



MMOD-EM-SAM7S
Embedded microcontroller module
User Manual

Ver. 01.00
20/01/2007

Version	Date	Changes	Author
01.00	20/01/2007	Initial version	Angel Gavrailov

Table of Contents

Table of Contents.....3
Introduction4
Key Features.....5
Block diagram of MMOD-EM-SAM7S Embedded Module.....6
Functional capabilities of the MMOD-EM-SAM7S Embedded Module7
Pin Configuration.....8
Customizations13
Electrical characteristics15
Mechanical characteristics.....16

Introduction

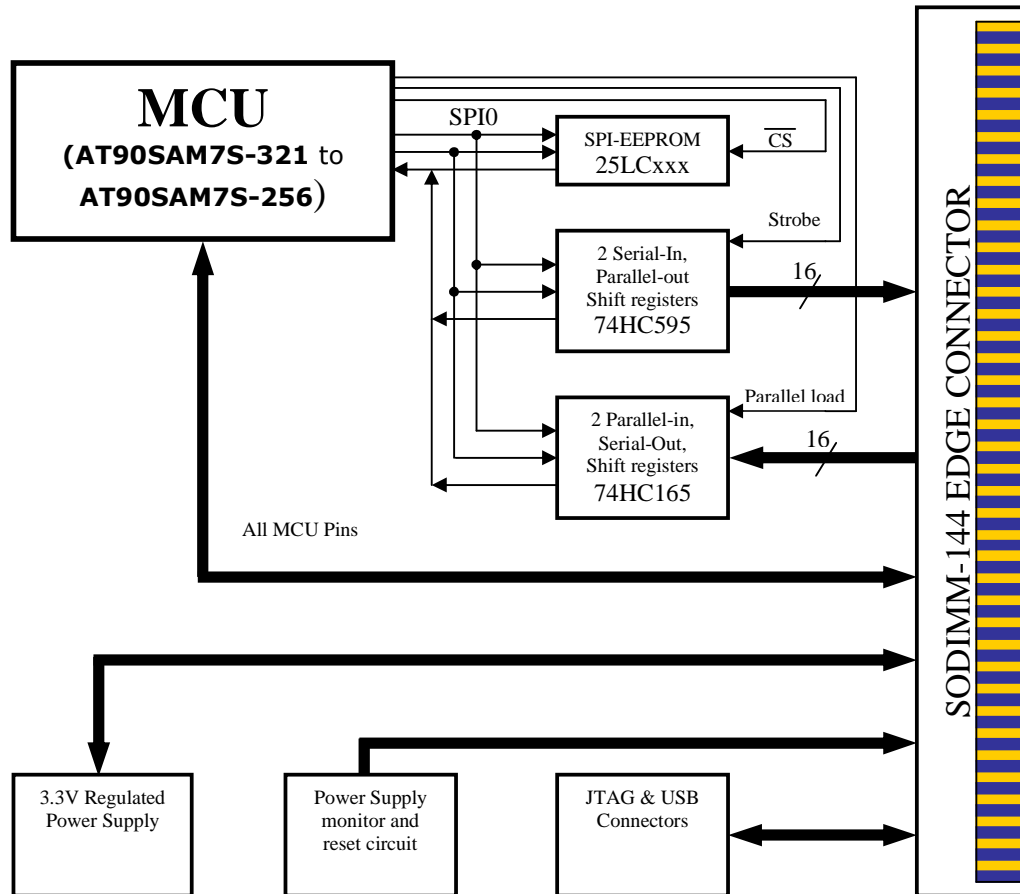
MMOD-EM-SAM7S is an embedded module, which incorporates an Atmel **AT90SAM7S-321** to **AT90SAM7S-256** MCU, the surrounding components, needed for its basic operation (quartz crystal, power supply, etc) and some basic utility features, such as serial-to-parallel shift registers, EEPROM memory, etc. The module itself is a complete core component of any small-to-medium sized embedded application, including industrial applications, test equipment, security and Time&Attendance applications, etc.

Due to its compact size and industry-standard footprint (suited for SODIMM-144 connector) the module is ideally suited for any kind of application, where board space is an issue and future flexibility is of special importance.

