SoM-215GS

User Manual

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1 Introduction

This document provides information regarding EMAC's SoM-215GS System-on-Module Carrier Board. The SoM-215GS is an ultra-compact SoM Carrier/Socket board with an optional 4.3" WQVGA (480X272) TFT color LCD with a resistive touch screen. This carrier is designed to work with all EMAC 200-pin SODIMM type SoMs. The SoM-215GS is specifically designed for 200-pin SoMs with video and dual ethernet capabilities.

Note: The SoM-215GS can support 10/100/1000 BaseT (GbE) Ethernet on one of its Ethernet Ports and 10/100 BaseT on the other.

The SoM-215GS provides access to much of the SoM's I/O through on-board connectors and headers. The SoM-215GS carrier features an IEEE 1588 precision-time-protocol (PTP) 10/100 BaseT Ethernet Interface in addition to the SoM's 10/100/1000 BaseT Ethernet Interface. The integrated 1588 functionality allows system users the flexibility and precision of a close to the wire timestamp.

The SoM-215GS pairs well with EMAC's SoM-A5D36 which is able to utilize all the features the SoM-215GS supports including dual Ethernet.

1.1 Features

- **200 Pin SODIMM SoM Connector**
- **1x 10/100/1000 BaseT Ethernet**
- **1x 10/100 BaseT IEEE 1588 PTP Ethernet (Optional)**
- **3x Serial Ports (2x RS232, 1x RS232/422/485)**
- **4x USB 2.0 Ports (2x Host, 1x Device, 1x OTG)**
- **1x CAN 2.0B**
- **Battery for Real Time Clock**
- **Audio Beeper**
- **GPIOs (SPI, I2C, Timers, Counters, etc...)**
- **WQVGA (480 X 272) TFT LCD with Resistive Touchscreen (Optional)**
- **Linux BSP and SDK available with Precision Time Protocol (PTP) package**

2 Hardware

2.1 Specifications

- **System Reset:** Reset Button
- **RTC:** RTC with battery backup provision
- **Digital I/O:** 10x GPIOs, IRQ, I2C
- **Analog I/O:** 4x ADCs
- **JTAG:** PTP Ethernet PHY JTAG
- **Clocks:** PTP Clock

LCD

- **Display Type:** 4.3” TFT Color LCD
- **Resolution:** 400 x 272 WQVGA @ 256K Colors
- **Dot pitch:** 0.66m x 0.198mm
- **Luminance:** 400 (cd/m^2) typical
- **Contrast Ratio:** 500 typical
- **Viewing Angle:** 70° typical
- **Brightness:** Software Controlled
- **Backlight:** White LED

Touchscreen

- **Type:** 4 Wire Analog Resistive
- **Resolution:** Continuous
- **Light Transparency:** 80% minimum
- **Controller:** Built-In
- **Driver:** WinCE, Linux
- **Durability:** Over one million touches

Serial Interfaces

- **UARTS:** 2x RS232, 1x RS232/422/485
- **SPI:** 1x SPI (3 chip selects)
- **USB:** 2.0 High Speed 2x Host, 1x Device (Serial Console), 1x OTG

Ethernet Interface

- **PHY:** 1x IEEE 1588 PTP Transceiver (PHY for the 1000 BaseT Port is on the SOM)
- **Interface:** 1x 10/100/1000 BaseT, 1x 10/100 BaseT (IEEE 1588 PTP)

Mechanical and Environmental

- **Dimensions:** 4.81" x 3.00" X 1.20"
- **Power Supply Voltage:** 5VDC**,** 8VDC ~ 36VDC
- **Power Requirements:**
  - Typical < 1.0 A @ 5VDC
- **Operating Temperature:** -20ºC ~ 70ºC

2.2 Jumper Configuration & Connector Descriptions

The SoM-215GS is factory configured. In the event that jumpers need to be verified or modified this section provides the information required, including instructions on setting jumpers and connecting peripherals, switches and indicators. Be sure to read all the safety precautions before you begin any configuration procedure. See Appendix A for connector pinouts and Appendix B for Jumper Settings.

