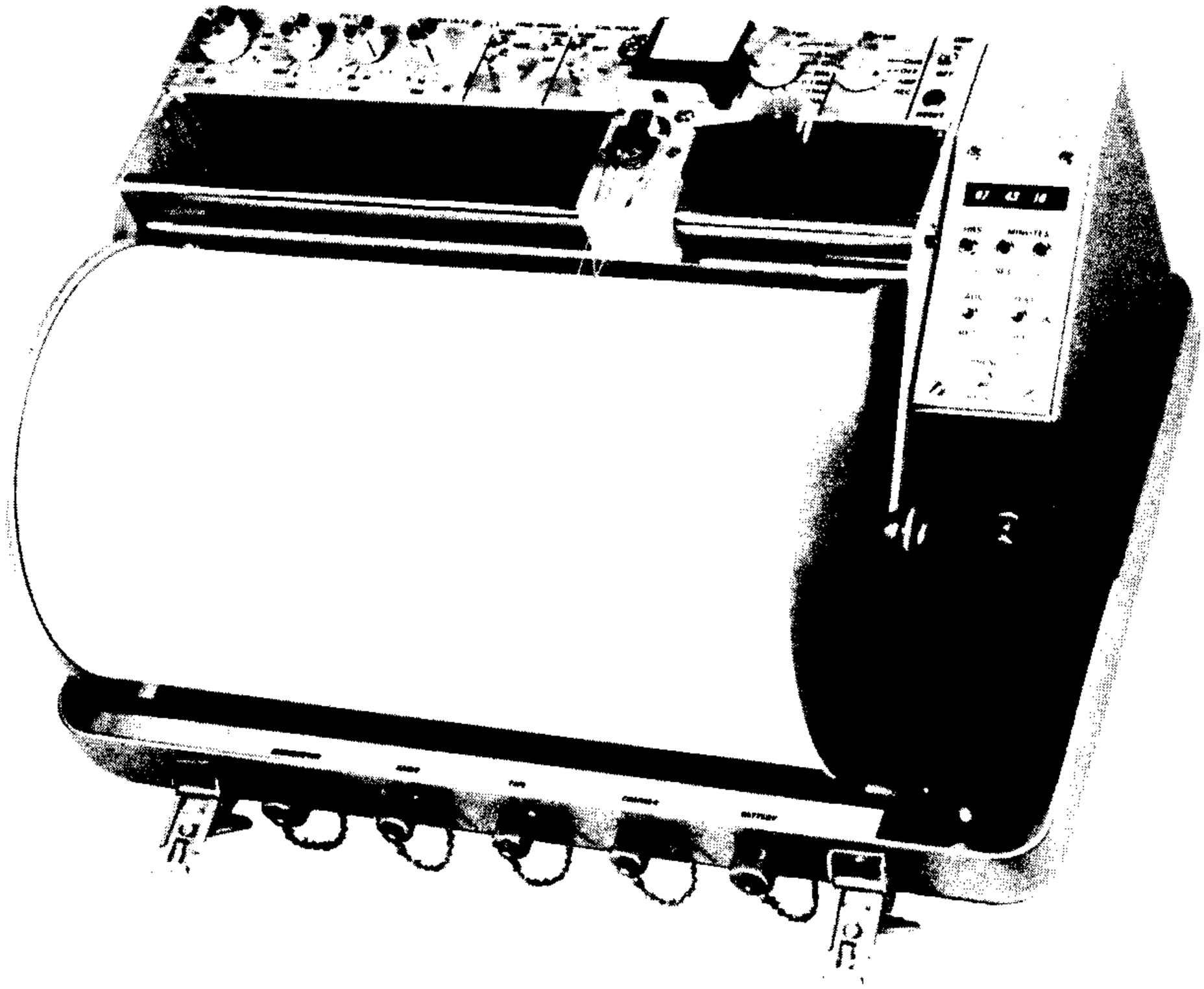
TECHNICAL MANUAL

MEQ-800

PORTABLE SEISMIC SYSTEM



W. F. Sprengnether Instrument Co., Inc.
4567 Swan Avenue
St. Louis, Missouri 63110 U.S.A.

Phone: Area Code (314) 535-1682
Cable: SPRENCO

WARRANTY

W. F. Sprengnether Instrument Company, Incorporated, warrants equipment of its manufacture against defective materials or workmanship for a period of one year from date of shipment.

The liability of W. F. Sprengnether Company, Incorporated, hereafter referred to as Seller, is limited, at Seller's option, solely to repair, replacement with equivalent Sprengnether equipment at an appropriate credit adjustment not to exceed the original equipment sales price, of equipment returned to the Seller provided that (a) Seller is promptly notified in writing by Buyer upon discovery of defects, (b) upon receipt of written authorization from Seller the defective equipment is returned to Seller, transportation charges prepaid by Buyer, and (c) Seller's examination of such equipment discloses to its satisfaction that defects were not caused by negligence, misuse, improper installation, accident, or unauthorized repair or alteration by the Buyer.

This warranty does not include mechanical parts failing from normal usage, nor does it cover electrical components associated with remote inputs, outputs or controls or those which deteriorate with age such as lamps, choppers, vacuum tubes, relays, etc.. In the case of accessories, i.e.; printers, paper tape readers, etc., not manufactured by Seller, but which are furnished with the Seller's equipment, Seller's liability is limited to whatever warranty is extended by the manufacturers thereof and transferrable to the Buyer.

This warranty is expressed in lieu of all other warranties expressed or implied, including warranty of fitness for a particular purpose, and all other obligations or liabilities on the Seller's part, and neither assumes nor authorizes any other person to assume for the Seller any other liabilities. Seller shall not be liable for consequential damages of any kind.

The aforementioned provisions do not extend the original warranty period on any equipment which has been either repaired or replaced by Seller.

W. F. Sprengnether Instrument Company, Incorporated, reserves the right to make changes in the design or construction of its instruments at any time and without incurring any obligation to make any changes in units previously delivered.

TABLE OF CONTENTS

TABLE OF CONTENTS (Cont.)

TABLE OF CONTENTS (Cont.)

LIST OF TABLES

LIST OF ILLUSTRATIONS

LIST OF ILLUSTRATIONS (Cont.)

SECTION I

INTRODUCTION

1.0 SCOPE OF MANUAL

This manual provides the user with the information required to install, operate, and maintain the MEQ-800 Portable Seismic System under normal conditions. Should contingencies arise which require further information, the manufacturer or his representative should be contacted.

1.1 SCOPE OF EQUIPMENT

The MEQ-800 is a self contained, portable, wide range seismic recording system. The system is primarily designed for site locations of very low (micro-earthquake) to moderately high levels of activity. It can also be used to monitor and record strong disturbances through use of an optional external attenuator.

Time-referenced amplitude/frequency records are produced on smoked paper tracings or, optionally, ink on paper.

Time references (real time) are provided on records from a precision digital chronometer. An external radio input feature facilitates synchronization with standard radio time broadcasts.

The solid state design and maximum use of integrated circuits in amplifier and time-keeping circuits result in a highly reliable system.

1.2 UNPACKING AND SHIPPING INSTRUCTIONS

Prior to formal acceptance from the carrier, visually inspect the packaged unit for damage. Signs of external damage should be brought to the immediate attention of the carrier. Functional tests outlined in Section III should be performed as soon as possible after unpacking. If physical damage is evident or if the system fails functional checks, notify the W. F. Sprengnether Instrument Co., Inc.

If reshipment is required, the original container or equivalent should be used. Attach a tag to the instrument specifying owner name, and equipment status. In all correspondence, identify the instrument by model number and serial number. The unit should be protected in the shipping container with packing material. Mark the shipping carton DELICATE INSTRUMENT, FRAGILE, etc.

1.3 SYSTEM COMPONENTS

The MEO-800 system is comprised of the following interconnected assemblies:

- GC 1215 Battery Pack Power Supply
- AS110 Amplifier and Main Control Panel
- Precision Digital Timing System
- R-6040 Recorder
- Model L-4C or Model S-7000 Seismometer

Optional equipment is listed in Table 1-1.

PART NUMBER	DESCRIPTION
MEQ-800-80	Spare Stylus
MEQ-800-78	Spare Stylus Hub
MEQ-800-59	Battery Charger
MEQ-800-01	Paper Smoking/Fixing Kit
MEQ-800-02	Recording Paper (1000 Sheets)
MEQ-800-03	External Battery Cable
MEQ-800-04	Spare Recording Drum
MEQ-800-05	Ink Recording Kit
MEQ-800-06	40 dB Attenuator
MEQ-800-07	Drum Rotation or Translation Motor **with Built-In Static Inverter**
MEQ-800-08	Drum Rotation or Translation Motor **Without Built-In Static Inverter**
MEQ-800-85	Ink Pen Assembly — Parts of Ink Recording Kit MEQ-800-05
MEQ-800-86	Ink Cartridge Clip — Parts of Ink Recording Kit MEQ-800-05
MEQ-800-87	Pierce and Prime Unit — Parts of Ink Recording Kit MEQ-800-05
MEQ-800-88	Syringe Assembly — Parts of Ink Recording Kit MEQ-800-05
MEQ-800-89	Tubing — Parts of Ink Recording Kit MEQ-800-05
MEQ-800-90	Ink Cartridge — Parts of Ink Recording Kit MEQ-800-05
MEQ-800-91	Pen Cleaning Wire — Parts of Ink Recording Kit MEQ-800-05
MEQ-800-92	Kit Box Assembly — Parts of Ink Recording Kit MEQ-800-05
MEQ-800-93	1 Pt. Recording Ink
MEQ-800-94	1 Qt. Recording Ink
	GC 1245 Battery Pack
	50 Ft. Extension Cable With Connectors (Geophone)
	100 Ft. Extension Cable With Connectors (Geophone)

MEQ-800 OPTIONAL EQUIPMENT LIST

TABLE 1-1

1.4 SYSTEM SPECIFICATIONS

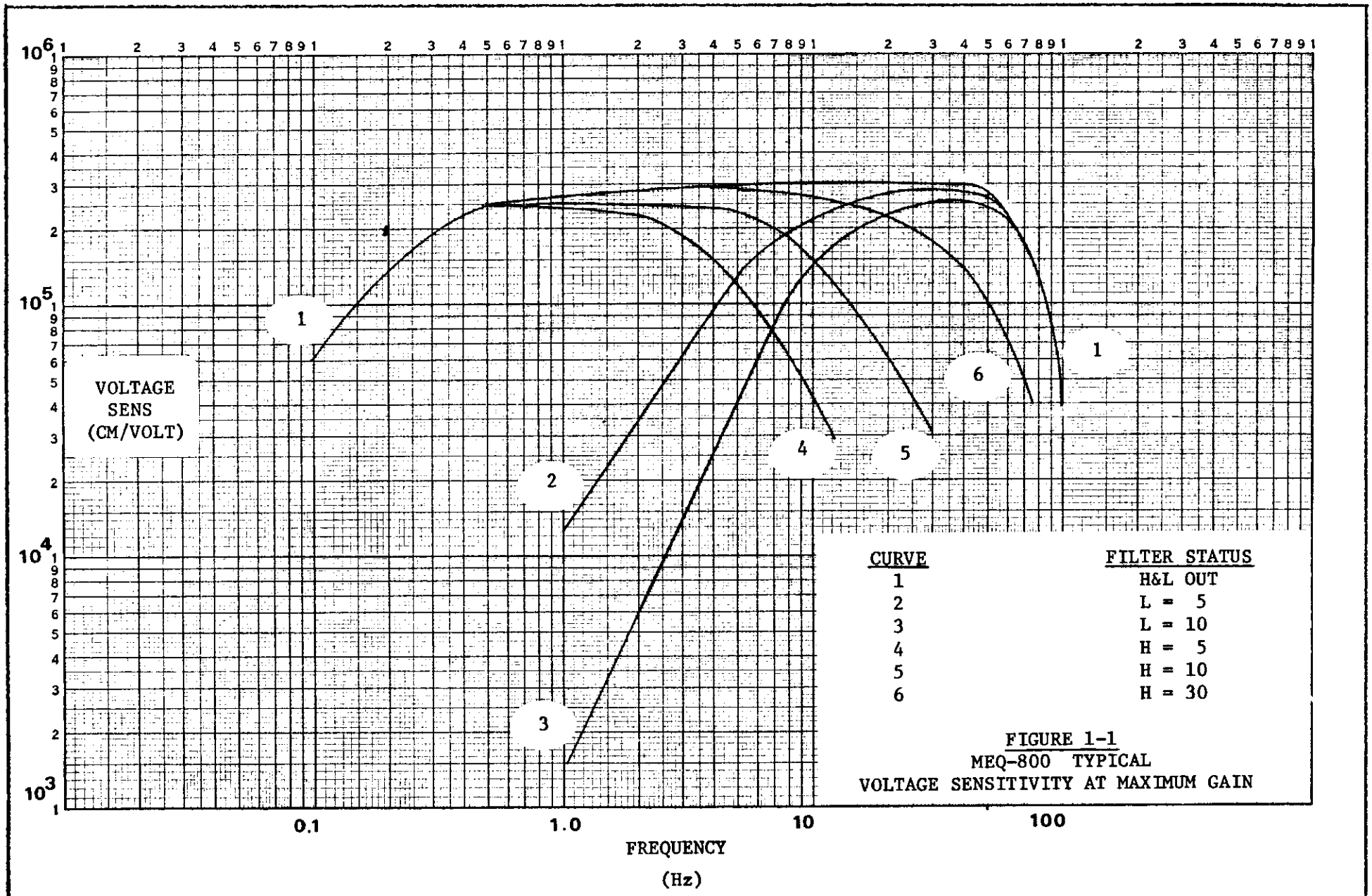
1.4.1 GENERAL

- Size: ..... 18¼" x 12½" x 9¼" (46cm x 32cm x 24cm)
- Weight: ..... 32 Lbs. (14.5 Kg) (excluding seismometer)
- Maximum Voltage Sensitivity: ..... 3×10^5 cm/volt
- Minimum Voltage Sensitivity: ..... 3 cm/volt with input attenuator, 3×10^2 cm/volt without input attenuator
- Power Requirements: . Internal batteries, +12VDC and -12VDC
- Velocity Sensitivity (Sv):.... _____ cm/cm/sec, maximum
- Displacement Sensitivity (Sd):.... _____ cm/cm, maximum at 10 Hertz
- Temperature Range ... 0° to 50°C (32° to 122°F)

1.4.2 AMPLIFIER

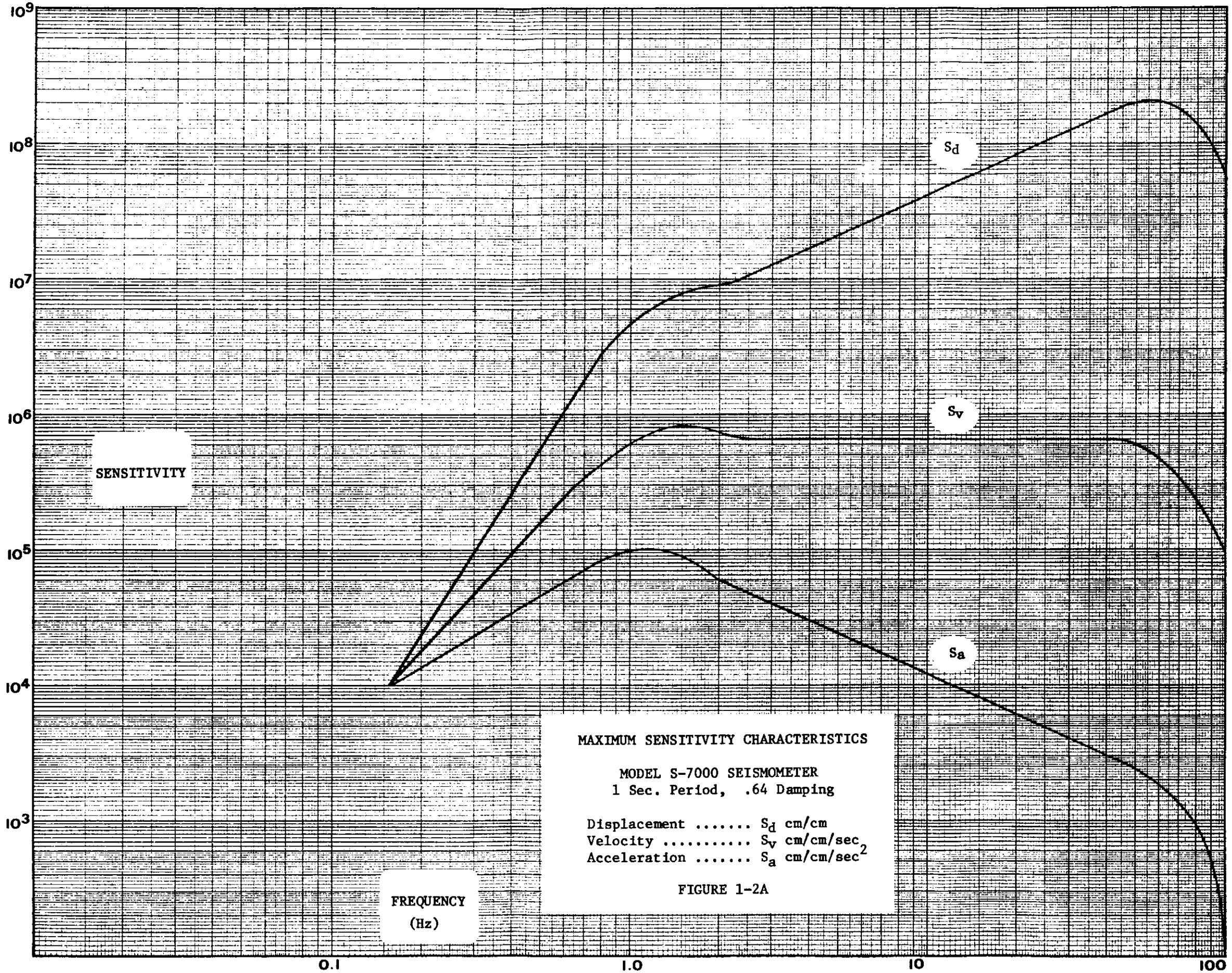
- Voltage Gain: ..... 1×10^3 minimum, 1×10^6 maximum
- Gain Control: ..... 60 dB to 120 dB in 6 dB increments
- Gain Stability: ..... $\pm$ 1%
- Noise Referred To Input: ..... .3 microvolt peak
- Unfiltered Frequency Response: ..... 3 dB points at .3 Hz and 70Hz
- Frequency Band Pass Limits: ..... .3Hz, 5Hz, or 10Hz (low end) and 5Hz, 10Hz, 30Hz, or 70Hz (high end)
- Input Impedance: .... 100 K ohms

Typical system performance curves for voltage sensitivity at maximum gain input are shown in Figure 1-1. DB to current or voltage ratio conversions are contained in Table 1-2.



CURVE	FILTER STATUS
1	H&L OUT
2	L = 5
3	L = 10
4	H = 5
5	H = 10
6	H = 30

FIGURE 1-1
MEQ-800 TYPICAL
VOLTAGE SENSITIVITY AT MAXIMUM GAIN



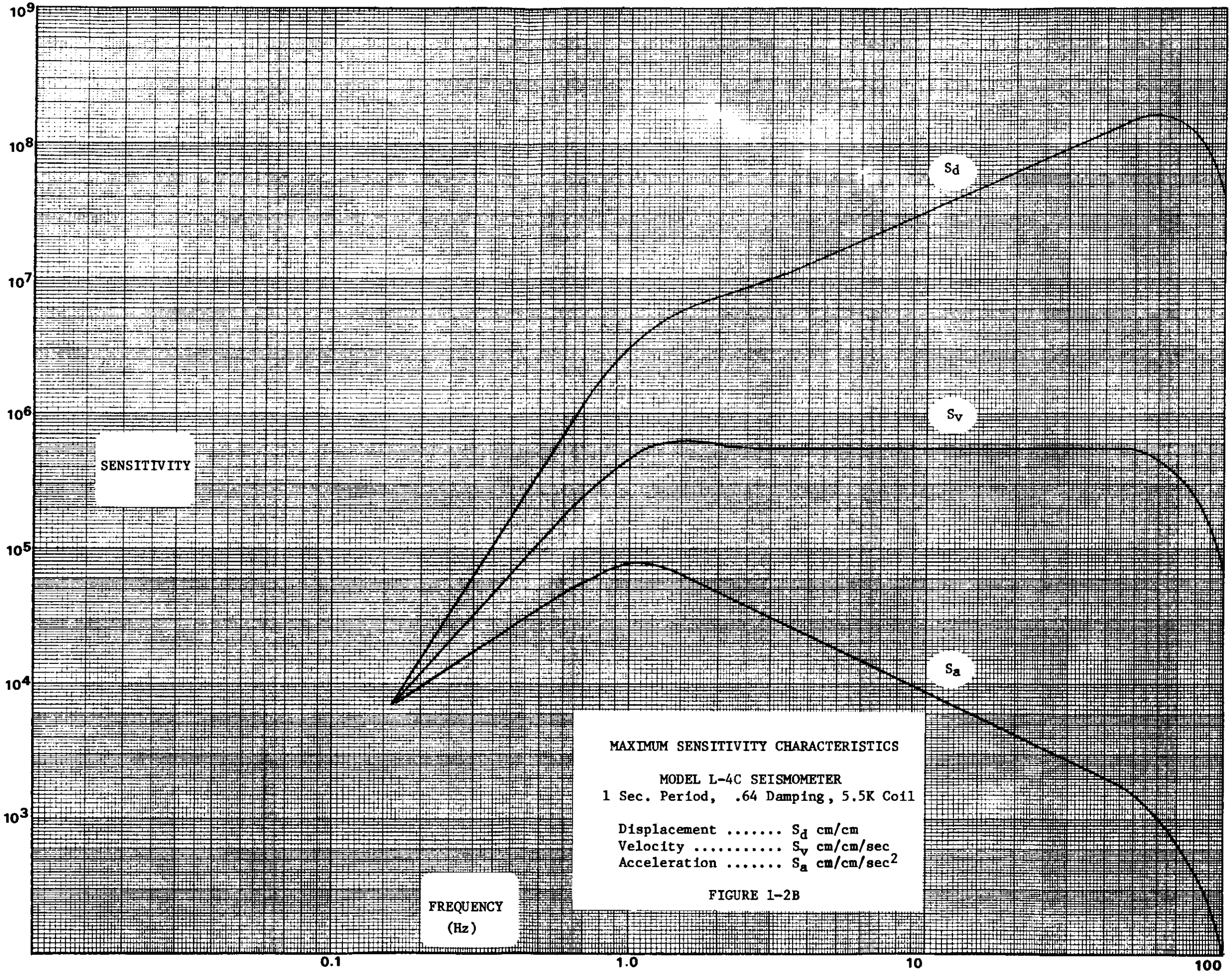
MAXIMUM SENSITIVITY CHARACTERISTICS

MODEL S-7000 SEISMOMETER
1 Sec. Period, .64 Damping

Displacement ..... S_d cm/cm
Velocity ..... S_v cm/cm/sec
Acceleration ..... S_a cm/cm/sec^2

FIGURE 1-2A

MEQ-800
30 OCT 75



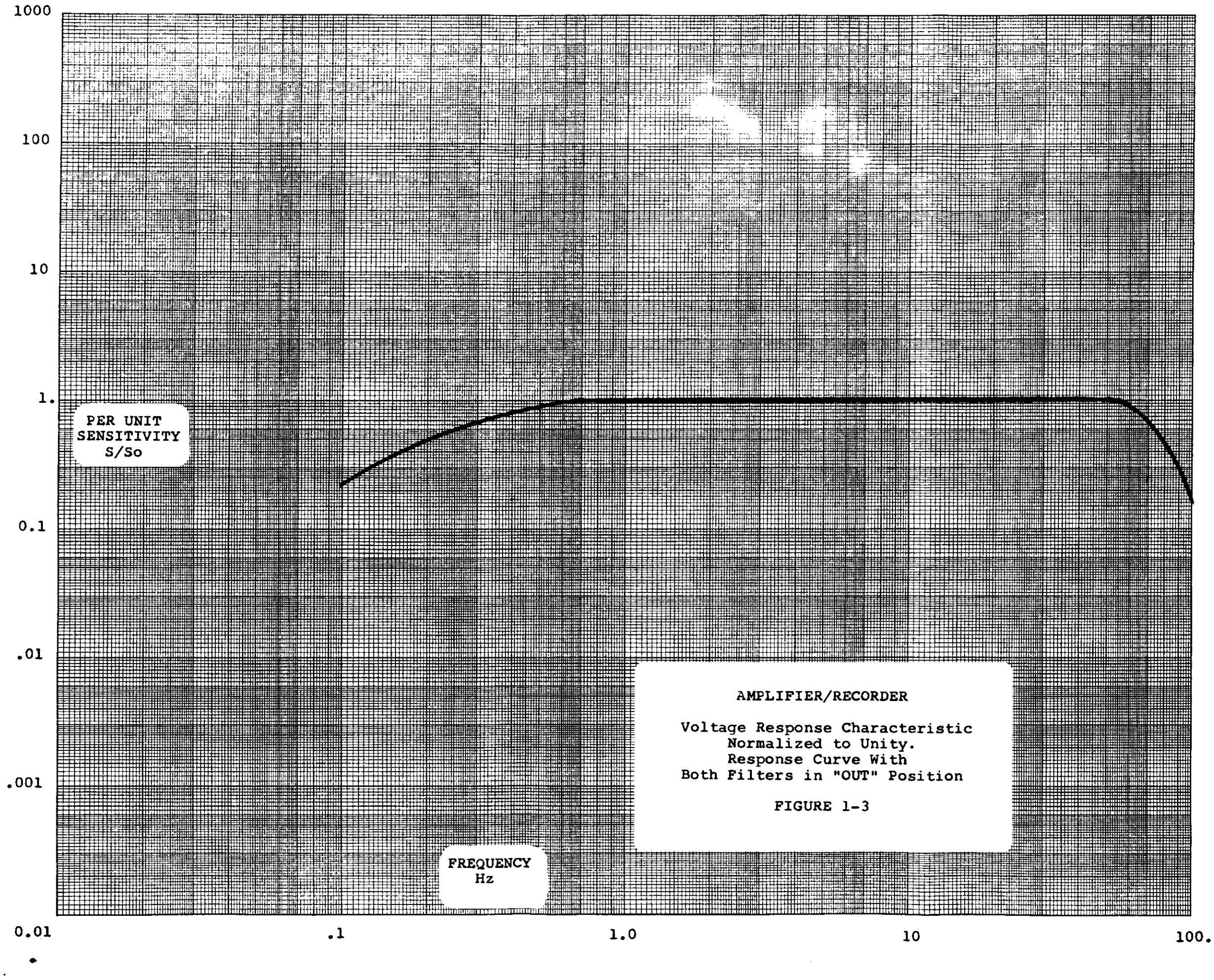
MAXIMUM SENSITIVITY CHARACTERISTICS

MODEL L-4C SEISMOMETER
1 Sec. Period, .64 Damping, 5.5K Coil

Displacement ..... S_d cm/cm
Velocity ..... S_v cm/cm/sec
Acceleration ..... S_a cm/cm/sec^2

