

88-RMB2
ROM BASIC Turnkey Module
User's Manual



mits

a subsidiary of Pertec Computer Corporation

TABLE OF CONTENTS

ABSTRACT.....1
SPECIFICATIONS.....1
INSTALLATION.....2
THEORY OF OPERATION.....5
ASSEMBLY.....7
SCHEMATIC DRAWINGS.....9

88-RMB2
User's Manual

ABSTRACT

The 88-RMB2 (ROM Basic Turnkey Module) provides MITS Extended Cassette Basic programming language in Read Only Memory (ROM). Basic is located in the upper 16K of main memory, addresses 48K through 64K (140000 through 177777 octal). This frees up the lower 48K for the user's Basic programs. An automatic startup circuit causes the computer to begin executing Basic at 140000 (octal) when system power is first applied and after a Reset.

In addition to Basic in ROM, the 88-RMB2 has system functions that allow the 8800b Turnkey Module to be eliminated.

A serial asynchronous input/output port on the 88-RMB2 interfaces the system console (or any terminal) to the computer. Most standard baud rates are available, as well as both RS-232 or TTL signal configurations. The port can interrupt on input or output. The I/O port addresses are fixed at 020 and 021 (octal).

The 88-RMB2 provides the signals to the Attaché or 8800bt front panel for the control switches "STOP/RUN" and "START", and the system indicators, 1) HLT (HALT), 2) I/O (INPUT/OUTPUT), 3) INTE (Computer interrupts enabled), 4) INT (Interrupt request) and PWR (+5V Power OK).

The 88-RMB2 also provides sense switch input at port address 377 (octal).

SPECIFICATIONS

Firmware.....Extended Cassette Basic in Read-Only Memory (16K bytes)
 (8 2K/* ROM IC's)
 ROM Address: 140000 (octal)

Auto-start.....Fixed address: 140000 (octal)
 Activation: Power-on or Reset

Serial I/O Port..Configuration: RS-232 or TTL
 Baud Rate: 110, 300, 1200, 4800, 9600
 Fixed I/O Address: 020 and 021 (octal)

Sense Switches...Eight data switches read from I/O port 377 (octal)

Power.....1 amp at +8V
 40 mA at ±18V

Physical.....5" x 10" printed circuit board
 1 slot required

INSTALLATION

Memory Address

The 88-RMB2 has a hardwired auto-start and non-user addressable ROMs. The auto-start jumps to the ROM at 140000 (octal). The ROM occupies memory from 140000 (octal) to 177777 (octal). Make sure your machine contains no other memory between these addresses.

Sense Switches

I/O port 377 (octal) is reserved for sense switches, at SW-2 on the 88-RMB2 board. These switches may be read by software to control I/O addressing, stop bits, etc. Unless instructed by a software manual, these switches will normally be set to produce 000 (octal). Set switches at SW-2 to the right to produce a 0, and to the left to produce a 1. Software manuals often uses the words "up" and "down" when specifying sense switch settings. On the 88-RMB2, "up" corresponds to left on SW-2, and "down" corresponds to right on SW-2. Software manuals refer to switch positions A8-A15, which correspond to SW-2 positions 8-15.

Status Connector

J1 is used to provide machine status to external LEDs located on the Attaché keyboard or 8800bt front panel. J2 is indexed to prevent installing the cable incorrectly.

<u>J1 Pin</u>	<u>Signal</u>	<u>Direction</u>	<u>Function</u>
1	+5V	Out	Power for 8800bt front panel
2	-SHLTA	Out	Low indicates CPU HALT condition
3	-PINTE	Out	Low indicates interrupts are enabled
4	-IO	Out	Low indicates Input or Output cycle
5	-PINT	Out	Low indicates interrupt requested
6	GND	Out	Ground reference
7	-POC	In	CPU reset from front panel STOP switch
8	PRDY	In	Input from front panel STOP/RUN switch
9	KEY	-	Pin removed for indexing connector
10	N/C	-	Not connected

Serial Port

J2 is used for the serial port. J1 is indexed to prevent installing the cable incorrectly.

