MINI-MAX/51-C
Single Board Computer
Technical Manual

Date: 23 May, 2000

Document Revision:1.10

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WARRANTY:

BiPOM Electronics warrants MINI-MAX/51-C for a period of 1 year . 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/51-C. 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.

1. Overview

MINI-MAX/51-C is a general purpose, low-cost and highly-expandable micro-controller system. It is based on the ATMEL AT89S53 single-chip Flash micro-controller. This micro-controller features

- 12 Kilobytes of In-System Re-programmable Downloadable Flash Memory
- 256 bytes of RAM
- Nine Interrupt Sources
- Three 16 bit Timer/Counters
- Programmable UART Serial Channel
- SPI Serial Interface
- Programmable Watchdog Timer
- 32 general purpose I/O pins

MINI-MAX/51-C board complements these features by providing

- 512-byte EEPROM (optional 64-Kilobyte EEPROM)
- RS232 Serial Port
- In-circuit Programming of the micro-controller through the serial port
- Keypad connector
- LCD connector (with programmable contrast adjustment for LCD)
- 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/51-C system

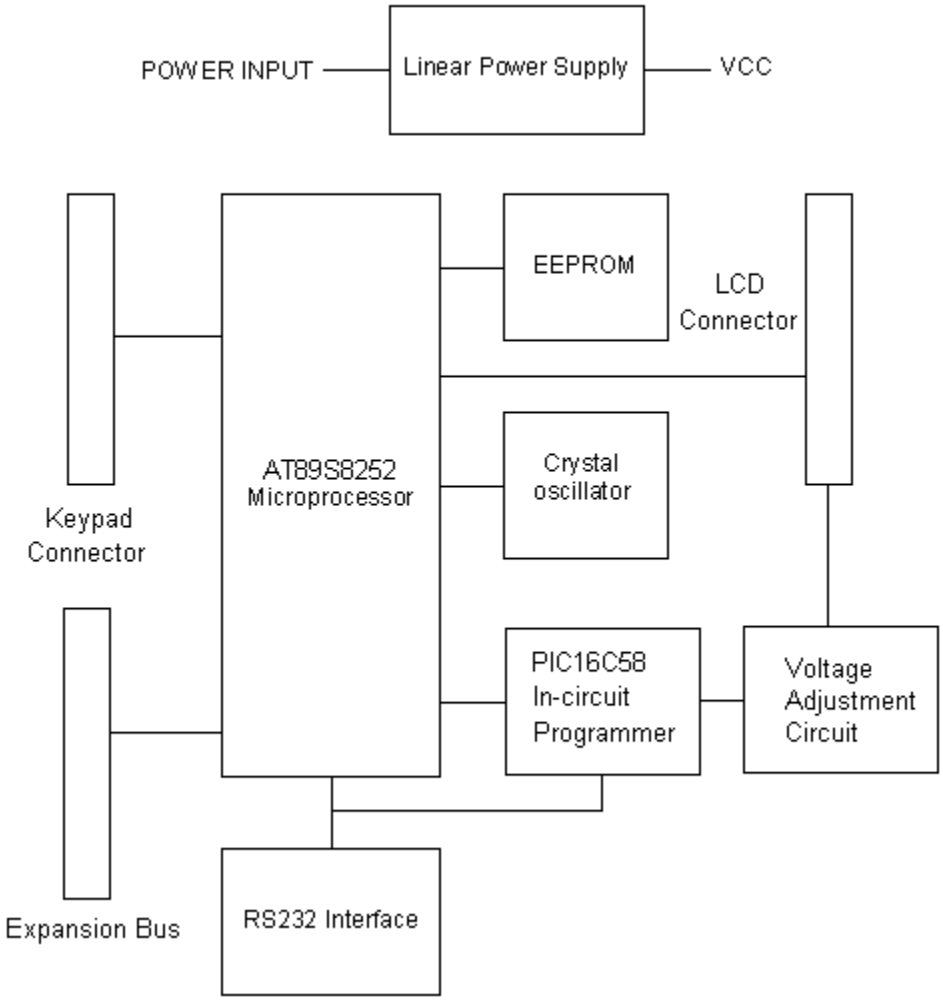


Figure 3

Micro-controller

MINI-MAX/51-C has an ATMEL AT89S53 micro-controller (U1). Micro-controller ports and power lines are provided on a 20-pin expansion bus for interfacing to peripherals and other external circuits. 89S53 has all the ports that are available on the 8051 family of micro-controllers: Port 1 (P1), Port 2 (P2), Port 3 (P3) and Port 4 (P4).

