

OPERATIONS MANUAL

EFT-3000
Frequency Extender

GENTNER

ELECTRONICS
CORPORATION

EFT-3000
Operations Manual

SPECIAL NOTICE

Your EFT-3000 unit was shipped with Version 1.0 Firmware. This Firmware does not contain all of the features and specifications outlined in this manual. The following items are different than indicated in the manual:

- a) Auto-line allocation. Your EFT-3000 does not yet have the capability of automatically assigning telephone lines to the low, medium and high frequency bands.

YOU MUST MATCH TELEPHONE LINE ASSIGNMENTS ON YOUR UNITS. LINE #1 ON THE TRANSMIT UNIT MUST BE CONNECTED TO LINE #1 ON THE RECEIVE UNIT, AND SO ON.

- b) Automatic reconfiguring. Version 1.0 will not reconfigure for a different bandwidth when a telephone line is lost. You must manually reconfigure by taking both units out of SETUP, then pressing SETUP again.

- c) Differential time delay between lines. Version 1.0 will only compensate for a differential time delay of 200 milliseconds. If time delay is greater than 200 milliseconds, you must re-dial the lines.

As an owner of a EFT-3000 with Version 1.0 Firmware, you will receive FREE Firmware upgrades for a period of one year after date of purchase. To register for free upgrades, be certain to promptly fill out and return to Gentner the Warranty Registration Card included with you EFT-3000.

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SECTION ONE -- THE BASICS

1.1 Introduction

This manual will provide you with all the information you need to properly use and maintain the EFT-3000. We urge you to read this manual thoroughly before attempting to use your EFT-3000.

Please refer to this manual first if you have any questions or problems regarding the use of the EFT-3000. If you can't find an answer in the manual, please contact:

Gentner Electronics Corporation
Customer Support
1825 Research Way
Salt Lake City, Utah 84119
Tel: (801) 975-7200
FAX: (801) 977-0087

Please check your EFT-3000 shipment to be certain that each item listed below is included. If any item is missing, notify Gentner immediately.

ITEM	GENTNER PART NUMBER
1. [1] EFT-3000 Unit Assembly	880-058-001
2. [1] Operations Manual	800-058-001
3. [2] Optional Rack Ears	740-058-004
4. [4] Rack Screws	681-400-001
5. [4] Rack Cups	684-400-001
6. [4] 6/32" X 1/2" Phillips Screws	681-010-608
7. [1] Hex Key	460-065-002
8. [3] 12' Modular Telephone Cables	830-000-012
9. [1] Quick Reference Sheet	432-058-006
10. [1] Warranty Registration Card	400-600-000

1.2 Overview

The Gentner EFT-3000 is a three line Digital Extended Frequency Transceiver. Using three standard dial-up telephone lines, an EFT-3000 system is capable of providing an audio channel with a frequency response of 50 Hz to 7.5 kHz. With the EFT-3000, you can send very high quality audio over standard telephone lines anywhere in the world. EFT-3000 units are required at both the Transmit and Receive ends of the telephone lines.

The EFT-3000 utilizes highly sophisticated digital circuitry and digital signal processing techniques to automatically equalize each of the three telephone lines, adjust for differential line delays and match amplitude levels between lines. All processing of the audio signals is performed in the digital domain.

Set-up of the three telephone lines is completely automatic and is initiated by the press of a single button on the front panel of the unit. The set-up process takes approximately ten seconds.

The EFT-3000 can also be used as a two line Extended Frequency Transceiver, or as a single line Extended Frequency Transceiver. In the two-line mode, the unit will provide a frequency response of 50 Hz to 5 kHz. In the single-line mode, a frequency response of 50 Hz to 2.5 kHz will be provided.

NOTE: In the single line and two line modes, the EFT-3000 is NOT compatible with other extenders.

No external telephone couplers are required. The EFT-3000 connects directly to the telephone lines, providing auto-answer/auto-disconnect capability. A built-in Touch-Tone (r) pad and memory dialer eliminate the need for a separate telephone instrument.

The EFT-3000 can be operated at a remote site as a standalone device, greatly reducing equipment needs. It contains a two input mixer and headset amplifier. Each input is switchable for microphone or line level, and phantom power for condenser microphones is internally selectable. A front panel VU meter with peak LED provides level indication. In addition, the EFT-3000 has an AGC limiter which can be activated by moving a front panel switch.

