

MOD-EKG development board

Users Manual



All boards produced by Olimex are ROHS compliant

Revision Initial, June 2011

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INTRODUCTION:

MOD-EKG is digital heart-rate monitor based on TI's MSP430FG439 microcontroller. The heartbeat rate per minute is displayed on the LCD. In addition, the application outputs a digital data stream via an RS232 serial port to allow EKG waveform display on a PC. The only way to do this is via board's UEXT connector, where RS232 signals are leaded. The connection between the PC and MOD-EKG can be made by using our adapter - MOD-USB-RS232 that converts the RS signals into USB signals, and vice versa.

An electrocardiogram (ECG), also called an EKG, is a graphic tracing of the voltage generated by the heart muscle during a heartbeat. In this application, the EKG waveform is used by the MCU to measure the heartbeat rate. Because heart-beat calculation is the major focus the electrodes are simplified to two connections, one to a right hand and the other to the left hand.

BOARD FEATURES:

- Microcontroller: **MSP430FG439**
- EKG amplifiers realized with **INA321EA**
- JTAG connector for direct plug in MSP430 2x7 JTAG connector to provide power for the target board
- UEXT connector so it can be connected to other board as heart beat monitor sensor board
- LCD custom display
- Lithium coin battery holder
- Extension headers for all microcontroller ports - no connectors mounted on the board
- Right and left hands contact electrodes - HR1 and HR2
- Two status leds
- Two user buttons
- Switch between Battery and UEXT power supply
- Based on Texas Instruments application note SLAA280a
- FR-4, 1.5 mm, soldermask, component print
- Dimensions: 76.20 x 71.12 mm (3.00 x 2.80 ")

ELECTROSTATIC WARNING:

The MOD-EKG board is shipped in protective anti-static packaging. The board must not be subject to high electrostatic potentials. General practice for working with static sensitive devices should be applied when working with this board.

BOARD USE REQUIREMENTS:

Cables: The cable you will need depends on the programmer/debugger you use. If you use MSP430-JTAG-TINY, MSP430-JTAG-TINY-V2, or MSP430-JTAG-ISO, you will need USB A-B cable. If you use MSP430-JTAG, you will need LPT cable.

Hardware: Programmer/Debugger [MSP430-JTAG](#), [MSP430-JTAG-TINY](#), MSP430-JTAG-TINY-V2, [MSP430-JTAG-ISO](#) or other compatible programming/debugging tool.

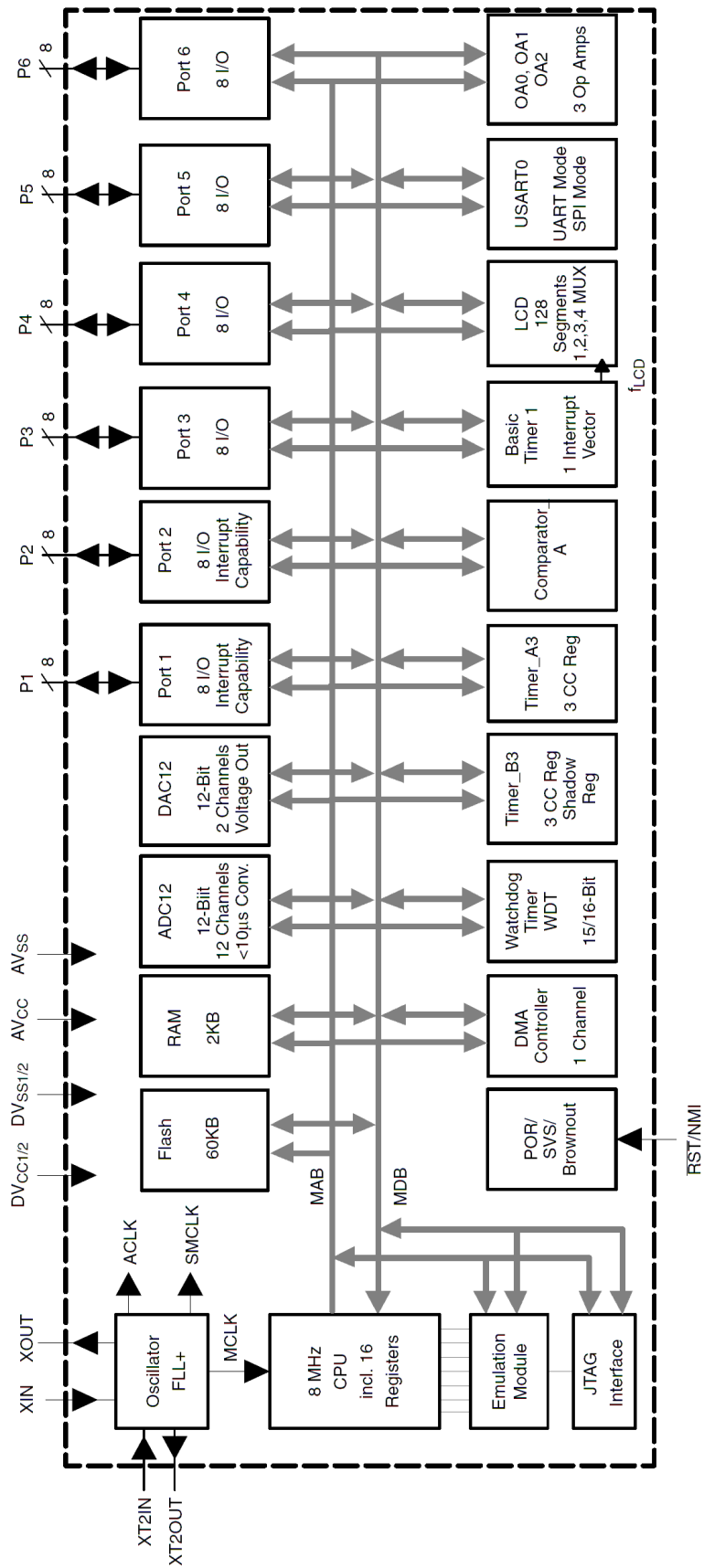
PROCESSOR FEATURES:

MOD-EKG board uses ultralow power microcontroller **MSP430FG439** from Texas Instruments with these features:

- Low Supply-Voltage Range, 1.8 V to 3.6 V
- Ultralow-Power Consumption:
 - Active Mode: 300 μ A at 1 MHz, 2.2 V
 - Standby Mode: 1.1 μ A
 - Off Mode (RAM Retention): 0.1 μ A
- Five Power Saving Modes
- Wake-Up From Standby Mode in Less Than 6 μ s
- 16-Bit RISC Architecture, 125-ns Instruction Cycle Time
- Single-Channel Internal DMA
- 12-Bit A/D Converter With Internal Reference, Sample-and-Hold and Autoscan Feature
- Three Configurable Operational Amplifiers
- Dual 12-Bit D/A Converters With Synchronization
- 16-Bit Timer_A With Three Capture/Compare Registers
- 16-Bit Timer_B With Three Capture/Compare-With-Shadow Registers
- On-Chip Comparator
- Serial Communication Interface (USART), Select Asynchronous UART or Synchronous SPI by Software
- Brownout Detector

- Supply Voltage Supervisor/Monitor With Programmable Level Detection
- Bootstrap Loader
- Serial Onboard Programming, No External Programming Voltage Needed
Programmable Code Protection by Security Fuse
- Integrated LCD Driver for Up to 128 Segments
- 60KB+256B Flash Memory
- 2KB RAM

