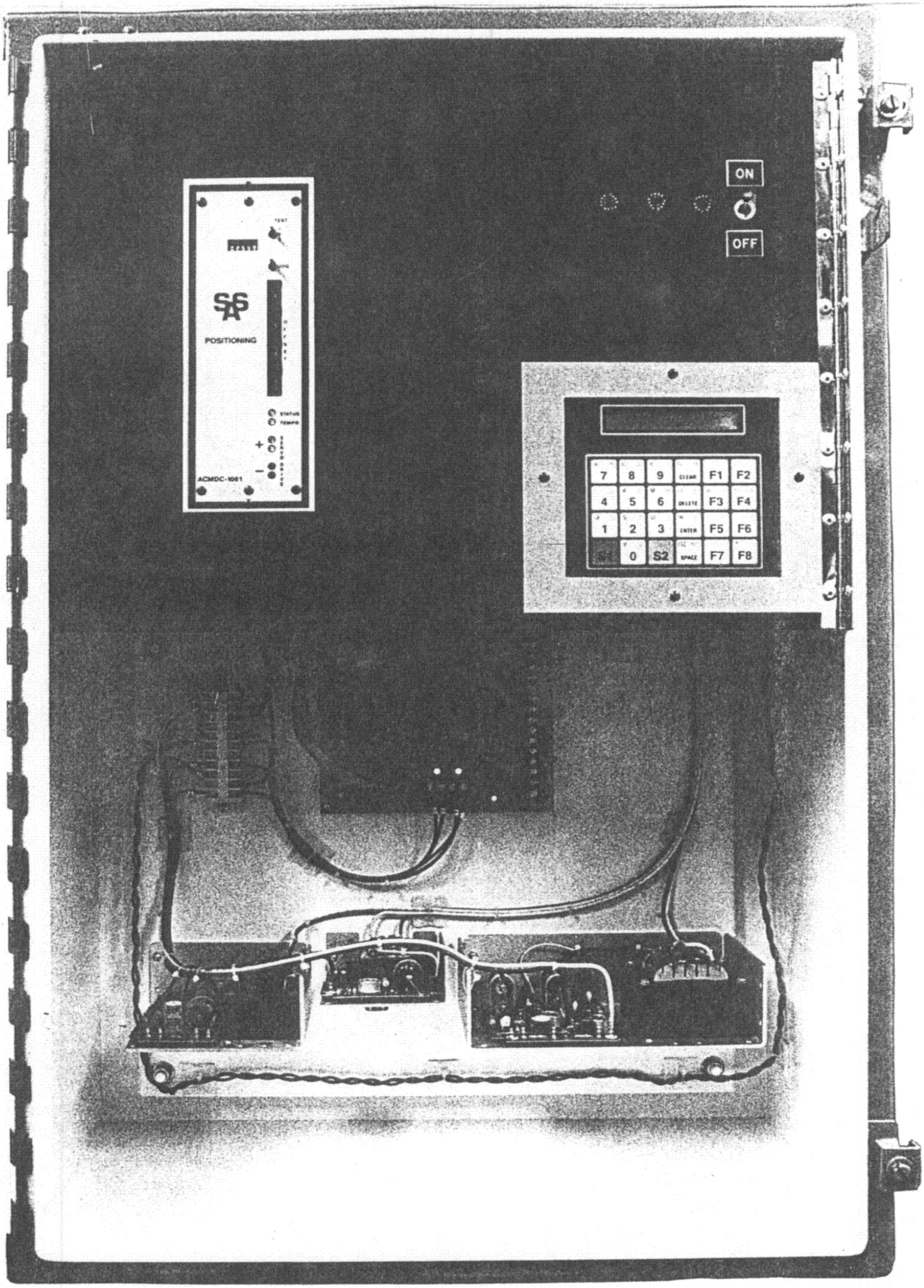
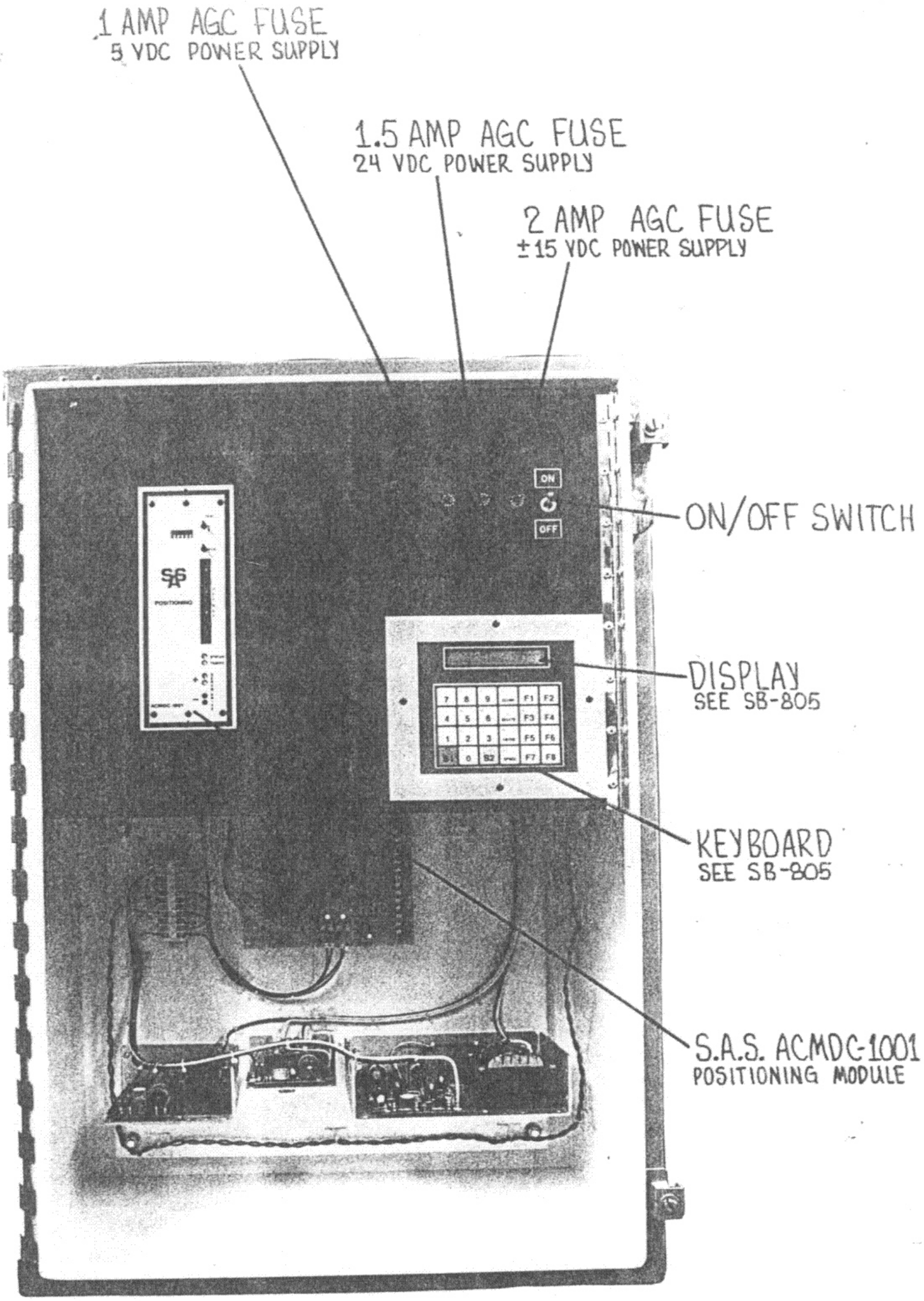
S.A.S. Fluid Power, Inc.



POSITIONING SYSTEM CONTROLS


1 AMP AGC FUSE
5 VDC POWER SUPPLY
1.5 AMP AGC FUSE
24 VDC POWER SUPPLY
2 AMP AGC FUSE
±15 VDC POWER SUPPLY
ON
OFF
ON/OFF SWITCH
DISPLAY
SEE SB-805
KEYBOARD
SEE SB-805
S.A.S. ACMDC-1001
POSITIONING MODULE

S.A.S. Fluid Power, Inc.

☐ 12700 N.E. 124th ST., #2 • KIRKLAND, WA 98034 • PHONE: (206) 821-2004 • TWX 910-449-2986 SAS FLUID KLND

☐ 13449 NORTHEAST WHITAKER WAY • PORTLAND, OR 97230 • PHONE: (503) 256-5110

S.A.S. ACMDC-1001 SERVO MODULE

TABLE OF CONTENTS

S.A.S. ACMDC-1001 SERVO MODULE

S.A.S. ACMDC-1001 SERVO MODULE

PHYSICAL CONFIGURATION

The ACMDC-1001 module is a stand alone, servo control system. Using an INTEL 8085 Microprocessor, it is designed to dynamically position a hydraulic cylinder by varying the electrical drive to a servo valve. Position feedback is accomplished by a linear transducer ("TEMPOSONICS") mounted within the envelope of the hydraulic cylinder.

The module is comprised of two circuit boards, servo board AC-550 and the interface board, mounted in an aluminum enclosure. Servo board AC-550 contains all user adjustable functions (servo gain,"0" point & transducer scale adjustment) and is standard to all modules. The interface board is changed to adapt the module to a particular system. The module face panel contains user display, test switch, jog switch, and "0" position offset. The rear panel contains all system interconnections.

