FLUKE 510A/AA

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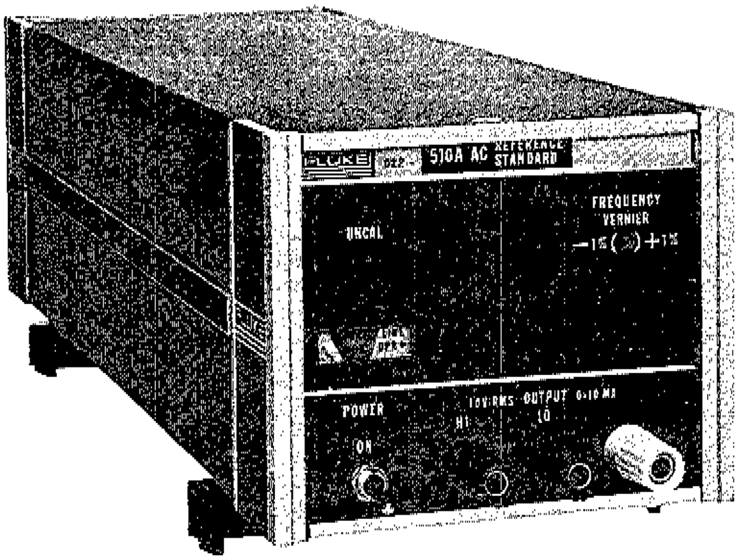

MODEL

510A/AA

AC REFERENCE STANDARD

FOR REFERENCE PURPOSES ONLY

NOVEMBER 1971

THIS DOCUMENT CONTROLS SPECIFICATIONS AND FABRICATION OF A SPECIAL INSTRUMENT MANUFACTURED BY THE JOHN FLUKE MANUFACTURING COMPANY, INCORPORATED.

MODEL 510A/AA

FLUKE JOHN FLUKE MFG CO., INC. P.O. BOX 7428, SEATTLE, WN.			
SPECIFICATION CONTROL DRAWING SPECIAL PRODUCTS DIVISION			
PROJ. ENG.	DATE 11-5-71	510A/AA-130	
MKTG.	DATE		
ENG. APPD.	DATE 11-9-71		
	JF NO. 298018	NO. OF PAGES 5	REV. 6

510A/AA-130

FORM NO. 5044

DOCUMENT CHANGE RECORD

REV. LTR.	PAGE	DESCRIPTION OF CHANGE
1	5,6	Added Serial number references
	7	Added page 7 (3rd page of Documentation Index)
2	4	Add: Section 4.1
	6	Delete: Item 3
3	6	Add: Item 2
4	4	Correct: OECO Transformer # from 17537 to 17584 and Dwg. # from 510A/AA-6001 to 510A/AN-6001 Section 4.1
5	4	Correct dwg. number, Sect. 4.1 from 510A/AN-6001 to 510A/AN-8001

Form No. 737

1.0 GENERAL - Similar to 510A-04 with the following exceptions:

1.1 Capable of being phase locked to an external 400Hz 26V RMS reference.

1.2 Provides eight separate transformer isolated outputs at 10V RMS into 100K ohms.

1.3 Each output has programmable phase control of 0 or 180 degrees.

1.4 Housed in 3-1/2 inch high full rack width package.

2.0 ELECTRICAL - All electrical specifications apply with each output loaded into 100K ohms.

2.1 Phase reference input: 26V RMS ± 10%, 380 to 420Hz, 30K ohm input impedance.

2.2 Outputs: Eight, transformer coupled, at 10V RMS ± .05%. Phase relationship to phase reference input 0 ± 1 degree or 180 ± 1 degrees programmable. Total harmonic distortion 0.15% isolation between any two outputs or input to any output: 300V DC or peak AC; 1100pf maximum capacitance.

2.3 Phase programming inputs: Power required 5V DC ± 5% at 150ma per input (1.2 Amp maximum for all inputs paralleled). Logic levels for phase programming (7400 series TTL): Logic "O", V in < 0.8V, I in - 3.2ma. Logic "1"; V in > 2V, I in < 1ma.
On a logic "1" to logic "O" transition at the phase control enable input, the output phase will be programmed according to phase control input status. Logic "O" corresponds to 180 degrees phase logic "1" corresponds to O degrees phase with respect to phase reference input.

3.0 MECHANICAL

3.1 Chassis size 3-1/2 in. high, 19 in. wide (rack mountable), 15½ in. depth behind front panel.

3.2 Input and outputs located on rear panel. Input, binding posts on 3/4 in. centers. Outputs 8-8 terminal barrier strips.

3.3 Power switch an d overload indicator on front panel.

4.0 PARTS LIST - See Bills of Material and Engineering Drawings listed in Section 5.2 MFG Column.

4.1 Purchased Parts
(1) OECO transformer 17584 per 510A/AN-8001

5.0 DOCUMENTATION

5.1 Standard 510A Manual with 510A/AA-130 Specification Control Drawing and Drawings listed in Section 5.2 MNLS Column.

5.2 DOCUMENTATION INDEX — MODEL: 510A/AA

ITEM	DRAWING NUMBER.	DRAWING TITLE	SHEETS	B/MTL	USAGE MFG	USAGE MNLS			Applies to instruments with Serial numbers:
1	510A/AA-160	Acceptance Test Procedure			X	X			All
2	510A/AA-1001	Schematic, 8 Output AC Ref Std.	1		X	X			through S/N 128
3									
4	510A/AA-2001	Front Panel Punch	1		X				All
5	510A/AA-2002	Rear panel punch	1		X				All
6	510A/AA-2003	Front Panel screened	1		X				All
7	510A/AA-2004	Rear Panel screened	1		X				All
8	510A/AA-2005	Inner Panel LH	1		X				All
9	510A/AA-2006	Inner Panel RH	1		X				All
10	510A/AA-2007	Bracket Xformer Mtg.	1		X				through S/N
11	510A/AA-2008	Hold Down, Transformer	1		X				All
12	510A/AA-2009	Pad, Transformer Mtg.	1		X				All
13									
14	510A/AA-3001	Drill Detail Phase Lock PCB Assy.	2		X				Through S/N 128
15									
16	510A/AA-4001	Phase Lock PCB Assy.	1	X	X	X			Through S/N 128
17	510A/AA-4002	Main PCB Assy. (Modifications)	1	X	X	X			Through S/N 128
18									
19	510A/AA-4451	Front Panel Assy.	1	X	X				All
20	510A/AA-4452	Rear Panel Assy.	1	X	X				All

5.2 DOCUMENTATION INDEX MODEL: 510A/AA

ITEM	DRAWING NUMBER	DRAWING TITLE	SHEETS	B/MTL	USAGE MFG	USAGE MNLS			Applies to instruments with serial numbers:
1	510A/AA-5001	Final Assy.	2	X	X				Through S/N 128
2	510A/AA-6510	Power Transformer							
3									
4									
5	510A/AA	Test & Button-up	1	X	X				All
6									
7									
8									
9									
10									
11									
12									
13									
14									
15									
16									
17									
18									
19									
20									

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Applicable Drawings

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JF FORM NO. 1484

5.2	DOCUMENTATION INDEX	MODEL: 510A/AA

ITEM	DRAWING NUMBER	DRAWING TITLE	SHEETS	B/MTL	USAGE MFG	USAGE MNLS			Applies to instruments with serial numbers:
1	510A/AA-1003	Schematic, 8 output AC Ref Std.	1		X	X			129 & on
2									
3	510A/AA-2010	Support	1		X				129 & on
4	510A/AA-2011	Support	1		X				129 & on
5	510A/AA-2012	Support	1		X				129 & on
6	510A/AA-2013	Support	1		X				129 & on
7									
8	510A/AA-3003	Drill Detail Phase Lock PCB	3		X				129 & on
9									
10	510A/AA-4003	Phase Lock PCB Assy.	2	X	X	X			129 & on
11	510A/AA-4004	Main PCB Assy (rework)	1	X	X	X			
12									
13	510A/AA-5002	Final Assy.	2	X	X	X			129 & on
14									
15									
16									
17									
18									
19									
20									

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Applicable Drawings	510A/AA-130	REV /	PAGE 7

6.0 TEST PROCEDURE - See 510A/AA-160

ACCEPTANCE TEST PROCEDURE

DOCUMENT NO: 510A/AA-160 REV. 1

TITLE: 510A/AA REFERENCE STANDARD (8 OUTPUT)

Number of Pages: 20

PREPARED RJ Lewandowski DATE 12-8-72
(Project Engineer)

TOOL PROOFED ____________ DATE ________
(Test Supervisor)

APPROVED James L Spitzer DATE 12-11-72
(Manufacturing Engineer)

APPROVED ____________ DATE ________
(Engineering Section Head)

APPROVED ____________ DATE ________
(Quality Assurance)

FLUKE

Form No. 775-Rev. 1 - 5/70

DOCUMENT CHANGE RECORD

REV. LTR.	PAGE	DESCRIPTION OF CHANGE
1	5	ADD: Sections 2.1 and 2.2
		ADD: "(S/N 001 through 128)" to Section 3.0
	13	ADD: "for instruments with S/N 001 through 128" to Section 3.4.7
	Accept. Test Record	ADD: Notation on top of page.
	14 - 20	ADD: New Section 4.0
		ADD: Additional "ACCEPTANCE TEST RECORD"

Prepared By: Robert J. Lewandowski (signature)
Robert J. Lewandowski

12-8-72
Date

	JOHN FLUKE MANUFACTURING CO., INC.
	510A/AA-160 — REV 1 — PAGE 2

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TABLE OF CONTENTS

The following is a list of equipment required to test the 510A/AA.

Multimeter	Fluke 8100A
Variac	1A Minimum
AC Ammeter	0-100ma
AC/DC Differential Voltmeter	Fluke 887A
Oscilloscope	Tektronix 545 with 1A1 Plug in and 10X attenuator probe or equiv.
Thermal Transfer Standard	Fluke 540B
DC Calibrator	10V and 14.14214 volts ± 20 ppm @ 5ma, Fluke 343A
Load resistors	(1) 700 ohms, (1) 1.3K ohms, (8) 100K ohms ± 1%, and (1) 110K ohms ± 1%.
Continuously variable	DC Power Supply 0 to ± 10V @ 1.5 Amp.
Frequency Counter	300-400Hz with 1Hz resolution.
Phase Reference Source	26V RMS, 350 to 450Hz.
RMS Voltmeter	Fluke 931B calibrated to ± 0.02% See 3.2.9.
Phase Meter	Wiltron 351
Distortion Analyzer	HP333A or
Wave Analyzer	HP3590A

1.0 PURPOSE

The purpose of the Test Procedure is to define requirements and procedures for production testing of the Model 510A/AA Reference Standard.

2.0 SCOPE

This procedure defines tests to be performed on all instruments.

2.1 Section 3 applies to instruments with serial numbers 001 through 128.

2.2 Section 4 applies to instruments with serial numbers above 128.

3.0 TEST PROCEDURE (Serial Numbers 001 through 128)

NOTE: All references to 510A are to the 510A-4001 (307869) PCB assembly. All references to the 510A/AA are to the 510A/AA-4001 PCB assembly. All measurements are made to circuit common (black binding post, TP 8 & 10 on 510A/AA or 510A shield cover) unless otherwise specified.

3.1 Turn-On - 510A Basic

NOTE: All referenced test points and adjustments are on 510A, unless otherwise noted. Referenced output terminals are TP 12 & TP 11 (common) on 510A/AA.

3.1.1 Disconnect red, blue and violet leads from 510A. Disconnect orange and yellow leads on 510A/AA.

3.1.2 <u>AC Power Input Receptacle</u>

Verify that the AC power input receptacle is installed with the grounding pin up and that the high side of the line (pin marked L on back of receptacle) is connected to the center post of the fuse holder.

3.1.3 Isolation Check

Set the multimeter to the 10M ohm range and measure the resistance between the rear panel WHITE and BLACK binding posts. The resistance should be infinite.

3.1.4 Output Transistor Check

Set the multimeter to the 1K ohm range. Connect the + lead to Q28 base and the - lead to Q28 emitter. The meter should read between 800 and 1500 ohms.

Repeat for Q25.

Connect the + lead to Q27 emitter and the - lead to Q27 base. The meter should read between 800 and 1500 ohms.

NOTE: If resistance is greater than 1500 ohms, the wrong transistors are installed.

3.1.5 Adjustment Preset

Set the 115-230V switch on the rear panel to 115V. Set R100 and R27 fully ccw and center all 9 remaining posts (including R96 at the front panel).

3.1.6 Plug In

Plug the instrument into the variable line voltage source. Monitor TP2 (+18V) with a DC voltmeter and the output with a scope (5V/cm sensitivity). Bring up the line voltage slowly. The +18V should come up but there may be no AC output depending on the setting of R90. Set the line to 115V. Input current should not exceed 50ma AC.

3.1.7 FET Bias Set

Monitor TP5 for +.6 to -6.0V and adjust R90 to produce -2.3V to -2.7V. With no output present, TP5 should be at +6.0V. If the output is >10V rms, TP5 will be approximately +3V.

3.2 Calibration - 510A Basic

3.2.1 -18V Regulated Supply (TP4)

-18V ± .5V

3.2.2 +18V Regulated Supply (TP2)

Set to +18V ± .2V with R9

3.2.3 Reference Voltage +14.14214V (TP10)

Measure TP10 with the 887A. Use internal circuit common (shield cover). Clip jumpers A and B per table.

V_{REF} - 14.14214V	Clip Jumper
0 to .00571	None
.00572 to .01141	A
.00142 to .01712	B
.01713 to .02182	A & B,

Next set reference with R27 to 14.14214V ± 200uV.

This step must be preceeded by 3.1.5.

3.2.4 V3, V4, Zero Set

Use internal circuit common (shield cover)

Monitor TP6. Set R49 to 0 ± 100uV.

Monitor TP7. Set R72 to 0 ± 100uV.

3.2.5 Output Stage Bias Current Set

Short TP14 to circuit common. (Oscillator will stop.) Adjust R100 for +250mV between TP4 and TP12. Disconnect voltmeter from TP4 and TP12. Remove short.'

3.2.6 Detector Diode Bias Set

With DC coupled scope and X10 probe, set R60 for + 100mV ± 10mV peak at TP8. Use 50mV or 100mV vertical sensitivity.

3.2.7 Amplitude Determining Resistor Balance

Monitor output TP12 & TP11 on 510A/AA board with AC Diff. VM with max null sensitivity. Adjust R37 for "Ø" shift in output level when A252 is switched (adjust R37 for half the shift and switch A252 to check setting). Repeat if necessary. Set for < 50uV shift.

3.2.8 Uncalibrated Indicator Check

Apply 700 ohm load to output. Uncalibrated indicator should come on. Apply 1.3K ohms. Indicator should not be on.

3.2.9 Inherent Absolute Calibration Check

Using a 540B, perform an AC-DC transfer on the 510A/AA. Error should be less than 0.02%.

Record the error with sigh (+ or -).

NOTE: This calibrated signal level can be used as a reference for calibrating the 910B used in final output level adjustment of the 510A/AA.

3.3 Operational Alignment - 510A/AA

3.3.1 Turn Instrument OFF

Reconnect red lead to TP2 & violet lead to TP4, turn instrument on. Observe that + and - 18 volts on 510A/AA are correct. Low level of + or - 18 volts indicates excessive loading or short circuit on 510A/AA. Disconnect red and violet leads and troubleshoot. Reconnect Orn & yel leads on 510A/AA blue lead to pin near Q21 on 510A.

3.3.2 On 510A/AA set R52, R54 and R88 to mid range and R49 max ccw. Remove U1 from its socket and apply +10 volts to TP5, and TP10 (common) on 510A/AA. Monitor voltage at TP5 on 510A.

3.3.3 Adjust R88 on 510A/AA for equal voltages at TP5 on 510A when polarity of 10 volt signal is reversed. R90 on 510A may have to be adjusted to maintain the voltage at TP5 on 510A between zero and -5 volts to maintain the 510A in linear operation.

3.3.4 Vary applied voltage at TP5 on 510A/AA from -10V through 0 to +10V while monitoring the voltage change at TP5 on the 510A. Change should be less than 2V. Adjust R90 on the 510A to center the voltage change about -2.5VDC. Remove voltmeter from TP5 on 510A.

3.3.5 Connect frequency counter to output TP12 and TP11 (common). With zero volts at TP5 on 510A/AA adjust R95 on 510A for 400 ± 1Hz, with +10 volts at TP5 the output frequency must be greater than 435Hz; with -10 volts at TP5 outut frequency must be less than 365Hz.

3.3.6 Apply +3 volts to TP5 on 510A/AA and adjust R52 for 420 ± 2Hz. With -3 volts at TP5 frequency should be 380 ± 3Hz. Disconnect frequency counter.

Monitor TP6 on 510A/AA with oscilloscope while adjusting R54 for minimum dc shift with voltage at TP5 on 510A/AA is changed from +10V to -10V. Shift should be less than 100mV.

3.3.7 Remove dc supply and short TP5 to TP10 on 510A/AA. Monitor TP9 with voltmeter and adjust R49 for 4 ± .05V DC.

3.3.8 Trigger oscilloscope externally from output at TP12 & TP11 (common). Observe that signal at TP2 is a symmetrical square wave of approximately 10 volts peak to peak centered about 0V DC and is 180° out of phase with the output.

3.3.9 Observe that the waveform at TP3 is a symmetrical square wave at 1/2 the output frequency, the amplitude should be 0V to -10V peak to peak.

3.3.10 Apply 26V RMS 400Hz phase reference signal to the rear panel phase reference input. Trigger oscilloscope externally from phase reference signal. Observe that signal at TP1 is a symmetrical square wave of approximately 10 volts peak to peak centered about 0 VDC and is in phase with the phase reference signal.

3.3.11 With power off replace U1. Remove short from TP5 on 510A/AA. Turn power on. Monitor TP3 on 510A/AA with oscilloscope the waveform should become a symmetrical square wave within a few seconds indicating the 510A/AA is phase locked to the reference signal.

3.3.12 Change the reference signal frequency to 370Hz and then to 430Hz observing that the square wave signal appears at TP3 on the 510A/AA indicating phase lock.

3.3.13 Apply a variable 5V DC source to terminals C and D of TB1 through TB8 in parallel. Connect all terminal A's of TB1 through TB8 together, this will be a common phase control function for all outputs.

3.3.14 Connect the phase control buss to +5V (terminal C) and alternately connect the phase control enable input (terminal B) of TB1 through TB8 to ground (terminal D) to set all phases to 0 degrees.

3.3.15 Externally trigger an oscilloscope from the phase reference input and check each output, terminals E & F (common) observing an in-phase condition with the phase reference.

3.3.16 Connect the phase control buss to Gnd, and alternately connect each phase control enable input to ground to set all phase to 180 degrees. Check each output with oscilloscope observing the 180 degree phase condition.

3.3.17 Reduce the voltage across terminals C & D to 4.5V. Repeat 3.3.13 to 3.3.15 above. All relays must function correctly with 4.5 volts applied.

3.4 Final Calibration 510A/AA

3.4.1 Terminate each output with 100K ohm ± 1% load. Calibrate using a 931B RMS Voltmeter accurate to ± .02% or better at 10VRMS 400Hz. Set output levels at E (high) and F (low) on TB1 through TB8 to 10.00V RMS ± .005%, using R67 through R74 respectively. See 3.2.9.

NOTE: The input impedance of the 931B is 1M ohm, this paralleled with the 100K ohm load impedance will reduce the actual load on the measured output to approximately 91K causing the indicated reading to be approximately 100 to 150 ppm low. To compensate for this error the load resistor on the measured output must be changed to 110K ohm. All outputs must be terminated into 100K ohm for proper level out of any channel due to transformer primary impedance loss with output loading.

3.4.2 Calibrate and zero phase meter for 0 degrees with resolution of 0.1 degree maximum. Connect input 1 (reference input) of phase meter to signal at phase reference input of510A/AA. Connect input 2 (test input) to an output channel using a cable approximately the same length as on input 1. Set the phase to 0 ± 0.1 degrees using R42 on 510A/AA. Reverse the input leads to the phase meter and observe the meter reads 0 ± 0.1 degrees.

3.4.3 Vary the phase reference input signal frequency from 380Hz to 420Hz and observe theat the phase error after settling is less than ±0.5 degrees.

3.4.4 Check each output channel with phase meter, maximum phase difference between any two channels must be less than 0.1 degrees.

NOTE: The effects of phase meter input loading on 100K ohms loads will be insignificant for phase meter input impedances of 1M ohms or greater. Load resistor on measured output channel need not be changed to 110K ohms.

3.4.5 Set phase refeeence frequency to 400Hz. Connect distortion analyzer or wave analyzer to an output (terminals E & F). Measure total harmonic distortion less than 0.15% or using a wave analyzer the second and third harmonics should be less than 10mV (60db below the level of the fundamental). Repeat for 2 additional outputs.

NOTE: DC Magnetization of the output transformer can cause an increase in harmonic distortion. This may be brought about by the application of a dc current through an output winding or by recovery transients generated by the 510A when an output is repeatedly shorted. This effect is not permanent and can be reduced by applying a variable dc source to an output through a 3K ohm resistor while monitoring the distortion. By varying the voltage both positive and negative a null of distortion will be observed, if the applied voltage is removed at the time, the the null is observed the distortion shaould remain at or near the minimum level noted. Several attempts may be required to achieve a minimum level.

3.4.6 Repeat 3.4.5 above for 380 Hz and 420 Hz.

3.4.7 Remove all test equipment, this concludes the Acceptance Test for instruments with Serial Number 001 through 128.

4.0 TEST PROCEDURE (Serial Numbers 129 and on)

NOTE: All references to 510A are to the 510A/4001 (307868) PCB assembly. All references to the 510A/AA are to the 510A/AA-4003 PCB assembly. All measurements are made to circuit common (black binding post, TP 8 and TP 12 on 510A/AA or 510A shield cover) unless otherwise specified.

4.1 Turn-On - 510A Basic

NOTE: All referenced test points and adjustments are on 510A, unless otherwise noted. Referenced output terminals are TP 11 and TP 12 (common) on 510A/AA.

4.1.1 Disconnect red, blue and violet leads from 510A. Disconnect orange leads on 510A/AA.

4.1.2 <u>AC Power Input Receptacle</u>

Verify that the AC power input receptacle is installed with the grounding pin up and that the high side of the line (pin marked L on back of receptacle) is connected to the center post of the fuse holder.

4.1.3 <u>Isolation Check</u>

Set the multimeter to the 10M ohm range and measure the resistance between the rear panel WHITE and BLACK binding posts. The resistance should be infinite.

4.1.4 <u>Output Transistor Check</u>

Set the multimeter to the 1K ohm range. Connect the + lead to Q28 base and the - lead to Q28 emitter. The meter should read between 800 and 1500 ohms.

Repeat for Q25.

Connect the + lead to Q27 emitter and the - lead to Q27 base. The meter should read between 800 and 1500 ohms.

NOTE: If resistance is greater than 1500 ohms, the wrong transistors are installed.

4.1.5 Adjustment Preset

Set the 115-230V switch on the rear panel to 115V. Set R 100 and R 27 fully ccw and center all 8 remaining pots (including R 96 at the front panel).

4.1.6 Plug In

Plug the instrument into the variable line voltage source. Monitor TP 2 (+18V) with a DC voltmeter and the output with a scope (5 V/cm sensitivity). Bring up the line voltage slowly. The +18V should come up but there may be no AC output depending on the setting of R 90. Set the line to 115V. Input current should not exceed 50 ma AC.

4.1.7 FET Bias Set

Monitor TP 5 and adjust R90 to produce -2.3V to -2.7V. With no output present, TP 5 should be at -6.0V. If the output is > 10V rms, TP 5 will be approximately +3V.

4.2 Calibration - 510A Basic

4.2.1 -18V Regulated Supply (TP 4)

-18V ± .5V

4.2.2 +18V Regulated Supply (TP 2)

Set to + 18V ± .2V with R9.

4.2.3 Reference Voltage +14.14214V (TP 10)

Measure TP 10 with 887A. Use internal circuit common (shield cover). Clip jumpers A and B per table.

V_{REF} -14.14214V	Clip Jumper
0 to .00571	None
.00572 to .01141	A
.00142 to .01712	B
.01713 to .02182	A & B

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Next set reference with R 27 to 14.14214V ± 200 uV. This step must be preceeded by 4.1.5.

4.2.4 V3, V4, Zero Set

Use internal circuit common (shield cover).
Monitor TP 6. Set R 49 to 0 ± 100 uV.
Monitor TP 7. Set R 72 to 0 ± 100 uV.

4.2.5 Output Stage Bias Current Set

Short TP 13 to circuit common. (Oscillator will stop).
Adjust R 100 for + 25mV between TP 4 and TP 11.
Disconnect voltmeter from TP 4 and TP 11.
Remove short.

4.2.6 Detector Diode Bias Set

With DC coupled scope and X10 probe, set R 60 for + 100 mv ± 10 mv peak at TP 8.
Use 50 mv or 100 mv vertical sensitivity.

4.2.7 Amplitude Determining Resistor Balance

Monitor output TP 11 and TP 12 on 510A/AA board with AC Differential Voltmeter with maximum null sensitivity. Adjust R 37 for "0" shift in output level when A 252 is switched (adjust R 37 for half the shift and switch A 252 to check setting).
Repeat if necessary. Set for < 50uV shift.

4.2.8 Uncalibrated Indicator Check

Apply 700 ohm load to output.
Uncalibrated indicator should come on.
Apply 1.3K ohms. Indicator should not be on.

4.2.9 Inherent Absolute Calibration Check

Using a 540B, perform an AC - DC transfer on the 510A/AA. Error should be less than 0.02%.

Record the error with sign (+ or -).

NOTE: This calibrated signal level can be used as a reference for calibrating the 910B used in final output level adjustment of the 510A/AA.

4.3 Operational Alignment - 510A/AA

4.3.1 Turn Instrument OFF

Reconnect red lead to TP 2 and violet lead to TP 4, turn instrument On. Observe that + and - 18 volts on 510A/AA are correct. Low level of + or - 18 volts indicates excessive loading or short circuit on 510A/AA. Disconnect red and violet leads and troubleshoot. Reconnect orange leads on 510A/AA, blue lead to pin near Q 21 on 510A.

4.3.2 On 510A/AA set R 34 and R 44 to mid-range. Short TP 5 to TP 8. Monitor TP 7 (Hi), TP 8 (Low) and operate R 34 across full range. Observe voltage varies from > +3.8 to < -3.8.

4.3.3 Connect frequency counter to 510A/AA output. Short 510A/AA TP 5, TP 7, and TP 8. Adjust R 95 on 510A for 400 ± 1 Hz on counter. Remove short from TP 8 to TP 7. Leave short between TP 5 and TP 8 connected.

4.3.4 Monitor voltage at 510A, TP 5, while varying 510A/AA, R 34, from one extreme to the other. Adjust the 510A/AA R 44 for equal voltages (± 0.2V) at TP 5 at the extremes of R 34 adjustment. 510A R90 may have to be adjusted to maintain the voltage at 510A TP 5 between 0 and -5V to maintain the 510A in linear operation.

4.3.5 Slowly vary the setting of 510A R 34 observing the voltage at 510A TP 5. The voltage change should be less than 1 volt. Adjust 510A R90 to center the voltage range at TP 5 about -2.5 volts.

4.3.6 Observe output frequency with R 34 set to extremes of adjustment. The maximum frequency must be greater than 415 Hz and the minimum frequency must be less than 385 Hz. Remove short.

4.3.7 Monitor voltage at 510A/AA TP 7. Adjust 510A/AA R 34 for 0 ± 0.1 VDC at TP 7.

4.3.8 Apply 26V RMS 400 Hz phase reference signal to the rear panel phase reference input. Trigger oscilloscope externally from phase reference signal. Observe that signal at TP 1 is a symmetrical square wave of approximately 0 to +5 volts peak to peak and is in phase with the phase reference signal.

4.3.9 Connect oscilloscope to 510A/AA TP 2 and observe that signal is a symmetrical square wave of approximately 0 to +5 volts peak to peak and is in phase with the phase reference signal.

4.3.10 Change the reference signal frequency to 370 Hz and then to 430 Hz observing that the signal at 510A/AA TP 2 comes into phase with the reference signal at each extreme indicating phase locked condition.

4.3.11 Apply a variable 5V DC source to terminals C and D of TB 1 through TB 8 in parallel. Connect all terminal A's of TB 1 through TB 8 together. This will be a common phase control function for all outputs.

4.3.12 Connect the phase control buss (Term. A) to +5V (Term. C) and alternately connect the phase control enabling input (Term. B) of TB 1 through TB 8 to ground (Term. D) to set all phases to 0 degrees.

4.3.13 Externally trigger an oscilloscope from the phase reference input and check each output, terminals E and F (common), observing an in-phase condition with the phase reference.

4.3.14 Connect the phase control buss (Terminal A) to ground and alternately connect each phase control enable input to ground to set all phase to 180 degrees. Check each output with oscilloscope observing the 180 degrees phase condition.

4.3.15 Reduce the voltage across terminals C and D to 4.5V. Repeat 4.3.15 above. All relays must function correctly with 4.5 volts applied.

4.4 Final Calibration - 510A/AA

4.4.1 Terminate each output (terminals E and F) with 100K ohm ± 1% load. Calibrate using a 931B RMS Voltmeter accurate to ± .02% or better at 10V RMS, 400 Hz. Set output levels at E (Hi) and F (Low) on TB 1 through TB 8 to 10.00V RMS ± .005% using R 48 through R 63 respectively. See 4.2.9.

NOTE: The input impedance of the 931B is 1M ohm. This, paralleled with 100K ohm load impedance, will reduce the actual load on the measured output to approximately 91K causing the indicated reading to be approximately 150 to 250 ppm low. To compensate for this error the load resistor on the measured output must be changed to 110K ohm. All outputs must be terminated into 100K ohm for proper level out of any channel due to output impedance loss with output loading.

4.4.2 Calibrate and zero phase meter 0 degrees with resolution of 0.1 degree maximum. Connect input 1 (reference input) of phase meter to signal at phase reference input of 510A/AA.
Connect input 2 (test input) to an output channel using a cable approximately the same length as on input 1. Set the phase to 0 ± 0.1 degrees using R 31 on 510A/AA. Reverse the input leads to the phase meter and observe the meter reads 0 ± 0.1 degrees.

4.4.3 Vary the phase reference input signal frequency from 380 Hz to 420 Hz and observe that the phase error after settling is less than ± 0.5 degrees.

4.4.4 Check each output channel with phase meter. Maximum phase difference between any two channels must be less than 0.1 degrees.

NOTE: The effects of phase meter input loading on 100K ohms loads will be insignificant for phase meter input impedance of 1M ohm or greater. Load resistor on measured output channel need not be changed to 110K ohms.

4.4.5 Set phase reference frequency to 400 Hz.
Connect distortion analyzer or wave anaylzer to an output (Terminals E and F).
Measure total harmonic distortion less than 0.15% or using a wave analyzer the second and third harmonics should be less than 10 mV (60 db below the level of the fundamental). Repeat for 2 additional outputs.

4.4.6 Repeat 4.4.5 above for 380 Hz and 420 Hz.

4.4.7 Remove all test equipment. This concludes the Acceptance Test for instrument with Serial Numbers 129 and on.

FLUKE **ACCEPTANCE TEST RECORD**

APPLICABLE TO SERIAL NUMBERS 129 AND ON

MODEL NO. 510A/AA SERIAL NO. DATE

TEST	LIMITS	ACTUAL	✓	T
4.1 TURN ON - 510A				
4.1.1 Disconnect 510A/AA				
leads.	-	-		
4.1.2 AC Pwr. Input Recept.	-	-		
4.1.3 Isol. Check	-	-		
4.1.4 Output Transistor Ck.	-	-		
4.1.5 Adj. Preset	-	-		
4.1.6 Plug In	< 50 ma AC	-		
4.1.7 FET Bias Set R90	-2.3 to -2.7V	-		
4.2 CALIBRATION - 510A				
4.2.1 -18V TP4	-18 ± 0.5V	-		
4.2.2 +18V TP2 R9	+18 ± 0.2V	-		
4.2.3 V REF TP10 R27	14.14214V ± 200uV	-		
4.2.4 TP6, R49; TP7, R72	0 ± 100 uV	-		
4.2.5 Bias Current TP4				
TP12 R100	250 ± 20 mV	-		
4.2.6 Detector Diode Bias	+100 ± 10 mV	-		
TP 8, R 60	peak			
4.2.7 Res. Bal. TP11 & 12	< 50 uV AC	-		
R37	shift			
4.2.8 Uncal. Indic.	ON 700Ω	-		
	OFF 1.3KΩ	-		
4.2.9 Absolute Cal	< ± 0.02%		*	
4.3 OPER. ALIGN. 510A/AA				
4.3.1 + & - 18V supply ck.	-	-		
4.3.2 TP7 Voltage R34	> +3.8V; < -3.8V	-		
4.3.3 R95 Set	400 ± 1 Hz	-		
4.3.4 R44 Set TP5	± 0.2V Diff.	-		
4.3.5 R90 Set TP5	Center at -2.5V	-		
4.3.6 Freq. Range	> 415Hz; < 385Hz	-		
4.3.7 R34 Set TP7	0 ± 0.1 VDC	-		
4.3.8 TP1 Check	0 to +5V p-p	-		
4.3.9 TP2 Check	0 to +5V p-p	-		
4.3.10 Phase Lock Check	370Hz, 430Hz	-		

TEST	LIMITS	ACTUAL	✓	T
4.3.13 1KΩ Phase Check	0° Phase	-		
4.3.14 180° Phase Check	180° Phase	-		
4.3.15 4.5V Operation	-	-		
4.4 FINAL CAL. 510A/AA				
4.4.1 10V RMS Cal R48-R63	10VRMS ±.005%	-		
4.4.2 Phase Adj. R31	0 ± 0.1 degree	-		
4.4.3 Phase Ck. 380Hz	± 0.5 degrees	-		
420Hz	±0.5 degrees	-		
4.4.4 Phase Ck. each output	±0.1 degrees difference			
4.4.5 Harmonic Dist.	0.15% or			
Second Harmonic	< 10mV (-60db)			
Third Harmonic	< 10mV (-60db)			
Record worst value			*	
4.4.6 H.D. 380Hz 420Hz			*	

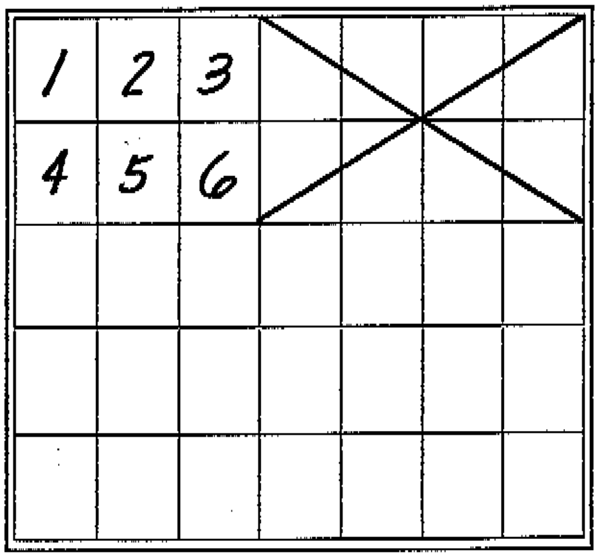
Q.C. INSP.	PAGE 1 OF 1	REV. 1

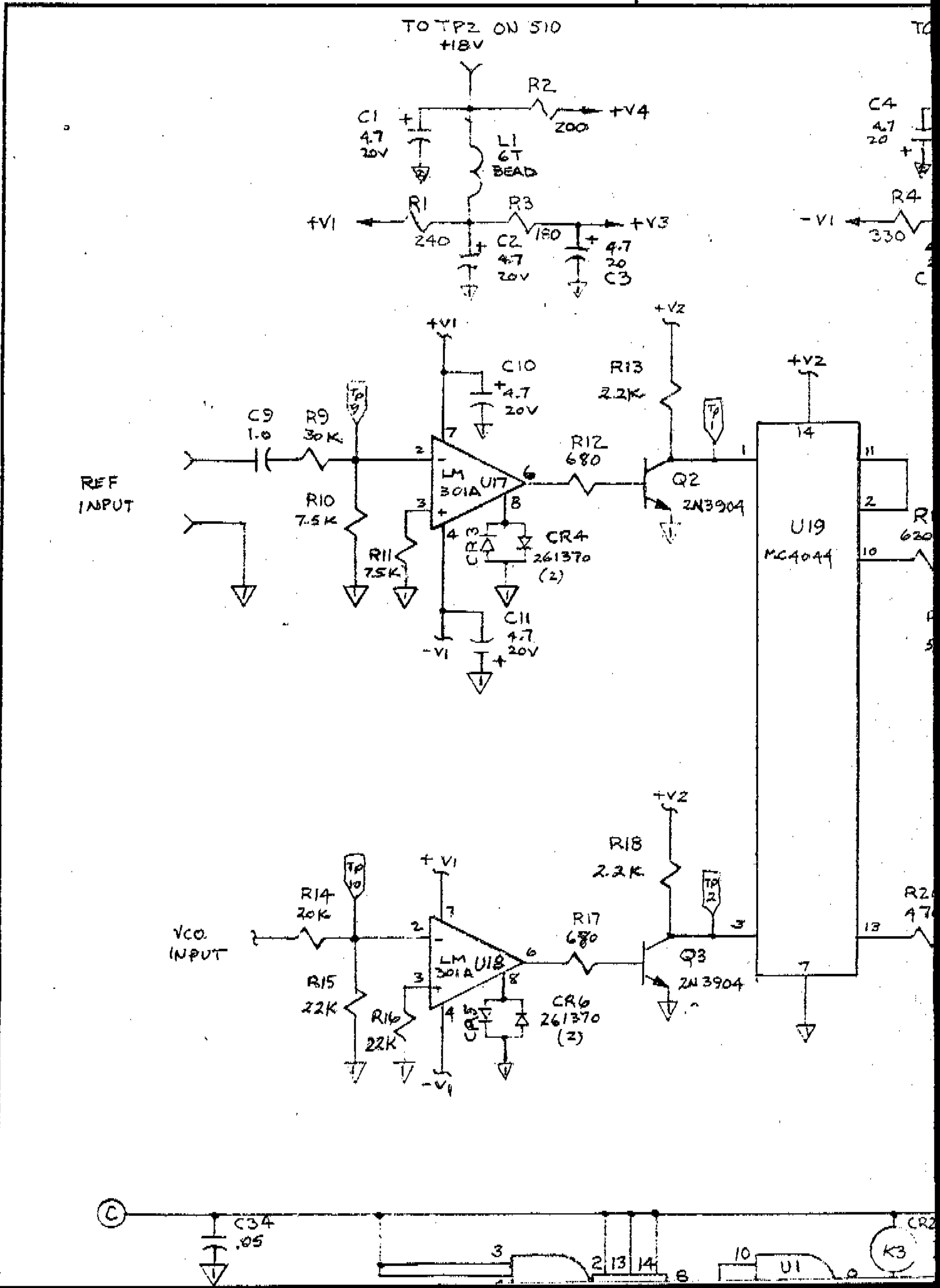
Form No. 779

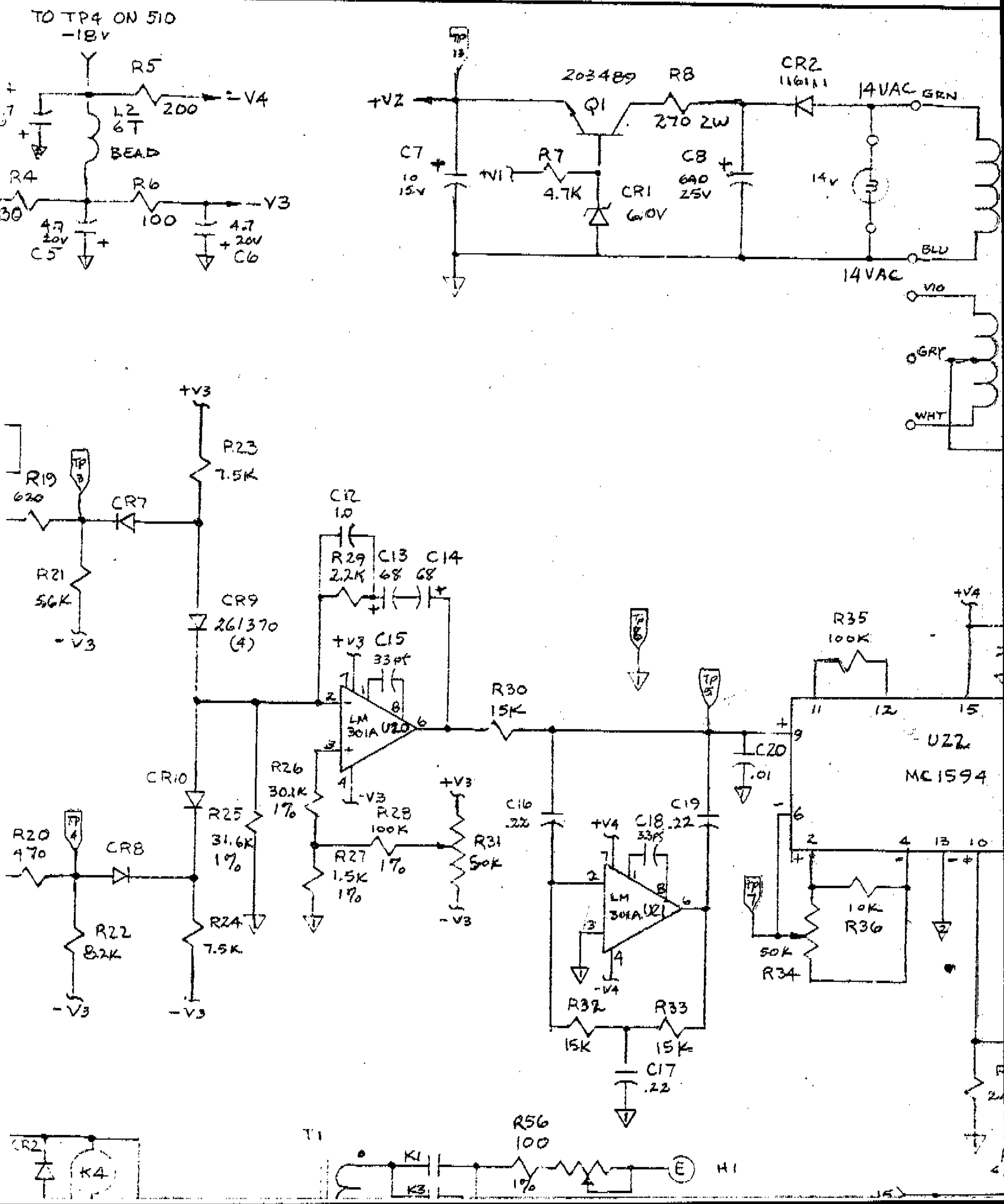
PHASE LOCK PCB ASSY

MODEL 510A/AA

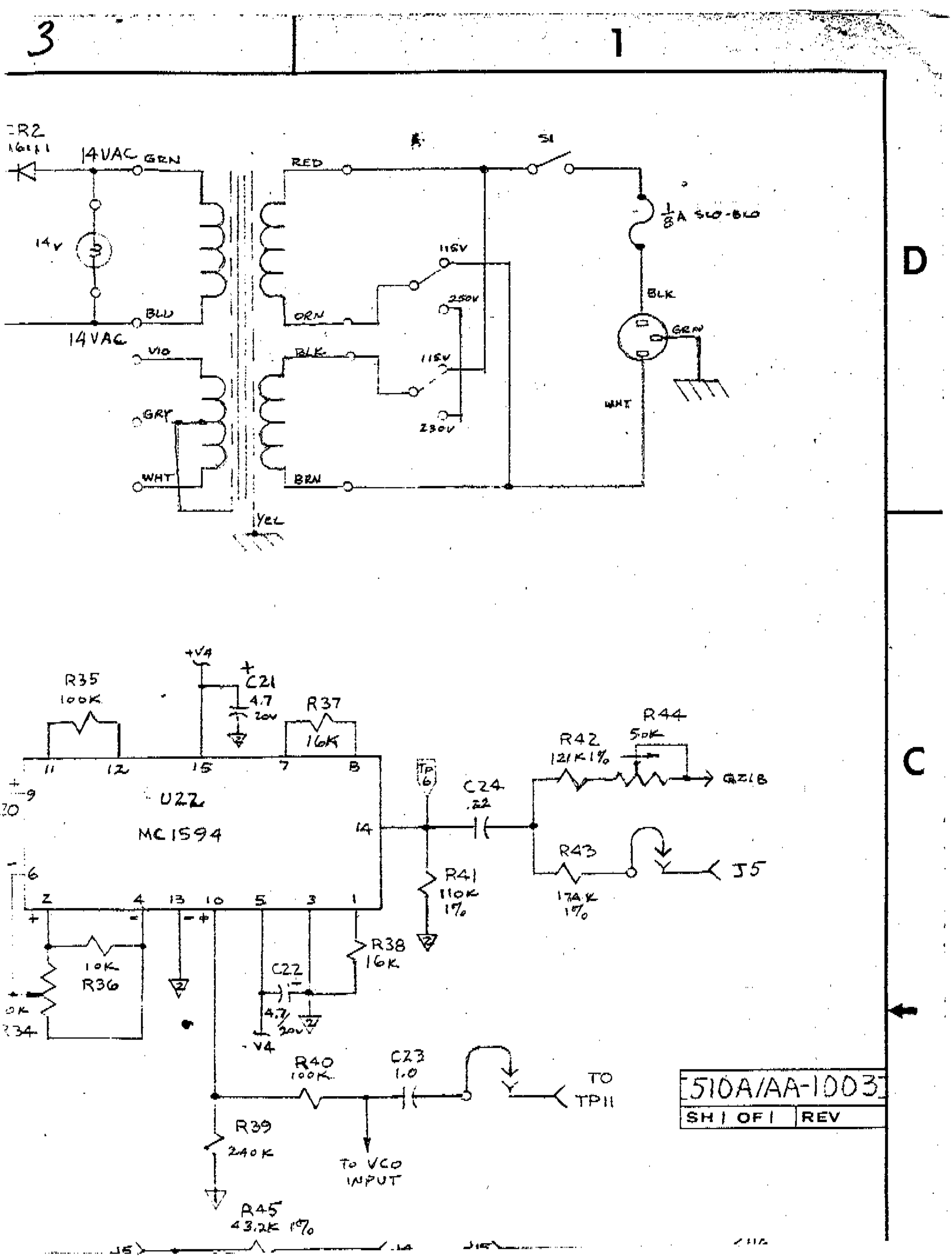
DIAGRAM LAYOUT

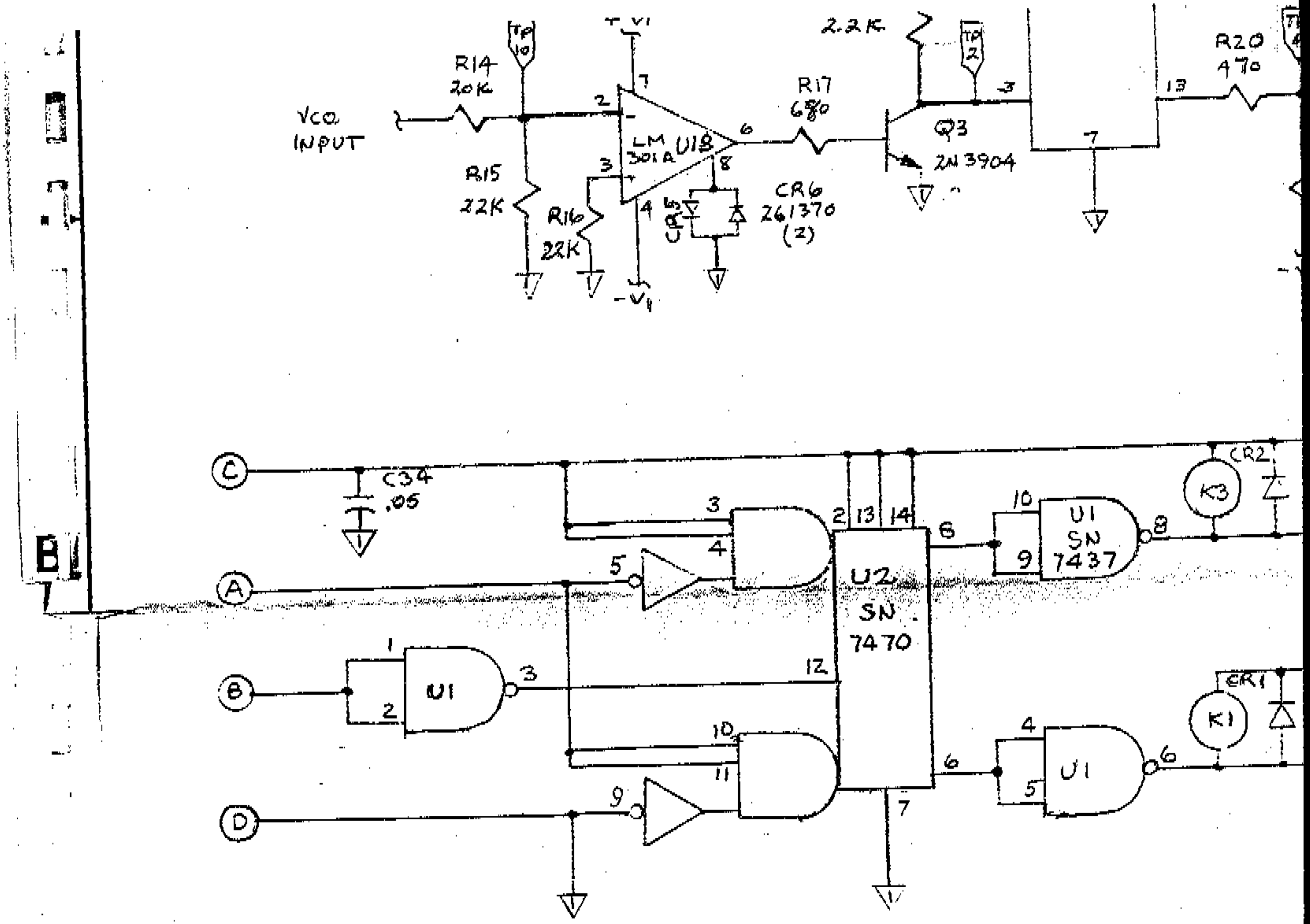



TO TP2 ON 510
+18V
R2
200
+V4
C1
4.7
20V
L1
6T
BEAD
R1
240
+V1
R3
180
+V3
C2
4.7
20V
4.7
20
C3
C4
4.7
20
R4
-V1
330
+V1
C10
4.7
20V
R13
2.2K
+V2
C9
1.0
R9
30K
R12
680
REF
INPUT
R10
7.5K
LM
301A
U17
R11
7.5K
CR3
CR4
261370
(2)
Q2
2N3904
U19
MC4044
C11
4.7
20V
-V1
+V2
R18
2.2K
R14
20K
VCO
INPUT
R15
22K
R16
22K
LM
301A
U18
CR5
CR6
261370
(2)
R17
680
Q3
2N3904
-V1
C34
.05
K3
U1



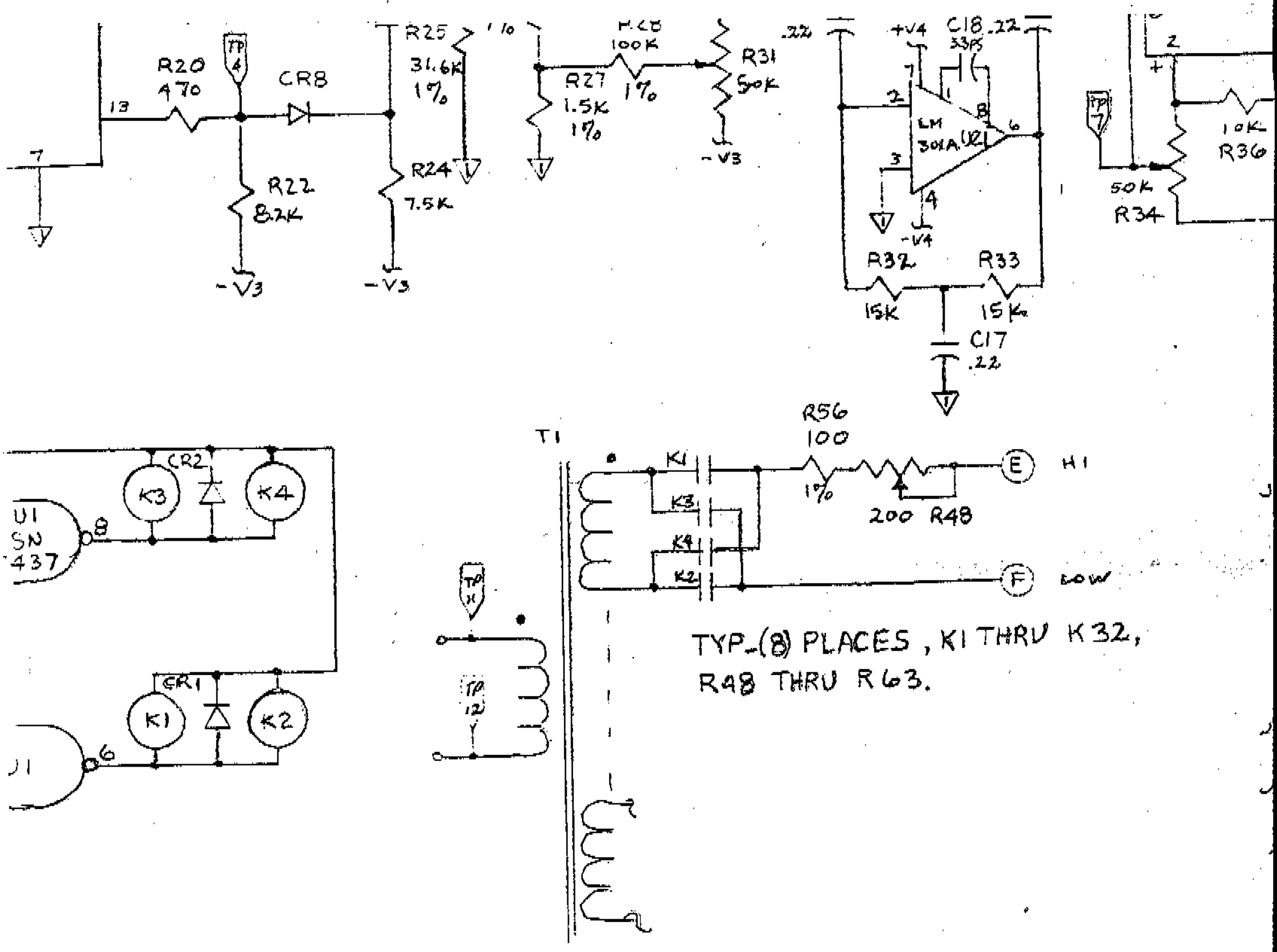
TO TP4 ON 510
-18V
R5
200
-V4
L2
6T
BEAD
R4
330
R6
100
-V3
C5
4.7 20V
C6
4.7 20V
+V2
C7
10 15V
203489
Q1
R8
270 2W
R7
4.7K
+V1
CR1
6.0V
C8
680 25V
CR2
14VAC
GRN
BLU
14VAC
VIO
GRY
WHT
+V3
R23
7.5K
R19
620
CR7
R21
5.6K
-V3
CR9
261370
(4)
C12
1.0
R29
2.2K
C13
68
C14
68
+V3
C15
33pf
LM 301A
U20
R30
15K
R35
100K
+V4
U22
MC1594
C20
.01
CR10
R25
31.6K 1%
R26
30.1K 1%
R28
100K
R27
1.5K 1%
R31
50K
C16
.22
C18
33PF
C19
.22
LM 301A
U21
R20
470
CR8
R22
8.2K
R24
7.5K
R32
15K
R33
15K
C17
.22
R36
10K
R34
50K
K4
T1
K1
K3
R56
100
1%
E
H1


3
1
D
C
CR2
1N914
14VAC
GRN
14V
BLU
14VAC
VIO
GRY
WHT
YEL
RED
ORN
BLK
BRN
115V
250V
115V
230V
S1
1/8A SLO-BLO
BLK
GRN
WHT
R35
100K
+V4
C21
4.7
20V
R37
16K
U22
MC1594
TP 6
C24
.22
R42
121K 1%
R44
50K
Q21B
R43
174K
1%
J5
R41
110K
1%
R38
16K
10K
R36
R34
C22
4.7
20V
-V4
R40
100K
C23
1.0
TO
TP11
R39
240K
TO VCO
INPUT
R45
43.2K 1%
510A/AA-1003
SH 1 OF 1
REV



TYP. (8) PLACES, U1 THRU U16,
C34 THRU C41, CR11 THRU CR26,
K1 THRU K32.

