

# **MINI-MAX/11-A**

## **Single Board Computer**

### **Technical Manual**

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**BiPOM Electronics, Inc.**

16301 Blue Ridge Road, Missouri City, Texas 77489  
Telephone: 1-713-283-9970. Fax: 1-281-416-2806  
E-mail: [info@bipom.com](mailto:info@bipom.com)  
Web: [www.bipom.com](http://www.bipom.com)

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### WARRANTY:

BiPOM Electronics warrants MINI-MAX/11-A for a period of 1 year. If the board becomes defective during this period, BiPOM Electronics will at its option, replace or repair the board. This warranty is voided if the product is subjected to physical abuse or operated outside stated electrical limits. BiPOM Electronics will not be responsible for damage to any external devices connected to MINI-MAX/11-A. BiPOM Electronics disclaims all warranties express or implied warranties of merchantability and fitness for a particular purpose. In no event shall BiPOM Electronics be liable for any indirect, special, incidental or consequential damages in connection with or arising from the use of this product. BiPOM's liability is limited to the purchase price of this product.

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## 1. Overview

MINI-MAX/11-A is a general purpose, low-cost highly-reliable, and highly expandable micro-controller system. It is based on the Freescale (Motorola) MC68HC11CPU4 high performance micro-controller unit (MCU). This MCU features:

- 1024 bytes of RAM
- 512 bytes of EEPROM
- 21 Interrupt Sources, Real-time interrupt circuit
- Enhanced 16-bit Timer System, 3 or 4 Input Capture (IC) and 4 or 5 Output Capture (OC) Functions
- 8-bit Pulse Accumulator
- Synchronous Serial Peripheral Interface (SPI)
- Asynchronous Non-return to Zero (NRZ) Serial Communication Interface (SCI)
- Eight-channel 8-bit ADC
- Computer Operating Properly (COP) Watchdog System and Clock Monitor
- Up to 6 MHz bus speed

MINI-MAX/11-A board complements these features by providing:

- 32 K - bytes FRAM - high endurance (10 Billions read/writes) ferroelectric nonvolatile memory for program and data
- 6-bit Output expander to control LCD module
- RS232 Serial Port
- Precision reference voltage source for ADC
- Micro-controller supervisor
- Keypad connector
- Expansion bus interface to low-cost peripherals boards such as
  - Instrumentation amplifiers
  - Pressure inputs
  - Strain-gage inputs
  - 12 and 16-bit Analog-to-Digital Converters
  - Digital Input/Output cards
  - LED and LCD displays

## 2. Specifications

Dimensions are 2.35 x 2.40 inches (5.97 x 6.10 centimeters). Mounting holes of 0.125 inches (3 millimeters) on four corners. 0° - 70° C operating, -40° - +85° C storage temperature range.

### 3. Software

Software examples for MINI-MAX/11-A and BiPOM Peripheral boards are available from the link below:

[http://www.bipom.com/web\\_softwares/318485.html](http://www.bipom.com/web_softwares/318485.html)

