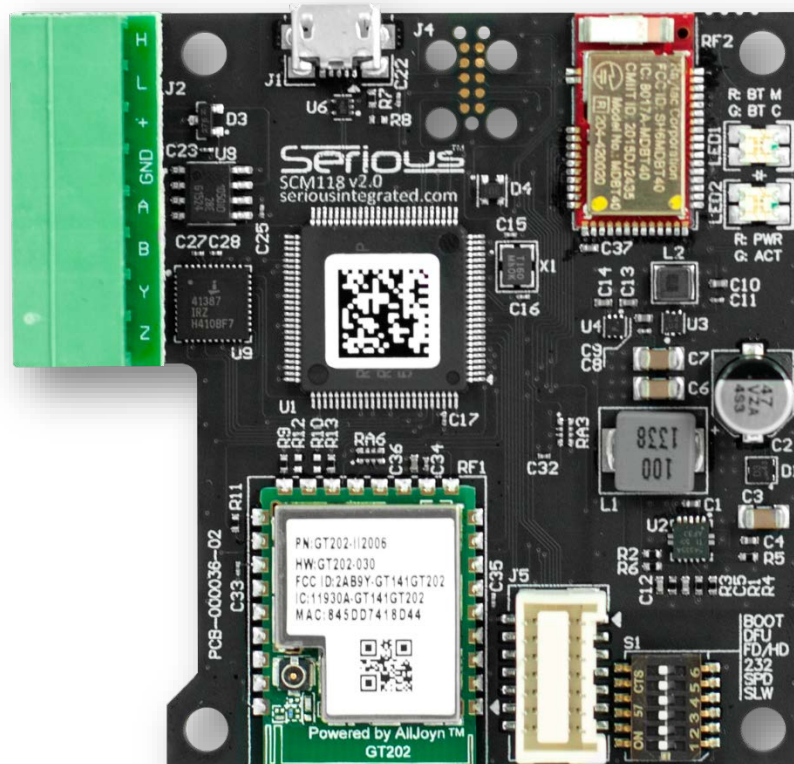


SERIOUS™

SCM118

Technical Reference Manual



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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 Rev	Date	HW Rev	PCB Rev	Major Changes
A0	20 Aug 15	2.0	02	▶ Initial advance information version
A1	01 Sep 15	2.0	02	▶ Numerous typos corrected

DOCUMENT CONVENTIONS



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



Pay special attention to this note – items especially subject to change, or related to compatibility, functionality, and usage.



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 [SCM118 Serious Communications/Power Module](#) family is a series of flexible and production-worthy communications and power conversion accessory boards for use with Serious Integrated Modules (SIMs). The SCM118 can dock directly into third generation (Gen3) SIMs such as the [SIM115](#), [SIM231](#), and [SIM535](#) as well as Gen4 SIMs forming a low profile and cost effective combination.

The SCM118 has two essential functions in the system: to provide connectivity among a collection of disparate communications interfaces, and to adapt incoming system/network +9-25VDC power to the required 5VDC required by the SCM and its attached SIM.



The SCM118 family has numerous members, or “variants”. All variants have the following features:

- ▶ Renesas RX113 MCU for local protocol translation and control
- ▶ USB device port for programming, updates, and PC connectivity
- ▶ DC-DC converter for powering the SCM and attached SIM from most network-borne power
- ▶ 14 wire GPIO connector for off-board control/monitoring (including ADC, DAC, I2C/SPI/UART)

Specific SCM118 variants will include a combination of these connectivity options:

- ▶ RS232/422/485
- ▶ CAN
- ▶ WiFi 802.11 b/g/n
- ▶ Bluetooth

Architecturally, the SCM118’s on-board MCU sits in between the external networks and the Serious Integrated Module, performing the role of an independent communications hub. The MCU on the SCM118 is an open programming environment, supported by off-the-shelf no-cost GNU C compilers and the e² studio eclipse-based IDE from Renesas.

For designs needing less computing resources and focused specifically on CAN and/or RS232/422/485 connectivity, the Serious Communications Module 117 ([SCM117](#)) is available.

For a complete list of available communications modules and front panel Serious Integrated Modules (SIMs), see www.seriousintegrated.com/SCMs and www.seriousintegrated.com/SIMs respectively.

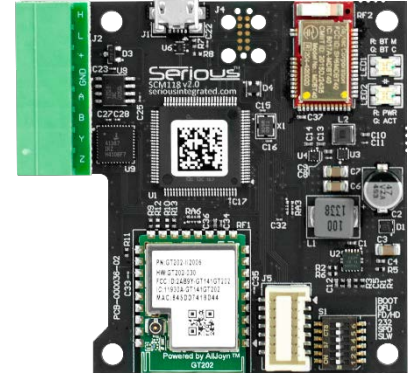
RELATED PRODUCTS

Serious has several new and upcoming communications daughter-cards designed to dock into the back of the Gen3 SIMs (SIM115, 231, 535) as well as the upcoming Gen4 SIM families.

SCM208

The upcoming [Serious Communications Module 208 \(SCM208\)](#) family adds significantly increased processing power, memory, and connectivity options beyond that of the SCM117 and SCM118, including:

- ▶ More processing and memory capabilities
 - Renesas Synergy S7G2 240MHz Cortex-M4 MCU with 4MB Flash and 512KB RAM
 - Up to 128MB QSPI NOR Serial FLASH
- ▶ SC117/118-compatible networking, GPIO, and power inputs
 - RS232/422/485 and CAN industrial network connectivity
 - DC-DC converter for powering the SCM and attached SIM
 - JST14 off-board analog/digital GPIO connector
 - WiFi 802.11 b/g/n
 - Bluetooth Low Energy
- ▶ 10/100 Ethernet connectivity
 - Optional 802.3af-compliant 1500V isolated Power-over-Ethernet (PoE)



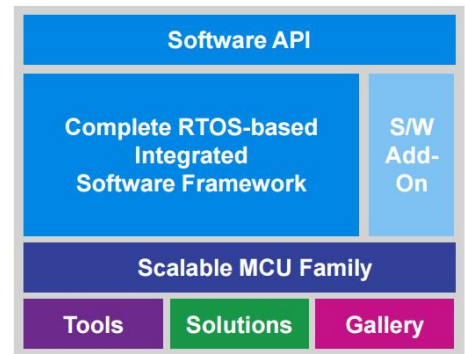
A full software source-code infrastructure, including RTOS, BSPs, Drivers, SHIPBridge & Modbus stacks, WiFi, and Bluetooth stacks are available from *Serious* and Micrium, enabling a common core knowledge base and code-set across all *Serious* SCM products.

The SCM208 comes pre-licensed with the Renesas Synergy™ Platform – an innovative new approach to highly-connected software development, including pre-developed certified building blocks (including RTOS, stacks, drivers, BSP, and middleware). See the [Synergy website](#) for more details.

For more information on the SCM208, [contact Serious](#).



A **complete** and **qualified** platform that **accelerates** embedded development, inspiring **innovation** and enabling **differentiation**



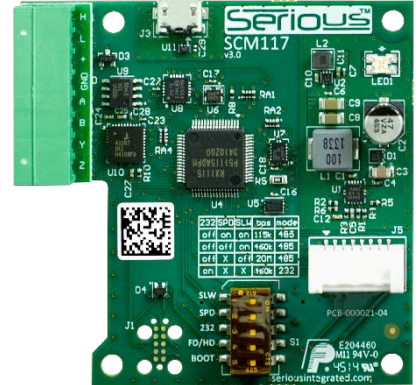
SCM117

The [Serious Communications Module 117 \(SCM117\)](#) family is a series of flexible and production-worthy communications and power conversion accessory boards with less processing and I/O capabilities than the SCM118 at a lower cost point. SCM117 family has numerous members, or “variants”, implementing all or a subset of the following:

- ▶ Renesas RX113 MCU for local protocol translation and control
- ▶ RS232/422/485 and CAN industrial network connectivity
- ▶ DC-DC converter for powering the SCM and attached SIM

Some SCM117 variants do not include the RX113 MCU, enabling SIM direct connectivity to Modbus or SHIPBridge-compatible networks over RS232/422/485.

For more information on the SCM117, see the [Serious website](#).



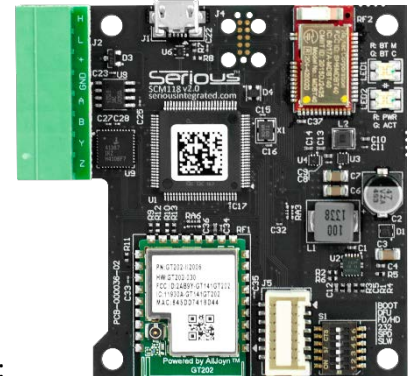
HARDWARE OVERVIEW

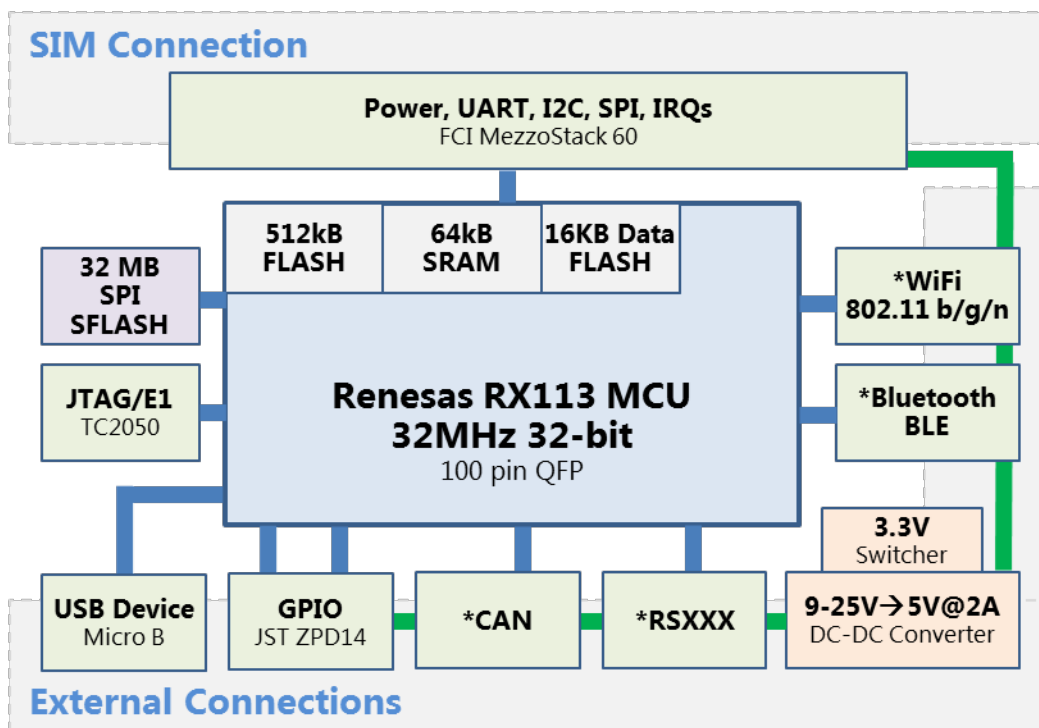
All SCM118 family variants include these hardware features:

- ▶ Board-to-board direct attach to Serious Integrated Modules (SIMs)
 - Gen3 SIMs (SIM115, 231, 535)
 - Gen4 SIMs (SIM25x, SIM55x, and 10.1" SIM85x)
- ▶ Renesas RX113 MCU for protocol translation and control
- ▶ USB FS device port for programming/updates, and PC connectivity
- ▶ 9-25VDC input power conversion for powering the SCM and SIM
- ▶ 14 wire GPIO for off-board control/monitoring (ADC, DAC, I2C/SPI/UART)
- ▶ -40 to +85C operating temperature

Depending on the specific variant, some or all these connectivity options are available:

- ▶ WiFi 802.11 b/g/n (Qualcomm [QCA4002](#))
- ▶ Bluetooth BLE (Nordic Semiconductor [nRF51](#))
- ▶ Multi-mode RS232/RS422/RS485 on an installer-friendly industrial plug-type connector
 - Half and full duplex
 - Differential and single ended operation
 - Switch selectable RS232 vs. RS4xx mode
 - Switch selectable slew rate control
- ▶ CAN transceiver on an installer-friendly industrial plug-type connector
 - Up to 1 Mbps line rate





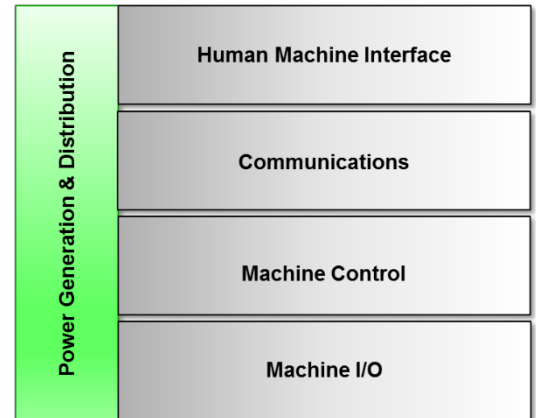
SCM118 Hardware Block Diagram

*options depend on variant

USAGE MODELS

Most OEM systems architectures can be represented as functional stack with four layered ingredients:

- ▶ The Human Machine Interface, traditionally lights and buttons, and now moving to intelligent graphic/touch LCD panels
- ▶ A communications hub handling all communications between the HMI and machine as well as externally to the cloud and industrial/enterprise networks
- ▶ Intelligent machine control, including sequencing and safety algorithms for monitoring and controlling the low level machine I/O
- ▶ Low-level machine I/O, including actuators, sensors and controls that affect the physical operation of the system



Alongside these four ingredients is the power generation and distribution system, often 12 or 24VDC supplied initially by 110/220VAC wall power.