<u>J2 Pin</u>	<u>Signal</u>	<u>Level</u>	<u>Direction</u>	<u>Function</u>
1	-RTS	TTL	Out	Active-low Request to Send
2	N/C	-	-	Not connected
3	N/C	-	-	Not connected
4	RxD	Both	In	Receive Data
5	-DCD	Both	In	Active low Data Carrier Detect
6	-CTS	Both	In	Active low Clear to Send
7	KEY	-	-	Pin removed for indexing
8	GND	-	-	Ground reference
9	-RTS	RS-232	Out	Active-low Request to Send
10	TxD	Both	Out	Transmit Data

The 88-RMB2's serial port is hardwired to ports 20 and 21 (octal). Use the following table to set up the port for TTL (Use these settings for the Attaché and the 8800bt).

<u>Signal</u>	<u>Direction</u>	<u>J2 Pin</u>	<u>Jumpers</u>
TxD	Out	10	W16 open, W17 jumpered
-RTS	Out	1	
RxD	In	4	W13 open
-CTS	In	6	W15 jumpered
-DCD	In	5	W14 jumpered
GND	-	8	

Use the following table to set up the port for RS-232.

<u>Signal</u>	<u>Direction</u>	<u>J2 Pin</u>	<u>DB25 Pin</u>	<u>Jumpers</u>
TxD	Out	10	3	W16 jumpered, W17 open
-RTS	Out	9	5	
RxD	In	4	2	W13 open
-CTS	In	6	4	W15 jumpered if not used
-DCD	In	5	20	W14 jumpered if not used
GND	-	8	7	

SW-1 sets the serial port baud rate. Use the following table to set the baud rate.

<u>Baud Rate</u>	<u>Switches "on" (right)</u>
110	2, 3, 4, 5, 6, 8
300	1, 2, 3, 4, 6, 7
1200	2, 3, 4, 5
4800	1, 2, 6
9600	4, 6

Bus Interface

The 88-RMB2 can automatically reset the machine during power-on. However, the Altair 8800 and 8800a should be reset from the front panel using the STOP and RESET switches. For power-on reset, install jumper W10. To disable power-on reset, remove W10.

The 88-RMB2 can generate the MWRITE signal on the bus, which is necessary for any machine that does not have a full front panel (such as the Altair 8800bt and the Attaché). If your machine does not have a front panel, then install jumper W11. If your machine has a front panel (such as the Altair 8800a or 8800b), then W11 should be removed.

The serial port on the 88-RMB2 can interrupt the processor. If your machine has a Vectored Interrupt Controller (88-VI), then set the interrupt vector with one of the jumpers W1 through W8, for interrupt vectors 0 through 7. To enable interrupts in a machine that does not have a vectored interrupt controller, install jumper W9, which connects the serial port interrupt to the -PINT signal on the bus.

Attaché Installation

The 88-RMB2 replaces the Turnkey Module in the Attaché, serving as the console I/O port interface to the Video Board, as well as ROM Basic. Set up the 88-RMB2 as follows:

Baud Rate: 9600 (Switches 4 and 6 set right, the rest set left)
Serial Port Level: TTL (Install jumpers W14, W15, W17)
Power-on Reset (Install jumper W10)
No front panel (Install jumper W11)
Sense Switches: 000 (octal) (All SW-2 switches to the right)

The cable between the 88-RMB2 and the Attaché video board is constructed as follows:

<u>Signal</u>	<u>88-RMB2 J1</u>	<u>88-RMB2 J2</u>	<u>Attaché Video J2</u>
-SHLTA	2.....		6
-PINTE	3.....		4
-IO	4.....		7
-PINT	5.....		5
KEY	9		
RxD		4.....	2
KEY		7	
GND		8.....	9
TxD		10.....	1
KEY			3

Altair 8800bt Installation

The 88-RMB2 replaces the Turnkey Module in the 8800bt, serving as the console I/O port, as well as ROM Basic. Set up the 88-RMB2 as follows:

Baud Rate: as required by the console terminal. (See table above.)
Serial Port Level: RS-232 (Install jumpers W14, W15, W16)
Power-on Reset (Install jumper W10)
No front panel (Install jumper W11)
Sense Switches: 000 (octal) (All SW-2 switches to the right)

You will need to replace the 8800bt's 10-pin 0.156" front panel connector with a 10-pin 0.1" connector to mate with J1 on the 88-RMB2. Note that the orientation of J1 is opposite of the connector on the Turnkey Module.

