

**BEFORE PROCEEDING WITH COMPLETE UNPACKING AND SETUP,  
CONSULT UNPACKING AND INSPECTION INSTRUCTIONS ON PAGE 6**

**model 2020  
DC INPUT MODULE**



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SECTION I

INTRODUCTION

1.1 FRONT PANEL

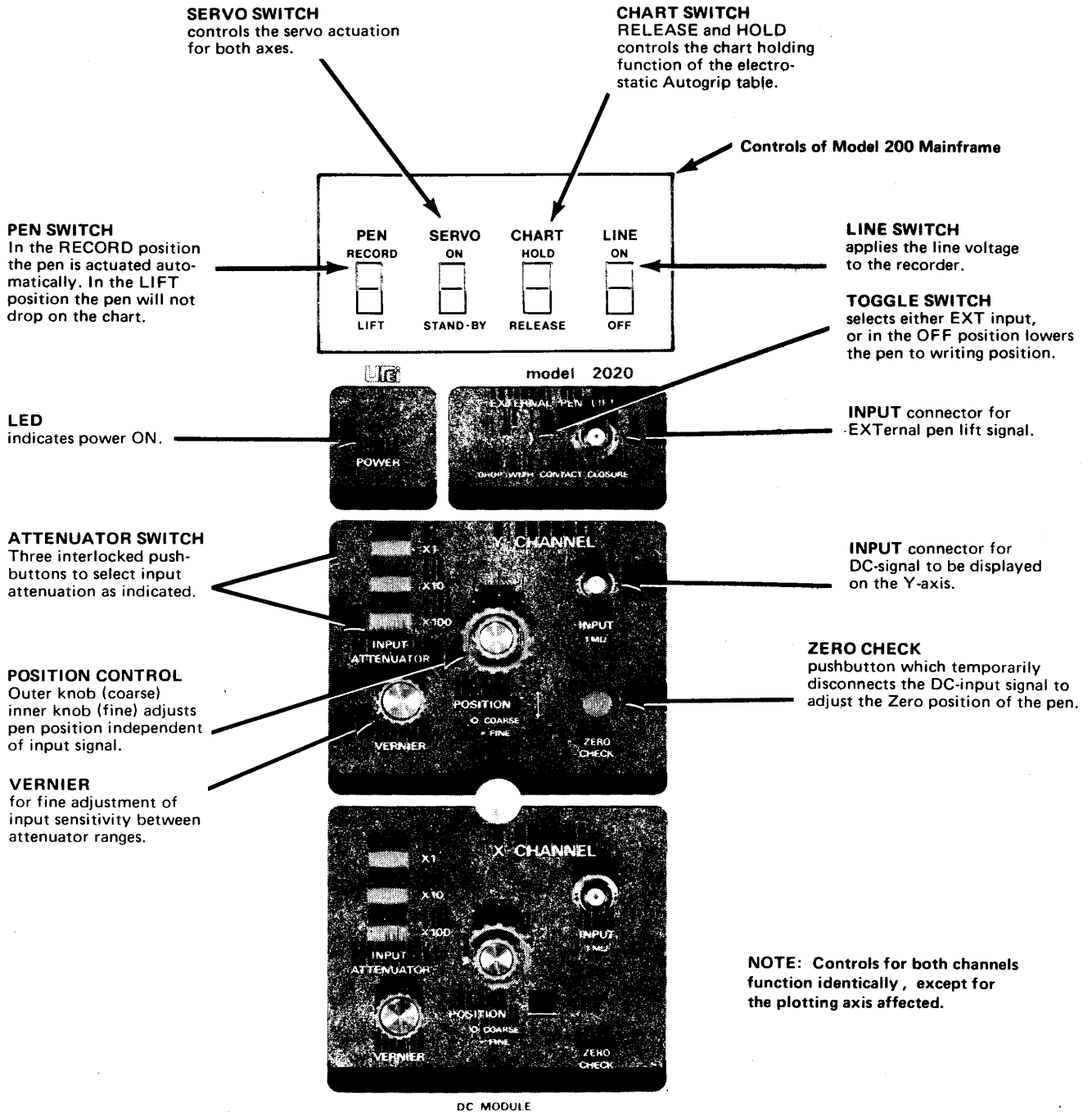


Fig. 1 – FUNCTIONS OF THE FRONT PANEL CONTROLS

## 1.2 DESCRIPTION

The Model 2020 is a general purpose DC plug-in to be used with the UREI 200 system mainframes. When installed in the 200 X-Y Recorder Mainframe it extends the capabilities of the recorder to produce hard-copy plots of the relationship between two DC variables, and accept signals from such devices as analyzers, sweep and function generators, multi-purpose tests sets, log converters, calculators, and computer readouts. Therefore, applications are suggested in research and development, quality control, manufacturing, maintenance, and in the field. When used with the Model 201 Display Interface Mainframe, the 2020 provides X, Y and Z information for the continuous viewing on long persistence or storage oscilloscopes.

For instructions regarding the mainframe in which the plug-in is used, please refer to the appropriate separate operating and instruction manual.

The inputs and outputs are protected through isolation amplifiers which do not limit the excellent slew rate capability and accuracy of the mainframe. Calibrated attenuators with overlapping verniers match the inputs to a wide range of voltages and adapt to either inch or metric scaling. Both axes have independent and fully variable zero-offset to position the pen over any point on the graph. Zero setting can always be instantly verified without removing the external voltage.

Although the pen lift may be controlled locally, an additional input is provided for an external pen lift signal. Closure of a contact to ground lowers the pen. With the 201 Display Interface Mainframe, this signal is utilized to generate retrace blanking information for the Z-axis.