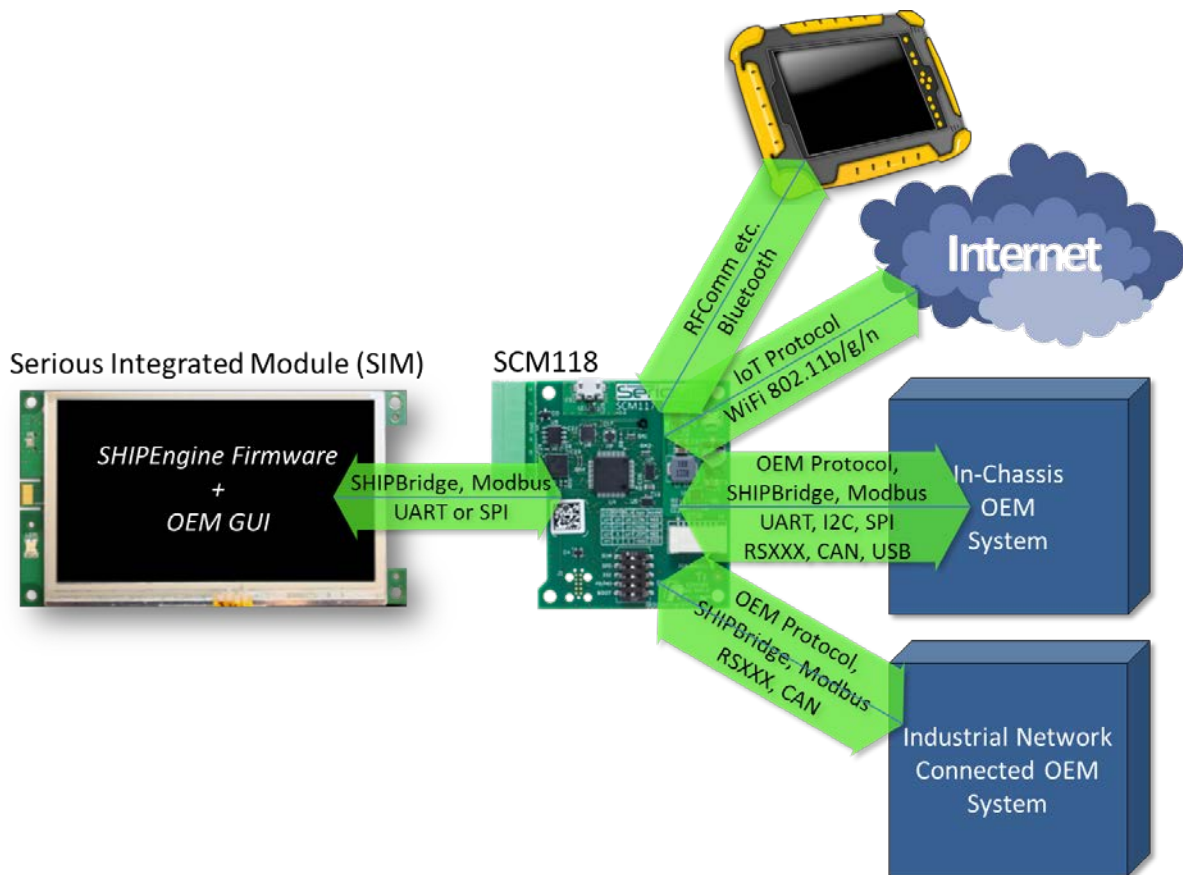
[Serious Integrated Modules \(SIMs\)](#) are off-the-shelf complete solutions to the HMI front panel, including no-cost rapid GUI development tools and software by *Serious* – the Serious Human Interface™ Platform (SHIP). SHIP is not a traditional low-level C-based programming environment, but rather a high level rapid user experience (UX) development system that abstracts the designer from the complexity of developing modern UX solutions. There is no faster and more effective way to develop, deploy, maintain, and evolve a scalable front panel HMI solution than with SIMs and SHIP enabling technologies.

[Serious Communications Modules \(SCMs\)](#) are off-the-shelf hardware solutions to the communications layer of the stack. The software on SCMs is designed to be highly tuned to the OEM’s specific system and communications needs, and traditional C-based development supported by *Serious* reference software and third party partner software infrastructure, such as complete software stacks from [Micrium](#), make software development for SCMs far easier than ground-up custom OEM designs.

The [Serious Communications Module 118](#) (or SCM118) is an intelligent communications hub which directly docks onto Generation 3 SIMs (SIM115, 231, 535) as well as upcoming Gen4 SIMs and provide industrial, wireless, and GPIO smart connectivity to an OEM’s system.

All SCM118 variants (family members) are designed to take 9-25VDC from an outside power source, often an industrial network or in-chassis power supply, and convert it down to the 5V required by the SCM as well as the attached SIM. An industry-standard 3.5mm industrial screw-terminal plug-type connector makes the creation and maintenance of wire harnesses straightforward and reliable.

With the on-board RX113 MCU, the SCM118 can perform protocol translation between the SIM and your unique networks, whether those networks are inside your chassis (for example, using RS232 to interconnect the SIM with our machine controller) or remotely through wireless, CAN, or industrial network.



You control all the software on the SCM118’s RX113 MCU – forwarding, translating, and filtering the GUI data and any other data between the SIM and your network, and between different networks. For example, you can implement an IoT connector on the SCM118 in order to monitor and control your machine from an internet-based control panel. In this case, messages from the cloud, received via the WiFi module on the SCM118 into the RX113 MCU, can then be manipulated into control and status requests to the in-chassis machine. The SIM need not be aware of this message traffic; your custom software on the SCM118 can perform many tasks in its role as a communications hub.

The [Serious Human Interface™ Platform](#) (SHIP) binary software engine on the SIM enables GUIs to communicate via Modbus or the full-featured *Serious* SHIPBridge protocol to a *Serious*-provided driver on the SCM118. Upcoming example code for the SCM118 will demonstrate how, over an IoT connection, to update the GUI and all firmware on the SIM as well as the firmware on the SC118 from the web – complete “push” updates to the embedded system.

SOFTWARE

The SCM118 is designed to operate as an accessory to a [Serious Integrated Module](#) running a graphical user interface (GUI).

For GUI development in as little as a few days, the [Serious Human Interface™ Platform \(SHIP\)](#) 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. Included in SHIP are communications facilities that can be used with the SCM118.

In SHIP Version 5 (SHIPv5), the Modbus protocol is available over UART and SPI connections to the SCM118. In addition to Modbus, the SIM can also communicate using the new SHIPBridge protocol. SHIPBridge affords much greater communications and control capability than Modbus, including over-the-wire GUI and SIM firmware updates and over-the-wire access to on-SIM file systems such as a thumb drive plugged into a SIM's USB port. See www.seriousintegrated.com/SHIPBridge for details.

Developing for the RX113 MCU requires both a debugger/programmer, such as the Renesas E1 or Segger J-Link as well as a [Tag-Connect TC2050 Cable with RX113 FINE Adapter](#). The SCM118 [Development Kits](#) include both these items.



Reference source code for the SCM118 is available from *Serious*. Check the community forums for registered hardware owners at mySerious.com or [contact Serious](#).



The Micrium μ C/OS-III kernel, μ C/Modbus, and μ C/CAN stacks have already been ported to the SIM118. Contact *Serious* for details.

VARIANTS

The SCM118 is a family of communications/power modules. The family includes several standard members, or “variants”, with a specific subset of the family features. As of the time of this document’s date, the standard variants are:









	SCM118-	A00	A01	A02
Core Features				
60-pin board-to-board SIM docking connector		✓	✓	✓
+9-25VDC to 5V @ 2A(max) DC-to-DC converter		✓	✓	✓
Renesas RX113 MCU		✓	✓	✓
USB device w/micro-B connector		✓	✓	✓
GPIO/Analog IO JST14 connector		✓	✓	✓
SPI NOR Serial Flash		64MB	32MB	32MB
Industrial Networking				
CAN		✓	✓	✓
RS232/485/422		✓	✓	✓
Pluggable network connector size		8		
Wireless Networking				
Bluetooth Low Energy		✓		
WiFi 802.11 b/g/n		✓	✓	

Serious can support semi-custom or new variants of our SCMs, including the SCM118. See [Semi-Custom Products](#) for details.

STANDARD PRODUCTS

The [SCM118-A00-SJL-01](#) development kit contains everything (except the graphic/touch SIM) needed to develop with SCM118 family and is available only in a single unit package.

For production and larger quantities, the following standard SCM118 products are available:

Variant	Ordering Code			Distributor Inventory	
	Individual Unit	10 Pack	50 Pack		
SCM118-A00	SCM118-A00-01	SCM118-A00-10	SCM118-A00-50		
SCM118-A01		SCM118-A01-10	SCM118-A01-50		
SCM118-A02		SCM118-A02-10	SCM118-A02-50		
SCM118-A03		SCM118-A03-10	SCM118-A03-50		
SCM118-A04		SCM118-A04-10	SCM118-A04-50		

Included with each non-development kit production module are the four (4)

See the [variant table](#) for detailed information on features per variant.

SEMI-CUSTOM PRODUCTS

The [Serious Custom Services team](#) may be able to provide a customized version of the SCM118 for certain OEM designs, or even a product similar to the SCM118 that directly meets a unique interconnect need.

For example, the services team could deliver an optimized dual RS485 over RJ45 version of the SCM118 under a customer-specific part number, but based on the SCM118 form factor and design, perhaps with a different power input connector.

Another example might be a semi-custom variant of the SCM118. Your design may require the SCM118-A02 feature-set but need larger memory; *Serious* could, for example, create an “SCM118-A06” or equivalent with this feature-set populated.

Contact your local [Serious Manufacturers Representative](#) or [Serious directly](#) for more information.



Many OEMs build their own custom daughter-cards, or contract with the *Serious* Services team to design and manufacture custom or semi-custom SCMs. It is possible to create a single daughter card that can dock into numerous SIMs, including all Gen3 and Gen4 SIMs. Consult the respective Technical Reference Manuals (TRMs) to validate a compatible footprint: there are slight differences in the physical and electrical characteristic for daughter cards across different SIMs.

GETTING STARTED

ASSEMBLING THE SCM+SIM

! Ensure the SCM and SIM are not powered when connecting them together.

Orient the SCM such that the 60 pin connector on the back of the SCM aligns with the identical mating connector on the SIM. The connector can only be plugged in one way; it is polarized. When correctly aligned, you should see the 4 stand-offs/mounting holes on the SIM aligning perfectly with the corresponding mounting holes of the SCM:



! Do not mate the two boards unless they are well-aligned; you will irreparably damage the board-to-board connectors.



The development kit includes nylon screws for easy assembly/removal; production units include stainless steel screws with a special nylon patch to ensure they stay assembled even in higher vibration environments; these nylon-patch screws are meant to be used only once or twice in a production usage model as the nylon wears down after removal and reduces their effectiveness.

Gently push the SCM with fingers on the four hole-areas to mate the connectors until the SCM's PCB touches the surface of all four standoffs. Using the four machine screws (provided) fasten the SCM118 into the SIM's standoffs. These M3-0.50 screws should be no more than 6mm in length.



Do not over tighten the screws or you may damage the SIM.



Using screws longer than 6mm can damage the LCD on the SIM.

POWERING THE SCM+SIM

When the SCM is connected to the SIM, the SCM is designed to power itself as well as the attached SIM.



Most SIMs have numerous ways to apply power; ensure the SCM is going to be the only power provider to avoid possible damage to the SCM, SIM, or attached power sources.

The simplest way to power the assembly is to wire the network supplied power (+9-25VDC 10W), such as a Programmable Logic Controller's 24VDC power supply, into the power input terminals of the SCM's [Industrial Networking Connector](#).



