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SIM535

Technical Reference Manual

RELEASE
Revision B2

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TRADEMARKS AND COPYRIGHTS

CONTENTS

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	13 Dec 12	1.0	• Initial prerelease version
A1	15 Feb 13	1.0	• Updated based on near-final schematics

A2	9 Jul 13	1.x & 2.0	• Added preliminary estimated power tables
			• Revised based on final 1.x schematics
			  • Revised SDRAM max to 32MB
			  • Updated LCD display specifications (NITs and pixel sizes)
			  • Audio rewrite for PCM1774 and Serial FIFO mode
			  • Updated for IDT VersaClock® and switcher
			  • Various other typos and cleanup

A3			• Clarified boot mode table • Added Touch Controller and I2C Device Summary section
A4	05 Sep 13	2.0	• Updated variant table in with final values • Noted potential memory size changes (SDRAM, e-MMC) • Changed Touch controller, added proximity and ALS • Changed Serious Power/Comms Connector to 16 pin JST ZPD
B0	06 Mar 14	2.0	• Replaced PCB Edge Connector with SHIP Programming Port and Tag-Connect TC2070 • Replaced USB Mini-B with Micro B • Replaced IDT clock tree with Si5351, removed SSG option from 7269 • Boot mode fixed for Serial Flash • Added LCD Option Tables and SSN decoder for LCD options • Updated physical specs for final outline • Added daughter card and SCM117 sections
B1	20 May 14	2.0,2.1	• Added daughter card fastener and standoff electrical recommendations • Added handling and care section • Updated dev kit contents to (5VDC Wall Adapter)
B2	16 Sep 14	2.0-2.2	• Added block diagram • TBD add note on alignment holes

DOCUMENT CONVENTIONS

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

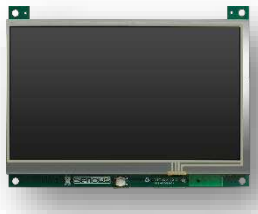
Pay special attention to this note – items especially subject to change, or related to compatibility, functionality, and usage.

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 SIM535 family of Serious Integrated Modules is a series of complete intelligent 7.0" WVGA 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.

USAGE MODELS

In most cases, you will be adding a SIM to a system that already has an MCU, I/O, power conditioning, and other custom interfaces. Perhaps your system already has a membrane keypad and a 2x16 character display or indicator LEDs. Your current MCU software in your existing system controller manages all aspects of your device, including (as applicable) belts, pumps, motors, servos, indicators, etc.

Rather than completely redesigning the hardware and software of your existing system to create a merged hardware/software architecture (LCD front panel plus system controller all-in-one), it is far more common to partition the problem by retaining your existing system controller and software and using the SIM as an intelligent stand-alone front panel.

Therefore SIMs typically most often used as stand-alone front panels responsible for managing just the Human Machine Interface (HMI) in a larger system. The existing, separate, device-specific system controller continues to manage the main functionality of the system. SIMs are equipped with several methods for simple interconnect to the external system controller, getting power from that external system, and communicating via a serial type link (SPI, UART, USB) to that controller to exchange data and commands.

Using the *Serious Human Interface™ Platform (SHIP)*, the software team can leverage the power of the *SHIPTide* rapid GUI development tools from *Serious*, developing a user interface in as little as a few hours and a few dozen lines of code. The *SHIPEngine* runtime firmware pre-installed on all SIMs takes care of all the drivers, rendering, communications, and event handling for the user interface, leaving the GUI development process to be focused on look and feel and differentiation of your device. You never need to write C code or use a JTAG debugger with a SIM to develop a modern-looking user interface.

SHIP software and development tools are available at no-cost for users of Serious Integrated Modules.
See www.seriousintegrated.com/SHIP for details.

Adding a simple software protocol driver to your system controller on the other end of the communications link allows your controller to communicate with the front panel. You can then architect inter-board messages such as "pump is on" which could be sent over the UART/SPI/etc. causing visual indicators to appear or change on the display. A GUI on the SIM535 could change user preferences, for instance, sending back messages such as "pump on days: MWF" which the system controller may store in its configuration EEPROM.

The possibilities are endless: the SIM535 module contains not only a powerful MCU but also a suite of hardware features that are commonly needed in many designs. An alarm panel, for example, could be as simple as a SIM535 connected to another PCB with a $0.20 MCU, a few relays and a battery.

HARDWARE

SIM535 family features include:

- 7” WQVGA 800x480 color TFT display
  - Various LCD features and touch panel options
- 240/266MHz 32-bit Renesas SH7269 MCU with FPU
  - 2.5MB RAM (frame buffer capable) with 2D Graphics Controller
- On Module Memory
  - 32MB SDRAM
  - 8MB boot serial FLASH + 2Kbit parameter EEPROM
  - Up to 4GB e-MMC FLASH memory for file systems, image data, executables, etc.
- Extensive I/O & Peripherals
  - Real Time Clock with coin cell battery backup option
  - PCB Temp Sensor
  - SD card socket
  - 60-Pin Board-to-Board Expansion Connector
  - 16-pin Power/Communications Connector
  - USB2.0 High-Speed Device Port
  - USB2.0 High Speed Embedded Host Port
  - Tag-Connect E10 Programming Port
  - SHIP Programming Port
- -20 to 70°C extended operating temperature
- -3.6 to 5.5V DC powered

Within the SIM535 are numerous family members, or “variants”. Each variant has a slightly different set of features and price points for an OEM to select the appropriate feature/cost point for their specific application.