### 4. Functional Blocks

Figure 1 shows the block diagram of the MINI-MAX/11-A board

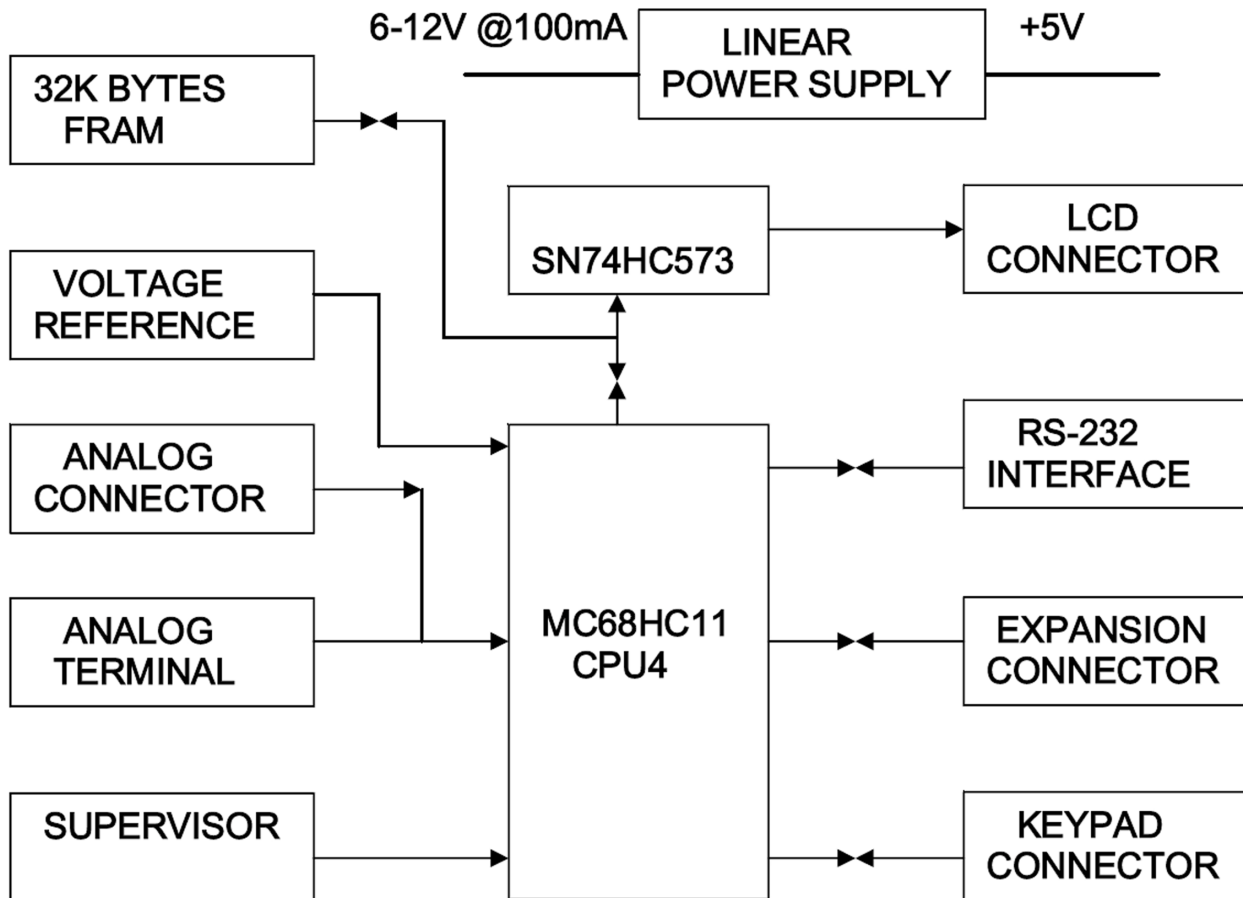


Figure 1

## **Microcontroller**

MINI-MAX/11-A has a Motorola MC68HC11CPU4 microcontroller unit (MCU). Some of MCU ports and power lines are provided on a 20 pin expansion bus for interfacing to peripherals and other external circuits. MC68HC11CPU4 has seven ports:

Three 8-bit ports (Port B, C and F) server as non-multiplexed address and data bus for communication to the FRAM memory (IC2) and LCD latch (IC8).

8-bit Port G is available on keypad connector J7.

8-bit Port E can be used either as analog inputs or digital inputs. PE0-PE5 are available on analog connector J5. J5 also has analog ground circuit and VCC.

PE3-PE7 and analog ground are available on screw terminal J6 for easy access.

PE0 has an alternative function, described in "Programming the MINI-MAX/11-A" section.

8-bit Port A and 6-bit Port D are present on expansion connector J2.

Non-maskable interrupt request (XIRQ) can be connected to the PA3 line through JP1-3 jumper.

Maskable interrupt request (IRQ) is permanently connected to PA1.

