



Reproduce Amplifier Revision-D

AMPEX UPGRADE ELECTRONICS

Owners Manual



RTZ Professional Audio
4260 Pine Vista Blvd
Alpharetta, GA 30022 USA
Web: <http://www.rtzaudio.com>
Email: rtzaudio@mindspring.com

1. INTRODUCTION

Thank you for purchasing your new RTZ upgrade electronics for Ampex studio recorders! All of our cards are hand built and individually tested prior to shipping. Before installing any cards, please read this document thoroughly and retain it for future reference. Additional copies of this manual are available upon request or may be downloaded from our website at <http://www.rtaudio.com>.

All items are carefully packed to endure the rigors of shipping and handling. However, please inspect all contents and packaging immediately upon receipt. Please report any problems to us immediately. In the event of damage, retain all shipping and packaging materials for shipper damage claims inspection.

2. DESCRIPTION

The Rev-D reproduce cards are modern replacement electronics designed to greatly enhance the playback performance of vintage Ampex 440/1100/1200 series studio recorders. The original Ampex head amplifier design has been combined with a new modern head input transformer. The line amplifier stage has been completely redesigned to provide improved specifications and sonic performance. The PCB's are full ground plane types for improved shielding and circuit stability. An onboard thermal poly fuse protects the PCB and components against further damage in the event of a short or component failure.

Originally, Ampex made a number of minor circuit design and component changes during the evolution of the various machines supported by the Rev-D reproduce cards. As such, our cards are populated with the appropriate components upon ordering for the machine type specified. In some cases the reproduce cards may interchange between different series recorders with only EQ realignment and/or jumper changes required. In other cases, a few component values may need to be changed, added or removed to achieve proper alignment. Please refer to the schematic for additional information on component values and changes.

In general, this document covers details specific to the RTZ Rev-D reproduce cards. Otherwise, you should perform the alignment procedures as originally specified in the Ampex Operation and

Maintenance manual supplied with the machine. If you experience any difficulty installing or aligning the electronics, please contact us directly for assistance.

3. HEAD INPUT TRANSFORMER CONFIGURATION

The input transformer must be configured to match the head impedance of the recorder being upgraded. Jumper block JP1 selects the head input transformer ratio for either 1:4 or 1:8 turns ratio. The jumper configuration also depends on whether the head resonance trimmer (VR2) is installed. In either case, you may want to experiment between ratios and note the record/playback response during testing. The goal is to obtain the best matching between the playback head and head input transformer for both tape speeds.

Note that the MM-1200 typically requires 1:8 turns ratio with the head resonance trimmer VR2 installed. Otherwise, the 1:4 ratio should be used with FET switch Q13 installed and no VR2 resonance trimmer for the MM1200. The AG440 series recorders usually require a 1:8 turns ratio for proper alignment. Refer to Table 1 for the jumper options. Confirm the JP1 jumper settings from the table below before installing the new cards.

Table 1

Ratio	JP1 Jumpers	Usage
1:4	1 & 2	LOW-Z
1:8	3 & 4	HIGH-Z

It is extremely important that the recorder heads are in good condition to obtain optimum alignment and frequency response. Worn or damaged heads will make optimum alignment difficult and/or impossible. Likewise it is extremely helpful to plot the current frequency response of the recorder using the stock electronics with a calibrated test tape (we recommend MRL alignment tapes) before making any upgrades. In other words, you want to know what the frequency response of the machine is prior to upgrade for comparison purposes later. The original frequency response information will be needed if you encounter alignment difficulties after upgrading!

NOTE

MAKE SURE YOUR RECORDER'S HEADS ARE IN PROPER CONDITION BEFORE UPGRADING. WE RECOMMEND SENDING THE HEADSTACK TO JRF MAGNETICS FOR EVALUATION PRIOR TO MAKING ANY CHANGES IF THE HEADSTACK IS OF UNKNOWN CONDITION!

4. EQUALIZER CONFIGURATION

The RTZ Rev-D cards include a universal EQ daughter card that is jumper configurable for any of the equalizations and tape speeds originally supported by the stock Ampex recorders. This includes speed ranges from 3-3/4 through 30 IPS for the NAB or CCIR equalization standards.