Key Features

- **Atmel AT90SAM7S-321 to AT90SAM7S-256 ARM7-TDMI** microcontroller MCU
- Serial-In, Parallel-Out registers for 16 SPI-managed logic outputs
- Parallel-In, serial-Out registers for 16 SPI-managed logic inputs
- **EEPROM** in various memory sizes (optional)
- 3.3V regulated supply
- **USB**-connector (optional)
- For mounting in modern, space-saving, industry standard **SODIMM-144** socket

Block diagram of MMOD-EM-SAM7S Embedded Module



MMOD-EM-SAM7S module consists of Atmel AT90SAM7S-321 to AT90SAM7S-256 MCU, 2 Serial-In-Parallel-Out shift registers, 2 Parallel-In-Serial-Out shift registers, SPI EEPROM, 3.3V power supply regulator and JTAG & USB connectors. This configuration allows very quick implementation of a system with a medium complexity just with a few external components. All pins of the MCU are connected to the SODIMM-144 edge connector. This way the user can use the full capabilities of the controller.

Functional capabilities of the MMOD-EM-SAM7S Embedded Module

Below follows a short description of the functional capabilities of the MCU module **MMOD-EM-SAM7S**. Each feature is pointed out along with the component, which implements it.

AT90SAM7S-321 to AT90SAM7S-256:

- 32/16 bit ARM7TDMI-S CPU with up to 48Mhz speed
- Up to 256 Kbytes embedded flash memory
- Up to 64 Kbytes internal SRAM
- One 8 channel 10-bit A/D converter
- Two UARTs (16C550) with IrDA support, Manchester Encoder/Decoder, etc., two Fast I2C-bus (400 kbit/s), SPI and SSP with buffering and variable data length capabilities
- Up to 32 5 V tolerant general purpose I/O
- One USB 2.0 Full Speed (12 Mbits per Second) Device Port

74HC595:

- SPI-controlled Serial-In, Parallel-out shift registers implementing 16 digital outputs
- Full-speed SPI interface allowing high-speed digital outputs

74HC165:

- SPI-controlled Serial-Out, Parallel-in shift registers implementing 16 digital inputs
- Full-speed SPI interface allowing high-speed digital inputs

25LCxxx:

- Easy to use SPI interface EEPROM
- Up to 256KBit non-volatile storage

Pin Configuration

The pinout of the edge connector of the MMOD-EM-SAM7S module is described in **Table 1** (odd pin numbers, i.e. "upper side") and **Table 2** (even pin numbers, i.e. "lower side"):

Pin Number	Signal	Description
1	AT91SAM7S pin 3	AD4 – A/D Converter Input 4
3	AT91SAM7S pin 4	AD5 – A/D Converter Input 5
5	AT91SAM7S pin 5	AD6 – A/D Converter Input 6
7	AT91SAM7S pin 6	AD7 – A/D Converter Input 7
9	AT91SAM7S pin 9	PA17/AD0/TD/PCK1 AD0 – A/D Converter Input 0 TD – Synchronous Serial Controller Transmit Data PCK1 – Programmable Clock Output #1
11	AT91SAM7S pin 10	PA18/AD1/RD/PCK2 AD1 – A/D Converter Input 1 RD – Synchronous Serial Controller Receive Data PCK2 – Programmable Clock Output 2
13	AT91SAM7S pin 11	PA21/RXD1/PCK1 RXD1 – USART #1 Receive Data PCK1 – Programmable Clock Output 1
15	AT91SAM7S pin 13	PA19/AD2/RK/FIQ AD2 – A/D Converter Input 2 RK – Synchronous Serial Controller Receive Clock FIQ – Fast Interrupt Input
17	AT91SAM7S pin 14	PA22/TXD1/NPCS3 TXD1 – USART #1 Transmit Data NPCS3 – SPI Peripheral Chip Select 3
19	AT91SAM7S pin 15	PA23/SCK1/PWM0 SCK1 – USART #1 Serial Clock PWM0 – PWM Channel 0
21	AT91SAM7S pin 16	PA20/AD3/RF/IRQ0 AD3 – A/D Converter Input 3 RF – Synchronous Serial Controller Receive Frame Sync IRQ0 – External Interrupt Input 0
23	AT91SAM7S pin 19	PA16/TK/TIOB1 TK – Synchronous Serial Controller Transmit Clock TIOB1 – Timer/Counter 1 I/O Line B
25	AT91SAM7S pin 20	PA15/TF/TIOA1 TF – Synchronous Serial Controller Transmit Frame Sync TIOA1 – Timer/Counter 1 I/O Line A
27	AT91SAM7S pin 21 MC74HC595 pin 11 SN74HC165 pin 2	PA14/SPCK/PWM3 SPCK – SPI Serial Clock PWM3 – PWM Channel 3 SCK of '165 and '595 shift registers
29	AT91SAM7S pin 22 MC74HC595 #1 pin 14	PA13/MOSI/PWM2 MOSI – SPI Master Out Slave In PWM2 – PWM Channel 2 Serial-In-Parallel-Out Shift register serial input
31	AT91SAM7S pin 23	PA24/RTS1/PWM1 RTS1 – USART #1 Request To Send PWM1 – PWM Channel 1

