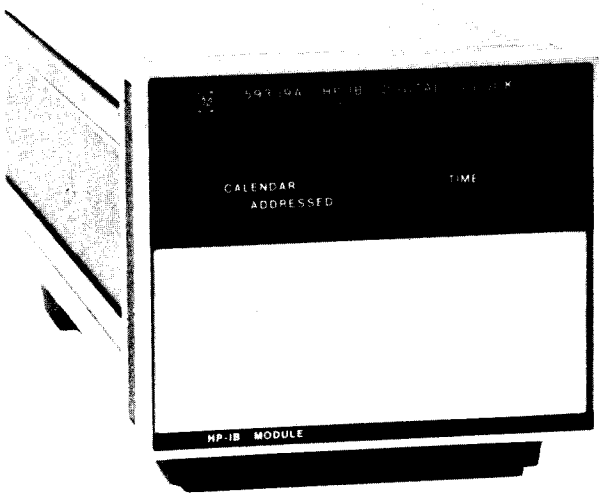
HP-IB DIGITAL CLOCK

59309A



HEWLETT hp PACKARD

HP 59309A

CERTIFICATION

Hewlett-Packard Company certifies that this instrument met its published specifications at the time of shipment from the factory. Hewlett-Packard Company further certifies that its calibration measurements are traceable to the United States National Bureau of Standards, to the extent allowed by the Bureau's calibration facility, and to the calibration facilities of other International Standards Organization members.

WARRANTY AND ASSISTANCE

This Hewlett-Packard product is warranted against defects in materials and workmanship for a period of one year from the date of shipment. Hewlett-Packard will, at its option, repair or replace products which prove to be defective during the warranty period provided they are returned to Hewlett-Packard, and provided the preventive maintenance procedures in this manual are followed. Repairs necessitated by misuse of the product are not covered by this warranty. NO OTHER WARRANTIES ARE EXPRESSED OR IMPLIED, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. HEWLETT-PACKARD IS NOT LIABLE FOR CONSEQUENTIAL DAMAGES.

Service contracts or customer assistance agreements are available for Hewlett-Packard products.

For any assistance, contact your nearest Hewlett-Packard Sales and Service Office. Addresses are provided at the back of this manual.

OPERATING AND SERVICE MANUAL

59309A

HP-IB DIGITAL CLOCK

SERIAL NUMBERS

This manual applies directly to Model 59309A HP-IB Digital Clock with serial prefix 1632A.

For serial prefixes above 1632A, a "Manual Changes" sheet is included with this manual. For serial prefixes below 1632A, refer to Section VII of this manual.

MANUAL PART NO. 59309-90004
Microfiche Part No. 59309-90005

Printed: DEC 1976

HEWLETT hp PACKARD

TABLE OF CONTENTS

TABLE OF CONTENTS (Continued)

TABLE OF CONTENTS (Continued)

LIST OF TABLES

LIST OF FIGURES

SAFETY CONSIDERATIONS

GENERAL

This is a Safety Class I instrument. This instrument has been designed and tested according to IEC Publication 348, "Safety Requirements for Electronic Measuring Apparatus".

OPERATION

BEFORE APPLYING POWER verify that the power transformer primary is matched to the available line voltage and the correct fuse is installed (see Section II, Paragraph 2-6). Make sure that only fuses with the required rated current and of the specified type (normal blow, time delay, etc.) are used for replacement. The use of repaired fuses and the short-circuiting of fuseholders must be avoided.

SERVICE

Although this instrument has been designed in accordance with international safety standards, this manual contains information, cautions, and warnings which must be followed to ensure safe operation and to retain the instrument in safe condition. Service and adjustments should be performed only by qualified service personnel.

Any adjustment, maintenance, and repair of the opened instrument under voltage should be avoided as much as possible and, when inevitable, should be carried out only by a skilled person who is aware of the hazard involved.

Capacitors inside the instrument may still be charged even if the instrument has been disconnected from its source of supply.

Whenever it is likely that the protection has been impaired, the instrument must be made inoperative and be secured against any unintended operation.

WARNING

IF THIS INSTRUMENT IS TO BE ENERGIZED VIA AN AUTOTRANSFORMER (FOR VOLTAGE REDUCTION) MAKE SURE THE COMMON TERMINAL IS CONNECTED TO THE EARTHED POLE OF THE POWER SOURCE.

WARNING

BEFORE SWITCHING ON THE INSTRUMENT, THE PROTECTIVE EARTH TERMINALS OF THE INSTRUMENT MUST BE CONNECTED TO THE PROTECTIVE CONDUCTOR OF THE (MAINS) POWER CORD. THE MAINS PLUG SHALL ONLY BE INSERTED IN A SOCKET OUTLET PROVIDED WITH A PROTECTIVE EARTH CONTACT. THE PROTECTIVE ACTION MUST NOT BE NEGATED BY THE USE OF AN EXTENSION CORD (POWER CABLE) WITHOUT A PROTECTIVE CONDUCTOR (GROUNDING).

WARNING

THE SERVICE INFORMATION FOUND IN THIS MANUAL IS OFTEN USED WITH POWER SUPPLIED AND PROTECTIVE COVERS REMOVED FROM THE INSTRUMENT. ENERGY AVAILABLE AT MANY POINTS MAY, IF CONTACTED, RESULT IN PERSONAL INJURY.

CAUTION

BEFORE SWITCHING ON THIS INSTRUMENT:

1. **Make sure the instrument is set to the voltage of the power source.**

2. **Ensure that all devices connected to this instrument are connected to the protective (earth) ground.**

3. **Ensure that the line power (mains) plug is connected to a three-conductor line power outlet that has a protective (earth) ground. (Grounding one conductor of a two-conductor outlet is not sufficient.)**

4. **Make sure that only fuses with the required rated current and of the specified type (normal blow, time delay, etc.) are used for replacement. The use of repaired fuses and the short-circuiting of fuseholders must be avoided.**

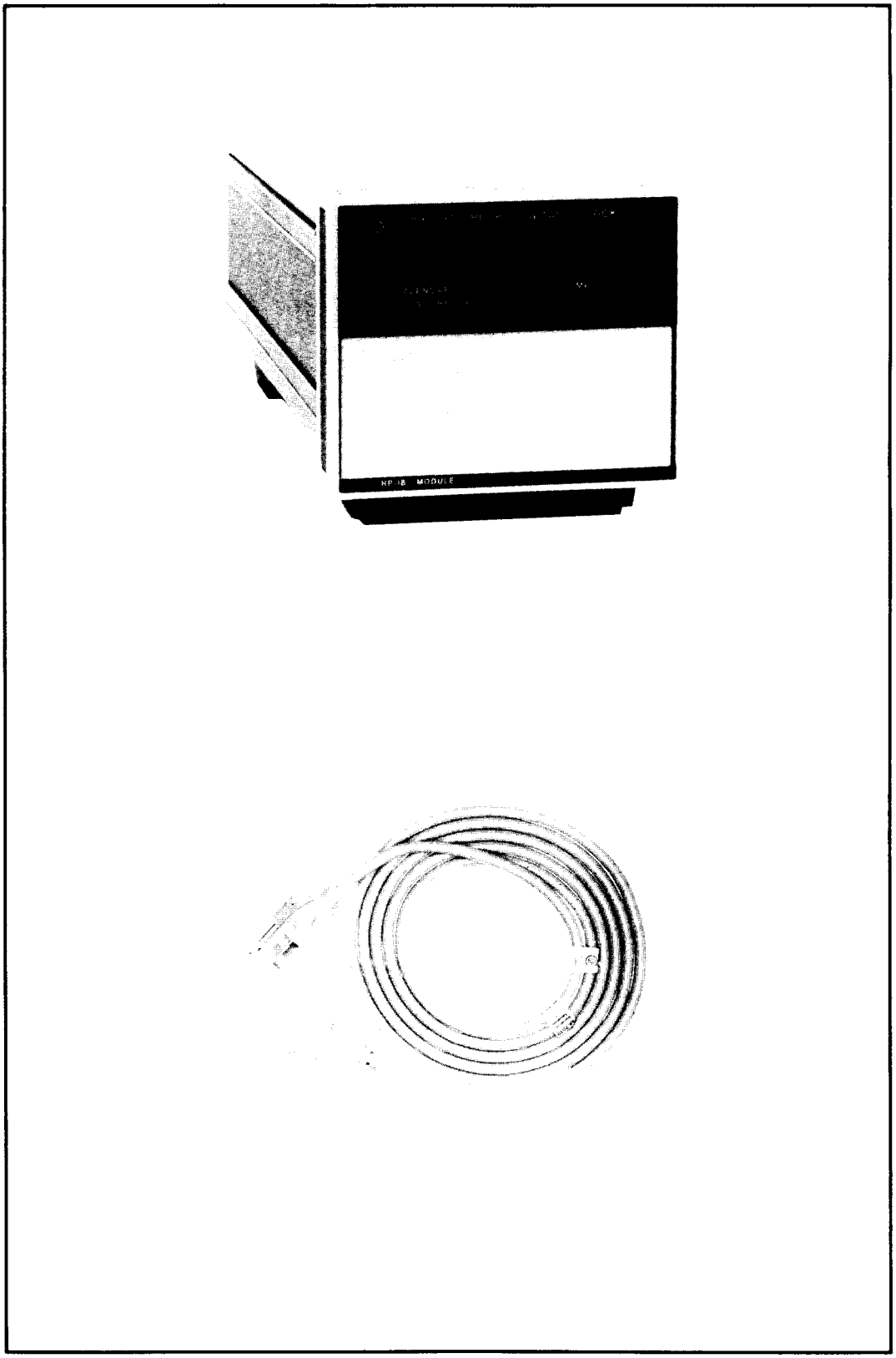


Figure 1-1. Model 59309A and Equipment Supplied

SECTION I
GENERAL INFORMATION

1-1. SCOPE OF MANUAL

1-2. This is an operating and service manual containing information about the Hewlett-Packard 59309A HP-IB Digital Clock. This manual is divided into sections as described in the following paragraphs.

1-3. Section I, General Information. This section describes the scope of the manual, the Model 59309A HP-IB Digital Clock, its applications, specifications, identification, options, equipment supplied with the instrument, accessories available, and safety considerations.

1-4. Section II, Installation. This section gives information for unpacking, inspection, preparation for use, storage, and power requirements.

1-5. Section III, Operation and Programming describes operating characteristics, controls, indicators, and connectors. It also describes stand-alone and remote operations of the 59309A, Hewlett-Packard Interface Bus (HP-IB). Programming setup procedures, programming, and programming examples are provided.

1-6. Section IV, Theory of Operation. This section describes, at a block diagram level, how the 59309A functions electronically.

1-7. Section V, Maintenance and Troubleshooting. This section describes how to keep the 59309A operating properly, and how to locate and repair the cause of malfunctions.

1-8. Section VI, Replaceable Parts. This section lists the replaceable parts along with Hewlett-Packard part numbers and/or other manufacturers part numbers and manufacturers code numbers. An explanation of the Hewlett-Packard part numbering system is furnished, as is a manufacturers code-to-name list for all applicable codes.

1-9. Section VII, Manual Changes. This section contains information needed to adapt this manual to older and/or newer instruments than those with serial prefixes shown on the title page.

1-10. Section VIII, Schematic Diagrams. This section contains schematic diagrams, component locator illustrations and individual assembly theory-of-operation.

1-11. DESCRIPTION

1-12. The 59309A provides a front-panel display of the date and time on a 24-hour basis. When used in a system, the 59309A is fully programmable and outputs the date and time onto the HP-IB for printout or other systems use. The display is a row of digits indicating:

	Month	Day of Month	Hour	Minute	Second
	MM	DD	HH	MM	SS
For example:	01	25	09	54	26

1-13. The 59309A output to the bus is formatted in the same sequence as the display and is followed by CR (carriage return), LF (linefeed).

1-14. The 59309A can be set or updated by switches located under the hinged lower portion of the front panel, or by remote programming on the interface bus. During programming of the new setting, the clock continues to keep time to maintain synchronization.

1-15. The 59309A contains a 1 MHz crystal as a time base (see specifications in *Table 1-1*) and has provisions for connecting an external frequency standard of 1, 5, or 10 MHz.

1-16. The 59309A contains provisions for two different types of standby power supplies. A standard 9-volt dry cell battery (not supplied) can be plugged onto the A2 board to supply standby power in case of momentary power line failure. The internal battery will supply power for approximately one day of operation (display cannot be illuminated).

1-17. For longer periods of standby operation, an 8- to 10-volt dc power supply may be connected via the STANDBY POWER INPUT connector on the rear panel. An accessary available for this purpose is the K10-59992 Standby Power Supply, packaged in a module identical in size to the 59309A. With the external power supply connected the display can be illuminated by pushing the PUSH TO READ button on the front panel.

1-18. APPLICATIONS

1-19. The 59309A can be used as a stand-alone digital clock or as a system time-of-day source. The operation of the 59309A can be controlled locally by front-panel controls or remotely via the HP-IB. Examples of specific applications are:

a. Stand-alone operation, with internal or external dc power supply, to provide a digital clock immune to power line noise or failure.

b. A data source for the HP-IB to provide calendar and time-of-day data for use by a system. For example, the 59309A can be used to start and stop measurements by having the controller run in a software loop looking for correct time or it can be used to supply information to data logging devices to record time of events.

c. A master clock to control remote readout devices such as the HP 59304A Numeric Display.

d. Used in conjunction with the HP 59308A Timing Generator for interval timing and pacing for precise execution of functions. Use of the 59308A provides the capability to have a system automatically schedule a sequence of measurements on a time-of-day basis.

e. Data logging complete with time information. The time at which data points are taken, or a printout made, is a vital part of a data record. With the 59309A in a System, time and data can be recorded simultaneously.

1-20. SPECIFICATIONS

1-21. Specifications for the HP 59309A are given in *Table 1-1*.

Table 1-1. Specifications

POWER REQUIREMENTS:
Line Voltage: 115 Vac or 230 Vac ±10%
Line Frequency: 48 to 440 Hz
Power Consumption: 20 VA max.
Load on Bus: 3.3 mA per line
Standby Power: Internal 9V dry cell battery (not supplied) can maintain time for about a day (display off). The K10-59992A Standby Power Supply can maintain time for up to a year (available as an accessory).

ENVIRONMENTAL: Operating Temperature: 0° to 50°C. Relative humidity to 95% at 40°C.

ACCURACY: Internal Time Base: Provides overall accuracy greater than one minute per month.

External Time Base: External frequency standard of 1, 5, or 10 MHz (1 Vrms into 1KΩ) can be applied to control the accuracy. (50 ohm termination required at EXT FREQ STD input connector when a 50 ohm source is used.)

FORMAT SELECTION: Output Format: Selectable by internal mini-switches. Selects colons or commas as delimiters, or deletes delimiters. Selects calendar with time-of-day or deletes calendar.

DIMENSIONS: Height: 101,6 mm (4 inches) including cabinet feet.
Width: 105,9 mm (4.17 inches)
Depth: 276,9 mm (10.9 inches)

WEIGHT: Net weight: 1,23 kg (2 lb. 11½ oz)
Shipping Weight: 1,58 kg (3 lb. 8 oz)

1-22. INSTRUMENT IDENTIFICATION

1-23. Each Hewlett-Packard instrument has a 10-character serial number (e.g., 0000A00000). The 4-digit serial prefix identifies a group of identical instruments, and the 5-digit suffix is a serial number unique to each instrument. If the serial prefix on your instrument is not on the title page of this manual, your instrument is different from this manual. If the serial prefix on your instrument is lower, the differences are covered in Section VII; if the serial prefix is higher, the differences are covered in a "Manual Change Sheet" included with this manual. If the change sheet is missing, request one from the nearest Hewlett-Packard Sales and Service Office listed at the back of this manual.

1-24. OPTIONS

1-25. No options are available. Some early versions of the 59309A were available as Option 001. This option provided a Julian calendar display and an output formatted in day-of-year digits, 001 to 365 or 366 days. See Section VII for details.

1-26. EQUIPMENT SUPPLIED AND ACCESSORIES AVAILABLE

1-27. *Table 1-2* lists the equipment supplied with the HP 59309A and *Table 1-3* lists accessories available.

Table 1-2. Equipment Supplied

Description	HP Part Number
Detachable Power Cord 229 cm 7½ ft. long	8120-1378

Table 1-3. Accessories Available

Description	HP Part Number
Circuit Board Extender, 15-pin (two required)	5060-0049
Standby Power Supply	K10-59992A
HP Interface Bus Interconnect Cables	10631A, B,C

1-28. MANUAL MICROFICHE

1-29. On the title page of this manual, below the manual part number, is a "Microfiche" part number. This number may be used to order 4x6-inch microfilm transparencies of the manual. The microfiche package also includes the latest Manual Changes supplement as well as pertinent Service Notes.

SECTION II
INSTALLATION

2-1. INTRODUCTION

2-2. This section contains information for unpacking, inspection, repacking, storage, and installation.

2-3. UNPACKING AND INSPECTION

2-4. If the shipping carton is damaged, inspect the instrument for damage. If the instrument is damaged or fails to meet electrical specifications, notify the carrier and the nearest Hewlett-Packard Sales and Service Office immediately (offices are listed at the back of this manual). Retain the shipping carton and padding material for the carrier's inspection. The Sales and Service office will arrange for the repair or replacement of your instrument without waiting for the claim against the carrier to be settled.

2-5. PREPARATION FOR USE

CAUTION

Before connecting this instrument to an ac power line, be sure that the AC Input Voltage Selector switch is set to the proper position as shown in *Figure 3-2.*

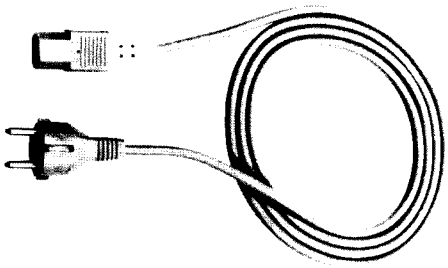
2-6. Power Requirements and Line Voltage

2-7. This instrument operates on single-phase 115 or 230 volts, 48 to 440 Hz only. The DC standby power capability keeps the clock running but does not provide access to or from the HP-IB bus. Before applying power, the slide switch on the rear panel must be set to the correct position (115 or 230) and the correct fuse (as labeled on the rear panel) must be installed. Power requirements are 20 VA maximum. For a description of standby power supply requirements, refer to paragraph 1-16.

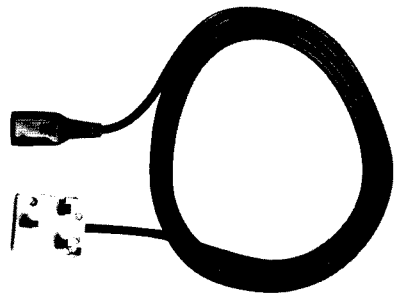
WARNING

TO PROTECT OPERATING AND SERVICING PERSONNEL, THIS INSTRUMENT IS EQUIPPED WITH A THREE-PIN POWER RECEPTACLE. THE CENTER PIN OF THE RECEPTACLE CONNECTS THE INSTRUMENT CHASSIS AND PANELS TO EARTH GROUND WHEN USED WITH A PROPERLY WIRED THREE CONDUCTOR OUTLET AND POWER CABLE. IMPROPERLY GROUNDED EQUIPMENT CAN RESULT IN HAZARDOUS POTENTIALS BETWEEN EQUIPMENT.

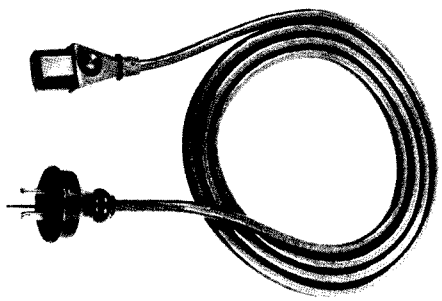
2-8. To accommodate the different power receptacles used throughout the world, this instrument is supplied with one of the power cables shown in *Figure 2-1.* The cable supplied for use in the United States meets the specifications established by the International Electrotechnical Commission (IEC). The male connector of this cable is a NEMA type and the female connector is C.E.E. type.



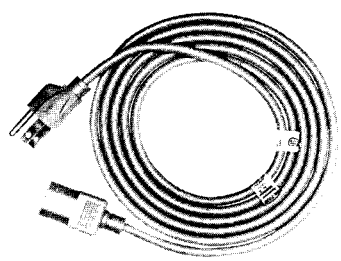
POWER CABLE HP NO. 8120-1689
(Germany, France, Sweden, Netherlands, Yugoslavia, Belgium, Norway, Finland)



POWER CABLE HP NO. 8120-1351
Great Britain



POWER CABLE HP NO. 8120-1369
Australia, New Zealand



POWER CABLE HP NO. 8120-1378
U.S.A., Canada

Figure 2-1. Power Cables

2-9. Connect the power cable to a power source that has a grounded third conductor. If the line power receptacle is a two-pin type instead of a three-pin receptacle, use a two-to-three pin type adaptor (HP Part No. 1251-0048 for USA applications) and connect the green lead on the adaptor to earth ground. See warning in paragraph 2-7.

2-10. STANDBY POWER

2-11. Standby Power Input

2-12. Extended periods of standby operations are possible by using the standby power input feature. Input DC power must be 8-10 volt at 2 mA from any external DC source. Connect the external DC source to rear-panel STANDBY POWER connector then disconnect the AC power input.

2-13. The HP 59309A clock circuits keep operating when on standby DC power, but the display is off and may be lighted by the front-panel PUSH TO READ Switch. Data transfer to or from the HP-IB is disabled when standby power is used.

2-14. 9-Volt Battery Installation

CAUTION

The 9-Volt dc battery is not a user serviceable component, hazardous live parts may be exposed with covers removed, refer servicing or installation to qualified service personnel.

2-15. To keep the clock circuits operating when ac power is removed for periods of less than 1 day, a 9-volt battery may be used.

2-16. The number of hours the 9-volt battery will supply power depends on its condition when installed into the 59309A.

2-17. To install the 9-volt battery, keep ac power connected to the instrument and remove the instrument top cover.

CAUTION

Use caution near the ac power connector when removing the shorting pin or install the battery.

2-18. Locate the battery connector at the right-rear of A2 Motherboard assembly and carefully remove the shorting pin. Install the 9-volt battery then remove ac power from the instrument. Reinstall the top cover. To remove the 9-volt battery, reapply ac power, remove the 9-volt battery and reinstall the shorting pin.

2-19. When the 59309A is operating from the 9-volt battery, only the clock circuits are working. The display is automatically turned off and the PUSH TO READ switch is disabled. Data transfer via the HP-IB is also disabled.

2-20. OPERATING ENVIRONMENT

2-21. Maximum and minimum allowable operating temperatures are listed in *Table 1-1*. If these limits are exceeded at the installation site, auxiliary heating or cooling should be used to keep the environment within limits.

2-22. PACKAGING FOR RESHIPMENT

2-23. Original Packaging

2-24. The same containers and materials used in factory packaging can be obtained through the Hewlett-Packard Sales and Service Offices listed at the rear of this manual.

2-25. If the instrument is being returned to Hewlett-Packard for service, attach a tag indicating the type of service required, your return address, HP model number, and full serial number. Mark the container FRAGILE to assure careful handling.

2-26. In any correspondence refer to the instrument by HP model number and full serial number.

2-27. Other Packaging Methods

2-28. If it becomes necessary to reship an instrument, good commerical packing should be used. Contract packaging companies in many cities can provide dependable custom packaging on short notice. The following general instructions should be followed when repackaging with commerically available materials.

a. If shipping to a Helwett-Packard Service Office or Center, attach a tag indicating the type of service required, your return address, HP model number, and full serial number.

b. Wrap the instrument in heavy paper or plastic.

c. Use a strong shipping container. A double-wall carton made of 350 pound test material is adequate.

d. Use enough shock-absorbing material (3- to 4-inch layer) around all sides of the instrument to provide a firm cushion and prevent movement inside the container. Protect the control panel with cardboard.

e. Seal the shipping container securely.

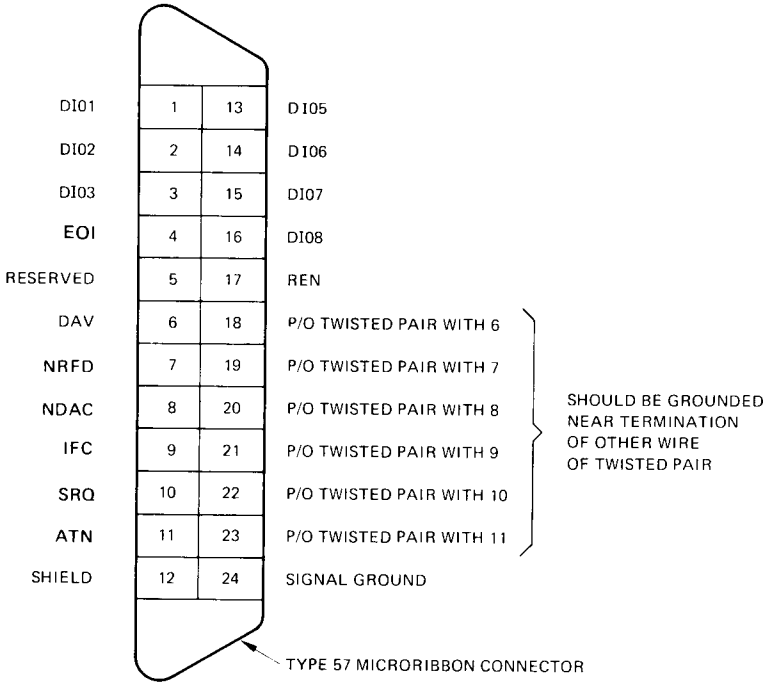
f. Mark the shipping container FRAGILE to assure careful handling.

2-29. STORAGE

2-30. If the instrument is to be stored for an extended period of time, it should be enclosed in a clean, sealed container.

2-31. INTERCONNECTING CABLES

2-32. The 59309A includes a 10631A cable (3 feet) for interconnection to the HP-IB. This cable has one overall shield to reduce susceptibility to external electrical noise. The cable uses a mixture of individual wires and twisted pairs to minimize crosstalk. Cable ends are identical and terminated into two, 24-pin piggy-back connectors: one male and one female. Pin connections of these connectors are shown in *Figure 2-2.*



NOTE 1: Pins 18 through 23 should be grounded near the termination of the other wire of its twisted pair.

Figure 2-2. Pin Connections of the 10631A, B, C Cables

SECTION III
OPERATION AND PROGRAMMING

3-1. INTRODUCTION

3-2. This section contains operating information including a description of controls, indicators and connectors, types of operation, programming, and programming examples.

3-3. CONTROLS, INDICATORS, AND CONNECTORS

3-4. *Figure 3-1* identifies and describes front-panel controls and indicators. *Figure 3-2* identifies and describes rear-panel connectors and controls.

3-5. OPERATION

CAUTION

Prior to operating the 59309A, set the voltage selector switch on the rear panel to correspond with the line voltage to be used (115V or 230V). Install the correct line fuse (0.5 amp for 115V source or 0.25 amp for 230V source) and connect the 59309A to the power source. The front-panel display should illuminate.

3-6. The 59309A can operate as a stand-alone clock or as a system clock. When operating stand-alone, the clock can be started, stopped, or set by the controls described in *Figure 3-1*. When operating in a system, the clock can be started, stopped, or set by the front panel controls or by ASCII coded characters sent by a controller on the HP-IB. For details and definitions of the HP-IB, refer to "Condensed Description of the Hewlett-Packard Interface Bus", HP Part No. 59401-90030.

3-7. Time Base

3-8. A crystal controlled 1 MHz oscillator is the time base and provides an overall accuracy of approximately 1-minute-per-month. If greater accuracy is desired, an external frequency standard of 1, 5, or 10 MHz (1 Vrms into 1 kΩ) can be connected via a rear-panel connector. To use the external frequency standard, the front-panel switch (INT/EXT) on the 59309A is set to EXT and the internal 1 MHz - 5 MHz - 10 MHz switch on the A2 board is set to the frequency of the external frequency standard.

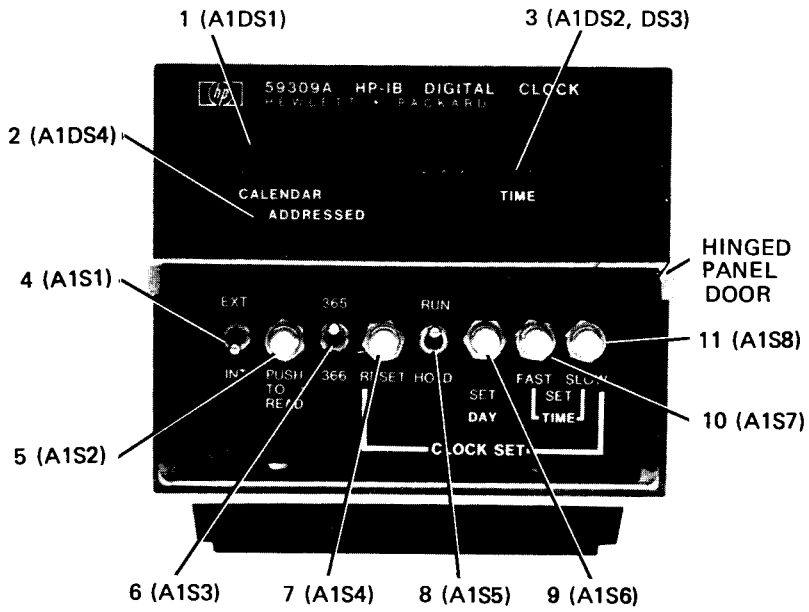
3-9. Clock Functions

3-10. The 59309A provides a 24-hour clock display on the front panel and also provides the time information to the HP-IB. The front-panel display formats:

Month	Day	Hour	Minute	Second
01	01	00	00	00

The output format to the bus (when addressed to talk and with packed format) is:

(? or ⓈⓅ)	ⓈⓅ	12	28	11	23	14	Ⓒⓡ	Ⓛⓕ
Status	Space	Month	Day of Month	Hour	Minute	Seconds	Carriage Return	Linefeed

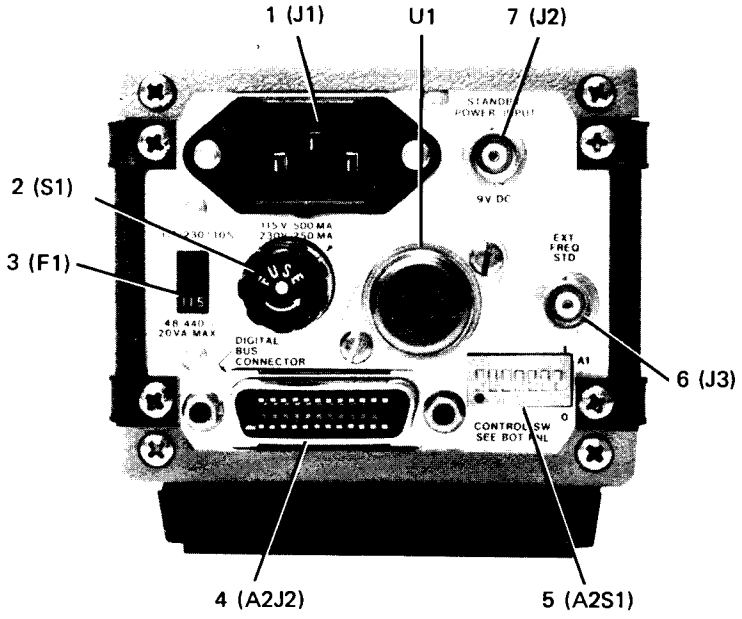


NOTE

To gain access to the front panel controls, the hinged lower portion of the front panel must be lifted. Insert the tip of a pencil or pen in the hole in the lower right corner and lift to a horizontal position.

1. CALENDAR indicator: When illuminated, indicates the month and the day of the month.
2. ADDRESSED indicator: When illuminated, indicates the 59309A is addressed to talk or listen.
3. TIME indicator. When illuminated, indicates the hour, minute, and second.
4. EXT/INT switch; When set to INT, an internal crystal-controlled time base (1.0 MHz) provides accuracy of approximately 1 minute per month. When set to EXT, an external frequency standard is accepted at a rear-panel connector.
5. PUSH TO READ switch (for use with external standby power): When pushed, display illuminates. Standby time is significantly shortened by this lighting. This switch is inoperative (display cannot be illuminated) when 59309A is powered by internal dc battery.
6. 365/366 switch: Set to 365 for common year, set to 366 for leap year.
7. RESET switch: When pushed, resets display to 01 01 00 00 00 and starts the clock.
8. RUN HOLD switch: When set to RUN position, clock advances at a 1-second rate. When set to HOLD position, clock stops advancing.
9. SET DAY switch: When pushed momentarily, the day display is updated one count. When pushed and held, the display updates continuously.
10. SET TIME FAST switch: When pushed, the minutes and seconds displays are updated rapidly.
11. SET TIME SLOW switch: When pushed, the minutes and seconds displays are updated slowly to permit arriving at desired time display.

Figure 3-1. Digital Clock Front Panel, Hinged Portion Lifted



1. AC Input Connector: AC power receptacle. IEC type with offset pin connected to the rear panel. Accepts 115 or 230 volts ±10%, 48 to 440 Hz.
2. AC Input Voltage Selector Switch: Selects 115 volt ac input operation or 230 volt ac input operation.
3. FUSE: Requires 500 mA fuse for 115 volt or 250 mA fuse for 230 volt operation.
4. DIGITAL BUS CONNECTOR: 24-pin connector used to convey data and programming information to and from the interface bus cable.
5. CONTROL Switch Assembly: The switch labeled A1 is switch 1 and the switches are numbered in consecutive order from right to left. Switches A1 through A5 establish the talk and listen addresses. Switches A6 and A7 select the mode of operation; set to the "Ø" state, the clock operates in a controllerless environment and outputs on the bus at a rate of 40 readings-per-second, set to the "1" state, the clock is addressable.
6. EXT FREQ STD connector: Provides a connection for an external frequency standard of 1, 5, or 10 MHz (1 Vrms into 1 kΩ). A 50-ohm termination is required at this connector when a 50-ohm source is used. A selector switch for selecting a 1, 5, or 10 MHz input is contained on the A2 board inside the 59309A.
7. STANDBY POWER INPUT Connector: Provides a connection for a K10-59992A Standby Power Supply (or any reserve power supply capable of providing 8 to 10 volts dc, 2 mA at 8V (display off)).

Figure 3-2. Digital Clock Rear Panel

3-11. Clock Error Indicators

3-12. If the operation of the internal oscillator is disrupted, such as when a power failure occurs (without standby power) an indication of error is present on the front-panel display and on the interface bus when power returns. On the display, all decimal points illuminate to indicate error. On the interface bus, the status word changes from an ASCII (SP) to an ASCII ? to indicate error. These error indications reamin until the 59309A is reset via either the front panel or the HP-IB. An error indication may also occur when an external frequency standard is initially connected or switched into the circuit.

3-13. LONG TERM STANDBY POWER

3-14. To provide standby power for extended periods of time, the 59309A STANDBY POWER rear-panel connector accepts 8 to 10 volts from an external dc power supply. An HP accessory available for this purpose is the K10-59992 Standby Power Supply. The K10-59992 contains D-size batteries packaged in a module identical in size with the 59309A. With a full set of fresh batteries, the K10-59992 can supply power to the 59309A and maintain accurate time for approximately 1 year (or for the shelf life of the batteries). The display can be illuminated by pressing the front panel pushbutton PUSH TO READ. However, the life of the standby power supply is significantly shortened by the additional power required to illuminate the display. Data transfer to or from the HP-IB lines is disabled when on standby power. Also, see paragraph 2-11.

3-15. SHORT-TERM STANDBY

3-16. The 59309A accepts a standard 9-volt dry cell battery which is plugged onto the A2 board. This battery allows the clock to continue operating during power line variations or failures for short periods of time (up to about 1 day). The front-panel display and the digital bus output are disabled when the internal battery is used for operating power. Also, see paragraph 2-14.

3-17. Stand-Alone Operating Procedures (Observe Caution of Paragraph 2-5)

3-18. When operating in a stand-alone environment, the 59309A is controlled by the front panel controls. Lift the hinged lower portion of the front panel and set the controls as follows:

a. Set the EXT/INT switch to the INT position if the internal time base is to be used. Set to EXT if an external frequency standard is connected to the rear-panel EXT FREQ STD connector. The EXT FREQ STD switch on the A2 board must be set to the 1 MHz, 5 MHz, or 10 MHz position to correspond with the output frequency of the external frequency standard used.

b. Set the 365/366 switch to 365 for a common year; to 366 for a leap year.

c. Set the RUN/HOLD switch to RUN, if synchronization with a reference clock is not desired.

d. Push and release the RESET button to clear the display of decimal points (error indicators) and reset the display to 01 01 00 00. The clock will start.

e. Push and hold the SET DAY button until the CALENDAR display indicates the month and day desired.

f. Push and hold the SET TIME FAST button to update the TIME display rapidly. Before the correct hour is reached, release the pushbutton and push the SET TIME SLOW button to arrive at the desired hours, minutes, and seconds display.

3-19. SYSTEM OPERATION

3-20. With the 59309A installed in a system, the clock can be controlled from the 59309A front panel switches or by ASCII-coded characters from an HP-IB controller. For details and definitions of the HP-IB, refer to "Condensed Description of the Hewlett-Packard Interface Bus", HP Part No. 59401-90030. Three system configurations are possible:

a. A system with no controller. Data transfer is direct between a device manually set to "talk only" and one or more devices manually set to "listen only".

b. A system with a single controller. Data transfer can be:

   1. Direct transfer between talkers and listeners.
   2. Transfer from a device to a controller.
   3. Transfer from a controller to a device.

c. A system with multiple controllers. Data transfer is the same as in item b except one controller must be designated "system controller".

3-21. Programming

3-22. A summary of the following programming information is provided on a label located on the 59309A bottom cover.

3-23. Listen Function

3-24. The start, stop, and clock set functions of the 59309A can be controlled by the interface bus when the 59309A is addressed to listen. An address is set on the rear-panel control switch assembly as shown in *Table 3-1*. When the ASCII listen address on the bus corresponds to the switch setting, as shown in *Table 3-1*, the ADDRESSED indicator illuminates. The 59309A will then respond to the programming codes listed in *Table 3-2*.

3-25. Talk Function

3-26. When the 59309A is addressed to talk, the ADDRESSED indicator illuminates and the time value is output on the bus in the format shown below. The talk address must correspond to the rear panel control switch setting as shown in *Table 3-1*. When the front-panel display is the following:

Month	Day	Hour	Minute	Second
12	28	11	23	14

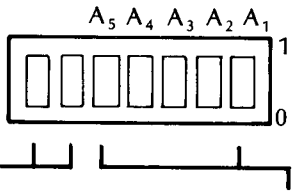
The output to the bus (when addressed to talk and with packed format) is in the following format:

(? or ⓈⓅ)	ⓈⓅ	12	28	11	23	14	ⒸⓇ	ⓁⒻ
Status	Space	Month	Day of Month	Hour	Minute	Seconds	Carriage Return	Linefeed

3-27. Talk Only Mode

3-28. When the two mode switches on the control switch assembly shown in *Table 3-1* are set to the "Ø", the 59309A is in the Talk Only mode. In this mode, the 59309A outputs data to the bus continuously at a rate of 40 readings per second without being addressed (operates in a controllerless environment). The 59309A cannot be programmed when operating in this mode.

Table 3-1. Addressing



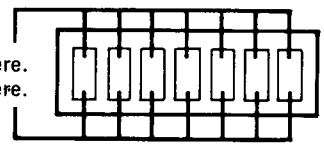
MODE SWITCH

ADDRESS SWITCHES

(ADDRESSABLE = "1" STATE)
(TALK ONLY = "Ø" STATE)

SWITCH OPERATION

To set a switch to 1 state press in or slide switch here.
To set a switch to Ø state press in or slide switch here.



ASCII ADDRESS CODES

A_5	A_4	A_3	A_2	A_1	ASCII LISTEN ADDRESS	ASCII TALK ADDRESS
0	0	0	0	0	SP	@
0	0	0	0	1	!	A
0	0	0	1	0	"	B
0	0	0	1	1	#	C
0	0	1	0	0	$	D
0	0	1	0	1	%	E
0	0	1	1	0	&	F
0	0	1	1	1	'	G
0	1	0	0	0	(	H
0	1	0	0	1	)	I
0	1	0	1	0	*	J
0	1	0	1	1	+	K
0	1	1	0	0	,	L
0	1	1	0	1	-	M
0	1	1	1	0	.	N
0	1	1	1	1	/	O
1	0	0	0	0	Ø	P
1	0	0	0	1	1	Q
1	0	0	1	0	2	R
1	0	0	1	1	3	S
1	0	1	0	0	4	T
1	0	1	0	1	5	U
1	0	1	1	0	6	V
1	0	1	1	1	7	W
1	1	0	0	0	8	X
1	1	0	0	1	9	Y
1	1	0	1	0	:	Z
1	1	0	1	1	;	[
1	1	1	0	0	<	\
1	1	1	0	1	=	]
1	1	1	1	0	>	‿

3-29. Addressable Mode

3-30. When the two mode switches on the control switch assembly shown in *Table 3-1* are set to the "1" state, the 59309A is in the Addressable mode. In this mode the 59309A can be addressed to listen or to talk. The listen function is described in paragraph 3-23 and the talk function is described in paragraph 3-25.

3-31. Bus Output Format Selection

3-32. The 59309A contains a switch assembly (*Figure 3-3*) near the top edge of board A5 to provide selection of various output formats to suit different applications. For example, the printout most legible to an operator uses colons to separate the units. However, colon delimiters are generally not acceptable to computers and controllers. Depending on the programming task, the use of commas or packed format (no delimiters), for numerical computations may be most convenient. The settings of the switch assembly, shown in *Figure 3-3*, allow selection of delimiters or not; colons or commas; calendar and time-of-day; or just time. The following output formats may be selected:

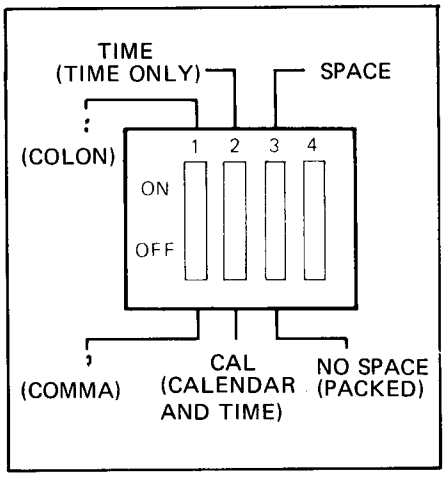


Figure 3-3. Format Switch Settings

a. SPACE (not packed)

1. TIME (Time Only)

: (Colon) (Status)* (SP) 1 1 : 2 3 : 1 4 CR (LF)

, (Comma) (Status)* (SP) 1 1 , 2 3 , 1 4 CR (LF)

2. CAL (Calendar and Time)

: (Colon) (Status)* (SP) 1 2 : 2 8 : 1 1 : 2 3 : 1 4 (CR) (LF)

, (Comma) (Status)* (SP) 1 2 , 2 8 , 1 1 , 2 3 , 1 4 (CR) (LF)

b. NO SPACE (packed)

1. TIME (Time Only)

: (Colon) (Status)* (SP) 1 1 2 3 1 4 CR (LF)

, (Comma) (Status)* (SP) 1 1 2 3 1 4 CR (LF)

2. CAL (Calendar and Time)

: (Colon) (Status)* (SP) 1 2 2 8 1 1 2 3 1 4 (CR) (LF)

, (Comma) (Status)* (SP) 1 2 2 8 1 1 2 3 1 4 (CR) (LF)

*The ASCII character is this position of the data output string will be either ? or (SP) depending on the error status (see paragraph 3-11).

