MSP430-169LCD development board
USER'S MANUAL

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Designed by OLIMEX Ltd, 2013

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THERE IS NO WARRANTY FOR THE DESIGN MATERIALS AND THE COMPONENTS USED TO CREATE MS430-169LCD. THEY ARE CONSIDERED SUITABLE ONLY FOR MSP430-169LCD.

Table of Contents

CHAPTER 1 | OVERVIEW

1.1 Introduction to the chapter

Thank you for choosing the MSP430-169LCD development board from Olimex! This document provides a User's Guide for the Olimex MSP430-169LCD development board. As an overview, this chapter gives the scope of this document and lists the board's features. The document's organization is then detailed.

The MSP430-169LCD development board enables code development of applications running on the MSP430F169 microcontroller, manufactured by Texas Instruments.

1.2 Features

- MCU: MSP430F169 with 60KB Program Flash, 256 Bytes Data Flash, 2 KB RAM
- NOKIA 3310 LCD 84x48 pixels black and white
- Joystick with 4 directions and push button function
- SD/MMC card connector
- Two LEDs: status and power
- RESET switch
- JTAG connector
- 32768 Hz crystal oscillator
- 8 MHz crystal oscillator
- Power supply voltage regulator and filtering capacitors
- Extension headers for all uC pins
- PCB: FR-4, 1.5 mm (0.062"), red soldermask, white silkscreen component print
- Dimensions 67 x 66 mm (2.65 x 2.6")

1.3 Organization

Each section in this document covers a separate topic, organized as follow:
- Chapter 1 is an overview of the board usage and features
- Chapter 2 provides a guide for quickly setting up the board
- Chapter 3 contains the general board diagram and layout
- Chapter 4 describes the component that is the heart of the board: the MSP430F169

microcontroller

- Chapter 5 is an explanation of the control circuitry associated with the microcontroller to reset. Also shows the clocks on the board
- Chapter 6 covers the connector pinout, peripherals and jumper description
- Chapter 7 shows the processor diagram and memory map
- Chapter 8 provides the schematics
- Chapter 9 contains the revision history

CHAPTER 2 | SETTING UP THE MSP430-169LCD BOARD

2.1 Introduction to the chapter

This section helps you set up the MSP430-169LCD development board for the first time.

Please consider first the electrostatic warning to avoid damaging the board, then discover the hardware and software required to operate the board.

The procedure to power up the board is given, and a description of the default board behavior is detailed.

2.2 Electrostatic warning

MSP430-169LCD is shipped in a protective anti-static package. The board must not be exposed to high electrostatic potentials. A grounding strap or similar protective device should be worn when handling the board. Avoid touching the component pins or any other metallic element.

2.3 Requirements

In order to set up the MSP430-169LCD, the following items are required:

- A source of power – the board can be powered through JTAG connector; or through the EXT1 connector.

Note: The board works very nice as an extension to the Olimex board MSP430-easyWEB rev3 by connecting directly to its EXT connectors.

- Programmer supporting 14 pin JTAG interface and the used microcontroller MSP430F169.

All our MSP programmers are recommended with MSP430-169LCD:

- Olimex MSP430-JTAG-TINY-V2 – small emulator/programmer ideal for beginners:
https://www.olimex.com/Products/MSP430/JTAG/MSP430-JTAG-TINY-V2/

- Olimex MSP430-JTAG-ISO-MK2 – our best MSP430 emulator/programmer (featuring display, SD card and 3 modes of operation):
https://www.olimex.com/Products/MSP430/JTAG/MSP430-JTAG-ISO-MK2/

- Olimex MSP430-JTAG-RF – the first wireless MSP430 emulator/programmer:
https://www.olimex.com/Products/MSP430/JTAG/MSP430-JTAG-RF/

Also, a host-based software toolchain is required in order to program/debug the MSP430-169LCD board. There are also a number of ready IDEs available like IAR Embedded Workbench, Rowley CrossWorks, Code Composer Studio, etc.

