

# ***SoM-350ES***

## User Manual

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## **1 Introduction**

This document provides information regarding EMAC's SoM-350ES System on Module Carrier Board. The SoM-350ES is a versatile SoM Carrier board ideal for evaluation and early development work. This Carrier works with all EMAC 314-pin SODIMM type SoMs although not all functionality of a particular module may be supported.

The SoM-350ES provides access to virtually all of the 314-pin Module's I/O through on-board connectors as well as a number of additional I/O expansion blocks such as Digital I/O, Audio, and MMC/SD flash disk. Full schematics of the SoM-350ES are provided giving the user a solid base with which to design their own SoM Carrier.

Although a good deal of customers will want a Carrier that is unique and is designed specifically for their application, the SoM-350ES, when coupled with a SODIMM SoM makes for a powerful yet affordable Graphic User Interface (GUI) with USB and Ethernet capabilities. This allows the user to gather data and respond with Control commands via the Internet.

When a unique custom board is needed, the amount of design work required is greatly minimized by the SoM approach. The custom Carrier designer does not have to worry about the processor, memory, and standard I/O functions and can concentrate on the I/O and dimensional aspects required for the application.

In situations where a custom Carrier is required but the customer does not have the capability to design such a board in-house, EMAC's Custom to Order Services (COS) can be utilized. Using COS the customer can select from a library of standard I/O blocks. These blocks can be put together quickly into a form-factor of the customer's choosing, providing prototypes in as little as 30 days.

## **1.1 Features**

- 314 Pin SODIMM SoM Connector
- Inexpensive Open-Frame Design
- Dual-Port 10/100/1000 BaseT Ethernet
- 3 RS232 & 1 RS232/422/485 Port
- 2 USB 2.0 (High Speed) Host Ports
- 1 USB 2.0(High Speed) OTG Port
- 1 CAN 2.0 Port
- 1 Micro SD/MMC Flash Card Socket
- 1 I2S Audio CODEC with Line-In/Line-Out
- 1 Audio Beeper
- 1 mini PCIe Slot
- 1 mSATA Socket
- 1 SIM socket
- I2C EEPROM
- 1 SPI Port and 1 I2C Port
- 4 Channels of A/D
- 2 Timer/Counters/PWM
- 16 SoM based GPIOs
- 4-wire Resistive Touchscreen Interface
- Software Controlled Backlight On/Off & Brightness
- 1 HDMI Port
- 1 LVDS LCD Connector
- Battery Socket for RTC
- Wi-Fi/BLE wireless – 802.11 b/g/n & Bluetooth (optional)
- FREE IDE with GCC & GDB development tools

## 2 Hardware

### 2.1 Specifications

#### LCD – 7" LCD (GM800480D-70-TTX2NLW-HTL)

- **Display Type:** 7" TFT Color LCD
- **Resolution:** 800 x 480 WVGA @ 262K Colors
- **Dot pitch:** 0.19mm x 0.19mm
- **Luminance:** 800 (cd/m<sup>2</sup>)
- **Viewing Angle:**
  - θ-right: 65° (55°-min)
  - θ-left: 65° (55°-min)
  - θ-up: 55° (45°-min)
  - θ-down: 65° (55°-min)
- **Brightness:** Software controlled
- **Backlight:** White LED (39 LEDS)
- **Light Transparency:** 80%
- **Durability:** Over one million touches

#### LCD – 10" LCD (OSD101T1515-45TS)

- **Display Type:** 10.1" TFT Color LCD
- **Resolution:** 1024 x 600 WSVGA @ 262K Colors
- **Dot pitch:** 0.22mm x 0.21mm
- **Luminance:** 460 (cd/m<sup>2</sup>)
- **Viewing Angle:**
  - θ-right: 45° (40°-min)
  - θ-left: 45° (40°-min)
  - θ-up: 15° (10°-min)
  - θ-down: 35° (30°-min)
- **Brightness:** Software controlled
- **Backlight:** White LED (36 LEDS)
- **Light Transparency:** 82%
- **Durability:** Over one million touches

#### Mechanical and Environmental

- **Dimensions:** 7.55" L x 4.15" W x 1.5" H (not including LCD)
- **Power Supply Voltage:** +12 to +28V DC
- **Power Consumption (typical):** 120mA @ 12V DC
- **Operating Temperature:** 0 ~ 60° C (32 ~ 140° F), [-40 ~ 85° C optional]
- **Operating Humidity:** 0% ~ 90% relative humidity, non-condensing

## 2.2 Jumper Configuration & Connector Descriptions

The SoM-350ES 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
<b>ANT1</b>	Ultra Small Coaxial Connector
<b>ANT2</b>	Ultra Small Coaxial Connector
<b>CN1</b>	7" LCD Backlight Connector
<b>CN2</b>	Serial Port COM B
<b>CN3</b>	10" Touch Screen Connector
<b>CN4</b>	7" Touch Screen Connector
<b>HDR1</b>	Vin Power 3 Pin Header
<b>HDR2</b>	USB Host Port A & B Header
<b>HDR3</b>	CAN 2.0 Port
<b>HDR4</b>	Serial Port COM A
<b>HDR5</b>	Serial Port COM C
<b>HDR6</b>	Serial Port COM D
<b>HDR7</b>	DSI Header
<b>HDR8</b>	I/O Header 2
<b>HDR9</b>	I/O Header 1
<b>HDR10</b>	LVDS LCD Connector
<b>JK1</b>	Vin Power Barrel Jack
<b>JK2</b>	Dual Port Ethernet Connector
<b>JK3</b>	USB Host Port A & B
<b>JK4</b>	USB OTG Port
<b>JK5</b>	Audio Input Jack
<b>JK6</b>	Audio Output Jack
<b>JK7</b>	HDMI Connector
<b>SOK1</b>	314 Pin SoM Socket
<b>SOK2</b>	MicroSD Card Socket
<b>SOK3</b>	mSATA Socket
<b>SOK4</b>	mini-PCIe Socket
<b>SOK5</b>	SIM Card Socket