THEORY OF OPERATION

The servo module will interface with any programmable controller capable of outputting a numeric value in "BCD" or "BINARY" format, or with a computer system using "RS-232", "RS-422" or "INTEL SBC I/O" format. A special interface is available for the "MODICON MICRO-84" and a dual servo board that is "INTEL SBC BUSS" compatible.

The servo module receives target information from the host programmable controller or computer system. This information is compared with the present position. If there is a difference, a signal is sent to the servo valve, moving the cylinder to the target position. When the cylinder is in position, the servo module will output a target achieved (set complete) to the host system. The servo module will then moniter the achieved target position, directing the servo valve to hold the cylinder on target.

If the host system does not send a target position,the servo module will accept the position of the cylinder as the target and will hold the cylinder at that position. If no target is sent, the jog switch may be used to position the cylinder. If the jog is used and a target is being sent to the servo module the cylinder will be forced off target untill the jog is centered.

J2
RIBBON CABLE
26 PIN
CONNECTOR

TEMPO
$\overline{\text{TEMPO}}$

27 MHz CLOCK

ISOLATED

COUNTER

FIVE DIGIT
LED DISPLAY
1 2 .3 4 5

S⁻ — 23

S⁺ — 25

R44 (FEEDBACK RESISTOR)

10Ω

10Ω

100KΩ

10Ω
CURRENT LIMIT

50KΩ

12 BIT DIGITAL/ANALOG
CONVERTER

STATUS (SYSTEM IN POSITION)

TEMPO (FEEDBACK OPERATIVE)

1 2 3 4 5 6 7 8
GAIN SWITCHES

1 INCHES
2 TENTHS
3 HUNDRETHS
4 THOUSANDTHS
OFFSET
THUMBWHEELS

ALL EVEN
NUMBERS ARE
COMMON

\+
\+
\-
\-
RELATIVE
OUTPUT
DRIVE
CURRENT
(LED DISPLAY)
SERVO DRIVE

CPU - RAM - SYSTEM CLOCK - IO

PROGRAM
2732

FOR TEMPO.
AND SERVO
DRIVE ONLY

9
11 — +5 VDC
5
7 — +15 VDC
EVEN # — COMMON
1 — -15 VDC
3

CONNECTIONS
TO INTERFACE
BOARD

RIBBON CABLE
50 PIN
CONNECTOR

ENA — 15
SPARE — 13
EVEN #

AC 500
SERVO BOARD

PAGE 2

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NO.	DATE	REVISION	BY

S.A.S. FLUID POWER INC.
318 SO. WEBSTER ST.
SEATTLE, WASHINGTON 98108

ACMDC-1001 SERVO
BOARD
AC-550

DATE 1-20-86
SCALE NONE
DRAWN BY RZIMSHAK
CHECK BY
DWG. NO. SC 788

DATA LINES

J1
RIBBON CABLE
26 PIN
CONNECTOR

+5VDC
10K

LM339 COMPARATOR
TYPICAL, 14 PLACES

LEAST SIGNIFICANT BIT — WD1 — 1
WD2 — 2
WD3 — 3
WD4 — 4

DATA LINES ARE HIGH TRUE, 3 DIGIT BCD

— WD13 — 13
— WD14 — 14
— WD15 — 15
MOST SIGNIFICANT BIT — WD16 — 16

22
24
26 — COMMON

TO SERVO BOARD

TO INPUT DATA 12.345 :

A) PUT "X12" ON DATA LINES
(X= ANY VALUE)
B) STROBE A LOW, THEN HIGH
C) PUT "345" ON DATA LINES
D) STROBE B LOW, THEN HIGH
E) DATA SHOULD APPEAR IN READOUT
WITH TEST SWITCH IN POSITION 3

J3

STROBE A — LM 339 COMPARATOR
STROBE B — LM 339 COMPARATOR

3 PIN MOLEX CONNECTORS

COMMON
+5 VDC
5V
— LOGIC POWER TO SERVO BOARD

AC 406 M
(INTERFACE BOARD)

PAGE 3

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SEATTLE, WASHINGTON 98108

ACMDC-1001 INTERFACE BOARD FOR MODICON AC 484 MA

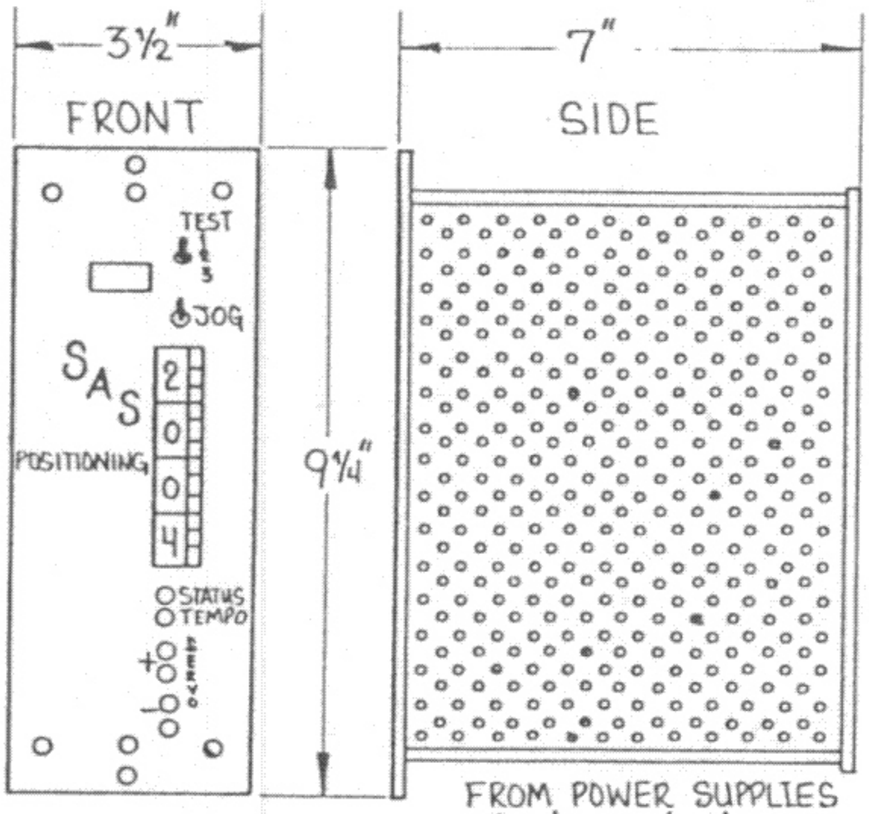
DATE 1-20-86 | DRAWN BY | CHECK BY | DWG. NO. SC 789