We also provide our own flash programming software which can be distributed free. You can find it at the device web page.

2.4 Powering the board

There are two options for powering the board:

Either set the jumpers P_IN closed, P_OUT open so you can power from JTAG connector

OR use EXT1 connector for powering up (if you have MSP430-EasyWeb3 you can just mount MSP430-169LCD on it)

On powering the board the PWR LED, LED1 and the display should turn on.

2.5 Prebuilt software

On powering the board the PWR LED should turn on. The LCD should show 3 lines of text and the ability to control the selector marker between them. On pressing the joystick over our test of choice it should be conducted.
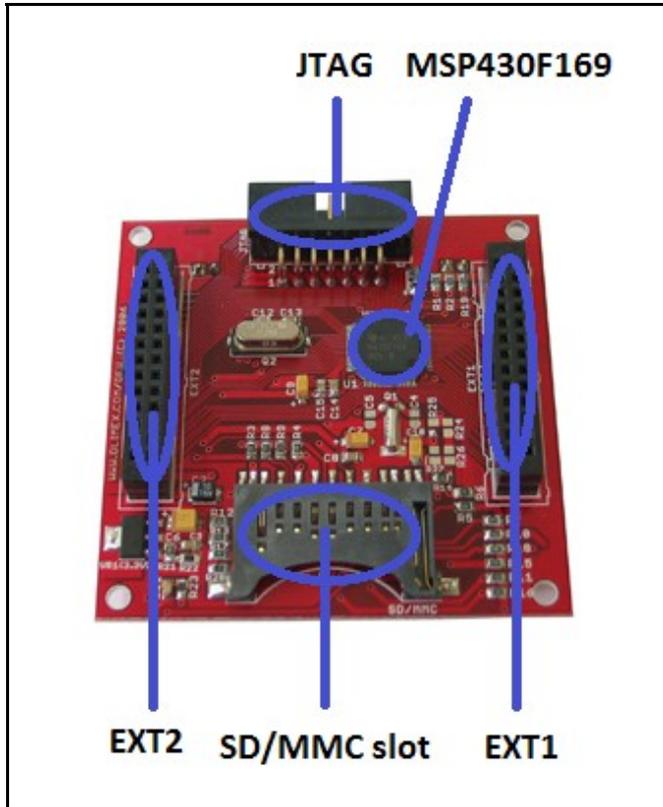
CHAPTER 3 | MSP430-169LCD BOARD DESCRIPTION

3.1 Introduction to the chapter

Here you get acquainted with the main parts of the board. Note the names used on the board differ from the names used to describe them. For the actual names check the MSP430-169LCD board itself.

3.2 Layout (top view)
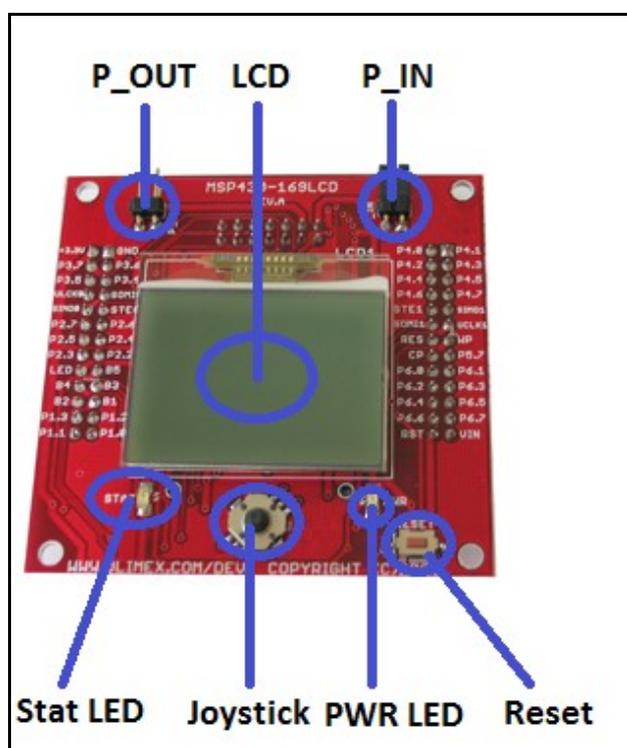
3.3 Layout (bottom view)

CHAPTER 4 | THE MSP430F169 MICROCONTROLLER

4.1 Introduction to the chapter

In this chapter is located the information about the heart of MSP430-169LCD – its microcontroller. The information is a modified version of the datasheet provided by its manufacturers.