Although the Model 2020 plug-in is simple to use and its design has no complicated features, a thorough understanding of the system can only benefit the user. Please, read these instructions carefully and also the H.P. Operating Manual which was prepared for the X-Y Recorder Mainframe.

## 1.3 APPLICATIONS

There are many applications where two DC variables are available for plotting their relationship. A few are mentioned in the introduction paragraph. This manual assumes that the user is familiar with typical plotting techniques. However, a special approach utilizing the 200 system should be mentioned. If the Model 2020 is installed in the X-Y Recorder, then the alternate 201 Display Interface Mainframe may be used to adapt any other UREI plug-in (for example the Frequency Response Module) simultaneously to an oscilloscope and the X-Y Recorder.

The advantage is a continuous viewing on the scope while occasionally a hard copy is plotted on the X-Y Recorder without the need to change and recalibrate modules.

#### 1.4 PERFORMANCE SPECIFICATIONS

DISPLAY UNIT  
(X-Y Recorder Mainframe)  
(Display Interface Mainframe)

INPUT SENSITIVITY: Vertical, 1.0 volts/inch.  
Horizontal, 0.1 volts/inch.

TYPE OF INPUT: Connectors to accept UREI plug-in modules.

MODEL 2020 DC INPUT  
MODULE SPECIFICATIONS  
(Identical for X and Y channels)

#### ELECTRICAL

SENSITIVITY: 0.1, 1.0, 10 volts per inch.

INPUT ATTENUATOR: 3 ranges, X1, X10, X100.

ATTENUATOR VERNIER: Continuously variable over a 10:1 range.

MAXIMUM INPUT VOLTAGE:  $\pm 100$  volts.

INPUT IMPEDANCE: 1 Mohm, constant under all conditions.

PROTECTION: Continuous short circuit will not cause damage.

ZERO POSITION: Control range covers any point on the paper.

Pen may be positioned within 0.005 inch at any point.

Position remains constant regardless of test signal amplitude or range setting.

ZERO CHECK: Momentary grounding of input amplifier.

ZERO DRIFT: Not more than 0.1 inch per day,  
independent of temperature.

PEN LIFT: Contact closure to ground lowers  
the pen.

## PHYSICAL

SIZE: 96.5 mm x 208.3 mm, depth behind  
front panel 81.3 mm (3.8" x 8.2"  
x 3.2"). Designed to fit all  
series 200 mainframes.

WEIGHT: 0.680 kg (1.5 pounds).