Connect J2 of the 88-RMB2 to a female DB25 connector on the rear panel of the 8800bt, as follows:

<u>Signal</u>	<u>Direction</u>	<u>J2 Pin</u>	<u>DB25 Pin</u>
TxD	Out	10	3
RxD	In	4	2
GND	-	8	7

Altair 8800, 8800a, and 8800b Installation

The 88-RMB2 will add ROM Basic and auto-start functionality to an Altair with a front panel, and also serve as the console terminal port.

To use the 88-RMB2 in an Altair that has a front panel, the sense switch port on the 88-RMB2 must be disabled. To disable the sense switch port, remove IC D1, and install a jumper from pin 8 to pin 14 in IC D1's empty socket.

If the Altair already has an 88-2SIO (or other interface board) that is addressed at ports 20 and 21 (octal), then that board must be removed or reassigned to another port address.

Set up the 88-RMB2 as follows:

- Baud Rate: as required by the console terminal. (See table above.)
- Serial Port Level: RS-232 (Install jumpers W14, W15, W16)
- Power-on Reset (Install jumper W10 for the 8800b)
- Front panel present (Remove jumper W11)
- Sense Switches: 000 (octal) (All SW-2 switches to the right)

Do not connect anything to J1 on the 88-RMB2.

Connect J2 of the 88-RMB2 to a female DB25 connector on the rear panel of the Altair, as follows:

<u>Signal</u>	<u>Direction</u>	<u>J2 Pin</u>	<u>DB25 Pin</u>
TxD	Out	10	3
RxD	In	4	2
GND	-	8	7

THEORY OF OPERATION

Auto-Start

IC R (74LS93) is a binary counter that serves as a sequencer for the auto-start function. This counter is reset by power-on clear, and counts through the four states of the auto-start sequence before stopping.

- State 1: Force "JMP" instruction (303 octal) onto the bus
- State 2: Force low address (000 octal) onto the bus
- State 3: Force high address (300 octal) onto the bus
- State 4: Release the bus

IC D (74LS153) creates the three data patterns that are forced onto the bus, based on the sequencer's state. IC Y (74LS244) gates these data patterns onto the bus during the first three states of the sequencer.

Data is forced onto the bus by overdriving the SMEMR signal on the bus with IC X1 (74LS367), using four drivers in parallel to overdrive the SMEMR signal that is generated on the CPU board. By forcing SMEMR to a false state, the memory board that is addressed at address 0 will not respond, and the data patterns generated by the auto-start circuit will be executed by the CPU.

Basic ROMs

MIT's Extended Cassette Basic is permanently written into eight 8316 ROMs, in locations G1, H1, J1, K1, L1, M1, N1, and P1. Note that P1

(on the right) is the lowest-address ROM socket, and G1 (on the right) is the highest-address ROM socket.

IC S (74 LS138) decodes which individual ROM is addressed, based on versions of address bits A11, A12 and A13 that are latched by IC F (74L75). The ROMs are addressed when both A14 and A14 are high, as determined by the NAND gate at IC P (74L10). ROM data is gated into the bus by IC Z (74LS244) when any of the ROMs is addressed, and when PDBIN and SMEMR are both active.

Sense Switches

SW-2 has a DIP switch for each of the 8 data bits. A data bit will be low if the switch is closed (grounding that bit, and will be pulled to a high state by resistor pack RP2 (4.7 K-ohms) if the switch is open.

IC X (74LS244) gates the sense switch data onto the bus when the CPU inputs from I/O port 377 (octal). IC D1 (74LS30) recognizes 377 (octal) on the address bus, and IC A (74L10) recognize a port input cycle.

Serial Port

The serial port is based on the 6850 ACIA at IC C1.

The ACIA drives its data pins when PDBIN is active and the ACIA is addressed during an I/O input cycle. ICs E1 (74LS04) and F1 (74LS30) recognize 20 and 21 (octal) on the address bus, and IC E (74L10) recognize a port input cycle. Address signal A0 determines whether the ACIA drives its data channel or its status channel onto its data pins. IC A1 (74LS244) gates the ACIA data onto the bus when the CPU inputs from I/O port 20 or 21 (octal).

IC B1 (74LS244) drives the bus data onto the ACIA data pins when the CPU performs any output cycle. If the output is to ports 20 or 21 (octal) then the ACIA will latch the data on the trailing edge of the -PWR bus signal. Address signal A0 determines whether the ACIA data channel or control channel is written to.

