

# **SOM-100ES**

# **Users Manual**



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# SOM-100ES Users Manual rev1.1

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# 1. Introduction

This document describes EMAC's SOM-100ES SOM Carrier/Socket board. (SBC) module. The SOM-100ES is versatile SOM Carrier/Socket board ideal for evaluation and early development work. This Carrier is designed to work with all EMAC SODIMM type SOMs.

The SOM-100ES provides access to all the SOM's I/O through on-board connectors as well as a number of additional I/O expansion blocks such as A/D, D/A, Digital I/O, Modem, and MMC flash disk. Full schematics of the SOM-100ES 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-100ES, when coupled with a SODIMM SOM makes for a powerful Remote Data Acquisition and Control system with Modem and Ethernet capabilities. This allows the user to gather data and respond with Control commands via the Internet. An Enclosure and Power Supply are available options for the SOM-100ES.

When a unique custom board is required, 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 SOM Benefits:

- Faster time to market
- Cost savings
- Reduced risk
- Scalable CPU choices
- Decreased customer design requirements
- Small footprint

## 1.2 Features

- **Small, Half EBX form factor (4.0" x 5.75")**
- **10/100 BaseT Ethernet with on-board Magnetics and RJ45**
- **2 serial RS232 ports and 1 RS232/485 port (ports must also be supported by the SOM)**
- **24, General Purpose digital I/O lines in addition to any SOM I/O lines**
- **8 digital input lines with dipswitch provision**
- **8 digital output lines with status LEDs (20 ma. drive)**
- **8 High Drive digital output lines (500 ma. sink)**
- **24 key, keypad interface**
- **Character LCD interface**
- **Battery for nonvolatile RAM and Real Time Clock**
- **MMC Flash Card Socket**
- **CAN port (SOM-400EM only)**
- **1-Wire access with on-board Temperature Sensor**
- **System Reset button**

## 1.3 Options

### ON-BOARD OPTIONS

- **ANALOG:** Analog I/O Upgrade Includes:
- 8 channel 12-bit A/D
- 4 channel 12-bit D/A
- **Modem:** V90 Socket Modem

## 1.4 Other Options

- **MBPC- 200 Enclosure:** This MicroBox metal chassis is an ideal housing for the SOM-100ES and SOM.
- **PS-50A Power Supply:** A 50 watt switching power supply that has an AC input of 100 to 240 volts and DC outputs of +5 volts and +12 volts. The PS-50A is especially designed to operate with the MBPC-200 MicroBox chassis.
- **Wall-Mount Power Supply:** An inexpensive 9 Volt DC supply capable of 500 ma. of current.

## 2. Hardware

### 2.1 Specifications

- **VOLTAGE REQUIREMENTS:** Onboard regulation allows 5 volt or 7.5 - 15 volt DC board input voltage.
- **CURRENT REQUIREMENTS:** 300 ma. @ 5 Volts Typical including SOM.
- **OPERATING TEMPERATURE:** 0 - 70 degrees Centigrade, humidity range without condensation 0% to 90% RH.
- **DIMENSIONS:** Half EBX form factor with dimensions of 4.0" x 5.75".
- **DIGITAL I/O:** 8 dedicated Digital Inputs with dipswitch provision and 8 bi-directional (nibble programmable) Digital Port lines with 20 ma. drive capability when used as outputs. 8 open collector High-Drive Digital outputs with 500 ma. sink drive capability, status LEDs, and a maximum total I/O drive of 1500 ma. for these 8 lines. All Digital I/O lines terminate to standard 50 pin, I/O Rack compatible header connectors.
- **OPTIONAL ANALOG INPUTS:** 8 analog inputs are multiplexed into a single 12-bit A/D converter with Sample & Hold. The analog input voltage range for each channel is 0 - 5 Volts.
- **ANALOG OUTPUTS:** 4 analog outputs implemented using a 4 channel, 12-bit D/A. The analog output voltage range for each output is 0 - 5 Volts with a drive capability of 5 ma.

### 2.2 Jumpers

This section describes the Jumpers and Jumper Blocks of the SOM-100ES.

#### 2.2.3 JP1

**LCD Config.** LCD configuration jumpers. These Jumpers allow for different types of LCDs and backlight control.

Jumper BC1	&	BC2	backlight always on
Jumper AB1	&	BC2	port line control (BACKLIGHT_EN) of backlight through software
Jumper AB1	&	AB2	allows the use of certain graphic LCDs

#### 2.2.4 JP8

**CAN Term.** Place a jumper in the 1 - 2 position to terminate the CAN bus.

#### 2.2.5 JP6

**Serial1 Config** This jumper determines which interface Serial COM 1 Port utilizes. Place the jumper in the 1 - 2 position for use as an RS/485 port and place the jumper in the 2 - 3 position for use as a RS 422 interface. Remove the jumper (default) for RS/232.

