

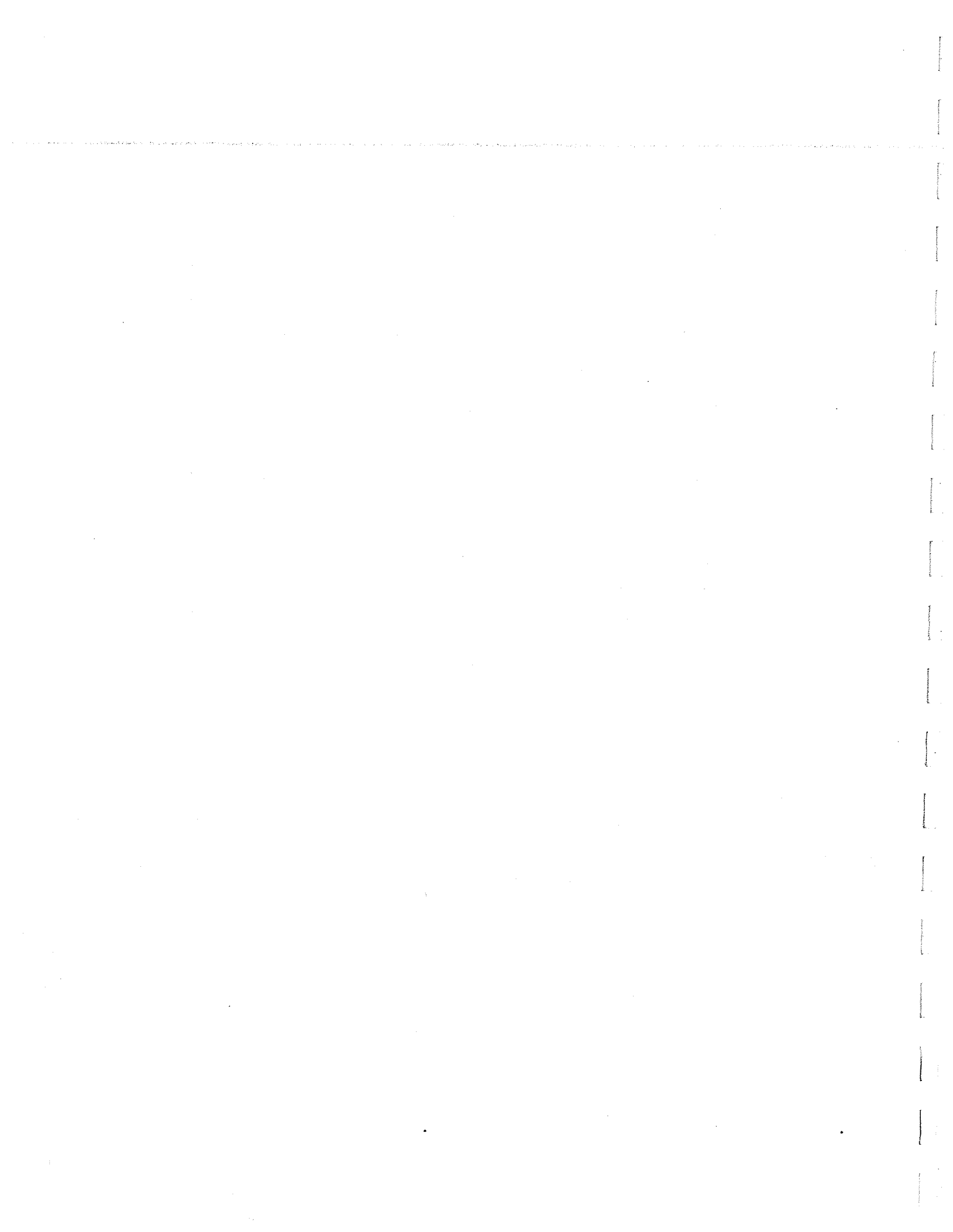
OPERATING INSTRUCTIONS  
FOR  
AFMSRX  
MODULATED SPEED ROTATOR

FROM  
PINE INSTRUMENT COMPANY  
GROVE CITY, PENNSYLVANIA



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## 1.1 General

Pine Instrument Company's AFMSRX Rotator is a solid-state-controlled servo-system, designed to operate in an application which requires the electrode speed to be modulated by a sine, square or other type waveform. The outstanding acceleration characteristics of the system allow electrode speed to follow the input signal with little error. This feature is particularly desirable for use in hydrodynamically modulated applications. The system may also be used effectively in non-modulated applications.

## 1.2 Specifications

Power: 115 VAC or 230 VAC, 50/60 Hz

Weight: Electronic Control Unit (ECU) - 11.5 lbs  
Body-Motor Assembly - 23 lbs

Operating Temp: 10 deg C to 40 deg C

Dimensions: ECU - 11 3/8" W x 10 1/8" D x 5 3/4" H  
Base - 11" x 15" x 3/4"

Motor: 1/50 HP permanent magnet DC

Motor Power Supply: +45 VDC, -20 VDC

Speed Control: Closed loop servo-system; temperature compensated tach-generator is mounted on the motor shaft and provides rotational speed information

Speed Range: 50 to 10,000 RPM

Accuracy: Better than 1% of setting

Controls: Illuminated On-Off switch  
Four digit pushbutton pot to set the speed

Front Panel Connections: Input jack for controlling the speed via an external source  
Output jack gives a voltage proportional to the rotational speed: 1 V/1000 RPM  $\pm$  1%  
Common jack is DC common, isolated from the case  
Ground terminal is connected to the ground lead of the power cord

Max Slew Rate of Motor: Approximately 300,000 RPM/sec (no load)

Bandwidth: @1000 RPM peak to peak modulation, 2000 RPM base speed: >50 HZ, -1db

Motor Protection: 1.5 amp thermal type circuit breaker

### 1.3 Highlights

- High performance system: rapid acceleration
  - Speed may be modulated from an external source (square wave, sine wave, etc)
- Bi-polar power supply improves dynamic performance
  - Chemical resistant base
  - Use with Disk or Ring-Disk type electrodes
  - Silver carbon contact brushes
  - Voltage output proportional to rotational speed
  - Speed range to 10,000 RPM
  - Ideal for use in hydrodynamically modulated systems
  - Low cost, high quality

The outstanding dynamic performance of the AFMSRX Rotator System is due to the use of a high speed, low inertia, permanent magnet DC motor and a high voltage, bi-polar power supply. The positive power supply voltage is

approximately twice the motor's rating. A dual protection scheme is employed to protect the motor from both demagnetization and overheating: an instantaneous electronic current limit set at 10 amps, and a thermal type circuit breaker.