3-33. System Operating Procedures

NOTE

When the 59309A is connected in a system on the interface bus, the front-panel controls are operative.

a. At initial turn on, set the clock by means of the front-panel controls (refer to paragraph 3-17).

b. Set the mode switch (*Table 3-1*) to the Addressable mode or to the Talk Only mode to select one of the following types of operations:

1. Addressable mode. In this mode, the 59309A will accept characters to update the time display when it is addressed to listen. The 59309A will output on the bus when it is addressed to talk. This mode is used in systems where a controller capable of addressing instruments is used.

2. Talk Only mode. In this mode, the 59309A operates in a controllerless environment and outputs continuously on the bus at a rate of 40 readings per second.

c. Select a listen address from *Table 3-1* (if the mode switch was set to Addressable in the preceding step) and set the address switches on the rear panel of the 59309A. In general, any address switch setting is allowable except 1 1 1 1 1 or an address already assigned to another instrument in the system. These switches need not be set if the mode switch is in the Talk Only mode.

d. To place the 59309A in the listen mode, send the ASCII listen address that corresponds with the switch settings set in the preceding step. The ADDRESSED indicator on the front panel should illuminate.

e. The 59309A is now ready to accept programming codes to control the start, stop, and update functions of the clock. Refer to *Table 3-2* for programming codes and their functions and paragraph 3-34 for an example program.

f. To program the 59309A to output on the bus, proceed as follows:

NOTE

Refer to paragraph 3-31 for information on selection of the output format.

1. Send the ASCII talk address (*Table 3-1*) that corresponds with the setting of the address switches on the rear panel of the 59309A. This action results in outputting the contents of the clock's output register to the bus.

2. In some situations, time displayed on the 59309A may be retained (stored), without immediate output, for later use. To achieve this, ASCII Code C is used. This code commands the 59309A to store the time when the command is received, but not to output it. Any additional C commands will not store time until the 59309A is addressed to talk. At a later operator-determined time, the time-of-occurrence at which the previous C command was received by the 59309A can be outputted by addressing the clock to talk. Sending the Group Execute Trigger (GET) command (ASCII Code BS) achieves the same results as the C command. However, this command also instructs any other addressed devices (if used) on the bus to respond according to their designed function.

Table 3-2. Programming Codes

Function	ASCII Character	Octal Code	Binary DIO Lines						
			7	6	5	4	3	2	1
Resets the clock to: 01:01:00:00:00 and clears output register	R	122	1	0	1	0	0	1	0
Stops the clock	P	120	1	0	1	0	0	0	0
Starts the clock	T	124	1	0	1	0	1	0	0
Updates the counting chain 1 second (for more than 1 update repeat entry desired times)	S	123	1	0	1	0	0	1	1
Updates the counting chain 1 minute (for more than 1 min. repeat entry desired times)	M	115	1	0	0	1	1	0	1
Updates the counting chain 1 hour (for more than 1 hr. repeat entry desired times)	H	110	1	0	0	1	0	0	0
Updates the counting chain 1 day (for more than 1 day, repeat entry desired times)	D	104	1	0	0	0	1	0	0
Commands the clock to store time value in the output register but does not output it. Time value is output when the 59309A is addressed to talk.	C	103	1	0	0	0	0	1	1
	or								
	BS	10	0	0	0	1	0	0	0
*Unlisten	?	077	0	1	1	1	1	1	1
*Untalk	—	137	1	0	1	1	1	1	1
*Universal command (effective when ATN is low)									

3-34. PROGRAM EXAMPLE

3-35. The following paragraphs describe programming of a Calculator (used as a bus controller) to control the 59309A. *Figure 3-4* is a flowchart of the example program. The 9820A and 9830A implementations of the following example program are in paragraphs 3-36 and 3-40 respectively. The functions performed are as follows:

a. Program the 59309A to reset, then update by 2 seconds, 4 minutes, 3 hours, and 5 days.

b. Store the time, then wait 10 seconds.

c. Address the 59309A to output the time to the bus.

d. Print the results of the output, wait 1 second, and repeat steps c and d.

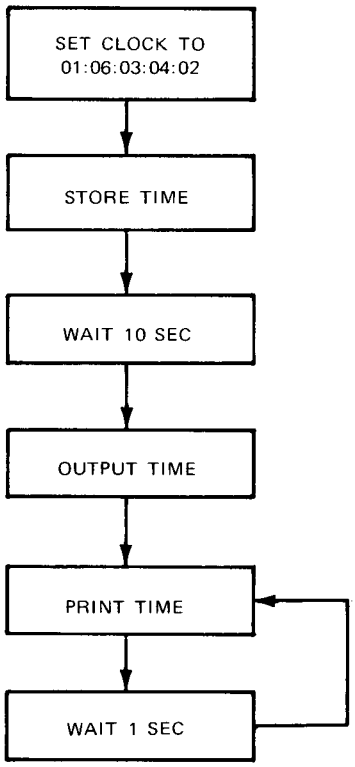


Figure 3-4. Flowchart of Example Programs

3-36. Program Example Using 9820A Calculator

NOTE

It is assumed that a system including the 9820A Calculator, the HP-IB Interface and Peripheral Control II, and the 59309A (with its address switches set to 10001) has been interconnected and prepared for operation. For detailed operating procedures, refer to Peripheral Control II operating manual, HP Part No. 09820-99024. Also refer to Hewlett-Packard Interface Bus Users Guide, 9820A, HP Part No. 59300-90001.

3-37. LOADING THE PROGRAM: Prior to loading the program, push the END and EXECUTE keys. This positions the program counter to zero. On 59309A, set A5 Format switch to NO SPACE and CALENDAR and TIME (see *Figure 3-3*). Push remaining keys to program the Calculator as shown in the following printer list:

9820A Calculator Program Printer List

Unaddresses all listeners on the bus (?). Addresses 9820A to talk (U) and the 59309A to listen (1). Stops clock (P), resets clock (R), updates clock by 2 seconds (SS), 4 minutes (MMMM), 3 hours (HHH), and 5 days (DDDDD). Starts clock (T).

```
0:
CMD "?U1","PRSSM
MMMHHHDDDDDT"⊢
```

Unaddresses all listeners (?). Addresses 9820A to talk (U) and 59309A to listen (1). Stores time in the 59309A output register (C).

```
1:
CMD "?U1","C"⊢
```

Instructs operator to wait 10 sec, then press PROGRAM key.

```
2:
DSP "WAIT 10 SEC
ONDS";DSP ;DSP ;
DSP ;DSP ;DSP ;
DSP "THEN RUN PR
OGRAM"⊢
```

Stops 9820A until RUN PROGRAM key is pressed.

```
3:
STP ⊢
```

Unaddresses all listeners (?). Addresses 9820A to listen (5) and 59309A to talk (Q). Enters "status" into A register and "Cal and Time" into B register of 9820A.

```
4:
CMD "?50";RDB 13
→A;FMT *;RED 13,
B⊢
```

Prints "Status" and "Cal and Time".

```
5:
FXD 0;PRT A,B⊢
```

Enters "Cal and Time" into 9820A C register.

```
6:
CMD "?50";FMT *;
RED 13,C⊢
```

Tests to see if 1 second or more has elapsed since step 1. If not, repeats tests.

```
7:
IF C-B=0;GTO 6⊢
```

Go gack to step 4.

```
8:
GTO 4⊢
```

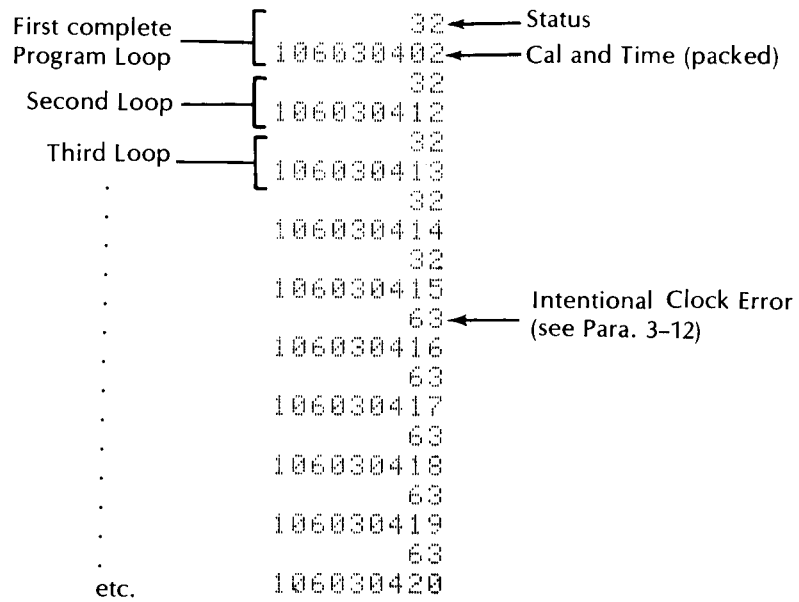
Ends program.

```
9:
END ⊢
```

3-38. VERIFYING THE PROGRAM. After the program has been loaded, push the END and LIST keys. This will run a printer list of the program. Check the list to verify that the program was entered correctly.

3-39. RUNNING THE PROGRAM. To run the program push the END and RUN PROGRAM keys. The printout should compare with the Calculator printout shown below.

Calculator Printout (32 = space, 63 = ?)



3-40. Program Example Using 9830A Calculator

NOTE

It is assumed that a system including the 9830A Calculator, the HP-IB Interface Card, the 9866A Printer, the Extended I/O ROM, and the 59309A (with its address switches set to 10001) has been interconnected and prepared for operation. For detailed operating procedures refer to 9830A Operating and Programming Manual, HP Part No. 09830-90001 and to the Extended I/O ROM Operating Manual, HP Part No. 09830-90007. Also refer to Hewlett-Packard Interface Bus Users Guide, 9830A, HP Part No. 59300-90002.

3-41. LOADING THE PROGRAM. Prior to loading the program, press the STOP key until STOP appears on display. If display remains blank, refer to the 9830A Operating and Programming Manual, Appendix A. On the 59309A, set A5 format switch to NO SPACE and CALENDAR AND TIME (see *Figure 3-3*). Press the remaining keys to program the calculator as shown in the following list:

9830A Calculator Program Printer List

Unaddresses all listeners on the bus (?). Addresses the 9830A to talk (U) and the 59309A to listen (1). Stops the clock (P), resets the clock (R), updates by 2 seconds (SS), 4 minutes (MMMM), 3 hours (HHH), and 5 days (DDDDD). Starts clock (T).

```
10 CMD "?U1","PRSSMMMMHHHDDDDDT"
```

Unaddresses all listeners (?). Addresses 9830A to talk (U) and the 59309A to listen (1). Stores the time in the output register of the 59309A (C).

```
20 CMD "?U1","C"
```

Wait 10 seconds.

```
30 WAIT 10000
```

Unaddresses all listeners (?). Addresses 9830A to listen (5) and 59309A to talk (Q).

```
40 CMD "?5Q"
```

Enters "Status" into register A, "Cal and Time" into register B of 9830A.

```
50 ENTER (13,60)A,B
```

Format of Entry (see 9830A Operating Manual).

```
60 FORMAT B,F12.0
```

9866A prints "Status" then "Cal and Time" from 59309A.

```
70 PRINT A;B
```

Wait 1000 milliseconds.

```
80 WAIT 1000
```

Go back to line 40 and repeat program.

```
90 GOTO 40
```

Ends program.

```
100 END
```

3-42. VERIFYING THE PROGRAM. After the program has been loaded, push the LIST and EXECUTE keys. This will run a printer list of the program. Check the list to verify that the program was entered correctly.

3-43. RUNNING THE PROGRAM. To run the program push the RUN and EXECUTE keys. The printout should compare with the calculator printout shown below.

Calculator Printout (32 = Space, 63 = ?)

Status	Cal and Time (Packed)	
32	106030402	
32	106030411	
32	106030412	
32	106030413	
32	106030414	
32	106030415	
32	106030416	
32	106030417	Intentional
63	106030417	Clock Error
63	106030418	(see Para. 3-13)
63	106030419	
63	106030420	
63	106030421	
63	106030422	

3-44. AUTOMATIC CLOCK SETTING PROGRAM EXAMPLES

3-45. The following example programs demonstrate how the 59309A clock can be set directly from the calculator keyboard. The calculator display will ask for data on months, days, hours, minutes, and seconds which is entered from the keyboard. For example, to set the 59309A to 1:15:30 p.m., November 25th, enter 11 for months, 25 for day, 13 for hours, 15 for minutes, and 30 for seconds. The 59309A is started by a single keystroke at the end of each program for synchronizing purposes.

3-46. To run the following program prepare the 59309A as follows:

Model Switches — 11 (Addressable)
Address Switches — 10000 (Ø, P)

365/366 — 365
INT/EXT — INT
RUN/HOLD — RUN

9820A Program List

```
0:
DSP "SET THE CLO
CK";DSP ;DSP ;
DSP ;DSP ⊢
1:
CMD "?U0","PR";
ENT "MONTH",A⊢
2:
JMP 13→A⊢
3:
CMD "?U0","DDDDD
DDDDDDDDDDDDDDDD
DDDDDDDDD"⊢
4:
CMD "?U0","DDDDD
DDDDDDDDDDDDDDDD
DDDDDDDDD"⊢
5:
CMD "?U0","DDDDD
DDDDDDDDDDDDDDDD
DDDDDDDDD"⊢
6:
CMD "?U0","DDDDD
DDDDDDDDDDDDDDDD
DDDDDDDDD"⊢
7:
CMD "?U0","DDDDD
DDDDDDDDDDDDDDDD
DDDDDDDDD"⊢
8:
CMD "?U0","DDDDD
DDDDDDDDDDDDDDDD
DDDDDDDDD"⊢
9:
CMD "?U0","DDDDD
DDDDDDDDDDDDDDDD
DDDDDDDDD"⊢
10:
CMD "?U0","DDDDD
DDDDDDDDDDDDDDDD
DDDDDDDDD"⊢
11:
CMD "?U0","DDDDD
DDDDDDDDDDDDDDDD
DDDDDDDDD"⊢
12:
CMD "?U0","DDDDD
DDDDDDDDDDDDDDDD
DDDDDDD"⊢
13:
CMD "?U0","DDDDD
DDDDDDDDDDDDDDDD
DDDDDDDDD"⊢
14:
CMD "?U0","P";
ENT "DAY",A⊢
15:
1→X⊢
16:
IF A=X;JMP 2⊢
17:
CMD "?U0","D";X+
1→X;GTO -1⊢
18:
CMD "?U0","P";
ENT "HOUR",A⊢
19:
0→X⊢
20:
IF X=A;JMP 2⊢
21:
CMD "?U0","H";X+
1→X;GTO -1⊢
22:
CMD "?U0","P";
ENT "MINUTE",A;0
→X⊢
23:
IF A=X;JMP 2⊢
24:
CMD "?U0","M";X+
1→X;GTO -1⊢
25:
CMD "?U0","P";
ENT "SECONDS",A;
0→X⊢
26:
IF X=A;JMP 2⊢
27:
CMD "?U0","S";X+
1→X;GTO -1⊢
28:
DSP "RUN TO STAR
T";STP ⊢
29:
CMD "?U0","T"⊢
30:
END ⊢
R319
```

9830A Program List

NOTE

9830A will require a 11274B string variables ROM for this program.

```
70 DIM A$[20],AC[1,12],B$[20]
80 DISP "WANT INSTRUCTIONS" ;"YES OR NO)";
90 INPUT A$
100 IF A$="YES" THEN 650
110 FOR N=1 TO 12
120 READ AC[1,N]
130 NEXT N
140 DATA 0,30,59,90,120,151,181,212,243,273,304,334
150 DISP "KEY IN DIGITS,PUSH EXECUTE"
160 WAIT 2000
170 DISP "MONTH";
180 INPUT M
190 IF M>12 THEN 320
200 DISP "DAY";
210 INPUT D
220 IF D>31 THEN 330
230 DISP "HOUR";
240 INPUT H
250 IF H>23 THEN 340
260 DISP "MINUTE";
270 INPUT M
280 IF M>60 THEN 350
290 DISP "SECOND";
300 INPUT S
310 IF S>60 THEN 360
320 GOTO 360
330 DISP "INPUT [<1OR> TO> ACCEPT"
340 WAIT 2000
350 GOTO 150
360 D=D+AC[1,M]-1
370 CMD "?U0","PR
380 FOR I=1 TO INT(D/3+
390 CMD "?U0","DDDDDDDDDDDDDDDDDDD"
400 NEXT I
410 FOR I=1 TO 20+D-70*INT(D/20+
420 CMD "?U0","D"
430 NEXT I
440 IF H=0 THEN 480
450 FOR I=1 TO H
460 CMD "?U0","H"
470 NEXT I
480 IF M=0 THEN 520
490 FOR I=1 TO M
500 CMD "?U0","M"
510 NEXT I
520 IF S=0 THEN 560
530 FOR I=1 TO S
540 CMD "?U0","S"
550 NEXT I
560 DISP "START CLOCK?(YES OR NO)";
570 INPUT B$
580 IF B$="YES" THEN 620
590 DISP "HOLDING!PRESS CONT & EXECUTE"
600 STOP
610 GOTO 560
620 CMD "?U0","T"
630 CMD "?"
640 GOTO 720
650 PRINT "INSTRUCTIONS TO SET CALENDAR AND 24 HOUR CLOCK (1:00 PM = 13 HOURS)"
660 PRINT "WHEN DISPLAY ASKS, MONTH?--KEY IN DIGITS (JAN=01)AND PRESS EXECUTE."
670 PRINT "CONTINUE,ANSWERING WITH DAY, HOUR, MINUTE, SECOND.USE ONLY
680 PRINT "TWO DIGITS PER ENTRY! ANSWER 'START CLOCK?' BY KEYING IN 'YES'"
690 PRINT "CLOCK STARTS WHEN YOU PUSH EXECUTE."
700 PRINT
710 GOTO 110
720 END
```

SECTION IV
THEORY OF OPERATION

4-1. GENERAL

4-2. Instrument theory of operation, at a block diagram level, is discussed in this section. Detailed assembly theory is included with the schematics in Section VIII.

4-3. Special integrated circuits, unique to the 59309A are also discussed in Section IV. Operation of common-usage IC's can be found in IC catalogs or text books.

4-4. OVERALL THEORY OF OPERATION

4-5. The following paragraphs describe the overall theory of operation, at a block diagram level. *Figure 4-1* is the block diagram.

4-6. 1 MHz Oscillator

4-7. Clock operation of the HP 59309A is controlled by the 1 MHz oscillator on A3 Calendar Oscillator Assembly. This oscillator is an ambient temperature, crystal-controlled time-base. The 1 MHz output is supplied to the Time Base Divider on A4 Time Assembly.

4-8. Time Base Divider

4-9. The A4 Time Base Divider receives the 1 MHz signal and divides it down to the one-pulse-per-second signal which is sent to the Seconds Counter. The A4 Time Base Divider also supplies four-bit digit position information to the Digit Position Encoder. In addition, the C Line signal is generated as a master clock to synchronize operation of the circuits in the A5 Bus I/O Assembly.

4-10. Seconds, Minutes, and Hours Counters

4-11. The seconds Counter divides the 1 Second signal by 60 and sends the resulting 1 Minute signal to the Minutes Counter. The Minutes Counter divides the 1 Minute signal by 60 and sends the resulting 1 Hour signal to the Hours Counter. The Hours Counter divides the 1 Hour signal by 24 and sends the 1 Day signal to the A3 Calendar Oscillator Assembly. Each counter outputs a BCD code to indicate the number of minutes, hours, seconds, etc., that have been counted. These codes are combined with the appropriate digit position bits (1 and 2 for seconds, 3 and 4 for minutes, etc.) to synchronize strobing of the seconds, minutes, and hours information on the Data Bus for use in the display.

4-12. Digit Position Decoder

4-13. The Digit Position Decoder receives the four-bit BCD code from the Time Base Divider and decodes it to a 10-bit output that is sent to the front-panel display to strobe the digit position one after the other. The 10-bit output is supplied, through the Digit Position Bus Drivers, to synchronize the outputs of the counters on the A3 and A4 boards on the Data Bus with the strobing of the display.

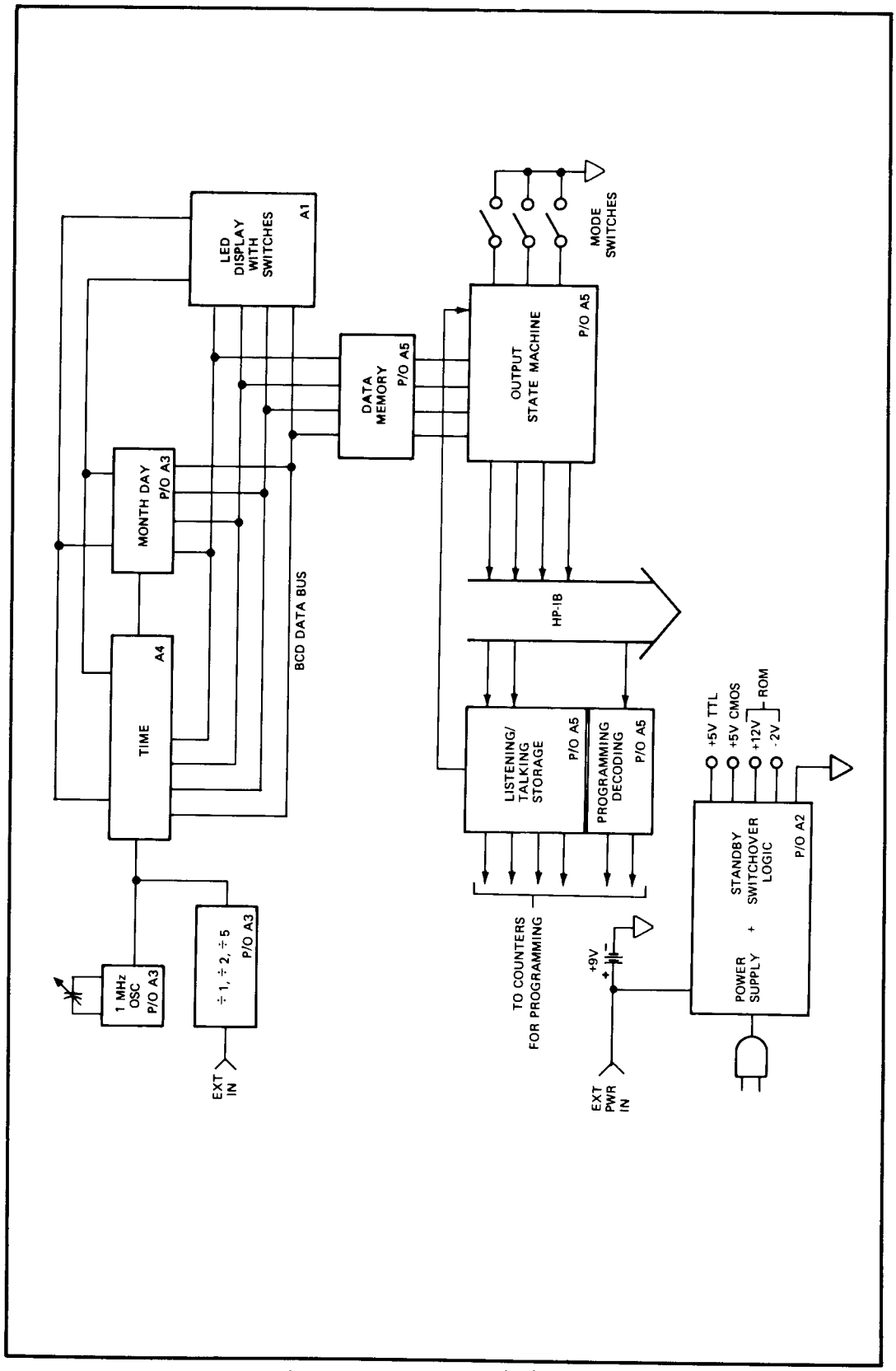


Figure 4-1. HP 59309A Block Diagram

4-14. Days and Months Counters

4-15. The Days Counter receives the 1-Day signal from the Hours Counter and counts the days of the month (28, 29, 30, or 31 days, depending on the month being counted and whether leap-year or not). The Months Counter is clocked by the Days Counter at the end of a month and counts the months of the year. Each counter outputs a BCD code to indicate the number of days and months that have been accumulated. These codes are combined with the appropriate digit position bits to synchronize the strobing of the days and months information on the Data Bus for use in the display.

4-16. Input Processing

4-17. The input processing circuits on the A5 Bus I/O Assembly process software instructions for the remote programming mode of the 59309A. The Run and Hold signals are sent to the Time Base Divider and the Update and Reset signals are sent to the counter circuits. The input processing circuits supply the Store, DAC, and RFD qualifiers to the Output State Machine.

4-18. Output State Machine

4-19. The Output State Machine controls the operation of the talk output of the 59309A. The four-bit codes from the Data Bus and the four-digit position bits from the Time Base Divider are processed by the Output State Machine to develop the talk output to the bus.

4-20. Seven-Segment Decoder

4-21. The Seven-Segment Decoder receives the four-bit code from the Data Bus and converts it to a control code to illuminate the segments in each digit of the display.

4-22. Segment Drivers

4-23. The Segment Drivers provide drive to the display segments for the Seven-Segment Decoder.

4-24. Clock Loss Detector

4-25. The Clock Loss Detector protects the display by blanking it completely if the strobe signals from the Digit Position Bus fail.

4-26. Display

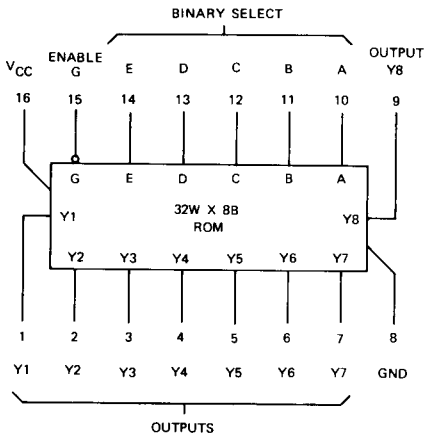
4-27. The display is an LED display that provides seven-segment digits. Two digits are provided for each of the months, days, hours, minutes, and seconds displayed. The display combines the segment control code from the Seven-Segment Decoder and the strobe code from the Digit Position Bus to produce a display of seconds, minutes, hours, days, and months.

4-28. INTEGRATED CIRCUIT OPERATION

4-29. The following paragraphs describe 14 of the IC's used in the 59309A. The other IC's used are common gates and flip-flops which can be found in standard text books or IC catalogs.

4-30. 256-Bit Read-Only-Memory A5U15 (1816-0353)

4-31. The read-only-memory shown in *Figure 4-2* is a 256-bit ROM whose output is organized into 32 words by 8 bits. A 5-bit code is used to select the desired output word. The eight outputs are open collector which permit "AND" tying of the outputs to the same line. A logic low is required at the enable input to activate the ROM.



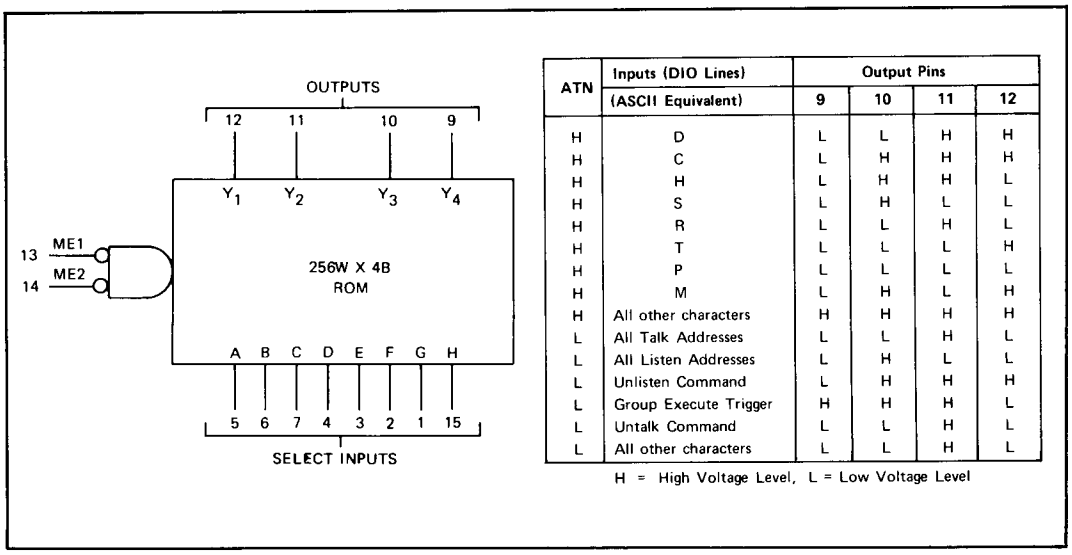
WORD	INPUTS						OUTPUTS							
	BINARY SELECT					ENABLE								
	E	D	C	B	A	G	Y8	Y7	Y6	Y5	Y4	Y3	Y2	Y1
0	L	L	L	L	L	L	L	L	H	H	H	H	H	H
1	L	L	L	L	H	L	L	L	H	H	H	H	H	H
2	L	L	L	H	L	L	L	L	H	H	H	H	H	H
3	L	L	L	H	H	L	L	L	H	H	H	H	H	H
4	L	L	H	L	L	L	L	L	H	H	H	H	H	H
5	L	L	H	L	H	L	L	L	H	H	H	H	H	H
6	L	L	H	H	L	L	L	L	H	H	H	H	H	H
7	L	L	H	H	H	L	L	L	H	H	H	H	H	H
8	L	H	L	L	L	L	L	L	H	H	H	H	H	H
9	L	H	L	L	H	L	L	L	H	H	H	H	H	H
10	L	H	L	H	L	L	L	L	H	L	L	L	L	L
11	L	H	L	H	H	L	L	L	L	L	H	H	L	H
12	L	H	H	L	L	L	L	L	L	L	H	L	H	L
13	L	H	H	L	H	L	L	L	H	H	H	H	H	H
14	L	H	H	H	L	L	L	L	H	H	H	L	H	L
15	L	H	H	H	H	L	L	L	L	L	L	L	L	L
16	H	L	L	L	L	L	L	L	H	H	H	H	H	H
17	H	L	L	L	H	L	L	L	H	H	H	H	H	H
18	H	L	L	H	L	L	L	L	H	H	H	H	H	H
19	H	L	L	H	H	L	L	L	H	H	H	H	H	H
20	H	L	H	L	L	L	L	L	H	H	H	H	H	H
21	H	L	H	L	H	L	L	L	H	H	H	H	H	H
22	H	L	H	H	L	L	L	L	H	H	H	H	H	H
23	H	L	H	H	H	L	L	L	H	H	H	H	H	H
24	H	H	L	L	L	L	L	L	H	H	H	H	H	H
25	H	H	L	L	H	L	L	L	H	H	H	H	H	H
26	H	H	L	H	L	L	L	L	H	L	L	L	L	L
27	H	H	L	H	H	L	L	L	L	L	H	H	L	H
28	H	H	H	L	L	L	L	L	L	L	H	L	H	L
29	H	H	H	L	H	L	L	L	H	H	H	H	H	H
30	H	H	H	H	L	L	L	L	H	L	H	H	L	L
31	H	H	H	H	H	L	L	L	L	L	L	L	L	L
ALL	X	X	X	X	X	H	L	H	H	H	H	H	H	H

H = high level, L = low level, X = irrelevant

Figure 4-2. 256-Bit Read-Only-Memory (ROM) A5U15

4-32. 1024-Bit Read-Only-Memory A5U18 (1816-0354)

4-33. The read-only-memory (ROM illustrated in *Figure 4-3* is a 1024-bit ROM whose output is organized into 256 words by four bits. An 8-bit code is used to select the desired output word. The four outputs are open-collector which permit "AND" tying of the outputs to the same line. Logic lows are required at inputs ME1 and ME2 to activate the ROM.



ATN	Inputs (DIO Lines) (ASCII Equivalent)	Output Pins 9	10	11	12
H	D	L	L	H	H
H	C	L	H	H	H
H	H	L	H	H	L
H	S	L	H	L	L
H	R	L	L	H	L
H	T	L	L	L	H
H	P	L	L	L	L
H	M	L	H	L	H
H	All other characters	H	H	H	H
L	All Talk Addresses	L	L	H	L
L	All Listen Addresses	L	H	L	L
L	Unlisten Command	L	H	H	H
L	Group Execute Trigger	H	H	H	L
L	Untalk Command	L	L	H	L
L	All other characters	L	L	H	L

H = High Voltage Level, L = Low Voltage Level

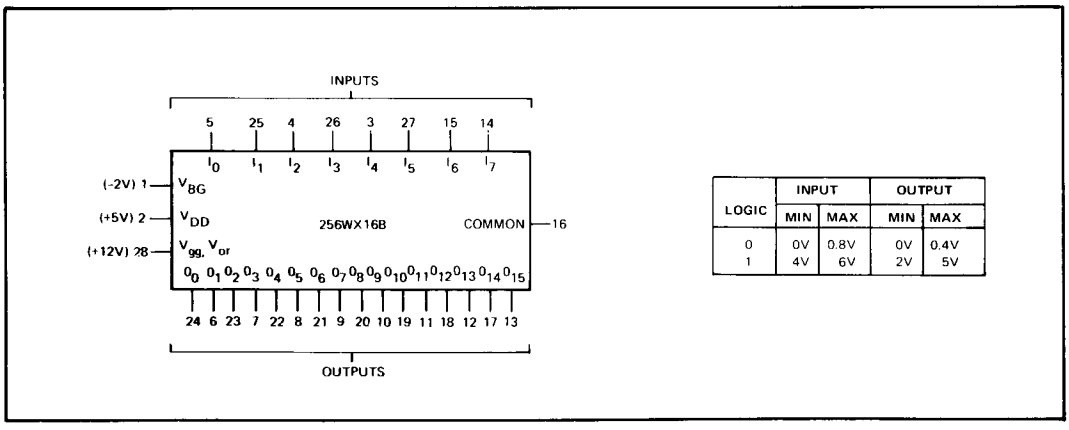
Figure 4-3. 1024-Bit Read-Only-Memory (ROM) A5U18

4-34. 4096-Bit Read-Only-Memory (ROM) A5U2 (1818-2193)

CAUTION

This ROM is a large-scale MOS integrated circuit. Its inputs are susceptible to damage by high voltage (>6 volts) and static charges. Particular care should be exercised when servicing or handling this circuit.

4-35. The 4096-bit (4K) read-only-memory shown in *Figure 4-4*, is a static ROM whose output is organized into 256 words by 16 bits. The ROM is used in the logic state machine of the 59309A. See *Table 5-5* and *5-6* for bit pattern listing.

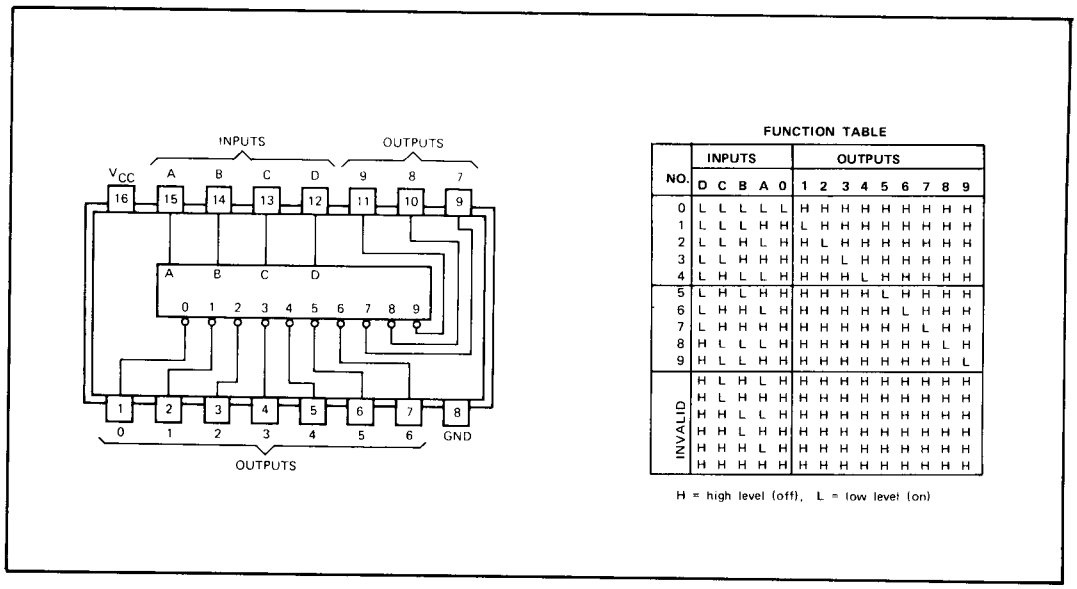


LOGIC	INPUT MIN	INPUT MAX	OUTPUT MIN	OUTPUT MAX
0	0V	0.8V	0V	0.4V
1	4V	6V	2V	5V

Figure 4-4. 4096-Bit Read-Only-Memory (ROM) A5U2

4-36. BCD-to-Decimal Decoder/Driver A4U18 (1820-0491)

4-37. This BCD-to-decimal decoder/driver, shown in *Figure 4-5*, consists of eight inverters and ten 4-input NAND gates. The inverters are connected in pairs to make BCD input data available for decoding by the NAND gates. Full decoding of valid BCD input logic ensures all outputs remain off for all invalid binary input conditions. The decoder features TTL inputs and N-P-N output transistors designed for use as indicator/relay drivers or as open-collector logic-circuit drivers.



FUNCTION TABLE

NO.	INPUTS D	C	B	A	0	OUTPUTS 1	2	3	4	5	6	7	8	9
0	L	L	L	L	L	H	H	H	H	H	H	H	H	H
1	L	L	L	H	H	L	H	H	H	H	H	H	H	H
2	L	L	H	L	H	H	L	H	H	H	H	H	H	H
3	L	L	H	H	H	H	H	L	H	H	H	H	H	H
4	L	H	L	L	H	H	H	H	L	H	H	H	H	H
5	L	H	L	H	H	H	H	H	H	L	H	H	H	H
6	L	H	H	L	H	H	H	H	H	H	L	H	H	H
7	L	H	H	H	H	H	H	H	H	H	H	L	H	H
8	H	L	L	L	H	H	H	H	H	H	H	H	L	H
9	H	L	L	H	H	H	H	H	H	H	H	H	H	L
INVALID	H	L	H	L	H	H	H	H	H	H	H	H	H	H
	H	L	H	H	H	H	H	H	H	H	H	H	H	H
	H	H	L	L	H	H	H	H	H	H	H	H	H	H
	H	H	L	H	H	H	H	H	H	H	H	H	H	H
	H	H	H	L	H	H	H	H	H	H	H	H	H	H
	H	H	H	H	H	H	H	H	H	H	H	H	H	H

H = high level (off), L = low level (on)

Figure 4-5. BCD-to-Decimal Decoder/Driver A4U18

4-38. 64-Bit Random-Access-Memory (RAM) A5U14 (1820-0628)

4-39. The 64-bit random-access-memory (RAM) symbol is shown in *Figure 4-6*. The RAM is organized 16 words by 4 bits. Four address lines are buffered and decoded for word selection. When the RAM receives a low at the memory enable (ME) input, the binary address (A through D) is coded to select 1 of 16 four-bit words. If the write enable (WE) is low, the data present on the data input lines (D_1 through D_4) is written into the four bits of the selected word. There is inversion of logic levels through the RAM in a read operation.

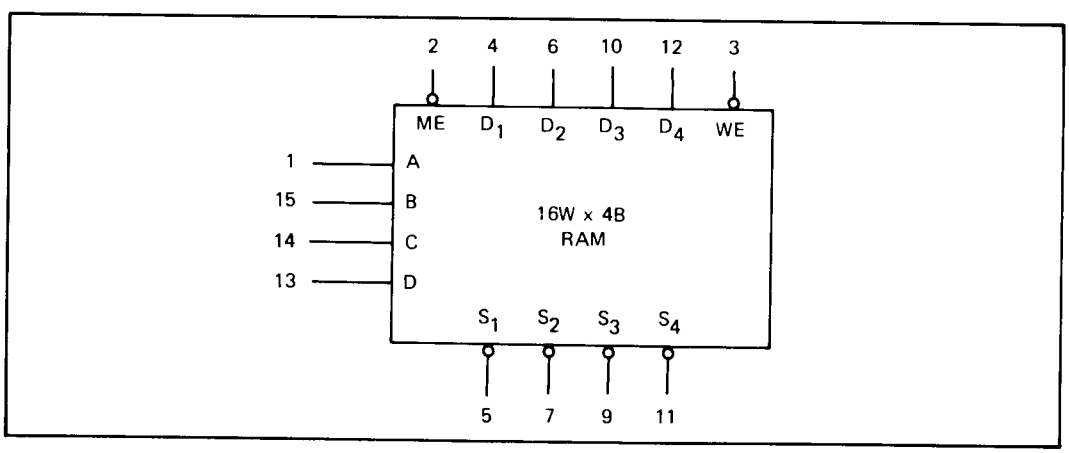
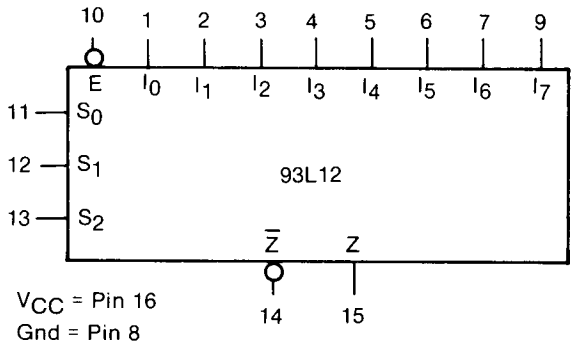


Figure 4-6. Random-Access-Memory (RAM) A5U14

4-40. Eight Input Multiplexer A5U8 (1820-0658)

4-41. The eight input multiplexer, shown in *Figure 4-7*, provides the ability to select one bit of data from up to eight sources. The circuit is a logical implementation of a single-pole, eight-position switch with the switch position controlled by the state of three select inputs, S_0, S_1, and S_2. Both assertion and negation outputs are provided. The enable input (E) is active low.