FIGURE 1-2B

MEQ-800
3 DEC 75



AMPLIFIER/RECORDER

Voltage Response Characteristic
Normalized to Unity.
Response Curve With
Both Filters in "OUT" Position

FIGURE 1-3

VOLTAGE OR CURRENT RATIO	DB	VOLTAGE OR CURRENT RATIO	VOLTAGE OR CURRENT RATIO	DB	VOLTAGE OR CURRENT RATIO
1.000 0	-0+	1.000	.005 012	46	199.5
.988 6	0.1	1.012	.004 467	47	223.9
.977 2	0.2	1.023	.003 981	48	251.2
.966 1	0.3	1.035	.003 548	49	281.8
.955 0	0.4	1.047	.003 162	50	316.2
.944 1	0.5	1.059	.002 818	51	354.8
.933 3	0.6	1.072	.002 512	52	398.1
.912 0	0.8	1.096	.002 239	53	446.7
.891 3	1.0	1.122	.001 995	54	501.2
.841 4	1.5	1.189	.001 778	55	562.3
.794 3	2.0	1.259	.001 585	56	631.0
.749 9	2.5	1.334	.001 413	57	707.9
.707 9	3.0	1.413	.001 259	58	794.3
.631 0	4	1.585	.001 122	59	891.3
.562 3	5	1.778	.001 000	60	1 000
.501 2	6	1.995	8.91×10^{-4}	61	1 122
.446 7	7	2.239	7.94×10^{-4}	62	1 259
.398 1	8	2.512	7.08×10^{-4}	63	1 413
.354 8	9	2.818	6.31×10^{-4}	64	1 585
.316 2	10	3.162	5.62×10^{-4}	65	1 778
.281 8	11	3.548	5.01×10^{-4}	66	1 995
.251 2	12	3.981	4.47×10^{-4}	67	2 239
.223 9	13	4.467	3.98×10^{-4}	68	2 512
.199 5	14	5.012	3.55×10^{-4}	69	2 818
.177 8	15	5.623	3.16×10^{-4}	70	3 162
.158 5	16	6.310	2.82×10^{-4}	71	3 548
.141 3	17	7.079	2.51×10^{-4}	72	3 981
.125 9	18	7.943	2.24×10^{-4}	73	4 467
.112 2	19	8.913	1.99×10^{-4}	74	5 012
.100 0	20	10.000	1.78×10^{-4}	75	5 623
.089 13	21	11.22	1.58×10^{-4}	76	6 310
.079 43	22	12.59	1.41×10^{-4}	77	7 079
.070 79	23	14.13	1.26×10^{-4}	78	7 943
.063 10	24	15.85	1.12×10^{-4}	79	8 913
.056 23	25	17.78	1.00×10^{-4}	80	10 000
.050 12	26	19.95	8.91×10^{-5}	81	11 220
.044 67	27	22.39	7.94×10^{-5}	82	12 590
.039 81	28	25.12	7.08×10^{-5}	83	14 130
.035 48	29	28.18	6.31×10^{-5}	84	15 850
.031 62	30	31.62	5.62×10^{-5}	85	17 780
.028 18	31	35.48	5.01×10^{-5}	86	19 950
.025 12	32	39.81	4.47×10^{-5}	87	22 390
.022 39	33	44.67	3.98×10^{-5}	88	25 120
.019 95	34	50.12	3.55×10^{-5}	89	28 180
.017 78	35	56.23	3.16×10^{-5}	90	31 620
.015 85	36	63.10	2.82×10^{-5}	91	35 480
.014 13	37	70.79	2.51×10^{-5}	92	39 810
.012 59	38	79.43	2.24×10^{-5}	93	44 670
.011 22	39	89.13	1.99×10^{-5}	94	50 120
.010 000	40	100.0	1.78×10^{-5}	95	56 230
.008 913	41	112.2	1.58×10^{-5}	96	63 100
.007 943	42	125.9	1.41×10^{-5}	97	70 790
.007 079	43	141.3	1.26×10^{-5}	98	79 430
.006 310	44	158.5	1.12×10^{-5}	99	89 130
.005 623	45	177.8	1.00×10^{-5}	100	100 000

TABLE 1-2

VOLTAGE OR CURRENT RATIO TO DB CONVERSIONS

1.4.3 SEISMOMETER

MODEL _____

- Moving Mass: ..... _____ Kg
- Period: ..... _____ Sec, Nominal
- Weight: ..... _____ Lbs (_____Kg)

SIGNAL COIL

- Turns: ..... _____
- Resistance: ..... _____ ohms
- Electrodynamic Constant: ..... _____ V/M/Sec., Nominal
- Effective Output _____ V/M/Sec. (across _____ ohm damping resistor)
- CDRX: ..... _____ ohms
- CDR: ..... _____ ohms
- External Damping Resistor (R_{ex}) .6H:.. _____ ohms
- Location of damping resistor ..... _____

CALIBRATE COIL

- Turns: ..... _____
- Motor Constant (K):.. _____ Newtons/Ampere
- Resistance: ..... _____ ohms, Nominal

Typical system maximum sensitivity curves for displacement (S_d), velocity (S_v), and acceleration are shown on Figure 1-2A and Figure 1-2B.

1.4.4 RECORDER

- Record Size: ..... 343mm x 600mm (13.5" x 24")
- Line Spacing: ..... _____mm,
  _____mm, or
  _____mm
- Recording Speeds: ... _____mm per min, or
  _____mm per min.
- Motor Type: ..... 60Hz synchronous inductive.
- Motor Accuracy: ..... Equal to base frequency oscillator of system clock.
- Drum Drive Motor Speed: ..... _____ RPM
- Translation Drive Motor Speed: ..... _____ RPM
- Stylus Length: 12.5cm
- Pen Motor Frequency Response: . DC to _____Hz

Recorder Speed, duration, and line spacing options are specified in Table 1-3.

RECORDING DURATION

DRUM MOTOR RPM**	1/4	1/2	1	1/2	1	2	1	2	4	2	4	8	4	8	16	DAYS
	6¼	12½	25	12½	25	50	25	50	100	50	100	200	100	200	400	HOURS
1/8													4	2	1	7.5
													2	1	.5	15
1/4				LINE SPACING - (MM)						4	2	1				15
										2	1	.5				30
1/2							4	2	1							30
							2	1	.5							60
1				4	2	1										60
				2	1	.5										120
2	4	2	1													120
	2	1	.5													240
	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	PULLEY SET *
	1/3			1/6			1/12			1/24			1/48			TRANSLATION MOTOR RPM**

DRUM SPEED (MM/MIN)

*Pulley Set numbers are assigned with reference to motor pulley size. (Largest motor pulley=Set 1, center motor pulley=Set 2, smallest motor pulley=Set 3.)

**Special rotation/translation rates available.

R-6040/MEQ-800

RECORDER TIME DRIVE CHARACTERISTICS

TABLE 1-3

1.4.5 TIMEKEEPING

- Display: ..... Seconds, minutes, hours (MEQ-800B only)
- Time Mark
  Duration and Rate: . .02 sec @ 1 per sec., 1 sec @ 1 per min
  2 sec @ 1 per hour, 10 sec @ 1 per 12 hours
- Time Set Trimming: .. Advance or retard at 16 m sec per sec rate, switch actuated
- Stability: ..... $\pm$ 5 x 10^{-8}/day

System stability to accuracy equivalencies are listed in Table 1-4.

STABILITY IN PPM/DAY	STABILITY IN SEC/DAY
$\pm 5 \times 10^{-6}$/DAY	.4320 SEC/DAY
$\pm 4 \times 10^{-6}$/DAY	.3456 SEC/DAY
$\pm 3 \times 10^{-6}$/DAY	.2592 SEC/DAY
$\pm 2 \times 10^{-6}$/DAY	.1728 SEC/DAY
$\pm 1 \times 10^{-6}$/DAY	.0864 SEC/DAY
$\pm 5 \times 10^{-7}$/DAY	.04320 SEC/DAY
$\pm 4 \times 10^{-7}$/DAY	.03456 SEC/DAY
$\pm 3 \times 10^{-7}$/DAY	.02592 SEC/DAY
$\pm 2 \times 10^{-7}$/DAY	.01728 SEC/DAY
$\pm 1 \times 10^{-7}$/DAY	.00864 SEC/DAY
$\pm 5 \times 10^{-8}$/DAY	.004320 SEC/DAY
$\pm 4 \times 10^{-8}$/DAY	.003456 SEC/DAY
$\pm 3 \times 10^{-8}$/DAY	.002592 SEC/DAY
$\pm 2 \times 10^{-8}$/DAY	.001728 SEC/DAY
$\pm 1 \times 10^{-8}$/DAY	.000864 SEC/DAY
$\pm 5 \times 10^{-9}$/DAY	432.0 uSEC/DAY
$\pm 4 \times 10^{-9}$/DAY	345.6 uSEC/DAY
$\pm 3 \times 10^{-9}$/DAY	259.2 uSEC/DAY
$\pm 2 \times 10^{-9}$/DAY	172.8 uSEC/DAY
$\pm 1 \times 10^{-9}$/DAY	86.4 uSEC/DAY
$\pm 5 \times 10^{-10}$/DAY	43.2 uSEC/DAY
$\pm 3 \times 10^{-10}$/DAY	25.92 uSEC/DAY
$\pm 1 \times 10^{-10}$/DAY	8.64 uSEC/DAY

FREQUENCY/RATE
EQUIVALENCIES

TABLE 1-4

SECTION II

THEORY OF OPERATION

2.0 GENERAL

This section presents a general theory of operation for the MEQ-800 Portable Seismic System. Applicable schematics are found in Section V. Main control panel function data is contained in Table 2-1, clock controls are explained in Table 2-2, and external connector functions are described in Table 2-3. Figure 2-1 presents a system functional block diagram. Refer to Figure 3-1 for controls and parts identification.

2.1 POWER SUPPLY

Four sealed lead dioxide storage batteries provide system power for the MEQ-800.

Connected in a "split bus" configuration, the 4 batteries supply the required +12VDC (BUS B) and -12VDC (BUS A). Each bus contains two of the 1.5 ampere hour (a.h.) units to combine for a total capacity of 3 a.h. per bus.

Parallel external inputs are provided through the BATTERY connector (J-2) to facilitate use of an auxiliary or "back up" power source. (Available GC 1245 batteries afford an additional 4.5 a.h. per bus capacity)

Each bus is protected by a 1 AMP fuse. Fused current surge protection is also provided between internal and external power sources.

System power is controlled by SYSTEM switch S-9. The SYSTEM switch AMP position allows supply voltages to be connected to all circuits (except clock) for testing without applying power to the recorder drive motors.

2.1 POWER SUPPLY (Cont.)

The REC position applies power to all system components (except clock) for normal operation. Power must also be applied to the clock for normal operation. The CHG position connects an external charger parallel input (CHARGER connector, J-4) to all batteries. In the CHG mode, power is removed from the amplifier and motor drive circuits while chronometer power is maintained to ensure clock output integrity. The OFF position removes power from all except the chronometer circuits.

2.2 SIGNAL PROCESSING

Seismometer output signals are coupled through the SEISMOMETER connector (J-1) to the Preamplifier section of the AS110 Amplifier. Preamplified signals are interfaced with the main amplifier via band pass and gain control networks.

LOW FILTER switch S2 selects filters to set band pass lower edge limits at .3Hz (LOW FILTER to OUT), 5Hz, or 10 Hz. Band pass upper edge limits are controlled by HI FILTER switch S3 at 5Hz, 10Hz or 70Hz (HI FILTER to OUT).

Signal amplification (gain) is controlled by GAIN switch S1. System gain is variable in 6dB increments from 60dB to 120dB.

Following conditioning in the filter and gain control networks, the signal is applied to the pen deflection amplifier. Maximum pen deflection ranges of approximately 5mm, 10mm, or 25mm are determined by the amplitude limiting circuits and DEFL switch S4. When the 25mm range is selected, the discrete limiters are switched out and pen excursions are limited by the normal amplifier clipping characteristics.

2.2 SIGNAL PROCESSING (Cont.)

Pen deflection drive signals are coupled from the pen drive amplifier to a galvanometer action penmotor through internal connectors P9/J9. A low impedance (3.3 ohm) tape recorder output is furnished at external connector J3 (Tape). A time signal input to the amplifier circuit provides accurate time mark references on system records.

Accurate amplifier balance provides a reliable zero base line reference for recording and aids in conserving battery power. Externally accessible controls facilitate exact balance adjustment. A multifunction panel mounted test meter monitors amplifier output during the balance adjustment procedure.

The test meter also serves, as determined by METER switch S-8, to display acceptable low limit of power supply levels. Three ammeter ranges are selectable for indications of current levels applied to the seismometer calibrate coil from the CAL PULSE switch (S-12)and AMPL control R-15.

2.3 TIMEKEEPING

A crystal controlled digital chronometer supplies the precise, highly stable (± 4.32 millisec/day throughout the 0 to 50°C temperature range) time base for MEQ-800 record time references. "Time Marks" are programmable in intervals of seconds, minutes and hours or minutes and hours only. A time mark of 10 seconds occurs at 12 hours and 24 hours. Clock time can be synchronized with standard radio time broadcasts (Coordinated Universal Time) through an external input connector.

Power to timekeeping circuits is controlled by CLOCK switch S-10. Inadvertent clock shutdown is prevented by the positive detent action of the switch.

Time mark signal input modes to the AS110 Main Amplifier are determined by TIME MARK signal switch S-5. In the manual (MAN) position, the Hours/Minutes/Seconds (HMS) relay output signals are bypassed and 12VDC is applied directly to the amplitude (AMPL) control potentiometer. This enables calibration of recorder pen excursions for time reference marks.

When the normal (NOR) position is selected, normal HMS relay data is applied through the precalibrated AMPLITUDE potentiometer to the main amplifier TIME MARKS input and pen drive circuit.

The RADIO position of S-5 enables synchronization of the system clock outputs with Coordinated Universal Time. Standard time broadcast receiver audio signals, via external connector J-5 (RADIO), are transformer coupled, conditioned and sent to the pen deflection circuit.

When radio source signals are displayed on the recorder and are available audibly, the system clock can be accurately synchronized. The clock displays are zeroed by the PRESET/RUN/RESET switch RESET position. The PRESET position is then selected and held, forcing the displays into a programmable state, permitting manual setting with the SET switches.

2.3 TIMEKEEPING (Cont.)

Upon reception of the radio 00 audio tone, the PRESET/RUN/RESET switch is released to the RUN position and the clock starts in approximate sync with radio time. Optimum time sync is now achievable using the advance/retard (ADV/RET) switch. The ADV/RET control rate is 16.67 milliseconds per second (1 second per minute). Manual setting accuracy is approximately ±10 milliseconds.

Internally generated time mark intervals are selected by the TIME MARK HMS/HM switch (S-6). Clock pulses are passed through the HMS relay to be amplified and converted into recorder pen excursions. The HMS position enables a pulse of .02 seconds duration for each second mark, a pulse of 1 second duration for each minute mark, a pulse of 2 seconds duration for each hour mark and a pulse of 10 seconds for 12 hours and 24 hours. The seconds pulse is inhibited when the HM mode is chosen.

External "Master Reset" output capabilities are available through the option of RESET switch S-7.

2.4 RECORDER

The R6040 recorder facilitates MEQ-800 record keeping. An electromechanically driven drum serves as the platform for the 343mm x 600mm (13.5" x 24") seismogram. Smoked paper or ink recordings can be produced.

Drum and recording pen translation drives are provided by inductive 60 Hz synchronous motors. Drum rotation is controlled by a direct drive friction element in contact with the drum end flange. Two adjacent driving wheels of different diameters allow dual speed selection by positioning of the element on the motor shaft.

The penmotor and stylus are mounted on a lead screw which is chain driven by the translation motor pulleys. Desired pen translation rates are adjustable through selection of appropriate pulley combinations. Record line spacing is a product of pen translation rate and drum speed. Pulley and motor selection data for recording duration and line spacing is contained in Table 1-3.

When the MEQ-800 record mode is selected (REC position of SYSTEM switch S-9), +12VDC and -12VDC primary power is connected to the motor drive amplifier. The system clock 60Hz output is applied to the motor drive amplifier to provide synchronous motor operation.

As the drum drive motor begins to operate, the friction drive starts drum rotation. Simultaneously, the translation screw turns, driven by the chain and pulley system of the translate motor. As the translation screw turns, the penmotor and stylus assemblies are pulled along its length.

With the stylus pen in contact with the record paper, amplified seismometer and time mark signals drive the penmotor, providing pen excursions above and below the pen trace base line (zero).

2.4 RECORDER (Cont.)

Limit switches remove power from the motor drive amplifier and signal amplifier when the penmotor and stylus reach the end of the translate screw. Using an auxiliary power source and appropriate motor/pulley configuration, up to 400 hours (16 days) of seismic activity can be recorded without interruption or operator attention.

SWITCH/CONTROL	POSITION	FUNCTION
SYSTEM (S-9)	CHG	Connects battery charger input to all batteries in parallel.
	OFF	Removes power from all system components except chronometer.
	AMP	Applies power to signal processing circuits only.
	REC	Applies power to all components except chronometer for normal system operation.
LOW FILTER (S-2)	OUT	Sets system bandpass lower edge limit at .3 Hz.
	5Hz	Sets system bandpass lower edge limit at 5Hz.
	10Hz	Sets system bandpass lower limit at 10Hz.
HI FILTER (S-3)	OUT	Sets system bandpass upper edge limit at 70 Hz.
	30Hz	Sets system bandpass upper edge limit at 30Hz.
	10Hz	Sets system bandpass upper edge limit at 10Hz.
	5Hz	Sets system bandpass upper edge limit at 5Hz.

MEQ-800 MAIN CONTROL PANEL FUNCTIONS

TABLE 2-1

(Cont. on Page 2-9)

SWITCH/CONTROL	POSITION	FUNCTION
DEFL (S-4)	25	Removes limiting circuits from pen deflection amplifier (25mm peak range).
	10	Connects 10mm peak output limiter to pen amplifier.
	5	Connects 5mm peak output limiter to pen amplifier.
TIME MARK MAN/NOR/RADIO (S-5)	MAN	Bypasses normal time mark signals to provide calibration of time mark pen deflections.
	NOR	Connects internally generated time mark signals to pen deflection circuits.
	RADIO	Applies externally input audio signals to pen deflection circuits.
CAL PULSE MAN/OFF/EXT (S-12)	MAN	Applies a controlled current pulse to seismometer calibrate coil.
	OFF	Removes all inputs from seismometer calibrate coil.
	EXT	Connects external input from CAL input jack.

MEQ-800 MAIN CONTROL PANEL FUNCTIONS

TABLE 2-1 (Cont. from Page 2-8)

(Cont. on Page 2-10)

SWITCH/CONTROL	POSITION	FUNCTION
GAIN DB (S-1)	60 THRU 114	Adds 6dB of attenuation per position to main amplifier input.
	120	Removes all attenuation from amplifier input.
TIME MARK HMS/HM (S-6)	HMS	Connects hours, minutes, and seconds time pulses to pen deflection amplifier.
	HM	Connects hours and minutes time pulses to pen deflection amplifier.
METER (S-8)	OFF	Removes all inputs to test meter and shorts out meter movement.
	B 12V	Connects meter across Bus B (+12VDC).
	A 12V	Connects meter across Bus A (-12VDC).
	BAL	Connects meter across main amplifier to provide for zero base line adjustment.
	0.1 MA 1.0 MA 10 MA	Connects meter across selected scaling resistor to allow monitoring seismometer manual calibrate current.

MEQ-800 MAIN CONTROL PANEL FUNCTIONS

TABLE 2-1 (Cont. from Page 2-9)

(Cont. on Page 2-11)

SWITCH/CONTROL	POSITION	FUNCTION
CLOCK (S-10)	ON	Connects Bus A battery terminals to system clock to provide =12VDC independant of system on/off status.
	OFF	Removes power from system clock.
RESET (S-7) (OPTIONAL)	RESET	Supplies external +12VDC master reset signal.
TIME MARK AMPL (R-14)	VARIABLE	Clockwise rotation increases amplitude of time mark indication on record. Used in conjunction with TIME MARK select switches.
CAL PULSE AMPL (R-15)	VARIABLE	Clockwise rotation increases level of internally generated calibrate current pulse. Used in conjunction with CAL PULSE MAN switch position.

MEQ-800 MAIN CONTROL PANEL FUNCTIONS

TABLE 2-1 (Cont. from Page 2-10)

SWITCH/CONTROL	POSITION	FUNCTION
PRESET/RUN/RESET	PRESET	Holds clock display at present state when selected.
	RUN	Allows normal clock inputs to display.
	RESET	Causes clock display to reset to zero.
TEST/OFF/ON	TEST	Drives all displays into illumination for display test.
	OFF	Removes power from clock displays to conserve power.
	ON	Allows normal system clock displays.
ADVANCE/NOR/RETARD	ADVANCE	Advances clock displays at 16.67 msec/sec (1 sec/min) rate.
	NOR	Allows normal system clock displays.
	RETARD	Retards clock displays at 16.67 msec/sec (1 sec/min) rate.
SET (MIN/HR)	MOMENTARY ACTION	Advances selected displays. Used in conjunction with PRESET position of PRESET/NOR/RESET switch.

MEQ-800 CLOCK CONTROL FUNCTIONS

TABLE 2-2

CONNECTOR/PIN	SIGNAL NAME	FUNCTION
SEISMOMETER (J-1)		
A	SIG IN	Seismometer signal coil output.
B	SIG IN Ret	Seismometer signal coil return.
C	CAL OUT	Seismometer calibrate coil input.
D	CAL OUT Ret	Seismometer calibrate coil return.
E		SPARE
F		SPARE
BATTERY (J-2)		
A	+12VDC (A)	Auxiliary battery inputs for BUS A.
B	-12VDC (A)	
C	+12VDC (B)	Auxiliary battery inputs for BUS B.
D	-12VDC (B)	
E		SPARE
F		SPARE
TAPE (J-3)		
A	TAPE OUT	Low impedance tape recorder output.
B	TAPE OUT Ret	Signal return for tape recorder output.
C		SPARE
CHARGER (J-4)		
A	+12VDC	12VDC battery charger input.
B	-12VDC	
RADIO (J-5)		
A	RADIO IN	50 ohm input for radio receiver audio.
B		SPARE
C	RADIO IN	Signal return for J-5A.
D		SPARE
CAL (J-10)* Phone Jack	Ext CAL INPUT	Provides external signal generator input access to seismometer calibrate coil.
*Located on main control panel		

EXTERNAL CONNECTOR FUNCTIONS

TABLE 2-3

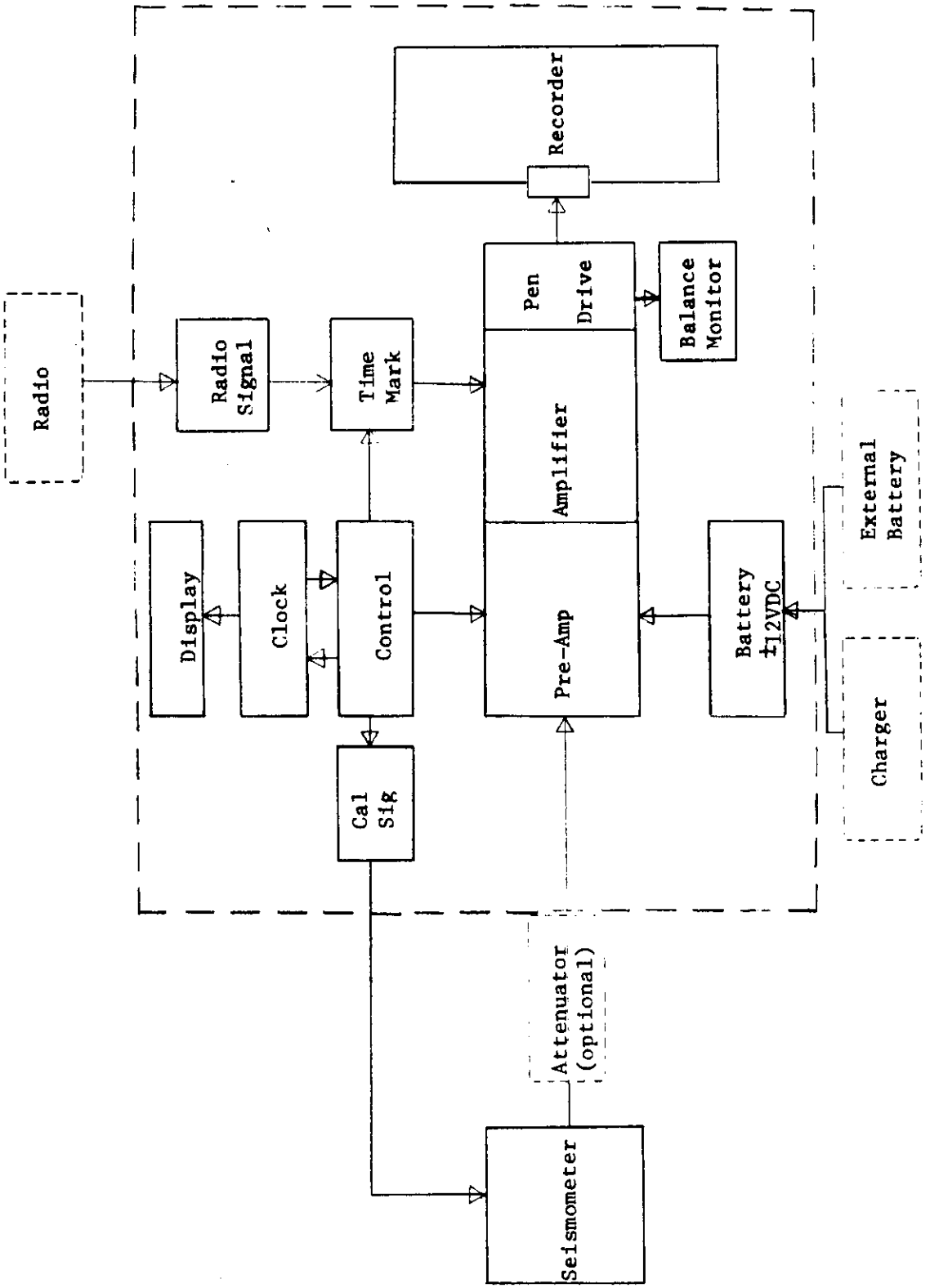


FIGURE 2-1

MEQ-800 FUNCTIONAL BLOCK DIAGRAM

SECTION III

INSTALLATION AND OPERATION

3.0 GENERAL

The following paragraphs are an introduction to operation of the MEQ-800 and provide a basis for system confidence level functional tests. If the systems fails Section III checks, refer to the applicable Section IV test. Refer to Figure 3-1 for controls and connector locations.