Pay careful attention to the polarity of the power input. It is not protected against reverse voltage and miswiring will damage your SCM and any attached SIM.

[Development kits for the SCM](#) may include a standard 110/220VAC wall power adapter to be used in the event that network power is unsuitable or unavailable in the lab environment. This standard wall adapter will have a barrel plug; using the Barrel Power Jack Adapter included in the dev kit, attach jumper wires from the adapter to the power inputs on the SCM's [Industrial Networking Connector](#).



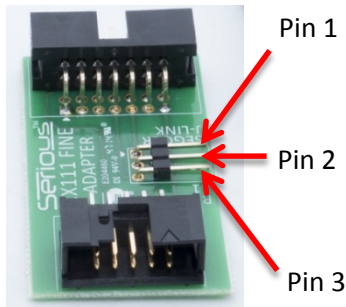
ATTACHING THE PROGRAMMER/DEBUGGER



Software developers will need access to the MCU's programming/debug port. Normally a Renesas E1 or one of the many models of [Segger J-Link](#) programmer/debugger devices will be used with Renesas or IAR tools for software development.

Connecting the programmer/debugger to the SCM is accomplished using a Tag-Connect TC2050-IDC cable, available separately from [Tag-Connect](#) or [Digi-Key](#) and included in all SCM118 [Development Kits](#).

One end of the TC2050 has spring-loaded pogo pins such that when inserted into the SCM118 makes electrical contact between the cable and the PCB. Built-in retention "legs" hold the connector firmly in place during debugging. Gently squeeze the leg-housing, then insert the legs into the four holes surrounding the landing pattern on the SCM118' to remove the connector from the board.



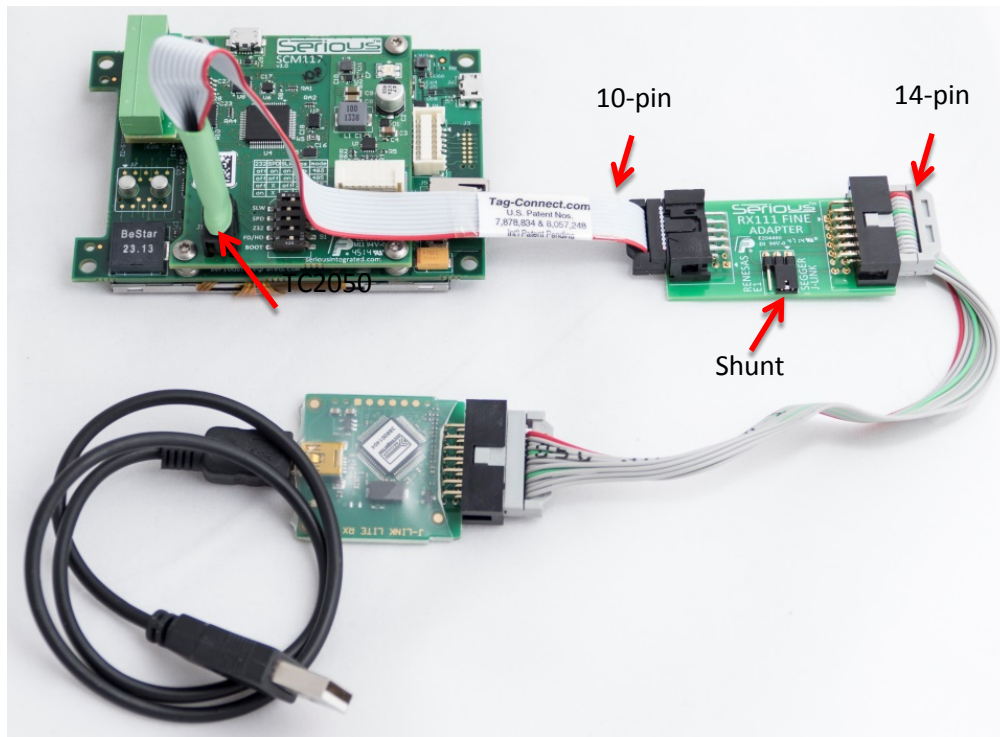
The other end of the TC2050 has a standard 0.1" female 10 pin IDC connector, unlike the 14-pin IDC connection on the Segger J-Link and Renesas E1 debuggers. Included in all SCM118 [Development Kits](#) is a small adapter board, the *Serious* RX113 FINE Adapter, which interconnects the 10 pin TC2050 cable to the E1 or J-Link 14-pin IDC connector. This adapter works for both the RX113 and RX113 MCUs on the SCM117 and SCM118 respectively.

Debugger	Shunt on Pins 1-2	Shunt on Pins 2-3
Segger J-Link LITE RX	X	
Segger J-Link EDU		X
Segger J-Link BASE		X
Segger J-Link PLUS		X
Segger J-Link PRO		X
Segger J-Link ULTRA+		X
Renesas E1		X

In addition to adapting the two connector types, the Adapter has an onboard shunt that is used to select the wiring configuration required by specific debuggers; see the table to determine the correct position.



WARNING: Incorrect shunt/jumper placement on the FINE Adapter may damage your SCM, debugger, and/or any other attached devices; place the jumper in the correct position before attaching the TC2050 to the SCM and the debugger.



SOFTWARE DEVELOPMENT ENVIRONMENT

Renesas provides a fully featured, downloadable, eclipse-based IDE and GNU toolchain at no cost. These are fully unlocked tools including all optimization capabilities and without artificial code-size limits.

To prepare for software development, [download and install](#) the e² studio IDE which includes:

- the eclipse-based e² studio IDE,
- drivers for the Segger J-Link LITE RX debugger,
- GNU tools required for compilation, linking, and debugging,
- starter/template projects for the RX113 MCU

Using Renesas example code for drivers and firmware, you can start right away to develop code.



Reference source code for the SCM118 is available from *Serious*. Check the community forums for registered hardware owners at [mySerious.com](#) or [contact Serious](#).



The Micrium μ C/OS-III kernel, μ C/Modbus, and μ C/CAN stacks have already been ported to the SIM118. Contact *Serious* for details.

SPECIFICATIONS

MAXIMUM OPERATING LIMITS

The SCM118 maximum operating power limits are as follows:

Specification	Permissible Range			Units
	Min	Typ	Max	
Power				
Input Voltage +VIN	9*		25*	VDC
Input Power +VIN			12*	W
Output Voltage to SIM (+5V)	4.75	5.00	5.25	VDC
Output Current to SIM (+5V)			2000*	mA

*preliminary and subject to final production characterization.

AC TIMING CHARACTERISTICS

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.

MAXIMUM BIT RATES

The following are the maximum bit rates/throughput achievable through each connectivity interface:

Connectivity	Max Throughput		
	Transceiver	Controller	RX113
CAN (via MCP2515/SPI)	1 Mbps IFX1050GVIO	1 Mbps MCP2515	TBD SCI SPI ¹
RS232	650kbps ISL41387		TBD SCI SPI ¹
RS422/485	20 Mbps ISL41387		TBD SCI SPI ¹
WiFi 802.11 b/g/n	10 Mbps QCA4002		TBD SCI SPI ¹
Bluetooth Smart & Low Energy	2Mbps nRF51		TBD SCI UART ¹
SIM UART			TBD SCI UART ¹
SIM SPI			TBD RSPI
SIM I2C			400kHz SCI I2C ¹

¹RX113 MCU Serial Communications Interface in SPI Master, UART, or I2C mode as appropriate

²All SIMs configure and use this I2C port at 400 kHz

The limit of each interface is the lowest value of the transceiver, controller, and interconnect. In practice, construction of software drivers and overall MCU workload will control (and often limit) the effective maximum throughput.

ENVIRONMENTAL CHARACTERISTICS

Specification	Min	Permissible Range		Units
		Typical	Max	
Operating Temperature	-40	25	+85	C
Storage Temperature	-40	25	+85	C
Humidity			90% (@60C) Non-condensing	RH

HANDLING AND CARE

Observe the following handling and care guidelines.

HANDLING



Do not attempt to disassemble the module or solder components or wires to the module; this may render your board non-functional and void your warranty.



As with all electronic subsystems and circuits, observe proper ESD handling procedures.

STORAGE

Follow these basic precautions when storing un-installed SCMs for extended periods:

1. Store SCMs in the original factory packaging whenever possible. The sealed polyethylene antistatic bags or the antistatic trays are designed for long term storage.
2. Store the SCM sub-packs where they will not be subjected to high heat, sunlight, or high humidity conditions. Recommended storage temperatures should be kept between 0C and +40C, with relative humidity below 80%.
3. Desiccant should not be required if properly sealed and room temperature ambient temperatures are maintained.

PHYSICAL CHARACTERISTICS

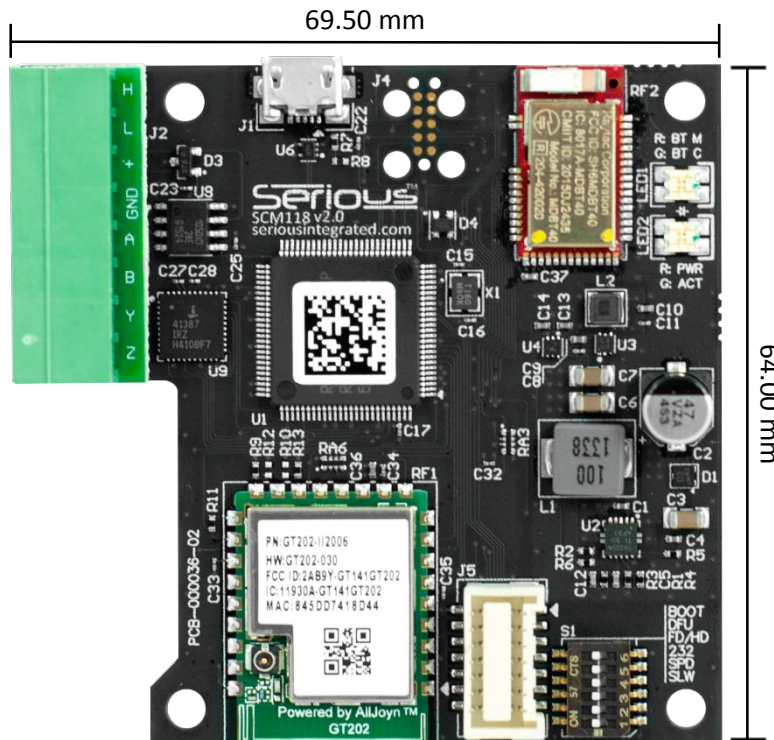
The following table summarizes the key physical characteristics of the SCM118.

Specification	Variant(s)	Typical	Tolerance	Units
Width	All	69.5	0.4	mm
Height	w/USB Micro B	66	0.4	mm
	no USB Micro B	64	0.4	mm
Thickness	A00		TBD	mm
	A01,A02,A03,A04		TBD	mm
Board-to-Board inner dimension when docked	All	4.0	0.2	mm
Weight	A00		TBD	g
	A01		TBD	g
	A02		TBD	g
	A03		TBD	g
	A04		TBD	g

*preliminary and subject to final production characterization.



Mechanical drawings and 3D CAD STEP models are available for most production-focused SIMs and SCMs. Visit www.seriousintegrated.com/docs for more information.



FASTENERS

AllGen3 and Gen4 SIMs include a 60-Pin FCI board-to-board expansion connector (the [FCI60 Dock Connector](#)) for direct-dock connection of daughter-cards including SCMs such as the SC117, SCM118, and the upcoming SCM208. In addition to the connector, these SIMs have four M3 threaded standoffs ([PennEngineering® SMTSO-M3-4-ET](#) or similar) to firmly support and attach the SCM at the correct 4mm board-to-board distance.

For prototyping, any M3-0.5x6mm pan head or cap socket screw can be used to attach the SCM to the SIM. [SCM118 development kits](#) include nylon screws for easy assembly and removal in the lab environment. Production units include four screws that comply with the following minimum specifications:

Parameter	Recommendation		
Material	Stainless A1-50 or better		
Size	M3-0.5 x 6mm		
Head	Cap Socket (hex) or Pan Head 6-lobe/5-lobe/Torx®		
Patch	Nylon Patch per Specification IFI-524 2002 <i>Test Procedure for the Performance of Metric Nonmetallic Resistant Element Prevailing Torque Screws</i>		
	Specification	N·m	inch·lbs
	Maximum Prevailing Torque:	0.60	5.31
	Minimum First Removal Prevailing Torque	0.14	1.24
Insertion Torque	Recommended: 0.60 N·m (5.3 inch·lbs) Maximum: 0.70 N·m (6.2 inch·lbs)		

Small quantities of this type of screw can be readily purchased from [McMaster-Carr \(93705A813\)](#). Production volumes are readily available from many suppliers, including part number . 30C60MRPS/NPAT from [North State Fastener, Inc.](#)



Do not apply excessive torque to daughter card screws into the threaded standoffs or they may tear from the PCB and permanently damage the SIM.