LOGIC SYMBOL



TRUTH TABLE

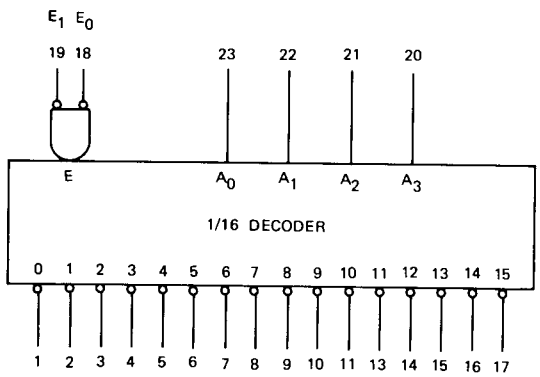
$\overline{E}$	S_2	S_1	S_0	I_0	I_1	I_2	I_3	I_4	I_5	I_6	I_7	$\overline{Z}$	Z
H	X	X	X	X	X	X	X	X	X	X	X	H	L
L	L	L	L	L	X	X	X	X	X	X	X	H	L
L	L	L	L	H	X	X	X	X	X	X	X	L	H
L	L	L	H	X	L	X	X	X	X	X	X	H	L
L	L	L	H	X	H	X	X	X	X	X	X	L	H
L	L	H	L	X	X	L	X	X	X	X	X	H	L
L	L	H	L	X	X	H	X	X	X	X	X	L	H
L	L	H	H	X	X	X	L	X	X	X	X	H	L
L	L	H	H	X	X	X	H	X	X	X	X	L	H
L	H	L	L	X	X	X	X	L	X	X	X	H	L
L	H	L	L	X	X	X	X	H	X	X	X	L	H
L	H	L	H	X	X	X	X	X	L	X	X	H	L
L	H	L	H	X	X	X	X	X	H	X	X	L	H
L	H	H	L	X	X	X	X	X	X	L	X	H	L
L	H	H	L	X	X	X	X	X	X	H	X	L	H
L	H	H	H	X	X	X	X	X	X	X	L	H	L
L	H	H	H	X	X	X	X	X	X	X	H	L	H

H = HIGH Voltage Level
L = LOW Voltage Level
X = Level does not affect output

Figure 4-7. Eight Input Multiplexer A5U8

4-42. Low Power One-of-Sixteen Decoder A5U17 (1820-0702)

4-43. This decoder, shown in *Figure 4-8,* accepts four active high binary inputs and provides up to 16 mutually exclusive active low outputs. The circuit can demultiplex data by routing it from one input to 1 of 16 possible decoder outputs. The desired output is addressed and the data is applied to one of the enable inputs. When the other enable is low, the addressed output will follow the state of the applied data.



PIN NAMES

A_0, A_1, A_2, A_3	Address Inputs
$\overline{E_0}$, $\overline{E_1}$	AND Enable (Active Low) Inputs
$\overline{0}$ to $\overline{15}$	(Active Low) Outputs

TRUTH TABLE

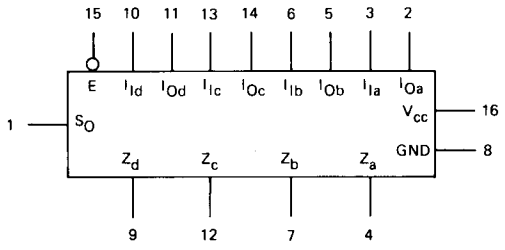
$\overline{E_0}$	$\overline{E_1}$	A_0	A_1	A_2	A_3	$\overline{0}$	$\overline{1}$	$\overline{2}$	$\overline{3}$	$\overline{4}$	$\overline{5}$	$\overline{6}$	$\overline{7}$	$\overline{8}$	$\overline{9}$	$\overline{10}$	$\overline{11}$	$\overline{12}$	$\overline{13}$	$\overline{14}$	$\overline{15}$
H	H	X	X	X	X	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H
H	L	X	X	X	X	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H
L	H	X	X	X	X	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H
L	L	L	L	L	L	L	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H
L	L	H	L	L	L	H	L	H	H	H	H	H	H	H	H	H	H	H	H	H	H
L	L	L	H	L	L	H	H	L	H	H	H	H	H	H	H	H	H	H	H	H	H
L	L	H	H	L	L	H	H	H	L	H	H	H	H	H	H	H	H	H	H	H	H
L	L	L	L	H	L	H	H	H	H	L	H	H	H	H	H	H	H	H	H	H	H
L	L	H	L	H	L	H	H	H	H	H	L	H	H	H	H	H	H	H	H	H	H
L	L	L	H	H	L	H	H	H	H	H	H	L	H	H	H	H	H	H	H	H	H
L	L	H	H	H	L	H	H	H	H	H	H	H	L	H	H	H	H	H	H	H	H
L	L	L	L	L	H	H	H	H	H	H	H	H	H	L	H	H	H	H	H	H	H
L	L	H	L	L	H	H	H	H	H	H	H	H	H	H	L	H	H	H	H	H	H
L	L	L	H	L	H	H	H	H	H	H	H	H	H	H	H	L	H	H	H	H	H
L	L	H	H	L	H	H	H	H	H	H	H	H	H	H	H	H	L	H	H	H	H
L	L	L	L	H	H	H	H	H	H	H	H	H	H	H	H	H	H	L	H	H	H
L	L	H	L	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	L	H	H
L	L	L	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	L	H
L	L	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	L

H = HIGH VOLTAGE LEVEL
L = LOW VOLTAGE LEVEL
X = LEVEL DOES NOT AFFECT OUTPUT

Figure 4-8. Low Power One-of-Sixteen Decoder A5U17

4-44. Quad Two-Input Multiplexer A5U7 (1820-0710)

4-45. The quad two-input multiplexer shown in *Figure 4-9* consists of four multiplexing circuits with common select and enable logic. The enable input (E) is active low. When not activated all outputs (Z) are low regardless of all other inputs. The quad two-input multiplexer is the logical implementation of a four-pole two-position switch, with the position of the switch being set by the logic level supplied to the one select input.



TRUTH TABLE

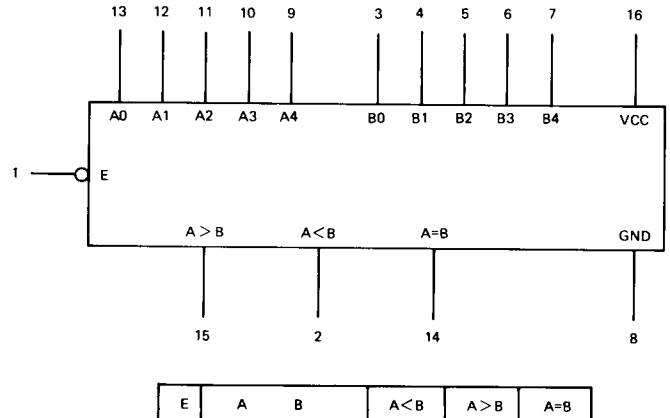
ENABLE	SELECT INPUT	INPUTS		OUTPUT
E	S_0	I_{0Y}	I_{1Y}	Z_Y
H	X	X	X	L
L	H	X	L	L
L	H	X	H	H
L	L	L	X	L
L	L	H	X	H

H = HIGH VOLTAGE LEVEL Y = a,b,c,d
L = LOW VOLTAGE LEVEL
X = LEVEL DOES NOT AFFECT OUTPUT

Figure 4-9. Quad Two Input Multiplexer A5U7

4-46. Low Power TTL Five-Bit Comparator A5U19 (1820-0904)

4-47. This IC (*Figure 4-10*) provides a comparison between two 5-bit words and gives one of three outputs; "less than", "greater than", or "equal to". A high level on the enable input forces all three outputs low. A low on the enable input allows a comparison to take place. The comparator function is shown in *Figure 4-10*.



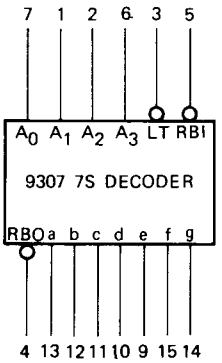
E	A B	A<B	A>B	A=B
H	X X	L	L	L
L	Word A = Word B	L	L	H
L	Word A > Word B	L	H	L
L	Word A < Word B	H	L	L

L = LOW Voltage Level
H = HIGH Voltage Level
X = Either HIGH or LOW Voltage Level

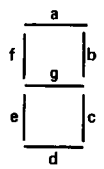
Figure 4-10. Low Power TTL Five-Bit Comparator A5U19

4-48. Seven-Segment Decoder A1U2 (1820-0914)

4-49. The seven-segment decoder, shown in *Figure 4-11*, accepts four-bit BCD 8421 code input. The circuit provides the appropriate outputs for selection of segments in a seven-segment matrix display used for representing the decimal numbers 0-9. The seven outputs (a, b, c, d, e, f, and g) of the decoder select the corresponding segments in the matrix shown in *Figure 4-11*.



DISPLAY MATRIX
SEGMENT DESIGNATION



TRUTH TABLE

LT	RB IN	A_0	A_1	A_2	A_3	a	b	c	d	e	f	g	RB OUT	
L	X	X	X	X	X	H	H	H	H	H	H	H	H	
H	L	L	L	L	L	L	L	L	L	L	L	L	L	0
H	H	L	L	L	L	H	H	H	H	H	H	L	H	0
|	X	H	L	L	L	L	H	H	L	L	L	L	H	1
|	|	L	H	L	L	H	H	L	H	H	L	H	H	2
|	|	H	H	L	L	H	H	H	H	L	L	H	H	3
|	|	L	L	H	L	L	H	H	L	L	H	H	H	4
|	|	H	L	H	L	H	L	H	H	L	H	H	H	5
|	|	L	H	H	L	H	L	H	H	H	H	H	H	6
|	|	H	H	H	L	H	H	H	L	L	L	L	H	7
|	|	L	L	L	H	H	H	H	H	H	H	H	H	8
|	|	H	L	L	H	H	H	H	H	L	H	H	H	9
|	|	L	H	L	H	L	L	L	H	H	L	H	H	10
|	|	H	H	L	H	L	L	L	H	L	L	H	H	11
|	|	L	L	H	H	L	H	H	L	L	H	H	H	12
|	|	H	L	H	H	H	L	H	H	L	H	H	H	13
|	|	L	H	H	H	L	L	L	H	H	H	H	H	14
H	X	H	H	H	H	L	L	L	L	L	L	L	H	15

H = HIGH VOLTAGE LEVEL
L = LOW VOLTAGE LEVEL
X = EITHER HIGH OR LOW VOLTAGE LEVEL

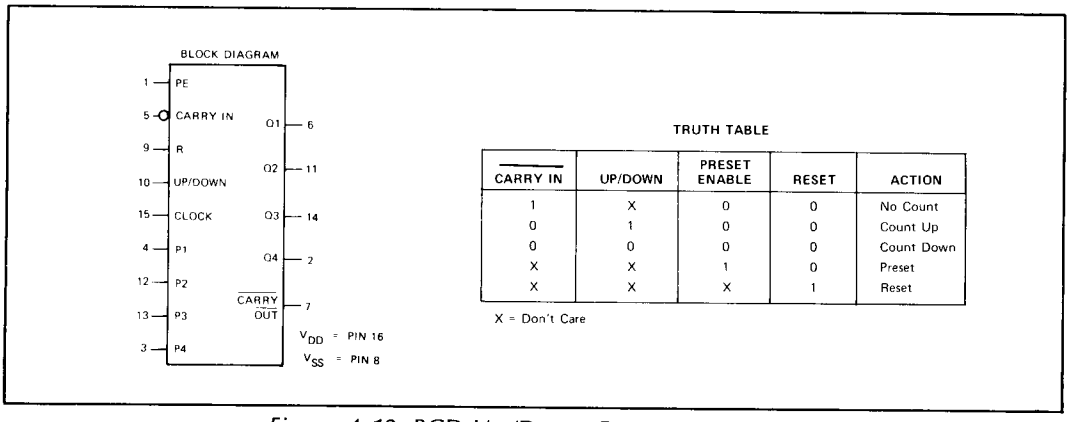
Figure 4-11. Seven-Segment Decoder A1U2

4-50. BCD Up/Down Counter A3U7 (1820-1189)

CAUTION

The device contains circuitry to protect its inputs against damage due to high static voltages or electric fields; however, precautions should be taken to avoid application of any voltage higher than maximum rated voltages to this high impedance circuit.

4-51. This CMOS counter, shown in *Figure 4-12*, consists of type D flip-flop stages with a gating structure to provide type T flip-flop capability.



TRUTH TABLE

$\overline{\text{CARRY IN}}$	UP/DOWN	PRESET ENABLE	RESET	ACTION
1	X	0	0	No Count
0	1	0	0	Count Up
0	0	0	0	Count Down
X	X	1	0	Preset
X	X	X	1	Reset

X = Don't Care

Figure 4-12. BCD Up/Down Counter A3U7

4-52. Timer A1U3 (1826-0180)

4-53. The timer, shown in *Figure 4-13*, provides a highly stable timing circuit capable of producing accurate time delays. The time is precisely controlled by an external capacitor and resistor. The circuit is used in the 59309A as a clock loss detector. If the display clock fails, a blanking signal is supplied by the timer to protect the display.

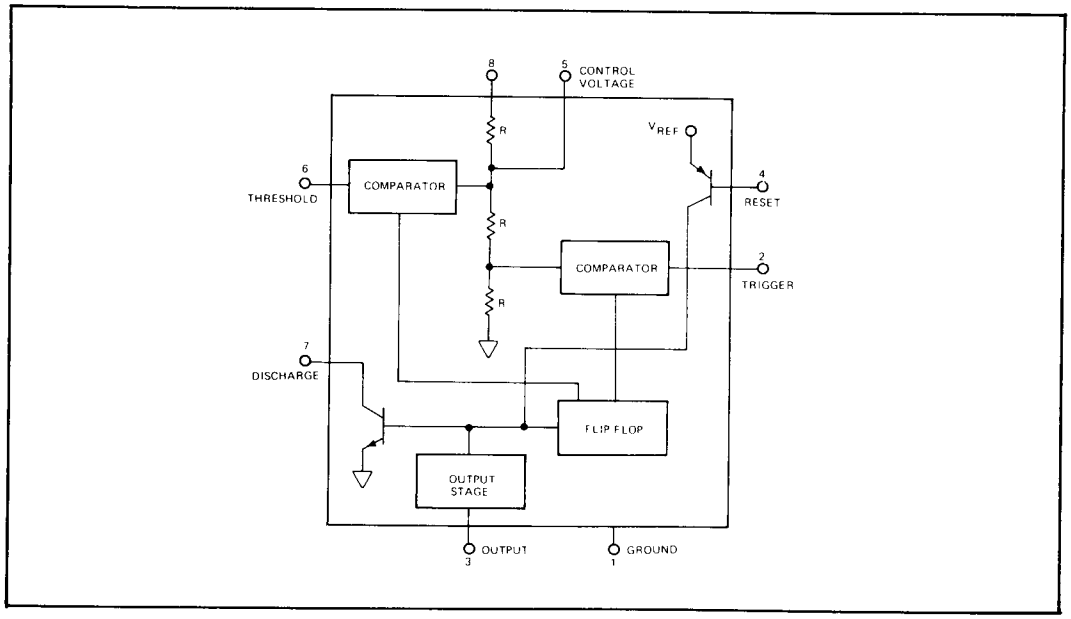


Figure 4-13. Timer A1U3

SECTION V
MAINTENANCE

5-1. INTRODUCTION

5-2. This section contains maintenance and service information including a table of recommended test equipment, in-cabinet performance checks, adjustments, and troubleshooting.

WARNING

ANY ADJUSTMENT, MAINTENANCE, AND REPAIR OF THE OPENED INSTRUMENT UNDER VOLTAGE SHOULD BE AVOIDED AS MUCH AS POSSIBLE AND, WHEN INEVITABLE, SHOULD BE CARRIED OUT ONLY BY A SKILLED PERSON WHO IS AWARE OF THE HAZARD INVOLVED. LINE VOLTAGE IS ALWAYS PRESENT ON TERMINALS INCLUDING THE POWER INPUT CONNECTOR, FUSE HOLDER, POWER SWITCH, AND OTHER POINTS. ENERGY AVAILABLE AT MANY POINTS MAY RESULT IN PERSONAL INJURY OR DEATH WHEN CONTACTED.

5-3. TEST EQUIPMENT

5-4. *Table 5-1* lists test equipment recommended for maintaining and checking the performance of the 59309A. Test equipment with equivalent characteristics may be substituted.

Table 5-1. Recommended Test Equipment

INSTRUMENT	REQUIRED CHARACTERISTICS	RECOMMENDED
Logic Probe	Test TTL Signal Levels	HP 10525T
Logic Pulser	Pulse In-Circuit IC's	HP 10526T
Digital Voltmeter	0 to +20 Volts Accuracy 0.3%	HP 3480A and HP 3482A
Logic State Display with Oscilloscope	Display state machine bit patterns	HP 1601A with HP 182C
Frequency Counter	1 MHz	HP 5328A Option 010

5-5. IN-CABINET PERFORMANCE TEST

5-6. *Table 5-2* contains the in-cabinet performance test. The 59309A is checked for proper functional operation in local (front panel) control and proper programming response in remote control (HP-IB verification).

Table 5-2. In-Cabinet Performance Test

NOTE

Prior to operating the 59309A, set the voltage selector switch on the rear panel to correspond with the line voltage to be used (115V or 230V). Install the correct line fuse (500 mA for 115-volt operation or 250 mA for 230-volt operation) and connect the 59309A to the power source. The front panel display should illuminate. See Warning in paragraph 5-2.

FRONT PANEL CONTROL

1. Lift hinged lower portion of front panel and set controls as follows:

   EXT/INT ..... INT
   365/366 365
   RUN/HOLD ..... HOLD

2. Push and hold RESET. Two pairs of 8's should appear above the word CALENDAR and three pairs should appear above TIME.

3. Release RESET button. Display should read a constant "01 01 00 00 00".

4. Set EXT/INT switch to EXT (do not connect on external frequency standard). Display should be blank.

5. Return EXT/INT switch to INT. Display should read as in step 3 except that the decimal point in each digit should also be lit.

6. Push RESET. The decimal points should clear from display.

7. Press PUSH TO READ button. Display should remain unchanged from that of step 3 (display will flicker as switch clicks).

8. Push and hold TIME SET SLOW. Seconds digits should update rapidly. Check for correct updating of minutes digits. Release button.

9. Push and hold TIME SET FAST. Seconds and minutes digits should update rapidly. Check for correct updating of the hours digits. Release button.

10. Push and hold DAY SET. Days and months digits only should update. Check for correct days and months updating (based on 365 days year). Release button.

11. Set 365/366 switch to 366. Push RESET. Push DAY SET and check for CALENDAR display of "02 29".

12. Push RESET. Set RUN/HOLD switch to RUN. Display should update at 1-second rate. Check for correct updating of seconds digits.

13. Apply 8 to 10 Vdc to rear panel STANDBY POWER INPUT. Remove AC line power. Display should be blank.

14. Press and hold PUSH TO READ. Display should light and be updating at 1-second rate. Release button.

Table 5-2. In-Cabinet Performance Test (Continued)

15. Remove top cover. Set EXT FREQ STD switch on A2 board to 10 MHz position. Apply 10 MHz (1 Vrms into 1 KΩ) to rear panel EXT FREQ STD input.

16. Set EXT/INT switch to EXT. Push RESET. Press and hold PUSH TO READ. Display should light and be updating at a 1-second rate. Release button.

17. Repeat steps 15 and 16 for both 5 MHz and 1 MHz.

18. Replace top cover.

HP-IB VERIFICATION PROGRAM USING 9820A or 9830A

1. Figure A is the basic flowchart for the verification program.

Figure A

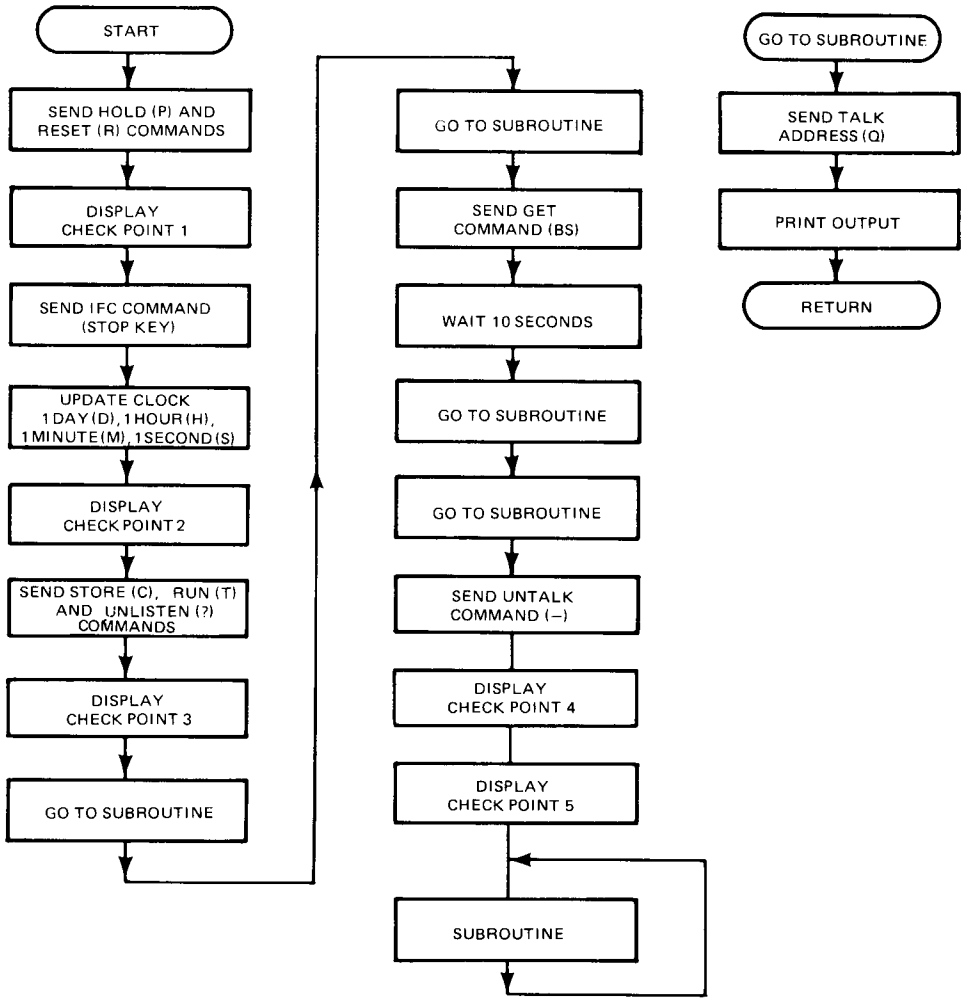


Table 5-2. In-Cabinet Performance Test (Continued)

2. Verification Using 9820A Calculator

   a. Set up a 9820A Calculator, 11224A PC II ROM, 59405A HP-IB Calculator Interface, 10631A HP-IB Cable, and 59309A HP-IB Clock for operation.

   b. Set 59309A controls as follows:

      Address switches - 10001 (1,Q)
      Mode switches - 11 (Addressable)
      Format switches - CAL, NO SPACE
      EXT/EXT - INT
      365/366 - 365
      RUN/HOLD - RUN

   c. Initialize 59309A by removing ac power, then reapplying power.

   d. Type in program of Figure B.

Figure B

```
0:
CMD "?U1","PR"⊢
1:
DSP "CHECK POINT
 1"⊢
2:
STP ⊢
3:
CMD "?U1","SMHD"
⊢
4:
DSP "CHECK POINT
 2"⊢
5:
STP ⊢
6:
CMD "?U1","CT","
?"⊢
7:
DSP "CHECK POINT
 3"⊢
8:
STP ⊢
9:
GSB 24⊢
10:
GSB 24⊢
11:
CMD "?U1▫("⊢
12:
DSP "WAIT 10 SEC
ONDS"⊢
13:
STP ⊢
14:
GSB 24⊢
15:
GSB 24⊢
16:
CMD "→"⊢
17:
DSP "CHECK POINT
 4"⊢
18:
STP ⊢
19:
DSP "CHECK POINT
 5"⊢
20:
STP ⊢
21:
GSB 24⊢
22:
GTO 21⊢
23:
END ⊢
24:
CMD "?05":RDB 13
→A:FMT *:RED 13,
B⊢
25:
FXD 0:PRT A,B⊢
26:
RET ⊢
```

Note: Unusual character in line 11 is made by pressing DISPLAY key.

   e. Press END and LIST keys on 9820A. Compare listing with Figure B for accuracy.

Table 5-2. In-Cabinet Performance Test (Continued)

f. Press END and RUN PROGRAM keys. As CHECK POINT's appear on calculator display, verify operation of 59309A with CHECK POINT explanations in steps 4 through 8. To continue program after each CHECK POINT, press RUN PROGRAM key.

3. Verification Using 9830A Calcualtor

a. Set up a 9830A Calculator, 9866A Printer, 11272B Extended I/O ROM, 59405A HP-IB Calculator Interface, 10631A HP-IB Cable, and 59309A HP-IB Clock for operation.

b. Set 59309A control as follows:

Address switches - 10001 (1,Q)
Mode switches - 11 (Addressable)
Format switches - CAL, NO SPACE
INT/EXT - INT
365/366 - 365
RUN/HOLD - RUN

c. Initialize 59309A by removing ac power, then reapplying power.

d. Type in program of Figure C.

Figure C

```
10 CMD "?U1","PR"
20 DISP "CHECK POINT 1"
30 STOP
40 CMD "?U1","SMHD"
50 DISP "CHECK POINT 2"
60 STOP
70 CMD "?U1","CT","?"
80 DISP "CHECK POINT 3"
90 STOP
100 GOSUB 280
110 GOSUB 280
120 CMD "?U1"
130 FORMAT 3B
140 OUTPUT (13,130)256,8,512
150 WAIT 10000
160 GOSUB 280
170 GOSUB 280
180 CMD "?U"
190 FORMAT 3B
200 OUTPUT (13,190)256,95,512
210 DISP "CHECK POINT 4"
220 STOP
230 DISP "CHECK POINT 5"
240 STOP
250 GOSUB 280
260 GOTO 250
270 END
280 CMD "?SQ"
290 ENTER (13,300)A,B
300 FORMAT B,F12.0
310 PRINT A;B
320 RETURN
```

Table 5-2. In-Cabinet Performance Test (Continued)

e. Press LIST and EXECUTE keys on 9830A. Compare listing with Figure C for accuracy.

f. Press RUN and EXECUTE keys. As CHECK POINT's appear on calculator display, verify operation of 59309A with CHECK POINT explanations in steps 4 through 8. To continue program after each CHECK POINT, press CONT and EXECUTE keys.

4. CHECK POINT 1.

   a. ADDRESSED light should be lit.

   b. Display should read a constant "01 01 00 00 00".

   c. Press STOP key on calculator, ADDRESSED light should go off.

5. CHECK POINT 2.

   a. ADDRESSED light should be lit.

   b. Display should read a constant "01 02 01 01 01".

6. CHECK POINT 3.

   a. ADDRESSED light should be off.

   b. Display should be updating at 1-second rate.

   c. When program is continued, ADDRESSED light should be lit.

   d. When program is continued on 9820A, calculator will print two 59309A outputs then display "WAIT 10 SECONDS". Using last 59309A output as reference and display of 59309A as timer, wait 10 seconds then press RUN PROGRAM key.

7. CHECK POINT 4.

   a. ADDRESSED light should be off.

   b. Calculator should have printed four 59309A outputs.

   c. First 59309A output should read "32" "102010101".

   d. Second and third output should be within 1-second of each other.

   e. Fourth output should be within 8 to 12 seconds of third output.

8. CHECK POINT 5.

   a. When program is continued, 59309A should output continuously with printout updating as display updates.

   b. After continuing program set INT/EXT switch to EXT, then return to INT. Calculator should be printing "63" in place of previous "32".

   c. Press STOP key on calculator to end test.

5-7. ADJUSTMENTS

5-8. The only adjustment required for the 59309A is the oscillator adjustment. Adjust the oscillator as follows:

a. Remove the top cover of the 59309A (see Warning in paragraph 5-2).

b. Connect the 1 MΩ INPUT connector of an HP 5328A Universal Counter (or equivalent) to the 59309A test point A3TP4 (see *Figure 8-5*).

c. Apply power to the equipment and allow 1 hour warmup.

d. Using an insulated tuning tool, adjust the variable resistor (OSC ADJ) on the 59309A for a display of 1 MHz on the 5328A.

5-9. TROUBLESHOOTING

5-10. Before removing the covers to troubleshoot the instrument, observe the Warning in paragraph 5-2. To troubleshoot the 59309A, perform the in-cabinet performance test in *Table 5-2* to determine the failure symptom. Refer to the overall functional description in Section IV to isolate the trouble to a major circuit area. Refer to the detailed description on each schematic diagram in Section VIII to isolate the trouble within a major circuit area.

5-11. The extender boards listed in *Table 1-3* are accessories available for troubleshooting.

5-12. ROM Listings

5-13. *Tables 5-3* through 5-6 are listings of the bit patterns of ROM's A5U2, U15, and U18. The input and output labels shown correspond with those of the A5 board schematic, *Figure 8-7*. Using these tables, proper operation of the ROM's can be established.

Table 5-3. A5U18 ROM Listing

Inputted ASCII Character	Inputs DIO Lines G	F	E	D	C	B	A	ATN H	Outputs Y_4	Y_3	Y_2	Y_1	Internal Line Effected
R	1	0	1	0	0	1	0	H	L	L	H	L	$\overline{\text{RESET}}$
P	1	0	1	0	0	0	0	H	L	L	L	L	$\overline{\text{HOLD}}$
T	1	0	1	0	1	0	0	H	L	L	L	H	$\overline{\text{RUN}}$
S	1	0	1	0	0	1	1	H	L	H	L	L	$\overline{\text{SECONDS}}$
M	1	0	0	1	1	0	1	H	L	H	L	H	$\overline{\text{MINUTES}}$
H	1	0	0	1	0	0	0	H	L	H	H	L	$\overline{\text{HOURS}}$
D	1	0	0	0	1	0	0	H	L	L	H	H	$\overline{\text{DAY}}$
C	1	0	0	0	0	1	1	H	L	H	H	H	$\overline{\text{STORE}}$
BS	0	0	0	1	0	0	0	L	H	H	H	L	DEVICE TRIGGER
?	0	1	1	1	1	1	1	L	L	H	H	H	"?"
—	1	0	1	1	1	1	1	L	L	L	H	L	$\overline{\text{TALK}}$
All Listen Addresses	0	1	X	X	X	X	X	L	L	H	L	L	$\overline{\text{LISTEN}}$
All Talk Addresses	1	0	X	X	X	X	X	L	L	L	H	L	$\overline{\text{TALK}}$
All other Characters	X	X	X	X	X	X	X	H	H	H	H	H	NO EFFECT

Table 5-4. A5U15 ROM Listing

WORD	INPUTS BINARY SELECT					OUTPUTS						OUTPUTTED ASCII CHARACTER
	E*	D	C	B	A	Y_6	Y_5	Y_4	Y_3	Y_2	Y_1	
0	L	L	L	L	L	H	H	H	H	H	H	?
1	L	L	L	L	H	H	H	H	H	H	H	
2	L	L	L	H	L	H	H	H	H	H	H	
3	L	L	L	H	H	H	H	H	H	H	H	
4	L	L	H	L	L	H	H	H	H	H	H	
5	L	L	H	L	H	H	H	H	H	H	H	
6	L	L	H	H	L	H	H	H	H	H	H	
7	L	L	H	H	H	H	H	H	H	H	H	
8	L	H	L	L	L	H	H	H	H	H	H	
9	L	H	L	L	H	H	H	H	H	H	H	
10	L	H	L	H	L	H	L	L	L	L	L	SP
11	L	H	L	H	H	L	L	H	H	L	H	CR
12	L	H	H	L	L	L	L	H	L	H	L	LF
13	L	H	H	L	H	H	H	H	H	H	H	?
14	L	H	H	H	L	H	H	H	L	H	L	:
15	L	H	H	H	H	L	L	L	L	L	L	NUL
16	H	L	L	L	L	H	H	H	H	H	H	?
17	H	L	L	L	H	H	H	H	H	H	H	
18	H	L	L	H	L	H	H	H	H	H	H	
19	H	L	L	H	H	H	H	H	H	H	H	
20	H	L	H	L	L	H	H	H	H	H	H	
21	H	L	H	L	H	H	H	H	H	H	H	
22	H	L	H	H	L	H	H	H	H	H	H	
23	H	L	H	H	H	H	H	H	H	H	H	
24	H	H	L	L	L	H	H	H	H	H	H	
25	H	H	L	L	H	H	H	H	H	H	H	
26	H	H	L	H	L	H	L	L	L	L	L	SP
27	H	H	L	H	H	L	L	H	H	L	H	CR
28	H	H	H	L	L	L	L	H	L	H	L	LF
29	H	H	H	L	H	H	H	H	H	H	H	?
30	H	H	H	H	L	H	L	H	H	L	L	,
31	H	H	H	H	H	L	L	L	L	L	L	NUL

*Level set by format switch

L = : (Colon)
H = , (Comma)

PERFORMANCE CHECK TEST CARD

HEWLETT-PACKARD MODEL 59309A
HP-IB DIGITAL CLOCK

Test Performed By _____

Instrument Serial No. _____ *Date* _____

PASSED

1. Front Panel Control, Step(s) _____
2. *HP-IB Verification Program for 98____*, Check Point(s) _____

FAILED

1. Front Panel Control Step _____, Reason _____

1. Front Panel Control Step _____, Reason _____

1. Front Panel Control Step _____, Reason _____

1. Front Panel Control Step _____, Reason _____

2. HP-IB Verification Program for 98____, Check Point _____ ,Reason _____

2. HP-IB Verification Program for 98____, Check Point _____, Reason _____

2. HP-IB Verification Program for 98____, Check Point _____, Reason _____

Table 5-5. A5U2 ROM Bit Pattern, Talk Enable = 1

Present Address	Qual.	Next Address						Next Qual.			Load	DAV	R_{out}	ROM/RAM Address			
I_1-I_6	I_0	O_0	O_1	O_2	O_3	O_4	O_5	O_8	O_7	O_6	O_9	O_{10}	O_{11}	O_{12}	O_{13}	O_{14}	O_{15}
00_8	0	0	0	0	0	0	1	1	1	0	0	0	1	1	1	1	1
	1	0	0	0	0	0	1	1	0	1	0	0	0	1	1	1	1
01_8	0	0	0	0	0	0	1	1	1	0	0	0	0	1	1	1	1
	1	0	0	0	0	1	0	1	1	1	0	0	0	1	1	1	1
02_8	0	0	0	0	0	1	0	1	1	1	1	0	0	1	1	1	1
	1	0	0	0	0	1	1	1	1	1	1	0	0	1	1	1	1
03_8	0	0	0	0	1	0	0	1	1	1	1	0	0	1	1	1	1
	1	0	0	0	0	1	1	1	1	1	1	0	0	1	1	1	1
04_8	0	0	0	0	1	0	0	1	1	1	1	0	0	1	1	1	1
	1	0	0	0	1	0	1	1	1	1	1	0	0	1	1	1	1
05_8	0	0	0	0	1	1	0	1	1	1	1	0	0	1	1	1	1
	1	0	0	0	1	0	1	1	1	1	1	0	0	1	1	1	1
06_8	0	0	0	0	1	1	0	1	1	1	1	0	0	1	1	1	1
	1	0	0	0	1	1	1	1	1	1	1	0	0	1	1	1	1
07_8	0	0	0	0	0	0	0	1	0	1	1	0	0	1	1	1	1
	1	0	0	0	1	1	1	1	0	1	1	0	0	1	1	1	1
*ZZ_8	X	0	0	0	0	0	0	1	0	1	0	0	1	1	1	1	1

*Where ZZ is any address above 07_8

LEGEND

LOAD
Enable = 1
Disable = 0

$\overline{DAV}$
Low = 0 on bus DAV line
High = 1 on bus DAV line

NEXT QUAL. CODES
TIME/CAL = 0 0 0
SP/NO SPACE = 0 0 1
ERROR = 0 1 0
NRFD = 0 1 1
NDAC = 1 0 0
STORE = 1 0 1
C LINE 5 = 1 1 0
B LINE = 1 1 1

R_{out}
Enable RAM output = 0
Disable RAM output = 1

X = don't care

NOTE

This ROM uses positive Logic (i.e., 1 = High, 0 = Low). $\overline{DAV}$ is a negative Logic Signal name.

Table 5-6. A5U2 ROM Bit Pattern, Talk Enable = 0

Present Address	Qual.	Next Address						Next Qual.			Load	DAV	R_{out}	ROM/RAM Address			
I_1–I_6	I_0	O_0	O_1	O_2	O_3	O_4	O_5	O_8	O_7	O_6	O_9	O_{10}	O_{11}	O_{12}	O_{13}	O_{14}	O_{15}
00_8	0	0	0	0	0	0	1	1	1	0	0	0	1	1	1	1	1
	1	0	0	0	1	1	0	0	1	0	0	0	0	1	1	1	1
01_8	0	0	0	0	0	0	1	1	1	0	0	0	0	1	1	1	1
	1	0	0	0	0	1	0	1	1	1	0	0	0	1	1	1	1
02_8	0	0	0	0	0	1	0	1	1	1	1	0	0	1	1	1	1
	1	0	0	0	0	1	1	1	1	1	1	0	0	1	1	1	1
03_8	0	0	0	0	1	0	0	1	1	1	1	0	0	1	1	1	1
	1	0	0	0	0	1	1	1	1	1	1	0	0	1	1	1	1
04_8	0	0	0	0	1	0	0	1	1	1	1	0	0	1	1	1	1
	1	1	0	1	1	1	1	1	1	1	1	0	0	1	1	1	1
05_8		(ADDRESS NOT USED)															
06_8	0	0	0	0	1	1	1	0	1	1	0	0	1	1	1	1	1
	1	0	0	1	0	0	0	0	1	1	0	0	1	1	1	1	1
07_8	0	0	0	0	1	1	1	0	1	1	0	0	1	1	1	1	1
	1	0	0	1	0	1	0	1	0	0	0	0	1	1	1	1	1
10_8	0	0	0	1	0	0	0	0	1	1	0	0	1	1	1	1	1
	1	0	0	1	0	0	1	1	0	0	0	0	1	1	1	1	1
11_8	0	0	0	1	0	0	1	0	1	1	0	1	1	1	1	0	1
	1	1	1	0	0	1	0	0	1	1	0	1	1	1	1	0	1
12_8	0	0	0	1	0	1	0	1	0	0	0	1	1	1	0	1	0
	1	1	1	0	0	1	0	0	1	1	0	1	1	1	0	1	0
13_8		(ADDRESS NOT USED)															
14_8	0	0	0	1	1	0	0	1	0	0	0	1	0	1	0	0	1
	1	0	0	1	1	0	0	0	1	1	0	1	0	1	0	0	1
15_8	0	0	0	1	1	0	1	0	1	1	0	0	1	1	0	0	1
	1	0	0	1	1	1	0	1	0	0	0	0	1	1	0	0	1
16_8	0	0	0	1	1	1	0	1	0	0	0	1	0	1	0	0	0
	1	0	0	1	1	1	1	0	0	1	0	1	0	1	0	0	0
17_8	0	0	1	0	0	0	0	0	1	1	0	0	1	1	0	0	0
	1	0	1	0	0	1	0	0	1	1	0	0	1	1	0	0	0
20_8	0	0	1	0	0	0	0	0	1	1	0	0	1	1	1	1	0
	1	0	1	0	0	0	1	1	0	0	0	0	1	1	1	1	0
21_8	0	0	1	0	0	0	1	1	0	0	0	1	1	1	1	1	0
	1	0	1	0	0	1	0	0	1	1	0	1	1	1	1	1	0

LEGEND

LOAD
Enable = 1
Disable = Ø

$\overline{DAV}$
Low = Ø on bus DAV line
High = 1 on bus DAV line

NEXT QUAL. CODES
TIME/CAL = 0 0 0
SP/NO SPACE = 0 0 1
ERROR = 0 1 0
NRFD = 0 1 1
NDAC = 1 0 0
STORE = 1 0 1
C LINE 5 = 1 1 0
B LINE = 1 1 1

R_{out}
Enable RAM output = Ø
Disable RAM output = 1

X = don't care

NOTE

This ROM uses positive logice (i.e., 1 = High, 0 = Low). $\overline{DAV}$ is a negative logic signal name.