SERVO POSITIONER ORDERING DATA

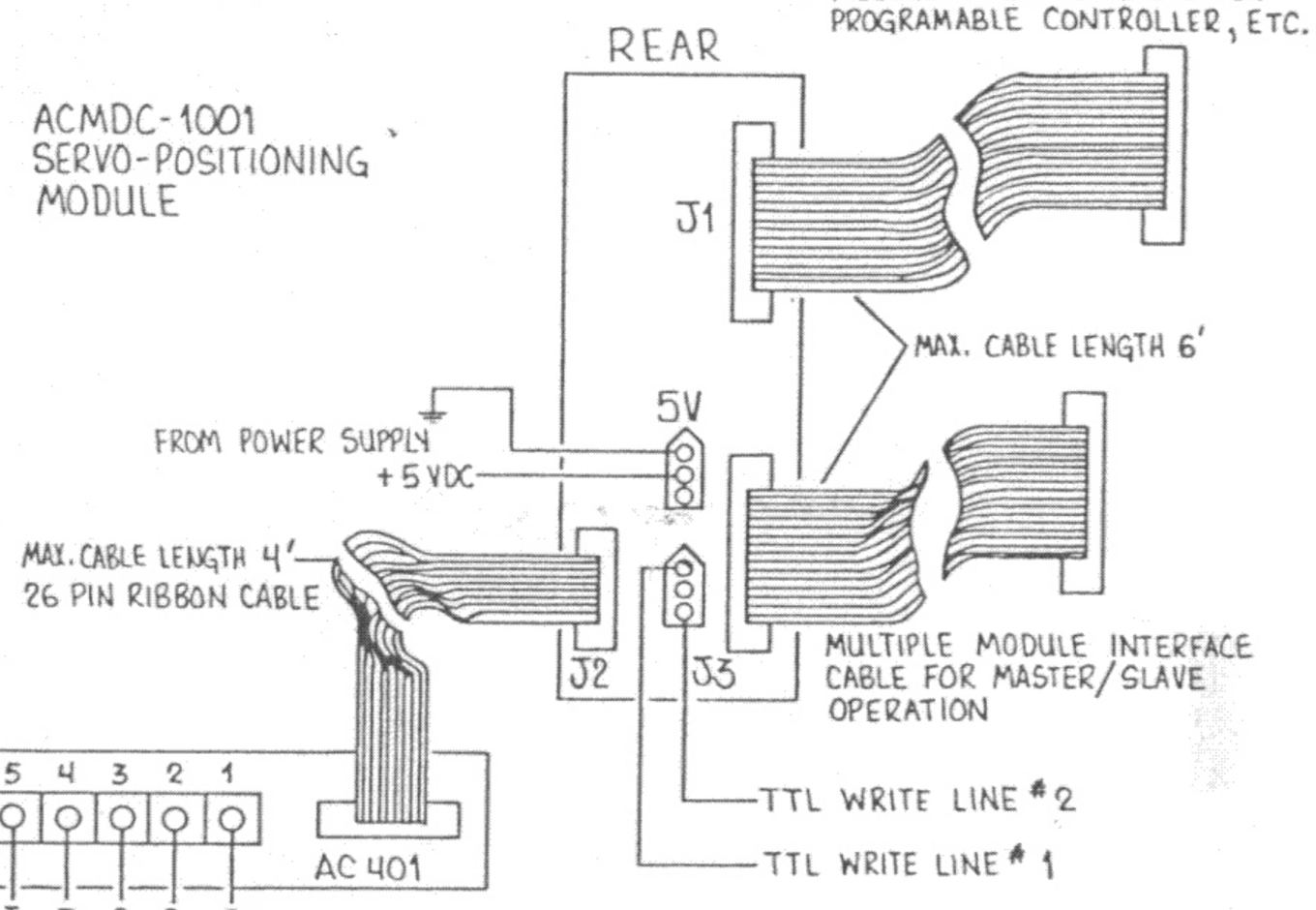
AND INTERCABLING INFORMATION

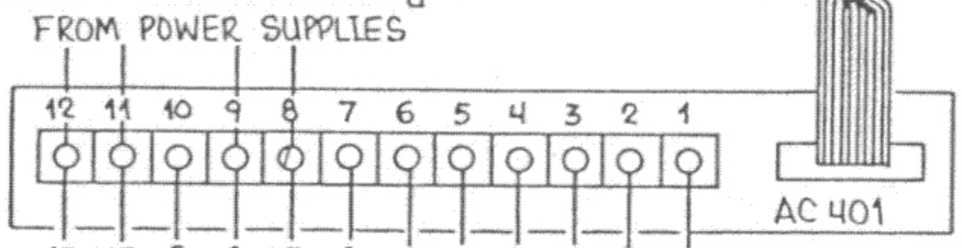
J1 AND J3 CABLES ARE 50 PIN FOR SBC PARALLEL BUS, ALL OTHERS (RS 232, PC, ETC...) ARE 26 PIN.

CABLES ARE NORMALLY CUSTOMER SUPPLIED

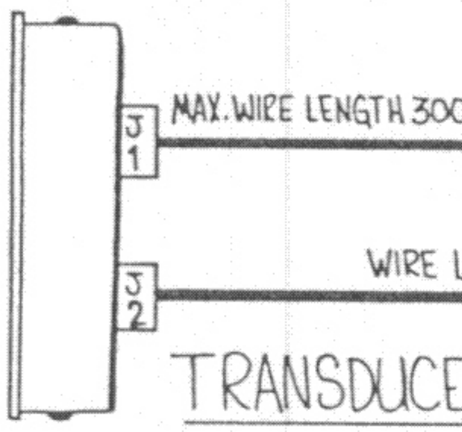


ACMDC-1001
SERVO-POSITIONING
MODULE



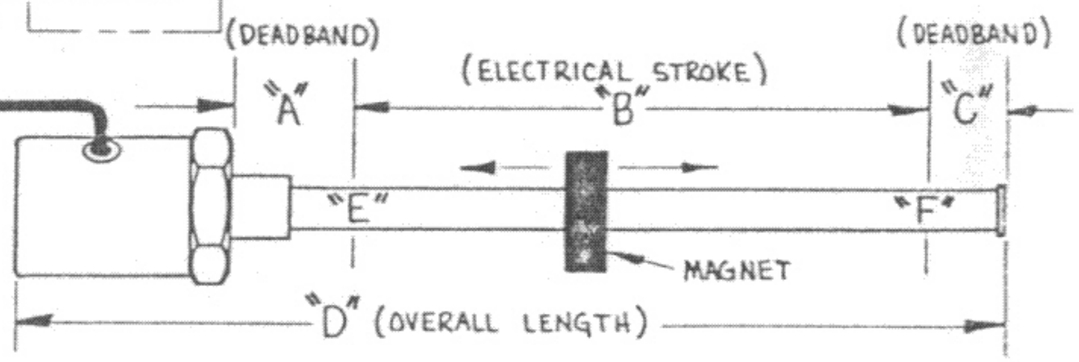


WIRING SHOWN IS FOR STANDARD SERVO POSITIONING MODULE USING PULSEWIDTH TRANSDUCER ELECTRONICS WITH INTERNAL INTERROGATION AND AND 4 INTERNAL RECIRCULATIONS.



MODULE INTERFACE

- ☐ ZERO AT "E"
- ☐ ZERO AT "F"
- ☐ PROGRAMABLE CONTROLLER
  - ☐ MODICON MICRO 84
  - ☐ OTHER _____
- ☐ RS232 SERIAL PORT _____
- ☐ SBC PARALLEL BUS _____
- ☐ OTHER _____



TRANSDUCER ELECTRONICS

- ☐ PULSEWIDTH
  - ☐ INTERNAL INTERROGATION
  - ☐ EXTERNAL INTERROGATION
  - ☐ 4 INTERNAL RECIRCULATIONS
  - ☐ ___ INTERNAL RECIRCULATIONS
- ☐ ANALOG
  - ☐ 0-10 VDC
  - ☐ ± 10 VDC
  - ☐ ± 5 VDC
  - ☐ OTHER _____

ANALOG VOLTAGE POINTS
"E" = _____ (+10V, -5V, ETC)
"F" = _____ (+10V, -5V, ETC)

- ☐ DIGITAL

TRANSDUCER DIMENSIONS

"A" DIMENSION
- ☐ 2" (STANDARD)
- ☐ OTHER _____

"B" DIMENSION _____ (LONGER THAN 120" SPECIAL)

"C" DIMENSION
- ☐ 7" (STANDARD)
- ☐ 5" (OPTIONAL)
- ☐ OTHER _____

"D" DIMENSION _____ (4" + A + B + C)

S.A.S. FLUID POWER, INC. KIRKLAND, WA (206) 821-2004

ACMDC-1001 SERVO MODULE FRONT PANEL FUNCTION

1. TEST TOGGLE

POSITION 1: (Upper most position) LED display reads
First two digits gain value
Last two digits processor code

POSITION 2: (Center position) LED display reads
Position of cylinder

POSITION 3: (Bottom most position) LED display reads
Position cylinder is to go to (target position)

2. JOG TOGGLE
Holding toggle to either side of center will drive cylinder to end of stroke

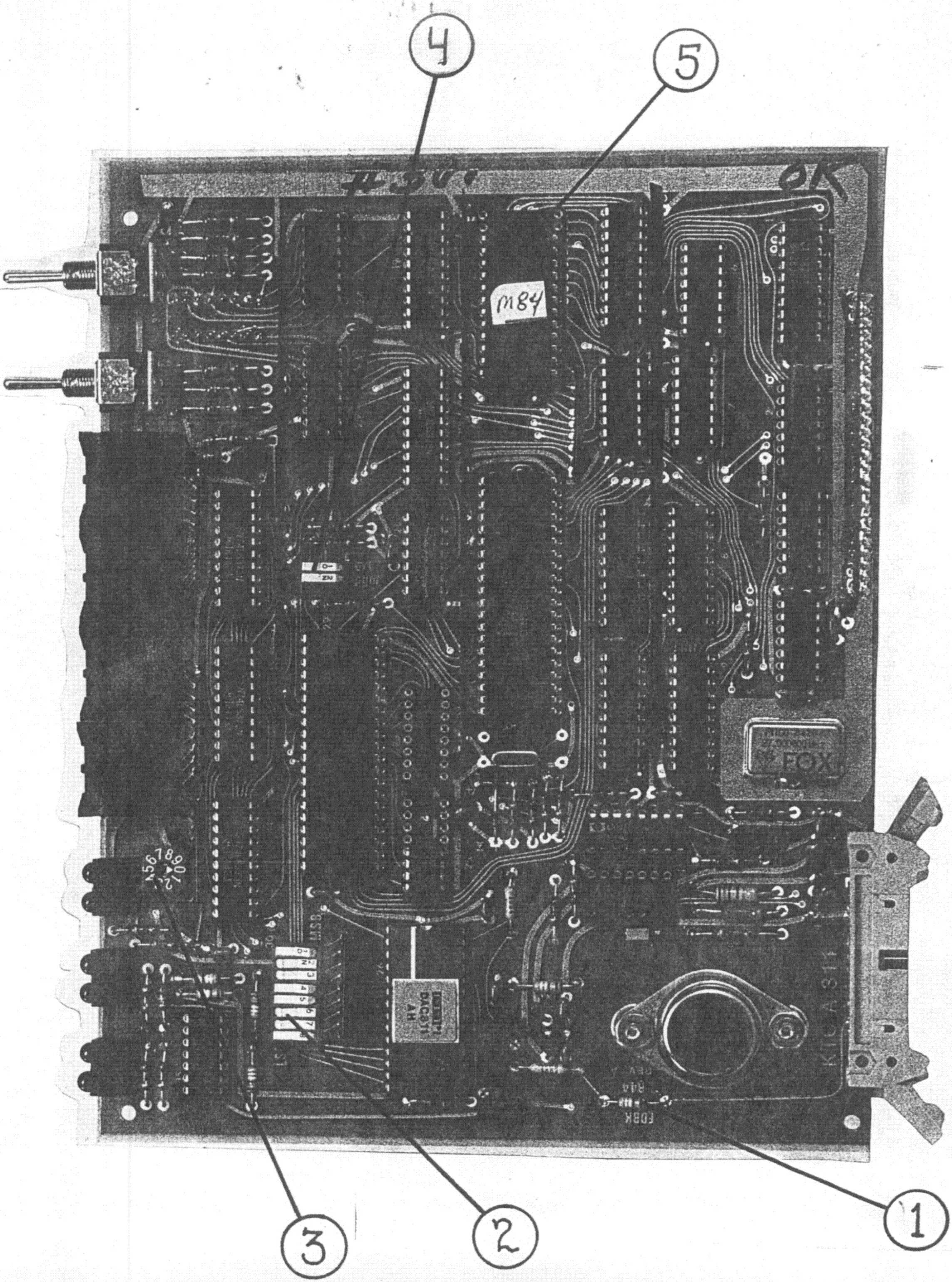
3. FOUR DIGIT THUMBWHEEL

Used to adjust cylinder off-set so that exact mounting position is not necessary

4. STATUS, SERVO DRIVE
TOP STATUS LED: This will remain on steady when within .050" of target and blink when more than .050" from target

