SECTION 14.
PROCESSOR BOARD (A14)

14.1 DESCRIPTION

The Processor board provides primary control and data manipulations for the System Analyzer. This board contains the microprocessor, program read-only memory (ROM), nonvolatile memory (NVM), random-access memory (RAM), peripheral-interface adapter (PIA), timing generator, and character generator. Input and output information is transferred through the PIA and the address, data, and control busses. The board uses a Motorola M6800-series microprocessor, 2K×8 of RAM, 1K×8 of NVM, and 24K×8 of paged ROM.

A block diagram of the Processor board is shown at the end of this section in Figure 14-2, a schematic in Figure 14-3, and the printed wiring board assembly and parts list in Figure 14-4.

14.2 THEORY OF OPERATION

14.2.1 MICROPROCESSOR

An M6809 microprocessor controls the System Analyzer's operating modes. The device has an 8-bit data bus, a 16-bit address bus, and a control bus which synchronizes data transfer and specialized processor functions. The microprocessor uses the 4-MHz crystal (Y1) to provide an operating frequency of 1 MHz on the E and Q lines.

14.2.2 MEMORY

14.2.2.1 Memory Access

To allow the microprocessor's 16-bit address to access more than 64K of memory, the memory is structured in pages, as shown in Figure 14-1. The pages are broken down into chip-select blocks. To select a page of memory, the processor uses two outputs (PB1 and PB2) from PIA U22. (See the A11 section, paragraph 13.2.1.1 for a description of the PIA.) These two signals work in conjunction with the address decoders (U23, U50, and U51) to select the proper memory device.

14.2.2.2 Program Read-Only Memory (ROM)

The program memory for the main System Analyzer is located on page 2 of the memory map. The ROM consists of three 8192 × 8-bit and two 16,384 × 8-bit read-only memory devices. The program memory for the IEEE option (Option B) and the cellular mobile telephone option (Option A) is contained on pages 1 and 3. Option B uses a single 8192 × 8-bit ROM device, while Option A uses two 16,384 × 8-bit ROM devices.

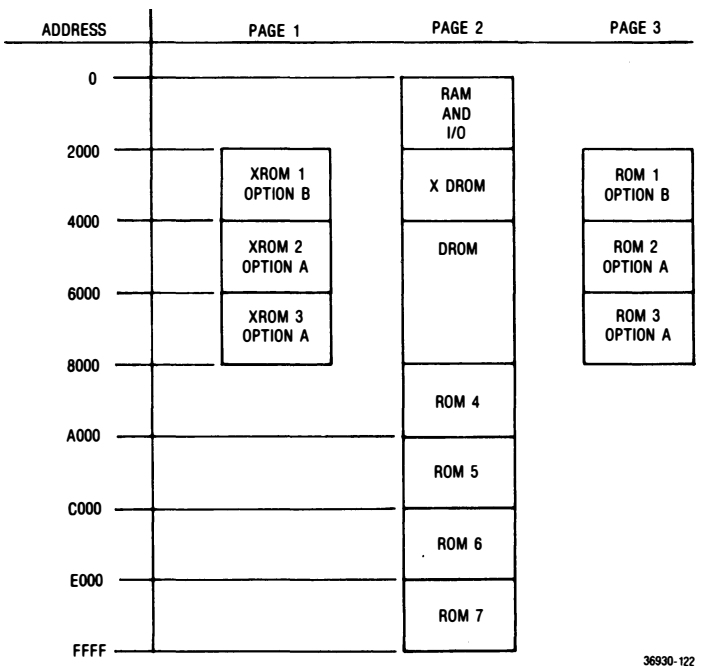


Figure 14-1. Memory Map

14.2.2.3 Random-Access Memory (RAM)

The random-access memory provides temporary data storage for the processor and for the CRT alphanumeric display. The RAM for the main program and all options is located on page 2 of memory. The main program's RAM can store 1024 eight-bit words, of which 512 are used for the CRT display data. Option A has provisions for a 1024 × 8-bit RAM device.

14.2.2.4 Nonvolatile Memory (NVM)

The nonvolatile memory provides storage for 1024 8-bit words. Data that is to be held during power-off is held in the NVM, which consists of a battery-backed RAM. When the power is turned on, the microprocessor reads the NVM contents to obtain its start-up mode, the RF and tone-memory presets, and the remainder of the preset data. If the operator changes a preset, the microprocessor changes the data in the NVM to remember the new preset.

14.2.3 INPUT/OUTPUT

Peripheral-interface adapters provide input and output latches for external data to and from the processor. The PIA on this board (U22) provides for nine inputs from the keyboard, four column inputs (COL 0-3), and five row inputs (ROW 0-4). When the two inputs OPT A DET and OPT B DET are pulled low, they signal the processor that the Option A or Option B boards are installed. Another input (OPTO DIR) provides the processor with the optical encoder's direction of rotation. Two outputs, PB0 and PB1, select the memory page.

14.2.4 CHARACTER DISPLAY

14.2.4.1 General

Characters are displayed on the CRT as 8-by-8 dot matrices. Thirty-two dot matrices, of which the last two are always blank, make one character line. Sixteen character lines, of which the last one is always blank, make a display frame. Thus, the total number of matrices available for character display is 30 × 15 or 450. The two blank matrices and the blank line are used for horizontal and vertical retrace blanking, respectively. The display is generated by dot rows. As the CRT sweeps the first dot row of a character line, the character generator outputs a serial-bit pattern of 1's and 0's that turns the CRT intensity on and off. The result is a row of dots that, when combined with the next seven rows, forms a character.