For more details on the MC68HC11CPU4 please refer to Motorola web site: <http://www.freescale.com/>

## **Keypad Connector**

Keypad connector can be used to scan various types of keypads, such as 3 by 5 or 4 by 4. Keypad connector contains 5 Volt power and ground lines and the 8 Port G lines of the microcontroller. The Port G lines can also be used as general-purpose inputs/outputs.

Table 1 shows the pin assignments for the Keypad connector.

**Keypad Connector (J2)**

Pin	Signal
1	PG0
2	PG1
3	PG2
4	PG3
5	PG4
6	PG5
7	PG6
8	PG7
9	Ground
10	Vcc

Table 1

## LCD Connectors

LCD connector serves to control various types of character and graphic LCD modules. Physically LCD port is a location in MCU's I/O space, addressable in the range \$04XX - \$07XX. It is a write-only location, so any reads from LCD are impossible. Upper four bits (D4-D7) are the 4-bit LCD data bus. D3 and D2 are control signals.

Alternatively LCD port can be used as a six bit general purpose output.

LCD contrast can be manually adjusted using the potentiometer R4.

**LCD Connector (J3)**

Signal	Pin	Pin	Signal
Ground	1	2	Vcc
Contrast	3	4	D2
GND	5	6	D3
N/C	7	8	N/C
N/C	9	10	N/C
D4	11	12	D5
D6	13	14	D7

Table 2

## Power Supply Unit

MINI-MAX/11-A board comes with a 6 VDC unregulated DC power supply. Other power supplies can also be used although this invalidates the warranty. External power supply should be able to supply 6 to 12 Volts DC at minimum 100mA current (more if peripheral boards are used). The inner pin of the supply connector is positive and the outer ring is negative.

**WARNING:** Correct polarity should be observed when applying external DC supply to the power jack; otherwise MINI-MAX/11-A will be permanently damaged.

**CAUTION:** Depending on the current requirements of the any external circuitry such as peripheral boards that are attached to MINI-MAX/11-A and the level of input voltage applied, the power regulator IC1 may dissipate enough heat to cause skin injury upon touch. Contact with this regulator should be avoided at all times, even after the power to circuit has been switched off.

## RS232 Serial Port

One RS232 serial port is available on the MINI-MAX/11-A. IC7 converts microcontroller's RXD and TXD pins to/from RS232 levels. It has an internal circuit that generates +/- 10 Volts for RS232 logic levels. The port has 9-pin female D connector J4, and can serve a wide range of peripherals using RxD and TxD lines.

Serial port also serves for program and data downloading to the MINI-MAX/11-A board. For this purpose DTR line is directly connected to DSR, CTS and CD. Active level on RTS line will reset MCU. Therefore, user applications must not use these handshake lines.

Table 3 shows the pin assignments for the RS232 serial port connector

**Serial Port Connector (J4)**

Pin	Signal
1	Carrier Detect (CD)
2	Transmit (TXD)
3	Receive (RXD)
4	DTR
5	Ground
6	DSR
7	RTS
8	CTS
9	Not Connected

Table 3

## **Expansion connector**

Expansion connector can be used for interfacing to external circuitry, prototyping boards and peripheral boards. Expansion connector has 8 lines of Port A, 4 lines of Port D, /RXD and /TXD signals. Note that PD4 occupies 3 pins of expansion connector. MINI-MAX/11-A peripheral boards can be connected either as a piggyback daughter-board on MINI-MAX/11-A using standoffs or can be placed up away from MINI-MAX/11-A using a 20-wire ribbon cable. Peripherals section lists the available expansion boards. Table 4 shows the pin assignments for the MINI-MAX/11-A Expansion connector.