**Table 2: Jumpers** (see SoM manual for correct boot settings)

Label	Function	Default
<b>JB1</b>	Standby Battery	OFF
<b>JB2</b>	Boot0 Source Selection	Position A
<b>JB3</b>	Boot1 Source Selection	Position B
<b>JB4</b>	Flash Write Protect	Position B
<b>JB5</b>	Serial Port RS422/485 Tx Enable	422
<b>JB6</b>	Serial Port RS232 or 422/485	232

## 2.3 Power Connectors

The SoM-350ES provides two power connectors. HDR1 is an AMP/Tyco locking power connector (part# 640445-3), the three-pin type connector mates with the TE Connectivity power connector (part# 3-640600-3). This power input provides a more rugged/industrial locking connection with an operating temperature of -55 ~ 105° C. 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 allows for easy connection to a wall mount power supply (EMAC part number PER-PWR-00035). The SOM-350ES's power input uses a switching regulator and allows a voltage input of +12V DC to +28V DC.

Pin-out for the HDR1 power connector:

Pin	Signal
1	+Vin (+12Vdc to 28Vdc)
2	Chassis GND
3	System GND

## 2.4 Ethernet

The SoM-350ES provides 10/100/1000 Base-T full duplex Ethernet and uses a standard 2 Port RJ-45 LAN jack (JK2) with integrated magnetics. It can be connected straight to a hub, or another computer via Ethernet crossover cable. The Ethernet crossover cable can be replaced with a patch cable if the SoM processor module supports the Auto MDI-X capability. The Ethernet MAC & PHY are integrated into the SoM processor module. Activity and Link LEDs are integrated into the RJ45 connector.

## 2.5 Serial Ports

The SoM-350ES is equipped with four serial ports, one of which terminates to a male DB9 connector and the other three which terminate to 10-pin header connectors. Three 10-pin headers to male DB9 connector cables are provided, giving easy access to these ports. Baud Rate, stop bits, etc. are all programmable for each port via software.

COM A is a RS232 port. This port offers RTS/CTS handshake lines.

COM B is a RS232 port with a full complement of handshaking lines allowing it to communicate with modems and other devices requiring hardware flow control.

COM C can be configured to RS232, RS422, or RS485 via two jumpers (JB6 & JB5). To select RS232 set jumper JB6 to 232 (this is the default). For RS422 set jumper JB6 to 4xx and jumper JB5 to 422. To select RS485, set jumper JB6 to 4xx and jumper JB5 to 485.

When using COM C in the RS422/485 mode, a terminating resistor (~120 Ohm) is recommended on the two far ends of the network.

COM D is an RS232 port. This port offers RTS/CTS handshake lines.

**Table 3: Serial Port COM A (HDR4)**

Pin	10-Pin Header: Description	DB9 Connector: Description
1	NC	NC
2	NC	RXD
3	RXD	TXD
4	RTS	NC
5	TXD	GND
6	CTS	NC
7	NC	RTS
8	NC	CTS
9	GND	NC
10	NC	N/A

**Table 4: Serial Port COM B (CN2)**

Pin	DB9 Connector: Description
1	DCD
2	RXD
3	TXD
4	DTR
5	GND
6	DSR
7	RTS
8	CTS
9	RI

**Table 5: Serial Port COM C (HDR5)**

Pin	10-Pin Header: Description	DB9 Connector: Description
1	422/485 TX-	422/485 TX-
2	NC	232 RX, 422/485 TX+
3	232 RX, 422/485 TX+	232 TX, 422/485 RX+
4	RTS	422/485 RX-
5	232 TX, 422/485 RX+	GND
6	CTS	NC
7	422/485 RX-	RTS
8	NC	CTS
9	GND	NC
10	NC	N/A

**Table 6: Serial Port COM D (HDR6)**

Pin	10-Pin Header: Description	DB9 Connector: Description
1	NC	NC
2	NC	RXD
3	RXD	TXD
4	RTS	NC
5	TXD	GND
6	CTS	NC
7	NC	RTS
8	NC	CTS
9	GND	NC
10	NC	N/A

## **2.6 USB**

The SoM-350ES provides for dual high speed (HS) USB 2.0 (480 Mbps) host ports (USB PortA & PortB). USB PortA and PortB can be accessed from the bulkhead connector (HDR2). EMAC can provide a cable (CAB-40-004) to access these ports.

The USB host ports are fused with automatically resettable Polyfuses. If a USB device tries to draw more than 500 milliamps, the fuses will open. Once the drawing source is removed the fuses will automatically reset. The USB ports are pinned as standard USB host ports and thus should work with any standard USB mating device or host.