The rotational speed of the electrode may be precisely controlled by a four digit pushbutton pot on the front panel, or by application of an externally generated voltage applied to a jack on the front panel. The rotational speed is to within 1% of the digital pot setting from 50 to 10,000 RPM. A voltage signal which is proportional to the electrode speed is available at the output jack, also located on the front panel.

The body of the rotator may be easily raised or lowered; a cell shelf is provided whose height is easily adjusted. These features facilitate introduction and removal of the cell. The base is made of a chemically resistant material.

The AFMSRX has been designed to accommodate both Disk and Ring-Disk type electrodes. Electrical connections are made to the electrode by silver carbon brushes - two each for the disk and ring - to provide consistent, reliable contact.

Pine Instrument Company manufactures a wide range of electrode types and produces many custom units to the customer's specifications. Consult factory for details.

## 2.1 Initial Inspection

Inspect the packing case and rotator for any damage; notify the carrier and Pine Instrument Company in case of any apparent damage.

Check the shipment against the packing list. Included with the rotator system should be:

- 1 Electronic Control Unit
- 1 Body-Motor Assembly
- 1 Instruction Manual
- 1 Inspection Sheet
- Electrodes Per Packing List (Optional)

## 2.2 General

Pine Instrument Company's AFMSRX Rotator is a solid-state-controlled servo-system, capable of rotating an electrode at speeds from 5 to 10,000 RPM. The speed may be set on a digital pushbutton pot located on the front panel, calibrated to within 1% accuracy from 50 to 10,000 RPM. The jack marked INPUT allows the operator to apply an external signal to the rotator and causes 1000 RPM of the electrode per volt applied. A positive voltage applied at the input jack produces counter-clockwise rotation at the electrode end of the rotator.

An outstanding feature of the AFMSRX is its ability to accelerate and decelerate very rapidly, making possible the application of any waveform the operator desires. The inputs from the calibrated pot and the input jack will be added electronically in the control box, and the sum will be the electrode rotational speed. This feature permits the operator to modulate the electrode speed around a set speed.

The jack marked OUTPUT gives a voltage indication of the electrode rotational speed: 1 volt per 1000 RPM.



## 2.3 Description

### Electronic Control Unit

The control unit contains the drive circuitry, power supply, and control circuitry:

AC Power Cord	Connect to a 3 prong AC outlet of proper voltage with a good quality earth ground.
Power Switch	Controls the AC power to the control box.
Speed Adjust	Four digit pushbutton pot.
Common Jack	Connected to DC common; used as common for measuring the rotator speed output and applying an external input (see below).
Output Jack	A voltage output appears at this point which is an indication of the rotator speed: 1 volt per 1000 RPM. The output impedance is about 600 ohms.
Input Jack	A voltage may be applied to this point from an external source to cause the rotator to turn at a rate of 1000 RPM per volt applied. The voltage applied at this point is summed with the pot setting. For example: if the speed adjust pot is set to 1,000, and +1VDC is applied to the input jack, the rotational speed at the electrode will be 2000 RPM. The input impedance is 50K ohms.
Circuit Breaker	A 1.5 amp thermal type circuit breaker is connected in series with the motor to protect the motor from overload.

### Body and Motor-Tach Assembly

This assembly contains the rotating components, frame, and base:

Motor-Tach	DC motor and DC tachometer are an integral unit.
Frame	Supports the motor-tach, bearings, etc. Cell holder and motor-tach section may be adjusted up and down on the column.
Base	Chemical resistant material; supports the frame.
Electrode Coupling	Holds the electrode in place.
Electrode Bearing Assembly	Supports the electrode at two places.
Pick-up Brushes	Contact the electrode for electrical pick-up.

### 2.4 Power Entry Module

The Power Entry Module, located on the rear panel, is where AC Voltage enters your equipment. The module has the following features: power cord receptacle for easy removal/changing of the power cord; replaceable line fuse to help protect equipment; and input voltage selection system for easy changeover of input voltage.

The correct operation voltage is set with a voltage selector card inside the module. A setting of 120 is used for voltage between 100 and 125 VAC. A setting of 240 is used for voltage between 200 and 250 VAC.

To change the setting: remove the power cord from the module, slide the clear door to the left, and use pliers to remove the voltage selector card. Re-insert the card with the desired operating voltage visible, either 120 or 240 Volts AC. Plug the power cord back into the module.

If your equipment will not operate, first check the fuse. Remove the power cord, slide the clear door to the left, and use the 'PULL FUSE' lever to remove the fuse. If the fuse is bad, replace it with a 3 Amp Slow Blow type

fuse after checking for the cause of the blown fuse. Plug the power cord back into the module.

## 2.5 Performance

Some tests were run to determine the performance which may be expected of the AFMSRX. Note that these figures are given as general information, and are not necessarily exact specifications for all conditions under which the rotator may be operated. It is suggested that the operator determine the performance under his/her operating conditions.

The tests were performed with an electrode inserted, and four brushes in contact with the electrode shaft.

Response to a step input applied at the input jack:

Start Speed	End Speed	Rise Time
0 RPM	1K RPM	4 msec
0 RPM	5K RPM	10 msec
0 RPM	10K RPM	30 msec

Frequency response to a sine wave signal of 1 volt peak to peak (1000 RPM peak to peak) applied to the unit running at a base speed of 2000 RPM: -3db point at 100 HZ.

## 2.6 Electrode Coupling Instructions

Pine Instrument Company's AFMSRX rotator is manufactured with a precision electrode coupling. In order to obtain maximum performance from the rotator, proper mounting of the electrode to the rotator is critical.

1. Open the "clam-shell" by loosening the small knurled knob on the front of the rotator body.
2. Loosen each of the screws (2) on the electrode coupling inside the rotator body.
3. Carefully insert the electrode through the bottom bearing fully into the coupling.
4. Hold the electrode in the coupling while lightly tightening one screw. Rotate coupling (still holding electrode) and firmly tighten second screw. Rotate coupling and firmly tighten first screw.

**CAUTION:** To avoid damage to the electrode be certain that it is securely clamped in rotator before releasing it.

5. If an interchangeable tip electrode arbor has been employed, the electrode tip is attached by sliding it onto the end of the arbor with the set screw in the tip in line with the machined flat on the arbor. Tighten set screw lightly with a 1/16" hex wrench. (Do not over tighten.)

**NOTE:** It is recommended that a small amount of silicon grease be applied to the arbor tip to prevent the electrode tip from seizing.

