

OPERATING AND SERVICE MANUAL
COUNTER
(PART OF 5501A LASER TRANSDUCER SYSTEM)

10760A

SERIAL PREFIX 1948A

This manual applies directly to Hewlett-Packard Model 10760A with serial prefix 1948A and below.

SERIAL PREFIXES NOT LISTED

For instruments with serial prefixes above 1948A, a "Manual Change Sheet" is included with this manual.

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SAFETY

This product has been designed and tested according to International Safety Requirements. To ensure safe operation and to keep the product safe, the information, cautions, and warnings in this manual must be heeded. Refer to Section 1 for general safety considerations applicable to this product.

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

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SECTION I

GENERAL INFORMATION

1-1. SCOPE OF THIS MANUAL

1-2. This manual provides operating and service information for the 10760A Counter. The 10760A (see Figure 1-1) is an optional printed-circuit board for the Hewlett-Packard Model 5501A Laser Transducer System. The 10760A plugs into the HP Model 10740A Coupler, which provides interconnections between the 10760A and the 5501A system.

NOTE

Programming information for the 10760A is contained in the Systems Manual.

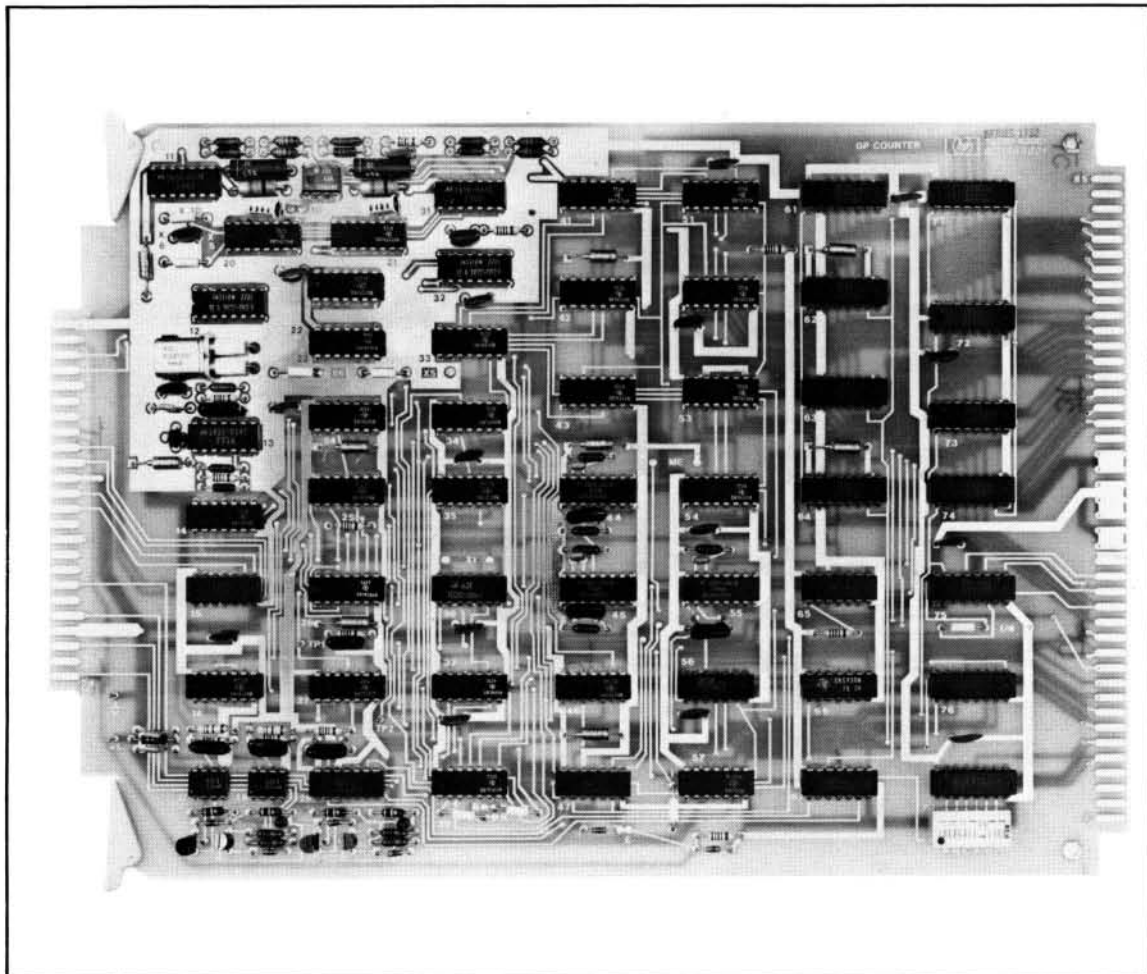


Figure 1-1. 10760A Counter

1-3. MANUAL MICROFICHE

1-4. On the title page of this manual, below the manual part number is a "microfiche" part number. This number may be used to order 4 x 6-inch microfilm transparencies of the manual. The microfiche package should include all pertinent Service Notes, but Manual Change sheets must be requested separately (see paragraph 1-6).

1-5. PRINTED-CIRCUIT BOARD IDENTIFICATION AND MANUAL CHANGES

1-6. Each 10760A printed-circuit board has a four-digit series identification number (e.g., 1512A). The series number identifies a group of identical printed-circuit boards. If the series number on your board is a higher number than the series number on the title page of this manual, a change sheet should be included that describes the differences between series numbers. If the change sheet is missing, request one from the nearest Hewlett-Packard Sales and Service Office (see the HP offices listing at the back of this manual). If your board has a series number lower than that shown on the title page, refer to the Manual Changes section, page 7-1, for differences in the documentation.

1-7. DESCRIPTION

1-8. A 10760A Counter accepts RF displacement signals from a 5501A Laser Transducer and one 10780A Receiver, and converts these signals to digital displacement information for use within the Laser Transducer system.

1-9. EQUIPMENT SUPPLIED

1-10. Table 1-1 lists the part numbers of items shipped with the 10760A.

Table 1-1. Equipment Supplied

DESCRIPTION	HP PART NO.
Counter Printed-Circuit Card	10760-60001
Interface Cable	10760-60002
Instruction Manual	10760-60004

1-11. SPECIFICATIONS

1-12. Table 1-2 lists the specifications for the standard 10760A and options.

1-13. SAFETY CONSIDERATIONS

1-14. This manual contains information, cautions, and warnings which must be followed by the user to ensure safe operation and to retain the instrument in good operating condition.

1-15. 10740A COUPLER BUS

1-16. All printed-circuit boards plugged into the 10740A Coupler are connected in parallel via the Coupler's 86-line backplane. Table 1-3 provides a pin number-to-signal name conversion for the backplane.

Table 1-2. 10760A Counter Specifications

Installation: 10740A Coupler

Input Requirements:

Power: +5 volts @ 1.8 amps
Reference Signal: Compatible with 5501A Laser Transducer
Measurement Signal: Compatible with 10780A Receiver

Measurement Resolution/Maximum Allowable Velocity:

The allowable resolutions and velocities are dependent on the type of interferometer used.

Interferometer	10702A, 10705A			10706A		
Resolution	$\lambda/4$	$\lambda/24$	$\lambda/40$	$\lambda/8$	$\lambda/48$	$\lambda/80$
Maximum Velocity mm/s (in./s)	304 (12)	51 (2)	30 (1.2)	152 (6)	25 (1)	15 (0.6)

10760A Counter Output:

The contents of the 28-bit counter on the 10760A along with 4 status bits are available for transfer to the System Controller via the 10746A Binary Interface.

Format: 32-bit word; 28-bit position word with 4 status bits which allow detecting Measurement or Reference signal errors, counter overflow, and decimal point. Can be transferred to System Controller as two 16-bit words or four 8-bit bytes.

Output Rate: Nine individual operations at typically one microsecond each are required to transfer two 32-bit words (two axes of measurement data) to the System Controller using the two 16-bit word format in conjunction with the 10746A Binary Interface.

Programmable Functions:

Counter Preset, Addressable Sample, Synchronous Sample, Output, Normal Resolution, Extended Resolution, Self-Test.

System Control Functions:

Input from System Controller via 10746A Binary Interface.

Reset: Initializes all interface electronics. Presets 10760A Counters to 160 counts. All counters may be present either individually or simultaneously.

Sample: Places Counter contents of 10760A in output buffer for transfer to System Controller. Can be initiated either by the System Controller or externally.

Weight: 0.45 kg (1 lb.)

Dimensions: 197 x 279 mm (7.75 x 11 in.)

Table 1-3. 10740A Coupler Bus Lines

	PINS	NAMES	PINS	NAMES
INSTRUCTION LINES	1	+15 VOLTS	2	+15 VOLTS
	3	-15 VOLTS	4	- VOLTS
	5	± 15 RETURN	6	±15 RETURN
	7	SPARE	8	SPARE
	9	CARD ADDRESS-A	10	CARD ADDRESS-B
	11	CARD ADDRESS-C	12	CARD ADDRESS-D
	13	CARD CMD-A	14	CARD CMD-B
	15	CARD CMD-C	16	CARD CMD-D
	17	DATA VALID	18	DATA VALID
	19	INSTRUCTION VALID	20	INSTRUCTION VALID
DATA	21	OPERATION COMPLETE	22	OPERATION COMPLETE
	23	SAMPLE	24	PWR-UP/SYSTEM RESET
	25	REF ERROR-BIT	26	MEAS ERROR-BIT
	27	V.O.L. ERROR-BIT	28	OVFL-BIT
	29	D.P.-BIT-1	30	D.P.-BIT-0
	31	D.P.-BIT-3	32	D.P.-BIT-2
	33	λ-MODE BIT	34	SYSTEM NULLED
	35	SPARE	36	SPARE
	37	+5V RETURN	38	+5V RETURN
	39	+5V RETURN	40	+5V RETURN
DATA	41	+5 VOLTS	42	+5 VOLTS
	43	+5 VOLTS	44	+5 VOLTS
	45	+5 VOLTS	46	+5 VOLTS
	47	+5V RETURN	48	+5V RETURN
	49	+5V RETURN	50	+5V RETURN
	51	SPARE	52	SPARE
	53	DATA BIT 1	54	DATA BIT 0
	55	DATA BIT 3	56	DATA BIT 2
	57	DATA BIT 5	58	DATA BIT 4
	59	DATA BIT 7	60	DATA BIT 6
DATA	61	DATA BIT 9	62	DATA BIT 8
	63	DATA BIT 11	64	DATA BIT 10
	65	DATA BIT 13	66	DATA BIT 12
	67	DATA BIT 15	68	DATA BIT 14
	69	DATA BIT 17	70	DATA BIT 16
	71	DATA BIT 19	72	DATA BIT 18
	73	DATA BIT 21	74	DATA BIT 20
	75	DATA BIT 23	76	DATA BIT 22
	77	DATA BIT 25	78	DATA BIT 24
	79	DATA BIT 27	80	DATA BIT 26
	81	MAKE NO CONNECTION	82	MAKE NO CONNECTION
	83		84	
	85		86	

SECTION II INSTALLATION

2-1. INTRODUCTION

2-2. For the 10760A Counter, this section provides instructions for unpacking, inspection, preparation for use, power requirements, operating environment, installation in 10740A Coupler, interconnecting cables, operational check and warranty claims, packaging for reshipment, storage, and field installation of options.