3.1 INITIAL SET UP

3.1.1 Place the MEQ-800 on a well lighted work surface, connectors and handle toward operator, with inspection port facing up.

CAUTION

IN THE FOLLOWING STEP, MAKE SURE COVER HAS CLEARED UPPER AREA OF RECORDER AND STYLUS BEFORE MOVING TO EITHER SIDE.

3.1.2 Release 4 wing handle fasteners and lift cover straight up and away from unit.

3.1.3 Remove tool and connector package and set aside. Visually inspect unit for signs of damage. Refer to SECTION I for claims and shipping information.

3.1.4 Swing stylus clamp away from stylus (22) and toward main control panel (1).

3.1.5 Fold stylus up and back against limit bracket. DO NOT ATTEMPT TO ROTATE PENMOTOR HUB (24).

3.1 INITIAL SET UP (Cont.)

3.1.6 Loosen drum shaft knurled clamp nuts until drum shaft sleeves are free in mounting slots. Drive control arm (18) should be up and locked.

3.1.7 Lift drum out of frame slots and set aside.

NOTE

Drum should be kept clean. Inside of unit cover can serve as a temporary storage location.

3.1.8 Prepare a smoked paper record per 4.8.

3.1.9 Ensure that stylus is folded back against pen limit bracket and that drive control arm (18) is up and latched.

3.1.10 Lift drum by the shaft clamp nuts. Record seam over-lap should now be facing away from operator (opposite to drum rotation) to prevent seam interference with pen travel.

3.1.11 Align shaft ends with slots and lower drum into recorder frame until shaft and sleeve shoulders are seated in slots.

3.1.12 Tighten drum shaft clamp nuts until they just "bottom out". DO NOT OVER TIGHTEN.

3.2 SYSTEM TURN-ON AND INITIAL TESTS

3.2.1 POWER

3.2.1.1 Position main control panel switches as follows and observe specified results. Reference to Figure 3-1 for parts and controls identification.

SWITCH	POSITION	RESULT
GAIN DB (2)	60	---
CLOCK (11)	OFF	---
SYSTEM (10)	AMP	---
METER (9)	B 12V	Meter indicates above red line.
METER (9)	A 12V	Meter indicates above red line.

3.2.2 CALIBRATION

3.2.2.1 Remove protective dust cap from seismometer connector, disconnect coil damping jumper from pins A and B, and connect seismometer to SEISMOMETER receptacle (16).

3.2.2.2 Release the penmotor carriage latch (at left of recorder frame) and raise stylus (22).

3.2.2.3 Depress translation release knob (23) and position carriage to desired location.

3.2.2.4 Release and lower drive control arm (18) to engage friction drive.

3.2.2.5 Position TIME MARK AMPL (6) fully CCW and set TIME MARK for HM.

3.2.2.6 Position CAL PULSE (7) to OFF.

3.2.2 CALIBRATION (Cont.)

3.2.2.7 Position METER switch (9) to 10MA.

3.2.2.8 Adjust CAL PULSE AMPL (7) to midrange and position CLOCK switch (11) to ON.

3.2.2.9 Set LOW FILTER switch (3) to OUT.

3.2.2.10 Position SYSTEM switch (10) to REC. Drum rotation starts.

3.2.2.11 Position and hold CAL PULSE to MAN. Pen will momentarily deflect.

3.2.2.12 After 10 seconds, release CAL PULSE switch to OFF and observe pen deflection amplitude.

3.2.2.13 Repeat 3.2.2.11 and 3.2.2.12 while adjusting CAL PULSE AMPL for approximately 5mm peak pen deflection. Observe meter current indication. If meter indicates below 10, change METER switch to 1 MA.

3.2.2.14 Record meter scale/current indication for 5mm peak pen deflection.

NOTE

This recorded current value should be used when applying a daily or "record start" calibrate verification pulse.

3.2.2.15 Position SYSTEM and CLOCK switches to OFF.

3.2.3 TIME MARKS (NOR/MAN)

3.2.3.1 Position CLOCK switch (11) ON.

3.2.3.2 Set SYSTEM switch (10) to REC to start drum rotation.

3.2.3.3 Position and hold the TIME MARKS MAN/NOR/RADIO switch (6) to MAN. Adjust the TIME MARK AMPL control for desired pen deflection amplitude (approximately .5mm).

3.2.3.4 Set TIME MARKS HMS/HM switch to HMS. Observe pen deflections for each 1 second elapsed time.

3.2.3.5 Position SYSTEM to AMP.

3.2.4 TIME MARKS (RADIO)

3.2.4.1 Tune radio to standard time broadcast signal.

CAUTION

IN THE FOLLOWING STEPS, AUDIO INPUT TO THE MEQ-800 MUST NOT EXCEED 10 VRMS. START WITH RADIO AUDIO OUTPUT AT MINIMUM.

3.2.4.2 Position TIME MARKS (6) MAN/NOR/RADIO switch to RADIO and HMS/HM switch to HM.

3.2.4.3 With radio source audio at minimum, connect the radio PHONE output to RADIO receptacle (15) with connector provided.

3.2.4.4 Set SYSTEM switch to REC to start drum rotation.

3.2.4.5 Adjust radio volume until seconds time ticks appear as negative (rightward) pen excursions. Set radio volume for desired time mark amplitude.

NOTE

Instructions for system operation in synchronization with CTU (Coordinated Universal Time) are included in 3.2.6.

3.2.4.6 Position SYSTEM switch to AMP.

3.2.5 SYSTEM CLOCK TEST AND TIMESETTING (TS-400)

3.2.5.1 Check that system clock switch (11) is ON and momentarily position the clock display switch (27) to TEST. Observe that time display indicates 88 88 88.

3.2.5.2 Position the clock display switch to ON. Observe that clock display is counting.

3.2.5.3 Position the RESET/PRESET switch (28) to RESET, then to PRESET and hold. Clock displays all zeros.

While holding RESET/PRESET switch in the PRESET position, use the SET switches to set clock display for desired time. (If desired time setting is inadvertantly overrun, repeat 3.2.5.3).

3.2.5.4 When the clock has been set for the desired time display, release the RESET/PRESET switch. Note that clock display is counting.

3.2.5.5 Position SYSTEM switch (10) to REC to start drum rotation. Observe that time marks appear on the record in accordance with 3.2.3.4.

3.2.5.6 Use the instructions provided in 3.2.5.3 and 3.2.5.4 to set the system clock for test times that will allow hour and minute time marks to appear on the system record.

If the MEQ-800 employs the TS-400 Digital Timing System, the 12 hour time mark can be checked by setting the clock for 11 59 00 and observing the 12 hour mark at 12 00 00 and then setting the clock for 23 59 00 and observing another 12 hour mark at 24 00 00.

3.2.5.7 To conserve battery power while clock is running, position the clock display switch to OFF.

3.2.6 RADIO TIME SYNCHRONIZATION (CTU)

3.2.6.1 Prepare system for radio time marks operation per 3.2.4

3.2.6.2 Set SYSTEM switch to REC to start drum rotation.

3.2.6.3 Position TIME MARKS switch for HMS indications.

3.2.6.4 Use instructions per 3.2.5.3 to set the system clock for upcoming standard radio broadcast time signal and hold clock control in PRESET.

3.2.6.5 When 00 audio tone occurs, release switch from PRESET to allow clock start.

3.2.6.6 While observing recorded time mark, use the system clock ADV/RET switch (26) to set system clock time marks for exact coincidence with radio time marks. (ADV/RET switch controls clock time mark only. The 60Hz clock rate is not affected.) The advance/retard rate is 16.67 milliseconds per second (1 second per minute).

3.2.6.7 Position SYSTEM switch to OFF.

3.3 SITE OPERATION

3.3.1 RECORDING DURATION

Select the desired record characteristics from Table 1-3. Set drum and translation speeds as follows.

3.3.1.1 Remove recorder drum per 3.1.4 through 3.1.7. Release penmotor carraige per 3.2.2.2.

3.3.1.2 Locate the drum rotation motor (20) and friction drive element (21). If set screw in drive wheel is not accessible DO NOT HAND TURN MOTOR, Perform 3.3.1.3 and 3.3.1.4.

3.3.1.3 Position SYSTEM switch (10) to REC and CLOCK switch (11) to ON to start drive wheel rotation.

3.3.1.4 When set screw is accessible, position SYSTEM to OFF.

3.3.1.5 Using the allen wrench provided, loosen set screw on drive wheel element and slide element to the appropriate end of the motor shaft.

3.3.1.6 Temporarily set the drum in position to verify the correct mating of the friction drive wheel with the drum flange.

3.3.1.7 Tighten set screw against flat area of motor shaft.

3.3.1.8 Locate the translation drive pulleys (30).

3.3.1.9 Move timing belt to applicable pulley set as selected from Table 1-3.

3.3.1.10 Install drum per 3.1.9 through 3.1.12.

3.3 SITE OPERATION (Cont.)

3.3.2 FINAL CHECKS

Prior to transport to the field, verify the following.

- STYLUS CLAMP is positioned to hold stylus.
- PENMOTOR assembly locked in far left position.
- DRIVE CONTROL ARM is up and locked.
- CONNECTOR protective dust caps are installed.
- COVER is secured with all four fasteners.

FIGURE 3-1A

CONTROLS AND PARTS IDENTIFICATION

1	MAIN CONTROL PANEL
2	GAIN DB (S-1)
3	FILTER LOW HZ (S-2)
4	FILTER HI HZ (S-3)
5	MAX DEFL (S-4)
6	TIME MARK CONTROLS
7	CAL PULSE CONTROLS
8	TEST METER
9	METER FUNCTION SELECT
10	SYSTEM (S-9)
11	CLOCK POWER (S-10)
12	BATTERY (J-2)
13	CHARGER (J-4)
14	TAPE (J-3)
15	RADIO (P-5)
16	SEISMOMETER (J-1)
17	CONNECTOR GUARD PLATE
18	DRIVE CONTROL ARM
19	REAR CROSS BRACE
20	DRUM ROTATION MOTOR
21	FRICTION DRIVE ELEMENT
22	STYLUS (STYLUS CLAMP RELEASED)
23	TRANSLATION RELEASE KNOB
24	PENMOTOR HUB
25	CHRONOMETER DISPLAY
26	ADV/RET CONTROL
27	DISPLAY CONTROL
28	RESET/PRESET CONTROL
29	TRANSLATION DRIVE MOTOR
30	TRANSLATION PULLEYS
31	CLOCK SIGNAL OUTPUT

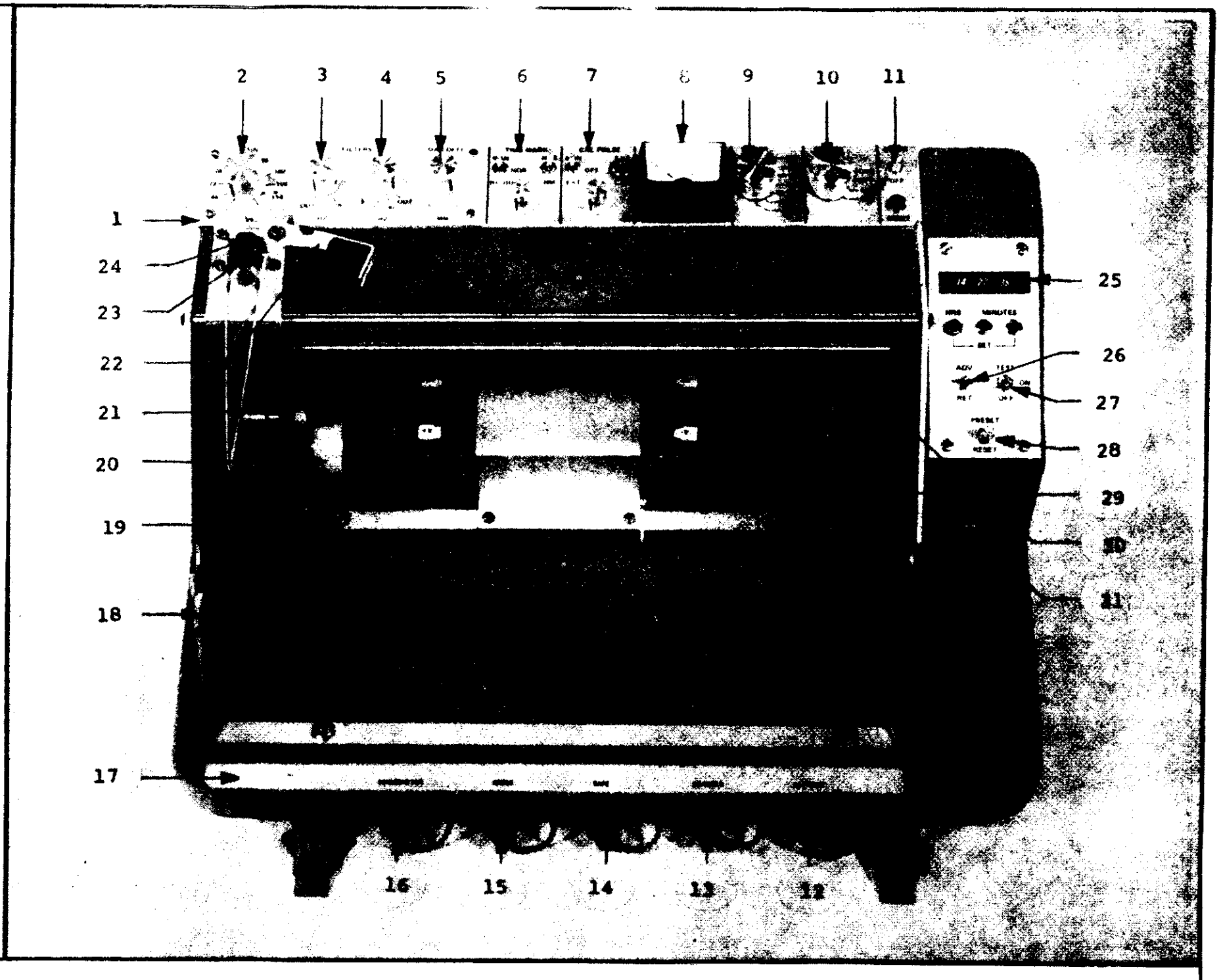


FIG 3-1A

1 of 2

FIGURE 3-1B

CONTROLS AND PARTS
IDENTIFICATION

34 SPARE FUSES (Typical 2 Places)
35 FUSE BLOCK
36 CLOCK CONNECTOR (P-8/J-8)
37 TRANSLATION DRIVE MOTOR CONNECTOR (P-7/J-7)
38 ROTATION DRIVE MOTOR CONNECTOR (P-6/J-6)
39 PEN MOTOR CONNECTOR (P-9/J-9)
40 "A" Batteries
41 "B" Batteries

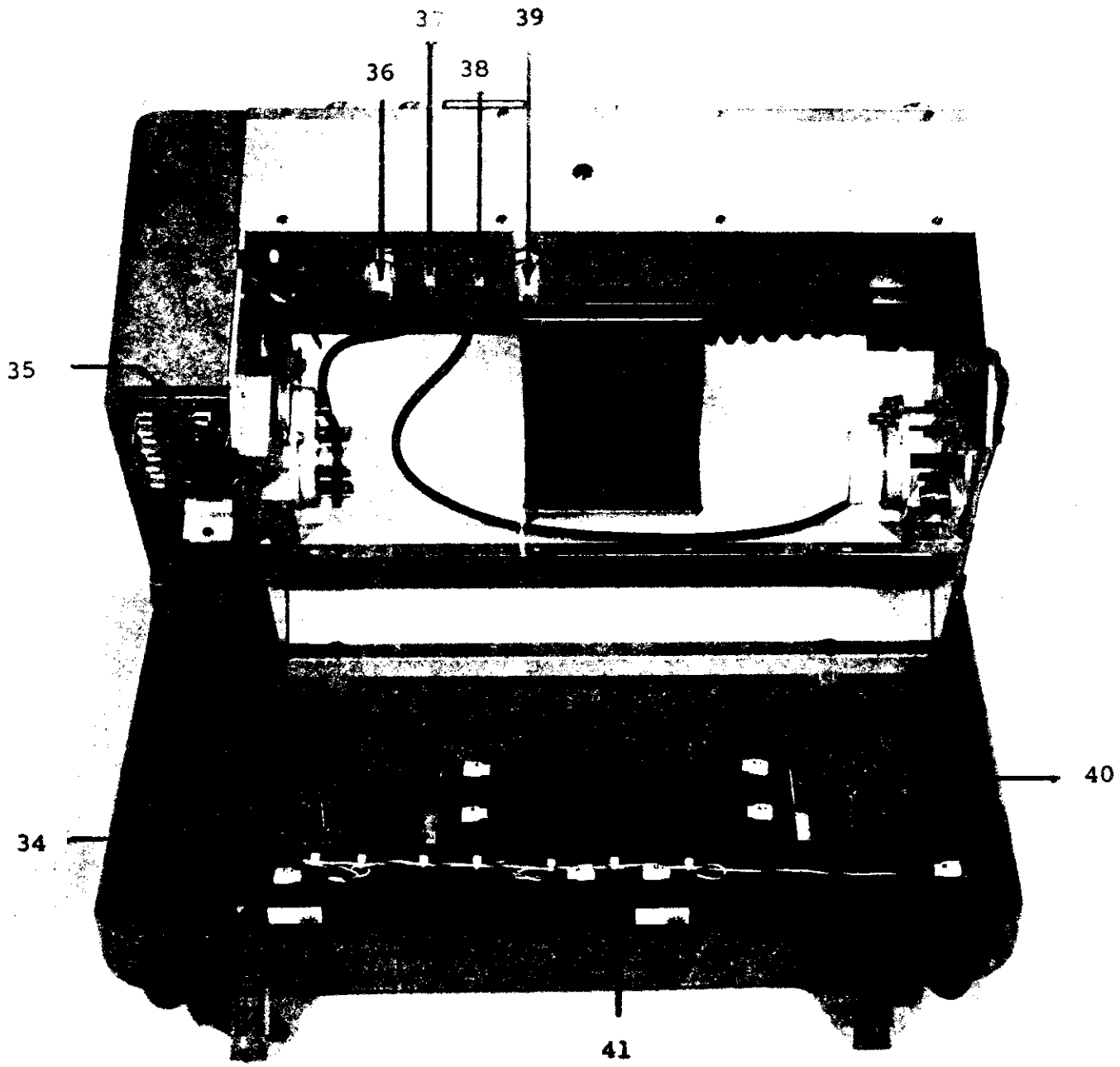


FIG 3-1B

2 of 2

SECTION IV

SYSTEM MAINTENANCE AND DETAILED ADJUSTMENTS

4.0 GENERAL

This section supplies suggested maintenance practices and establishes detailed alignment and adjustment procedures.

4.1 SYSTEM ENVIRONMENTAL AND CLEANING REQUIREMENTS

The MEQ-800 should be shielded against environmental extremes during storage and operation. Ink recording material should be used and stored only where ambient temperatures will remain above freezing.

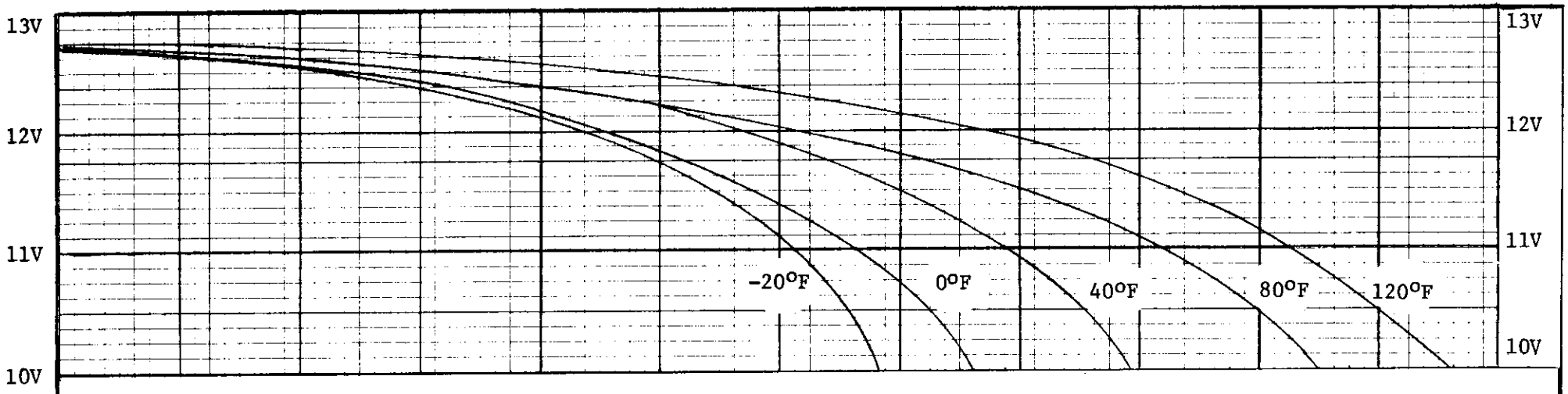
Mechanical parts of the system require no lubrication or periodic maintenance other than cleaning.

Surfaces should be cleaned with mild cleaning agents. NEVER USE SOLVENTS for cleaning painted or plastic surfaces.

4.2 POWER SUPPLY

IMPORTANT

The GC 1215-1 Batteries that comprise the MEQ-800 power supply have an estimated life of 3 to 5 years in an ambient operating temperature of 70°F (21°C). For each 20°F over 70°F ambient operating temperature, battery life is shortened by one-half. Battery life is considered terminated when the battery weight has dropped to one-half the initial 1.5 lb. (.7 Kg) weight. GC 1215-1 operating characteristics are contained in Figure 4-1.



HOURS	10	20	30	40	50	60	70	80	90	100	110
(1 Batt) DAYS	.416	.832	1.25	1.66	2.1	2.5	2.91	3.33	3.74	4.20	4.58

For Two Batteries in Parallel, Multiply x 2.

FIGURE 4-1

GC 1215 BATTERY OPERATING CHARACTERISTICS,

AMBIENT TEMPERATURE/VOLTS/DISCHARGE TIME (15ma Load)

4.2 POWER SUPPLY (Cont.)

4.2.1 FUSE REPLACEMENT

4.2.1.1 Refer to Figure 3-1B for fuse block and spares location.

4.2.1.2 For access to fuse block perform 4.2.4.1 through 4.2.4.6.

4.2.1.3 Lift up on fuse extractor to remove fuse. Insert new fuse through extractor prior to replacement.

4.2.1.4 Secure recorder main frame per 4.2.4.13.

4.2.1.5 Perform battery test per 4.2.2.

4.2.2 BATTERY TEST

Position main control panel switches as follows. Observe specified results. Refer to Figure 3-1 for parts and controls identification.

4.2.2.1 With SYSTEM switch in AMP or REC, rotate METER to B 12V and A 12V. Observe meter indicates above red line for both positions.

4.2.2.2 If meter indicates below red line (less than 10 volts), batteries may require charging or replacement.

4.2.3 BATTERY CHARGING

CAUTION

WHEN CHARGING BATTERIES, USE ONLY A CONTROLLABLE CURRENT LIMITED CHARGER SUCH AS THE SPRENGNETHER MEQ-800-59 OR EQUIVALENT.

4.2.3 BATTERY CHARGING (Cont.)

4.2.3.1 Position the main control panel SYSTEM switch to CHG. DO NOT DISTURB SYSTEM CLOCK CONTROLS.

4.2.3.2. With battery charger OFF, connect charger output to front panel CHARGER receptacle.

4.2.3.3. With current limiter at minimum, turn charger ON.

4.2.3.4. Set initial charge current to .225 Amps. Charge until battery voltage (while charging) reaches 14.4 volts.

4.2.3.5. Charge at 14.4 volts until charge current drops to approximately .035 Amps.

4.2.3.6. Turn charger OFF, remove cable and replace dust cap and check clock displays for correct time indications.

4.2.3.7. Test batteries per 4.2.2 and return to normal system operation. If system is to be stored, leave SYSTEM switch in CHG position.

4.2.3.8. The requirements listed above are fulfilled by automatic and semiautomatic chargers that may be furnished with the MEQ-800 system.

The MEQ-800-59 automatic charger incorporates automatic current and voltage limiting circuits that switch from fast (250 mA) to float (25 mA) when the batteries reach full charge condition. This charger is employed when 115 V 50/60 hz power is available.

When only 220 V 50/60 hz power is accessible, the MEQ-800-59 (220 Volt) charger must be used.

This unit is equipped with a manual switch marked "C" (fast charge - 300 mA) and "F" (float charge - 25 mA).

If charger is to remain connected for more than 24 hours the switch must be deflected to "F" position.

These units are intended for battery charging only.

They connect to the "charger" input and the system control switch must be in the "Chg" position during operation.

4.2.4. EXTERNAL POWER OPERATION

4.2.4.1 External Batteries

The internal (3 AH) battery capacity may be supplemented with a ± 12 volt external battery array.

Connect battery cable to batteries first. Then connect to "BATTERY" input at the MEQ-800 (FIG. 4-4).

External battery capacity may be figured as multiples of the internal (3 AH) capacity with corresponding recording duration.

4.2.4.2. Floating Battery Operation

If AC line power is available, a power supply may be used to maintain battery charge at ± 13.2 float voltage.

This supply must provide isolation and 0.1% regulation line and load. In addition, the system should be protected by a constant voltage/isolation transformer located at the AC line output.

Do not use a battery charger for this application.

Excessive ripple will limit the available amplifier gain. Poor regulation obtaining in most battery chargers will pass damaging power line surges.

If a regulated power supply is connected to a battery circuit, series connected diodes must be provided at the output to prevent reverse current inrush during line power failure.

The MEQ-800-100 is a regulated dual power supply that is suitable for this purpose.

The necessary connecting cables are furnished with the power supply.

Connect to the "BATTERY" input receptacle.

The outputs have been factory adjusted to the level required by the MEQ-800.

If further adjustment is required, the float voltage level (± 13.2 V) must be measured at the internal battery terminals.

4.2.4.3. System Switch

When external power supply or batteries are connected, the System Switch must be in the "REC" or "OFF" position.

DO NOT TURN SYSTEM SWITCH TO "CHG".

If External Battery Array is connected while System Switch is in "CHG" position, severe damage may be sustained by the MEQ-800.

4.2.5 BATTERY REPLACEMENT

Refer to Figure 3-1 for parts and controls identification. Refer to Figure 4-2 for battery hook-up and installation (page 4-7).

To prevent system clock power interruption, each "A" battery will be completely removed and replaced before proceeding to the next "A" unit.