BOTTOM STATUS LED: This will remain lighted as long as processor is receiving valid information from temposonics feedback

SERVO DRIVE: Shows that drive is being sent to valve two innermost lights will strobe dimly when target position has been reached.


4
5
M84
FOX
3
2
1

AC-500 SERVO BOARD

USER ADJUSTMENT LOCATIONS

ITEM 1: Servo feedback resistor R-44
refer to R-44 Valve sheet Page 10

ITEM 2: Gain DIP switches; refer to gain switch setting sheet and gain profile diagram Pages 8 & 9

ITEM 3: Internal thumbwheel: refer to zero point adjustment Page 13

ITEM 4: 0 at extend and program mode select DIP switch

ITEM 5: EPROM carries module program

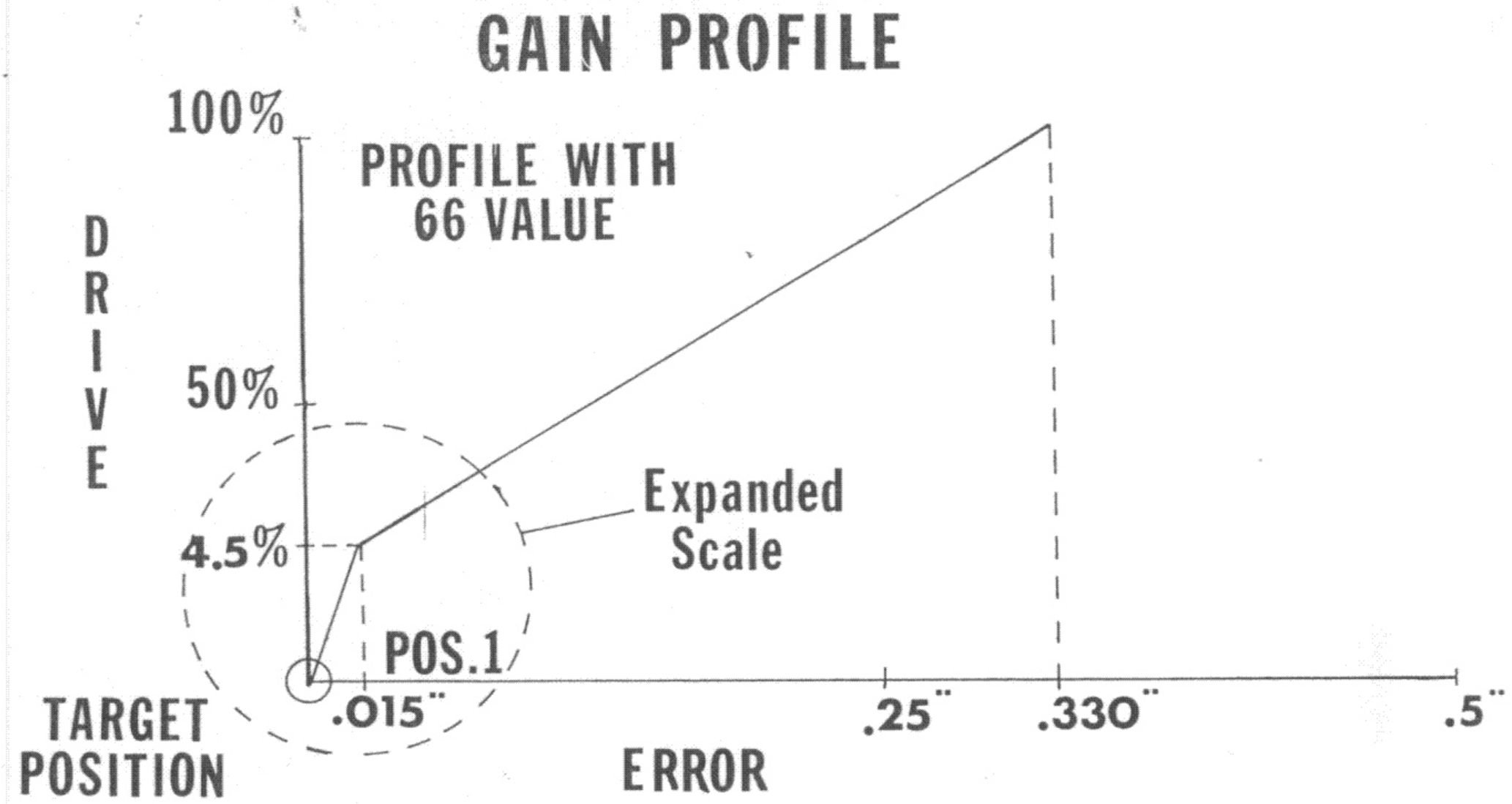
GAIN SWITCH SETTING

TEST SWITCH
POSITION 1

LEFT HAND DIGITS / FIRST DIGIT	SW 1-4			
	1	2	3	4
0	OFF	OFF	OFF	OFF
1	OFF	OFF	OFF	ON
2	OFF	OFF	ON	OFF
3	OFF	OFF	ON	ON
4	OFF	ON	OFF	OFF
5	OFF	ON	OFF	ON
6	OFF	ON	ON	OFF
7	OFF	ON	ON	ON
8	ON	OFF	OFF	OFF
9	ON	OFF	OFF	ON

SECOND DIGIT	SW 5-8			
	5	6	7	8
0	OFF	OFF	OFF	OFF
1	OFF	OFF	OFF	ON
2	OFF	OFF	ON	OFF
3	OFF	OFF	ON	ON
4	OFF	ON	OFF	OFF
5	OFF	ON	OFF	ON
6	OFF	ON	ON	OFF
7	OFF	ON	ON	ON
8	ON	OFF	OFF	OFF
9	ON	OFF	OFF	ON

*NOTE: IF PROGRAM HAS OPTIONAL RAMP INSTALLED, THIS WILL BE CALLED UP WHEN SWITHCH 1 IS ON AND DISPLAY WILL BE "L".



The gain adjust switch (Item 1) determines how much current is applied to servo valve for a certain amount of error. (Error defined as distance from asked for target). Switches 5 to 8 indicate a binary number to multiply times the position error that is less than the number called "POS 1". Switches 1 to 4 are multiplied times the error greater than POS 1.

This gain setting is displayed on the module LED readout, (left hand two digits), with the test switch in position 1, (upper most position). Switches 1 to 4 first digit, 5 to 8 second digit.

[Switch value (switches 5 to 8)] X [error in thousandth of inch] = [Value A] Divided by 2000 = Percent of drive to POS 1

[Switch value (switches 1 to 4)] X [(total error) - (error to POS 1) Divided by [2000 - Value A] + Drive value to POS 1 = percent of drive

R-44 VALVE

Feedback resistor R-44 is used to control maximum output current to the servo valve. The higher resistance the higher current output. Output current has an additional limit at 100 MA. Regardless of R-44 value.

TYPICAL R-44 VALVE S

	max current	R-44
MOOG 76, 77 and 78 series valves	25MA	50K 1/4 watt
MOOG 62 series valve	50MA	90K 1/4 watt
REXROTH, 4WS2EM10 and 4WS2EM16	30MA	60K 1/4 watt
MOOG 77 used by Ukiah Machine *	12.5MA	25K 1/4 watt

*NOTE: - Drive is set to 1/2 full valve opening to deep cylinder speed at 20 inches per second.

SERVO MODULE & TEMPOSONICS POWER REQUIREMENT

Power supplies should meet or exceed the following specifications.

DC output: Adjustment range +/- 5% minimum

Line Regulation: +/- 5% for a 10% line change

Load Regulation: +/- .05% for a 50% load change

Output Ripple: + .05% of E. out P-P maximum

Transient Response: 50U seconds for a 50 to 100% load change

Stability: +/- .3% for 24 hour period after warmup

POWER REQUIREMENT

Servo Module: + 5 volts D C @ 2.5 AMPS
Allowable range (checked at plug on servo module 4.95 to 5.15 or at check point on AC-500 board) no lower than 4.85 volts.