SHIPPING WEIGHT: 1.5 kg (3.3 pounds).

FINISH: Front panel--aluminum with dark  
and light gray baked enamel, to  
match mainframes.

### 1.5 CONTROLS - X-Y RECORDER

PEN SWITCH: A two-position slide switch  
controls the lowering and raising  
of the pen. In the RECORD  
position the pen is actuated  
automatically through the pen lift  
logic. In the LIFT position,  
the pen will not drop.

SERVO SWITCH: A two-position slide switch  
controls the servo actuation  
for both axes.

CHART SWITCH: A two-position slide switch,  
RELEASE and HOLD, controls the  
chart holding function of the  
electrostatic Autogrip table.

LINE SWITCH: A two-position slide switch applies  
the line voltage to the recorder.

## 1.6 CONTROLS - MODEL 2020

- 3 PUSHBUTTONS: Interlocked, to select desired input range.
- VERNIER: Adjusts input sensitivity between attenuator ranges.
- POSITION: Outer knob adjusts coarse pen position.  
Inner concentric knob for fine position control.
- ZERO CHECK: Momentary pushbutton disconnects input signal and applies 0 volts to the input amplifier.
- EXTERNAL PEN LIFT: Toggle switch. In the EXT position, an external pen lift signal may be applied to the circuit. In the OFF position the pen will remain in the writing mode.
- SIGNAL INPUTS: BNC connectors.
- MAINFRAME INTERCONNECTION: Edge connectors.

## 1.7 ACCESSORIES

UREI Instruction Manual

Audio Frequency Graph Paper; UREI order number: 200 G.

NOTE: Similar paper is available from Keuffel and Esser order number: 46 6882.

Metric paper for use on the X-Y recorder has the following specification:

"Logarithmic Frequency paper for Audio Conception," according to DIN 45 408, Number 666 356, 437-1/2.  
UREI order number: 200 M.

Linear paper may be obtained in most stationery supply stores. However, we stock pads with linear paper (inch/inch, 1/10 grid) under UREI part number: 200 L.

## SECTION II

### INSPECTION AND INSTALLATION

#### 2.1 UNPACKING AND INSPECTION

The Model 2020 DC Input Module is normally packed in a small carton, and is not installed in any Display Unit. For installation in the mainframe, also see the H.P. Operating Manual.

The instrument was carefully packed at the factory, and the container was designed to protect the unit from rough handling. Nevertheless, we recommend careful examination of the shipping carton and its contents for any sign of physical damage which could have occurred in transit.

If damage is evident, do not destroy any of the packing material or the carton, and immediately notify the carrier of a possible claim for damage. Shipping claims must be made by the consignee.

The shipment should include:

Model 2020 DC Input Module

UREI Instruction Manual

Two-part Warranty Card bearing the same serial number as the plug-in module

#### 2.2 ENVIRONMENTAL CONSIDERATIONS

The system will operate satisfactorily over a range of ambient temperatures from +10°C to +40°C (+50°F to 104°F), and up to 80% relative humidity.

If the system is installed in an equipment rack together with high heat producing equipment (such as power amplifiers), adequate ventilation should be provided to prolong the life of components. Also, while circuitry susceptible to hum pick-up is sufficiently shielded from moderate electromagnetic fields, installation should be planned to avoid mounting the system immediately adjacent to large power transformers, motors, etc.

To comply with existing U.S. electrical codes, the Display Unit is supplied with a three-wire power cord, the grounding pin of which is connected to the chassis. For this reason, where a significant potential difference exists between AC conduit ground and either the device under test or the grounded metal enclosure in which the chassis is installed, ground-loops may occur. If hum is experienced, the possibility of ground-loop pick-up may be checked



by using a 3-wire to 2-wire AC adaptor at the power receptacle. Caution is advised while operating the system with the AC plug ungrounded.

### 2.3 OPERATING POWER

For correct connection of the Model 2020/Model 200 system to the AC power source, refer to the H.P. manual. The Model 2020 plug-in module receives its power from the Display Unit, via card edge connectors. No additional voltage selections are necessary. If the Model 2020 module is not used in conjunction with the Model 200, then power must be supplied according to the specifications in Section 4.5.

