AlliedSignal

ELECTRONIC AND AVIONICS SYSTEMS

MAINTENANCE MANUAL

BENDIX/KING®

KR 87

AUTOMATIC DIRECTION FINDER

KI 227/228

ADF INDICATORS

MANUAL NUMBER 006-05184-0007

REVISION 7, JULY, 1998

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ITEM	ACTION
Title Pages, All	Remove and Replace
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KR 87 MM Pages 6-100.1 thru 6-100.8	Insert after 6-100

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ITEM	ACTION
Title Page	Remove and Replace
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KR 87 MM Table of Contents	Remove and Replace
KR 87 MM Section 5	Remove and Replace
KR 87 MM Section 6	Remove and Replace
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KI 227/228 MM Section 4	Remove and Replace
KI 227/228 MM Section 5	Remove and Replace
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ITEM	ACTION
KR 87 MM Title Page	Remove and Replace
KR 87 MM Revision History	Insert Behind Title Page
KR 87 IM	Remove and Replace

REVISION HISTORY AND INSTRUCTIONS

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Revision 4
006-00184-0004

KR87 Maintenance Manual
Revision 2
006-05201-0002

KI227/228 Maintenance Manual
Rev. 0
006-05202-0000

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PAGE	ACTION
KR 87 Installation Manual	Remove and Replace

MANUAL: KR 87/KI 227/228 Maintenance Manual
REVISION: 3, November, 1985
PART NUMBER: 006-5184-03

Add delete or replace pages as indicated below. Insert this page immediately behind the Title Page as a record of revisions. This revision level of this manual contains the following individual publications:

KR 87 Installation Manual
Revision 3
006-0184-03

KR 87 Maintenance Manual
Revision 2
006-5219-02

KI 227/228 Maintenance Manual
Revision 2
006-5220-02

PAGE	ACTION
KR 87/KI 227/KI 228 MM Title Page	Replace
KR 87/KI 227/KI 228 MM Revision History	Add; insert immediately behind Title Page
KR 87 Installation Manual	Replace
KR 87 MM Title Page	Replace
KI 227/KI 228 MM Title Page	Replace

KING RADIO MAINTENANCE MANUAL REVISION INSTRUCTIONS AND HISTORY

MANUAL KR 87 KPN 006-5184-02

REVISION 2, DECEMBER, 1980

Where R&R appears in the action column, remove the page now in the maintenance manual and replace it with the enclosed page; otherwise, ADD or DESTROY pages as listed. Retain these instructions in the front of the maintenance manual as a Record of Revisions.

PAGE	ACTION	REASON FOR CHANGE
KR 87 SECTION		RETAIN ALL TABS
COVER	R&R	UPDATED
REV HIST	ADD	2ND REVISION
TABLE OF CONTENTS	R&R	UPDATED
4 - 7	R&R	ADDED KA 44B INFORMATION
4 - 11	R&R	ADDED KA 44B INFORMATION
5 - 1	R&R	ADDED KA 44B INFORMATION
5 - 3	R&R	ADDED KA 44B INFORMATION
5 - 5	R&R	5.2.2.2 CHANGED ENABLE TO DISABLE ON LOOP SWITCH 5.2.2.3 ADDED SENTENCE AFTER....IN THE ADF MODE.
5 - 6	R&R	ADDED KA 44B INFORMATION
5 - 7	R&R	ADDED KA 44B INFORMATION AND 5.2.3.1B CHANGED PIN E TO 6 P302.
5 - 12	R&R	5.2.3.3 TP 207 CHANGED TO TP 507. CHANGED 2.048KHz to MHz.
5 - 13	R&R	5.2.3.7 NOTE: TP 207 to TP 507
5 - 14	R&R	ADDED KA 44B INFORMATION
5 - 15	R&R	ADDED KA 44B INFORMATION
5 - 17	R&R	ADDED KA 44B INFORMATION
5 - 19	R&R	ADDED KA 44B INFORMATION
5-21/5-49	R&R	RETYPED
SECTION 6	R&R	UPDATED
KA 44 SECTIONS	R&R	UPDATED AND ADDED KA 44B INFORMATION
KA 44B SECTIONS	ADD	INSERT AFTER THE KA 44 SECTION
KI 227/ 228 SECTION 6 ONLY	R&R	UPDATED
KTS 156 SECTIONS	R&R	UPDATED AND ADDED KA 44B INFORMATION

KING RADIO MAINTENANCE MANUAL REVISION INSTRUCTIONS AND HISTORY

MANUAL KR 87

REVISION 1

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PAGE	ACTION	REASON FOR CHANGE
COVER	R & R	NEW REVISION
REV. HIST.	ADD	1st REVISION
REV. PACKAGE	ADD	ADDED KTS 156 TEST SET TO KR 87 (Insert in front of Appendix Tab.)

INSTALLATION MANUAL
SECTIONS I, II AND III

Sections I, II, and III have been deleted from the Maintenance-Overhaul Manual format. The Installation Manual, which covers the same information, should be placed behind this tab to complete your technical library for each unit. It is recommended that the entire Installation Manual be removed and replaced when a revision is issued. The revision number and date of revision are printed on each Installation Manual cover page.

AlliedSignal

ELECTRONIC AND AVIONICS SYSTEMS

INSTALLATION MANUAL

BENDIX/KING®

KR 87

AUTOMATIC DIRECTION FINDER

MANUAL NUMBER 006-00184-0005

REVISION 5, DECEMBER, 1996

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SECTION I

GENERAL INFORMATION

1.1 INTRODUCTION

This manual contains information relative to the physical, mechanical, and electrical characteristics of the Bendix/King Silver Crown KR 87 Automatic Direction Finder, the KI 227 and KI 228 ADF Indicators, and the KA 44 and KA 44B ADF Antennas. Installation and operating instructions are also included. Information concerning the maintenance and repair of this equipment may be found in the KR 87/KI 227/KI 228 Maintenance/Overhaul Manual, P/N 006-05184-XXXX, and the KA 44/ KA 44B/ KTS 156 Maintenance/Overhaul Manual, P/N 006-05535-XXXX.

1.2 EQUIPMENT DESCRIPTION

The KR 87 Automatic Direction Finder is a digitally tuned solid state receiver which provides bearing information to stations in the 200 KHz to 1799 KHz frequency band and which also provides audio reception to enable the pilot to identify stations and listen to transcribed weather broadcasts or commercial radio stations in the AM broadcast band. The unit features a gas- discharge display that displays the active ADF frequency in the left window. The right window will display either the standby frequency (which can be transferred to the active window) or a flight timer or programmable elapsed timer. The flight timer will keep track of the total flight time, while the independent programmable elapsed timer can be reset to count up from zero or preset to a value and count down to zero. This feature will prove especially valuable for non- precision timed approaches, fuel management, dead reckoning navigation, etc.

An automatic dimming circuit adjusts the brightness of the display to compensate for changes in ambient light level. A single-chip microprocessor is used to control the display, provide the timer functions, control the tuning circuitry, and provide timing reference signals. A non- volatile electrically alterable memory (EAROM) is used to store the active and standby frequencies even after the unit is turned off. The tuning circuitry utilizes a single reference frequency crystal and a large scale integrated circuit (LSI).

The KR 87 is an extremely compact ADF, requiring only 1.3 inches of panel height. Power consumption is only 12 watts at any input voltage, therefore, forced air cooling is not required.

The KI 227 is a single needle ADF Indicator and is the basic indicator used with the KR 87. The KI 227 is available with a manually rotatable compass card or with a slaved compass card that can be interfaced to the stepper motor output of the KCS 55/55A Pictorial Navigation System. The KI 228 is a dual needle ADF Indicator and is also available with manual or slaved compass cards.

The KA 44 and KA 44B ADF Antennas contain both loop and sense amplifiers, preamplifiers, and modulators which combine the loop and sense antenna signals into a single RF signal which is output to the KR 87 via a triaxial cable of non-critical length.

A complete system includes the KR 87 ADF Receiver, a KA 44 or KA 44B ADF Antenna, and an ADF Indicator such as the KI 227 or KI 228. The KR 87 may also be interfaced to the Bendix/King KI 229 or KNI 582 RMI's.

1.3 TECHNICAL CHARACTERISTICS

1.3.1 KR 87 ADF RECEIVER

SPECIFICATION	CHARACTERISTIC
TSO COMPLIANCE:	TSO C41c Class A DO-160 Env.. Cat A1D1/A/SKP/XXXXXX/ZBABA
APPLICABLE DOCUMENTS:	RTCA DO-142
ENVIRONMENTAL SPECIFICATIONS:	
Temperature	-20°C to +55°C
Altitude	Up to 50,000 feet
Humidity	95% + RH at 50°C for 48 hours
PHYSICAL DIMENSIONS: (including mounting rack)	
Length (behind aircraft control panel)	10.73 in (27.25 cm)
Width	6.32 in (16.05 cm)
Height	1.35 in (3.43 cm)
WEIGHT:	
Without rack and connectors	2.9 lb (1.32 Kg) nominal
With rack and connectors	3.2 lb (1.47 Kg) nominal
POWER REQUIREMENTS:	
066-1072-00/01/03/04/06/07/17:	11 to 33 VDC, 12W typical 13.75 ± 0.5 VDC 0.9A max
066-1072-14:	11 to 33 VDC, 12W typical 13.75 ±0.5 VDC 1.031A max
066-1072-02/05:	27.5 ±0.5 VDC 0.45A max w/ one load 27.5 ±0.5 VDC 0.56A max w/ two loads
066-1072-15:	27.5 ±0.5 VDC 0.515A max w/ one load 27.5 ±0.5 VDC 0.625A max w/ two loads
MAXIMUM LIGHTING CURRENT	
066-1072-00/01/02/03/04/05:	13.75 VDC±0.5 VDC applied @ Pin L, and Pin 9 grounded; .252Amps Max 27.5 VDC ±0.5VDC applied @ Pin 9, and Pin L open; .126Amps Max
066-1072-06/07:	4.5 VDC ±0.1VDC applied @ Pin L and Pin 9 grounded; .635 Amps Max
066-1072-14/15:	13.75 VDC ±0.5 VDC applied @ Pin L, and Pin 9 grounded; .383 Amps Max

SPECIFICATION	CHARACTERISTIC
066-1072-17:	27.5 VDC ±0.5 VDC applied @ Pin 9, and Pin L open; .191 Amps Max 4.5 VDC ±0.1 VDC applied @ Pin L, and Pin 9 grounded; 1.031 Amps Max
DISPLAY INFORMATION:	
Left Window	Active ADF frequency (displayed at all times)
Right Window (FRQ Mode)	Standby frequency
Right Window (FLT Mode)	Flight timer
Right Window (ET Mode)	Elapsed timer
Right Window (ET SET Mode)	Preset value for timer countdown
FREQUENCY RANGE:	200 KHz to 1799 KHz in 1 KHz increments.
RECEIVER SENSITIVITY:	
ADF Mode	150uV/m max for s+n/n = 6dB
ANT Mode	70uV/m max for s+n/n = 6dB
RECEIVER SELECTIVITY:	
6dB Bandwidth	± 2 KHz max off center frequency
80dB Bandwidth	±7 KHz max off center frequency
SPURIOUS RESPONSE:	80dB down ±12KHz from center frequency
CROSS MODULATION/ INTER MODULATION:	
50 to 550 KHz	66dB min.
550 KHz to 150 MHz	72dB min.
ADF BEARING ACCURACY:	± 3° from 70uV/m to 0.5V/m RF input signal level
ADF INDICATOR SPEED:	7 sec max with indicator 175° off bearing and 70uV/m to 0.5V/m RF input signal level
INDICATOR DRIVE:	DC sine and cosine voltages 4.5 ± 3.0VDC at 150mA max
AUDIO OUTPUT:	50mW across 500Ω
ALARM OUTPUT:	Maximum current 1.0A. Maximum open circuit voltage 33VDC.
SUPER FLAG OUTPUT:	
14 VDC A/C	Valid=12VDC @ 250mA
28VDC A/C	Valid=26VDC @ 250mA

1.3.2 KI 227 ADF INDICATOR

SPECIFICATION	CHARACTERISTIC
TSO COMPLIANCE:	TSO C41c Class A DO-160 Env. Cat A1D1/A/SKP/XXXXXX/ZBABA
ENVIRONMENTAL SPECIFICATIONS:	
Temperature	-20°C to +55°C
Altitude	Up to 50,000 feet
Humidity	95% + RH at 50°C for 48 hours
PHYSICAL DIMENSIONS: (with connector)	
Length	2.73 in (6.92cm)
Width	3.26 in (8.28 cm)
Height	3.26 in (8.28 cm)
WEIGHT (with connector):	0.7 lb (0.32 Kg) nominal
POWER REQUIREMENTS:	
Lighting	14VDC at 0.16A or 28VDC at 0.08A
Compass Card Drive	12VDC at 0.12A
ADF BEARING INPUT:	DC sine and cosine voltages, ±3.0VDC max across each winding
COMPASS CARD INPUT: (066-3063-01 only)	2 phase digital stepper motor signals from KCS 55/55A Compass System
HEADING SELECTOR:	
066-3063-00	Manual
066-3063-01	Manually synchronized stepper motor drive

1.3.3 KI 228 ADF INDICATOR

SPECIFICATION	CHARACTERISTIC
TSO COMPLIANCE:	TSO C41c Class A DO-160 Env. Cat A1D1/A/SKP/XXXXXX/ZBABA
ENVIRONMENTAL SPECIFICATIONS:	
Temperature	-20°C to +55°C
Altitude	Up to 50,000 feet
Humidity	95% + RH at 50°C for 48 hours
PHYSICAL DIMENSIONS: (with connector)	
Length	4.88 in (12.38 cm)

Width Height	3.26 in (8.28 cm) 3.26 in (8.28 cm)
WEIGHT (with connector):	0.91 lb (0.41 Kg) nominal
POWER REQUIREMENTS: Lighting Compass Card Drive	 14VDC at 0.16A or 28VDC at 0.08A 12VDC at 0.12A
ADF BEARING INPUT:	DC sine and cosine voltages, ±3.0VDC max across each winding for each pointer
COMPASS CARD INPUT: (066-3059-01 only)	2 phase digital stepper motor signals from KCS 55/55A Compass System

SPECIFICATION	CHARACTERISTIC
HEADING SELECTOR: 066-3059-00 066-3059-01	 Manual Manually synchronized stepper motor drive

1.3.4 KA 44 ADF ANTENNA

SPECIFICATION	CHARACTERISTIC
TSO COMPLIANCE:	TSO C41c Class A DO-160 Env. Cat B2D2/A/LJY/XXXXXX/ABABA
ENVIRONMENTAL SPECIFICATIONS: Temperature Altitude Humidity	 -20°C to +55°C Up to 50,000 feet 95% + RH at 50°C for 48 hours
APPROXIMATE VERTICAL HEIGHT (from A/C fuselage):	9.0 in (22.9 cm)
WEIGHT:	2.0 lb (0.91 Kg) nominal
POWER REQUIREMENTS:	9VDC at 80mA max (supplied by KR 87)

1.3.5 KA 44B ADF ANTENNA

SPECIFICATION	CHARACTERISTIC
TSO COMPLIANCE:	TSO C41c Class A DO-160 Env. Cat B2D2/A/LJY/XXXXXX/ABABA
ENVIRONMENTAL SPECIFICATIONS: Temperature Altitude Humidity	 -20°C to +55°C Up to 50,000 feet 95% + RH at 50°C for 48 hours

SPECIFICATION	CHARACTERISTIC
APPROXIMATE VERTICAL HEIGHT (from A/C fuselage):	2.1 in (5.33 cm)
WEIGHT:	4.2 lb (1.89 Kg) nominal
POWER REQUIREMENTS:	9VDC at 80mA max (supplied by KR 87)

1.4 UNITS AND ACCESSORIES SUPPLIED

1.4.1 KR 87 ADF RECEIVER

The KR 87, P/N 066-1072-XX, is available in the following versions:

066-1072-	-00	-01	-02	-03	-04	-05	-06	-07	-14	-15	-17
14/28 VOLT	X	X	–	X	X	–	X	X	X	–	X
28 VOLT ONLY	–	–	X	–	–	X	–	–	–	X	–
STD LENS	X	–	X	–	X	X	N/A	X	X	X	X
SHINY LENS	–	X	–	X	–	–	N/A	–	–	–	–
SNGL IND	X	X	–	X	X	–	X	X	X	–	X
DUAL IND	–	–	X	–	–	X	–	–	–	X	–
SUPER FLAG	–	–	–	–	X	X	X	X	X	X	X
5V LAMPS	–	–	–	–	–	–	X	X	–	–	X
14/28 V LAMPS	X	X	X	X	X	X	–	–	X	X	–
CLR LIGHT	X	X	X	X	X	X	–	–	X	X	–
BLUE LIGHT	–	–	–	–	–	–	X	X	–	–	X
BACKLIT NOMENCLATURE	–	–	–	–	–	–	–	–	X	X	X

1.4.2 KI 227 ADF INDICATOR

The KI 227, P/N 066-3063-XX, is a single needle ADF Indicator and is the standard indicator for the KR 87. The KI 227, P/N 066-3063-00, has a manually rotatable compass card. KI 227, P/N 066-3063-01, has a slaved compass card which may be interfaced to the stepper motor output of the KCS 55/55A Compass System.

1.4.3 KI 228 ADF INDICATOR

The KI 228, P/N 066-3059-XX, is a dual needle ADF Indicator which will accept ADF bearing information from two KR 87's. The KI 228, P/N 066-3059-00, has a manually rotatable compass card. The KI 228, P/N 066-3059-01, has a slaved compass card which may be interfaced to the stepper motor output of the KCS 55/55A Compass System.

1.4.4 KA 44 ADF ANTENNA

The KA 44, P/N 071-1196-00, is a blade type ADF Antenna which contains both loop and sense antennas, preamplifiers, and modulators which combine the antenna signals into a single RF signal which is output to the KR 87 via a triaxial cable of non-critical length. This antenna is NO LONGER AVAILABLE.

1.4.5 KA 44B ADF ANTENNA

The KA 44B, P/N 071-1234-XX, is a low profile ADF Antenna which contains both loop and sense antennas, preamplifiers, and modulators which combine the antenna signals into a single RF signal which is output to the KR 87 via a triaxial cable of non-critical length. The KA 44B is available in three versions. KA 44B antenna P/N 071-1234-00 includes a mounting plate. KA 44B P/N 071-1234-01 includes a grounding ring. KA 44B P/N 071-1234-02 has no mounting plate and has the QE adjust accessible vertically.

1.4.6 KR 87 INSTALLATION KIT

The KR 87 Installation Kit, P/N 050-01756-XXXX, is available is seven versions which contain antenna cable assemblies in 12, 24, 36, or 48 foot lengths. Antenna cable length is not critical and any of the cable assemblies may be shortened as required by a particular installation. Kit identification and contents are shown below.

P/N	DESCRIPTION	UM	-0000	-0001	-0002	-0003	-0004	-0005	-0006
006-00538-0000	IS KR87	EA	1	1	1	1	1		
006-08126-0000	KR 87 INSTR SHT	EA	1	1	1	1	1	1	1
030-00101-0000	PANEL MNT PLUG	EA	1	1	1	1	1	1	1
030-01094-0051	CONN W/KEY	EA	1	1	1	1	1	1	1
030-01107-0030	CONNECTOR TERM 30T	EA	1	1	1	1	1	1	1
047-04956-0003	BACKUP PLATE	EA							1
047-05657-0001	GRNDG RING W/F	EA							1
047-05657-0011	GRNDG RING .015 THK	EA						1	
047-10794-0001	ADAPTER PLATE	EA						1	
057-02259-0000	ANT MTG TEMPLATE	EA	1	1	1	1	1	1	1
076-01042-0001	FERRULE W/F	EA	1	1	1	1	1	1	1
089-02051-0024	NUT SPEED U 6-32	EA	4	4	4	4	4	4	4
089-02191-0022	NUT LOCK 6-32	EA	1	1	1	1	1	1	1
089-02353-0001	NUT CLIP 6-32	EA	6	6	6	6	6	6	6
089-05534-0020	SCR FLHP 1/4-28	EA						2	2
089-05534-0036	SCR FLHP 1/4-28	EA						2	2
089-05878-0007	SCR PHP 4-40X7/16	EA	2	2	2	2	2	2	2
089-05907-0006	SCR PHP 6-32X3/8	EA	1	1	1	1	1	1	1
089-06012-0008	SCR FHP 6-32X1/2	EA	6	6	6	6	6	6	6
090-00019-0007	RING RTNR .438	EA	1	1	1	1	1	1	1
091-00072-0002	CABLE CLAMP 2	EA	1	1	1	1	1	1	1
200-02586-0000	ANTENNA CABLE ASSY	EA	1						
200-02586-0001	ANTENNA CABLE ASSY	EA		1					
200-02586-0002	ANTENNA CABLE ASSY	EA			1				
200-02586-0003	ANT CBL ASSY 48FT	EA				1			
200-02586-0004	ANT CABLE NON-PVC	EA					1	1	1

1.4.7 KI 227/228 INSTALLATION KIT

The KI 227/228 Installation Kit, P/N 050-01808-0000/0001, (-0000 has solder-type connections, -0001 has crimp-type connections) contains the following parts:

P/N	DESCRIPTION	UM	-0000	-0001
030-01008-0000	LVR/PVT ASSY	EA	2	2
030-01009-0000	HOOD CONN	EA	1	1
030-01280-0001	CONNECTOR SOCKET	EA		14
030-02000-0000	CONN 14 PIN FEM	EA	1	
030-03248-0000	CONN RCPT HOUSING	EA		1
090-00348-0000	GUIDE PILOT/SCKT	EA		1
090-00348-0001	GUIDE PILOT/SCKT	EA		1

1.5 ACCESSORIES REQUIRED BUT NOT SUPPLIED

A. Alarm Device (Sonalert), P/N 038-00008-0000, with bracket, P/N 047-03748-0001, or equivalents are required if the system is to be configured with an audible alarm.

B. Pressure Sensor, P/N 071-01247-0000, may be used to control flight timer operation. See Section II of this manual for further information.

1.6 LICENSE REQUIREMENTS

NONE

1.7 REQUIREMENTS FOR A FULLY TSO'D SYSTEM

The KR 87 with a KA 44 or KA 44B ADF Antenna and an appropriate indicator comprise a fully TSO'd ADF system. Compatible indicators include the following:

A. Bendix/King KI 227 ADF Indicator

B. Bendix/King KI 228 ADF Indicator

C. Bendix/King KI 229 RMI

D. Bendix/King KNI 582 RMI

SECTION II

INSTALLATION

2.1 GENERAL INFORMATION

This section contains suggestions and factors to consider before installing the KR 87 ADF System. Close adherence to these suggestions will assure a more satisfactory level of performance from the system. Read this section carefully before attempting the installation.

The conditions and tests required for TSO approval of this article are minimum performance standards. It is the responsibility of those desiring to install this article either on or within a specific type or class of aircraft to determine that the aircraft installation conditions are within TSO standards. The article may be installed only if further evaluation by the applicant documents an acceptable installation and is approved by the Administrator.

2.2 UNPACKING AND INSPECTING EQUIPMENT

Unpack the equipment carefully and inspect each item for evidence of damage incurred during shipment. If a damage claim must be filed, save the shipping container and all packing materials to substantiate your claim. The claim should be filed as soon as possible. The shipping container and packing material should be saved in any case in the event that storage or reshipment of the equipment is necessary.

2.3 EQUIPMENT INSTALLATION

2.3.1 COOLING CONSIDERATIONS

The most important contribution to improved reliability of avionics equipment is to limit the maximum operating temperature of each unit. While modern designs consume less total energy, the heat dissipated per unit volume (Watts/cubic inch) remains much the same due to contemporary high density packaging techniques. While each individual unit may or may not require forced air cooling, the combined heat generated by several units operating in a typical panel or rack can significantly degrade the reliability of the equipment if provisions for adequate cooling are not incorporated in the initial installation.

2.3.2 KR 87 MOUNTING TRAY INSTALLATION

A. Select a location on the instrument panel that is clearly visible and readily accessible to the pilot. The KR 87 must be mounted at least 12 inches from the magnetic compass. Remember to allow adequate space at the rear of the unit for installation of cables and connectors. Avoid sharp bends in the cables and be careful not to route cables where they might interfere with aircraft control cables.

CAUTION

Avoid mounting the unit near heater vents or other high heat sources, or near alternator wiring, inverter supplies, or 400 Hz compass system cabling.

B. Refer to **Figure 2-17** for the panel cutout dimensions. Mark and cut the panel opening.

C. Install the mounting rack in the aircraft panel using six (6) 6-32 X 1/2" flat head phillips screws (P/N 089-06012-0008) and six (6) 6-32 clip nuts (P/N 089-02353-0001) as shown in **Figure 2-18**. Note that the screws are inserted from the inside through holes in the side of the rack.

2.3.3 KI 227/228 INSTALLATION

A. Select a location on the instrument panel that is clearly visible to the pilot with the least practicable deviation from his normal position and from his line of vision when looking forward along the flight path. Remember to allow adequate space at the rear of the unit to allow installation and removal of the rear connector.

CAUTION

> Avoid mounting the KI 227 or KI 228 close to heater vents or other high heat sources.

B. Cut the panel cutout and drill mounting holes as shown in **Figures 2-19** or **2-20**.

C. Secure the indicator to the instrument panel using three (3) 6-32 X 1/2" flat head screws (installer supplied). The indicator may be secured from the front or rear of the instrument panel.

2.3.4 KA 44/44B INSTALLATION

A. Location Considerations

The antenna installation will determine to a large extent whether or not the KR 87 will give optimum performance. The KA 44/44B contains both the loop and sense antennas, and the following considerations should be taken into account before selecting a location for the antenna:

(1) Mount the antenna on the centerline of the aircraft fuselage.

(2) Keep the antenna at least 4 feet away from DME or transponder antennas to minimize L-band interference.

(3) The antenna should be well removed from any projections such as the engines and propellers, as well as landing gear doors, access doors, or other openings which will break the antenna ground plane.

(4) If the antenna is to be top mounted, select a location where shadowing from the wings, etc., is minimized.

(5) If the antenna is to be mounted on an aircraft with floats, the antenna should be top mounted to avoid interference by floats and steel cables.

(6) When installing the antenna on a fabric covered aircraft, a metal ground plane as large as physically practical (but at least 3 feet in diameter) should be used.

(7) The antenna should be mounted well clear of the aircraft alternator/generator. The antenna cable must not be routed with alternator cables, 400 Hz cables, or high level transmitting cables.

(8) Insure that the antenna cable does not interfere with any aircraft control cables

(9) If the antenna is a KA 44 or a KA 44B, serial number 8799 or below, be sure to plug the drain hole at the rear of the antenna with a good caulking compound or sealant such as RTV 3116 (available under P/N 016-01021-0000). KA 44B's, serial number 8800 and above, no longer have a drain hole.

(10) If the antenna is top mounted, be sure to fill the mounting screw holes with sealant such as RTV 3116 (P/N 016-01021-0000) to prevent water from standing in the holes.

B. Installation Procedures

(1) Using the template included in the installation kit mark the antenna mounting holes on the aircraft skin.
(2) Punch and drill the mounting holes.
(3) Sand the area on the inside of the aircraft skin on which the doubler plate is to be mounted with fine sandpaper or emery cloth.
(4) Carefully following the directions on the container, apply Alumiprep No. 33 (available under P/N 016-01127-0000) to both the inside surface of the aircraft skin and the back of the doubler plate to cleanse the metal of any residue.
(5) Apply Alodine No. 1001 (available under P/N 016-01128-0000) to both locations following the directions on the container to insure good bonding and prevent oxidation.
(6) Rivet the antenna doubler plate in place. It is imperative that the doubler plate make good electrical contact with the ground plane. It is also imperative that the four (4) star washers (P/N 089-08018-0037) that are supplied with the antenna be used underneath the heads of the four (4) antenna mounting bolts in order to insure proper grounding.
(7) Refer to **Figures 2-21, 2-22 or 2-23** and mount the antenna.

2.3.5 FLIGHT TIMER RESET SWITCH INSTALLATION

A. KR-87's, Serial Number 10,999 and below (Without Mod 3)

The flight timer within the KR 87 is automatically reset to zero when the unit is turned on. Additionally, the timer can be reset externally if it is wired to accept an external reset line. As an example, the reset line could be wired to the landing gear retraction switch to initiate counting immediately after takeoff. It could also be wired to an external reset switch, allowing the pilot to reset it after he switches fuel tanks, for instance. In any event, the owner or operator of the aircraft should be consulted as to how the reset switch is to be configured. If no external reset feature is desired, leave pins K and J of the KR 87 rear connector open. If, however, the external reset feature is desired, it can be wired in one of two ways:

(1) A momentary or prolonged ground on pin J will reset the timer. To reset the timer after a prolonged ground on pin J, the connection must be momentarily opened and then regrounded. This can be wired in a number of ways, examples of which are shown in **Figure 2-1** below. If desired, a pressure sensor (P/N 071-01247-0000 or equivalent) can be used as the flight timer reset switch. Refer to **Figure 2-25** for further information.

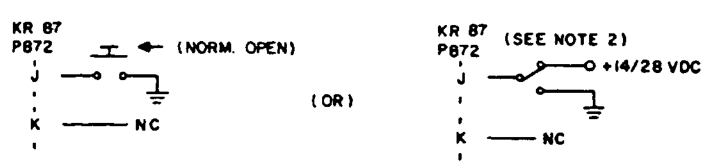


FIGURE 2-1 EXTERNAL RESET WIRING USING NORMALLY OPEN SWITCH

NOTE

1. Switches are shown in an inflight condition. Timer will not start until these conditions are met.
2. KR 87 must have Mod 1 incorporated in order to accommodate a positive voltage on pin J or K.

(2) If pin K is normally connected to ground, a momentary or prolonged breaking (opening) of that connection will reset the flight timer. A prolonged opening of the connection requires that the line be momentarily grounded and then reopened to reset the timer. This can also be wired a number of ways, examples of which are shown in **Figure 2-2**.

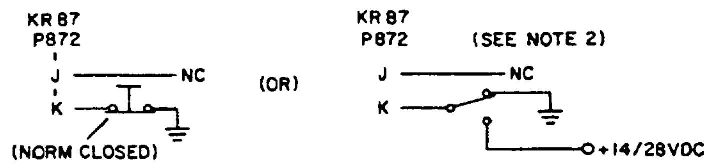


FIGURE 2-2 EXTERNAL RESET WIRING USING NORMALLY CLOSED SWITCH

NOTE

1. Switches are shown in an inflight condition. Timer will not start until these conditions are met.
2. KR 87 must have Mod 1 incorporated in order to accommodate a positive voltage on pin J or K.

B. KR 87's Serial Number 11,000 and above (or any KR 87 with Mod 3)

KR 87's serial number 11,000 and above, or any unit that has had Mod 3 installed in accordance with Service Bulletin KR 87-3 (P/N 600-01690-0030), have incorporated a change in flight timer operation. Instead of having the flight timer reset to zero whenever an external switch is activated, the flight timer will now "stop and hold" the accumulated time. The only way to reset the flight timer to zero in such units is to turn the KR 87 off and then back on. This method of operation will enable those who have the flight timer connected to the landing gear or "squat" switch to be able to note their flight time after landing. If the "stop and hold" feature is not desired, leave pins J and K on the KR 87 rear connector open. This will cause the flight timer to begin counting when the KR 87 is turned on and will continue until it is turned off or the power removed. If, however, the "stop and hold" feature is desired, it may be wired in one of two ways:

(1) A ground on pin J will "stop and hold" the flight timer. Opening the switch again will cause the timer to continue until the switch is closed again. This can be wired in a number of ways, examples of which are shown in **Figure 2-3** below. If desired, a pressure sensor (P/N 071-01247-0000 or equivalent) can be used as the flight timer "stop and hold" switch. See **Figure 2-25** for further information.

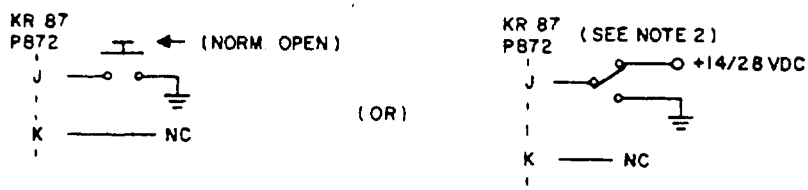


FIGURE 2-3 EXTERNAL STOP AND HOLD WIRING USING NORMALLY OPEN SWITCH

<u>NOTE</u>

1. Switches are shown in an inflight condition. Timer will not start until these conditions are met.
2. KR 87 must have Mod 1 incorporated in order to accommodate a positive voltage on pin J or K.

(2) An open on pin J will "stop and hold" the flight timer. Closing the switch again will cause the timer to continue until the switch is opened again. This can be wired in a number of ways, examples of which are shown in **Figure 2-4** below.

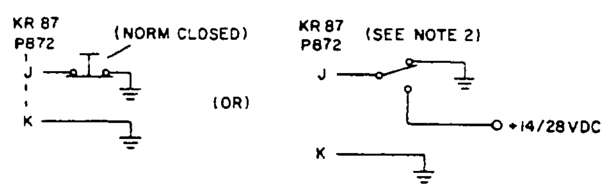


FIGURE 2-4 EXTERNAL STOP AND HOLD WIRING USING NORMALLY CLOSED SWITCH

<u>NOTE</u>

1. Switches are shown in an inflight condition. Timer will not start until these conditions are met.
2. KR 87 must have Mod 1 incorporated in order to accommodate a positive voltage on pin J or K.

2.3.6 ELAPSED TIMER ALARM INSTALLATION

The elapsed timer feature of the KR 87 enables the pilot to enter a time of up to 59 minutes, 59 seconds, and have the timer count down to zero. The display will commence flashing when zero is reached and will continue flashing for 15 seconds. In addition, an output is provided at pin 11 of the rear connector which may be used to activate an external horn, light, or other alarm device for 1 second when zero is reached. A Sonalert audible alarm which can be used for this purpose is available under P/N 038-00008-0000. The owner or operator of the aircraft should be consulted prior to installation to determine the desirability of an alarm, the type of alarm preferred, and the location. If no external alarm is desired, pin 11 should be left open.

The alarm output is the open collector of an NPN transistor. The alarm output will sink up to 1.0A of current (max) when active and can tolerate a voltage of 33VDC (max) when inactive. The alarm device should be wired to pin 11 of the KR 87 as shown in **Figure 2–5** below.

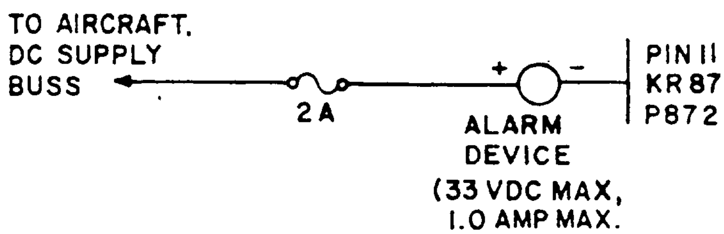


FIGURE 2–5 EXTERNAL ALARM WIRING

2.3.7 CABLE HARNESS AND CONNECTOR ASSEMBLY

The KR 87 uses a special connector fastened to the mounting rack that mates directly to the printed circuit board inside the unit. Refer to the KR 87 Interconnect Diagrams, **Figures 2–26** thru **2–30**, and consider the following items when fabricating the cable harness:

A. The KR 87 antenna connector is designed to connect all the cables to the antenna, including the triaxial cable. This connector is supplied in the installation kit with the antenna end pre-terminated at the factory in order to facilitate proper installation and minimize installation-related service problems. The connector assembly is shown in **Figure 2–24**. The triaxial cable and signal wires are supplied with the connector and are available in 12, 24, 36, or 48 foot lengths. These wires should be cut to a convenient length for the particular installation and terminated at the receiver connector. THEIR LENGTH IS NOT CRITICAL. Refer to the KR 87 Interconnect Diagrams, **Figures 2–26** thru **2–30**, for the proper receiver pin connections and color code.

B. The bare drain wire of the shield that surrounds the four 24AWG wires in the 6 conductor antenna cable should be grounded at the receiver end. It has been left open at the antenna connector end.

C. Refer to **Figure 2–18** for instructions on installing the right angle coaxial BNC connector to the receiver end of the triaxial cable.

D. The signal cable and the triaxial cable leading to the antenna should be tie–wrapped together to facilitate handling and routing.

E. The audio output line should be a shielded wire with its shield grounded at the load end. The audio output of the KR 87 is designed to drive a 500 ohm load, so it should be wired to the proper input of an audio panel isolation amplifier or a 500 ohm headphone jack.

F. Use 22AWG or heavier wire for the DC power to the KR 87 and for the output lines to the KI 227 or KI 228 indicator.

G. For a top–mounted antenna leave pin E on the KR 87 rear connector open. For a bottom mounted antenna ground pin E.

H. The rear connector of the KR 87 uses solderless Molex pins. Assembly of the connector is as follows:

(1) Contact Terminal Assembly using Molex Crimper (**Figure 2–7**)

a. Strip each wire 5/32" for contact terminal (P/N 030–01107–XXXX). Note: The last four digits of the contact terminal part number indicate the number of terminals furnished.

b. Open the Molex hand crimper (See **Figure 2-7**) with the engraved side toward the operator. Place the conductor tab section of a contact terminal on Anvil B with the contact portion facing away from the operator. Close the crimper slightly until the contact tabs touch the female jaw.

c. Insert the stripped conductor until the insulation is even with the side of the crimper facing the operator. Crimp the conductor tabs by squeezing the handles together until the jaws are fully closed or a sufficient crimp is obtained.

d. Move the lead to Anvil A. Place the insulating tab section on Anvil A. Crimp again until the jaws are fully closed or a sufficient crimp is obtained.

(2) Contact Insertion into Molex Connector Housing

a. After the contact terminals have been installed on the wiring harness, the contact terminals can be inserted into the proper location in the connector housing (P/N 030-01094-0051). The terminal cannot be inserted upside down. Be sure to push the terminal all the way in until a click can be felt or heard.

b. The self-locking feature can be tested by gently pulling on the wire.

(3) Location of Polarizer Key in Housing

a Prior to insertion of connector into rear of unit, check the polarizing key position between contacts 5 and 6.

b. Refer to **Figure 2-18** to check the correct position of the polarizing key.

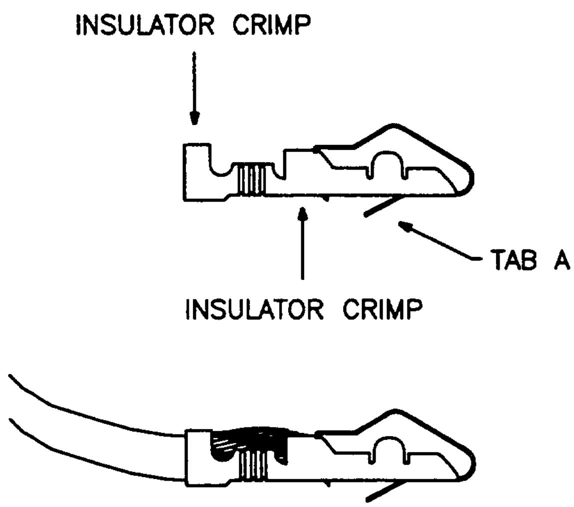
(4) Extraction of Contact from Molex Connector

a. Slip the flat narrow blade of a Molex contact ejection tool, P/N 047-05099-0001, under the contact on the mating side of the connector. By turning the connector upside down one can see the blade slide into the stop.

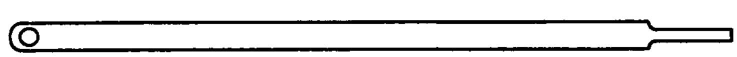
b. When the ejection is slid into place, the locking key of the contact is raised, allowing the contact to be removed by pulling moderately on the lead.

c. Neither the contact or position is damaged by removing a contact; however, the contact should be checked visually before reinstalling in the connector to be certain that retaining tab A extends as shown (See **Figure 2-6**) for retention in the connector.

I. After the harness has been fabricated and is ready for installation, secure the antenna coax connector and the circuit board connector to the rear of the mounting rack as shown in the KR 87 Installation Drawing, **Figure 2-18**.



SOLDERLESS CONTACT TERMINAL
P/N 030-01107-0030



HAND EJECTOR
P/N 047-05099-0001
MOLEX P/N HT-1884

FIGURE 2-6 MOLEX TERMINALS AND TOOLS

2.3.8 MOLEX TERMINAL INSTRUCTIONS

The Molex hand crimpers are available under P/N 071-06041-0000, or from Molex under P/N 6115.

Holding the hand crimpers as shown, release the crimper's ratchet pawl and open by squeezing tightly on the handles, and then releasing pressure.

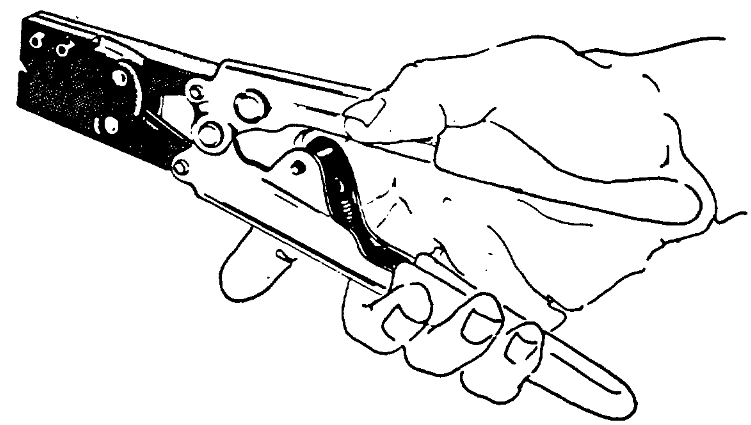


FIGURE 2-7 HAND CRIMPER

Close crimpers until ratchet begins to engage. Then insert the terminal into the jaws from the back side. (See **Figures 2-8 and 2-9**) For 24 to 30 AWG wire, it will be necessary to start the crimp in jaw A and then complete it in jaw B. The terminal is in the correct position when the insulation tabs are flush with the outside face of the crimp jaws.

JAW	TERMINAL	WIRE SIZE	INSULATION RANGE
A	030-01107-0030	18 TO 24 AWG	.110 TO .055
B	030-01107-0030	24 TO 30AWG	.055 TO .030

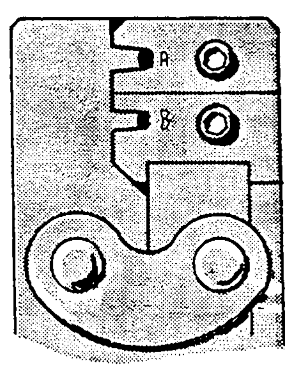


FIGURE 2-8 CRIMP JAWS

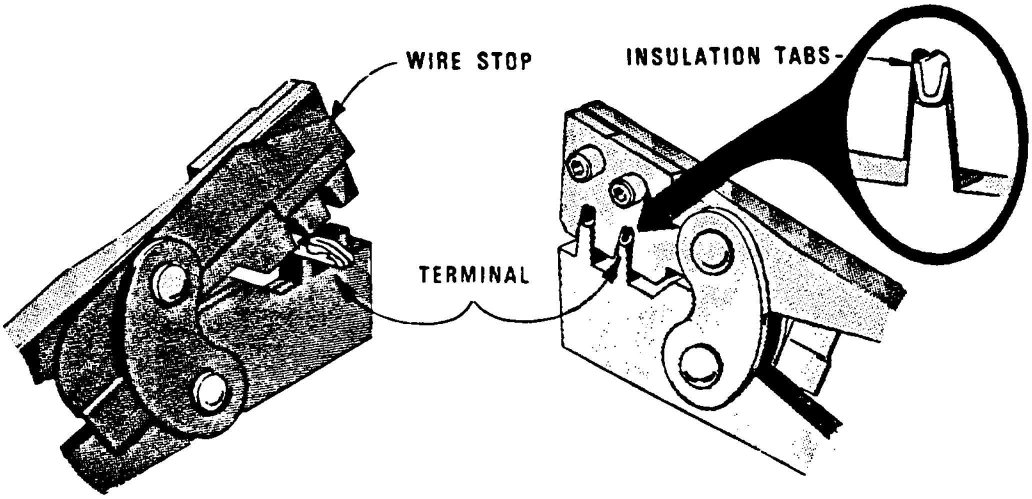


FIGURE 2-9 TERMINAL INSERTION

Once the terminal is in the correct position, close the jaws gently until the terminal is held loosely in place. Push the wire stop down so that it rests snugly behind the contact portion of the terminal.

Strip the wire insulation back 1/8 inch and insert the wire through the insulation tabs into the conductor tabs until the insulation hits the conductor jaw face or until the conductor touches the wire stop. Squeeze the handles until the crimp jaws close and the ratchet releases. Straighten the terminal if necessary, then release the plier grips and remove the crimped terminal.

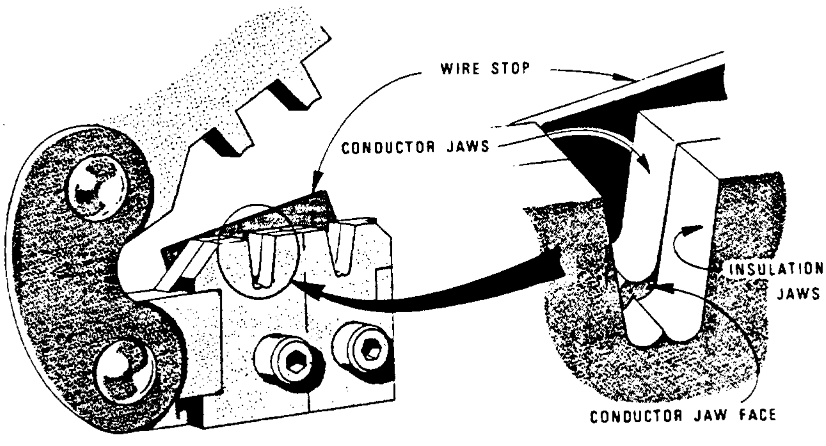


FIGURE 2-10 HAND CRIMPER INSERTION

If too much or too little pressure is needed to release the crimper's ratchet pawl at the end of the crimp stroke, the ratchet can be easily adjusted. A spanner wrench provided with the tool can be used to loosen the lock nut, and rotate the keyed stud clockwise for increased pressure and counter clockwise for decreased pressure. Once the desired pressure has been set, the lock nut must be tightened again. Newer models may have a screwdriver adjustment.

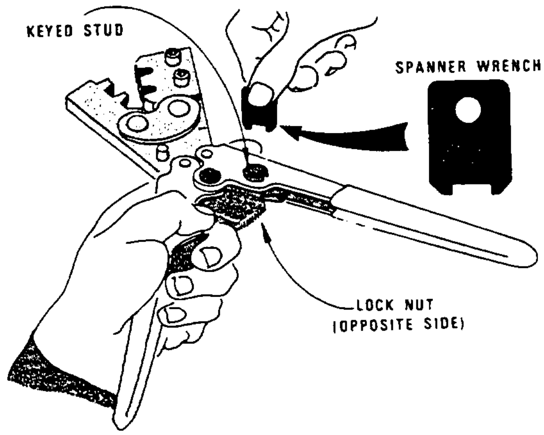


FIGURE 2-11 CRIMPING PRESSURE ADJUSTMENT

2.3.9 KR 87 RECEIVER INSTALLATION

Prior to installing the KR 87 into the mounting tray, make a careful point-to-point continuity check to verify proper wiring and to insure that aircraft power is applied only to the correct pins. Verify that the antenna and indicator connectors are in place.

With the rear connectors in place in the mounting rack, slide the KR 87 into the rack and secure it by turning the hold down screw clockwise with a 3/32" Allen wrench. The locking screw is accessible through a hole in the front panel. Continue turning until the unit is secure in the mounting rack, being careful not to overtighten the locking screw.

2.4 POST INSTALLATION CHECKS

2.4.1 SYSTEM CHECK

A quick preliminary check can be made by turning on the KR 87 and tuning it to a local AM broadcast station or strong NDB station. Check for satisfactory audio (this should be done where clear reception is possible, preferably outside of the hanger).

NOTE

The KR 87 has an extremely sensitive receiver, and occasionally, when the unit is tuned to a weak station in the ADF mode, an erratic switching sound is heard on the audio. This sound is normal and is due to the following phenomena: As soon as the receiver locks onto the signal, the loop circuits are automatically activated and the added noise from the loop circuit is heard over the audio. This additional noise, coupled with the fact that the signal is very weak to begin with, causes the receiver to unlock from the signal, and the loop circuits are shut off immediately to boost the signal-to-noise ratio. This causes the audio to become slightly quieter. Now, without the added noise of the loop circuits, the receiver once again picks up enough signal to lock, and the process is repeated. The bearing information is generally good, however, as the receiver still acquires enough information while the loop circuits are turned on to determine the relative bearing to the station. This characteristic is actually desirable, as it greatly improves the range of the receiver by automatically shutting off the loop circuits in noisy conditions and then locking on to the signal. Therefore, the proper pilot technique for tuning the ADF is to tune and identify the station in the quieter ANT mode and then select the ADF mode for bearing information.

It should be noted that the KR 87 receiver will mute the audio in either the ANT or ADF modes whenever the signal becomes too weak to lock on to. Therefore, make sure that the receiver is tuned to a strong station before concluding that the unit may not be working properly. This audio muting feature may be overridden by selecting the BFO function, in which case the audio signal is passed uninterrupted to the audio system. A tone will be heard whenever the receiver is picking up a receivable signal.

2.4.2 QUADRANTAL ERROR ADJUSTMENT

The system has been factory adjusted to compensate for the average amount of quadrantal error (QE) that exists due to the shape of the airframe. Therefore, little or no QE compensation adjustment should be required. Nonetheless, the following procedure should be followed after the installation is complete in order to verify proper pointing. In the event that QE adjustment is required, follow the procedure outlined below.

A. Tune in a nearby broadcast station, NDB station, or compass locator that gives a strong, clear signal free of fading. Position the aircraft on the ramp in an area that is clear of surrounding buildings, such that the indicator points to 0° (i.e., the aircraft is heading directly toward the station). Note the aircraft heading.

B. Using the aircraft directional gyro or compass, turn the aircraft to the left 45°. Note the indicated relative bearing and the amount of error. Continue to turn the aircraft, stopping at each 45° point and noting the relative bearing error. The errors at the 90°, 180°, and 270° points should be within ±5°. Average the absolute errors at the quadrantal points (45°;, 135°, 225°, and 315°) to determine the amount of QE compensation required.

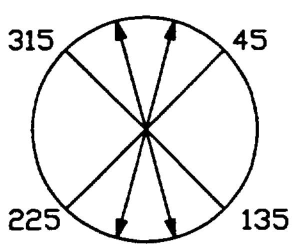
C. The QE compensation potentiometer is located to the side of the antenna connector on the KA 44 and KA 44B P/N 071-1234-00/01 antenna. The KA 44B P/N 071-1234-02 QE adjust potentiometer is accessible vertically from the surface just above and to the side of the connector. If the antenna is inaccessible from inside the aircraft the antenna will have to be unfastened and pulled away from the aircraft far enough to insert a jeweler's screwdriver into the adjustment hole. The adjustment hole is protected by a threaded cap which must first be removed.

NOTE

Take care to not misplace the O-ring seal underneath the threaded cap. After QE adjustments have been completed this seal and the threaded cap must be reinstalled in the antenna to insure that the electronics compartment is environmentally sealed.

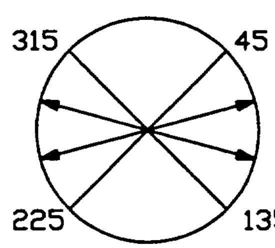
The QE adjustment pot has a sensitivity of approximately 1° per turn. Refer to **Figure 2-12** to determine which direction to turn the pot.

If the relative bearings at the quadrantal points appear as below,



turn the Q.E. adjustment pot counter-clockwise.

If the relative bearings at the quadrantal points appear as below,



turn the Q.E. adjustment pot clockwise.

FIGURE 2-12 QE COMPENSATION ADJUSTMENT

D. Recheck the relative bearings and readjust the QE compensation pot as necessary to split the errors at the quadrantal points and obtain the lowest possible average error.

E. When QE adjustments are complete, reinstall the O-ring seal and the threaded cap in the adjustment hole to seal the antenna. No further ground adjustments are required.

2.4.3 OPERATIONAL CHECKS

The following operational checks are to verify proper operation of the various internal functions of the KR 87 and can be made with the aircraft in the parking area.

A. Turn the unit on and verify that the right hand side of the display shows either the standby frequency or the flight or elapsed timer. If the radio is in one of the timer modes press the FRQ button once to display the standby frequency. Verify that the tuning knobs will change the standby frequency and that pressing the FRQ button again transfers the active and standby frequencies.

B. Press the FLT/ET button and verify that the unit returns to one of the timer modes. The radio will return to whichever timer mode was active before the FRQ button was pressed in Step A above. If the unit has reentered the ET (Elapsed Timer) mode press the FLT/ET button once more to enter the FLT (Flight Timer) mode. Turn the unit off and then back on and verify that the flight timer has reset to zero.

C. Press the FLT/ET button to enter the ET mode and note that the timer is in the Count Up mode. Press the RESET button and verify that the timer resets to zero and then continues counting up.

NOTE

Pressing the RESET button will reset the Elapsed Timer regardless of the information currently displayed.

D. Enter the Count Down mode by pressing and holding the RESET button for approximately 2 seconds until the ET annunciator on the display begins to flash and then enter any convenient time (up to 59 minutes and 59 seconds) with the tuning knobs. The timer will remain in the ET Set mode (as indicated by the flashing ET annunciator) for 15 seconds after the time is entered or until the RESET, FLT/ET, or FRQ button is pressed. The preset time will remain unchanged until the RESET button is pressed, at which time the Elapsed Timer will begin to count down. Verify the following conditions:

   (1) The timer counts down to zero and then begins to count up.
   (2) The display flashes for approximately 15 seconds after the counter reaches zero.
   (3) External alarms (if installed) are activated for approximately 1 second after the counter reaches zero.

E. Verify that pressing the FLT/ET button exchanges the two timers in the display. Press the FRQ button and verify that the standby frequency is displayed in the right hand window of the display and that subsequent FRQ button cycles will cause the active and standby frequencies to be exchanged.

F. Place the KR 87 in the ANT mode and tune in several known stations. Verify that audio reception is satisfactory and that volume control operation is normal. Verify that the ADF indicator needle is parked at the 90° position relative to the nose of the aircraft. Place the unit in the ADF mode and verify that the needle points to the station.

G. Press the BFO button to enter the BFO mode and verify that the BFO tone is present in the receiver audio (if a keyed CW station is used the tone heard will be the coded identifier).

H. For the KR 87 -14/15/17, verify that the lighting for the backlit nomenclature (ADF, STBY/TIMER, OFF, and VOL) is operating and dims in conjunction with the aircraft lighting dimmer control.

2.4.4 KI 227-01 AND KI 228-01 INDICATOR CHECKS

Following installation of the KI 227-01 or the KI 228-01 it is advisable to conduct the following checks to insure that the indicator has been properly installed and is functioning correctly under nominal conditions.

A. Compass Card Accuracy

With the KCS 55/55A Compass System operational, manually synchronize the compass card of the KI 227 or KI 228 with the SYNC knob until the heading of the KI 227/228 matches that of the compass system. Rotate the aircraft 90° and verify that the KI 227/228 compass card matches that of the KCS 55/55A compass card within $\pm 2°$.

B. ADF Accuracy

Tune in an ADF station at a known magnetic heading and verify that the ADF pointer indicates the correct relative bearing within $\pm 3°$.

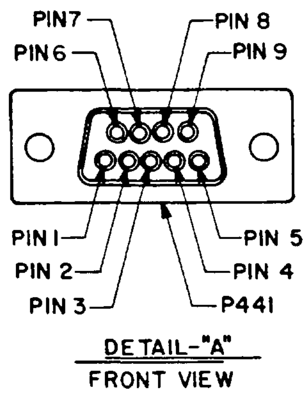


FIGURE 2-13 KA 44/44B PIN LOCATION DIAGRAM

	IN		OUT	
1	←	------------------------		ANTENNA POWER
2	←	------------------------		LOOP ENABLE
3		------------------------	→	RF INPUT
4	←	------------------------		32Hz $\angle \pm 90°$
5	←	------------------------		32Hz $\angle 0°$
6		------------------------		NO CONNECTION
7		------------------------		GROUND
8		------------------------		CENTER SHIELD GND
9		------------------------		OUTER SHIELD GND

TABLE 2-1 KA 44/44B PIN FUNCTION DIAGRAM

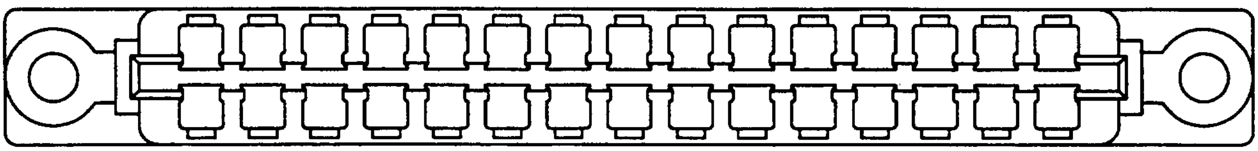


FIGURE 2-14 KR 87 PIN LOCATION DIAGRAM P871

PIN	IN		OUT	FUNCTION
A	←	------------------------	→	DC SIN HI
B		------------------------	→	DC COS HI
C		------------------------	→	SUPER FLAG
D		------------------------	→	4.5V REF
E	←	------------------------		TOP/BOTTOM MOUNT
F		------------------------	→	32Hz $\angle$ 0°
H		------------------------		A/C GND
J	←	------------------------		FLT TIMER CONTROL 1
K	←	------------------------		FLT TIMER CONTROL 2
L	←	------------------------		14V LIGHTING HI
M		------------------------		A/C GND
N		------------------------		NOT USED
P		------------------------		A/C GND
R		------------------------		A/C GND
S		------------------------		A/C GND
1		------------------------		NOT USED
2		------------------------		NOT USED
3		------------------------		NOT USED
4		------------------------		NOT USED
5		------------------------		NOT USED
6		------------------------	→	32Hz $\angle \pm 90°$
7		------------------------	→	32Hz VARIABLE OUT
8		------------------------	→	LOOP ENABLE
9	←	------------------------		28V LIGHTING HI
10		------------------------	→	AUDIO OUT
11		------------------------	→	ET ALARM OUT
12		------------------------	→	ANTENNA POWER
13	←	------------------------		A/C POWER
14		------------------------		AGC OUT
15		------------------------		ANTENNA GND
	IN		OUT	

TABLE 2-2 KR 87 PIN FUNCTION DIAGRAM

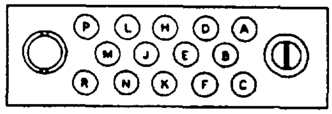


FIGURE 2–15 KI 227 PIN LOCATION DIAGRAM

A	←	------------------------	28V LIGHTING HI
B	←	------------------------	4.5V REF
C	←	------------------------	DC SIN HI
D	←	------------------------	14V LIGHTING HI
E	←	------------------------	DC COS HI
F		------------------------	NOT USED
H		------------------------	A/C GND
J		------------------------	NOT USED
K		------------------------	NOT USED
L	←	------------------------	DRIVE 2 (–01 ONLY)
M	←	------------------------	STEPPER COMMON (–01 ONLY)
N	←	------------------------	DRIVE 3 (–01 ONLY)
P	←	------------------------	DRIVE 1 (–01 ONLY)
R	←	------------------------	DRIVE 4 (–01 ONLY)
	IN		OUT

TABLE 2–3 KI 227 PIN FUNCTION DIAGRAM

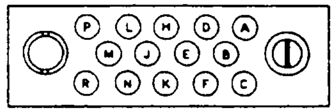


FIGURE 2-16 KI 228 PIN LOCATION DIAGRAM

A	←	28V LIGHTING HI
B	←	4.5V REF (SGL NEEDLE)
C	←	DC SIN HI (SGL NEEDLE)
D	←	14V LIGHTING HI
E	←	DC COS HI (SGL NEEDLE)
F	←	4.5V REF (DBL NEEDLE)
H		A/C GND
J	←	DC SIN HI (DBL NEEDLE)
K	←	DC COS HI (DBL NEEDLE)
L	←	DRIVE 2 (-01 ONLY)
M	←	STEPPER COMMON (-01 ONLY)
N	←	DRIVE 3 (-01 ONLY)
P	←	DRIVE 1 (-01 ONLY)
R	←	DRIVE 4 (-01 ONLY)
	IN	OUT

TABLE 2-4 KI 228 PIN FUNCTION DIAGRAM

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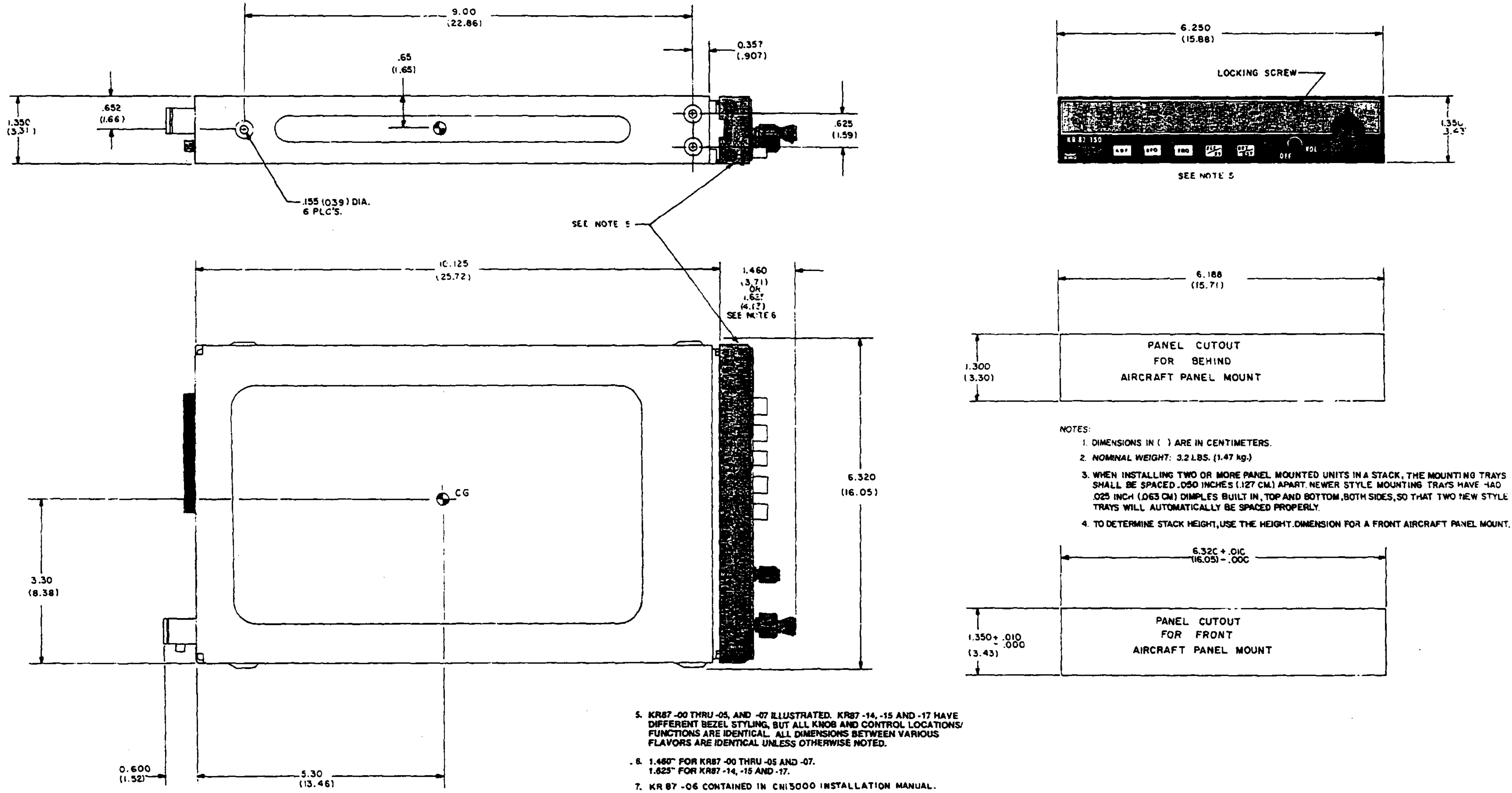


FIGURE 2-17 KR 87 OUTLINE AND MOUNTING DRAWING
(Dwg No 155-05329-0000 R-3)

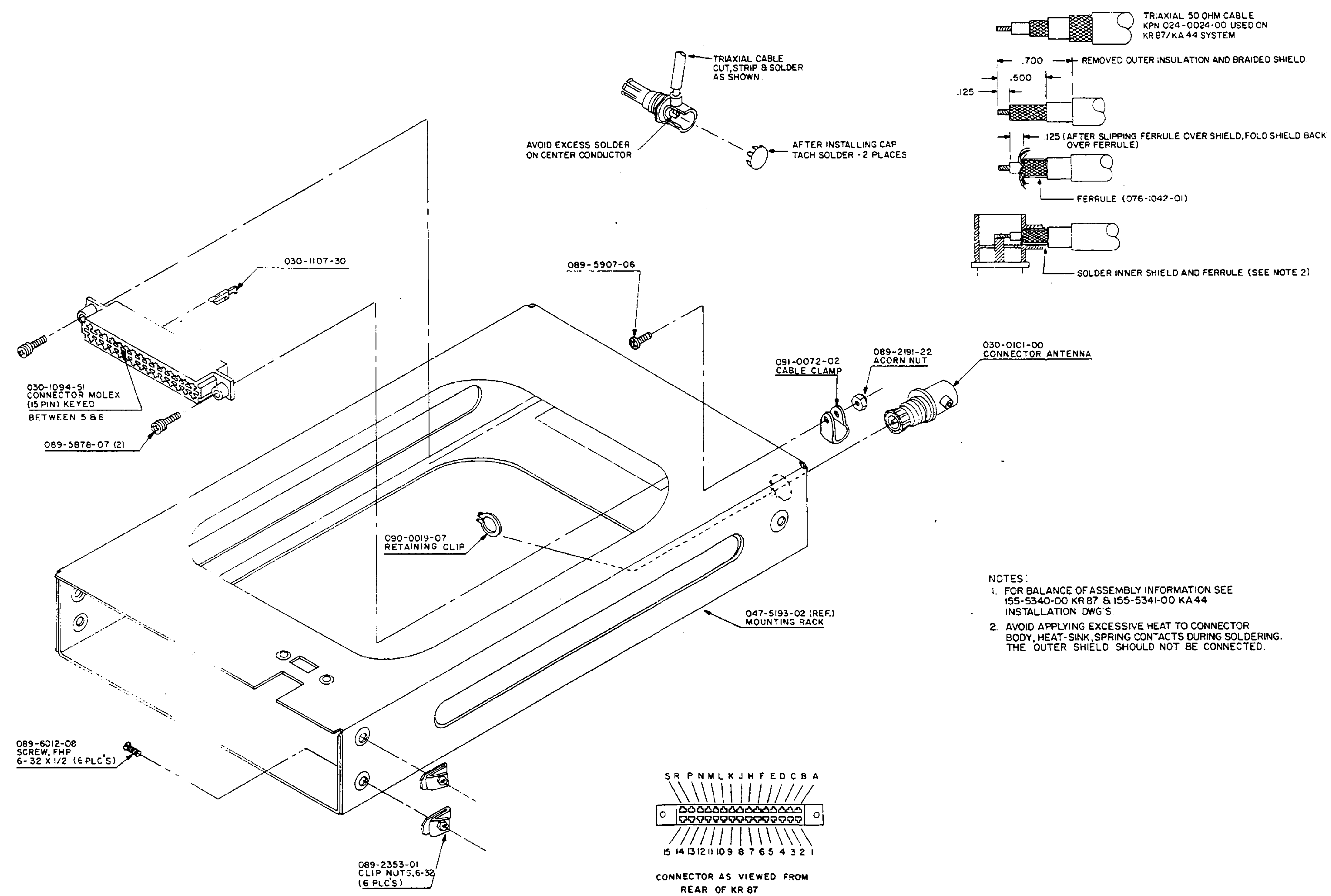


FIGURE 2-18 KR 87 RECEIVER INSTALLATION DRAWING (Dwg No 155-05340-0000 R-3)

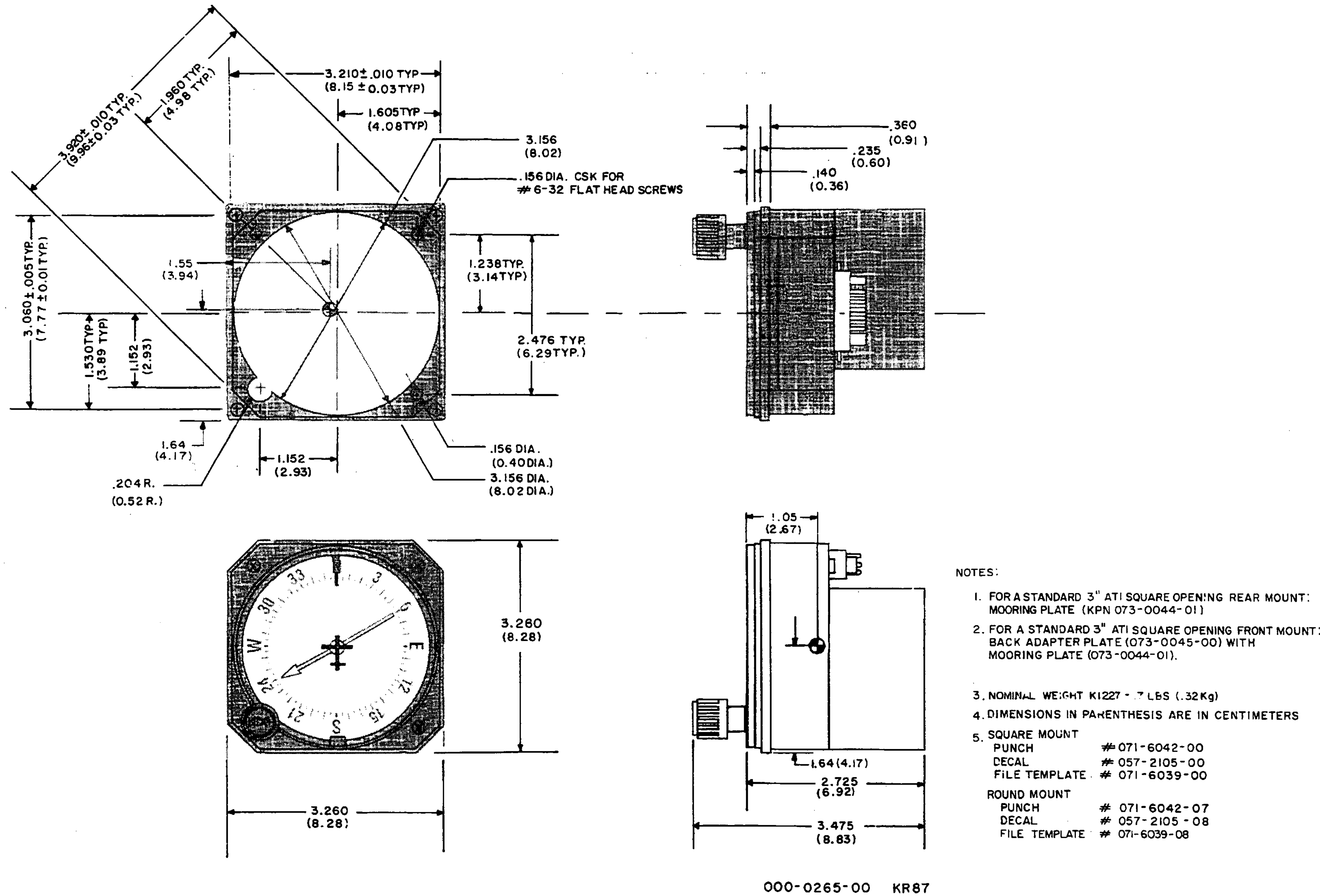
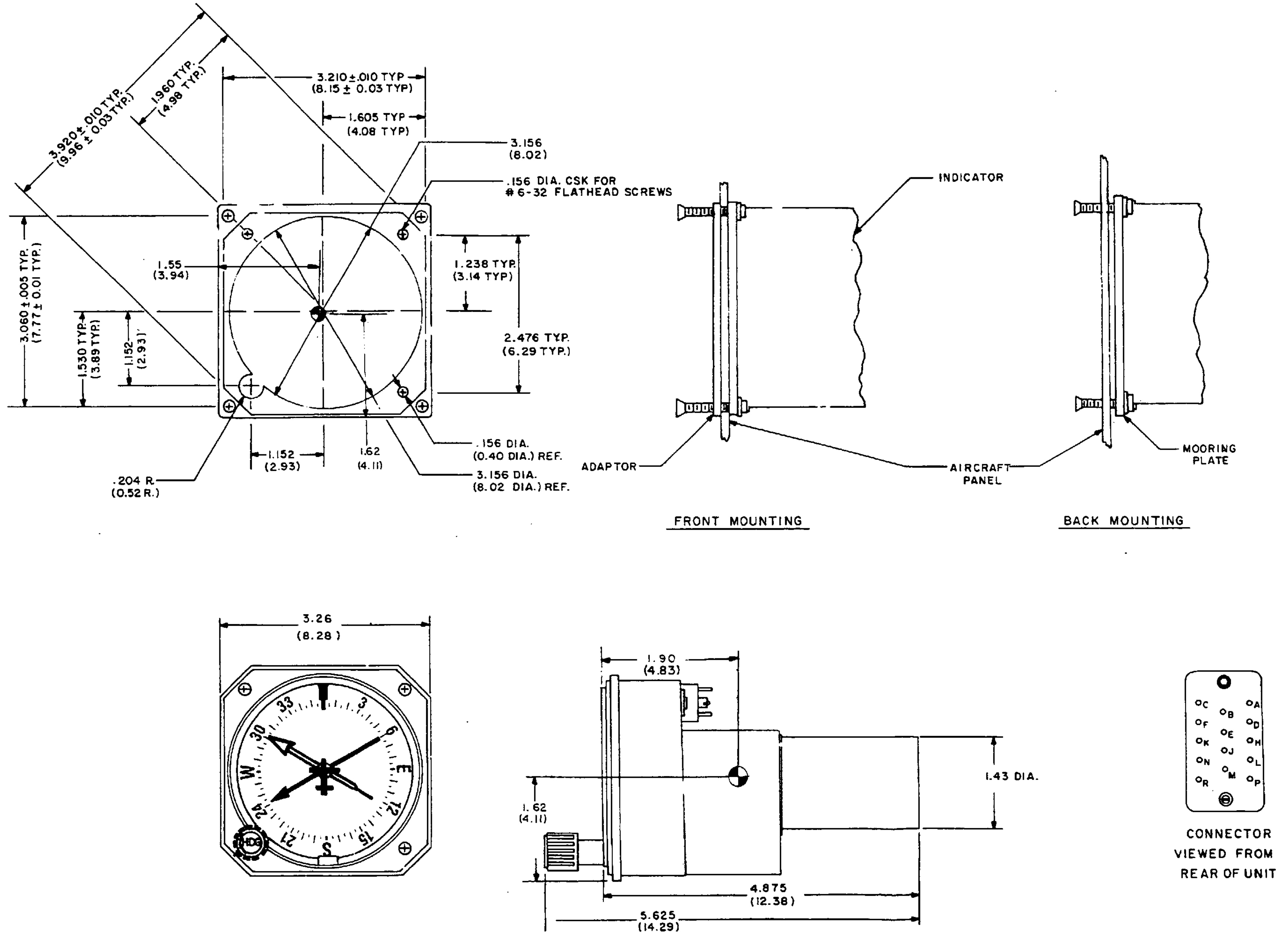


FIGURE 2-19 KI 227 OUTLINE AND MOUNTING DRAWING
(Dwg No 155-05342-0000 R-3)



NOTES:

1. FOR A STANDARD 3" ATI SQUARE OPENING REAR MOUNT: MOORING PLATE (KPN 073-0044-01).
2. FOR A STANDARD 3" ATI SQUARE OPENING FRONT MOUNT: BACK ADAPTER PLATE (073-0045-00) WITH MOORING PLATE (073-0044-01).
3. NOMINAL WEIGHT: KI 228 - .91Kg (.41Kg)
4. DIMENSIONS IN PARENTHESIS ARE IN CENTIMETERS.
5. SQUARE MOUNT

PUNCH	KPN 071-6042-00
DECAL	KPN 057-2105-00
FILE TEMPLATE	KPN 071-6039-00

ROUND MOUNT

PUNCH	KPN 071-6042-07
DECAL	KPN 057-2105-08
FILE TEMPLATE	KPN 071-6039-08

FIGURE 2-20 KI 228 OUTLINE AND MOUNTING DRAWING
(Dwg No 155-05355-0000 R-3)

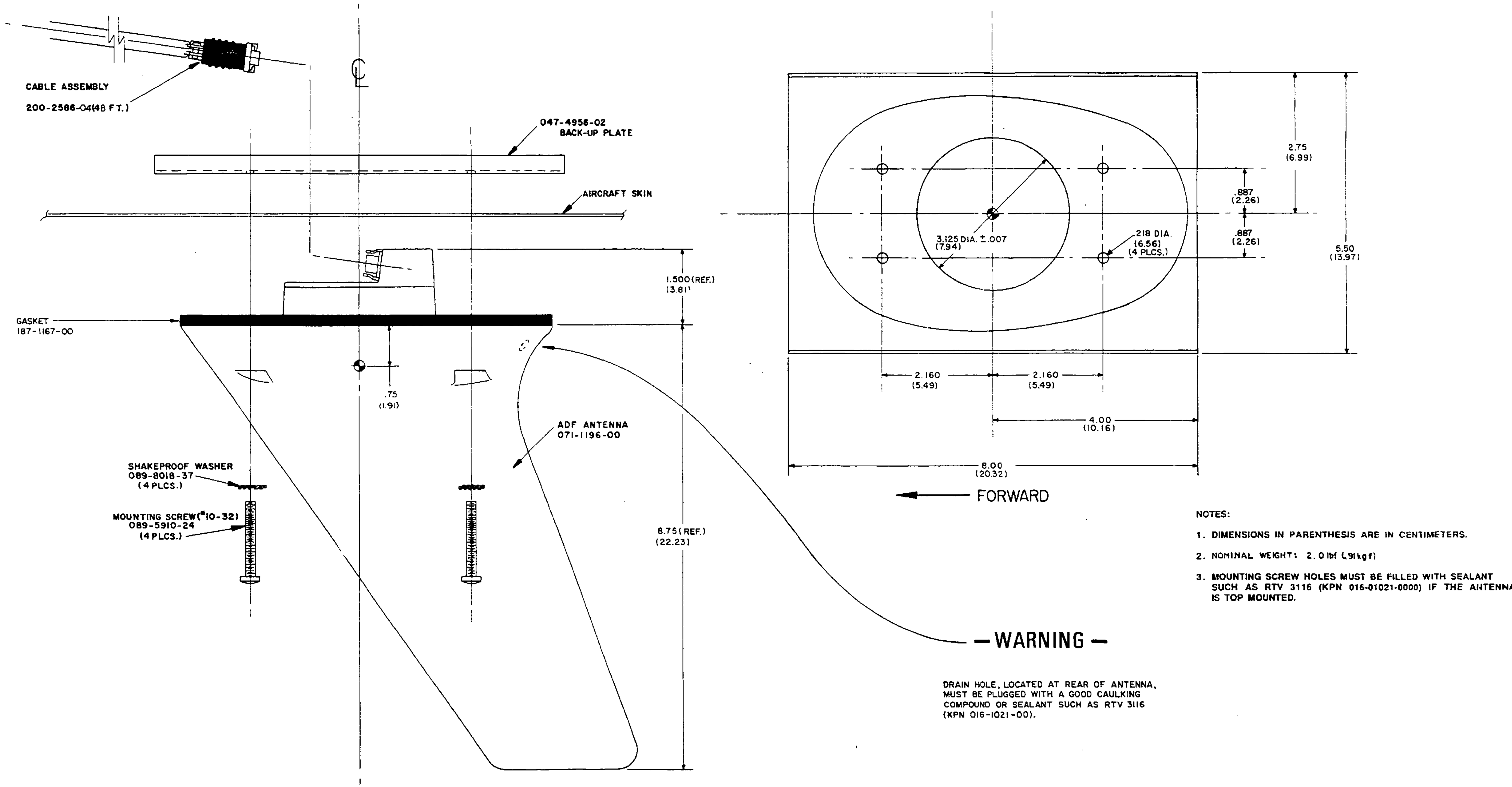
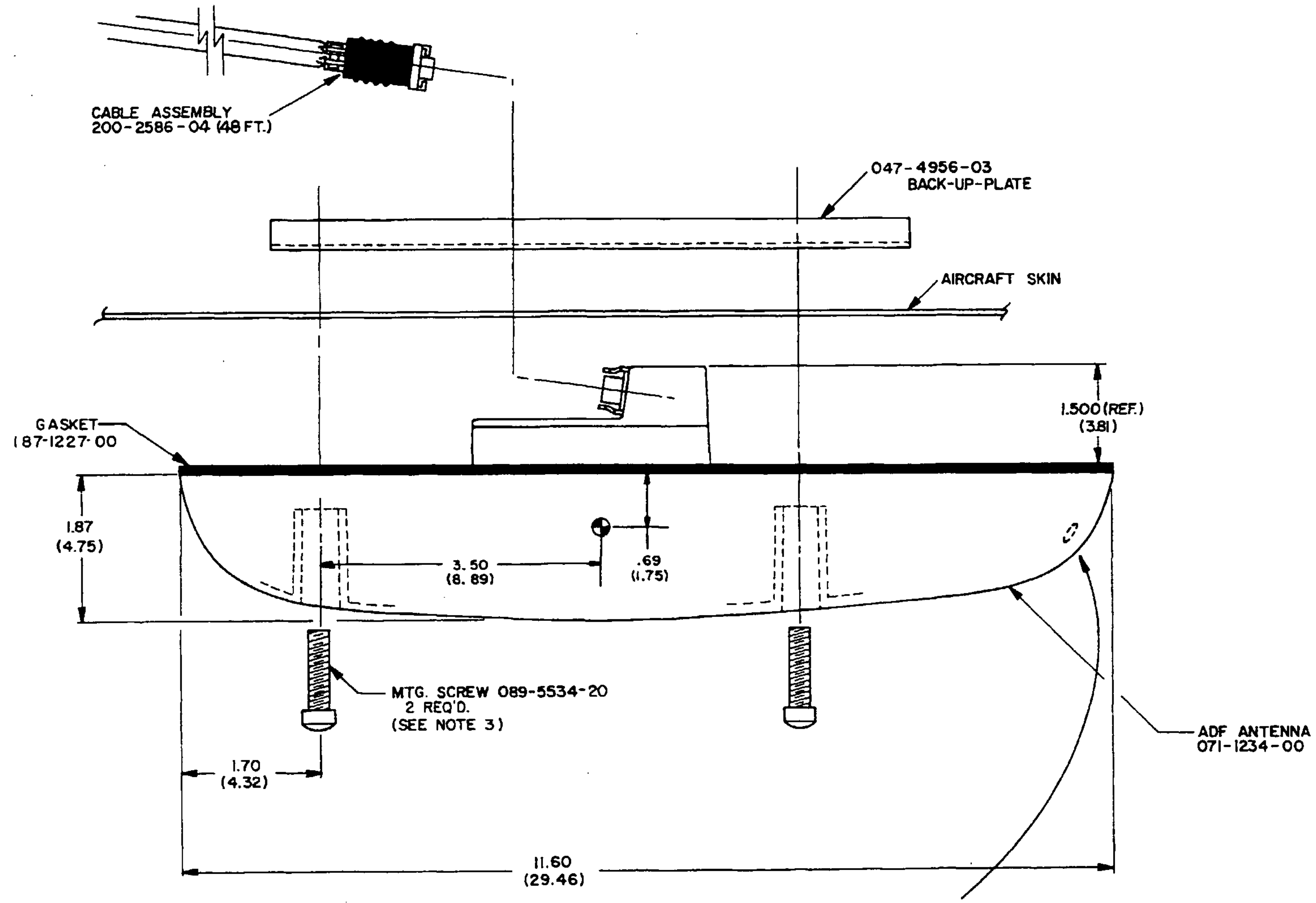


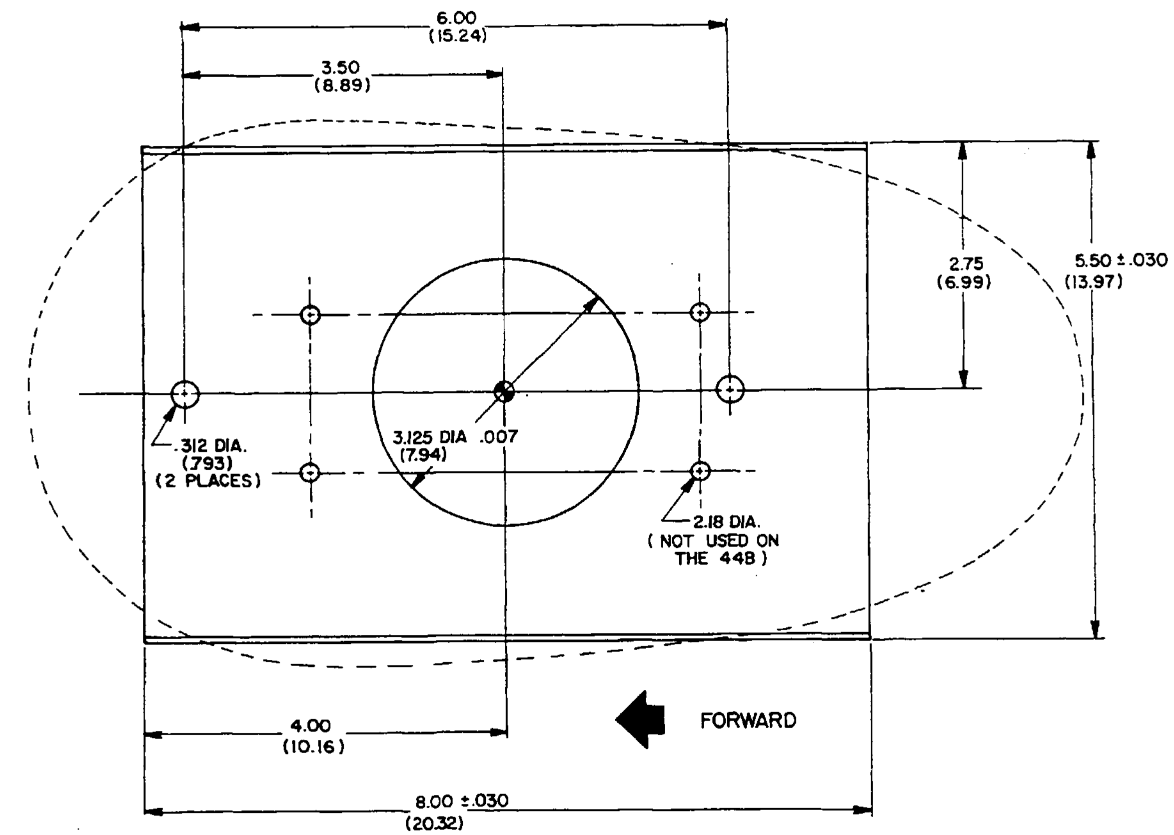
FIGURE 2-21 KA 44 OUTLINE AND MOUNTING DRAWING
(Dwg No 155-05341-0000 R-7)



— WARNING —

1) KA44B, S/N 8799 AND BELOW:
DRAIN HOLE, LOCATED AT REAR OF ANTENNA, MUST BE PLUGGED WITH A GOOD CAULKING COMPOUND OR SEALANT SUCH AS RTV 3116 (KPN 016-1021-00).

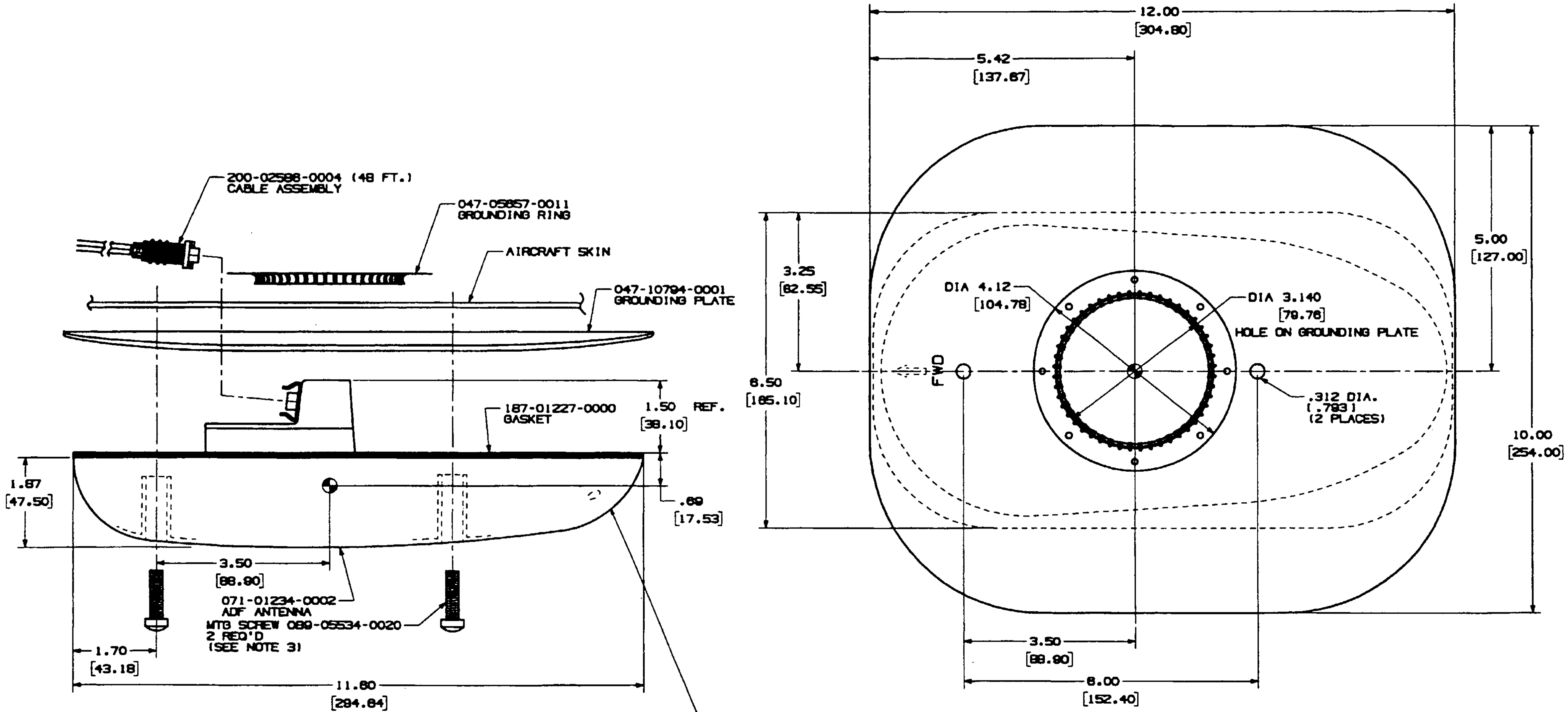
2) KA44B, S/N 8800 AND ABOVE:
DRAIN HOLE HAS BEEN ELIMINATED. NO ACTION IS REQUIRED.



NOTES:

1. DIMENSIONS IN PARENTHESES ARE IN CENTIMETERS.
2. NOMINAL WEIGHT: 4.2 LBS. (1.89Kg).
3. 2 EA. 089-05534-0036 SCREWS ARE ALSO SUPPLIED WITH ANTENNA FOR INSTALLATIONS THAT REQUIRE LONGER MOUNTING SCREWS.
4. MOUNTING SCREW HOLES MUST BE FILLED WITH SEALANT SUCH AS RTV 3116 (KPN 016-01021-0000) IF ANTENNA IS TOP MOUNTED.

FIGURE 2-22 KA 44B OUTLINE AND MOUNTING DRAWING
(Dwg No 155-05334-0000 R-9)



NOTES:

1. DIMENSIONS ARE IN INCHES, [ ] IN MILLIMETERS.
2. NOMINAL WEIGHT: 4.2 LBS. (1.89 Kg).
3. SCREWS 089-05534-0038 (2 EACH) ARE ALSO SUPPLIED WITH ANTENNA FOR INSTALLATIONS THAT REQUIRE LONGER MOUNTING SCREWS.
4. MOUNTING SCREW HOLES MUST BE FILLED WITH SEALANT SUCH AS RTV 3118 (KPN 016-01021-0000) IF ANTENNA IS TOP MOUNTED.
5. GROUNDING RING (047-05857-0011) AND ADAPTER PLATE (047-10794-0001) ARE INSTALLED TO AIRCRAFT SKIN USING RIVETS. SUGGESTED RIVETS MS 2428 AD.

-WARNING-

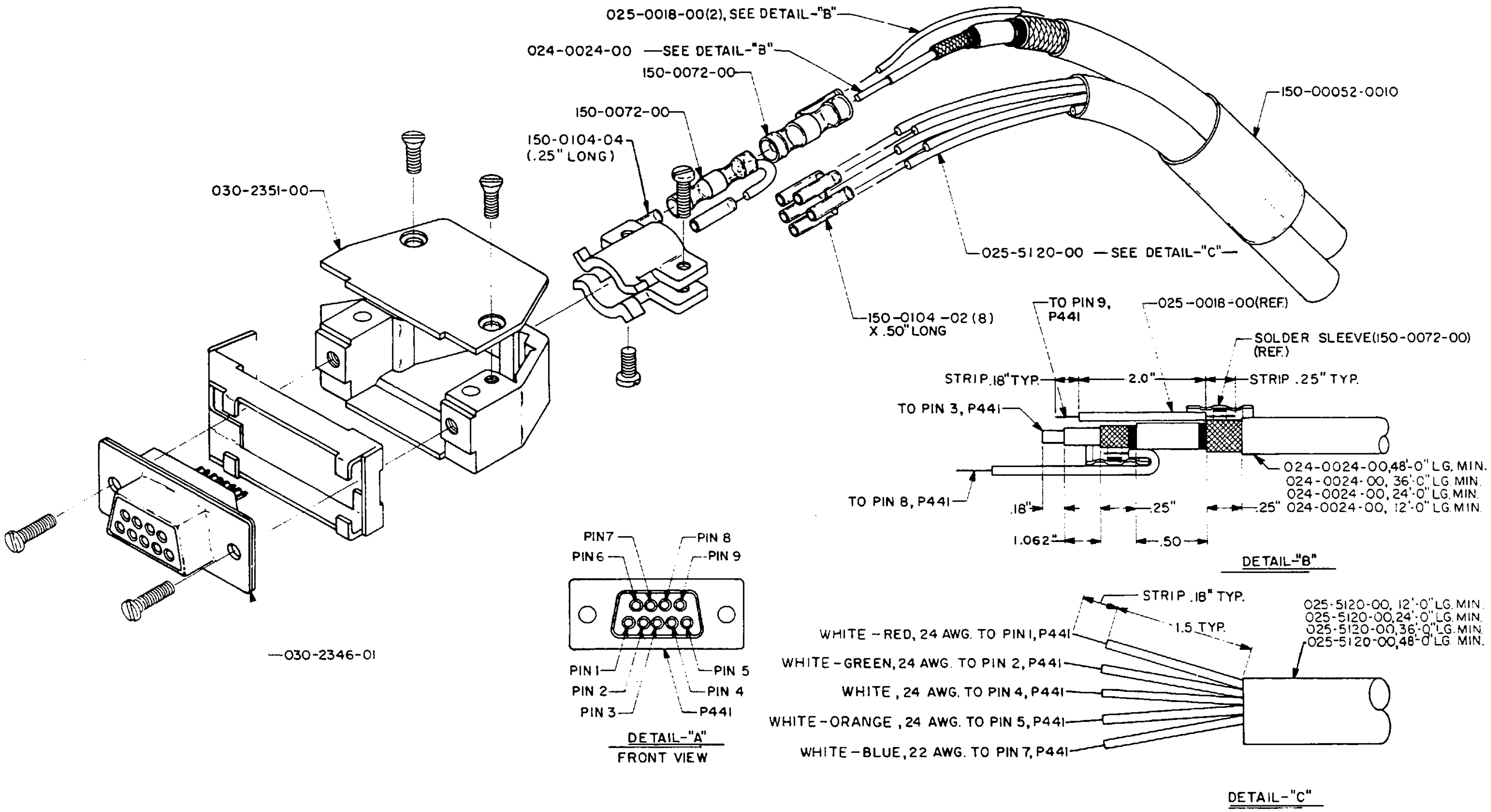
1. KA44B, S/N 8799 AND BELOW:

   DRAIN HOLE, LOCATED AT REAR OF ANTENNA, MUST BE PLUGGED WITH A GOOD CAULKING COMPOUND OR SEALANT SUCH AS RTV 3118 (KPN 016-01021-0000).

2. KA 44B, S/N 8800 AND ABOVE:

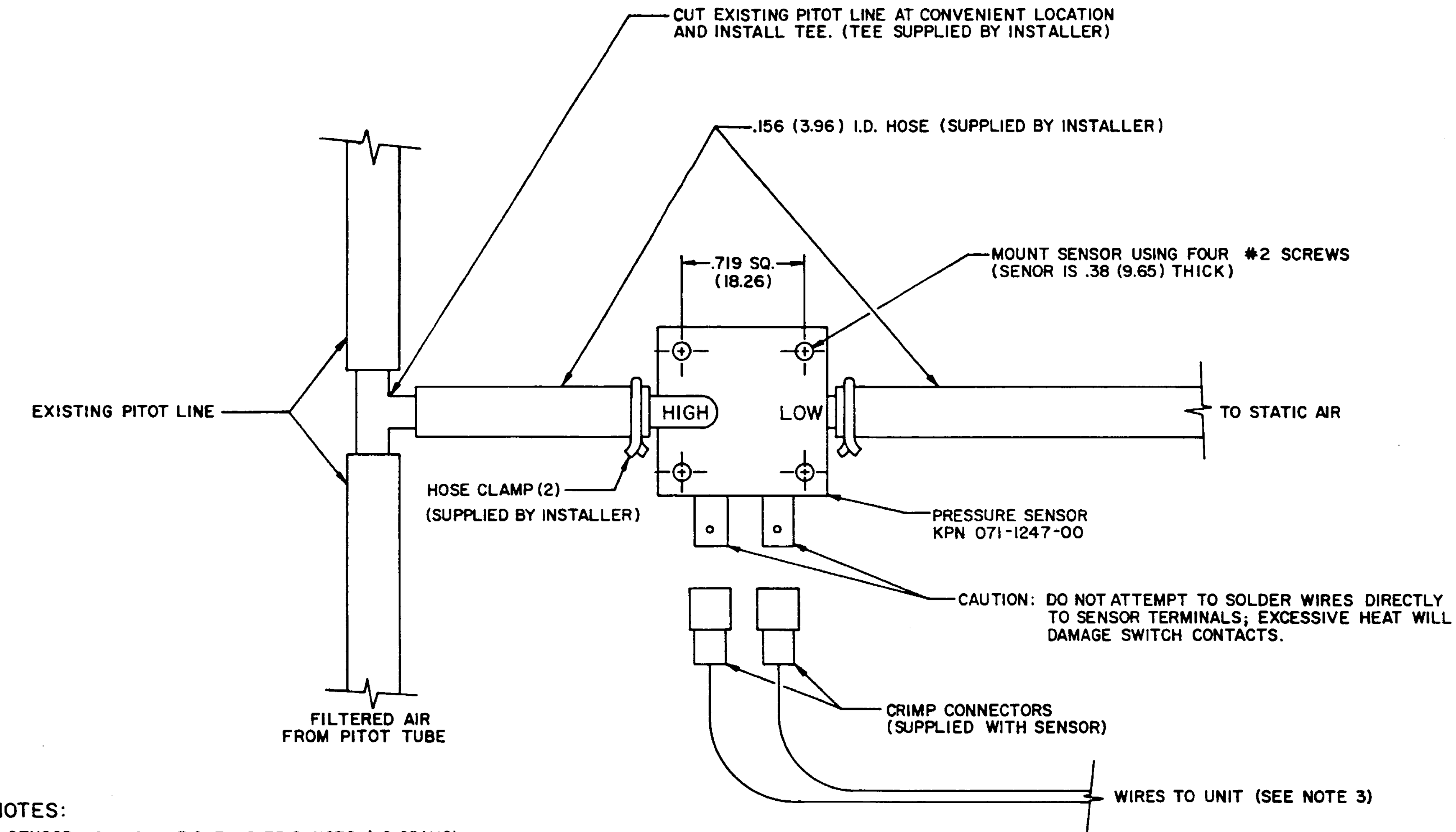
   DRAIN HOLE HAS BEEN ELIMINATED. NO ACTION IS REQUIRED.

FIGURE 2-23 KA 44B OUTLINE AND MOUNTING DRAWING W/ GROUND PLANE
(Dwg No 155-05334-0010 R-3)



NOTES:
1. TOLERANCE ON OVERALL LENGTH - ± 2" PER 12' LENGTH.

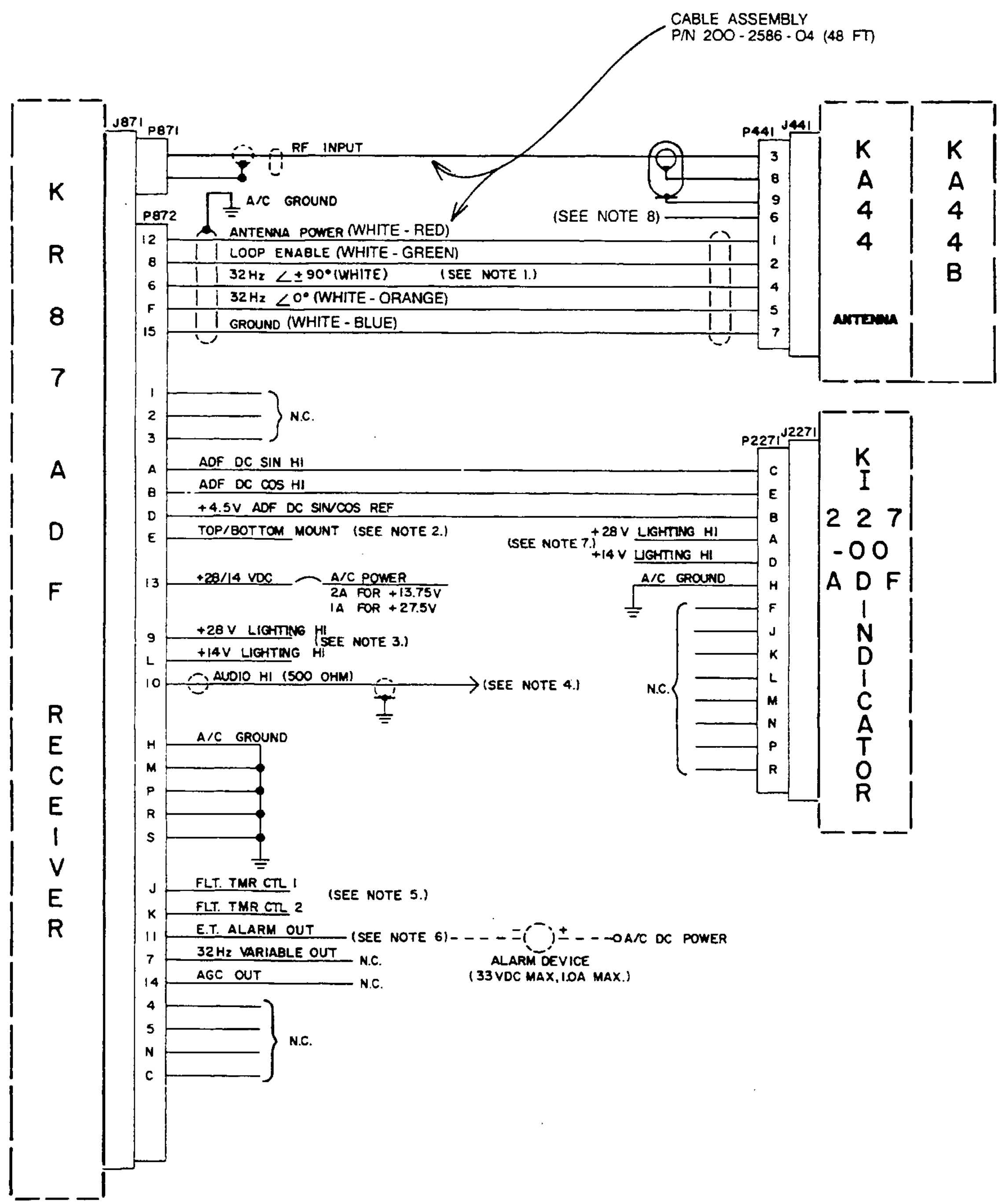
FIGURE 2-24 ANTENNA CABLE ASSEMBLY
(Dwg No 300-02586-0000 R-18)



NOTES:

1. SENSOR NOMINAL WEIGHT: 0.35 OUNCES (10 GRAMS).
2. DIMENSIONS ARE INCHES (MILLIMETERS).
3. PRESSURE SENSOR 071-1247-00 IS A SINGLE POLE, SINGLE THROW (SPST) NORMALLY OPEN SWITCH. THE SWITCH CONTACTS CLOSE AT AN INDICATED AIRSPEED OF APPROX. 60 KNOTS. THE SENSOR IS OFFERED AS A NON-PRECISION ON/OFF SWITCH FOR SPEED RELATED FUNCTIONS. EXAMPLES OF ITS USE ARE WITH THE KR 87 ADF; TO PROVIDE AUTOMATIC SWITCHING OF THE KR 87 FLIGHT TIMER, OR WITH THE KRA 10 RADAR ALTIMETER; TO PROVIDE POWER TO THE KRA 10 AFTER AIRSPEED IS ATTAINED.
4. CURRENT RATING: 10 MA, RESISTIVE, DC NOMINAL.
5. CONTACT RESISTANCE: LESS THAN 1 OHM.

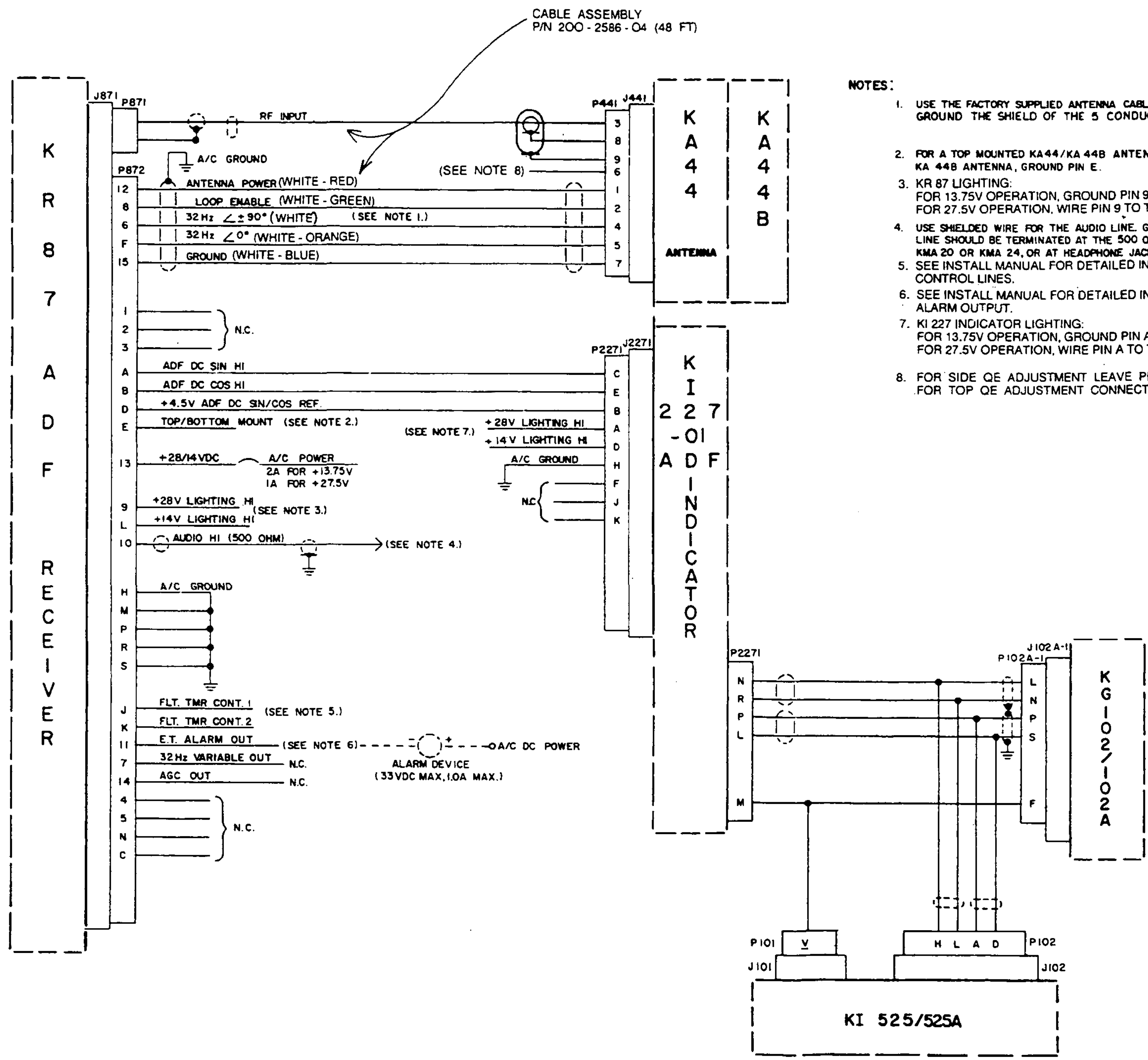
FIGURE 2-25 PRESSURE SENSOR INSTALLATION
(Dwg No 155-05387-0000 R-2)



NOTES:

1. USE THE FACTORY SUPPLIED ANTENNA CABLE ASSEMBLY AND FOLLOW THE COLOR CODE IN DIAGRAM. GROUND THE SHIELD OF THE 5 CONDUCTOR CABLE AT THE RECEIVER END.
2. FOR A TOP MOUNTED KA44/KA 44B ANTENNA, LEAVE PIN E OPEN. FOR A BOTTOM MOUNTED KA 44/KA 44B ANTENNA, GROUND PIN E.
3. KR87 LIGHTING:
   FOR 13.75V OPERATION, GROUND PIN 9 AND WIRE PIN L TO THE +13.75V DIMMER LINE.
   FOR 27.5V OPERATION, WIRE PIN 9 TO THE +27.5V DIMMER LINE AND LEAVE PIN L OPEN.
4. USE SHIELDED WIRE FOR THE AUDIO LINE. GROUND THE SHIELD AT THE LOAD END ONLY. THE AUDIO LINE SHOULD BE TERMINATED AT THE 500 OHM INPUT OF AN ISOLATION AMPLIFIER SUCH AS THE KMA 20 OR KMA 24, OR AT HEADPHONE JACK.
5. SEE INSTALL MANUAL FOR DETAILED INSTALLATION INFORMATION ON FLIGHT TIMER RESET LINES.
6. SEE INSTALL MANUAL FOR DETAILED INSTALLATION INFORMATION ON ELAPSED TIMER ALARM OUTPUT.
7. KI 227 INDICATOR LIGHTING:
   FOR 13.75V OPERATION, GROUND PIN A AND WIRE PIN D TO THE 13.75V DIMMER LINE.
   FOR 27.5V OPERATION, WIRE PIN A TO THE 27.5V DIMMER LINE AND LEAVE PIN D OPEN.
8. FOR SIDE QE ADJUSTMENT LEAVE PIN 6 OPEN.
   FOR TOP QE ADJUSTMENT CONNECT PIN 6 TO PIN 7.

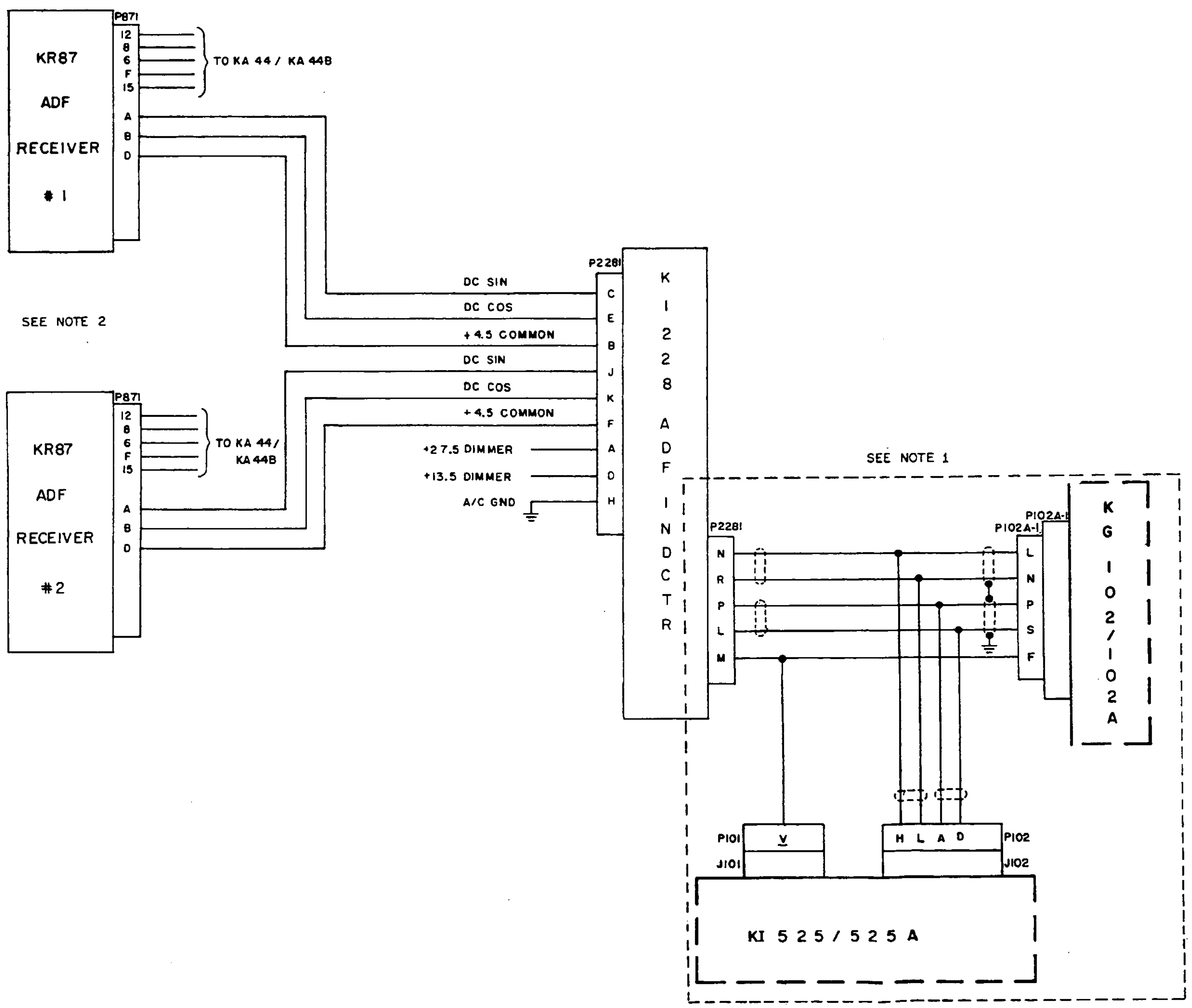
FIGURE 2-26 KR 87/KI 227-00 INTERCONNECT
(Dwg No 155-01360-0000 R-11)



NOTES:

1. USE THE FACTORY SUPPLIED ANTENNA CABLE ASSEMBLY AND FOLLOW THE COLOR CODE IN DIAGRAM. GROUND THE SHIELD OF THE 5 CONDUCTOR CABLE AT THE RECEIVER END.
2. FOR A TOP MOUNTED KA44/KA 44B ANTENNA, LEAVE PIN E OPEN. FOR A BOTTOM MOUNTED KA 44/KA 44B ANTENNA, GROUND PIN E.
3. KR 87 LIGHTING:
   FOR 13.75V OPERATION, GROUND PIN 9 AND WIRE PIN L TO THE +13.75V DIMMER LINE.
   FOR 27.5V OPERATION, WIRE PIN 9 TO THE +27.5V DIMMER LINE AND LEAVE PIN L OPEN.
4. USE SHIELDED WIRE FOR THE AUDIO LINE. GROUND THE SHIELD AT THE LOAD END ONLY. THE AUDIO LINE SHOULD BE TERMINATED AT THE 500 OHM INPUT OF AN ISOLATION AMPLIFIER SUCH AS THE KMA 20 OR KMA 24, OR AT HEADPHONE JACK.
5. SEE INSTALL MANUAL FOR DETAILED INSTALLATION INFORMATION ON FLIGHT TIMER CONTROL LINES.
6. SEE INSTALL MANUAL FOR DETAILED INSTALLATION INFORMATION ON ELAPSED TIMER ALARM OUTPUT.
7. KI 227 INDICATOR LIGHTING:
   FOR 13.75V OPERATION, GROUND PIN A AND WIRE PIN D TO THE 13.75V DIMMER LINE.
   FOR 27.5V OPERATION, WIRE PIN A TO THE 27.5V DIMMER LINE AND LEAVE PIN D OPEN.
8. FOR SIDE QE ADJUSTMENT LEAVE PIN 6 OPEN.
   FOR TOP QE ADJUSTMENT CONNECT PIN 6 TO PIN 7.