LAST USED:
U22
K32
R63
C41
CR26
TP13



FLUKE

89536

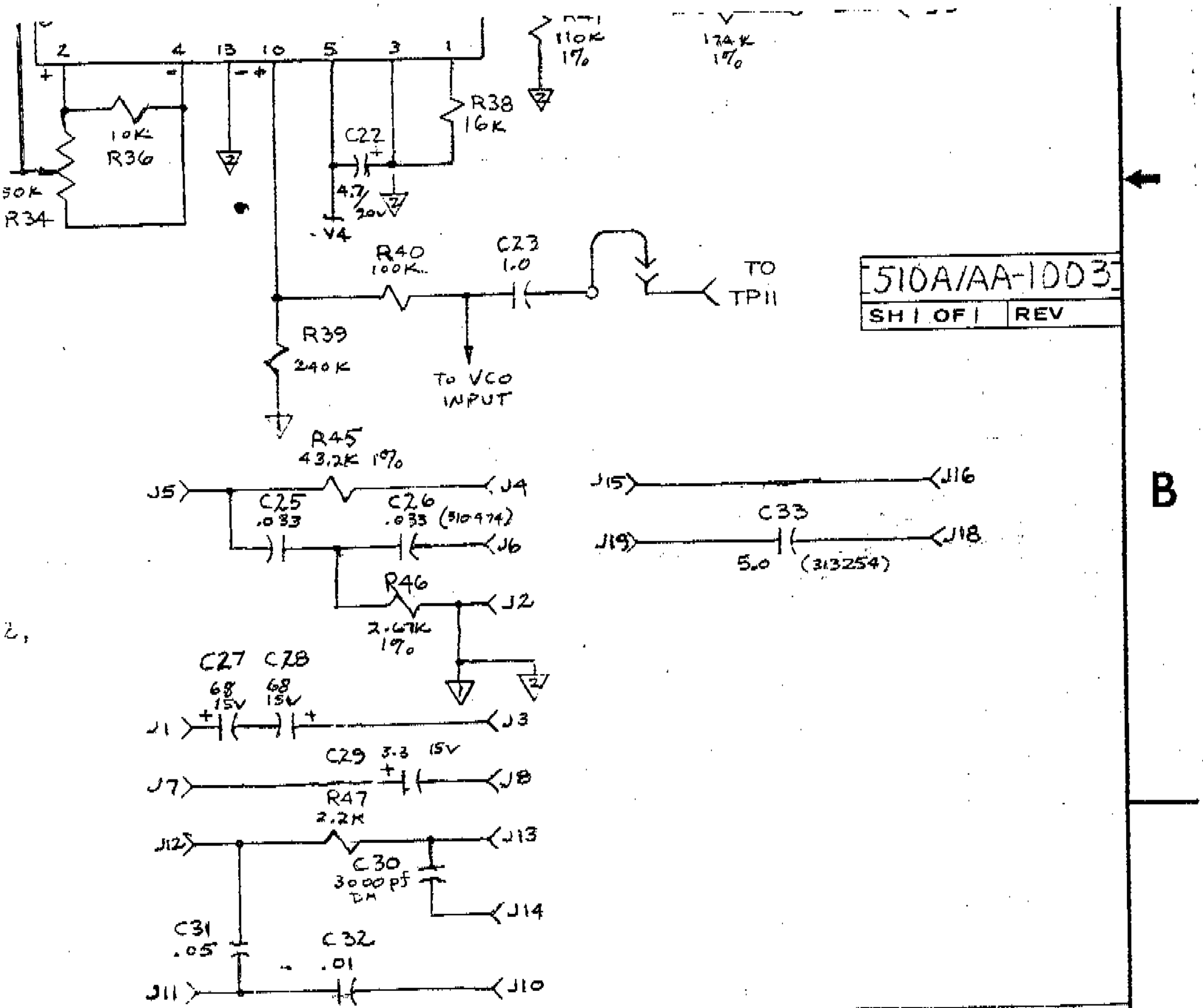
JOHN FLUKE MFG. CO., INC.
P.O. BOX 7428, SEATTLE, WA.

DO NOT SCALE DRAWING
DIMENSIONS IN INCHES

TOLERANCES

.XX ±.020	.000–.100 DIA	+.003–.002
.XXX ±.010	.010–.200 DIA	+.004–.002
ANGLES ±	.201–.500 DIA	+.006–.003
X_C =	.501–1.00 DIA	+.010–.005

DR
CHK
ENG
ENG
MAT
FIN



REV	CHANGE DESCRIPTION	DR	CHK	APPR
X	NEW PART PER ECO 6322 SPECIALS RELEASE	EJK 10/31/72		

A

O., INC.	DR GENE KIRCHNER	10-31-72	PHASE LOCK PCB ASSY
.E. WA.	CHK		
AWING CHES	ENG	11-15-72	
	ENG		
.003–.002 .004–.002 .006–.003 .010–.005	MATERIAL		PART NO: —— / SIZE: C / DRAWING NO: 510A/AA-1003
	FINISH		SCALE —— / SHT 1 OF 1 / REV

DIST 933

6

PHASE LOCK ASSY

MODEL 510A/AA

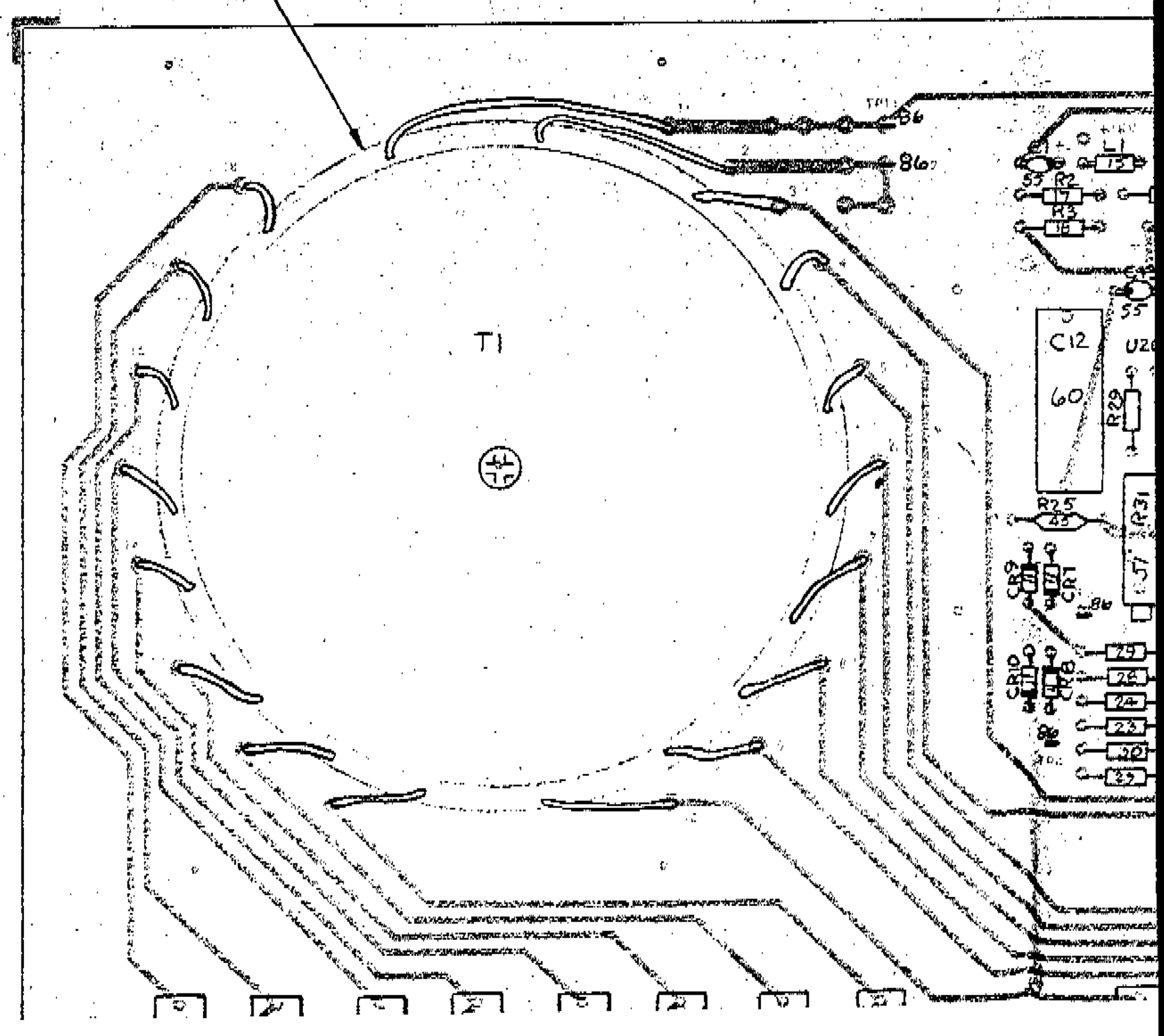
DIAGRAM LAYOUT

1	2	3	4	5		
6	7	8	9	10		

8 | 7

D

SEE DETAIL I FOR INSTALLATION OF T1.



C

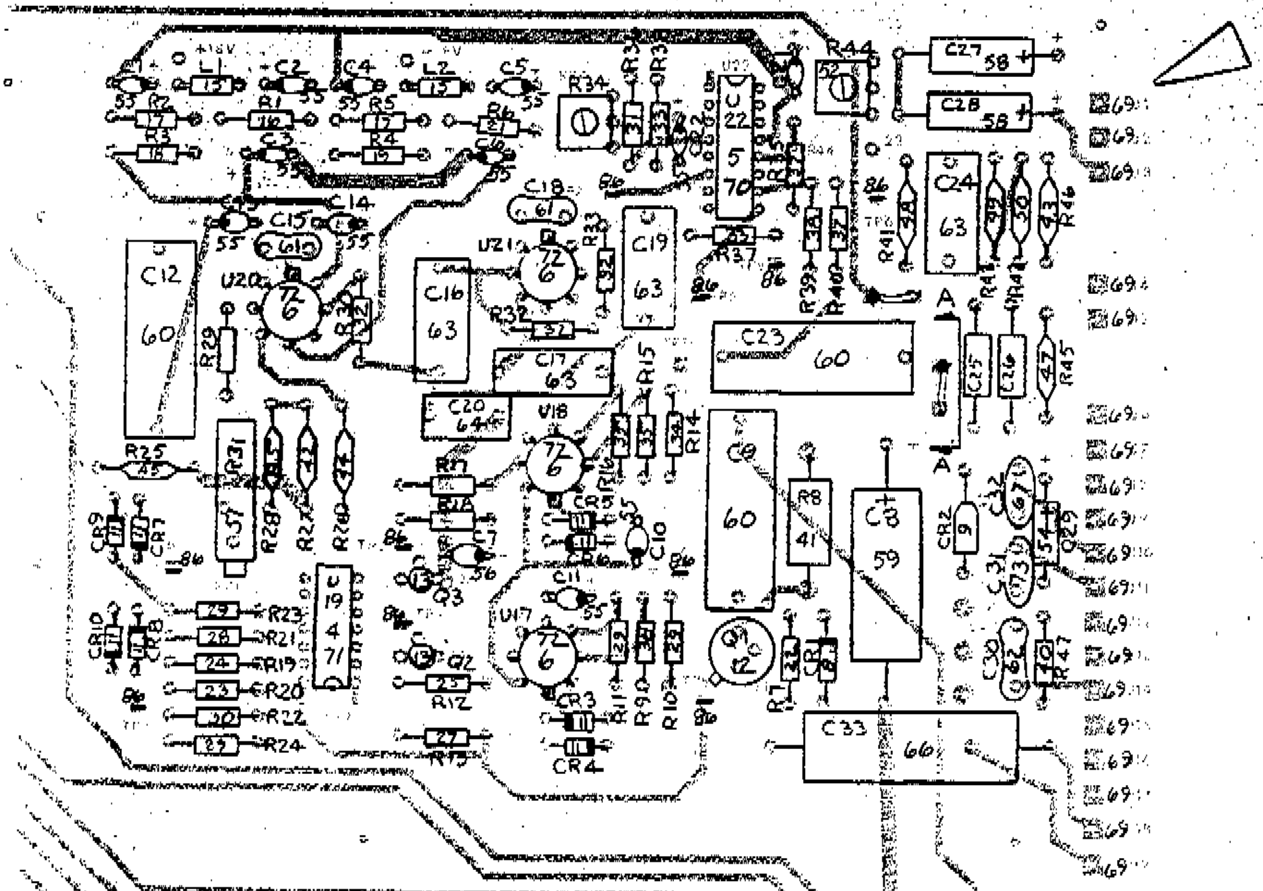
2

6	5

NOTES:

▷ INSTALL ITEM 69 FROM CKT SIDE AFTER FLOW SOLDERING.

ON



3

5 4 3

DE

ITEM	REF	P/N	NOMEMC
38	R39	2180,16	RESISTOR 1/
39			
40	R47	198390	"
41	R8	110189	" 2V
42	R27	313098	" 1/8W
43	R46	312173	" "
44	R26	168286	" "
45	R25	261610	" "
46	R56-63	168195	" "
47	R45	312223	" "
48	R41	234708	" "
49	R42	229369	" "
50	R43	235184	" "
51	R31	268581	" VA
52	R34.44	335778	" "
53	R48-55	275743	" "
54	C29	182808	CAPACITOR
55	C1,2,3,4,5, 6,10,11,21,22	161943	"
56	C7	193623	"
57	C13.14	193615	"
58	C27.28	182824	"
59	C8	218172	"
60	C9,12,23	190330	"
61	C15.18	160317	" D
62	C30	161786	" "
63	C16,17,19,24	194803	" M
64	C20	325548	" P

4

3 | 2

510A/AA-4003

SH / OF / | REV

NOMEMCLATURE				QTY
RESISTOR	1/4W C.C.5%		240K	1
"	"		2.2M	1
"	2W C.C10%		270	1
"	1/8W M.F 1%		1.5K	1
"	"	"	2.67K	1
"	"	"	30.1K	1
"	"	"	31.6K	1
"	"	"	100Ω	8
"	"	"	43.2K	1
"	"	"	110K	1
"	"	"	121K	1
"	"	"	174K	1
"	VAIR		100K	1
"	"		50K	2
"	"		200Ω	8
CAPACITOR	TANT		3.3uf	1
"	"		4.7uf	10
"	"		10uf	1
"	"		68uf	2
"	"		68uf	2
"	ELECT		640uf	1
"	FILM		1.0uf	3
"	DIP MICA		33Pf	2
"	"	"	3000Pf	1
"	MYLAR		.22uf	4
"	POLYEST.		.01uf	1

ITEM	REF	P/N	NOMENCLATURE	
1			510A/AA-3003, PHASE LOCK PCB	
2	U1,3,5,7,9,11, 13,15	296228	I.C.	SN743
3	U2,4,6,8,10, 12,14,16	293035	"	SN747
4	U19	320721	"	MC4044
5	U22		"	MC1594
6	U17.18.20. 21	271502	"	LM301A
7	K1-32	354639	RELAY -ZESTRON 13	
8	CR1	325795	DIODE	ZENER
9	CR2	116111	"	IN 4817
10	CR11-26	203323	"	IN 4148
11	CR 3-10	261370	"	
12	Q1	203489	TRANSISTOR	
13	Q2,3	218396	"	2N3904
14				
15	L1.2	320911	CHOKE	6T BEA
16	R1	221895	RESISTOR	1/4W C.C 5%
17	R2,5	193482	"	"
18	R3	147942	"	"
19	R4	147967	"	"
20				
21	R6	147926	"	"
22	R7	148072	"	"
23	R20	147983	"	"
24	R19	221903	"	"
25	R12.17	148007	"	"
26				
27	R13.18.29	148049	"	"

5

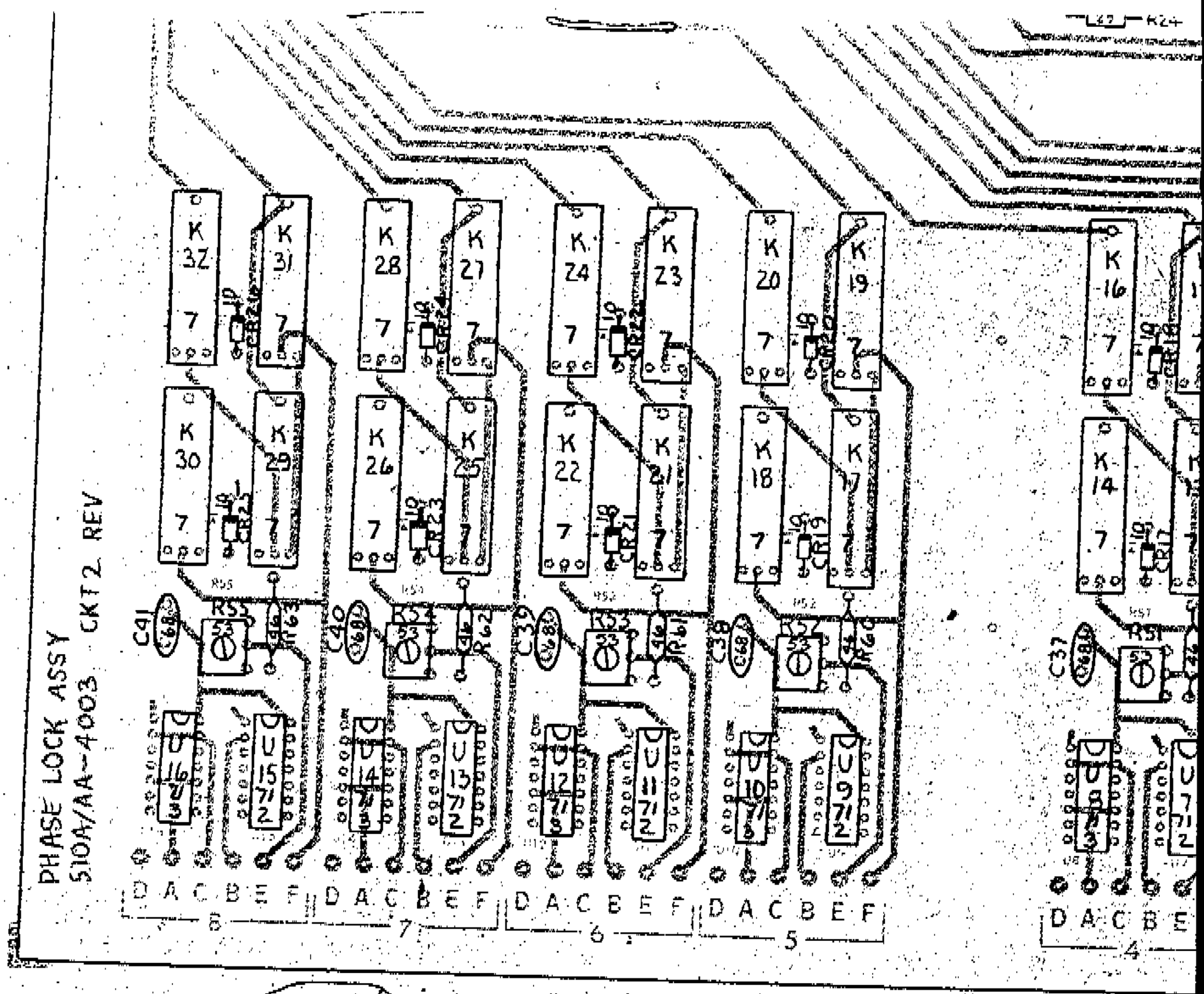
2 | 1

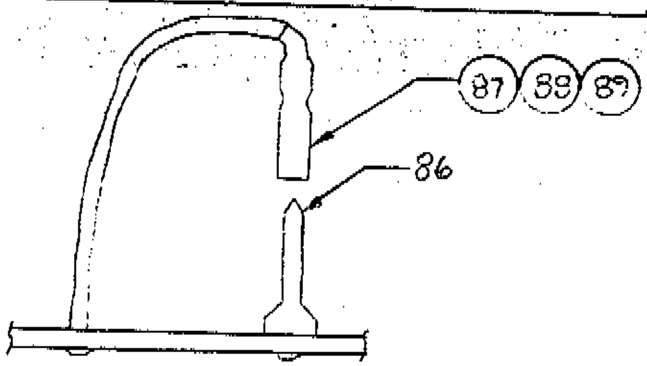
510A/AA-4003
SH 1 OF 1 | REV

D

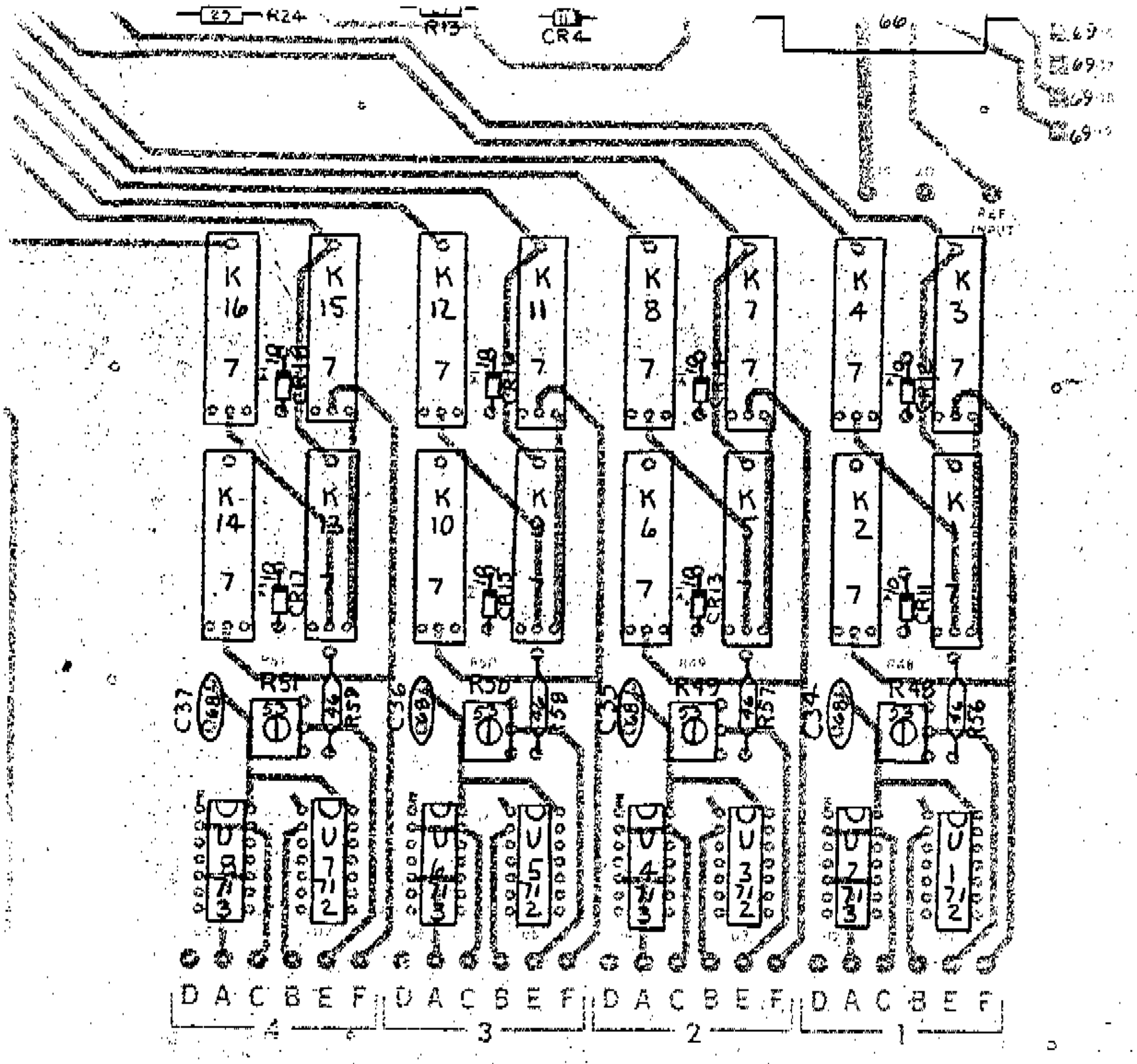
QTY	ITEM	REF	P/N	NOMENCLATURE	QTY
1	1			510A/AA-3003 PHASE LOCK PCB	1
	2	U1,3,5,7,9,11, 13,15	296228	I.C. SN7437N	8
1	3	U2,4,6,8,10, 12,14,16	293035	" SN7470	8
1	4	U19	320721	" MC4044	1
1	5	U22		" MC1594	1
1	6	U17.18.20. 21	271502	" LM301A	4
1	7	K1-32	354639	RELAY - ZESTRON 1300-4-1A	32
1	8	CR1	325795	DIODE ZENER 6.0V	1
8	9	CR2	116111	" IN4817	1
1	10	CR11-26	203323	" IN4148	16
1	11	CR3-10	261370	"	8
1	12	Q1	203489	TRANSISTOR	1
1	13	Q2,3	218396	" 2N3904	2
1	14				
2	15	L1.2	320911	CHOKE 6T BEAD	2
8	16	R1	221895	RESISTOR 1/4W C.C 5% 240	1
1	17	R2,5	193482	" " 200	2
10	18	R3	147942	" " 180	1
1	19	R4	147967	" " 330	1
2	20				
2	21	R6	147926	" " 100	1
1	22	R7	148072	" " 4.7K	1
3	23	R20	147983	" " 470Ω	1
[illegible]	24	R19	221903	" " 620Ω	1
	25	R12.17	148007	" " 680Ω	2
[illegible]	26				
	27	R13.18.29	148049	" " 2.2K	3

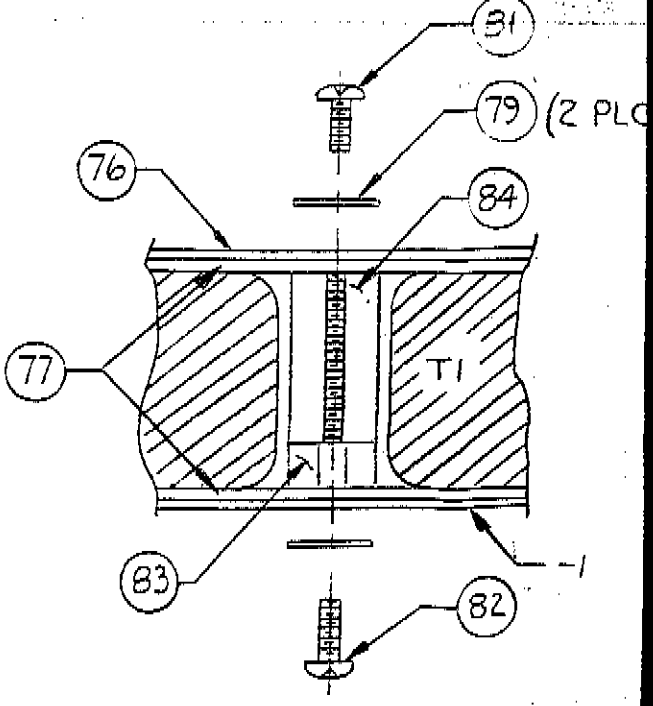
C





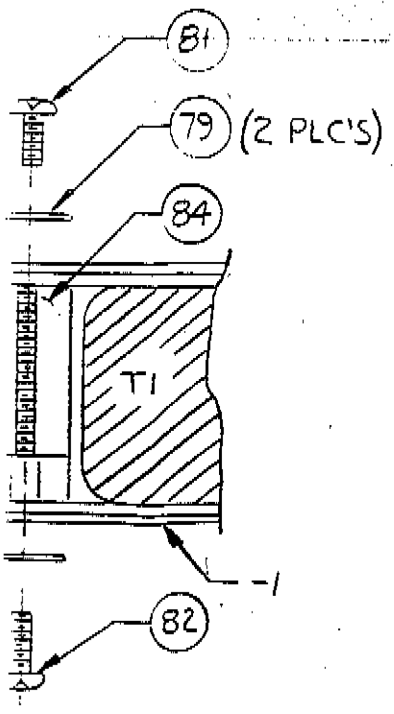
VIEW A-A
TYPE 2 PLACES





DETAIL I
T1 MOUNTING OF OECO
FURNISHED TRANSFORMER.

60	[illegible]	[illegible]		
61	C15,18	160317	"	DIP
62	C30	161786	"	"
63	C16,17,19,24	194803	"	MYL
64	C20	325548	"	POLY
65	C25,26	310474	"	POLY
66	C33	313254	"	
67	C32	149153	"	CER.
68	C34-41	148924	"	"
69	P1-16	267591	CONNECTOR RE	
70	U22	291534	SOCKET. I.C.	
71		291542	" "	
72		289843	" "	
73	C31	149161	CAP. CER DI	
74		285262	SOCKET, TRANSIS	
75	T1		TRANSFORMER, 510	
76			PLATE, XFORMER. 5	
77			PAD, XFORMER. 5	
78				
79		110320	LOCKWASHER, IN	
80				
81		114983	SCREW, #8-32 X 5	
82		276477	" " X	
83		158634	SPACER	
84		101642	" , THREA	
85	R28	248807	RESISTOR 1/8W M	
86	TP1-13	277415	AMP PIN	
87		267542	AMP SOCKET, AW	
88		200733	WIRE, TEFLON, AW	
89		144410	SHRINK TUBING	



L I
G OF OECO
TRANSFORMER.

8

FLUKE

89536

.XX ±.020
.XXX ±.010
ANGLES ±
X_C =

" FILM .0 uf	3
" DIP MICA 33Pf	2
" " " 3000Pf	1
" MYLAR .22uf	4
" POLYEST. .01uf	1
" POLYCARB. .033uf	2
" " 5.0uf	1
" CER. DISC .01uf	1
" " " .05uf	8
NNECTOR RECEPTACLE	19
CKET. I.C. 16 PIN	1
" " 14 PIN	17
" " 8 PIN	4
P. CER DISC. .05uf	1
CKET. TRANSISTOR	3
NSFORMER. 510A/AA-6001	1
TE. XFORMER. 510A/AA-2008	1
. XFORMER. 510A/AA-2009	2
CK WASHER. INT TOOTH #8	2
EW. #8-32 X 5/8. PHP	1
" " X 3/4 "	1
ACER	1
" . THREADED	1
ISTOR 1/8W M.F. 1% 100K	1
P PIN	14
P SOCKET. AWG #26	2
E. TEFLON. AWG #26. ORN	2 IN.
RINK TUBING	1 IN.

23	R20	147983	"	"	470
24	R19	221903	"	"	620
25	R12.17	148007	"	"	680
26					
27	R13.18,29	148049	"	"	2.2K
28	R21	148080	"	"	5.6K
29	R10, 11, 23, 24	193326	"	"	7.5K
30	R22	160796	"	"	8.2K
31	R36	148106	"	"	10K
32	R30,32,33	148114	"	"	15K
33	R38,37	221606	"	"	16K
34	R14	221614	"	"	20K
35	R15.16	148130	"	"	22K
36	R9	193417	"	"	30K
37	R35.40	148189	"	"	100K

9

REV	CHANGE DESCRIPTION
—	ECO 6322 REPLACES 510A/AA-4001 SPECIALS RELEASE

FLUKE

JOHN FLUKE MFG. CO., INC.
P.O. BOX 7428, SEATTLE, WA.

89536

DO NOT SCALE DRAWING
DIMENSIONS IN INCHES

TOLERANCES

.XX ±.020	.000–.100 DIA	+.003–.002
.XXX ±.010	.010–.200 DIA	+.004–.002
ANGLES ±	.201–.500 DIA	+.006–.003
X_C =	.501–1.00 DIA	+.010–.005

DR GENE KIRCHNER	8-18-72
CHK	
ENG R. Lewandowski	11-15-72
ENG	
MATERIAL ———	
FINISH ———	

PHASE LOCK

PART NO	SIZE	DRAWI
	D	510A/A

SCALE 2:1 SHT 1 OF 1

ʄ	2
ʄ	1
uf	4
f	1
uf	2
uf	1
uf	1
uf	8
	19
	1
	17
	4
f	1
	3
	1
3	1
	2
3	2
	1
	1
	1
	1
	1
	14
	2
	2 IN.
	1 IN.

24	R19	221903	"	"	620 Ω	1
25	R12,17	148007	"	"	680 Ω	2
26						
27	R13,18,29	148049	"	"	2.2K	3
28	R21	148080	"	"	5.6K	1
29	R10,11,23,24	193326	"	"	7.5K	4
30	R22	160796	"	"	8.2K	1
31	R36	148106	"	"	10K	1
32	R30,32,33	148114	"	"	15K	3
33	R38,37	221606	"	"	16K	2
34	R14	221614	"	"	20K	1
35	R15,16	148130	"	"	22K	2
36	R9	193417	"	"	30K	1
37	R35,40	148189	"	"	100K	2

B

10

REV	CHANGE DESCRIPTION	DR	CHK	APPR
—	ECO 6322 REPLACES 510A/AA-4001 SPECIALS RELEASE	E.J.K. 10/31/72	10-31-72	11-15-72

A

...G. CO., INC. ...TTLE, WA.	DR GENE KIRCHNER	8-18-72	PHASE LOCK ASSY
DRAWING INCHES	CHK		
	ENG R. Lewandowski	11-15-72	
	ENG		
+.003–.002 +.004–.002 +.006–.003 +.010–.005	MATERIAL —— FINISH ——		PART NO: — / SIZE: D / DRAWING NO: 510A/AA-4003
			SCALE 2:1 / SHT 1 OF 1 / REV

~~DIST 933~~

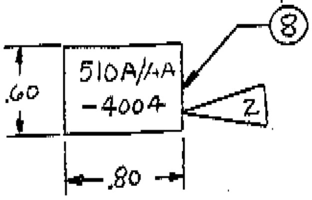
DWG. 510A/AA-4004
SHT. 1 OF 2

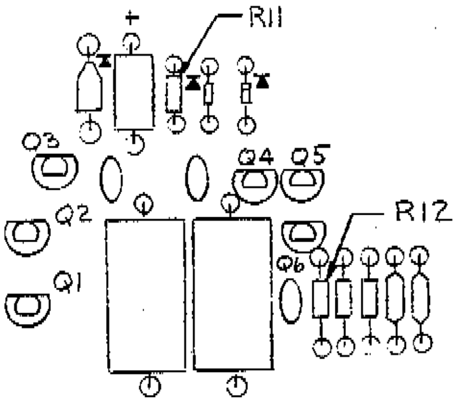
510A/AA-4004
SH 1 OF 1 | REV

ITEM
1
2
3
4
5
6
7
8

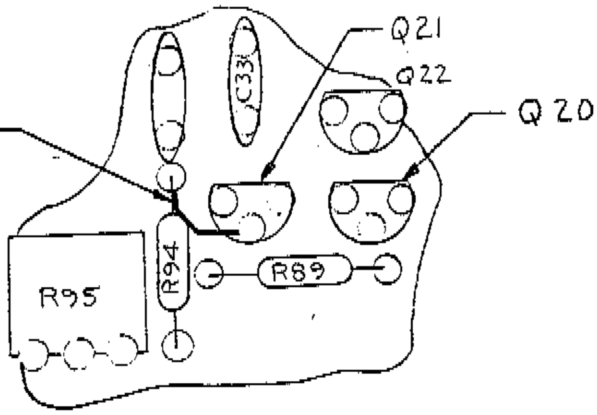
REWORK* 510A-4001 PCB ASSY:

1. REMOVE DS1 & DS2.
2. REPLACE Q1 WITH 2N4890 (269076).
3. REPLACE Q4 WITH (203489).
4. CHANGE R11 FROM 22K TO 10 Ω. (147868).
5. CHANGE R12 FROM 5.6K TO 2.2K (148049).
6. ADD TP TO R94-R89 JUNCTION (SEE DETAIL).
7. CHANGE C33 FROM 10 PF DM TO 33 PF DM (160317).



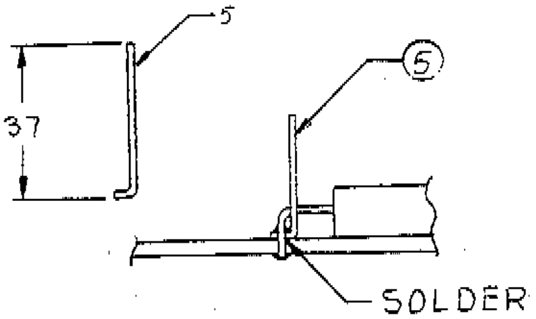


R11 & R12 LOCATION



TP LOCATION

N



TP DETAIL

FLUKE

JOHN FLUKE MFG. CO., INC.
P.O. BOX 7428, SEATTLE, WA.

89536

DO NOT SCALE DRAWING
DIMENSIONS IN INCHES

TOLERANCES

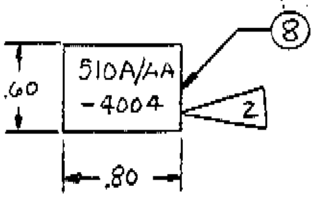
.XX ±.020	.000–.100 DIA	+.003–.002
.XXX ±.010	.010–.200 DIA	+.004–.002
ANGLES ±	.201–.500 DIA	+.006–.003
X_C =	.501–1.00 DIA	+.010–.005

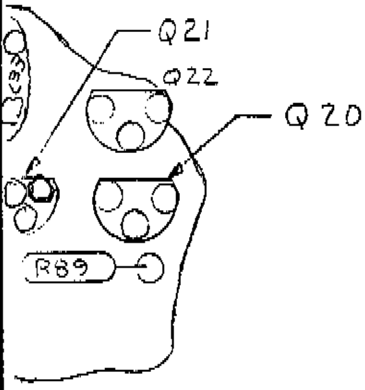
DR GEN
CHK W. R
ENG
ENG
MATERIA
510A
FINISH

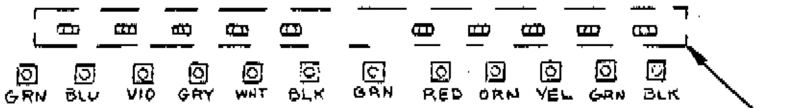
DWG. 510A/AA - 4004
SHT. 2 OF 2

510A/AA-4004 | SH 1 OF 1 | REV

ITEM	REF	P/N	NOMENCLATURE	QTY
1	Q4	203489	TRANSISTOR, NPN	1
2	R11	147868	RESISTOR, 1/4W 5% 10 Ω	1
3	R12	148049	" " " 2.2K	1
4	—	307868	MAIN PCB ASSY, 510A-4001	1
5	—	171744	WIRE AWG#22 GOLD PL	1 IN.
6	Q1	269076	TRANSISTOR, 2N4890	1
7	C33	160317	CAPACITOR, 33pf DM	1
8	—	—	DECAL, WHITE VINYL, ADHESIVED BACKED	1







CUT OFF AMP PINS THIS AREA ONLY .020 MAX H.T.

DETAIL I

NOTES:

1. ALL COMPONENT LEADS INCLUDING SI SHALL BE TRIMMED TO .020 MAX. SEE DETAIL I.

2 ▷ TYPE NEW PART NUMBER ON ITEM 8 APPLY OVER OLD PART NUMBER & NAME.