**MINI-MAX/11-A Expansion (J3)**

<b>Signal</b>	<b>Pin</b>	<b>Pin</b>	<b>Signal</b>
/RXD	20	19	/TXD
PA1	18	17	PD2
PD4	16	15	PD5
PA2	14	13	PD3
PA4	12	11	PA7
PD4	10	9	PA0
PA5	8	7	PA3
PD4	6	5	PA6
VCC	4	3	GND
VCC	2	1	GND

Table5

## 5. Peripherals

MINI-MAX/11-A can be connected to a wide variety of low-cost peripheral boards to enhance its functionality. Some possibilities are:

- Prototyping board (PROTO-1)
- Training Board (TB-1)
- 4-digit 7-segment LED display board (LED-1)
- 12-bit Analog-To-Digital Converter Board (DAQ-2543)
- Digital Input/Output Expander Board (DIO-1)
- Real time clock + 128 MB flash card board (MMC-RTC-1)
- Terminal board (TERMINAL-1)
- Reed relay board with 4 relays (RELAY-4REED)
- Power relay board with 1 or 2 relays (RELAY-1 or RELAY-2)
- Stepper motor driver board (MOTOR-1)

Peripheral boards can either be stacked on top of MINI-MAX/11-A using stand-offs or connected in a chain configuration using flat ribbon cable. Figure 2 shows how MINI-MAX/11-A can be connected to a peripheral board in a stacked fashion. Figure 3 shows chain connection.