Consult an authorized *Serious* representative for an up-to-date listing of order codes, family variants, and LCD options available.

This document version contains prerelease information prior to product introduction and is subject to change.

SOFTWARE

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 delivering video best-of-class GUI examples, fostering community demos and solutions, and providing software, tools, and consulting services.

The SIM535 is designed for use with the Serious Human Interface™ Platform tools and software. These PC-based tools offer rapid GUI prototyping, development, and deployment without the use of JTAG debuggers and low level coding. With minimal custom software you can create attractive and functional GUIs in a fraction of the time of C-based GUIs. See www.seriousintegrated.com/SHIP for details.

Renesas supports a limited set of customers for C-based development on the SH2 series of processors. For those applications requiring C-based development, contact *Serious*.

GETTING STARTED

The SIM535 comes pre-configured with a boot loader in the boot Serial FLASH and a demo program pre-installed in a FAT file system on the e-MMC FLASH. When initially powered, the demo will start running and displaying info on the LCD screen.

Many SIMs can be easily powered in the lab environment using the USB device connector from a PC/hub. However the SIM535's power needs exceed the capabilities of PC-based USB ports or hubs, so powering the SIM535 requires an external power supply. In addition, since the primary mechanism of communicating from the SHIPTide development tool to the SIM is through that same USB device port, you cannot use a higher-capacity tablet/phone power charger for this connection or you would obstruct the ability to communicate with the SIM. Therefore, powering the SIM535 requires delivering approximately 5V@1A to one of the ports that exposes the +VEXT signal:

- 16-pin Power/Communications Connector
- 60-Pin Board-to-Board Expansion Connector
- SHIP Programming Port

Powering from the 16-pin Power/Communications Connector

All SIM535 development kits come with a 16 pin wire harness for prototyping that can connect in to the 16-pin Power/Communications Connector. An AC power adapter with fixed 5VDC@1A output or similar lab power supply can be connected to the power pins of this harness to power the SIM535.

Powering from the 60-Pin Board-to-Board Expansion Connector

A variety of daughter-cards can be plugged into the 60-Pin Board-to-Board Expansion Connector and through this connector the SIM can be powered. For example, the off-the-shelf SCM117 Intelligent Power/Protocol Converter daughter card has an on-SCM DC-DC converter that can converter 9-25VDC to the 5VDC needed by both the SCM and the SIM. An AC power adapter or lab power supply with 9, 12, 15, or 24VDC at 5W or greater can be connected into the direct-wire-insert connectors on the SCM117.

Powering from the SHIP Programming Port

The SIM535 can be powered via the SHIP Programming Port (SPP). This port is commonly used for GUI development and connection with the SHIPTide development tool on the PC, since the SPP carries both USB and power to the SIM, and is a common port across many new SIMs including the SIM115, SIM231, and SIM535. Some SIM535 development kits include the SHIP Programming Connector 200 (SPC200), a small connector/cable adapter which plugs into the SPP on one end and on the other end plugs into a SHIP Programming Adapter 200 (SPA200). The SPA200 is connected to the PC via USB and provides intelligent programming services from SHIPTide and other PC-based software for development and volume programming. A stand-alone USB AC power adapter (1A minimum) connected to the SPA100 powers not only the SPA220, but also can power the attached SIM.

Be careful to connect the right power connections on the 16-pin wire harness to avoid damaging your SIM.

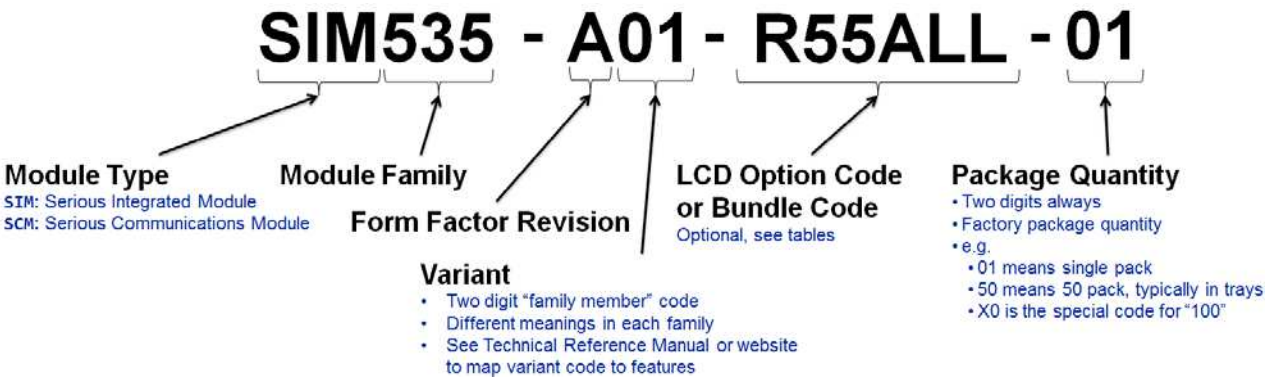
Several connectors may be used to power the SIM535. See Power Supplies.