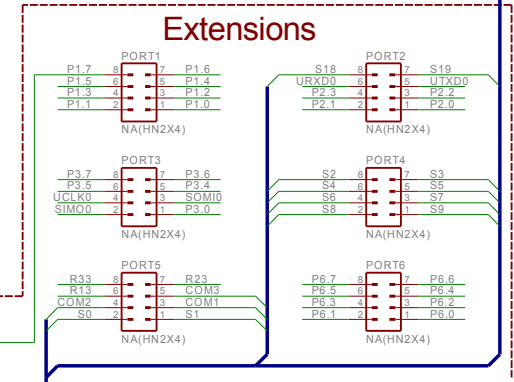
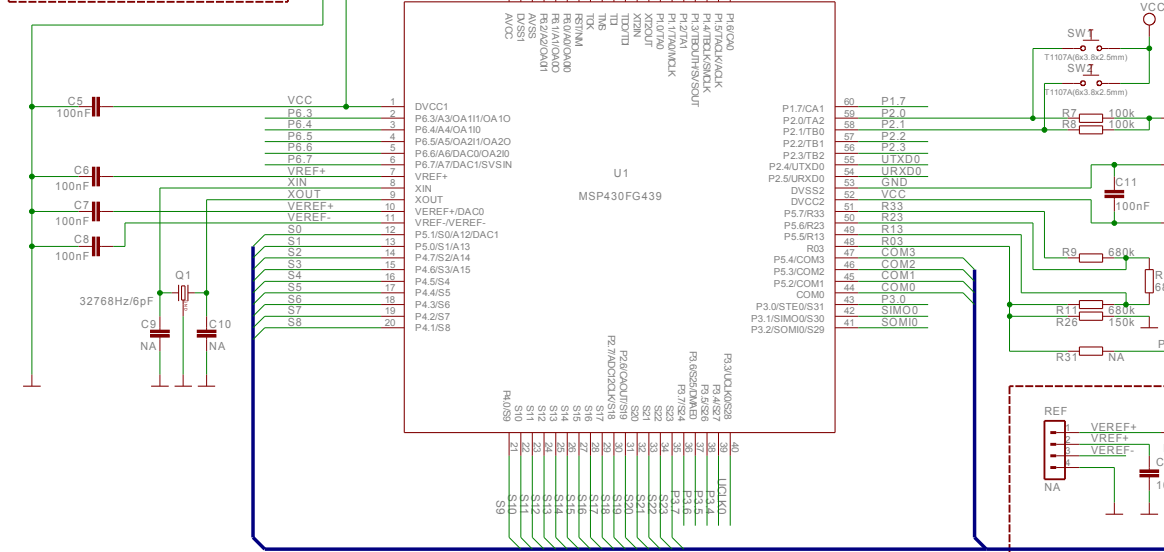
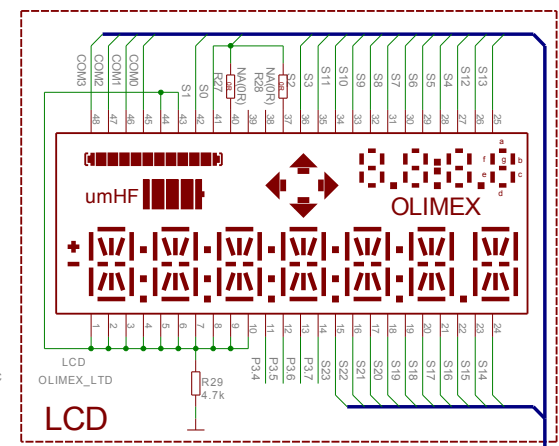
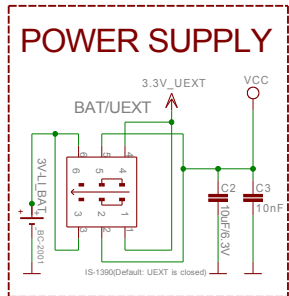
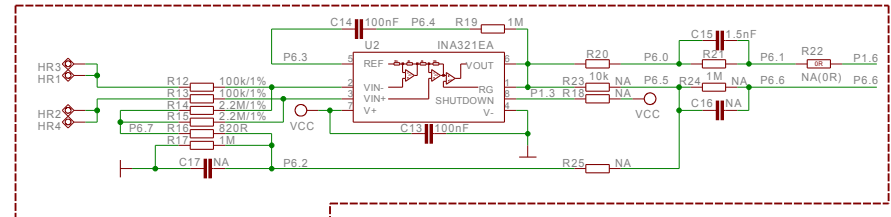
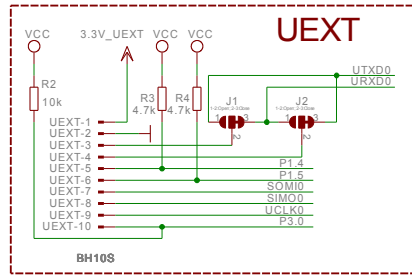
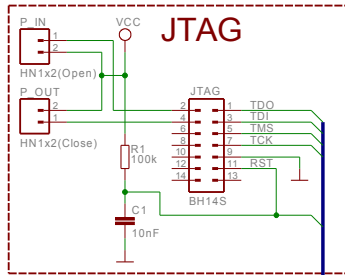
BLOCK DIAGRAM:



MEMORY ORGANIZATION:

Memory Main: interrupt vector Main: code memory	Size Flash Flash	60KB 0FFFFh – 0FFE0h 0FFFFh – 01100h
Information memory	Size Flash	256 Byte 010FFh – 01000h
Boot memory	Size ROM	1KB 0FFFh – 0C00h
RAM	Size	2KB 09FFh – 0200h
Peripherals	16-bit 8-bit 8-bit SFR	01FFh – 0100h 0FFh – 010h 0Fh – 00h

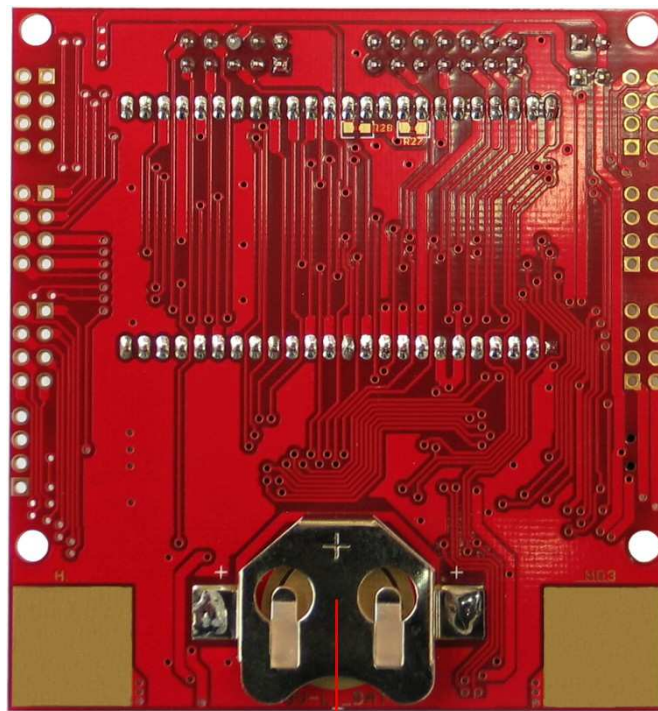
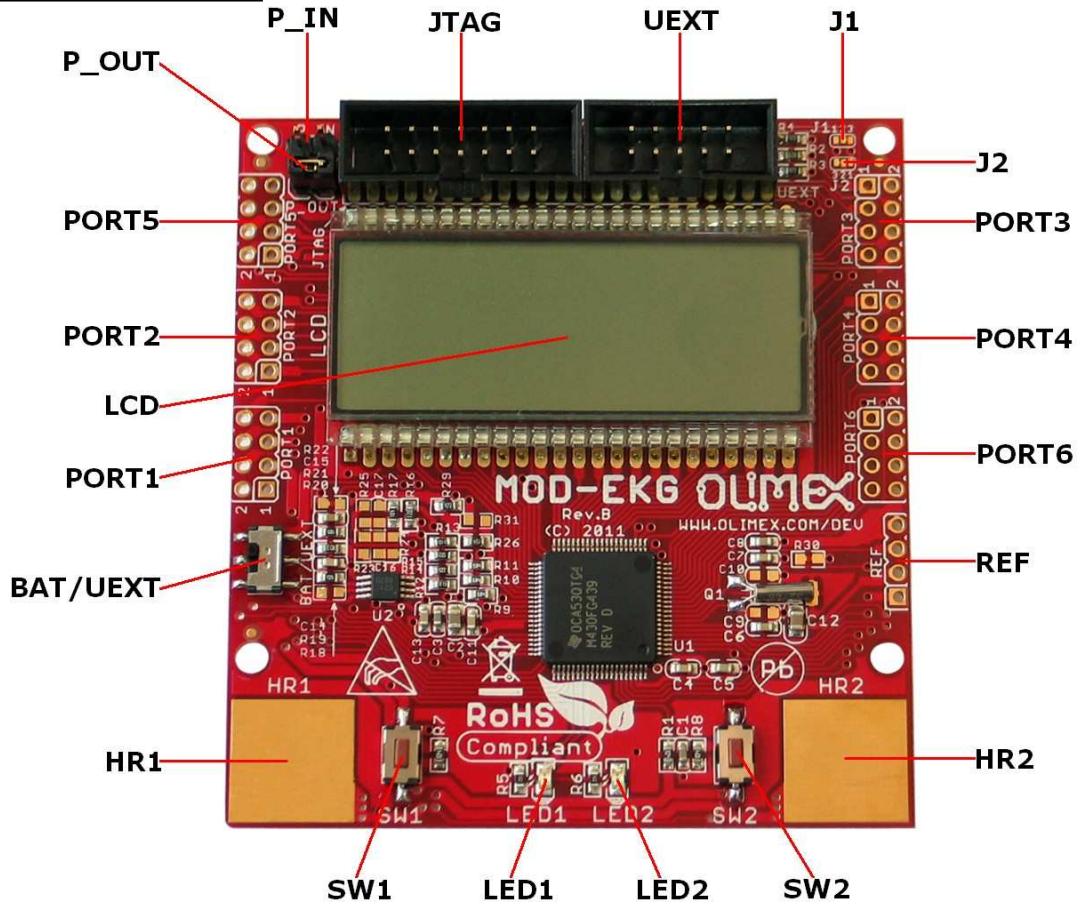
SCHEMATIC:



MOD-EKG

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BOARD LAYOUT:



3V-LI_BAT

POWER SUPPLY CIRCUIT:

MOD-EKG can take power from:

-+3V Lithium battery - when switch BAT/UEXT is in position BAT.

-JTAG - when jumper P_IN is closed and P_OUT is opened.

-UEXT connector - when switch BAT/UEXT is in position UEXT.

The programmed board power consumption is about 3.4 mA with all peripherals enabled.

The power supply source depends on jumpers P_IN and P_OUT position and BAT/UEXT switch position.

RESET CIRCUIT:

MOD-EKG reset circuit includes R1 (100k), C1(10nF), JTAG pin 11 and MSP430FG439 pin 74 (RST/NMI).

CLOCK CIRCUIT:

Quartz crystal (**Q1**) 32.768 kHz is connected to MSP430FG439 pin 8 (XIN) and pin 9 (XOUT).

JUMPER DESCRIPTION:

P_IN



When this jumper is closed, the board is power supplied by the standard JTAG pin 2. This is only possible when the consumption of the board is not very high which is typically the case with MSP430 microcontrollers. If this jumper is open the board should be power supplied by another external source. This jumper and P_OUT should always be reversely open/closed, i.e. if P_IN is closed, P_OUT should be open and vice versa.

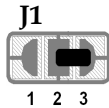
Default state is opened.

P_OUT

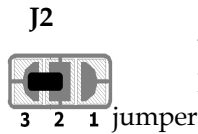


When this jumper is closed, the board is power supplied not by the JTAG but from external source. Then the JTAG has to synchronize with the working voltages which is done through this line. This is especially important when debugging with JTAG. This jumper and P_IN should always be reversely open/closed, i.e. if P_OUT is closed, P_IN should be open and vice versa.

Default state is closed.



When jumper J1 is shorted in position 1-2, UEXT pin 3 is connected to MSP430FG439 pin 55 (P2.4/UTXD0) – signal “UTXD0”. When jumper J1 is shorted in position 2-3, UEXT pin 3 is connected to MSP430FG439 pin 54 (P2.5/URXD0) – signal “URXD0”.
Default state is shorted in position 2-3.



When jumper J2 is shorted in position 1-2, UEXT pin 4 is connected to MSP430FG439 pin 54 (P2.5/URXD0) – signal “URXD0”. When J2 is shorted in position 2-3, UEXT pin 4 is connected to MSP430FG439 pin 55 (P2.4/UTXD0) – signal “UTXD0”.
Default state is shorted in position 2-3.

Depending on jumpers J1 and J2 configuration, the board can work in host, or in device mode. The default state of J1 and J2 is for device mode (shorted in position 2-3).

INPUT/OUTPUT:

LED1 (red) connected to MSP430FG439 pin 67 (P1.0/TA0).

LED2 (red) connected to MSP430FG439 pin 65 (P1.2/TA1).

User button with name **SW1** connected to **MSP430FG439** pin 59 (P2.0/TA2).

User button with name **SW2** connected to **MSP430FG439** pin 58 (P2.1/TB0).