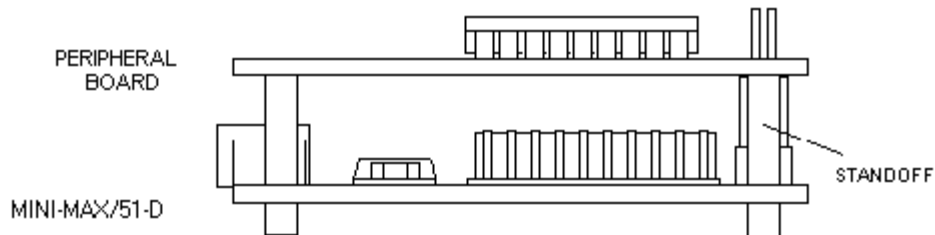


Figure 2

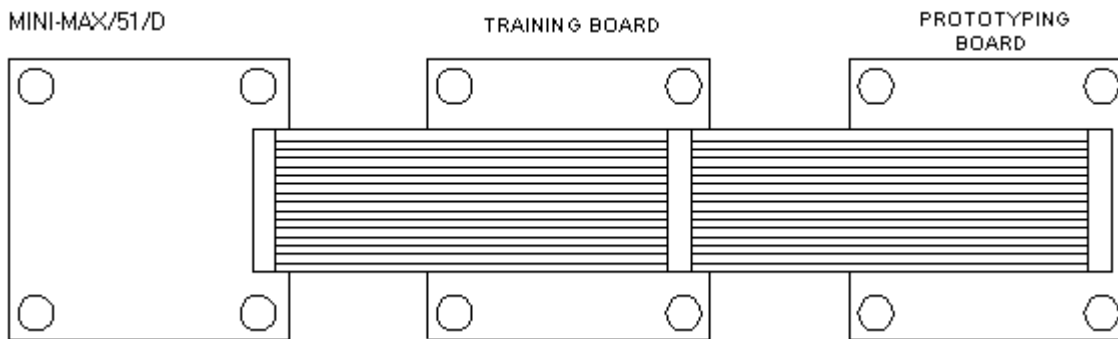


Figure 3



## 6. Programming

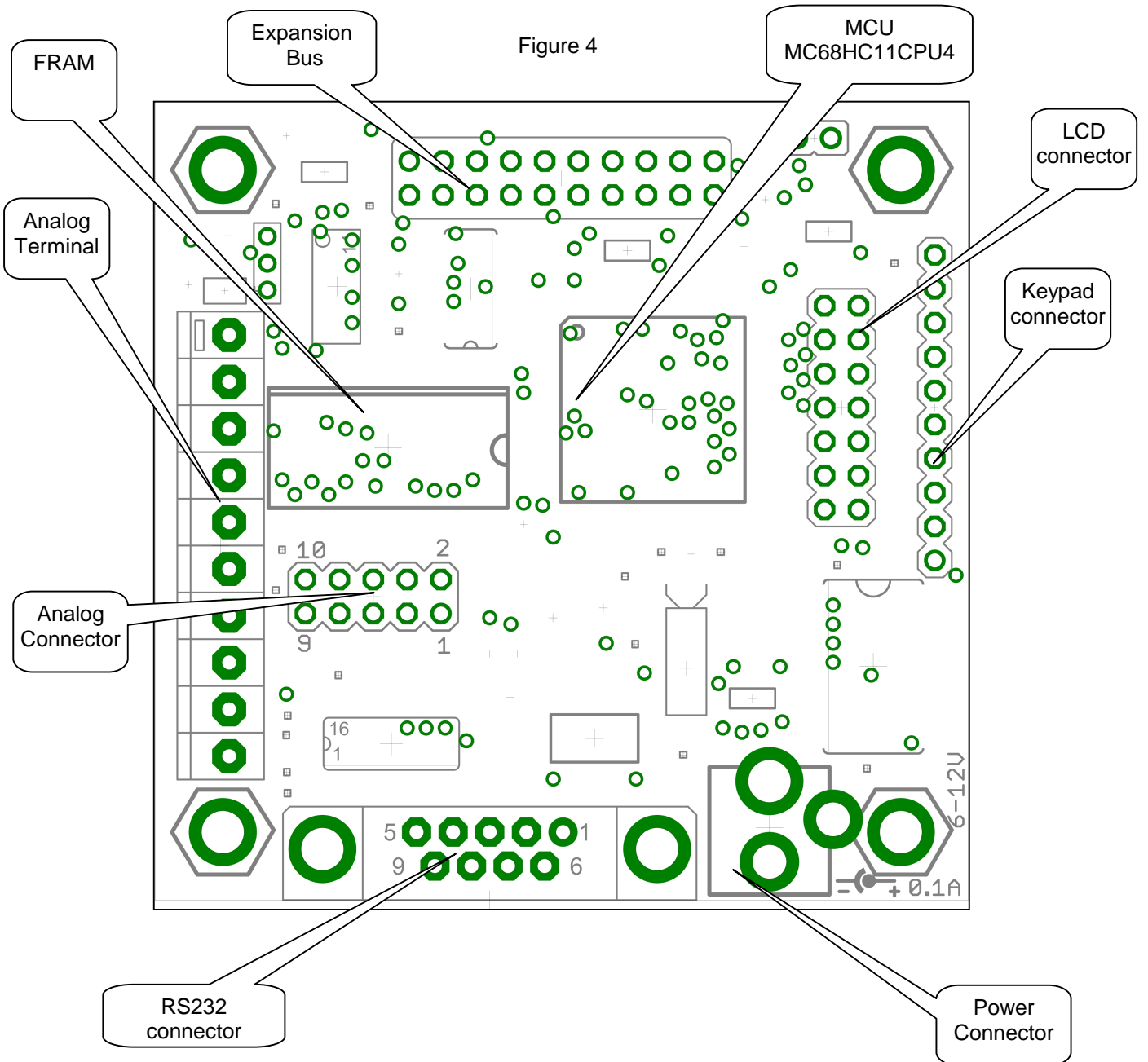
MINI-MAX/11-A comes with BUFFALO monitor, programmed in FRAM. It is a useful tool for downloading and debugging software. BUFFALO occupies address range \$E000 - \$FFFF of FRAM. It also uses MCU's internal RAM locations \$0036 - \$00FF. PA3 and XIRQ are used for TRACE instruction if JP1-1 jumper is set. User applications should not use these MINI-MAX/11-A resources.

Upon reset, the monitor checks the logic state of the PE0 line. If PE0 = 0 (a jumper installed on pins 9 and 10 of analog connector), the monitor program is executed and the prompt displayed. If PE0 = 1, the monitor automatically jumps directly to EEPROM (address location \$B600) and executes user program code without monitor intervention.