2-3. UNPACKING AND INSPECTION

2-4. If the shipping carton is damaged, inspect the 10760A for visible damage (scratches, cracks, etc.). If the unit is damaged, notify the carrier and the nearest Hewlett-Packard Sales and Service Office immediately (offices are listed at the back of this manual). Keep the shipping carton and packing material for the carrier's inspection. The HP Sales and Service Office will arrange for repair or at HP's option replacement of your instrument without waiting for the claim against the carrier to be settled.

2-5. PREPARATION FOR USE

2-6. The following paragraphs provide information necessary to prepare the 10760A for use. Included are power requirements, operating environment, installation, interconnecting cables, and warranty claims.

2-7. Power Requirements

2-8. The 10760A receives operating power from the 10740A Coupler. Power required is 5 volts at 1.8 amperes.

2-9. Operating and Non-Operating Environment

2-10. The 10760A can be used in the following environments:

OPERATION

Temperature: 32°F to 130°F (0°C to 55°C)
Relative Humidity: 0% to 95%

STORAGE

Temperature: -40°F to +167°F (-40°C to +75°C)
Relative Humidity: 0% to 95%

2-11. Installation

CAUTION

Switch OFF power to 10740A Coupler before installing or removing a circuit board.

2-12. Refer to Figure 2-1, 10760A Installation in 10740A Coupler.

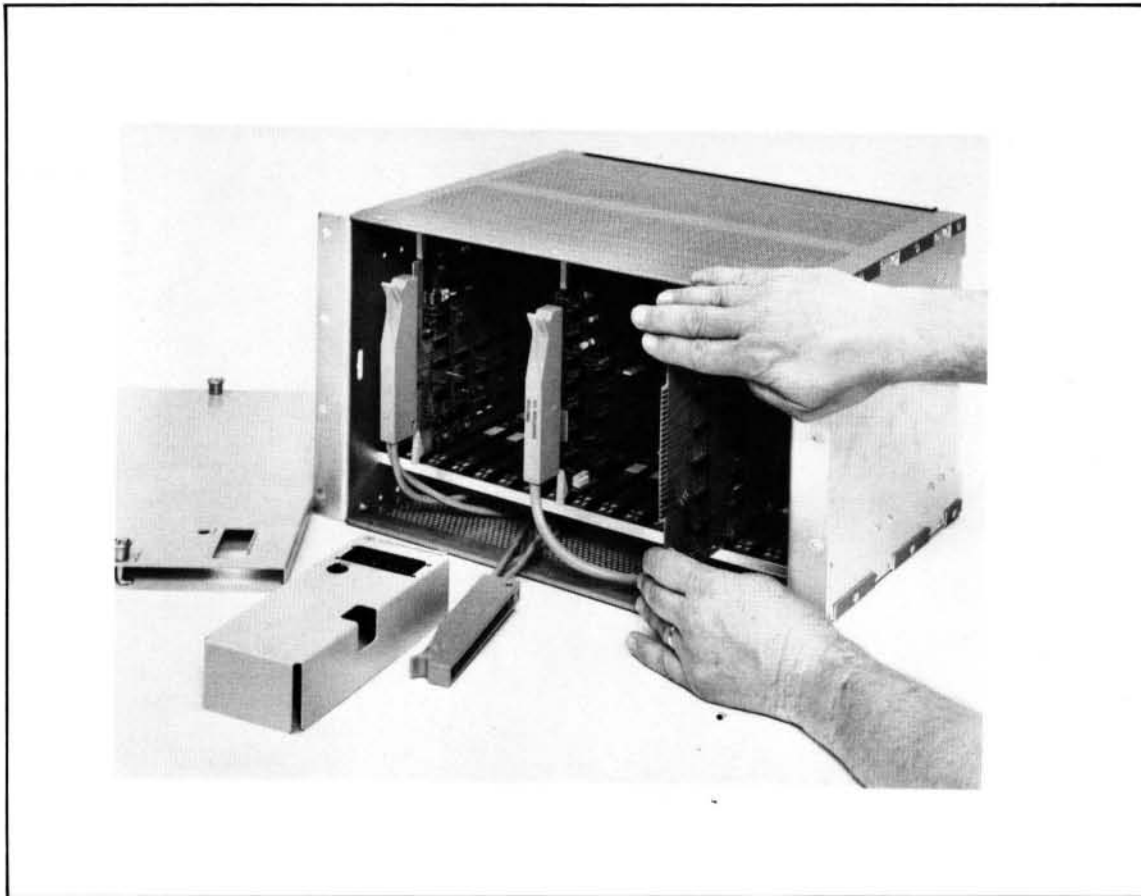


Figure 2-1. Installation

NOTE

When installed, extractor tabs on the 10760A remain outside the 10740A slide guides.
When viewed from the front, IC's are on the right-hand side of the board.

2-13. Connectors

2-14. The dual 24-pin (48) connector edge of the 10760A board mates with the hooded connector on the cable supplied with the board. Three smaller connectors on the cable are used for inputs. Refer to the 5501A System Manual for interconnection information.

2-15. WARRANTY CLAIMS

2-16. Contact the nearest Hewlett-Packard Sales and Service Office (see manual back cover) for information relative to warranty claims.

2-17. PACKAGING FOR RESHIPMENT

2-18. The same containers and materials used in factory packaging can be obtained through the Hewlett-Packard Sales and Service Offices listed at the back of this manual.

2-19. If the 10760A is being returned to Hewlett-Packard for service, attach a tag indicating the type of service required, return address, model number and full serial number. Mark the container FRAGILE to assure careful handling.

2-20. In all correspondence with Hewlett-Packard always reference the full model number and serial number of the board.

2-21. STORAGE

2-22. If the instrument is to be stored for an extended period of time, it should be enclosed in a clean, sealed container.

2-23. 10760A COUNTER ADDRESSES AND COMMANDS (INSTRUCTIONS)

2-24. The 10760A Counter will respond to coded addresses and commands from the 10740A Coupler bus. The 10760A Counter address is selectable with a jumper wire (see paragraph 2-25). Table 2-1 lists the specific instructions and responses for the 10760A.

Table 2-1. 10760A Counter Addresses and Commands (Instructions)

Instruction		Response
Command	Address	
0	X*	Preset counter to 160, clear error bits, and set normal resolution
1	X	Load contents of counter into output data buffer
2	X	Output last sample, decimal point, and error bits to Coupler bus
4	X	Count DOWN
5	X	Go to normal resolution mode, preset counter, clear error bits
6	X	Go to extended resolution mode, preset counter, clear error bits
7	X	Count UP
System Reset	**	Same as 0X
Sample	**	Same as 1X

*Address "X" is used in this table as an example. To have instruction apply to another counter card replace "X" with that card's address.

**Non-addressed instructions. These commands are initiated upon system power up or individually by the system input/output card (i.e., 10746A Binary Interface).

2-25. Address Switch "A, B, C, X, Y, Z" (S1)

2-26. The 10760A operates in the Laser Transducer system through the 10740A Coupler backplane. A transducer system controller, such as a calculator or computer, can be programmed to control one or more 10760A Counters. Each 10760A in one system must have a separate "address" to receive instructions from the controller. Each 10760A can be set to respond to one of six addresses by placing all switches toward the dot on component S1 (reference Figure 8-2), then moving the switch corresponding to the address desired (A, B, C, X, Y, or Z) away from the dot.

2-27. There is no required specific address for any axis of a system, but for convenience the address "X" is typically assigned to the 10760A Counter for the "X" axis of a system, the "Y" address for the "Y" axis, and the "Z" address for the "Z" axis.

2-28. Select one of the letters A, B, C, X, Y or Z for the 10760A address, and then move the individual switch in line with the selected letter. All other switches must be in the opposite (dot) position.

NOTE

Only one of the six "addresses" may be used on one 10760A Counter at one time.

2-29. JUMPER WIRE SETTINGS

2-30. Nine changeable jumper wires are on the 10760A circuit board. Figure 2-2 shows the jumper wire locations. Figure 2-3 shows how to connect the jumpers for the various modes of operation. Functions and settings for the jumper wires are described in the following paragraphs.

CAUTION

These jumper wires should only be changed by qualified service personnel.

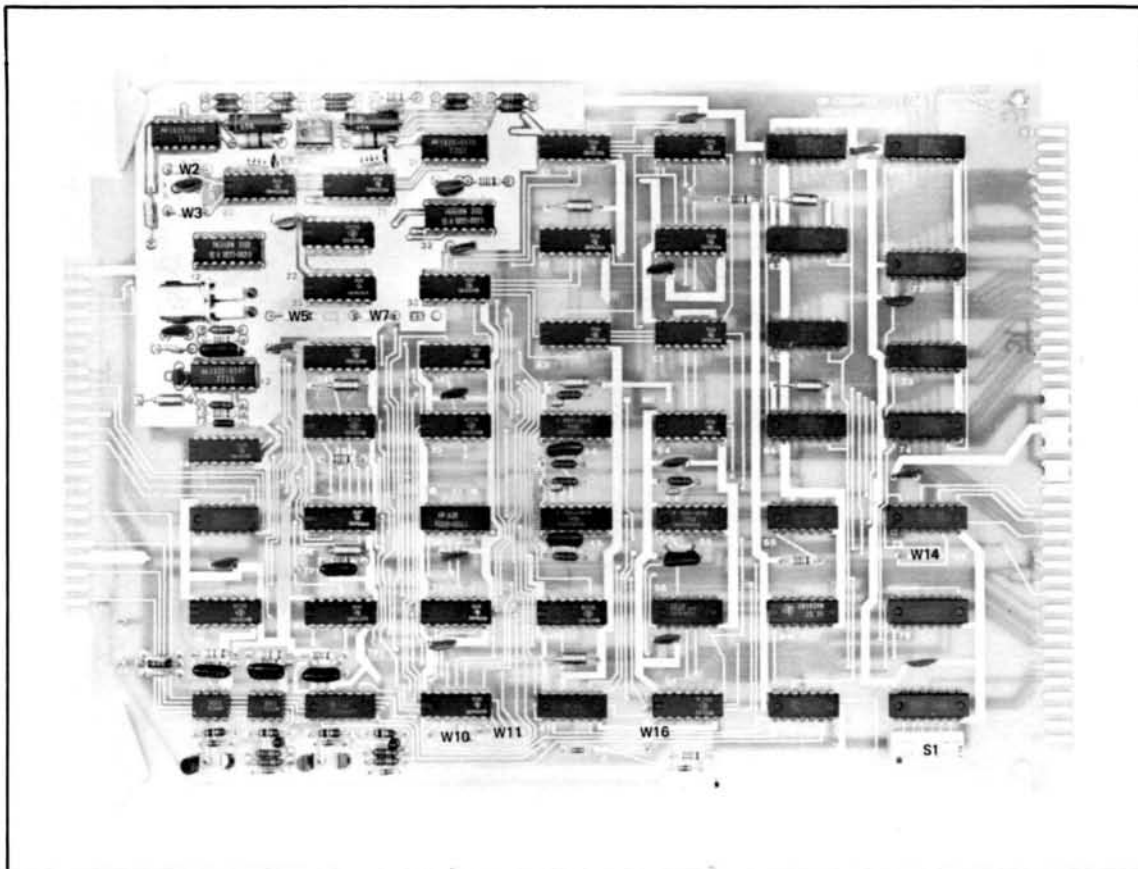


Figure 2-2. Jumper Wire Locations

2-31. Changing Jumper Wires

2-32. If it is desirable or necessary to change the position of a jumper wire, use the following lettered instruction steps:

CAUTION

Use a small soldering iron (35 watts or less) to heat the jumper wire connections. Larger wattage soldering irons may damage the printed-circuit board. The jumper wire holes in the printed-circuit board have metal plated-through walls to ensure good electrical contact. Apply heat sparingly and work carefully to avoid damaging the metal plated conductors and the insulating board.