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

ORDERING INFORMATION

ORDER CODES

SIM order codes are constructed as follows:



As of the time of this document's publish date, the current order codes are as follows:

Order Code	Description	Detail	Pkg Qty
SIM535-A01-DEV- 01	Dev Kit SIM115-A01-R45ALL w/SPA200-A00, Cables, Acrylic Case	Includes Serious SHIP Programming Adapter (SPA200-A00), no JTAG debugger/adapter included	1
SIM535-A01-R22ALL-01	Full Featured Color Graphic LCD Module 7.0" WVGA, Res Touch SH7269, 32MB RAM, 8MB FLASH, 4GB eMMC USB Host, USB Device, SD Card Prox, Ambient Light, RTCC	200+ NIT, 20k Hour Backlight, 24bit	1
SIM535-A01-R22ALL-05			5
SIM535-A01-R22ALL-25			25
SIM535-A01-R55ALL-01		500+ NIT, 50k Hour Backlight, 24bit	1
SIM115-A04-N55ALL-10			10
SIM115-A04-N55ALL-50			50
SIM535-A03-R22ALL-01	Low Cost Color Graphic LCD Module 7.0" WVGA, Res Touch SH7269, 32MB RAM, 8MB FLASH, 2GB eMMC Prox, Ambient Light, RTCC	200+ NIT, 20k Hour Backlight, 24bit	1
SIM535-A03-R22ALL-05			5
SIM535-A03-R22ALL-25			25
SIM535-A03-R55ALL-01		500+ NIT, 50k Hour Backlight, 24bit	1
SIM115-A03-N55ALL-10			10
SIM115-A03-N55ALL-50			50

SIM535 FAMILY MEMBER (VARIANT) OVERVIEW

As of the time of this document's publish date, the variants (aka family members) are:

Family Variant	A01	A02	A03	A04
MCU				
MCU	SH7269	SH7269	SH7269	SH7269
MCU Max MHz	266	266	266	266
MCU FLASH/RAM(kB)	0/2560	0/2560	0/2560	0/2560
JTAG E10 Debug	○◎	○◎	○◎	○◎
Memory				
SDRAM (MB)	32	32	32	32
eMMC (GB)	4	4	2	2
Boot Serial FLASH (MB)	8	8	8	8
EEPROM	✓	✓	✓	✓
LCD & Touch				
Touch	R4		R4	
Capacitive Proximity Sensor	✓		✓	
Ambient Light Sensor	✓	✓	✓	✓
Peripherals & GPIO				
User Red/Green/Orange LED	✓	✓		
PCB Temp Sensor	✓	✓		
Piezo Sounder	✓	✓		
32.768kHz Clock/Calendar	PCF8523	PCF8523	MCU	MCU
USB 2.0 HS device circuitry	S○▭	S○▭	S○	S○
USB 2.0 HS host circuitry	S○▬	S○▬		
Expansion Connectors				
USB2.0 High-Speed Device Port	✓	✓		
USB2.0 High Speed Embedded Host Port	✓	✓		
Full-sized SD Card Socket (SDIO)	✓	✓		
60-Pin Board-to-Board Expansion Connector Power, I2C, SPI, UART, DAC, I2S	✓	✓	✓	✓
16-pin Power/Communications Connector Power, I2C, SPI, UART	✓	✓	✓	✓
Power				
Power Input (5V typical)	○⊙S▭	○⊙S▭	○⊙S	○⊙S
CR1025 coin cell holder for RTCC backup	✓	✓		

⊙ on 16-pin Power/Communications Connector

○ on 60-pin Expansion Connector

◎ on Tag-Connect JTAG Port

S on SHIP Programming Port

▬ on USB2.0 High Speed Embedded Host Port

▭ on USB Micro B Device Port

⚠ This table contains pre-release information prior to product introduction and is subject to change.

LCD OPTIONS

Consult the following table for available LCD Options on the SIM535 family at the time of this document release. Not all LCD options are available for all variants: for an up-to-date list, contact an authorized *Serious* representative. For a detailed explanation of LCD Option Codes, consult the Serious website.

LCD Option Code **Serial Number Byte[1]**	**R22ALL** **0x01**	**R43AEL** **0x00**	**R55ALL** **0x02**
Size (diagonal, active, inches)	7.0	7.0	7.0
Resolution	800x480	800x480	800x480
Touch	R4	R4	R4
NITs (mcd/m min typ)	200+	400+	500+
Backlight Life (min typ, hours)	20k	30k	50k
Viewing Technology	Landscape	Landscape	Landscape
Viewing Angles (min typ)			
Y+ (12o'clock)	65°	60°	65°
Y- (6o'clock)	55°	50°	55°
X+ (3o'clock)	70°	70°	70°
X- (9o'clock)	70°	70°	70°
Proximity Detect Capable	✓	✓	✓
Color Depth (bits)	24	18	24
Operating Temp Range	-20[2] to +70C[3]	-20[2] to +70C[3]	-20[2] to +70C[3]
Storage Temp Range	-30 to +80C	-30 to +80C	-30 to +80C
On-glass RAM	0	0	0
Active Area (W x W mm)	154.08 x 85.92	153.6 x 86.64	154.08 x 85.92
Pixel Pitch (W x H µm)	192.6x179	192 x180.5	192.6 x179
Backlight Power (min typ/max typ @100%, mW)	975/1025[4]	1400/1550[4]	1600/1699[4]

Notes: [1]See *Serious* Serial Number

[2]LCD will become slightly sluggish at low temperatures below -10C

[2]LCD will become darker near the high end of the temperature range

[4]LCD power at the backlight; SIM boost converter inefficiencies increase this at a module level; see DC Operating Characteristics

Note that the PCB, MCU, and associated components may be rated for a larger operating temperature range than the LCD. In this case, the MCU will operate correctly over the entire operating range however the LCD may not function or be visible outside its specified operating range. In all cases, the narrower of the two recommended storage temperature ranges (PCB and LCD) should not be exceeded.

