CTR90 Series Recorders & Reproducers

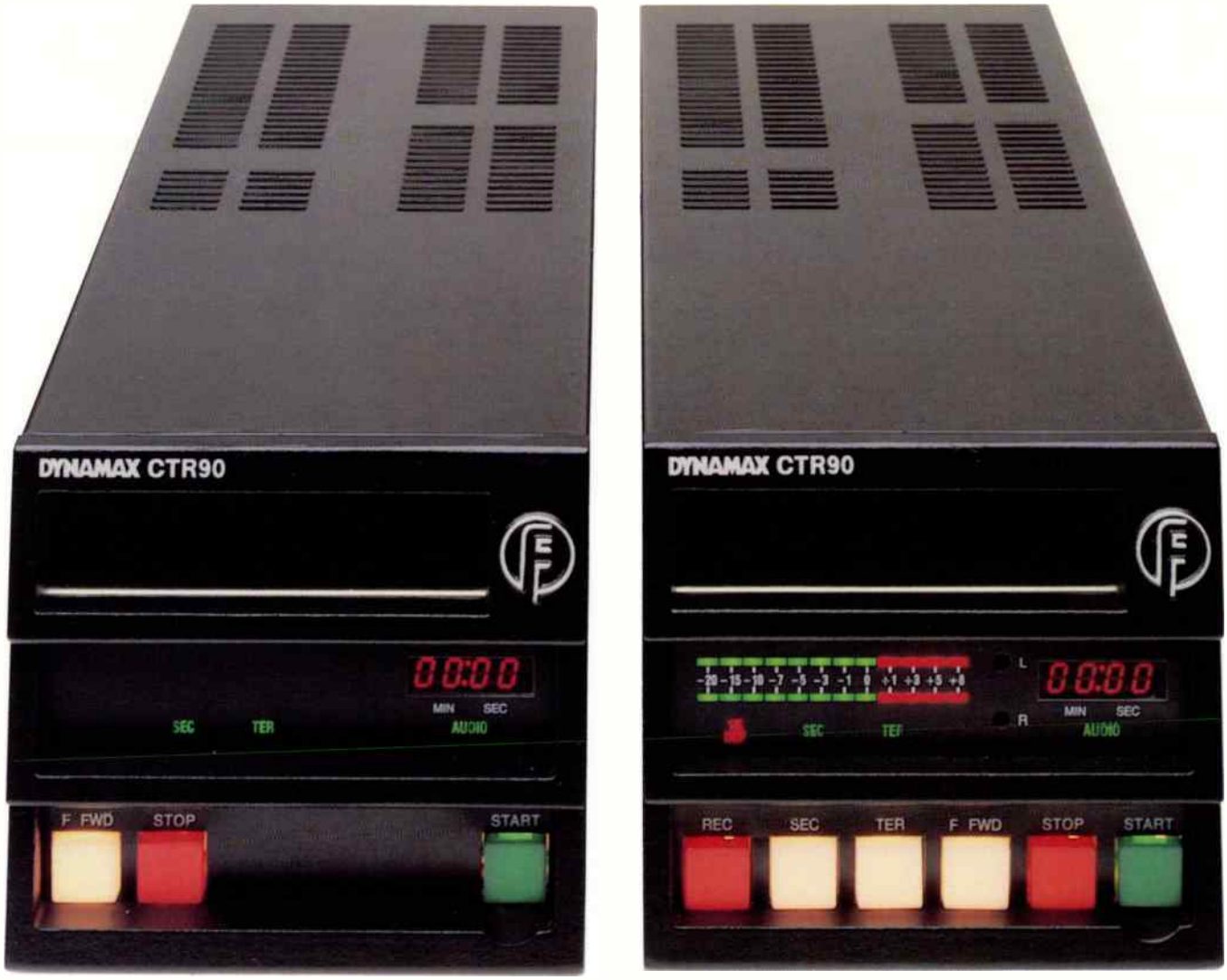
DYNAMAX®

Broadcast Products by Fidelipac

The CTR90 Series

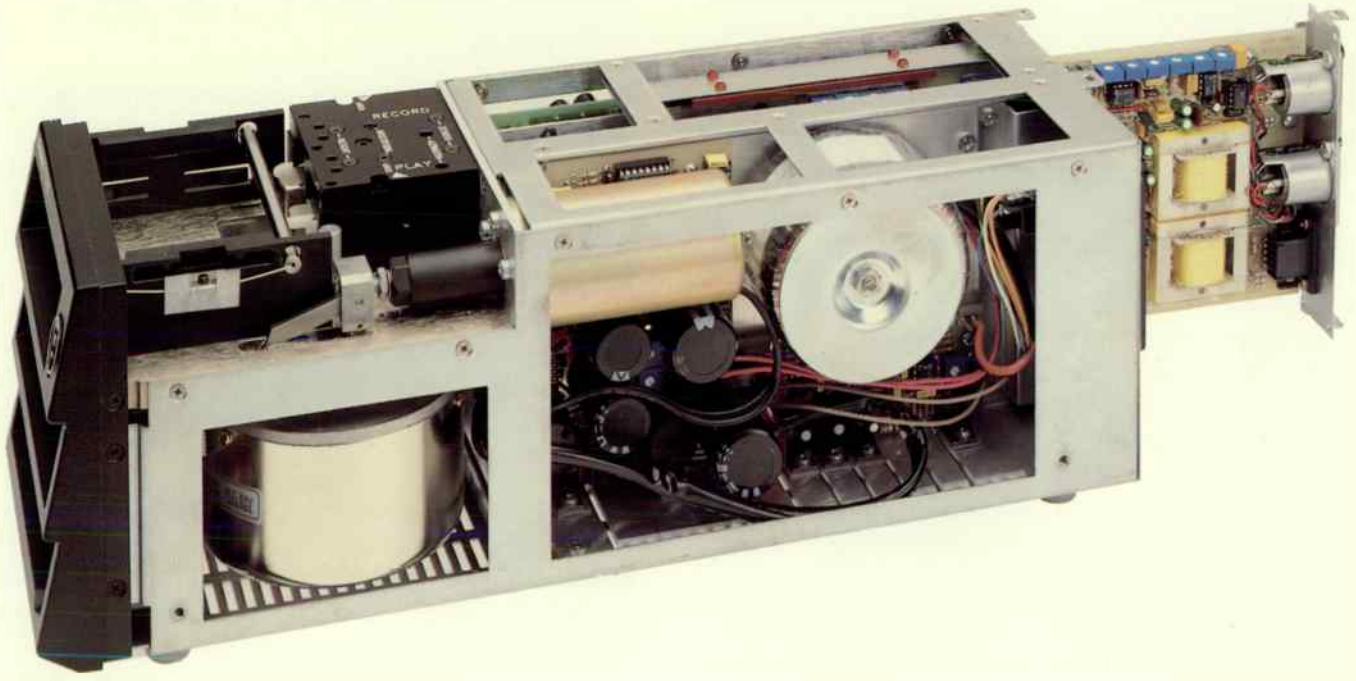
A NEW STANDARD IN CARTRIDGE BASED AUDIO SYSTEMS

The DYNAMAX® CTR90 Series has been designed specifically to compliment the audiophile quality of todays sophisticated digital audio systems. Now, both compact disc based program material and local productions can be reproduced with equal quality, and aired in a traditional, convenient, and inexpensive format.



The CTR90 Series is a totally new design from Dynamax, the world leader in cartridge technology. It outperforms all other Broadcast Audio Cartridge Machines. Audio specifications exceed those of typical broadcast transmission chains as well as the finest commonly available receivers. Incorporating the best of current technology, while retaining proven mechanical and logic configurations, the CTR90 Series surpasses previously accepted audio specifications, and establishes a new standard by which to judge broadcast audio cartridge performance.

Features



- ☐ SUPERIOR AUDIO QUALITY
- ☐ DOLBY HX PRO™ HEADROOM EXTENSION (Recorder Only)
- ☐ DNR® DYNAMIC NOISE REDUCTION
- ☐ 3 CUE TONES
- ☐ FSK COMPATIBILITY
- ☐ FAST FORWARD
- ☐ FAST FORWARD CUE DETECTION
- ☐ EXTENDED SCALE VU/PPM METERING (Recorder Only)
- ☐ ACTIVE BALANCED DIFFERENTIAL INPUTS AND OUTPUTS (Transformers Optionally Available)
- ☐ BALANCED XLR TYPE AND "D" INPUT/OUTPUT CONNECTORS
- ☐ NAB OR IEC EQUALIZATION
- ☐ BRIDGING SELECTABLE OUTPUTS FOR PARALLEL UNIT OPERATION
- ☐ 110/120/220/240 VAC 50/60 HZ MAINS
- ☐ COOL RUNNING - RUGGED CONSTRUCTION
- ☐ DC/PLL CAPSTAN SERVO DRIVE
- ☐ REAL TIME MINUTES & SECONDS TIMER WITH AUTO-FREEZE CAPABILITY
- ☐ HIGH STABILITY NON-INTERACTIVE HEAD BRIDGE
- ☐ CONSTANT CURRENT SOLENOID
- ☐ SELF-ALIGNING LONG LIFE PINCH ROLLER
- ☐ STATUS INDICATORS
- ☐ CLEANING MODE
- ☐ FULL FUNCTION REMOTE INTERCONNECTS
- ☐ ADVANCED PROGRAMMABLE INTERNAL LOGIC NETWORK
- ☐ PC CARDS REMOVABLE FROM REAR OF MACHINE
- ☐ 19" RACK MOUNTABLE - 3 ACROSS
- ☐ 2 YEAR LIMITED WARRANTY

Superior Audio Performance

The CTR90 Series attains new standards, and obsoletes previously acceptable specifications. Input and Output circuitry is balanced, and direct coupling is utilized through all possible internal stages. Dolby HX Pro™ and DNR® Dynamic Noise Reduction are incorporated as standard features on CTR90 Series Recorders, and DNR is incorporated as standard on all Reproducers.

DOLBY HX PRO™

Broadcasters now have access to program and production sources containing far more dynamic range and bandwidth than ever before. Dolby HX Pro permits high quality analog recording of such material.

THE SELF BIAS/SELF ERASURE EFFECT

During the audio magnetic recording process, high frequency program content can cause an effect called "self biasing", sometimes also referred to as self erasure. While this effect has been recognized for years, it was not previously an important factor when recording for broadcast use due to the nature of typical programs sourced from vinyl. Digital audio source material requires more refined techniques.

Magnetic recording tape requires bias to accept magnetization by an analog audio signal. Bias is an ultrasonic signal which is mixed with the audio and serves as a fluxivity source for the tape. This fluxivity initiates movement of the magnetic particles contained on the tape surface, permitting their alignment in accordance with a low level magnetic current generated by the applied audio signal via the recording head.

High frequency audio signals may cause an increased fluxivity effect. These signals can alter the effective bias, as seen by lower frequency audio signals, and cause self erasure of the high frequency signal applied. As music is a complex and constantly changing mixture of low, mid, and high frequency signals, it can be demonstrated that an increase in high frequency program content, such as encountered from a digital audio source, becomes an important factor in cartridge recording quality.

Dolby HX Pro continually analyzes the sum of prealigned bias and audio input signals. It then varies the applied fluxivity so that effective bias is always at optimum.

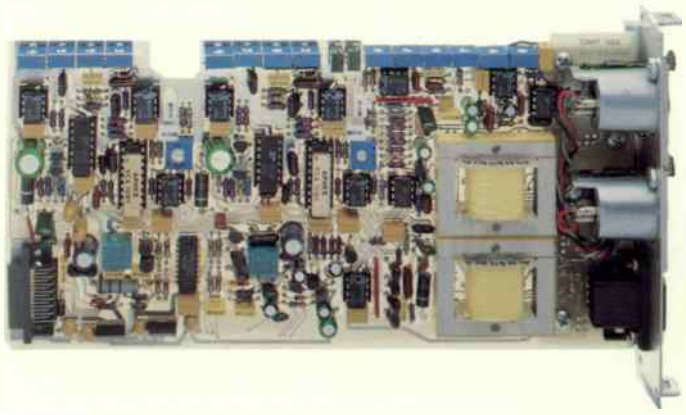
MINIMUM DISTORTION AND HEADROOM EXTENSION

Excessive bias applied to magnetic recording tape decreases its sensitivity. Sensitivity is the amount of signal current required to achieve nominal magnetization of the tape, and directly relates to distortion of the recorded audio signal. When effective bias is at optimum, distortion is at minimum.

Headroom is the difference in levels between nominal signal and the maximum signal which may be recorded before reaching 3% total harmonic distortion (THD). As excessive bias decreases sensitivity, it decreases headroom.

By maintaining optimum effective bias, Dolby HX Pro ensures minimum distortion and maximum headroom. Cartridges have the ability to accurately record all source material, including digital audio and that with high level transient peaks.

As implemented in the CTR90, Dolby HX Pro is completely transparent to the operator. There are no In/Out switches, and no alignments required.



DNR® DYNAMIC NOISE REDUCTION

Existing cartridge libraries, including older selections originally recorded from worn and noisy sources, or those degraded with use, will be enhanced through the use of DNR. It is operator transparent, requires no alignment, is internally selectable, or may be deactivated when using external noise reduction systems.

DNR is non-encoded, usable with all cartridges, and operational only during reproduce. Continuously analyzing audio content, it controls a variable frequency lowpass filter providing increasing amounts of bandwidth reduction during periods of lower signal content. DNR has a virtually instantaneous attack time, and natural decay time, so that there is no audible perception of its action.

Functional Front Panel

EXTENDED SCALE VU/PPM METERING

12 Segment Extended Scale Metering is standard on all CTR90 Series Recorders. Bright LEDs permit easy meter viewing at a distance or angular offset, while the -20 to + 8 dB range provides additional accuracy for monitoring all types of program material. Internal selections permit VU or PPM (Peak) ballistics, and metering sources of Input, Output, Bias, or Cue.

REAL TIME TIMER

The 4 Digit Real Time Minutes and Seconds Timer automatically resets upon cartridge insertion, and may be internally programmed to freeze on primary, secondary, or tertiary cue tone detection. The timer, standard on every CTR90 Recorder and Reproducer, is synchronized to the capstan tachometer and accurately tracks Starts, Stops, and Fast Forward excursions.

Large illuminated switches provide all Recorder and Reproducer operational controls. Bright Status Indicators announce the activation of important functions.

STOP Overrides all controls and stops the machine. Also illuminates as a Ready signal upon cartridge insertion, flashes slowly after any normal Play cycle, and quickly after a manually interrupted Play cycle.

START Initiates the Reproduce process, or Record if selected. The bezel reference detent permits easy control location by experienced operators in a fast paced environment. Internal programming may be selected for Re-Start Inhibit.

REC Preselects the Recording process, which is then initiated by the START switch, and causes insertion of a 1 KHz Primary Cue Tone.

1K DEF Defeats the Primary Cue Tone, and may be activated by a double-push of the REC switch.

SEC and TER Initiate the recording of Secondary and Tertiary Cue Tones, while SEC and TER indicate their detection.

F FWD Initiates Fast Forward mode, which may also be internally selected to activate upon secondary or tertiary cue tone detection.

AUDIO Indicates that the Audio Outputs are unmuted, verifying that the machine is running on speed, or has been commanded to unmute during wind by pushing the FAST FORWARD switch. Mute may be internally selected to occur upon secondary or tertiary cue tone detection.

Cleaning Mode is enabled by pushing momentarily with no cartridge inserted, and is disabled via the STOP switch. START

Rugged Construction

The CTR90 Series has been designed to provide years of reliable operation, and to withstand the abuse so often encountered in a fast paced broadcast environment. Premium quality components assure dependable and quality performance, backed by the Dynamax 2 year limited warranty. Each unit undergoes thorough and comprehensive factory testing and alignment, and is delivered with a complete test printout for performance verification.

PRECISION DRIVE SYSTEM

A high torque DC Capstan Motor, regulated by sophisticated Phase Locked Loop (PLL) control circuitry and a precision resolution tachometer, guarantees accurate speed. The large diameter constant current Solenoid provides cool operation, and stable pressure on the long life composition, self aligning, Pinch Roller.

ADVANCED PROGRAMMABLE LOGIC

A sophisticated and non-volatile Programmable Logic Array (PAL) is the heart of the CTR90 Series Logic System. Numerous logic options and configuration designations are internally user selectable via easily reset switches and jumpers.

INPUT and OUTPUT CONNECTIONS

Audio Inputs and Outputs are accessible via both XLR type and 9 pin "D" connectors to facilitate ease of installation in all environments. Remote commands and tallies, and Frequency Shift Keying (FSK) Data Interfacing are accessed via a 50 pin "D" connector at the rear of the machine.

SERVICEABILITY

Record, Reproduce, and Logic PC Boards are easily removable from the rear of the machine. Internal cleaning may be performed while the unit is rack mounted, as may Level and Equalization alignments, when utilizing the optional TE-90 Test Extender Board.

MECHANICAL INTEGRITY

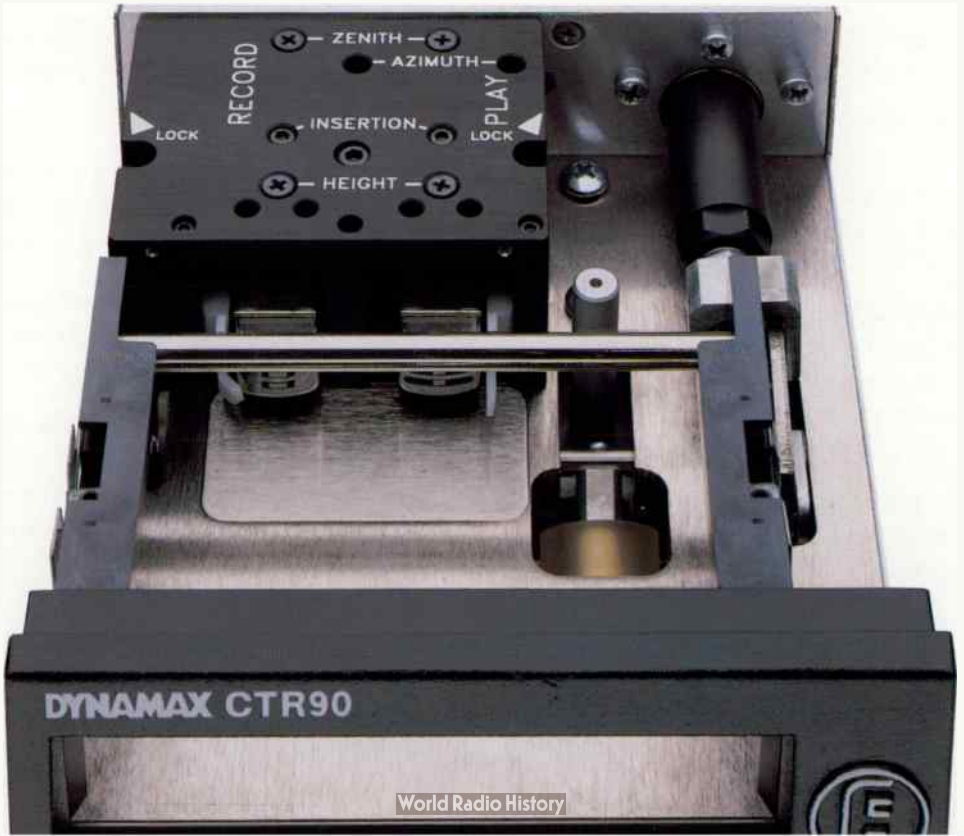
All cartridge and tape guidance elements are referenced to a thick and hardened nickel plated aluminum deck plate. Smooth self aligning lateral guides and heavy duty rails ensure that an inserted cartridge is forced into its optimum operational position firmly against precision reference surfaces. Tape guides and head mountings are extremely stable, with non-interactive adjustments for height, azimuth, zenith, and penetration into the cartridge.

ROBUST POWERING

The cool running and well filtered DC Power Supply is toroidal transformer based, providing clean and stable audio power. Maximum shielding of heads and low level circuitry prevents the spurious detection of stray RF signals. Mains voltage selection is easily accomplished via a rear mounted voltage selector/fuseholder with twin fusing. Earthing and high voltage wiring comply with applicable European and Asian standards.

INPUT/OUTPUT TRANSFORMER OPTION

To facilitate installation in adverse or remote environments, easily installed Input and Output Transformers are optionally available.



Performance Specifications

RECORD/REPRODUCE ELECTRONICS

Inputs	Active Balanced & Differential Transformers Optional
Input Impedance	≥10 K Ω
Maximum Input Level	+20 dBm Adjustable off to +20 dBm
Outputs	Active Balanced & Differential Transformers Optional
Output Impedance	≤60 Ω
Bridging Output Impedance	≤600 Ω
Maximum Output Level (Ref. 600Ω Load)	+ 20 dBm Adjustable -20 dBm to +20 dBm
Equalization	NAB or IEC
Dolby HX Pro™ Headroom Extension	(Recorder Only)
DNR®	Internally Selectable
Frequency Response	40 Hz - 16 kHz ± 1.5 dB
Signal to Noise Ratio "A" Weighted	
With DNR®	≥81 dB
Without DNR®	≥70 dB
Depth of Mute	≥90 dB
System Distortion	
(Total output distortion may be greater, and is dependent on the quality of the cartridge and tape utilized.)	
Record/Reproduce	≤0.8% THD at 1 kHz
Reproduce	≤0.5% THD at 1 kHz
Crosstalk between audio tracks at 1kHz	≥50 dB
Crosstalk, Cue to audio tracks at 1 kHz	≥50 dB
Bias Frequency	144 kHz
Cue Tones	
Primary	1 kHz
Secondary	150 Hz 200 Hz Optional
Tertiary	8 kHz
Input Provided for FSK and Cue Bias Enable	
Metering (Recorder Only)	
LED, 12 Segment, -20 to +8 dB Scale, VU or PPM Selectable	

TAPE TRANSPORT

Cartridge Type Accepted	NAB Type A or AA
Tape Speed	
Play or Record	7½ ips (19 cms) 3¾ & 15 ips (9.5 & 38 cms) Internally Selectable
Fast Forward	22½ ips (57 cms)
Tape Speed Accuracy	
Play or Record	≤0.2%
Head Configuration	NAB Optional MAXTRAX®
Start Time	≤100 msec.
Stop Time	≤80 msec.
Capstan Motor	
DC Phase Locked Loop (PLL) Drive Internally Selectable for Command Run or Continuous Run	
Wow & Flutter (Ref. DIN 45507 @ 7½ ips)	0.12% max.

PHYSICAL

Power Requirements	
110/120/220/240 VAC ± 10%	50/60 Hz 60 VA max.
Ambient Environment	10° to 50° C 50° to 122° F
Mounting	Tabletop or Optional 19" Rack
Dimensions	5.50 H X 5.48 W X 16.34 L inches 14.0 H X 13.9 W X 41.5 L cm.
Weight	
CTR91	21½ lb. (9.8 kg.)
CTR92	21½ lb. (9.8 kg.)
CTR92MX	21½ lb. (9.8 kg.)
CTR93	22¼ lb. (10.2 kg.)
CTR94	22¼ lb. (10.2 kg.)
CTR94MX	22¼ lb. (10.2 kg.)

SPECIFICATIONS ARE SUBJECT TO CHANGE WITHOUT PRIOR NOTIFICATION

All specifications taken on typical Stereo units with NAB equalization and referenced to 250 nWB/m. Other models may vary slightly.

Dynamax cartridge products are manufactured by Fidelipac Corporation, the world leader in cartridge systems and technology, and the standard against which others are judged.

No manufacturer is better qualified to develop an improved machine. Fidelipac invented the endless loop tape cartridge around which the original NAB Broadcast Audio Cartridge Standards were written. A major supplier of cartridges to the broadcast industry, the company received its first patent in 1956, and is the only manufacturer to maintain a complete tape manufacturing facility dedicated exclusively to the needs of the broadcast industry. Features originally introduced on Dynamax cartridge machines are now defacto industry standards, and Dynamax is the established market leader.

Fidelipac provides a full range of cartridge based products; Recorders, Reproducers, Eraser/Splice Finders, Cartridges, Magnetic Recording Tape, Splicing Tape, Bulk Erasers, Alignment Tapes and Gauges, and Cartridge Storage Systems.

DYNAMAX
BROADCAST PRODUCTS BY FIDELIPAC®

Fidelipac Corporation ☐ P.O. Box 808 ☐ Moorestown, NJ 08057 USA ☐ Tel: 609-235-3900 ☐ Fax: 609-235-7779 ☐ Tlx: 710-897-0254

CTR90/990/50K PRINTED IN THE USA

DYNAMAX
CTR90 SERIES

Technical Operation and Service Manual
Part # 730-A0-400

The CTR90 Series of Audio Cartridge Recorders and Reproducers are manufactured by:

Fidelipac Corporation
PO Box 808
97 Foster Road
Moorestown, NJ 08057 USA

Tel: (609) 235-3900
Fax: (609) 235-7779
Tlx: 710-897-0254

The following statements apply to circuitry or format options utilized in some or all CTR90 Series units.

TABLE OF CONTENTS

LIST OF TABLES AND ILLUSTRATIONS

LIST OF FIGURES

LIST OF DRAWINGS AND SCHEMATICS

FIDELIPAC®
BROADCAST TAPE PRODUCTS
Fidelipac Corporation
P.O. Box 808 • Moorestown, NJ 08057 • USA
609-235-3900 TELEX: 710-897-0254
FAX: 609-235-7779

ENGINEERING CHANGE NOTICE

DATE: September 24 1991

SUBJECT: CTR90 Record Boards, part numbers 807-A0-404 through 807-C0-404.

SYMPTOM:

Occasional distorted audio recorded during the first second of recording.

Resolution:

1. On solder side of PCB cut traces to right ends of R4 and R71

2. Solder 26 or 30 gauge wire from disconnected end of R4 to U9 pin 12.

3. Solder 26 or 30 gauge wire from disconnected end of R71 to U10 pin 12.

Sheet two of this ECN will aid in locating the correct locations for these modifications, while sheet three shows these changes schematically.

SECTION I GENERAL INFORMATION

1.1 INTRODUCTION

This Service Manual contains complete information required for the installation, operation, and maintenance of the DYNAMAX CTR90 Series Broadcast Audio Cartridge Recorders and Reproducers.

All information provided is current at time of printing, however product updates and improvements are made periodically. Such changes may not be reflected in the text of this Service Manual, but may be reflected in the Errata & Addenda section. Further information is available from any Dynamax Dealer, or from Fidelipac Corporation.

1.2 CTR90 SERIES DESCRIPTION

The CTR90 Series Broadcast Audio Cartridge Recorders and Reproducers have been designed to compliment modern audio broadcast operations, to provide quality audio performance, ease of operation, minimum and simple maintenance, and years of reliable service.

1.2.1 MODELS AVAILABLE

Several models of the CTR90 Series are available.

MODEL	FUNCTION
CTR91	Mono Reproducer
CTR92	Stereo Reproducer
CTR92MX	Stereo Reproducer Maxtrax® Format
CTR93	Mono Recorder
CTR94	Stereo Recorder
CTR94MX	Stereo Recorder Maxtrax ® Format

The Maxtrax head format does not adhere to published NAB standards. Cartridges recorded using Maxtrax head format are incompatible with cartridges recorded in the more commonly used standard NAB head format.

1.2.2 FEATURES

3 CUE TONES

FSK COMPATIBILITY

FAST FORWARD

FAST FORWARD CUE DETECTION

DOLBY HX PRO™ HEADROOM EXTENSION

DNR® DYNAMIC NOISE REDUCTION

PROGRAMMABLE LOGIC NETWORK

STATUS INDICATORS

BALANCED XLR AND "D" TYPE INPUT/OUTPUT CONNECTORS

REAL TIME MINUTES & SECONDS TIMER WITH AUTO-FREEZE CAPABILITY

BRIDGING SELECTABLE OUTPUTS FOR PARALLEL UNIT OPERATION

CLEANING MODE

REMOTE INTERCONNECTS

EXTENDED SCALE VU/PPM METERING (Recorder Only)

HIGH STABILITY, INDEPENDENTLY ADJUSTABLE HEAD BRIDGE

DC/PLL CAPSTAN SERVO DRIVE

OPTIONAL THIRD TAPE GUIDE

OPTIONAL AUDIO INPUT/OUTPUT TRANSFORMERS

1.2.2.1 DOLBY * HX PRO ™ HEADROOM EXTENSION [Recorder Only]

With the advent of the Compact Disc, broadcasters have access to program source material with increased bandwidth and improved dynamic range. The CTR90, with Dolby HX Pro ™, has been developed specifically to offer a more advanced cartridge re cording process, for both the accurate reproduction of Compact Discs, and spot production of equal quality.

The Self Bias / Self Erasure Effect

During the audio magnetic recording process, higher frequency program content can cause an effect called "self biasing", sometimes referred to as "self erasure".

To accept magnetization by an audio signal, magnetic recording tape requires bias. Bias is an ultrasonic signal which is mixed with the audio and serves as a fluxivity source for the tape. This fluxivity puts the magnetic particles contained on the tape surface in motion, permitting them to be easily aligned in accordance with a low level magnetic field generated by the applied audio signal through the recording head. The amount of bias required is a function of the recording tapes chemical and physical composition, and is specified by each tape manufacturer [See Standard vs. Operating Levels, Section 3.2.2]. Any deviation from those specifications results in a degradation of recorded audio quality.

High frequency audio signals also provide a bias, or increased fluxivity, effect. These signals may alter the effective bias, as seen by lower frequency audio signals, and can even cause self erasure of the high frequency signal applied. As music is a complex and ever changing mixture of low, mid, and high frequency signals, it can be seen that an increase in high frequency content becomes an important factor in magnetic recording quality.

Dolby HX Pro ™ continually analyzes the sum of prealigned bias and audio input signals. It then varies the applied fluxivity so that effective bias is always at optimum.

Minimum Distortion and Headroom Extension

Excessive bias applied to magnetic recording tape decreases its sensitivity. Sensitivity is the amount of signal current required to achieve nominal magnetization of the tape, and directly relates to distortion of the recorded audio signal. When effective bias is at optimum, distortion is at minimum.

Headroom is the difference in levels between nominal signal and the maximum signal which may be recorded before reaching 3% total harmonic distortion (THD). As excessive bias decreases sensitivity, it decreases headroom.

By maintaining optimum effective bias, Dolby HX Pro ™ ensures minimum distortion and maximum headroom. Cartridges have the ability to accurately record all source material, including high level transient peaks.

As implemented in the CTR90, Dolby HX Pro ™ is completely transparent to the operator. There are no In/Out switches, and no alignments required. It is resident at all times and improves quality of recorded audio.

* HX Pro headroom extension originated by Bang & Olufsen and manufactured under license from Dolby Laboratories Licensing Corporation.

"DOLBY", the double-D symbol, and "HX Pro" are trademarks of Dolby Laboratories Licensing Corporation.

1.2.2.2 DNR® DYNAMIC NOISE REDUCTION *

Existing cartridge libraries often include older cartridges that may have been originally recorded from worn and noisy sources, or whose recorded quality may have degraded with use and age. For this purpose a noise reduction system is desirable.

DNR ® is a noise reduction system requiring no encoding during the original recording process. It continuously analyzes the audio content and controls the high frequency cutoff of a variable lowpass filter in the audio signal path. While noise is naturally masked during periods of high signal content, DNR ® activates to provide continuously variable amounts of bandwidth reduction during periods of lower signal content, thereby minimizing the apparent noise. Unlike many companding systems, DNR ® has a virtually instantaneous attack time and natural decay time, so that there is no audible perception of its action.

It is suggested that DNR ® not be utilized when using external noise reduction units. DNR ® may be bypassed for such applications.

When the frequency response is tested with DNR ® active, a steady frequency test tone will not provide a true reading of the DNR ® circuit's frequency response. The DNR ® circuit's control path must be bypassed to properly check the frequency response with a steady frequency test tone.

The CTR90 includes DNR ® Dynamic Noise Reduction which, during use, is operator transparent. [See section 2.3.4.3]

* DNR ® is a registered trademark of National Semiconductor Corporation.

1.2.3 CONSTRUCTION

The CTR90 Series utilizes modular construction techniques to facilitate ease of maintenance. Logic, Record, and Reproduce Boards mate with a Interconnect Board, and are easily removable from the rear of the machine. Where possible, integrated circuits and other components utilized are common types and values readily available in most urban areas.

1.2.4 CARTRIDGE TECHNOLOGY OVERVIEW

The use of Broadcast Audio Endless Loop Cartridges has simplified audio broadcast operations since 1956. Originally conceived as a method of frequently airing various material without causing undue wear and damage to vinyl records, it has since also evolved into the recording media of choice for music, commercial spots, station identifiers, public service announcements, special effects, etc. Today, it is the most frequently used tool to easily facilitate broadcast programming, including choice of material and the order of occurrence.

The modern Broadcast Audio Endless Loop Cartridge, when used with a contemporary and properly maintained Recorder and Reproducer, provides audio quality rivaling that available from any commonly used music source, including Compact Disc and other digital audio equipment.

Users should be cautioned that there are several types of broadcast audio cartridges presently available. To maintain maximum audio quality, the intermixing of differing cartridge shell designs, or those loaded with dissimilar tape types requiring differing optimum bias or operating levels, is <u>not</u> recommended.

Various cartridge shell designs do not typically yield compatible azimuth tracking. Intermixing of various shell designs may cause dramatic differences in azimuth, detected on air as phase errors between stereo channels.

The recording of cartridges requiring bias levels other than what the recording machine has been optimized to, will cause an increase in audio distortion, and a perceptible degradation in both frequency response and signal to noise ratio.

The intermixing during the recording and/or reproduction processes of cartridges utilizing various operating levels may cause perceptible distortion, frequency response, and signal to noise ratio variations, as well as differing average output levels.

Contemporary cartridge recorders and reproducers, such as the CTR90 Series, provide a number of features to simplify normal broadcast operations. Among these are remote interconnects to permit start/stop of the cartridge machine from a broadcast console fader or from a remote control of several types, various indicators to inform the operator of machine status, and selectable logic functions. Cue tones are utilized to permit automatic location to the beginning of a recorded selection, to switch to another audio source, or to initiate fast forward/recue, mute, or stop the cartridge. The Cue Tone Audio Track may also be used for FSK (Frequency Shift Keying) recording, permitting data output identifying the cartridge in use.

Like all professional electronic equipment, cartridge recorders and reproducers require scheduled cleaning and alignment. Due to the nature of the back lubricated tape utilized in broadcast audio cartridges, cleaning of the heads, pinch roller, and capstan shaft is required on a frequent basis to ensure proper tape to head contact, speed stability, and maximum audio quality. Periodic alignment of the heads, pinch roller, and audio electronics is recommended using the alignment cartridges and accessories available from Fidelipac Corp.

1.2.5 SPECIFICATIONS

TAPE TRANSPORT

Cartridge Accepted.....NAB Type A or AA
Tape Speed
Play or Record..... 7½ ips (19 cms)
..... 3¾ & 15 ips (9.5 & 38 cms) Internally Selectable
Fast Forward..... 22½ ips (57 cms)
Tape Speed Accuracy
Play or Record..... ± 0.2 %
Head Configuration [FACTORY SET]..... NAB Standard
.....MAXTRAX ® Optional SEE SECTION 1.2.1
Start Time..... ≤ 100 msec.
Stop Time..... ≤ 80 msec.
Capstan Motor..... DC Phase Locked Loop [PLL] Drive
..... Internally Selectable for Command Run or Continuous Run
Wow & Flutter [REF. DIN 45507].....0.12% max. at 7½ ips

RECORD/REPRODUCE ELECTRONICS

Inputs..... Active Balanced & Differential
.....Transformers Optional
Input Impedance.....≥10 KΩ
Maximum Input Level.....+20 dBm
Adjustable.....-20 dBm to +20 dBm
Outputs.....Active Balanced & Differential
.....Transformers Optional
Output Impedance.....≤60 Ω
Bridging Output Impedance..... ≤600 Ω
Maximum Output Level [REF. 600Ω Load].....+20 dBm
Adjustable.....-20 dBm to +20 dBm
Equalization..... NAB
.....IEC optional
Dolby HX Pro™ Headroom Extension.....[RECORDER ONLY]
DNR®..... Internally Selectable
Frequency Response.....40 Hz – 16 kHz ±1½ dB
Signal to Noise Ratio "A" WEIGHTED, BALANCED OUTPUTS [REF. 250 nWb/m]
With DNR®..... ≥81 dB
Without DNR®..... ≥70 dB
Depth of Mute..... ≥90 dB
System Distortion [REF. 250 nWb/m. Total output distortion may be greater, and is dependent on the quality of the cartridge utilized.]
Record/Reproduce..... ≤0.8 % THD at 1 kHz
Reproduce.....≤0.5 % THD at 1 kHz
Crosstalk between audio tracks at 1 kHz..... ≥50 dB
Crosstalk, Cue to audio tracks at 1 kHz..... ≥50 dB
Bias Frequency.....144 kHz
Cue Tones
Primary..... 1 kHz
Secondary.....150 Hz
.....200 Hz Optional
Tertiary..... 8 kHz
Input Provided for FSK and Cue Bias Enable
Metering [RECORDER ONLY]..... LED, Expanded Scale VU or PPM Selectable

SPECIFICATIONS ARE SUBJECT TO CHANGE WITHOUT PRIOR NOTIFICATION

All specifications taken on typical Stereo NAB units. Other units may vary slightly.

PHYSICAL

Power Requirements.....110/120/220/240 VAC 50/60 Hz (+/- 10%)
..... 60 VA max.
Ambient Environment..... 10°-50° C
..... 50°-122° F
Mounting..... Tabletop or Optional 19" Rack
Dimensions..... 5.50 H X 5.48 W X 16.34 L inches
..... 14.0 H X 13.9 W X 41.5 L cm.
Weight
CTR91..... 21½ lb. (9.8 kg.)
CTR92..... 21½ lb. (9.8 kg.)
CTR92MX..... 21½ lb. (9.8 kg.)
CTR93..... 22¼ lb. (10.2 kg.)
CTR94..... 22¼ lb. (10.2 kg.)
CTR94MX..... 22¼ lb. (10.2 kg.)

SPECIFICATIONS ARE SUBJECT TO CHANGE WITHOUT PRIOR NOTIFICATION

DYNAMAX® Product 2 Year Limited Warranty

Fidelipac Corporation warrants its Dynamax® Cartridge Recorder, Reproducer, and Eraser/Splice Finder products to be free of defects in materials and workmanship for a period of 2 years from date of original shipment. This warranty is extended only to the original purchasing user, and excludes wear items such as indicators, fuses, heads, rollers, bearings, etc. Assemblies obtained by Fidelipac from other manufacturers for use in Dynamax products, such as motors, carry a warranty only as stated by the original manufacturer, typically 1 year, and Fidelipac Corporation assumes no other liability. Fidelipac Corporation assumes no liability for damage to product incurred in shipment or handling.

To establish the validity of this warranty, warranty registration cards included with product at time of shipment must be completed and submitted to Fidelipac Corporation at time of receipt by the original purchasing user. Failure to do so may invalidate any or all portions of the warranty.

This warranty is limited to malfunctions or defects discovered in the course of normal and correct usage and/or maintenance of the product. Damages due to abuse, user misalignment, lack of proper maintenance, usage or maintenance outside that prescribed in the Service Manual for the product, mains voltage fluctuations or excursions, exposure to heat or the elements, or act of God, are not covered under this warranty. Modification or alteration of the product by any party other than Fidelipac Corporation causes this warranty to be null and void.

Warranty claims will be honored only through the established procedures of Fidelipac Corporation. Product may be returned only following written notification to Fidelipac Corporation within thirty days of the discovery of a malfunction or defect, and then only by utilizing Fidelipac Corporation's Material Return Authorization system and required approvals. Fidelipac Corporation reserves the right to, at its option, repair, replace, or refund the original purchase price of defective product. Fidelipac Corporation assumes no liability for shipping, handling, insurance, duty, or tariff fees incurred in connection with the support of this warranty.

The full extent of the purchaser rights and remedies are stated above. No other warranties expressed or implied by any third party is binding on Fidelipac Corporation. Fidelipac Corporation assumes no liability for incidental or consequential damages arising from the use, or inability of use, of this product.

FIDELIPAC®
Broadcast Tape Products
Fidelipac Corporation
P.O.Box 808
Moorestown, NJ 08057 U.S.A.
Tel: 609-235-3900
Fax: 609-235-7779
Telex II: 710-897-0254

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SECTION II INSTALLATION

2.1 UNPACKING & INSPECTION

CTR90 Series Audio Cartridge Recorders and Reproducers are shipped in specially constructed packing cartons designed to protect equipment during transit. Upon receipt...

CHECK THE CARTON FOR ANY VISIBLE EXTERNAL DAMAGE

If any damage is visible, immediately notify the freight carrier of the damage, and follow their instructions. The carton and all packing materials should be retained for inspection by the carrier or their insurer.

CAREFULLY UNPACK THE UNIT

CARE SHOULD BE EXERCISED TO AVOID DAMAGE TO THE EXTERNAL FINISH

Each CTR90 Series Audio Cartridge Recorder and Reproducer is supplied with a Mains AC cord, and mating "D" connectors.

It is suggested that the carton and all packing materials be retained for possible future use.

2.2 WARRANTY REGISTRATION

A Warranty Registration Card is included with each CTR90 Series Audio Cartridge Recorder and Reproducer at time of shipment. To protect your rights as stated on the DYNAMAX 2 YEAR LIMITED WARRANTY, this card must be promptly filled out and returned to Fidelipac Corporation. Failure to comply will result in lack of registration of your ownership with Fidelipac Corporation, and may be grounds for refusal of warranty support.

2.3 INSTALLATION PROCEDURE

The following information and instructions should be read in their entirety before attempting the installation of a CTR90 Series Audio Cartridge Recorder or Reproducer. Failure to follow these instructions may result in accidental injury to the installer or operator, and/or damage to the unit. Damage caused by improper installation is not covered under the limited warranty provided with this unit.

Refer to page 15 for the following Installation Procedures. This page serves nicely as a quick reference guide. Should any questions arise, or difficulty be encountered during installation, a professional service staff is available for assistance during normal working hours.

Fidelipac Corporation
PO Box 808
97 Foster Rd.
Moorestown, NJ 08057 USA

Customer Service Department:

Tel: (609) 235-3900
Fax: (609) 235-7779

2.3.1 MAINS VOLTAGE SELECTION

Each CTR90 Series unit is provided with a fuse holder located on the rear of the unit, and multiple mains transformer taps internal to the machine. Selection between the 100 VAC and 200 VAC categories of Mains Voltages is accomplished internally by the wiring of the Mains Transformer. Selection between various Mains Voltages within a category are accomplished internally by the wiring of the Mains Transformer. Mains voltages are selectable for 100, 120, 130, 220, 240, or 250VAC.

Before the application of AC power, the installer must ascertain the mains voltage present at the installation site and, if needed, set both the fuse holder and power transformer tap to the appropriate voltage. Mains AC frequency of 50 or 60 Hz can be ignored. If the mains AC voltage encountered is not an available selection, but is within a ±10% variation of either of two available selections, the voltage selector should be set to the higher of the two.

The Mains Transformer must be set for the correct AC line voltage. If it is necessary to change the Mains Transformer taps to obtain the correct AC line voltage setting, remove the 4 screws retaining the outer cover of the CTR90. Refer to drawing 827-A0-412 and change the Mains Transformer taps for the proper AC line voltage. Remove the fuse holder from the rear panel power module and install the proper value fuses for the AC line voltage selection (see table 2.3.1, Mains Fusing). Locate the number stamped on the fuse holder that matches the AC line voltage category (110 or 220) you are using. Align the stamped voltage and arrow with the power cord socket on the power module and reinstall the fuse holder. Replace the unit's outer cover and 4 retaining screws.

VOLTAGE	VALUE	PART NO
100/120 VAC		
130VAC	1A/250VAC Slo-Blo	MDL 1
220/240 VAC		
250VAC	.5A/250VAC Slo-Blo	MDL .5

TABLE 2.3.1 MAINS FUSING

2.3.2 GROUNDING

GROUNDING MUST COMPLY WITH THE PREVAILING ELECTRICAL CODES AT THE SITE OF INSTALLATION. THE FOLLOWING SHOULD BE FOLLOWED AS A GENERAL RULE, BUT MAY NOT COMPLY WITH ALL CODES IN EFFECT AT ALL LOCALES.
CONSULT A LICENSED ELECTRICIAN FOR THE CODES APPLICABLE TO YOUR AREA.
FAILURE TO COMPLY WITH PROPER GROUNDING CODES MAY RESULT IN ELECTRICAL SHOCK TO THE INSTALLER OR OPERATOR OF THIS UNIT.

Mains AC Grounding is provided to the CTR90 Series by two methods, both of which should be utilized to ensure fail safe ground.

The third pin, Neutral, of the mains connector is internally connected to chassis ground. This corresponds with the wiring of standard AC mains power receptacles, where the third pin, Neutral, should be tied to the mains AC ground.

All CTR90 Series units include a binding post at the rear of the machine which is attached to chassis ground. A heavy gauge [minimum 18 Ga.] wire of minimum length should be firmly attached to this binding post and to system ground.

2.3.3 AUDIO INPUTS & OUTPUTS

For ease of installation in various environments, Audio Inputs and Outputs are available via both XLR type and 9 pin "D" connectors on the rear of each Record and Reproduce PC board. Input and Output connectors are wired similarly.

Typical audio connections are shown on page 15. Three things that should be emphasized are:

1. Only one termination should be made at the record inputs or play outputs.

2. When the audio connections are made utilizing balanced lines, connect the shield at one (usually console) end only. This allows

many shields to be tied together at a common point, creating a star ground.

3. When making unbalanced connections, one audio lead (normally the -) must be grounded.

2.3.4 AUDIO OUTPUT IMPEDANCE

The CTR90's audio output impedance may be raised from the factory supplied 60 ohms to a nominal 600 ohms by cutting traces at W5, W6, W7, and W8 [refer to page 15 and drawings 750-C0-403 & 807-D0-403].

2.3.5 OPERATIONAL SETUP:

Computer type circuit shunts, or jumpers, are used for easy selection of most of the CTR90's operating modes. Page 15 contains a comprehensive list of user selectable jumpers and their locations. The following is a more detailed description of the various features and their respective jumpers.

2.3.5.1 LOGIC BOARD OPTIONS

AUTO FUNCTION DESCRIPTION AND SELECTION. Jumpers on the Logic Board allow the use of one of the CTR-90's three cue-initiated Auto functions. They are FAST FORWARD, AUTO MUTE, and AUTO FORWARD.

FAST FORWARD functions just as though it were manually selected by pressing the FAST FORWARD switch.

AUTO MUTE freezes the clock and mutes the unit's output upon initiation. Tape continues to travel at play speed until the detection of a primary cue tone or until another mode is manually initiated. Note that when FAST FORWARD is initiated from this mode the clock remains frozen and that audio may not be toggled on and off until after the unit has been stopped. AUTO MUTE may also be initiated during play by a momentary ground at the PLAY MUTE COMMAND pin of the remote connector. AUTO MUTE has no manually operated equivalent.

AUTO FORWARD is similar to AUTO MUTE except that the tape shuttles at high speed until the unit is stopped. This mode may not be initiated from the remote connector. AUTO FORWARD has no manually operated equivalent.

JUMPER DESCRIPTION:

W5 and W6 are used to initiate FAST FORWARD, AUTO MUTE, OR AUTO FORWARD upon cue tone detection. W5 must be in place for FAST FORWARD, or AUTO FORWARD while W6 must be in place for AUTO MUTE or AUTO FORWARD.

AUTO FUNCTION INITIATION:
Only one of the two jumpers W1 or W2 may be installed at the same time. The same applies to jumpers W3 or W4.

Insertion of:

W1 enables secondary cue tones to initiate auto functions.

W2 enables tertiary cue tones to initiate auto functions.

W3 causes Auto Functions to be initiated at the selected cue tone's leading edge.

W4 causes Auto Functions to be initiated at the selected cue tone's trailing edge.

START INHIBIT:
W7 removed inhibits start after the unit has been manually stopped.

W8 removed inhibits start after a primary cue tone has stopped the unit.

MOTOR RUN:
W9 removed causes the CTR-90's motor to run continuously. Removal of W9 allows the motor to rest when a cart is not fully inserted. This is often acceptable because the motor will be locked at 7.5 IPS, it's normal speed, in less than two seconds from the time of cart insertion.

SERVO ERROR MUTE:
W10 inserted allows the MOTOR DRIVER to mute audio output whenever the motor is not in servo lock. This occurs whenever the motor is changing speeds.

MOTOR SPEED:
This rarely changed option is not shunt selectable. To change the motor speed the trace connecting W15 must be cut and only one of three jumpers may be soldered into place. Installing **W14**, **W15**, or **W16** runs the motor at 3.75, & 7.5, or 15 IPS respectability.

2.3.5.2 METER OPTIONS

SOURCE SELECTION:
Logic Board Switch SW1 partially controls which signals are sent to the display panel meters. SW1's forward, or AUDIO, position is intended for normal use. This position selects audio input or output metering depending on the placement of W11 and the unit's current mode of operation. The center, or BIAS, position displays left and right bias on the top and bottom meter respectively. The rear, or CUE, position displays cue bias on the top meter and reproduced cue signal on the bottom meter. When relative bias readings are made a few seconds may be required for the meters to stabilize.

With SW1 in the audio position and W11 in place, the meters display audio input while in RECORD READY mode and audio output at all other times. With W11 removed the meters display audio input during <u>all</u> RECORD modes.

VU / PEAK:
Removing jumpers at W3 and W4 on the display panel changes the meter's ballistics from VU to Peak. Changing meter ballistics generally requires recalibration of meters for correct absolute levels to be displayed. See Meter Alignment SEC 4.4.5.

2.3.5.3 DYNAMIC NOISE REDUCTION (DNR)®

DNR ® may be bypassed entirely by placing jumpers across W1 and W3 on the REPRODUCE BOARD. To place DNR ® in the circuit the jumpers must be installed at W2 and W4. Note that although each pair of jumpers switches only one audio channel, both channels must be in the circuit for DNR ® to operate properly.

2.3.6 REMOTE CONNECTOR

Besides a number of features that are available only from the 50 pin remote connector, all front panel functions except the meters have corresponding remote connector pins. Generally, inputs were designed to interface with relays or open collector type circuits that momentarily switch to ground when active. Indicator outputs are of the same type but are often pulled to approximately +15V by the lamps and indicators that may be internal to the machine. These outputs are capable of sinking greater than 100ma from the remote connector. Other lines are also described below. Page 15 contains a comprehensive list of pin numbers, their uses, and configurations to be used for quick reference. Users should consult the interface information which follows this paragraph before connecting anything to the remote connector.

AUXILIARY CONTROL INPUTS
Auxiliary Command Inputs: These inputs are paralleled with the START, STOP, FAST FORWARD, SECONDARY, TERTIARY, and RECORD front panel switches. Applying a momentary ground longer than 5ms will initiate the corresponding function just as though the front panel button itself were pressed. New commands will not be recognized while START, STOP, FAST FORWARD, or RECORD pins are low. These pins may also be used to indicated that a front panel switch has been pressed since they are pulled from +5V to ground when the corresponding switch is pressed. It is recommended that the front panel switches not be required to sink greater than 100ma from the remote connector.

SENSE OUTPUTS
The first eight SENSE OUTPUTS are START, STOP, FAST FORWARD, SECONDARY, TERTIARY, RECORD, AUDIO ENABLE, and PRIMARY-DEFEAT all have lamps and/or LEDS that are illuminated by these circuits. Consequently these pins are low when their corresponding displays are illuminated, and otherwise are pulled to +15V by their respective displays. Since these displays have differing impedances it is recommended that if an external circuit that is to

interface with one of these pins requires some minimum impedance to V+, that value resistor should be placed in parallel with the display by connecting it from the corresponding pin to the units +15V supply at pin 36. (See Logic +15V). When active, these pins can sink in excess of 100ma each.

READY SENSE OUTPUT is open collector as it has no built in display to pull it high and it is active low when the stop lamp is on steady. This occurs at cartridge insertion, when a stop flash mode has been exited by a second stop command, or when RECORD READY 1K DEFEAT has been canceled by a RECORD command. This pin can also sink in excess of 100ma.

THE CUE TRACK/FSK BIAS ENABLE interface is similar to the Auxiliary Command Inputs. The difference is that it is only an input since it does not have a corresponding switch. Applying ground to this lead turns on cue bias and allows signals at the CUE TRACK/FSK DATA INPUT to be recorded.

CUE TRACK/FSK DATA INPUT
This input pin, in conjunction with the CUE TRACK/FSK BIAS ENABLE (see Auxiliary Control Inputs), allows recording of externally sourced material on the cue track. It is a single ended input to the cue track with an input impedance of 10K ohms. It's nominal FSK input level is -4dBu.

CUE TRACK/FSK DATA OUTPUT
The signal on this output is derived from the cue head after equalization and buffering. It's output impedance is 1k ohm, and it's nominal FSK output level is -10dBu.

CUE RELAY CONTACTS
Both the SECONDARY and TERTIARY cue detect circuits provide a normally open and a normally closed relay contact which switch during that cue tones detection. These contacts use a common center pin and have a maximum current rating of 1 amp.

PLAY MUTE COMMAND
The PLAY MUTE COMMAND pin is a bidirectional signal line which is normally at +15V. As an output this pin provides a 1ms ground each time that units audio is enabled. As an input the pin allows a machines audio to be muted and timer frozen during a play cycle at the application of a similar short ground pulse. A CTR-90 will not recognize further commands while this pin is held low. Often these pins are paralleled with the same pin on a number of other units, forcing all active units to mute each time another is started.

EXTERNAL TIMER CONTROLS
The TIMER RESET pin which is normally at +5V provides a short ground going pulse each time the internal timer is reset. It is often used to reset an external timer. This pin can source or sink only 10mA of current.

The TIMER COUNT pin provides an accurate indication of tape travel at all motor speeds. Normally at ground this pin provides a +5V pulse for every 7.5 inches of tape travel. During PLAY at 7.5 IPS this corresponds to a pulse every second which may be used to drive a timer or other external device. This pin can source or sink only 10mA of current.

LAMP FLASH SYNCHRONIZATION
The LAMP FLASH SYNCHRONIZATION pin is a bidirectional signal line which provides a short ground pulse approximately every 10 seconds, otherwise the pin is pulled to +15V. Ground pulses at this pin, whether generated internally or externally, resets a flash controlling counter within the unit. Paralleling these pins within a group of CTR-90's forces their stop lamps to be synchronized when flashing. Holding this pin low will force the counter to halt with a flashing stop lamp extinguished.

LOGIC +15V OUTPUT
This pin is provided to supply CTR-90 interface circuits. It is rated at greater than 100ma. Care should be taken when using this pin since tying electrically noisy circuits to this line may degrade performance of the unit.

OPTIONAL +5V OUTPUT
Though normally inactive as supplied from Fidelipac, this pin may be internally connected and used to supply CTR-90 interface circuits. Consult Fidelipac for specific details.

LOGIC GROUND
The three ground pins provided on the remote connector are provided to supply CTR-90 interface circuits. Special care should be taken when using these pins since tying electrically noisy circuits to these lines may degrade performance of the unit.

2.4 ACCESSORIES

Fidelipac Corporation also has a full line of accessories available to enhance the alignment, operation, and maintenance of cartridge machines.