### 3.1 General

The AFMSRX Rotator is covered by a six month warranty. Attempts to recalibrate or modify the instrument by an unauthorized person may void the warranty. It is suggested that the factory be advised on all matters of improper operation.

### 3.2 Trouble Shooting

This section provides some suggestions for an operator to follow in the event of problems.

<u>Problem</u>	<u>Cause and/or action</u>
Motor fails to rotate	Check the motor shaft and spindle for freedom of rotation.  Confirm that the unit is connected to a live outlet of the proper voltage, that the power switch is "on" and the lamp glows.  Check the connection from the ECU to the motor-tach assembly.  Check the circuit breaker: reset if tripped.  The digital pushbutton pot is to be set to a speed other than "0000".  Remove the top cover and insure that the printed circuit board is fully inserted into the connector.  Faulty connection or wire - contact the factory.

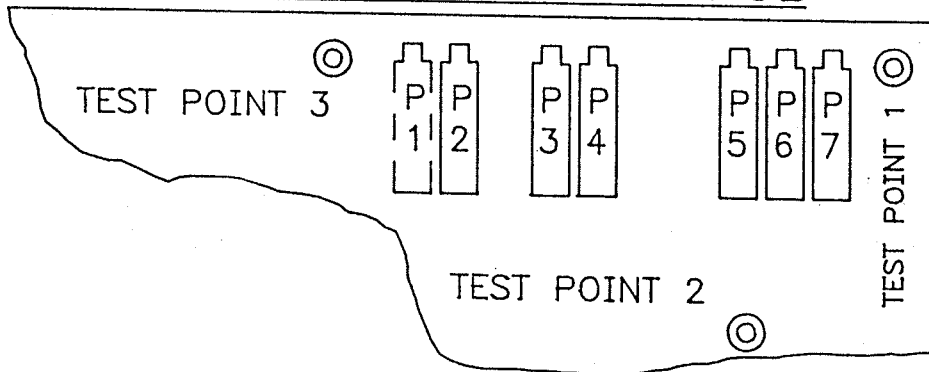
	Faulty circuitry or motor - contact the factory.
Motor runs at high speed at any dial setting	Faulty connection or wire - contact the factory.  Faulty circuitry - contact the factory.
Excessive noise	Spindle bearings are worn out - contact the factory.  Motor bearings are worn - contact the factory.
Excessive electrical noise in system	Connect DC Common to the Ground Jack; use only one point in the system as the common; eliminate ground loops.  CAUTION: Care must be taken when making connections to ground. This should be done only on a "floating" system. Contact the factory for more information.  Use shielded cables as connections to the brushes.  Clean the surface where the brushes contact the rotating rings.
The breaker trips	The breaker is a thermal type, sized to limit the average motor current to within the motor specification. Running the motor at a high modulation rate, or great amplitude changes, or a combination of the two, may cause tripping. It may be necessary to reduce the modulation rate and/or amplitude to prevent tripping of the breaker.

# AFMSRX CALIBRATION

IF ERRATIC OPERATION OCCURS WHEN UNIT IS INITIALLY POWERED, ADJUST P5 UNTIL SYSTEM IS STABLE.

1. SET SPEED-ADJUST-POT (P8 ON FRONT PANEL) TO 0000 ; ADJUST P3 FOR 0.000 V AT TP3 (U4 OUTPUT).
2. ADJUST P2 TO CAUSE MOTOR TO COME TO DEAD STOP ; ADJUST P7 FOR 0.000 V AT YELLOW OUTPUT JACK ON FRONT PANEL.
3. SET THE MOTOR SPEED TO 3600 RPM BY ADJUSTING THE SPEED-ADJUST-POT (P8) FOR ONE IMAGE OF THE MOTOR SHAFT WHEN A LINE-TRIGGERED STROBE IS FOCUSED ONTO THE SHAFT ; ADJUST P6 FOR 3.60 V AT YELLOW OUTPUT JACK.
4. SET SPEED-ADJUST-POT (P8) TO 0200 ; ADJUST P2 FOR 0.200 V AT YELLOW OUTPUT JACK.
5. SET SPEED-ADJUST-POT (P8) TO 3600 ; ADJUST P4 FOR 1.44 V AT TP1.
6. ADJUST P5 FOR 3600 RPM OF MOTOR SHAFT AS INDICATED BY STROBE.
7. SET SPEED-ADJUST-POT (P8) TO 0100 ; ADJUST P2 FOR 100 RPM OF MOTOR SHAFT.
8. SET SPEED-ADJUST-POT (P8) TO 0000 ; APPLY 3.60 V TO THE GREEN INPUT JACK ON THE FRONT PANEL AND ADJUST P5 FOR ONE IMAGE OF THE MOTOR SHAFT AS INDICATED BY THE STROBE.
9. SET SPEED-ADJUST-POT (P8) TO 3600 ; ADJUST P4 FOR ONE IMAGE OF THE MOTOR SHAFT AS INDICATED BY THE STROBE.
10. REPEAT STEPS 7, 8, & 9.