### 2.4 RACK MOUNTING ACCESSORY

The 200 X-Y Plotter may be mounted with brackets in a standard 19-inch rack. Only those screws which are packed with the mounting kit should be used to fasten the brackets to the plotter. (Longer screws could damage the plug-in module.) Also see the H.P. Operating Manual.

### 2.5 EXTERNAL CONNECTIONS

The BNC connectors for the X-channel, Y-channel and Pen Lift inputs are located on the Model 2020's front panel. These connectors remain accessible at all times, even if the Recorder is permanently installed in a rack.

## SECTION III

### OPERATING INSTRUCTIONS

#### 3.1 GENERAL

As suggested in the introduction, the user also is advised to read the appropriate sections in the H.P. Operating Manual for the X-Y Recorder, or the manual for any other display mainframe. The Model 2020 plug-in module should never be inserted or pulled out of the mainframe while power is ON (Line switch should be OFF).

#### 3.2 CALIBRATION

Perform the calibration procedure before plotting a graph. This assures that the system is operating under optimum conditions and that specified accuracy will be maintained.

An initial warm up period of two minutes is sufficient before the actual calibration is performed. During long periods of continuous use, the calibration points should be checked occasionally to be sure that the instruments have not drifted.

#### 3.3 PAPER ALIGNMENT

The paper stop protrudes at the lower left corner of the platen. It is helpful for alignment of the paper provided with the plug-in. For alignment of the DIN A 4 paper, the left edge of the platen is used as a reference and the paper stop may be removed.

#### 3.4 ZERO POSITION ADJUSTMENT

##### 3.4.0. GENERAL

These controls function identically in both the X and Y channel and are therefore described for only one channel. Also, the procedure is basically the same regardless whether the mainframe is the Model 200 X-Y Recorder or the Model 201 Display Interface in conjunction with an oscilloscope.

##### CAUTION:

If the pen remains for an extended time in the writing position on the paper, the ink will blot through the paper and stain the platen. Lift the pen! Similarly, if a bright spot on the CRT of an oscilloscope is left stationary at high intensity, it may burn into the screen. Reduce the intensity!

##### 3.4.1. POSITION CONTROLS

The coarse and fine controls of the X-channel move the pen to any position on the horizontal axis; the controls of the Y-channel move the pen to any position on the vertical axis.

### 3.4.2. ZERO CHECK

This pushbutton control is helpful to momentarily disconnect any signal from the input buffer amplifier and apply ground potential to the amplifier's input. This enables the user to check or change the zero reference of either axis without disconnecting the signal from the 2020 plug-in.

## 3.5 INPUT SENSITIVITY AND GAIN CALIBRATION

The combination of an input attenuator and vernier enable the user to accommodate the desired display to a wide range of input voltage levels. The module is in its most sensitive position with the X1 attenuator pushed in and the vernier turned clockwise (0.1 volt/inch = 0.039 volt/cm). A known DC reference voltage may be used to calibrate the module to the graph paper used, or to the graticule of the oscilloscope. To avoid overload conditions and to protect the inputs of the module, voltages should not exceed:

plus or minus 10 volts in the X1 range, and  
plus or minus 100 volts in the X10 and X100 ranges.

## 3.6 POST CALIBRATION PROCEDURE IN PREPARATION FOR RESPONSE PLOTTING

After the system is calibrated and the device under test is connected, the Model 2020 is ready to generate a plot of the input voltages. All controls and connectors are on the front panel.

### CAUTION:

When using the X-Y Recorder: to avoid unnecessary wear on the servo potentiometers and on other mechanical parts, the SERVO slide switch should be in the STAND-BY position when not recording. If the input voltage exceeds the range settings, the pen will move off scale, the motor will stop, and the recorder is protected against damage until the signal returns to an on-scale value.