CARTRIDGES

DYNAMAX COBALT
AUDIOMAX 4000
MASTERCART
AUDIOMAX 3000
300/350 SERIES CARTRIDGES

19" RACK MOUNTING KITS
Although a Rack Mount is not included with the unit, installation drawings utilizing a RM90 Rack Mount Kit are included, for convenience, on page 16 of this manual.

MAINTENANCE KITS
SEMICONDUCTOR & IC KITS
TEST EXTENDER BOARDS
HEAD ALIGNMENT GAUGES
ALIGNMENT TAPES

ERASER/SPLICE FINDERS
BULK ERASERS

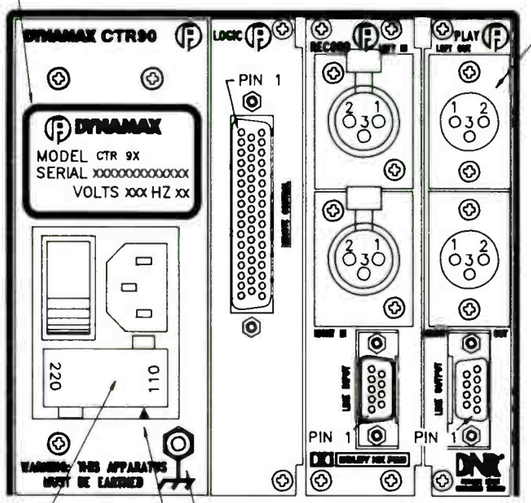
CARTRIDGE STORAGE SYSTEMS

ON-AIR and RECORDING LIGHTS

CONNECTIONS

SERIAL TAG – MAINS VOLTAGE INFORMATION
FOR MAINS VOLTAGE SELECTION SEE SECTION 2.3.1

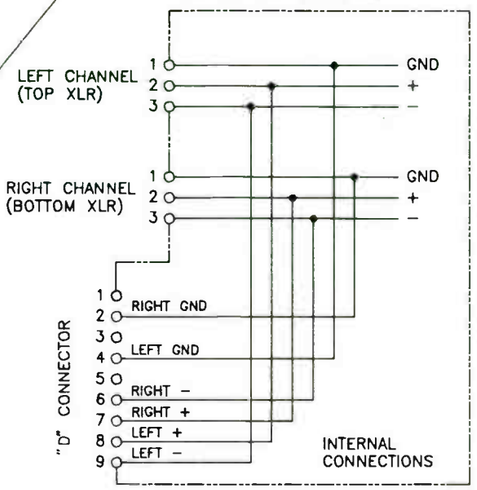
REAR PANEL



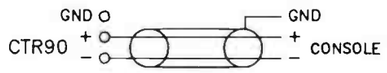
POWER CORD
REMOTE CONTROL
AUDIO INPUTS
AUDIO OUTPUTS
TO EARTH GROUND
INDICATES SELECTED VOLTAGE
PULL OUT FUSE DRAWER/VOLTAGE SELECTOR

SELECTABLE OUTPUT IMPEDANCE
60 OR 600 OHMS
(FOR ACTIVE BALANCED OUTPUTS ONLY)

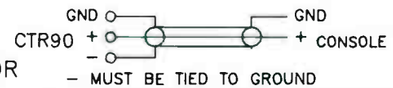
AUDIO CONNECTIONS
INPUT & OUTPUT



BALANCED CONNECTION



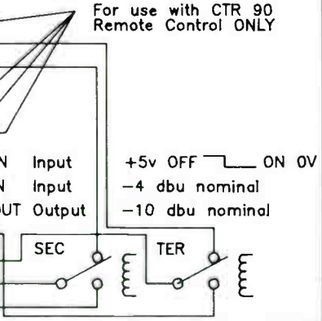
UNBALANCED CONNECTION



REMOTE CONTROL CONNECTOR

PIN	FUNCTION	COMMENT	LOGIC
Pin 1	Timer Reset	Output	+5v ⊓⊔ Active low
Pin 2	Timer Count	Output	+5v ⊔⊓ Active High
Pin 3	Not Used		
Pin 4	LOGIC GROUND	For use with CTR 90 Remote Control ONLY	
Pin 5	LOGIC +15 VDC	For use with CTR 90 Remote Control ONLY	
Pin 6	Not Used		
Pin 7	Not Used		
Pin 8	Not Used		
Pin 9	Not Used		
Pin 10	Not Used		
Pin 11	Not Used		
Pin 12	Not Used		
Pin 13	Not Used		
Pin 14	Not Used		
Pin 15	Not Used		
Pin 16	SEC SENSE	Output	+15v OFF ⊓⊔ ON 0V
Pin 17	TER SENSE	Output	+15v OFF ⊓⊔ ON 0V
Pin 18	SEC COMMAND	Input	+5v OFF ⊓⊔ ON 0V
Pin 19	FAST FWD SENSE	Output	+15v OFF ⊓⊔ ON 0V
Pin 20	FAST FWD COMMAND	Input	+5v OFF ⊓⊔ ON 0V
Pin 21	STOP SENSE	Output	+15v OFF ⊓⊔ ON 0V
Pin 22	STOP COMMAND	Input	+5v OFF ⊓⊔ ON 0V
Pin 23	START SENSE	Output	+15v OFF ⊓⊔ ON 0V
Pin 24	START COMMAND	Input	+5v OFF ⊓⊔ ON 0V
Pin 25	Not Used		

PIN	FUNCTION	COMMENT	LOGIC
Pin 26	Not Used		
Pin 27	Not Used		
Pin 28	FLASH SYNC BUS	Input/Output (Connect to other CTR90 Units)	+15V OFF ⊓⊔ ON 0V 10 sec
Pin 29	Not Used		
Pin 30	Not Used		
Pin 31	OPTIONAL +5V	For use with CTR 90 Remote Control ONLY	
Pin 32	TER RELAY NC	For use with CTR 90 Remote Control ONLY	
Pin 33	SEC RELAY NC	For use with CTR 90 Remote Control ONLY	
Pin 34	LOGIC GROUND	For use with CTR 90 Remote Control ONLY	
Pin 35	LOGIC GROUND	For use with CTR 90 Remote Control ONLY	
Pin 36	LOGIC +5V	For use with CTR 90 Remote Control ONLY	
Pin 37	CUE/FSK BIAS EN	Input	+5v OFF ⊓⊔ ON 0V
Pin 38	CUE/FSK DATA IN	Input	–4 dbu nominal
Pin 39	CUE/FSK DATA OUT	Output	–10 dbu nominal
Pin 40	TER RELAY NO		
Pin 41	TER RELAY C		
Pin 42	SEC RELAY C		
Pin 43	SEC RELAY NO		
Pin 44	READY SENSE	Output	Open Collector ⊔⊓ ON 0V
Pin 45	PLAY MUTE COM.	Input	+5v OFF ⊓⊔ ON 0V
Pin 46	PRI DEFEAT SENSE	Output	+15v OFF ⊓⊔ ON 0V
Pin 47	AUDIO EN SENSE	Output	+15v OFF ⊓⊔ ON 0V
Pin 48	REC SENSE	Output	+15v OFF ⊓⊔ ON 0V
Pin 49	REC COMMAND	Input	+5v OFF ⊓⊔ ON 0V
Pin 50	TER COMMAND	Input	+5v OFF ⊓⊔ ON 0V



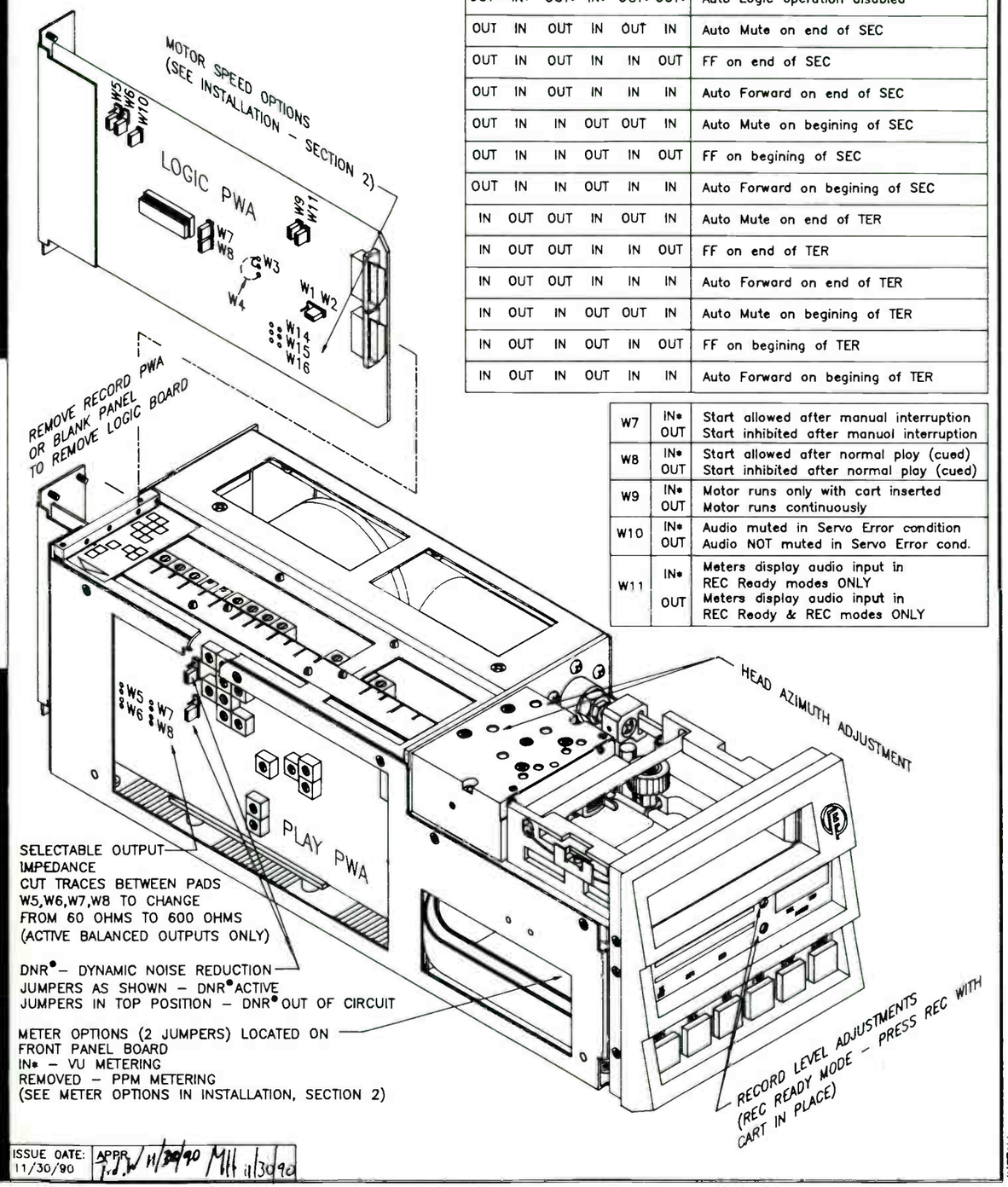
INSTALLATION

INTERNAL PROGRAMMING

PROGRAMMING JUMPERS ARE SHOWN IN STANDARD FACTORY SETTINGS *

W1	W2	W3	W4	W5	W6	FUNCTION
OUT*	IN*	OUT*	IN*	OUT*	OUT*	Auto Logic operation disabled
OUT	IN	OUT	IN	OUT	IN	Auto Mute on end of SEC
OUT	IN	OUT	IN	IN	OUT	FF on end of SEC
OUT	IN	OUT	IN	IN	IN	Auto Forward on end of SEC
OUT	IN	IN	OUT	OUT	IN	Auto Mute on begining of SEC
OUT	IN	IN	OUT	IN	OUT	FF on begining of SEC
OUT	IN	IN	OUT	IN	IN	Auto Forward on begining of SEC
IN	OUT	OUT	IN	OUT	IN	Auto Mute on end of TER
IN	OUT	OUT	IN	IN	OUT	FF on end of TER
IN	OUT	OUT	IN	IN	IN	Auto Forward on end of TER
IN	OUT	IN	OUT	OUT	IN	Auto Mute on begining of TER
IN	OUT	IN	OUT	IN	OUT	FF on begining of TER
IN	OUT	IN	OUT	IN	IN	Auto Forward on begining of TER

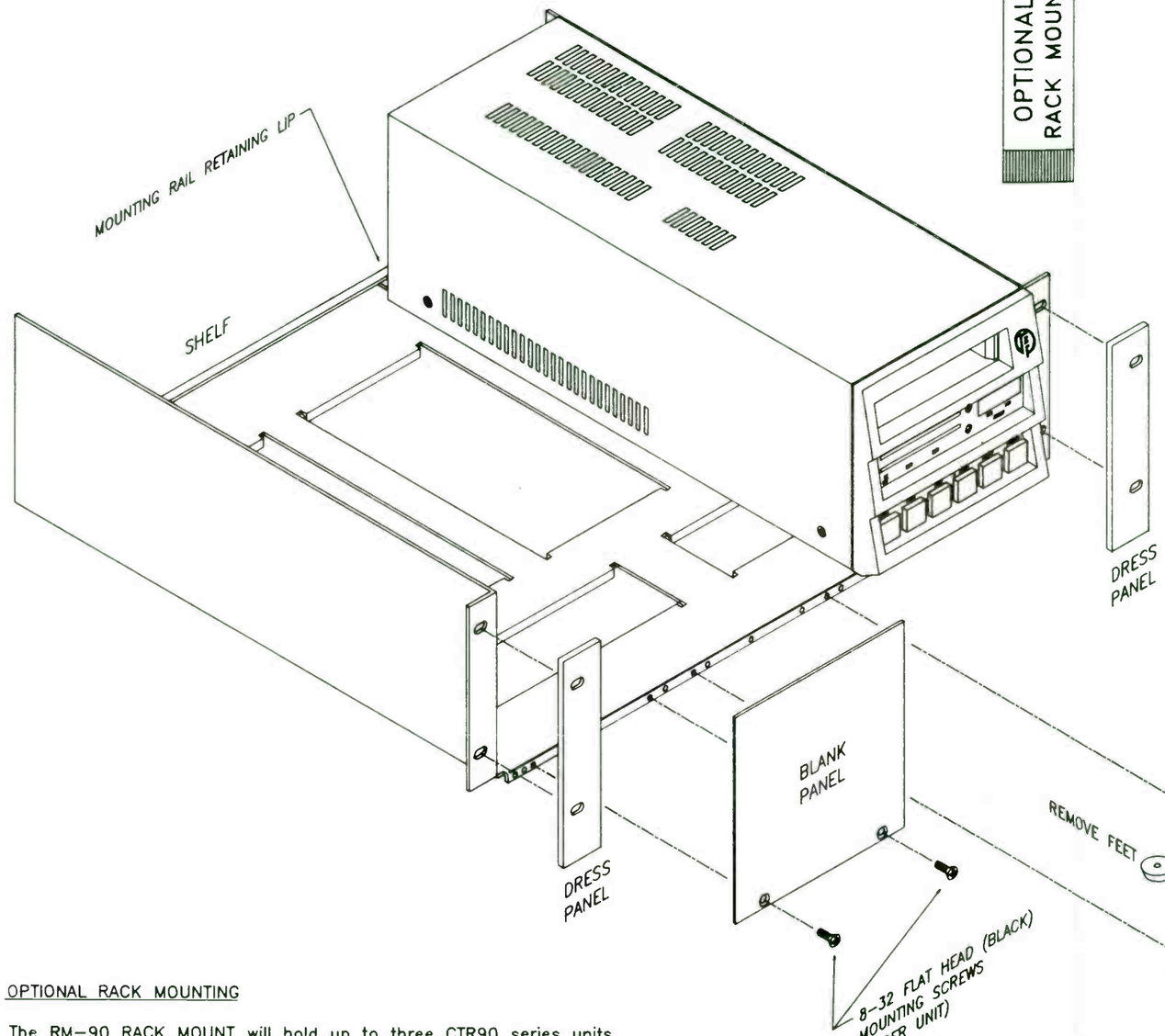
W7	IN*	Start allowed after manual interruption
	OUT	Start inhibited after manuol interruption
W8	IN*	Start allowed after normal ploy (cued)
	OUT	Start inhibited after normal play (cued)
W9	IN*	Motor runs only with cart inserted
	OUT	Motor runs continuously
W10	IN*	Audio muted in Servo Error condition
	OUT	Audio NOT muted in Servo Error cond.
W11	IN*	Meters display audio input in REC Ready modes ONLY
	OUT	Meters display audio input in REC Ready & REC modes ONLY

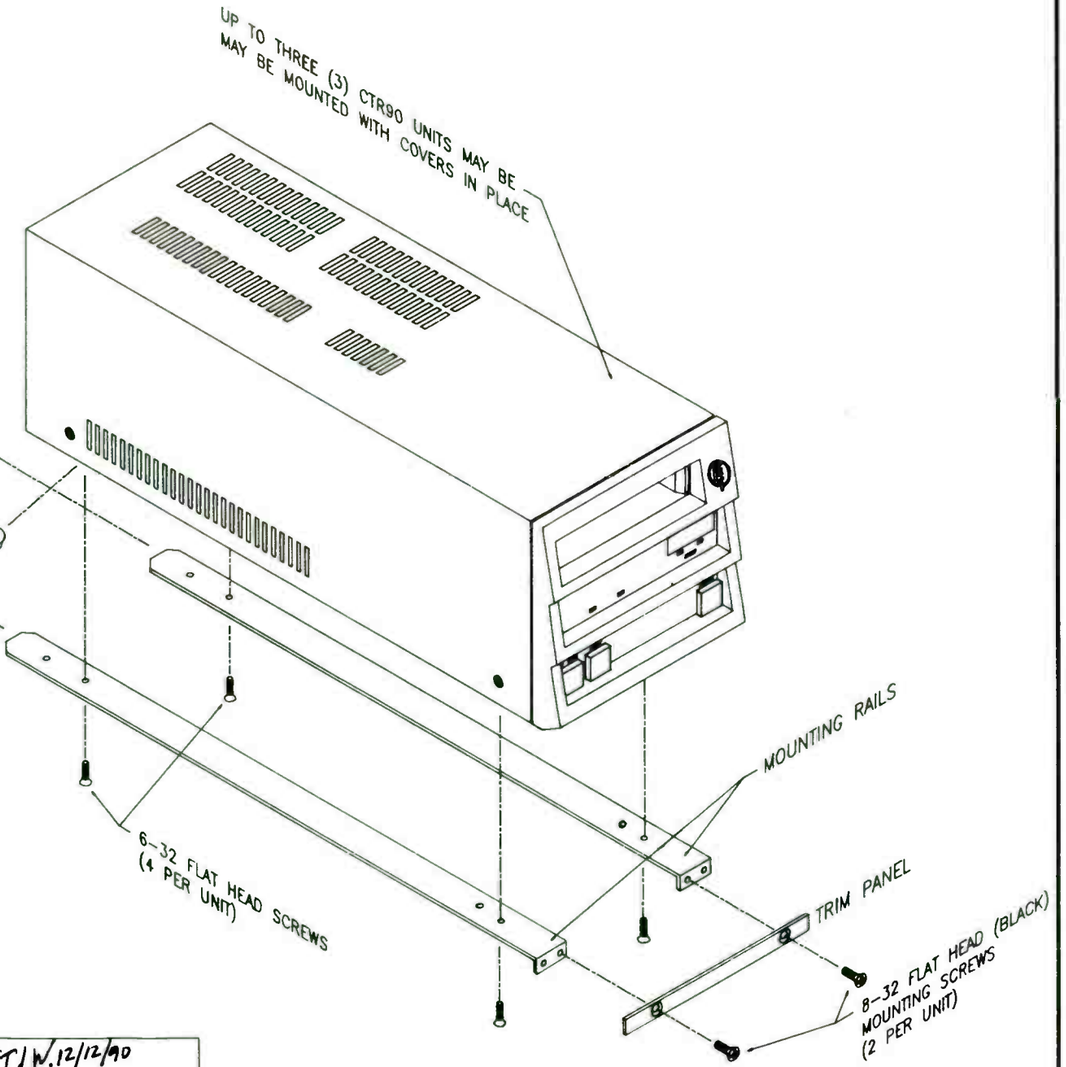


ISSUE DATE: 11/30/90 APPR. J.J.W 11/30/90 MH 11/30/90

INSTALL

OPTIONAL RACK MOUNT





OPTIONAL RACK MOUNTING

The RM-90 RACK MOUNT will hold up to three CTR90 series units. The units are locked in position by positive retention of the MOUNTING RAILS in the rear and two MOUNTING SCREWS on the front edge of the SHELF.

The SHELF may be mounted in ANY location on a standard EIA type 19" rack or cabinet. The assembled RACK MOUNT requires 5-3/4" of panel space and may be stacked with out filler panels.

CTR90 units are easily removed for maintenance (without removing the SHELF from the rack or cabinet) by removing the MOUNTING SCREWS at the front edge of the SHELF and sliding the unit forward.

The CTR90 RACK MOUNT will accommodate all other Fidelipac DYNAMAX units in combination with the CTR90 series or for retrofit with existing installations. Consult the factory of details.

RM-90

ISSUE DATE: 12/12/90 T.I.W. 12/12/90

RM-90

SECTION III OPERATION

3.1 FUNCTION IDENTIFICATION

STOP Switch: Stops the machine. Also illuminates as a Ready signal upon cartridge insertion, flashes slowly upon completion of a normal Play cycle, and flashes quickly after a manually interrupted Play cycle.

START Switch: Initiates the Play process, or Record if selected. Internal user programming may be selected for Re-Start Inhibit after any Play cycle. The bezel reference detent in front of the Start switch permits easy switch location by operators.

When a cartridge is not inserted, Cleaning mode may be entered by pushing and momentarily holding the Start switch. Cleaning mode is exited by similarly pushing and momentarily holding the Stop switch.

RECORD Switch [Recorder only]: Preselects the Recording process, which is then initiated by the Start switch. A 1 kHz Primary Cue Tone is normally recorded at the beginning of the Recording process.

1 K DEFEAT Indicator [Recorder only]: When the Record switch is pressed twice, the 1 K DEFEAT indicator will illuminate, signifying that a 1 kHz Primary Cue Tone will not be recorded.

SECONDARY Switch [Recorder only]: While in Play or Record mode, this switch initiates the recording of a 150 Hz Secondary Cue Tone. The tone will be recorded for the duration of the command.

SECONDARY Indicator: Illuminates upon detection of a Secondary Cue Tone. On Recorders only, the Secondary switch will also illuminate upon detection of a Secondary Cue Tone.

TERTIARY Switch [Recorder only]: While in Play or Record mode, this switch initiates the recording of a 8kHz Tertiary Cue Tone. The tone will be recorded for the duration of the command.

TERTIARY Indicator: Illuminates upon detection of a Tertiary Cue Tone. On Recorders only, the Tertiary switch will also illuminate upon detection of a Tertiary Cue Tone.

FAST FORWARD Switch: Initiates Fast Forward mode. Fast Forward may also be selected via internal user programming to activate upon Secondary or Tertiary Cue Tone detection.

AUDIO Indicator: Illuminates during normal Play mode, indicating that the Audio outputs have been enabled. Audio outputs may also be enabled during Fast Forward mode by toggling the Fast Forward switch. Internal user programming may be selected to disable Audio outputs upon Secondary or Tertiary Cue Tone detection, or during motor servo error.

3.2 RECORDING

3.2.1 CARTRIDGE PREPARATION

Prior to recording, cartridges to be utilized should be erased and the splice located such that it appears 2 to 4 inches (5 to 10 cm.) past the start point. Erasure may be accomplished with a bulk eraser, taking care to avoid low frequency noise bursts caused by improper erasing technique, or preferably with a dual function Eraser/Splice Detector utilizing a high erase frequency and dedicated erase heads, and including a reliable splice detection function. Failure to properly prepare cartridges will result in recordings of less than optimal quality.

3.2.2 STANDARD VS. ELEVATED OPERATING LEVELS

Two operating level standards are commonly utilized in broadcast audio recording.

Standard Operating Level is referenced to a recording fluxivity of 160 nWb/m, and is typically used with cartridges loaded with low or normal coercivity tape, usually referred to as standard tape.

Elevated Operating Level is referenced to a recording fluxivity of 250 nWb/m, and is typically used with cartridges loaded with

high coercivity tape, usually referred to as high output, low noise tape.

Refer to the cartridge manufacturers specifications and recommendations to ascertain the correct operating level for the cartridges being used. Table 3.2.2 may be used as a general guide and covers many commonly used cartridges. Note that it includes an extra 2 dB overbias, as required with Dolby HX Pro, and may not reflect manufacturers subsequent modifications or recommendations.

CARTRIDGE MODEL	RECOMMENDED OPERATING LEVEL	RECOMMENDED OVERBIAS @ 10 kHz
DYNAMAX COBALT	ELEVATED	+ 5.0 dB
AUDIOMAX 4000	ELEVATED	+ 4.0 dB
AUDIOPAK AA-4	ELEVATED	+ 4.0 dB
ITC CART II	ELEVATED	+ 5.0 dB
MASTERCART	STANDARD	+ 4.0 dB
AUDIOMAX 3000	STANDARD	+ 4.0 dB
AUDIOPAK AA-3	STANDARD	+ 4.0 dB
300 OR 350	STANDARD	+ 4.0 dB
AUDIOPAK AA-2	STANDARD	+ 3.0 dB

TABLE 3.2.2 RECOMMENDED OVERBIASING USING DOLBY HX PRO

3.2.3 MACHINE PREPARATION

Prior to initial use, and periodically during routine use, all components in the cartridge tape path should be cleaned and demagnetized. [See Section 4.2].

3.2.4 CARTRIDGE RECORDING

Insert a properly prepared cartridge into the recorder. [The cartridge must be of a proper length to facilitate recording of the desired material.] The STOP lamp will illuminate, and the TIMER will reset to 00:00.

Press the RECORD switch. The RECORD lamp will illuminate, signifying that the Record function is enabled.

If the METERS have been selected to monitor Input Levels during Record [See Sections 2.3.4.2 & 5.1.3.8], start the input source and check for proper input levels. [See Metering, Section 3.3] Adjust the Input Levels via output level controls of the input source, or intermediate faders, if required.

Recue the Input Source.
Press the START switch. The STOP lamp will extinguish and the START lamp will illuminate, signifying initiation of Recording. Start the Input Source.

An interval of at least ¼ second should be allowed between initiation of Start and initiation of the Input Source. This allows time for the pinch roller to engage, and the cartridge tape path to stabilize.

A Primary Cue Tone will automatically be recorded on the cartridge cue track upon initiation of RECORD and START. If a Primary Cue Tone is not desired, press the RECORD switch twice before pressing START. The 1KHZ DEFEAT indicator will illuminate, signifying that the Primary Cue Tone has been disabled.

A third press of the RECORD switch, prior to the initiation of Recording, will cancel the Record function.

Secondary or Tertiary Cue Tones may optionally be recorded at this time. [See Cue Tone Recording, Section 3.5]

To stop recording, push the STOP switch. The START and RECORD lamps will extinguish and the STOP lamp will flash, signifying the end of the Recording process.

The TIMER will display the total amount of recorded time. Should several recordings be made on a single cartridge, the TIMER will display the total recorded time from the leading edge of the last primary cue tone that was recorded.

The cartridge may be returned to the start of the recording by pressing the FAST FORWARD switch. The STOP lamp will extinguish and the FAST FORWARD lamp will illuminate, signifying that the cartridge is being driven at high speed to the Primary Cue Tone location. Upon location of the Primary Cue Tone, the machine will stop, the FAST FORWARD lamp will extinguish, and the STOP lamp will flash,

signifying completion of the Fast Forward cycle.

If Primary Cue Tone was defeated upon initiation of the Record process, Fast Forward will not be able to locate a valid stop location. If more than one event has been recorded on a single cartridge, each with a Primary Cue Tone, Fast Forward will locate to the first Primary Cue Tone recognized.

Remove the cartridge.

3.3 METERING [Recorder Only]

All CTR90 Series Recorders include Expanded Scale LED Metering, selectable for VU or PPM [Peak Program Meter] ballistics, and for Input or Output Level monitoring. [See Sections 2.3.4.2, 5.1.1.1, & 5.1.3.8]. NOTE: All units are shipped from the factory in the VU mode unless otherwise requested.

PPM Metering provides instantaneous indication of short duration transient peaks, as well as integrating an exaggerated fall time to indicate average monitored levels. It is very useful when recording highly dynamic or inconsistent vocal or music passages. Rise times are typically ≤100 msec., and fall times typically 2 sec./20 dB.

Using PPM Metering, the operator can be assured of the monitoring of high level transients, and adjust levels appropriately to avoid tape overload and distortion.

PPM meters are typically adjusted such that a nominal line level input presents a -8 dB meter indication. The audio level of material to be recorded should be adjusted such that there are no peak excursions above the 0 dB meter indication.

VU Metering provides RMS [average] monitoring of the audio signal. VU ballistics are familiar to most operators, and are very useful when monitoring levels of many conventional music and voice sources. Rise and fall times for VU metering are typically 40 msec/20 dB. The CTR90 offers an expanded VU range of 28 dB versus the more typical usable range of 23 dB.

VU indication of short duration and high level transient peaks, such as microphone pops, sibilance, or percussive music passages may not be at their true level and may contribute to accidental tape overload and distortion.
VU meters are typically adjusted such that a nominal line level input presents a 0 dB meter indication. The audio level of material to be recorded should be adjusted such that there are no excursions above the 0 dB meter indication.

3.4 REPRODUCTION

Insert a prerecorded cartridge into the machine. The STOP lamp will illuminate, and the TIMER will rest to 00:00.

Press the START switch. The STOP lamp will extinguish and the START lamp will illuminate, signifying the initiation of Reproduce. The AUDIO indicator will illuminate signifying that the audio outputs are enabled. The SECONDARY and TERTIARY indicators and switches (Recorders only) will illuminate upon detection of Secondary or Tertiary Cue Tones, respectively.

The cartridge will continue to run until commanded to stop either manually or via a Primary Cue Tone.

If the cartridge is stopped via a Primary Cue Tone, the STOP lamp will flash slowly, signifying a normal PLAY cycle has occurred.

To manually exit Reproduce, press the STOP switch. If the cartridge is stopped via any method other than a Primary Cue Tone, the STOP lamp will flash quickly, signifying a manually stopped play cycle.

The TIMER will display the total amount of reproduced time. Should several recordings be available on a single cartridge, the TIMER will display the total amount of time since the previous primary cue tone.

The cartridge may be returned to the start of the recording by pressing the FAST FORWARD switch while in either the Stop or Reproduce mode. At such time the STOP or

START lamp will extinguish and the FAST FORWARD lamp will illuminate, signifying that the cartridge is being driven at high speed to the Primary Cue Tone location.

Audio is normally muted during Fast Forward. It may be enabled by a second press of the FAST FORWARD switch, and muted again by a third press.

Upon location of the Primary Cue Tone, the machine will stop, the FAST FORWARD lamp will extinguish, and the STOP lamp will flash quickly, signifying completion of the Fast Forward cycle.

If no Primary Cue Tone is present on the cartridge, Fast Forward will not be able to locate a valid stop location.

If more than one event has been recorded on a single cartridge, each with a Primary Cue Tone, Fast Forward will locate to the first Primary Cue Tone recognized.

Reproduce may be entered from the Fast Forward mode. In such case, the audio output will mute until the cartridge speed has stabilized at play speed, then will unmute and revert to normal Reproduce mode. Internal programming may be selected to prohibit this mute function. [See Section 2.3.4.1 & 5.1.3.4]

Remove the cartridge.

3.5 CUE TONE RECORDING

PRIMARY CUE TONE

A 1 kHz PRIMARY Cue Tone is automatically recorded for 635 msec at the beginning of any normal Record cycle. If the RECORD button is pushed twice, the 1 kHZ DEFEAT indicator will illuminate, signifying that a PRIMARY Cue Tone will not be automatically recorded at the beginning of the Recording.

SECONDARY CUE TONE

A 150 Hz SECONDARY Cue Tone, of a length equal to the command, is recorded whenever the SECONDARY button is pushed or it's remote input is pulled low.

TERTIARY CUE TONE

A 8 kHz TERTIARY Cue Tone, of a length equal to the command, is recorded whenever the TERTIARY button is pushed, or it's remote input is pulled low.

3.6 FSK RECORDING

FSK Data, or other data for informational purposes, may be recorded on the Cue Track. Such data may be input at Cue Track/FSK Data Input [Remote Connector / Pin 38] with a level not exceeding −4 dBm. A logic low input at Cue Track/FSK Bias Enable [Remote Connector / Pin 37] will activate the Cue Record function.

3.7 FAST FORWARD

FAST FORWARD may be manually entered by pushing the FAST FORWARD button, by a remote input command, or automatically upon sensing of a Secondary or Tertiary Cue Tone, as selected via the Programmable Logic Network.

4.1 CLEANING

Optimum performance of any cartridge machine can be assured only if it is cleaned and aligned regularly.

The Pinch Roller, Motor Shaft, Heads, and tape guiding elements should be cleaned often to remove oxide build-up. It is recommended that these be cleaned with cotton swabs lightly saturated with isopropyl alcohol. Rubbing alcohol is not acceptable, and strong solvents are not recommended.

Care must be taken to ensure that cleaning fluid does not run down the motor shaft into the bearings, or flow into any electronic portion of the machine.

Cartridge guidance surfaces may be cleaned with any mild cleaner.

Ventilation ports in the machines outer cover should periodically be checked for dust or dirt. There are no fans or filters to clean, nor any parts requiring lubrication.

4.2 DEMAGNETIZATION

Audio tapes can be damaged when played on equipment that is not correctly and regularly demagnetized. Magnetized reproduce heads will cause higher second order harmonic distortion and will degrade the recorded signal as tape passes across them. Tape damage will first be noticed as a loss of high frequencies and an increase in the background noise level. Regular demagnetizing of the heads and motor shaft is essential to the proper maintenance of a tape recorder and should be done before audio performance is effected.

How to demagnetize:

If necessary, remove the machine's outer cover, permitting access to the unit's heads.

Turn off the recorder. Make sure all recorded tapes are away from the energized demagnetizer.

Turn on the demagnetizer away from the tape recorder.

Slowly bring the demagnetizer towards the component to be demagnetized. Some demagnetizers are insulated at the tip to guard against scratches to delicate head and shaft surfaces. Be careful not to touch metal-to-metal surfaces when using demagnetizers without insulation. Bring the probe tip to within 1/8 to 1/4 of an inch and move it up and down covering the area of the head or shaft, then slowly, while still energized, pull the demagnetizer away from the area to a distance of at least 24".

Turn off the demagnetizer away from the unit being demagnetized.

If removed, reinstall the unit's outer cover.

4.3 MECHANICAL ADJUSTMENTS

Refer to drawing 750-A0-440 for the following adjustments.

The unit's outer cover must be removed to perform adjustments under this heading.

4.3.1 PINCH ROLLER ALIGNMENT

The Pinch Roller must be square to the motor shaft, ensuring horizontal tape travel with no offsetting vertical forces. Pinch Roller alignment should be checked periodically, and must be performed following any repositioning or reinstallation of the Pinch Roller, Motor, or Solenoid.

With no cartridge inserted, turn the machine on. Press and momentarily hold the Start switch, to enter Cleaning Mode.

As shown in drawing 750-AO-440 sheet 2, place a HG-1 Head Height & Zenith Gauge very near the Pinch Roller, such that you can sight between the two and

ascertain whether the two vertical surfaces are parallel.

If the two surfaces are not parallel, the motor must be repositioned. Slightly loosen the motor mounting screws, and slide the motor forwards or backwards to accomplish proper Pinch Roller alignment referenced to the HG-1. Carefully retighten the motor mounting screws.

Press and momentarily hold the Stop switch, to exit Cleaning Mode.

It is suggested that after alignment, Cleaning mode be entered and exited several times, then Pinch Roller alignment be rechecked.

4.3.2 SOLENOID PLUNGER ADJUSTMENT

The Solenoid must be properly adjusted such that the Pinch Roller is fully pulled into its operational position. Solenoid adjustment should be checked periodically, and must be performed following any reinstallation of the Solenoid, Pinch Roller, or Motor.

Using 9/16" and 3/8" wrenches, loosen the locking nut on the Solenoid Plunger.

With no cartridge inserted, turn the machine on. Press and momentarily hold the Start switch, to enter Cleaning Mode. Listen for an audible "bottoming" sound as the Solenoid is engaged.

If no "bottoming" sound is heard, press and momentarily hold the Stop switch to exit Cleaning Mode, then turn the Solenoid Plunger ½ turn clockwise. Again enter Cleaning Mode and listen for the "bottoming" sound. Repeat, adjusting the Solenoid Plunger for the firmest "bottoming" sound.

Exit Cleaning Mode. Turn the Solenoid Plunger ¼ turn counterclockwise. Alternately enter and exit Cleaning mode, turning the Solenoid Plunger in ¼ turn counterclockwise increments until a "bottoming" sound is no longer heard.

Exit Cleaning Mode. Turn the Solenoid Plunger another ¾ turn counterclockwise.

Tighten the locking nut on the Solenoid Plunger.

4.3.3 SOLENOID DAMPING ADJUSTMENT

The speed at which the Solenoid engages and releases the Pinch Roller is determined by an air escape valve, and regulated by an adjustment screw at the rear of the Solenoid. Turning this screw clockwise will restrict air passage, yielding a slower Pinch Roller engage/release time. Conversely, turning the screw counterclockwise will open the air passage, yielding a faster Pinch Roller engage/release time.

4.3.4 TAPE GUIDE ALIGNMENT

Using the Tape Guide/Head Alignment gauge, align the tape guides by turning the tape guide adjustment screw so that the inside edge of the upper guide finger just contacts the top of the height gauge (see drawing 750-A0-440 sheet 2). Repeat for the other guide(s). Note: there are normally 2 Tape Guides on each unit, however, an optional Center Tape Guide is available.

NOTE: Worn guides may seriously affect stereo phase performance. Guides should be checked periodically for signs of wear and replaced when necessary.

4.3.5 HEAD ALIGNMENT

The Head Bridge includes alignment in four axes; Height, Azimuth, Zenith, and Insertion.

Remove the machines outer cover, permitting access to the Head Block.

NEVER FORCE HEAD ALIGNMENT SCREWS

INSERTION

To adjust Insertion for most common cartridges, insert a Fidelipac Model 328 Head Insertion Gauge cartridge into the machine. Adjust Tape Heads for equal penetration within limits of scribe marks on cartridge cover as viewed from directly above.

HEIGHT & ZENITH

Loosen the .050" Allen head locking screws on each side of the head block 1/4 turn.

Height and Zenith alignments should be performed with the machine turned off.

As shown in drawing 750-AO-440 sheet 2, place a HG-1 Head Height & Zenith Gauge against the head to be aligned.

Using a Phillips screwdriver, adjust the Height alignment screw such that the top edge of the top track pole piece is aligned with the top of the HG-1.

Using a Phillips screwdriver, adjust the Zenith alignment screw such that the vertical front surfaces of the head and HG-1 are parallel.

Recheck both Height and Zenith alignments.

Repeat the above procedure for the second head.

Retighten both head locking screws.

> **BE SURE TO DEMAGNETIZE THE HEADS BEFORE USING THE MACHINE. [See Section 4.2]**

NOTE: Head Height will be peaked during electronic adjustment. [See Section 4.4.1]

AZIMUTH

Azimuth alignment is normally performed during reproduce and record alignments.

A 5/64" Allen head driver is required to adjust the Height alignment screws.

NOTE: Stereo Azimuth alignments are most easily accomplished using either a dual trace oscilloscope in the dual trace "chop" display mode, or a good quality phase meter.

MONO REPRODUCE AZIMUTH

While playing the "Set Azimuth" portion of a standard Spot Frequency Alignment Cartridge, adjust Play Azimuth for a peak signal at the audio output of the machine.

MONO RECORD AZIMUTH [Recorder Only]

Load a blank cartridge into the machine. Inject a 16 kHz signal at nominal level into the audio input and enter Record mode. Adjust Record Azimuth for a peak signal at the audio output of the machine.

STEREO REPRODUCE AZIMUTH

While playing the "Set Azimuth" portion of a standard Spot Frequency Alignment Cartridge, adjust Play Azimuth for both peak and in phase signals at the audio outputs of the machine.

STEREO RECORD AZIMUTH [Recorder Only]

Load a blank cartridge into the machine. Inject a 16 kHz signal at nominal level into both audio inputs and enter Record mode. Adjust Record Azimuth for both peak and in phase signals at the audio outputs of the machine.

4.4 ELECTRONIC ADJUSTMENTS

Prior to performing any electronic alignments, mechanical adjustments must be optimized [See Section 4.3].

Reference drawing 750-A0-440 for the location of the following adjustments.

The unit's outer cover must be removed to perform the adjustments under this heading.

NOTE: Electronic alignments are most easily accomplished using either an audio test set or oscillator and high impedance AC voltmeter connected to the machines input(s) and output(s). Care must be taken to ensure proper load impedance and balancing.

4.4.1 AUDIO REPRODUCE ALIGNMENT

It is suggested that standard Spot Frequency

Alignment Cartridges be utilized as alignment references, and that these be unimpaired by age or wear. All reproduce alignment procedures assume use of such a cartridge.

It is recommended that the following Audio Reproduce alignments be performed with the DNR® circuit disabled (jumpers installed in W1 and W3 on Play Amp), unless otherwise noted.

Before proceeding with Reproduce Alignment it must be determined if the alignment is to be referenced to Standard Operating Level / 160 nWb/m or Elevated Operating Level / 250 nWb/m [See Section 3.2.2], and what nominal output level is to be.

HEAD PEAKING

Azimuth must be set prior to adjusting head peaking. Before adjusting head peaking, the 0.050" Allen head locking screw on the Play side of the head block must be loosened ¼ turn. [See Section 4.3.5]

During the 1 kHz / 0 dBm reference tone, vary the head height to achieve maximum signal level at the audio output(s).

Retighten the head block adjustment locking screw. Recheck the azimuth setting as in section 4.3.5.

SET DNR® LEVEL

During the 1 kHz / 0 dBm reference tone, set the DNR ® Reference Potentiometer(s) for 1 Vpp (.353 Vrms) at U14 / Pin 13 [U14 / Pin 2].

SET OUTPUT LEVEL

During the 1 kHz / 0 dBm reference tone, set the Output Level Potentiometer(s) for nominal level at the audio output(s).

REPRODUCE EQUALIZATION

During the 50 Hz Low Frequency and 12.5 kHz High Frequency reference tones, adjust Low Frequency EQ Potentiometer(s) and High Frequency EQ Potentiometer(s), respectively, for nominal levels at the audio output(s).

Recheck the output levels throughout the test cartridge, readjusting as necessary for flat-test response.

SET DNR ® SENSITIVITY

NOTE: This alignment should only be done after a complete Audio Alignment has been completed and verified. A single DNR ® Sensitivity adjustment performs the alignment for both left and right audio channels. Remove the DNR ® circuit from the audio path by placing jumpers over W1 and W3.

Note the output level of the unit while reproducing a 12.5kHz tone recorded at -20dB below reference level. Place the DNR ® circuit in the audio path by removing jumper caps from W1 & W3 and placing them on W2 & W4.

Turn the DNR ® sensitivity pot (R43) fully clockwise. Reproduce a 12.5kHz tone at -20dB below the reference level and note the output level of the left channel. Continue reproducing the 12.5kHz -20dB tone and turn potentiometer R43 fully counterclockwise. Verify that the output level on the left channel has decreased by at least -10dB.

Slowly turn R43 clockwise until the output level of the left channel is 1dB below the level noted previously.

Although this adjustment will be satisfactory to most users, discretion may be used to optimize the DNR ® for a particular station's tape library.

4.4.2 CUE REPRODUCE ALIGNMENT

During the 8 kHz / -16 dBm tertiary cue test tone, rotate the Cue Tone Threshold Potentiometer fully counterclockwise, then clockwise until the Tertiary indicator illuminates.

Check that the 150 Hz / 0 dBm secondary cue test tone causes illumination of the Secondary indicator. If not, turn the Cue Tone Threshold Potentiometer clockwise until it does.

Check that the 1 kHz / -6 dBm primary cue test tone causes the machine to stop. If not,

turn the Cue Tone Threshold Potentiometer clockwise until it does.

Enter Fast Forward mode, and check that the primary cue tone causes the machine to stop. If not, turn the Cue Tone Threshold Potentiometer clockwise until it does.

While reproducing a 8 kHz / −16 dBm tertiary cue tone, adjust the Cue/FSK Output Level Potentiometer for a −16 dBm output at Cue/FSK Data Output (Remote Connector Pin 39).

Note: There is a 1.6 second delay incorporated between machine start and the ability to detect a cue tone.

4.4.3 AUDIO RECORD ALIGNMENT [Recorder Only]

Record alignment should be done only after the Reproduce Board is properly aligned. [See sections 4.4.1 and 4.4.2].

HEAD PEAKING

Prior to adjusting head peaking, the 0.050" Allen head locking screw on the Record side of the head block must be loosened ¼ turn. Azimuth should have been set. [See Section 4.3.5]

Load a blank cartridge of the type being aligned to into the machine. Inject a 1 kHz signal at nominal level into the audio input(s) and enter Record mode. Vary the head height adjustment to achieve maximum signal level at the audio output(s).

Retighten the head block adjustment locking screw. Recheck the azimuth.

BIAS ALIGNMENT

Load a blank cartridge of the type being aligned to into the machine. Inject a 10 kHz signal at −10 dBm level into the audio input(s) and enter Record mode.

Turn the Bias Potentiometer(s) fully counterclockwise, then clockwise until maximum output signal is achieved, then continue clockwise until an output signal reduction is achieved that is the optimum recommended overbias for the cartridge type being aligned to. [See Table 3.2.2] Note: Due to the use of Dolby HX Pro this is typically 2 dB more overbias than recommended by the cartridge manufacturer.

RECORD LEVEL

Load a blank cartridge of the type being aligned to into the machine. Inject a 1 kHz signal at nominal level into the audio input(s) and enter Record mode. Adjust the Record Level Potentiometer(s) for nominal output level.

HIGH FREQUENCY RECORD EQUALIZATION

Load a blank cartridge of the type being aligned to into the machine. Inject a 12.5 kHz signal at nominal level into the audio input(s) and enter Record mode.

Adjust the High Frequency EQ Potentiometer(s) for nominal output level.

LOW FREQUENCY RECORD EQUALIZATION

Load a blank cartridge of the type being aligned to into the machine. Inject a 50 Hz signal at nominal level into the audio input(s) and enter Record mode.
Adjust the Low Frequency EQ Potentiometer(s) for nominal output level.

Sweep the input(s) from 50 Hz to 16 kHz and note the output level variation(s). Minor readjustment of Level(s) or EQ(s) may be required to reach optimum throughout the spectrum.

Recheck record level(s), and a sweep of frequencies from 50 Hz through 16 kHz.

4.4.4 CUE RECORD ALIGNMENT [Recorder Only]

BIAS ALIGNMENT

Load a blank cartridge of the type being aligned to into the machine. Press and hold the Tertiary switch.

Turn the Cue Bias Potentiometer fully counterclockwise, then clockwise until maximum output signal is achieved at Cue/FSK

Data Output (Remote Connector Pin 39), then continue clockwise until an output signal reduction of 2 dB is achieved.

RECORD ALIGNMENT

Load a blank cartridge of the type being aligned to into the machine.

Monitoring the Cue/FSK Data Output (Remote Connector Pin 39), enter Record mode and note the output level during the 635 msec that a Primary Cue Tone is recorded. The output level should be 0 dBm. If necessary, exit and re-enter Record several times while adjusting the Primary Record Level Potentiometer for the correct output level.

Monitoring the Cue/FSK Data Output (Remote Connector Pin 39), press the Secondary switch, checking for a +6 dBm output level. Adjust the Secondary Record Level Potentiometer if necessary.

Repeat the above procedure while holding the Tertiary switch, checking for a -10 dBm output at the Cue/FSK Data Output (Remote Connector Pin 39). Adjust the Tertiary Record Level Potentiometer if necessary.
Inject a 3.5 kHz / -4 dBm signal at the Cue/FSK Data Input (Remote Connector Pin 38). Adjust the Cue/FSK Record Level Potentiometer to achieve a -10 dBm output at the Cue/FSK Data Output (Remote Connector Pin 39).

4.4.5 METER ALIGNMENT

Meters may be selected for VU or PPM standards. Each standard requires alignment to different reference levels. [See Sections 3.3 & 5.1.1.1]. REFER TO DRAWING 750-A0-440 SHEET 1 FOR THE FOLLOWING ADJUSTMENTS.

Setting the Audio Input meter levels

Set SW1 on the Logic Board to the AUDIO position (nearest to the front of the unit). Connect an input level of +1dB higher than the nominal input level to the Record Audio Input and adjust the Audio Input Meter Level Potentiometer(s) on the Record Board for a meter reading of -7dB (PPM Metering) or +1dB (VU Metering).

Setting the Audio Output meter levels

Set SW1 on the Logic Board to the AUDIO position (nearest to the front of the unit). Insert jumper W11 on the Logic Board if it is not installed already. Connect an input level of +1dB higher than the nominal input level to the Record Audio Input. Enter Record mode. Adjust the Audio Output Meter Level Potentiometers on the Play Board for a meter reading of -7dB (PPM Metering) or +1dB (VU Metering). RETURN W11 TO THE DESIRED SETTING.

Setting the Audio BIAS meter levels

Set SW1 on the Logic Board to the Program Bias position (middle position). Enter Record mode. Allow the meters to settle and adjust the Bias Meter Potentiometer(s) on the Record Board for a meter reading of 0dB. Bias Metering is for reference only!

Setting the Cue Output meter levels

Set SW1 on the Logic Board to the Cue Meter position (closest to the back of the unit). Reproduce a 1kHz Reference Level Cue Tone Test Tape and adjust the Cue Output Meter Level Potentiometer on the Play Board for a meter reading of 0dB on the Cue Audio meter (bottom meter).

Setting the Cue BIAS meter levels

Set SW1 on the Logic Board to the Cue Meter position (closest to the back of the unit). Enter Record mode. Press and hold the SEC switch. Allow the Cue Bias meter (top meter) to settle and adjust the Cue BIAS Meter Potentiometer on the Record Board for a meter reading of 0dB. Bias metering is for reference only!

Reset SW1 on the Logic Board to the Audio position.

4.5 TROUBLESHOOTING GUIDE

4.5.1 TESTING & HANDLING OF CMOS DEVICES

The CTR90 Series of Audio Cartridge Recorders and Reproducers utilizes a number of CMOS Integrated Circuits. These circuits are not immune to electrostatic damage, and require prudent handling precautions when any maintenance or disassembly of the unit is required. These precautions are recommended procedure when working with all integrated circuits, but are particularly applicable when working with CMOS devices.

TEST & MAINTENANCE PROCEDURES:

All test equipment should be connected or disconnected only when the device under test, or printed circuit board containing such devices, has power applied. When maintenance is being performed on printed circuit boards containing CMOS devices, it should be performed on a grounded service bench. The technician performing such maintenance should also be grounded, typically through a wrist strap which makes contact with the skin. Such straps are commonly available in most locales.

Never insert or remove CMOS devices from printed circuit board sockets with power applied. Never insert or remove PC boards containing CMOS devices with power applied.

CAUTION: A low voltage, grounded-tip soldering iron is recommended to prevent damage to components due to excessive heat or static discharge!

HANDLING & STORAGE PROCEDURES

CMOS devices, or printed circuit boards containing such devices, should not come in contact with nylon or other synthetic or static generating materials.

CMOS devices should not be stored in styrofoam or other plastic trays. CMOS devices should not be stored loosely where the pins may come into contact with other devices. Storage in designated antistatic containers is recommended.

Plastic wrapping of CMOS devices, or printed circuit boards containing such devices, should be avoided. Special anti-static plastic wrappings are available, and are typically colored pink or black and labeled as such.

FAILURE TO COMPLY WITH THESE RECOMMENDED PROCEDURES MAY RESULT IN REVOCATION OF THE LIMITED WARRANTY PROVIDED WITH THIS DYNAMAX PRODUCT.

4.5.2 HOW TO USE THE TROUBLE SHOOTING GUIDE

1. Scan bold-faced main headings in left column for general area.

2. Scan indented headings in regular type for applicable function.

3. Proceed in order, looking for incorrect voltages and/or signals as specified.

4. When a malfunction is found, continue checking in order until a section that is functioning properly is discovered. The malfunction should be located at the preceding point.

5. After rectifying this problem, return step-by-step to the point at which you began. Make repairs as necessary and verify that each dependent circuit is now operating properly.

4.5.3 HELPFUL HINTS

1. The main POWER Supply is located on the POWER SUPPLY/MOTOR DRIVER PCB. It may be easily removed from the chassis for service as an isolated unit.

2. With the PLAY and RECORD PCB's removed and the unit on it's right side, the component side of the LOGIC BOARD is easily reached. Since The LOGIC BOARD and POWER SUPPLY/MOTOR DRIVER PCB's together control the whole unit, all functions that do not involve signals going to or from the heads will operate properly in this configuration. This is generally the preferred manner in which to service logic problems.

3. With a unit's logic circuits operating properly, the PLAY AMP may often be serviced in the same manner.

4. Generally, servicing the RECORD AMP and/or MOTOR DRIVER requires the use of an extender card. Note that it may be used to make any of the main boards more accessible.

5. Block diagrams are located at the end of this section to aid in the understanding and trouble shooting of the CTR90. Detailed schematics are located in the Drawings Section.

4.5.4 SOLENOID

Linkage

1. Check that the linkage is free and may be operated smoothly by hand.

Connector

2. Check that P11 on DISTRIBUTION BOARD is firmly connected.

Constant Current Drive

3. Verify the following voltages with unit in clean mode:

a. +5V	U3.8
b. -16V	U20.7
c. -0.37V	U20.2 & U20.3
d. 5.5V	U20.1
e. -2.5V	Q1.2

Drive Engagement

4. Verify that at time of attempted engagement, pin 2 of Q1 & Q2 on Logic Board pulses to +15V.

Impedance

5. Check that Solenoid impedance is between 35 and 40 ohms.

4.5.5 MOTOR

Run on Command

1. Fully insert a cartridge. Verify that the motor runs. Shunting W9 on the LOGIC BOARD causes the motor to run only with a cart inserted.

Motor Plug

2. Check motor plug TB1 on POWER SUPPLY/MOTOR DRIVER BOARD. Make sure that it is secure and is oriented correctly.

Motor Reference Frequencies

3. Remove W9. With unit in PLAY, verify the following frequencies on LOGIC BOARD:

U29.14	600Hz square
U24.11	1800Hz pulse
U11.4	600Hz square

Fast Forward

4. With unit in FAST-FORWARD verify that frequency switch U11.4 now outputs an 1800Hz pulse. Also see Fast Forward Lamp under MISCELLANEOUS LOGIC (section 4.5.8).

Tach Amp, and Motor Protection

5. With the capstan revolving (it may be spun by hand, slowly is OK), verify that:

U1.6 & U1.8 squared tach signal (2VAC) frequencies are proportional to motor speed.

U7.7 goes to approximately 4V with only slight motor movement.

Phase Frequency Comparator

6. U4.14 should be: HIGH if the previous sections of the motor circuit are functioning correctly and the motor is still not running; LOW if the motor is still not running because of malfunctions in the previous sections.
DUTY CYCLE WAVEFORM-which is locked to the reference frequency when the motor is operating on speed.

Motor Switching and Braking

7. The bases of Q8,9,& 10 should have a 0.75 VAC signal with the capstan rotating.

U5.13 should be low, going high only during a transition from FF.