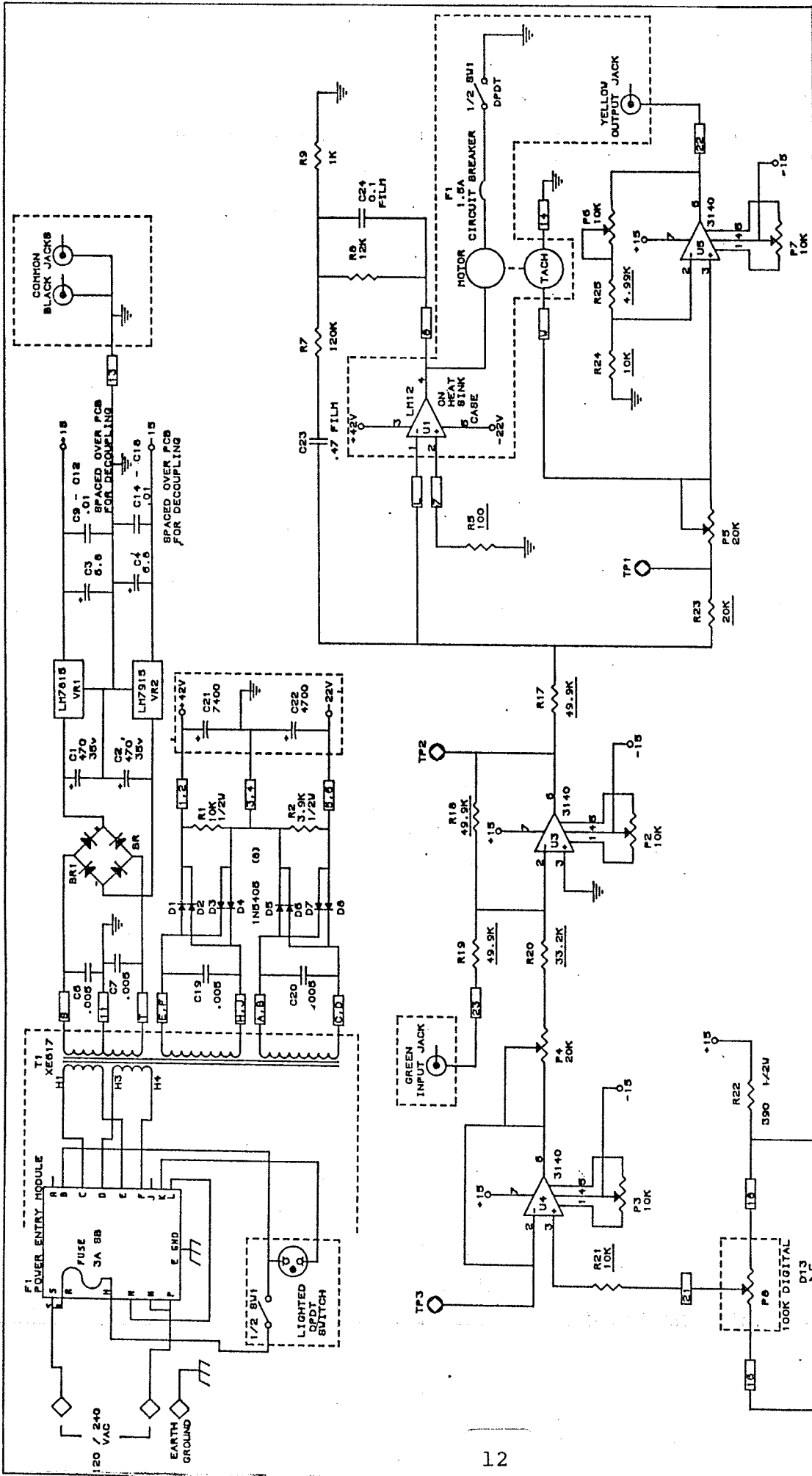
## MSRX ASSEMBLED PCB



2	3/31/92	UPDATED DWG.	JNH
1	5/17/88	ECO #175	TJM

**PINE** Instrument Company  
Grove City, PA. 16127-1091

DWG.	TJM	MSRX CALIBRATION INSTRUCTIONS		SHEET	REV.		
CKD.	CEB			DWG. SIZE	DRAWING NO.	1/1	2
ENG.	CEB						
DATE	4/28/88						



**PINE**  
 Instrument Company  
 10000 Pine Street  
 San Diego, CA 92121  
 (619) 451-1111

DATE: 6/6/88  
 REV: 2

DESIGN: JGW  
 CHECKED: CEB  
 ENGINEER: ETB

**MSRX SCHEMATIC**

DATE: 6/6/88  
 REV: 2

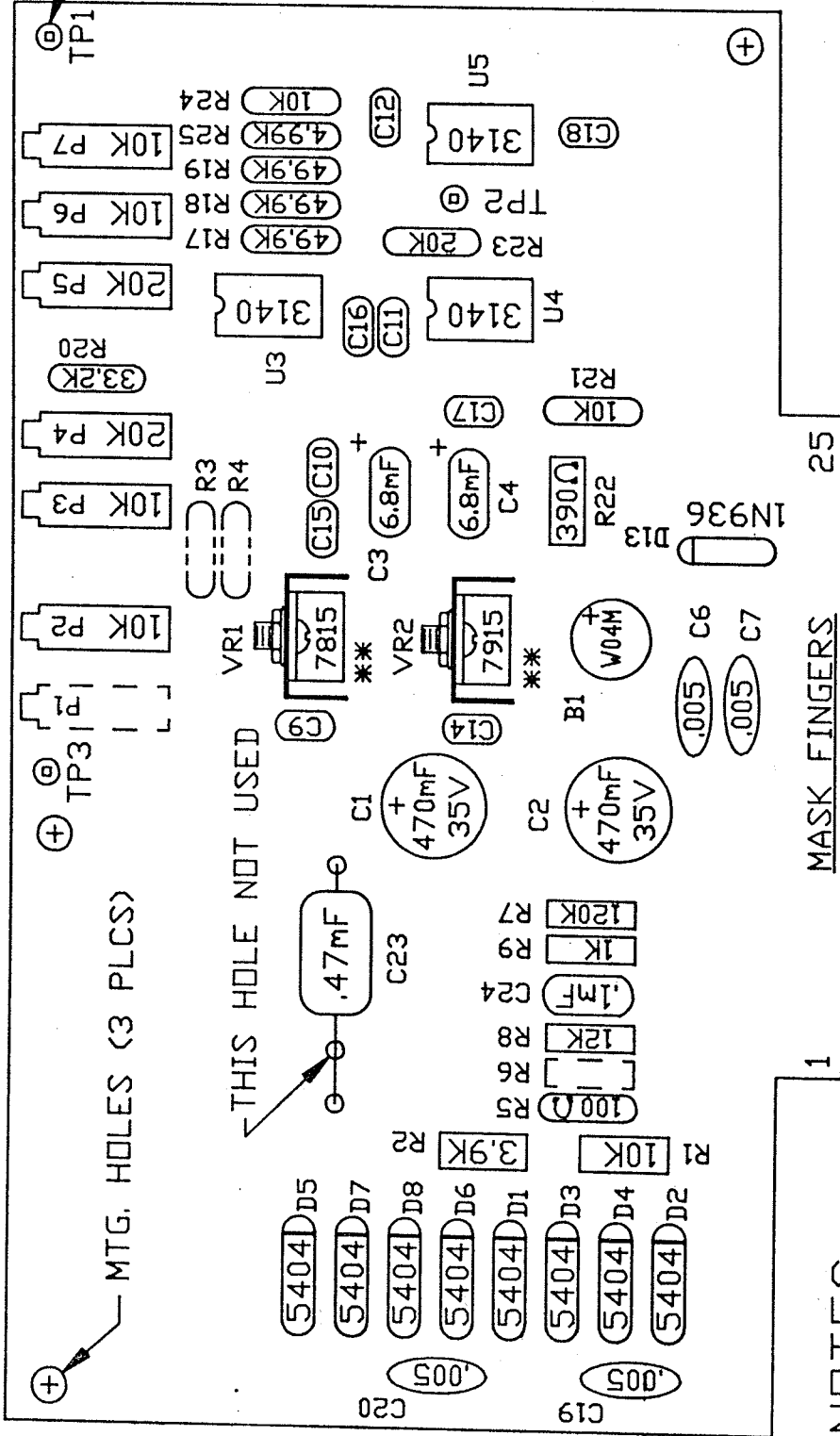
**AFMSRX**

UNDERLINED RESISTORS ARE 1%  
 XXXX - EDGE CONNECTOR NUMBER  
 COMPONENTS INSIDE DASHED LINES ARE  
 NOT ON THE PCB

LAST NUMBERS  
 C24 C9, C9, C13 NOT USED  