Table 1: Connectors

Label	Function
CN1	4-pin (0.1") Alternative Power Supply
CN2	3-pin (0.1") CAN Connector
CN3	LCD Connector
HDR1	I/O Header
HDR2	COM C (RS232/422/485) Header
HDR3	COM D (RS232) Header
HDR4	COM A (RS232) Header
HDR5*	IEEE 1588 PTP Ethernet Transceiver I/O Header
HDR6*	IEEE 1588 PTP Ethernet Transceiver JTAG Header
JK1	5VDC Barrel Jack
JK2	USB Micro B Device Connector (Serial Console)
JK3	Dual RJ45 Connector
JK4	Dual USB Type-A Connector
JK5*	SMA Connector
JK6*	SMA Connector
JK7	USB Mini AB OTG Connector
SOK1	200-pin SODIMM

***Special Order Item Contact EMAC**

Table 2: Jumpers

Label	Function	Default
JB1	Boot 0 Source Selection	A
JB2	Boot 1 Source Selection	B
JB3	Flash Write Protect	B
JB4	Retention Battery	ON
JB5	CAN Termination	OFF
JB6	Ethernet Phy Mode	Installed across both pins (GbE Mode)

2.3 Power Connectors

The SoM-215GS provides two main power supply connectors. The 5VDC barrel jack (JK1) is a standard 5.5mm barrel jack with an inner diameter of 2.1mm with a center V+ connection and has an operating temperature of -25 ~ 85°C. This jack (part# PJ-102A) allows for an easy connection to a wall mount power supply. The alternative wide-input, 5VDC and/or 8VDC to 36VDC, power connector (CN1) is a locking power connector intended for industrial applications (part# 254B5V1040). This power input provides a more rugged/industrial locking connection with an operating temperature of -25 ~ 85°C. The mating connector for CN1 is part# 171822-4. When CN1 is utilized, the SoM-215GS can be powered from 5VDC or 8VDC to 36VDC.

Table 3: CN1 Pinout

Pin	Description
1	5VDC
2	Ground
3	Ground
4	8VDC ~ 36VDC

2.4 Ethernet

The SoM-215GS provides a 10/100/1000 BaseT (GbE) port, ETH0. Note: this port supports both 100BaseT SoMs as well as 1000 BaseT SoMs. Setting the mode (either 10/100 or GbE) is accomplished using the Phy Mode jumper (JB6). See Appendix B (5.6) for jumper settings. The design also features Texas Instruments' DP83640 Precision PHYTER (IEEE 1588 Precision Time Protocol (PTP) Transceiver) which provides a 10/100 BaseT IEEE 1588 PTP Ethernet port, ETH1. The PHYTER device delivers the highest level of precision clock synchronization for real time industrial connectivity based on the IEEE 1588 standard. The device supports the following 1588 features: Packet time stamps for clock synchronization, Integrated IEEE 1588 synchronized clock generation and synchronized event triggering and time stamping. Both Ethernet interfaces are accessible on the Dual RJ45 Connector (JK3). Note the SoM must support dual Ethernet for 1588 functionality.

Table 4: Dual RJ45 Connector (JK3) Port Mapping

Port	Interface
Top	ETH0
Bottom	ETH1

2.5 Serial Ports

The SoM-215GS is equipped with three serial ports, all of which terminate to 10-pin header connectors. Two of the three are RS232 serial ports (COM A and COM D) and one is a RS232/422/485 software configurable multi-mode serial port (COM C). A USB to Serial chip allows the connection from a PC USB Host Port to communicate to the SoM-215GS Serial Console (COM B).

- Serial Port COM A is an RS232 port. This port offers RTS and CTS handshake lines terminating at header HDR4.

Table 5: Serial Port COM A (HDR4)

Pin	RS232 10-Pin Header Description
1	NC
2	NC
3	COMA232_RXD
4	COMA232_RTS
5	COMA232_TXD
6	COMA232_CTS
7	NC
8	NC
9	GND
10	NC

- Serial Port COM C terminates to a 10-Pin header located at HDR2 and can be configured as RS232, RS422, or RS485 via software. Please reference tables 7 & 8 below for COM C configurations. Note: COM C is disabled on power-up. When using COM C, a 120Ω termination resistor can be enabled by setting GPIO8 high (pin-122).