## 3.7 RECORDER PEN LIFT

When the PEN slide switch, which is part of the Model 200 X-Y Recorder Mainframe, is placed in the LIFT position, it will override all writing functions. This enables the operator to make a "dry run" before committing the plot to paper. With the switch in the RECORD position, the pen will drop on the paper if the following conditions are met:

1. The toggle switch (PEN LIFT) of the 2020 is in the OFF position; or [continued on next page]

2. The toggle switch is in the EXT position and a signal, constituting a contact closure to ground, is applied to the EXT Pen Lift Input.

NOTE: The same conditions have to be fulfilled to display a trace on the CRT of an oscilloscope utilizing the Model 201 Display Interface Mainframe.

### 3.8 PLOTTING A GRAPH

Except for the purpose of exchanging a plug-in module, the LINE switch should remain ON while working with the recorder. This assures warm up and avoids drift. After the Model 2020 has been calibrated according to the previous paragraph and the system is connected to the signal sources, the operator may proceed to plot the graph.

How much interaction from the user is necessary depends on the level of automation of signal sources. Some experimentation may be helpful. Also, if more than one graph is plotted on the same paper, interpretation is easier if different colors are used for different measurements.

Since both channels are identical in specifications, the operator may interchange the X-channel and Y-channel inputs for display of information. It is conventional, though, to display parameters like frequency and time on the horizontal axis.

For later analysis and reference it is important to document as much information concerning the measurements as possible. This should include the device under test, additional test equipment used, calibration references, labeling and scaling of X- and Y-axes, environmental conditions, etc. Remember: a graph which is dated and bears the operator's signature becomes an engineering document.

## SECTION IV

### THEORY OF OPERATION

#### 4.1 INPUT STAGE

For the following explanation of the Model 2020, refer to the detailed schematic, Section VI, Figure 2. Both X- and Y-channels are almost identical and are described together. The DC input signal is applied through a BNC connector to the input attenuator which has a constant resistive impedance of 1 Mohm. The attenuator switch selects voltage divisions of 1:1, 1:10, and 1:100. Input protection is provided through resistor R 122 (R 123) and diodes which conduct if excess input voltage is connected to the input buffer amplifier.

The input stage is section B (D) of a quad operational amplifier having a JFET-input with its typical high input impedance and low offset currents. The circuit configuration provides unity gain, and the voltage is fed to a vernier potentiometer R 104 (R 112). The attenuation range is restricted due to R 105 (R 113).

#### 4.2 OUTPUT AMPLIFIER

In the X-channel, the output amplifier IC 101 A provides unity gain, and the output voltage is fed through the current limiting resistor R 116 to the X-channel edge connectors #5 and #6. Since the X-axis input sensitivity of the Model 200 X-Y Recorder Mainframe is 0.1 volts/inch, an input voltage of plus or minus 1.0 volt is sufficient to drive the pen over the useful range of 10 inches, if no attenuation is applied.

In the Y-channel, the output amplifier IC 101 C provides a gain of 10, and the output voltage is fed through the current limiting resistor R 108 to the Y-channel edge connectors #7 and #8. The input sensitivity of the Y-channel of the Model 200 X-Y Recorder Mainframe is 1.0 volt/inch, therefore each 0.1 volt input voltage will move the pen 1 inch over the vertical axis (approximately 6.5 inches if no attenuation is applied).

NOTE: Both output amplifiers may be changed in their gain structure if the output levels must be matched to different input sensitivities of other mainframes. Caution is advised to prevent overload conditions, and any change should be performed only by qualified service personnel.

### 4.3 ZERO POSITION

There are two concentric potentiometers which affect the zero position. Section B of the potentiometer is for the coarse adjustment, and section A controls the position over a smaller range. These controls are only important if the Model 2020 is used in the X-Y Recorder Mainframe since visual displays (oscilloscopes) have their own position controls.

Zero positions may be adjusted with no input signal connected to the X- and Y-channels. However, for convenience a momentary pushbutton is provided, disconnecting the input signal and grounding the input buffer amplifier. This feature enables the operator to change or check the zero position of either axis while the input signals are connected.