Table 5-6. A5U2 ROM Bit Pattern, Talk Enable = 0 (Continued)

Present Address	Qual.	Next Address						Next Qual.			Load	DAV	R_{out}	ROM/RAM Address			
I_1–I_6	I_0	O_0	O_1	O_2	O_3	O_4	O_5	O_8	O_7	O_6	O_9	O_{10}	O_{11}	O_{12}	O_{13}	O_{14}	O_{15}
22_8	0	0	1	0	0	1	0	0	1	1	0	0	0	0	1	1	1
	1	0	1	0	0	1	1	1	0	0	0	0	0	0	1	1	1
23_8	0	0	1	0	0	1	1	1	0	0	0	1	0	0	1	1	1
	1	0	1	0	1	0	0	0	1	1	0	1	0	0	1	1	1
24_8	0	0	1	0	1	0	0	0	1	1	0	0	0	0	1	1	0
	1	0	1	0	1	0	1	1	0	0	0	0	0	0	1	1	0
25_8	0	0	1	0	1	0	1	1	0	0	0	1	0	0	1	1	0
	1	0	1	0	1	1	0	0	0	1	0	1	0	0	1	1	0
26_8	0	0	1	0	1	1	1	0	1	1	0	0	0	0	1	1	0
	1	0	1	1	0	0	1	0	1	1	0	0	0	0	1	1	0
27_8	0	0	1	0	1	1	1	0	1	1	0	0	0	0	1	1	0
	1	0	1	1	0	0	0	1	0	0	0	0	1	1	1	1	0
30_8	0	0	1	1	0	0	0	1	0	0	0	1	1	1	1	1	0
	1	0	1	1	0	0	1	0	1	1	0	0	0	1	1	1	0
31_8	0	0	1	1	0	0	1	0	1	1	0	0	0	1	1	1	0
	1	0	1	1	0	1	0	1	0	0	0	0	0	1	1	1	0
32_8	0	0	1	1	0	1	0	1	0	0	0	1	0	0	1	0	1
	1	0	1	1	0	1	1	0	1	1	0	1	0	0	1	0	1
33_8	0	0	1	1	0	1	1	0	1	1	0	0	0	0	1	0	1
	1	0	1	1	1	0	0	1	0	0	0	0	0	0	1	0	1
34_8	0	0	1	1	1	0	0	1	0	0	0	1	0	0	1	0	0
	1	0	1	1	1	0	1	0	0	1	0	1	0	0	1	0	0
35_8	0	0	1	1	1	1	0	0	1	1	0	0	0	0	1	0	0
	1	1	0	0	0	0	0	0	1	1	0	0	0	0	1	0	0
36_8	0	0	1	1	1	1	0	0	1	1	0	0	0	0	1	0	0
	1	0	1	1	1	1	1	1	0	0	0	0	0	0	1	0	0
37_8	0	0	1	1	1	1	1	1	0	0	0	1	1	1	1	1	0
	1	1	0	0	0	0	0	0	1	1	0	1	1	1	1	1	0
40_8	0	1	0	0	0	0	0	0	1	1	0	0	0	1	1	1	0
	1	1	0	0	0	0	1	1	0	0	0	0	0	1	1	1	0
41_8	0	1	0	0	0	0	1	1	0	0	0	1	0	0	0	1	1
	1	1	0	0	0	1	0	0	1	1	0	1	0	0	0	1	1
42_8	0	1	0	0	0	1	0	0	1	1	0	0	0	0	0	1	1
	1	1	0	0	0	1	1	1	0	0	0	0	0	0	0	1	1
43_8	0	1	0	0	0	1	1	1	0	0	0	1	0	0	0	1	0
	1	1	0	0	1	0	0	0	0	1	0	1	0	0	0	1	0
44_8	0	1	0	0	1	0	1	0	1	1	0	0	0	0	0	1	0
	1	1	0	0	1	1	1	0	1	1	0	0	0	0	0	1	0

LEGEND

LOAD
Enable = 1
Disable = 0

$\overline{DAV}$
Low = 0 on bus DAV line
High = 1 on bus DAV line

NEXT QUAL. CODES
TIME/CAL = 0 0 0
SP/NO SPACE = 0 0 1
ERROR = 0 1 0
NRFD = 0 1 1
NDAC = 1 0 0
STORE = 1 0 1
C LINE 5 = 1 1 0
B LINE = 1 1 1

R_{out}
Enable RAM output = 0
Disable RAM output = 1

X = don't care

Table 5-6. A5U2 ROM Bit Pattern, Talk Enable = 0 (Continued)

Present Address	Qual.	Next Address						Next Qual.			Load	DAV	R_{out}	ROM/RAM Address			
I_1–I_6	I_0	O_0	O_1	O_2	O_3	O_4	O_5	O_8	O_7	O_6	O_9	O_{10}	O_{11}	O_{12}	O_{13}	O_{14}	O_{15}
45_8	0	1	0	0	1	0	1	0	1	1	0	0	0	0	0	1	0
	1	1	0	0	1	1	0	1	0	0	0	0	0	0	0	1	0
46_8	0	1	0	0	1	1	0	1	0	0	0	1	1	1	1	1	0
	1	1	0	0	1	1	1	0	1	1	0	1	1	1	1	1	0
47_8	0	1	1	0	1	1	1	0	1	1	0	0	0	1	1	1	0
	1	1	0	1	0	0	0	1	0	0	0	0	0	1	1	1	1
50_8	0	1	0	1	0	0	0	1	0	0	0	1	0	0	0	0	1
	1	1	0	1	0	0	1	0	1	1	0	1	0	0	0	0	1
51_8	0	1	0	1	0	0	1	0	1	1	0	0	0	0	0	0	1
	1	1	0	1	0	1	0	1	0	0	0	0	0	0	0	0	1
52_8	0	1	0	1	0	1	0	1	0	0	0	1	0	0	0	0	0
	1	1	0	1	0	1	1	0	1	1	0	1	0	0	0	0	0
53_8	0	1	0	1	0	1	1	0	1	1	0	0	0	0	0	0	0
	1	1	0	1	1	0	0	1	0	0	0	0	0	0	0	0	0
54_8	0	1	0	1	1	0	0	1	0	0	0	1	1	1	0	1	1
	1	1	0	1	1	0	1	0	1	1	0	1	1	1	0	1	1
55_8	0	1	0	1	1	0	1	0	1	1	0	0	1	1	0	1	1
	1	1	0	1	1	1	0	1	0	0	0	0	1	1	0	1	1
56_8	0	1	0	1	1	1	0	1	0	0	0	1	1	1	1	0	0
	1	0	0	0	0	0	0	1	0	1	0	1	1	1	1	0	0
57_8	0	1	1	0	0	0	0	1	1	1	1	0	0	1	1	1	1
	1	1	0	1	1	1	1	1	1	1	1	0	0	1	1	1	1
60_8	0	1	1	0	0	0	0	1	1	1	1	0	0	1	1	1	1
	1	1	1	0	0	0	1	1	1	1	1	0	0	1	1	1	1
61_8	0	0	0	0	1	1	0	0	1	0	1	0	0	1	1	1	1
	1	1	1	0	0	0	1	1	1	1	1	0	0	1	1	1	1
62_8	0	1	1	0	0	1	0	0	1	1	0	0	1	1	0	1	0
	1	1	1	0	0	1	1	1	0	0	0	0	1	1	0	1	0
63_8	0	1	1	0	0	1	1	1	0	0	0	1	1	1	0	1	0
	1	1	1	0	1	0	0	0	1	1	0	1	1	1	0	1	0
64_8	0	1	1	0	1	0	0	0	1	1	0	0	1	1	0	1	0
	1	1	1	0	1	0	1	0	0	0	0	0	1	1	0	1	0
65_8	0	0	1	1	0	1	0	1	0	0	0	0	1	1	0	1	0
	1	0	0	1	1	0	0	1	0	0	0	0	1	1	0	1	0
ZZ_8	X	0	0	0	0	0	0	1	0	1	0	0	1	1	1	1	1

Where ZZ_8 is any address greater than 65_8

LEGEND

LOAD
Enable = 1
Disable = Ø

$\overline{DAV}$
Low = Ø on bus DAV line
High = 1 on bus DAV line

NEXT QUAL. CODES
TIME/CAL = 0 0 0
SP/NO SPACE = 0 0 1
ERROR = 0 1 0
NRFD = 0 1 1
NDAC = 1 0 0
STORE = 1 0 1
C LINE 5 = 1 1 0
B LINE = 1 1 1

R_{out}
Enable RAM output = Ø
Disable RAM output = 1

X = don't care

NOTE

This ROM uses positive Logic (i.e., 1 = High, 0 = Low). $\overline{DAV}$ is a negative Logic Signal name.

5-14. OPERATIONAL FLOWCHARTS

5-15. The operational flowcharts shown in *Figures 5-1* and *5-2* describe the sequence of operation of the A5U2 State Machine ROM. This ROM controls the talk output of the Model 59309A Digital Clock.

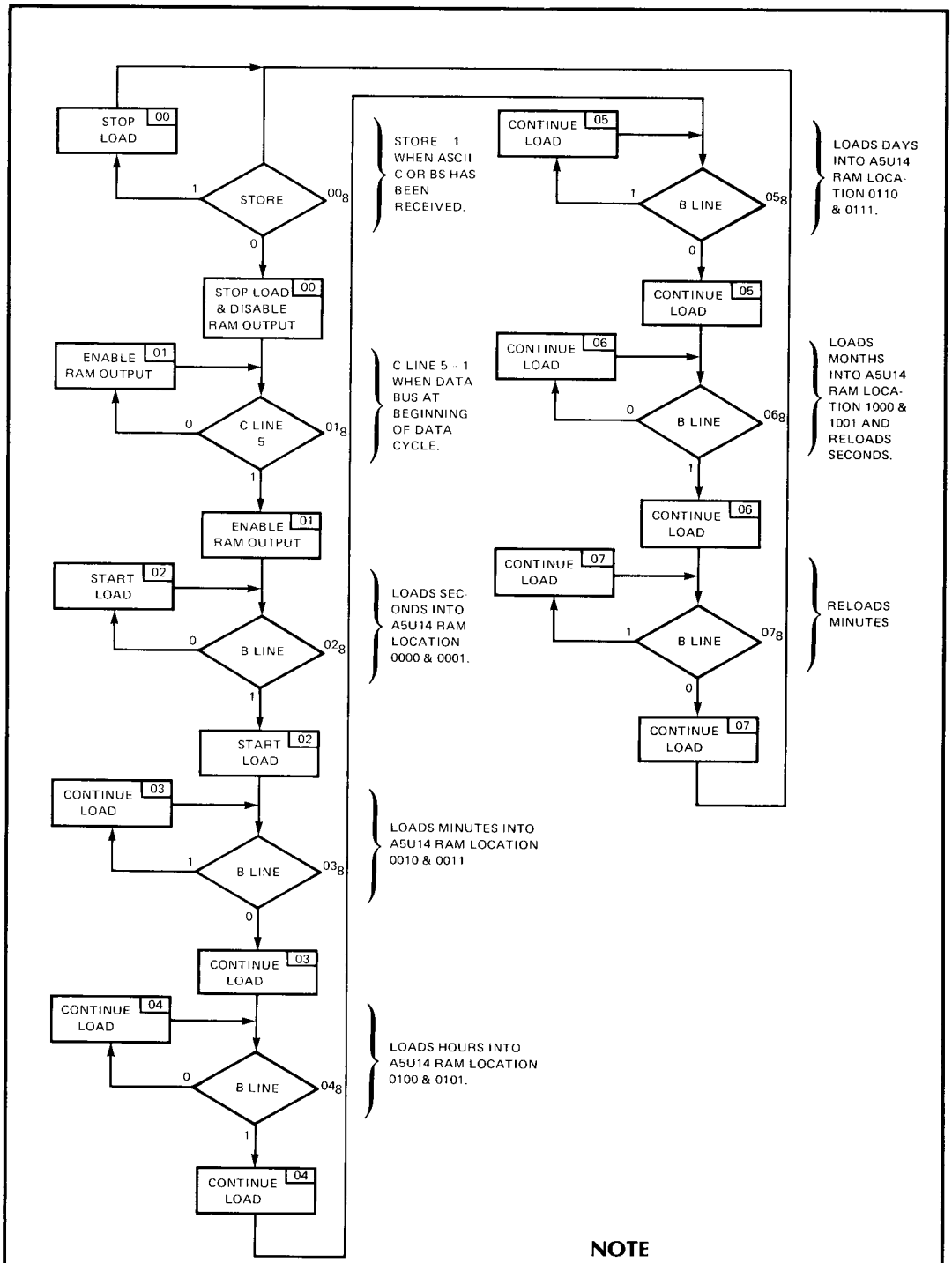
5-16. The octal numbers shown in the flowcharts represent the present address (octal) of the operation. This address can be correlated to the PRESENT ADDRESS shown in *Table 5-5* and *Table 5-6*. The column headings of *Tables 5-5* and *5-6* are the inputs and outputs of ROM A5U2 shown in the schematic diagram, *Figure 8-7*. The bit pattern in *Tables 5-5* and *5-6* can be displayed on an HP 1601A/182C Logic State Display with Oscilloscope. The display can then be compared with the bit pattern in *Tables 5-5* and *5-6* and with the flowchart to determine if State Machine A5U2 is operating properly.

5-17. The rectangular blocks in the flowcharts are process symbols which indicate performance of an operation by the ROM. The diamond symbols are decision blocks which interrogate the state of the named qualifier. The notes adjacent to the symbols describe the overall function performed at each point in the flowchart. All signal names are positive logic names except where noted.

5-18. The flowchart operation starts with *Figure 5-1* A5U2 Talk Disabled Flowchart when the Talk Enable Signal is a logic 1. When the $\overline{\text{Talk Enable}}$ Signal is a logic 0, flowchart operation starts with *Figure 5-2* A5U2 Talk Enabled Flowchart. The program jumps from one flowchart to the other when the state of the $\overline{\text{Talk Enable}}$ Signal changes. The program will jump to the same address with two exceptions, as follows:

a. Address 57_8, 60_8, and 61_8 on the Talk Enable Flowchart will jump to 05_8, 06_8, and 07_8 respectively on the Talk Disable Flowchart.

b. Address 05_8, 06_8, and 07_8 on the Talk Disable Flowchart will jump to 57_8, 60_8, and 61_8 on the Talk Enable Flowchart.

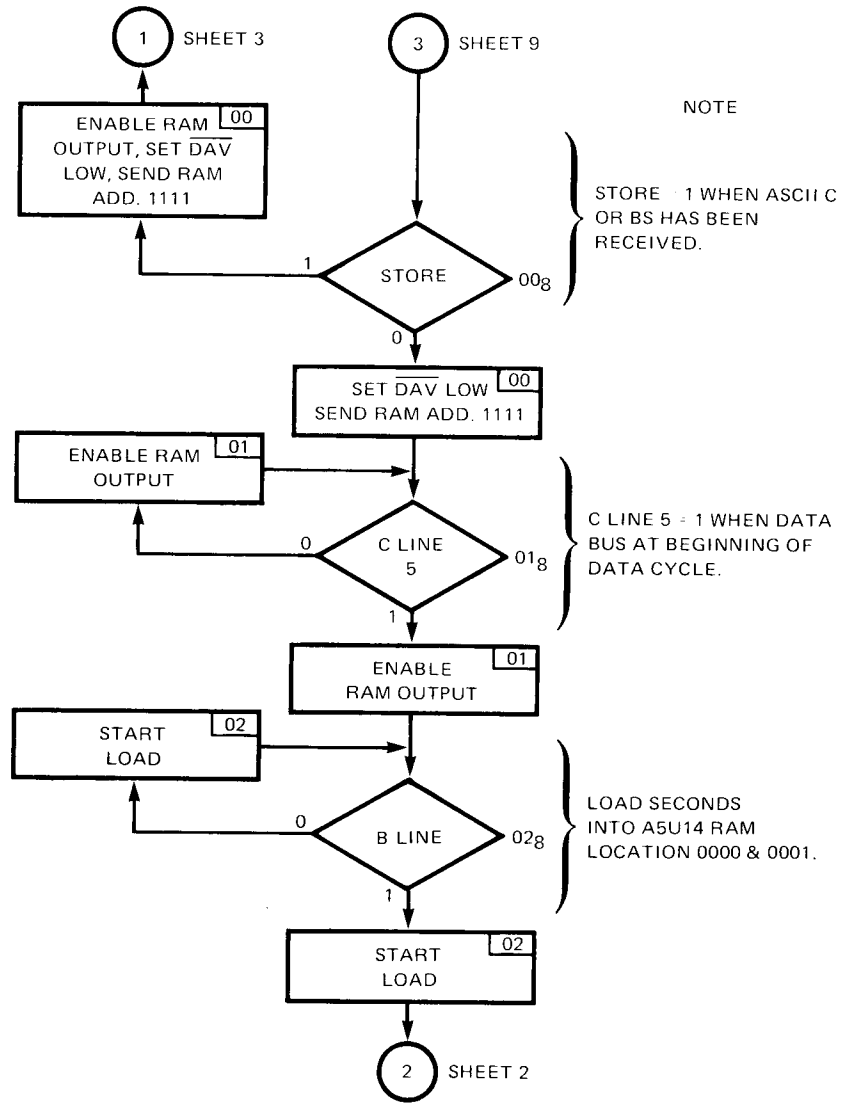


NOTE

1. 0 = Qualifier Low,
   1 = Qualifier High

2. This flowchart applies when the 59309A is addressed to talk, i.e., $\overline{\text{TALK ENABLE}}$ = 1. This program loops until $\overline{\text{TALK ENABLE}}$ = 0.

Figure 5-1. A5U2 Talk Disabled Flowchart



NOTES

1. 0 = Qualifier Low,
   1 = Qualifier High

2. This flowchart applies when the 59309A is addressed to talk, i.e., $\overline{\text{TALK ENABLE}} = 0$. Signal names are positive logic names except $\overline{\text{DAV}}$, NRFD, and NDAC which are negative logic names.