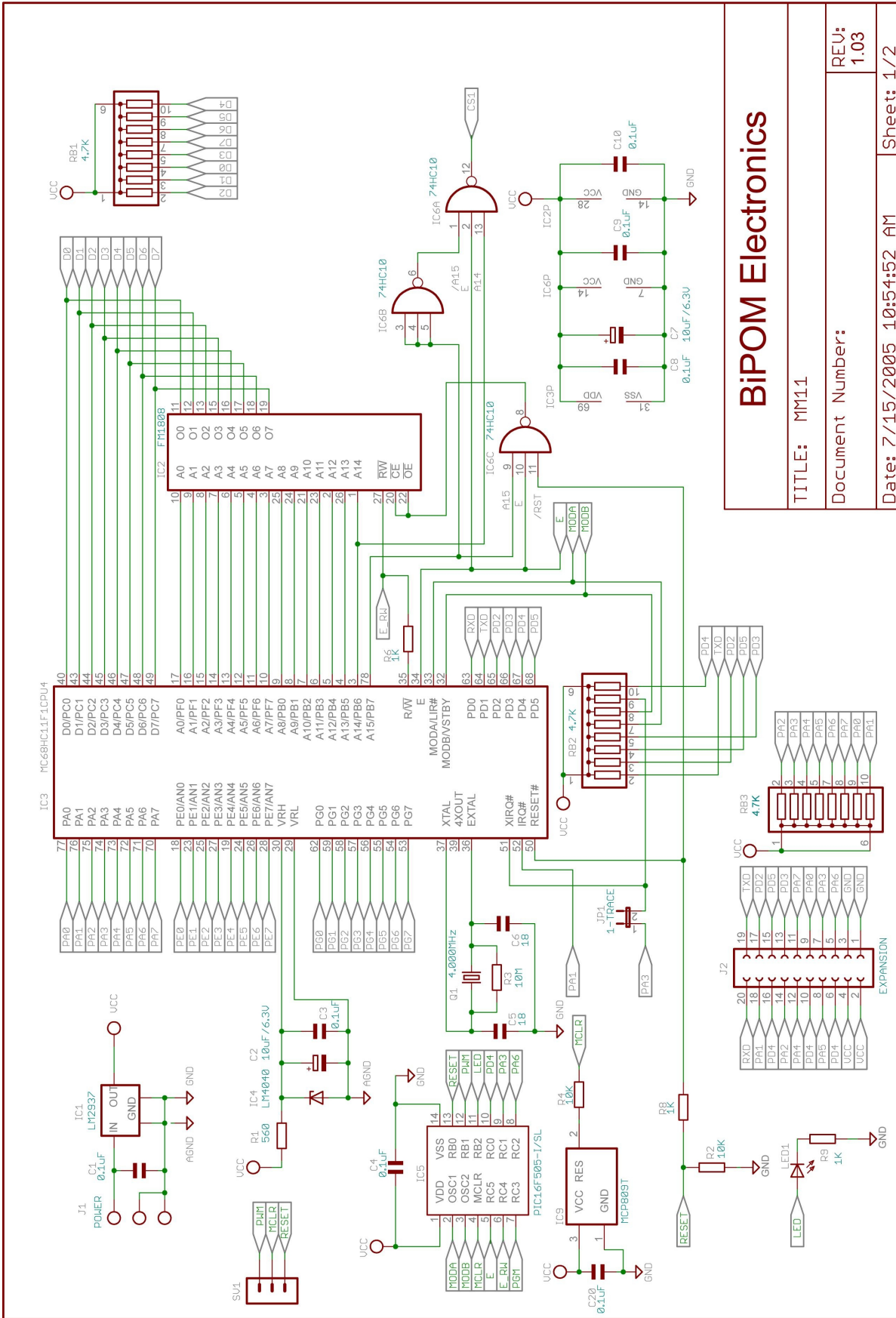
JP1-2 and JP1-3 jumpers serve to select operation mode of MCU. If both jumpers are installed, MINI-MAX/11-A will go to the special bootstrap mode after reset. If the jumpers are not installed, the board runs in expanded mode.