TION

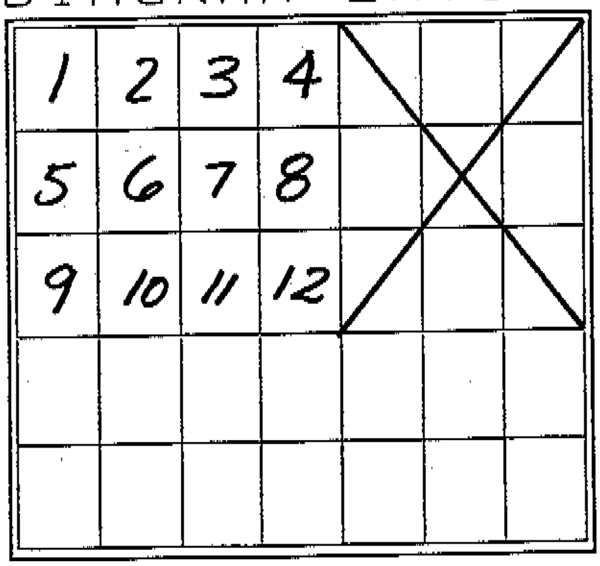
REV	CHANGE DESCRIPTION	DR	CHK	APPR
—	NEW PART PER ECO 6322 SPECIALS RELEASE	EJK 10/31/72	WRM 10/31/72	11-15-72

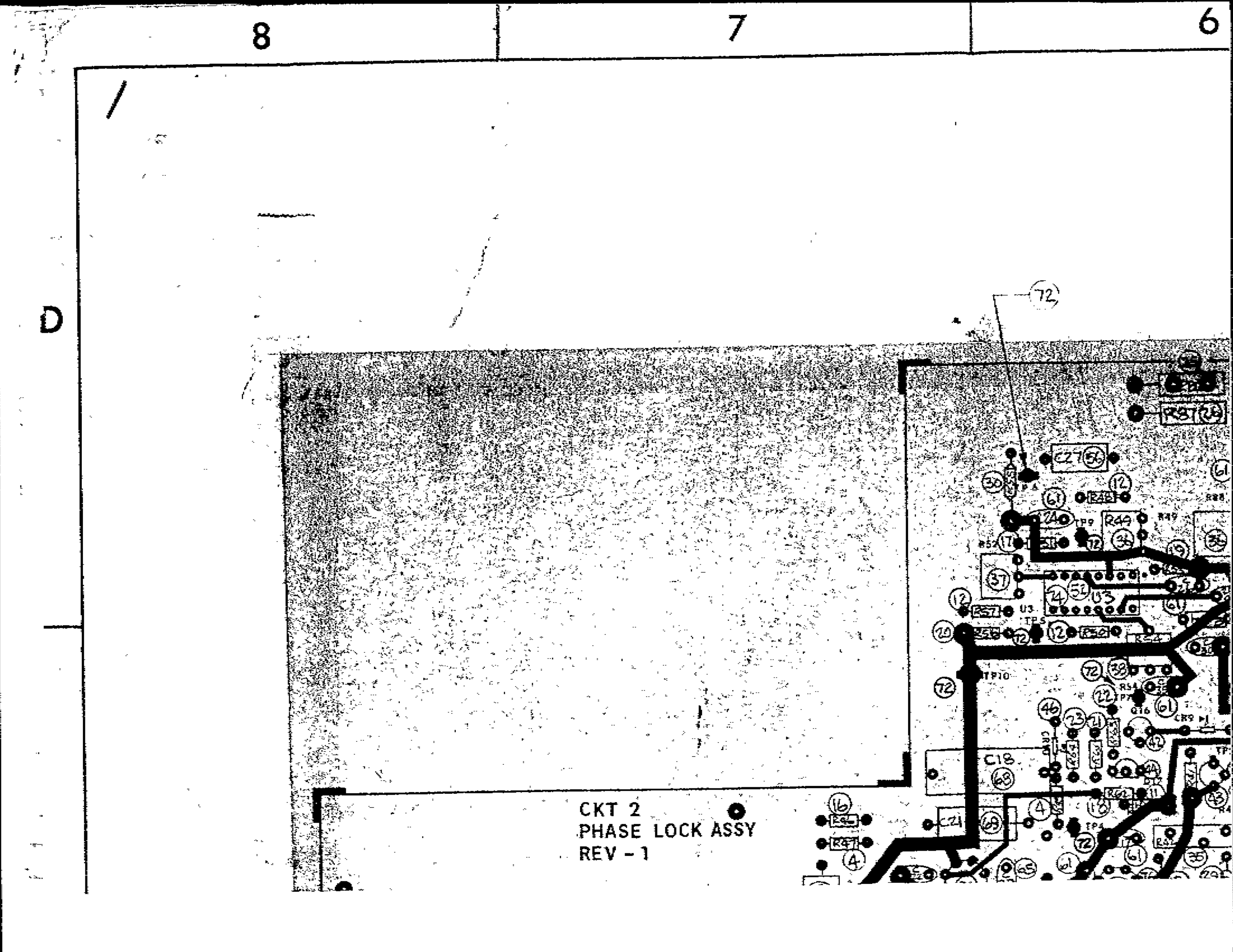
JOHN FLUKE MFG. CO., INC. P.O. BOX 7428, SEATTLE, WA.	DR GENE KIRCHNER	9-5-72	MAIN PCB ASSY (REWORK)
DO NOT SCALE DRAWING DIMENSIONS IN INCHES	CHK W.R. MacLAREN	10-31-72	
	ENG [signature]	11-15-72	
TOLERANCES	ENG		
.000–.100 DIA +.003–.002 .010–.200 DIA +.004–.002 .201–.500 DIA +.006–.003 .501–1.00 DIA +.010–.005	MATERIAL MAKE FROM 510A-4001 FINISH		PART NO: — / SIZE: B / DRAWING NO: 510A/AA-4004
			SCALE NONE / SHT 1 OF 1 / REV

DIST 933

PHASE LOCK PCB ASSEMBLY

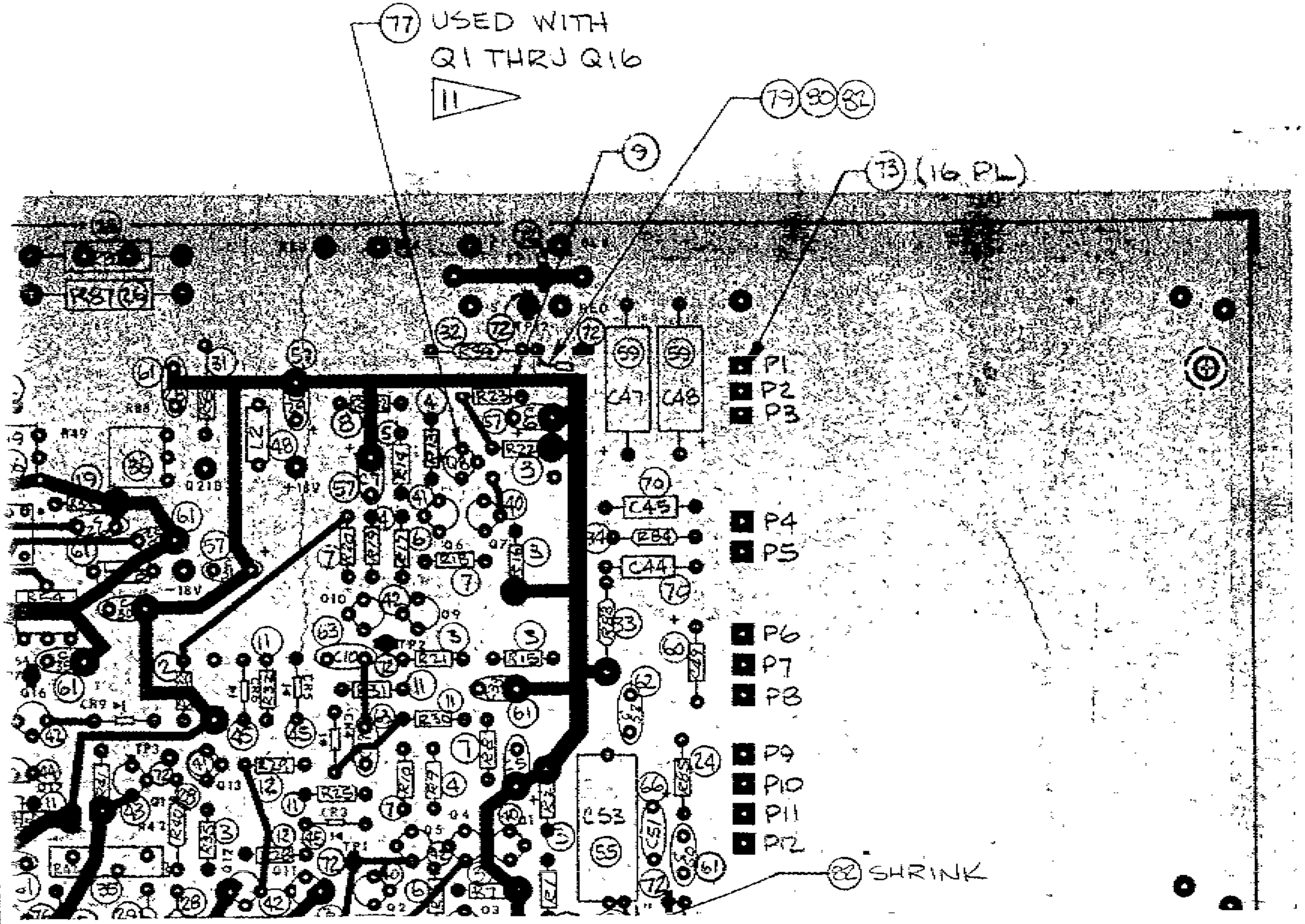
DIAGRAM LAYOUT




8
7
6
D
72
C27
R48
R49
R52
R57
R56
R50
U3
TP5
TP9
TP10
C18
C21
R46
R47
Q16
CR9
CKT 2
PHASE LOCK ASSY
REV - 1

6 5 4

2



ITEM	REF
40	Q1,Q2,Q
41	Q3,Q6,
42	3
43	Q15
44	Q17
45	CR1-CR6 CR11-C
46	CR7,C
47	CR8
48	L1 - L
49	K1-K
50	K1-K
51	U1,U
52	U3
53	4
54	5
55	C1,C5
56	C27
57	6

4 | 3 | 2

3

5104/AA-4001 SH 1 OF 1 REV 3

ITEM	REF	P/N	NOMENCLATURE	QTY
40	Q1,Q2,Q7,Q8	288761	TRANSISTOR, PNP, RS-2048	4
41	Q3,Q6,Q13	195974	PNP, 2N3906	3
42	3	218396	NPN, 2N3904	8
43	Q15	261578	FET, U1897E	1
44	Q17	268110	UNIJUNCT., 2N6027	1
45	CR1-CR6, CR9 CR11-CR26	203323	DIODE, SILICON, IN4148	23
46	CR7, CR10	246611	" ZENER, IN961B	2
47	CR8	260695	" " , IN754A	1
48	L1-L3	320911	CHOKE, 6TURN	3
49	K1-K16	267708	RELAY, REED	16
50	K1-K16	288357	COIL, REED RELAY	16
51	U1, U2	271502	INTEGRATED CIRCUIT, LM301A	1
52	U3	—	MC1594L	1
53	4	293035	SN7470N	3
54	5	296228	SN7437N	3
55	C1, C53	190330	CAPACITOR, FF µf	2
56	C27	194803	" " .22	1
57	6	161943	CAPACITOR, TANT. 20V 4.7µf	3

ITEM	REF	P/N
1	—	—
2	R1, R26, R27 R36, R41	221614
3	1	148106
4	2	159731
5	R4, R14	193367
6	R6, R17	193334
7	R8, R10 R18, R20	193508
8	R12, R65	234252
9	R23	193433
10	R24	221952
11	R25, R30, R31 R32, R60	220533
12	R28, R29, R48 R60 R57	148189
13	R34	193342
14	R37	148148
15	R44	148130
16	R46	221911
17	R51	148023
18	R67	221937

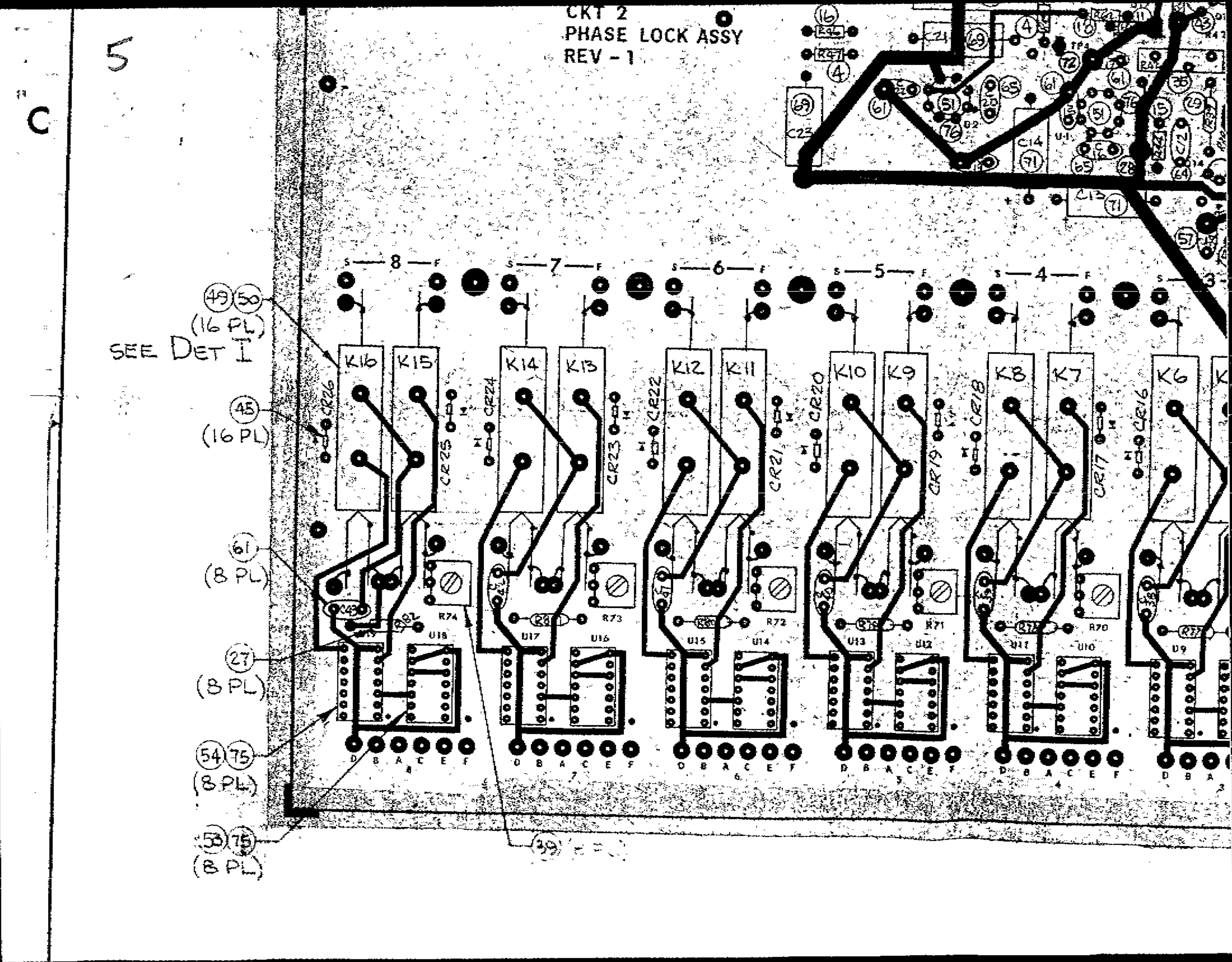
4

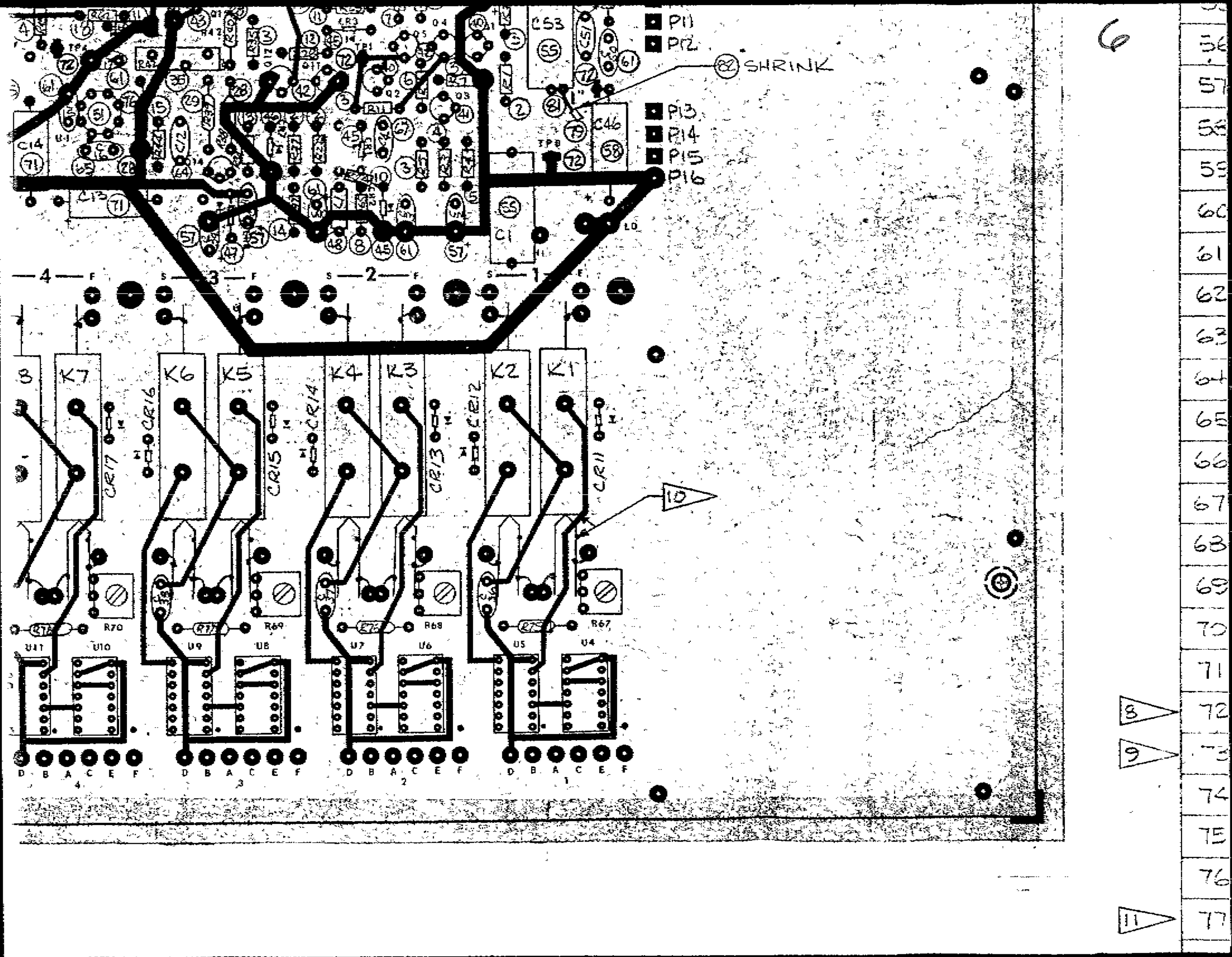
3 | 2 | 1 | D

...CLATURE	QTY
...R, PNP, RS-2048	4
PNP, 2N3906	3
NPN, 2N3904	8
FET, U1897E	1
...UNIJUNCT, 2N6027	1
...CON, IN4148	23
...NER, IN961B	2
IN754A	1
...URN	3
...D	16
... RELAY	16
CIRCUIT, LM301A	1
MC1596L	1
SN7470N	8
SN7437N	8
...FF 1μf	2
.22	1
..., 30V 4.7μf	8

510A/AA-4001 SH 1 OF 1 REV 3

ITEM	REF	P/N	NOMENCLATURE	QTY
1	—	—	PHASE LOCK PCB 510A/AA-3001	1
2	R1, R26, R27, R36, R41	221614	RESISTOR, CC, ¼W, 5%, 20K	5
3	[1]	148106	10K	9
4	[2]	159731	12K	6
5	R4, R14	193367	43K	2
6	R6, R17	193334	51K	2
7	R8, R10, R18, R20	193508	3K	4
8	R12, R65	234252	1.3K	2
9	R23	193433	2.4K	1
10	R24	221952	3M	1
11	R25, R30, R31, R32, R60	220533	560K	5
12	R28, R29, R48, R60, R57	148189	100K	5
13	R34	193342	5.1K	1
14	R37	148148	27K	1
15	R44	148130	22K	1
16	R46	221911	6.2K	1
17	R51	148023	1K	1
18	R67	221937	[illegible]	1


CKT 2
PHASE LOCK ASSY
REV - 1
5
C
SEE DET I
49 50 (16 PL)
45 (16 PL)
61 (8 PL)
27 (8 PL)
54 75 (8 PL)
53 75 (8 PL)
39
K16
K15
K14
K13
K12
K11
K10
K9
K8
K7
K6
CR16
CR17
CR18
CR19
CR20
CR21
CR22
CR23
CR24
CR25
CR26
R70
R71
R72
R73
R74
U9
U10
U11
U12
U13
U14
U15
U16
U17
U18
C13
C14
C23
S — 8 — F
S — 7 — F
S — 6 — F
S — 5 — F
S — 4 — F
D B A C E F



6
P11
P12
P13
P14
P15
P16
82 SHRINK
C53
C46
C1
C14
C13
K1
K2
K3
K4
K5
K6
K7
CR11
CR12
CR13
CR14
CR15
CR16
CR17
R67
R68
R69
R70
U4
U5
U6
U7
U8
U9
U10
U11
10
8
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7

57	6	161943	CAPACITOR, TANT, 20V, 4.7μf	8
58	C46	182840	220μf	1
59	C47,C48	182824	68μf	2
60	C49	182808	3.3μf	1
61	7	149161	CAPACITOR, FIXED, CD, .05	21
62	C52	149153	" " " .01	1
63	C9,C10	148460	CAPACITOR, FIXED, DM, 180pf	2
64	C12	170431	560pf	1
65	C16,C20	160317	33pf	2
66	C51	161786	3000pf	1
67	C4	148387	1000pf	1
68	C18	——	CAPACITOR, FIXED, MYLAR .82μf	1
69	C21,C23	246017	CAPACITOR, FIXED, POLY, 39μf	2
70	C44,C45	310474	" " " .033μf	2
71	C13,C14	106492	CAPACITOR, AL ELECT, 16V, 30μf	2
8 72	TP1-TP12	277418	CONNECTOR POST	14
9 73	P1-P16	267591	CONNECTOR, RECEPTACLE	16
74	——	291534	SOCKET, I.C., 16 PIN	1
75	——	291542	" 14 PIN	16
76	——	289343	" 8 PIN	2
11 77	——	285262	SOCKET, TRANSISTOR	16
78	——	115469	WIRE, BUS, AWG # 22	1.5 FT
79		267542	AMP SOCKET, AWG #26	2

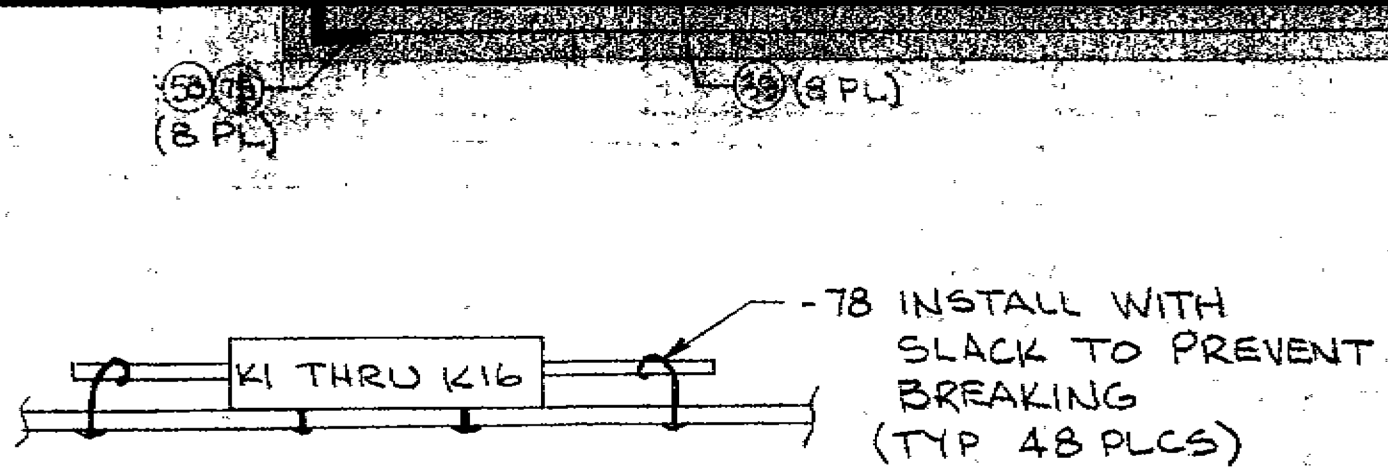
18	R62	2
19	R53	22
20	R56	2
21	R61	19
22	R63	14
23	R64	[illegible]
24	R85	19
25	R86	21
26	R87	11
27	R75-R82	24
28	R38,R40,R43	29
29	R39	16
30	R55	[illegible]
31	R58	22
32	R59	23
33	R83	23
34	R84	272
35	R42	190
36	R49,R88	
37	R52	
38	R54	309
39	R67-R74	275

8

1	17	R51	148023	1K	1
8	18	R62	221537	750K	1
1	19	R53	221606	16K	1
2	20	R56	218016	240K	1
1	21	R61	193326	7.5K	1
21	22	R63	148155	33K	1
1	23	R64	285629	1.8M	1
2	24	R85	193390	2.2M	1
1	25	R86	218834	RESISTOR, CC, 2W, 5%, 2.4K	1
2	26	R87	110148	RESISTOR, CC, 2W 10% 2.7K	1
1	27	R75-R82	245373	RESISTOR, MF, 1/8W, 1%, 402Ω	8
1	28	R38, R40, R43	291872	20K	3
1	29	R39	163260	10K	1
2	30	R55	234708	110K	1
2	31	R58	229369	121K	1
2	32	R59	235184	174K	1
14	33	R83	285587	2.67K	1
16	34	R84	272153	45.2K	1
1	35	R42	190363	RESISTOR, WW, TRIMMER, 1K	1
16	36	R49, R88		RESISTOR, VAR CERMET 50K	2
2	37	R52		20K	1
16	38	R54	309674	10K	1

C

B


(8 PL)
(8 PL)
K1 THRU K16
-78 INSTALL WITH
SLACK TO PREVENT
BREAKING
(TYP 48 PLCS)

DET I

75	—	
76	—	
11 ▷ 77	—	
78	—	
79		
80		
81		
82		

NOTES:

1. R2, R5, R7, R11, R15, R16, R21, R22, R35
2. R3, R9, R13, R19, R45, R47
3. Q4, Q5, Q9, Q10, Q11, Q12, Q14, Q16
4. U4, U6, U8, U10, U12, U14, U16, U18
5. U5, U7, U9, U11, U13, U15, U17, U19
6. C2, C5, C6, C7, C11, C29, C31, C34
7. C3, C8, C15, C17, C19, C22, C24, C25, C26, C28, C30, C33, C35-C43, C50
8. INSTALL ITEM 72 FROM CKT 2 SIDE BEFORE INSTALLING COMPONENTS. (14 PL)
9. INSTALL ITEM 73 FROM CKT 1 SIDE AFTER FLOW SOLDERING.
10. ALIGN BLUE SPOT ON REED RELAY WITH DOT ON PCB.
11. INSTALL ITEM 77 SO PCB BEFORE INSTALL ITEM 40, 41, 42 & 43.

75	—	291542	" " 14 PIN	16
76	—	289343	" " 8 PIN	2
77	—	285262	SOCKET, TRANSISTOR	16
78	—	115469	WIRE, BUS, AWG # 22	1.5 FT
79		267542	AMP SOCKET, AWG #26	2
80		200733	WIRE, TEFLON, AWG #26, ORN	.2 FT
81		200725	WIRE, TEFLON, AWG #26, YEL	.2 FT
82		144410	SHRINK TUBING	.1 FT

36	R49, R8
37	R52
38	R54
39	R67-R7

11 INSTALL ITEM 77 SOCKET ON PCB BEFORE INSTALLING ITEM 40, 41, 42 & 43.

(4 PL)

FLUKE JOHN FLUKE MFG CO., INC. P.O. BOX 7428, SEATTLE, WN.	DO NOT SCA
UNLESS OTHERWISE SPECIFIED ALL DIMENSIONS ARE IN INCHES	DFTM W.R.MACLA PROJ ENG MFG ENG
3 PLACE DECIMALS ± .010 2 PLACE DECIMALS ± .02 FRACTIONS ± ANGLES ± X CONST.	MATERIAL: FINISH:

//

" 14 PIN	16
" 8 PIN	2
ET, TRANSISTOR	16
BUS, AWG # 22	1.5 FT
XKET, AWG #26	2
TEFLON, AWG #26, ORN	.2 FT
EFLON, AWG #26, YEL	.2 FT
TUBING	.1 FT

36	R49, R88		RESISTOR, VAR CERMET 50K	2
37	R52		20K	1
38	R54	309674	10K	1
39	R67-R74	275743	200Ω	8

NOT TO BE USED FOR CURRENT PRODUCTION S/N 129 SEE - 4003 AND ON. EJK 11-13-72

ZONE	REV	DESCRIPTION	DWN	CKD	APPD
	3	ADDED (72) TO PCB - 14 PL. ITEM 72 QTY. FROM 1 TO 14 (B) 14 PL.	PRM 12-9-71	12-15	Ellison
	2	REVISED PER 2nd RUN	WRM 11-9	[illegible]	Ellison
	1	REVISED FOR 2ND RUN	WRM 8-26	RJ	Ellison
B/M	-	SPECIALS RELEASE	WRM 6-10-71	[illegible]	Ellison

FLUKE JOHN FLUKE MFG CO., INC. P.O. BOX 7428, SEATTLE, WN.

UNLESS OTHERWISE SPECIFIED ALL DIMENSIONS ARE IN INCHES

3 PLACE DECIMALS ± .010
2 PLACE DECIMALS ± .02
FRACTIONS ±
ANGLES ± X CONST.

DO NOT SCALE DRAWING

DFTM	W.R. MACLAREN	6-10-71
PROJ ENG	[illegible]	11-10-71
MFG ENG	Ellison	11-10-71

MATERIAL:

FINISH:

PHASE LOCK PCB ASSEMBLY

PART NO	SIZE	DRAWING NUMBER
	D	510A/AA-4001
SCALE FULL	SHEET 1 OF 1	REV 3

DIST

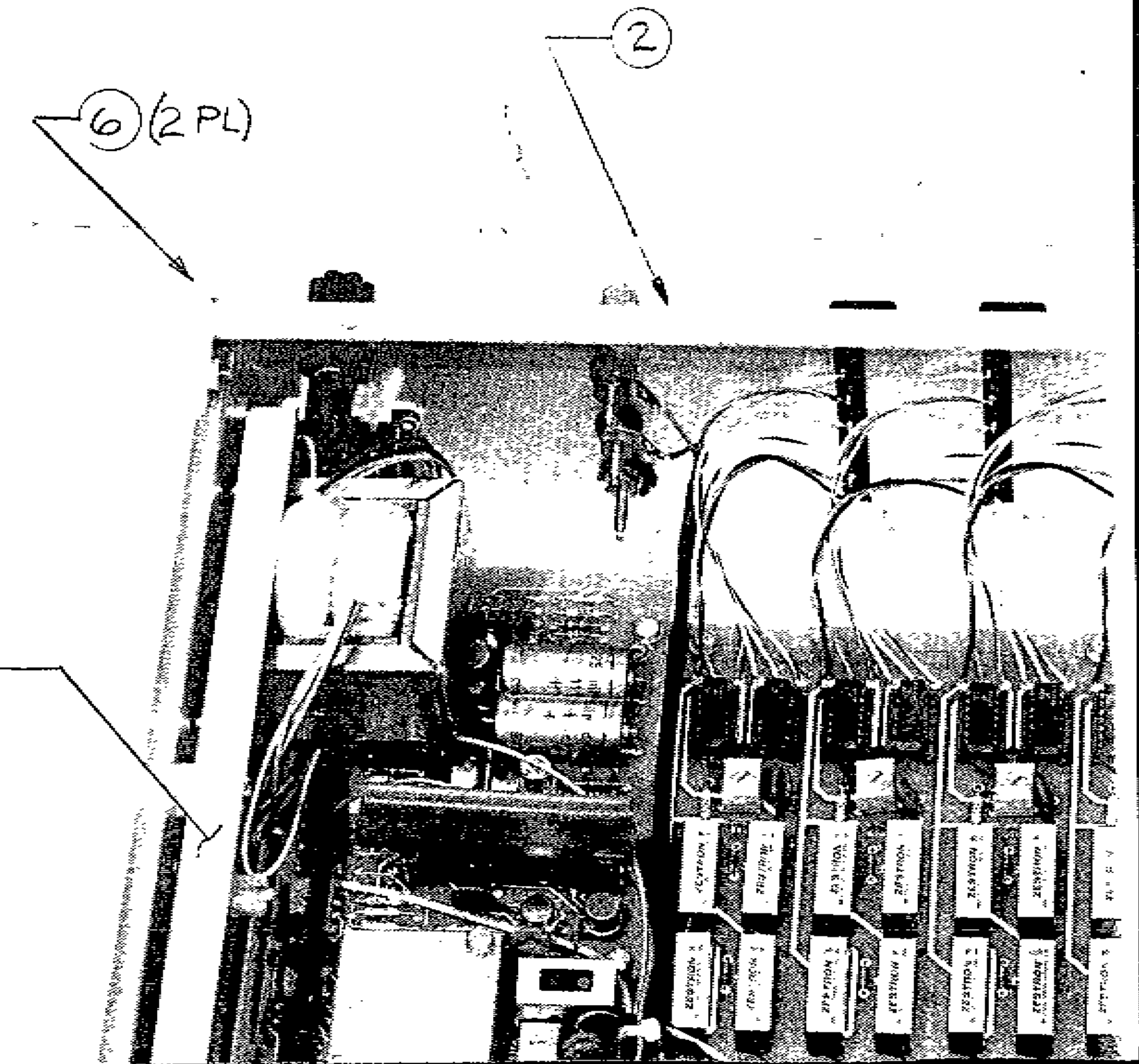
12

FINAL ASSY, AC REF. STD.
8 OUTPUT

MODEL 510A/AA

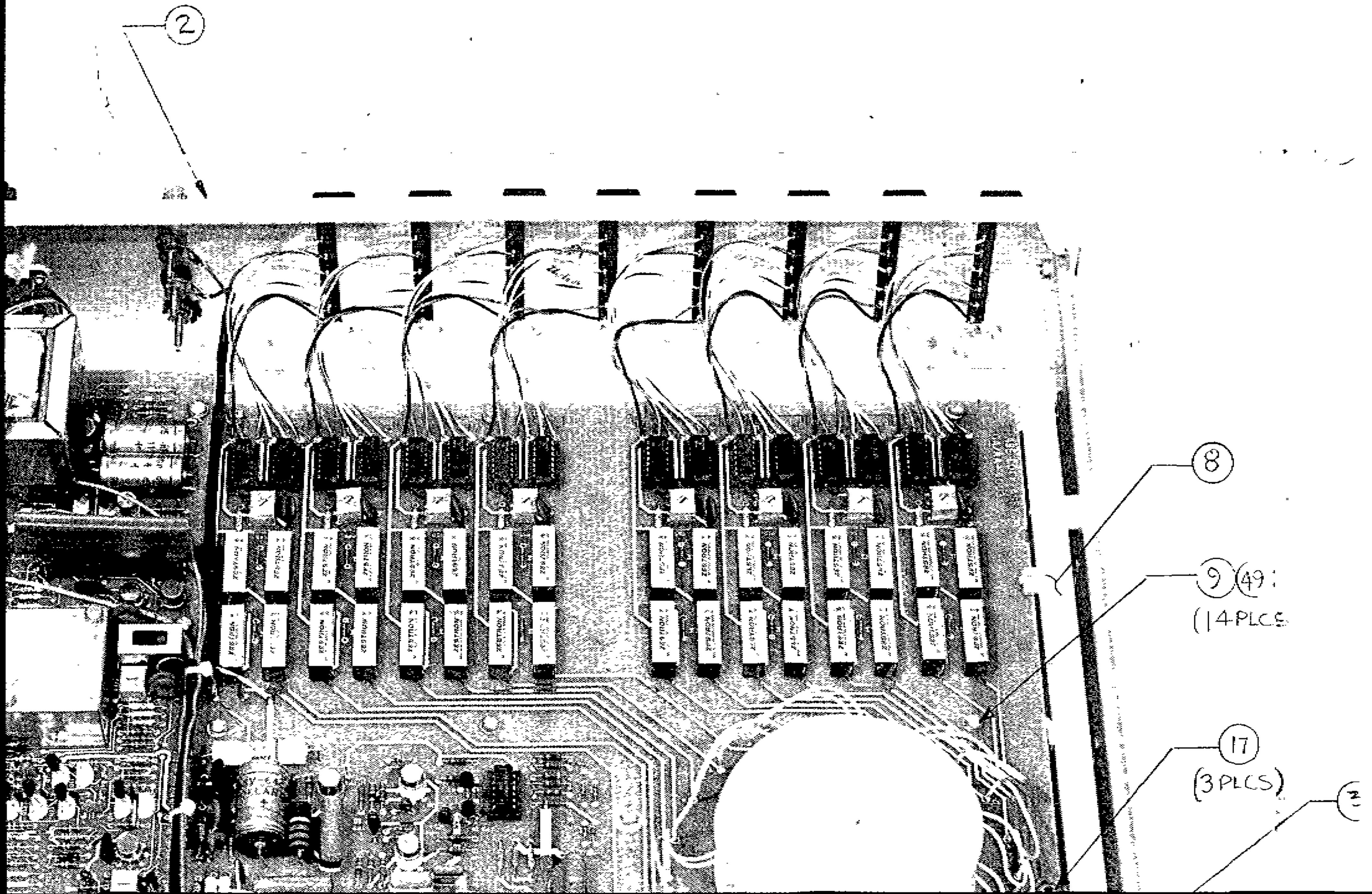
DIAGRAM LAYOUT

1	2	3	4			
5	6					
7	8	9				

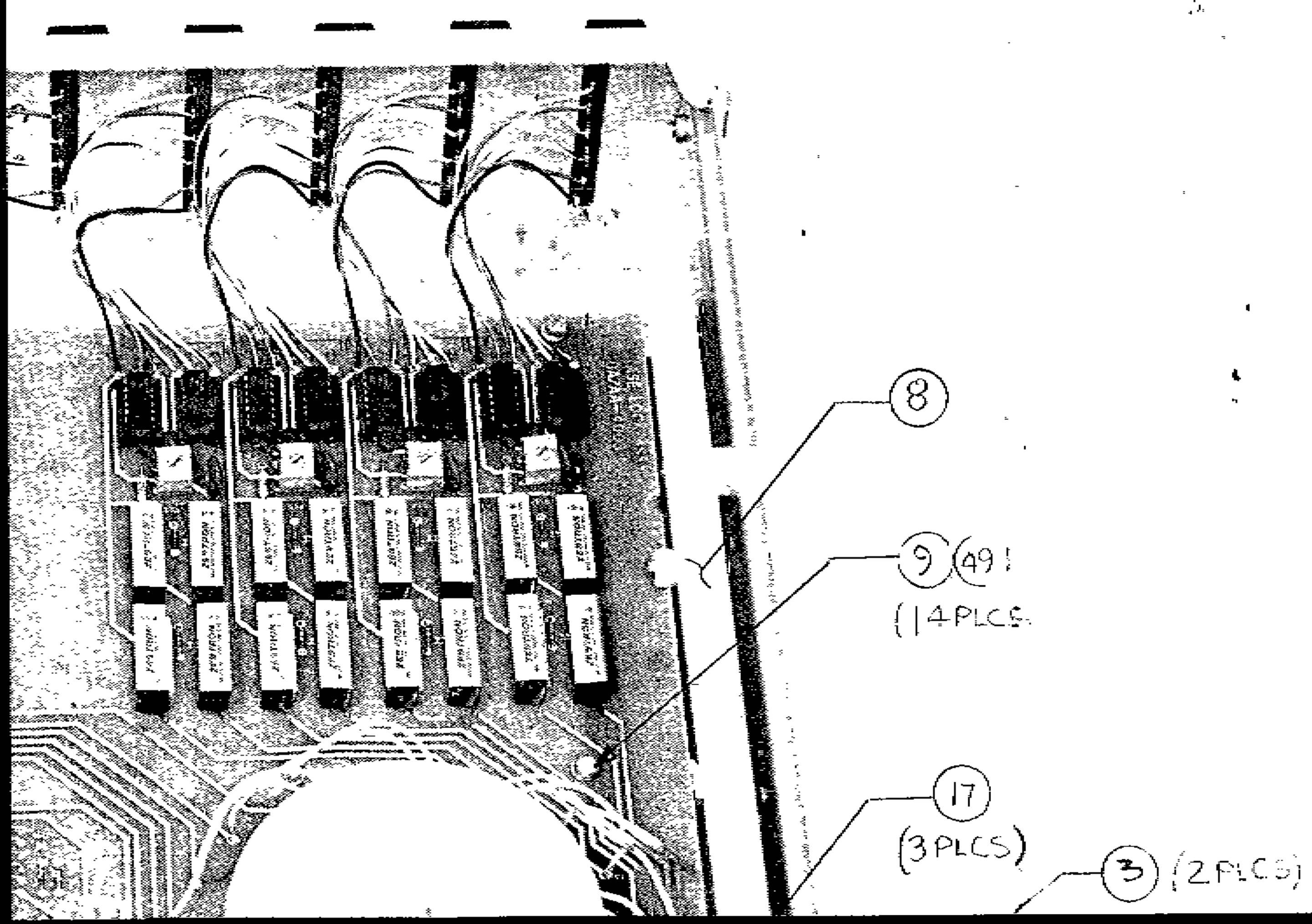


2
6 (2 PL)
7

2



3



3 2 1

4

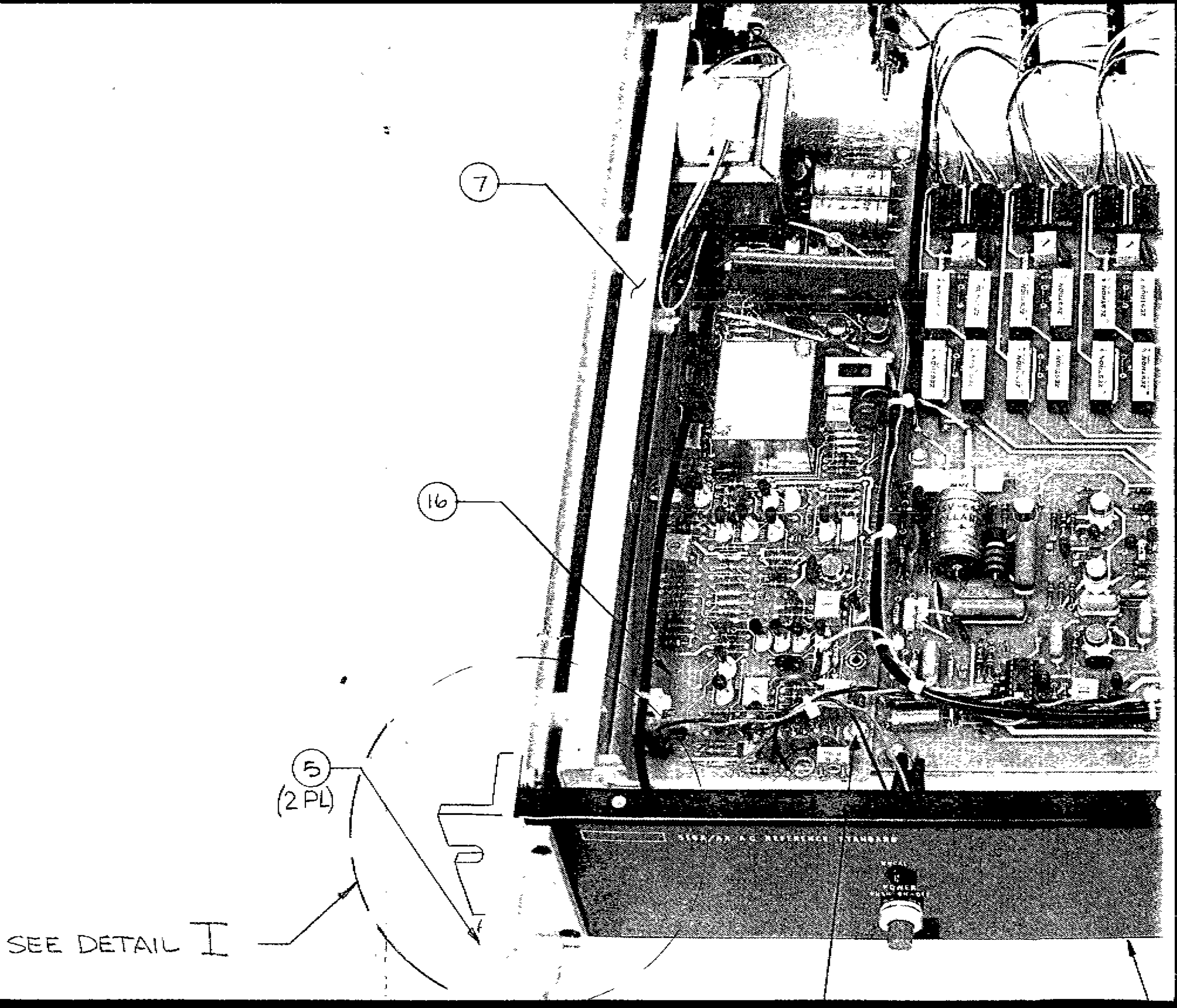
510A/AA-5002 SH 1 OF 2 REV 2

ITEM	PART NO.	NOMENCLATURE	QTY
1	—	FRONT PANEL ASSY, 510A/AA-4451	1
2	—	REAR PANEL ASSY, 510A/AA-4452	1
3	297283	CHASSIS SIDE, 730A-2003	2
4	292136	CORNER BRKT, M03-200-309	2
5	295659	HANDLE M03-800-303	2
6	295972	CORNER, M03-800-300	2
7	—	INNER PANEL, L.H, 510A/AA-2005	1
8	—	INNER PANEL, R.H., 510A/AA-2006	1
9	177022	SCREW, #6-32 X 1/4 PHP	21
10	222406	SPACER, SNAP IN	8
11	306233	SCREW, #8 x 1/2"	8
12	114116	SCREW, #8-32 x 3/8, FHP	12
13	295105	SCREW, #8-32 x 3/8, SOC HD CAP	4
14	228890	SCREW, #8-32 x 1/4, PHP	2
15	—	PHASE LOCK PCB ASSY, 510A/AA-4003	1
16	—	MAIN PCB MOD, 510A/AA-4004	1
17	115089	SCREW, #6 x 1/2, THP	3
18	115139	SCREW, #6-32 x 3/8, THP	6
19	303081	RACK EAR, M03-205-206	2
20	184994	SCREW, #8-32 x 5/8, FHP	4
49	111005	WASHER, #6	20

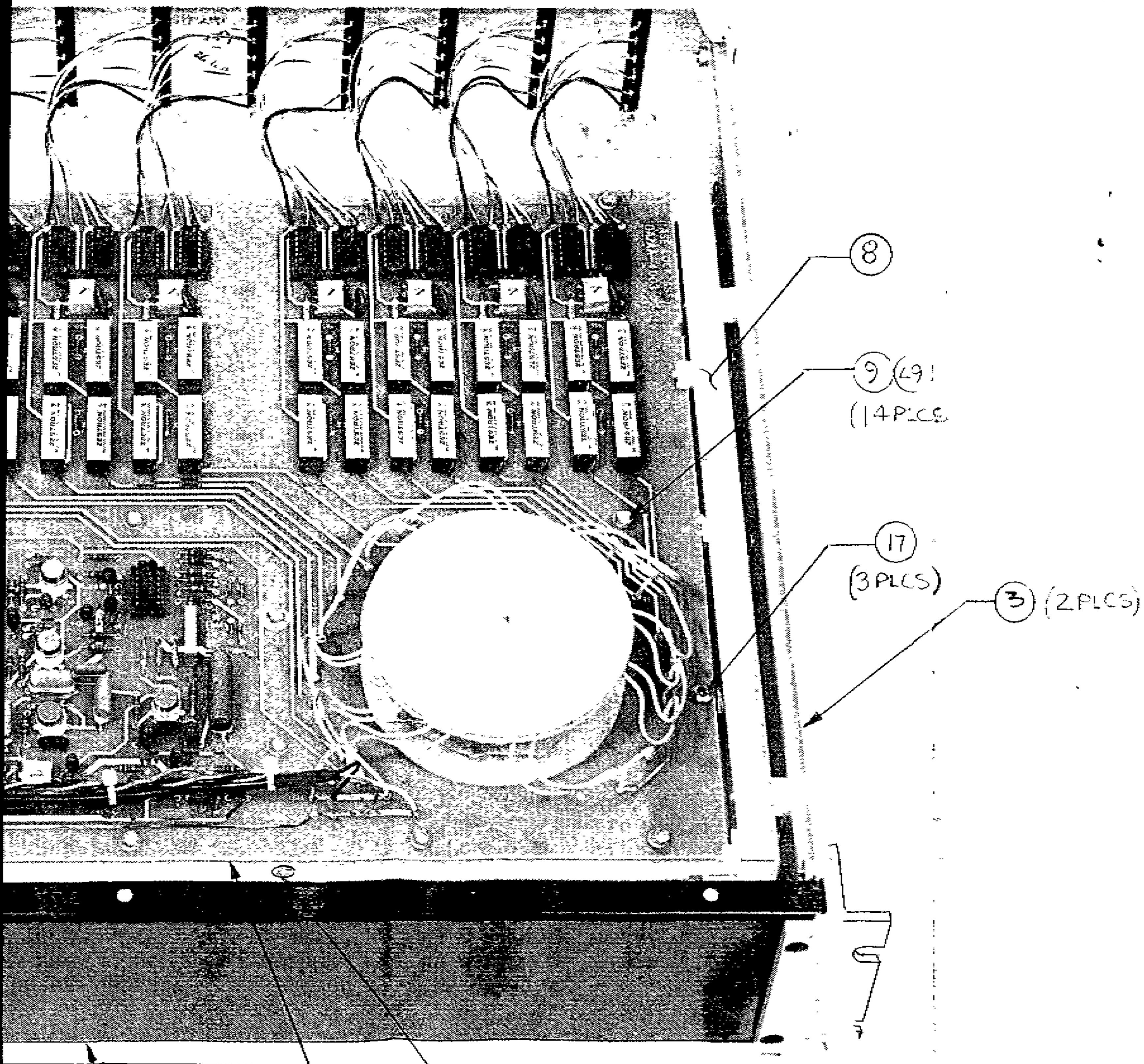
D

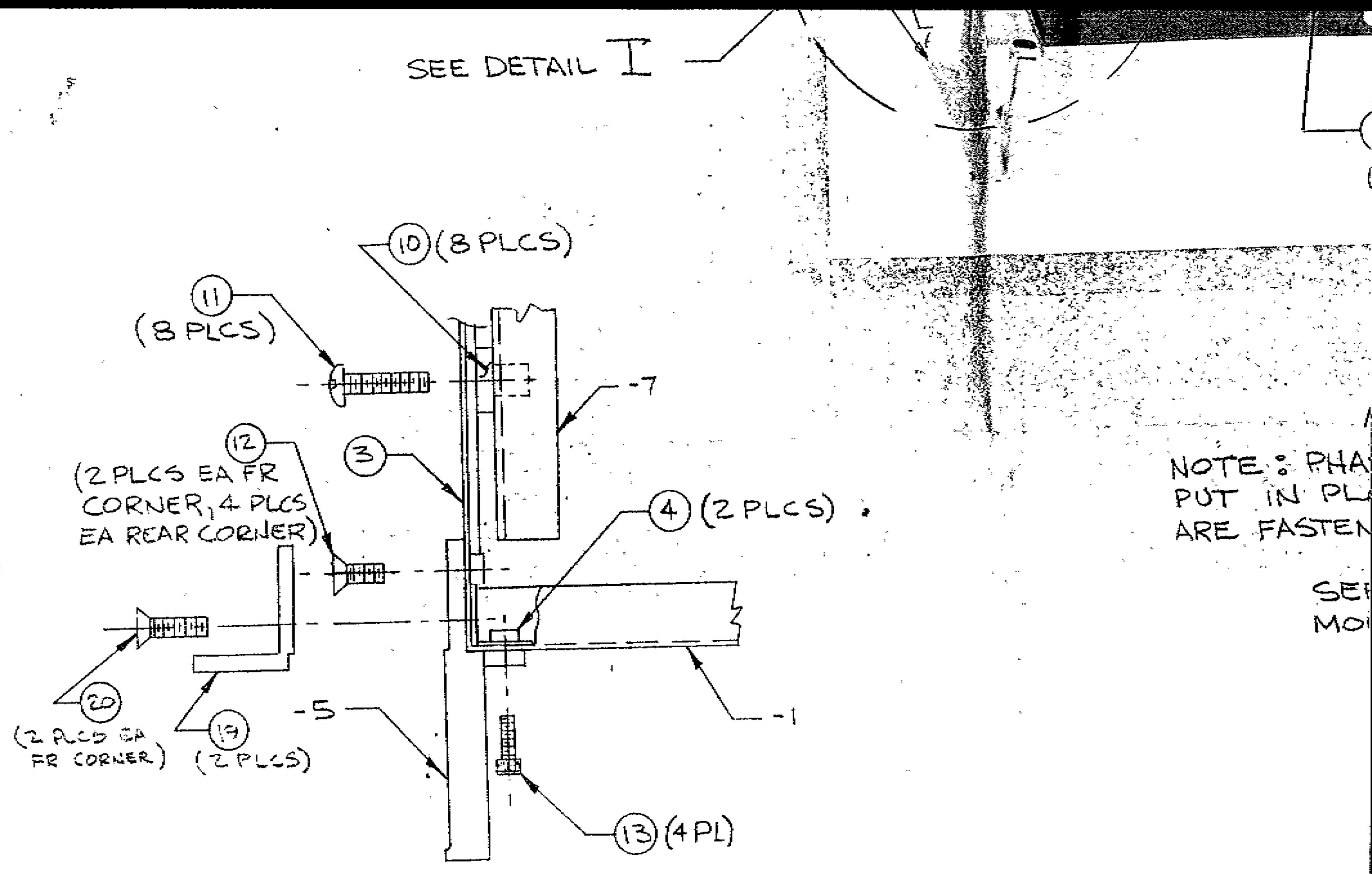
C

5



6



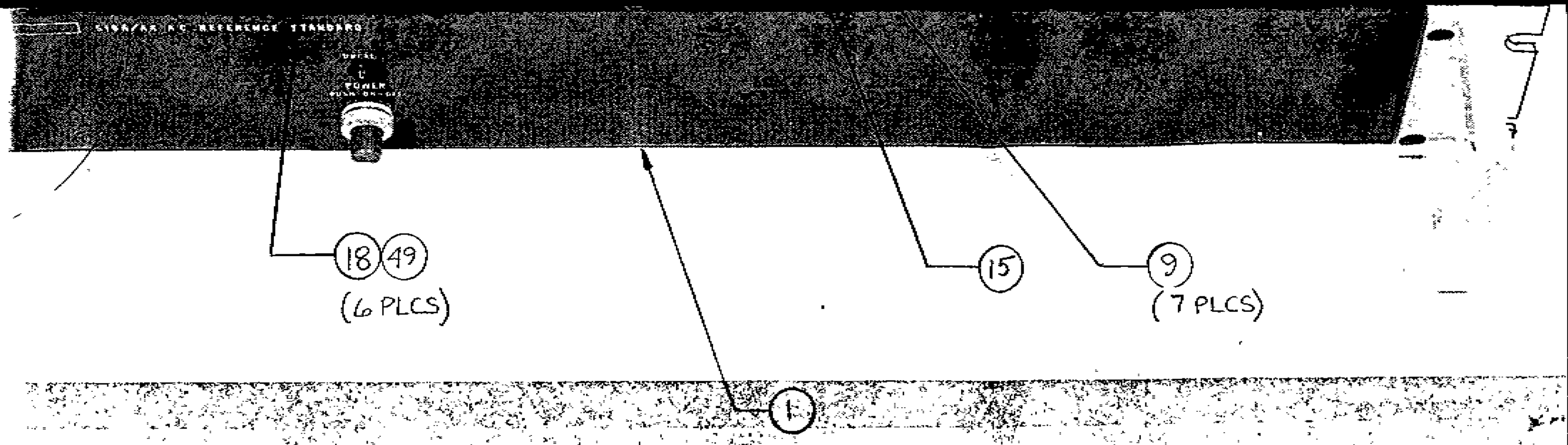


DETAIL I

NOTE: PHA
PUT IN PL
ARE FASTEN

SEE
MO

7



ASSEMBLY VIEW

NOTE: PHASE LOCK PCB (ITEM 15) MUST BE PUT IN PLACE BEFORE INNER PANELS (ITEMS 7 & 8) ARE FASTENED DOWN SECURELY

SEE SH 2 FOR TRANSFORMER MOUNTING & ALL WIRING

8

ZONE	REV	DESCRIPTION	DWN	CKD	APPD
	2	ECO 6322. EXTENSIVLY REVISED TO SHOW INSTALLATION OF NEW 510A/AA-4003 PCB	E.J.K 10/26/72	Ellison	11-15-72
	1	ADDED ITEMS 19 & 20			Ellison
B/M	—	SPECIALS RELEASE	WRM		Ellison

FLUKE JOHN FLUKE MFG CO., INC.
P.O. BOX 7428, SEATTLE, WN.

UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS ARE IN INCHES

3 PLACE DECIMALS ± .010
2 PLACE DECIMALS ± .02
FRACTIONS ±
ANGLES ± X CONST.

DO NOT SCALE DRAWING

DFTM	W.R. MAC LAREN	8-20-71
PROJ ENG		11 12 71
MFG ENG	Ellison	11-12-71

MATERIAL: SEE B/M

FINISH: ——

FINAL ASSY, AC REF STD
8 OUTPUT

PART NO	SIZE	DRAWING NUMBER
	D	510A/AA-5002
SCALE NONE	SHEET 1 OF 2	REV 2

DIST

9

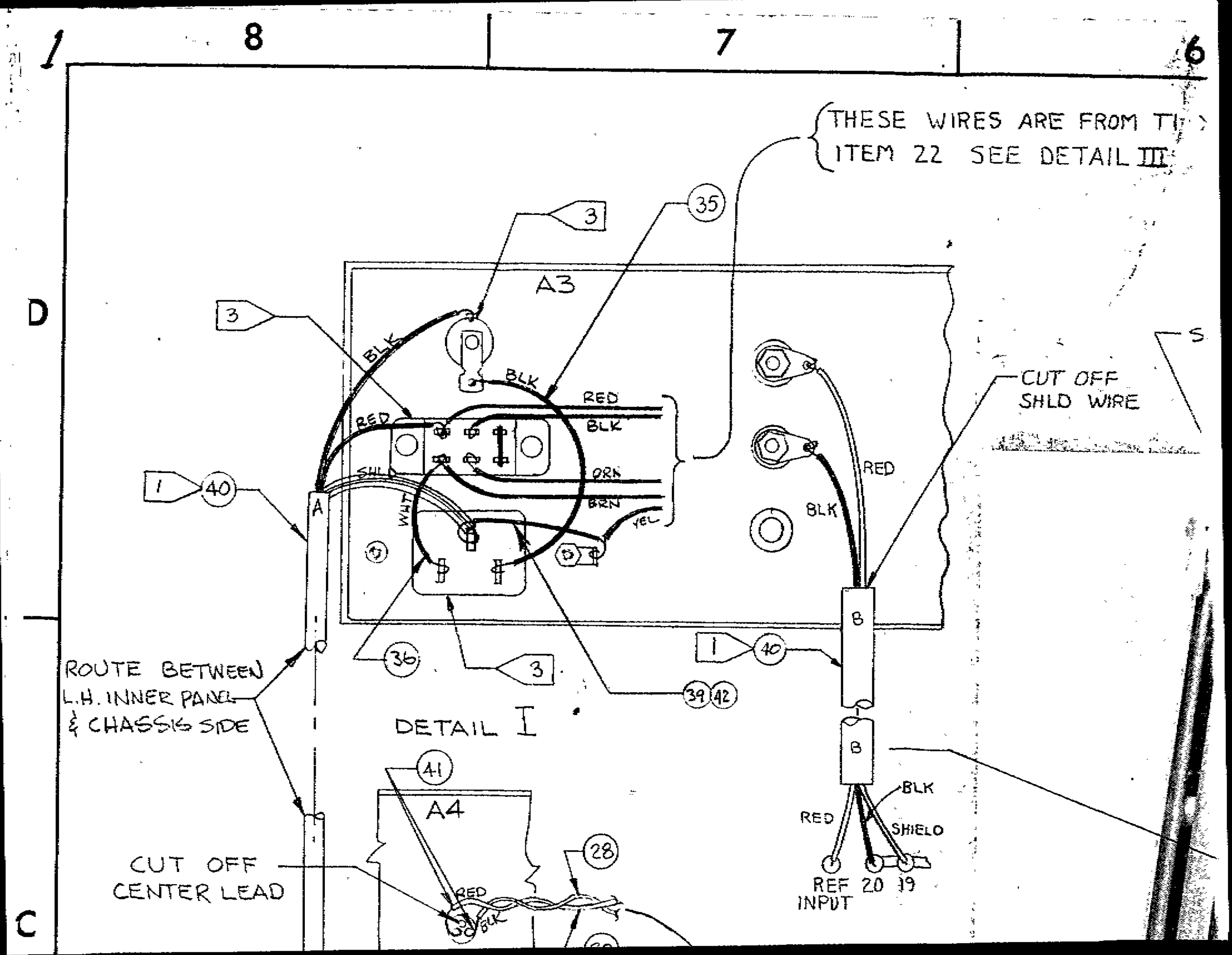
FINAL ASSY

AC REFERENCE STD

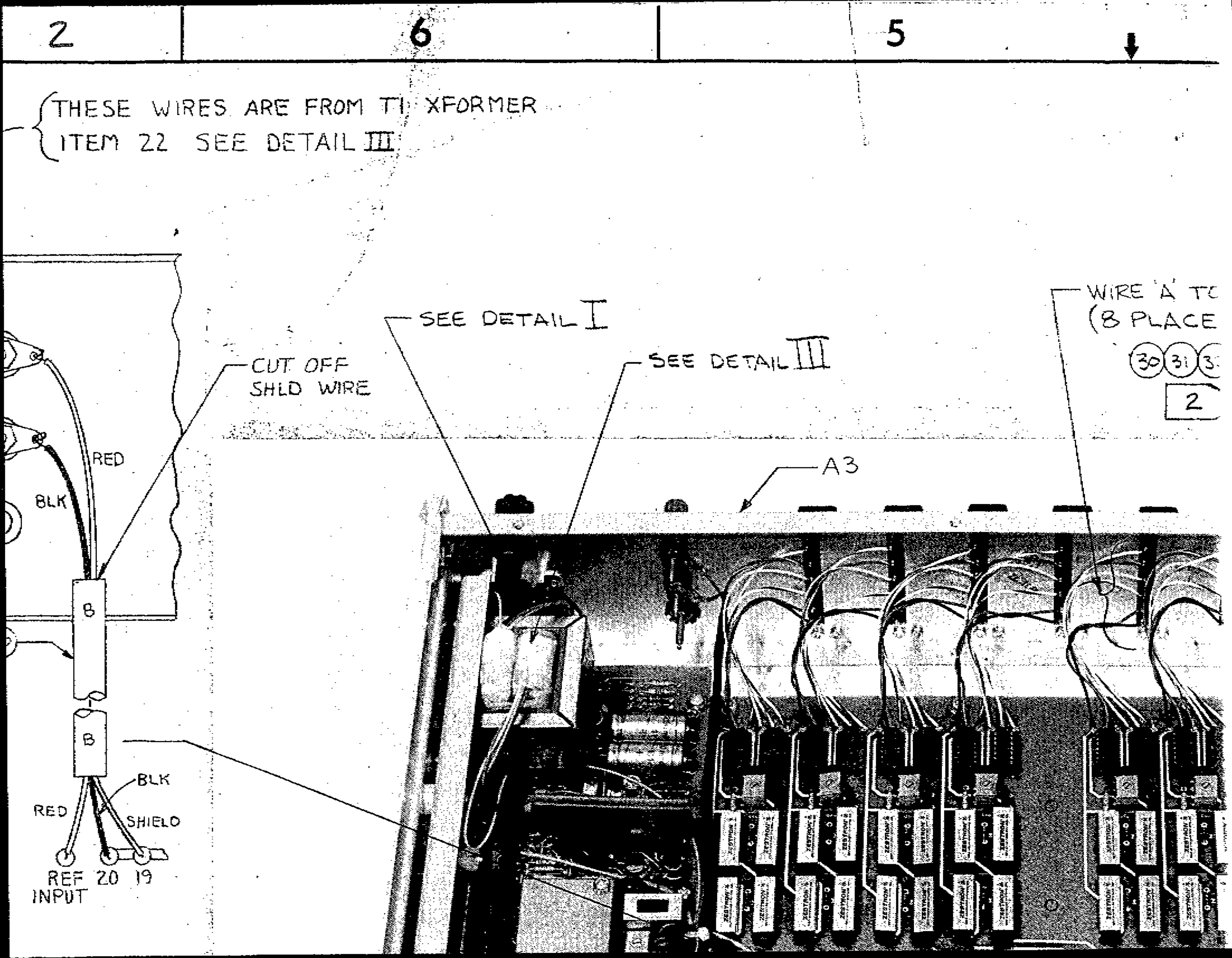
MODEL 510A/AA

DIAGRAM LAYOUT

1	2	3	4			
5	6	7	8			
9	10	11	12			



8
7
6
D
C
THESE WIRES ARE FROM TI
ITEM 22 SEE DETAIL III
A3
BLK
RED
BLK
ORN
BRN
YEL
RED
SHLD
WHT
CUT OFF
SHLD WIRE
RED
BLK
A
B
B
ROUTE BETWEEN
L.H. INNER PANEL
& CHASSIS SIDE
DETAIL I
A4
CUT OFF
CENTER LEAD
RED
BLK
SHIELD
REF 20 19
INPUT



2
6
5
THESE WIRES ARE FROM T1 XFORMER
ITEM 22 SEE DETAIL III
CUT OFF
SHLD WIRE
RED
BLK
B
B
BLK
RED
SHIELD
REF 20 19
INPUT
SEE DETAIL I
SEE DETAIL III
A3
WIRE 'A' TO
(8 PLACE
30
31
2

3

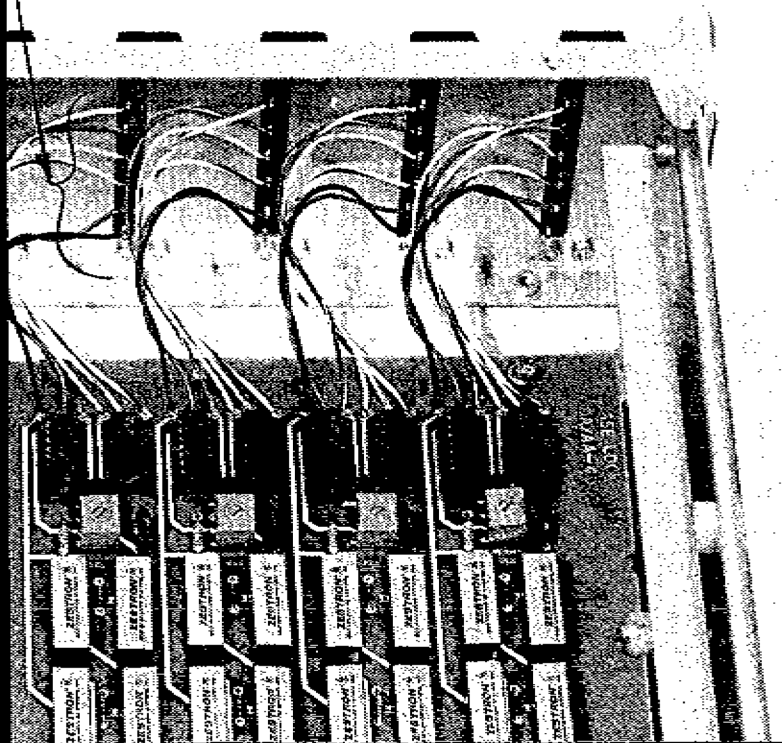
4	3	

5IOA/AA-5002 SH 2 OF 2 REV 2

WIRE 'A' TO 'A', 'B' TO 'B' ETC.
(8 PLACES)

(30) (31) (32) (33) (34) (35)

2



ITEM
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39

3 | 2 | 1

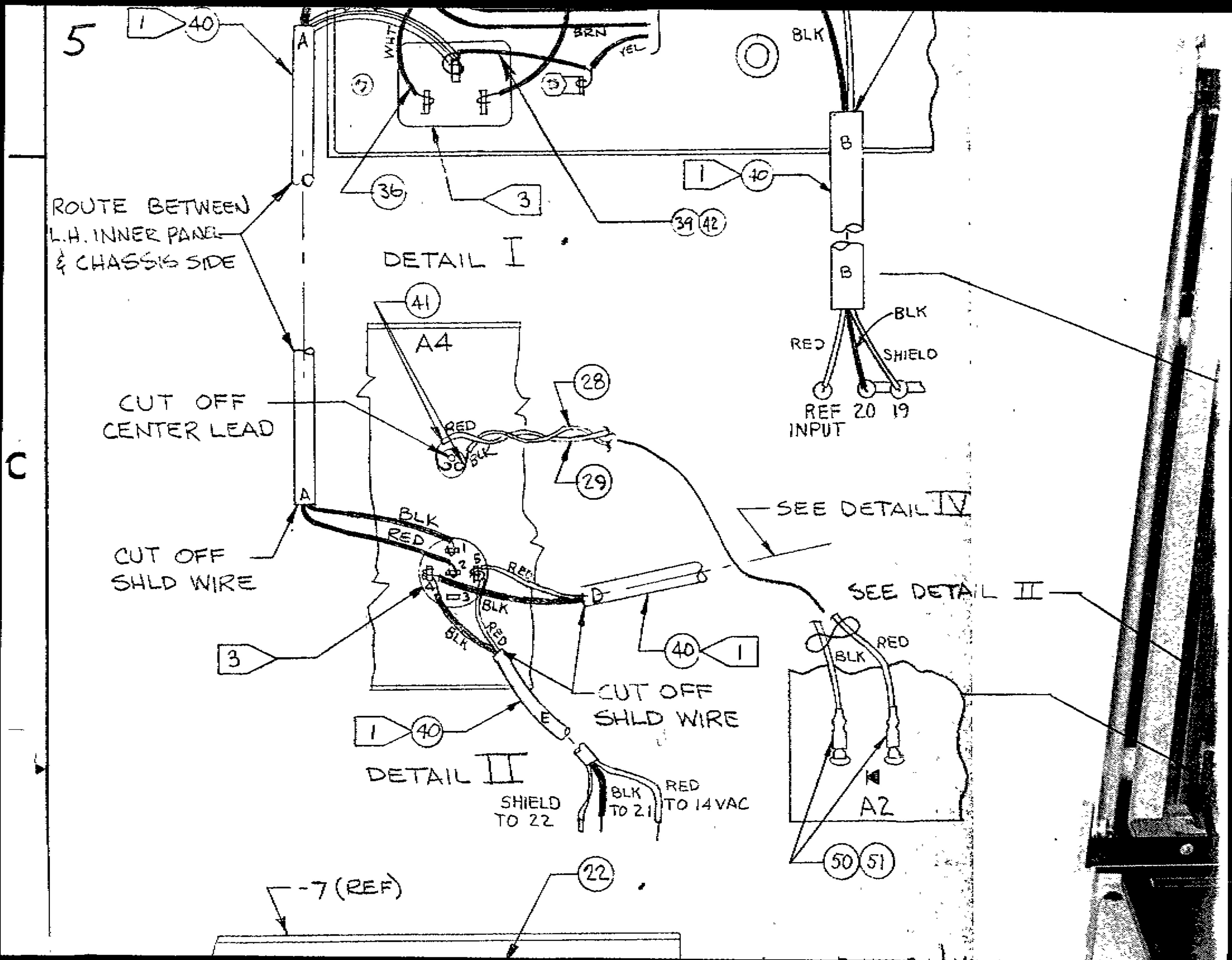
4

510A/AA-5002 SH 2 OF 2 REV 2

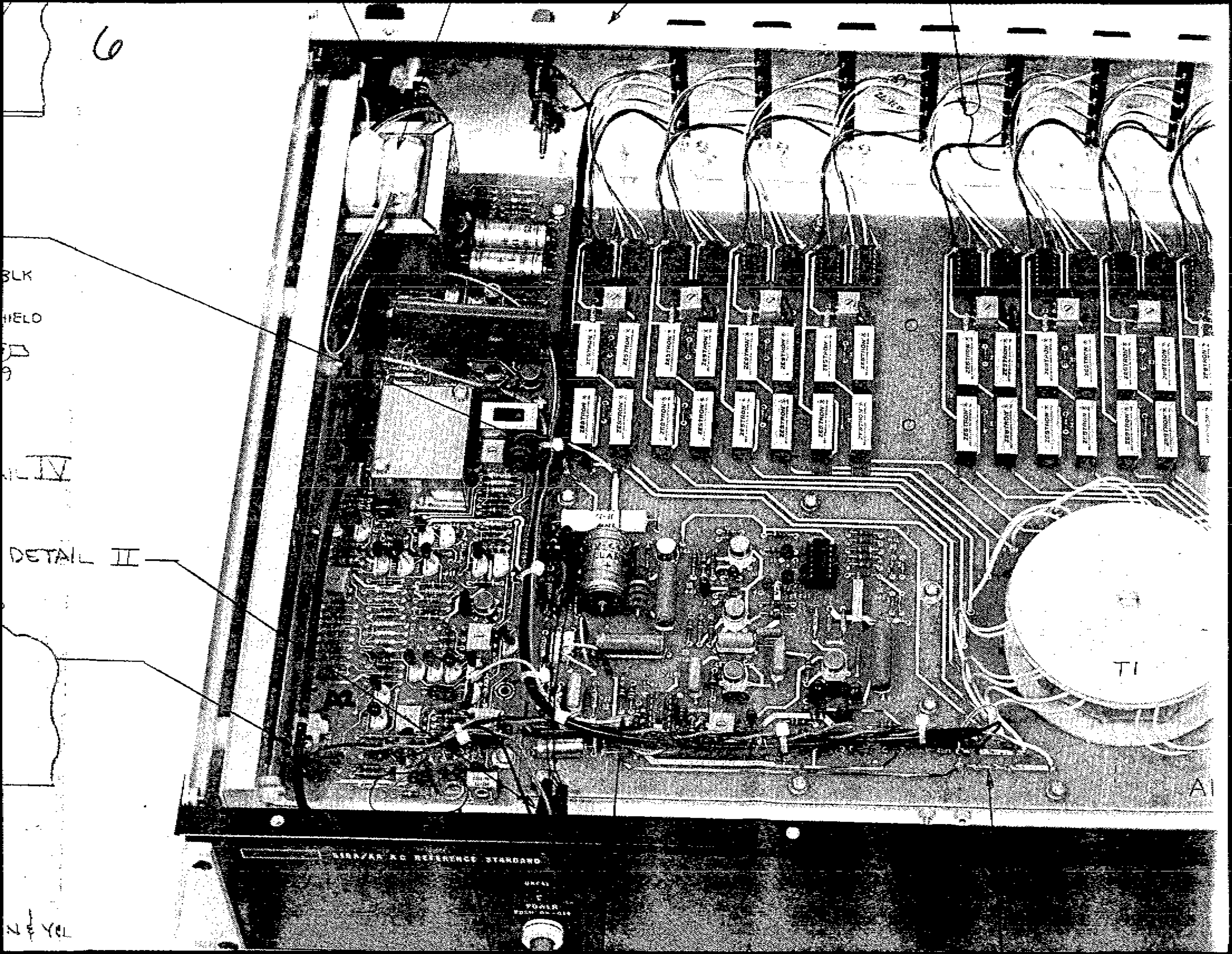
ITEM	PART NO.	NOMENCLATURE	
21			
22	—	TRANSFORMER, PWR, 510A/AA-6510	1
23			
24			
25			
26			
27			
28	170217	WIRE, TEFLON, AWG #26, RED	1 FT
29	200766	BLK	1 FT
30	200725	YEL	2.5 FT
31	200667	BLK/WHT	2.5 FT
32	236448	GRN/WHT	2.5 FT
33	236455	BLU/WHT	2.5 FT
34	115576	AWG #22, RED	4 FT
35	115774	BLK	3 FT
36	115667	WHT	.5 FT
37	115808	VIO	1 FT
38	115675	BLU	.5 FT
39	115469	WIRE, BUSS,	.2 FT

D

C

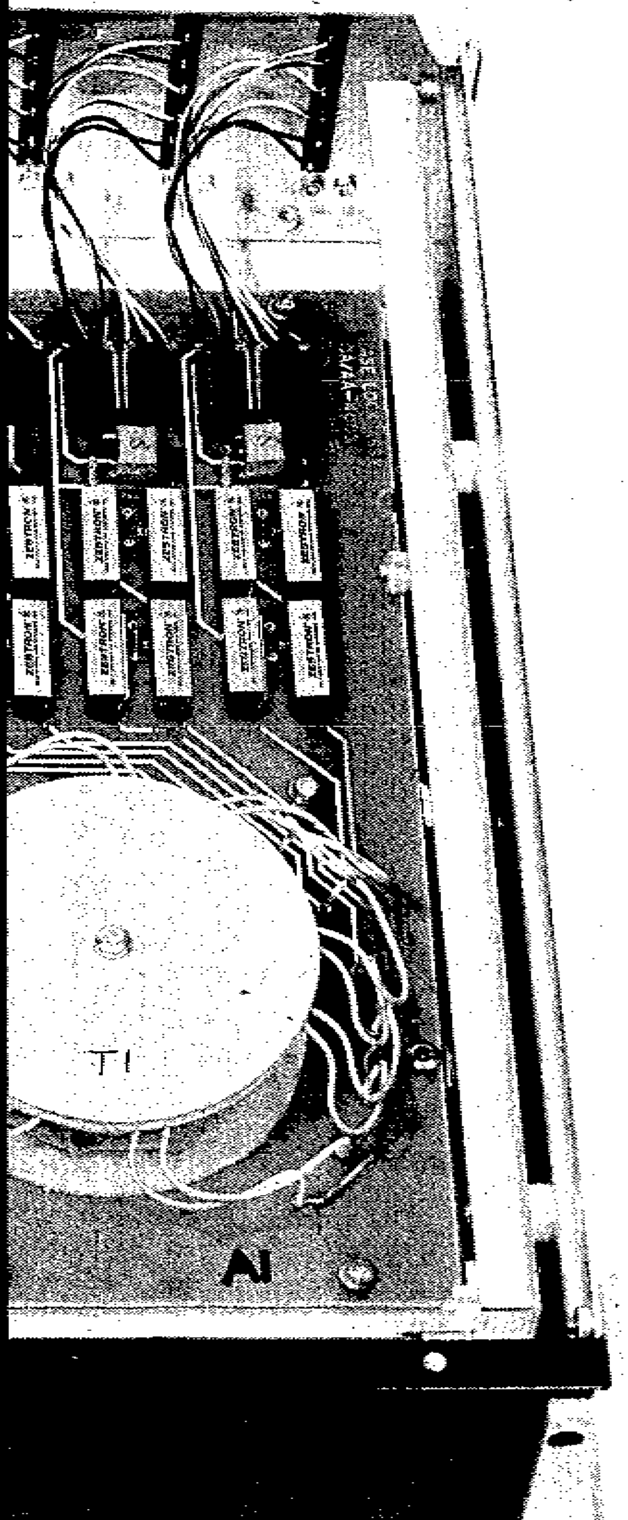


5
C
ROUTE BETWEEN
L.H. INNER PANEL
& CHASSIS SIDE
DETAIL I
DETAIL II
SEE DETAIL IV
SEE DETAIL II
CUT OFF
CENTER LEAD
CUT OFF
SHLD WIRE
CUT OFF
SHLD WIRE
A4
A2
REF
INPUT
20
19
RED
BLK
SHIELD
WHT
BRN
YEL
SHIELD
TO 22
BLK
TO 21
RED
TO 14 VAC
-7 (REF)
40
36
39
42
41
28
29
22
50
51



6
BLK
HIELD
IL IV
DETAIL II
N & YEL
T1
A1
REFERENCE STANDARD
POWER

7



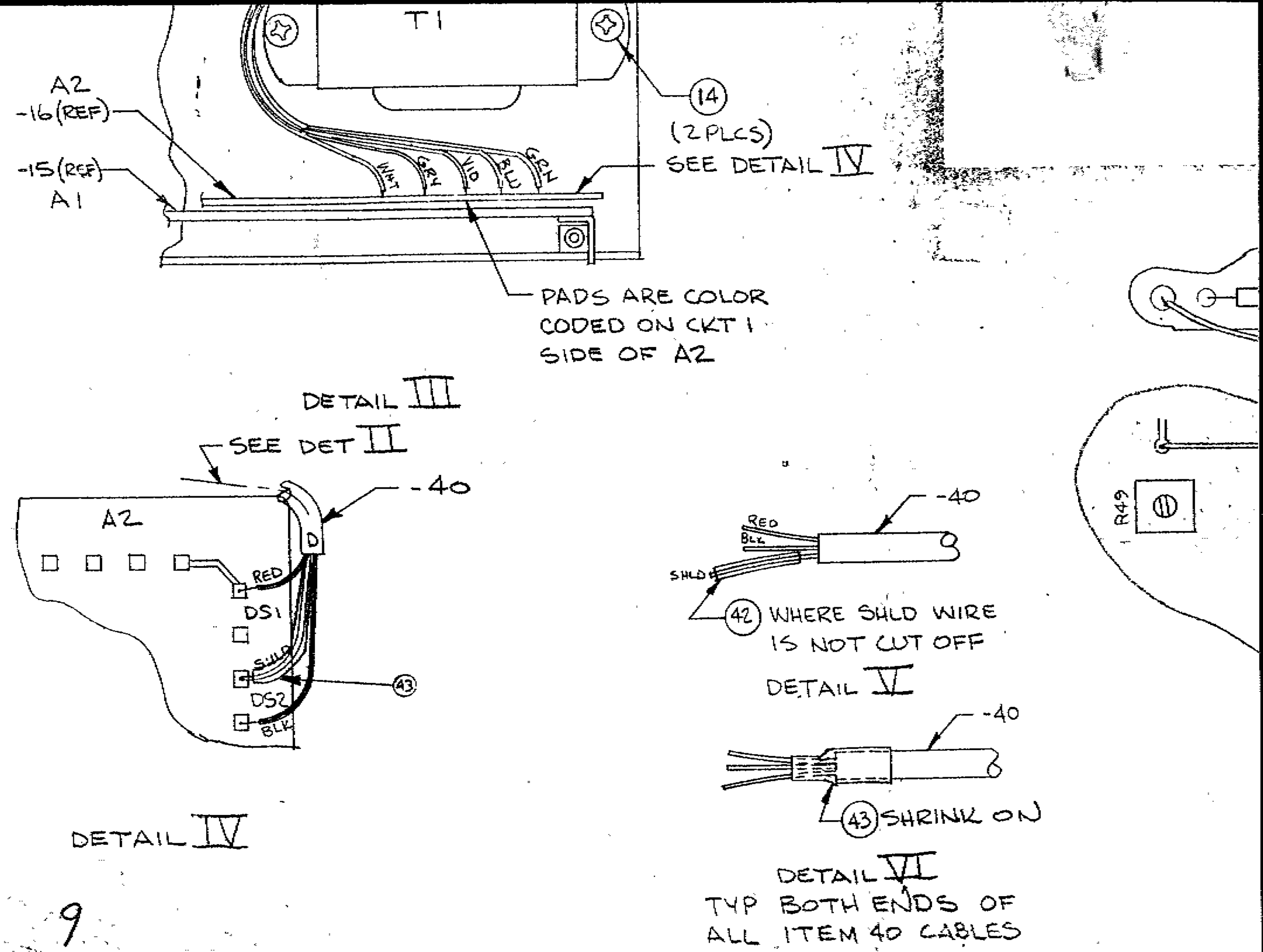
29	200766
30	200765
31	200667
32	236448
33	236455
34	115576
35	115774
36	115607
37	115808
38	115675
39	115469
1 ▷ 40	135772
41	175976
42	146717
43	271734
44	
45	
46	
47	
50	267534
51	144410

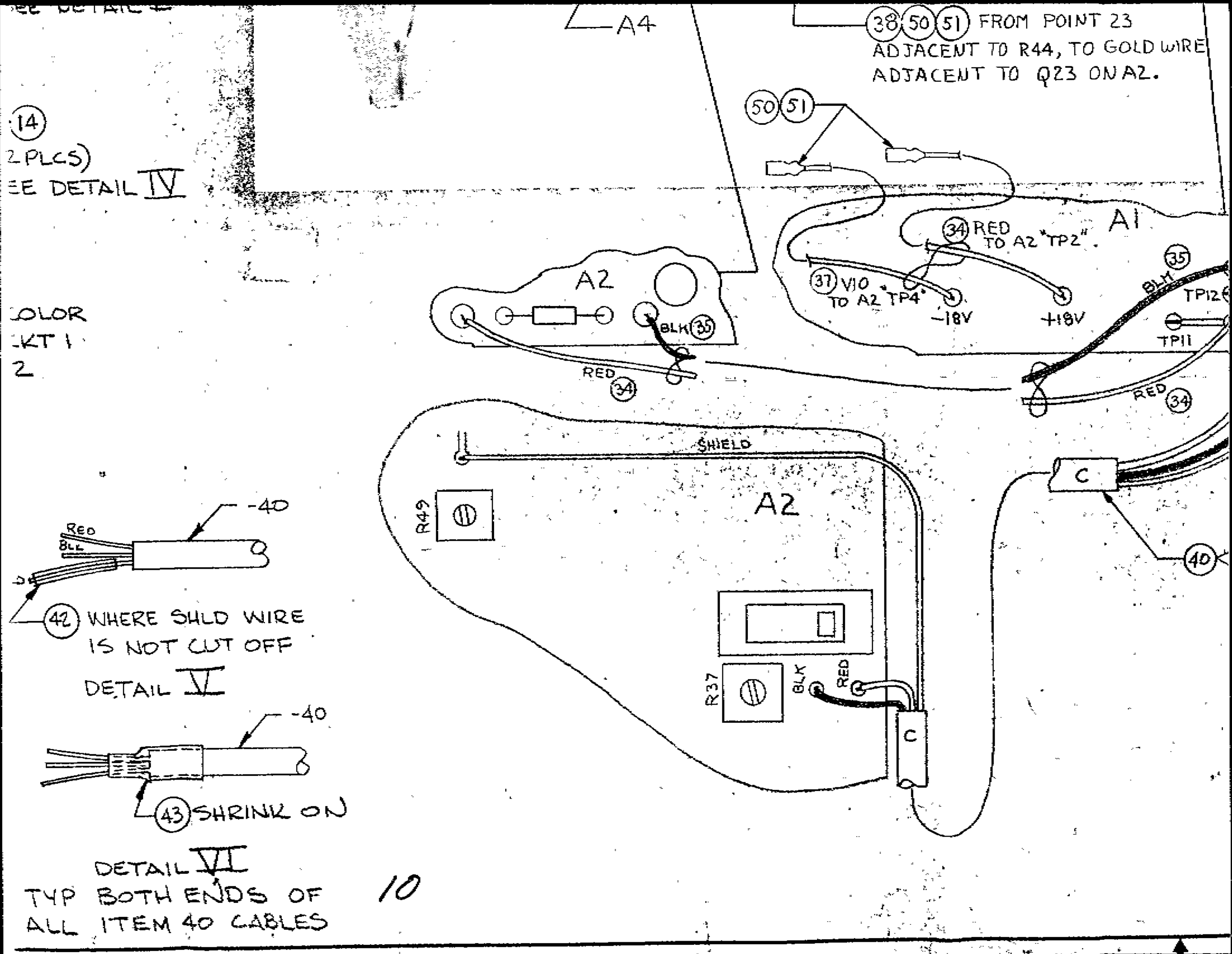
31	200667	BLK/WHT	[illegible] FT
32	236448	GRN/WHT	2.5 FT
33	236455	BLU/WHT	2.5 FT
34	115576	AWG #22, RED	4 FT
35	115774	BLK	3 FT
36	115607	WHT	.5 FT
37	115808	VIO	1 FT
38	115675	BLU	.5 FT
39	115469	WIRE, BUSS,	.2 FT
[1] 40	135772	CABLE, SHIELDED, 2 CONDUCTOR	5.5 FT
41	175976	SLEEVING, TEFLON, #18	2 FT
42	196717	SLEEVING, TEFLON, #22	.2 FT
43	271734	TUBING, SHRINKABLE, 1/4"	1 FT
44			
45			
46			
47			
50	267534	AMP SOCKET. AWG #22	5
51	144410	SHRINK TUBING	4 IN.

[1] THERE ARE 5 CABLES MADE OF ITEM 40, CABLE, 2COND, (135772)

LTR	FROM	TO	LENGTH
A	A3	A4	22"

C

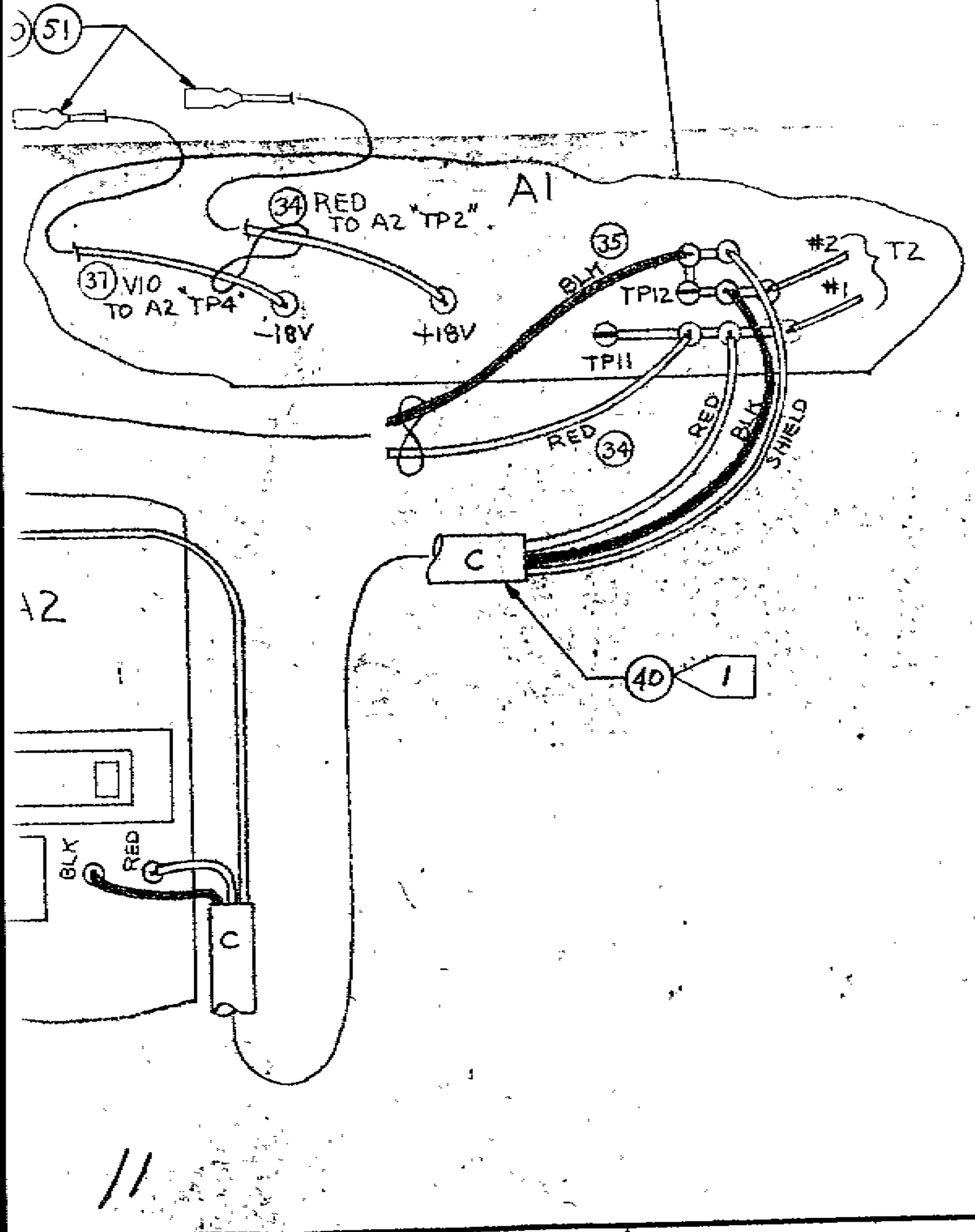

T1
A2
-16(REF)
-15(REF)
A1
WHT
GRY
VIO
BLU
GRN
14
(2PLCS)
SEE DETAIL IV
PADS ARE COLOR
CODED ON CKT 1
SIDE OF A2
DETAIL III
SEE DET II
-40
A2
RED
DS1
SHLD
DS2
BLK
43
DETAIL IV
-40
RED
BLK
SHLD
42 WHERE SHLD WIRE
IS NOT CUT OFF
DETAIL V
-40
43 SHRINK ON
DETAIL VI
TYP BOTH ENDS OF
ALL ITEM 40 CABLES
R49



EE DETAIL
14
2 PLCS)
EE DETAIL IV
OLOR
KT 1
2
A4
38 50 51 FROM POINT 23
ADJACENT TO R44, TO GOLD WIRE
ADJACENT TO Q23 ON A2.
50 51
A1
34 RED TO A2 "TP2".
37 VIO TO A2 "TP4"
-18V
+18V
35
BLK
TP12
TP11
A2
BLK 35
RED 34
RED 34
SHIELD
A2
R49
R37
BLK
RED
C
C
40
-40
RED
BLL
42 WHERE SHLD WIRE
IS NOT CUT OFF
DETAIL V
-40
43 SHRINK ON
DETAIL VI
TYP BOTH ENDS OF
ALL ITEM 40 CABLES

10

ADJACENT TO R44, TO GOLD WIRE
ADJACENT TO Q23 ON A2.



FLUKE
UNLES
ALL DI
3 PLACE
2 PLACE
FRACTIO
ANGLES

1. THERE ARE 5 CABLES MADE OF ITEM 40, CABLE, 2COND (135772)

LTR	FROM	TO	LENGTH
A	A3	A4	22"
B	A3	A1	9"
C	A1	A2	18"
D	A4	A2	22"
E	A4	A1	6"

SEE DETAIL V & VI FOR END PREP.

2. WIRE LENGTHS OF ITEMS 30 THRU 35

ITEM	COLOR	LENGTH	
30	GRN/WHT	3"	
31	BLK/WHT	2 3/4"	
32	YEL	2 3/4"	
33	BLU/WHT	2 1/2"	
34	RED 22	12 3/4"	TWISTED PR.
35	BLK 22	12 3/4"	TWISTED PR.

3. APPLY SHRINK TUBING ITEM 51 TO ALL CONNECTIONS.

B

A

ZONE	REV	DESCRIPTION	DWN	CKD	APPD
	2	ECO 6322 EXTENSIVLY REVISED TO SHOW INSTALLATION OF NEW 510A/AH 4003 PCB	E.S.K 10/31/72		
	1	ADDED DETAIL VII			
B/M	-	SPECIALS RELEASE			

FLUKE JOHN FLUKE MFG CO., INC. P.O. BOX 7428, SEATTLE, WN.	DO NOT SCALE DRAWING	FINAL ASSY AC REFERENCE STD
UNLESS OTHERWISE SPECIFIED ALL DIMENSIONS ARE IN INCHES	DFTM W.R. MACLAREN 9-20-71; PROJ ENG 11-12-71; MFG ENG Ellison 11-12-71	
3 PLACE DECIMALS ± .010; 2 PLACE DECIMALS ± .02; FRACTIONS ±; ANGLES ± X CONST.	MATERIAL: SEE B/M; FINISH: —	PART NO: ; SIZE: D; DRAWING NUMBER: 510A/AA-5002; SCALE NONE; SHEET 2 OF 2; REV 2

DIST

Table of Contents

(Continued on page ii)

TABLE OF CONTENTS, *continued*

List of Illustrations

(Continued on page iv)

LIST OF ILLUSTRATIONS, *continued*

List of Tables

Section 1
Introduction & Specifications

1-1. INTRODUCTION

1-2. The Model 510A is a precision ac reference standard. It produces a fixed frequency output having an amplitude of 10V rms. Standard frequencies and accuracies are given in Table 1-1. Other frequencies are available upon special request. The center frequency can be varied ±1% with a control on the front panel. Frequency resolution with this control is better than ±0.05%.

Table 1-1. STANDARD FREQUENCIES AND ACCURACY

24 HOUR ACCURACY	30 DAY ACCURACY	STANDARD FREQUENCY
±0.01%	±0.015%	50 Hz, 60 Hz, 400 Hz, 1 kHz, 2.4 kHz, 5 kHz, 19.2 kHz
±0.04%	±0.05%	100 kHz

1-3. Output current is fully protected from overloads and short circuits. Maximum load current for rated accuracy is 10 mA. Visual indication of an overload is provided by a light emitting diode (LED) on the front panel. Two sets of parallel connected binding posts on the front and rear panel provide load connection.

1-4. The ac reference standard can be operated from line power or it can be battery powered through an optional rechargeable battery pack. Line voltage requirement is 115/230 vac, 50 to 500 Hz, single phase. The rechargeable battery pack is available as the –01 Option. It allows at least 16 hours of continuous operation without line power. Battery charging is done whenever line power is applied.

1-5. The Model 510A is designed for bench top use or it can be installed in a standard 19 inch equipment rack. Rack mounting kits are available as accessories to permit single, dual, triple, and quadruple side-by-side rack installation

1-6. SPECIFICATIONS

OUTPUT VOLTAGE	10V rms
OUTPUT CURRENT	10 mA rms, short circuit protected
SINGLE FIXED FREQUENCY OUTPUT	Any single fixed frequency from 50 Hz to 100 kHz. Standard frequencies are: 50; 60; 400; 1,000; 2,400; 5,000; 19,200 and 100,000 Hertz.

Amplitude Accuracy	24 Hours	30 Days	90 Days
50 Hz – 20 kHz	±0.01%	±0.015%	±0.02%
20 kHz – 50 kHz	±0.015%	±0.025%	±0.035%
50 kHz – 100 kHz	±0.04%	±0.05%	±0.06%

Above accuracy applies after 10 minutes warmup, operating temperature of 23 ±2°C, and includes worst case deviations of the output caused by line, load, stability, and noise conditions. Assumes calibration against an AC-DC transfer standard with an AC-DC difference of 50 ppm from 50 Hz to 50 kHz and 300 ppm from 50 kHz to 100 kHz.

Amplitude Accuracy Using DC Calibration . . . Using a DC reference accurate to ±15 ppm and standard laboratory equipment, the 510A may be calibrated to achieve the following accuracies at standard operating temperatures of 23 ±2°C, and worst case deviations caused by line, load, stability and noise conditions.

	30 Days	90 Days
50 Hz – 5 kHz	±0.01%	±0.02%
5 kHz – 10 kHz	±0.02%	±0.03%
10 kHz – 30 kHz	±0.05%	±0.07%
30 kHz – 100 kHz	±0.15%	±0.17%

Amplitude Stability	24 Hours	30 Days	90 Days
50 Hz – 20 kHz	±0.002%	±0.005%	±0.01%
20 kHz – 100 kHz	±0.004%	±0.01%	±0.02%

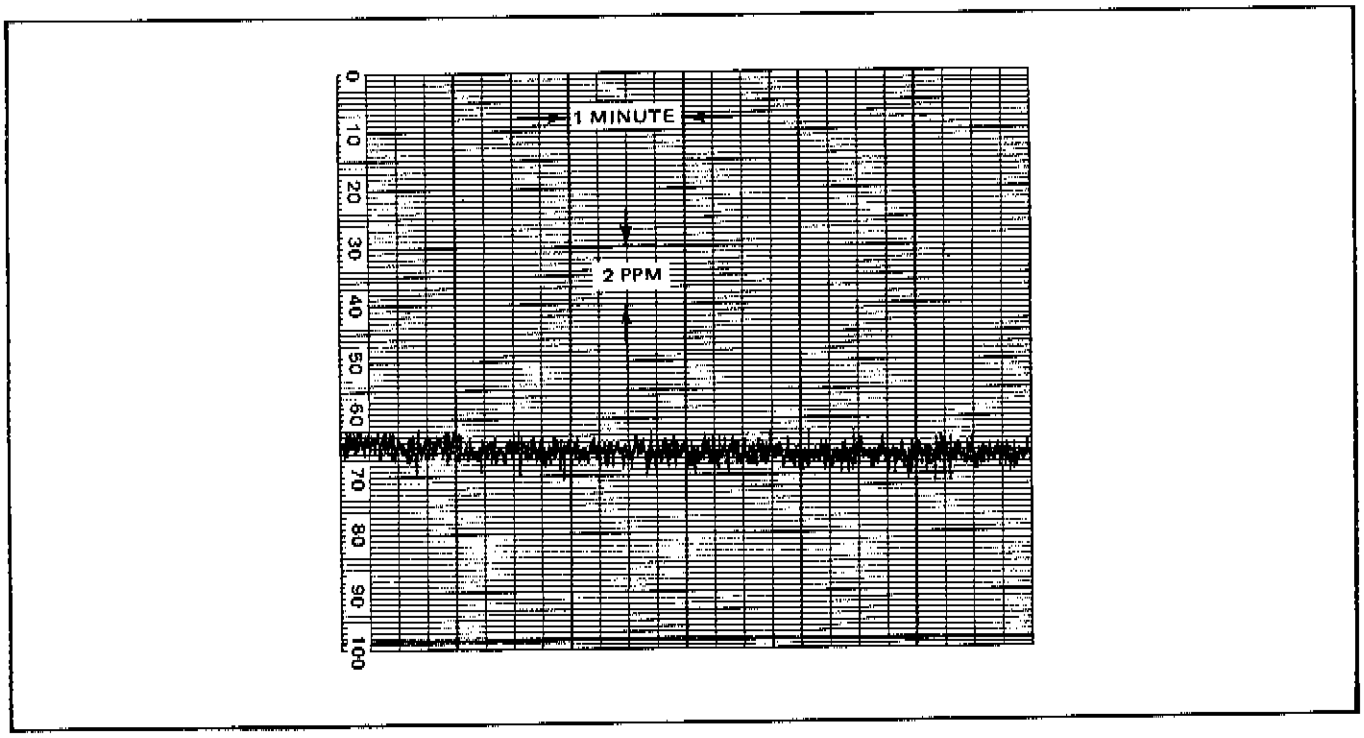


Figure 1-1. TYPICAL SHORT TERM STABILITY

AMPLITUDE NOISE . . . Amplitude deviation due to noise is less than 20 ppm peak-to-peak through a 1 Hz bandwidth over a 1 minute interval.