The frame display is stored at U27 in 32 × 16 bytes of RAM; this RAM is shared by the character generator and the processor. The two are synchronized to access the RAM during alternate half cycles of the master E clock. The RAM multiplexer (U24-U26) allows both the processor and the character generator to have non-interference access to the RAM every other 0.5 microsecond. In RAM, the processor stores an 8-bit word representing the character to be displayed.

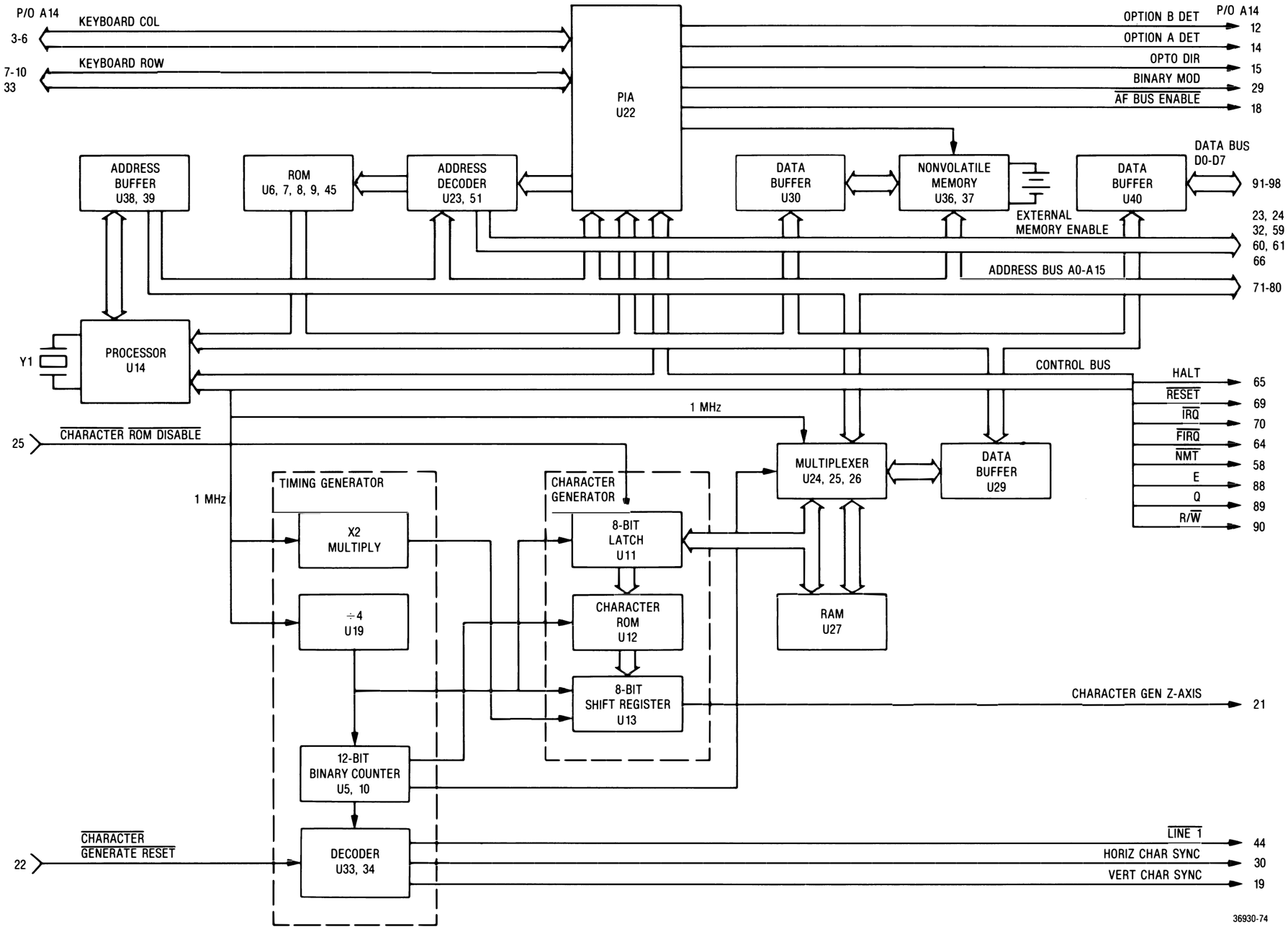
14.2.4.2 Timing Generator

The timing generator provides timing signals for the character generator. All the timing signals are synchronized to the 1-MHz E clock from the microprocessor. The E and Q clocks are exclusive-OR'd to provide a 2-MHz signal which is used to clock the 8-bit shift register (U13). This clock signal provides the dot rate. The 1-MHz E clock is divided-by-four by U19, and the resulting signal is used to latch one dot-matrix row into U11. This provides a dot-matrix rate of 250 kHz. The divided-by-four signal is further divided by a 12-bit binary counter (U10 and U15), to provide a row rate of 7812.5 Hz, a character line rate of 976.5 Hz, and a frame rate of 61.04 Hz.