P0 has open collector outputs that are available on the LCD connector. P1 and P2 are general-purpose bi-directional input/output ports. Port 2 is available on the keypad connector. P1 and P3 are available on the expansion connector. P3 pins can either be used as general-purpose input/output pins or have special purposes such as asynchronous serial port, interrupt inputs and timer inputs.

More information on the AT89S53 micro-controller can be obtained from ATMEL web site at www.atmel.com.

EEPROM

MINI-MAX/51-C uses a 24C04 (U2) 512 byte Electrically Erasable Programmable Read-Only-Memory (EEPROM). Typically this EEPROM is used for storing calibration values for sensors, customer identification, serial number and other parameters. This EEPROM is on a socket and can easily be replaced with higher capacity EEPROM's (up to 64 KiloBytes).

In-System Programming

AT89S53 micro-controller can be re-programmed remotely over the RS-232 interface using a second micro-controller on the board (PIC16C58). The in-circuit programming feature simplifies program development on the board since downloading programs from a host PC takes only few seconds. User programs can also be debugged over the serial port.

Micro-IDE Integrated Development Environment from BiPOM Electronics fully supports In-System Programming and debugging on the MINI-MAX/51-C using the serial port.

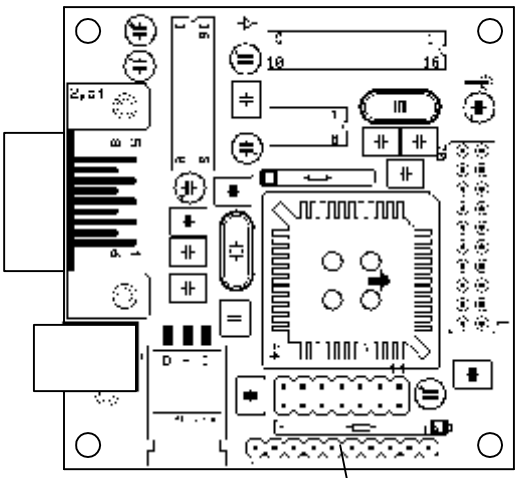
Keypad connector

8 pins of Port 2 are connected to the Keypad connector. Many different keypads (for example, 3 by 5 or 4 by 4) can be connected directly to the keypad connector. 5 Volt and Ground power lines are also available on the Keypad connector. This connector can also be used as a general-purpose port.

Keypad Connector (J2)

Signal	Pin
P2.0	1
P2.1	2
P2.2	3
P2.3	4
P2.4	5
P2.5	6
P2.6	7
P2.7	8
Ground	9
Vcc	10

Table 1



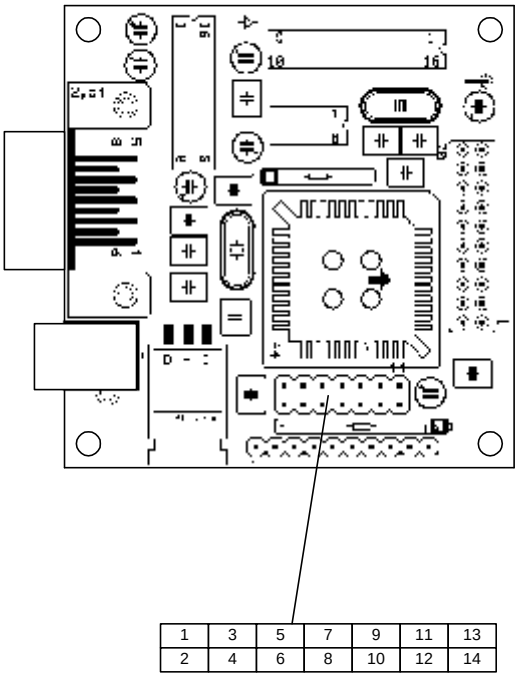
1 Keypad connector

LCD Connector

LCD Connector (J3)