4.2.5.1. Position main control panel SYSTEM switch to CHG. DO NOT DISTURB SYSTEM CLOCK CONTROLS.

4.2.5.2. Remove recorder drum per 3.1.4 through 3.1.7.

4.2.5. BATTERY REPLACEMENT (Contd.)

4.2.5.3. Fold stylus down and secure with stylus clamp.

CAUTION

IN THE FOLLOWING STEPS, EXTREME CARE MUST BE TAKEN NOT TO DAMAGE THE STYLUS. IF WORKING QUARTERS ARE CONFINED, IT MAY BE ADVISABLE TO REMOVE STYLUS PER 4.6.1.2

4.2.5.4. Remove the two nuts and washers that secure the rear cross brace.

4.2.5.5. Position unit with front panel connectors facing away from operator. CLEAR WORK SURFACE AREA AHEAD OF FRONT PANEL CONNECTORS.

4.2.5.6. Raise and tilt recorder main frame forward until it rests against the base front edge.

4.2.5.7. Remove connectors from the "B" (rear) batteries. DO NOT EXERT EXCESSIVE STRESS ON BATTERY TERMINALS OR PULL ON WIRES. A STEADY PULL WITH A ROCKING MOTION IS SUFFICIENT.

4.2.5.8. Lift the "B" batteries from the battery case and set aside.

4.2.5.9. Slide "A" batteries to the rear of battery holder.

4.2.5.10. Remove connectors from ONE "A" battery and replace it with a fully charged unit. Reinstall connectors before performing next step to prevent clock interruption.

4.2.5.11. Remove and replace remaining "A" battery and return both "A" units to their forward location.

4.2.5.12. Install fully charged batteries in "B" locations and connect per Figure 4-2.

4.2.5.13. Lower main frame into the base and replace washers and nuts to secure rear cross brace.

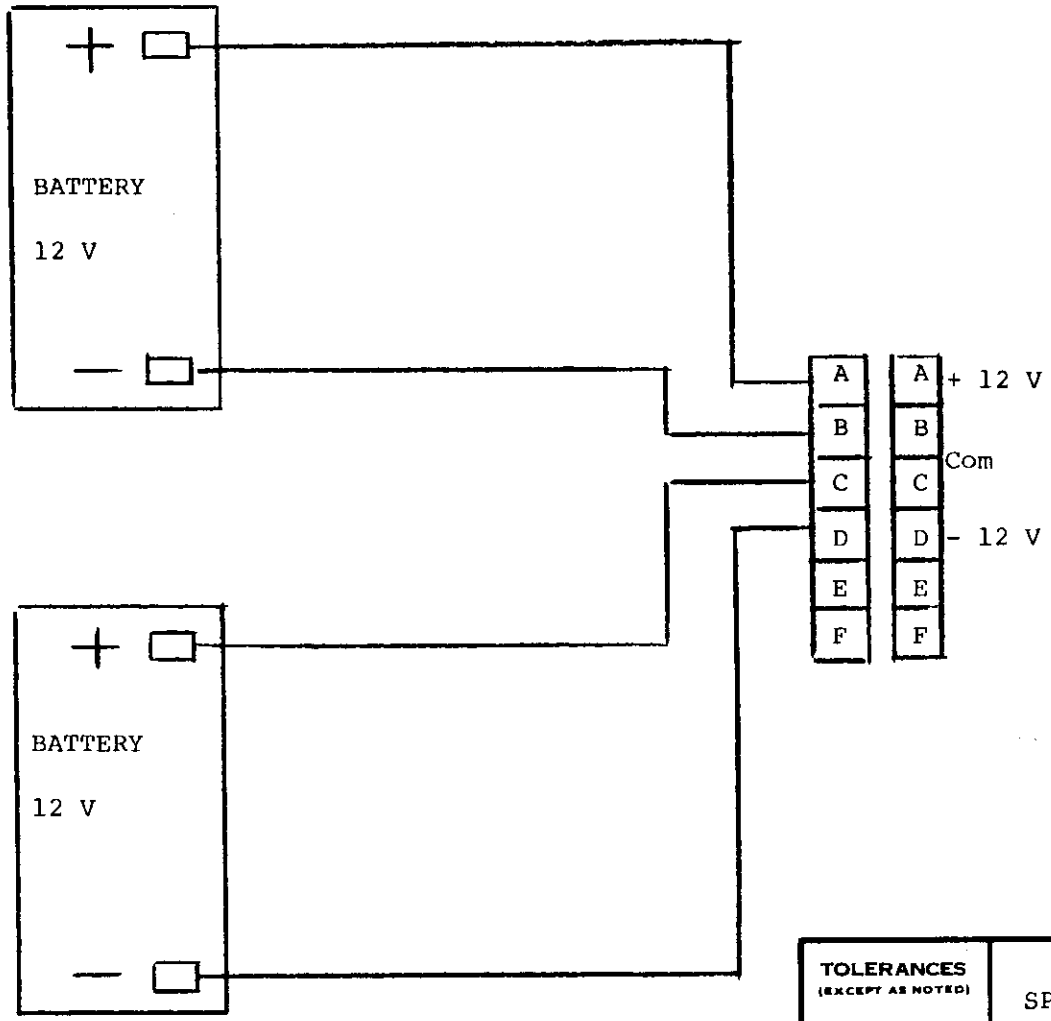
4.2.5.14. Replace drum per 3.1.9 through 3.1.12.

4.2.5.15 Perform 4.2.2 BATTERY TEST.

4.2.5.16 If stylus has been removed, perform 4.6.1.3, 4.6.1.4 and 4.6.1.5.

4.2.5.17. Perform 4.3.1. AMPLIFIER BALANCE TEST. Return system to normal operation. If system is to be left inactive, position METER switch to OFF and SYSTEM switch to CHG.

DATE	SYM	REVISION RECORD	AUTH.	DR.	CK.



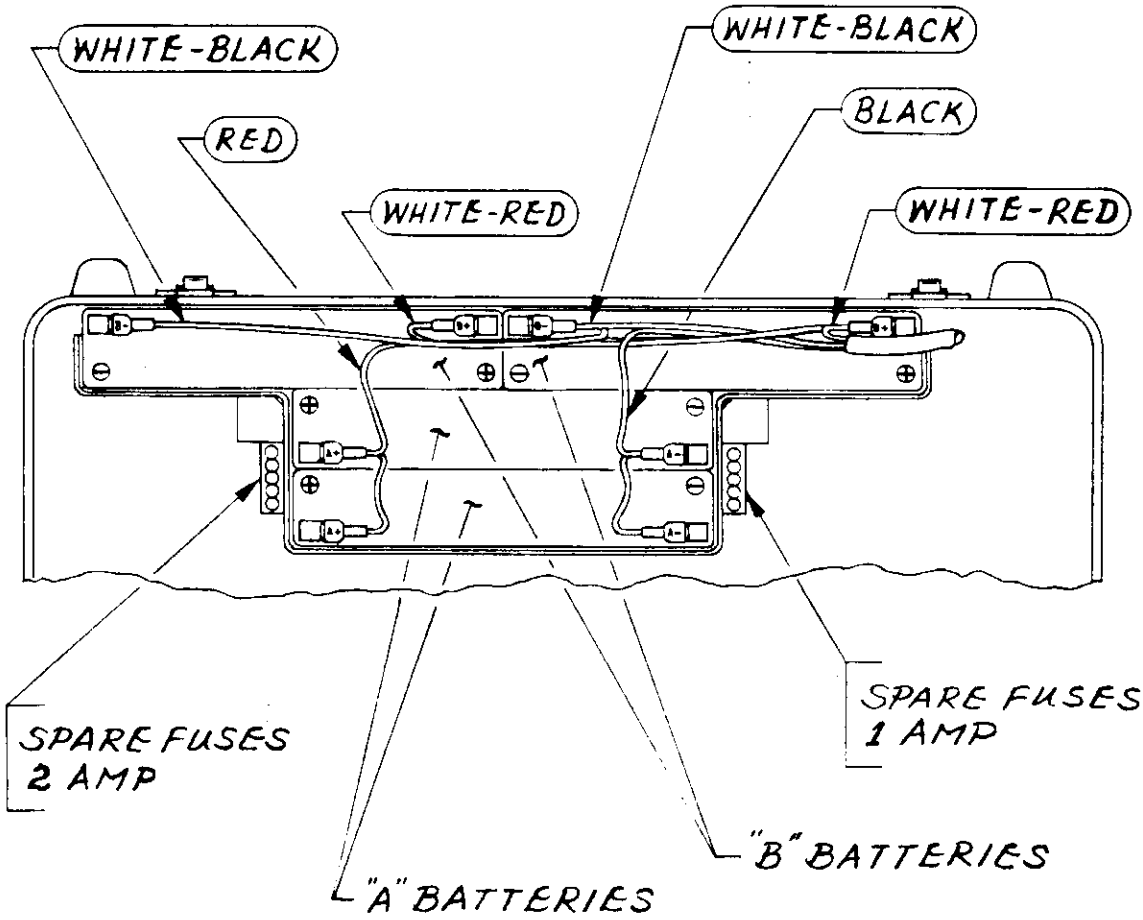
MEQ-800

"BATTERY"

POWER INPUT

FIG 4-4

TOLERANCES (EXCEPT AS NOTED)	SPRENGNETHER INSTRUMENTS, INC.		
DECIMAL ±		SCALE	DRAWN BY AVB APPROVED BY
FRACTIONAL ±	TITLE MEQ-800 EXTERNAL BATTERY CONNECTIONS		
ANGULAR ±	DATE 9-26-80	DRAWING NUMBER	



WHEN INSTALLING BATTERIES, CONNECT WIRES PER TABLE. REFER TO DRAWING FOR WIRE ROUTING.

WIRE COLOR	BATTERIES	TERMINAL
RED	A	+
BLACK	A	−
WHT-RED	B	+
WHT-BLK	B	−

BATTERY INSTALLATION

FIGURE 4-2

4.3 AMPLIFIER BALANCE

Optimum amplifier balance provides an accurate pen zero base line and equalizes plus and minus battery power drain.

Balance should be checked when exchanging seismometers and following battery or amplifier replacement.

4.3.1 BALANCE TEST

Position main control panel switches as follows. Observe specified results. Balance test is conducted with record installed and seismometer disconnected. Refer to Figure 3-1 for controls and parts identification.

4.3.1.1 Prepare system for test as specified in 4.3.2.1 through 4.3.2.6.

4.3.1.2 Position METER switch to BAL.

4.3.1.3 Observe meter and rotate the GAIN DB switch through all positions. Meter indication should remain on zero and the stylus frame should remain centered over the penmotor release knob.

4.3.1.4 If the results of 4.3.1.3 were not as specified, amplifier balance adjustment should be performed.

4.3.2 AMPLIFIER BALANCE ADJUSTMENT

Amplifier balance adjustment is performed with record installed and seismometer disconnected.

Position main control panel switches as follows. Observe specified results. Refer to Figure 3-1 for controls and parts identification.

4.3.2.1 Obtain a one watt resistor, equivalent in value to seismometer signal coil resistance as specified in Section I.

4.3.2.2 Connect seismometer cable to SEISMOMETER receptacle on front panel.

4.3.2.3 Insert test resistor leads into pins "A" and "B" of connector at remaining end of seismometer cable.

4.3.2.4 Ensure that the stylus frame is centered over the penmotor translation release knob per 4.6.1.5.

4.3.2.5 Position GAIN DB switch to 60; LOW FILTER to OUT: METER to OFF.

4.3.2.6 Rotate SYSTEM switch to AMP and allow system to stabilize for 5 minutes.

4.3.2.7 Place METER switch to BAL and observe meter deflection.

4.3.2.8 Insert the metal balance adjusting tool (provided) into main amplifier balance control access hole located at the GAIN switch 114 position and adjust balance control for meter zero. (Clockwise moves meter upscale.)

4.3.2.9 Position METER switch to OFF; GAIN DB switch to 120.

4.3.2 AMPLIFIER BALANCE ADJUSTMENT (Cont.)

4.3.2.10 Remove hole plug from access hole in rear panel of main control assembly.

4.3.2.11 Position METER switch to BAL and observe meter deflection.

4.3.2.12 Use blade end of plastic adjusting tool through access hole to adjust preamplifier balance control for meter zero. (Counter-clockwise moves meter upscale.)

4.3.2.13 Observe meter and rotate the GAIN DB switch through all positions. Meter indication should remain on zero.

4.3.2.14 Position METER switch to OFF. Return system to normal operation. If system is to be left inactive, position SYSTEM switch to CHG.

4.4 SYSTEM SENSITIVITY AND EXTERNAL CALIBRATION TESTS

The low frequency coupling characteristics between seismometer signal and calibrate coils allow reasonably accurate system calibration below 5Hz. System sensitivity and external calibration tests are conducted using a constant voltage output low frequency sine wave generator. A high input impedance DC voltmeter (such as a VTVM) or a calibrated oscilloscope is required for voltage measurement. Tests are performed with record and seismometer installed per Section III. Refer to Section I for system specifications required for computations. Refer to Figure 3-1 for parts and controls identification.

4.4.1 Perform battery test per 4.2.2 and amplifier balance test per 4.3.1.

4.4.2 Position CAL PULSE EXT/OFF/MAN switch to EXT.

4.4 SYSTEM SENSITIVITY AND EXTERNAL CALIBRATION TESTS (Cont.)

4.4.3 Set LOW FILTER switch to OUT; HI FILTER switch to 10.

4.4.4 Position GAIN DB switch to 60.

4.4.5 Turn on signal generator and set its output amplitude for minimum.

4.4.6 Connect signal generator output to CAL PULSE CAL input jack.

4.4.7 Position SYSTEM switch to AMP.

4.4.8 Adjust signal generator frequency for seismometer natural frequency.

NOTE

Seismometer natural frequency is shown on the seismometer name plate. Natural frequency (f_n) can be calculated using the seismometer PERIOD specification provided in Section I as follows:

$$f_n = \frac{1}{\text{PERIOD}}$$

4.4.9 Increase signal generator output amplitude until the recorder pen deflection is approximately equal to 20mm peak to peak.

4.4.10 Set signal generator frequency for 0.1Hz.

4.4.11 Measure and record peak to zero output amplitude (E) of signal generator. (Generator should remain connected to CAL PULSE input during amplitude measurement.)

4.4.12 Position SYSTEM switch to REC. Allow recorder to record at least 5 complete oscillations.

4.4 SYSTEM SENSITIVITY AND EXTERNAL CALIBRATION TESTS (Cont.)

4.4.13 Repeat 4.4.12 for 0.2Hz, 0.4Hz, 0.8Hz, 1.0Hz, 1.5Hz, 2.0Hz, 3.0Hz and 5.0Hz.

4.4.14 Position SYSTEM switch to CHG.

4.4.15 Turn signal generator OFF and remove connection to recorder.

4.4.16 Record zero to peak pen deflection (D) for each frequency.

4.4.17 Calculate seismometer mass acceleration (ACC) as follows:

$$ACC = \frac{KI}{M}$$

NOTE

K = Motor Constant in NEWTON/AMPERE (reference Section I specifications).

I = $\frac{E}{R}$ in AMPERES

E = Peak voltage obtained in 4.4.11

R = Calibrate coil resistance in ohms (reference Section I specifications) plus 681 ohms.

M = Pendulum Moving Mass in Kg (reference Section I specifications).

4.4.18 Use the following equations to compute acceleration (S_a), velocity (S_v), and Displacement (S_d) sensitivities for each frequency.

$$S_a = \frac{D}{ACC} \qquad S_v = \frac{DW}{ACC} \qquad S_d = \left(\frac{D}{ACC}\right) W^2$$

NOTE

W = $2\pi F$

F = Input Frequency

D = Peak Pen Deflection obtained in 4.4.16

4.4 SYSTEM SENSITIVITY AND EXTERNAL CALIBRATION TESTS (Cont.)

4.4.19 Sensitivity characteristics can beplotted on full logarithmic graph paper. Typical sensitivity curves are presented in Figure 1-2A and Figure 1-2B.

4.4.20 Return system to normal operation. If system is to be left inactive, verify SYSTEM switch is in CHG position.

4.5 AMPLIFIER AND MAIN CONTROL PANEL ASSEMBLY REPLACEMENT

Refer to Figure 3-1 for parts and controls identification. Refer to Figure 4-2 for battery hook-up.

4.5.1 Position SYSTEM switch to CHG; CLOCK to OFF.

4.5.2 Remove recorder drum per 3.1.4 through 3.1.7

NOTE

If working quarters are confined, it may be advisable to remove stylus per 4.6.1.2.

4.5.3 Remove the two nuts and washers that secure the external connector guard plate (17) and lift guard plate out of main frame.

4.5.4 Replace and tighten the nuts and washers to secure the main frame front cross brace.

4.5.5 Remove external recepticles SEISMOMETER, RADIO, TAPE and CHARGE.

4.5.6 Remove the two nuts and washers that secure the rear cross brace.

4.5.7 Raise and tilt recorder main frame forward until it rests against the base front edge.

4.5 AMPLIFIER AND MAIN CONTROL PANEL ASSEMBLY REPLACEMENT (Cont.)

4.5.8 Remove battery terminal connectors. DO NOT EXERT EXCESSIVE STRESS ON BATTERY TERMINALS OR PULL ON WIRES. A STEADY PULL WITH A ROCKING MOTION IS SUFFICIENT.

4.5.9 Disconnect the four plugs on the underside of the assembly.

4.5.10 Remove the five screws that hold the clock assembly to the main frame and set the clock carefully aside.

4.5.11 Remove amplifier and control panel wires from the battery terminal block (TB_1). MAKE A NOTE OF WIRE COLORS AND THEIR LOCATION AS REMOVED.

4.5.12 Remove the four screws that hold the amplifier and assembly to the main frame brackets (do not remove brackets) and lift the assembly from the main frame.

4.5.13 Remove cable clamps and cable ties as required to free wire harness.

4.5.14 Mount new amplifier and control panel assembly to the main frame brackets.

4.5.15 Connect amplifier and control panel wires to their appropriate terminal block locations as noted in 4.5.9.

4.5.16 Mount the clock assembly to the main frame.

4.5.17 Connect the 4 plugs to their respective receptacles on the panel assembly underside. (36, 37, 38, 39).

4.5.18 Position SYSTEM switch to OFF, CLOCK to OFF.

4.5.19 Connect battery terminal wires per Figure 4-2.

4.5.20 Lower recorder main frame into base and replace rear cross brace nuts and washers.

4.5 AMPLIFIER AND MAIN CONTROL PANEL ASSEMBLY REPLACEMENT (Cont.)

4.5.21 Replace external receptacles in their appropriate connector panel location and install the external connector guard plate.

4.5.22 If stylus has been removed, replace per 4.6.1.3, 4.6.1.4 and 4.6.1.5.

4.5.23 Perform battery test per 4.2.2.

4.5.24 Reinstall recorder drum per 3.1.9 through 3.1.12.

4.5.25 Connect Seismometer, perform amplifier balance test per 4.3.1 and return system to normal operation. If system is to be left inactive, position SYSTEM switch to CHG.

4.6 RECORDER MAINTENANCE AND ADJUSTMENTS

4.6.1 STYLUS REPLACEMENT

For ink recordings, the smoked paper stylus is replaced with an ink pen included in Ink Recording Kit MEQ-800-5. Refer to Figure 3-1 for system controls and parts identification. Refer to Figure 4-3 for ink recorder parts identification.

4.6.1.1 Position SYSTEM switch to OFF. DO NOT DISTURB SYSTEM CLOCK CONTROLS.

4.6.1.2 Loosen 4-40 brass screw in penmotor hub. Slide stylus mounting hub up on penmotor shaft until stylus retention spring clears end of motor shaft. Remove stylus. DO NOT ATTEMPT TO ROTATE PENMOTOR SHAFT.

4.6.1 STYLUS REPLACEMENT (Cont.)

4.6.1.3 Install replacement stylus on penmotor hub. (Center stylus hinge pin in groove on lower front of penmotor hub.)

4.6.1.4 Hold stylus in place with spring clip and lower penmotor hub until spring clip is secure to the motor shaft.

4.6.1.5 Position hub so stylus penmotor translation release knob is centered within stylus frame and tighten hub set screw. DO NOT OVERTIGHTEN.

CAUTION

USE OF OTHER THAN THE 4-40 BRASS MOUNTING SCREW WILL RESULT IN DAMAGE TO THE PENMOTOR HUB AND PENMOTOR SHAFT.

4.6.1.6 Remove penmotor mounting screw (1) and install ink cartridge mounting bracket (3) on penmotor assembly. (Use just removed mounting screw.)

4.6.1.7 Insert pierce and prime unit (2) into cartridge (5).

4.6.1.8 Insert ink cartridge in mounting bracket slot (bulb toward drum).

4.6.1.9 Attach the reduced diameter free end of the plastic capillary tubing (4) to the pen capillary tube (6).

CAUTION

IF PLASTIC CAPILLARY TUBING IS REVERSED, AIR LEAKAGE WILL CAUSE ERRATIC INKING. REDUCED DIAMETER END MUST CONNECT TO PEN CAPILLARY TUBE.

4.6.1.10 Ensure that plastic capillary tubing does not touch pen limit bracket. TUBING CONTACT CAN CAUSE ERRATIC RECORDING.

4.6.1 STYLUS REPLACEMENT (Cont.)

4.6.1.11 Prime the inking system by placing a finger over the end of the bulb while squeezing. Remove finger tip and release bulb. Continue pumping action until ink appears at pen tip. INKING SYSTEM MUST BE AIR TIGHT FOR PROPER INK FLOW.

4.6.1.12 Install record per 4.8.1 and 4.8.2.

4.6.1.13 Install drum per 3.1.9 through 3.1.12 and return system to operation.

NOTE

System should not be left inactive with ink recording system primed.

4.7 CLEANING INK RECORDING SYSTEM

Refer to Figure 4-3 for ink recording system parts identification.

4.7.1 Remove the pierce and prime from unit and place an absorbent material pad under it.

4.7.2 Fill syringe (8) with CLEAN ALCOHOL ONLY.

4.7.3 Place syringe tube over pen tip and back-flush alcohol through inking system. Repeat as required to clean system.

4.7.4 Use cleaning wire (7) if abnormal clogging is present at pen tip.

4.8 SMOKED RECORD PREPARATION

An 80 lb. heavy enamel paper is recommended for smoked records. The smoking procedure should be conducted in an area well ventilated but free of strong air currents. Record preparation prior to transport to the field is suggested.

The MEQ-800-01 Paper Smoking/Fixing Kit contains provisions for a spare recorder drum and materials for preparing smoked records.

4.8.1 Lay a 13 inch strip of ½ inch double sided tape along one end of the record paper.

4.8.2 Tightly wrap record around drum and join by pressing down on tape seam.

NOTE

Rubber cement or glue stick adhesive can be substituted for double sided tape. It should be applied in a light coat and allowed to "set" for about 5 minutes before record installation on drum.

4.8.3 Fill smoker unit with furnace or diesel fuel.

4.8.4 Light smoker unit wick and allow flame to stabilize.

4.8.5 Adjust wick for a large smoky flame.

4.8.6 Support drum by shaft ends and spin rapidly, moving the spinning drum through the smoke until it is uniformly blackened.

4.8.7 Wipe the edges of the drum flange and place drum in carrier. DO NOT USE ABRASIVE CLEANERS ON DRUM.

NOTE

Record drum installation instructions are contained in 3.1.9 through 3.1.12.

4.9 SMOKED RECORD PRESERVATION (FIXING)

Commercial liquid shellac diluted 1 part to 30 parts of grain or ethyl alcohol is normally used for preserving records. If liquid shellac is unavailable, white shellac (dry form) may be dissolved in grain or ethyl alcohol at a shellac/alcohol ratio of .1 lb/gal (12 Gm/Liter) and used as the preservative.

4.9.1 Remove fixing tray from the bottom of the case and fill tray with enough solution to cover record.

4.9.2 Carefully remove record from the drum.

4.9.3 Hold record face up and submerge one end. Draw entire record through solution ensuring completed coverage.

4.9.4 Hang record for about 10 minutes of initial air drying.

NOTE

Record should be dried several days before storage.

4.10 CLOCK STABILITY/ACCURACY

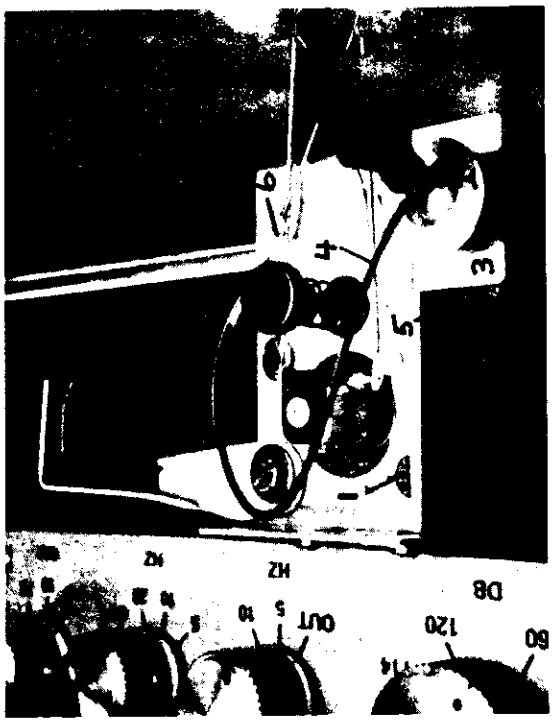
Comparison of system clock generated time marks versus radio input time marks can provide an indication of clock stability and accuracy. If system generated time marks appear to drift excessively through the duration of the record, the time base oscillator may require adjustment. Frequency/rate equivalencies are shown on Table 1-4. Refer to Section III for time marks operating instructions.

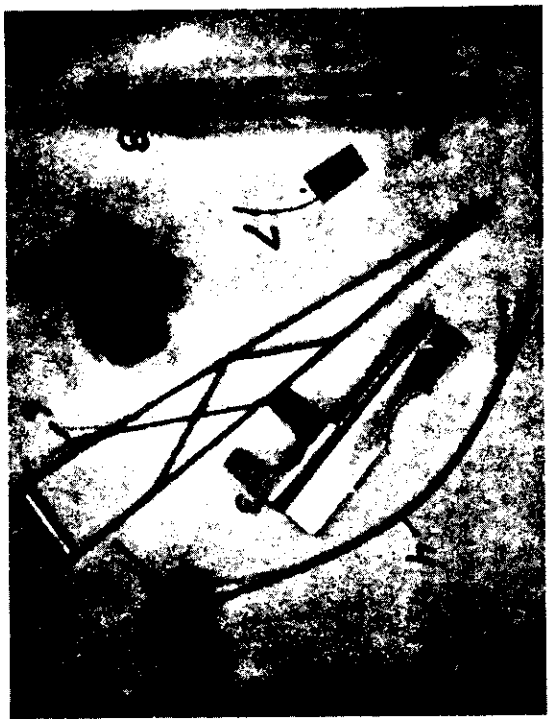
4.10.1 OSCILLATOR ADJUSTMENT (TS-300-1/-1A)

Refer to Figure 3-1 for controls and parts identification.