14.2.4.3 Character Generator

The character generator simultaneously scans the RAM in sequence with the CRT display scan. The signals for the CRT display scan come from the horizontal and vertical character-sweep generators on the Scope Amplifier board (A7). The 12-bit binary counter provides the 9 bits of information stored in RAM. As each location in RAM is addressed, the 8-bit word stored at that location is latched into the 8-bit latch (U11) at the dot-matrix rate of 250 kHz. Seven of the bits are held in the latch and are applied to the character ROM (U12); the remaining bit is not used. An additional 3 bits from the 12-bit binary counter tell which row of dots is being scanned. Thus, the 10 bits being applied to the character ROM define a particular dot row of a particular character. The 8-bit pattern that defines this dot row is then available at the output of the character ROM. This output is parallel-loaded into the 8-bit shift register, U13. The 8 bits are serially shifted out on the CHAR GEN Z-AXIS line at a dot rate of 2 MHz. The 12-bit binary counter also provides synchronizing signals for the character-sweep generators on the A7 board. The horizontal and vertical character-sweep generators are reset and started by one-shots U34A and U34B, respectively. The horizontal one-shot enable is located at the end of a dot row. The vertical one-shot enable has two sources: the CHAR GEN RESET line for dual-display mode, and the 12-bit binary counter end-of-frame for character display. Also provided is a signal LINE 1 which signals the dual-display control on the Scope/DVM Control board that the first character line has been traced.

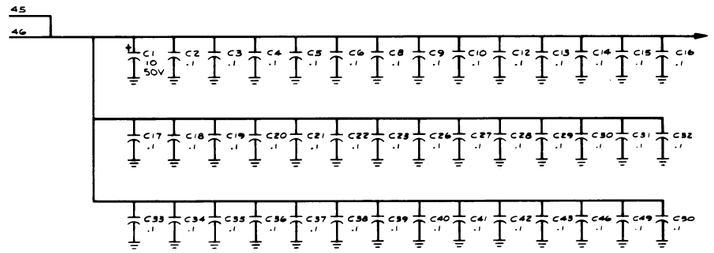
Figure 14-2. Block Diagram

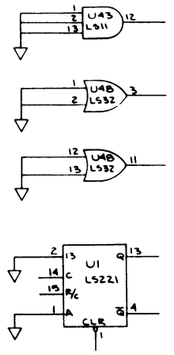


PROCESSOR BOARD (A14)

(RTC-1010A)

Figure 14-3a. Schematic (Sheet 1 of 5)





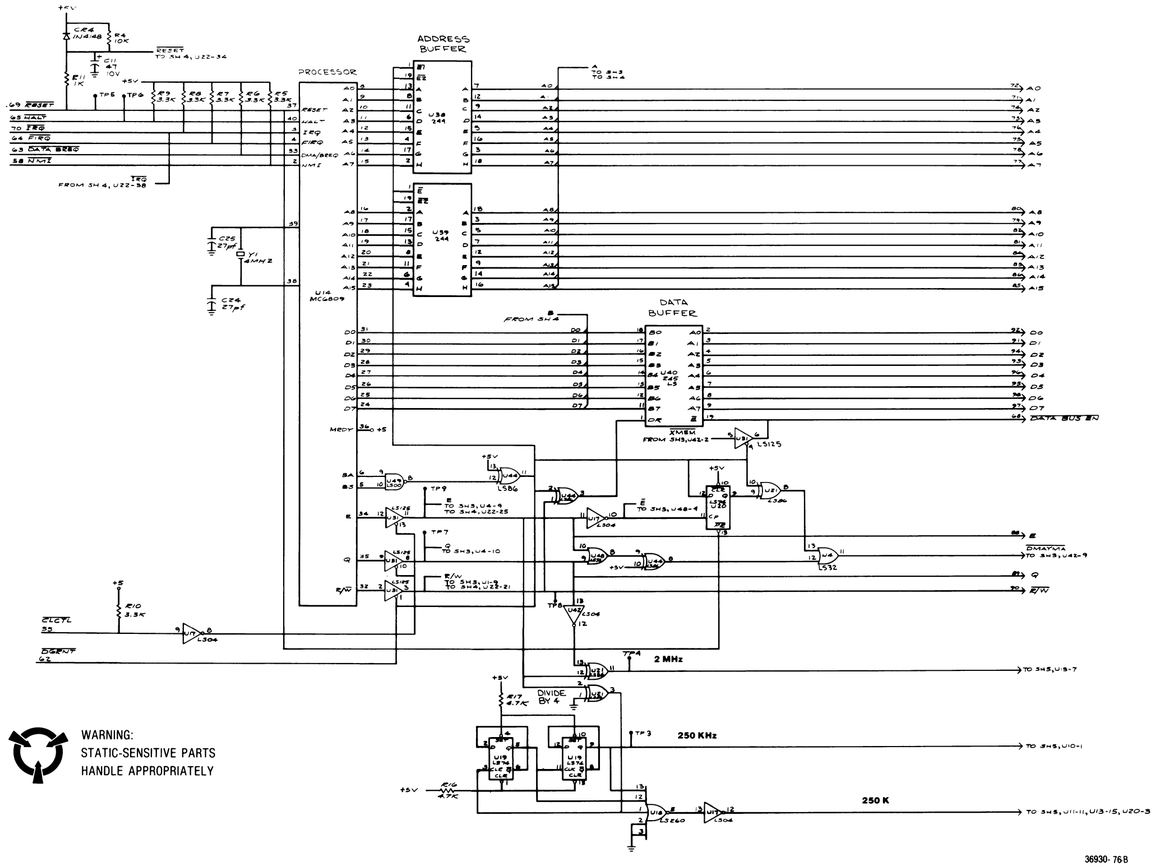
DEVICE	+5	GND	NO CONN
U1 74LS221	11,16	1,2,8	3,12,13,14,15
U2 NOT USED			
U3 NOT USED			
U4 74LS32	14	7	
U5 74LS191	9,10,15,16	4,5,8	13
U6 2764	28	14,22	26
U7 2764	28	14,22	26
U8 2764	28	14,22	26
U9 2764	28	14,22	26
U10 74LS393	14	7	
U11 74LS374	20	10	
U12 44562	21,24	18,19,20	12
U13 74LS166	5,16	1,6,8	
U14 MC6809P	7	1	
U15 NOT USED			
U16 NOT USED			
U17 74LS04	14	7	
U18 74LS260	14	4,7,2,3	
U19 74LS74	14	7	
U20 74LS74	4,5,10,14	7	6,8
U21 74LS86	14	7	
U22 6821	20,22	1	
U23 74LS139	16	8	
U24 74LS157	16	8,15	
U25 74LS157	16	8,15	
U26 74LS157	16	8,13	
U27 6116	24	12,18,20	

