX63N/631	4	PC7	MD1
MD/FINED	MCU enters USB boot mode when pulled low at RESET#	5	MD/FINED	MD0
PC7/MISOA	SPI Data Master In/Slave Out	6	PC7/MISOA	
TCK/FINEC	Debug/Programming Pin	7	TCK/FINEC	
PC5/RSPCKA	SPI Clock	8	PC5/RSPCKA	
EMLE	Debug/Programming Pin	9	EMLE	
PC6/MOSIA	SPI Data Master Out/Slave In	10	PC6/MOSIA	
TRST#	Debug/Programming Pin	11	TRST#	
PC4/SSLA0	SPI Slave Select (active low)	12	PC4/SSLA0	
TDO	Debug/Programming Pin	13	TDO	
USB0DM	USB Device Data+. Connected to USB Mini-B	14	USB0DM	USB1DM
TMS	Debug/Programming Pin	15	TMS	
USB0DP	USB Device Data+. Connected to USB Mini-B	16	USB0DP	USB1DP
TDI	Debug/Programming Pin	17	TDI	
P20/SDA1	I2C Data	18		
GND	Ground	19	GND	
P21/SCL1	I2C Clock	20	P12/SCL1/RXD2	P12/SCL0/RXD2

You can design your own adapter or daughterboard to fit this connector, or use the Serious Programming Adapter 100 (SPA100).

SPA100 SERIOUS PROGRAMMING ADAPTER

The Serious Programming Adapter 100 (SPA100) is an inexpensive programming/USB cable adapter for use with the SIM110 and other Serious Integrated Modules with the 20 pin PCB Edge Connector. Features include:

- Samtec MEC6-110-02-L-D-RA1-TR 20-position mating connector for the PCB Edge Connector
- Standard Renesas 14 pin JTAG header allowing simple connection to various debuggers and programmers, including the Renesas E1 and the Segger J-Link family. A full description of the E1 connector signals and interactions with the RX MCU can be found in the Renesas E1/E20 Emulator Additional Notes for RX600 Family Application Note
- USB Mini-B connector exposing the USB Device of the target SIM (especially useful for SIMs that have the circuit but no connector, such as the SIM110-A01)
- Power jumpers so the USB Mini-B connector can supply (or not) the power to the unit
- Jumper to put the SIM110 in Renesas USB Boot Mode
- Low cost

⚠ The SPA100 PCB Edge Connector is not polarized or keyed. **Connecting it backwards may damage your SIM.**

⚠ Unless the appropriate jumper on SPA100 is removed, the USB Mini-B Power input pin on the SPA-100 is directly connected to the USB Mini-B power input: **connecting both simultaneously may damage your SIM or even your PC/Hub powering the SIM/SPA100.**

⚠	The PCB Edge Connector is not designed for live power insertion/removal. Ensure the power to the SIM is off when connecting or disconnecting from this port to **avoid damage your SIM or connected equipment.**

Consult the SPA100 documentation for more details and recommended usage guidelines.

J2: TAG-CONNECT PROGRAMMING PORT

Tag-Connect is a rapid-connection system designed for in-situ reprogramming or connectivity. It adds no cost to the target hardware and is implemented on the PCB through a simple set of landing pads and guide holes. The SIM110 has a 10 pin pad-set designed to accommodate the TC2050-IDC-NLFP cable or similar.

In some variants, the SIM110 will not have the Mini-B connector populated. In some customer designed systems incorporating a SIM, system access to the Mini-B connector may be obstructed. J2 allows rapid connection to the SIM for maintenance/servicing.

Signal Name	Description	J2 Pin	RX631/63N MCU Pin Name	RX621/62N MCU Pin Name
+D_USBF	USB Device Data+. Connected to USB Mini-B.	1	USB0DP	USB1DP
-D_USBF	USB Device Data+. Connected to USB Mini-B.	2	USB0DM	USB1DM
TD0	*TxD UART Transmit 3.3V	3	TxD1	

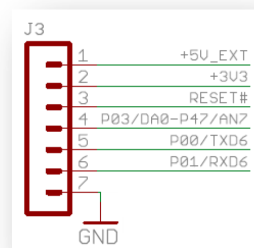
TDI	*RxD UART Receive 3.3V	4	RxD1	
BOOTMODE1	PC7 (RX63X) and MD1 (RX62X) special boot-mode function pins when RESET# is released	5	PC7	MD1
+5V_USBF	Same as the +5V incoming power pin on USB Device Connector. Do not connect power simultaneously to both of these pins. See [USB Device ("Function") Power]().	6		
BOOTMODE0	MCU enters USB boot mode when pulled low at RES#.	7	MD/FINED	MD0
RESET#	System Reset input and/or output; pulled high on the module.	8	RES#	
GND	Ground	9	GND	
GND	Ground	10	GND	

Upcoming versions of SHIP may support SHIPEngine and cargo uploading via the USB Device port, including (with the correct hardware adapter) via the Tag-Connect connector. A maintenance person (for example) could, with a laptop and USB<>Tag-Connect cable, hold the connector to the pads and upgrade the GUI and SHIPEngine on the unit in a few seconds.

At this time, there is no standard ***Serious*** cable for this port; contact ***Serious*** for assistance in using this connector.

J3: 7-PIN JST POWER AND COMMUNICATIONS CONNECTOR

The most common way a SIM110 is connected to another system is via the 7-pin JST wire-to-board connection enabled by J3. The connector on the SIM110 PCB is a JST SM07B-GHS-TB(LF)(SN).



