

MINI-MAX/11-A

Single Board Computer

Technical Manual

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MINI-MAX/11-A Single Board Computer Technical Manual. No part of this work may be reproduced in any manner without written permission of BiPOM Electronics.

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WARRANTY:

BiPOM Electronics warrants MINI-MAX/11-A for a period of 90 days. If the board becomes defective during this period, BiPOM 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 Electronics' 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 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

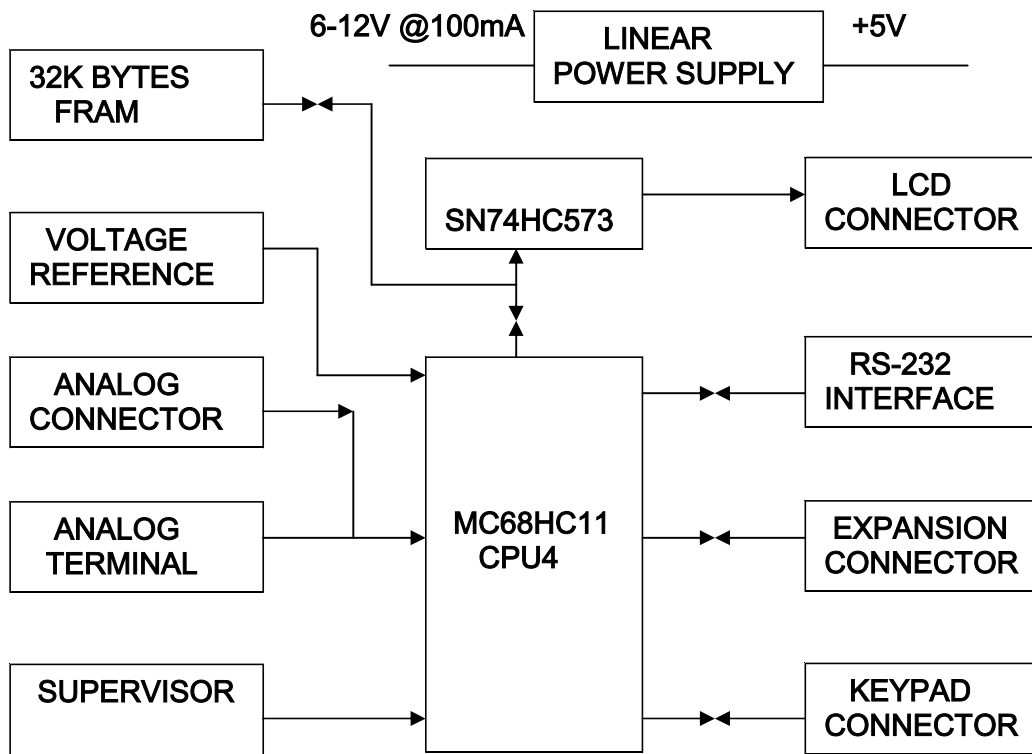
- 32 K - bytes FRAM – high endurance (10 Billions read/writes) ferroelectric nonvolatile memory for program and data.
- 6-bit Output expander to control LCD module.
- RS232 Serial Port
- Precision reference voltage source for ADC
- Micro-controller supervisor
- Keypad connector
- Expansion bus interface to low-cost peripheral 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. Functional Blocks

Block diagram of the MINI-MAX/11-A system



Micro-controller

MINI-MAX/11-A has a Motorola MC68HC11CPU4 micro-controller 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, Port C and Port F) serve 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://e-www.motorola.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 micro-controller. The Port G lines can also be used as general-purpose inputs/outputs.

Keypad Connector (J2)

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

Table 1

LCD Connector

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 Volts 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. 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.

MINI-MAX/11-A has an on-board 5 Volt regulator (IC1).

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 micro-controller'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.

RS232 Serial Port (J4)

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

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)

Signal	Pin	Pin	Signal
/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

Table 4

4. 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 3 shows how MINI-MAX/11-A can be connected to a peripheral board in a stacked fashion. Figure 4 shows chain connection.