DEVELOPMENT KITS

The SIM535-A01-DEV-01 development kit contains everything needed to develop with SIM535 family. The kit contains:

- SIM535-A01-R55ALL module
  - Superset of all SIM535 features
  - Bright 500+ NIT Resistive Touch LCD with proximity and ambient light detection
- SHIP Programming Adapter 200 (SPA200)
  - Includes SHIP Programming Connector 200 (SPC200)
  - Enables easy powering/connectivity from the PC
  - 5V 12W wall power supply for lab use (110/220VAC EU/US voltage and plug compatibility)
  - Barrel to screw terminal power jack adapter
- 16 pin wire harness (JST16 plug one end, tinned the other) for lab cable enabling
- Acrylic “enclosure” for safe handling and demonstration use

The SPA200 and SPC200 are set for release in Q3 2014; Development kits shipped prior to this release will include a mail-in coupon for these.

This is a preliminary table (prior to product release) and is subject to change.

The SIM535 is intended for GUI development with the Serious Human Interface™ Platform and has limited support from Renesas for C-level development, therefore the standard SIM535 development kit has no JTAG debugger included. Customers who which to do C/JTAG-level development will need a Tag-Connect TC2070 adapter cable and a Renesas E10 programmer/debugger.

SPECIFICATIONS

DC MAXIMUM RATINGS

The following are absolute maximum limits for the specified variants:

Specification	Variants	DC Limits			
		Min	Typ	Max	Units
Input Supply Voltage +VEXT	A01[1] A02[1]	4.50	5.00	5.25	V
	A01[2] A02[2]	3.60	5.00	5.25	V
	A03 A04	3.60	5.00	5.50	V

Notes: [1]USB Host circuit enabled
[2]USB Host circuit never enabled

DC OPERATING CHARACTERISTICS

MODULE LEVEL

The following DC characteristics apply to all variants of the SIM535, and ***do not include LCD backlight power*** which must be added to the total depending on the LCD option selected:

NOTE: All numbers in *colored italics* are pre-production estimates.

Specification	USB Host Boost	Range				
		Typ[1,2,5]	Typ[1,3,5]	Max[1,2]	Max[1,3]	Units
Input Supply Current +VEXT	RESET					mW
	off					mW
	on[4]				*3000*	mW

Notes: [1]Any additional external current draw from the module is in addition to this value
[2]At minimum voltage on supply
[3]At typical input supply voltage
[4]No device inserted; device power is in addition to this number plus typical conversion loss of 10%.
[5]Estimated (will be changed to "Measured" after characterization)

BY SUBSYSTEM

The amount of power necessary for SIM to function is highly dependent on how and which features of the module you use. This is especially true for major power consumers such as the LCD backlight and USB embedded host port. Depending how your application uses these features, the typical and maximum power numbers can be appropriately subtracted from the maximums for the SIM respectively. Assuming typical switching conversion efficiency, the power breakdown of the elements is as follows:

NOTE: All numbers in *colored italics* are pre-production estimates.

Subsystem	Circuit-Local Power Required (mW)[1]			+VEXT to Local Conversion Efficiency (typ)	+VEXT Power Required (mW)[1]		
	Min	Typ	Max		Min	Typ	Max
LCD (backlight) – R22ALL		*975*	*1025*	*86%*		*1134*	*1192*
LCD (backlight) – R43AEL		*1400*	*1550*	*86%*		*1627*	*1802*
LCD (backlight) – R55ALL		*1600*	*1699*	*86%*		*1860*	*1976*
LCD (logic)		*561*	*700*	*92%*		*610*	*760*
Piezo w/Boost Enabled		3	12	*80%*		4	15
MCU (3.3V)		*521*	*616*	*92%*		*567*	*670*
MCU (1.25V)		*299*	*414*	*90%*		*332*	*460*
SDRAM		*165*	*495*	*92%*		*179*	*538*
SFLASH		33	83	*92%*		36	90
e-MMC		*10*	*264*	*92%*		*11*	*287*
SD card		0[2]	0[2]	*92%*		0[2]	0[2]
Resistive Touch		*33*	*56*	*92%*		*36*	*61*
USB Host		0[2]	0[2]	*90%*		0[2]	0[2]
USB Host (device inserted)			*750*	*90%*			*833*
Other logic and miscellaneous		*tbd*	*tbd*	*92%*			

Notes: [1]At typical input supply voltage
[2]No device inserted; device power is in addition to this number.
[3]50% white/50% black or 50% RGB pixel intensity
[4]100% white

MCU I/O

Many I/O signals on the SIM535 are directly and exclusively connected to SH7269 MCU pins. Consult the SH7269 data sheet for complete specifications of each pin.

There are specific power limitations on the MCU pins. Consult the SH7269 data sheet for more information. Exceeding these limits may damage your board, damage attached systems, overheat or cause things to catch fire.

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.

The no-cost Serious Human Interface™ Platform software initializes the MCU and SIM components for correct operation.

ENVIRONMENTAL CHARACTERISTICS

Specification	Variant	Permissible Range			
		Min	Typ	Max	Units
Operating Temperature	All	-20		+70	C
Storage Temperature	All	-30		+80	C
Humidity	All			90% (@60C)	RH

HANDLING AND CARE

Observe the following handling and care guidelines.

HANDLING

Be very careful when handling the edge of the SIM where the flexible cable from the LCD panel is exposed. This can be easily damaged or ripped if shear-force is applied in 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.

As with any glass product, use reasonable care when handling to avoid glass chips and cracks.