Figure 5-2. A5U2 Talk Enable Flowchart, Sheet 1

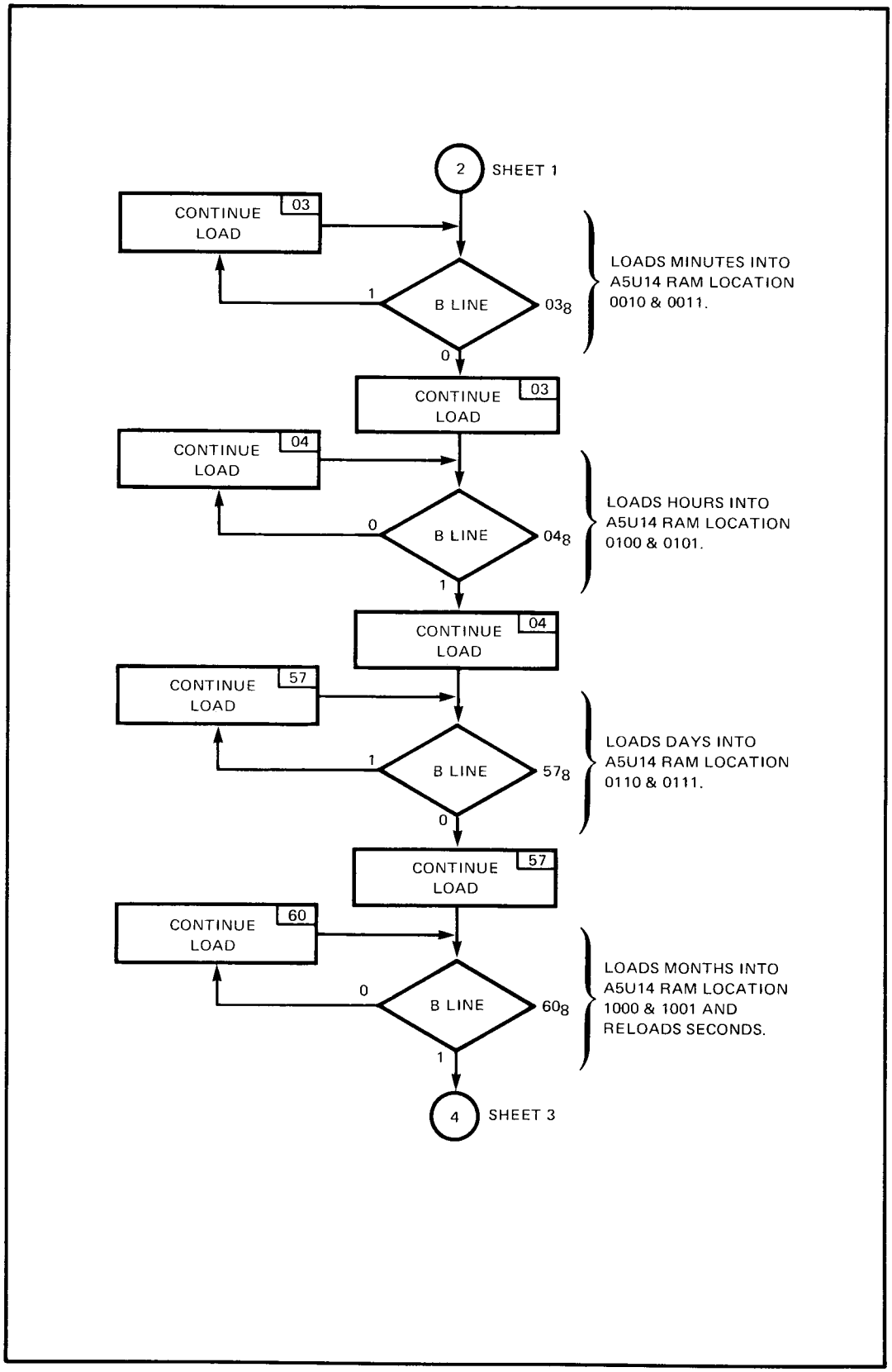


Figure 5-2. A5U2 Talk Enable Flowchart, Sheet 2

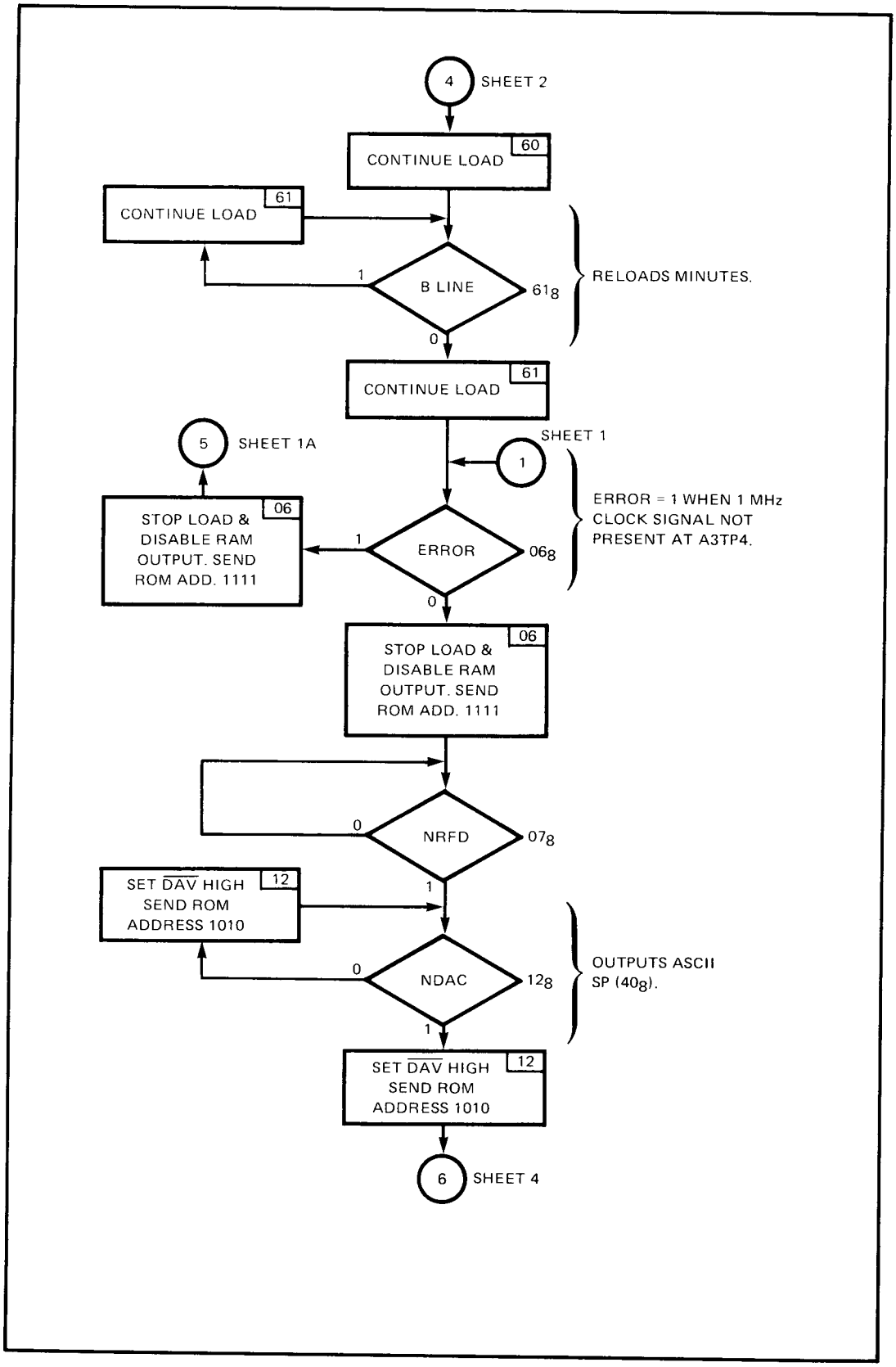


Figure 5-2. A5U2 Talk Enable Flowchart, Sheet 3

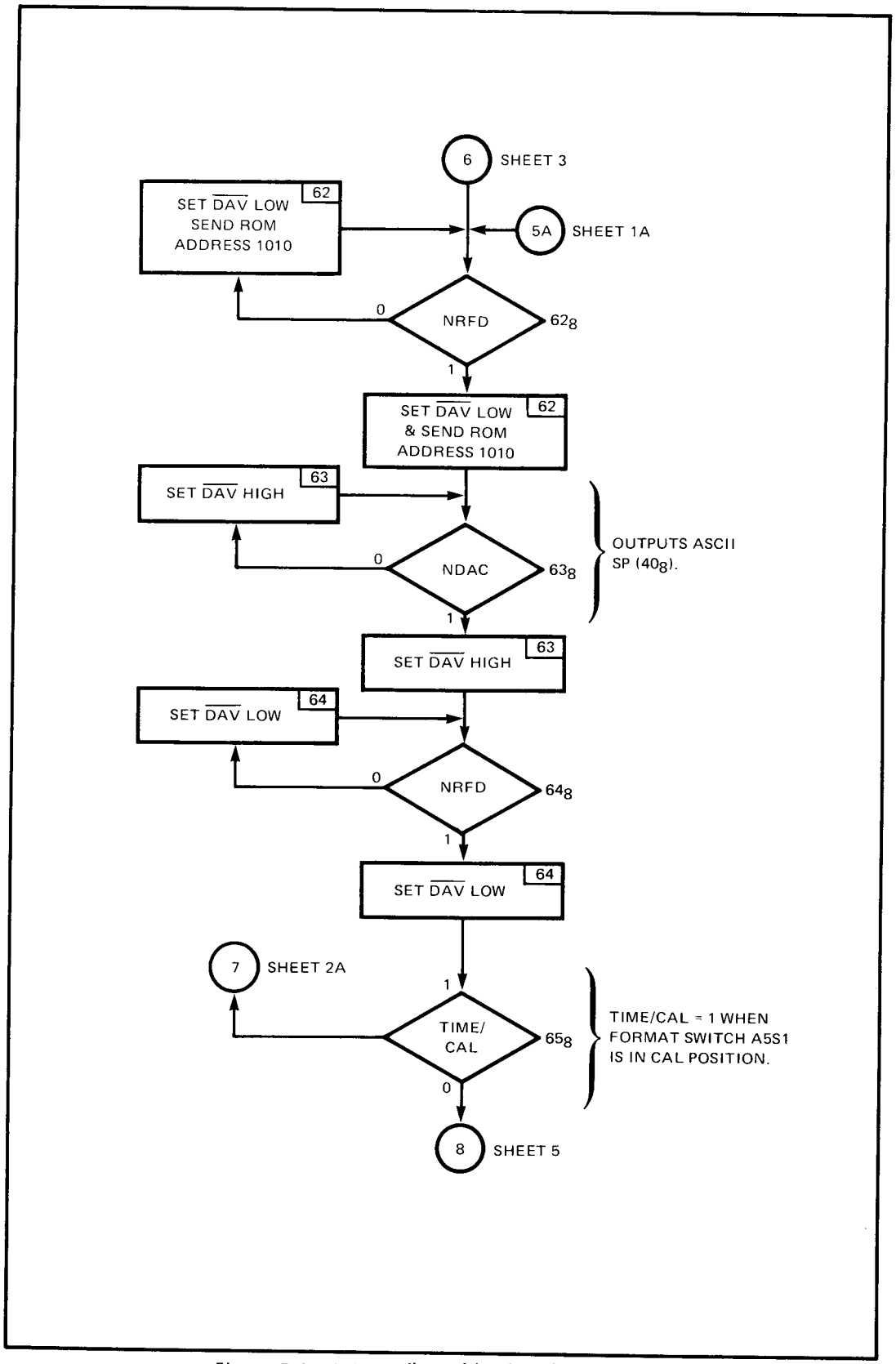


Figure 5-2. A5U2 Talk Enable Flowchart, Sheet 4

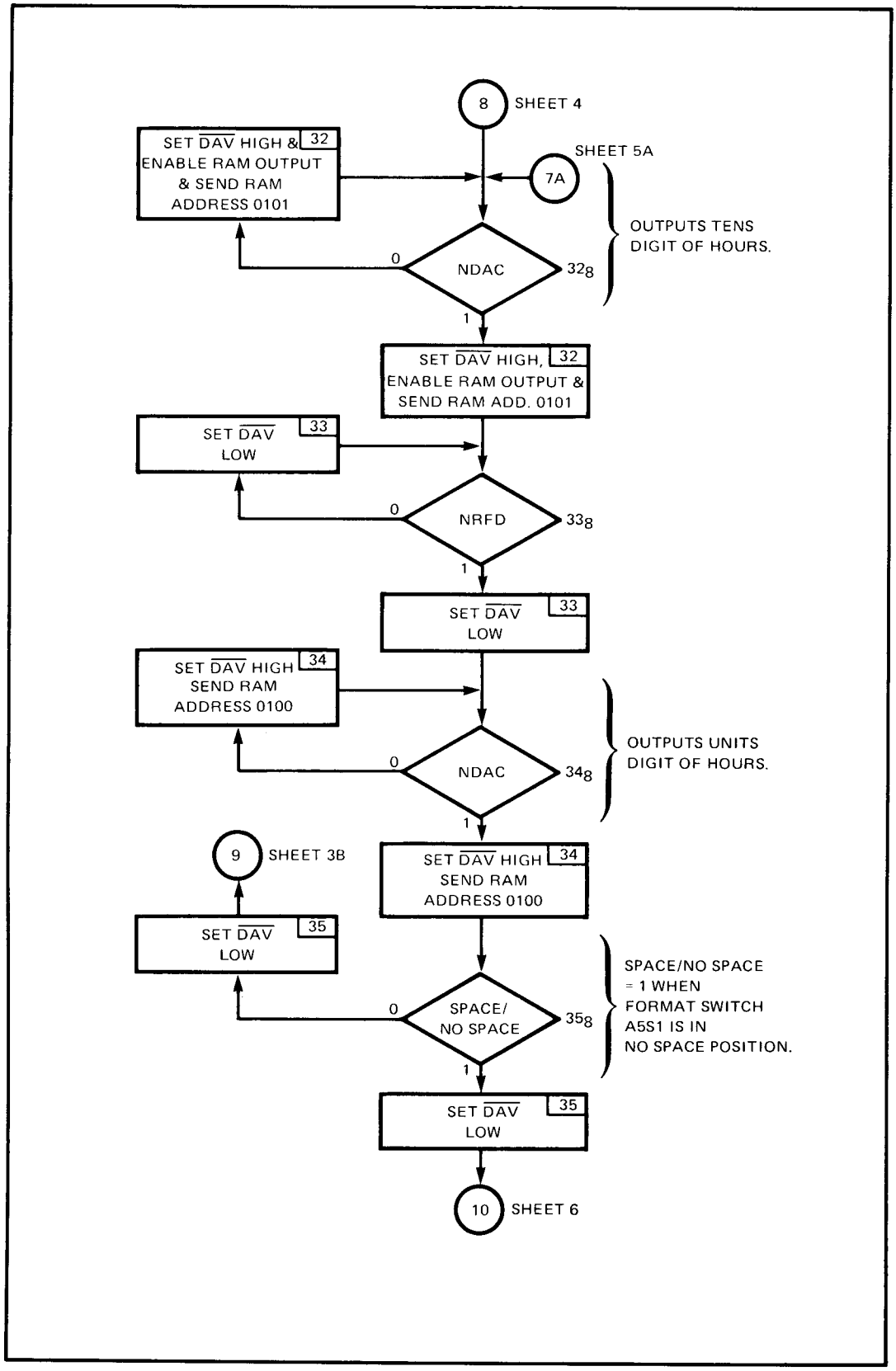


Figure 5–2. A5U2 Talk Enable Flowchart, Sheet 5

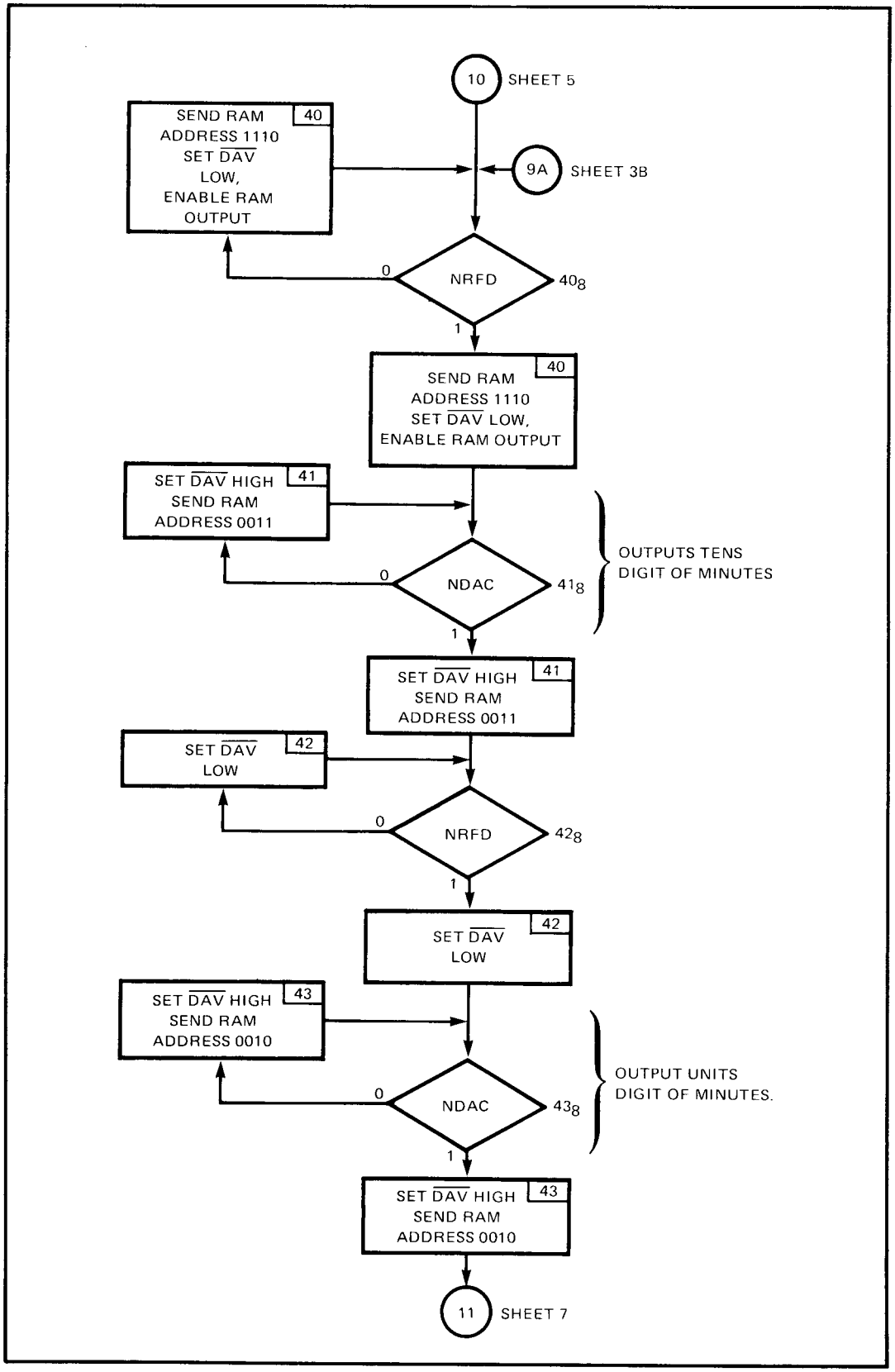


Figure 5-2. A5U2 Talk Enable Flowchart, Sheet 6

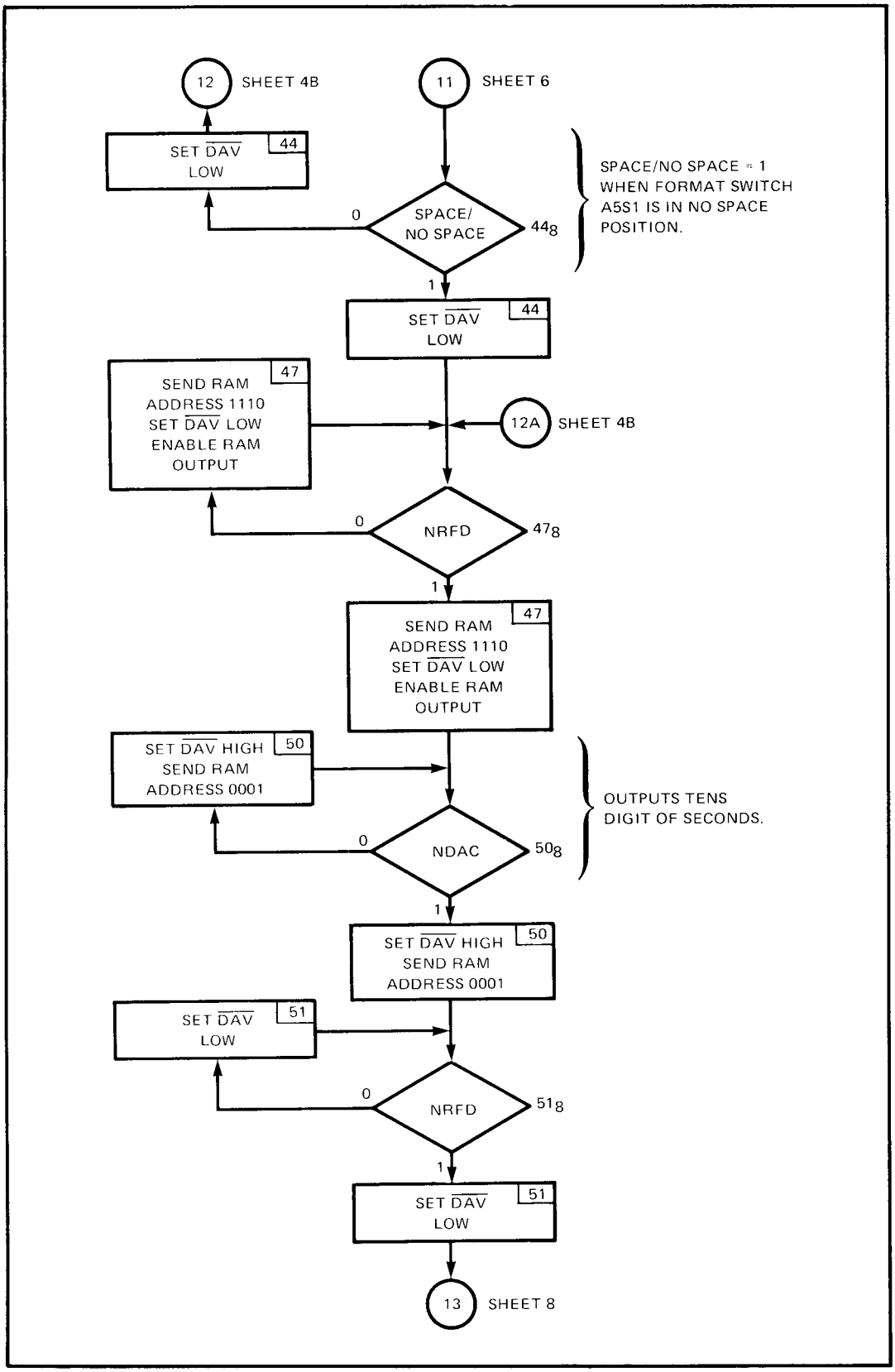


Figure 5-2. A5U2 Talk Enable Flowchart, Sheet 7

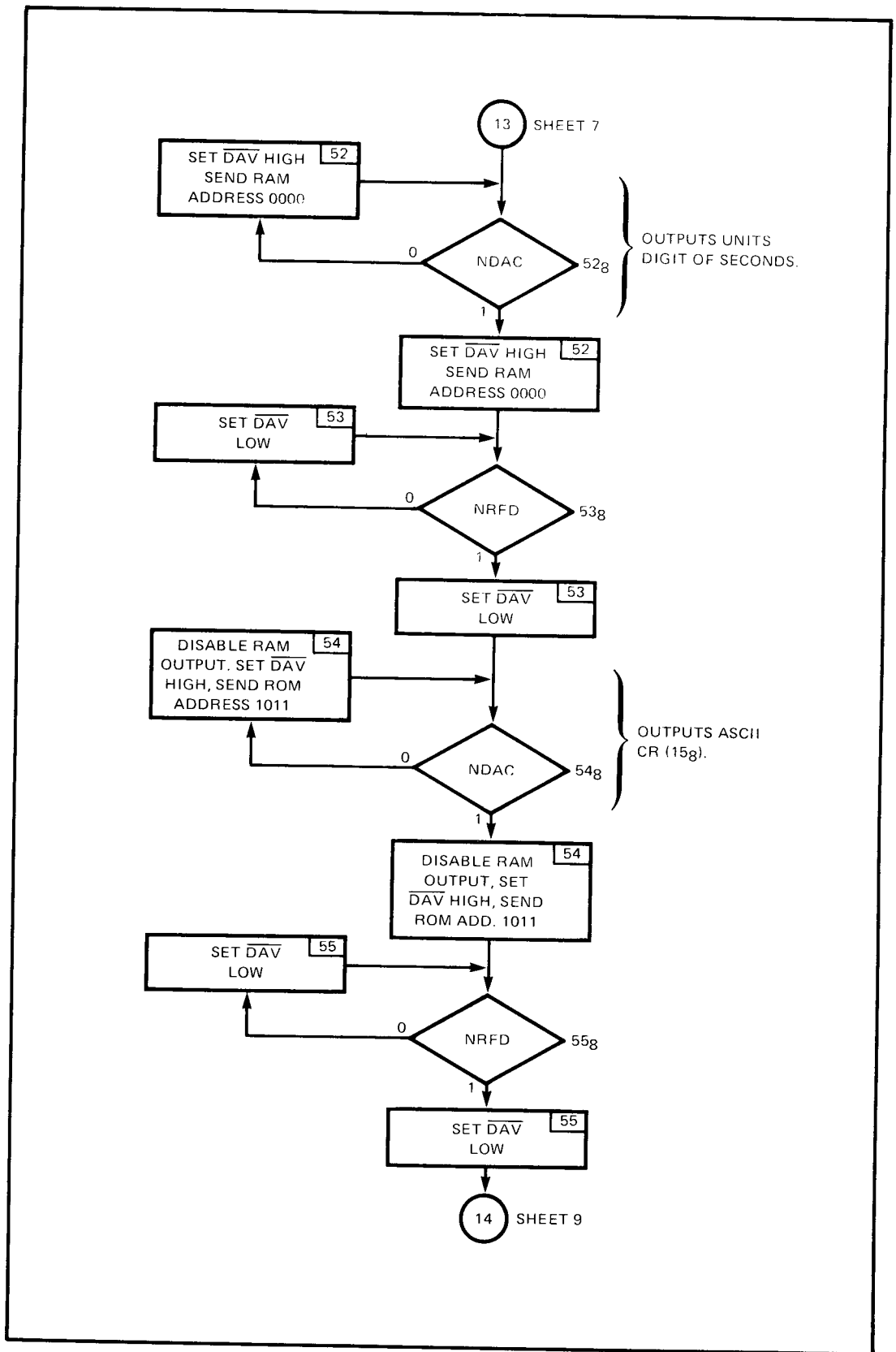


Figure 5–2. A5U2 Talk Enable Flowchart, Sheet 8

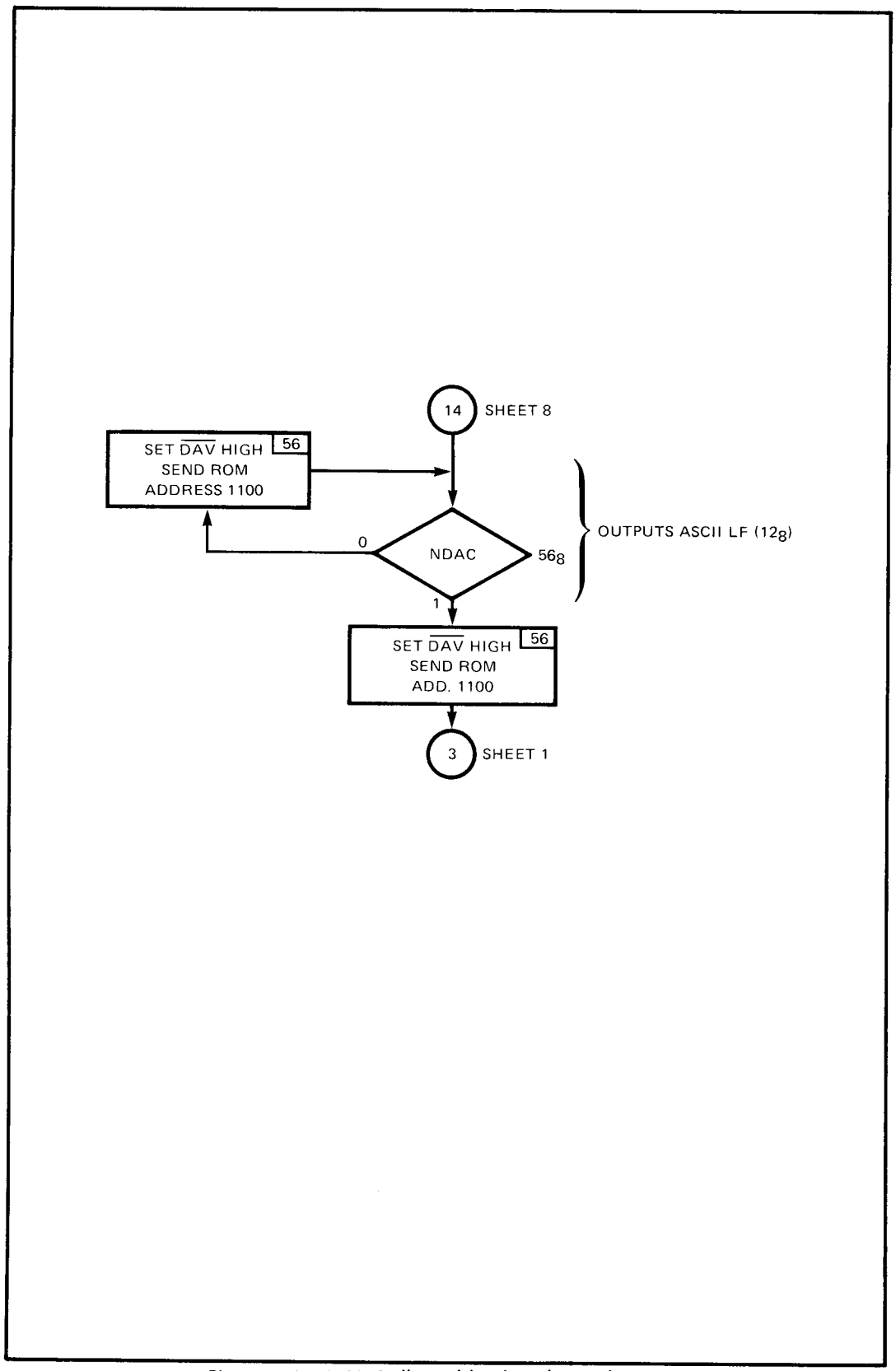


Figure 5-2. A5U2 Talk Enable Flowchart, Sheet 9

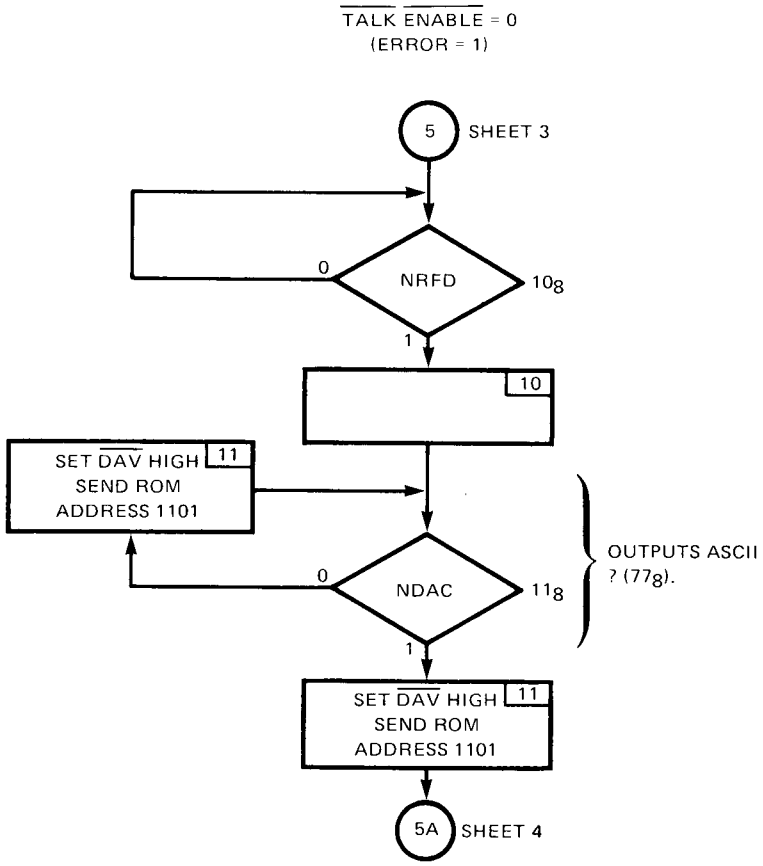


Figure 5-2. A5U2 Talk Enable Flowchart, Sheet 1A

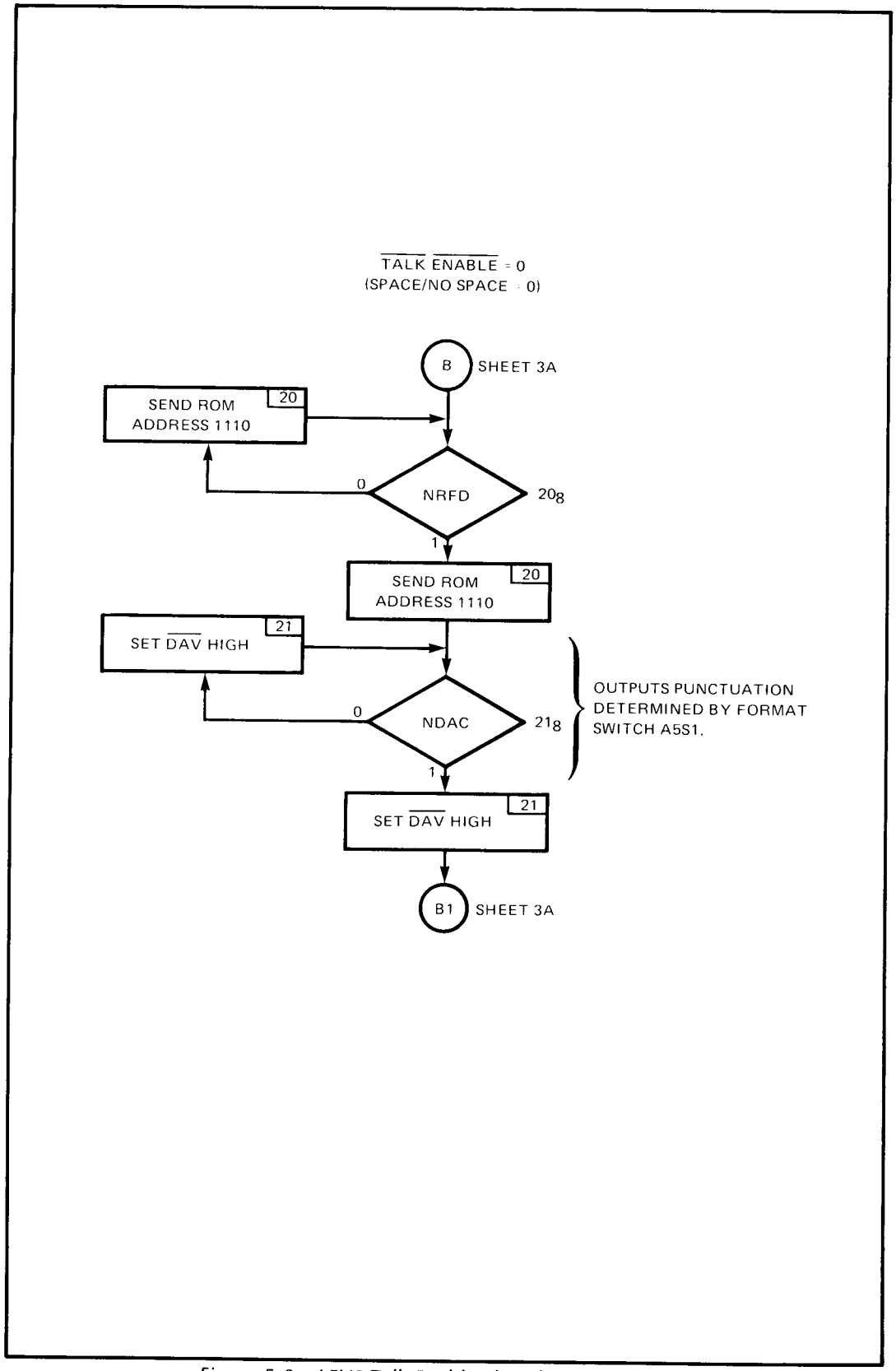


Figure 5-2. A5U2 Talk Enable Flowchart, Sheet 1B

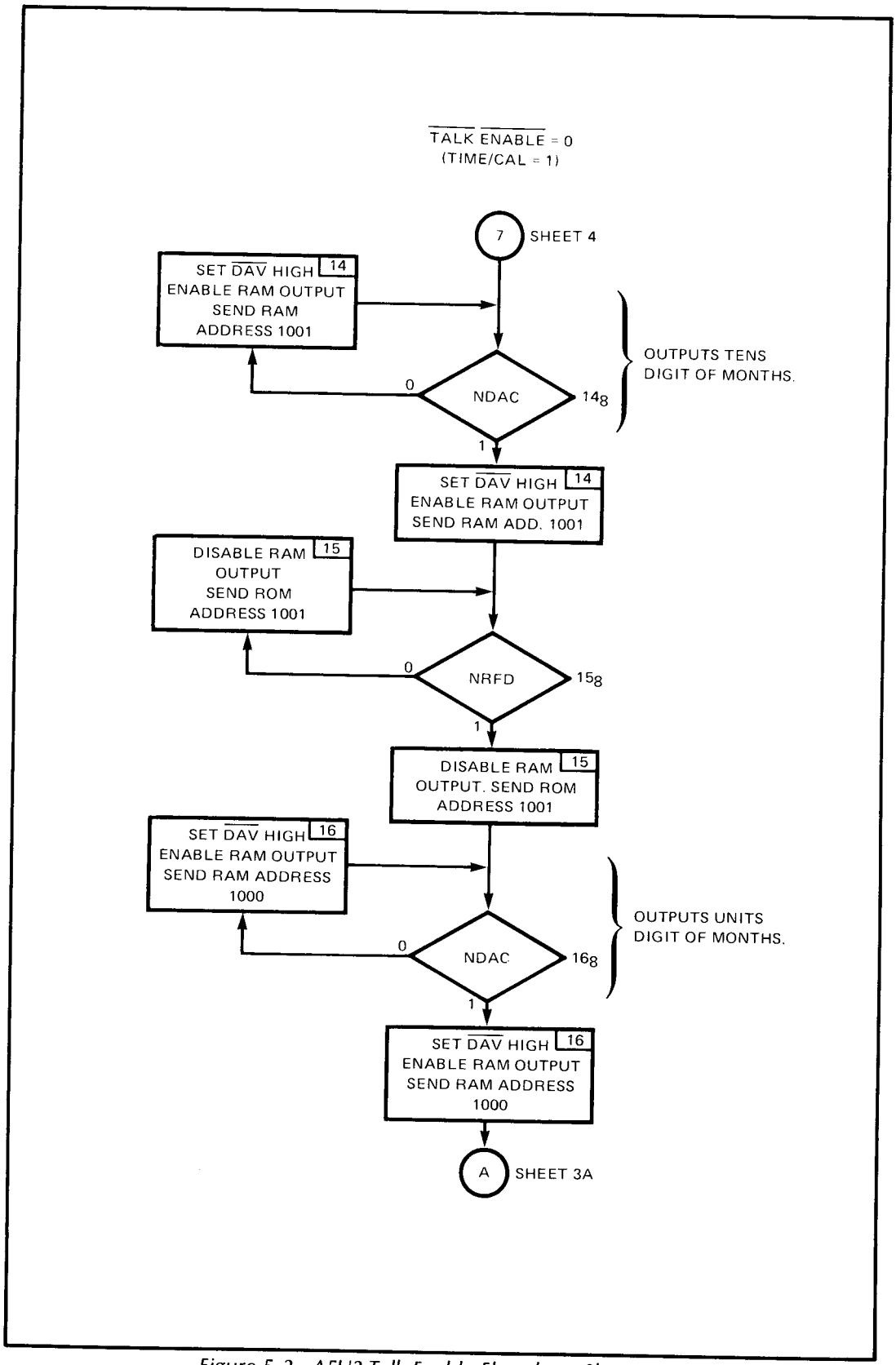


Figure 5-2. A5U2 Talk Enable Flowchart, Sheet 2A

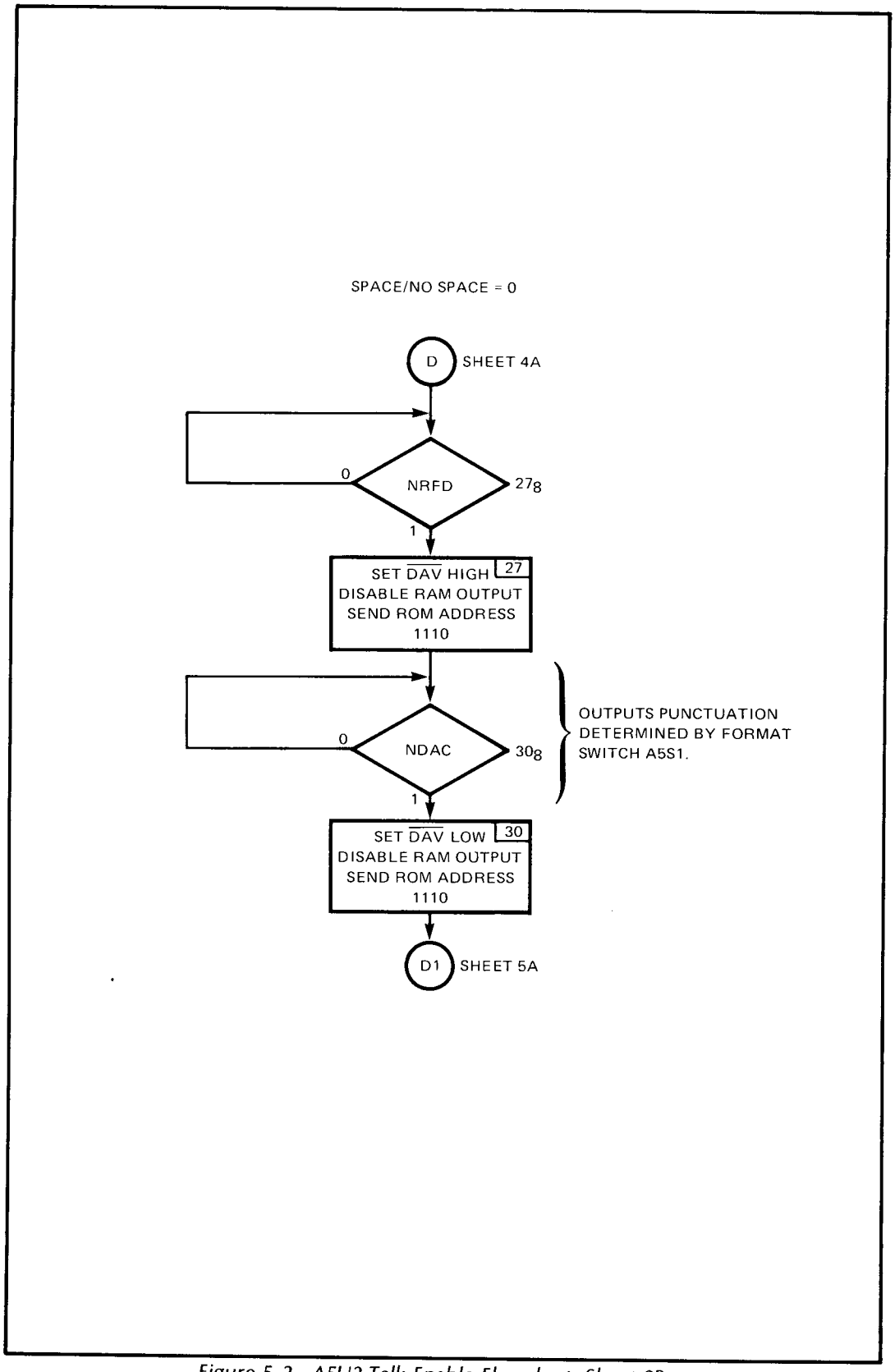


Figure 5-2. A5U2 Talk Enable Flowchart, Sheet 2B

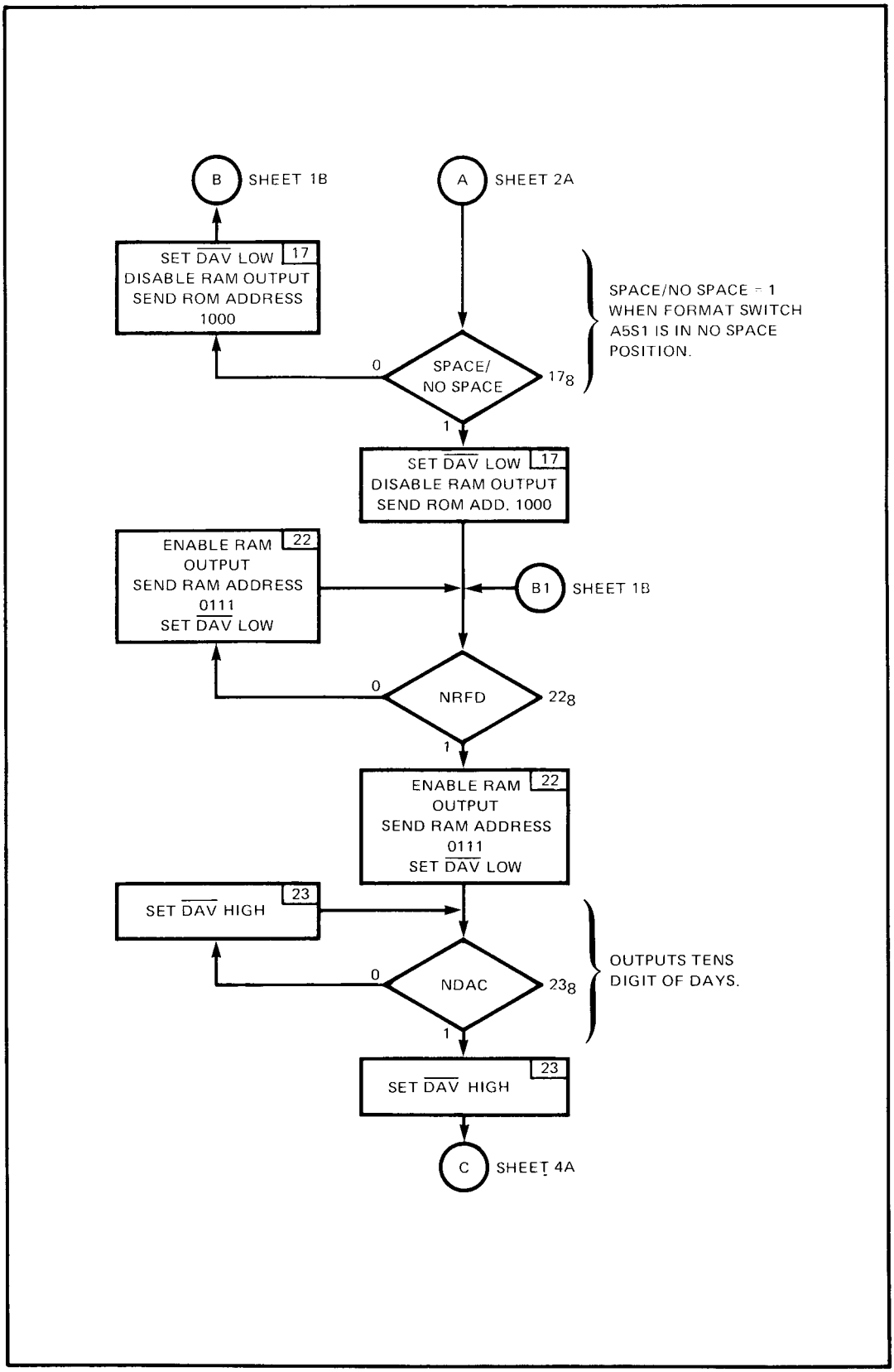


Figure 5-2. A5U2 Talk Enable Flowchart, Sheet 3A

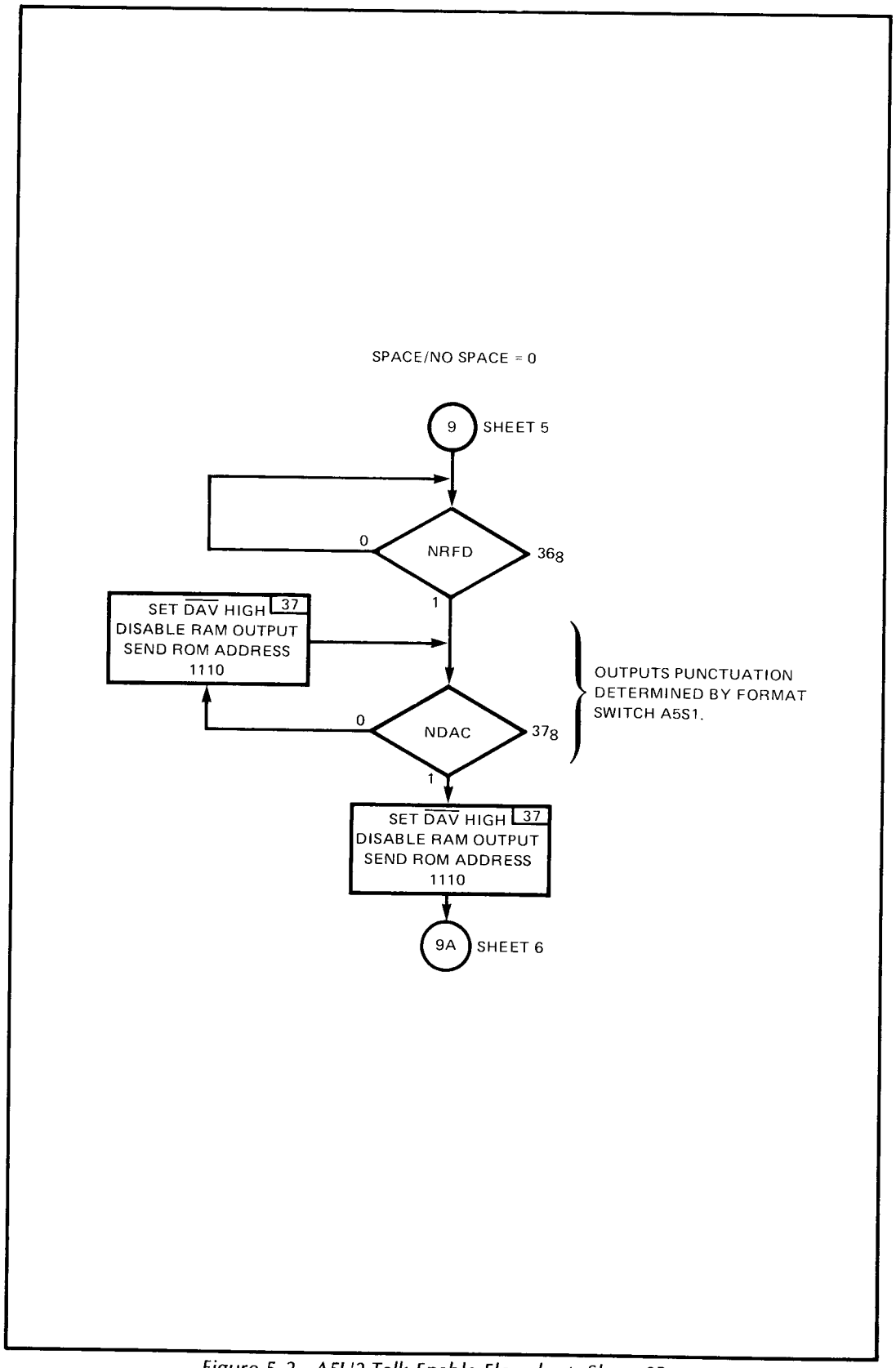


Figure 5-2. A5U2 Talk Enable Flowchart, Sheet 3B

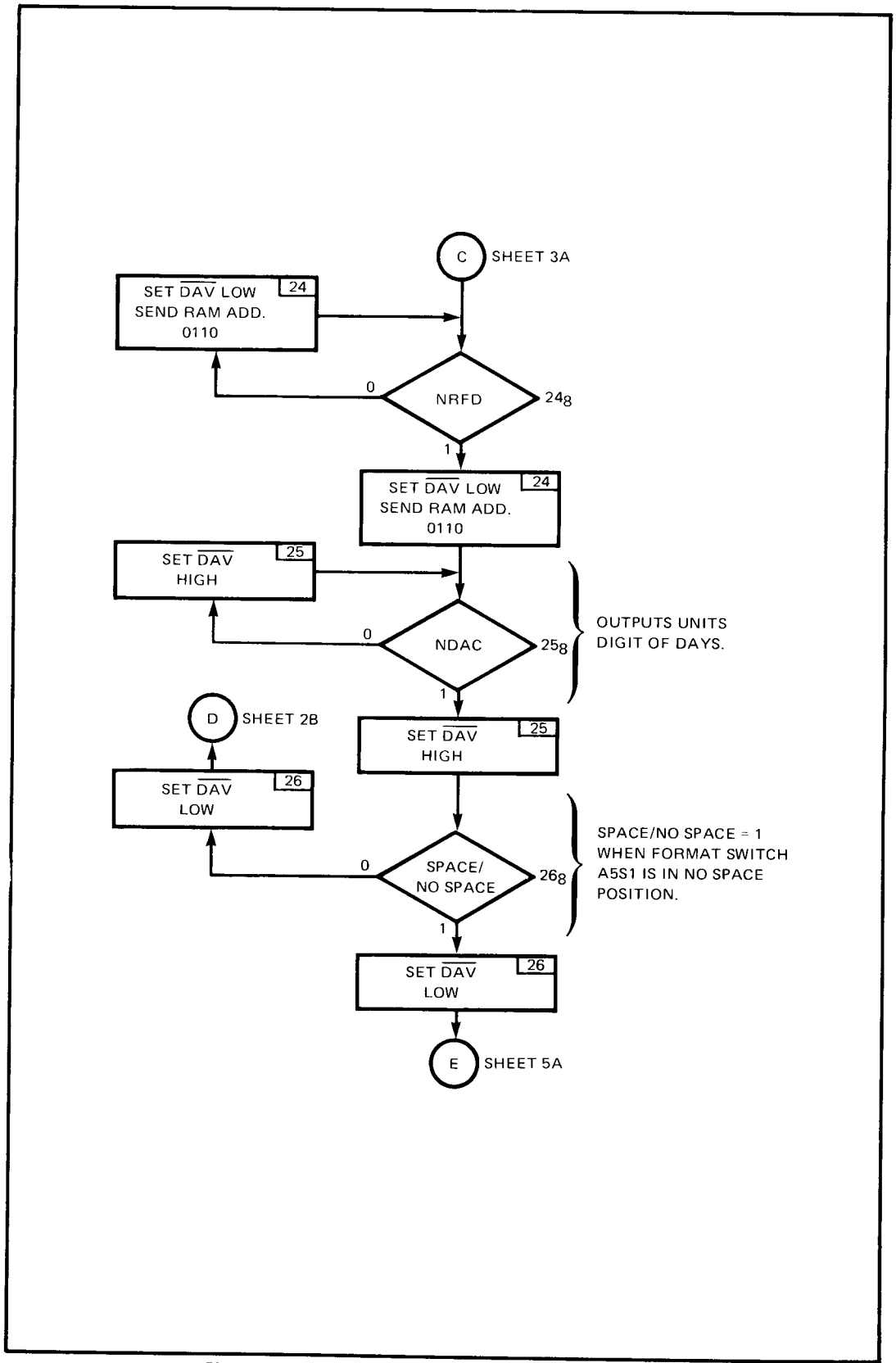


Figure 5–2. A5U2 Talk Enable Flowchart, Sheet 4A

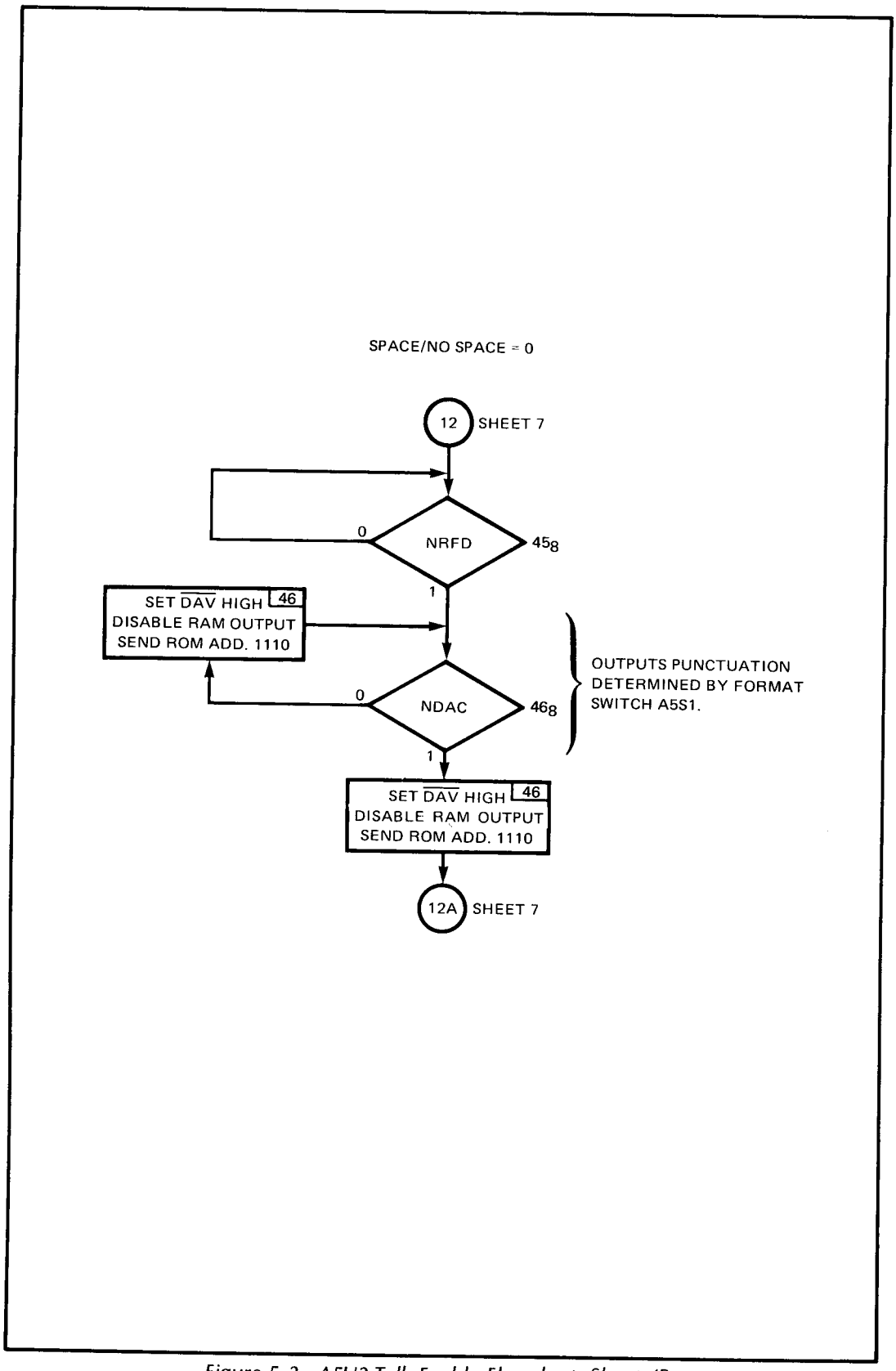


Figure 5-2. A5U2 Talk Enable Flowchart, Sheet 4B

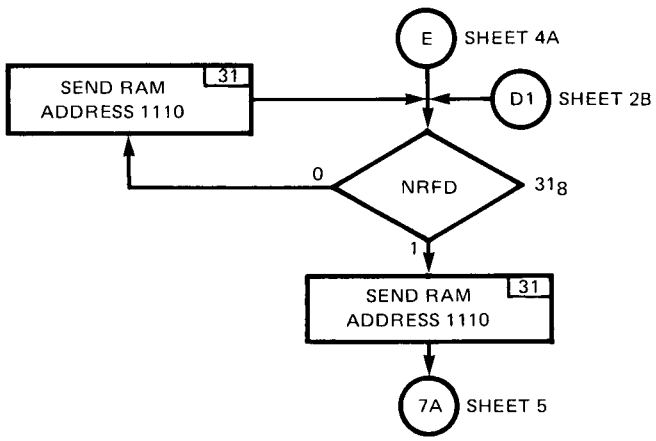


Figure 5-2. A5U2 Talk Enable Flowchart, Sheet 5A

SECTION VI
REPLACEABLE PARTS

6-1. INTRODUCTION

6-2. This section contains information for ordering replaceable parts for the 59309A. *Tables 6-1* and *6-2* list cabinet parts and replaceable parts respectively. *Table 6-3* contains a list of manufacturers of the replaceable parts and their respective code numbers. *Figure 6-1* identifies the cabinet parts.

6-3. Parts are listed in alpha-numeric order of their reference designator starting with A and ending with chassis and miscellaneous parts. The replaceable parts table includes the following information.

a. Reference designator (when applicable).
b. HP part number.
c. Total quantity (Qty) used in the instrument.
d. Description of the part (see abbreviations below).
e. Manufacturers code number.
f. Manufacturers part number.

REFERENCE DESIGNATIONS

A	= assembly	E	= miscellaneous electrical part	P	= electrical connector (movable portion); plug	V	= electron tube
AT	= attenuator; isolator; termination	F	= fuse			VR	= voltage regulator; breakdown diode
B	= fan; motor	FL	= filter	Q	= transistor; SCR; triode thyristor	W	= cable; transmission path; wire
BT	= battery	H	= hardware			X	= socket
C	= capacitor	HY	= circulator	R	= resistor	Y	= crystal unit-piezoelectric
CP	= coupler	J	= electrical connector (stationary portion); jack	RT	= thermistor		
CR	= diode; diode thyristor; varactor			S	= switch	Z	= tuned cavity; tuned circuit
				T	= transformer		
DC	= directional coupler	K	= relay	TB	= terminal board		
DL	= delay line	L	= coil; inductor	TC	= thermocouple		
DS	= annunciator; signaling device (audible or visual); lamp; LED	M	= meter	TP	= test point		
		MP	= miscellaneous mechanical part	U	= integrated circuit; microcircuit		

ABBREVIATIONS

A	= ampere	BAL	= balance	COEF	= coefficient	°C	= degree Celsius (centrigrade)
ac	= alternating current	BCD	= binary coded decimal	COM	= common	°F	= degree Fahrenheit
ACCESS	= accessory	BD	= board	COMP	= composition	°K	= degree Kelvin
ADJ	= adjustment	BE CU	= beryllium copper	COMPL	= complete	DEPC	= deposited carbon
A/D	= analog-to-digital	BFO	= beat frequency oscillator	CONN	= connector	DET	= detector
AF	= audio frequency			CP	= cadmium plate	diam	= diameter
AFC	= automatic frequency control	BH	= binder head	CRT	= cathode-ray tube	DIA	= diameter (used in parts list)
		BKDN	= breakdown	CTL	= complementary transistor logic		
AGC	= automatic gain control	BP	= bandpass			DIFF	
AL	= aluminum	BPF	= bandpass filter	CW	= continuous wave	AMPL	= differential amplifier
ALC	= automatic level control	BRS	= brass	cw	= clockwise	div	= division
AM	= amplitude modulation	BWO	= backward-wave oscillator	D/A	= digital-to-analog	DPDT	= double-pole, double-throw
AMPL	= amplifier			dB	= decibel		
APC	= automatic phase control	CAL	= calibrate	dBm	= decibel referred to 1 mW	DR	= drive
		ccw	= counterclockwise			DSB	= double sideband
ASSY	= assembly	CER	= ceramic	dc	= direct current	DTL	= diode transistor logic
AUX	= auxiliary	CHAN	= channel	deg	= degree (temperature interval or difference)	DVM	= digital voltmeter
avg	= average	cm	= centimeter			ECL	= emitter coupled logic
AWG	= american wire gauge	CMO	= coaxial	∠°	= degree (plane angle)		

ABBREVIATIONS (CONTINUED)

EMF	= electromotive force
EDP	= electronic data processing
ELECT	= electrolytic
ENCAP	= encapsulated
EXT	= external
F	= farad
FET	= field-effect transistor
F/F	= flip-flop
FH	= flat head
FOL H	= fillister head
FM	= frequency modulation
FP	= front panel
FREQ	= frequency
FXD	= fixed
g	= gram
GE	= germanium
GHz	= gigahertz
GL	= glass
GND	= ground(ed)
H	= henry
h	= hour
HET	= heterodyne
HEX	= hexagonal
HD	= head
HDW	= hardware
HF	= high frequency
HG	= mercury
HI	= high
HP	= Hewlett-Packard
HPF	= high pass filter
HR	= hour (used in parts list)
HV	= high voltage
Hz	= Hertz
IC	= integrated circuit
ID	= inside diameter
IF	= intermediate frequency
IMPG	= impregnated
in	= inch
INCD	= incandescent
INCL	= include(s)
INP	= input
INS	= insulation
INT	= internal
kg	= kilogram
kHz	= kilohertz
kΩ	= kilohm
kV	= kilovolt
lb	= pound
LC	= inductance-capacitance
LED	= light-emitting diode
LF	= low frequency
LG	= long
LH	= left hand
LIM	= limit
LIN	= linear taper (used in parts list)
lin	= linear
LK WASH	= lockwasher
LO	= low; local oscillator
LOG	= logarithmic taper (used in parts list)
log	= logarithm(ic)
LPF	= low pass filter
LV	= low voltage
m	= meter (distance)
mA	= milliampere
MAX	= maximum
MΩ	= megohm
MEG	= meg (10^6) (used in parts list)
MET FLM	= metal film
MET OX	= metal oxide
MF	= medium frequency; microfared (used in parts list)
MFR	= manufacturer
mg	= milligram
MHz	= megahertz
mH	= millihenry
mho	= mho
MIN	= minimum
min	= minute (time)
′	= minute (plane angle)
MINAT	= miniature
mm	= millimeter
MOD	= modulator
MOM	= momentary
MOS	= metal-oxide semiconductor
ms	= millisecond
MTG	= mounting
MTR	= meter (indicating device)
mV	= millivolt
mVac	= millivolt, ac
mVdc	= millivolt, dc
mVpk	= millivolt, peak
mVp-p	= millivolt, peak-to-peak
mVrms	= millivolt, rms
mW	= milliwatt
MUX	= multiplex
MY	= mylar
μA	= microampere
μF	= microfarad
μH	= microhenry
μmho	= micromho
μs	= microsecond
μV	= microvolt
μVac	= microvolt, ac
μVdc	= microvolt, dc
μVpk	= microvolt, peak
μVp-p	= microvolt, peak-to-peak
μVrms	= microvolt, rms
μW	= microwatt
nA	= nanoampere
NC	= no connection
N/C	= normally closed
NE	= neon
NEG	= negative
nF	= nanofarad
NI PL	= nickel plate
N/O	= normally open
NOM	= nominal
NORM	= normal
NPN	= negative-positive-negative
NPO	= negative-positive zero (zero temperature coefficient)
NRFR	= not recommended for field replacement
NSR	= not separately replaceable
ns	= nanosecond
nW	= nanowatt
OBD	= order by description
OD	= outside diameter
OH	= oval head
OP AMPL	= operational amplifier
OPT	= option
OSC	= oscillator
OX	= oxide
oz	= ounce
Ω	= ohm
P	= peak (used in parts list)
PAM	= pulse-amplitude modulation
PC	= printed circuit
PCM	= pulse-code moudulation; pulse-count modulation
PDM	= pulse-duration modulation
pF	= picofarad
PH BRZ	= phosphor bronze
PHL	= Phillips
PIN	= positive-intrinsic-negative
PIV	= peak inverse voltage
pk	= peak
PL	= phase lock
PLO	= phase lock oscillator
PM	= phase modulation
PNP	= positive-negative-positive
P/O	= part of
POLY	= polystyrene
PORC	= porcelain
POS	= positive; position(s) (used in parts list)
POSN	= position
POT	= potentiometer
p-p	= peak-to-peak
PP	= peak-to-peak (used in parts list)
PPM	= pulse-position modulation
PREAMPL	= preamplifier
PRF	= pulse repetition frequency
PRR	= pulse repetition rate
ps	= picosecond
PT	= point
PTM	= pulse-time modulation
PWM	= pulse-width modulation
PWV	= peak working voltage
RC	= resistance capacitance
RECT	= rectifier
REF	= reference
REG	= regulated
REPL	= replaceable
RF	= radio frequency
RFI	= radio frequency interference
RH	= round head; right hand
RLC	= resistance-inductance-capacitance
RMO	= rack mount only
rms	= root-mean-square
RND	= round
ROM	= read-only memory
R&P	= rack and panel
RWV	= reverse working voltage
S	= scattering parameter
s	= second (time)
″	= second (plane angle)
S-B	= slow-blow (fuse (used in parts list)
SCR	= silicon controlled rectifier; screw
SE	= selenium
SECT	= sections
SEMICON	= semiconductor
SHF	= superhigh frequency
SI	= silicon
SIL	= silver
SL	= slide
SNR	= signal-to-noise ratio
SPDT	= single-pole, double-throw
SPG	= spring
SR	= split ring
SPST	= single-pole, single-throw
SSB	= single sideband
SST	= stainless steel
STL	= steel
SQ	= square
SWR	= standing-wave ratio
SYNC	= synchronize
T	= timed (slow-blow fuse)
TA	= tantalum
TC	= temperature compensating
TD	= time delay
TERM	= terminal
TFT	= thin-film transistor
TGL	= toggle
THD	= thread
THRU	= through
TI	= titanium
TOL	= tolerance
TRIM	= trimmer
TSTR	= transistor
TTL	= transistor-transistor logic
TV	= television
TVI	= television interference
TWT	= traveling wave tube
U	= micro (10^{-6}) (used in parts list)
UF	= microfarad (used in parts list)
UHF	= ultrahigh frequency
UNREG	= unregulated
V	= volt
VA	= voltampere
Vac	= volts ac
VAR	= variable
VCO	= voltage-controlled oscillator
Vdc	= volts dc
VDCW	= volts dc, working (used in parts list)
V(F)	= volts, filtered
VFO	= variable-frequency oscillator
VHF	= very-high frequency
Vpk	= volts peak
Vp-p	= Volts peak-to-peak
Vrms	= volts rms
VSWR	= voltage standing wave ratio
VTO	= voltage-tuned oscillator
VTVM	= vacuum-tube voltmeter
V(X)	= volts, switched
W	= watt
W/	= with
WIV	= working inverse voltage
WW	= wirewound
W/O	= without
YIG	= yttrium-iron-garnet
Zo	= characteristic impedance

NOTE

All abbreviations in the parts list will be in upper case.