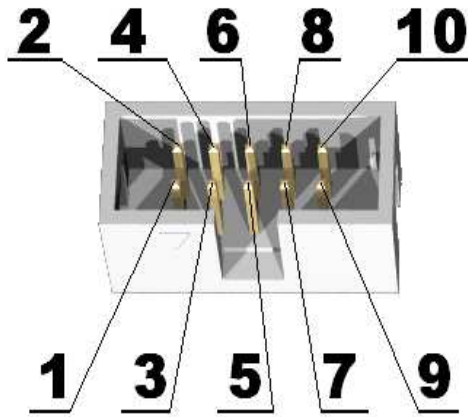
Power supply switch with name **BAT/UEXT** – when in position **BAT** – the board is power supplied via +3V lithium battery, when is in position **UEXT** – the board is connected to other board with UEXT and is power supplied by the other board via UEXT connector.

LCD custom display.

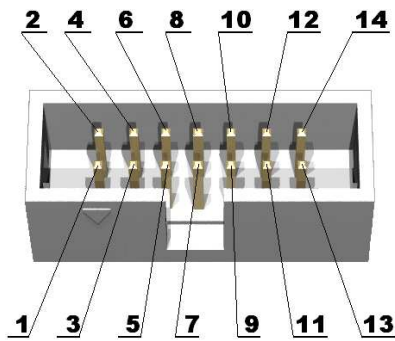
EXTERNAL CONNECTORS DESCRIPTION:

UEXT:

Pin #	Signal Name
1	VDD
2	GND
3	TX
4	RX
5	P1.4
6	P1.5
7	SOMI0
8	SIMO0
9	UCLK0
10	P3.0



JTAG:

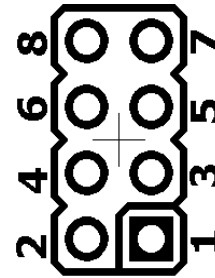


Pin #	Signal Name	Pin #	Signal Name
1	TDO	2	Via P_IN to VCC
3	TDI	4	Via P_OUT to VCC
5	TMS	6	Not Connected
7	TCK	8	Not Connected

9	GND	10	Not Connected
11	RST	12	Not Connected
13	Not Connected	14	Not Connected

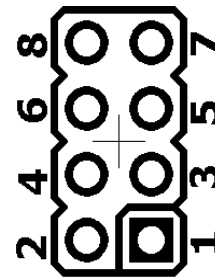
PORT1:

Pin #	Signal Name	Pin #	Signal Name
1	P1.0	2	P1.1
3	P1.2	4	P1.3
5	P1.4	6	P1.5
7	P1.6	8	P1.7



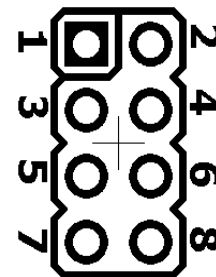
PORT2:

Pin #	Signal Name	Pin #	Signal Name
1	P2.0	2	P2.1
3	P2.2	4	P2.3
5	UTXD0	6	URXD0
7	S19	8	S18



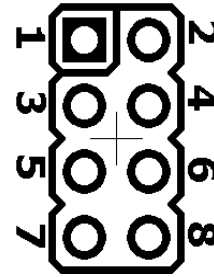
PORT3:

Pin #	Signal Name	Pin #	Signal Name
1	P3.0	2	SIMO0
3	SOMI0	4	UCLK0
5	P3.4	6	P3.5
7	P3.6	8	P3.7



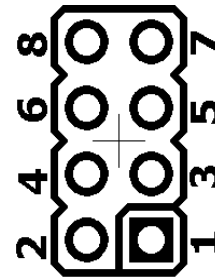
PORT4:

Pin #	Signal Name	Pin #	Signal Name
1	S9	2	S8
3	S7	4	S6
5	S5	6	S4
7	S3	8	S2



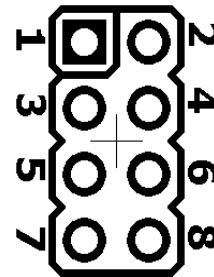
PORT5:

Pin #	Signal Name	Pin #	Signal Name
1	S1	2	S0
3	COM1	4	COM2
5	COM3	6	R13
7	R23	8	R33



PORT6:

Pin #	Signal Name	Pin #	Signal Name
1	P6.0	2	P6.1
3	P6.2	4	P6.3
5	P6.4	6	P6.5
7	P6.6	8	P6.7

