OPERATING AND SERVICE MANUAL

10780A

RECEIVER
(Part of 5501A Laser Transducer System)

SERIES 2204A

This manual applies directly to Hewlett-Packard Model 10780A Receivers with Serial Prefix 2204A.

SERIAL NUMBERS NOT LISTED

For Serial Prefixes after 2204A, a "Manual Change Sheet" is included with this manual. For Serial Prefixes below 2204A, refer to Section 7, Manual Changes.

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HEWLETT PACKARD

CERTIFICATION

Hewlett-Packard Company certifies that this product met its published specifications at the time of shipment from the factory. Hewlett-Packard 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.

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This Hewlett-Packard system product is warranted against defects in materials and workmanship for a period of 90 days from date of installation. During the warranty period, HP will, at its option, either repair or replace products which prove to be defective.

Warranty service of this product will be performed at Buyer's facility at no charge within HP service travel areas. Outside HP service travel areas, warranty service will be performed at Buyer's facility only upon HP's prior agreement and Buyer shall pay HP's round trip travel expenses. In all other cases, products must be returned to a service facility designated by HP.

For products returned to HP for warranty service, Buyer shall prepay shipping charges to HP and HP shall pay shipping charges to return the product to Buyer. However, Buyer shall pay all shipping charges, duties, and taxes for products returned to HP from another country.

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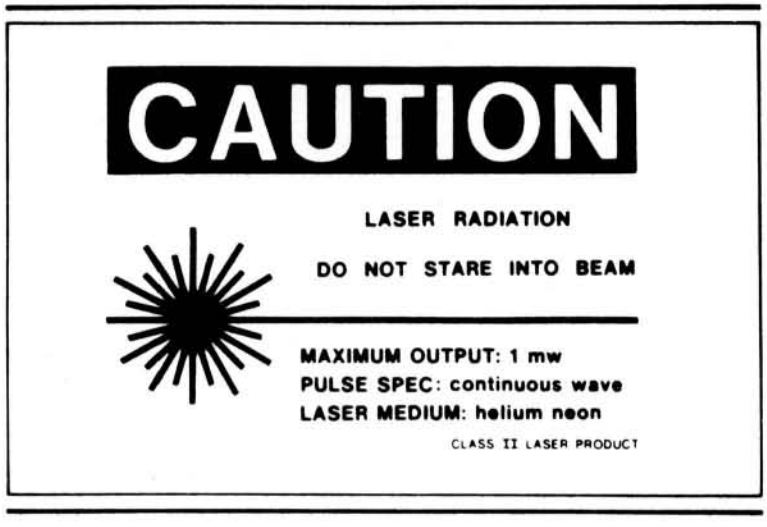
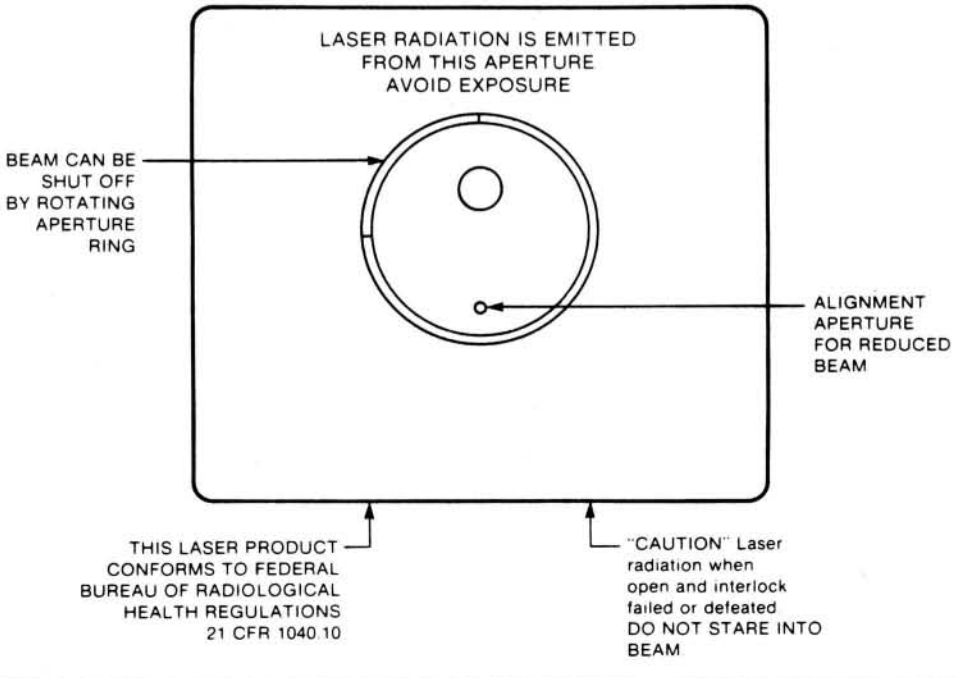
Product maintenance agreements and other customer assistance agreements are available for Hewlett-Packard products.

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

SAFETY PRECAUTIONS

This is a Safety Class I system. This system has been designed and tested according to IEC Publication 348, "Safety Requirements for Electronic Measuring Apparatus". This product is also a Class II Laser Product conforming to Federal Bureau of Radiological Health Regulations 21 CFR 1040.10.





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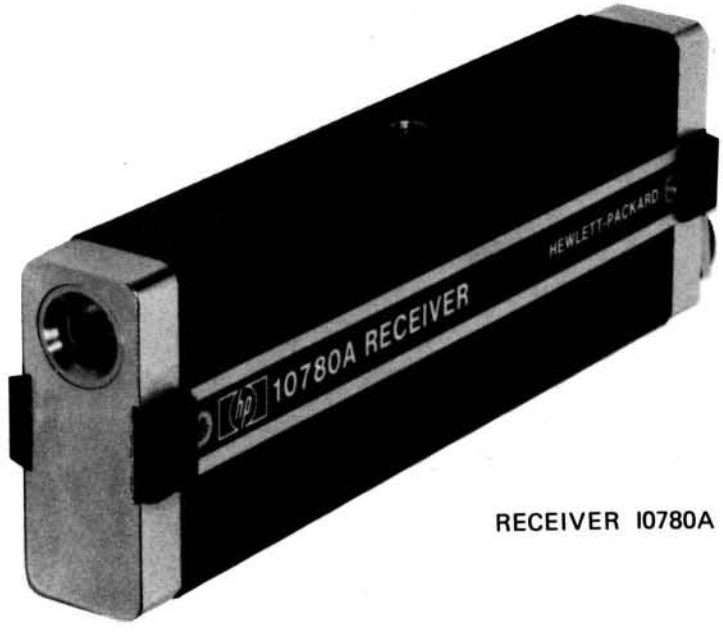


RECEIVER I0780A

TARGET
10780–40003

Figure 1-1. 10780A Receiver

SECTION 1
GENERAL INFORMATION

1-1. INTRODUCTION

1-2. This manual provides operation procedures, installation, theory, and maintenance information for the 10780A Receiver.