## 2.2.6 JP5

**Input Voltage** This jumper allows the selection of the input voltage used to power the board. With the jumper in the 1 – 2 position the regulator is bypassed directly feeding 5 Volts DC from the power connector HDR6 pin labeled 5V to the board. With the jumper in the 2 – 3 position the regulator is now in place allowing 7 – 15 DC Volts from the power connector pin labeled VIN to power the board.

## 2.2.7 JP10

**JTAG Chain** This jumper is utilized by the factory when programming the PLDs.

## 2.2.8 JP7, JP9, JP11

**Configuration** These jumpers are SoM dependent and are used to configure the SoM modules. Refer to the SoM manual for further details on these jumpers.

## 2.2.9 JP12

**MMC Mode** This jumper is used to select the MMC mode. Set the jumper to position 1 – 2 for default SPI access. Set to position 2 – 3 for standard MMC access (requires special software).

## 2.2.10 JP13

**COM3 Select** This jumper is used to select how COM3 gets utilized. Set the jumper to position 2 – 3 for default RS232 access through HDR10. Set to position 1 – 2 for Modem access (requires modem option and SOM with 3 serial ports).

## 2.3 JTAG & Debug

This multipurpose header provides a programming interface to the PLD which resides on the SOM-100ES as well as any PLD or Debug port on the SoM itself. Currently it is only used internally by EMAC.

**Table 1: JTAG & BDM Interface (HDR10)**

Pin	Signal	Pin	Signal
1	JTAG_TCK	2	GND
3	JTAG_TDO	4	5V (Vcc)
5	JTAG_TMS	6	SOM Dependent
7	NC/Reserved	8	SOM Dependent
9	JTAG_TDI	10	GND

## 2.4 SoM I/O Lines

The IO lines terminating to Header Connector HDR3 are made up of SoM I/O lines. This 50 pin connector consists of grounds on one side allowing 25 signals on the other side. These 23 of these 25 signals come directly from the SoM and are therefore SoM dependent so reference your SoM manual for details concerning the functions of these lines. 5 of these signal lines are reserved for SPI across all SoMs. Two of these SPI lines are derived on the Carrier, Slave Select 2 and Slave Select 3. Refer to the Carrier Schematic for details.

**Table 2: SoM I/O Connector (HDR8)**

Header Pin	SODIMM Pin	Header Pin	Signal
1	100	2	GND
3	116	4	GND
5	(SPI Slave Select 3)	6	GND
7	(SPI Slave Select 2)	8	GND
9	(SPI MISI) 122	10	GND
11	(SPI MOSI) 121	12	GND
13	(SPI CLK) 120	14	GND
15	101	16	GND
17	40	18	GND
19	42	20	GND
21	117	22	GND
23	115	24	GND
25	114	26	GND
27	136	28	GND
29	135	30	GND
31	134	32	GND
33	133	34	GND
35	132	36	GND
37	131	38	GND
39	130	40	GND
41	129	42	GND
43	128	44	GND
45	127	46	GND
47	126	48	GND
49	125	50	GND

## 2.5 PLD Based General Purpose Digital I/O

These input and output are connected to the PLD of the SOM-100ES. The Port-A lines are nibble programmable (PA0 – PA3 & PA4 – PA7) as input or output lines. If programmed as inputs the input lines should not exceed 5 Vdc and if programmed as outputs, these lines are capable of driving 25 ma. loads. Port lines PB0 – PB7 make up a dedicated input port, whose input lines should not exceed 5 Vdc. The open collector high drive output port PC0 – PC7 has drive 500 ma. sink drive capability and a maximum total I/O drive of 1500 ma. for these 8 lines.

**Table 3: PLD BASED DIGITAL I/O Connector (HDR3)**

Pin	Signal	Pin	Signal
1	5V(Vcc)	2	GND
3	PA0	4	GND
5	PA1	6	GND
7	PA2	8	GND
9	PA3	10	GND
11	PA4	12	GND
13	PA5	14	GND
15	PA6	16	GND
17	PA7	18	GND
19	PB0	20	GND
21	PB1	22	GND
23	PB2	24	GND
25	PB3	26	GND
27	PB4	28	GND
29	PB5	30	GND
31	PB6	32	GND
33	PB7	34	GND
35	PC0	36	GND
37	PC1	38	GND
39	PC2	40	GND
41	PC3	42	GND
43	PC4	44	GND
45	PC5	46	GND
47	PC6	48	GND
49	PC7	50	GND

The SOM-100ES's PLD is connected to the SoM's processor data bus and uses SODIMM pin 108 as its select line. The Base Address of the PLD is SOM dependent. See the manual that accompanied the SoM for further details. Additional PLD registers exist see the Keypad and LCD section for details on these PLD registers.