4.10.1.1 Remove the cap screw located at the front of the clock assembly panel for access to oscillator control.

4.10.1.2 Adjust oscillator clockwise to slow clock, counter-clockwise to speed up clock. The control rate is 7 milliseconds per hour for each turn of the ten-turn control.





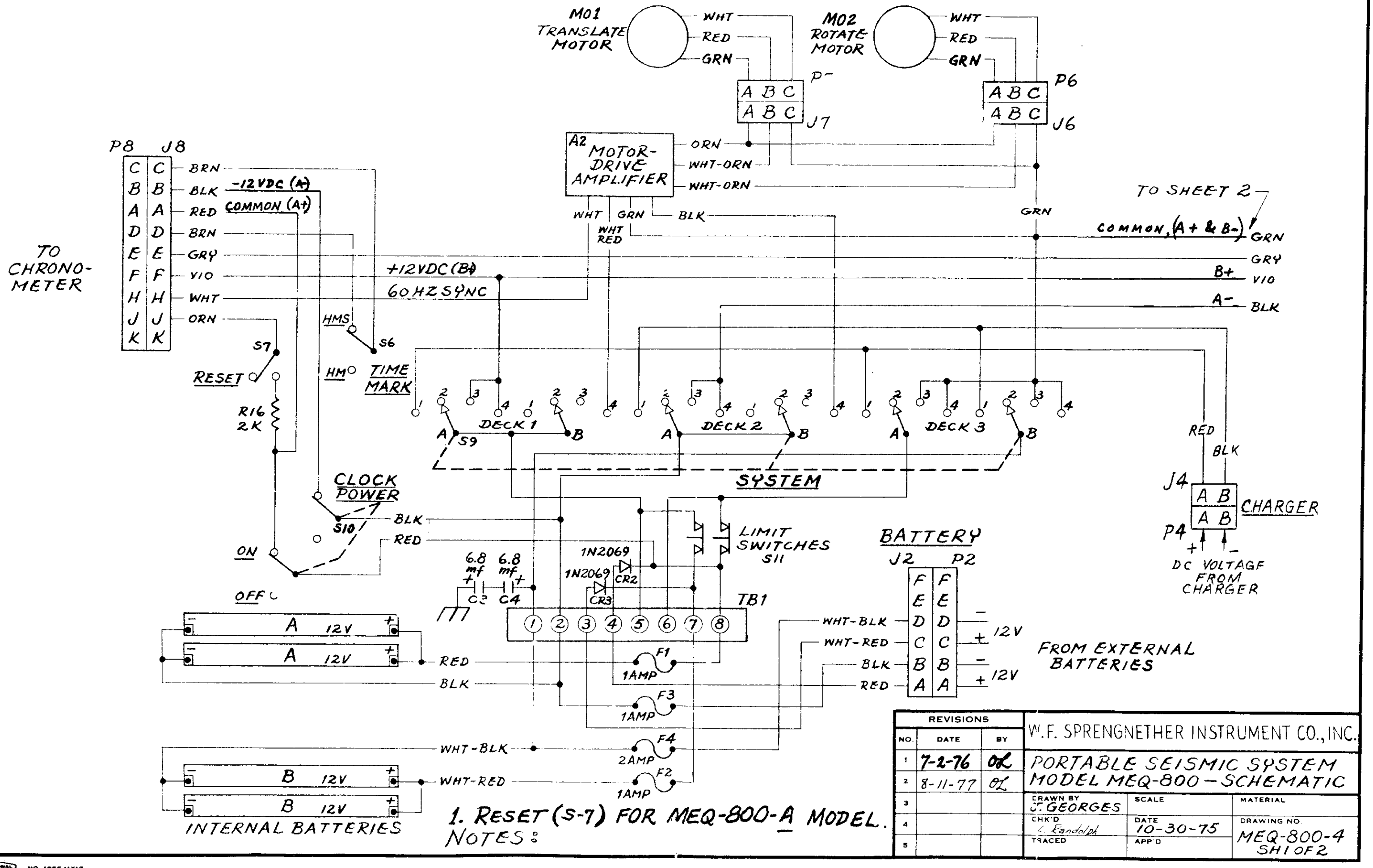
1..... PEN MOTOR MOUNTING
2..... PIERCE AND PRIME UNIT
3..... INK CARTRIDGE MOUNTING BRACKET
4..... INK TUBING*
5..... INK CARTRIDGE
6..... INK PEN CAPILLARY TUBE
7..... PEN CLEANING WIRE
8..... PEN CLEANING SYRINGE

*Replacement tube can be fabricated with vinyl tubing. Soften the tubing in hot water and reduce the diameter of one end by stretching and cooling.

INK RECORDING KIT

MEQ-800-05
PARTS IDENTIFICATION

FIGURE 4-3



1. RESET (S-7) FOR MEQ-800-A MODEL.

NOTES:

REVISIONS		
NO.	DATE	BY
1	7-2-76	OL
2	8-11-77	OL
3		
4		
5		

W.F. SPRENGNETHER INSTRUMENT CO., INC.

PORTABLE SEISMIC SYSTEM
MODEL MEQ-800 – SCHEMATIC

DRAWN BY J. GEORGES	SCALE	MATERIAL
CHK'D L. Randolph	DATE 10-30-75	DRAWING NO MEQ-800-4 SH 1 OF 2
TRACED	APP'D	

OPERATIONS MONITOR

M1

EXTERNAL CALIBRATE INPUT

J10

CR1 1N3019B

R2 182K

M03 PENMOTOR

RED BLK GRN YEL

WHT BLK

P9

A B C D

J9

ORN BRN

3 18.1K

METER

S8

DECK 1

DECK 2

DECK 3

DECK 4

R15 5M CW

R4 300Ω

R7 18.2Ω

R6 200Ω

FROM SHEET 1

GRN

GRY

VIO

BLK

WHT

GRY

WHT

R1 1K

OFF EXT MAN

S12

CALIB SIGNAL

TIME SIGNAL S5

RAD MAN NOR

R18 330K

R20 16K

Q2 2N 3391A

C6 2.2mf

R17 33K

R19 1.5K

C5 6.8mf

R13 20Ω

CR4

Q1 2N 525

C7 2.2mf

R14A 10K CW

R9 2M

R10 1M

R11 1M CW

R5 681Ω

WHT GRY

C2 .022 mf

BLU 1000 BRN

T1

50

GRN YEL

RED BLK

P5

A B C D

A B C D

RADIO

J5

RADIO INPUT

R12 1K

R14B 10K

J1

A B C D E F

A B C D E F

SEISMOMETER

P1

SIGNAL INPUT

A1 AS110 PREAMP. SCHEM. 20B006

SEIS. SIGNAL IN

SIGNAL RET

C1 .022 mf

PREAMP SIGNAL OUT

A1 AS110 MAIN AMP. SCHEM. 20B006

VIO TIME MARKS IN

RED +12VDC

GRN GND

BLK -12VDC

RED MAIN AMP SIGNAL IN

BLK GND

PEN AMP OUTPUT HI LO

TAPE OUTPUT HI GND

RED

BLK

J3

A B C

A B C

TAPE

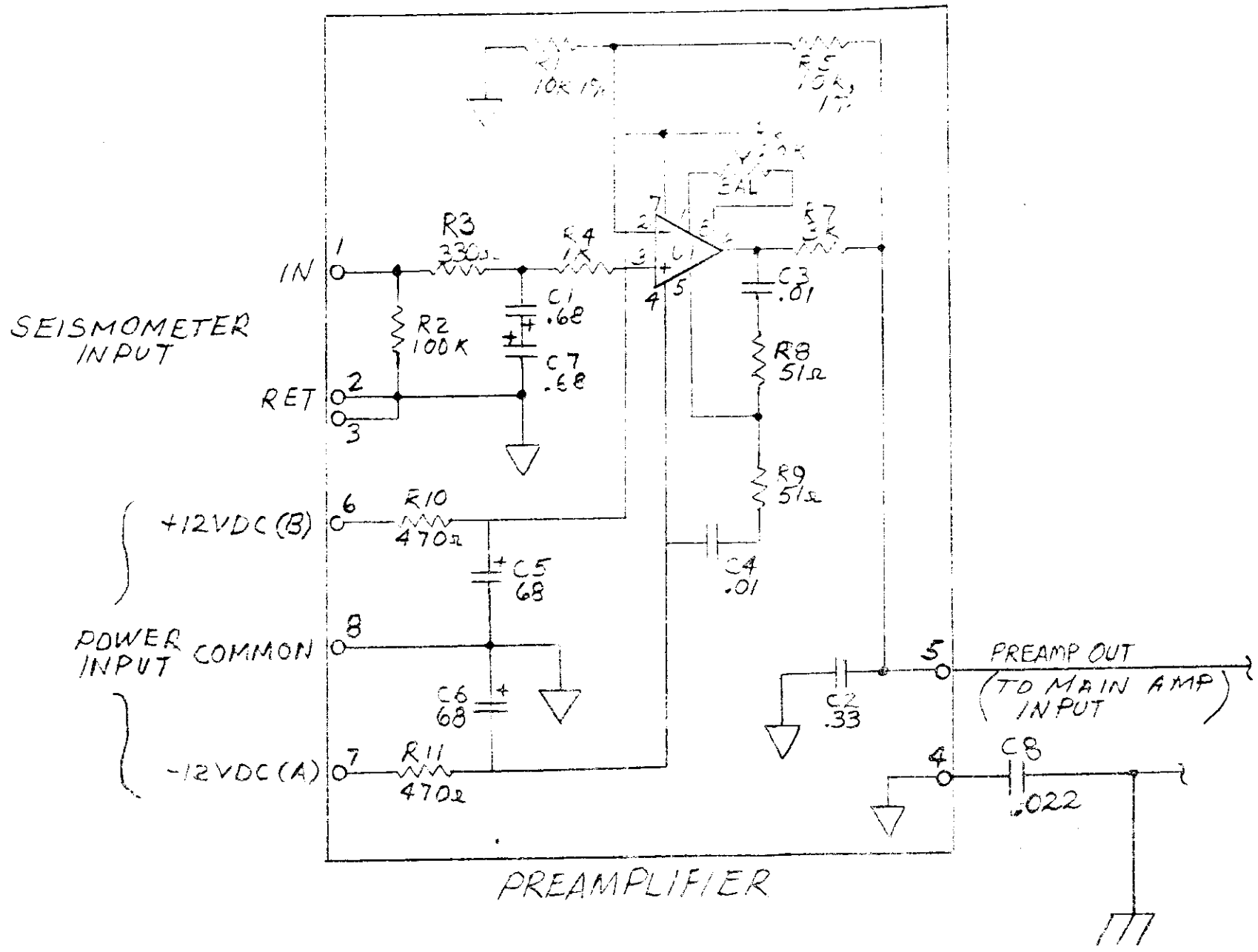
P3

SIGNAL OUTPUT

NOTES ON SH. 1

REVISIONS			W.F. SPRENGNETHER INSTRUMENT CO., INC.
NO.	DATE	BY	
1	7-2-76	OL	PORTABLE SEISMIC SYSTEM MODEL MEQ-800-SCHEMATIC
2			
3			DRAWN BY J. GEORGES — SCALE — MATERIAL
4			CHK'D L. Pendolph — DATE 10-30-75 — DRAWING NO. MEQ-800-4 SH 2 OF 2
5			TRACED — APP'D

REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVED



PREAMPLIFIER

SEISMOMETER INPUT

2. THE SYMBOL ▽ INDICATES DC COMMON, NOT CHASSIS GND.

(E) ALL CAPS ARE IN μf.
(A) ALL RESISTORS ARE ¼W, 5% EXCEPT R1 & R5 WHICH ARE ⅛W, 1%.

1. UNLESS OTHERWISE SPECIFIED:

NOTES:

NEXT ASSY	USED ON
APPLICATION	

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES ARE:
FRACTIONS DECIMALS ANGLES
± .XX ± ±
.XXX ±

MATERIAL

FINISH

DO NOT SCALE DRAWING

CONTRACT NO.

APPROVALS	DATE
DRAWN MP	3/11/81
CHECKED	

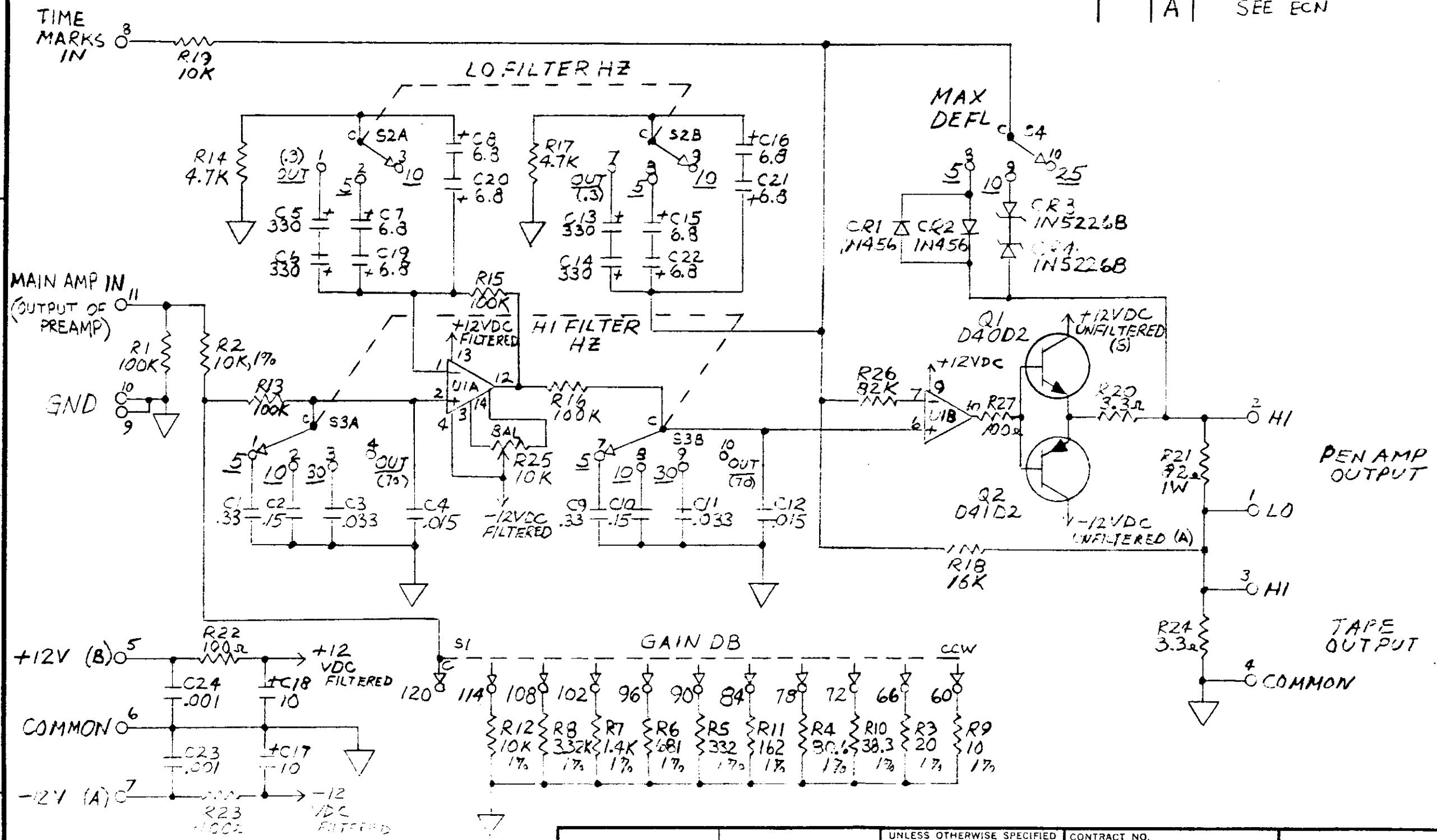
W.F. Sprengnether Instrument Co., Inc.

AS110 PREAMPLIFIER SCHEMATIC

SIZE	CODE IDENT NO.	DRAWING NO.
B		10B0023

SCALE | SHEET 3 OF 3

REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVED
	A	SEE ECN	3/11/91	



NOTES:

1. UNLESS OTHERWISE SPECIFIED:
(A) ALL RESISTORS ARE IN OHMS.
(B) ALL CAPS ARE IN μF.

NEXT ASSY	USED ON
	A5110
APPLICATION	

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES ARE:
FRACTIONS DECIMALS ANGLES
± .XX ± ±
.XXX ±

MATERIAL

FINISH

DO NOT SCALE DRAWING

CONTRACT NO.

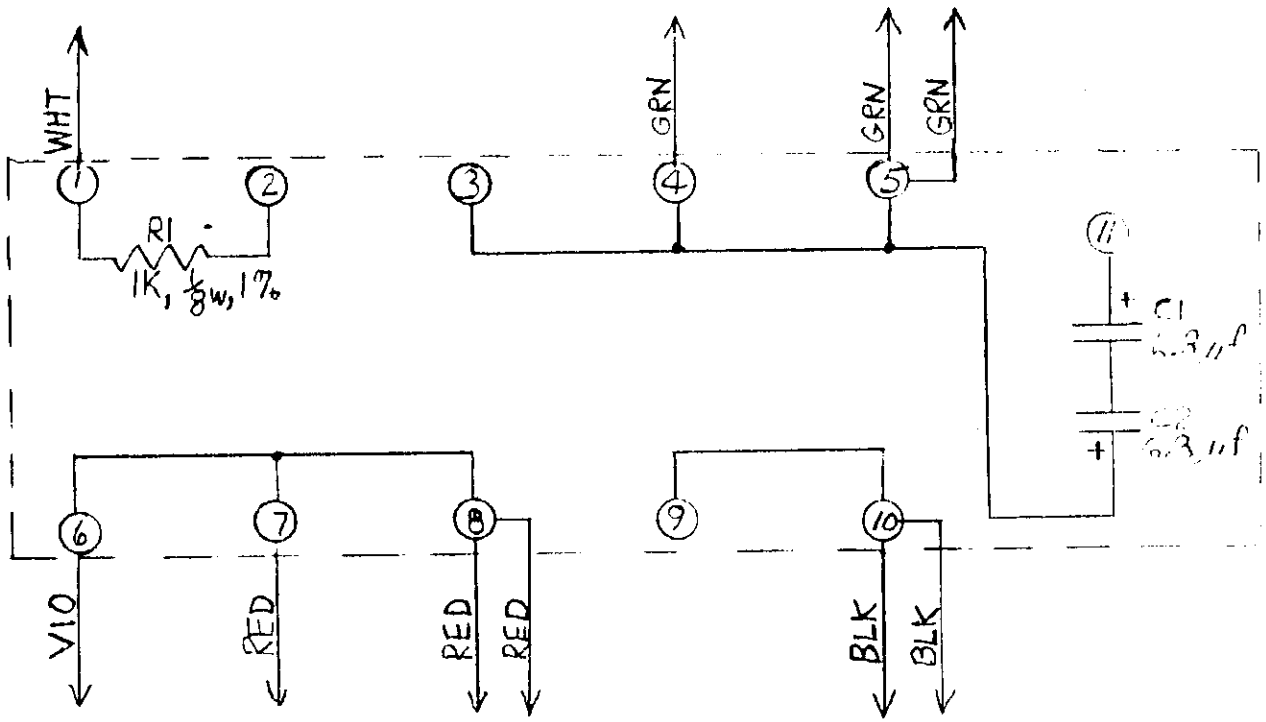
APPROVALS	DATE
DRAWN MP	3/11/91
CHECKED	

W.F. Sprengnether Instrument Co., Inc.

A5110 MAIN AMPLIFIER FILTER SCHEMATIC

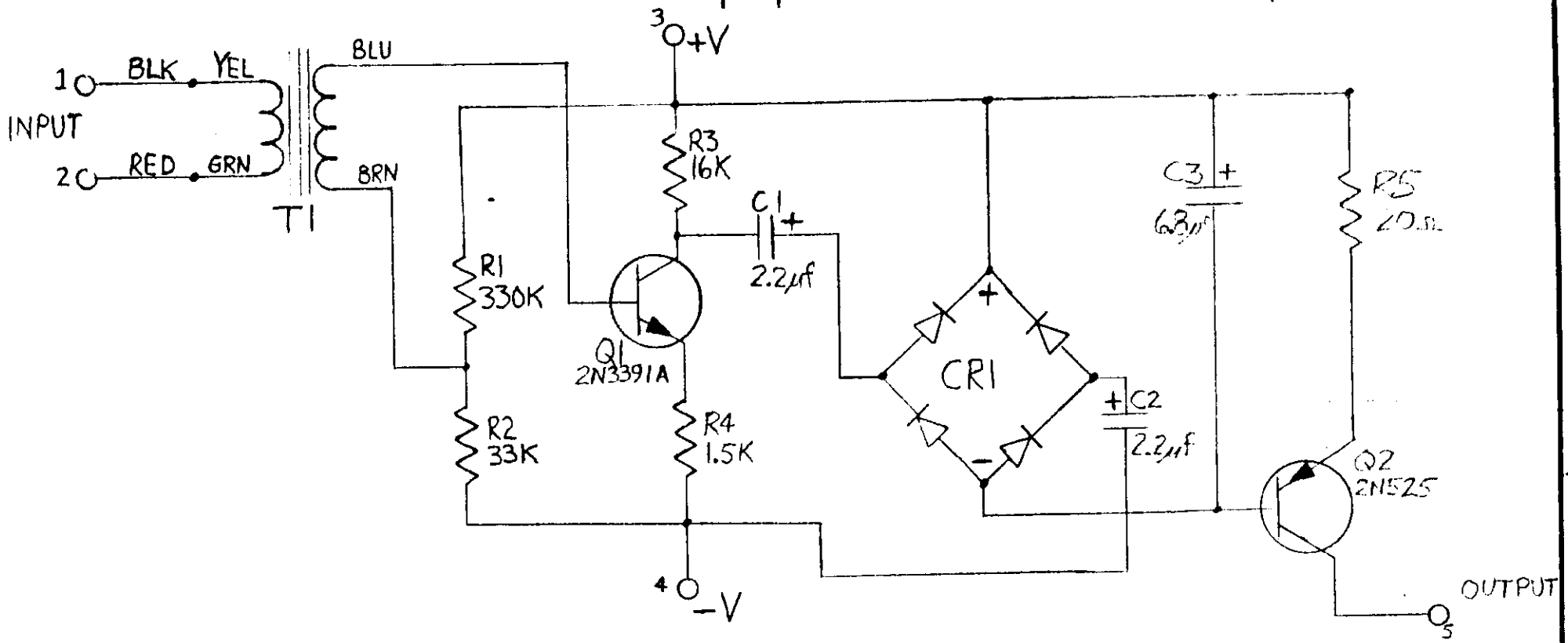
SIZE	CODE IDENT NO.	DRAWING NO.
B		1080024
SCALE		SHEET 2 OF 2

REVISIONS			
LTR	DESCRIPTION	DATE	APPROVED



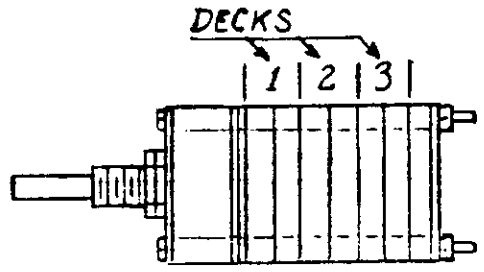
		UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE:	CONTRACT NO.	**W.F. Sprengnether Instrument Co., Inc.**	
		FRACTIONS DECIMALS ANGLES ± .XX ± ± .XXX ±	APPROVALS / DRAWN MP	DATE 3/6/81	MEQ-800 DISTRIBUTION BOARD SCHEMATIC
		MATERIAL	CHECKED		
		FINISH		SIZE A	CODE IDENT NO.
NEXT ASSY	USED ON			SCALE —	SHEET 3 OF 3
APPLICATION		DO NOT SCALE DRAWING			

REVISIONS			
LTR	DESCRIPTION	DATE	APPROVED

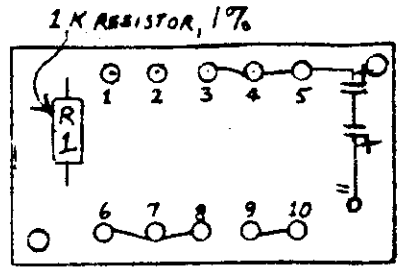


		UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE:	CONTRACT NO.	**W.F. Sprengnether Instrument Co., Inc.**	
		FRACTIONS DECIMALS ANGLES ± .XX ± ± .XXX ±	APPROVALS / DRAWN MP	DATE 3/6/81	MEQ-800-1 RADIO CIRCUIT BOARD SCHEMATIC
		MATERIAL	CHECKED		SIZE A / CODE IDENT NO. / DRAWING NO. 02725
		FINISH			SCALE — / SHEET 3 OF 3
NEXT ASSY	USED ON	DO NOT SCALE DRAWING			
APPLICATION					

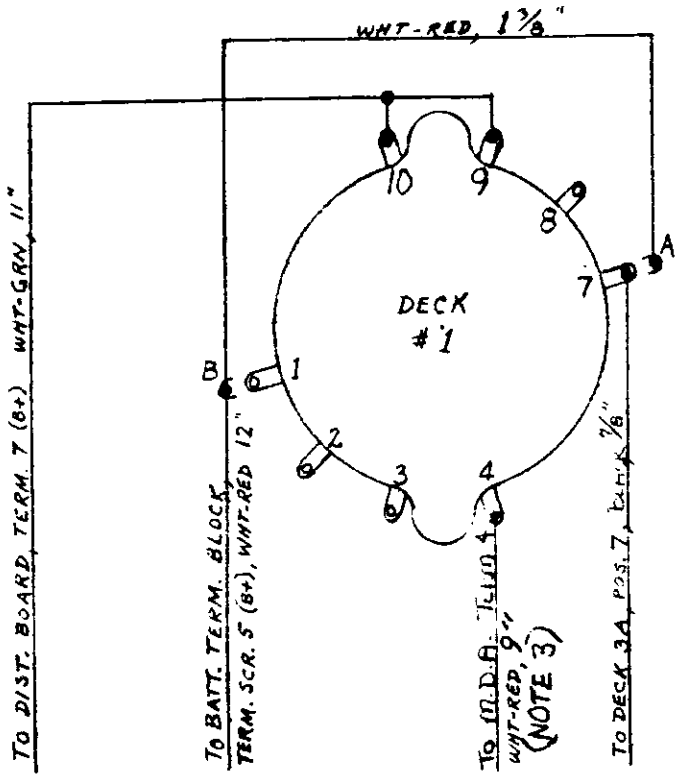
DATE	BY	REVISION RECORD	AUTH.	DR.	CK.
4-25-73		ENTIRELY REDRAWN	R.H.	OK	
10-3-73	BO	COMPLETELY UPDATED		G.T.	