If the LCD glass breaks and the LCD liquid materials escape, avoid contact with bare skin. Wash exposed skin with soap and water immediately and dispose of the product according to local materials handling procedures.

If the SIM comes in factory packaging with a protective cover sheet on the LCD, it is advised to leave this protective film in place until the SIM is mounted in the final assembly to prevent scratches and fingerprints from marring the display surface. Do not expose to high temperature and/or high humidity testing with the protective sheet place. Slowly remove the protective sheet to minimize potential static electricity creation.

PRESSURE AND IMPACT

On non-touch variants apply no pressure, and ensure no impact can be made by end users, to the surface of the LCD display. There is no specification for pressure or impact on non-touch LCDs.

On touch variants, do not use sharp objects to activate the touch screen or the overlay material may be damaged.

Do not apply any bending/twisting force to the LCD or the SIM PCB or the unit may be permanently damaged.

STORAGE

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

1. Store SIMs 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 SIM 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.

CLEANING

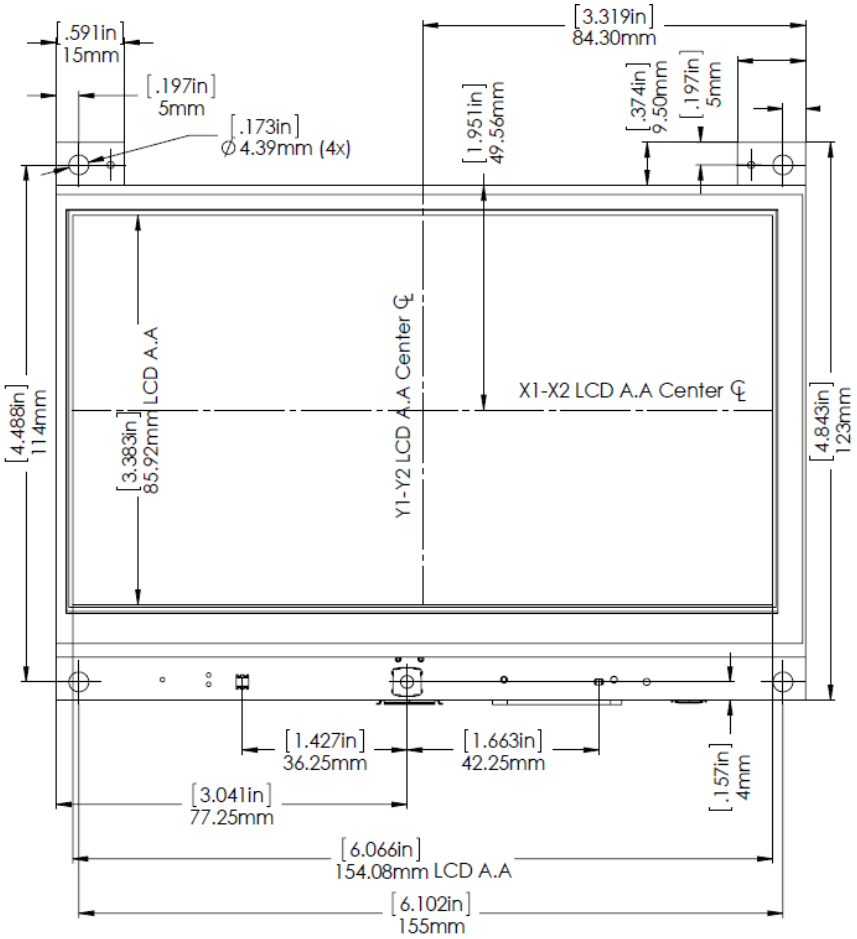
If cleaning of the LCD panel surface is necessary, Isopropyl or Ethyl alcohol, either 100% or mixed 50%/50% with distilled water, may be used on a moist clean soft cloth.

Do not use abrasive, ketone-containing, and aromatic solvents which will damage polarizer materials.

PHYSICAL CHARACTERISTICS

This section is provided as a helpful overview only.
The authoritative mechanical reference is the SIM535 Mechanical Design Package (MDP), which includes 2D drawings and STEP models, and is available for download at www.seriousintegrated.com/docs.

The outer dimensions of the SIM535 are 165mm x 123mm. Any connectors populated along the bottom edge may extend up to an additional 2mm beyond the 123mm of the PCB. The SIM is designed to be mounted using four M4 machine screws.



Example SIM535-A01-R22ALL Outline Dimensions

Each LCD option may be slightly different, and each variant may remove some features from the total possible. For example, the A03 variant has fewer connectors populated, affecting the maximum outer dimensions of the module.