NOTE

All jumper wires have a small piece of white plastic insulation on them that resembles the body of a small electronic component. The wires are straight through the insulation, and they only have the slight resistance, inductance and capacitance of a normal short piece of wire.

- a. Heat the jumper wire connections with a soldering iron and remove the solder with a solder removing tool. (Good commercial solder "sucking" tools are recommended.)
- b. Remove the loose jumper wire with pliers. It may be necessary to heat the connections with the soldering iron while pulling the wire with pliers.
- c. Clean the excess solder from the wire ends with the soldering iron.
- d. Put the jumper wire ends into the selected holes, and solder the connections carefully.
- e. Clean the connection area on the board with a good commercial electronic solder flux solvent.

2-33. Selecting “R” and “N” Jumper Wires (W10 & W11)

2-34. Two separate jumper wires with adjacent “R” and “N” markings are on the 10760A board. These two jumpers determine if the transducer system pulses counted by the particular 10760A board are counted in “normal” (N) or “reverse” (R).

NOTE

Both jumper wires must be connected to the same letter terminal “N” & “N” or “R” & “R” for proper operation. See Figure 2-3.

2-35. The correct position for the pair of wires is determined by the arrangement of the 5501A Transducer System optics. (The technical factors that determine the “reverse” or “normal” counter operation are described in Section IV.) Usually a 5501 Laser Transducer system operates with increasing distance between optics causing an increase in the number of pulses counted by the counter. Refer to the Installation section of the 5501A System Operating and Service Manual for optical mounting and jumper placement instructions.

2-36. Selecting the “ $\lambda/4$ — $\lambda/8$ ” Jumper Wires (W13 or W14)

2-37. The “ $\lambda/4$ — $\lambda/8$ ” jumper wire is factory set to “ $\lambda/4$ ”. The “ $\lambda/8$ ” position is used only if the 10706A Plane Mirror Interferometer, the 10761A Multiplier, and the 10763A English/Metric Pulse Output boards are included in the 5501A Laser Transducer System.

2-38. Selecting “X5, X6, X9 and X10” Jumper Wires (W1 thru W8, & W9)

2-39. Either “normal” or “extended” resolution can be selected with a digital command from the laser system controller. (Refer to the system manual for programming information.) When extended resolution is selected, W9 must first be installed, then the system resolution is increased by a factor of 6 or 10 depending on how jumpers W1–W8 are installed. Install the four resolution extension jumper wires to the positions specified in Table 2-2.

Table 2-2. Extended Resolution Jumper Wire Settings

Extended Resolution	Jumper Across			
X10	X10	X9	X9	X10
X6	X6	X5	X6	X5

NOTE

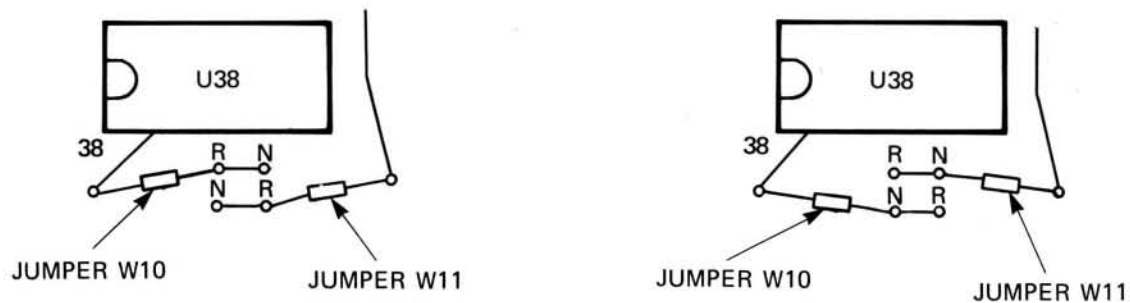
Jumpers W1–W8 are installed at the factory for X10 resolution. This includes the proper capacitance values for C15 and C16 (12 pF). If X6 resolution is desired, the jumpers must be changed, and C15 and C16 must be replaced with C15A and C16A (22 pF).

2-40. Selecting Internal or External “SAMPLE” (W15 or W16)

2-41. The SAMPLE instruction causes the 10760A to load the contents of its counter into its output data buffers. Either internal SAMPLE from the 10740A Coupler bus or external SAMPLE from any other unit can be selected by setting the jumper next to U57 in the I (internal) or E (external) position.

NOTE

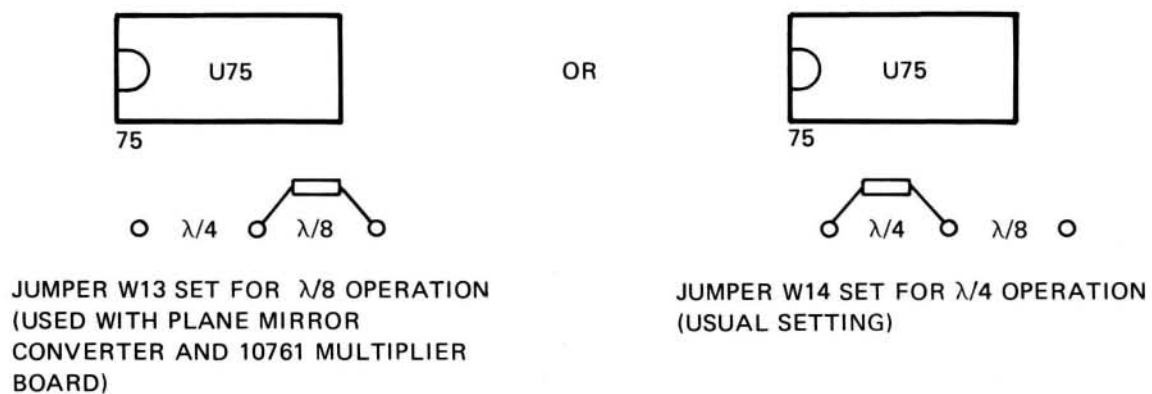
Only one end of the jumper needs to be moved to change the SAMPLE. The upper end can be moved from I to the hole marked E to change the SAMPLE to external. If external SAMPLE is selected a contact closure (1 μ s min.) must be applied across 10760A front connector pins 2/B and 1/A to activate the SAMPLE function.



REVERSE OPERATION

NORMAL OPERATION

"REVERSE" OR "NORMAL" COUNTER OPERATION



"λ/4" OR "λ/8" OPERATION

Figure 2-3. Jumper Connections

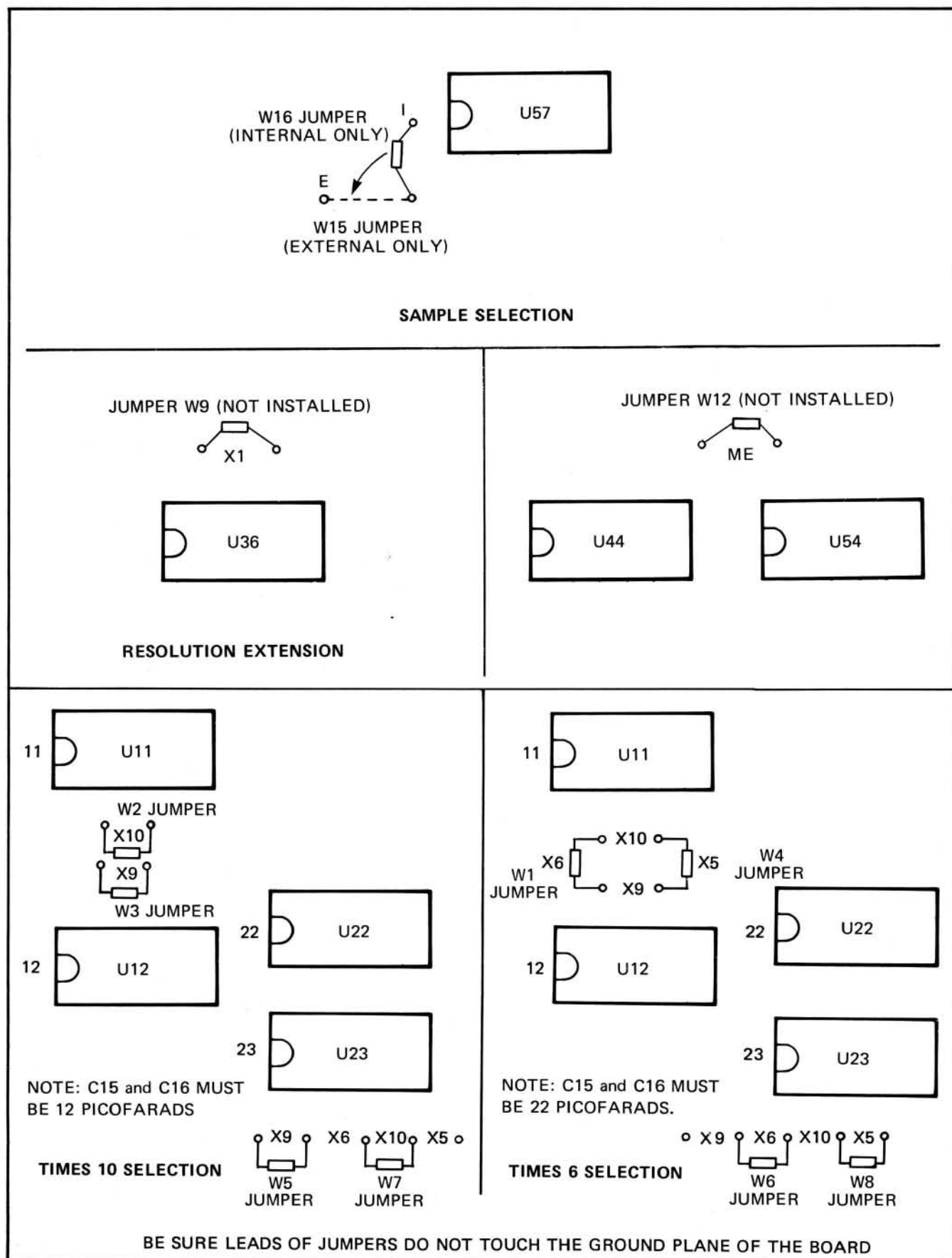


Figure 2-3. Jumper Connections (Cont'd)

SECTION III OPERATION

3-1. OPERATION

3-2. The 10760A Counter does not have any operating controls and must be used with an output card such as the 10746A or 10745A. Operation of the 10760A is accomplished by programming a system controller in a 5501A Laser Transducer system. Programming system controllers is described in the 5501A System Manual.