IC K (1488) and IC W (1489) serve as RS-232 drivers and receivers when RS-232 levels are used. IC J (7404) is used to drive TTL signals. The 1489 also serves as the TTL-level receiver.

Pullup resistors R3, R4, and R5 (4.7 K-ohms) are available for unused signal inputs, and are put in circuit with jumpers W13, W14, and W15.

C5 (1 uF) is available for slew-rate control on the RxD signal. This capacitor is put in circuit with jumper W12.

Baud Rate Generator

The baud rate generator uses the 2 MHz CLK signal from the bus for its time base.

ICs U, V, and H (all 74LS161s) form a 12-bit synchronous counter that is clocked by the CLK signal. This counter counts up, and is re-loaded with the value set by DIP switch SW-1 when it overflows. Thus, the SW-1 controls the frequency of its reload signal, as detected by IC T (74LS13). Note that to minimize the number of DIP switches, several counter-reload bits are tied together. This has the side effect of

eliminating several common baud rates. Also note that the switches are not in bit-order.

The counter-reload signal is too short to be used as the ACIA clocks, so it is stretched by the flip-flop constructed with IC E and IC P (both 74L10s) to produce the ACIA transmit and receive clocks.

Assembly

Errata

The following rework is required to correct a PCB layout mistake:

1. Cut the trace on the component side (near IC A) that goes from IC A pin 9 to IC E pin 13.
2. Cut the trace on the solder side that goes from IC A pin 9 to IC A pin 13
3. Install a jumper on the solder side from IC A pin 4 to IC A pin 9. (Do this after sockets are installed for IC A.)
4. Install a jumper from IC S pin 1 to IC E pin 13. (Do this after sockets are installed for ICs E and S.)

Install Axial Components

1. (1) 1K-ohm 1/4W resistor at R1
2. (3) 4.7K-ohm 1/4W resistors at R3, R4, and R5
3. (1) 68 ohm 1/4W resistor at R6

Install IC Sockets

1. (20) 14-pin DIP sockets at A,B,C,E,J,L,K,M,N,P,R,S,T,W,D1,E1,F1,P1,RP1,RP2
2. (9) 16-pin sockets at D,F,G,H,U,V,S1,T1,X1
3. (5) 20-pin sockets at X,Y,Z,A1,B1
4. (9) 24-pin sockets at C1,G1,H1,J1,K1,L1,M1,N1,P1

Install Switches

1. (2) 8-position DIP switches at SW-1 and SW-2. Orient them such that "ON" is to the right.

Install Radial Components

1. (4) 47 uF 16V (or higher) electrolytic or tantalum capacitors at C1,C2,C3,C4
2. (1) 1 uF 16V (or higher) tantalum capacitor at C5
3. (4) 22 uF 35V (or higher) electrolytic or tantalum capacitors at C8,C9,C10,C11
4. (1) 27 pF ceramic capacitor at C12
5. (20) 0.1 uF capacitors at all 20 "SC" locations

Install TO-92 Components

1. (1) 79L12C at VR4
2. (1) 78L12C at VR5. NOTE: This component should be installed backwards from the silkscreen indication, such that the flat side of the 78L12C faces downward.

Install TO-220 Components

1. (2) 7805, with heat sink grease, heat sink, 3-30 screws and nuts at VR1,VR2

Install Jumpers

These may be installed on either side of the board, though they look better when installed on the component side.