### 4.4 PEN LIFT

The electronic pen lift circuit is part of the X-Y Recorder Mainframe. It is activated (that is, the pen drops into writing position) if pin #4 of the Y-channel edge connector is shorted to circuit ground. Switch S3 of the Model 2020 provides an option of either grounding this terminal in the "OFF" position or connecting the pen lift circuit to the external input BNC connector in the EXT position.

### 4.5 POWER SUPPLY

Power to the plug-in module is provided from the mainframe in which the plug-in is used. Dual supply voltage is nominally  $\pm 16$  volts. Due to low power requirements and excellent ripple rejection, only moderate decoupling and protection is necessary.

## SECTION V

### MAINTENANCE

#### 5.1 GENERAL

The Model 2020 plug-in module is a ruggedly constructed, all solid-state unit, and is mechanically protected by its own housing. As such, the Model 2020 should provide years of trouble free use with normal care. All parts are conservatively rated for their application, and workmanship meets the rigid standards you have learned to expect in UREI products.

NO SPECIAL PREVENTIVE MAINTENANCE IS REQUIRED.

#### 5.2 REPAIRS AND WARRANTY

The instrument is factory warranted against defects in material and workmanship for one year after initial purchase. This Warranty must be activated at the time of purchase by returning the registry portion of the Warranty Card to the factory. Should a malfunction ever occur, the dealer from whom the unit was purchased will be glad to handle return for factory repair; alternately, for prompt service, ship the unit prepaid freight directly to the factory. Be sure that it is well packed in a sturdy carton, with shock-absorbing material such as foam rubber, styrofoam pellets, or "bubble-pack" completely filling the remaining space. Particular attention should be paid to protecting the protruding parts. Include a note describing the malfunction, and instructions for return. We will pay one-way return shipping costs on any in-warranty repair.

NOTE: If the malfunction clearly indicates that the problem is due to a defect in the plug-in module, and not in the mainframe, it is sufficient to return only the module. In all other cases, or when in doubt, the complete system (that is, the mainframe and the Model 2020 module) should be returned to avoid delay in service.

#### 5.3 PERFORMANCE CHECKS

Every time the system is calibrated according to Section III, a complete performance check has been carried out. All necessary adjustments are accessible on the front panel, and no additional maintenance is necessary.

#### 5.4 X-Y RECORDER MAINTENANCE

It has been our experience that the H.P. Mainframe will perform without trouble for a long period of time. It is suggested, though, that the maintenance described in the H.P. Operating Manual should be performed when necessary.