Within the PLD are several registers that are referenced as offsets from the PLD Base address. They are defined as follows:

Base + 0 - Port-A data port - writing to this sets the output lines of the Port-A if configured as an output and reading from this address will return the status of these lines if configured as an input.

Base + 1 - Control register - bit control defined as follows:

- Bit 0 - low nibble Port0 data direction. 0 is input, 1 is output
- Bit 1 - high nibble Port1 data direction. 0 is input, 1 is output
- Bit 2 - backlight enable. 1 on, 0 off
- Bit 3 - LCD read/write line
- Bit 4 - LCD instruction mode line
- Bits 5 - 7 unused

Base + 2 - Port-B data port - reading from this register returns the current state of this read only port.

Base + 3 - Port-C data port - writing to this register modifies the output of this write only port.

## 2.6 Analog Channels

The SOM-100ES optionally provides a 12-bit, 8 channel A/D. In addition to the A/D, the SOM-100ES optionally provides 4 D/A channels with 12-bit resolution. These optional converters communicate with the processor through the on-board SPI. The A/D input channel accepts 0 – 5 Volt inputs. The D/A channels provide 0 – 5 Volt outputs with a drive capability of 5 ma.

**Table 4: ANALOG (HDR2)**

Pin	Signal	Pin	Signal
1	GND	2	GND
3	ANI00	4	ANI01
5	ANI02	6	ANI03
7	ANI04	8	ANI05
9	ANI06	10	ANI07
11	GND	12	GND
13	ANO00	14	ANO01
15	ANO02	16	ANO03
17	ANI07	18	GND
19	VCC +5VDC	20	Vref +2.5VDC

In order to access the optional 12 bit A/D (LTC1290) and D/A (TLV5614) communication must take place using the SoM's SPI port. The A/D uses SPI select 0 and the D/A uses SPI select 1. Refer to the SOM-100ES's schematics and your SoM manual for further details.

**Table 5: OPTIONAL A/D & D/A PORT LINE ASSIGNMENTS**

SODIMM Pin	Description
122	MISO
121	MOSI
120	SCLK
105	*LDAC
(SPI Slave Select 0)	A/D *CS
(SPI Slave Select 1)	D/A *CS

## 2.7 RS232 SERIAL 0 UART

The SOM-100ES provides one dedicated RS232 UART Serial 0 which has software configurable baud rates. No handshake Lines are available for use on this port. The DTR line however is connected to processor reset when jumper JP7 is enabled. (default position 2 – 3, disabled). This Reset connection is used by Javakit in conjunction with the SOM-400EM module.

**Table 6: Serial 0 (CN1)**

Pin	DB9 Description
1	-
2	TxD
3	RxD
4	Reset In
5	GND
6	-
7	-
8	-
9	-

## 2.8 RS 232/422/485 SERIAL 1 UART

The SOM-100ES provides one jumper (JP6) selectable RS 232/422/485 Serial Port which has software configurable baud rates. This jumper determines which interface Serial 1 (COM 2) Port utilizes. Place the jumper in the 1 - 2 position for use as an RS/485 port and place the jumper in the 2 - 3 position for use as a RS 422 interface. Remove the jumper (default) for RS/232. RS232 Handshake Lines are implemented by the use of SODIMM pins 78 and 82. When using this serial port in the RS422/485 mode, the Handshake Line implemented through the use of SODIMM pin 82 controls the transmitter enable line of the RS422/485 driver.

**Table 7: Serial 1 (CN2)**

Pin	DB9 Description
1	RS422/485 TX-
2	RS232 RXD or 422/485 TX+
3	RS232 TXD or 422/485 RX+
4	RS422/485 RX-
5	GND
6	Reserved
7	RTS (82)
8	CTS (78)
9	Reserved

## 2.9 RS 232/Modem SERIAL 2 UART

The SOM-100ES provides one jumper (JP13) selectable RS 232/Modem Serial Port which has software configurable baud rates. This jumper is used to select how COM3 (Serial 2) gets utilized. Set the jumper to position 1 – 2 for default RS232 access through HDR10. A serial cable is provided to allow standard DB9 terminations. Set to position 2 – 3 for Modem access (requires modem option and SOM with 3 serial ports). When used as a RS/232 serial port Serial 2 provides complete handshaking. Table 9 outlines these connections.