1. A-A
2. B-B
3. C-C
4. D-D

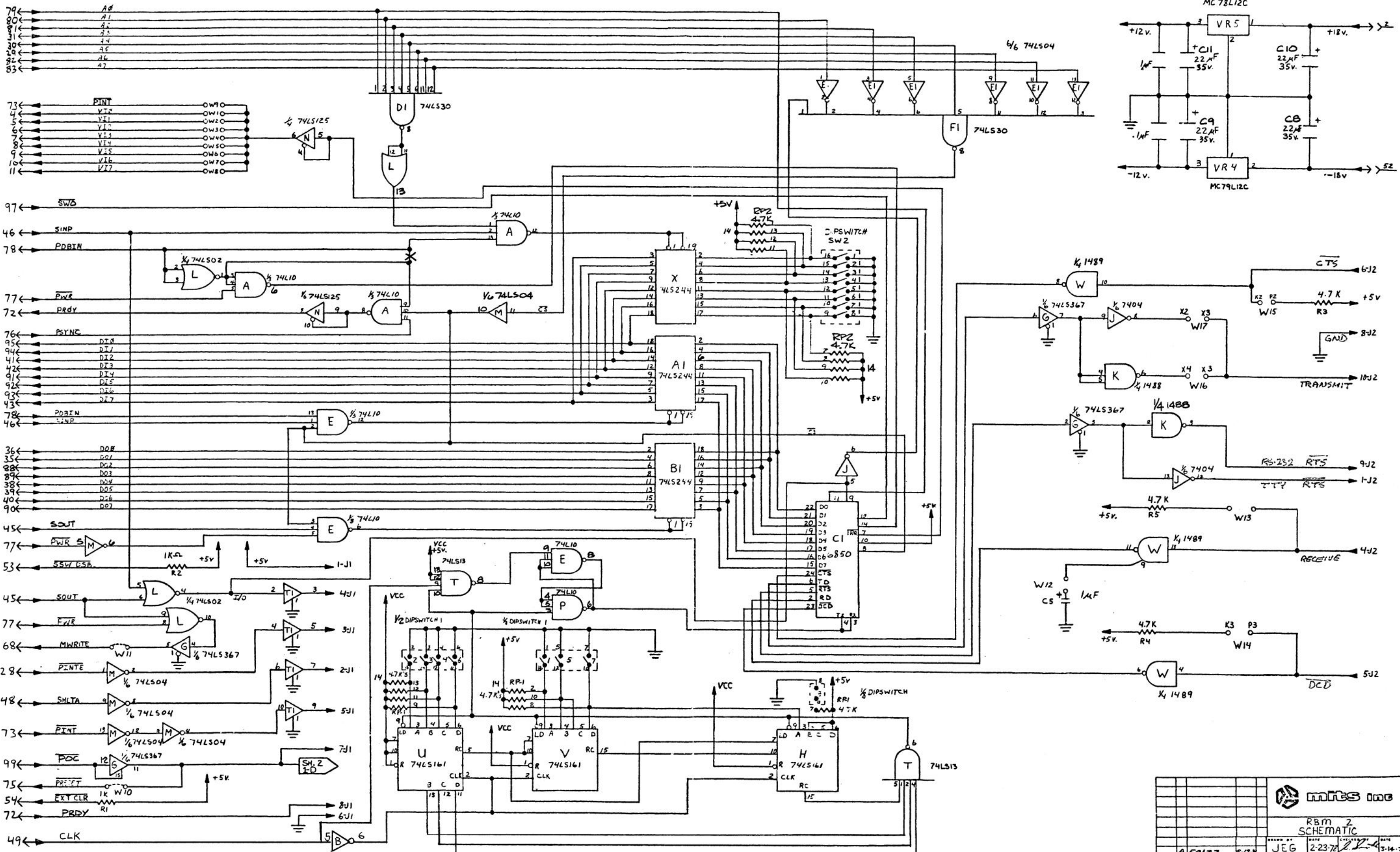
Install Standard DIP Components in Sockets

1. (1) 74L00 at S
2. (1) 74LS02 at L
3. (2) 7404 at J,R1
4. (1) 74L04 at B
5. (2) 74LS04 at M,E1
6. (3) 74L10 at A,E,P
7. (1) 74LS13 at T
8. (2) 74LS30 at D1,F1
9. (1) 74L75 at F
10. (1) 74LS93 at R
11. (2) 74LS125 at C,N
12. (1) 74LS138 at S1
13. (1) 74LS153 at D
14. (3) 74LS161 at H,U,V
15. (5) 74LS244 at X,Y,Z,A1,B1
16. (2) 74367 at X1,T1
17. (1) 74LS367 at G
18. (2) 4.7K-ohm, 13-resistor resistor packs at RP1,RP2
19. (1) 1488 at K
20. (1) 1489 at W
21. (1) 6850 at C1