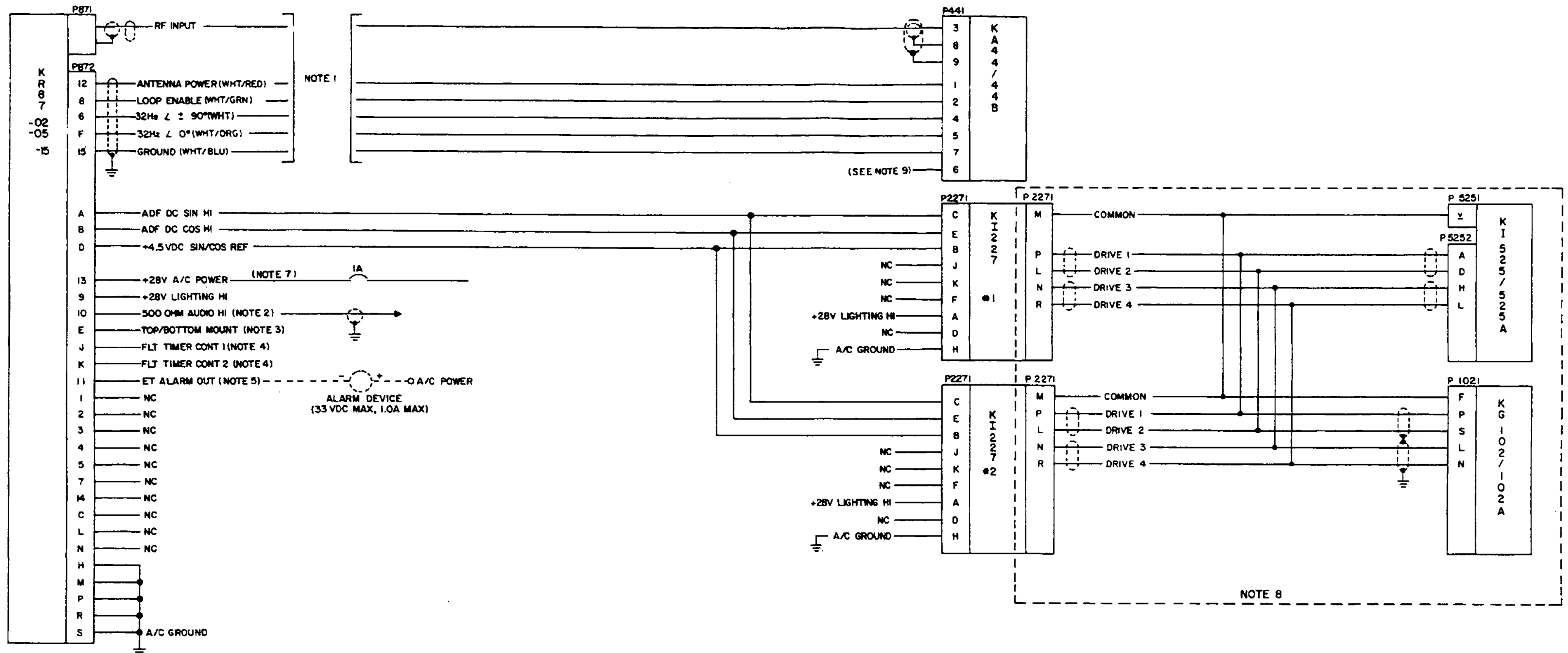
FIGURE 2-27 KR 87/KI 227-01 INTERCONNECT
(Dwg No 155-01360-0001 R-14)



NOTES:

1. CONNECTIONS INSIDE DASHED LINES APPLICABLE TO KI 228-01 ONLY.
2. THIS INTERCONNECT ONLY SHOWS CONNECTIONS EXCLUSIVE TO THE KI 228. FOR REMAINING CONNECTIONS, REFER TO THE KR 87/KI227 INTERCONNECT DWG KPN 155-1360-00 OR -01.

FIGURE 2-28 DUAL KR 87/KI 228 INTERCONNECT
(Dwg No 155-01365-0000 R-4)



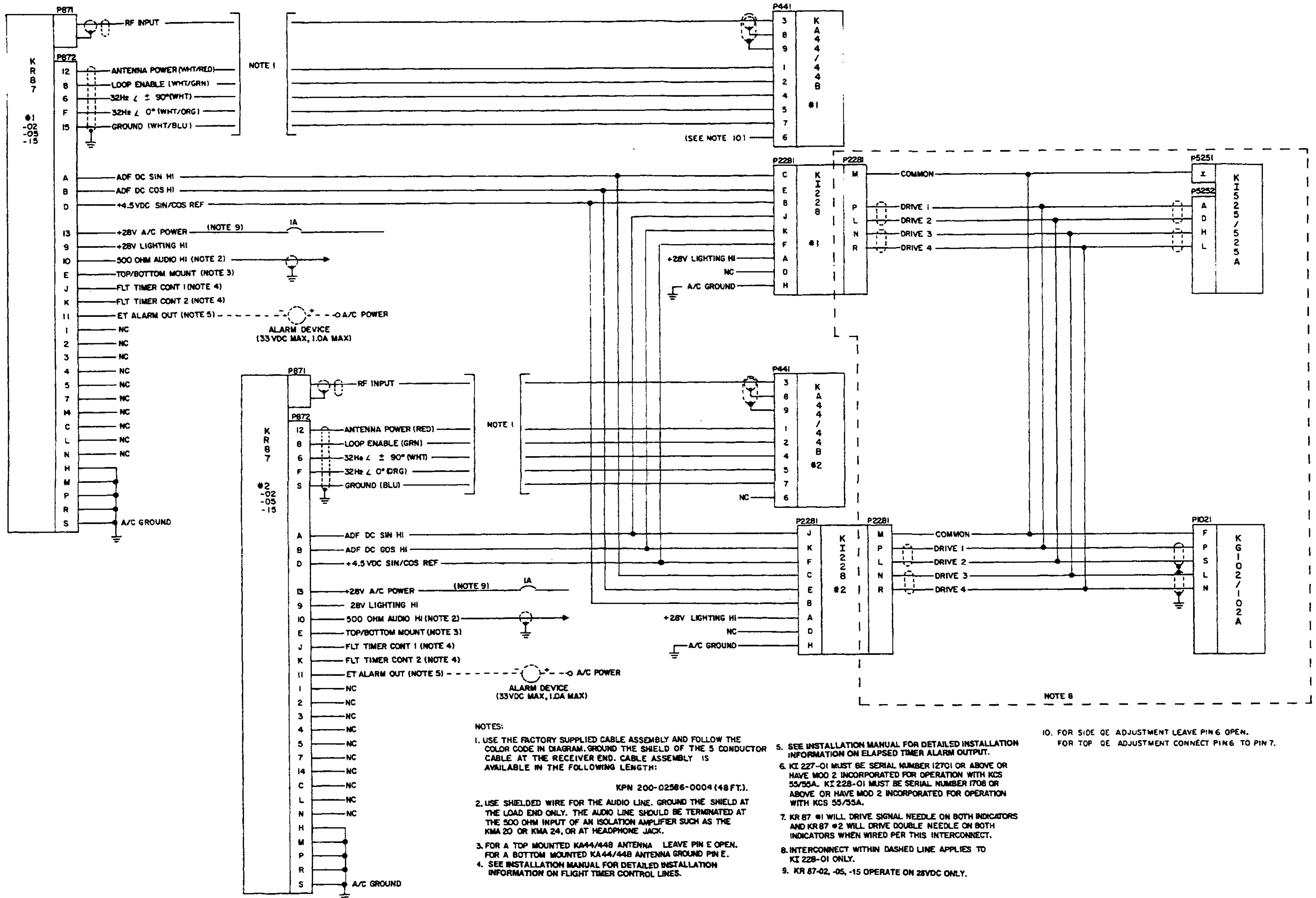
NOTES:

1. USE THE FACTORY SUPPLIED CABLE ASSEMBLY AND FOLLOW THE COLOR CODE IN DIAGRAM. GROUND THE SHIELD OF THE 5 CONDUCTOR CABLE AT THE RECEIVER END. CABLE ASSEMBLY IS AVAILABLE IN THE FOLLOWING LENGTH:

   KPN 200-02586-0004 (48 FT.).

2. USE SHIELDED WIRE FOR THE AUDIO LINE. GROUND THE SHIELD AT THE LOAD END ONLY. THE AUDIO LINE SHOULD BE TERMINATED AT THE 500 OHM INPUT OF AN ISOLATION AMPLIFIER SUCH AS THE KMA 20 OR KMA 24, OR AT HEADPHONE JACK.
3. FOR A TOP MOUNTED KA44/44B ANNTENNA LEAVE PIN E OPEN. FOR A BOTTOM MOUNTED KA 44/44B ANTENNA GROUND PIN E.
4. SEE INSTALLATION MANUAL FOR DETAILED INSTALLATION INFORMATION ON FLIGHT TIMER CONTROL LINES.
5. SEE INSTALLATION MANUAL FOR DETAILED INSTALLATION INFORMATION ON ELAPSED TIMER ALARM OUTPUT.
6. KI 227-01 MUST BE SERIAL NUMBER 12701 OR ABOVE OR HAVE MOD 2 INCORPORATED FOR OPERATION WITH KCS 55/55A. KI 228-01 MUST BE SERIAL NUMBER 1708 OR ABOVE OR HAVE MOD 2 INCORPORATED FOR OPERATION WITH KCS 55/55A.
7. KR 87-02, -05, -15 OPERATE ON 28VDC ONLY.
8. INTERCONNECT WITHIN DASHED LINE APPLIES TO KI 227-01 ONLY.
9. FOR SIDE QE ADJUSTMENT LEAVE PIN 6 OPEN. FOR TOP QE ADJUSTMENT CONNECT PIN 6 TO PIN 7.

FIGURE 2-29 DUAL KR 87/DUAL KI 227/KCS 55A INTERCONNECT (Dwg No 155-01360-0002 R-3)



NOTES:

1. USE THE FACTORY SUPPLIED CABLE ASSEMBLY AND FOLLOW THE COLOR CODE IN DIAGRAM. GROUND THE SHIELD OF THE 5 CONDUCTOR CABLE AT THE RECEIVER END. CABLE ASSEMBLY IS AVAILABLE IN THE FOLLOWING LENGTH:

   KPN 200-02586-0004 (48 FT.).

2. USE SHIELDED WIRE FOR THE AUDIO LINE. GROUND THE SHIELD AT THE LOAD END ONLY. THE AUDIO LINE SHOULD BE TERMINATED AT THE 500 OHM INPUT OF AN ISOLATION AMPLIFIER SUCH AS THE KMA 20 OR KMA 24, OR AT HEADPHONE JACK.
3. FOR A TOP MOUNTED KA44/44B ANTENNA LEAVE PIN E OPEN. FOR A BOTTOM MOUNTED KA44/44B ANTENNA GROUND PIN E.
4. SEE INSTALLATION MANUAL FOR DETAILED INSTALLATION INFORMATION ON FLIGHT TIMER CONTROL LINES.
5. SEE INSTALLATION MANUAL FOR DETAILED INSTALLATION INFORMATION ON ELAPSED TIMER ALARM OUTPUT.
6. KI 227-01 MUST BE SERIAL NUMBER 12701 OR ABOVE OR HAVE MOD 2 INCORPORATED FOR OPERATION WITH KCS 55/55A. KI 228-01 MUST BE SERIAL NUMBER 1708 OR ABOVE OR HAVE MOD 2 INCORPORATED FOR OPERATION WITH KCS 55/55A.
7. KR 87 #1 WILL DRIVE SIGNAL NEEDLE ON BOTH INDICATORS AND KR 87 #2 WILL DRIVE DOUBLE NEEDLE ON BOTH INDICATORS WHEN WIRED PER THIS INTERCONNECT.
8. INTERCONNECT WITHIN DASHED LINE APPLIES TO KI 228-01 ONLY.
9. KR 87-02, -05, -15 OPERATE ON 28VDC ONLY.
10. FOR SIDE QE ADJUSTMENT LEAVE PIN 6 OPEN. FOR TOP QE ADJUSTMENT CONNECT PIN 6 TO PIN 7.

FIGURE 2-30 DUAL KR 87/DUAL KI 228/KCS 55A INTERCONNECT (Dwg No 155-01360-0003 R-3)

SECTION III
OPERATION

3.1 OPERATING PROCEDURES

It is recommended that the KR 87 unit be turned off when the aircraft engine is started in order to prevent possible voltage transient damage to the radio. The unit is turned on by rotating the volume control clockwise past the detent. The volume control is used to adjust the audio output for a comfortable listening level.

NOTE

> The audio muting feature of the KR 87 will cause the audio output to be muted unless the receiver is locked onto a valid station. This reduces interstation noise and aids the pilot in identifying usable stations.

3.1.1 OPERATING MODES

The KR 87 Automatic Direction Finder has two operational modes. In the ANT (Antenna) mode (ADF button out) the loop antenna is disabled, and the unit simply acts as a receiver, allowing audio reception through the speaker or headphones. The indicator needle will remain parked at the 90° relative position and the ANT message on the left side of the display will be lighted. This mode provides slightly clearer audio reception, and is used for station identification. In various parts of the world, some L/MF stations use an interrupted carrier for identification purposes. A Beat Frequency Oscillator (BFO) function is provided to permit these stations to be more easily identified. pushing the BFO switch will cause a 1000Hz tone to be heard whenever there is a radio carrier signal present at the selected frequency. It will also light the BFO message in the center of the display.

With the ADF button depressed, the unit is placed into the ADF mode and the loop antenna is enabled. The ADF message on the left side of the display will be lighted and the indicator needle will point to the relative bearing of the selected station. In order to tell if there is a sufficient signal for navigational purposes, the pilot can place the KR 87 back in the ANT mode, parking the indicator needle at 90°. When the unit is then switched to the ADF mode, the needle should slew to the station bearing in a positive manner, without excessive sluggishness, wavering, or reversals.

3.1.2 FREQUENCY CONTROL

A Active Frequency (The frequency to which the ADF is tuned).

The active frequency is displayed in the left hand window. This frequency may be changed with the concentric knobs when either timer mode (FLT or ET) is being displayed in the right hand window. The exception to this is when the ET message is flashing (see below). To set the 10's digit push the small knob in and rotate it. Clockwise rotation will increment the digit. The digit will roll over at 9 to 0 and roll under (when turning the knob counterclockwise) at 0 to 9. With the small knob pulled out the 1's digit may be set. Its operation is the same as for the 10's digit.

Turning the large knob changes the 100's digit and the 1000's digit. The 100's digit carries to the 1000's digit from 9 to 10 and borrows from 10 to 9. The two digits roll over from 17 to 02 and under from 02 to 17 thus limiting the frequencies to the range of 200KHz to 1799KHz.

B. Standby Frequency

The standby frequency is displayed in the right window when the FRQ message is lighted. When this is the case, this frequency may be changed with the knobs in a manner similar to that explained above for the active frequency.

If the standby frequency is not being displayed it may be called to the window by pressing the FRQ button. Pressing this button when the standby frequency is displayed causes the current standby and active frequencies to be exchanged.

3.1.3 TIMERS

A. FLT/ET Button

If elapsed time (ET) is currently displayed the FLT/ET button will cause the flight timer to be displayed. Pressing this button again will exchange the two timers in the display. If the standby frequency is displayed the FLT/ET button will cause the timer which was last displayed to reappear in the window. (Note: When power is first applied, the flight timer is displayed).

B. Flight Timer

The flight timer is displayed in the right hand window when the FLT message is lit. This timer will count up to 59 hours, 59 minutes, 59 seconds. When the unit is first turned on this timer is automatically started at 0. Minutes and seconds will be displayed until a value of 59 minutes and 59 seconds is reached. On the next count the display will shift to hours and minutes.

See Section 2.3.5.A or 2.3.5.B of this manual for additional information.

C. Elapsed Timer

This timer has two modes; Count Up and Count Down. When power is applied it is in the Count Up mode starting at 0. As is true with the flight timer, the elapsed timer will count to 59 hours, 59 minutes, 59 seconds, displaying minutes and seconds until one hour has elapsed, then displaying hours and minutes. When in the Count Up mode the timer may be reset to 0 by pressing the reset button. (Note: Pressing the reset button will reset the elapsed timer regardless of what is currently being displayed).

To enter the Count Down mode, the Reset (RST) button is held depressed for approximately 2 seconds until the ET message begins to flash (this may be done regardless of current display). While the ET message is flashing the timer is in the ET Set mode. In this mode a number up to 59 minutes, 59 seconds may be preset into the elapsed timer with the concentric knobs. With the small knob pressed in the 10's of seconds digit may be changed; it will roll over from 5 to 0 and under 0 to 5. With the knob pulled out the 1's of seconds digit may be changed. It rolls over from 9 to 0 and under from 0 to 9. The larger knob modifies the minutes. It rolls over from 59 to 0 and under from 0 to 59. The timer will remain in the ET Set mode (ET message flashing) for 15 seconds after a number is set in or until the RST, FLT/ET, or FRQ button is pressed. The number preset will remain unchanged until the RST button is pressed. When the RST button is pressed after a number is preset, the elapsed timer will start counting down. (Note: The timer will start when RST is pressed regardless of the current display). When the timer reaches 0 it changes to the Count Up mode and continues up from 0. Also the right hand display will flash for 15 seconds and the timer alarm line will be pulled low for 1 second. While the elapsed timer is counting down, pressing the RST button will have no effect unless it is held for approximately 2 seconds. This will cause the timer to stop and enter the Set mode (ET message flashing).

3.1.4 INDICATOR OPERATION

The KI 227-00 and the KI 228-00 have a manually rotatable compass card which the pilot can set to a selected bearing reference with the HDG knob. If a KI 227-01 or a KI 228-01 is installed in conjunction with the KCS 55/55A Compass System, the compass card on the KI 227/228 is synchronized to the KI 525/525A compass card by rotating the SYNC knob of the KI 227/228 until the heading matches that of the KI 525/525A. This may be done with both, either, or neither system energized. Once aligned, the KI 227/228 compass card will track the KI 525/525A compass card.

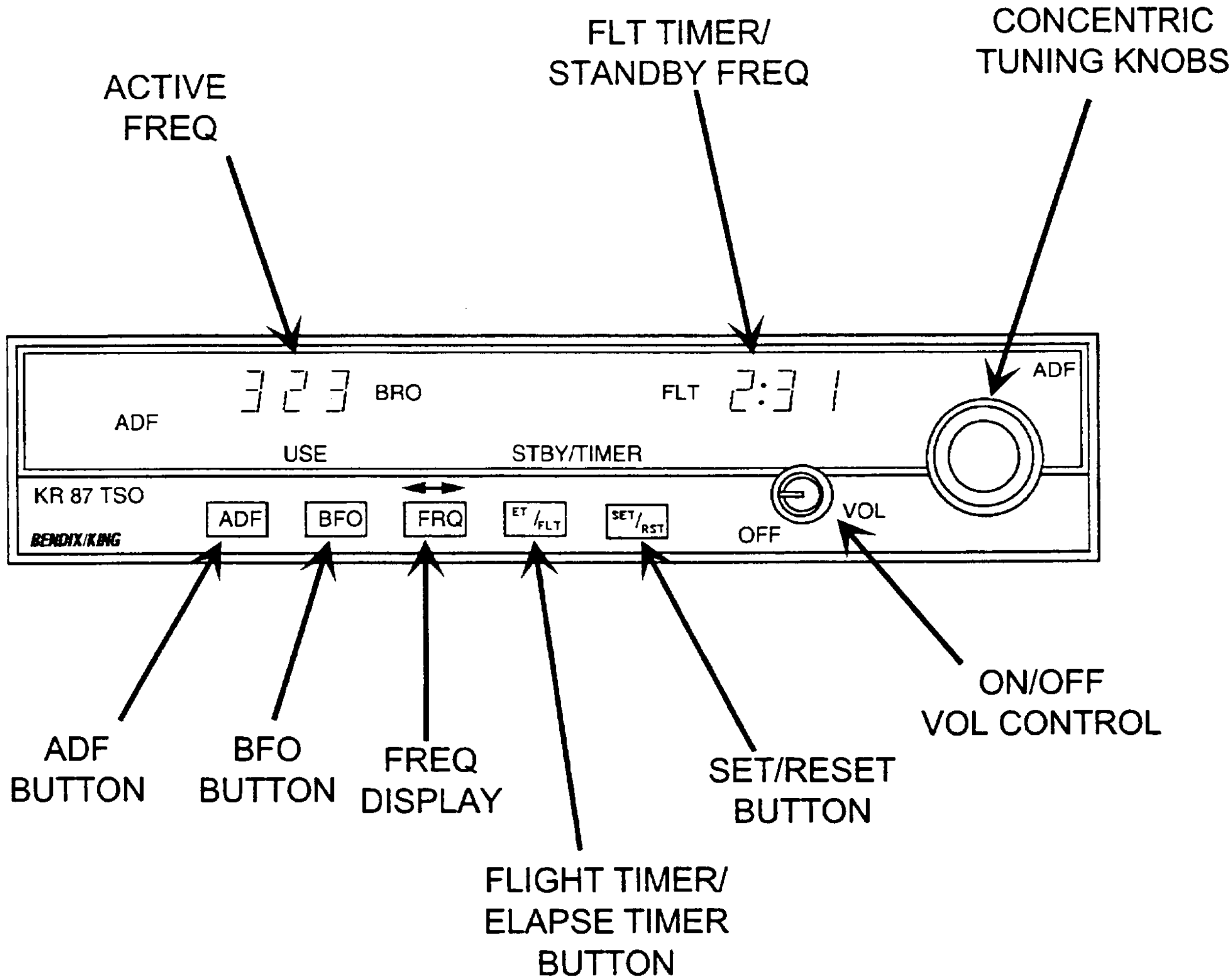


FIGURE 3-1 KR 87 CONTROL FUNCTIONS
(UNIT P/N 066-1072-00 THRU -05, -07)

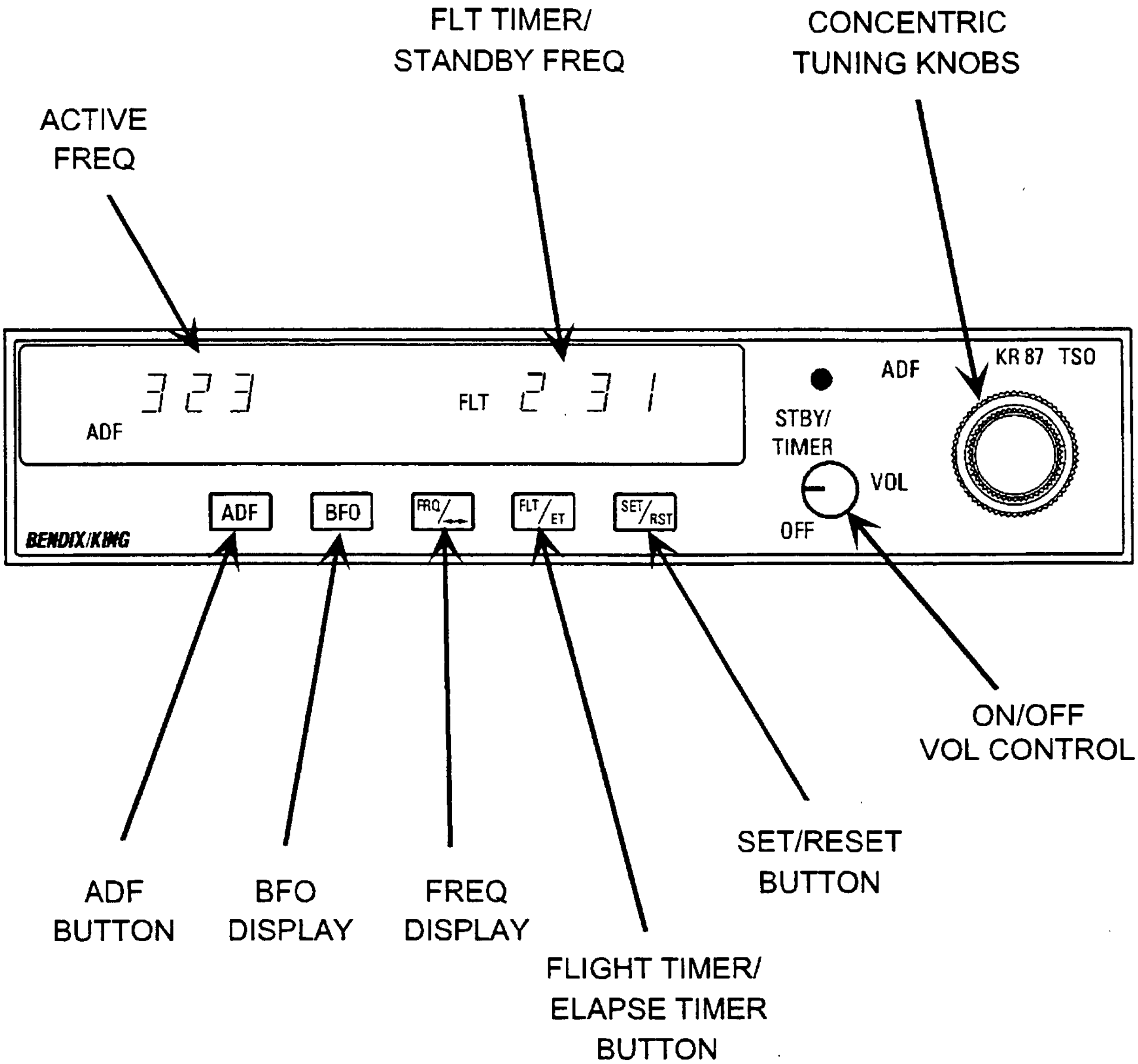


FIGURE 3-2 KR 87 CONTROL FUNCTIONS
(UNIT P/N 066-1072-14, - 15, -17)

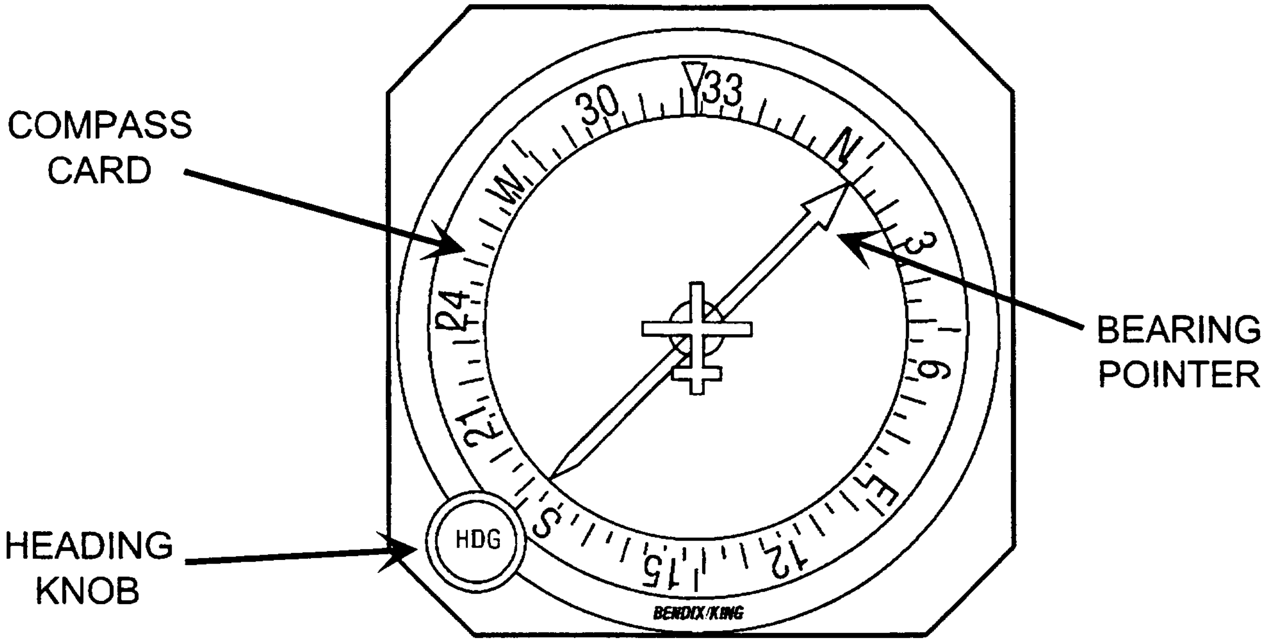


FIGURE 3–3 KI 227–00 CONTROL FUNCTIONS

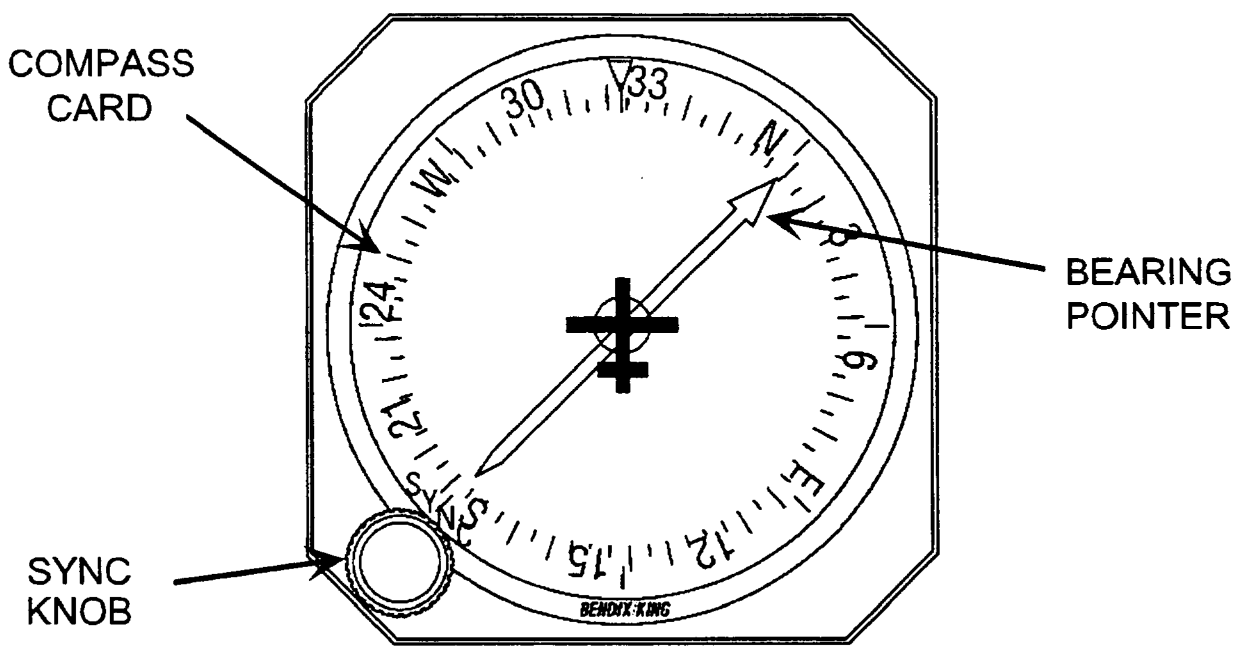


FIGURE 3–4 KI 227–01 CONTROL FUNCTIONS

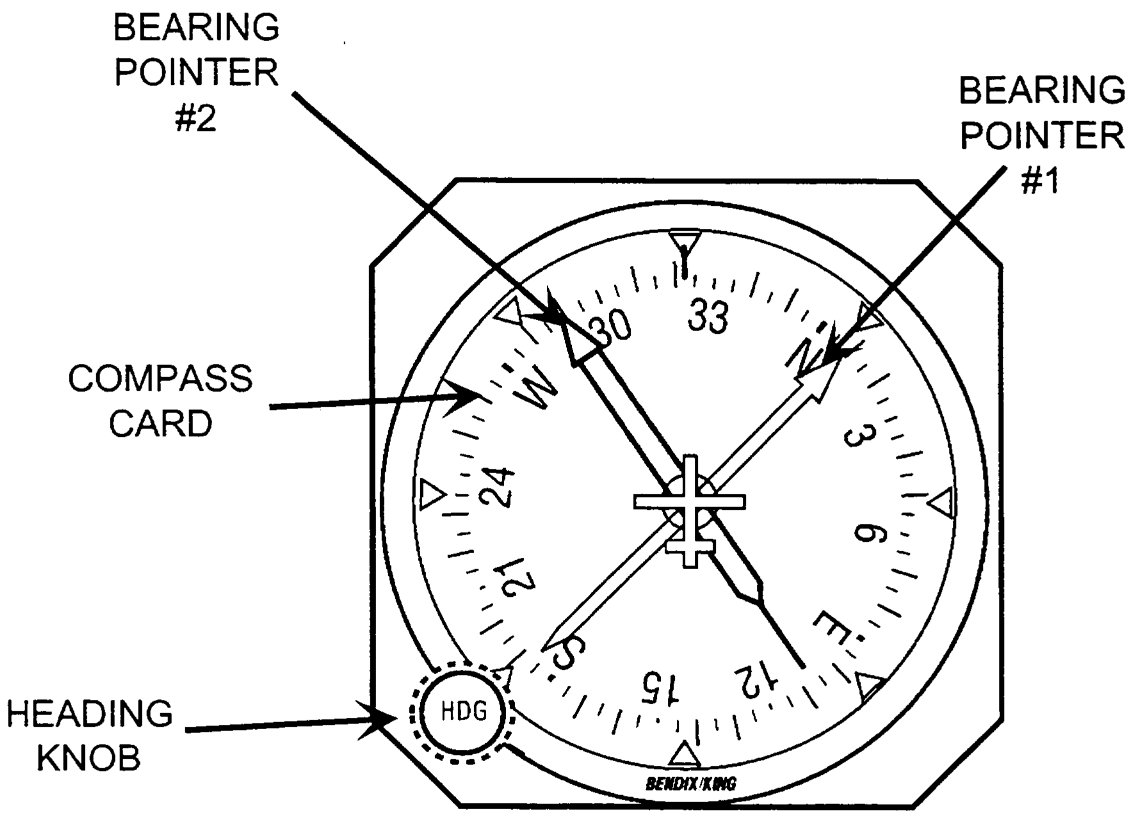


FIGURE 3-5 KI 228-00 CONTROL FUNCTIONS

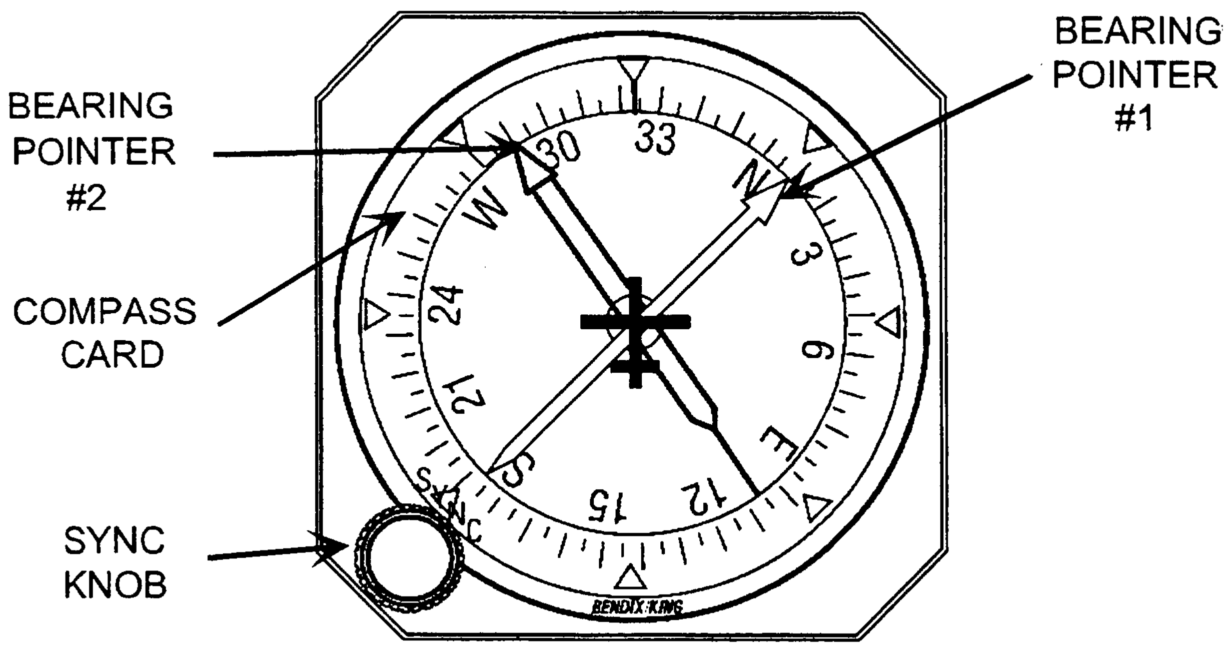


FIGURE 3-6 KI 228-01 CONTROL FUNCTIONS

MAINTENANCE/OVERHAUL MANUAL
SECTIONS IV, V AND VI

Section I, II, and III have been deleted from the Maintenance-Overhaul Manual format. The Installation Manual, which covers the same installation information, should be added behind the red Installation Manual Tab provided in this binder.

KR 87

AlliedSignal

ELECTRONIC AND AVIONICS SYSTEMS

MAINTENANCE MANUAL

BENDIX/KING®

KR 87

AUTOMATIC DIRECTION FINDER

WARNING

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SECTION IV
THEORY OF OPERATION

4.1 GENERAL

4.1.1 BASIC ADF PRINCIPLES

In order to fully understand the operation of an ADF system, it is advantageous to first examine the radio wave which induces the signals in an ADF antenna system. A radio wave consists of two electromagnetic field components; an electric field (E) and a magnetic field (H). These fields are perpendicular in space and their amplitudes vary sinusoidally with time. A simplified illustration of a plane electromagnetic wave is shown in Figure 4-1. Stations which broadcast in the ADF band (200KHz - 1799KHz) transmit vertically polarized radio waves, meaning that the E field is vertical in space, while the H field is horizontal.

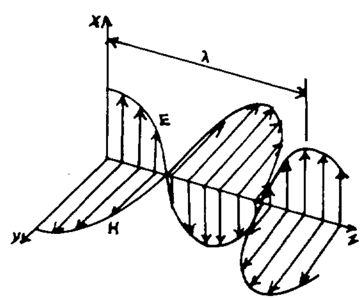


FIGURE 4-1
PLANE E-M WAVE

It is the magnetic field of the radio wave which induces voltages in the loop windings of the ADF antenna. The loop antenna consists of two mutually perpendicular windings on a square ferrite core. The high magnetic permeability of the ferrite core serves to concentrate the magnetic field through the loops and increase the induced signal. The voltages that are induced in the loop windings lag the H field by 90° due to their inductive nature. The axis of one winding is aligned with the longitudinal axis of the aircraft, and the voltage in it is proportional to the sine of the angle between the nose of the aircraft and the station, an angle known as the relative bearing. The other winding axis is parallel to the lateral axis of the aircraft, and a voltage proportional to the cosine of the relative bearing is induced in it. Figure 4-2 illustrates the relationship of the two induced voltages as the relative bearing changes through 360°. Note that as one of the signal passes through a null (e.g.; the cosine of 90° is 0, so no voltage is induced in the cosine loop at a relative bearing of 90°), it goes through a 180° phase shift. For example, the cosine of 135° is -.707, so at a relative bearing of 135°, the induced cosine voltage will be 70.7% of the voltage induced at a relative bearing of 0°, and 180° out of phase. Thus the loop antenna receives directional information from the transmitting station. Note, however, that the sine and cosine loop signals will be in phase with each other at both 45° and 225° relative bearings, for instance. Without some kind of a reference signal, the ADF system would be unable to determine which of the two relative bearings was correct. This is the purpose of the sense antenna, which responds to the electric field of the radio wave. The sense signal maintains a reference phase to which the loop signals are compared in order to resolve the bearing ambiguity. The sense signal is in phase with the E field of the radio wave, hence it is 90° out of phase with the loop signals.

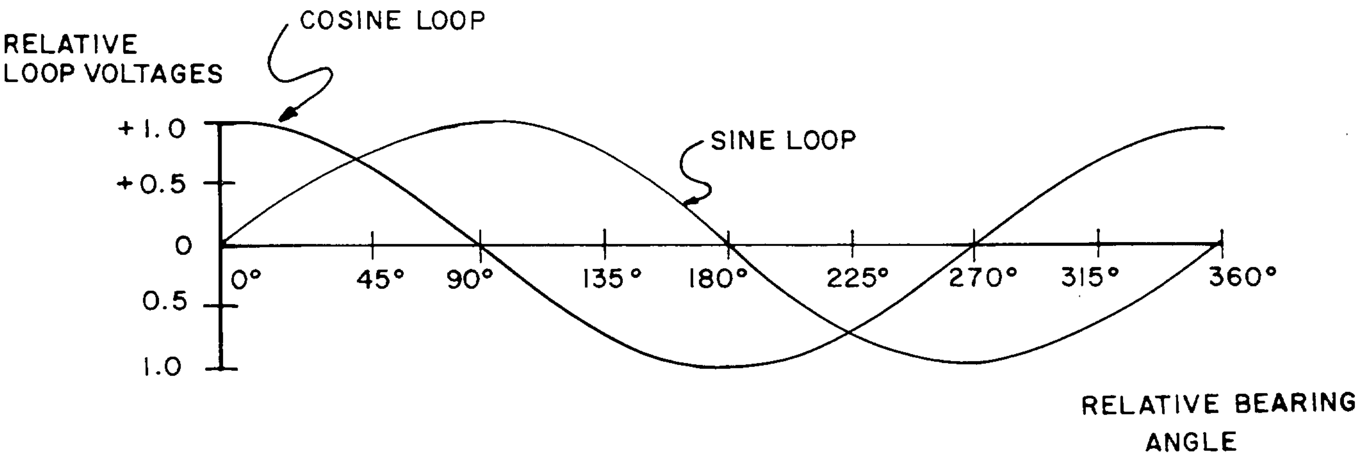


FIGURE 4-2
INDUCED VOLTAGES VS RELATIVE BEARING ANGLE

The KR 87 has two basic operating modes, the antenna mode (ANT) and the ADF mode. In the ANT mode, the loop signals are disabled and the receiver functions as a simple AM receiver. The indicator needle remains parked at the 90° bearing position. This mode allows improved audio reception and is most useful for station identification. In the ADF mode, the loop signals provide bearing information and the indicator points to the relative bearing of the station.

4.1.2 PHASE-MODULATED POINTING SYSTEM

The KR 87 uses a phase-modulated (PM) system to derive the bearing pointer signals. Refer to the pointing system block diagram in Figure 4-3 for the following discussion.

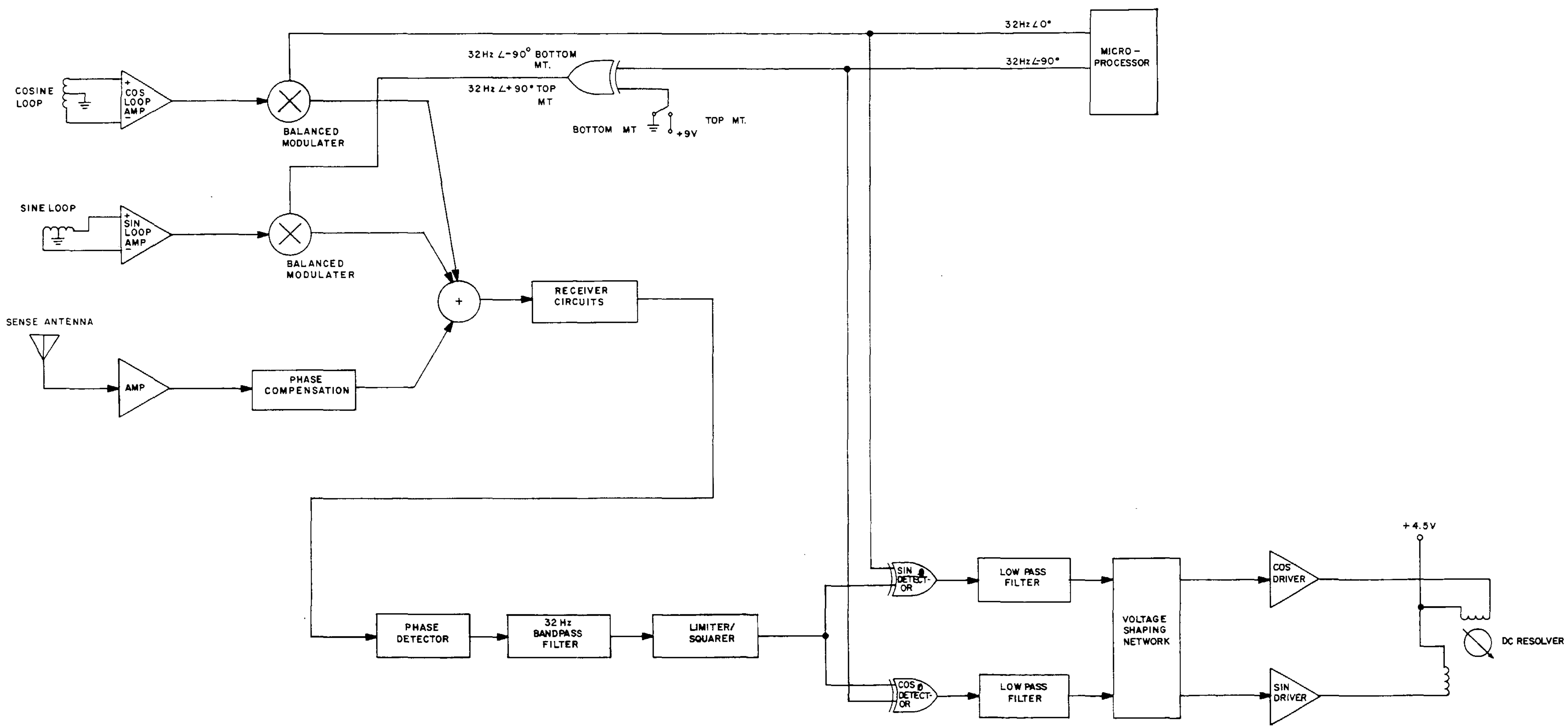


FIGURE 4-3 POINTING SYSTEM BLOCK DIAGRAM
(Dwg. No. 696-3268-00, R-0)

The sine loop signal, cosine loop signal, and sense signal are each separately amplified in the antenna amplifier/modulator circuit. The loop signals are then applied to the inputs of a pair of balanced modulators which are modulated by 32Hz square waves in quadrature. As shown in Figure 4-4, the phase of the square wave driving the sine modulator leads the cosine modulation signal by 90° (It lags by 90° for a bottom-mounted antenna). These square waves effectively act as switching signals to reverse the phase of the loop signals. When the modulation square wave is positive, the modulator passes the loop signal with no phase shift, while the negative half of the modulation square wave causes the modulator to pass the signal with a 180° phase reversal. Therefore, the loop signals appear at the outputs of the modulators reversing phase at a 32Hz rate. The outputs of the modulators are then summed with the amplified sense signal, the phase of which is in quadrature with the loop signals. This quadrature summing operation produces a phase modulation of the sense signal, with the amount of modulation a function of the relative sine and cosine loop signals, and hence the angle to the station.

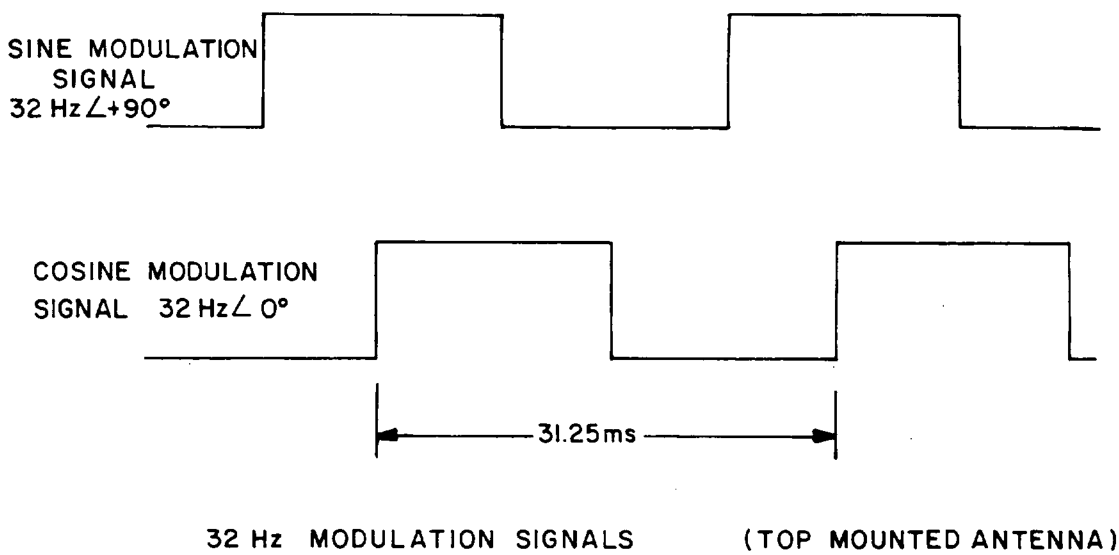


FIGURE 4-4
32HZ MODULATION SIGNALS
(TOP MOUNTED ANTENNA)

As an example, consider the case where the relative bearing to the station is 45°. During the first quarter of the 32Hz period, both modulation signals are high (see Figure 4-5) and the loop signals are passed through the modulators with zero phase shift. They are in phase with each other and at a relative amplitude of .707 (sin 45° = cos 45° = .707). At the summing junction, they are added together with the

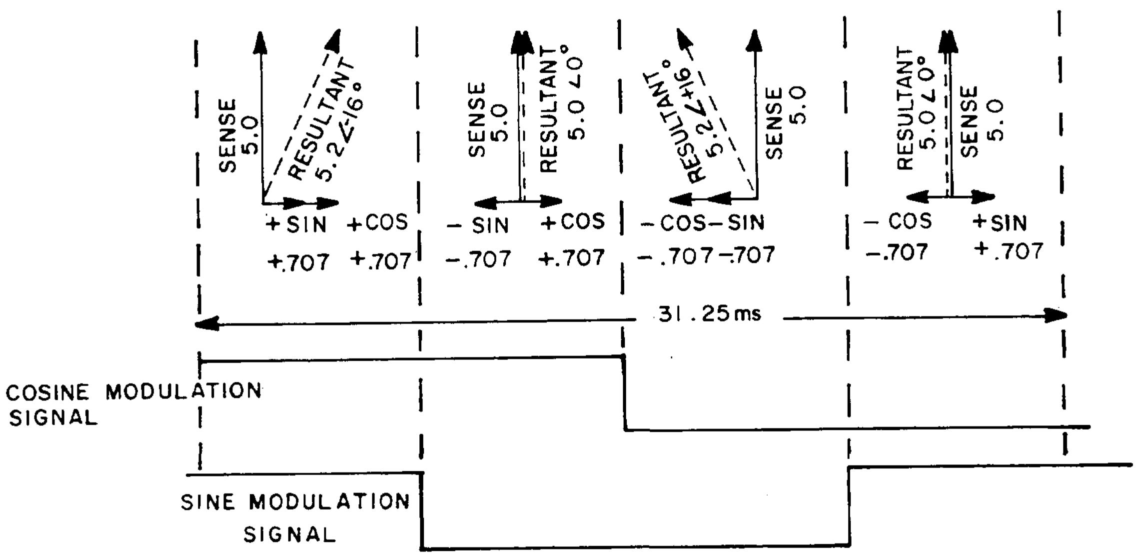


FIGURE 4-5 PHASE MODULATOR PHASOR DIAGRAM

sense signal, which is in quadrature with the loop signals and at a relative amplitude of approximately 5.0. The vector diagram in the first quarter of Figure 4-5 illustrates how the signals add. The resulting output signal has a relative amplitude of 5.2 and a phase of -16° relative to the sense signal. In effect, the smaller loop signals are being used to phase modulate the sense carrier. During the second quarter of the 32Hz period, the sine modulator inverts the sine loop signal. The sine and cosine signals, being equal in amplitude and opposite in phase, cancel, leaving the sense signal itself as the resultant. Similarly, the resultant signal during the third quarter has a relative amplitude of 5.2 with a phase of +16° relative to the sense, while the fourth quarter resultant is the sense signal itself. Figure 4-6 illustrates the phase modulation of the sense carrier at a relative bearing of 150°. Notice that this phase modulation is dependent upon the amplitude of the combined loop signals, and that the resultant signal either leads or lags the sense carrier, depending upon the polarity of the summed loop signals. Notice also that a small amount of amplitude modulation will be present. This has no effect upon the system performance, as the signal is later amplified and limited, the pointing information being derived solely from the zero-crossing points by the phase detector.

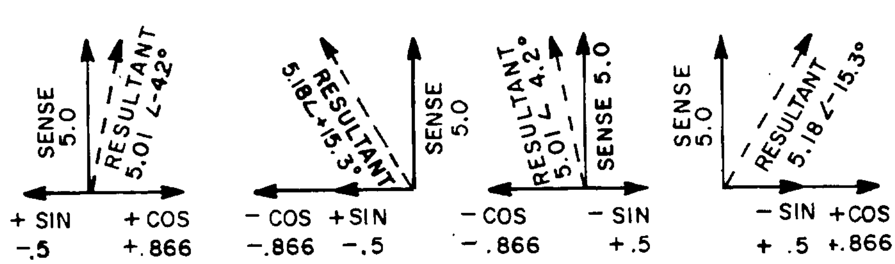


FIGURE 4-6 PHASE MODULATION OF SENSE CARRIER AT A RELATIVE BEARING OF 150°

The output of the antenna amplifier/modulator circuit is filtered, mixed, and amplified to an intermediate frequency (IF) of 140KHz with the phase modulation information intact. This phase modulated 140KHz signal is limited and squared to remove any amplitude modulation and reduce noise. It is then applied to the input of a phase-locked loop coherent detector circuit which compares its phase to that of a 140KHz constant phase reference signal. The output of the phase comparator thus contains a signal component at 32Hz, the rate at which the phase of the input signal is being switched. This output is passed through a 32Hz bandpass filter to produce a 32Hz sine wave whose phase relative to the 32Hz angle -90° square wave is equal to the relative bearing to the received station. The 32Hz sine wave is limited and squared, since the requisite pointing information lies in the zero crossings.

Figure 4-7 illustrates the phase relationship of the variable phase 32Hz signal to the 32Hz reference signals. In the first case, the variable signal leads the 32Hz angle -90° signal by (3.906ms/31.25ms) X $360^{\circ} = 45^{\circ}$, so the relative bearing to the station is 45°. In the second case, the relative bearing is (13.021ms/31.25ms) X $360^{\circ} = 150^{\circ}$.

The KR 87 uses a DC resolver in the indicator to display the angle to the station. The DC resolver contains two perpendicular windings and a permanent magnet rotor which aligns itself according to the resultant magnetic field set up by currents flowing through the two windings. Since the windings are perpendicular, the magnetic fields add in quadrature to produce a resultant. Therefore, DC voltages proportional to the sine and cosine of the intended angle are required at the inputs of the resolver in order to obtain correct pointing.

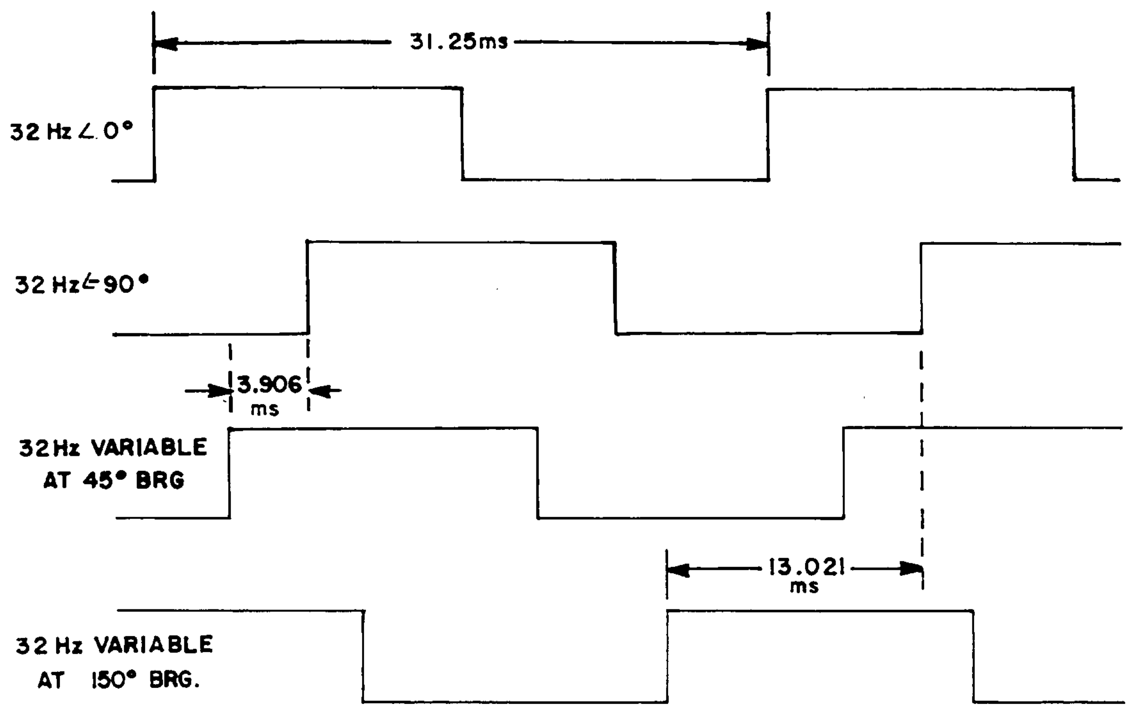


FIGURE 4-7 PHASE RELATIONSHIP OF 32Hz VARIABLE SIGNAL TO REFERENCE SIGNALS

To derive DC voltages proportional to the sine and cosine of the relative bearing, the variable phase signal is exclusive-OR'd with the 32Hz angle 0° and 32Hz angle -90° modulation signals. The output of these two exclusive-OR gates are pulsed signals which are then integrated to obtain average DC voltages that are linearly related to the angle to the station, as shown in Figure 4-8. These voltages cannot be used to drive the indicator directly, however, as they are linearly related to the angle rather than the sine or cosine of the angle. The DC voltages are applied to a voltage shaping network that has a sinusoidal transfer function to derive a voltage proportional to the sine or cosine of the angle. These voltages are then buffered by output stages to provide current drive to the indicator.

When the KR 87 is in the ANT mode, the 32Hz angle 0° reference signal is switched to the phase detector exclusive-OR gate via the mode switch, in effect simulating a signal at a bearing of 90°. This causes the indicator needle to park at the 90° position whenever the unit is in the ANT mode.

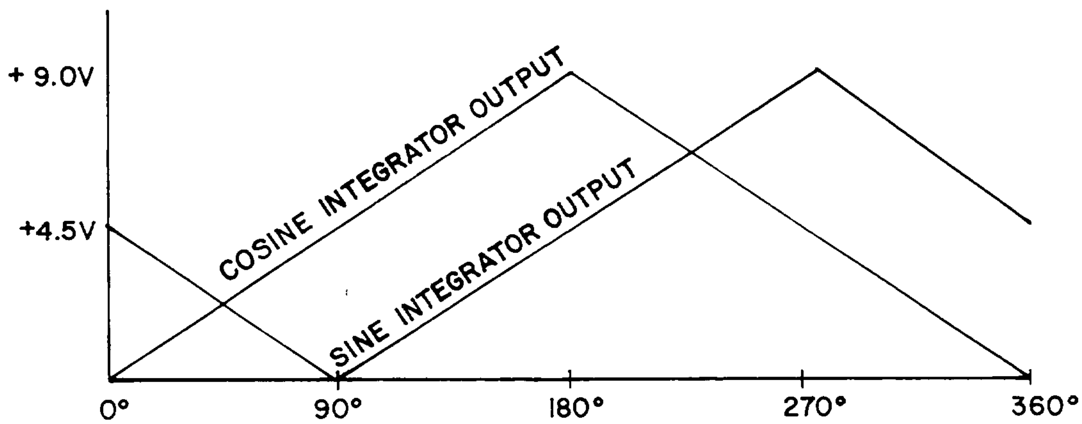


FIGURE 4-8 INTEGRATOR OUTPUT VOLTAGE VS BEARING ANGLE

The preceeding discussion has assumed that the antenna is mounted on top of the aircraft. Were the antenna to be mounted on the bottom of the aircraft, the phases of the sense signal and cosine loop signal would be reversed, while the sine loop phase would remain unchanged. As far as the pointing system is concerned, however, the sine loop signal appears to be reversed in phase since the sense and cosine loop signals retain the same phase relationship. In order to maintain correct pointing, the 32Hz angle $+90^\circ$ modulation square wave that normally modulates the sine loop signal is inverted, effectively inverting the sine loop signal and reestablishing the proper phase relationships between the three signals.

4.2 BLOCK DIAGRAM DISCUSSION

(Refer to the KR 87 System Block Diagram, Figure 4-9, for the following discussion.)

4.2.1 KA 44/44B ANTENNA

Both the loop and sense antennas that an ADF system require are contained in the KA 44/44B antenna. The loop antenna consists of perpendicular windings around a block of ferrite core material which serves to increase the magnetic flux density through the windings. The loop signals are amplified by separate FET differential amplifiers. The carrier inputs to the modulators, two 32Hz square waves, are supplied by the receiver. The modulating signal to the sine channel lags the other by 90° (leads by 90° for a top-mounted antenna). The modulating signals simply reverse the phase of the loop RF signals at a 32Hz rate. Output signals from the modulators are summed with the amplified and phase compensated sense signal. The sense signal must be 90° out of phase with the loop signals at the summing point, so phase compensation is necessary to maintain the 90° phase difference over frequency. This quadrature summing operation effectively produces a phase modulation of the sense signal, which is further amplified before being supplied to the receiver.

4.2.2 KR 87 RECEIVER RF SECTION

The RF signal from the antenna passes through one of a set of selectable half-octave bandpass filters into the first mixer. It converts the signal up to an IF frequency of 12.428MHz after which it is filtered by a crystal to provide selectivity and image rejection. The signal is then amplified in an AGC-controlled stage and mixed a second time with a 12.288MHz local oscillator frequency to produce the second IF frequency of 140KHz. The 140KHz signal is then bandpass filtered to improve the selectivity and further amplified before going through a conventional AM envelope detector and low pass filter to remove the audio modulation. The detected audio is then amplified and passed to the audio output terminals. It is also integrated and amplified to provide the AGC voltages to the AGC'd stages in the IF section.

Tuning is controlled by a microprocessor and a large scale integrated (LSI) frequency synthesizer chip. An 8.192MHz crystal oscillator drives the synthesizer chip, and this frequency is internally divided by 4 by the synthesizer and is output at 2.048MHz to clock the microprocessor. The processor then interprets movements of the frequency control knob on the receiver front panel and sends tuning data to the synthesizer chip. The synthesizer is part of a phase-locked loop (PLL) wherein control signals from it are filtered and applied as the controlling voltage to a voltage-controlled oscillator (VCO). The output of the VCO is fed back to the synthesizer to complete the loop, as well as being injected as the LO frequency to the first mixer. The second LO frequency of 12.428MHz is generated by dividing the 8.192MHz reference frequency by 2 and then multiplying it by 3 with a passive frequency tripler.

4.2.3 KR 87 PHASE DETECTOR AND POINTING CIRCUITRY

The phase-modulated pointing information is recovered from the 140KHz IF signal by a phase-locked loop detector circuit. The 140KHz signal is limited and squared before being input to the detector to remove any AM and reduce noise. The loop then locks onto the signal and a lock detector enables the audio mute switch, allowing detected audio to pass to the audio output amplifier. Thus the audio is muted whenever the receiver is not locked onto a valid station, thereby eliminating annoying interstation noise. If the unit is in the ADF mode, the lock detector also allows the loop enable line to the antenna to go high, turning on the loop modulators. The loop modualtors are turned off whenever the receiver is not locked onto a signal, or whenever the unit is in the ANT mode.

An exclusive-OR gate in the phase-locked loop detects the phase difference between the modulated input signal and a 140KHz constant-phase reference signal from the VCO. The output of the phase detector is then passed through a 32Hz bandpass filter to produce a 32Hz sine wave whose phase relative to the 32Hz angle -90° reference signal is equal to the angle to the station. This 32Hz sine wave is squared and exclusive -OR'd with the two 32Hz square waves to produce a series of pulses which are then integrated to produce DC voltages which are linearly related to the angle to the station (see Figure 4-8). A voltage shaping network then converts these voltages to sine and cosine voltages which are buffered in order to drive the low impedance DC resolver in the ADF indicator. (See Section 4.1.2 for complete explanation of the KR 87 pointing system.)

4.2.4 POWER SUPPLY

The KR 87 uses a ringing choke power supply to produce DC voltages of -26V, +6.2V, -12V, and +192V. This type of supply allows the unit to be operated at any DC input voltage from 11 volts to 33 volts. The 6.2 volt line is used to produce a well-regulated +5 volts for powering the microprocessor while the 12 volt line is used to produce a well-regulated +9 volts for powering the CMOS digital circuitry and analog RF circuitry. The -26 volt line is needed for the EAROM and several op amps, while the +192 volt line is required to drive the high voltage gas-discharge display. The power supply has over-voltage protection at the input and also employs current-limiting circuitry.

4.2.5 MICROPROCESSOR, SWITCHING AND DISPLAY CIRCUITRY

The microprocessor in the KR 87 contains its own specially programmed ROM (read-only memory) which is programmed to perform several functions, among them:

1. Receive inputs from the front panel mode switches and tuning knobs.

2. Interface directly with the electrically alterable read-only memory (EAROM) which stores the active and standby frequencies while the unit is turned off.

3. Provide tuning data to the LSI frequency synthesizer.

4. Perform the flight timer and elasped timer functions.

5. Control the timing and multiplexing of the gas-discharge display circuitry.

6. Generate the 32Hz reference signals that modulate the sense signal.

The five pushbuttons on the KR 87 front panel are tied directly to the processor, as is the concentric tuning knob. The processor receives the various inputs and changes the display, tuning data, and/or timer accordingly. The gas discharge display is driven in a multiplexed fashion. The display itself consists of eight anodes, each of which has several cathodes associated with it. Each cathode corresponds to a particular display segment or nomenclature letter. Through the anode driver circuit, the processor switches on each anode for 1 ms., completing the cycle every 8 ms. During the time that an anode is on, the processor selects the proper cathode segments that are to be illuminated and pulls them low through the cathode drivers. The multiplexing rate is fast enough, however, that no visible flickering of the display can be detected. A photocell dimming circuit automatically adjusts the brightness of the display to compensate for changes in the ambient light level.

The KR 87 has two timer modes, flight timer (FLT) and elapsed timer (ET). The flight timer begins counting when the unit is turned on and continues until an externally generated reset signal is received, or until the unit is turned off. It displays minutes and seconds until it reaches 59 minutes, 59 seconds, after which it displays hours and minutes up to 59 hours and 59 minutes. The elapsed timer also begins counting when the unit is turned on, but it can be reset to zero by pressing the front panel reset button. The elapsed timer counts up to 59 minutes and 59 seconds. The elapsed timer also has a count down mode wherein a specific time interval, such as the time from a final approach fix to missed approach point, can be entered into the timer and counted down to zero. This mode is activated by depressing the reset button for approximately 2 seconds until the ET message begins to flash, entering the time in the display with the concentric knobs, then pushing the reset button when it is desired to initiate counting. When the unit has counted down to zero, the display flashes for 15 seconds and an alarm output at the rear connector is pulled to ground for 1 second, allowing the unit to sink up to 1 amp to drive an external aural or visual alarm device.

When the KR 87 display is in the frequency mode, both the active and standby frequencies are displayed. Pressing the FRQ button on the front panel causes these frequencies to be interchanged. Both the active and standby frequencies are stored in the EAROM while the unit is turned off.

The BFO button on the front panel causes a 1KHz tone to be injected into the audio line. This feature allows audio identification of interrupted carrier NDB stations that are used in various parts of the world.

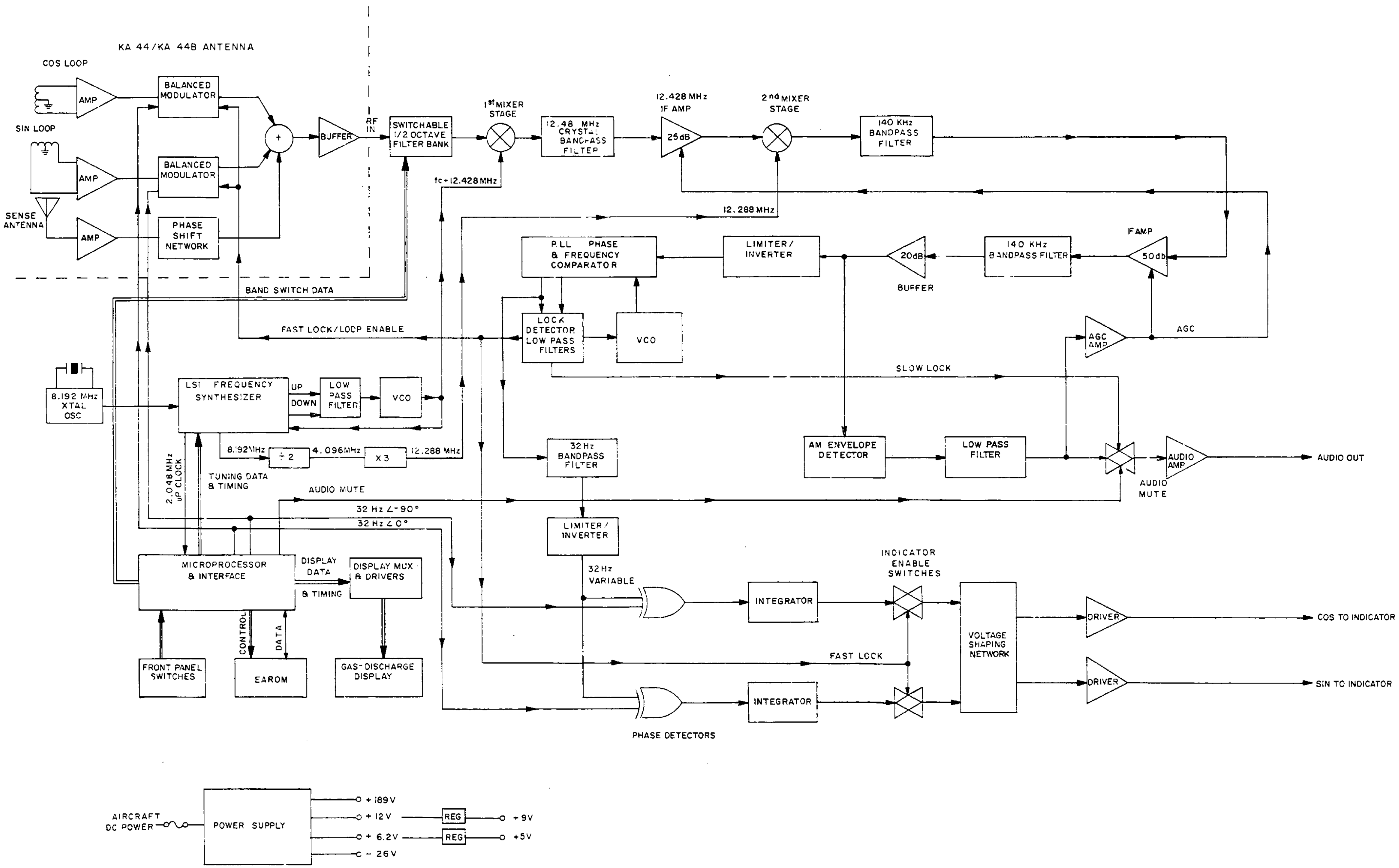


FIGURE 4-9 KR 87 SYSTEM BLOCK DIAGRAM
(Dwg. No. 696-3250-00, R-1)

4.3 DETAILED CIRCUIT THEORY

4.3.1 KR 87 RECEIVER RF SECTION

The RF signal from the antenna is impedance matched to the set of switchable preselector filters by transformer T113. The preselectors consist of 4 half-octave, three-pole Chebychef bandpass filters which are selected by the microprocessor according to the tuned frequency. A high signal on one of the inverters of I101 pulls its output low, forward biasing the diodes at the input and output of the desired filter and allowing signals to pass. All the other diodes in the network will be reverse biased, blocking any signals through their filters. Transformers T101, T102, and T103 form a 200KHz to 300KHz filter; T104, T105, and T105 a 300KHz to 400KHz filter; T107, T108, and T109 form a 400KHz to 600KHz bandpass filter; and T110, T111, and T112 comprise a 600KHz to 900KHz filter. Signals above 900KHz are not filtered in the preselector, but pass through diodes CR105 and CR106. Capacitors C102 - C105 are included to steepen the skirts on the high-frequency sides of the passbands. The preselector output drives a 2MHz low pass filter consisting of C106, C107, and L103, after which the signal is impedance matched to the first mixer stage by T114.

The output of T114 is a double ended signal which drives the balanced mixer Q101. Q102 is a constant current sink which provides bias current for the mixer. The local oscillator frequency of 12.428MHZ + f_c (f_c is the selected receiver frequency) is low-pass filtered to attentuate unwanted harmonics by C170, C171 and L108 before being injected into the gates of the balanced mixer. Heterodyning in the mixer produces frequencies at 12.428MHz and 12.428MHz + $2f_c$, the former being the first IF frequency. Transformer T115 provides impedance matching to the highly selective 12.428MHz twin crystal filter, which enhances station selectivity and improves image rejection. The output of the crystal filter is impedance matched to the tuned 12.428MHz amplifier Q103 by T116. Q103 is a dual gate FET whose gain is controlled by the AGC voltage which varies the gate 2-to-source bias voltage of the device. This stage provides up to 25dB of power gain. Transformer T117 tunes the output of Q103 and provides impedance matching to the input of the second mixer Q104, a dual-gate FET.

The second LO frequency of 12.288MHz is derived by first dividing the 8.192MHz master reference frequency at pin 16 of I104 by 2 using toggle flip-flop I106. The resonant circuit consisting of C173, C123, and L105 responds to the third harmonic of the 4.096MHz square wave at the output of I106, injecting a 12.288MHz signal into gate 2 of Q104. Q104 is an active mixer, providing 17dB of gain. Its output is filtered by a 140KHz 4-pole bandpass filter which also provides impedance matching between the mixer output and the IF amplifier input. I102 is an integrated circuit IF amplifier that is AGC controlled through the voltage applied to pin 5. An increasing AGC voltage at this point shunts signal current within the amplifier, decreasing its gain. The amplifier provides a maximum gain of 50dB. The output of I102 is further filtered by a second 140KHz 4-pole bandpass filter which drives FET Q105, a source-follower buffer stage. This stage provides an additional 20dB of power gain.

4.3.2 AUDIO AND AGC SECTION

The audio amplitude modulation at the output of Q105 is peak detected by CR112 and low-pass filtered by I103. R139 and C147 provide further filtering before the audio signal is passed to the input of the audio mute switches, I115A and I115B. The audio is further filtered by R141 and C149 before being applied to the input of I117B, an integrator and AGC threshold detector. The output of I117B provides the AGC control for I102 and also drives the second AGC amplifier I117A. Potentiometer R151 adjusts the AGC threshold of I117A to delay AGC action to Q103 until the signal is 20dB stronger than the threshold level of I117B. This AGC delay improves noise characteristics by operating the first AGC'd amplifier at maximum gain at low input signal levels. Note that I117A is an inverting amplifier, since AGC action occurs in Q103 as a result of decreasing gate-to-source bias voltage at gate 2. Depressing the BFO switch on the receiver front panel causes a 1KHz tone from divider chip I514 to be applied through the switch to the AGC line of I102, effectively modulating the IF signal at 1KHz and causing an audio tone to be heard.

The audio signal is enabled through the mute switch by either the BFO switch or a lock signal from the phase detector. This lock signal goes high only when the detector has locked onto a valid 140KHz IF signal (See Section 4.2.3 for phase detector detailed theory). The audio signal passes through the switch to the volume control potentiometer on the display board, then to audio amplifier I516 on the main board. Audio tranformer T501 impedance matches the output to a 500 ohm load. Audio muting also occurs during channel switching. The microprocessor detects switching of the frequency tuning knobs on the front panel and sends out appropriate signals on its serial data line. Serial-to-parallel converter I509 picks out the audio mute signal and turns on transistor Q505, which shorts out the input to audio amplifier I516.

4.3.3 LSI FREQUENCY SYNTHESIZER

The first LO frequency is synthesized by a custom-designed digital frequency synthesizer chip, I104, which uses the latest in large scale integrated technology. It incorporates emitter-coupled logic (ECL) and integrated-injection logic (I^2L) to perform the programmable divide and phase detection function for the phase-locked loop synthesis operation. Serial tuning data from the microprocessor is shifted through an externally clocked shift register within the chip and latched when the sync signal from the processor is received. The data is then loaded into the programmable counters which divide the 8.192MHz master clock signal down to the appropriate reference frequency. The 8.192MHz clock originates from crystal oscillator Q112, which is precisely tuned by variable capacitor C152. I105 is a voltage controlled oscillator (VCO) chip whose output is fed back to the synthesizer and compared with the reference frequency. Pump up and pump down pulses are output at pins 3 and 2 of the synthesizer to control the frequency of the VCO.

As an example, assume the VCO frequency is too low. Phase and frequency comparison within the synthesizer would cause the pump up output at pin 3 to go high. The pump down output at pin 2 would be in the low state. The high signal at pin 3 turns on Q107, which then turns on Q106. Meanwhile, the low output at pin 2 causes Q108 to be turned off. Therefore, collector current flowing through Q106 and R159 builds charge on capacitors C157 and C158, increasing the voltage at that node. This voltage is applied through resistor R162 to varactor diode CR118, with the resistor providing isolation between the charge pump and the VCO. The varactor diode acts as voltage-variable capacitor which forms a tank circuit with T122 to tune the VCO frequency of I105. The increasing bias voltage on CR115 lowers its capacitance, increasing the resonant frequency of the tank. If the VCO frequency is greater than the reference frequency, the pump up output at pin 3 is low, keeping Q107 and Q106 turned off. The pump down output at pin 2 is high, turning on Q108 and bleeding charge off capacitors C157 and C158 through R160. This decreases the bias voltage on CR118, causing its capacitance to increase and lower the resonant frequency of the VCO tank circuit. When the VCO is on frequency, the pump up and pump down outputs are normally both low, causing Q106, Q107 and Q108 to be turned off, although infrequent pump up pulses can be observed at pin 3 as leakage paths dissipate charge from the node, necessitating periodic refreshing.

The output of the VCO is an ECL level square wave which is amplified by Q109 and low pass filtered to a sine wave by L108, C170, and C171. It is then coupled to the gates of Q101, the first mixer stage.

The synthesizer chip performs an additional function by dividing the 8.192MHz clock frequency down to 2.048MHz, which is output as the microprocessor clock signal.

4.3.4 PHASE DETECTOR - BASIC THEORY

The operation of the phase detector is rather complex, involving two phase-locked loops and separate phase and frequency comparators. Refer to the phase detector block diagram, Figure 4-10, for the following basic discussion before looking at the detailed circuit theory.

The 140KHz IF signal is first limited and squared to remove any amplitude modulation, while still preserving the phase modulation. This signal is applied to the input of both phase and frequency comparators. The selection of which comparator output is low pass filtered is made by a lock detector. Before lock is achieved, the frequency comparator output is low pass filtered twice and applied to the VCO. Once the VCO has achieved frequency lock with the 140KHz IF signal, the lock detector switches the phase comparator output to the low pass filters. Recall that until the loop achieves lock, the enable line to the loop modulators in the antenna is disabled, so no phase modulation is yet present.

A second control loop in the VCO circuit is used to ensure frequency stability. This loop requires 140KHz signals 90° apart in phase. Therefore, the VCO is run at 280KHz and is divided down into 140KHz signals of 0°, 90°, 180°, and 270° (-90°) by a pair of flip-flops. The 0° signal is supplied as the reference frequency to the phase and frequency comparators while the 90° and 180° signals are used in the frequency stabilizer loop. The frequency stabilizer passes the 90° signal through a 140KHz bandpass filter, then compares its phase to that of the 180° signal. Any drift in frequency of the VCO will cause a phase shift of the 90° signal through the filter, which is detected by the stability loop detector. The detector then sends an error signal to the VCO, bringing the frequency back in line.

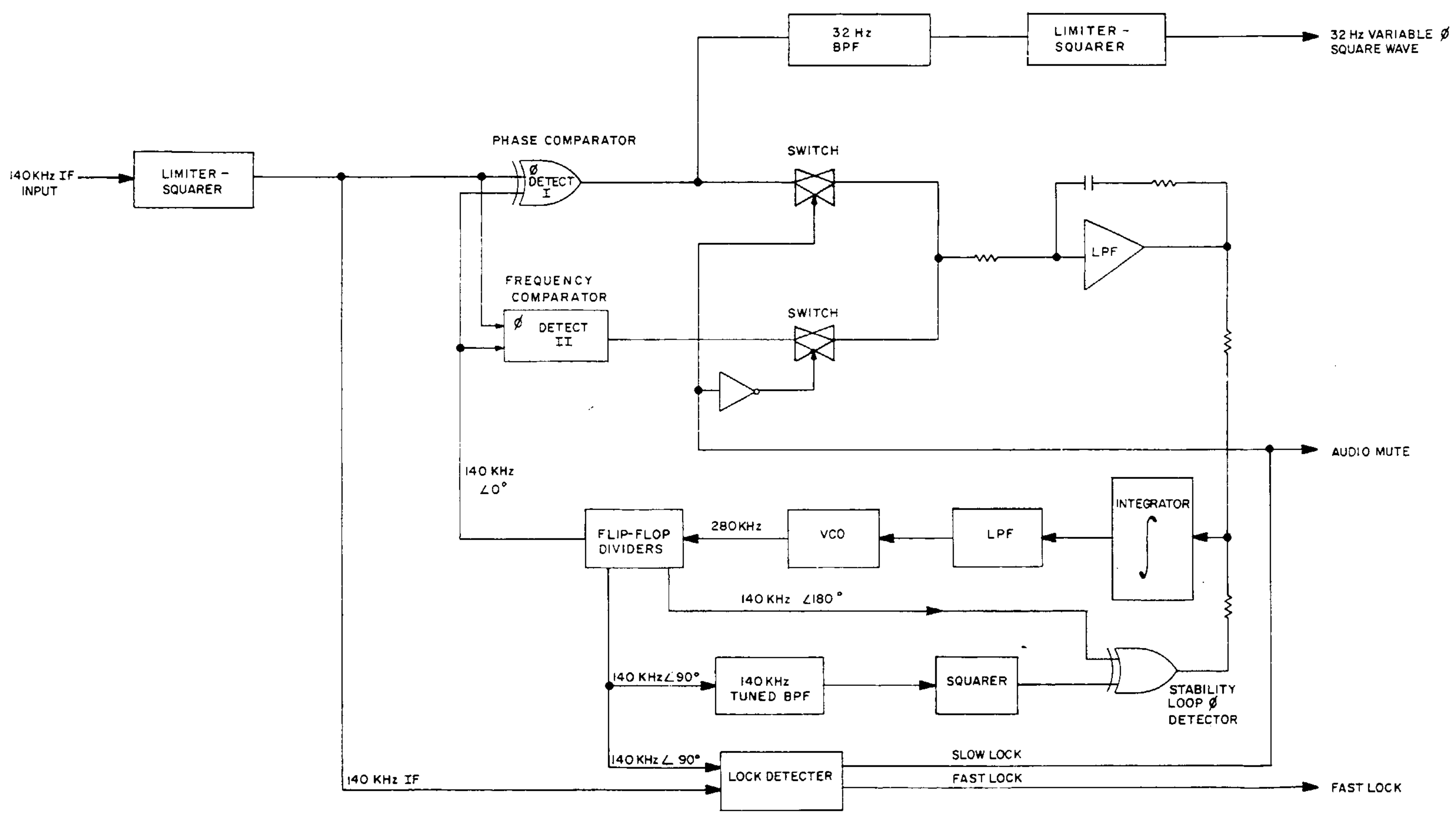


FIGURE 4-10 PHASE DETECTOR BLOCK DIAGRAM
(Dwg. No. 696-3251-00, R-0)

The lock detector functions by comparing the phase of the 140KHz angle 90° signal with that of the 140KHz IF signal. A locked condition results when the signals are in phase. At this point, the lock signal drives two detectors, a fast lock detector and a slow lock detector. The two lock detectors are included due to the fact that certain international NDB stations interrupt their carrier signal at coded intervals for identification purposes. The time constant of the slow-lock detector is such that the loss of a carrier signal for a few seconds will not cause the audio to mute. The slow-lock signal also switches off the frequency comparator in the phase-locked loop and enables the phase-comparator to control the VCO. The fast-lock signal enables both the loop modulators in the antenna and the bearing pointer circuits. The absence of a carrier signal causes the fast-lock signal to go low, disabling the loop modulators and also freezing the bearing indicator to prevent the needle from wandering during the interrupted carrier idents.

During normal operation when the loop is locked and the frequency is stabilized, the phase-comparator detects the phase modulation of the 140KHz IF signal and provides an output which is filtered and passed on to the bearing pointer circuits.

4.3.5 PHASE DETECTOR - DETAILED CIRCUIT THEORY

The 140KHz IF output of Q105 contains both the amplitude modulation of the received signal as well as the phase modulation produced by the loop signals in the antenna. The AM is removed by saturating amplifier I116 and the signal is further squared by inverter I114A. The resulting square wave at pin 10 of I114A still contains the original phase modulation. At this point, it is applied to the input of the phase-detector circuit.

The major components of the detector circuit are CMOS phase-locked loop chips I109 and I112. Each chip contains two phase comparators: phase comparator I is an exclusive-OR network, while phase comparator II is a tri-state output, edge-controlled network that produces pump up or pump down pulses according to the frequency difference of the two inputs. Each chip also contains its own voltage controlled oscillator. However, in this application, the VCO in I109 is inhibited and only the VCO is I112 is used. Potentiometer R189 is adjusted such that the center of the VCO range is approximately 280KHz. The 280KHz gets divided by flip-flops I111A and I111B into four phases of 140KHz which are then used for phase and frequency comparisons. Filters I108B and I110B provide the low-pass filtering of the various phase comparator outputs before they are fed back as VCO input signals.

Assume that the detector is initially unlocked. The output of slow lock detector I108C is low, shutting off the audio switch I115B and also shutting off switch I115D. The output of inverter I114D is high, turning on switch I115C and enabling the output of phase comparator II of I109 to be low-pass filtered by I108B. Pump up or pump down pulses from this comparator then bring the frequency of the 140KHz angle 0° signal that is divided down from the VCO exactly into line with the 140KHz IF signal. At this point, the 140KHz IF and 140KHz angle 90° signals are in phase, causing the output of exclusive-OR gate I114B to remain low. This in turn switches on both fast lock detector I108D and slow lock detector I108C. Note that the time constant of the slow lock detector is longer due to the presence of capacitor C197. The locked state causes phase comparator I of I109 to be switched to the low pass filter I108B to control the VCO. During lock, the 140KHz IF input and the 140KHz angle 0° input are 90° apart in phase, causing a 280KHz signal at the output of phase comparator I. The phase modulation from the antenna causes this signal to have a 32Hz component, which is filtered out and passed on to the bearing pointer circuitry.

This 32Hz component does not affect the frequency of the VCO, however, due to heavy filtering by I108B and I110B.

Frequency stability in the phase-locked loop is achieved by utilizing phase comparator I in PLL chip I112. Capacitors C205, C206 and coil T123 form a tank circuit that is tuned to resonate at 140KHz. The 140KHz angle 90° signal is passed through the tank and resquared by I113A, then buffered by I113B. Its phase is compared to that of the 140KHz angle 180° signal. Any frequency shift will result in a phase shift through the tank, causing the phase comparator output at pin 2 to apply a correction signal to the VCO through low-pass filter I110B.

4.3.6 BEARING POINTER CIRCUITRY

The output of I109 contains a pulse train whose phase is dithering at a 32Hz rate. Substantial low pass filtering by R172, C178, R173, and C179 produces a sine wave which is amplified by Q110. The sine wave is further filtered by I108A, which is a bandpass filter tuned to 32Hz by R177. Its output is then squared by inverter I114C. The resulting output is thus a 32Hz square wave whose phase varies directly with the relative bearing to the station.

The derivation of DC voltages which are proportional to the sine and cosine of the relative bearing is accomplished by first exclusive-OR'ing the 32Hz variable phase signal with each of the two 32Hz reference signals. Gates I504A and B accomplish this. The outputs of these gates are pulse trains whose duty cycles are linearly related to the relative bearing angle.

The cosine channel works as follows. The output of cosine phase detector I204B is applied through switch I515B to I502B, a two-pole low pass filter that produces a DC output voltage at pin 1 that is linearly related to the bearing angle. A bearing of 0° produces 0 volts at pin 1, and increasing bearing angles produce linearly increasing voltages, up to 9 volts at 180° relative bearing. Further increases in relative bearing cause the voltage to linearly decrease, down to 0 volts at 360° (0°) bearing once again. The output of the filter is connected to a shaping network which converts the linearly related voltages to sinusoidally related voltages. Resistors R508 - R515 form a set of precision voltages which are used to determine the switching thresholds of diodes CR501 - CR512. These diodes switch divider resistors R516 - R518 in and out of the circuit according to the voltage at pin 1 of I502B. In this way, a network is formed which makes a piecewise-linear approximation of a sine wave with a triangular wave input. The shaping network causes the sinusoidal voltage to be applied to the input of inverting amplifier I501B, which drives the push-pull output driver consisting of Q503 and Q504. The output driver amplifier sources or sinks up to 136ma of current for the DC resolver in the ADF indicator. One end of the cosine coil winding in the indicator is tied to a +4.5V reference, while the other end is tied to the output of the cosine driver. The driver output can swing from +1.5V to +7.5V, causing $\pm$3.0V swings across the indicator coil. The coil currents produce a magnetic field within the resolver which adds in quadrature with the field set up by similar currents in the sine winding, causing the permanent magnetic rotor to align itself at the desired relative bearing.

The sine channel is identical to the cosine channel except that the voltage at the output of I502A is minimum at a relative bearing of 90°, linearly rising to a peak of +9V at 270°; then linearly decreasing back down to zero at 90°. Gains through the channels are equalized by R522 to minimize quadrantal error. The +4.5V reference for the resolver windings is supplied by unity-gain voltage reference I501C. Transistors Q511 and Q512 provide push-pull current drive, allowing the node to source or sink considerable current depending upon the polarities of the sine and cosine voltages.

As mentioned previously, the fast lock signal from the detector circuit enables switches I515A and I515B. The loss of a carrier signal disables these switches, allowing the low-pass filters to retain their accumulated charges and output voltages. This causes the indicator position to be retained if lock is lost, preventing erratic wandering of the needle.

4.3.7 MICROPROCESSOR CIRCUITRY

The circuitry surrounding the microprocessor on the KR 87 main board is relatively simple, since most of the I/O signals interface directly to the processor. The processor's four 8-bit I/O ports are internally programmed into the desired I/O configuration for maximum utility. The front panel pushbutton switches and concentric frequency control switches all interface directly to the processor, while the electrically alterable read-only memory (EAROM), I513, requires level shifting to +9V at its inputs. Pins 7-9 of the EAROM are mode control inputs, while pin 12 is its bi-directional serial data port. The EAROM is clocked at 16KHz by I514, a 12 stage CMOS binary counter. I514 accepts the 2.048MHz clock from the LSI synthesizer and provides a 16KHz output from its seventh stage for the EAROM and also a 1KHz output from its eleventh stage which is used for the BFO tone.

Serial data is output from the processor on pin 15 and latched into shift register I509 when the sync signal is high. The serial data also passes through the shift register and on to the LSI frequency synthesizer. The data at the output pins of register I509 switch on the various RF preselector filters, turn on the elapsed timer alarm signal, and mute the audio during channel switching. (See Data Format, Figure 4-11)

Power on reset to the processor is accomplished by comparator I503A, which resets the processor at its base address when the +5V line has charged up and exceeded the +4.5 volt comparator threshold.

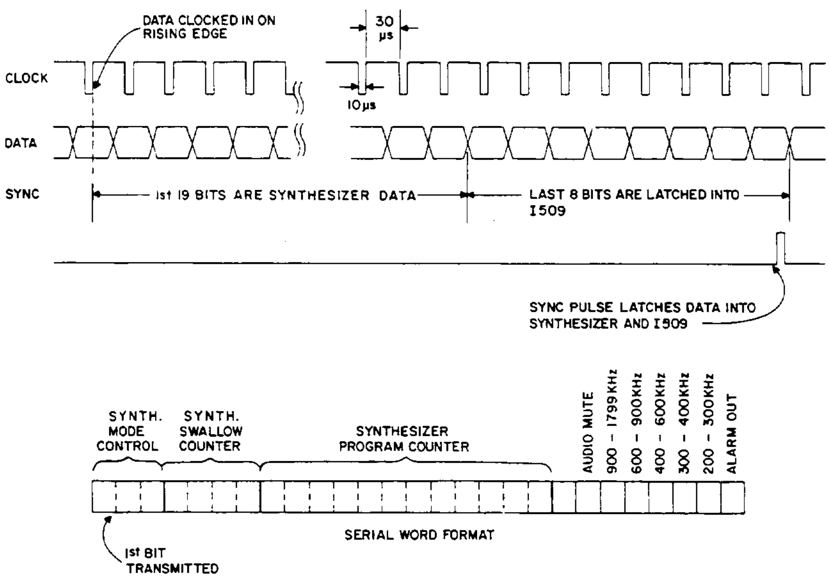


FIGURE 4-11 MICROPROCESSOR SERIAL DATA FORMAT AND TIMING
(Dwg. No. 696-3252-00, R-0)

4.3.8 GAS DISCHARGE DISPLAY MULTIPLEX CIRCUITRY

The KR 87 uses a high-voltage gas discharge display that is time-multiplexed by the microprocessor. The display itself consists of ten anodes, each of which has several digit segments, colon points, or nomenclature letters associated with it as cathodes. Corresponding cathode segments are wired together, as are various nomenclature cathodes, to form 14 different cathode inputs. The display can then be thought of as a two dimensional matrix, where a particular segment or letter is illuminated when its anode is pulled high and its cathode pulled low. When they are not being fired, the display anodes remain at about +130V, while the cathodes sit at about +70V. The resulting 60V potential across the tube is not enough to completely ionize the gas and fire the tube, although it does partially ionize the gas and serve to reduce the firing time once the tube is turned on. In order to illuminate a particular segment or nomenclature letter, the anode must be pulled up to +187V by anode driver I402 while its cathode must be pulled down to around +40V by one of the cathode drivers, I507 or I508. The resulting 150V potential will fire the gas tube. The firing time is also reduced by the presence of three "keep-alive" segments hidden in the display that remain ionizeed continuously. The keep-alive anodes are connected to +190V through 820K resistors, while their cathodes are grounded. As a result, approximately 30uA of current flows through each keep-alive.

The "ADF" anode is connected to the second digit anode and the "ET" anode is connected to the seventh digit anode, thereby consolidating the ten anodes into eight anode inputs. The anodes are fired sequentially by the anode driver, which is driven by an eight-bit ring counter, I401. The ring counter is clocked every 1 msec. by the microprocessor, so it turns on each of the anodes once every 8 msec. (See Display Timing Diagram, Figure 4-12) Each anode is turned on for 1 msec., and during this time the processor outputs the proper display data to decoder/cathode driver chips I507 and I508. These chips decode the BCD data and pull the corresponding cathode lines low, firing the proper segments or letters. The diodes on the cathode lines protect the cathode drivers by clamping any voltage spikes to 80V, while the resistors from the +80V line to the cathodes provide leakage currents to the cathode drivers when they are turned off. In order to prevent a visual rippling effect, adjacent anodes are not fired in order, but rather the anode firing sequence was shuffled to produce a smooth continuous display.

4.3.9 DISPLAY DIMMING CIRCUITRY

The brightness of the display is controlled by varying both the duty cycle of the cathode drivers and the cathode current. The cathode current varies over a 3:1 range, while the duty cycle varies over a 10:1 range. Thus, a 30:1 dimming range is possible. Maximum brightness occurs at high ambient light levels, while minimum brightness occurs when the cockpit is dark.

Duty cycle dimming is accomplished in the following manner. Amplifier I505A is configured as a voltage-to-current converter whose output current is determined by the voltage at the junction of R568, R573, and the photocell. The photocell acts as a light-sensitive resistor whose resistance decreases with increasing light intensity. The photocell forms a voltage divider with R573 at the input of I505A, so changes in light intensity vary the divider ratio and hence the current control voltage. Meanwhile, the 1KHz display clock at pin 24 of the processor drives the positive input of comparator I503B, which functions as an open-collector buffer. The display clock consists of narrow, negative-going pulses (see Display Timing Diagram, Figure 4-12) which pull down the output of the comparator, discharging C540. While the display clock is high, the open-collector output allows the current output of I505A to charge C540 linearly. When the voltage on the capacitor exceeds the threshold voltage on pin 9 of comparator I503C, its output pulls low, forward biasing CR516 and shunting the bias current to the cathode drivers. When high ambient light level exists (see Figure 4-13A), the photocell exhibits a low resistance and little voltage appears at the input to I505A. Consequently, C540 charges very slowly and never reaches the threshold voltage of I503C before it is discharged by the display clock. Thus, I503C never gets turned off, resulting in maximum duty cycle. At low light levels, (see Figure 4-13B), the photocell exhibits a high resistance, and a large current from I505A charges C540 rapidly. The voltage across the capactior quickly triggers I503C, resulting in a very short duty cycle.

Amplifier I505B is also configured as a voltage-to-current converter. It provides the proper current to the cathode drivers through programming resistors R566 and R565. The current control voltage is derived by filtering the variable duty cycle pulse at the output of I503C. In this manner, current control is obtained along with duty cycle control.

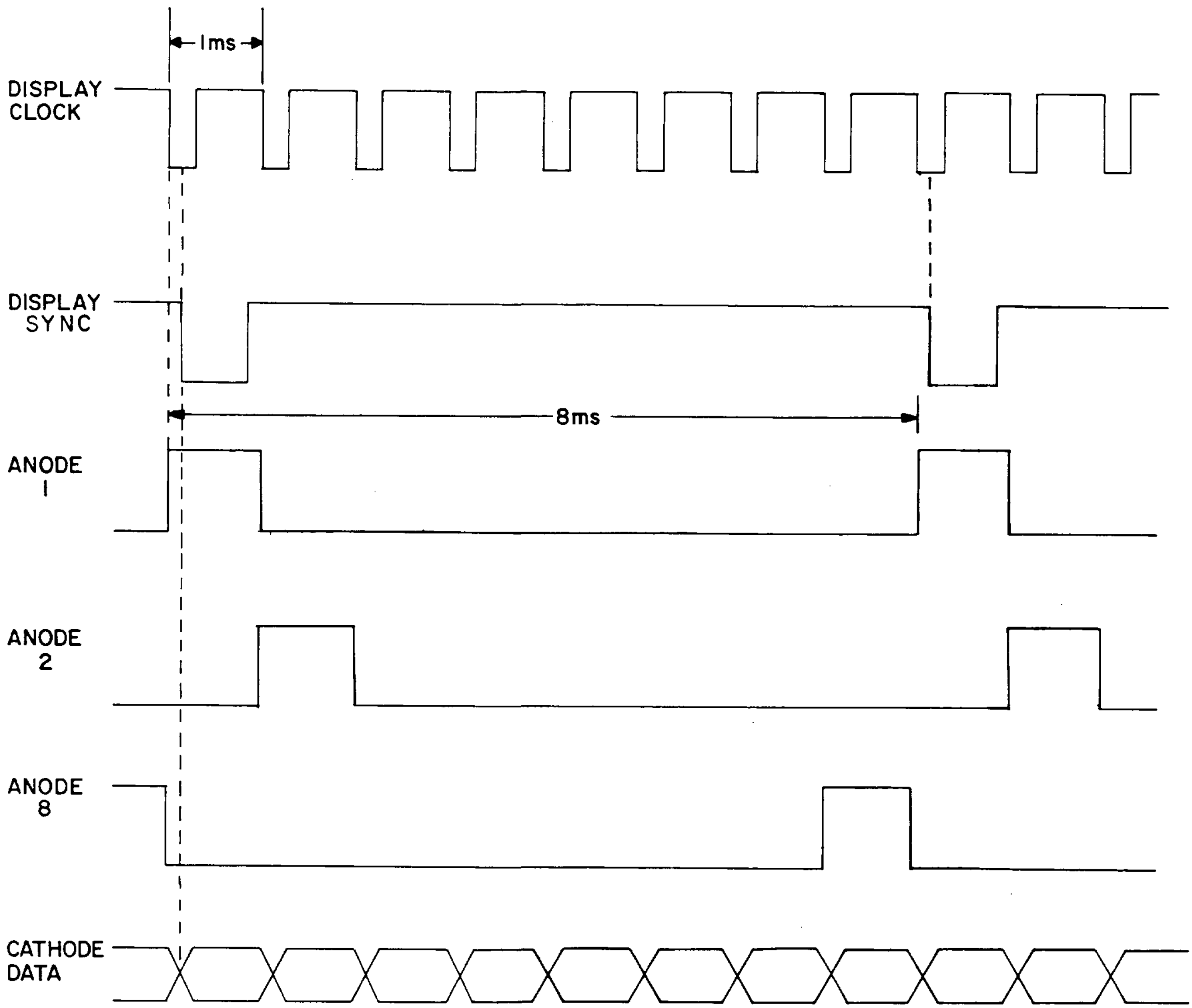


FIGURE 4-12 DISPLAY TIMING DIAGRAM

4.3.10 POWER SUPPLY

The KR 87 power supply is a switching type supply that achieves a high-degree of regulation by using current and voltage-sensing feedback to control the duty cycle of the switching transistor, Q303. While the transistor is turned on, current flowing through the primary of T301 induces a magnetic field inside the transformer. When Q303 is turned off, the energy stored in the magnetic field is dissipated by current flowing in the secondary winding. The secondary is tapped to produce voltages of -26V, +6.2V, +12V, and +189V.

The aircraft DC power is filtered by two LC stages before being applied to I301, a three-terminal 5 volt regulator. Zener diode CR301 provides over-voltage protection at the input. The DC input also acts the current source for the transformer primary.

I302D is an open-collector voltage comparator which functions as oscillator. Its positive input is at +2.5 volts due to voltage divider resistors R312 and R313. Initially, its output is turned off and C306 begins to charge up through R316, R315, and R330. When its voltage exceeds the 2.5 volt threshold, the comparator output goes low, causing it to discharge through R330 and R315. It must now discharge to a threshold voltage of about +1.6 volts, however, since the series conbination of R332 and R314 now appears in parallel with R313 in the threshold voltage divider. Potentiometer R330 adjusts the time constant of the circuit and hence the oscillation frequency.

Voltage regulation is achieved by comparators I302A and I302C. Comparator I302A monitors the +189V line and switches state when the voltage drops below a preset threshold. Its output effectively maintains a DC threshold voltage which varies according to the power supply load. This voltage determines the switching threshold of comparator I302C, the output of which is a constant frequency, variable duty cycle switching signal. This signal switches base current to Q301, which drives Q302. Q302 provides the increased base drive current to power transistor Q303, which switches on the primary current. When the output of I302C pulls low, Q301 shuts off, turning off Q302 and Q303. The turn-off time of Q303 is reduced by the fact that the -26V tap on the secondary begins to go negative at this time, drawing base current through R320 and C311.

Current flowing through R323 in the emitter of Q303 produces a voltage at the negative input of comparator I302B. When excessive current causes the voltage to exceed the 0.5 volt threshold at the positive terminal, I302B pulls low, turning off I302C and thereby turning off the switching transistors. This provides current-limiting protection.

The taps on the transformer secondary are rectified and filtered to DC. The 6.2 volt line is used to provide a well-regulated +5 volts for powering the microprocessor circuitry. Voltage regulator chip I303 regulates the base current to series-pass transistor Q304 which supplies the +5 volt current. The same type regulator chip, I107, is used on the receiver board to provide a well-regulated +9 volt supply from the +12 volt tap. Potentiometer R170 adjusts the output voltage of I107 to precisely +9 volts to provide the supply for the analog RF circuitry and the CMOS logic circuitry.

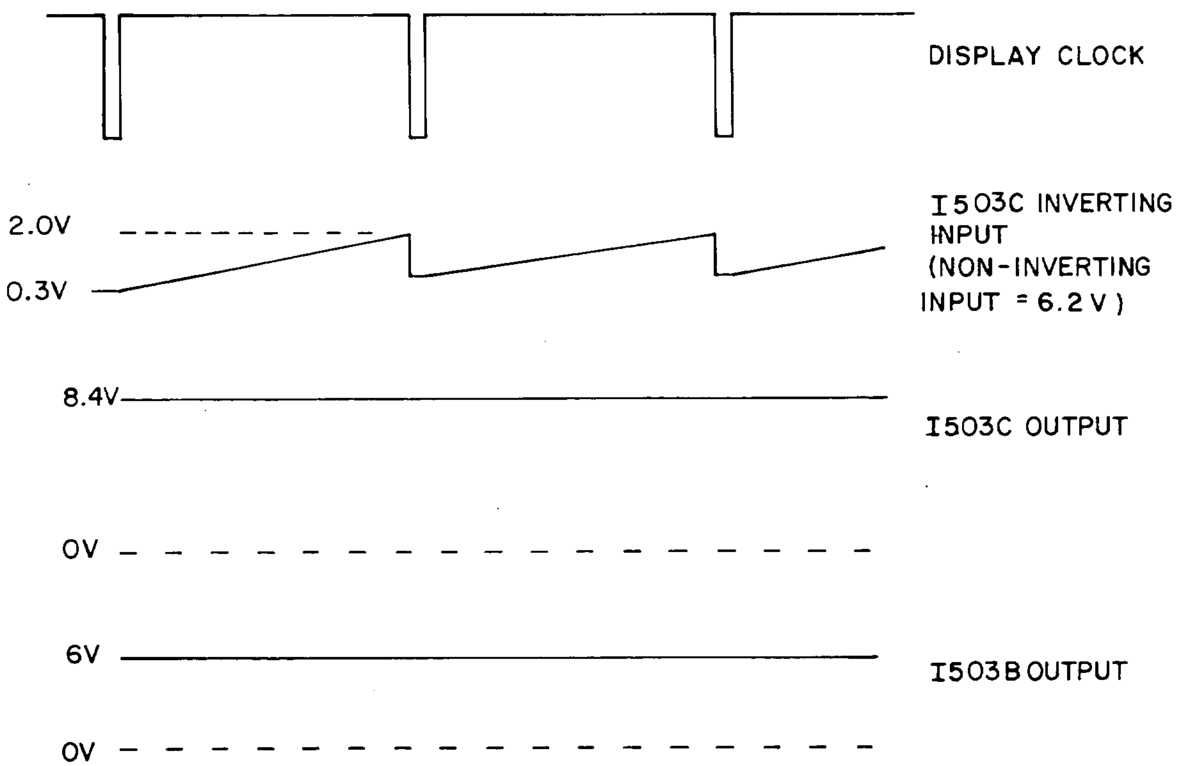


FIGURE 4-13A DISPLAY DIMMING SIGNALS:
HIGH AMBIENT LIGHT CONDITION

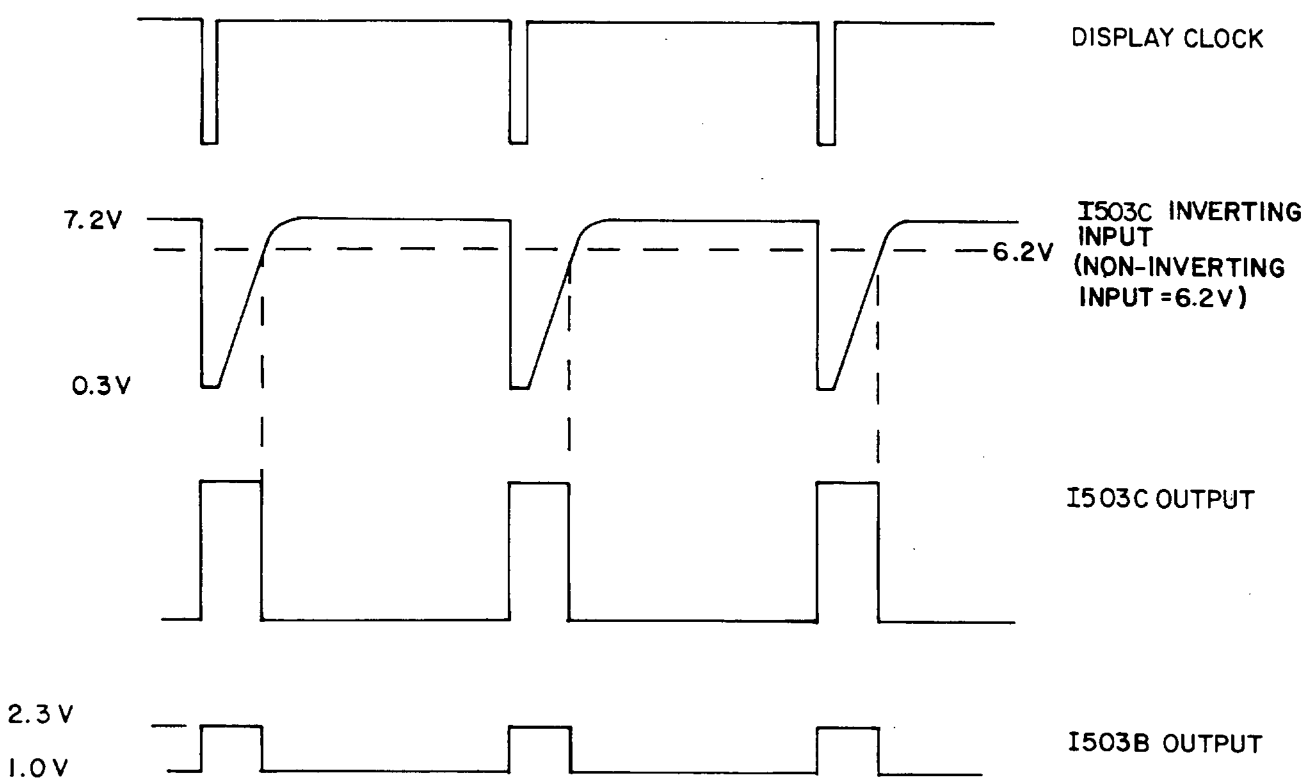


FIGURE 4-13B DISPLAY DIMMING SIGNALS:
LOW AMBIENT LIGHT CONDITION

SECTION V MAINTENANCE

SECTION V
TEST PROCEDURES

5.1 GENERAL INFORMATION

This section contains test, alignment, cleaning, repair, and troubleshooting procedures for the KR 87 ADF Receiver and KA 44/44B ADF antenna. Included are detailed assembly/disassembly instructions and troubleshooting instructions.

Information concerning semiconductor test equipment, semiconductor and integrated circuit maintenance, and specific integrated circuits used in the KR 87 System may be found in Appendix A at the end of this manual. It is suggested that Appendix A be consulted before attempting to service the KR 87.

5.2 TEST AND ALIGNMENT

The following test procedures may be followed to determine if the KR 87 system is operating properly. If it is not, alignment procedures are detailed in order to bring the KR 87 up to its minimum performance standards.

5.2.1 TEST EQUIPMENT REQUIRED

A. Power Supply

+13.75VDC @ 1.5 amps
+27.5VDC @ .75 amps

B. Oscilloscope

$\geq$15MHz scope with external triggering capability
Tektronics 465 or equivalent

C. RF Signal Generator

HP606A/B or equivalent

D. Digital Voltmeter

Fluke 8600A or equivalent

E. Frequency Counter

Monsanto 100A or equivalent

F. AC VTVM

Ballantine 310 or equivalent

G. ADF Field Simulator

King KTS 156 Antenna Simulator

H. Audio Oscillator

HP201C or equivalent

5.2.2 OPERATIONAL TEST SETUP AND PROCEDURE

The KR 87 System should be configured as shown in **Figure 5-1** in order to ascertain that the units are working properly. The procedures below should be followed and the resulting data should meet the minimum requirements given. Should any criteria not be met, refer to the Alignment and Troubleshooting section for guidance in correcting the problem. Unless otherwise noted, the unit should be in the ANT mode.