The original Ampex 4020270-01, 4020270-02 or 4020270-03 EQ option types may be selected via jumpers JP1 and JP2. Optional speed indicator LED's may also be installed on the

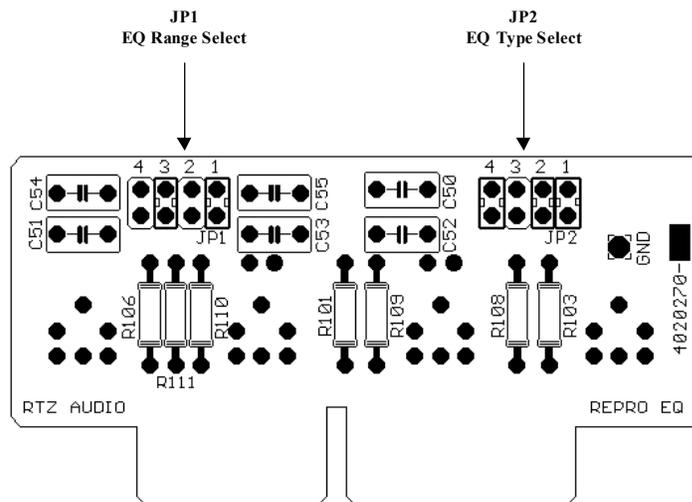
card for diagnostic purposes as well. The LED's may be enabled or disabled via jumper 4 on JP4. Refer to the schematic or Table 2 for the EQ configuration options available.

Note that the RTZ 4020270-D equalizer cards are direct replacements for standard Ampex equalizer cards used in the AG-440, MM-1000, MM-1100, and MM-1200 series studio recorders with the appropriate jumper settings configured. Thus, the reproduce EQ cards may be swapped between the original Ampex cards or RTZ cards if needed.

Before installing your new RTZ cards, verify that the correct EQ jumper settings are set from Table 2 according to the machine and tape speed required. Note that the speed select indicator LED's are generally not installed or enabled on multi-track recorders to avoid excessive current drain on the power supply and EQ switching driver transistors. However, you may wish to install LED's on a couple of cards for diagnostics purposes if desired.

Table 2

Original Ampex EQ Card P/N	JP1	JP2
4020270-01 (3¾ - 15ips NAB or CCIR)	2 & 4	1
4020270-02 (7½ - 15ips NAB or CCIR)	1 & 3	1
4020270-03 (15 - 30ips NAB or CCIR)	1 & 3	1 & 2



5. INSTALLING THE NEW CARDS

Many of the components on the repro cards have HOT +39V supply voltage directly exposed. This includes the metal transistors cases and the heat sink. Any contact of the heat sink or metal transistor bodies, to ground or other signal sources, will most likely cause immediate damage to the card components. Always use extreme care when handling or working around the repro cards during testing and alignment to avoid damage.

In the event of component damage or a short, thermal poly fuse MF1 will heat rapidly at around 200ma current and revert to high impedance open circuit state. The fuse remains heated and open as long as the over-current condition persists. If the card fails to operate and the fuse is hot to the touch, do not attempt to continue operating the card. This indicates a shorted component condition that requires repair. If card damage occurs, please contact RTZ directly or a qualified service person for repairs.

CAUTION

SOME RECORDERS (I.E THE AG-440) HAVE AN INTERNAL CARD CHASSIS SHIELD IN THE SLOT NEAR THE REAR EDGE CONNECTOR. MAKE SURE THE REPRO CARD HEATSINK DOES NOT CONTACT THIS WHEN INSERTED BEFORE POWERING UP THE MACHINE! IF NEEDED, BEND THE SHIELD OVER SLIGHTLY BY HAND TO AVOID ANY POSSIBLE CONTACT WITH THE HEATSINK WHEN THE CARD IS INSERTED INTO THE SLOT!

6. ALIGNMENT PROCEDURES

After the head input transformer ratio and EQ select jumpers are properly configured, align and bias the recorder using the normal reproduce and record alignment procedures. Refer to the original Ampex Operation and Maintenance manual alignment section for complete details.

You will notice the reproduce calibration level drops by about 5 – 7 dB after installing the RTZ cards – this is normal. Adjust the reproduce calibration level to make up this difference. The gain structure of the RTZ cards is designed for high output tape levels. This design helps recover some of the lost headroom associated

with using stock cards with modern high output tape formulations.

We strongly recommend making notes of the record and reproduce response of the recorder with the original cards before installing the new cards. This will provide a known response for comparison purposes after installing the new cards. As with any major component changes, it is advisable to change one card initially. If possible, make sure the tape recorder is in (or at least close to) proper alignment, including head alignment, before installing any new cards.