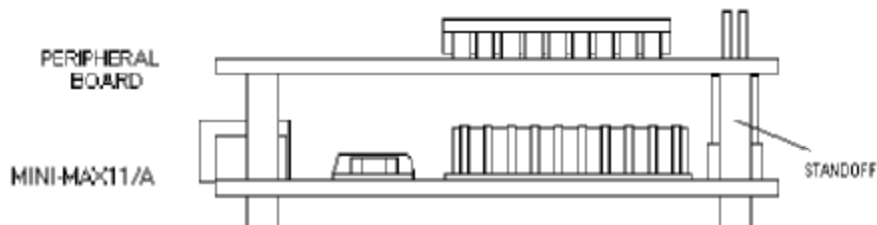


Figure 3

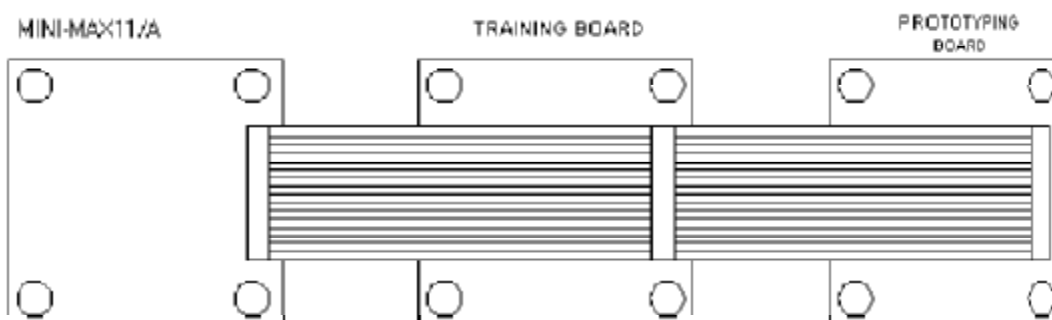
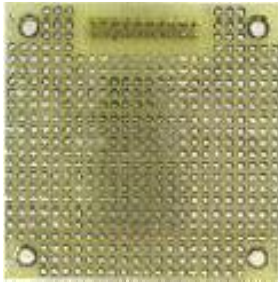


Figure 4

PROTO-1 Board



PROTO-1 provides prototyping area to add custom circuitry to MINI-MAX/11-A. PROTO-1 can either be stacked with MINI-MAX/11-A using standoffs or connected to MINI-MAX/11-A as a separate board using

ribbon cable (EXPCABLE-6 or EXPCABLE-18). The latter method is useful for mounting behind the panel of an instrument enclosure, for example, as a detachable display board.

LED-1 Board



A peripheral board with four 7-segment LED displays with decimal point. The displays are placed on sockets and can be easily replaced. 4-digit LED-driver with I2C-Bus interface is installed to this board. The segment outputs of LED-driver are controllable current-sink sources. They

are switched on by the corresponding data bits and their current is adjusted by control bits. LED-driver on the board is controlled via an I2C-compatible 2-wire serial bus.

TB-1 Training Board



TB-1 Training Board allows performing various experiments with the MINI-MAX/11-A board. TB-1 has programmable traffic lights, 4-channel, 8-bit analog inputs, buzzer, switch inputs, and counter/timer inputs to test the interrupts.

DIO-1 Board



DIO-1 is an expander board with 8 open/collector outputs (each capable of 400mA) and 12 TTL/CMOS inputs/outputs. A PIC16C62 micro-controller on this board acts as an I2C 2-wire slave device to control

inputs and outputs. DIO-1 can also be used as a standalone PIC micro-controller board

RTC board



Real Time Clock board with DS1307 Real-Time Clock from Dallas Semiconductor. The DS1307 is a battery-backed, low power, full-BCD clock/calendar with 56 bytes of nonvolatile

static RAM. Address and data are transferred serially via I2C 2-wire bus. The clock/calendar provides seconds, minutes, hours, day, date, month and year information. RTC board has a 3Volt standard lithium battery which allows clock/calendar to operate in the absence of external power.

MMC/RTC board



MMC/RTC board is a storage flash device which is designed specifically for storage/data logger applications. MMC/RTC board has built-in Multi Media Card (MMC) socket. A Multi Media Card with high capacities such as 128 Megabytes

can be installed on this board. MMC/RTC board also includes a DS1307 Real-Time Clock (RTC) from Dallas Semiconductor. The DS1307 has a battery-backed, low power full-BCD clock/calendar with 56 bytes of nonvolatile static RAM.

Terminal-1



Brings out ports 1 and 3 on the MINI-MAX/11-A to terminal blocks for easier access.