DAUGHTER CARD PHYSICAL GUIDELINES

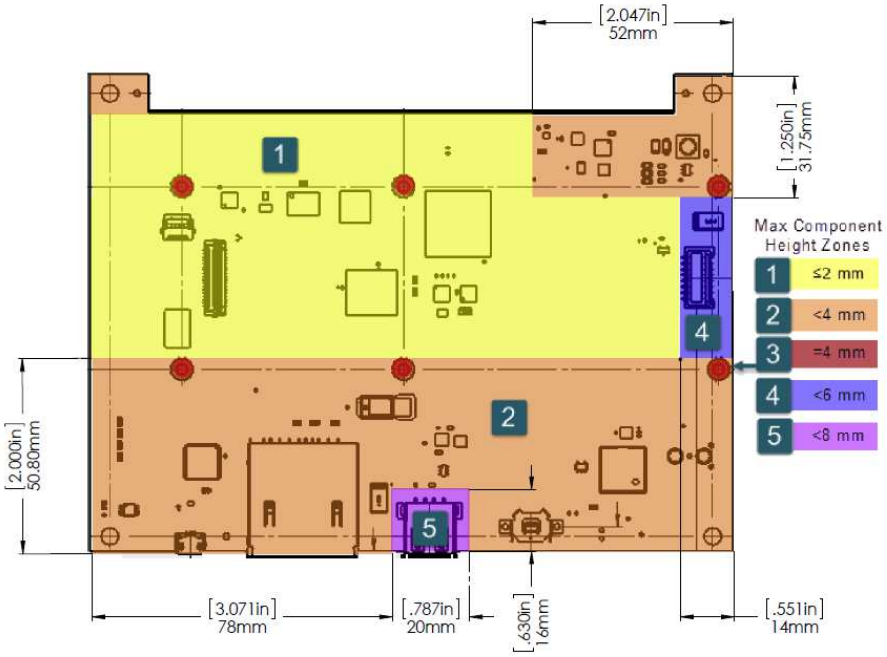
This section is provided as a helpful overview only.
The authoritative mechanical reference is the SIM535 Mechanical Design Package (MDP), which includes 2D drawings and STEP models, and is available for download at www.seriousintegrated.com/docs.

Most SIM535 variants include the 60-Pin Board-to-Board Expansion Connector. These variants also include six M3 threaded standoffs (PennEngineering® SMTSO-M3-4-ET or similar) to firmly support and attach a daughter card at the correct 4mm board-to-board distance.

Serious reserves the right to substitute components and/or change component layout on SIMs at any time without notice. Exceeding the height envelope described below with the assumption of specific SIM component used and/or placement so as to utilize the inner-stack-height for daughter card components may cause mechanical conflicts in future SIM revisions.

It is possible to create a single daughter card that can dock into numerous SIMs, including the SIM115, SIM231, and SIM535. 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.

The board-to-board distance with this connector (when used with an identical mated connector) is only 4mm, enabling a daughter card to be developed with a very low overall combined profile. For components on the side of the daughter card facing the SIM, observe the maximum component height zones on the SIM – your components may extend only 4mm *less this distance* on the SIM-facing side of your PCB:



Example SIM535-A01-R22ALL Max Height Zone Map

For example, in the yellow shaded area above, the components on the SIM535 are less than 2mm total height, leaving (4mm board-to board) minus (2mm yellow height zone) = 2mm for components on the SIM-facing side of a daughter card.

Note that component data sheets typically indicate the physical height of the component which is not necessarily the same as the total height of the component after soldering, which may slightly raise (or even lower, in the case of some BGAs) the component.

For prototyping, any M3-0.5x6mm pan head or cap socket screw can be used to attach a daughter card to the SIM. For production units, the recommended screw and assembly torque specifications for attaching a daughter card are as follows:

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 *Test Procedure for the Performance of Metric Nonmetallic Resistant Element Prevailing Torque Screws*		
	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)		

**subject to final production characterization*

Small quantities of this type of screw can be readily purchased from McMaster-Carr (93705A813).

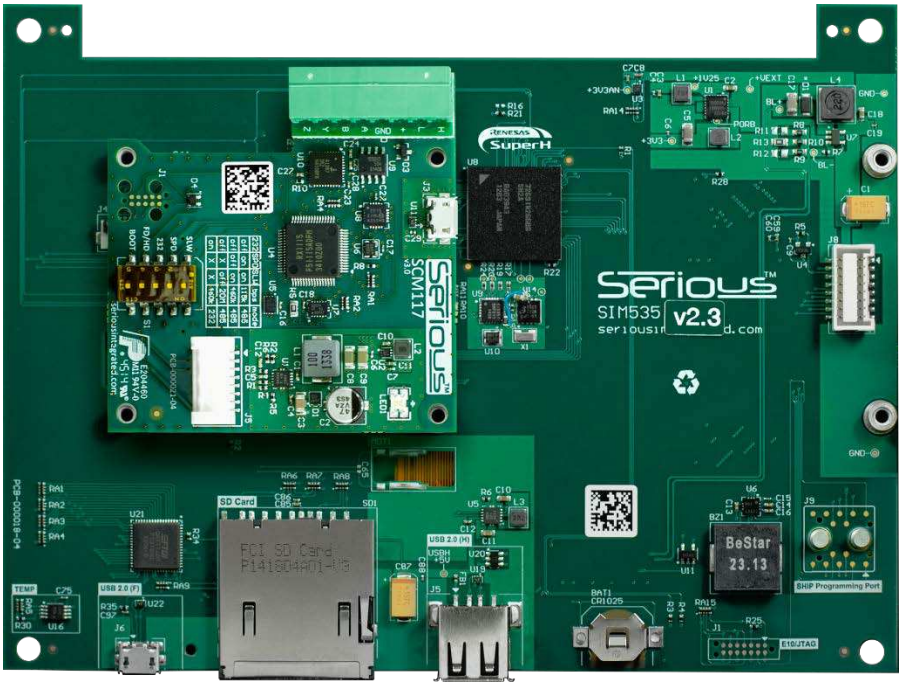
Do not apply excessive torque to daughter card screws into the threaded standoffs or they may tear from the PCB and permanently damage the SIM.

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.

SERIOUS COMMUNICATIONS MODULES

Serious has several new communications daughter cards designed to dock into the back of the SIM115, SIM231, and SIM535 as well as some future SIMs.