AMPLITUDE TEMPERATURE COEFFICIENT	15° – 50°C	0° – 15°C
50 Hz – 5 kHz	5 ppm/°C	12 ppm/°C
5 kHz – 10 kHz	7 ppm/°C	15 ppm/°C
10 kHz – 30 kHz	10 ppm/°C	17 ppm/°C
30 kHz – 100 kHz	15 ppm/°C	22 ppm/°C

TOTAL HARMONIC DISTORTION	(See Figure 1-2).
CENTER FREQUENCY ACCURACY	±0.1%
FREQUENCY RESOLUTION	±0.05% using front panel vernier
FREQUENCY VERNIER	Screwdriver adjustment, ±1% of center frequency
FREQUENCY STABILITY	500 ppm per month
Frequency Temperature Coefficient	Less than 150 ppm/°C
Common Mode Rejection	Common Mode Rejection is defined as the affect on the rms or average value of the 10V rms output due to a common mode signal between the low terminal and chassis. This rejection is: Greater than 100 db for common mode signals from 1 Hz to 500 Hz, 10V peak-to-peak maximum. Greater than 70 db for common mode signals from 500 Hz to 1 MHz, 3V peak-to-peak maximum. Maximum allowable dc potential between output low and chassis ground is 100 volts.
LOAD REGULATION	(See Figure 1-3).

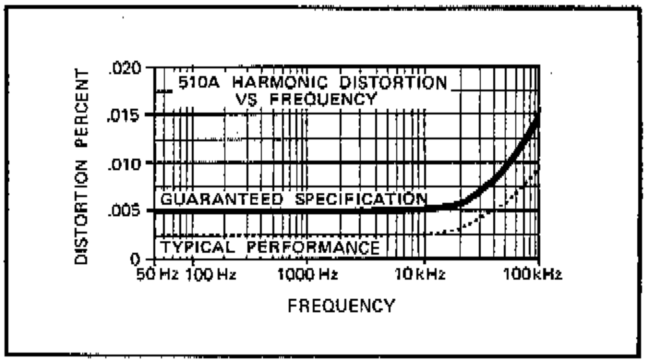


Figure 1-2. TOTAL HARMONIC DISTORTION

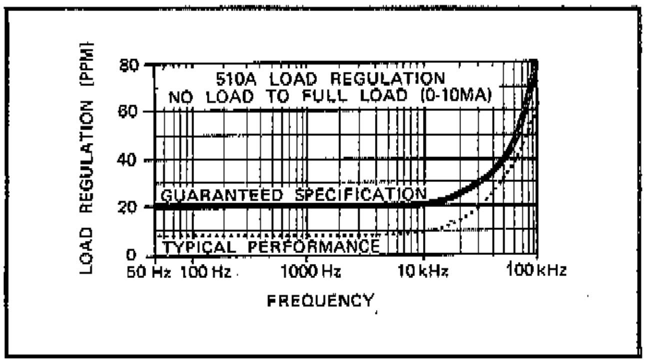


Figure 1-3. LOAD REGULATION

LINE REGULATION	< 10 ppm, ±10% line change
OUTPUT CONNECTIONS	High, Low and Chassis binding posts on front and rear panels.
UNCALIBRATED INDICATION	Front panel display labeled "UNCAL" indicates when load exceeds 10 mA.
ENVIRONMENTAL	
Operating Temperature Range	0°C to 50°C
Storage Temperature	–40°C to +75°C; –40°C to +60°C with batteries
Humidity Range	Up to 80% relative humidity, 0°C to 35°C Up to 70% relative humidity, 35°C to 50°C
Shock	20g, 11 millisec half-sine wave
Vibration	4.5g, 10 Hz – 55 Hz
Altitude	0 to 10,000 feet – Operating 50,000 feet – Non-Operating
INPUT POWER 115/230V ac ±10%, 50 – 500 Hz, Single Phase	An optional rechargeable battery pack will power the AC Reference Standard for 16 hours. The battery pack is field installable.
SIZE	3–1/2" high x 4–1/4" wide x 12" deep
MOUNTING	Up to four 510A's can be mounted side by side and installed in a standard 19" EIA rack with optional accessory ears.

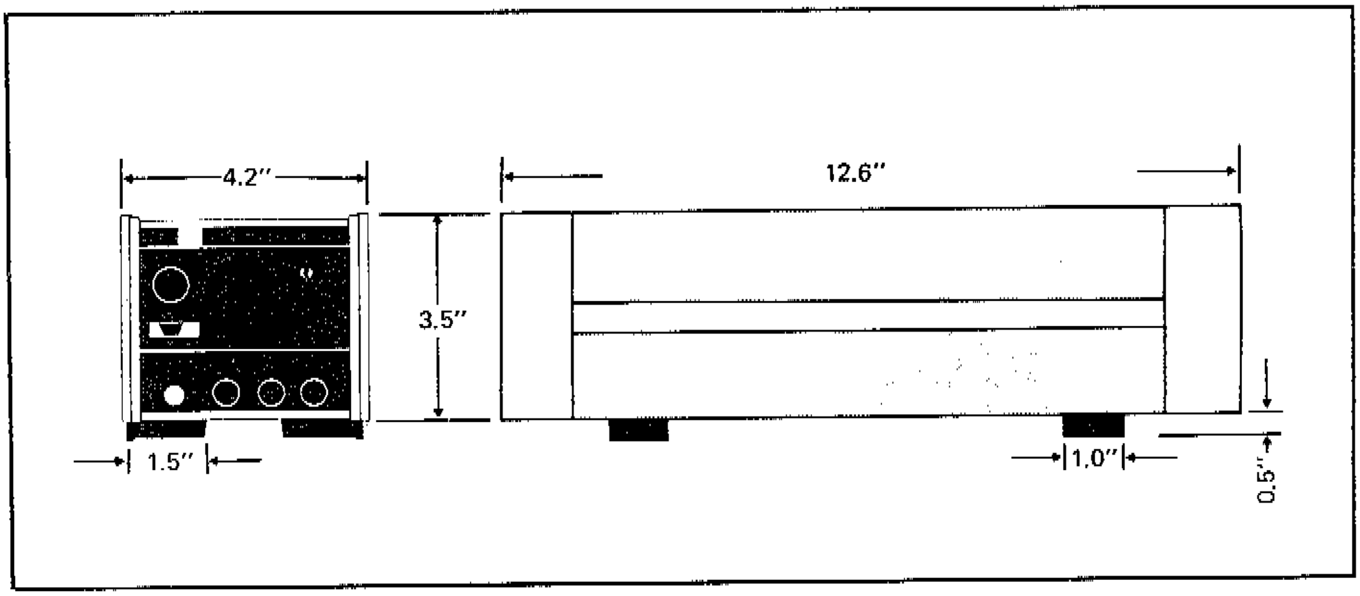


Figure 1-4. OUTLINE DRAWING

Section 2
Operating Instructions

2-1. INTRODUCTION

2-2. This section contains operating instructions for the Model 510A. If any difficulties are encountered, contact the nearest John Fluke Sales Representative or write directly to the John Fluke Mfg. Co., Inc. Please include the instrument serial number when writing.

2-3. SHIPPING INFORMATION

2-4. The Model 510A was packaged and shipped in a foam packed cardboard carton. Upon receipt, a thorough inspection should be performed to reveal any damage in transient. Special instructions for inspection and claims are included in the carton.

2-5. If reshipment is necessary, the original container should be used. If the original container is not available, a new one can be obtained from the John Fluke Mfg. Co., Inc. Please reference the Model number when requesting a new container.

2-6. INPUT POWER

2-7. This instrument can be operated from either a 115 or 230V ac, 50 to 500 Hz, single phase power line. A slide switch on the rear panel allows selection of the appropriate line voltage. The rated value of the rear panel fuse F1 is as follows:

115 VAC	230 VAC
1/4A, 3AG	1/8A, 3AG

2-8. INSTALLATION

2-9. The Model 510A is designed for bench-top use or it can be installed in a standard 19 inch equipment rack with Accessory rack mounting brackets. Up to four units can be rack mounted in side-by-side positions. Rack installation procedures are located in Section 6.

2-10. OPERATING FEATURES

2-11. The location and function of all controls, connectors, and indicators is shown in Figure 2-1.

2-12. OPERATING NOTES

2-13. AC Line Connection

2-14. The input power cord has a three prong, polarized connector. This plug allows connection to either a 115 or 230V ac, 50 to 500 Hz, single phase power line. The round pin connects the chassis to earth ground; therefore, ensure that the round pin is connected to a high quality earth ground. The instrument is energized through a POWER switch on the front panel. A front panel meter indicates LINE OPR when the instrument is energized.

2-15. Battery Power (–01 Option)

2-16. When the –01 Option is installed, the Model 510A can be operated from an internal rechargeable battery. Battery operation is activated by disconnecting the power

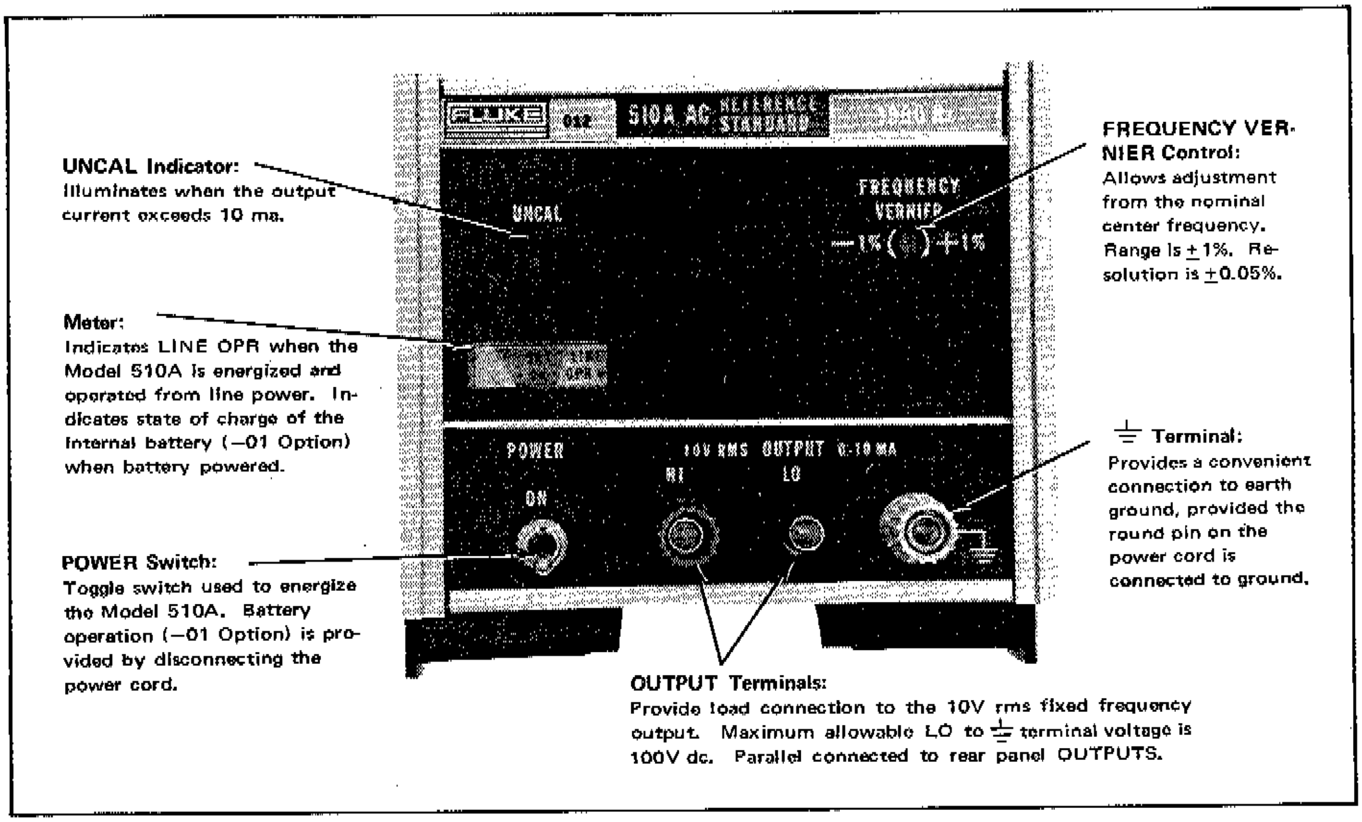


Figure 2-1. OPERATING FEATURES (1 of 2)

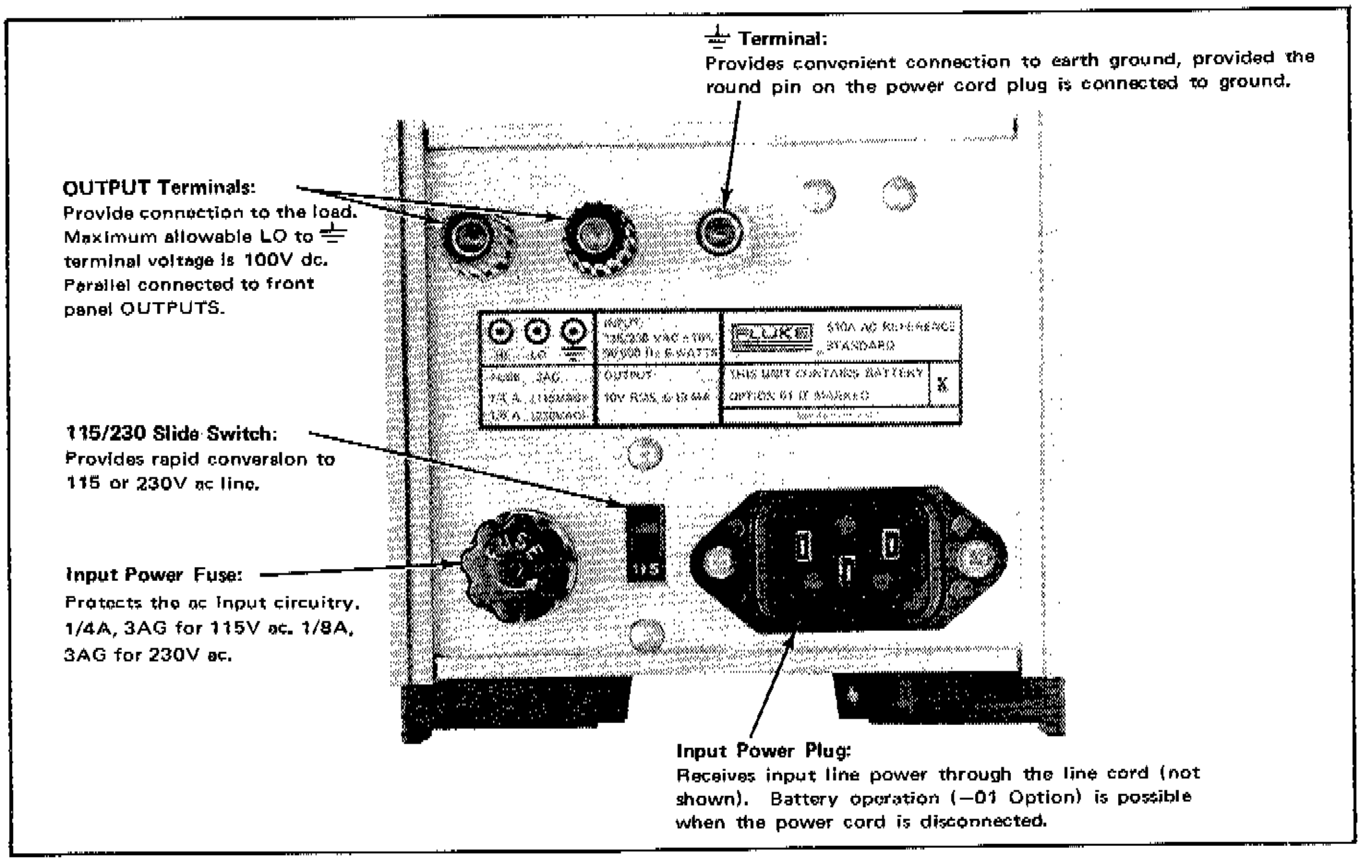


Figure 2-1. OPERATING FEATURES (2 of 2)

cord from line power and turning the instrument on with the POWER switch on the front panel. Relative state of charge (BAT OK) is indicated by a meter on the front panel. The battery is automatically charged whenever the instrument is operated from line power.

NOTE!

The chassis of the instrument and the ⏚ terminal are connected to ground through the power cord. When battery operation is used and the chassis is isolated from ground, this ground connection will be broken.

2-17. Load Connections

2-18. Output load connection is done using HI and LO OUTPUT terminals on the front or rear panel. These OUTPUT terminals are parallel connected and only one set should be connected to a load at one time. A ⏚ terminal is included for convenient connection to ground (see preceding note). Maximum allowable potential between the LO OUTPUT and ⏚ terminal is 100V dc.

2-19. The following rules should be observed for all load connections.

a. AC power to the Model 510A and associated equipment should be derived from the same power line. Line power connections should be as close together as possible.

b. Shielded, twisted pair load cables should be used. Typical load connections are shown in Figure 2-2.

c. Load cables should be kept as short as possible. Maximum lead resistance should be less than 20 mΩ.

2-20. Overload Protection

2-21. The maximum output current is limited by the power capability of the internal circuitry. This circuitry will not be damaged even if the OUTPUT terminals are short circuited. However, when the output current exceeds 10 mA, the output will not be within its specified accuracy. Visual indication of an output current greater than 10 mA is provided by an UNCAL lamp (LED) on the front panel.

2-22. OPERATING PROCEDURES

2-23. The Model 510A produces a fixed frequency output having an amplitude of 10V rms. Frequency accuracy is ±0.1%, adjustable ±1% with a FREQUENCY VERNIER on the front panel. Amplitude accuracy is given in Section 1.

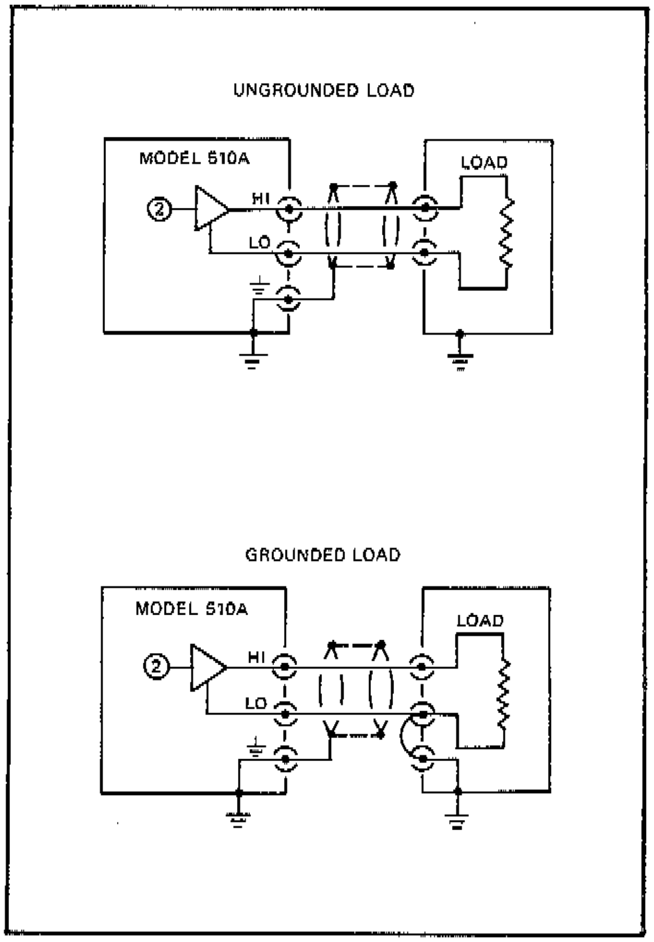


Figure 2-2. LOAD CONNECTIONS

2-24. To operate the instrument, proceed as follows:

a. Connect the power cord to line power. See paragraph 2-6 and 2-13.

b. Make the desired load connections at the front or rear panel OUTPUT terminals.

c. Set the POWER switch to ON and allow the instrument to operate for ten minutes. The meter on the front panel should indicate LINE OPR and the UNCAL indicator should be out.

d. After ten minutes of operation, the output is at its specified accuracy.

NOTE!

Battery operation (–01 Option) is described in paragraph 2-15.

2-25. APPLICATIONS

2-26. Introduction

2-27. The Model 510A can be used in a number of ways as a precise ac reference. The following paragraphs describe a few of its applications.

2-28. Precision AC Source for Automatic Test Systems

2-29. Automated test systems containing Fluke 4200 series voltage sources can use the Model 510A as an external reference to produce precise ac voltages. Figure 2-3 shows such a system. System ac output is from 0 to 45V ac rms at up to 0.7 amperes rms. Overall system accuracy of ±0.02% can be achieved for frequencies up to 5 kHz.

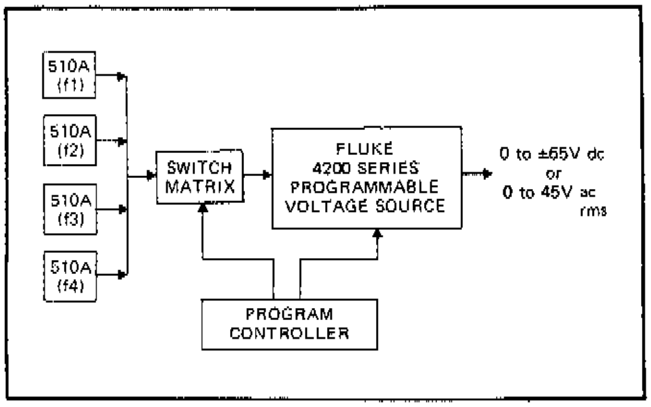


Figure 2-3. AUTOMATED TEST SYSTEM AC REFERENCE

2-30. Phase Locked AC Reference Standard

2-31. A Model 510A can be modified to phase lock with an external signal and provide multiple outputs. Figure 2-4 shows the modified Model 510A/AA which is designed to synchronize with an external 400 Hz signal and provide eight transformer coupled outputs. Programmable phase reversal at each output is also provided. The outputs can be used as external references in the system application described in paragraph 2-28. Typical specifications for the Model 510A/AA are as follows:

FREQUENCY	400 Hz ±5% (other frequencies can be specified)
OUTPUT VOLTAGE	10V rms (eight outputs, transformer coupled)
OUTPUT ACCURACY	±0.1%
OUTPUT PHASE RELATIONSHIP	0° ±1° or 180° ±1° (programmable
TOTAL HARMONIC DISTORTION	0.2%
PHASE LOCK CAPTURE RANGE	±5% about center frequency
SYNC INPUT VOLTAGE	24V rms

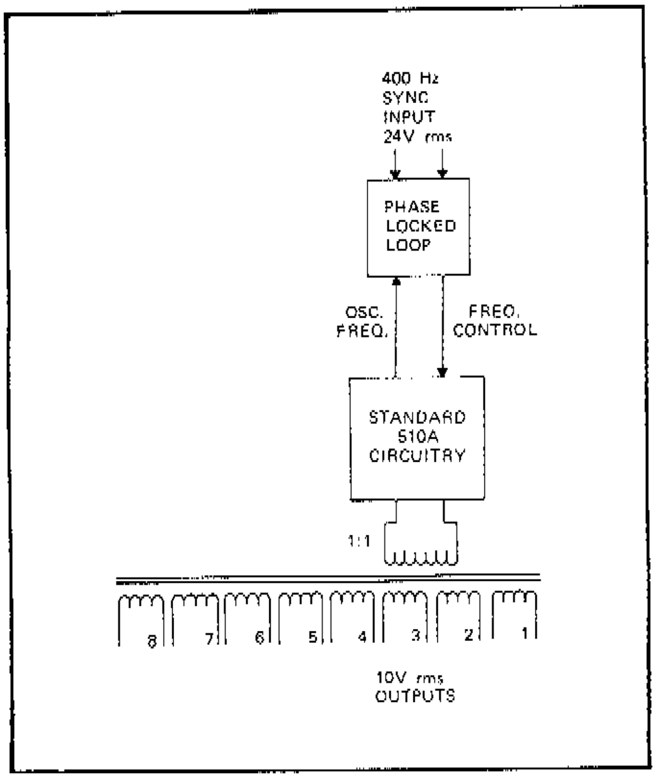


Figure 2-4. MODEL 510A/AA BLOCK DIAGRAM

Section 3

Theory of Operation

3-1. INTRODUCTION

3-2. This section contains the theory of operation for the Model 510A. The information is arranged under headings of "BLOCK DIAGRAM ANALYSIS and CIRCUIT DESCRIPTIONS." It is recommended that this section be thoroughly read and understood before any attempt is made at servicing this instrument.

3-3. BLOCK DIAGRAM ANALYSIS

3-4. The Model 510A produces an extremely stable 10V rms signal at a fixed frequency. Five major circuits are used to produce and control the output. These circuits and their interconnection are shown in Figure 3-1.

3-5. The DC Reference Supply produces an accurate, low temperature coefficient, dc voltage of +14.14214V. This voltage is applied to one end of a divider at the input of the Peak AC to DC Convertor and also functions as a reference for the −18V Regulator. The other end of the divider receives the 10V rms output of the Model 510A, thus producing a 0V condition at its center when the peak of the output signal is equal to minus the Reference Supply voltage. The Peak AC to DC Convertor produces an amplified signal that is equal to the negative difference between the output signal and the +14.14214V reference. This signal charges a capacitor at the output of the Peak AC to DC Convertor which is then transferred to a capacitor at the input of the Integrator by the Sample and Hold. Transfer is done only during the positive peak excursion of

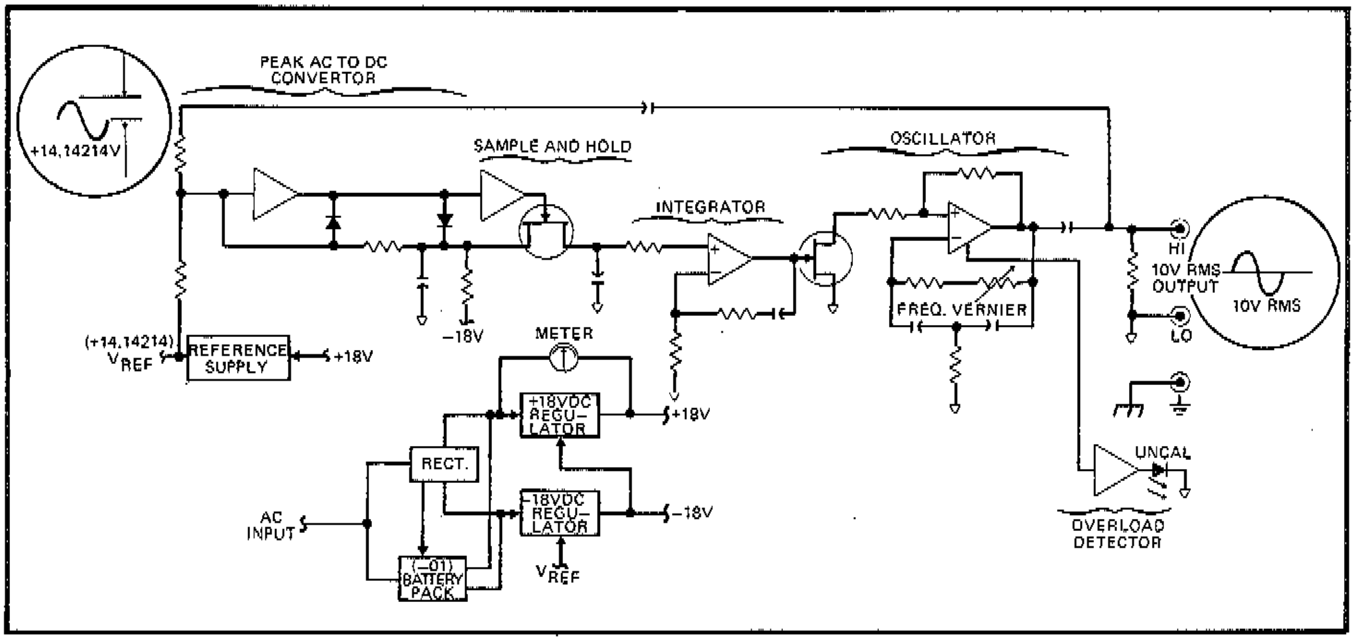


Figure 3-1. MODEL 510A BLOCK DIAGRAM

the signal. The Integrator produces a dc output proportional to the time integral of the voltage stored on its input capacitor. This dc output is applied to the Oscillator where it causes the peak output amplitude to maintain a near 0V condition at the input to the Integrator. The Overload Detector monitors the output of the Model 510A and turns on the UNCAL indicator when the output current exceeds 10 mA.

3-6. All operating voltages are produced by the ±18V DC Regulators. Reference voltage for the +18V DC Regulator is derived from the −18V DC Regulator. The −18V DC Regulator receives a reference voltage from the Reference Supply. Unregulated inputs to each regulator are derived from the Rectifier or the −01 Option Battery Pack. The Battery Pack operates in the absence of line power to the Rectifier. Relative charge state of the batteries is indicated by a meter connected across the +18V DC Regulator. A rectifier located in the −01 Battery Pack circuitry provides recharging of the batteries whenever line power is applied.

3-7. CIRCUIT DESCRIPTIONS

3-8. The following paragraphs describe the circuitry in the Model 510A. Each description is keyed to the schematic diagram located at the rear of the manual.

3-9. Input Power

3-10. AC line power from A4J1 is applied to A4T1 throught the POWER switch A1S1A and the 115/230 slide switch A4S1. The primary of A4T1 consists of two windings which are interconnected through A4S1 for operation from either a 115 or 230V ac line. Parallel connection is used for 115V ac line operation while series connection is used for 230V ac line operation. Both primary windings are completely shielded to reduce capacitive coupling between the power line and the floating circuitry in the instrument. The shield is connected to chassis ground and power line ground through the power cord. The secondary of A4T1 consists of two separate windings both of which are shielded to eliminate the generation of common mode signals that could appear at the OUTPUT terminals. This shield is connected to the center-tap of a secondary winding and power supply common. The center-tapped secondary winding provides ac power to rectifiers CR2 and CR3, CR4. The other secondary winding supplies ac power to the Battery Pack PCB (-01 Option) and the meter, A1M1. Diode CR1 rectifies the ac voltage present during line operation to provide a full-scale LINE OPR indication on A1M1. A2DS1 and DS2 function to stabilize and limit the maximum current used by the Battery Pack PCB during charging of the batteries.

3-11. A3 Battery Pack

3-12. The A3 Battery Pack is installed as the −01 Option. It consists of a Battery Pack PCB and two batteries, BT1 and BT2. This circuitry provides operation from the batteries in absence of line power, disconnects the batteries when they are in a low charge-state to prolong battery life, limits the maximum battery current drain should a circuit malfunction occur, and disconnects the batteries from the instrument circuitry and recharges them during line operation.

3-13. BATTERY OPERATION. When line power is removed and the POWER switch is ON, the batteries BT1 and BT2 are connected to the inputs of the ±18V Regulators through the Battery Pack PCB. The positive output of BT1 is applied through S1B to J5 where a divider consisting of R2, CR3 and R4 supplies the base of Q2 with a positive voltage. This voltage turns on Q2 which supplied base current to Q1 and also turns it on. Conduction of Q1 applies the positive output of BT1 through the series transistor Q3 to the input of the +18V Regulator. The diode connection of Q3 prevents reverse current flow from the +18V Regulator to the battery. The negative output of BT2 is applied through S1C to the series transistors Q5. Since a positive voltage is available at the emitter of Q4 through R8, Q4 is turned on in sequence with the conduction of Q1. This condition turns on Q5 and applies the negative output of BT2 through the series transistor Q6 to the input of the −18V Regulator. The diode connection of Q6 prevents reverse current flow from the −18V Regulator to the battery.

3-14. Should the batteries discharge to a state where they can no longer furnish adequate power, the series transistors Q1 and Q5 are automatically switched off. This is made possible through the use of zener diode CR3. As the output of BT1 decreases, the voltage at the base of Q2 reaches a point where the transistor can no longer furnish enough base current for Q1 to maintain conduction. Q1 is therefore cut-off and disconnects the output of BT1 from the −18V Regulator. Sharp cut-off for Q1 is ensured by R6 which provides some of the base current for Q2. Once the voltage at the collector of Q1 begins to drop, base current to Q2 is further reduced, this sharply cutting-off Q1. Since the conduction of Q4 and Q5 is slaved to the conduction of Q1, as described in the preceding paragraph, the negative output of BT2 is also disconnected from the −18V Regulator.

3-15. The maximum current drain from the batteries is limited by the selection of the value of R5 and R9. These resistors limit the maximum base current to Q1 and Q5. Should a short circuit appear at either output, the maximum current is therefore dependent upon the base current of Q1 or Q5 times their current gain.

3-16. LINE OPERATION. When line power is applied, the batteries are disconnected from the ±18V Regulators and are recharged. Battery disconnection is caused by a −22V battery disconnect voltage produced by CR3, CR4 and C1. This voltage is applied to a divider consisting of R3 and R4 in the Battery Pack PCB. Presence of a negative voltage at the base of Q2 turns it off and causes Q1 to turn off. Since Q4 and Q5 are slaved to Q1, they are also turned off and both batteries are disconnected from the ±18V Regulators. Diodes CR4 and CR5 limit the maximum negative base and emitter voltage at Q2 and Q5 during line operation.

3-17. Charging of the batteries is provided through full-wave rectifier CR1 in the Battery Pack PCB. AC power for this rectifier is derived from the untapped secondary of T1. A2DS1 and DS2 function as a ballast to limit the maximum charging current. Zeners CR2 and CR6 in the Battery Pack PCB limit the maximum battery voltage during charging.

3-18. ±18V Regulator

3-19. The ±18V Regulators produce low ripple operating voltages for the instrument. Input voltage to the regulators is derived from full-wave rectifiers when the instrument is line powered or from batteries if the −01 Option is installed. The −18V Regulator receives its reference from the Reference Supply. Reference voltage for the +18V Regulator is derived from the −18V Regulator; thus, should any malfunction occur in one supply, all will be affected.

3-20. +18V REGULATOR. The +18V Regulator consists of Q1 through Q3. Q1 is the series-pass element. Q2 and Q3 control the base current of Q1 to maintain the +18V dc output. Resistor R3 ensures initial turn-on of Q2 and Q3. The base of Q3 is referenced to the −18V Regulator through R10 and receives a sample of the +18V dc output through R8 and R9. Any change in the +18V dc output is therefore amplified by Q2 and Q3, which then alters the conduction of Q1 to maintain the regulated output. Variable resistor R9 allows adjustment of the +18V dc output.

3-21. −18V REGULATOR. The −18V Regulator consists of Q4 through Q6. Q4 is the series-pass element. Q5 and Q6 control the base current of Q4 to maintain the −18V dc output. R12 ensures initial turn-on of Q5 and Q6. The base of Q6 is referenced to the Reference Supply (V_{REF}) through R18, CR5, and CR6 and receives a sample of the −18V dc output through R17. CR5 and CR6 compensate for the voltage temperature coefficient at the base of Q6 as well as its base emitter voltage drop. Output voltage from this supply is therefore dependent upon V_{REF} and the ratio of R17 to R18.

3-22. Reference Supply

3-23. The Reference Supply produces an extremely stable reference voltage (V_{REF}) upon which the accuracy and stability of the rms output is based. It consists of a high gain, high input impedance, differential amplifier U1 and a reference amplifier U2. The temperature coefficient of the base/emitter voltage for U2 is accurately matched to the temperature coefficient of the zener element through factory selection of R22 and R23. Output voltage of this supply is scaled to +14.14214V dc through selection of R30 and R31. Variable resistor R27 allows adjustment of V_{REF}. The adjustment range of R27 is compensated through jumper selection of R25 and R29. The resulting stable reference at the collector of U2 is applied to the non-inverting input of U1. The other input to U1 receives an equivalent voltage from the divider composed of R20 and R21. Any change in V_{REF} is sensed at the base of U2 which produces an amplified change at the non-inverting input to U1. This change then alters the conduction of U1 such that V_{REF} is maintained at +14.14214V dc.

3-24. Peak AC to DC Convertor

3-25. The Peak AC to DC Convertor is a video amplifier which compares the amplitude of the output signal to V_{REF} and produces a dc voltage equal to four times any negative difference. The circuitry consists of input divider R37 through R42, differential amplifiers U3 and Q8 through Q10, and emitter followers Q11, Q12. A simplified diagram is shown in Figure 3-2.

3-26. The input divider R37 through R42 receives the rms output signal and V_{REF} through S2. The center of this divider is tapped at the junction of R40 and R41 and applied to one input of U3. Unity ratio is made possible at this tap by reversal of the inputs through S2 and adjustment of R37. Except for a small interval of time during the negative most peak of the rms signal, a positive current is flowing into the input of the video amplifier; however, since the input resistance of U3 is extremely high and the current is of proper polarity of forward bias CR9, it is conducted through CR9 and Q11 to −18V. When the peak of the rms signal is more negative than V_{REF}, the input cur-

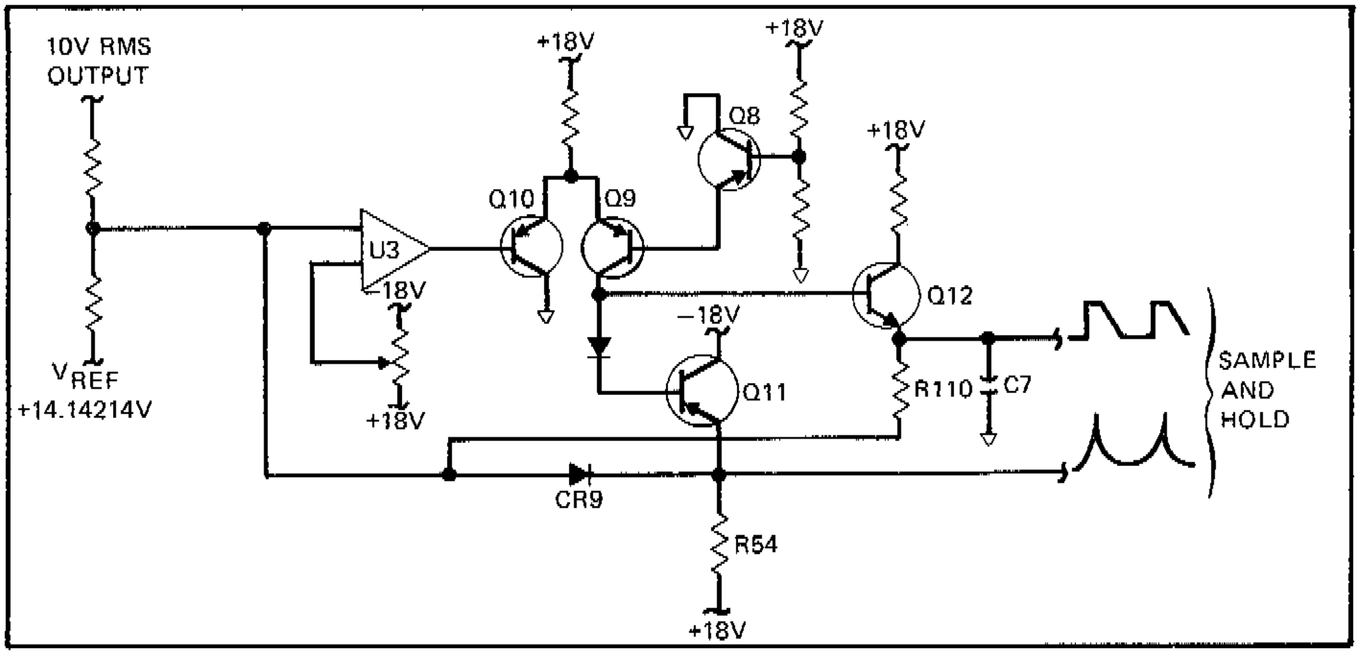


Figure 3-2. PEAK AC TO DC CONVERTOR (SIMPLIFIED)

rent reverses direction and CR9 is cut-off. This signal condition is then amplified by U3 and Q8 through Q10, which produces an emitter current in Q12. The resulting current produces a voltage charge on C7 in the A2A1 PCB that is four times the negative peak difference between the rms output and V_{REF}. Variable resistor R60 allows adjustment of the bias on CR9. R49 allows zero adjustment of the video amplifier input offset voltage.

3-27. Sample and Hold

3-28. The Sample and Hold circuit transfers the charge on C7 in the A2A1 PCB to the input of the Integrator. This circuit is operational only at output frequencies below 20 kHz. It is disabled on output frequencies above 20 kHz because the overall detection is sufficiently fast without sample and hold. The circuitry consists of Schmitt Trigger Q13, Q14, inverter amplifiers Q7 and Q15, Q16, and FET gate Q17.

3-29. Positive excursions of the pulse wave form at the base of Q13 correspond to when CR9 in the Peak AC to DC Convertor is cut-off and a negative peak difference signal is being stored on C7 in the A2A1 PCB. This positive going pulse is shaped by Schmitt Trigger Q13 and Q14. Normally, Q14 is conducting and Q13 is cut-off. Presence of a positive going input to Q13 turns it on and turns off Q14. The resulting positive pulse at the collector of Q14 subsequently has a duration equal to the conduction interval of Q13. This pulse is coupled through C29 and turns on inverter Q15, Q16. The conduction of Q15 and the clamping action of Q16 produces a positive pulse through C8 in the A2A1 PCB and CR13, which is applied to the gate of Q17. This positive pulse occurs at the trailing edge of the Schmitt Trigger pulse and turns on Q17. Conduction of Q17 then transfers the voltage charge on C7 in the A2A1 PCB to C9, which is at the input of the Integrator. The rectifier action of CR13 and C40 produces a zero volt turn on signal at the gate of Q17 in the absence of pulses from the Schmitt Trigger. This is necessary because the Schmitt Trigger of Q13 and Q14 is disabled on output frequencies above 20 kHz by a jumper between P9 and P17. Inverter Q7 provides a positive pulse to Q17 which compensates for the small error caused by the gate to drain capacitance.

3-30. Integrator

3-31. The Integrator consisting of U4 and associated components produces an amplitude control voltage for the Oscillator that is dependent upon the error signal from Peak AC to DC Convertor. U4 is a high gain, non-inverting amplifier. One input is derived from C9 in the A2A1 PCB and the other from divider R72 through R75. Variable resistor R72 allows offset voltage compensation for U4. The network consisting of CR14 through CR16 and R78 functions as a clamping circuit which limits the maximum output voltage from U4. This circuit improves the recovery time of the Integrator upon initial turn-on and fault (UNCAL) conditions.

3-32. Oscillator

3-33. The Oscillator produces the constant amplitude 10V rms, fixed frequency output signal. It is a bridge "T" oscillator formed by input amplifier Q18 through Q24, voltage controlled resistor FET Q26, and output amplifier Q25, Q27, Q28. Output amplitude is precisely maintained at 10V rms by the integrator output voltage applied to Q26. Output frequency is dependent upon the component values in the bridge "T" feedback network.

3-34. Input amplifier Q18 through Q24 is the heart of the Oscillator. The differential pair of Q19 and Q21 receives two inputs derived from feedback networks connected to the Oscillator output. The input to the base of the Q19 is through a bridge "T" network in the A2A1 PCB. Component values of A2A1C1 C2, R1 and R2 determine the center output frequency. The input to the base of Q21 is through the positive feedback network composed of R95 and R96. This feedback signal together with the conduction level of Q26 controls the output amplitude. Adjustment of R95 and R96 allows offsetting the output frequency. Conduction of Q26 is dependent upon the voltage control signal applied to its gate. This signal is derived from the Integrator and is of such a level as to maintain the output signal at precisely 10V rms. Q18 and Q20 combine the collector signals of Q19 and Q20 in the appropriate phase so that the output signal to Q22 base is twice that of what is normally obtained from a differential input stage. This configuration provides minimum ac current flow in Q19 and Q21. The collector signal at Q23 is the first point at which a 10V rms signal is available. Emitter follower Q24 drives the following output stage of Q27 and Q28. AC current in Q23 and Q24 is minimized by bootstrapping R88 and the emitter load of Q24 through C35 to the output. Overall open loop forward gain of the input amplifier is determined by the ratio of C33 (X_C) in ratio with the sum of R82 and R83 times two.

3-35. The output amplifier of Q25 and Q27, Q28 is a complementary output stage. Temperature compensation of the bias current for Q27 and Q28 is provided through Q25 and the divider network of R99 through R101. Variable resistor R100 allows adjustment of this bias current. Output amplifiers Q27 and Q28 produce the output signal of the instrument. Maximum output current is limited by the collector load resistors and the supply voltage. The output signal is specified to 10 mA, above which clipping and distortion may result.

3-36. Overload Indicator

3-37. The Overload Indicator consists of Q29 and the light emitting diode CR23. This circuit illuminates the UNCAL indicator wherever the output current exceeds 10 mA.

3-38. Q29 monitors the voltage drop across R106. When the output current is greater than 10 mA, the voltage drop across R106 will be greater than 0.6 volts. This voltage turns on Q29 whose conduction path is through the UNCAL indicator CR23. Since CR23 acts similar to a zener, the first 1 mA of collector current of Q29 is bypassed around CR23 through R113. Any further increase in current is through CR23, thus assuring rapid turn on of the UNCAL indicator.

Section 4
Maintenance

4-1. INTRODUCTION

4-2. This section contains service and maintenance information for the Model 510A. The information is arranged under headings of "SERVICE INFORMATION, GENERAL MAINTENANCE, MAINTENANCE ACCESS, PERFORMANCE CHECKS, CALIBRATION PROCEDURES, COMPENSATING COMPONENT SELECTION, and TROUBLESHOOTING." Equipment required to service this instrument is listed in Table 4-1. If the recommended equipment is not available, substitute equipment having equivalent specifications can be used.

4-3. SERVICE INFORMATION

4-4. Each instrument that is manufactured by the John Fluke Mfg. Co., Inc. is warranted for a period of one year upon delivery to the original purchaser. The WARRANTY is located at the front of the manual.

4-5. Factory authorized calibration and service for each Fluke product is available at various world-wide locations. A complete list of these authorized service centers is located at the rear of the manual. Shipping information is given in Section 2 paragraph 2-3. If requested, an estimate will be provided to the customer before any repair work is begun on instruments that are beyond the warranty period.

4-6. GENERAL MAINTENANCE

4-7. Cleaning

4-8. The Model 510A should be cleaned periodically to remove accumulation of any dust or other contaminates. The exterior should be cleaned using a cloth moistened with ordinary soap and water. Cleaning of the interior should be done with clean, dry air at low pressure. If the printed circuit boards require cleaning, first spray them with Freon T.F. Degreaser (Miller Stephenson Co., Inc.) and then remove the dirt with clean, dry air at low pressure.

4-9. Fuse Replacement

4-10. Input line power to the instrument is overload protected by a fuse installed on the rear panel. A decal giving the type and rating of the fuse is also located on the rear panel. If replacement is necessary, use only the type fuse specified on the decal for 115 or 230V ac line power.

4-11. Lamp Replacement

4-12. An UNCAL status indicator (LED) is located on the front panel. This indicator is accessible after removing the top dust cover and requires no special tools to replace. If replacement is necessary, use a Fairchild, type FLV 102 (FLUKE PART NO. 309617) or equivalent.

TABLE 4-1. REQUIRED TEST EQUIPMENT

NOMENCLATURE	RECOMMENDED EQUIPMENT	TEST FUNCTION
Autotransformer	Variac	Performance checks Calibration Troubleshooting
Multimeter	FLUKE 853A	Troubleshooting
AC/DC Differential Voltmeter	FLUKE 887AB	Performance checks Calibration Troubleshooting
DC Voltage Standard/Null Detector	FLUKE 335D	Performance checks Calibration
Thermal Transfer Standard	FLUKE 540B, A54-2 (Certified to ±0.04% at 50 kHz – 100 kHz)	Performance checks Calibration
Frequency Counter	HP 5245L	Performance checks Calibration Troubleshooting
Oscilloscope	Tektronix 543, 1A1, X10 Probe	Calibration Troubleshooting
Resistive Loads	700, 900, 1k ±2% (Usable to 100 kHz)	Performance checks

4-13. Two ballast lamps designated DS1 and DS2 that are part of the –01 Option are installed on the A2 Main PCB. These lamps are mounted in clip holders attached to the inner rear panel. Access to the lamps is provided after removal of the top dust cover. Replacement requires no special tools. If replacement is necessary, use only GE757 (FLUKE PART NO. 175265) or equivalent.

4-14. MAINTENANCE ACCESS

4-15. The following procedure is to be used to gain access to the interior sections of the Model 510A.

4-16. Major Section Access

a. Turn off the Model 510A and remove the top dust cover. Access is provided to all adjustments and test points shown in Figure 4-1.

b. Remove the bottom dust cover. Access is now provided to assemblies shown in Figure 4-2.

4-17. Plug-In Assembly Removal and Installation

a. Locate the assembly to be removed using Figure 4-2.

b. Disconnect any wiring and then remove mounting screws.

c. Remove the plug-in assembly using a gentle rocking motion and an even pulling force.

d. Install the plug-in assembly in its correct position using a gentle rocking motion and steady downward pressure. Ensure that each mating connector is correctly aligned during installation.

e. Reconnect any wiring disconnected in step c. Each wire is labeled with a number which corresponds to a connector on the PCB.