Table 1. Pin Configuration – Odd Pin numbers

Pin Number	Signal	Description
33	AT91SAM7S pin 25	PA25/CTS1/PWM2 CTS1 – USART #1 Clear To Send PWM2 – PWM Channel 2
35	AT91SAM7S pin 26	PA26/DCD1/TIOA2 DCD1 – USART #1 Data Carrier Detect TIOA2 – Timer/Counter 2 I/O Line A
37	AT91SAM7S pin 27 SN74HC165 #0 pin 9	PA12/MISO/PWM1 MISO – SPI Master In Slave Out PWM1 – PWM Channel 1 Parallel-In-Serial-Out Shift register 0 serial output
39	AT91SAM7S pin 28 25Cxxx pin 1	PA11/NPCS0/PWM0 NPCS0 – SPI Peripheral Chip Select 0 PWM0 – PWM Channel 0 EEPROM CS (active low)
41	AT91SAM7S pin 29	PA10/DTXD/NPCS2 DTXD – Debug Transmit Data NPCS2 – SPI Peripheral Chip Select 2
43	AT91SAM7S pin 30	PA9/RI1/TCLK2 RI1 – USART #1 Ring Indicator TCLK2 – External Clock Input 2
45	AT91SAM7S pin 31	PA8/CTS0/ADTRG CTS0 – USART #0 Clear To Send ADTRG – ADC Trigger
47	AT91SAM7S pin 32	PA7/RTS0/PWM3 RTS0 – USART #0 Request To Send PWM3 – PWM Channel 3
49	AT91SAM7S pin 34	PA6/TXD0/PCK0 TXD0 – USART #0 Transmit Data PCK0 – Programmable Clock Output 0
51	AT91SAM7S pin 35	PA5/RXD0/NPCS3 RXD0 – USART #0 Receive Data NPCS3 – SPI Peripheral Chip Select 3
53	AT91SAM7S pin 36	PA4/TWCK/TCLK0 TWCK – Two-wire Serial Clock TCLK0 – External Clock Input 0
55	AT91SAM7S pin 37	PA27/DTR1/TIOB2 DTR1 – USART #1 Data Terminal Ready TIOB2 – Timer/Counter 2 I/O Line B
57	AT91SAM7S pin 38	PA28/DSR1/TCLK1 DSR1 – USART #1 Data Set Ready TCLK1 – External Clock Input 1
59	AT91SAM7S pin 40	TST – Test Mode Select
61	AT91SAM7S pin 41 MC74HC595 pin 12	PA29/RI1/TCLK2 RI1 – USART #1 Ring Indicator TCLK2 – External Clock Input 2 STROBE of '595
63	AT91SAM7S pin 42 SN74HC165 pin 1	PA30/IRQ1/NPCS2 IRQ1 – External Interrupt Input 1 NPCS2 – SPI Peripheral Chip Select 2 PARALLEL_LOAD of '165
65	AT91SAM7S pin 43	PA3/TWD/NPCS3 TWD – Two-wire Serial Data NPCS3 – SPI Peripheral Chip Select 3
67	AT91SAM7S pin 44	PA2/PWM2/SCK0 PWM2 – PWM Channel 2 SCK0 – USART #0 Serial Clock

Table 1. Pin Configuration – Odd Pin numbers (continued)