DAQ-2543 Board



DAQ-2543 is Analog-To-Digital / Digital-To-Analog peripheral board with TLC2543, 11-channel, 12-bit Analog-To-Digital Converter from Texas Instruments. All the channels are available on terminal blocks

X10-1



Connects MINI-MAX/11-A to standard X10 devices through the TW523 Power line interface

MOTOR-1



Peripheral board to drive unipolar stepper motors. Provides up to 1.5A, 35V outputs. HALF-STEP and ONE-PHASE jumpers will determine the drive format (one-phase, two-phase or half-step).

RELAY-1 and RELAY-2



Relay peripheral board with 1 or 2 power relay respectively. Normally Open and Normally Closed Contacts

RELAY-4REED



Relay peripheral board with 4 reed relays. Normally Open Contacts.

RS232 Devices

Various keypads and terminals may be connected to the RS232 port of MINI-MAX/11-A through connector J4. MINI-MAX/11-A can be connected to a host PC through the RS232 port. For example, MINI-MAX/11-A can be used as a remote data acquisition or control unit serving a host PC in a client-server configuration.

Connection to a host PC is accomplished by using a straight-through serial cable. MINI-MAX/11-A end of this cable should be a 9-pin male D connector for connection to J4 on the board. Host PC end of this cable can be either 9-pin Female or 25-pin Female D Connector depending on available serial (COM) ports on the host PC.

5. 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.

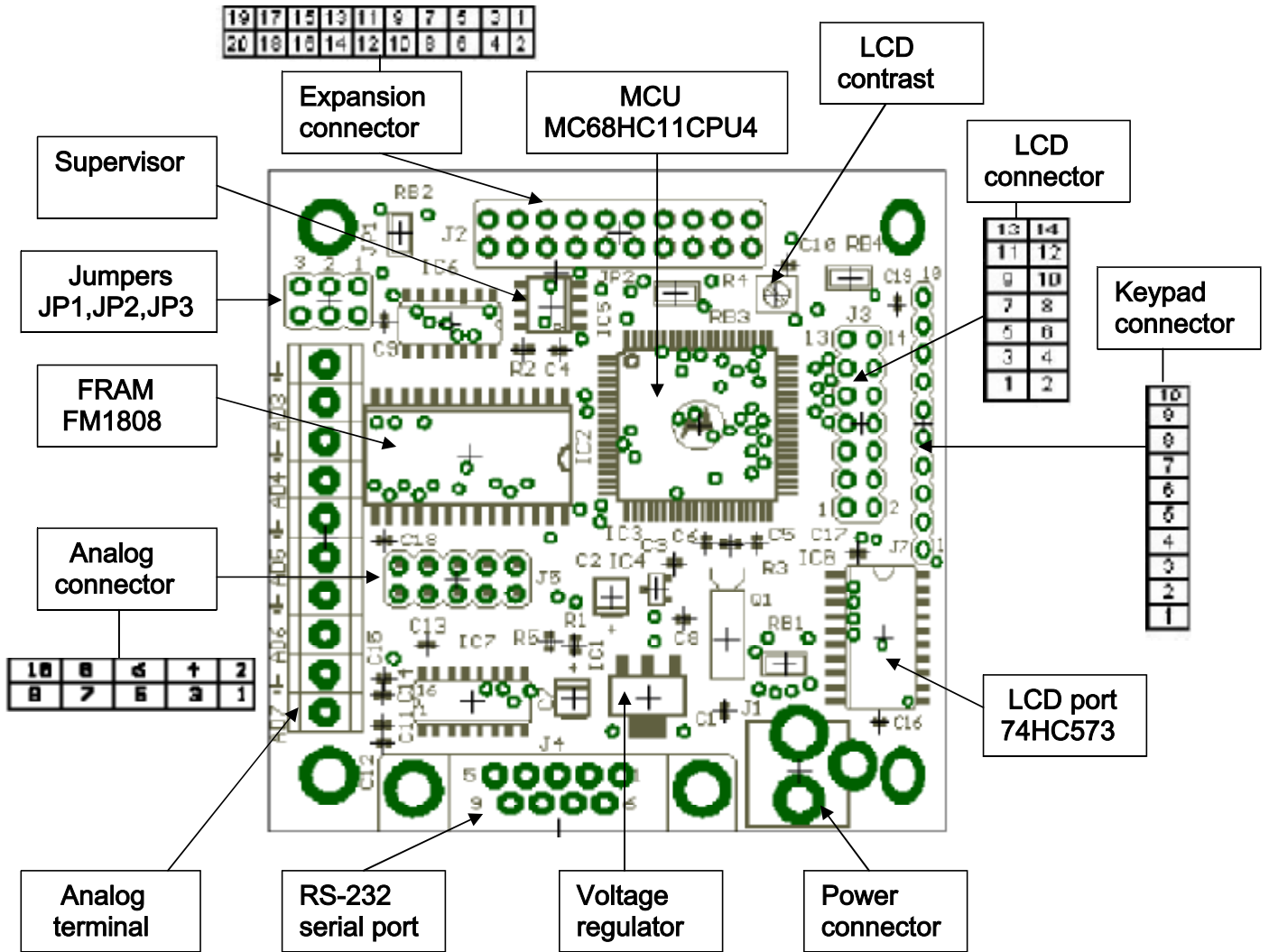
Upon reset, the monitor checks the logic state of the PE0 line. If PE0 = 0 (a jumper installed on pins 9 and 10 of analog connector), the monitor program is executed and the prompt displayed. If PE0 = 1, the monitor automatically jumps directly to EEPROM (address location \$B600) and executes user program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