During initial alignment, start incrementally with one channel (or group of channels for multi-track recorders) and perform the complete reproduce and record alignment procedures as outlined in the Ampex manual. Be sure to compare frequency response notes against the original cards. In general, you should pay particular attention to the HF frequency response during RECORD ALIGNMENT (particularly at 10 KHZ and above 16 KHZ). If excessive HF rise occurs or you are unable to obtain fairly flat frequency response in the HF range, you will need to try swapping the input transformer ratio jumpers and note the results after repeating all alignment procedures.

Also, you should notice extended high frequency response while performing the record alignment procedures. You may need to reduce the record high frequency EQ boost (due to improved reproduce EQ frequency response). In most cases, the new precision cards and components provide significant improvements over the original design cards.

7. HEAD RESONANCE ADJUSTMENT

Later generations of the AG-440C recorders electronics included a head resonance adjustment trimmer. The Rev-D cards also support head resonance adjustment if trimmer VR2 is installed. The resonance adjustment trimmer was only available in later issues as far as we know. Some of the later issues of the 440 and 1200 series recorders were equipped with this option also.

Note the head resonance trimmer adjustment procedure requires a repro extender card. If you do not have access to an extender card, trimmer VR2 should be adjusted counter clockwise (CCW) for 18 or more turns to disable. The

trimmer clicks when adjusted past either end stop. Note that the reproduce high frequency equalization response is associated with the resonance trimmer and the EQ HF trimmers for each speed. The resonance trimmer adjustment is a one-time procedure that affects both speeds. When turned clockwise VR2 raises the resonant frequency and reduces the gap loss compensation.

During record alignment (while monitoring on playback) the resonance trimmer should be adjusted while sweeping the recorder from between 15-25 kHz. Typically the HF response will tend to rise above 15 kHz due to resonance. Adjust the resonance trimmer clockwise (CW) to raise the resonance point. As the resonance point is raised, the HF response should flatten out when the peak resonance point is moved higher in frequency.

Note that if the resonance trimmer is adjusted to extreme CW position, the 1-10 kHz frequency response will begin to degrade and alignment will not be possible. On some machines, such as the MM1200, the circuit may begin to "motorboat" or oscillate if adjusted to the extreme. Therefore, the resonance trimmer must be adjusted during the HF record/playback alignment and proper response is obtained over the entire frequency range.

8. RECORDER ALIGNMENT AND CONFIGURATION TIPS

As previously mentioned, the HF response must be verified during record and playback to obtain optimum HF response. The 1 kHz and 10 kHz alignment tape test tones will typically align easily. However, the frequency response above 15 kHz requires tweaking to obtain optimum results. The HF frequency response is directly affected by the resonance of the head input transformer and playback head.

Head resonance adjustments are facilitated by trimmer VR2 or by using a damping resistor installed at R11. FET switch Q13 (J174) is provided to enable head damping resistor R11 at high tape speed only if desired. Normally this build configuration is used on the MM-1200 if no resonance trimmer is installed and the head input transformer ratio is configured for 1:4. If a damping resistor is required at both speeds, Q13 may be omitted and the D (drain) and S (source) pads should be jumpered. In this

configuration, the optimum value of the damping resistor will depend on the recorder's playback head. We suggest installing temporary lead wires to an external 100K potentiometer to determine the best value for R11 during record alignment. We've found 22.1K to be the best value for our MM-1200 when the resonance trimmer is not used.

We've discovered that the input transformer ratio of 1:8 must be used on the MM-1200 at 15/30 IPS if the resonance adjustment trimmer is installed. Using GP-9 tape over-biased at 3.00 db, we were able to obtain flat response to well above 20 kHz at 15 IPS. The 30 IPS response tended to have a slight, but acceptable, rise above 20 kHz. When the resonance trimmer is properly adjusted, both tape speeds should show significant improvements in HF frequency response. Improper or over adjustment will affect the entire frequency response and possibly cause the circuit to oscillate or "motorboat". A fixed damping resistor value (Q13 source and drain pads jumpered) of 20-50k may also be required to prevent any oscillation.

On the AG-440 the 1:8 ratio will generally yield the best results. In some cases, depending on tape speed used, the 1:4 ratio may give better results. Our lab machine is a 440-C configured for 15-30 IPS NAB using the 1:8 ratio. Therefore, it is typically best to start with 1:8 turns ratio on the 440 machines. With proper adjustment you should notice significant improvement in the overall frequency response of the recorder.