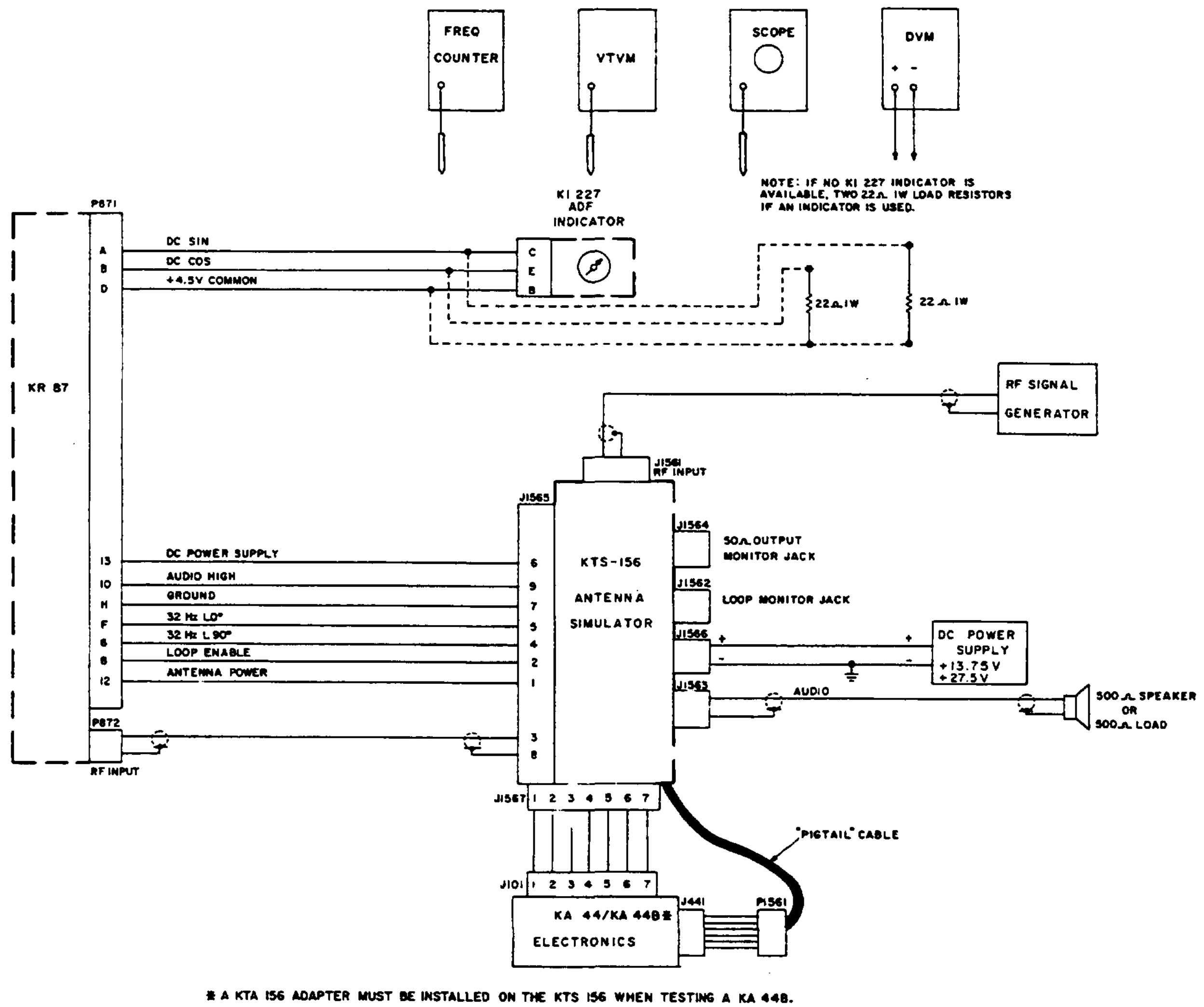


FIGURE 5-1 KR 87 OPERATIONAL TEST SETUP

5.2.2.1 Input Current

Measure the DC Input Current to the unit. It should be in accordance to the following table.

Unit	Operating Voltage	Load KI 227 (or equivalent)	Current Draw (enter value)	Max. Current
-0000, -0001, -0003, -0004, -0006, -0007, -0017	13.75 VDC ±0.5 VDC	One		0.9 Amp
-0000, -0001, -0002, -0003, -0004, -0005, -0006, -0007, -0017	27.5 VDC ±0.5 VDC	One		0.45 Amp
-0002, -0005	27.5 VDC ±0.5 VDC	Two		0.56 Amp
-0014	13.75 VDC ± 0.5 VDC	One		1.031 Amp
-0014, -0015	27.5 VDC ±0.5 VDC	One		0.515 Amp
-0015	27.5 VDC ±0.5 VDC	Two		0.625 Amp

TABLE 5-1 KR 87 INPUT CURRENT SPECIFICATIONS

5.2.2.2 Sensitivity

Apply an unmodulated 70uv, 200KHz signal to the RF input of the KTS 156. The KTS 156 switches should be in the following positions:

Loop Switch:	Disable
Sense Switch:	Enable
Output Load:	RCVR
Switching Source:	RCVR
Mode Switch:	Brg. Simulate
Function Switch:	Brg.
Bearing Selector:	0^{o}

Tune the receiver to 200KHz and monitor the loaded audio output voltage with a VTVM. Adjust the KR 87 volume control to a convenient reference level on the VTVM, then modulate the RF signal at 30% with a 1KHz tone and note the increase in audio output level. A minimum increase of 6dB should be noted.

ANT Sensitivity at 200KHz, 70uv/m signal: (S + N)/N = _________dB.

5.2.2.3 ADF Sensitivity

Perform the same test as described above, except apply a 150uv, 200KHz signal to the KTS 156 and place the KR 87 in the ADF mode. Enable the loop switch on the KTS 156. A minimum increase of 6dB should be noted.

ADF Sensitivity at 200KHz, 150uV/m signal: (S + N)/N = _________dB.

5.2.2.4 Indicator Output Voltage

Apply a 200KHz, 0.1v signal to the antenna simulator. With the bearing selector set at 0° and the unit in the ADF mode, measure the DC voltage at the +4.5V common line to the ADF indicator (pin D of P871). It should read +4.5V ± .25V DC.

+4.5V DC Common Voltage: _____VDC

Now measure the DC voltage from the DC cosine output (pin B) to the 4.5V common line. It should read +3.0V ± .3VDC

Cosine Output Voltage: _____VDC

Turn the bearing selector to 90° and measure the DC voltage from the DC sin output (pin A) to the 4.5V common line. It should also be +3.0V ± .3VDC.

Sine Output Voltage: _____VDC

5.2.2.5 Display Functions and Timer Test

Turn the unit off, then back on. It should be in the FLT time mode (FLT message lighted), with the FLT timer starting at zero. Pressing the FLT/ET button should engage the ET mode (ET message lighted). Further depressions of the FLT/ET button should alternate the two timer modes. Pressing the RESET button should reset the ET mode only. TIMERS _________(OK)

Press the FRQ button once. The right side of the display should show the stand-by frequency, and the FRQ message should be lighted. Further depressions of the FRQ button should exchange the active and stand-by frequencies. FRQ MODE _________(OK)

Depress the RESET button for approximately 2-3 seconds until the ET message begins to flash. Enter a countdown interval with the concentric tuning knob and press the RESET button. The timer should begin counting down and should flash for 15 seconds after it has reached zero. ET COUNTDOWN _________(OK)

The display timer should be accurate to 1 second in 5 minutes. TIMER ACCURACY_________(OK)

5.2.2.6 Display Dimming

Check to see that the display dims evenly in a dark environment. DIMMING __________(OK)

5.2.2.7 Bearing Accuracy

NOTE

The KA 44/44B antenna is shipped from the factory with 6° quadrantal error already compensated. Other units that have been in use will also have had Q.E. compensations made. Therefore, when the bearing selector is in the 45°, 135°, 225°, or 315° positions, the indicator needle will be in error by the amount of Q.E. compensation. In order to determine bearing accuracy without disturbing the Q.E. adjustment, note the amount of error at the quadrantal points. The absolute value of the error should be the same at the four points, within a range of ±3°. For example, if the indicator reads 51° at a simulated bearing of 45° (an error of +6°), it should read 129° ±3° at a bearing of 135° (an error of −6° ±3°). At simulated bearings of 225° and 315°, the indicator should read 231° ±3° (error of +6° ±3°) and 309° ±3° (error of −6° ±3°), respectively.

If the amount of quadrantal error exceeds 10°, it is likely that the antenna or the receiver needs realignment.

To perform the bearing accuracy test, apply an unmodulated 550KHz, .1V signal to the field simulator. Tune the KR 87 to 550KHz and put it in the ADF mode. Then note the indicator bearings as the bearing selector is switched to the following positions. Plus or minus 3° of error is permitted.

Bearing Selector	Bearing Indicator (Q.E. = 0)
0°	________ (0° ± 3°)
45°	________ (45° ± 3°)
90°	________ (90° ± 3°)
135°	________ (135° ± 3°)
180°	________ (180° ± 3°)
225°	________ (225° ± 3°)
270°	________ (270° ± 3°)
315°	________ (315° ± 3°)

NOTE

A MORE PRECISE DETERMINATION OF THE ACTUAL INDICATED BEARING CAN BE OBTAINED BY MEASURING THE DC OUTPUT VOLTAGES TO THE INDICATOR. THE SIN VOLTAGE IS MEASURED FROM PIN A TO PIN D, WHILE THE COS VOLTAGE IS MEASURED FROM PIN B TO PIN D. TO DETERMINE THE ACTUAL INDICATED BEARING, USE THE FOLLOWING FORMULAS:

SIN and COS both positive:

BRG = arctan SIN/COS

SIN positive, COS negative

BRG = 180 + arctan SIN/COS

SIN and COS both negative:

BRG = 180 + arctan SIN/COS

SIN negative, COS positive

BRG = 360 + arctan SIN/COS

5.2.3 ALIGNMENT

The following instructions describe the alignment procedures for the KR 87 system. If the preceding tests indicate that alignment is necessary, follow these instructions while referring to the disassembly instructions (section 5.3.4), schematics, and assembly drawings for the location of components, adjustments, and test points. The numbering sequence is as follows:

	SCHEMATICS	COMPONENT OR TEST POINT DESIGNATORS
KA 44/44B:	Amplifier/Modulator Board #1	101 - 199
	Amplifier/Modulator Board #2	201 - 299
	Antenna Board	301 - 399
KR 87:	Receiver Board	101 - 299
	Power Supply Board	301 - 399
	Display Board	401 - 499
	Main Board	500 - 699

Refer to **Figure 5-1** for a typical KR 87 test setup.

It should be noted that if the entire system is to be aligned, the KA 44/44B Antenna should be aligned first. Refer to the alignment procedures in the KA 44/44B section of this manual prior to aligning the KR 87 Receiver.

5.2.3.1 Power Supply Alignment

A) Turn on the KR 87 with an A+ voltage of either +13.75VDC or +27.5VDC.

B) Remove the power supply cover and measure the DC voltage at pin 6 P302 (See Page 6-25) with a DVM set to a high voltage scale.

C) Adjust R302 such that the voltage reads 189V ± 1V.

D) Connect a frequency counter to TP301 and observe the frequency.

E) Adjust R330 for a frequency of 18.66KHz ± 50Hz (18.61 - 18.71KHz).

F) Check the remaining power supply voltages for the following tolerances: 12V ± 1V; 5V ± .25V; -26V ± 2V.

G) Adjust R170 on the receiver board such that the voltage at TP105 is 9V ± .05V.

H) Replace the power supply cover.

5.2.3.2 RF Preselector Alignment

NOTE

The RF preselectors have been sweep-aligned at the factory and should never need realignment unless one of the RF transformers has been replaced. Therefore, in order to insure optimum performance, do not attempt to realign the preselectors unless a problem can definitely be traced to the filters or unless a new transformer has been installed.

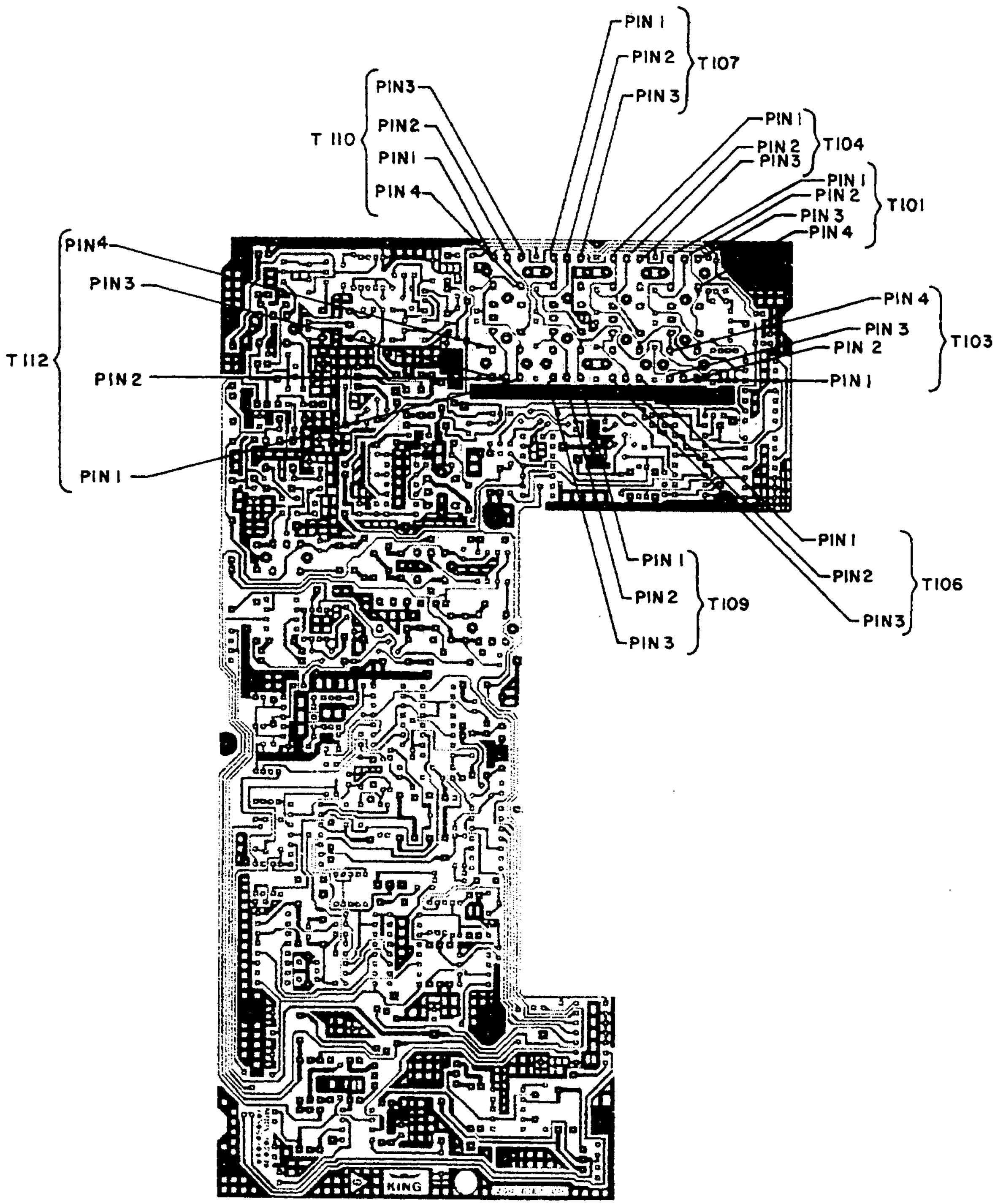


FIGURE 5-2 FAR SIDE OF RECEIVER BOARD

1. On the rear side of the receiver board, solder a small jumper wire from pin 2 to pin 4 of T101. Also solder a jumper from pin 2 to pin 4 of T103 (see **Figure 5-2**).

2. Tune the receiver to 245KHz and apply a 10mV, 245KHz signal directly into the receiver from the signal generator. (Bypass the antenna) Monitor the AGC voltage at pin 14 of P871 with a voltmeter.
3. Tune T102 for peak AGC voltage.

NOTE

During this and the following adjustments, it may be necessary to reduce the signal as the peak is approached. Attempt to keep the AGC voltage between 6.0 and 6.5 volts in order to maintain AGC sensitivity.

4. Remove the jumpers and solder a 2.2K resistor from pin 1 to pin 3 of T103. Apply a 1mV, 200KHz signal, tune the receiver to 200KHz, and tune T101 for peak AGC.
5. Remove the 2.2K resistor from T103 and now solder it from pin 1 to pin 3 of T101. Apply a 1mV, 299KHz signal, tune the receiver to 299KHz, and tune T103 for peak AGC.
6. Remove the 2.2K resistor from T101 and repeat steps 4 and 5 until no further adjustment can be made.
7. Solder a short jumper wire from pin 2 to pin 3 on T104 and also one from pin 2 to pin 3 of T106. Apply a 10mV, 346KHz signal and tune the receiver to 346KHz. Tune T105 for peak AGC.
8. Remove the jumpers and solder a 2.2K resistor from pin 1 to pin 3 of T106. Apply a 1mV, 300KHz signal, tune the receiver to 300KHz and tune T104 for peak AGC.
9. Remove the resistor and solder it from pin 1 to pin 3 of T104. Apply a 1mV, 399KHz signal, tune the receiver to 399KHz and tune T106 for peak AGC.
10. Remove the 2.2K resistor from T104 and repeat steps 8 and 9 until no further adjustment can be made.
11. Solder a short jumper from pin 2 to pin 3 of T107 and also one from pin 2 to pin 3 fo T109. Apply a 10mV, 490KHz input signal, tune the receiver to 490KHz and tune T108 for peak AGC.
12. Remove the jumper and solder a 1.5K resistor from pin 1 to pin 3 of T109. Apply a 1mV, 400KHz input signal, tune the receiver to 400KHz, and tune T107 for peak AGC.
13. Remove the 1.5K resistor and solder it from pin 1 to pin 3 of T107. Apply a 1mV, 599KHz input signal, tune the receiver to 599KHz, and tune T109 for peak AGC.
14. Remove the 1.5K resistor from T107 and repeat steps 12 and 13 until no further adjustment can be made.
15. Solder a short jumper wire from pin 2 to pin 4 of T110 and also one from pin 2 to pin 4 of T112. Apply a 10mV, 735KHz input signal, tune the receiver to 735KHz, and tune T111 for peak AGC.
16. Remove the jumpers and solder a 1.5K resistor from pin 1 to pin 3 of T112. Tune the receiver to 600KHz and apply a 1mV, 600KHz RF input signal. Tune T110 for peak AGC.
17. Remove the 1.5K resistor and solder it from pin 1 to pin 3 of T110. Tune the receiver to 899KHz, apply a 1mV, 899KHz input signal, and tune T112 for peak AGC.
18. Remove the 1.5K resistor and repeat steps 16 and 17 until no further adjustment can be made.

5.2.3.3 Crystal Oscillator Frequency Adjustment

Monitor TP507 on the main board with a frequency counter. Adjust C152 on the receiver board such that the frequency is 2.048MHz $\pm$ 25Hz.

5.2.3.4 Mixer L.O. Level Adjust

A) Monitor the DC voltage at TP106 on the receiver board with a DVM and tune the receiver to 200KHz.

B) Adjust T122 such that the voltage is 2.0V $\pm$ .1V.

C) Tune the receiver to 550KHz and monitor TP107 with a scope.

D) Adjust R164 for 1.8V peak-to-peak at TP107.

5.2.3.5 IF Alignment

A) Apply an unmodulated 50uV, 200KHz signal from the RF generator directly into the RF input jack of the receiver.

B) Monitor the AGC voltage at pin 14 of the rear connector with a DVM.

C) Tune the receiver to 200KHz.

D) Position R109 to the center of its range and set R151 to the full CCW position for the IF alignment. They will be readjusted later.

E) Adjust T115 for a maximum AGC voltage.

NOTE

The RF level should be reduced during the alignment such that AGC is maintained at approximately 6V.

F) Adjust T116, T117, T118, T119, T120 and T121 to obtain maximum AGC voltage.

G) Repeat steps (E) and (F) until no further increase in AGC voltage can be obtained.

5.2.3.6 Coherent Detector Alignment

A) Place a circuit jumper between TP102 and TP103 on the receiver board and monitor TP104 with a frequency counter.

B) Adjust R189 for a frequency of 139.8 $\pm$ .1KHz.

C) Remove the end of the jumper from TP102 and jumper from TP103 to TP101.

D) Adjust T123 for a frequency of 139.8 $\pm$ .05KHz at TP104.

E) Repeat steps (a) through (d) until no further improvements can be made.

F) Remove the circuit jumper.

5.2.3.7 Crystal Filter Center Frequency Adjustment

A) Tune the receiver to 200KHz, and apply a 10uV, 200KHz signal from the RF generator directly into the RF input of the receiver. Use an audio oscillator to externally amplitude modulate the 200KHz signal. Modulate the signal at 50% with 1KHz.

B) Monitor the audio output voltage (loaded with a 500 ohm speaker or load) with a VTVM and adjust the receiver volume pot for approximately 1VRMS.

C) Maintain the 50% AM and increase the audio modulation frequency until the audio output drops to 0.3VRMS.

D) Readjust C152 on the receiver board to obtain a local null.

NOTE

If C152 is adjusted too far, a false minimum may occur. This may be checked by measuring the frequency at TP507 for 2.048MHz ± 50Hz. If this frequency is out of adjustment, repeat Section 5.2.3.3 and steps (a) through (d) above.

E) Recheck the adjustment of T115, T116, and T117 by adjusting for maximum AGC voltage, as described in Section 5.2.3.5.

F) Replace the small synthesizer shield cover.

5.2.3.8 AGC Level Adjustment

A) Tune the receiver to 200KHz, and apply an unmodulated, 60uV, 200KHz signal from the RF generator directly into the receiver RF input jack.

B) Monitor the DC voltage at TP108 on the receiver board, and adjust R151 such that the voltage is 7 ± 1V.

5.2.3.9 Mixer Bias Adjustment

A) Leave the receiver tuned to 200KHz and reduce the input signal level to 3.5uV with no modulation.

B) Monitor the audio output with the VTVM and adjust it with the volume control for approximately 0.2VRMS.

C) Adjust R109 to obtain a minimum on the audio noise output.

D) Replace the large RF section shield cover.

5.2.3.10 Indicator Driver Level Adjustment

A) Leave the receiver tuned to 200KHz and increase the 200KHz input signal to 50uV.

B) Jumper TP508 and TP509 on the main board to ground.

C) Measure the DC voltage between the SIN DC output (pin A on the rear connector) and the COS DC output (pin B).

D) Adjust R522 such that the average DC voltage is 0 ± 5mV.

E) Remove the jumpers.

5.2.3.11 Photocell Dimming Adjust

A) Monitor TP506 on the main board with a scope.

B) Cover the photocell on the upper left side of the KR 87 front panel.

C) Adjust R571 for a positive pulse width of 100usec ± 5usec.

5.2.3.12 Rotational Bias Adjustment

A) Apply a 200KHz, 0.5V signal from the RF generator to the RF input of the KTS 156 simulator. The KTS 156 switches should be in the following positions:

Sense Switch:	Enable
Switching Switch:	RCVR
Output Switch:	RCVR
Mode Switch:	Brg. Simulate
Function Switch:	Brg.
Bearing Selector:	0°

B) Monitor the voltage between the SIN DC output (pin A of P871) and the +4.5V common output (pin D of P871) with a DVM.

C) Adjust R177 on the receiver board through the adjustment hole in the shield cover to obtain a voltage of 0 ± 20mV. (Average DC reading).

5.3 OVERHAUL

5.3.1 INSPECTION

This section contains instructions to assist in determining, by inspection, the condition of the KR 87 and KA 44/44B assemblies. Defects resulting from wear, physical damage, deterioration, or other causes can be found by these inspection procedures. To aid inspection, detailed procedures are arranged in alphabetical order.

A) Capacitors, Fixed

Inspect capacitors for case damage, body damage, and cracked, broken, or charred insulation. Check for loose, broken, or corroded terminal studs, lugs, or leads. Inspect for loose, broken, or improperly soldered connections.

B) Capactiors, Variable

Inspect trimmers for chipped and cracked bodies, damaged dielectrics and damaged contacts.

C) Chassis

Inspect the chassis for deformation, dents, punctures, badly worn surfaces, damaged connectors, damaged fastener devices, component corrosion, and damage to the finish.

D) Connectors

Inspect connectors for broken parts, deformed shells or clamps, and other irregularities. Inspect for cracked or broken insulation and for contacts that are broken, deformed, or out of alignment. Also, check for corroded or damaged plating on contacts and for loose, improperly soldered, broken, or corroded terminal connections.

E) Covers and Shields

Inspect covers and shields for punctures, deep dents, and badly worn surfaces. Also, check for corrosion and damage to finish.

F) Insulators

Inspect insulators for evidence of damage, such as broken or chipped edges, burned areas, and presence of foreign matter.

H) Potentiometers

Inspect all potentiometers for evidence of damage such as dents, cracked insulation, or other irregularities.

I) Resistors, Fixed

Inspect the fixed resistors for cracked, broken, blistered, or charred bodies and loose, broken, or improperly soldered or corroded terminal connections.

J) RF Coils

Inspect all RF coils for broken leads, loose mountings, and loose, improperly soldered, or broken terminal connections. Check for crushed, scratched, cut or charred windings. Inspect the windings, leads, terminals and connections for corrosion or physical damage. Check for physical damage to forms and tuning slug adjustment screws.

K) Transformers

1. Inspect for signs of excessive heating, physical damage to case, cracked or broken insulation, and other abnormal conditions.
2. Inspect for corroded, poorly soldered, or loose connecting wires.

L) Wiring

Inspect wiring for breaks in insulation, conductor breaks, and improper dress in relation to adjacent wiring or chassis.

5.3.2 CLEANING

A) Using a clean, lint-free cloth lightly moistened with a regular cleaning detergent, remove the foreign matter from the equipment case and unit front panels. Wipe dry using a clean, dry, lint-free cloth.

B) Using a hand controlled dry air jet (not more than 15psi), blow dust from inaccessible areas. Care should be taken to prevent damage by the air blast.

C) Clean the receptacles and plugs with a hand controlled dry air jet (not more than 25psi), and a clean, lint-free cloth lightly moistened with an approved cleaning solvent. Wipe dry with a clean, dry, lint-free cloth.

5.3.3 REPAIR

This section describes the procedure, along with any special techniques, for replacing damaged or defective components in the KR 87 or KA 44/44B.

A. Diodes

Diodes used in the KR 87 are silicon. Use long nose pliers as a heatsink under normal soldering conditions. Note the diode polarity before removal.

B. Integrated Circuits

The microprocessor, I506, is mounted in a socket for easy replacement. Be careful to avoid breaking the IC package during removal and insertion. Carefully line up the pins of the IC with the holes in the socket when replacing it. Be sure pin 1 (marked with a dot on the case or slot in the pin) is oriented properly. The medium scale integrated circuits are soldered to the PC boards. Refer to the integrated circuit maintenance section in the Appendix for removal and replacement instructions. The microprocessor, EAROM, and CMOS integrated circuits may be damaged by static electricity and should be kept in conductive packaging when not installed.

C. PC Boards

Use a low wattage soldering iron to avoid damaging the boards by excessive heat. A path that has opened up on the top or bottom of a board can be replaced with insulated hookup wire.

D. Transistors

Refer to the semiconductor maintenance section in the Appendix for removal and replacement instructions.

5.3.4 DISASSEMBLY/ASSEMBLY

The KR 87 has been constructed so that all the parts are accessible by removing the top cover of the unit and folding out the top receiver board. The shield cover on the receiver board snaps off, allowing easy access to the RF, IF, and coherent detector sections. A second, smaller cover snaps off to allow access to the LSI synthesizer section. The modular power supply is accessible by removing the rectangular power supply cover that is held on by four Phillips head screws.

A. Disassembly of the KR 87 Receiver for Troubleshooting or Alignment Purposes. (Refer to **Figure 6-2** thru 6-4, the Final Assembly Drawings.)

a) Remove the six small Phillips screws that hold the top cover of the unit in place. Remove the top cover.

b) Remove the 5 Phillips screws that hold the receiver board in place. Then carefully foldout the receiver board.

c) Carefully unsnap the large shield cover on the receiver board and remove it.

d) Carefully unsnap the small shield cover over the synthesizer section and remove it.

e) Remove the 4 Phillips screws that hold the cover on the modular power supply, then remove the cover.

At this point, all components and adjustments are readily accessible for troubleshooting and alignment purposes. If it is found that further disassembly is necessary for part replacement or otherwise, follow the instructions below.

B. Power Supply Removal

a) Remove the bottom cover of the KR 87 unit by removing the 6 Phillips screws that hold it in place.

b) Remove the 4 nuts on the bottom of the main board that hold the power supply module in place.

c) Lift the power supply module off the main board, taking care not to damage the connector pins.

d) The rear of the power supply board is accessible by removing the 4 threaded standoffs and the two screws that hold the power transistors to the heat sink, then removing the power supply base.

C. Display Board Access

Versions −00, −01, −02, −04, −05, −07 (−06 uses CNI 5000 bezel)

a) Remove the 4 Phillips screws that hold the front bezel onto the unit, then slide off the front bezel.

b) It if is necessary to replace the gas−discharge display, or to remove the display to replace components on the display board, simply slide the display tube straight up, out of its connector.

Display Board Access

Versions −14, −15, −17

a) Loosen setscrew holding volume knob to its shaft, and remove volume knob.

b) Loosen setscrew holding slide switch activation spool to shaft of inner concentric knob. Remove inner concentric knob and shaft.

c) Pull outer concentric knob from its shaft.

d) Remove the 4 Phillips screws that hold the front bezel onto the unit, then slide off the front bezel.

e) It if is necessary to replace the gas−discharge display, or to remove the display to replace components on the display board, simply slide the display tube straight up, out of its connector.

D. Assembly

To reassemble the unit, reverse the steps listed above. On −14, −15, and −17 units, line up setscrews with flats on shafts, and line up "D" on outer concentric knob with corresponding flat on its shaft.

5.4 TROUBLESHOOTING

Included in this section are troubleshooting flowcharts and detailed troubleshooting procedures. The detailed troubleshooting procedures should be used in conjunction with the flowcharts. Typical waveforms and voltage levels may be found on the schematics.

5.4.1 SYSTEM TROUBLESHOOTING

The system troubleshooting flowchart, **Figure 5−3**, should be used to isolate a problem to a general area of the unit. Once the problem has been isolated to a particular area, refer to the appropriate detailed procedure and also to section IV, Theory of Operation.

The following hints can also be used to rapidly isolate whether the problem lies in the KA 44/44B Antenna or the KR 87 Receiver.

A. If the receiver will not lock onto a station or output audio:

1. Connect the antenna electronics unit to the KTS 156 Antenna Simulator and apply a .6V RMS signal at 550KHz. Use the KTA 156 adapter if a KA 44B is being used. Place the KTS 156 switches in the following positions:

Sense Switch:	Enable
Loop Switch:	Disable
Switching Source:	RCVR
Output Load:	50 ohm
Mode Switch:	Brg. simulate
Function Switch:	Brg.
Bearing Switch:	0^{o}

Monitor the 50 ohm output jack of the KTS 156 with an oscilloscope. The 550KHz signal should be between 40–50mV RMS. If this is correct, enable the Loop Switch on the KTS 156. Turn the bearing selector on the KTS 156 to 90^{o} and observe a similar signal. If the signals are not correct, the problem is in the antenna electronics unit. Proceed to the KA 44/44B section of this manual for troubleshooting information.

2. Tune the receiver to 550KHz in the ANT mode and look at pin 10 of I114 with a scope. A clean 140KHz square wave should be present. If not, troubleshoot the RF/IF section. If so, troubleshoot the coherent detector circuit.
3. If the coherent detector is functioning properly, troubleshoot the audio detector and amplifier.

B. If the receiver locks onto a signal but doesn't point properly:

1. Check alignment of antenna; troubleshoot if it is necessary.
2. Verify that the loop enable signal to the antenna pulls to +2.8 volts when locked on in the ADF mode. (Lock occurs when the audio panel output is enabled.)
3. Troubleshoot the 32Hz band pass filter and bearing detector circuits.

C. If the display blanks except for keep-alives, check the +9V and +5V lines.

5.4.2 POWER SUPPLY TROUBLESHOOTING

When troubleshooting the power supply, exercise caution with probes, fingers, etc. in the vicinity of the +189 volt line.

Refer to the Theory of Operation, the voltages and waveforms on the Power Supply Schematic, **Figure 6-30**, and the Power Supply Troubleshooting Flowchart, **Figure 5-4**.

A. With the unit turned off, check for a shorted A+ line and blown fuse, F501. Also check for shorts on any of the power supply lines (+189V, +12V, +9V, +5V and -26V). Isolate any shorts that are found.

B. If a short has occurred somewhere, the most probable components that would be blown are driver transistors Q302 and Q303. Check that these transistors are still good.

C. Check the operation of the oscillator and comparators as it is described in the Theory of Operation. Circuit jumper CJ301 should be removed to disable the supply.

1. Verify the oscillator output at pin 2 of I302.
2. Verify pin 1 of I302 is high.
3. Verify a square wave at TP301.

D. If all the voltage lines are too high or too low, check that the reference voltage at pin 9 of I302 is +5V $\pm$ 3%. If not, replace I301.

E. If any or all of the voltage lines are too low, check for excessive current drains on the appropriate lines.

F. If the +5 volt line is shorted, check Q304 and regulator chip I303.

G. If the +9 volt line is shorted, check Q111 and regulator I107 on the receiver board.

5.4.3 LSI SYNTHESIZER TROUBLESHOOTING

The LSI Synthesizer circuit provides a 2.048MHz clock signal to the microprocessor as well as synthesizing the first LO frequency. Therefore, the synthesizer should be investigated first when there appears to be a processor problem to determine if it is supplying the proper clock signal.

Refer to the KR 87 Receiver Board Schematic, **Figure 6-6**, the Theory of Operation, and the Synthesizer Troubleshooting Flowchart, **Figure 5-5** when troubleshooting this area.

A. Ensure that the 8.192MHz master oscillator is working properly and that pin 15 of I104 is receiving the 8.192MHz signal. If not, troubleshoot the oscillator circuit consisting of Y101 and Q112.

B. Verify that pin 17 of I104 is outputting a TTL level 2.048MHz clock to the processor. If not, check that there is not a short on that line; otherwise replace I104.

C. If the processor is receiving the 2.048MHz, verify that it is outputting and the synthesizer (I104) is receiving clock, sync, and data signals on pins 5, 10, and 7, respectively. (See Timing Diagram, **Figure 4-11**.)

D. Verify that pump up or pump down pulses are being output on pins 2 and 3 of I104. With the receiver tuned to 200KHz, TP106 should be at about +2VDC. As the tuning frequency is increased to 1799KHz, TP106 should rise to about +6VDC. Check that the above is occurring. If the voltage doesn't change properly, or if pins 2 or 3 are continually high or outputting pulses, check Q106 – Q108 for proper operation (See Theory of Operation). Also check for leakage paths on either side of R162.

E. VCO chip I105 should output an ECL level signal (3.5V – LO; 4.2V – HI) at pin 3. To determine whether the VCO circuit is working properly, lift the end of R162 that is tied to TP106 and apply an external DC tuning voltage (2–6VDC) to the lifted end. The VCO output should be about 12.628MHz with a 2 volt input and about 14.228MHz with a 6 volt input. If it and the charge pump circuit (Q106 – Q108) are working properly and the synthesizer is receiving valid tuning data from the processor, then the chip is bad and I104 must be replaced.

F. Verify that the output of I105 gets through buffer transistor Q109 and that it appears as a 1.8V p-p sine wave at TP107.

5.4.4 RF AND IF TROUBLESHOOTING

The basic procedure for troubleshooting the receiver section is to trace the signal through the receiver until the problem area is isolated. Begin by applying a 10mV/550KHz signal directly from the signal generator into the receiver. Tune the receiver to 550KHz.

Refer to the RF and IF Troubleshooting Flowchart, **Figure 5-6**, the Theory of Operation, and the KR 87 Receiver Board Schematic, **Figure 6-6**.

A. After applying the 10mv/550KHz signal and tuning the receiver, examine pin 10 of I114 for a clean 140KHz square wave. If one is present, tune the receiver off of 550KHz and verify that the signal gets noisy. If so, the RF and IF circuits are working properly.

B. If the above procedure checks properly, modulate the RF with a 1000Hz tone at 30%. Turn up the volume and listen for the audio tone. If none is present, troubleshoot the coherent detector and/or the audio detector and amplifier circuits.

C. If the problem is in the RF or IF sections, retune the receiver to 550KHz and begin tracing the signal. If the signals that are encountered below are not very clean, make sure that all the RF transformers have been properly aligned.

1. Verify the 550KHz signal at the output of the preselector filters (at anode of CR107). It should be approximately 80mv p-p.
2. Follow the signal through T114 and Q101. Verify a 1.8V p-p, 12.978MHz LO signal at TP107 and compare the mixer output waveform with that shown on the schematic.
3. Verify a 110mV (approximate) 12.428MHz sine wave at G1 of Q103.
4. Compare the waveforms at the drain output of Q103, the G1 and G2 inputs to Q104, and the drain output of Q104 with those shown on the schematic.
5. Verify an approximate .22V p-p, 140KHz sine wave at pin 4 of I102.
6. Verify a 140KHz sine wave at the gate and source of Q105.
7. Verify a 140KHz square wave at the output of I116, which functions as a hard limiter.

D. If the problem is in the audio circuit, verify first that the audio enable line is high (pin 12 of I115) if the receiver is locked onto a signal. If so, troubleshoot the detector circuit and the audio amplifier, I516. If the audio enable line is low, verify that the receiver is tuned to the proper input frequency. If it is still low, investigate the coherent detector.

E. If the problem appears to be in the AGC circuit, troubleshoot it as follows:

1. Verify that the AGC voltage goes from approximately 6.0 volts with a 3.5uv input signal (directly from the RF generator) to +7.6 volts with a 3mV input signal. If not, proceed as outlined below.
2. Break the AGC loop by lifting the end of R147 that is tied to the AGC output line. Then ground the AGC output line and apply a DC voltage from +5V to +8V to the lifted end of R147. Examine the output of the IF amplifier, I102, to determine if the AGC voltage is working properly. The output should be attenuated as the voltage is increased.
3. Lift the end of R117 that is tied to TP108 and apply a DC voltage from 10V to about 1 volt. Examine the drain output of Q103 to determine if the AGC voltage to it is working properly. The output should decrease as the AGC voltage is decreased.
4. Recall that AGC amplifier I117A should remain saturated at the positive rail until the input signal reaches approximately 35uV.

5.4.5 COHERENT DETECTOR TROUBLESHOOTING

Before attempting to troubleshoot the coherent detector circuit, refer to the Theory of Operation for an overview of how it works. The detailed block diagram is shown in **Figure 4-10**. While troubleshooting the circuit, refer to the Coherent Detector Troubleshooting Flowchart, **Figure 5-7**, and the Receiver Board Schematic, **Figure 6-6**, and Assembly Drawing, **Figure 6-5**.

A. Verify that the problem is actually in the coherent detector by first applying a 10mV/550KHz signal directly from the RF generator into the receiver. Tune the receiver to 550KHz and examine pin 10 of I114 for a clean 140KHz square wave. If one is present, apply a 30% modulated 1KHz tone to the RF carrier and turn up the receiver volume to listen for the tone. If nothing is heard, the problem is probably in the coherent detector, as the loop has not locked onto the signal and turned on the audio enable switches.

B. Verify the reference voltage at TP102 to be +4.5V. Then jumper TP102 to TP103 and connect a frequency counter to TP104. The frequency should be approximately 140KHz. If it is off, adjust R189 for a frequency of 139.8KHz. If the circuit will not adjust properly, verify that pin 9 of I112 is at +4.5V and that pin 16 is at +9V. Also check C194, R188, R189 and flip–flops I111A and B. If it still doesn't adjust properly, replace I112.

C. Remove the jumper from TP102 and jumper TP101 to TP103 with the counter still on TP104. It should also read approximately 140KHz. Adjust T123 for a frequency of 139.8KHz. If it does not adjust properly, examine T123, C205, and C206. Pin 4 of I112 should be outputting a 280KHz square wave, pins 3 and 14 should be receiving 140KHz square waves which are 90° apart in phase, and pin 2 should be outputting a 280KHz square wave. Isolate any bad components or shorts that are causing problems. Once this has been done, recheck the above adjustments (two or three iterations may be necessary).

D. Once the above circuits have been properly adjusted, remove the jumpers and reapply the 550KHz input signal. A locked condition occurs when the 140KHz IF signal and one of the 140KHz VCO signals are in phase at pins 1 and 2 of I114. If the loops fails to lock, verify that the PC II output of I109 (pin 13) is passing through switch I115C. If pin 13 of I109 is continually high or low, examine I108B for a saturated output. Check I108 and its associated circuitry to determine the cause of saturation.

E. Once lock is established (I114B output low), verify that the output of I108C goes high and I114C goes low, enabling switch I115D and disabling I115C. Also verify that audio switch I115B is enabled.

F. Verify that slow lock detector I108D goes high, that I503D (on the main board) goes high, and that switches I515A and B are enabled with the unit in the ADF mode.

G. Place the antenna electronics assembly on the KTS 156 antenna simulator and apply a .1V RF signal at 550KHz. Tune the receiver to 550KHz in the ADF mode and verify that the loop enable line (at the anode of CR514 or CR515) pulls up to 2.8V. The sense and loop switches on the KTS 156 should be enabled.

H. Verify that a 32Hz sine wave (approximately 2V p–p) is present at pin 8 of I108 and that it is converted to a 0–9V square wave by I114C. If no 32Hz signal is present, sync the scope on the 140KHz signal at TP104 and look at pin 2 of I109 on another scope channel. Verify the presence of phase modulation (seen as a rapid phase dithering) when the unit is in the ADF mode, and verify that it is removed when the unit is switched to the ANT mode. If there is phase dither present in the ADF mode and no 32Hz output signal, troubleshoot the 32Hz band pass filter. If there is no phase dither present, check the loop enable line for 2.8 volts, then troubleshoot the antenna.

5.4.6 BEARING DETECTOR AND DRIVER TROUBLESHOOTING

The bearing selector and driver circuitry consists of phase detectors I504A and B, low pass filters I502A and B, the diode–resistor voltage conversion network, level shifters I501A and B, and output transistors Q501 - Q502. Also included is the +4.5 volt reference supply consisting of I501C and Q511 - Q512

In order to troubleshoot the bearing detector circuitry, it is generally necessary to have the antenna electronics unit connected to the KTS 156 Antenna Simulator such that various relative bearings can be simulated.

Refer to the Theory of Operation, The Bearing Detector and Driver Troubleshooting Flowchart, **Figure 5–8**, and the nominal DC voltages on the Main Board Schematic, **Figure 6–20** thru 6–22.

A. Verify that the +4.5V DC voltage reference consisting of I501C, Q511 and Q512 is operating properly. It is simply a unity gain op-amp configuration with a push-pull current driver output stage.

B. Place the KR 87 in the ANT mode for the following checks. Verify that the 32Hz angle 0° and 32Hz variable square waves are being input to I504A at TP502 and TP501. Verify that the 32Hz angle 90° and 32Hz variable signals are also input to I504B at TP503 and TP501. Verify that the output signals are good at TP508 and TP509.

C. With the KR 87 tuned to 550KHz in the ADF mode, apply a 550KHz, .5V signal to the KTS 156 antenna simulator. Verify that analog switches I515A and B have high signals at pins 6 and 12 and that the signal passes through the switches with no distortion. Verify that the phase of the 32Hz variable signal changes as the relative bearing on the simulator is changed. If the lock signals at pins 6 and 12 of I515 are not high, make sure that the receiver is receiving the RF from the antenna and that it is tuned to the proper frequency. Otherwise, the coherent detector and/or the RF/IF section may need to be examined.

D. Verify the presence of the +12V and -6.2V supply voltages on I501 and I502.

E. Verify the operation of low pass filters I502A and B as follows:

A relative bearing of 90° should produce a low output at TP509 and a DC output voltage at TP504 of approximately 0 volts. It should also produce a square wave output at TP508 and a +4.5V DC voltage at TP505. Verify that the DC voltage at the filter outputs is equal to the average DC value of the pulsed signal at the phase detector outputs (i.e., DC voltage at TP504 is average value of pulsed signal at TP509) as the relative bearing is changed.

F. Verify the proper DC voltages along the resistor network consisting of R508 - R515. Also verify that the diodes are switching properly as the voltages across them exceed the switching threshold.

G. Verify the proper operation of the output amplifier and driver circuits. Approximate DC voltages for various relative bearings at certain test points are outlined below.

RELATIVE BEARING	DUTY CYCLE AT TP509	DCV AT TP504	DCV AT J871-A	DUTY CYCLE AT TP508	DCV AT TP505	DCV AT J871-B
0°	50%	+4.5V	+4.5V	0	0	+7.5V
45°	25%	+2.3V	+6.6V	25%	+2.3V	+6.6V
90°	0	0	+7.5V	50%	+4.5V	+4.5V
135°	25%	+2.3V	+6.6V	75%	+6.7V	+2.4V
180°	50%	+4.5V	+4.5V	100%	+9.0V	+1.5V
225°	75%	+6.7V	+2.4V	75%	+6.7V	+2.4V
270°	100%	+9.0V	+1.5V	50%	+4.5V	+4.5V
315°	75%	+6.7V	+2.4V	25%	+2.3V	+6.6V

TABLE 5-2 BEARING DETECTOR TROUBLESHOOTING GUIDE

H. Verify that the coil windings of the indicator have a DC resistance on the order of 20-25 ohms each.

5.4.7 DISPLAY TROUBLESHOOTING

A. Before troubleshooting the display, check the display tube to make sure it makes good electrical contact in its socket. Also, be extremely careful with scope probes, ground clips, etc., in the vicinity of the high voltage lines.

B. Refer to the display board assembly drawings **Figure 6-23** thru 6-25 and and schematics **Figure 6-26** thru 6-27; and main board assembly drawings **Figure 6-15** thru 6-19 and schematics, **Figure 6-20** thru 6-22 for the following procedures. Voltage levels and representative waveforms are given. Also refer to the display timing diagrams, **Figure 4-12**, and the Theory of Operation.

C. If the +187V line is shorted, it may be caused by a short in CR404, I402, Q401, C402, or a short in the display. Generally if one of the components shorts first, other components, especially current-limiting transistor Q401, will also be blown, so check all associated high voltage components before reapplying power to the unit.

   If zener diode CR404 shorts, I401 and I402 will also probably need to be replaced.

D. If only individual digits or messages do not light, while other digits appear fine, the problem is in the anode driver circuit. Check I401, I402 and the display tube.

E. If only certain segments are continually lit or unlit in all digits, the problem is in the cathode driver circuit. Check I507, I508, C501, CR517 - CR526, and the display tube.

F. If the display intensity is dim, or if it flickers slightly, check the keep- alive segments and associated circuitry. The keep-alives should be lighted continuously. They are visible at very bottom of the display tube.

5.4.7.1 Display Dimming

The display is dimmed by controlling the amount and duty cycle of the bias current to cathode drivers I207 and I208. Refer to the dimming circuit timing diagrams, **Figure 4-13A & B** for assistance in troubleshooting the dimming circuit. Follow the depicted waveforms through the circuit in both light and dim conditions and refer to the Display Dimming Troubleshooting Flowchart, **Figure 5-10**.

Recall that the photocell should exhibit high DC resistance at low light levels and low resistance at high light levels.

5.4.8 PROCESSOR TROUBLESHOOTINGS

The LSI microprocessor is very reliable and not prone to failure; however, the following troubleshooting procedure is provided (refer also to **Figure 5-11**).

A. Verify that the processor is receiving +5 volts and ground.

B. Verify that it is receiving the 2.048MHz clock at pin 2. If not, troubleshoot the LSI synthesizer circuit.

C. Examine the processor inputs and outputs that pertain to the area of the problem. Be certain there are no shorts on the output lines before concluding that the processor is bad.

   a) For display problems:

      1. Check for 1KHz display clock at pin 24.
      2. Check for 125Hz display sync at pin 25.
      3. Check for multiplexed cathode data at pins 22, 23, and 34-37 and verify that the cathode drivers are working properly.

   b) For pointing problems:

Check that the 32Hz angle 0 signal at pin 18 and the 32Hz angle 90° signal at pin 19 are present and that they are passing through the buffers to the rear connector and to the bearing detectors, I504A and B. Also check that they are actually 90° apart in phase.

c) For mode selection problems:

Verify that depressing one of the front panel switches applies a ground to the appropriate processor input pin and that an open circuit is presented to the inputs when the pushbuttons are in the out position. If not, examine the switch contacts.

d) For tuning problems:

1. Verify that serial data is being output at pin 15 and that strobe and sync signals are present at pins 7 and 8 (See Timing Diagram, **Figure 4-11**).
2. Verify that the serial data is being passed through shift register I509. (See Appendix for I509 operation).
3. Verify that the proper RF preselector filter line is high at the output of I509.
4. If the operation of the concentric tuning knobs does not change the display, examine the operation of the switches and the switch contacts.

e) For EAROM problems:

1. Verify that the EAROM, I513, is receiving +9V at pin 1 and -26V at pin 2.
2. Verify that it is receiving the 16KHz clock at pin 6.
3. Verify that pins 7, 8, 9, and 12 of I513 are normally high (+9V) and that they go momentarily low approximately 3 seconds after a new active or stored frequency is entered.
4. Also verify that very narrow positive pulses are output at pin 16 of I506 approximately 3 seconds after a new frequency is entered.

NOTE

Since the above pulses are not synchronous, it is impossible to examine the timing sequence without sophisticated equipment. The above tests can be made with an ordinary oscilloscope by carefully watching for momentary highs and lows.

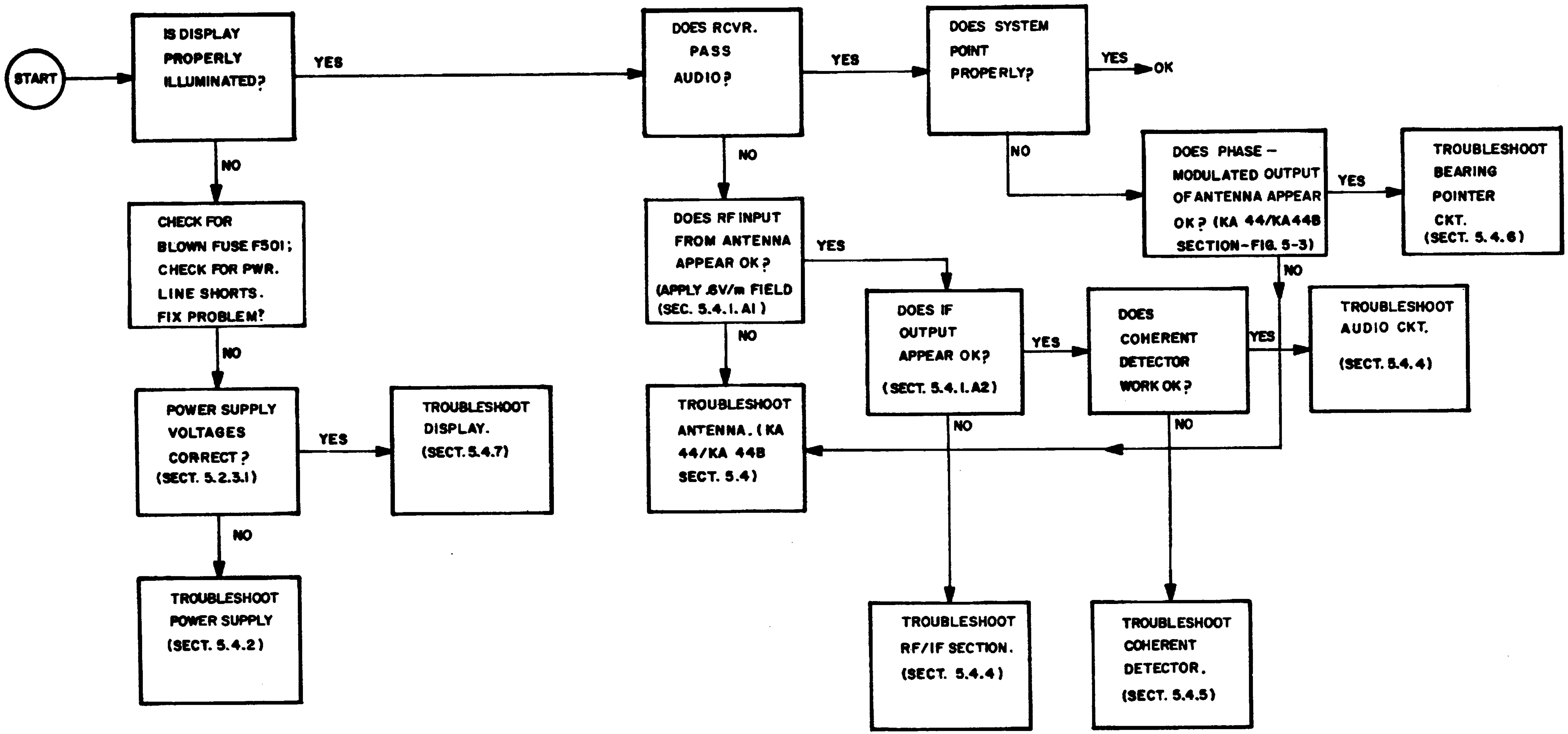


FIGURE 5-3 KR 87 SYSTEM TROUBLESHOOTING FLOWCHART

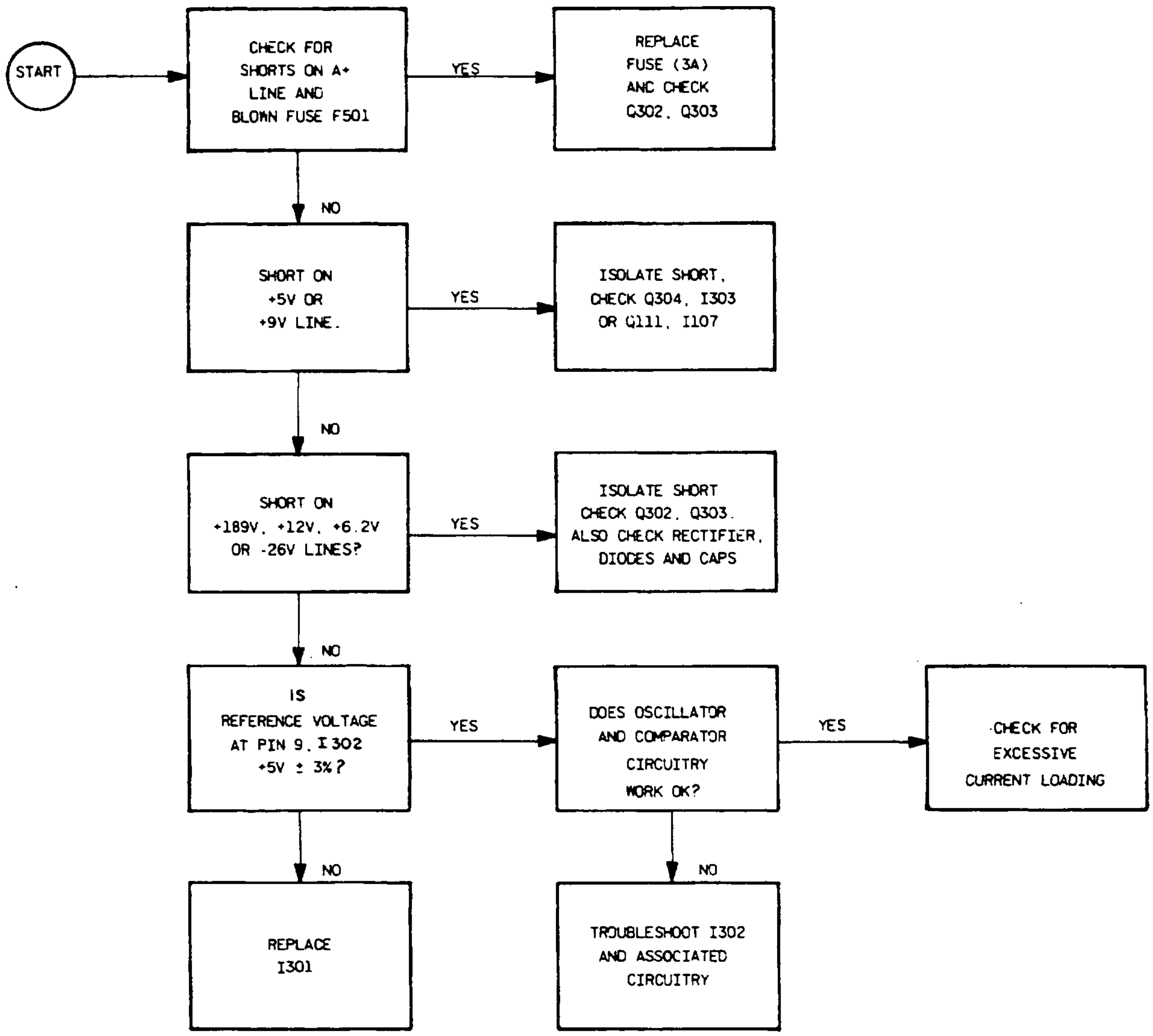


FIGURE 5–4 POWER SUPPLY TROUBLESHOOTING FLOWCHART

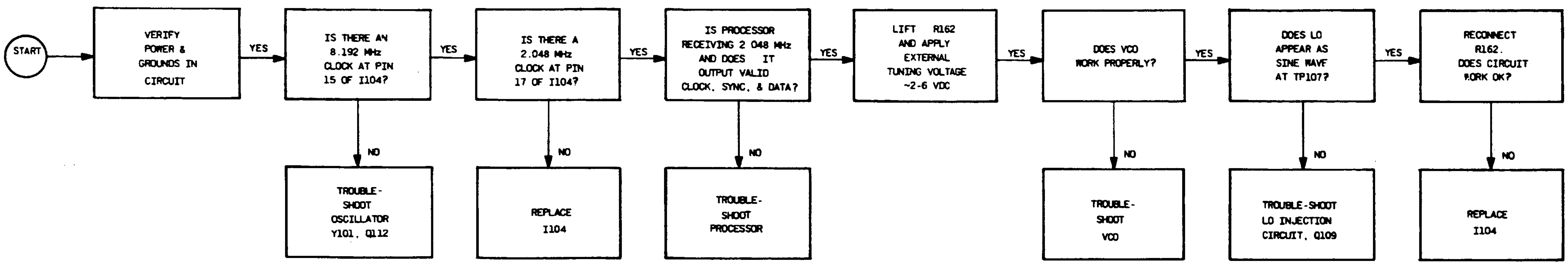


FIGURE 5-5 LSI SYNTHESIZER TROUBLESHOOTING FLOWCHART

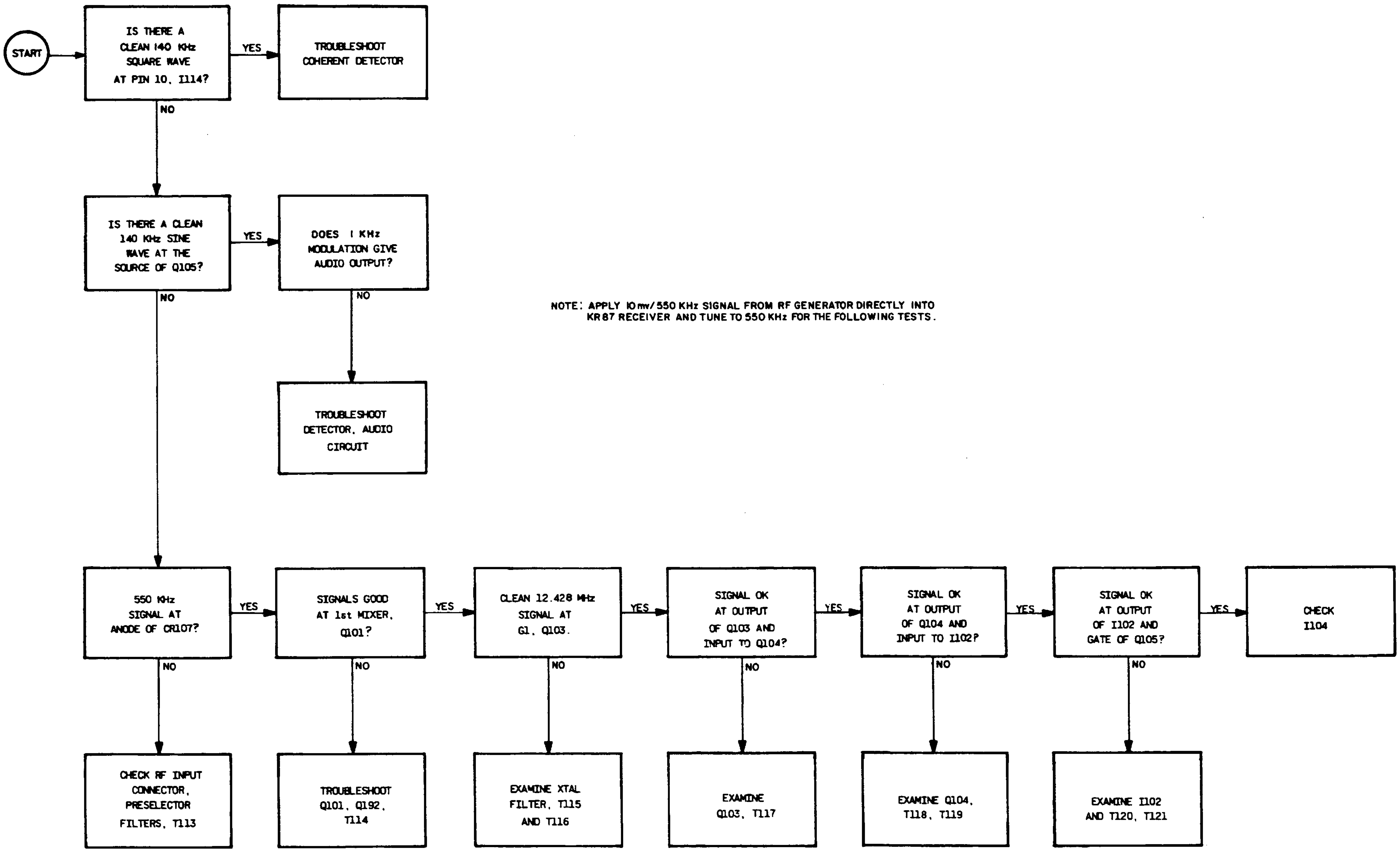


FIGURE 5-6 RF AND IF SECTION TROUBLESHOOTING FLOWCHART

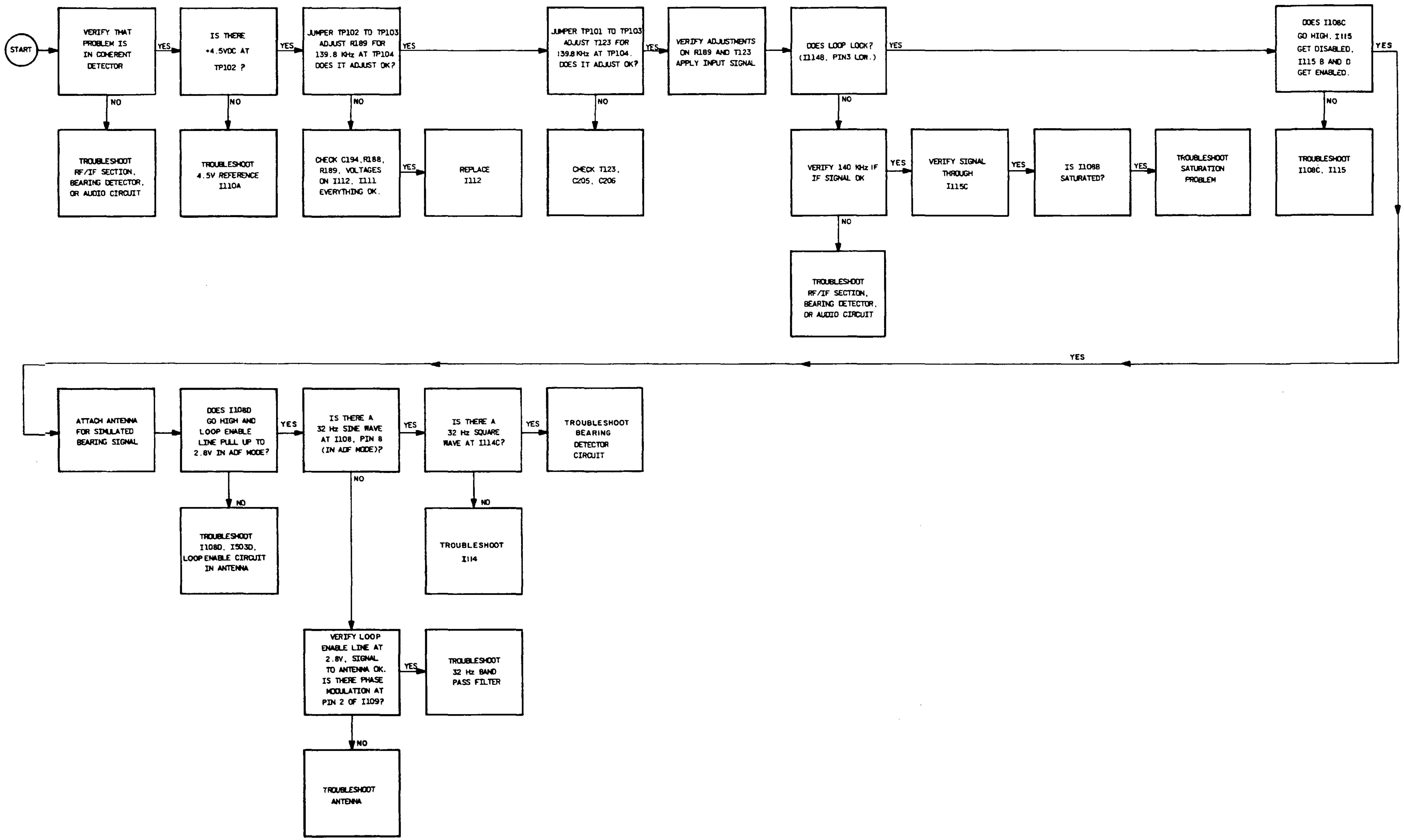


FIGURE 5-7 COHERENT DETECTOR TROUBLESHOOTING FLOWCHART

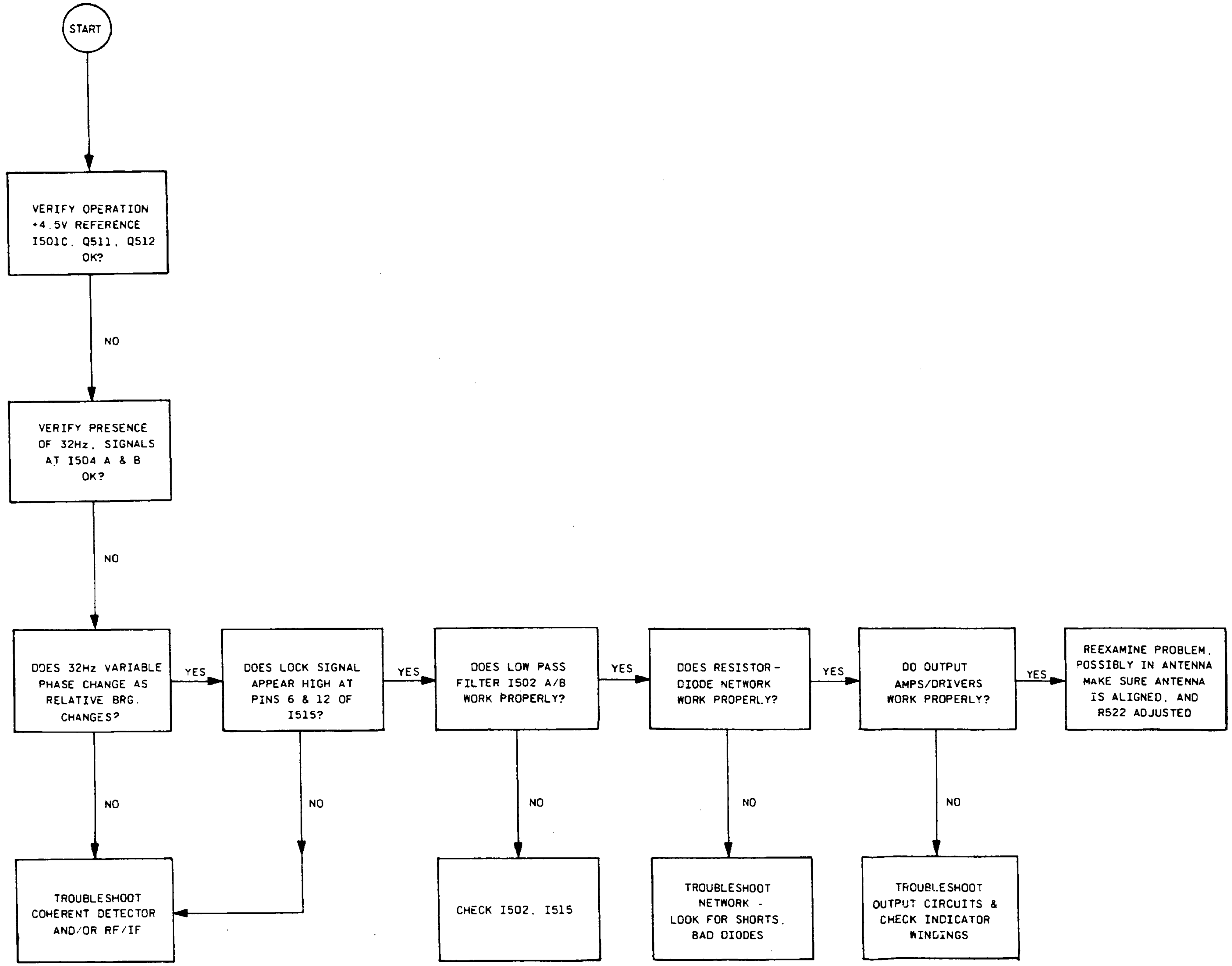


FIGURE 5-8 BEARING DETECTOR AND DRIVER TROUBLESHOOTING FLOWCHART

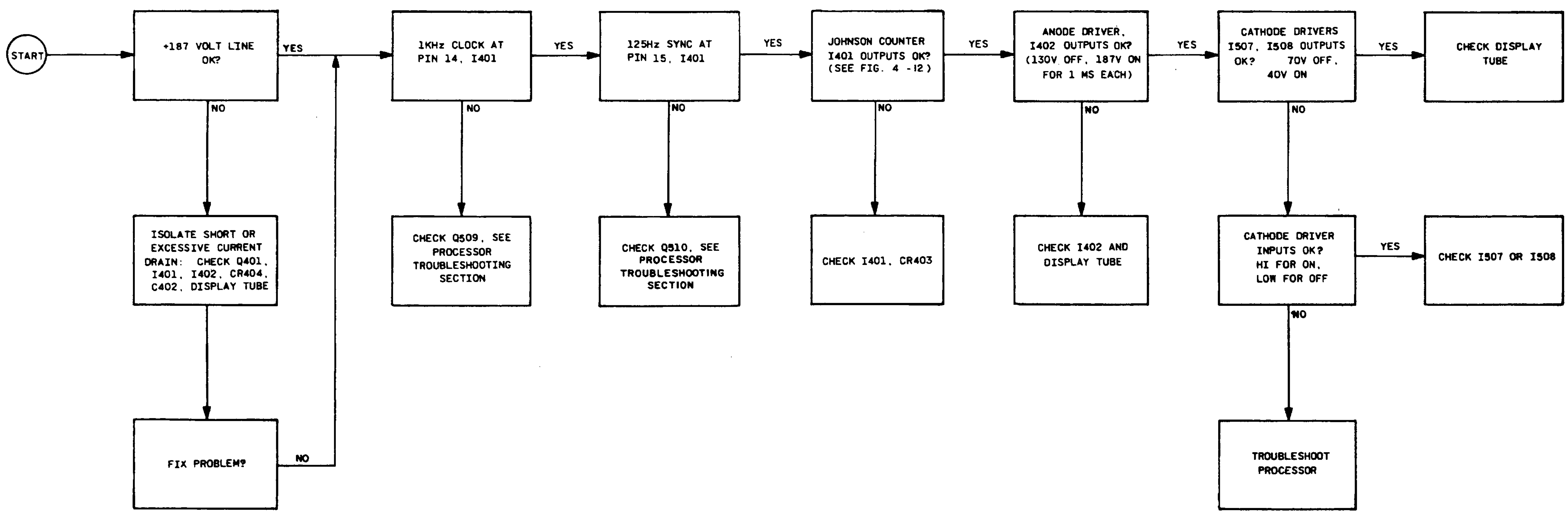


FIGURE 5–9 DISPLAY TROUBLESHOOTING FLOWCHART

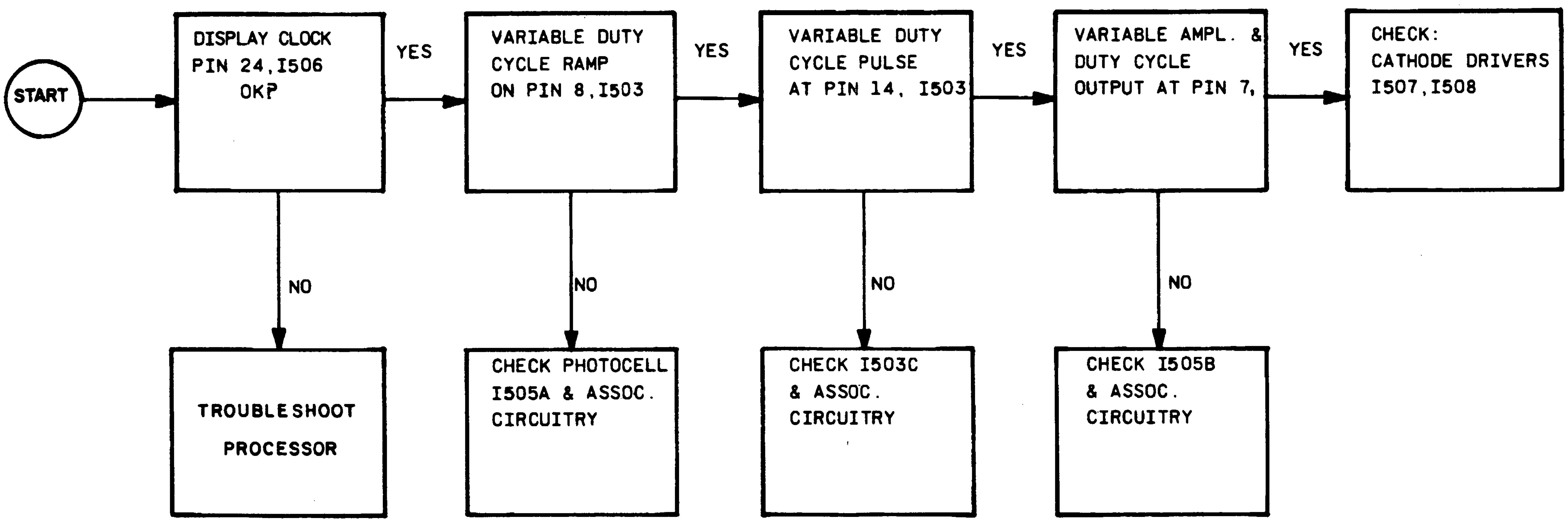


FIGURE 5–10 DISPLAY DIMMING TROUBLESHOOTING FLOWCHART

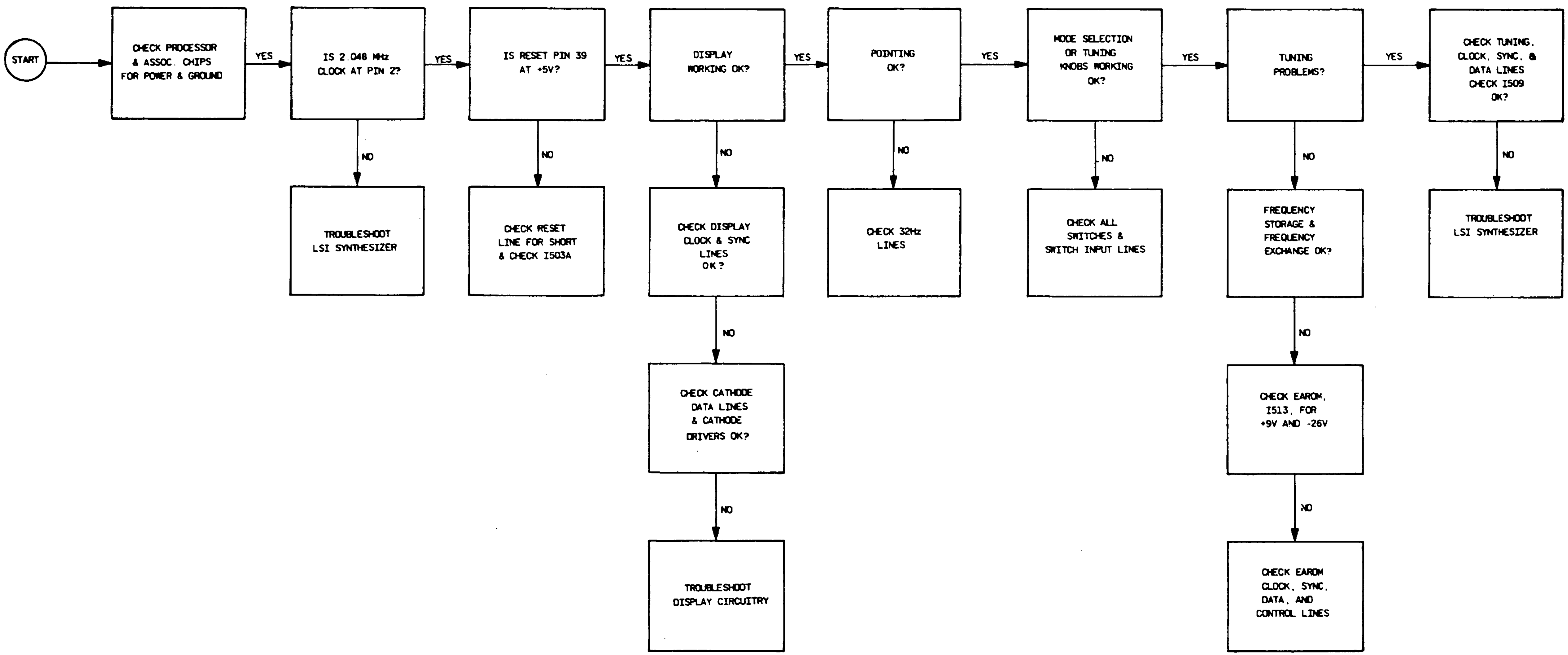


FIGURE 5-11 PROCESSOR TROUBLESHOOTING FLOWCHART

SECTION VI ILLUSTRATED PARTS LIST

SECTION VI

ILLUSTRATED PARTS LIST

6.1 INTRODUCTION

The Illustrated Parts List (IPL) is a complete list of assemblies and parts required for the unit. The IPL also provides for the proper identification of replacement parts. Individual Bills of Material (BOM) within this IPL are arranged in numerical sequence starting with the top assembly and continuing with the sub-assemblies. All mechanical parts will be separated from the electrical parts used on the sub-assembly. Each BOM is followed by the Assembly Drawing and Schematic Diagram for that assembly.

Parts identified in this IPL by AlliedSignal Part Number meet design specifications for this equipment and are the recommended replacement parts. Warranty information concerning AlliedSignal replacement parts is contained in Service Memo #1, P/N 600-08001-00XX.

This section describes the various items that appear on the Bills of Material. A sample BOM is included in this section as **Figure 6-1**.

A. BOM Number

The Bill of Material Number appears at the top of the BOM as a 12-digit number which is also the AlliedSignal Part Number for the assembly. The BOM Number is followed by the assembly description and the revision level of the BOM.

B. Symbol Column

This column contains the Reference Designators of the electrical components of the assembly. Mechanical parts are not assigned Reference Designators; however, they may be assigned item numbers to assist in locating the part on an assembly drawing. The Reference Designator consists of a letter abbreviation which indicates the type of component followed by the number assigned to that part (C101, Q101, etc). Common Reference Designator abbreviations are listed below.

B	Motor or Synchro	Q	Transistor
C	Capacitor	P	Plug
CJ	Circuit Jumper	R	Resistor
CR	Diode	RT	Thermistor
DS	Lamp	S	Switch
F	Fuse	T	Transformer
FL	Filter	TP	Test Point
I	Integrated Circuit	U	Resistor/Capacitor Network/Integrated Circuit
J	Jack	V	Photocell/Vacuum Tube
L	Inductor	WG	Waveguide
M	Meter	Y	Crystal

C. Part Number Column

This column contains the AlliedSignal Part Number for each part. Special purpose 999-09999-00XX series part numbers may appear in the BOM and are described below.

(1) CR401 999-09999-0096 RESERVED

The Reference Designator CR401 has been reserved for future use; the assembly does not currently include a CR401.

(2) CR401 999-09999-0097 SEE NEXT ASSEMBLY

CR401 is a part of the electrical circuit but due to assembly or testing requirements is actually part of a different assembly.

(3) CR401 999-09999-0098 NOT USED

The Reference Designator CR401 is available for future assignment. The assembly does not currently include a CR401.

(4) CR401 999-09999-0099 DO NOT USE

The Reference Designator CR401 has been previously used for this assembly and later deleted. It may not be reassigned on this assembly.

(5) I401 999-09999-0090 REF SFTWARE SET

I401 is a programmed memory device. Refer to Section H, Software Documentation in this introduction for a description of the software documentation system being used at the time of publication of this manual.

D. Description Column

This column contains the description of each part in the assembly. Common abbreviations which may appear in this column are listed below.

AL	Aluminum	MY	Mylar
ASSY	Assembly	PC	Polycarbonate
BIFLR	Bifilar	PF	Precision Film
BOM	Bill of Material	PP	Paper
CAP	Capacitor	PS	Polystrene
CC	Carbon Composite	QW	Quarter Watt
CF	Carbon Film	RES	Resistor
CH	Choke	S	Silicon
CR	Ceramic	SCR	Screw
CRT	Cathode Ray Tube	SM	Silver Mica
DC	Disc Ceramic	STDF	Standoff
DIO	Diode	SW	Switch
EL	Electrolytic	TERM	Terminal
EW	Eighth Watt	TN	Tantalum
FC	Fixed Composition	TST PT	Test Point
FERR	Ferrite	TW	Tenth Watt
FLTR	Filter	U	Integrated Circuit
FT	Feedthru	VA	Variable
HV	High Voltage	WW	Wire Wound
HVXFMR	High Voltage XFMR	XFMR	Transformer
HW	Half Watt	XSTR	Transistor Ceramic
MC	Monolithic	XTAL	Crystal

E. Assembly (A) Column

An "A" in this column indicates that the part indicated is an assembly. If the P/N and description reads "200-0XXXX-0099 COMMON BOM" or "200-XXXX-99 COMMON BOM" the parts for that assembly are included in the same BOM. The parts breakdown for an assembly with any other P/N will be found in the BOM with the same number.

F. Unit of Measure (UM) Column

This column indicates the Unit of Measure for each part. Common abbreviations found in this column are listed below.

EA	Each	RF	For Reference Only
FT	Foot	IN	Inch
AR	As Required		

G. Quantity and Flavor Columns

Individual flavors of an assembly are identified by the last four digits of the P/N. Part quantities for each flavor will be indicated under headings numbered 0000 through 9900 as required. The parts indicated in the 9900 Column are common to all other flavors of the assembly and are considered the Common Bill of Material for the assembly.

H. Software Documentation

The documentation of software involves the use of several unique types of part numbers. The following subsections list these part numbers with their description. In some cases, some specific versions of hardware must be used with specific versions of software. To determine the correct P/N for ordering the programmed device, you will need to know the part number of and the software revision level of the unit.

The last two digits of all software related P/N's, designated in the following text as -RN, indicate the revision number or level of the related software. This number is incremented with each revision of software. For example, -01 is revision 0, -02 is revision 1, and so on. When ordering specific integrated circuits or devices, the applicable 122-XXXXX-XXRN P/N is used. When ordering a circuit board which contains software, the applicable 205-XXXXX-XXRN P/N is used. Applicable assembly drawings and schematic diagrams will then follow in order.

(1) General Information

The part number of the unit, typically the 065-, 066- or 071-top assembly part number, contains a 206- item in its bill of materials. This 206- item is the configuration control mechanism for programmable electronic devices of the unit. Two different means exist to label the hardware/software configuration of the unit depending on the the part number of the unit:

(a) When the part number of the unit is a 9-digit part as represented on the TSO label, the last 2 digits of the 206-item are the digits of the Software Identification (SW ID) tag that appears on the unit.

(b) When the part number of the unit is a 12-digit part as represented on the TSO label, the last 4 digits of the 206- item are the digits of the Software Modification (SW MOD) tag that appears on the unit. In the example shown in figure 6-1, sheet 1 the 206- item is flagged with an "A" in the right hand margin.

(2) Definition of a Hardware/Software System

The 206- item represents the collection of all boards in the unit which contain electronic programmable devices (software). The hardware/software system (206-) bill of materials contains two categories of items:

(a) The part number of the unit label,i.e. the SOFT ID or SOFT MOD tag.

1) In the case of the 9-digit TSOed unit the unit label part number 057-03284-00XX where XX is the last two digits of the 206- number. The software identification tag is illustrated below.

KRC
00
SW ID

2) In the case of the 12-digit TSOed unit the unit label part number is 057-05287-YYYY where YYYY is the last four digits of the 206- number. This number is also referred to as the software mod level of the unit. The software mod tag is illustrated below.

SW MOD
01/01

(b) The 205- hardware/software board assemblies constitute all the hardware/software boards which this unit contains. In the example, the item marked "B" is the 205- hardware/software board used in the rest of the example.

(3) Definition of a Hardware/Software Board

The hardware/software board (205-) bill of materials contains four categories of items:

(a) The part numbers of the board label:

1) For 12-digit 205-0XXXX-00YY board labels, the first 10 digits are contained on a label part number of 057-05252-XXXX and the last two digits are specified by 057-05335-00YY.

2) For 9-digit 205-WWWW-ZZ board labels, the first 7 digits are contained on a label part number of 057-050WW-00WW and the last two digits are specified by 057-05252-00ZZ.

The 205-0XXXX-00YY and the 057-05252-00YY P/N is incremented whenever the revision number of any one or more of the 125-0XXXX-XXRN P/N's is incremented. This means that the -RN part of the P/N's for the 057-05252-XXRN and the 205-0XXXX-XXRN will be the same. A circuit board identification tag is illustrated below.

205-06616-	0000

(b) The software programmable device set assemblies (125-):

Each 125- programmable device set constitutes all the software for a unique microprocessor on the hardware board. The group of 125- programmable device sets constitutes all of the software for all of the microprocessors.

1) 125-0XXXX-XXRN AlliedSignal Part Numbers

The 125-0XXXX-XXRN P/N is a BOM which lists all the 122-0XXXX-XXRN programmed devices in a software set for a given circuit board. There may be only one 122-0XXXX-XXRN P/N listed or there may be several. Whenever the revision number (RN) of any one or more of the 122-0XXX-XXRN programmed devices is incremented in a new software release, the -XXRN part of the 125-0XXXX-RN P/N is also incremented. This 125-0XXXX-XXRN BOM also indentifies the "U" or "I" circuit designators used to identify the programmed devices on assembly drawings and schematic diagrams.

2) The 122-0XXXX-XXRN P/N is used to identify an individual integrated circuit or other device containing software.

(c) The non-software programmable device set assemblies (126-) which fulfill software requirements.

(d) The specification of the hardware board (200-).

In the example, the items marked "C" in the right margin are all the programmable device assemblies which fulfill the software requirements.

(4) Definition of a Hardware Board

The hardware board (200-) bill of materials contains two categories of items that relate to programmable devices:

(a) The non-software programmable device sets (126s) that fulfill hardware requirements. (Items D1 thru D4 in the example).

(b) The references to all of the programmable devices (122-) on the board. These references resolve device location on the board in that they use the SYMBOL field of the bill of materials to specify component location. These 122-numbers are of the form 122-3XXXX-9999 or 122-0YYYY-9999.

The 122- numbers of the form 122-3XXXX-9999 are used for non-software programmable devices (126-) that fulfill hardware requirements and therefore these programmable device sets appear on the hardware board (200-) bill of materials. (Items D5 thru D10 in the example).

The 122- numbers of the form 122-0YYYY-9999 are used for both software programmable devices (125-) (items D12 thru D15 in the example) and non-software programmable devices (126-) (item D11 inthe example) that fulfill software requirements.

These programmable device sets appear on the hardware/software board (205-) bill of materials.

The exact programmable device (the resolution of the -9999 in the above items) is specified by the respective software programmable device set (125-) or the non-software programmable device set (126-) bill of materials.

Using the SYMBOL field as specified above would discourage the use of the SYMBOL field for this purpose in the programmable device sets (125- and 126-) bill of materials. This would then permit the specification of the same programmable device sets in different boards, hence different component designators.

In the example, **Figure 6-1**:

- the items flagged D1 thru D4 in the right margin are non-software programmable device sets,

- the items flagged D5 thru D10 in the right margin are non-software programmable device designators that fulfill hardware requirements,

- the item flagged D11 in the right margin is a non-software programmable device designator that fulfills software requirements,

- the items flagged D12 thru D15 in the right margin are software programmable device designators that fulfill software requirements,

Figure 6-1, while closely related to a specific product, does not represent an exact configuration in use by that product. This example has been modified to clarify certain points.

Assy: 066-04020-0203 SG464 HSI W/O WX

Symbol	Part Number	Rev	Description	UM	Quantity	BxItm	
	016-01008-0004	3	GLYPTAL 7526 BL	AR	1.00		
	016-01131-0000	1	CNTCT CMT BND 1055	AR	1.00		
	047-02579-0002	2	HANDLE ASSEMBLY	EA	1.00		
	047-09392-0001	0	SPACER RT W/FIN	EA	1.00		
	057-02203-0002	3	FLAVOR STCKR	EA	1.00		
	057-02203-0003	3	FLAVOR STCKR	EA	1.00		
	057-05286-0000	0	SERIAL TAG SG 464	EA	1.00		
	075-05082-0002	0	GUIDE PLATE TOP	EA	1.00		
	090-00277-0000	1	HOLD DOWN BRACKET	EA	1.00		
	155-02536-0001	1	CABLE ASSY	EA	1.00		
	200-07703-0000	2	DPX CONN BD ASSY	EA	1.00		
	200-07704-0000	8	LV PS BD ASSY	EA	1.00		
	206-00118-0301	0	EFS40/50 HSI SET	EA	1.00		<--- A

Assy: 206-00118-0301 EFS40/50 HSI SET

Symbol	Part Number	Rev	Description	UM	Quantity	BxItm	
	057-05287-0301	0	SW MOD TAG	EA	1.00		
	205-00564-0002	0	EFIS 40/50 I/O PBS	EA	1.00		
	205-00565-0004	0	E40/50 HSI P/D PBS	EA	1.00		<--- B

Assy: 205-00565-0004 E40/50 HSI P/D PBS

Symbol	Part Number	Rev	Description	UM	Quantity	BxItm	
	057-02241-0016	1	IDENT LABEL	EA	1.00		
	057-05252-0565	1	IDT 205-00565-0000	EA	1.00		
	125-00602-0004	0	EFIS 40/50 NAV SDS	EA	1.00		<--- C1
	125-00603-0002	0	EFIS40/50 DSPL SDS	EA	1.00		<--- C2
	126-00019-0000	1	EFS40/50 CLIPPER	EA	1.00		<--- C3
	200-07706-0000	1	PRCSR/DSPL BD ASSY	EA	1.00		

FIGURE 6-1 TYPICAL BILL OF MATERIAL
(Sheet 1 of 4)

Assy: 200-07706-0000 PRCSR/DSPL BD ASSY

Symbol	Part Number	Rev	Description	UM	Quantity	BxItm
	009-07706-0000	0	PC BD PRCSR/DSPL	EA	1.00	
	.					
	.					
	.					
	150-00004-0010	3	TUBING TFLN 22AWG	IN	2.00	
	200-04969-0000	0	EXT BD PRCSR/ADI A	RF	0.00	
	126-00005-0000	1	EFS40/50 INT LOGIC	EA	1.00	<--- D1
	126-00006-0000	1	EFS40/50 VIDEO MUX	EA	1.00	<--- D2
	126-00017-0000	1	EFS40/50 SM SET	EA	1.00	<--- D3
	126-00018-0000	1	EFS40/50 SINE SET	EA	1.00	<--- D4
C 5001	111-02104-0042	26	CAP MC100KPF50V20%	EA	1.00	
	.					
	.					
	.					
I 5005	122-30001-9999	0	EFS40/50 VIDEO MUX	RF	0.00	<--- D5
I 5008	122-30002-9999	0	EFS40/50 INT LOGIC	RF	0.00	<--- D6
	.					
	.					
	.					
I 5036	122-30003-9999	0	EFS40/50 SM HIGH	RF	0.00	<--- D7
I 5037	122-30004-9999	0	EFS40/50 SM LOW	RF	0.00	<--- D8
I 5038	122-30005-9999	0	EFS40/50 SINE HIGH	RF	0.00	<--- D9
I 5039	122-30006-9999	0	EFS40/50 SINE LOW	RF	0.00	<--- D10
	.					
	.					
	.					
I 5075	122-00958-9999	0	EFS40/50 CLIPPER	RF	0.00	<--- D11
	.					
	.					
	.					
I 5138	122-00918-9999	0	EFS40/50 HSI NAV-E	RF	0.00	<--- D12
I 5139	122-00919-9999	0	EFS40/50 HSI NAV-O	RF	0.00	<--- D13
	.					
	.					
	.					
I 5158	122-00920-9999	0	EFS40/50 HSI DSP-E	RF	0.00	<--- D14
I 5159	122-00921-9999	0	EFS40/50 HSI DSP-0	RF	0.00	<--- D15
	.					
	.					
	.					

Assy: 126-00005-0000 EFS40/50 INT LOGIC

Symbol	Part Number	Rev	Description	UM	Quantity	BxItm
	122-30002-0000	0	EFS40/50 INT LOGIC	EA	1.00	

Assy: 122-30002-0000 EFS40/50 INT LOGIC

Symbol	Part Number	Rev	Description	UM	Quantity	BxItm
	120-02376-0000	1	EPLD EP320 (OTP)	EA	1.00	

FIGURE 6-1 TYPICAL BILL OF MATERIAL
(Sheet 2 of 4)

Assy: 125-00602-0004 EFIS 40/50 NAV SDS

Symbol	Part Number	Rev	Description	UM	Quantity	BxItm
	122-00918-0004	0	EFS40/50 HSI NAV-E	EA	1.00	
	122-00919-0004	0	EFS40/50 HSI NAV-O	EA	1.00	

Assy: 125-00603-0002 EFIS40/50 DSPL SDS

Symbol	Part Number	Rev	Description	UM	Quantity	BxItm
	122-00920-0002	0	EFS40/50 HSI DSP-E	EA	1.00	
	122-00921-0002	0	EFS40/50 HSI DSP-0	EA	1.00	

FIGURE 6-1 TYPICAL BILL OF MATERIAL
(Sheet 3 of 4)

BOM NUMBER — ASSEMBLY VERSION — PROGRAMMABLE DEVICE SET — UNIT OF MEASURE — QUANTITY — REFERENCE DESIGNATOR — PART NUMBER — DESCRIPTION

200-08366-0000 MST67 IOP/DLP R: 2 MST0067A
200-08366-0000 MST67 IOP/DLP R: 2 MST0067A

SYMBOL	PART NUMBER	DESCRIPTION	A	UM	0000	9900
	009-08366-0000	PC BD IOP/DLP	A	EA	1.00	1.00
	016-01040-0000	COATING TYPE AR		AR	1.00	1.00
	033-00114-0021	SOCKET IC DIP 28C	A	EA	3.00	3.00
	047-09680-0001	KEYING BRACKET	A	EA	3.00	3.00
	090-00087-0000	CLIP CRYSTAL		EA	1.00	1.00
	092-05003-0015	EYELET .049		EA	2.00	2.00
	126-00030-0000	MST67A ASIC SFTWR	A	EA	1.00	1.00
C 9001	106-04104-0047	CH 100KX7R/50V		EA	1.00	1.00
C 9002	106-04104-0047	CH 100KX7R/50V		EA	1.00	1.00
C 9003	106-04104-0047	CH 100KX7R/50V		EA	1.00	1.00
CR 9001	007-06180-0000	DIO SW MMBD6050		EA	1.00	1.00
CR 9002	007-08092-0000	QUAD SO DIODE		EA	1.00	1.00
CR 9003	007-08092-0000	QUAD SO DIODE		EA	1.00	1.00
DS 9001	007-06408-0000	COM CATH 7 SEG LED		EA	1.00	1.00
J 9002	030-02174-0000	PIN CONT		EA	50.00	1.00
P 9003	155-02688-0003	RIBBON CABLE ASSY	A	EA	1.00	1.00
Q 9003	007-00065-0001	XSTR 2N3906 (SOT)		EA	1.00	1.00
Q 9006	007-00383-0004	SOT-23 2N2222A XST		EA	1.00	1.00
Q 9011	007-00530-0000	XSTR NPN MMBT3903	A	EA	1.00	1.00
R 9001	130-05104-0023	RES CH 100K EW 5%		EA	1.00	1.00
R 9002	015-00207-0020	OCTAL SO RESISTOR		EA	1.00	1.00
R 9003	130-05472-0023	RES CHIP 4.7KEW5%		EA	1.00	1.00
R 9004	130-05471-0023	RES CHIP 470EW5%		EA	1.00	1.00
R 9005	130-05104-0023	RES CH 100K EW 5%		EA	1.00	1.00
R 9006	130-05104-0023	RES CH 100K EW 5%		EA	1.00	1.00
R 9007	130-05000-0025	RES CHIP 0 EW CJ		EA	1.00	1.00
TP 9001	008-00096-0001	TERMINAL TEST PNT		EA	1.00	1.00
TP 9002	008-00096-0001	TERMINAL TEST PNT		EA	1.00	1.00
U 9001	120-02208-0004	UPRGSSR 10MHZ16B.T	A	EA	1.00	1.00
U 9002	120-06129-0009	6264-15 8K X 8 RAM		EA	1.00	1.00
U 9003	120-06129-0009	6264-15 8K X 8 RAM		EA	1.00	1.00
U 9004	122-01195-9999	*MST67 PRGMD ODD	A	RF	X.	
U 9005	122-01194-9999	*MST67 PRGMD EVEN	A	RF	X.	
U 9006	124-00574-0003	IC 74HCT574		EA	1.00	1.00
U 9007	123-00138-0003	74HC138 SO PKG		EA	1.00	1.00
Y 9001	044-00089-0019	XTAL 14.75MHZ		EA	1.00	1.00
Y 9002	044-00293-0000	20 MHZ OSC		EA	1.00	1.00

FIGURE 6-1 TYPICAL BILL OF MATERIAL
(Sheet 4 of 4)

KR 87 FINAL ASSY

6.2 066-01072-0000 Rev. 20 KR 87 ADF RECEIVER
066-01072-0001 Rev. 20 KR 87 ADF RECEIVER
066-01072-0002 Rev. 7 KR 87 ADF RECEIVER
066-01072-0003 Rev. 4 KR 87 ADF RECEIVER
066-01072-0004 Rev. 4 KR 87 ADF RECEIVER
066-01072-0005 Rev. 4 KR 87 ADF RECEIVER

SYMBOL	PART NUMBER	DESCRIPTION	[UM]	QUANTITY						
				-0000	-0001	-0002	-0003	-0004	-0005	-0099
	012-01127-0000	TAG COVER	[EA]							1
	016-01013-0000	VAC GREASE DC 976	[AR]							0
	016-01040-0000	COATING TYPE AR	[AR]							1
	016-01082-0000	DC RTV 3145	[AR]							0
	016-01131-0000	CNTCT CMT BND 1055	[AR]							0
	025-00003-0000	WIRE 22 BLK	[IN]							9.9
	025-00003-0002	WIRE 22 RED	[IN]							9.9
	025-00003-0003	WIRE 22 ORG	[IN]							4.2
	025-00003-0008	WIRE 22 GRY	[IN]							
	025-00003-0009	WIRE 22 WHT	[IN]							
	035-01361-0015	PROTECTIVE COVER	[EA]	1	1	1	1	1	1	
	037-00055-0000	G D DISPLAY	[EA]							1
	047-04852-0001	FRAME	[EA]							1
	047-04853-0001	TOP CVR	[EA]							1
	047-04854-0001	BTM CVR	[EA]							1
	047-04926-0001	SPREADER HD W/F	[EA]							1
	047-05193-0002	MTG RACK	[EA]	1	1	1	1	1	1	
	047-10052-0001	PROT BEZEL W/PLTNG	[EA]							
	057-01764-0010	TAG WARNING 2X	[EA]							
	057-02203-0000	FLAVOR STCKR	[EA]	1						
	057-02203-0001	FLAVOR STCKR	[EA]		1					
	057-02203-0002	FLAVOR STCKR	[EA]			1				
	057-02203-0003	FLAVOR STCKR	[EA]				1			
	057-02203-0004	FLAVOR STCKR	[EA]					1		
	057-02203-0005	FLAVOR STCKR	[EA]						1	

SYMBOL	PART NUMBER	DESCRIPTION	[UM]	QUANTITY						
				-0000	-0001	-0002	-0003	-0004	-0005	-0099
	057-02203-0006	FLAVOR STCKR	[EA]							
	057-02203-0007	FLAVOR STCKR	[EA]							
	057-02203-0014	FLAVOR STCKR	[EA]							
	057-02203-0015	FLAVOR STCKR	[EA]							
	057-02203-0017	FLAVOR STCKR	[EA]							
	057-02286-0000	DECAL RVCR BD	[EA]							1
	057-02287-0000	DECAL MAIN DSPLY	[EA]							1
	057-02311-0001	VOLTAGE TAG 28V	[EA]			1			1	
	057-03157-0000	DECAL DOT	[EA]							1
	057-03284-0000	UNIT SOFTWARE V00	[RF]							0
	057-05635-0000	LABEL	[EA]							
	057-05818-0001	DECAL KR 87 TSO	[EA]							
	057-05818-0002	DECAL KR 87 TSO GRY	[EA]							
	066-01072-0099	COMMON BOM	[EA]	1	1	1	1	1	1	
	073-00379-0002	HOLD DOWN 80	[EA]							1
	073-00402-0004	FRONT PANEL	[EA]	1	1	1	1	1	1	
	073-00402-0006	FRONT PNL GRY DEC	[EA]							
	073-00991-0004	KNOB W/ DECORATION	[EA]							
	073-00999-0004	BEZEL_ BLACK	[EA]							
	073-00999-0005	BEZEL_ GRAY	[EA]							
	076-01100-0001	SPACER W/F	[EA]							1
	076-02979-0002	SPOOL_ W / FINISH	[EA]							
	076-02981-0001	ADAPTER_ SHAFT	[EA]							
	088-00773-0001	KNOB	[EA]	1	1	1	1	1	1	
	088-00854-0001	LENS NON-GLARE	[EA]	1		1		1	1	
	088-00854-0003	LENS W/SS SHINY	[EA]		1		1			
	088-00856-0001	PUSH BUTTON ADF	[EA]	1	1	1	1	1	1	
	088-00856-0002	PUSH BUTTON BFO	[EA]	1	1	1	1	1	1	
	088-00856-0003	PUSH BUTTON FRQ	[EA]	1	1	1	1	1	1	
	088-00856-0004	PUSH BTN FLT/ET	[EA]	1	1	1	1	1	1	
	088-00856-0005	PUSH BTN SET/RST	[EA]	1	1	1	1	1	1	
	088-00856-0007	BUTTON FRQ/TRNSFER	[EA]							
	088-03172-0001	KNOB OUTER PAINTED	[EA]							
	088-03229-0008	KNOB INNER W/SHAFT	[EA]							
	088-03230-0011	PUSHBUTTON	[EA]							
	088-03230-0012	PUSHBUTTON	[EA]							
	088-03230-0013	PUSHBUTTON	[EA]							

SYMBOL	PART NUMBER	DESCRIPTION	[UM]	QUANTITY -0000	-0001	-0002	-0003	-0004	-0005	-0099
	088-03230-0014	PUSHBUTTON	[EA]							
	088-03230-0015	PUSHBUTTON	[EA]							
	088-03232-0002	LENS W/ SILKSCREEN	[EA]							
	089-02076-0030	NUT FLAT 4-40	[EA]							4
	089-05436-0006	SCR FHP 4-40X3/8	[EA]							1
	089-06200-0003	SCR SET 2-56X3/32	[EA]	1		1		1	1	
	089-06293-0004	SCR PHP 3-48X1/4	[EA]							14
	089-06293-0005	SCR PHP 3-48X5/16	[EA]							1
	089-06298-0003	SCR FHP 2-48X3/16	[EA]							13
	089-06303-0003	SCR FHP 3-48X3/16	[EA]	4	4	4	4	4	4	
	089-06455-0003	SCR FHP 3-48X3/16	[EA]							
	089-06561-0000	SCR SHC 6-32X1.140	[EA]							1
	089-08003-0034	WSHR SPLT LK #4	[EA]							4
	089-08065-0030	WSHR FLT STD .128	[EA]							
	089-08069-0030	WSHR FLT STD #4	[EA]							
	089-08077-0030	WASHER	[EA]							1
	089-08205-0000	WSHR FELT .156	[EA]	1	1	1	1	1	1	
	089-08231-0000	WASHER FLAT	[EA]							1
	090-00265-0000	PIN GRO .046X.250	[EA]							1
	090-00499-0003	RING COMP .412	[EA]							
	150-00020-0010	TUBING SHRINK 18G	[IN]							1.2
	187-01135-0001	CUSHION	[EA]							4
	195-00123-0000	S/N TAG KR87	[EA]							1
	200-06184-0000	RECEIVER BOARD	[EA]							1
	200-06185-0000	MAIN BOARD	[EA]	1	1					
	200-06185-0001	KR87 MAIN BD	[EA]			1				
	200-06185-0002	MAIN BD	[EA]				1			
	200-06185-0003	KR87 MAIN BOARD	[EA]					1		
	200-06185-0004	KR87 MAIN BOARD	[EA]						1	
	200-06185-0006	MAIN 5VLTGCNI5000	[EA]							
	200-06185-0007	KR87 MAIN BD SVLTG	[EA]							
	200-06186-0000	DISPLAY BOARD	[EA]	1	1	1		1	1	
	200-06186-0001	DISPLAY BD	[EA]				1			
	200-06186-0002	DISPLAY GOLD KNOBS	[EA]							
	200-06186-0010	DISPLAY BOARD_ LIGHTED	[EA]							
	200-06186-0017	DISPLAY BD 5VLTG	[EA]							
	200-06187-0001	POWER SUPPLY	[EA]							1

066-01072-0006 Rev. 5 KR 87 ADF RECEIVER
066-01072-0007 Rev. 5 KR 87 ADF RECEIVER
066-01072-0014 Rev. 1 KR 87 ADF RECEIVER
066-01072-0015 Rev. 1 KR 87 ADF RECEIVER
066-01072-0017 Rev. 1 KR 87 ADF RECEIVER
066-01072-0099 Rev. 15 KR 87 ADF RECEIVER COMMON BOM

SYMBOL	PART NUMBER	DESCRIPTION	[UM]	QUANTITY					
				-0006	-0007	-0014	-0015	-0017	-0099
	012-01127-0000	TAG COVER	[EA]						1
	016-01013-0000	VAC GREASE DC 976	[AR]						0
	016-01040-0000	COATING TYPE AR	[AR]						1
	016-01082-0000	DC RTV 3145	[AR]						0
	016-01131-0000	CNTCT CMT BND 1055	[AR]						0
	025-00003-0000	WIRE 22 BLK	[IN]						9.9
	025-00003-0002	WIRE 22 RED	[IN]						9.9
	025-00003-0003	WIRE 22 ORG	[IN]						4.2
	025-00003-0008	WIRE 22 GRY	[IN]			12	12	12	
	025-00003-0009	WIRE 22 WHT	[IN]			12	12	12	
	035-01361-0015	PROTECTIVE COVER	[EA]		1				
	037-00055-0000	G D DISPLAY	[EA]						1
	047-04852-0001	FRAME	[EA]						1
	047-04853-0001	TOP CVR	[EA]						1
	047-04854-0001	BTM CVR	[EA]						1
	047-04926-0001	SPREADER HD W/F	[EA]						1
	047-05193-0002	MTG RACK	[EA]		1	1	1	1	
	047-10052-0001	PROT BEZEL W/PLTNG	[EA]	1					
	057-01764-0010	TAG WARNING 2X	[EA]	2	2			2	
	057-02203-0000	FLAVOR STCKR	[EA]						
	057-02203-0001	FLAVOR STCKR	[EA]						
	057-02203-0002	FLAVOR STCKR	[EA]						
	057-02203-0003	FLAVOR STCKR	[EA]						
	057-02203-0004	FLAVOR STCKR	[EA]						
	057-02203-0005	FLAVOR STCKR	[EA]						
	057-02203-0006	FLAVOR STCKR	[EA]	1					
	057-02203-0007	FLAVOR STCKR	[EA]		1				
	057-02203-0014	FLAVOR STCKR	[EA]			1			
	057-02203-0015	FLAVOR STCKR	[EA]				1		
	057-02203-0017	FLAVOR STCKR	[EA]					1	
	057-02286-0000	DECAL RVCR BD	[EA]						1

SYMBOL	PART NUMBER	DESCRIPTION	[UM]	QUANTITY -0006	-0007	-0014	-0015	-0017	-0099
	057-02287-0000	DECAL MAIN DSPLY	[EA]						1
	057-02311-0001	VOLTAGE TAG 28V	[EA]				1		
	057-03157-0000	DECAL DOT	[EA]						1
	057-03284-0000	UNIT SOFTWARE V00	[RF]						0
	057-05635-0000	LABEL	[EA]	1					
	057-05818-0001	DECAL KR 87 TSO	[EA]			1	1		
	057-05818-0002	DECAL KR 87 TSO GRY	[EA]					1	
	066-01072-0099	COMMON BOM	[EA]	1	1	1	1	1	
	073-00379-0002	HOLD DOWN 80	[EA]						1
	073-00402-0004	FRONT PANEL	[EA]						
	073-00402-0006	FRONT PNL GRY DEC	[EA]		1				
	073-00991-0004	KNOB W/ DECORATION	[EA]			1	1	1	
	073-00999-0004	BEZEL_ BLACK	[EA]			1	1		
	073-00999-0005	BEZEL_ GRAY	[EA]					1	
	076-01100-0001	SPACER W/F	[EA]						1
	076-02979-0002	SPOOL_ W / FINISH	[EA]			1	1	1	
	076-02981-0001	ADAPTER_ SHAFT	[EA]			1	1	1	
	088-00773-0001	KNOB	[EA]		1				
	088-00854-0001	LENS NON-GLARE	[EA]		1				
	088-00854-0003	LENS W/SS SHINY	[EA]						
	088-00856-0001	PUSH BUTTON ADF	[EA]	1	1				
	088-00856-0002	PUSH BUTTON BFO	[EA]	1	1				
	088-00856-0003	PUSH BUTTON FRQ	[EA]		1				
	088-00856-0004	PUSH BTN FLT/ET	[EA]	1	1				
	088-00856-0005	PUSH BTN SET/RST	[EA]	1	1				
	088-00856-0007	BUTTON FRQ/TRNSFER	[EA]	1					
	088-03172-0001	KNOB OUTER PAINTED	[EA]			1	1	1	
	088-03229-0008	KNOB INNER W/SHAFT	[EA]			1	1	1	
	088-03230-0011	PUSHBUTTON	[EA]			1	1	1	
	088-03230-0012	PUSHBUTTON	[EA]			1	1	1	
	088-03230-0013	PUSHBUTTON	[EA]			1	1	1	
	088-03230-0014	PUSHBUTTON	[EA]			1	1	1	
	088-03230-0015	PUSHBUTTON	[EA]			1	1	1	
	088-03232-0002	LENS W/ SILKSCREEN	[EA]			1	1	1	
	089-02076-0030	NUT FLAT 4-40	[EA]						4
	089-05436-0006	SCR FHP 4-40X3/8	[EA]						1
	089-06200-0003	SCR SET 2-56X3/32	[EA]		1	3	3	3	

SYMBOL	PART NUMBER	DESCRIPTION	[UM]	QUANTITY -0006	-0007	-0014	-0015	-0017	-0099
	089-06293-0004	SCR PHP 3-48X1/4	[EA]						14
	089-06293-0005	SCR PHP 3-48X5/16	[EA]						1
	089-06298-0003	SCR FHP 2-48X3/16	[EA]						13
	089-06303-0003	SCR FHP 3-48X3/16	[EA]	4		4	4		
	089-06455-0003	SCR FHP 3-48X3/16	[EA]		4			4	
	089-06561-0000	SCR SHC 6-32X1.140	[EA]						1
	089-08003-0034	WSHR SPLT LK #4	[EA]						4
	089-08065-0030	WSHR FLT STD .128	[EA]			1	1	1	
	089-08069-0030	WSHR FLT STD #4	[EA]			1	1	1	
	089-08077-0030	WASHER	[EA]						1
	089-08205-0000	WSHR FELT .156	[EA]		1	1	1	1	
	089-08231-0000	WASHER FLAT	[EA]						1
	090-00265-0000	PIN GRO .046X.250	[EA]						1
	090-00499-0003	RING COMP .412	[EA]			1	1	1	
	150-00020-0010	TUBING SHRINK 18G	[IN]						1.2
	187-01135-0001	CUSHION	[EA]						4
	195-00123-0000	S/N TAG KR87	[EA]						1
	200-06184-0000	RECEIVER BOARD	[EA]						1
	200-06185-0000	MAIN BOARD	[EA]						
	200-06185-0001	KR87 MAIN BD	[EA]						
	200-06185-0002	MAIN BD	[EA]						
	200-06185-0003	KR87 MAIN BOARD	[EA]			1			
	200-06185-0004	KR87 MAIN BOARD	[EA]				1		
	200-06185-0006	MAIN 5VLTGCNI5000	[EA]	1					
	200-06185-0007	KR87 MAIN BD 5VLTG	[EA]		1			1	
	200-06186-0000	DISPLAY BOARD	[EA]		1				
	200-06186-0001	DISPLAY BD	[EA]						
	200-06186-0002	DISPLAY GOLD KNOBS	[EA]	1					
	200-06186-0010	DISPLAY BOARD_ LIGHTED	[EA]			1	1		
	200-06186-0017	DISPLAY BD 5VLTG	[EA]					1	
	200-06187-0001	POWER SUPPLY	[EA]						1

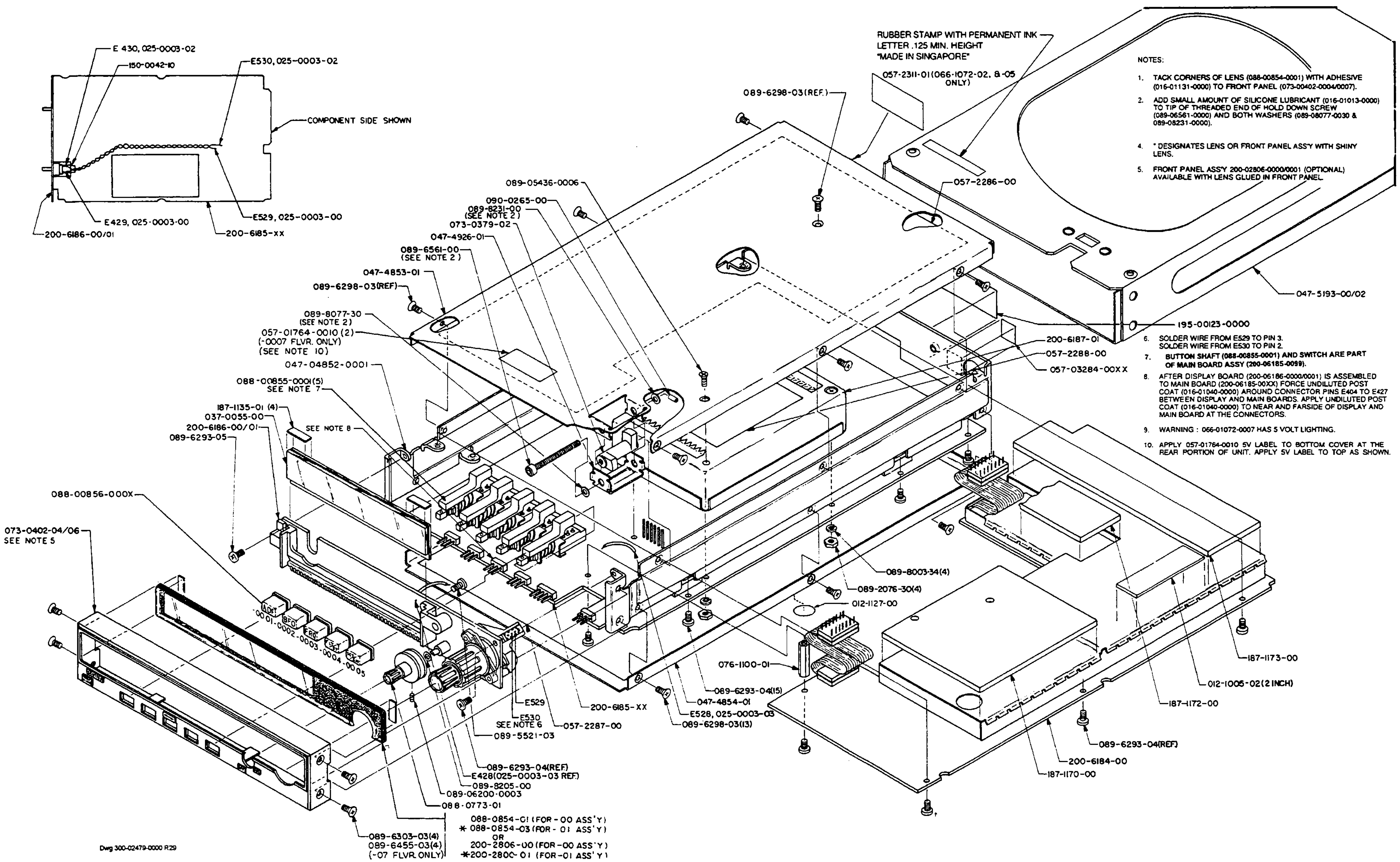


FIGURE 6-2 KR 87 FINAL ASSEMBLY
(Dwg. No. 300-02479-0000 R-29, For Use With 066-01072-0000 thru -0005 & -0007)

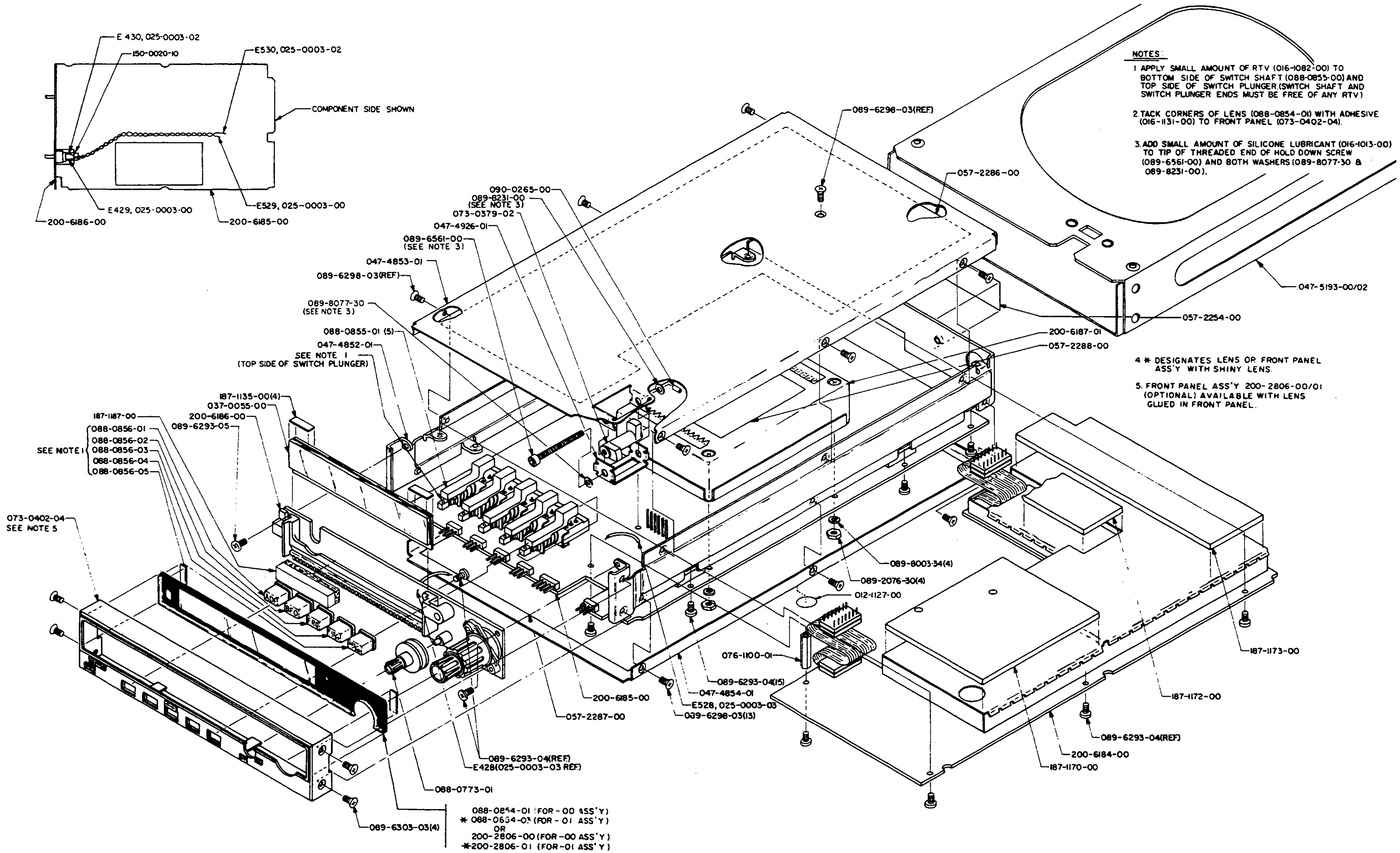


FIGURE 6-2A KR 87 FINAL ASSEMBLY
(Dwg. No. 300-02479-0000 R-7, For Use With 066-01072-0000 thru -0005 & -0007)

NOTES:

1. ADD SMALL AMOUNT OF SILICONE LUBRICANT (016-01013-0000) TO TIP OF THREADED END OF HOLD DOWN SCREW (089-06561-0000) AND BOTH WASHERS (089-08077-0030 & 089-08231-0000).
2. SOLDER WIRE FROM E529 TO PIN 3. SOLDER WIRE FROM E530 TO PIN 2.
3. BUTTON SHAFT (088-00855-0001), SHAFT EXTENSION (088-03025-0000) AND SWITCH ARE PART OF MAIN BOARD ASSY 200-06185-0006.
4. AFTER DISPLAY BOARD (200-06186-0000) IS ASSEMBLED TO MAIN BOARD (200-06185-00XX) FORCE UNDILUTED POST COAT (016-01040-0000) AROUND CONNECTOR PINS E404 TO E427 BETWEEN DISPLAY AND MAIN BOARDS. APPLY UNDILUTED POST COAT (016-01040-0000) TO NEAR AND FARSIDE OF DISPLAY AND MAIN BOARD AT THE CONNECTORS.
5. CAUTION 066-01072-0006 HAS 5 VOLT LIGHTING.
6. APPLY 057-01764-0010 5V LABEL TO BOTTOM COVER AT THE REAR PORTION OF UNIT. APPLY 5V LABEL TO TOP COVER AS SHOWN.
7. APPLY PROTECTIVE BEZEL LABEL APPROXIMATELY AS SHOWN.