Do not use screws longer than recommended or the screw may apply force to the back side of the LCD panel and permanently damage it.

POWER SUBSYSTEM

The SCM118 must be powered from an external +9-25VDC power supply. This supply is efficiently regulated from the 9-25VDC input down to the 5VDC required by both the SCM as well as attached SIM. Locally on the SCM and SIM respectively are further regulation systems from 5V to other required voltages.

The SCM118 **cannot be powered from the SIM**. When SCM118 +9-25VDC input power is not present the SIM may still be able to operate from an external 5V supply to the SIM directly (e.g. the USB device port on a SIM231), however the SCM118 will be held in shutdown mode without the explicit presence of 9-25V input power.

+9-25VDC INPUT POWER

The SCM can accept +9-25VDC from the [Industrial Networking Connector](#), and on the schematics this power input is marked as +VIN and GND. The GND signal on the connector is common to the SIM/SCM system ground. For current and voltage limits on this input, see [Maximum Operating Limits](#).

+5V MAIN AND 3.3V REGULATION

+VIN is delivered to the input of the main +9-25V buck DC-DC switching regulator capable of supplying up to 5.0V @ 2A (10W) to the +5V main power rail. This regulator typically operates at 90% efficiency and powers all the 5V needs on the SCM as well as supplies the main 5V power required to the attached SIM.

LED1 Green will light when the +5V main power rail is active.

The network side of both the [CAN](#) and the [RS232/422/485](#) transceivers are both powered by the +5V supply.

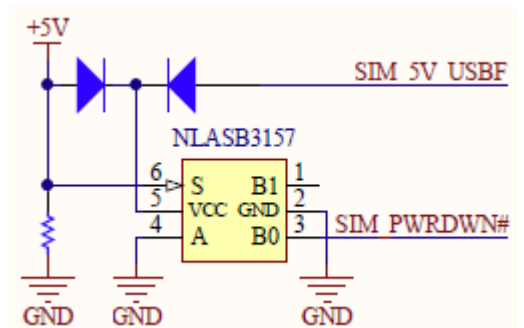
Several circuits on the SCM118 require 3.3V power. The SCM118 does not use the 3.3V supply generated and delivered from the SIM, but rather has its own independent regulator to convert +5V to the +3V3 power signal on the SCM.

SIM USB DEVICE POWER

Some SIMs, for example the SIM231, can be powered through their USB device port since these SIMs need less than the 500mA@5V normally available from PC USB ports/power hubs. It is a common to develop GUIs for these SIMs connected/ powered in this fashion. On other (typically larger) SIMs such as the SIM535, the USB device port cannot power the SIM and that input is only used to detect the presence of a USB initial connection.

When the SCM is connected, however, even for SIMs that may support stand-alone USB powering, the combined power needs of the SCM and SIM is too great for the USB 500mA limit. Therefore, in the absence of the external +9-25VDC on the SCM118 to power the combination, the SIM is held in power down mode and will not operate.

This simple circuit (or equivalent) shown on the right ensures that the SIM is held in power down mode until the external 9-25VDC power is present.



CONTROLLING AND MONITORING THE SIM

SIMRESET CONTROL

All SIM's have an open-drain, active-low reset circuit with a pull-up resistor ensuring that, on power-up, the SIM is reset briefly and then allowed to run.

Since the SCM118 is designed to provide power and network connectivity to the SIM, it can also control this SIM reset circuit from the RX113. When the RX113 software asserts P26-SIM_RESET# (low, active), this SCM signal holds the SIM in reset until it is de-asserted (high, inactive).

Port	MCU Mode	PSEL	FCI60 Pin	Schematic Net Name	Operation
P26	GPO	-	3	P26-SIM_RESET#	SIM FCI60.3 RESET# control to SIM

Most SIMs (consult the respective Technical Reference Manual) have a minimum 50mS self-reset period, enabling the RX113 on boot to assert P26-SIM_RESET# and hold the SIM in reset before it has a chance to start running. The SCM can perform any necessary pre-boot operations and then, when appropriate, release the SIM to run.

P26-SIM_RESET# can also be monitored by RX113 software to see if the SIM self-resets.



If you use this P26-SIM_RESET# capability, do not configure this pin as a push-pull output to avoid potential conflicts with the on-SIM reset circuitry.

The recommended process for resetting the SIM is as follows:

1. Write "1" to the Open Drain Register `PORT2.ODR1.B4` to make P26-SIM_RESET# an open drain pin (when an output)
2. Write "0" to the Port Output Data Register `PORT2.PODR.B6`, so that when it is made an output it will reset the SIM
3. Write "1" to the Port Direction Register `PORT2.PDR.B6` to make it an output
4. Wait 1mS; the SIM will start the self-reset process
5. Write "0" to the Port Direction Register `PORT2.PDR.B6` to make it an input
6. Monitor the Port Input Data Register (`PORT2.PIDR.B6`) to see when the SIM leaves reset over the next 200mS

SIM POWER STATUS

The SIM is normally powered by the 5V supply from the SCM118. The SIM then generates its internal 3.3V supply and makes a small portion of that 3.3V available on the [FCI60 Dock Connector](#). The status of this 3.3V signals can be read on the RX113 via the PH7/SIM_3V3_DOCK signal:

Port	MCU Mode	PSEL	FCI60 Pin	Schematic Net Name	Operation
PH7	GPI	-	46	PH7/SIM_3V3_DOCK	SIM FCI60.46 3V3 present

Normally, this signals will always read high since the SCM118 has no mechanism to directly control the SIM power. However, in some rare configurations the SIM power (or power-down) may be controlled from some other mechanism and these signals allow for detection of a power-down state.

SIM UART

The RX113 MCU's UART **sci5** is connected to the SIM's UART present on the [FCI60 Dock Connector](#):

Port	MCU Mode	PSEL	FCI60 Pin	Schematic Net Name	Operation
PC2	RXD5	01010	35	PC2/RXD5-SIM_UART_TX	SIM FCI60.35 UART transmit data (SIM to RX113)
PC3	TXD5	01010	37	PC3/TXD5-SIM_UART_RX	SIM FCI60.37 UART receive data (RX113 to SIM)

This SIM UART is connected to the **sci5** UART on the RX113 MCU and the RSXXX transceiver is connected to a different RX113 UART (**sci12**). The RX113 sits in between the two connections, able to provide protocol translation and other intermediary services. For example, the RX113 could talk UART to the SIM, and CAN to the network with a completely different protocol. Or the RX113 could talk one baud rate with Modbus to the SIM as a slave, and another baud rate as a Modbus Master to the network.

SIM SPI

All Gen3 and Gen4 SIMs make a 5-wire SPI port available for communication with external devices on the [FCI60 Dock Connector](#). The SIM is always the SPI Master, and in addition to the SPI signals MISO, MOSI, and CLK, the SCM receives the Slave Select signal and can indicate the desire to communicate to the SIM by asserting a GPIO the SIM watches for this purpose; the SCM must only respond to SPI communications when the Slave Select is asserted (active low):

Port	MCU Mode	PSEL	FCI60 Pin	Schematic Net Name	Operation
PA4	SSLA0	01101	19	PA4/SSLA0-SIM_SPI_SSEL#	SIM FCI60.19: SPI Slave Select (active low, from SIM)
PDO	GPO	-	41	PDO/TRQ0-SIM_IRQ#	SIM FCI60.41: SPI Data Available (active low, to SIM)
P15	RSPCKA	01101	22	P15/RSPCKA-SIM_SPI_SCLK	SIM FCI60.22 SPI Clock (from SIM)
PA3	MISOA	01101	26	PA3/MISOA-SIM_SPI_MISO	SIM FCI60.26 SPI MISO (to SIM)
PA6	MOSIA	01101	24	PA6/MOSIA-SIM_SPI_MOSI	SIM FCI60.24 SPI MOSI (from SIM)
PE6	GPO	-	20	PE6-SIM_SPI_DATA#	SIM FCI60.20 SPI Data Ready to SIM (active low)



The [Serious Human Interface™ Platform](#) v5 release contains built-in support for this SPI communications port using a robust and light framing protocol supporting both Modbus and the Serious SHIPBridge Protocol over SPI. Out of the box, you can communicate from your SIM-based GUI over SPI to your RX113 software, including updating your GUI or SHIPEngine from the network via the RX113. Contact *Serious* for the RX113 low level driver for this protocol.

SIM I2C

All Gen3 and Gen4 SIMs make a 2-wire I2C port available for communication with external devices. The SIM is the I2C master on this bus, and there are no I2C pull-up resistors on the SCM118 – these are provided on the SIM. These signals are connected to the RX113 MCU's I2C port "0" as follows:

Port	MCU Mode	PSEL	FCI60 Pin	Schematic Net Name	Operation
PB0	SCL0	01111	39	PB0/SCL0-SIM_I2C_SCL	SIM FCI60.39 I2C Clock (from SIM)
P17	SDA0	01111	42	P17/SDA0-SIM_I2C_SDA	SIM FCI60.42 I2C Data



The I2C bus may be shared on the SIM with other devices, and will always operate at 400 kHz.



The [Serious Human Interface™ Platform \(SHIP\)](#) does not currently use the I2C feature of the SCM118, however on most SIMs this I2C port is actively used for other devices from SHIP.

RX113 MCU

The Renesas RX series of MCUs have a wide range of families from power to 200MHz high performance. The RX113 MCU used on the SCM118 features:

- ▶ High performance 32MHz (50DMIPS, 98.56 CoreMark) RX Core
 - High code efficiency
 - Low power consumption 0.1mA/MHz, 14.9CoreMark/mA
- ▶ 512kB Program FLASH, 8kB Data FLASH (100k write/erase cycles), 64kB RAM
- ▶ Powerful peripheral modules, including a strong array of serial communications peripherals
- ▶ Fast wake-up (4.8µs) from standby mode to run mode
- ▶ Event link controller (ELC) for activating a peripheral module directly from another peripheral module
- ▶ 12-bit A/D converter capable of max. 1 us conversion and temperature sensor are built in
- ▶ Built-in safety functions: clock accuracy measurement circuit, RAM testing assistance, independent watchdog timer

Depending on the version of the SCM118, either the 100-pin QFP or LGA parts will be populated, with part numbers R5F51138ADFP or R5F51138ADLJ respectively or equivalent. There is no detectable difference at the software level in these components, and the parts are used interchangeably based on availability, cost, and manufacturing optimization.



Serious reserves the right to substitute components with equal or greater memory or speed capabilities at any time based on availability or other factors; ensure you do not take advantage in your design of any specifications beyond those listed above or your software may not be compatible with future SCM118 manufacturing lots.

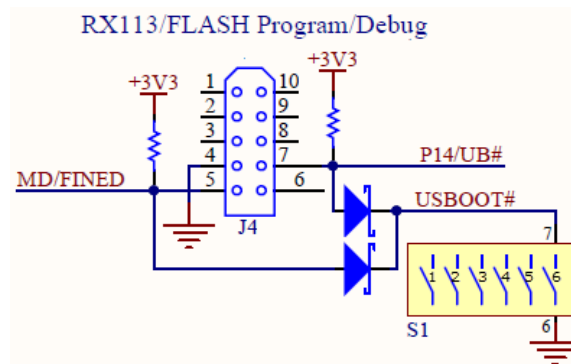
USB BOOT MODE

The RX-series of MCUs have a built-in ROM-based bootloader preprogrammed and architected by the MCU supplier, Renesas. This bootloader firmware, when activated, enables updating of the RX113 MCU firmware without the use of a JTAG debugger, only using the USB device port and a Renesas-supplied uploader program from a MS Windows-based PC.

There are two ways of activating USB Boot Mode; the external JTAG debugger can manipulate the boot mode pins directly, or DIP Switch S1.6, when ON, forces the RX MCU into USB Boot Mode when the SCM118 exits a hardware reset condition such as power-on.

The circuit facilitating these two methods is shown on the right. The DIP switch S1.6ON grounds both P14/UB# and MD/FINED, indicating USB Boot Mode selected on exiting RESET#.

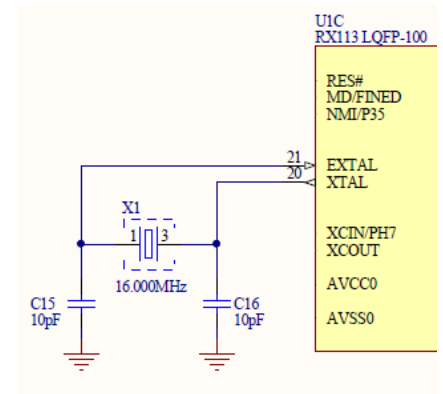
When the DIP Switch S1.6 is OFF, P14/UB# and MD/FINED are completely controlled by a programmer/debugger, if attached.