3-3. There are several jumper wires soldered on the 10760A board that can be rewired to change operating characteristics of the 10760A. Changing these jumper wires is described in Section II of this manual.

3-4. LIGHT EMITTING DIODES

3-5. Two light emitting diodes (LED's) on the 10760A may glow bright red during normal operation. These LED's are not operating indicators, and they do not require observation or monitoring. The functions of these two LED's are described in Section IV of this manual.

SECTION IV

THEORY OF OPERATION

4-1. INTRODUCTION

4-2. This section contains the theory of operation of the 10760A Counter.

4-3. BLOCK DIAGRAM DESCRIPTION

4-4. The 10760A Counter accepts a reference signal from the 5501A Laser Transducer and a measurement signal from the 10780A Receiver. These signals are processed to produce a digital signal which is counted and represents the distance that the optical element has moved. Usually one counter is used for each axis of movement in the system. Figure 4-1 is a block diagram of the counter.

4-5. 12.6 MHz Clock

4-6. The 12.6 MHz clock circuit provides the timing signal for the pulse converter, self-test control, and the window detector.

4-7. Instruction and Control Logic

4-8. The instruction and control logic section of the counter interfaces the instruction lines of the 10740A Coupler bus to the counter. Address and Command signals from the Coupler bus are decoded in this logic and activate the counter for its modes. The other five separate instruction lines (RESET, INSTRUCTION VALID, SAMPLE, DATA VALID, and OPERATION COMPLETE) also are either received or generated in the instruction and control logic.

4-9. INSTRUCTIONS (ADDRESSES AND COMMANDS). Responses of the counter to coded addresses and commands are listed in Table 2-1.

4-10. ADDRESS LINES. The counter is set for one of six unique addresses which allows the system controller to operate the counter. The correct address must be set on the four address lines.

4-11. COMMAND LINES. Functions of the counter are selected by the system controller by applying appropriate commands on the command lines. The correct address must be on the address lines for the counter to respond to a command except the counter will always respond to INSTRUCTION VALID with OPERATION COMPLETE.

4-12. INSTRUCTION VALID and OPERATION COMPLETE. If the INSTRUCTION VALID line is set true by another unit, the counter responds by setting the OPERATION COMPLETE line true even if the counter was not addressed. (If the counter is addressed, the counter sets the INSTRUCTION VALID line true, then after initiation of the instruction, sets the OPERATION COMPLETE line true.)

4-13. SAMPLE. When the SAMPLE line is set true, either internally by the system controller or by an external device, the counter loads the current displacement data in the 28-bit buffer. The instruction "1" plus the correct address causes the counter to do the same thing as the SAMPLE line.

4-14. DATA VALID. The counter sets the DATA VALID lines true when given an OUTPUT INSTRUCTION; a short delay allows the data lines to settle.

4-15. OUTPUT INSTRUCTION. The command "2" plus the correct address causes the counter card to output buffered data to the backplane. The counter then sets DATA VALID true and OPERATION COMPLETE true, in that order.

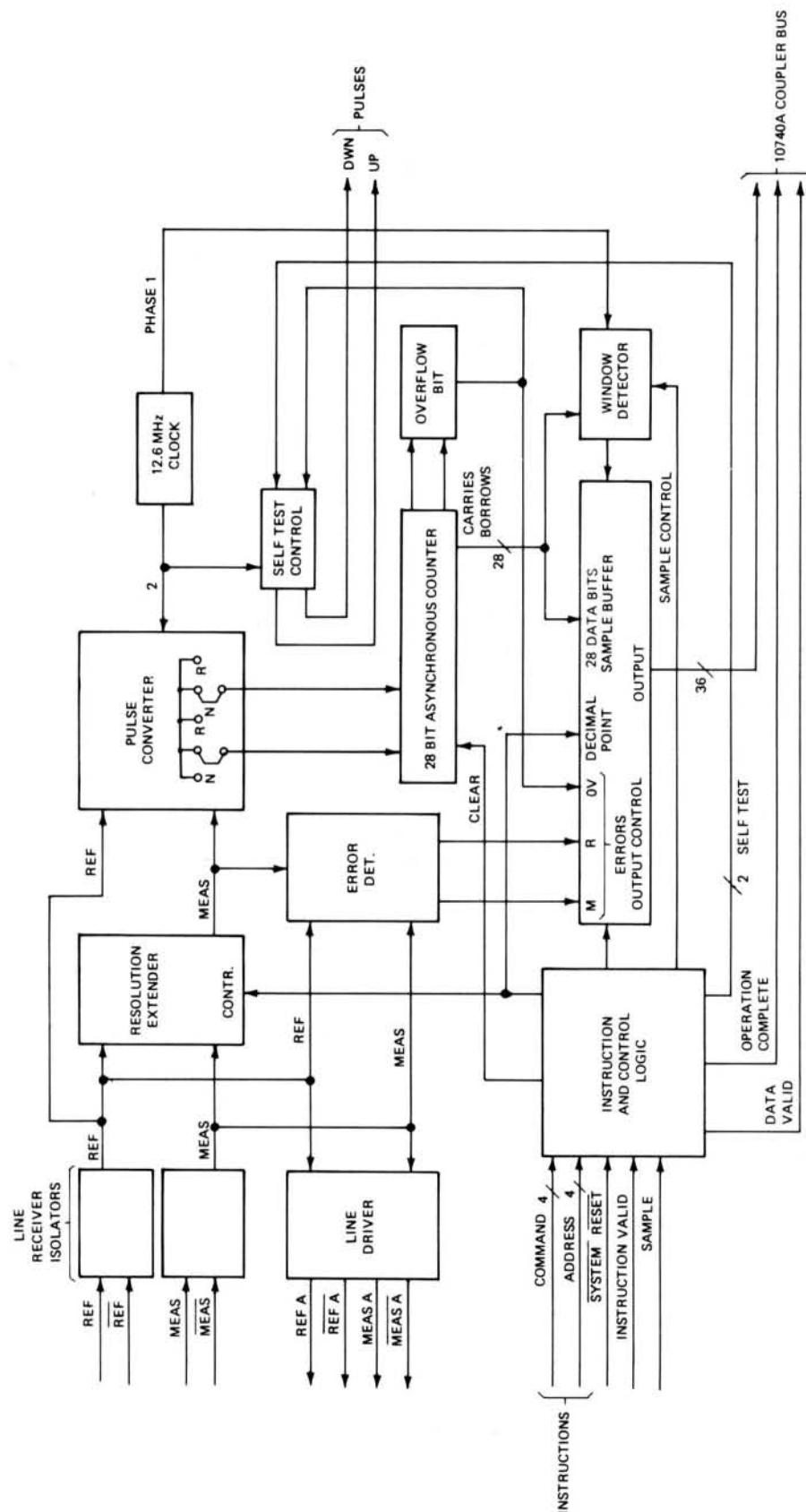


Figure 4-1. Block Diagram

4-16. Laser Reference and Measurement Signal

4-17. The two-line reference signal from the 5501A Laser Transducer and the two-line measurement signal from the 10780A Receiver are applied to line receivers in the 10760A Counter. The line receivers amplify and isolate the signals. After the receivers, the two signals are applied to four separate circuits: Line Drivers, Pulse Converters, Resolution Extenders, and Error Detectors.

4-18. Line Drivers

4-19. The measurement and reference signals from the line receiver-isolators are applied separately to duplicate line drivers. The two-line outputs of the line drivers are available at the 10760A front connector for use in the system.

4-20. Pulse Converters, Counters and Output Buffers

4-21. The main signal paths for the 10760A are through the pulse converters to the counters and then through the output buffers to the 10740A Coupler bus. The reference and measurement signals in square wave form are changed in the pulse converter to one of two forms of pulses. Either "up" pulses or "down" pulses are produced that represent displacement data in either increasing (up) pulses or decreasing (down) pulses. From the pulse converter the up or down pulses are applied to a 28-bit asynchronous counter which counts the pulses. The pulse count is applied to storage buffers which hold the data until an output is desired on the Coupler bus. Reverse or normal (up or down) pulse counting can be selected by two jumper wires in the pulse converter.

4-22. Pulse Output

4-23. The buffered up or down pulses are also available for use at the front connector of the counter.

4-24. Resolution Extender

4-25. The resolution extender controls the resolution of the counter. If desired, the resolution of the counter can be extended by a multiplier of six or ten. A command (6 or 5) from the 10740A Coupler bus causes the counter instruction logic to select either extended or normal resolution in the counter. With X10 resolution extension, maximum velocity of system measurements is reduced (by a factor of ten) to 30 mm/s (1.2 in./s).

4-26. Error Detection

4-27. Several conditions are detectable by the counter as errors. If the reference beam is interrupted, the REF ERROR bit is set. If the measurement beam is interrupted or the retroreflector movement is too fast, the MEAS ERROR bit is set.

4-28. Overflow Condition

4-29. At the output end of the counter chain, an overflow circuit allows the count to overflow by 28 bits before the count is lost. When this occurs, the OVFL ERROR bit is set but will be reset if the counter picks up the correct count in time.

4-30. Window Detector

4-31. A sample of displacement data cannot be taken from the counter while the counter is accumulating pulses. The window detector allows a sample to be taken only during periods of time that the counter contents are stable.

4-32. Self-Test Control

4-33. The 28-bit counter in the 10760A can be tested for proper operation by applying the correct command ("4" or "7") with the correct address on the 10740A Coupler bus. A "4" command causes the counter to count down to underflow; a "7" command causes the counter to count up to overflow. The 12.6 MHz clock is used for a time base.

4-34. The countup or countdown can be terminated prior to overflow or underflow by issuing a command, for example "1", or sample. This can be useful to preset the counter where an initial condition of greater than 160 counts is desired. Since a total countup takes about 22 seconds, the timing between the countup and sample commands must be determined empirically to obtain the desired counter contents.

SECTION V

MAINTENANCE

5-1. INTRODUCTION

5-2. This section contains maintenance and service references for the 10760A Counter.