1-3. EQUIPMENT DESCRIPTION

1-4. The Model 10780A Receiver is a photodetector/preamplifier module which senses the 5501A Laser Head beam returning from an interferometer. The resultant radio frequency signal is the MEAS signal for displacement measurement.

1-5. Since it is to be installed on the measurement axis of a machine, this small electronic module is lightweight, rugged, and easy to mount. It is highly resistive to electric noise and features a NEMA-12 enclosure. Designed to dissipate the least heat possible (less than 2.7 watts), it rests on plastic stand-off caps so that convection currents may dissipate even this minimal energy. When nylon mounting screws are used the Receiver is electrically isolated from the mounting points.

1-6. The photodiode is located on the 10780A Receiver in such a position that the module may be placed above, below, left or right of the incoming laser beam. To aid in aligning the laser beam, a light-emitting diode which lights when the beam is captured is conveniently located near the photodiode. A dc voltage, as a function of the incoming laser signal level, is also available for assistance in fine-tuning the laser beam alignment. Initial receiver positioning, and coarse beam alignment is achieved with a snap-on beam target fixture, which is supplied with the 10780A Receiver. The target is for beam alignment only. Remove this fixture prior to operating the Receiver.

1-7. IDENTIFICATION

1-8. This manual is identified on the title page by equipment description and nomenclature, part number and revision code, manual part number and publication date. Refer to information presented in the following paragraphs and ensure that this manual applies to equipment being serviced.

1-9. Hewlet-Packard instruments have a two-section nine-digit plus one letter serial number usually attached to the instrument rear panel. The four-digit prefix (first four digits from the left) identifies a group of series of instruments manufactured identical to each other. The letter indicates the assembly plant location. The five-digit serial number is different for each instrument. If the serial prefix of your instruments differs from that listed on the title page of this manual, there are differences between this manual and your instrument.

1-10. SPECIFICATIONS

1-11. Table 1-1 lists the characteristics and specifications for the 10780A Receiver.

Table 1-1. 10780A Receiver Specifications

INPUT REQUIREMENTS

+15 volts (+1) at 0.18 amp maximum.

OUTPUT

Measurement Signal:
Differential square wave at Doppler-shifted frequency (100 kHz to 5.0 MHz). Levels compatible with all Laser Transducer output accessories.

Maximum cable length (using HP 10790C Cable):
65 feet (20 meters)

ENCLOSURE

NEMA Type 12

MAXIMUM POWER DISSIPATION

2.7 watts (with 20 meter output cable)

WEIGHT

4.8 ounces (136 grams)

SECTION 2
INSTALLATION AND OPERATION

2-1. INTRODUCTION

2-2. This section contains information for unpacking, inspection, repacking, storage, and installation of the 10780A Receiver.

2-3. UNPACKING AND INSPECTING

2-4. If the shipping carton is damaged, ask that the carrier's agent be present when the instrument is unpacked. Inspect the instrument for damage. If the instrument is damaged or fails to meet electrical specifications, notify the carrier and the nearest Hewlet-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 and replacement of your instrument without waiting for the claim against the carrier to be settled.

2-5. STORAGE AND SHIPMENT

2-6. To protect the Receiver during storage or shipment, good commercial packing methods should be used. Reliable commercial packing and shipping companies have the facilities and materials to be adequately repack an instrument.

NOTE

Before returning an instrument to Hewlett-Packard contact the nearest Hewlett-Packard Sales and Service office for instructions.

2-7. Conditions during storage and shipment should normally be limited as follows:

1. Maximum altitude: 25,000 feet.
2. Minimum temperature: (–40° C).
3. Maximum temperature: +167° F(+75° C).

2-8. INSTALLATION

2-9. The 10780A Receiver is shipped with the following items as standard equipment:

- One (1) Alignment Target, 10780-40003.
- One (1) Receiver Module, 10780A.
- A 4-pin connector HP P/N 1251-3452 is supplied to allow for fabricating a custom-length interconnect cable. Prefabricated cables are available in the following lengths; 10790A (5 metres), 10790B (10 metres), and 10790C (20 metres). Refer to the 5501A System Operating and Service Manual for cabling information.
- Four (4) plastic machine screws (2 required).

2-10. One 10780A Receiver package is required for each measurement axis in the Laser Transducer system being installed. Figure 2-1 shows the required optic components, and the alignment of the receiver to these optics, required for each measurement axis.