When designing your own wire harness, specify mating housing GHR-07V-S with 7 JST crimp pins SSHL-002T-P0.2 which support wire gauges from 26 to 30 AWG. Check the SIM DC Power Specifications of the SIM to ensure the gauge of wire selected is sufficient for the power required.

Signal Name	Description	J3 Pin
+5V_EXT	+5V incoming power pin. See Power Supplies.	1
+3V3	Regulated 3.3V output from module, See Power Supplies for current limitations and more information.	2
RESET#	System Reset input and/or output; pulled high on the module.	3
P03/DA0 P47/AN7/AAN7	With SHIPEngine, this functions as a 3.3V p-p audio output DAC. It is multi-connected to an analog input port, a DAC port, and can also be used as GPIO with custom software.	4
P00/TXD6	With SHIPEngine, this is the primary UART0 TxD pin (3.3V). Custom software may be able reconfigure this pin in numerous ways depending on the MCU pin it is connected to.	5
P01/RXD6	With SHIPEngine, this is the primary UART0 RxD pin (3.3V). Custom software may be able reconfigure this pin in numerous ways depending on the MCU pin it is connected to.	6
GND	Ground	7

Several signals on this connector are directly connected to signals on other connectors, including +3V3, RESET#, +5V_EXT. **Ensure that common signal connections are appropriate or you may damage your SIM or connected equipment.**

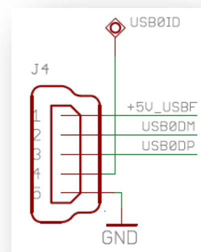
SHIPEngine uses the primary UART0 provided on pins 4 and 5 of J3 as the main communications mechanism for communicating with external systems.

JST America offers a sample service for wire harnesses, and custom wire harness manufacturers such as TLC Electronics can assist in small to large volume harness development and production.

There is no legacy full-level RS232 port on the SIM110. However, a simple and very inexpensive adaptor (such as the CircuitMonkey.com USB-Serial TTL Adapter) can be easily attached to primary 3.3V UART Tx/Rx signals to enable full serial-over-USB communications to a PC. Alternatively, a common RS232 chip (like the venerable MAX232 or similar) can boost the 3.3V UART levels to traditional RS232 voltages.

J4: USB MINI-B DEVICE CONNECTOR

All SIM110 variants have the USB device (or "function" in USB nomenclature) circuitry populated. However, only some SIM110 variants (family members) have the USB Mini-B connector J4 present. The five standard USB device signals (+5V, GND, USBID, USB-, USB+) are always present on the PCB Edge Connector.



The USB port is a USB 2.0 Full Speed (12 mbps max) port. The USB Vendor ID (VID) and Product ID (PID) are software dependent. See www.seriousintegrated.com/docs/usb for information on *Serious* VID/PID combinations.

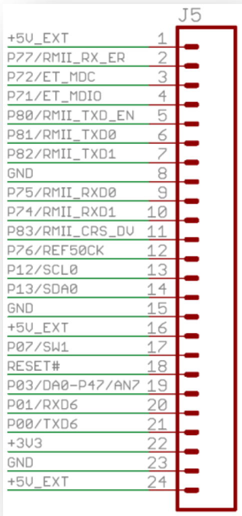
Verify the USB hub or PC can supply the required power to the SIM before connecting.

The USB Mini-B Power input pin (+5V_USBF) on the **PCB Edge Connector** is directly connected to the USB Mini-B power input: **connecting both simultaneously may damage your SIM or even connected equipment such as a PC or USB Hub.**

SHIPTide and SHIPEngine communicate over the USB Device port to download and update the SHIPEngine and GUI cargo during the development and manufacturing processes.

J5: 24-PIN FFC EXPANSION CONNECTOR

J5, if present on the SIM family member, is designed for expansion of numerous GPIO signals from the MCU. Note that J5 contains the same seven connections redundantly as the 7-pin J3 JST connection, and can (if desired) be the only connection into the SIM110.



The connector on the PCB is the FCI 10051922-2410ELF 24 position 0.5mm Gold plated Bottom signal latching connector. Molex makes a line of standard flex cables that can be used for this connector, for example the 6" Molex 21020-0259.

If the SIM110 family member has the RX63N (vs. RX631) MCU specified, the MCU's Reduced MII (RMII) Ethernet MAC connection is fully available on J5 for connection of an external RMII PHY, magnetics, and 10/100 Ethernet jack.

The RX63N/RX631 MCUs have an extensive I/O multiplexers allowing one of many different peripheral functions to map to a given I/O pin: consult the RX63N/RX631 hardware manuals for the complete list of options.

Several signals on this connector are directly connected to signals on other connectors, including +3V3, RESET#, +5V_EXT. **Ensure that common signal connections are appropriate or you may damage your SIM or connected equipment.**

SHIPEngine uses the primary UART0 supplied on pins J5.20 and J5.21 as the main communications mechanism for communicating with external systems.

SCHEMATICS AND MORE INFORMATION

Schematics for the SIM110 and SPA100 Programming Adapter in Adobe PDF format can be found in the Serious Documentation Zone at www.seriousintegrated.com/docs.

For more information on the SIM110:

- Visit www.seriousintegrated.com/SIM110
- Contact a Serious manufacturers' representative
- Contact a Serious authorized distributor
- Visit mySerious.com
- Contact Serious directly