DEVICE	+5	GND	NO CONN
U28 NOT USED			
U29 74LS245	20	10	
U30 74LS245	20	10	
U31 74LS125	14	7	
U32 NOT USED			
U33 74LS00	14	7	
U34 74LS123	9,10,11,16	8	5,13
U35 NOT USED			
U36 6514	18	9	
U37 6514	18	9	
U38 74LS244	20	10	
U39 74LS244	20	10	
U40 74LS245	20	10	
U41 NOT USED			
U42 74LS04	14	7	
U43 74LS11	14	7,1,2,13	12
U44 74LS86	5,10,13,14	7	
U45 2764	28	14,22	26
U46 NOT USED			
U47 74L808	14	7	
U48 74LS32	14	1,2,12,13	3,11
U49 74LS00	14	7	
U50 74LS139	16	8	
U51 74LS139	16	8	
U52 74LS30	3,6,12,14	4,7	1,2,9,10,13

WARNING:
STATIC-SENSITIVE PARTS
HANDLE APPROPRIATELY

36930-76 A

Figure 14-3b. Schematic (Sheet 2 of 5)



PROCESSOR BOARD (A14)

(RTC-1010A)

Figure 14-3c. Schematic (Sheet 3 of 5)

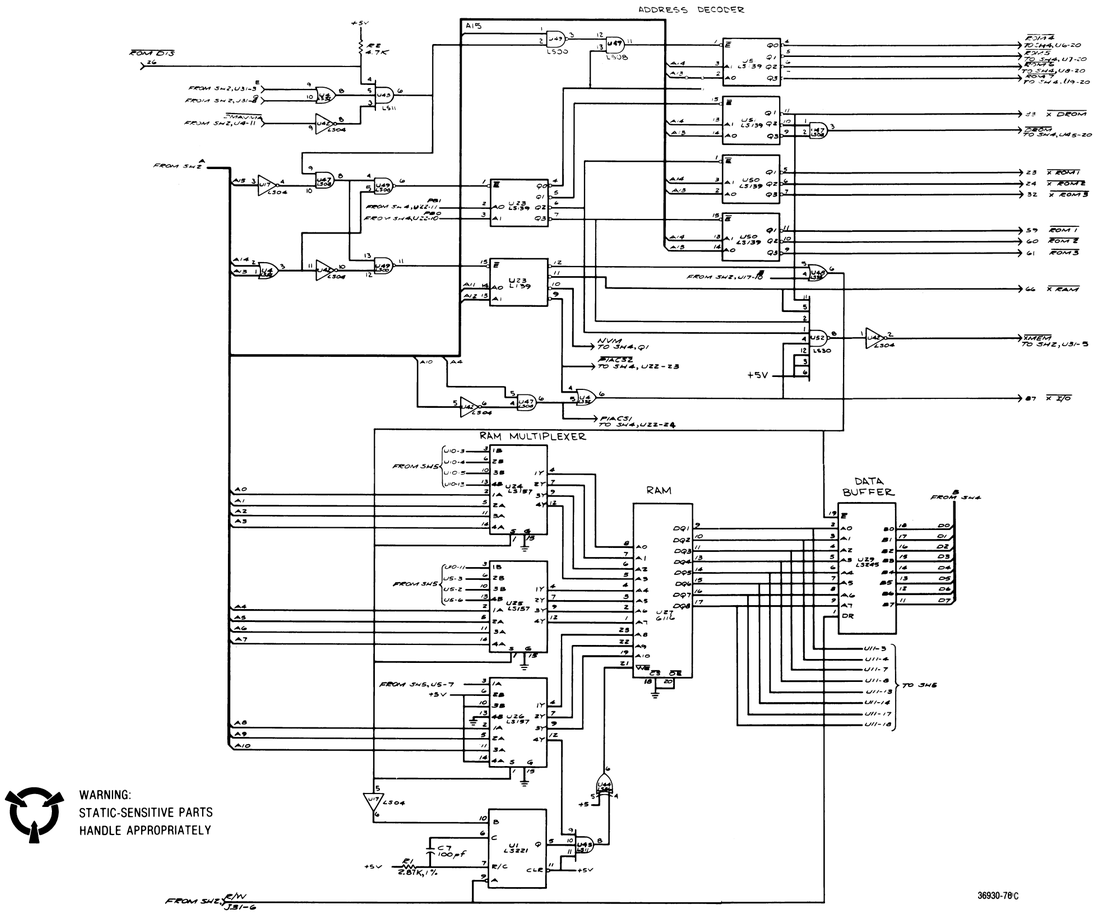
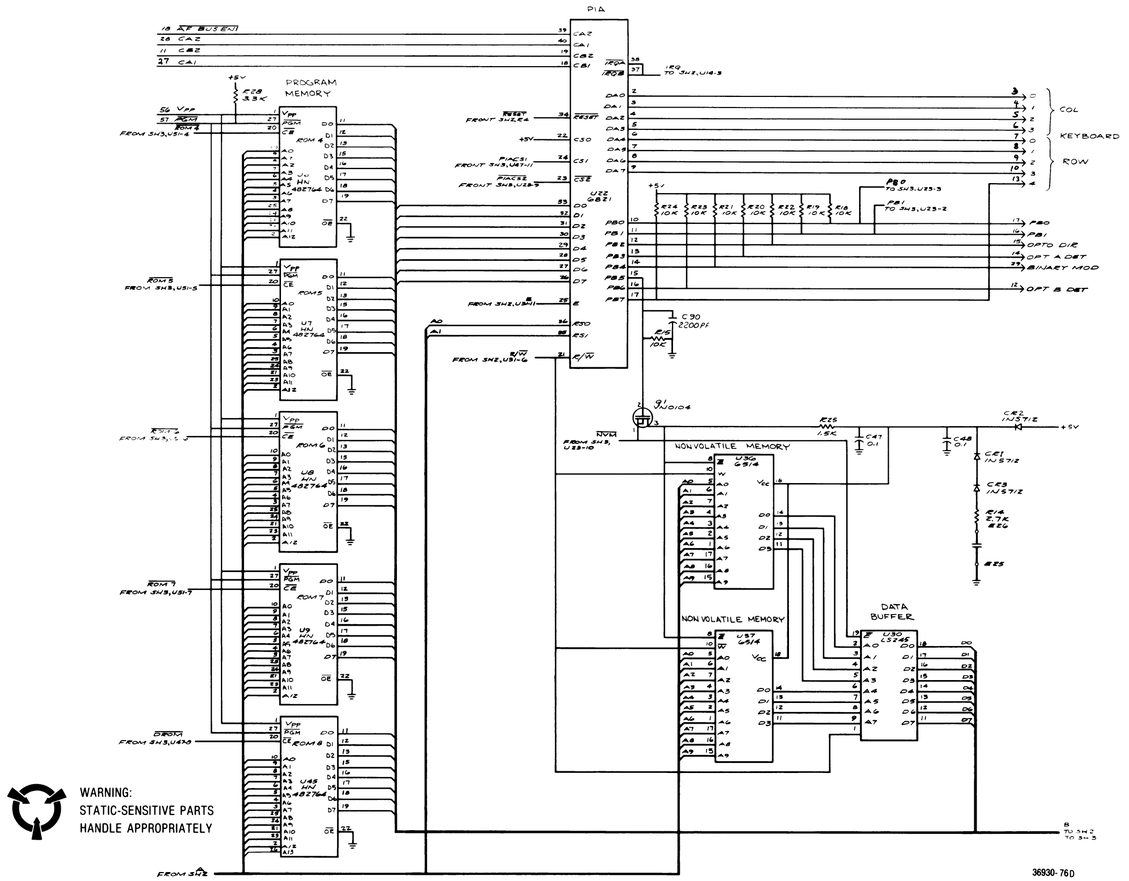


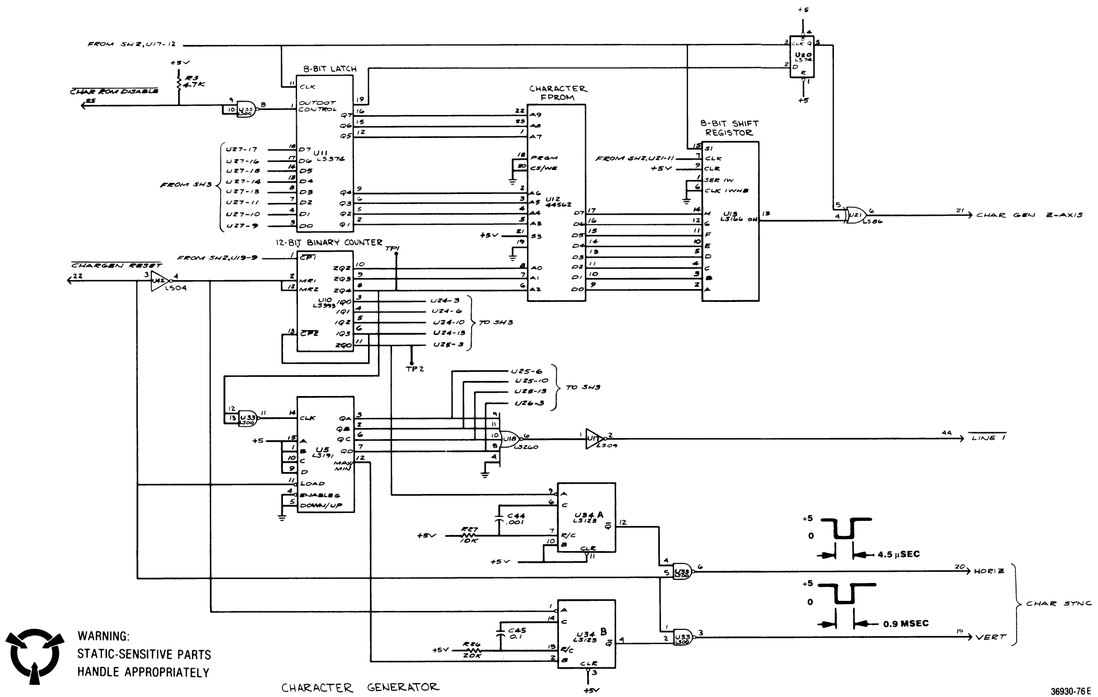
Figure 14-3d. Schematic (Sheet 4 of 5)