The emitters and collectors of Q5,6,& 7 will have 0.2VAC and 27VDC when operating properly. Their bases are then driven by about 5VAC and 22VDC.

Motor Drive

8. U6.1 and U6.7 maintain 1VDC with the motor running, 0VDC with the motor idle.

   Q2 should be off with it's emitter and base near ground. It's correct operating voltages are:

0.6v	emitter
1.0v	base
25-30v	collector

   Q4's correct operating voltages are:

0.125v	emitter
0.6v	base
25-30v	collector

Servo Error

9. U5.1 remains low, and Q1 off as long as the motor is locked to it's reference frequency.

4.5.6 TIMER

ON LOGIC BOARD:

Count Enable

1. To enable counting, U3.7 must be high and tach pulses present at U19.9 should also be present at U19.8.

Count Reset

2. A low at U3.20 will produce a low at U12.3 which resets the display and tach divider. The low at U15.9 -- while a 1 KHz cue tone is being recorded -- produces a pulse at U12.1 and U12.3, which also resets the display and tach divider.

ON POWER SUPPLY / MOTOR DRIVER BOARD:

Tach Divider

3. U10's output should represent the number of tach pulses received since the last timer reset. U11's output should follow on the falling edge of the tach pulse. U12.1 should go high every 600 tach pulses (once every second at 7.5 IPS) and during timer reset.

ON DISPLAY PANEL:

Counter/Display

4. Verify that all cables (left side under deck) between the distribution board and display panel are firmly connected.

   From the LOGIC BOARD U1.10 receives the low reset pulse, while U10.9 receives the count pulses. U1 directly drives U2, the display chip.

4.5.7 LAMPS AND INDICATORS

1. Verify that all cables (left side under deck) between the distribution board and display panel are firmly connected. Verify that switch lamps are not open.

ON LOGIC BOARD:

Stop Lamp and Remote Ready

2. During STOP STEADY the following voltages are correct:

U3.7, U7.8, U7.6	high
U16.15, U16.16	low

During STOP FAST FLASH the following is correct:

U3.16	high
U12.8, U7.8, U7.6	0.8Hz

During STOP SLOW FLASH the following is correct:

U3.9	high
U12.6, U7.6	0.8 Hz

Start Lamp

3. With the solenoid engaged verify that U16.14 is low.

Fast Forward Lamp

4. With the motor running at fast forward speed U14.4 should be high and U14.13 low. Verify that the FAST FORWARD lamp illuminates.

Audio Indicator

5. With W10 removed and the unit in PLAY, U3.18 and U1.11 are high while U10.14 is low and the audio indicator illuminates.

Record Lamp

6. During record mode, U3.5 should be high and U16.12 low with the switch lamp illuminated.

1K Defeat Indicator

7. From stop, press record twice. U3.10 should be high and U10.12 low. The 1K defeat indicator should be illuminated.

Secondary Lamp and Indicator

8. See cue detect. U10.11 goes low directly driving the lamp and indicator as well as the relay.

Tertiary Lamp and Indicator

9. See cue detect. U10.10 goes low directly driving the lamp and indicator as well as the relay.

4.5.8 MISCELLANEOUS LOGIC

Cart Sense

1. Verify that the cart sense flag (reference DWG No 847-B0-401) swings freely into and out of the cart sense optocoupler's slot when a cart is inserted. Verify that the cart sense optocoupler is plugged into the distribution board. Without

the optocoupler in circuit, a CTR90 will act as though a cart is always in place.

2. When a cart is fully inserted, U1.9, U1.10 and U1.8 should all go from high to low.

Power Up Reset

3. At power up U17.9 should produce a low going pulse. Also verify that cart sense is operating correctly.

Switch Input

4. At the press of the specified function switch and/or when pulled low at the remote connector these input pins should go low with the debounced and delayed output following:

INPUT	INPUT PIN	OUTPUT PIN
START	U13.1	U13.15
STOP	U13.14	U13.2
FAST FORWARD	U13.3	U13.13
RECORD	U13.12	U13.4
SECONDARY	U13.5	U13.11
TERTIARY	U13.10	U13.6
REMOTE CUE BIAS	U14.12	U14.4

4 KHz should always be present at U14.7. See FREQUENCY GENERATION (section 4.5.9).

6.3 Hz should be present at U11.14 until a cartridge is inserted when it should provide 1 KHz.

Also see CART SENSE.

Logic Clock

5. For any state change to occur, U3.1 must see a leading edge change. (A logic probe is useful here.) The remote connector's pin 45, or other command lines, must not be held low for this to occur.

When a function switch is pressed, U3.21 should go high.

4.5.9 FREQUENCY GENERATION

1. Verify that the following pins produce the specified frequencies:

U21.9	18.432 MHz	U30.2	6.3 Hz
U21.6	144 KHz	U30.4	3.2 Hz
U21.15	18 KHz	U30.12	0.79 Hz
U25.14	9.215 MHz	U30.1	0.01 Hz
U22.14	3.072 MHz	U16.11	0.01 Hz
U9.3	3.072 MHz	U23.12	614.4 kHz
U26.14	1.024 MHz	U9.6	614.4 kHz
U9.8	1.024 MHz	U29.12	1200 Hz
U28.4	8 KHz	U29.14	600 Hz
U28.13	4 KHz	U29.15	300 Hz
U28.12	2 KHz	U29.1	150 Hz
U28.14	1 KHz	U24.14	9 kHz
U27.12	400 Hz	U24.11	1800 Hz
U8.10	400 Hz	U9.11	1800 Hz
U30.9	200 Hz		

4.5.10 REPRODUCE AUDIO

ON PLAY AMP PCB:

Shunts

1. Verify that shunts W1,3 or W2,4 are in place. The first pair ties audio directly from the EQ AMP to the mute circuit, while the latter pair places the DNR NOISE REDUCTION between the EQ AMP and the mute circuit.

Audio Output

2. Verify that U7.1/[U10.1] and U7.7/[U10.7] are not at a rail, and that they pass audio. Repeat for U6.1/[U9.1] and U6.7/[U9.7].

   U6.8/[U9.8] should remain near ground.

   With the unit's outputs disconnected, U6.14/[U9.14] should remain at ground with and without audio present.

Mute

3. While attempting to reproduce audio, verify that the audio appears at the drain, upper leg, of Q6/[Q8 lower leg] with 1 1/2 times the amplitude at the drain of Q5/[Q7]. During MUTE, these pins should be near ground.

   During REPRODUCE O1.8 should be at +15V and go nearly to ground during MUTE.

   During MUTE O1.4 should drop from 5V to 3V, while pin 3 remains at 5V.

   On the LOGIC BOARD U1.11 goes low during mute, and to +5V at all other times.

   U3.18 goes high, enabling mute during fast forward. Also see AUDIO INDICATOR (section 4.5.7).

Servo Error Mute

When installed, W10 enables mute during SERVO ERROR by pulling U1.13 low, otherwise it remains high.

Equalization

4. U2.10/[U4.10] should pass audio but remain near DC ground.

Pre-preamp

5. U1.6/[U3.6] should pass audio but remain near DC ground. At the following points audio will be small or nonexistent. Proper DC voltages are:

-8V	U2.12/[U4.12]
-8V	Pin 2 of Q1,Q2/[Q3,4] (collector)
-8V	Pin 3 of Q1,Q2/[Q3,4] (base)

4.5.11 CUE DETECT:

ON PLAY AMP:

Cue Equalization, Buffer, and Detect Levels

1. While reproducing a 0dB reference tone the following AC voltages are correct:

75mVpp	U11.1
2.3Vpp	U11.7
0.75Vpp	U11.14

Filters

2. While reproducing the respective threshold tones, the following AC rms voltages may be verified:

150Hz	4.6V	U12.7
1kHz	5.0V	U12.8
3kHz	3.2V	U12.14
8kHz	1.7V	U12.1

Detect

3. Comparator outputs U13 pins 7,8,14, and 1 switch between +15V during detection and -15V when idle.

4. Optocoupler O2 should measure 2V at pins 1,3,5, and 7 during the corresponding tone detection, and -0.65V otherwise. Pins 16,14,12,10 go from +5V to less than 2V during the corresponding tone detection.

Disable

5. Pins 15,13,11, and 9 of O2 are held at about 1.5V by U16.13 on the LOGIC BOARD, except when cue detection is disabled, then these pins float.

ON LOGIC BOARD:

U3.8 goes high (+5V) at the beginning of solenoid engagement. U17.7 outputs a 1.6 second low (ground) pulse disabling cue detect.

Cue Logic Inputs

The following conditions enable 150Hz, 1KHz, and 8KHz detection during all modes except FAST FORWARD. These points invert during FAST FORWARD disabling the former cue detect inputs, and enable the 3KHz detect input.

high	U3.18
low	U4.4
high	U4.1

Cue Relays

6. U10.10 and U10.11, normally at +15V, each go low during their respective cue detection, driving it's relay. Also see LAMPS AND INDICATORS (section 4.5.7).

Auto Functions

7. See table 5.1.3.4.3 for placement of jumpers W1 through W6. The selected logic transition causes U15.7 to output a low pulse which may be used to initiate one of several automatic functions.

4.5.12 RECORD

ON RECORD PCB:

Note: Unless otherwise noted all audio points should remain near DC ground.

Input

1. The following should pass audio:

Left Channel	Right Channel
U2.1 U2.7	U7.1 U7.7

Electronic Attenuator

2. DISPLAY PANEL level potentiometers should be capable of varying the DC voltage at U8.7/[U8.1] from ground to -15V.

3. The attenuators and associated buffers should pass audio. Their outputs are:

Left Channel	Right Channel
U5.17 U5.13 U1.7	U12.17 U12.13 U14.1

Equalization

4. The equalization amplifiers should pass audio at their outputs: U9.12/[U10.12].

Record Mute

5. When the deck is not actually recording, the signal at the drains of Q3 and Q4 (pin 3) should be 1/30 (-30dB) their amplitude during record. The drains of Q2 and Q5 should

be 1/1000 (-60dB) their record amplitude. See record control for mute enable detail.

DC Servo Loop

6. U9.6 should always remain near ground. U1.7/[U14.7] operates near 7V during record.

Audio Current Source

7. U9.7/[U10.7] typically drives approximately 0.1vpp of audio during record.

Remote Cue Amp

8. U15.7 should provide a signal corresponding to the remote input at 2.7 times it's input amplitude.

Note: An oscilloscope should be used to accurately make the following AC measurements:

Cue Tone Filters

9. While recording a cue tone, the respective cue filter should provide the following:

150 Hz	20Vpp	U15.1
1 KHz	10Vpp	U4.7
8 KHz	10Vpp	U4.1

10. During RECORD approximately 7Vpp of bias (144KHz) should be present at U13.1. See record control.

Audio Bias

11. The pair U6.7 and U6.8/[U6.11 and U6.12] should produce 144KHz pulses that are out of phase with each other.

The emitters of Q9 and Q10/[Q7 and Q8] should follow the above pulses, while the ungrounded end of R95/[R86] should ride at roughly 7V DC varying slightly with the position of the bias pot R31/[R30].

Greater than 30Vpp of bias should be available at T4.4/[T3.4].

An amplified representation of the total head drive signal (bias + audio) should be present at U3.1/[U11.1]. This signal is normally greater than 10Vpp.

Cue Bias

12. During the RECORDING of a cue tone 20Vpp of bias should be available at U16.7, and approximately 7Vpp at U13.1.

The gate of Q11 pin 3 should go from +15V to -15V during cue track recording. See cue record enable. The drain and source (Pins 1 and 2) may be shorted to demonstrate that it is not the cause of a problem.

Record Control

13. During audio record the collector (at pin 3) of Q1 goes to ground while the collectors (also pin 3) of Q6 and Q12 go to +15v.

14. While recording on the cue track the collector of Q13 goes from +15V to -15V.

ON THE LOGIC BOARD:

Note: Reference frequencies are +5V square waves.

Record Bias

11. Recording on any track requires that there be a bias reference signal at U19.4 and U19.6. See FREQUENCY GENERATOR for a malfunction at pin 4 (section 4.5.9).

Audio and Primary Cue Record Enable

12. During audio and primary cue record, the following points must be high (+5V): U19.11, U3.5, U3.8, U7.11, while U16.12 will be low.

Cue Record Enable

13. During any cue track recording U7.12 must be high (+5V).

Cue Tones

14. At the start of a recording, U15.10 and U12.11 should produce a 600ms +5V pulse. The primary reference frequency must be present at U18.3 and U18.1 any time it is being recorded. See FREQUENCY GENERATOR for malfunction at pin 1 (section 4.5.9).

In 1K DEFEAT U3.10 and U10.12 should be low and U8.2 high, keeping U15.10 from producing a pulse at initiation of record.

U13.5 and U13.11 should go low and U8.4 high when the secondary switch is pressed. U3.6 should also be high with U18.3 outputting the 150 Hz reference frequency for the duration of the button push.

U13.10 and U13.6 should go low and U8.6 high when the secondary switch is pressed. U3.6 should also be high with U19.3 outputting the 8 KHz reference frequency for the duration of the button push.

Remote Cue Record

15. With ground applied to the remote connector's pin 37, U14.12 and U14.4 should be low with U8.12 and U7.11 high. The bias reference signal should the be present at U19.6 and U19.4. See FREQUENCY GENERATOR for malfunctions at pin 4 (section 4.5.9).

4.5.13 METERS

Cables

1. Verify that both cables (left side under deck) between the distribution board and display panel are firmly connected.

ON LOGIC BOARD:

Options

2. Verify that W11 on the LOGIC BOARD is properly set. It determines meter source during RECORD SET, and RECORD SET 1K DEFEAT.

Switch

Verify that the meter switch (at top of logic board) is set to the desired position. It selects left and right audio (forward), left and right bias during record (center), cue signal and cue bias (rear).

Source Selector

3. U8.8 should go low when the solenoid is engaged.

With W11 in place U1.3 should be high in REC SET and go low during RECORD. U6.11 should do just the opposite.

With SW1 in it's forward position, U2.10 and U2.9 should follow U6.11.

The table below gives the correct states for U6.9 and U6.10 at different switch positions along with their meter functions and the pins U2 should tie together.

Switch Position	U6 PIN # 10	9	Meter Function	U2 Connects To:
Forward	High	High	Audio Output	11 to 13, 4 to 3
	-or-			
Forward	Low	Low	Audio Input	12 to 13, 1 to 3
Middle	High	Low	L & R Bias	15 to 13, 2 to 3
Rear	Low	High	Cue & Cue Bias	14 to 13, 5 to 3

Meter Source Amps

4. The meter source amp outputs and their adjustment pots are listed below:

ON PLAY BOARD:

U8.1	LEFT AUDIO OUT	R66
U8.7	RIGHT AUDIO OUT	R67
U11.8	CUE SIGNAL OUT	R99

ON RECORD BOARD:

U3.7	LEFT RECORD AUDIO	R39
U11.7	RIGHT RECORD AUDIO	R61
U3.1	LEFT BIAS	R33
U11.1	RIGHT BIAS	R37
U16.1	CUE BIAS	R120

ON DISPLAY PANEL:

Meter Display

5. Meter signal should be present at U3.3/[U4.3]. A 1Khz, 353mVpp signal should drive the display to 0dB.

A consecutive group of four LED's inoperative usually means that one of them is open.

+12V produced by VR1 at pin 3 should be present at U3.1 and U4.1.

4.5.14 MAIN POWER SUPPLY

ON POWER SUPPLY / MOTOR DRIVER PCB:

1. Check AC cord and outlet.

Voltage selector

2. Check selector in power module for correct voltage.

Fuses

3. Check fuses in power module.

Note: Ripple measurements should be made between a supply and ground on a particular board.

DC Output

4. Check DC output of main regulators -- All should have less than 5mV rms ripple at the following DC voltages:

+5V	VR2 pin 2(center)
+16.3V	VR1 pin 2(center)
+18V	VR3 pin 2(center)
-18V	VR4 pin 3(left)

5. Remove Power Supply Assembly from unit and recheck supplies as in Step 4.

6. Check rectifier output. Ripple here should be less than 0.5V at the following DC levels:

+30V at cathode D7, left end
-30V at cathode D10, left end

Secondary AC

7. Check rectifier input (AC):

44 ACVrms across anodes of D7 & D8

Primary Wiring

8. Check wiring of power module, and transformer primary. See drawing No. 827-A0-412.

4.5.15 LOCAL SUPPLIES

ON NOTED PCB'S

Note: Ripple voltage on local supplies should not exceed 0.5mVrms.

Play Amp Supplies

1. On PLAY AMP the correct DC voltages are as follows:

+15v	U1.7
-15v	U1.4
+8v	U14.1
-8v	U14.7

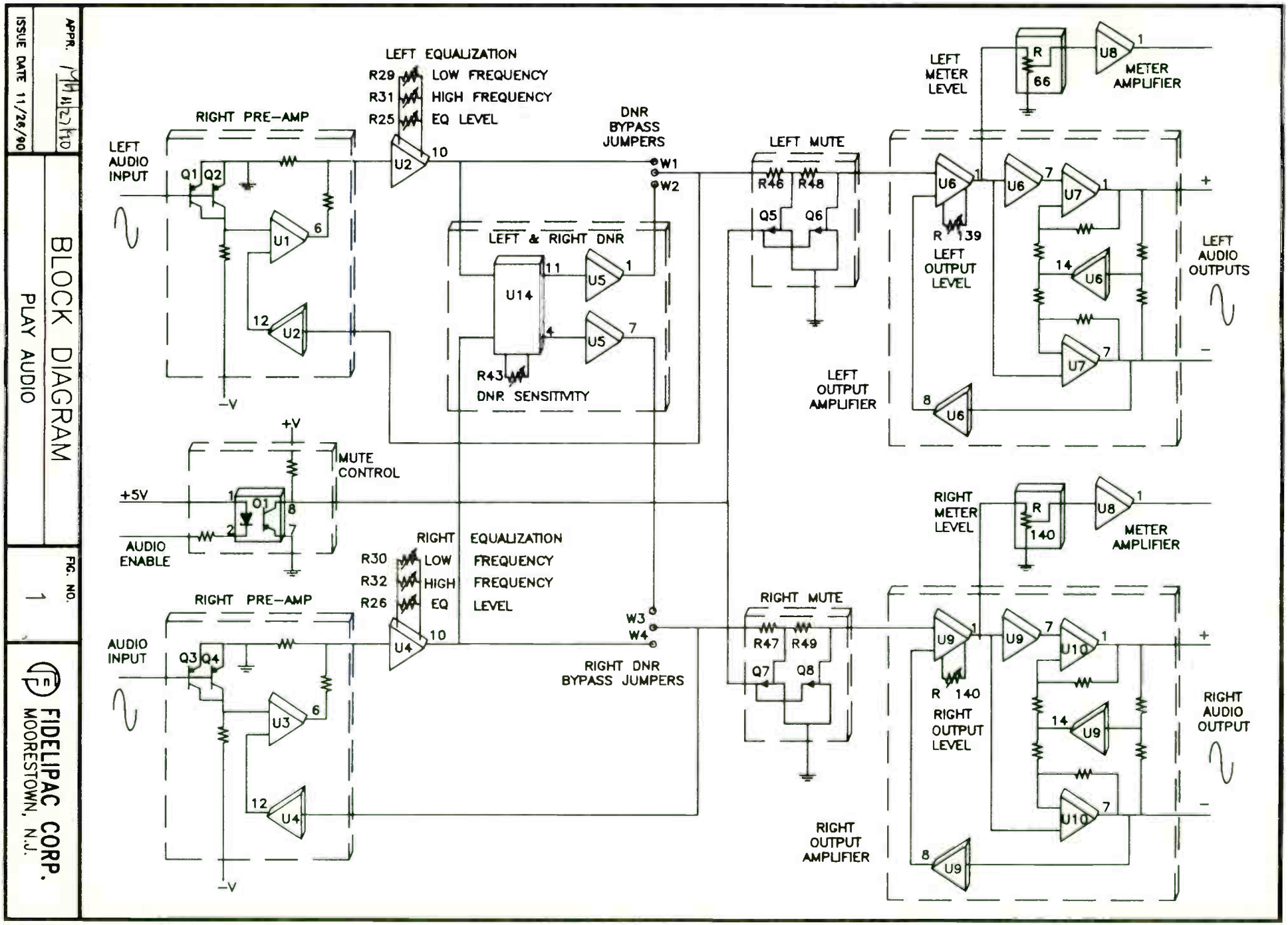
Record Amp Supplies

2. Following are the RECORD AMP supply voltages:

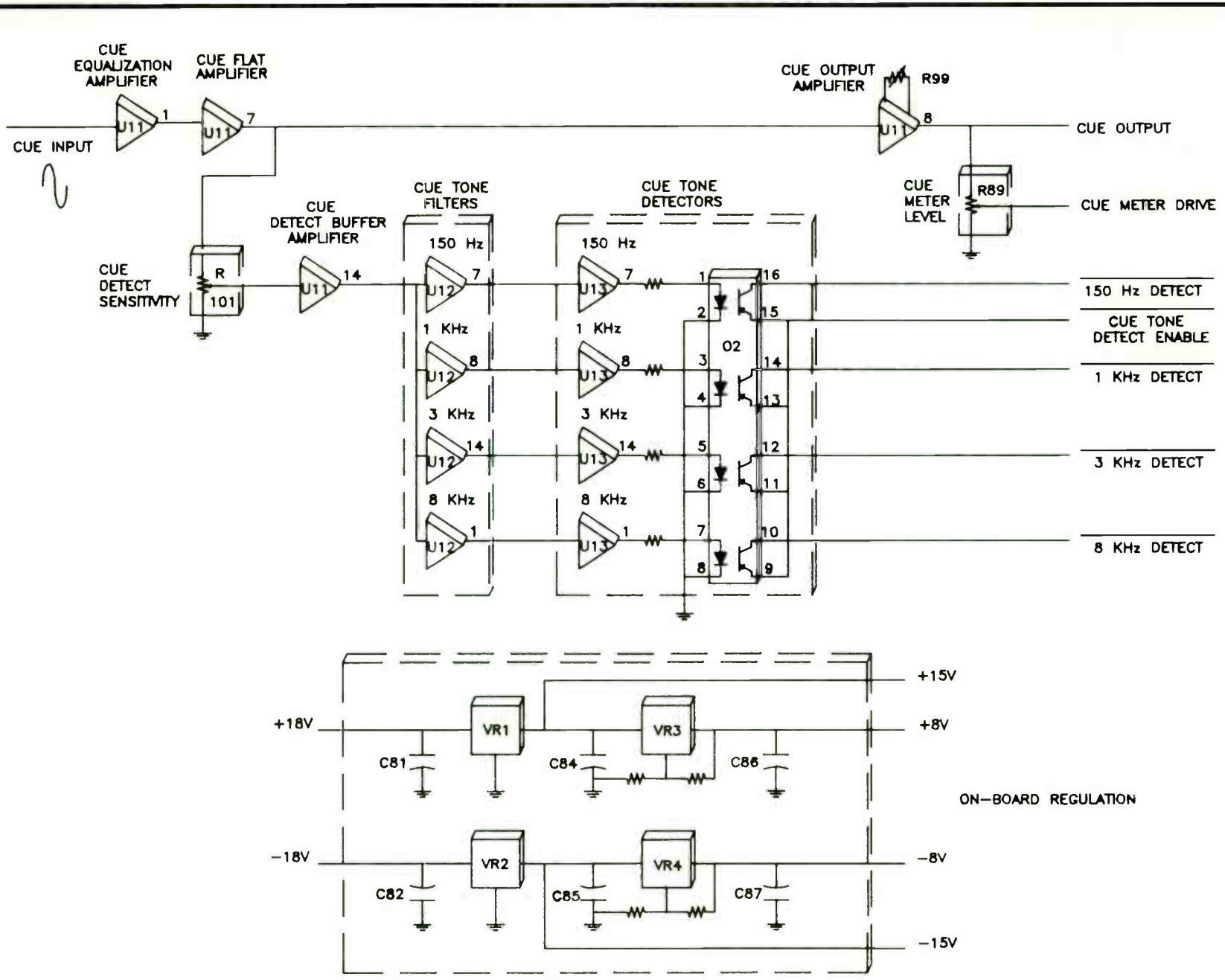
+15v	U12.15
-15v	U12.5

+12V Meter Supply

2. On the DISPLAY PANEL the 12V supply may be measured at U3.1.



908LOCK



ISSUE DATE 11/28/90

APPR. MH 12/3/90

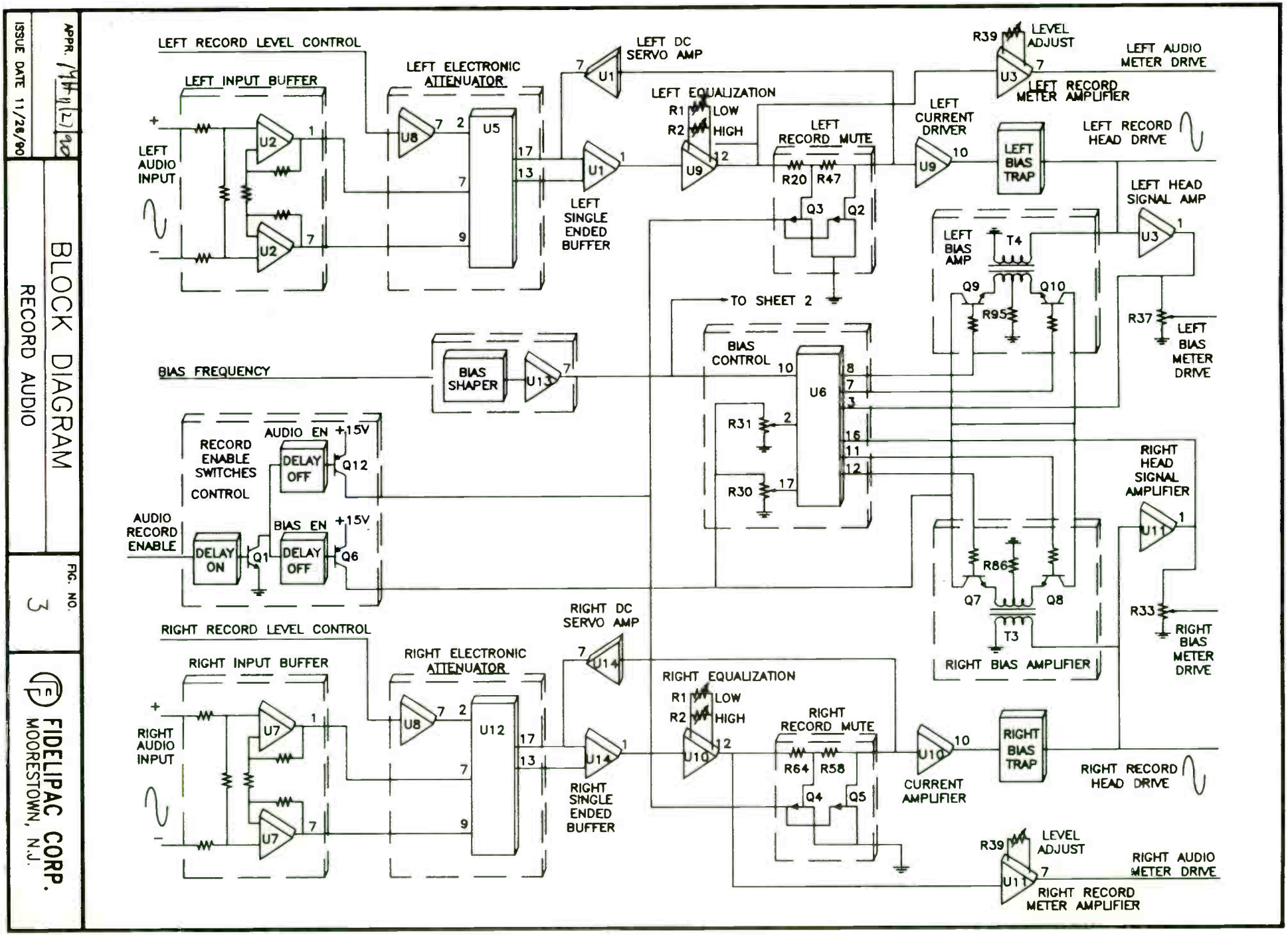
BLOCK DIAGRAM

PLAY CUE & POWER

FIG. NO. 2

FIDELIPAC CORP.
MOORESTOWN, N.J.

908LOCK



APPR. MH 11/27/90

ISSUE DATE 11/28/90

BLOCK DIAGRAM

RECORD AUDIO

FIG. NO. 3

FIDELIPAC CORP. MOORESTOWN, N.J.

90BLOCK

APPR. MH 11/25/90

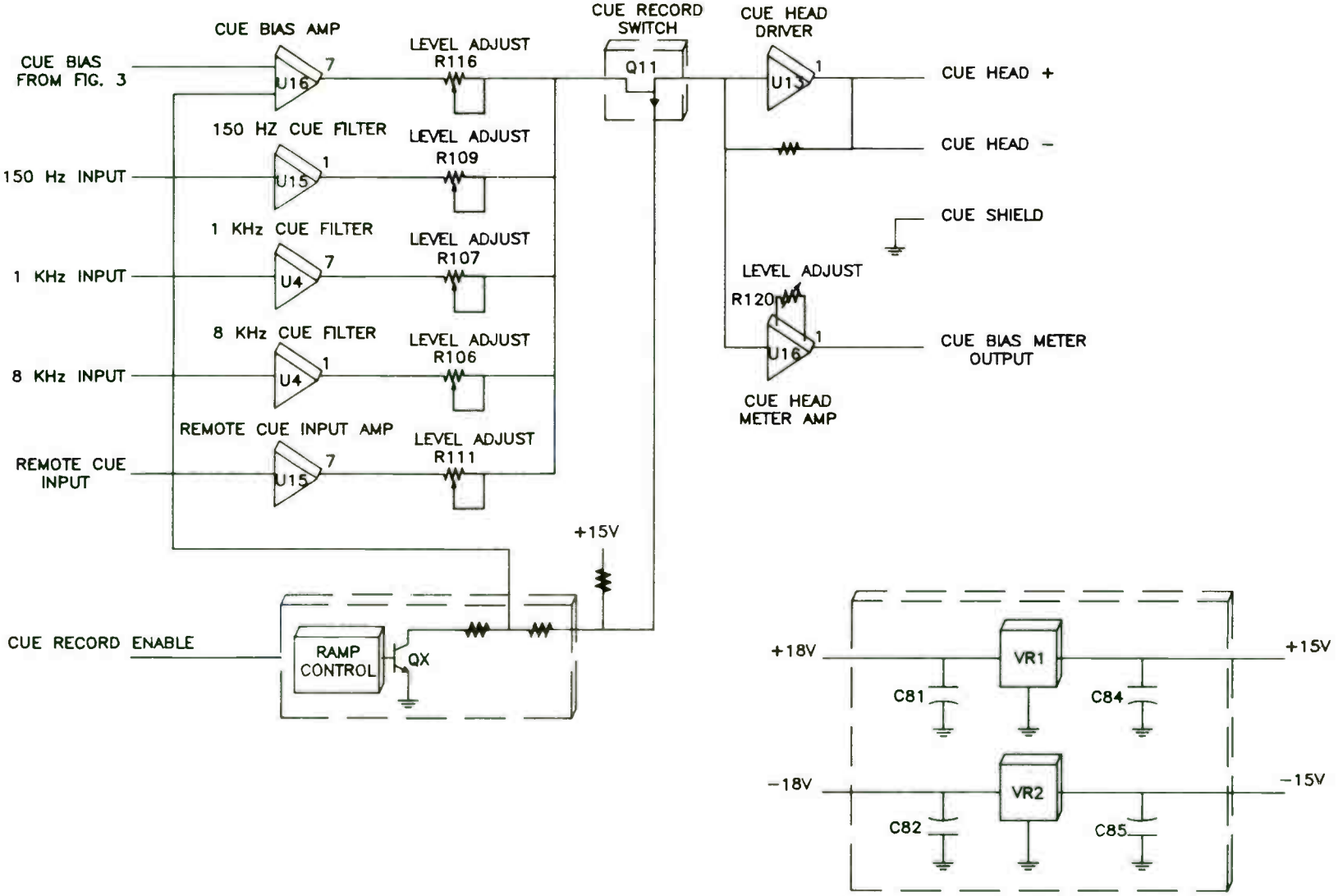
ISSUE DATE 11/6/90

BLOCK DIAGRAM

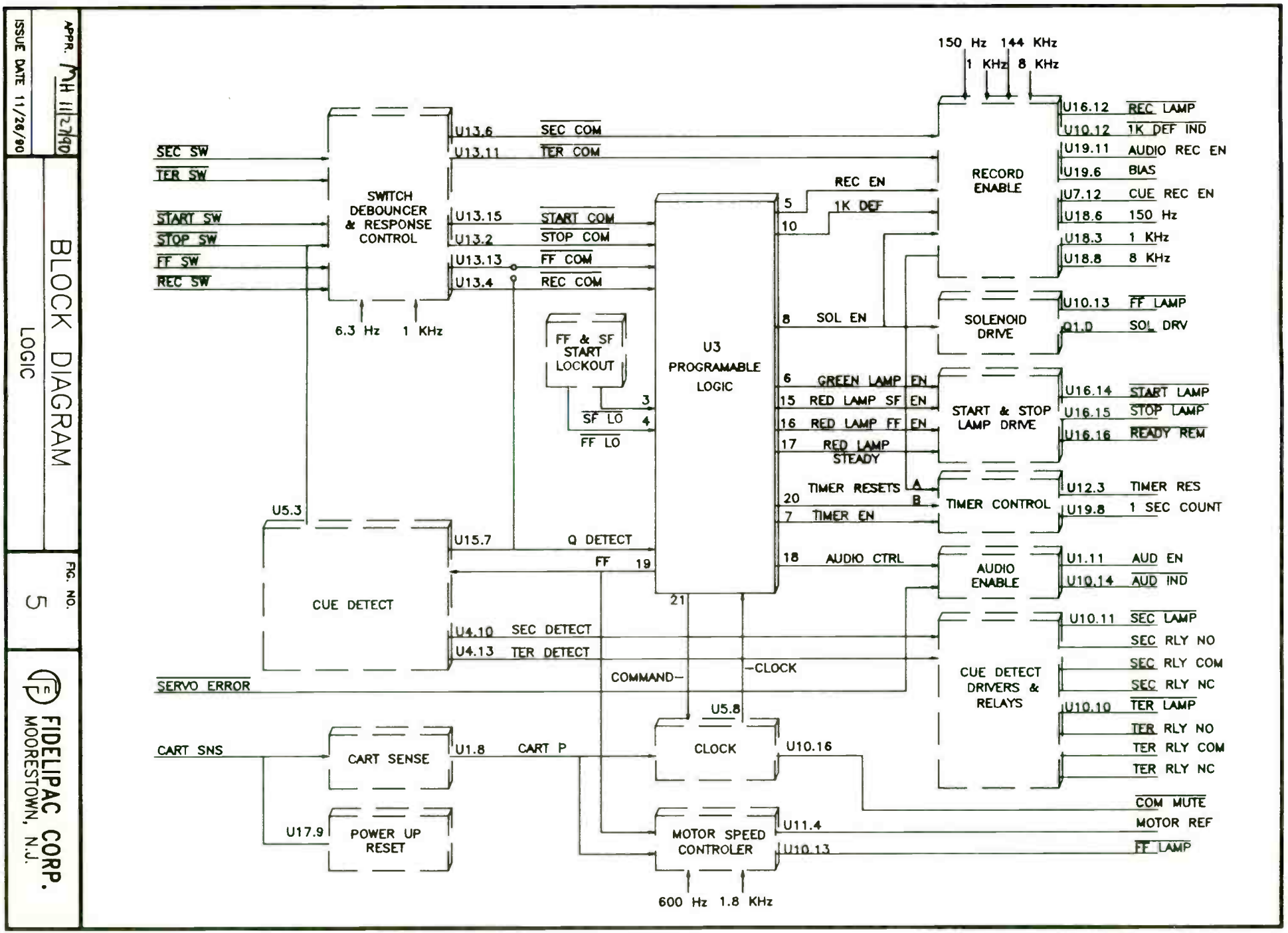
RECORD CUE & POWER

FIG. NO. 4

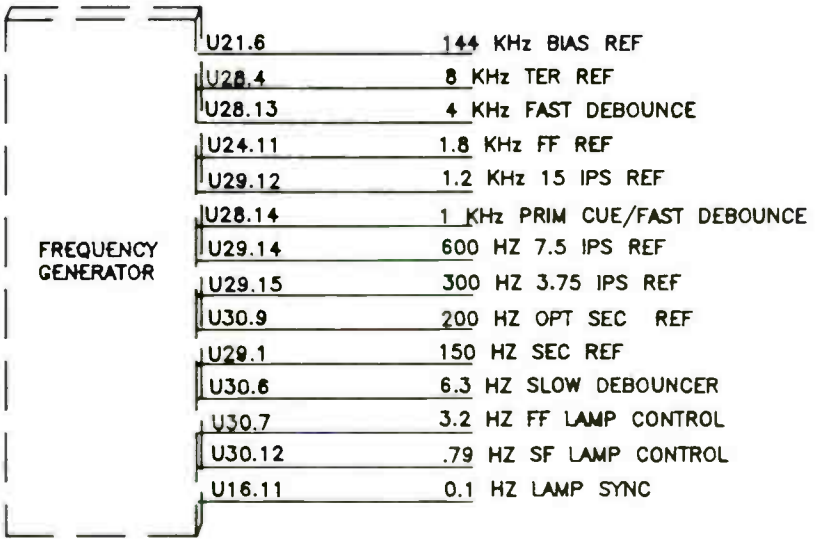
FIDELIPAC CORP.
MOORESTOWN, N.J.



90BLOCK



90BLOCK



APPR. MH 11/27/90 ISSUE DATE 11/26/90	BLOCK DIAGRAM FREQUENCY GENERATOR (LOGIC BOARD)	FIG. NO. 6	FIDELIPAC CORP. MOORESTOWN, N.J.

908BLOCK

APPR. MW 11/21/80

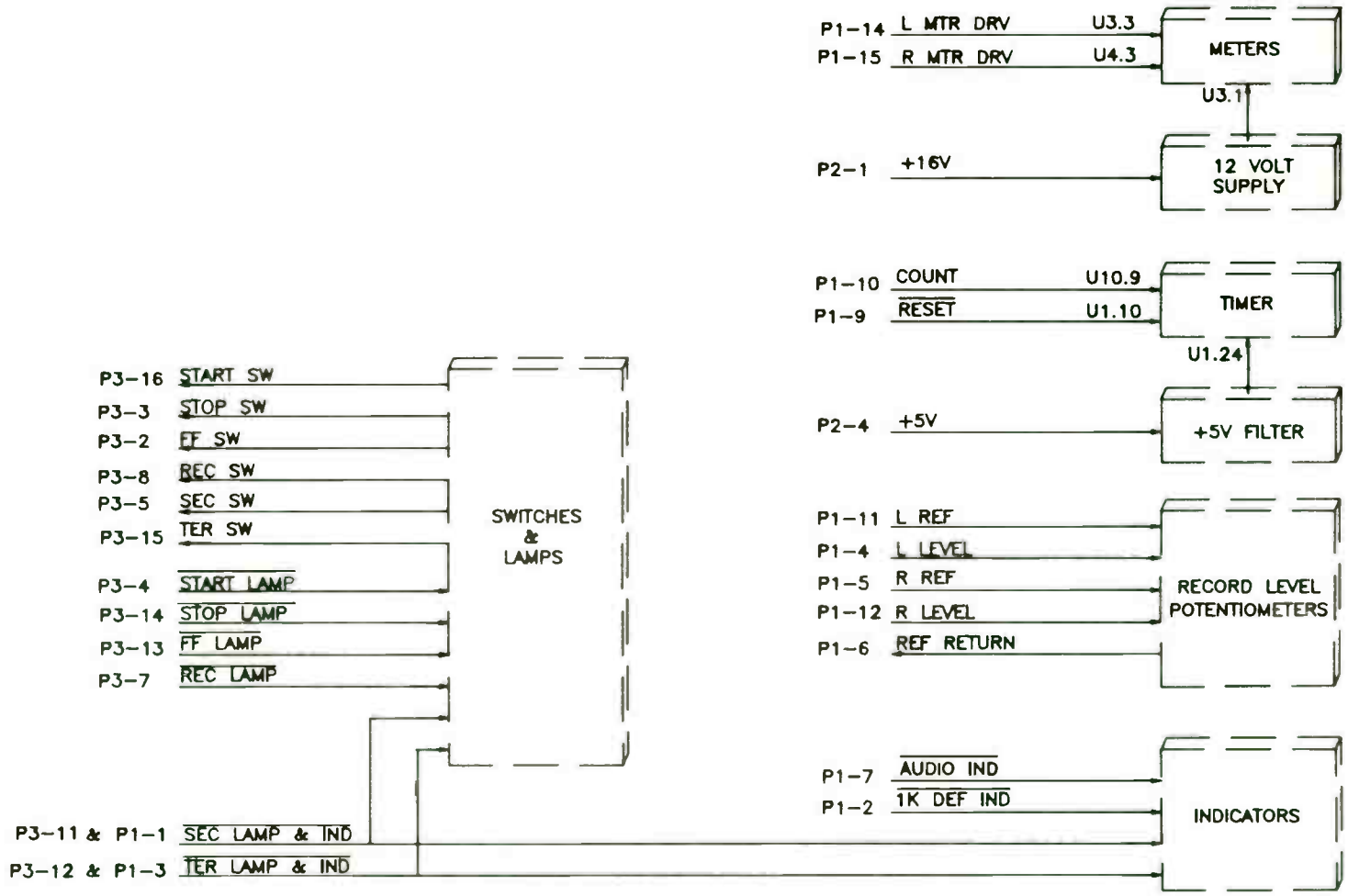
ISSUE DATE 11/28/80

BLOCK DIAGRAM

FRONT PANEL SWITCHES & DISPLAY

FIG. NO. 7

FIDELIPAC CORP.
MOORESTOWN, N.J.



90BLOCK

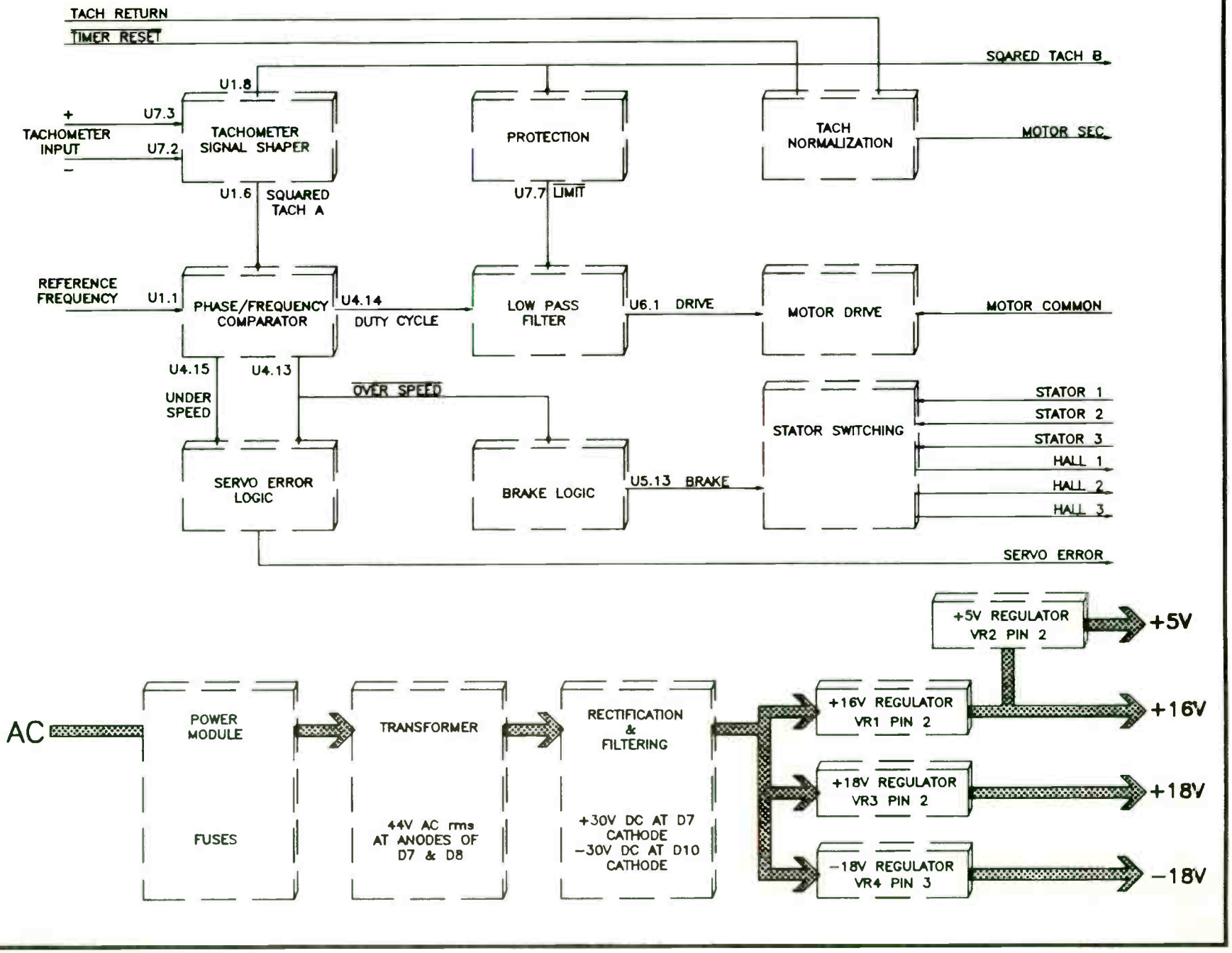
ISSUE DATE 11/26/90 APPR. MH 11/27/90

BLOCK DIAGRAM

MOTOR DRIVER & POWER SUPPLY

FIG. NO. 8

FIDELIPAC CORP. MOORESTOWN, N.J.



5.1 THEORY OF OPERATION

NOTE: Component designators utilized in circuit descriptions refer to the Left channel, where applicable. Those in brackets refer to the Right channel.

5.1.1 DISPLAY BOARD

5.1.1.1 METERING [Recorder Only]

Level adjustments for the LED meters are performed at their points of origin. Meter sources are switched via U2 on the Logic Board , enter the Display Board through P1 / Pin 14 [P1 / Pin 15] and are routed to U4 [U3], a 12 segment Meter Driver.

Potentiometer R15 [R9] functions as an input offset null. The value of R18 [R12] sets LED current, therefore meter intensity. The Red LEDs D21 through D24 [D9 through D12] use the secondary limiting resistor R22 [R21] to set their intensity with respect to the Green LEDs, D13 through D20 [D1 through D8].

Although the meter LEDs draw their current from the primary +16 VDC, power to U4 [U3] is via the local +12VDC Regulator, VR1.

PPM (Peak) meter ballistics corresponding to DIN 45406 specifications are present when W5 & W6 [W3 & W4] are not jumpered together, and are set by the values of C9 & R20 [C7 & R14].

VU (Average) meter ballistics corresponding to ANSI C165 specifications are present when W5 & W6 [W2 & W3] are jumpered together, and are set by the values of C8, C9, R19, & R20 [C6, C7, R13, & R14].

5.1.1.2 RECORD LEVEL POTENTIOMETERS [Recorder Only]

Multi-turn potentiometer R23 [R24] is mounted on the Display Board for easy front access, but is used by the Record Board to set Left [Right] Record Level. Reference voltage enters the Display Board via P1 / Pin 11 [P1 / Pin 5], and the adjusted voltage exits the board via P1 / Pin 4 [P1 / Pin 12]. P1 / Pin 6 returns to signal ground at the Record Board.

5.1.1.3 REAL TIME TIMER

Tachometer pulses equal to 1 PPS (Pulse per Second) at normal Play speed, generated by motor rotation, then processed and scaled on the Power Supply/Motor Driver and Logic Boards, enter the board via P1 / Pin 10 and are applied to Pin 8 of U1, a Time Counter / Multiplexed Display Driver. Timer reset is accomplished via a low, originating on the Logic Board, applied to U1 / Pin 14.

U1 drives U2, a 4 Digit / 7 Segment Display. Resistors R5 & R6 set colon display intensity.

5.1.1.4 STATUS INDICATORS

Three Green LED Status Indicators announce the presence of SECondary Cue Tone Detection (D32/D33), TERtiary Cue Tone Detection (D30/D31), and AUDIO Enable (D28/D29/D34/D35), these are driven by low commands from the Logic Board via P1 / Pin 1, P1 / Pin 3, and P1 / Pin 7, respectively. Indicator intensity is set by the values of R4, R2, & R3, respectively.

Recorders also include a Red LED Status Indicator for 1KHz DEFeat (D25/D26/D27), driven by a low logic command from the Logic Board via P1 / Pin 2. Indicator intensity is set by the value of R1.

5.1.2 SWITCH PANEL BOARD

The Switch Panel Board is used merely to mount the front panel switches and lamps. Reproducers include START Switch and Lamp S1, STOP Switch and Lamp S2, and FAST FORWARD Switch and Lamp S3. Recorders also include TERTIARY Switch and Lamp S4, SECONDARY Switch and Lamp S5, and RECORD Switch and Lamp S6.

5.1.3 LOGIC, FREQUENCY GENERATOR, & SOLENOID DRIVE BOARD

5.1.3.1 FREQUENCY GENERATION

U21 functions as the Master Oscillator, generating the Master Reference frequency of 18.432 MHz, as well as the 144 KHz bias frequency (18.432 MHz + 1280). Master Reference frequency is set by the values of Crystal X1, and R28.

U24 and U9 / Pins 11, 12, & 13 function as a Divide By 10 Counter to provide the 1800 Hz Fast Forward Reference Frequency used by the motor.

U22 and U25 each function as Dividers to establish a First Intermediate frequency of 3.072 MHz (18.432 MHz + 6). The 18.432 MHz output from U21 / Pin 9 is applied to U25 / Pin 2 and divided by 2 to provide a 9.216 MHz output at U25 / Pin 14, then applied to U22 / Pin 2. The combination of U22 and U9 divide by 3 to provide a 3.072 MHz output at U9 / Pin 3.

(3.072 MHz + 5). 3.072 MHz applied to U26 / Pin 2 is divided by 3 to provide a 1.024 MHz output at U9 / Pin 8. 3.072 MHz applied to U23 / Pin 2 is divided by 5 to provide a 614.4 KHz output at U9 / Pin 6.

The Second Intermediate frequency of 1.024 MHz is then applied to U28 / Pin 10 for further division. U28 outputs 1 KHz (1.024 MHz + 1024) at Pin 14, subsequently used as the Primary Cue Tone Reference and for switch response control at Response Controller U11; 2 KHz (1.024 MHz + 516) at Pin 12, a Fourth Intermediate frequency routed to U27 for further division; 4 KHz (1.024 MHz + 256) at Pin 13, subsequently used by the Cue/FSK Bias Enable Switch Debouncer U14; and 8 KHz (1.024 MHz + 128) at Pin 4, subsequently used as the Tertiary Cue Tone Reference by the Cue Tone Switch Gate U18.

The Third Intermediate frequency of 614.4 KHz is then applied to U29 / Pin 10 for further division. U29 outputs 1200 Hz (614.4 KHz + 512) at Pin 12, subsequently used as

18.432 MHz	Master Reference
3.072 MHz	First Intermediate
1.024 MHz	Second Intermediate
614.4 KHz	Third Intermediate
144 KHz	Bias Reference
8 KHz	Tertiary Cue Tone Reference
4 KHz	Cue/FSK Bias Enable Debounce Controller
2 KHz	Fourth Intermediate
1800 Hz	Fast Forward Reference
1200 Hz	15 ips Speed Reference
1 KHz	Primary Cue Tone Ref./1st Switch Debounce Controller
600 Hz	7.5 ips Speed Reference
400 Hz	Fifth Intermediate
300 Hz	3.75 ips Speed Reference
200 Hz	Optional Secondary Cue Tone Reference
150 Hz	Secondary Cue Tone Reference
6.3 Hz	2nd Switch Debounce Controller
3.2 Hz	Fast Flash Lamp Control
0.79 Hz	Slow Flash Lamp Control

Table 5.1.3.1 MASTER, INTERMEDIATE, and REFERENCE FREQUENCIES

The First Intermediate frequency of 3.072 MHz is further divided by the combinations of U26 & U9 and U23 & U9 to provide the Second and Third Intermediate frequencies of 1.024 MHz (3.072 MHz + 3) and 614.4 KHz

the optional Primary Speed Reference at 15 ips; 600 Hz (614.4 KHz + 1024) at Pin 14, subsequently used by the motor as the standard Primary Speed Reference at 7.5 ips; 300 Hz (614.4 KHz + 2048) at Pin 15,

subsequently used as the optional Primary Speed Reference at 3.75 ips; and 150 Hz (614.4 KHz ÷ 4096) at Pin 1, subsequently used as the Secondary Cue Tone Reference.

The Fourth Intermediate frequency of 2 KHz applied to U27 / Pin 2 is further divided by the combinations of U27 & U8 to provide the Fifth Intermediate frequency of 400 Hz, output at U8 / Pin 10.

The Fifth Intermediate frequency of 400 Hz is then applied to U30 / Pin 10 for further division. U30 outputs 200 Hz (400 Hz ÷ 2) at Pin 9, subsequently used as an optional Secondary Cue Tone source; 6.3 Hz (400 Hz ÷ 64) at Pin 2, subsequently used for switch response control at Response Controller U11; 3.2 Hz (400 Hz ÷ 128) at Pin 4 and 0.79 Hz (400 Hz ÷ 512) at Pin 12, both subsequently used by the Lamp Control Gate U12. The output at U30 / Pin 1 is routed via U16 / Pins 6 & 11 to the Remote Connector / Pin 28 where it functions as the Lamp Synchronization Bus. Similar signal(s) from other machines tied to this bus will be applied via U16 / Pins 7 & 10 to U30 / Pin 11 to accomplish synchronization.

5.1.3.2 CARTRIDGE SENSE

When a cartridge is fully inserted into the machine, it pivots a flag located in the deck plate on the left side of the head bridge, blocking an opto-coupler located under the deck plate. R30 supplies emitter current to this opto-coupler via P1 / Pin 19. Ground is supplied via P1 / Pin 17.

The collector enters the Logic Board via P1 / Pin 18 and is applied to Schmitt Trigger U1. The resulting high achieved upon cartridge insertion is applied to the PAL, U3 / Pin 22, the Motor Run Switch U7 / Pin 2, as well as the Response Controller U11 / Pin 11, and portions of the Clock logic U6 / Pin 10 and U14 / Pin 10.

5.1.3.3 MOTOR SPEED CONTROL

Two sections of Response Controller U11 are used to form a virtual single pole triple throw switch, determining when the motor runs, and at what speed.
The Motor Reference Frequency, determining the speed at which the motor runs, is selected during Idle, Play, and Record by the Speed Reference applied to U11 / Pin 2. This Speed Reference is determined by the position of jumpers W14, W15, and W16. Normally jumper W15 is inserted, selecting a Speed Reference of 600 Hz for 7.5 ips operation. Optionally, jumper W14 may be installed for a Speed Reference of 1200 Hz / 15 ips, or jumper W16 for a Speed Reference of 300 Hz / 3.75 ips. Only one of these three jumpers may be selected at any given time.