In addition to the two USB Host ports is a HS USB 2.0 OTG (Up to 480 Mbps) Host/Device port. This port can be used as either a USB Host or USB Device port and is also fused when used as a Host.

Note: When sizing a power supply, make sure to allow for USB Device consumption. A device can potentially draw 500mA, therefore these devices could use a total of up to 1.5 amp of power. USB ports must be supported by the SoM for the ports to operate.

## **2.7 CAN Port**

The SoM-350ES provides a CAN 2.0 port utilizing the TI SN65HVD232 CAN Transceiver chip. Note the CAN controller must be supported by the SOM in order to have CAN functionality The CAN port is accessible via a 3-pin header (HDR3).

Pin-out for the CAN 2.0 Port (HDR3):

<b>Pin</b>	<b>Signal</b>
1	CAN_H
2	CAN_L
3	GND

## **2.8 MicroSD Card Socket**

The SoM-350ES provides a high capacity MicroSD socket. This socket is hot-swappable and can accept a wide variety of Flash Cards. A green activity LED (LD7) will be lit when the Flash card is accessed and the card should not be removed at this time. A card that is written to by the SoM-350ES can be read by another computer using a MicroSD card reader. The MicroSD interface is compatible with Standard and High Capacity MicroSD cards.

## 2.9 Audio

The SoM-350ES provides Audio Line Out and Line In capabilities through two standard audio jacks (JK5 & JK6). Audio Jack JK5 is stereo line level input and Audio Jack JK6 is stereo line level output. The processor interfaces to the Audio CODEC through its I2S interface. Volume and Balance are controlled through software using the I2C interface lines SOM\_I2C\_B\_CLK & SOM\_I2C\_B\_DAT, which are accessible via HDR8.

The CODEC is the Texas Instruments TLV320AIC3204, which is a flexible, low-power, low-voltage stereo audio codec with programmable inputs and outputs, PowerTune capabilities, fixed predefined and parameterizable signal-processing blocks, integrated PLL, integrated LDOs and flexible digital interfaces.

## 2.10 Mini PCI Express

The SoM-350ES provides one PCI Express (PCIe) mini card connector (SOK4). The PCIe connector has the card retention features for a PCIe Full-Mini Card. Half-Mini Cards can be equipped with a half size to full size Mini PCIe PCI Express Adapter enabling the card to be mounted in the PCIe mini card connector.

The PCIe System Management Bus (SMBus) lines, SMB\_CLK & SMB\_DATA, are driven by the SoM's processor module's I2C lines, I2C\_SCL & I2C\_SDA (SODIMM pins 235 & 237 respectively), accessible via header HDR8.

The UIM signals are defined on the PCIe mini card connector to provide the interface between the removable Subscriber Identity Module (SIM), and a wireless wide area network (WWAN) radio device residing on the PCIe Mini Card.

Three LED signals are provided to enable wireless communications add-in cards to provide status indications to users. LED\_WPAN#, LED\_WLAN#, and LED\_WWAN# output signals are active low and drive LEDs LD11, LD10, and L9 respectively.

**Note:** The SoM does not support Hot-Plug/Hot-Removal events.

## 2.11 SIM

The SoM-350ES provides one subscriber identification module (SIM) socket (SOK5) to interface with a WWAN radio device residing on the PCIe Mini Card. The SIM socket is compatible with plug-in SIM/SAM cards, ensures correct orientation of SIM/SAM card, and provides a reliable and durable locking and latching mechanism.

## 2.12 Mini-SATA

The SoM-350ES provides one mini serial AT attachment (mSATA) socket (SOK3). The mSATA interface connector is a low profile connector compatible with small form factor solid state drives (SSDs) and hard disk (HDD). The mSATA interface runs with a native transfer rate of 3.0 Gbit/s and is backward compatible with SATA 1.5 Gbit/s.

The mSATA interface supports a two wire interface, I2C\_SCL & I2C\_SDA (SODIMM pins 231 & 233 respectively), to read a memory device to determine device information. These pins are not designed to be active in conjunction with the SATA signal differential pairs.

**Note:** The SoM does not support Hot-Plug/Hot-Removal events.

### **2.13 I2C EEPROM**

The SoM-350ES provides a 32-Kbit I2C-compatible EEPROM organized as 4k x 8 bits. The SoM's processor module's I2C signals, I2C\_SCL & I2C\_SDA (SODIMM pins 231 & 233 respectively), are used to transfer data in/out of the EEPROM device.

The EEPROM device, STMicroelectronics' M24C32, is compatible with all I2C bus modes: 1 MHz, 400 KHz, and 100 KHz, supports more than 4 million write cycles and more than 200 years data retention, and is capable of a byte write or page write within 5 ms.

### **2.14 HDMI**

The SoM-350ES provides a standard HDMI 1.4 receptacle connector (JK7) compatible with the following HDMI 1.4 cable types:

- Standard HDMI Cable (up to 1080i and 720p)
- Standard HDMI Cable with Ethernet
- Standard Automotive HDMI Cable (does not support HDMI Ethernet Channel)
- High Speed HDMI Cable (1080p, 4k, 3D, and deep color)
- High Speed HDMI Cable with Ethernet

**Note:** HS HDMI 1.3 cables work with all HDMI 1.4 features except for the HDMI Ethernet Channel.

The HDMI 1.4 Ethernet Channel (HEC) allows for a 100 Mbit/s Ethernet connection between two HDMI connected devices so they can share the Ethernet connection.