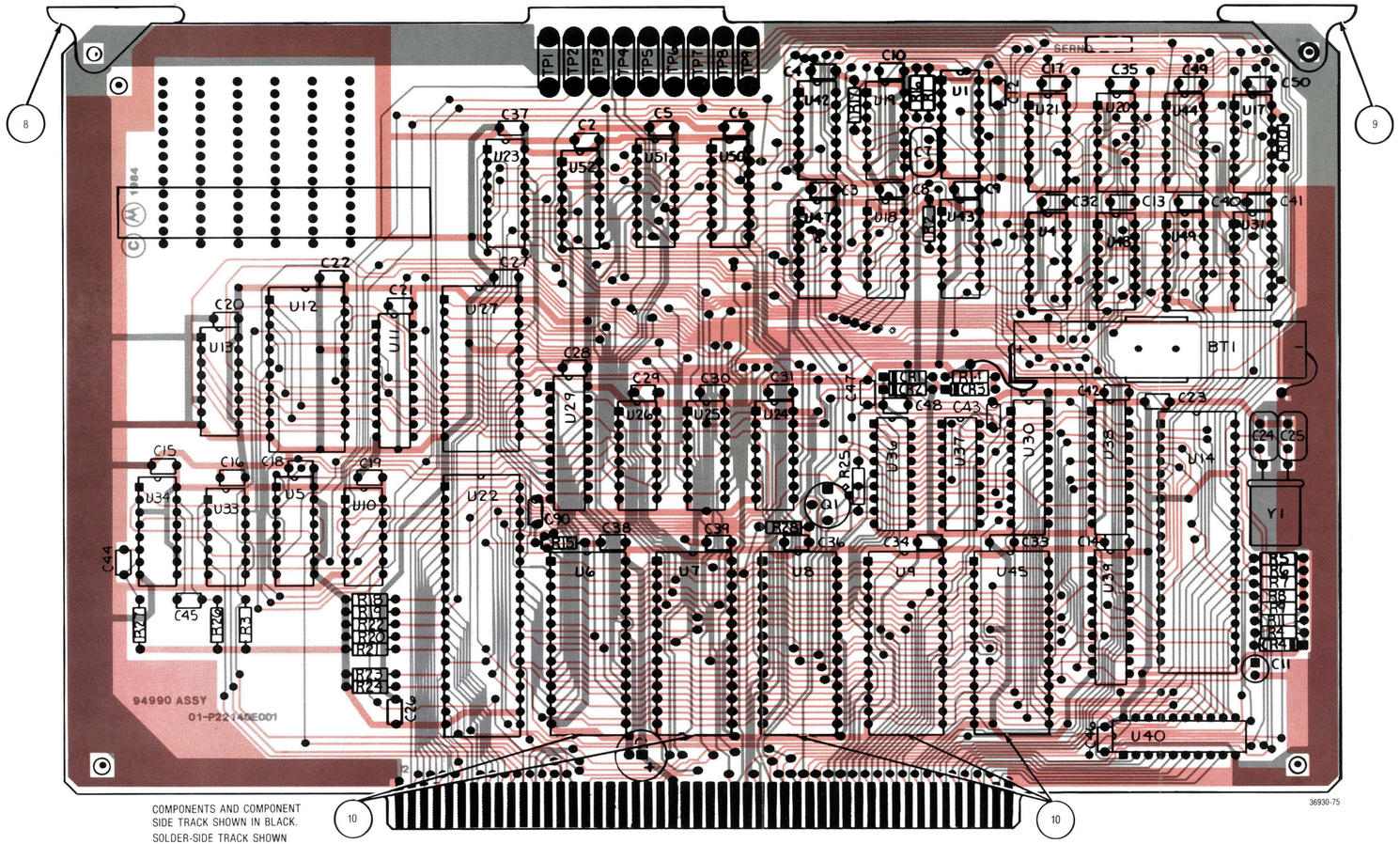


PROCESSOR BOARD (A14)

(RTC-1010A)

Figure 14-3e. Schematic (Sheet 5 of 5)