Temposonics: + 5 volts D C @ 1 AMP
± 15 volts D C @ 1 AMP
Allowable range (checked at Temposonics unit) 4.95 to 5.15 volts if below 4.85 volts eratic operation may occur. 14.90 to 15.15 volts

PLC TO SERVO MODULE COMMUNICATION

SERVO MODULE RECEIVES TWO THREE DIGIT BCD WORDS FROM PLC. THESE WORDS ARE INPUT TO MODULE ON CONNECTOR J1 ON MODULE BACK. CONNECTOR J2 IS WIRED LSB PIN 1--MSB PIN 12. INFORMATION IS TTL LEVEL TRUE HIGH. STROBES (WIRE LINES) ARE CONNECTED TO MODULE AT J3 (THREE WIRE MOLEX CONNECTOR). STROBE IS TTL LEVEL TRUE LOW.

TYPICAL MODULE UPDATE SEQUENCE

1ST SCAN	BCD WORD 1 SENT TO MODULE (MSW)
2ND SCAN	STROBE (WRITE 1)
3RD SCAN	BCD WORD 2 SENT TO MODULE (LSW)
4TH SCAN	STROBE (WRITE 2)

BCD WORD MUST BE ON MODULE AT TIME OF IT'S STROBE.

IF USING PLC WITH WORD OUTPUT MODULE THE ABOVE SEQUENCE WILL HAPPEN SEPARATE OF PLC SCAN.

NOTE: ABOVE SEQUENCE IS INTENDED ONLY AS A SAMPLE AND INFORMATION MAY BE SENT TO MODULE FASTER THAN EVERY 4 SCANS

ZERO POINT ADJUSTMENT

ZERO_AT_EXTEND_END; ITEM 4, PAGE 6, DIP SWITCH 1 ON

ITEM 3,INTERNAL T/W SET TO MOST SIGNIFICANT
VALUE OF STROKE.
example; If 12" set at 1
If 30" set at 3

USE THUMBWHEELS ON MODULE FACE TO FINE TUNE ZERO POSITION.

X=UNITS
X=TENTHS
X=HUNDREDTHS
X=THOUSANDTHS

_ZERO_AT_RETRACT_END; ITEM 4, PAGE 6, DIP SWITCH 1 OFF

ITEM 3,INTERNAL T/W SET TO 0

USE THUMBWHEELS ON MODULE FACE TO FINE TUNE ZERO POSITION.

Note:If all thumbwheels at 0 and test switch in position 2 with LED display showing 0.000 than cylinder will be approximately 1.5" from full retract.

TEMPOSONICS SCALE ADJUSTMENT

IMPORTANT NOTE: If zero adjustment has been done, record setting of thumbwheels on module face.

STEP 1: PUT TEST SWITCH ON MODULE FACE IN #2 POSITION.

STEP 2: GIVE POSITIONER A SET COMMAND WHICH IS EASY TO MEASURE (SUCH AS 10").

STEP 3: RECORD AMOUNT OF MOVEMENT SHOWN BY LED DISPLAY ON MODULE FACE (THIS WILL BE THE SAME AS SET STEP 2).

STEP 4: MEASURE AND RECORD AMOUNT OF ACTUAL MOVEMENT.

STEP 5: TURN ON "DIP SWITCH" #2 , ITEM #4

STEP 6: LED DISPLAY ON MODULE FACE WILL SHOW CURRENT TEMPOSONICS ADJUSTMENT VALUE AN INDICATION THAT MODULE IS NOW IN PROGRAM MODE.

EXAMPLE: "P8377"

STEP 7: USE THE FOLLOWING FORMULA TO CALCULATE NEW TEMPOSONICS ADJUSTMENT VALUE.

NEW TMPADJ. = OLD TMPADJ X (ACTUAL MOVE /DISPLAY MOVE)

STEP 8: PUT NEW TEMPOSONICS ADJUSTMENT VALUE INTO THUMBWHEELS ON MODULE FACE.

STEP 9: TO ENTER NEW VALUE MOVE TEST TOGGLE THROUGH THE FOLLOWING SEQUENCE.

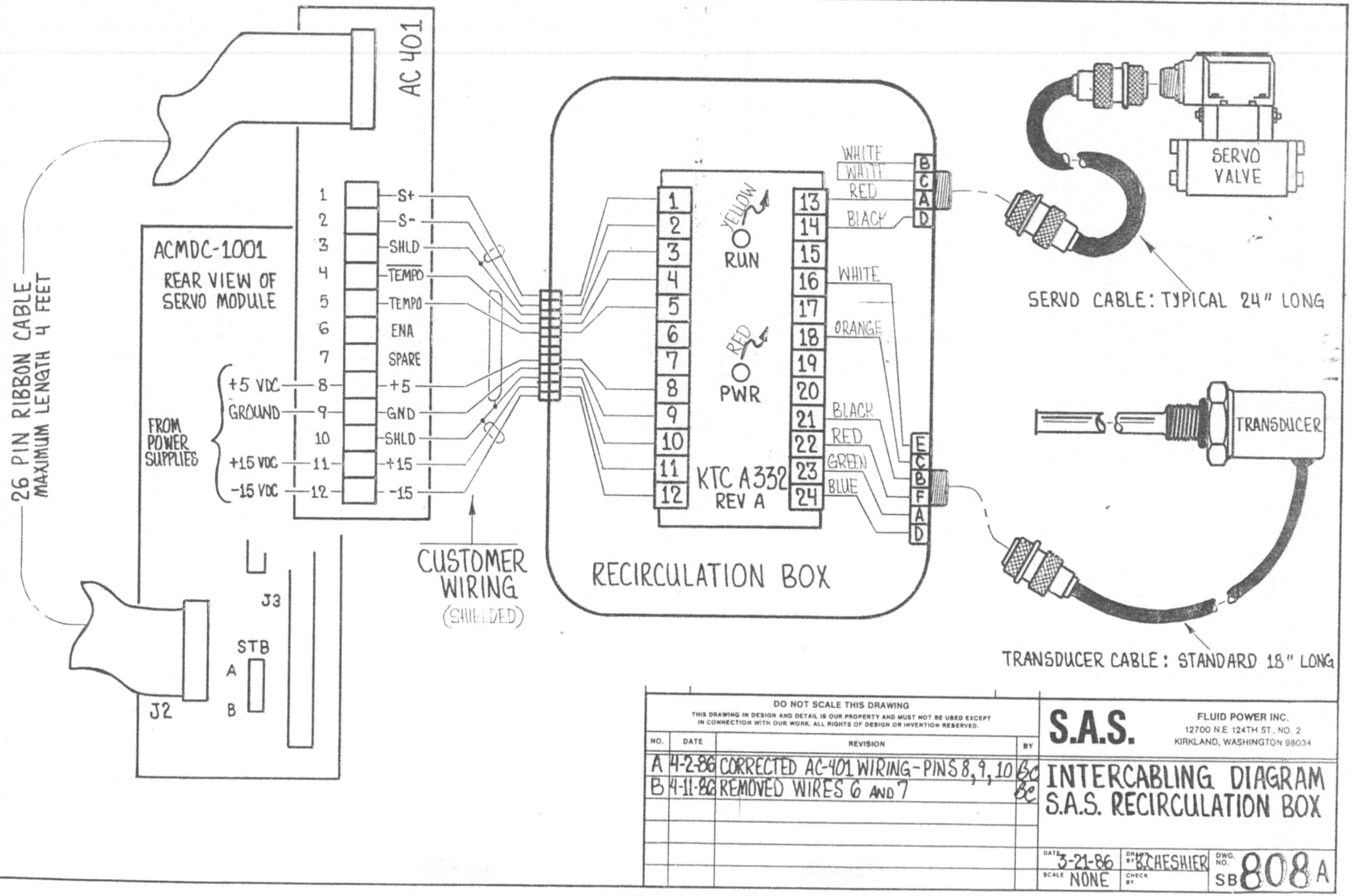
TO POSITION # 3
TO POSITION # 1
TO POSITION # 2

DISPLAY WILL NOW SHOW NEW ADJUSTMENT VALUE

STEP 10: TURN OFF "DIP SWITCH" #2 , ITEM # 4
MODULE LEAVES PROGRAM MODE.

STEP 11: RETURN THUMBWHEELS ON MODULE FACE TO ZERO POINT SETTING.

NOTE: A SLIGHT ADJUSTMENT OF ZERO POINT MAY BE REQUIRED
Adjustment is maintained in EEPROM.