HDMI can only be used with older analog-only devices (such as SCART, VGA, RCA, etc.) by means of a digital-to-analog converter or AV receiver.

HDMI is backward compatible with single-link Digital Visual Interface (DVI) digital video (DVI-D or DVI-I, but not DVI-A). No signal conversion is required when an adapter or asymmetric cable is used, so there is no loss of video quality. While HDMI and DVI compliance rules ensure that a DVI video connection can be successfully negotiated and established, the audio signal must still be transported through means outside of the DVI connection.

### 2.15 LVDS

The SoM-350ES provides a 34-pin header (HDR10) to support a 24-bit LVDS LCD interface compatible with the two specified LCDs (7" LCD (GM800480D-70-TTX2NLW-HTL) & 10" LCD (OSD101T1515-45TS)).

LVDS provides a 350mV typical differential signal swing for fast data transfers (up to 3.125 Gbps) at significantly reduced power and with excellent noise immunity. The SoM's processor module supports a 165 Mpixel/sec fillrate.

Twisted pair cable is recommended since it provides two identical conductors to transmit the signal and its complement. Ideally, any distortion will affect both conductors equally; therefore, the differential signal will not change.

**Note:** The specified LCDs and cables can be purchased from EMAC. Custom cables would be required to interface unspecified LCDs with header (HDR10).

### 2.16 Touch Screen Interface

The SoM-350ES provides a 4-wire resistive touch screen interface and two FFC/FPC 4-position touch screen connectors, one for the 10" LCD (CN3) and another for the 7" LCD (CN4).

The touch screen connectors require a very small insertion force of the cable, prevent cable buckling, avoid excessive scraping of contact surfaces (allows highest possible number of mating cycles), and utilizes slider activation (ensures smooth insertion and firmly locked connection).

The touch screen connectors are compatible with both Flat Flexible Cables (FFC) and Flexible Printed Circuits (FPC). FFC is the most robust of the flexible circuitry with the highest current carrying capability. FPC is lighter weight and utilizes a stiffener (slider activation) for termination into the board connector. The FPC type cable is utilized by both of the specified LCDs' touch screen interface.

### 2.17 LCD Back-Light

The SoM-350ES provides a 2-position BHS, wire-to-wire, connector (CN1) to interface with the 7" LCD's Back-light unit. The Back-light system is an edge-lighting type with 39 white LEDs. The Back-light Unit's typical power consumption is 2.57 watts and the minimum LED life time is 40000 hours.

**Note:** If the SoM-350ES' supply voltage (+12Vdc to 28Vdc) drops below 11.4 volts the LCD will exhibit diminished back-light intensity.

**Note:** The specified 10" LCD has an internal back-light power supply which is fed through the LCD connector.

### 2.18 DSI

The SoM-350ES provides a 16-pin header (HDR7) to interface with SoM's processor module's DSI signals. The DSI (Display Serial Interface) link operates in either low power (LP) mode or high speed (HS) mode. In low power mode the data rate is insufficient to drive a display, but is usable for sending configuration

information or commands. High speed mode is designed to reduce power usage due to its low voltage signaling and parallel transfer ability.

### **2.19 Wi-Fi [optional]**

The SoM-350ES provides two Wi-Fi/Bluetooth antenna jacks (JK11 & JK12) which utilizes the on-board Wi-Fi/Bluetooth/BLE module (WL1835MOD).

The antenna jacks, (U.FL-R-SMT (10)) offers high frequency performance from DC to 6GHz, with a V.S.W.R of 1.3 to 1.5 max. EMAC provides an antenna kit: 2.4GHz Duck Antenna RP-SMA and U.FL.(IPEX) to RP-SMA male pigtail cable that plugs into the SoM's antenna jack.

The TI WiLink 8 module (WL1835MOD) offers high throughput and extended range along with Wi-Fi and Bluetooth (BT) coexistence in a power-optimized design.

#### **WLAN Features:**

- Integrated 2.4 GHz power amplifiers
- Baseband processor: 802.11 b/g/n data rates with 20 or 40 MHz SISO and 20 MHz MIMO
- 2.4 GHz radio: Internal LNA & PA, Standard 802.11 b/g/n
- 4 bit SDIO interface, high speed (HS) and V3 modes

#### **Bluetooth (BT) Features:**

- Bluetooth 4.1 & CSA2
- Audio processor: on-chip SBC encoding + A2DP
- Concurrent operation and prioritization of BT & BLE, audio processing, and WLAN

#### **Bluetooth Low Energy (BLE) Features:**

- Bluetooth 4.0 LE dual-mode
- Up to 10 BLE connections
- Multiple connections with no effect on BR/EDR performance



## 2.20 I/O Expansion

The SoM-350ES provides access to a number of I/O lines on connectors HDR8 and HDR9. The 40-pin dual row headers contain GPIO lines, SPI bus, I2C bus, CAN bus, A/D lines, interrupts and power pins. In addition, the inputs (SPR\_MNO\_An & SPR\_MNO\_B) and outputs (SPR\_MNO\_Qn & SPR\_MNO\_Q) to the spare monostable (free for customer use) are accessible via header HDR8. Signal names listed in the tables below are the SoM names as defined in the SoM 314 pin specification.