5-3. MAINTENANCE AND TROUBLESHOOTING

5-4. The 10760A Counter does not operate separately from a 5501A Laser Transducer system and a 10740A Coupler. This manual contains the board schematic, component locators, and a parts list to aid in troubleshooting. Procedures to isolate system troubles to this assembly are contained in the 5501A System Manual.

5-5. PREVENTIVE MAINTENANCE

5-6. The preventive maintenance procedures given in the following paragraphs are provided to help prolong the useful life of the 10760A.

5-7. Visual Inspection

5-8. Inspect the unit for indications of mechanical and electrical defects. Look for signs of overheating, corrosion, accumulations of dust, oil, loose electrical connections, or broken parts.

5-9. Repair and Cleaning

5-10. Repair any obvious defects; and if necessary clean the unit with a brush, compressed clean dry air jet, or a vacuum cleaner, or a suitable liquid solvent.

5-11. EXTENDER BOARD 10743A

5-12. The 10760A components can be accessed during operation by using the optional 10743A Extender board. The extender board is plugged into the 10760A slot and contains straight-through lines to a female connector for plugging in the 10760A.

SECTION VI REPLACEABLE PARTS

6-1. INTRODUCTION

6-2. This section contains information for ordering replacement parts. Table 6-1 lists parts in alphanumeric order of their reference designators and indicates the description and HP Part Number of each part, together with any applicable notes. The table includes the following information.

- Description of part (see abbreviations below).
- Typical manufacturer of the part in a five-digit code; see list of manufacturers in Table 6-2.
- Manufacturer's part number.
- Total quantity used in the instrument.

6-3. ORDERING INFORMATION

6-4. To obtain replacement parts, address order of inquiry to your local Hewlett-Packard Sales and Service Office (see lists at rear of this manual for addresses). Identify parts by their Hewlett-Packard part numbers, and reference designation (including instrument model number).

6-5. To obtain a part that is not listed, include:

- Instrument model number.
- Instrument serial number.
- Description of the part.
- Function and location of the part.

REFERENCE DESIGNATIONS

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

ABBREVIATIONS

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

ABBREVIATIONS

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

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
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

6-6. HP PART NUMBER ORGANIZATION

6-7. 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 (semiconductor)
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 wire-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
9011-	Transformers, Coils, Chokes, Inductors, and Filters

6-8. HP manufactured parts, such as side frames, feet, top and bottom covers, etc., for general instruments are categorized below. These are eight-digit part numbers with the four-digit prefix identifying the type of part.

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

6-9. HP manufactured parts for use in specific instruments are identified below. For these parts, the prefix indicates the instrument and the **suffix** indicates the type of part. For example, 05501-60001 is an assembly used in the 5501A. 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 -90999

Table 6-1. Replaceable Parts

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
	10760-60001	1	BOARD ASSEMBLY, COUNTER (SERIES 1732A)	28480	10760-60001
C1	0160-2055	19	CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
C2	0150-0084	3	CAPACITOR-FXD .1UF +80-20% 100VDC CER	28480	0150-0084
C3	0180-0155	9	CAPACITOR-FXD 2,2UF+-20% 20VDC TA	0420J	150D225X0020A2
C4	0150-0084		CAPACITOR-FXD .1UF +80-20% 100VDC CER	28480	0150-0084
C5	0150-0084		CAPACITOR-FXD .1UF +80-20% 100VDC CER	28480	0150-0084
C6	0160-2055		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
C7	0160-2306	1	CAPACITOR-FXD 27PF +-5% 300VDC	28480	0160-2306
C8	0160-2055		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
C9	0160-2206	2	CAPACITOR-FXD 160PF +-5% 300VDC MICA0+70	28480	0160-2206
C10	0160-2207	2	CAPACITOR-FXD .01UF +-5% 200VDC POLYE	0420J	292P10352
C11	0160-2055		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
C12	0160-2055		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
C12	0160-2206		CAPACITOR-FXD 160PF +-5% 300VDC MICA0+70	28480	0160-2206
C13	0160-2055		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
C14	0160-2055		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
C15*	0160-2258	2	CAPACITOR-FXD 12PF +-5% 500VDC CER0+-30	28480	0160-2258
C16*	0160-2258		CAPACITOR-FXD 12PF +-5% 500VDC CER0+-30	28480	0160-2258
C17	0180-0155		CAPACITOR-FXD 2,2UF+-20% 20VDC TA	0420J	150D225X0020A2
C18	0180-0155		CAPACITOR-FXD 2,2UF+-20% 20VDC TA	0420J	150D225X0020A2
C19	0180-0155		CAPACITOR-FXD 2,2UF+-20% 20VDC TA	0420J	150D225X0020A2
C20	0160-2204	2	CAPACITOR-FXD 100PF +-5% 300VDC MICA0+70	28480	0160-2204
C21	0160-2204		CAPACITOR-FXD 100PF +-5% 300VDC MICA0+70	28480	0160-2204
C22	0160-2055		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
C23	0160-2055		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
C24	0160-2055		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
C25	0160-2055		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
C26	0160-2055		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
C27	0160-0207		CAPACITOR-FXD .01UF +-5% 200VDC POLYE	0420J	292P10352
C28	0180-0155		CAPACITOR-FXD 2,2UF+-20% 20VDC TA	0420J	150D225X0020A2
C29	0180-0155		CAPACITOR-FXD 2,2UF+-20% 20VDC TA	0420J	150D225X0020A2
C30	0160-0573	3	CAPACITOR-FXD 4700PF +-20% 100VDC CER	28480	0160-0573
C31	0140-0192	3	CAPACITOR-FXD 68PF +-5% 300VDC	72136	DM15E680J0300HV1CR
C32	0160-0573		CAPACITOR-FXD 4700PF +-20% 100VDC CER	28480	0160-0573
C33	0140-0192		CAPACITOR-FXD 68PF +-5% 300VDC	72136	DM15E680J0300HV1CR
C34	0180-0155		CAPACITOR-FXD 2,2UF+-20% 20VDC TA	0420J	150D225X0020A2
C35	0160-2055		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
C36	0160-2055		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
C37	0160-2055		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
C38	0160-0573		CAPACITOR-FXD 4700PF +-20% 100VDC CER	28480	0160-0573
C39	0140-0192		CAPACITOR-FXD 68PF +-5% 300VDC	72136	DM15E680J0300HV1CR
C40	0160-2055		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
C41	0180-0155		CAPACITOR-FXD 2,2UF+-20% 20VDC TA	0420J	150D225X0020A2
C42	0180-0155		CAPACITOR-FXD 2,2UF+-20% 20VDC TA	0420J	150D225X0020A2
C43	0160-2055		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
C44	0160-2055		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
C46	0160-2055		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
C47	0160-0576	1	CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
CR1	NOT ASSIGNED		NOT ASSIGNED		
CR2	NOT ASSIGNED		NOT ASSIGNED		
CR3	1901-0040	8	DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
CR4	1901-0040		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
CR5	1901-0040		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
CR6	1901-0040		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
CR7	1901-0040		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
CR8	1901-0040		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
CR9	NOT ASSIGNED		NOT ASSIGNED		
CR10	1901-0040		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
CR11	1901-0040		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
DB1	1990-0416	2	LED-VISIBLE LUM-INT=800UCD IF=50MA-MAX	28480	1990-0416
DB2	1990-0416		LED-VISIBLE LUM-INT=800UCD IF=50MA-MAX	28480	1990-0416
L1	9100-1623	2	COIL-MLD 27UH 5% Q=60 ,155DX,375LG	0217B	15-4455-2J
L2	9100-1623		COIL-MLD 27UH 5% Q=60 ,155DX,375LG	0217B	15-4455-2J
MP1	1480-0059	2	PINISPRING 0,062" NOM, DIA	0000J	DBD
Q1	1853-0036	1	TRANSISTOR PNP SI PD=310MW FT=250MHZ	28480	1853-0036
Q2	1854-0215	4	TRANSISTOR NPN SI PD=350MW FT=300MHZ	0203G	SP8 3611
Q3	1854-0215		TRANSISTOR NPN SI PD=350MW FT=300MHZ	0203G	SP8 3611
Q4	1854-0215		TRANSISTOR NPN SI PD=350MW FT=300MHZ	0203G	SP8 3611
Q5	1854-0215		TRANSISTOR NPN SI PD=350MW FT=300MHZ	0203G	SP8 3611
R1	0684-0271	2	RESISTOR 2,7 10% ,25W FC TC=400/+500	0160G	CB27G1
R2	0757-0442	4	RESISTOR 10K 1% ,125W F TC=0/+100	0329B	C4-1/8-T0-1002-F
R3	0757-0442		RESISTOR 10K 1% ,125W F TC=0/+100	0329B	C4-1/8-T0-1002-F
R4	0698-4037	1	RESISTOR 46,4 1% ,125W F TC=0/+100	0329B	C4-1/8-T0-46R4-F
R5	0757-0280	12	RESISTOR 1K 1% ,125W F TC=0/+100	0329B	C4-1/8-T0-1001-F
*C15A	0160-2265	2	CAPACITOR-FXD 22PF +-5% CER0+-30	28480	0160-2265
*C16A	0160-2265		CAPACITOR-FXD 22PF +-5% CER0+-30	28480	0160-2265

See introduction to this section for ordering information

Table 6-1. Replaceable Parts (cont'd)