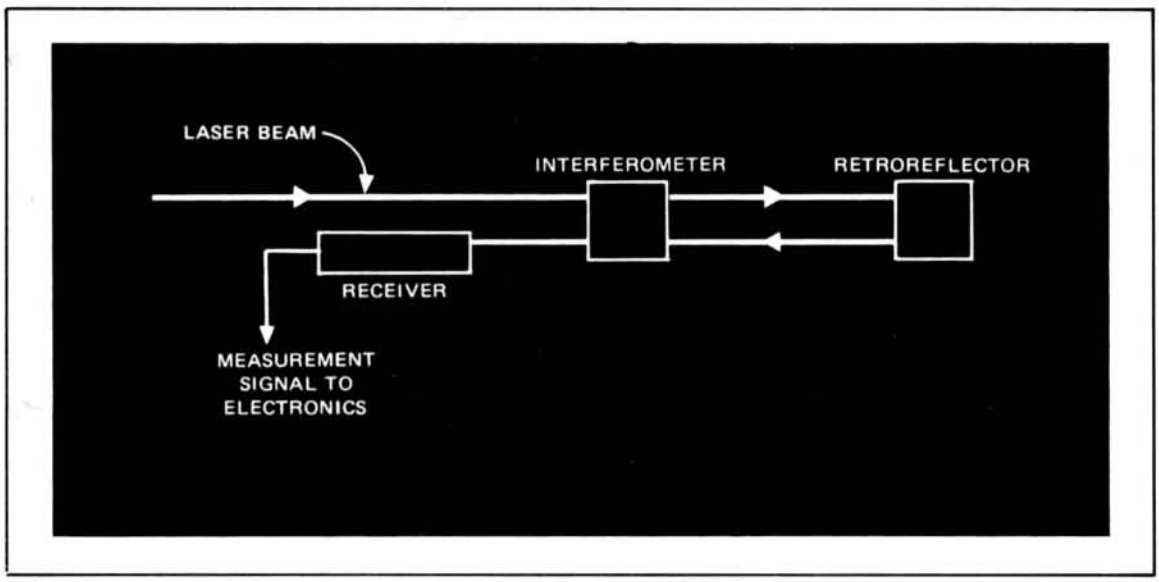


Figure 2-1. Basic Measurement System

2-11. Specific details for the placement of the receiver and its associated optics and installation examples can be found in the Laser Transducer System Operating Manual. Also a detailed alignment procedure can be found in the system operating manual.

2-12. Briefly, each axis of the Laser Transducer System has a receiver with a lens photodiode assembly in the front. It must be positioned so that the polarizing vectors of the laser beam are parallel or perpendicular to the line defined by the two mounting holes (within +3) as shown in Figure 2-1.

2-13. When mounting the receiver, the following points are important to remember:

- At a 45° position, the signal will go to zero.
- The receiver dissipates between 2 and 2.7 watts. Plastic pads keep an air gap around the receiver and also act as thermal and electrical isolators.
- The cable to connect to the back connector of the receiver, must have ample room to make connection. (See dimensional drawing Figure 2-28 in the 5501A System Operating and Service Manual).

CAUTION

The receiver housing must be electrically isolated from the equipment that it is to be mounted on. Use nylon screws only.

2-14. CABLING

2-15. For cable preparation, connectors, and part numbers, refer to Appendix C of the 5501A System Operating and Service Manual.

2-16. OPERATING CONTROLS

2-17. There are no operating controls associated with the 10780A Receiver. However, there are operating characteristics. An LED lamp lights to provide visual indication that the Receiver photo detector has received an adequate laser beam. If, when the laser system is in operation, this LED does not light, perform the alignment procedure in Section 2 of the Laser Transducer System Operating Manual. If this procedure does not solve the problem, refer to the Checks and Adjustments section of this manual and the 5501A System Operating and Service Manual for troubleshooting procedures. Refer to the Theory of Operation section for more details on operational characteristics.

Table 2-1. Model 10780A Receiver Signal Chart

Input	Output	Signal Name	Function	Source	Destination
	J1-1	$\overline{\text{MEAS}}$	Electrical signal corresponding to reflected Laser beam frequency shift.		I/O Board
	J1-2	MEAS	Inverted version of $\overline{\text{MEAS}}$		I/O Board
J1-3		Fused +15V RET	Return path for +15V input power.	I/O Board	
J1-4		Fused +15V	Receiver operating power originating from the 5501A Laser Transducer system, or user designated power source.	I/O Board	

SECTION 3
THEORY OF OPERATION

3-1. INTRODUCTION

3-2. This section provides a component-level discussion of the 10780A Receiver Circuit Operation.

3-3. CIRCUIT DESCRIPTION

3-4. The 10780A Receiver intercepts the doppler shifted difference measurement beam from the Transducer Optical devices, and converts this beam into square wave MEAS (measurement) signals. These signals are applied to an accessory unit and compared with REF (reference) signals (derived from the 5501A Laser Head) to establish a displacement measurement value. In addition, the Receiver contains an LED lamp which indicates adequate beam reception, and circuits that provide a monitoring voltage which indicates relative intensity of the received beam.

3-5. The 5501A Laser Head or an external power supply source provides a +15 Vdc input to pin 4 of the Receiver connector. This input is applied to Regulators U2 and U3 which produce nominal +5 Vdc and +10 Vdc operating voltages for the receiver.

3-6. The received beam illuminates a polarizing plate which is oriented to pass only 45 degree components fo the f1 (REF) and (f2 $\pm$ Δf) (MEAS) signals. CR1 mixes these two beam components and the resulting amplitude modulated light generates an ac current at the difference frequency (i.e., f1 - [f2 $\pm$ Δf]).

3-7. The CR2 difference frequency current is applied to R1, generating an ac voltage at the gate of Q1. A high-to-low impedance circuit consisting of FET Q (source follower) and emmitter follower Q2 matches CR2 to high gain amplifier U1. Overload adjust potentiometer R12 is used to prevent overloading the high-gain amplifier when the receiver is used in single axis systems.

3-8. The symptom of overloading is a decrease in the dc voltage at the beam monitor test point with an increase in incident laser light. When overloading occurs, adjust R12 ccw until the overload condition is corrected. (When rotating the control cw, the test voltage will begin to increase, then top out and then begin to decrease. The proper setting for R12 is 0.2V before saturation.)

NOTE

R12 is provided primarily as an aid in alignment. Overloading does not affect the laser system operation.

3-9. U1 provides a square wave output at a nominal amplitude of 2 volts (peak-to-peak). This signal is applied to voltage amplifier Q3. The resulting square wave output is applied to TTL Converter Q4, which provides a TTL level square wave input to Line Driver U5.The output from Q3 is also applied to a detector circuit consisting of CR1 and associated filter components. The resulting dc output level charges C8 proportionally to the input signal level. This dc level provides an external indication of received signal strength (i.e., beam monitoring) and comprises one input to Threshold Detector U4.