4.2 The microcontroller

Features:

- Low Supply-Voltage Range: 1.8 V to 3.6 V
- Ultralow Power Consumption:
  - Active Mode: 330 µA at 1 MHz, 2.2 V
  - Standby Mode: 1.1 µA
  - Off Mode (RAM Retention): 0.2 µA
- Five Power-Saving Modes
- Wake-Up From Standby Mode in Less Than 6 µs
- 16-Bit RISC Architecture, 125-ns Instruction Cycle Time
- Three-Channel Internal DMA
- 12-Bit Analog-to-Digital (A/D) Converter With Internal Reference, Sample-and-Hold, and Autoscan Feature
- Dual 12-Bit Digital-to-Analog (D/A) Converters With Synchronization
- 16-Bit Timer_A With Three Capture/Compare Registers
- 16-Bit Timer_B With Three or Seven Capture/Compare-With-Shadow Registers
- On-Chip Comparator
- Serial Communication Interface (USART0), Functions as Asynchronous UART or Synchronous SPI or I2C™ Interface
- Serial Communication Interface (USART1), Functions as Asynchronous UART or Synchronous SPI Interface
- Supply Voltage Supervisor/Monitor With Programmable Level Detection
- Brownout Detector
- Bootstrap Loader
- Serial Onboard Programming, No External Programming Voltage Needed, Programmable Code Protection by Security Fuse
- Family Members Include

MSP430F169
60KB+256B Flash Memory,
2KB RAM

Literature Number SLAU049

For comprehensive information on the microcontroller visit the Texas Instruments web page for a datasheet.

At the moment of writing the microcontroller datasheet can be found at the following link:
http://www.ti.com/lit/ds/symlink/msp430f169.pdf

CHAPTER 5 | CONTROL CIRCUITY

5.1 Introduction to the chapter

Here you can find information about reset circuit, power circuit and quartz crystal locations.

5.2 Reset

MSP430-169LCD reset circuit includes MSP430F169 pin 58 (RST/NMI) and a RESET button. The reset can be found also at the EXT2.

5.3 Clocks

Real time clock (RTC) 32 768Hz Q1 is connected to pins 8 and 9 of the processor.

8 MHz quarz crystal Q2 is found at pins 52 and 53 of the processor.

CHAPTER 6 | HARDWARE

6.1 Introduction to the chapter

In this chapter are presented the connectors that can be found on the board all together with their pinout. Proto area is shown. Jumpers functions are described. Notes and info on specific peripherals are presented. Notes regarding the interfaces are given.

6.2 JTAG connector

The 14 pin JTAG connector provides the interface for JTAG programming/debugging. The plastic connector is situated at the bottom of the board. The pinout can be found in the table below.

JTAG Connector			
Pin #	Signal Name	Pin #	Signal Name
1	TDO	8	Not connected
2	P_IN/NC*	9	GND
3	TDI	10	Not connected
4	NC/P_OUT*	11	#RST
5	TMS	12	Not connected
6	Not connected	13	Not connected
7	TCK	14	Not connected
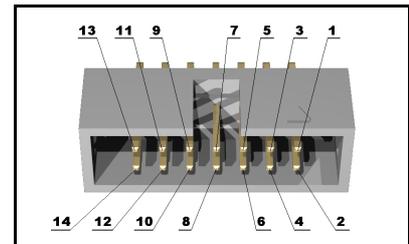
*Depending on the jumper **P_OUT/P_IN** position