An EFT-3000 system consists of two identical units. Transmit and Receive unit designations are made by entering a simple code on the built-in Touch-Tone key pad. The Transmit unit sends audio with a frequency response of 50 Hz to 7.5 kHz; the Receive unit sends return cue audio with a frequency response of 50 Hz to 2.5 kHz. Because the system is capable of sending cues back to the remote site, a fourth telephone line is not required unless you need continuous off air return audio.

Rack ears are provided with your EFT-3000, allowing you to mount the unit in a standard 19 inch equipment rack or road case.

The Gentner EFT-3000 provides you with these benefits:

- a) Frequency response of 50 Hz to 7.5 kHz using three standard telephone lines.
- b) Built-in return channel provides two-way communication for cueing personnel at the Transmit site.
- c) Built-in telephone couplers with auto-answer/auto-disconnect capability provide direct connection to the telephone lines.
- d) Advanced Digital Signal Processing (DSP) technology delivers the highest quality audio possible.
- e) Built-in Touch-Tone key pad and memory dialer eliminate the need for a separate telephone instrument and speed connect time.
- f) Ten second, one button set-up automatically equalizes each telephone line's frequency response; compensates for differential line delay; matches amplitude levels between lines.
- g) Digital noise reduction algorithm significantly reduces ambient line noise.
- h) Three line, two line, or single line operation.
- i) Two built in microphone/line level selectable inputs and headset amplifier. Phantom power for condenser microphones is internally selectable.

- j) User friendly and completely automatic set-up and operation. One person can initiate calls, set-up, and operate the EFT-3000 system without any assistance.

The EFT-3000's ease of use and capabilities make it suitable for use in the following applications:

- a) Broadcast remotes. The system provides an easy method to deliver high quality audio using standard, inexpensive dial-up telephone lines.
- b) Backup for a broadcast STL. The EFT-3000 can be used as an emergency backup for your studio to transmitter link, providing a monaural channel of 50 Hz to 7.5 kHz.
- c) Teleconferencing. The EFT-3000 provides maximum intelligibility and audio quality. Use for return audio in videoconferencing, or for high quality audio conferences.
- d) Recording studios. Use the EFT-3000 to lay down voice tracks with remote talent. Your sessions can be done in real time, without the expense of bringing the talent to the studio.

1.3 Brief Technical Description

An EFT-3000 system consists of two identical units. Either unit can be configured for operation at the Transmit or Receive site. Unit configuration is made by entering a simple programming code on the built-in Touch-Tone key pad on each unit. A unit set up for Transmit will send an audio channel of 50 Hz to 7.5 kHz, and will receive an audio channel of 50 Hz to 2.5 kHz. The Receive unit is a mirror image, receiving 50 Hz to 7.5 kHz, and sending 50 Hz to 2.5 kHz.

Note that the system provides two-way communication. This duplex audio path is very useful for rapid exchange of information, making program breaks smooth and eliminating the need for precise back-timing during breaks.

Three standard dial-up telephone lines can be connected to a unit with either the front or rear panel modular RJ-11C telephone jacks. A fourth jack is provided for connection of an attendant telephone set if desired. An external telephone instrument is not required in most cases, since the EFT-3000 includes its own Touch-Tone key pad and line monitoring through the headset amplifier. The only time an external telephone set is required is when Touch-Tone service is not available; in this situation, pulse dialing must be done with the set.

Telephone line connection is established pressing the DIAL and CONNECT buttons associated with each line. Dialing can be done with an external telephone set, with the built-in Touch-Tone pad, or with the unit's memory dialer.

Once the lines are established, the EFT-3000's automatic configuration sequence is initiated by pressing the SETUP button. This sequence takes approximately ten seconds to complete. The EFT-3000 measures the frequency response, level, and impedance characteristics of each telephone line and makes line assignments for the three frequency bands. The unit then automatically equalizes each of the three telephone lines, adjusts for differential time delays and matches amplitude levels between lines.