3-10. Threshold adjust potentiometer R9 determines the triggering level of U4. This potentiometer is set so that U4 changes state when the peak-to-peak signal level at TP1 reaches approximately 15 millivolts. The triggered Threshold Detector output goes to ground turning on LED diode indicator DS1. This indicates a minimum beam strength of four microwatts or more has been received. The ground level signal also enables Line Driver U5. U5 then responds to the TTL squarewave input signal from Q4 by providing a complementary squarewave output that comprises the transducer system MEAS and $\overline{\text{MEAS}}$ signals.

SECTION 4
MAINTENANCE AND SERVICE

4-1. INTRODUCTION

4-2. This section contains maintenance and service information for the 10780A Receiver.

4-3. MAINTENANCE

4-4. To prevent problems, maintenance should be performed once every 6 months as follows:

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

- REPAIR AND CLEANING -- 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.

4-5. Periodically you may also wish to verify proper beam alignment. For this procedure, refer to the Laser Transducer System Operating Manual.

4-6. ADJUSTMENTS

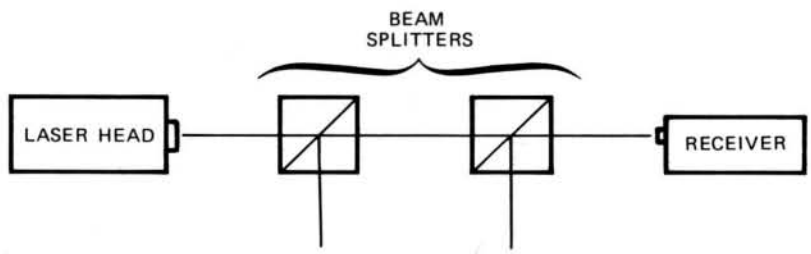
4-7. The following procedure sets the 10780A Receiver adjustments. Initially, the adjustments are made with the receiver located in line from the furthest beam splitter, then the system is setup in the desired user configuration and checked.

1. Align the system on the machine in the desired configuration using the maximum number of optical beam splitters.

2. Remove the Receiver cover to gain access to the adjustment potentiometers.

3. Connect an oscilloscope to the Beam Monitor test point on the back of the Receiver.

4. Place Receiver in the beam path in line from the furthest optical beam splitter where the signal strength should be minimum.



5. Position Receiver for maximum signal indication on oscilloscope. Maximum signal should be about 1 volt.

6. Adjust R12 overload potentiometer fully ccw, then rotate cw until saturation is reached i.e., point where a further cw adjustment results in very little voltage increase. From the saturation point, adjust R12 ccw until the voltage at the beam monitor test point decreases by 0.2V.

7. Reposition the receiver for maximum signal at the beam monitor test point.

8. Check that the receiver is not saturated by repeating step 6 and noting if adjustment point is the same. Repeat steps 6 and 7 as necessary to maximize the beam monitor test point voltage at 0.2V short of saturation.

9. Place the receiver and optics in the configuration to be used and position the receiver for maximum beam monitor test point voltage.

NOTE

Record the voltage reading at the beam monitor test point for use as an axis reference for future troubleshooting.

10. Break the measurement beam and check the beam indicator LED on the 10780A. If on, adjust R9 threshold adjust until LED just goes out.

4-8. TROUBLESHOOTING

4-9. Use the schematic diagram Figure 4-2 for troubleshooting. The schematic shows test points, voltages, and waveforms for the various stages of the receiver.

SECTION 5
REPLACEABLE PARTS

5-1. INTRODUCTION

5-2. This section contains a listing of replaceable parts for the 10780A Receiver (Table 5-2), a list of manufacturers codes (Table 5-3), an explanation of the reference designations and abbreviations used in the replaceable parts list (Table 5-1) and information on how to order replaceable parts.

5-3. ORDERING INFORMATION

5-4. To obtain replacement parts, address your order to your local Hewlett-Packard Sales and Service Office listed at the back of this manual. Identify parts by their Hewlett-Packard part number (see Table 5-2). To obtain a part that is not listed or does not show an associated part number, provide the following information when ordering:

- Instrument model number.
- Instrument serial number.
- Description of the part.
- Function and location of the part as near as you can determine them.

An explanation of instrument model numbers and instrument serial numbers can be found in the Laser Head Operating and Service Manual.

Table 5-1. Reference Designations and Abbreviations

REFERENCE DESIGNATIONS

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

ABBREVIATIONS

- A = ampere
- ac = alternating current
- ACCESS = accessory
- ADJ = adjustment
- A/D = analog-to-digital
- AF = audio frequency
- AFC = automatic frequency control
- AGC = automatic gain control
- AL = aluminum
- ALC = automatic level control
- AM = amplitude modulation
- AMPL = amplifier
- APC = automatic phase control
- ASSY = assembly
- AUX = auxiliary
- AVG = average
- AWG = american wire gauge
- BAL = balance
- BCD = binary coded decimal
- BD = board
- BE CU = beryllium copper
- BFO = beat frequency oscillator
- BH = binder head
- BKDN = breakdown
- BP = bandpass
- BPF = bandpass filter
- BRS = brass
- BWO = backward-wave oscillator
- CAL = calibrate
- ccw = counterclockwise
- CER = ceramic
- CHAN = channel
- cm = centimeter
- CMO = coaxial
- COEF = coefficient
- COM = common
- COMP = composition
- COMPL = complete
- CONN = connector
- CP = cadmium plate
- CRT = cathode-ray tube
- CTL = complementary transistor logic
- CW = continuous wave
- cw = clockwise
- D/A = digital-to-analog
- dB = decibel
- dBm = decibel referred to 1 mW
- dc = direct current
- deg = degree (temperature interval or difference)
- ° = degree (plane angle)
- °C = degree Celsius (centrigrade)
- °F = degree Fahrenheit
- °K = degree Kelvin
- DEPC = deposited carbon
- DET = detector
- diam = diameter
- DIA = diameter (used in parts list)
- DIFF AMPL = differential amplifier
- div = division
- DPDT = double-pole, double-throw
- DR = drive
- DSB = double sideband
- DTL = diode transistor logic
- DVM = digital voltmeter
- ECL = emitter coupled logic
- 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 = metre (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; microfarad (used in parts list)
- MFR = manufacturer
- mg = milligram
- MHz = megahertz
- mH = millihenry
- mho = conductance
- MIN = minimum
- min = minute (time)
- ' = minute (plane angle)
- MINAT = miniature
- mm = millimetre
- 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
- ns = nanosecond
- NSR = not separately replaceable
- 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 modulation; 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
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}