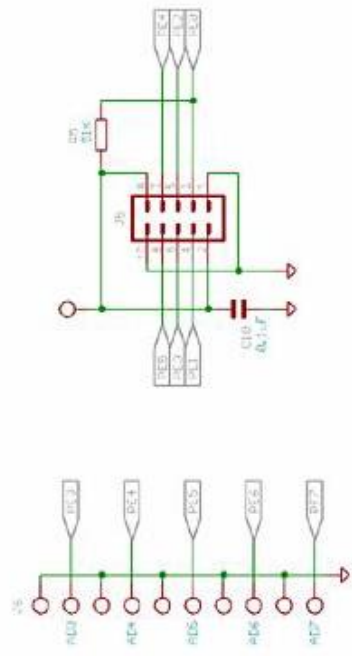
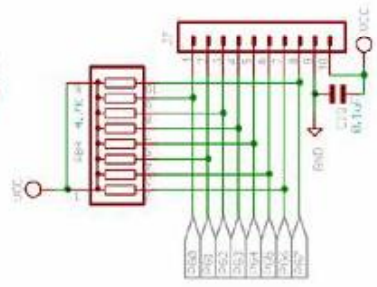
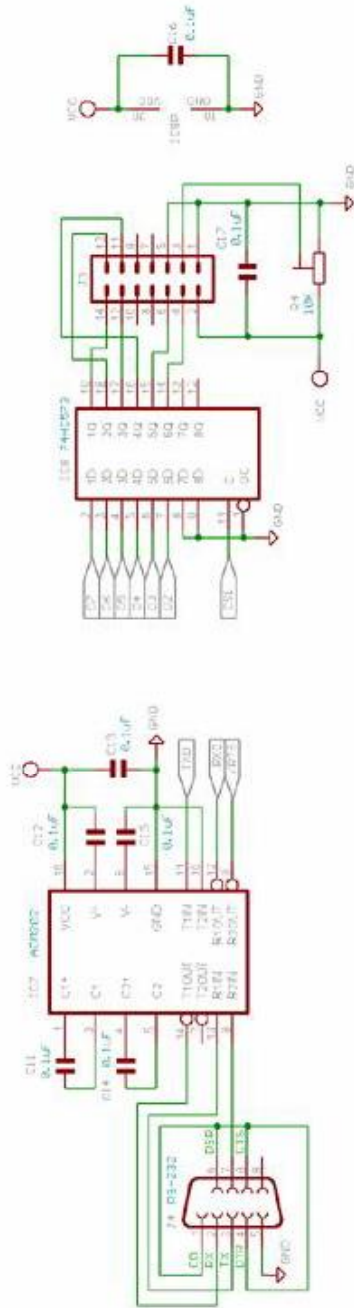
JP1-2 and JP1-3 jumpers serve to select operation mode of MCU. If both jumpers are installed, MINI-MAX/11-A will go to the special bootstrap mode after reset. If the jumpers are not installed, the board runs in expanded mode.

6. Software

All required software can be downloaded from www.bipom.com.

7. Board Layout





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