During Fast Forward, a high applied to U11 / Pin 10 causes the Motor Reference Frequency to be determined by the 1800 Hz Fast Forward Reference applied at U11 / Pin 1.

MOTOR REFERENCE FREQUENCY	JUMPER	MOTOR SPEED
Ground		STOP
300 Hz	W16	3.75 ips
600 Hz	W15	7.5 ips
1200 Hz	W14	15 ips
1800 Hz		FAST FWD

Table 5.1.3.3.1 MOTOR REFERENCE FREQS

Jumper W9 determines if the motor runs at all times, or only upon cartridge insertion. If it is not installed, U11 / Pin 9 is held high, causing the Motor Reference Frequency at U11/ Pin 4 to be present at all times. If it is installed, U11 / Pin 9 will be gated by cartridge insertion, via U1 & U7, such that the Motor Reference Frequency at U11/ Pin 4 will be present only when a cartridge is fully inserted.

W9	MOTOR ACTION
IN	Command Run
OUT	Continuous Run

Table 5.1.3.3.2 MOTOR RUN JUMPER

5.1.3.4 PROGRAMMABLE LOGIC ARRAY (PAL)

The heart of the machine logic is U3, a Programmable Logic Array (PAL). The output logic configuration of the PAL defines the states, or operational modes in which the CTR90 logic may exist, as defined in Table 5.1.2.4.1. PAL Inputs and Outputs are defined in Table 5.1.3.4.2.

IDLE: The default mode, and the only powered mode in which no Status Lamps are illuminated. IDLE occurs only when a cartridge is not inserted. Motor Continuous Run or Command Run is the only selectable option for IDLE, and is determined by jumper W9.

STOP/STEADY: The second default mode, identifiable by a steadily illuminated STOP Lamp. STOP/STEADY causes TIMER RESET and indicates that a cartridge is inserted but has not been actuated. PLAY, FAST FORWARD or RECORD READY Modes may be entered from STOP/STEADY.

STOP/SLOW FLASH: Identifiable by a slowly flashing STOP Lamp, indicating that the STOP was initiated by detection of a PRIMARY CUE TONE after a normal PLAY, RECORD, or AUTO FORWARD cycle. PLAY or RECORD READY Modes cannot be entered from STOP/SLOW FLASH unless jumper W8 is installed.

STOP/FAST FLASH: Identifiable by a rapidly flashing STOP Lamp, indicating that STOP was manually commanded prior to completion of a normal PLAY, RECORD, or FAST FORWARD cycle. PLAY or RECORD READY Modes cannot be entered from STOP/FAST FLASH, unless jumper W7 is installed. STOP/READY Mode may be entered by pressing the STOP Switch.

PLAY: Initiated by a PLAY command, and identifiable by an illuminated START Lamp, indicating that the solenoid is engaged. AUDIO Output and the TIMER are enabled during PLAY Mode.

FAST FORWARD: Initiated by a FAST FORWARD command, and identifiable by an illuminated FAST FORWARD Lamp, indicating that the motor is driving the cartridge at shuttle speed. During FAST FORWARD Mode the AUDIO Output is disabled and the TIMER is enabled. FAST FORWARD Mode may be manually exited by commanding STOP or START, or automatically upon detection of a PRIMARY CUE TONE.

FAST FORWARD/UNMUTE: Initiated and exited during FAST FORWARD Mode by toggling of the FAST FORWARD switch. Identifiable by illumination of both the FAST FORWARD Lamp and AUDIO Indicator.

	PAL OUTPUT LOGIC / PIN #											
	RECORD	START LAMP	TIMER COUNT	START	AUTO CUE ENABLE	1 KHz DEFEAT	STOP LAMP SLOW	STOP LAMP FAST	STOP LAMP STEADY	AUDIO ENABLE	FAST FORWARD	TIMER RESET
MODE	5	6	7	8	9	10	15	16	17	18	19	20
IDLE	LOW	LOW	LOW	LOW	HIGH	LOW	LOW	LOW	LOW	LOW	LOW	LOW
STOP/STEADY	LOW	LOW	LOW	LOW	HIGH	LOW	LOW	LOW	HIGH	LOW	LOW	HIGH
STOP/SLOW FLASH	LOW	LOW	LOW	LOW	HIGH	LOW	HIGH	LOW	LOW	LOW	LOW	LOW
STOP/FAST FLASH	LOW	LOW	LOW	LOW	HIGH	LOW	LOW	HIGH	LOW	LOW	LOW	LOW
PLAY	LOW	HIGH	HIGH	HIGH	HIGH	LOW	LOW	LOW	LOW	HIGH	LOW	LOW
FAST FORWARD	LOW	LOW	HIGH	LOW	HIGH	LOW	LOW	LOW	LOW	LOW	HIGH	LOW
FAST FORWARD/UNMUTE	LOW	LOW	HIGH	LOW	HIGH	LOW	LOW	LOW	LOW	HIGH	HIGH	LOW
AUTO MUTE	LOW	HIGH	LOW	LOW	HIGH	LOW	LOW	LOW	LOW	LOW	LOW	LOW
AUTO FORWARD	LOW	LOW	LOW	LOW	HIGH	LOW	LOW [1]	LOW [1]	LOW [1]	LOW	HIGH	LOW
RECORD READY	HIGH	LOW	LOW	LOW	HIGH	LOW	HIGH [1]	HIGH [1]	HIGH [1]	LOW	LOW	LOW
RECORD READY/PRIMARY DEFEAT	HIGH	LOW	LOW	LOW	HIGH	HIGH	HIGH	HIGH	HIGH	LOW	LOW	LOW
RECORD	HIGH	HIGH	HIGH	HIGH	HIGH	LOW	LOW	LOW	LOW	HIGH	LOW	LOW
RECORD/PRIMARY DEFEAT	HIGH	HIGH	HIGH	HIGH	HIGH	HIGH	LOW	LOW	LOW	HIGH	LOW	LOW
CLEAN	LOW	HIGH	LOW	HIGH	HIGH	LOW	LOW	LOW	LOW	LOW	LOW	LOW

Table 5.1.3.4.1 PAL OUTPUT LOGIC vs OPERATIONAL MODES
ALL OUTPUTS ARE ACTIVE HIGH

Note 1: Only one STOP Mode will occur during RECORD READY Modes, dependent on jumpers W7 & W8.

AUTO MUTE: Identifiable by illumination of the START Lamp and non-illumination of the AUDIO Indicator. May be initiated only from PLAY Mode, by detection of a SECONDARY or TERTIARY CUE TONE [as selected by jumpers W1, W2, W3, W4, & W6], or a COMMON MUTE command at the Remote Connector. AUDIO Output is disabled, and the TIMER Display is frozen during AUTO MUTE Mode.

AUTO FORWARD: Identifiable by illumination of the FAST FORWARD Lamp, non-illumination of the AUDIO Indicator, and frozen TIMER display. AUTO FORWARD may be initiated from PLAY and AUTO MUTE Modes by detection of a SECONDARY or TERTIARY CUE TONE [as selected by jumpers W1, W2, W3, W4, W5, & W6], or from AUTO MUTE Mode by a FAST FORWARD command.

RECORD READY: May be initiated only from STOP/STEADY, STOP/SLOW FLASH, or STOP/FAST FLASH Modes [as selected by jumpers W7 & W8], by a RECORD command. RECORD READY prepares the machine to enter RECORD Mode and switches the Meter Source to Input. Identifiable by illumination of the RECORD and STOP Lamps.

RECORD READY/PRIMARY DEFEAT: May be initiated only from RECORD READY Mode, by a second RECORD command. RECORD READY/ PRIMARY DEFEAT inhibits the recording of a PRIMARY CUE TONE during RECORD/ PRIMARY DEFEAT Mode, and is identifiable by illumination of the RECORD and STOP Lamps, and the 1KHz DEF Indicator.

RECORD: May be initiated only from RECORD READY Mode, by a START command. RECORD Mode initiates both the Audio and PRIMARY CUE TONE Recording processes, enables the TIMER, and switches the Meter Source to either input or output (via W11). Identifiable by illumination of the RECORD and START Lamps.

RECORD/PRIMARY DEFEAT: May be initiated only from RECORD READY/PRIMARY DEFEAT Mode, by a START command. RECORD/PRIMARY DEFEAT Mode initiates the Audio Recording process, and enables the TIMER. RECORD/PRIMARY DEFEAT is identifiable by illumination of the RECORD and START Lamps, and 1KHz DEF Indicator.

CLEAN: May be initiated only from IDLE Mode, by a long [1 second] START command. CLEAN Mode causes activation of the solenoid and motor, and is exited by a long [1 second] STOP command.

FUNCTION	ACTIVE LOGIC	PIN
CLOCK INPUT	HIGH	1
COMMAND INPUTS		
Start	LOW	2
Slow Flash Start Inhibit	HIGH	3
Fast Flash Start Inhibit	HIGH	4
Cue Detect	HIGH	11
Record	LOW	13
Stop	LOW	14
Cartridge Sense	LOW	22
Fast Forward	LOW	23
OUTPUTS		
Record	HIGH	5
Start Lamp	HIGH	6
Timer Count	HIGH	7
Start	HIGH	8
Auto Cue Defeat	LOW	9
1 KHz Defeat	HIGH	10
Stop Lamp Slow Flash	HIGH	15
Stop Lamp Fast Flash	HIGH	16
Stop Lamp Steady	HIGH	17
Audio Enable	HIGH	18
Fast Forward	HIGH	19
Timer Reset	HIGH	20
Selected Switch Activation	HIGH	21

Table 5.1.3.4.2 PAL INPUTS & OUTPUTS

All PAL logic transitions are synchronous. Each transition triggers on a rising edge of the clock input.

COMMANDS

Start, Stop, Record, and Fast Forward switch commands from the front panel and remote connector are routed through U13, a Switch Debouncer. The outputs of U13 follow its respective inputs (Pins 1 & 15, 14 & 2, 3 & 13, and 12 & 4) after the sensing of four rising edges at pin 7, making the response time of these switches dependent on the Debounce Controlling Frequency as determined by Response Controller U11 / Pin 14.

When no cartridge is inserted, U11 / Pin 11 is low, causing 6.3 Hz to be selected as the Debounce Controlling Frequency at Pin 14, or a switch response time of 635 msec. as used for the Cleaning Mode delay. When a cartridge is inserted, U11 / Pin 11 goes high, selecting 1 KHz as the Debounce Controlling Frequency produced at Pin 14, for a normal switch response time of 4 msec.

Secondary & Tertiary switch commands from the front panel and remote connector are similarly debounced by U13 / Pins 5 & 11 and 10 & 6, though are not used as PAL inputs.

Remote Cue Track/FSK Bias Enable from the remote connector and Cartridge Sense are similarly debounced through U14, where a 4 KHz Debounce Controlling Frequency is utilized, giving a response time of 1 msec.

Each of the four Cue Tone Detection Logic Inputs, Secondary Cue Detection at P2 / Pin 7, Primary Cue Detection at P2 / Pin 25, Primary/Fast Forward Cue Detection at P2 / Pin 8, and Tertiary Cue Detection at P2 / Pin 24, are active low. This Cue Detection Logic originates on the Reproduce Board, but is disabled by the output of the Cue Inhibit Timer U17 / Pin 7 for 1.6 seconds after the initiation of Play or Record. Upon Start, a high at U17 / Pin 4 creates a Cue Inhibit pulse of the desired duration, determined by the values of C1 and R10.

Primary and Primary/Fast Forward Cue Tone Detection are sensed at the inputs of NOR gate U5 / Pins 1 & 2, whose output is routed to D3 which serves to OR the signal with the Stop Command.

Secondary & Tertiary Cue Tone Detection are sensed at the inputs of NOR Gates U4 / Pins 9 & 12, respectively. The other inputs to these NOR gates, Pins 8 & 11, originate from the Fast Forward output of the PAL, inhibiting Secondary or Tertiary Cue Tone Detection during Fast Forward.

Secondary Cue Tone Detection at U4 / Pin 10 is selectable via jumper W2 to Cue Detect Timer U15, but always drives Inverter U10 / Pin 6. The output of U10 / Pin 11 is used as the Secondary Lamp Driver, Secondary remote tally, and to drive relay K1, with dry form C contacts available at the remote connector.

Tertiary Cue Tone Detection at U4 / Pin 13 is selectable via jumper W1 to Cue Detect Timer U15, but always drives Inverter U10 / Pin 7. The output of U10 / Pin 10 is used as the Tertiary Lamp Driver, Tertiary remote tally, and to drive relay K2, with dry form C contacts available at the remote connector.

W1	W2	W3	W4	W5	W6	ACTION
	IN		IN		IN	Auto Mute On End Of Secondary Cue Tone
	IN		IN	IN		Fast Forward On End Of Secondary Cue Tone
	IN		IN	IN	IN	Auto Forward On End Of Secondary Cue Tone
	IN	IN			IN	Auto Mute On Beginning Of Secondary Cue Tone
	IN	IN		IN		Fast Forward On Beginning Of Secondary Cue Tone
	IN	IN		IN	IN	Auto Forward On Beginning Of Secondary Cue Tone
IN			IN		IN	Auto Mute On End Of Tertiary Cue Tone
IN			IN	IN		Fast Forward On End Of Tertiary Cue Tone
IN			IN	IN	IN	Auto Forward On End Of Tertiary Cue Tone
IN		IN			IN	Auto Mute On Beginning Of Tertiary Cue Tone
IN		IN		IN		Fast Forward On Beginning Of Tertiary Cue Tone
IN		IN		IN	IN	Auto Forward On Beginning Of Tertiary Cue Tone

Table 5.1.3.4.3 CUE TONE SELECTIONS

The Cue Detect Timer, U15, may be configured by several jumpers to produce a Cue Detect and/or Fast Forward input command to the PAL, to produce such commands from Secondary and/or Tertiary Cue Tone Detection, and to trigger such command on either the leading or trailing edge of a cue tone. Table 5.1.3.4.3 shows jumper possibilities.

There are two Start Lockout modes, each with a corresponding jumper. Both disallow transitions from a Stop/Flash Mode to any other mode except Stop/Steady or Fast Forward. Jumper W7 creates a logic low at U3 / Pin 4, disabling Start Inhibit after an Interrupted Play cycle. Jumper W8 creates a logic low at U3 / Pin 3, disabling Start Inhibit prior to cartridge removal after a normal Play cycle.

W7	W8	ACTION
OUT		Start Inhibited After Interrupted Play
IN		Start Allowed After Interrupted Play
	OUT	Start Inhibited After Normal Play
	IN	Start Allowed After Normal Play

Table 5.1.3.4.4 START INHIBIT JUMPERS

CLOCK PULSES

Clock pulses, causing a PAL logic transition, are created by Cartridge Sense, Power Up, Cue Tone Detection, Front Panel or Remote Switch Actions, Audio Mute, or an input to the Play Mute Command Line at the remote connector.

When a cartridge is inserted, the high occurring at U1 / Pin 8 is fed to both the Switch Debouncer U14 / Pin 10 and Exclusive OR Gate U6 / Pin 10. The debounced, and 4 msec. delayed, signal appearing at U14 / Pin 6 is applied to the other input of the Exclusive OR Gate U6 / Pin 9. Whenever either input to the Exclusive OR Gate U6 changes, its output at Pin 8 will change, and remain in that state only until the two inputs are again equal. The result is a shaped output pulse, 4 msec. in duration, at U6 / Pin 8 whenever a cartridge is inserted or removed.

Power-Up initiates a pulse at the output of U17 / Pin 9, created by the charge time of C5 and R24. This pulse is applied to the inputs of AND Gate U1, and then treated exactly as Cartridge Sense in the preceding paragraph. The result is an output pulse at U6 / Pin 8 anytime that the machine is switched on.

Similarly, 1 KHz Primary Cue Tone Detection via P2 / Pin 25 and 3 KHz Fast Forward Primary Cue Detection via P2 / Pin 25 are selected at OR Gate U5 / Pins 1, 2, & 3, delayed by U14 / Pins 3 & 13, and applied to Exclusive OR Gate U6 / Pins 4 & 5. The resultant output at U6 / Pin 6 is a shaped pulse whenever a Primary Cue Tone is Detected. If the appropriate jumpers are installed, Secondary and/or Tertiary Cue Detection via P2 / Pin 7 and P2 / Pin 24, respectively, U4, U15, and D6 may also originate a logic pulse at this point.

During Fast Forward modes, the output of the PAL, U3 / Pin 19, is conditioned and applied via NOR Gates U4 / Pins 5, 6, 4, 2, 3, & 1, to OR Gates U5 / Pins 1 & 2, U4 / Pins 8 & 11. This allows Primary, Secondary, & Tertiary Cue Detection during Play and Record modes. During Fast Forward modes, it allows 3 KHz Fast Forward Cue Detection, but disallows Secondary and Tertiary Cue Tone Detection.

The PAL, U3, prioritizes the Start, Stop, Fast Forward, and Record Switch Commands from both the Front Panel and Remote Connector, and outputs an active high signal at pin 21 whenever any of these are activated. This signal is delayed 1 Ms by U14 / Pins 1 & 15, and is routed to OR Gate U5 / Pin 9.

Auto Mute employs a similar circuit, sensing the Audio Enable output of the PAL U3/ Pin 18, using U14 / Pins 14 & 2 to implement the delay, and the Exclusive OR Gate U6 / Pins 1, 2, & 3 and AND Gate U1 / Pins 4, 5, & 6. This +5V signal is converted to a +15VDC open collector active low signal by U10 / Pins 1 & 16, and routed to the remote connector's Play Mute Command Line at J45, which outputs a 1 msec. low pulse every time the PAL's Audio Enable Output (Pin 18) goes high. Conversely, this

Mute logic, and that of any other machine tied to this remote connector bus, is sensed and routed back through Inverter U10 / Pins 2 & 15, converting it to an active high which is applied to OR Gate U5 / Pin 13. The result is a pulse whenever the machine or any other selected CTR90 machine experiences Auto Mute.

All of the above clock sources eventually arrive at OR Gate U5, and appear at the clock input of the PAL, U3 / Pin 1.

5.1.3.5 LOGIC OUTPUTS

Record Enable logic is generated by AND Gate U19. PAL outputs of Start and Record are applied to Pins 13 & 12, respectively, with the resultant output at Pin 11 used as in input to Cue Recording Logic Gates (U7 / Pin 13, U12 / Pin 13) and is sent to the Record Board via P2 / Pin 16.

The Primary Cue Tone is enabled whenever Record Enable is present, the Solenoid is energized, and the 1 KHz Defeat output of the PAL is not active. U3 / Pin 10 outputs a low whenever 1 KHz defeat is not commanded. This is applied to U10 / Pin 5. and U8 / Pin 1. Inverter U10 / Pin 12 drives the 1 KHz indicator on the front panel. Inverter U8 / Pin 2 applies a high to the 1 KHz Timer U16 / Pin 13, enabling a 600 msec. output pulse at Pin 10. This logic is applied to AND Gate U12 / Pin 12, which together with Record Enable at Pin 13 provides a true output at Pin 11 then routed to both AND Gate U18, where it enables the 1 KHz Primary Cue Tone Reference Frequency, and is fed to the Record Board via P2 / Pin 19, and to D15 where it becomes part of an OR equation resulting in a Cue Bias Enable that is also sent to the Record Board via P1 / Pin 21.

Secondary and Tertiary Cue Tones are similarly enabled. The debounced commands from either the front panel or remote connector appear at U13 / Pins 11 & 6, and are input to Inverters U8 / Pins 3 & 5, respectively. The Inverters outputs are applied to AND Gates U18 / Pin 12 and U19 / Pin 1, which together with Record Enable at the complimentary inputs produce true outputs at U18 / Pin 11 and U19 / Pin 3, respectively. These are applied to AND Gates U18 / Pins 5 & 10, where they enable the 150 Hz and 8 KHz Secondary and Tertiary Cue Tone Reference Frequencies, and are fed to the Record Board via P2 / Pins 4 & 3, respectively, and to D16 & D17 where they become part of an OR equation resulting in a Cue Bias Enable that is also sent to the Record Board via P1 / Pin 21.

Cue Track/FSK Bias Enable from the remote connector provides Cue Bias Enable via D14 identical to that provided by Cue Tone commands. The remote input at J37 is De bounced through U14 / Pins 12 & 4, Inverted by U8 / Pins 13 & 12, and applied to both OR Gate U7 / Pin 12 and D14. When Record Enable is present, U7 / Pin 11 is high and applied to AND Gate U19 / Pin 5, where combined with the 144 KHz Bias Reference Frequency it is fed to the Record Board via P2 / Pin 2.

Tachometer pulses arrive via P2 / Pin 21, are gated with the Timer Count Enable output of the PAL U3 / Pin 7 through U19 / Pins 9, 10, & 8, and are sent to the Power Supply/Motor Driver Board via P1 / Pin 29.

Timer Reset occurs at AND Gate U12 / Pin 3 during Stop (No Flashing Lamp) as per the output at U3 / Pin 20, and when a Start occurs as output from the 1 KHz Record Timer U15 / Pin 9. Timer Reset logic is sent to the front panel via P1 / Pin 29.

The Audio Enable line used on the Reproduce Board to unmute the audio outputs is produced at AND Gate U11 / Pin 11. The inputs to this gate are the Audio Enable output of the PAL U3 / Pin 18 and Servo Error Detect from the Power Supply/Motor Driver Board. Jumper W10 determines whether audio will be muted whenever the motor servo is off speed.

W10	AUDIO ENABLE ACTION
IN	Mute During Speed Error
OUT	No Mute During Speed Error

Table 5.1.3.5 AUDIO MUTE JUMPER

5.1.3.6 LAMP DRIVERS & REMOTE TALLIES

All front panel lamps and remote tallies are driven by Inverters outputting active lows and capable of sinking the current required to illuminate up to two 100 mA lamps.

The STOP Lamp, and tally at remote connector Pin 21, are driven by Inverter U16 / Pin 15. The input to U16 can be commanded by OR Gates U7 and AND Gates U12 to be steady state upon active Stop/Steady logic at U3 / Pin 17, flashing at the slow rate of .79 Hz upon active Stop/Slow Flash logic at U3 / Pin 15, or fast rate of 3.2 Hz upon active Stop/Fast Flash logic at U3 / Pin 16.

The START Lamp, and tally at remote connector Pin 23, are driven by Inverter U16 / Pin 14. START indication follows active Start Lamp logic at U3 / Pin 6.

The FAST FORWARD Lamp, and tally at remote connector Pin 19, are driven by Inverter U10 / Pin 13. FAST FORWARD indication follows active Fast Forward logic at U3 / Pin 19.

On Recorders only, the RECORD Lamp and tally at remote connector Pin 48, are driven by Inverter U16 / Pin 12. RECORD indication follows active Record logic at U3 / Pin 5.

On Recorders only, the SECONDARY Lamp, Indicator, and tally at remote connector Pin 16, are driven by Inverter U10 / Pin 11. SECONDARY indication follows an active high at U4 / Pin 10.

On Recorders only, the TERTIARY Lamp, Indicator, and tally at remote connector Pin 17, are driven by Inverter U10 / Pin 10. SECONDARY indication follows an active high at U4 / Pin 13.

On Recorders only, the 1 KHz Defeat Indicator and tally at remote connector Pin 46, are driven by Inverter U10 / Pin 12. 1 KHz DEFEAT indication follows active 1 KHz Defeat logic at U3 / Pin 10.

The AUDIO Indicator, and tally at remote connector Pin 47, are driven by Inverter U10 / Pin 14. AUDIO indication follows an active high at U1 / Pin 11.

On Recorders only, the READY tally at remote connector Pin 44 is driven by Inverter U16 / Pin 16. READY tally follows active Stop Lamp Steady logic at U3 / Pin 17.

5.1.3.7 SOLENOID DRIVE

Solenoid activation follows PAL Start logic at U3 / Pin 8. Initial activation is caused by the +5 VDC logic high applied to Voltage Comparator U20 / Pin 6. Comparison to the +2 VDC reference determined by divider network R35 & R36, and applied to Pin 5, causes output Pin 7 to go low , turning FET Q2 fully on, causing Sense Amplifier U2 / Pin 1 to go low, turning FET Q1 fully on. A full 34 VDC is now applied to the solenoid.

After activation, solenoid drive is reduced, then controlled by a 360mA constant current circuit. The discharge of C11, according to its time constant with R32, turns off FET Q1, thereby lowering the voltage applied to the solenoid after initial energization. Thereafter the solenoid draws current through R31. This current varies the voltage at U20 / Pin 2, regulating the forward bias to FET Q1, thus the current through the solenoid.

5.1.3.8 METER CONTROL

All Meter Input sources are selected by Analog Switch U2 , which has 4 two channel inputs, and 2 control lines. Meter source selection is accomplished via SW1, with positions for Audio, Bias, and Cue. Audio source selection is determined by machine mode and jumper W11 as per table 5.1.3.8.

MACHINE MODE	W11	METER FUNCTION
Non Record	NO	Audio Output
Record	NO	Audio Input
Non Record	YES	Audio Output
Ready	YES	Audio Input
Record	YES	Audio Output

Table 5.1.3.8 INPUT/OUTPUT METERING

5.1.4 REPRODUCE BOARD

5.1.4.1 HEAD INPUT

The low level output of the Reproduce Head enters the board via P1 / Pin 2 [P1 / Pin 4] and is applied to the Head Preamplifier, comprised of Q1, Q2, & U1 [Q3, Q4, & U3]. R1 & C1 [R2 & C36] provide resonant loading for the Reproduce Head.

5.1.4.2 EQUALIZATION & LEVEL

Reproduce Equalization is accomplished in the feedback loop of Equalization Amplifier U2 / Pins 6, 7, & 10 [U4 / Pins 6, 7 & 10]. Equalization is adjusted by Low Frequency Potentiometer R29 [R30], and High Frequency Potentiometer R31 [R32]. The equalization networks have sufficient range to be adjusted to NAB or IEC (DIN) standards. Potentiometer R25 [R26] adjusts Reproduce Level.

5.1.4.3 DNR DYNAMIC NOISE REDUCTION

The output of Equalization Amplifier U2 / Pin 10 [U4 / Pin 10] is applied to the input of DNR Controller U14 / Pin 13 [U14 / Pin 2]. Potentiometer R43 sets the Level Sensitivity at which the lowpass filtering effect of DNR begins to take effect. The output of the DNR Controller U14 / Pin 11 [U14 / Pin 4] is buffered via Inverter U5 / Pins 1, 2, & 3 [U5 / Pins 5, 6, & 7], and, if DNR is enabled by the insertion of jumper W2 [W4], is applied to Servo Feedback Amplifier U2 / Pin 1 [U4 / Pin 1]. If DNR is not enabled, jumper W1 [W3] is installed, and the output to U2 / Pin 1 [U4 / Pin 1] is derived from the output of Equalization Amplifier U2 / Pin 10 [U4 / Pin 10].

W1 W2 W3 W4	ACTION
IN OUT	DNR NOT Active
OUT IN	DNR Active

Table 5.1.4.3 DNR JUMPERS

5.1.4.4 AUDIO MUTE

The output of either the Equalization Amplifier or Inverter, dependent on Jumpers W1 & W2 [W3 & W4], is applied to Output Buffer U6 / Pin 2 [U9 / Pin 2] via a Dual Stage Mute configuration consisting of FETs Q5 & Q6 [Q7 & Q8]. These FETs are simultaneously activated via Opto-Isolator O1 whenever Audio Enable is not commanded by the Logic Board at P1 / Pin 22.

5.1.4.5 AUDIO OUTPUT

The Active Balanced Differential Output Stage consists of U6 & U7 [U9 & U10]. Level Potentiometer R139 [R140], in the feedback loop of Output Buffer U6 [U9] adjusts Output Level. Output Buffer U6 / Pin 1 [U9 / Pin 1] feeds two Differential Drivers, U7 / Pin 3 [U10 / Pin 3] via Inverter U6 / Pins 5, 6, & 7 [U9 / Pins 5, 6, & 7], and U7 / Pin 5 [U10 / Pin 5]. Null Amplifier U6 / Pins 12, 13, & 14 [U9 / Pins 12, 13, & 14] provides error correction to the Differential Drivers whenever an unequal or unbalanced load is encountered. Servo Amplifier U6 / Pins 8, 9, & 10 senses and corrects DC offsets appearing at the Audio Output due to component tolerances or changing load conditions.

Traces at jumpers W5 and W6 [W7 and W8] may be cut to change the output impedance from 60Ω low Z to 600Ω whenever outputs are to be bridged together, paralleling the outputs of several Reproducers into a single Control Console Input.

Pads are also provided for the optional Output Transformer T1 [T2].

If the Output Transformer is installed PC traces from T1 [T2] / Pins 1 to 8 and 4 to 5 must be cut, and jumpers must be installed for 600Ω output impedance, as detailed above.

A number of pads are also provided for various custom output configurations.

The Audio Output is available at both the Output XLR and 9 pin "D" type connectors provided. Either, but only one , type output connector should be utilized. See Sec 2.2.3 for table of pin numbers.

5.1.4.6 CUE TONE DETECTION

The low level output of the Cue Head enters the board via P1 / Pin 19 and is applied to Cue Equalization Preamplifier U11 / Pin 3. Preamplifier output at U11 / Pin 1 feeds Cue Buffer U11 / Pin 6, and the buffered output at U11 / Pin 7 is sent to both Cue Detect Level Potentiometer R101 and Cue Meter/FSK Data Amplifier U11 / Pin 9. Buffered FSK Data Output is sent from U11 / Pin 8 via P10 to the remote connector.

Cue Tone Recognition is accomplished by four Bandpass Filters, each tuned to the appropriate frequency, with outputs rectified, shaped by Voltage Comparator, and sent via Opto-Isolator to the Logic Board.

1 KHz recognition is accomplished via filter U12 / Pins 8, 9 & 10, rectified by D3, shaped by comparator U13 / Pins 8, 9, & 10, applied to Opto-Isolator O2 , / Pin 3 and sent via P1 / Pin 26 to the Logic Board as Primary Cue Detection.

3 KHz recognition is accomplished via filter U12 / Pins 12, 13 & 14, rectified by D4, shaped by comparator U13 / Pins 12, 13, & 14, applied to Opto-Isolator O2 / Pin 5, and sent via P1 / Pin 27 to the Logic Board as Primary/Fast Forward Cue Detection.

150 Hz recognition is accomplished via filter U12 / Pins 5, 6 & 7, rectified by D2, shaped by comparator U13 / Pins 5, 6, & 7, applied to Opto-Isolator O2 / Pin 1, and sent via P1 / Pin 25 to the Logic Board as Secondary Cue Detection.

8 KHz recognition is accomplished via filter U12 / Pins 1, 2 & 3, rectified by D5, shaped by comparator U13 / Pins 1, 2, & 3, applied to Opto-Isolator O2 / Pin 7, and sent via P1 / Pin 12 to the Logic Board as Tertiary Cue Detection.

5.1.4.7 METER SOURCES

The Audio Output Metering source is derived at U6 / Pin 1 [U9 / Pin 1], adjusted via Audio Meter Level Potentiometer R66 [R67], buffered by Meter Amplifier U8 / Pins 1, 2 & 3 [U8 / Pins 5, 6, & 7], and sent via P1 / Pin 23 [P1 / Pin 24] to meter source switching on the Logic Board.

The Cue Metering source is derived at U11 / Pin 7, buffered by U11 / Pins 8, 9, & 10, adjusted by Cue Meter Level Potentiometer R89, and sent via P1 / Pin 11 to meter source switching on the Logic Board.

5.1.4.8 LOCAL VOLTAGE REGULATION

Bipolar 15VDC is locally provided on the Reproduce Board by Positive Voltage Regulator VR1 and Negative Voltage Regulator VR2, fed by + 18VDC & - 18VDC via P1 / Pins 15 30, and Pins 14 & 29, respectively.

Bipolar 8VDC, for use by DNR Controller U14, is provided by Positive Voltage Regulator VR3 and Negative Voltage Regulator VR4, fed by the bipolar 15VDC outputs of VR1 & VR2, respectively.

5.1.5 RECORD BOARD

5.1.5.1 AUDIO INPUT

The Audio Input arrives via both the Input XLR type and 9 pin "D" connectors provided. Either, but only one, type input connector should be utilized. See Sec 2.2.3 for table of pin numbers.

C5 & C30 [C43 & C46] provide DC input blocking, and resistor package R44 [R82] sets the input impedance. With C9 & C10, [C44 & C45] they form a lowpass RF filter.

Pads LX15, LX16, LX17, LX18, & LX19 [RX15, RX16, RX17, RX18, & RX19] are provided for the optional addition of loading resistors R5 & R6 [R83 & R84] to change the input from high impedance bridging to 600Ω terminating, if required.

Pads are also provided for the optional Input Transformer T1 [T2].

If transformers are installed, cut the traces between T1 pins 1 & 8, and between T1 pins 4 & 5 [T2 pins 1 & 8, and 4 & 5] at arrow shaped traces.

The input signal is applied to Differential Input Amplifier U2 / Pins 3 & 5 [U7 / Pins 3 & 5], whose balanced output at Pins 1 & 7 are sent to Voltage Controlled Amplifier (VCA) U5 / Pins 2 & 7 [U12 / Pins 2 & 7]. The VCA is utilized as an electronic attenuator controlled by the DC voltage set by Record Level Potentiometer R23 [R24] on the Display Board at the front of the machine, input via P1 / Pin 20 [P1 / Pin 21], buffered through inverting DC Amplifier U8 / Pins 5, 6, & 7 [U8 / Pins 1, 2, &3], and applied to VCA Pin 9. R11 [R80] is a factory set VCA control.

The balanced output of the VCA at Pins 13 & 17 is sent to Differential Receiver Amplifier U1 / Pins 2 & 3 [U14 / Pins 2 & 3], which converts the balanced input signal to an unbalanced signal for subsequent processes.

5.1.5.2 EQUALIZATION

Record Equalization is accomplished at the input of Equalization Amplifier U9 / Pin 1 [U10 / Pin 1]. Low frequency equalization is adjusted by the values of potentiometer R1 & C2 [R74 & C42], while high frequency equalization is adjusted by the values of potentiometer R2 & C33 [R73 & C34]. The equalization networks have sufficient range to be adjusted to NAB or IEC (DIN) standards.

5.1.5.3 NON-RECORD MUTE

The output of the Equalization Amplifier at U9 / Pin 12 [U10 / Pin 12] is applied to Head Driver U9 / Pin 6 [U10 / Pin 6] via a Dual Stage Mute configuration consisting of FETs Q2 & Q3 [Q4 & Q5]. These FETs are simultaneously activated by the Bias Ramp (whenever Audio Record Enable is not present) via Mute Driver Q12.

DC offsets are eliminated by Servo Amplifier U1 / Pins 5, 6, & 7 [U14 / Pins 5, 6, & 7.

5.1.5.4 AUDIO BIAS DERIVATION / DOLBY HX PRO

During Record Mode, the 144 KHz Bias Frequency is input via J1 / Pin 9. This square wave output of the Logic Board is applied to Bias Buffer U13 / Pin 6 via a Filter composed of R24, L1, C12, & C14, resulting in a 144 KHz sine wave output at U13 / Pin 7. Filtered Bias Reference Frequency is then applied to Dolby Hx Pro Controller U6 / Pin 10.

Record Enable drive is derived by Drivers Q1, Q6, & Q12. Audio Record Enable Logic at J1 / Pin 12 forward biases Q1, with the time constants of D2, R40, & C31 determining a Bias Ramp having a slow turn on time and rapid turn off. This ramp prevents "thumps" at the initiation of recording.

When Q1 is on, it forward biases Q12, which deactivates the Mute FETs Q2 & Q3 [Q4 & Q5]. Q1 also forward biases Q6, enabling Dolby HX Pro.

As Record is enabled via Q6, a DC voltage determined by the adjustment of potentiometer R31 [R30] is applied to the Bias Reference Input of the Dolby HX Pro Controller U6 / Pin 2 [U6 / Pin 17].

As Bias is enabled, it is applied to the Bias Level Input of the Dolby HX Pro Controller U6 / Pin 3 [U6 / Pin 16] via a 10 KHz Highpass Filter network consisting of R22 & C11 [R23 & C24].

After comparison of the Bias Reference and Bias Level Inputs, the Dolby HX Pro Controller U6 produces differential Bias Control Outputs at Pins 7 & 8[Pins 11 & 12]. Applied to High Power Shaping Amplifiers Q9 & Q10 [Q7 & Q8], Controlled Bias is transformer coupled through T4 [T3] to the Record Head via P28 [P29].

5.1.5.5 HEAD DRIVER

During Record, audio is applied to Head Driver U9 / Pin 6 [U10 / Pin 6]. This driver is configured as a current amplifier, with sensing resistor R48 [R57] included in the feedback loop. The output of U9 / Pin 10 [U10 / Pin 10] is sent to the Record Head at J2 / Pin 28 [J2 / Pin 29] via a Bias Trap Filter consisting of L3 & C50 [L2 & C25].

5.1.5.6 CUE BIAS DERIVATION / CUE TONES

The 1 KHz Primary, 150 Hz Secondary, and 8 KHz Tertiary Cue Tone Reference Frequencies arrive as square waves when commanded by, and from, the Logic Board via J1 / Pins 10, 26, and 25, respectively. There are three Active Filters U4, U15, and U4, used to shape the frequencies into sine waves for Cue Tone Recording, as well as 3 potentiometers, R107, R109, and R106, respectively, for setting Cue Tone Record Levels. Cue Track/FSK Data Input from the remote connector is input at J1 / Pin 13, and through U15 / Pins 5, 6 & 7, with potentiometer R111 adjusting its Record Level.

The Bias Reference Frequency, shaped previous to Bias Buffer U13 / Pin 7, is applied to Cue Bias Buffer U16 / Pin 6. Cue Bias Output at U13 / Pin 7, is adjusted by Cue Bias Level potentiometer R116.

Cue Bias and Cue Tone Frequencies or Cue Track/FSK Input, when commanded, are mixed at the input to FET Q11. Q11 is turned on via Transistor Q13 when Cue Record Enable is commanded from the Logic Board and input at P11.

The output of Q11 is applied to the Cue Head Driver U13 / Pin 2. The output at U13 / Pin 1 is sent to the Cue Record Head via J2 / Pin 14. The Cue Head Driver is configured as a current amplifier by the inclusion of R119, in series with the Cue Record Head via J2 / Pin 15, in its feedback loop.

5.1.5.7 METER SOURCES

The Audio Input Metering source is derived at U1 / Pin 1 [U14 / Pin 1], applied to Input Meter Amplifier U3 / Pin 6 [U11 / Pin 6]. Potentiometer R39 [R61] adjusts the Meter Level. The output at U3 / Pin 7 [U11 / Pin 7], is sent to meter source switching on the Logic Board via J1 / Pin 8 [J1 / Pin 24].

The Bias Reference Metering source is derived at Bias Meter Amplifier U3 / Pin 2 [U11 / Pin 2]. adjusts. The output at U3 / Pin 1 [U11 / Pin 1], adjusted by Bias Meter Level Potentiometer R37 [R33], is sent to meter source switching on the Logic Board via J1 / Pin 23 [J1 / Pin 7].

The Cue Metering Source is derived at the Cue Recording Head connection J2 / Pin 15, and applied to Cue Meter Amplifier U16 / Pin 2. Potentiometer R120 adjusts the Meter Level. The output at U16 / Pin 1 is sent to meter source switching on the Logic Board via J1 / Pin 6.

5.1.5.8 LOCAL VOLTAGE REGULATION

Bipolar 15VDC is locally provided on the Record Board by Positive Voltage Regulator VR1, and Negative Voltage Regulator VR2, fed by +18VDC & -18VDC via J1 / Pins 3 & 18 and Pins 2 & 17, respectively.

5.1.6 POWER MODULE, POWER SUPPLY & MOTOR DRIVER BOARD

5.1.6.1 MAINS VOLTAGE SELECTION

Selection between the 100 VAC and 200 VAC categories of Mains Voltages is accomplished internally by the wiring of the Mains Transformer. Selection between various Mains Voltages within a Category, and Twin Mains Fusing are accomplished at the Voltage Selector Fuse holder. [See Mains Voltage Selection, Section 2.2.1]

The selected Mains AC Voltage is applied via Fuses F1 & F2 to the Power Transformer Primary winding. The Secondary Windings are a center tapped configuration, producing a total 44 VAC at nominal Mains input voltage.

5.1.6.2 VOLTAGE REGULATION

Bridge Rectifier D7, D8, D9, & D10 and Filter Capacitors C3 & C6 provide Unregulated 28 VDC to + 16 VDC Regulator VR1, ± 18 VDC Regulators VR3 & VR4, and the Motor.
The Regulated Output of VR1 is routed via P1

/ Pins 11, 12, 13, & 28 to the remote connector Logic + 15 VDC output, to the Logic and Display Boards [where it is also locally regulated to + 12 VDC], and to the +5 VDC Regulator VR2.

The Regulated Output of VR2 is routed via P1 / Pins 1, 2, 16 & 17 to the Logic, Display Panel, and Reproduce Boards as + 5 VDC Logic, as well as being used on-board by the Motor Driver.

The +18 VDC Regulated Output of VR3 is adjusted by + DC SET Potentiometer R4, and routed via P1 / Pins 14, 15, 29, & 30 to the Reproduce & Record Boards where it is locally regulated to +15 VDC Audio Power.

The -18 VDC Regulated Output of VR4 is adjusted by - DC SET Potentiometer R5, and routed via P1 / Pins 10, 25, 26, & 27 to the Reproduce & Record Boards where it is locally regulated to -15 VDC Audio Power, and to the Logic Board and Solenoid as Solenoid Power.

5.1.6.3 PHASE LOCKED LOOP MOTOR DRIVE

The Phase Locked Loop system compares two signals, one a fixed reference frequency, the other a frequency generated according to the motor speed, and attempts to match the two by varying the drive applied to the motor.

The Reference Frequency, as generated on the Logic Board [See Motor Speed Controller, Section 5.1.3.3] enters P1 / Pin 6 and is applied via Inverter U1 / Pins 1 & 2 to Timer U2 / Pin 2.

When no Reference Frequency is present, the motor will not run.

The Tachometer Frequency, corresponding to the motor speed, at TB1-5 & TB1-4 is applied to Comparator U7 / Pins 3 & 2, respectively, for pulse shaping. It is then applied, via Inverter U1 / Pins 5 & 6, to Timer U2 / Pin 10.

The Phase Comparator, used to determine the motor drive required, consists of U2, U3, & U4. Timer U2 outputs a negative pulse at Pins 4 & 12 for each corresponding inputs rising edge, at Pins 2 & 10, respectively. NAND Gates U3 control the Shift Register U4 at Pins 9 & 10. The resultant output duty cycle at U4 / Pin 14 is proportional to the phase/frequency difference between the Reference and Tachometer Frequencies, or analogous to the instantaneous motor drive required to achieve or maintain phase lock. The more drive required, the longer the duty cycle.

For example, if tachometer pulses are received less frequently than reference pulses (i.e. motor running under speed), the pulse train output will have a longer positive duration (higher duty cycle). Conversely, if tachometer pulses are received more frequently than reference pulses (i.e. motor running over speed), the pulse train output will have a shorter positive duration (lower duty cycle).

An Active Filter Network consisting of U6 / Pins 1, 2, & 3, R13, R14, R15, C12, C13, & C14 removes the fundamental frequency and presents a DC voltage proportional to the duty cycle of the Motor Drive Reference output at U4 / Pin 14. The output of U6 / Pin 1 is then applied to the Motor Driver consisting of U6 / Pins 5, 6, & 7, Q2, Q3, & Q4. Motor Drive Gain is regulated by Drive Potentiometer R25.

The motor contains three Stator coils in a "Y" configuration. Motor Drive is regulated at the common point of these Stators via TB1-12. When gated sequentially, a three phase drive system is created.

Three Hall Effect Sensors, input at TB1-10, TB1-9, & TB1-11, monitor the position of the Rotor, and gate the Stators via Analog Switch U9 / Pins 12 & 14, 2 & 15, and 5 & 4, respectively.

If the motor is running under speed, the inputs from the Hall Effect Sensors, via Analog Switch U9, will forward bias Stator Gates Q8 & Q5, Q9 & Q6, and Q10 & Q7, enabling Raw DC Voltage to the Stators via TB1-7, TB1-8, and TB1-6, respectively.

If the Motor is running over speed, the output duty cycle at U4 / Pin 14 will decrease, and pulses will be output at U4 / Pin 11. After 32 such pulses applied to Counter U8 / Pin 10, Pin 2 will go high,

causing corresponding highs at Flip-Flop U5 / Pin 13, toggling the switches of Analog Switch U9 via Pins 9, 10, & 11. The outputs of U5 / Pins 4, 14, & 15 will reflect the +5 VDC inputs at Pins 1, 3.& 13, applying Dynamic Braking [Shorting all Stators via Gates Q8 & Q5, Q9 & Q6, and Q10 & Q7].

Additional functions of the Tachometer Frequency Comparator are as the reference for the Real Time Timer and Motor Stall Protection.

The output at U7 / Pin 1 is fed via Inverter U1 / Pins 9 & 8 and P1 / Pin 5 to the Logic Board, where it is gated and returned via P1 / Pin 4 to the input of Counter/Divider U10 / Pin 10.

The output at U7 / Pin 1 via Inverter U1 . Pins 9 & 8 is also rectified , filtered, and applied to Comparator U7 / Pins 5 & 6. With a normal creation of tachometer pulses the output at U7 / Pin 7 is high, blocked by D17 enabling normal Motor Drive Reference from U4 / Pin 4 through R13. In the absence of tachometer pulses, such as would be the case if the motor were stalled, U7 / Pin 7 goes low, inhibiting Motor Drive Reference through R13, thereby removing motor drive.

When Phase Lock is achieved, Shift Register U4 / Pin 15 goes low, and Pin 13 goes high, while there is a continuous stream of rising edges at Pin 14 applied to Flip Flop U5 / Pin 4. If Phase Lock is lost, and U4/ Pin 15 goes high and is passed via OR Diode D12 to U5 / Pin 3, or U4 / Pin 13 goes low and is passed via Inverter U1 / Pins 11 & 10 and OR Diode D11 to U5 / Pin 3, the result is a high at U5 / Pin 1, forward biasing Servo Error Driver Q1, and sending that logic via P1 / Pin 18 to the Logic Board. The AUDIO indicator will be commanded to extinguish during Servo Error, if jumper W10 is selected to do so. Upon reestablishment of Phase Lock, the input at U5 / Pin 4 will reset the Servo Error logic.

5.1.6.4 TIMER REFERENCE

The gated Tachometer Frequency returned from the Logic Board via P1 / Pin 19 is sent to Counter/Divider U10 / Pin 10.

The final Timer Frequency of 1 PPS is sent via P1 / Pin 3 to the Real Time Timer on the Display Board.

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SECTION VI MECHANICAL ASSEMBLIES PARTS LISTS

FINAL ASSEMBLY 857-B0-401

DESCRIPTION	QTY	DESIGNATOR	PART NUMBER
TOP ASM, CTR 90RP-C	1	M1	847-B0-401
TOP COVER	1	M2	541-B0-402
BOTTOM COVER	1	M3	541-B0-409
FOOT	4	M4	5A1-AO-001
OVERLAY, PLAY ADJ	1	M5	582-B0-401
OVERLAY, RECORD ADJ	1	M6	582-A0-400
SHIPPING ASM, CTR90R	1		867-A0-401
SCREW P.H. PHIL 6-32 X 5/16 PL	4	M7	621-05-632
SCREW F.H. PHIL 4-40 X 3/16 SS	2	M8	645-03-440
SCREW 100 DEG FH PH BK 6-32X1/4	4	M9	64H-04-632
SCREW SOC HD 2-56X3/16 BLK	2	M10	6Y2-03-256
HEAD SHIELD, CTR 90	1	M11	525-B0-401
ACCESSORIES			
CONN PLUG 9 PIN D MALE	1		417-A0-001
PLUG 50 PIN D	1		417-A0-002
CONNECTOR 9 PIN D FEMALE	1		418-A0-005
CONNECTOR HOOD 9 PIN D	2		41G-A0-000
CONNECTOR HOOD 50 PIN D	1		41G-A0-002
POWER CORD	1		427-A0-001
MANUAL, CTR 90	1		730-A0-400

TOP ASSEMBLY 847-B0-401

DESCRIPTION	QTY	DESIGNATOR	PART NUMBER
ASSEMBLIES			
DISTRIBUTION PWA, CTR 90	1	M4	807-B0-400
PLAY AMP ASM, CTR 90	1	M30	807-D0-403
PWA LOGIC, CTR 90	1	M32	877-C0-405
RECORD PWA, CTR90	1	M31	807-C0-404
HEAD BRIDGE ASM, CTR90	1	M6	827-C0-401
DECK ASM, MECH.	1	M1	827-A0-402
FRONT PANEL ASM, CTR90RP (RECORDER)	1	M9	827-C0-407
or			
FRONT PANEL ASM, CTR90P (PLAYER)	1	M9	827-C0-408
MOTOR ASM, DC SERVO, C	1	M5	827-A0-409
POWER SUPPLY MODULE-A	1	M33	827-A0-412
CART SENSOR ASM	1	M8	837-A0-401
SOLENOID 1.74 OD	1	M3	320-A0-300
PLAY HEAD, STEREO	1	M12	340-A0-002
or			
PLAY HEAD, MONO	1	M12	340-A0-000
or			
PLAY HEAD, STEREO MAXTRAX	1	M12	340-A0-006
RECORD HEAD, STEREO	1	M13	340-A0-003
or			
RECORD HEAD, MONO	1	M13	340-A0-001
or			
RECORD HEAD, STEREO MAXTRAX	1	M13	340-A0-007
METALWORK			
FRONT PANEL, CTR90	1	M17	521-B0-400
MOTOR SHIELD	1	M7	525-B0-400
RETAINER, REAR PANEL	2	M26	535-B0-400
BULKHEAD	1	M2	541-B0-407
FRAME, BOTTOM U	1	M23	571-C0-400
FRAME, TOP U	1	M24	571-B0-401
HARDWARE			
NUT HEX 4-40 STEEL PLATE	2	M27	601-20-440
SCREW P.H. PHIL 4-40X3/16 PL	4	M20	621-03-440
SCREW P.H. PHIL 4-40X1/4 SP	5	M19	621-04-440
SCREW, 8-32X3/8, PHL, PAN, STL PLT	3	M14	621-06-832
SCREW P.H. PHIL 4-40X5/8 STL	3	M18	621-0A-440
SCREW P.H. PHIL 10-32X3/4 SP	2	M15	621-0C-032
SCREW F.H. PHIL 4-40X3/16 SS	20	M28	645-03-440
SCREW F.H. PHIL 6-32X1/4	3	M35	645-04-632
SCREW F.H. PHIL 10-32X3/8 SS	2	M21	645-06-032
+SCREW F.H. PHIL 4-40X1/4 SS	6	M29	645-A0-440
SCREW SOC HD 6-32X 1 3/8 BLK	1	M16	6Y2-16-632
MISCELLANEOUS			
HOUSING, MTA 100 2 COND	1	M22	415-A0-011
FRONT PANEL CABLE	2	M10	42C-A0-400
CARD GUIDE	6	M25	5A4-A0-002
HEAD CABLE, STEREO	2	M11	837-B0-004

DECK ASSEMBLY 827-A0-402

DESCRIPTION	QTY	DESIGNATOR	PART NUMBER
COUPLER, SOLENOID	1	M10	501-B0-401
WHEEL	1	M8	502-A0-401
SHIELD, DECK	1	M34	525-B0-000
DECK PLATE, CTR 90	1	M1	531-B0-400
LINK, PINCH ROLLER	1	M9	535-B0-401
RETAINER, CART SPRING	2	M20	543-B0-401
LINK, SPRING	1	M6	5A0-A0-400
FLAG, CART SENSOR	1	M25	5A0-A0-401
BUMPER, SOLENOID	1	M33	5A1-A0-402
PINCH ROLLER	1	M29	5A3-C0-002
CART HOLD DOWN, LEFT	1	M17	5AB-A0-400
CART HOLD DOWN, RIGHT	1	M18	5AB-A0-401
DOWEL PIN, .093 X .25, SS	2	M21	5B4-A0-400
DOWEL PIN, .093 X .312, SS	1	M22	5B4-A0-402
DOWEL PIN, .062 X .312, SS	1	M23	5B4-A0-403
CAM	1	M4	5B7-B0-401
CART ROLLER	2	M27	5B8-A0-400
SHAFT, HORIZ.	1	M2	5B8-B0-401
SHAFT, VERT.	1	M3	5B8-B0-402
SPRING,SOL RET,CTR 90	1	M7	5E1-A0-400
SPRING, CART HOLD DN	2	M19	5E2-A0-403
SPRING, FLAG	1	M26	5E2-A0-404
NUT,HEX,10-32 STL PL	1	M12	600-20-032
WASHER, .31 X .191 X .025 SS	3	M35	601-07-000
WASHER .50 X .252 X .01 SS	2	M28	601-07-002
WASHR,SS,.31OD X .191ID X .065	2	M30	601-07-065
WAVY WASHER .25 ID X .38 OD	1	M32	603-02-124
WASHER, SS, .020 THK	2	M31	605-00-020
FLAT WASHER SS .187 OD	1	M24	605-00-231
SCREW P.H. PHIL 2-56X1/4 SP	2	M16	621-04-256
SCREW 4-40 X 3/8 PH PHILLIPS	1	M14	621-06-440
SCREW 10-32X11/8 PH PHL STLPLT	1	M11	621-10-032
SCREW,SOC ST. 4-40X1/8 FL PT	1	M5	6G2-02-440
SCREW SOC H.C. 2-56X1 BLK	3	M13	6Y2-10-256
SHOULDER SCREW, 4-40	1	M15	6Z0-09-440

HEAD BRIDGE ASSEMBLY 827-C0-401

DESCRIPTION	QTY	DESIGNATOR	PART NUMBER
BEARING BLOCK	2	M3	501-A0-400
HEAD LOCKING BLOCK	2	M7	501-A0-402
HEAD SHAFT	2	M4	502-B0-400
HEAD BRIDGE	1	M1	512-C0-400
HEIGHT ZENITH BEAM	2	M2	570-A0-400
HEAD CLAMP	2	M5	570-B0-401
THRUST PLATE	2	M6	570-B0-402
AZIMUTH BEAM	2	M9	571-B0-405
TAPE GUIDE CURVED	1	M21	5AB-A0-001
TAPE GUIDE STRAIGHT	1	M20	5AB-A0-002
BALL 3/16	2	M8	5B6-A0-400
SPRING COMP .1480 X 1/4	2	M22	5E2-04-148
SPRING, ZENITH BEAM	4	M10	5E2-A0-400
SPRING, AZIMUTH	2	M11	5E2-A0-401
SPRING, PENETRATION	2	M12	5E2-A0-402
FLAT WASHER SS .187 OD	2	M19	605-00-231
SCREW FL PHIL 4-40 X 1/4 SS	4	M17	645-A0-440
SCREW, 4-40X1/2 1820 FHP BLK	4	M14	64H-08-440
SCREW, 4-40X3/8 PBH STL	4	M15	681-06-440
SCREW, 4-40X5/16 SHS BLK	2	M18	6G2-05-440
SCREW SH 4-40X3/8 BL	2	M23	6Y2-06-440
SCREW SOC H.C. 2-56 X 1 BLK	4	M13	6Y2-10-256
SCREW SOC H.C. 2-56 X 5/8 BLK	4	M16	6Y2-0A-256
# 4 FLAT WASHER, STEEL PLATE	4	M24	601-00-400