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NO.	DATE	REVISION	BY
A	4-2-86	CORRECTED AC-401 WIRING - PINS 8, 9, 10	BC
B	4-11-86	REMOVED WIRES 6 AND 7	BC

S.A.S.
FLUID POWER INC.
12700 N.E. 124TH ST., NO. 2
KIRKLAND, WASHINGTON 98034

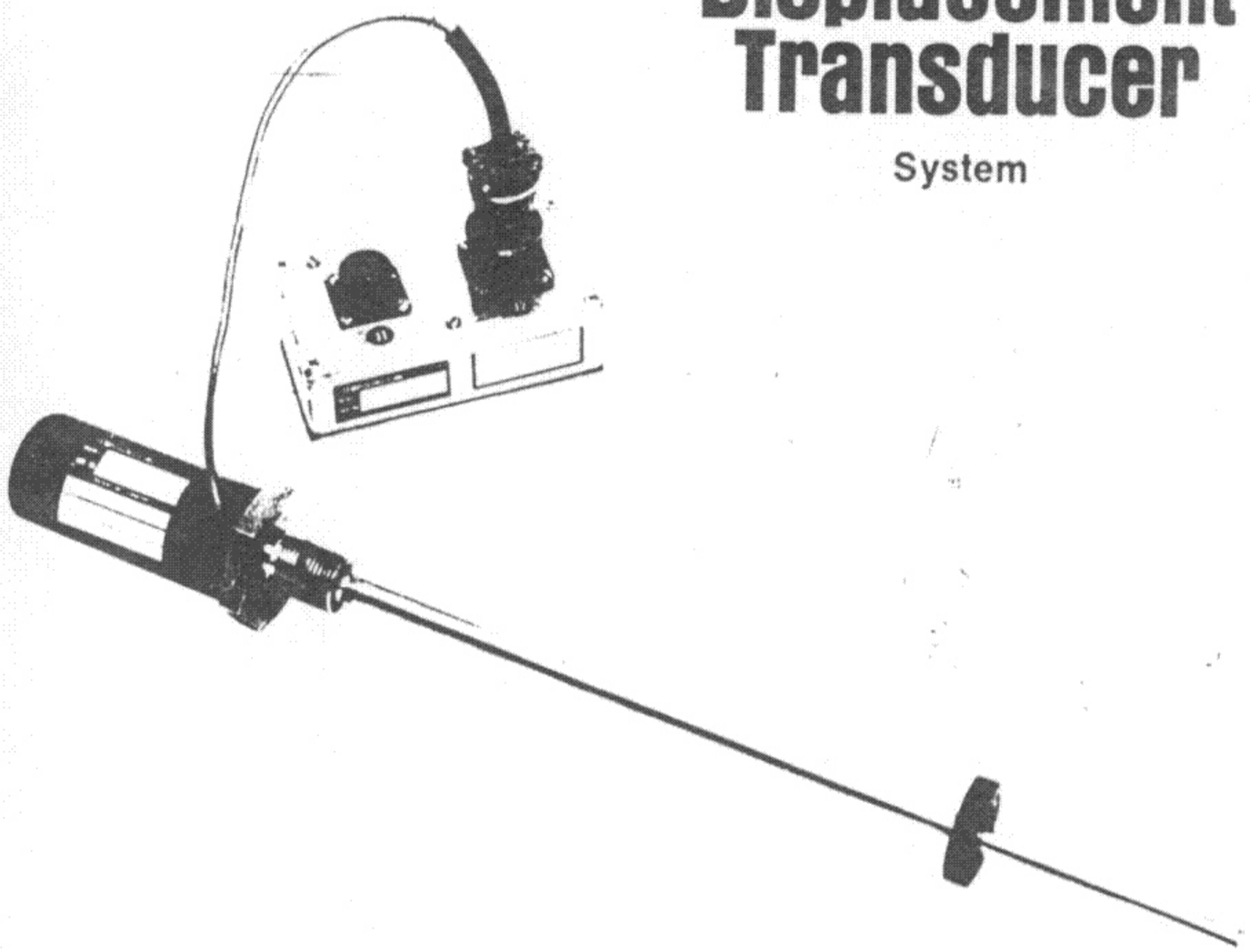
INTERCABLING DIAGRAM S.A.S. RECIRCULATION BOX

DATE 3-21-86 | DRAWN BY B. CHESHIER | DWG. NO. SB 808 A
SCALE NONE | CHECK BY

Precision
Non Contacting

Digital Linear Displacement Transducer

System



131 East Ames Court, Plainview, New York 11803 • (516) 349-1950 • TWX 510-226-3787

NOTES ON DIGITAL TEMPOSONICS TRANSDUCERS

Stroke Length:	Standard up to 10 Feet (Options up to 30 Feet)
Linearity:	Better than ± .05% of full range
Repeatability:	Better than ± .002% of full range
Temp Coef:	.0005% per °F
Resolution:	Standard 16 Bit Binary (65,536 parts) 18 Bit available (262,144 parts)
Update Time:	Typical update time in microseconds is (50 + 10 x Length in inches) When resolution is finer than .002" longer update times are required.
Output:	Absolute, (not incremental) Natural Binary TTL compatible BCD optional Serial or Parallel Output
Operating Temp Range:	0°F to 185°F (Wider Rangers Optional)
Zero:	Can be positioned anywhere along stroke length.
Operation in Hydraulic Cylinders:	The 3/8" diameter rod and magnet are capable of operating in hydraulic fluid and will withstand pressures up to 5,000 psi.

ORDERING INFORMATION

Stroke Length:	_____ inches
Resolution:	_____ thousanths of inch per count
Maximum acceptable update time:	_____ milliseconds
Location of Zero:	_____ inches from face of flange
Total Length of Rod:	_____ inches from face of flange to end

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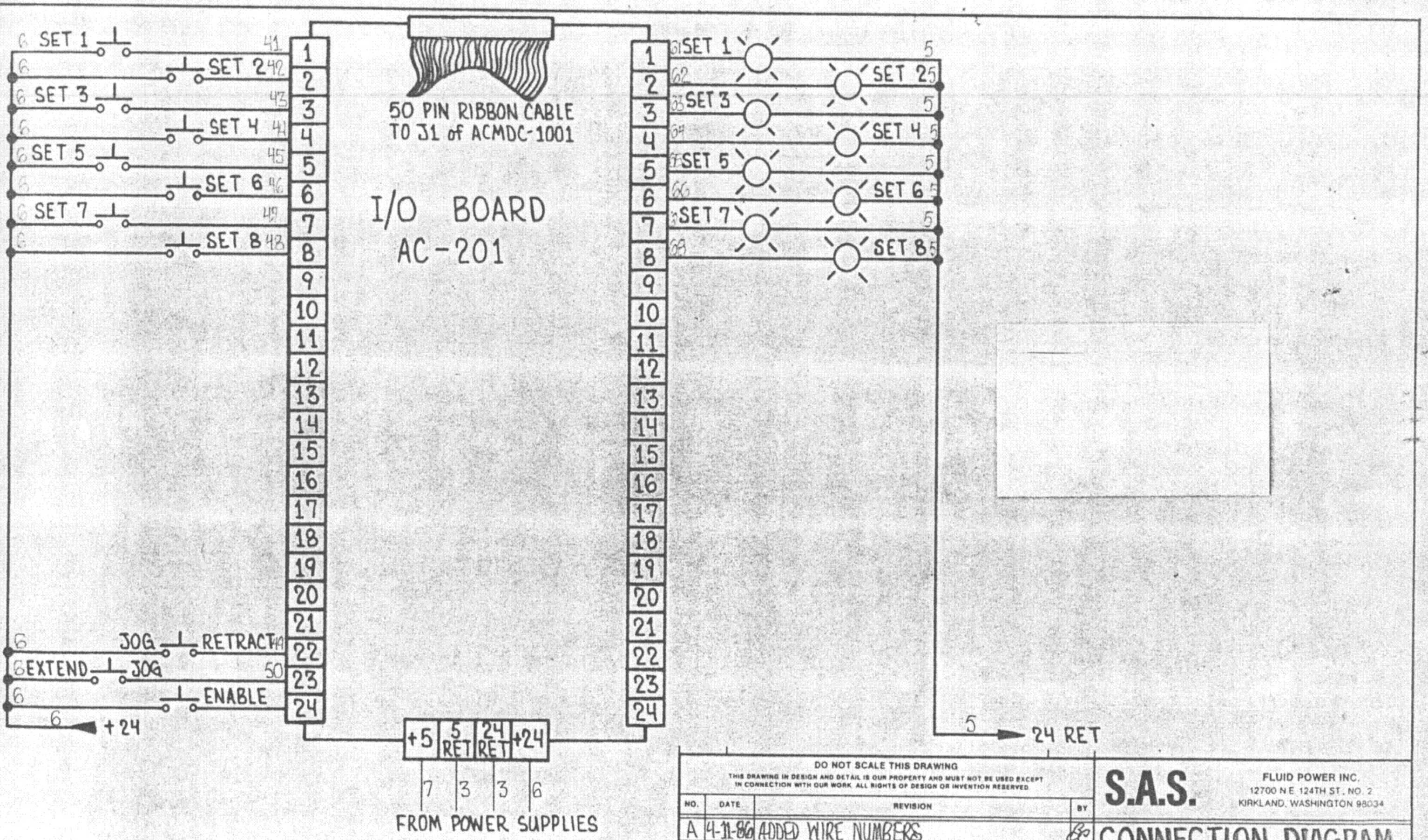