MULTIPLIERS

Abbreviation	Prefix	Multiple
T	tera	10^{12}
G	giga	10^{9}
M	mega	10^{6}
k	kilo	10^{3}
da	deka	10^{1}
d	deci	10^{-1}
c	centi	10^{-2}
m	milli	10^{-3}
μ	micro	10^{-6}
n	nano	10^{-9}
p	pico	10^{-12}
f	femto	10^{-15}
a	atto	10^{-18}

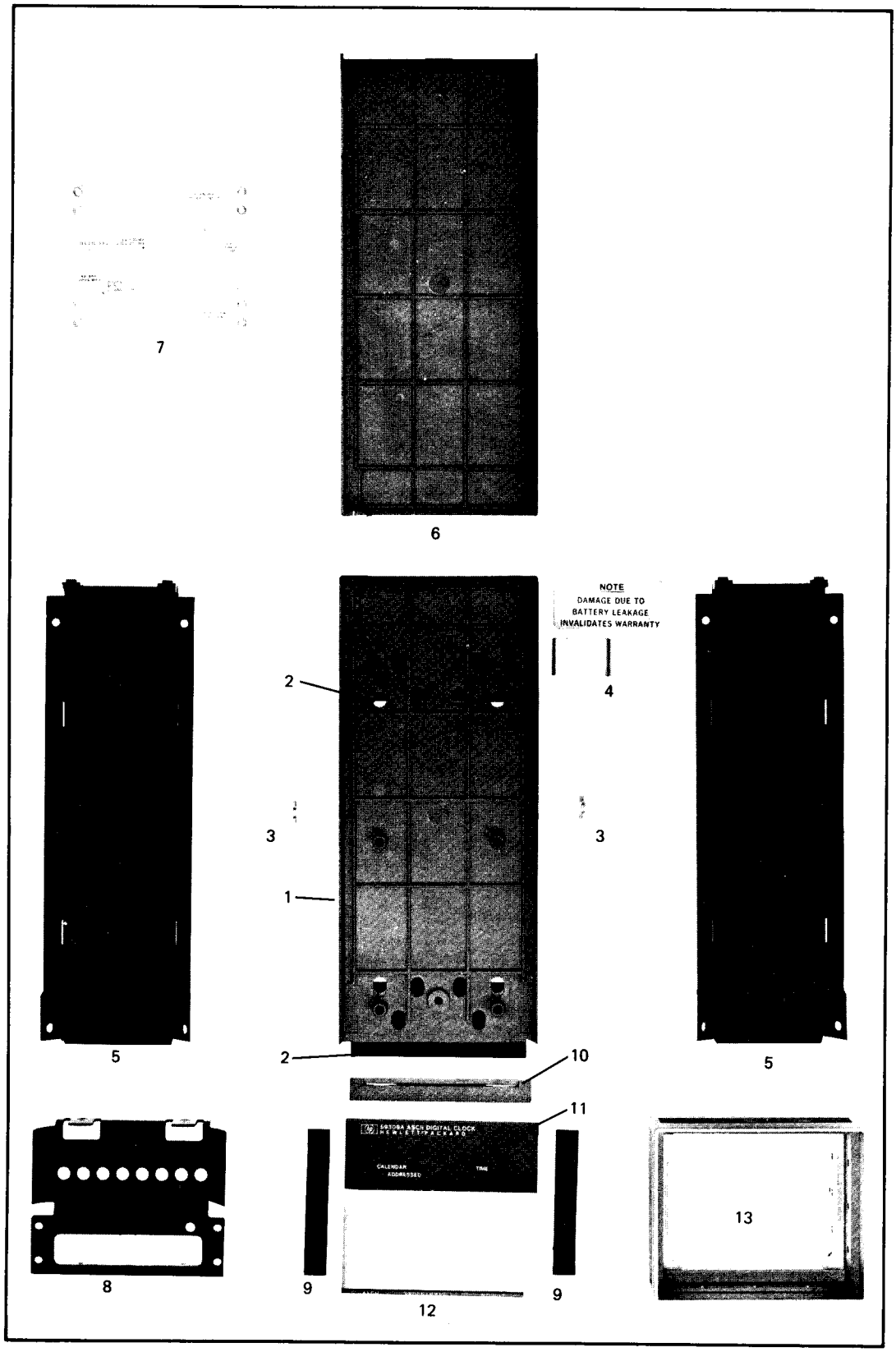


Figure 6-1. 59309A Cabinet Parts

6-4. ORDERING INFORMATION

6-5. To obtain replacement parts, address order of inquiry to your local Hewlett-Packard Sales and Service Office. Identify parts by their Hewlett-Packard part number.

6-6. To obtain a part that is not listed, include:

a. Instrument model number.
b. Instrument serial number.
c. Description of the part.
d. Function and location of the part.

6-7. HP PART NUMBER ORGANIZATION

6-8. Following is a general descritpion of the HP part number system.

6-9. Component Parts and Materials

6-10. Generally, the prefix of HP part numbers identifies the type of device. Eight-digit part numbers are used, where the four-digit prefix identifies the type of component, part, or material and the four-digit suffix indicates the specific type. Following is a list of some of the more commonly used prefixes for component parts. The list includes HP manufactured parts and purchased parts.

Prefix	Component/Part/Material
0121-	Capacitors, Variable (mechanical)
0122-	Capacitors, Voltage Variable (semiconducator)
0140-	Capacitors, Fixed }
0150-	Capacitors, Fixed } Non-Electrolytic
0160-	Capacitors, Fixed }
0180-	Capacitors, Fixed Electrolytic
0330-	Insulating Materials
0340-	Insulators, Formed
0370-	Knobs, Control
0380-	Spacers and Standoffs
0410-	Crystals
0470-	Adhesives
0490-	Relays
0510-	Fasteners
0674- thru 0778-	Resistors, Fixed (non wired wound)
0811- thru 0831-	Resistors (wire wound)
1200-	Sockets for components
1205-	Heat Sinks
1250-	Connectors (RF and related parts)
1251-	Connectors (non RF and related parts)
1410-	Bearings and Bushings
1420-	Batteries
1820-	Monolithic Digital Integrated Circuits
1826-	Monolithic Linear Integrated Circuits
1850-	Transistors, Germanium PNP
1851-	Transistors, Germanium NPN
1853-	Transistors, Silicon PNP
1854-	Transistors, Silicon NPN
1855-	Field-Effect-Transistors

1900- thru 1912-	Diodes
1920- thru 1952-	Vacuum Tubes
1990-	Semiconductor Photosensitive and Light-Emitting Diodes
3100- thru 3106-	Switches
8120-	Cables
9100-	Transformers, Coils, Chokes, Inductors, and Filters

6-11. For example, 1854-0037, 1854-0221, and 1851-0192 are all NPN transistors. The first two are silicon and the last is germanium.

6-12. General Usage Parts

6-13. The following list gives the prefixes for HP manufactured parts used in several instruments, e.g., side frames, feet, top and bottom covers, etc. These are eight-digit part numbers with the four-digit prefix identifying the type of parts as shown below:

Type of Part	Prefix
Sheet Metal	5000- to 5019-
Machined	5020- to 5039-
Molded	5040- to 5059-
Assemblies	5060- to 5079-
Components	5080- to 5099-

6-14. Specific Instrument Parts

6-15. These are HP manufactured parts for use in individual instruments or series of instruments. For these parts, the prefix indicates the instrument and the suffix indicates the type of part. For example, 59309-60001 is an assembly used in the 59309A. Following is a list of suffixes commonly used.

Type of Part	P/N Suffix
Sheet Metal	-00000 to -00499
Machined	-20000 to -20499
Molded	-40000 to -40499
Assembly	-60000 to 60499
Component	-80000 to -80299
Documentation	-90000 to -90249

Table 6-1. 59309A Cabinet Parts

Ref.	HP Part No.	Qty.	Description	Mfr. Code	Mfr. Part No.
1	5040-7211	1	COVER, BOTTOM	28480	5040-7211
2	5040-7205	2	FOOT	28480	5040-7205
3	59309-00004	2	BRACKET, MOTHERBOARD	28480	59309-00004
4	59309-00006	1	BRACKET, BATTERY	28480	59309-00006
5	5040-7212	2	COVER, SIDES	28480	5040-7212
6	5040-7210	1	COVER, TOP	28480	5040-7210
7	59309-00003	1	PANEL, REAR	28480	59309-00003
8	59309-00001	1	SUBPANEL, FRONT	28480	59309-00001
9	5001-0438	2	TRIM, SIDE	28480	5001-0438
10	5040-7204	1	TRIM, TOP	28480	5040-7204
11	59309-40002	1	WINDOW, FRONT	28480	59309-40002
12	59309-00002	1	PANEL, FRONT DOOR	28480	59309-00002
13	59304-20003	1	FRAME, MODIFIED	28480	59304-20003

Table 6-2. Replaceable Parts

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A1	59309-60001	1	BOARD ASSEMBLY, DISPLAY	28480	59309-60001
A1C1	0160-3879	8	CAPACITOR-FXD .01UF +-20% 100WVDC CER	28480	0160-3879
A1C2	0160-3879		CAPACITOR-FXD .01UF +-20% 100WVDC CER	28480	0160-3879
A1C3	0180-0210	1	CAPACITOR-FXD 3.3UF+-20% 15VDC TA	56289	150D335X0015A2
A1CR1	1901-0535	3	DIODE-SCHOTTKY	28480	1901-0535
A1CR2	1901-0535		DIODE-SCHOTTKY	28480	1901-0535
A1DS1	1990-0465	3	DISPLAY NUM SEG 4 CHAR .109 IN HIGH	28480	1990-0465
A1DS2	1990-0465		DISPLAY NUM SEG 4 CHAR .109 IN HIGH	28480	1990-0465
A1DS3	1990-0465		DISPLAY NUM SEG 4 CHAR .109 IN HIGH	28480	1990-0465
A1DS4	1990-0442	1	LED (ADDRESSED)	28480	1990-0442
A1J1	1251-3489	1	CONNECTOR-PC EDGE 18-CONT/ROW 2-ROWS	05574	3VH18/1JV12/079
A1Q1	1854-0071	9	TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A1Q2	1854-0071		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A1Q3	1854-0071		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A1Q4	1854-0071		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A1Q5	1854-0071		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A1Q6	1854-0071		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A1Q7	1854-0071		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A1Q8	1854-0071		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A1Q9	1853-0015	1	TRANSISTOR PNP SI PD=200MW FT=500MHZ	28480	1853-0015
A1R1	0683-1115	8	RESISTOR 110 5% .25W FC TC=-400/+600	01121	CB1115
A1R2	0683-1115		RESISTOR 110 5% .25W FC TC=-400/+600	01121	CB1115
A1R3	0683-1115		RESISTOR 110 5% .25W FC TC=-400/+600	01121	CB1115
A1R4	0683-1115		RESISTOR 110 5% .25W FC TC=-400/+600	01121	CB1115
A1R5	0683-1115		RESISTOR 110 5% .25W FC TC=-400/+600	01121	CB1115
A1R6	0683-1115		RESISTOR 110 5% .25W FC TC=-400/+600	01121	CB1115
A1R7	0683-1115		RESISTOR 110 5% .25W FC TC=-400/+600	01121	CB1115
A1R8	0683-1115		RESISTOR 110 5% .25W FC TC=-400/+600	01121	CB1115
A1R9	0683-2725	9	RESISTOR 2.7K 5% .25W FC TC=-400/+700	01121	CB2725
A1R10	0683-2725		RESISTOR 2.7K 5% .25W FC TC=-400/+700	01121	CB2725
A1R11	0683-2725		RESISTOR 2.7K 5% .25W FC TC=-400/+700	01121	CB2725
A1R12	0683-2725		RESISTOR 2.7K 5% .25W FC TC=-400/+700	01121	CB2725
A1R13	0683-4725	2	RESISTOR 4.7K 5% .25W FC TC=-400/+700	01121	CB4725
A1R14	0683-5115	1	RESISTOR 510 5% .25W FC TC=-400/+600	01121	CB5115
A1R15	0683-1045	4	RESISTOR 100K 5% .25W FC TC=-400/+800	01121	CB1045
A1R16	0683-1035	12	RESISTOR 10K 5% .25W FC TC=-400/+700	01121	CB1035
A1R17	1810-0041	2	NETWORK-RES 9-PIN-SIP .15-PIN-SPCG	28480	1810-0041
A1S1	3101-0878	2	SWITCH-TGL SUBMIN SPDT NS 2A 250VAC	28480	3101-0878
A1S2	3101-0858	5	SWITCH-PB SPDT MOM 1A 115VAC	09353	P8121-C
A1S3	3101-0692	1	SWITCH-TGL SUBMIN DPDT NS .02A 20VAC/DC	28480	3101-0692
A1S4	3101-0858		SWITCH-PB SPDT MOM 1A 115VAC	09353	P8121-C
A1S5	3101-0878		SWITCH-TGL SUBMIN SPDT NS 2A 250VAC	28480	3101-0878
A1S6	3101-0858		SWITCH-PB SPDT MOM 1A 115VAC	09353	P8121-C
A1S7	3101-0858		SWITCH-PB SPDT MOM 1A 115VAC	09353	P8121-C
A1S8	3101-0858		SWITCH-PB SPDT MOM 1A 115VAC	09353	P8121-C
A1U1	1820-1199	4	IC SN74LS04N TTL LS HEX	01295	SN74LS04N
A1U2	1620-0914	1	IC DECODER	07263	9307DC
A1U3	1826-0180	1	IC NE 555 TIMER	18324	NE555V
A1XDS1	1200-0601	3	SOCKET-IC 14-CONT W-WRAP-TERMS	28480	1200-0601
A1XDS2	1200-0601		SOCKET-IC 14-CONT W-WRAP-TERMS	28480	1200-0601
A1XDS3	1200-0601		SOCKET-IC 14-CONT W-WRAP-TERMS	28480	1200-0601
A2	59309-60002	1	BOARD ASSEMBLY, MB/POWER SUPPLY	28480	59309-60002
A2C1	0180-2154	1	CAPACITOR-FXD 1900UF+75-10% 15VDC AL	56289	39D198G015GL4
A2C2	0160-3879		CAPACITOR-FXD .01UF +-20% 100WVDC CER	28480	0160-3879
A2C3	0180-1735	2	CAPACITOR-FXD .22UF+-10% 35VDC TA	56289	150D224X9035A2
A2C4	0160-3879		CAPACITOR-FXD .01UF +-20% 100WVDC CER	28480	0160-3879
A2C5	0160-3879		CAPACITOR-FXD .01UF +-20% 100WVDC CER	28480	0160-3879
A2C6	0160-3879		CAPACITOR-FXD .01UF +-20% 100WVDC CER	28480	0160-3879
A2C7	0160-3879		CAPACITOR-FXD .01UF +-20% 100WVDC CER	28480	0160-3879
A2CR1	1906-0027	1	DIODE-MULT FULL WAVE BRIDGE RECTIFIER	04713	MDA922-6
A2CR2	1901-0028	3	DIODE-PWR RECT 400V 750NA DO-29	04713	SR1358-9
A2CR3	1901-0028		DIODE-PWR RECT 400V 750NA DO-29	04713	SR1358-9
A2CR4	1901-0028		DIODE-PWR RECT 400V 750NA DO-29	04713	SR1358-9
A2CR5	1902-3122	1	DIODE-ZNR 6.65V 2% DO-7 PD=.4W TC=+.038%	04713	SZ 10939-132
A2CR6	1901-0040	19	DIODE-SWITCHING 30V 50NA 2NS DO-35	28480	1901-0040
A2CR7	1901-0040		DIODE-SWITCHING 30V 50NA 2NS DO-35	28480	1901-0040
A2CR8	1901-0040		DIODE-SWITCHING 30V 50NA 2NS DO-35	28480	1901-0040
A2CR9	1901-0040		DIODE-SWITCHING 30V 50NA 2NS DO-35	28480	1901-0040
A2CR10	1901-0040		DIODE-SWITCHING 30V 50NA 2NS DO-35	28480	1901-0040

See introduction to this section for ordering information

Table 6-2. Replaceable Parts (Continued)

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A2CR11	1901-0040		DIODE-SWITCHING 30V 50NA 2NS DO-35	28480	1901-0040
A2J1			NOT ASSIGNED		
A2J2	1251-3283	1	CONNECTOR: 24-CONT; FEM; MICRORIBBON	28480	1251-3283
A2Q1	1854-0053	1	TRANSISTOR NPN 2N2218 SI TO-5 PD=800MW	04713	2N2218
A2Q2	1854-0210	1	TRANSISTOR NPN 2N2222 SI TO-18 PD=500MW	04713	2N2222
A2Q3	1854-0575	1	TRANSISTOR NPN SI PD=625MW FT=100MHZ	28480	1854-0575
	1205-0011	1	HEAT-DISSIPATOR SGL TO-5/TO-39 PKG	28480	1205-0011
A2R1	0683-0275	2	RESISTOR 2.7 5% .25W FC TC=-400/+500	01121	CB27G5
A2R2	0683-0275		RESISTOR 2.7 5% .25W FC TC=-400/+500	01121	CB27G5
A2R3	0683-3335	1	RESISTOR 33K 5% .25W FC TC=-400/+800	01121	CB3335
A2R4	0683-2225	1	RESISTOR 2.2K 5% .25W FC TC=-400/+700	01121	CB2225
A2R5	0683-1235	1	RESISTOR 12K 5% .25W FC TC=-400/+800	01121	CB1235
A2S1	3101-1973	1	SWITCH-SL 7-1A-NS DIP-SLIDE-ASSY .1A	11237	206 TYPE
A2S2	3101-1313	1	SWITCH-SL DP3T-NS MINTR .5A 125VAC/DC PC	79727	G128S-0004
A2XA3	1251-2035		CONNECTOR-PC EDGE 15-CONT/ROW 2-ROWS	71785	252-15-30-300
A2XA4A	1251-2035	5	CONNECTOR-PC EDGE 15-CONT/ROW 2-ROWS	71785	252-15-30-300
A2XA4B	1251-2035		CONNECTOR-PC EDGE 15-CONT/ROW 2-ROWS	71785	252-15-30-300
A2XA5A	1251-2035		CONNECTOR-PC EDGE 15-CONT/ROW 2-ROWS	71785	252-15-30-300
A2XA5B	1251-2035		CONNECTOR-PC EDGE 15-CONT/ROW 2-ROWS	71785	252-15-30-300
A2XDS1	1200-0485	1	SOCKET:IC 14-PIN PC MOUNTING	28480	1200-0485
			A2 MISCELLANEOUS		
	1400-0454	1	STUD, SNAP-ON(FOR INTERNAL BT.(-)	28480	1400-0454
	1400-0456	1	SOCKET, SNAP-ON(FOR INTERNAL BT.(+)	28480	1400-0456
	1530-1098	2	FASTENER:0.136" DIA 6-32 THREAD	00000	OBD
	0380-0046	4	STANDOFF-RVT-ON .375LG .152ID .250D BRS	28480	0380-0046
A3	59309-60003	1	BOARD ASSEMBLY, CALNDR OSC	28480	59309-60003
A3C1	0160-3879		CAPACITOR-FXD .01UF +-20% 100WVDC CER	28480	0160-3879
A3C2	0140-0210	2	CAPACITOR-FXD 270PF +-5% 300WVDC MICA	72136	DM15F271J0300WV1CR
A3C3	0121-0180	1	CAPACITOR-V TRMR-CER 15/60PF 200V PC-MTG	00865	304324 15/60PF N1500
A3C4	0140-0175	2	CAPACITOR-FXD 39PF +-2% 300WVDC MICA	72136	DM15E390G0300WV1CR
A3C5	0140-0175		CAPACITOR-FXD 39PF +-2% 300WVDC MICA	72136	DM15E390G0300WV1CR
A3C6	0160-3878	1	CAPACITOR-FXD 1000PF +-20% 100WVDC CER	28480	0160-3878
A3C7	0140-0210		CAPACITOR-FXD 270PF +-5% 300WVDC MICA	72136	DM15F271J0300WV1CR
A3CR1	1901-0040		DIODE-SWITCHING 30V 50NA 2NS DO-35	28480	1901-0040
A3CR2	1901-0040		DIODE-SWITCHING 30V 50NA 2NS DO-35	28480	1901-0040
A3CR3	1901-0040		DIODE-SWITCHING 30V 50NA 2NS DO-35	28480	1901-0040
A3CR4	1901-0040		DIODE-SWITCHING 30V 50NA 2NS DO-35	28480	1901-0040
A3CR5	1901-0040		DIODE-SWITCHING 30V 50NA 2NS DO-35	28480	1901-0040
A3Q1	1854-0009	1	TRANSISTOR NPN 2N709 SI TO-18 PD=300MW	28480	1854-0009
A3R1	0757-0442	2	RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-TO-1002-F
A3R2	0757-0442		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-TO-1002-F
A3R3	0683-1025	1	RESISTOR 1K 5% .25W FC TC=-400/+600	01121	CB1025
A3R4	0683-1035		RESISTOR 10K 5% .25W FC TC=-400/+700	01121	CB1035
A3R5	0683-2725		RESISTOR 2.7K 5% .25W FC TC=-400/+700	01121	CB2725
A3R6	0757-0438	2	RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-TO-5111-F
A3R7	0757-0438		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-TO-5111-F
A3R8	0683-2265	1	RESISTOR 22M 5% .25W FC TC=-900/+1200	01121	CB2265
A3R9	0683-6835	1	RESISTOR 68K 5% .25W FC TC=-400/+800	01121	CB6835
A3R10	0683-1045		RESISTOR 100K 5% .25W FC TC=-400/+800	01121	CB1045
A3R11	0683-1035		RESISTOR 10K 5% .25W FC TC=-400/+700	01121	CB1035
A3R12	0683-1045		RESISTOR 100K 5% .25W FC TC=-400/+800	01121	CB1045
A3TP1	0360-0124	12	TERMINAL-STUD SGL-PIN PRESS-MTG	28480	0360-0124
A3TP2	0360-0124		TERMINAL-STUD SGL-PIN PRESS-MTG	28480	0360-0124
A3TP3	0360-0124		TERMINAL-STUD SGL-PIN PRESS-MTG	28480	0360-0124
A3TP4	0360-0124		TERMINAL-STUD SGL-PIN PRESS-MTG	28480	0360-0124
A3U1	1820-1189	2	IC MC14510CP COUNTER	04713	MC14510CP
A3U2	1820-1189		IC MC14510CP COUNTER	04713	MC14510CP
A3U3	1820-0939	2	IC CD4013AE FLIP-FLOP	02735	CD4013AE
A3U4	1820-0939		IC CD4013AE FLIP-FLOP	02735	CD4013AE
A3U5	1820-0979	2	IC CD4009AE BUFFER	02735	CD4009AE
A3U6	1820-0949	4	IC CD4011AE GATE	02735	CD4011AE
A3U7	1820-0978	1	IC CD4007AE DIGITAL	02735	CD4007AE
A3U8	1820-0950	1	IC CD4012AE GATE	02735	CD4012AE
A3U9	1820-0943	3	IC CD4023AE GATE	02735	CD4023AE
A3U10	1820-0943		IC CD4023AE GATE	02735	CD4023AE
A3U11	1820-0949		IC CD4011AE GATE	02735	CD4011AE
A3U12	1820-0055	1	IC:SN7490N	01295	SN7490N

See introduction to this section for ordering information

Table 6-2. Replaceable Parts (Continued)

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A3Y1	0410-0142	1	CRYSTAL:QUARTZ 1.0 MHZ	28480	0410-0142
			A3 MISCELLANEOUS		
	5000-9043	3	PIN:P.C. BOARD EXTRACTOR	28480	5000-9043
	5040-6843	3	EXTRACTOR, P.C. BOARD	28480	5040-6843
A4	59309-60004	1	BOARD ASSEMBLY, TIME BOARD	28480	59309-60004
A4C1	0160-2204	2	CAPACITOR-FXD 100PF +-5% 300WVDC MICA	28480	0160-2204
A4C2	0160-2204		CAPACITOR-FXD 100PF +-5% 300WVDC MICA	28480	0160-2204
A4R1	1810-0055	4	NETWORK-RES 9-PIN-SIP .15-PIN-SPCG	28480	1810-0055
A4R2	0683-1045		RESISTOR 100K 5% .25W FC TC=-400/+800	01121	CB1045
A4R3	0683-1035		RESISTOR 10K 5% .25W FC TC=-400/+700	01121	CB1035
A4R4	0683-1035		RESISTOR 10K 5% .25W FC TC=-400/+700	01121	CB1035
A4R5	0683-1035		RESISTOR 10K 5% .25W FC TC=-400/+700	01121	CB1035
A4R6	0683-1035		RESISTOR 10K 5% .25W FC TC=-400/+700	01121	CB1035
A4R7	0683-1035		RESISTOR 10K 5% .25W FC TC=-400/+700	01121	CB1035
A4R8	0683-1035		RESISTOR 10K 5% .25W FC TC=-400/+700	01121	CB1035
A4TP1	0360-0124		TERMINAL-STUD SGL-PIN PRESS-MTG	28480	0360-0124
A4TP2	0360-0124		TERMINAL-STUD SGL-PIN PRESS-MTG	28480	0360-0124
A4TP3	0360-0124		TERMINAL-STUD SGL-PIN PRESS-MTG	28480	0360-0124
A4TP4	0360-0124		TERMINAL-STUD SGL-PIN PRESS-MTG	28480	0360-0124
A4U1	1820-1122	6	IC MC14518CP COUNTER	04713	MC14518CP
A4U2	1820-1122		IC MC14518CP COUNTER	04713	MC14518CP
A4U3	1820-0949		IC CD4011AE GATE	02735	CD4011AE
A4U4	1820-1122		IC MC14518CP COUNTER	04713	MC14518CP
A4U5	1820-0949		IC CD4011AE GATE	02735	CD4011AE
A4U6	1820-0943		IC CD4023AE GATE	02735	CD4023AE
A4U7	1820-0979		IC CD4009AE BUFFER	02735	CD4009AE
A4U8	1820-1198	8	IC SN74LS03N TTL LS QUAD 2 NAND	01295	SN74LS03N
A4U9	1820-1198		IC SN74LS03N TTL LS QUAD 2 NAND	01295	SN74LS03N
A4U10	1820-1198		IC SN74LS03N TTL LS QUAD 2 NAND	01295	SN74LS03N
A4U11	1820-1198		IC SN74LS03N TTL LS QUAD 2 NAND	01295	SN74LS03N
A4U12	1820-0980	1	IC CD4010AE BUFFER	02735	CD4010AE
A4U13	1820-1122		IC MC14518CP COUNTER	04713	MC14518CP
A4U14	1820-1122		IC MC14518CP COUNTER	04713	MC14518CP
A4U15	1820-1122		IC MC14518CP COUNTER	04713	MC14518CP
A4U16	1820-1198		IC SN74LS03N TTL LS QUAD 2 NAND	01295	SN74LS03N
A4U17	1820-1199		IC SN74LS04N TTL LS HEX	01295	SN74LS04N
A4U18	1820-0491	1	IC:TTL BCD-TO-DECIMAL DECODER/DRIVER	01295	SN74145N
A4U19	1820-1199		IC SN74LS04N TTL LS HEX	01295	SN74LS04N
A4U20	1820-1198		IC SN74LS03N TTL LS QUAD 2 NAND	01295	SN74LS04N
A4U21	1820-1198		IC SN74LS03N TTL LS QUAD 2 NAND	01295	SN74LS03N
A4U22	1820-1198		IC SN74LS03N TTL LS QUAD 2 NAND	01295	SN74LS03N
A4U23	1820-0946	1	IC CD4001AE GATE	02735	CD4001AE
			A4 MISCELLANEOUS		
	5000-9043		PIN:P.C. BOARD EXTRACTOR	28480	5000-9043
	5040-6843		EXTRACTOR, P.C. BOARD	28480	5040-6843
A5	59309-60005	1	BOARD ASSEMBLY, BUS I/O	28480	59309-60005
A5C1	0160-0158	2	CAPACITOR-FXD 5600PF +-10% 200WVDC POLYE	56289	292P56292
A5C2	0180-0106	1	CAPACITOR-FXD 60UF+-20% 6VDC TA	56289	150D606X0006B2
A5C3	0160-0158		CAPACITOR-FXD 5600PF +-10% 200WVDC POLYE	56289	292P56292
A5CR1	1901-0040		DIODE-SWITCHING 30V 50NA 2NS DO-35	28480	1901-0040
A5CR2	1901-0040		DIODE-SWITCHING 30V 50NA 2NS DO-35	28480	1901-0040
A5CR3	1901-0040		DIODE-SWITCHING 30V 50NA 2NS DO-35	28480	1901-0040
A5CR4	1901-0040		DIODE-SWITCHING 30V 50NA 2NS DO-35	28480	1901-0040
A5CR5	1901-0040		DIODE-SWITCHING 30V 50NA 2NS DO-35	28480	1901-0040
A5CR6	1901-0040		DIODE-SWITCHING 30V 50NA 2NS DO-35	28480	1901-0040
A5CR7	1901-0040		DIODE-SWITCHING 30V 50NA 2NS DO-35	28480	1901-0040
A5CR8	1901-0040		DIODE-SWITCHING 30V 50NA 2NS DO-35	28480	1901-0040
A5CR9	1901-0535		DIODE-SCHOTTKY	28480	1901-0535
A5Q1	1854-0071		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A5R1	0683-1035		RESISTOR 10K 5% .25W FC TC=-400/+700	01121	CB1035
A5R2	1810-0055		NETWORK-RES 9-PIN-SIP .15-PIN-SPCG	28480	1810-0055
A5R3	1810-0055		NETWORK-RES 9-PIN-SIP .15-PIN-SPCG	28480	1810-0055
A5R4	1810-0055		NETWORK-RES 9-PIN-SIP .15-PIN-SPCG	28480	1810-0055
A5R5	0683-2725		RESISTOR 2.7K 5% .25W FC TC=-400/+700	01121	CB2725
A5R6	1810-0164	1	NETWORK-RES 9-PIN-SIP .15-PIN-SPCG	28480	1810-0164
A5R7	1810-0136	2	NETWORK-RES 10-PIN-SIP .1-PIN-SPCG	28480	1810-0136
A5R8	1810-0136		NETWORK-RES 10-PIN-SIP .1-PIN-SPCG	28480	1810-0136
A5R9	1810-0041		NETWORK-RES 9-PIN-SIP .15-PIN-SPCG	28480	1810-0041
A5R10	0683-2725		RESISTOR 2.7K 5% .25W FC TC=-400/+700	01121	CB2725

Table 6-2. Replaceable Parts (Continued)

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A5R11	0683-2725		RESISTOR 2.7K 5% .25W FC TC=-400/+700	01121	CB2725
A5R12	0683-1035		RESISTOR 10K 5% .25W FC TC=-400/+700	01121	CB1035
A5R13	0683-1215	1	RESISTOR 120 5% .25W FC TC=-400/+600	01121	CB1215
A5R14	0683-1035		RESISTOR 10K 5% .25W FC TC=-400/+700	01121	CB1035
A5R15	0683-2725		RESISTOR 2.7K 5% .25W FC TC=-400/+700	01121	CB2725
A5R16	0683-4725		RESISTOR 4.7K 5% .25W FC TC=-400/+700	01121	CB4725
A5S1	3101-1841	1	SWITCH-SL 4P 1A-NS DIP-SLIDE-ASSY .1A	71450	206 TYPE
A5TP1	0360-0124		TERMINAL-STUD SGL-PIN PRESS-MTG	28480	0360-0124
A5TP2	0360-0124		TERMINAL-STUD SGL-PIN PRESS-MTG	28480	0360-0124
A5TP3	0360-0124		TERMINAL-STUD SGL-PIN PRESS-MTG	28480	0360-0124
A5TP4	0360-0124		TERMINAL-STUD SGL-PIN PRESS-MTG	28480	0360-0124
A5U1	1820-0788	1	IC SN74 174 N FLIP-FLOP	01295	SN74174N
A5U2	1818-2193	1	IC 4K ROM MOS	28480	1818-2193
A5U3	1820-1112	3	IC SN74LS74N TTL LS DUAL	01295	SN74LS74N
A5U4	1820-1112		IC SN74LS74N TTL LS DUAL	01295	SN74LS74N
A5U5	1820-1112		IC SN74LS74N TTL LS DUAL	01295	SN74LS74N
A5U6	1820-0054	1	IC:SN7400N	01295	SN7400N
A5U7	1820-1470	1	IC SN74LS157N TTL LS QUAD 2	01295	SN74LS157N
A5U8	1820-0658	1	IC MUXR	07263	93L12DC
A5U9	1820-1202	1	IC SN74LS10N TTL LS TPL 3 NAND	01295	SN74LS10N
A5U10	1820-1197	1	IC SN74LS00N TTL LS QUAD 2 NAND	01295	SN74LS00N
A5U11	1820-1144	2	IC SN74LS02N TTL LS QUAD 2 NOR	01295	SN74LS02N
A5U12	1820-0595	1	IC DM74L 73N FLIP-FLOP	27014	DM74L73N
A5U13	1820-1144		IC SN74LS02N TTL LS QUAD 2 NOR	01295	SN74LS02N
A5U14	1820-0628	1	IC SN74 89N 64-BIT RAM TTL	01295	SN7489N
A5U15	1816-0353	1	IC 256-BIT ROM TTL	28480	1816-0353
A5U16	1820-0621	2	IC SN74 38 N BUFFER	01295	SN7438N
A5U17	1820-0702	1	IC DECODER	07263	93L11DC
A5U18	1816-0354	1	IC SN74 187N 1K ROM TTL	28480	1816-0354
A5U19	1820-0904	1	IC COMPTR	07263	93L24DC
A5U20	1820-0621		IC SN74 38 N BUFFER	01295	SN7438N
A5U21	1820-1199		IC SN74LS04N TTL LS HEX	01295	SN74LS04N
A5XU2	1200-0469	1	SOCKET, ELEC, IC 28-CONT DIP SLDR TERM	06776	IC-286-S2
A5XU15	1200-0473	2	SOCKET-IC 16-CONT DIP-SLDR	28480	1200-0473
A5XU18	1200-0473		SOCKET-IC 16-CONT DIP-SLDR	28480	1200-0473
			A5 MISCELLANEOUS		
	5000-9043		PIN:P.C. BOARD EXTRACTOR	28480	5000-9043
	5040-6843		EXTRACTOR, P.C. BOARD	28480	5040-6843
			CHASSIS PARTS		
C1	0160-3333	1	CAPACITOR FXD .005 UF 20% 250WVAC CER	28480	0160-3333
C2	0180-1735		CAPACITOR-FXD .22UF+-10% 35VDC TA	56289	150D224X9035A2
F1	2110-0201	1	FUSE .25A 250W 1.25X.25 UL IEC (230VAC)	71400	AGC-1/4
F1	2110-0202	1	FUSE .5A 250V 1.25X.25 UL IEC (115VAC)	71400	AGC 1/2
J1	1251-2357	1	CONNECTOR-AC PWR HP-9 MALE FLG MTG	28480	1251-2357
J2	1250-0083	2	CONNECTOR-RF BNC FEM SGL HOLE FR (STDBY PCWER)	24931	28JR-130-1
J3	1250-0083		CONNECTOR-RF BNC FEM SGL HOLE FR (EXT FREQUENCY STANDARD)	24931	28JR-130-1
MP1	5040-7211	1	COVER, BOTTOM	28480	5040-7211
MP1	59309-00001	1	SUB-PANEL, FRONT	28480	59309-00001
MP2	5040-7205	2	FOOT, 1/4	28480	5040-7205
MP2	59309-00002	1	FRONT PANEL, DOOR	28480	59309-00002
MP3	59309-00003	1	PANEL, REAR	28480	59309-00003
MP4	59309-00004	2	BRACKET, MOTHER BOARD	28480	59309-00004
MP5	59309-00005	1	BRACKET, TRANSISTOR	28480	59309-00005
MP5	5040-7212	2	COVER, SIDES	28480	5040-7212
MP6	5040-7210	1	COVER, TOP	28480	5040-7210
MP6	59309-00006	1	BRACKET, BATTERY	28480	59309-00006
MP7	59309-00007	1	PLATE, SWITCH	28480	59309-00007
MP8	59309-00008	1	INSULATOR, POWER INPUT	28480	59309-00008
MP9	5001-0438	2	TRIM SIDE	28480	5001-0438
MP10	5040-7204	1	TRIM, TOP	28480	5040-7204
MP13	59304-20003	1	FRAME, MODIFIED	28480	59304-20003
MP16	59309-40002	1	WINDOW, FRONT	28480	59309-40002
S1	3101-1234	1	SWITCH-SL DPDT-NS STD 1.5A 250VAC SLDR (115/230V)	82389	11A-1242A
T1	9100-3040	1	TRANSFORMER POWER INPUT	28480	9100-3040
U1	1820-0430	1	IC LM 309 V RGLTR	27014	LM309K

See introduction to this section for ordering information

Table 6-2. Replaceable Parts (Continued)

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
W1	8120-1378	1	CABLE ASSY 3-COND 18-AWG (PLUGS INTO A2J2)	28480	8120-1378
W2	8120-1833	1	CABLE ASSY 24-COND 24-AWG	28480	8120-1833
W3	59308-60007	1	STRAP, GROUND	28480	59308-60007
W4	59309-60006	1	CABLE ASSEMBLY, REGULATOR	28480	59309-60006
XF1	1400-0085	1	FUSEHOLDER-EXTR POST 15A 250V UL	75915	340297
XU1	1200-0456	1	SOCKET-XSTR 2-CONT TO-3-PKG	28480	1200-0456
			MISCELLANEOUS PARTS		
	0380-0644	2	STANDOFF-HEX HD .336 LG; 6-32 INT/EXT	28480	0380-0579
	2420-0022	6	NUT-SPCLY 6-32-THD .23-THK .354-A/F STL	77122	NR632005
	3050-0454	4	WASHER-FL MTLC NO.-4 .125-IN-ID	00141	84-1
	3101-1820	5	CAP-PB WHITE; .2-IN DIA; .155-IN L; FOR	09353	7089-1
	7120-2699	1	LABEL-IDENT "59309A ASC11 DIGITAL CLOCK	28480	7120-2699
	59309-20010	1	LITE PIPE (USED WITH A1DS4)	28480	59309-20010

Table 6-3. Manufacturers Code List

MFR NO.	MANUFACTURERS NAME AND ADDRESS	ZIP CODE
00141	PIC DESIGN CORP, RIDGEFIELD CT	06877
0086S	STETTNER-TRUSH INC., CAZENOVIA NY	13035
001121	ALLEN-BRADLEY CO, MILWAUKEE WI	53212
01295	TEXAS INSTR INC SEMICOND CMPNT DIV, DALLAS TX	75231
02735	RCA CORP SOLID STATE DIV, SOMMERVILLE NJ	08876
04713	MOTOROLA SEMICONDUCTOR PRODUCTS, PHOENIX AZ	85008
05574	VIKING INDUSTRIES INC, CHATSWORTH CA	91311
06776	ROBINSON NUGENT INC, NEW ALBANY IN	47150
07263	FAIRCHILD SEMICONDUCTOR DIV, MOUNTAIN VIEW CA	94040
09353	C AND K COMPONENTS INC, WATERTOWN MA	02172
11237	CTS KEENE INC, PASO ROBLES CA	93446
18324	SIGNETICS CORP, SUMMYVALE CA	94086
24546	CORNING GLASS WORKS (BRADFORD), BRADFOR PA	16701
24931	SPECIALTY CONNECTOR CO INC., INDIANAPOLIS IN	46227
27014	NATIONAL SEMICONDUCTOR CORP, SANTA CLARA CA	95051
28480	HEWLETT-PACKARD CO CORPORATE HQ, PALO ALTO CA	94304
56289	SPRAGUE ELECTRIC CO, NORTH ADAMS MA	01247
71400	BUSSMAN MFG DIV OF MCGRAW-EDISON CO, ST LOUIS MO	63017
71450	CTS CORP, ELKART IN	46514
71785	TRW ELEK COMPONENTS CINCH DIV, ELK GROVE VIL IL	60007
72136	ELECTO MOTIVE MFG CO INC, WILLIMANTIC CT	06226
75915	LITTELFUSE INC, DES PLAINES IL	60016
77122	PALNUT CO UNITED-CARR DIV TRW INC, MTSIDE NJ	07092
79727	C-W INDUSTRIES, WARMINSTER PA	18974
82389	SWITCHCRAFT INC, CHICAGO IL	60630

SECTION VII
MANUAL CHANGES AND OPTIONS

7-1. OPTIONS

7-2. No options are presently available for the 59309A. Some earlier instruments were equipped with an Option 001, Julian Calendar Display which is now available as a special option. The configurations for the standard instrument and Option 001 instrument and their respective schematics and parts list are as follows:

Assy No.	Std. Instr. 59309-	For Schem see Page	For Parts see Table	Opt. Instr. 59309-	For Schem. see Page	For Parts see Table
A1	60001	8-3	6-4	60009	8-3	7-2
A2	60002	8-4	6-4	60002	8-4	6-4
A3	60003	8-5	6-4	60007	7-3	7-2
A4	60004	8-6	6-4	60004	8-6	6-4
A5	60005	8-7	6-4	60008	8-7	7-2

7-3. MANUAL CHANGES

7-4. This manual applies directly to Model 59309A having serial prefix 1632A (refer to paragraph 1-23).