DISTRIBUTION BOARD 807-A0-400

DESCRIPTION	QTY	DESIGNATOR	PART NUMBER
DISTRIBUTION PWA	1	M1	407-D0-400
SOCKET DIP 16 PIN	2	P3,P4	410-A0-003
CONNECTOR 30 POS HEADER	5	P1,P2,P5,P6,P7	412-A0-401
HOUSING MTA 100 4 COND	1	M5	415-A0-006
HEADER MTA 100 2 POS	1	P11	416-A0-008
HEADER MTA 100 4 POS	2	P10,P10	416-A0-010
HEADER .079 9 POS	2	P8,P9	416-A0-016
WIRE, STRANDED 22AWG BLACK	24	M2	423-A2-20N
WIRE, STRANDED 22AWG BLACK	12	M3	423-A2-22N
WIRE, STRANDED 22AWG BLUE	12	M4	423-A2-26N
HEX NUT,2-56,SMALL PATTERN	10	M7	609-19-256
SCREW P.H. PHIL 2-56 X 1/4 SP	10	M6	621-04-256

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LOGIC BOARD 807-C0-405

DESCRIPTION	QTY	DESIGNATOR	PART NUMBER
CIRCUIT BOARD			
PCB, LOGIC CTR90	1	M1	407-C0-405
CAPACITORS			
CAP, .1UF, 100V, CER	25	C14,C15,C16,C17, C18,C19,C20,C21, C22,C23,C24,C25, C26,C27,C28,C29, C31,C32,C33,C34, C35,C36,C37,C38, C39	001-AK-104
1UF 50V E CAP	3	C3,4,11	011-A5-105
10UF 50V E CAP	3	C1,2,12	011-A5-106
4.7UF 50V E CAP	2	C5,C42	011-A5-475
CAP, 1UF, 35V, CTE	3	C6,9,10	02A-A0-105
CAP 5PF 5%	1	R28	031-A2-50A
CAP .01 25V D CAP	3	C13,C40,C41	006-A6-103
RESISTORS			
100 1/4W 5% CF RES	2	R39,40	110-22-101
10K 1/4W 5% CF RES	24	R1,2,3,6,7,8, 9,12,13,14,15, 16,19,20,23,24, 26,27,41,44,45, 47,48,49	110-22-103
100K 1/4W 5% CF RES	2	R11,46	110-22-104
1.2K 1/4W 5% CF RES	1	R21	110-22-122
2.2K 1/4W 5% CF RES	1	R35	110-22-222
22K 1/4W 5% CF RES	1	R32	110-22-223
270 1/4W 5% CF RES	2	R30,R36	110-22-271
270K 1/4W 5% CF RES	1	R10	110-22-274
4.7K 1/4W 5% CF RES	1	R22	110-22-472
47K 1/4W 5% CF RES	6	R4,5,25, R17,18,50	110-22-473
820 1/4W 5% CF RES	1	R34	110-22-821
13K 1/4W 1% MF RES	1	R42	120-20-133
681 1/4W 1% MF RES	1	R43	120-20-69J
RES/ 1E. 1W. 1%	1	R31	150-50-10A
RES. NETWORK 47K-8	1	R37	182-11-473
SEMICONDUCTOR DEVICES			
1N4148 DIODE	16	D1,2,3,4,5,6,7, 11,12,13,14,15, 16,17,18,19	200-A0-000
1N4005 DIODE	2	D8,9	201-A0-000
1N4733A DIODE	1	D20	204-A0-002
1N4737A DIODE	1	D10	204-A0-004
TRANSISTOR MTP 8PO8	2	Q1,2	221-A0-400
5532 DUAL OP-AMP IC	1	U20	230-A0-000
IC HC4053	1	U11	230-A0-406
IC HC4052	1	U2	230-A0-407

DESCRIPTION	QTY	DESIGNATOR	PART NUMBER
IC MC1413P	2	U10,16	230-A0-408
IC 74HC04	1	U8	231-A0-402
IC 74HC00	1	U9	231-A0-403
IC 74HC4040	3	U28,29,30	231-A0-404
IC 74HC4060	1	U21	231-A0-405
IC 74HC 08	4	U1,12,18,19	231-A0-407
IC 74HC32	2	U5,7	231-A0-409
IC 74HC86	1	U6	231-A0-410
IC MC14490	2	U13,14	231-A0-411
IC 74HC163	6	U22,23,24,25, 26,27	231-A0-412
IC HC4538	2	U15,17	231-A0-413
IC 74HC02	1	U4	231-A0-414
IC, P29M16 PG 000 REV A0	1	U3	460-A0-000
SWITCHES			
SWITCH, MINI SLIDE, 3 POS DP	1	SW1	361-A0-006
MISCELLANEOUS			
RELAY SPDT 12V PC MOUNT	2	K1,2	350-A0-000
CRYSTAL 18.432MHZ HC18U	1	Y1	384-A0-000
SHUNT, TWO CIRCUIT	8	M8,M8,M8,M8, M8,M8,M8,M8	414-A0-012
WIRE BUS 22 AWG	3	M12,M12,M12	420-A0-001
CONNECTORS & HARDWARE			
SOCKET DIP 8 PIN	1	U20	410-A0-001
SOCKET DIP 14 PIN	10	U1,4,5,6,7,8,9, 12,18,19	410-A0-002
SOCKET DIP 16 PIN	18	U2,10,11,13,14, 15,16,17,21,22, 23,24,25,26,27, 28,29,30	410-A0-003
SOCKET, 24 PIN DIP, .3 X .1	1	U3	410-A0-010
CONNECTOR 30 POS PLUG	2	P1,2	412-A0-400
HEADER, 3 PIN	1	M9	416-A0-024
HEADER, 2 PIN	5	M10,M10,M10, M10,M10	416-A0-023
HEADER, 4 PIN	1	M11	416-A0-025
RECEPTACLE 50 PIN D RT ANGLE	1	J1	418-A0-003
CONNECTOR HARDWARE RT ANGLE D	1	M6	41G-A0-001
TUBING, TEFLON 16 AWG	1	M16	44T-A0-002
REAR PANEL, LOGIC PWA	1	M2	541-B0-411
NUT HEX 4-40 STEEL PLATE	4	M4,M4.M4,M4	601-20-440
HEX NUT,2-56,SMALL PATTERN	4	M14,M14,M14,M14	609-19-256
L'WASHER I.T. #4	4	M5,M5,M5,M5	60C-11-400
SCREW P.H. PHIL 2-56 X 1/4 SP	4	M13,M13,M13,M13	621-04-256
SCREW P.H. PHIL 4-40 X 1/4 SP	2	M15,M15	621-04-440
SCREW P.H. PHIL 4-40 X 5/16 PL	4	M3,M3,M3,M3	621-05-440
CAPTIVE SCREW	2	M7,M7	651-04-440

REPRODUCE BOARD 807-D0-403

DESCRIPTION	QTY	DESIGNATOR	PART NUMBER
CIRCUIT BOARD			
PWA, PLAY CTR 90	1	1	407-C0-403
CAPACITORS			
CAP, .1UF, 100V, CER	24	C14,C18,C90,C91, C92,C93,C94,C95, C96,C97,C98,C99, C100,C101,C102, C103,C104,C105, C106,C107,C108, C109,C110,C111	001-AK-104
1UF 50V E CAP	1	C20	011-A5-105
10UF 50V E CAP	1	C26	011-A5-106
100UF 35V E CAP	3	C3,C22,C38	011-A5-107
CAP, 47UF, NPE, 35V, 20%	2	C2,C37	0E2-A6-476
CAP, 3.3UF, 50V, NPE	10	C27,C29,C52,C54, C67,C68,C69,C71, C74,C80	012-A7-335
10UF TANTALUM, 35V, 10%	4	C84,C85,C86,C87	021-A4-106
CAP, 1UF, 35V, CTE	2	C119,C120	02A-A0-105
47UF, 35V, CTE	2	C81,C82	02A-A0-476
CAP 5PF 5%	10	C5,C10,C23,C24, C31,C39,C44,C49, C50,C56	031-A2-50A
10PF S CAP	3	C28,C53,C65	031-A3-100
100PF S CAP	1	C66	031-A3-101
150PF 500V 5% CAP	2	C1,C36	031-A3-151
22PF S CAP	4	C30,C35,C55,C57	031-A3-220
220PF S CAP	1	C62	031-A3-221
.047UF 63V F CAP	1	C19	041-A4-473
CAP., .001UF, 50V PF	5	C17,C75,C76,C78, C79	041-A3-102
.0033UF, 50V, PF CAP	2	C15,C21	041-A3-332
.1UF 63V F CAP	4	C12,C13,C16,C89	041-A4-104
.47UF 63V F CAP	4	C25,C51,C88,C118	041-A4-474
CAP .33UF, 63V, MF	1	C77	067-A3-334
CAP, .01UF, 50V, PF	12	C9,C33,C34,C45, C59,C60,C70,C72, C73,C115,C116, C117	0D6-A6-014
CAP, 100UF, NPE, 25V, 20%	2	C8,C42	0E2-A6-107
CAP, 47UF, NPE, 35V, 20%	2	C32,C58	0E2-A6-476
RESISTORS			
220K 1/4 W 5% RES	1	R112	110-22-224
330 OHM 1/4W 5% CF RESISTOR	2	R116,R137	110-22-331
4.7K 1/4W 5% CF RES	1	R126	110-22-472
RES 1K, 1/4W, 1%, MF	2	R100,R121	120-20-102
RES, 1M, 1/4W, 1%, MF	9	R19,R20,R21,R22, R60,R61,R90,R91,R113	120-20-105
102K 1/4W 1% MF RES	1	R107	120-20-10B

DESCRIPTION	QTY	DESIGNATOR	PART NUMBER
10K 1/4W 1% MF RES	39	R39,R44,R46,R47, R48,R49,R50,R51, R54,R55,R58,R59, R64,R65,R68,R69, R70,R71,R72,R73, R74,R75,R80,R81, R82,R83,R84,R85, R96,R98,R118,R119 R120,R127,R128,R129, R130,R145,R146	120-20-10S
115K 1/4W 1% MF RES	3	R5,R6,R92	120-20-11Y
12.4K 1/4W 1% MF RES	4	R40,R45,R122, R123	120-20-12T
RES, 130K, 1/4W, 1%, MF	1	R109	120-20-134
1.33K 1/4W 1% MF RES	2	R132,R133	120-20-13P
RES,1.4M,1/4W,1%,MF	2	R3,R4	120-20-146
RES, 150K, 1/4W, 1%, MF	1	R149	120-20-154
RES, 15.8K, 1/4W, 1%, MF	3	R7,R8,R86	120-20-15U
RES, 21 OHMS, 1/4W, 1%, MF	2	R11,R12	120-20-210
2.15K 1/4W 1% MF RES	3	R15,R16,R88	120-20-21P
21.5K 1/4W 1% MF RES	2	R9,R10	120-20-21T
RES, 2.21M, 1/4W, 1%, MF	2	R17,R18	120-20-225
RES, 249 OHMS, 1/4W, 1%, MF	2	R131,R134	120-20-24B
2.43K, 1/4W, 1%, MF	1	R103	120-20-24S
RES, 30.1 OHMS, 1/4W, 1%, MF	4	R141,R142,R143, R144	120-20-30B
RES, 301 OHMS, 1/4W, 1%, MF	4	R76,R77,R78,R79	120-20-30C
RES,3.01K,1/4W,1%,MF	1	R105	120-20-30D
RES. 324K. 1/4W, 1%, MF	2	R94,R97	120-20-324
RES, 33.2K, 1/4W, 1%, MF	3	R102,R125,R138	120-20-33S
RES, 348K, 1/4W, 1%, MF	1	R108	120-20-34S
340K 1/4W 1% MF RES	2	R110,R111	120-20-34W
RES, 402 OHMS, 1/4W, 1%, MF	2	R13,R14	120-20-40B
5.11K 1/4W 1% MF RES	7	R37,R42,R56,R57, R95,R135,R136	120-20-51N
RES, 698K, 1/4W, 1%, MF	1	R106	120-20-69S
80.6K 1/4W 1% MF RES	2	R27,R28	120-20-80S
8.25K, 1/4W, 1%, MF	2	R104,R124	120-20-82S
RES, 909 OHMS, 1/4W, 1%, MF	4	R23,R24,R38,R93	120-20-90A
SIP, 1KX4	1	R115	164-21-102
SIP, 56KX4	1	R114	164-21-563
POTENTIOMETERS			
POT, 100 OHM, HORIZ.	1	R43	13T-33-101
10K H TRIM	2	R31,R32	13T-33-103
20K H TRIM	4	R66,R67,R89,R101,	13T-33-203
5K H TRIM	2	R25,R26	13T-33-502
50K H TRIM	1	R99	13T-33-503
POT, 500K H	4	R29,R30,R139,R140	13T-33-504

DESCRIPTION	QTY	DESIGNATOR	PART NUMBER
SEMICONDUCTOR DEVICES			
1N4148 DIODE	8	D2,D3,D4,D5,D6, D7,D8,D9	200-A0-000
IN4005 DIODE	1	D1	201-A0-000
TRANSISTOR, 2SB737	4	Q1,Q2,Q3,Q4	210-A0-400
TRANSISTOR P FET P1086E	4	Q5,Q6,Q7,Q8	220-A0-000
5532 DUAL OP-AMP IC	2	U7,U10	230-A0-000
5533 DUAL OP-AMP IC	2	U2,U4	230-A0-001
LF353 IC	2	U5,U8	230-A0-008
LM7815CT 15 VOLT REGULATOR	1	VR1	230-A0-012
LM7915CT 15 VOLT REGULATOR	1	VR2	230-A0-014
IC TL074CP	5	U6,U9,U11,U12,U13	230-A0-301
IC, LM317LZ, REG.	1	VR3	230-A0-400
IC, LM337LZ REG.	1	VR4	230-A0-401
IC, OP37 G	2	U1,U3	230-A0-403
IC, LM1894N	1	U14	230-A0-405
OPTO COUPLER, TLP621-2	1	O1	270-A0-400
OPTO COUPLER, TLP621-4	1	O2	270-A0-401
MISCELLANEOUS			
SHUNT, TWO CIRCUIT	2	M2	414-A0-012
WIRE BUS 22 AWG	6	M4	420-A0-001
WIRE, STRANDED 22AWG BLACK	4	10	423-A2-20N
WIRE, STRANDED 22AWG RED	4	9	423-A2-22N
WIRE, STRANDED 22AWG GREEN	4	8	423-A2-20N
CONNECTORS & HARDWARE			
SOCKET DIP 8 PIN	7	SO1,SU1,SU3,SU5, SU7,SU8,SU10	410-A0-001
SOCKET DIP 14 PIN	8	SU2,SU4,SU6,SU9, SU11,SU12,SU13, SU14	410-A0-002
SOCKET DIP 16 PIN	1	S02	410-A0-003
CONNECTOR 30 POS PLUG	1	P1	412-A0-400
CONN, XLR, MALE	2	4	412-A0-406
HEADER, 3 PIN	2	M3	416-A0-024
RECEPTACLE 9 PIN D RT ANGLE	1	P2	418-A0-004
CONNECTOR HARDWARE RT ANGLE D	1	7	41G-A0-001
TUBING, TEFLON 16AWG	6	M5	44T-A0-002
REAR PANEL, PLAY PWA	1	2	541-B0-413
NUT HEX 4-40 STEEL PLATE	2	M7	601-20-440
HEX NUT,2-56,SMALL PATTERN	2	M9	609-19-256
SCREW P.H. PHIL 2-56 X 1/4 SP	2	M8	621-04-256
SCREW P.H. PHIL 4-40 X 1/4 SP	10	6	621-04-440
SCREW P.H. PHIL 4-40 X 5/16 PL	2	M6	621-05-440
SCREW FL PHIL 4-40 X 1/4 SS	4	5	645-A0-440
CAPTIVE SCREW	2	3	651-04-440

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RECORD BOARD 807-C0-404

DESCRIPTION	QTY	DESIGNATOR	PART NUMBER
CIRCUIT BOARD			
PCB, RECORD CTR90	1	M1	407-C0-404
CAPACITORS			
CAP. 680 PF 200V 10% CER.	2	C58,C61	001-A4-681
CAP, .1UF, 100V, CER	30	C81,C82,C83,C84, C85,C86,C87,C88, C89,C90,C91,C92, C93,C94,C95,C96, C97,C98,C99,C100, C101,C102,C103, C104,C105,C106, C107,C108,C109, C110	001-AK-104
10UF 50V E CAP	4	C18,C31,C77,C117	011-A5-106
2.2UF 50V E CAP	1	C116	011-A5-225
100UF 25V E CAP	2	C52,C57	011-A8-107
CAP, 22UF, 25V, ELECTROLYTIC	1	C71	012-A6-226
CAP, 3.3UF, 50V, NPE	6	C70,C78,C79,C80 C121,C122	012-A7-335
10UF TANTALUM, 35V, 10%	6	C73,C74,C75,C76, C118,C119	021-A4-106
CAP 5PF 5%	6	C7,C8,C38,C39, C120,C121	031-A2-50A
10PF S CAP	4	C3,C13,C41,C68	031-A3-100
100PF S CAP	4	C9,C10,C44,C45	031-A3-101
CAPACITOR 120 PF	2	C33,C34	031-A3-121
220PF S CAP	1	C72	031-A3-221
50PF S CAP	1	C14	031-A3-500
500PF S CAP	4	C1,C6,C53,C56	031-A3-501
CAP. 68 PF MICA 300V 5%	1	C63	031-A3-680
CAP., .001UF, 50V PF	2	C54,C55	041-A3-102
CAP .022/63/5	3	C17,C22,C59	041-A3-223
.0033UF, 50V, PF CAP	1	C62	041-A3-332
.1UF 63V F CAP	4	C2,C15,C42,C67	041-A4-104
CAP 1500 PF 100V	5	C11,C24,C12,C25, C50	041-A4-152
CAP .015/63/10	1	C113	041-A4-153
.033UF 63V F CAP	2	C114,C115	041-A4-333
CAP PCF 5% 50V .018 UF	2	C20,C21	061-A3-184
.47UF 63V F CAP	4	C4,C32,C35,C40	041-A4-474
CAP. .18 UF PF 63V 5%	1	C65	061-A3-184
CAP. .0056 UF PF 50V 5%	1	C60	0A1-A3-562
CAP, .01UF, 50V, PF	7	C19,C23,C27,C47, C64,C111,C112	0D6-A6-014
CAP, .0039UF, 50V, PF	1	C66	0D6-B6-00C
CAP, 100UF, NPE, 25V, 20%	6	C5,C30,C43,C46, C48,C51	0E2-A6-107

DESCRIPTION	QTY	DESIGNATOR	PART NUMBER
RESISTORS			
1K 1/4W 5% CF RES	12	R41,R87,R88,R89, R90,R91,R92,R93, R94,R105,R108, R112	110-22-102
100K 1/4W 5% CF RES	1	R40	110-22-104
1.2K 1/4W 5% CF RES	1	R122	110-22-122
13 1/4W 5% CF RES	2	R13,R78	110-22-130
510 1/4W 5% CF RES	2	R12,R79	110-22-511
RES, 1M, 1/4W, 1%, MF	9	R4,R7,R21,R49, R56,R63,R71,R81, R124	120-20-105
RES 100 OHM 1/4W 1% MF	5	R48,R57,R110, R119,R115	120-20-10C
10.2K 1/4W 1% MF RES	21	R26,R34,R36,R19, R38,R50,R51,R52, R53,R54,R55,R62, R65,R98,R99, R117,R118,R126, R127,R128,R129	120-20-10T
12.4K 1/4W 1% MF RES	2	R97,R100	120-20-12T
RES, 13.3K, 1/4W, 1%, MF	2	R22,R23	120-20-13T
RES, 150K, 1/4W, 1%, MF	1	R114	120-20-154
1.69K 1/4W 1% MF RES	1	R123	120-20-16Q
16.9 RESISTOR	1	R103	120-20-16U
169K 1/4W 1% MF RES	2	R45,R60	120-20-16Y
20.5K 1/4W 1% MF RES	6	R8,R14,R15,R67, R70,R77	120-20-20T
21.5K 1/4W 1% MF RES	4	R3,R27,R42,R72	120-20-21T
RES. 324K. 1/4W, 1%, MF	2	R17,R66	120-20-324
RES, 348K, 1/4W, 1%, MF	1	R113	120-20-34S
RES, 48.7K, 1/4W, 1%, MF	2	R28,R29	120-20-48S
5.11K 1/4W 1% MF RES	16	R9,R10,R16,R18, R20,R24,R25,R43, R47,R58,R64,R68, R69,R75,R76,R121	120-20-51N
RES, 60.4K, 1/4W, 1%, MF	2	R96,R104	120-20-60S
63.4K 1/4W 5% MF RES	1	R101	120-20-63S
6.81K RES 1/4W 1% MF RES	1	R102	120-20-68N
RES 100 OHM 2W 5% MF	2	R86,R95	120-62-101
RES, NET., 10K-4	2	R85,R125	144-11-103
RES. NET., 20K-4	2	R46,R59	144-11-203
RES. NET.,10K,12 PIN, 2%	2	R44,R82	182-11-103
POTENTIOMETERS			
10K V TRIM	3	R107,R111,R120	13M-33-103
2K V TRIM	2	R33,R37	13M-33-202
20K V TRIM	3	R39,R61,R106	13M-33-203
5K VERTICAL TRIM POT	2	R116,R109	13M-33-502
500K V TRIM	4	R1,R2,R73,R74	13M-33-504
1K H TRIM	2	R11,R80	13T-33-102

DESCRIPTION	QTY	DESIGNATOR	PART NUMBER
SEMICONDUCTOR DEVICES			
1N4148 DIODE	2	D2,D3	200-A0-000
IN4005 DIODE	1	D1	201-A0-000
GES5816 TRANSISTOR	4	Q7,Q8,Q9,Q10	210-A0-002
2N4403 TRANSISTOR	2	Q6,Q12	210-A0-003
TRANSISTOR MPS-A13	1	Q1	210-A0-004
TRANSISTOR P FET P1086E	5	Q2,Q3,Q4,Q5, Q11	220-A0-000
5532 DUAL OP-AMP IC	2	U13,U16	230-A0-000
5533 DUAL OP-AMP IC	2	U9,U10	230-A0-001
LF353 IC	9	U1,U2,U3,U4, U7,U8,U11,U14, U15	230-A0-008
LM7815CT 15 VOLT REGULATOR	1	VR1	230-A0-012
LM7915CT 15 VOLT REGULATOR	1	VR2	230-A0-014
VCA 1001	2	U5,U12	236-A0-007
IC HX PRO	1	U6	236-A0-008
MISCELLANEOUS			
INDUCTOR 1 MH	3	L1,L2,L3	300-A0-002
TRANSFORMER MIN.	2	T3,T4	310-A0-001
WIRE, STRANDED 22AWG BLACK	8	M13	423-A2-20N
WIRE, STRANDED 22AWG RED	8	M12	423-A2-22N
WIRE, STRANDED 22AWG GREEN	8	M11	423-A2-25N
CONNECTORS & HARDWARE			
SOCKET DIP 8 PIN	11	SU1,SU2,SU3,SU4, SU7,SU8,SU11, SU13,SU14,SU15, SU16	410-A0-001
SOCKET DIP 14 PIN	2	SU9,SU10	410-A0-002
SOCKET DIP 18 PIN	2	SU5,SU12	410-A0-007
CONNECTOR 30 POS PLUG	1	P1	412-A0-400
CONN, XLR, FEMALE	2		412-A0-405
PLUG 9 PIN D RT ANGLE	1	P2	417-A0-000
CONNECTOR HARDWARE RT ANGLE D	1		41G-A0-001
REAR PANEL, REC PWA	1		541-B0-412
NUT HEX 4-40 STEEL PLATE	2		601-20-440
L'WASHER I.T. #4	2		60C-11-400
SCREW P.H. PHIL 4-40 X 5/16 PL	4		621-05-440
SCREW FL PHIL 4-40 X 1/4 SS	2		645-A0-440
CAPTIVE SCREW	2		651-04-440

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POWER SUPPLY MODULE 827-A0-412

DESCRIPTION	QTY	DESIGNATOR	PART NUMBER
CIRCUIT BOARD			
PCB, PWR/MOTOR DRV CTR90	1	1	407-A0-412
CAPACITORS			
CAP, .1UF, 100V, CER	12	C25,C26,C27,C28, C29,C30,C31,C32, C33,C34,C35,C36	001-AK-104
1UF 50V E CAP	2	C13,C20	011-A5-105
10UF 50V E CAP	6	C18,C19,C21,C22, C23,C24	011-A5-106
CAP 470 UF 50 V	4	C1,C2,C5,C8	011-A5-477
CAP 6800 UF 50V	2	C3,C6	011-A5-688
10PF S CAP	2	C9,C10	031-A3-100
CAP .01/63/5	3	C11,C14,C16	041-A3-103
.1UF 63V F CAP	2	C15,C17	041-A4-104
.22UF 63V F CAP	1	C12	041-A4-224
RESISTORS			
100 1/4W 5% CF RES	1	R26	110-22-101
1K 1/4W 5% CF RES	2	R12,R20	110-22-102
10K 1/4W 5% CF RES	7	R7,R8,R9,R10, R11,R34,R43	110-22-103
100K 1/4W 5% CF RES	2	R28,R32	110-22-104
22K 1/4W 5% CF RES	3	R13,R14,R15	110-22-223
2.7K 1/4W 5% CF RES	1	R27	110-22-272
33K 1/4W 5% CF RESISTOR	3	R18,R21,R31	110-22-333
330K 1/4W 5% CF RES	2	R17,R19	110-22-334
4.7K 1/4W 5% CF RES	5	R23,R29,R35,R37, R39	110-22-472
470K 1/4W 5% CF RES	1	R16	110-22-474
68K 1/4W 5% CF RES	2	R30,R33	110-22-683
100 1/2W 5% CF RES	1	R22	110-32-101
470 1/2W 5% CF RESISTOR	3	R36,R38,R40	110-32-471
56 1/2W 5% CF RES	1	R41	110-32-560
RES, 249 OHMS, 1/4W, 1%, MF	4	R1,R3,R6,R44	120-20-24B
RES,3.01K,1/4W,1%,MF	1	R2	120-20-30D
750 1/4 1% MF RESISTOR	1	R45	120-20-75J
RES NET 10KX10	1	R42	144-11-400
.33 3W 5% WW RES	1	R24	150-72-33B
POTENTIOMETERS			
TRIMPOT 500 HORIZ	1	R25	13T-33-501
5K H TRIM	2	R4,R5	13T-33-502
SEMICONDUCTOR DEVICES			
1N4148 DIODE	6	D11,D12,D13,D14, D15,D17	200-A0-000
IN4005 DIODE	4	D1,D2,D3,D6	201-A0-000
6A4 DIODE	4	D7,D8,D9,D10	201-A0-002
GES5816 TRANSISTOR	5	Q1,Q2,Q8,Q9, Q10	210-A0-002

DESCRIPTION	QTY	DESIGNATOR	PART NUMBER
MPSU05 TRANSISTOR	1	Q3	211-A0-003
MJE2955T TRANSISTOR	3	Q5,Q6,Q7	211-A0-005
MJE3055T TRANSISTOR	1	Q4	211-A0-006
LM358 IC (NATIONAL ONLY)	2	U6,U7	230-A0-009
LM317T IC	3	VR1,VR2,VR3	230-A0-019
LM 337T IC	1	VR4	230-A0-020
74LS00 IC	1	U3	231-A0-003
74LS123 IC (NOT MOTOROLA)	1	U2	231-A0-011
4040 IC	2	U8,U10	231-A0-023
4053 IC ***RCA ONLY***	1	U9	231-A0-025
4069 IC	1	U1	231-A0-030
4013 IC (NATIONAL ONLY)	1	U5	231-A0-034
74LS195 IC	1	U4	231-A0-041
74C374	1	U11	231-A0-400
4048 IC	1	U12	231-A0-401
MISCELLANEOUS			
TRANSFORMER, TOROIDAL	1		311-C0-402
.75A SLO BLO FUSE	2		371-A0-002
WIRE, STRANDED 16AWG GREEN	16		423-A1-65N
WIRE, STRANDED 18AWG BLACK	4		423-A1-80N
CONNECTORS & HARDWARE			
SOCKET DIP 8 PIN	2	S6,7	410-A0-001
SOCKET DIP 14 PIN	3	S1,3,5	410-A0-002
SOCKET DIP 16 PIN	6	S2,4,8,9,10,12	410-A0-003
SOCKET DIP 20 PIN	1	S11	410-A0-008
CONNECTOR 30 POS PLUG	1	P1	412-A0-400
CONN. COMBINATION, AC 3 PIN	1		413-A0-001
TERMINAL FEMALE .062	4		414-A0-003
TERMINAL PIN .062	4	P2,3,4,5	414-A0-005
SCOTCHLOC BUTT SPLICE UR CONN	1		414-A0-008
CRIMP CONNECTOR, QUICK SLIDE	5		414-A0-009
HEADER MTA 100 12 POS	1	TB1	416-A0-013
INSULATOR TO 220 SIL PAD	8		440-A0-000
TUBING, HEAT SHRINK 1/8	6		44S-A0-001
POWER SUPPLY CHASSIS/HEAT SINK	1		541-B0-401
REAR PANEL, P.S.	1		541-B0-408
P.S. PANEL BRKT.	1		543-B0-400
TY WRAP 1/16 TO 2" DIA.	4		5A2-A0-000
GROUND LUG	2		5A2-A0-006
NUT,HEX,10-32 STL PL	1		600-20-032
NUT THUMB 6-32	1		600-33-632
NUT HEX 6-32 STEEL PLATE	1		601-20-632
WASHER SHOULDER	8		607-01-124
HEX NUT,2-56,SMALL PATTERN	2		609-19-256
L'WASHER I.T. #10	1		60C-11-000
L'WASHER I.T. #6	1		60C-11-600
SCREW P.H. PHIL 2-56 X 1/4 SP	2		621-04-256
SCREW P.H. PHIL 4-40 X 1/4 SP	12		621-04-440
SCREW PH PHL 6-32 X 1/2 LG STL	1		621-08-632
SCREW FL PHIL 10-32 X 2 1/2 PL	1		641-28-032
SCREW FL PHIL 4-40 X 1/4 SS	7		645-A0-440

FRONT PANEL ASSEMBLY, RECORDER 827-C0-407

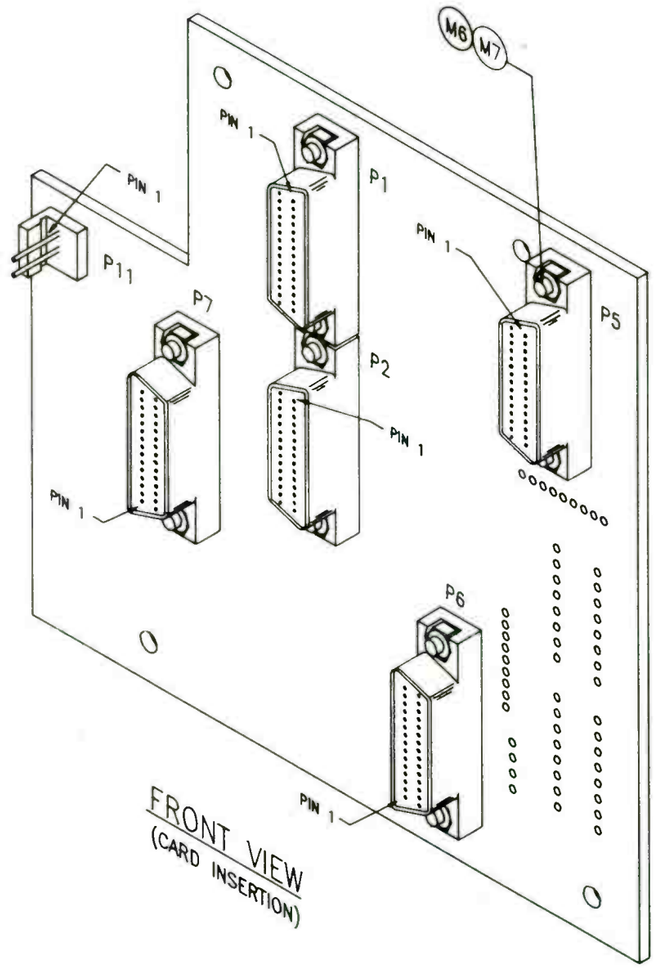
DESCRIPTION	QTY	DESIGNATOR	PART NUMBER
CIRCUIT BOARD			
PCB, FRONT PNL DISPLAY CTR90	1	M1	407-C0-406
PCB, FRONT PNL SWITCH CTR90	1	M2	407-A0-410
CAPACITORS			
CAP, .1UF, 100V, CER	1	C2	001-AK-104
2.2UF 50V E CAP	4	C4,5,7,9	011-A5-225
220/25/20 CAP	2	C6,8	011-A5-227
1000UF E CAP	1	C1	011-B5-108
10UF TANTALUM, 35V, 10%	4	C3,10,11,12	021-A4-106
RESISTORS			
1K 1/4W 5% CF RES	3	R1,R2,R4	110-22-102
10K 1/4W 5% CF RES	2	R10,16	110-22-103
1 OHM 1/4W 5% CF RESISTOR	1	R25	110-22-10A
RES,110K,1/4W,5%,CF	2	R14,20	110-22-114
18K 1/4W 5% CF RES	2	R12,18	110-22-183
2.2K 1/4W 5% CF RES	1	R8	110-22-222
270 1/4W 5% CF RES	3	R5,6,7	110-22-271
RES, 240K, 1/4W, 5%, CF	2	R11,17	110-22-244
470 1/4W 5% CF RES	2	R13,19	110-22-471
270 1/2W 5% CF RES	2	R21,R22	110-32-271
56 1/2W 5% CF RES	6	R26,R27,R28,R29, R30,R31	110-32-560
680 1/2W 5% CF RES	1	3	110-32-681
2.00 K 1/4 W 1% MF RES	1	R8	120-20-20N
POTENTIOMETERS			
POT, 5K,12T,HORIZ.	2	R23,R24	13N-23-502
TRIMPOT 500 HORIZ	2	R9,15	13T-33-501
SEMICONDUCTOR DEVICES			
IC, LM317LZ, REG.	1	VR1	230-A0-400
IC 7217BIJI UP/DN COUNTER	1	U1	236-A0-001
IC, BA682A	2	U3,4	250-A0-400
SWITCHES & INDICATORS			
4 DIGIT LED DISPLAY	1	U2	250-A0-002
LED, GREEN	24	D1,2,3,4,5,6, 7,8,13,14,15, 16,17,18,19, 20,28,29,30, 31,32,33,34, 35	250-A0-298
LED, RED	11	D9,10,11,12, 21,22,23,24, 25,26,27	250-A0-299
LAMP 382	6		260-A0-001
SWITCH PUSH BUTTON LIGHTED	6		364-A0-005

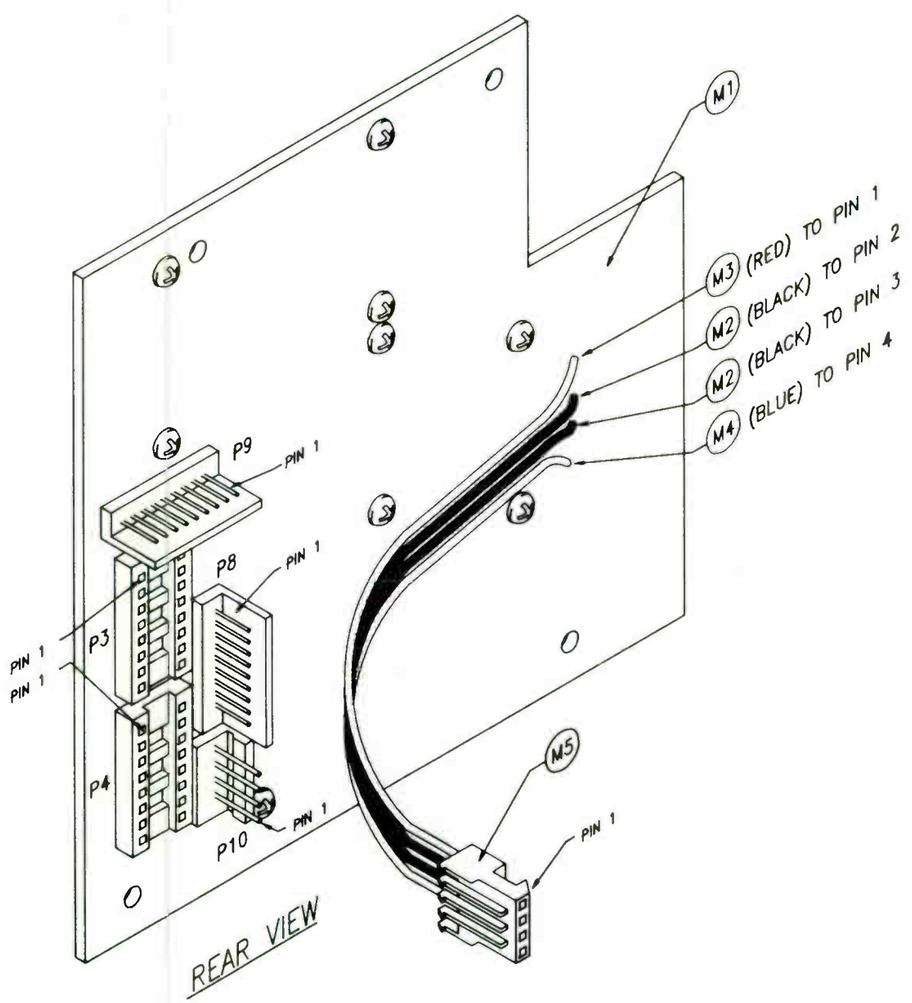
DESCRIPTION	QTY	DESIGNATOR	PART NUMBER
LENS – SWITCH WHITE	3		364-A0-006
LENS – SWITCH RED	2		364-A0-007
LENS SWITCH GREEN	1		364-A0-008
CONNECTORS & HARDWARE			
SOCKET DIP 16 PIN	2	P1,P3	410-A0-003
SOCKET DIP 28 PIN	1	U1	410-A0-004
SOCKET DIP 18 PIN	2	U3,4	410-A0-007
SHUNT, TWO CIRCUIT	2	M12	414-A0-012
HEADER MTA 100 4 POS	1	P2	416-A0-010
HEADER, 2 PIN	2	M11	416-A0-023
F.P. INSERT, REC SWITCHES	1		541-B0-403
OVERLAY, RECORD	1		581-B0-400
SCREW 4-40 X 3/8 PH PHILLIPS	2		621-06-440

FRONT PANEL ASSEMBLY, REPRODUCER 827-B0-408

DESCRIPTION	QTY	DESIGNATOR	PART NUMBER
CIRCUIT BOARD			
PCB, FRONT PNL DISPLAY CTR90P	1	M1	407-C0-406
PCB, FRONT PNL SWITCH CTR90P	1	M2	407-A0-411
CAPACITORS			
1000UF E CAP	1	C1	011-B5-108
RESISTORS			
1K 1/4W 5% CF RES	2	R2,R4	110-22-102
1 OHM 1/4W 5% CF RESISTOR	1	R25	110-22-10A
270 1/4W 5% CF RES	3	R5,6,7	110-22-271
56 1/2W 5% CF RES	3	R26,R27,R28	110-32-560
680 1/2W 5% CF RES	1	R3	110-32-681
SEMICONDUCTOR DEVICES			
IC 7217BIJI UP/DN COUNTER	1	U1	236-A0-001
SWITCHES & INDICATORS			
4 DIGIT LED DISPLAY	1	U2	250-A0-002
LED, GREEN	8	D28,29,30,31, 32,33,34,35	250-A0-298
LAMP 382	3		260-A0-001
SWITCH PUSH BUTTON LIGHTED	3		364-A0-005
LENS - SWITCH WHITE	1		364-A0-006
LENS - SWITCH RED	1		364-A0-007
LENS SWITCH GREEN	1		364-A0-008
CONNECTORS & HARDWARE			
SOCKET DIP 16 PIN	2	P1,P3	410-A0-003
SOCKET DIP 28 PIN	1	U1	410-A0-004
HEADER MTA 100 4 POS	1	P2	416-A0-010
F.P. INSERT PLATE, PLAY	1		541-B0-404
OVERLAY, CTR 90 PLAY	1		581-B0-401
SCREW 4-40 X 3/8 PH PHILLIPS	2		621-06-440

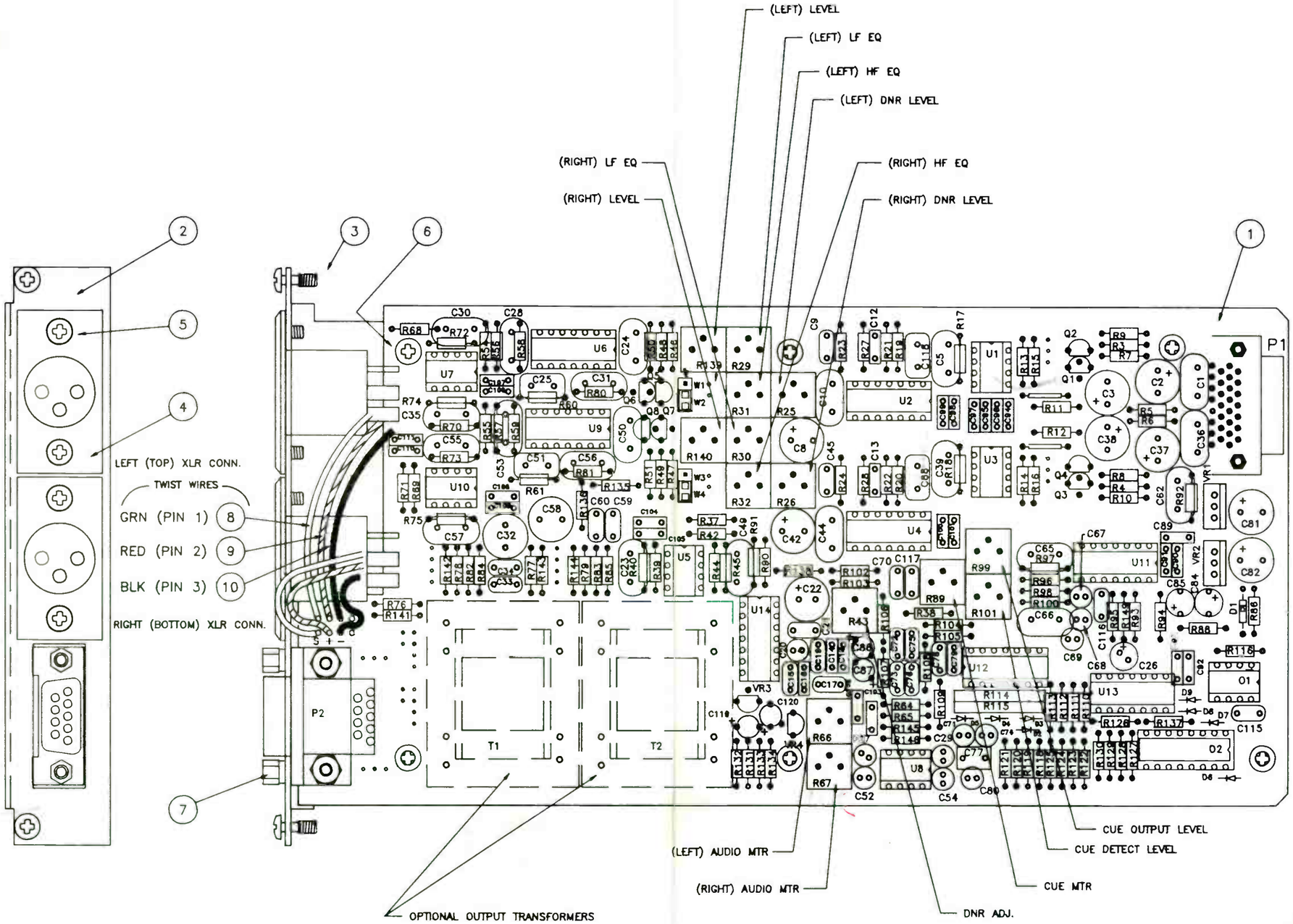
MECHANICAL DRAWINGS





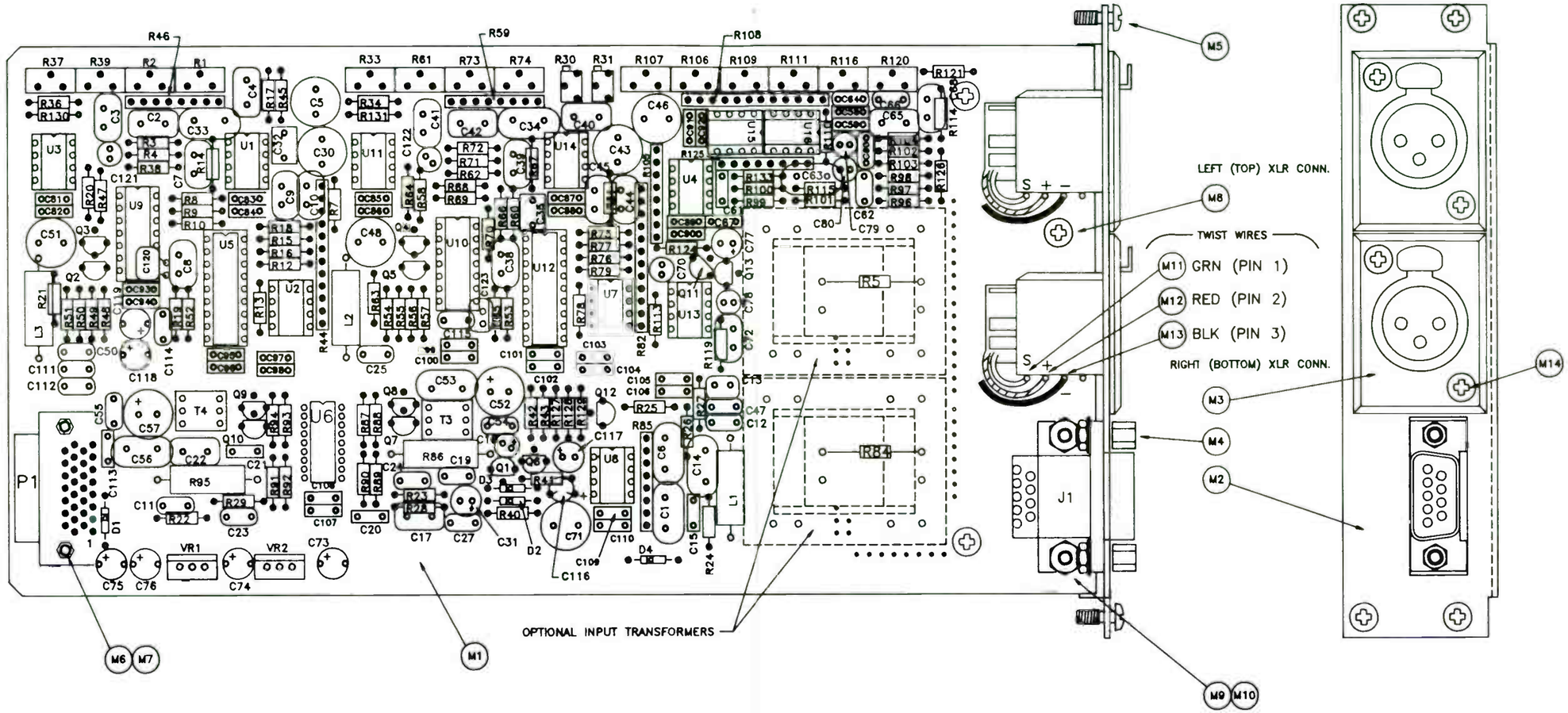
MODEL NOS. ALL CTR90 MODELS	ASSEMBLY INTERCONNECTION PWA	DWG. NO. 807-B0-400 SHEET 1 OF 1	APPR. T.J.W 11/24/90 MH 11/24/90 ISSUE DATE 11/21/90	REVISION LEVELS BILL OF MAT. 807-B0-400 SCHEMATIC 750-C0-400 P.C.BOARD 407-D0-400	FIDELIPAC CORP. MOORESTOWN, N.J.	THIS DOCUMENT CONTAINS PROPRIETARY INFORMATION OF FIDELIPAC CORPORATION. NO USE, DISCLOSURE OR REPRODUCTION OF ANY PART THEREOF MAY BE MADE WITHOUT PRIOR WRITTEN PERMISSION.

807AM400



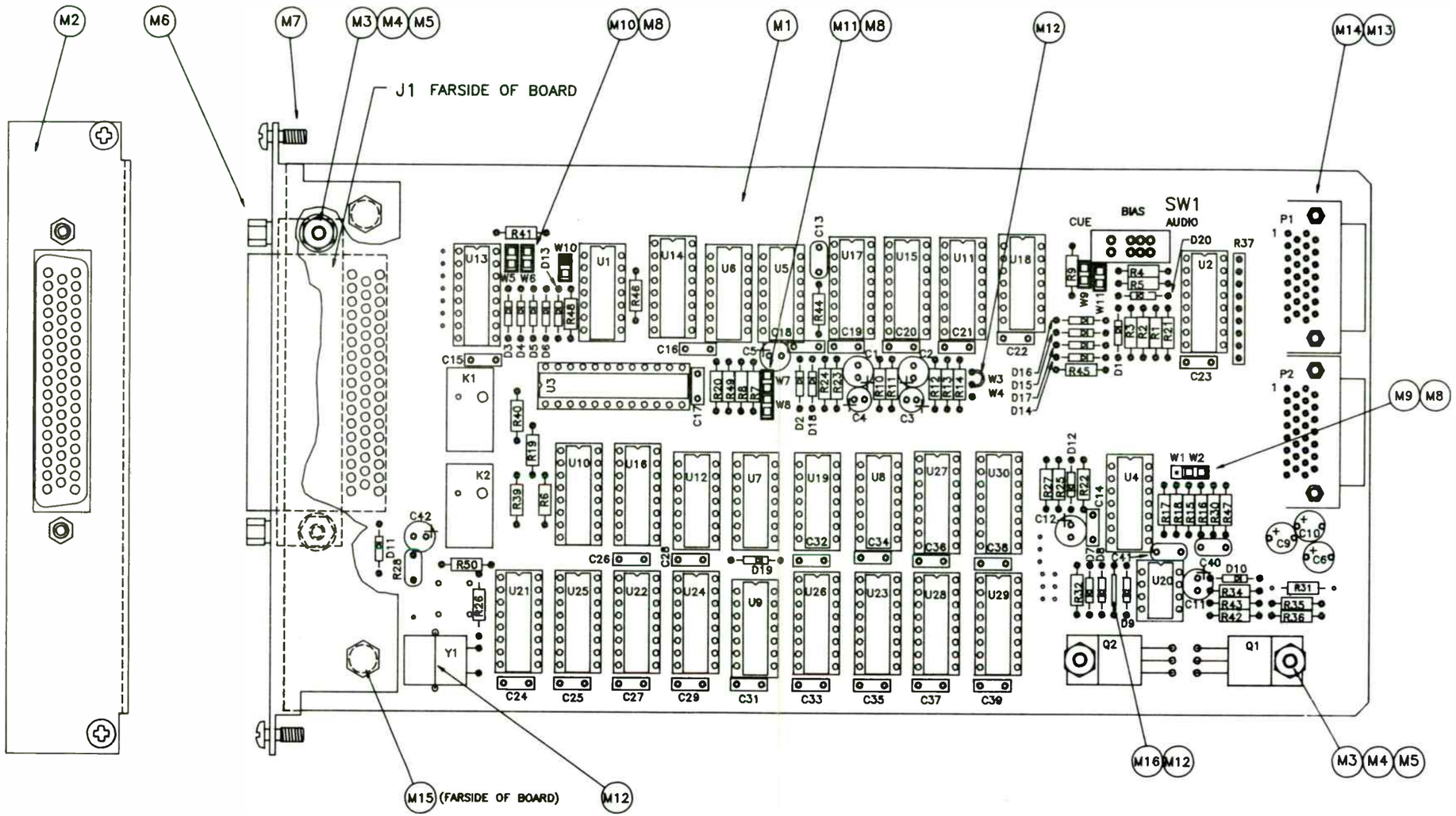
MODEL NOS. ALL CTR90 MODELS	ASSEMBLY PLAY PWA	DWG. NO. 807-D0-403 SHEET 1 OF 1	APPR. T.W 11/5/90 ISSUE DATE 11/9/90	REVISION LEVELS BILL OF MAT. 807-D0-403 SCHEMATIC 750-C0-403 P.C.BOARD 407-C0-403	FIDELIPAC CORP. MOORESTOWN, N.J.	THIS DOCUMENT CONTAINS PROPRIETARY INFORMATION OF FIDELIPAC CORPORATION. NO USE, DISCLOSURE OR REPRODUCTION OF ANY PART THEREOF MAY BE MADE WITHOUT PRIOR WRITTEN PERMISSION.

807BM403



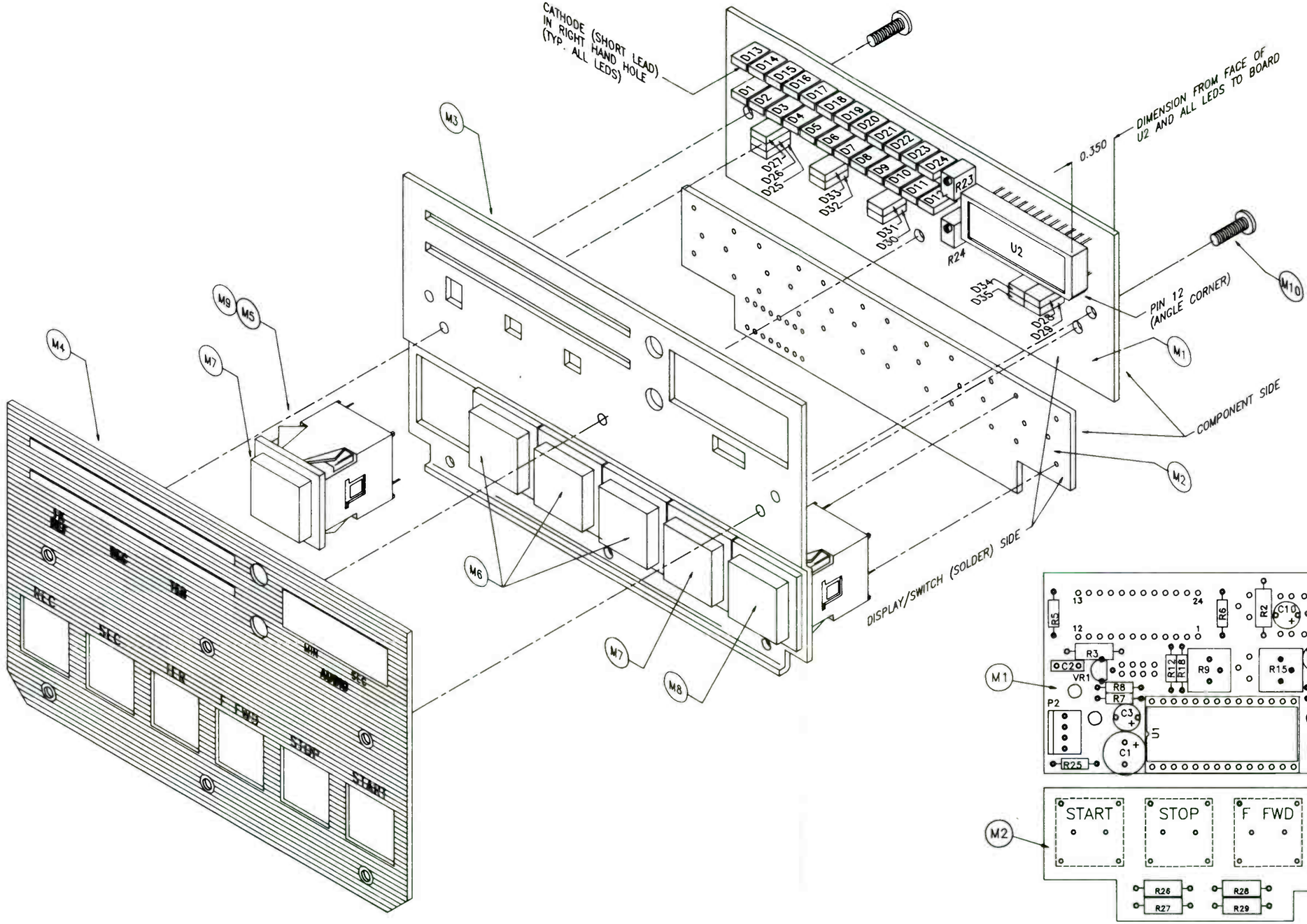
MODEL NOS. CTR93 CTR94 CTR94MX	ASSEMBLY RECORD PWA	DWG. NO. 807-CO-404 SHEET 1 OF 1	APPR. ISSUE DATE 11/20/90	REVISION LEVELS BILL OF MAT. 807-CO-404 SCHEMATIC 750-CO-404 P.C.BOARD 407-CO-404	FIDELIPAC CORP. MOORESTOWN, N.J.	THIS DOCUMENT CONTAINS PROPRIETARY INFORMATION OF FIDELIPAC CORPORATION. NO USE, DISCLOSURE OR REPRODUCTION OF ANY PART THEREOF MAY BE MADE WITHOUT PRIOR WRITTEN PERMISSION.