The reproduce equalizer card JP3 jumper position #2 enables an additional low frequency smoothing network for high-speed. Typically, this option was used on the MM-1200 to smooth the LF response around the 100 Hz and below region. The low-frequency EQ trimmer will have less effect if the jumper is installed in position #2. If you are unable to obtain acceptable LF response adjustment during alignment, remove the jumper at position #2 from JP3 on the equalizer card.

Line Amplifier Specifications

The following specifications are for the line amplifier stage only. Max level is about +23 dbu, direct and about +27 dbu via transformer at 39 VDC. Data is shown for the RTZ and stock cards for comparison purposes.

Noise Measurements:

RMS measurement with input "OFF" (grounded).

A-Weighted	RTZ	Ampex
22Hz/22kHz	-88 dbu	-75 dbu
22Hz/80 kHz	-88 dbu	-75 dbu

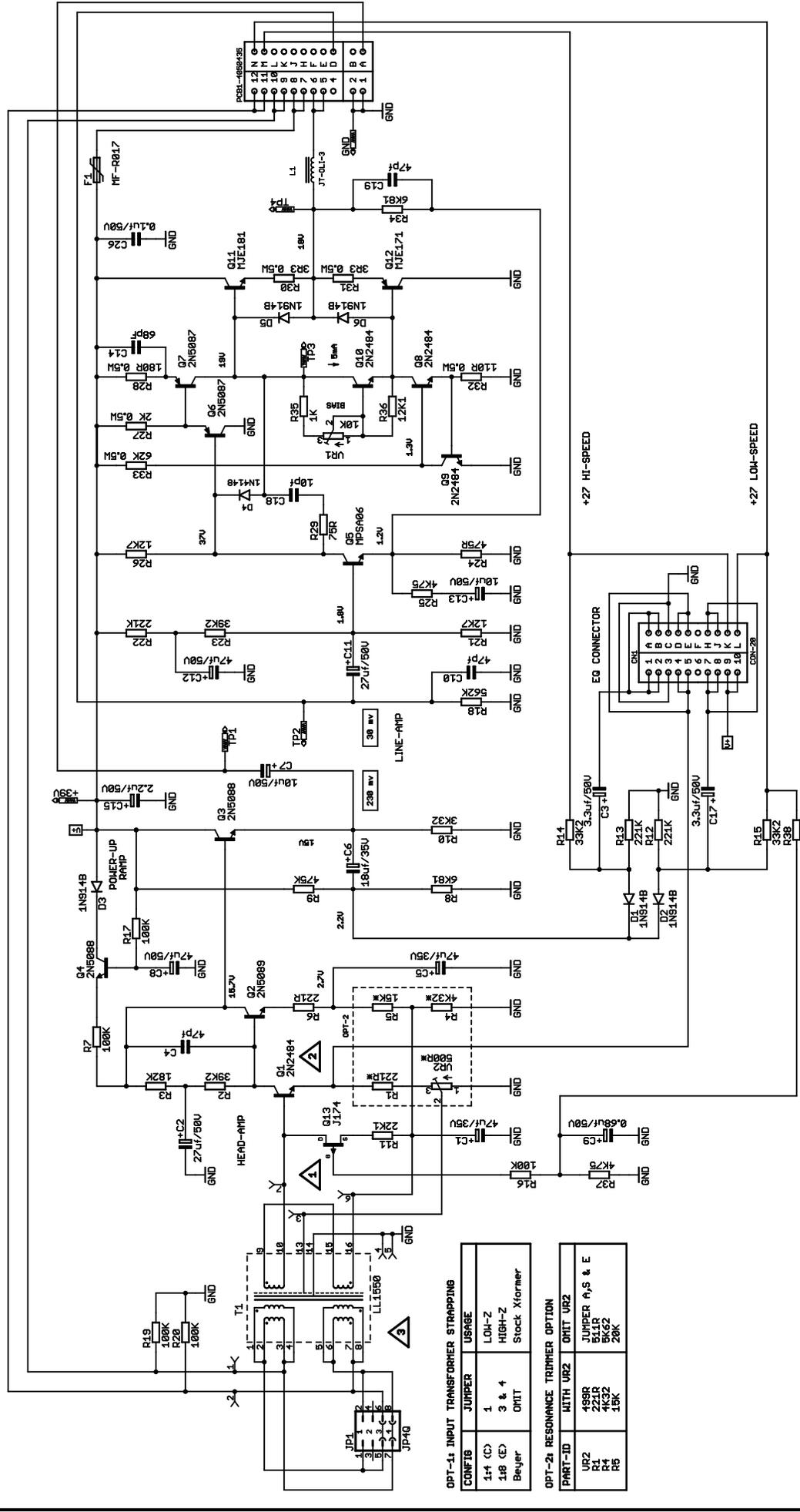
Basic THD+N:

No transformer @ +4dbu into 150 Ohm Load or no load (100k):

Frequency	RTZ		Ampex	
	150 Ohm load	100k load	150 Ohm load	100k load
1 kHz	0.0029%	0.00290%	0.0151%	0.0067%
10 kHz	0.0056%	0.00522%	0.0269%	0.0252%
100 Hz	0.00384%	0.00282%	0.0108%	0.0135%
20 Hz	0.00289%	0.00281%	0.053%	0.031%

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PROPRIETARY



OPT-1s INPUT TRANSFORMER STRAPPING

COMP ID	JUMPER	USAGE
11+ (C)	1	LOW-Z
14B (E)	3 & 4	HIGH-Z
Bayer	OMIT	Stock Xformer

OPT-2s RESONANCE TRIMMER OPTION

PART-ID	WITH UR2	OMIT UR2
UR2	459R	JUMPER A, S & E
R1	221R	511R
R4	4K32	9K52
R6	10K	20K

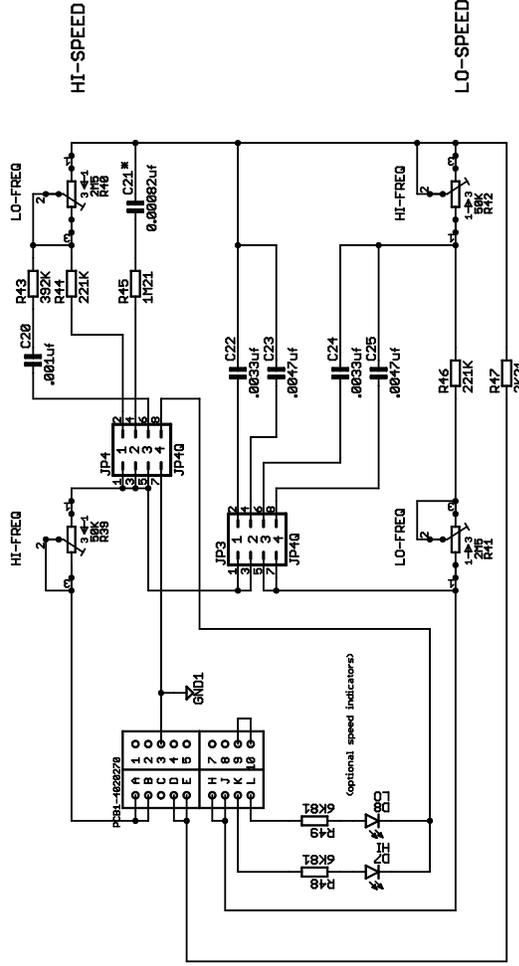
NOTES:

- 1 FET switch Q13 enables damping resistor R11 for 30 IPS on the MHL200. Omit Q13, R11, R16, R37, R38 and C9 for RB-440 usage.
- 2 Select components R4, R4 and R5 according to resonance trimmer option table above. Jumper trimmer pads A, S & E together if UR2 is omitted.
- 3 Transformer T1 is a Lundahl LL1550 or original Ampex head input transformer. Omit jumper block J1 if Ampex transformer is used.

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PROPRIETARY



NOTES:
 EQUALIZER 4020270-01 CAN BE ADJUSTED FOR 3-3/4 THRU 15IPS, NAB OR CCIR.
 EQUALIZER 4020270-02 CAN BE ADJUSTED FOR 7-1/2 THRU 15IPS, NAB OR CCIR.
 EQUALIZER 4020270-03 CAN BE ADJUSTED FOR 15 THRU 30IPS, NAB OR CCIR.
 * TO USE 4020270-03 CONFGS WITH FLUX MAGNETICS EXTENDED HEAD,
 CHANGE C52 TO 1000pF, OTHERWISE, USE JUMPER TBL BELOW
 FOR 'IMPROVED MCI' STYLE EQUALIZER.

AMPEX P/N	JP3	JP4
4020270-01 (3-3/4 THRU 15 IPS)	2 & 4	1
4020270-02 (7-1/2 THRU 15 IPS)	1 & 3	1
4020270-03 (15 THRU 30 IPS)	1 & 3	1 & 2
IMPROVED MCI & FLUX MAG (15 - 30 IPS)	1 & 3	2 & 3
LED SPEED SELECT INDICATOR ENABLE	n/a	4

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