CLOCKS

The RX113 boots using an MCU internally generated clock; a 16MHz crystal is attached to its EXTAL/XTAL pins and the “main oscillator” capability of the MCU should be configured to switch to this 16MHz source as the main clock source for the MCU’s core and peripherals. At 16MHz, the core can run at 32MHz and the USB device port can (through its independent PLL) be driven at the correct 48MHz input (12MHz bus speed).

If CAN is available on the variant and is necessary for your application, you must also enable the CLKOUT capability of the RX MCU to deliver 16MHz downstream to the CAN Controller. See [CAN Transceiver and Controller](#) for details.



LEDS AND SWITCHES

There are two bi-color LEDs on the SCM118. Each LED has 2 independent LEDs in the package: one red, one green. When both are illuminated, the LED will appear orange.

LED1: POWER & USER INDICATOR

LED1 is a combination indicator of “power good” and an MCU-software controlled user LED. LED1 green component is visible when the +5V power rail is available. LED1 red component is visible based on user I/O as follows:

Port	MCU Mode	PSEL	FCI60 Pin	Schematic Net Name	Operation
PE7	GPO	-	-	PE7-LED1_R	LED1 Red (active high)

Since, of course, the user Red component cannot be activated without power to the SCM118, the LED1 will either show green (PE7 low) or orange (PE7 high).

LED2: BLUETOOTH STATUS

LED2 indicates the status of the Bluetooth radio. LED2 will not be populated in the absence of the Bluetooth feature on those variants. Port pins can also monitor the status of these indicators:

Port	MCU Mode	PSEL	FCI60 Pin	Schematic Net Name	Operation
P43	GPI	-	-	P43-BT_MODE	BT Mode status (LED2 Red when high)
P44	GPI	-	-	P44-BT_CONN	BT Connection Status (LED2 Green when high)

S1: DIP SWITCH

The miniature 6-position switch S1 sets the modes of the RS232/422/485 transceiver (see [RS232/RS422/RS485](#)), the [USB Boot Mode](#), as well as can reset the [Bluetooth](#) module back to factory defaults. See each of the respective sections for the individual switch operation, however the positions and operation are summarized here for completeness:

Switch	Name	Description
1	SLW	RS422/485 Slew Rate Limit
2	SPD	RS422/485 Speed Limit
3	232	RS232 mode when ON
4	HALF	Half Duplex when ON
5	BTDFU	Bluetooth reset factory defaults when ON
6	USBBOOT	USB Boot Mode when ON

SERIAL NOR FLASH

The SCM features a Micron N25Q Series Serial NOR FLASH for bulk storage of files and data. The size of the bulk storage is [variant dependent](#). It is connected to the RX113 MCU on a dedicated SCI SPI port:

Port	MCU Mode	PSEL	FCI60 Pin	Schematic Net Name	Operation
P53	GP0	-	-	P53/SS2#- FLASH_CS#	TC2050 J4.8 Serial NOR FLASH SPI Slave Select (active low)
P51	SCK2	01010	-	P51/SCK2- FLASH_SCKL	TC2050 J4.9 Serial NOR FLASH SPI Clock
P50	SMDSI2	01010	-	P50/SMDSI2- FLASH_SI	TC2050 J4.2 Serial NOR FLASH SPI MOSI
P52	SMSO2	01010	-	P52/SMSO2- FLASH_SO	TC2050 J4.3 Serial NOR FLASH SPI MISO



The popular, free, and very tiny [Petit FAT File System Module](#) or the more full-featured (also free!) [FatFs Generic FAT File System Module](#) can turn this bulk storage into an easy-to-use FAT file system.



Serious has pre-ported the robust and reliable Micrium µC/FS File System libraries, which include optional journaling, background erase, and more; contact *Serious*.



Serious reserves the right to substitute components with equal or greater memory or speed capabilities at any time based on availability or other factors; ensure you do not take advantage in your design of any specifications beyond those listed for the specific variant or your software may not be compatible with future SCM118 manufacturing lots.

SERIOUS SERIAL NUMBER AND VARIANT IDENTIFICATION

Beyond the bulk storage area, the N25Q device also contains a small one-time programmable (OTP) region containing factory pre-programmed information including the serial number of the unit as well as variant/version information. Reading this information at run-time can enable software to dynamically adapt to the specific variant as well as accommodate any software-visible differences between versions of the specific module.



Do not write to the Serial NOR FLASH's OTP region.

This region is reserved for manufacturing and configuration information by *Serious*.

Modifying or writing to this area will void your warranty with *Serious* and may render the module unusable.

The first 64 bits of the OTP area in the Serial NOR FLASH are structured as follows:

Location	Size (Bytes)	Contents	Example
0x00 . 0x01	2	ID	0x0118 means SCM118
0x02	1	Version (major + minor)	0x21 means v2.1
0x03	1	Variant (see chart below)	0x01 means A01
0x04	1	Unused on SCM118; always 0x00	0x00
0x05 . 0x07	3	Sequence number of this unit	0x000023

The aggregate of these locations form the unique *Serious* Serial Number (SSN) for the module. All elements and the aggregate 64-bit number are always represented/stored in Big Endian order, regardless of the endian-ness of the processor on the module. The following table correlates the value at offset 0x03 to the actual Variants of the module:

Variant Byte	Variant Name
0x00	-A00
0x01	-A01
0x02	-A02
0x03	-A03
0x04	-A04
0xFF	Invalid/Unknown
All others	Reserved

WIFI

Some variants of the SCM118 include 802.11 b/g/n WiFi based on the [Qualcomm/Atheros QCA4002](#)-based WiFi module with the following features:

- 802.11 b/g/n 2.4GHz support with integrated power amplifier
- Low power modes and fast wake-up times
- Integrated AllJoyn® software to ensure seamless connectivity and services
- Integrated IPv4/IPv6 networking and WPS, WPA, WPA2, WEP security with SSL Client with AES encryption
- Fully FCC and CE certified



The WiFi subsystem is connected to the RX113 MCU via SPI (SCIO), with the MCU as the SPI Master, as follows:

Port	MCU Mode	PSEL	FCI60 Pin	Schematic Net Name	Operation
P27	GPO	-	-	P27-WIFI_PWD#	WiFi Power down (active low)
P23	GPO	-	-	P23/SS0#-WIFI_CS#	WiFi SPI Slave Select (active low)
P22	SCK0	01010	-	P22/SCK0-WIFI_SCLK	WiFi SPI Clock
P20	SMOSI0	01010	-	P20/SMOSI0-WIFI_SI	WiFi SPI MOSI
P21	SMISO0	01010	-	P21/SMISO0-WIFI_SO	WiFi SPI MISO
PD1	IRQ1	ISEL	-	PD1/IRQ1-WIFI_IRQ#	WiFi IRQ (active low)

BLUETOOTH

On variants with Bluetooth, the Nordic Semiconductor nRF51-based subsystem has the following features:

- ▶ 2.4GHZ transceiver: -93dbm sensitivity in Bluetooth low energy mode; TX Power -20 to +4dbm; RSSI (1db resolution)
- ▶ ARM Cortex-M0 32bit processor ; Serial Wire Debug (SWD)
- ▶ S100 series SoftDevice ready
- ▶ Memory: 256kb or 128kb embedded flash program, memory ; 16kb RAM
- ▶ Support for non-concurrent multiprotocol operation: On-air compatibility with nRF24L series
- ▶ AES HW encryption

The Bluetooth subsystem is connected to the RX113 MCU via SPI (SCI6), with the MCU as the SPI Master, as follows:

Port	MCU Mode	PSEL	FCI60 Pin	Schematic Net Name	Operation
P43	GPI	-	-	P43- BT_MODE	BT Mode status (LED2 Red when high)
P44	GPI	-	-	P44- BT_CONN	BT Connection Status (LED2 Green when high)
P25	GPO	-	-	P25- BT_SWDI0/RESET#	BT Reset (active low)
P46	GPO	-	-	P46- BT_DFU	BT Factor Defaults (on reset)
PJ3	SS6#	01011	-	PJ3/SS6#- BT_CS#	BT SPI Slave Select (active low)
P04	SCK6	01011	-	P04/SCK6- BT_SCKL	BT SPI Clock
P07	SMOSI6	01011	-	P07/SMOSI6- BT_SI	BT SPI MOSI
P02	SMIS06	01011	-	P02/SMIS06- BT_SO	BT SPI MISO
PD2	IRQ2	ISEL	-	PD2/IRQ2- BT_IRQ#	BT IRQ (active low)

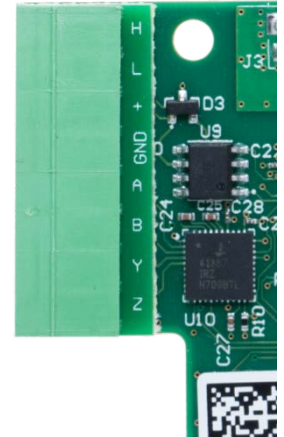
For development software and more information on the Nordic nRF51, see the [Nordic website](#).

INDUSTRIAL NETWORKING AND POWER INPUT CONNECTOR

All SCM118 variants have an industrial networking and power input connector for attachment to an external CAN and/or RS232/422/485 network as well as the [+9-25VDC Input Power](#) source for the SCM+SIM combination.

The connector, depending on [the variant presence of CAN and/or RS232/422/485](#), has 2, 4, 6, or 8 terminals, and is populated in a subset of the full 8-pin position:

Pins	Range	Feature	
		CAN	RSXXX
2	3-4		
4	1-4	✓	
6	3-8		✓
8	1-8	✓	✓



For example on a variant with CAN available but not RS232/422/485, a 4-position connector will be populated at locations 1 through 4, and a 4-position plug will be included with the product. If, for example, the variant has RS232/422/485 capability but not CAN, a 6-position connector will be populated in positions 3 through 8, and a 6-terminal plug will be included with the product. The signals as follows:

Pin	Label	Description
1	H	CAN Network "H"
2	L	CAN Network "L"
3	+VIN	Main +9-25V Power Input; see Power Supplies
4	GND	System Ground; see Power Supplies
5	A	Receive: RS232 or RS4xx inverting input
6	B	Receive: RS4xx non-inverting input
7	Y	Transmit: RS232 or RS4xx inverting output
8	Z	Transmit: RS4xx non-inverting output

All variants and all package quantities (including single and multi-unit volume packaging) come with the corresponding plug supplied:

Pins	Connector	Plug	Variants
2	FCI 20020107-C021A01LF*	FCI 20020004-C021B01LF*	No CAN/RSXXX
4	FCI 20020107-C041A01LF*	FCI 20020004-C041B01LF*	CAN only
6	FCI 20020107-C061A01LF*	FCI 20020004-C061B01LF*	RSXXX only
8	FCI 20020107-C081A01LF*	FCI 20020004-C081B01LF*	CAN + RSXXX

*or equivalent



This plug has screw terminals, and is designed to accept solid or stranded wires of 18 to 24 AWG. The entry areas for each terminal also support 2 or 3 wire insertion per terminal to facilitate multi-drop network chaining or termination resistors alongside the communications wires without requiring pigtailed.

To fasten wires into the Industrial Networking Connector use a small flat screwdriver. Ensure the port you are entering the wire into has the screw loosened to allow the wire to enter completely. Simply push the untinned bare wire into the correct port. The wire should be pushed in far enough to the port that when the screw is tightened down it has a good connection and does not fall out. Take your screwdriver and turn the screw clockwise. Do not overtighten the screws, but make sure that each screw is snug and does not allow the wire to fall out.

To remove the wire, turn the screw counterclockwise. Once the screw has been backed off to the point where the wire has become loose you can remove the wire.

POWER CONNECTIONS

The main SCM's input power should be supplied on terminals 3 and 4 (+VIN and GND respectively). See the [+9-25VDC Input Power](#) chapter for details.



Pay careful attention to the polarity of the power input. It is not protected against reverse voltage and miswiring will damage your SCM118 and any attached SIM.

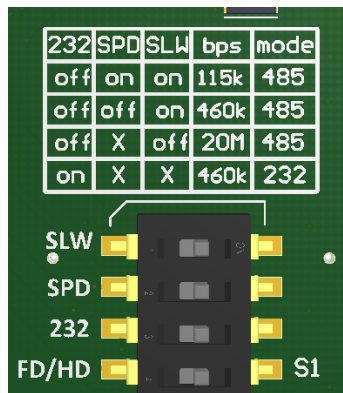
RS232/RS422/RS485

SCM118 variants with RS232/422/485 employ an [IntersilISL41387IRZ-T](#) multi-protocol transceiver, supporting selectable RS232 or RS485/RS422 (referenced generically as "RSXXX") modes. This transceiver is managed by the SCM's RX113 MCU.