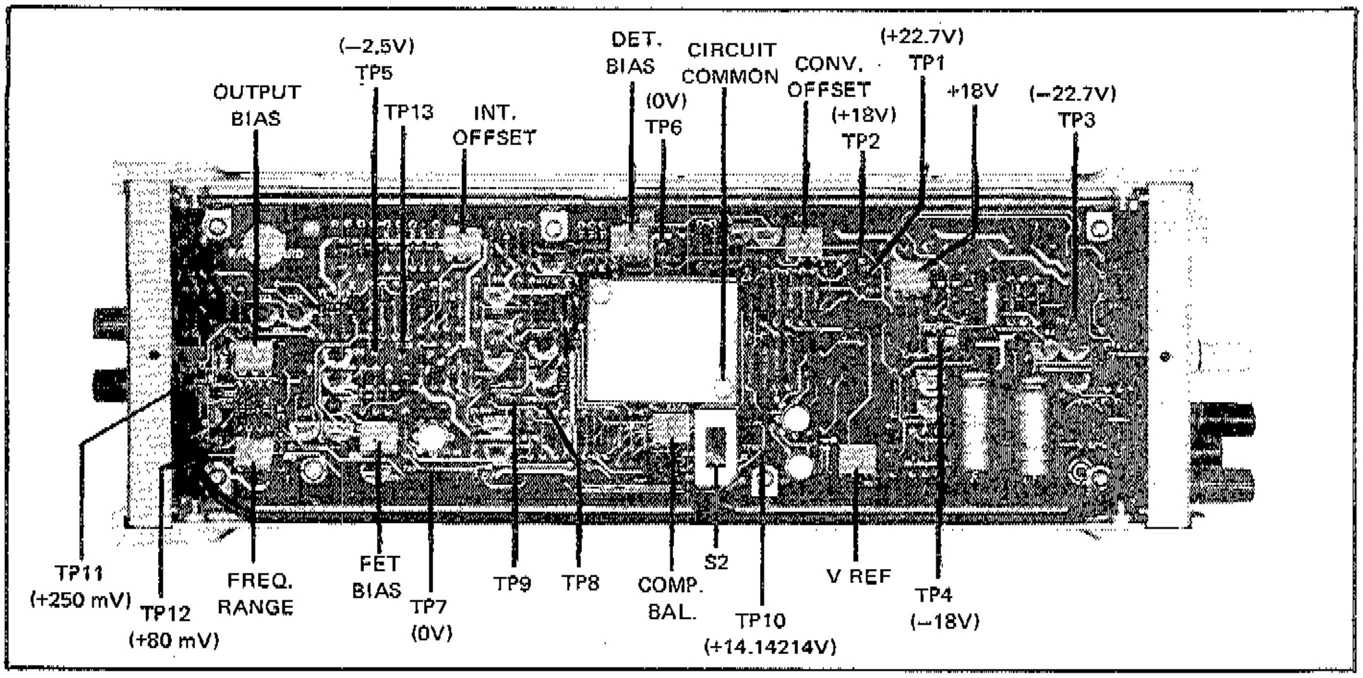


Figure 4-1. ADJUSTMENT AND TEST POINT LOCATIONS

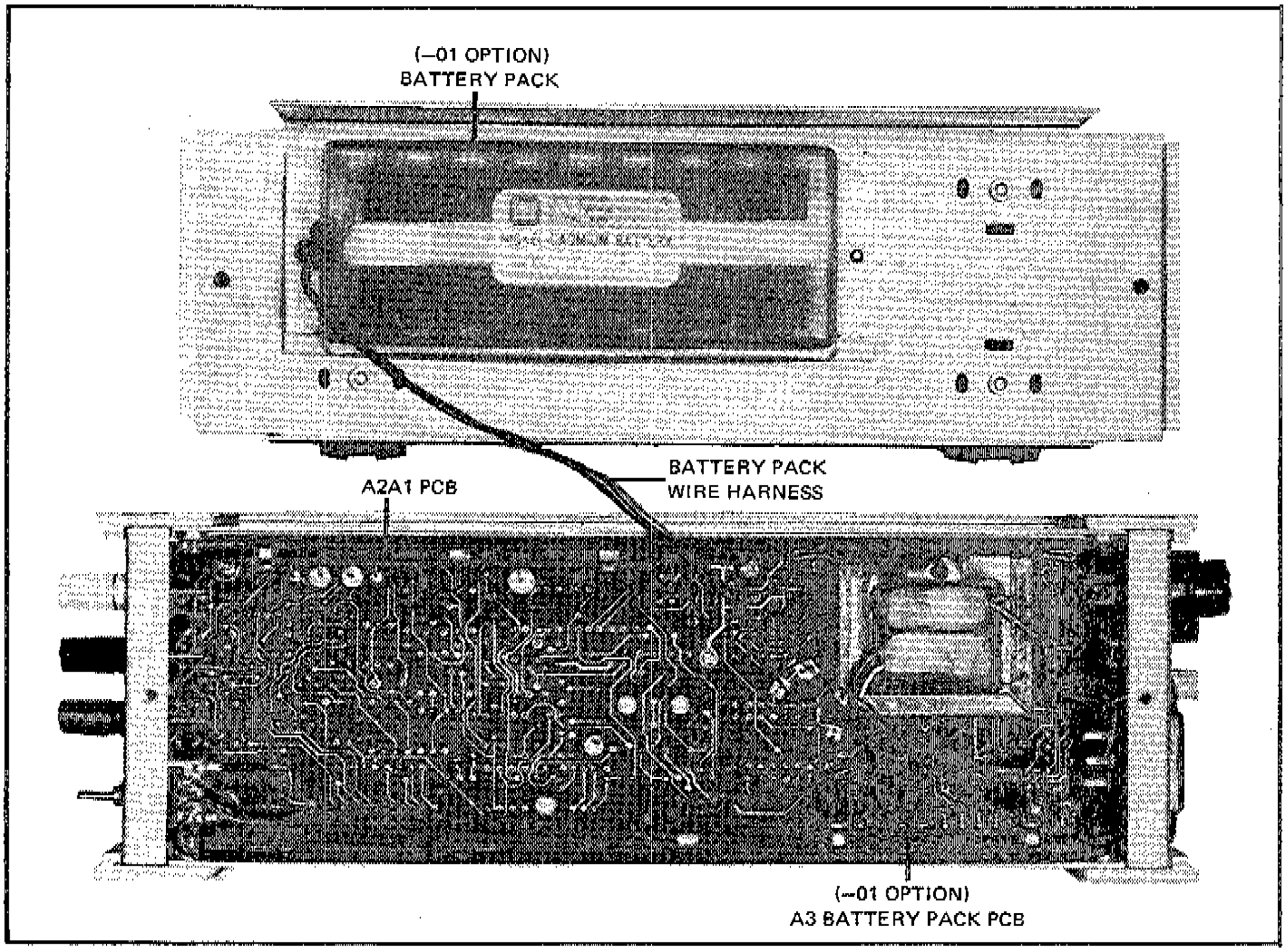


Figure 4-2. ASSEMBLY LOCATIONS (BOTTOM COVER REMOVED)

4-18. Battery Removal and Replacement (–01 Option)

4-19. The batteries for the –01 Option are installed on the inside of the bottom dust cover as shown in Figure 4-2. If replacement is necessary, the entire Battery Pack, FLUKE PART NO. 284356, should be replaced. Proceed as follows:

a. Disconnect the four wires labeled 1 through 4 from A3 Battery Pack PCB. Refer to Figure 4-2 for location.

b. Remove the screws which secure the Battery Pack to the bottom dust cover and then remove the Battery Pack.

c. Install a new Battery Pack, FLUKE PART NO. 284356, on the bottom dust cover using the mounting screws removed in step b.

d. Connect the four Battery Pack wires to the A3 Battery Pack PCB. Each wire is labeled with a number which corresponds to a connector on the PCB.

4-20. PERFORMANCE CHECKS

4-21. The following checks can be used to verify most electrical specifications on the Model 510A. Each check includes an introduction which states the objectives and lists the required test equipment. Refer to Table 4-1 for the recommended equipment.

4-22. Should a trouble be discovered, first determine that the instrument does not require calibration. If calibration does not correct the problem, troubleshoot the instrument and repair as necessary.

4-23. Preliminary Operation

a. Connect the power cord through an autotransformer to line power. Set the autotransformer output to 115V ac.

b. Set the POWER switch on the front panel to ON. The meter should indicate LINE OPR.

c. Allow the instrument to operate for at least 10 minutes.

4-24. Line and Load Regulation Checks

4-25. This check provides a means of verifying the line and load regulation performance. Line voltage changes should not cause output variations greater than 10 ppm under full load. No load to full load changes should not cause output variations greater than those given in Figure 4-3. The following test equipment is required to perform these checks:

1. Autotransformer
2. AC Differential Voltmeter
3. 1k Resistive Load

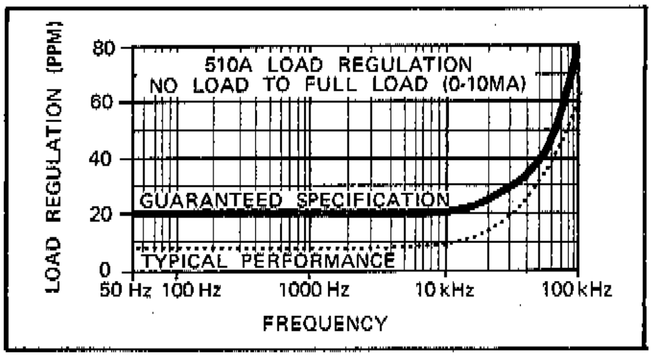


Figure 4-3. LOAD REGULATION

a. Perform the steps given in paragraph 4-23.

b. Connect the 1k load to the front panel OUTPUT terminals.

c. Connect an ac differential voltmeter to the front panel OUTPUT terminals and record its indication.

d. Vary the autotransformer output setting from 102 to 128V ac, observing that the output voltage does not change more than ±100 uV.

e. Return the autotransformer setting to 115V ac and disconnect the 1k load from the OUTPUT terminals.

f. Record the OUTPUT terminal voltage with the ac differential voltmeter.

g. Reconnect the 1k load to the OUTPUT terminals, observing that the output voltage does not change more than the limit specified in Figure 4-3.

h. Disconnect the test equipment from the front panel OUTPUT terminals.

i. Repeat steps b through g at the rear panel OUTPUT terminals.

j. Disconnect the test equipment.

4-26. UNCAL Indicator Check

4-27. This check verifies correct operation of the UNCAL indicator on the front panel. This indicator should illuminate when the output load current exceeds 10 ma. The test equipment required to perform this check is a 700 and 900 ohm resistive load.

a. Connect a 700 ohm load to the OUTPUT terminals, observing that the UNCAL indicator illuminates.

b. Disconnect the 700 ohm load.

c. Connect a 900 ohm load to the OUTPUT terminals, observing that the UNCAL indicator remains out.

d. Disconnect the 900 ohm load.

4-28. Frequency Accuracy and Resolution Checks

4-29. This check provides a means of verifying the output frequency accuracy and resolution capability. The output frequency should be within ±0.1% of its specified value. It should be adjustable ±1% with the FREQUENCY VERNIER control on the front panel. Resolution capability of this adjustment is ±0.05%. The only equipment required to perform this check is a frequency counter.

a. Connect the frequency counter to the front panel OUTPUT terminals. The output frequency should be within ±0.1% of the frequency labeled on the front panel.

NOTE!

Use period mode on the frequency counter to increase measurement resolution.

b. Adjust the FREQUENCY VERNIER control on the front panel to each limit, observing that the output frequency changes ±1%. Resolution with this control should be ±0.05%.

c. Adjust the FREQUENCY VERNIER control for the output frequency labeled on the front panel.

d. Disconnect the frequency counter.

4-30. Output Accuracy Check

4-31. This check provides a means of verifying the amplitude accuracies given in Table 4-2. It consists of two different methods: dc reference and thermal transfer. The test equipment required to perform these checks is listed at the beginning of each method.

TABLE 4-2. OUTPUT AMPLITUDE ACCURACY

DC REFERENCE		
OUTPUT FREQ.	AMPLITUDE ACCURACY 30 days	AMPLITUDE ACCURACY 90 days
50 Hz–5 kHz	±0.01%	±0.02%
5 kHz–10 kHz	±0.02%	±0.03%
10 kHz–30 kHz	±0.05%	±0.07%
30 kHz–100 kHz	±0.15%	±0.17%

THERMAL TRANSFER			
OUTPUT FREQ.	AMPLITUDE ACCURACY 24 Hrs	AMPLITUDE ACCURACY 30 days	AMPLITUDE ACCURACY 90 days
50 Hz–20 kHz	±0.01%	±0.015%	±0.02%
20 kHz–50 kHz	±0.015%	±0.025%	±0.035%
50 kHz–100 kHz	±0.04%	±0.05%	±0.06%

4-32. DC REFERENCE.

TEST EQUIPMENT:

1. DC Voltage Standard/Null Detector

a. Turn off the Model 510A and remove the top dust cover.

b. Make the equipment connections shown in Figure 4-4.

c. Set the dc voltage standard output to +14.14214V dc with a null detector sensitivity of 1V.

d. Turn on the Model 510A and allow it to operate for at least 10 minutes.

e. Increase the null detector sensitivity and record its indication. Maximum offset is ±140 uV.

f. Turn off the Model 510A and disconnect the test equipment. Replace the upper dust cover.

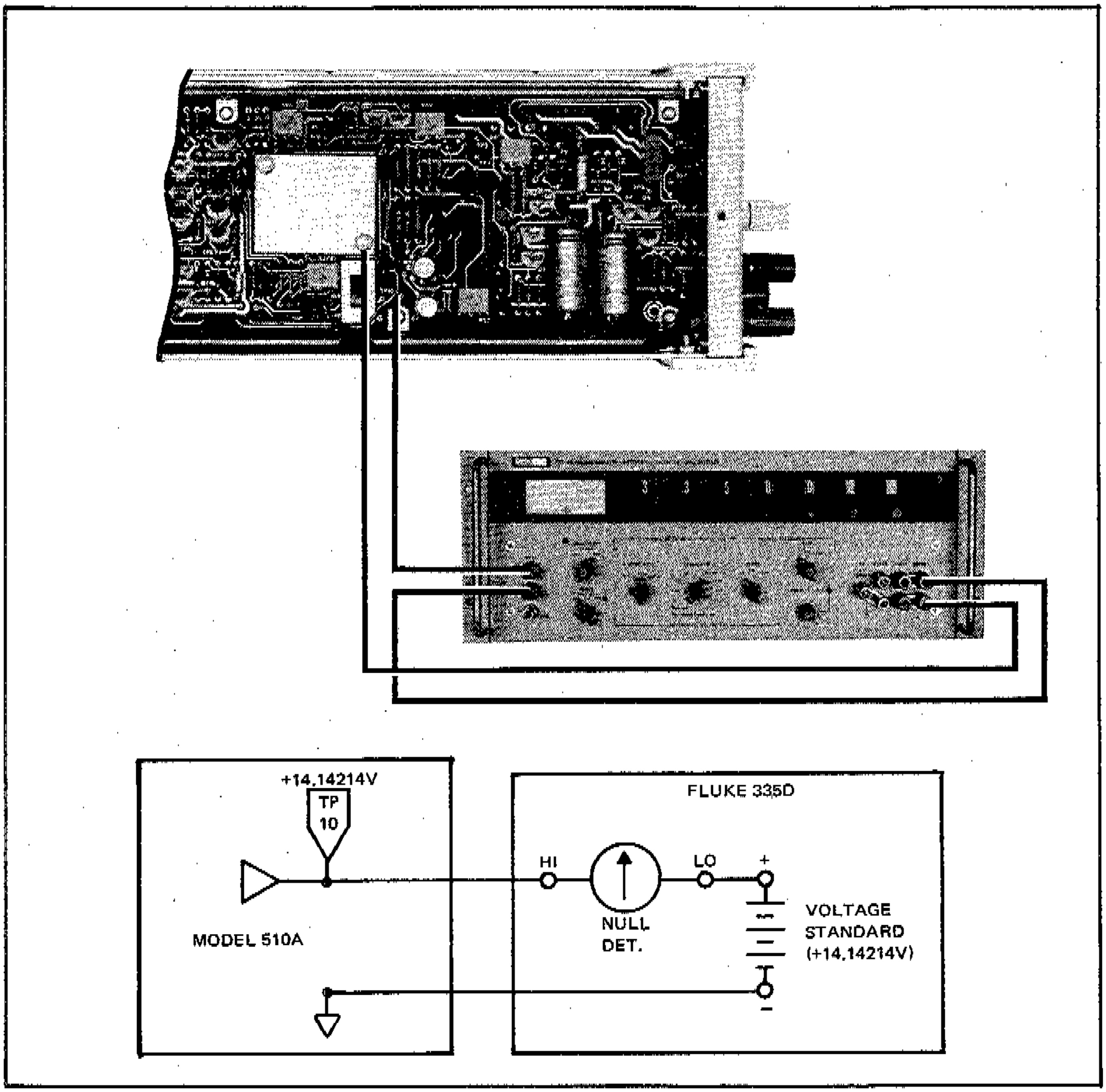


Figure 4-4. DC REFERENCE EQUIPMENT CONNECTIONS

4-33. THERMAL TRANSFER.

TEST EQUIPMENT:

1. DC Voltage Standard
2. Thermal Transfer Standard (Certified to ± 0.04% at 50 KHz - 100 KHz)

a. Make the equipment connections shown in Figure 4-5.

b. Set the dc voltage standard output to 10V dc.

c. Perform dc to ac transfer, observing that the thermal transfer, amplitude accuracy given in Table 4-2 is achieved.

d. Disconnect the test equipment.

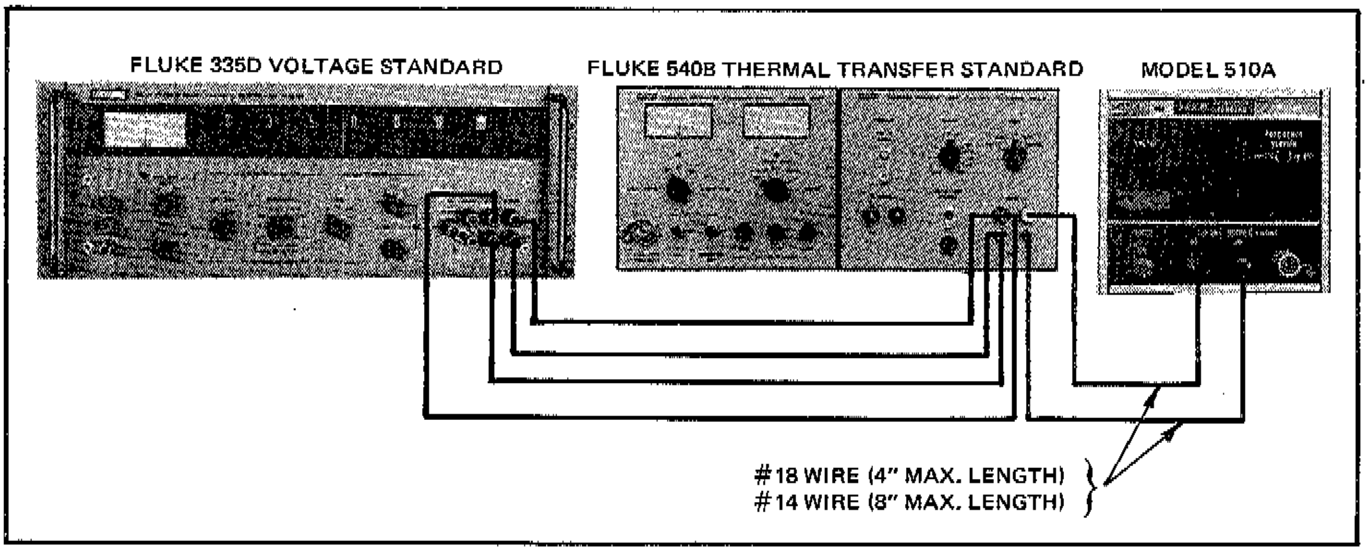


Figure 4-5. THERMAL TRANSFER EQUIPMENT CONNECTIONS

4-34. CALIBRATION PROCEDURES

4-35. Introduction

4-36. The Model 510A should be checked for calibration every 24 hours or 60 or 90 days, as desired, or whenever repairs have been made which affect the electrical characteristics. Calibration should be performed after a 10 minute operating period and at an ambient temperature of 23°C ±5°.

4-37. All calibration test points and adjustments are shown in Figure 4-1. These calibration points are accessible after removal of the top dust cover. Required test equipment is listed in Table 4-1.

4-38. Regulator Alignment

a. Remove the top dust cover. Adjustment and test point locations are shown in Figure 4-1.

b. Connect the power cord through an autotransformer to line power. Set the autotransformer output to 115V ac.

c. Turn on the Model 510A and allow it to operate for 10 minutes.

d. Connect the input of a dc voltmeter to TP2 (+) and circuit common.

e. Adjust +18V (R9) for +18 ±0.2V dc at TP2.

f. Connect the dc voltmeter input to TP4, observing that the voltage is −18 ±0.5V dc.

g. Disconnect the dc voltmeter input from TP4.

4-39. Reference Supply Alignment

a. Make the equipment connections shown in Figure 4-6.

b. Set the voltage standard output to +14.14214V dc with a null detector sensitivity of 1V.

c. Increase the null detector sensitivity and adjust V REF (R27) for a 0 ±70 uV indication on the null detector.

NOTE!

If this adjustment cannot be made, refer to paragraph 4-47 for range compensation of R27.

d. Disconnect the test equipment.

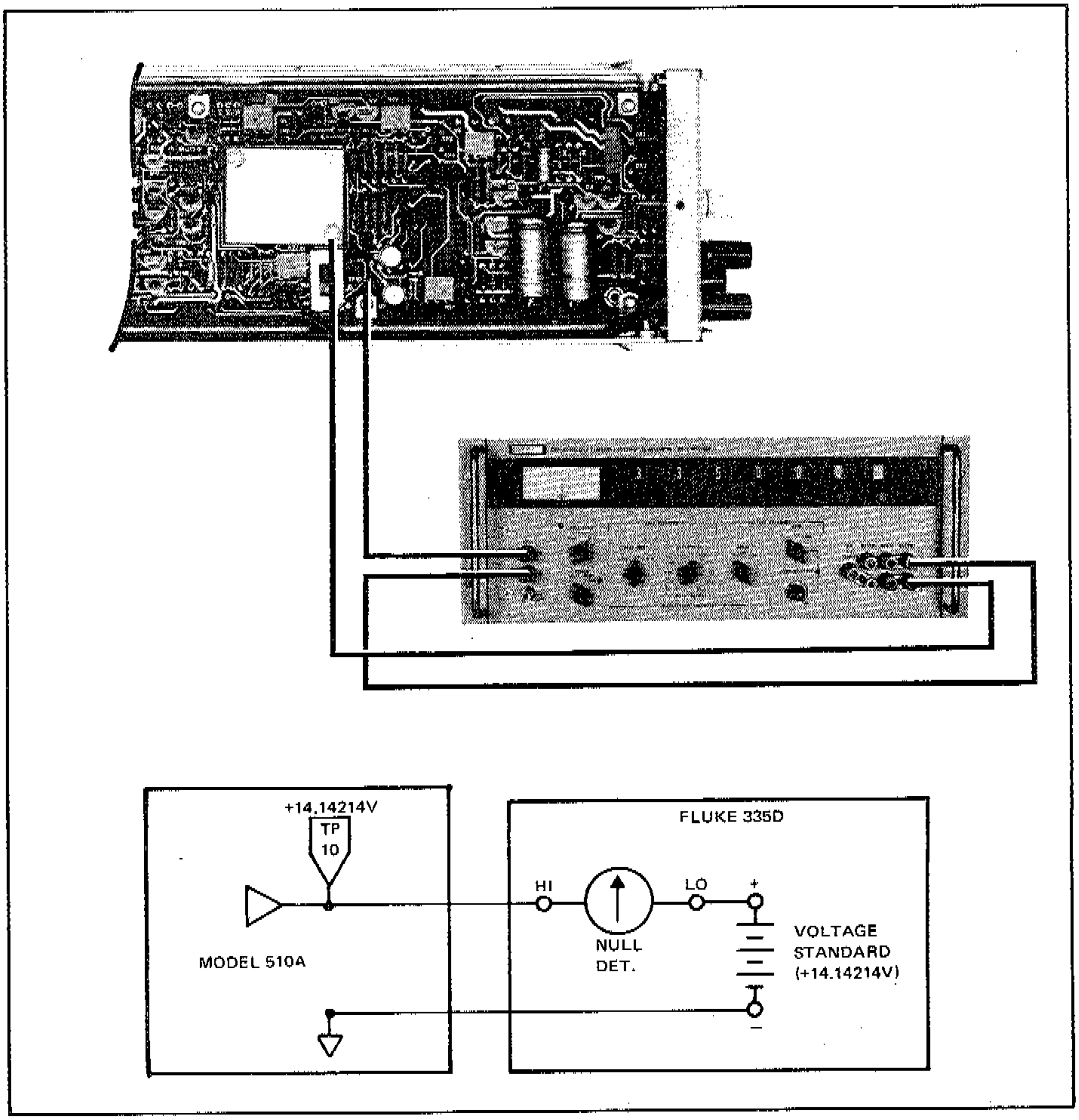


Figure 4-6. DC REFERENCE EQUIPMENT CONNECTIONS

4-40. FET Bias

a. Connect the input of the dc voltmeter to TP5 (+) and circuit common.

b. Adjust FET BIAS (R90) for −2.5 ±0.2V dc at TP5.

c. Disconnect the dc voltmeter input from TP5.

4-41. Zero Set

a. Connect the dc voltmeter input to TP6.

b. Adjust CONV. OFFSET (R49) for 0 ±100 uV at TP6.

c. Connect the dc voltmeter input to TP7.

d. Adjust INT. OFFSET (R72) for 0 ±100 uV at TP7.

e. Disconnect the dc voltmeter from the instrument.

4-42. Output Bias

a. Connect a shorting jumper between TP13 and circuit common.

b. Connect the input for a dc voltmeter to TP11 (+) and TP4 (−).

c. Adjust OUTPUT BIAS (R100 for +250 mV dc between TP11 and TP4.

d. Disconnect the dc voltmeter and shorting jumper from the instrument.

4-43. Detector Bias

a. Set the controls of a dc coupled oscilloscope to provide a .01V vertical sensitivity with an established 0V reference (Model 510A circuit common) on the display.

b. Connect the input through X10 probe to TP8. Connect the probe ground clip to circuit common.

c. Adjust the oscilloscope sweep speed to view at least two complete cycles of the peaked waveform at TP8.

d. Adjust DET BIAS (R60) until the peak of the waveform is at 100 ±10 mV in respect to circuit common.

e. Disconnect the oscilloscope.

4-44. Comparator Balance

a. Connect the input of an ac differential voltmeter to the front panel OUTPUT terminals.

b. Record the ac output voltage.

c. Switch S2 to the opposite position (white dot not showing) and record the ac voltmeter indication.

d. Adjust COMP BAL (R37) for a maximum shift of 0 ±50 uV in output voltage of each setting of S2.

e. Set S2 to "white dot position" and disconnect the ac differential voltmeter.

4-45. Frequency Adjust

a. Connect the input of a frequency counter to the front panel OUTPUT terminals. Use period mode for maximum resolution.

b. Set the FREQUENCY VERNIER control (R96) on the front panel to the center of its adjustment range.

c. Adjust FREQ. RANGE (R95) for the output frequency labeled on the front panel. If necessary, refine the FREQUENCY VERNIER setting slightly to obtain the appropriate frequency.

d. Disconnect the frequency counter.

4-46. The Model 510A is now calibrated to meet amplitude accuracy specifications related to a dc reference accurate to ±15 ppm. If an amplitude accuracy related to a thermal transfer is required, perform the following procedure:

a. Make the equipment connections shown in Figure 4-7.

b. Set the dc voltage standard output to the 10V dc.

c. Perform dc to ac transfer, observing the ac amplitude error.

d. Adjust COMP. BAL. (R37) for a 10V rms output from the Model 510A.

NOTE!

Transfer accuracy of the thermal transfer standard must be certified to at least ±0.04% from 50 KHz to 100 KHz.

e. Disconnect the test equipment and replace the top dust cover. The Model 510A is now fully calibrated.

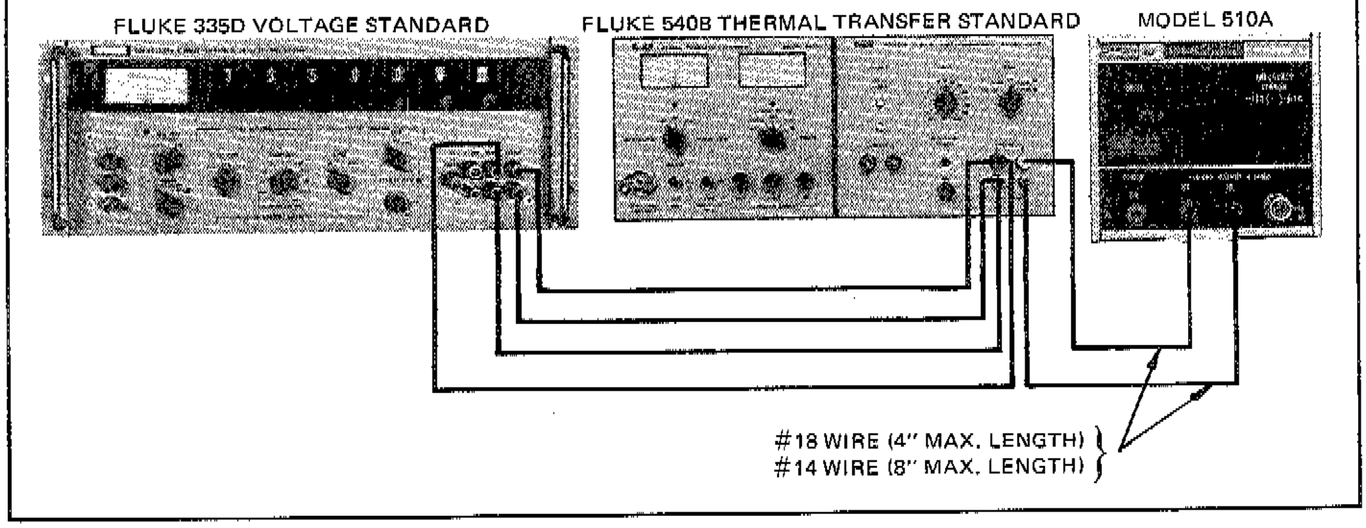


Figure 4-7. THERMAL TRANSFER EQUIPMENT CONNECTIONS

4-47. COMPENSATING COMPONENT SELECTION

4-48. Replacement of U2 and associated matched components in the Reference Supply will require selection of jumpers A and B. These jumpers compensate the adjustment range of V REF (R27). Selection of jumpers is done as follows:

a. Turn off the Model 510A and set V REF (R27) fully counterclockwise.

b. Locate jumpers A and B using Figure 4-8 and reconnect any cut jumpers.

c. Turn on the Model 510A and make the equipment connections shown in Figure 4-6.

d. Set the voltage standard output to +14.14214V dc with a null sensitivity of 1V.

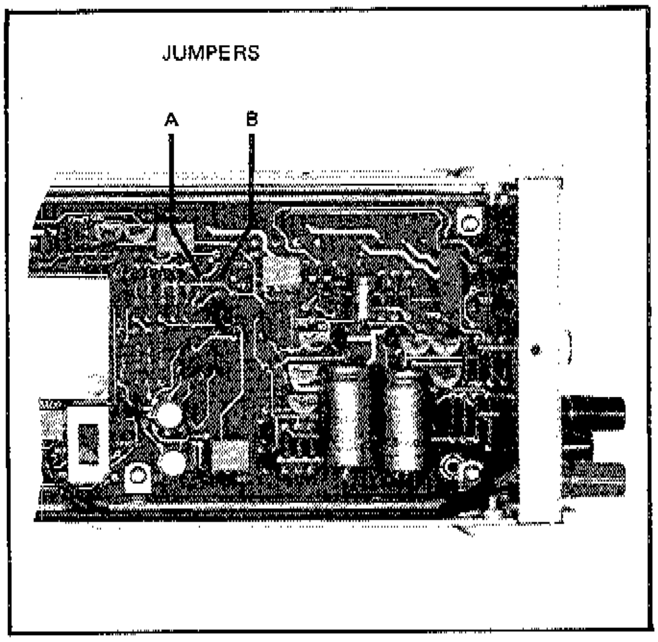


Figure 4-8. V_{REF} JUMPER LOCATIONS

e. Increase the null detector sensitivity and record the offset voltage.

f. Cut jumpers A and B per Table 4-3.

g. Adjust V REF (R27) for a 0 ±70 uV indication on the null detector.

TABLE 4-3. A & B JUMPER SELECTION

OFFSET VOLTAGE (TP 10)	CLIP JUMPER
0 to 0.00571	None
0.00572 to 0.01141	A
0.00142 to 0.01712	B
0.01713 to 0.02182	A and B

NOTE!

The Model 510A should be recalibrated using the procedures given in paragraph 4-34 through 4-46.

4-49. TROUBLESHOOTING

4-50. The following information is provided to assist in locating troubles in the Model 510A. It is recommended that the theory of operation in Section 3 be completely understood before attempting any troubleshooting.

4-51. Initial Troubleshooting

4-52. Troubleshooting begins by first performing a thorough inspection for improperly seated plug-in assemblies, loose wires, physically damaged parts, or other obvious problems. The next step is to insure that the instrument is being operated correctly, but fails to meet specifications. Performance checks especially designed for this purpose are given in paragraphs 4-20 through 4-33.

4-53. Once it is determined that a malfunction exists, all operating voltages should be checked as shown in Figure 4-9. During these checks, the instrument must be operated from nominal line power. If the Rechargeable Battery Pack (–01 Option) is installed, the optional circuitry can be checked using the information in paragraph 4-54.

TEST POINT	VOLTAGE (VDC)	CIRCUITRY CHECKED
(1) TP1	+23V	AC INPUT (T1, CR2)
(2) TP3	–23V	AC INPUT (T1, CR2)
(3) TP4	–18 ±0.5V	–18V REGULATOR
(4) TP2	+18 ±0.2V	+18V REGULATOR
(5) TP10	+14.14214V	REFERENCE SUPPLY

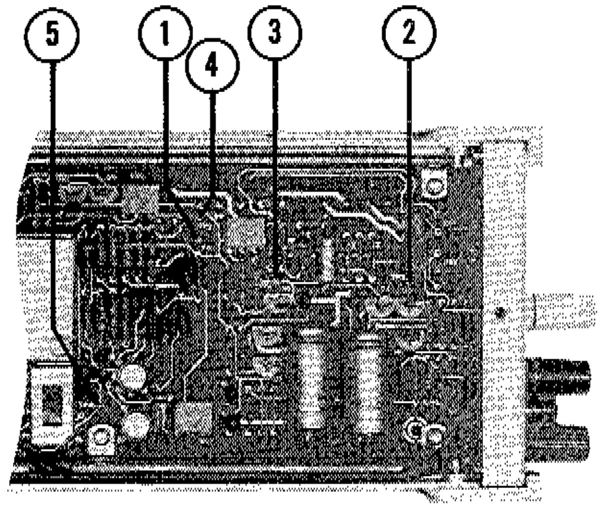


Figure 4-9. OPERATING VOLTAGE CHECK POINTS

4-54. Rechargeable Battery Pack (–01 Option)

4-55. Operating voltages for the optional battery pack circuitry can be checked using the following procedure:

a. Connect the power cord through an autotransformer to line power. Set the autotransformer output to 0V.

b. Make the voltage checks on the A3 Battery Pack PCB as shown in Figure 4-10.

TEST POINT	NORMAL INDICATION (VDC)
(1) TP4	+19.2 to +23V
(2) TP5	−19.2 to −23V
(3) TP1	+0.1V
(4) TP3	+19.1 to +22.9V
(5) TP2	+0.6V

NOTE: USE OUTPUT LO ON REAR PANEL AS CIRCUIT COMMON.

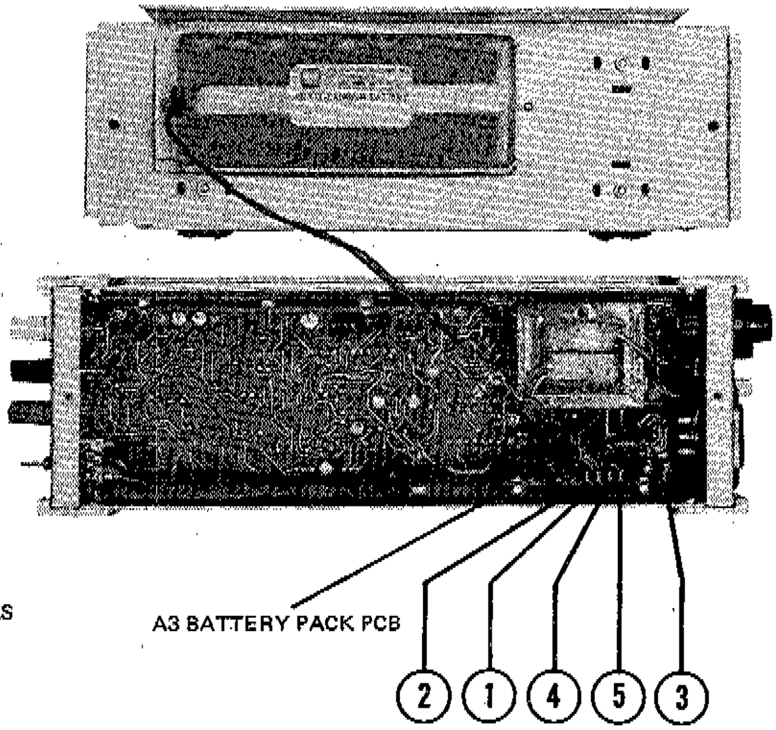


Figure 4-10. A3 BATTERY PACK PCB CHECKS

c. Connect the dc voltmeter to A3TP1 and slowly increase the autotransformer output. The voltage at TP1 should increase from +0.1V dc to approximately +25V dc at a line voltage between 30 and 90V ac.

d. Set the autotransformer output to 115V ac.

e. Connect the dc voltmeter input to A3TP2 and slowly decrease the autotransformer output. The voltage at TP2 should increase from −25V dc to +0.6V dc at a line voltage between 90 and 30V ac.

f. Turn off the Model 510A and disconnect the power cord.

g. Disconnect wire #1 from P1 on the A3 Battery Pack PCB.

h. Connect the output of a dc power supply set to +24V dc to P1 on the A3 Battery Pack PCB. Connect the power supply common to the OUTPUT LOW terminal on the rear panel.

i. Turn on the Model 510A and slowly decrease the power supply output until the meter on the front panel swings abruptly to the left.

j. Record the power supply output voltage. The Model 510A should turn-off at a power supply output between 18.5 and 19.5V dc.

k. Increase the power supply output until the meter on the front panel abruptly swings to the right. The Model 510A should turn on at a power supply output that is 1.2V above the value recorded in step j.

l. Turn off the Model 510A and disconnect the power supply. Reconnect wire #1 to P1 on the A3 Battery Pack PCB.

4-56. Circuit Isolation Checks

4-57. The voltage checks given in Figure 4-11 can be used to isolate a trouble to a major circuit. General troubleshooting of the major circuit should then reveal the exact source of trouble. Circuit voltages are given on the schematic diagram.

CHECK POINT	NORMAL INDICATION	FAULT ANALYSIS
(1) TP12	10V RMS	IF ABNORMAL CHECK (2), TP5.
(2) TP5	−2.5 ±0.2V dc	A. IF TP12 IS HIGH OR LOW AND TP5 IS ±0.6V, TROUBLE IS IN THE OSCILLATOR. B. CHECK (3), TP7, IF TP5 IS AT SOME OTHER VOLTAGE.
(3) TP7	0 ±100 uV	A. IF TP5 IS NOT +0.6V AND TP7 IS +10 mV OR MORE, TROUBLE IS IN THE INTEGRATOR. B. IF TP5 IS MORE POSITIVE THAN −5V AND TP7 IS −10 mV OR MORE, TROUBLE IS IN THE INTEGRATOR. C. IF TP5 IS NOT +0.6V AND TP7 IS 0V OR NEGATIVE, TROUBLE IS IN THE PEAK AC TO DC CONVERTER. D. IF TP5 IS MORE POSITIVE THAN −5V AND TP7 IS 0V OR POSITIVE, TROUBLE IS IN THE PEAK AC TO DC CONVERTER.

NOTE!

SAMPLE AND HOLD IS CONSIDERED PART OF PEAK AC TO DC CONVERTER.

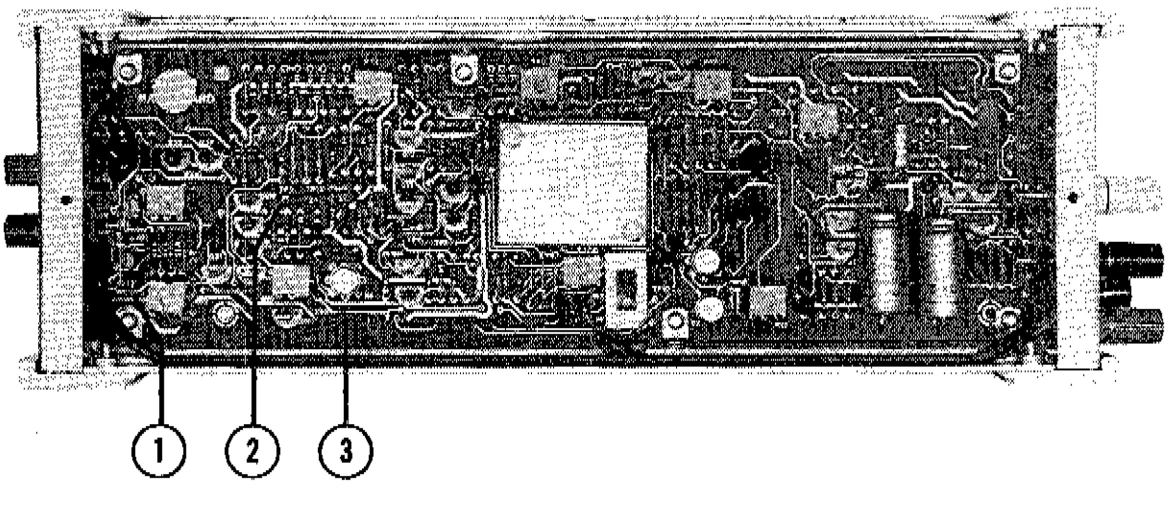


Figure 4-11. CIRCUIT ISOLATION CHECKS

Section 5
List of Replaceable Parts

5-1. INTRODUCTION

5-2. This section contains an illustrated parts breakdown list of the instrument and a Cross Reference List of FLUKE stock numbers to original MANUFACTURERS' part numbers. It also lists recommended spare parts and contains part ordering information. The starting page number of each major listing is given in the Table of Contents.

5-3. The parts list shows the location of all assemblies and the replaceable components. Major assemblies are identified by a designation beginning with the letter A followed by a number (e.g., A1 etc). Subassemblies are identified in the same manner; however, the parent assembly designator precedes this designator (e.g., A1A1 etc.). Electrical components are identified by their schematic diagram designator and listed hardware parts are identified by the FLUKE stock number. All listed components are described, and the FLUKE stock number is given. The original MANUFACTURER'S part number for each listed item is given in the Cross Reference List at the rear of this section.

5-4. PARTS LIST COLUMN DESCRIPTIONS

a. The REF DESIG column indexes the item description to the associated illustration. In general the reference designations are listed under each assembly in alpha-numeric order. Subassemblies of minor proportions are sometimes listed with the assembly of which they are a part. In this case, the reference designations may appear out of order.

b. The DESCRIPTION column describes the salient characteristics of the component. Indention of the description indicates the relationship to other assemblies, components, etc. In many cases it is necessary to abbreviate in this column. For abbreviations and symbols used, refer to Appendix B located at the rear of the manual.

c. The six-digit part number, by which the item is identified at the John Fluke Mfg. Co., Inc. is listed in the STOCK NO. column. Use this number when ordering parts from the factory or authorized representatives. In the case where a flag note is used, special ordering is required. Flag note explanations are located as close as possible to the flag note.

d. The TOT QTY column lists the total quantity of the item used in each particular assembly. This quantity reflects only the latest Use Code. Second and subsequent listings of the same item are referenced to the first listing with the abbreviation REF.

e. Entries in the REC QTY column indicate the recommended number of spare parts necessary to support one to five instruments for a period of two years. This list presumes an availability of common electronic parts at the maintenance site. For maintenance for one year or more at an isolated site, it is recommended that at least one of each assembly in the instrument be stocked. In the case of optional subassemblies, plug-ins, etc. that are not always part of the instrument, or are deviations from the basic instrument model, the REC QTY column lists the recommended quantity of the item in that particular assembly.

f. The USE CODE column identifies certain parts which have been added, deleted or modified during the production of the instrument. Each part for which a Use Code has been assigned may be identified with a particular instrument serial number by consulting the Serial Effectivity List, paragraph 5-9. Sometimes when a part is changed, the new part can and should be used as a replacement for the original part.

5-5. MANUFACTURERS' CROSS REFERENCE LIST COLUMN DESCRIPTIONS

a. The six-digit part number, by which the item is identified at the John Fluke Mfg. Co., Inc. is listed in the FLUKE STOCK NO. column. Use this number when ordering parts from the factory or authorized representatives.

b. The Federal Supply Code for the item manufacturer is listed in the MFG column. An abbreviated list of Federal Supply Codes is included in Appendix A.

c. The part number which uniquely identifies the item to the original manufacturer is listed in the MFG PART NO. column. If a component must be ordered by description, the type number is listed.

5-6. HOW TO OBTAIN PARTS

5-7. Standard components have been used whenever possible. Standard components may be ordered directly from the manufacturer by using the manufacturer's part number, or parts may be ordered from the John Fluke Mfg. Co., Inc. factory or authorized representative by using the FLUKE stock number. In the event the part you order has been replaced by a new or improved part, the replacement will be accompanied by an explanatory note and installation instructions, if necessary.

5-8. You can insure prompt and efficient handling of your order to the John Fluke Mfg. Co., Inc. if you include the following information:

a. Quantity.

b. FLUKE Stock Number.

c. Description.

d. Reference Designation.

e. Instrument model and serial number.

Example: 2 each, 215897, Transistor, 2N4126 A2A1Q1 & Q2 for 645A, S/N 123.

If you must order structural parts not listed in the parts list, describe the part as completely as possible. A sketch of the part, showing its location to other parts of the instrument is helpful.

5-9. SERIAL NUMBER EFFECTIVITY

5-10. A Use Code column is provided to identify certain parts that have been added, deleted or modified during production of the Model 510A. Each part for which a use code has been assigned may be identified with a particular instrument serial number by consulting the Use Code Effectivity List below. All parts with no code are used on all instruments with serial numbers above 123.