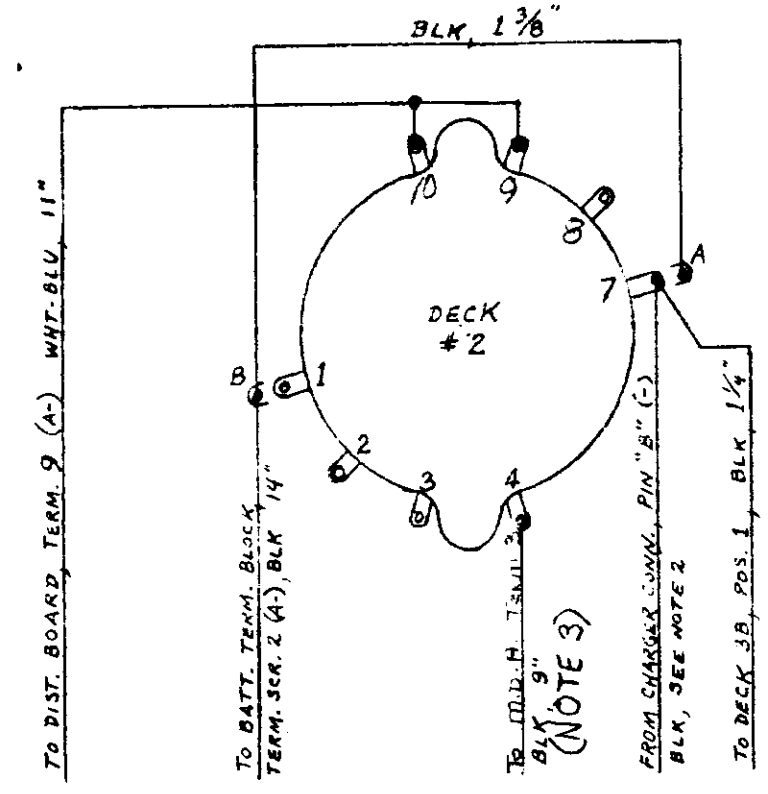


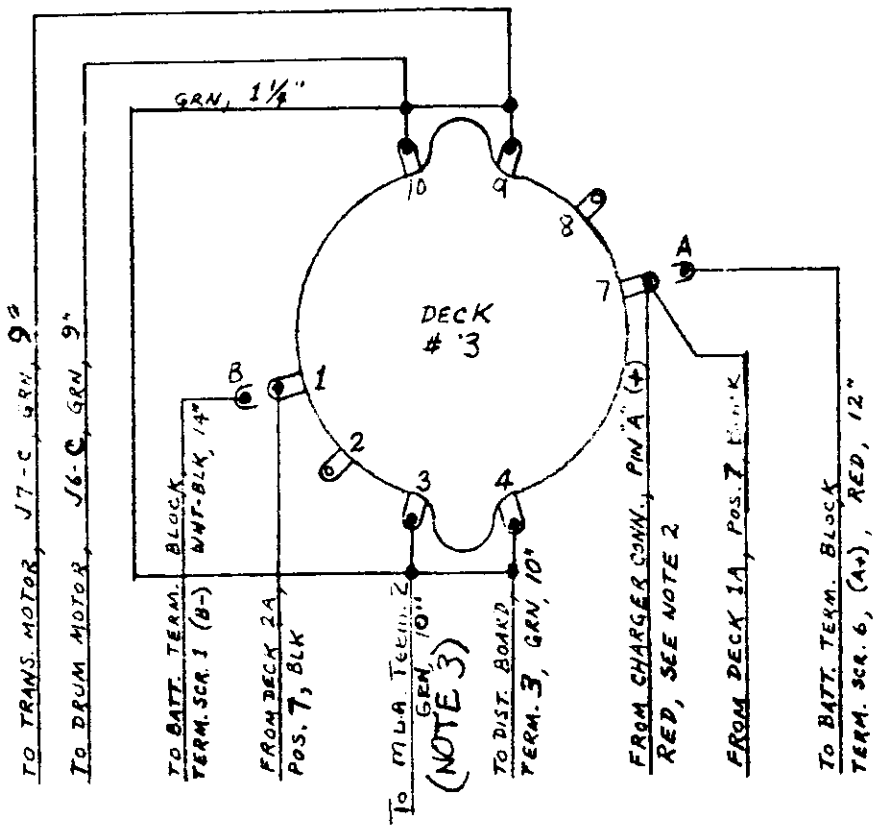
ACTUAL SIZE OF SWITCH.
CONTACTS NOT SHOWN.



DISTRIBUTION BOARD, 10 TERMINALS,
3, 4 & 5 ARE "COMMON" (A+ AND B-),
6, 7 & 8 ARE B+ AND 9 & 10 ARE A-.





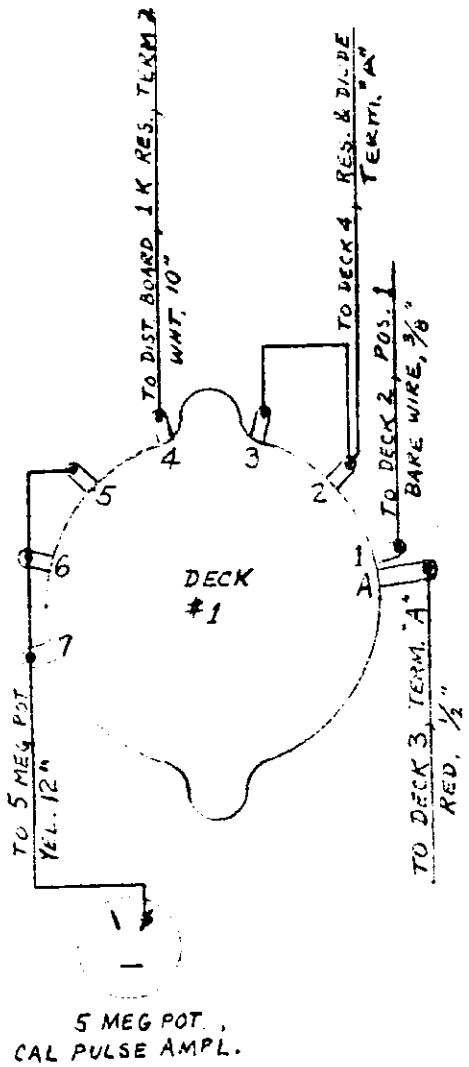


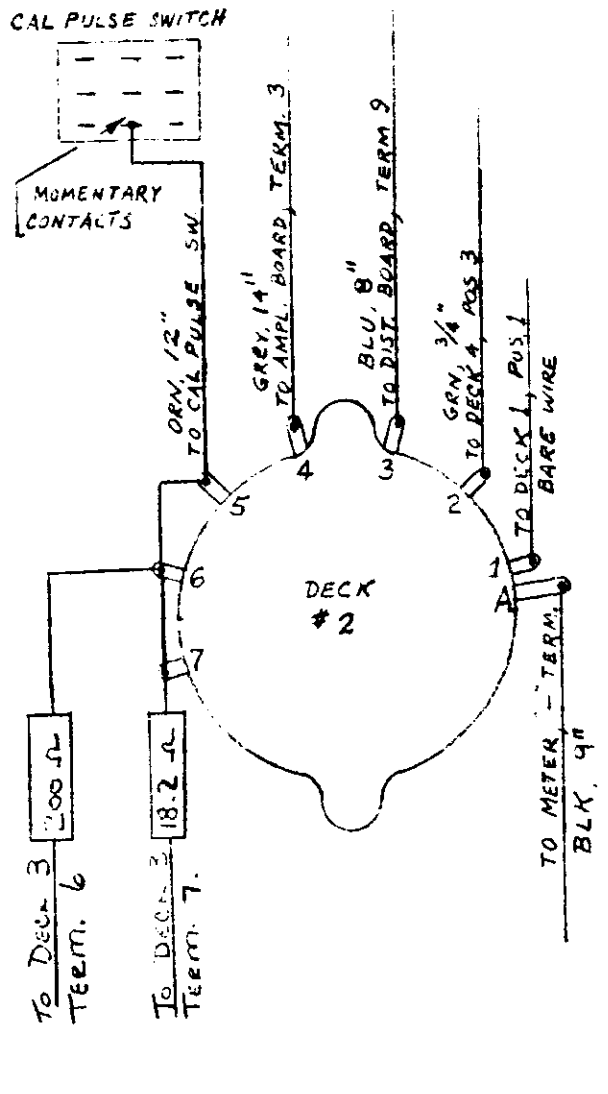
SWITCH DECKS SHOWN THREE TIMES ACTUAL SIZE.

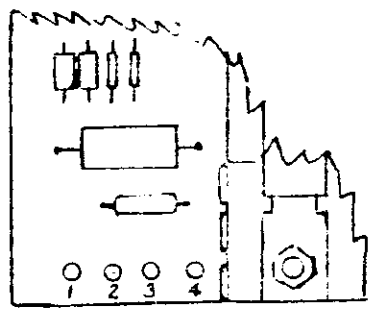
NOTES:
1. SWITCH IS GRAYHILL No. 9A30-03-2-FS
2. INSTALLATION OF WIRES IN CHARGER CABLE ORIGINATES AT CHARGER CONNECTOR.
3. " " " " " " M.D.A. ORIGINATES AT M.D.A CONNECTOR.

TOLERANCES (EXCEPT AS NOTED)	W. F. SPRENGNETHER INSTRUMENT CO., INC.		
DECIMAL ± ———		SCALE 1 TO 1 EXCEPT AS NOTED	DRAWN BY D.P. Lenz
			APPROVED BY
FRACTIONAL ± ———	TITLE WIRING DIAGRAM - SYSTEM SWITCH - MEQ-800		
ANGULAR ± ———	DATE 4-24-73	DRAWING NUMBER 102007	

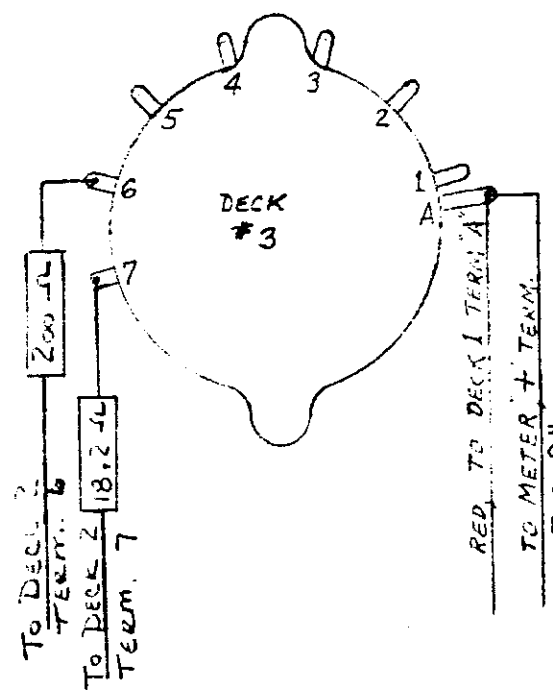
DATE	SYM	REVISION RECORD	AUTH.	DR.	CK.
10-3-73		COMPLETE W/PLATE		GT	

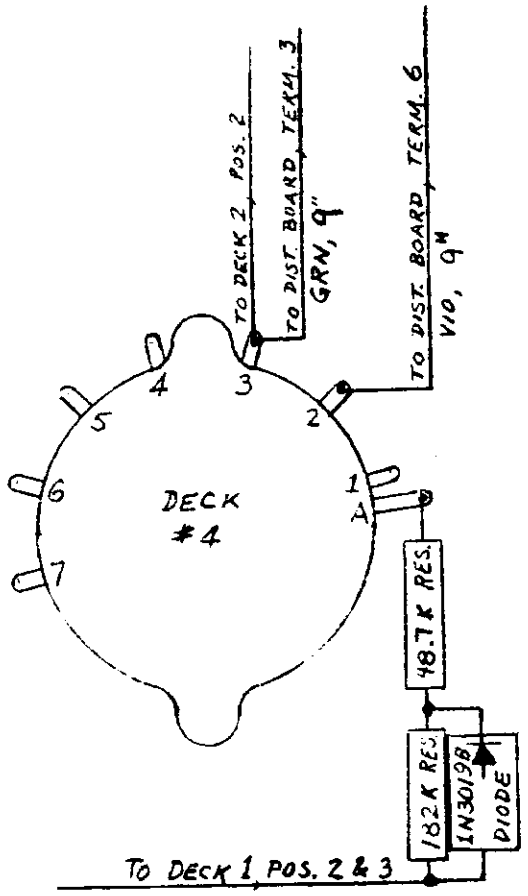




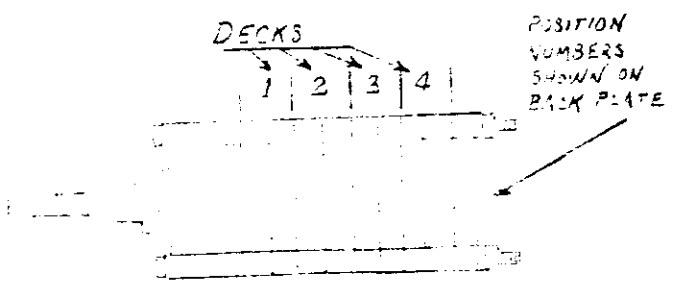


CORNER OF AMPLIFIER BOARD
4 TERMINALS

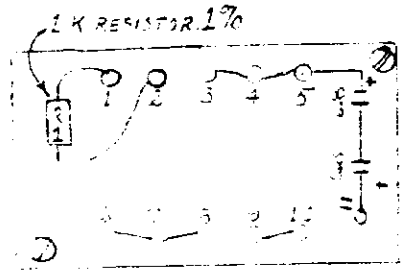




SWITCH DECKS SHOWN THREE TIMES ACTUAL SIZE.



ACTUAL SIZE OF SWITCH.
CONTACTS NOT SHOWN.

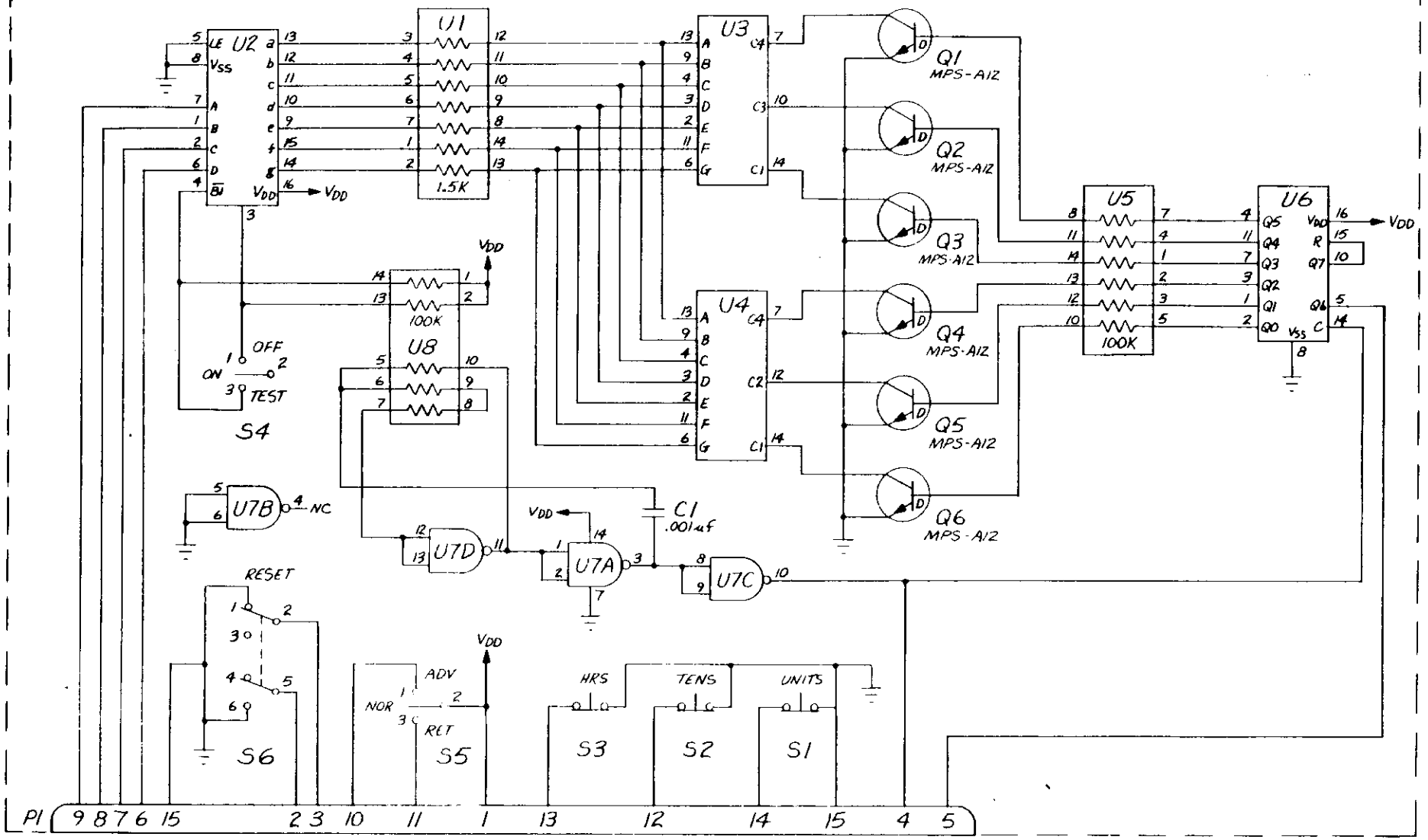


DISTRIBUTION BOARD, 10 TERMINALS, 3, 4 & 5 ARE COMMON (A+ AND B-),
6, 7 & 8 ARE B+ AND 9 & 10 ARE A-.

NOTE:
1. SWITCH IS GRAYHILL No. 9A30-04-1-7N.

TOLERANCES (EXCEPT AS NOTED)	W. F. DRENNONETHER INSTRUMENT CO. INC.		
DECIMAL ±		SCALE 1=1 EXCEPT AS NOTED	DRAWN BY G.R. Lenz
			APPROVED BY
FRACTIONAL ±	TITLE WIRING DIAGRAM - METER SWITCH - MEQ-300		
ANGULAR ±	DATE 1-25-73	DRAWING NUMBER 102028	2-2

MADE IN U.S.A.
30166



REVISIONS		
NO	DATE	BY
1		
2		
3		
4		
5		

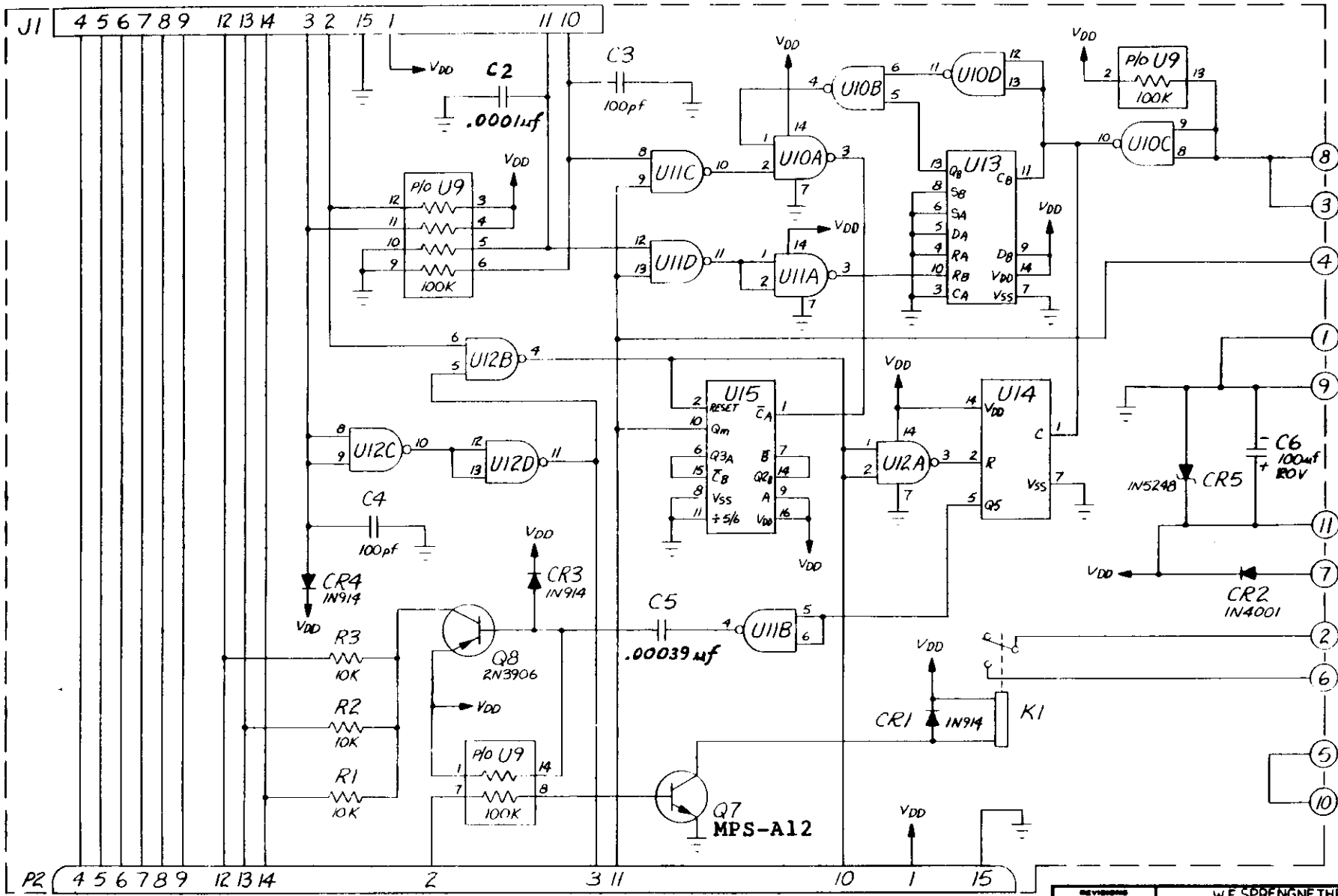
W. F. SPRENGNETHER INSTRUMENT CO. INC.

TS400 DIGITAL TIMING SYSTEM

DRAWN BY SPRINGMEYER | SCALE NONE | DATE 2-12-76 | DRAWING NO TS400-01-1

S-5

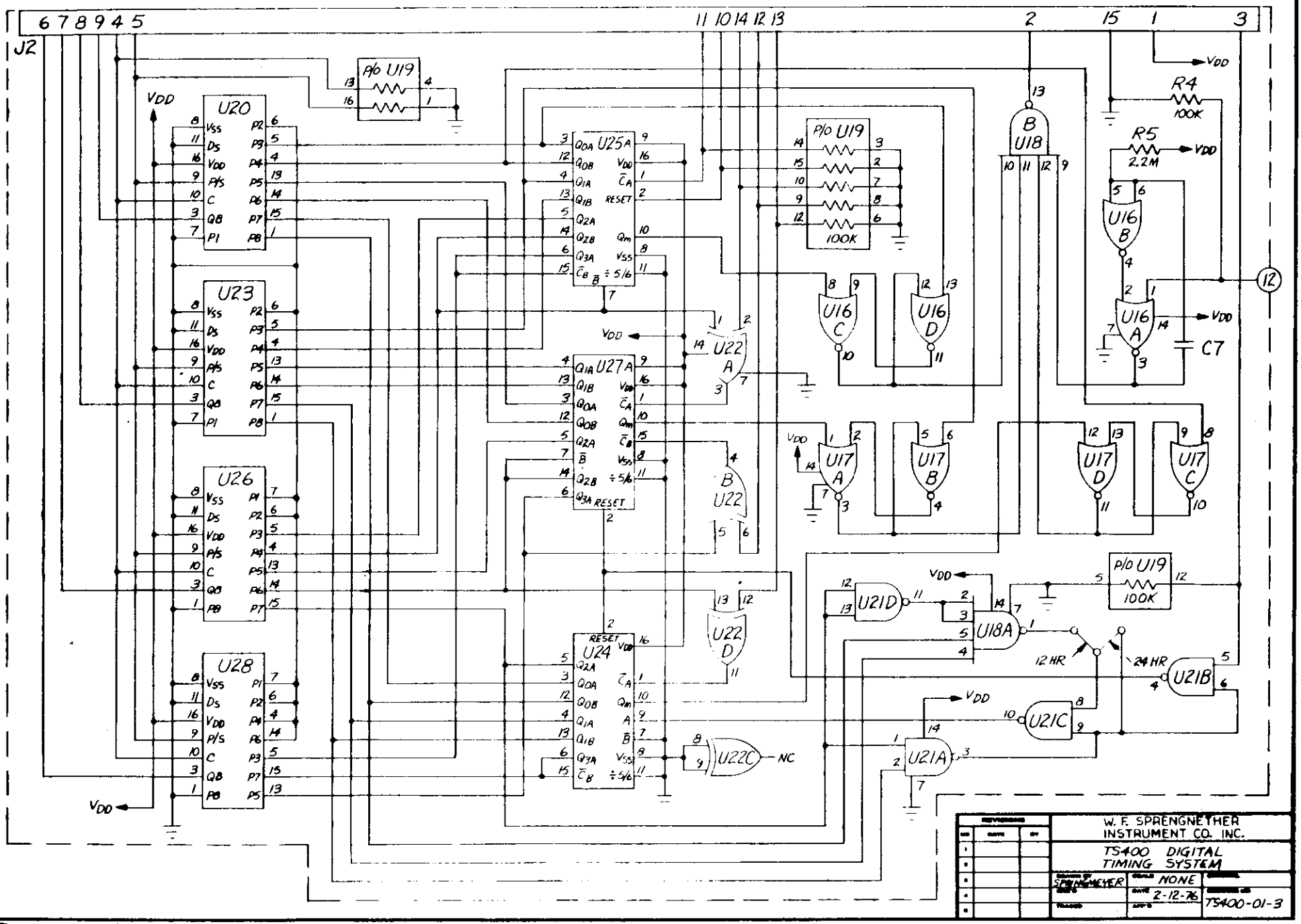
SH 2 OF 3



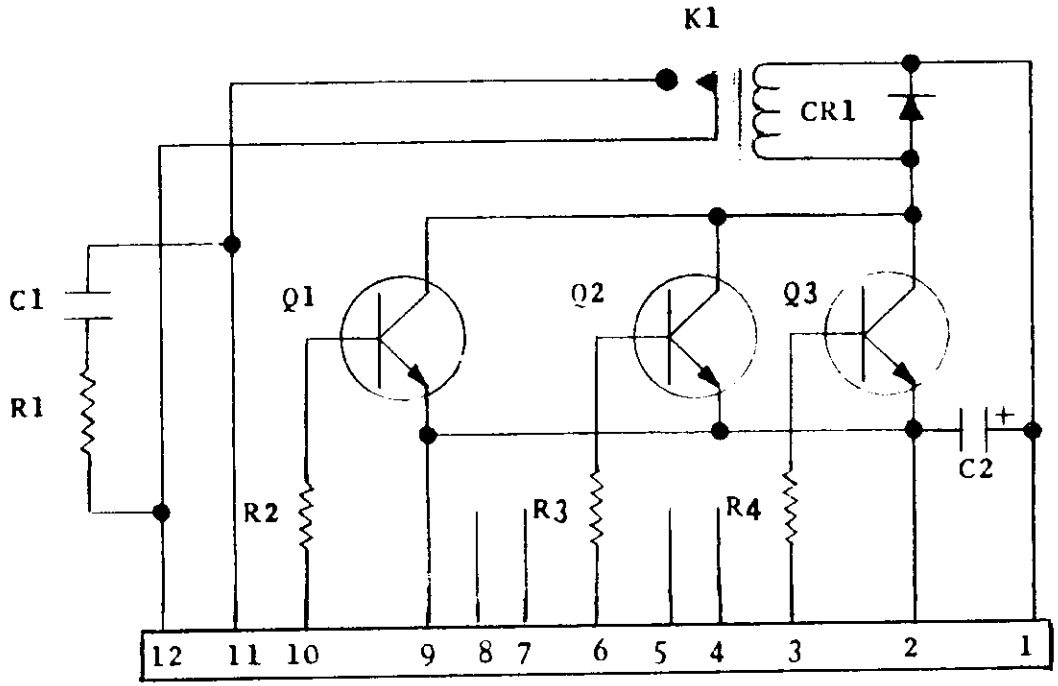
	W.F. SPRENGNETHER INSTRUMENT CO. INC.	
6/77	TS400 DIGITAL TIMING SYSTEM	
	SPRENGMEYER / NONE	
	2-12-76	TS400-01-2