The Serious Communications/Power Module 117 (SCM117) family, for example, is a series of flexible and production-worthy communications and power conversion accessory boards for use with Serious Integrated Modules (SIMs). The SCM117 can dock directly into newer SIMs such as the SIM115, SIM231, and SIM535 forming a low profile and cost effective combination.



Example SCM117 Docked into SIM535 v2.3

The SCM117 family has numerous members, or "variants", implementing all or a subset of the following:

- RS232, RS422, RS485, and CAN transceivers
- Renesas RX111 MCU for local protocol translation and control
- DC-DC converter for powering the SCM and attached SIM from network-borne power

The SCM117's most basic functionality is to provide network physical layer transceivers from the network cabling (RS232, RS485, RS422, or CAN) to the SIM, as well as network power conversion from whatever voltage (+9-25VDC) is available on the network cabling to the 5VDC required by the SIM and SCM.

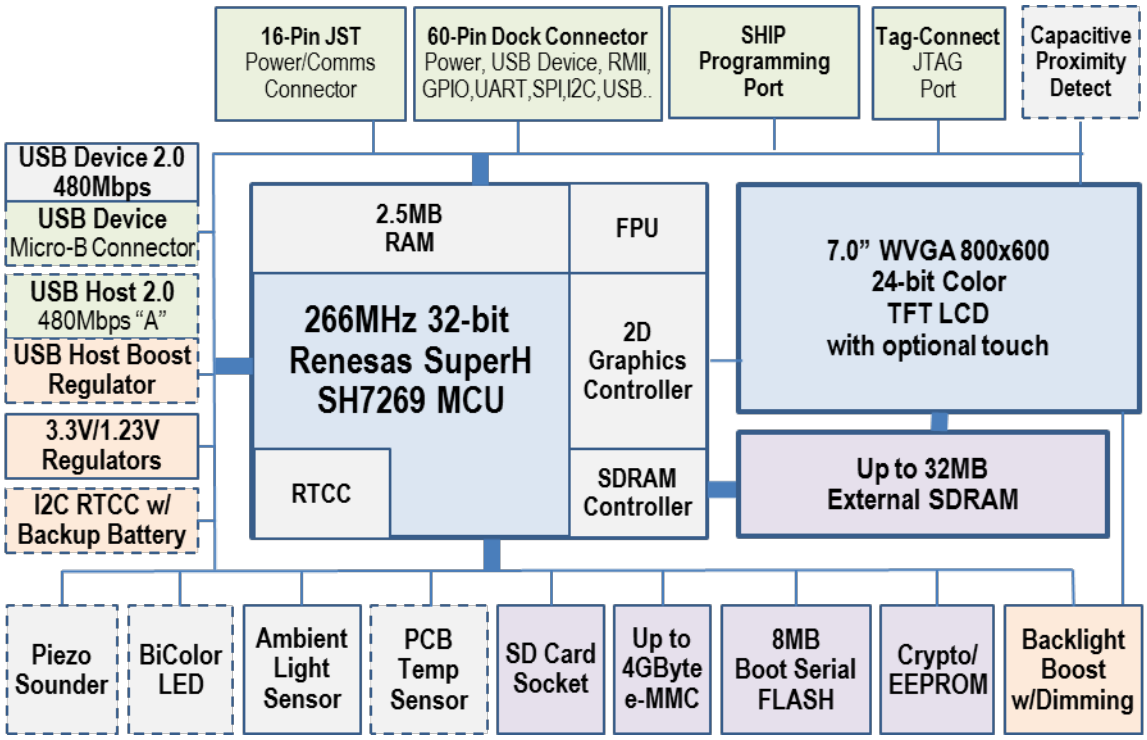
Variants with the RX111 MCU place the RX111 in the middle of this conversation: the RX111 can communicate with the SIM using one protocol (for example, Modbus or the new *SHIP Bridge* protocol) and another protocol on the network (for example, your own proprietary protocol).

For more information on the SCM117, see the *Serious* website.

HARDWARE OVERVIEW

HIGH PERFORMANCE RENESAS SH2 MCU

The heart of the SIM535 is the 32-bit Renesas SH7269 microcontroller (MCU) with up to 2.5MB of internal RAM, FPU, and integrated 2D Graphics Controller. This powerful MCU is equipped with extensive analog and digital peripherals and, with software, can deliver an excellent user interface experience. At a high level, the functional block diagram of the SIM535 is as follows:



SIM535 Hardware Block Diagram
options depend on variant selected

Not all features are available on all SIM5353 variants (family members).

GRAPHIC COLOR LCD DISPLAY AND TOUCH OPTION

The SIM535's Liquid Crystal Display ("LCD" or "glass") has an on-glass row-column driver chip for illuminating pixels but has no on-glass frame buffer or memory. The SH7269 MCU has an on-chip 2D graphics controller/accelerator for delivering pixel data at ~60 frames per second directly to the LCD over a 16, 18, or 24 bit LCD RGB interface. The MCU also has ~2.5MB of internal RAM capable of storing some or all of the pixel data that composes the image(s) to be delivered to the LCD plus other software program data. At 800x480 pixels and 16 bits per pixel, ~1.5MB of the RAM will be used for the graphic frame buffers and this data can fit inside the internal MCU RAM. When used in 24 bit color mode, one frame buffer will fit in internal RAM and the other must be placed in SIM's on-board DRAM.

Some SIM535 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 converter channels and translated with a simple algorithm into a pixel hit position. These touch-enabled variants may also include proximity detection where the proximity of a bare finger will be detectable by sensors which can be read by software.