Table 5-2. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A1	10780-60101	8	1	DOPPLER RECEIVER BOARD ASSEMBLY (SERIES 1644A)	28480	10780-60101
C1	0180-0230	9	1	CAPACITOR-FXD 1UF+-20% 50VDC TA	56289	150D105X0050A2
C2	0160-4084	8	2	CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
C3	0160-0205	7	1	CAPACITOR-FXD 10PF +-5% 500VDC MICA	28480	0160-0205
C4	0160-3277	9	5	CAPACITOR-FXD .01UF +-20% 50VDC CER	28480	0160-3277
C5	0180-0229	7	1	CAPACITOR-FXD 33UF+-10% 10VDC TA	56289	150D336X9010B2
C6	0160-3277	9		CAPACITOR-FXD .01UF +-20% 50VDC CER	28480	0160-3277
C7	0180-0230	0	1	CAPACITOR-FXD 1UF+-20% 50VDC TA	56289	150D105X0050A2
C8	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
C9	0160-2327	8	1	CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-2327
C10	0160-3277	9		CAPACITOR-FXD .01UF +-20% 50VDC CER	28480	0160-3277
C11	0180-0228	6	1	CAPACITOR-FXD 22UF+-10% 15VDC TA	56289	150D226X9015B2
C12	0160-3277	9		CAPACITOR-FXD .01UF +-20% 50VDC CER	28480	0160-3277
C13	0160-3277	9		CAPACITOR-FXD .01UF +-20% 50VDC CER	28480	0160-3277
C14	0160-0137	4	2	CAPACITOR-FXD .33UF +-20% 25VDC CER	28480	0160-0137
C15	0160-0137	4		CAPACITOR-FXD .33UF +-20% 25VDC CER	28480	0160-0137
C16	0160-0576			CAPACITOR-FXD 0.1 UF+-20% 50 VDC CER	28480	0160-0576
CR1	1901-0179	7	1	DIODE-SWITCHING 15V 50MA 750PS DO-7	28480	1901-0179
DS1	1990-0522	1	1	LED-VISIBLE LUM-INT=12MCD IF=50MA-MAX	28480	5082-4958
Q1	1855-0081	1	1	TRANSISTOR J-FET N-CHAN D-MODE SI	01295	2N5245
Q2	1854-0092	2	1	TRANSISTOR NPN SI PD=200MW FT=600MHZ	28480	1854-0092
Q3	1853-0015	7	1	TRANSISTOR PNP SI PD=200MW FT=500MHZ	28480	1853-0015
Q4	1854-0019	3	1	TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0019
R1	0757-0959	3	1	RESISTOR 30K 2% .125W F TC=0+-100	24546	C4-1/8-T0-3002-G
R2	0757-0948	0	3	RESISTOR 10K 2% .125W F TC=0+-100	24546	C4-1/8-T0-1002-G
R3	0757-0934	4	1	RESISTOR 2.7K 2% .125W F TC=0+-100	24546	C4-1/8-T0-2701-G
R4	0757-0948	0		RESISTOR 10K 2% .125W F TC=0+-100	24546	C4-1/8-T0-1002-G
R5	0757-0964	0	2	RESISTOR 47K 2% .125W F TC=0+-100	24546	C4-1/8-T0-4702-G
R6	0757-0933	3	1	RESISTOR 2.4K 2% .125W F TC=0+-100	24546	C4-1/8-T0-2401-G
R7	0757-0911	7	1	RESISTOR 300 2% .125W F TC=0+-100	24546	C4-1/8-T0-301-G
R8	0757-0948	0		RESISTOR 10K 2% .125W F TC=0+-100	24546	C4-1/8-T0-1002-G
R9	2100-2030	6	1	RESISTOR-TRMR 20K 10% C TOP-ADJ 1-TRN	73138	82PR20K
R10				NOT ASSIGNED		
R11				NOT ASSIGNED		
R12	2100-2522	1	1	RESISTOR-TRMR 10K 10% C SIDE-ADJ 1-TRN	30983	ET50X103
R13	0757-0964	0		RESISTOR 47K 2% .125W F TC=0+-100	24546	C4-1/8-T0-4702-G
R14	0757-0919	5	1	RESISTOR 620 2% .125W F TC=0+-100	24546	C4-1/8-T0-621-G
R15				NOT ASSIGNED		
R16	0757-0961	7	1	RESISTOR 36K 2% .125W F TC=0+-100	24546	C4-1/8-T0-3602-G
R17	0683-1815	5	1	RESISTOR 180 5% .25W FC TC=-400/+600	01121	CB1815
R18	0757-0926	4	1	RESISTOR 1.2K 2% .125W F TC=0+-100	24546	C4-1/8-T0-1201-G
R19	0757-0954	8	1	RESISTOR 18K 2% .125W F TC=0+-100	24546	C4-1/8-T0-1802-G
R20	0757-0936	6	1	RESISTOR 3.3K 2% .125W F TC=0+-100	24546	C4-1/8-T0-3301-G
R21	0757-0898	9	1	RESISTOR 82 2% .125W F TC=0+-100	24546	C4-1/8-T0-82R0-G
R22	0757-0923	1	1	RESISTOR 910 2% .125W F TC=0+-100	24546	C4-1/8-T0-911-G
R23	0757-0930	0	1	RESISTOR 1.8K 2% .125W F TC=0+-100	24546	C4-1/8-T0-1801-G
R24	0757-0925	3	1	RESISTOR 1.1K 2% .125W F TC=0+-100	24546	C4-1/8-T0-1101-G
R25	0757-0909	3	1	RESISTOR 240 2% .125W F TC=0+-100	24546	C4-1/8-T0-241-G
R26	0757-0900	4	1	RESISTOR 100 2% .125W F TC=0+-100	24546	C4-1/8-T0-101-G
U1	1826-0037	6	1	IC RF/IF AMPL TO-99	04713	MC1590G
U2	1826-0122	0	1	IC 7805 V RGLTR TO-220	07263	7805UC
U3	1826-0367	8	1	IC V REGULATOR 5V	27014	UA78M05HC
U4	1826-0065	0	1	IC 311 COMPARATOR 8-DIP-P	01295	SN72311P
U5	1820-0720	2	1	IC DRVR TTL LED DRVR DUAL 4-INP	27014	DS8830N
A2	10780-60002	8	1	DETECTOR ASSEMBLY (REPLACEABLE ONLY AS AN ASSEMBLY)	28480	10780-60002
C3	0160-2049	1	1	CAPACITOR-FDTHRU 5000PF +80 -20% 500V	28480	0160-2049
J1	1251-3451	5	1	CONNECTOR 4-PIN CIRCULAR	28480	1251-3451
	1251-3452	6	1	CONNECTOR 4-PIN CIRCULAR	28480	1251-3452
				MISCELLANEOUS PARTS		
	10780-20004	6	1	CAP, FRONT	28480	10780-20004
	10780-20005	7	1	CAP, REAR	28480	10780-20005
	10780-20006	8	1	COVER, BOTTOM	28480	10780-20006
	10780-00002	2	1	HEAT SINK	28480	10780-00002
	10780-20002	4	1	SPACER	28480	10780-20002
	10780-40002	6	4	SPACER	28480	10780-40002
	10780-40003	7	1	TARGET, ALIGNMENT	28480	10780-40003
	0340-0410	8	2	INSULATOR-XSTR NYLON	28480	0340-0410
	2360-0369	0	4	SCREW-MACH 6-32 1-IN-LG PAN-HD-SLT	00000	ORDER BY DESCRIPTION
	10790A, B, C			CABLE 5M, 10M, 20M Not supplied, order separately	28480	10790A, B, C
	3030-0150			SCREW, SET, 2-56	00000	ORDER BY DESCRIPTION