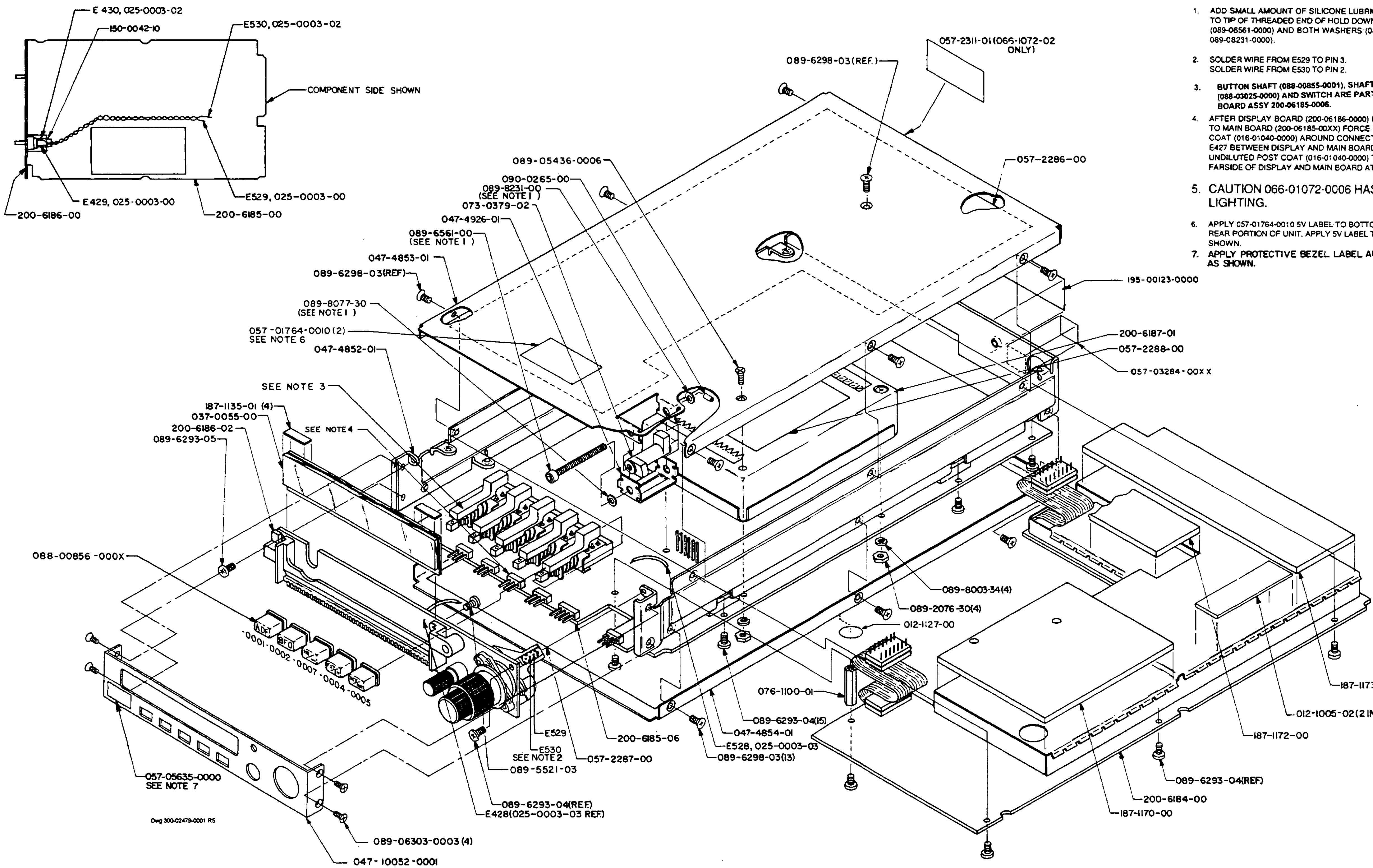


FIGURE 6–3 KR 87 FINAL ASSEMBLY
(Dwg. No. 300–02479–0001 R–5, For Use With 066–01072–0006 only)

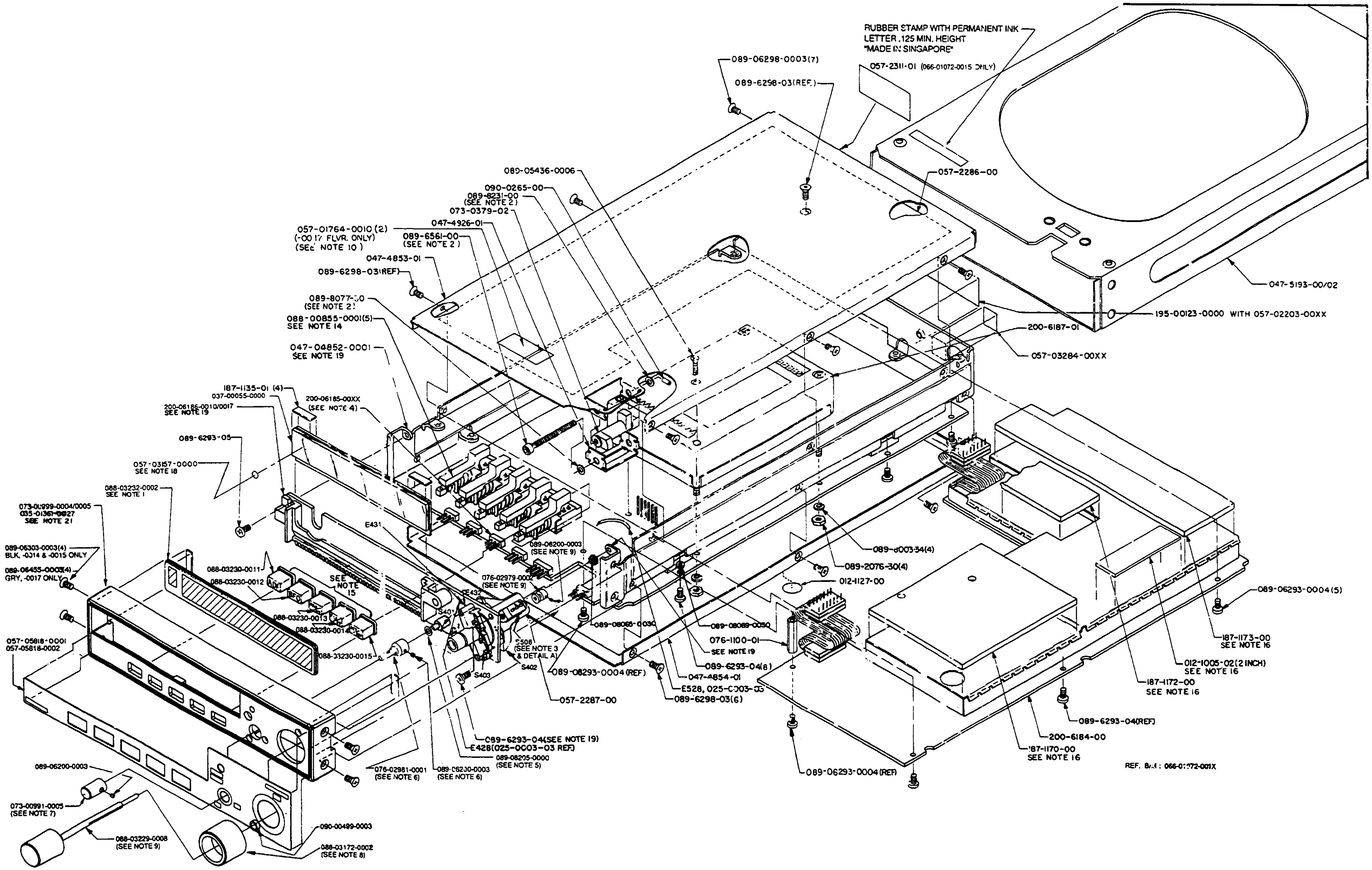
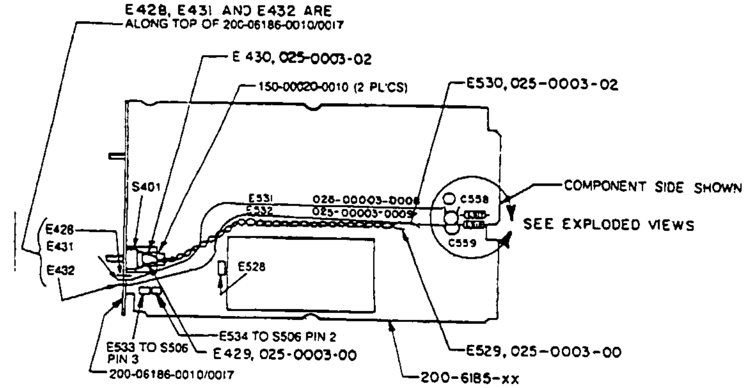


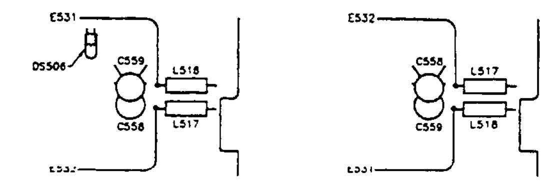
FIGURE 6-4 KR 87 FINAL ASSEMBLY
(Dwg. No. 300-02479-0002 R-6, Sheet 1 of 2, For Use With 066-01072-0014, -0015 & -0017)

NOTES:

1. TACK EACH CORNER OF LENS AND AT LEAST TWO PLACES IN MIDDLE ALONG TOP & BOTTOM OF LENS (088-03232-0002) WITH ADHESIVE (016-01131-0000) TO BEZEL (073-00999-0004/0005). NO ADHESIVE MAY BE VISIBLE ON LENS WHEN VIEWED FROM FRONT, AFTER ASSEMBLY.
2. ADD SMALL AMOUNT OF SILICONE LUBRICANT (016-01013-0000) TO TIP OF THREADED END OF HOLD DOWN SCREW (089-06561-0000) AND BOTH WASHERS (089-08077-0030 AND 089-08231-0000).
3. SOLID, GREEN WIRE (025-00018-0055) FROM E533 SOLDERS TO PIN 3 OF S506. SOLID, GREEN WIRE (025-00018-0055) FROM E534 SOLDERS TO PIN 2 OF S506.
4. MOUNT AND SOLDER DISPLAY BOARD (200-06186-0010/0017) TO PINS ON MAIN BOARD (200-06185-00XX), 27 PLACES, SO THAT GAP BETWEEN MAIN AND DISPLAY BOARD DOES NOT EXCEED .010". VERIFY THAT GAP BETWEEN MAIN AND DISPLAY BOARD IS EVEN, AT ALL PLACES. AFTER DISPLAY BOARD IS ASSEMBLED TO MAIN BOARD FORCE UNDILUTED POST COAT (016-01040-0000) AROUND CONNECTOR PINS E404 TO E427 BETWEEN DISPLAY AND MAIN BOARDS. APPLY UNDILUTED POST COAT (016-01040-0000) TO NEAR AND FAR SIDE OF DISPLAY AND MAIN BOARD AT THE CONNECTORS.
5. INSTALL FELT WASHER (089-08205-0000) OVER S401 SHAFT SO THAT IT SEATS AGAINST BUSHING (076-01091-0000). S401 AND BUSHING ARE PART OF 200-06186-0010/-0020.
6. LOCATE SHAFT ADAPTER (076-02981-0001) OVER S401 SHAFT SO THAT IT COMPRESSES FELT WASHER .005" TO .010". ORIENT SHAFT ADAPTER (076-02981-0000) ON S401 SHAFT SO THAT SET SCREW (089-06200-0003) SEATS ON FLAT AREA.
7. INSTALL KNOB (073-00991-0004) ON ADAPTER (076-02981-0001) USING SET SCREW (089-06200-0003) AFTER BEZEL HAS BEEN INSTALLED. SET SCREW SHALL LOCATE IN FLAT ON ADAPTER. VERIFY THAT WHITE KNOB MARKING ALIGNS WITH "OFF" NOMENCLATURE ON DECAL (057-05818-0001) WHEN S401 IS ROTATED TO EXTREME COUNTERCLOCKWISE POSITION.
8. OUTER KNOB (088-03172-0001) PRESSES ON TO S403 SHAFT, AFTER INSTALLATION OF COMPRESSION RING (090-00499-0003). REAR KNOB SURFACE IS TO BE .040" +/- .005" AWAY FROM DECAL FACE.
9. POSITION SPOOL (076-02979-0002) OVER SWITCH SLIDE. INSERT KNOB W/SHAFT (088-03229-0008) THROUGH OUTER KNOB (088-03172-0001), S403 AND S402. ALIGN SLOT IN 088-03229-0008 WITH KEY WAY IN S402. SECURE SPOOL (076-02979-0002) TO 088-03229-0008 BY LOCATING SET SCREW (089-06200-0003) IN FLAT PROVIDED.
10. WARNING: 066-01072-0017 HAS 5 VOLT LIGHTING. APPLY 057-01764-0010 5V LABEL TO BOTTOM COVER AT THE REAR PORTION OF UNIT. APPLY 5V LABEL TO TOP APPROXIMATELY AS SHOWN.
11. SOLDER 22GA BLK WIRE (025-00003-0000) FROM E529 TO E429 (ON S401). SOLDER 22 GA RED WIRE (025-00003-0002) FROM E530 TO E430 (ON S401). ROUTE WIRE APPROXIMATELY AS SHOWN ON DETAIL A. APPLY SHRINK SLEEVING (150-00020-0010) TO E429 AND E430. SOLDER JOINTS @ S401.
12. SOLDER 22 GA GRY WIRE (025-00003-0008) FROM INDICATED LEG OF L518 TO E431 (14V LIGHTING OR 5V LIGHTING). SOLDER 22 GA WHT WIRE (025-00003-0009) FROM INDICATED LEG OF L517 TO E432 (28V LIGHTING OR 5V GND.). ROUTE WIRES APPROXIMATELY AS SHOWN ON DETAIL A. NOTE THAT L517 AND L518 POSITIONS CAN BE REVERSED, DEPENDING ON 009-06185 VERSION. SEE DETAIL A EXPLODED VIEW FOR ILLUSTRATION.
13. SOLDER 22 GA ORANGE WIRE (025-00003-0003) FROM E528 TO E428.
14. PUSH BUTTON SHAFT 088-00855-0001 IS PART OF 200-06185-00XX. IF END OF 088-00855-0001 IS NOT OPAQUE, LIGHTLY SAND END OF EACH SHAFT WITH 240 GRIT SANDPAPER TO ACHIEVE OPAQUENESS. PROPERLY SUPPORT SHAFT DURING SANDING. REMOVE GRIT FROM SHAFTS AND UNIT AFTER SANDING.
15. ATTACH BUTTONS 088-03230-0011/0015 TO BUTTON SHAFTS 088-00855-0001 AS SHOWN USING RTV 016-01082-0000. REMOVE EXCESS RTV.
16. PART OF 200-06184-0000 RECEIVER BOARD. VERIFY PRESENCE BEFORE FASTENING RECEIVER BOARD INTO 066-01072-00XX.
17. 066-01072-0017 ONLY:
    . VERIFY BUTTON SHAFT COATING, 3 PL.
    . VERIFY PRESENCE OF BLUE BULB BOOTS ON DS501-506 AND DS401-406.
    . VERIFY PRESENCE OF CJ503-507 ON MAIN BD.
    . VERIFY PRESENCE OF CJ401-404 ON DISPLAY BD.
18. APPLY DECAL DOT (057-03157-0000) TO FRONT SIDE OF DISPLAY, COVERING FILL TUBE SPOT AS SHOWN IN DETAIL B. CAUTION: DOT MUST NOT OBSTRUCT DISPLAY NOMENCLATURE WITHIN 45° VIEWING ANGLE.
19. LOCATE TOP EDGE OF DISPLAY BOARD (200-06186-0010/0017) EVEN WITH TOP OF FRAME BRACKETS AT INITIAL UNIT ASSEMBLY. CHECK FOR EVENNESS OF LIGHTING HALO AROUND LARGE CONCENTRIC TUNING KNOB AND OFF/VOL KNOB (SEE DETAIL C). IF NECESSARY, SCREW (089-06293-0004) MAY BE LOOSENED AND DISPLAY BOARD REPOSITIONED SLIGHTLY LOWER OR HIGHER AT UPPER RIGHT CORNER AS NECESSARY TO CENTER HALOS WITH KNOBS. RETIGHTEN 089-06293-0004 AFTER REPOSITIONING DISPLAY BOARD.
20. LINE ON VOLUME CONTROL KNOB SHALL BE LOCATED AS SHOWN BY DETAIL C WITH VOLUME KNOB IN ITS OFF (MAXIMUM COUNTERCLOCKWISE) POSITION.

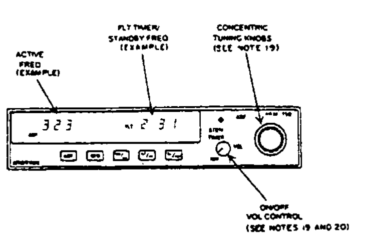


DETAIL A
WIRING INTERCONNECTS
(SEE NOTES 3, 11, 12 & 13)



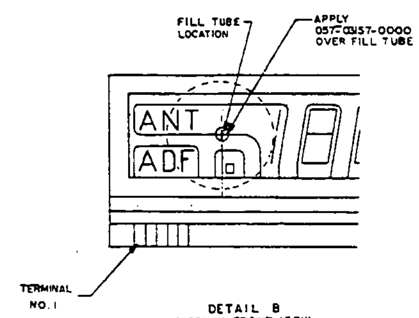
EXPLODED VIEW
009-06185-0000/0020

EXPLODED VIEW
009-06185-0030



DETAIL C
KR87 -001X FRONT VIEW

Dwg 300-02479-0002 R5 SH 2



DETAIL B
DISPLAY, FRONT VIEW
(SEE NOTE 18)

FIGURE 6-4 KR 87 FINAL ASSEMBLY
(Dwg. No. 300-02479-0002 R-6, Sheet 2 of 2, For Use With 066-01072-0014, -0015 & -0017)

RECEIVER BOARD

6.3 200-06184-0000 Rev. 70 KR 87 RECEIVER BOARD

SYMBOL	PART NUMBER	DESCRIPTION	[UM]	QUANTITY
				-0000
	009-06184-0000	PC BD RCVR	[EA]	1
	012-01005-0002	TAPE MYLAR .500 W	[IN]	2
	012-01038-0000	ADHESIVE DISC	[EA]	12
	012-01174-0000	INSULATOR	[EA]	2
	016-01007-0001	LOCTITE 84 C	[AR]	0
	016-01040-0000	COATING TYPE AR	[AR]	0
	016-01082-0000	DC RTV 3145	[AR]	0
	016-01122-0000	EPOXY DEVCON 14250	[AR]	0
	026-00003-0000	WIRE COP TIN 22G	[AR]	0
	047-05119-0001	CVR FENCE	[EA]	1
	047-05120-0001	CVR FENCE	[EA]	1
	047-05121-0001	FENCE	[EA]	1
	047-05359-0001	COVER VCO W/F	[EA]	1
	076-01142-0001	SPACER SWAGE W/F	[EA]	1
	089-02005-0037	NUT FLAT 2-56	[EA]	1
	089-05899-0004	SCR PHP 2-56X1/4	[EA]	1
	089-08012-0037	WSHR INTL LK #2	[EA]	1
	089-08023-0030	WSHR FLT STD #2	[EA]	1
	090-00169-0000	CAP SHD EPOXY XSTR	[EA]	1
	091-00188-0000	CLIP COMPONENT	[EA]	1
	150-00004-0010	TUBING TFLN 22AWG	[AR]	1
	187-01170-0000	CUSHION	[EA]	1
	187-01172-0000	CUSHION	[EA]	1
	187-01173-0000	CUSHION	[EA]	1
	200-08506-0002	PC BOARD	[EA]	1
	200-08506-0003	PC BOARD	[EA]	1
C 101	111-00001-0001	CAP CR .1UF 50V	[EA]	1
C 102	096-01082-0017	CAP TN 6.8UF 15V	[EA]	1
C 103	096-01082-0017	CAP TN 6.8UF 15V	[EA]	1
C 104	096-01082-0017	CAP TN 6.8UF 15V	[EA]	1
C 105	096-01082-0017	CAP TN 6.8UF 15V	[EA]	1
C 106	113-03151-0000	CAP DC 150PF 500V	[EA]	1
C 107	113-03151-0000	CAP DC 150PF 500V	[EA]	1
C 108	111-00001-0001	CAP CR .1UF 50V	[EA]	1
C 109	111-00001-0001	CAP CR .1UF 50V	[EA]	1
C 110	111-00001-0001	CAP CR .1UF 50V	[EA]	1
C 111	111-00001-0034	CAP CR 1500PF 50V	[EA]	1

SYMBOL	PART NUMBER	DESCRIPTION	[UM]	QUANTITY
				-0000
C 112	111-00001-0000	CAP CR .01UF 50V	[EA]	1
C 113	106-00049-0021	CAP CH .1uF50V10%	[EA]	1
C 114	104-00001-0044	CAP SM 56PF 100V	[EA]	1
C 115	109-00007-0000	CAP DC .01UF 25V	[EA]	1
C 116	104-00001-0013	CAP SM 150PF 100V	[EA]	1
C 117	113-05102-0000	CAP DC .001UF 500V	[EA]	1
C 118	096-01082-0005	CAP TN 10UF 20V	[EA]	1
C 119	111-00001-0001	CAP CR .1UF 50V	[EA]	1
C 120	109-00007-0003	CAP DC .05UF 25V	[EA]	1
C 121	104-00001-0004	CAP SM 470PF 100V	[EA]	1
C 122	111-00001-0000	CAP CR .01UF 50V	[EA]	1
C 123	113-03820-0000	CAP DC 82PF 500V	[EA]	1
C 124	096-01082-0005	CAP TN 10UF 20V	[EA]	1
C 125	111-00001-0000	CAP CR .01UF 50V	[EA]	1
C 126	114-05152-0000	CAP DC 1500PF 500V	[EA]	1
C 127	096-01082-0005	CAP TN 10UF 20V	[EA]	1
C 128	096-01082-0005	CAP TN 10UF 20V	[EA]	1
C 129	109-00009-0000	CAP DC 170PF 1KV	[EA]	1
C 130	104-00001-0022	CAP SM 330PF 100V	[EA]	1
C 131	113-03120-0000	CAP DC 12PF 500V	[EA]	1
C 132	104-00001-0021	CAP SM 390PF 100V	[EA]	1
C 133	109-00009-0000	CAP DC 170PF 1KV	[EA]	1
C 134	096-01082-0005	CAP TN 10UF 20V	[EA]	1
C 135	109-00007-0000	CAP DC .01UF 25V	[EA]	1
C 136	096-01082-0005	CAP TN 10UF 20V	[EA]	1
C 137	109-00009-0000	CAP DC 170PF 1KV	[EA]	1
C 138	104-00001-0021	CAP SM 390PF 100V	[EA]	1
C 139	113-03120-0000	CAP DC 12PF 500V	[EA]	1
C 140	096-01082-0017	CAP TN 6.8UF 15V	[EA]	1
C 141	109-00009-0000	CAP DC 170PF 1KV	[EA]	1
C 142	104-00001-0021	CAP SM 390PF 100V	[EA]	1
C 143	114-07104-0000	CAP DC .1UF 16V	[EA]	1
C 144	096-01082-0042	CAP TN 33UF 15V	[EA]	1
C 145	113-05181-0000	CAP DC 180PF 500V	[EA]	1
C 146	113-05390-0000	CAP DC 39PF 500V	[EA]	1
C 147	111-00001-0001	CAP CR .1UF 50V	[EA]	1
C 148	111-00001-0032	CAP CR 1UF 50V	[EA]	1

SYMBOL	PART NUMBER	DESCRIPTION	[UM]	QUANTITY
				-0000
C 149	096-01082-0042	CAP TN 33UF 15V	[EA]	1
C 150	096-01082-0042	CAP TN 33UF 15V	[EA]	1
C 151	096-01082-0016	CAP TN 2.2UF 20V	[EA]	1
C 152	102-00024-0009	CAP VA 7-35PF 160V	[EA]	1
C 153	113-03068-0000	CAP DC 6.8PF 500V	[EA]	1
C 154	111-00001-0001	CAP CR .1UF 50V	[EA]	1
C 155	113-03820-0000	CAP DC 82PF 500V	[EA]	1
C 156	111-00001-0000	CAP CR .01UF 50V	[EA]	1
C 157	111-00001-0026	CAP CR .33UF 50V	[EA]	1
C 158	111-00001-0012	CAP CR .047UF 50V	[EA]	1
C 159	111-00001-0035	CAP CR 1000PF 50V	[EA]	1
C 160	111-00001-0001	CAP CR .1UF 50V	[EA]	1
C 161	111-00001-0001	CAP CR .1UF 50V	[EA]	1
C 162	111-00001-0000	CAP CR .01UF 50V	[EA]	1
C 163	096-01082-0005	CAP TN 10UF 20V	[EA]	1
C 164	096-01082-0017	CAP TN 6.8UF 15V	[EA]	1
C 165	109-00007-0000	CAP DC .01UF 25V	[EA]	1
C 166	111-00001-0001	CAP CR .1UF 50V	[EA]	1
C 167	096-01082-0017	CAP TN 6.8UF 15V	[EA]	1
C 168	111-00001-0000	CAP CR .01UF 50V	[EA]	1
C 169	109-00007-0000	CAP DC .01UF 25V	[EA]	1
C 170	113-03560-0000	CAP DC 56PF 500V	[EA]	1
C 171	113-03560-0000	CAP DC 56PF 500V	[EA]	1
C 172	109-00007-0003	CAP DC .05UF 25V	[EA]	1
C 173	113-05271-0000	CAP DC 270PF 500V	[EA]	1
C 174	096-01082-0017	CAP TN 6.8UF 15V	[EA]	1
C 175	096-01082-0005	CAP TN 10UF 20V	[EA]	1
C 176	096-01082-0017	CAP TN 6.8UF 15V	[EA]	1
C 177	113-05102-0000	CAP DC .001UF 500V	[EA]	1
C 178	108-05016-0073	CAP PC .1UF 50V	[EA]	1
C 179	108-05016-0037	CAP PC .01UF 50V	[EA]	1
C 180	108-05016-0085	CAP PC .22UF 50V	[EA]	1
C 181	108-05016-0085	CAP PC .22UF 50V	[EA]	1
C 182	111-00001-0001	CAP CR .1UF 50V	[EA]	1
C 183	111-00001-0001	CAP CR .1UF 50V	[EA]	1
C 184	096-01082-0031	CAP TN 4.7UF 35V	[EA]	1
C 185	104-00001-0003	CAP SM 200PF 100V	[EA]	1

SYMBOL	PART NUMBER	DESCRIPTION	[UM]	QUANTITY
				-0000
C 186	111-00001-0000	CAP CR .01UF 50V	[EA]	1
C 187	096-01082-0005	CAP TN 10UF 20V	[EA]	1
C 188	096-01082-0031	CAP TN 4.7UF 35V	[EA]	1
C 189	104-00001-0031	CAP SM 27PF 500V	[EA]	1
C 190	111-00001-0001	CAP CR .1UF 50V	[EA]	1
C 191	113-05101-0001	CAP DC 100PF 500V	[EA]	1
C 192	096-01082-0009	CAP TN 15UF 20V	[EA]	1
C 193	111-00001-0000	CAP CR .01UF 50V	[EA]	1
C 194	104-00001-0023	CAP SM 270PF 100V	[EA]	1
C 195	096-01082-0047	CAP TN 1UF 20V	[EA]	1
C 196	114-07104-0000	CAP DC .1UF 16V	[EA]	1
C 197	096-01082-0047	CAP TN 1UF 20V	[EA]	1
C 198	113-03151-0000	CAP DC 150PF 500V	[EA]	1
C 199	108-05023-0001	CAP PC 1UF 100V	[EA]	1
C 200	096-01082-0005	CAP TN 10UF 20V	[EA]	1
C 201	111-00001-0000	CAP CR .01UF 50V	[EA]	1
C 202	114-07104-0000	CAP DC .1UF 16V	[EA]	1
C 203	111-00001-0000	CAP CR .01UF 50V	[EA]	1
C 204	096-01082-0006	CAP TN 47UF 15V	[EA]	1
C 205	118-00031-0000	CAP DC 56PF 500V	[EA]	1
C 206	104-00005-0064	CAP SM 910PF	[EA]	1
C 207	111-00001-0000	CAP CR .01UF 50V	[EA]	1
C 208	111-00001-0001	CAP CR .1UF 50V	[EA]	1
C 209	111-00001-0000	CAP CR .01UF 50V	[EA]	1
C 210	111-00001-0001	CAP CR .1UF 50V	[EA]	1
C 211	096-01082-0017	CAP TN 6.8UF 15V	[EA]	1
C 212	096-01082-0006	CAP TN 47UF 15V	[EA]	1
C 213	111-00001-0000	CAP CR .01UF 50V	[EA]	1
C 214	111-00001-0000	CAP CR .01UF 50V	[EA]	1
C 215	106-04563-0046	CAP CH 56K X7R/50V	[EA]	1
C 216	096-01082-0017	CAP TN 6.8UF 15V	[EA]	1
C 217	096-01082-0021	CAP TN 12UF 10V	[EA]	1
C 218	111-00001-0000	CAP CR .01UF 50V	[EA]	1
C 219	096-01082-0017	CAP TN 6.8UF 15V	[EA]	1
C 220	106-00049-0019	CAP CHIP 270PF20%	[EA]	1
C 221	111-00001-0001	CAP CR .1UF 50V	[EA]	1
C 222	113-05102-0000	CAP DC .001UF 500V	[EA]	1

SYMBOL	PART NUMBER	DESCRIPTION	[UM]	QUANTITY
				-0000
C 223	096-01082-0011	CAP TN 4.7UF 20V	[EA]	1
C 224	111-00001-0076	CAP CR .012UF 50V	[EA]	1
C 225	111-00001-0027	CAP CR .39UF 50V	[EA]	1
C 226	096-01082-0000	CAP TN 68UF 25V	[EA]	1
C 227	111-00001-0083	CAP CR 390PF 50V	[EA]	1
CR 101	007-06029-0000	DIO S 1N457A	[EA]	1
CR 102	007-06029-0000	DIO S 1N457A	[EA]	1
CR 103	007-06029-0000	DIO S 1N457A	[EA]	1
CR 104	007-06029-0000	DIO S 1N457A	[EA]	1
CR 105	007-06029-0000	DIO S 1N457A	[EA]	1
CR 106	007-06029-0000	DIO S 1N457A	[EA]	1
CR 107	007-06029-0000	DIO S 1N457A	[EA]	1
CR 108	007-06029-0000	DIO S 1N457A	[EA]	1
CR 109	007-06029-0000	DIO S 1N457A	[EA]	1
CR 110	007-06029-0000	DIO S 1N457A	[EA]	1
CR 111	007-06016-0000	DIO S 1N4154	[EA]	1
CR 112	007-06112-0000	DIO S MSD6150	[EA]	1
CR 113	007-06016-0000	DIO S 1N4154	[EA]	1
CR 114	007-06016-0000	DIO S 1N4154	[EA]	1
CR 115	007-06016-0000	DIO S 1N4154	[EA]	1
CR 116	007-06016-0000	DIO S 1N4154	[EA]	1
CR 117	007-06016-0000	DIO S 1N4154	[EA]	1
CR 118	007-04016-0015	DIO V MV2115	[EA]	1
CR 119	007-05046-0002	DIO Z 1N5234B	[EA]	1
FL 101	017-00074-0000	FLTR 12.428MHZ 4P	[EA]	1
I 101	120-03102-0000	IC DS75492	[EA]	1
I 102	120-03020-0000	IC MC1350P	[EA]	1
I 103	120-03012-0004	IC MC1741CP1	[EA]	1
I 104	120-08025-0000	IC C2392N	[EA]	1
I 105	120-04004-0000	IC MC1648P	[EA]	1
I 106	120-00098-0000	IC SN74LS73N	[EA]	1
I 107	120-03023-0001	IC UA723883B	[EA]	1
I 108	120-03052-0000	IC LM324N	[EA]	1
I 109	120-06038-0004	CMOS PLL (REF4046)	[EA]	1
I 110	120-03053-0000	IC LM358N	[EA]	1
I 111	120-06017-0001	IC SCL4027ABC+	[EA]	1
I 112	120-06038-0004	CMOS PLL (REF4046)	[EA]	1

SYMBOL	PART NUMBER	DESCRIPTION	[UM]	QUANTITY
				-0000
I 113	120-06025-0001	IC SCL4049ABC+	[EA]	1
I 114	120-06070-0000	IC CD4070BF	[EA]	1
I 115	120-06012-0001	IC SCL4016ABC+	[EA]	1
I 116	120-03081-0000	IC LM311N	[EA]	1
I 117	120-03053-0000	IC LM358N	[EA]	1
J 101	155-02030-0010	JMPR CABLE 3.60	[EA]	1
J 102	155-02030-0021	JMPR CABLE 2.70	[EA]	1
J 872	030-00059-0000	CONN COAX PNL MTD	[EA]	1
L 101	019-02082-0053	CH 47UH 5%	[EA]	1
L 102	019-02084-0081	CH 330UH 10%	[EA]	1
L 103	019-02084-0069	CH 100UH 10%	[EA]	1
L 104	019-02084-0041	CH 6.8UH 10%	[EA]	1
L 105	019-02084-0031	CH 2.7UH 10%	[EA]	1
L 106	019-02084-0031	CH 2.7UH 10%	[EA]	1
L 107	019-02102-0004	CHOKE 90UH	[EA]	1
L 108	019-02084-0031	CH 2.7UH 10%	[EA]	1
L 109	019-02084-0024	CH 1.5UH 5%	[EA]	1
Q 101	007-00423-0001	XSTR U431 MOD	[AR]	1
Q 101	007-00428-0003	XSTR J309	[EA]	1
Q 102	007-00078-0000	XSTR S NPN 2N3415	[EA]	1
Q 104	999-09999-0098	NOT USED	[RF]	0
Q 105	007-00212-0000	XSTR 2N5245	[EA]	1
Q 106	007-00163-0000	XSTR S PNP MPS6519	[EA]	1
Q 107	007-00162-0000	XSTR S NPN MPS6515	[EA]	1
Q 108	007-00162-0000	XSTR S NPN MPS6515	[EA]	1
Q 109	007-00065-0000	XSTR S PNP 2N3906	[EA]	1
Q 110	007-00215-0000	XSTR 2N5486	[EA]	1
Q 111	007-00315-0012	XSTR S PNP D43C2-G	[EA]	1
Q 112	007-00162-0000	XSTR S NPN MPS6515	[EA]	1
R 101	131-00333-0013	RES CF 33K EW 5%	[EA]	1
R 102	131-00333-0013	RES CF 33K EW 5%	[EA]	1
R 103	131-00333-0013	RES CF 33K EW 5%	[EA]	1
R 104	131-00333-0013	RES CF 33K EW 5%	[EA]	1
R 105	131-00333-0013	RES CF 33K EW 5%	[EA]	1
R 106	131-00561-0013	RES CF 560 EW 5%	[EA]	1
R 107	131-00122-0013	RES CF 1.2K EW 5%	[EA]	1
R 108	131-00561-0023	RES CF 560 QW 5%	[EA]	1

SYMBOL	PART NUMBER	DESCRIPTION	[UM]	QUANTITY
				-0000
R 109	133-00096-0026	RES VA 100 HW 10%	[EA]	1
R 110	131-00820-0013	RES CF 82 EW 5%	[EA]	1
R 111	131-00821-0013	RES CF 820 EW 5%	[EA]	1
R 112	131-00622-0013	RES CF 6.2K EW 5%	[EA]	1
R 113	131-00201-0013	RES CF 200 EW 5%	[EA]	1
R 114	131-00101-0013	RES CF 100 EW 5%	[EA]	1
R 115	131-00363-0023	RES CF 36K QW 5%	[EA]	1
R 116	131-00363-0023	RES CF 36K QW 5%	[EA]	1
R 117	131-00104-0023	RES CF 100K QW 5%	[EA]	1
R 118	131-00271-0023	RES CF 270 QW 5%	[EA]	1
R 119	131-00823-0023	RES CF 82K QW 5%	[EA]	1
R 120	131-00153-0013	RES CF 15K EW 5%	[EA]	1
R 121	131-00302-0013	RES CF 3K EW 5%	[EA]	1
R 122	131-00333-0023	RES CF 33K QW 5%	[EA]	1
R 123	131-00271-0013	RES CF 270 EW 5%	[EA]	1
R 124	131-00394-0023	RES CF 390K QW 5%	[EA]	1
R 125	131-00273-0023	RES CF 27K QW 5%	[EA]	1
R 126	131-00100-0023	RES CF 10 QW 5%	[EA]	1
R 127	131-00100-0023	RES CF 10 QW 5%	[EA]	1
R 128	131-00394-0023	RES CF 390K QW 5%	[EA]	1
R 129	131-00334-0023	RES CF 330K QW 5%	[EA]	1
R 130	131-00102-0013	RES CF 1K EW 5%	[EA]	1
R 131	131-00102-0023	RES CF 1K QW 5%	[EA]	1
R 132	131-00103-0013	RES CF 10K EW 5%	[EA]	1
R 133	131-00224-0013	RES CF 220K EW 5%	[EA]	1
R 134	131-00105-0013	RES CF 1M EW 5%	[EA]	1
R 135	131-00184-0023	RES CF 180K QW 5%	[EA]	1
R 136	131-00105-0023	RES CF 1M QW 5%	[EA]	1
R 137	131-00202-0023	RES CF 2K QW 5%	[EA]	1
R 138	131-00105-0023	RES CF 1M QW 5%	[EA]	1
R 139	131-00101-0023	RES CF 100 QW 5%	[EA]	1
R 140	131-00102-0023	RES CF 1K QW 5%	[EA]	1
R 141	131-00102-0023	RES CF 1K QW 5%	[EA]	1
R 142	131-00332-0023	RES CF 3.3K QW 5%	[EA]	1
R 143	131-00223-0023	RES CF 22K QW 5%	[EA]	1
R 144	131-00183-0023	RES CF 18K QW 5%	[EA]	1
R 145	131-00101-0023	RES CF 100 QW 5%	[EA]	1

SYMBOL	PART NUMBER	DESCRIPTION	[UM]	QUANTITY
				-0000
R 146	131-00224-0023	RES CF 220K QW 5%	[EA]	1
R 147	131-00431-0023	RES CF 430 QW 5%	[EA]	1
R 148	131-00622-0023	RES CF 6.2K QW 5%	[EA]	1
R 149	131-00623-0023	RES CF 62K QW 5%	[EA]	1
R 150	131-00202-0023	RES CF 2K QW 5%	[EA]	1
R 151	133-00113-0018	RES VA 10K 20% A	[EA]	1
R 152	131-00822-0023	RES CF 8.2K QW 5%	[EA]	1
R 153	131-00222-0013	RES CF 2.2K EW 5%	[EA]	1
R 154	131-00104-0013	RES CF 100K EW 5%	[EA]	1
R 155	132-00105-0041	RES WW 36 1.5W 5%	[EA]	1
R 156	131-00472-0013	RES CF 4.7K EW 5%	[EA]	1
R 157	131-00472-0013	RES CF 4.7K EW 5%	[EA]	1
R 158	131-00472-0013	RES CF 4.7K EW 5%	[EA]	1
R 159	131-00753-0013	RES CF 75K EW 5%	[EA]	1
R 160	131-00753-0013	RES CF 75K EW 5%	[EA]	1
R 161	131-00563-0023	RES CF 56K QW 5%	[EA]	1
R 162	131-00104-0023	RES CF 100K QW 5%	[EA]	1
R 163	131-00563-0023	RES CF 56K QW 5%	[EA]	1
R 164	133-00113-0012	RES VA 1K 20% A	[EA]	1
R 165	131-00470-0023	RES CF 47 QW 5%	[EA]	1
R 166	131-00201-0013	RES CF 200 EW 5%	[EA]	1
R 167	131-00101-0023	RES CF 100 QW 5%	[EA]	1
R 169	136-01001-0072	RES PF 1K QW 1%	[EA]	1
R 170	133-00113-0012	RES VA 1K 20% A	[EA]	1
R 171	136-04531-0072	RES PF 4.53K QW 1%	[EA]	1
R 172	136-05112-0072	RES PF 51.1K QW 1%	[EA]	1
R 173	136-05113-0072	RES PF 511K QW 1%	[EA]	1
R 174	131-00202-0023	RES CF 2K QW 5%	[EA]	1
R 175	136-01432-0072	RES PF 14.3K QW 1%	[EA]	1
R 176	136-04421-0072	RES PF 4.42K QW 1%	[EA]	1
R 177	133-00100-0039	RES VA 10K QW 10%	[EA]	1
R 178	136-01153-0072	RES PF 115K QW 1%	[EA]	1
R 179	136-01153-0072	RES PF 115K QW 1%	[EA]	1
R 180	131-00102-0013	RES CF 1K EW 5%	[EA]	1
R 181	131-00105-0013	RES CF 1M EW 5%	[EA]	1
R 182	131-00392-0013	RES CF 3.9K EW 5%	[EA]	1
R 183	131-00392-0013	RES CF 3.9K EW 5%	[EA]	1

SYMBOL	PART NUMBER	DESCRIPTION	[UM]	QUANTITY
				-0000
R 184	131-00510-0013	RES CF 51 EW 5%	[EA]	1
R 185	131-00222-0013	RES CF 2.2K EW 5%	[EA]	1
R 186	131-00392-0013	RES CF 3.9K EW 5%	[EA]	1
R 187	131-00100-0023	RES CF 10 QW 5%	[EA]	1
R 188	131-00362-0013	RES CF 3.6K EW 5%	[EA]	1
R 189	133-00100-0039	RES VA 10K QW 10%	[EA]	1
R 190	131-00333-0013	RES CF 33K EW 5%	[EA]	1
R 191	131-00105-0013	RES CF 1M EW 5%	[EA]	1
R 192	131-00103-0013	RES CF 10K EW 5%	[EA]	1
R 193	131-00303-0013	RES CF 30K EW 5%	[EA]	1
R 194	131-00273-0013	RES CF 27K EW 5%	[EA]	1
R 195	131-00103-0013	RES CF 10K EW 5%	[EA]	1
R 196	131-00225-0013	RES CF 2.2M EW 5%	[EA]	1
R 197	131-00225-0013	RES CF 2.2M EW 5%	[EA]	1
R 198	131-00104-0013	RES CF 100K EW 5%	[EA]	1
R 199	131-00104-0013	RES CF 100K EW 5%	[EA]	1
R 200	131-00105-0013	RES CF 1M EW 5%	[EA]	1
R 201	131-00333-0013	RES CF 33K EW 5%	[EA]	1
R 202	131-00103-0013	RES CF 10K EW 5%	[EA]	1
R 203	131-00753-0013	RES CF 75K EW 5%	[EA]	1
R 204	131-00753-0013	RES CF 75K EW 5%	[EA]	1
R 205	131-00103-0023	RES CF 10K QW 5%	[EA]	1
R 206	131-00203-0023	RES CF 20K QW 5%	[EA]	1
R 207	131-00203-0013	RES CF 20K EW 5%	[EA]	1
R 208	131-00183-0023	RES CF 18K QW 5%	[EA]	1
R 209	131-00203-0013	RES CF 20K EW 5%	[EA]	1
R 210	131-00332-0023	RES CF 3.3K QW 5%	[EA]	1
R 211	131-00473-0023	RES CF 47K QW 5%	[EA]	1
R 212	131-00103-0013	RES CF 10K EW 5%	[EA]	1
R 213	131-00105-0023	RES CF 1M QW 5%	[EA]	1
R 214	131-00822-0013	RES CF 8.2K EW 5%	[EA]	1
R 215	131-00225-0013	RES CF 2.2M EW 5%	[EA]	1
R 216	131-00203-0013	RES CF 20K EW 5%	[EA]	1
R 217	131-00273-0013	RES CF 27K EW 5%	[EA]	1
R 218	131-00683-0013	RES CF 68K EW 5%	[EA]	1
R 219	131-00100-0013	RES CF 10 EW 5%	[EA]	1
R 220	131-00332-0013	RES CF 3.3K EW 5%	[EA]	1

SYMBOL	PART NUMBER	DESCRIPTION	[UM]	QUANTITY
				-0000
R 221	131-00332-0013	RES CF 3.3K EW 5%	[EA]	1
R 222	131-00100-0013	RES CF 10 EW 5%	[EA]	1
R 223	131-00102-0013	RES CF 1K EW 5%	[EA]	1
R 224	131-00332-0013	RES CF 3.3K EW 5%	[EA]	1
R 225	131-00510-0013	RES CF 51 EW 5%	[EA]	1
R 227	131-00363-0013	RES CF 36K EW 5%	[EA]	1
R 228	131-00820-0023	RES CF 82 QW 5%	[EA]	1
R 229	131-00134-0013	RES CF 130K EW 5%	[EA]	1
R 230	131-00513-0013	RES CF 51K EW 5%	[EA]	1
RT 101	134-01036-0000	PTC THRMSTR 1K	[EA]	1
T 101	019-05086-0000	XFMR PSLCTR	[EA]	1
T 102	019-05086-0000	XFMR PSLCTR	[EA]	1
T 103	019-05086-0000	XFMR PSLCTR	[EA]	1
T 104	019-05087-0000	XFMR PSLCTR	[EA]	1
T 105	019-05087-0000	XFMR PSLCTR	[EA]	1
T 106	019-05087-0000	XFMR PSLCTR	[EA]	1
T 107	019-05088-0000	XFMR PSLCTR	[EA]	1
T 108	019-05088-0000	XFMR PSLCTR	[EA]	1
T 109	019-05088-0000	XFMR PSLCTR	[EA]	1
T 110	019-05089-0000	XFMR PSLCTR	[EA]	1
T 111	019-05089-0000	XFMR PSLCTR	[EA]	1
T 112	019-05089-0000	XFMR PSLCTR	[EA]	1
T 113	019-07089-0001	XFMR MOD	[EA]	1
T 114	019-07088-0001	XFMR BIFILAR MOD	[EA]	1
T 115	019-08094-0000	XFMR IF	[EA]	1
T 116	019-08093-0000	XFMR IF	[EA]	1
T 117	019-08093-0000	XFMR IF	[EA]	1
T 118	019-08101-0000	XFMR 140HZ	[EA]	1
T 119	019-08101-0000	XFMR 140HZ	[EA]	1
T 120	019-08101-0000	XFMR 140HZ	[EA]	1
T 121	019-08101-0000	XFMR 140HZ	[EA]	1
T 122	019-08095-0000	XFMR IF	[EA]	1
T 123	019-02306-0000	COIL ADJ 1MH	[EA]	1
TP 101	008-00096-0001	TERMINAL TEST PNT	[EA]	1
TP 102	008-00096-0001	TERMINAL TEST PNT	[EA]	1
TP 103	008-00096-0001	TERMINAL TEST PNT	[EA]	1
TP 104	008-00096-0001	TERMINAL TEST PNT	[EA]	1

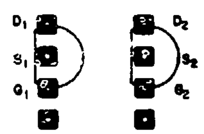
SYMBOL	PART NUMBER	DESCRIPTION	[UM]	QUANTITY
				-0000
TP 105	008-00096-0001	TERMINAL TEST PNT	[EA]	1
TP 106	008-00096-0001	TERMINAL TEST PNT	[EA]	1
TP 107	008-00096-0001	TERMINAL TEST PNT	[EA]	1
TP 108	008-00096-0001	TERMINAL TEST PNT	[EA]	1
Y 101	044-00105-0000	XTAL 8.192MHZ	[EA]	1

NOTES:

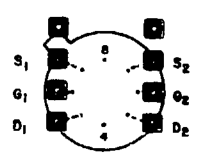
1. PRIOR TO POST COATING BOTH SIDES OF ASS'Y WITH CLEAR URETHANE COATING (016-1040-00) MASK OFF THE FOLLOWING AREAS: ALL MOUNTING AREAS, J872 T101 THRU T112, T115 THRU T123, R109, R164, R170, R151, R177, R189, C152, TEST POINTS 101 THRU 108, P501, P502, RIBBON CABLE P501, P502.
2. THE FOLLOWING COMPONENTS MUST BE LAID DOWN: C211, C147, C148, C212, C204, C150, C149, C151, C202, C196.
3. 047-6389-01 TO BE INSTALLED PRIOR TO 047-5120-01
4. T122 TO BE INSTALLED AFTER WAVE SOLDER PROCESSES ARE COMPLETE PRIOR TO POST COAT PROCESSES.
5. C159 TO BE SECURED TO T122 USING EPOXY (016-1122-00).
6. CR118 TO BE SPACED APPROXIMATELY .125 INCHES OFF OF P.C. BOARD.

8. PLACE 012-1038-00 OVER T101-T112 AFTER ALIGNMENT PROCEDURE IS COMPLETE.

9a. WHEN USING 007-00428-0003 AS Q101· ASSEMBLE AS SHOWN BELOW. 007-00428-0003 CONSISTS OF A PAIR OF J309 FETS WITH IDENTICAL COLOR CODING.



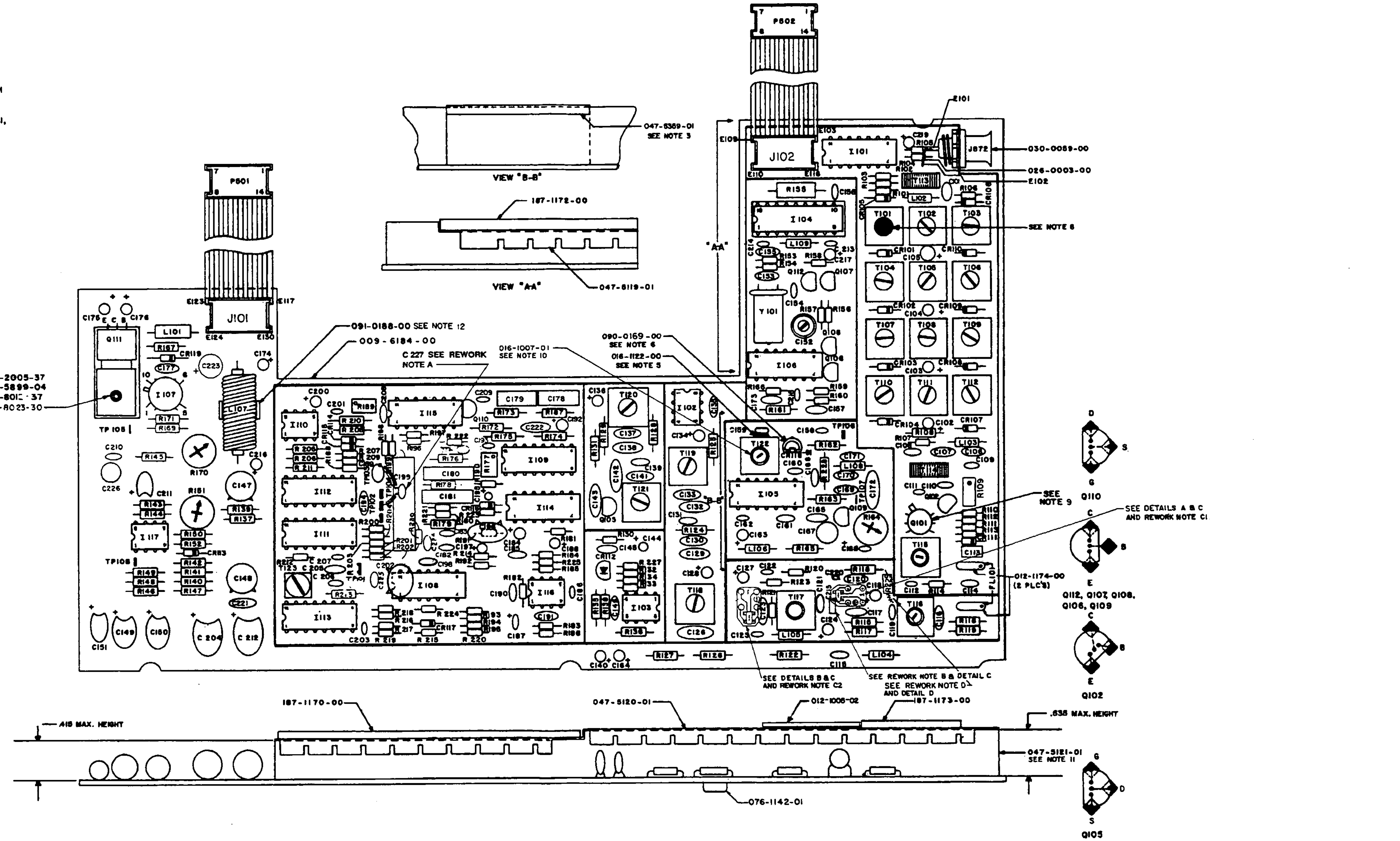
9b. WHEN USING 007-0423-01 AS Q101 ASSEMBLE AS SHOWN BELOW. 007-0423-01 IS A U431 (DUAL J-FET) WITH PINS 4 AND 8 REMOVED.



10. AFTER FINAL ADJUSTMENT OF T122, SECURE ITS CORE WITH LOCTITE (016-1007-01).

11. 047-05121-0001 MUST BE 100% SOLDERED TO ALL GROUND PAD AREA ON RECEIVER BOARD EXCEPT WHERE COMPONENT INTERFERENCE DOES NOT ALLOW ROOM FOR SOLDERING.

12. SECURE 091-00188-0000 TO BOARD WITH RTV (016-01082-0000).



REWORK NOTES:

A. INSTALL C227 FROM TP104 TO GROUND SIDE OF C189. USE 150-00004-0010 TO INSULATE BARE LEADS.

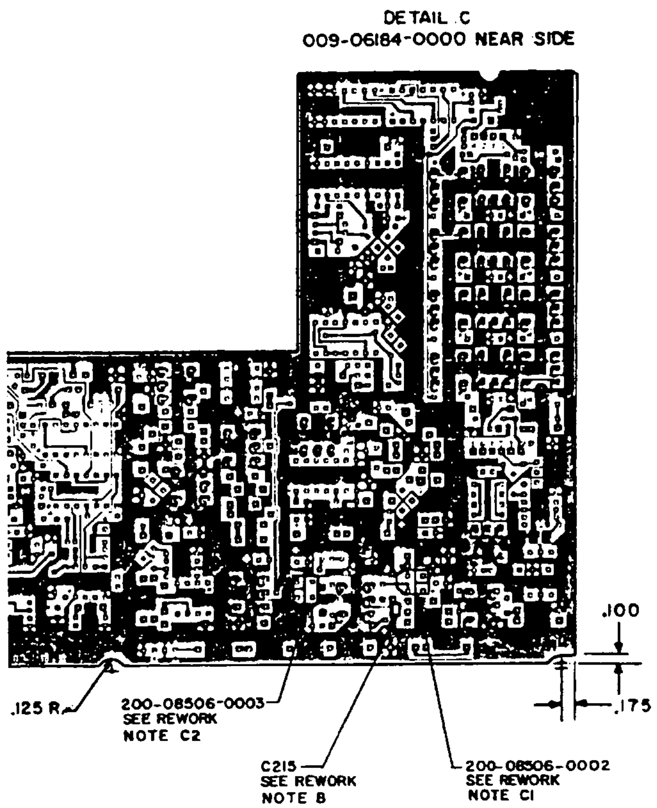
B. CONNECT ONE SIDE OF C215 CHIP CAP TO PAD CLOSEST TO C121 AND CONNECT THE OTHER SIDE TO THE GROUND SIDE OF C124, AS SHOWN IN DETAIL C (SHEET 3).

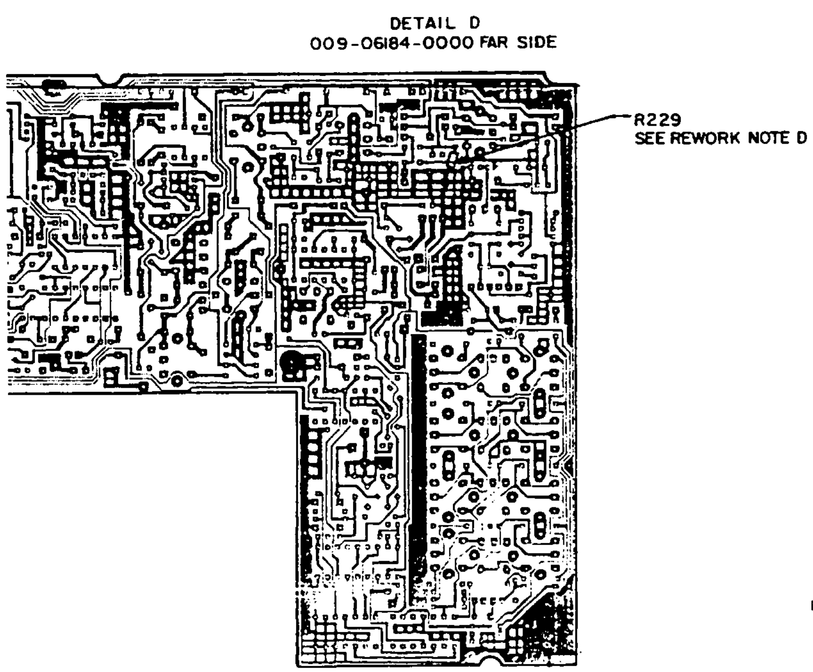
C1. INSTALL 200-08506-0002 WITH BUSS WIRES 026-00003-0000(4PL) AS SHOWN IN DETAILS A & C (SHEET 3)
C2. INSTALL 200-08506-0003 WITH BUSS WIRES 026-00003-0000(4PL) AS SHOWN IN DETAILS B & C (SHEET 3)

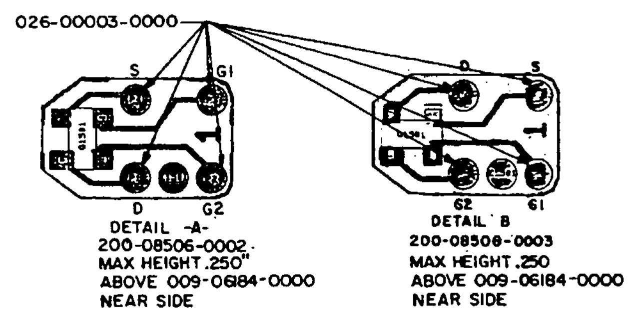
D. CONNECT R229 BETWEEN THE RIGHT LEAD OF R118 AND THE TOP LEAD OF C119. USE TUBING 150-00004-0010 AS REQUIRED. R229 TO BE MOUNTED ON FARSIDE OF BOARD. SEE DETAIL D (SHEET 3)

Dwg 300-06184-0000 R55 Sht 1

FIGURE 6–5 KR 87 RECEIVER BOARD ASSEMBLY (Dwg. No. 300–06184–0000 R–55, Sheet 1 of 2)





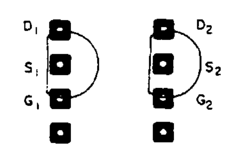


Dwg 300-06184-0000 R55 Sht 3

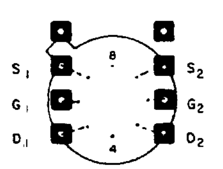
**FIGURE 6-5 KR 87 RECEIVER BOARD ASSEMBLY
(Dwg. No. 300-06184-0000 R-55, Sheet 2 of 2)**

NOTES:

1. PRIOR TO POST COATING BOTH SIDES OF ASS'Y WITH CLEAR URETHANE COATING (016-1040-00) MASK OFF THE FOLLOWING AREAS: ALL MOUNTING AREAS, J872 T101 THRU T112, T115 THRU T123, R109, R164, R170, R151, R177, R189, C152, TEST POINTS 101 THRU 108, P501, P502, RIBBON CABLE P501, P502.
2. THE FOLLOWING COMPONENTS MUST BE LAID DOWN: C211, C147, C148, C212, C204, C150, C149, C151, C202, C196.
3. 047-5359-01 TO BE INSTALLED PRIOR TO 047-5120-01
4. C159 TO BE SECURED TO T122 USING EPOXY (016-1122-00).
5. CR118 TO BE SPACED APPROXIMATELY .125 INCHES OFF OF P.C. BOARD.
6. C113 TO BE BENT AGAINEST AND SECURED TO FL101 USING EPOXY (016-1122-00).
7. PLACE 012-1038-00 OVER T101-T112 AFTER ALIGNMENT PROCEDURE IS COMPLETE.
8. WHEN USING 007-0427-02 AS Q101 ASSEMBLE AS SHOWN BELOW. 007-0427-02 CONSISTS OF A PAIR OF J310 FETS WITH IDENTICAL COLOR CODING.



WHEN USING 007-0423-01 AS Q101 ASSEMBLE AS SHOWN BELOW 007-0423-01 IS A U431 (DUAL J-FET) WITH PINS 4 AND 8 REMOVED



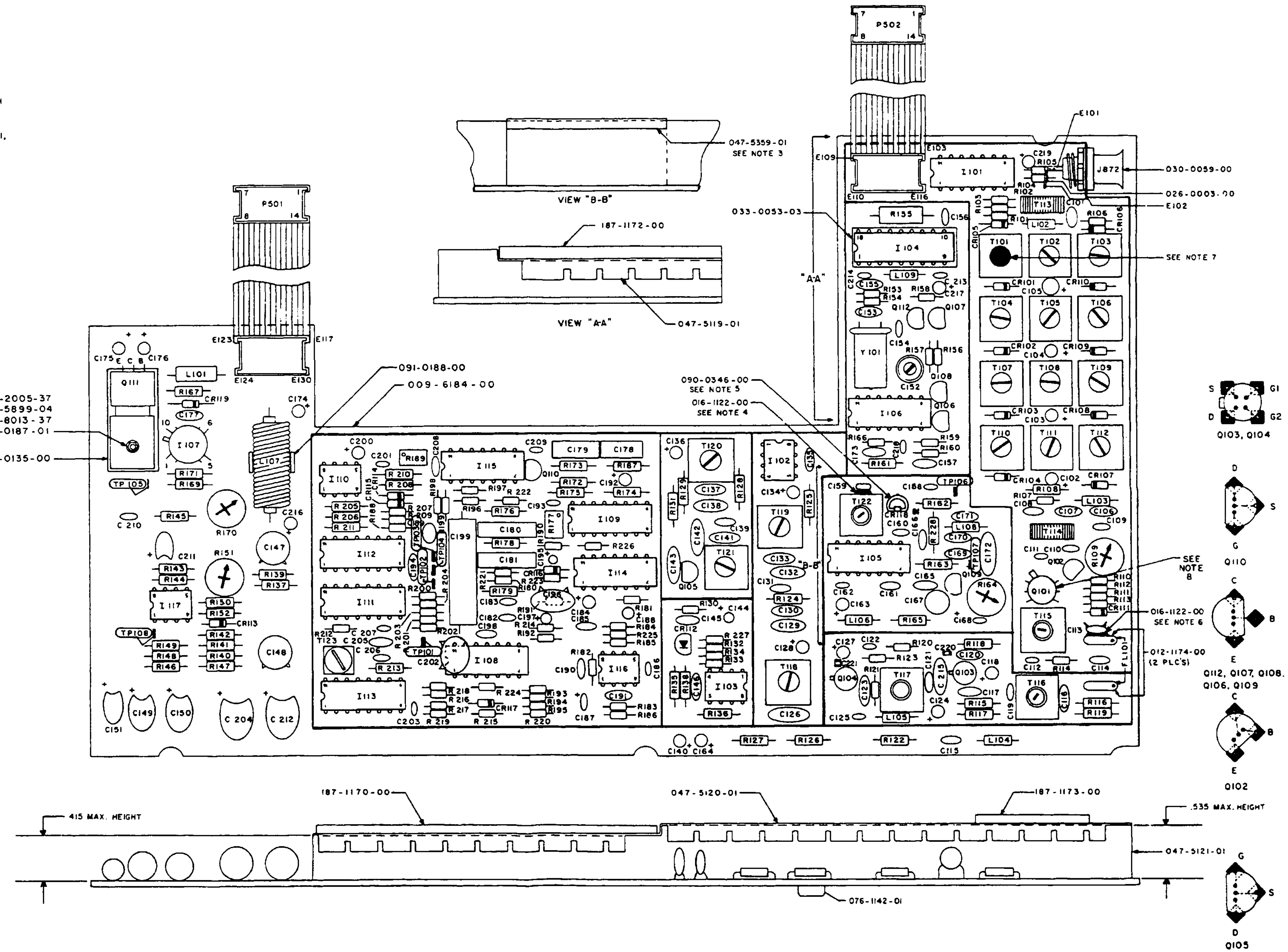


FIGURE 6-5A KR 87 RECEIVER BOARD ASSEMBLY
(Dwg. No. 300-06184-0000 R-12)

NOTES:

1. PRIOR TO POST COATING BOTH SIDES OF ASS'Y WITH CLEAR URETHANE COATING (016-1040-00) MASK OFF THE FOLLOWING AREAS: ALL MOUNTING AREAS, J872 T101 THRU T112, T115 THRU T123, R109, R164, R170, R151, R177, R189, C152, TEST POINTS 101 THRU 108, P501, P502, RIBBON CABLE P501, P502.
2. THE FOLLOWING COMPONENTS MUST BE LAID DOWN: C211, C147, C148, C212, C204, C150, C149, C151, C202, C196.
3. APPLY RTV (KPN 016-1100-00) TO T113 AND T114 TO SECURE IN PLACE.

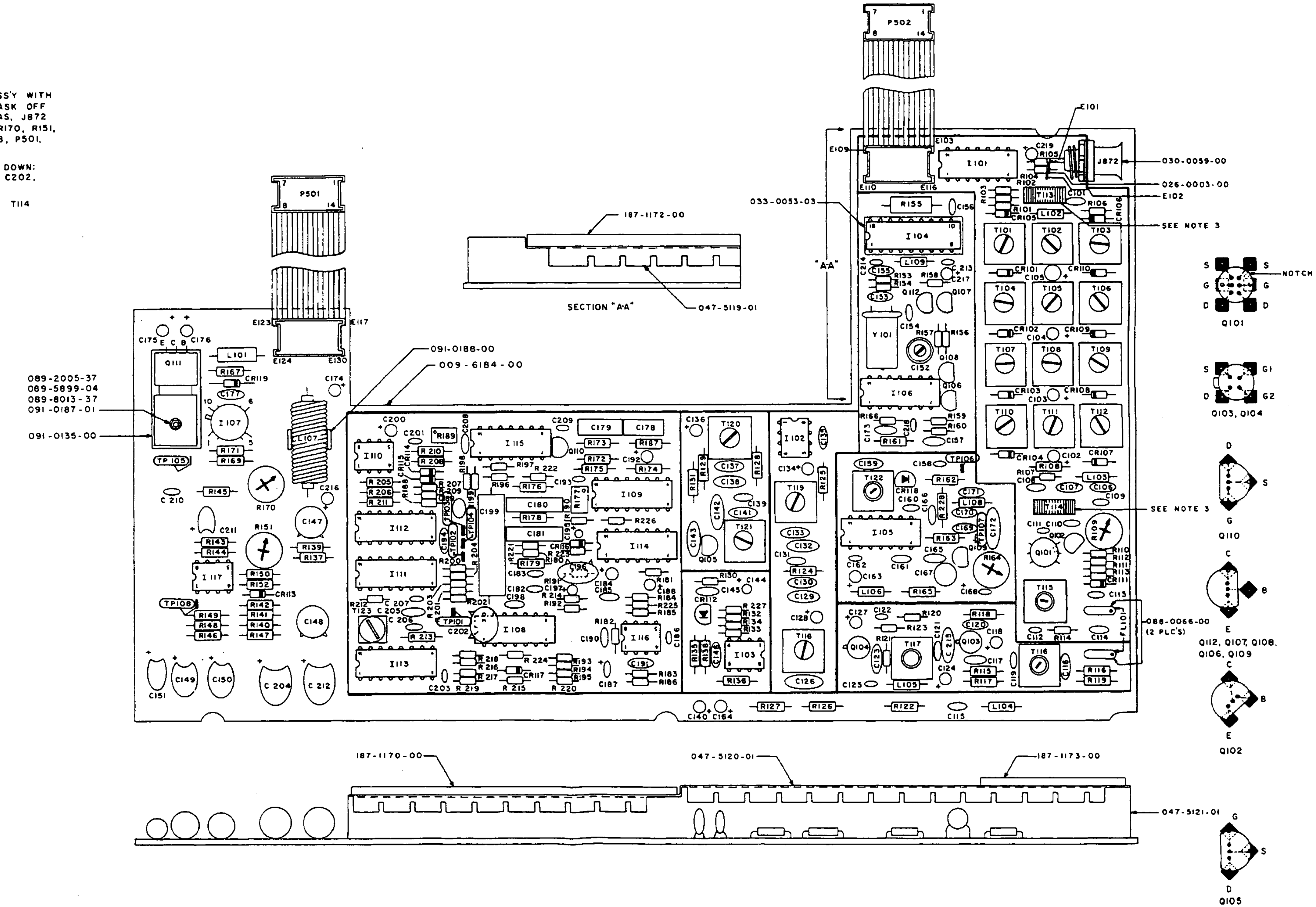


FIGURE 6-5B KR 87 RECEIVER BOARD ASSEMBLY
(Dwg. No. 300-06184-0000 R-1)

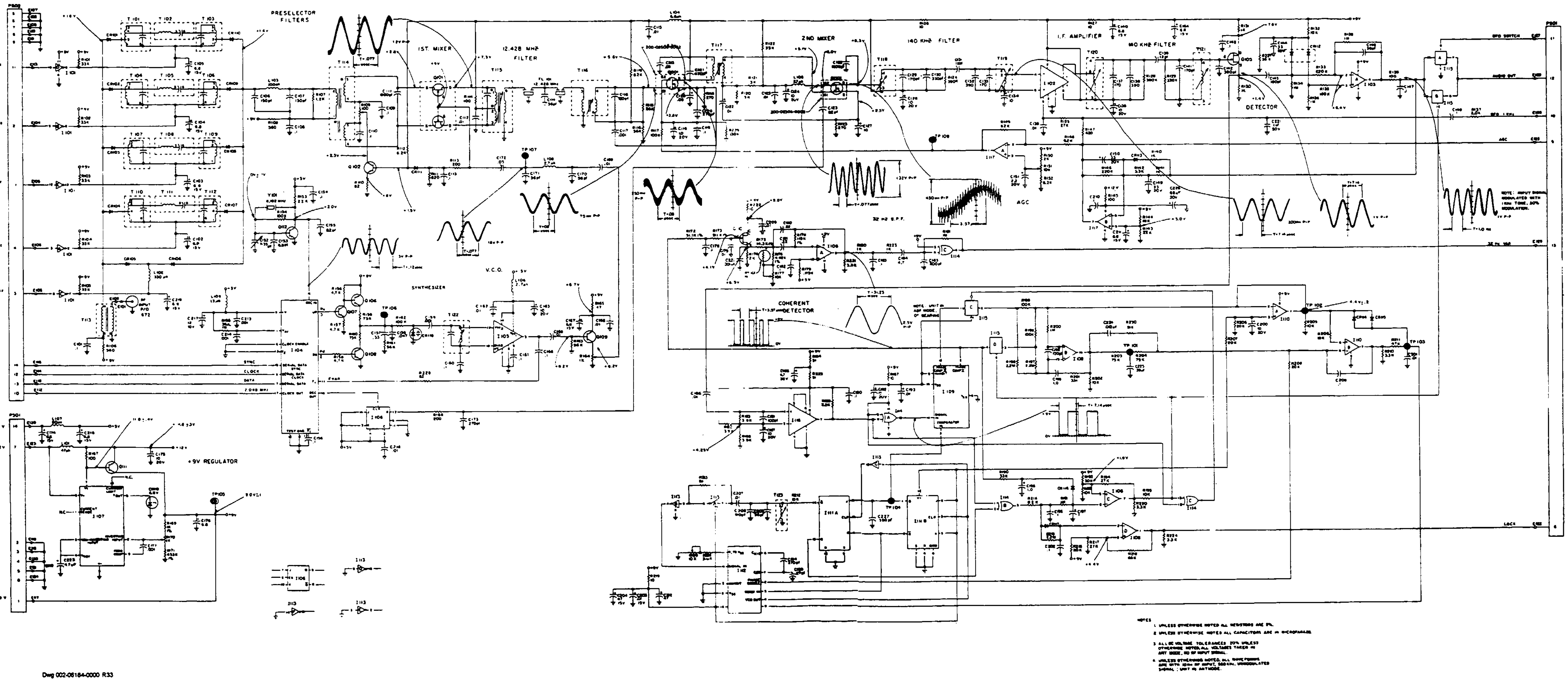
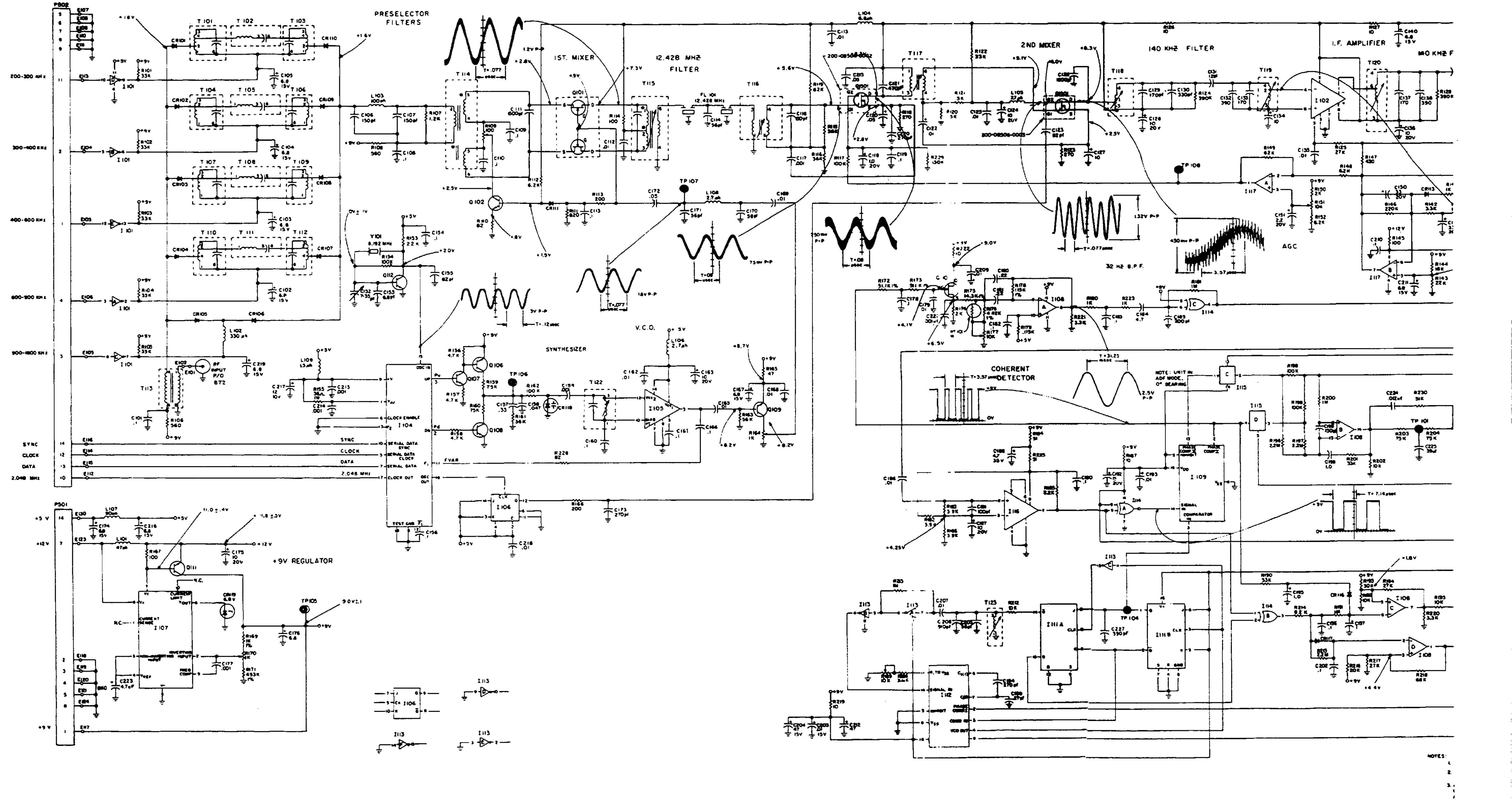


FIGURE 6–6 KR 87 RECEIVER BOARD SCHEMATIC
(Dwg. No. 002–06184–0000 R–33)



Dwg 002-06184-0000 R33

FIGURE 6-6 KR 87 RECEIVER BOARD SCHEMATIC
(Dwg. No. 002-06184-0000 R-33, Zoom Left)

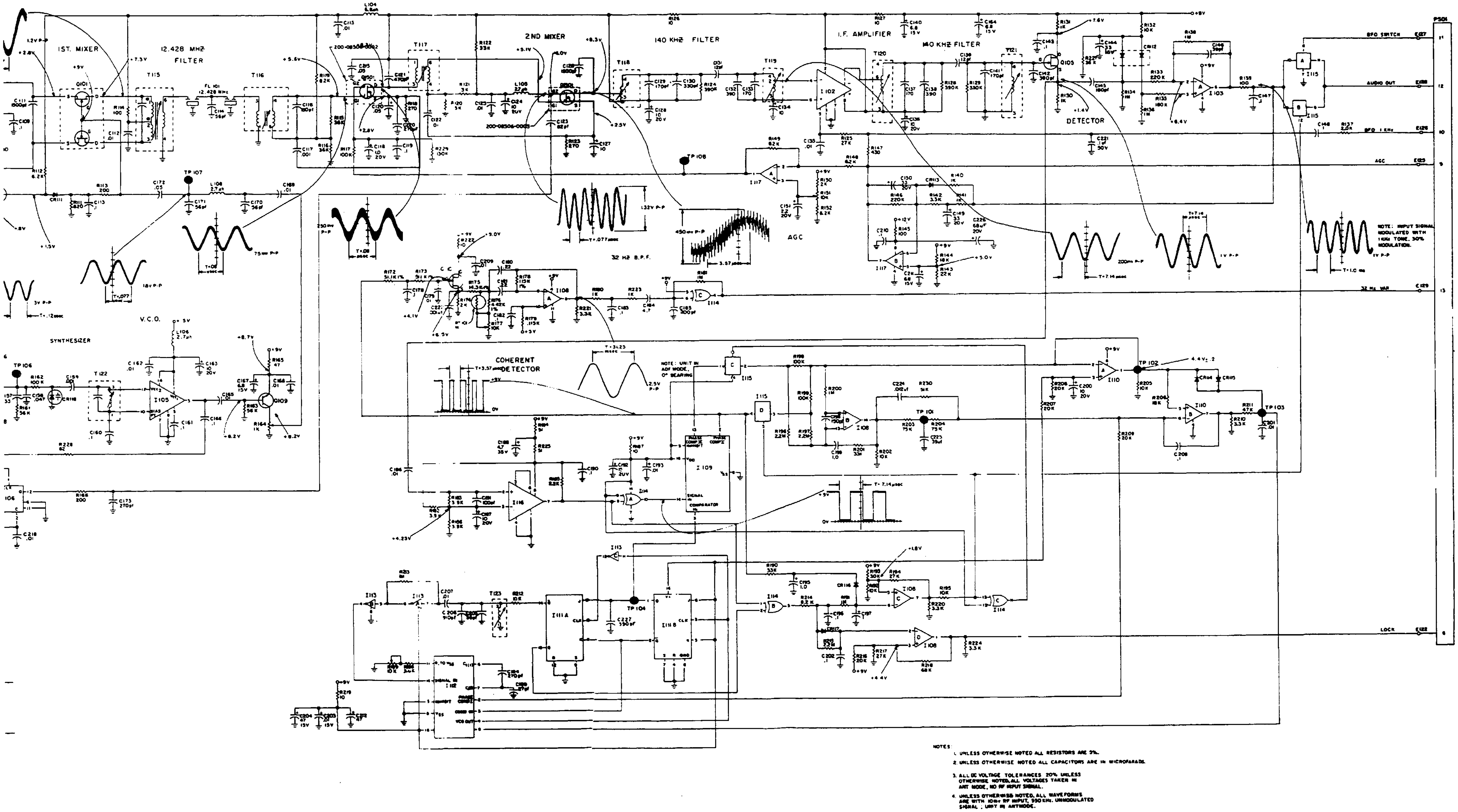


FIGURE 6-6 KR 87 RECEIVER BOARD SCHEMATIC
(Dwg. No. 002-06184-0000 R-33, Zoom Right)

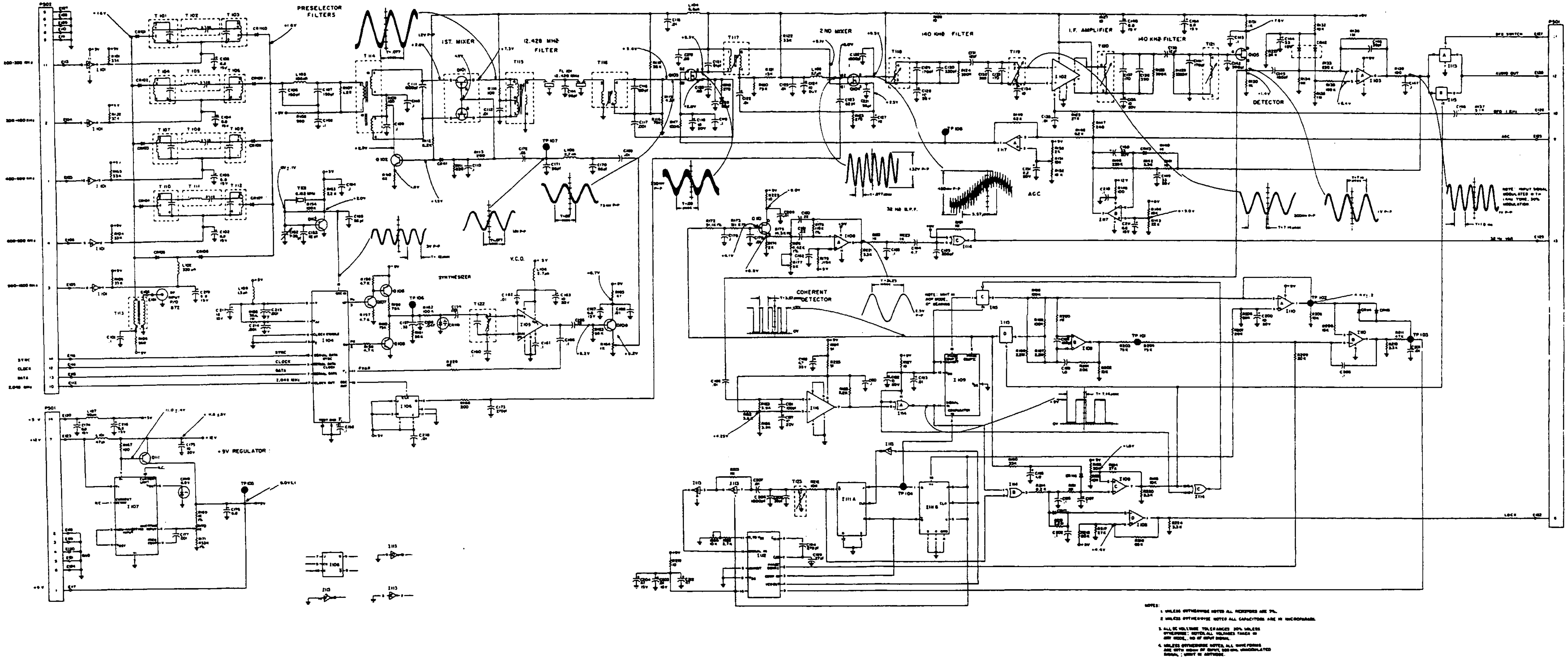


FIGURE 6-6A KR 87 RECEIVER BOARD SCHEMATIC
(Dwg. No. 002-06184-0000 R-10)

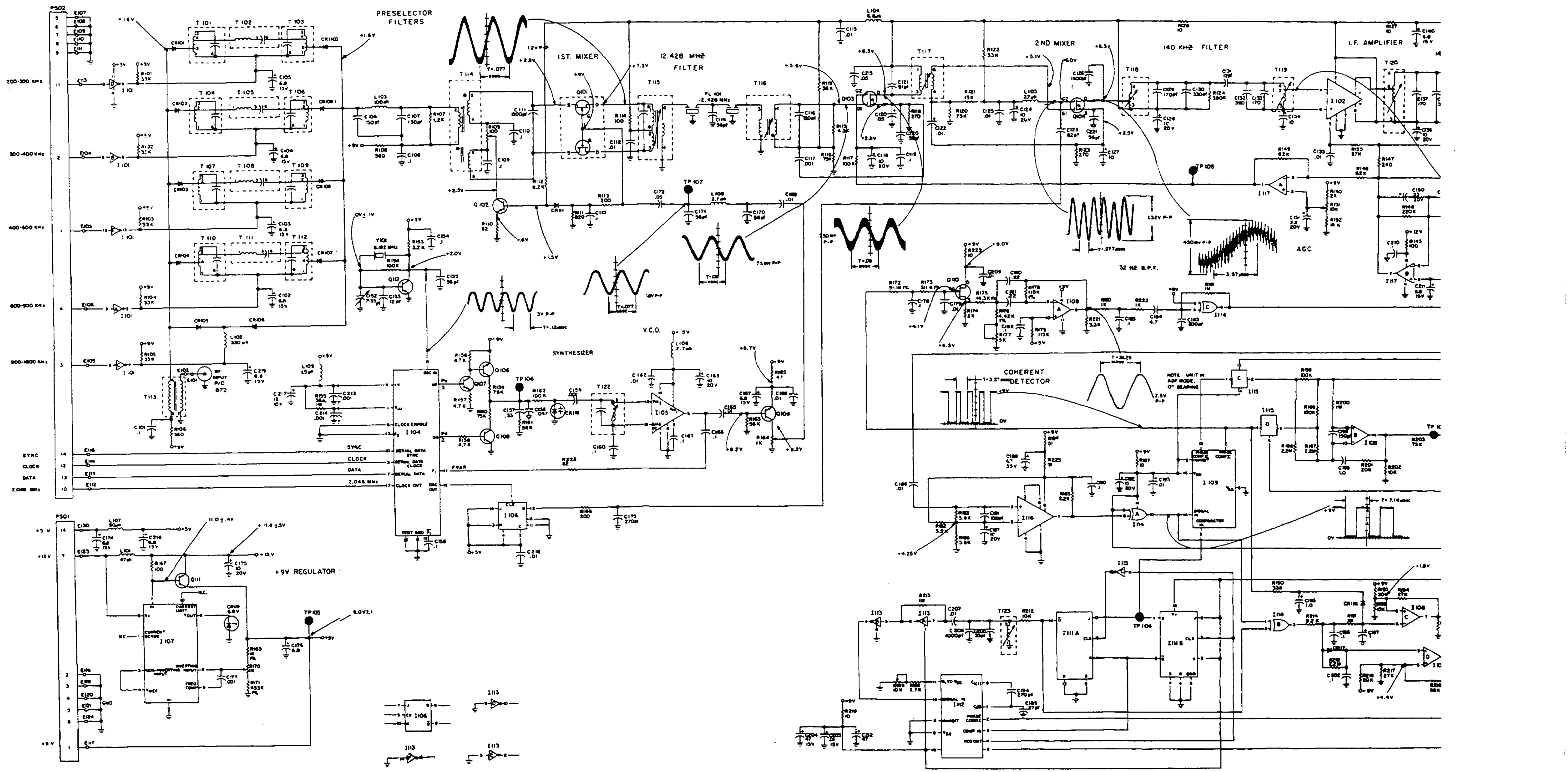


FIGURE 6-6A KR 87 RECEIVER BOARD SCHEMATIC
(Dwg. No. 002-06184-0000 R-10, Zoom Left)

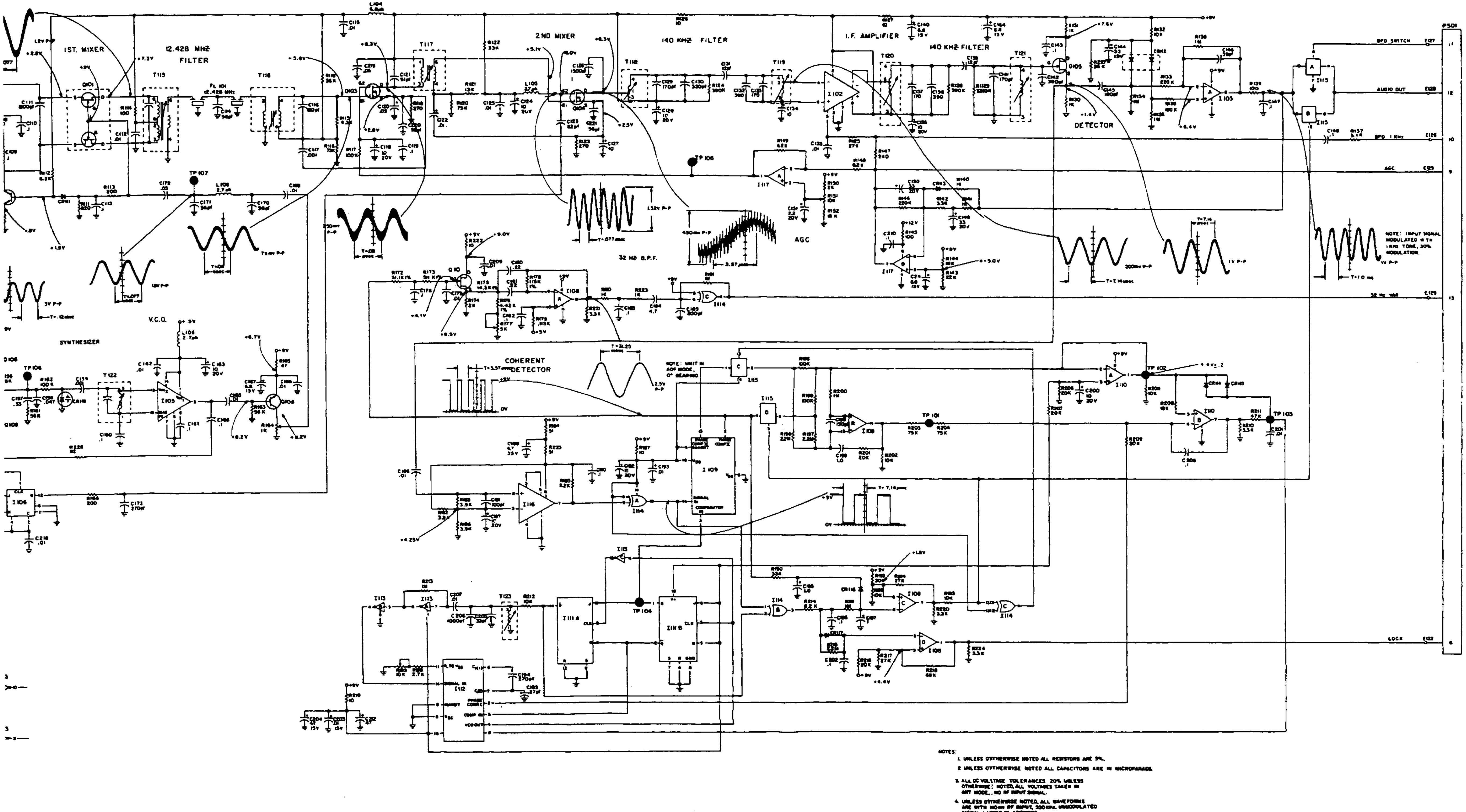


FIGURE 6–6A KR 87 RECEIVER BOARD SCHEMATIC
(Dwg. No. 002–06184–0000 R–10, Zoom Right)

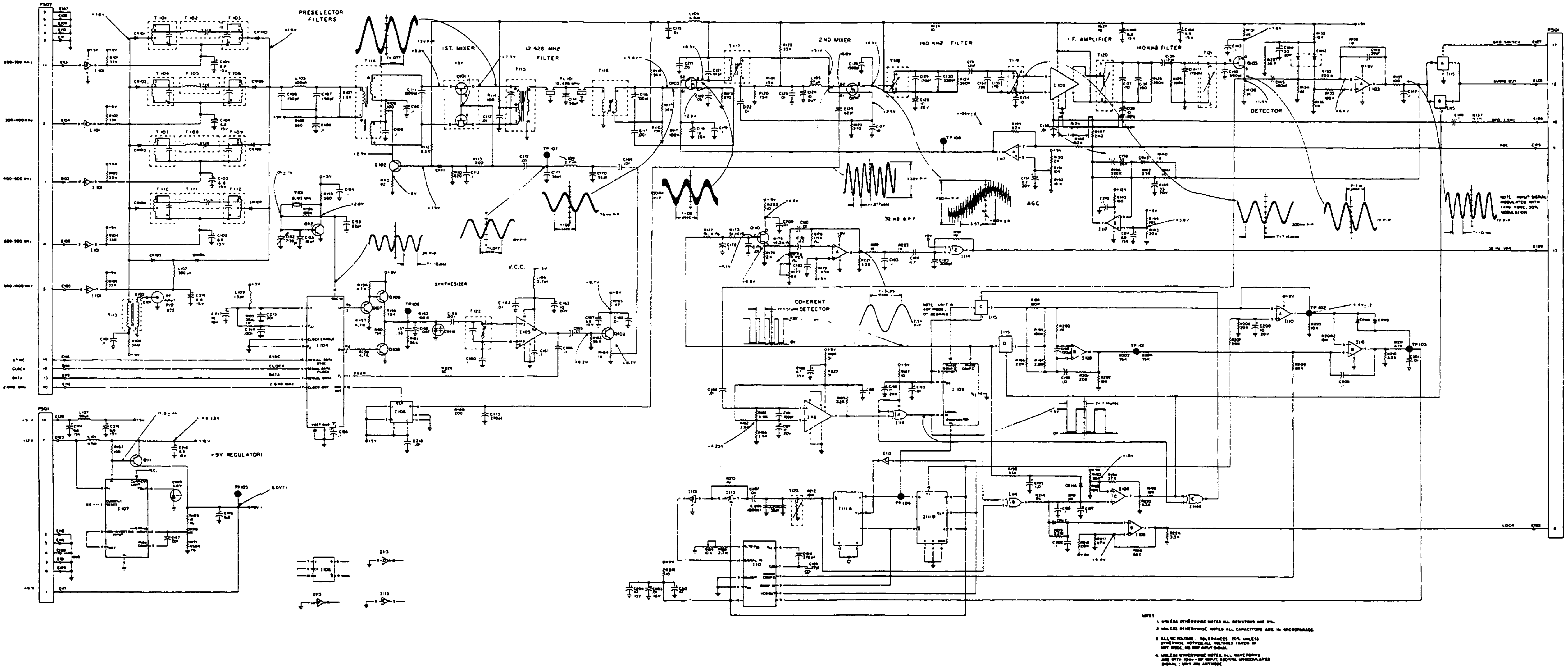


FIGURE 6-6B KR 87 RECEIVER BOARD SCHEMATIC
(Dwg. No. 002-06184-0000 R-3)

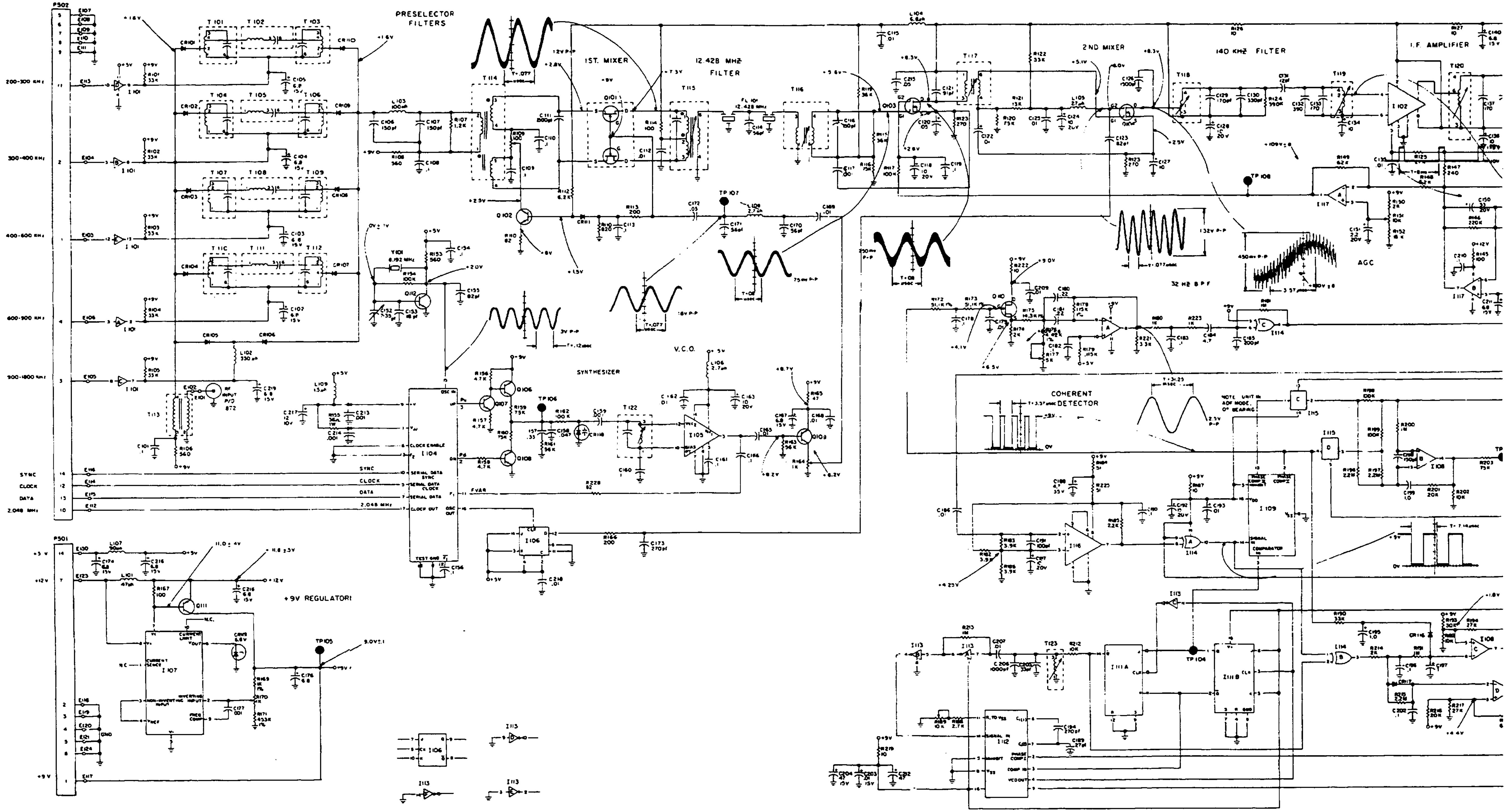


FIGURE 6-6B KR 87 RECEIVER BOARD SCHEMATIC
(Dwg. No. 002-06184-0000 R-3, Zoom Left)

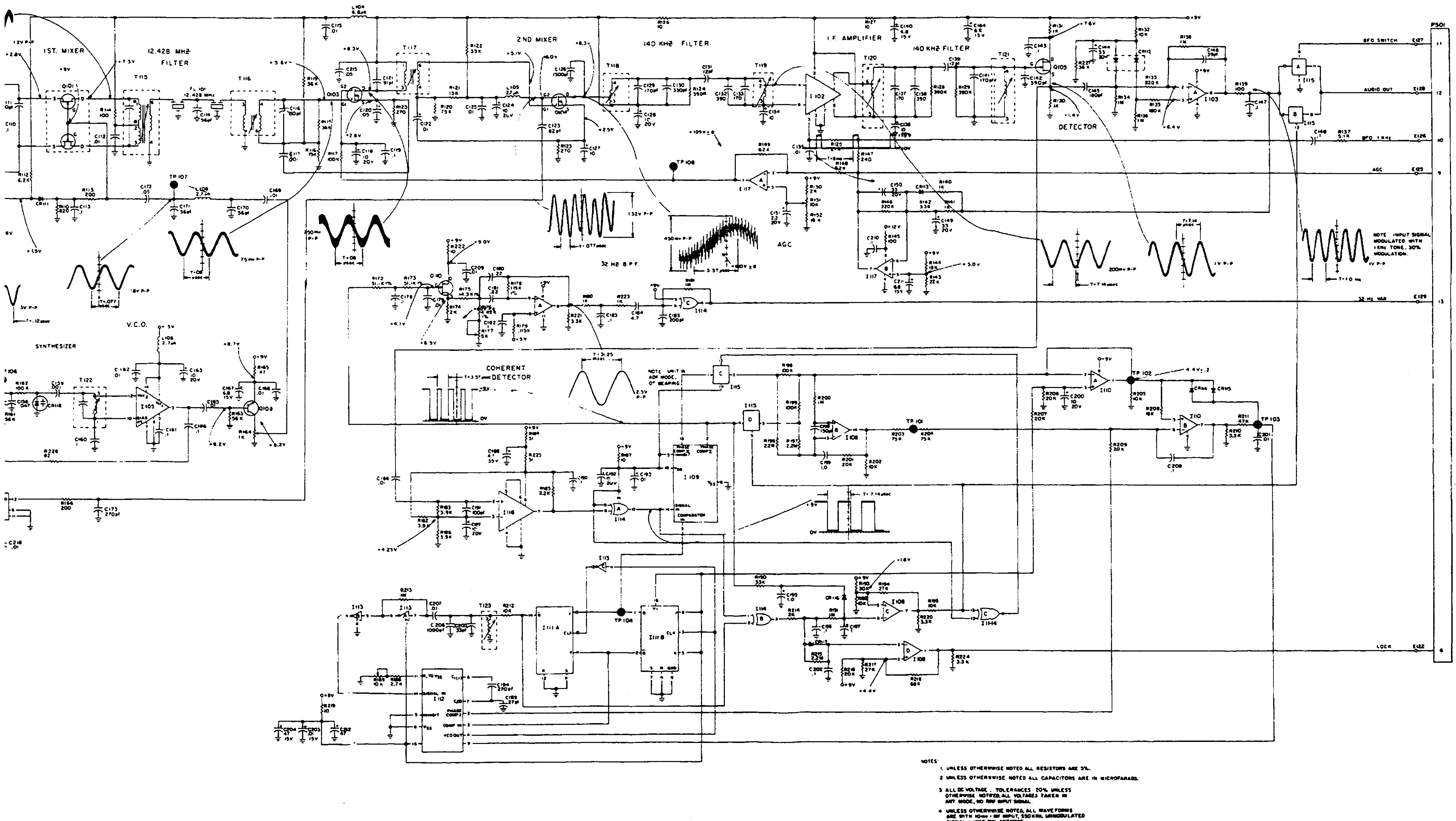


**FIGURE 6-6B KR 87 RECEIVER BOARD SCHEMATIC
(Dwg. No. 002-06184-0000 R-3, Zoom Right)**

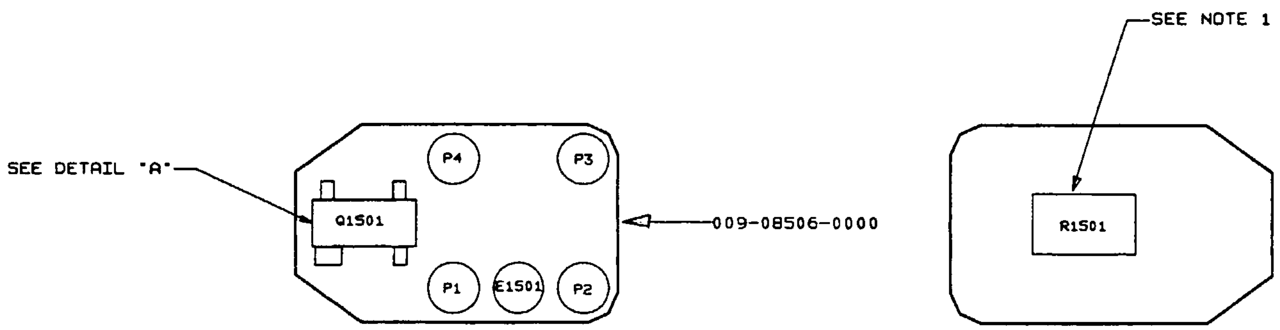
RF AMP BOARD

6.4	200-08506-0000	Rev. 2	KR 87 PC BOARD
	200-08506-0001	Rev. 3	KR 87 PC BOARD
	200-08506-0002	Rev. 3	KR 87 PC BOARD
	200-08506-0003	Rev. 3	KR 87 PC BOARD

SYMBOL	PART NUMBER	DESCRIPTION	[UM]	QUANTITY -0000	-0001	-0002	-0003	-0004
	009-08506-0000	PC RF AMP BD	[EA]	1	1	1	1	1
	025-00018-0098	WIRE 26 WH/GY	[IN]	1				
	026-00003-0000	WIRE COP TIN 22G	[IN]	8	8	8	8	8
Q 1501	007-00957-0000	TSTR MOS FET BF996	[EA]	1	1	1	1	1
R 1501	139-01301-0000	RES CH 1.30K EW 1%	[EA]	1	1	1	1	

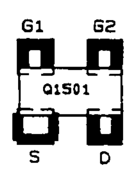
NOTES:

1. R1501 IS NOT USED ON 200-08506-0004.



NEARSIDE VIEW

FARSIDE VIEW



Q1501

DETAIL "A"

Dwg 300-08506-0000 R1

FIGURE 6-7 KR 87 RF AMP BOARD ASSEMBLY
(Dwg. No. 300-08506-0000 R-1)

NOTES:

1. PRIOR TO POST COATING BOTH SIDES OF P.C. BOARD WITH KPN 016-01040-0000, MASK OFF THE FOLLOWING; P1 THRU P4 AND E1501.

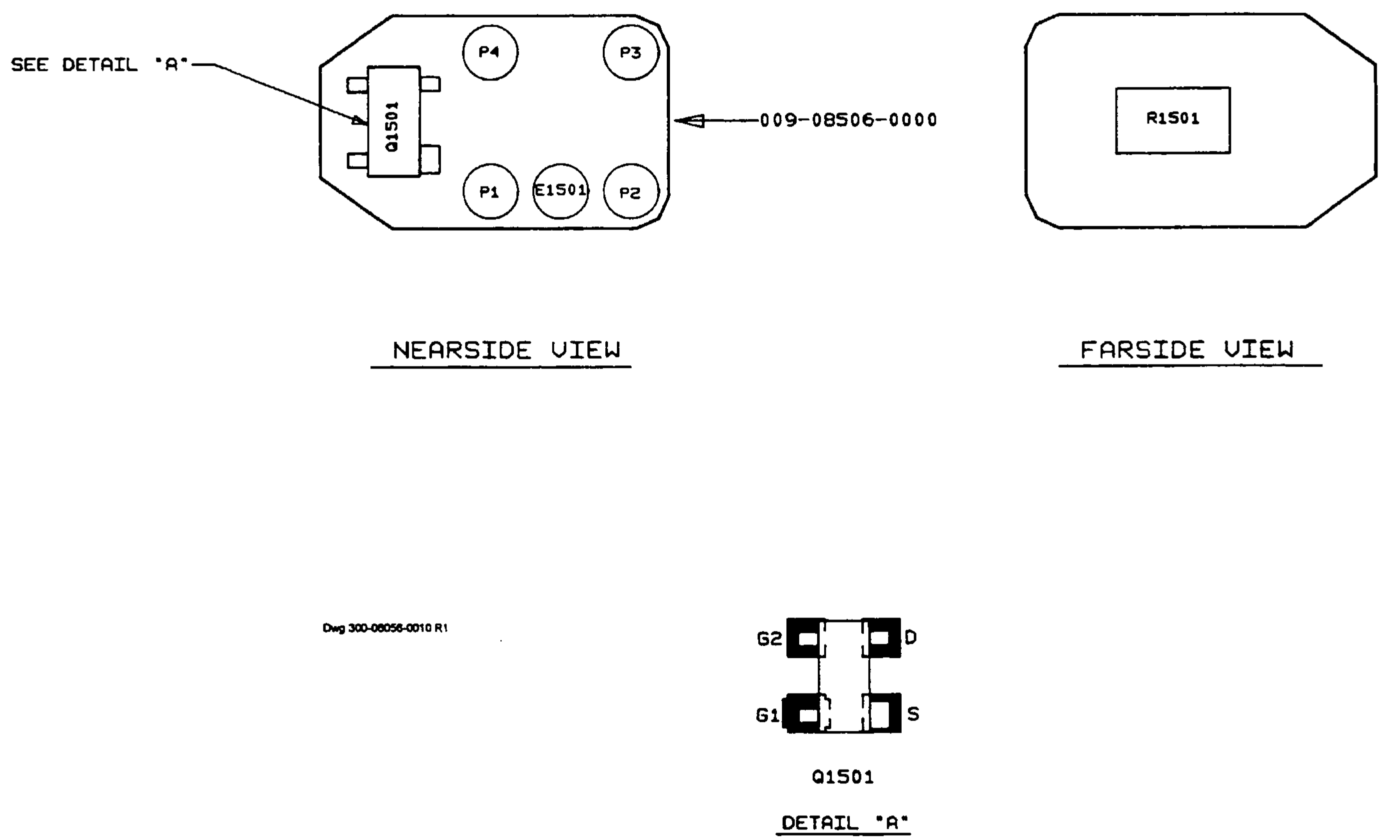


FIGURE 6-8 KR 87 RF AMP BOARD ASSEMBLY
(Dwg. No. 300-08506-0010 R-1)

NOTES:

1. PRIOR TO POST COATING BOTH SIDES OF P.C. BOARD WITH KPN 016-01040-0000, MASK OFF THE FOLLOWING: P1 THRU P4, E1501.

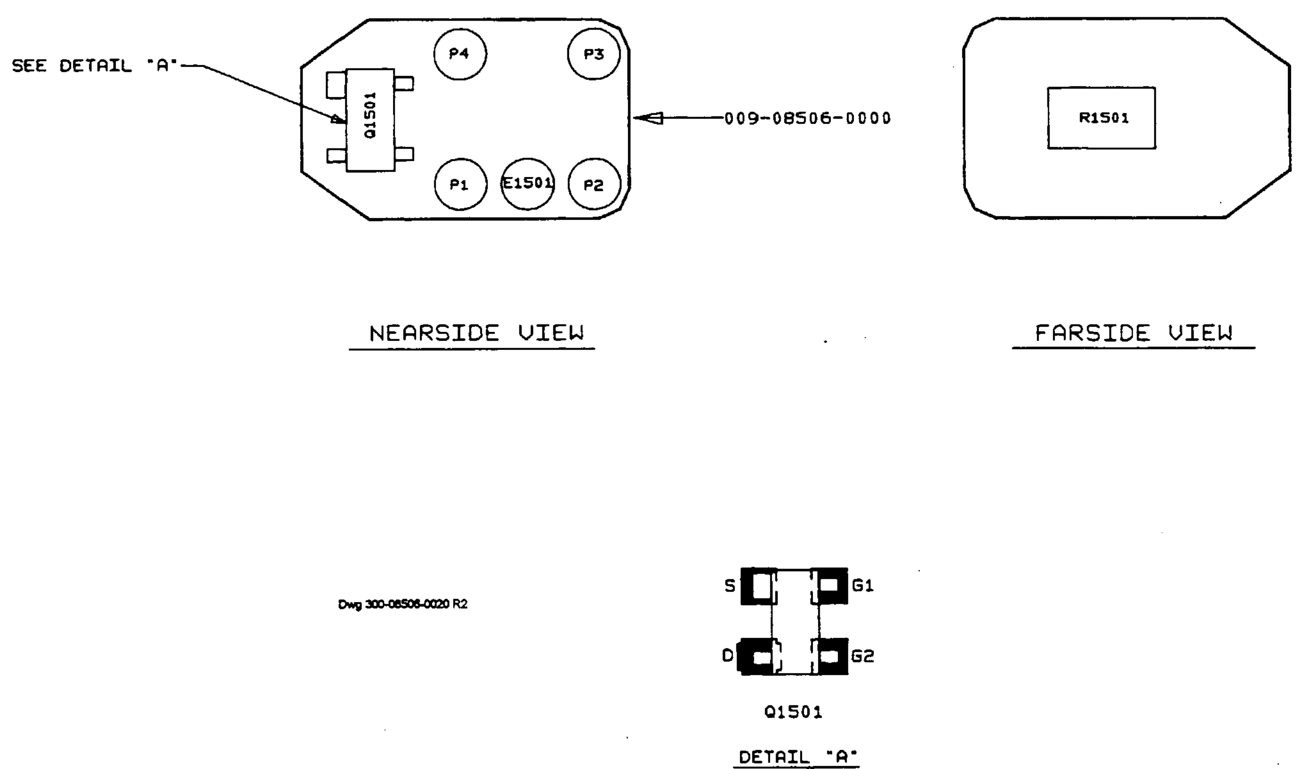
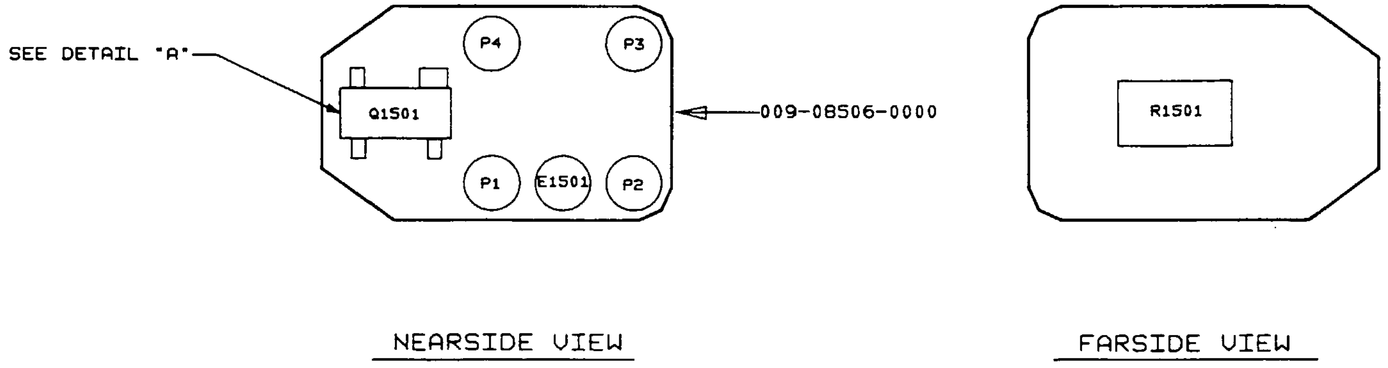
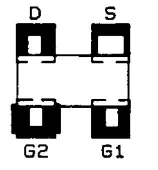


FIGURE 6-9 KR 87 RF AMP BOARD ASSEMBLY
(Dwg. No. 300-08506-0020 R-2)

NOTES:

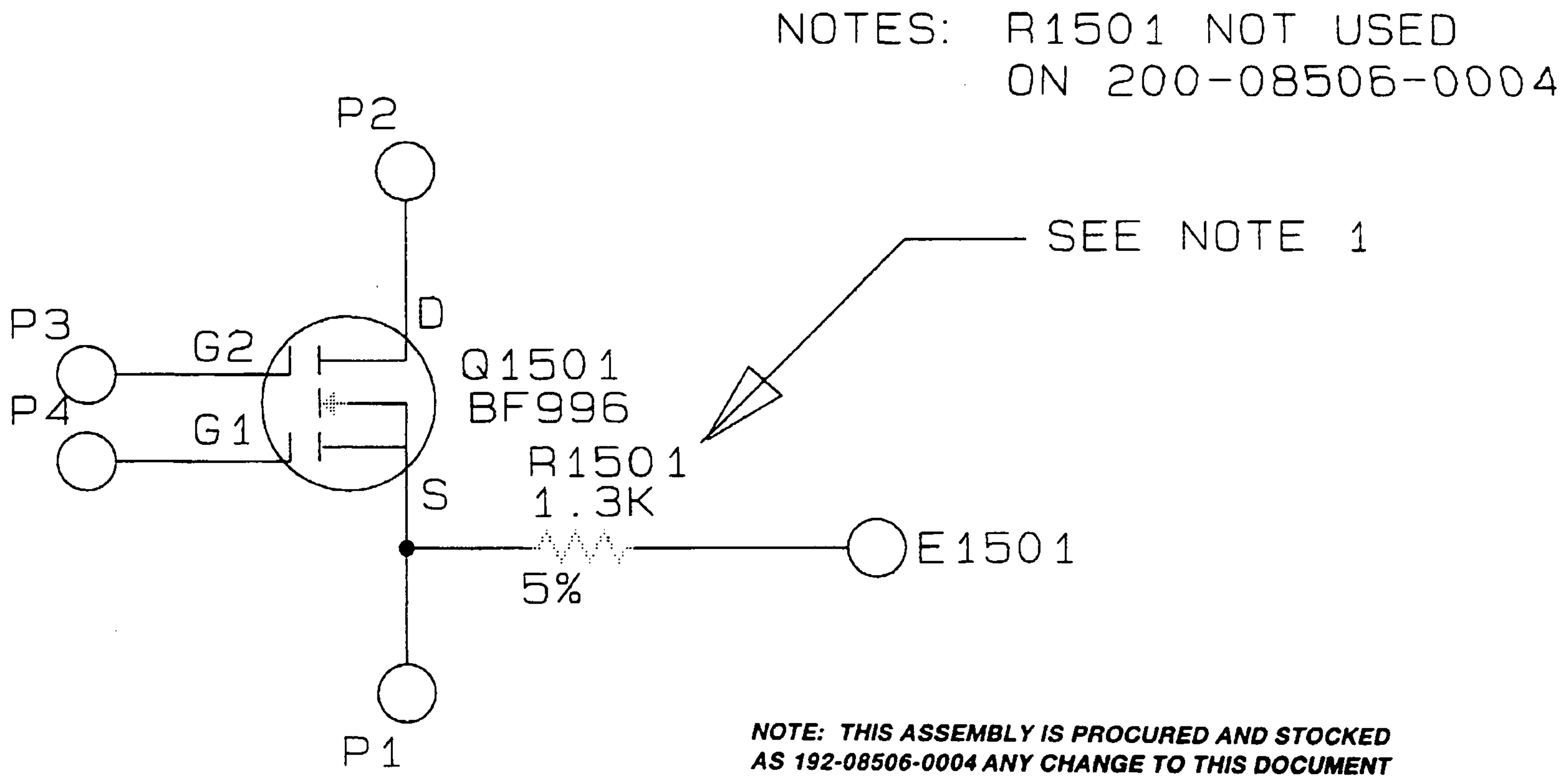
1. PRIOR TO POST COATING BOTH SIDES OF P.C. BOARD WITH KPN 016-01040-0000, MASK OFF THE FOLLOWING: P1 THRU P4 AND E1501.