**Table 7: I/O Header (HDR8)**

Pin	Signal	Pin	Signal
<b>1</b>	5V_VCC	<b>2</b>	5V_VCC
<b>3</b>	GND	<b>4</b>	GND
<b>5</b>	3V3_VCC	<b>6</b>	3V3_VCC
<b>7</b>	S3	<b>8</b>	ON_OFF
<b>9</b>	S5	<b>10</b>	GPIO2/PWM2
<b>11</b>	PMIC_BATLOW#	<b>12</b>	GPIO3/PWM3
<b>13</b>	PMIC_I2C_SDA	<b>14</b>	GPIO5/TC2
<b>15</b>	PMIC_I2C_SCL	<b>16</b>	GPIO13
<b>17</b>	PMIC_CHARGE#	<b>18</b>	GPIO14
<b>19</b>	PMIC_CHARGE_DET#	<b>20</b>	GPIO16
<b>21</b>	PMIC_TEST#	<b>22</b>	GPIO17
<b>23</b>	PMIC_SLEEP#	<b>24</b>	GPIO18
<b>25</b>	I2C_B_SCL	<b>26</b>	GPIO19
<b>27</b>	I2C_B_SDA	<b>28</b>	GPIO20
<b>29</b>	SPI_B_MOSI	<b>30</b>	GPIO21
<b>31</b>	SPI_B_MISO	<b>32</b>	GND
<b>33</b>	SPI_B_CLK	<b>34</b>	SPR_MNO_An
<b>35</b>	SPI_B_CS0#	<b>36</b>	SPR_MNO_B
<b>37</b>	SPI_B_CS1#	<b>38</b>	SPR_MNO_Q
<b>39</b>	SPI_B_CS2#	<b>40</b>	SPR_MNO_Qn

**Table 8: I/O Connector (HDR9)**

Pin	Signal	Pin	Signal
<b>1</b>	5V_VCC	<b>2</b>	5V_VCC
<b>3</b>	GND	<b>4</b>	GND
<b>5</b>	3V3_VCC	<b>6</b>	3V3_VCC
<b>7</b>	CAN_B_TX	<b>8</b>	CAN_B_RX
<b>9</b>	GND	<b>10</b>	ADC_VREF
<b>11</b>	ADC_3	<b>12</b>	ADC_4
<b>13</b>	ADC_1	<b>14</b>	ADC_2
<b>15</b>	GND	<b>16</b>	GPIO12
<b>17</b>	I2S_B_RXD	<b>18</b>	GPIO11
<b>19</b>	I2S_B_TXFS	<b>20</b>	GPIO4/TC1
<b>21</b>	I2S_B_TXD	<b>22</b>	GPIO1/PWM1
<b>23</b>	I2S_B_TXC	<b>24</b>	GPIO0/PWM0
<b>25</b>	I2S_B_CLK	<b>26</b>	SPI_A_CS2#
<b>27</b>	HSIC_A_STRB	<b>28</b>	SPI_A_CS1#
<b>29</b>	HSIC_A_DATA	<b>30</b>	SPI_A_CS0#
<b>31</b>	HSIC_B_STRB	<b>32</b>	SPI_A_CLK
<b>33</b>	HSIC_B_DATA	<b>34</b>	SPI_A_MISO
<b>35</b>	I2C_A_SCL	<b>36</b>	SPI_A_MOSI
<b>37</b>	I2C_A_SDA	<b>38</b>	GND
<b>39</b>	GPIO15	<b>40</b>	SPDIF_OUT

## 2.21 Real-Time Clock

The SoM-350ES is equipped with an external battery (BH1) for backing up the module's Real-Time Clock (RTC). Drivers to access the RTC are included in the operating systems. Jumper JB1 should be placed in the ON position in order to retain system time when powered down.

## 2.22 Reset

The SoM-350ES provides a Reset Button (PB1). Pressing this button will cause the system to reset.

### 3 Software

The SoM-350ES is programmable via a selection of free software tools and open source EMAC software. Software Board Support Packages (BSPs) and Linux Software Development Kits (SDKs) are available for most SoM processor modules.

#### 3.1 Introduction

Whichever module is used in the SoM-350ES can be programmed in a variety of languages and utilize a variety of Operating Systems. There are a number of free compilers, interpreters, and assemblers available allowing the processor Module to be programmed in C, BASIC, or Assembly languages. EMAC has Board Support Packages available for Linux. For more information on these particular Operating Systems, contact EMAC, Inc.