Signal	Pin	Pin	Signal
Ground	1	2	Vcc
Vee	3	4	P0.0
P0.1	5	6	P0.2
P0.3	7	8	Ground
Ground	9	10	Ground
P0.4	11	12	P0.5
P0.6	13	14	P0.7

Table 2



LCD connector

Power Supply Unit

MINI-MAX/51-C series boards come 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 Power terminal; otherwise MINI-MAX/51-C will be permanently damaged.

MINI-MAX/51-C has an on-board 5 Volt regulator (U5).

CAUTION: Depending on the current requirements of the any external circuitry such as peripheral boards that are attached to MINI-MAX/51-C and the level of input voltage applied, the power regulator U5 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.

Asynchronous Serial Port

One asynchronous RS232 serial port (U3) is available on MINI-MAX/51-C.

U3 converts micro-controller's RXD and TXD pins to/from RS232 levels. U3 has built-in voltage-doubler and inverter that generates +/- 10 Volts for RS232 logic levels. RS232 port is made available on a 9-pin male D connector J4. Hand-held terminals, computers, modems and other serial devices may be connected to the RS232 port. CTS/RTS Modem control lines are provided on the RS232 port. CTS is used by external host such as a PC to put MINI-MAX/51-C in program or run modes. Therefore, user applications must not use CTS.

RS232 Serial Port (J4)

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

Table 3

Expansion

Most of the micro-controller pins and the power supply are available on the 20-pin MINI-MAX/51 Expansion connector (J3) for interfacing to external circuitry, prototyping boards and peripheral boards. MINI-MAX/51 peripheral boards can be connected either as a piggyback daughter-board on MINI-MAX/51-C using standoffs or can be placed up away from MINI-MAX/51 using a 20-wire ribbon cable. Peripherals section lists the available expansion boards. Table 4 shows the pin assignments for the MINI-MAX/51 Expansion connector.

MINI-MAX/51 Expansion (J3)

Signal	Pin	Pin	Signal
P3.0	20	19	P3.1
P3.2	18	17	P3.3
P3.4	16	15	P3.5
P3.6	14	13	P3.7
P1.0	12	11	P1.1
P1.2	10	9	P1.3
P1.4	8	7	P1.5
P1.6	6	5	P1.7
VCC	4	3	GND
VCC	2	1	GND

Table 4

4. Peripherals

MINI-MAX/51 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)
- Digital Input/Output Expander Board
- 12-bit Analog-To-Digital Converter Board
- Additional MINI-MAX/51 Boards
- Temperature Sensor Interface Board
- Pressure Sensor Interface Board

Peripheral boards can either be stacked on top of MINI-MAX/51 using stand-offs or connected in a chain configuration using flat ribbon cable. Figure 3 shows how MINI-MAX/51 can be connected to a peripheral board in a stacked fashion. Figure 4 shows chain connection.