Dwg 300-08506-0030 R2

FIGURE 6-10 KR 87 RF AMP BOARD ASSEMBLY
(Dwg. No. 300-08506-0030 R-2)



NOTE: THIS ASSEMBLY IS PROCURED AND STOCKED AS 192-08506-0004 ANY CHANGE TO THIS DOCUMENT ALSO REQUIRES A CHANGE TO THE 192-08506-0004 DOCUMENT REFLECTING THE LATEST REVISION.

NOTE: THIS ASSEMBLY IS PROCURED AND STOCKED AS 192-08506-0000 ANY CHANGE TO THIS DOCUMENT ALSO REQUIRES A CHANGE TO THE 192-08506-0000 DOCUMENT REFLECTING THE LATEST REVISION.

FIGURE 6-11 KR 87 RF AMP BOARD SCHEMATIC
(Dwg. No. 002-08506-0000 R-1)

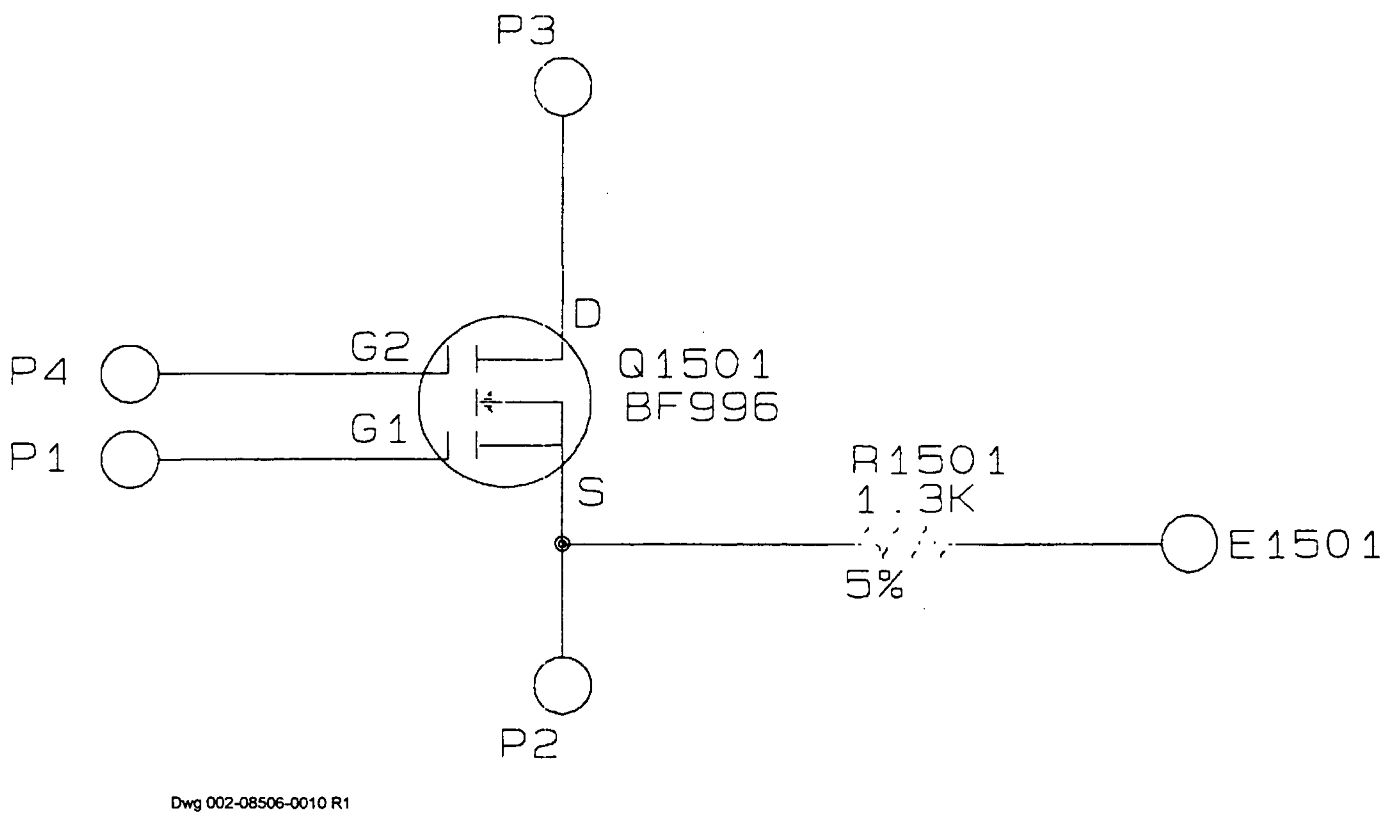


FIGURE 6-12 KR 87 RF AMP BOARD SCHEMATIC
(Dwg. No. 002-08506-0010 R-1)

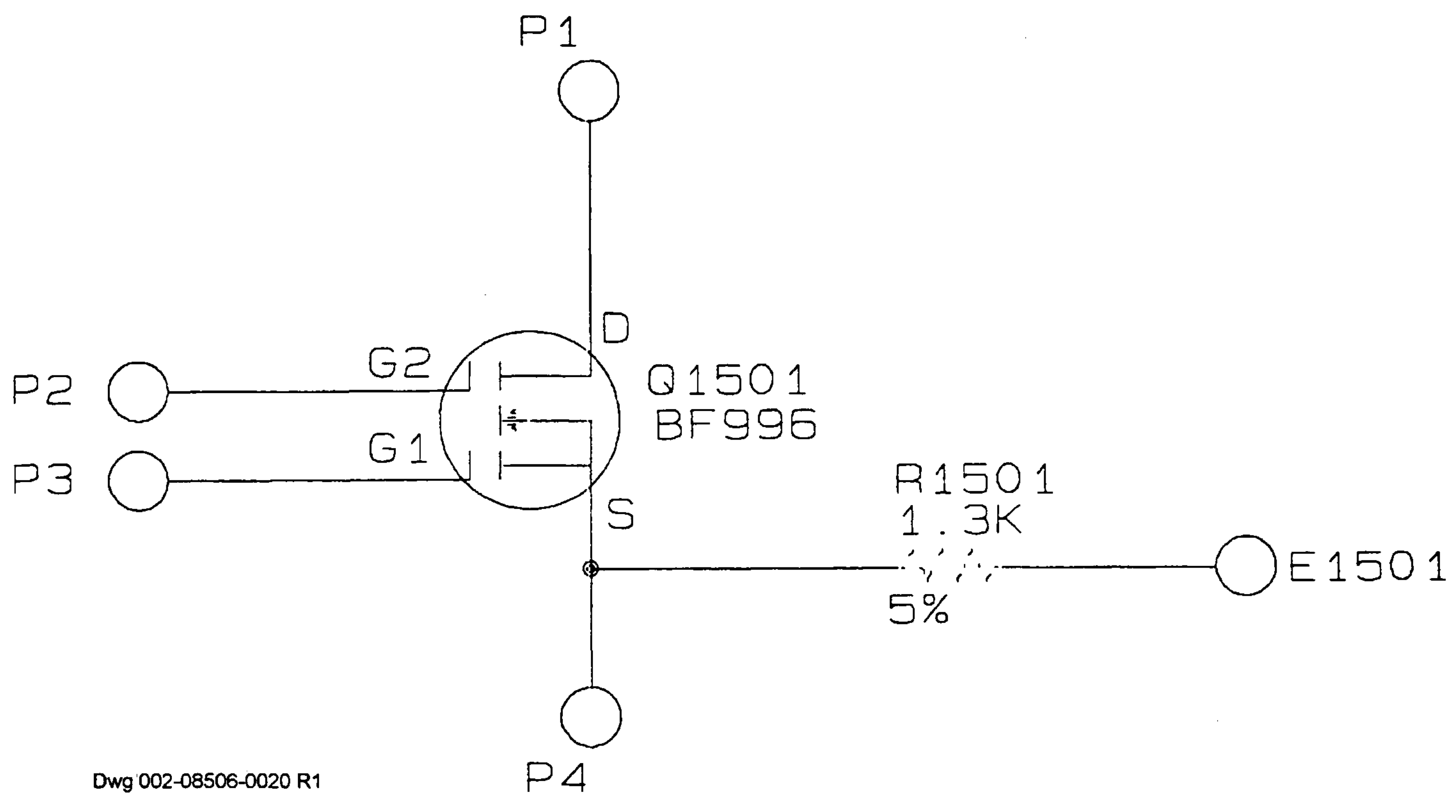


FIGURE 6-13 KR 87 RF AMP BOARD SCHEMATIC
(Dwg. No. 002-08506-0020 R-1)

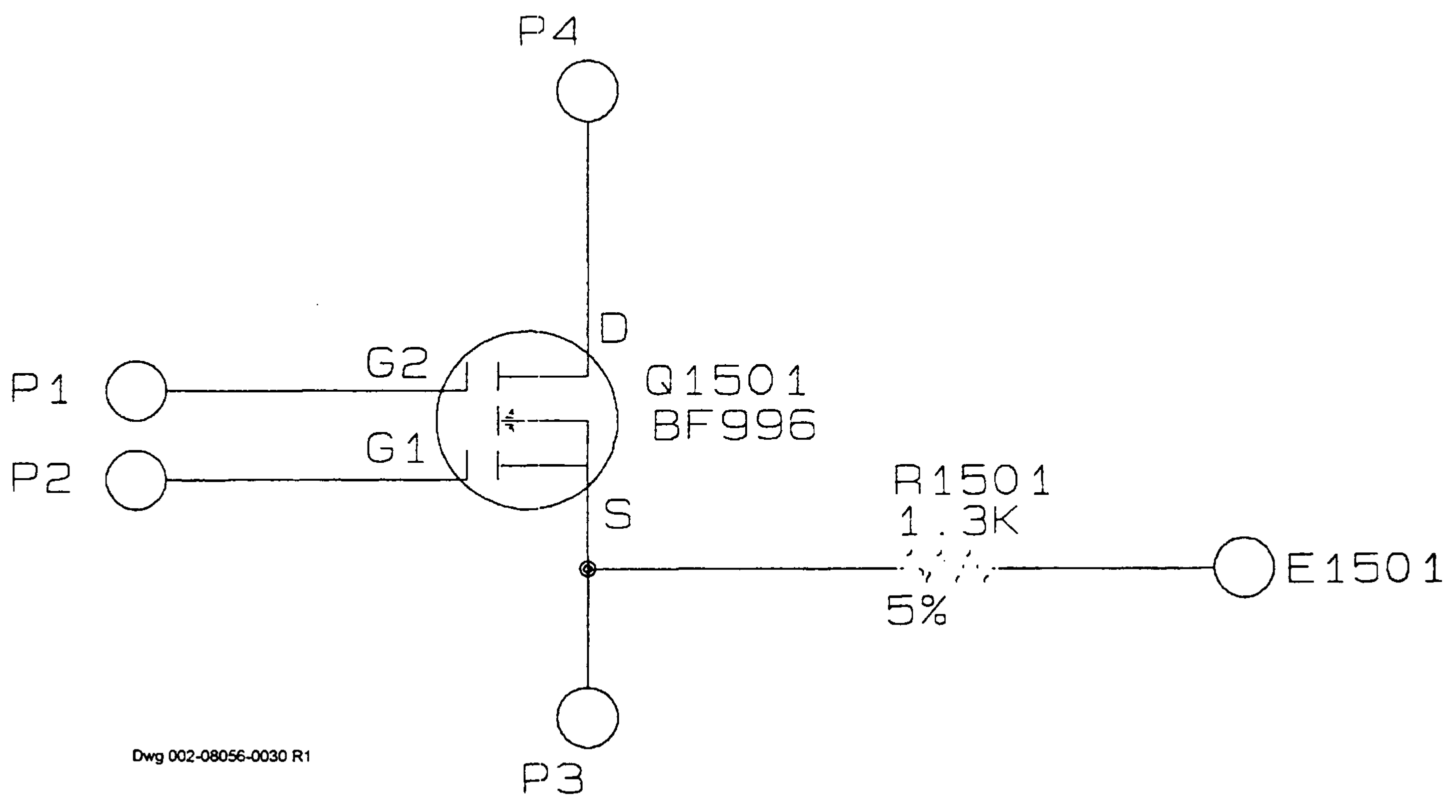


FIGURE 6-14 KR 87 RF AMP BOARD SCHEMATIC
(Dwg. No. 002-08506-0030 R-1)

MAIN BOARD

6.5	200-06185-0000	Rev. 42	KR 87 MAIN BOARD
	200-06185-0001	Rev. 13	KR 87 MAIN BOARD
	200-06185-0002	Rev. 8	KR 87 MAIN BOARD
	200-06185-0003	Rev. 8	KR 87 MAIN BOARD
	200-06185-0099	Rev. 22	KR 87 MAIN BOARD

SYMBOL	PART NUMBER	DESCRIPTION	[UM]	QUANTITY -0000	-0001	-0002	-0003	-0099
_	009-06185-0030	PC MAIN BD	[EA]					1
_	016-01040-0000	COATING TYPE AR	[AR]					0
_	016-01082-0000	NUVASIL 5084	[AR]					
_	025-00018-0055	WIRE 26 GRN	[IN]					4
_	030-02174-0002	PIN CONN MALE	[EA]					8
_	030-02229-0004	RGT ANG HDR 8P	[EA]					1
_	030-02229-0011	RGT ANG HDR 3P	[EA]					5
_	030-02229-0012	RGT ANG HDR 4P	[EA]					1
_	088-00855-0001	PUSH BUTTON SHAFT	[EA]					5
_	088-03025-0000	SHAFT EXTENSION	[EA]					
_	090-00296-0000	FUSE CLIP	[EA]					2
_	091-00055-0001	SCR RHS 2-56X.250	[EA]					1
_	091-00058-0000	NUT FLAT 2-56	[EA]					1
_	091-00186-0000	INSUL XSTR	[EA]					1
_	091-00210-0000	INSUL XSTR	[EA]				1	
_	125-00774-0000	KR87 PDS	[EA]					1
_	126-00094-0000	MEMORY CONTROLLER	[EA]					1
_	150-00047-0000	SHRNK TUBING BLK A	[IN]					2
_	200-06185-0099	MAIN BD	[EA]	1	1	1	1	
C 501	113-03121-0000	CAP DC 120PF 500V	[EA]					1
C 502	113-05102-0000	CAP DC .001UF 500V	[EA]					1
C 503	113-03121-0000	CAP DC 120PF 500V	[EA]					1
C 504	113-05102-0000	CAP DC .001UF 500V	[EA]					1
C 505	113-05102-0000	CAP DC .001UF 500V	[EA]					1
C 506	113-03121-0000	CAP DC 120PF 500V	[EA]					1
C 507	113-03121-0000	CAP DC 120PF 500V	[EA]					1
C 508	113-03121-0000	CAP DC 120PF 500V	[EA]					1
C 509	113-05102-0000	CAP DC .001UF 500V	[EA]					1
C 510	113-03121-0000	CAP DC 120PF 500V	[EA]					1
C 511	113-03121-0000	CAP DC 120PF 500V	[EA]					1

SYMBOL	PART NUMBER	DESCRIPTION	[UM]	QUANTITY -0000	-0001	-0002	-0003	-0099
C 512	113-03121-0000	CAP DC 120PF 500V	[EA]					1
C 513	111-00001-0001	CAP CR .1UF 50V	[EA]					1
C 514	109-00007-0000	CAP DC .01UF 25V	[EA]					1
C 516	096-01082-0005	CAP TN 10UF 20V	[EA]					1
C 517	097-00056-0060	CAP AL 22UF 25V	[EA]					1
C 518	111-00001-0001	CAP CR .1UF 50V	[EA]					1
C 519	109-00007-0000	CAP DC .01UF 25V	[EA]					1
C 521	096-01082-0005	CAP TN 10UF 20V	[EA]					1
C 522	105-00031-0044	CAP MY .022UF 80V	[EA]					1
C 523	113-05101-0001	CAP DC 100PF 500V	[EA]					1
C 524	113-05101-0001	CAP DC 100PF 500V	[EA]					1
C 525	114-07104-0000	CAP DC .1UF 16V	[EA]					1
C 526	113-03121-0000	CAP DC 120PF 500V	[EA]					1
C 527	109-00007-0000	CAP DC .01UF 25V	[EA]					1
C 528	096-01082-0031	CAP TN 4.7UF 35V	[EA]					1
C 529	114-07104-0000	CAP DC .1UF 16V	[EA]					1
C 530	096-01082-0005	CAP TN 10UF 20V	[EA]					1
C 531	096-01082-0019	CAP TN 33UF 20V	[EA]					1
C 532	097-00066-0001	CAP AL 68UF 50V	[EA]					1
C 533	096-01082-0021	CAP TN 12UF 10V	[EA]					1
C 534	108-05023-0001	CAP PC 1UF 100V	[EA]					1
C 535	195-00182-0000	CAP OPTIONS (KR87)	[EA]					1
C 536	108-05023-0001	CAP PC 1UF 100V	[EA]					1
C 537	195-00182-0000	CAP OPTIONS (KR87)	[EA]					1
C 538	096-01082-0022	CAP TN 22UF 10V	[EA]					1
C 539	111-00001-0001	CAP CR .1UF 50V	[EA]					1
C 540	105-00031-0032	CAP MY .01UF 80V	[EA]					1
C 541	114-07104-0000	CAP DC .1UF 16V	[EA]					1
C 542	096-01082-0002	CAP TN 1UF 35V	[EA]					1
C 543	111-00001-0002	CAP CR .015UF 50V	[EA]					1
C 544	096-01082-0012	CAP TN 3.3UF 15V	[EA]					1
C 545	096-01082-0012	CAP TN 3.3UF 15V	[EA]					1
C 546	109-00007-0000	CAP DC .01UF 25V	[EA]					1
C 547	109-00007-0000	CAP DC .01UF 25V	[EA]					1
C 548	109-00007-0000	CAP DC .01UF 25V	[EA]					1
C 549	097-00056-0060	CAP AL 22UF 25V	[EA]					1
C 550	096-01082-0022	CAP TN 22UF 10V	[EA]					1

SYMBOL	PART NUMBER	DESCRIPTION	[UM]	QUANTITY -0000	-0001	-0002	-0003	-0099
C 551	113-03121-0000	CAP DC 120PF 500V	[EA]					1
C 552	111-00001-0063	CAP CR .022UF 200V	[EA]					1
C 553	097-00066-0001	CAP AL 68UF 50V	[EA]					1
C 554	096-01082-0035	CAP TN 22UF 20V	[EA]					1
C 555	096-01082-0022	CAP TN 22UF 10V	[EA]					1
C 556	096-01082-0010	CAP TN 10UF 35V	[EA]					1
C 558	113-03121-0000	CAP DC 120PF 500V	[EA]					1
C 559	113-03121-0000	CAP DC 120PF 500V	[EA]					1
C 560	096-01082-0050	CAP TN 4.7UF 50V	[EA]					1
C 561	096-01082-0050	CAP TN 4.7UF 50V	[EA]					1
C 562	096-01053-0000	CAP TN 6.8UF 35V	[EA]					1
C 563	096-01053-0000	CAP TN 6.8UF 35V	[EA]					1
C 564	096-01053-0000	CAP TN 6.8UF 35V	[EA]					1
C 565	096-01053-0000	CAP TN 6.8UF 35V	[EA]					1
C 566	111-00001-0035	CAP CR 1000PF 50V	[EA]					1
C 567	111-00001-0001	CAP CR .1UF 50V	[EA]					1
C 568	111-00001-0001	CAP CR .1UF 50V	[EA]					1
C 569	111-00001-0001	CAP CR .1UF 50V	[EA]					1
C 570	113-03121-0000	CAP DC 120PF 500V	[EA]				1	
C 571	096-01082-0042	CAP TN 33UF 15V	[EA]				1	
CJ 501	026-00018-0001	WIRE CKTJMPR 24AWG	[EA]	1		1	1	
CJ 503	026-00018-0001	WIRE CKTJMPR 24AWG	[IN]					
CJ 504	026-00018-0001	WIRE CKTJMPR 24AWG	[IN]					
CJ 505	026-00018-0001	WIRE CKTJMPR 24AWG	[IN]					
CJ 506	026-00018-0001	WIRE CKTJMPR 24AWG	[IN]					
CJ 507	026-00018-0001	WIRE CKTJMPR 24AWG	[IN]					
CJ 508	026-00018-0000	WIRE CKTJMPR 22AWG	[IN]					1
CJ 509	026-00018-0000	WIRE CKTJMPR 22AWG	[IN]					1
CR 501	007-06016-0000	DIO S 1N4154	[EA]					1
CR 502	007-06016-0000	DIO S 1N4154	[EA]					1
CR 503	007-06016-0000	DIO S 1N4154	[EA]					1
CR 504	007-06016-0000	DIO S 1N4154	[EA]					1
CR 505	007-06016-0000	DIO S 1N4154	[EA]					1
CR 506	007-06016-0000	DIO S 1N4154	[EA]					1
CR 507	007-06016-0000	DIO S 1N4154	[EA]					1
CR 508	007-06016-0000	DIO S 1N4154	[EA]					1
CR 509	007-06016-0000	DIO S 1N4154	[EA]					1

SYMBOL	PART NUMBER	DESCRIPTION	[UM]	QUANTITY -0000	-0001	-0002	-0003	-0099
CR 510	007-06016-0000	DIO S 1N4154	[EA]					1
CR 511	007-06016-0000	DIO S 1N4154	[EA]					1
CR 512	007-06016-0000	DIO S 1N4154	[EA]					1
CR 513	007-05011-0000	DIO Z 6.2V 1W 5%	[EA]					1
CR 514	007-06016-0000	DIO S 1N4154	[EA]					1
CR 515	007-06016-0000	DIO S 1N4154	[EA]					1
CR 516	007-06016-0000	DIO S 1N4154	[EA]					1
CR 517	007-06105-0000	DIO HV FDH444	[EA]					1
CR 518	007-06105-0000	DIO HV FDH444	[EA]					1
CR 519	007-06105-0000	DIO HV FDH444	[EA]					1
CR 520	007-06105-0000	DIO HV FDH444	[EA]					1
CR 521	007-06105-0000	DIO HV FDH444	[EA]					1
CR 522	007-06105-0000	DIO HV FDH444	[EA]					1
CR 523	007-06105-0000	DIO HV FDH444	[EA]					1
CR 524	007-06105-0000	DIO HV FDH444	[EA]					1
CR 525	007-06105-0000	DIO HV FDH444	[EA]					1
CR 526	007-06105-0000	DIO HV FDH444	[EA]					1
CR 527	007-06016-0000	DIO S 1N4154	[EA]					1
CR 528	007-06016-0000	DIO S 1N4154	[EA]					1
CR 529	007-06016-0000	DIO S 1N4154	[EA]					1
CR 530	007-05046-0001	DIO Z 1N5231B	[EA]					1
CR 531	007-06016-0000	DIO S 1N4154	[EA]					1
CR 532	007-06016-0000	DIO S 1N4154	[EA]					1
CR 533	007-06016-0000	DIO S 1N4154	[EA]					1
CR 534	007-06016-0000	DIO S 1N4154	[EA]				1	
CR 535	007-05039-0002	DIO Z 40.2V	[EA]				1	
DS 501	037-00012-0001	LAMP MIN T-1 5V	[EA]	1	1		1	
DS 501	088-00084-0008	FLTR LAMP LT BLU	[EA]					
DS 502	037-00012-0001	LAMP MIN T-1 5V	[EA]	1	1		1	
DS 502	088-00084-0008	FLTR LAMP LT BLU	[EA]					
DS 503	037-00012-0001	LAMP MIN T-1 5V	[EA]	1	1		1	
DS 503	088-00084-0008	FLTR LAMP LT BLU	[EA]					
DS 504	037-00012-0001	LAMP MIN T-1 5V	[EA]	1	1		1	
DS 504	088-00084-0008	FLTR LAMP LT BLU	[EA]					
DS 505	037-00012-0001	LAMP MIN T-1 5V	[EA]	1	1		1	
DS 505	088-00084-0008	FLTR LAMP LT BLU	[EA]					
DS 506	037-00012-0001	LAMP MIN T-1 5V	[EA]	1	1		1	

SYMBOL	PART NUMBER	DESCRIPTION	[UM]	QUANTITY -0000	-0001	-0002	-0003	-0099
F 501	036-00058-0003	FUSE AGA 32V 3A	[EA]					1
I 501	120-03052-0000	IC LM324N	[EA]					1
I 502	120-03084-0001	IC TL082CP	[EA]					1
I 503	120-03048-0000	IC LM339N	[EA]					1
I 504	120-06070-0000	IC CD4070BF	[EA]					1
I 505	120-03053-0000	IC LM358N	[EA]					1
I 506	120-02038-0002	M/PROC MK3870	[RF]					0
I 507	120-00163-0000	IC DS8884AN	[EA]					1
I 508	120-00163-0000	IC DS8884AN	[EA]					1
I 509	120-06056-0001	IC SCL4094ABC+	[EA]					1
I 511	120-06058-0000	IC MM74C906N+	[EA]					1
I 512	120-06058-0000	IC MM74C906N+	[EA]					1
I 515	120-06012-0001	IC SCL4016ABC+	[EA]					1
I 516	120-03080-0000	IC SL60827	[EA]					1
I 517	122-30085-0000	MEMORY CONTROLLER	[RF]					0
I 518	120-02183-0005	64K EEPROM	[EA]					1
J 501	033-00092-0007	IC DIP SCKT 14C	[EA]					1
J 502	033-00092-0007	IC DIP SCKT 14C	[EA]					1
L 501	013-00028-0000	FERR BEAD W/LEAD	[EA]					1
L 502	013-00028-0000	FERR BEAD W/LEAD	[EA]					1
L 503	019-02084-0031	CH 2.7UH 10%	[EA]					1
L 504	019-02084-0031	CH 2.7UH 10%	[EA]					1
L 505	013-00028-0000	FERR BEAD W/LEAD	[EA]					1
L 506	013-00028-0000	FERR BEAD W/LEAD	[EA]					1
L 507	013-00028-0000	FERR BEAD W/LEAD	[EA]					1
L 508	013-00038-0000	FERR BEAD	[EA]					1
L 509	013-00028-0000	FERR BEAD W/LEAD	[EA]					1
L 510	013-00028-0000	FERR BEAD W/LEAD	[EA]					1
L 511	013-00028-0000	FERR BEAD W/LEAD	[EA]					1
L 512	019-02084-0031	CH 2.7UH 10%	[EA]					1
L 513	019-02102-0004	CHOKE 90UH	[EA]					1
L 514	019-02083-0010	CH 680UH 5%	[EA]					1
L 515	013-00028-0000	FERR BEAD W/LEAD	[EA]					1
L 516	013-00028-0000	FERR BEAD W/LEAD	[EA]					1
L 517	013-00028-0000	FERR BEAD W/LEAD	[EA]					1
L 518	013-00028-0000	FERR BEAD W/LEAD	[EA]					1
L 519	013-00028-0000	FERR BEAD W/LEAD	[EA]				1	

SYMBOL	PART NUMBER	DESCRIPTION	[UM]	QUANTITY -0000	-0001	-0002	-0003	-0099
Q 501	007-00208-0003	DARLINGTON TSTR	[EA]		1			
Q 501	007-00276-0000	XSTR MJE180	[EA]			1		
Q 501	007-00276-0004	XSTR MJE182	[EA]	1			1	
Q 502	007-00207-0002	XSTR PNP MJE702	[EA]		1			
Q 502	007-00276-0001	XSTR MJE170	[EA]			1		
Q 502	007-00276-0005	XSTR MJE172	[EA]	1			1	
Q 503	007-00208-0003	DARLINGTON TSTR	[EA]		1			
Q 503	007-00276-0000	XSTR MJE180	[EA]			1		
Q 503	007-00276-0004	XSTR MJE182	[EA]	1			1	
Q 504	007-00207-0002	XSTR PNP MJE702	[EA]		1			
Q 504	007-00276-0001	XSTR MJE170	[EA]			1		
Q 504	007-00276-0005	XSTR MJE172	[EA]	1			1	
Q 505	007-00078-0000	XSTR S NPN 2N3415	[EA]					1
Q 506	007-00276-0004	XSTR MJE182	[EA]					1
Q 507	007-00065-0000	XSTR S PNP 2N3906	[EA]					1
Q 509	007-00162-0000	XSTR S NPN MPS6515	[EA]					1
Q 510	007-00257-0000	XSTR S NPN MPSA42	[EA]					1
Q 511	007-00276-0004	XSTR MJE182	[EA]					1
Q 512	007-00207-0002	XSTR PNP MJE702	[EA]		1			
Q 512	007-00276-0001	XSTR MJE170	[EA]			1		
Q 512	007-00276-0005	XSTR MJE172	[EA]	1			1	
Q 513	007-00065-0000	XSTR S PNP 2N3906	[EA]					1
Q 514	007-00383-0001	XSTR S NPN 2N2222A	[EA]		1			
Q 515	007-00830-0000	XSTR FET VN1310N3	[EA]				1	
Q 516	007-00573-0000	POWER HEXFET	[EA]				1	
R 501	131-00471-0023	RES CF 470 QW 5%	[EA]					1
R 502	131-00104-0023	RES CF 100K QW 5%	[EA]					1
R 503	136-01913-0072	RES PF 191K QW 1%	[EA]					1
R 504	136-02103-0072	RES PF 210K QW 1%	[EA]					1
R 505	136-08061-0072	RES PF 8.06K QW 1%	[EA]					1
R 506	136-01821-0072	RES PF 1.82K QW 1%	[EA]					1
R 507	136-00332-0072	RES PF 33.2 QW 1%	[EA]					1
R 508	136-01300-0072	RES PF 130 QW 1%	[EA]					1
R 509	136-00432-0072	RES PF 43.2 QW 1%	[EA]					1
R 510	136-00499-0072	RES PF 49.9 QW 1%	[EA]					1
R 511	136-00169-0072	RES PF 16.9 QW 1%	[EA]					1
R 512	136-00169-0072	RES PF 16.9 QW 1%	[EA]					1

SYMBOL	PART NUMBER	DESCRIPTION	[UM]	QUANTITY -0000	-0001	-0002	-0003	-0099
R 513	136-00499-0072	RES PF 49.9 QW 1%	[EA]					1
R 514	136-00432-0072	RES PF 43.2 QW 1%	[EA]					1
R 515	136-01300-0072	RES PF 130 QW 1%	[EA]					1
R 516	136-08061-0072	RES PF 8.06K QW 1%	[EA]					1
R 517	136-01821-0072	RES PF 1.82K QW 1%	[EA]					1
R 518	136-00332-0072	RES PF 33.2 QW 1%	[EA]					1
R 519	136-01913-0072	RES PF 191K QW 1%	[EA]					1
R 520	131-00104-0023	RES CF 100K QW 5%	[EA]					1
R 521	131-00471-0023	RES CF 470 QW 5%	[EA]					1
R 522	133-00113-0022	RES VA 50K 20% A	[EA]					1
R 523	136-01873-0072	RES PF 187K QW 1%	[EA]					1
R 524	131-00512-0023	RES CF 5.1K QW 5%	[EA]					1
R 526	131-00100-0023	RES CF 10 QW 5%	[EA]					1
R 527	131-00027-0023	RES CF 2.7 QW 5%	[EA]					1
R 528	131-00223-0023	RES CF 22K QW 5%	[EA]					1
R 529	131-00303-0023	RES CF 30K QW 5%	[EA]					1
R 530	131-00472-0023	RES CF 4.7K QW 5%	[EA]					1
R 531	131-00121-0023	RES CF 120 QW 5%	[EA]					1
R 532	131-00562-0023	RES CF 5.6K QW 5%	[EA]					1
R 533	131-00105-0023	RES CF 1M QW 5%	[EA]					1
R 534	131-00104-0023	RES CF 100K QW 5%	[EA]					1
R 535	131-00104-0023	RES CF 100K QW 5%	[EA]					1
R 536	131-00105-0023	RES CF 1M QW 5%	[EA]					1
R 537	131-00473-0023	RES CF 47K QW 5%	[EA]					1
R 538	131-00202-0023	RES CF 2K QW 5%	[EA]					1
R 539	131-00203-0023	RES CF 20K QW 5%	[EA]					1
R 540	136-01001-0072	RES PF 1K QW 1%	[EA]					1
R 541	136-07153-0072	RES PF 715K QW 1%	[EA]					1
R 542	136-03573-0072	RES PF 357K QW 1%	[EA]					1
R 543	136-03573-0072	RES PF 357K QW 1%	[EA]					1
R 544	136-01001-0072	RES PF 1K QW 1%	[EA]					1
R 545	136-07153-0072	RES PF 715K QW 1%	[EA]					1
R 546	136-03573-0072	RES PF 357K QW 1%	[EA]					1
R 547	136-03573-0072	RES PF 357K QW 1%	[EA]					1
R 548	131-00062-0033	RES CF 6.2 HW 5%	[EA]					1
R 549	131-00471-0023	RES CF 470 QW 5%	[EA]					1
R 550	136-08251-0072	RES PF 8.25K QW 1%	[EA]					1

SYMBOL	PART NUMBER	DESCRIPTION	[UM]	QUANTITY -0000	-0001	-0002	-0003	-0099
R 551	136-08251-0072	RES PF 8.25K QW 1%	[EA]					1
R 552	131-00473-0023	RES CF 47K QW 5%	[EA]					1
R 553	131-00103-0023	RES CF 10K QW 5%	[EA]					1
R 554	131-00103-0023	RES CF 10K QW 5%	[EA]					1
R 564	131-00222-0023	RES CF 2.2K QW 5%	[EA]					1
R 565	131-00182-0023	RES CF 1.8K QW 5%	[EA]					1
R 566	131-00242-0023	RES CF 2.4K QW 5%	[EA]					1
R 567	131-00394-0023	RES CF 390K QW 5%	[EA]					1
R 568	131-00394-0023	RES CF 390K QW 5%	[EA]					1
R 569	131-00104-0023	RES CF 100K QW 5%	[EA]					1
R 570	131-00202-0023	RES CF 2K QW 5%	[EA]					1
R 571	133-00113-0012	RES VA 1K 20% A	[EA]					1
R 572	131-00104-0023	RES CF 100K QW 5%	[EA]					1
R 573	131-00113-0023	RES CF 11K QW 5%	[EA]					1
R 574	131-00472-0023	RES CF 4.7K QW 5%	[EA]					1
R 575	131-00682-0023	RES CF 6.8K QW 5%	[EA]					1
R 576	131-00392-0023	RES CF 3.9K QW 5%	[EA]					1
R 577	131-00101-0023	RES CF 100 QW 5%	[EA]					1
R 578	131-00472-0023	RES CF 4.7K QW 5%	[EA]					1
R 579	131-00393-0023	RES CF 39K QW 5%	[EA]					1
R 580	131-00823-0023	RES CF 82K QW 5%	[EA]					1
R 581	131-00204-0023	RES CF 200K QW 5%	[EA]					1
R 582	131-00683-0023	RES CF 68K QW 5%	[EA]					1
R 583	131-00683-0023	RES CF 68K QW 5%	[EA]					1
R 584	131-00182-0023	RES CF 1.8K QW 5%	[EA]					1
R 585	131-00103-0023	RES CF 10K QW 5%	[EA]					1
R 586	131-00333-0023	RES CF 33K QW 5%	[EA]					1
R 587	131-00100-0023	RES CF 10 QW 5%	[EA]	1		1	1	
R 587	131-00130-0033	RES CF 13 HW 5%	[EA]		1			
R 588	131-00100-0023	RES CF 10 QW 5%	[EA]	1		1	1	
R 588	131-00130-0033	RES CF 13 HW 5%	[EA]		1			
R 589	131-00103-0023	RES CF 10K QW 5%	[EA]					1
R 590	131-00512-0023	RES CF 5.1K QW 5%	[EA]					1
R 591	131-00335-0023	RES CF 3.3M QW 5%	[EA]					1
R 592	131-00335-0023	RES CF 3.3M QW 5%	[EA]					1
R 593	131-00335-0023	RES CF 3.3M QW 5%	[EA]					1
R 594	131-00335-0023	RES CF 3.3M QW 5%	[EA]					1

SYMBOL	PART NUMBER	DESCRIPTION	[UM]	QUANTITY -0000	-0001	-0002	-0003	-0099
R 595	131-00335-0023	RES CF 3.3M QW 5%	[EA]					1
R 596	131-00132-0033	RES CF 1.3K HW 5%	[EA]					1
R 597	131-00272-0023	RES CF 2.7K QW 5%	[EA]					1
R 598	131-00204-0023	RES CF 200K QW 5%	[EA]					1
R 599	136-09092-0072	RES PF 90.9K QW 1%	[EA]					1
R 600	131-00103-0023	RES CF 10K QW 5%	[EA]					1
R 601	131-00203-0023	RES CF 20K QW 5%	[EA]					1
R 602	131-00203-0023	RES CF 20K QW 5%	[EA]					1
R 603	131-00103-0023	RES CF 10K QW 5%	[EA]					1
R 604	131-00102-0023	RES CF 1K QW 5%	[EA]					1
R 605	136-04531-0072	RES PF 4.53K QW 1%	[EA]					1
R 606	136-05111-0072	RES PF 5.11K QW 1%	[EA]					1
R 607	131-00823-0013	RES CF 82K EW 5%	[EA]					1
R 608	131-00130-0033	RES CF 13 HW 5%	[EA]		1			
R 609	131-00130-0033	RES CF 13 HW 5%	[EA]		1			
R 610	131-00474-0023	RES CF 470K QW 5%	[EA]				1	
R 611	131-00363-0023	RES CF 36K QW 5%	[EA]				1	
R 612	131-00303-0023	RES CF 30K QW 5%	[EA]				1	
R 613	131-00203-0023	RES CF 20K QW 5%	[EA]				1	
S 501	031-00357-0000	SWITCH PUSHBUTTON	[EA]					1
S 502	031-00357-0000	SWITCH PUSHBUTTON	[EA]					1
S 503	031-00357-0001	PUSHBUTTON SWITCH	[EA]					1
S 504	031-00357-0001	PUSHBUTTON SWITCH	[EA]					1
S 505	031-00357-0001	PUSHBUTTON SWITCH	[EA]					1
T 501	019-05078-0001	XFMR OUT 500	[EA]					1
TP 501	008-00096-0001	TERMINAL TEST PNT	[EA]					1
TP 502	008-00096-0001	TERMINAL TEST PNT	[EA]					1
TP 503	008-00096-0001	TERMINAL TEST PNT	[EA]					1
TP 504	008-00096-0001	TERMINAL TEST PNT	[EA]					1
TP 505	008-00096-0001	TERMINAL TEST PNT	[EA]					1
TP 506	008-00096-0001	TERMINAL TEST PNT	[EA]					1
TP 507	008-00096-0001	TERMINAL TEST PNT	[EA]					1
TP 508	008-00096-0001	TERMINAL TEST PNT	[EA]					1
TP 509	008-00096-0001	TERMINAL TEST PNT	[EA]					1
U 501	015-00046-0001	NTWK RES/DIO	[EA]					1

200-06185-0004	Rev. 9	KR 87 MAIN BOARD
200-06185-0006	Rev. 7	KR 87 MAIN BOARD
200-06185-0007	Rev. 6	KR 87 MAIN BOARD
200-06185-0099	Rev. 22	KR 87 MAIN BOARD

SYMBOL	PART NUMBER	DESCRIPTION	[UM]	QUANTITY -0004	-0006	-0007	-0099
_	009-06185-0030	PC MAIN BD	[EA]				1
_	016-01040-0000	COATING TYPE AR	[AR]				0
_	016-01082-0000	NUVASIL 5084	[AR]		1		
_	025-00018-0055	WIRE 26 GRN	[IN]				4
_	030-02174-0002	PIN CONN MALE	[EA]				8
_	030-02229-0004	RGT ANG HDR 8P	[EA]				1
_	030-02229-0011	RGT ANG HDR 3P	[EA]				5
_	030-02229-0012	RGT ANG HDR 4P	[EA]				1
_	088-00855-0001	PUSH BUTTON SHAFT	[EA]				5
_	088-03025-0000	SHAFT EXTENSION	[EA]		5		
_	090-00296-0000	FUSE CLIP	[EA]				2
_	091-00055-0001	SCR RHS 2-56X.250	[EA]				1
_	091-00058-0000	NUT FLAT 2-56	[EA]				1
_	091-00186-0000	INSUL XSTR	[EA]				1
_	091-00210-0000	INSUL XSTR	[EA]	1	1	1	
_	125-00774-0000	KR87 PDS	[EA]				1
_	126-00094-0000	MEMORY CONTROLLER	[EA]				1
_	150-00047-0000	SHRNK TUBING BLK A	[IN]				2
_	200-06185-0099	MAIN BD	[EA]	1	1	1	
C 501	113-03121-0000	CAP DC 120PF 500V	[EA]				1
C 502	113-05102-0000	CAP DC .001UF 500V	[EA]				1
C 503	113-03121-0000	CAP DC 120PF 500V	[EA]				1
C 504	113-05102-0000	CAP DC .001UF 500V	[EA]				1
C 505	113-05102-0000	CAP DC .001UF 500V	[EA]				1
C 506	113-03121-0000	CAP DC 120PF 500V	[EA]				1
C 507	113-03121-0000	CAP DC 120PF 500V	[EA]				1
C 508	113-03121-0000	CAP DC 120PF 500V	[EA]				1
C 509	113-05102-0000	CAP DC .001UF 500V	[EA]				1
C 510	113-03121-0000	CAP DC 120PF 500V	[EA]				1
C 511	113-03121-0000	CAP DC 120PF 500V	[EA]				1
C 512	113-03121-0000	CAP DC 120PF 500V	[EA]				1
C 513	111-00001-0001	CAP CR .1UF 50V	[EA]				1
C 514	109-00007-0000	CAP DC .01UF 25V	[EA]				1

SYMBOL	PART NUMBER	DESCRIPTION	[UM]	QUANTITY -0004	-0006	-0007	-0099
C 516	096-01082-0005	CAP TN 10UF 20V	[EA]				1
C 517	097-00056-0060	CAP AL 22UF 25V	[EA]				1
C 518	111-00001-0001	CAP CR .1UF 50V	[EA]				1
C 519	109-00007-0000	CAP DC .01UF 25V	[EA]				1
C 521	096-01082-0005	CAP TN 10UF 20V	[EA]				1
C 522	105-00031-0044	CAP MY .022UF 80V	[EA]				1
C 523	113-05101-0001	CAP DC 100PF 500V	[EA]				1
C 524	113-05101-0001	CAP DC 100PF 500V	[EA]				1
C 525	114-07104-0000	CAP DC .1UF 16V	[EA]				1
C 526	113-03121-0000	CAP DC 120PF 500V	[EA]				1
C 527	109-00007-0000	CAP DC .01UF 25V	[EA]				1
C 528	096-01082-0031	CAP TN 4.7UF 35V	[EA]				1
C 529	114-07104-0000	CAP DC .1UF 16V	[EA]				1
C 530	096-01082-0005	CAP TN 10UF 20V	[EA]				1
C 531	096-01082-0019	CAP TN 33UF 20V	[EA]				1
C 532	097-00066-0001	CAP AL 68UF 50V	[EA]				1
C 533	096-01082-0021	CAP TN 12UF 10V	[EA]				1
C 534	108-05023-0001	CAP PC 1UF 100V	[EA]				1
C 535	195-00182-0000	CAP OPTIONS (KR87)	[EA]				1
C 536	108-05023-0001	CAP PC 1UF 100V	[EA]				1
C 537	195-00182-0000	CAP OPTIONS (KR87)	[EA]				1
C 538	096-01082-0022	CAP TN 22UF 10V	[EA]				1
C 539	111-00001-0001	CAP CR .1UF 50V	[EA]				1
C 540	105-00031-0032	CAP MY .01UF 80V	[EA]				1
C 541	114-07104-0000	CAP DC .1UF 16V	[EA]				1
C 542	096-01082-0002	CAP TN 1UF 35V	[EA]				1
C 543	111-00001-0002	CAP CR .015UF 50V	[EA]				1
C 544	096-01082-0012	CAP TN 3.3UF 15V	[EA]				1
C 545	096-01082-0012	CAP TN 3.3UF 15V	[EA]				1
C 546	109-00007-0000	CAP DC .01UF 25V	[EA]				1
C 547	109-00007-0000	CAP DC .01UF 25V	[EA]				1
C 548	109-00007-0000	CAP DC .01UF 25V	[EA]				1
C 549	097-00056-0060	CAP AL 22UF 25V	[EA]				1
C 550	096-01082-0022	CAP TN 22UF 10V	[EA]				1
C 551	113-03121-0000	CAP DC 120PF 500V	[EA]				1
C 552	111-00001-0063	CAP CR .022UF 200V	[EA]				1
C 553	097-00066-0001	CAP AL 68UF 50V	[EA]				1

SYMBOL	PART NUMBER	DESCRIPTION	[UM]	QUANTITY -0004	-0006	-0007	-0099
C 554	096-01082-0035	CAP TN 22UF 20V	[EA]				1
C 555	096-01082-0022	CAP TN 22UF 10V	[EA]				1
C 556	096-01082-0010	CAP TN 10UF 35V	[EA]				1
C 558	113-03121-0000	CAP DC 120PF 500V	[EA]				1
C 559	113-03121-0000	CAP DC 120PF 500V	[EA]				1
C 560	096-01082-0050	CAP TN 4.7UF 50V	[EA]				1
C 561	096-01082-0050	CAP TN 4.7UF 50V	[EA]				1
C 562	096-01053-0000	CAP TN 6.8UF 35V	[EA]				1
C 563	096-01053-0000	CAP TN 6.8UF 35V	[EA]				1
C 564	096-01053-0000	CAP TN 6.8UF 35V	[EA]				1
C 565	096-01053-0000	CAP TN 6.8UF 35V	[EA]				1
C 566	111-00001-0035	CAP CR 1000PF 50V	[EA]				1
C 567	111-00001-0001	CAP CR .1UF 50V	[EA]				1
C 568	111-00001-0001	CAP CR .1UF 50V	[EA]				1
C 569	111-00001-0001	CAP CR .1UF 50V	[EA]				1
C 570	113-03121-0000	CAP DC 120PF 500V	[EA]	1	1	1	
C 571	096-01082-0042	CAP TN 33UF 15V	[EA]	1	1	1	
CJ 501	026-00018-0001	WIRE CKTJMPR 24AWG	[EA]		1	1	
CJ 503	026-00018-0001	WIRE CKTJMPR 24AWG	[IN]		1	1	
CJ 504	026-00018-0001	WIRE CKTJMPR 24AWG	[IN]		1	1	
CJ 505	026-00018-0001	WIRE CKTJMPR 24AWG	[IN]		1	1	
CJ 506	026-00018-0001	WIRE CKTJMPR 24AWG	[IN]		1	1	
CJ 507	026-00018-0001	WIRE CKTJMPR 24AWG	[IN]		1	1	
CJ 508	026-00018-0000	WIRE CKTJMPR 22AWG	[IN]				1
CJ 509	026-00018-0000	WIRE CKTJMPR 22AWG	[IN]				1
CR 501	007-06016-0000	DIO S 1N4154	[EA]				1
CR 502	007-06016-0000	DIO S 1N4154	[EA]				1
CR 503	007-06016-0000	DIO S 1N4154	[EA]				1
CR 504	007-06016-0000	DIO S 1N4154	[EA]				1
CR 505	007-06016-0000	DIO S 1N4154	[EA]				1
CR 506	007-06016-0000	DIO S 1N4154	[EA]				1
CR 507	007-06016-0000	DIO S 1N4154	[EA]				1
CR 508	007-06016-0000	DIO S 1N4154	[EA]				1
CR 509	007-06016-0000	DIO S 1N4154	[EA]				1
CR 510	007-06016-0000	DIO S 1N4154	[EA]				1
CR 511	007-06016-0000	DIO S 1N4154	[EA]				1
CR 512	007-06016-0000	DIO S 1N4154	[EA]				1

SYMBOL	PART NUMBER	DESCRIPTION	[UM]	QUANTITY -0004	-0006	-0007	-0099
CR 513	007-05011-0000	DIO Z 6.2V 1W 5%	[EA]				1
CR 514	007-06016-0000	DIO S 1N4154	[EA]				1
CR 515	007-06016-0000	DIO S 1N4154	[EA]				1
CR 516	007-06016-0000	DIO S 1N4154	[EA]				1
CR 517	007-06105-0000	DIO HV FDH444	[EA]				1
CR 518	007-06105-0000	DIO HV FDH444	[EA]				1
CR 519	007-06105-0000	DIO HV FDH444	[EA]				1
CR 520	007-06105-0000	DIO HV FDH444	[EA]				1
CR 521	007-06105-0000	DIO HV FDH444	[EA]				1
CR 522	007-06105-0000	DIO HV FDH444	[EA]				1
CR 523	007-06105-0000	DIO HV FDH444	[EA]				1
CR 524	007-06105-0000	DIO HV FDH444	[EA]				1
CR 525	007-06105-0000	DIO HV FDH444	[EA]				1
CR 526	007-06105-0000	DIO HV FDH444	[EA]				1
CR 527	007-06016-0000	DIO S 1N4154	[EA]				1
CR 528	007-06016-0000	DIO S 1N4154	[EA]				1
CR 529	007-06016-0000	DIO S 1N4154	[EA]				1
CR 530	007-05046-0001	DIO Z 1N5231B	[EA]				1
CR 531	007-06016-0000	DIO S 1N4154	[EA]				1
CR 532	007-06016-0000	DIO S 1N4154	[EA]				1
CR 533	007-06016-0000	DIO S 1N4154	[EA]				1
CR 534	007-06016-0000	DIO S 1N4154	[EA]	1	1	1	
CR 535	007-05039-0002	DIO Z 40.2V	[EA]	1	1	1	
DS 501	037-00012-0001	LAMP MIN T-1 5V	[EA]	1	1	1	
DS 501	088-00084-0008	FLTR LAMP LT BLU	[EA]		1	1	
DS 502	037-00012-0001	LAMP MIN T-1 5V	[EA]	1	1	1	
DS 502	088-00084-0008	FLTR LAMP LT BLU	[EA]		1	1	
DS 503	037-00012-0001	LAMP MIN T-1 5V	[EA]	1	1	1	
DS 503	088-00084-0008	FLTR LAMP LT BLU	[EA]		1	1	
DS 504	037-00012-0001	LAMP MIN T-1 5V	[EA]	1	1	1	
DS 504	088-00084-0008	FLTR LAMP LT BLU	[EA]		1	1	
DS 505	037-00012-0001	LAMP MIN T-1 5V	[EA]	1	1	1	
DS 505	088-00084-0008	FLTR LAMP LT BLU	[EA]		1	1	
DS 506	037-00012-0001	LAMP MIN T-1 5V	[EA]	1			
F 501	036-00058-0003	FUSE AGA 32V 3A	[EA]				1
I 501	120-03052-0000	IC LM324N	[EA]				1
I 502	120-03084-0001	IC TL082CP	[EA]				1

SYMBOL	PART NUMBER	DESCRIPTION	[UM]	QUANTITY -0004	-0006	-0007	-0099
I 503	120-03048-0000	IC LM339N	[EA]				1
I 504	120-06070-0000	IC CD4070BF	[EA]				1
I 505	120-03053-0000	IC LM358N	[EA]				1
I 506	120-02038-0002	M/PROC MK3870	[RF]				0
I 507	120-00163-0000	IC DS8884AN	[EA]				1
I 508	120-00163-0000	IC DS8884AN	[EA]				1
I 509	120-06056-0001	IC SCL4094ABC+	[EA]				1
I 511	120-06058-0000	IC MM74C906N+	[EA]				1
I 512	120-06058-0000	IC MM74C906N+	[EA]				1
I 515	120-06012-0001	IC SCL4016ABC+	[EA]				1
I 516	120-03080-0000	IC SL60827	[EA]				1
I 517	122-30085-0000	MEMORY CONTROLLER	[RF]				0
I 518	120-02183-0005	64K EEPROM	[EA]				1
J 501	033-00092-0007	IC DIP SCKT 14C	[EA]				1
J 502	033-00092-0007	IC DIP SCKT 14C	[EA]				1
L 501	013-00028-0000	FERR BEAD W/LEAD	[EA]				1
L 502	013-00028-0000	FERR BEAD W/LEAD	[EA]				1
L 503	019-02084-0031	CH 2.7UH 10%	[EA]				1
L 504	019-02084-0031	CH 2.7UH 10%	[EA]				1
L 505	013-00028-0000	FERR BEAD W/LEAD	[EA]				1
L 506	013-00028-0000	FERR BEAD W/LEAD	[EA]				1
L 507	013-00028-0000	FERR BEAD W/LEAD	[EA]				1
L 508	013-00038-0000	FERR BEAD	[EA]				1
L 509	013-00028-0000	FERR BEAD W/LEAD	[EA]				1
L 510	013-00028-0000	FERR BEAD W/LEAD	[EA]				1
L 511	013-00028-0000	FERR BEAD W/LEAD	[EA]				1
L 512	019-02084-0031	CH 2.7UH 10%	[EA]				1
L 513	019-02102-0004	CHOKE 90UH	[EA]				1
L 514	019-02083-0010	CH 680UH 5%	[EA]				1
L 515	013-00028-0000	FERR BEAD W/LEAD	[EA]				1
L 516	013-00028-0000	FERR BEAD W/LEAD	[EA]				1
L 517	013-00028-0000	FERR BEAD W/LEAD	[EA]				1
L 518	013-00028-0000	FERR BEAD W/LEAD	[EA]				1
L 519	013-00028-0000	FERR BEAD W/LEAD	[EA]	1	1	1	
Q 501	007-00208-0003	DARLINGTON TSTR	[EA]	1			
Q 501	007-00276-0000	XSTR MJE180	[EA]				
Q 501	007-00276-0004	XSTR MJE182	[EA]		1	1	

SYMBOL	PART NUMBER	DESCRIPTION	[UM]	QUANTITY -0004	-0006	-0007	-0099
Q 502	007-00207-0002	XSTR PNP MJE702	[EA]	1			
Q 502	007-00276-0001	XSTR MJE170	[EA]				
Q 502	007-00276-0005	XSTR MJE172	[EA]		1	1	
Q 503	007-00208-0003	DARLINGTON TSTR	[EA]	1			
Q 503	007-00276-0000	XSTR MJE180	[EA]				
Q 503	007-00276-0004	XSTR MJE182	[EA]		1	1	
Q 504	007-00207-0002	XSTR PNP MJE702	[EA]	1			
Q 504	007-00276-0001	XSTR MJE170	[EA]				
Q 504	007-00276-0005	XSTR MJE172	[EA]		1	1	
Q 505	007-00078-0000	XSTR S NPN 2N3415	[EA]				1
Q 506	007-00276-0004	XSTR MJE182	[EA]				1
Q 507	007-00065-0000	XSTR S PNP 2N3906	[EA]				1
Q 509	007-00162-0000	XSTR S NPN MPS6515	[EA]				1
Q 510	007-00257-0000	XSTR S NPN MPSA42	[EA]				1
Q 511	007-00276-0004	XSTR MJE182	[EA]				1
Q 512	007-00207-0002	XSTR PNP MJE702	[EA]	1			
Q 512	007-00276-0001	XSTR MJE170	[EA]				
Q 512	007-00276-0005	XSTR MJE172	[EA]		1	1	
Q 513	007-00065-0000	XSTR S PNP 2N3906	[EA]				1
Q 514	007-00383-0001	XSTR S NPN 2N2222A	[EA]	1			
Q 515	007-00830-0000	XSTR FET VN1310N3	[EA]	1	1	1	
Q 516	007-00573-0000	POWER HEXFET	[EA]	1	1	1	
R 501	131-00471-0023	RES CF 470 QW 5%	[EA]				1
R 502	131-00104-0023	RES CF 100K QW 5%	[EA]				1
R 503	136-01913-0072	RES PF 191K QW 1%	[EA]				1
R 504	136-02103-0072	RES PF 210K QW 1%	[EA]				1
R 505	136-08061-0072	RES PF 8.06K QW 1%	[EA]				1
R 506	136-01821-0072	RES PF 1.82K QW 1%	[EA]				1
R 507	136-00332-0072	RES PF 33.2 QW 1%	[EA]				1
R 508	136-01300-0072	RES PF 130 QW 1%	[EA]				1
R 509	136-00432-0072	RES PF 43.2 QW 1%	[EA]				1
R 510	136-00499-0072	RES PF 49.9 QW 1%	[EA]				1
R 511	136-00169-0072	RES PF 16.9 QW 1%	[EA]				1
R 512	136-00169-0072	RES PF 16.9 QW 1%	[EA]				1
R 513	136-00499-0072	RES PF 49.9 QW 1%	[EA]				1
R 514	136-00432-0072	RES PF 43.2 QW 1%	[EA]				1
R 515	136-01300-0072	RES PF 130 QW 1%	[EA]				1

SYMBOL	PART NUMBER	DESCRIPTION	[UM]	QUANTITY -0004	-0006	-0007	-0099
R 516	136-08061-0072	RES PF 8.06K QW 1%	[EA]				1
R 517	136-01821-0072	RES PF 1.82K QW 1%	[EA]				1
R 518	136-00332-0072	RES PF 33.2 QW 1%	[EA]				1
R 519	136-01913-0072	RES PF 191K QW 1%	[EA]				1
R 520	131-00104-0023	RES CF 100K QW 5%	[EA]				1
R 521	131-00471-0023	RES CF 470 QW 5%	[EA]				1
R 522	133-00113-0022	RES VA 50K 20% A	[EA]				1
R 523	136-01873-0072	RES PF 187K QW 1%	[EA]				1
R 524	131-00512-0023	RES CF 5.1K QW 5%	[EA]				1
R 526	131-00100-0023	RES CF 10 QW 5%	[EA]				1
R 527	131-00027-0023	RES CF 2.7 QW 5%	[EA]				1
R 528	131-00223-0023	RES CF 22K QW 5%	[EA]				1
R 529	131-00303-0023	RES CF 30K QW 5%	[EA]				1
R 530	131-00472-0023	RES CF 4.7K QW 5%	[EA]				1
R 531	131-00121-0023	RES CF 120 QW 5%	[EA]				1
R 532	131-00562-0023	RES CF 5.6K QW 5%	[EA]				1
R 533	131-00105-0023	RES CF 1M QW 5%	[EA]				1
R 534	131-00104-0023	RES CF 100K QW 5%	[EA]				1
R 535	131-00104-0023	RES CF 100K QW 5%	[EA]				1
R 536	131-00105-0023	RES CF 1M QW 5%	[EA]				1
R 537	131-00473-0023	RES CF 47K QW 5%	[EA]				1
R 538	131-00202-0023	RES CF 2K QW 5%	[EA]				1
R 539	131-00203-0023	RES CF 20K QW 5%	[EA]				1
R 540	136-01001-0072	RES PF 1K QW 1%	[EA]				1
R 541	136-07153-0072	RES PF 715K QW 1%	[EA]				1
R 542	136-03573-0072	RES PF 357K QW 1%	[EA]				1
R 543	136-03573-0072	RES PF 357K QW 1%	[EA]				1
R 544	136-01001-0072	RES PF 1K QW 1%	[EA]				1
R 545	136-07153-0072	RES PF 715K QW 1%	[EA]				1
R 546	136-03573-0072	RES PF 357K QW 1%	[EA]				1
R 547	136-03573-0072	RES PF 357K QW 1%	[EA]				1
R 548	131-00062-0033	RES CF 6.2 HW 5%	[EA]				1
R 549	131-00471-0023	RES CF 470 QW 5%	[EA]				1
R 550	136-08251-0072	RES PF 8.25K QW 1%	[EA]				1
R 551	136-08251-0072	RES PF 8.25K QW 1%	[EA]				1
R 552	131-00473-0023	RES CF 47K QW 5%	[EA]				1
R 553	131-00103-0023	RES CF 10K QW 5%	[EA]				1

SYMBOL	PART NUMBER	DESCRIPTION	[UM]	QUANTITY -0004	-0006	-0007	-0099
R 554	131-00103-0023	RES CF 10K QW 5%	[EA]				1
R 564	131-00222-0023	RES CF 2.2K QW 5%	[EA]				1
R 565	131-00182-0023	RES CF 1.8K QW 5%	[EA]				1
R 566	131-00242-0023	RES CF 2.4K QW 5%	[EA]				1
R 567	131-00394-0023	RES CF 390K QW 5%	[EA]				1
R 568	131-00394-0023	RES CF 390K QW 5%	[EA]				1
R 569	131-00104-0023	RES CF 100K QW 5%	[EA]				1
R 570	131-00202-0023	RES CF 2K QW 5%	[EA]				1
R 571	133-00113-0012	RES VA 1K 20% A	[EA]				1
R 572	131-00104-0023	RES CF 100K QW 5%	[EA]				1
R 573	131-00113-0023	RES CF 11K QW 5%	[EA]				1
R 574	131-00472-0023	RES CF 4.7K QW 5%	[EA]				1
R 575	131-00682-0023	RES CF 6.8K QW 5%	[EA]				1
R 576	131-00392-0023	RES CF 3.9K QW 5%	[EA]				1
R 577	131-00101-0023	RES CF 100 QW 5%	[EA]				1
R 578	131-00472-0023	RES CF 4.7K QW 5%	[EA]				1
R 579	131-00393-0023	RES CF 39K QW 5%	[EA]				1
R 580	131-00823-0023	RES CF 82K QW 5%	[EA]				1
R 581	131-00204-0023	RES CF 200K QW 5%	[EA]				1
R 582	131-00683-0023	RES CF 68K QW 5%	[EA]				1
R 583	131-00683-0023	RES CF 68K QW 5%	[EA]				1
R 584	131-00182-0023	RES CF 1.8K QW 5%	[EA]				1
R 585	131-00103-0023	RES CF 10K QW 5%	[EA]				1
R 586	131-00333-0023	RES CF 33K QW 5%	[EA]				1
R 587	131-00100-0023	RES CF 10 QW 5%	[EA]		1	1	
R 587	131-00130-0033	RES CF 13 HW 5%	[EA]	1			
R 588	131-00100-0023	RES CF 10 QW 5%	[EA]		1	1	
R 588	131-00130-0033	RES CF 13 HW 5%	[EA]	1			
R 589	131-00103-0023	RES CF 10K QW 5%	[EA]				1
R 590	131-00512-0023	RES CF 5.1K QW 5%	[EA]				1
R 591	131-00335-0023	RES CF 3.3M QW 5%	[EA]				1
R 592	131-00335-0023	RES CF 3.3M QW 5%	[EA]				1
R 593	131-00335-0023	RES CF 3.3M QW 5%	[EA]				1
R 594	131-00335-0023	RES CF 3.3M QW 5%	[EA]				1
R 595	131-00335-0023	RES CF 3.3M QW 5%	[EA]				1
R 596	131-00132-0033	RES CF 1.3K HW 5%	[EA]				1
R 597	131-00272-0023	RES CF 2.7K QW 5%	[EA]				1

SYMBOL	PART NUMBER	DESCRIPTION	[UM]	QUANTITY -0004	-0006	-0007	-0099
R 598	131-00204-0023	RES CF 200K QW 5%	[EA]				1
R 599	136-09092-0072	RES PF 90.9K QW 1%	[EA]				1
R 600	131-00103-0023	RES CF 10K QW 5%	[EA]				1
R 601	131-00203-0023	RES CF 20K QW 5%	[EA]				1
R 602	131-00203-0023	RES CF 20K QW 5%	[EA]				1
R 603	131-00103-0023	RES CF 10K QW 5%	[EA]				1
R 604	131-00102-0023	RES CF 1K QW 5%	[EA]				1
R 605	136-04531-0072	RES PF 4.53K QW 1%	[EA]				1
R 606	136-05111-0072	RES PF 5.11K QW 1%	[EA]				1
R 607	131-00823-0013	RES CF 82K EW 5%	[EA]				1
R 608	131-00130-0033	RES CF 13 HW 5%	[EA]	1			
R 609	131-00130-0033	RES CF 13 HW 5%	[EA]	1			
R 610	131-00474-0023	RES CF 470K QW 5%	[EA]	1	1	1	
R 611	131-00363-0023	RES CF 36K QW 5%	[EA]	1	1	1	
R 612	131-00303-0023	RES CF 30K QW 5%	[EA]	1	1	1	
R 613	131-00203-0023	RES CF 20K QW 5%	[EA]	1	1	1	
S 501	031-00357-0000	SWITCH PUSHBUTTON	[EA]				1
S 502	031-00357-0000	SWITCH PUSHBUTTON	[EA]				1
S 503	031-00357-0001	PUSHBUTTON SWITCH	[EA]				1
S 504	031-00357-0001	PUSHBUTTON SWITCH	[EA]				1
S 505	031-00357-0001	PUSHBUTTON SWITCH	[EA]				1
T 501	019-05078-0001	XFMR OUT 500	[EA]				1
TP 501	008-00096-0001	TERMINAL TEST PNT	[EA]				1
TP 502	008-00096-0001	TERMINAL TEST PNT	[EA]				1
TP 503	008-00096-0001	TERMINAL TEST PNT	[EA]				1
TP 504	008-00096-0001	TERMINAL TEST PNT	[EA]				1
TP 505	008-00096-0001	TERMINAL TEST PNT	[EA]				1
TP 506	008-00096-0001	TERMINAL TEST PNT	[EA]				1
TP 507	008-00096-0001	TERMINAL TEST PNT	[EA]				1
TP 508	008-00096-0001	TERMINAL TEST PNT	[EA]				1
TP 509	008-00096-0001	TERMINAL TEST PNT	[EA]				1
U 501	015-00046-0001	NTWK RES/DIO	[EA]				1

200-06185-0000 Rev. 20 KR 87 MAIN BOARD

SYMBOL	PART NUMBER	DESCRIPTION	[UM]	QUANTITY
				-0000
_	009-06185-0010	PC MAIN BD	[EA]	1
_	016-01040-0000	COATING TYPE AR	[AR]	AR
_	030-02174-0002	PIN CONN MALE	[EA]	8
_	030-02229-0004	RGT ANG HDR 8P	[EA]	1
_	030-02229-0011	RGT ANG HDR 3P	[EA]	5
_	030-02229-0012	RGT ANG HDR 4P	[EA]	1
_	033-00078-0000	SCKT IC 40P	[EA]	1
_	090-00296-0000	FUSE CLIP	[EA]	2
_	091-00055-0001	SCR RHS 2-56X.250	[EA]	1
_	091-00058-0000	NUT FLAT 2-56	[EA]	1
_	091-00186-0000	INSUL XSTR	[EA]	1
C 501	113-03121-0000	CAP DC 120PF 500V	[EA]	1
C 502	113-05102-0000	CAP DC .001UF 500V	[EA]	1
C 503	113-03121-0000	CAP DC 120PF 500V	[EA]	1
C 504	113-05102-0000	CAP DC .001UF 500V	[EA]	1
C 505	113-05102-0000	CAP DC .001UF 500V	[EA]	1
C 506	113-03121-0000	CAP DC 120PF 500V	[EA]	1
C 507	113-03121-0000	CAP DC 120PF 500V	[EA]	1
C 508	113-03121-0000	CAP DC 120PF 500V	[EA]	1
C 509	113-05102-0000	CAP DC .001UF 500V	[EA]	1
C 510	113-03121-0000	CAP DC 120PF 500V	[EA]	1
C 511	113-03121-0000	CAP DC 120PF 500V	[EA]	1
C 512	113-03121-0000	CAP DC 120PF 500V	[EA]	1
C 513	111-00001-0001	CAP CR .1UF 50V	[EA]	1
C 514	109-00007-0000	CAP DC .01UF 25V	[EA]	1
C 515	111-00001-0001	CAP CR .1UF 50V	[EA]	1
C 516	096-01082-0005	CAP TN 10UF 20V	[EA]	1
C 517	097-00056-0060	CAP AL 22UF 25V	[EA]	1
C 518	111-00001-0001	CAP CR .1UF 50V	[EA]	1
C 519	109-00007-0000	CAP DC .01UF 25V	[EA]	1
C 520	111-00001-0001	CAP CR .1UF 50V	[EA]	1
C 521	096-01082-0005	CAP TN 10UF 20V	[EA]	1
C 522	105-00031-0044	CAP MY .022UF 80V	[EA]	1
C 523	113-05101-0001	CAP DC 100PF 500V	[EA]	1
C 524	113-05101-0001	CAP DC 100PF 500V	[EA]	1
C 525	114-07104-0000	CAP DC .1UF 16V	[EA]	1

SYMBOL	PART NUMBER	DESCRIPTION	[UM]	QUANTITY
				-0000
C 526	113-03121-0000	CAP DC 120PF 500V	[EA]	1
C 527	109-00007-0000	CAP DC .01UF 25V	[EA]	1
C 528	096-01082-0031	CAP TN 4.7UF 35V	[EA]	1
C 529	114-07104-0000	CAP DC .1UF 16V	[EA]	1
C 530	096-01082-0005	CAP TN 10UF 20V	[EA]	1
C 531	096-01082-0019	CAP TN 33UF 20V	[EA]	1
C 532	097-00066-0001	CAP AL 50UF 50V	[EA]	1
C 533	096-01082-0021	CAP TN 12UF 10V	[EA]	1
C 534	108-05023-0001	CAP PC 1UF 100V	[EA]	1
C 535	096-01074-0001	CAP TN 1.5UF 35V	[EA]	1
C 536	108-05023-0001	CAP PC 1UF 100V	[EA]	1
C 537	096-01074-0001	CAP TN 1.5UF 35V	[EA]	1
C 538	096-01082-0022	CAP TN 22UF 10V	[EA]	1
C 539	111-00001-0001	CAP CR .1UF 50V	[EA]	1
C 540	105-00031-0032	CAP MY .01UF 80V	[EA]	1
C 541	114-07104-0000	CAP DC .1UF 16V	[EA]	1
C 542	096-01082-0002	CAP TN 1UF 35V	[EA]	1
C 543	111-00001-0002	CAP CR .015UF 50V	[EA]	1
C 544	096-01082-0012	CAP TN 3.3UF 15V	[EA]	1
C 545	096-01082-0012	CAP TN 3.3UF 15V	[EA]	1
C 546	109-00007-0000	CAP DC .01UF 25V	[EA]	1
C 547	109-00007-0000	CAP DC .01UF 25V	[EA]	1
C 548	109-00007-0000	CAP DC .01UF 25V	[EA]	1
C 549	097-00056-0060	CAP AL 22UF 25V	[EA]	1
C 550	096-01082-0022	CAP TN 22UF 10V	[EA]	1
C 551	113-03121-0000	CAP DC 120PF 500V	[EA]	1
C 552	114-07203-0000	CAP DC .02UF 200V	[EA]	1
C 553	097-00066-0001	CAP AL 50UF 50V	[EA]	1
C 554	096-01082-0035	CAP TN 22UF 20V	[EA]	1
C 555	096-01082-0022	CAP TN 22UF 10V	[EA]	1
C 556	096-01082-0010	CAP TN 10UF 35V	[EA]	1
C 557	096-01082-0005	CAP TN 10UF 20V	[EA]	1
C 558	113-03121-0000	CAP DC 120PF 500V	[EA]	1
C 559	113-03121-0000	CAP DC 120PF 500V	[EA]	1
C 560	096-01082-0050	CAP TN 4.7UF 50V	[EA]	1
C 561	096-01082-0050	CAP TN 4.7UF 50V	[EA]	1
C 562	096-01053-0000	CAP TN 6.8UF 35V	[EA]	1
C 563	096-01053-0000	CAP TN 6.8UF 35V	[EA]	1

SYMBOL	PART NUMBER	DESCRIPTION	[UM]	QUANTITY
				-0000
C 564	096-01053-0000	CAP TN 6.8UF 35V	[EA]	1
C 565	096-01053-0000	CAP TN 6.8UF 35V	[EA]	1
CR 501	007-06016-0000	DIO S 1N4154	[EA]	1
CR 502	007-06016-0000	DIO S 1N4154	[EA]	1
CR 503	007-06016-0000	DIO S 1N4154	[EA]	1
CR 504	007-06016-0000	DIO S 1N4154	[EA]	1
CR 505	007-06016-0000	DIO S 1N4154	[EA]	1
CR 506	007-06016-0000	DIO S 1N4154	[EA]	1
CR 507	007-06016-0000	DIO S 1N4154	[EA]	1
CR 508	007-06016-0000	DIO S 1N4154	[EA]	1
CR 509	007-06016-0000	DIO S 1N4154	[EA]	1
CR 510	007-06016-0000	DIO S 1N4154	[EA]	1
CR 511	007-06016-0000	DIO S 1N4154	[EA]	1
CR 512	007-06016-0000	DIO S 1N4154	[EA]	1
CR 513	007-05011-0000	DIO Z 6.2V 1W 5%	[EA]	1
CR 514	007-06016-0000	DIO S 1N4154	[EA]	1
CR 515	007-06016-0000	DIO S 1N4154	[EA]	1
CR 516	007-06016-0000	DIO S 1N4154	[EA]	1
CR 517	007-06105-0000	DIO HV FDH444	[EA]	1
CR 518	007-06105-0000	DIO HV FDH444	[EA]	1
CR 519	007-06105-0000	DIO HV FDH444	[EA]	1
CR 520	007-06105-0000	DIO HV FDH444	[EA]	1
CR 521	007-06105-0000	DIO HV FDH444	[EA]	1
CR 522	007-06105-0000	DIO HV FDH444	[EA]	1
CR 523	007-06105-0000	DIO HV FDH444	[EA]	1
CR 524	007-06105-0000	DIO HV FDH444	[EA]	1
CR 525	007-06105-0000	DIO HV FDH444	[EA]	1
CR 526	007-06105-0000	DIO HV FDH444	[EA]	1
CR 527	007-06016-0000	DIO S 1N4154	[EA]	1
CR 528	007-06016-0000	DIO S 1N4154	[EA]	1
CR 529	007-06016-0000	DIO S 1N4154	[EA]	1
CR 530	007-05046-0001	DIO Z 1N5231B	[EA]	1
DS 501	037-00075-0000	LMP 6150 T1 5V	[EA]	1
DS 502	037-00075-0000	LMP 6150 T1 5V	[EA]	1
DS 503	037-00075-0000	LMP 6150 T1 5V	[EA]	1
DS 504	037-00075-0000	LMP 6150 T1 5V	[EA]	1
DS 505	037-00075-0000	LMP 6150 T1 5V	[EA]	1

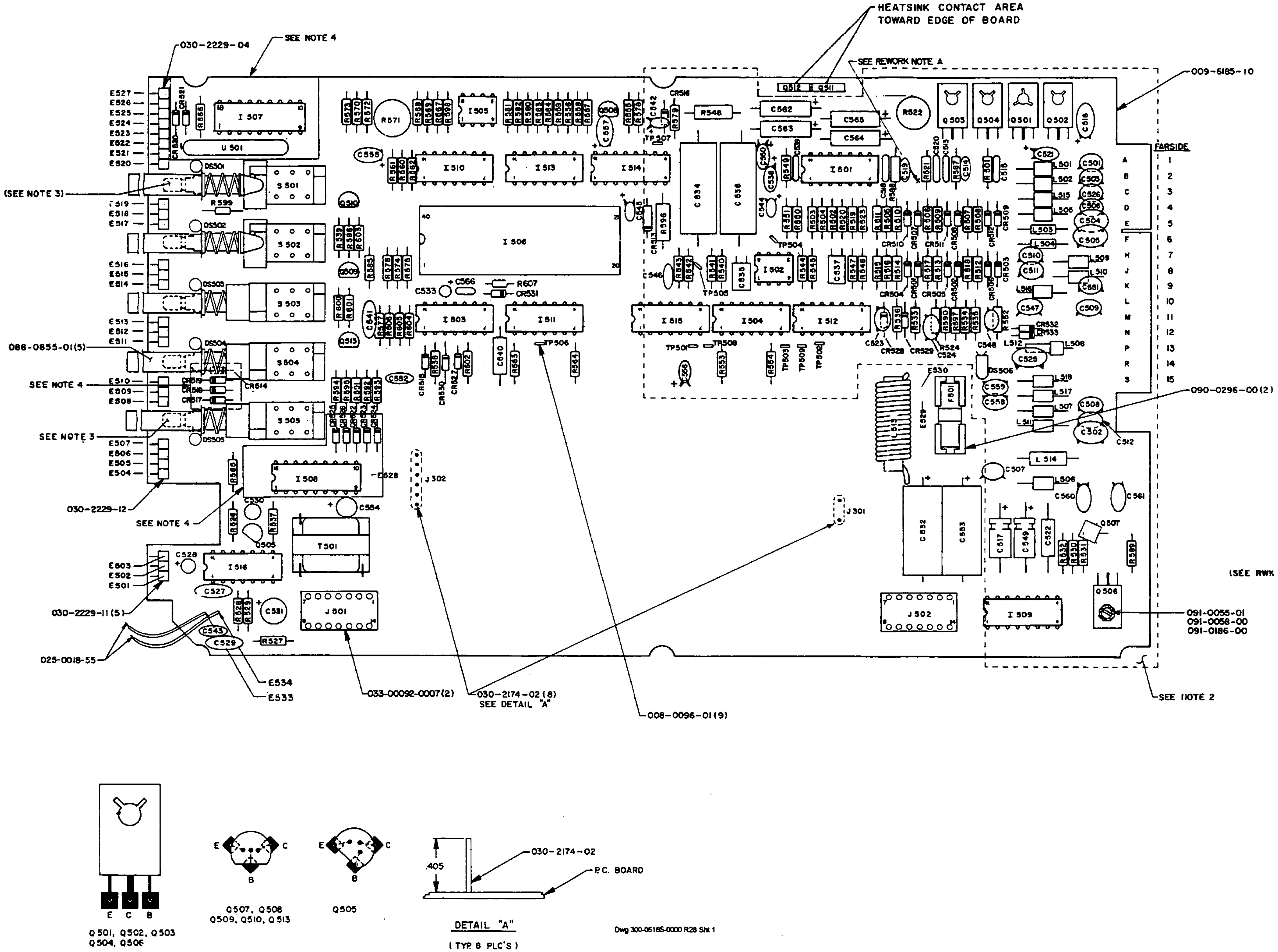
SYMBOL	PART NUMBER	DESCRIPTION	[UM]	QUANTITY
				-0000
F 501	036-00058-0003	FUSE AGA 32V 3A	[EA]	1
I 501	120-03052-0000	IC LM324N	[EA]	1
I 502	120-03084-0001	IC TL082CP	[EA]	1
I 503	120-03078-0000	IC MC3302P	[EA]	1
I 504	120-06070-0000	IC CD4070BF	[EA]	1
I 505	120-03053-0000	IC LM358N	[EA]	1
I 506	120-02038-0001	UPROCESSOR MK3870	[EA]	1
I 507	120-00089-0000	IC DS8884AN+	[EA]	1
I 508	120-00089-0000	IC DS8884AN+	[EA]	1
I 509	120-06056-0001	IC SCL4094ABC+	[EA]	1
I 510	120-06058-0000	IC MM74C906J+	[EA]	1
I 511	120-06058-0000	IC MM74C906J+	[EA]	1
I 512	120-06058-0000	IC MM74C906J+	[EA]	1
I 513	120-02028-0000	IC ER1400T	[EA]	1
I 514	120-06028-0001	IC SCL4040ABC+	[EA]	1
I 515	120-06012-0001	IC SCL4016ABC+	[EA]	1
I 516	120-03080-0000	IC SL60827	[EA]	1
J 501	033-00053-0001	SCKT IC 14P	[EA]	1
J 502	033-00053-0001	SCKT IC 14P	[EA]	1
L 501	013-00028-0000	FERR BEAD W/LEAD	[EA]	1
L 502	013-00028-0000	FERR BEAD W/LEAD	[EA]	1
L 503	019-02084-0031	CH 2.7UH 10%	[EA]	1
L 504	019-02084-0031	CH 2.7UH 10%	[EA]	1
L 505	013-00028-0000	FERR BEAD W/LEAD	[EA]	1
L 506	013-00028-0000	FERR BEAD W/LEAD	[EA]	1
L 507	013-00028-0000	FERR BEAD W/LEAD	[EA]	1
L 508	013-00038-0000	FERR BEAD	[EA]	1
L 509	013-00028-0000	FERR BEAD W/LEAD	[EA]	1
L 510	013-00028-0000	FERR BEAD W/LEAD	[EA]	1
L 511	013-00028-0000	FERR BEAD W/LEAD	[EA]	1
L 512	019-02084-0031	CH 2.7UH 10%	[EA]	1
L 513	019-02102-0004	CH 90UH	[EA]	1
L 514	019-02083-0010	CH 680UH 5%	[EA]	1
L 515	013-00028-0000	FERR BEAD W/LEAD	[EA]	1
L 516	013-00028-0000	FERR BEAD W/LEAD	[EA]	1
L 517	013-00028-0000	FERR BEAD W/LEAD	[EA]	1
L 518	013-00028-0000	FERR BEAD W/LEAD	[EA]	1

SYMBOL	PART NUMBER	DESCRIPTION	[UM]	QUANTITY
				-0000
Q 501	007-00276-0000	XSTR MJE180	[EA]	1
Q 502	007-00276-0001	XSTR MJE170	[EA]	1
Q 503	007-00276-0000	XSTR MJE180	[EA]	1
Q 504	007-00276-0001	XSTR MJE170	[EA]	1
Q 505	007-00078-0000	XSTR S NPN 2N3415	[EA]	1
Q 506	007-00276-0002	XSTR MJE181	[EA]	1
Q 507	007-00065-0000	XSTR S PNP 2N3906	[EA]	1
Q 508	007-00065-0000	XSTR S PNP 2N3906	[EA]	1
Q 509	007-00162-0000	XSTR S NPN MPS6515	[EA]	1
Q 510	007-00257-0000	XSTR S NPN MPSA42	[EA]	1
Q 511	007-00276-0000	XSTR MJE180	[EA]	1
Q 512	007-00276-0001	XSTR MJE170	[EA]	1
Q 513	007-00065-0000	XSTR S PNP 2N3906	[EA]	1
R 501	131-00471-0023	RES CF 470 QW 5%	[EA]	1
R 502	131-00104-0023	RES CF 100K QW 5%	[EA]	1
R 503	136-01913-0072	RES PF 191K QW 1%	[EA]	1
R 504	136-02103-0072	RES PF 210K QW 1%	[EA]	1
R 505	136-08061-0072	RES PF 8.06K QW 1%	[EA]	1
R 506	136-01821-0072	RES PF 1.82K QW 1%	[EA]	1
R 507	136-00332-0072	RES PF 33.2 QW 1%	[EA]	1
R 508	136-01300-0072	RES PF 130 QW 1%	[EA]	1
R 509	136-00432-0072	RES PF 43.2 QW 1%	[EA]	1
R 510	136-00499-0072	RES PF 49.9 QW 1%	[EA]	1
R 511	136-00169-0072	RES PF 16.9 QW 1%	[EA]	1
R 512	136-00169-0072	RES PF 16.9 QW 1%	[EA]	1
R 513	136-00499-0072	RES PF 49.9 QW 1%	[EA]	1
R 514	136-00432-0072	RES PF 43.2 QW 1%	[EA]	1
R 515	136-01300-0072	RES PF 130 QW 1%	[EA]	1
R 516	136-08061-0072	RES PF 8.06K QW 1%	[EA]	1
R 517	136-01821-0072	RES PF 1.82K QW 1%	[EA]	1
R 518	136-00332-0072	RES PF 33.2 QW 1%	[EA]	1
R 519	136-01913-0072	RES PF 191K QW 1%	[EA]	1
R 520	131-00104-0023	RES CF 100K QW 5%	[EA]	1
R 521	131-00471-0023	RES CF 470 QW 5%	[EA]	1
R 522	133-00113-0022	RES VA 50K 20% A	[EA]	1
R 523	136-01873-0072	RES PF 187K QW 1%	[EA]	1
R 524	131-00512-0023	RES CF 5.1K QW 5%	[EA]	1

SYMBOL	PART NUMBER	DESCRIPTION	[UM]	QUANTITY
				-0000
R 526	131-00100-0023	RES CF 10 QW 5%	[EA]	1
R 527	131-00027-0023	RES CF 2.7 QW 5%	[EA]	1
R 528	131-00223-0023	RES CF 22K QW 5%	[EA]	1
R 529	131-00303-0023	RES CF 30K QW 5%	[EA]	1
R 530	131-00472-0023	RES CF 4.7K QW 5%	[EA]	1
R 531	131-00121-0023	RES CF 120 QW 5%	[EA]	1
R 532	131-00562-0023	RES CF 5.6K QW 5%	[EA]	1
R 533	131-00105-0023	RES CF 1M QW 5%	[EA]	1
R 534	131-00104-0023	RES CF 100K QW 5%	[EA]	1
R 535	131-00104-0023	RES CF 100K QW 5%	[EA]	1
R 536	131-00105-0023	RES CF 1M QW 5%	[EA]	1
R 537	131-00473-0023	RES CF 47K QW 5%	[EA]	1
R 538	131-00202-0023	RES CF 2K QW 5%	[EA]	1
R 539	131-00203-0023	RES CF 20K QW 5%	[EA]	1
R 540	136-01001-0072	RES PF 1K QW 1%	[EA]	1
R 541	136-07153-0072	RES PF 715K QW 1%	[EA]	1
R 542	136-03573-0072	RES PF 357K QW 1%	[EA]	1
R 543	136-03573-0072	RES PF 357K QW 1%	[EA]	1
R 544	136-01001-0072	RES PF 1K QW 1%	[EA]	1
R 545	136-07153-0072	RES PF 715K QW 1%	[EA]	1
R 546	136-03573-0072	RES PF 357K QW 1%	[EA]	1
R 547	136-03573-0072	RES PF 357K QW 1%	[EA]	1
R 548	131-00062-0033	RES CF 6.2 HW 5%	[EA]	1
R 549	131-00471-0023	RES CF 470 QW 5%	[EA]	1
R 550	136-08251-0072	RES PF 8.25K QW 1%	[EA]	1
R 551	136-08251-0072	RES PF 8.25K QW 1%	[EA]	1
R 552	131-00473-0023	RES CF 47K QW 5%	[EA]	1
R 553	131-00103-0023	RES CF 10K QW 5%	[EA]	1
R 554	131-00103-0023	RES CF 10K QW 5%	[EA]	1
R 555	131-00103-0023	RES CF 10K QW 5%	[EA]	1
R 556	131-00103-0023	RES CF 10K QW 5%	[EA]	1
R 557	131-00103-0023	RES CF 10K QW 5%	[EA]	1
R 558	131-00103-0023	RES CF 10K QW 5%	[EA]	1
R 559	131-00103-0023	RES CF 10K QW 5%	[EA]	1
R 560	131-00244-0023	RES CF 240K QW 5%	[EA]	1
R 561	131-00274-0023	RES CF 270K QW 5%	[EA]	1
R 562	131-00103-0023	RES CF 10K QW 5%	[EA]	1
R 563	131-00222-0023	RES CF 2.2K QW 5%	[EA]	1
R 564	131-00222-0023	RES CF 2.2K QW 5%	[EA]	1
R 565	131-00182-0023	RES CF 1.8K QW 5%	[EA]	1

SYMBOL	PART NUMBER	DESCRIPTION	[UM]	QUANTITY
				-0000
R 566	131-00242-0023	RES CF 2.4K QW 5%	[EA]	1
R 567	131-00394-0023	RES CF 390K QW 5%	[EA]	1
R 568	131-00394-0023	RES CF 390K QW 5%	[EA]	1
R 569	131-00104-0023	RES CF 100K QW 5%	[EA]	1
R 570	131-00202-0023	RES CF 2K QW 5%	[EA]	1
R 571	133-00113-0012	RES VA 1K 20% A	[EA]	1
R 572	131-00104-0023	RES CF 100K QW 5%	[EA]	1
R 573	131-00113-0023	RES CF 11K QW 5%	[EA]	1
R 574	131-00472-0023	RES CF 4.7K QW 5%	[EA]	1
R 575	131-00682-0023	RES CF 6.8K QW 5%	[EA]	1
R 576	131-00392-0023	RES CF 3.9K QW 5%	[EA]	1
R 577	131-00101-0023	RES CF 100 QW 5%	[EA]	1
R 578	131-00202-0023	RES CF 2K QW 5%	[EA]	1
R 579	131-00393-0023	RES CF 39K QW 5%	[EA]	1
R 580	131-00823-0023	RES CF 82K QW 5%	[EA]	1
R 581	131-00204-0023	RES CF 200K QW 5%	[EA]	1
R 582	131-00683-0023	RES CF 68K QW 5%	[EA]	1
R 583	131-00683-0023	RES CF 68K QW 5%	[EA]	1
R 584	131-00182-0023	RES CF 1.8K QW 5%	[EA]	1
R 585	131-00103-0023	RES CF 10K QW 5%	[EA]	1
R 586	131-00333-0023	RES CF 33K QW 5%	[EA]	1
R 587	131-00100-0023	RES CF 10 QW 5%	[EA]	1
R 588	131-00100-0023	RES CF 10 QW 5%	[EA]	1
R 589	131-00103-0023	RES CF 10K QW 5%	[EA]	1
R 590	131-00512-0023	RES CF 5.1K QW 5%	[EA]	1
R 591	131-00335-0023	RES CF 3.3M QW 5%	[EA]	1
R 592	131-00335-0023	RES CF 3.3M QW 5%	[EA]	1
R 593	131-00335-0023	RES CF 3.3M QW 5%	[EA]	1
R 594	131-00335-0023	RES CF 3.3M QW 5%	[EA]	1
R 595	131-00335-0023	RES CF 3.3M QW 5%	[EA]	1
R 596	131-00132-0033	RES CF 1.3K HW 5%	[EA]	1
R 597	131-00272-0023	RES CF 2.7K QW 5%	[EA]	1
R 598	131-00204-0023	RES CF 200K QW 5%	[EA]	1
R 599	136-09092-0072	RES PF 90.9K QW 1%	[EA]	1
R 600	131-00103-0023	RES CF 10K QW 5%	[EA]	1

SYMBOL	PART NUMBER	DESCRIPTION	[UM]	QUANTITY
				-0000
R 601	131-00203-0023	RES CF 20K QW 5%	[EA]	1
R 602	131-00203-0023	RES CF 20K QW 5%	[EA]	1
R 603	131-00103-0023	RES CF 10K QW 5%	[EA]	1
R 604	131-00102-0023	RES CF 1K QW 5%	[EA]	1
R 605	136-04531-0072		[EA]	1
R 606	136-05111-0072	RES PF 5.11K QW 1%	[EA]	1
S 501	031-00357-0000	SWITCH	[EA]	1
S 502	031-00357-0000	SWITCH	[EA]	1
S 503	031-00357-0001	PUSHBUTTON SWITCH	[EA]	1
S 504	031-00357-0001	PUSHBUTTON SWITCH	[EA]	1
S 505	031-00357-0001	PUSHBUTTON SWITCH	[EA]	1
S 506	031-00343-0003	SWITCH	[EA]	1
T 501	019-05078-0001	XFMR OUT 500	[EA]	1
TP 501	008-00096-0001	TERMINAL TEST PNT	[EA]	1
TP 502	008-00096-0001	TERMINAL TEST PNT	[EA]	1
TP 503	008-00096-0001	TERMINAL TEST PNT	[EA]	1
TP 504	008-00096-0001	TERMINAL TEST PNT	[EA]	1
TP 505	008-00096-0001	TERMINAL TEST PNT	[EA]	1
TP 506	008-00096-0001	TERMINAL TEST PNT	[EA]	1
TP 507	008-00096-0001	TERMINAL TEST PNT	[EA]	1
TP 508	008-00096-0001	TERMINAL TEST PNT	[EA]	1
TP 509	008-00096-0001	TERMINAL TEST PNT	[EA]	1
U 501	015-00046-0001	NTWK RES/DIO	[EA]	1



NOTES:

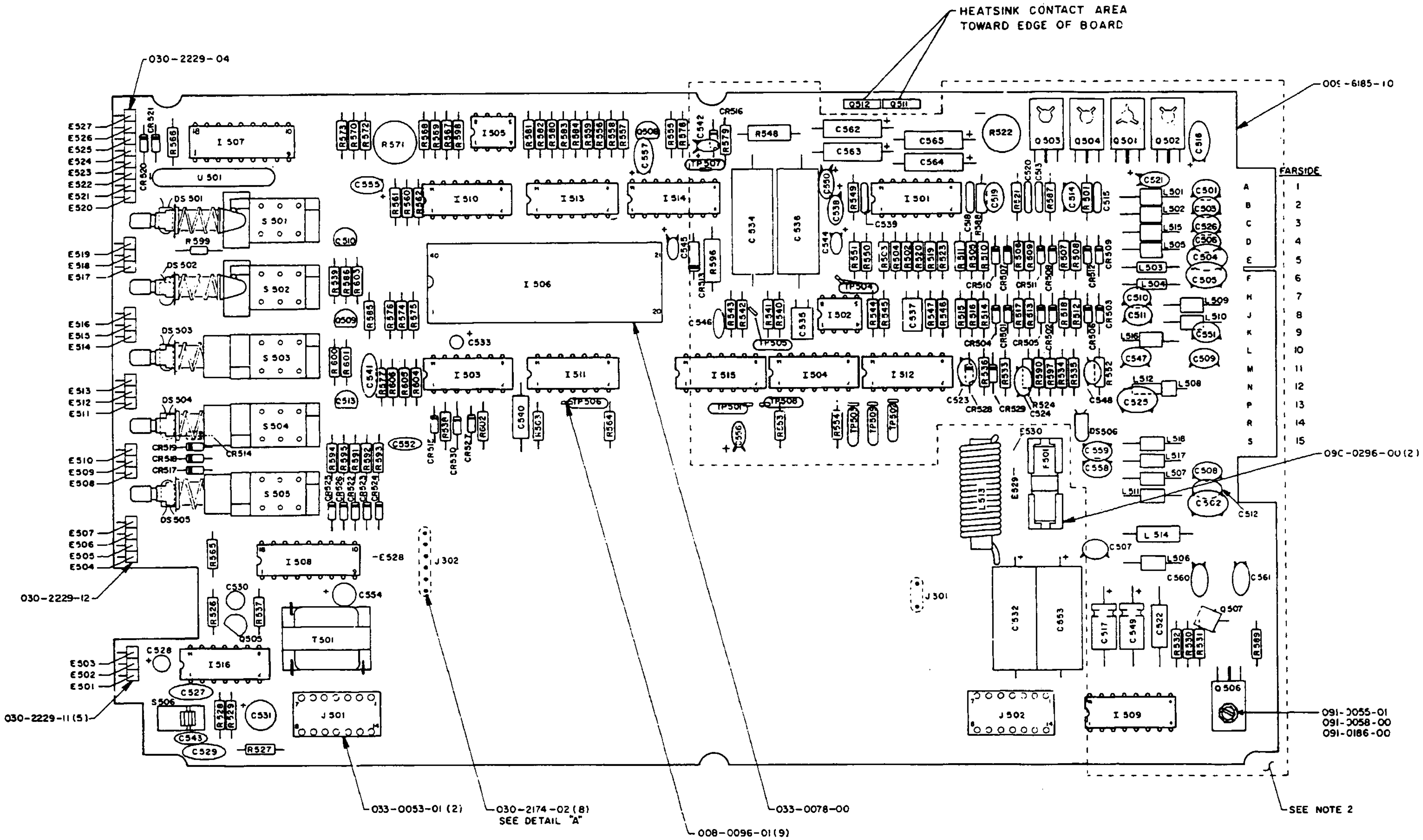
1. PRIOR TO POST COATING WITH CLEAR URETHANE COATING (016-1040-00) MASK OFF THE FOLLOWING AREAS:
   TP501-TP507, R522, R571, J501, J502, F501, S501-S506, 030-2229-04, 030-2229-11, 030-2229-12, 030-2174-02 (8), MOUNTING AREAS, CONNECTOR.
2. A HEIGHT CLEARANCE OF .250 MUST BE MAINTAINED WITHIN THE DASHED AREA, WITH THE EXCEPTION OF C534 AND C536 WHICH MAY BE .280. COMPONENTS THAT EXCEED THIS CLEARANCE, AS EXCEPTED, MUST BE BENT TOWARDS THE BOARD AS SHOWN.
3. APPLY SMALL AMOUNT OF RTV (016-1082-00) TO BOTTOM SIDE OF SWITCH SHAFT (088-0855-01) AND TOP SIDE OF SWITCH PLUNGER. SWITCH PLUNGER ENDS MUST BE FREE OF ANY RTV.
   SPACE BULBS TO CLEAR PUSH BUTTON SHAFT BY 1/32".
4. FORCE UNDILUTED POSTCOAT (016-01040-0000) BETWEEN AND UNDER LEGS OF I507, 508, AND U501. APPLY HEAVY COAT OF UNDILUTED POSTCOAT (016-01040-0000) TO AREAS MARKED NEARSIDE AND FARSIDE.

REWORK NOTES:

A. ON UNITS WITH CUT PATH HERE, ADD MAGWIRE FROM BOTTOM LEAD OF C519 TO TOP LEAD OF R521.

B. ON UNITS WITH CUT PATH HERE, ADD MAGWIRE FROM BOTTOM LEAD OF C514 TO BOTTOM LEAD OF R501.

FIGURE 6-15 KR 87 MAIN BOARD ASSEMBLY
(Dwg. No. 300-06185-0000 R-28)



NOTES:

1. PRIOR TO POST COATING WITH CLEAR URETHANE COATING (016-1040-00) MASK OFF THE FOLLOWING AREAS: TP501-TP507, R522, R571, J501, J502, F501, S501-S506, 030-2229-04, 030-2229-11, 030-2229-12, 030-2174-02 (8), MOUNTING AREAS, CONNECTOR,
2. A HEIGHT CLEARANCE OF .250 MUST BE MAINTAINED WITHIN THE DASHED AREA, WITH THE EXCEPTION OF C534 AND C536 WHICH MAY BE .280. COMPONENTS THAT EXCEED THIS CLEARANCE, AS EXCEPTED, MUST BE BENT TOWARDS THE BOARD AS SHOWN.

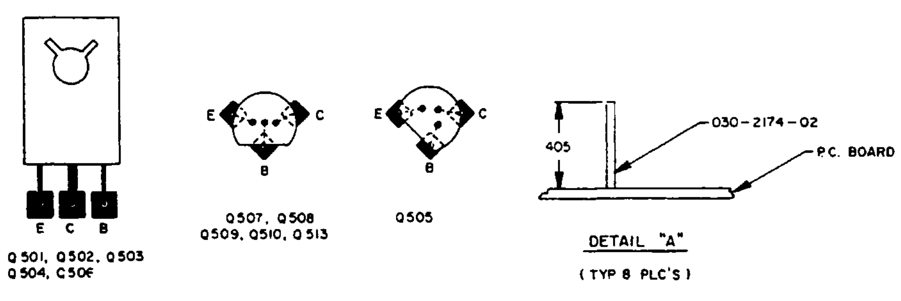
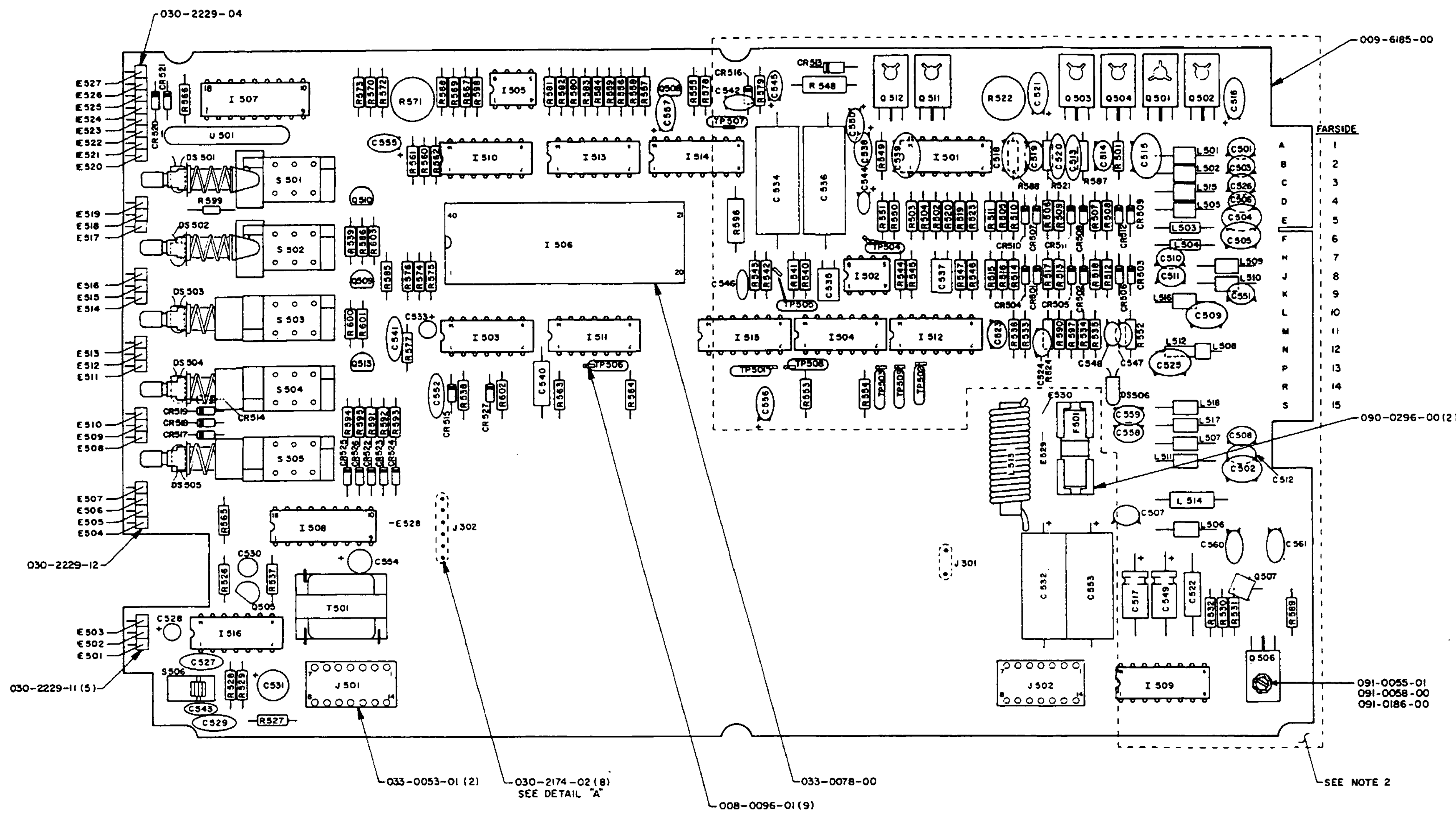


FIGURE 6-15A KR 87 MAIN BOARD ASSEMBLY
(Dwg. No. 300-06185-0000 R-10)



NOTES:

1. PRIOR TO POST COATING WITH CLEAR URETHANE COATING (016-1040-00) MASK OFF THE FOLLOWING AREAS:
   TP501-TP507, R522, R571, J501, J502, F501, S501-S506, 030-2229-04, 030-2229-11 030-2229-12, 030-2174-02 (8), MOUNTING AREAS, CONNECTOR.
2. A HEIGHT CLEARANCE OF .250 MUST BE MAINTAINED WITHIN THE DASHED AREA. COMPONENTS THAT EXCEED THIS CLEARANCE MUST BE BENT TOWARDS THE BOARD AS SHOWN.