For more information on Linux Software Support, please visit the EMAC Wiki Software Section at:

[http://wiki.emacinc.com/wiki/product\\_wiki](http://wiki.emacinc.com/wiki/product_wiki)

#### 3.2 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.

#### 3.3 Embedded Linux

EMAC Open Embedded 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](http://www.openembedded.org)) and Yocto ([www.yoctoproject.org](http://www.yoctoproject.org)) Linux build system. 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
- JFS2 or EXT4 file system with utilities

### **3.3.1 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  $\mu$ s 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/>

### **3.3.2 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.

### **3.3.3 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.

## **3.4 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>

## **3.5 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 7" LCD Back-Light Connector (CN1)

Pin	Signal
1	Vin
2	GND

### 4.2 Serial Port COM B (CN2)

Pin	DB9 Connector: Description
1	DCD
2	RXD
3	TXD
4	DTR
5	GND
6	DSR
7	RTS
8	CTS
9	RI

### 4.3 10" Touch Screen Connector (CN3)

Pin	Signal
1	TOUCH_X-
2	TOUCH_Y-
3	TOUCH_X+
4	TOUCH_Y+
5	GND
6	GND

### 4.4 7" Touch Screen Connector (CN4)

Pin	Signal
1	TOUCH_X-
2	TOUCH_Y-
3	TOUCH_X+
4	TOUCH_Y+
5	GND
6	GND

## 4.5 Vin Power Header (HDR1)

Pin	Signal
1	Vin
2	GND_FRM
3	GND

## 4.6 USB Host Port A & B Header (HDR2)

Pin	Signal	Pin	Signal
1	5V0_VCC	2	5V0_VCC
3	USBA_D-	4	USBB_D-
5	USBA_D+	6	USBB_D+
7	GND	8	GND
9	GND_FRM	10	GND_FRM

## 4.7 CAN 2.0 Port (HDR3)

Pin	Signal
1	CANH
2	CANL
3	GND

## 4.8 Serial Port COM A (HDR4)

Pin	10-Pin Header: Description	DB9 Connector: Description
1	NC	NC
2	NC	RXD
3	RXD	TXD
4	RTS	NC
5	TXD	GND
6	CTS	NC
7	NC	RTS
8	NC	CTS
9	GND	NC
10	NC	N/A

#### 4.9 Serial Port COM C (HDR5)

Pin	10-Pin Header: Description	DB9 Connector: Description
<b>1</b>	422/485 TX-	422/485 TX-
<b>2</b>	NC	232 RX, 422/485 TX+
<b>3</b>	232 RX, 422/485 TX+	232 TX, 422/485 RX+
<b>4</b>	RTS	422/485 RX-
<b>5</b>	232 TX, 422/485 RX+	GND
<b>6</b>	CTS	NC
<b>7</b>	422/485 RX-	RTS
<b>8</b>	NC	CTS
<b>9</b>	GND	NC
<b>10</b>	NC	N/A

#### 4.10 Serial Port COM D (HDR6)

Pin	10-Pin Header: Description	DB9 Connector: Description
<b>1</b>	NC	NC
<b>2</b>	NC	RXD
<b>3</b>	RXD	TXD
<b>4</b>	RTS	NC
<b>5</b>	TXD	GND
<b>6</b>	CTS	NC
<b>7</b>	NC	RTS
<b>8</b>	NC	CTS
<b>9</b>	GND	NC
<b>10</b>	NC	N/A

#### 4.11 DSI Header (HDR7)

Pin	Signal	Pin	Signal
<b>1</b>	GND	<b>2</b>	GND
<b>3</b>	DSI_D0-	<b>4</b>	DSI_D0+
<b>5</b>	GND	<b>6</b>	GND
<b>7</b>	DSI_CLK-	<b>8</b>	DSI_CLK+
<b>9</b>	GND	<b>10</b>	GND
<b>11</b>	DSI_D1-	<b>12</b>	DSI_D1+
<b>13</b>	GND	<b>14</b>	GND
<b>15</b>	3V3_VCC	<b>16</b>	3V3_VCC

## 4.12 I/O Header (HDR8)

Pin	Signal	Pin	Signal
<b>1</b>	5V_VCC	<b>2</b>	5V_VCC
<b>3</b>	GND	<b>4</b>	GND
<b>5</b>	3V3_VCC	<b>6</b>	3V3_VCC
<b>7</b>	S3	<b>8</b>	ON_OFF
<b>9</b>	S5	<b>10</b>	GPIO2/PWM2
<b>11</b>	PMIC_BATLOW#	<b>12</b>	GPIO3/PWM3
<b>13</b>	PMIC_I2C_SDA	<b>14</b>	GPIO5/TC2
<b>15</b>	PMIC_I2C_SCL	<b>16</b>	GPIO13
<b>17</b>	PMIC_CHARGE#	<b>18</b>	GPIO14
<b>19</b>	PMIC_CHARGE_DET#	<b>20</b>	GPIO16
<b>21</b>	PMIC_TEST#	<b>22</b>	GPIO17
<b>23</b>	PMIC_SLEEP#	<b>24</b>	GPIO18
<b>25</b>	I2C_B_SCL	<b>26</b>	GPIO19
<b>27</b>	I2C_B_SDA	<b>28</b>	GPIO20
<b>29</b>	SPI_B_MOSI	<b>30</b>	GPIO21
<b>31</b>	SPI_B_MISO	<b>32</b>	GND
<b>33</b>	SPI_B_CLK	<b>34</b>	SPR_MNO_An
<b>35</b>	SPI_B_CS0#	<b>36</b>	SPR_MNO_B
<b>37</b>	SPI_B_CS1#	<b>38</b>	SPR_MNO_Q
<b>39</b>	SPI_B_CS2#	<b>40</b>	SPR_MNO_Qn