USE CODE	SERIAL NUMBER EFFECTIVITY

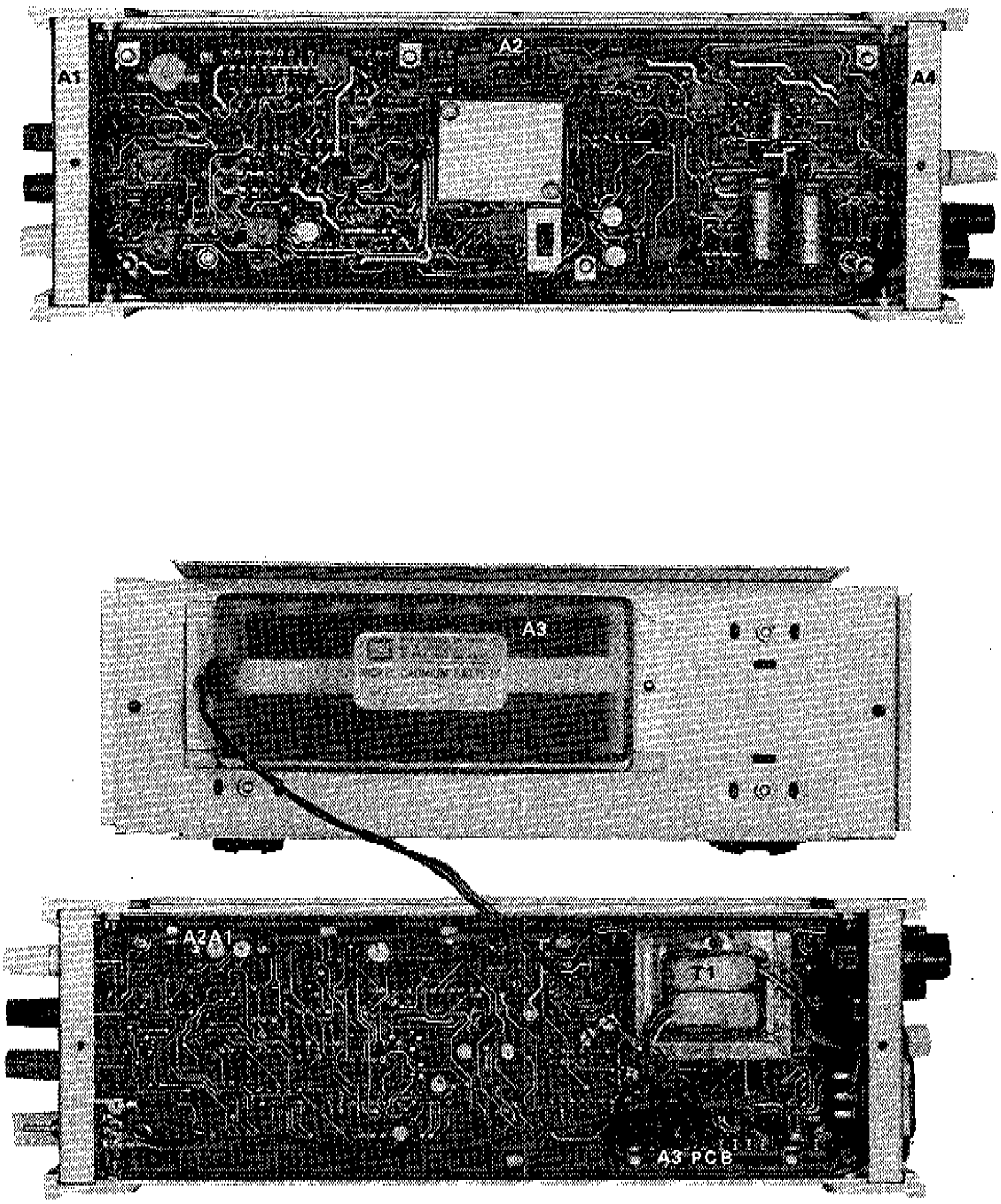


Figure 5-1. AC REFERENCE STANDARD

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
	AC REFERENCE STANDARD	510A			
	Figure 5-1				
A1	Front Panel Assembly (Figure 5-2)	307884	1		
A2	Main PCB Assembly (Figure 5-3)	307868	1		
A2A1	PCB Assembly, 50 Hz, 60 Hz, 400 Hz, 1000 Hz, 2400 Hz, 5000 Hz, 19.2 KHz, 100 KHz (Figure 5-4)		1		
A3	Rechargeable Battery Kit (–01 Option) Figure 5-5				
A4	Rear Panel Assembly (Figure 5-6)	307892	1		
T1	Xfmr, Power	304097	1		
	[1] Field installation Kit P/N is 510A–01k				

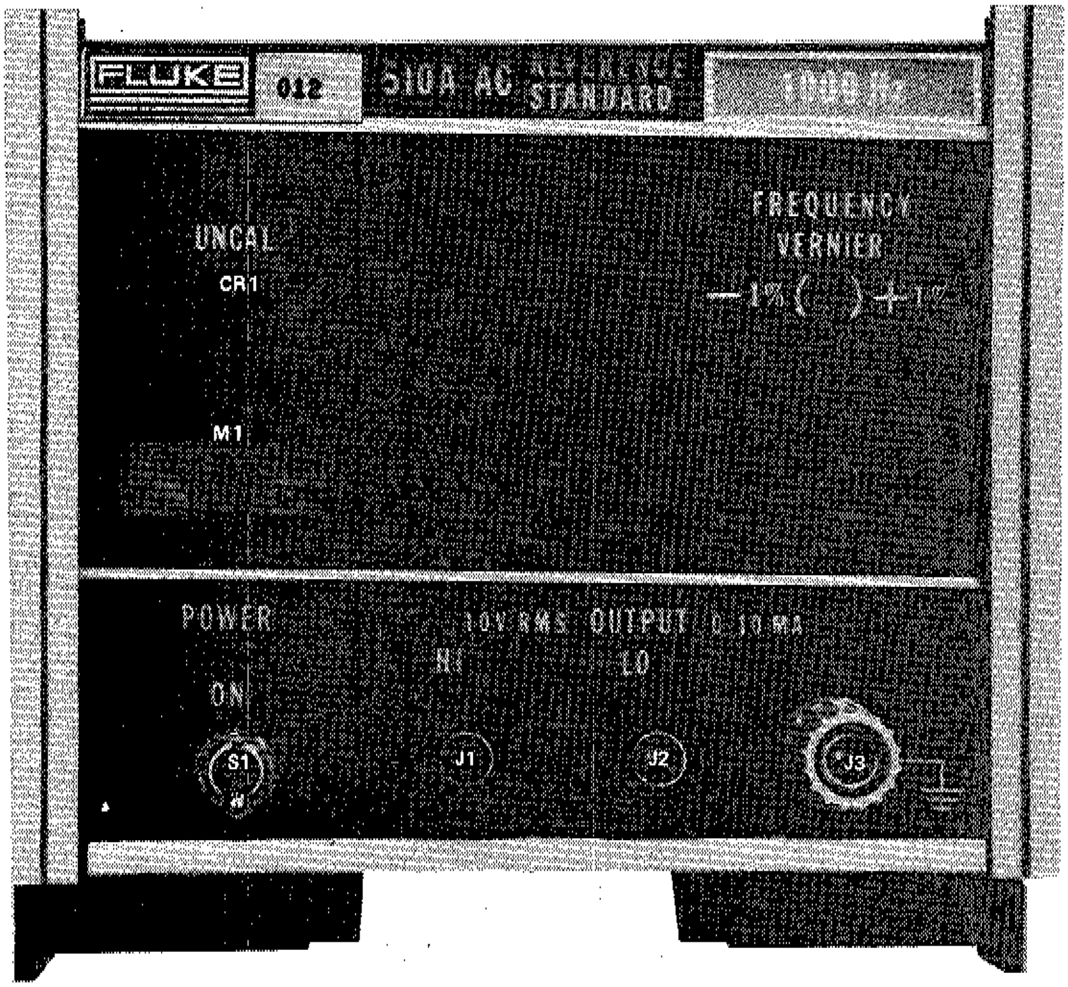


Figure 5-2. FRONT PANEL ASSEMBLY

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
A1	**FRONT PANEL ASSEMBLY** **Figure 5-2**	307686	REF		
CR1	Diode, light emitting, 50 mA	309617	1	1	
J1	Binding post, red, HI	275552	1		
J2	Binding post, black, LO	275560	1		
J3	Binding post, white	275586	1		
M1	Meter, 0-1 mA, ±10%	266494	1		
S1	Switch, toggle, mini, 3 PDT	284299	1	1	
	Decal, front panel	309351	1		
	Meter, retainer	307322	1		

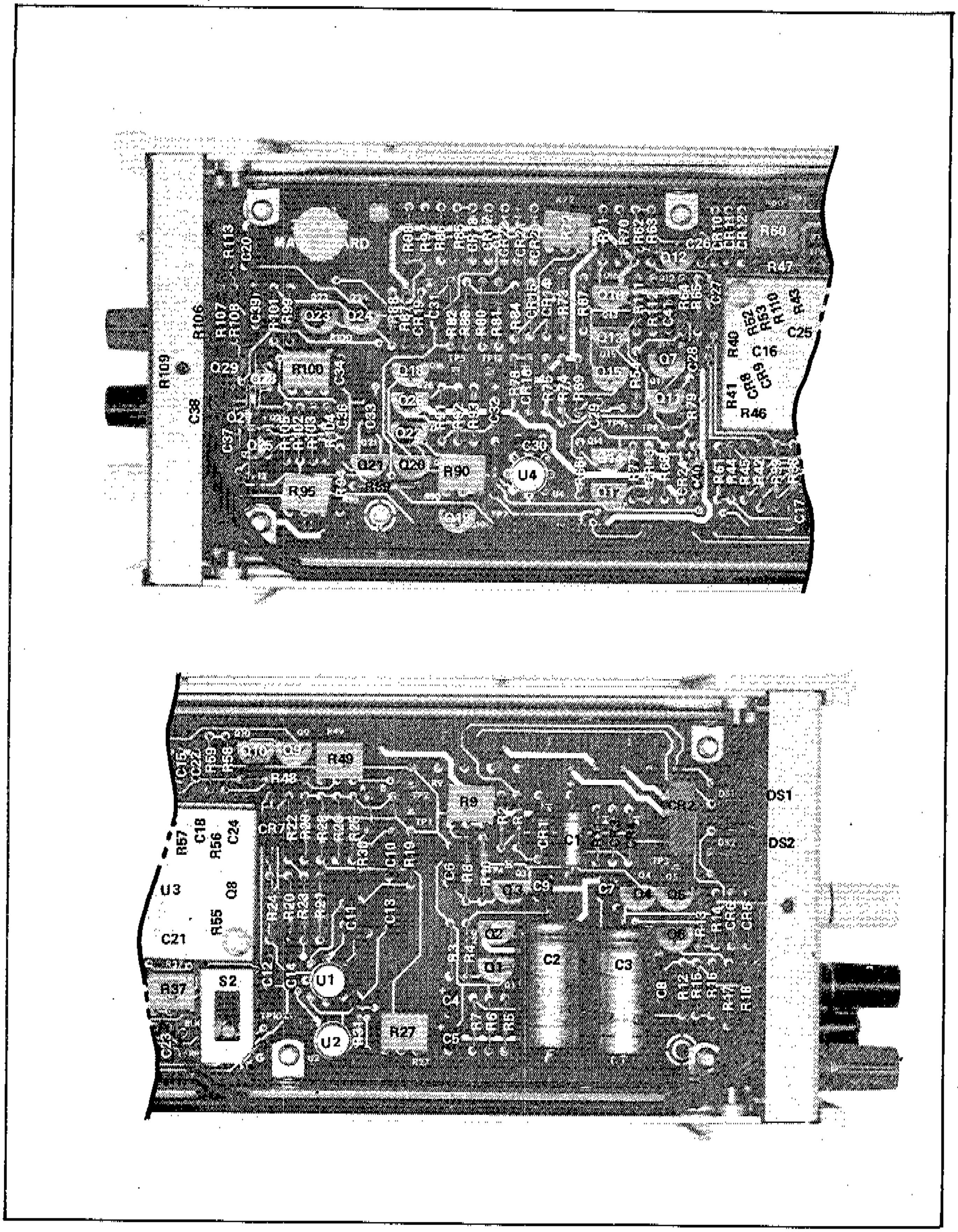


Figure 5-3. MAIN PCB ASSEMBLY

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
A2	**MAIN PCB ASSEMBLY** **Figure 5-3**	307868	REF		
C1	Cap, elect, 2 uf +75/–10%, 50V	105197	1	1	
C2, C3	Cap, elect, 250 uf +50/–10%, 40V	178616	2	1	
C4, C5, C7, C9, C28, C32	Cap, Ta, 2.2 uf ±20%, 20V	161927	6	1	
C6, C8, C10, C12 thru C14, C17, C20, C23, C37, C38	Cap, cer, 0.05 uf +80/–20%, 25V	148924	11	1	
C11, C18, C30	Cap, mica, 33 pf ±5%, 500V	160317	3	1	
C15, C21, C22, C24, thru C26, C34, C36	Cap, fixed, cer, 0.01 uf ±20%, 100V	149153	8	1	
C16	Cap, mica, 4 pf ±5%, 500V	190397	1	1	
C19	Not used				
C27	Cap, mica, 47 pf ±5%, 500V	148536	1	1	
C29	Cap, cer, 180 pf ±10%, 1 kV	105890	1	1	
C31	Cap, cer, 20 pf ±10%, 500V	106369	1	1	
C33	Cap, mica, 10 pf ±10%, 500V	175216	1	1	
C35	Cap, Ta, 4.7 uf ±20%, 20V	161943	1	1	
C39	Cap, Ta, 39 uf ±20%, 20V	163915	1	1	
C40	Cap, Ta, 3.3 uf ±10%, 15V	182808	1	1	
C41	Cap, cer, 3.3 uf ±10%, 500V	106377	1	1	
CR1, CR7	Diode, silicon, 1 amp, 100 piv	116111	2		
CR2	Diode, bridge, 2 amp, 100 piv	296509	1		
CR3 thru CR6, CR13, thru CR15, CR17, CR18, CR20 thru CR22, CR24	Diode, silicon, 150 MA	203323	13	2	
CR8	Diode, semicon, silicon, 100 MA at 1.5V	161810	1	1	
CR9	Diode, high speed, switching	256339	1	2	

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
CR10, CR11, CR12	Diode, germanium, 80 MA, 100 piv	149187	3		
CR16, CR19	Diode, zener, 6.2V	180497	2	1	
CR23	Not used				
DS1, DS2	Lamp, incandesant, 28V, 80 MA	175265	2	1	
Q1, Q5, Q7 thru Q10 Q27	Tstr, silicon, PNP	195974	7	1	
Q2, Q4, Q12 thru Q16, Q24, Q25, Q28	Tstr, silicon, NPN	218396	10	2	
Q3, Q19, Q21	Tstr, semicon, silicon NPN	218081	3	1	
Q6, Q11, Q18, Q20 Q29	Tstr, silicon, PNP	229898	5	1	
Q17, Q26	Tstr, FET, N-channel	261388	2	1	
Q22, Q23	Tstr, silicon, PNP	225599	2	1	
R1, R2, R65, R67, R78, R87, R91, R92, R109	Tes, comp, 10k ±5%, 1/4w	148106	9		
R3, R7, R16 R68, R107, R108, R113	Res, comp, 1.8k ±5%, 1/4w	175042	7		
R4, R13, R101	Res, comp, 6.8k ±5%, 1/4w	148098	3		
R5, R14, R19	Res, comp, 270Ω ±5%, 1/4w	160804	3		
R6, R15	Res, comp, 180k ±5%, 1/4w	193441	2		
R8	Res, met flm, 54.9k ±1%, 1/8w	271353	1	1	
R9, R95	Res, var, cermet 10k ±10%, 1/2w	309674	2	1	
R10	Res, met flm, 63.4k ±1%, 1/8w	235382	1	1	
R11, R75 R76, R84 R88	Res, comp, 22k ±5%, 1/4w	148130	5		

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
R12, R97	Res, comp, 5.6k ±5%, 1/4w	148080	2		
R17	Res, met flm, 57.6k ±1%, 1/8w	289116	1	1	
R18	Res, met flm, 45.3k ±1%, 1/8w	234971	1	1	
R20	Res, met flm, 51.1k ±1%, 1/8w	309757	1	1	
R21	Res, met flm, 49.9k ±1%, 1/8w	293456	1	1	
R22, R23, R30, R31	Res, ref amp, matched set	1	1	1	
R24	Res, met flm, 2.49k ±1%, 1/8w	309732	1	1	
R25	Res, met flm, 1.05k ±1%, 1/8w	293530	1	1	
R26	Res, met flm, 107Ω ±1%, 1/8w	309716	1	1	
R27	Res, var, 100Ω ±10%, 1/2w	275735	1		
R28	Res, met flm, 200Ω ±1%, 1/8w	309724	1	1	
R29	Res, met flm, 10Ω ±1%, 1/8w	268789	1	1	
R32 thru R36	Not used				
R37	Res, var, cermet, 20Ω ±20%, 1/2w	275727	1	1	
R38	Res, met flm, 40.2Ω ±1%, 1/8w	245373	1	1	
R39	Res, met flm, 100Ω ±1%, 1/8w	168195	1	1	
R40, R41	Res, network (2 resistors)	293506	1	1	
R42	Res, met flm, 33.2Ω ±1%, 1/8w	199950	1	1	
R43, R54, R57, R64	Res, comp, 100k ±5%, 1/4w	148189	4		
R44, R45 R93	Res, comp, 1k ±5%, 1/4w	148023	3		

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
R46	Res, met flm, 13.7k ±1%, 1/8w	236752	1	1	
R47, R74	Res, met flm, 453Ω ±1%, 1/8w	267393	2	1	
R48, R73	Res, met flm, 1M ±1%, 1/8w	268797	2	1	
R49, R72	Res, var, 1M ±10%, 1/2w	276691	2	1	
R50, R51	Not used				
R52	Res, comp, 2.4M ±5%, 1/4w	221945	1	1	
R53	Res, comp, 470k ±5%, 1/4w	188441	1		
R55, R58, R70, R111, R112	Res, comp, 47k ±5%, 1/4w	148163	5		
R56	Res, comp, 360k ±5%, 1/4w	234690	1		
R59	Res, comp, 12k ±5%, 1/4w	159731	1		
R60, R90	Res, var, cermet, 1k ±10%, 1/2w	275750	2	1	
R61	Res, comp, 27k ±5%, 1/4w	148148	1		
R62, R85, R99	Res, comp, 8.2k ±5%, 1/4w	160796	3		
R63, R105	Res, comp, 100Ω ±5%, 1/4w	147926	2		
R66	Res, comp, 91Ω ±5%, 1/4w	221887	1		
R69	Res, comp, 820k ±5%, 1/4w	220541	1		
R71	Res, comp, 6.2k ±5%, 1/4w	221911	1		
R77	Res, comp, 2.2M ±5%, 1/4w	198390	1		
R79	Res, comp, 36k ±5%, 1/4w	221929	1		
R80, R81	Res, met flm, 1k ±1% 1/8w	168229	2	1	
R82, R83	Res, met flm, 1.47k ±1%, 1/8w	293654	2	1	
R86	Res, comp, 510Ω ±5%, 1/4w	218032	1		
R89	Res, met flm, 4.53k ±1%, 1/8	260331	1	1	

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
R94	Res, met flm, 41.2k ±1%, 1/8w	289538	1	1	
R96	Res, var, cermet, 2k ±10%, 1/2w	285163	1	1	
R98	Res, comp, 4.7k ±5%, 1/4w	148072	1		
R100	Res, var, cermet, 2k ±10%, 1/4w	309666	1	1	
R102, R104	Res, comp, 5.6Ω ±5%, 1/4w	208033	2		
R103	Res, comp, 10Ω ±5%, 1/4w	147868	1		
R106	Res, met flm, 84.5Ω ±1%, 1/8w	236851	1	1	
R110	Res, comp, 56k ±5%, 1/4w	170738	1		
S1	Switch, double pole, double throw	234278	1	1	
U1	IC, operational amplifier	271502	1	1	
U2	Ref, amp assembly, matched set	▷1	1	1	
U3, U4	IC, operational amplifier	306266	2	1	
	Socket, tstr	285262	25		
▷1	R22, R23, R30, R31 and U2 are a matched set. For replacement order ref amp set P/N 4842-307918.				

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
A2A1	**PCB ASSEMBLY 50 Hz (—02 Option) Figure 5-4**	307926	REF		
C1, C2	Cap, fxd, met poly, 0.27 uf ±5%, 100V	310466	2	1	
C3	Cap, Ta, 330 uf ±10%, 6V	193011	1	1	
C4, C5	Cap, Ta, 220 uf ±10% 10V	182840	2	1	
C6	Cap, Ta, 5.6 uf ±10% 6V	198259	1	1	
C7	Cap, Ta, 0.47 uf ±10% 250V	184366	1	1	
C8	Cap, cer, 0.025 uf ±2%, 100V	168435	1	1	
C9	Cap, cer, 0.1 uf ±20%, 100V	149146	1	1	
C10	Cap, plstc 0.1 uf ±10%, 250V	161992	1	1	
J1 thru J19	Amp, receptacle	267617	19	5	
R1	Res, met flm, 2.67k ±1%, 1/8w	312173	1	1	
R2	Res, met flm, 42.2k ±1%, 1/8w	312215	1	1	
R3	Res, comp, 47k ±5%, 1/4w	148163	1		
R4	Res, comp, 2.2M ±5%, 1/4w	198390	1		

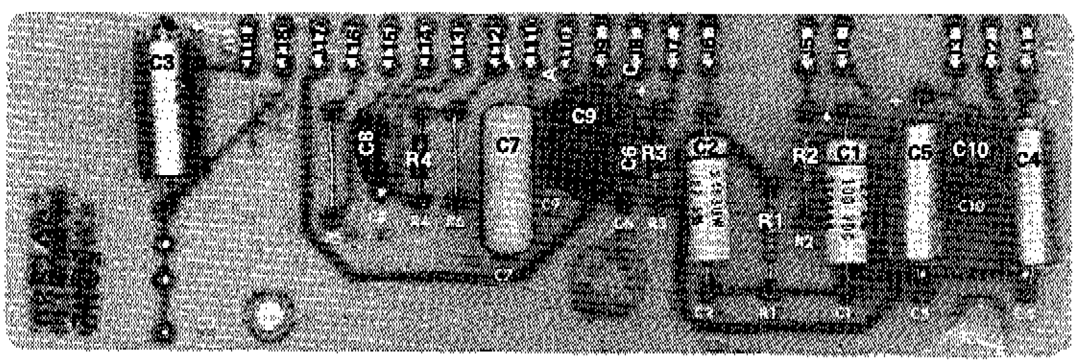


Figure 5-4. PCB ASSEMBLY, 50 Hz (—02 Option)

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
A2A1	**PCB Assembly, 60 Hz (—03 Option) Figure 5-5**	307934	REF		
C1, C2	Cap, fxd, met poly, 27 uf ±5%, 100V	310466	2	1	
C3	Cap, Ta, 330 uf ±10%, 6V	193011	1	1	
C4, C5	Cap, Ta, 220 uf ±10%, 10V	182840	2	1	
C6	Cap, Ta, 5.6 uf ±10%, 6V	198259	1	1	
C7	Cap, Ta, 0.47 uf ±10%, 250V	184366	1	1	
C8	Cap, cer, 0.025 uf ±2%, 100V	168435	1	1	
C9	Cap, cer, 0.1 uf ±20%, 100V	149146	1	1	
C10	Cap, plstc, 0.1 uf ±10%, 250V	161992	1	1	
J1 thru J19	Connector, receptacle	267617	19	5	
R1	Res, met flm, 2.21k ±1%, 1/8w	310508	1	1	
R2	Res, met flm, 34.8k ±1%, 1/8w	312181	1	1	
R3	Res, comp, 47k ±5%, 1/4w	148163	1		
R4	Res, comp, 2.2M ±5%, 1/4w	198390	1		

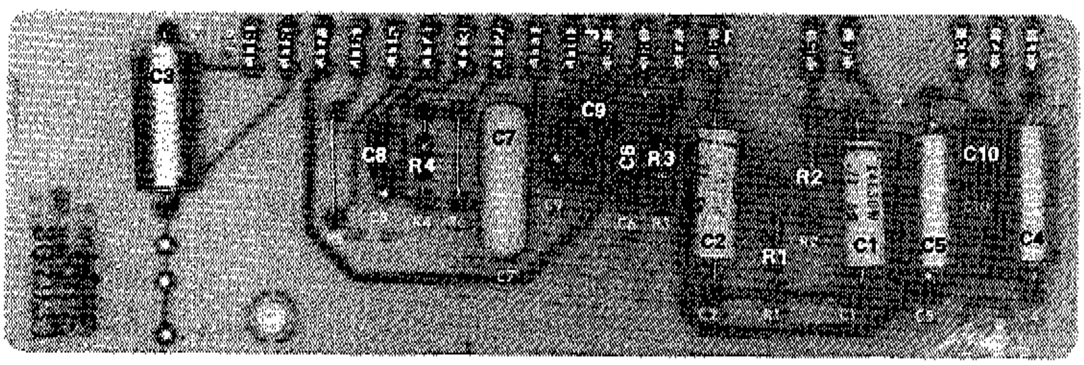


Figure 5-5. PCB ASSEMBLY, 60 Hz (—03 Option)

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
A2A1	**PCB Assembly, 400 Hz (—04 Option) Figure 5-6**	307942	REF		
C1, C2	Cap, fxd, met poly, 0.033 ±5%, 100V	310474	2	1	
C3	Cap, fxd, met poly, 5 uf ±10%, 50V	313254	1	1	
C4, C5	Cap, Ta, 68 uf ±10%, 15V	182824	2	1	
C6	Cap, Ta, 3.3 uf ±10%, 15V	182808	1	1	
C7	Cap, cer, 0.05 uf ±20%, 100V	149161	1	1	
C8	Cap, mica, 3000 pf ±5%, 500V	161786	1	1	
C9	Cap, fxd, cer, 0.01 uf ±20%, 100V	149153	1	1	
J1 thru J19	Connector, receptacle	267617	19	5	
R1	Res, met flm, 2.67k ±1%, 1/8w	312173	1	1	
R2	Res, met flm, 43.2k ±1%, 1/8w	312223	1	1	
R3	Not used				
R4	Res, comp, 2.2M ±5%, 1/4w	198390	1		

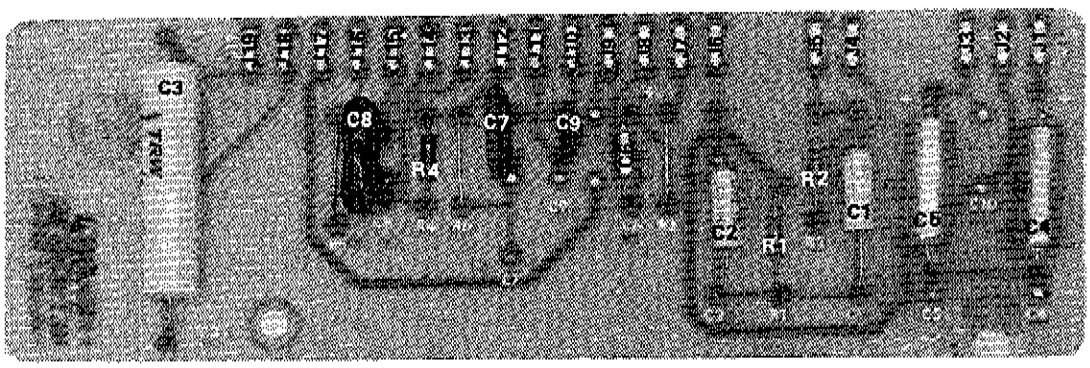


Figure 5-6. PCB ASSEMBLY, 400 Hz (—04 Option)

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
A2A1	**PCB Assembly, 1000 Hz (–05 Option) Figure 5-7**	307959	REF		
C1, C2	Cap, fxd, met poly, 0.015 uf ±5%, 100V	310482	2	1	
C3	Cap, fxd, met poly, 2 uf ±10%, 50V	284687	1	1	
C4, C5	Cap, Ta, 68 uf ±10%, 15V	182824	2	1	
C6	Cap, Ta, 2.2 uf ±20%, 20V	161927	1	1	
C7	Cap, cer, 0.05 uf ±20%, 100V	149161	1	1	
C8	Cap, mica, 1200 pf ±5%, 500V	148379	1	1	
C9	Cap, fxd, cer, 0.01 uf ±20%, 100V	149153	1	1	
J1 thru J19	Connector, receptacle	267617	19	5	
R1	Res, met flm, 2.43k ±1%, 1/8w	310524	1	1	
R2	Res, met flm, 39.2k ±1%, 1/8w	312207	1	1	
R3	Not used				
R4	Res, comp, 1.2M ±5%, 1/4w	188425	1		

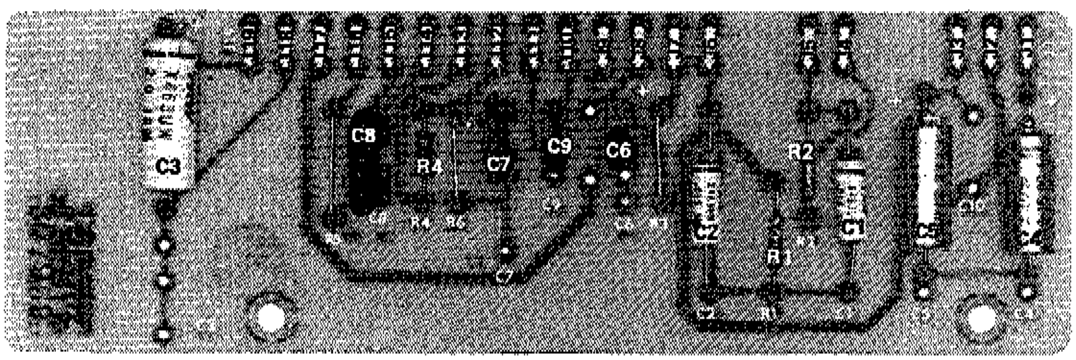


Figure 5-7. PCB ASSEMBLY, 1000 Hz (–05 Option)

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
A2A1	**PCB ASSEMBLY, 2400 Hz (–06 Option) Figure 5-8**	307967	REF		
C1, C2	Cap, mica, 6200 pf ±5%, 300V	310490	2	1	
C3	Cap, fxd, met poly, 1.0 uf ±10%, 100V	313262	1	1	
C4, C5	Cap, Ta, 68 uf ±10%, 15V	182824	2	1	
C6	Cap, Ta, 0.68 uf ±10%, 35V	182790	1	1	
C7	Cap, cer, 0.05 uf ±20%, 100V	149161	1	1	
C8	Cap, mica, 510 pf ±5%, 500V	148411	1	1	
C9	Cap, Fxd, cer, 0.01 uf ±20%, 100V	149153	1	1	
J1 thru J19	Connector, receptacle	267617	19	5	
R1	Res, met flm, 2.43k ±1%, 1/8w	310524	1	1	
R2	Res, met flm, 39.2k ±1%, 1/8w	312207	1	1	
R3	Not used				
R4	Res, fxd, comp, 750k ±5%, 1/4w	221937	1		

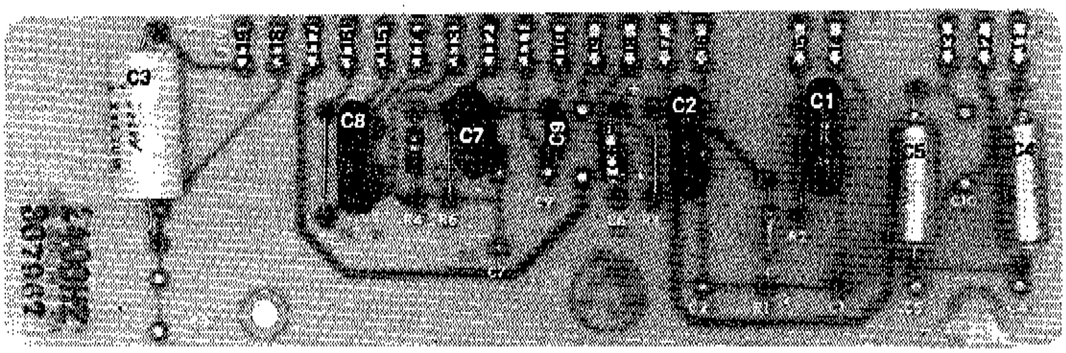


Figure 5-8. PCB ASSEMBLY 2400 Hz (–06 Option)

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
	PCB Assembly, 5000 Hz (−07 Option) Figure 5-9	307975	REF		
C1, C2	Cap, mica, 3000 pf ±5%, 500V	161786	2	1	
C3	Cap, fxd, met poly, 1 uf ±10%, 100V	313262	1	1	
C4, C5	Cap, Ta, 68 uf ±10%, 15V	182824	2	1	
C6	Cap, Ta, .33 uf ±5%, 20V	271338	1	1	
C7	Cap, cer, 0.05 uf ±20%, 100V	149161	1	1	
C8	Cap, mica, 220 pf ±5%, 500V	170423	1	1	
C9	Cap, fxd, cer, 0.01 uf ±20%, 100V	149153	1	1	
J1 thru J19	Connector, receptacle	267617	19	5	
R1	Res, met flm, 2.43k ±1%, 1/8w	310524	1	1	
R2	Res, met flm, 39.2k ±1%, 1/8w	*312207	1	1	
R3	Not used				
R4	Res, comp, 360k ±5%, 1/4w	234690	1		

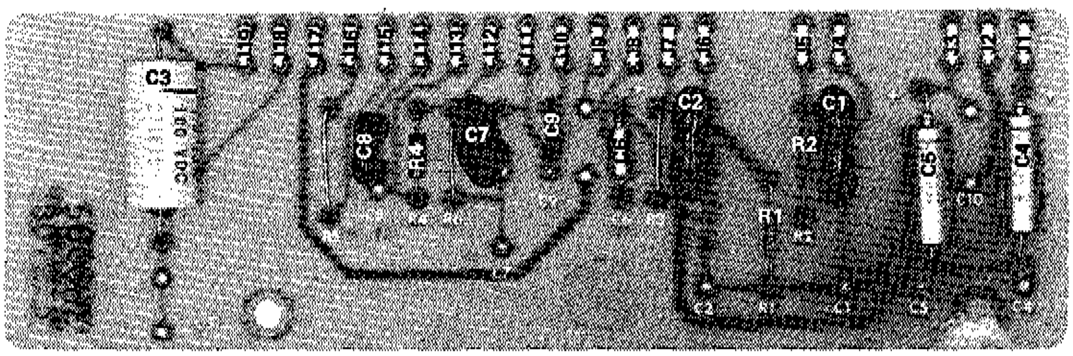


Figure 5-9. PCB ASSEMBLY, 5000 Hz (−07 Option)

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
	PCB Assembly, 19.2 KHz (–08 Option) Figure 5-10	307983	REF		
C1, C2	Cap, mica, 750 pf ±5%, 500V	208983	2	1	
C3	Cap, fxd, met poly, 1 uf ±10%, 100V	313262	1	1	
C4, C5	Cap, Ta, 68 uf ±10%, 15V	182824	2	1	
C6	Cap, plstc, 0.068 uf ±10%, 100V	182170	1	1	
C7	Cap, cer, 0.05 uf ±20%, 100V	149161	1	1	
C8	Cap, mica, 68 pf ±5%, 500V	148510	1	1	
C9	Cap, fxd, cer, 0.01 uf ±20%, 100V	149153	1	1	
J1 thru J19	Connector, receptacle	267617	19	5	
R1	Res, met flm, 2.49k ±1%, 1/8w	309732	1	1	
R2	Res, met flm, 39.2k ±1%, 1/8w	312207	1	1	
R3	Not used				
R4	Res, comp, 100k ±5%, 1/4w	148189	1		
R5	Not used				
R6	Res, comp, 5.1Ω ±5%, 1/4w	281832	1		

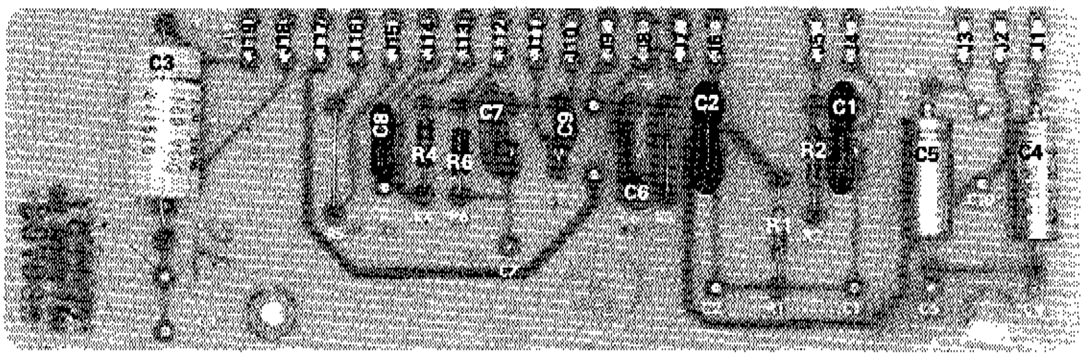


Figure 5-10. PCB ASSEMBLY, 19.2 kHz (–08 Option)

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
	PCB Assembly, 100 KHz (–09 Option) Figure 5-11	307991	REF		
C1, C2	Cap, mica, 150 pf ±5%, 500V	148478	2	1	
C3	Cap, fxd, met poly, 1 uf ±10%, 100V	313262	1	1	
C4, C5	Cap, Ta, 68 uf ±10%, 15V	182824	2	1	
C6	Cap, cer, 0.05 uf ±20%, 100V	149161	1	1	
C7, C9	Cap, fxd, cer, 0.01 uf ± 20%, 100V	149153	2	1	
C8	Not used				
J1 thru J19	Connector, receptacle	267617	19	5	
R1	Res, fxd, met flm, 2.26k ± 1%, 1/8w	310516	1	1	
R2	Res, fxd, met flm, 36.5k ±1%, 1/8w	312199	1	1	
R3	Not used				
R4	Res, comp, 4.7M ±5%, 1/4w	220046	1	1	

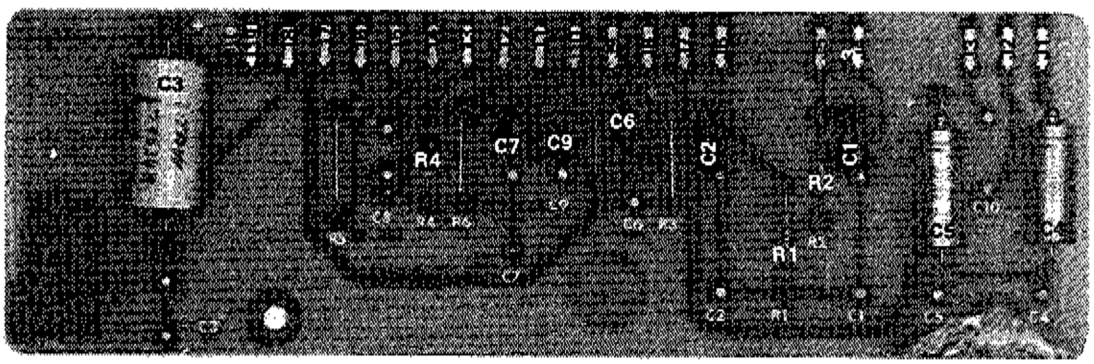


Figure 5-11. PCB ASSEMBLY, 100 kHz (–09 Option)

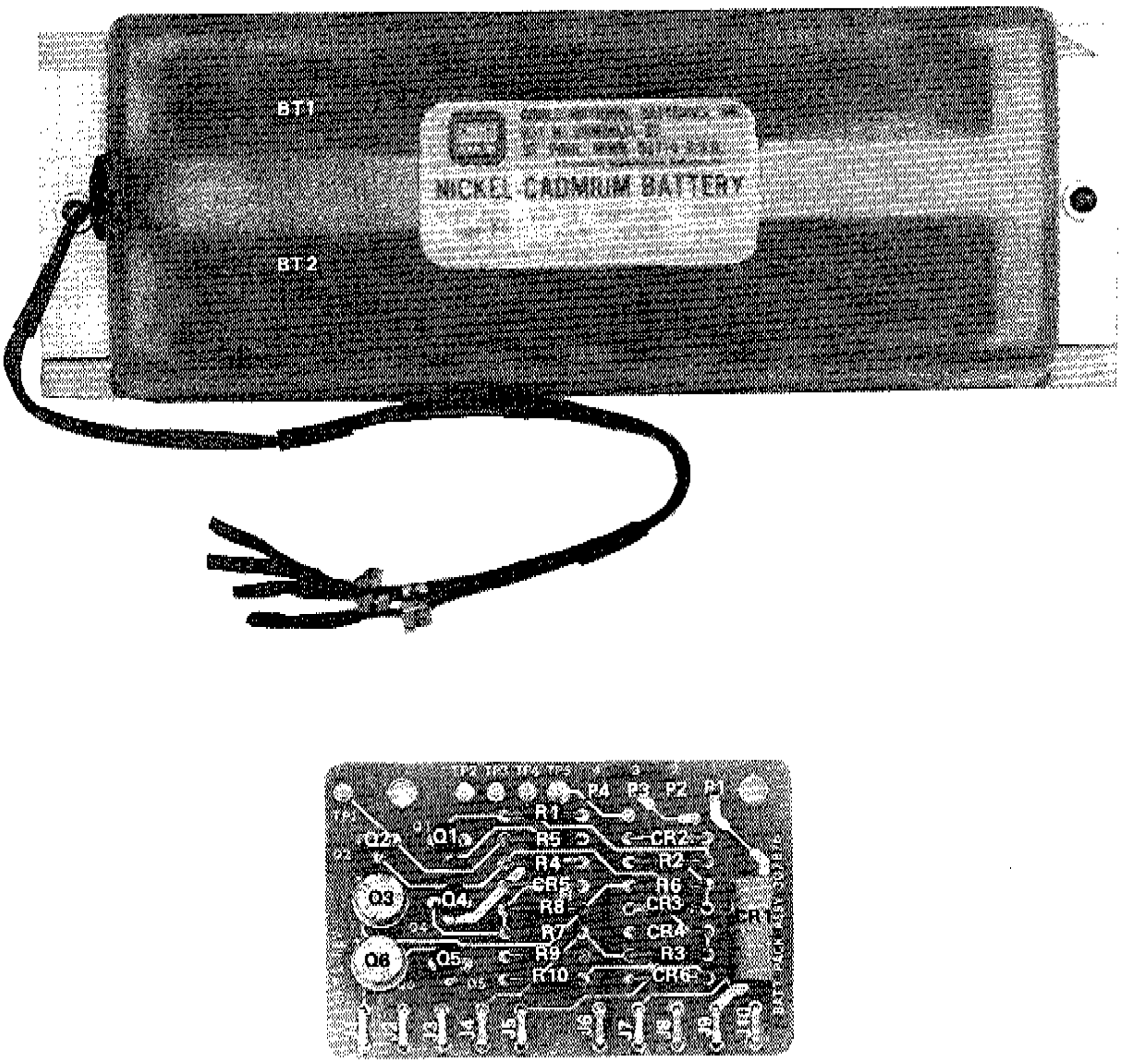


Figure 5-12. RECHARGEABLE BATTERY KIT (–01 OPTION)

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
A3	**RECHARGEABLE BATTERY Kit (—01 Option) Figure 5-12**	510A–01K	Ref		
	Battery Pack	307900	1		
BT1, BT2	Battery	284356	1	2	
	Battery Pack PCB	307876	1	1	
CR1	Diode, bridge, 2 amp, 200 piv	296509	1		
CR2, CR6	Diode, zener, 36V ±5%, 1w	284364	2	1	
CR3	Diode, zener, 18.5V	309450	1	1	
CR4, CR5	Diode, silicon, 150 mA	203323	2	1	
J1 thru J10	Connector, receptacle	267617	10	3	
P1 thru P4	Connector, post	267500	4		
Q1, Q4	Tstr, silicon, PNP	195974	2	1	
Q2, Q5	Tstr, silicon, NPN	218396	2	1	
Q3, Q6	Tstr, semicon, germanium, PNP	148619	2	1	
R1, R10	Res, comp, 1M ±5%, 1/4w	182204	2		
R2	Res, comp, 15k ±5%, 1/4w	148114	1		
R3	Res, comp, 27k ±5%, 1/4w	148148	1		
R4	Res, comp, 150k ±5%, 1/4w	182212	1		
R5, R8	Res, comp, 56k ±5%, 1/4w	170738	2		
R6, R7	Res, comp, 330k ±5%, 1/4w	192948	2		
R9	Res, comp, 68k ±5%, 1/4w	148171	1		

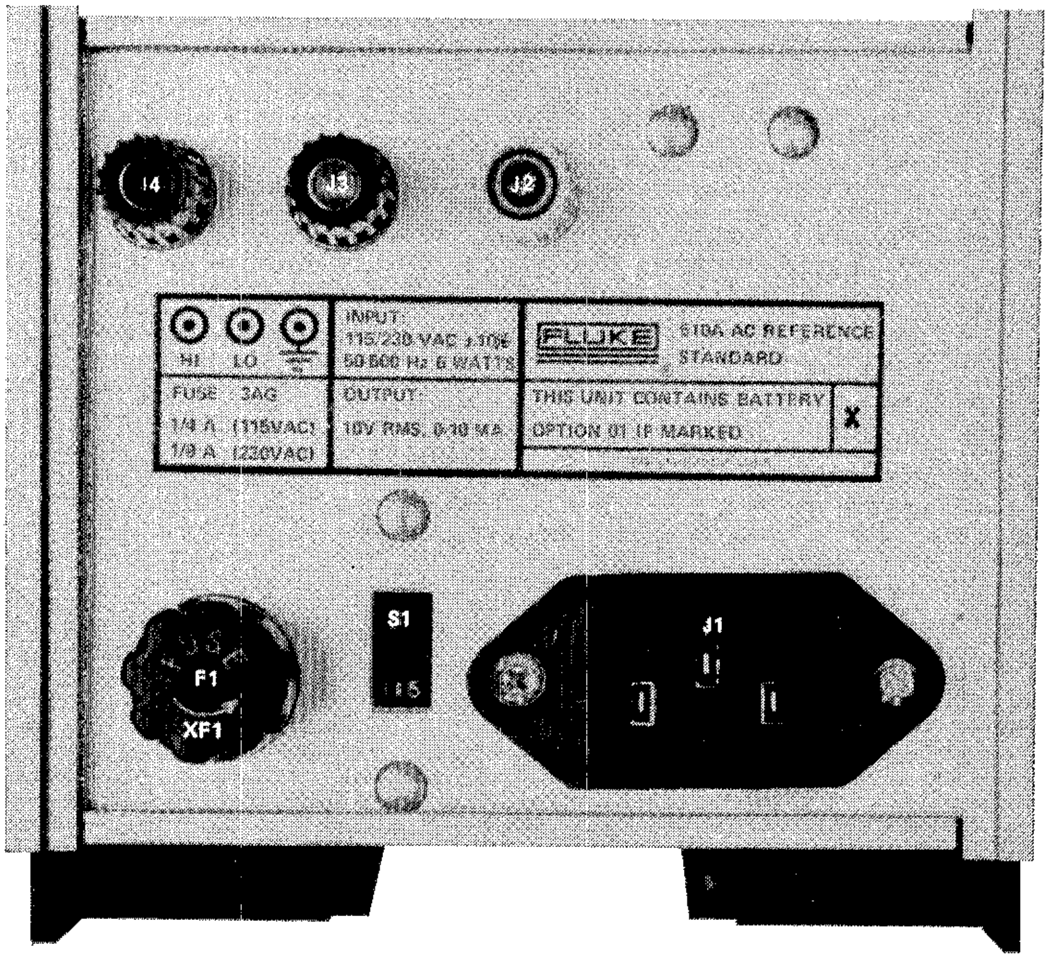


Figure 5-13. REAR PANEL ASSEMBLY

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
A4	**REAR PANEL ASSEMBLY** **Figure 5-13**	307884	REF		
F1	Fuse, fast acting, 1/4 amp, 250V (for 115V operation)	109314	1		
F1	Fuse, fast acting, 1/8 amp, 250V (for 230V operation)	196790			
J1	Connector, male, 3 pin	284166	1		
J2	Binding post, white	275586	1		
J3	Binding post, black, LO	275560	1		
J4	Binding post, red, HI	275552	1		
S1	Switch, slide	226274	1		
XF1	Fuse holder	160846	1		
	Decal	313064	1		
	Rear panel	307694	1		

MANUFACTURERS' CROSS REFERENCE LIST

FLUKE STOCK NO.	MFR.	MFR. PART NO.	FLUKE STOCK NO.	MFR.	MFR. PART NO.
105197	56289	30D205G-050BA4	160804	01121	CB2715
105890	71590	BB60181KS3N	161810	03877	SG5658
106369	32897	831-000-T2HO-200	161927	56289	196D225X0020
106377	32897	861-000-T2H0-3R3	161943	56289	196D475X0020
1166111	05279	1N4817	161992	73445	C280AEA100K
147868	01121	CB1005	163915	56289	196D396X0006
147926	01121	CB1015	168195	91637	TYPE MFF 1/8
148023	01121	CB1025	168229	91637	TYPE MFF1/8
148072	01121	CB4725	168435	56289	C128B101H253M
148080	01121	CB5625	170423	14655	CD15F221J
148098	01121	CB6825	170738	01121	CB5635
148106	01121	CB1035	175042	01121	CB1825
148114	01121	CB1535	175216	14655	CD15C200K
148130	01121	CB2235	175265	08806	757
148148	01121	CB2735	178616	73445	C437ARG250
148163	01121	CB4735	180497	07910	1N753
148171	01121	CB6835	182170	14655	DMF1568
148189	01121	CB1045	182204	01121	CB1055
148379	14655	CD19F122J	182212	01121	CB1545
148478	14655	CD15F151J	182790	56289	150D684X9035A2
148510	14655	CD15F680J	182808	56289	150D330X9A2
148536	14655	CD15E470J	182824	56289	150D686X9015R2
148619	01295	2N1303	182840	56289	150D227X9010S2
148924	72982	5855-Y5U-5032	184366	73445	C280AE/A470K
149146	56289	33C41B6	188441	01121	CB4745
149153	56289	C023B101F103M	190397	14655	CD15C40K
149161	56289	55C23A1	192948	01121	CB3315
149187	93332	1N270	193011	56289	150D330X9006S2
159731	01121	CB1235	193441	01121	CB1845
160317	14655	CD15E330J	195974	04713	2N3906
160796	01121	CB8225	196790	71400	TYPE AGC

MANUFACTURERS' CROSS REFERENCE LIST

FLUKE STOCK NO.	MFR.	MFR. PART NO.	FLUKE STOCK NO.	MFR.	MFR. PART NO.
198390	01121	CB2255	275560	32767	820-45
199950	91637	TYPE MFF1/8	275586	32767	820-25
203323	03508	DHD1105	275727	11236	360T200B
208033	01121	CB5615	275735	11236	360T101A
208983	14655	CD19F751J	275750	11236	360T102A
218032	01121	CB5115	276691	11236	360T105A
218081	04713	MPS6520	281832	01121	CB5105
218396	04713	2N3904	284166	82389	EAC301
220046	01121	CB4755	284299	09353	7301
220541	01121	CB8245	284364	12969	UZ8736
221911	01121	CB6225	285163	11236	360S202A
221929	01121	CB3635	285262	71785	133-23-92-039
221937	01121	CB7545	289116	91637	TYPE MFF1/8
221945	01121	CB2415	289538	91637	TYPE MFF1/8
229898	04713	MPS6522	293456	91637	TYPE MFF1/8
234690	01121	CB3645	293506	18612	310865
234971	91637	TYPE MFF1/8	293530	91637	TYPE MFF1/8
235382	91637	TYPE MFF1/8	293654	91637	TYPE MFF1/8
236752	91637	TYPE MFF1/8	296509	09423	FB100
236851	91637	TYPE MFF1/8	309450	15818	TD333379
245373	91637	TYPE MFF1/8	309617	31718	FLV102
256339	28480	5082-2900	309666	11236	360T202A
260331	91637	TYPE MFF1/8	309674	11236	360T103A
266494	32539	TYPE TS-10	309716	91637	TYPE MFF1/8
267393	91637	TYPE MFF1/8	309724	91637	TYPE MFF1/8
267617	00779	85863-5	309732	91637	TYPE MFF1/8
268789	91637	TYPE MFF1/8	309757	91637	TYPE MFF1/8
271338	56289	150DX5020A2	310466	01281	X4630W27
271353	91637	TYPE MFF1/8	310474	01281	X463UW33351
271502	12040	LM301A	310482	01281	X4630W15051
275552	32767	820-65	310490	14655	CD19F622J

MANUFACTURERS' CROSS REFERENCE LIST

FLUKE STOCK NO.	MFR.	MFR. PART NO.	FLUKE STOCK NO.	MFR.	MFR. PART NO.
310508	91637	TYPE MFF1/8			
310524	91637	TYPE MFF1/8			
312173	91637	TYPE MFF1/8			
312181	91637	TYPE MFF1/8			
312207	91637	TYPE MFF1/8			
312215	91637	TYPE MFF1/8			
312223	91637	TYPE MFF1/8			
313262	01281	X4630W10091			

Section 6

Option & Accessory Information

6-1. INTRODUCTION

6-2. This section of the manual contains information pertaining to the accessories and options available for your instrument.

6-3. ACCESSORY INFORMATION

6-4. The accessory information, if applicable, will contain details concerning accessories that may be used with this particular instrument.

6-5. OPTION INFORMATION

6-6. Option descriptions contain applicable field installation procedures.