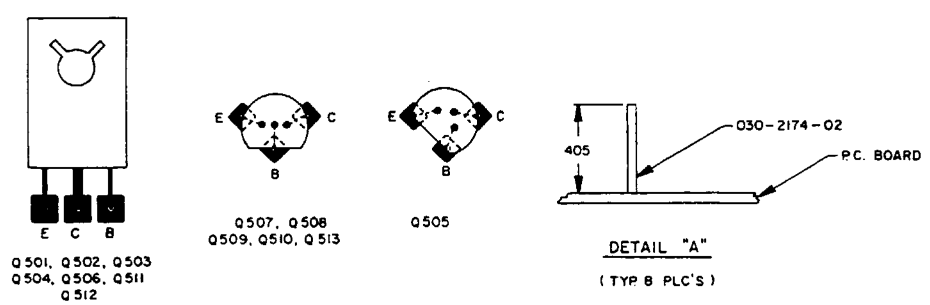
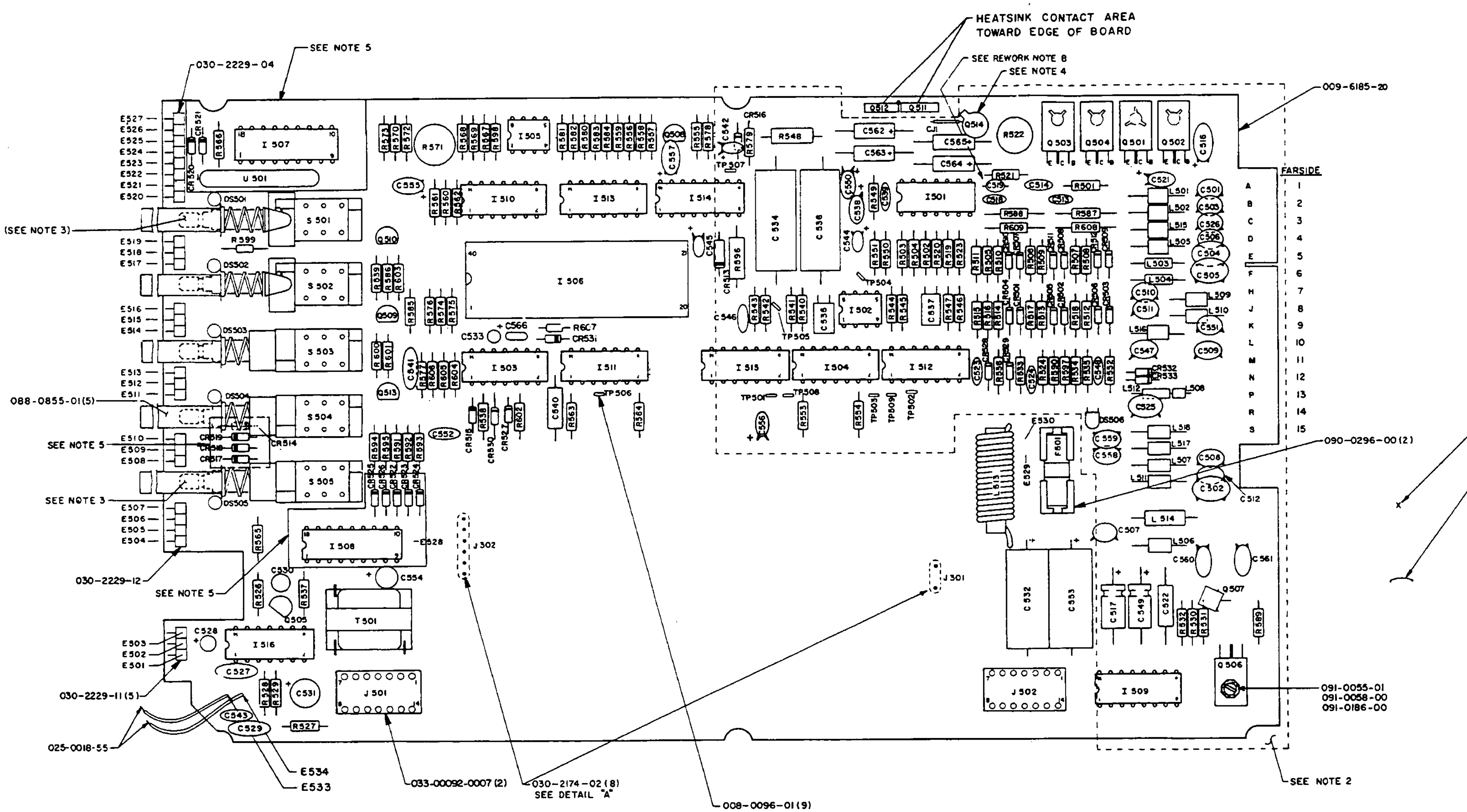


FIGURE 6-15B KR 87 MAIN BOARD ASSEMBLY
(Dwg. No. 300-06185-0000 R-2)



NOTES:

1. PRIOR TO POST COATING WITH CLEAR URETHANE COATING (016-1040-00) MASK OFF THE FOLLOWING AREAS:
   TP501-TP507, R522, R571, J501, J502, F501, S501-S506, 030-2229-04, 030-2229-11, 030-2229-12, 030-2174-02 (8), MOUNTING AREAS, CONNECTOR
2. A HEIGHT CLEARANCE OF .250 MUST BE MAINTAINED WITHIN THE DASHED AREA, WITH THE EXCEPTION OF C534 AND C536 WHICH MAY BE .280. COMPONENTS THAT EXCEED THIS CLEARANCE, AS EXCEPTED, MUST BE BENT TOWARDS THE BOARD AS SHOWN.
3. APPLY SMALL AMOUNT OF RTV (016-1082-00) TO BOTTOM SIDE OF SWITCH SHAFT (088-00855-0001) AND TOP SIDE OF SWITCH PLUNGER. SWITCH PLUNGER ENDS MUST BE FREE OF ANY RTV.
   SPACE BULBS TO CLEAR PUSH BUTTON SHAFT BY 1/32".
4. CJ1 AND Q514 HAVE A COMMON PAD. HOWEVER, CJ1 IS USED ON -00 BOARD AND Q514 IS USED ON -01.
5. FORCE UNDILUTED POST COAT (016-01040-0000) BETWEEN AND UNDER LEGS OF I507, 508, AND U501. APPLY HEAVY COAT OF UNDILUTED POST COAT (016-01040-0000) TO AREAS MARKED NEARSIDE AND FARSIDE.

REWORK NOTES:

A. ADD MAGWIRE (1) PLACE FAR SIDE FROM R517 TO R518.

B. ON UNITS WITH CUT PATH HERE. ADD MAGWIRE FROM LEFT LEAD OF C519 TO LEFT LEAD OF R521.

C. ON UNITS WITH CUT PATH HERE. ADD MAGWIRE FROM RIGHT LEAD OF C514 TO LEFT LEAD OF R501.

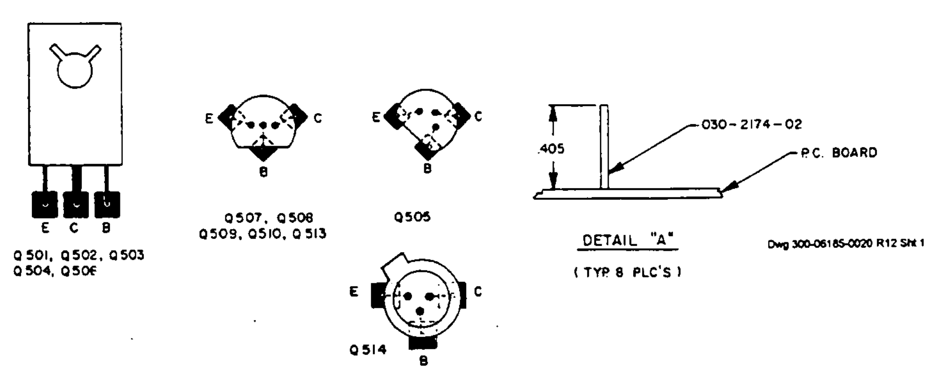
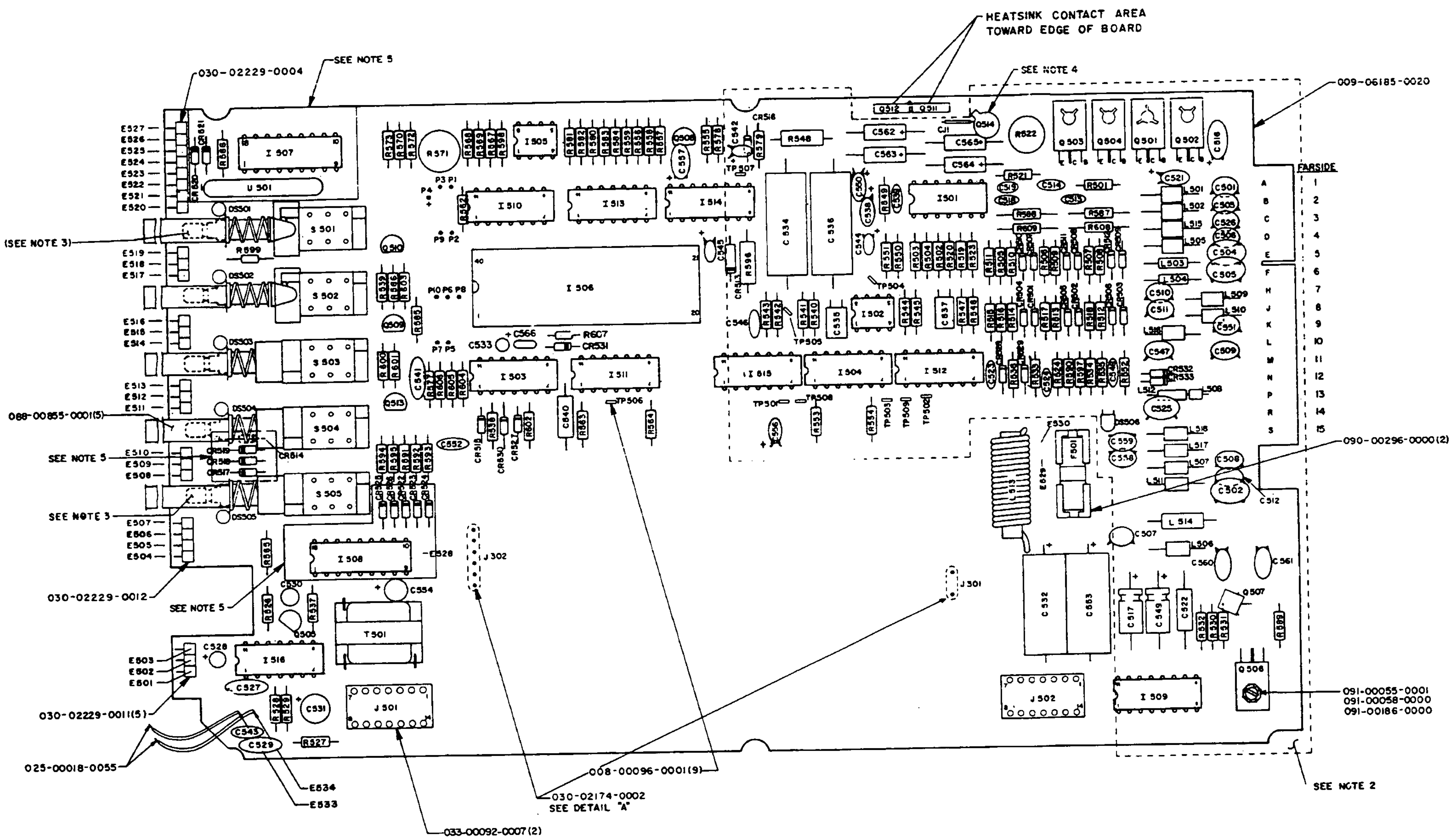


FIGURE 6-16 KR 87 MAIN BOARD ASSEMBLY
(Dwg. No. 300-06185-0020 R-12)



NOTES:

1. PRIOR TO POST COAT WITH CLEAR URETHANE COATING (016-01040-0000) MASK OFF THE FOLLOWING AREAS; TP501–TP509, R522, R571, J501, J502, F501, S501–S506, 030-02229-0004, 030-02229-0011, 030-02229-0012, 030-02174-0002(8), MOUNTING AREAS, CONNECTOR.
2. A HEIGHT CLEARANCE OF .250 MUST BE MAINTAINED WITHIN THE DASHED AREA, WITH THE EXCEPTION OF C534 AND C536 WHICH MAY BE .260. COMPONENTS THAT EXCEED THIS CLEARANCE, AS EXCEPTED, MUST BE BENT TOWARDS THE BOARD AS SHOWN.
3. APPLY SMALL AMOUNT OF RTV (016-01082-0000) BOTTOM SIDE OF SWITCH SHAFT (088-00855-0001) AND TOP SIDE OF SWITCH PLUNGER. SWITCH PLUNGER ENDS MUST BE FREE OF ANY RTV. SPACE BULBS TO CLEAR PUSH BUTTON SHAFT BY 1/32".
4. CJ1 AND Q514 HAVE A COMMON PAD. HOWEVER, CJ1 IS USED ON -0003 AND Q514 IS USED ON -0004.
5. FORCE UNDILUTED POST COAT (016-01040-0000) BETWEEN AND UNDER LEGS OF I507, 508 AND U501. APPLY HEAVY COAT OF UNDILUTED POST COAT (016-01040-0000) TO AREAS MARKED NEARSIDE AND FARSIDE.

REWORK NOTES:

A. ADD MAGWIRE (1 PLACE) FROM R517 TO R518 ON FARSIDE OF P.C. BOARD AS SHOWN.

B. CUT PATH (2PLACES) ON NEARSIDE AND (3 PLACES) ON FARSIDE.

ADD MAGWIRE FROM PIN 8 CONNECTION OF 200-08388-0000 ON MOTHER BOARD TO POSITIVE SIDE OF C553.

ADD MAGWIRE FROM PIN 9 CONNECTION OF 200-08388-0000 ON MOTHER BOARD TO PIN C OF J871.

ADD MAGWIRE FROM PIN 10 CONNECTION OF 200-08388-0000 ON MOTHER BOARD TO PIN 8 OF J871.

REST 200-08388-0000 ON R562 AND R585 FOR MINIMUM HEIGHT.

C. ON UNITS WITH CUT PATH HERE, ADD MAGWIRE FROM LEFT LEAD OF C519 TO LEFT LEAD OF R521.

D. ON UNITS WITH CUT PATH HERE, ADD MAGWIRE FROM RIGHT LEAD OF C514 TO LEFT LEAD OF R501.

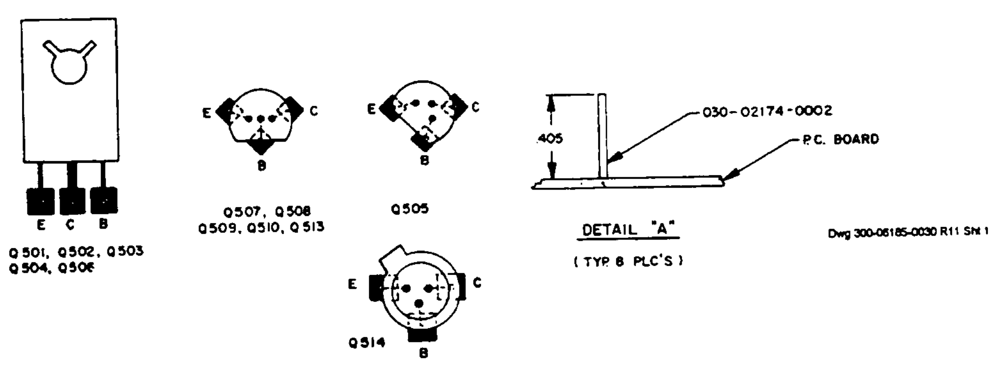
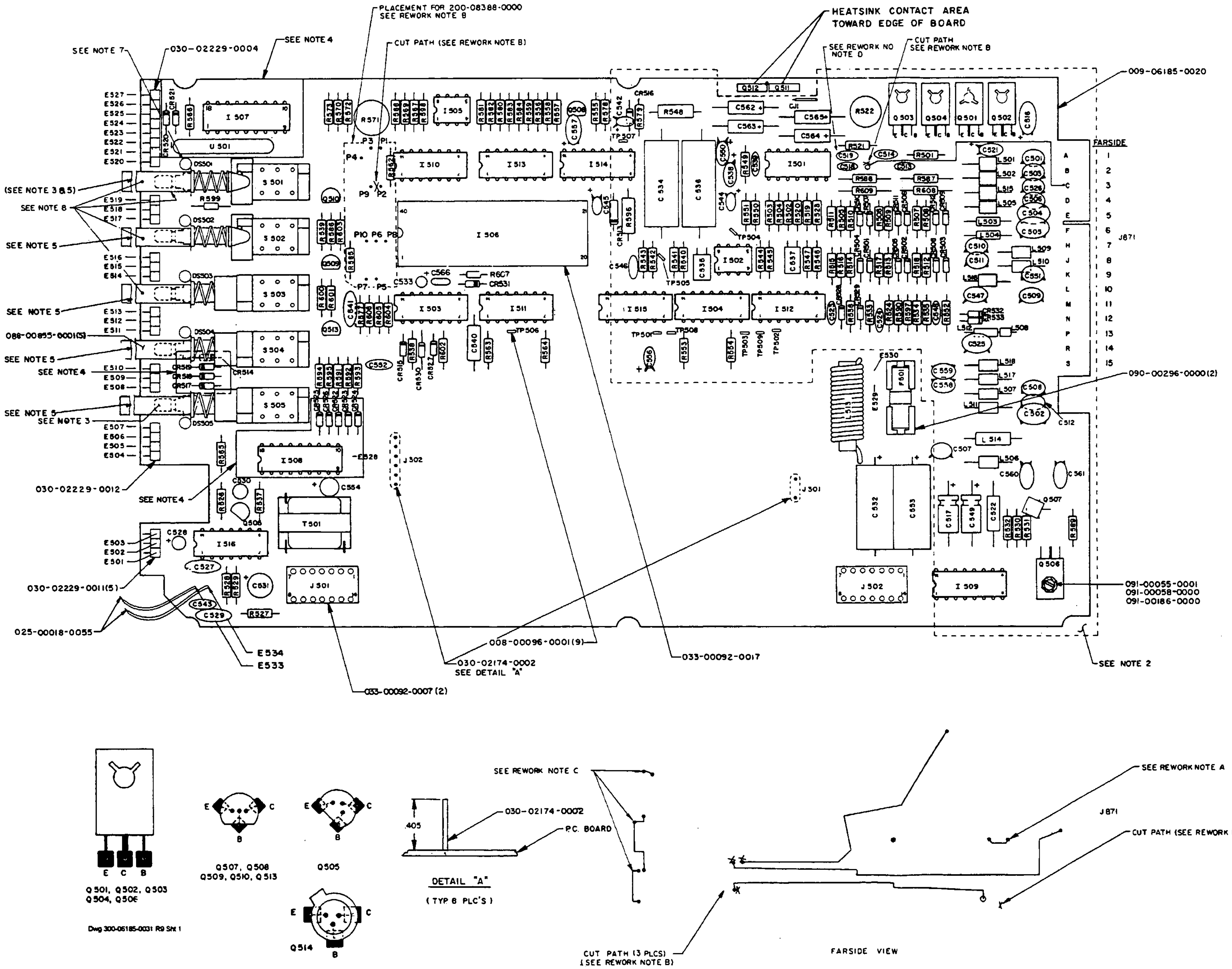


FIGURE 6–17 KR 87 MAIN BOARD ASSEMBLY
(Dwg. No. 300-06185-0030 R–11)



NOTES:

1. PRIOR TO POST COAT WITH CLEAR URETHANE COATING (016-01040-0000) MASK OFF THE FOLLOWING AREAS; TP501–TP509, R522, R571, J501, J502, F501, S501–S506, 030-02229-0004, 030-02229-0011, 030-02229-0012, 030-02174-0002(8), MOUNTING AREAS, CONNECTOR.
2. A HEIGHT CLEARANCE OF .250 MUST BE MAINTAINED WITHIN THE DASHED AREA, WITH THE EXCEPTION OF C534 AND C536 WHICH MAY BE .280. COMPONENTS THAT EXCEED THIS CLEARANCE, AS EXCEPTED, MUST BE BENT TOWARDS THE BOARD AS SHOWN.
3. APPLY SMALL AMOUNT OF RTV (016-01082-0000) BOTTOM SIDE OF SWITCH SHAFT (088-00855-0001) AND TOP SIDE OF SWITCH PLUNGER. SWITCH PLUNGER ENDS MUST BE FREE OF ANY RTV.
4. FORCE UNDILUTED POST COAT (016-01040-0000) BETWEEN AND UNDER LEGS OF I 507, 508 AND U501. APPLY HEAVY COAT OF UNDILUTED POST COAT (016-01040-0000) TO AREAS MARKED NEARSIDE AND FARSIDE.
5. INSTALL SHAFT EXTENDER (088-03025-0000) ON SWITCH W/ RTV 5 PLACES ON 200-06185-0006 ONLY.
6. CAUTION: 200-06185-0006 & -0007 HAVE 5 VOLT LIGHTING.
7. DS 501, DS 502, DS 503, DS 504, DS 505 TO BE .37 ± .030 HIGH AND MUST ACHIEVE LIGHTING REQUIREMENTS AS SPECIFIED BY MPS. ALL BULBS ARE TO HAVE 088-00084-0008 BOOT. BOOT MUST BE FULLY SEATED ON BULB. BOOT MUST NOT CONTACT SWITCH ASSY.
8. COAT TOP AND RIGHT SURFACE OF THE LIGHTING SHAFT FOR BUTTONS ADF, BFO, & FRQ WITH BLACK PERMANENT MARKER OR EQUIVALENT.

REWORK NOTES:

A. ADD MAGWIRE (1 PLACE) FROM R517 TO R518 ON FARSIDE OF P.C. BOARD AS SHOWN.

* SUPER FLAG REWORK

B. CUT PATH (2 PLACES) ON NEARSIDE AND (3 PLACES) ON FARSIDE.

   ADD MAGWIRE FROM PIN 8 CONNECTION OF 200-08388-0000 ON MOTHER BOARD TO POSITIVE SIDE OF C553.

   ADD MAGWIRE FROM PIN 9 CONNECTION OF 200-08388-0000 ON MOTHER BOARD TO PIN C OF J871.

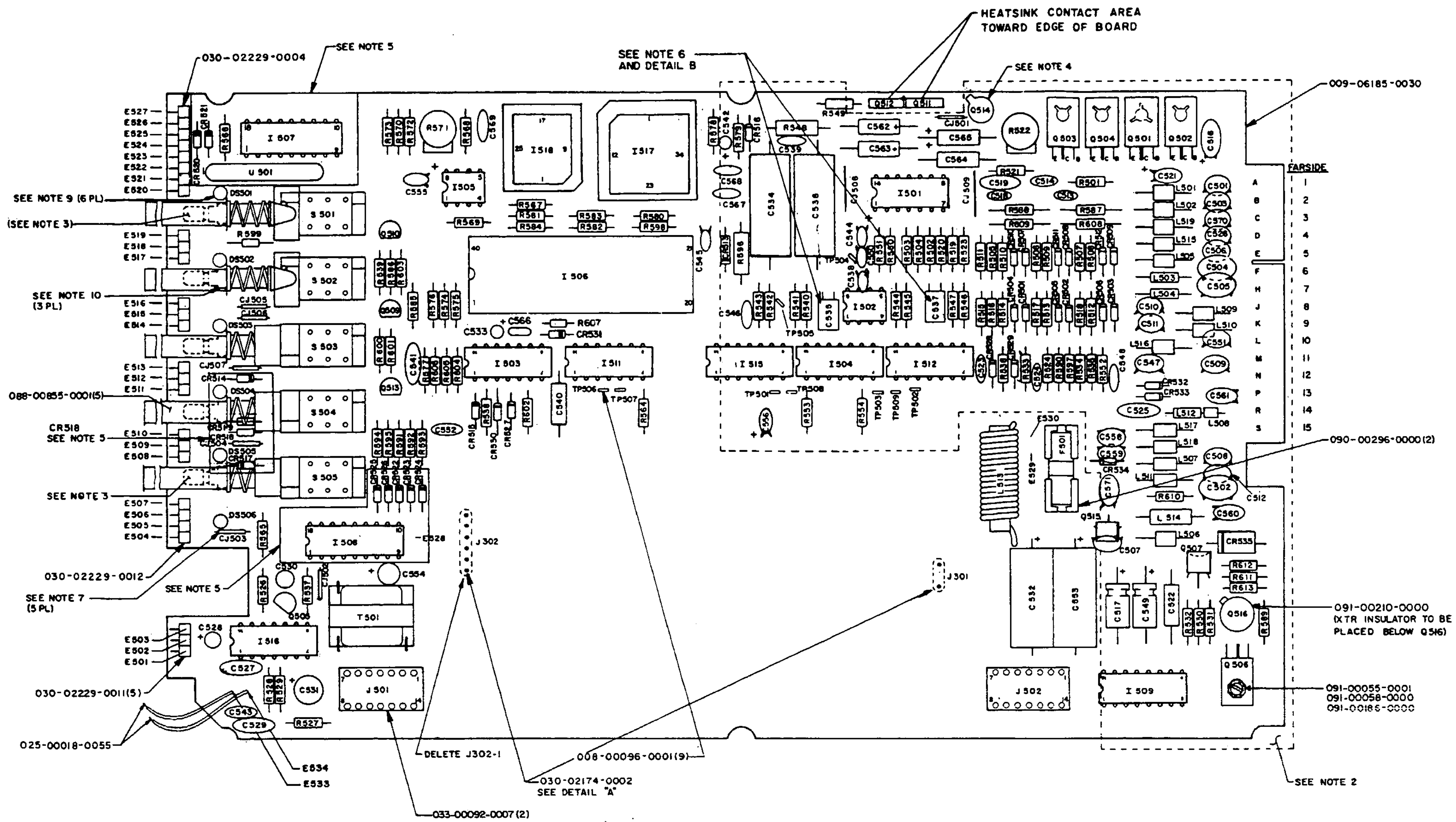
   ADD MAGWIRE FROM PIN 10 CONNECTION OF 200-08388-0000 ON MOTHER BOARD TO PIN 8 OF J871.

   REST 200-08388-0000 ON R562 AND R585 FOR MINIMUM HEIGHT.

REWORK FOR 5 VOLT LIGHTING:

C. ADD MAGWIRE 026-00031-0008 4 PLACES ON FARSIDE VIEW AS SHOWN.
D. ON UNITS WITH CUT PATH HERE, ADD MAGWIRE FROM LEFT LEAD OF C519 TO LEFT LEAD OF R521.
E. ON UNITS WITH CUT PATH HERE, ADD MAGWIRE FROM RIGHT LEAD OF C514 TO LEFT LEAD OF R501.

FIGURE 6–18 KR 87 MAIN BOARD ASSEMBLY
(Dwg. No. 300–06185–0031 R–9)



NOTES:

1. PRIOR TO POST COAT WITH CLEAR URETHANE COATING (016-01040-0000) MASK OFF THE FOLLOWING AREAS;
   TP501–TP509, R522, R571, J501, J502, F501, S501–S506, 030-02229-0004, 030-02229-0011, 030-02229-0012, 030-02174-0002(8), MOUNTING AREAS, CONNECTOR.
2. A HEIGHT CLEARANCE OF .250 MUST BE MAINTAINED WITHIN THE DASHED AREA, WITH THE EXCEPTION OF C534 AND C536 WHICH MAY BE .280. COMPONENTS THAT EXCEED THIS CLEARANCE, AS EXCEPTED, MUST BE BENT TOWARDS THE BOARD AS SHOWN.
3. APPLY SMALL AMOUNT OF RTV (016-01082-0000) BOTTOM SIDE OF SWITCH SHAFT (088-00855-0001) AND TOP SIDE OF SWITCH PLUNGER. SWITCH PLUNGER ENDS MUST BE FREE OF ANY RTV.
   SPACE BULBS TO CLEAR PUSH BUTTON SHAFT BY 1/32".
4. CJ501 AND Q514 HAVE A COMMON PAD. HOWEVER, CJ501 IS USED ON -0003 AND Q514 IS USED ON -0004.
5. FORCE UNDILUTED POST COAT (016-01040-0000) BETWEEN AND UNDER LEGS OF I507, 508 AND U501. APPLY HEAVY COAT OF UNDILUTED POST COAT (016-01040-0000) TO AREAS MARKED NEARSIDE AND FARSIDE.
6. 195-00182-0000
   C535 & C537
   EACH WITH 096-01082-0034 4.7 uF 20V 5% IN SERIES WITH 096-01082-0045 2.2uF 35V 10% WITH CAPS NEGATIVE LEADS TWISTED TOGETHER, SOLDERED AND WITH SHRINKABLE TUBE 150-00047-0000 FOR INSULATION. (SEE DETAIL B)
   OR
   C535 ONE PCS 096-01074-0001
   C537 ONE PCS 096-01074-0001
7. CJ503 THRU CJ507 ARE USED ONLY FOR 200-06185-0006 AND -0007, WHICH ARE USED IN 5V LIGHTING UNITS 066-01072-0006, -0007 AND -0017.
8. CAUTION: 200-06185-0006 AND -0007 HAVE 5 VOLT LIGHTING.
9. 200-06185-0006 AND 0007 ONLY:
   DS501 THRU DS506 TO BE .37 ± .030 HIGH. ALL BULBS ARE TO HAVE 088-00084-0008 BOOT. BOOT MUST BE FULLY SEATED ON BULB. BOOT MUST NOT CONTACT SWITCH ASSY.
10. 200-06185-0006 AND -0007 ONLY:
    COAT TOP AND RIGHT SURFACE OF LIGHTING SHAFT FOR S501, S502 AND S503 WITH BLACK PERMANENT MARKER OR EQUIVALENT.

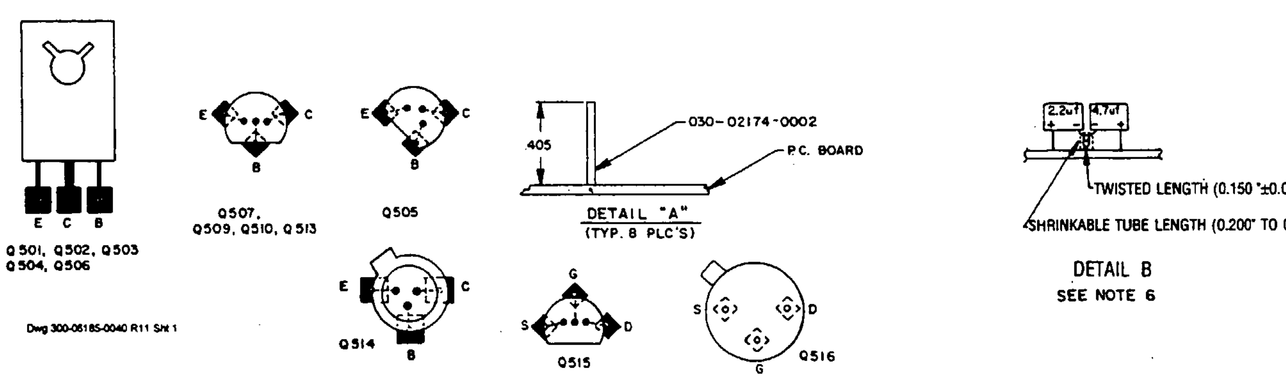
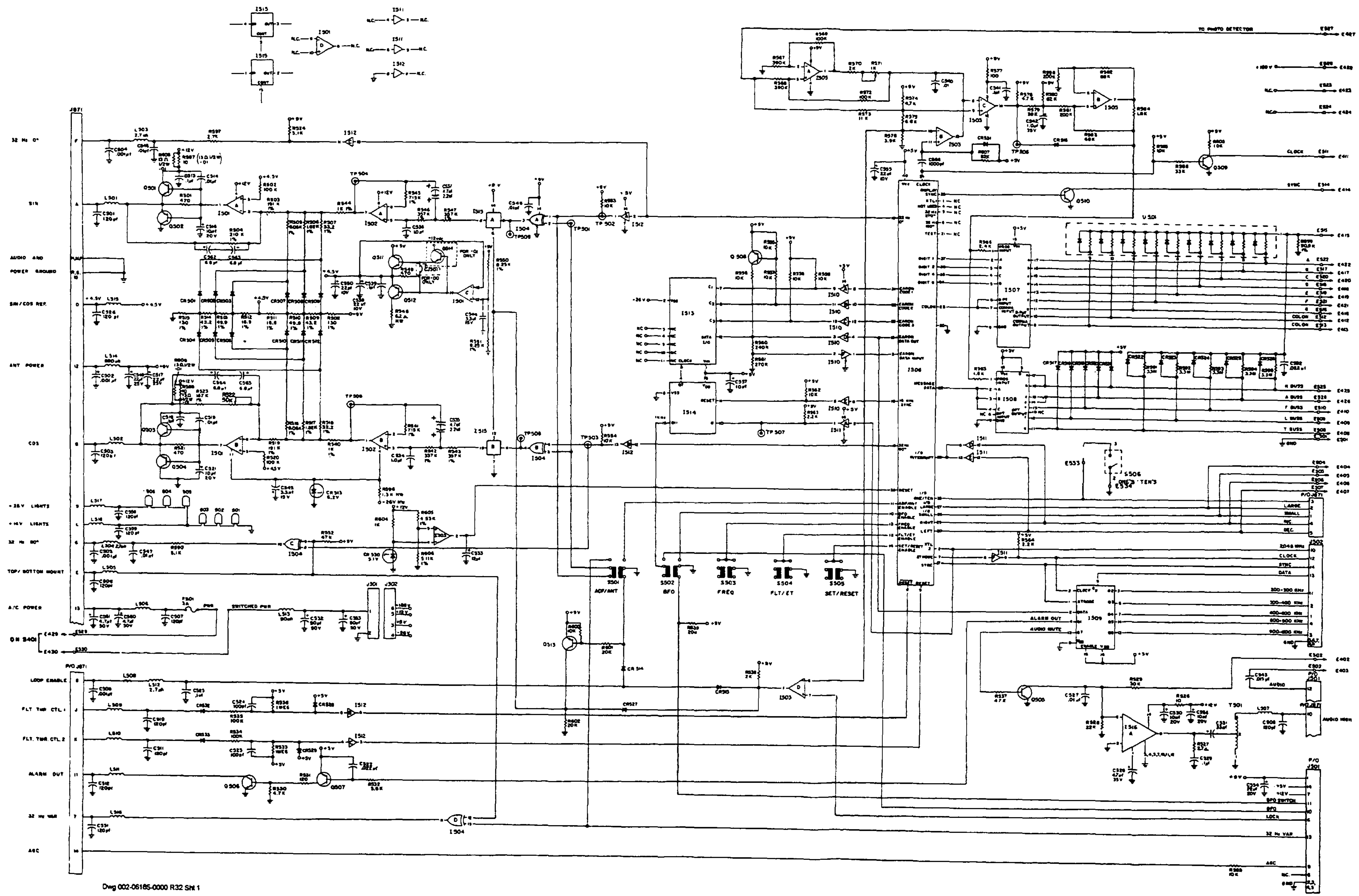


FIGURE 6–19 KR 87 MAIN BOARD ASSEMBLY
(Dwg. No. 300-06185-0040 R-11)



Dwg 002-06185-0000 R32 Sht 1

FIGURE 6-20 KR 87 MAIN BOARD SCHEMATIC
(Dwg. No. 002-06185-0000 R-32)

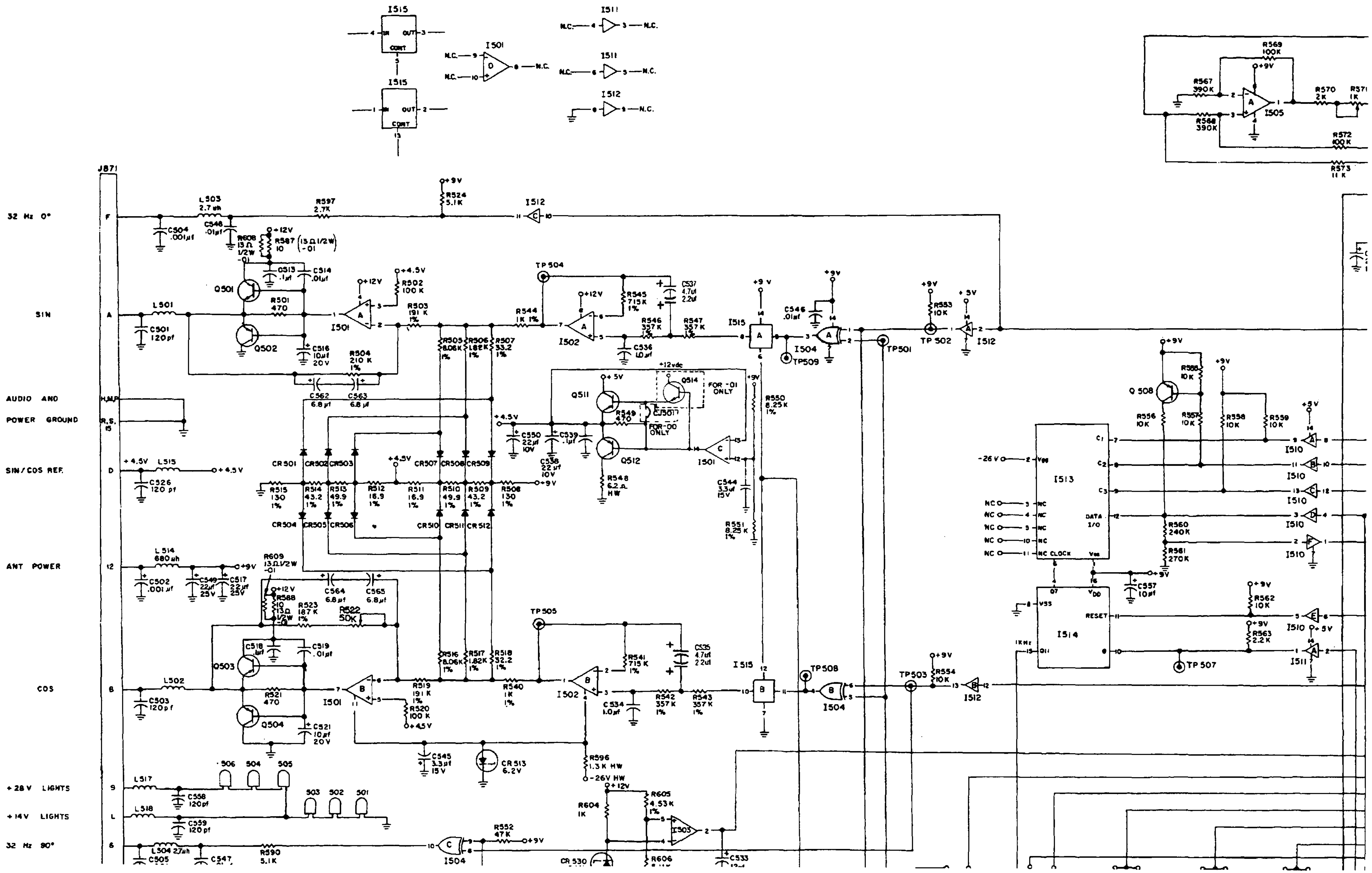


FIGURE 6-20 KR 87 MAIN BOARD SCHEMATIC
(Dwg. No. 002-06185-0000 R-32, Zoom Upper Left)

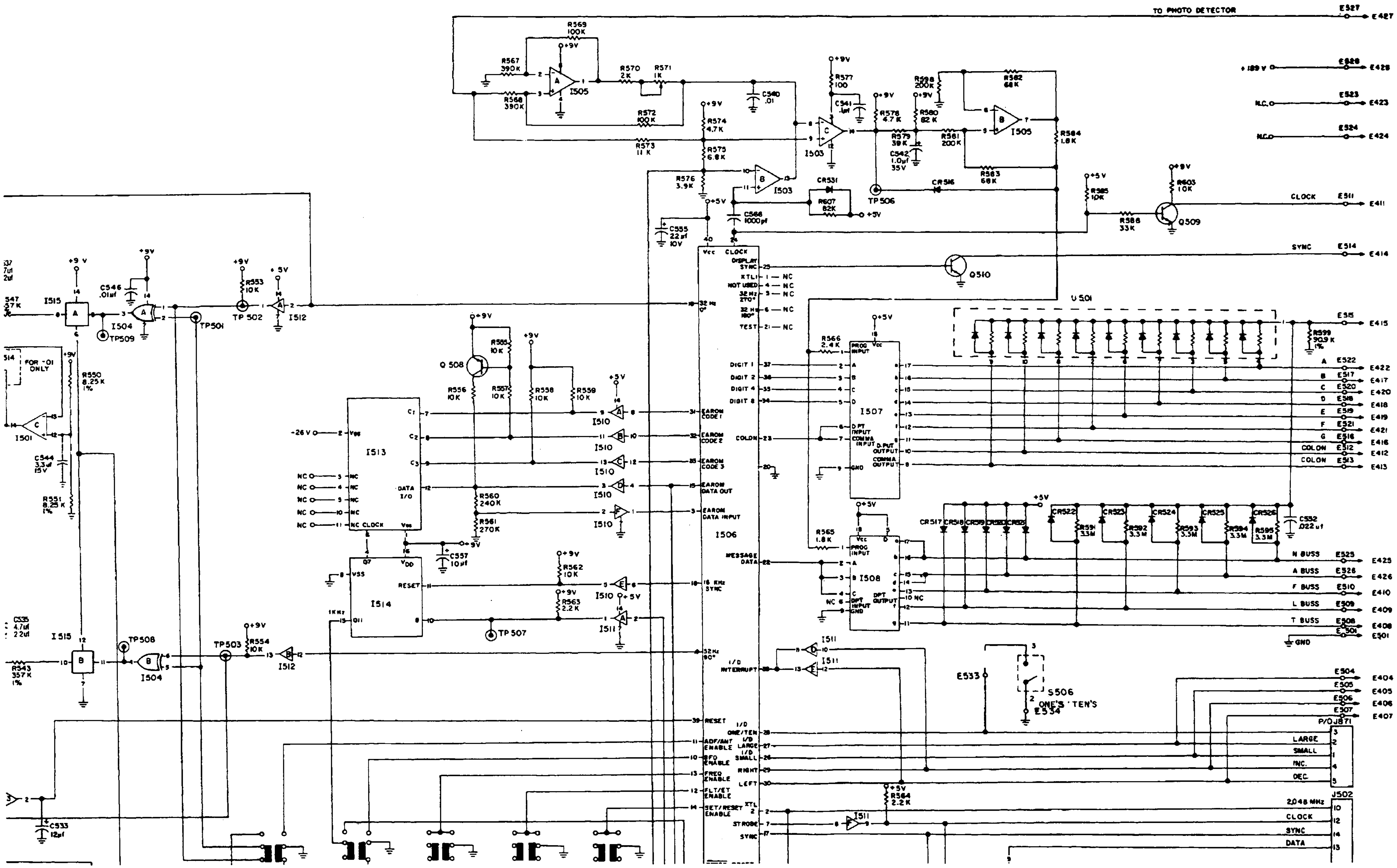
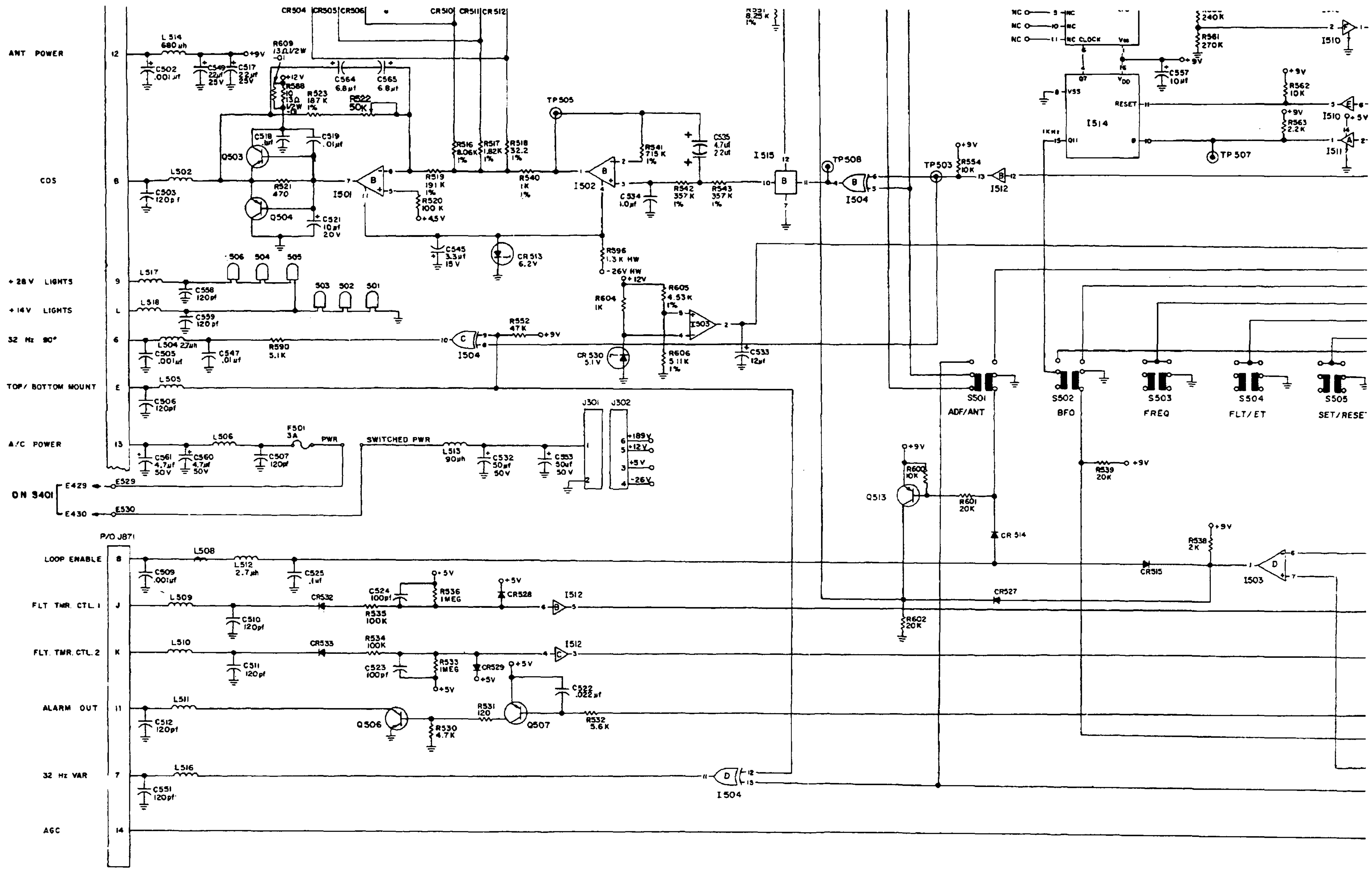


FIGURE 6-20 KR 87 MAIN BOARD SCHEMATIC
(Dwg. No. 002-06185-0000 R-32, Zoom Upper Right)



Dwg 002-06185-0000 R32 Sht 1

FIGURE 6-20 KR 87 MAIN BOARD SCHEMATIC (Dwg. No. 002-06185-0000 R-32, Zoom Lower Left)

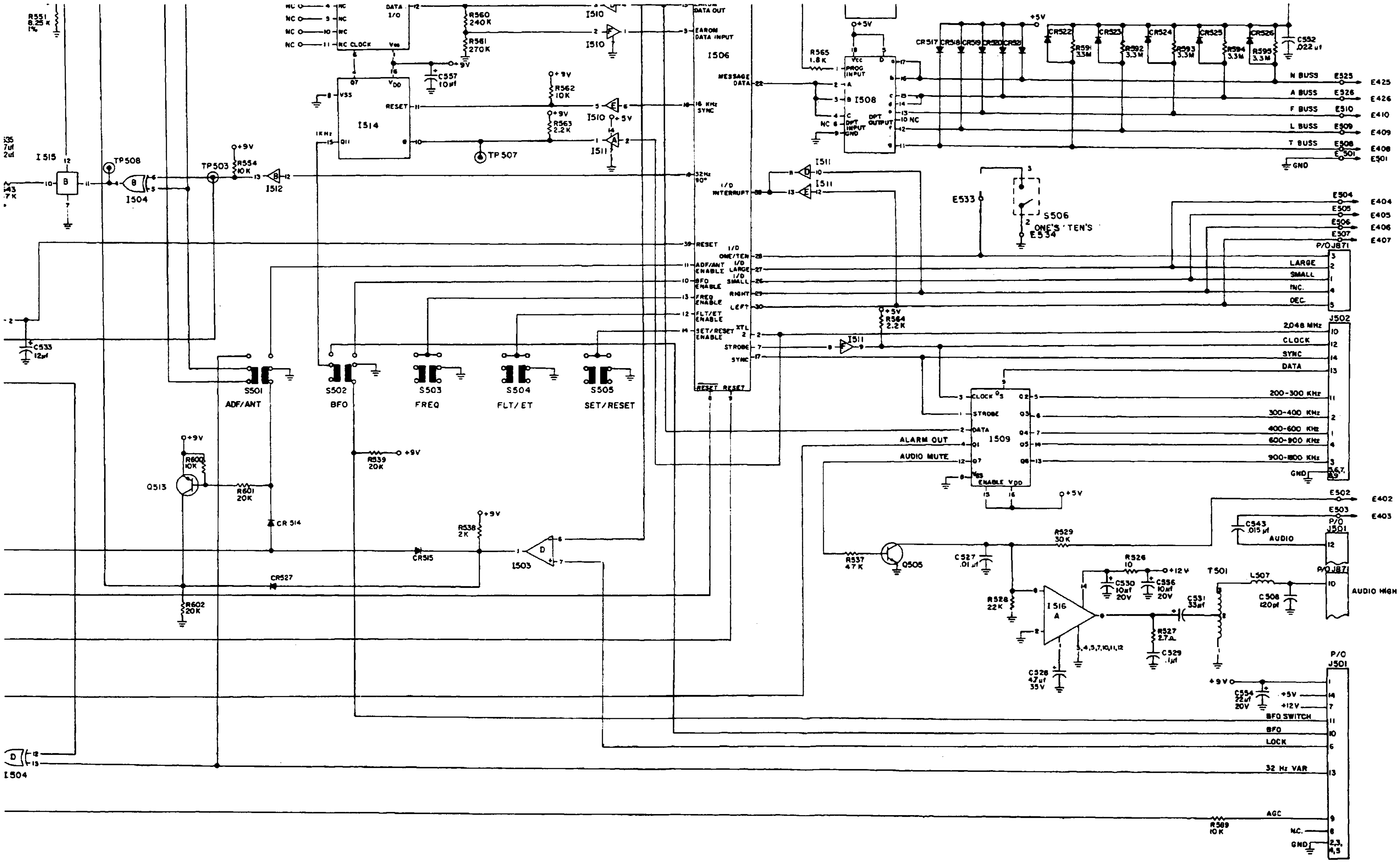


FIGURE 6-20 KR 87 MAIN BOARD SCHEMATIC
(Dwg. No. 002-06185-0000 R-32, Zoom Lower Right)

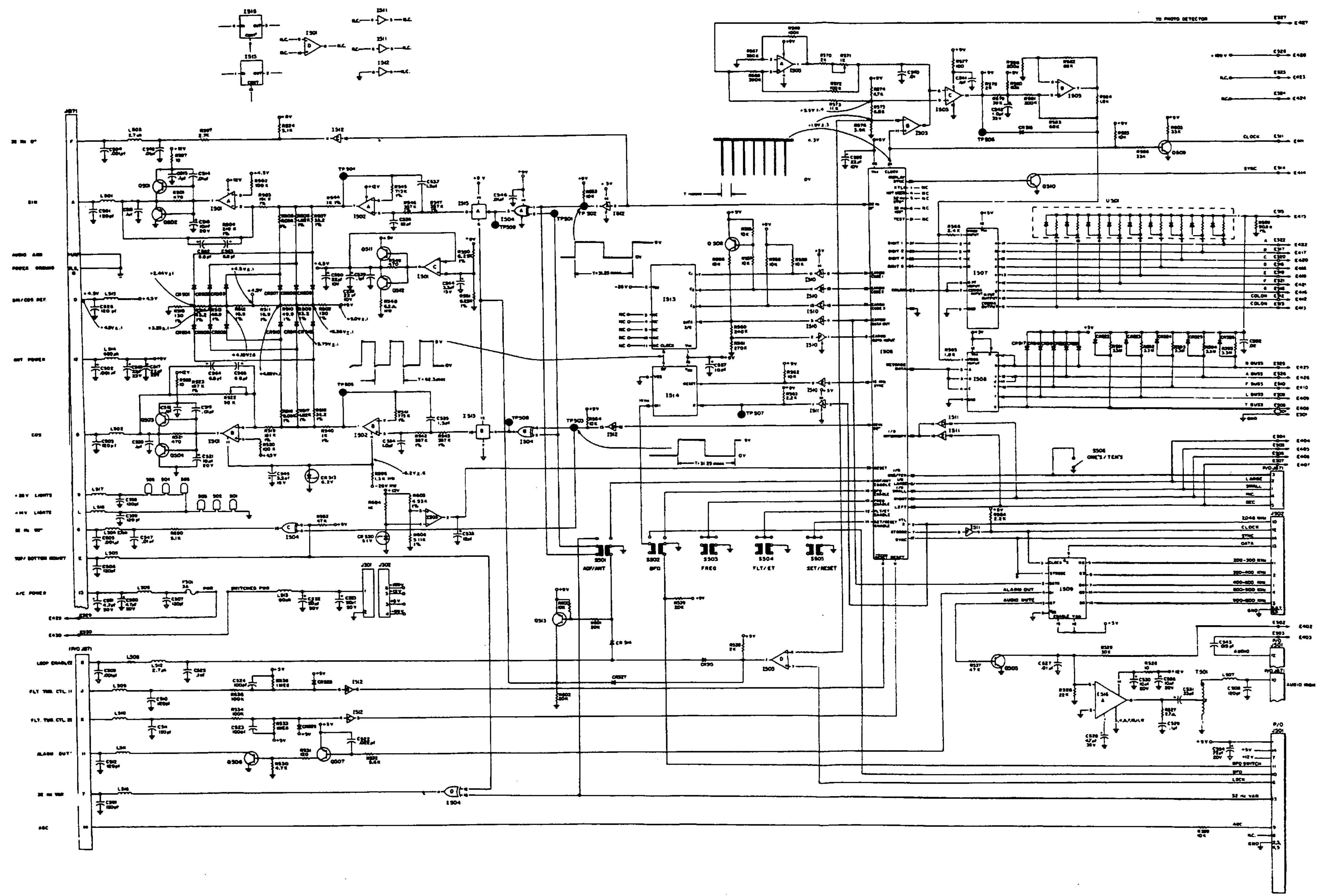


**FIGURE 6–20A KR 87 MAIN BOARD SCHEMATIC
(Dwg. No. 002–06185–0000 R–15)**

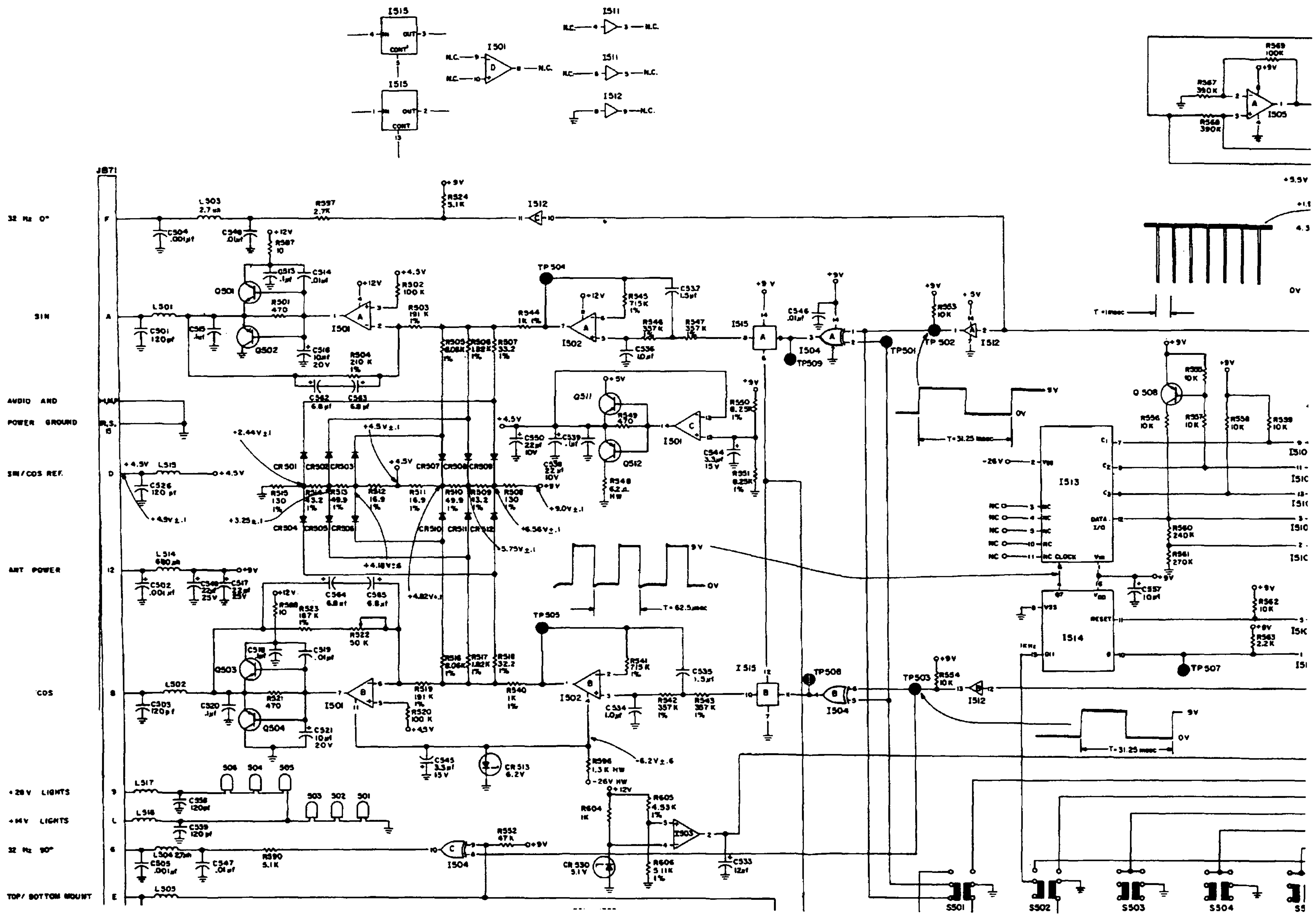


FIGURE 6–20A KR 87 MAIN BOARD SCHEMATIC
(Dwg. No. 002–06185–0000 R–15, Zoom Upper Left)

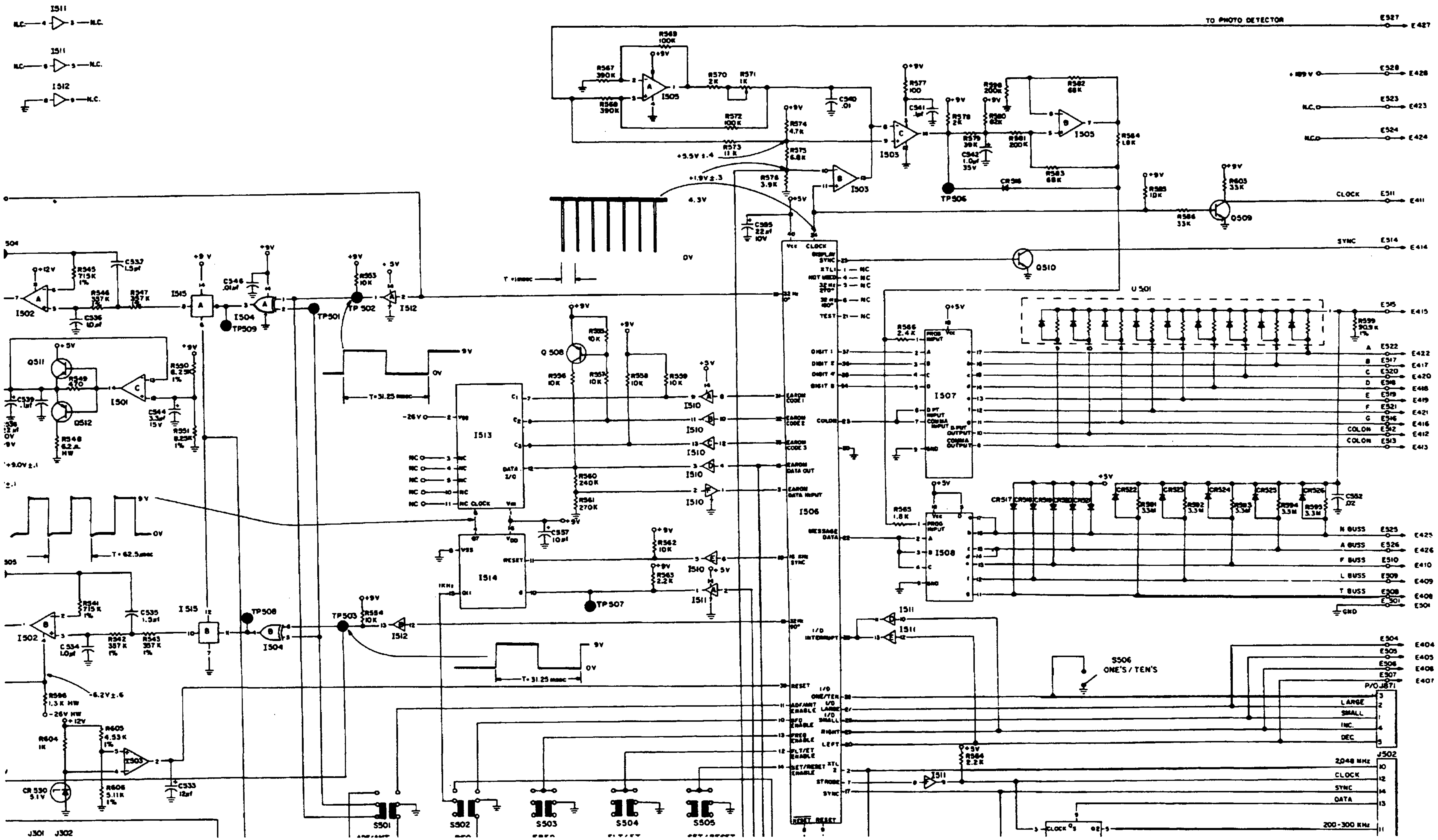


**FIGURE 6-20A KR 87 MAIN BOARD SCHEMATIC
(Dwg. No. 002-06185-0000 R-15, Zoom Upper Right)**

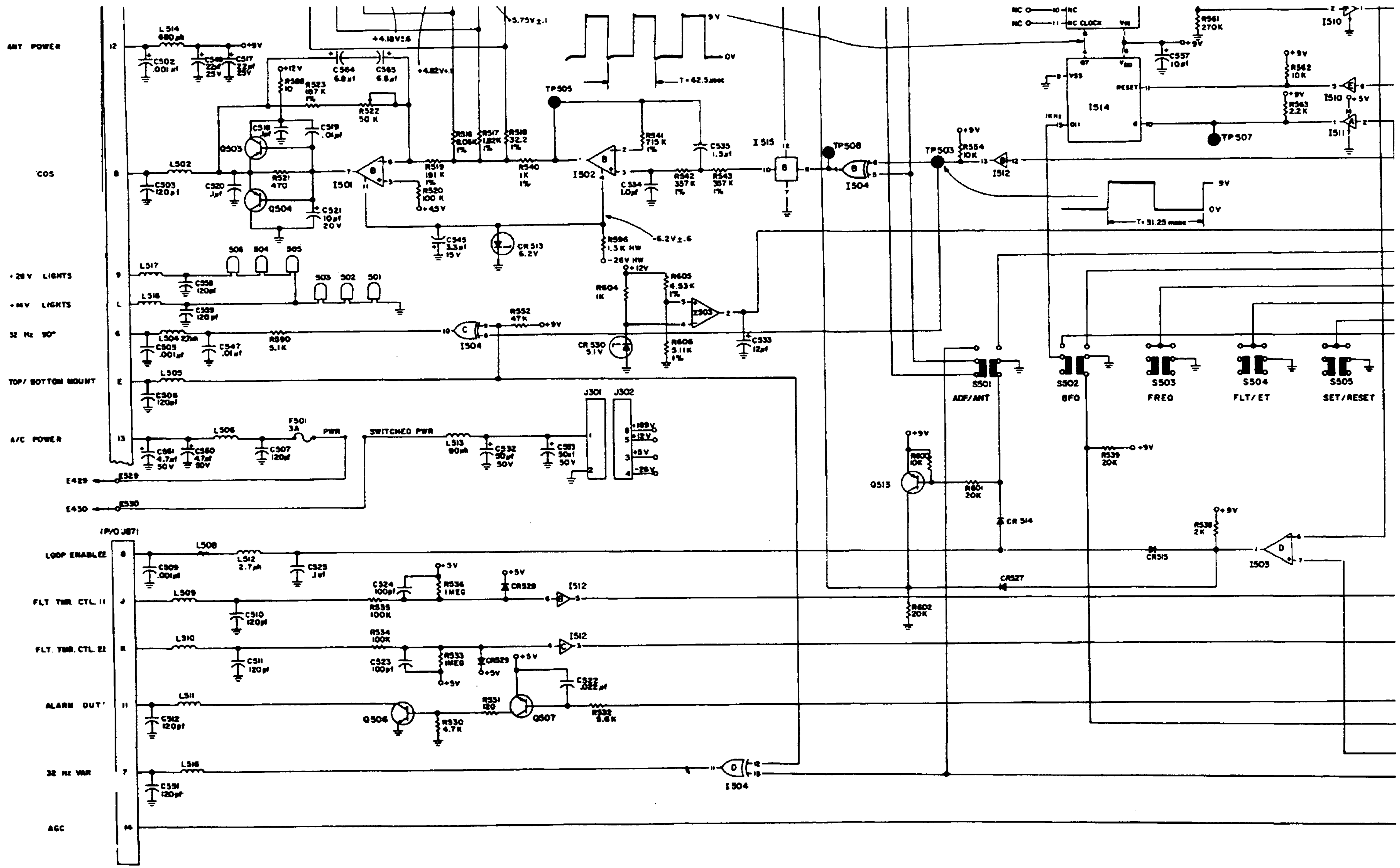


FIGURE 6-20A KR 87 MAIN BOARD SCHEMATIC
(Dwg. No. 002-06185-0000 R-15, Zoom Lower Left)

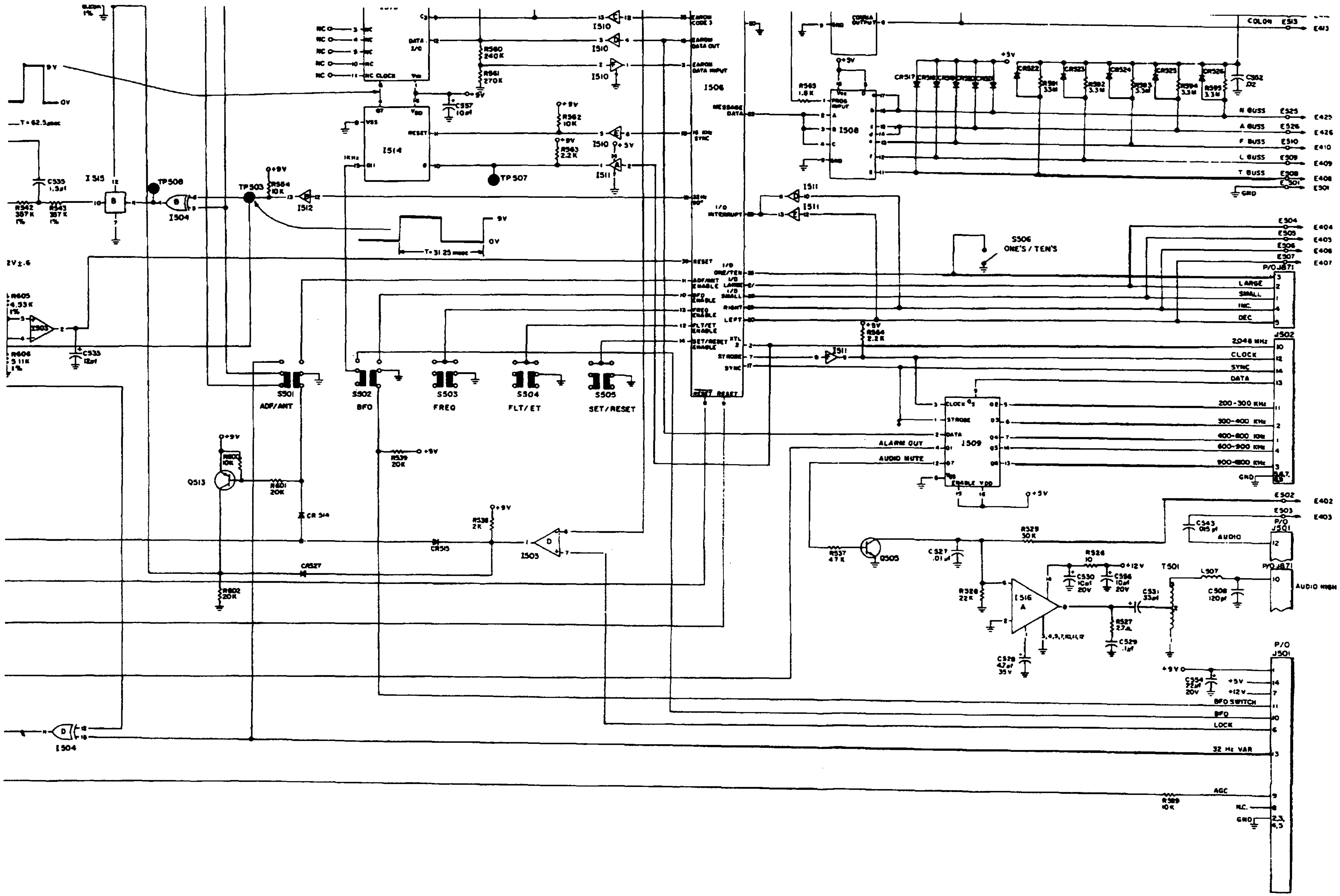


FIGURE 6-20A KR 87 MAIN BOARD SCHEMATIC
(Dwg. No. 002-06185-0000 R-15, Zoom Lower Right)

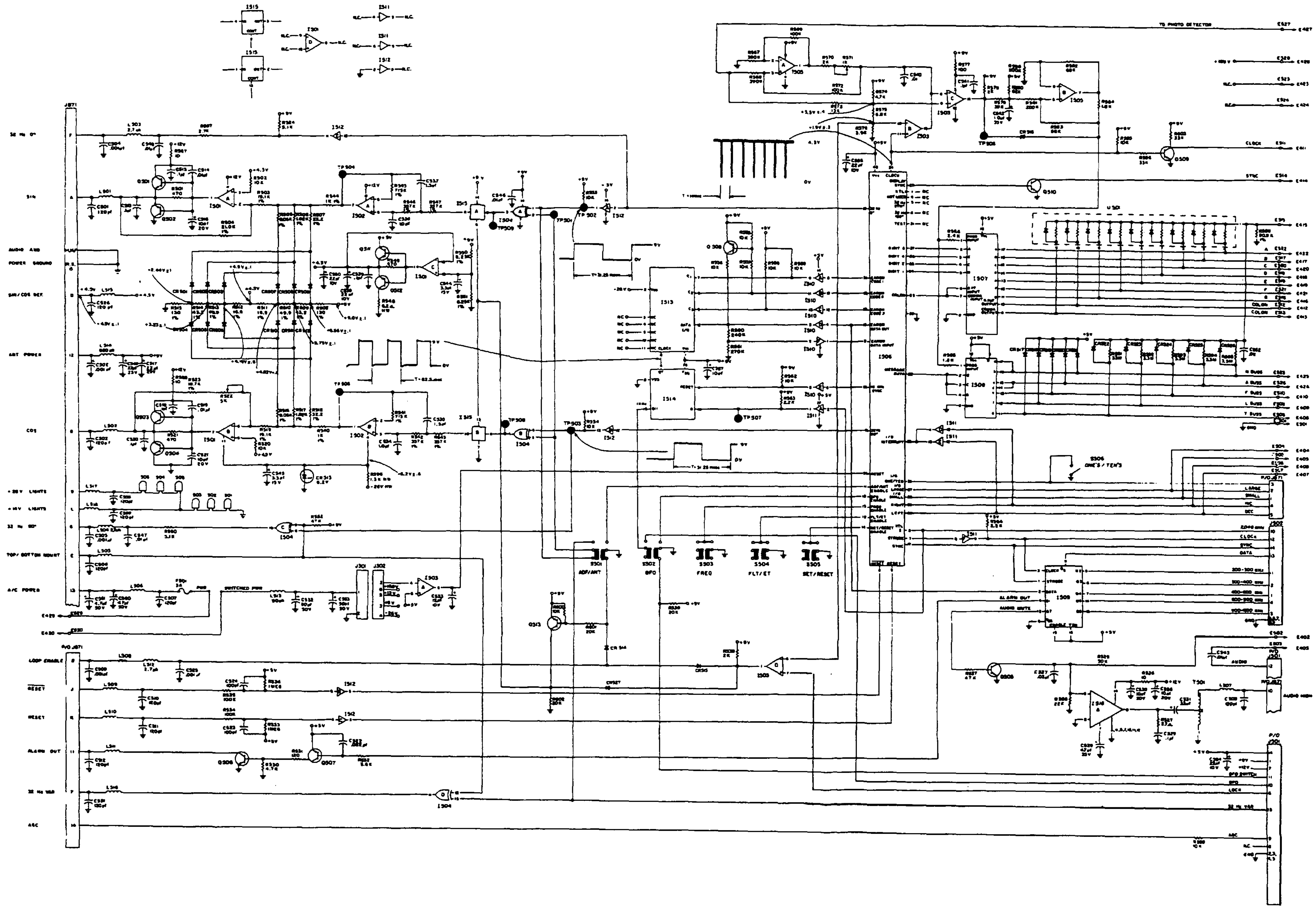


FIGURE 6-20B KR 87 MAIN BOARD SCHEMATIC
(Dwg. No. 002-06185-0000 R-2)

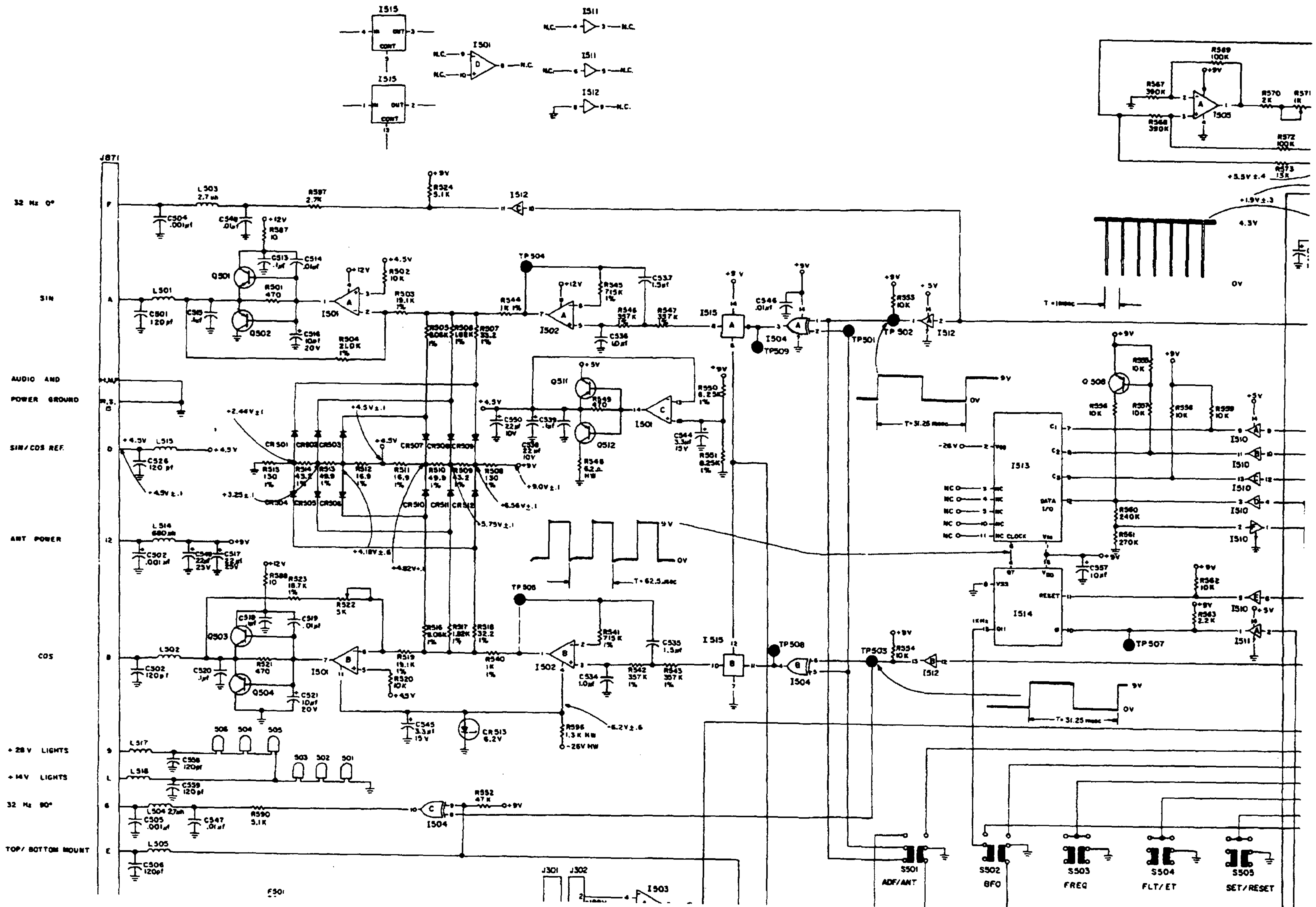


FIGURE 6-20B KR 87 MAIN BOARD SCHEMATIC
(Dwg. No. 002-06185-0000 R-2, Zoom Upper Left)

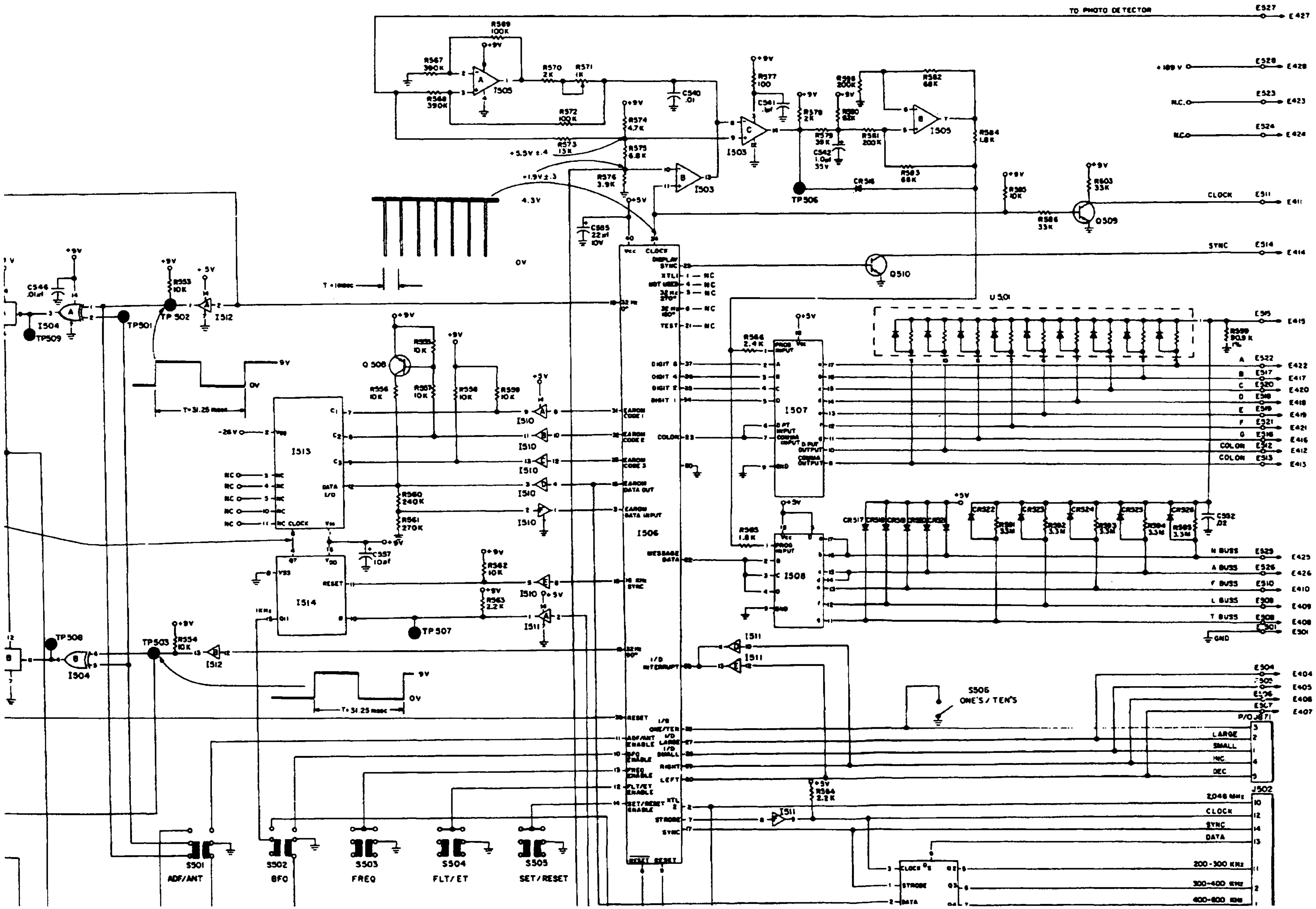


FIGURE 6-20B KR 87 MAIN BOARD SCHEMATIC
(Dwg. No. 002-06185-0000 R-2, Zoom Upper Right)

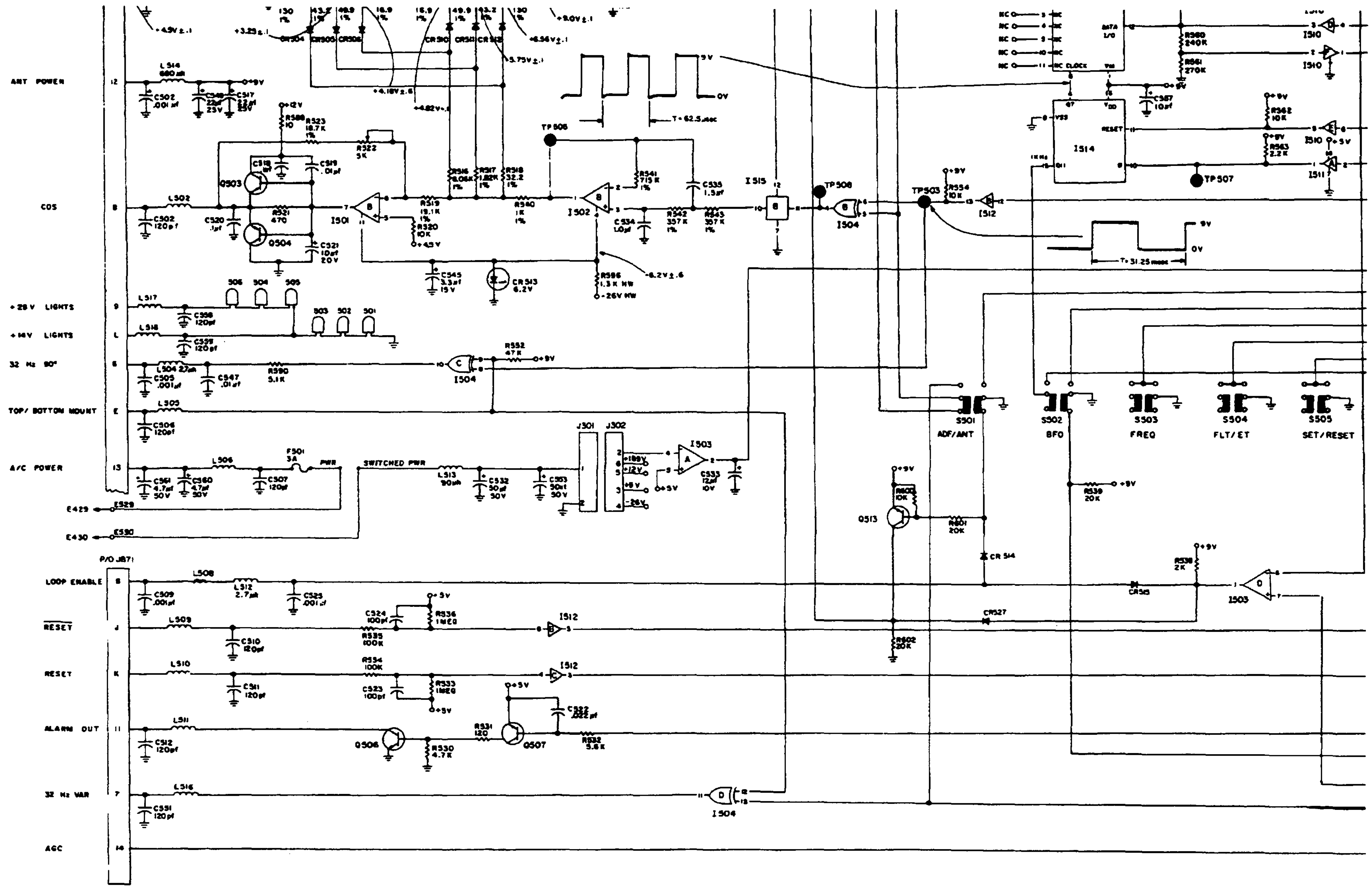


FIGURE 6–20B KR 87 MAIN BOARD SCHEMATIC
(Dwg. No. 002–06185–0000 R–2, Zoom Lower Left)

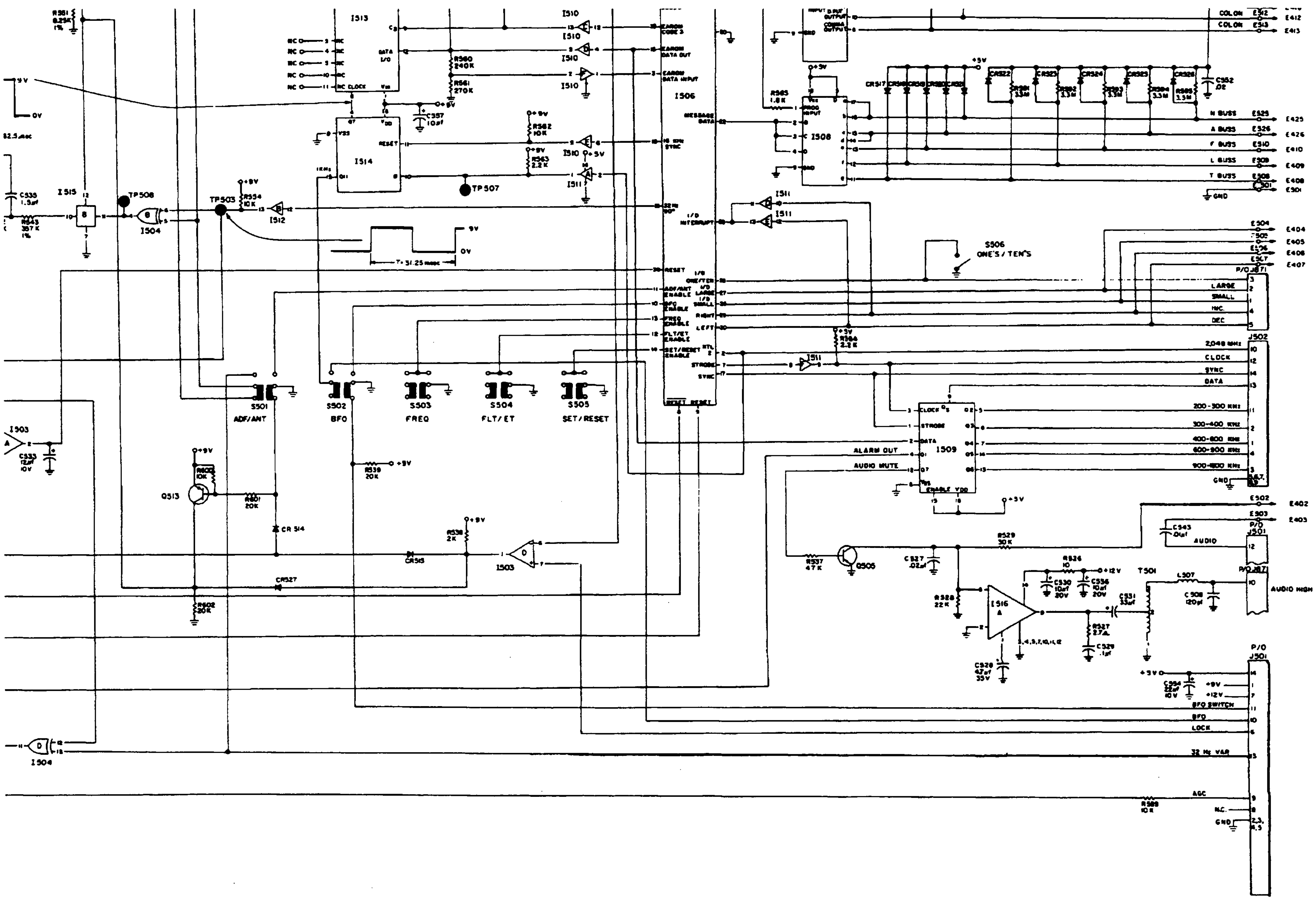


FIGURE 6-20B KR 87 MAIN BOARD SCHEMATIC
(Dwg. No. 002-06185-0000 R-2, Zoom Lower Right)

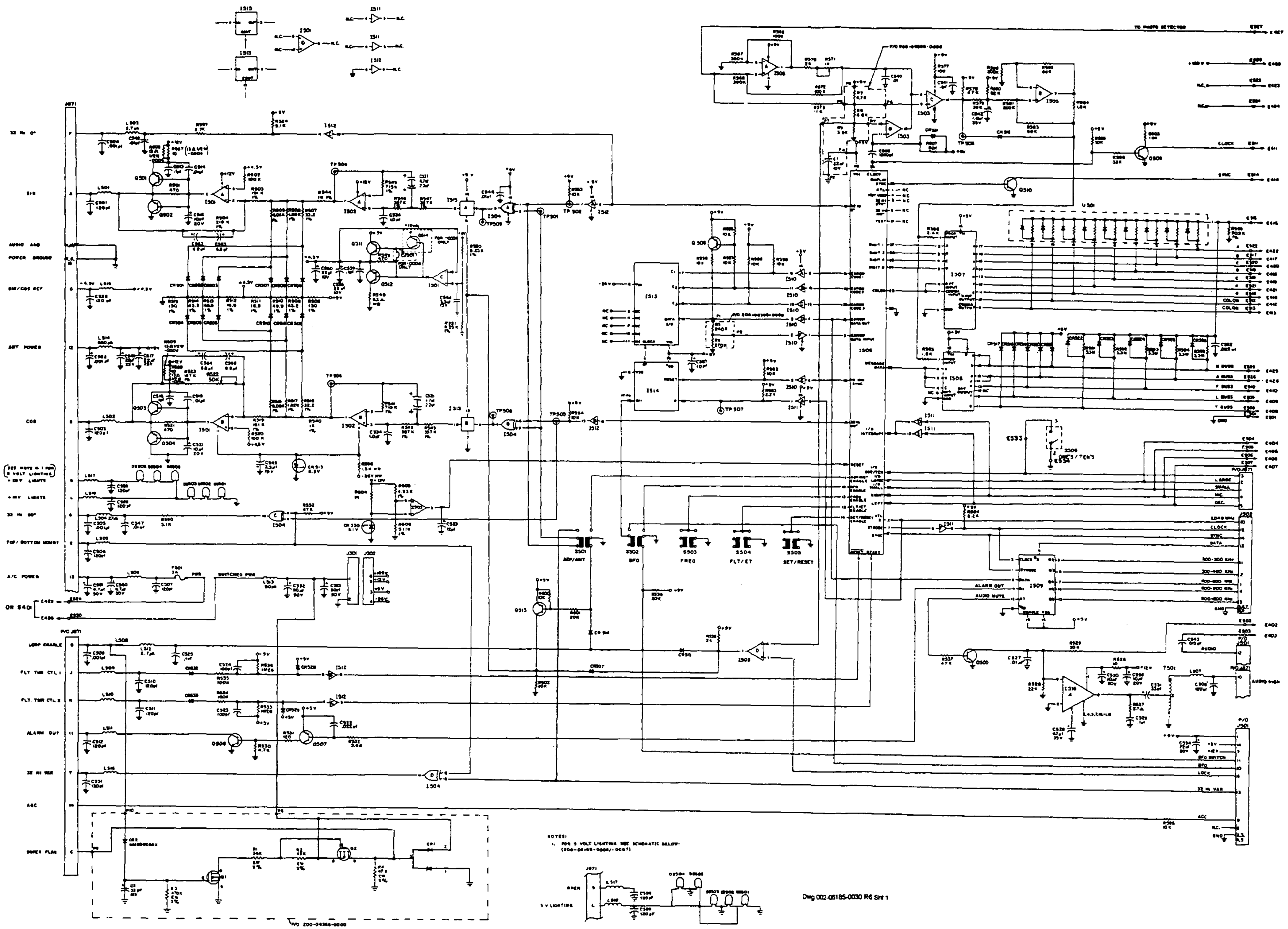


FIGURE 6-21 KR 87 MAIN BOARD SCHEMATIC
(Dwg. No. 002-06185-0030 R-6)

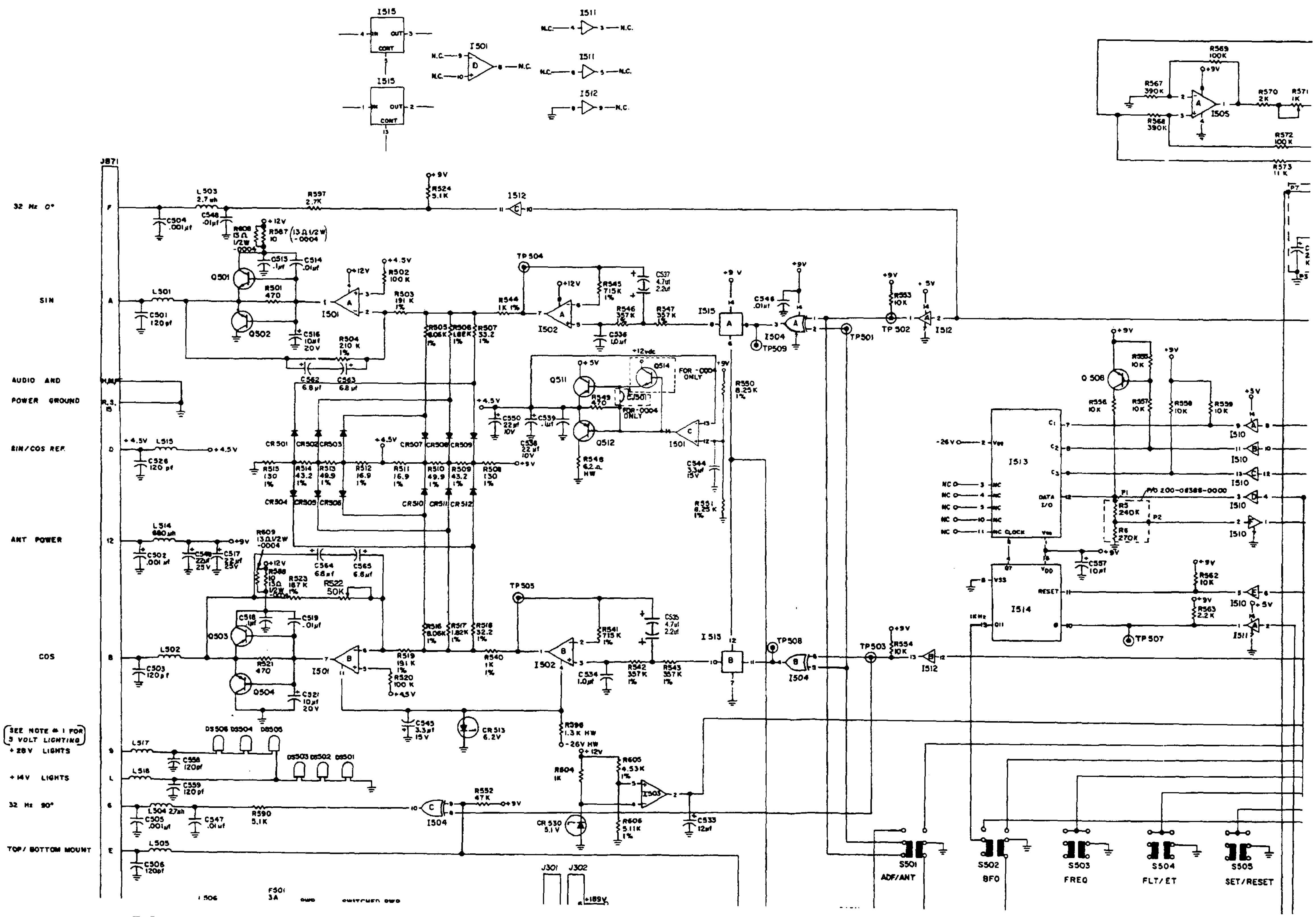


FIGURE 6-21 KR 87 MAIN BOARD SCHEMATIC
(Dwg. No. 002-06185-0030 R-6, Zoom Upper Left)

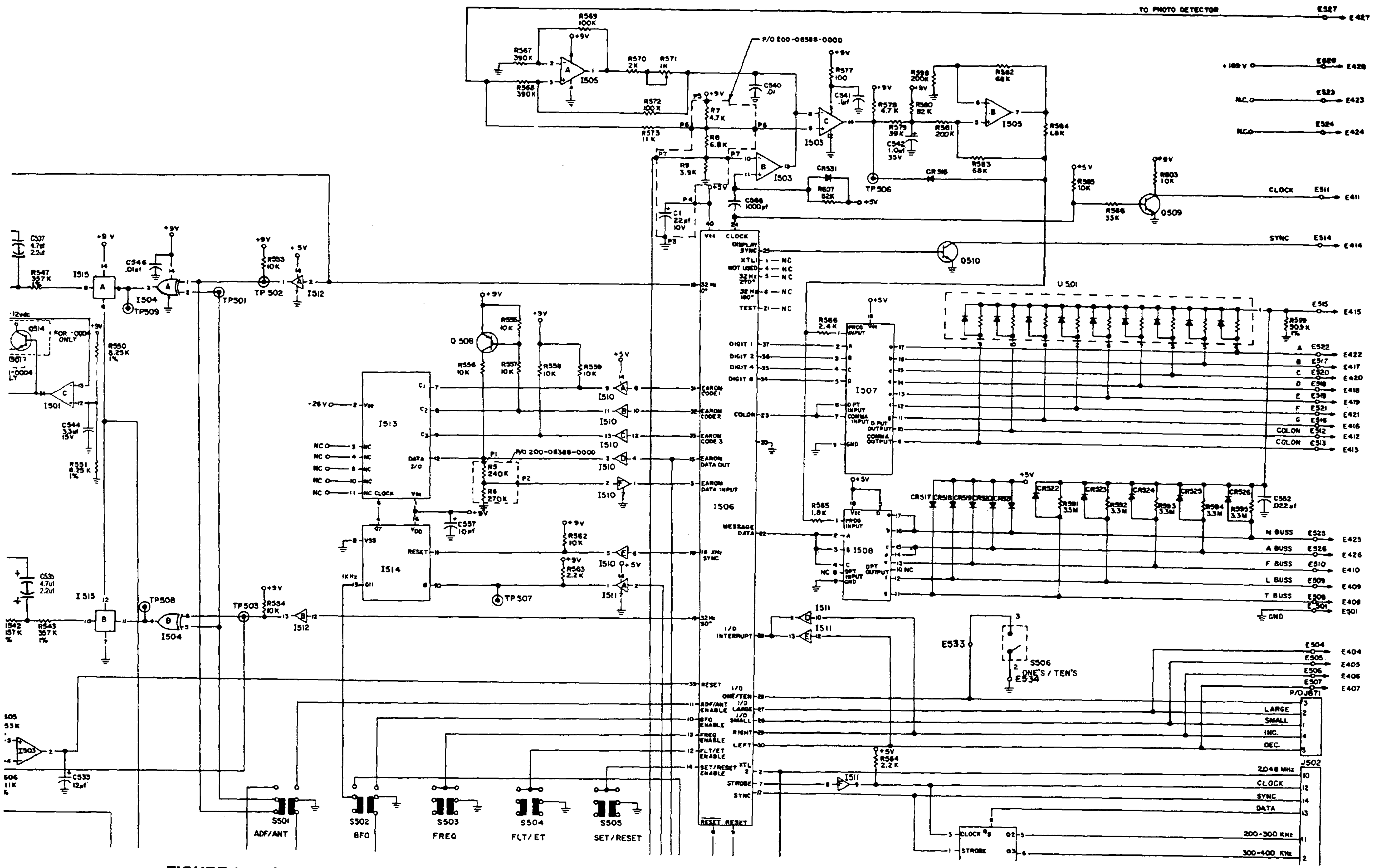


FIGURE 6-21 KR 87 MAIN BOARD SCHEMATIC
(Dwg. No. 002-06185-0030 R-6, Zoom Upper Right)

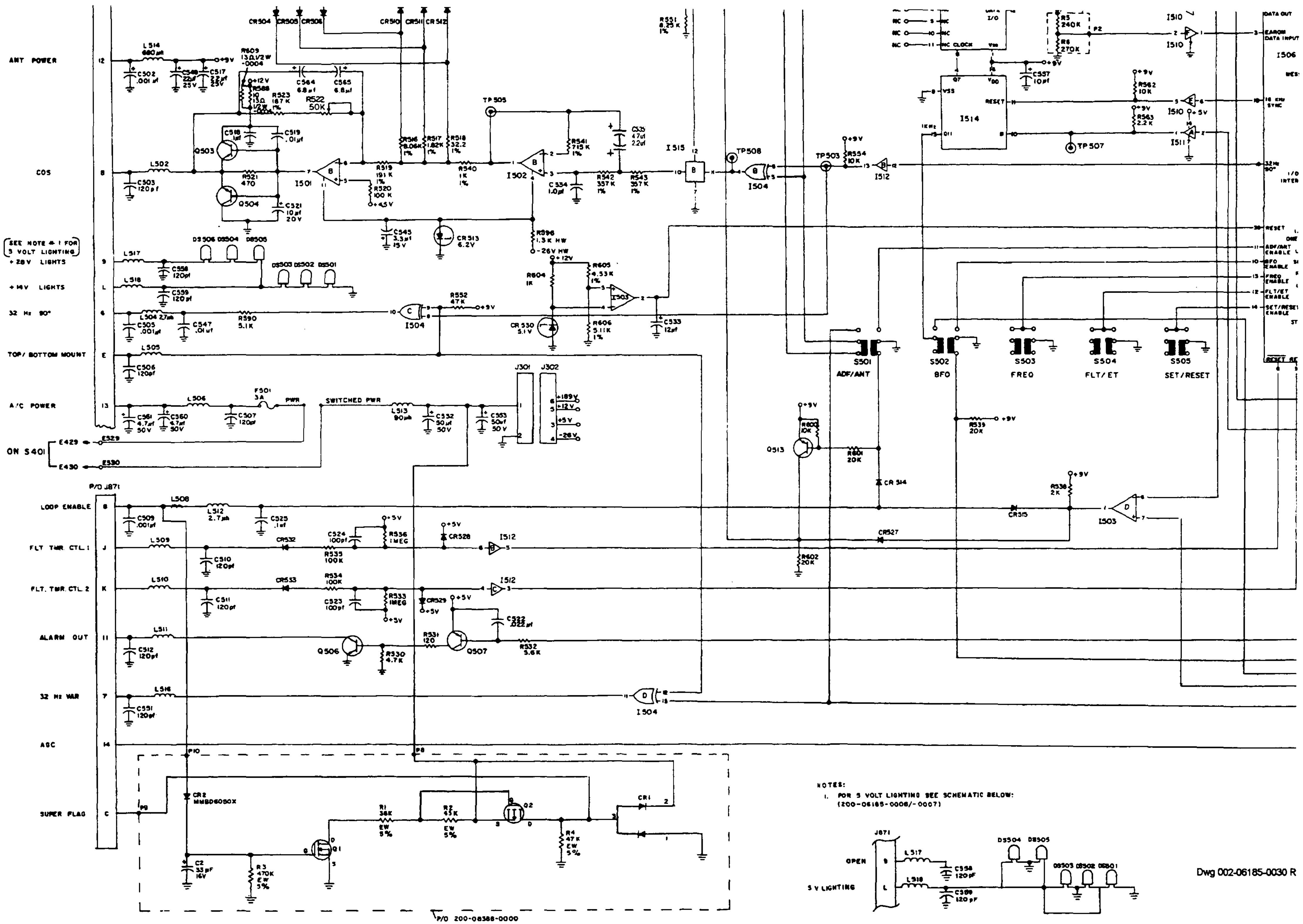


**FIGURE 6-21 KR 87 MAIN BOARD SCHEMATIC
(Dwg. No. 002-06185-0030 R-6, Zoom Lower Left)**

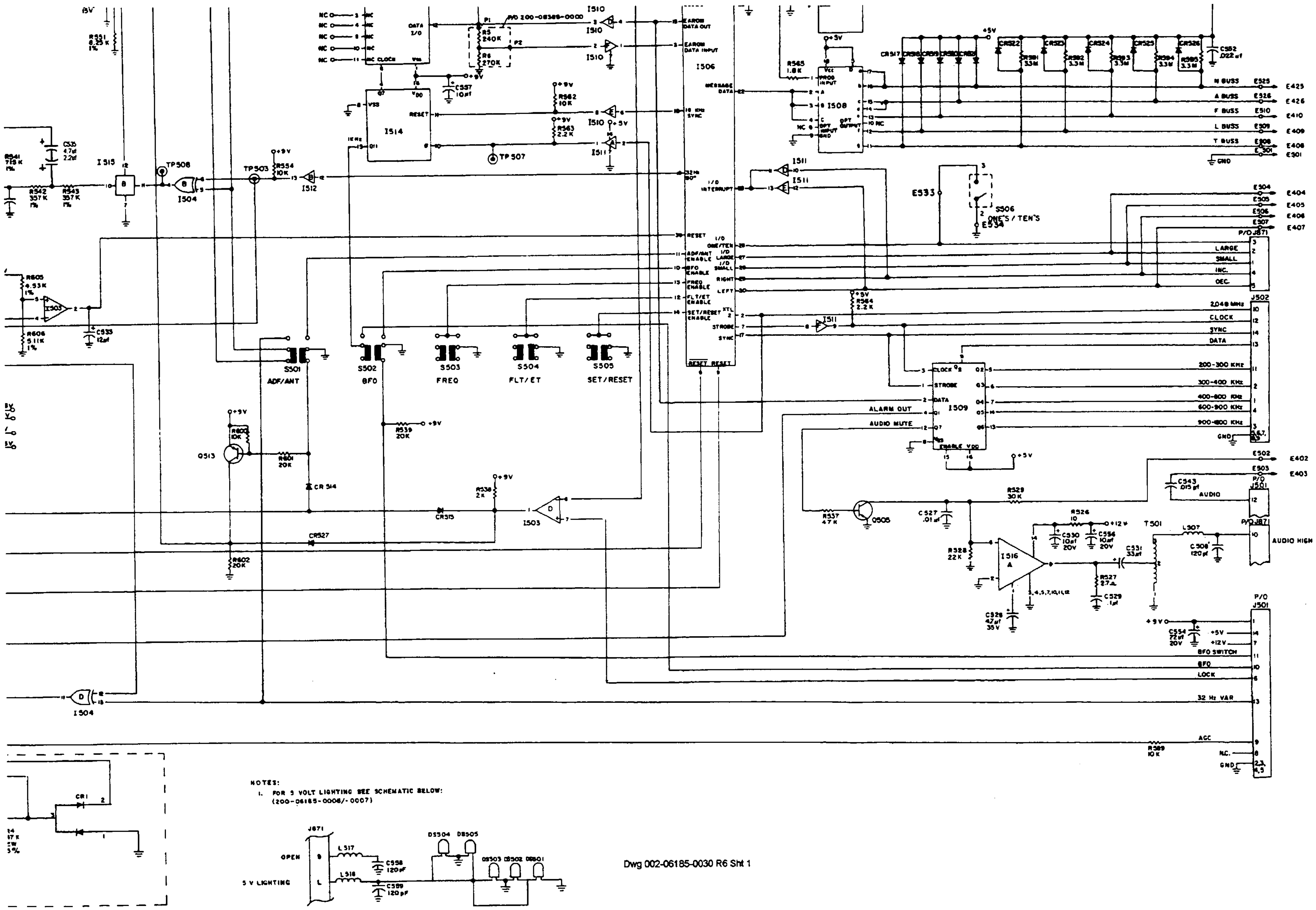


FIGURE 6–21 KR 87 MAIN BOARD SCHEMATIC
(Dwg. No. 002–06185–0030 R–6, Zoom Lower Right)

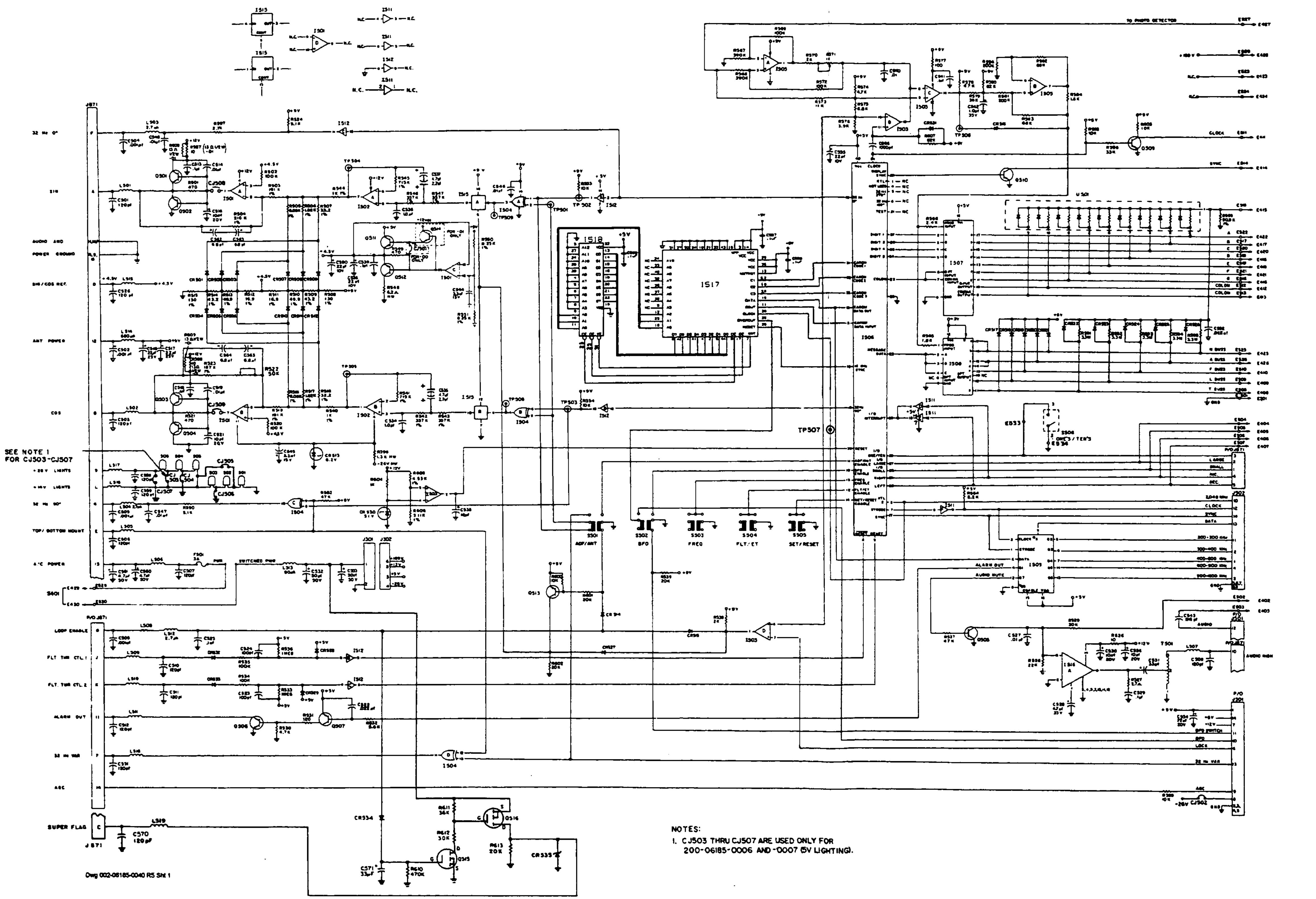


FIGURE 6-22 KR 87 MAIN BOARD SCHEMATIC
(Dwg. No. 002-06185-0040 R-5)