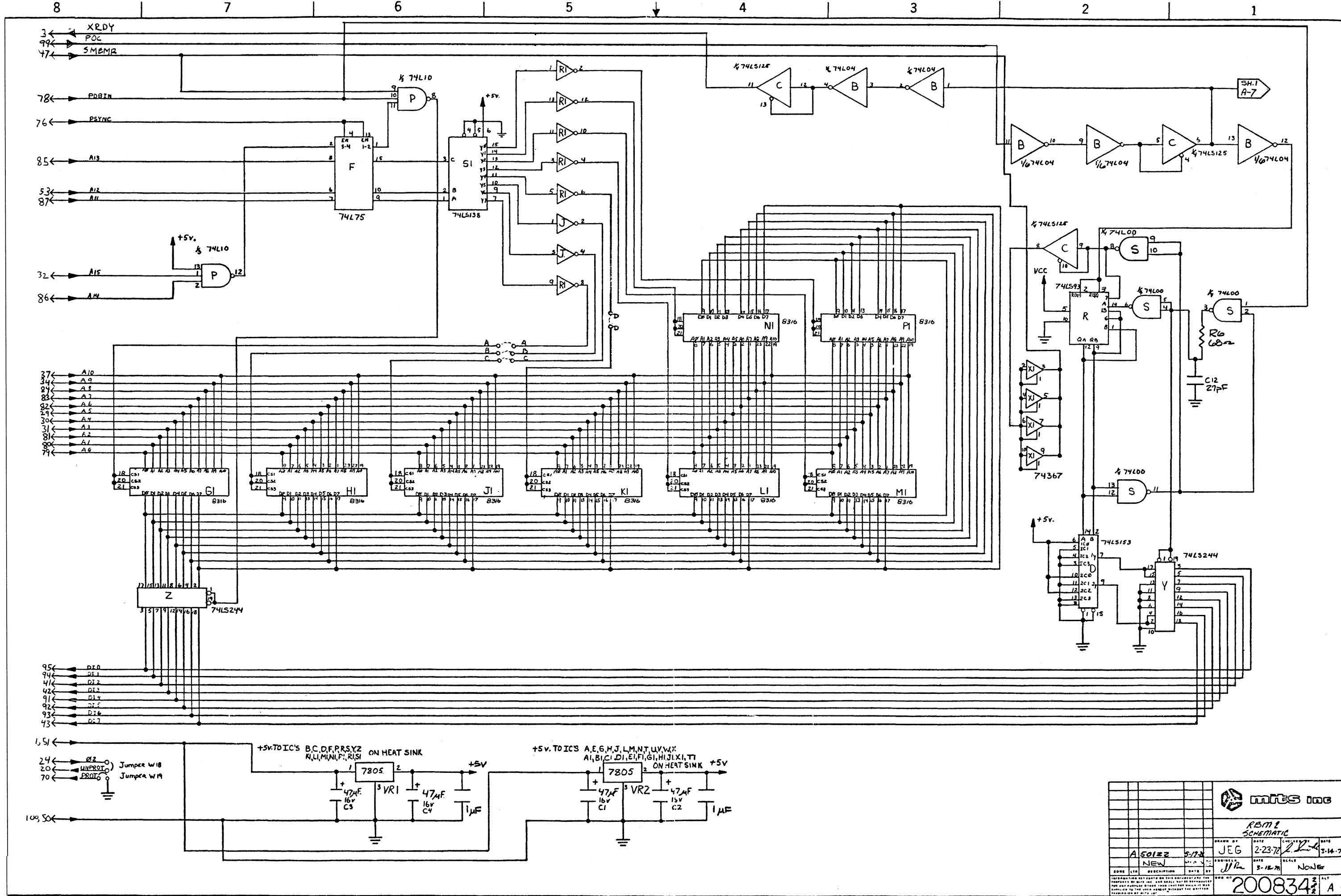
Install ROMs

The eight 8316 ROMs are programmed with MITS Extended Cassette Basic, and are each labeled with a unique part number. Install the ROMs in sockets as follows:

<u>Part Number</u>	<u>Location</u>
101481 or MP1481	P1
101482 or MP1482	N1
101483 or MP1483	M1
101484 or MP1484	L1
101485 or MP1485	K1
101486 or MP1486	J1
101487 or MP1487	H1
101488 or MP1488	G1



MITS INC	
RBM 2 SCHEMATIC	
DESIGNED BY	JEG
DATE	2-23-78
PROJECT	NEW
DATE	3-12-78
SCALE	NONE
200834 1/2 A	



		mts inc	
RBM 2 SCHEMATIC			
DRAWN BY	DATE	CHECKED BY	DATE
A50122	5-78	JEG	2-23-78
NEW		DATE	SCALE
		5-12-78	NONE
2008342 A			