See introduction to this section for ordering information
*Indicates factory selected value

Table 5-3. Manufacturers Code List

Mfr. No.	Manufacturer Name	Address	ZIP Code
00000	Any Satisfactory Supplier		
01121	Allen-Bradley Co.	Milwaukee, WI	53204
01295	Texas Instruments, Inc., Semiconductor Cmpnt. Div.	Dallas, TX	75222
04713	Motorola Semiconductor Products	Phoenix, AZ	85062
07263	Fairchild Semiconductor Division	Mountain View, CA	94042
24546	Corning Glass Works (Bradford)	Bradford, PA	16701
27014	National Semiconductor Corp.	Santa Clara, CA	95051
28480	Hewlett-Packard Co., Corporate Headquarters	Palo Alto, CA	94304
30983	Mepco/Electra Corp.	San Diego, CA	92121
56289	Sprague Electric Co.	North Adams, MA	01247
73138	Beckman Instruments, Inc., Helipot Division	Fullerton, CA	92634

SECTION 6
MANUAL CHANGES

6-1. INTRODUCTION

6-2. This section of the manual contains information necessary to update the manual to cover newer instruments and to backdate the manual to cover older instruments.

6-3. MANUAL CHANGES

6-4. This manual applies directly to units having serial number prefix 2204A. For units with different serial number prefixes, refer to the following paragraphs.

6-5. NEWER INSTRUMENTS

6-6. New instruments may have higher serial number prefixes that are listed on the title page of this manual. The manuals shipped with these units will include a "Manual Changes" sheet that describes all required manual changes. If the updating information is missing, contact the local HP Sales and Service Office for information.

6-7. OLDER INSTRUMENTS

6-8. Table 6-1 lists the serial numbers and serial number prefixes of units that differ electrically from the units documented in this manual. Find the prefix or range of serial numbers that corresponds to your unit, and make the manual changes specified in Table 6-1.

Table 6-1. Backdating Changes

Serial Number or Prefix	Make These Manual Changes
1948A	1
1912A	1, 2
1644A	1, 2, 3
1504A	1, 2, 3, 4
1408A	1, 2, 3, 4, 5

CHANGE 1

Page 5-3, Table 5-2, Replaceable Parts:
Change U3 to "1826-0394, IC V Regulator 10V, 27014, LM78L10ACH.

Page 7-3, Figure 7-2, Schematic Diagram:
At lower left corner of schematic, delete connection from U2 pin 2 to U3 pin 3. Connect U3 pin 3 to ground.

At lower right corner of schematic, change HP Part Number of U3 to 1826-0394, change Vendor Part Number to 78L10ACH.

CHANGE 2

For units with serial prefix 1912A and below, the 10780-60003 cable was not supplied. Instead a 4-pin connector P/N 1251-3452 was supplied to wire an interconnecting cable between the receiver and the Laser System electronics.

Page 2-1, Paragraph 2-9, Item 3:
Delete the sentence and replace with "One (1) 4-pin connector, P/N 1251-3452, that may need to be wired to an interconnecting cable which connects the receiver to the Laser System electronics.

Page 2-1, Add the following paragraph:
"2-9a. In addition, an interconnecting cable is required to connect the receiver to the Laser System electronics. This cable is specified when ordering the Laser System."

Page 1-2, Table 1-1:
In the Maximum Cable Length specification, replace "10780-60003" with "C05-59995A". This was the special order available with the 10780A.

Page 5-3, Table 5-2, Replacement Parts:
Delete the 10780-60003 cable and the listing.

CHANGE 3

Page 5-3, Table 5-2, Replaceable Parts:
Delete A1C16 and listing.

Page 7-3, Figure 7-2, Schematic Diagram:
On component, delete C16. On schematic, delete C16 .01. Add jumper W1 between the +10 volt line and U1 pin 6. Add jumper W2 between ground and U3 pin 3.

CHANGE 4

Page 5-3, Table 5-2 Replaceable Parts:
Add R10/0757-0919/1/R:FXD FLM 620 OHM 2% 1/8W/28480/0757-0919.

Add R11/0757-0912/1/R: FXD MET FLM 330 OHM 2% 1/8W/28480/0757-0912.