### 4.13 I/O Header (HDR9)

Pin	Signal	Pin	Signal
<b>1</b>	5V_VCC	<b>2</b>	5V_VCC
<b>3</b>	GND	<b>4</b>	GND
<b>5</b>	3V3_VCC	<b>6</b>	3V3_VCC
<b>7</b>	CAN_B_TX	<b>8</b>	CAN_B_RX
<b>9</b>	GND	<b>10</b>	ADC_VREF
<b>11</b>	ADC_3	<b>12</b>	ADC_4
<b>13</b>	ADC_1	<b>14</b>	ADC_2
<b>15</b>	GND	<b>16</b>	GPIO12
<b>17</b>	I2S_B_RXD	<b>18</b>	GPIO11
<b>19</b>	I2S_B_TXFS	<b>20</b>	GPIO4/TC1
<b>21</b>	I2S_B_TXD	<b>22</b>	GPIO1/PWM1
<b>23</b>	I2S_B_TXC	<b>24</b>	GPIO0/PWM0
<b>25</b>	I2S_B_CLK	<b>26</b>	SPI_A_CS2#
<b>27</b>	HSIC_A_STRB	<b>28</b>	SPI_A_CS1#
<b>29</b>	HSIC_A_DATA	<b>30</b>	SPI_A_CS0#
<b>31</b>	HSIC_B_STRB	<b>32</b>	SPI_A_CLK
<b>33</b>	HSIC_B_DATA	<b>34</b>	SPI_A_MISO
<b>35</b>	I2C_A_SCL	<b>36</b>	SPI_A_MOSI
<b>37</b>	I2C_A_SDA	<b>38</b>	GND
<b>39</b>	GPIO15	<b>40</b>	SPDIF_OUT

#### 4.14 LVDS LCD Connector (HDR10)

Pin	Signal	Pin	Signal
<b>1</b>	GND_FRM	<b>2</b>	GND_FRM
<b>3</b>	LVDS_3V3	<b>4</b>	LVDS_3V3
<b>5</b>	LVDS_A0-	<b>6</b>	LVDS_A0+
<b>7</b>	GND	<b>8</b>	GND
<b>9</b>	LVDS_A1-	<b>10</b>	LVDS_A1+
<b>11</b>	GND	<b>12</b>	GND
<b>13</b>	LVDS_A2-	<b>14</b>	LVDS_A2+
<b>15</b>	GND	<b>16</b>	GND
<b>17</b>	LVDS_CLK-	<b>18</b>	LVDS_CLK+
<b>19</b>	LVDS_5V0	<b>20</b>	LVDS_5V0
<b>21</b>	LVDS_ABL	<b>22</b>	GND
<b>23</b>	LVDS_SDA	<b>24</b>	LVDS_SCL
<b>25</b>	LVDS_3V3	<b>26</b>	LVDS_5V0
<b>27</b>	NC	<b>28</b>	NC
<b>29</b>	NC	<b>30</b>	NC
<b>31</b>	GND	<b>32</b>	GND
<b>33</b>	NC	<b>34</b>	NC

#### 4.15 Vin Power Barrel Jack (JK1)

Pin	Signal
<b>1</b>	Vin
<b>2</b>	GND
<b>3</b>	NC

## 4.16 Dual Port Ethernet Connector (JK2)

Pin	Signal
<b>T1</b>	GND
<b>T2</b>	GBE2_MDI0+
<b>T3</b>	GBE2_MDI0-
<b>T4</b>	GBE2_MDI1+
<b>T5</b>	GBE2_MDI2+
<b>T6</b>	GBE2_MDI2-
<b>T7</b>	GBE2_MDI1-
<b>T8</b>	GBE2_MDI3+
<b>T9</b>	GBE2_MDI3-
<b>T10</b>	NC
<b>T11</b>	3V3_VCC
<b>T12</b>	ACT2#
<b>T13</b>	LINK2#1K/LINK2#100
<b>T14</b>	3V3_VCC
<b>B1</b>	GND
<b>B2</b>	GBE1_MDI0+
<b>B3</b>	GBE1_MDI0-
<b>B4</b>	GBE1_MDI1+
<b>B5</b>	GBE1_MDI2+
<b>B6</b>	GBE1_MDI2-
<b>B7</b>	GBE1_MDI1-
<b>B8</b>	GBE1_MDI3+
<b>B9</b>	GBE1_MDI3-
<b>B10</b>	NC
<b>B11</b>	3V3_VCC
<b>B12</b>	ACT1#
<b>B13</b>	LINK1#1K/LINK1#100
<b>B14</b>	3V3_VCC

#### 4.17 USB Host Port A & B (JK3)

Pin	Signal
<b>T1</b>	5V0_VCC
<b>T2</b>	USBA_D-
<b>T3</b>	USBA_D+
<b>T4</b>	GND
<b>B1</b>	5V0_VCC
<b>B2</b>	USBB_D-
<b>B3</b>	USBB_D+
<b>B4</b>	GND
<b>9</b>	GND_FRM
<b>10</b>	GND_FRM
<b>11</b>	GND_FRM
<b>12</b>	GND_FRM
<b>13</b>	GND_FRM

#### 4.18 USB OTG Port (JK4)

Pin	Signal
<b>1</b>	USB_OTG_VBUS
<b>2</b>	USB_OTG_D-
<b>3</b>	USB_OTG_D+
<b>4</b>	USB_OTG_ID
<b>5</b>	GND
<b>6</b>	GND_FRM
<b>7</b>	GND_FRM