807CM404



MODEL NOS.	ASSEMBLY	DWG. NO.	APPR. T.J.W. 11/8/90	REVISION LEVELS		FIDELIPAC CORP. MOORESTOWN, N.J.	THIS DOCUMENT CONTAINS PROPRIETARY INFORMATION OF FIDELIPAC CORPORATION. NO USE, DISCLOSURE OR REPRODUCTION OF ANY PART THEREOF MAY BE MADE WITHOUT PRIOR WRITTEN PERMISSION.
ALL CTR90 MODELS	LOGIC PWA	807-C0-405	M.H 11/9/90	BILL OF MAT. 807-C0-405			
		SHEET 1 OF 1	ISSUE DATE 11/6/90	SCHEMATIC 750-C0-405	P.C.BOARD 407-C0-405		

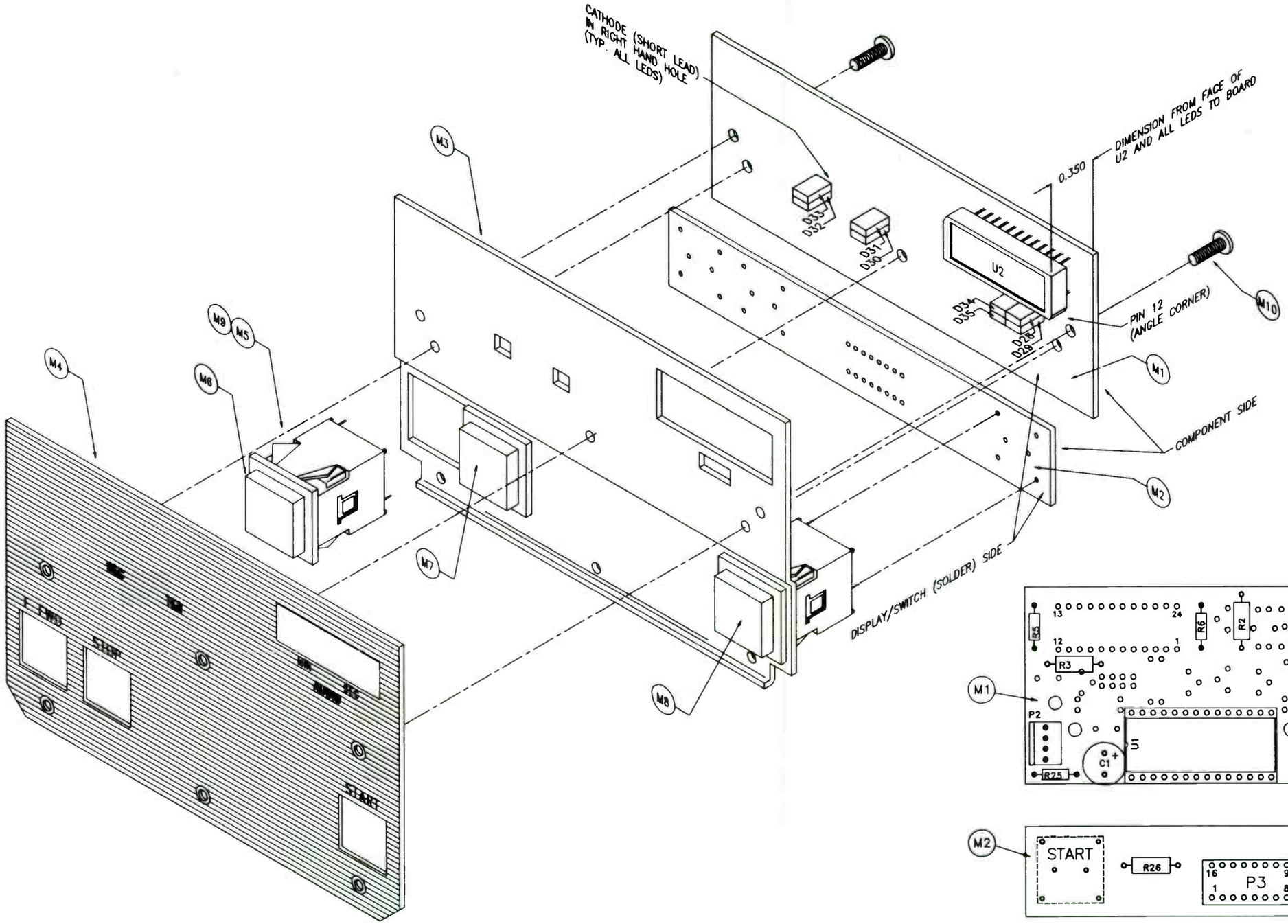
807BM405



COMPONENT SIDE VIEW

MODEL NOS. CTR93 CTR94 CTR94MX	ASSEMBLY FRONT PANEL PWA – RECORD	DWG. NO. 827-C0-407 SHEET 1 OF 1	APPR ISSUE DATE 11/29/90	REVISION LEVELS BILL OF MAT. 827-C0-407 P.C.B. 407-C0-406/407-A0-410 SCHEMATIC 750-C0-406	FIDELIPAC CORP. MOORESTOWN, N.J.	THIS DOCUMENT CONTAINS PROPRIETARY INFORMATION OF FIDELIPAC CORPORATION. NO USE, DISCLOSURE OR REPRODUCTION OF ANY PART THEREOF MAY BE MADE WITHOUT PRIOR WRITTEN PERMISSION.

827BM407



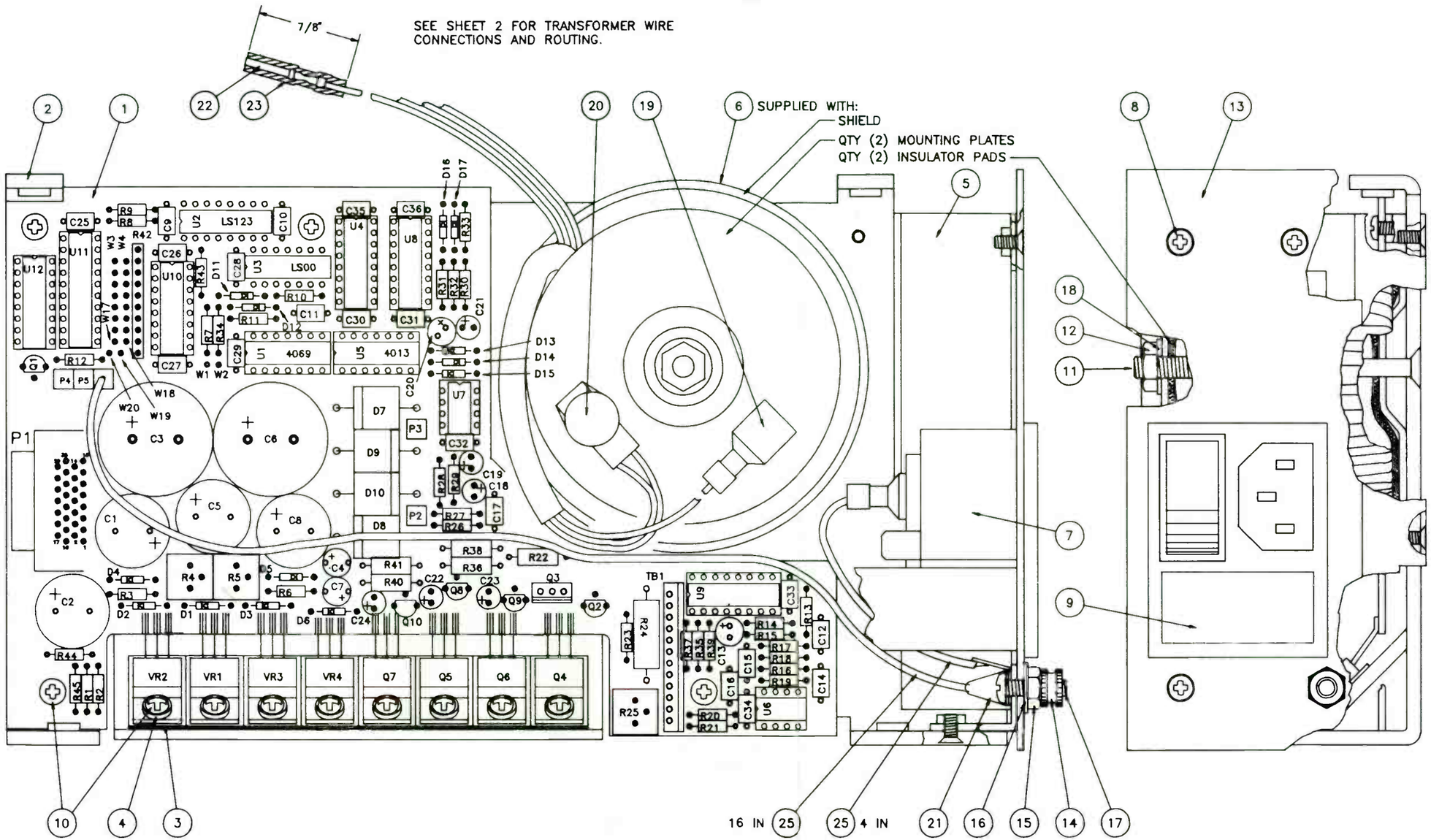
COMPONENT SIDE VIEW

MODEL NOS. CTR91 CTR92 CTR92MAX	ASSEMBLY	DWG. NO. 827-C0-408	APPR. 11/20/90	REVISION LEVELS		FIDELIPAC CORP. MOORESTOWN, N.J.
	FRONT PANEL PWA – RECORD	SHEET 1 OF 1	ISSUE DATE 11/27/90	BILL OF MAT. 827-C0-408	P.C.B. 407-C0-406/407-A0-411	
				SCHEMATIC 750-C0-406		

827BM408

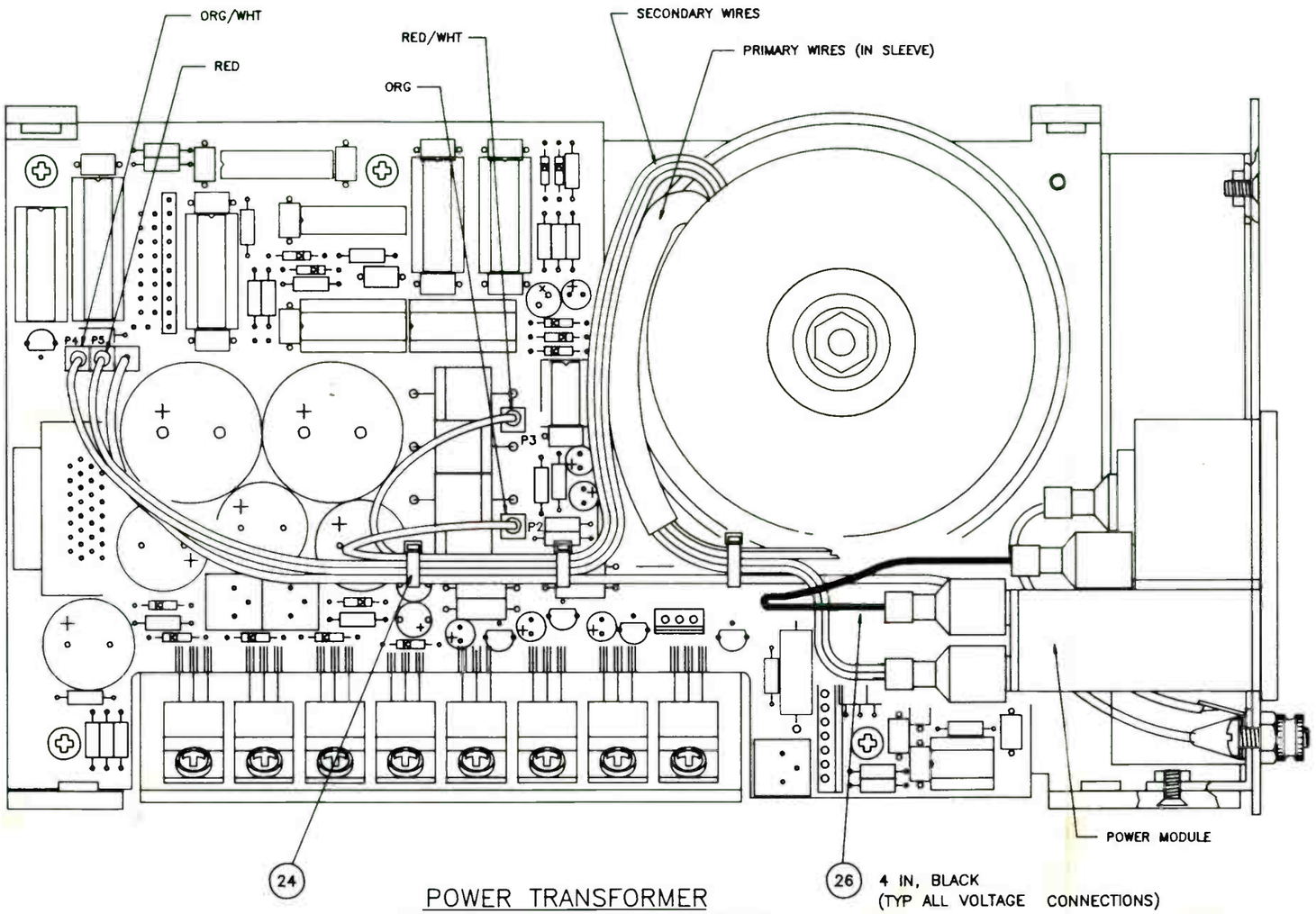
SECONDARY CONNECTIONS

PRIMARY CONNECTIONS



MODEL NOS.	ASSEMBLY	DWG. NO.	APPR.	REVISION LEVELS		FIDELIPAC CORP. MOORESTOWN, N.J.	THIS DOCUMENT CONTAINS PROPRIETARY INFORMATION OF FIDELIPAC CORPORATION. NO USE, DISCLOSURE OR REPRODUCTION OF ANY PART THEREOF MAY BE MADE WITHOUT PRIOR WRITTEN PERMISSION.
ALL CTR90 MODELS	POWER SUPPLY/MOTOR DRIVER MODULE	827-A0-412	T.J.W. 11/4/90 MH 11/4/90	BILL OF MAT. 827-A0-412			
		SHEET 1 OF 2	ISSUE DATE 11/21/90	SCHEMATIC 750-A0-412	P.C.BOARD 407-A0-412		

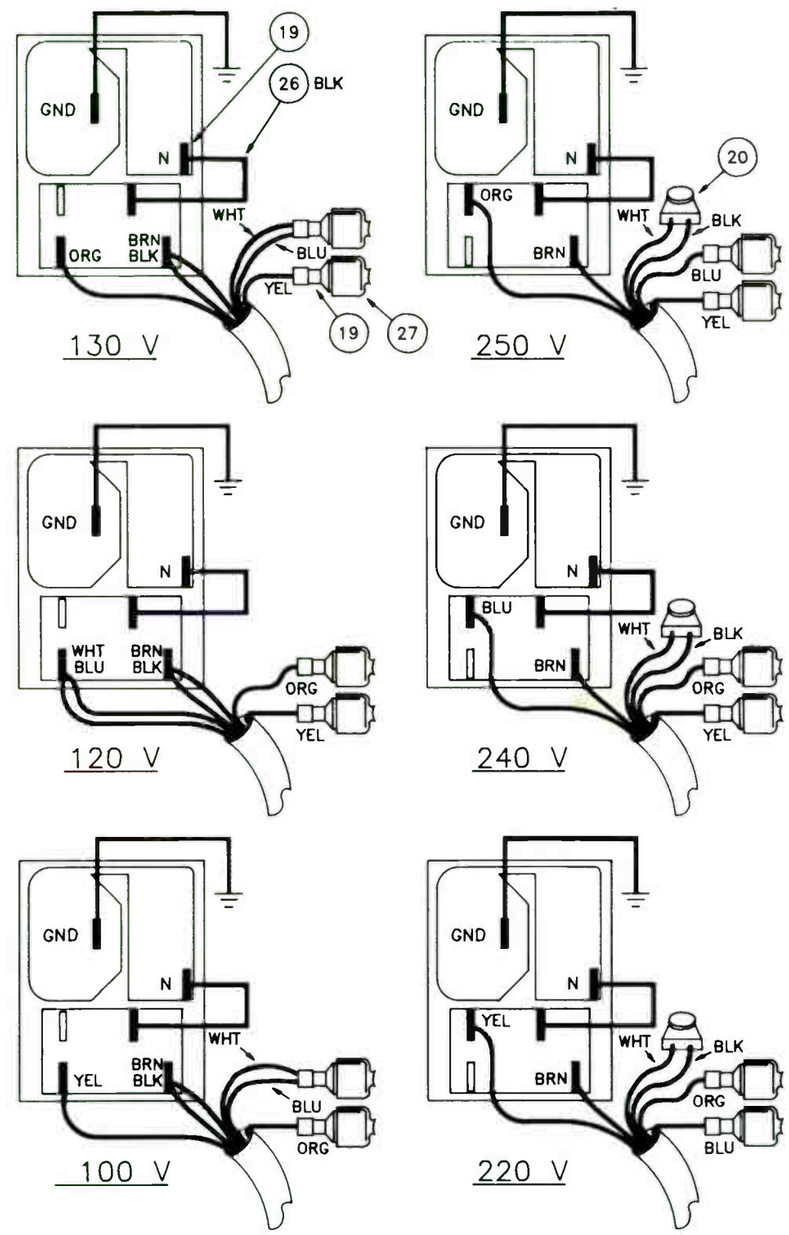
827BM412



POWER TRANSFORMER
CONNECTIONS & WIRE ROUTING

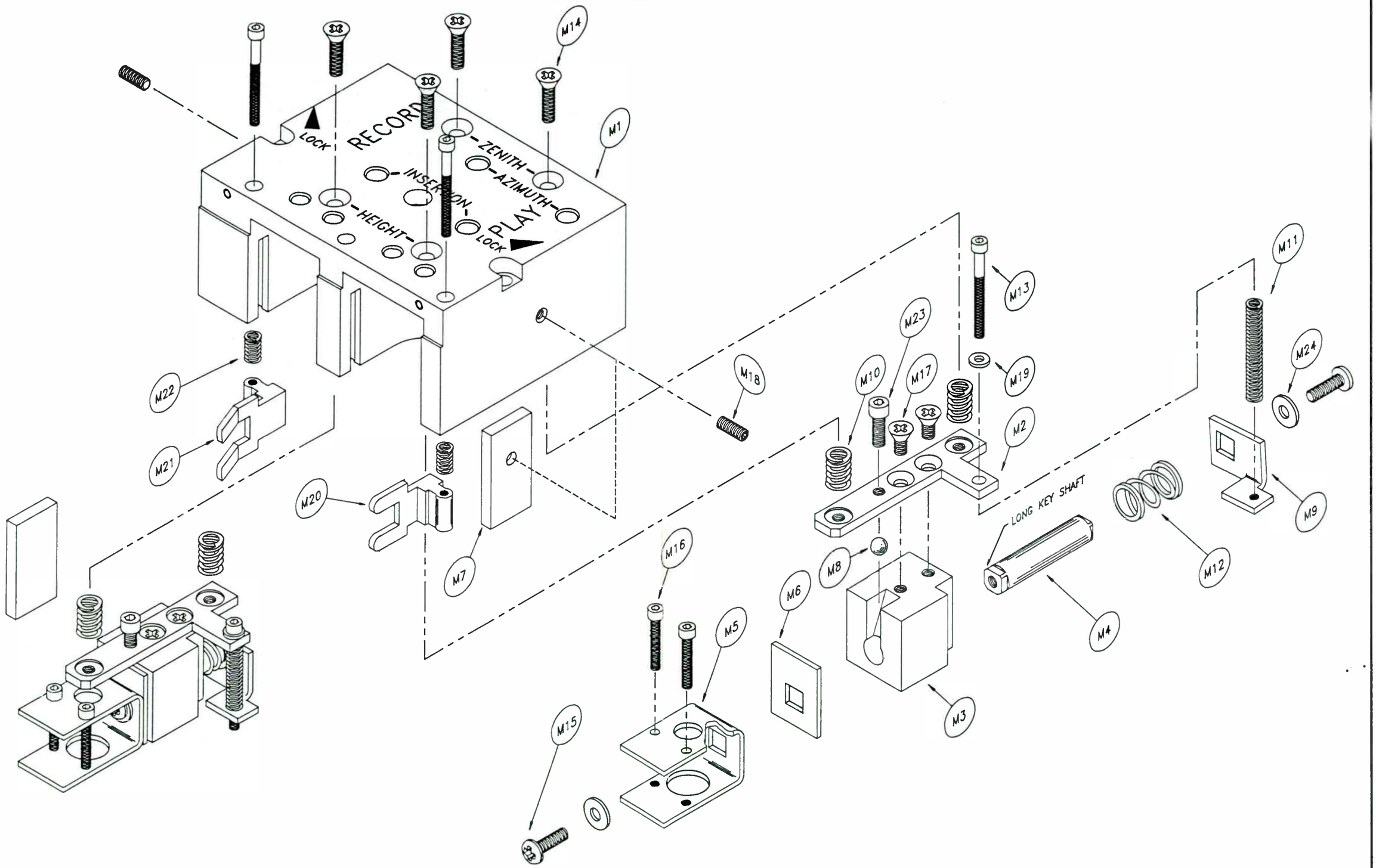
4 IN, BLACK
(TYP ALL VOLTAGE CONNECTIONS)

PRIMARY WIRE CONNECTION
TO POWER MODULE
(REAR VIEW OF POWER MODULE)



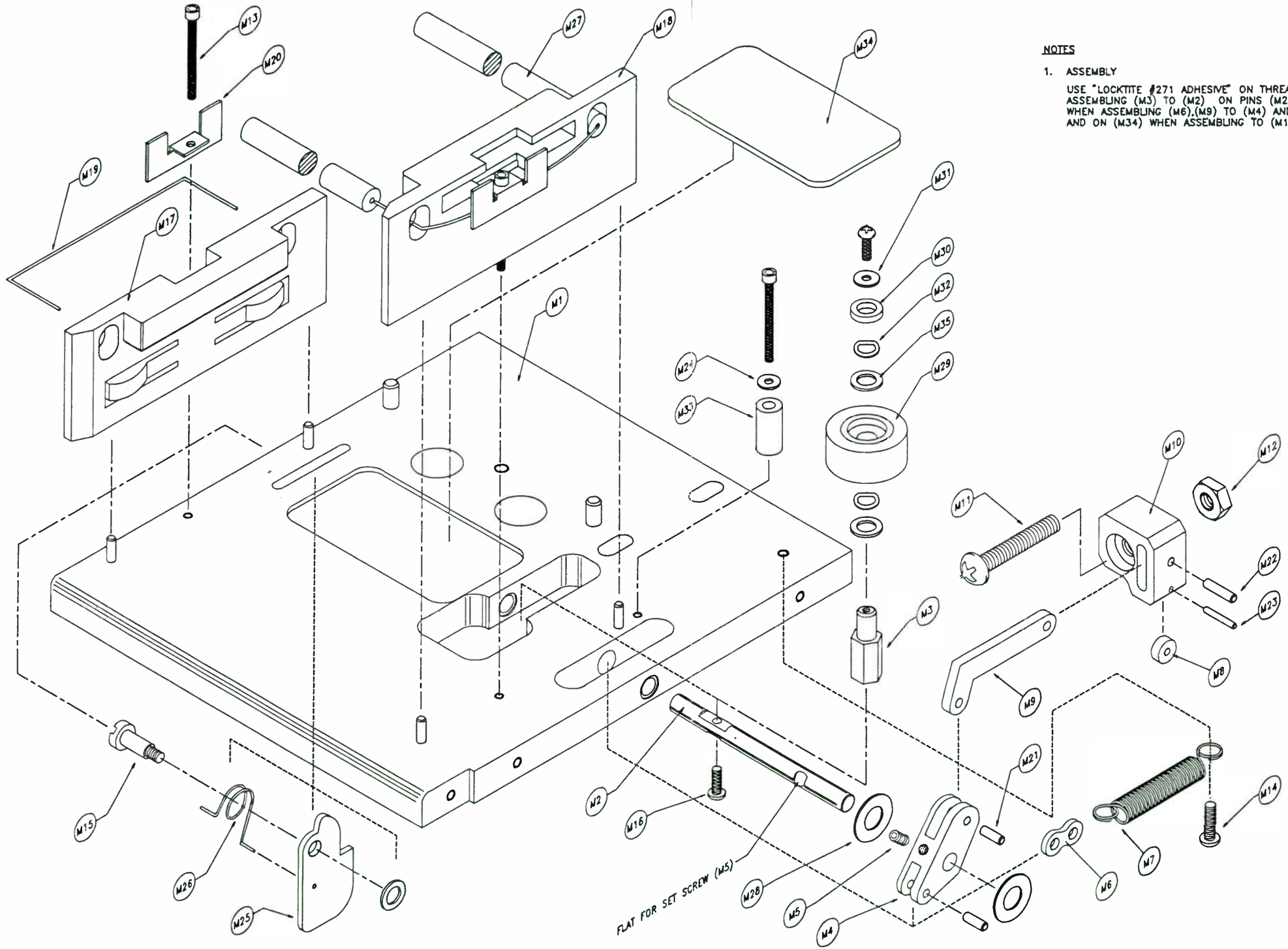
MODEL NOS.	ASSEMBLY	DWG. NO.	APPR.	REVISION LEVELS		FIDELIPAC CORP. MOORESTOWN, N.J.	THIS DOCUMENT CONTAINS PROPRIETARY INFORMATION OF FIDELIPAC CORPORATION. NO USE, DISCLOSURE OR REPRODUCTION OF ANY PART THEREOF MAY BE MADE WITHOUT PRIOR WRITTEN PERMISSION.
ALL CTR90 MODELS	POWER SUPPLY/MOTOR DRIVER MODULE	827-A0-412	T.J.W 11/21/90	BILL OF MAT. 827-A0-412			
		SHEET 2 OF 2	MH 11/21/90 ISSUE DATE 11/21/90	SCHEMATIC 750-A0-412	P.C.BOARD 407-A0-412		

827BM412



MODEL NOS.	ASSEMBLY	DWG. NO.	APPR.		
ALL CTR90 MODELS	HEAD BRIDGE	827-CO-401	T.J.N. 11/26/90	FIDELIPAC CORP. MOORESTOWN, N.J.	THIS DOCUMENT CONTAINS PROPRIETARY INFORMATION OF FIDELIPAC CORPORATION. NO USE, DISCLOSURE OR REPRODUCTION OF ANY PART THEREOF MAY BE MADE WITHOUT PRIOR WRITTEN PERMISSION.
		SHEET 1 OF 1	ISSUE DATE 11/26/90		

827AM401

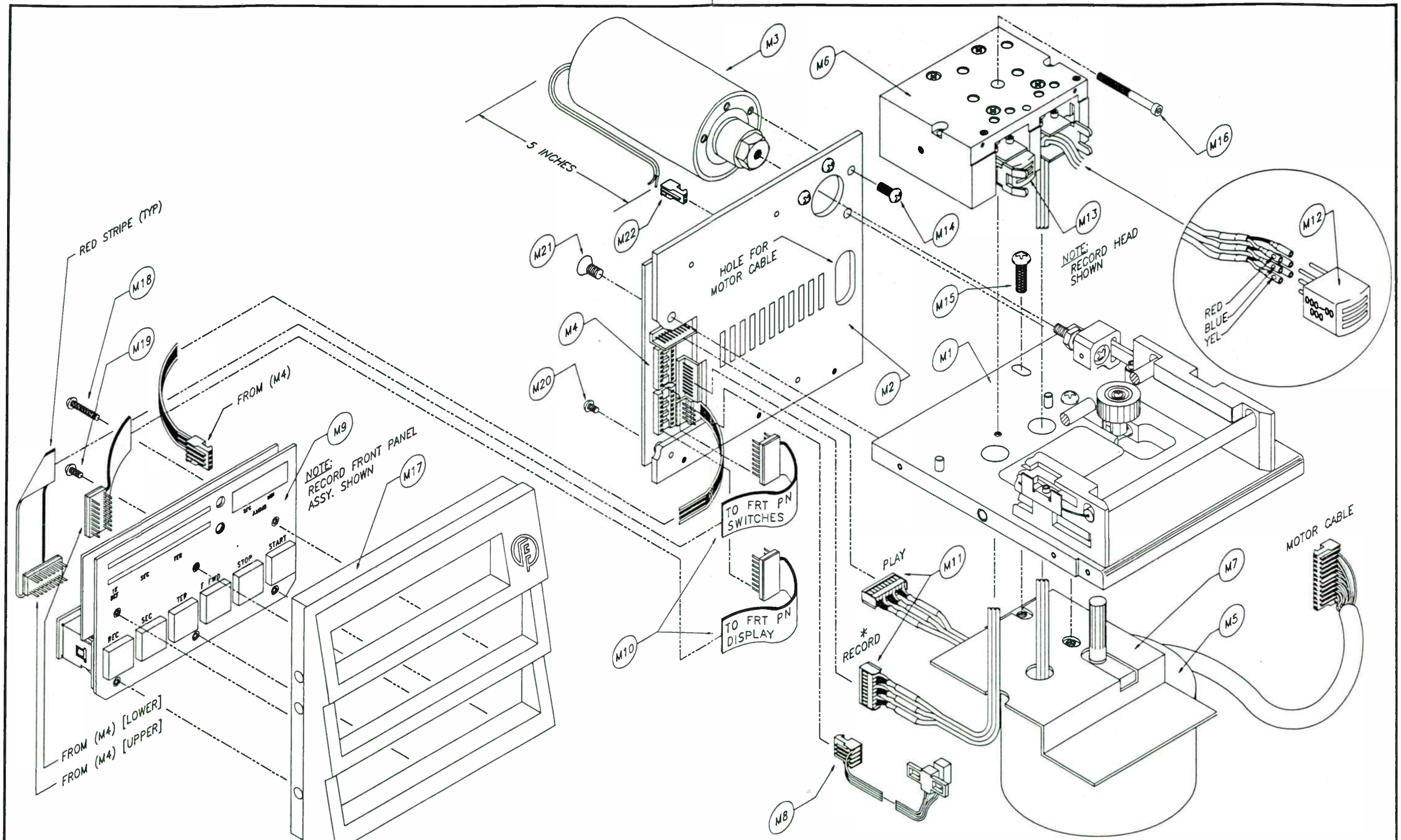


NOTES

1. ASSEMBLY

   USE "LOCKTITE #271 ADHESIVE" ON THREADS OF (M16) WHEN ASSEMBLING (M3) TO (M2) ON PINS (M21),(M22),(M23) WHEN ASSEMBLING (M6),(M9) TO (M4) AND (M9),(M8) TO (M10). AND ON (M34) WHEN ASSEMBLING TO (M1)

MODEL NOS. ALL CTR90 MODELS	ASSEMBLY DECK	DWG. NO. 827-A0-402 SHEET 1 OF 1	APPR. T.J.N 11/27/90 ISSUE DATE 11/27/90	FIDELIPAC CORP. MOORESTOWN, N.J.	

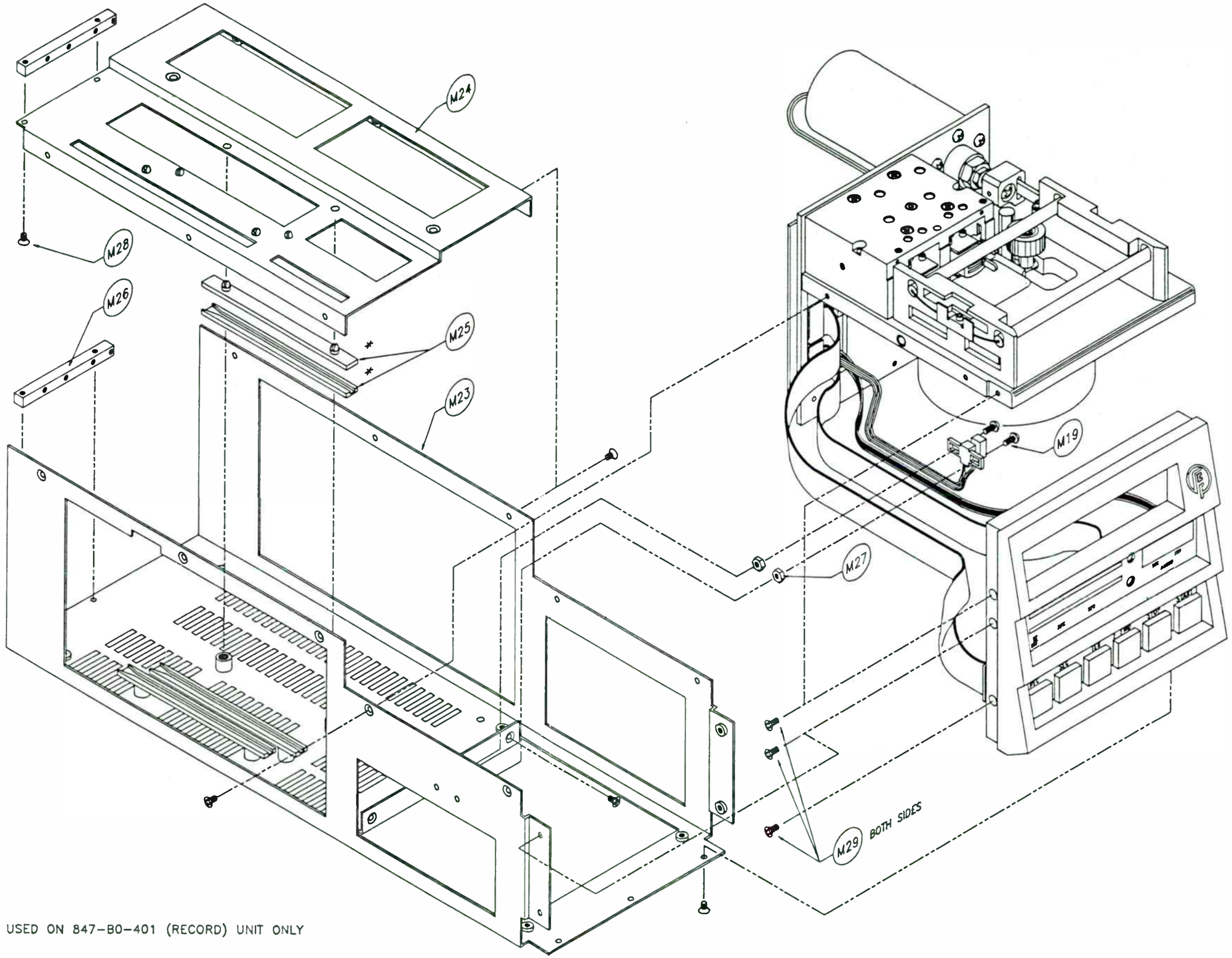


* INDICATES COMPONENTS USED ON 847-B0-401 (RECORD) UNIT ONLY

ASSEMBLY	DWG. NO.	UNIT	MODEL NO.	SHEET	APPR. T.J.N. 11/29/90
TOP	847-B0-400	REPRODUCE	CTR91,CTR92,CTR92MX	1 OF 3	ISSUE DATE 11/29/90
	847-B0-401	RECORD	CTR93,CTR94,CTR94MX		

FIDELIPAC CORP. MOORESTOWN, N.J.

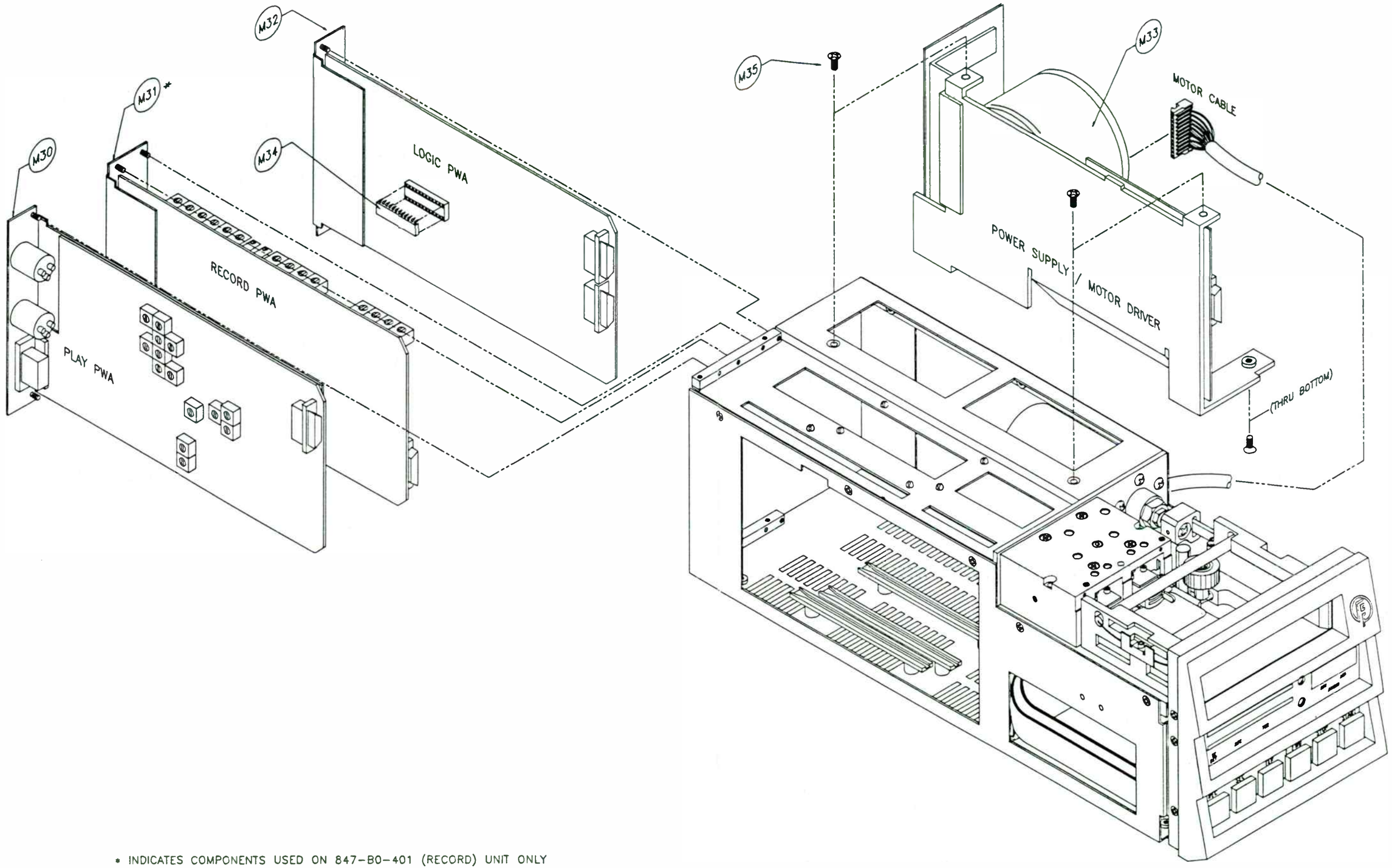
8471M400



INDICATES COMPONENTS USED ON 847-B0-401 (RECORD) UNIT ONLY

ASSEMBLY	DWG. NO.	UNIT	MODEL NO.	SHEET	APPR. T.J.W 11/24/90
TOP	847-B0-400	REPRODUCE	CTR91,CTR92,CTR92MX	2 OF 3	ISSUE DATE 11/29/90
	847-B0-401	RECORD	CTR93,CTR94,CTR94MX		

FIDELIPAC CORP.
MOORESTOWN, N.J.

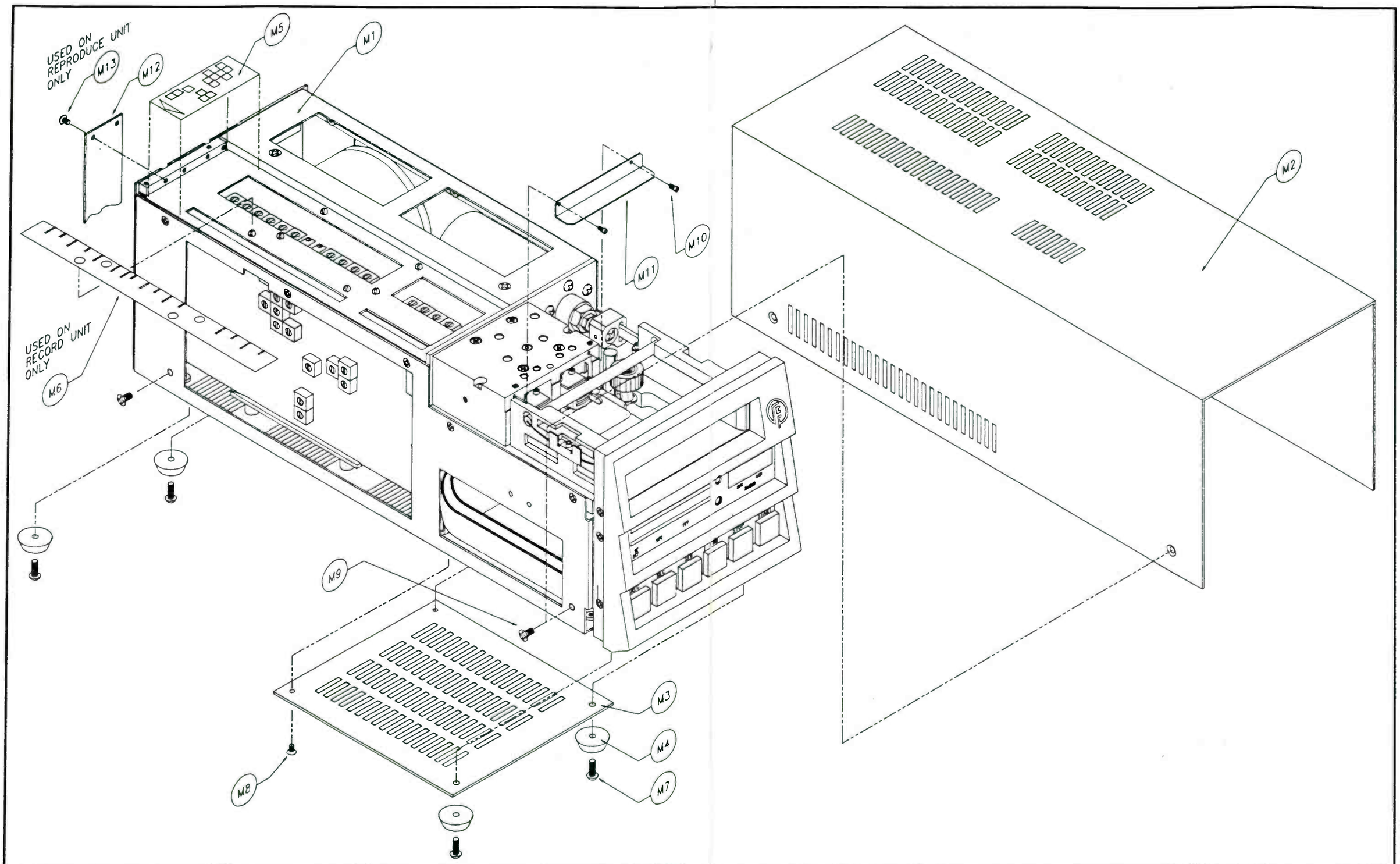


* INDICATES COMPONENTS USED ON 847-B0-401 (RECORD) UNIT ONLY

ASSEMBLY	DWG. NO.	UNIT	MODEL NO.	SHEET	APPR. T.J.W. 11/29/90
TOP	847-B0-400	REPRODUCE	CTR91,CTR92,CTR92MX	3 OF 3	ISSUE DATE 11/29/90
	847-B0-401	RECORD	CTR93,CTR94,CTR94MX		

FIDELIPAC CORP.
MOORESTOWN, N.J.

847JM400

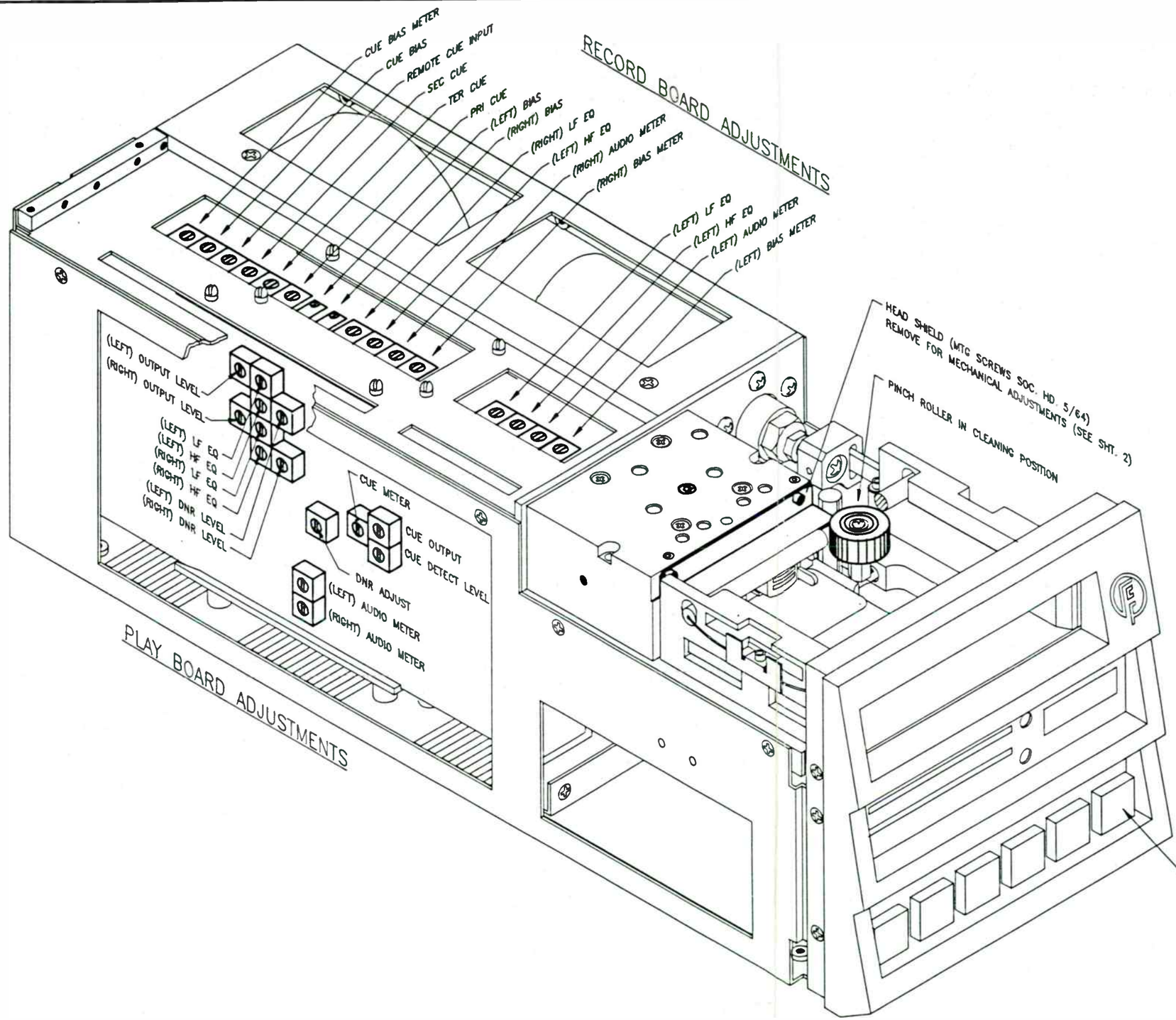


ASSEMBLY	DWG. NO.	UNIT	MODEL NO.	SHEET	APPR. T.W.
FINAL	857-B0-400	REPRODUCE	CTR91,CTR92,CTR92MX	1 OF 1	ISSUE DATE 11/29/90
	857-B0-401	RECORD	CTR93,CTR94,CTR94MX		

FIDELIPAC CORP.
MOORESTOWN, N.J.

857BM401

ELECTRICAL DRAWINGS



CLEANING MODE (PINCH ROLLER & CAPSTAN)

PUSHING AND HOLDING THE START SWITCH FOR TWO SECONDS WITHOUT AT CARTRIDGE IN THE MACHINE WILL ENGAGE THE SOLENOID AND START THE MOTOR .

ELECTRONIC ALIGNMENT LOCATIONS

DWG. NO. 750-A0-440

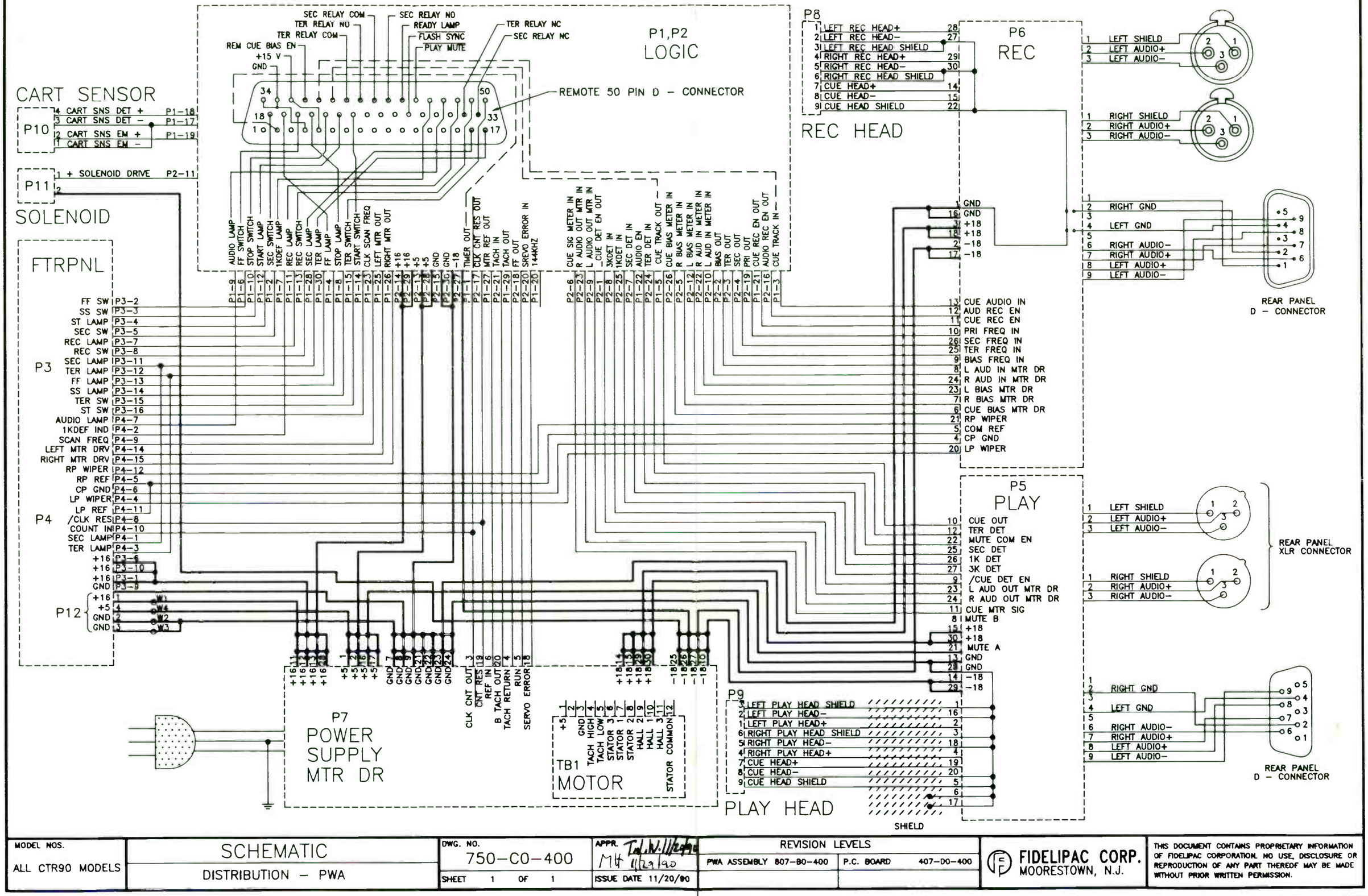
SHEET 1 OF 2

APPR. T.J.M. 11/27/90
T.H. 11-29-90

ISSUE DATE 11/27/90

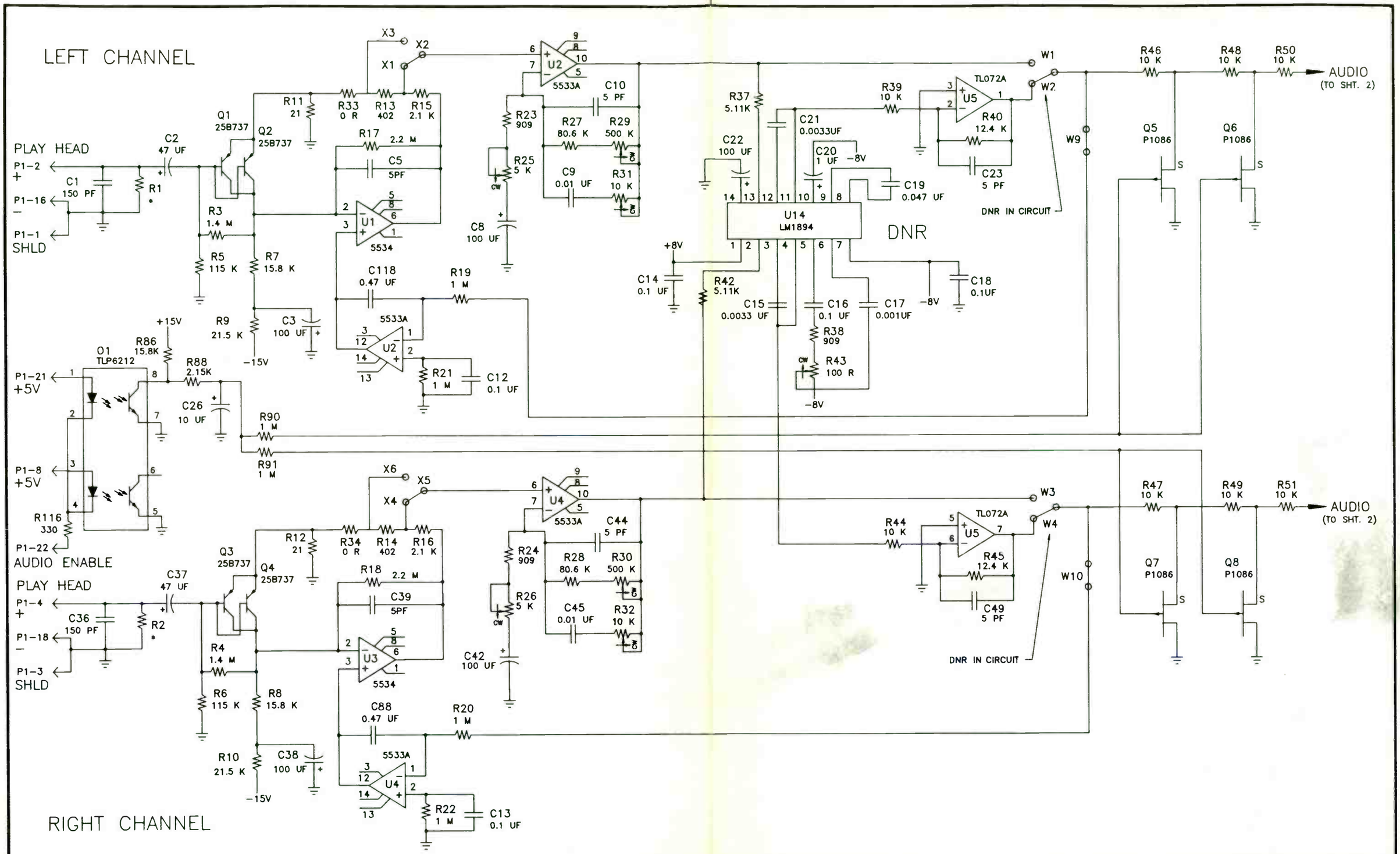
FIDELIPAC CORP.
MOORESTOWN, N.J.