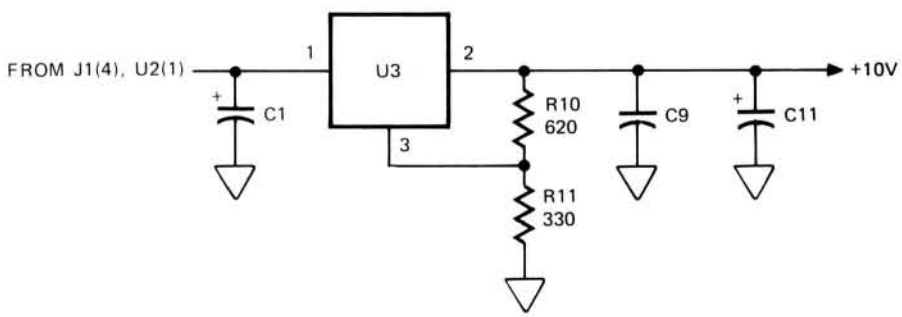
Change the value of R17 from 180 OHM 1/4W to 130 OHM 1/8W.

Change HP Part Number of U3 from 1826-0384 to 1820-0429 and Mfg. Number to LM309H.

Delete W2.

Page 7-3, Figure 7-2 Schematic Diagram:
Delete W2 jumper wire from U3(3) to ground.

Add R10 (620 OHM) and R11 (330 OHM) from U3(2,3) to ground as shown below:



Change value of R17 from 180 OHM to 130 OHM.

On Integrated Circuit Chart, change U3 HP Part No. from 1826-0394 to 1820-0429 and Mfg. No. from 78L10 ACH to LM309H.

CHANGE 5

Page 5-3, Table 5-2 Replaceable Parts:

Change R14 from 620 OHM (HP Part No. 0575-0919) to read:
R14/0757-9021/1/R:FXD MET FLM 750 OHM 2% 1/8W/28480/0757-0921.

Delete W1 (HP Part No. 8155-0005).

Add R15/1/0757-0921/R: FXD MET FLM 750 OHM 2% 1/8W/28480/0757-0921.

Page 7-3, Figure 7-2 Schematic Diagram:

Change the value of R14 from 620 to 750.

Delete W1 and replace with R15 (750 OHM). R15 connects from U1(6) to +10V.

SECTION 7
SCHEMATIC DIAGRAM

7-1. INTRODUCTION

7-2. This section of the manual contains a schematic diagram of the 10780A Receiver circuit board assembly and additional supportive information as listed below.

- Schematic diagram notes, Figure 7-1, which describes symbols and reference designations of components and assemblies used in the Receiver.

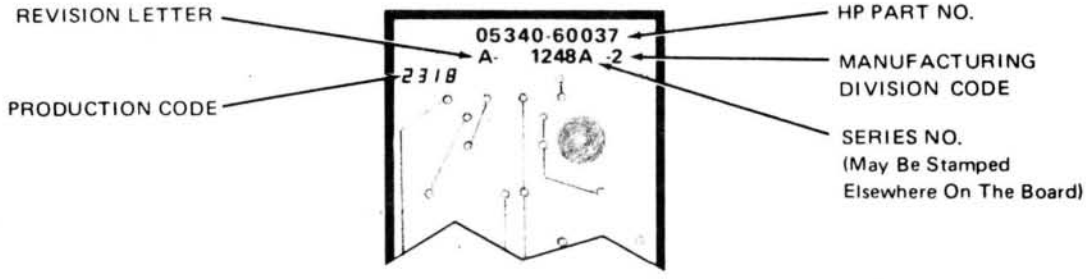
- Component locator and an integrated circuit chart for the 10780A Receiver board.

7-3. Use the information in this section in conjunction with the information provided in Section IV for maintenance and servicing.