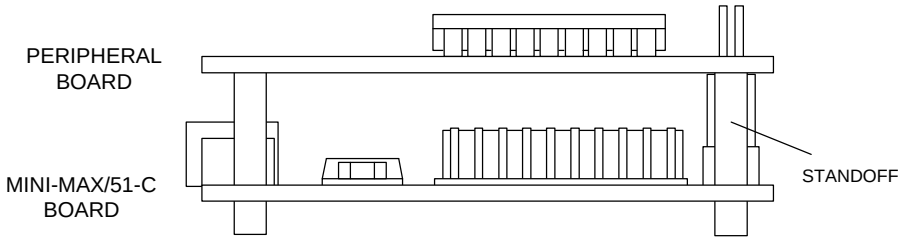


Figure 3

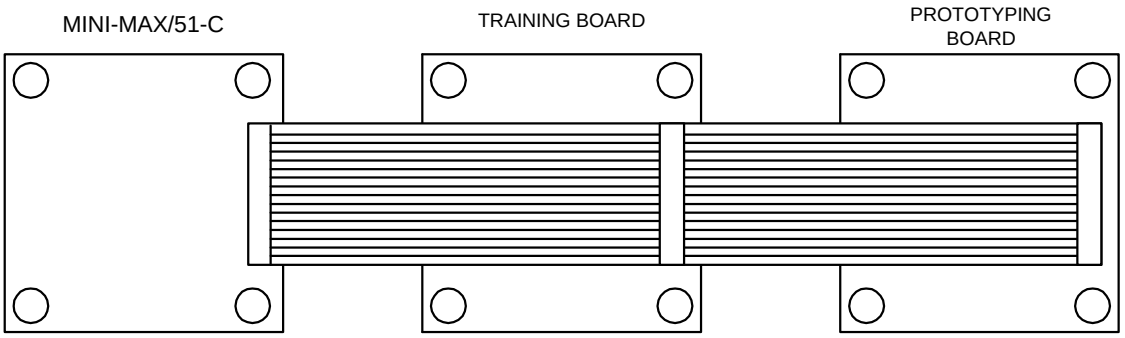
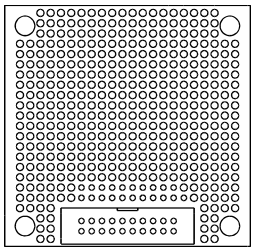


Figure 4

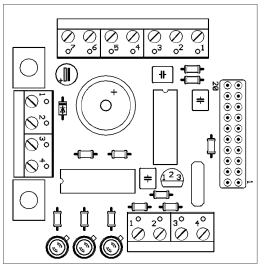
MINI-MAX/51- PROTO-1 Board

PROTO-1 provides prototyping area to add custom circuitry to MINI-MAX/51. PROTO-1 can either be stacked with MINI-MAX/51 using standoffs or connected to MINI-MAX/51 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.



TB-1 Training Board

TB-1 Training Board allows performing various experiments with the MINI-MAX/51-C or other 8051 compatible boards. TB-1 has programmable traffic lights, 4-channel, 8-bit analog inputs, buzzer, switch inputs, and counter/timer inputs to test the interrupts.



RS232 Devices

Various keypads and terminals may be connected to the RS232 port of MINI-MAX/51-C through connector J4. MINI-MAX/51-C can be connected to a host PC through the RS232 port. For example, MINI-MAX/51 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 NULL-Modem cable. MINI-MAX/51-C end of this cable should be a 9-pin Female D connector for connection to J4 on the MINI-MAX/51-C 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.

A NULL modem cable can be obtained from BiPOM Electronics (Part#: CNM1-9F9F-6) or it can be prepared according to the wiring diagram below:

MINI-MAX/51 9-pin Female			Host PC 9-pin Female
RECEIVE DATA (RXD)	2	3	TRANSMIT DATA (TXD)
TRANSMIT DATA (TXD)	3	2	RECEIVE DATA (RXD)
GROUND	5	5	GROUND
RTS	7	8	CTS
CTS	8	7	RTS

MINI-MAX/51 9-pin Female			Host PC 25-pin Female
RECEIVE DATA (RXD)	2	2	TRANSMIT DATA (TXD)
TRANSMIT DATA (TXD)	3	3	RECEIVE DATA (RXD)
GROUND	5	7	GROUND
RTS	7	5	CTS
CTS	8	4	RTS

Table 5

5. Software

MINI-MAX/51-C comes with sample 8051 programs to access on-board peripherals and perform self-diagnostics. MINI-MAX/51-C loader is under **loader** directory and sample 8051 programs are under **examples** directory.