## 7. Board Layout

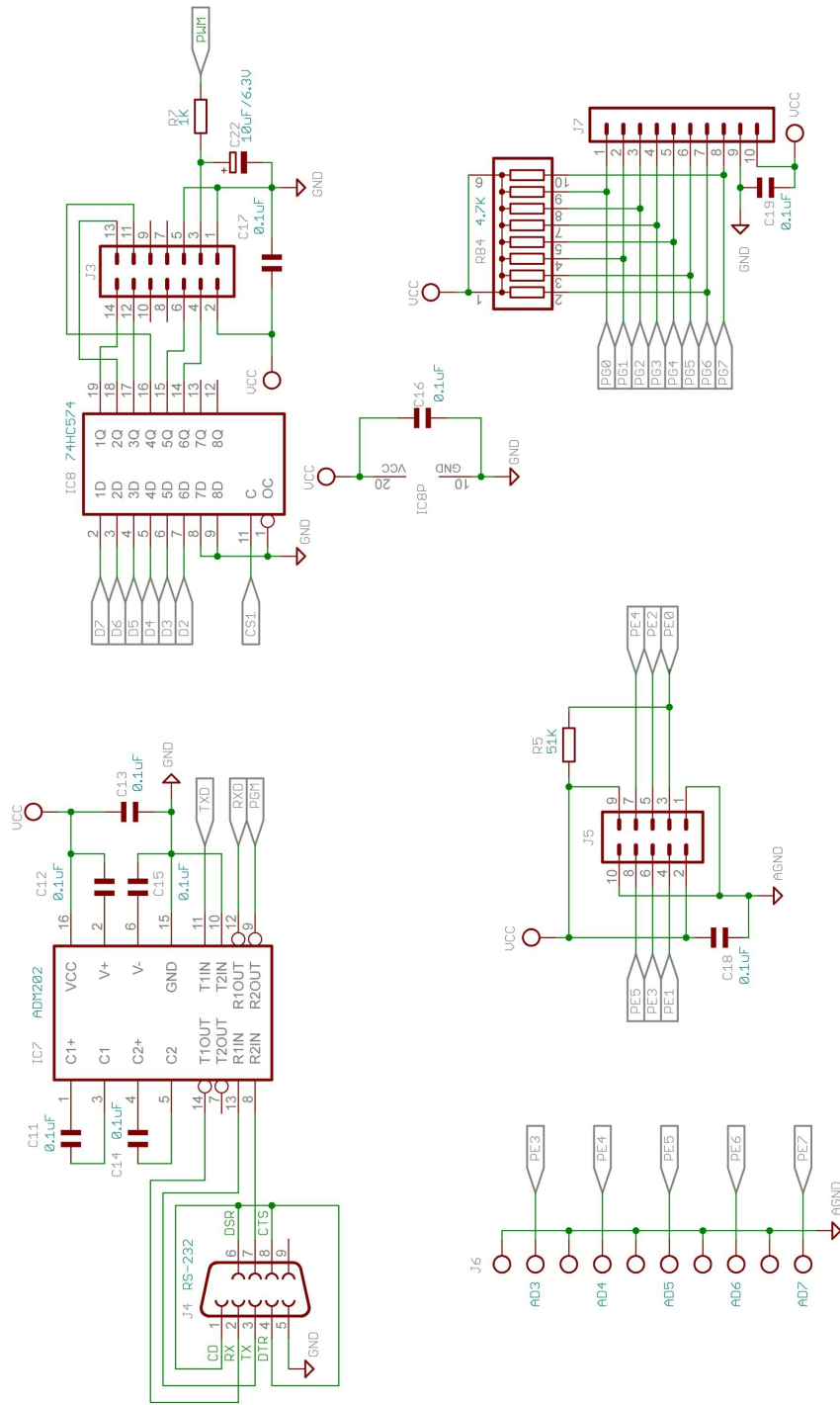
Figure 4 shows positions of major components, connectors and terminals on the MINI-MAX/51-E board.



# 8. Schematics



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