 D13 D9-12 NOT USED  
 F1 F1 NOT USED  
 R25 R3, +.6, 1.0-1.6 NOT USED  
 TP3 U5  
 U2 U2 NOT USED



# ABMSRX

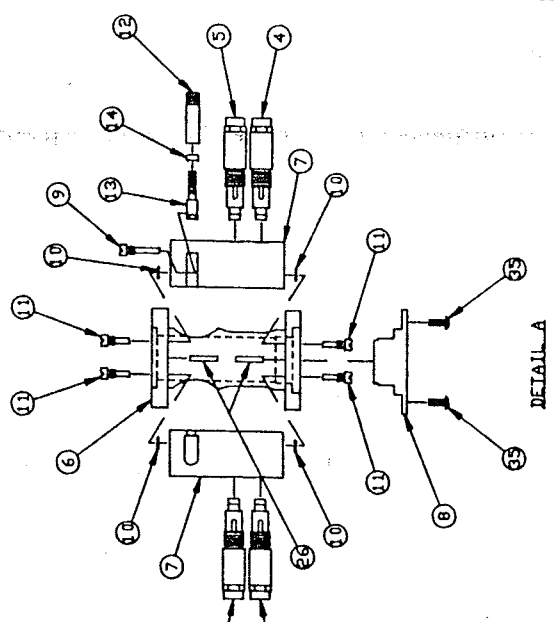
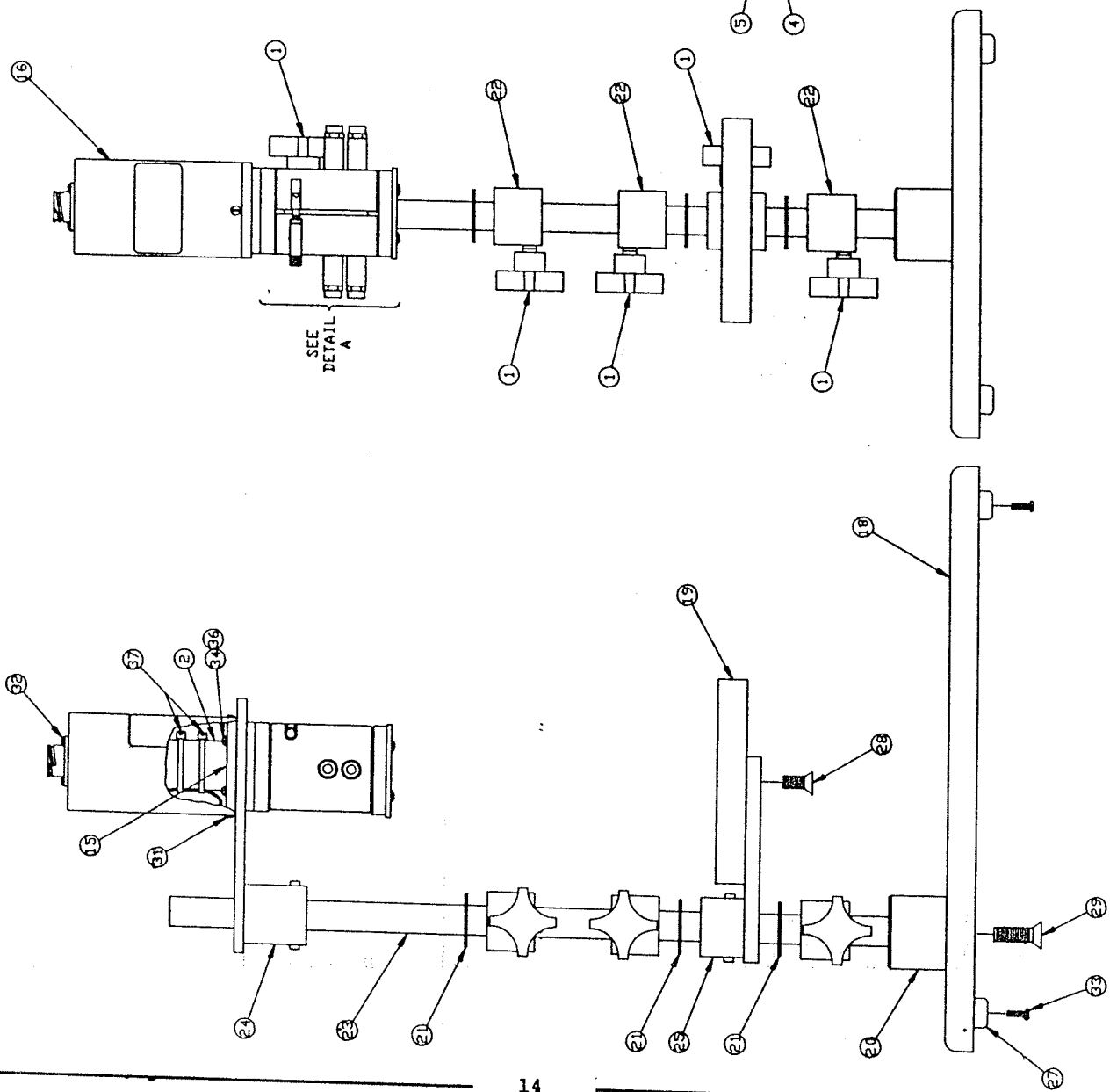


## NOTES:

- \*\* = KAH5770B (6-32 X 1/4 RH SS & KEP NUT) & THERMALLOY (2 PLCS)
- [ ] = UNMARKED CAPS ARE .01MF, 100V
- [ ] = 1/4 W, 5% RESISTOR
- [ ] = 1/8 W, 1% RESISTOR
- [ ] = 1/2 W, 5 OR 10% RESISTOR
- [ ] = DO NOT INSTALL (4 PLCS)

2	9/21/90	CHG'D. BRIDGE TO W04M	RSB
1	5/31/88	ECO #175	TJM
<h1 style="text-align: center;">PINE</h1> <p style="text-align: center;">Instrument Company Grove City, PA 16127</p>			
OWN.	T.J.M.	TITLE	MSRX PCB ASSEMBLY
CHKD.	C.E.B.	DWG. SIZE	A
ENG.	E.B.	DRAWING NO.	ABMSRX 1/12
DATE	1-28-88	SHEET	REV.