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
R6	0757-0403	1	RESISTOR 121 1K 1%, 125W F TC=0+-100	0329B	C4=1/8-T0=121R-F
R7	0757-0280		RESISTOR 1K 1%, 125W F TC=0+-100	0329B	C4=1/8-T0=1001-F
R8	0757-0407	1	RESISTOR 200 1K 1%, 125W F TC=0+-100	0329B	C4=1/8-T0=201-F
R9	0757-0418	2	RESISTOR 619 1K 1%, 125W F TC=0+-100	0329B	C4=1/8-T0=619R-F
R10	0757-0280		RESISTOR 1K 1%, 125W F TC=0+-100	0329B	C4=1/8-T0=1001-F
R11	0757-0400	4	RESISTOR 90.9 1K 1%, 125W F TC=0+-100	0329B	C4=1/8-T0=90R9-F
R12	0698-3155	4	RESISTOR 4.04K 1K 1%, 125W F TC=0+-100	0329B	C4=1/8-T0=4641-F
R13	0698-3155		RESISTOR 4.04K 1K 1%, 125W F TC=0+-100	0329B	C4=1/8-T0=4641-F
R14	0757-0418		RESISTOR 619 1K 1%, 125W F TC=0+-100	0329B	C4=1/8-T0=619R-F
R15	0757-0280		RESISTOR 1K 1%, 125W F TC=0+-100	0329B	C4=1/8-T0=1001-F
R16	0757-0400		RESISTOR 90.9 1K 1%, 125W F TC=0+-100	0329B	C4=1/8-T0=90R9-F
R17	0757-0346	4	RESISTOR 10 1K 1%, 125W F TC=0+-100	0329B	C4=1/8-T0=10R0-F
R18	0757-0346		RESISTOR 10 1K 1%, 125W F TC=0+-100	0329B	C4=1/8-T0=10R0-F
R19	0757-0280		RESISTOR 1K 1%, 125W F TC=0+-100	0329B	C4=1/8-T0=1001-F
R20	0757-0280		RESISTOR 1K 1%, 125W F TC=0+-100	0329B	C4=1/8-T0=1001-F
R21	0757-0280		RESISTOR 1K 1%, 125W F TC=0+-100	0329B	C4=1/8-T0=1001-F
R22	0684-0271		RESISTOR 2.7 10K 1%, 25W FC TC=400/+500	0160G	CB27G1
R23	0757-0400		RESISTOR 90.9 1K 1%, 125W F TC=0+-100	0329B	C4=1/8-T0=90R9-F
R24	0757-0280		RESISTOR 1K 1%, 125W F TC=0+-100	0329B	C4=1/8-T0=1001-F
R25	0757-0400		RESISTOR 90.9 1K 1%, 125W F TC=0+-100	0329B	C4=1/8-T0=90R9-F
R26	0757-0346		RESISTOR 10 1K 1%, 125W F TC=0+-100	0329B	C4=1/8-T0=10R0-F
R27	0757-0346		RESISTOR 10 1K 1%, 125W F TC=0+-100	0329B	C4=1/8-T0=10R0-F
R28	0757-0442		RESISTOR 10K 1K 1%, 125W F TC=0+-100	0329B	C4=1/8-T0=1002-F
R29	0757-0442		RESISTOR 10K 1K 1%, 125W F TC=0+-100	0329B	C4=1/8-T0=1002-F
R30	0757-0280		RESISTOR 1K 1%, 125W F TC=0+-100	0329B	C4=1/8-T0=1001-F
R31	0698-3155		RESISTOR 4.04K 1K 1%, 125W F TC=0+-100	0329B	C4=1/8-T0=4641-F
R32	0698-3155		RESISTOR 4.04K 1K 1%, 125W F TC=0+-100	0329B	C4=1/8-T0=4641-F
R33	0757-0438	6	RESISTOR 5.11K 1K 1%, 125W F TC=0+-100	0329B	C4=1/8-T0=5111-F
R34	0757-0438		RESISTOR 5.11K 1K 1%, 125W F TC=0+-100	0329B	C4=1/8-T0=5111-F
R35	0757-0438		RESISTOR 5.11K 1K 1%, 125W F TC=0+-100	0329B	C4=1/8-T0=5111-F
R36	0757-0438		RESISTOR 5.11K 1K 1%, 125W F TC=0+-100	0329B	C4=1/8-T0=5111-F
R37	0757-0438		RESISTOR 5.11K 1K 1%, 125W F TC=0+-100	0329B	C4=1/8-T0=5111-F
R38	0757-0438		RESISTOR 5.11K 1K 1%, 125W F TC=0+-100	0329B	C4=1/8-T0=5111-F
R39	0757-0280		RESISTOR 1K 1%, 125W F TC=0+-100	0329B	C4=1/8-T0=1001-F
R40	0757-0280		RESISTOR 1K 1%, 125W F TC=0+-100	0329B	C4=1/8-T0=1001-F
R41	0757-0280		RESISTOR 1K 1%, 125W F TC=0+-100	0329B	C4=1/8-T0=1001-F
R42	0698-3161	1	RESISTOR 38.3K 1K 1%, 125W F TC=0+-100	0329B	C4=1/8-T0=3832-F
R43	0757-0289	1	RESISTOR 13.3K 1K 1%, 125W F TC=0+-100	0299E	MF6C1/8-T0=1332-F
S1	3101-1973	1	SW-JUMPER SL 7-1A-NS DIP-SLIDE-ASSY .1A	02484	11P-1028
TP1	0360-0124	4	TERMINAL-STUD SGL-PIN PRESS-MTG	26480	0360-0124
TP2	0360-0124		TERMINAL-STUD SGL-PIN PRESS-MTG	26480	0360-0124
TP3	0360-0124		TERMINAL-STUD SGL-PIN PRESS-MTG	26480	0360-0124
TP4	0360-0124		TERMINAL-STUD SGL-PIN PRESS-MTG	26480	0360-0124
U10	1820-0346	1	IC OP AMP	0340F	LM358N
U11	1820-0630	2	IC MISC TTL	0203G	MC044P
U12	1820-0629	2	IC FF TTL S J-K NEG-EDGE-TRIG	0223G	74S112PC
U13	1820-0142	1	IC GATE ECL OR-NOR DUAL 4-INP	0203G	MC1004P
U14	1820-0685	1	IC GATE TTL S NAND TPL 3-INP	0169H	SN74810N
U15	1820-0720	1	IC DRV R TTL LED DRV R DUAL 4-INP	0340F	D3A830N
U16	1820-0693	5	IC FF TTL S D-TYPE POS-EDGE-TRIG	0223G	74S74PC
U17	1990-0602	2	OPTO-ISOLATOR LED-IC GATE IF=20MA-MAX	26480	1990-0602
U18	1990-0602		OPTO-ISOLATOR LED-IC GATE IF=20MA-MAX	26480	1990-0602
U20	1820-1324	2	IC OSC TTL S DUAL	0169H	SN748124N
U21	1820-1324		IC OSC TTL S DUAL	0169H	SN748124N
U22	1820-0693		IC FF TTL S D-TYPE POS-EDGE-TRIG	0223G	74S74PC
U23	1820-0751	1	IC CNTR TTL DEC D ASYNCHRO NEG-EDGE-TRIG	0169H	SN74196N
U24	1820-0683	1	IC INV TTL S HEX 1-INP	0223G	74S04PC
U25	1820-0693		IC FF TTL S D-TYPE POS-EDGE-TRIG	0223G	74S74PC
U26	1820-0694	1	IC GATE TTL S EXCL-OR QUAD 2-INP	0291J	N74886A
U27	1820-1056	1	IC SCHMITT-TRIG TTL NAND QUAD 2-INP	0169H	SN74132N
U28	1820-0077	3	IC FF TTL D-TYPE POS-EDGE-TRIG CLEAR	0223G	7474PC
U31	1820-0630		IC MISC TTL	0203G	MC044P
U32	1820-0629		IC FF TTL S J-K NEG-EDGE-TRIG	0223G	74S112PC
U33	1820-1323	1	IC GATE TTL S NAND 8-INP	0169H	SN74830N
U34	1820-1322	2	IC GATE TTL S NOR QUAD 2-INP	0169H	SN74802N
U35	1820-0693		IC FF TTL S D-TYPE POS-EDGE-TRIG	0223G	74S74PC
U36	1820-0063	1	IC GATE TTL AND-OR-INV DUAL 2-INP	0223G	74S1PC
U37	1820-1124	1	IC BFR TTL NOR QUAD 2-INP	0169H	SN7433N
U38	1820-1322		IC GATE TTL S NOR QUAD 2-INP	0169H	SN74802N
U41	1820-0233	7	IC CNTR TTL BIN UP/DOWN SYNCHRO	0340F	DM74193N
U42	1820-0233		IC CNTR TTL BIN UP/DOWN SYNCHRO	0340F	DM74193N
U43	1820-0233		IC CNTR TTL BIN UP/DOWN SYNCHRO	0340F	DM74193N
U44	1820-0515	3	IC MV TTL MONOSTBL RETRIG/RESET DUAL	0379D	2602PC
U45	1820-0515		IC MV TTL MONOSTBL RETRIG/RESET DUAL	0379D	2602PC
U46	1820-0693		IC FF TTL S D-TYPE POS-EDGE-TRIG	0223G	74S74PC
U47	1820-0077		IC FF TTL D-TYPE POS-EDGE-TRIG CLEAR	0223G	7474PC
U51	1820-0233		IC CNTR TTL BIN UP/DOWN SYNCHRO	0340F	DM74193N
U52	1820-0233		IC CNTR TTL BIN UP/DOWN SYNCHRO	0340F	DM74193N

See introduction to this section for ordering information

Table 6-1. Replaceable Parts (cont'd)

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
U53	1820-0233		IC CNTR TTL BIN UP/DOWN SYNCHRO	0340F	DM74193N
U54	1820-0233		IC CNTR TTL BIN UP/DOWN SYNCHRO	0340F	DM74193N
U55	1820-0515		IC MV TTL MONOSTBL RETRIG/RESET DUAL	0379D	2602PC
U56	1820-0071	1	IC BFR TTL NAND DUAL 4-INP	0223G	7440PC
U57	1820-0054	1	IC GATE TTL NAND QUAD 2-INP	0223G	7400PC
U61	1820-0574	8	IC FF TTL D-TYPE COM CLEAR QUAD	0340F	DM8551N
U62	1820-0574		IC FF TTL D-TYPE COM CLEAR QUAD	0340F	DM8551N
U63	1820-0574		IC FF TTL D-TYPE COM CLEAR QUAD	0340F	DM8551N
U64	1820-0574		IC FF TTL D-TYPE COM CLEAR QUAD	0340F	DM8551N
U65	1820-0077		IC FF TTL D-TYPE POS-EDGE-TRIG CLEAR	0223G	7474PC
U66	1820-0070	1	IC GATE TTL NAND 8-INP	0223G	7450PC
U67	1820-0661	1	IC GATE TTL OR QUAD 2-INP	0340F	DM7432N
U71	1820-0574		IC FF TTL D-TYPE COM CLEAR QUAD	0340F	DM8551N
U72	1820-0574		IC FF TTL D-TYPE COM CLEAR QUAD	0340F	DM8551N
U73	1820-0574		IC FF TTL D-TYPE COM CLEAR QUAD	0340F	DM8551N
U74	1820-0574		IC FF TTL D-TYPE COM CLEAR QUAD	0340F	DM8551N
U75	1820-1254	1	IC BFR TTL NON=INV HEX 1-INP	0340F	DM8095N
U76	1820-0214	2	IC DCDR TTL BCD=TO=DEC 4=TO=10=LINE	0340F	DM7442N
U77	1820-0214		IC DCDR TTL BCD=TO=DEC 4=TO=10=LINE	0340F	DM7442N
Y1	0410-0143	1	CRYSTALQUARTZ 12.632 MHZ	28480	0410-0143
	1200-0758	1	SOCKET=XTAL 2=CONT HC=25/U DIP=8LDR	0551H	8004-1G17
	10760-60002	1	CABLE, INTERFACE	28480	10760-60002
	8159-0005	8	WIRE 22AWG W PVC 1X22 80C	0133I	L-2007-1
	5040-1464	2	EXTRACTOR, P.C. BOARD	28480	5040-1464

See introduction to this section for ordering information

Table 6-2. Manufacturers Code List

Mfr. Number	Manufacturer Name	Address	ZIP Code
00000	U.S.A. Common	Any Supplier of USA	
0073G	Gettig Engineering & Manufacturing Co., Inc.	Spring Mills, PA	16875
01121	Allen Bradley Co.	Milwaukee, WI	53212
01295	Texas Instruments Inc., Semiconductor Cmpnt. Div.	Dallas, TX	75231
04713	Motorola Semiconductor Products	Phoenix, AZ	85008
07263	Fairchild Semiconductor Division	Mountain View, CA	94040
09353	C and K Components, Inc.	Watertown, MA	02172
11237	CTS Keene, Inc.	Paso Robles, CA	93446
16299	Corning Glass Works, Electronic Cmpnt. Div.	Raleigh, NC	27604
18324	Signetics Corp.	Sunnyvale, CA	94086
24226	Gowanda Electronics Corp.	Gowanda, NY	14070
24546	Corning Glass Works (Bradford)	Bradford, PA	16701
27014	National Semiconductor Corp.	Santa Clara, CA	95051
28480	Hewlett-Packard Company, Corporate Headquarters	Palo Alto, CA	94304
34335	Advanced Micro Devices, Inc.	Sunnyvale, CA	94086
56289	Sprague Electric Co.	North Adams, MA	01247
71785	TRW Electronic Components, Cinch Division	Elk Grove Village, IL	60007
72136	Electro Motive Mfg. Co., Inc.	Willimantic, CT	06226
73957	Groov-Pin Corp.	Ridgefield, NJ	07657
75915	Littlefuse, Inc.	Des Plaines, IL	60016
91506	Augat, Inc.	Attleboro, MA	02703

SECTION VII

MANUAL CHANGES

7-1. INTRODUCTION

7-2. This section contains information necessary to adapt this manual to older instruments (serial prefixes prior to 1948A).