The [Intersil ISL41387IRZ-T](#) multi-protocol transceiver has the following key features:

- ▶ Selectable RS232 or RS485/RS422
- ▶ ±15kV (HBM) ESD protected
- ▶ Large (2.7V) differential VOUT for improved noise immunity in RS485/RS422 networks
- ▶ Full failsafe (open/short) RX in RS485/RS422 mode
- ▶ RS232 transmit rates up to 650kbps, receive rates to 2Mbps
- ▶ RS485/RS422 data rates up to 20Mbps
- ▶ RS485/RS422 slew rate limit options for 460kbps and 115kbps

It is well-suited for many point-to-point and multi-drop networks and works particularly well in many industrial PLC configurations. DIP switch **S1** configures the operational mode of the RS232/422/485 transceiver:



The position of these switches can be read from the RX113 MCU as follows:

Port	MCU Mode	PSEL	FCI60 Pin	Schematic Net Name	Operation
PJ7	GPI	-	-	PJ7- RSXXX_SLEW	RSXXX S1.1 SLEW status (read only)
PJ6	GPI	-	-	PJ6- RSXXX_SPD	RSXXX S1.2 SPD status (read only)
P41	GPI	-	-	P41- RS485/232#	RSXXX S1.3 232# status (read only)
PB3	GPI	-	-	PB3- RSXXX_RXEN	RSXXX S1.4 HALF# status (read only)

It is not recommended you attempt to control these signals from software; the ON position cannot be overridden and most of these pins are not open-drain.

In all usage models of the RS232/422/485 subsystem, the following key MCU signals are the control and data connections to the transceiver:

Port	MCU Mode	PSEL	FCI60 Pin	Schematic Net Name	Operation
PE2	RXD12	01100	-	PE2/RXD12- RSXXX_RA	RSXXX UART Receive Data
PE1	TXD12	01100	-	PE1/TXD12- RSXXX_TX	RSXXX UART Transmit Data
PB5	GPO	-	-	PB5/RTS12#- RSXXX_DE	RSXXX UART Transmit Enable
P40	GPO	-	-	P40- RSXXX_ON	RSXXX UART RS232 Power On

The receive data signal (PE2/RXD12-RSXXX_RA) has a weak pull-up so that when transmitting and the receiver is disabled the receive data predictably “marks idle”. This signal is delivered to the RX113 MCU’s PE2/RXD12 pin

INDUSTRIAL NETWORKING CONNECTOR – RSXXX TERMINALS

Positions 5 through 8 on the [Industrial Networking Connector](#) contain signals related to RS232 or RS422/485 network connectivity:

J2 #	Signal	Description
5	A	Receive: RS232 or RS4xx inverting input
6	B	Receive: RS4xx non-inverting input
7	Y	Transmit: RS232 or RS4xx inverting output
8	Z	Transmit: RS4xx non-inverting output

There is no termination facility on the SCM; external network termination must be provided if needed. Since the connector plug supports multi-wire insertion into a single terminal, the termination resistor lead may be collocated in the plug with the network wire.

RS232 MODE SELECTION (“232”)

DIP switch **S1.3** (marked **232#**) controls the mode of the transceiver. In the **ON** position (**GND**) the transceiver operates in RS232 mode. In the **OFF** position, the control signal **P41-RS485/232#** has a weak pull-up and the transceiver operates in RS485/RS422 mode. The state of the switch is visible to the RX113 on port **P41**.



P41 is not open-drain capable. Do not drive this signal high from the MCU as it may short to **GND** if the switch is **ON**. You may simulate open-drain behavior in software by only driving as an output low, but making the pin mode an input to allow the pull-up to pull the signal high.

RS4XX SPEED/SLEW RATE CONTROL

DIP switches **S1.1** and **S1.2** are ignored in RS232 mode, however in RS422/485 mode DIP switches **S1.1** (marked **SLW**) and **S1.2** (marked **SPD**) control the slew rate and speed control of the transceiver respectively:

S1.1 SLW	S1.2 SPD	Description
OFF	X	20mbps max -- non slew rate controlled
ON	OFF	460kbps max – slew rate controlled
ON	ON	115kbps max – slew rate controlled

These switch positions can be read via ports **PJ7** and **PJ6** respectively, with “high” indicating **OFF** and “low” indicating **ON**.



PJ6 and **PJ7** are not open-drain capable. Do not drive these signals high from the MCU as it may short to **GND** if a switch is in the **ON** position. You may simulate open-drain behavior in software by only driving as an output low, but making the pin mode an input to allow the pull-up to pull the signal high.

HALF/FULL DUPLEX SELECTION

The RSXXX port can operate in full duplex mode where data can independently and simultaneously flow in/out the receive/transmit pins respectively. It can also be configured to operate in half duplex mode where input/output data is often carried on the same wire(s) and the directionality takes turns.

The main difference between the modes lies in how the transmit and receive enable of the transceiver are configured and used. In full duplex mode, the transceiver receive data is always enabled and being processed by the appropriate MCU. In half duplex mode, the receive data is only valid when not transmitting – this avoids receive MCU algorithms from “seeing” the same data that they send if the network shares the same wires for transmit and receive. Full duplex mode always implies separate network wires for transmit and receive. Even then, you may not want to always have your transmitter enabled – there are many custom networks where the “master” in a network owns one network wire (or pair in differential mode) and can broadcast at any time to the “slaves” whereas the slaves must share the return line according to some convention to avoid collisions.

Given the many possible combinations on custom networks, there are two key elements that need to be addressed:

1. Is the receiver always on, delivering data to the SCM’s UART all the time, or is it disabled during transmission to avoid “seeing your own packets”?
2. Is the transmitter always on, or must it be only turned on when the SCM transmits on the network?

DIP switch **S1.4** controls how the RSXXX transceiver’s *receiver* is enabled. When **S1.4** is **OFF** (full duplex mode), a weak pull-up on the RSXXX transceiver’s **RXEN** pin ensures that by default the RSXXX transceiver’s receiver is always enabled and delivering data to the SCM’s MCU. When **S1.4** is **ON** (half duplex mode), the RSXXX transceiver’s **RXEN** pin is connected to GND. In this mode, the RSXXX transceiver’s receive enable is controlled by its **RXEN#** which is connected to the opposite polarity **DEN** (drive enable) pin. In this configuration, whenever the transmitter is enabled, the receiver is disabled and the receive data “marks idle” with a pull-up.

The state of **S1.4** can be read by the RX113 MCU on port **PB3**. **PB3** is an open-drain capable pin, so it is possible to force half duplex mode (by driving **PB3** low in open drain mode) however it is not possible to force full duplex mode if the **S1.4** is **ON**.



PB3 is open-drain capable; however it can be configured by software to also be push-pull CMOS. Do not attempt to drive this signal high from the MCU in push-pull mode as it may short to **GND** if the **S1.4** is **ON**.

TRANSMIT ENABLE

The transceiver’s transmit drive enable (**DEN**) pin (when asserted/high) turns on the output drivers on the transceiver and presents UART transmit data onto the network. To avoid any network glitches on power-up, this is always held low (inactive) until either the SCM explicitly asserts this signal active/high.

USING RS232

In order to use the SCM118 in RS232 mode:

- Configure the DIP Switches
 - Ensure DIP switch **S1.3** is **ON** to ensure the transceiver operates in RS232 mode.
 - Set DIP switch **S1.4** for half (**ON**) or full (**OFF**) duplex mode.

Connect the RS232 receive/transmit data onto **J2** as follows:

J2#	Signal	Description
5	A	RS232 data in to SCM
6	B	Do not connect
7	Y	RS232 data out from SCM
8	Z	Do not connect

- Configure the RX113's **PE2/RXD12, PE1/TXD12, PB5/RTS12#-RSXXX_DE, P40-RSXXX_ON** UART pins appropriately and write the device driver/protocol necessary to manage the port.



The no-cost SHIPWare source code for SCM118 includes the Micrium µC/OS-III kernel and a set of UART, SPI, I2C, and Modbus drivers you can use to write this protocol adaptation layer.



There will be reference code available with the upcoming [Serious Human Interface™ Platform v5](#) release for the Serious Bridge Protocol so you can write RX113 code to communicate with SHIP GUIs, including updating the firmware and GUI on the SIM from the network.

USING RS422/RS485

RS422 is a point-to-point protocol, and can be implemented on a network in differential or single-ended mode, with half or full duplex data flow. RS485 adds the concept to of a multi-drop network that can be used in one-master/multiple-slaves (with protocols like Modbus) or in custom protocol multi-master or peer-to-peer topologies. To use the SCM118 with an RS422/RS485 network:

- Configure the DIP Switches
 - Ensure DIP switch **S1.3** is **OFF** to ensure the transceiver operates in RS422/RS485 mode.
 - Set DIP switches **S1.1** and **S1.2** according to the [desired maximum line rate chart](#).
 - Set DIP switch **S1.4** for [half/full duplex receive/transmit enable control](#).

- Connect the RS422/RS485 receive/transmit data onto **J2** as follows:

J2#	Signal	Description
5	A	RS4xx data in (inverting/single ended)
6	B	RS4xx data in (non-inverting differential) Connect to GND for single ended
7	Y	RS4xx data out (inverting/single ended)
8	Z	RS4xx data out (non-inverting differential) Do not connect for single ended

- Terminate the cable if needed by inserting a resistor across pins 5 and 8 of the plug's screw terminals
- Configure the RX113's **PE2/RXD12, PE1/TXD12, PB5/RTS12#-RSXXX_DE, P40-RSXXX_ON**UARTpins appropriately and write the device driver/protocol necessary to manage the port.



The no-cost SHIPWare source code for SCM118 includes the Micrium µC/OS-III kernel and a set of UART, SPI, I2C, and Modbus drivers you can use to write this protocol adaptation layer.



There will be reference code available with the upcoming [Serious Human Interface™ Platform v5](#) release for the Serious Bridge Protocol so you can write RX113 code to communicate with SHIP GUIs, including updating the firmware and GUI on the SIM from the network.

PLC CONNECTIVITY

Many Programmable Logic Controllers have RS485 communications ports that can act as a Modbus Master or Slave. These ports are often “2-wire” ports which are differential lines run in half duplex. When the Master is transmitting, the two wires are a differential transmit from the master to the slave(s). When a slave is responding, the two wires are a differential transmit in from the slave to the master.



The term “2-wire RS485” is a misnomer when it refers to differential half duplex RS485. You **must** also have a third wire, the shared network ground. If you do not connect the ground, the RS485 differential signal can have a common mode offset that has the potential of physically damaging your SCM. See [this article](#) for a more detailed description of this issue.

To use the SCM118 in these topologies:

- ▶ Configure the DIP Switches
 - Ensure DIP switch **S1.3** is **OFF** to ensure the transceiver operates in RS422/RS485 mode.
 - Set DIP switches **S1.1** and **S1.2** according to the [desired maximum line rate chart](#).
 - Ensure DIP switch **S1.4** is **ON** for [half duplex receive/transmit enable control](#).

Connect the RS422/RS485 receive/transmit data onto J2 as follows:

J2#	Signal	PLC Connection
5+7 (bridged)	A+Y	R- (inverting in/out)
6+8 (bridged)	B+Z	R+ (non-inverting in/out)
4	GND	GND

- ▶ Terminate the cable if needed by inserting a resistor across pins 5 and 8 of the plug’s screw terminals
- ▶ Configure the RX113’s **PE2/RXD12**, **PE1/TXD12**, **PB5/RTS12#-RSXXX_DE**, **P40-RSXXX_ON** UART pins appropriately and write the device driver/protocol necessary to manage the port.

An outstanding connection guide for dozens of common PLCs [can be found at this web link](#).

CAN

INDUSTRIAL NETWORK CONNECTOR - CAN TERMINALS

J2 has the following CAN-related signals:

J2#	Signal	Description
1	CANH	CAN Transmit/Receive H
2	CANL	CAN Transmit/Receive L

There is no termination facility on the SCM; external network termination must be provided if needed. Since the connector plug supports multi-wire insertion into a single terminal, the termination resistor lead may be collocated in the plug with the network wire.