ITEM	PART NUMBER	DESCRIPTION	QTY
1	ACHR3163	KNOB ASSY.	5
2	ACHR3165X	MSRX MOTOR-COUPLING ASSY.	1
3	ACHR3235	BRACE, PCB 2.31 LONG	1
4	ACHR3236XB	MSRX BRUSH HOLDER ASSY., BLUE	2
5	ACHR3236XY	MSRX BRUSH HOLDER ASSY., YELLOW	2
6	ACHR3239X	MAIN BODY, MSRX	1
7	ACHR3300X	CLAM SHELL BODY, MSRX	1
8	ACHR3301X	BEARING ASSY. HOUSING	1
9	ACHR3302	WASHER, THIN, LOCK W/SHIMS	1
10	ACHR3303	WASHER, THIN, LOCK W/SHIMS	1
11	ACHR3306	CLAM SHELL HINGE SCREW	4
12	ACHR3310	KNURLED NUT, LOCK ASSY.	1
13	ACHR3311	HINGED LOCK STUD	1
14	ACHR3312	WASHER, THICK NYLON	1
15	ACHR3314X	ENCLOSURE FLANGE, MSRX	1
16	ACHR3317Y	MOTOR ENCLOSURE, MSRX	1
17	ACHR944X	CONTROL BOX ASSY., MSRX	1
18	ACHR001H	POLYPROPYLENE BASE, MACHINED	1
19	ACHR002H	BEAKER PLATFORM, MACHINED	1
20	ACHR003	MSRX COLLAR	1
21	ACHR004	MSRX WASHER .765 x 1.317 x .062	1
22	ACHR005	COLLAR	3
23	ACHR007	COLLAR	1
24	ACHR102	MOUNTING BKT ASSY.	1
25	ACHR103	PLATFORM SUPPORT ASSY.	1
26	KAP125D10	PIN, DOVEL 1/8 X 5/8 SS	2
27	KAU2194	BUMPER, RUBBER 3/4 DIA	4
28	KBC3118F06HS	SCREW, CAP 5/16-18 X 3/4 FH SS	1
29	KBC3816F10HJ	SCREW, CAP 3/8-16 X 1-1/4 FH BOX	1
30	KSH0440R04SS	SCREW, 4-40 X 1/4 RH SS	1
31	KSM0440T04SS	SCREW, 4-40 X 3/8 TH SS	3
32	KSM0440T06SS	SCREW, 4-40 X 1/2 PH ZINC	4
33	KSM0632R06C	SCREW, 6-32 X 3/8 TH SS	4
34	KSM0632T06SS	SCREW, 6-32 X 3/8 TH SS	4
35	KVS006	WASHER #6 SPLIT LOCK	4
36	KAM524	CABLE TIE, T L B 524H	2



1 3/31/92 REV. ITEM 29 PART # WAS KBC3816F10H JINH

**PINE**  
Instrument Company  
Grove City, PA 16127

REV. RSB  
REV. JCW  
DATE 11/6/90

AFMSRX ASSEMBLY  
MECHANICAL PARTS LIST

B ACMSRX-M 1/11

4  
WARRANTY

The AFMSRX Rotator unit manufactured by Pine Instrument Company is warranted to be free from defects in material and workmanship for a six month period from date of shipment to original purchaser and when used under normal conditions. The obligation under this warranty being limited to replacing or repairing any part or parts which shall upon examination disclose to Pine Instrument's satisfaction to have been defective and shall have been returned freight prepaid and clear of encumbrances to Pine Instrument Company in Grove City, PA U.S.A. within the warranty period. This warranty being expressly in lieu of all other warranties, expressed or implied and all other obligations or liabilities.

All specifications are subject to change without notice.

## 5.1 AFMSRX Rotator Electrodes

STYLE	TYPE	DISK O.D. (IN)	RING I.D. (IN)	RING O.D. (IN)	SHROUD (IN)
AFMD03	DISK	.1181	0.0	0.0	.201
AFMD06	DISK	.2362	0.0	0.0	.472
AFMD10	DISK	.0394	0.0	0.0	.375
AFMD19	DISK	.1969	0.0	0.0	.472
AFMD28	DISK	.1800	0.0	0.0	.472
AFMDI05	DISK	.1969	0.0	0.0	.472
AFMDI19	DISK	.1969	0.0	0.0	.531
AFMDI23	DISK	.2362	0.0	0.0	.472
AFMDI28	DISK	.1800	0.0	0.0	.472
AFMT26	DISK-RING	.1920	.2300	.3320	.531
AFMT28	DISK-RING	.1800	.1940	.2120	.531
AFMT29	DISK-RING	.2210	.2460	.3120	.531
AFMTI34	DISK-RING	.2362	.2953	.3346	.590
AFMTI35	DISK-RING	.1969	.2600	.2990	.590
AFQC0580	DISK	.1969	0.0	0.0	.472
AFQC1080	DISK	.3937	0.0	0.0	.662
AFQC44480	DISK	.4440	0.0	0.0	.662
AFVD04	DISK	.1575	0.0	0.0	.472
AFVD10	DISK	.3937	0.0	0.0	.590

## NOTE:

1. Each electrode style is available in a variety of standard materials and may also be assembled with your custom material.
2. Other electrode sizes and designs are available. Please consult factory with your specific requirements.

## 5.2 Electrode Handling Precautions

AFMSRX electrodes are precision research tools. Each is tested and guaranteed to be leak free before shipment. The tests are conducted at an ambient temperature of about 23<sup>o</sup> C, in a solution of 0.2M H<sub>2</sub> SO<sub>4</sub>.