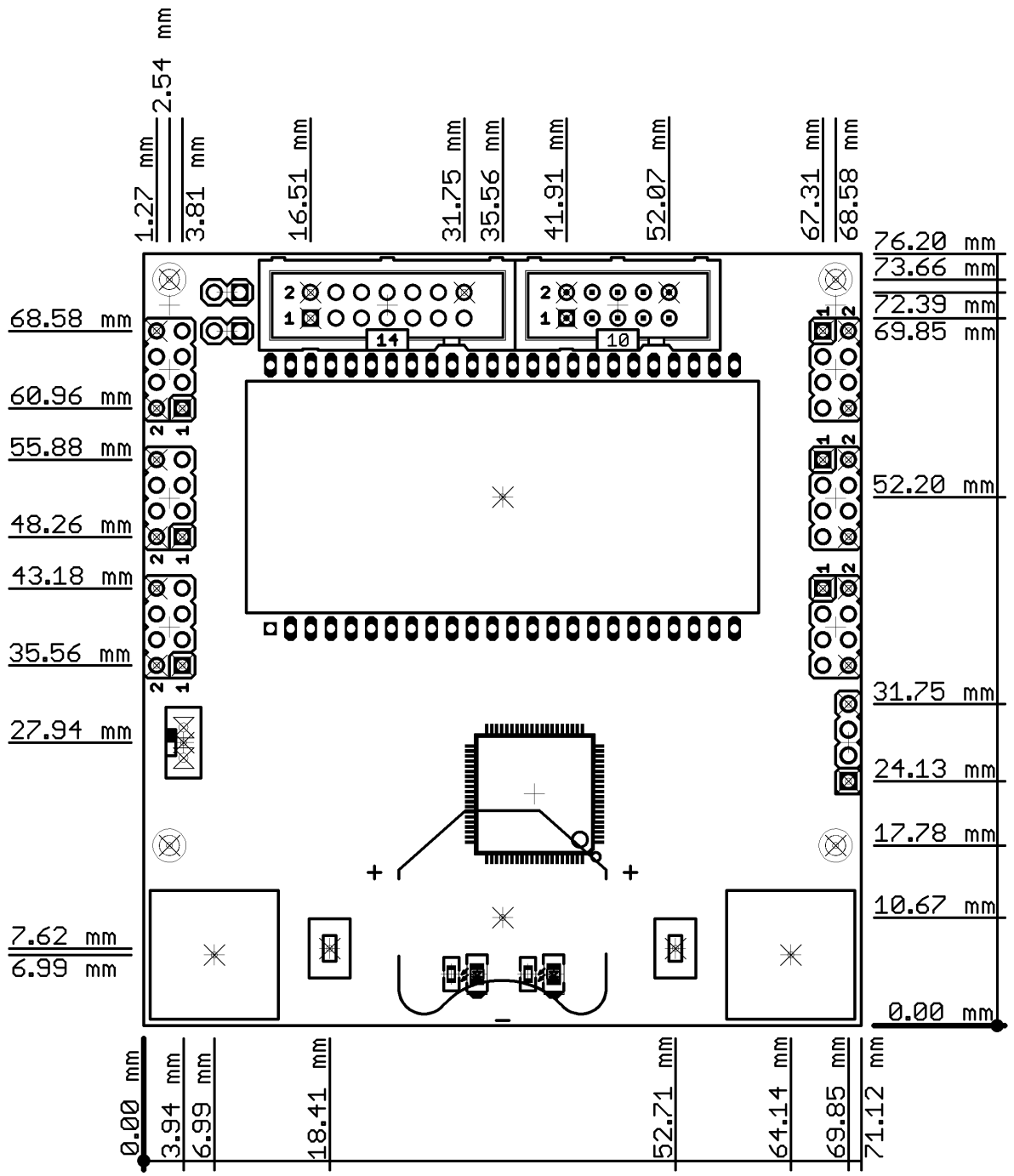


REF:

Pin #	Signal Name	Pin #	Signal Name
1	VEREF+	2	VREF+
3	VEREF-	4	GND



MECHANICAL DIMENSIONS:



AVAILABLE DEMO SOFTWARE:

Demonstrates heart rate measuring, using MSP430FG439 microcontroller.

-MOD-EKG_DemoSoft IAR for MSP v.4.21

ORDER CODE:

MOD-EKG - assembled and tested board

How to order?

You can order to us directly or by any of our distributors.
Check our web www.olimex.com/dev for more info.

Revision history:

Board's revision: Rev. B, April 2011

Manual's revision: Rev. Initial, June 2011

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