CAN TRANSCEIVER AND CONTROLLER

The CAN transceiver on the SCM118 is implemented with an Infineon [IFX1050GVIO](#) or similar device with the following specifications:

- ▶ CAN data transmission rate up to 1 Mbaud
- ▶ Suitable for 12V and 24V network applications
- ▶ Excellent EMC performance (high immunity and low emission)
- ▶ ISO/DIS 11898 compatible

The CAN transceiver is electrically routed to the CAN TX/RX signals to a [MCP2515 CAN Controller](#) is connected to the RX113's SCI1-as-SPI port as follows:

Port	MCU Mode	PSEL	FCI60 Pin	Schematic Net Name	Operation
PE0	GPO	-	-	PE0-MCP2515_RESET#	CAN Controller reset (active low)
P42	GPO	-	-	P42-MCP2515_CS#	CAN Controller SPI Slave Select (active low)
PC6	SMS01		-	PC6/SMS01-CAN_SO	CAN Controller SPI MISO
PC7	SMDSI 1		-	PC6/SMDSI 1-CAN_SI	CAN Controller SPI MOSI
PC5	SCK1		-	PC5/SCK1-CAN_SCLK	CAN Controller SPI CLK
PB1	IRQ4	ISEL	-	PB1/IRQ4-CANIRQ#	CAN Controller Interrupt (active low)

The network side of the MCP2515 is connected to the transceiver. The MCP2515 requires an input clock; rather than a separate crystal the RX113's CLKOUT capability should be enabled in "main clock oscillator + no division" mode via the RX113's CKOCR Clock Output Control Register to deliver a 16MHz clock signal to the MCP2515:

Port	MCU Mode	PSEL	FCI60 Pin	Schematic Net Name	Operation
PC4	CLKOUT	01001	-	PC4/CLKOUT	CAN Controller 16MHz Input Clock

A CAN stack and protocol of your choosing must be implemented on the RX113 in conjunction with the MCP2515.



The [Micrium](#) μC/CAN stack is available for the RX family along with the μC/CAN driver for the MCP2515 controller.



The no-cost SHIPWare source code release for the SCM118 available from [mySerious.com](#) contains a basic CAN stack that can be adapted for your use.

USB DEVICE AND MICRO B CONNECTOR

The RX MCU has a USB device (or “function”) port. This port is commonly plugged into a PC and, depending on your software, can act like any number of PC peripherals such as a serial port. This USB port is available on the standard Micro B connector at location J1.

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.

When a PC/Hub is plugged into the device connector, a 5V level is delivered by the PC/Hub on pin J1.1 to indicate the presence of the host. This 5V signal is delivered to a 5V tolerant RX111 MCU pin designed for this purpose in order that the presence of a USB Host plugged into the device connector can be detected by software:

Port	MCU Mode	PSEL	FCI60 Pin	Schematic Net Name	Operation
P16	USBO_VBUS	10010	-	P16/USBO_VBUS	USB Connection Detect (active high)
	USBO_DM	-	-	USB_D_N	USB D-
	USBO_DP	-	-	USB_D_P	USB D+



The power input from the USB device port is not sufficient to operate the SCM + attached SIM, and is not available for this purpose. This signal is only used to detect the presence of a USB connection.

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. The *Serious* VID is **0x25D8**. *Serious*-delivered software for the SCM118 identifies all SCM118 variants as VID**0x25D8** and PID**0x0118**.



You may use the *Serious* VID **only with software supplied from Serious for the module**. If you wish to write your own software for the SCM, you **must** obtain your own VID from the USB Implementers Forum.



SCM118 comes with the Renesas USB boot mode loader installed, however the USB ID may have been modified by *Serious* to identify the SCM as VID**0x25D8** and PIDs in the **0x0001...0x00FF** range. This modified version and the original Renesas loader are available for re-installation; see [Additional Information](#).

SOFTWARE

Renesas provides extensive documentation of the RX 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 RX MCUs.

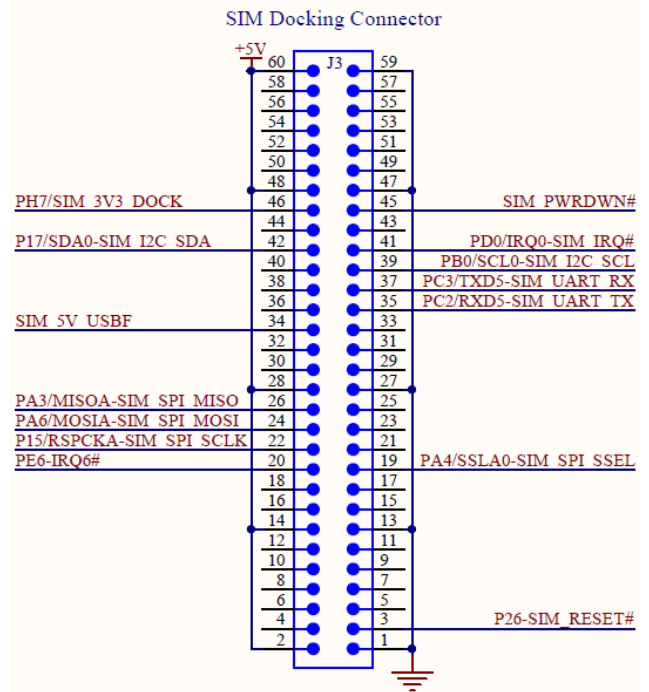
FCI60 DOCK CONNECTOR

The SCM118 connects to a SIM through connector J3, a 60-pin board-to-board “docking” connector. The [FCI 10106813-061112LF](#) is a 60-position, 0.5mm, gold plated, hermaphroditic board-to-board SMT connector. This connector is inexpensive, reliable, and widely carried at authorized distributors, including [Digi-Key](#) and [Arrow Electronics](#).



The pin numbering of this connector is the left-right mirror of the pin numbering on the SIM. Consult and compare with those in the applicable SIM Technical Reference Manual.

Note that not all pins on this connector are used on the SCM118; all unmentioned pins are unconnected and not used on the SCM118. The signals used on the SCM118 are as follows:

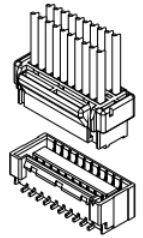


Port	MCU Mode	PSEL	FCI60 Pin	Schematic Net Name	Operation
P26	GPO	-	3	P26-SIM_RESET#	SIM FCI60.3 RESET# control to SIM
PA4	SSLA0	01101	19	PA4/SSLA0-SIM_SPI_SSEL#	SIM FCI60.19: SPI Slave Select (active low, from SIM)
PE6	GPO	-	20	PE6-SIM_SPI_DATA#	SIM FCI60.20 SPI Data Ready to SIM (active low)
P15	RSPCKA	01101	22	P15/RSPCKA-SIM_SPI_SCLK	SIM FCI60.22 SPI Clock (from SIM)
PA6	MDSIA	01101	24	PA6/MDSIA-SIM_SPI_MOSI	SIM FCI60.24 SPI MOSI (from SIM)
PA3	MISOA	01101	26	PA3/MISOA-SIM_SPI_MISO	SIM FCI60.26 SPI MISO (to SIM)
-	-	-	34	SIM_5V_USBF	Detects presence of power on SIM via its USB device port
PC2	RXD5	01010	35	PC2/RXD5-SIM_UART_TX	SIM FCI60.35 UART transmit data (SIM to RX113)
PC3	TXD5	01010	37	PC3/TXD5-SIM_UART_RX	SIM FCI60.37 UART receive data (RX113 to SIM)
PB0	SCL0	01111	39	PB0/SCL0-SIM_I2C_SCL	SIM FCI60.39I2C Clock (from SIM)
PD0	GPO	-	41	PD0/IRQ0-SIM_IRQ#	SIM FCI60.41: SPI Data Available (active low, to SIM)
P17	SDA0	01111	42	P17/SDA0-SIM_I2C_SDA	SIM FCI60.42 I2C Data
PH7	GPI	-	46	PH7/SIM_3V3_DOCK	SIM FCI60.46 3V3 present
-	-	-	1, 13, 27, 47, 59	GND	Common system ground; see Power Supplies
-	-	-	2, 14, 28, 48, 60	+5V	Outgoing +5VDC; see Power Supplies .

JST14 ANALOG/DIGITAL GPIO CONNECTOR

Most variants include a 14-pin wire-harness-friendly expansion connector carrying analog and digital GPIO and communications busses for easy control and connection to other nearby embedded sensors, actuators, or intelligent controllers under the direction of software on the RX113 MCU.

The connector is a [JST ZPD Series wire-to-board connector](#), and the compatible mating wire housing and crimp pin products are:



JST Part Number	Description
ZPDR- 14V- S	Wire Housing
SZPD- 002T- P0. 3	Crimp pin for AWG#24 to AWG#28 stranded wire (see ⚠ below)

This connector is similar to the 16-pin version found on many *Serious* modules, including the SIM115, SIM231 and SIM535, and can carry 2A per pin, is RoHS and UL94V-0 compliant, and fully supports -40 to +85C operation.



While operational to -40C, take care with insertion/removal outside normal room temperatures; the housing will be more susceptible to breakage at low temperatures.

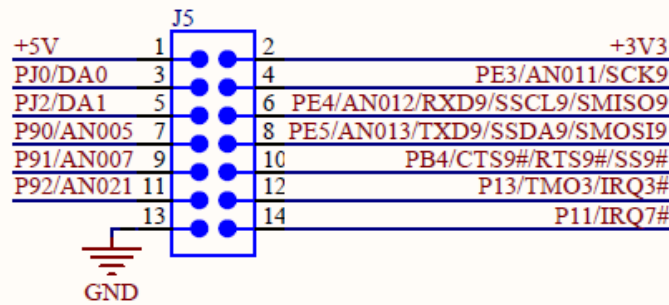


The JST ZPD series data sheet indicates a minimum operational temperature of -25C. JST has provided *Serious* a quality and reliability certification for this connector down to -40C. Contact *Serious* for a copy of this certification.



Ensure sufficient wire size to avoid wire overheating and adequate power handling capability.

[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 at reasonable cost. [SCM118 Development Kits](#) include a sample single-ended wire harness for your use in prototyping.



The RX113 MCU signals to this connector are highly reconfigurable, and the ports are mapped as follows:

Pin	Schematic Name	Direction	Description
1	+5V	O	Outgoing +5VDC; see Power Supplies
2	+3V3	O	Regulated +3.3VDC from SIM; see Power Supplies
3	PJ0/DA0	I/O	GPIO, 12-bit DAC output
4	PE3/AN011/SCK9	I/O	GPIO, 12-bit ADC input, SPI Clock
5	PJ2/DA1	I/O	GPIO, 12-bit DAC output
6	PE4/AN012/RXD9/SSCL9/SMIS09	I/O	GPIO, 12-bit ADC input, UART RXD, I2C Clock, SPI MISO
7	P90/AN005		GPIO, 12-bit ADC input
8	PE5/AN013/TXD9/SSDA9/SMOSI9	I/O	GPIO, 12-bit ADC input, UART TXD, I2C Data, SPI MOSI
9	P91/AN007		GPIO, 12-bit ADC input
10	PB4/CTS9#/RTS9#/SS9#	I/O	GPIO, UART CTS/RTS, SPI Slave Select
11	P92/AN021		GPIO, 12-bit ADC input
12	P13/TM03/IRQ3#	I/O	GPIO, Timer Output, Interrupt Input
13	GND	-	System Ground; see Power Supplies
14	P11/IRQ7#	I/O	GPIO, Interrupt Input

This flexibility enables some combination of up to:

- ▶ 11 digital GPIOs
- ▶ 2 DAC analog outputs 0-3.3V rail-to-rail 12-bit
- ▶ 6 ADC analog inputs 0-3.3V rail-to-rail 12-bit
- ▶ 4-Wire SPI, 4-wire UART, or 2-wire I2C port
- ▶ 2 interrupt inputs
- ▶ Timer-driven output

Note the analog outputs and inputs are high-impedance; external buffering is recommended as necessary to match to lower-impedance endpoints.

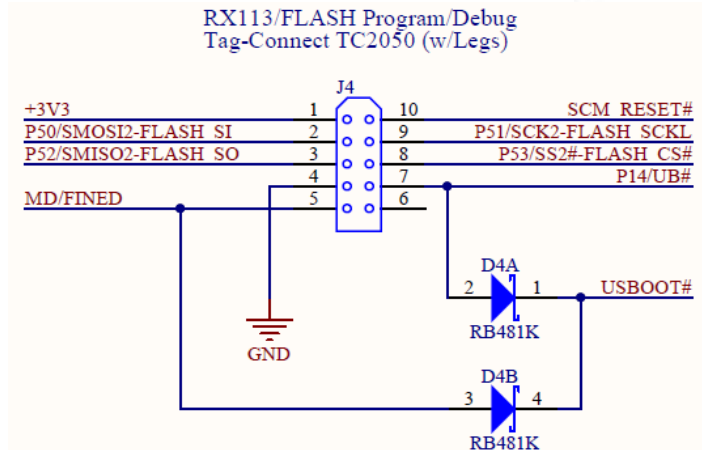
PROGRAMMING/DEBUG CONNECTOR

Software developers will need access to the MCU’s programming/debug port. Normally a Renesas E1 or one of the many models of Segger J-Link programmer/debugger devices will be used with Renesas or IAR tools for software development. With the RX113-series, the debug protocol is called “FINE” as opposed to “JTAG”.