**Table 8: RS232 (HDR10)**

Pin	Signal	DB9 Description
1	NC	-
2	NC	TxD (102)
3	TxD (102)	RxD (103)
4	RTS (39)	DTR (32/106)
5	RxD (103)	GND
6	CTS (79)	-
7	DTR (32/106)	RTS (39)
8	RI (76)	CTS (79)
9	GND	RI (76)
10	NC	-

## 2.10 CAN I/O

The SOM-100ES provides a single CAN bus channel. The CAN bus is provided by the processor CAN port is only available on the SOM-400EM SoM. Jumpering JP8 pins 1 & 2 enables the terminating resistor for end of network termination.

**Table 9: CAN (HDR1)**

Pin	Signal	DB9 Description
1	NC	-
2	NC	CANL
3	CANL	GND
4	CANH	-
5	GND	-
6	NC	-
7	NC	CANH
8	NC	-
9	NC	-
10	NC	-

## 2.11 LCD

The LCD interface currently supports 2 and 4 line, character LCDs and some graphic LCDs.

**Table 10: LCD Interface (HD4)**

Pin	Signal	Pin	Signal
1	VCC	2	GND
3	RS	4	CNTR
5	E	6	R/W*
7	D1	8	D0
9	D3	10	D2
11	D5	12	D4
13	D7	14	D6
15	K (JP1 Pin3)	16	A (JP1 Pin4)

The LCD is connected to the SOM-100ES's on-board PLD using the SOM's data bus. The Base Address of the PLD is SOM dependent. See the manual that accompanied the SoM for further details. The SOM-100ES's PLD is connected to the SoM's processor data bus and uses SODIMM pin 108 as its select line. The PLD register details for the LCD and Keypad are listed below in the keypad section.

If using an LCD with backlight capability set Bit-2 of the Control register high to turn on the backlight.

## 2.12 Keypad

This header provides an interface for a 4x4, 4x5, or 4x6 matrix Keypad. These row and column scan lines are directly connected to the SOM-100ES's on-board PLD. The Base Address of the PLD is SOM dependent. The SOM-100ES's PLD is connected to the SoM's processor data bus and uses SODIMM pin 108 as its select line. See the manual that accompanied the SoM for further details. When scanning the keypad Columns are connected to output lines and the Rows are connected to input lines. The PLD register details for the LCD and Keypad are listed below.

**Table 11: KEYPAD (HDR7)**

Pin	Signal	PLD Port Line
1	COL6	PC5
2	COL5	PC4
3	COL4	PC3
4	COL3	PC2
5	COL2	PC1
6	COL1	PC0
7	ROW1	PD0
8	ROW2	PD1
9	ROW 3	PD2
10	ROW 4	PD3
11	ESD SHIELD	ESD SHIELD

Within the PLD are several registers that are referenced as offsets from the PLD Base address. They are defined as follows:

Base + 0 - Port-A data port - writing to this sets the output lines of the Port-A if configured as an output and reading from this address will return the status of these lines if configured as an input.

Base + 1 - Control register - bit control defined as follows:

- Bit 0 - low nibble Port0 data direction. 0 is input, 1 is output
- Bit 1 - high nibble Port1 data direction. 0 is input, 1 is output
- Bit 2 - backlight enable. 1 on, 0 off
- Bit 3 - LCD read/write line
- Bit 4 - LCD instruction mode line
- Bits 5 - 7 unused

Base + 2 - Port-B data port - reading from this register returns the current state of this read only port.

Base + 3 - Port-C data port - writing to this register modifies the output of this write only port.

Base + 4 - Keypad data port - reading this register returns the last value latched from the keypad -> high nibble = row, low nibble = column. The keypad sets it's interrupt line when a button is pressed and releases it when data is read from this register.

Base + 5 - LCD data register - this is used to latch data to the LCD data bus

Base + 7 - reset line - this register can be used to reset the output data lines, currently it is unused.

## 2.13 Multi-Media Card (MMC) Socket

The SOM-100ES provides an MMC Socket. This Socket is connected to the processor's SPI bus. Jumper JP12 is used to select the MMC mode. Set the jumper to position 1 – 2 for default SPI access. Set to position 2 – 3 for standard MMC access (requires special Software/Firmware). The utilization of this socket is not compatible with MMC readers that commonly connect to the PC when configured in SPI mode. Atmel MMC cards are the only cards that have been tested using this Socket although other cards should work once properly initialized to SPI mode.

**Table 12: MMC Socket (SOK1)**

Pin	Signal
1	Slave Select 2
2	MOSI
3	GND
4	Vcc
5	SCK
6	NC
7	MISO

## **3. Software**

### **3.1 Introduction**

Drivers for the SOM-100ES's I/O is provided with the SoM. Consult the SoM manual for information on the drivers included drivers for the SOM-100ES.