6.3 EXT1

The EXT1 and EXT2 headers are female headers at the bottom of the board mouted for easier access to the processor's signals. They also can be used to mount the MSP430-169LCD on MSP430-EASYWEB-3 (https://www.olimex.com/Products/MSP430/Starter/MSP430-EASYWEB-3/). The signal table may be found below:

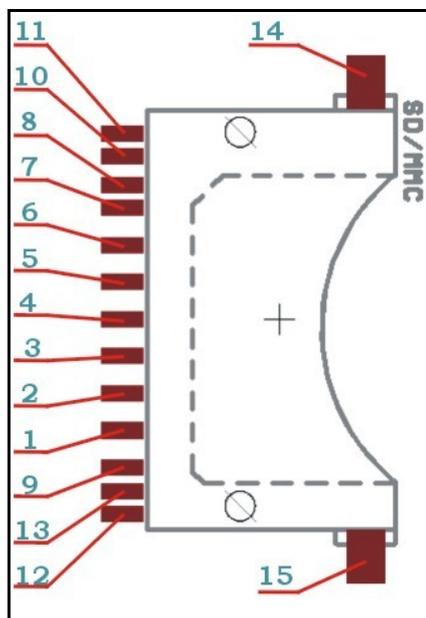| Pin #	Signal Name	Pin#	Signal Name
1	GND	2	+3.3V
3	P3.6	4	P3.7
5	P3.4	6	P3.5
7	SOMI0	8	ULCK0
9	STE0	10	SIMO0
11	P2.6	12	P2.7
13	P2.4	14	P2.5
15	P2.2	16	P2.3
17	B5	18	LED
19	B3	20	B4
21	B1	22	B2
23	P1.2	24	P1.3
25	P1.0	26	P1.1

6.4 EXT2

For your convenience the pads are named individually near each of them.

Pin #	Signal Name	Pin#	Signal Name
1	P4.1	2	P4.0
3	P4.3	4	P4.2
5	P4.5	6	P4.4
7	P4.7	8	P4.6
9	SIMO1	10	STE1
11	UCLK1	12	SOMI1

Pin #	Signal Name	Pin#	Signal Name
13	WP	14	RES
15	P5.7	16	CP
17	P6.1	18	P6.0
19	P6.3	20	P6.2
21	P6.5	22	P6.4
23	P6.7	24	P6.6
25	RST	26	Vin

6.5 SD/MMC slot

Pin #	Signal Name
1	STE1
2	SIMO1
3	GND
4	3.3V
5	UCLK1
6	GND
7	SOMI1
8	Via 100k to 3.3V
9	Via 100k to 3.3V
10	WP
11	NC
12	NC

Pin #	Signal Name
13	CP
14	Via 10k to 3.3V
15	Via 10k to 3.3V

6.6 Jumper description

P_OUT/P_IN

This jumper controls power on pins 2 and 4 of the JTAG connector. When in P_OUT is closed 3.3V can be measured at pin 4.

Check the schematic for more info.

Default position is P_OUT – closed, P_IN - open.

6.7 LCD Display

Nokia 3310 display – 84x48 pixels (30x22mm).

6.8 Additional hardware components

The components below are mounted on MSP430-169LCD but are not discussed above. They are listed here for completeness:

STAT + power-on LED
Joystick J1

CHAPTER 7 | MEMORY AND BLOCK DIAGRAM

7.1 Introduction to the chapter

At the right side of the page is located the block diagram of the processor and on the next page you can find a memory map for this family of processors. It is strongly recommended to refer to the original datasheet released by Texas Instruments for ones of higher quality.
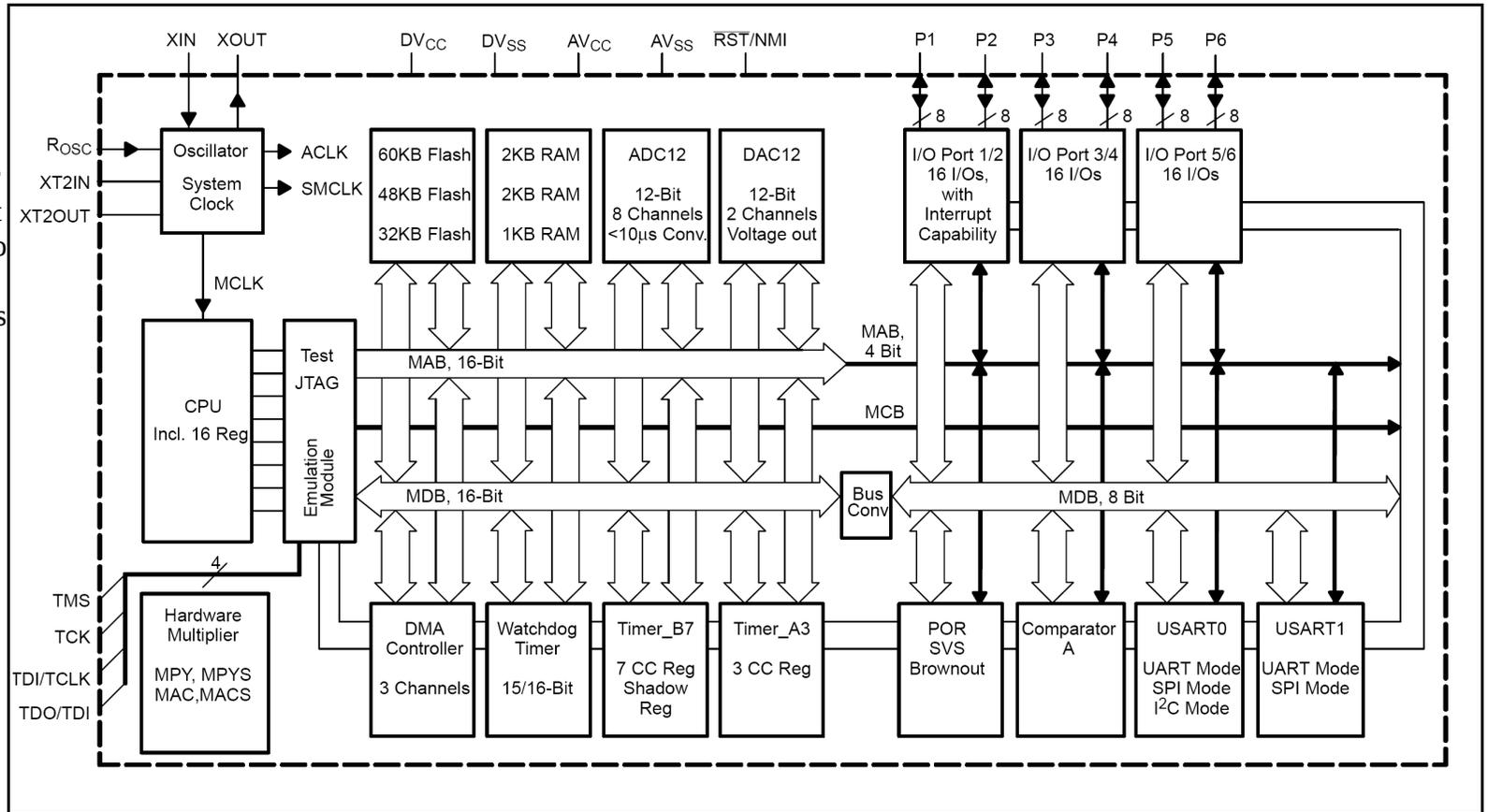
7.2 Memory organization

The interrupt vectors and the power-up starting address are located in the address range 0FFFFh to 0FFE0h. The vector contains the 16-bit address of the appropriate interrupt-handler instruction sequence.