Table 6: Serial Port COM C (HDR2)

Pin	RS-232 10-Pin Header Description	RS-422/485 10-Pin Header Description
1	COMC232_DCD	COMC4XX_TX-
2	NC	NC
3	COMC232_RXD	COMC4XX_TX+
4	COMC232_RTS	NC
5	COMC232_TXD	COMC4XX_RX+
6	COMC232_CTS	NC
7	COMC232_DTR	COMC4XX_RX-
8	NC	NC
9	GND	GND
10	NC	NC

Table 7: COM C RS232 MODE

Pin Number	Pin Name	Pin State
115	GPIO1	H
120	GPIO6	H

Table 8: COM C RS422/485 MODE

Pin Number	Pin Name	Pin State
115	GPIO1	L
120	GPIO6	L

- Serial Port COM D is an RS232 port. This port also offers RTS and CTS handshake lines terminating at header HDR3.

Table 9: Serial Port COM D (HDR3)

Pin	RS232 10-Pin Header Description
1	NC
2	NC
3	COMD232_RXD
4	COMD232_RTS
5	COMD232_TXD
6	COMD232_CTS
7	NC
8	NC
9	GND
10	NC

2.6 USB

The SoM-215GS provides four USB 2.0 ports: HOST A, HOST B, OTG C, Serial Console COM B

Host A and Host B are High-Speed USB 2.0 Host Ports accessible on the Dual USB Connector (JK4).

Table 10: Dual USB Connector (JK4) Port Mapping

Port	Interface
Top	HOST B
Bottom	HOST A

OTG C is a High-Speed USB 2.0 software configurable Host or Device Port accessible on the mini-USB Connector (JK7). The OTG C interface includes an external USB VBUS power switch (U18), which is disabled by default. The 5V power switch can be enabled by setting GPIO11 (pin-125) high. Note in order for true OTG capabilities the SoM most support true OTG.

COM B is a Full-Speed USB 2.0 Device port, which provides a console interface by default, accessible on the micro-USB Connector (JK2). Green LED (LD3) provides verification of USB link.

2.7 LCD

The SoM-215GS provides a 24-bit (RGB) TTL LCD interface accessible on the 40-pin (0.5 mm) FFC/FPC Connector (CN3). The LCD interface is compatible with FEMA Electronics 4.3" Color TFT (480x272) LCD with resistive touchscreen. LCD brightness can be controlled by adjusting the duty cycle of the LCD PWM output (pin-85).

Note: The LCD backlight can be enabled by setting GPIO0 (pin-114) high.

A compatible 4.3" LCD bracket is available. The SoM-215GS provides four interior mounting holes to support the LCD bracket.

2.8 CAN

The SoM-215GS provides a CAN 2.0B interface utilizing the TI TCAN332GDCNT Transceiver chip. The CAN is accessible via a 3-pin (0.1") Locking Connector (CN2). Note: A 120Ω termination resistor can be enabled by setting the CAN termination jumper (JB5) to the 'TRM' position.

Table 11: CN2 Pinout

Pin	Description
1	GND
2	CAN_L
3	CAN_H

2.9 I/O Expansion

The SoM-215GS provides access to a number of I/O lines on header (HDR1). This 20-pin dual row header features ADC, I2C, SPI, GPIO and IRQ interfaces. Signal names are listed in the table below.

Table 12: HDR1 Pinout

Pin	Signal
1	GND
2	3.3V
3	I2C_DAT
4	I2C_CLK
5	RST_OUT#
6	SPI0_MISO
7	SPI0_SCLK
8	SPI0_MOSI
9	SPI0_NCS1
10	SPI0_NCS0
11	SPI0_NCS3
12	GPIO7
13	ADC5
14	GPIO13
15	ADC6
16	IRQA
17	ADC4
18	GPIO15
19	ADC7
20	GPIO12

2.10 Audio

The SoM-215GS features one 85dB audio buzzer (SPK1). The audio buzzer can be enabled by driving GPIO14 (pin-128) high.