95

SH 2 OF 3


J2
6 7 8 9 4 5
11 10 14 12 13
2 15 1 3
VDD
U20
U23
U26
U28
U25A
U27A
U24
U22A
U22B
U22C
U22D
P/O U19
100K
R4
100K
R5
2.2M
C7
U16A
U16B
U16C
U16D
U17A
U17B
U17C
U17D
U18A
B U18
U21A
U21B
U21C
U21D
12 HR
24 HR
NC
W. F. SPRENGNETHER INSTRUMENT CO. INC.
TS400 DIGITAL TIMING SYSTEM
NONE
2-12-76
TS400-01-3

DATE	SYM	REVISION RECORD	AUTH.	DR.	CK.
5-8-75	A	ADDED C2 INFO. CORRECTED DIODE & RELAY NUMBERS		OK	
10-30-75	B	ADDED CONNECTOR DESIGNATION			



PIN NO.	FUNCTION
1	+12 VDC
2	-12 VDC
3	Seconds Input
4	Spare
5	Spare
6	Minutes Input
7	Spare
8	Spare
9	-12 VDC
10	Hours Input
11	Output, Low
12	Output, High

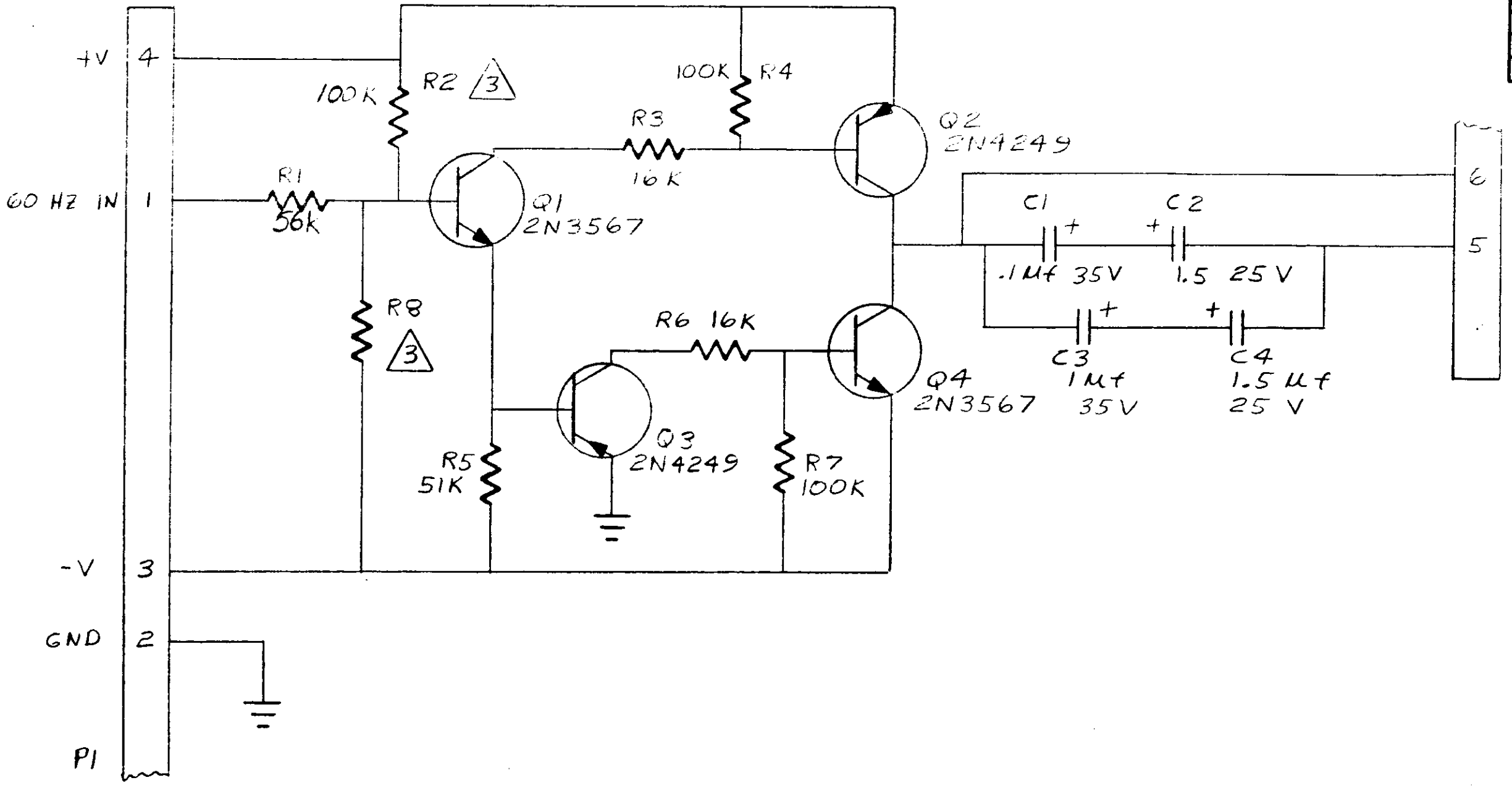
BILL OF MATERIALS

C1 Capacitor, Ceramic, Disc, 4700pf @600WVDC
C2 Capacitor, Tantalum, 1 mf, 35VDC, 10%
R1 Resistor, 270 Ohm, 1/4W, 5%
R2, 3, 4 Resistor, 24K, 1/4W, 5%
Q1, 2, 3 Transistor, 2N2369A
CR1 Diode, 1N662
K1 Relay, Elec-Trol No. 4040-1

NOTE: This module and a TS-300-1 T.C.X.O. comprise the no-display timing unit on the MEQ-800-A

TOLERANCES (EXCEPT AS NOTED)	W. F. SPRENGNETHER INSTRUMENT CO., INC.		
DECIMAL ± N/A	Used on: MEQ-800-A	SCALE N/A	DRAWN BY / APPROVED BY
FRACTIONAL ± N/A	TITLE: SCHEMATIC, ELECTRICAL, REED RELAY MODULE		
ANGULAR ± N/A	DATE	DRAWING NUMBER: TS-300-2	

DATE	SYM	REVISION RECORD	AUTH.	DR.	CK.
4/77	C		J. H.		
5/81	D	CHANGE VALUE OF R1 & R2	MP		



4. NEXT ASSY: 10C0048

3. R2 ON PA-1 ONLY, R8 ON PA-2 ONLY
2. THIS DWG. REDRAWN FROM 20B0028 REV B
1. ALL RESISTORS ARE IN OHMS, 1/4 W, 5% UNLESS OTHERWISE SPECIFIED

NOTES:

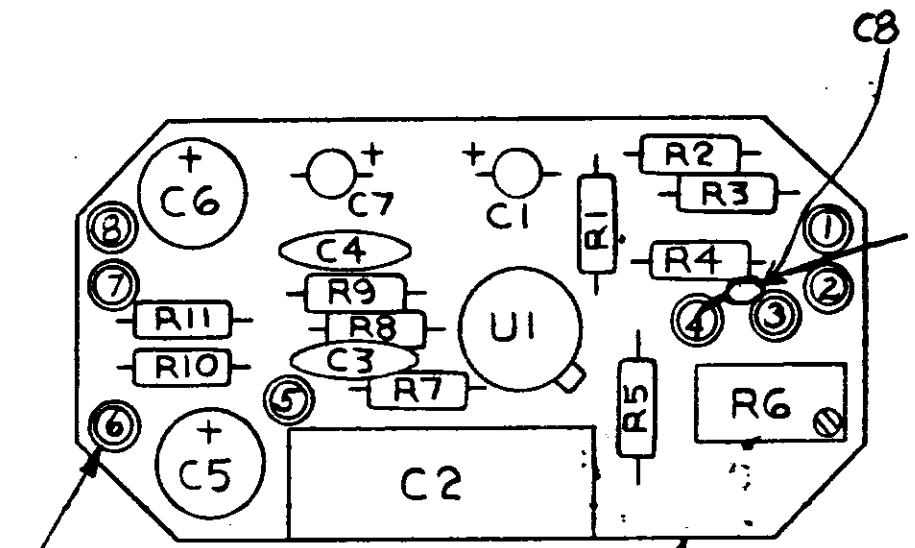
TOLERANCES (EXCEPT AS NOTED)	W.F. SPRENGNETHER INST. CO		
DECIMAL ±		SCALE	DRAWN BY HENSON
			APPROVED BY
FRACTIONAL ±	TITLE SCHEMATIC - PA-1 POWER AMPLIFIER		
ANGULAR ±	DATE	DRAWING NUMBER 20B0028	

MEQ-800 MAIN FRAME PARTS LIST (1 of 3)	
Part No.	Description
A_1	Preamplifier & Filter-Amplifier Subassembly, AS-110
A_2	Motor-Drive Amplifier Subassembly
C_1, C_2	Capacitor .022 mfd (Centralab UK16-223)
C_3, C_4, C_5	Capacitor 6.8 mf, 35 VDC, Tant.
C_6, C_7	Capacitor 2.2 mf, 35 VDC, Tant.
CR_1	Zener Diode 1N3019B
CR_2, CR_3	Diode 1N2069
CR_4	Rectifier Bridge (Motorola MDA920A-1)
F_1, F_2, F_3	Fuse, 1 Ampere (Bussman #AGC1)
F_4	Fuse, 2 Ampere (Bussman #AGC2)
J_1	Connector (Bendix PTO2E-10-98S)
J_2	Connector (Bendix PTO2E-10-6S)
J_3	Connector (Bendix PTO2E-8-3S)
J_4	Connector (Bendix PTO2E-8-2S)
J_5	Connector (Bendix PTO6A-8-4S(SR)
J_6, J_7	Connector (Positronic #MGH3F-SC-LRN)
J_8	Connector (Positronic #GH9F-SC-LRN-O)
J_9	Connector (Positronic #GH4F-SC-LRN-O)
J_{10}	Phone Jack (Switchcraft Tini-Jax #41)
M_1	Panel Meter, 0-100 Microamperes DC (Simpson Model 4295, 1800 ohms)
MO_1	Translation Drive Motor (A.W.Haydon H81399-M)

MEQ-800 MAIN FRAME PARTS LIST (2 of 3)	
Part No.	Description
MO_2	Rotation Drive Motor (A.W.Haydon H81399-M)
MO_3	Penmotor (MFE #T4-150-B Torque Motor)
P_1	Connector (Bendix PTO6A-10-98P(SR)
P_2	Connector (Bendix PTO6A-10-6P(SR)
P_3	Connector (Bendix PTO6A-8-3P(SR)
P_4	Connector (Bendix PTO6A-8-2P(SR)
P_5	Connector (Bendix PTO2E-8-4P)
P_6,P_7	Connector (Positronic #MGH3M-SC-LS-H7)
P_8	Connector (Positronic #GH9M-SC-LS-H10S)
P_9	Connector (Positronic #GH4M-SC-LS-H10S)
P_{10}	Phone Plug (Switch Craft, Tini Plug #750)
Q_1	Transistor 2N525
Q_2	Transistor 2N3391A
R_1	Resistor 1000 Ohms 1% ¼ Watt
R_2	Resistor 182K Ohms 1% ¼ Watt Metal Film
R_3	Resistor 48.7K Ohms 1% ¼ Watt Metal Film
R_4	Resistor 300 Ohms 5% ¼ Watt
R_5	Resistor 681 Ohms 1% ¼ Watt Metal Film
R_6	Resistor 200 Ohms 1% ¼ Watt Metal Film
R_7	Resistor 18.2 Ohms 1% ¼ Watt Metal Film
R_9	Resistor 2 Megonms 5% ¼ Watt
R_{10},R_{11}	Resistor 1 Megohm 5% ¼ Watt

MEQ-800 MAIN FRAME PARTS LIST (3 of 3)	
Part No.	Description
R_{12}	Resistor 1000 Ohms 5% ¼ Watt
R_{13}	Resistor 20 Ohms 5% ¼ Watt
$R_{14}A,B$	Dual Potentiometer 10K Ohms/10K Ohms
R_{15}	Potentiometer 5 Meg CCW Log Taper
R_{16}	Resistor 2K Ohms 5% ¼ Watt
R_{17}	Resistor 33K Ohms 5% ¼ Watt
R_{18}	Resistor 330K Ohms 5% ¼ Watt
R_{19}	Resistor 1.5K Ohms 5% ¼ Watt
R_{20}	Resistor 16K Ohms 5% ¼ Watt
S_5	Time Signal Switch (C & K 7107)
S_6	Time Mark Switch (C & K 7101)
S_7	Reset Switch (C & K 7108KB)
S_8	Meter Switch, 4 Pole, 7 Position (Grayhill #9A30-04-1-7-N)
S_9	System Switch 6 Pole, 4 Position (Grayhill #9A30-03-2-4-S)
S_{10}	Clock Power Switch (C & K 7201KB)
S_{11}	Limit Switches (Microswitch 1SM1/JS-294)
S_{12}	Calibrate Signal Switch (C & K 7307)
T_1	Transformer (Stancor PMTF-73)
TB_1	Battery Terminal Block (Cinch #8-171)

REVISIONS		
LTR	INIT	DATE
A ECN 63		12/14/73



NOTES:

1. SEE SEPARATE SHEET(S) FOR B/M.
2. ITEM 4, ALUMINUM ENCLOSURE, TO BE SUPPLIED TO CUSTOMER AS SEPARATE ITEM, ALONG WITH PC BD ASSY.

DASH NO	NEXT ASSY	USED ON
-1		AS-110
APPLICATION		

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES
DECIMALS FRACTIONS±
.XX±
.XXX± ANGLES± °

REMOVE BURRS & SHARP EDGES, R. (OR CHAMFER) MAX.
DO NOT SCALE THIS PRINT

MATERIAL

DRAWN	C. R.	11-15-73
CHECK		
ENG/DES	[illegible]	11/20/73
PRODUCT CATEGORY	[illegible]	11/21/73
INSTRUMENT TYPE		

DEVELOPMENT NO.

SUPERSEDES

INTERFACE TECHNOLOGY, INC.

TITLE ASSY, PC BD - AS 110 PREAMPLIFIER

SIZE	DRAWING NO.	REV.
B	10B0023	B

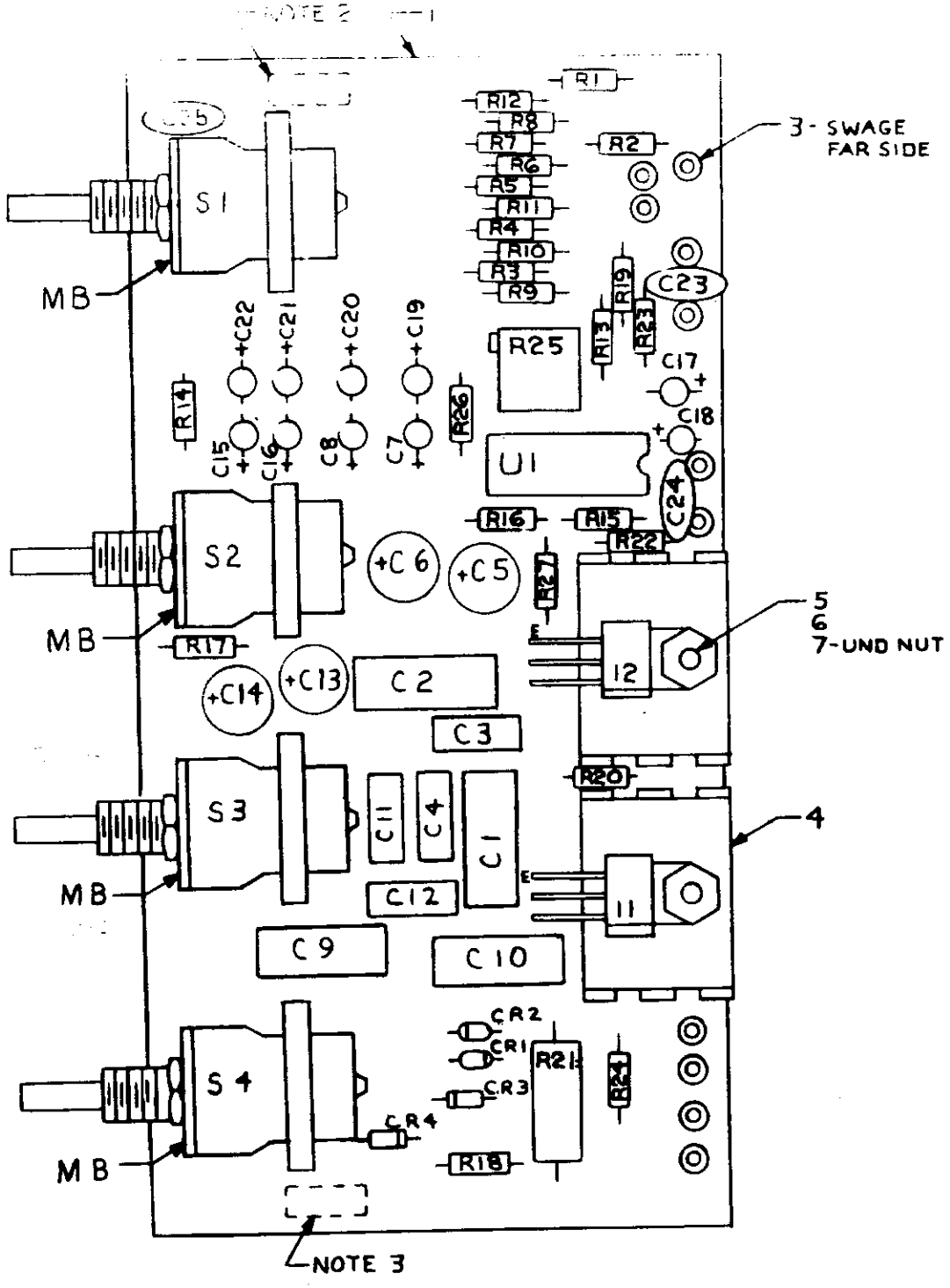
SCALE 2:1 SHT. 2 OF 3

DATE	NEXT ASSY:
3/6/81	

DATE	SYM	REVISION RECORD	DR	CK

ITEM NO.	QUAN.	REF. DESIG.	DESCRIPTION	PART NO.	SPRENCO CONTROL NO.
1.	1	PCB	Board, P. C.	50B0059	
2.	Ref		Schematic	10B0023	
3.	8		Terminal	1562-2	82 011 0
4.	1		Enclosure, Aluminum	2417	34 002 0
5.	1	R1	Resistor 10 ohm 1/8W 1%		78 002 0
6.	1	R2	" 100K 1/4W 5%		78 242 0
7.	1	R3	" 330 ohm 1/4W 5%		78 213 4
8.	1	R4	" 1K 1/4W 5%		78 220 0
9.	1	R5	" 10K 1/8W 1%		78 055 0
10.	1	R6	Potentiometer, 20K	3299W-1-203	73 024 0
11.	1	R7	Resistor 3K 1/4W 5%		78 224 0
12.	2	R8,R9	" 51 ohm 1/4W 5%		78 207 0
13	2	R10,R11	" 470 ohm 1/4W 5%		78 215 0
14.	2	C1,C7	Capacitor .68 uf 35V Dip Tant	TAG20-.68/35-20	14 101 0
15.	1	C2	" .33 uf 50V Mylar	75F4R5A334	14 306 0
16.	2	C3,C4	" .01 uf 50V Ceramic	UK50-103	14 017 0
17.	2	C5,C6	" 68 uf 16V Dip Tant	TAG-20-68/16-20	14 113 0
18.	1	C8	" 22,000 pf 16V	UK16-223	14 022 0
19.	1	U1	Microcircuit	OP-07CJ	52 008 0

REVISIONS		
LTR	INIT	DATE
A ECN126		11/4/75



ITEM	REF DESIG
40	C7, C8, C15 C16 C19-C22

QTY	PART NUMBER	ITEM	REF DESIG & NOTES	DESCRIPTION	MANUFACTURER & PART NO.	
2		42	C23, C24, C25	CAPACITOR, .001 µf, 1KV, CER DISC	CRL	DD-102
2		41	C17, C18	10 µf, 16V, DIP TANT	ITT	TAG-20-10/16-10
8		40	SEE TABLE	6.8 µf, 16V, DIP TANT	ITT	TAG-20-6.8/16-10
4		39	C5, C6, C13, C14	330 µf, 6.3V, DIP TANT	ITT	TAG-20-330/6.3-10
2		38	C4, C12	.015 µf, 50V, MYLAR	GE	75F1R5A153
2		37	C3, C11	.033 µf	↕	75F1R5A333
2		36	C2, C10	.15 µf	↕	75F3R5A154
2		35	C1, C9	CAPACITOR, .33 µf, 50V, MYLAR	GE	75F3R5A334
1		34	R25	POT, 10K	BOURNS	3299P-1-103
1		33	R26	RESISTOR, 82K, 1/4W, 5%		
3		32	R22, R23, R27	100Ω, 1/4W		
1		31	R21	82Ω, 1W		
2		30	R20, R24	3.3Ω, 1/4W		
1		29	R19	10K		
1		28	R18	16K		
2		27	R14, R17	4.7K, 1/4W, 5%		
1		26	R11	162 1/8W, 1%		
1		25	R10	38.3		
1		24	R9	10Ω		
1		23	R8	3.32K		
1		22	R7	1.4K		
1		21	R6	681		
1		20	R5	332		
1		19	R4	80.6		
1		18	R3	20Ω		
2		17	R2, R12	10K, 1/8W, 1%		
4		16	R1, R13, R15, R16	RESISTOR, 100K, 1/4W, 5%		
2		15	CR3, CR4	DIODE		IN4728A
2		14	CR1, CR2	DIODE		IN4156
1		13	U1	INT CKT	MOT	MC1747C
1		12	Q2	TRANSISTOR	GE	D41D2
1		11	Q1	TRANSISTOR	GE	D40D2
1		10	MB	MOUNTING BUSHING	GRAYHILL	71C2054
2		9	S1, S4	SWITCHES 1 POLE, 12 POS	GRAYHILL	71ADF30-01-1
1		8	S2, S3	SWITCHES 2 POLE, 6 POS	GRAYHILL	71ADF30-01-2
2		7		WASHER, LK, INT TOOTH, #4		
2		6		NUT, HEX, #4-40		
2		5		SCREW, PHIL PN HD, #4-40 x 3/8		
2		4		HEAT SINK	THERMALLOY	6107B-14
11		3		TERMINAL, SWAGE	USECO	20108
REF	20800060	2		SCHEMATIC		
1	50800060	1		BOARD, PC		

NOTES:

1. ADD ASSY REV LTR ON PC BD.
2. ADD S.O. NO. ON PC BD IN APPROX AREA SHOWN.
3. ADD S/N ON PC BD IN APPROX AREA SHOWN.

DASH NO.	NEXT ASSY	USED ON
-1		A5110

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES
DECIMALS FRACTIONS±
.XX± .XXX± ANGLES±
REMOVE BURRS & SHARP EDGES, R .031 (CHAMFER) MAX.
DO NOT SCALE THIS PRINT

MATERIAL

DRAWN	C.R.	11-4-75
CHECK		11-4-75
ENG/DES		11-4-75
PRODUCT CATEGORY		11/4/75
INSTRUMENT TYPE		
DEVELOPMENT NO.		
SUPERSEDES		

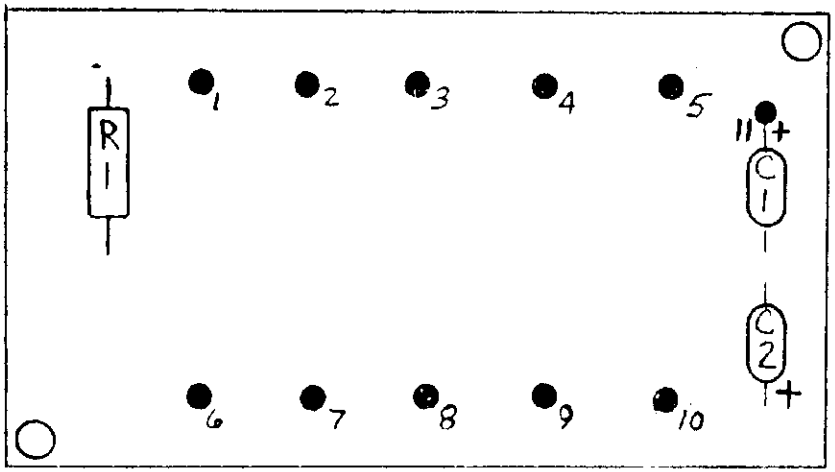
SPRENGNETHER INSTRUMENT CO.

TITLE ASSY, PC - A5110 MAIN AMPLIFIER

SIZE	DRAWING NO.	REV.
C	10C0024	D

SCALE 2:1 SHT. 1 OF 1

REVISIONS			
LTR	DESCRIPTION	DATE	APPROVED



NEXT ASSY	USED ON
APPLICATION	

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE:
FRACTIONS DECIMALS ANGLES
± .XX ± ±
.XXX ±

MATERIAL

FINISH

DO NOT SCALE DRAWING

CONTRACT NO.

APPROVALS	DATE
DRAWN MP	3/6/81
CHECKED	

W.F. Sprengnether Instrument Co., Inc.