Accessory
Rack Mounting Fixtures

6-1. INTRODUCTION

6-2. The FLUKE quarter-rack instruments can be installed in a 19 inch equipment rack in various combinations and in conjunction with other FLUKE half-rack instruments. Figure 6-1 shows various mounting configurations.

6-3. Instructions for attaching rack mounting brackets are given in Figure 6-2. Figure 6-3 gives instructions for dual, triple, quadruple rack mounting. Instructions for combining quarter-rack with half-rack instruments are given in Figure 6-4.

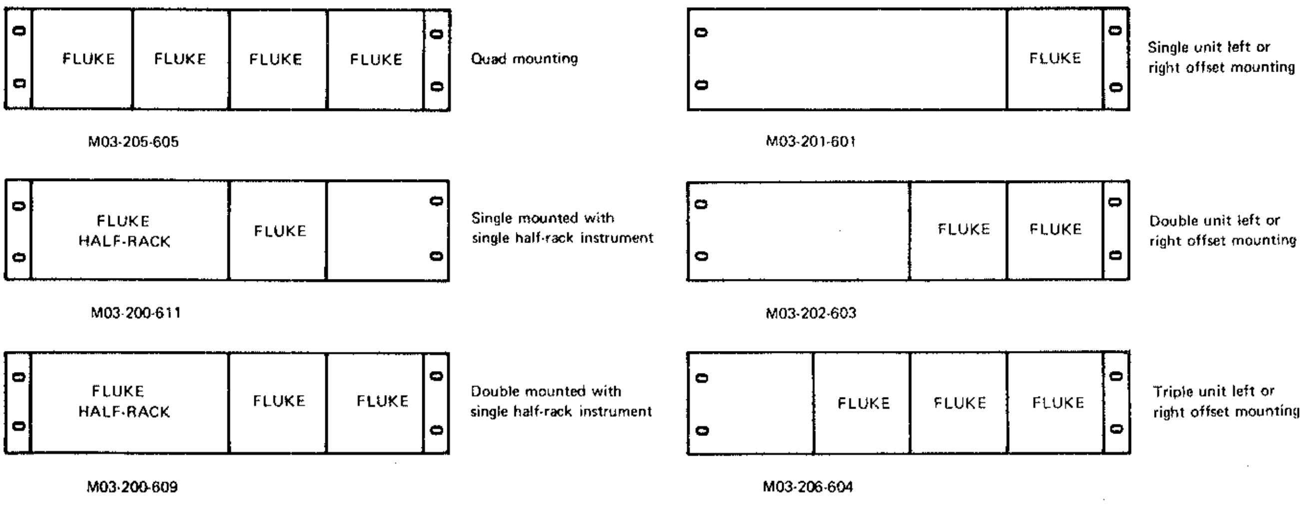
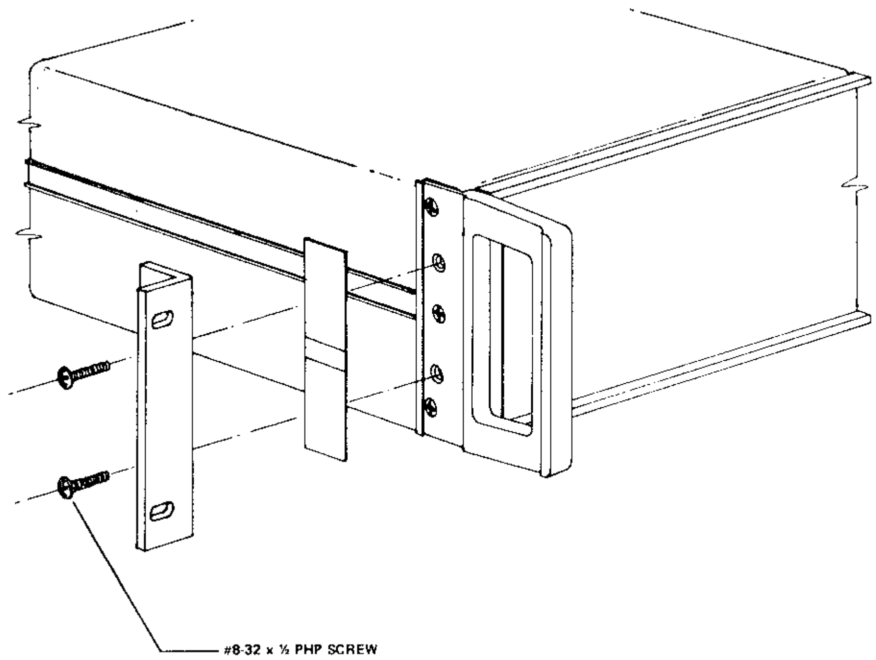


Figure 6-1. RACK MOUNTING CONFIGURATIONS

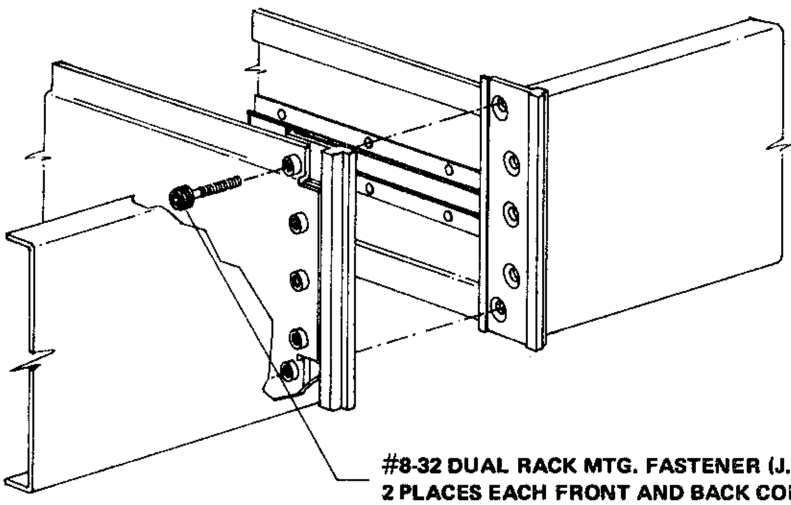
RACK MOUNTING PROCEDURE FOR MODULAR SERIES INSTRUMENTS



1. REMOVE THE FOUR MOLDED FEET AND BAIL FROM BOTTOM COVER.
2. REMOVE THE NAMEPLATE DECALS FROM THE FRONT CORNERS.
3. REMOVE THE SCREWS FROM CORNERS WHICH MATCH HOLE PATTERNS IN RACK MOUNTING EARS.
4. ATTACH RACK MOUNTING EARS WITH PAN HEAD SCREWS (ENCLOSED).

Figure 6-2. RACK EAR INSTALLATION

DUAL, TRIPLE & QUAD MOUNTING FOR MODULAR SERIES INSTRUMENTS



FLUKE PART NO.	DESCRIPTION	QUANTITY		
		DUAL RACK KIT #304816 #304808 #304782 #304360	TRIPLE RACK KIT #308130	QUAD RACK KIT #304980
#309708	DUAL RACK MTG. FASTENER	4	8	12

1. REMOVE TOP & BOTTOM COVERS FROM BOTH INSTRUMENTS.
2. REMOVE NAMEPLATE DECALS FROM CORNERS.
3. REMOVE TOP & BOTTOM SCREWS FROM BOTH FRONT & REAR CORNERS ON THE MATING SIDE OF THE INSTRUMENTS.
4. INSERT NO. 8-32 DUAL MOUNTING FASTENER, THROUGH THE P-NUTS IN BOTH FRONT & REAR CORNERS.
5. REMOVE FEET FROM BOTTOM COVERS AND REPLACE TOP & BOTTOM COVERS.

Figure 6-3. DUAL, TRIPLE AND QUAD MOUNT

Not available at this printing

Figure 6-4. COMBINING WITH HALF-RACK INSTRUMENTS

Option –01

Rechargeable Battery Pack

OPTION –01 RECHARGEABLE BATTERY PACK

INTRODUCTION

6-2. The Rechargeable Battery Pack shown in Figure 6-1 is installed as the –01 Option. It provides at least 16 hours of continuous operation in the absence of line power. The battery is automatically recharged during line operation.

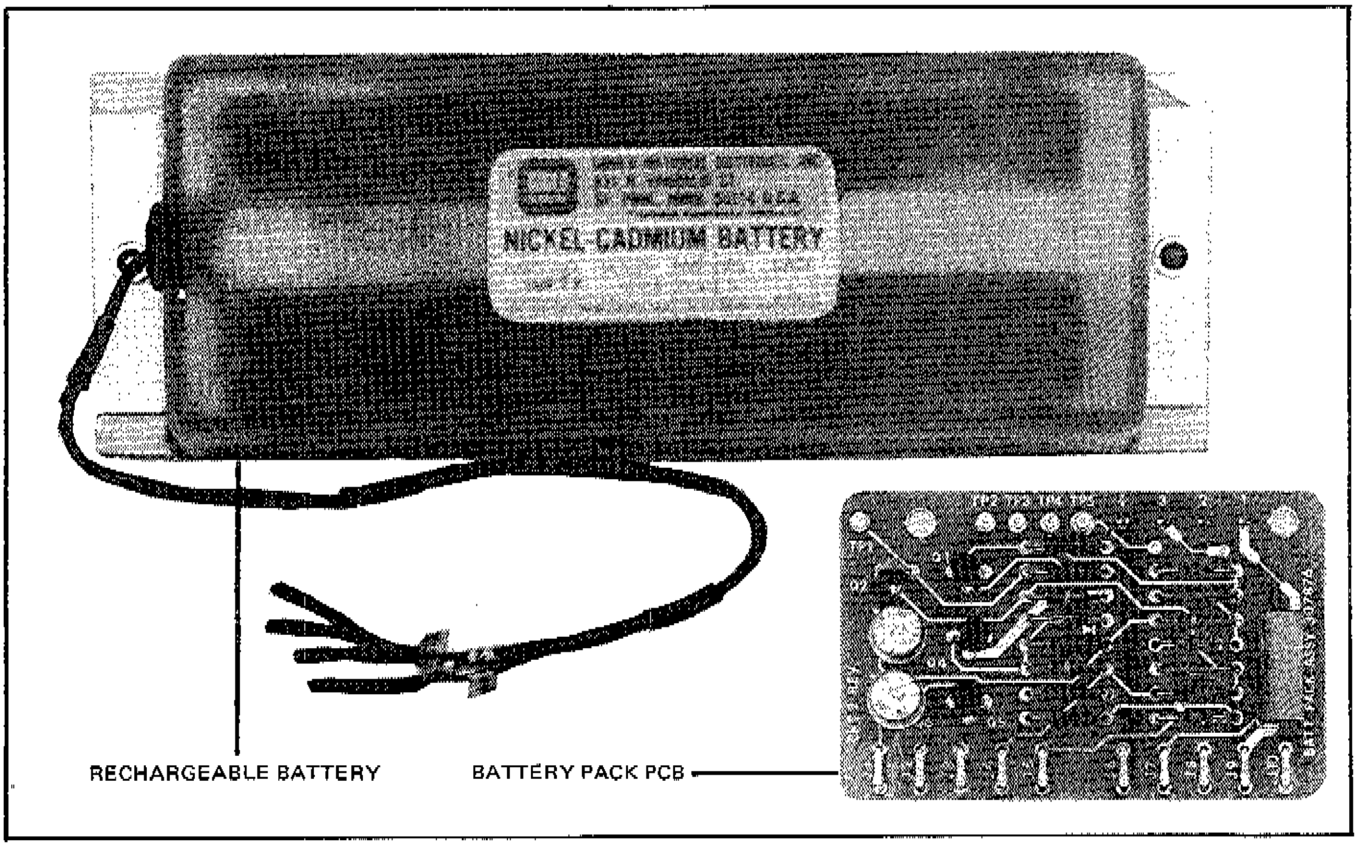


Figure 6-1. 510A–01K BATTERY PACK

6-3. INSTALLATION

6-4. The Rechargeable Battery Pack can be ordered installed at the factory during manufacture by requesting the –01 Option. Field installation of this option is also possible at any time. The field installation kit can be obtained by ordering FLUKE KIT 510A–01K. Installation is as follows:

a. Turn off the Model 510A and disconnect the power cord.

b. Remove the bottom dust cover.

c. Install the Battery Pack (BT1, BT2) on the bottom dust cover as shown in Figure 6-2.

d. Install the Battery Pack PCB in the position shown in Figure 6-2. Ensure that the mating connectors are correctly aligned during installation.

e. Connect the four (4) Battery Pack wires to the Battery Pack PCB. Each wire is labeled with a number which corresponds to a connector on the PCB.

f. Install the bottom dust cover.

NOTE!

Operating instructions, theory of operation maintenance, and parts list are located in the Model 510A Instruction Manual.

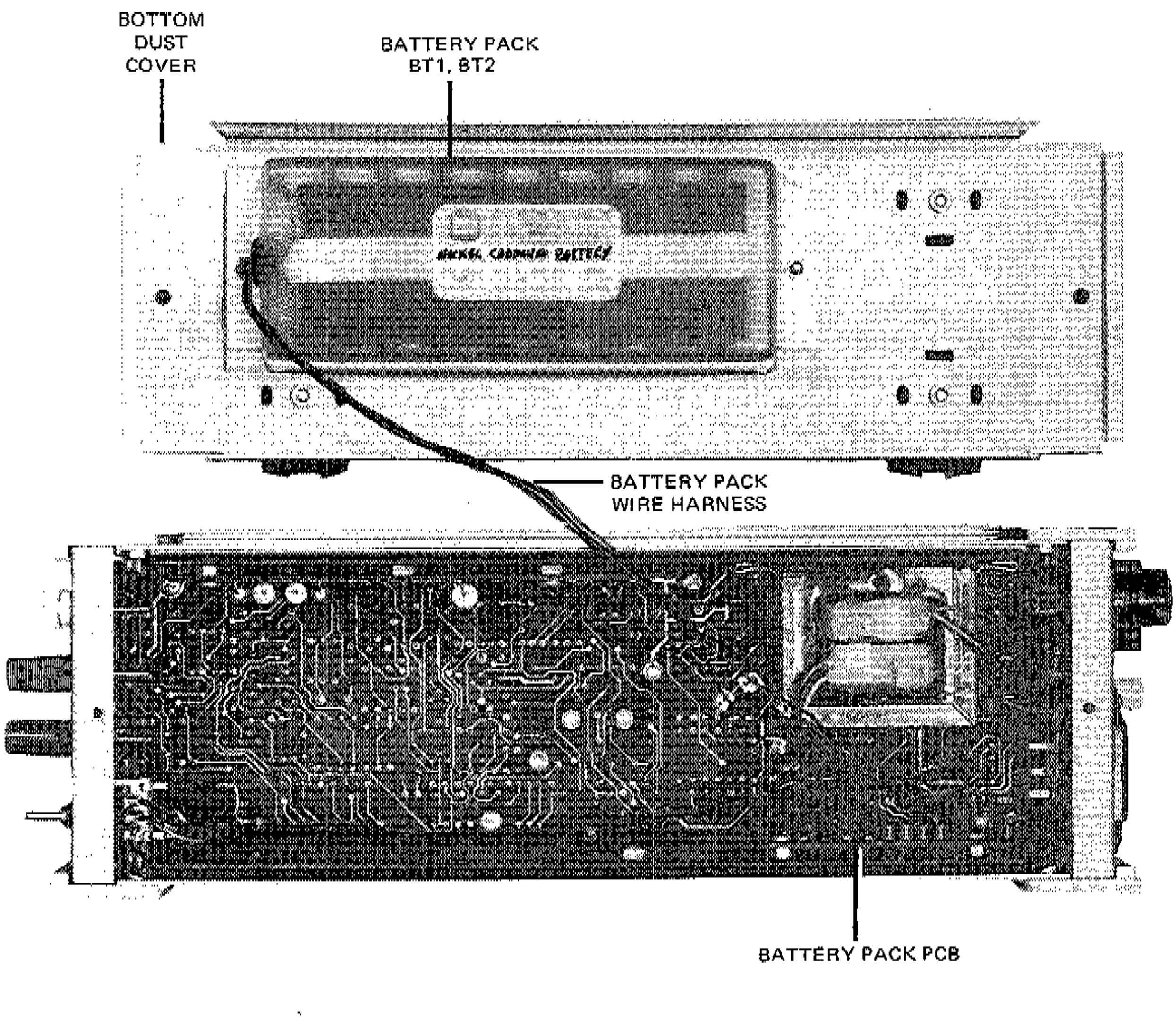


Figure 6-2. BATTERY PACK KIT LOCATIONS

Appendix A

Federal Supply Code for Manufacturers

A-1. CODE TO NAME

A-2. The following five digit code numbers are listed in numerical sequence along with the manufacturer's name and address to which the code has been assigned. The Federal Supply Code has been taken from Cataloging Handbook H 4-2, Code to Name.

00213	Sage Electronics Corp. Rochester, New York
00327	Welwyn International, Inc. Westlake, Ohio
00656	Aerovox Corp. New Bedford, Massachusetts
00686	Film Capacitors Passaic, New Jersey
00779	AMP Inc. Harrisberg, Pennsylvania
01121	Allen-Bradley Co. Milwaukee, Wisconsin
01281	TRW Semiconductors Lawndale, California
01295	Texas Instruments, Inc. Semiconductor Components Div. Dallas, Texas
01686	RCL Electronics Inc. Manchester, New Hampshire
01730	Deleted
01884	Dearborn Electronics Inc. Orlando, Florida
02114	Ferroxcube Corp. Saugerties, New York
02606	Replaced by 15801
02660	Amphenol-Borg Elect. Corp. Broadview, Illinois
02799	Arco Capacitors, Inc. Torrence, California
03508	General Electric Co. Semiconductor Products Syracuse, New York
03614	Replaced by 71400
03651	Replaced by 44655
03797	Eldema Corp. Compton, California
03877	Transitron Electronic Corp. Wakefield, Massachusetts
03888	Pyrofilm Resistor Co., Inc. Cedar Knolls, New Jersey
03911	Clairex Corp. New York, New York
03980	Muirhead Instruments, Inc. Mountainside, New Jersey
04009	Arrow Hart and Hegemen Electronic Company Hartford, Connecticut
04062	Replaced by 72136
04202	Replaced by 81312
04217	Essex Wire Corp. Wire & Cable Div. Anaheim, California
04221	Aemco, Div. of Midtex Inc. Mankato, Minnesota
04222	Aerovox Corp. (H-Q) Myrtle Beach, South Carolina
04645	Replaced by 75376
04713	Motorola Semiconductor Products Inc. Phoenix, Arizona
05082	Replaced by 94154
05236	Jonathan Mfg. Co. Fullerton, California
05277	Westinghouse Electric Corp. Semiconductor Dept. Youngwood, Pennsylvania
05278	Replaced by 43543
05397	Union Carbide Corp. Electronics Div. Cleveland, Ohio
05279	Southwest Machine & Plastic Co. Los Angeles, California
05397	Union Carbide Corp. Electronics Div. New York, New York
05571	Sprague Electric Co. Pacific Div. Los Angeles, California
05704	Alac, Inc. Glendale, California
05820	Wakefield Engineering Ind. Wakefield, Massachusetts
06001	General Electric Company Capacitor Department Irmo, South Carolina
06136	Replaced by 63743
06473	Amphenol Space & Missile Sys. Chatsworth, California
06555	Beede Electrical Instrument Co. Penacook, New Hampshire
06739	Electron Corp. Littletown, Colorado
06743	Clevite Corp. Cleveland, Ohio
06751	Semcor Div. Components Phoenix, Arizona
06860	Gould National Batteries Inc. City of Industry, California
06980	Varian
06980	Varian-Eimac San Carlos, California
07115	Replaced by 14674
07138	Westinghouse Electric Corp., Electronic Tube Division Elmira, New York
07256	Silicon Transistor Corp. Garden City, New York
07263	Fairchild Semiconductor Div. of Fairchild Camera & Instrument Corp. Mountain View, California
07344	Bircher Co., Inc. Rochester, New York
07792	Lerma Engineering Corp. Northampton, Massachusetts
07910	Teledyne Corp. (Continental Device) Hawthorne, California
08225	Industro Transistor Corp. Long Island City, New York
08530	Reliance Mica Corp. Brooklyn, New York
08792	Discontinued
08806	General Electric Co. Miniature Lamp Dept. Cleveland, Ohio
08863	Nylomatic Corp. Norrisville, Pennsylvania
08988	Skottie Electronics Inc. Archbald, Pennsylvania
09353	C and K Components Watertown, Massachusetts
09423	Scientific Components, Inc. Santa Barbara, California
09922	Burndy Corp. Norwalk, Connecticut
11236	CTS of Berne Berne, Indiana
11237	Chicago Telephone of Calif., Inc. (CTC) Paso Robles, California
11358	Discontinued
11403	Best Products Co. Chicago, Illinois

11503 Keystone Mfg.
Div. of Avis Industrial Corp.
Warren, Michigan

11726 Qualidyne Corp.
Santa Clara, California

12014 Chicago Rivet & Machine Co.
Bellwood, Illinois

12040 National Semiconductor Corp.
Danburry, Connecticut

12060 Diodes, Inc.
Chatsworth, California

12136 Philadelphia Handle Co.
Camden, New Jersey

12323 Presin Co., Inc.
Shelton, Connecticut

12327 Freeway Washer & Stamping Co.
Cleveland, Ohio

12400 Replaced by 75042

12617 Hamlin Inc.
Lake Mills, Wisconsin

12697 Clarostat Mfg. Co.
Dover, New Hampshire

12749 James Electronics
Chicago, Illinois

12856 Micrometals
Sierra Madre, California

12954 Dickson Electronics Corp.
Scottsdale, Arizona

12969 Unitrode Corp.
Watertown, Massachusetts

13103 Thermalloy Co.
Dallas, Texas

13511 Amphenol Corp.
Los Gatos, California

13606 Sprague Electric Co.
Transistor Div.
Concord, New Hampshire

13839 Replaced by 23732

14099 Semtech Corp.
Newbury Park, California

14193 California Resistor Corp.
Santa Monica, California

14298 American Components, Inc.
Conshohocken, Pennsylvania

14655 Cornell-Dubilier Electronics
Newark, New Jersey

14674 Discontinued, see 16299

14752 Electro Cube Inc.
San Gabriel, California

14869 Replaced by 96853

15636 Elec-Trol Inc.
Northridge, California

15801 Fenwal Electronics Inc.
Framingham, Massachusetts

15818 Amelco Semiconductor
Div. of Teledyne Inc.
Mountain View, California

15849 USECO, Inc.
Mt. Vernon, New York

15898 International Business
Machines (IBM)
Essex Junction, Vermont

15909 Replaced by 17870

16299 Corning Glass
Raleigh, North Carolina

16332 Replaced by 28478

16473 Cambridge Scientific Ind. Inc.
Cambridge, Maryland

16742 Paramount Plastics
Downey, California

16758 Delco Radio
Div. of General Motors
Kokomo, Indiana

17069 Circuit Structures Lab.
Upland, California

17856 Siliconix, Inc.
Sunnyvale, California

17870 Daven-Div of Thomas A. Edison
Ind. – McGraw - Edison Co.
Manchester, New Hampshire

18083 Deleted

18178 Vactec Inc.
Maryland Heights, Missouri

18612 Vishay Intertechnology
Inc.
Malvern, Pennsylvania

18736 Voltronics Corp.
Hanover, New Jersey

19429 Discontinued, use 89536

19451 Perine Machinery & Supply Co.
Seattle, Washington

19701 Electra Mfg. Co.
Independence, Kansas

20584 Enochs Mfg. Co.
Indianapolis, Indiana

20891 Self-Organizing Systems,
Inc.
Dallas, Texas

22767 ITT Semiconductors
Div. of ITT
Palo Alto, California

23732 Tracor
Rockville, Maryland

23880 Stanford Applied Engrng.
Santa Clara, California

24248 Southco
Div. of South Chester Corp.
Lester, Pennsylvania

24655 General Radio Co.
West Concord, Massachusetts

24759 Lenox-Fugle Electronics
Plainfield, New Jersey

25403 Amperex Electronic Corp.
Semiconductor & Receiving
Tube Division
Slatersville, Rhode Island

27014 National
Semiconductor
Corp.
Santa Clara, California

27264 Molex Products
Downers Grove, Illinois

28425 Bohannon Industries
Fort Worth, Texas

28478 Deltrol Controls,
Corp.
Milwaukee, Wisconsin

28480 Hewlett Packard
Co.
Palo Alto, California

28520 Heyman Mfg. Co.
Kenilworth, New Jersey

29083 Monsanto, Co., Inc.
Santa Clara, California

30323 Illinois Tool
Works, Inc.
Chicago, Illinois

32539 Mura Corp.
Great Neck, New York

32767 Griffith Plastic
Products Co.
Burlingame, California

32879 Advanced Mechanical
Components
Northridge, California

32897 Erie Technological
Products, Incorporated
Frequency Control Div.
Carlisle, Pennsylvania

33173 General Electric
Co., Tube Dept.
Owensboro, Kentucky

34333 Silicon General
Westminister, California

34335 Advanced Micro
Devices.
Sunnyvale, California

37942 Mallory, P. R. & Co., Inc.
Indianapolis, Indiana

42498 National Company
Melrose, Massachusetts

43543 Nytronics Inc.
Transformer Co. Div.
Alpha, New Jersey

44655 Ohmite Mfg. Co.
Skokie, Illinois

49671 Radio Corp. of America
New York, New York

49956 Raytheon Company
Lexington, Maine

53021 Sanamo Electric Co.
Springfield, Illinois

55026 Simpson Electric Company
Chicago, Illinois

56289 Sprague Electric Co.
North Adams, Massachusetts

58474 Superior Electric Co.
Bristol, Connecticut

60399 Torrington Mfg. Co.
Torrington, Connecticut

62460 Deleted

63743 Ward Leonard Electric Co.
Mount Vernon, New York

64834 West Mfg. Co.
San Francisco, California

65092 Weston Instruments Inc.
Newark, New Jersey

66150 Winslow Tele-Tronics Inc.
Asbury Park, New Jersey

70563 Amperite Company
Union City, New Jersey

70903 Belden Mfg. Co.
Chicago, Illinois

71002 Birnbach Radio Co., Inc.
New York, New York

71236 "ELMENCO"
Willimantic, Connecticut

71400 Bussmann Mfg.
Div. of McGraw - Edison Co.
Saint Louis, Missouri

71450 CTS Corp.
Elkhart, Indiana

71468 ITT Cannon Electric Inc.
Los Angeles, California

71482 Clare, C. P. & Co.
Chicago, Illinois

71590 Centralab
Div. of Globe Union Inc.
Milwaukee, Wisconsin

71707 Coto Coil Co., Inc.
Providence, Rhode Island

71744 Chicago Miniature Lamp Works
Chicago, Illinois

71785 Cinch Mfg. Co. & Howard
B. Jones Div.
Chicago, Illinois

72005 Driver, Wilber B., Co.
Newark, New Jersey

72092 Replaced by 06980

72136 Electro Motive Mfg. Co.
Willimantic, Connecticut

72259 Nytronics Inc.
Berkeley Heights, New Jersey

72354 Deleted

72619 Dialight Corp.
Brooklyn, New York

72653 G. C. Electronics
Rockford, Illinois

72665 Replaced by 90303

72794 Dzus Fastener Co., Inc.
West Islip, New York

72928 Gudeman Co. (Gulton
Industries)
Chicago, Illinois

72982 Erie Tech. Products Inc.
Erie, Pennsylvania

73138 Beckman Instruments Inc.
Helipot Division
Fullerton, California

73293 Hughes Aircraft Co.
Electron Dynamics Div.
Torrence, California

73445 Amperex Electronic Corp.
Hicksville, New York

73559 Carling Electric Inc.
Hartford, Connecticut

73586 Circle F Industries
Trenton, New Jersey

73734 Federal Screw Products, Inc.
Chicago, Illinois

Code	Manufacturer
73743	Fischer Special Mfg. Co. Cincinnati, Ohio
73899	JFD Electronics Co. Brooklyn, New York
73949	Guardian Electric Mfg. Co Chicago, Illinois
74199	Quam Nichols Co. Chicago, Illinois
74217	Radio Switch Corp. Marlboro, New Jersey
74276	Signalite Inc. Neptune, New Jersey
74306	Piezo Crystal Co. Carlisle, Pennsylvania
74542	Hoyt Elect. Instr. Works Penacook, New Hampshire
74970	Johnson, E. F., Co. Waseca, Minnesota
75042	IRC Inc. (Div. of TRW) Philadelphia, Pennsylvania
75376	Kurz-Kasch, Inc. Dayton, Ohio
75382	Kulka Electric Corp. Mount Vernon, New York
75915	Littlefuse Inc. Des Plaines, Illinois
76854	Oak Mfg. Co. Crystal Lake, Illinois
77342	Potter & Brumfield Div. of Amer. Machine & Foundry Princeton, Indiana
77969	Rubbercraft Corp. of Calif. LTD. Torrance, California
78189	Shakeproof Div. of Illinois Tool Works Elgin, Illinois
78277	Sigma Instruments, Inc. South Braintree, Massachusetts
78488	Stackpole Carbon Co. Saint Marys, Pennsylvania
78553	Tinnerman Products Cleveland, Ohio
79136	Waldes Kohinoor Inc. Long Island City, New York
79497	Western Rubber Company Goshen, Indiana
79963	Zierick Mfg. Corp. New Rochelle, New York
80031	Mepco Div. of Sessions Clock Co. Morristown, New Jersey
80145	API Instruments Co. Chesterland, Ohio
80183	Sprague Products North Adams, Massachusetts
80294	Bourns Inc. Riverside, California
80583	Hammarlund Co., Inc. Mars Hill, North Carolina
80640	Stevens, Arnold Inc. Boston, Massachusetts
81073	Grayhill Inc. La Grange, Illinois
81590	Korry Mfg. Co. Seattle, Washington
81312	Winchester Electronics Div. of Litton Industries Oakville, Connecticut
81439	Therm-O-Disc Inc. Mansfield, Ohio
81483	International Rectifier Corp. Los Angeles, California
82376	Deleted
82389	Switchcraft Inc. Chicago, Illinois
82415	Price Electric Corp. Frederick, Maryland
82872	Roanwell Corp. New York, New York
82877	Rotron Mfg. Co., Inc. Woodstock, New York
82879	ITT Wire & Cable Div. Pawtucket, Rhode Island
83003	Varo Inc. Garland, Texas
83298	Bendix Corp. Electric Power Division Eatontown, New Jersey
83330	Smith, Herman H., Inc. Brooklyn, New York
83478	Rubbercraft Corp. of America New Haven, Connecticut
83594	Burroughs Corp. Electronic Components Div. Plainfield, New Jersey
83740	Union Carbide Corp. Consumer Products Div. New York, New York
84171	Arco Electronics, Inc. Great Neck, New York
84411	TRW Ogallala, Nebraska
86577	Precision Metal Products Stoneham, Massachusetts
86684	Radio Corp. of America Electronic Components & Devices Harrison, New Jersey
86689	Deleted
87034	Marco-Oak Inc. Anaheim, California
88245	Litton Products Inc. Van Nuys, California
88419	Use 14655
88690	Replaced by 04217
89536	Fluke, John Mfg. Co., Inc. Seattle, Washington
89730	Replaced by 08806
90201	Mallory Capacitor Co. Indianapolis, Indiana
90215	Best Stamp & Mfg. Co Kansas City, Missouri
90211	Square D Co. Chicago, Illinois
90303	Mallory Battery Co. Tarrytown, New York
91293	Johanson Mfg. Co. Boonton, New Jersey
91407	Replaced by 58474
91502	Associated Machine Santa Clara, California
91637	Dale Electronics Inc. Columbus, Nebraska
91662	Elco Corp. Willow Grove, Pennsylvania
91737	Gremar Mfg Co., Inc. (ITT) Woburn, Massachusetts
91802	Industrial Devices, Inc. Edgewater, New Jersey
91836	King's Electronics Tuckahoe, New York
91929	Honeywell Inc. Micro Switch Div. Freeport, Illinois
91934	Miller Electric Co., Inc. Pawtucket, Rhode Island
93332	Sylvania Electric Products Semiconductor Products Div Woburn, Massachusetts
94145	Replaced by 49956
94154	Tung-Sol Div. of Wagner Electric Corp. Newark, New Jersey
95146	Alco Electronics Products Inc. Lawrence, Massachusetts
95263	Leecraft Mfg. Co. Long Island City, New York
95264	Replaced by 98278
95275	Vitramon Inc. Bridgeport, Connecticut
95303	Radio Corp. of America Solid State & Receiving Tube Div. Cincinnati, Ohio
95354	Methode Mfg. Corp. Rolling Meadows, Illinois
95712	Dage Electric Co., Inc. Franklin, Indiana
95987	Weckesser Co., Inc. Chicago, Illinois
96733	San Fernando Electric Mfg. Co. San Fernando, California
96853	Rustrak Instrument Co. Manchester, New Hampshire
96881	Thomson Industries, Inc. Manhasset, New York
97540	Master Mobile Mounts Div. of Whitehall Electronics Corp. Los Angeles, California
97913	Industrial Electronic Hdware Corp. New York, New York
97945	White, S. S. Co. Plastics Div. New York, New York
97966	Replaced by 11358
98094	Replaced by 49956
98159	Rubber-Teck, Inc. Gardena, California
98278	Microdot Inc. Pasadena, California
98291	Sealectro Corp. Conhex Div. Mamaroneck, New York
98388	Accurate Rubber & Plastics Culver City, California
98743	Replaced by 12749
98925	Deleted
99120	Plastic Capacitors, Inc. Chicago, Illinois
99217	Southern Electronics Corp. Burbank, California
99515	Marshall Industries Capacitor Div. Monrovia, California
99779	Barnes Corp. Lansdowne, Pennsylvania

Appendix B

List of Abbreviations

A, amp	ampere(s) (2.1A, 2.1 amp)
ampl	amplifier
ac	alternating current
assy	assembly
@	at
BCD	binary coded decimal
cap	capacitor
cm	centimeter
C	clear; reset
°C	celsius or centigrade (0° C)
cer	ceramic
clk	clock
cw	clockwise
CMRR	common mode rejection ratio
cbn cmpsn	carbon composition
ccw	counterclockwise
conn	connector
cbn flm	carbon film
CRT	cathode ray tube
cps	cycles per second (Hz preferred)
db	decibel
dep cbn	deposited carbon
dvm	digital voltmeter
dio	diode
dc	direct current
dpdt	double-pole, double-throw
dpst	double-pole, single-throw
elctlt	electrolytic
elek	electronic (equip.)
elex	electronics (science)
ext	external
°F	fahrenheit (32° F)
F	farad
FET	field effect transistor
Ge	germanium
g	giga or 10^9
G	gravity
gnd	ground
gmv	guaranteed minimum value
gd	guard
h	henry
Hz	Hertz (60Hz, 60gHz, 60 gigahertz)
hf	high frequency
"	inch(es) (6 3/4" or 0.575 feet)
IC	integrated circuit
if	intermediate frequency
intl	internal
kc	kilocycle (kilohertz preferred)
k	kilo or 10^3
lf	low frequency
mc	megacycle (megahertz preferred)
M	meg or mega or 10^6
met	metal
met flm	metal film
MOS	metal oxide silicon
μ	micro or 10^{-6} ($60\mu V$)
m	milli or 10^{-3}
mA	milliampere(s)
mm	millimeter
n	nano or 10^{-9}
neg	negative
Ω	ohm
scope	oscilloscope
ppm	parts per million
prv	peak inverse voltage
p-p	peak to peak
p	pico or 10^{-12} (300pF)
plstc	plastic
±	plus or minus
pos	positive
pps	pulses per second
PCB	printed circuit board
QTY	quantity
rf	radio frequency
rfi	radio frequency interference
RECM	recommended
REF	reference
RH	relative humidity
res	resistor
rms	root mean square
rtry	rotary
s	second
sect	section
SERNO	serial number
Si	silicon
scr	semiconductor controlled rectifier
spdt	single-pole, double-throw
spst	single-pole, single-throw
sw	switch
Ta	tantalum
TC	temperature coefficient
t	tera or 10^{12}
xfmr	transformer
xstr	transistor
tvm	transistor voltmeter
uhf	ultra high frequency
vtvm	vacuum tube voltmeter
var	variable
vs	versus
vhf	very high frequency
vlf	very low frequency
V	volt (115Vac)
VCO	voltage controlled oscillator
w	watt
ww	wire wound

Appendix C

Sales Representatives

ALABAMA
HUNTSVILLE
BSC Associates, Inc.
3322 S. Memorial Parkway
P.O. Box 1273
Tel. (205) 881-6220
Zip 35807

ALASKA
SEATTLE
Showalter-Judd, Inc.
1806 S. Bush Place
Seattle, Washington 98144
Tel. (206) 324-7911

ARIZONA
PHOENIX
Barnhill Associates
537 E. Osborn Road, Suite 4
Tel. (602) 263-1250
Zip 85012

CALIFORNIA
LOS ANGELES
Instrument Specialists, Inc.
1109 S. Central Ave.
Glendale, California 91204
Tel (213) 245-9404

SANTA CLARA
Instrument Specialists, Inc.
2359 De La Cruz Blvd.
Tel. (408) 244-1505
Zip 95050

SAN DIEGO
Instrument Specialists, Inc.
1909 State St.
Tel. (714) 232-2017
Zip 92101

COLORADO
DENVER
Barnhill Associates
1170 S. Sheridan Blvd.
Tel. (303) 934-5505
Zip 80226

CONNECTICUT
HARTFORD
Instrument Representatives, Inc.
P. O. Box 165
Glastonbury, Connecticut 06033
Tel (203) 633-0777

FLORIDA
ORLANDO
BCS Associates, Inc.
940 N. Fern Creek Ave.
P.O. Box 6578
Tel. (305) 843-1510
Zip 32803

GEORGIA
ATLANTA
BCS Associates, Inc.
1230 Briar Hill Dr.
Tel. (404) 874-9925
Zip 30306

HAWAII
HONOLULU
Industrial Electronics, Inc.
646 Queen Street
P.O. Box 135
Tel. (808) 533-6095
Zip 96817

ILLINOIS
CHICAGO
Cozzens & Cudahy, Inc.
9501 W. Devon Ave.
Rosemont, Illinois 60018
Tel. (312) 825-1144

INDIANA
INDIANAPOLIS
Cozzens & Cudahy, Inc.
Port O'Call Executive Ctr.
21 Beachway Drive
Tel. (317) 244-2456
Zip 46234

MARYLAND
BALTIMORE
Electronic Marketing Assoc. Inc.
11501 Huff Court
Kensington, Maryland 20795
Tel. (301) 881-5300, 744-7700

MASSACHUSETTS
BOSTON
Instrument Representatives, Inc.
1046 Massachusetts Avenue
Arlington, Massachusetts 02174
Tel. (617) 646-1034

MICHIGAN
DETROIT
WKM Associates, Inc.
1474 East Outer Dr.
Tel. (313) 892-2500
Zip 48234

MINNESOTA
MINNEAPOLIS
Cozzens & Cudahy, Inc.
7450 France Ave. So.
Tel. (612) 920-1022
Zip 55435

MISSOURI
ST. LOUIS
Cozzens & Cudahy, Inc.
P. O. Box 10013
Lambert Field - Zip 63145
Tel. (314) 423-1234

NEW JERSEY
NEWARK
SBM Representatives
1519 Stuyvesant Avenue
Union, New Jersey 07083
Tel. (201) 687-8737

NEW MEXICO
ALBUQUERQUE
Barnhill Associates
1410—D Wyoming N.E.
Tel. (505) 299-7658
Zip 87110

NEW YORK
NEW YORK
SBM Representatives
28 Hobby Street
Pleasantville, N.Y. 10570
Tel. (914) 769-1811

ROCHESTER
SBM Representatives
4515 Culver Rd.
Tel. (716) 226-1400
Zip 14622

NORTH CAROLINA
GREENSBORO
BCS Associates, Inc.
1039 E. Wendover Ave.
P.O. Box 6426
Tel. (919) 273-1918
Zip 27405

OHIO
CLEVELAND
WKM Associates, Inc.
16141 Puritas Ave.
Tel. (216) 267-0445
Zip 44135

DAYTON
WKM Associates, Inc.
6073 Far Hills Ave.
Tel. (513) 434-7500
Zip 45429

OREGON
PORTLAND
Showalter-Judd, Inc.
1445 N. E. Arrington
Hillsboro, Oregon 97123
Tel. (503) 648-6372

PENNSYLVANIA
PHILADELPHIA
Electronic Marketing Assoc.
210 Goddard Blvd.—Suite 100
King of Prussia, Pennsylvania
Tel (215) 248-5050
Zip 19406

PITTSBURGH
WKM Associates, Inc.
90 Clairton Blvd.
Tel. (412) 892-2953
Zip 15236

TEXAS
DALLAS
Barnhill Associates
Suite 220
312 N. Central Express Wy.
Richardson, Texas 75080
Tel. (214) 231-2573

HOUSTON
Barnhill Associates
Suite 332
3810 Westheimer
Tel. (713) 621-0040
Zip 77027

EASTERN VIRGINIA
WILLIAMSBURG
BCS Associates, Inc.
107 Rich Neck Road
Tel. (703) 229-5108
Zip 23185

WASHINGTON
SEATTLE
Showalter-Judd, Inc.
1806 S. Bush Place
Seattle, Washington 98144
Tel. (206) 324-7911

CANADA

BRITISH COLUMBIA
VANCOUVER
Allan Crawford Associates, Ltd.
1820 Pandora St.
Tel. (604) 253-7136

ONTARIO
MALTON
Allan Crawford Associates, Ltd.
6427 Northam Drive.
Tel. (416) 678-1500

OTTAWA, 3
Allan Crawford Associates, Ltd.
376 Churchill Ave. — Suite 106
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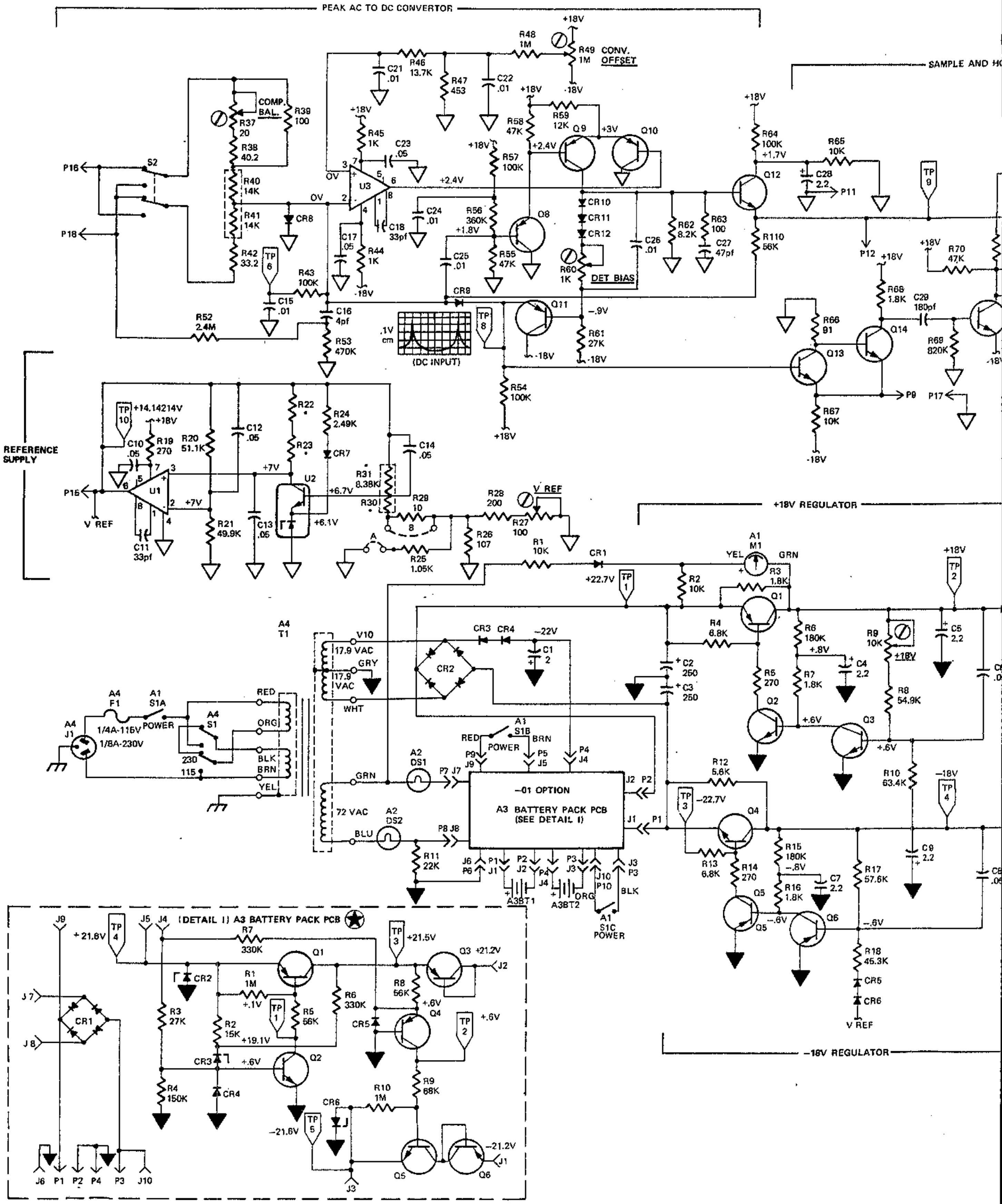
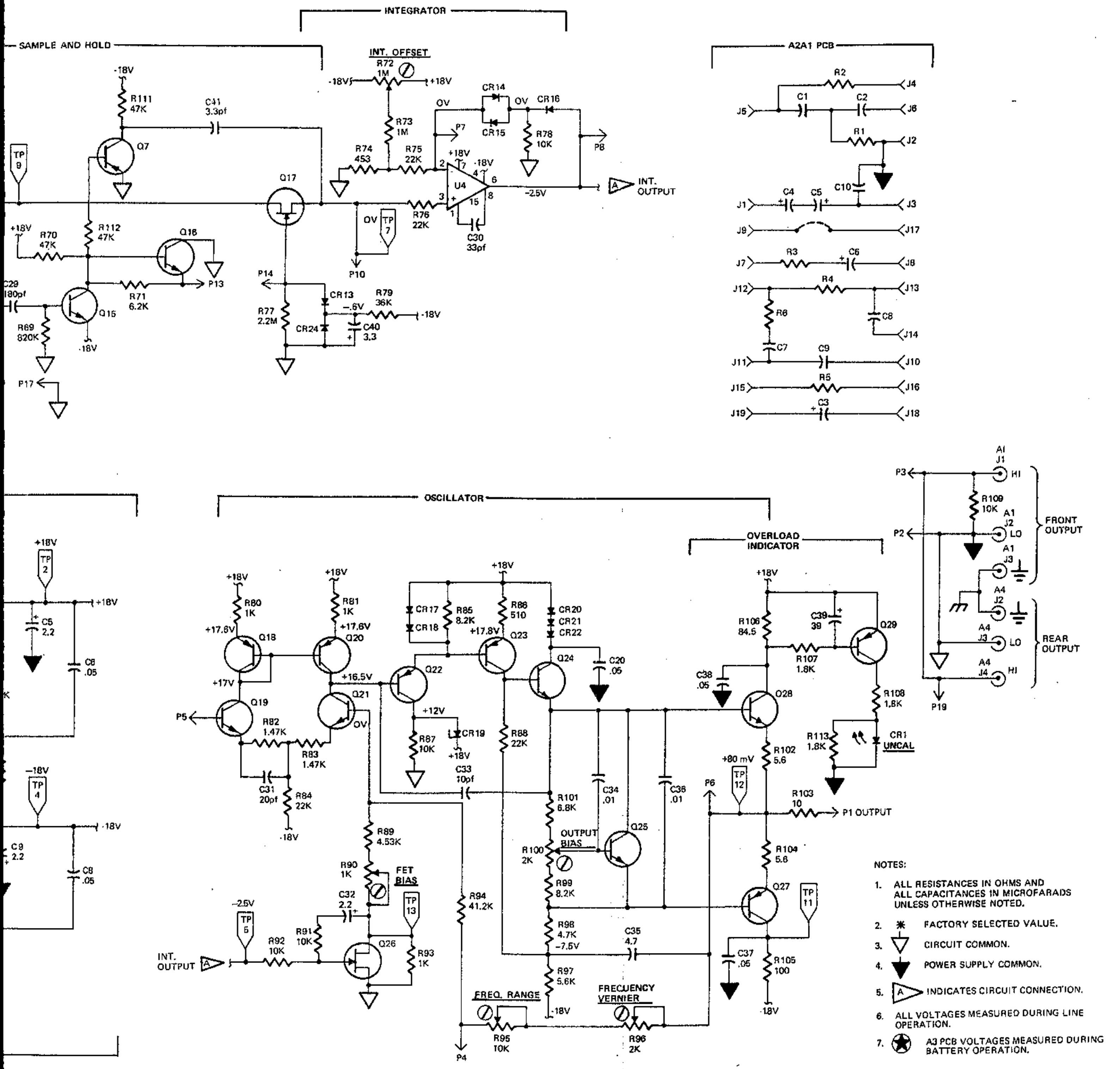
DWG. 510A-1002
SHT. 1 OF 2



DWG. 510A-1002
SHT. 2 OF 2



NOTES:

1. ALL RESISTANCES IN OHMS AND ALL CAPACITANCES IN MICROFARADS UNLESS OTHERWISE NOTED.
2. ✱ FACTORY SELECTED VALUE.
3. ▽ CIRCUIT COMMON.
4. ▼ POWER SUPPLY COMMON.
5. A▷ INDICATES CIRCUIT CONNECTION.
6. ALL VOLTAGES MEASURED DURING LINE OPERATION.
7. ★ A3 PCB VOLTAGES MEASURED DURING BATTERY OPERATION.

FUNCTIONAL SCHEMATIC DIAGRAM

MODEL 510A

AC REFERENCE STANDARD

Drawing No. 510A-1002	REV.
	a

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