Pin Number	Signal	Description
69	AT91SAM7S pin 47	PA1/PWM1/TIOB0 <i>PWM1 - PWM Channel 1</i> <i>TIOB0 - Timer/Counter 0 I/O Line B</i>
71	AT91SAM7S pin 48	PA0/PWM0/TIOA0 <i>PWM0 - PWM Channel 0</i> <i>TIOA0 - Timer/Counter 0 I/O Line A</i>
73	AT91SAM7S pin 50	JTAGSEL - JTAG Selection
75	AT91SAM7S pin 52	PA31/NPCS1/PCK2 <i>NPCS1 - SPI Peripheral Chip Select 1</i> <i>PCK2 - Programmable Clock Output 2</i>
77	AT91SAM7S pin 55	ERASE - Flash and NVM Configuration Bits Erase Command
79	AT91SAM7S pin 56	DDM - USB Device Port Data -
81	AT91SAM7S pin 57	DDP - USB Device Port Data +
95	N.C.	Not Connected
97	N.C.	Not Connected
99	N.C.	Not Connected
101	N.C.	Not Connected
103	N.C.	Not Connected
105	N.C.	Not Connected
107	N.C.	Not Connected
109	N.C.	Not Connected
111	Shift register 0 output 0	SPI-managed output 0
113	Shift register 0 output 1	SPI-managed output 1
115	Shift register 0 output 2	SPI-managed output 2
117	Shift register 0 output 3	SPI-managed output 3
119	Shift register 0 output 4	SPI-managed output 4
121	Shift register 0 output 5	SPI-managed output 5
123	Shift register 0 output 6	SPI-managed output 6
125	Shift register 0 output 7	SPI-managed output 7
127	Shift register 0 output 0	SPI-managed output 8
129	Shift register 1 output 1	SPI-managed output 9
131	Shift register 1 output 2	SPI-managed output 10
133	Shift register 1 output 3	SPI-managed output 11
135	Shift register 1 output 4	SPI-managed output 12
137	Shift register 1 output 5	SPI-managed output 13
139	Shift register 1 output 6	SPI-managed output 14
141	Shift register 1 output 7	SPI-managed output 15
143	Shift register 1 SDO output	SPI-managed SDO output

Table 1. Pin Configuration – Odd Pin numbers (continued)

Pin Number	Signal	Description
2	VCC In	Input unregulated DC voltage (4.2V - 7V max)
4	VCC In	Input unregulated DC voltage (4.2V - 7V max)
6	VCC In	Input unregulated DC voltage (4.2V - 7V max)
8	3.3V Supply <i>AT91SAM7S321-256</i> <i>pins 23, 43, 51</i>	In case of voltage regulator: Regulated 3.3V output/Supply for MCU and peripherals In case of voltage regulator missing: 3.3V input for MCU and peripherals
10	3.3V Supply <i>AT91SAM7S321-256</i> <i>pins 23, 43, 51</i>	In case of voltage regulator: Regulated 3.3V output/Supply for MCU and peripherals In case of voltage regulator missing: 3.3V input for MCU and peripherals
12	3.3V Supply <i>AT91SAM7S321-256</i> <i>pins 23, 43, 51</i>	In case of voltage regulator: Regulated 3.3V output/Supply for MCU and peripherals In case of voltage regulator missing: 3.3V input for MCU and peripherals
14	1.8V Supply	Not used
16	1.8V Supply	Not used
18	1.8V Supply	Not used
20	1.8V Supply	Not used
22		Reference voltage for the ADC of the MCU
24		MCU analog Power supply. By default connected via 0R and 10uH inductance to VDD
26		Battery supply input. Used for the RTC of the MCU
28	GND <i>AT91SAM7S321-256</i> <i>pins 6, 18, 25, 42, 50</i>	Power supply ground (0V) <i>MCU ground pins</i>
30	GND	Power supply ground (0V)
32	GND	Power supply ground (0V)
34	GND	Power supply ground (0V)
36	GND	Power supply ground (0V)
38	GND	Power supply ground (0V)
40		Analog ground (0V). By default connected to GND by 0R
42	N.C.	Not Used
44	N.C.	Not Used
46	N.C.	Not Used
48	N.C.	Not Used
50	N.C.	Not Used
52	N.C.	Not Used
54	N.C.	Not Used
56	N.C.	Not Used
58	N.C.	Not Used
60	N.C.	Not Used
62		MCU main crystal input. Connected via 0R to the MCU
64		MCU main crystal output. Connected via 0R to the MCU
66	N.C.	Not Used
68	N.C.	Not Used
70		MCU RTC crystal input. Connected via 0R to the MCU
72		MCU RTC crystal output. Connected via 0R to the MCU
74	N.C.	Not Used
76	N.C.	Not Used
78	N.C.	Not Used
80	N.C.	Not Used
82	N.C.	Not Used
84	N.C.	Not Used
86	Shift register 0 input 0	SPI-managed input 0
88	Shift register 0 input 1	SPI-managed input 1
90	Shift register 0 input 2	SPI-managed input 2
92	Shift register 0 input 3	SPI-managed input 3
94	Shift register 0 input 4	SPI-managed input 4
96	Shift register 0 input 5	SPI-managed input 5
98	Shift register 0 input 6	SPI-managed input 6
100	Shift register 0 input 7	SPI-managed input 7