Connecting the programmer/debugger to the SCM118 is accomplished using a Tag-Connect TC2050-IDC cable, available separately from [Tag-Connect](#) or [Digi-Key](#) as well as the RX111 FINE Adapter from Serious; both of these items are included in all SCM118 [Development Kits](#). See [Attaching the Programmer/Debugger](#) for instructions on how to use this port to connect to a debugger/programmer unit.



The FINE protocol only requires a small number of signals. The TC2050 debug pads also include signals necessary for pre-programming (using a custom adapter for the TC2050 IDC cable) the Serial NOR FLASH on the SCM118 if desired. The connector has the following signals:



Port	MCU Mode	PSEL	FCI60 Pin	Schematic Net Name	Operation
		-	-	+3V3	TC2050 J4.1 Debugger “device power-on” detect
P50	SMOSI2	01010	-	P50/SMOSI2-FLASH_SI	TC2050 J4.2 Serial NOR FLASH SPI MOSI
P52	SMISO2	01010	-	P52/SMISO2-FLASH_SO	TC2050 J4.3 Serial NOR FLASH SPI MISO
-	-	-	-	GND	TC2050 J4.4 Common system ground; see Power Supplies
MD	MD/FINED	-	-	MD/FINED	TC2050 J4.5 FINE debug/Boot mode pin
-	-	-	-	-	TC2050 J4.6 Unconnected
P14	UB#	-	-	P14/UB#	TC2050 J4.7 USB Boot (active low)
P53	GPO	-	-	P53/SS2#-FLASH_CS#	TC2050 J4.8 Serial NOR FLASH SPI Slave Select (active low)
P51	SCK2	01010	-	P51/SCK2-FLASH_SCKL	TC2050 J4.9 Serial NOR FLASH SPI Clock
RES#	RES#	-	-	SCM_RESET#	TC2050 J4.10 SCM/RX113RESET#

RX113 MCU CONNECTION SUMMARY

PORT PINS

PORT 0

Port	MCU Mode	PSEL	FCI60 Pin	Schematic Net Name	Operation
P02	SMIS06	01011	-	P02/SMIS06-BT_S0	BT SPI MISO
P04	SCK6	01011	-	P04/SCK6-BT_SCKL	BT SPI Clock
P07	SMOSI6	01011	-	P07/SMOSI6-BT_SI	BT SPI MOSI

PORT 1

Port	MCU Mode	PSEL	FCI60 Pin	Schematic Net Name	Operation
P11	*		-	P11/IRQ7#	JST14.14: GPIO, Interrupt Input
P13	*		-	P13/TMD3/IRQ3#	JST14.12: GPIO, Timer Output, Interrupt Input
P14	UB#	-	-	P14/UB#	TC2050 J4.7 USB Boot (active low)
P15	RSPCKA	01101	22	P15/RSPCKA-SIM_SPI_SCLK	SIM FCI60.22 SPI Clock (from SIM)
P16	USBO_VBUS	10010	-	P16/USBO_VBUS	USB Connection Detect (active high)
P17	SDA0	01111	42	P17/SDA0-SIM_I2C_SDA	SIM FCI60.42 I2C Data

PORT 2

Port	MCU Mode	PSEL	FCI60 Pin	Schematic Net Name	Operation
P20	SMOSI0	01010	-	P20/SMOSI0-WIFI_SI	WiFi SPI MOSI
P21	SMIS00	01010	-	P21/SMIS00-WIFI_S0	WiFi SPI MISO
P22	SCK0	01010	-	P22/SCK0-WIFI_SCLK	WiFi SPI Clock
P23	GPO	-	-	P23/SS0#-WIFI_CS#	WiFi SPI Slave Select (active low)
P25	GPO	-	-	P25-BT_SWDI0/RESET#	BT Reset (active low)
P26	GPO	-	3	P26-SIM_RESET#	SIM FCI60.3 RESET# control to SIM
P27	GPO	-	-	P27-WIFI_PWD#	WiFi Power down (active low)

PORT 4

Port	MCU Mode	PSEL	FCI60 Pin	Schematic Net Name	Operation
P40	GPO	-	-	P40-RSXXX_ON	RSXXX UART RS232 Power On
P41	GPI	-	-	P41-RS485/232#	RSXXX S1.3 232# status (read only)
P42	GPO	-	-	P42-MCP2515_CS#	CAN Controller SPI Slave Select (active low)
P43	GPI	-	-	P43-BT_MODE	BT Mode status (LED2 Red when high)
P44	GPI	-	-	P44-BT_CONN	BT Connection Status (LED2 Green when high)
P46	GPO	-	-	P46-BT_DFU	BT Factor Defaults (on reset)

PORT 5

Port	MCU Mode	PSEL	FCI60 Pin	Schematic Net Name	Operation
P50	SMOSI 2	01010	-	P50/SMOSI 2- FLASH_SI	TC2050 J4.2 Serial NOR FLASH SPI MOSI
P51	SCK2	01010	-	P51/SCK2- FLASH_SCKL	TC2050 J4.9 Serial NOR FLASH SPI Clock
P52	SMIS02	01010	-	P52/SMIS02- FLASH_S0	TC2050 J4.3 Serial NOR FLASH SPI MISO
P53	GPO	-	-	P53/SS2#- FLASH_CS#	TC2050 J4.8 Serial NOR FLASH SPI Slave Select (active low)

PORT 9

Port	MCU Mode	PSEL	FCI60 Pin	Schematic Net Name	Operation
P90	*		-	P90/AN005	JST14.7: GPIO, 12-bit ADC input
P91	*		-	P91/AN007	JST14.9: GPIO, 12-bit ADC input
P92	*		-	P92/AN021	JST14.11: GPIO, 12-bit ADC input

PORT A

Port	MCU Mode	PSEL	FCI60 Pin	Schematic Net Name	Operation
PA3	MISOA	01101	26	PA3/MISOA- SIM_SPI_MISO	SIM FCI60.26 SPI MISO (to SIM)
PA4	SSLA0	01101	19	PA4/SSLA0- SIM_SPI_SSEL#	SIM FCI60.19: SPI Slave Select (active low, from SIM)
PA6	MDSIA	1101	24	PA6/MDSIA- SIM_SPI_MOSI	SIM FCI60.24 SPI MOSI (from SIM)

PORT B

Port	MCU Mode	PSEL	FCI60 Pin	Schematic Net Name	Operation
PB0	SCL0	01111	39	PB0/SCL0- SIM_I2C_SCL	SIM FCI60.39 I2C Clock (from SIM)
PB1	IRQ4	I SEL	-	PB1/IRQ4- CANIRQ#	CAN Controller Interrupt (active low)
PB3	GPI	-	-	PB3-RSXXX_RXEN	RSXXX S1.4 HALF# status (read only)
PB4	*		-	PB4/CTS9#/RTS9#/SS9#	JST14.10: GPIO, UART CTS/RTS, SPI Slave Select
PB5	GPO	-	-	PB5/RTS12#- RSXXX_DE	RSXXX UART Transmit Enable

PORT C

Port	MCU Mode	PSEL	FCI60 Pin	Schematic Net Name	Operation
PC2	RXD5	01010	35	PC2/RXD5- SIM_UART_TX	SIM FCI60.35 UART transmit data (SIM to RX113)
PC3	TXD5	01010	37	PC3/TXD5- SIM_UART_RX	SIM FCI60.37 UART receive data (RX113 to SIM)
PC4	CLKOUT	01001	-	PC4/CLKOUT	CAN Controller 16MHz Input Clock
PC5	SCK1		-	PC5/SCK1- CAN_SCLK	CAN Controller SPI CLK
PC6	SMIS01		-	PC6/SMIS01- CAN_S0	CAN Controller SPI MISO
PC7	SMOSI 1		-	PC6/SMOSI 1- CAN_SI	CAN Controller SPI MOSI

PORT D

Port	MCU Mode	PSEL	FCI60 Pin	Schematic Net Name	Operation
PD0	GP0	-	41	PD0/IRQ0-SIM_IRQ#	SIM FCI60.41: SPI Data Available (active low, to SIM)
PD1	IRQ1	ISEL	-	PD1/IRQ1-WIFI_IRQ#	WiFi IRQ (active low)
PD2	IRQ2	ISEL	-	PD2/IRQ2-BT_IRQ#	BT IRQ (active low)

PORT E

Port	MCU Mode	PSEL	FCI60 Pin	Schematic Net Name	Operation
PE0	GP0	-	-	PE0-MCP2515_RESET#	CAN Controller reset (active low)
PE1	TXD12	01100	-	PE1/TXD12-RSXXX_TX	RSXXX UART Transmit Data
PE2	RXD12	01100	-	PE2/RXD12-RSXXX_RA	RSXXX UART Receive Data
PE3	*	-	-	PE3/ANO11/SCK9	JST14.4: GPIO, 12-bit ADC input, SPI Clock
PE4	*	-	-	PE4/ANO12/RXD9/SSCL9/SMS09	JST14.6: GPIO, 12-bit ADC input, UART RXD, I2C Clock, SPI MISO
PE5	*	-	-	PE5/ANO13/TXD9/SSDA9/SMSI9	JST14.8: GPIO, 12-bit ADC input, UART TXD, I2C Data, SPI MOSI
PE6	GP0	-	20	PE6-SIM_SPI_DATA#	SIM FCI60.20 SPI Data Ready to SIM (active low)
PE7	GP0	-	-	PE7-LED1_R	LED1 Red

PORT H

Port	MCU Mode	PSEL	FCI60 Pin	Schematic Net Name	Operation
PH7	GPI	-	46	PH7/SIM_3V3_DOCK	SIM FCI60.46 3V3 present

PORT J

Port	MCU Mode	PSEL	FCI60 Pin	Schematic Net Name	Operation
PJ0	*	-	-	PJ0/DA0	JST14.3: GPIO, 12-bit DAC output
PJ2	*	-	-	PJ2/DA1	JST14.5: GPIO, 12-bit DAC output
PJ3	SS6#	01011	-	PJ3/SS6#-BT_CS#	BT SPI Slave Select (active low)
PJ6	GPI	-	-	PJ6-RSXXX_SPD	RSXXX S1.2 SPD status (read only)
PJ7	GPI	-	-	PJ7-RSXXX_SLEW	RSXXX S1.1 SLEW status (read only)

*Configuration of pins on the JST14 connector depends on the OEM-desired usage of each pin.

INTERRUPTS

The following summarizes interrupt sources presented to the MCU:

Port	MCU IRQ	Schematic Net Name	Operation
PD0	0	PD0/IRQ0- SIM_IRQ#	SIM FCI60.41: SPI Data Available (active low, to SIM)
PD1	1	PD1/IRQ1- WIFI_IRQ#	WiFi IRQ (active low)
PD2	2	PD2/IRQ2- BT_IRQ#	BT IRQ (active low)
P13	3	P13/TMD3/IRQ3#	JST14.12: GPIO, Timer Output, Interrupt Input
PB1	4	PB1/IRQ4- CANIRQ#	CAN Controller Interrupt (active low)
P11	7	P11/IRQ7#	JST14.14: GPIO, Interrupt Input

*Not used as an IRQ input, but rather a simple GPIO output

SERIAL BUSSES AND DEVICES

The following summarizes the serial busses connected to the RX113 MCU:

Module	Mode	SPI/I2C/UART						Details
		SS#	CLK	MOSI TX SDA	MISO RX	IRQ#	RESET#	
RSPIA	SPI Slave	PA4	P15	PA6	PA3	-	P26	SIM SPI and SIM Reset Control
RIICO	I2C		PB0	P17		-		SIM I2C
SCI0	SPI Master	P23	P22	P20	P21	PD1	P26	WiFi
SCI1	SPI Master	P42	PC5	PC7	PC6	PB1	PE0	CAN
SCI2	SPI Master	P53	P51	P50	P52	-	-	Serial NOR FLASH
SCI5	UART			PC3	PC2			SIM UART
SCI6	SPI Slave	PJ3	P04	P07	P02	PD2	P25	Bluetooth
SCI12	UART			PE1	PE2			RS232/RS422/RS485

ADDITIONAL INFORMATION

The home page for SCM118 technical documentation is: <http://www.seriousintegrated.com/w/index.php?title=SCM118>

Further documentation, including schematics, STEP 3D CAD files, and more can be found there.

For more information on the SCM118:

- ▶ Visit www.seriousintegrated.com/SCM118
- ▶ Contact a [Serious manufacturers' representative](#)
- ▶ Contact a [Serious authorized distributor](#)
- ▶ Visit mySerious.com
- ▶ [Contact Serious](#) directly