MAINTAIN



MODEL NOS.	SCHEMATIC	DWG. NO.	APPR.	REVISION LEVELS		FIDELIPAC CORP. MOORESTOWN, N.J.	THIS DOCUMENT CONTAINS PROPRIETARY INFORMATION OF FIDELIPAC CORPORATION. NO USE, DISCLOSURE OR REPRODUCTION OF ANY PART THEREOF MAY BE MADE WITHOUT PRIOR WRITTEN PERMISSION.
ALL CTR90 MODELS	DISTRIBUTION – PWA	750-C0-400	MH 1/29/90	PWA ASSEMBLY 807-B0-400	P.C. BOARD 407-D0-400		
		SHEET 1 OF 1	ISSUE DATE 11/20/90				

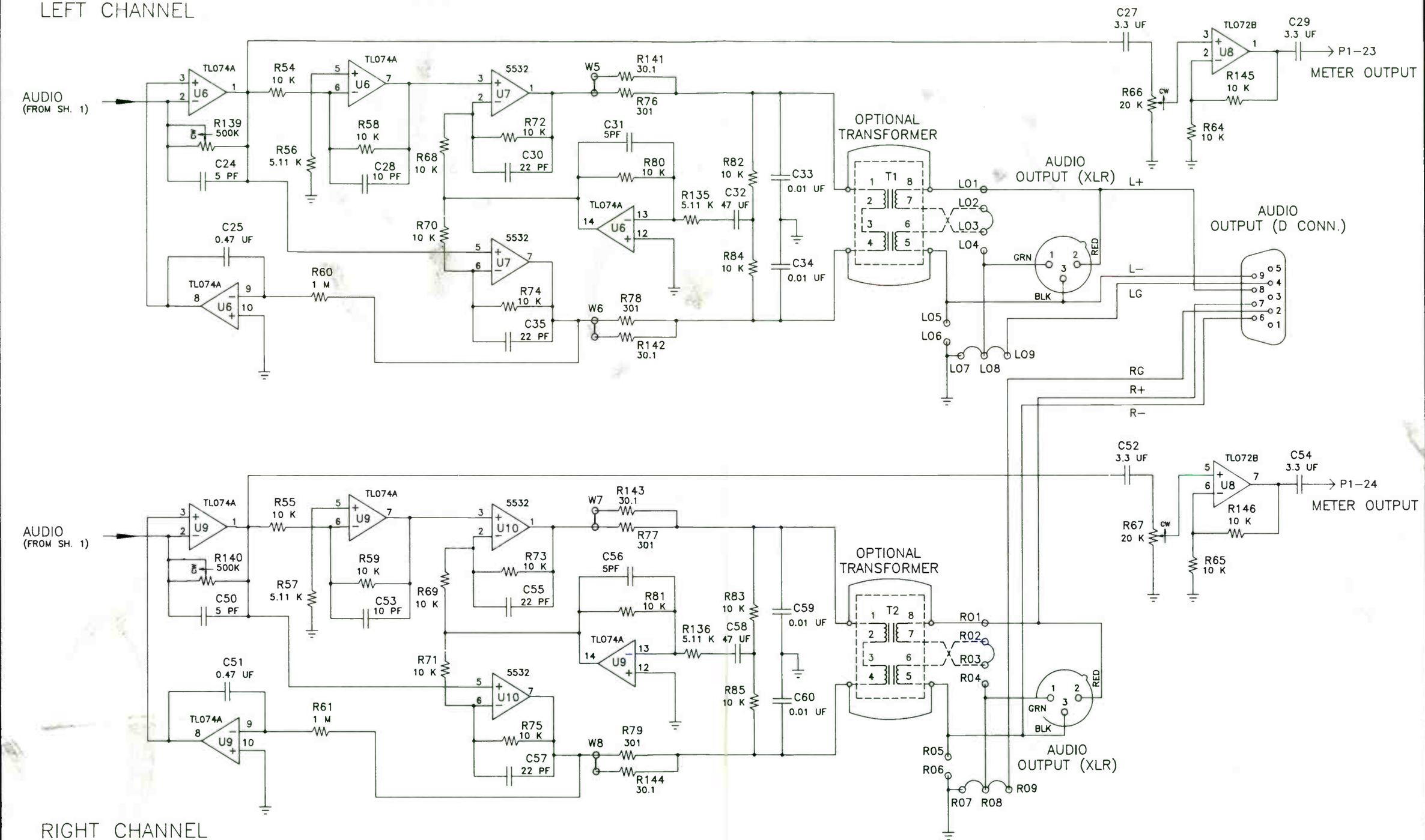
SCHMDIS1



MODEL NOS.	SCHEMATIC	DWG. NO.	APPR.	REVISION LEVELS		FIDELIPAC CORP. MOORESTOWN, N.J.	THIS DOCUMENT CONTAINS PROPRIETARY INFORMATION OF FIDELIPAC CORPORATION. NO USE, DISCLOSURE OR REPRODUCTION OF ANY PART THEREOF MAY BE MADE WITHOUT PRIOR WRITTEN PERMISSION.
ALL CTR90 MODELS	PLAY PWA – (AUDIO FRONT END)	750-C0-403	J.J.W 11/5/90 M.H 11/15/90	PWA ASSEMBLY 807-D0-403	P.C. BOARD 407-C0-403		
		SHEET 1 OF 4	ISSUE DATE 11/9/90				

SCHMPLA1

LEFT CHANNEL

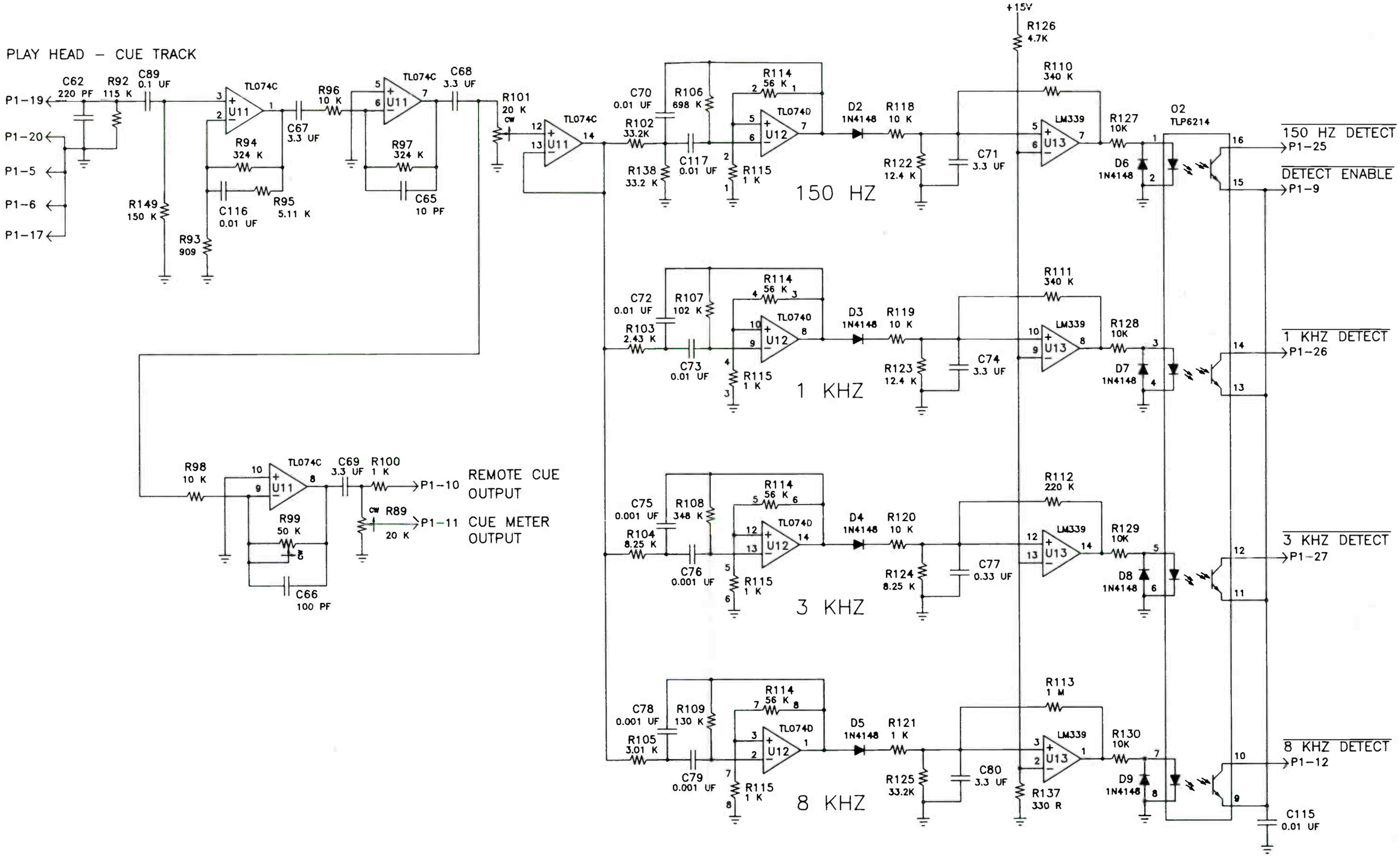


RIGHT CHANNEL

MODEL NOS.	SCHEMATIC	DWG. NO.	APPR.	REVISION LEVELS		FIDELIPAC CORP. MOORESTOWN, N.J.	THIS DOCUMENT CONTAINS PROPRIETARY INFORMATION OF FIDELIPAC CORPORATION. NO USE, DISCLOSURE OR REPRODUCTION OF ANY PART THEREOF MAY BE MADE WITHOUT PRIOR WRITTEN PERMISSION.
ALL CTR90 MODELS	PLAY PWA – (AUDIO OUTPUT)	750-C0-403	J.W. 11/24/90	PWA ASSEMBLY 807-D0-403	P.C. BOARD 407-C0-403		
		SHEET 2 OF 4	MH 11/24/90 ISSUE DATE 11/9/90				

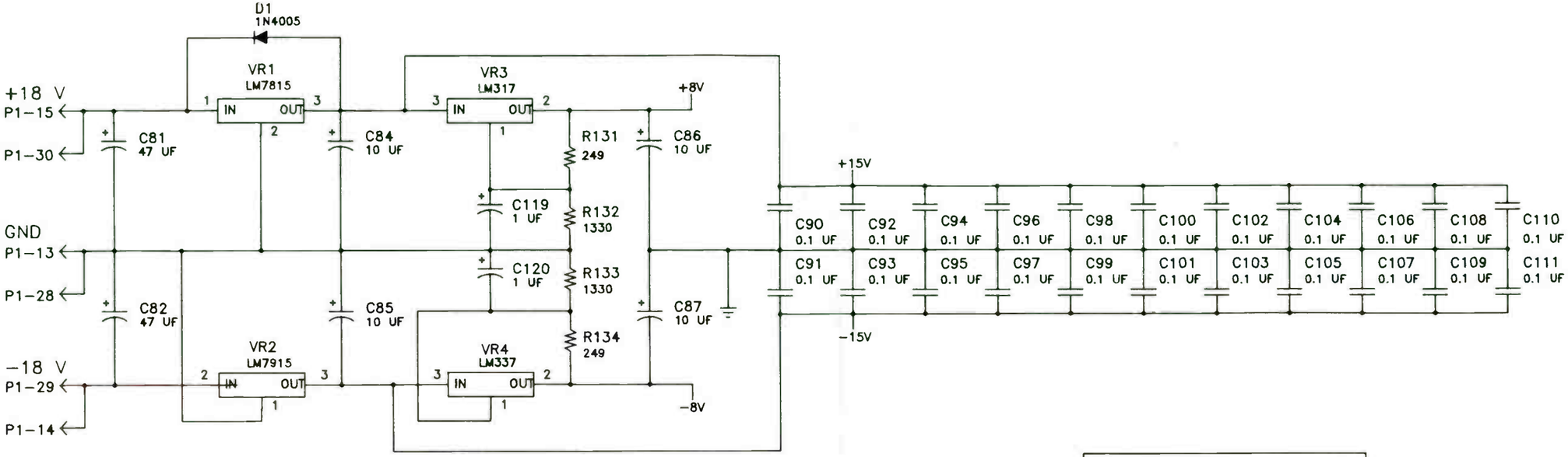
SCHMPLA2

PLAY HEAD – CUE TRACK



MODEL NOS. ALL CTR90 MODELS	SCHEMATIC PLAY PWA – (CUE CIRCUITS)	DWG. NO. 750-C0-403 SHEET 3 OF 4	APPR. ISSUE DATE 11/9/90	REVISION LEVELS PWA ASSEMBLY 807-D0-403 P.C. BOARD 407-C0-403	FIDELIPAC CORP. MOORESTOWN, N.J.	THIS DOCUMENT CONTAINS PROPRIETARY INFORMATION OF FIDELIPAC CORPORATION. NO USE, DISCLOSURE OR REPRODUCTION OF ANY PART THEREOF MAY BE MADE WITHOUT PRIOR WRITTEN PERMISSION.

SCHMPLA3



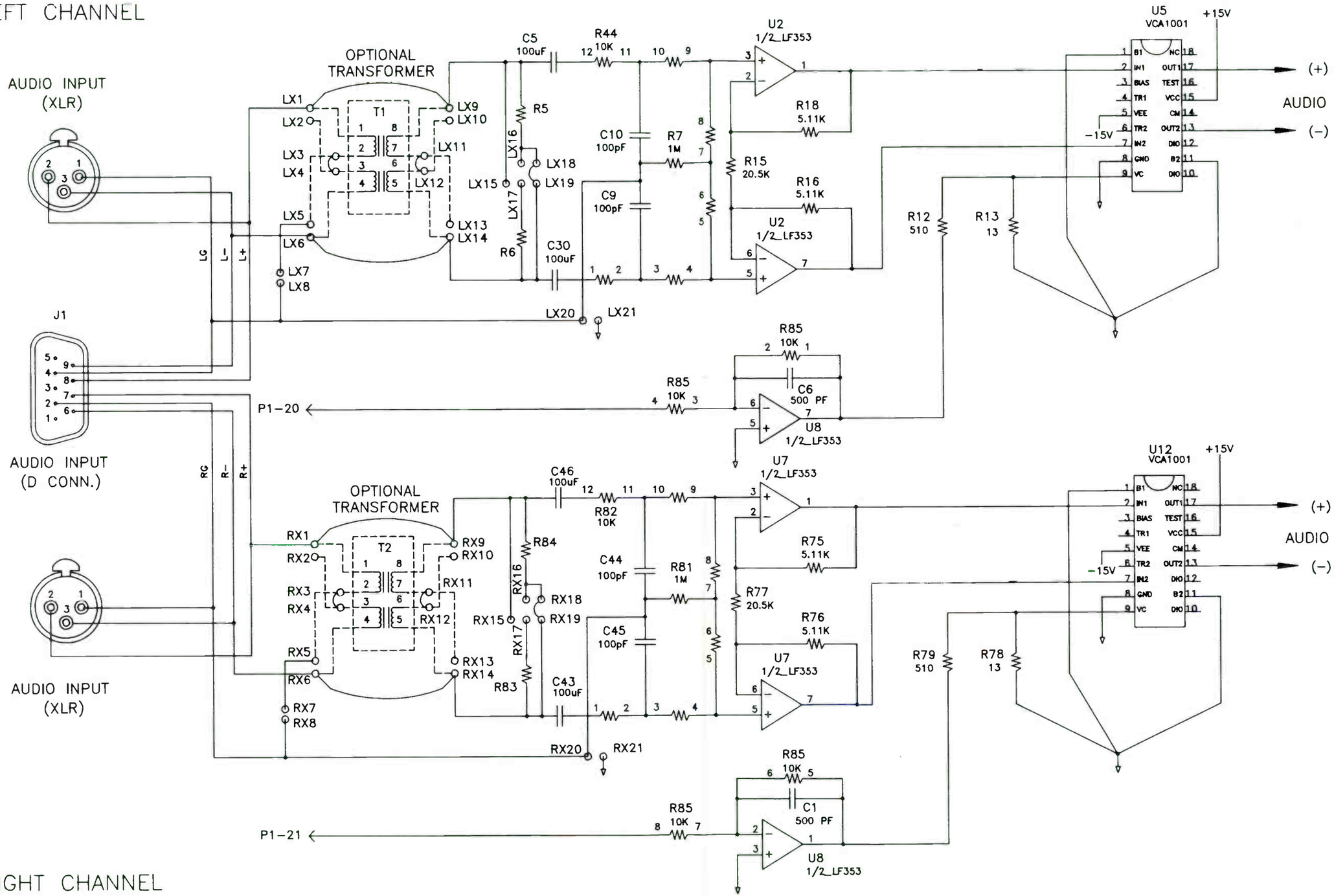
I.C.	−15 V	+15 V
U1	4	7
U2	4	11
U3	4	7
U4	4	11
U5	4	8
U6	11	4
U7	4	8
U8	4	8
U9	11	4
U10	4	8
U11	11	4
U12	11	4
U13	11	4

POWER CONNECTIONS NOT
SHOWN ON SCHEMATIC

MODEL NOS.	SCHEMATIC	DWG. NO. 750-C0-403	APPR. J.J.W 11/15/90	REVISION LEVELS		FIDELIPAC CORP. MOORESTOWN, N.J.	
ALL CTR90 MODELS	PLAY PWA – (POWER)	SHEET 4 OF 4	ISSUE DATE 11/9/90	PWA ASSEMBLY 807-D0-403	P.C. BOARD 407-C0-403		

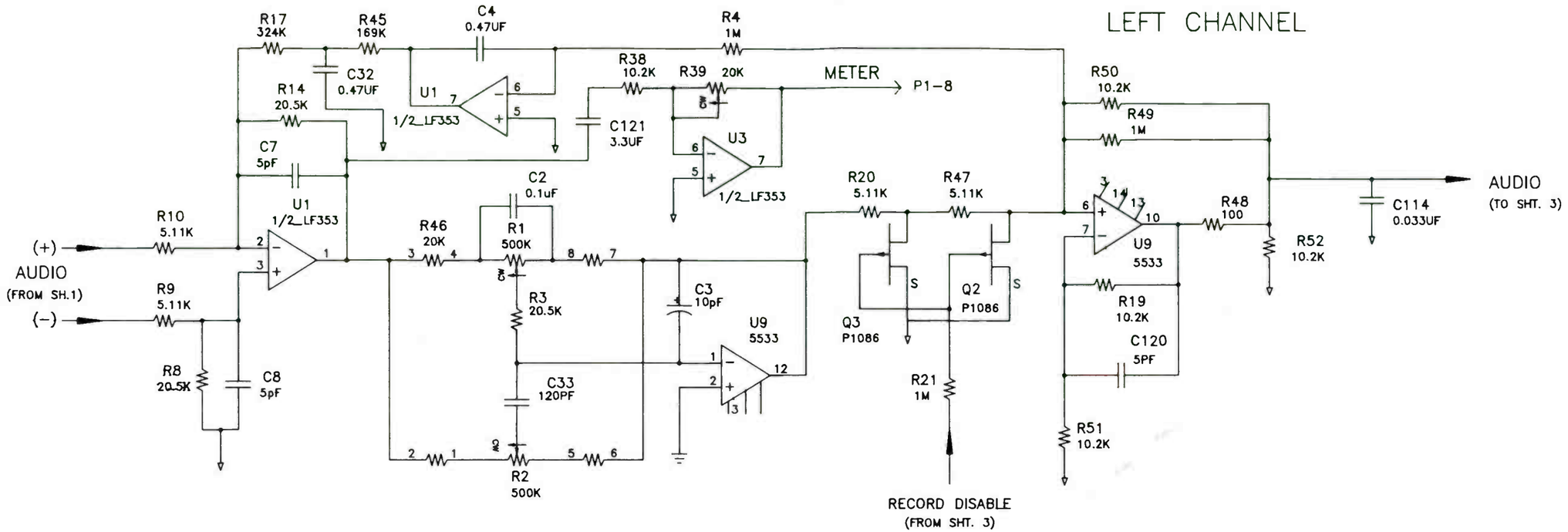
SCHMPLA4

LEFT CHANNEL



MODEL NOS. CTR93 CTR94 CTR94MX	SCHEMATIC RECORD PWA	DWG. NO. 750-C0-404 SHEET 1 OF 4	APPR. T.M.W. 12/7/90 M.H. 11-9-90 ISSUE DATE 11/27/90	REVISION LEVELS PWA ASSEMBLY 807-C0-404 P.C. BOARD 407-C0-404	FIDELIPAC CORP. MOORESTOWN, N.J.	THIS DOCUMENT CONTAINS PROPRIETARY INFORMATION OF FIDELIPAC CORPORATION. NO USE, DISCLOSURE OR REPRODUCTION OF ANY PART THEREOF MAY BE MADE WITHOUT PRIOR WRITTEN PERMISSION.

SCHMREC1



MODEL NOS. CTR93 CTR94 CTR94MX	SCHEMATIC RECORD PWA	DWG. NO. 750-C0-404 SHEET 2 OF 4	APPR. ISSUE DATE 11/27/90	REVISION LEVELS PWA ASSEMBLY 807-C0-404 P.C. BOARD 407-C0-404	FIDELIPAC CORP. MOORESTOWN, N.J.	THIS DOCUMENT CONTAINS PROPRIETARY INFORMATION OF FIDELIPAC CORPORATION. NO USE, DISCLOSURE OR REPRODUCTION OF ANY PART THEREOF MAY BE MADE WITHOUT PRIOR WRITTEN PERMISSION.

SCHMREC2

TO CUE BIAS
(SHT. 4)

BIAS IN
P1-9
C15 0.1UF
R24 5.11K
C14 50PF
C12
0.0015UF
L1 1mH
R26 10.2K
C13 10PF
R27 21.5K
U13 1/2 5532
C47 .01 UF
R25 5.11K

R92 1K
R91 1K
R94 1K
Q9 5816
R95 100
C57 100 UF
T4
R93 1K
Q10 5816
C56 500PF
C55 0.001UF

U3 1/2_LF353
R36 10K
R130 16.2K
R37 5K CW
P1-23
P1-28

C111 0.01UF
RECORD HEAD
P1-27

AUDIO
(FROM SHT.2)
C51 100UF
C50 0.0015UF
L3 1MH

R22 13.3K
C11 0.0015UF
C23 10nF
C22 22nF
C21 0.018UF
C27 10n

+15V
R43 5.11K
Q6 2N4403
C117 10UF
C116 2.2 UF
R41 1K
D3 1N4148
+15V
R127 10K
Q12 2N4403
R128 10K
RECORD DISABLE

U6 1297
R29 48.7K
R28 48.7K
C17 22nF
C19 10nF
C20 0.018UF
R23 13.3K
C24 0.0015UF

R42 21.5K
D2 1N4148
Q1 MPSA13
P1-12
R40 100K
C31 10UF
R129 10K
C18 10UF
R31 10K CW
R30 10K CW

R87 1K
Q8 5816
R86 100
C52 100 UF
T3
R88 1K
Q7 5816
C53 500PF
C54 0.001UF

U11 1/2_LF353
R34 10K
R131 16.2K
R33 5K CW
P1-7
P1-29

C112 0.01UF
RECORD HEAD
P1-30

AUDIO
(FROM SHT.2)
C48 100UF
C25 0.0015UF
L2 1MH

+15V
P1-5
P1-4

R89 1K
R90 1K

MODEL NOS. CTR93 CTR94 CTR94MX	SCHEMATIC RECORD PWA	DWG. NO. 750-C0-404 SHEET 3 OF 4	APPR. J.J.W 11/21/90 M.H 11/27/90 ISSUE DATE 11/27/90	REVISION LEVELS PWA ASSEMBLY 807-C0-404 P.C. BOARD 407-C0-404	FIDELIPAC CORP. MOORESTOWN, N.J.	THIS DOCUMENT CONTAINS PROPRIETARY INFORMATION OF FIDELIPAC CORPORATION. NO USE, DISCLOSURE OR REPRODUCTION OF ANY PART THEREOF MAY BE MADE WITHOUT PRIOR WRITTEN PERMISSION.

SCHMREC3

CUE BIAS (FROM SH.1)

C68 10 PF
R126 10.2K
R114 150K
U16 1/2_5532
R115 100R
R116 5K
C70 3.3 UF
Q11 P1086
C78 3.3 UF
R113 330K
U13 1/2_5532
C71 22u
P1-14
C113 0.015 UF
P1-15
R119 100

R105 10K
R124 1M
R105 10K

C65 180n
U15 1/2_LF353
R110 100R
R109 5K
P1-26
C79 3.3 UF
R102 6.81K
R103 16.2K
R104 60.4K
R125 10K
C64 10n
C66 3.9n
150 HZ

C59 22n
U4 1/2_LF353
R108 1K
R107 10K
P1-10
C80 3.3 UF
R98 10.2K
R97 12.4K
R96 60.4K
R125 10K
C60 5.6n
C58 680p
1 KHZ
8 KHZ

C62 3.3n
U4
R108 1K
R106 20K
P1-25
C67 100n
R99 10.2K
R100 12.4K
R101 63.4K
R125 10K
C61 680p
C63 68p

R133 26.7K
R125 10K
R108 1K
R111 10K
P1-13
REMOTE CUE TRACK INPUT
U15 1/2_LF353

C72 220pF
R121 5.1K
R120 10K
P1-22
U16 1/2_5532
P1-6

-15 V	+15 V
U1-4	U1-8
U2-4	U2-8
U3-4	U3-8
U4-4	U4-8
U7-4	U7-8
U8-4	U8-8
U9-4	U9-11
U10-4	U10-11
U11-4	U11-8
U13-4	U13-8
U14-4	U14-8
U15-4	U15-8
U16-4	U16-8

D1 1N4005
VR1 LM7815
+15V
P1-3 +18 V P1-18
C75 10 UF
C74 10 UF
C119 10 UF
C108 C82 C86 C88 C100 0.1UF
C107 C81 C85 C87 C99 0.1UF
P1-1 GROUND P1-16
C73 10 UF
VR2 LM7915
C76 10 UF
C118 10 UF
P1-2 -18 V P1-17
-15V
C90 C92 C94 C98 C96 C104 C106 C84 C102 C110 0.1UF
C89 C91 C93 C97 C95 C103 C105 C83 C101 C109 0.1UF

+15V
R108 1K
R108 1K
D4 1N4746
P1-11
R105 10K
R105 10K
C77 10 UF
Q13 TIP125
-15V

MODEL NOS. CTR93 CTR94 CTR94MX	SCHEMATIC RECORD PWA	DWG. NO. 750-C0-404 SHEET 4 OF 4	APPR. ISSUE DATE 11/27/90	REVISION LEVELS PWA ASSEMBLY 807-C0-404	P.C.BOARD 407-C0-404	FIDELIPAC CORP. MOORESTOWN, N.J.

SCHMREC4

CUE DETECT

P2-7 SECONDARY DETECT
P2-24 TERTIARY DETECT
P2-8 3KHZ DETECT
P2-25 1KHZ DETECT
+5V
R18 47K
R17 47K
C40 .01uF
C41 .01uF
U4 HC02
U5 HC 32
R16 10K
R15 10K
C12 10uF
R22 4.7K
R25 47K
D12 1N4148
FAST FWD (0)
TO MOTOR SPEED CONTROLLER (SHT.2)
W1
W2
W3
W4
R12 10K
R13 10K
R14 10K
C3 1uF
U15 HC4538
FROM SOLENOID DRIVE (SHT.3)
START (0)
D5 1N4148
D6 1N4148
W6
W5
D3 1N4148
D4 1N4148
TO CLOCK CONTROL (SHT.2)
CUE DETECT (I)
R10 270K
C1 10uF
CUE INHIBIT TIMER
HC 4538
U17

CUE DETECT DRIVERS & RELAYS

U10 MC1413
+15V
R40 100R
K1 OUA-SS-112D
SECONDARY RELAY CONTACT (NC) J1-33
SECONDARY RELAY CONTACT (NO) J1-43
SECONDARY RELAY CONTACT (COMMON) J1-42
SECONDARY LAMP P1-28
SECONDARY LAMP REM J1-16
R39 100R
K2 OUA-SS-112D
TERTIARY RELAY CONTACT (NC) J1-32
TERTIARY RELAY CONTACT (NO) J1-41
TERTIARY RELAY CONTACT (COMMON) J1-40
TERTIARY LAMP P1-30
TERTIARY REM J1-17
U16 MC1413
/CUE DETECT ENABLE P2-1
FF LAMP P1-4
FF LAMP REM J19
MTRSPD_O P2-18

AUDIO ENABLE

SERVO ERROR P2-20
TO CLOCK CONTROL (SHT.2)
R41 10K
W10
+5v
U1 HC 08
U10 MC1413
AUDIO ENABLE A P1-22
AUDIO EN REM J47
AUDIO INDICATOR P1-9

SWITCH DEBOUNCE & RESPONSE CONTROL

P1-14 START SW
J1-24 START REM
P1-10 STOP/START SW
J1-22 STOP/START REM
P1-6 FAST FORWARD SW
J1-20 FAST FORWARD REM
P1-13 RECORD SW
J1-49 RECORD REM
P1-2 SECONDARY SW
J1-18 SECONDARY REM
P1-15 TERTIARY SW
J1-50 TERTIARY REM
+5V
R38
U13 MC 4490
R48 10K
D13 1N4148
SW RES FREQ
U11 HC4053
(6.3Khz)
(1Khz)
FROM CART SENSE (SHT.2)
(MOTOR SPEED CONTROLLER)
TER
SEC
TO REC ENABLE
RECORD (I)
FAST FWD (I)
STOP (I)
START (I)
AUTO CUE DEFEAT (O)
CUE DETECT (I)
FAST FWD (O)
MUTE (O)

START & STOP LAMP DRIVE

START LAMP (0)
TO MOTOR SPEED CONTROLLER (SHT.2)
TO RECORD ENABLE (SHT.3)
U16 MC1413
START LAMP P1-12
START LAMP REM J23
STOP LAMP SLO FLASH (0)
(.79Hz)
SF FREQ
U12 HC 08
U7 HC 32
STOP LAMP P1-8
STOP LAMP REM J21
STOP LAMP FLASH FLASH (0)
(3.2Hz)
FF FREQ
STOP LAMP STEADY (0)
READY LAMP REM J1-44

U3, PROGRAMMABLE LOGIC

MODEL NOS. ALL CTR90 MODELS	SCHEMATIC LOGIC PWA	DWG. NO. 750-C0-405 SHEET 1 OF 4	APPR. MH 11/7/90 ISSUE DATE 11/7/90	REVISION LEVELS PWA ASSEMBLY 807-C0-405 P.C.BOARD 407-B0-405	FIDELIPAC CORP. MOORESTOWN, N.J.	THIS DOCUMENT CONTAINS PROPRIETARY INFORMATION OF FIDELIPAC CORPORATION. NO USE, DISCLOSURE OR REPRODUCTION OF ANY PART THEREOF MAY BE MADE WITHOUT PRIOR WRITTEN PERMISSION.

SCHMLOG1

CART SENSE

R46 100K

TO SWITCH DEBOUNCE & RESPONSE CONTROL (SHT.1)

P1-18 > U1 HC 08

P1-17 >

P1-19 >

+5V

R30 270R

POWER UP RESET

+5V

R47 10K

U17 HC 4538

D2 1N4148

T2, T1, CD

C4 1uF

D18 1N4148

R23 10K

+5V

R24 10K

C5 4.7uF

FF & SF START LOCKOUT

+5V

R7 10K

R8 10K

W7 — FF

W8 — SF

SLOW FLASH START INHIBIT (I)

FAST FLASH START INHIBIT (I)

CLOCK CONTROL

CART SENSE (I)

+5V

R20 10K

U6 HC86

U5 HC 32

U14 MC4490

CUE DETECT (I) FROM CUE DETECT (SHT.1)

(4Khz)

OSCI, OSCO

* (SEE RECORD ENABLE, SHT. 3)

U5 HC32

+5V

R19 10K

+15V

R6 10K

U10 MC 1413

MUTE (O) FROM AUDIO ENABLE (SHT.1)

U6 HC86

U1 HC 08

U10 MC 1413

COMMON PLAY MUTE > J1-45

CLOCK INPUT (I)

SELECTED SWITCH ACTIVATION (O)

22 CART SENSE (I)

21

1

MOTOR SPEED CONTROLLER

+5V

R9 10K

U7 HC32

W9

START LAMP (O)

FROM START & STOP LAMP DRIVE (SHT.1)

U11 HC 4053

(PLAY REF)

(FF REF)

MOTOR REFERENCE > P1-27

* (SEE SWITCH DEBOUNCE & RESPONSE CONTROL – SHT. 1)

FAST FWD (O)

FROM CUE DETECT (SHT.1)

METER SWITCHING

SW1

R1 10K

+5V

R2 10K

U2 4052

R21 1.2K

-18V

D20 1N4733A

R5 47K

R4 47K

METER CIRCUIT (LEFT) > P1-25

METER CIRCUIT (RIGHT) > P1-26

U3, PROGRAMMABLE LOGIC

R37 47K

FROM SOLENOID DRIVE (SHT.3)

START (O)

U8 HC04

W11

+5V R3 10K

RECORD (O)

FROM RECORD ENABLE (SHT.3)

U1 HC 08

+5V

U6 HC86

D1 1N4148

P2-10 > AUDIO INPUT A

P2-26 > CUE and CUE BIAS A

P2-12 > BIAS A

P2-9 > AUDIO OUTPUT A

P2-22 > AUDIO INPUT B

P2-6 > CUE and CUE BIAS B

P2-5 > BIAS B

P2-23 > AUDIO OUTPUT B

MODEL NOS. ALL CTR90 MODELS	SCHEMATIC LOGIC PWA	DWG. NO. 750-C0-405 SHEET 2 OF 4	APPR. T.J.W 11/9/90 MH 11/9/90 ISSUE DATE 10/3/90	REVISION LEVELS PWA ASSEMBLY 807-C0-405 P.C. BOARD 407-B0-405	FIDELIPAC CORP. MOORESTOWN, N.J.	THIS DOCUMENT CONTAINS PROPRIETARY INFORMATION OF FIDELIPAC CORPORATION. NO USE, DISCLOSURE OR REPRODUCTION OF ANY PART THEREOF MAY BE MADE WITHOUT PRIOR WRITTEN PERMISSION.

SCHMLOG2

SOLENOID DRIVE

TO METER SWITCHING (SHT.2)

TO CUE DETECT (SHT.1)

+16V

R32 22K, D7 1N4148

Q2 MTP8P10

R31 1R, D8 1N4005

R43 681R, U20 5532, R33 0K, Q1 MTP8P10

D10 1N4737

R42 13.0K

C11 1UF

P2-11

D9 1N4005

-18V

+16V, R35 2.2K

START (0)

R34 820R

U20 5532

R36 270R

U3, PROGRAMMABLE LOGIC

START (0) 8

10

5

7

20

RECORD ENABLE

REM CUE BIASEN FROM START & STOP LAMP DRIVE (SHT.1) J1-37

+5V, R49 10K, U14 MC4490 (DI, DO, CLOCK CONTROL), U8 HC04

START LAMP (0)

1khz REC TIMER

+5V, R11 100k, C2 10uF, U8 HC04

HC 4538 U15 (A, B, T2, T1, CD, Q, Q̄), C13 .01uF

1KHZ DEFEAT (0)

U10 MC1413

1K DEFEAT INDICATOR → P1-7, J1-46

1K DEFEAT REM

FROM SWITCH DEBOUNCE & RESPONSE CONTROL

SEC, TER

(1Khz), (150Khz), (8Khz), (144Khz)

U7 HC32, U12 HC08, U18 HC08, U19 HC08, U8 HC04

D14 1N1418, D19 1N4148, C42 4.7UF, R50 47K

R45 10K

CUE REC ENABLE → P1-21

1 khz REC FREQ → P2-19

150 hz REC FREQ → P2-4

8 khz REC FREQ → P2-3

BIAS FREQ (144khz) → P2-2

D15 1N1418, D16 1N1418, D17 1N1418

AUD REC EN → P2-16

RECORD (0) → TO METER SWITCHING (SHT.2)

U16 MC1413

REC LAMP → P1-11

REC LAMP REM → J1-48

TIMER CONTROL

P2-21 → 1 SEC CLK → U19 HC 08 → CLK_E → P1-29

TIMER COUNT (0)

+5V, R44 10K

TIMER RESET (0)

U12 HC 08 → /CLK_RES → P2-17, /REM CLK RES → J1-1

P1-1 CLOCK COUNT IN → REM CLOCK COUNT J1-2

P1-5 CUE AUDIO OUT → CUE AUDIO OUT J1-39

P1-3 CUE AUDIO IN → CUE AUDIO IN J1-38

POWER

D11 1N4148

P2-14 +16V, P2-29 +16V → C6 1uF

P2-13 +5V, P2-28 +5V → C9 1uF

P2-15 GROUND, P2-30 GROUND → C10 1uF

P2-27 -18V

+15V → J5, J36

+5V → C26 .1uF, C15 .1uF, C16 .1uF, C17 .1uF, C18 .1uF, C19 .1uF, C20 .1uF, C21 .1uF, C22 .1uF, C23 .1uF, C24 .1uF, C25 .1uF, C14 .1uF, C26 .1uF → J4, J34

-18V → J35

C27 .1uF, C28 .1uF, C29 .1uF, C31 .1uF, C32 .1uF, C33 .1uF, C34 .1uF, C35 .1uF, C36 .1uF, C37 .1uF, C38 .1uF, C39 .1uF

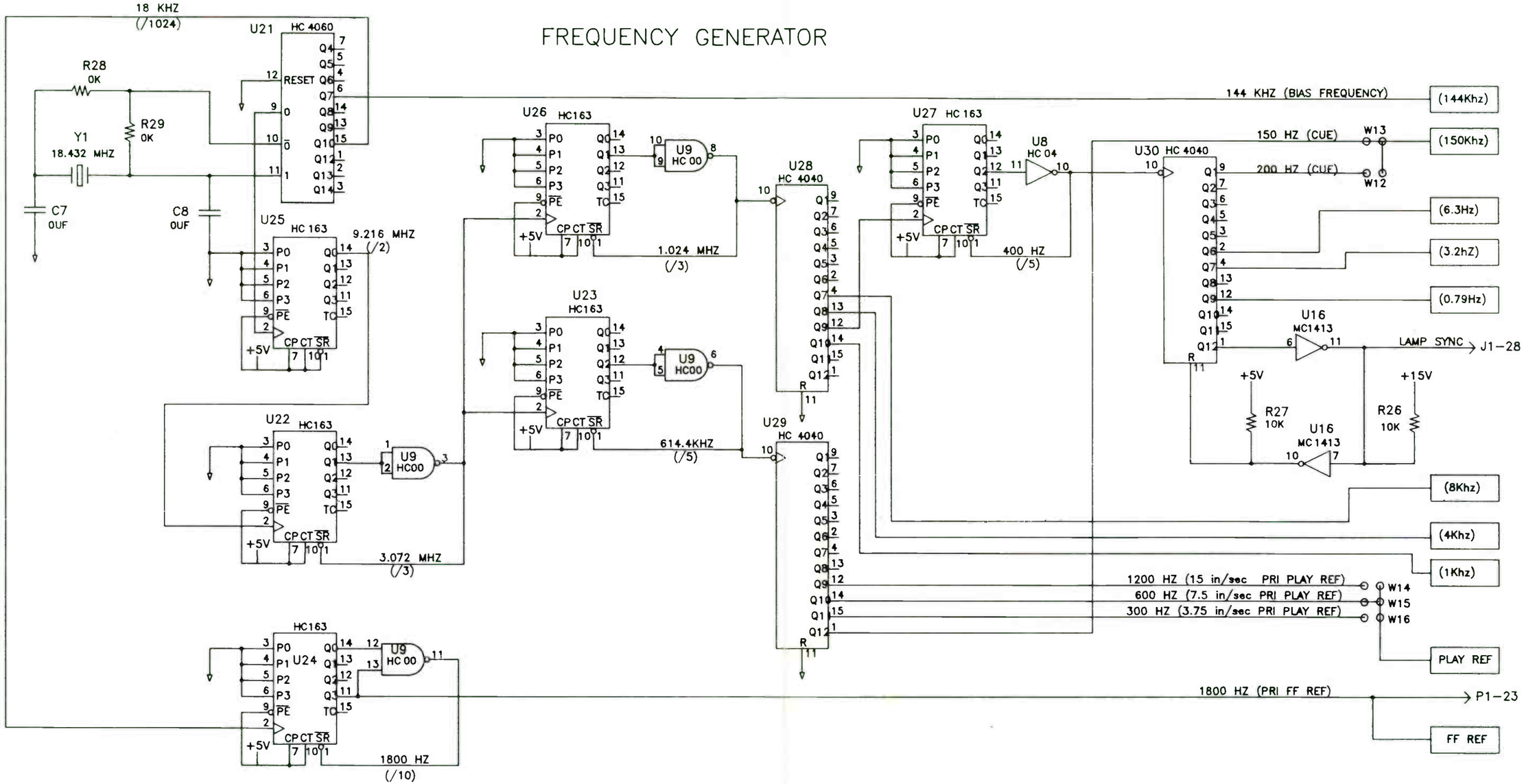
POWER CONNECTIONS NOT SHOWN

-18V	GROUND	+5V	+16V
	U1-7	U1-14	
	U2-8	U2-16	
	U3-12	U3-24	
	U4-7	U4-14	
	U5-7	U5-14	
	U6-7	U6-14	
	U7-7	U7-14	
	U8-7	U8-14	
	U9-7	U9-14	
	U10-8		U10-9
	U11-8	U11-16	
	U12-7	U12-14	
	U13-8	U13-16	
	U14-8	U14-16	
	U15-8	U15-16	
	U16-8		U16-9
	U17-8	U17-16	
	U18-7	U18-14	
	U19-7	U19-14	
U20-4			U20-8
	U21-8	U21-16	
	U22-8	U22-16	
	U23-8	U23-16	
	U24-8	U24-16	
	U25-8	U25-16	
	U26-8	U26-16	
	U27-8	U27-16	
	U28-8	U28-16	
	U29-8	U29-16	
	U30-8	U30-16	

MODEL NOS. ALL CTR90 MODELS	SCHEMATIC LOGIC PWA	DWG. NO. 750-C0-405	APPR. T.N 11/9/90 MH 11/9/90	REVISION LEVELS PWA ASSEMBLY 807-C0-405	P.C.BOARD 407-C0-405	FIDELIPAC CORP. MOORESTOWN, N.J.
		SHEET 3 OF 4	ISSUE DATE 11/7/90			

SCHMLOG3

FREQUENCY GENERATOR



MODEL NOS. ALL CTR90 MODELS	SCHEMATIC LOGIC PWA	DWG. NO. 750-C0-405 SHEET 4 OF 4	APPR. T.J.W 11/7/90 MH 11/9/90 ISSUE DATE 11/7/90	REVISION LEVELS PWA ASSEMBLY 807-C0-405 P.C.BOARD 407-C0-405	FIDELIPAC CORP. MOORESTOWN, N.J.	THIS DOCUMENT CONTAINS PROPRIETARY INFORMATION OF FIDELIPAC CORPORATION. NO USE, DISCLOSURE OR REPRODUCTION OF ANY PART THEREOF MAY BE MADE WITHOUT PRIOR WRITTEN PERMISSION.

SCHMLOG4

P2-4
+5V
R25
1R

U2
LN543RA
24 23 22 21 20 19 18 17 16 15 14 13
1 2 3 4 5 6 7 8 9 10 11 12

R5
270R
R6
270R

C1
1000uF

U1
7217
1 2 3 4 5 6 7 8 9 10 11 12 13 14
28 27 26 25 24 23 22 21 20 19 18 17 16 15

P1-10
TIMER RESET
NOT USED
P1-9
P1-8
COUNT IN

SEC IND
R4
1K 1/2W
D33
LTL-433G
D32
LTL-433G
P1-1

TER IND
R2
1K 1/2W
D31
LTL-433G
D30
LTL-433G
P1-3

R3
680 1/2W
D34
LTL-433G

AUDIO IND
D35
LTL-433G
D28
LTL-433G
D29
LTL-433HR
P1-7

R15 500R CW
R17 240K
R16 10K
R18 18K
C5 2.2 UF
P1-14
METER INPUT
W4
R20 110K
R19 470R
C8 220UF
C9 2.2 UF
U4
BA682
1 2 3 4 9

D24 D23 D22 D21 LTL-433HR
D20 D19 D18 D17 D16 D15 D14 D13 LTL-433G
R22 270R 1/2W
C11 10 UF
LEFT CHANNEL

C12 10uF
R9 500R CW
R11 240K
R10 10K
R12 18K
C4 2.2 UF
P1-15
METER INPUT
W3
R14 110K
R13 470R
C6 220UF
C7 2.2 UF
U3
BA682
1 2 3 4 9

D12 D11 D10 D9 LTL-433HR
D8 D7 D6 D5 D4 D3 D2 D1 LTL-433G
R21 270R 1/2W
C10 10 UF
RIGHT CHANNEL

COMPONENTS INTERNAL TO
HIDDEN LINES ARE USED
IN RECORDERS ONLY

+16v
P2-1
GND
P2-2
P2-3

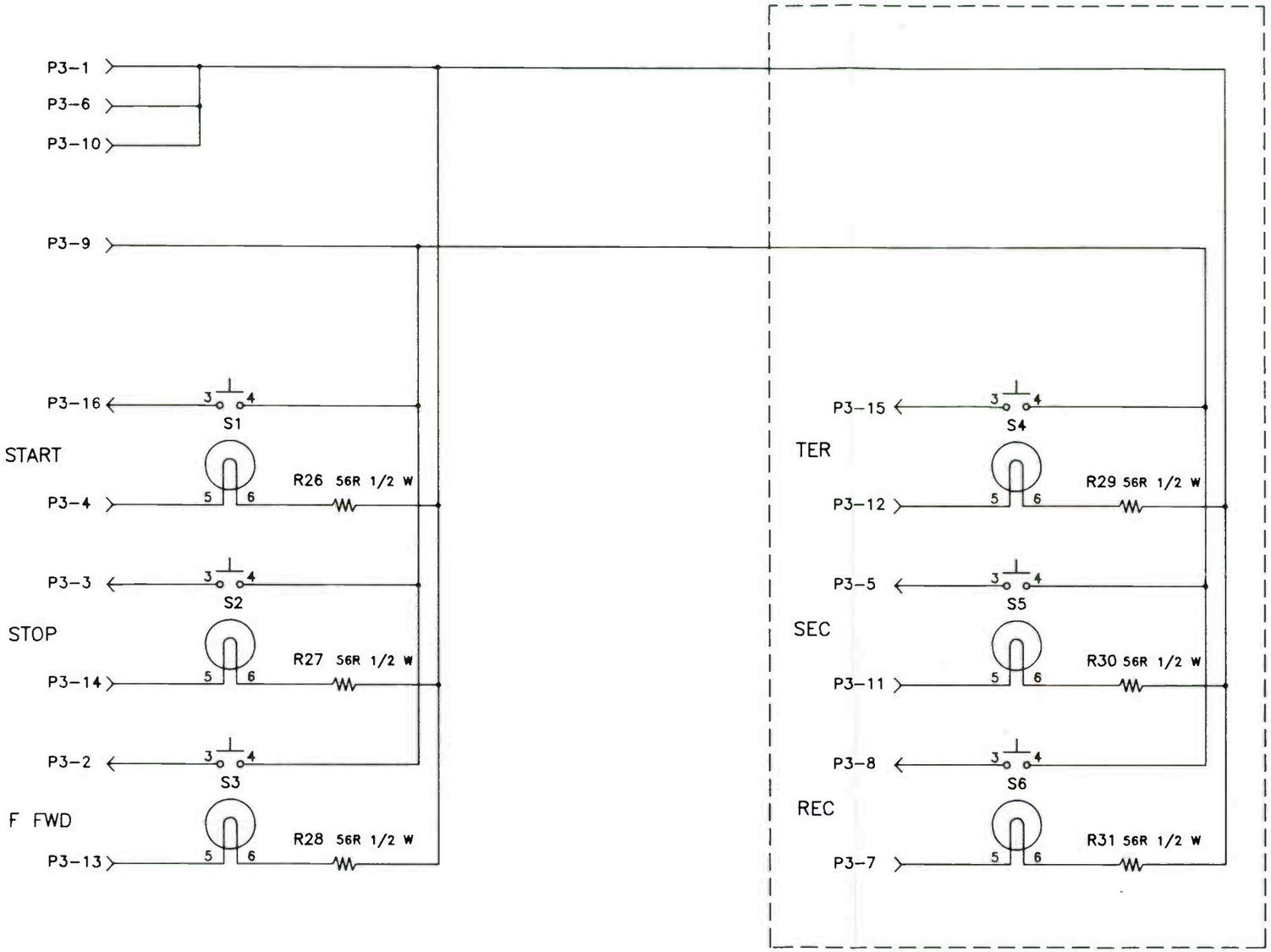
VR1
LM317LZ
IN OUT REF
R7 270R
C2 .1uf
R8 2.2K
C3 10uF

P1-11
TOP (L)
P1-4
R23 5K CW
P1-5
P1-12
R24 5K CW
P1-6
BOTTOM (R)

1KHZ DEFEAT IND
R1
1K 1/2W
D27
LTL-433HR
D26
LTL-433HR
D25
LTL-433HR
P1-2

MODEL NOS. ALL CTR90 MODELS	SCHEMATIC FRONT PANEL P.C. BOARDS (DISPLAY)	DWG. NO. 750-C0-406 SHEET 1 OF 2	APPR. MH 11/20/90 ISSUE DATE 11/21/90	REVISION LEVELS PWA ASSEMBLY 827-C0-407 P.C.BOARD 407-C0-406 PWA ASSEMBLY 827-C0-408	FIDELIPAC CORP. MOORESTOWN, N.J.	THIS DOCUMENT CONTAINS PROPRIETARY INFORMATION OF FIDELIPAC CORPORATION. NO USE, DISCLOSURE OR REPRODUCTION OF ANY PART THEREOF MAY BE MADE WITHOUT PRIOR WRITTEN PERMISSION.

SCHMDSPB

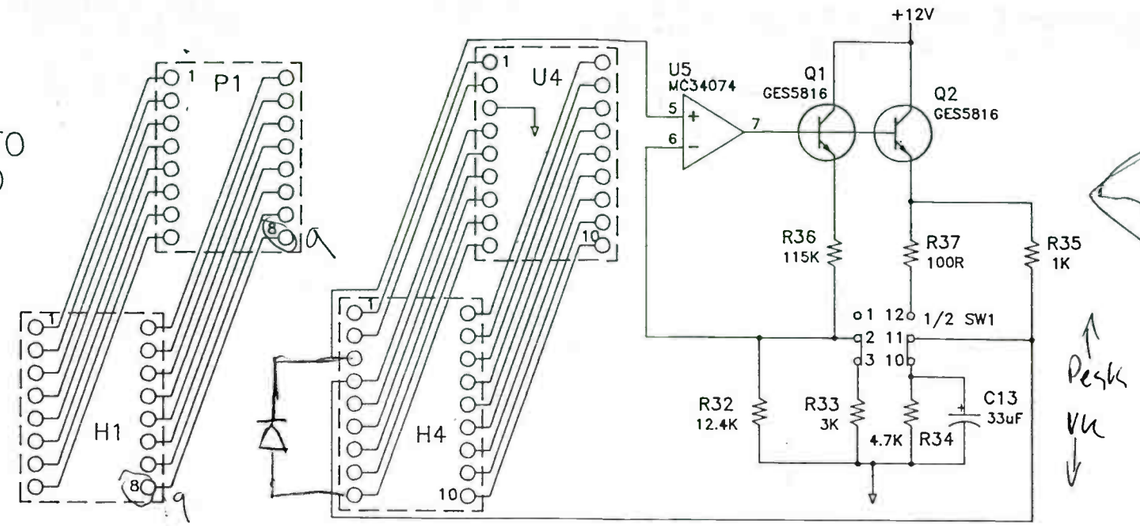


COMPONENTS INTERNAL TO HIDDEN LINES ARE USED IN RECORDERS ONLY

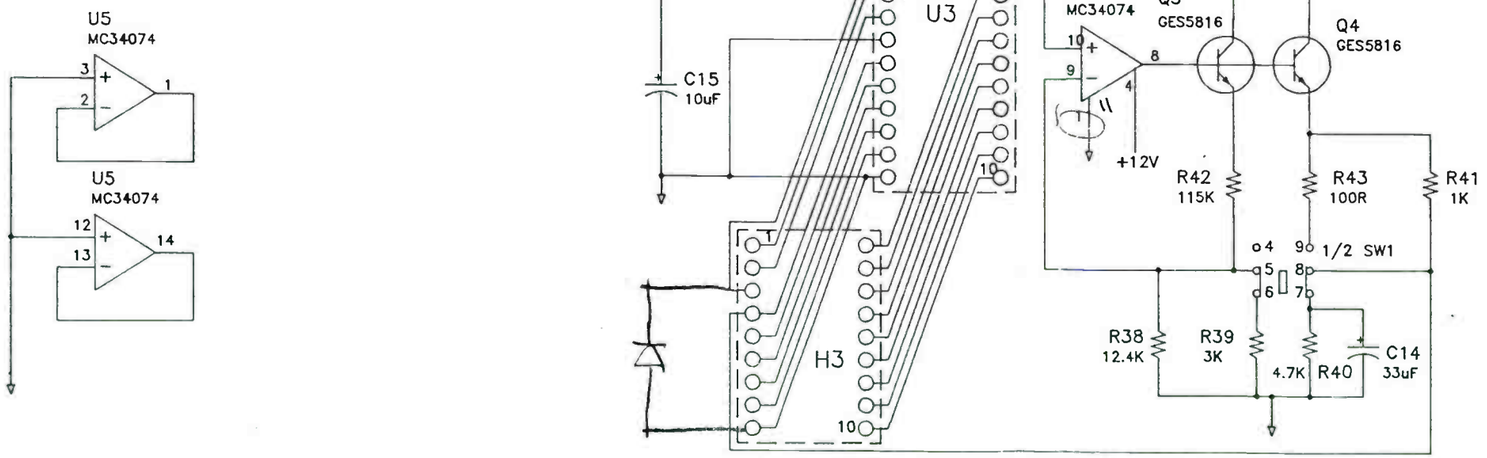
MODEL NOS. ALL CTR90 MODELS	SCHEMATIC FRONT PANEL P.C. BOARDS (SWITCH)	DWG. NO. 750-C0-406 SHEET 2 OF 2	APPR. J.W. 11/28/90 MH 11/20/90 ISSUE DATE 11/21/90	REVISION LEVELS PWA ASSEMBLY 827-C0-407 P.C. BOARDS PWA ASSEMBLY 827-C0-408 407-A0-410, 407-A0-411	FIDELIPAC CORP. MOORESTOWN, N.J.	