7-3. MANUAL CHANGES

7-4. The table below identifies previous serial prefixes of units that differ electrically from those documented in this manual. If your unit has one of these prefixes, make the changes indicated.

Backdating Table

Serial Prefix	Make Changes to this Manual
1736A	Change 1
1732A	Change 1,2
1604A, 1632A	Change 1,2,3
1512A	Change 1,2,3,4

CHANGE 1

Page 1-2, Table 1-1, Equipment Supplied:

Replace Interface Cable 10760-60002 with "Connector Kit, 48-Pin; 5060-8339."

Page 2-2, Paragraph 2-14:

Change paragraph to read: "The dual 24-pin (48) connector edge of the 10760A board mates with the connector in an HP connector kit part number 5060-8339. The dual 43-pin (86) connector edge of the 10760A board mates with HP connector number 1251-3755."

Page 6-7, Table 6-1:

Delete 10760-60002 and replace with "5060-8339, Kit, Connector, P.C. Board, 28480, 5060-8339."

CHANGE 2 Change values of C15 and C16

Page 2-5, in the NOTE below Table 2-2:

Change C15 and C16 values to 12PF.

Page 2-7, in the NOTE in lower left corner:

Change C15 and C16 to 12PF.

Page 6-5, Table 6-1:

Change C15 and C16 to 0160-2258, 12PF, 0160-2258.

Page 8-3, Bottom Center of schematic:

Change C15 and C16 to 12PF.

CHANGE 3 Revise Resolution Extender and separate DAV and INSTRV lines

Page 6-5, Table 6-1:

Change C10 and C27 to 0160-3878/C:FXD 1000PF +20% 100 WVDC CER/28480/0160-3878

Delete C47/0160-0576/C:FXD .1UF +20% 50 VDC CER/28480/0160-0576

Delete L2/9100-1623/COIL-MLD 27UH 5% Q=60 .155DX,375LG/02178/15-4455-2J

Change R12, R13, R31, R32 to 0683-1025/R:1K 5% .25W FC TC=-400 +600/01121/CB 1025

Delete S1/3101-1973/SW-JUMPER SL 7-1A-NS DIP-SLIDE-ASSY .1A/02484/11P-1028

Delete U10/1826-0346/IC OP AMP/0340F/LM358N

Delete U20/1820-1324/IC OSC TTL S DUAL/0169H/SN74S124N

Page 8-3, Figure 8-2:

Replace this schematic with Figure 8-2a in this section. (For convenience, it is recommended that you label Figure 8-2 "Not Applicable" and insert Figure 8-2a after Figure 8-2, renumbering the page from "7-3" to "8-3a".)

CHANGE 4 Delete External Sampling and change Opto-Isolator P/N

Page 2-5, Paragraph 2-40:

Delete external sample capability description.

Page 6-5, Table 6-1:

Delete CR10 and CR11 1901-0040/D-SWITCHING 30V 50MA 2NS DO-35/28480/1901-0040

Delete R41/0757-0280/R-1K 1% .125W F TC=0+-100/0329B/C4-1/8-T0-1001-F

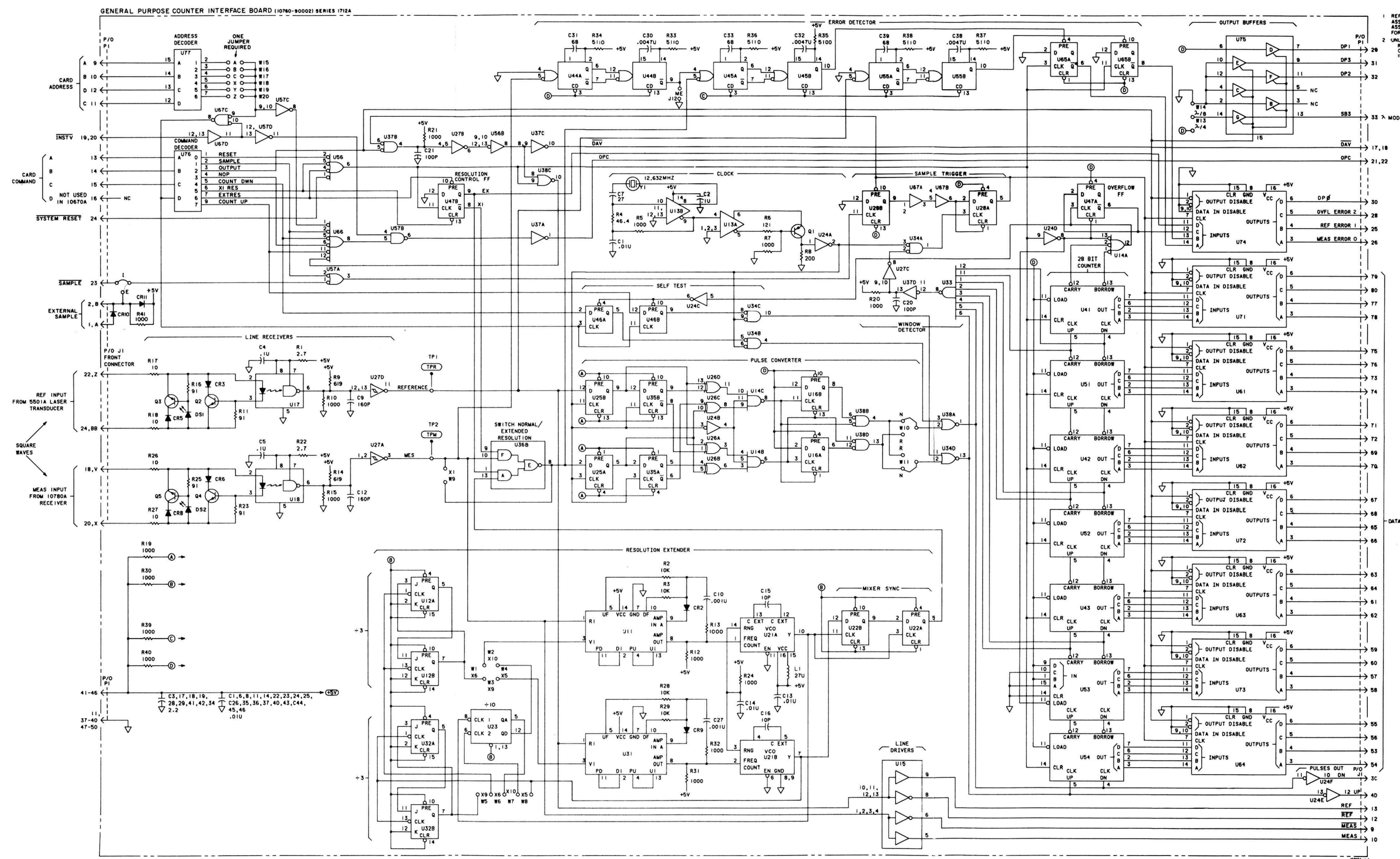
Change U17 and U18 to 1990-0429/OPTOISOLATOR-LED IC GATE/28480/1990-0429

Page 7-3 (8-3a), Figure 8-2a:

Delete CR10, CR11, R41 (external sample circuit).

NOTE

The use of resolution extension on boards prior to serial prefix 1732A is not recommended. Please contact your HP Field Engineer for information before using this feature on prior boards.



7-3

BACKDATING

SECTION VIII

SCHEMATIC DIAGRAMS

8-1. INTRODUCTION

8-2. This section contains information for schematic diagrams, notes, reference designation system, identification markings on printed-circuit boards, schematic and component locators.

8-3. SCHEMATIC DIAGRAM NOTES

8-4. Figure 8-1 shows the symbols used on schematic diagrams. Component reference designations are assigned in vertical columns, left to right, according to physical layout on the board.

8-5. REFERENCE DESIGNATOR SYSTEM

8-6. Figure 8-1 shows the method of assigning reference designations. Assemblies such as printed-circuit boards are assigned in sequence, A1, A2, etc. As shown in Figure 8-1, subassemblies within assemblies are given a subordinate A number. For example, rectifier assembly 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.

8-7. IDENTIFICATION MARKINGS ON PRINTED-CIRCUIT BOARDS

8-8. HP printed-circuit boards (see Figure 8-1) have four means of identification: an assembly part number, a series number, a revision letter, and a production code number.

8-9. The assembly part number has 10 digits (such as 10760-60001) 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 loose-leaf 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 etched on the board (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.