7-5. Newer Instruments

7-6. As changes are made, newer instruments may have serial prefixes that are not listed in this manual. Manuals for these instruments are supplied with a manual change sheet, containing the required information. Contact the nearest Hewlett-Packard Sales and Service Office for information if this sheet is missing.

7-7. Older Instruments

7-8. Manual Changes listed in *Table 7-1* apply to Model 59309A with serial prefix numbers below 1632A.

Table 7-1. Manual Changes for Older Instruments

Instrument Prefix	Make Manual Changes
1604A	1
1600A	1,2
1544A	1,2,3
1524A	1,2,3,4
1428A	1,2,3,4,5

CHANGE 1 (1604A)

Table 6-2:

For series 1604A and below, A1U1 was an 1820-0586, an 1820-1199 is the preferred parts replacement.

For series 1604A and below, A2Q3 was an 1854-0533, an 1854-0575 is the preferred parts replacement. Some instruments with series 1604A have an 1854-0575 installed.

For series 1604A and below, A4U8 through A4U11, U20 through U22 and U16 were 1830-0585's, 1820-1198 is the preferred parts replacement.

For series 1604A and below, A4U17 and U19 were 1820-0586's, the preferred parts replacement is an 1820-1199.

For series 1604A and below, A5U3 through U5 were 1820-0596's, the preferred parts replacement is 1820-1112.

For series 1604A and below, A5U7 was an 1820-0710, the preferred parts replacement is 1820-1470.

For series 1604A and below, A5U9 was an 1820-0587, the preferred parts replacement is 1820-1202.

For series 1604A and below, A5U10 was an 1820-0583, the preferred parts replacement is 1820-1197.

For series 1604A and below, A5U11 and U13 were 1820-0584's, the preferred parts replacement is 1820-1144.

For series 1604A and below, A5U21 was an 1820-0586, the preferred parts replacement is 1820-1199.

CHANGE 2 (1660A)

Capacitor C1 (chassis component on input power module) was HP Part Number 0160-3043 (a dual .005 UF). The capacitors were connected from one side of the line to chassis ground.

CHANGE 3 (1544A)

Table 6-2, Chassis Parts:

Change F1, 2110-0201 to 2110-0004.
Change F1, 2110-0202 to 2110-0012.

Table 6-2, Miscellaneous Parts:

Change Standoff-Hex. 0380-0644 to 0380-0579.

CHANGE 4 (1524A)

Table 6-2, A1 Display Assembly:

Change A1DS1 from 1990-0465 to 1990-0335.
Change A1DS2 from 1990-0465 to 1990-0468.
Change A1 Series number to 1428.
Change A1S2, 4, 6, 7, 8 from 3101-0858 to 3101-1261.
Change manual title page to 1524.

CHANGE 5 (1428A)

Table 6-2, A2 Assembly:

Change A2S1 from 3101-1973 to 3101-1826.

Table 7-2, A5 Assembly:

(For earlier units available as Option 001.)
Change A5S1 from 3101-1841 to 3101-1817.
Change A5C2 from 0180-0106, cap. 60 μf to 0180-0376, cap .47 μf.
Change A5C2 value in Figure 8-7 for Option 001 instruments.

U.S. INSTRUMENT RENTALS 592-9230 BOB

HEWLETT hp PACKARD

MANUAL CHANGES

MANUAL DESCRIPTION

INSTRUMENT: 59309A HP-IB Digital Clock
Operating and Service Manual
SERIAL PREFIX: 1632A

DATE PRINTED: DEC 1976
HP PART NO: 59309-90004
MICROFICHE NO: 59309-90005

CHANGE DATE December 13, 1977

(This change supersedes all earlier dated changes)

- Make all changes listed as ERRATA.
- Check the following table for your instrument's serial prefix or serial number and make listed change(s) to manual.

IF YOUR INSTRUMENT HAS SERIAL PREFIX OR SERIAL NUMBER	MAKE THE FOLLOWING CHANGES TO YOUR MANUAL	IF YOUR INSTRUMENT HAS SERIAL PREFIX OR SERIAL NUMBER	MAKE THE FOLLOWING CHANGES TO YOUR MANUAL
1704A	1		
1712A	1, 2		

► NEW OR REVISED ITEM

ERRATA

Page 6-9, Table 6-2, A5 (59309-60005) Replaceable Parts:
Change A5U9 to 1820-0587; IC SN74L10N TTL L TPL 3 NAND 01295; SN74L10N.

Page 7-2, Manual Changes, Series 1604 and below:
Delete sixth sentence which reads as follows:
"For series 1604A and below, A5U9 was an 1820-0587, the preferred parts replacement is 1820-1202".

Change the series prefix number for CHANGE 2 from 1660A to 1600A. No 59309A instruments with a 1660A serial prefix number have ever been made.

Page 7-5, Table 7-2, A5 (59309-60008) Replaceable Parts:
Change A5U9 to 1820-0587; IC SN74L10N TTL L TPL 3 NAND; 01295; SN74L10N.

Page 8-17, Figure 8-7, Sheet 2 of 2; A5 Schematic Diagram:
Change U9 in TABLE OF ACTIVE ELEMENTS to HP PART NUMBER 1820-0587 and MFG OR INDUSTRY PART NUMBER to SN74L10N.

Page 6-6, Table 6-2, A2 (59309-60002) Replaceable Parts:
Change A2CR1 from 1906-0027 to 1901-0366; DIODE FW BRIDGE 400V 1A; 02037; SDA-10185-6.

►Page 6-8, Table 6-2, A5 (59309-60005) Replaceable Parts:
Change A9CR2 to 1901-0535; DIODE-SCHOTTKY; 28480; 1901-0535.

Change A9CR9 to 1901-0040; DIODE-SWITCHING 30V 50 NA 2NS DO-35; 28480; 1901-0040.

►Page 8-17, Figure 8-7, TABLE OF ACTIVE ELEMENTS:
Change listing in table for CR1 thru CR9 to the following:

CR1, 3-9	1901-0040	1901-0040
CR2	1901-0535	1901-0535

CHANGE 1 (1704A)

Page 6-7, Table 6-2, A3 (59309-60003) Replaceable Parts:
Add "(SERIES 1704)" to A3 description.

Change A3C4 and A3C5 from 0140-0175 (39 pF) to 0160-2199; CAPACITOR 30 pF 5% 300VDCW.

Change A3R6 and A3R7 from 0757-0438 (5110Ω) to 0683-1025; RESISTOR 5.11K 1% .125W F TC = 0±100.

Page 8-9, Figure 8-5, A3 (59309-60003) Schematic Diagram:
Change series number, at top of diagram, from 1600A to 1704.

Change A3C4 and A3C5 from 39 to 30 pF.

Add an asterisk (*) to A3C4 and A3C5.

Change A3R6 and A3R7 from 5110 to 1000 ohms.

Add an asterisk (*) adjacent to A3R6 and A3R7.

CHANGE 2 (1712A)

Pages 6-8 and 6-9, Table 6-2, A5 (59309-60005) Replaceable Parts:
Add "SERIES 1712" to A5 description.

Change A5U13 from 1820-1144 (SN74LS02N) to 1820-0328; IC GATE TTL NOR QUAD DUAL INPUT; 01295; SN7402N.

Change A5U21 from 1820-1199 (SN74LS04N) to 1820-1416; IC SCHMITT-TRIG TTLS INV HEX 1-INPUT; 01295; SN74LS14N.

Page 18, Figure 8-7 Sheet 1 of 2, A5 (59309-60005) Schematic Diagram:
Change A5 series number, at top of schematic, from 1600A to 1712.

Page 19, Figure 8-7 Sheet 2 of 2, A5 Schematic Diagram:
Change A5 series number, at top of schematic, from 1600A to 1712.

Change TABLE OF ACTIVE ELEMENTS to reflect the above changes in Table 6-2; U13 to 1820-0328 type SN7402N and U21 to 1820-1416 type SN74LS14N.

7-9. A3 JULIAN OSCILLATOR (OPTION 001) 59309-60007

7-10. This circuit includes the External Frequency Divider, the 1 MHz Oscillator, the Day-of-Year Counter, and the Clock Error FF.

7-11. EXTERNAL FREQUENCY DIVIDER (A3U10). This divider and transistor A3Q7 receive operating voltages through the EXT position of the EXT INT switch on the front panel. The output of an external frequency standard, connected to the EXT FREQ STD connector, is divided by A3U10 to supply 1 MHz through gates A3U9D and A3U9C.

7-12. 1 MHz OSCILLATOR (A3U5). The internal oscillator supplies 1 MHz through gates A3U9A and A3U9C when the EXT INT switch on the front panel is set to INT.

7-13. The 1 Hz signal, from either the External Frequency Divider or the Internal 1 MHz Oscillator is the time base for the 59309A and is supplied to the Time Base Divider on A4 and to Clock Error FF A3U1B.

7-14. DAY-OF-YEAR COUNTER (A3U7 and A3U8). This counter receives the 1 Day signal from gate A4U6B. The day units are counted by A3U7, tens are counted by A3U8B and hundreds are counted by A3U8A. A reset signal is generated when the count reaches 366 with switch A3S1 in the 365 position. A reset occurs when the count reaches 367 with switch A3S1 in the 366 position. The outputs of the counters are sent to the A4 board and combined with the appropriate digit position bit to synchronize the strobing of the day-of-year display via the Data Bus.

7-15. CLOCK ERROR FF (A3U3A). The Clock Error FF provides an error signal which illuminates all decimal points in the front-panel display. In addition, the error signal is sent to Qualifier Selector A5U8 to result in an ASCII question mark as the first character in the talk output format to the HP-IB. The error signal is generated when the operation of the oscillator is initiated or disrupted, for example, by initial application of power, or when an external frequency standard is first connected into the circuit, or when the oscillator output fails.

Table 7-2. Julian Oscillator Option 001, Replaceable

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A1	59309-60009	1	(SEE A1 OF STANDARD INSTRUMENT FOR OPTION 001 PARTS BREAKDOWN)	28480	59309-60009
A3	59309-60007	1	BOARD ASSEMBLY, JULIAN OSCILLATOR (OPTION 001 ONLY)	28480	59309-60007
A3C1	0160-3879	1	CAPACITOR-FXD .01UF +-20% 100WVDC CER	28480	0160-3879
A3C2	0140-0210	1	CAPACITOR-FXD 270PF +-5% 300WVDC MICA	72136	DM15F271J0300WV1CR
A3C3	0121-0180	1	CAPACITOR-V TRMR-CER 15/60PF 200V PC-MTG	0086S	304324 15/60PF N1500
A3C4	0140-0175	2	CAPACITOR-FXD 39PF +-2% 300WVDC MICA	72136	DM15E390G0300WV1CR
A3C5	0140-0175		CAPACITOR-FXD 39PF +-2% 300WVDC MICA	72136	DM15E390G0300WV1CR
A3C6	0160-3878	1	CAPACITOR-FXD 1000PF +-20% 100WVDC CER	28480	0160-3878
A3CR1	1901-0040	12	DIODE-SWITCHING 30V 50NA 2NS DO-35	28480	1901-0040
A3CR2	1901-0040		DIODE-SWITCHING 30V 50NA 2NS DO-35	28480	1901-0040
A3CR3	1901-0040		DIODE-SWITCHING 30V 50NA 2NS DO-35	28480	1901-0040
A3CR4	1901-0040		DIODE-SWITCHING 30V 50NA 2NS DO-35	28480	1901-0040
A3Q1	1854-0009	1	TRANSISTOR NPN 2N709 SI TO-18 PD=300MW	28480	1854-0009
A3R1	0757-0442	2	RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-TO-1002-F
A3R2	0757-0442		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-TO-1002-F
A3R3	0683-1035	4	RESISTOR 10K 5% .25W FC TC=-400/+700	01121	CB1035
A3R4	0683-1025	1	RESISTOR 1K 5% .25W FC TC=-400/+600	01121	CB1025
A3R5	0683-2725	5	RESISTOR 2.7K 5% .25W FC TC=-400/+700	01121	CB2725
A3R6	0757-0438	2	RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-TO-5111-F
A3R7	0757-0438		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-TO-5111-F
A3R8	0683-2265	1	RESISTOR 22M 5% .25W FC TC=+900/+1200	01121	CB2265
A3R9	0683-6835	1	RESISTOR 68K 5% .25W FC TC=-400/+800	01121	CB6835
A3R10	0683-1045	3	RESISTOR 100K 5% .25W FC TC=-400/+800	01121	CB1045
A3R11	0683-1045		RESISTOR 100K 5% .25W FC TC=-400/+800	01121	CB1045
A3R12	0683-1045		RESISTOR 100K 5% .25W FC TC=-400/+800	01121	CB1045
A3TP1	0360-0124	8	TERMINAL-STUD SGL-PIN PRESS-MTG	28480	0360-0124
A3TP2	0360-0124		TERMINAL-STUD SGL-PIN PRESS-MTG	28480	0360-0124
A3TP3	0360-0124		TERMINAL-STUD SGL-PIN PRESS-MTG	28480	0360-0124
A3TP4	0360-0124		TERMINAL-STUD SGL-PIN PRESS-MTG	28480	0360-0124
A3U1	1820-0939	1	IC CD4013AE FLIP-FLOP	02735	CD4013AE
A3U2	1820-0949	2	IC CD4011AE GATE	02735	CD4011AE
A3U3	1820-0979	1	IC CD4009AE BUFFER	02735	CD4009AE
A3U4	1820-0950	2	IC CD4012AE GATE	02735	CD4012AE
A3U5	1820-0978	1	IC CD4007AE DIGITAL	02735	CD4007AE
A3U6	1820-0950		IC CD4012AE GATE	02735	CD4012AE
A3U7	1820-1189	1	IC MC14510CP COUNTER	04713	MC14510CP
A3U8	1820-1122	1	IC MC14518CP COUNTER	04713	MC14518CP
A3U9	1820-0949		IC CD4011AE GATE	02735	CD4011AE
A3U10	1820-0055	1	IC:SN7490N	01295	SN7490N
A3Y1	0410-0142	1	CRYSTAL:QUARTZ 1.0 MHZ A3 MISCELLANEOUS (OPT 001 ONLY)	28480	0410-0142
	5000-9043	2	PIN:P.C. BOARD EXTRACTOR	28480	5000-9043
	5040-6843	2	EXTRACTOR, P.C. BOARD	28480	5040-6843
A5	59309-60008	1	BOARD ASSEMBLY, JULIAN I/O (OPTION 001 ONLY)	28480	59309-60008
A5C1	0160-0158	2	CAPACITOR-FXD 5600PF +-10% 200WVDC POLYE	56289	292P56292
A5C2	0180-0106	1	CAPACITOR-FXD 60UF+-20% 6VDC TA	56289	150D606X000682
A5C3	0160-0158		CAPACITOR-FXD 5600PF +-10% 200WVDC POLYE	56289	292P56292
A5CR1	1901-0040		DIODE-SWITCHING 30V 50NA 2NS DO-35	28480	1901-0040
A5CR2	1901-0535	1	DIODE-SCHOTTKY	28480	1901-0535
A5CR3	1901-0040		DIODE-SWITCHING 30V 50NA 2NS DO-35	28480	1901-0040
A5CR4	1901-0040		DIODE-SWITCHING 30V 50NA 2NS DO-35	28480	1901-0040
A5CR5	1901-0040		DIODE-SWITCHING 30V 50NA 2NS DO-35	28480	1901-0040
A5CR6	1901-0040		DIODE-SWITCHING 30V 50NA 2NS DO-35	28480	1901-0040
A5CR7	1901-0040		DIODE-SWITCHING 30V 50NA 2NS DO-35	28480	1901-0040
A5CR8	1901-0040		DIODE-SWITCHING 30V 50NA 2NS DO-35	28480	1901-0040
A5CR9	1901-0040		DIODE-SWITCHING 30V 50NA 2NS DO-35	28480	1901-0040
A5Q1	1854-0071	1	TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A5R1	0683-1035		RESISTOR 10K 5% .25W FC TC=-400/+700	01121	CB1035
A5R2	1810-0055	3	NETWORK-RES 9-PIN-SIP .15-PIN-SPCG	28480	1810-0055
A5R3	1810-0055		NETWORK-RES 9-PIN-SIP .15-PIN-SPCG	28480	1810-0055
A5R4	1810-0055		NETWORK-RES 9-PIN-SIP .15-PIN-SPCG	28480	1810-0055
A5R5	0683-2725		RESISTOR 2.7K 5% .25W FC TC=-400/+700	01121	CB2725

Table 7-2. Julian Oscillator Option 001, Replaceable Parts (Cont'd)

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A5R6	1810-0164	1	NETWORK-RES 9-PIN-SIP .15-PIN-SPCG	28480	1810-0164
A5R7	1810-0136	2	NETWORK-RES 10-PIN-SIP .1-PIN-SPCG	28480	1810-0136
A5R8	1810-0136		NETWORK-RES 10-PIN-SIP .1-PIN-SPCG	28480	1810-0136
A5R9	1810-0041	1	NETWORK-RES 9-PIN-SIP .15-PIN-SPCG	28480	1810-0041
A5R10	0683-2725		RESISTOR 2.7K 5% .25W FC TC=-400/+700	01121	CB2725
A5R11	0683-2725		RESISTOR 2.7K 5% .25W FC TC=-400/+700	01121	CB2725
A5R12	0683-1035		RESISTOR 10K 5% .25W FC TC=-400/+700	01121	CB1035
A5R13	0683-1215	1	RESISTOR 120 5% .25W FC TC=-400/+600	01121	CB1215
A5R14	0683-1035		RESISTOR 10K 5% .25W FC TC=-400/+700	01121	CB1035
A5R15	0683-2725		RESISTOR 2.7K 5% .25W FC TC=-400/+700	01121	CB2725
A5R16	0683-4725	1	RESISTOR 4.7K 5% .25W FC TC=-400/+700	01121	CB4725
A5S1	3101-1841	1	SWITCH-SL 4-1A-NS DIP-SLIDE-ASSY .1A	71450	206 TYPE
A5TP1	0360-0124		TERMINAL-STUD SGL-PIN PRESS-MTG	28480	0360-0124
A5TP2	0360-0124		TERMINAL-STUD SGL-PIN PRESS-MTG	28480	0360-0124
A5TP3	0360-0124		TERMINAL-STUD SGL-PIN PRESS-MTG	28480	0360-0124
A5TP4	0360-0124		TERMINAL-STUD SGL-PIN PRESS-MTG	28480	0360-0124
A5U1	1820-0788	1	IC SN74 174 N FLIP-FLOP	01295	SN74174N
A5U2	1818-2236	1	IC MEMORY	28480	1818-2236
A5U3	1820-1112	3	IC SN74LS74N TTL LS DUAL	01295	SN74LS74N
A5U4	1820-1112		IC SN74LS74N TTL LS DUAL	01295	SN74LS74N
A5U5	1820-1112		IC SN74LS74N TTL LS DUAL	01295	SN74LS74N
A5U6	1820-0054	1	IC:SN7400N	01295	SN7400N
A5U7	1820-1470	1	IC SN74LS157N TTL LS QUAD 2	01295	SN74LS157N
A5U8	1820-0658	1	IC MUXR	07263	93L12DC
A5U9	1820-1202	1	IC SN74LS10N TTL LS TPL 3 NAND	01295	SN74LS10N
A5U10	1820-1197	1	IC SN74LS00N TTL LS QUAD 2 NAND	01295	SN74LS00N
A5U11	1820-1144	2	IC SN74LS02N TTL LS QUAD 2 NAND	01295	SN74LS02N
A5U12	1820-0595	1	IC DM74L 73N FLIP-FLOP	27014	DM74L73N
A5U13	1820-1144		IC SN74LS02N TTL LS QUAD 2 NAND	01295	SN74LS02N
A5U14	1820-0628	1	IC SN74 89N 64-BIT RAM TTL	01295	SN7489N
A5U15	1816-0353	1	IC 256-BIT ROM TTL	28480	1816-0353
A5U16	1820-0621	2	IC SN74 38 N BUFFER	01295	SN7438N
A5U17	1820-0702	1	IC DECODER	07263	93L11DC
A5U18	1816-0354	1	IC SN74 187N 1K ROM TTL	28480	1816-0354
A5U19	1820-0904	1	IC CGMPTR	07263	93L24DC
A5U20	1820-0621		IC SN74 38 N BUFFER	01295	SN7438N
A5U21	1820-1199	1	IC SN74LS04N	01295	SN74LS04N
A5XU2	1200-0469	1	SOCKET, ELEC, IC 28-CONT DIP SLDR TERM	06776	IC-286-S2
A5XU15	1200-0473	2	SOCKET-IC 16-CONT DIP-SLDR	28480	1200-0473
A5XU18	1200-0473		SOCKET-IC 16-CONT DIP-SLDR	28480	1200-0473
			A5 MISCELLANEOUS(OPTION 001)		
	5000-9043		PIN:P.C. BOARD EXTRACTOR	28480	5000-9043
	5040-6843		EXTRACTOR, P.C. BOARD	28480	5040-6843

See introduction to this section for ordering information

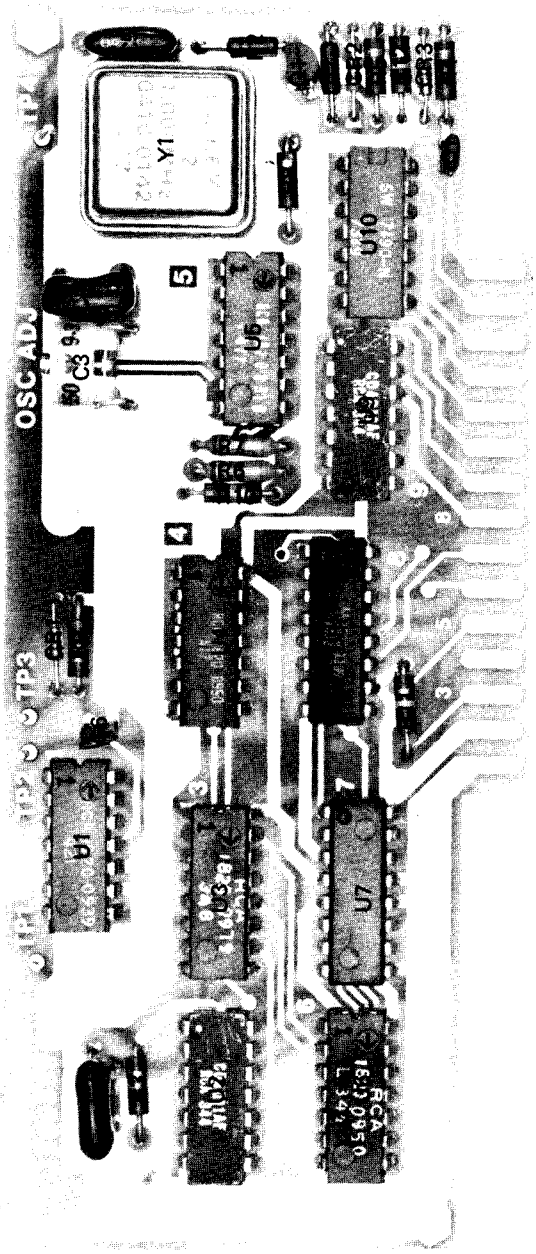


Figure 7-1. Julian Oscillator A3 Option 001, Component Locator

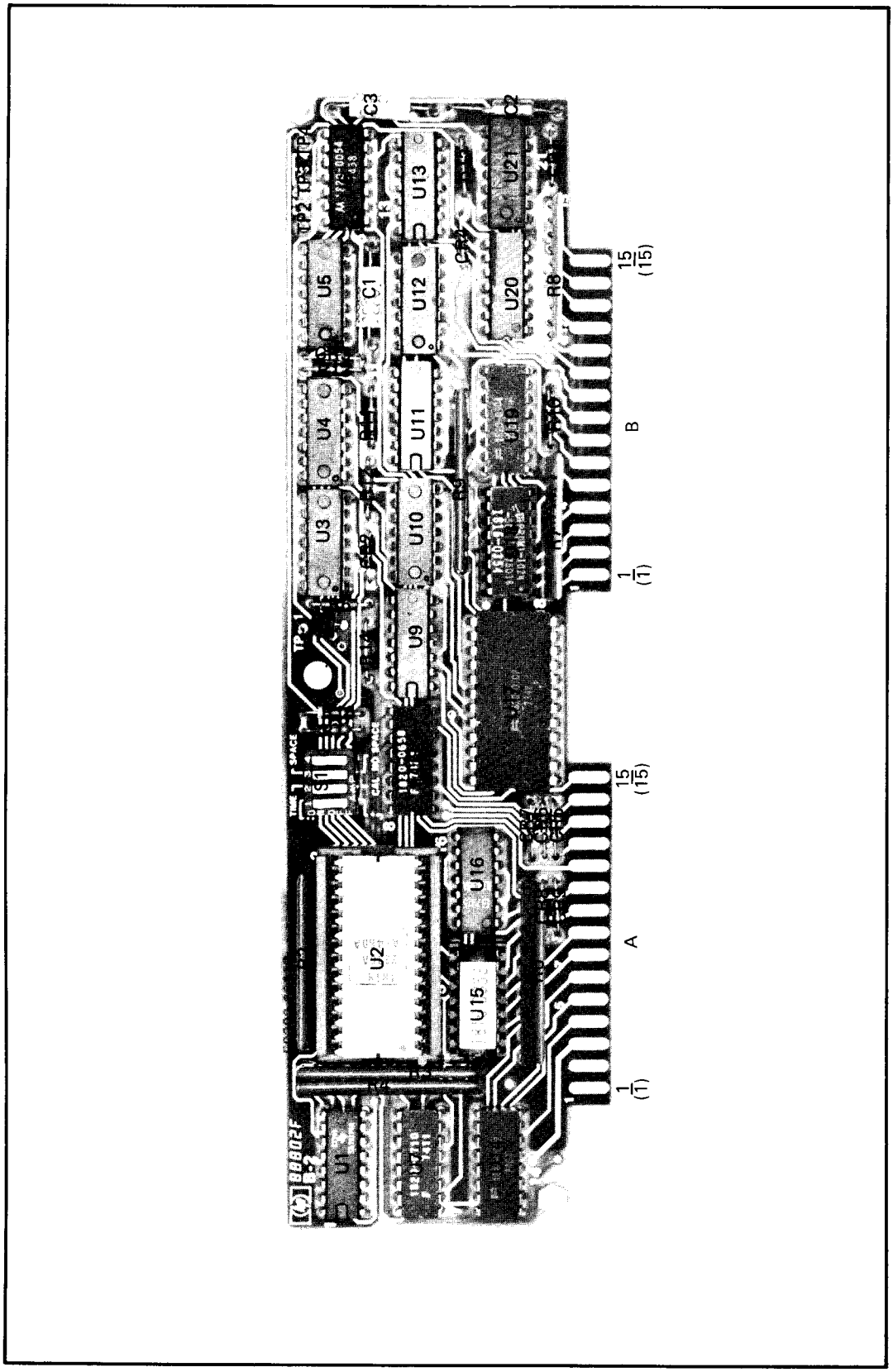


Figure 7-2. Julian I/O Board Assembly A5 Option 001, Component Locator

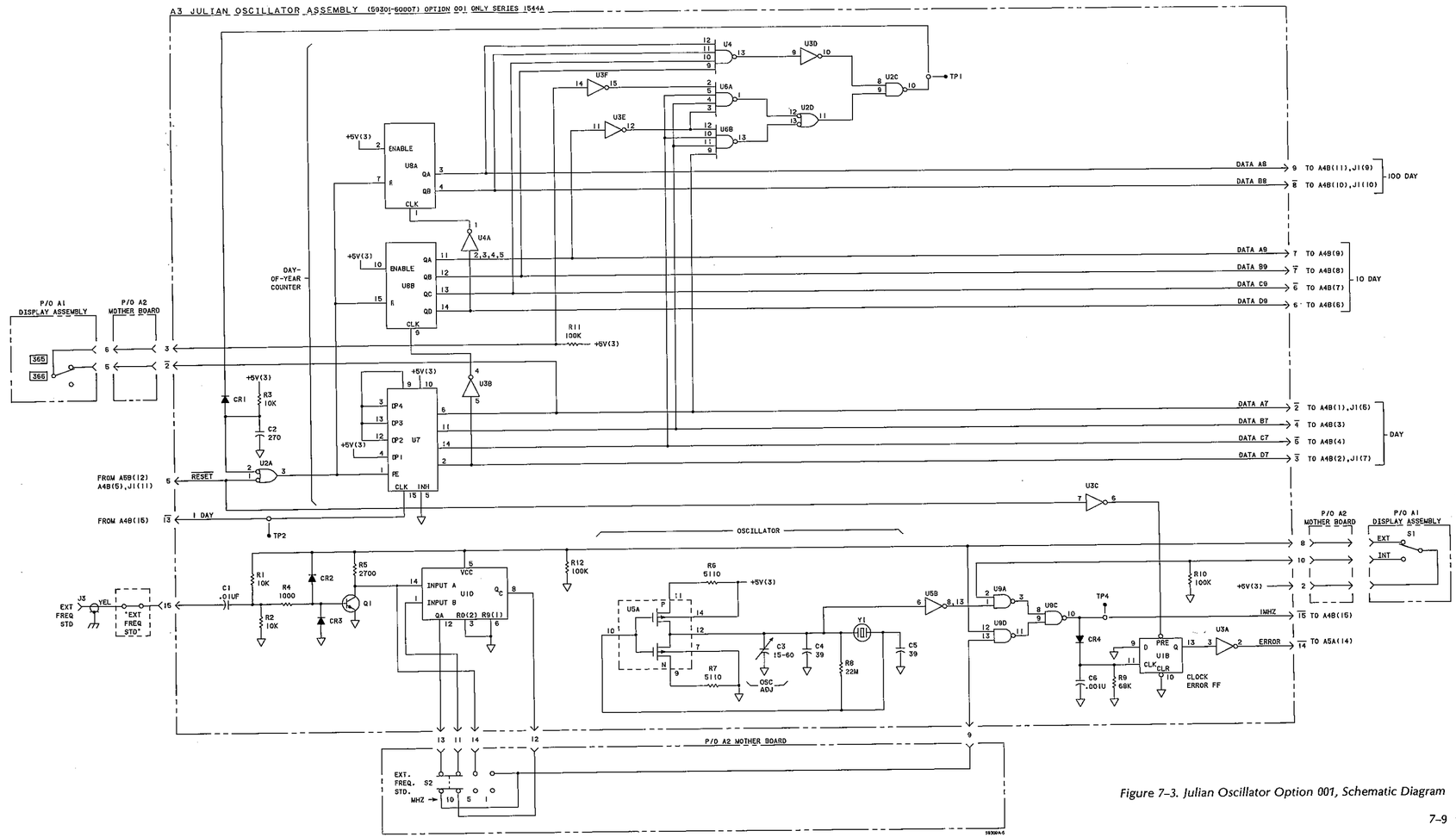


Figure 7-3. Julian Oscillator Option 001, Schematic Diagram

SECTION VIII
SCHEMATIC DIAGRAMS

8-1. INTRODUCTION

8-2. This section includes schematic diagram notes (*Figure 8-1*), Digital Bus Connector pin designations (*Figure 8-2*), component locator illustrations, and schematic diagrams for the PC board assemblies included in the 59309A HP-IB Digital Clock.

8-3. SCHEMATIC DIAGRAM NOTES, ASSEMBLY NUMBERS, AND REFERENCE DESIGNATORS

8-4. *Figure 8-1* shows the symbols used on the schematic diagram. At the bottom of *Figure 8-1*, the system for reference designators, assemblies, and subassemblies are shown. On the schematic, a table of active elements is included which lists the HP part number and manufacturer's part number for IC's, diodes, and transistors.

8-5. Reference Designations

8-6. Assemblies such as printed circuit boards are assigned numbers in sequence, A1, A2, etc. As shown in *Figure 8-1*, subassemblies within an assembly are given a subordinate A number. For example, rectifier subassembly A1 has the complete designator of A25A1. For individual components, the complete designator is determined by adding the assembly number and subassembly number if any. For example CR1 on the rectifier assembly is designated A25A1CR1. On the schematic, a table of reference designators is included which lists the number of designations assigned.

8-7. Identification Markings on Printed-Circuit Boards

8-8. HP printed circuit boards (see *Figure 8-1*) have four identifications numbers; an assembly part number, a series number, a revision letter, and a production code.

8-9. The assembly part number has 10 digits (such as 05340-60037) and is the primary identification. All assemblies with the same part number are interchangeable. When a production change is made on an assembly that makes it incompatible with previous assemblies, a change in part number is required. The series number (such as 1248A) is used to document minor electrical changes. As changes are made, the series number is incremented. When replacement boards are ordered, you may receive a replacement with a different series number. If there is a difference between the series number marked on the board and the schematic in this manual, a minor electrical difference exists. If the number on the printed-circuit board is lower than that on the schematic, refer to Section VII for backdating information. If it is higher, refer to the looseleaf manual change sheets for this manual. If the manual change sheets are missing, contact your local Hewlett-Packard Sales and Service Office. See the listing on the back cover of this manual.

8-10. Revision letters (A, B, etc.) denote changes in printed circuit layout. For example, if a capacitor type is changed (electrical value may remain the same) and requires different spacing for its leads, the printed circuit board layout is changed and the revision letter is incremented to the next letter. When a revision letter changes, the series number is also usually changed. The production code is the four-digit, seven-segment number used for production purposes.

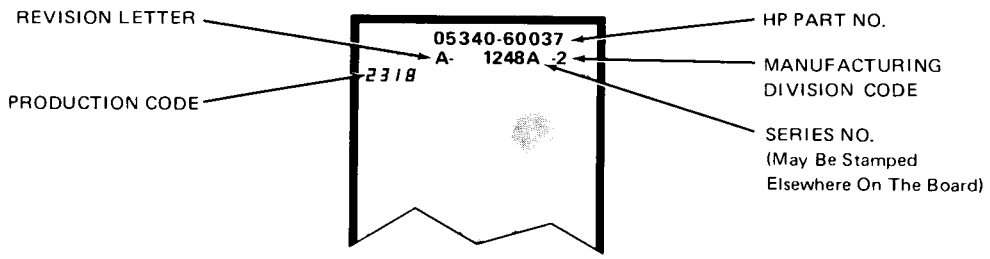
8-11. COMPONENT LOCATORS

8-12. Component locators for each printed circuit assembly are located next to the schematic diagram.

SYMBOLS

- FRONT PANEL
- REAR PANEL
- INTERIOR AND PC BOARDS
- WIPER MOVES TOWARD "CW" WHEN CONTROL IS ROTATED CLOCKWISE
- POWER LINE GROUND
- CIRCUIT COMMON GROUND
- FLOATING GROUND
- CHASSIS GROUND
- KNOB CONTROL
- SCREWDRIVER ADJUST
- MAIN SIGNAL PATH
- FEEDBACK PATH
- TEST POINT
- "AND" GATE
- "OR" GATE
- INVERTER
- NAND GATE
- NOR GATE
- EXCLUSIVE NOR

PRINTED CIRCUIT BOARD IDENTIFICATION



REFERENCE DESIGNATIONS

REFERENCE DESIGNATIONS WITHIN ASSEMBLIES ARE ABBREVIATED. ADD ASSEMBLY NUMBER TO ABBREVIATION FOR COMPLETE DESCRIPTION. JACKS ARE THE STATIONARY CONNECTORS AND PLUGS ARE THE MORE MOVEABLE OF TWO CONNECTORS.

ASSEMBLY	ABBREVIATION	COMPLETE DESCRIPTION
A25	C1	A25C1
A25A1	CR1	A25A1CR1
NO PREFIX	J3	J3

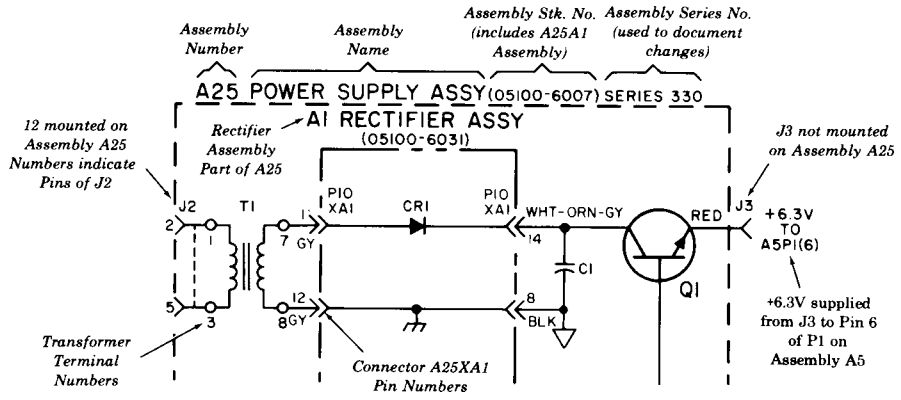
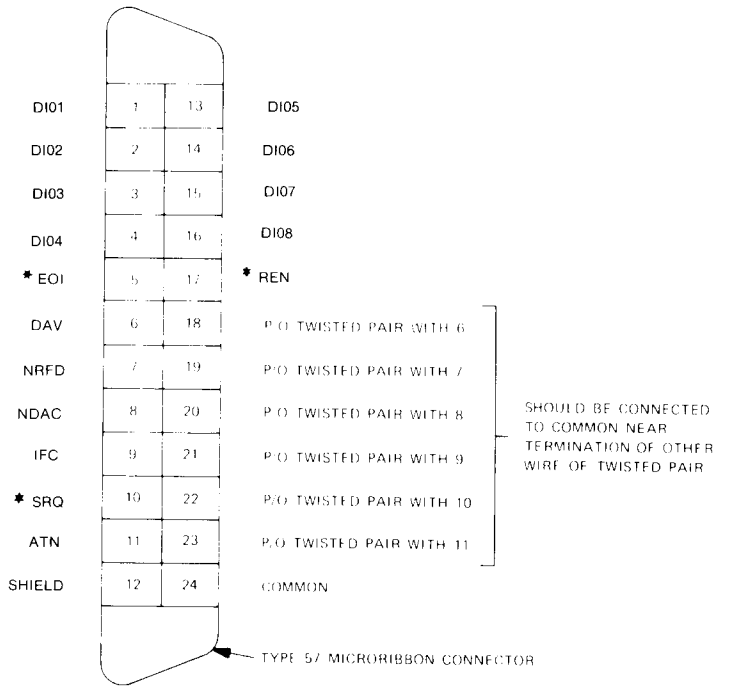


Figure 8-1. Schematic Diagram Notes



* THESE PINS ARE TERMINATED WITH RESISTIVE NETWORKS (SEE SCHEMATIC) AND NORMALLY FLOAT AT APPROXIMATELY 3V.

NOTE 1: PINS 18 THROUGH 23 SHOULD BE CONNECTED TO COMMON NEAR THE TERMINATION OF THE OTHER WIRE OF ITS TWISTED PAIR.

NOTE 2: PIN 12 IS CONNECTED TO COMMON THROUGH THE TALK ONLY SWITCH WHEN IN TALK ONLY MODE. OTHERWISE PIN 12 IS NOT CONNECTED.

DIGITAL BUS PIN SUMMARY

Pin No.	Line Name	Use
1–4, 13–15	DIO1–7	Carries character to 59309A for clock updating or for processing as Bus commands.
16	DIO8	Not monitored or driven; terminated by resistive network.
6 7 8	DAV NRFD NDAC	These three lines make up the "handshake" system on the HP-IB. DAV is monitored and driven and NRFD and NDAC are driven by 59309A to control rate of data transferred on DIO lines.
9	IFC	Unconditionally clears Listen and Talk FF's, halting remote operation.
11	ATN	Indicates to 59309A whether character on DIO lines is Bus Command or for clock updating.
5	EOI	Not monitored or driven; terminated by resistive network.
10	SRQ	Not monitored or driven; terminated by resistive network.
12	Shield	Connected to common through TALK ONLY switch on rear panel.
18–24	Common	Connected to chassis common.

Figure 8-2. Digital Bus Connector Pin Designations

A1 DISPLAY ASSEMBLY (59309-60001)

The display assembly consists of an LED Display, a Seven-Segment Decoder, Segment Drivers, a Clock Loss Detector, an Addressed Indicator, and Front-Panel Switches.

LED DISPLAY (A1DS1, A1DS2, and A1DS3). The display provides seven segments per-digit. Two digits are provided for each of the months, days, hours, minutes, and seconds displayed. A1DS1 contains months and days digits, A1DS2 contains hours digits, and A1DS3 contains minutes and seconds digits. Each of the input lines from the Segment Drivers to A1DS1, A1DS2, and A1DS3 is connected in parallel to each digit.

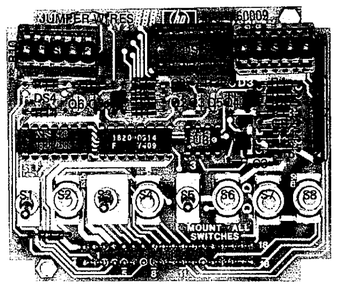
SEVEN-SEGMENT DECODER (A1U2). The seven-segment decoder receives the 4-bit code from the Data Bus and converts it into control codes. The codes control the illumination of the seven-segments in each digit of the display.

SEGMENT DRIVERS (A1Q1 through A1Q8). Transistors A1Q1 through A1Q7 provide drive to the display segments for the seven-segment decoder. Transistor A1Q8 provides for the Error signal to illuminate the decimal points in the display as an indication of error.

CLOCK LOSS DETECTOR (A1U3). The Clock Loss Detector protects the display from damage by blanking it completely if the strobe signals fail. If the Digit $\overline{8}$ signal is not received within the timing period of the timer circuit (A1U3), a signal is sent from the timer to the blanking input of decoder A1U2 and to transistor A1Q8 in the error circuit to blank the display. The blanking action occurs when the time base oscillator or associated circuitry fails. Blanking also occurs when the EXT INT switch on the front panel is switched to EXT without an external frequency applied.

ADDRESSED INDICATOR (A1DS4). The Addressed Indicator illuminates to indicate that the 59309A is addressed to listen or to talk.

FRONT PANEL SWITCHES (A1S1 through A1S8). Front Panel Switches are provided to start, stop, reset, or update the clock manually. The switches and connector pins are shown on the display assembly schematic diagram. The switches are also shown in the appropriate functional locations on other schematic diagrams for the 59309A.