SCHSWBD

COMPONENTS INTERNAL TO HIDDEN LINES ARE USED IN RECORDERS ONLY

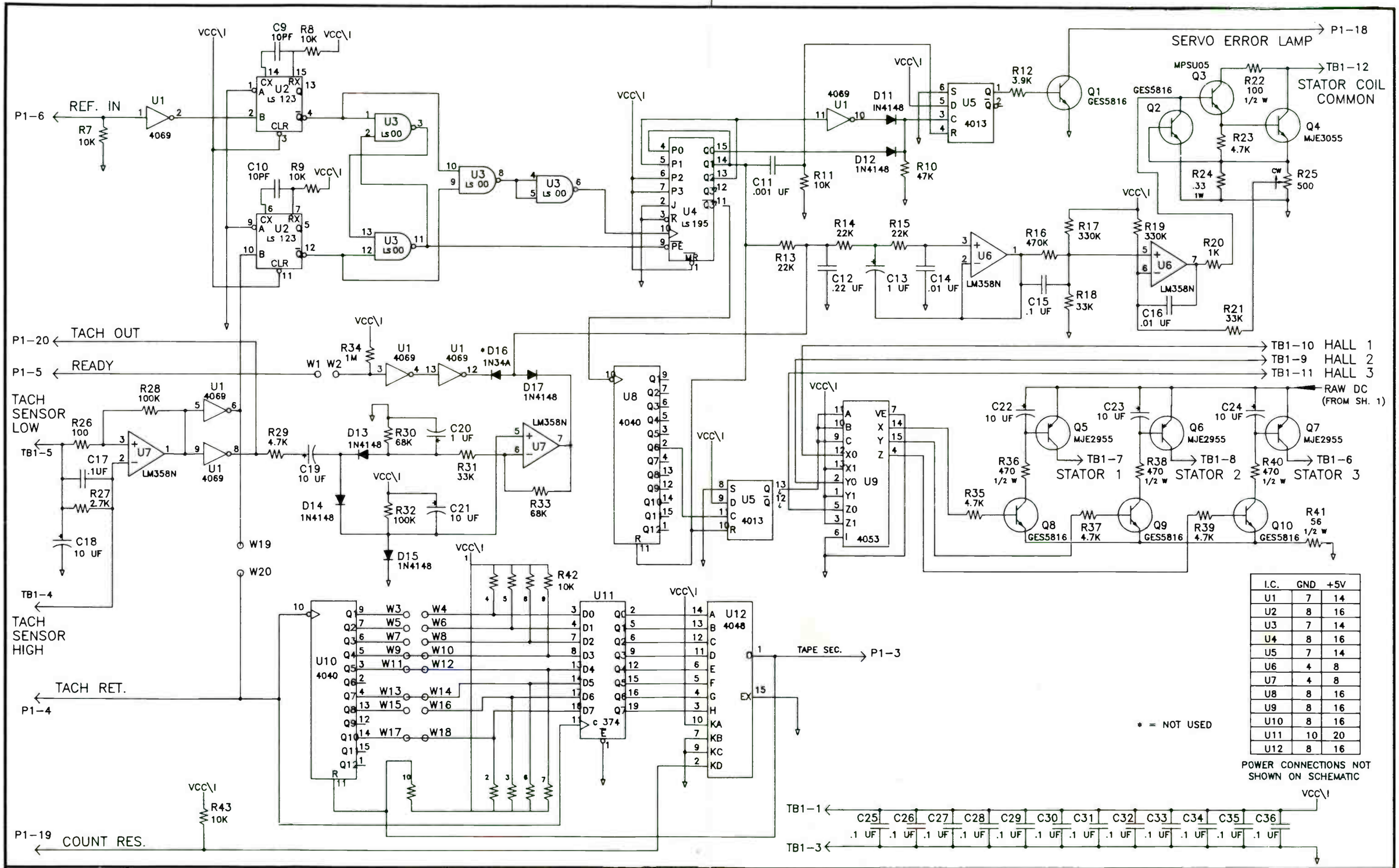


TO ALL POWER AND GND ON THIS BOARD



MODEL NOS. ALL CTR90 MODELS	SCHEMATIC FRONT PANEL P.C. BOARDS (METER)	DWG. NO. 750-D0-406 SHEET 3 OF 3	APPR. ISSUE DATE 2/11/91	REVISION LEVELS PWA ASSEMBLY 827-D0-407 P.C.BOARD 407-A0-413 PWA ASSEMBLY 827-D0-408	FIDELIPAC CORP, MOORESTOWN, N.J.	THIS DOCUMENT CONTAINS PROPRIETARY INFORMATION OF FIDELIPAC CORPORATION. NO USE, DISCLOSURE OR REPRODUCTION OF ANY PART THEREOF MAY BE MADE WITHOUT PRIOR WRITTEN PERMISSION.

SCHMMETR



I.C.	GND	+5V
U1	7	14
U2	8	16
U3	7	14
U4	8	16
U5	7	14
U6	4	8
U7	4	8
U8	8	16
U9	8	16
U10	8	16
U11	10	20
U12	8	16

MODEL NOS.	SCHEMATIC	DWG. NO.	APPR.	REVISION LEVELS		FIDELIPAC CORP. MOORESTOWN, N.J.	
ALL CTR90 MODELS	POWER SUPPLY/MOTOR DRIVER MODULE	750-A0-412	T.J.W 11/24/90	PWA ASSEMBLY 827-A0-412	P.C.BOARD 407-A0-412		THIS DOCUMENT CONTAINS PROPRIETARY INFORMATION OF FIDELIPAC CORPORATION. NO USE, DISCLOSURE OR REPRODUCTION OF ANY PART THEREOF MAY BE MADE WITHOUT PRIOR WRITTEN PERMISSION.
		SHEET 2 OF 2	ISSUE DATE 11/21/90				SCHMPSM2

Fidelipac items – August 2000

867 – Highest level … includes shipping materials

847 – Top assembly level (no shipping materials)
This is a machine, working in-house

827 – ElectroMechanical Assembly

807 – PCB with components

407 – PCBs

30 – Metal assembly

31 – Other assembly.

220 – Diodes
230 – Resistors
540 – Metal

023 = AC transformer

404 = DC transformer for CTR90

Parts formula … five times the wholesale cost.

Under $1.00 = eight times wholesale cost.

Heads = 2.5
Motors = $450 (from $260)

Tape = 2.5

ADDENDA

LOGIC BOARD
807-BO-405

SETUP:

1. Inspect Logic board to insure all IC's are inserted properly; especially U3!

2. Plug extender card into unit and plug Logic board into extender card.

FRONT PANEL OPERATIONS:

3. Turn on power. Look at timer on front panel, it should read either "00:01" or "00:00". No other indicators should be lit (Idle state).

4. Press and hold the START button. The unit should enter it's "cleaning" mode in 650 ms. The pinch roller will engage, the motor will run, and start lamp light. The "AUDIO" indicator should not be lit (unit will be muted). The timer should read "00:00".

5. Press and hold the RECORD, SECONDARY, TERITIARY, FAST-FORWARD, and START buttons individually for several seconds. The unit should remain in the "CLEANING" mode.

6. Press and hold the STOP button, in 650 ms the unit should return to its idle state.

7. Insert an empty cart into the unit. It should enter the "READY" mode with the Stop lamp lit steady and motor running.

8. With the cart still in place turn power off. Wait about 10 seconds and turn the power back on. The unit should come up in the "READY" state and the timer should read "00.00".

9. Remove jumper W9. The motor should be running. Remove the cart from the unit. The motor should continue to run.

10. Install jumper W9. The motor should stop running. Insert the blank cart. The motor should run when the cart is inserted.

11. Look at U17 pin 7 with a scope. Set scope for a .5 second horizontal time base. Press Start. U17 pin 7 should go low for about 1.6 secs or between 3 divs and 4 divs. Press STOP.

12. Look at U15 pin 9. Set scope for .5 seconds per div. horizontal. Press START U15 pin 9 should go low for about .6 secs between or 1.0 divs. and 1.5 divs.

13. Look at U19 pin 5. Set scope to .5 sec/div. horizontal. Press START. Repeatedly press SECONDARY switch while looking at scope. The falling edge of the signal should take about 1/4 a division to go low.

14. Look at Q2, the bottom pin of the transistor with a scope set to 15V/div vert. and 10mS/div horizontal. Use normal trigger (AC) with negative slope. While repeatedly engaging the solenoid, adjust the scopes hold-off knob to trigger on the rising slope of the pulse on Q2. The slope should rise from -16V to about 10V in 4 divisions. Press START. Read the voltage across R31 with a DC Voltmeter. The voltage should be about 360mV, +- ~~5~~ 20mV.

15. Insert an erased cart. Press Start - Start 1Lamp illuminates, "AUDIO" indicator lights, clock counts at 1 second intervals, pinch roller engages.

16. Press Stop (when unit is in Start state) - Clock "freezes," Stop lamp flashes "fast" -- about 3 times a second.

17. Press Stop again - Clock resets to "00:00", stop lamp is lit steadily. The unit is in the "READY" state.

18. Press FAST-FORWARD -- Clock counts at 1/3 second interval (3 times per sec.), FAST-FORWARD lamp illuminates, pinch roller engages, motor runs at 22.5 RPM, FAST-FORWARD speed.

19. Press FAST-FORWARD again -- unit will unmute, "AUDIO" indicator lights.

20. Press START - "AUDIO" indicator goes out until motor locks in normal speed, then it comes on. Clock count slows to normal speed. Unit is in the "Start" mode.

21. Press Stop - Unit should stop with frozen timer.

22. Note reading of timer. Press RECORD two times - 1K DEFEAT indicator lights, RECORD button lights, stop button remains lit, timer should not reset.

    Press START, Now the START and RECORD buttons and the 1KHz DEFEAT indicator should be lit, and timer should begin counting from the noted reading.

23. Press STOP - Unit enters STOP - Fast Flash mode.

24. Press RECORD once - unit enters RECORD Ready mode.

25. Press START - unit enters RECORD. Timer resets and counts.

26. Press STOP - unit enters Stop-Fast flash mode.

27. Note reading of timer, press RECORD - unit enters RECORD-READY mode.

28. Press RECORD again - unit enters RECORD-1K DEFEAT READY mode.

29. Press RECORD again - unit goes into Stop-Ready mode, clock resets to "00:00".

30. Press START - Connect pin 39 of remote connector to scope.

31. Press SECONDARY - unit should record a 150 Hz secondary tone. The secondary indicator and switch should light and Pin 39 of Remote should have a 150Hz secondary tone.

32. Press TERITIARY - unit should record a 8 KHz teriary tone. The tertiary indicator and switch should light and Pin 39 of Remote should have a 8 KHz tertiary tone.

33. Press FAST-FORWARD.

    Press SECONDARY then TERITIARY - nothing should change, no signals on Pin 39 of Remote connector.

34. Press STOP.

    Press RECORD.

    Press START - When unit enters RECORD, a 1kHz tone is recorded for about 650 mS. You will see the 1K tone on Pin 39 of the Remote connector.

35. Press Stop.

    Press RECORD twice to get to the 1K defeat mode.

    Press Start - unit should enter RECORD without recording a 1KHz cue tone.

FREQUNCY MEASUREMENTS:

36. Look at U29 pins 12, 14, and 15 with a frequency counter. Pin 12 is 1200Hz, pin 14 is 600Hz, and pin 15 is 300 Hz.

37. Look at U30 pin 9 - it should be 200 Hz.

38. Look at U19 pin 4 - it is 144KHz. Look at U18 pins 1, 4, and 9. Pin 1 = 1KHz. Pin 4 = 150Hz and pin 9 = 8KHz.

39. Look at U11 pin 4. It is 600 Hz. Press FAST-FORWARD button and look at U11 pin 4 - it should switch to 1800 Hz.

    Press STOP.

40. Look at U19 pin 8. There should not be any frequency present. Press Start. A 600Hz pulse is produced. Press FAST-FORWARD. A 3Hz pulse is produced.
    1800

    Press Stop.

41. Remove W7. Press PLAY. Press STOP. Unit should be in STOP-FAST-FLASH mode. Press Start. Nothing should happen. Press RECORD. Nothing should happen. Press STOP. Unit should enter STOP READY mode. Press START. Unit should enter PLAY mode. Let unit stop when a primary cue tone is detected. Stop lamp will flash slowly. Press PLAY. Unit will enter PLAY mode.

    Replace W7 and remove W8.

    Press PLAY. Let unit stop when a primary cue tone is detected. Unit should be in STOP-SLOW-FLASH mode. Press Start. Nothing should happen. Press RECORD. Nothing should happen. Press STOP. Unit should enter STOP READY mode. Press START. Unit should enter PLAY mode. Press STOP. Stop lamp will flash quickly. Press PLAY. Unit will enter PLAY mode. Press STOP.

METER SWITCH:

42. Remove W11 Insert a tapeless cartridge. Connect Audio Generator to RECORD amp. Set to 1K at -35dB attenuation. Push RECORD button. Set SW1 on Logic to its forward position. The front panel meters should show audio level. Press START the audio meters should still display audio level. Replace W11, meters should go out.

    Insert an erased cart. Turnimg pots R39 (L-audio) and R61 (R-audio) on RECORD board should adjust meter levels. Press Play. Meters should light. R66(L-m) and R67(R-m) on PLAY Amp should adjust meters. Move SW1 on Logic to middle position. Meters should light. R37 (L-bias) and R33 (R-bias) on RECORD amp should adjust meters. Move SW1 on Logic to the back position (Cue). Meters should not light. Press and hold SECONDARY switch. R89 on Play amp should adjust bottom (cue audio) meter. R120 on RECORD amp should adjust top (bias) meter. Press stop. Move SW1 back to the front (audio) position.

CUE:

43. Make sure W5 and W6 are not jumped.

    Insert a 150Hz (SECONDARY) cue tape. Connect Relay tester to Remote connector.

    Press START. SECONDARY switch, indicator, and Relay tester should all illuminate when tone is detected.

44. Press STOP. Insert W6. Press START. When leading edge of secondary tone is detected the unit will be muted and the clock will "freeze." W3 for leading edge

    Press FAST-FORWARD. The unit will enter FAST-FORWARD mode, but the audio will be locked out--pushing FAST-FORWARD again will not allow "audio" to be unmuted.

    START will also be locked out until the unit has been stopped.

45. Insert W5. Press START. When the leading edge of the secondary tone is detected, the unit will go into FAST-FORWARD, and the clock will be frozen.

    Press FAST-FORWARD. Nothing should happen (Audio is locked out). Press START. Nothing should happen (START is locked out). Press STOP. The unit will Stop.

46. Insert an 8KHz cue tape. Push START. The tertiary switch, indicator, and relay tester should all illuminate when the tone detected. The unit should remain in PLAY mode. Press STOP.

    Move jumper W2 to W1. Push START. The unit should go into FAST-FORWARD when the tone is detected. Press FAST-FORWARD. The unit should not un-mute (audio indicator remains on). Press START. Nothing should happen. Press STOP.

    Move W1 back to W2. Place jumper caps for W5 and W6 on one post only! (W5 and W6 not shorted).

    *Test Trailing edge. Move W3 to W4 and see that cue detect occurs on trailing edge.

47. Connect audio generator between pins 38(+) and 35 (GND) of Remote. Set generator to 3.5 KHz for a voltage of 1.4Vpp on pin 38. Look at P1-pin 3 with a scope. You should see the same signal as on Pin 38. Disconnect generator.

    Look at U19 pin 6 with a scope. Short pin 37 of remote to ground. U19 pin 6 should have a 144KHz square wave when pin 37 is grounded.

REMOTE CONNECTOR

Pin 1 - Timer reset out: (active low)

Pin 2 - Timer count out: active high - 1 pulse/sec in ST, RECORD
3 pulses/sec in FAST-FORWARD

Pin 4 - Ground

Pin 5 - +15V

Pin 16 - SECONDARY Lamp: (active low +15V) goes low when SECONDARY
LED & lamp light.

Pin 17 - Tertiary Lamp: (active low +15V) goes low when
TERTIARY LED & LAMP light.

Pin 18 - Secondary Switch: (active low +5V) goes low when
Secondary Switch pushed.

Pin 19 - Fast-Forward Lamp: (active low +15V) goes low when
FAST-FORWARD lamp lights

Pin 20 - Fast-Forward Switch: (active low +5V) goes low when Fast-
Forward button pushed

Pin 21 - Stop lamp: (active low +15v) goes low when Stop lamp
lights.

Pin 22 - Stop switch: (active low +5V) goes low when stop button
pushed

Pin 23 - Start lamp: (active low _15V) goes low when Start lamp
lights

Pin 24 - Start switch: (active low +5V) goes low when Start button
pushed

Pin 28 - Flash sync: (active low +15V) goes low (Stop lamp flashes)
to reset lamp flash

Pin 32 - Tertiary Relay NC: Connected to Tertiary Relay Common when
Tertiary tone not detected

Pin 33 - Secondary Relay NC. Connected to Secondary Relay Common
when Secondary tone not detected

Pin 34 - Ground

Pin 35 - Ground

Pin 36 - +15V

Pin 37 - Rem cue bias enable: (active low +5V) - ground pin to
enable U19-6 bias and cue U7-12 enable.

Pin 38 - Cue track input: (Cue logging Audio input.

Pin 39 - Cue output: Cue audio output

Pin 40 - TERTIARY Relay common

Pin 41 - TERTIARY Relay NO

Pin 42 - SECONDARY Relay Common

Pin 43 - SECONDARY Relay NO

Pin 44 - Ready Lamp: (Open collector) sinks current when unit in READY mode.

Pin 45 - Play mute: (active low +5V) pulses when Audio is umuted.

Pin 46 - 1K def. lamp: (active low +15v) goes low when 1KhZ DEFEAT indicator lights

Pin 47 - Audio lamp: (active low +15V) goes low when AUDIO LED Lights

Pin 48 - RECORD lamp: (active low +15V) goes low when RECORD lamp lights

Pin 49 - RECORD switch: (active low +5V) goes low when RECORD switch pushed

Pin 50 - TERTIARY switch: (active low +5V) goes low when TER switch pushed

2/1/91

CTR90 FORMAT CONVERSION

NAB TO MAXTRAX

PLAY BOARD:

1. Replace C1 and C36 with 50pF caps. Their part No. is 031-A3-500.

2. Place a 150pF cap in parallel with the current cap at 220pF cap at C62. The part No. for the additional cap is 031-A3-151.

3. Replace R96, R121, and R125 with 5.11K resistors. Their part No. is 120-20-51N.

4. Replace R113 with a 150K resistor, part No. 110-22-154.

5. Replace R102 with a 16.9K resistor, part No. 120-20-16U.

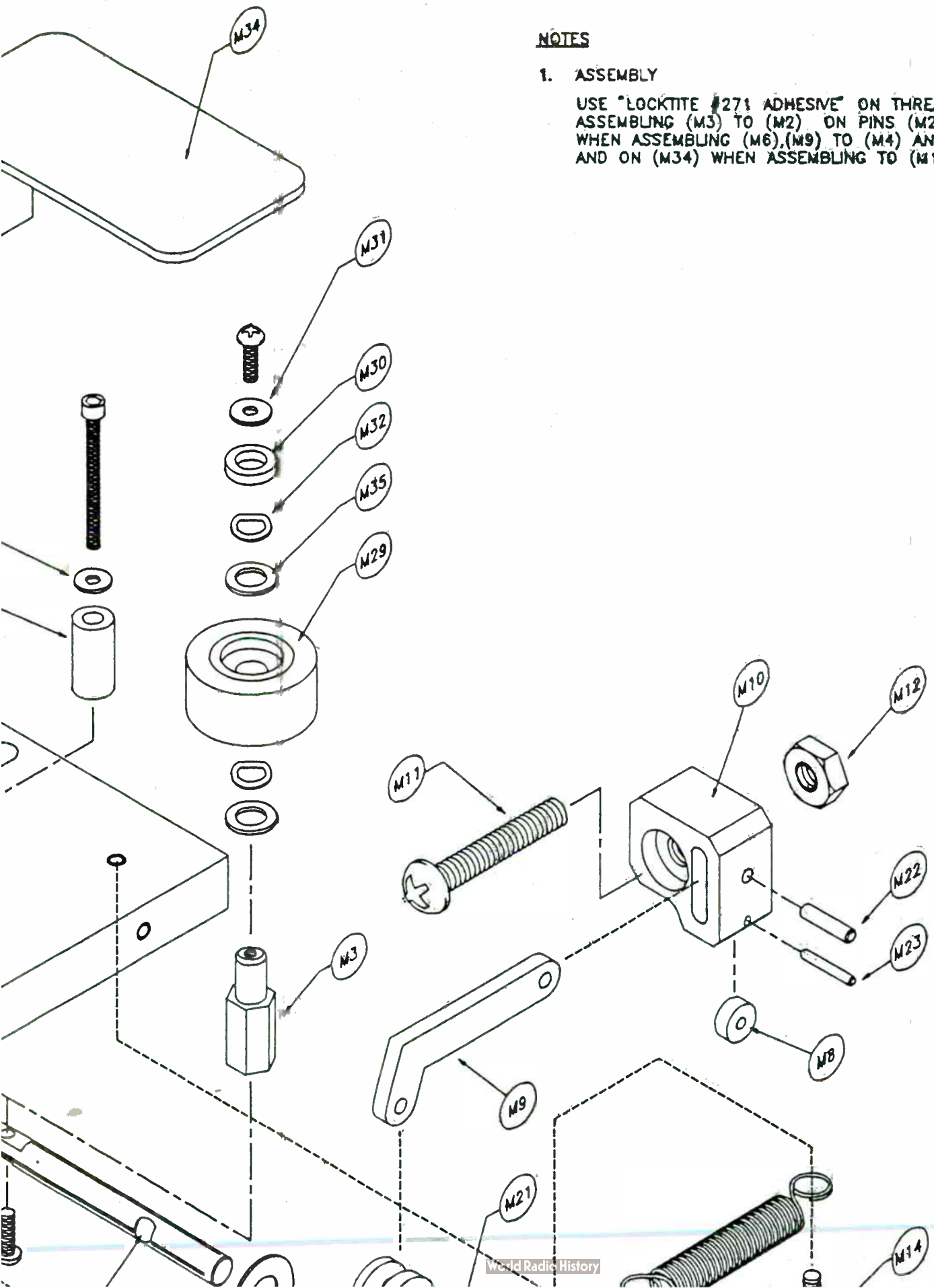
6. Remove R138.

RECORD BOARD:

1. Replace C111 and C112 with .015uF caps. Their part No. is 041-A4-153.

2. Replace C113 with a .01uF cap, part No. 0D6-A6-014.

3. Replace R109 with a 20K pot, part No. 13M-33-203.



NOTES

1. ASSEMBLY

USE "LOCKTITE #271 ADHESIVE" ON THREADS OF (M16) W
ASSEMBLING (M3) TO (M2) ON PINS (M21),(M22),(M23)
WHEN ASSEMBLING (M6),(M9) TO (M4) AND (M9),(M8) TO
AND ON (M34) WHEN ASSEMBLING TO (M1)

CONVERSIONS TO MONO

TO CONVERT A STANDARD CTR-90 PLAY AMP TO MONO:

1. Remove right channel active components. This includes:

transistors	Q3, Q4, Q7, Q8
IC's	U3, U4, U9, U10

2. Remove right channel XLR wiring, and transformer if installed.

3. Place a 26-30 gauge jumper from U4's existing socket pin 6, to pin 10.

TO CONVERT A STANDARD CTR-90 RECORD AMP TO MONO:

1. Remove right channel active components. This includes:

transistors	Q4, Q4, Q7, Q8
IC's	U7, U10, U11, U14,

2. Remove T3, right channel XLR wiring, and transformer if installed.

3. Turn right channel bias pot R30 fully counter clockwise to it's minimum setting.

PLAY AMP
807-B0-402

AUDIO

1. Inspect VR1 and VR2 to make certain their cases do not touch. Check that all IC's are seated properly.

2. Turn Pots R25 and R26 fully clockwise. Turn pots R29, R30, R31, and R32 to their midway point. Set pots R139 and R140 to point directly towards the front edge of the board (towards P1). Set R43 fully clockwise. Set pots R89 and R99 to their midway points. Set R101 fully counter-clockwise. SEt R66 and R67 one-third of a turn from fully counter-clockwise.

3. Place shunts across x7 and x8, and also across x10 and x11.

4. Plug board into a CTR94 test machine. Turn power on.

5. Check the + and - 15V supply rails at U4 pin 11 and 4 respectively. Check the DNR supply at pin 1 of U14 for +8V, and check pin 7 of U14 for -8V.

6. Insert a cartridge with no tape and press the start button.

7. Measure U2 pin 10 and U4 pin 10 with a voltmeter, both pins should measure less than a 20mV DC offset.

8. Measure T1 pins 1 & 4 and T2 pins 1 & 4 with a voltmeter, all 4 pins should measure less than 20 mV DC offset.

9. Stop machine. Move jumper cap from X7 and X8 to X8 and X9. Move jumper cap from X10 and X11 to X11 and X12.

10. Press Start. Measure T1 pins 1 & 4 and T2 pins 1 & 4 with a voltmeter all four pins should measure less than 10 mV offset.

11. Stop machine. Move jumper caps back to their original position.

12. Remove empty cart from machine and insert an STL Stereo NAB alignment tape. (Ref. to 160nWb/m).

13. Connect audio analyzer to output of unit. Set Sig. Com. switch on analyzer to "float" position. Press Start (1Khz 106nWb/m).

14. Turn R139 (left) and R140 (right) to verify the output levels will reach at least ±20 dBm.

15. Set output levels to +20dBm. View U7 and 1 & 7 and U10 pins 1 & 7, there should be no clipping on any of the pins.

16. Set the output levels to 0dBm.

17. While looking at T1 pin 1 with an oscilloscope, ground pin 4 of T1. The voltage at T1 pin 1 should double. View T2 pin 1 and ground T2 pin 4. The voltage at T2 pin 1 should double.

18. Switch the Sig. Com. switch on the audio analyzer to the "Chassis" position.

19. Play a 12.5kHz -10dB (160nWB+0dB) tone. Check the phase of the output signals.

20. Adjust R31 (left) and R32 (right) and verify that the output level will adjust at least +6dB from reference level.

21. Play a 50Hz -10dB (160nWB=0db) tone. Adjust R29 (left) and R30 (right) and verify that the output level will adjust at least +4db from the reference level.

22. Play a 1Khz 160nWb/m tone. Press FF twice (FF-unmuted) and wait for the audio indicator to illuminate. Then note left and right output levels.

3. Push FF once (FF-muted). Measure output levels. The output levels should be at least -65dB from the levels noted in step 22.

DYNAMIC NOISE REDUCTION

1. Move jumper caps from X7 and X8 to X8 and X9, and from X10 and X11 to X11 and X12.

2. Play a 12.5kHz -10dB (160nWb=0dB) tone. Turn pot R43 fully clockwise and note output level. Turn R43 counter-clockwise all the way. The output level should now be at least 10dB lower than it was with the pot fully clockwise.

3. Slowly turn R43 clockwise until the output level is equal to the level noted with R43 fully clockwise. Note the position of the pot's wiper -- it should NOT reach the half-way point of its adjustment.

METERS

1. Play a 1kHz 160 nWb/m tone. Adjust R139 (left) and R140 (right) for an output of 0dBm.

2. While looking at U8 pin, adjust R66 through its full range. U8 pin 1 should adjust from 0V to 1 Vpp.

3. Repeat step 2 using U8 pin 7 and R67.

4. Check to see that front panel bargraph meters are working.

CUE

1. Connect a scope probe to pin 39 of remote connector.

2. Play a 1kHz Threshold Level (-6dB) cue to tone test tape.

3. Adjust R99 while watching scope. The voltage should at least adjust from 0V to 6Vpp.

4. Slowly turn R101 clockwise until the unit stops. Press FF. Unit should stop after a few seconds (less than 3 seconds). The pot (R101) should be between 1/4 and 1/2 turn from the fully counterclockwise position.

5. Play a 150Hz Threshold (0)dB) cue tone test tape.

6. Adjust R99 while watching pin 39 of the remote connector with a scope. The voltage should adjust from at least 0V to about 14V.

7. With R101 set (Step 4), the Sec cue detector should trigger. Check SEC indicators on front panel for SEC detection.

8. Play an 8Khz Threshold (-16dB) due tone test tape.

9. Adjust R99 while watching pin 39 of the remote connector with a scope. The voltage should adjust from at least 0V to about 2V.

10. With R101 set (step 4), the TER cue detector should trigger. Check TER indicators on front panel to verify triggering.

11. Switch SW1 on Logic board to the "Cue Meter" position.

12. Play a 1Khz Threshold cue tone test tape. Set R99 for a voltage of 1.1Vpp at pin 39 of remote connector.

13. Adjust R89 for a front panel meter level of (-6dB actual) (-7dB) (Bottom bargraph).

14. Play a 150Hz Threshold cue tone test tape. The voltage on pin 39 of the remote connector should be about 2.2Vpp. Verify that the bargraph meter reads 0dB.

15. Play an 8Khz Threshold cue tone test tape. The voltage on pin 39 of the remote connector should be about 350 mVpp. Verify that the bargraph meter reads 0dB.

16. Insert a blank cart. Look at 02 pin 9 with a scope, and press the start button. 02 pin 9 should go to +.6V after 1.75 seconds.

RECORD AMP
807-B0-404

1. Turn the [redacted] all record board potentiometers to their minimum (counter clockwise settings).

Bend cathode of D2 slightly from surface of board.

Plug board into CTR94 Test unit. Turn power on. Check ±15V supply voltage. At pins 4 and 8 of U2.

The case of VR1 is a quiet and convenient grounding point for scope probes etc.

Plug Audio Generator into Rec. Amp. Set generator to 1KHz at -15dBm in balanced mode. Set generator in "Test" position.

✓Insert blank cartridge (no tape) into unit. Press Rec and Start.

2. ✓Look at the bottom side of L3 (left) and L2 (right) with an oscilloscope. Watch scope and adjust R31 (left) R30 (right) clockwise twoard maximum settings until at least 6 Vpp of bias is reached. The bias should adjust smoothly from 1V upward and not be distorted. NO LESS THAN 6 VPP

✓Look at bias voltage at tops of L3 and L2. The voltage should be less than 100mVpp.

✓Press STOP. Verify that their is no bias at the bottoms of the inductors.

3. Look at collectors (left leg) of ~~Q7~~, Q8, Q9, and ~~Q10~~ with scope. When in Record, the collectors should have +15Vdc. but when in any other mode, the collectors should have 0V on them.

Look at collector (left leg) of Q6 (TOP OF R48) with an oscilloscope. Connect a scope probe from the scope's external trigger to the cathode of D2. Set scope triggering to external. Set scope coupling to DC + slope. Set scope horizontal time to .1s per division. Repeatedly enter and exit REC mode while viewing scope. Adjust scope's holdoff and level controls until scope triggers on waveform. Total time for voltage to go from ground to +15V is about 2.6 divs (260mS). Change scope settings to: Internal trigger, AC couplings + slope, 10mS per divs horiz. ✓ Repeatedly enter and exit REC mode while watching scope. Adjust scope's holdoff and level controls until you trigger on a rising wave form that begins at about 0V. The ✓slope should reach +15V in about 1.5 divs. (20-30mS).

Look at collector of Q12 (bottom leg) with (A) X channel of scope. Scope settings: external trigger, AC coupling, + slope, .1 sec/divs horiz. Repeatedly enter and exit REC mode while watching scope. Adjust level and hold controls until scope triggers. The waveform should reach +15V in about 2.5 ✓divs (250mS).

Change scope settings to: internal trigger, AC coupling, + slope, 5mS/div hor. Repeatedly adjust holdoff and levels controls until you see a + slope starting at about 0V. The slope should reach +15V in about 0.6 divs (6mS).✓

Press STOP✓

4. Connect scope probe to U9 pin 10 or the top of R48. DC offset should be small (~~<100mV~~).

Press RECORD then Start. U9 pin 10 or top of ~~R57~~ R48 should still be at 0V DC.

Push Stop.

NOTE: After power-up of unit, the first time REC mode is entered the DC level on U9 pin 10 and U10 pin 10 will swing between ± voltages for about 10 seconds.

Repeat for the right channel using U10 pin 10. ~~TO POT~~ ~~R57~~

32 Set generator to "operate". Look at U9 pin 10 (R48) with scope. Enter RECORD mode. Adjust the upper front panel pot clockwise to it's maximum setting. There should be a 1KHz sine wave of about .9 Vpp on the pin. Signal should have increased smoothly while the pot was rotated.

✓ Repeat for U10 pin 10 and lower front panel pot.

✓ Press Stop -- the 1KHz signal on U9 and U10 pin 10 should disappear.

5. ✓ With the front panel level pots fully clockwise. Set generator frequency to 12.5 KHz, -15dBm (-35dBm on a Potomac). 0db

✓ Enter Rec. mode. Look at U9 pin 10 (R48) with a scope and adjust R2 (left-OF ATE) through its entire range. The voltage should vary from about .9Vpp to about 1.5Vpp

✓ Reset R2 at minimum.

✓ Repeat for the right channel, using U10 pin 10 and R73. R57

6. ✓ Change generator frequency to 50 Hz.

Enter Record mode. Look at U9 pin 10 with a scope. Signal should be about 500mVpp. Turn the R1 clockwise until it points straight away from board. Signal should increase to about 1Vpp.

✓ Reset R1 at minimum. APPROX HALF

✓ Repeat for the right channel using U10 pin 10 and R74.

✓ Set generator to TEST position.

HX-PRO

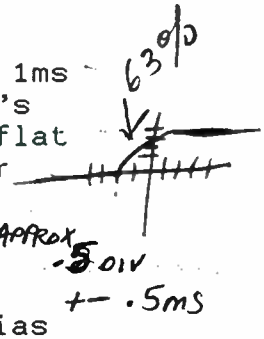
✓7. Set bias pots, R31(L) and R30(R) for a bias at bottom of L2 and L3 level of 4.0V pp. STAY HERE FOR FOLLOWING TEST

Connect scope's external trigger to trigger on test generator. Connect test board, to REC audio inputs. Connect ~~X channel of scope to pin 6 of U6 (NEC uPC1297)~~. Set scope to external trigger, + slope autocoupling, 1V/div. vert., 2mS/div hor.

Enter RECORD mode.

Adjust front panel pots ON TEST GEN(BOX) so that the gated 10KHz signal attenuates the bias at the bottom of L1 and L2 to 2Vpp (1/2 of it's 4Vpp) when the signal is present.

U6 pin 6 should have a rising edge time of approximately 1ms (.5 div) in 63.7% of the total amount of rise. After it's initial settling time the top of this wave form must be flat until it's exponential decay. Any deviation is cause for trouble shooting.



✓Repeat for right channel using U6 pin 131. → DISCONNECT BOX

✓SET POTOMAC @ 1K 0db

✓Enter RECORD mode. Set SW1 on Logic board for program bias position (middle position). Vary R37 (L) and R33 (R) verifying that meter drivers funtion properly by viewing the changing LED Bargraphs.

8. ✓Set S1 on Logic board to "Audio" (front) position. Vary R39 (L) and R61 (R) verifying that meter drivers funtion properly by viewing the changing LED Bargraphs.

Disconnect audio test generator from the record inputs.

Cue Section

9. Insert an erased cart. Connect Audio generator between pin 38 (+) and pin 35 (ground) of the remote connector. Set generator for an output voltage of .5V rms (1.4Vpp) at 3.5 KHz. Set generator to TEST position (no output). Connect scope probe to pin 39 of Remote connector. Set R106 to it's halfway point.

   Press START button.

   You should not see any signals on Pin 39 of Remote. Press and hold the TERTIARY button. Adjust R116 (cue bias) for highest 8 KHz signal. It should be a clean 8kHz sine wave. Turn R106 and verify the voltage on Pin 39 of the Remote will adjust from at least 1Vpp to ~~8V~~ 5Vpp.

   Press and hold SEC button. Adjust R109 and verify the voltage on Pin 39 of the Remote will adjust from at least ~~3Vpp~~ 1 to ~~7Vpp~~ 6. Press STOP ✓

   Enter and exit Record mode repeatedly while adjusting R107 to verify the voltage on pin 39 of the Remote and connector will adjust from at least ~~3~~.5Vpp to ~~8V~~ 5Vpp.

   Press Start. Set generator output to "operate." Ground pin 37 of the Remote connector. There should be a 3.5kHz sine wave on Pin 39 of Remote. Adjust R111 and verify the voltage will adjust from at least ~~.5Vpp to 4Vpp~~ .2 TO 2. Unground Pin 37 of the Remote -- the 3.5 kHz signal should be gone.

   Return both front panel pots to their maximum (full clockwise) position.

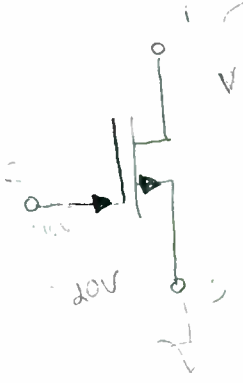
   Press SEC. Set S1 on Logic board to the CUE position (towards back). Adjust R120 (Cue bias meter) to verify you can adjust for the full range of the TOP LED BARGRAPH meter.

ADJ AH EN 28.5

RED

SET R106 & 109 TO MIN.

GEN TO TEST



8K = 300mV to 5V → AT LEAST

150Hz = 1 VOLT OR 600mV to 5V → AT LEAST

1K = 200mV to 4V ✓

AT LEAST .5 VOLT

POWER SUPPLY TEST PROCEDURE
807-A0-412

1. Inspect board to be certain large capacitors are installed with the proper polarity. Check all IC's for proper seating.*

2. Plug transformer secondary into PS board. Turn power on.

3. Set output voltage of VR3 (middle pin) to +18V by adjusting R4.

4. Set output voltage of VR4 (pin closest to P1) to -18V by adjusting R5.

5. Check output voltage of VR1 (middle pin), verify that it is +6.3V

6. Check output voltage of VR2 (middle pin), verify that it is +5V.

7. Turn power off.

8. Plug test motor into TB1 connector of PS.

9. Plug Motor Reference Generator Test board into P1 of PS.

10. Set pot R25 a little past center in a clockwise direction.

11. Turn power on.

12. Check that motor spins-up and "locks" in about 2 seconds when power is switched on.

13. Place scope probe on U4 pin 14 and adjust R25 for a 30% positive duty-cycle (about 1 division on the scope at .5mS horiz. deflection).

14. Place scope probe on U12 pin 1. There should be a positive pulse every one second.

15. While looking at U12 pin 1 with the scope, turn the switch on the Motor Reference Generator Test board to the ON position. U12 pin 1 should go to +5V.

***NOTE:** When the PS board is mounted to the heatsink, the transistors and regulators must be checked to insure proper case isolation from ground.

CONVERSIONS TO MONO

TO CONVERT A STANDARD CTR-90 PLAY AMP TO MONO:

1. Remove right channel active components. This includes:

   transistors Q3, Q4, Q7, Q8

   IC's U3, U4, U9, U10

2. Remove right channel XLR wiring, and transformer if installed.

3. Place a 26-30 gauge jumper from U4's existing socket pin 6 to pin 10.

TO CONVERT A STANDARD CTR-90 RECORD AMP TO MONO:

1. Remove right channel active components. This includes:

   transistors Q4, Q4, Q7, Q8

   IC's U7, U10, U11, U14,

2. Remove T3, right channel XLR wiring, and transformer if installed.

3. Turn right channel bias pot R30 fully counter clockwise to it's minimum setting.

CTR90

Electronic part change made as of 12/18/90

LOGIC BOARD:

D12, a 200-A0-000 no longer used

C11 value changed and part number from 1uF 011-A5-105 to 2.2uF 011-A5-225

PLAY AMP:

R145 & R146 formerly 10K 120-20-10S are now 33.2K 120-20-33S

RECORD AMP:

Pots R39 & R61 formerly 20K V trim 13M-33-203 are currently 50K V trim 13M-33-503.

RECORDER DISPLAY PANEL:

C6 & C8 220uF 011-A5-227 are now 100uF 011-A8-107

C7 & C9 2.2uF 011-A5-225 are now 6.8uF 011-A5-685

R14 & R20 110K 110-22-114 are now 100K 110-22-104

R13 & R19 470R 110-22-471 are now 2.2K 110-22-222

POWER SUPPLY TEST PROCEDURE
807-A0-412

1. Inspect board to be certain large capacitors are installed with the proper polarity. Check all IC's for proper seating.*

2. Plug transformer secondary into PS board. Turn power on.

3. Set output voltage of VR3 (middle pin) to +18V by adjusting R4.

4. Set output voltage of VR4 (pin closest to P1) to -18V by adjusting R5.

5. Check output voltage of VR1 (middle pin), verify that it is +6.3V

6. Check output voltage of VR2 (middle pin), verify that it is +5V.

7. Turn power off.

8. Plug test motor into TB1 connector of PS.

9. Plug Motor Reference Generator Test board into P1 of PS.

10. Set pot R25 a little past center in a clockwise direction.

11. Turn power on.

12. Check that motor spins-up and "locks" in about 2 seconds when power is switched on.

13. Place scope probe on U4 pin 14 and adjust R25 for a 30% positive duty-cycle (about 1 division on the scope at .5mS horiz. deflection).

14. Place scope probe on U12 pin 1. There should be a positive pulse every one second.

15. While looking at U12 pin 1 with the scope, turn the switch on the Motor Reference Generator Test board to the ON position. U12 pin 1 should go to +5V.

*NOTE: When the PS board is mounted to the heatsink, the transistors and regulators must be checked to insure proper case isolation from ground.

RECORD AMP
807-B0-404

1. Turn the front panel and all record board potentiometers to their minimum (counter clockwise settings).

   Bend cathode of D2 slightly from surface of board.

   Plug board into CTR94 Test unit. Turn power on. Check ±15V supply voltage. At pins 4 and 8 of U2.

   The case of VR1 is a quiet and convenient grounding point for scope probes etc.

   Plug Audio Generator into Rec. Amp. Set generator to 1KHz at -15dBm in balanced mode. Set generator in "Test" position.

   Insert blank cartridge (no tape) into unit. Press Rec and Start.

2. Look at the bottom side of L3 (left) and L2 (right) with an oscilloscope. Watch scope and adjust R31 (left) R32 (right) clockwise twoard maximum settings until at least 6 Vpp of bias is reached. The bias should adjust smoothly from 1V upward and not be distorted.

   Look at bias voltage at tops of L3 and L2. The voltage should be less than 100mVpp.

   Press STOP. Verify that their is no bias at the bottoms of the inductors.

3. Look at collectors (left leg) of Q7, Q8, Q9, and Q10 with scope. When in Record, the collectors should have +15Vdc. but when in any other mode, the collectors should have 0V on them.

   Look at collector (left leg) of Q6 with an oscilloscope. Connect a scope probe from the scope's external trigger to the cathode of D2. Set scope triggering to external. Set scope coupling to DC + slope. Set scope horizontal time to .1s per division. Repeatedly enter and exit REC mode while viewing scope. Adjust scope's holdoff and level controls until scope triggers on waveform. Total time for voltage to go from ground to +15V is about 2.6 divs (260mS). Change scope settings to: Internal trigger, AC couplings + slope, 10mS per divs horiz. Repeatedly enter and exit REC mode while watching scope. Adjust scope's holdoff and level controls until you trigger on a rising wave form that begins at about 0V. The slope should reach +15V in about 1.5 divs. (20-30mS).

   Look at collector of Q12 (bottom leg) with X channel of scope. Scope settings: external trigger, AC coupling, + slope, .1 sec/divs horiz. Repeatedly enter and exit REC mode while watching scope. Adjust level and hold controls until scope triggers. The waveform should reach +15V in about 2.5 divs (250mS).

   Change scope settings to: internal trigger, AC coupling, + slope, 5mS/div hor. Repeatedly adjust holdoff and levels controls until you see a + slope starting at about 0V. The slope should reach +15V in about 0.6 divs (6mS).

   Press STOP

4. Connect scope probe to U9 pin 10 or the top of R48. DC offset should be small (1<100mV).

   Press RECORD then Start. U9 pin 10 or top of R57 should still be at 0V DC.

   Push Stop.

   NOTE: After power-up of unit, the first time REC mode is entered the DC level on U9 pin 10 and U10 pin 10 will swing between ± voltages for about 10 seconds.

Repeat for the right channel using U10 pin 10.

Set generator to "operate". Look at U9 pin 10 with scope. Enter RECORD mode. Adjust the upper front panel pot clockwise to it's maximum setting. There should be a 1KHz sine wave of about .9 Vpp on the pin. Signal should have increased smoothly while the pot was rotated.

Repeat for U10 pin 10 and lower front panel pot.

Press Stop -- the 1KHz signal on U9 and U10 pin 10 should disappear.

5. With the front panel level pots fully clockwise. Set generator frequency to 12.5 KHz, -15dBm (-35dBm on a Potomac).

   Enter Rec. mode. Look at U9 pin 10 with a scope and adjust R2 (left-OF ATE) through its entire range. The voltage should vary from about .9Vpp to about 1.5Vpp

   Reset R2 at minimum.

   Repeat for the right channel, using U10 pin 10 and R73.

6. Change generator frequency to 50 Hz.

   Enter Record mode. Look at U9 pin 10 with a scope. Signal should be about 500mVpp. Turn the R1 clockwise until it points straight away from board. Signal should increase to about 1Vpp.

   Reset R1 at minimum.

   Repeat for the right channel using U10 pin 10 and R74.

   Set generator to TEST position.

7. Set bias pots R31(L) and R30(R) for a bias at bottom of L2 and L3 level of 4.0V pp.

   Connect scope's external trigger to trigger on test generator. Connect test board, to REC audio inputs. Connect X channel of scope to pin 6 of U6 (NEC uPC1297). Set scope to external trigger, + slope autocoupling, 1V/div. vert., 2mS/div hor.

   Enter RECORD mode.

   Adjust front panel pots so that the gated 10KHz signal attenuates the bias at the bottom of L1 and L2 to 2Vpp (1/2 of it's 4Vpp) when the signal is present.

   U6 pin 6 should have a rising edge time of approximately 1ms (.5 div) in 63.7% of the total amount of rise. After it's initial settling time the top of this wave form must be flat until it's exponential decay. Any deviation is cause for trouble shooting.

   Repeat for right channel using U6 pin 131.

   Enter RECORD mode. Set SW1 on Logic board for program bias position (middle position). Vary R37 (L) and R33 (R) verifying that meter drivers funtion properly by viewing the changing LED Bargraphs.

8. Set S1 on Logic board to "Audio" (front) position. Vary R39 (L) and R61 (R) verifying that meter drivers funtion properly by viewing the changing LED Bargraphs.

   Disconnect audio test generator from the record inputs.

Cue Section

9. Insert an erased cart. Connect Audio generator between pin 38 (+) and pin 35 (ground) of the remote connector. Set generator for an output voltage of .5V rms (1.4Vpp) at 3.5 KHz. Set generator to TEST position (no output). Connect scope probe to pin 39 of Remote connector. Set R106 to it's halfway point.

   Press START button.

   You should not see any signals on Pin 39 of Remote. Press and hold the TERTIARY button. Adjust R116 (cue bias) for highest 8 KHz signal. It should be a clean 8kHz sine wave. Turn R106 and verify the voltage on Pin 39 of the Remote will adjust from at least 1Vpp to 8Vpp.

   Press and hold SEC button. Adjust R109 and verify the voltage on Pin 39 of the Remote will adjust from at least 3Vpp to 7Vpp. Press STOP.

   Enter and exit Record mode repeatedly while adjusting R107 to verify the voltage on pin 39 of the Remote and connector will adjust from at least 1.5Vpp to 8Vpp.

   Press Start. Set generator output to "operate." Ground pin 37 of the Remote connector. There should be a 3.5kHz sine wave on Pin 39 of Remote. Adjust R111 and verify the voltage will adjust from at least .5Vpp to 4Vpp. Unground Pin 37 of the Remote -- the 3.5 kHz signal should be gone.

   Return both front panel pots to their maximum (full clockwise) position.

   Press SEC. Set S1 on Logic board to the CUE position (towards back). Adjust R120 (Cue bias meter) to verify you can adjust for the full range of the TOP LED BARGRAPH meter.

PLAY AMP
807-B0-402

AUDIO

1. Inspect VR1 and VR2 to make certain their cases do not touch. Check that all IC's are seated properly.

2. Turn Pots R25 and R26 fully clockwise. Turn pots R29, R30, R31, and R32 to their midway point. Set pots R139 and R140 to point directly towards the front edge of the board (towards P1). Set R43 fully clockwise. Set pots R89 and R99 to their midway points. Set R101 fully counter-clockwise. SEt R66 and R67 one-third of a turn from fully counter-clockwise.

3. Place shunts across x7 and x8, and also across x10 and x11.

4. Plug board into a CTR94 test machine. Turn power on.

5. Check the + and - 15V supply rails at U4 pin 11 and 4 respectively. Check the DNR supply at pin 1 of U14 for +8V, and check pin 7 of U14 for -8V.

6. Insert a cartridge with no tape and press the start button.

7. Measure U2 pin 10 and U4 pin 10 with a voltmeter, both pins should measure less than a 20mV DC offset.

8. Measure T1 pins 1 & 4 and T2 pins 1 & 4 with a voltmeter, all 4 pins should measure less than ~~10~~ 20 mV DC offset.

9. Stop machine. Move jumper cap from X7 and X8 to X8 and X9. Move jumper cap from X10 and X11 to X11 and X12.

10. Press Start. Measure T1 pins 1 & 4 and T2 pins 1 & 4 with a voltmeter all four pins should measure less than 10 mV offset.

11. Stop machine. Move jumper caps back to their original position.

12. Remove empty cart from machine and insert an STL Stereo NAB alignment tape. (Ref. to 160nWb/m)

13. Connect audio analyzer to output of unit. Set Sig. Com. switch on analyzer to "float" position. Press Start (1Khz 106nWb/m).

14. Turn R139 (left) and R140 (right) to verify the output levels will reach at least ±20 dBm.

15. Set output levels to +20dBm. View U7 and 1 & 7 and U10 pins 1 & 7, there should be no clipping on any of the pins.

16. Set the output levels to 0dBm.

17. While looking at T1 pin 1 with an oscilloscope, ground pin 4 of T1. The voltage at T1 pin 1 should double. View T2 pin 1 and ground T2 pin 4. The voltage at T2 pin 1 should double.

18. Switch the Sig. Com. switch on the audio analyzer to the "Chassis" position.

19. Play a 12.5kHz -10dB (160nWB+0dB) tone. Check the phase of the output signals.

20. Adjust R31 (left) and R32 (right) and verify that the output level will adjust at least +6dB from reference level.

21. Play a 50Hz -10dB (160nWB=0db) tone. Adjust R29 (left) and R30 (right) and verify that the output level will adjust at least +4db from the reference level.

22. Play a 1Khz 160nWb/m tone. Press FF twice (FF-unmuted) and wait for the audio indicator to illuminate. Then note left and right output levels.

3. Push FF once (FF-muted). Measure output levels. The output levels should be at least -65dB from the levels noted in step 22.

DYNAMIC NOISE REDUCTION

1. Move jumper caps from X7 and X8 to X8 and X9, and from X10 and X11 to X11 and X12.

2. Play a 12.5kHz -10dB (160nWb=0dB) tone. Turn pot R43 fully clockwise and note output level. Turn R43 counter-clockwise all the way. The output level should now be at least 10dB lower than it was with the pot fully clockwise.

3. Slowly turn R43 clockwise until the output level is equal to the level noted with R43 fully clockwise. Note the position of the pot's wiper -- it should NOT reach the half-way point of its adjustment.

METERS

1. Play a 1kHz 160 nWb/m tone. Adjust R139 (left) and R140 (right) for an output of 0dBm.

2. While looking at U8 pin, adjust R66 through its full range. U8 pin 1 should adjust from 0V to 1 Vpp.

3. Repeat step 2 using U8 pin 7 and R67.

4. Check to see that front panel bargraph meters are working.

CUE

1. Connect a scope probe to pin 39 of remote connector.

2. Play a 1kHz Threshold Level (-6dB) cue to tone test tape.

3. Adjust R99 while watching scope. The voltage should at least adjust from 0V to 6Vpp.

4. Slowly turn R101 clockwise until the unit stops. Press FF. Unit should stop after a few seconds (less than 3 seconds). The pot (R101) should be between 1/4 and 1/2 turn from the fully counterclockwise position.

5. Play a 150Hz Threshold (0)dB) cue tone test tape.

6. Adjust R99 while watching pin 39 of the remote connector with a scope. The voltage should adjust from at least 0V to about 14V.

7. With R101 set (Step 4), the Sec cue detector should trigger. Check SEC indicators on front panel for SEC detection.

8. Play an 8Khz Threshold (-16dB) due tone test tape.

9. Adjust R99 while watching pin 39 of the remote connector with a scope. The voltage should adjust from at least 0V to about 2V.

10. With R101 set (step 4), the TER cue detector should trigger. Check TER indicators on front panel to verify triggering.

11. Switch SW1 on Logic board to the "Cue Meter" position.

12. Play a 1Khz Threshold cue tone test tape. Set R99 for a voltage of 1.1Vpp at pin 39 of remote connector.

13. Adjust R89 for a front panel meter level of (-6dB actual) (-7dB) (Bottom bargraph).

14. Play a 150Hz Threshold cue tone test tape. The voltage on pin 39 of the remote connector should be about 2.2Vpp. Verify that the bargraph meter reads 0dB.

15. Play an 8Khz Threshold cue tone test tape. The voltage on pin 39 of the remote connector should be about 350 mVpp. Verify that the bargraph meter reads 0dB.

16. Insert a blank cart. Look at 02 pin 9 with a scope, and press the start button. 02 pin 9 should go to +.6V after 1.75 seconds.