INTERRUPT SOURCE	INTERRUPT FLAG	SYSTEM INTERRUPT	WORD ADDRESS	PRIORITY
Power-up External Reset Watchdog Flash memory	WDTIFG KEYV (see Note 1)	Reset	0FFFEh	15, highest
NMI Oscillator Fault Flash memory access violation	NMIIFG (see Notes 1 and 3) OFIFG (see Notes 1 and 3) ACCVIFG (see Notes 1 and 3)	(Non)maskable (Non)maskable (Non)maskable	0FFFCh	14
Timer_B7 (see Note 5)	TBCCR0 CCIFG (see Note 2)	Maskable	0FFFAh	13
Timer_B7 (see Note 5)	TBCCR1 to TBCCR6 CCIFGs, TBIFG (see Notes 1 and 2)	Maskable	0FFF8h	12
Comparator_A	CAIFG	Maskable	0FFF6h	11
Watchdog timer	WDTIFG	Maskable	0FFF4h	10
USART0 receive	URXIFG0	Maskable	0FFF2h	9
USART0 transmit I^2C transmit/receive/others	UTXIFG0 I2CIFG (see Note 4)	Maskable	0FFF0h	8
ADC12	ADC12IFG (see Notes 1 and 2)	Maskable	0FFEEh	7
Timer_A3	TACCR0 CCIFG (see Note 2)	Maskable	0FFECh	6
Timer_A3	TACCR1 and TACCR2 CCIFGs, TAIFG (see Notes 1 and 2)	Maskable	0FFEAh	5
I/O port P1 (eight flags)	P1IFG.0 to P1IFG.7 (see Notes 1 and 2)	Maskable	0FFE8h	4
USART1 receive	URXIFG1	Maskable	0FFE6h	3
USART1 transmit	UTXIFG1	Maskable	0FFE4h	2
I/O port P2 (eight flags)	P2IFG.0 to P2IFG.7 (see Notes 1 and 2)	Maskable	0FFE2h	1
DAC12 DMA	DAC12_0IFG, DAC12_1IFG DMA0IFG, DMA1IFG, DMA2IFG (see Notes 1 and 2)	Maskable	0FFE0h	0, lowest

NOTES: 1. Multiple source flags
2. Interrupt flags are located in the module.
3. (Non)maskable: the individual interrupt-enable bit can disable an interrupt event, but the general-interrupt enable cannot disable it.
4. I^2C interrupt flags located in the module
5. Timer_B7 in MSP430F16x/161x family has 7 CCRs; Timer_B3 in MSP430F15x family has 3 CCRs; in Timer_B3 there are only interrupt flags TBCCR0, 1 and 2 CCIFGs and the interrupt-enable bits TBCCR0, 1 and 2 CCIEs.