2.11 Real-Time Clock (RTC)

The SoM-215GS is equipped with an external battery (BH1) for backing up the module's Real-Time Clock (RTC) for the RTC retention battery. Jumper JB4 should be placed in the ON position in order to retain the system's time when powered down.

2.12 LEDs and Reset

The SoM-215GS features a 3.3V power status LED (LD1) and a user programmable LED (LD2). The user programmable LED can be enabled by driving GPIO10 (pin-124) high.

The SoM-215GS also features a System Reset Button (PB1) that will initiate a hardware reset when actuated.

2.13 FRAM (Special Order Item Contact EMAC)

The SoM-215GS can support a Ferroelectric RAM (2Mb, 4Mb and 8Mb density options).

3 Software

The SoM-215GS offers a wide variety of software support from both open source and proprietary sources. Software Board Support Packages (BSPs) and Linux Software Development Kits (SDKs) are available for most SoM processor modules. For more information on Linux Software Support, please visit the EMAC Wiki Software Section at:

http://wiki.emacinc.com/wiki/Product_wiki

3.1 Das U-Boot

EMAC utilizes Das U-Boot for its ARM based products. U-Boot is an open source/cross-architecture platform independent bootloader. It supports reading and writing to the flash, auto-booting, environmental variables, and TFTP. Das U-boot can be used to upload and run and/or reflash the OS or to run stand-alone programs without an OS. Products are shipped with a valid MAC address installed in flash in the protected U-boot environmental variable “ethaddr”. At boot time U-Boot automatically stores this address in a register within the MAC, which effectively provides it to any OS loaded after that point.

3.2 Embedded Linux

EMAC Open Embedded Linux (EMAC OE Linux) is an open source Linux distribution for use in embedded systems. The EMAC OE Linux Build is based on the Open Embedded (www.openembedded.org) and Yocto (www.yoctoproject.org) Linux build systems. Open Embedded is a superior Linux distribution for embedded systems. Custom Linux builds are also available on request.

The distribution contains everything a user could expect from a standard Linux kernel: powerful networking features, advanced file system support, security, debugging utilities, and countless other features.

The basic root file system includes:

- Busybox
- Hotplugging support
- APM utilities for power management
- Openssh SSH server
- lighttpd HTTP server
- JFFS2 or EXT4 file system with utilities

3.2.1 Linux with Xenomai Real Time Extensions

Xenomai provides real time extensions to the kernel and can be used to schedule tasks with hard deadlines and µs latencies. The Xenomai build is an additional module that can be added to the standard Linux kernel and is available for a one-time inexpensive support/installation fee.

http://www.xenomai.org/

3.2.2 Linux Packages

EMAC provides support for many Linux Packages such as: PHP, SQLite, Perl, SNMP, DHCP Server, etc. As with the Xenomai Package, other Packages can be added to the standard Linux file system and are available for a one-time inexpensive support/installation fee.

3.2.3 Linux Patches

In addition to standard Embedded Linux support, EMAC has released a number of patches and device drivers from the open source community and from internal EMAC engineering into its standard distribution. Along with kernel patches, EMAC provides the binaries for the kernel and root file system.

3.3 Qt Creator

Qt Creator is a cross-platform IDE (Integrated Development Environment) tailored to the needs of Qt developers but works well for Headless applications as well. EMAC provides sample code as projects that can be imported into Qt Creator. Qt Creator supports remote deployment and source debugging.

http://wiki.qt.io/Main

3.4 ARM EABI Cross Compiler

The popular open source gcc compiler has a stable build for the ARM family. EMAC uses the 4.9.1 version of the ARM EABI compiler. The Embedded Linux kernel and EMAC Qt Creator projects use this compiler for building ARM stand alone, and OS specific binaries. The EMAC Qt Creator provides source level debugging over Ethernet or serial using gdbserver. The Linux binaries for the ARM EABI cross compiler are available online along with the SDK. See the EMAC wiki for further information.