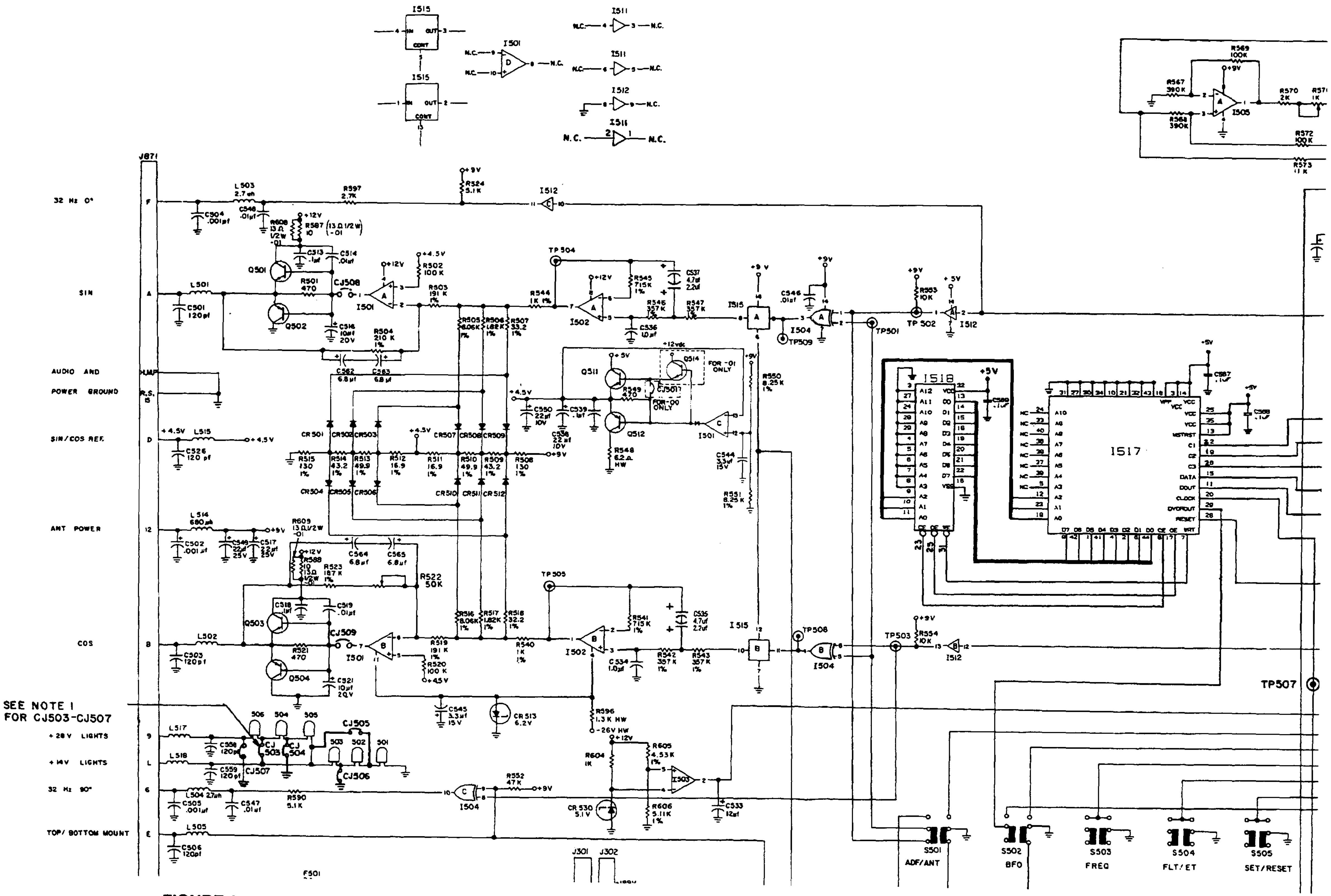


FIGURE 6-22 KR 87 MAIN BOARD SCHEMATIC
(Dwg. No. 002-06185-0040 R-5, Zoom Upper Left)

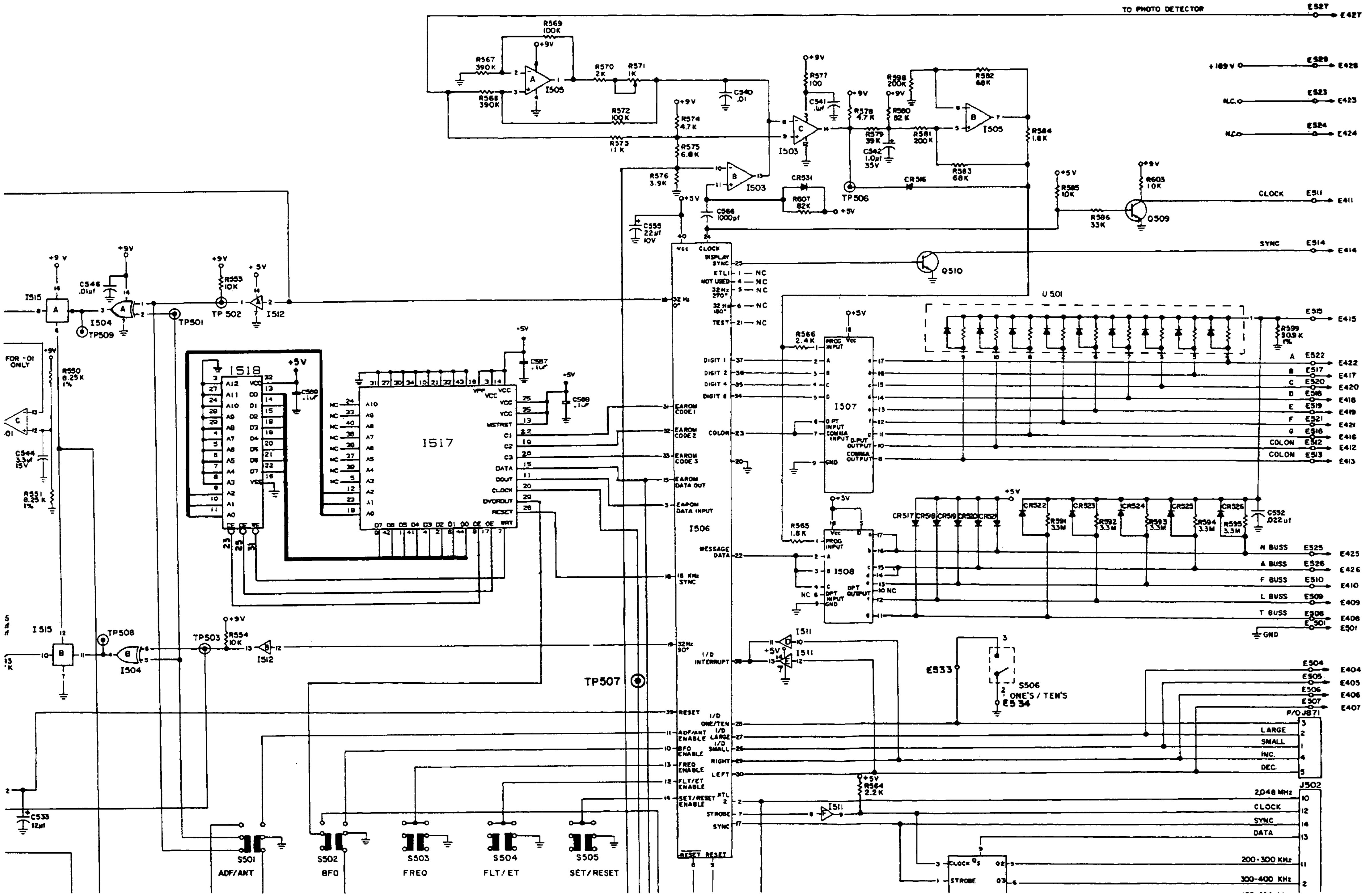


FIGURE 6-22 KR 87 MAIN BOARD SCHEMATIC
(Dwg. No. 002-06185-0040 R-5, Zoom Upper Right)

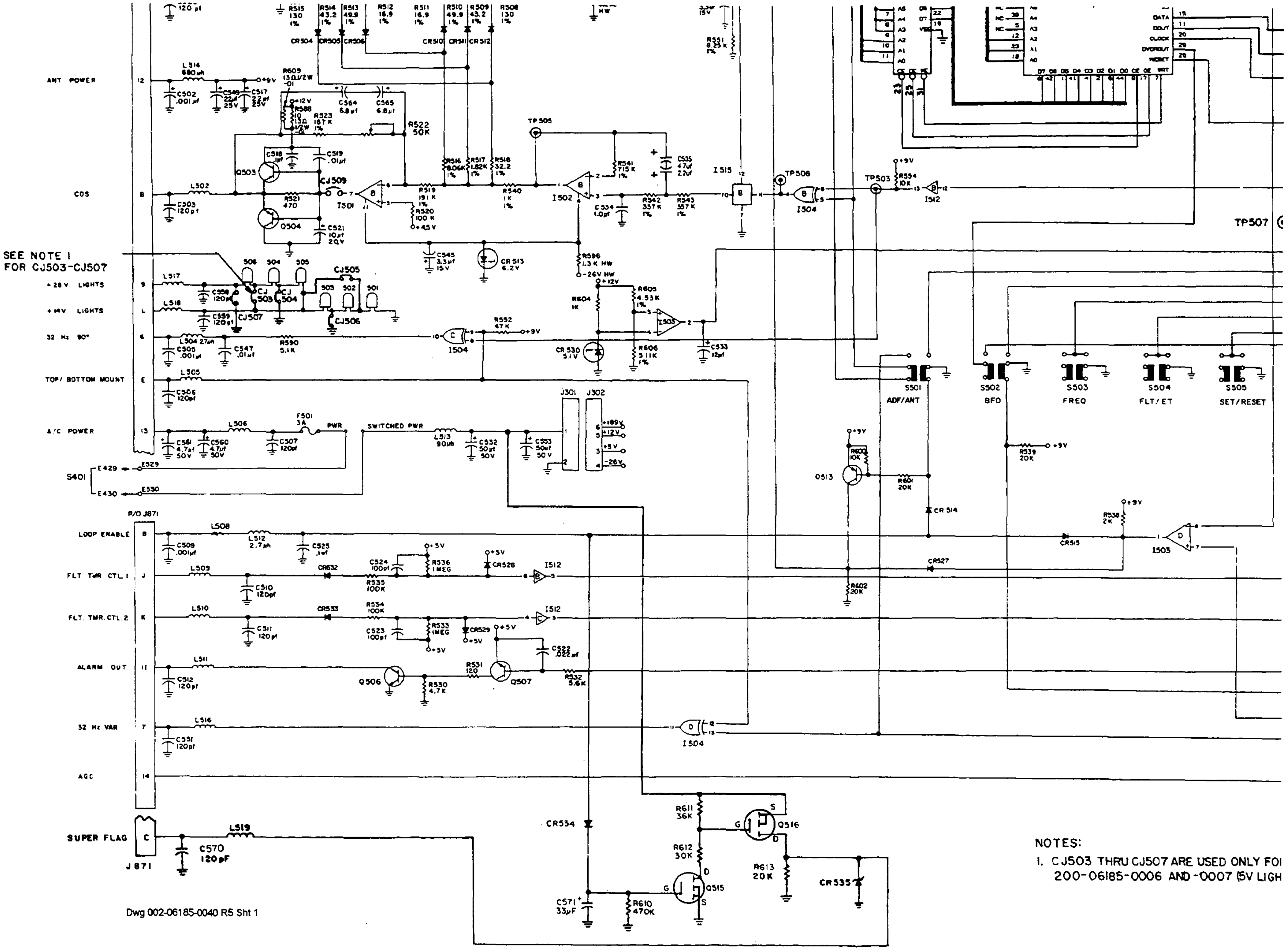


FIGURE 6-22 KR 87 MAIN BOARD SCHEMATIC
(Dwg. No. 002-06185-0040 R-5, Zoom Lower Left)

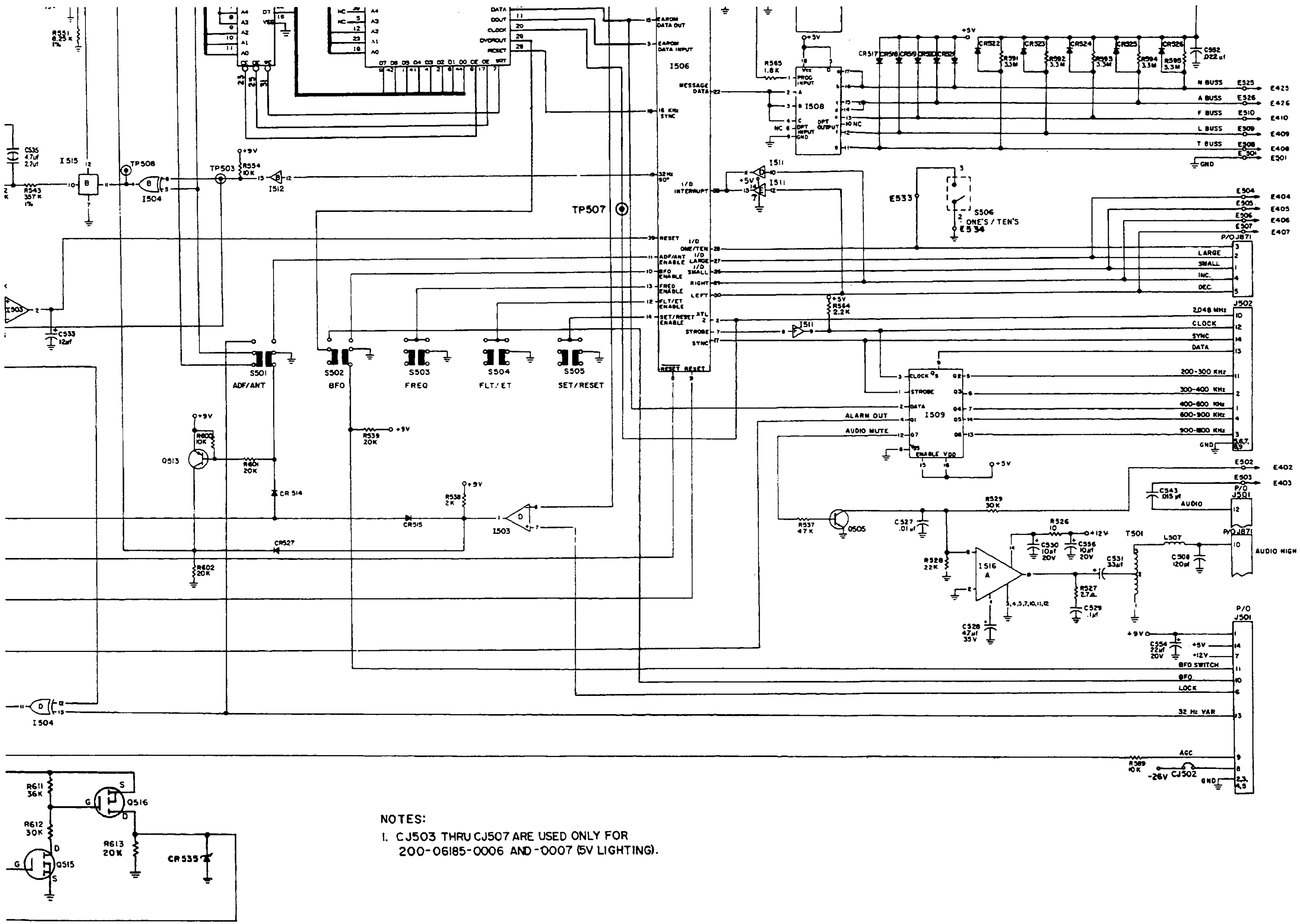


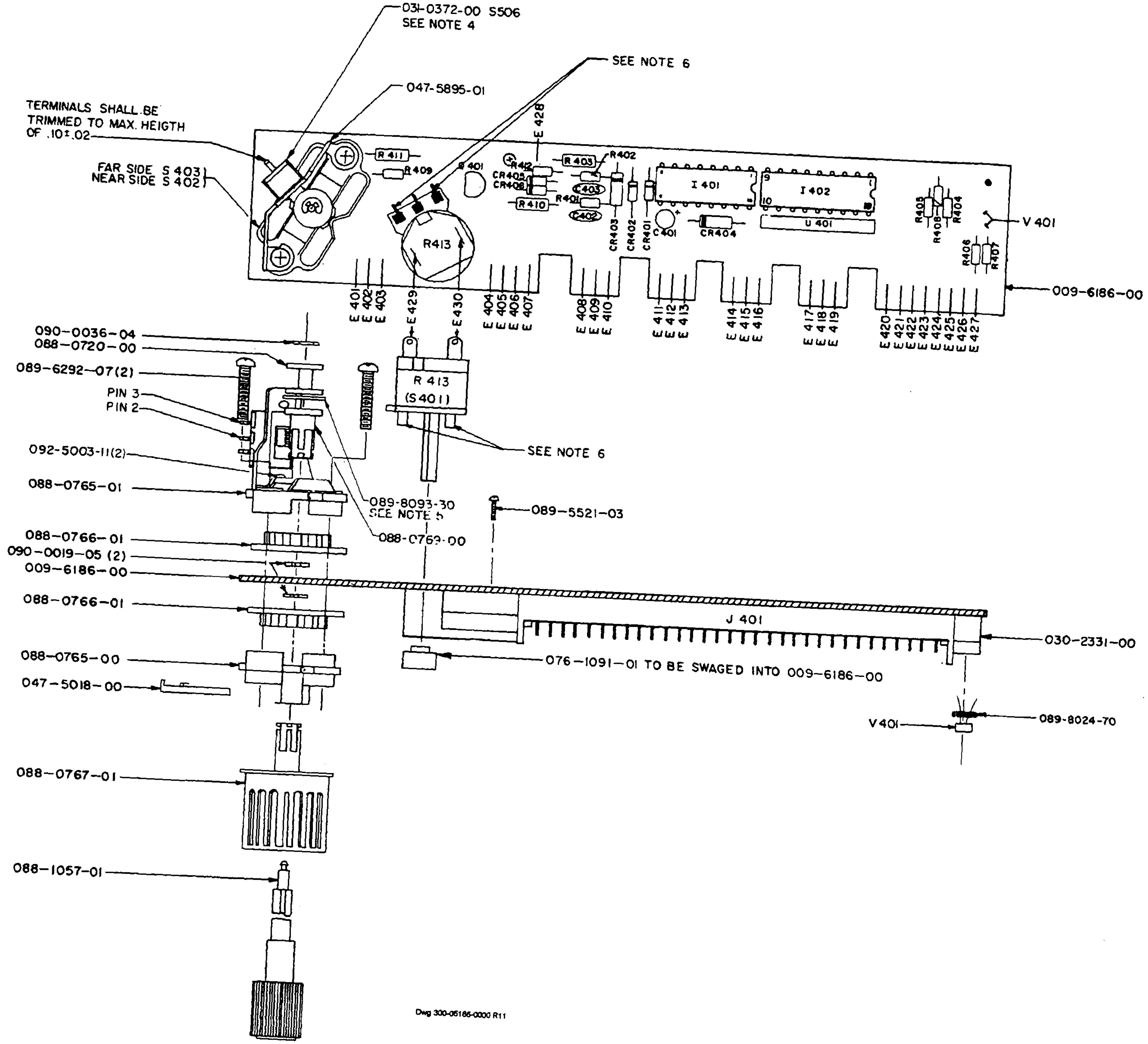
FIGURE 6-22 KR 87 MAIN BOARD SCHEMATIC
(Dwg. No. 002-06185-0040 R-5, Zoom Lower Right)

6.6	200-06186-0000	Rev. 23	KR 87 DISPLAY BOARD
	200-06186-0001	Rev. 1	KR 87 DISPLAY BOARD
	200-06186-0002	Rev. 4	KR 87 DISPLAY BOARD
	200-06186-0010	Rev. 2	KR 87 DISPLAY BOARD
	200-06186-0017	Rev. 0	KR 87 DISPLAY BOARD

SYMBOL	PART NUMBER	DESCRIPTION	[UM]	QUANTITY				
				-0000	-0001	-0002	-0010	-0017
	009-06186-0000	PC BD DISPLAY	[EA]	1	1	1		
	016-01040-0000	COATING TYPE AR	[AR]	0	0	0		
	047-05018-0000	SPRING SW 8 POS	[EA]	1	1	1		
	047-05895-0001	SW BRACKET W/F	[EA]	1	1	1		
	073-00550-0002	SHAFT W/F	[EA]			1		
	073-00554-0004	KNOB W/H	[EA]			1		
	073-00900-0004	KNOB KR87 VOLUMN	[EA]			1		
	073-00919-0003	KNOB	[EA]			1		
	076-01091-0001	SPACER W/F	[EA]	1	1	1		
	076-01232-0003	SHAFT W/F	[EA]			1		
	088-00720-0000	SPOOL SWITCH	[EA]	1	1	1		
	088-00765-0000	HOUSING SWITCH	[EA]	1	1	1		
	088-00765-0001	HOUSING SWITCH	[EA]	1	1	1		
	088-00766-0001	DETENT WHEEL 53/80	[EA]	2	2	2		
	088-00767-0001	KNOB	[EA]	1	1			
	088-00769-0000	SLEEVE LOCKING	[EA]	1	1	1		
	088-01057-0001	KNOB AND SHAFT W/F	[EA]	1	1			
	089-05521-0003	SCR FLHP 3-48X3/16	[EA]	1	1	1		
	089-06292-0007	SCR PHP 2-56X7/16	[EA]	2	2	2		
	089-08024-0070	WSHR FLT STD #3	[EA]	1	1	1		
	089-08093-0030	WSHR FLT STD .094	[EA]	1	1	1		
	089-08476-0005	WSHR FLT FELT .125	[EA]			1		
	090-00019-0005	RING RTNR .188	[EA]	2	2	2		
	090-00036-0004	RING RTNR .051	[EA]	1	1	1		
	092-05003-0011	EYE ROLL .059X.125	[EA]	2	2	2		
C 401	096-01082-0017	CAP TN 6.8UF 15V	[EA]	1	1	1		
C 401	096-01186-0018	CAP 6.8UF 20V 10%	[EA]				1	1
C 402	111-00001-0063	CAP CR .022UF 200V	[EA]	1	1	1	1	1
C 403	106-00044-0051	CAP CH 100PF 500V	[EA]				1	1
C 403	113-05101-0001	CAP DC 100PF 500V	[EA]	1	1	1		
CJ 401	026-00031-0008	WIRE CU26AWG 7500G	[IN]					0.6
CJ 402	026-00031-0008	WIRE CU26AWG 7500G	[IN]					0.9
CJ 403	026-00031-0008	WIRE CU26AWG 7500G	[IN]					1

SYMBOL	PART NUMBER	DESCRIPTION	[UM]	QUANTITY -0000	-0001	-0002	-0010	-0017
CJ 404	026-00031-0008	WIRE CU26AWG 7500G	[IN]					0.9
CR 401	007-06016-0000	DIO S 1N4154	[EA]	1	1	1		
CR 401	007-06227-0000	SOT23 DIO MMBD6100	[EA]				1	1
CR 402	007-06016-0000	DIO S 1N4154	[EA]	1	1	1		
CR 402	007-06227-0000	SOT23 DIO MMBD6100	[EA]				1	1
CR 403	007-05045-0015	DIO Z 1/4M9.1Z5	[EA]		1			
CR 403	007-05046-0003	DIO Z 1N5239B	[EA]	1		1		
CR 403	007-05117-0011	DIO Z 9.1V SOT	[EA]				1	1
CR 404	007-05046-0007	DIO Z 1N5271B	[EA]	1	1	1	1	1
CR 405	007-06016-0000	DIO S 1N4154	[EA]	1	1	1		
CR 405	007-06227-0000	SOT23 DIO MMBD6100	[EA]				1	1
CR 406	007-06016-0000	DIO S 1N4154	[EA]	1	1	1		
CR 406	007-06227-0000	SOT23 DIO MMBD6100	[EA]				1	1
DS 401	037-00012-0011	LAMP MIN T-1 5V	[EA]				1	1
DS 402	037-00012-0011	LAMP MIN T-1 5V	[EA]				1	1
DS 403	037-00012-0011	LAMP MIN T-1 5V	[EA]				1	1
DS 404	037-00012-0011	LAMP MIN T-1 5V	[EA]				1	1
DS 405	037-00012-0011	LAMP MIN T-1 5V	[EA]				1	1
DS 406	037-00012-0011	LAMP MIN T-1 5V	[EA]				1	1
I 401	120-06045-0000	IC CD4022BFX	[EA]	1		1		
I 401	120-06045-0001	IC SCL4022ABC+	[EA]		1			
I 401	120-06045-0004	IC 4022 SO PKG	[EA]				1	1
I 402	120-00161-0000	HIGH VOLT DSPLY DR	[EA]	1	1	1	1	1
I 402	120-03083-0000	IC DI-512	[AR]	0	0	0	0	0
ITM 1	009-06186-0010	DISPLAY BD_ LIGHTED	[EA]				1	1
ITM 10	047-05895-0001	SW BRACKET W/F	[EA]				1	1
ITM 11	092-05003-0011	EYE ROLL .059X.125	[EA]				2	2
ITM 12	089-06292-0007	SCR PHP 2-56X7/16	[EA]				2	2
ITM 13	089-08024-0070	WSHR FLT STD #3	[EA]				1	1
ITM 14	089-05521-0003	SCR FLHP 3-48X3/16	[EA]				1	1
ITM 15	016-01040-0000	COATING TYPE AR	[AR]				1	1
ITM 16	016-01013-0000	VAC GREASE DC 976	[AR]				1	1
ITM 17	088-00084-0008	FLTR LAMP LT BLU	[EA]					6
ITM 18	026-00029-0000	WIRE CU22AWG TIN	[IN]				2	2
ITM 19	150-00004-0010	TUBING TFLN 22AWG	[IN]				2	2
ITM 2	076-01091-0001	SPACER W/F	[EA]				1	1
ITM 3	088-00766-0001	DETENT WHEEL 53/80	[EA]				2	2

SYMBOL	PART NUMBER	DESCRIPTION	[UM]	QUANTITY -0000	-0001	-0002	-0010	-0017
ITM 4	088-00765-0000	HOUSING SWITCH	[EA]				1	1
ITM 5	047-05018-0000	SPRING SW 8 POS	[EA]				1	1
ITM 6	073-00550-0002	SHAFT W/F	[EA]				1	1
ITM 7	090-00019-0005	RING RTNR .188	[EA]				2	2
ITM 8	088-00765-0001	HOUSING SWITCH	[EA]				1	1
ITM 9	088-00769-0000	SLEEVE LOCKING	[EA]				1	1
J 401	030-02331-0000	CONN DSPLY	[EA]	1	1	1	1	1
Q 401	007-00254-0000	XSTR S PNP MPSA92	[EA]	1	1	1		
Q 401	007-00254-0001	XSTR S PNP SOT-23	[EA]				1	1
R 401	131-00184-0013	RES CF 180K EW 5%	[EA]	1	1	1		
R 401	139-01823-0000	RES CH 182K EW 1%	[EA]				1	1
R 402	131-00393-0013	RES CF 39K EW 5%	[EA]	1	1	1		
R 402	139-03922-0000	RES CH 39.2K EW 1%	[EA]				1	1
R 403	131-00393-0023	RES CF 39K QW 5%	[EA]	1	1	1		
R 403	139-03922-0020	RES CH 39200 QW 1%	[EA]				1	1
R 404	131-00334-0013	RES CF 330K EW 5%	[EA]	1	1	1		
R 404	139-03323-0000	RES CH 332K EW 1%	[EA]				1	1
R 405	131-00334-0013	RES CF 330K EW 5%	[EA]	1	1	1		
R 405	139-03323-0000	RES CH 332K EW 1%	[EA]				1	1
R 406	131-00334-0013	RES CF 330K EW 5%	[EA]	1	1	1		
R 406	139-03323-0000	RES CH 332K EW 1%	[EA]				1	1
R 407	131-00334-0013	RES CF 330K EW 5%	[EA]	1	1	1		
R 407	139-03323-0000	RES CH 332K EW 1%	[EA]				1	1
R 408	131-00334-0013	RES CF 330K EW 5%	[EA]	1	1	1		
R 408	139-03323-0000	RES CH 332K EW 1%	[EA]				1	1
R 409	131-00334-0013	RES CF 330K EW 5%	[EA]	1	1	1		
R 409	139-03323-0000	RES CH 332K EW 1%	[EA]				1	1
R 410	131-00224-0023	RES CF 220K QW 5%	[EA]	1	1	1		
R 410	139-02213-0020	RES CH 221K QW 1%	[EA]				1	1
R 411	136-01303-0072	RES PF 130K QW 1%	[EA]	1	1	1		
R 411	139-01303-0020	RES CH 130K QW 1%	[EA]				1	1
R 412	131-00240-0013	RES CF 24 EW 5%	[EA]	1	1	1		
R 412	139-00243-0000	RES CH 24.3 EW 1%	[EA]				1	1
S 401	031-00353-0000	SWITCH POT	[EA]	1	1	1	1	1
S 506	031-00372-0000	SW SPDT	[EA]	1	1	1	1	1
U 401	015-00105-0000	RESISTOR MODULE	[AR]	0	0	0	0	0
V 401	134-05005-0002	PHOTODETECTOR	[EA]	1		1	1	1



NOTES:

1. INSTALL SPRING (047-5018-00) ON HOUSING (088-0765-00) AFTER SWITCH IS ASSEMBLED ON P.C. BOARD.
2. AFTER ASSEMBLE, APPLY A SMALL AMOUNT OF EPOXY (016-1122-00) TO THE RETAINING RING (090-0036-04) TO SECURE IT TO THE SHAFT (088-0768-02).
3. PRIOR TO POST COATING BOTH SIDES OF ASSEMBLY WITH CLEAR URETHANE COATING (016-1040-00) MASK OFF THE FOLLOWING: ALL MOUNTING AREAS, E 401 THRU E 430, J 401, V 401, S 401, S 402, S 403.
4. ATTACH SWITCH TO BRACKET BY SWAGING OVER EYELETS.
5. USE WASHER AS NECESSARY TO REMOVE EXCESSIVE PLAY BETWEEN SPOOL AND SHAFT.
5. HEATSINK OUTER LEADS OF R413 WHEN SOLDERING TO P.C. BOARD.

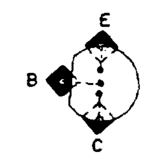
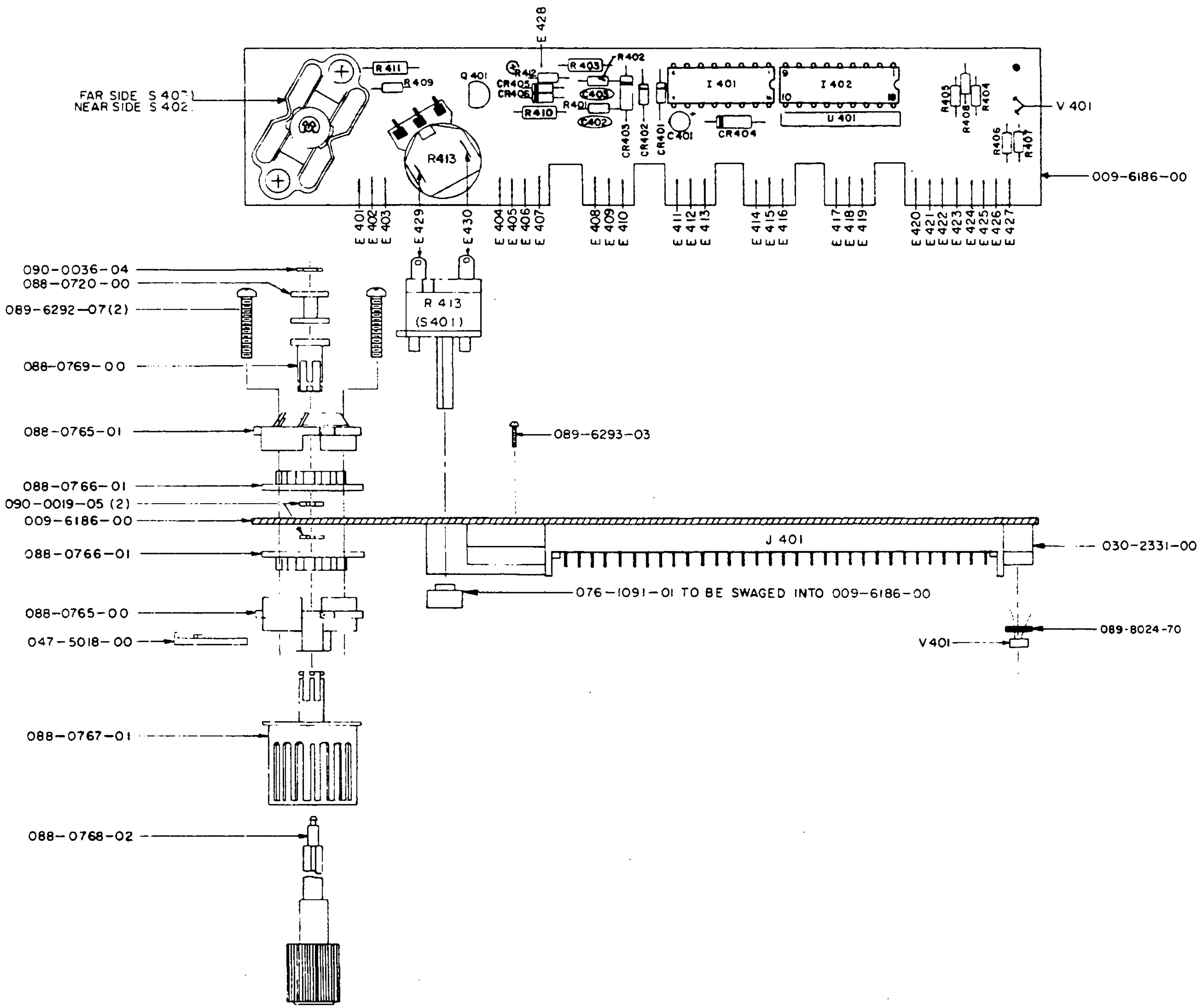


FIGURE 6-23 KR 87 DISPLAY BOARD ASSEMBLY
(Dwg. No. 300-06186-0000 R-11, For Use With 200-06186-0000 & -0001)



NOTES:

1. INSTALL SPRING (047-5018-00) ON HOUSING (088-0765-00) AFTER SWITCH IS ASSEMBLED ON P.C. BOARD.
2. AFTER ASSEMBLE, APPLY A SMALL AMOUNT OF EPOXY (016-1122-00) TO THE RETAINING RING (090-0036-04) TO SECURE IT TO THE SHAFT (088-0768-02).
3. PRIOR TO POST COATING BOTH SIDES OF ASSEMBLY WITH CLEAR URETHANE COATING (016-1040-00) MASK OFF THE FOLLOWING: ALL MOUNTING AREAS, E 401 THRU E 430, J 401, V 401, S 401, S 402, S 403.

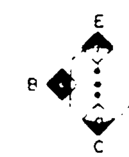
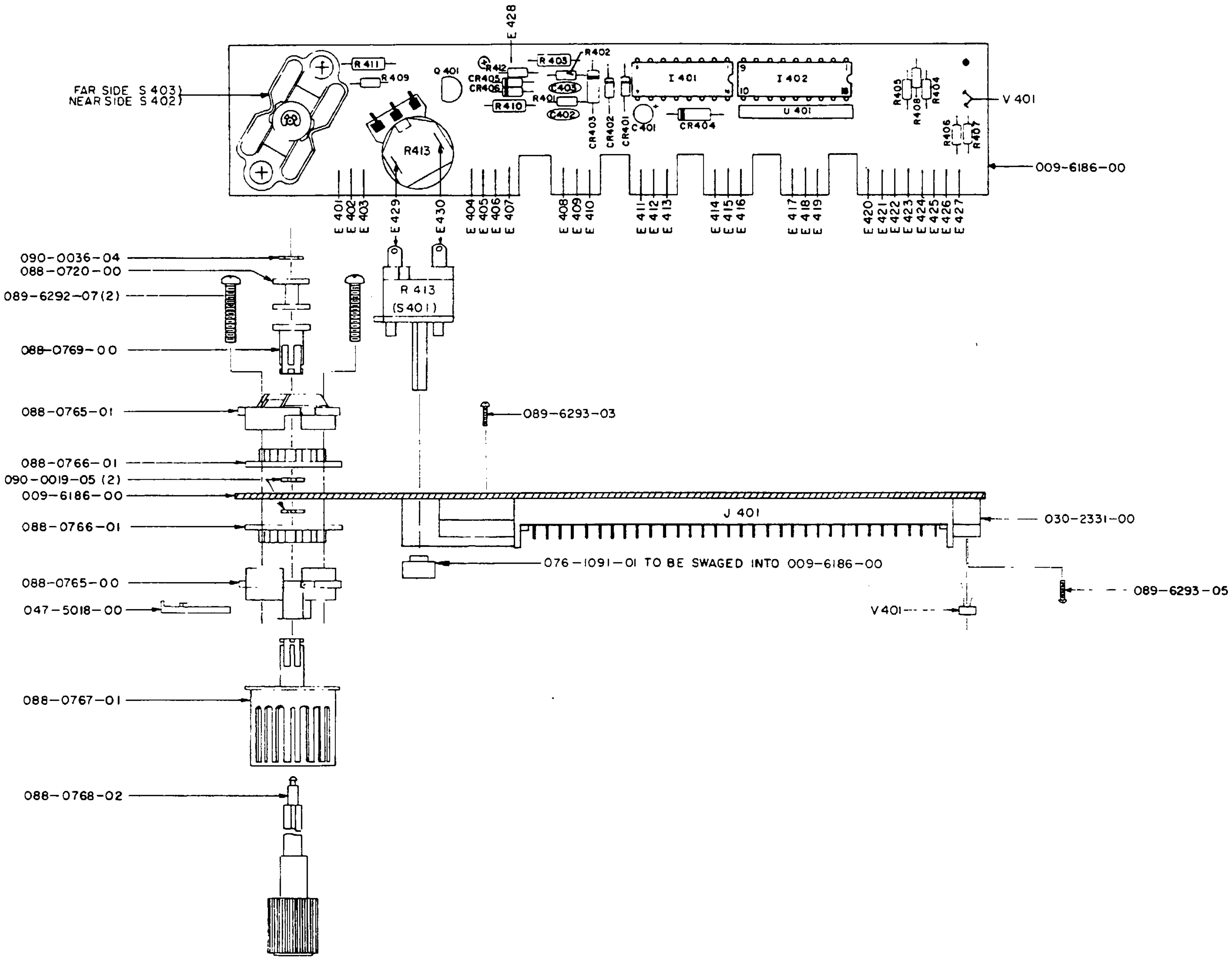


FIGURE 6-23A KR 87 DISPLAY BOARD ASSEMBLY
(Dwg. No. 300-06186-0000 R-3, For Use With 200-06186-0000 & -0001)



NOTES

1. INSTALL SPRING (047-5018-00) ON HOUSING (088-0765-00) AFTER SWITCH IS ASSEMBLED ON P C BOARD.
2. AFTER ASSEMBLE, APPLY A SMALL AMOUNT OF EPOXY (016-1122-00) TO THE RETAINING RING (090-0036-04) TO SECURE IT TO THE SHAFT (088-0768-02).
3. PRIOR TO POST COATING BOTH SIDES OF ASSEMBLY WITH CLEAR URETHANE COATING (016-1040-00) MASK OFF THE FOLLOWING ALL MOUNTING AREAS, E 401 THRU E 430, J 401, V 401, S 401, S 402, S 403.

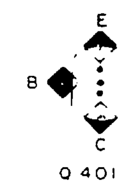
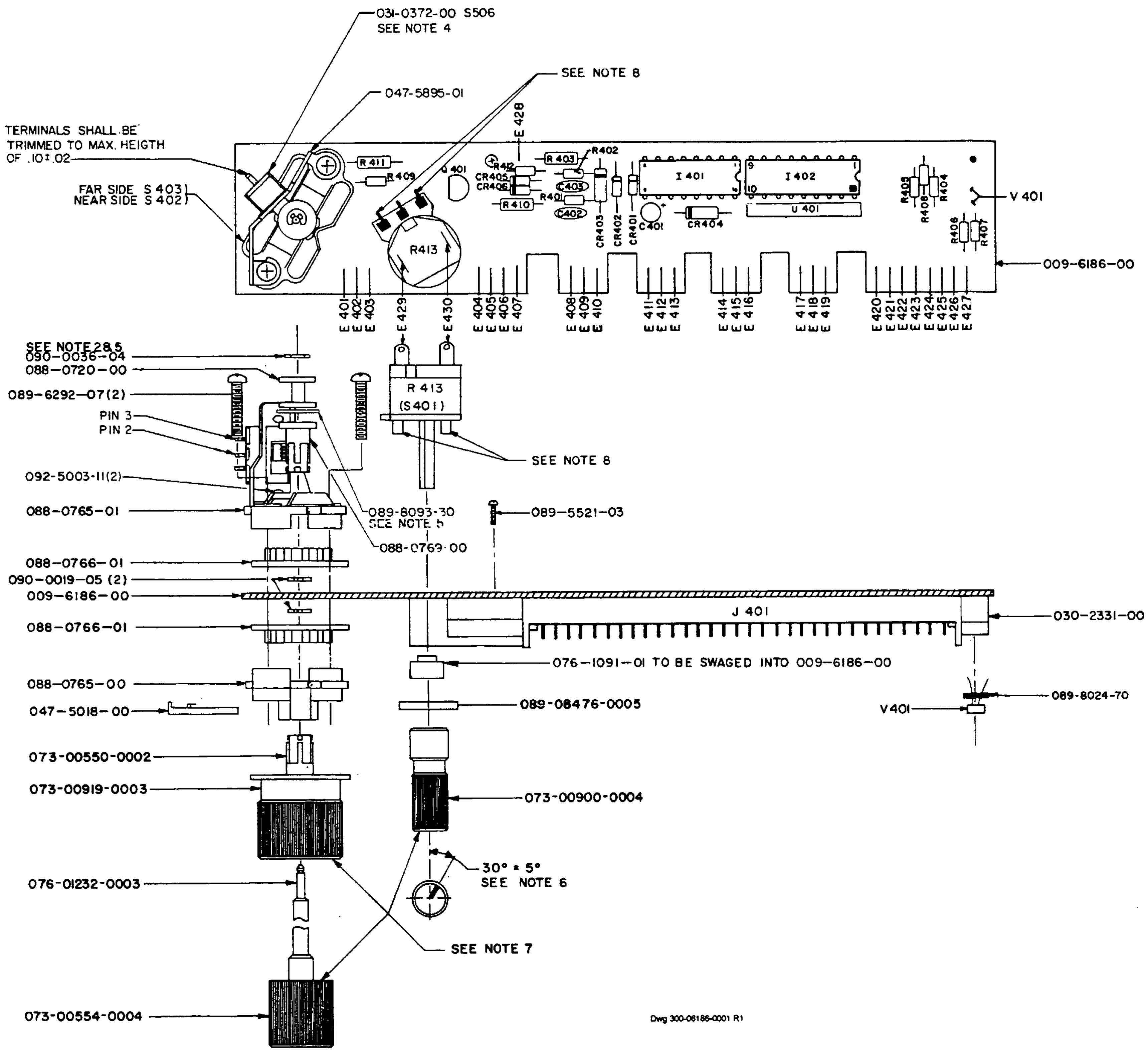


FIGURE 6-23B KR 87 DISPLAY BOARD ASSEMBLY
(Dwg. No. 300-06186-0000 R-1, For Use With 200-06186-0000 & -0001)



NOTES:

1. INSTALL SPRING (047-05018-0000) ON HOUSING (088-00765-0000) AFTER SWITCH IS ASSEMBLED ON P.C. BOARD.
2. AFTER ASSEMBLY, APPLY A SMALL AMOUNT OF EPOXY (016-01122-0000) TO THE RETAINING RING (090-00036-0004) TO SECURE IT TO THE SHAFT 076-01232-0003.
3. PRIOR TO POST COATING BOTH SIDES OF ASSEMBLY WITH CLEAR URETHANE COATING (016-01040-0000) MASK OFF THE FOLLOWING: ALL MOUNTING AREAS, E401 THRU E430, J401, V401, S401, S402, S403.
4. ATTACH SWITCH TO BRACKET BY SWAGING OVER EYELETS.
5. USE WASHER AS NECESSARY TO REMOVE EXCESSIVE PLAY BETWEEN SPOOL AND SHAFT.
6. HASH MARK OF KNOB 073-00901-0002 IS TO BE LOCATED AS SHOWN WHEN SWITCH IS IN THE OFF POSITION.
7. KNOB 073-00919-0003 IS TO BE MOUNTED WITH .025 MAX CLEARANCE FROM KNOB REAR SURFACE AND MUST TURN FREELY THRU A FULL ROTATION. KNOB 073-00900-0004 MUST CONTACT FELT WASHER.
8. HEATSINK OUTER LEADS OF R413 WHEN SOLDERING TO P.C. BOARD.

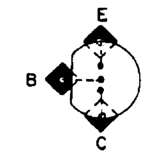


FIGURE 6-24 KR 87 DISPLAY BOARD ASSEMBLY
(Dwg. No. 300-06186-0001 R-1, For Use With 200-06186-0002 Only)

REWORK NOTES:

(A) TO CORRECT R413 POLARITY (REV 0 & REV 0B BOARDS)

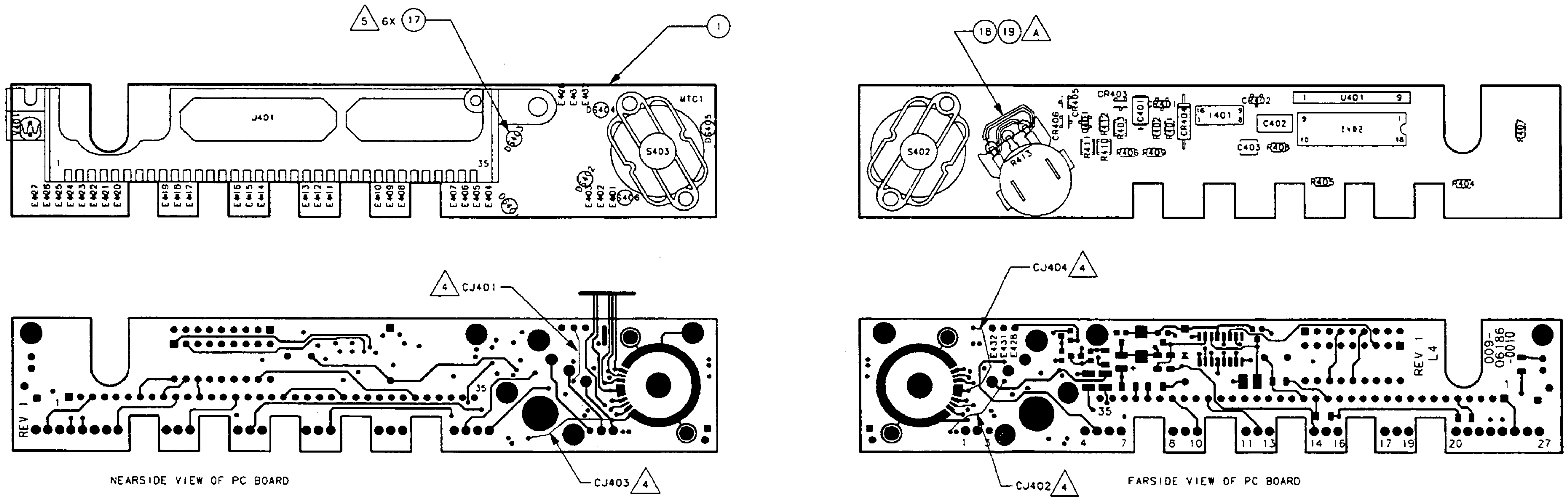
1. CUT OFF OUTER TWO LEADS OF R413 TRIPLE CONTACT AT BEND.
2. SOLDER BUSS WIRE (ITEM 18) WITH SLEEVING (ITEM 19) FROM R413 CUT LEADS TO BOARD IN A CROSSED PATTERN.
3. HEATSINK CUT LEADS OF R413 WHEN SOLDERING BUSS WIRE.

NOTES:

1. PRIOR TO POST COATING BOTH SIDES OF P.C. BOARD WITH CLEAR URETHANE COATING (ITM 15), MASK OFF ALL MOUNTING AREAS. E401 THRU E430, DS401-DS406, J401, R413, S402-S403
2. PRINTED CIRCUIT ASSEMBLY IDENTIFICATION MUST BE IN ACCORDANCE WITH SPEC. 001-01101-0000.
3. LIQUID STAKE ALL FASTENERS PER SPEC. 001-01080-0000.

(4) 200-06186-0017 ONLY:
ADD CJ401 - CJ404 AS SHOWN PRIOR TO R413 AND S402/403.

(5) 200-06186-0017 ONLY:
DS401 THRU DS406 ARE TO HAVE (ITEM 17) BOOT.
BOOT MUST BE FULLY SEATED ON BULB.
DS405 AND DS406 BOOTS MUST NOT CONTACT S403.



Dwg 300-06186-0010 R2 Sht 1

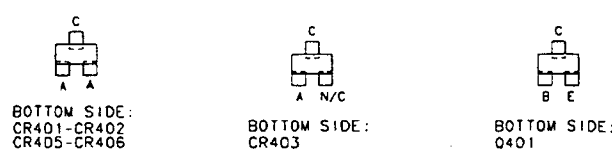


FIGURE 6-25 KR 87 DISPLAY BOARD ASSEMBLY
(Dwg. No. 300-06186-0010 R-2, Sheet 1 of 2, For Use With 200-06186-0010 & -0017)

NOTES: (SEE SHEET 1 FOR NOTES 1 THRU 5)

6. ATTACH SPACER (ITM 2) TO PC BOARD (ITM 1) BY SWAGING PRIOR TO INSTALLATION OF SWITCH (S401).
7. ATTACH SWITCH (S506) TO BRACKET (ITM 10) AS SHOWN BY SWAGING OVER EYELETS (ITM 11, 2X).
8. INSTALL SPRING (ITM 5) ON HOUSING AS SHOWN (ITM 4) AFTER SWITCH IS ASSEMBLED TO PC BOARD (ITM 1).
9. APPLY A THIN FILM OF VACUUM GREASE (ITM 16) TO (ITM 3) DETENTS AFTER SWITCH IS FULLY ASSEMBLED.

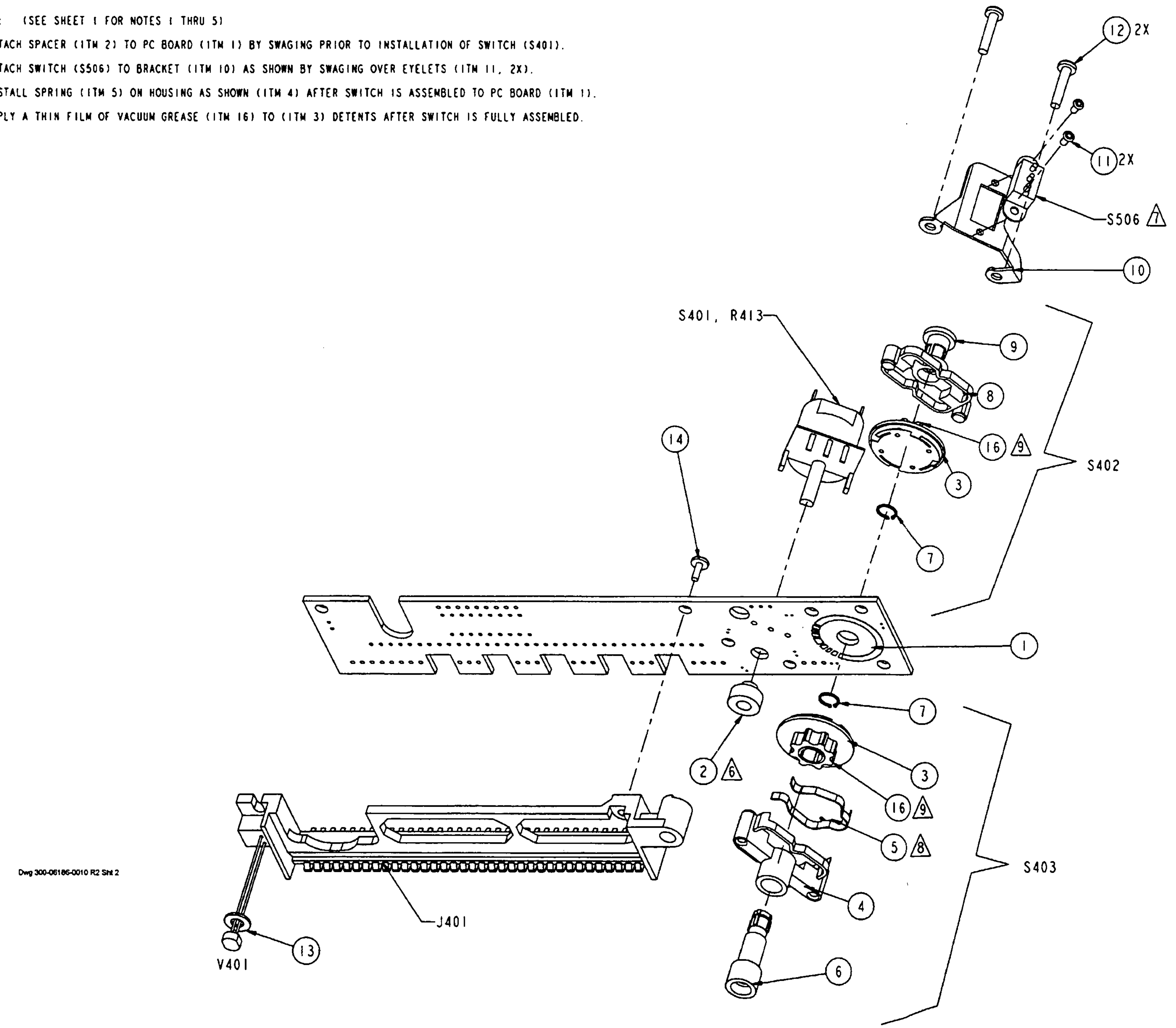


FIGURE 6-25 KR 87 DISPLAY BOARD ASSEMBLY
(Dwg. No. 300-06186-0010 R-2, Sheet 2 of 2, For Use With 200-06186-0010 & -0017)

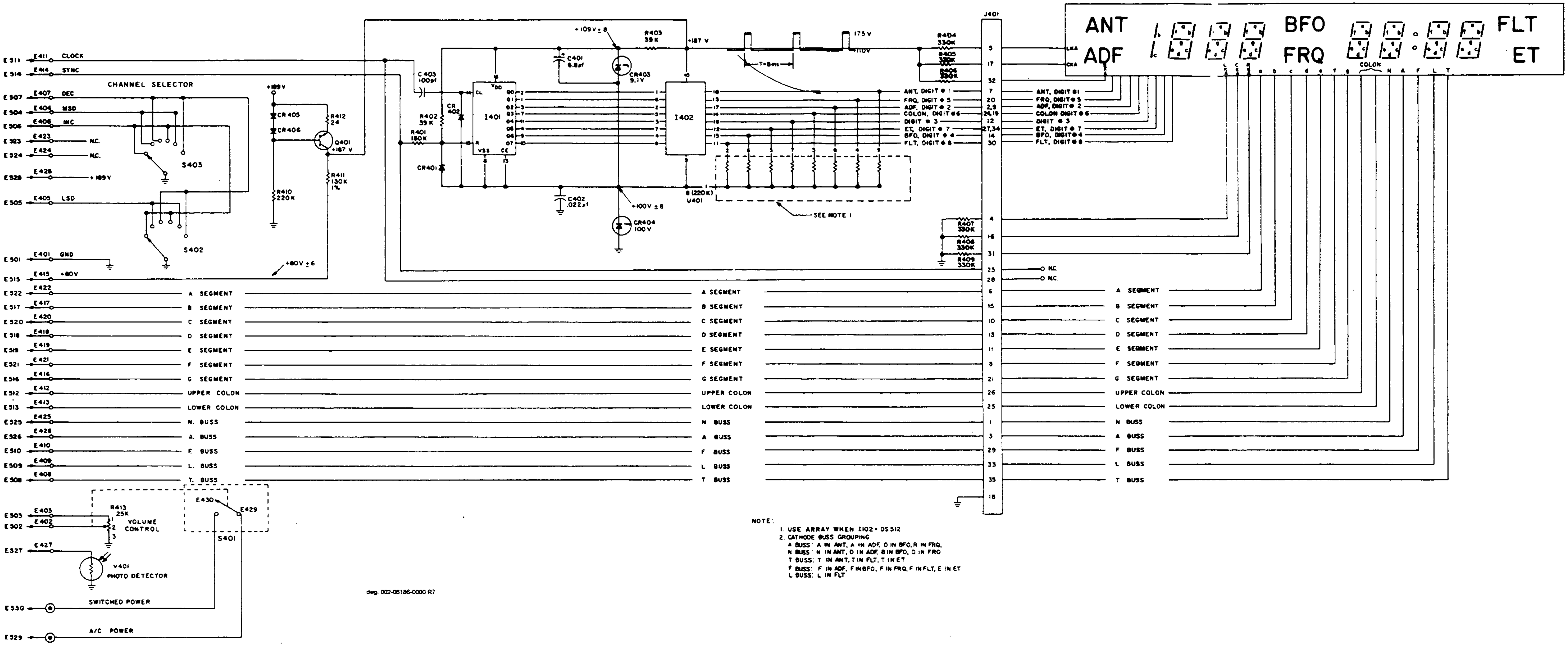


FIGURE 6-26 KR 87 DISPLAY BOARD SCHEMATIC
(Dwg. No. 002-06186-0000 R-7, For Use With 200-06186-0000, -0001 & -0002)

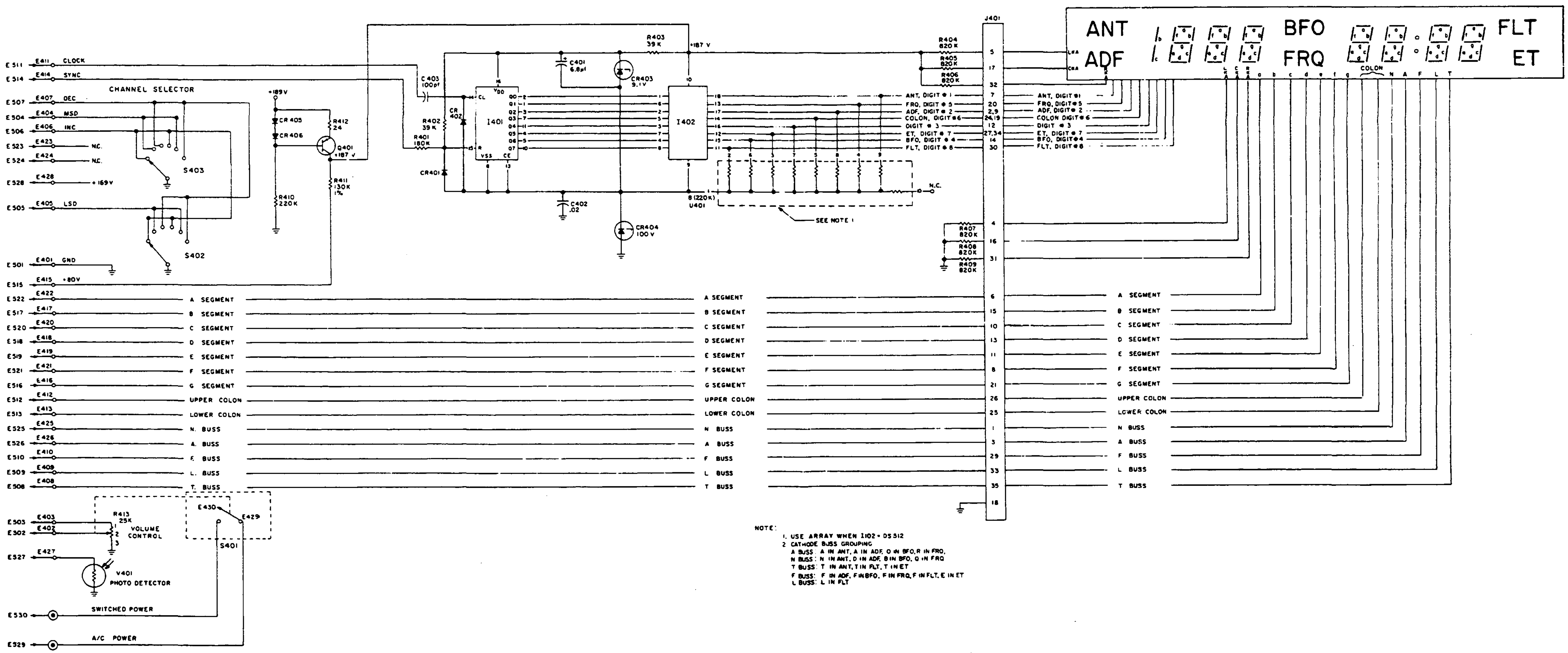


FIGURE 6-26A KR 87 DISPLAY BOARD SCHEMATIC
(Dwg. No. 002-06186-0000 R-3, For Use With 200-06186-0000, -0001 & -0002)

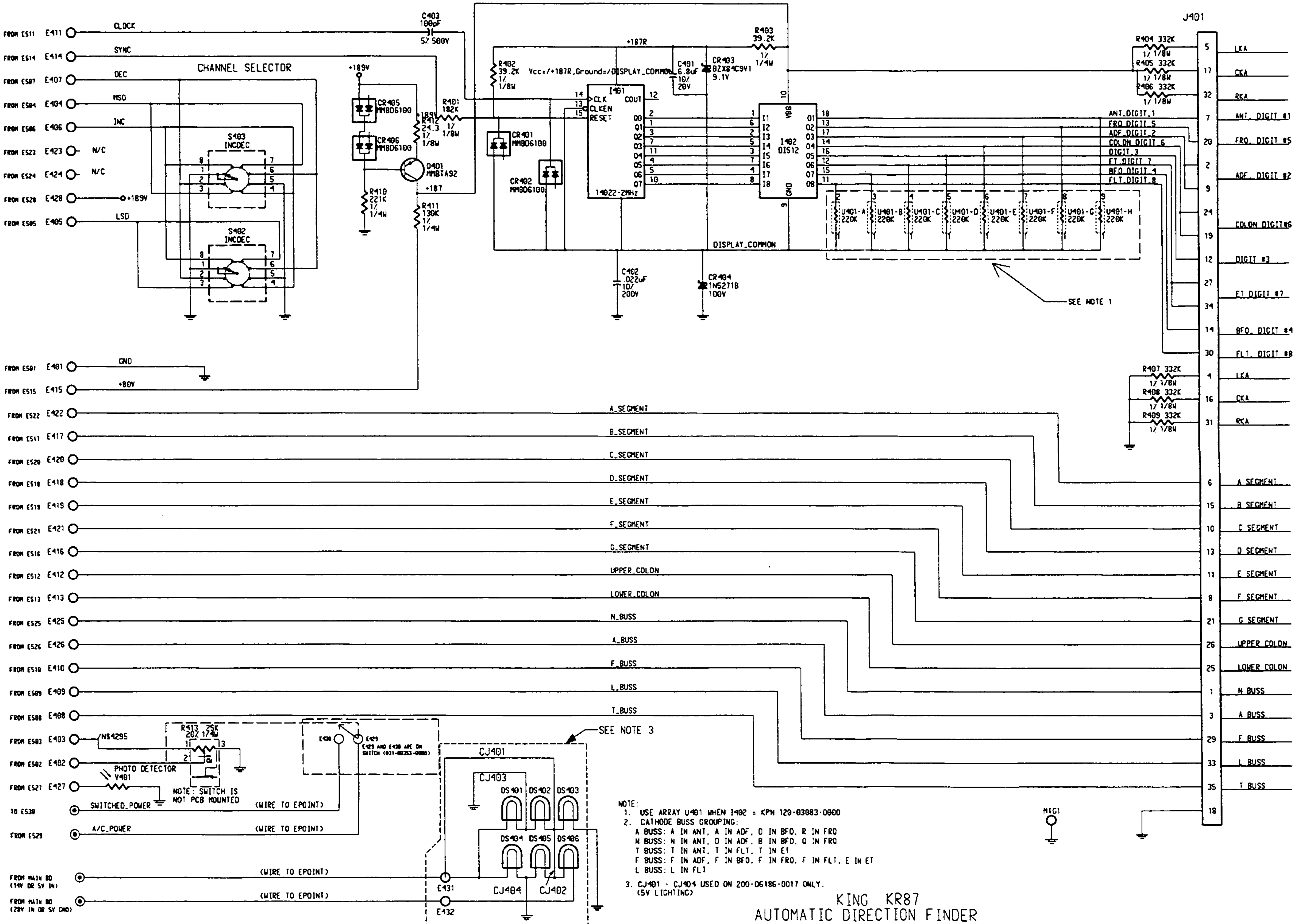


FIGURE 6-27 KR 87 DISPLAY BOARD SCHEMATIC
(Dwg. No. 002-06186-0010 R-1, Sheet 1 of 2, For Use With 200-06186-0010, & -0017)

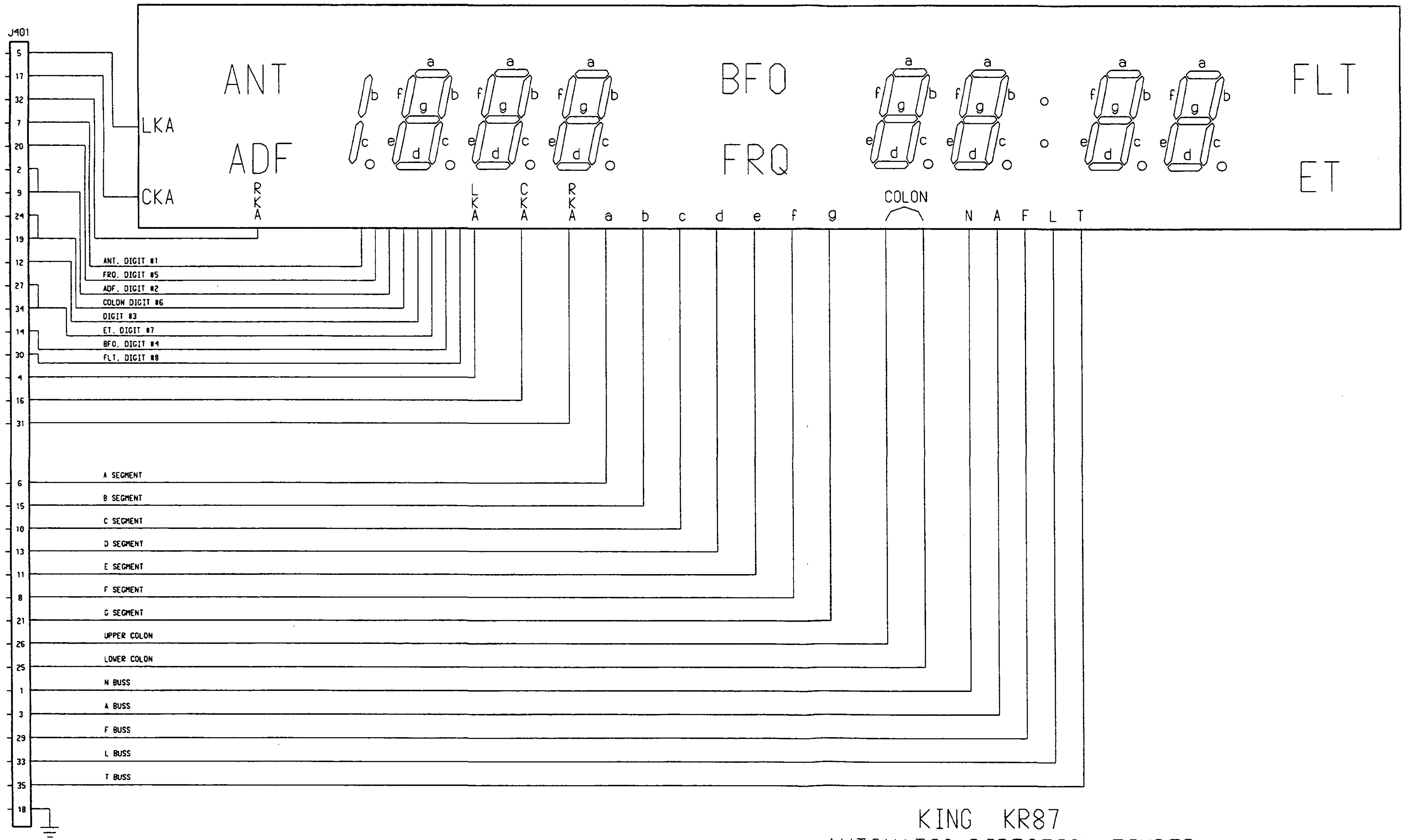


FIGURE 6-27 KR 87 DISPLAY BOARD SCHEMATIC
(Dwg. No. 002-06186-0010 R-1, Sheet 2 of 2, For Use With 200-06186-0010, & -0017)

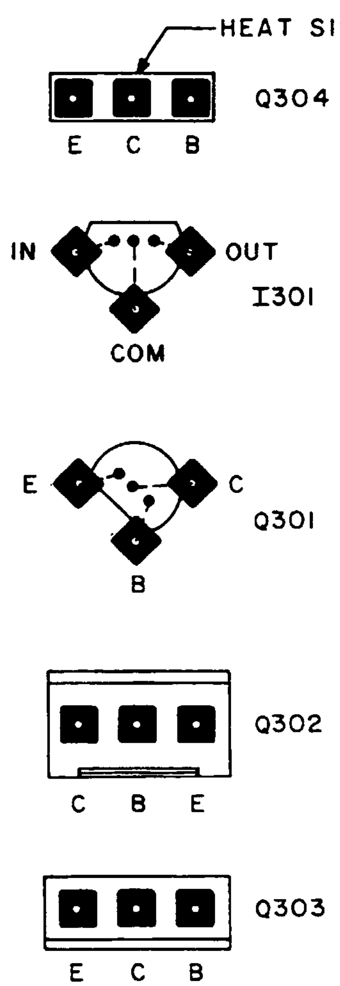
6.7 200-06187-0000 Rev. 22 KR 87 POWER SUPPLY
200-06187-0001 Rev. 21 KR 87 POWER SUPPLY

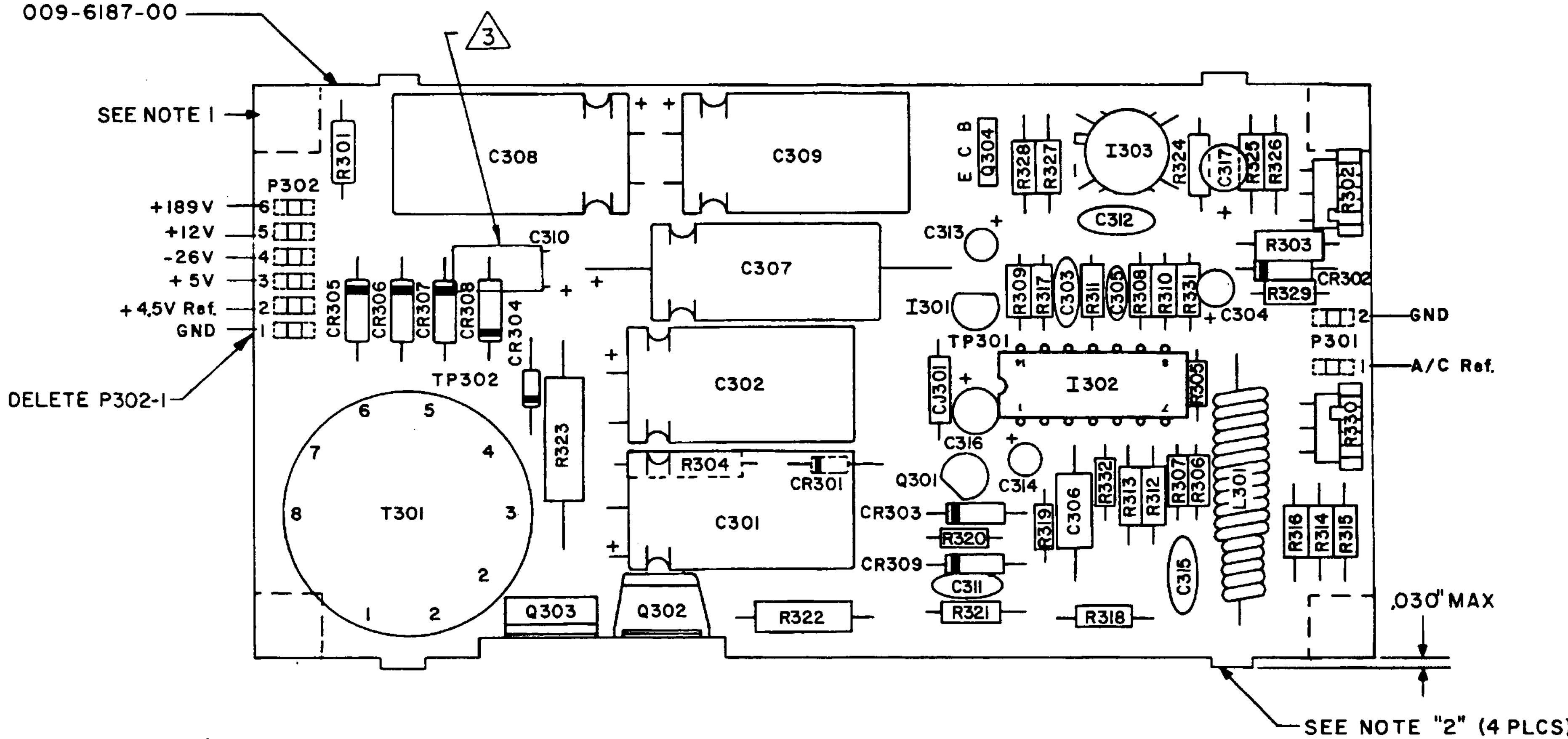
SYMBOL	PART NUMBER	DESCRIPTION	[UM]	QUANTITY -0000	-0001
	009-06187-0000	PC BD PWR SPLY	[EA]	1	
	016-01040-0000	COATING TYPE AR	[AR]	0	
	047-04977-0003	FNGR STOCK .625	[AR]		1
	047-04977-0005	FNGR STOCK 1.812	[EA]		2
	047-04977-0006	FNGR STOCK 2.313	[AR]		1
	047-04977-0010	FNGR STOCK 3.780	[AR]		1
	047-05117-0001	TOP SHLD PS	[EA]		1
	047-05118-0002	BTM SHLD PS	[EA]		1
	047-09337-0001	HEAT SINK PAD	[EA]		1
	057-02288-0000	DECAL PWR SPLY	[EA]		1
	076-01086-0002	SPACER HEX .600	[EA]		4
	089-02005-0037	NUT FLAT 2-56	[EA]		2
	089-05436-0006	SCR FHP 4-40X3/8	[EA]		3
	089-05899-0004	SCR PHP 2-56X1/4	[EA]		1
	089-05899-0005	SCR PHP #2-56X5/16	[EA]		1
	089-08003-0034	WSHR SPLT LK #4	[EA]		4
	089-08012-0037	WSHR INTL LK #2	[EA]		2
	089-08023-0030	WSHR FLT STD #2	[EA]		2
	089-08024-0030	WSHR FLT STD #3	[EA]		4
	091-00187-0001	WASHER SHOULDER	[EA]		2
	091-00286-0002	INSUL XSTR .687	[EA]		1
	091-00286-0005	INSUL XSTR .437	[EA]		1
	091-00319-0000	INSUL PWR SPLY	[EA]		1
	187-01171-0000	CUSHION	[EA]		1
	187-01181-0000	CUSHION	[EA]		1
	200-06187-0000	POWER SUPPLY	[EA]		1
C 301	097-00078-0027	CAP AL 100UF 50V	[EA]	1	
C 302	097-00078-0027	CAP AL 100UF 50V	[EA]	1	
C 303	114-07104-0000	CAP DC .1UF 16V	[EA]	1	
C 304	096-01082-0047	CAP TN 1UF 20V	[EA]	1	
C 305	109-00007-0000	CAP DC .01UF 25V	[EA]	1	
C 306	105-00018-0015	CAP MY .001UF 200V	[EA]	1	
C 307	097-00071-0001	CAP AL 4.7UF 350V	[EA]	1	
C 308	097-00078-0016	CAP AL 220UF 25V	[EA]	1	
C 309	097-00078-0010	CAP AL 330UF 16V	[EA]	1	

SYMBOL	PART NUMBER	DESCRIPTION	[UM]	QUANTITY -0000	-0001
C 310	097-00104-0038	CAP AL 47UF 50V	[EA]	1	
C 311	113-05102-0000	CAP DC .001UF 500V	[EA]	1	
C 312	113-05471-0000	CAP DC 470PF 500V	[EA]	1	
C 313	096-01082-0005	CAP TN 10UF 20V	[EA]	1	
C 314	096-01082-0002	CAP TN 1UF 35V	[EA]	1	
C 315	113-05331-0000	CAP DC 330PF 500V	[EA]	1	
C 316	096-01082-0022	CAP TN 22UF 10V	[EA]	1	
C 317	096-01082-0025	CAP TN 150UF 10V	[EA]	1	
CJ 301	026-00018-0000	WIRE CKTJMPR 22AWG	[EA]	1	
CR 301	007-05011-0024	DIO Z 33V 1W 5%	[EA]	1	
CR 302	007-06016-0000	DIO S 1N4154	[EA]	1	
CR 303	007-06111-0000	DIO S IN4157	[EA]	1	
CR 304	007-06105-0000	DIO HV FDH444	[EA]	1	
CR 305	007-06140-0000	DIO S LA25	[EA]	1	
CR 306	007-06091-0002	DIO MR811	[EA]	1	
CR 307	007-06091-0001	DIO MR810	[EA]	1	
CR 308	007-06091-0003	DIO MR814	[EA]	1	
CR 309	007-06016-0000	DIO S 1N4154	[EA]	1	
I 301	120-03094-0032	IC LM340LAZ-5.0	[EA]	1	
I 302	120-03048-0000	IC LM339N	[EA]	1	
I 303	120-03023-0001	IC UA723883B	[EA]	1	
L 301	019-02102-0004	CHOKE 90UH	[EA]	1	
P 301	030-01117-0000	RECEPTACLE	[EA]	1	
P 302	030-01117-0000	RECEPTACLE	[EA]	1	
Q 301	007-00078-0001	XSTR S NPN 2N3417	[EA]	1	
Q 302	007-00244-0000	XSTR S MPSU05-3	[EA]	1	
Q 303	007-00230-0025	XSTR S NPN D44H8	[EA]	1	
Q 304	007-00276-0004	XSTR MJE182	[EA]	1	
R 301	135-00364-0012	RES MF 360K QW 5%	[EA]	1	
R 302	133-00113-0015	RES VA 2K 20% B	[EA]	1	
R 303	135-00912-0012	RES MF 9.1K QW 5%	[EA]	1	
R 304	131-00681-0033	RES CF 680 HW 5%	[EA]	1	
R 305	131-00563-0013	RES CF 56K EW 5%	[EA]	1	
R 306	131-00162-0013	RES CF 1.6K EW 5%	[EA]	1	
R 307	131-00203-0013	RES CF 20K EW 5%	[EA]	1	
R 308	131-00393-0013	RES CF 39K EW 5%	[EA]	1	
R 309	131-00363-0013	RES CF 36K EW 5%	[EA]	1	

SYMBOL	PART NUMBER	DESCRIPTION	[UM]	QUANTITY -0000	-0001
R 310	131-00202-0013	RES CF 2K EW 5%	[EA]	1	
R 311	131-00393-0013	RES CF 39K EW 5%	[EA]	1	
R 312	136-03322-0072	RES PF 33.2K QW 1%	[EA]	1	
R 313	136-03322-0072	RES PF 33.2K QW 1%	[EA]	1	
R 314	136-03322-0072	RES PF 33.2K QW 1%	[EA]	1	
R 315	136-03402-0072	RES PF 34K QW 1%	[EA]	1	
R 316	136-02261-0072	RES PF 2.26K QW 1%	[EA]	1	
R 317	131-00302-0013	RES CF 3K EW 5%	[EA]	1	
R 318	131-00391-0023	RES CF 390 QW 5%	[EA]	1	
R 319	131-00471-0013	RES CF 470 EW 5%	[EA]	1	
R 320	131-00301-0013	RES CF 300 EW 5%	[EA]	1	
R 321	131-00390-0023	RES CF 39 QW 5%	[EA]	1	
R 322	131-00018-0033	RES CF 1.8 HW 5%	[EA]	1	
R 323	132-05046-0000	RES WW .05 2W 5%	[EA]	1	
R 324	136-02001-0072	RES PF 2.0K QW 1%	[EA]	1	
R 325	136-04990-0072	RES PF 499 QW 1%	[EA]	1	
R 326	136-04221-0072	RES PF 4.22K QW 1%	[EA]	1	
R 327	131-00200-0023	RES CF 20 QW 5%	[EA]	1	
R 328	131-00132-0023	RES CF 1.3K QW 5%	[EA]	1	
R 329	131-00822-0013	RES CF 8.2K EW 5%	[EA]	1	
R 330	133-00113-0017	RES VA 5K 20% B	[EA]	1	
R 331	131-00242-0013	RES CF 2.4K EW 5%	[EA]	1	
R 332	131-00102-0013	RES CF 1K EW 5%	[EA]	1	
T 301	019-07090-0000	XFMR PWR	[EA]	1	
TP 301	008-00096-0001	TERMINAL TEST PNT	[EA]	1	
TP 302	008-00096-0001	TERMINAL TEST PNT	[EA]	1	

TOP VIEWS





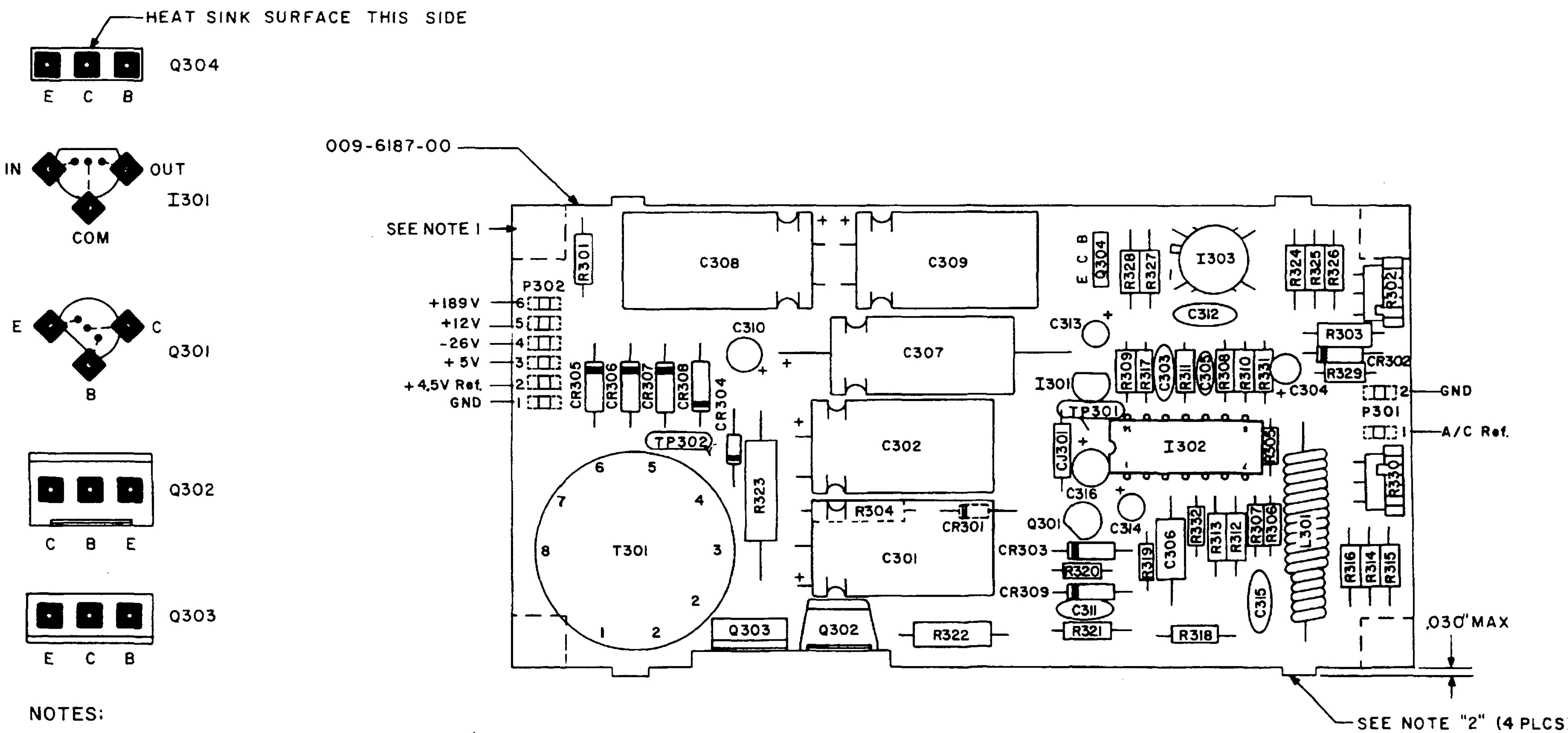
NOTES:

1. PRIOR TO POST COATING BOTH SIDES OF ASS'Y WITH CLEAR URETHANE COATING (016-1040-00) MASK OFF THE FOLLOWING: ALL MOUNTING AREAS, R302, R330, P301, P302, TP301, TP302, HEAT SINK SURFACES OF Q302, Q303.
2. 009-6187-00 MAY BE BUILT WITH 4 BOARDS ON ONE PANEL AND BROKEN APART AFTER ASS'Y AND WAVE SOLDERING. WHEN THIS IS DONE, THERE WILL BE 4 TABS APPROX. .187" WIDE LEFT ON BOARD. THESE TABS ARE TO BE TRIMMED TO WITHIN .030" FROM EDGE OF BOARD.

3. SECURE C310 TO BOARD WITH RTV.

FIGURE 6-28 KR 87 POWER SUPPLY BOARD ASSEMBLY
(Dwg. No. 300-06187-0000 R-6)

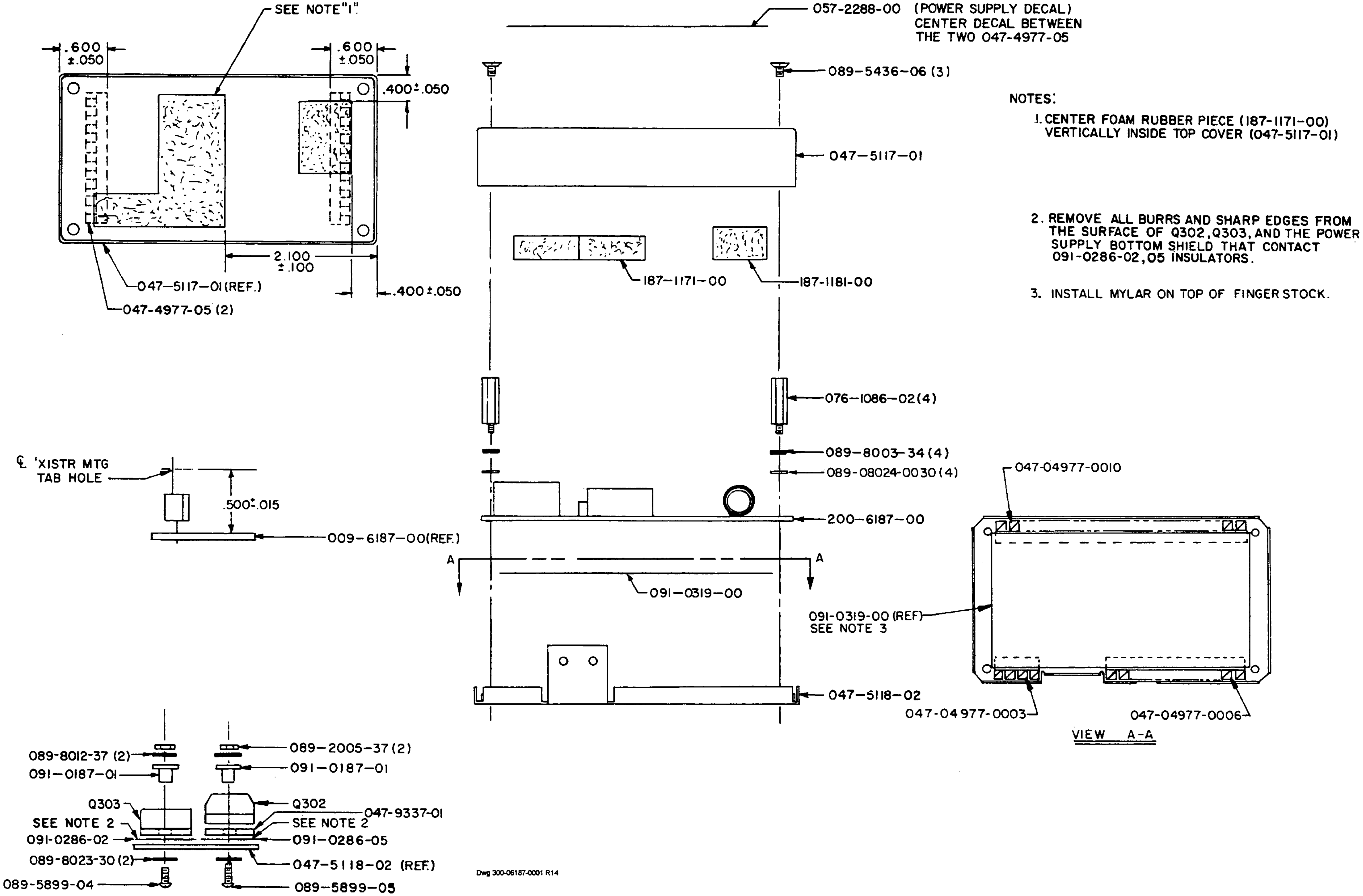
TOP VIEWS



NOTES:

1. PRIOR TO POST COATING BOTH SIDES OF ASS'Y WITH CLEAR URETHANE COATING (016-1040-00) MASK OFF THE FOLLOWING: ALL MOUNTING AREAS, R302, R330, P301, P302, TP301, TP302, HEAT SINK SURFACES OF Q302, Q303.
2. 009-6187-00 MAY BE BUILT WITH 4 BOARDS ON ONE PANEL AND BROKEN APART AFTER ASS'Y AND WAVE SOLDERING. WHEN THIS IS DONE, THERE WILL BE 4 TABS APPROX. .187" WIDE LEFT ON BOARD. THESE TABS ARE TO BE TRIMMED TO WITHIN .030" FROM EDGE OF BOARD.

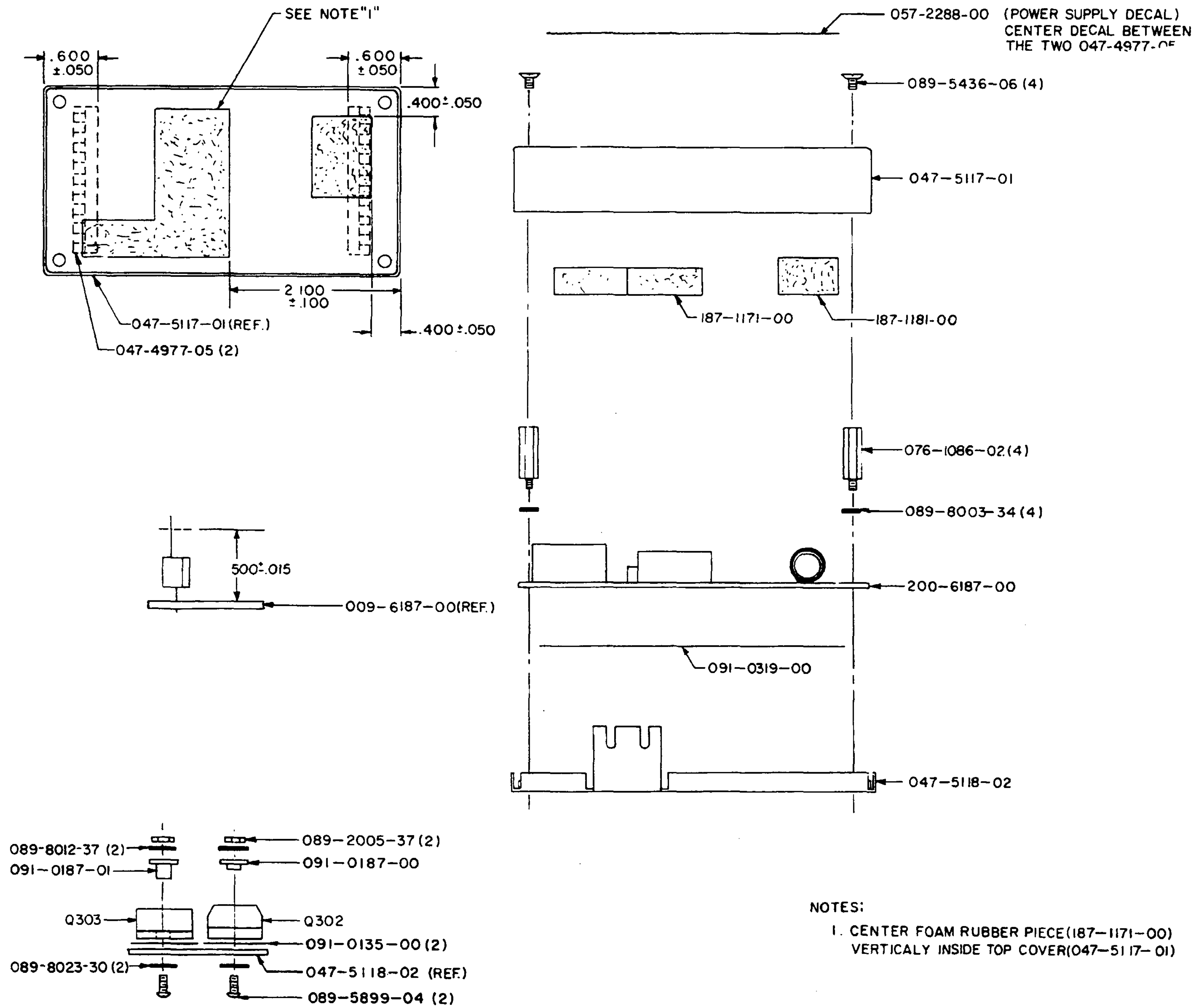
FIGURE 6–28A KR 87 POWER SUPPLY BOARD ASSEMBLY
(Dwg. No. 300–06187–0000 R–0)



NOTES:

1. CENTER FOAM RUBBER PIECE (187-1171-00) VERTICALLY INSIDE TOP COVER (047-5117-01)
2. REMOVE ALL BURRS AND SHARP EDGES FROM THE SURFACE OF Q302, Q303, AND THE POWER SUPPLY BOTTOM SHIELD THAT CONTACT 091-0286-02, 05 INSULATORS.
3. INSTALL MYLAR ON TOP OF FINGER STOCK.

FIGURE 6–29 KR 87 POWER SUPPLY BOARD ASSEMBLY
(Dwg. No. 300-06187-0001 R-14)



NOTES:

1. CENTER FOAM RUBBER PIECE(187-1171-00) VERTICALY INSIDE TOP COVER(047-5117-01)

FIGURE 6-29A KR 87 POWER SUPPLY BOARD ASSEMBLY
(Dwg. No. 300-06187-0001 R-5)

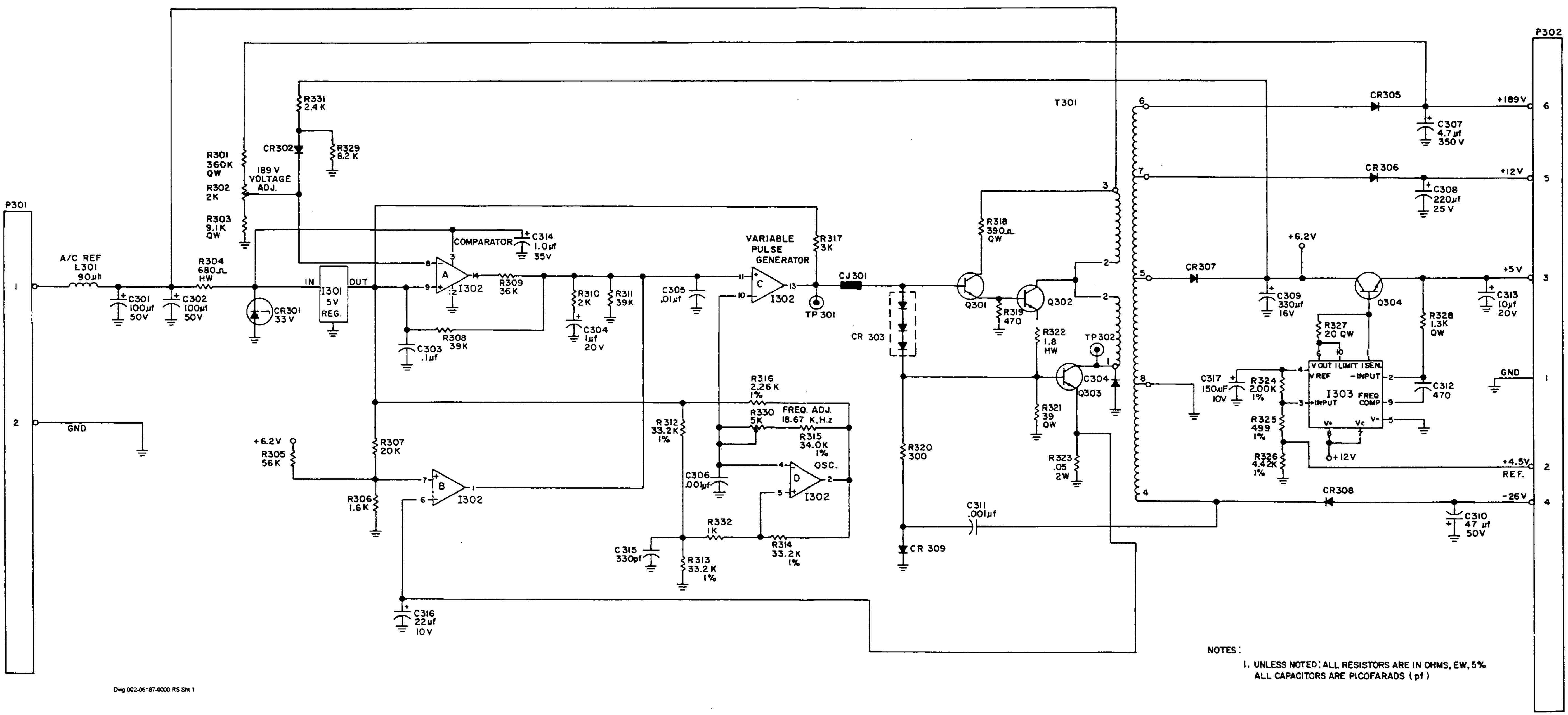


FIGURE 6-30 KR 87 POWER SUPPLY BOARD SCHEMATIC
(Dwg. No. 002-06187-0000 R-5)

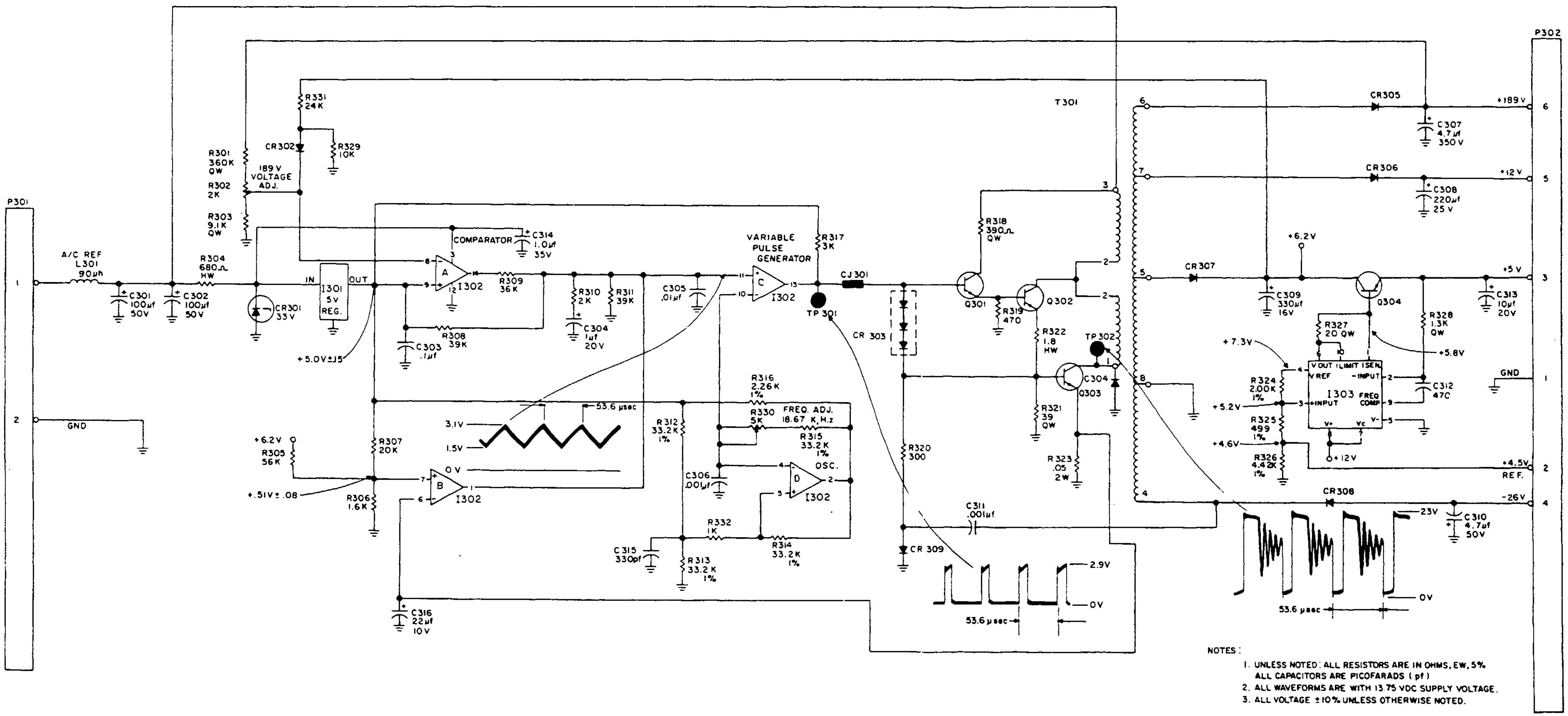


FIGURE 6-30A KR 87 POWER SUPPLY BOARD SCHEMATIC
(Dwg. No. 002-06187-0000 R-1)

KI 227/228

AlliedSignal

ELECTRONIC AND AVIONICS SYSTEMS

MAINTENANCE MANUAL

BENDIX/KING®

KI 227/228

ADF INDICATORS

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SECTION IV

THEORY OF OPERATION

4.1 INTRODUCTION

The KI 227/228 are ADF indicators which show the ADF ground station's position relative to the nose of the aircraft. The input to the KI 227/228 is a DC sin/cos signal which drives a DC resolver. The KI 228 has a second indicator needle which is driven by another separate DC sin/cos signal.

In the -01 versions of the KI 227/228, the compass card can be connected to the compass system as a repeater of a KI 525/KI 525A. The compass card is positioned digitally by a stepper motor which moves the compass card .25° per step. The Sync control knob is used to synchronize the KI 227/228-01 compass card with the KI 525 compass card for in-flight use.

SECTION V

MAINTENANCE

5.1 INTRODUCTION

This section contains the test and alignment procedures for the KI 227/228.

5.2 TEST & ALIGNMENT KI 227/228

5.2.1 GENERAL

The test alignment procedures may be followed to determine if the KI 227/228 is operating properly.

5.2.2 TEST EQUIPMENT REQUIRED:

A. 3.0V DC Power Supply

B. Digital Voltmeter

5.2.3 TESTING

5.2.3.1 STEPPER MOTOR TESTING

1. Check to see if pins L and M, N and M, P and M, and R and M are open or shorted by measuring the resistance between the pins using a digital ohm meter. Typical resistance should be 220 ohms. See **Figure 6-7**.
2. Check to see if motor shaft turns freely.
3. Check to see if there are any broken gears.

5.2.3.2 DC RESOLVER TESTING

1. Follow alignment procedure for testing. Should indicators fail to align properly, unit may have improper wiring hook up or a defective DC resolver.
2. Ground cos and common(s) input(s) and apply +3.0V to sin input(s) to verify that needles point at $90^{\circ} \pm 1.3^{\circ}$.

5.2.4 KI 227 ALIGNMENT

1. Apply a +3.0V to cos input (pin E) and ground sin input (pin C) and ground common (pin B).
2. Loosen three screws on DC resolver hold down.
3. Gently turn until needle is at $0^{\circ} \pm 1.3^{\circ}$ (Relative to lubber line).
4. Tighten screws.

5.2.5 KI 228 ALIGNMENT

1. Apply +3.0V to cos inputs of both channels (pins E and K), ground both sin inputs (pins C and J) and ground common signals (pins B and F).
2. Loosen three screws on DC resolver hold down.

3. Gently turn until double needle is at $0^{o} \pm 1.3^{o}$ (Relative to lubber line).
4. Tighten hold down screws.
5. Loosen two screws on tube case.
6. Gently turn rear DC resolver until single needle is at $0^{o} \pm 1.3^{o}$ (Relative to lubber line)
7. Tighten screws on tube case.

5.3 DISASSEMBLY/ASSEMBLY

Refer to **Figure 6-2** for KI 227 assembly drawing and refer to **Figure 6-3** for KI 228 assembly drawing.

SECTION VI

ILLUSTRATED PARTS LIST

6.1 INTRODUCTION

The Illustrated Parts List (IPL) is a complete list of assemblies and parts required for the unit. The IPL also provides for the proper identification of replacement parts. Individual Bills of Material (BOM) within this IPL are arranged in numerical sequence starting with the top assembly and continuing with the sub-assemblies. All mechanical parts will be separated from the electrical parts used on the sub-assembly. Each BOM is followed by the Assembly Drawing and Schematic Diagram for that assembly.

Parts identified in this IPL by AlliedSignal Part Number meet design specifications for this equipment and are the recommended replacement parts. Warranty information concerning AlliedSignal replacement parts is contained in Service Memo #1, P/N 600-08001-00XX.

This section describes the various items that appear on the Bills of Material. A sample BOM is included in this section as **Figure 6-1**.

A. BOM Number

The Bill of Material Number appears at the top of the BOM as a 12-digit number which is also the AlliedSignal Part Number for the assembly. The BOM Number is followed by the assembly description and the revision level of the BOM.

B. Symbol Column

This column contains the Reference Designators of the electrical components of the assembly. Mechanical parts are not assigned Reference Designators; however, they may be assigned item numbers to assist in locating the part on an assembly drawing. The Reference Designator consists of a letter abbreviation which indicates the type of component followed by the number assigned to that part (C101, Q101, etc). Common Reference Designator abbreviations are listed below.

B	Motor or Synchro	Q	Transistor
C	Capacitor	P	Plug
CJ	Circuit Jumper	R	Resistor
CR	Diode	RT	Thermistor
DS	Lamp	S	Switch
F	Fuse	T	Transformer
FL	Filter	TP	Test Point
I	Integrated Circuit	U	Resistor/Capacitor Network/Integrated Circuit
J	Jack	V	Photocell/Vacuum Tube
L	Inductor	WG	Waveguide
M	Meter	Y	Crystal

C. Part Number Column

This column contains the AlliedSignal Part Number for each part. Special purpose 999-09999-00XX series part numbers may appear in the BOM and are described below.

(1) CR401 999-09999-0096 RESERVED

The Reference Designator CR401 has been reserved for future use; the assembly does not currently include a CR401.

(2) CR401 999-09999-0097 SEE NEXT ASSEMBLY

CR401 is a part of the electrical circuit but due to assembly or testing requirements is actually part of a different assembly.

(3) CR401 999-09999-0098 NOT USED

The Reference Designator CR401 is available for future assignment. The assembly does not currently include a CR401.

(4) CR401 999-09999-0099 DO NOT USE

The Reference Designator CR401 has been previously used for this assembly and later deleted. It may not be reassigned on this assembly.

(5) I401 999-09999-0090 REF SFTWARE SET

I401 is a programmed memory device. Refer to Section H, Software Documentation in this introduction for a description of the software documentation system being used at the time of publication of this manual.

D. Description Column

This column contains the description of each part in the assembly. Common abbreviations which may appear in this column are listed below.

AL	Aluminum	MY	Mylar
ASSY	Assembly	PC	Polycarbonate
BIFLR	Bifilar	PF	Precision Film
BOM	Bill of Material	PP	Paper
CAP	Capacitor	PS	Polystrene
CC	Carbon Composite	QW	Quarter Watt
CF	Carbon Film	RES	Resistor
CH	Choke	S	Silicon
CR	Ceramic	SCR	Screw
CRT	Cathode Ray Tube	SM	Silver Mica
DC	Disc Ceramic	STDF	Standoff
DIO	Diode	SW	Switch
EL	Electrolytic	TERM	Terminal
EW	Eighth Watt	TN	Tantalum
FC	Fixed Composition	TST PT	Test Point
FERR	Ferrite	TW	Tenth Watt
FLTR	Filter	U	Integrated Circuit
FT	Feedthru	VA	Variable
HV	High Voltage	WW	Wire Wound
HVXFMR	High Voltage XFMR	XFMR	Transformer
HW	Half Watt	XSTR	Transistor Ceramic
MC	Monolithic	XTAL	Crystal

E. Assembly (A) Column

An "A" in this column indicates that the part indicated is an assembly. If the P/N and description reads "200-0XXXX-0099 COMMON BOM" or "200-XXXX-99 COMMON BOM" the parts for that assembly are included in the same BOM. The parts breakdown for an assembly with any other P/N will be found in the BOM with the same number.

F. Unit of Measure (UM) Column

This column indicates the Unit of Measure for each part. Common abbreviations found in this column are listed below.

EA	Each	RF	For Reference Only
FT	Foot	IN	Inch
AR	As Required		

G. Quantity and Flavor Columns

Individual flavors of an assembly are identified by the last four digits of the P/N. Part quantities for each flavor will be indicated under headings numbered 0000 through 9900 as required. The parts indicated in the 9900 Column are common to all other flavors of the assembly and are considered the Common Bill of Material for the assembly.

H. Software Documentation

The documentation of software involves the use of several unique types of part numbers. The following subsections list these part numbers with their description. In some cases, some specific versions of hardware must be used with specific versions of software. To determine the correct P/N for ordering the programmed device, you will need to know the part number of and the software revision level of the unit.

The last two digits of all software related P/N's, designated in the following text as -RN, indicate the revision number or level of the related software. This number is incremented with each revision of software. For example, -01 is revision 0, -02 is revision 1, and so on. When ordering specific integrated circuits or devices, the applicable 122-XXXXX-XXRN P/N is used. When ordering a circuit board which contains software, the applicable 205-XXXXX-XXRN P/N is used. Applicable assembly drawings and schematic diagrams will then follow in order.

(1) General Information

The part number of the unit, typically the 065-, 066- or 071-top assembly part number, contains a 206- item in its bill of materials. This 206- item is the configuration control mechanism for programmable electronic devices of the unit. Two different means exist to label the hardware/software configuration of the unit depending on the the part number of the unit:

(a) When the part number of the unit is a 9-digit part as represented on the TSO label, the last 2 digits of the 206-item are the digits of the Software Identification (SW ID) tag that appears on the unit.

(b) When the part number of the unit is a 12-digit part as represented on the TSO label, the last 4 digits of the 206- item are the digits of the Software Modification (SW MOD) tag that appears on the unit. In the example shown in figure 6-1, sheet 1 the 206- item is flagged with an "A" in the right hand margin.

(2) Definition of a Hardware/Software System

The 206- item represents the collection of all boards in the unit which contain electronic programmable devices (software). The hardware/software system (206-) bill of materials contains two categories of items:

(a) The part number of the unit label,i.e. the SOFT ID or SOFT MOD tag.

1) In the case of the 9-digit TSOed unit the unit label part number 057-03284-00XX where XX is the last two digits of the 206- number. The software identification tag is illustrated below.

KRC
00
SW ID

2) In the case of the 12-digit TSOed unit the unit label part number is 057-05287-YYYY where YYYY is the last four digits of the 206- number. This number is also referred to as the software mod level of the unit. The software mod tag is illustrated below.

SW MOD
01/01

(b) The 205- hardware/software board assemblies constitute all the hardware/software boards which this unit contains. In the example, the item marked "B" is the 205- hardware/software board used in the rest of the example.

(3) Definition of a Hardware/Software Board

The hardware/software board (205-) bill of materials contains four categories of items:

(a) The part numbers of the board label:

1) For 12-digit 205-0XXXX-00YY board labels, the first 10 digits are contained on a label part number of 057-05252-XXXX and the last two digits are specified by 057-05335-00YY.

2) For 9-digit 205-WWWW-ZZ board labels, the first 7 digits are contained on a label part number of 057-050WW-00WW and the last two digits are specified by 057-05252-00ZZ.

The 205-0XXXX-00YY and the 057-05252-00YY P/N is incremented whenever the revision number of any one or more of the 125-0XXXX-XXRN P/N's is incremented. This means that the -RN part of the P/N's for the 057-05252-XXRN and the 205-0XXXX-XXRN will be the same. A circuit board identification tag is illustrated below.

205-06616-	0000

(b) The software programmable device set assemblies (125-):

Each 125- programmable device set constitutes all the software for a unique microprocessor on the hardware board. The group of 125- programmable device sets constitutes all of the software for all of the microprocessors.

1) 125-0XXXX-XXRN AlliedSignal Part Numbers

The 125-0XXXX-XXRN P/N is a BOM which lists all the 122-0XXXX-XXRN programmed devices in a software set for a given circuit board. There may be only one 122-0XXXX-XXRN P/N listed or there may be several. Whenever the revision number (RN) of any one or more of the 122-0XXX-XXRN programmed devices is incremented in a new software release, the -XXRN part of the 125-0XXXX-RN P/N is also incremented. This 125-0XXXX-XXRN BOM also indentifies the "U" or "I" circuit designators used to identify the programmed devices on assembly drawings and schematic diagrams.

2) The 122-0XXXX-XXRN P/N is used to identify an individual integrated circuit or other device containing software.

(c) The non-software programmable device set assemblies (126-) which fulfill software requirements.

(d) The specification of the hardware board (200-).

In the example, the items marked "C" in the right margin are all the programmable device assemblies which fulfill the software requirements.

(4) Definition of a Hardware Board

The hardware board (200-) bill of materials contains two categories of items that relate to programmable devices:

(a) The non-software programmable device sets (126s) that fulfill hardware requirements. (Items D1 thru D4 in the example).