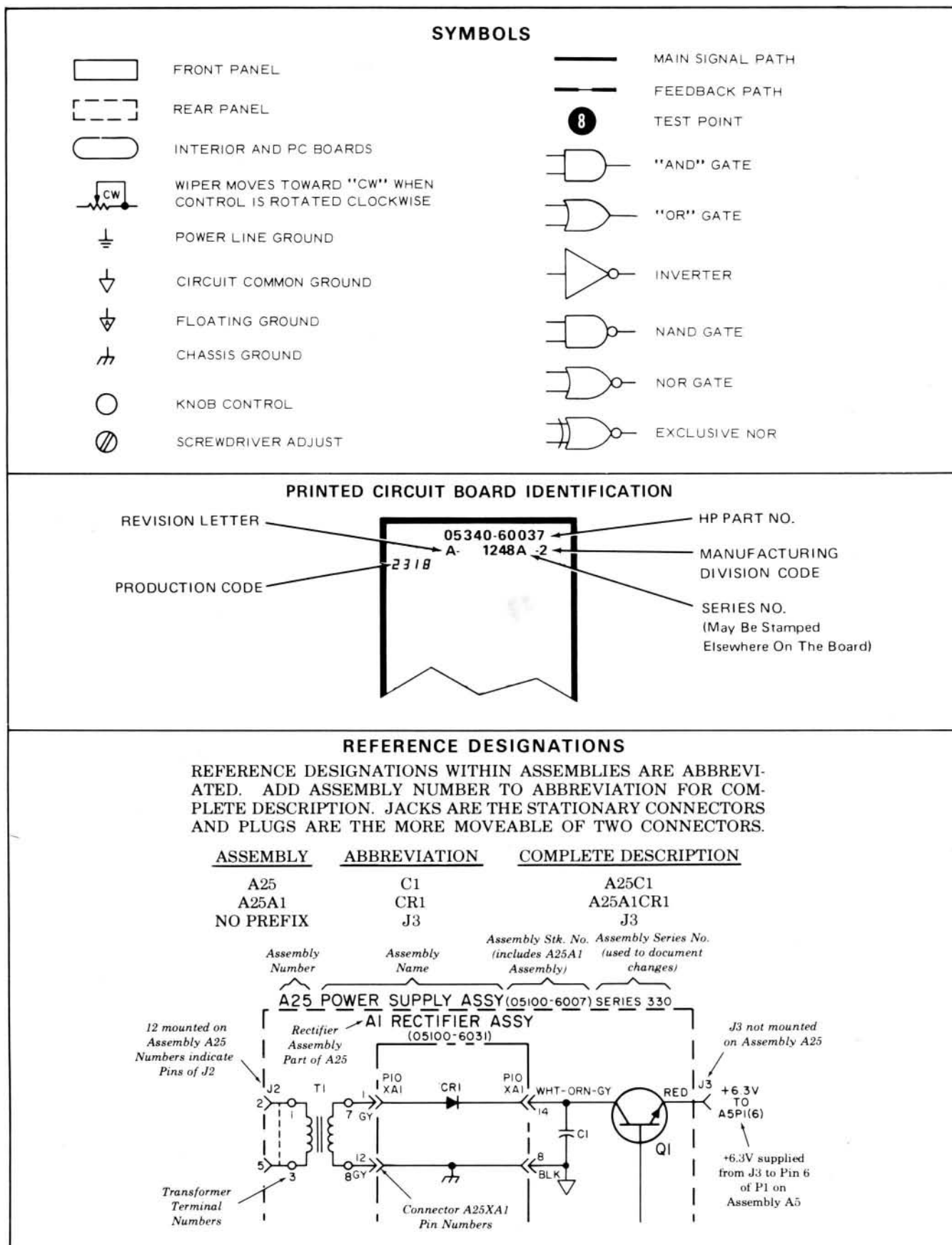
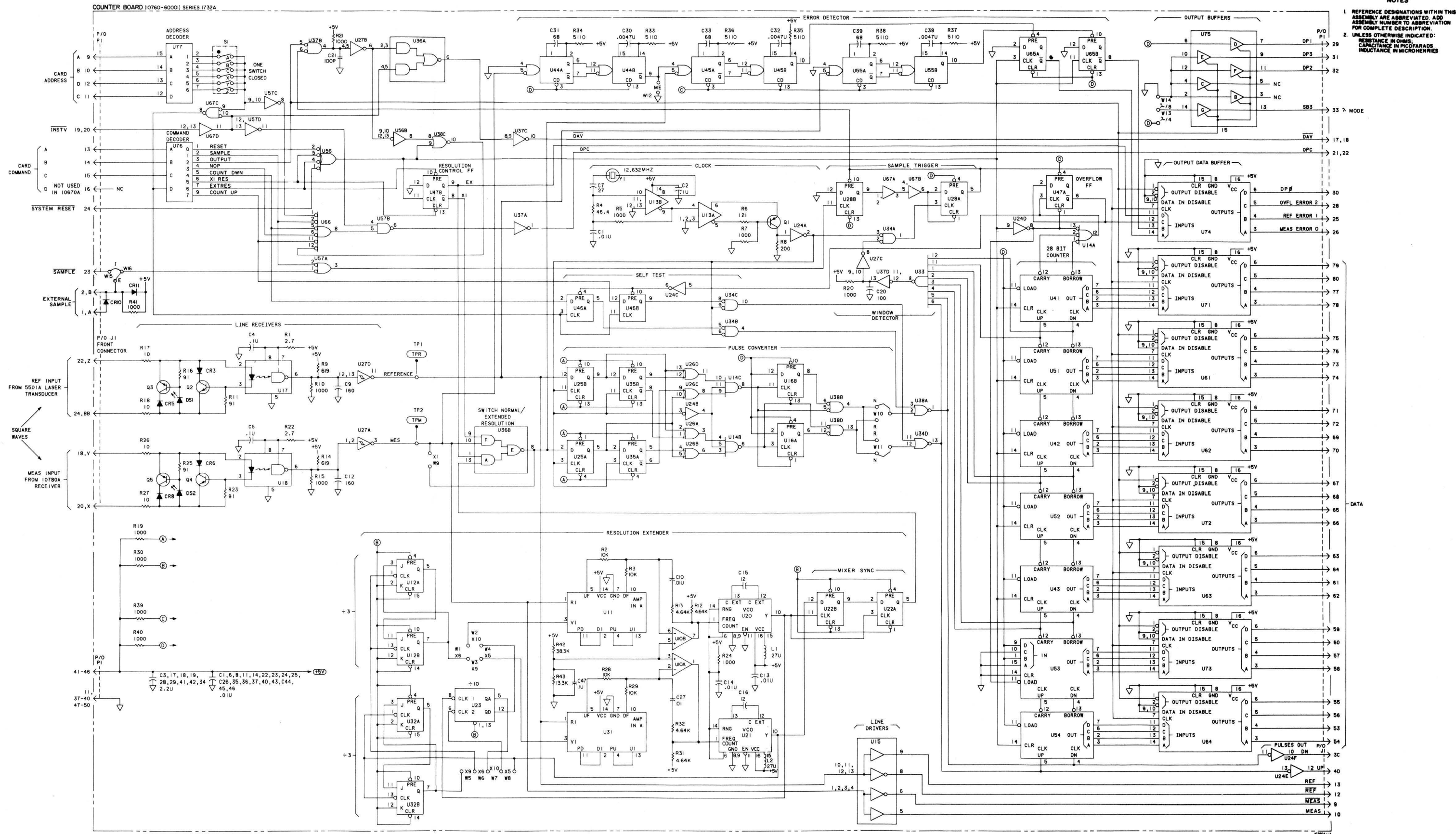
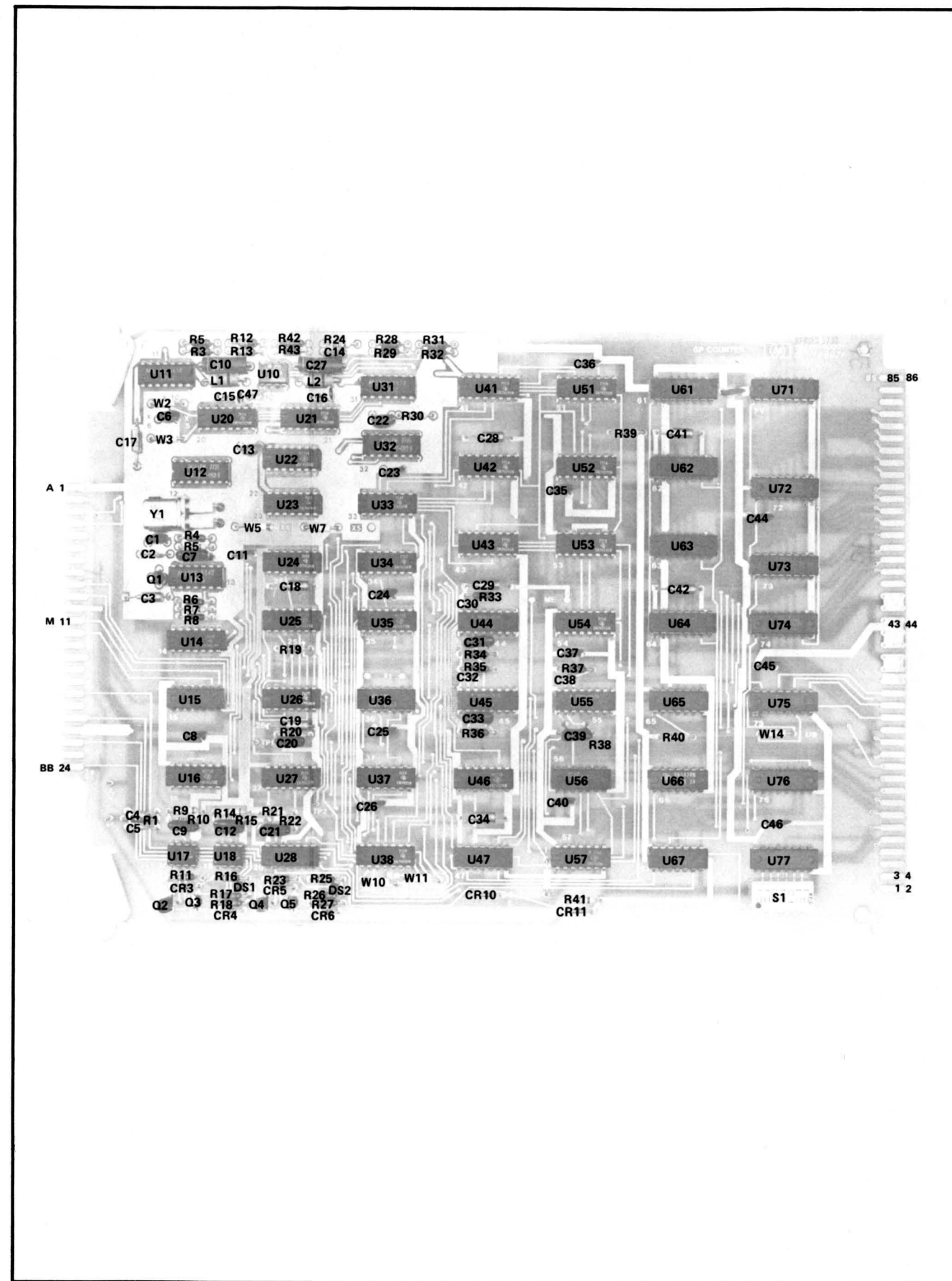


Figure 8-1. Schematic Diagram Notes



NOTES
1. REFERENCE DESIGNATIONS WITHIN THIS SCHEMATIC ARE ABBREVIATED. ADD ASSEMBLY NUMBER TO ABBREVIATION FOR COMPLETE DESCRIPTION.
2. UNLESS OTHERWISE INDICATED: RESISTANCE IN OHMS, CAPACITANCE IN MICROFARADS, INDUCTANCE IN MICROHENRIES.

Figure 8-2. 10760A Counter Schematic Diagram (Series 1732A)