ON-MODULE PERIPHERALS

The SIM535 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 device, USB host, boot Serial FLASH, high speed UART(s), EEPROM, bi-color indicator LED, a user "select" switch, and more.

ON-MODULE MEMORY

The SIM535 module has a variety of memory for storage of program, data, images, parameters, etc.:

FLASH Memory:

- Up to 8Mbytes (64 Mbits) bootable serial FLASH memory attached via dedicated SPI
- Up to 4GB of e-MMC FLASH

EEPROM

- 2Kbits EEPROM

RAM

- 2.5MBytes RAM within the SH7269
- Up to 32MBytes of external DRAM

COMMUNICATIONS AND CONNECTORS

The SIM535 has numerous off-module communication ports and connectors. Some may or may not be available on specific SIM535 variants.

- 60-Pin Board-to-Board Expansion Connector with extensive I/O including:
  - SPI, I2C, CAN, and high-speed UART ports
  - USB device and host connections
  - Power input/output
  - GPIO
  - I2S and 10 bit mono 3.3V DAC
- Tag-Connect E10 Programming Port for JTAG MCU-level debugging, including:
  - Tag-Connect TC2070 adapter connection to 14-pin Renesas E10 and equivalent devices
- USB2.0 High-Speed Device Port
- USB2.0 High Speed Embedded Host Port with 150mA drive capability
- 16-pin Power/Communications Connector
  - Suitable for an inexpensive wire harness with latching plug connection
  - 3.3V Tx/Rx UART, SPI, +5V in, +3V3 out, RESET#, and DAC 3.3V (mono audio) output

POWER

The SIM535 module can be powered from 5VDC 1A typical supply applied to the +VEXT signal available on several connectors:

- Power and Communications Connector
- 60-Pin Board-to-Board Expansion Connector
- SHIP Programming Port

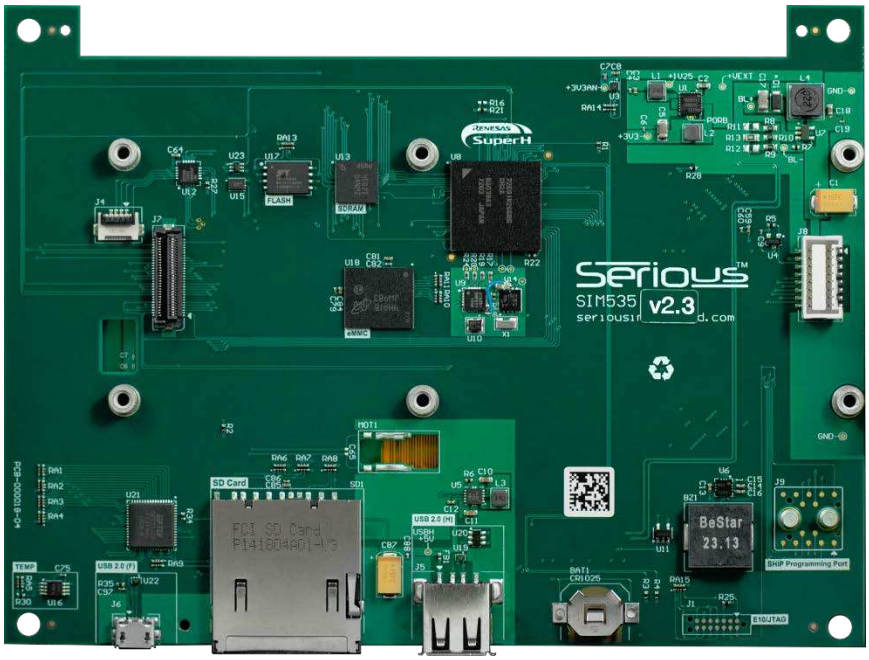
In the software development environment, the SHIP Programming Connector 200 (SPC200) plugged into the SHIP Programming Port and used with the SHIP Programming Adapter 200 (SPA200) is often the best choice.

See Getting Started for an overview of how to power the SIM535.

See DC Operating Characteristics for more information on input power supply parameters.

See Power Supplies for a detailed description of the power circuitry on the SIM.

MODULE FEATURE DETAIL



SIM535-A01 v2.0 Component Side View

RENESAS SH7269 MCU

At the heart of the SIM535 is a 266MHz 32-bit Renesas SH7269 MCU equipped with extensive analog and digital peripherals. Features include:

MCU Core & Memory

- 266MHz 32-bit core with 16KB cache
- 2,624 kB internal RAM
- Hardware Floating Point Unit (FPU)

Peripherals include:

- One USB 2.0 HS port
- SDRAM controller
- SD Card Controller
- Graphics controller with 2D acceleration (up to 800x600)
- 16-channel DMA controller
- 8 channel 10-bit A/D Converter
- Numerous SPI, I2C, CAN, I2S, and high-speed-capable serial ports

MCU BOOT MODES

The SIM535 is wired such that the SH7269 always boots from Serial FLASH. This chip comes factory programmed with a *Serious* boot loader program.

To use the full features of the Serious Human Interface™ Platform, you need to preserve the *Serious* firmware in the boot Serial FLASH.

The firmware in the boot Serial FLASH can be updated to new revisions over-the-wire from your attached system using the *Serious* SHIPBridge protocol over USB, UART, or SPI. It can also be updated over USB (via the SHIP Programming Port or USB Micro B Device Port) from a PC using the SHIPTide development tool or the SHIPCrane production programming tool.