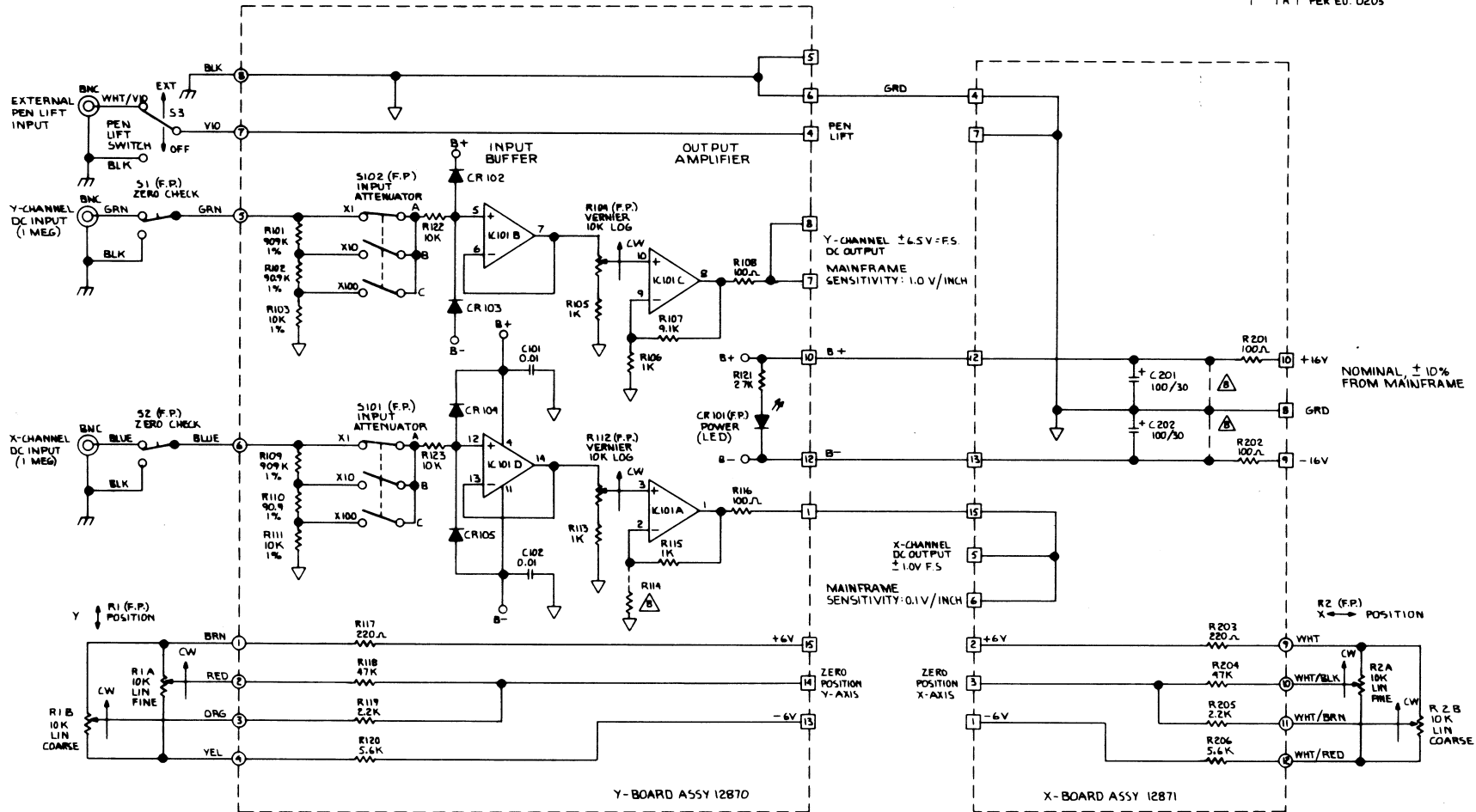
The Autogrip table should be cleaned regularly to assure adhesion of the graph paper.

After the first few weeks of use, the operator may notice that the motor which moves the pen along the Y-axis will not stall when the carriage is driven off the paper. This suggests that the string tension requires adjustment. This is a simple procedure and is described in detail in the H.P. Operating Manual.



SECTION VI  
SCHEMATIC DIAGRAM

ZONE		REVISIONS		DATE	APPROVED
LTR	DESCRIPTION				
A	PER ED. 0205			4-24-78	R.P.M.



10. IC 101 QUAD OP-AMP (TL 084 OR EQUIVALENT)
9. ALL DIODES ARE VIOLET (5037 URE)
- FACTORY SELECT COMPONENT (MAY BE OMITTED)
7. INDICATES NUMBERED WIRE TERMINATION POINT ON P.C.B.
6. (FP) INDICATES FRONT PANEL CONTROL
5. INDICATES CIRCUIT GROUND
4. INDICATES CHASSIS GROUND.
3. INDICATES CARD EDGE CONNECTION
2. CAPACITOR VALUES ARE IN MICROFARADS
1. RESISTOR VALUES ARE IN OHMS  $\pm 5\%$  1/2W
- NOTES: UNLESS OTHERWISE SPECIFIED

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE: FRACTIONS DECIMALS ANGLES		CONTRACT NO.		UNITED RECORDING ELECTRONICS INDUSTRIES <small>1802 VALLEJO STREET - HOLLYWOOD, CALIFORNIA 91605</small>	
MATERIAL		APPROVALS	DATE	<b>SCHMATIC</b>	
FINISH		DRAWN R.P.M.	11-21-77		
NEXT ASSY USED ON		CHECKED		SIZE D	MODEL NO 2020
APPLICATION		DO NOT SCALE DRAWING		DRAWING NO 12872A	SHEET OF