COMPONENTS AND COMPONENT SIDE TRACK SHOWN IN BLACK.
SOLDER-SIDE TRACK SHOWN IN ORANGE

PROCESSOR BOARD (A14)
RTC-1010A

Find No.	Qty. Req.	Part No.	Nomenclature	Part Value
008	1	45-80339B28	CARD EJECTOR	
009	1	45-80339B33	CARD EJECTOR	MARKED
010	5	09-80339B81	SOCKET	28 PIN
BT001	1	60-80396A01	BATTERY,LITHIUM-MANGANESE	3V
C 001	1	23-80341B15	CAPACITOR	10UF-20-50
C 002	1	21-80342B10	CAPACITOR	.1UF-20-50
C 003	1	21-80342B10	CAPACITOR	.1UF-20-50
C 004	1	21-80342B10	CAPACITOR	.1UF-20-50
C 005	1	21-80342B10	CAPACITOR	.1UF-20-50
C 006	1	21-80342B10	CAPACITOR	.1UF-20-50
C 007	1	21-00850118	CAPACITOR	100PF-5-500
C 008	1	21-80342B10	CAPACITOR	.1UF-20-50
C 009	1	21-80342B10	CAPACITOR	.1UF-20-50
C 010	1	21-80342B10	CAPACITOR	.1UF-2050
C 011	1	23-84665F25	CAPACITOR	47UF-20-10
C 012	1	21-80342B10	CAPACITOR	.1UF-2050
C 013	1	21-80342B10	CAPACITOR	.1UF-2050
C 014	1	21-80342B10	CAPACITOR	.1UF-20-50
C 015	1	21-80342B10	CAPACITOR	.1UF-2050
C 016	1	21-80342B10	CAPACITOR	.1UF-20-50
C 017	1	21-80342B10	CAPACITOR	.1UF-20-50
C 018	1	21-80342B10	CAPACITOR	.1UF-20-50
C 019	1	21-80342B10	CAPACITOR	.1UF-20-50
C 020	1	21-80342B10	CAPACITOR	.1UF-2050
C 021	1	21-80342B10	CAPACITOR	.1UF-20-50
C 022	1	21-80342B10	CAPACITOR	.1UF-20-50
C 023	1	21-80342B10	CAPACITOR	.1UF-20-50
C 024	1	21-80339B14	CAPACITOR	24PF-5-500
C 025	1	21-80339B14	CAPACITOR	24PF-5-500
C 026	1	21-80342B10	CAPACITOR	.1UF-20-50
C 027	1	21-80342B10	CAPACITOR	.1UF-20-50
C 028	1	21-80342B10	CAPACITOR	.1UF-20-50
C 029	1	21-80342B10	CAPACITOR	.1UF-20-50
C 030	1	21-80342B10	CAPACITOR	.1UF-2050
C 031	1	21-80342B10	CAPACITOR	.1UF-20-50
C 032	1	21-80342B10	CAPACITOR	.1UF-20-50
C 033	1	21-80342B10	CAPACITOR	.1UF-20-50
C 034	1	21-80342B10	CAPACITOR	.1UF-20-50
C 035	1	21-80342B10	CAPACITOR	.1UF-20-50
C 036	1	21-80342B10	CAPACITOR	.1UF-20-50
C 037	1	21-80342B10	CAPACITOR	.1UF-20-50
C 038	1	21-80342B10	CAPACITOR	.1UF-20-50
C 039	1	21-80342B10	CAPACITOR	.1UF-20-50
C 040	1	21-80342B10	CAPACITOR	.1UF-20-50
C 041	1	21-80342B10	CAPACITOR	.1UF-20-50
C 042	1	21-80342B10	CAPACITOR	.1UF-20-50
C 043	1	21-80342B10	CAPACITOR	.1UF-20-50
C 044	1	21-80341B93	CAPACITOR	1000PF-20-100
C 045	1	21-80341B97	CAPACITOR	.1UF-20-100
C 046	1	21-80342B10	CAPACITOR	.1UF-20-50
C 047	1	21-80342B10	CAPACITOR	.1UF-20-50
C 048	1	21-80342B10	CAPACITOR	.1UF-20-50
C 049	1	21-80342B10	CAPACITOR	.1UF-20-50
C 050	1	21-80342B10	CAPACITOR	.1UF-20-50
C 090	1	21-80341B99	CAPACITOR	2200PF-20-100
CR001	1	48-80396A27	DIODE	
CR002	1	48-80396A27	DIODE	
CR003	1	48-80396A27	DIODE	
CR004	1	48-84463K02	DIODE	
Q 001	1	48-80341B22	TRANSISTOR	
R 001	1	06-10621C39	RESISTOR	2.87K-1-1/4
R 002	1	06-11009C65	RESISTOR	4.7K-5-1/4
R 003	1	06-11009C65	RESISTOR	4.7K-5-1/4
R 004	1	06-11009C73	RESISTOR	10K-5-1/4
R 005	1	06-11009C61	RESISTOR	3.3K-5-1/4
R 006	1	06-11009C61	RESISTOR	3.3K-5-1/4
R 007	1	06-11009C 61	RESISTOR	3.3K-5-1/4
R 008	1	06-11009C61	RESISTOR	3.3K-5-1/4
R 009	1	06-11009C 61	RESISTOR	3.3K-5-1/4
R 010	1	06-11009C61	RESISTOR	3.3K-5-1/4
R 011	1	06-11009C49	RESISTOR	1K-5-1/4
R 014	1	06-11009C59	RESISTOR	2.7K-5-1/4
R 015	1	06-11009C73	RESISTOR	10K-5-1/4
R 016	1	06-11009C 65	RESISTOR	4.7K-5-1/4
R 017	1	06-11009C65	RESISTOR	4.7K-5-1/4
R 018	1	06-11009C73	RESISTOR	10K-5-1/4
R 019	1	06-11009C73	RESISTOR	10K-5-1/4
R 020	1	06-11009C73	RESISTOR	10K-5-1/4
R 021	1	06-11009C73	RESISTOR	10K-5-1/4
R 022	1	06-11009C73	RESISTOR	10K-5-1/4
R 023	1	06-11009C73	RESISTOR	10K-5-1/4
R 024	1	06-11009C73	RESISTOR	10K-5-1/4
R 025	1	06-11009C53	RESISTORS	1.5K-5-1/4