FOR INTERCABLING SEE SC-800

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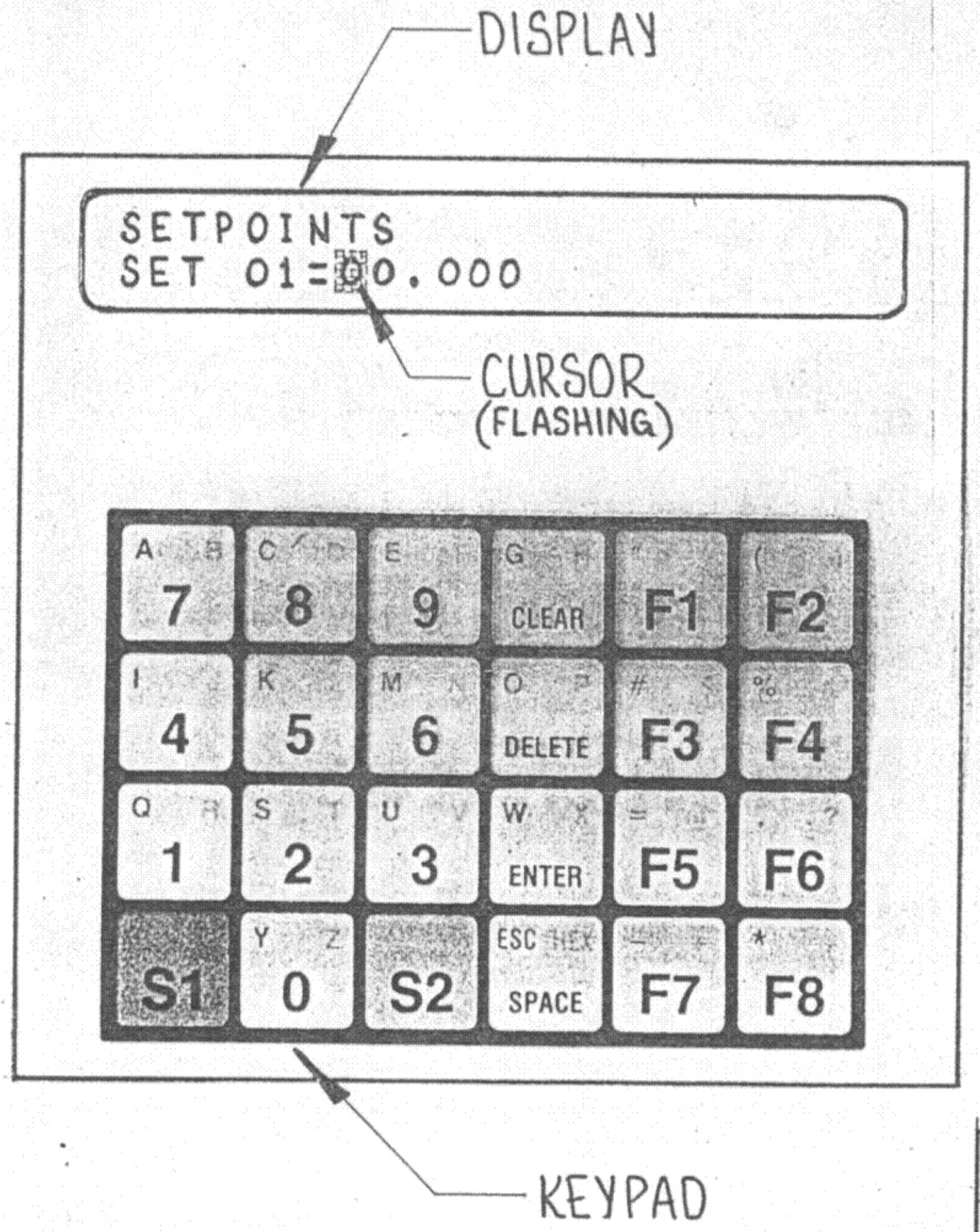
NO.	DATE	REVISION	BY
A	4-11-86	ADDED WIRE NUMBERS	

S.A.S.
FLUID POWER INC.
12700 N.E. 124TH ST., NO. 2
KIRKLAND, WASHINGTON 98034

CONNECTION DIAGRAM POSITIONING SYSTEM INPUT/OUTPUT BOARD

DATE 3-24-86 | DRAWN BY R.CHESHIER | DWG. NO. SB 818-B
SCALE NONE | CHECK BY



CHANGING and EXAMINING SETPOINTS VIA the TRANSTERM 5 KEYPAD

1) If the power is not already on (display active), then turn it on. Within one second after the power is turned on, three "beeps" will be heard indicating a successful power-up sequence.

2) To enter "MODE 1" (Examine/Change Setpoints) press "CLEAR", then press "1". The display will read as shown at the left.

   NOTE: Entering "MODE 1" places the cursor at the last setpoint to be examined or changed since power-up.

3) Press "SPACE" to move to the next setpoint (set 2, set 3, set 4, etc...) or press "DELETE" to move to the previous setpoint (set 21, set 20, set 19, etc...).

4) Enter set size desired by "overwriting" existing setpoint value. To enter a set size of 12.000", press "1", "2", "0", "0", "0", in that order. To enter a set size of 1.500", actually enter 01.500", by pressing "0", "1", "5", "0", "0", in that order. The decimal point is automatically inserted between the second and third digits. The location of the cursor is indicated by a flashing rectangle and an underlined character. That location is changed by entering a new character or retained by entering the same character. The cursor automatically moves to the next character position after a value is entered. The cursor will continue to "wrap" around the five character positions of each setpoint as values are entered.

5) To store the set size into memory, press "ENTER". When entering a set size into memory, be sure that the set size desired is displayed properly before pressing "ENTER".

6) To verify that the set size was actually stored into memory, move to the next setpoint by pressing "SPACE", then move back to the entered setpoint by pressing "DELETE". If the desired set size was entered into memory, it will be displayed properly after moving to a different setpoint and back.

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NO.	DATE	REVISION	BY

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12700 N.E. 124TH ST., NO. 2
KIRKLAND, WASHINGTON 98034

PROGRAMMING INSTRUCTIONS
POSITIONING SYSTEM KEYPAD

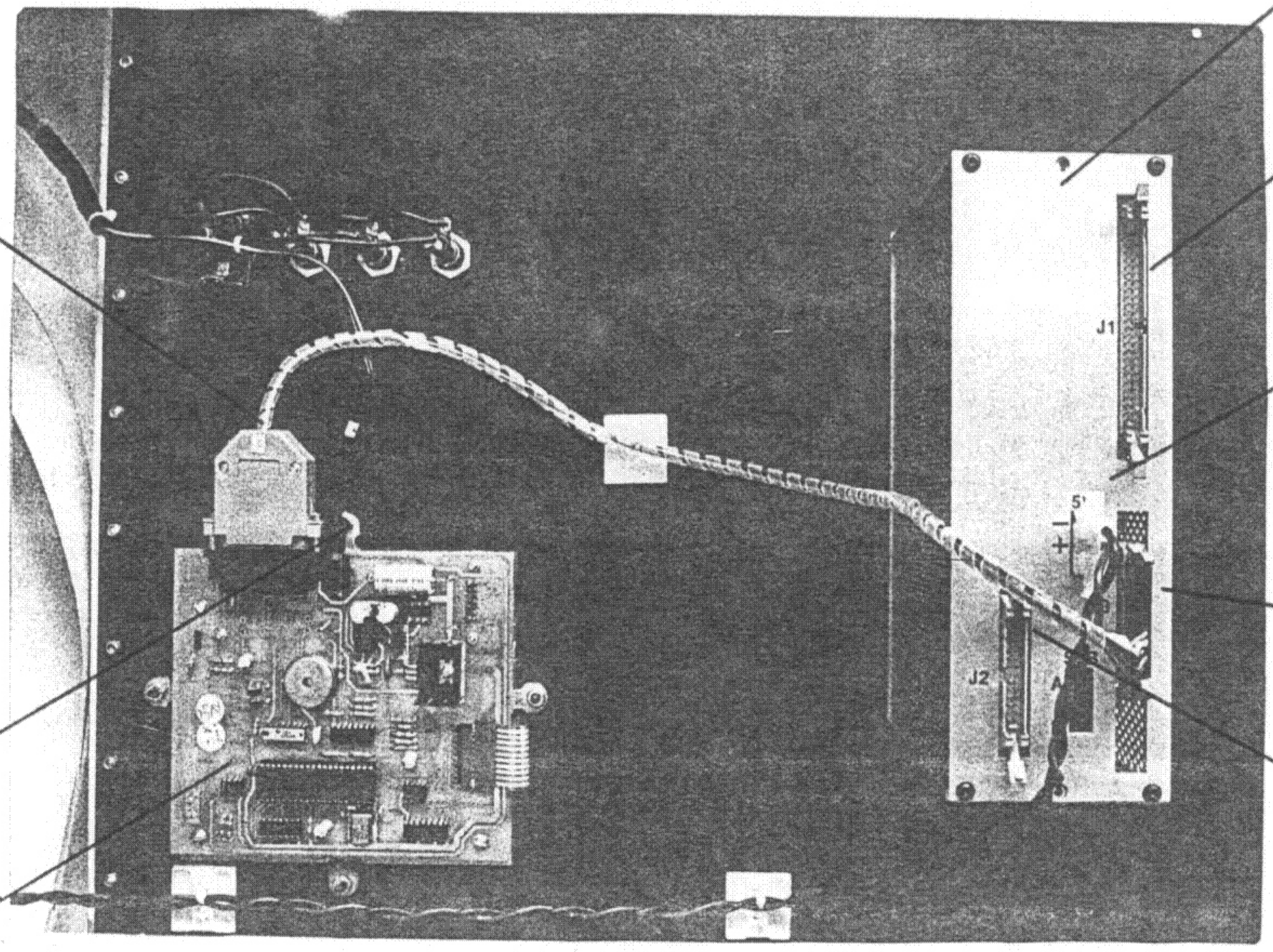
DATE 3-24-86 | DRAWN BY BCHESHIER | DWG. NO. SB 805
SCALE NONE | CHECK BY