Table 2. Pin Configuration – Even pin numbers

Pin Number	Signal	Description
102	Shift register 0 input 0	SPI-managed input 8
104	Shift register 1 input 1	SPI-managed input 9
106	Shift register 1 input 2	SPI-managed input 10
108	Shift register 1 input 3	SPI-managed input 11
110	Shift register 1 input 4	SPI-managed input 12
112	Shift register 1 input 5	SPI-managed input 13
114	Shift register 1 input 6	SPI-managed input 14
116	Shift register 1 input 7	SPI-managed input 15
118	Shift register 1 SDI input	SPI-managed SDO input
120	N.C.	Not Used
122	N.C.	Not Used
124		MCU JTAG TDO
126		MCU JTAG TCK
128		MCU JTAG TDI
130		MCU JTAG TRST
132		MCU JTAG RTCK
134		MCU JTAG TMS
136	N.C.	Not Used
138		MCU Reset(active low)
140	N.C.	Not Used
142	USB D-	USB connector D- pin
144	USB D+	USB connector D+ pin

Table 2. Pin Configuration – Even pin numbers (continued)

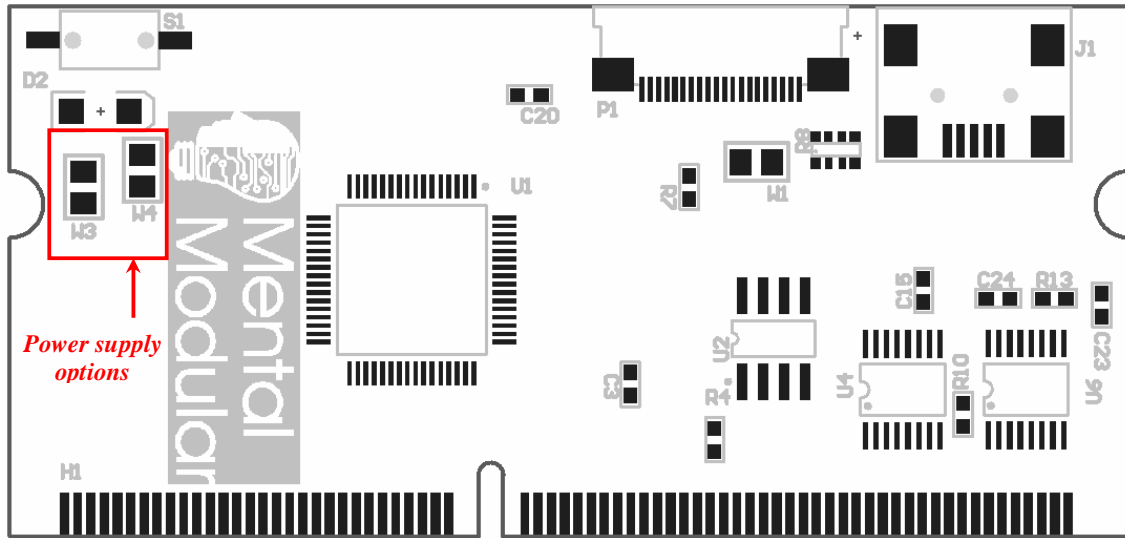
Customizations

There is a possibility of small number of customizations of the module. These include using external regulated 3.3V power supply, using external clocks, etc. The possible module variants and the components which should be mounted or not for a certain variant are shown in **Table 3**:

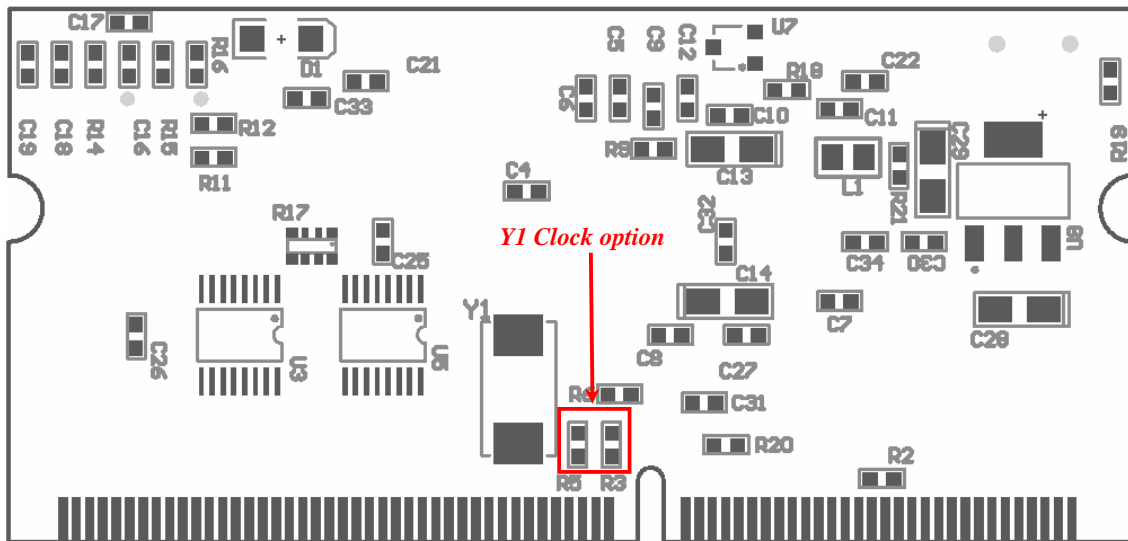
Component action	Resulting Variant	Default	Default variant
W3 – unmount W4 – mount	The module operates with external pre-regulated 3.3V power supply (edge connectors pins 8, 10, 12)	W3 - mounted W4 - unmounted	The module operates with external non-regulated power supply in the range of 4.2V-7.0V (edge connectors pins 2, 4 and 6)
R3 – unmount	System crystal MCU pin (Y1, XTAL_IN) disconnected from the edge connector	R3 – mounted	System crystal MCU pin (Y1, XTAL_IN) connected to the edge connector. If the user wishes to use external clock, he must remove Y1
R5 – unmount	System crystal MCU pin (Y1, XTAL_OUT) disconnected from the edge connector	R5 – mounted	System crystal MCU pin (Y1, XTAL_OUT) connected to the edge connector

Table 3

The user can easily find the exact component location of the components on **Picture 1** and **Picture 2**:



Picture 1 Top side of the module



Picture 2 Bottom side of the module

Electrical characteristics

Absolute maximum ratings:

Parameter	Value
Operating temperature	-40°C to +85°C
Storage temperature	-60°C to +150°C
Voltage on Input pins with respect to GND	-0.3V to +3.6V
Maximum operating voltage - 3.3V Supply (pins 8, 10, 12)	+3.6V
Maximum operating voltage - Vcc_In (pins 2, 4, 6)	+7.0V
Maximum voltage at digital inputs (pins 86, 88, 90, 92, 94, 96, 98, 100, 102, 104, 106, 108, 110, 112, 114, 116, 118)	+3.6V

DC Characteristics:

Parameter	Value
Nominal voltage on Input pins with respect to GND	+3.3V
Nominal operating voltage - 3.3V Supply (pins 8, 10, 12)	+3.3V
Nominal operating voltage - Vcc_In (pins 2, 4, 6)	+5.0V
All other	See the corresponding IC datasheet

Mechanical characteristics

Physical dimensions