MEQ-800 DISTRIBUTION BOARD PARTS PLACEMENT

SIZE	CODE IDENT NO.	DRAWING NO.
A		[illegible]

SCALE —

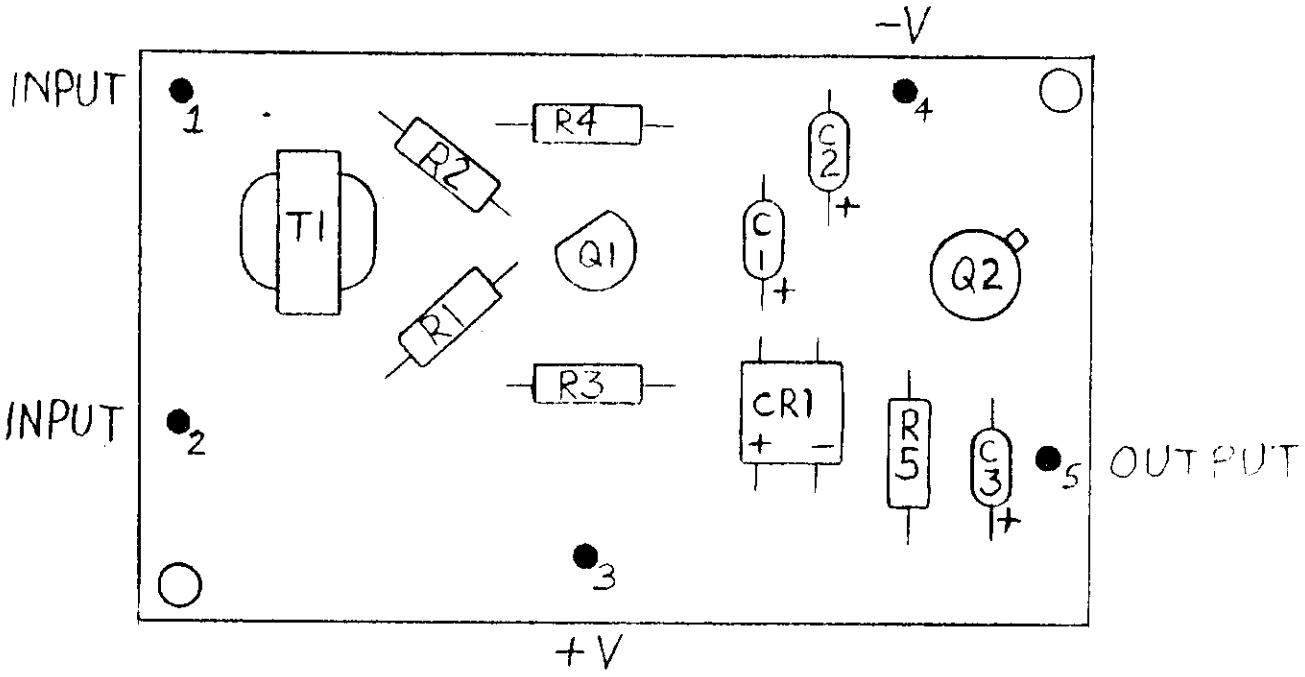
SHEET 2 OF 3

DATE	NEXT ASSY:
3/6/81	

DATE	SYM	REVISION RECORD	UTH	DR	CK

ITEM NO.	QUAN.	REF. DESIG.	DESCRIPTION	PART NO.	SPRENCO CONTROL NO
1.	1	PCB	Board, P. C.	102004	
2.	1	R1	Resistor 1K 1/8W 1%		78 037 0
3.	2	C1,C2	Capacitor 6.8 uf 16V Dip Tant	TAG-20-6.8/16-20	14 105 0
4.	11		Terminal	1562-2	85 011 0

Sprengnether Instruments, Inc.	MEQ-800 DISTRIBUTION BOARD ASSEMBLY PARTS LIST	DWG. NO. 102004
		SHEET 1. of 3.



		UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE: FRACTIONS DECIMALS ANGLES ± .XX ± ± .XXX ±	CONTRACT NO.	**W.F. Sprengnether Instrument Co., Inc.**	
			APPROVALS / DATE		
			DRAWN MP 3/6/81	MEQ-800-1 RADIO CIRCUIT BOARD PARTS PLACEMENT	
		MATERIAL	CHECKED		
				SIZE A / CODE IDENT NO. / DRAWING NO. 12005	
		FINISH			
NEXT ASSY	USED ON				
APPLICATION		DO NOT SCALE DRAWING		SCALE —	SHEET 2 OF 3

DATE	NEXT ASSY:
3/6/81	

DATE	SYM	REVISION RECORD	JTH	DR	CK

ITEM NO.	QUAN.	REF. DESIG.	DESCRIPTION	PART NO.	SPRENCO CONTROL NO
1.	1	PCB	Board, P. C.	MEQ-800-1	
2.	1	C3	Capacitor 6.8 uf 16V	TAG-20-6.8/16-20	14 105 0
3.	1	Q1	Transistor	2N3391A	88 011 0
4.	1	Q2	"	2N525	88 001 0
5.	1	CR1	Bridge Rectifier	MDA-920A-1	29 023 0
6.	1	T1	Transformer	PMTF-73	89 003 0
7.	1	R1	Resistor 330K $\frac{1}{4}$W 5%		78 248 0
8.	1	R2	" 33K $\frac{1}{4}$W 5%		78 235 0
9.	1	R3	" 16K $\frac{1}{4}$W 5%		78 232 0
10.	1	R4	" 1.5K $\frac{1}{4}$W 5%		78 221 0
11.	1	R5	" 20 ohm $\frac{1}{4}$W 5%		78 205 0
12.	5		Terminal	1562-2	85 011 0
13.	2	C1,C2	Capacitor 2.2 uf 35V	TAG-20-2.2/35-20	14 103 0

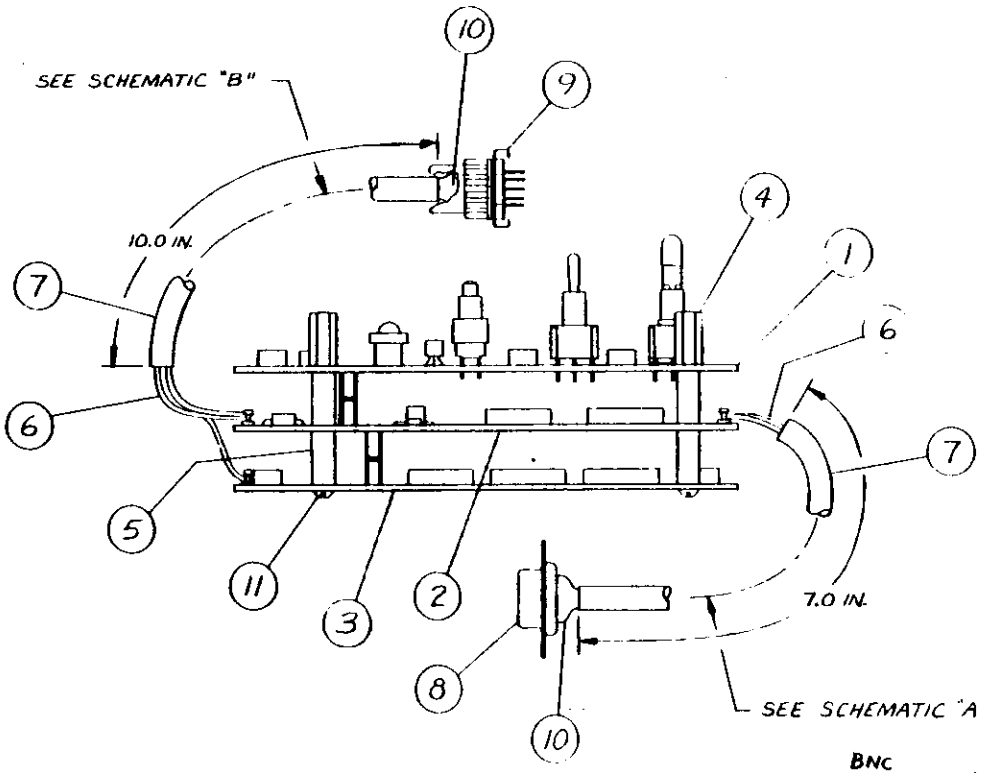
Sprengnether Instruments, Inc.	MEQ-800-1 RADIO CIRCUIT BOARD ASSEMBLY PARTS LIST	DWG. NO. 102005
		SHEET 1. of 3.

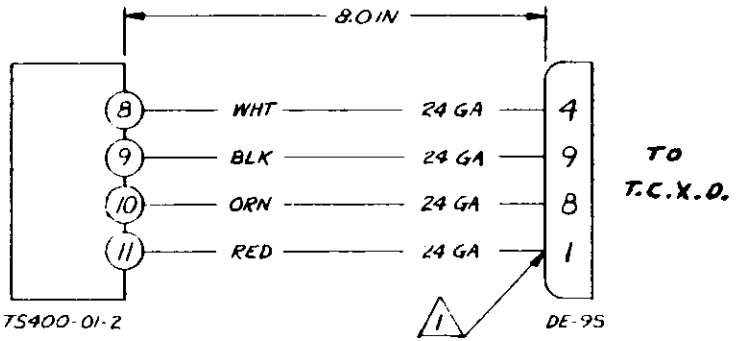
DATE	NEXT ASSY:
3-11-81	

DATE	SYM	REVISION RECORD	H.	DR	CK.

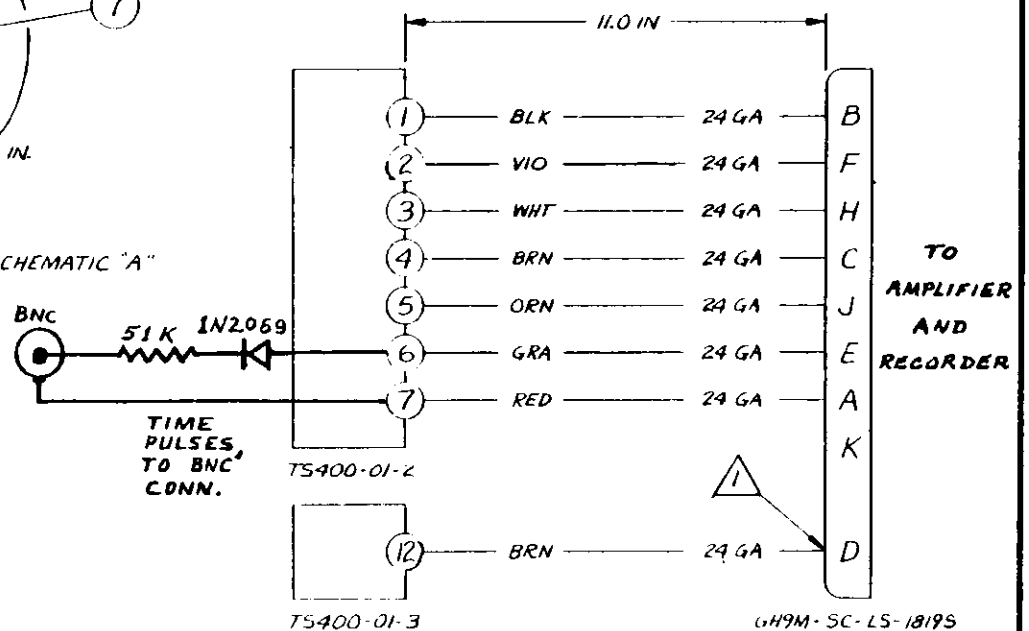
ITEM NO.	QUAN.	REF. DESIG.	DESCRIPTION	PART NO.	SPRENCO CONTROL NO.
1.	1	S1	Switch, Grayhill	9A30-04-1-7N	82 040 0
2.	1	R1	Resistor 200 ohm 1/8W 1%		78 025 0
3.	1	R2	" 8.2 ohm 1/8W 1%		78 004 0
4.	1	R3	" 48.7K 1/8W 1%		78 072 9
5.	1	R4	" 182K 1/8W 1%		78 086 9
6.	1	CR1	Diode	1N3019B	29 007 0

Sprengnether Instruments, Inc.	MEQ-800 METER SWITCH ASSEMBLY PARTS LIST	DWG. NO. 102008
		SHEET 1. of 2.





SCHEMATIC "A"



SCHEMATIC "B"

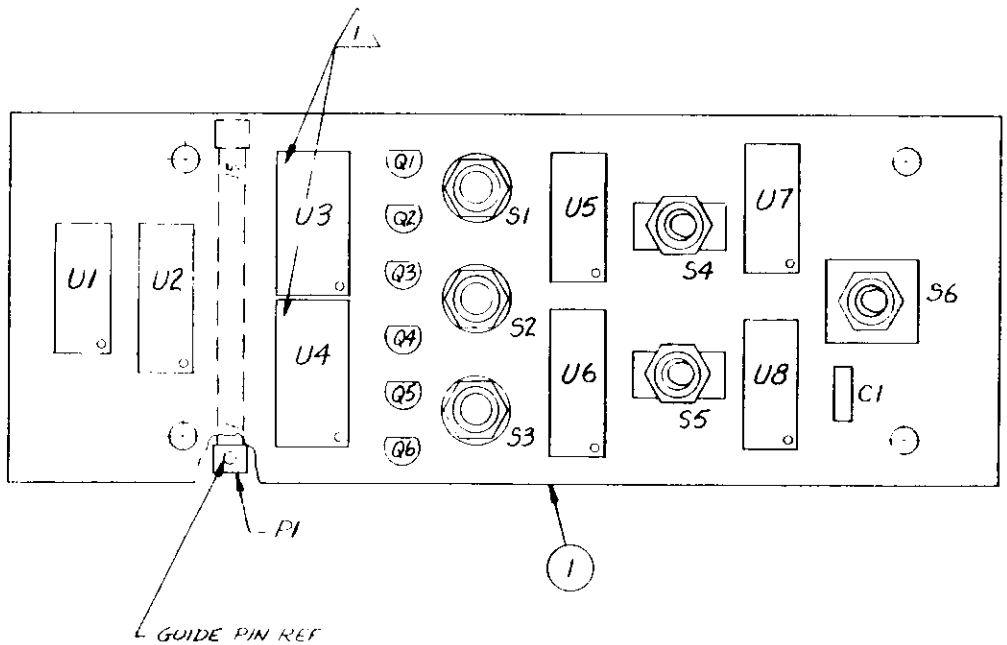
⚠1 COVER SOLDER CUPS WITH .4 IN LONG SHRINKABLE TUBING (FIT-221-1/16 IN.)

NOTES:

REVISIONS			W.F. SPRENGNETHER INSTRUMENT CO. INC.	
NO	DATE	BY	TS400 DIGITAL TIMING SYSTEM	
1	8-11-77	DK		
DRAWN BY	SPRINGMEYER		SCALE FULL	
CHK'D			DATE 2-12-76	TS400-01

L-9

SH 1 OF 1



2 UNLESS OTHERWISE SPECIFIED, ALL RESISTORS ARE ±5%, 1/4 WATT, VALUES IN OHMS

1 PIN 8 IS MISSING ON DISPLAY PACKAGE

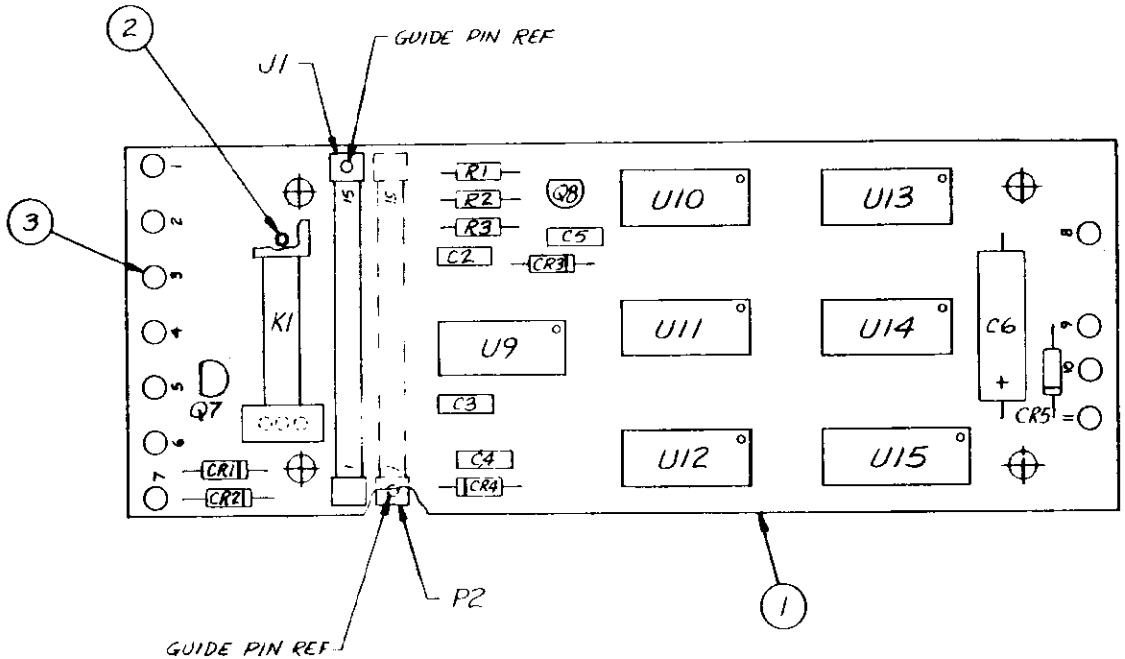
NOTES:

REVISIONS			W. F. SPRENGNETHER INSTRUMENT CO. INC.		
NO	DATE	BY	TS400 DIGITAL TIMING SYSTEM		
1					
2					
3					
4					
5					
			DRAWN BY SPRINGMEYER	SCALE 2X	MATERIAL
			CHK'D	DATE 2-12-76	DRAWING NO TS400-01-1
			TRACED	APP'D	

TS-400 CLOCK

PARTS LIST

ITEM	DESCRIPTION/MANUFACTURER	PART NUMBER	QTY
1	Board, printed circuit/PWA	TS400-01-1	1
2	Connector/ELCO	00-8129-015 -603-002	1
U1,U5 U8	Resistor pack/BOURNS	4114R-001- 104S	3
U2	Decoder-driver/MOT	MC14511CP	1
U3,U4	Display, L. E. D./LITRONIX	DL-34M	2
U6	Counter, devide-by-8/MOT	MC14022CP	1
U7	NAND gate, quad 2-input/MOT	MC14011CP	1
Q1-Q6	Transistor/MOT	MPS-A12	6
C1	Capacitor, ceramic 0.001 MFD	CK05BX102K	1
S1,S2 S3	Switch, push button/C & K	8533	3
S4	Switch, toggle/C & K	7105	1
S5	Switch, toggle/C & K	7107	1
S6	Switch, toggle/C & K	7205	1



1. UNLESS OTHERWISE SPECIFIED, ALL RESISTORS ARE ±5%, 1/4 WATT, VALUES IN OHMS

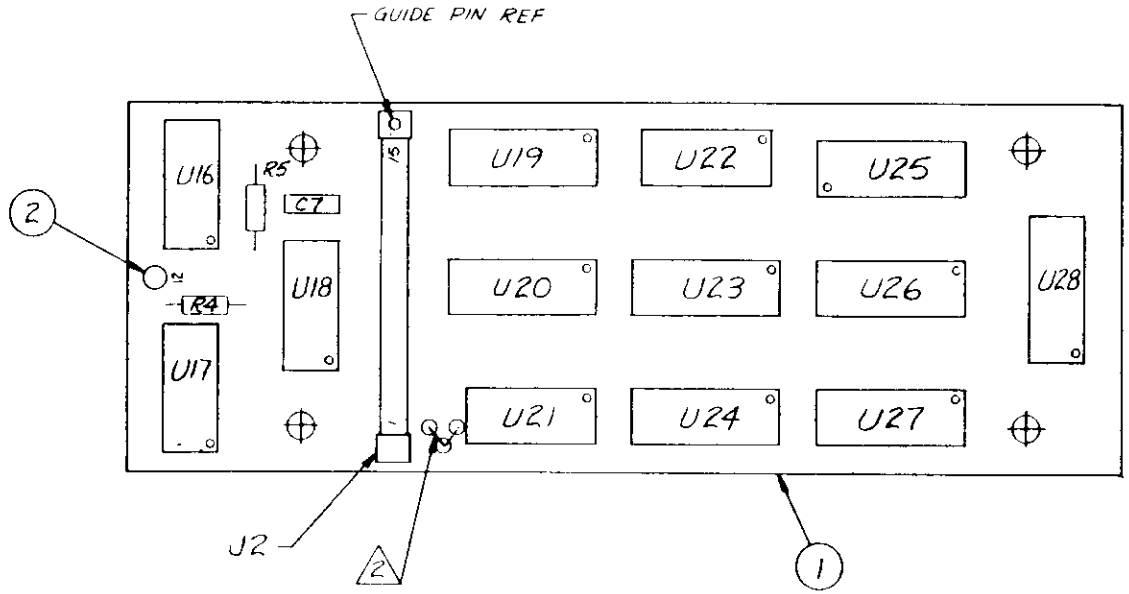
NOTES:

W.E. SPRENGNETHER INSTRUMENT CO. INC.	
TS400 DIGITAL TIMING SYSTEM	
SPRENGMEYER	2X
	2-12-76
	TS400-01-2

TS-400 CLOCK

PARTS LIST

ITEM	DESCRIPTION/MANUFACTURER	PART NUMBER	QTY
1	Board, Printed Circuit/PWA	TS400-01-2	1
2	Socket/AMP	1-332080-2	4
3	Terminal/USECO	2030B-1	11
J1,P1	Connector/ELCO	00-8129-015 -603-002	2
U9	Resistor pack/BOURNS	4114R-001-104S	1
U10, U11, U12	NAND gate, quad 2-input/MOT	MC14011CP	3
U13	Flip-flop, dual type "D"/MOT	MC14013CP	1
U14	Counter, 7 stage/MOT	MC14024CP	1
U15	Time base generator/MOT	MC14566CP	1
Q7	Transistor	MPS-A12	1
Q8	Transistor	2N3906	1
C2,C3	Capacitor, ceramic, 0.0001 mfd	CK05BX101K	2
C4	Capacitor, ceramic, 0.001 MFD	CK05BX102K	1
C5	Capacitor, ceramic, 0.00039 MFD	CK05BX391K	1
C6	Capacitor, tantalum, 100 MFD/KEM	921HE	1
R1,R2 R3	Resistor, metal film, ¼W, 5%	10K ohm	3
CR1, CR3, CR4	Diode	1N914	3
CR2	Diode	1N4001	1
CR5	Diode	1N5248	1
K1	Relay, reed/ELEC-TROL	RA30311121	1



2 SOLID LINE JUMPER IS FOR 12 AND 24 HR RELAY CLOSURES. WHEN ONLY 24 HR RELAY CLOSURE IS NEEDED JUMPER DOTTED LINE

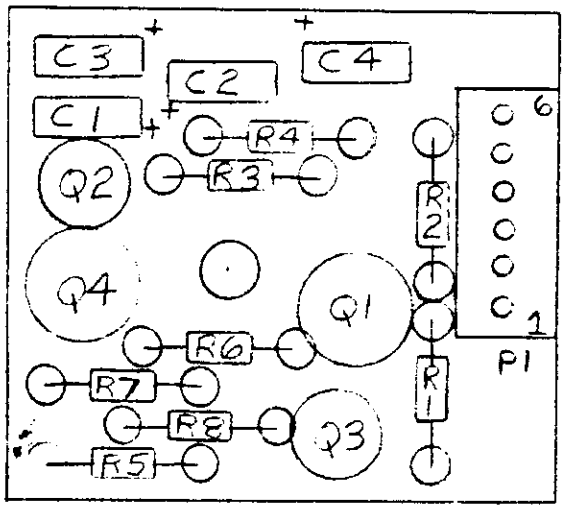
1. UNLESS OTHERWISE SPECIFIED, ALL RESISTORS ARE ±5%, 1/4 WATT, VALUES IN OHMS

NOTES

TS-400 CLOCK
PARTS LIST

ITEM	DESCRIPTION/MANUFACTURER	PART NUMBER	QTY
1	Board, Printed Circuit/PWA	TS400-01-3	1
2	Terminal/USECO	2030B-1	1
J2	Connector/ELCO	00-8129-015 -603-002	1
U19	Resistor pack/BOURNS	4116R-001 -104S	1
U16 U17	NOR gate, quad 2-input/MOT	MC14001CP	2
U18	NAND gate, dual 4-input/MOT	MC14021CP	1
U20, U23, U26, U28	Shift register, 8-stage/MOT	MC14012CP	4
U21	NAND gate, quad 2-input/MOT	MC14011CP	1
U22	Exclusive OR gate, quad 2-input/ MOT	MC14507CP	1
U24, U25, U27	Time Base Generator/MOT	MC14566CP	3
C7	Capacitor, ceramic, 0.047 MFD	CK06BX473K	1
R4	Resistor, metal film, ¼W, 5%	100K ohm	1
R5	Resistor, metal film, ¼W, 5%	2.2M ohm	1

REV.	APPLICATION		REVISIONS			
SH	NEXT ASSY	USED ON	REV.	DESCRIPTION	DATE	APPROVED
DWG. NO.			E			



UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE: FRACTIONS ± DECIMALS .XX ± .XXX ± ANGLES ±	CONTRACT NO.		W.F. SPRENGNETHER INST. CO.
TERIAL	APPROVALS	DATE	ASSY, PC BD - PA-1A, PA-2A POWER AMPLIFIER
	DRAWN HENSON	7/27/79	
FINISH	CHECKED		SIZE A / FSCM NO. / DWG. NO. 100048 / REV. E
DO NOT SCALE DRAWING	ISSUED		SCALE / SHEET 2 OF 3

DATE	NEXT ASSY:
3-20-81	

DATE	SYM	REVISION RECORD	BY	DR	CK

ITEM NO.	QTY -1	QTY -2	REF.DESIG.	DESCRIPTION	PART NO.	SPRENCO CONTROL NO.
1.	1	1		Board, P. C.	50B0113D	
2.	Ref	Ref		Schematic		
3.	2	2	Q1,Q4	Transistor	2N3567	88 012 5
4.	2	2	Q2,Q3	"	2N4249	88 015 5
5.	2	2	C1,C3	Capacitor 1.0 mfd 35V Dip Tant	TAG-20-1/35-20	14 102 0
6.	2	2	C2,C4	" 1.5 mfd 25V Dip Tant	TAG-20-1.5/25-20	14 103 2
7.	3	3	R4,R7,R2	Resistor 100K ¼W 5%		78 242 0
8.	1	0	R1	" 56K ¼W 5%		78 238 0
9.	2	2	R3,R6	" 16K ¼W 5%		78 232 0
10.	1	1	R5	" 51K ¼W 5%		78 237 0
11.	0	1	R8	" 680K ¼W 5%		78 249 0
12.	1	1	P1	Connector	1100-8-106-01	22 611 0