(b) The references to all of the programmable devices (122-) on the board. These references resolve device location on the board in that they use the SYMBOL field of the bill of materials to specify component location. These 122-numbers are of the form 122-3XXXX-9999 or 122-0YYYY-9999.

The 122- numbers of the form 122-3XXXX-9999 are used for non-software programmable devices (126-) that fulfill hardware requirements and therefore these programmable device sets appear on the hardware board (200-) bill of materials. (Items D5 thru D10 in the example).

The 122- numbers of the form 122-0YYYY-9999 are used for both software programmable devices (125-) (items D12 thru D15 in the example) and non-software programmable devices (126-) (item D11 inthe example) that fulfill software requirements.

These programmable device sets appear on the hardware/software board (205-) bill of materials.

The exact programmable device (the resolution of the -9999 in the above items) is specified by the respective software programmable device set (125-) or the non-software programmable device set (126-) bill of materials.

Using the SYMBOL field as specified above would discourage the use of the SYMBOL field for this purpose in the programmable device sets (125- and 126-) bill of materials. This would then permit the specification of the same programmable device sets in different boards, hence different component designators.

In the example, **Figure 6-1**:

- the items flagged D1 thru D4 in the right margin are non-software programmable device sets,

- the items flagged D5 thru D10 in the right margin are non-software programmable device designators that fulfill hardware requirements,

- the item flagged D11 in the right margin is a non-software programmable device designator that fulfills software requirements,

- the items flagged D12 thru D15 in the right margin are software programmable device designators that fulfill software requirements,

Figure 6-1, while closely related to a specific product, does not represent an exact configuration in use by that product. This example has been modified to clarify certain points.

Assy: 066-04020-0203 SG464 HSI W/O WX

Symbol	Part Number	Rev	Description	UM	Quantity	BxItm
	016-01008-0004	3	GLYPTAL 7526 BL	AR	1.00	
	016-01131-0000	1	CNTCT CMT BND 1055	AR	1.00	
	047-02579-0002	2	HANDLE ASSEMBLY	EA	1.00	
	047-09392-0001	0	SPACER RT W/FIN	EA	1.00	
	057-02203-0002	3	FLAVOR STCKR	EA	1.00	
	057-02203-0003	3	FLAVOR STCKR	EA	1.00	
	057-05286-0000	0	SERIAL TAG SG 464	EA	1.00	
	075-05082-0002	0	GUIDE PLATE TOP	EA	1.00	
	090-00277-0000	1	HOLD DOWN BRACKET	EA	1.00	
	155-02536-0001	1	CABLE ASSY	EA	1.00	
	200-07703-0000	2	DPX CONN BD ASSY	EA	1.00	
	200-07704-0000	8	LV PS BD ASSY	EA	1.00	
	206-00118-0301	0	EFS40/50 HSI SET	EA	1.00	<--- A

Assy: 206-00118-0301 EFS40/50 HSI SET

Symbol	Part Number	Rev	Description	UM	Quantity	BxItm
	057-05287-0301	0	SW MOD TAG	EA	1.00	
	205-00564-0002	0	EFIS 40/50 I/O PBS	EA	1.00	
	205-00565-0004	0	E40/50 HSI P/D PBS	EA	1.00	<--- B

Assy: 205-00565-0004 E40/50 HSI P/D PBS

Symbol	Part Number	Rev	Description	UM	Quantity	BxItm
	057-02241-0016	1	IDENT LABEL	EA	1.00	
	057-05252-0565	1	IDT 205-00565-0000	EA	1.00	
	125-00602-0004	0	EFIS 40/50 NAV SDS	EA	1.00	<--- C1
	125-00603-0002	0	EFIS40/50 DSPL SDS	EA	1.00	<--- C2
	126-00019-0000	1	EFS40/50 CLIPPER	EA	1.00	<--- C3
	200-07706-0000	1	PRCSR/DSPL BD ASSY	EA	1.00	

FIGURE 6-1 TYPICAL BILL OF MATERIAL
(Sheet 1 of 4)

Assy: 200-07706-0000 PRCSR/DSPL BD ASSY

Symbol	Part Number	Rev	Description	UM	Quantity	BxItm
	009-07706-0000	0	PC BD PRCSR/DSPL	EA	1.00	
	. . .					
	150-00004-0010	3	TUBING TFLN 22AWG	IN	2.00	
	200-04969-0000	0	EXT BD PRCSR/ADI A	RF	0.00	
	126-00005-0000	1	EFS40/50 INT LOGIC	EA	1.00	<--- D1
	126-00006-0000	1	EFS40/50 VIDEO MUX	EA	1.00	<--- D2
	126-00017-0000	1	EFS40/50 SM SET	EA	1.00	<--- D3
	126-00018-0000	1	EFS40/50 SINE SET	EA	1.00	<--- D4
C 5001	111-02104-0042	26	CAP MC100KPF50V20%	EA	1.00	
	. . .					
I 5005	122-30001-9999	0	EFS40/50 VIDEO MUX	RF	0.00	<--- D5
I 5008	122-30002-9999	0	EFS40/50 INT LOGIC	RF	0.00	<--- D6
	. . .					
I 5036	122-30003-9999	0	EFS40/50 SM HIGH	RF	0.00	<--- D7
I 5037	122-30004-9999	0	EFS40/50 SM LOW	RF	0.00	<--- D8
I 5038	122-30005-9999	0	EFS40/50 SINE HIGH	RF	0.00	<--- D9
I 5039	122-30006-9999	0	EFS40/50 SINE LOW	RF	0.00	<--- D10
	. . .					
I 5075	122-00958-9999	0	EFS40/50 CLIPPER	RF	0.00	<--- D11
	. . .					
I 5138	122-00918-9999	0	EFS40/50 HSI NAV-E	RF	0.00	<--- D12
I 5139	122-00919-9999	0	EFS40/50 HSI NAV-O	RF	0.00	<--- D13
	. . .					
I 5158	122-00920-9999	0	EFS40/50 HSI DSP-E	RF	0.00	<--- D14
I 5159	122-00921-9999	0	EFS40/50 HSI DSP-0	RF	0.00	<--- D15
	. . .					

Assy: 126-00005-0000 EFS40/50 INT LOGIC

Symbol	Part Number	Rev	Description	UM	Quantity	BxItm
	122-30002-0000	0	EFS40/50 INT LOGIC	EA	1.00	

Assy: 122-30002-0000 EFS40/50 INT LOGIC

Symbol	Part Number	Rev	Description	UM	Quantity	BxItm
	120-02376-0000	1	EPLD EP320 (OTP)	EA	1.00	

FIGURE 6-1 TYPICAL BILL OF MATERIAL
(Sheet 2 of 4)

Assy: 125-00602-0004 EFIS 40/50 NAV SDS

Symbol	Part Number	Rev	Description	UM	Quantity	BxItm
	122-00918-0004	0	EFS40/50 HSI NAV-E	EA	1.00	
	122-00919-0004	0	EFS40/50 HSI NAV-O	EA	1.00	

Assy: 125-00603-0002 EFIS40/50 DSPL SDS

Symbol	Part Number	Rev	Description	UM	Quantity	BxItm
	122-00920-0002	0	EFS40/50 HSI DSP-E	EA	1.00	
	122-00921-0002	0	EFS40/50 HSI DSP-0	EA	1.00	

FIGURE 6-1 TYPICAL BILL OF MATERIAL
(Sheet 3 of 4)

BOM NUMBER

200-08366-0000 MST67 IOP/DLP R: 2 MST0067A
200-08366-0000 MST67 IOP/DLP R: 2 MST0067A

ASSEMBLY VERSION

SYMBOL	PART NUMBER	DESCRIPTION	A	UM	0000	9900
	009-08366-0000	PC BD IOP/DLP	A	EA	1.00	1.00
	016-01040-0000	COATING TYPE AR		AR	1.00	1.00
	033-00114-0021	SOCKET IC DIP 28C	A	EA	3.00	3.00
	047-09680-0001	KEYING BRACKET	A	EA	3.00	3.00
	090-00087-0000	CLIP CRYSTAL		EA	1.00	1.00
	092-05003-0015	EYELET .049		EA	2.00	2.00
	126-00030-0000	MST67A ASIC SFTWR	A	EA	1.00	1.00
C 9001	106-04104-0047	CH 100KX7R/50V		EA	1.00	1.00
C 9002	106-04104-0047	CH 100KX7R/50V		EA	1.00	1.00
C 9003	106-04104-0047	CH 100KX7R/50V		EA	1.00	1.00
CR 9001	007-06180-0000	DIO SW MMBD6050		EA	1.00	1.00
CR 9002	007-08092-0000	QUAD SO DIODE		EA	1.00	1.00
CR 9003	007-08092-0000	QUAD SO DIODE		EA	1.00	1.00
DS 9001	007-06408-0000	COM CATH 7 SEG LED		EA	1.00	1.00
J 9002	030-02174-0000	PIN CONT		EA	50.00	1.00
P 9003	155-02688-0003	RIBBON CABLE ASSY	A	EA	1.00	1.00
Q 9003	007-00065-0001	XSTR 2N3906 (SOT)		EA	1.00	1.00
Q 9006	007-00383-0004	SOT-23 2N2222A XST		EA	1.00	1.00
Q 9011	007-00530-0000	XSTR NPN MMBT3903	A	EA	1.00	1.00
R 9001	130-05104-0023	RES CH 100K EW 5%		EA	1.00	1.00
R 9002	015-00207-0020	OCTAL SO RESISTOR		EA	1.00	1.00
R 9003	130-05472-0023	RES CHIP 4.7KEW5%		EA	1.00	1.00
R 9004	130-05471-0023	RES CHIP 470EW5%		EA	1.00	1.00
R 9005	130-05104-0023	RES CH 100K EW 5%		EA	1.00	1.00
R 9006	130-05104-0023	RES CH 100K EW 5%		EA	1.00	1.00
R 9007	130-05000-0025	RES CHIP 0 EW CJ		EA	1.00	1.00
TP 9001	008-00096-0001	TERMINAL TEST PNT		EA	1.00	1.00
TP 9002	008-00096-0001	TERMINAL TEST PNT		EA	1.00	1.00
U 9001	120-02208-0004	UPRGSSR 10MHZ16B.T	A	EA	1.00	1.00
U 9002	120-06129-0009	6264-15 8K X 8 RAM		EA	1.00	1.00
U 9003	120-06129-0009	6264-15 8K X 8 RAM		EA	1.00	1.00
U 9004	122-01195-9999	*MST67 PRGMD ODD	A	RF	X.	
U 9005	122-01194-9999	*MST67 PRGMD EVEN	A	RF	X.	
U 9006	124-00574-0003	IC 74HCT574		EA	1.00	1.00
U 9007	123-00138-0003	74HC138 SO PKG		EA	1.00	1.00
Y 9001	044-00089-0019	XTAL 14.75MHZ		EA	1.00	1.00
Y 9002	044-00293-0000	20 MHZ OSC		EA	1.00	1.00

PROGRAMMABLE DEVICE SET

UNIT OF MEASURE

QUANTITY

REFERENCE DESIGNATOR

PART NUMBER

DESCRIPTION

FIGURE 6-1 TYPICAL BILL OF MATERIAL
(Sheet 4 of 4)

KI 227 FINAL ASSY

6.2 066-03063-0000 Rev. 16 KI 227 ADF INDICATOR
066-03063-0001 Rev. 21 KI 227 ADF INDICATOR
066-03063-0099 Rev. 8 KI 227 ADF INDICATOR COMMON BOARD

SYMBOL	PART NUMBER	DESCRIPTION	[UM]	QUANTITY -0000	-0001	-0099
	008-00075-0000	LAMP CONTACT	[EA]			2
	012-01017-0001	ELEC TAPE 1/4 W	[AR]			0
	012-05004-0000	LENS	[EA]		1	
	012-05004-0002	LENS_ W/FINISH	[EA]	1		
	016-01016-0000	MOLYKOTE G-N PASTE	[AR]			0
	025-00018-0011	WIRE 26 BRN	[IN]			1.1
	025-00018-0022	WIRE 26 RED	[IN]		5.8	
	025-00018-0033	WIRE 26 ORG	[IN]		8.4	1.6
	025-00018-0044	WIRE 26 YEL	[IN]		5.8	
	025-00018-0055	WIRE 26 GRN	[IN]		6	
	025-00018-0066	WIRE 26 BLU	[IN]		5.8	
	025-00018-0088	WIRE 26 GRY	[IN]			1.4
	025-00018-0099	WIRE 26 WHT	[IN]		5.8	
	029-00399-0000	GEAR PIN 12T	[EA]		1	
	029-00405-0000	GEAR 28T/24T	[EA]			1
	029-00406-0000	GEAR IDLER 28T/14T	[EA]	1		
	029-00407-0000	GEAR IDLER 42T/14T	[EA]		1	
	030-01007-0000	TAB LOCKING	[EA]			2
	030-02001-0000	CONN 14 PIN MALE	[EA]			1
	035-01361-0006	PROTECTIVE CVR	[EA]			1
	037-00007-0011	LMP 382 T1-3/4 14	[EA]			2
	047-04923-0001	REAR LMP CNTCT W/F	[EA]			1
	047-04925-0000	WASHER HEAT SINK	[EA]		1	
	047-05344-0001	DAMPING SPRING W/F	[EA]			1
	047-05383-0001	IND NEEDLE W/PNT	[EA]			1
	057-02231-0000	S/N TAG	[EA]			1
	057-02337-0000	PRTCTV CVR DECAL	[EA]			1
	066-03063-0099	COMMON BOM	[EA]	1	1	
	073-00034-0001	MOUNTING LUG	[EA]			3
	073-00411-0002	BEEL W/BLK PNT	[EA]			1
	076-00372-0002	SPACER .312	[EA]		4	
	088-00193-0002	FLTR LMP BLU WHT	[EA]			2
	088-00578-0003	CONN COVER 0.936	[EA]			1
	088-00697-0002	KNOB W/F - HDG	[EA]	1		

SYMBOL	PART NUMBER	DESCRIPTION	[UM]	QUANTITY -0000	-0001	-0099
	088-00824-0007	LIGHTENING WEDGE	[EA]	1		
	088-00824-0008	LIGHTENING WEDGE	[EA]		1	
	088-00877-0000	REAR GEAR PLT	[EA]			1
	088-00878-0000	DUST COVER	[EA]			1
	088-00952-0001	KNOB	[EA]		1	
	089-05878-0004	SCR PHP 4-40X1/4	[EA]		4	
	089-05878-0005	SCR PHP 4-40X5/16	[EA]			4
	089-05903-0003	SCR PHP 4-40X3/16	[EA]		4	
	089-06077-0003	SCR PHP 2-56X3/16	[EA]			3
	089-06167-0008	SCR FHP 6-32X1/2	[EA]			3
	089-06204-0004	SCR SET 4-40X1/8	[EA]		2	
	089-06204-0006	SCR SET 4-40X3/16	[EA]	2		
	089-06414-0004	SCR PHP 2-28X1/4	[EA]		2	2
	089-06415-0004	SCR PHP 4-20X1/4	[EA]			2
	089-06415-0008	SCR PHP 4-20X1/2	[EA]			7
	089-08054-0030	WSHR FLT STD .128	[AR]	1		
	089-08159-0000	WSHR THR .130	[EA]			3
	089-08256-0028	SPRING WASHER	[AR]	1		
	091-00109-0003	CABLE TIE .195	[EA]			1
	091-00166-0000	RETAINER	[EA]			3
	148-00034-0000	BRUSHLESS RPTR	[EA]			1
	148-05053-0002	STEPPER MOTOR	[EA]		1	
	150-00020-0010	TUBING SHRINK 18G	[AR]			1
	187-01023-0002	GSKT FIBER	[EA]			1
	200-02565-0000	FRONT PLATE ASSY	[EA]			1
	200-06630-0000	BUFFER BOARD	[EA]		2	

NOTES :

1. PARTS 089-8054-30 (2 MAX.) AND 089-8256-28 ARE TO BE ADDED AS REQUIRED TO PROVIDE 3.00 ± 1.0 IN-OZ. OF TORQUE AT "HDG" KNOB. (-00 UNIT ONLY). SPRING WASHER-089-8256-28, WHEN USED, SHOULD ALWAYS BE ACCOMPANIED BY TWO FLAT-WASHERS-089-8054-30.
2. IDENTIFICATION TAG TO BE CENTERED BETWEEN NOTCHES IN REAR PLATE AND LOCATED WITH ITS BOTTOM EDGE ON OUTSIDE PLATE EDGE AS SHOWN.
3. ELECTRICAL TAPE (012-1017-01) TO BE APPLIED TO PREVENT DUST INFILTRATION THROUGH OPENINGS BETWEEN BEZEL (073-0411-02) AND FRONT PLATE ASSY. (200-2565-00). TAPE SHOULD NOT OVERLAP OUTERMOST EDGE OF BEZEL. TAPE SHOULD BEGIN AND END ON A CORNER FLAT AND SHOULD NOT OVERLAP ITSELF.
4. APPLY MOLYBDENUM DISULFIDE (016-1016-00) TO ALL BEARING SURFACES ON THE GEARS.
5. SHRINKABLE TUBING SHOULD BE USED ON CONNECTOR WIRING (150-00020-0010).
6. USE LIQUID STAKING ON ALL SCREWS THAT HAVE NO OTHER LOCKING DEVICE.
7. THE FRONT PLATE ASSEMBLY (200-2565-00) AND THE GEAR PLATE (088-0877-00) MUST BE ALIGNED FOR MINIMUM GEAR ROTATIONAL TORQUE (-01 UNIT). GEARS MUST NOT BIND IN ANY WAY AND SHOULD ROTATE SMOOTHLY.
8. ON SECOND PC BOARD THE "E" NUMBERS CHANGE FROM 100'S TO 200'S.
9. 148-5053-02, FOR PROPER ROTATION THE RED AND WHITE LEADS CONNECTED TO TERMINALS E105 AND E106 MUST BE REVERSED RED TO E105 AND WHITE TO E106.
10. USE CABLE TIE (091-00109-0003) TO HOLD DOWN MOTOR WIRES.

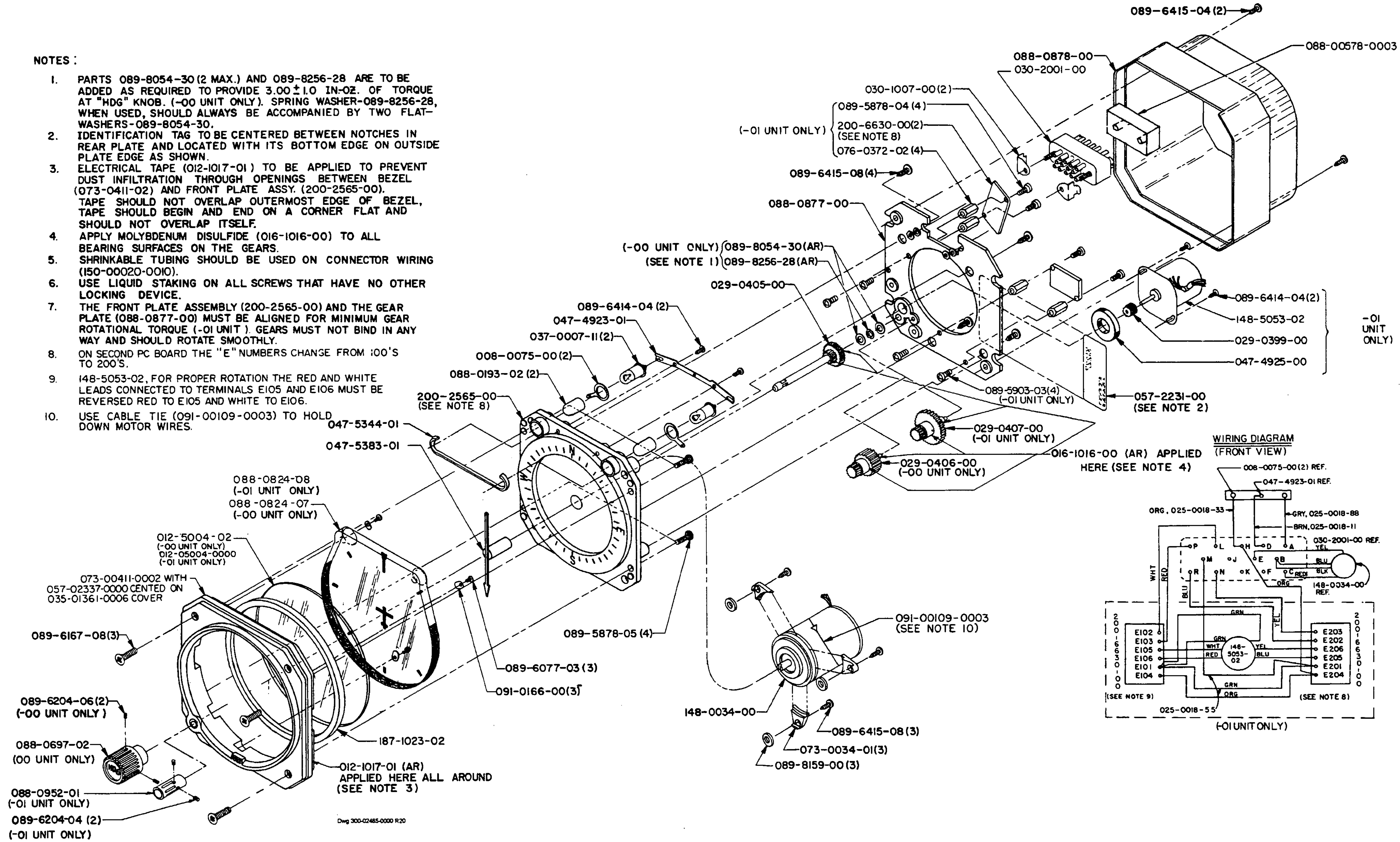


FIGURE 6–2 KI 227 FINAL ASSEMBLY
(Dwg. No. 300-02485-0000 R-20)

NOTES :

1. PARTS 089-8054-30 (2 MAX.) AND 089-8256-28 ARE TO BE ADDED AS REQUIRED TO PROVIDE 3.00±1.0 IN-OZ. OF TORQUE AT "HDG" KNOB. (-00 UNIT ONLY). SPRING WASHER-089-8256-28, WHEN USED, SHOULD ALWAYS BE ACCOMPANIED BY TWO FLAT-WASHERS-089-8054-30.
2. IDENTIFICATION TAG TO BE CENTERED BETWEEN NOTCHES IN REAR PLATE AND LOCATED WITH ITS BOTTOM EDGE ON OUTSIDE PLATE EDGE AS SHOWN.
3. ELECTRICAL TAPE (012-1017-01) TO BE APPLIED TO PREVENT DUST INFILTRATION THROUGH OPENINGS BETWEEN BEZEL (073-0411-02) AND FRONT PLATE ASSY. (200-2565-00). TAPE SHOULD NOT OVERLAP OUTERMOST EDGE OF BEZEL. TAPE SHOULD BEGIN AND END ON A CORNER FLAT AND SHOULD NOT OVERLAP ITSELF.
4. APPLY MOLYBDENUM DISULFIDE (016-1016-00) TO ALL BEARING SURFACES ON THE GEARS.
5. SHRINKABLE TUBING SHOULD BE USED ON CONNECTOR WIRING (150-0049-10).
6. USE LIQUID STAKING ON ALL SCREWS THAT HAVE NO OTHER LOCKING DEVICE.

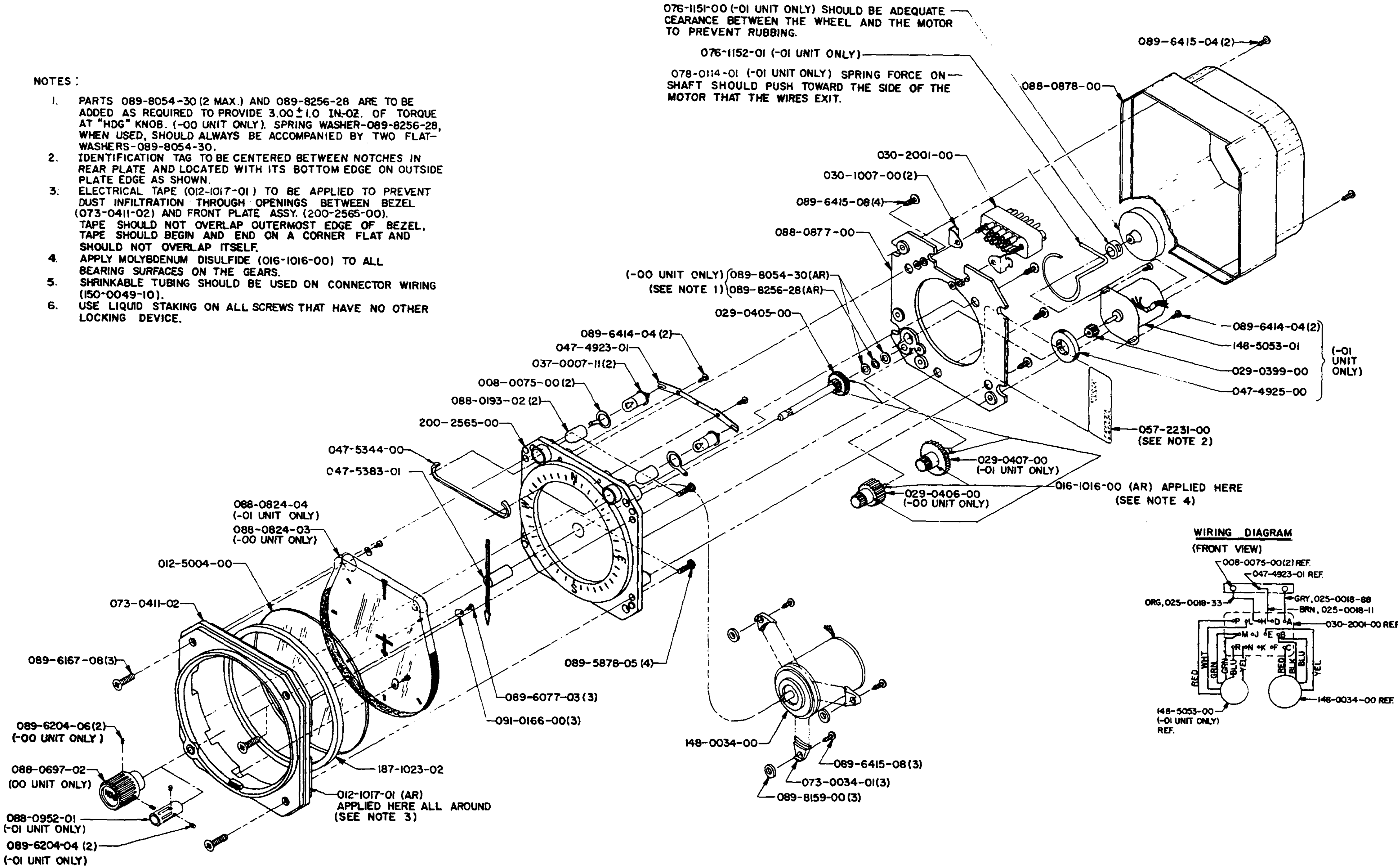


FIGURE 6-2A KI 227 FINAL ASSEMBLY
(Dwg. No. 300-02485-0000 R-7)

NOTES:

1. PARTS 089-8054-30 (2 MAX.) AND 089-8256-28 ARE TO BE ADDED AS REQUIRED TO PROVIDE 1.00 ± .25 IN-OZ. OF TORQUE AT "HDG" KNOB. (-00 UNIT ONLY). SPRING WASHER-089-8256-28, WHEN USED, SHOULD ALWAYS BE ACCOMPANIED BY TWO FLAT-WASHERS-089-8054-30.
2. IDENTIFICATION TAG TO BE CENTERED BETWEEN NOTCHES IN REAR PLATE AND LOCATED WITH ITS BOTTOM EDGE ON OUTSIDE PLATE EDGE AS SHOWN.
3. ELECTRICAL TAPE (012-1017-01) TO BE APPLIED TO PREVENT DUST INFILTRATION THROUGH OPENINGS BETWEEN BEZEL (073-0411-02) AND FRONT PLATE ASSY. (200-2565-00). TAPE SHOULD NOT OVERLAP OUTERMOST EDGE OF BEZEL. TAPE SHOULD BEGIN AND END ON A CORNER FLAT AND SHOULD NOT OVERLAP ITSELF.

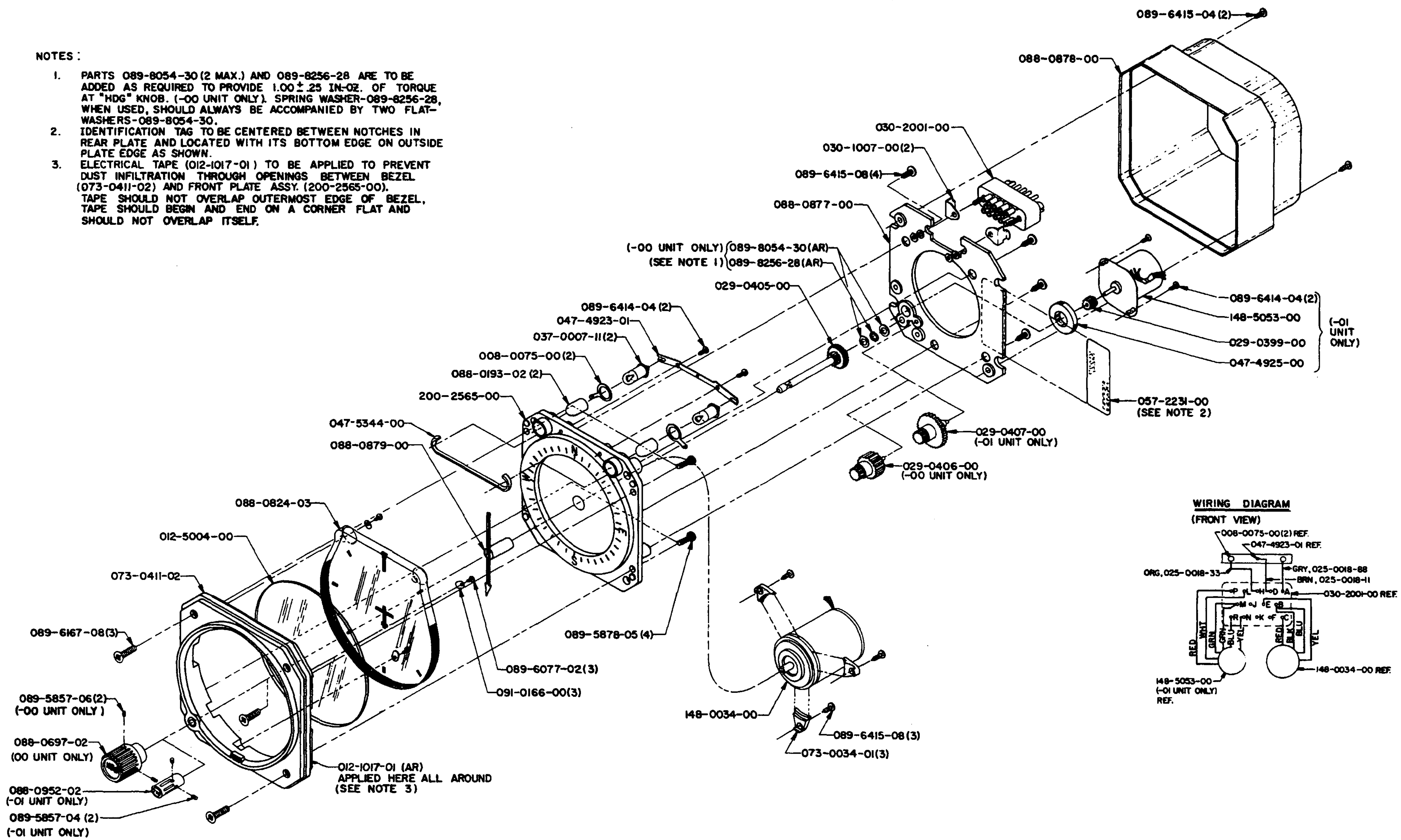


FIGURE 6-2B KI 227B FINAL ASSEMBLY
(Dwg. No. 300-02485-0000 R-1)

KI 228 FINAL ASSY

6.3 066-03059-0000 Rev. 10 KI 228 ADF INDICATOR
066-03059-0001 Rev. 16 KI 228 ADF INDICATOR
066-03059-0099 Rev. 5 KI 228 ADF INDICATOR COMMON BOARD

SYMBOL	PART NUMBER	DESCRIPTION	[UM]	QUANTITY -0000	-0001	-0099
	008-00075-0000	LAMP CONTACT	[EA]			2
	012-01017-0001	ELEC TAPE 1/4 W	[AR]			0
	012-05004-0000	LENS	[AR]			1
	016-01016-0000	MOLYKOTE G-N PASTE	[AR]			0
	016-01082-0000	DC RTV 3145	[AR]			0
	016-01139-0000	SUPERBONDER 414	[AR]			0
	025-00018-0011	WIRE 26 BRN	[IN]			1.1
	025-00018-0022	WIRE 26 RED	[IN]		5.8	
	025-00018-0033	WIRE 26 ORG	[IN]		8.4	1.6
	025-00018-0044	WIRE 26 YEL	[IN]		5.8	
	025-00018-0055	WIRE 26 GRN	[IN]		6	
	025-00018-0066	WIRE 26 BLU	[IN]		5.8	
	025-00018-0088	WIRE 26 GRY	[IN]			1.4
	025-00018-0099	WIRE 26 WHT	[IN]		5.8	
	029-00399-0000	GEAR PIN 12T	[EA]		1	
	029-00405-0000	GEAR 28T/24T	[EA]			1
	029-00406-0000	GEAR IDLER 28T/14T	[EA]	1		
	029-00407-0000	GEAR IDLER 42T/14T	[EA]		1	
	030-01007-0000	TAB LOCKING	[EA]			2
	030-02001-0000	CONN 14 PIN MALE	[EA]			1
	035-01361-0006	PROTECTIVE CVR	[EA]			1
	037-00007-0011	LMP 382 T1-3/4 14	[EA]			2
	047-04923-0001	REAR LMP CNTCT W/F	[EA]			1
	047-04925-0000	WASHER HEAT SINK	[EA]		1	
	047-05317-0001	INDICATOR W/PNT	[EA]			1
	047-05318-0001	IND NEEDLE W/PNT	[EA]			1
	047-05344-0001	DAMPING SPRING W/F	[EA]			1
	057-02246-0000	S/N TAG	[EA]			1
	066-03059-0099	COMMON BOM	[EA]	1	1	
	073-00034-0001	MOUNTING LUG	[EA]			3
	073-00411-0002	BEEL W/BLK PNT	[EA]			1
	076-00372-0002	SPACER .312	[EA]		4	
	076-01128-0001	EXTENSION SHFT W/F	[EA]			1
	088-00193-0002	FLTR LMP BLU WHT	[EA]			2

SYMBOL	PART NUMBER	DESCRIPTION	[UM]	QUANTITY -0000	-0001	-0099
	088-00697-0002	KNOB W/F - HDG	[EA]	1		
	088-00824-0003	LIGHT WEDGE	[EA]	1		
	088-00824-0004	LIGHTING WEDGE	[EA]		1	
	088-00877-0000	REAR GEAR PLT	[EA]			1
	088-00878-0002	DUST COVER W/CAP	[EA]			1
	088-00892-0000	MTR MNT SL	[EA]			2
	088-00893-0000	SHAFT COUPLER	[EA]			1
	088-00952-0001	KNOB	[EA]		1	
	089-05878-0004	SCR PHP 4-40X1/4	[EA]		4	
	089-05878-0005	SCR PHP 4-40X5/16	[EA]			4
	089-05903-0003	SCR PHP 4-40X3/16	[EA]		4	
	089-06077-0003	SCR PHP 2-56X3/16	[EA]			3
	089-06167-0008	SCR FHP 6-32X1/2	[EA]			3
	089-06204-0004	SCR SET 4-40X1/8	[EA]		2	
	089-06204-0006	SCR SET 4-40X3/16	[EA]	2		
	089-06414-0004	SCR PHP 2-28X1/4	[EA]		2	2
	089-06415-0004	SCR PHP 4-20X1/4	[EA]			2
	089-06415-0008	SCR PHP 4-20X1/2	[EA]			9
	089-08054-0030	WSHR FLT STD .128	[AR]	0		
	089-08159-0000	WSHR THR .130	[EA]			3
	089-08256-0028	SPRING WASHER	[AR]	0		
	091-00166-0000	RETAINER	[EA]			3
	148-00034-0000	BRUSHLESS RPTR	[EA]			1
	148-00035-0000	BRUSHLESS RPTR	[EA]			1
	148-05053-0002	STEPPER MOTOR	[EA]		1	
	150-00020-0010	TUBING SHRINK 18G	[AR]			1
	187-01023-0002	GSKT FIBER	[EA]			1
	200-02565-0000	FRONT PLATE ASSY	[EA]			1
	200-06630-0000	BUFFER BOARD	[EA]		2	

NOTES:

1. PARTS 089-8054-30(2 MAX.) AND 089-8256-28 ARE TO BE ADDED AS REQUIRED TO PROVIED 3.00±1.0 IN.-OZ. OF TORQUE AT "HDG" KNOB. (-00 UNIT ONLY). SPRING WASHER-089-8256-28, WHEN USED, SHOULD ALWAYS BE ACCOMPANIED BY TWO FLAT-WASHERS-089-8054-30.
2. BREAK LOCK-TAB OFF OF COUPLER SLEEVE-088-0892-00 BEFORE COUPLING MOTOR. (ONE PART ONLY).
3. TO INSURE PROPER ALIGNMENT OF MOTORS, REMOVE INSPECTION TAGS BEFORE APPLYING COUPLER SLEEVE.
4. IDENTIFICATION TAG TO BE CENTERED BETWEEN NOTCHES IN REAR PLATE AND LOCATED WITH ITS BOTTOM EDGE ON OUTSIDE PLATE EDGE AS SHOWN.
5. ELECTRICAL TAP (012-1017-01) TO BE APPLIED TO PREVENT DUST INFILTRATION THROUGH OPENING BETWEEN BEZEL (073-0411-02) AND FRONT PLATE ASSY. (200-2565-00). TAP SHOULD NOT OVERLAP OUTMOST EDGE OF BEZEL. TAPE SHOULD BEGIN AND END ON A CORNER FLAT AND SHOULD NOT OVERLAP ITSELF.
6. APPLY MOLYBDENUM DISULFIDE (016-1016-00) TO ALL BEARING SURFACES ON GEARS.
7. ASSEMBLE 076-1128-01 AND 088-0893-00 USING A FIXTURE, PREVIOUS TO ASSEMBLING THEM TO 148-0034-00 (MOTOR) SHAFT. 076-1128-01 SHOULD MOUNT DOWN AGAINST THE MOTOR SHAFT IN FINAL ASSY.
8. SHRINKABLE TUBING SHOULD BE USED ON CONNECTOR WIRING (150-00020-0010).
9. USE LIQUID STAKING ON ALL SCREWS THAT HAVE NO OTHER LOCKING DEVICE.
10. THE FRONT PLATE ASS'Y (200-2565-00) AND THE GEAR PLATE (088-0877-00) MUST BE ALIGNED FOR MINIMUM GEAR ROTATIONAL TORQUE (-01 UNIT). GEARS MUST NOT BIND IN ANY WAY AND SHOULD ROTATE SMOOTHLY.
11. ON SECOND PC BOARD THE "E" NUMBERS CHANGE FROM 100'S TO 200'S.
12. 148-5053-02, FOR PROPER ROTATION THE RED AND WHITE LEADS CONNECTED TO TERMINALS E105 AND E106 MUST BE REVERSED RED TO E105 AND WHITE TO E106.

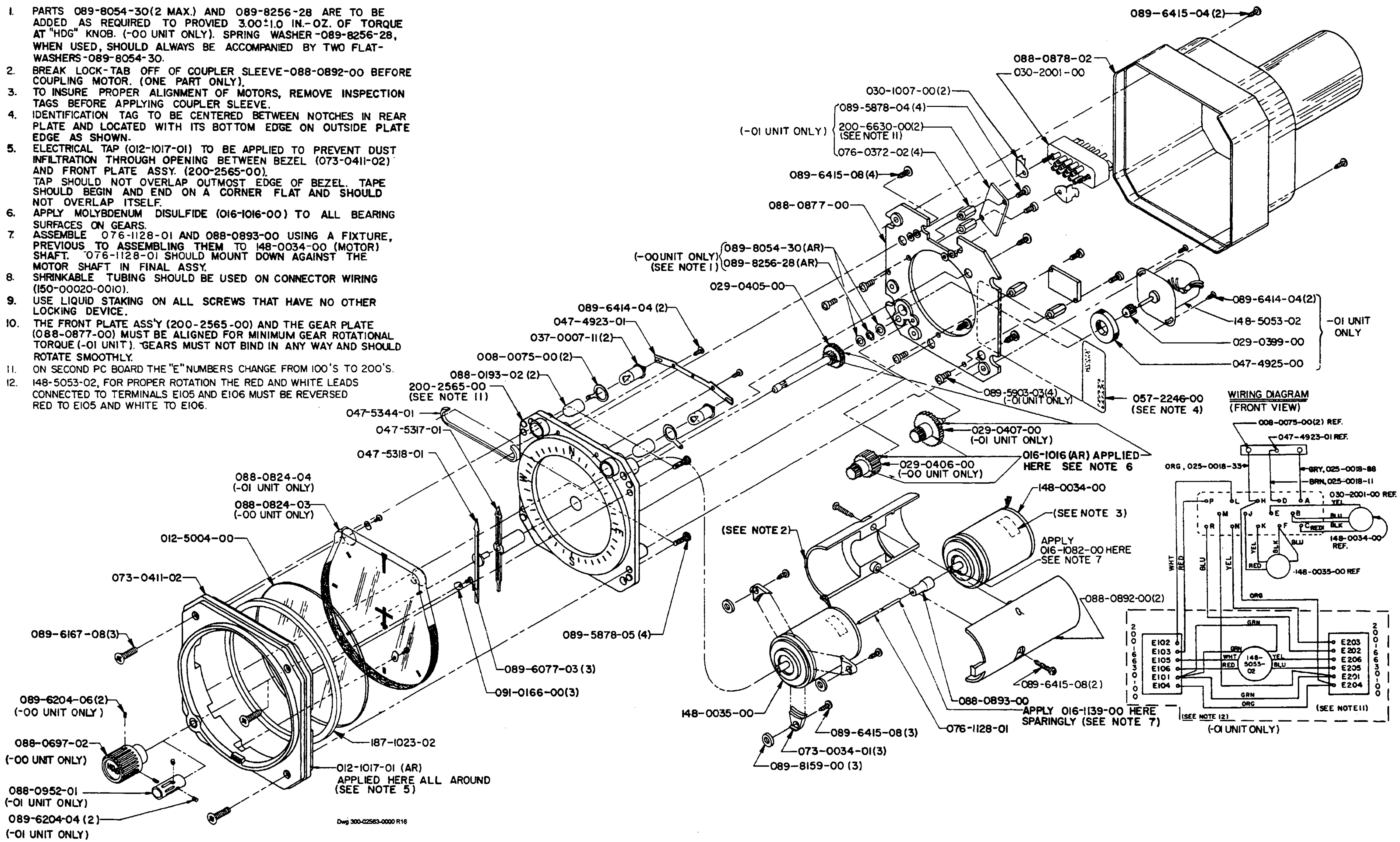


FIGURE 6-3 KI 228 FINAL ASSEMBLY
(Dwg. No. 300-02563-0000 R-16)

NOTES:

1. PARTS 089-8054-30(2 MAX.) AND 089-8256-28 ARE TO BE ADDED AS REQUIRED TO PROVIDE 3.00±1.0 IN.-OZ. OF TORQUE AT "HDG" KNOB. (-00 UNIT ONLY). SPRING WASHER -089-8256-28, WHEN USED, SHOULD ALWAYS BE ACCOMPANIED BY TWO FLAT-WASHERS -089-8054-30.
2. BREAK LOCK-TAB OFF OF COUPLER SLEEVE-088-0892-00 BEFORE COUPLING MOTOR. (ONE PART ONLY).
3. TO INSURE PROPER ALIGNMENT OF MOTORS, REMOVE INSPECTION TAGS BEFORE APPLYING COUPLER SLEEVE.
4. IDENTIFICATION TAG TO BE CENTERED BETWEEN NOTCHES IN REAR PLATE AND LOCATED WITH ITS BOTTOM EDGE ON OUTSIDE PLATE EDGE AS SHOWN.
5. ELECTRICAL TAP (012-1017-01) TO BE APPLIED TO PREVENT DUST INFILTRATION THROUGH OPENING BETWEEN BEZEL (073-0411-02) AND FRONT PLATE ASSY. (200-2565-00). TAP SHOULD NOT OVERLAP OUTMOST EDGE OF BEZEL. TAPE SHOULD BEGIN AND END ON A CORNER FLAT AND SHOULD NOT OVERLAP ITSELF.
6. APPLY MOLYBDENUM DISULFIDE (016-1016-00) TO ALL BEARING SURFACES ON GEARS.
7. ASSEMBLE 076-1128-01 AND 088-0893-00 USING A FIXTURE, PREVIOUS TO ASSEMBLING THEM TO 148-0034-00 (MOTOR) SHAFT. 076-1128-01 SHOULD MOUNT DOWN AGAINST THE MOTOR SHAFT IN FINAL ASSY.
8. SHRINKABLE TUBING SHOULD BE USED ON CONNECTOR WIRING (150-0049-10).
9. USE LIQUID STAKING ON ALL SCREWS THAT HAVE NO OTHER LOCKING DEVICE.

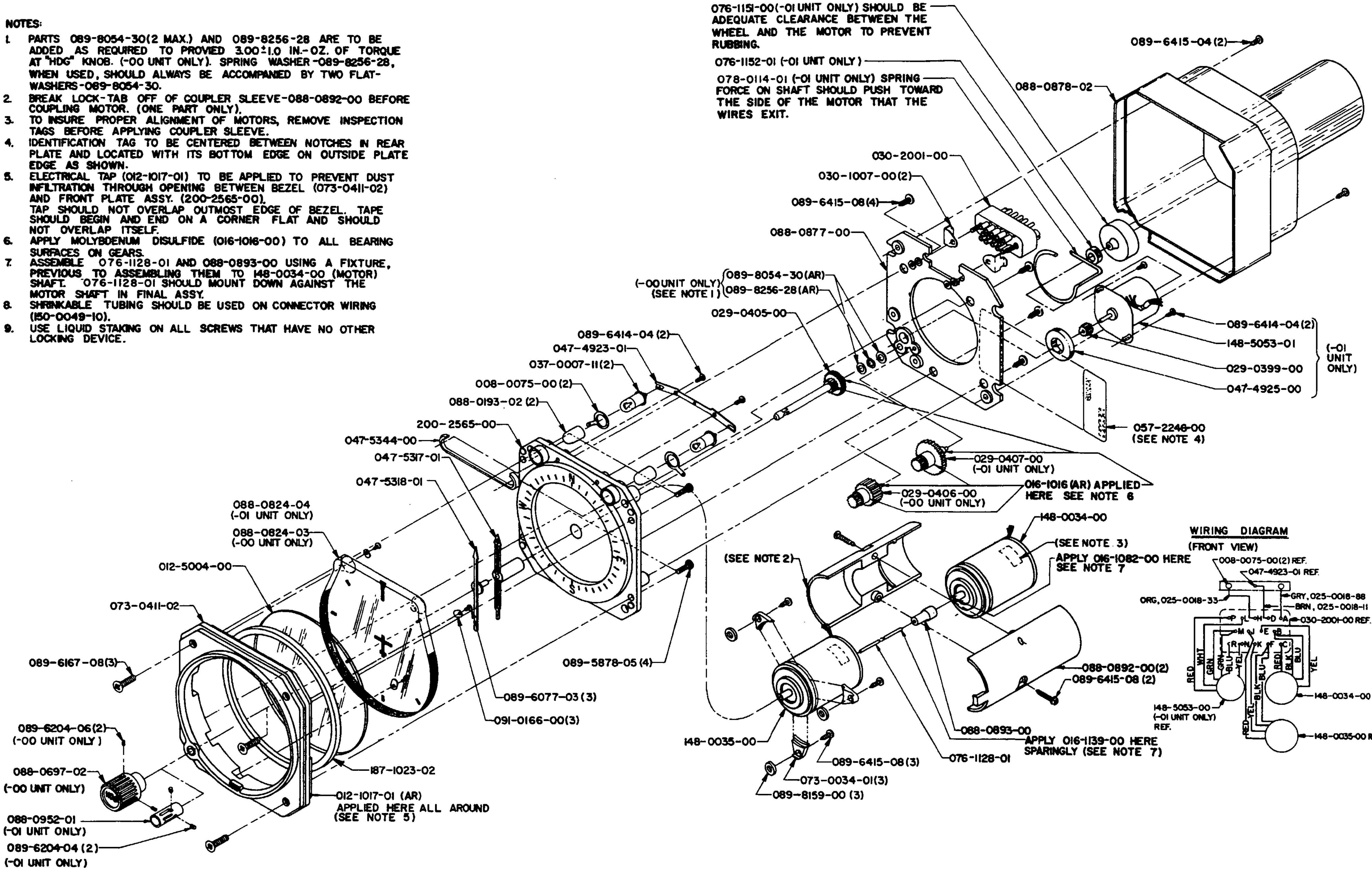


FIGURE 6-3A KI 228 FINAL ASSEMBLY
(Dwg. No. 300-02563-0000 R-6)

NOTES:

1. PARTS 089-8054-30 (2 MAX.) AND 089-8256-28 ARE TO BE ADDED AS REQUIRED TO PROVIDE 1.00 ± .25 IN.-OZ. OF TORQUE AT "HDG" KNOB. (-00 UNIT ONLY). SPRING WASHER-089-8256-28, WHEN USED, SHOULD ALWAYS BE ACCOMPANIED BY TWO FLAT-WASHERS-089-8054-30.
2. BREAK LOCK-TAB OFF OF COUPLER SLEEVE-088-0892-00 BEFORE COUPLING MOTORS. (ONE PART ONLY).
3. TO INSURE PROPER ALIGNMENT OF MOTORS, REMOVE INSPECTION TAGS BEFORE APPLYING COUPLER SLEEVE.
4. IDENTIFICATION TAG TO BE CENTERED BETWEEN NOTCHES IN REAR PLATE AND LOCATED WITH ITS BOTTOM EDGE ON OUTSIDE PLATE EDGE AS SHOWN.
5. ELECTRICAL TAPE (012-1017-01) TO BE APPLIED TO PREVENT DUST INFILTRATION THROUGH OPENINGS BETWEEN BEZEL (073-0411-02) AND FRONT PLATE ASSY. (200-2565-00). TAPE SHOULD NOT OVERLAP OUTERMOST EDGE OF BEZEL. TAPE SHOULD BEGIN AND END ON A CORNER FLAT AND SHOULD NOT OVERLAP ITSELF.

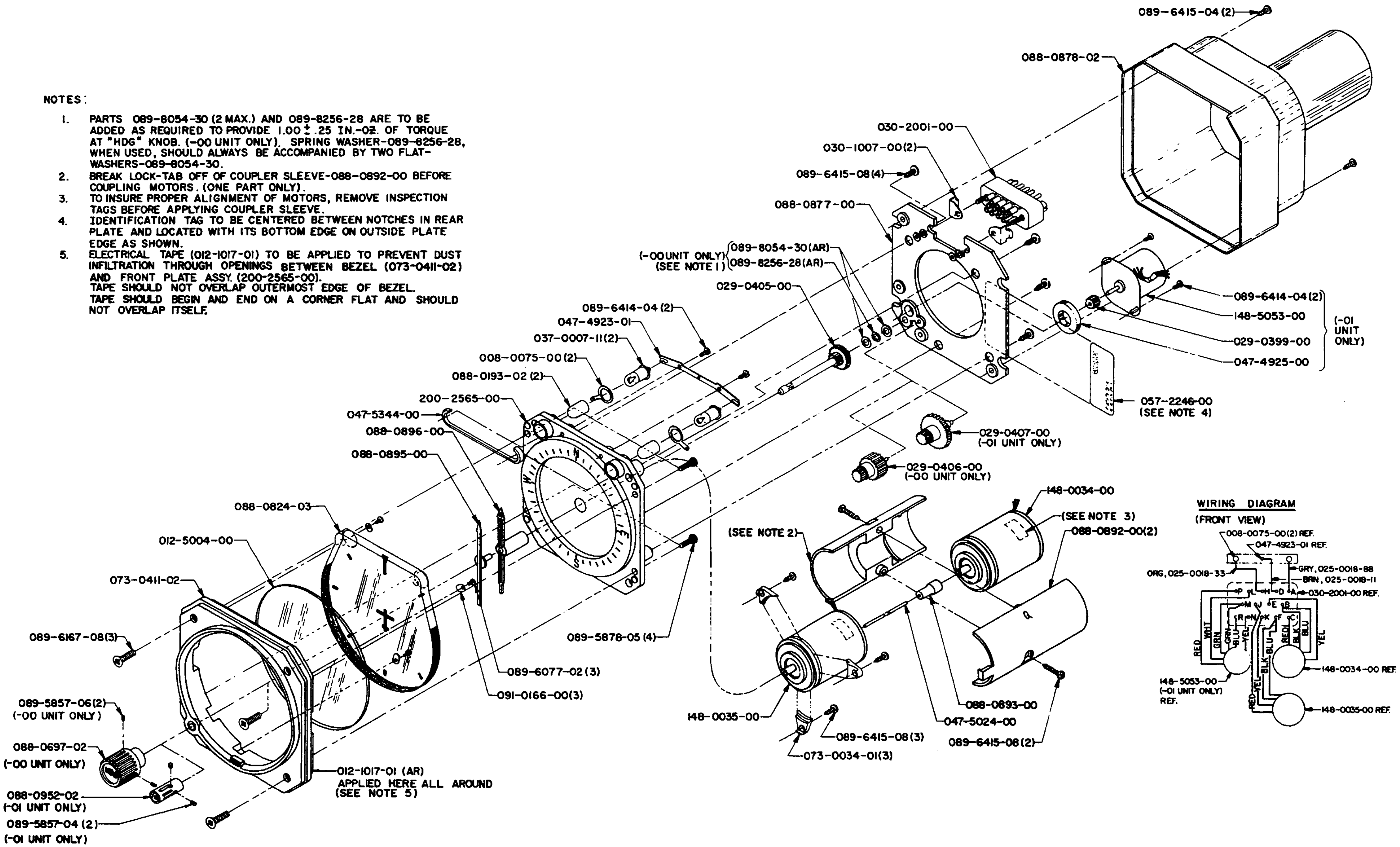


FIGURE 6-3B KI 228 FINAL ASSEMBLY
(Dwg. No. 300-02563-0000 R-1)

KI 227/228
FRONT PLATE ASSY

6.4 200-02565-0000 Rev. 1 KI 227/228 FRONT PLATE ASSY.

SYMBOL	PART NUMBER	DESCRIPTION	[UM]	QUANTITY
				-0000
	076-02836-0001	SPACER W/IRIDITE	[EA]	1
	088-00876-0000	FRT GEAR PLT	[EA]	1
	088-00881-0051	COMPASS CARD	[EA]	1
	089-08199-0003	SHIM WASHER W/NOTC	[EA]	1
	090-00019-0014	RETAINING RING	[EA]	1

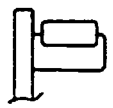
KI 227/228
BUFFER BOARD

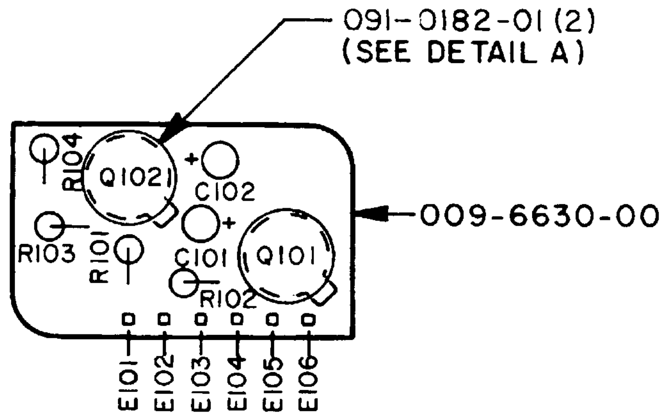
6.5 200-06630-0000 Rev. 1 KI 227/228 BUFFER BOARD

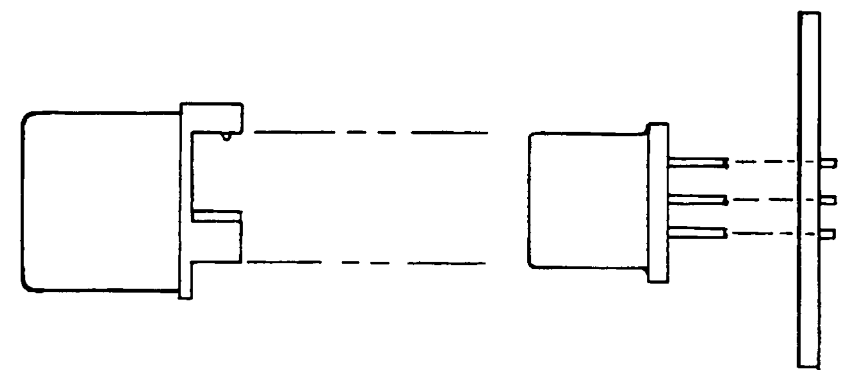
SYMBOL	PART NUMBER	DESCRIPTION	[UM]	QUANTITY
				-0000
	009-06630-0000	PC BD BUFFER	[EA]	1
	016-01040-0000	COATING TYPE AR	[AR]	0
	091-00182-0001	CAP SEMICN TO-18	[EA]	2
C 101	096-01082-0014	CAP TN .68UF 20V	[EA]	1
C 102	096-01082-0014	CAP TN .68UF 20V	[EA]	1
E 101	030-02174-0004	PIN CONTACT	[EA]	1
E 102	030-02174-0004	PIN CONTACT	[EA]	1
E 103	030-02174-0004	PIN CONTACT	[EA]	1
E 104	030-02174-0004	PIN CONTACT	[EA]	1
E 105	030-02174-0004	PIN CONTACT	[EA]	1
E 106	030-02174-0004	PIN CONTACT	[EA]	1
Q 101	007-00261-0000	XSTR S PNP 2N2907A	[EA]	1
Q 102	007-00261-0000	XSTR S PNP 2N2907A	[EA]	1
R 101	131-00432-0023	RES CF 4.3K QW 5%	[EA]	1
R 102	131-00222-0023	RES CF 2.2K QW 5%	[EA]	1
R 103	131-00432-0023	RES CF 4.3K QW 5%	[EA]	1
R 104	131-00222-0023	RES CF 2.2K QW 5%	[EA]	1

NOTES:

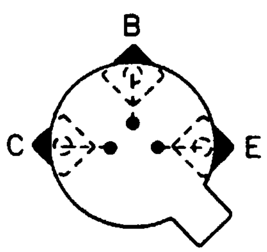
1. PRIOR TO POST COATING BOTH SIDES OF P.C. BOARD WITH CLEAR URETHANE (016-1040-00), MASK OFF THE FOLLOWING: ALL MOUNTING AREAS, ALL "E" NUMBERS







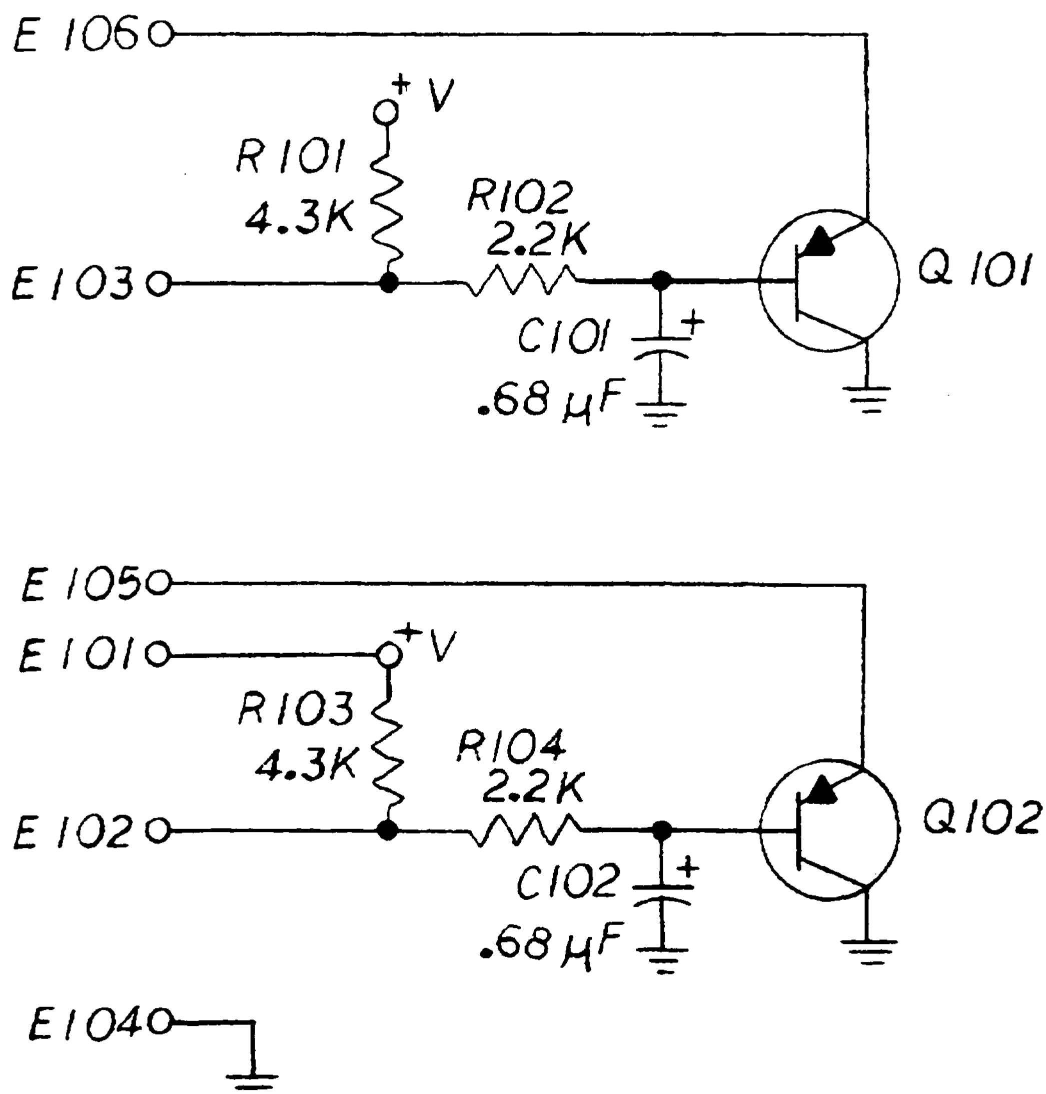
DETAIL A
4 / 1



Q101, Q102

Dwg 300-06630-0000 R1

FIGURE 6-5 KI 227 BUFFER BOARD ASSEMBLY
(Dwg. No. 300-06630-0000 R-1)



Dwg 002-06630-0000 R0

FIGURE 6-6 KI 227 BUFFER BOARD SCHEMATIC
(Dwg. No. 002-06630-0000 R-0)

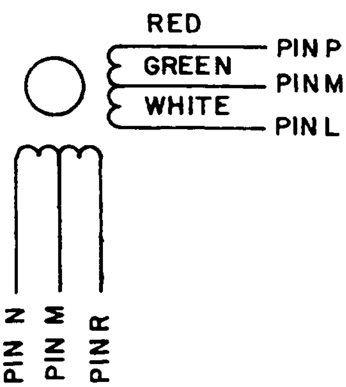


FIGURE 6-7 KI 227 STEPPER MOTOR WIRING CONNECTION

APPENDIX 'A'

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SEMICONDUCTOR AND INTEGRATED CIRCUIT DATA

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1.1 GENERAL

Due to the wide utilization of semiconductors in this electronic equipment, somewhat different techniques are necessary in maintenance procedures. In solid state circuits the impedances and resistances encountered are of much lower values than those encountered in vacuum-tube circuits. Therefore, a few ohms discrepancy can greatly affect the performance of the equipment. Also, coupling and filter capacitors are of larger values and usually are of the tantalum type. Hence, when measuring values of capacitors, an instrument accurate in the high ranges must be employed. Capacitor polarity must be observed when measuring resistance. Usually more accurate measurements can be obtained if the semiconductors are removed or disconnected from the circuits.

1.1.1 SEMICONDUCTOR TEST EQUIPMENT

Damage to semiconductors by test equipment is usually the result of accidentally applying too much voltage to the elements. Common causes of damage from test equipment are discussed in the following paragraph.

A. Transformerless Power Supplies

Test equipment with transformerless power supplies is one source of high current. However, this type of test equipment can be used by employing an isolation transformer in the AC power line.

B. Line Filter

It is still possible to damage semiconductors from line current, even though the test equipment has a power transformer in the power supply, if the test equipment is provided with a line filter. This filter may function as a voltage divider and apply half voltage to the semiconductor. To eliminate this condition, connect a ground wire from the chassis of the test equipment to the chassis of the equipment under test before making any other connections.

C. Low-Sensitivity Multimeters

Another cause of semiconductor damage is a multimeter that requires excessive current to provide adequate indications. Multimeters with sensitivities of less than 20,000 ohms-per-volt should not be used on semiconductors. When in doubt as to the amount of current supplied by a multimeter, check the multimeter circuits on all scales with an external, low-resistance multimeter connected in series with the multimeter leads. If more than one milliampere is drawn on any range, this range cannot be safely used on small semiconductors.

D. Power Supply

When using a battery-type power supply, always use fresh batteries of the proper value. Make certain that the polarity of the power supply is correct for the equipment under test. Do not use power supplies having poor voltage regulation.

1.1.2 SEMICONDUCTOR VOLTAGE AND RESISTANCE MEASUREMENTS

When measuring voltage or resistance in circuits containing semiconductor devices, remember that these components are polarity and voltage conscious. Since the values of capacitors used in semiconductor circuits are usually large, time is required to charge these capacitors when they appear. Thus, any reading obtained is subject to error if sufficient time is not allowed for the capacitor to fully charge. When in doubt it may be best in some cases to isolate the components in question and measure them individually.

1.1.3 TESTING OF TRANSISTORS

A transistor checker should be used to properly evaluate transistors. If a transistor tester is not available, a good multimeter may be used. Make sure that the multimeter meets the requirements outlined in the preceding paragraph.

A. PNP Transistor

To check a PNP transistor, connect the positive lead of the multimeter to the base of transistor and the negative lead to the emitter or collector. Generally, a resistance reading of 50,000 ohms or more should be obtained. Reconnect the multimeter with the negative lead to the base. With the positive lead connected to the emitter or collector a resistance value of 500 ohms or less should be obtained.

B. NPN Transistor

Similar tests made on a NPN transistor should produce the following results:

With the negative lead of the multimeter connected to the base of the transistor the value of resistance between the base and the collector or emitter should be high. With the positive lead of the multimeter connected to the base, the value of resistance between the base and the collector or emitter should be low. If these results are not obtained, the transistor is probably defective and should be replaced.

CAUTION

IF A TRANSISTOR IS FOUND TO BE DEFECTIVE, MAKE CERTAIN THAT THE CIRCUIT IS IN GOOD OPERATING ORDER BEFORE INSTALLING A REPLACEMENT TRANSISTOR. IF A SHORT CIRCUIT EXISTS IN THE CIRCUIT, PUTTING IN ANOTHER TRANSISTOR WILL MOST LIKELY RESULT IN BURNING OUT THE NEW COMPONENT. DO NOT DEPEND UPON FUSES TO PROTECT TRANSISTORS.

1.1.4 REPLACING SEMICONDUCTORS

Never remove or replace a semiconductor with the supply voltage turned on. Transients thus produced may damage the semiconductor or others remaining in the circuit. If a semiconductor is to be evaluated in an external test circuit, be sure that no more voltage is applied to the semiconductor than normally is used in the circuit from which it came.

A. Use only a low heat soldering iron when installing or removing soldered-in semiconductors. Grasp the lead to which heat is applied between the solder joint and the semiconductor with long-nosed pliers.

This will dissipate some of the heat that would otherwise be conducted into the semiconductor from the soldering iron. Make certain that all wires soldered to semiconductor terminals have first been properly tinned so that the necessary connection can be made quickly. Excessive heat will permanently damage a semiconductor.

B. In some cases, power transistors are mounted on heat-sinks that are designed to dissipate heat away from them. In some power circuits, the transistor must also be insulated from ground. This insulating is accomplished by means of an insulating washer made of mica. When replacing transistors mounted in this manner, be sure that the insulating washers are replaced in proper order. After the transistor is mounted, and before making any connections, check from the case of the transistor to ground with a multimeter to see that the insulation is effective.

1.2 INTEGRATED CIRCUIT MAINTENANCE

1.2.1 GENERAL

A knowledge of integrated circuit fundamentals is as necessary in testing digital logic circuits involving IC's as a knowledge of rectification fundamentals is needed to test a power supply.

1.2.2 TERMINOLOGY

Several terms are used whenever logic circuits are discussed:

A. A logic state is defined as a high or low level voltage applied to the input or seen at the output of a device. A high level voltage is called a logic "1". A low level voltage is called a logic "0". Logic threshold voltage of a device is the input voltage required at an input to change the output state.

B. A truth table is a list of input logic states that will yield certain output logic states. A digital logic element should be thought of as a circuit element with its output level being either HI or LO as programmed by the levels present on its inputs.

   A logic element may be tested by verifying that it is performing per the Truth Table of that logic element.

C. Logic elements which have multiple inputs and a single output are known as gates. The OR gate produces a HI output when one or more of the inputs are HI. With all inputs LO, the output is LO. The AND gate produces a HI output only when all inputs are HI. When any input is LO the output is LO. A small circle at the output of a gate on the schematics indicates "negation", which means that the sense of the gate logic is reversed. An OR gate with negation is called a NOR gate and an AND gate with negation is called a NAND gate. A NOR gate produces a LO output when one or more of the inputs are HI and a NAND gate produces a LO output only when all inputs are HI.

D. The Flip-Flop logic element is the basic data storage element of digital logic. It has two outputs that are always at opposite logic levels. That is, when one output is HI the other is LO. The Flip-Flop wil remain in a particular state until that state is changed by an input signal.

   The operation of these Flip-Flops is controlled by the signals on their inputs, and is best understood by a careful study of their Truth Tables. It should be kept in mind that a small circle on either the input or the output indicates negation. Also, a circle on a clock input indicates that a HI to LO transition causes the Flip-Flop to function.

E. Besides the gates and Flip-Flops, two other commonly used logic elements are inverters and expanders. Inverters are merely switching transistors such that if a logic "1" is the input to a device, a logic "0" will be the output and vice-versa. An expander is a set of parallel switching transistors that depends upon another resistor to provide their supply voltage. Generally, these devices are used to expand the number of inputs available to a standard gate.

1.2.3 INTEGRATED CIRCUIT TEST EQUIPMENT

As with semiconductors, damage to integrated circuits by test equipment is usually the result of applying too much current or voltage to the elements. The same precautions as discussed in Paragraph 1.1.1 apply here.

1.2.4 VOLTAGE MEASUREMENTS

Precise voltage measurements are not needed in testing digital IC's other than to see that the voltage is a HI or a LO level. An oscilloscope is needed where the input levels are of short duration, either HI or LO. For instance, if a 10 microsecond pulse going from LO to HI was applied to one input of a NOR gate, while the other input stayed LO, the output would go LO for 10 microseconds and then return HI. This, of course, could not be seen without an oscilloscope.

1.2.5 TESTING INTEGRATED CIRCUITS

The fully loaded guaranteed minimum high and maximum low for the digital logic output levels are:

TTL (V_{cc} = +5V)		ECL (V_{cc} = +5.2V)	
High	Low	High	Low
2.4	0.5	4.25	3.48

The minimum high and maximum low input levels which are guaranteed to be correctly interpreted are:

TTL (V_{cc} = +5V)		ECL (V_{cc} = +5.2V)	
High	Low	High	Low
2.0	0.8	4.06	3.75

When checking input and output levels of a logic element under question it should be remembered that an input or output may not agree with its truth table not because it has malfunctioned but because some other component connected to the same point has shorted to ground or to the supply voltage (V_{cc}). This is not common when an output on one element is connected to an input of another. A majority of digital IC failures can be grouped into three categories:

A. Input(s) or output shorted to ground pin of IC.

B. Input(s) or output shorted to V_{cc} pin of IC.

C. Open input(s) or output.

An input or output shorted to ground would be a constant LO and an input or output shorted to V_{cc} would be a constant HI.

Other failures common in digital IC's are:

A. Ground pin open.

B. V_{cc} pin open.

C. Inputs shorted together.

An open ground pin would not allow a LO on the output. An open V_{cc} pin would not allow a HI on the output. (Remember to isolate the device from other components connected to it). Two or more inputs shorted together can be checked by grounding one of the inputs under question. If the other input also goes to ground they are probably shorted.

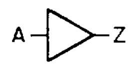
CAUTION

IF AN IC IS FOUND TO BE DEFECTIVE, VERIFY THAT PROPER POWER SUPPLY VOLTAGES ARE PRESENT BEFORE INSTALLING A REPLACEMENT IC.

1.2.6 REPLACING INTEGRATED CIRCUITS

If an IC is known to be defective, the easiest way to remove it is to cut off each of its pins, remove the case, and then unsolder the remaining pins from the integrated circuit card one by one. This is preferrable over removing the IC intact because attempts to remove the IC intact may result in damage to the printed circuit board.

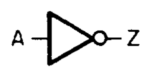
FIGURE 1. BUFFER



$Z = A$

A	Z
0	0
1	1

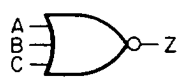
FIGURE 2. INVERTER



$Z = \overline{A}$

A	Z
0	1
1	0

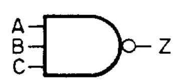
FIGURE 3. NOR GATE



$Z = \overline{A+B+C}$

A	B	C	Z
0	0	0	1
1	0	0	0
0	1	0	0
0	0	1	0
1	1	0	0
1	0	1	0
0	1	1	0
1	1	1	0

FIGURE 4. NAND GATE



$Z = \overline{ABC}$

A	B	C	Z
0	0	0	1
1	0	0	1
0	1	0	1
0	0	1	1
1	1	0	1
1	0	1	1
0	1	1	1
1	1	1	0

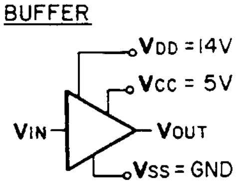
FIGURE 5. EXCLUSIVE OR GATE

$Z = A \oplus B$

A	B	Z
0	0	0
1	0	1
0	1	1
1	1	0

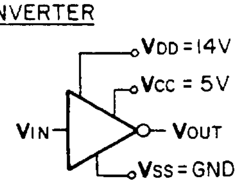
FIGURE 6. TTL TO CMOS VOLTAGE LEVEL TRANSLATORS

BUFFER



V_{IN}	0V	14V
V_{OUT}	0V	5V

INVERTER

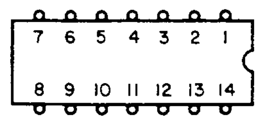


V_{IN}	0V	14V
V_{OUT}	5V	0V

INTEGRATED CIRCUIT PIN LOCATION DIAGRAMS

(Viewed From TOP of IC)

1



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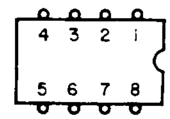

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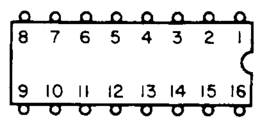

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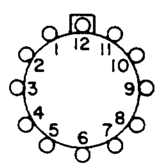

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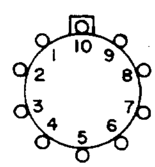

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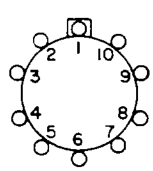

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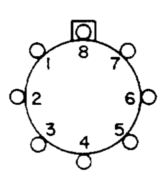
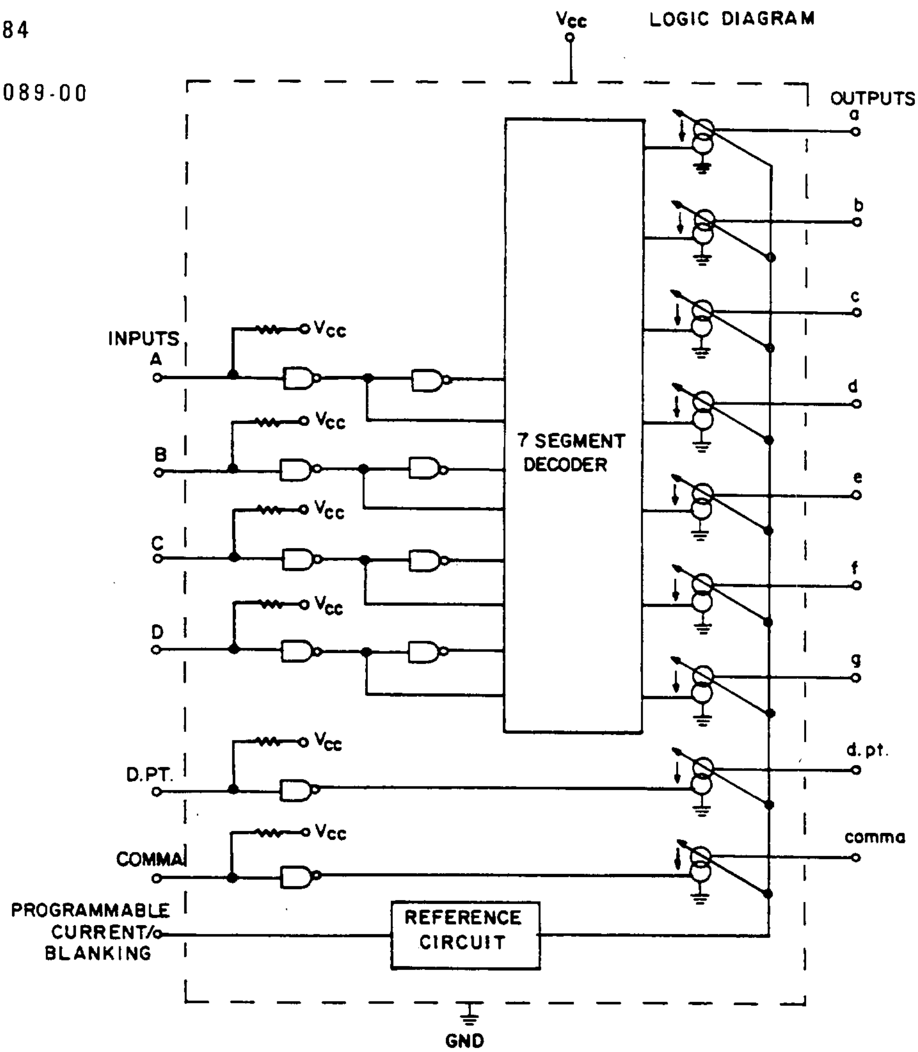


DS8884

120-0089-00

LOGIC DIAGRAM



HIGH VOLTAGE CATHODE DECODER/DRIVER

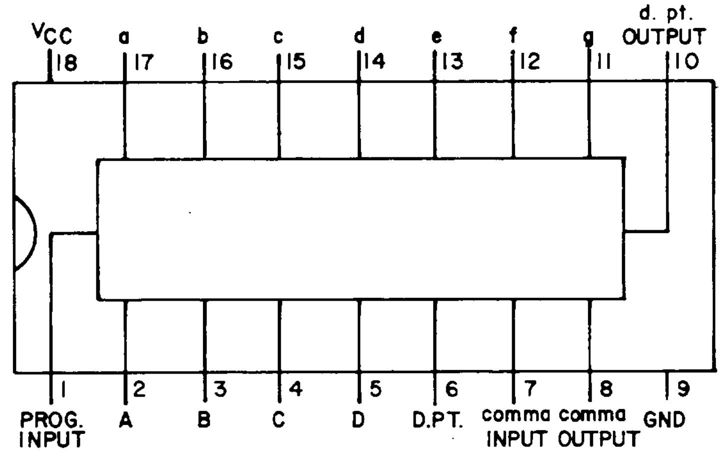
GENERAL DESCRIPTION

The DS8884A is designed to decode four lines of BCD input and drive seven-segment digits of gas-filled readout displays. Two separate inputs are provided for driving the decimal point and comma cathodes.

All outputs consists of switchable and programmable current sinks which provide constant current to the tube cathodes, even with high tube anode supply tolerance. Output currents may be varied over the 0.2 to 1.2ma range for multiplex operation. The output current is adjusted by connecting an external program resistor (R_p) from V_{CC} to the program input in accordance with the programming curve.

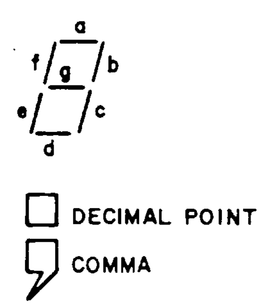
DS8884

120-0089-00



TOP VIEW

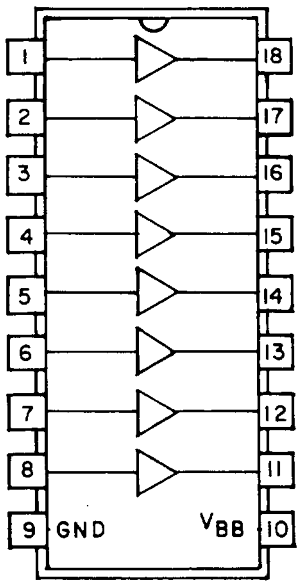
FUNCTION	D.PT.	COMMA	D	C	B	A	a	b	c	d	e	f	g	DISPLAY
0	1	1	0	0	0	0	0	0	0	0	0	0	1	
1	1	1	0	0	0	1	1	0	0	1	1	1	1	
2	1	1	0	0	1	0	0	0	1	0	0	1	0	
3	1	1	0	0	1	1	0	0	0	0	1	1	0	
4	1	1	0	1	0	0	1	0	0	1	1	0	0	
5	1	1	0	1	0	1	0	1	0	0	1	0	0	
6	1	1	0	1	1	0	0	1	0	0	0	0	0	
7	1	1	0	1	1	1	0	0	0	1	1	1	1	
8	1	1	1	0	0	0	0	0	0	0	0	0	0	
9	1	1	1	0	0	1	0	0	0	0	1	0	0	
10	1	1	1	0	1	0	1	1	0	0	0	1	1	
11	1	1	1	0	1	1	1	1	0	0	0	1	0	
12	1	1	1	1	0	0	0	0	1	1	1	0	0	
13	1	1	1	1	0	1	0	1	1	0	0	0	0	
14	1	1	1	1	1	0	1	1	1	1	1	1	0	
15	1	1	1	1	1	1	1	1	1	1	1	1	1	
* D.PT.	0	1	X	X	X	X	X	X	X	X	X	X	X	
* Comma	0	0	X	X	X	X	X	X	X	X	X	X	X	



* DECIMAL POINT AND COMMA CAN BE DISPLAYED WITH OR WITHOUT ANY NUMERAL.

UDN-6184

120-0095-00



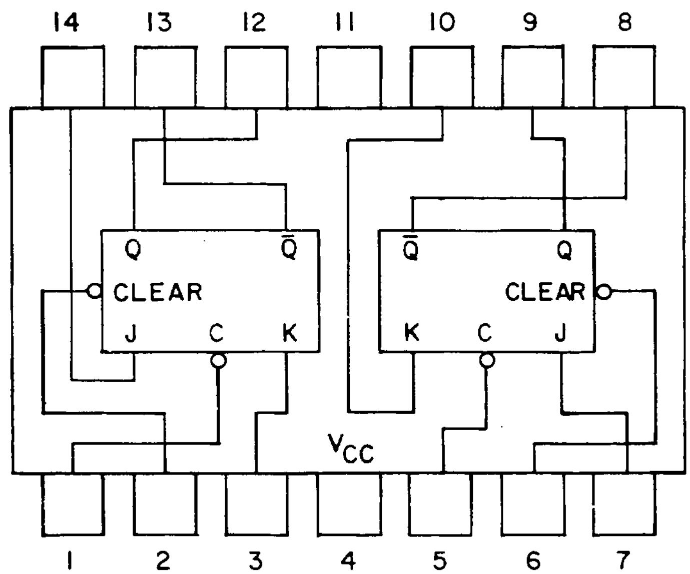
GAS DISPLAY DIGIT DRIVER

The UDN-6184 is designed for interfacing between MOS, or other low-voltage circuitry, and the anodes of gas discharge displays driven in a multiplexed fashion. The UDN-6184 contains eight drivers. Each driver contains appropriate level shifting, signal amplification, output off state voltage bias, and 70ma output current sourcing for the sequential addressing of display anodes. The inputs include pull-down resistors for direct connection to open drain PMOS logic.

MC74LS73

120-0098-00

A,F PACKAGE



MC74LS73

120-0098-00

LOGIC

(EACH FLIP FLOP)		
tn		tn+1
J	K	Q
0	0	Q_n
0	1	0
1	0	1
1	1	$\bar{Q}_n$

DUAL J-K MASTER SLAVE FLIP-FLOP

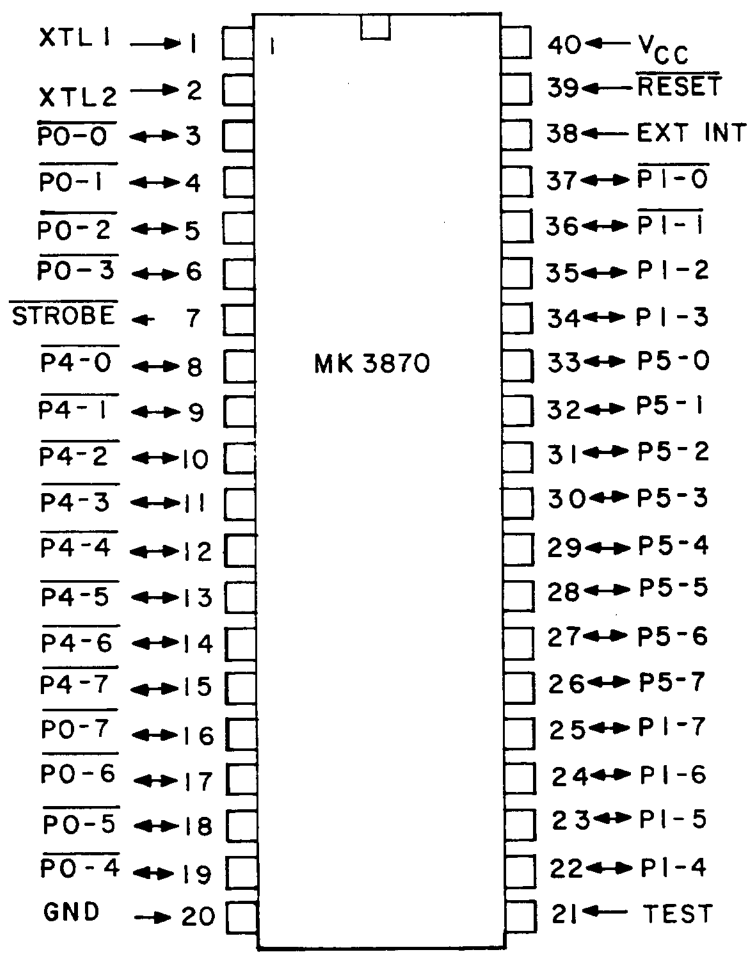
DESCRIPTION:
The Dual J-K Flip Flop is based on the master-slave principle. Inputs to the master section are controlled by the clock pulse. The clock pulse also regulates the state of the coupling transistors which connect the master and slave sections. The sequence of operation is as follows:

1) Isolate slave from master
2) Enter information from J and K inputs to master
3) Disable J and K inputs
4) Transfer information from master to slave

MK3870

120-2038-00

PIN CONNECTIONS



KING

KR 87 APPENDIX

MK3870

120-2038-00

1.0 SINGLE-CHIP MICROCOMPUTER DEVICE SPECIFICATIONS

The device shall be equivalant to a programmed version of the Mostek 3870 Single-Chip Microcomputer. The Internal Rom is to be programmed with the listing continued on pages 6 through 9 . All I/O ports shall be standard TTL.

1.1 INPUTS

PIN	NAME	FUNCTION
1	XTL 1	N.C.
2	XTL 2	2.48 MHz CLOCK INPUT
3	EAROM DATA	EAROM DATA INPUT
4	NOT USED	NOT USED
5	32 Hz 270°	32 Hz SIGNAL
6	32 Hz 180°	32 Hz SIGNAL
7	STROBE	UNIV. SYN. CLOCK
8	RESET	FLT TIMER RESET (GND)
9	RESET	FLT TIMER RESET (+5)
10	BFO	BFO ENABLE INPUT
11	ADF/ANT	ADF/ANT ENABLE INPUT
12	FLT/ET	FLT/ET ENABLE INPUT
13	FREQ	FREQ ENABLE INPUT
14	SET/RESET	SET/RESET ENAB INPUT
15	EAROM DATA	EAROM DATA OUT
16	16 KHz SYNC	EAROM SYNC
17	SYNC	TUNING DATA ENABLE
18	32 Hz 0°	32 Hz ANT REF
19	32 Hz 90°	32 Hz ANT REF
20	GND	GND
21	TEST	TEST FUNCTION
22	MESSAGE DATA	N,A,F,L,T BUSS
23	COLON	UPPER & LOWER COLON
24	CLOCK	DISPLAY CLOCK
25	SYNC	DISPLAY SYNC
26	I/D SMALL	1 KHz/10 KHz SWITCH
27	I/D LARGE	100 KHz/1 MHz SWITC
28	I/D ONE's/TEN's	1 KHz/10 KHz CONTROL
29	RIGHT	INCREMENT
30	LEFT	DECREMENT
31	EAROM CODE 1	EAROM DATA 1
32	EAROM CODE 2	EAROM DATA 2
33	EAROM CODE 3	EAROM DATA 3
34	BCD DIGIT DATA 1	BCD DATA 1's
35	BCD DIGIT DATA 2	BCD DATA 2's
36	BCD DIGIT DATA 4	BCD DATA 4's
37	BCD DIGIT DATA 8	BCD DATA 8's
38	INTERRUPT	INC/DEC INTERRUPT
39	RESET	POWER ON RESET
40	VCC + 5V	+5V LOGIC

MC1350P

120-3020-00

MONOLITHIC IF AMPLIFIER

...an integrated circuit featuring wide range AGC for use as an IF amplifier in radio and TV over the temperature range 0 to +75°C. The MC 1352 is similar in design but has a keyed-AGC amplifier as an integral part of the same chip.

Power Gain - 50dB typ. at 45MHz,
- 48dB typ. at 58MHz

AGC Range - 60dB min, DC to 45MHz

Nearly constant input and output admittance over the entire AGC range

Y_{21} Constant (-3.0dB) to 90MHz

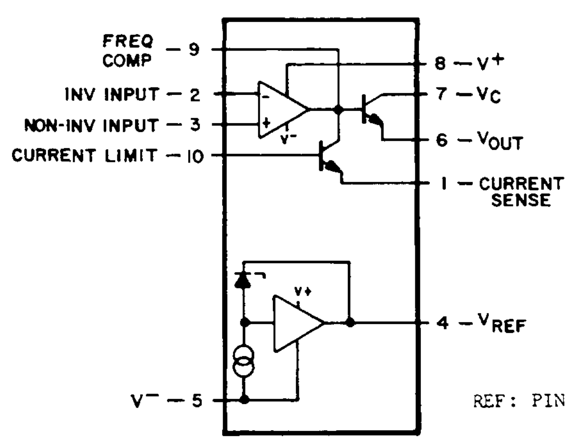
Low Reverse Transfer Admittance - 1.0umho typ.

12-Volt Operation, Single-Polarity Power Supply

LM723

120-3023-01

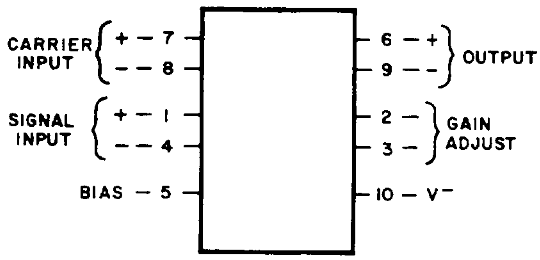
General Description - The μA723 is a monolithic Voltage Regulator:
The device consists of a temperature compensated reference amplifier, error amplifier, power series pass transistor and current limit circuitry. Additional NPN or PNP pass elements may be used when output currents exceeding 150mA are required. Provisions are made for adjustable current limiting and remote shutdown. In addition to the above, the device features low standby current drain, low temperature drift and high ripple rejection. The μA723 is intended for use with positive or negative supplies as a series, shunt, switching or floating regulator. Applications include laboratory power supplies, isolation regulators for low level data amplifiers, logic card regulators, small instrument power supplies, airborne systems and other power supplies for digital and linear circuits.

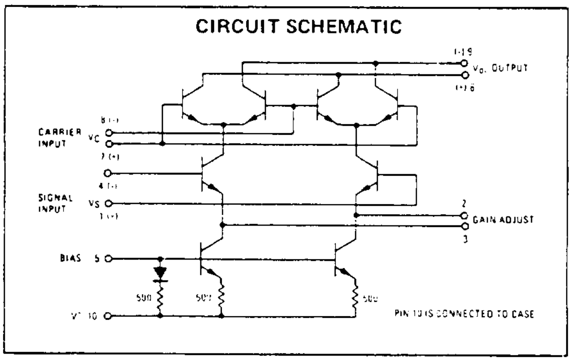


REF: PIN LOCATION DIAGRAM #4

MC1596/MC1496

120-3027-00/01





The MC1596/MC1496 is a monolithic balanced modulator circuit.

This circuit consists of an upper quad differential amplifier driven by a standard differential amplifier with dual current sources. The output collectors are cross-coupled so that full-wave balanced multiplication of the two input voltages occurs. That is, the output signal is a constant times the product of the two input signals.

Mathematical analysis of linear ac signal multiplication indicates that the output spectrum will consist of only the sum and difference of the two input frequencies. Thus, the device may be used as a balanced modulator, doubly balanced mixer, product detector, frequency doubler, and other applications requiring these particular output signal characteristics.

The lower differential amplifier has its emitters connected to the package pins so that an external emitter resistance may be used. Also, external load resistors are employed at the device output.

The upper quad differential amplifier may be operated either in a linear or a saturated mode. The lower differential amplifier is operated in a linear mode for most applications.

For low-level operation at both input ports, the output signal will contain sum and difference frequency components and have an amplitude which is a function of the product of the input signal amplitudes.

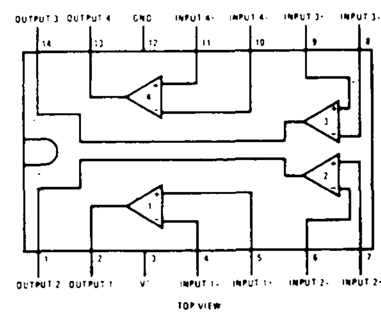
For high-level operation at the carrier input port and linear operation at the modulating signal port, the output signal will contain sum and difference frequency components of the modulating signal frequency and the fundamental and odd harmonics of the carrier frequency. The output amplitude will be a constant times the modulating signal amplitude. Any amplitude variation in the carrier signal will not appear in the output.

LM339

120-3048-00

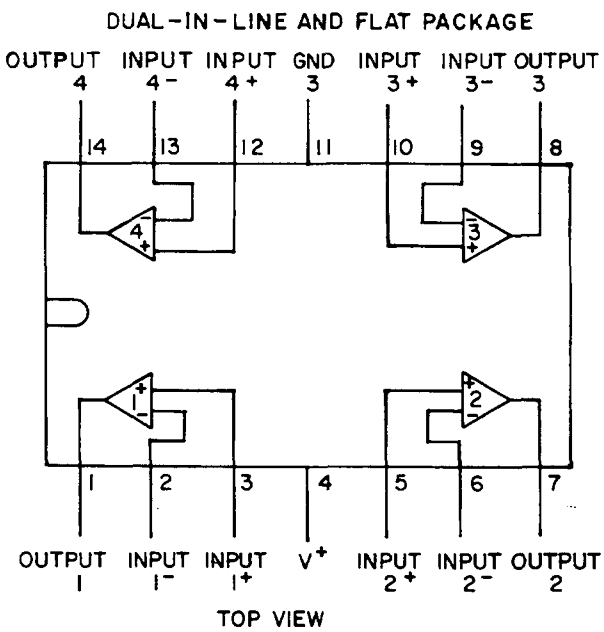
The LM339 consists of four independent voltage comparators which were designed specifically to operate from a single power supply over a wide range of voltages. Operation from split power supplies is also possible and the low power supply current drain is independent of the magnitude of the power supply voltage. These comparators also have a unique characteristic in that the input common-mode voltage range includes ground, even though operated from a single power supply voltage.

Dual-In-Line and Flat Package



LM324

120-3052-00



Quad OP Amp

general description

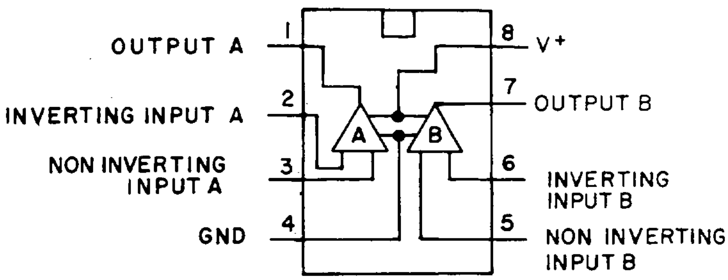
The LM324 series consists of four independent, high gain, internally frequency compensated operational amplifiers which were designed specifically to operate from a single power supply over a wide range of voltages. Operation from split power supplies is also possible and the low power supply current drain is independent of the magnitude of the power supply voltage.

Application areas include transducer amplifiers, DC gain blocks and all the conventional op amp circuits which now can be more easily implemented in single power supply systems. For example, the LM324 series can be directly operated off of the standard $+5V_{DC}$ power supply voltage which is used in digital systems and will easily provide the required interface electronics without requiring the additional $\pm 15V_{DC}$ power supplies.

LM358

120-3053-00

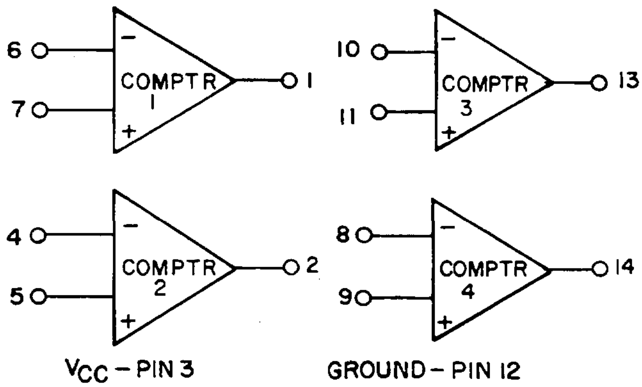
DUAL-IN-LINE PACKAGE



The LM358N consists of two independent, high gain, internally frequency compensated operational amplifiers which were designed specifically to operate from a single power supply over a wide range of voltages. Operation from split power supplies is also possible and the low power supply current drain is independent of the magnitude of the power supply voltage.

MC3302P

120-3078-00



QUAD SINGLE-SUPPLY COMPARATOR

These comparators are designed specifically for single postive-power-supply Consumer Automotive and Industrial electronic applications. Each MC3302P contains four independent comparators - suiting it ideally for usages requiring high density and low-cost.

Wide Operating Temperature Range -- -40 to +85°C

Single-Supply Operation -- +2.0 to +28VDC

Differential Input Voltage = $\pm V_{CC}$

Compare Voltages at Ground Potential

MTTL Compatible

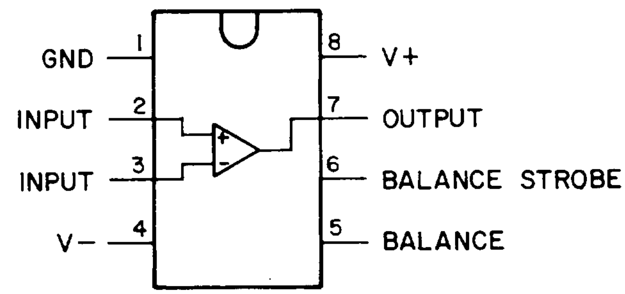
Low Current Drain - 700ua typical @ V_{CC} +5.0 to +28VDC

Outputs can be connected to give the implied AND function

LM311N

120-3081-00

The LM311 is a voltage comparator with low input currents. It is designed to operate over a wide range of supply voltages: from standard ±15V op amp supplies down to single 5V supply used for IC logic. Its output is compatible with RTL, DTL, and TTL as well as MOS circuits. It can switch voltages up to 40V at currents as high as 50ma.



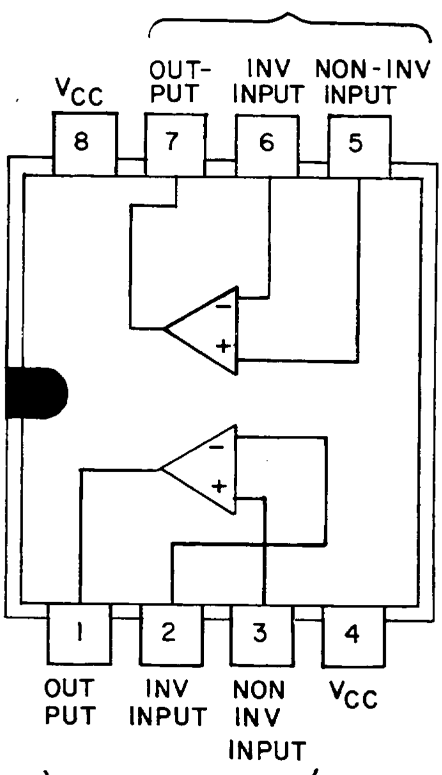
TOP VIEW

TL082

120−3084−01

OP AMP BIFET

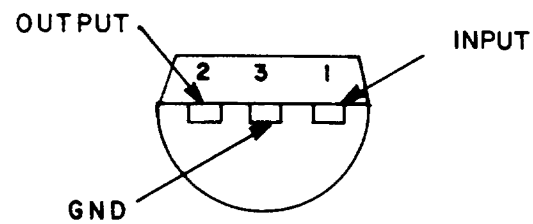
AMPLIFIER NO. 2



AMPLIFIER NO. 1

340LAZ-5.0

120-3094-32



BOTTOM VIEW

5V
3-TERMINAL POSTIVE REGULATORS

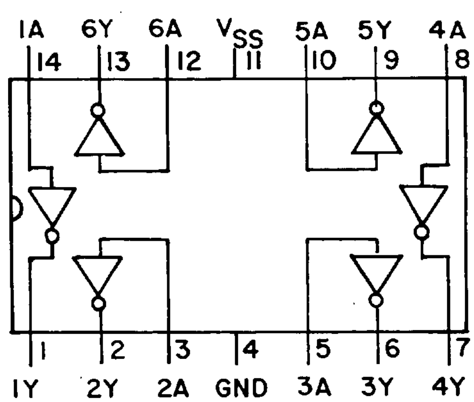
GENERAL DESCRIPTION

This series of three terminal positive regulators is available with several fixed output voltages making them useful in a wide range of applications. The regulators have ±3% V_{OUT} specification, 0.04%/V line regulation, and 0.01%/ma load regulation. When used as a zener diode/resistor combination replacement, the regulator usually results in an effective output impedance improvement of two orders of magnitude, and lower quiescent current. These regulators can provide local on card regulation, eliminating the distribution problems associated with single point regulation.

With adequate heat sinking the regulator can deliver 100ma output current. Current limiting is included to limit the peak output current to a safe value. Safe area protection for the output transistor is provided to limit internal power dissipation. If internal power dissipation becomes too high for the heat sinking provided, the thermal shutdown circuit takes over, preventing the IC from overheating.

75492

120-3102-00



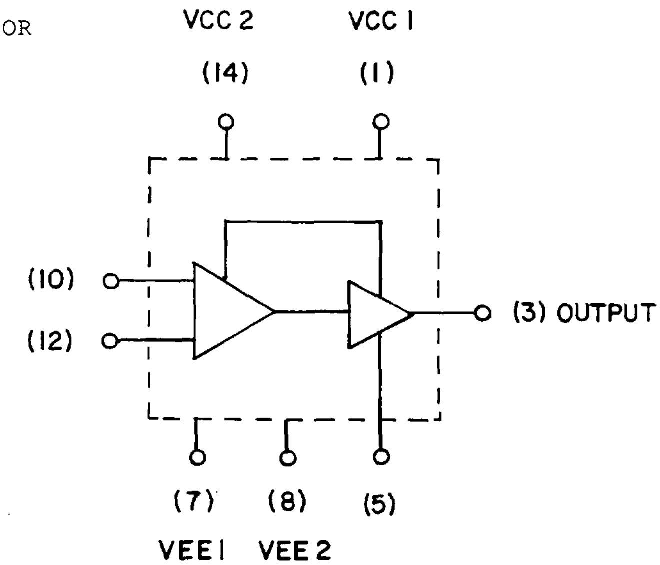
TOP VIEW

HEX DIGIT DRIVER

MC1648

120-4004-00

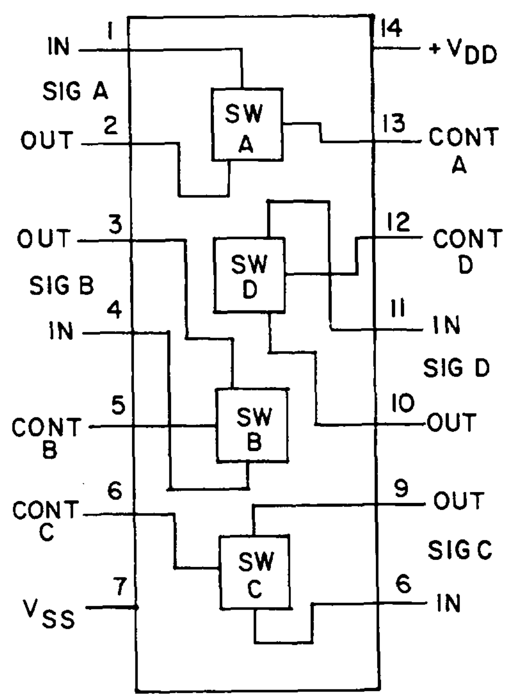
EMITTER COUPLED OSCILLATOR



SCL4016

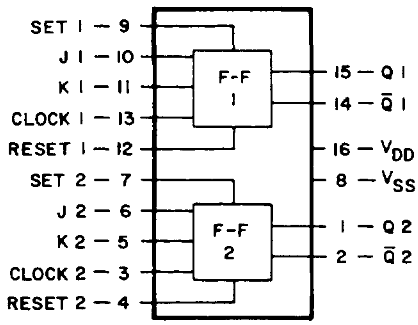
120-6012-01

QUAD ANALOG SWITCH/QUAD MULTIPLEXER



SCL4027ACT

120-6017-01



PRESENT STATE					CL▲	NEXT STATE		
INPUTS				OUTPUT		OUTPUTS		
J	K	S	R	Q		Q	$\overline{Q}$	
1	X	0	0	0	↑	1	0	
X	0	0	0	1	↑	1	0	
0	X	0	0	0	↑	0	1	
X	1	0	0	1	↑	0	1	
X	X	0	0	X	↓			← NO CHANGE
X	X	1	0	X	X	1	0	
X	X	0	1	X	X	0	1	
X	X	1	1	X	X	1	1	

WHERE 1 = HIGH LEVEL
0 = LOW LEVEL
▲ - LEVEL CHANGE
X - DON'T CARE

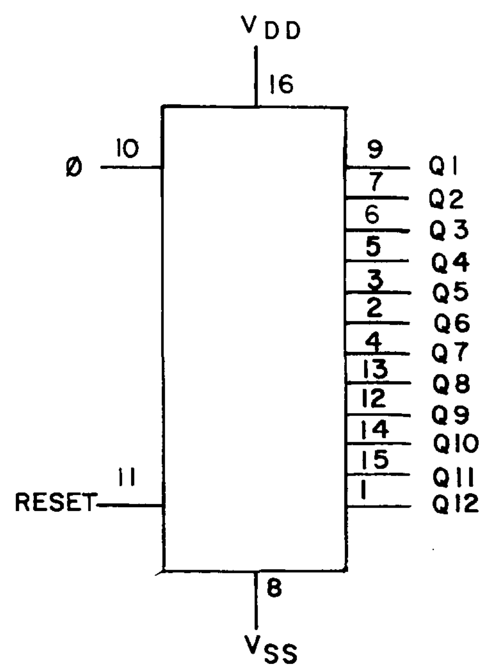
SCL4027A is a single monolithic chip integrated circuit containing two identical complemenatry-symmetry "J-K" master-slave flip-flops. Each flip-flop has provisions for individual "J", "K", "Set", "Reset", and "Clock" input signals. Buffered "Q" and "$\overline{Q}$" signals are provided as outputs. This input-output arrangement provides for compatible operation with the SCL4013A dual "D" type flip-flop.

4040

120-6028-00/01

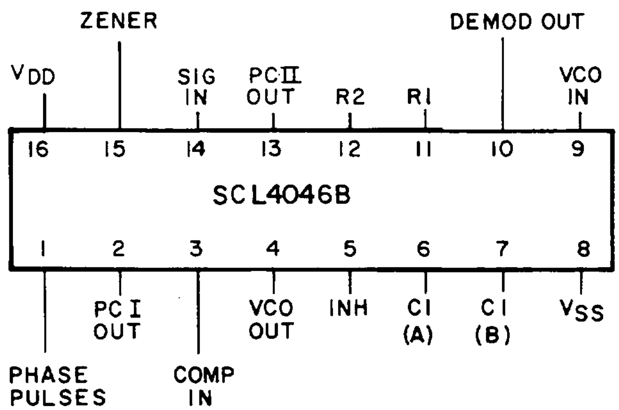
12-BIT BINARY COUNTER

This 12-stage counter is constructed with MOS P-channel and N-channel enhancement mode devices in a single monolithic structure. This part is designed with an input wave shaping circuit and 12 stages of ripple-carry binary counter. The device advances the count on the negative-going edge of the clock pulse. Applications include time delay circuits, counter controls, and frequency-driving circuits.



SCL4046

120-6038-01



PHASE-LOCKED LOOP

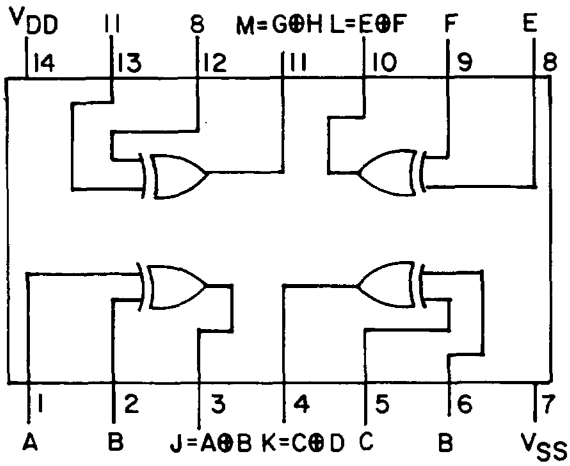
DESCRIPTION:

This phase locked loop contains two phase comparators, a voltage-controlled oscillator (VCO), source follower, and zener diode. The comparators have two common signal inputs, PCA_{in} and PCB_{in}. Input PCA_{in} can be used directly coupled to large voltage signals, or indirectly coupled (with a series capacitor) to small voltage signals. The self-bias circuit adjusts small voltage signals in the linear region of the amplifier. Phase comparator 1 (an exclusive OR gate) provides a digital error signal $PC1_{out}$ and maintains 90° phase shift at the center frequency between PCA_{in} and PCB_{in} signals (both at 50° duty cycle). Phase comparator 2 (with leading edge sensing logic) provides digital error signals $PC2_{out}$ and PCP_{out} and maintains a 0° phase shift between PCA_{in} and PCB_{in} signals (duty cycle is immaterial). The linear VCO produces an output signal VCO_{out} whose frequency is determined by the voltage of input VCO_{in} and the capacitor and resistors connected to pins $C1_A$, $C1_B$, R1 and R2. The source-follower output SF_{out} with an external resistor is used where the VCO_{in} signal is needed but no leading can be tolerated. The inhibit input Inh, when high, disables the VCO and source follower to minimize standy power consumption. The zener diode can be used to assist in power supply regulation.

KING

4070

120-6070-00/01



INPUTS		OUTPUTS
A	B	Y
L	L	L
L	H	H
H	L	H
H	H	L

QUAD EXCLUSIVE OR GATE

KING

KR 87 APPENDIX

LSI

120-8025-00

UNIVERSAL FREQUENCY SYNTHESIZER
DESCRIPTION:

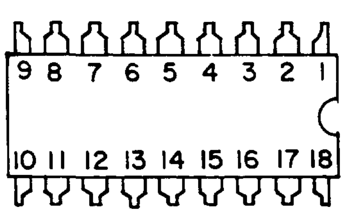
This LSI circuit performs the programmable divide and phase detection function for a phase lock loop frequency synthesizer.

1.3 INPUTS

NAME	DESCRIPTION	PIN #
+V	5 Volts	9
GND	Ground	8
F_1	Prescaler Input	11
F_2	Direct Input to Programmable Divider	12
VJJ	I2L Positive Supply	1
Osc IN	Input to Reference Divider	15
$\overline{\text{CLOCK ENABLE}}$	Clock Enable	6
Serial Data	Programmable Counter and Mode Control Data	7
Serial Data Clock	Clock for Serial Data	5
Serial Data Sync	Load Pulse for Serial Data	10
Test	Used in Testing	18

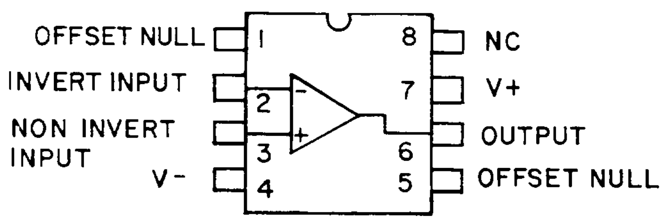
1.4 OUTPUTS

NAME	DESCRIPTION	PIN #
UP	Phase Detector UP Output	3
DN	Phase Detector DOWN Output	2
Data Out	Selectable Output	14
Osc - Out	Buffered OSC-IN	16
ØDet Out	"Osc In" ÷ by 4	17
	Phase Detector Output	4



LM741H

120-3012-03



NOTE:
Pin 4 connected to bottom of package
Top View

OPERATIONAL AMPLIFIER
The LM741 is a general purpose Op Amp which features offset voltage and current nulls, overload protection on the input and output, no latch-up when the common mode range is exceeded and freedom from oscillations.