PROCESSOR BOARD (A14)

(RTC-1010A)

Figure 14-4. Printed Wiring Board Assembly and Parts List

PROCESSOR BOARD (A14) (Cont)
RTC-1010A

Find No.	Qty. Req.	Part No.	Nomenclature	Part Value
R 026	1	06-11009C80	RESISTOR	20K-5-1/4
R 027	1	06-11009C73	RESISTOR	10K-5-1/4
R 028	1	06-11009C61	RESISTOR	3.3K-5-1/4
TP001	1	09-80331A88	JACK	WHITE
TP002	1	09-80331A88	JACK	WHITE
TP003	1	09-80331A88	JACK	WHITE
TP004	1	09-80331A88	JACK	WHITE
TP005	1	09-80331A88	JACK	WHITE
TP006	1	09-80331A88	JACK	WHITE
TP007	1	09-80331A88	JACK	WHITE
TP008	1	09-80331A88	JACK	WHITE
TP009	1	09-80331A88	JACK	WHITE
U 001	1	51-05722G02	INTEGRATED CIRCUIT	
U 004	1	51-84561L36	INTEGRATED CIRCUIT	
U 005	1	51-80368A74	INTEGRATED CIRCUIT	SN74LS191N
U 006	1	51-90006B01	INTEGRATED CIRCUIT,	EPROM
U 007	1	51-90006B01	INTEGRATED CIRCUIT,	EPROM
U 008	1	51-90006B01	INTEGRATED CIRCUIT,	EPROM
U 009	1	51-90006B01	INTEGRATED CIRCUIT,	EPROM
U 010	1	51-82609M30	INTEGRATED CIRCUIT	
U 011	1	51-82609M67	INTEGRATED CIRCUIT	
U 012	1	51-80340B13	INTEGRATED CIRCUIT	
U 013	1	51-82609M53	INTEGRATED CIRCUIT	
U 014	1	51-80340B21	INTEGRATED CIRCUIT	
U 017	1	51-84561L03	INTEGRATED CIRCUIT	
U 018	1	51-82609M61	INTEGRATED CIRCUIT	
U 019	1	51-83627M93	INTEGRATED CIRCUIT	
U 020	1	51-83627M93	INTEGRATED CIRCUIT	
U 021	1	51-82609M79	INTEGRATED CIRCUIT	
U 022	1	51-82807K20	INTEGRATED CIRCUIT	
U 023	1	51-84561L42	INTEGRATED CIRCUIT	
U 024	1	51-84561L48	INTEGRATED CIRCUIT	
U 025	1	51-84561L48	INTEGRATED CIRCUIT	
U 026	1	51-84561L48	INTEGRATED CIRCUIT	
U 027	1	51-80339B86	INTEGRATED CIRCUIT	CMOS RAM
U 029	1	51-82609M57	INTEGRATED CIRCUIT	
U 030	1	51-82609M57	INTEGRATED CIRCUIT	
U 031	1	51-82609M48	INTEGRATED CIRCUIT	
U 033	1	51-84561L04	INTEGRATED CIRCUIT	
U 034	1	51-84561L11	INTEGRATED CIRCUIT	
U 036	1	51-80396A21	INTEGRATED CIRCUIT	CMOS RAM
U 037	1	51-80396A21	INTEGRATED CIRCUIT	CMOS RAM
U 038	1	51-82609M56	INTEGRATED CIRCUIT	
U 039	1	51-82609M56	INTEGRATED CIRCUIT	
U 040	1	51-82609M57	INTEGRATED CIRCUIT	
U 042	1	51-84561L03	INTEGRATED CIRCUIT	
U 043	1	51-84561L44	INTEGRATED CIRCUIT	
U 044	1	51-82609M79	INTEGRATED CIRCUIT	
U 045	1	51-80339B89	INTEGRATED CIRCUIT	EPROM
U 047	1	51-84561L07	INTEGRATED CIRCUIT	
U 048	1	51-84561L36	INTEGRATED CIRCUIT	
U 049	1	51-84561L04	INTEGRATED CIRCUIT	
U 050	1	51-84561L42	INTEGRATED CIRCUIT	
U 051	1	51-84561L42	INTEGRATED CIRCUIT	
U 052	1	51-84561L39	INTEGRATED CIRCUIT	
Y 001	1	48-80346A06	CRYSTAL	4.0 MHZ