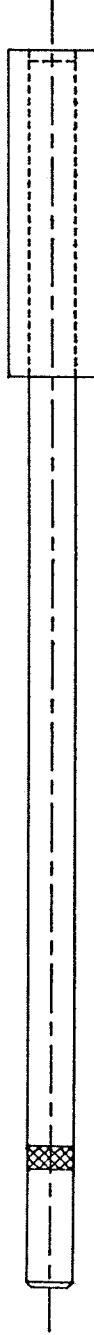
1. Precautionary measures should be taken to avoid damage to the electrode. Leave electrode wrapped while not in use.
2. Do not use teflon shrouded electrodes above 30<sup>o</sup>C temperature because expansion at higher temperature may cause a leak in the electrode.
3. Keep the protective cover on the electrode while not in use.
4. Mount the electrode securely in the rotator. Excessive force should not be applied to the teflon shroud of the electrode as this may result in the slipping of the shroud along the metal shaft. Mount the electrolysis cell in a position so that the electrode enters the cell through the electrode port and the end of the electrode is submerged approximately 5mm below the surface of the solution. The electrode should be centered in the electrode port so the shroud of the electrode does not rub against the cell cover.



ELECTRODE TIP - MD03



MSRX ARBOR - ACMD0350



MSRX ELECTRODE - MD

**PINE**  
Instrument Company  
Grove City, PA 16127

DISK ELECTRODE  
STYLE MD/MD03

DWG. RAP

CRD.

ENG.

DATE 4-6-90

DWG. SIZE

A

DRAWING NO.

MD

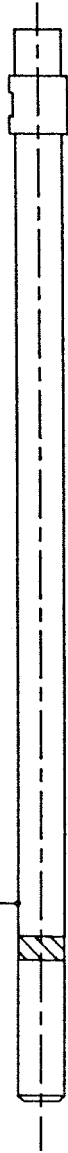
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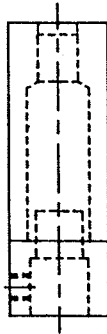
REV.

1

DISK ELECTRICAL CONTACT AREA

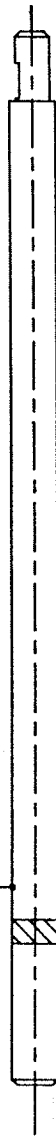


MSRX ARBOR - ACMDI1906



ELECTRODE TIP

DISK ELECTRICAL CONTACT AREA



MSRX ARBOR - ACMDI2805



ELECTRODE TIP

**PINE**

Instrument Company  
Grove City, PA 16127

DRAWN RAP

CHKD.

ENG.

DATE 3/29/90

DISK ELECTRODE

INTERCHANGABLE TIP - STYLE MDI

DWG. SIZE A

DRAWING NO. MDI

SHEET

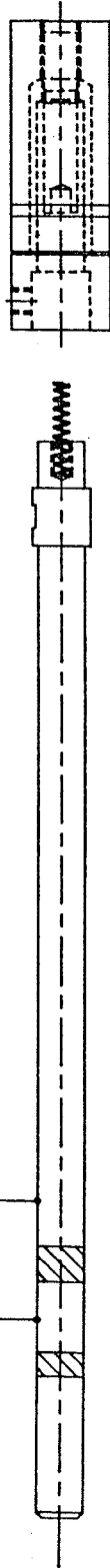
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REV.

MDI

DISK ELECTRICAL CONTACT AREA

RING ELECTRICAL CONTACT AREA



MSRX\_ARBOR - ACMDRD2805

ELECTRODE TIP

**PINE**

Instrument Company  
Grove City, PA 16127

DWG. RAP

CHKD.

ENC.

DATE 3/29/90

DISK-RING ELECTRODE

INTERCHANGABLE TIP - STYLE MT

DWG. SIZE A

DRAWING NO. MT

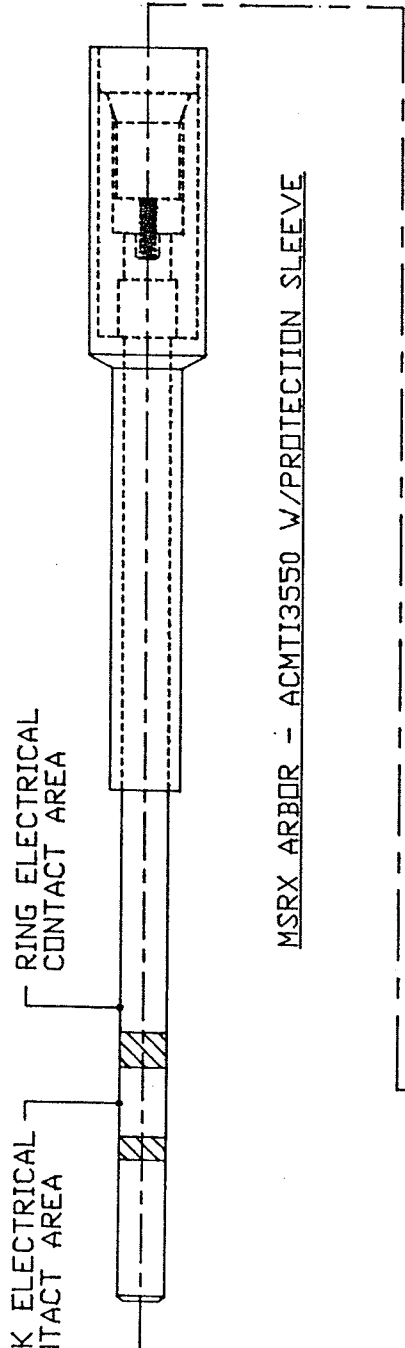
SHEET

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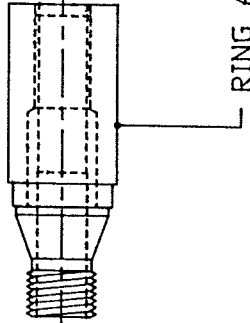


DISK ELECTRICAL CONTACT AREA



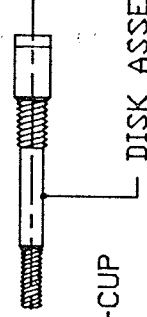
MSR-X ARBOR - ACMTI3550 W/PROTECTION SLEEVE