#### 4.19 Audio Input Jack (JK5)

Pin	Signal
<b>1</b>	GND
<b>2</b>	IN1_L
<b>3</b>	IN1_R

#### 4.20 Audio Output Jack (JK6)

Pin	Signal
<b>1</b>	GND
<b>2</b>	HPL
<b>3</b>	HPR

#### 4.21 HDMI Connector (JK7)

Pin	Signal
1	HDMI_D2+
2	GND
3	HDMI_D2-
4	HDMI_D1+
5	GND
6	HDMI_D1-
7	HDMI_D0+
8	GND
9	HDMI_D0-
10	HDMI_CLK+
11	GND
12	HDMI_CLK-
13	HDMI_CEC
14	NC
15	HDMI_SCL
16	HDMI_SDA
17	GND
18	5V0_VCC
19	HDMI_HPD
20	GND_FRM
21	GND_FRM
22	GND_FRM
23	GND_FRM

#### 4.22 MicroSD Card Socket (SOK2)

Pin	Signal
1	SDIO_A_DAT2
2	SDIO_A_DAT3
3	SDIO_A_CMD
4	3V3_VCC
5	SDIO_A_CLK
6	GND
7	SDIO_A_DAT0
8	SDIO_A_DAT1
9	SDIO_A_CD
10	GND

## 4.23 mSATA Socket (SOK3)

Pin	Signal	Pin	Signal
1	NC	2	3V3_VCC
3	NC	4	GND
5	NC	6	NC
7	NC	8	NC
9	GND	10	NC
11	NC	12	NC
13	NC	14	NC
15	GND	16	NC
17	NC	18	GND
19	NC	20	NC
21	GND	22	NC
23	SATA_RXP	24	3V3_VCC
25	SATA_RXN	26	GND
27	GND	28	NC
29	GND	30	SOM_I2C_A_CLK
31	SATA_TXN	32	SOM_I2C_A_DAT
33	SATA_TXP	34	GND
35	GND	36	NC
37	GND	38	NC
39	3V3_VCC	40	GND
41	3V3_VCC	42	NC
43	GND	44	NC
45	NC	46	NC
47	NC	48	NC
49	NC	50	GND
51	NC	52	3V3_VCC

#### 4.24 Mini-PCIe Socket (SOK4)

Pin	Signal	Pin	Signal
1	NC	2	3V3_VCC
3	NC	4	GND
5	NC	6	1V5_VCC
7	NC	8	UIM_PWR
9	GND	10	UIM_DATA
11	PCIEA_CLK-	12	UIM_CLK
13	PCIEA_CLK+	14	UIM_RESET
15	GND	16	UIM_VPP
17	NC	18	GND
19	NC	20	SOM_GPIO_10
21	GND	22	NC
23	PCIEA_RX+	24	3V3_VCC
25	PCIEA_RX-	26	GND
27	GND	28	1V5_VCC
29	GND	30	SOM_I2C_B_CLK
31	PCIEA_TX-	32	SOM_I2C_B_DAT
33	PCIEA_TX+	34	GND
35	GND	36	NC
37	GND	38	NC
39	3V3_VCC	40	GND
41	3V3_VCC	42	LED_WWAN#
43	GND	44	LED_WLAN#
45	NC	46	LED_WPAN#
47	NC	48	1V5_VCC
49	NC	50	GND
51	NC	52	3V3_VCC

#### 4.25 SIM Card Socket (SOK5)

Pin	Signal
1	VCC
2	RST
3	CLK
5	GND
6	VPP
7	I/O

## 5 Appendix B: Jumper Settings

(See SoM Module manual for correct Boot jumper settings)

### **JB1 RTC Battery Enable**

<b>Jumper</b>	<b>Position</b>	<b>Setting</b>
Pins 1 & 2*	OFF	Disable Battery Backup
Pins 2 & 3	ON	Enable Battery Backup

\* Default setting

### **JB2 Boot Mode 0 Selection**

<b>Jumper</b>	<b>Position</b>	<b>Setting</b>
Pins 1 & 2*	A	Line pulled HIGH
Pins 2 & 3	B	Line pulled LOW

\* Default Setting

### **JB3 Boot Mode 1 Selection**

<b>Jumper</b>	<b>Position</b>	<b>Setting</b>
Pins 1 & 2	A	Line pulled HIGH
Pins 2 & 3*	B	Line pulled LOW

\* Default setting

### **JB4 Flash Write Protect**

<b>Jumper</b>	<b>Position</b>	<b>Setting</b>
Pins 1 & 2	OFF	Resident Flash Disable
Pins 2 & 3*	ON	Resident Flash Enable

\* Default setting

### **JB5 RS485/RS422 Select**

<b>Jumper</b>	<b>Position</b>	<b>Setting</b>
Pins 1 & 2	485	Select RS485
Pins 2 & 3*	422	Select RS422

\* Default setting

### **JB6 RS232/RS4XX Select**

<b>Jumper</b>	<b>Position</b>	<b>Setting</b>
Pins 1 & 2*	232	Select RS232
Pins 2 & 3	4XX	Select RS422/RS485 via JB5

\* Default setting



## 6 Appendix C: Mechanical Drawing with Dimensions