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

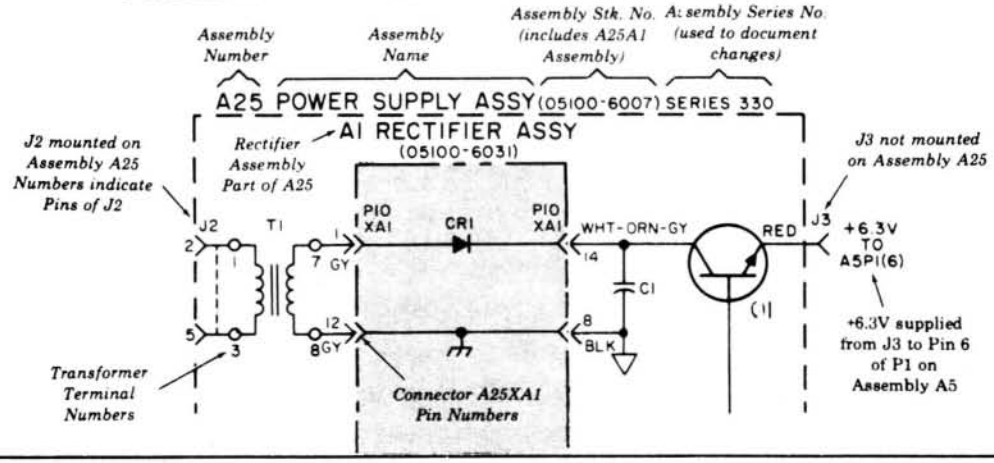
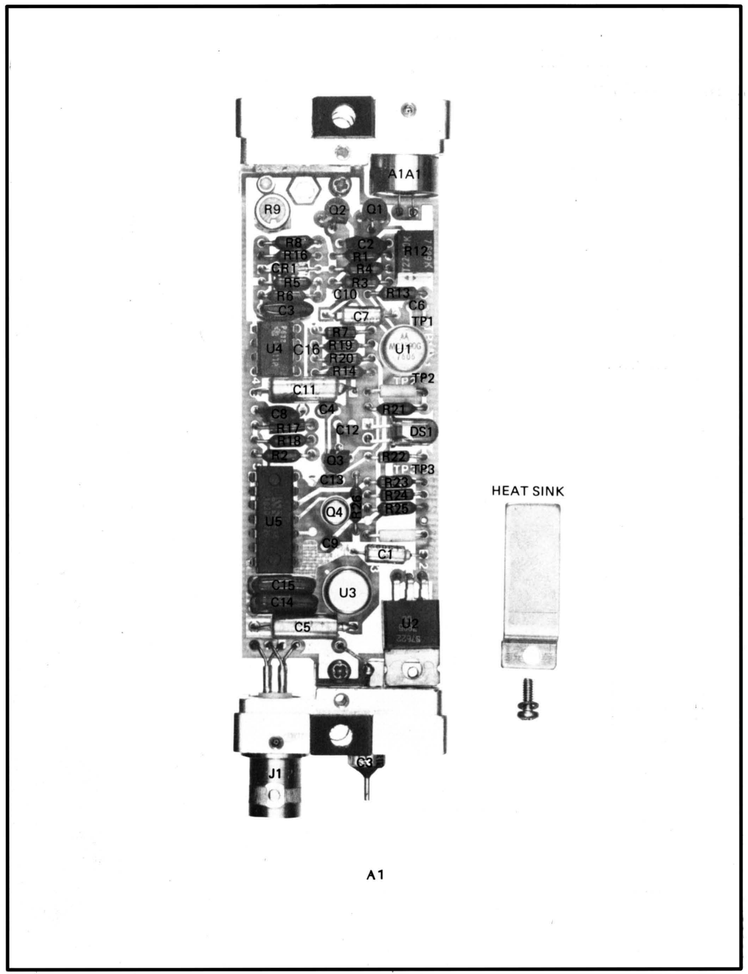
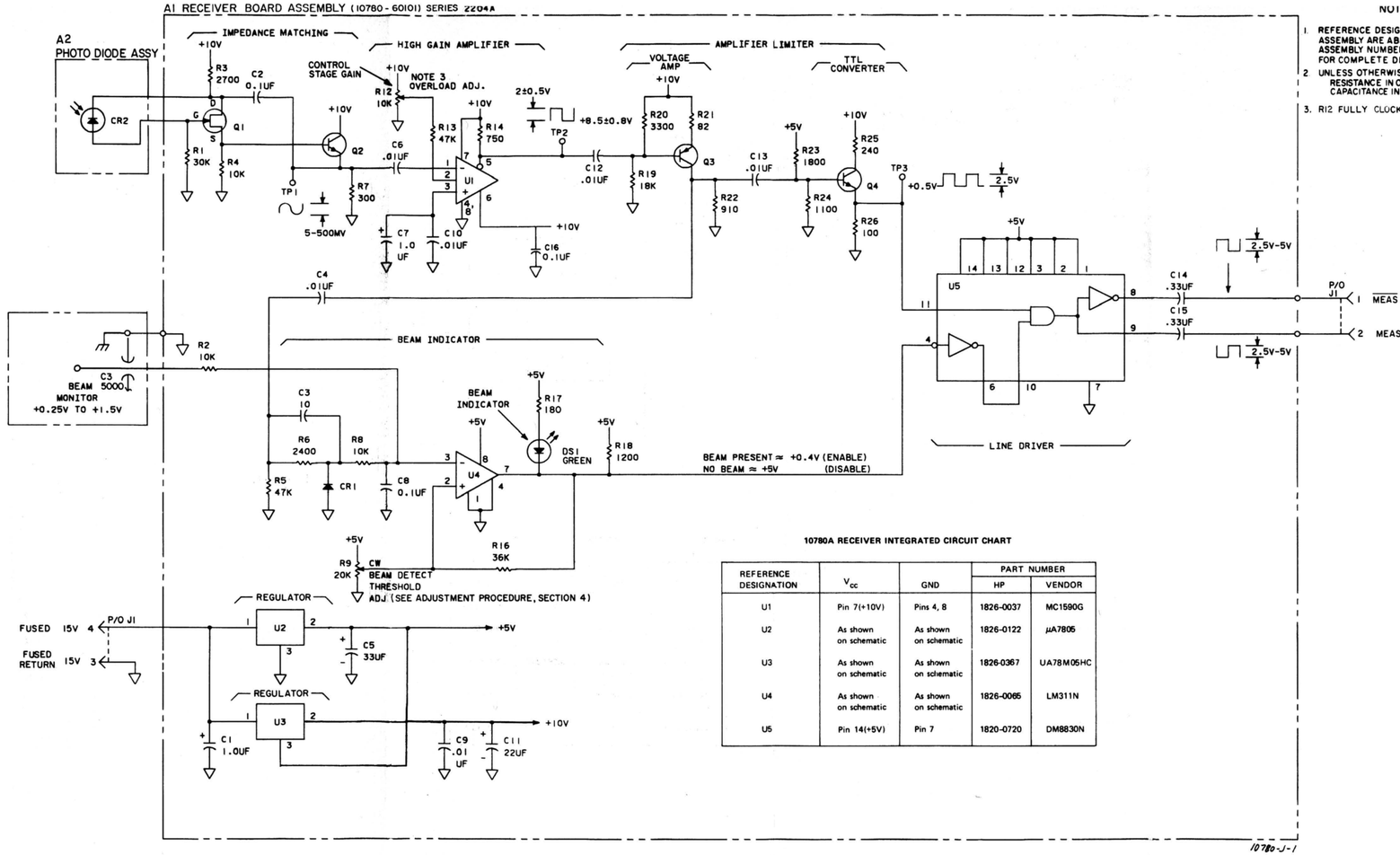


Figure 7-1. Schematic Diagram Notes





NOTES

1. REFERENCE DESIGNATIONS WITHIN THIS ASSEMBLY ARE ABBREVIATED. ADD ASSEMBLY NUMBER TO ABBREVIATION FOR COMPLETE DESCRIPTION.
2. UNLESS OTHERWISE INDICATED: RESISTANCE IN OHMS, CAPACITANCE IN PICOFARADS
3. RI2 FULLY CLOCKWISE = MAXIMUM GAIN

10780A RECEIVER INTEGRATED CIRCUIT CHART

REFERENCE DESIGNATION	V_{cc}	GND	PART NUMBER	
			HP	VENDOR
U1	Pin 7(+10V)	Pins 4, 8	1826-0037	MC1590G
U2	As shown on schematic	As shown on schematic	1826-0122	μA7805
U3	As shown on schematic	As shown on schematic	1826-0367	UA78M05HC
U4	As shown on schematic	As shown on schematic	1826-0065	LM311N
U5	Pin 14(+5V)	Pin 7	1820-0720	DM8830N

Figure 7-2
10780A Doppler Receiver Schematic Diagram

MANUAL PART NO. 10780-90009

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