Part of Figure 8-3. Display Assembly A1

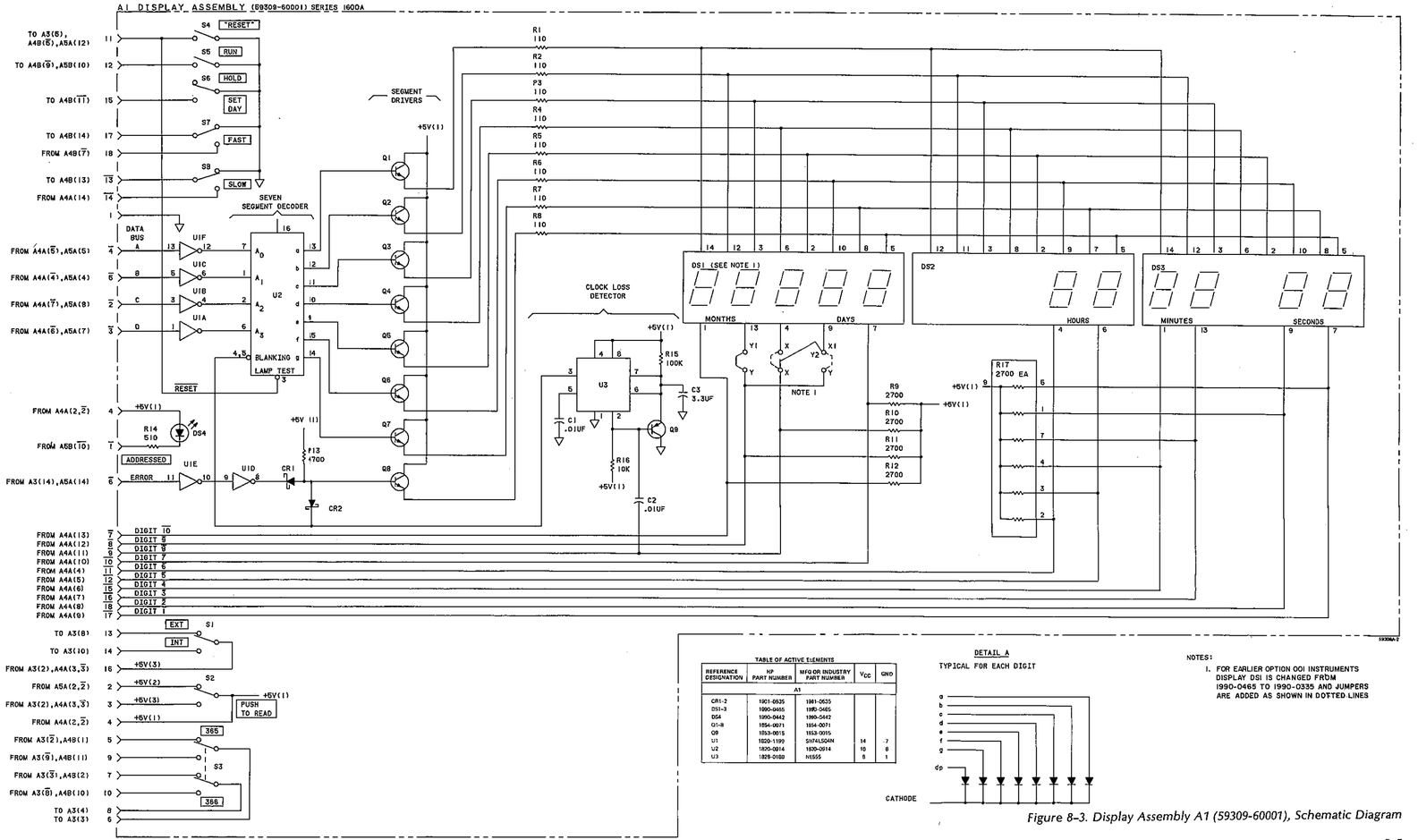


TABLE OF ACTIVE ELEMENTS

REFERENCE DESIGNATION	HP PART NUMBER	MFG OR INDUSTRY PART NUMBER	V_{CC}	GND
A1				
CR1-2	1901-0535	1901-0535		
DS1-3	1990-0465	1990-0465		
DS4	1990-0442	1990-0442		
Q1-8	1854-0071	1854-0071		
Q9	1853-0015	1853-0015		
U1	1820-1199	SN74LS00N	14	7
U2	1820-0914	1820-0914	16	8
U3	1826-0180	NE555	8	1

Figure 8-3. Display Assembly A1 (59309-60001), Schematic Diagram

A2 MOTHERBOARD (59309-60002)

The motherboard contains the Power Supply and provides all interconnections for the plug-in cards, the rear-panel connectors and the front-panel (display circuit) connector.

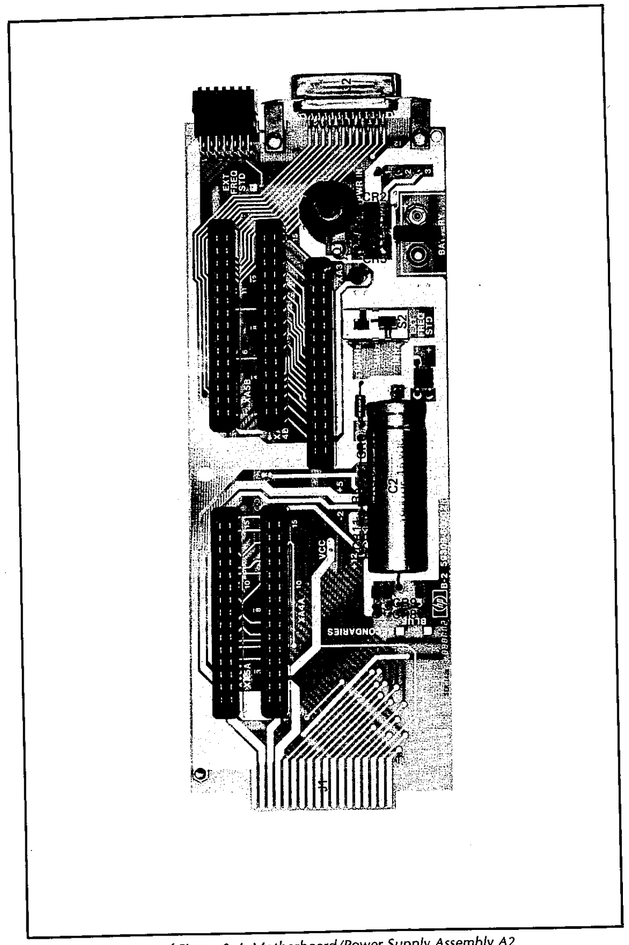
POWER SUPPLY. The Power Supply operates from an ac power source of 115V or 230V, selected by S1. The power input is sent through a transformer, a full-wave bridge rectifier and regulator circuits to provide +5V (1) to the display logic, +5V (2) to the TTL logic, and +5V (3) to the CMOS logic. The C Line signal is a 5-volt square wave returned from the CMOS circuit (A4U15B) to the power supply to develop –2V and +12V. These two voltages are supplied to low-current drain State Machine ROM A5U2. (The C Line signal is also used as Master Clock signal for the circuits in the 59309A).

The STANDBY POWER INPUT 9V connector on the rear panel allows connection of an 8- to 10-volt dc power source to maintain operation of the 59309A if the ac power fails. In this mode of operation, the display is not illuminated unless the PUSH TO READ button on the front panel is pushed. In addition, the talk output and the remote programming circuits are inoperative (not powered).

A plug-in connector on the motherboard allows installation of a 9-volt dry cell battery to provide standby operation during short periods (up to a day) of power outage. Operation in this mode is similar to the standby operation described in the preceding paragraph except the display cannot be illuminated. A jumper installed between the battery connector terminals must be removed to allow installation of the battery. Removal of the jumper disconnects PUSH TO READ switch A1S2.

Figure 8–3
DISPLAY ASSEMBLY A1 (59309-60001), SCHEMATIC DIAGRAM

(See Page 8–5)



Part of Figure 8–4. Motherboard/Power Supply Assembly A2

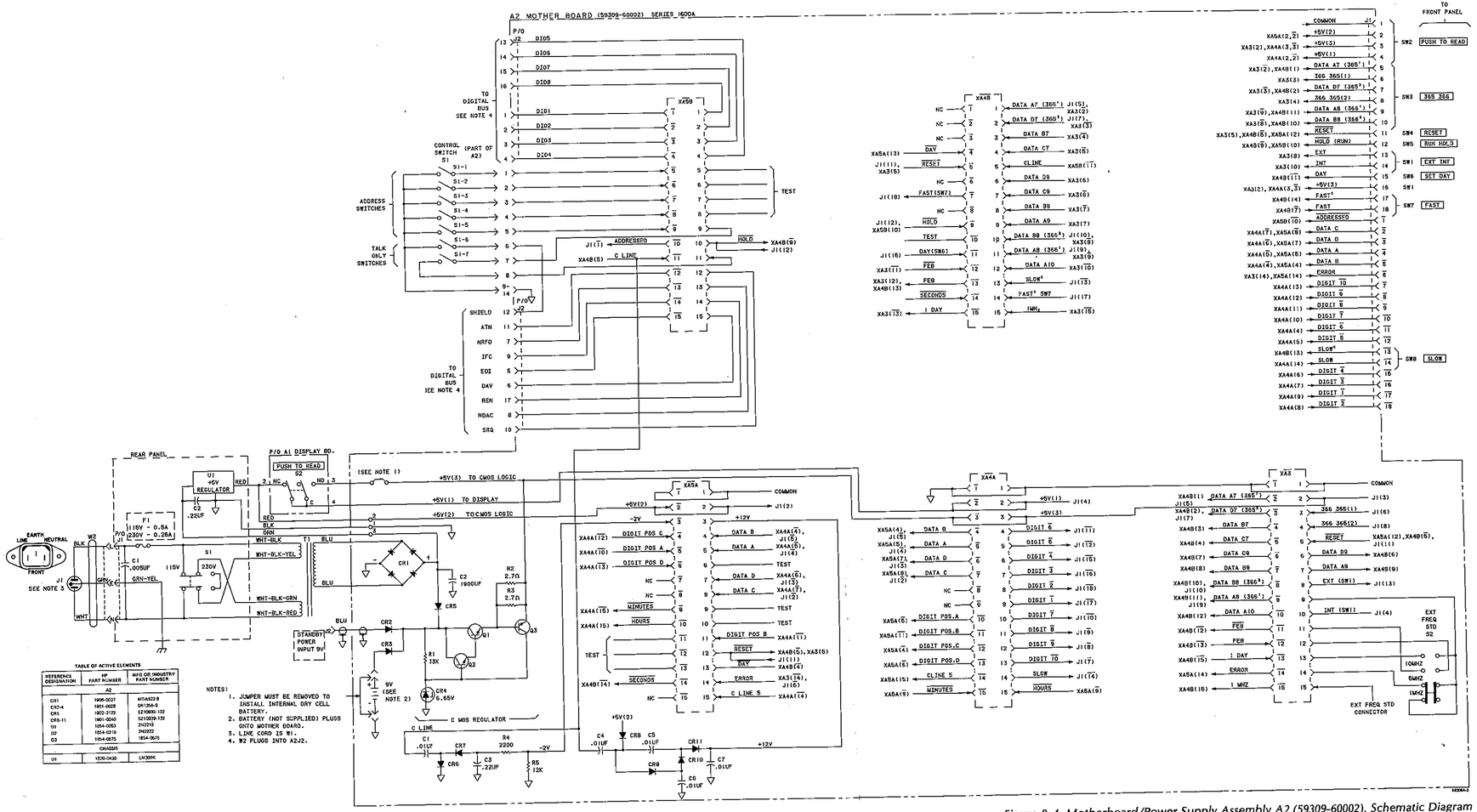


Figure 8–4. Motherboard/Power Supply Assembly A2 (59309-60002), Schematic Diagram

A3 CALENDAR OSCILLATOR ASSEMBLY (59309-60003)

This circuit includes the External Frequency Divider, the 1 MHz oscillator, the Day Counter, the Month Counter and the Clock Error FF.

EXTERNAL FREQUENCY DIVIDER (A3U12). This divider and transistor A3Q1 receive operating voltage through the EXT. position of the EXT INT switch on the front panel. The output of an external frequency standard, connected to the rear-panel EXT FREQ STD connector is divided by A3U12 to supply 1 MHz through gates A3U11D and A3U11C.

1 MHz OSCILLATOR (A3U7). The internal oscillator supplies 1 MHz through gates A3U11A and A3U11C when the EXT INT switch on the front panel is set to INT.

The 1 MHz signal from either the External Frequency Divider or the internal 1 MHz oscillator is the time base for the 59309A and is supplied to the Time Base Divider on board A4 and to Clock Error FF A3U3.

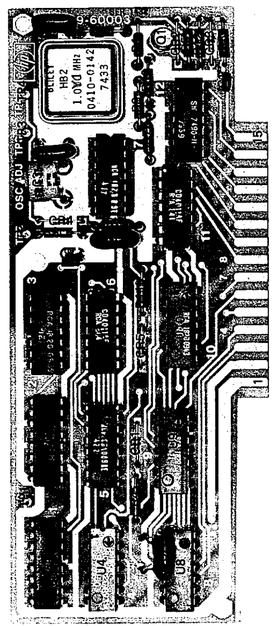
DAY COUNTER (A3U1 and A3U4). The Day Counter receives the 1 day signal from gate A4U6. The day units are counted by A3U1 and the day tens are counted by A3U4. Gates A3U8 and A3U9 provide feedback to reset the counters at the end of the month. A3U8A provides a reset when a 31 count occurs in a 30 day month; A3U8B provides a reset when a 30 count occurs in a 29 day month or when a 29 count occurs in a 28 day month. A3U9B provides a reset when a 32 count occurs in a 31 day month. The outputs of the counters are sent to the A4 board and synchronized by the appropriate digit position bit for output to the display via the Data Bus.

MONTH COUNTER (A3U2 and A3U3B). The Month Counter is clocked by the Day Counter at the end of a month. The month units (ø to 9) are counted by A3U2 and the tens (ø to 1) are counted by A3U3B. At a count of 13 by A3U2 and A3U3B a reset is applied through A3U10C to the counter. The outputs of the counters are sent to the A4 board and synchronized by the appropriate digit position bit for output to the display via the Data Bus.

CLOCK ERROR FF (A3U3A). The Clock Error FF provides an error signal which illuminates all decimal points in the front-panel display. In addition, the error signal is sent to Qualifier Selector A5U8 to result in an ASCII question mark as the first character in the talk output format to the HP-IB. The error signal is generated when the operation of the oscillator is initiated or disrupted, for example by initial application of power, or when an external frequeny standard is first connected into the circuit, or when the oscillator output fails.

Figure 8-4
MOTHERBOARD/POWER SUPPLY ASSEMBLY A2 (59309-60002), SCHEMATIC DIAGRAM

(See Page 8-7)



Part of Figure 8-5. Calendar Oscillator Assembly A3

A3 CALENDAR OSCILLATOR ASSEMBLY (59309-60003) SERIES 1600A

FROM A5B(12), A4B(5), J1(11)

RESET

DAY COUNTER

MONTH COUNTER

FROM A4B(15)

DAY

TP2

P/O A1 DISPLAY ASSEMBLY

P/O A2 MOTHER BOARD

366

365

FROM A4B(13)

FEB

DAY 31

DAY 29, 30

DAY 32

30 DAY MONTH

MONTH RESET

DATA A8 → TO AB(11), J1(9)

DATA B8 → TO A4B(10), J1(10)

DATA A10 → TO A4B(10)

DATA A9 → TO A4B(9)

DATA B9 → TO A4B(8)

DATA C9 → TO A4B(7)

DATA D9 → TO A4B(6)

DATA A7 → TO A4B(1), J1(8)

DATA B7 → TO A4B(3)

DATA C7 → TO A4B(4)

DATA D7 → TO A4B(2), J1(7)

FEB → TO A4B(12)

OSCILLATOR

EXT FREQ DIVIDER

P/O A2 MOTHER BOARD

P/O A1 DISPLAY ASSEMBLY

EXT

INT

S1

J3

EXT FREQ STD

YEL

1 MHZ → TO A4(B15)

ERROR → TO A5A(14)

CLOCK ERROR FF

OSC ADJ

EXT. FREQ. S2 STD. MHZ

P/O A2 MOTHER BOARD

TABLE OF ACTIVE ELEMENTS

REFERENCE DESIGNATION	HP PART NUMBER	MFG OR INDUSTRY PART NUMBER	V_{DD}	GND
		A3		
CR1-5	1901-0040	1901-0040		
Q1	1854-0009	1854-0009		
U1, 2	1820-1189	MC14510CP	16	8
U3, 4	1820-0939	CD4013AE	14	7
U5	1820-0979	CD4029AE	$(V_{CC}+1)$ 16	8
U6, U11	1820-0948	CD4011AE	14	7
U7	1820-0978	CD4007AE	14	7
U8	1820-0050	CD4012AE	14	7
U9, 10	1820-0043	CD4023AE	14	7
U12	1820-0055	SN7490N	5	10
Y1	0410-0142	0410-0142		

59309A-4

Figure 8-5. Calendar Oscillator Assembly A3 (59309-60003), Schematic Diagram

Figure 8–5
CALENDAR OSCILLATOR ASSEMBLY A3 (59309-60003)
SCHEMATIC DIAGRAM

(See Page 8–9)

A4 TIME ASSEMBLY (59309-60004)

The Time Assembly contains the Time Base Divider and the counter circuits that develop the information supplied to the Data Bus for the clock display and the talk output.

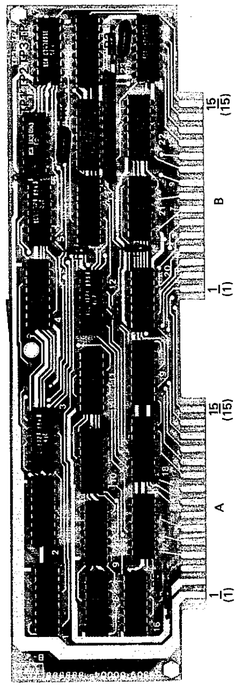
TIME BASE DIVIDER (A4U13, A4U14, A4U15). The Time Base Divider decades receive the 1 MHz signal from the time base oscillator on the A3 board and divide the signal down to 1 Hz to supply the 1-second signal to the seconds counter. In addition, an output called C Line is supplied by A4U15B. This signal is used by the Handshake Synchronizer on the A5 board, and by the Power Supply (on the A2 board) to develop the –2V and +12V which is supplied to the State Machine ROM A5U2, and is the main clock for the State Machine ROM.

The Time Base Divider circuit also supplies digit position information for the display and provides the C Line 5 signal. The digit position information is generated by four-bit counter (A4U13A) via the Digit Position Bus to Digit Position Decoder (A4U18) and to the RAM Address Counter A5U7. The C-Line-5 signal is used as a qualifier by the Qualifier Selector A5U8.

An output from counter A4U13A is provide through the SLOW switch on the front panel to gate A4U23 for manual slow update of the clock. An output from U14A is provided through the FAST switch for fast update of the Clock.

DIGIT POSITION DECODER (A4U18). This decoder receives a four-bit code from the Time Base Divider and decodes it to a 10-bit output that is sent to the front panel display to illuminate the digit positions. This 10-bit output is also supplied, through drivers (A4U17 and A4U19), to synchronize the outputs of the counters (on the A3 and A4 boards) to the Data Bus for strobing the display.

SECONDS COUNTER (A4U4), MINUTES COUNTER (A4U2), HOURS COUNTER (A4U1B). The Seconds Counter receives the 1 Second signal from gate A4U6B and divides it by 10 (A4U4A), then by 6 (A4U4B), and supplies the output to the Minutes Counter which divides by 10 (A4U2A), then by 6 (A4U2B), and supplies the output to the Hours Counter which divides by 24 to provide the 1 Day signal. The 1 Day signal is sent through gate U6A to the Day Counter on the A3 board. All the BCD outputs of each counter, synchronized by the appropriate digit position bit are output via the Data Bus for display. The counters and gate A4U6 receive update and reset signals from Program Code Decoder A5U17 or from the switches on the front panel.



Part of Figure 8–6. Time Assembly A4

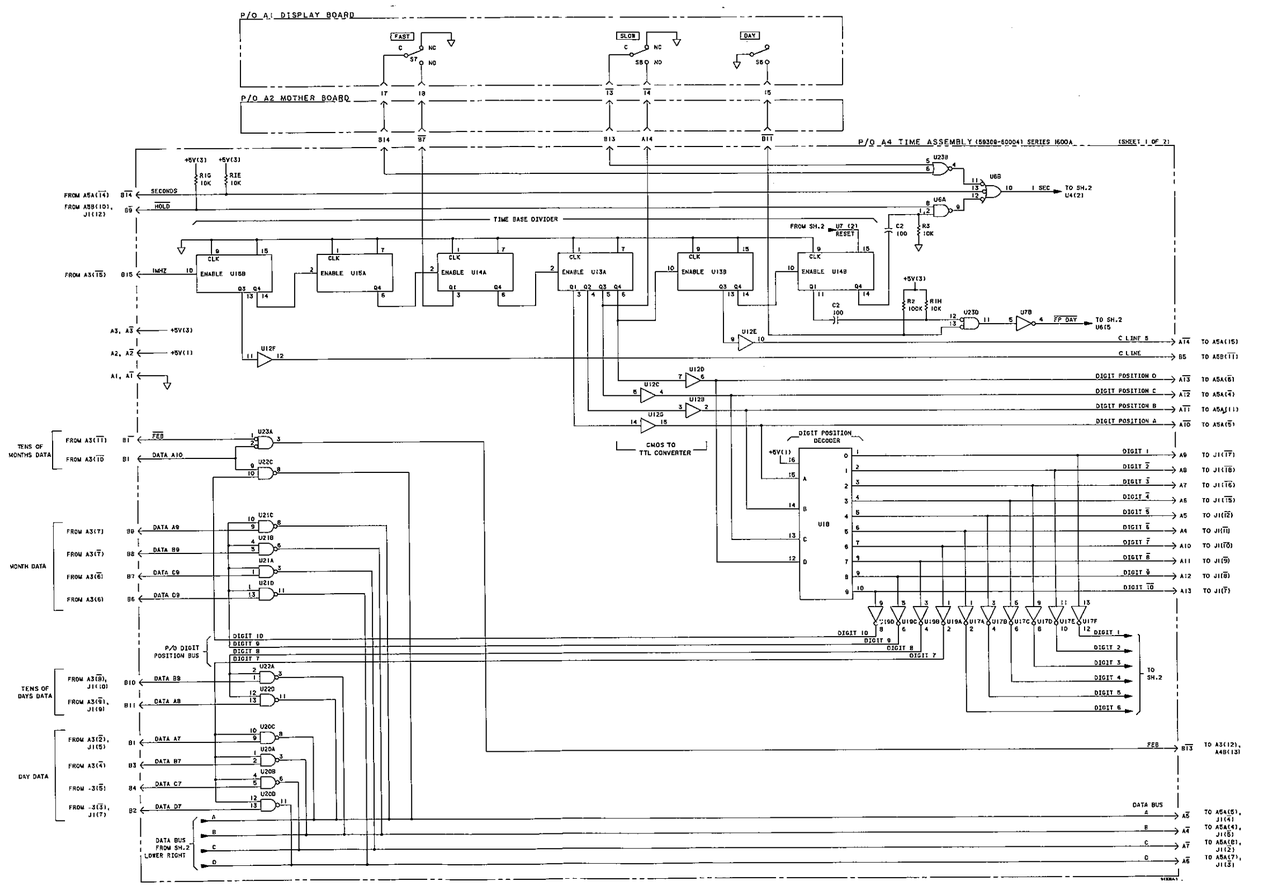


Figure 8–6. Time Assembly A4 (59309-60004), Schematic Diagram (Sheet 1 of 2)

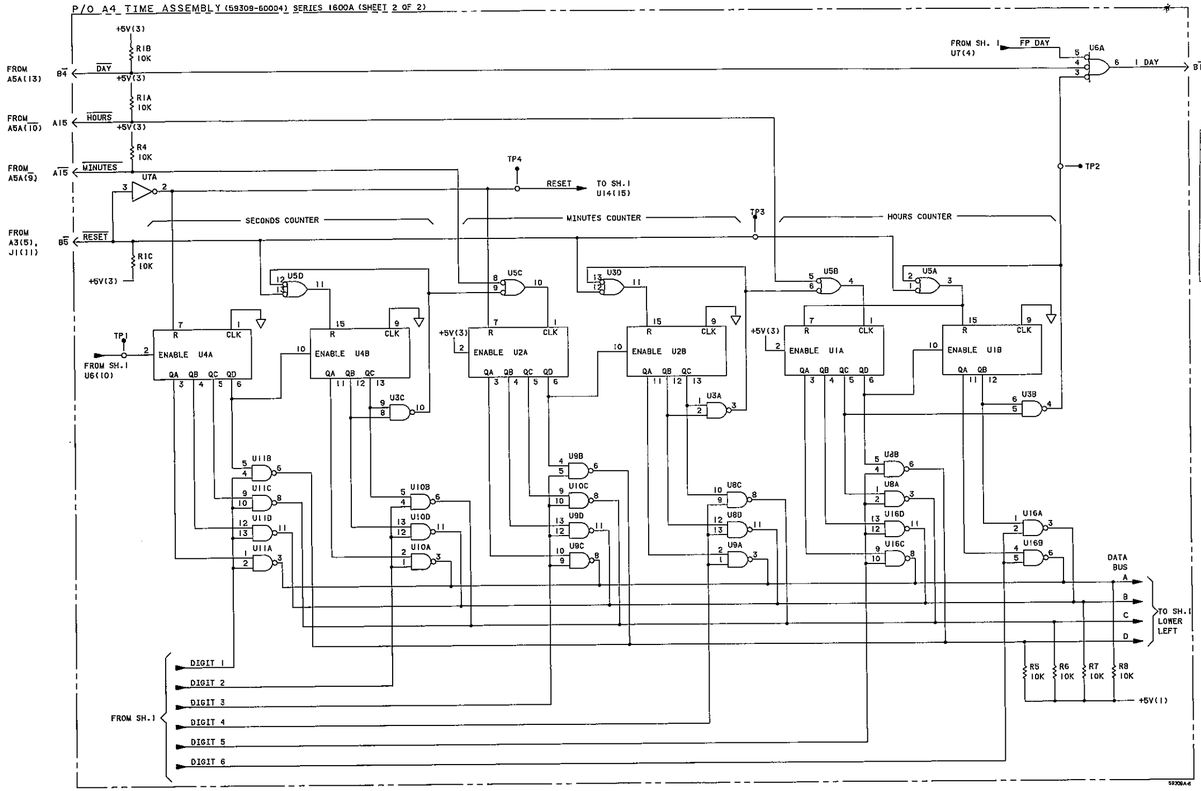


TABLE OF ACTIVE ELEMENTS

REFERENCE DESIGNATION	HP PART NUMBER	MFG OR INDUSTRY PART NUMBER	V_{DD}	GND
A4				
U1, 2, 4, 13-15	1820-1122	MC14518CP	16	8
U3, 5	1820-0949	CD4011AE	14	7
U6	1820-0943	CD4023AE	14	7
U7	1820-0070	CD4009AE	(V_{CC} + 1) 16	8
U8, 9, 10, 11, 16, 20, 21, 22	1820-1181	SN74LS02N	(V_{CC} + 1) 14	7
U12	1820-0980	CD4016AE	(V_{CC} + 1) 16	8
U17, 19	1820-1199	SN74LS04N	14	7
U18	1820-0491	SN74145N	16	8
U23	1820-0946	CD4001AE	14	7

Figure 8-6. Time Assembly A4 (59309-60004), Schematic Diagram
(Sheet 2 of 2)

A5 BUS I/O ASSEMBLY (59309-60005)

The bus I/O assembly contains circuits for communicating with the bus. It also contains circuits for processing software instructions for the remote programming mode of the 59309A.

INPUT DECODER ROM (A5U18). This ROM has two operating modes which are controlled by the state of the ATN signal. When ATN is low the ROM monitors the DIO lines and processes valid Universal Commands. When ATN is high, the ROM processes valid data codes.

ADDRESS COMPARATOR (A5U19). The address Comparator monitors DIO lines 1 through 5 and compares their logic states with the logic states of switches 1 through 5 on the rear-panel address switches of the 59309A. The Address Comparator outputs a high signal (pin 14) to indicate comparison. The output of the Address Comparator combines with the output of the Input Decoder ROM command statement (ATN low) to control the Listen FF and the Talk FF.

LISTEN FF (A5U12A). This FF is set by the $\overline{\text{LISTEN}}$ signal and the address comparison signal from the Address Comparator. When set, this FF indicates the 59309A has been addressed to listen. The Listen FF is cleared by the Unlisten (?) command, and is clocked by the Address Clock signal generated by the Listen Handshake Synchronizer Circuit.

TALK FF (A5U12B). The Talk FF is set by the $\overline{\text{Talk}}$ signal from the Input Decoder ROM in combination with the output of the Address Comparator. When set, this FF indicates the 59309A has been addressed to talk. The Talk FF is cleared by IFC, by the Untalk command, or by a Talk Address that differs from the setting of the Address Switch. The FF is clocked by the Address Clock signal generated by the Listen Handshake Synchronizer circuit.

PROGRAM CODE DECODER (A5U17). The Program Code Decoder monitors the outputs of the Input Decoder ROM and sets various clock update signals in response to software programming codes processed by the Input Decoder ROM. The clock update signals are sent to the A4 Time Assembly for further processing. The program code decoder also supplies the Store signal to the Store FF.

Figure 8-6
TIME ASSEMBLY A4 (59309-60004), SCHEMATIC DIAGRAM
(Sheet 2 of 2)

(See Page 8-13)

STORE FF (A5U4B). The Store FF receives the $\overline{\text{Store}}$ signal from the Program Code Decoder (when programmed) and supplies a qualifier (Store) to Qualifier Selector A5U8. This action results in the storage of data (representing the time at that moment) in the Output Data Storage RAM A5U14.

RUN/HOLD FF (A5U19). This FF receives the $\overline{\text{Run}}$ signal or the $\overline{\text{Hold}}$ signal from the program code decoder to start ($\overline{\text{Run}}$) or to stop ($\overline{\text{Hold}}$) the clock. The output of this FF controls the output of the Time Base Divider on the A4 board.

LISTEN HANDSHAKE SYNCHRONIZER (A5U5). This circuit monitors the DAV signal from the bus and sets the NRFD and NDAC signals in response, on the HP-IB. This cycle (DAV, NRFD, and NDAC) is synchronized by the C Line signal from the Time Base Divider (A4U15B) on board A4. The C Line signal occurs only when the clock time is not updating and ensures that an update command on the bus does not interfere with the time count of the clock.

QUALIFIER SELECTOR (A5U8). This circuit selects one of eight qualifiers for storage in the Qualifier Storage FF. Selection control is provided by the State Machine ROM A5U2.

QUALIFIER STORAGE FF (A5U3A). This FF stores state of the qualifier selected by A5U8 for use in the state machine program.

STATE MACHINE ROM (A5U2). This 4K ROM controls the operation of the circuits that develop the talk output of the 59309A. The operational flowchart is shown in Section V. The number label adjacent to each block in the flowchart represents the state number at that point. The state number represents the octal equivalent of address coming into the ROM from the Next Address Shift Register (U1).

NEXT ADDRESS LATCH (A5U1). This circuit receives the next address from the State Machine ROM next address outputs and stores it until the next clock period of the machine. At the next clock period the address is output to the State Machine ROM as the present address.

OUTPUT DATA STORAGE RAM (A5U14). This RAM receives the four bits of data from the data bus on the A4 board (the same data that is supplied to the display) and stores them in the location defined by the digit position bits (illuminate digit positions) from the RAM Address Multiplexer (A5U7). The RAM outputs this data to the DIO Drivers when the 59309A is addressed to talk.

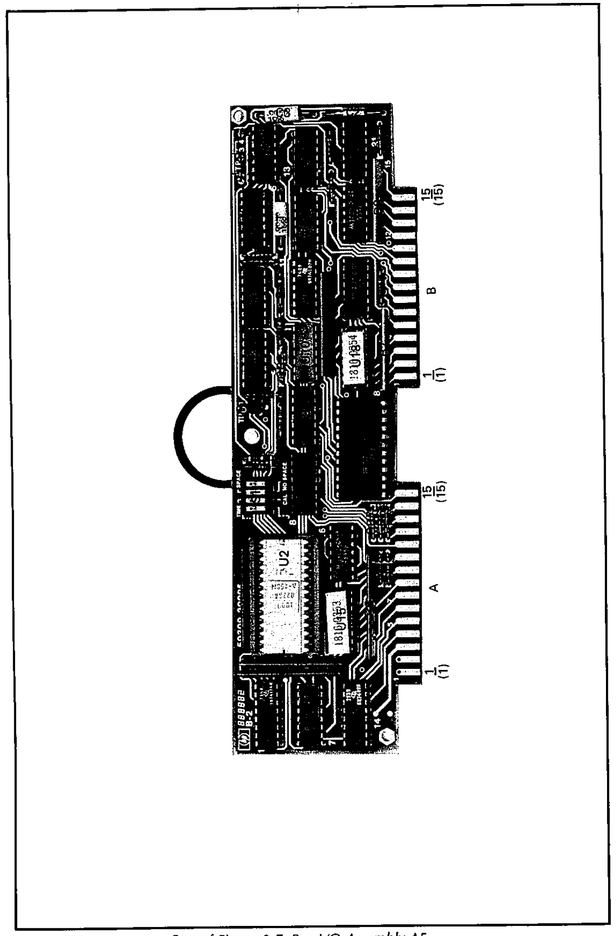
RAM ADDRESS MULTIPLEXER (A5U7). This circuit acts as a switch to provide digit position or state machine information to address the Output Data Storage RAM.

ASCII ENCODING ROM (A5U15). This ROM, in conjunction with the Output Data Storage RAM, outputs the data string to the bus. The Output Data Storage RAM supplies bit 1 through 4 of the digit information and the ASCII Encoding ROM supplies bit 5, 6, and 7 of the digit information in addition to LF and ? (question mark).

DIO DRIVERS (A5U16 and A5U20). The DIO Drivers are enabled by the Talk Enable Signal to accept the outputs of RAM (A5U14) and ROM (A5U15) to provide the talk output to the DIO lines of the HP-IB.

DAV FF (A5U3B). This FF is set by one of the outputs of the State Machine ROM and clocked by the C Line signal to provide the DAV signal to the HP-IB for the talk handshake.

LOAD FF (A5U4A). The Load FF is controlled by one of the outputs of the State Machine ROM and clocked by the C Line signal for storage of the clock time present just before receipt of the Load Command.



Part of Figure 8–7. Bus I/O Assembly A5

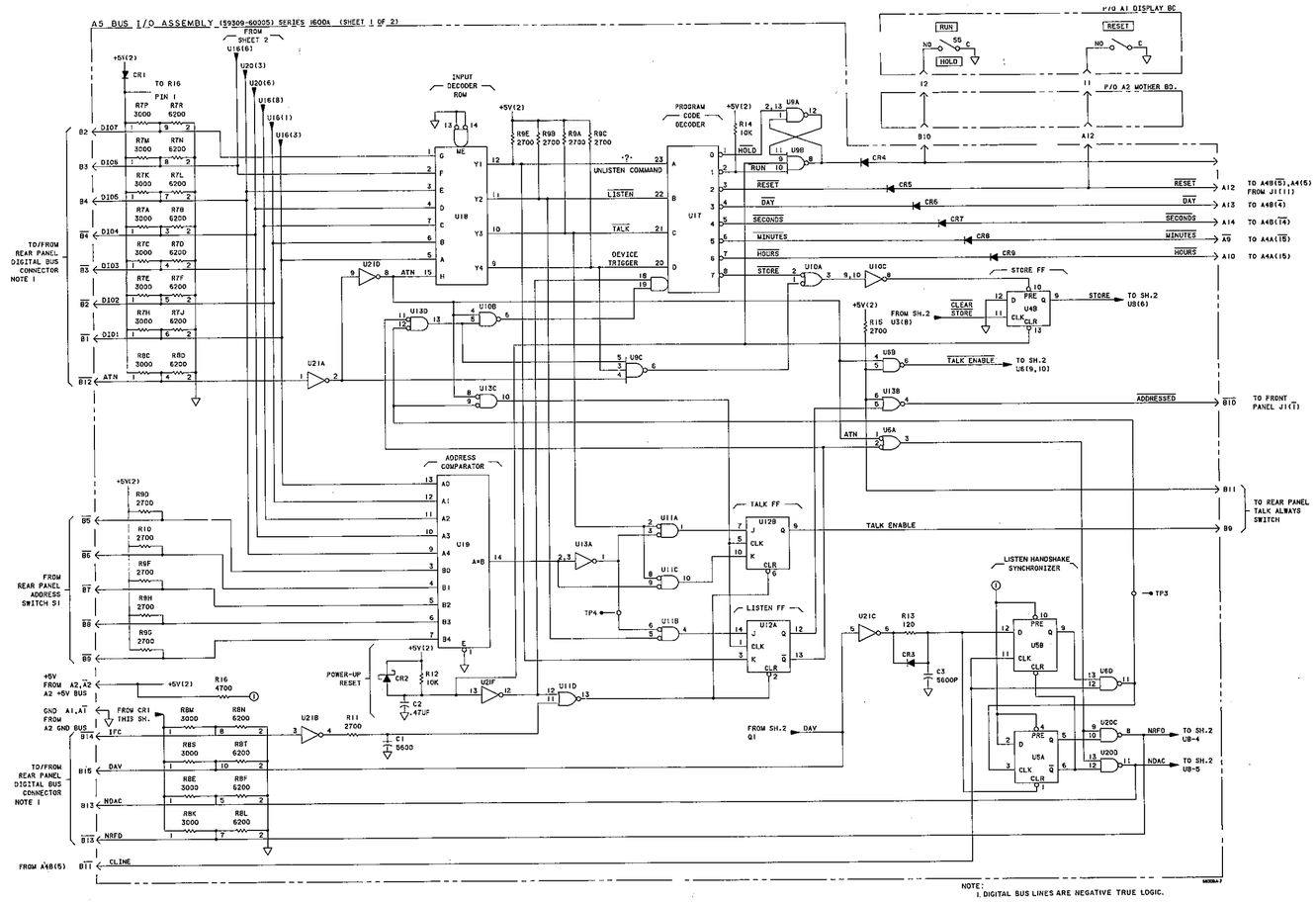


Figure 8–7. Bus I/O Assembly A5 (59309-60005), Schematic Diagram (Sheet 1 of 2)

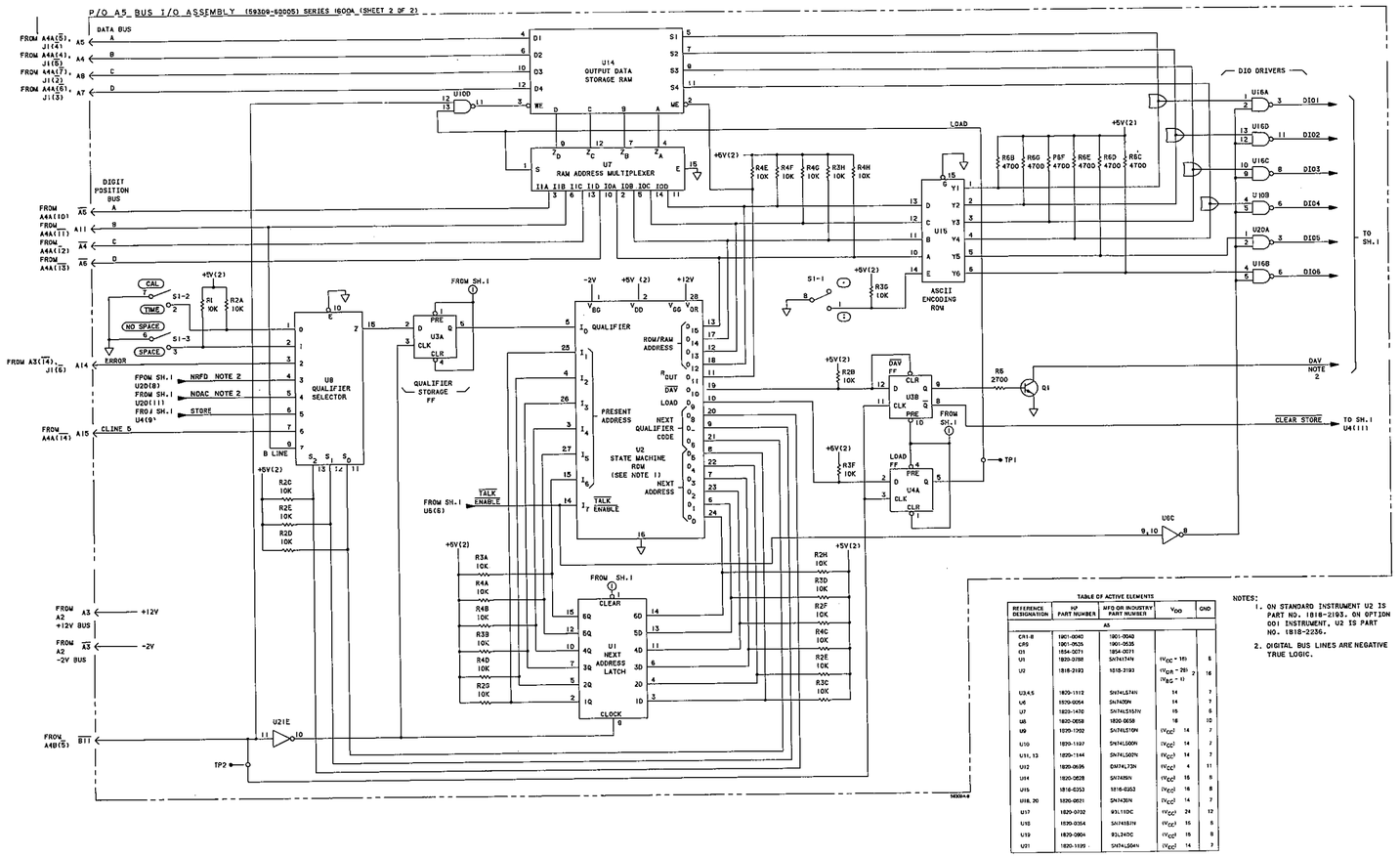


Figure 8-7. Bus I/O Assembly A5 (59309-60005), Schematic Diagram (Sheet 2 of 2)

Figure 8-7
BUS I/O ASSEMBLY A5 (59309-60005)
SCHEMATIC DIAGRAM (Sheet 2 of 2)

(See Page 8-17)

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