CHAPTER 8 | SCHEMATICS
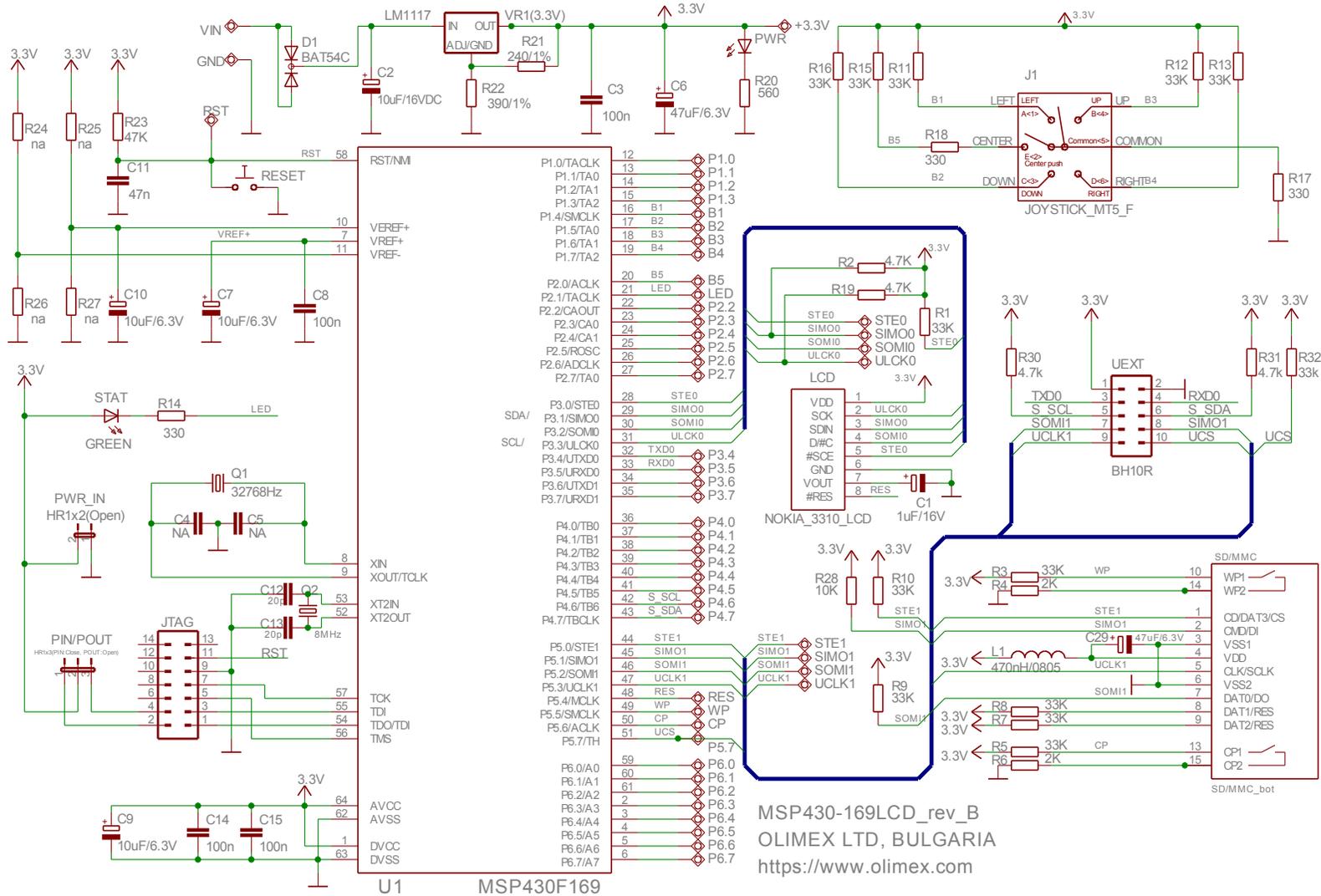
8.1 Introduction to the chapter

In this chapter is located the schematic describing logically MSP430-169LCD.

8.2 Eagle schematic

MSP430-169LCD schematic is visible for reference here. You can also find it with higher quality on the web page for MSP430-169LCD at our site:
https://www.olimex.com/Products/MSP430/Starter/MSP430-169LCD/. It is located in HARDWARE section.

The EAGLE schematic is situated on the next page for quicker reference.

MSP430-169LCD_rev_B
OLIMEX LTD, BULGARIA
https://www.olimex.com

U1   MSP430F169

CHAPTER 9 | REVISION HISTORY

9.1 Introduction to the chapter

In this chapter you will find the current and the previous version of the document you are reading. Also the web-page for your device is listed. Be sure to check it after a purchase for the latest available updates and examples.

9.2 Document revision

Revision	Changes	Modified Pages
A	**Initial Creation**	**All**

9.3 Web page of your device

The web page you can visit for more info on your device is https://www.olimex.com/Products/MSP430/Starter/MSP430-169LCD/. There you can find more info and some examples.

ORDER CODES:

MSP430-169LCD - completely assembled and tested

MSP430-JTAG-ISO – emulator/debugger with 1000VDC isolation
MSP430-JTAG-TINY - mini emulator/programmer USB<->JTAG 14p
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