4 Appendix A: Connector Pinouts

4.1 Alternative Power Supply Connector (CN1)

Pin	Description
1	5VDC
2	Ground
3	Ground
4	8VDC ~ 36VDC

4.2 CAN Connector (CN2)

Pin	Description
1	GND
2	CAN_L
3	CAN_H

4.3 LCD Connector (CN3)

Pin	Description
1	LED-
2	LED+
3	GND
4	3.3V
5	RED_DAT0
6	RED_DAT1
7	RED_DAT2
8	RED_DAT3
9	RED_DAT4
10	RED_DAT5
11	RED_DAT6
12	RED_DAT7
13	GRN_DAT0
14	GRN_DAT1
15	GRN_DAT2
16	GRN_DAT3
17	GRN_DAT4
18	GRN_DAT5
19	GRN_DAT6
20	GRN_DAT7
21	BLU_DAT0
22	BLU_DAT1
23	BLU_DAT2
24	BLU_DAT3
25	BLU_DAT4
26	BLU_DAT5
27	BLU_DAT6
28	BLU_DAT7
29	GND
30	CLK
31	DISP ON/OFF
32	NC
33	NC
34	DATA ENABLE
35	NC
36	GND
37	TCHSCR X1
38	TCHSCR Y1
39	TCHSCR X2
40	TCHSCR Y2

4.4 I/O Header (HDR1)

Pin	Description
1	GND
2	3.3V
3	I2C_DAT
4	I2C_CLK
5	RST_OUT#
6	SPI0_MISO
7	SPI0_SCLK
8	SPI0_MOSI
9	SPI0_NCS1
10	SPI0_NCS0
11	SPI0_NCS3
12	GPIO7
13	ADC5
14	GPIO13
15	ADC6
16	IRQA
17	ADC4
18	GPIO15
19	ADC7
20	GPIO12

4.5 COMC Header (HDR2)

Pin	Description
1	DCD/TX-
2	NC
3	RXD/TX+
4	RTS
5	TXD/RX+
6	CTS
7	DTR/RX-
8	NC
9	GND
10	NC

4.6 COMD Header (HDR3)

Pin	Description
1	NC
2	NC
3	RXD
4	RTS
5	TXD
6	CTS
7	NC
8	NC
9	GND
10	NC

4.7 COM A Header (HDR4)

Pin	Description
1	NC
2	NC
3	RXD
4	RTS
5	TXD
6	CTS
7	NC
8	NC
9	GND
10	NC

4.8 PTP ETH PHY I/O Header (HDR5)

Pin	Description
1	PCLK_OUT
2	SMA1
3	3.3V
4	GND
5	PGPIO3
6	SMA2
7	3.3V
8	GND
9	PGPIO1
10	PGPIO2
11	GND
12	PGPIO4
13	PGPIO8
14	PGPIO9

4.9 PTP ETH PHY JTAG Header (HDR6)

Pin	Description
1	3.3V
2	JTAG_TMS
3	GND
4	JTAG_TCK
5	GND
6	JTAG_TDO
7	GND
8	JTAG_TDI
9	GND
10	JTAG_TRST#

5 Appendix B: Jumper Settings

5.1 Boot0 Source Selection (JB1)

Jumper	Position	Description
Pins 1 & 2*	A	High
Pins 2 & 3	B	Low

*Default Setting

5.2 Boot1 Source Selection (JB2)

Jumper	Position	Description
Pins 1 & 2	A	High
Pins 2 & 3*	B	Low

*Default Setting

5.3 Flash Write Protect (JB3)

Jumper	Position	Description
Pins 1 & 2*	B	Disable
Pins 2 & 3	A	Enable

*Default Setting

5.4 Retention Battery (JB4)

Jumper	Position	Description
Pins 1 & 2	OFF	Disable
Pins 2 & 3*	ON	Enable

*Default Setting

5.5 CAN Termination (JB5)

Jumper	Position	Description
Pins 1 & 2	TRM	Enable
Pins 2 & 3*	OFF	Disable

*Default Setting

5.6 Ethernet PHY Mode (JB6)

Jumper	Position	Description
Across Pins 1 & 2*	1000 Base T	Gigabit (GbE) Ethernet Enable
Uninstalled	10/100 Base T	10/100 Ethernet Enable

*Default Setting

6 Appendix C: Dimensional Drawing