KEEPER NUT  
TEFLON WASHER



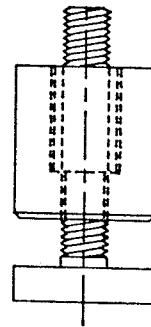
RING ASSEMBLY

KEEPER NUT  
U-CUP



DISK ASSEMBLY

ELECTRODE TIP ASSEMBLY

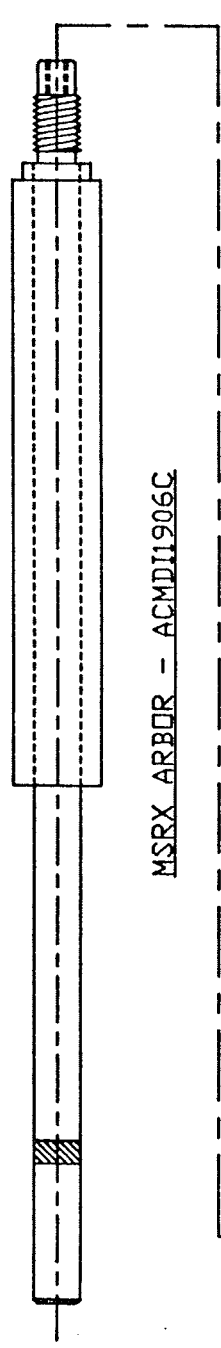


DISK EJECTOR  
ACDI3503

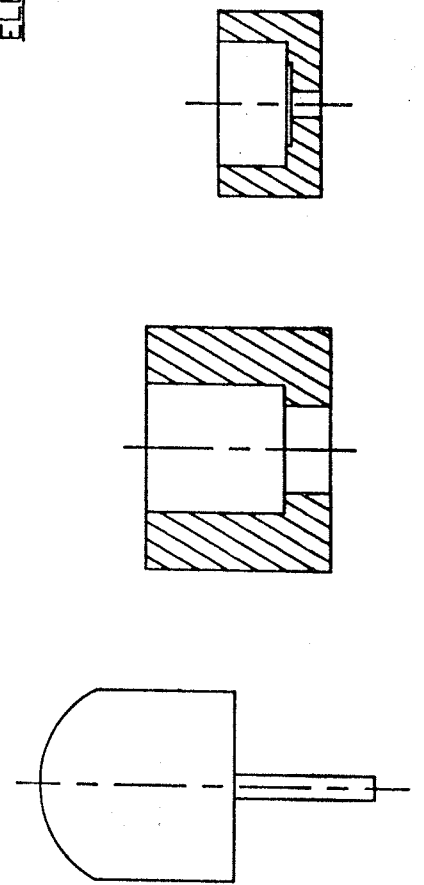
**PINE**

Instrument Company  
Grove City, PA 16127

DWG. NO.	RAP	U-CUP DISK-RING ELECTRODE
CHG.		INTERCHANGABLE TIP - STYLE MTI
ENG.		DWG. SIZE A
DATE	3/29/90	DRAWING NO. MTI
		SHEET 1/1
		REV. 1

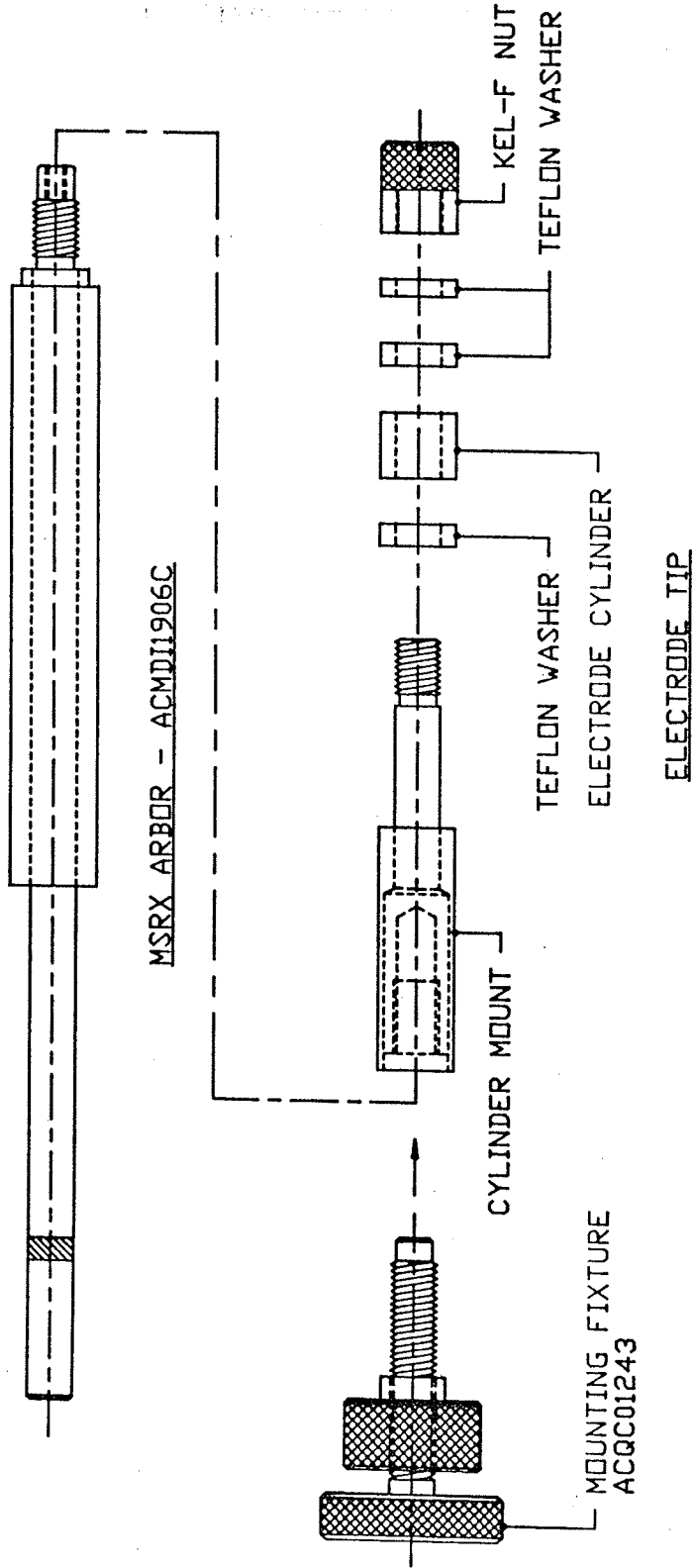


ELECTRODE TIP



**PINE**  
Instrument Company  
Grove City, PA 16127

DRAWN	JNH	DISK ELECTRODE
CHKD.	RAP	QUICK CHANGE - STYLE QC
ENGL.		DRAWING NO.
DATE	11/5/90	A QC-MSRX
		SHEET 1/10



<b>PINE</b>		Instrument Company Grove City, PA 16127	
DWG. JNH	CYLINDER ELECTRODE	DWG. SIZE A	SHEET 1/10
ORD. RAP	QUICK CHANGE - STYLE QC	DRAWING NO. QCCYL-MSRX	REV.
ENG.	DATE 11/5/90		