Loader

A command-line loader is provided to download programs to the MINI-MAX/51-C, to erase and reset the microcontroller and to read the microcontroller's memory. The syntax of the loader is

Loadmm51 /p=<COM port> /f=<filename> /c=<command> /nomenu

Where

/p=<COM port> selects the serial communications port to use. Allowed values are COM1, COM2, COM3 and COM4

/f=<filename> shows the name of the file to download to the board or the name of the file which will be created with the data that is uploaded from the board. The file should be in binary (raw) form. Hex files are currently not supported.

/c=<command> selects the command to perform. Possible values are READ, WRITE, ERASE, RESET.

READ command reads (uploads) from the board into the specified file. This command reads all the program memory locations of the microcontroller.

WRITE command writes (downloads) the contents of the specified binary file to the board. This command writes as many bytes as there are in the specified file. If there are more bytes in the file than the microcontroller can hold, only as many bytes as there are in microcontroller's program memory are written.

ERASE command erases all the program memory locations of the microcontroller.

RESET command resets the board and leaves it in RUN mode.

/nomenu options shows that the loader will execute without a menu. This is useful for calling the program from within another application or batch file.

If /nomenu is not specified, the loader enters the interactive mode and displays a menu to the user. In interactive mode, command-line arguments are ignored and user can enter commands through the menu.

Loadmm51 is a Windows application that runs under Windows 95/98/NT and 2000. It will run in a DOS environment. Please contact BiPOM Electronics if you need a DOS command-line loader for MINI-MAX/51-C.

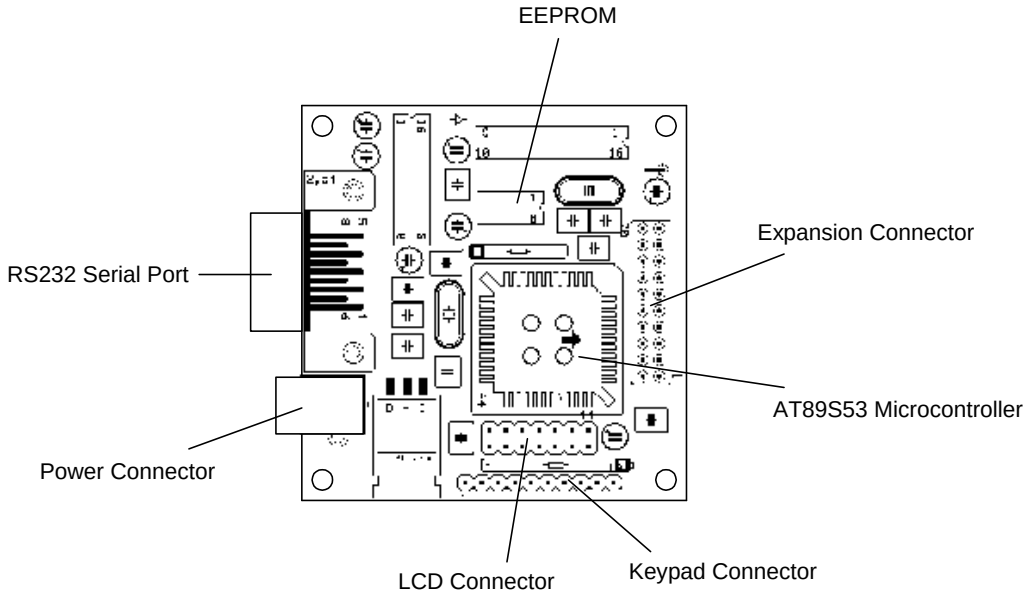
Examples

Programs are provided on a PC formatted 3.5" diskette in the **examples** directory:

MM51DIAG.C:	Demonstrates how to access MINI-MAX/51 on-board peripherals by performing various tests and diagnostics. Written in Micro-C Compiler but can be easily adapted to other C compilers for the 8051.
MM51DIAG.HEX:	Binary file for MM51DIAG.C in INTEL Hex format.
MM51DIAG.BIN:	Binary file for MM51DIAG.C in raw format.

6. Board Layout

Layout of MINI-MAX/51-C board is shown below:



7. Schematics