S.A.S. ACMDC-1001
POSITIONING MODULE

50 PIN RIBBON CABLE PLUG
AC-201 I/O BOARD-INTERFACE

-SUBMINIATURE PLUG
S-422 MODULE INTERFACE

3 PIN MOLEX CONNECTOR
5 VDC POWER SUPPLY

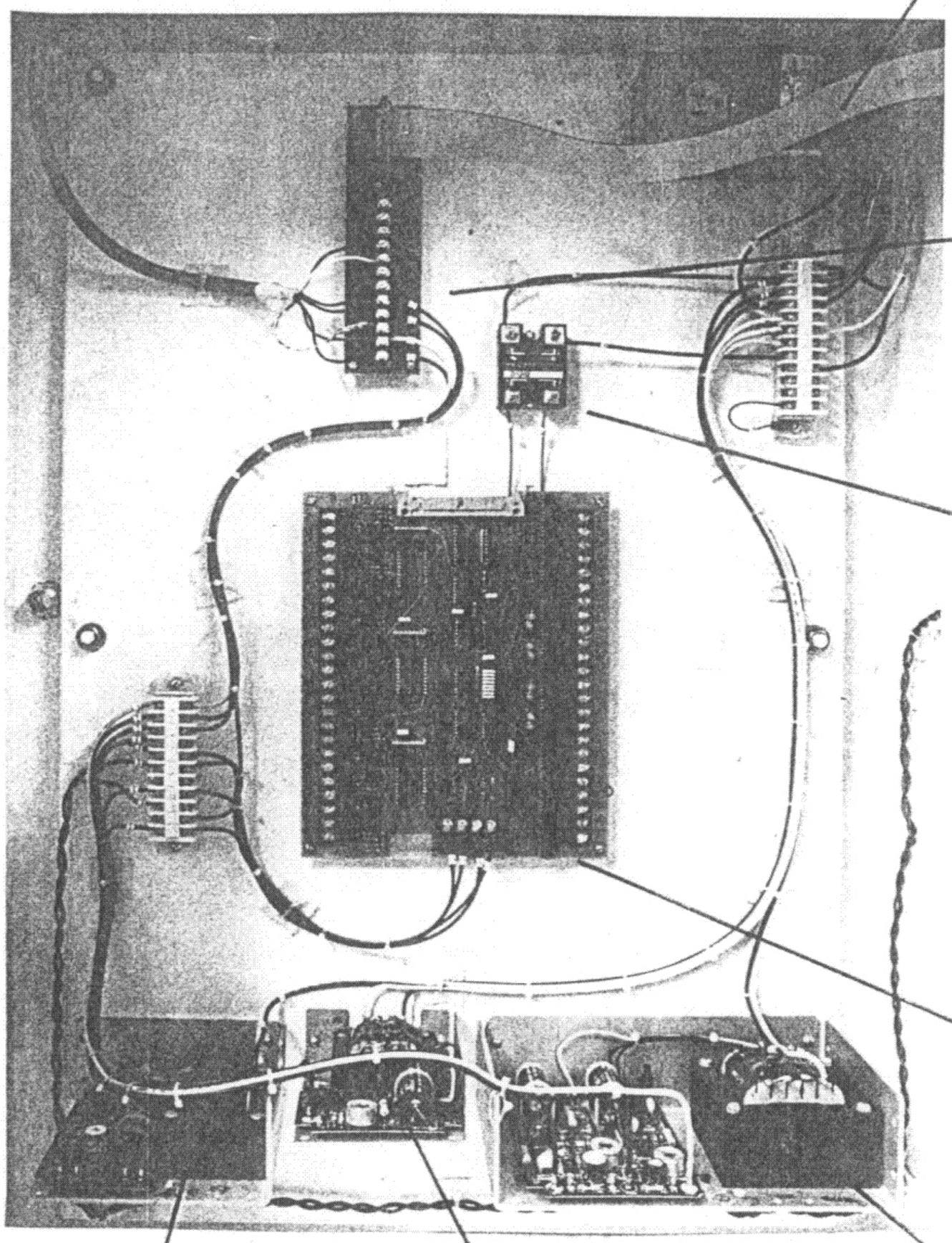


26 PIN RIBBON CABLE PLUG
RS-422 KEYBOARD INTERFACE

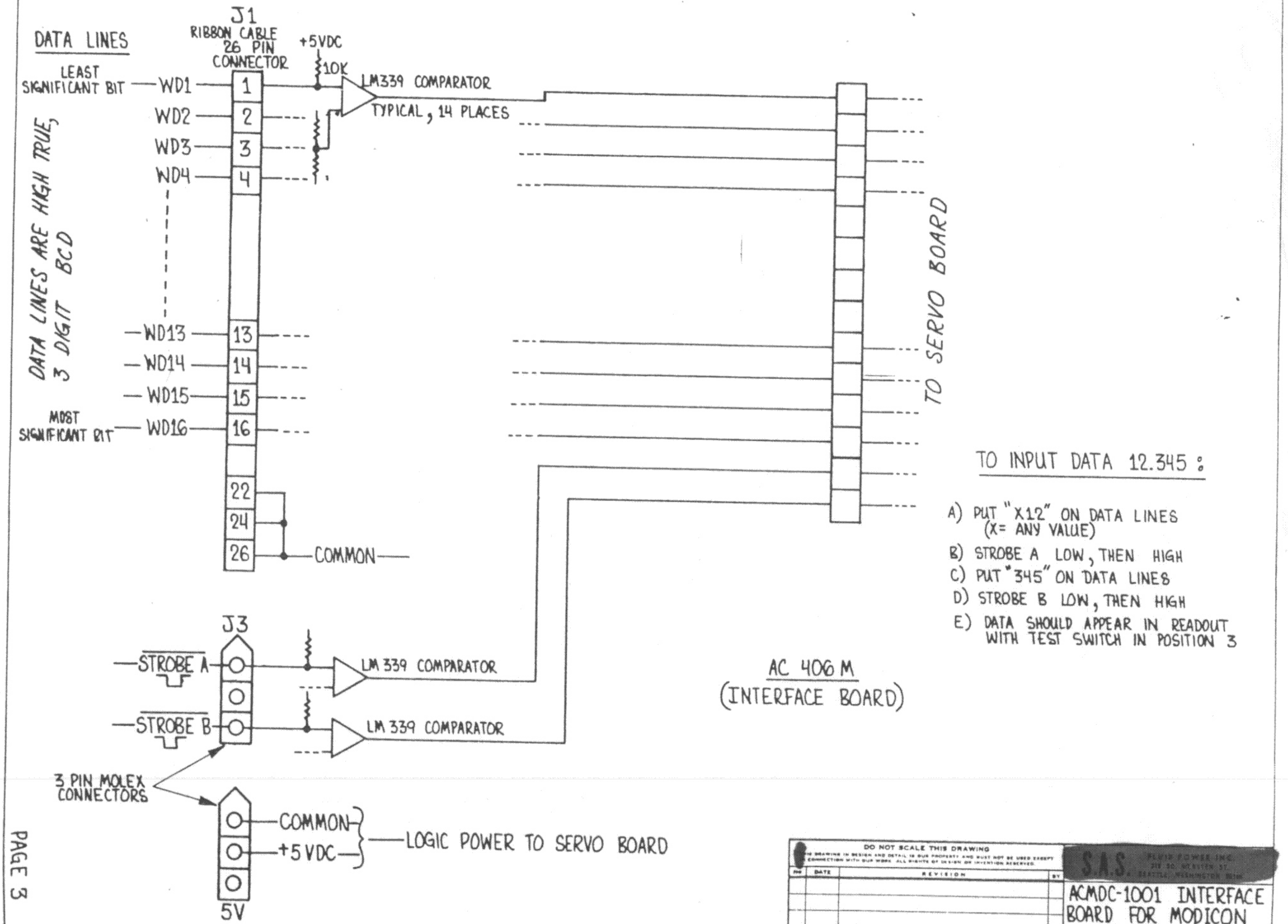
POWER CONNECTOR

26 PIN RIBBON CABLE PLUG
AC-401 POSITION FEEDBACK

TRANSTERM 5
KEYBOARD / DISPLAY



FOR ADDITIONAL WIRING INFORMATION, SEE SC-800, SB-818 AND SB-808



AC 406 M
(INTERFACE BOARD)

TO INPUT DATA 12.345 :

A) PUT "X12" ON DATA LINES (X= ANY VALUE)
B) STROBE A LOW, THEN HIGH
C) PUT "345" ON DATA LINES
D) STROBE B LOW, THEN HIGH
E) DATA SHOULD APPEAR IN READOUT WITH TEST SWITCH IN POSITION 3

DO NOT SCALE THIS DRAWING
THIS DRAWING IN DESIGN AND DETAIL IS OUR PROPERTY AND MUST NOT BE USED EXCEPT IN CONNECTION WITH OUR WORK. ALL RIGHTS OF INVENTION OR INVENTION RESERVED.

NO	DATE	REVISION	BY

S.A.S. [redacted]

ACMDC-1001 INTERFACE BOARD FOR MODICON AC 484 MA

DATE 1-20-86 | DWG. NO. SC 789