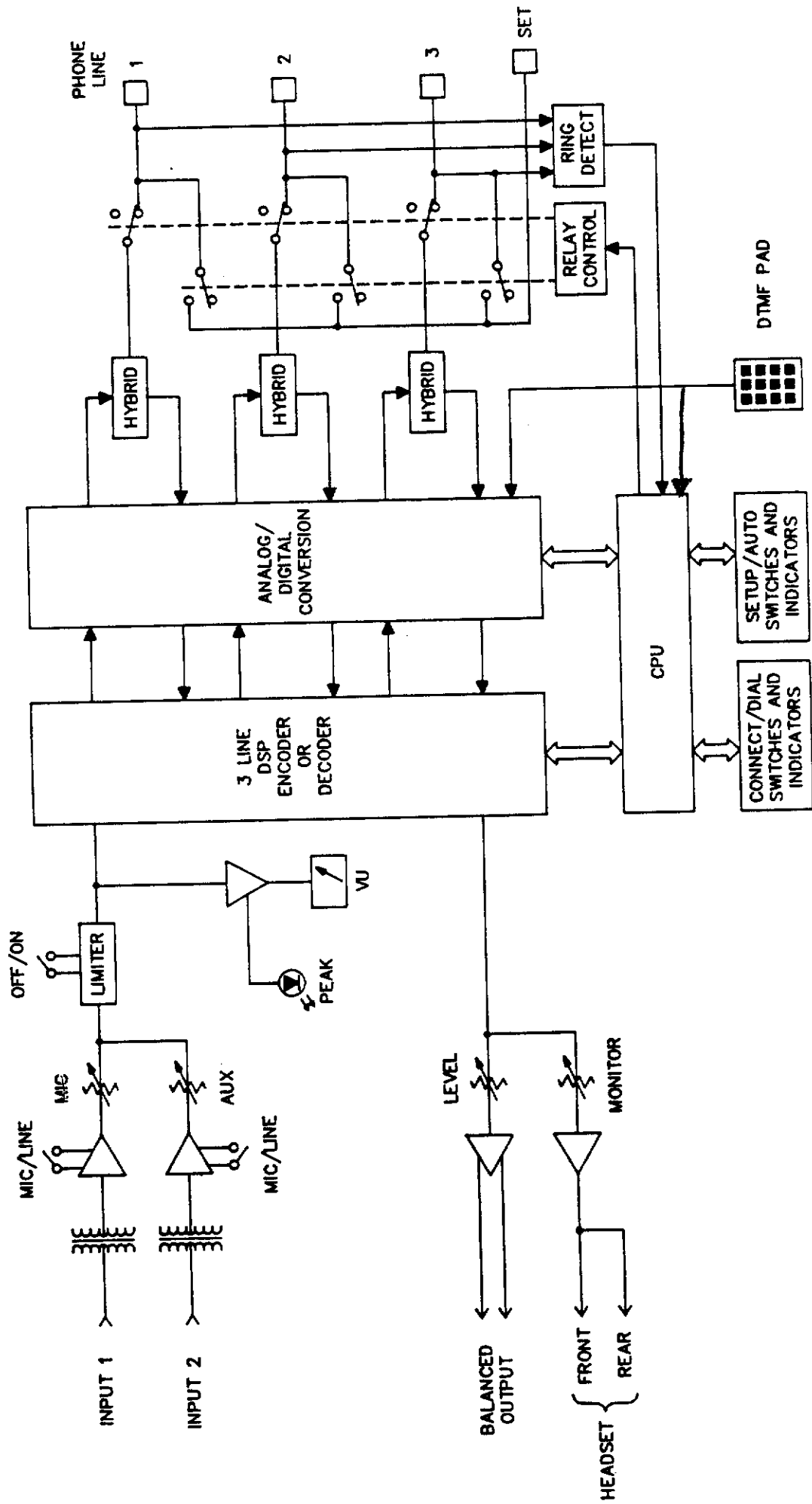
All processing of the audio signals is performed in the digital domain. The audio output of the Receive unit is automatically muted during the configuration process. The SETUP indicator light will flash until the configuration process is complete. After the configuration process is completed, the SETUP indicator will remain ON continuously.

As long as this LED is lit, the telephone lines are frozen in the EFT-3000. Lines cannot be manually disconnected until the SETUP switch is pressed for one second. This safety feature prevents accidental disconnection of lines.

High fidelity audio is derived from inexpensive standard telephone lines through the use of advanced Digital Signal Processing (DSP) technology.- Audio from the Transmit unit is digitized and numerically processed, then returned to three separate analog signals for transmission by the telephone company. Audio received over the three lines at the Receive unit is again digitized and numerically processed, then reassembled into the original analog frequency signal.

The EFT-3000 is equipped with XLR connectors for two microphone or line level inputs, an XLR connector for line level output, and phone jack outputs for two headsets.

A front panel VU meter and peak level indicator help you set proper input levels. A user-selectable audio processor (limiter) is also provided to protect the EFT-3000 and the telephone lines from being overdriven.



EFT-3000 BLOCK DIAGRAM

FIGURE 1

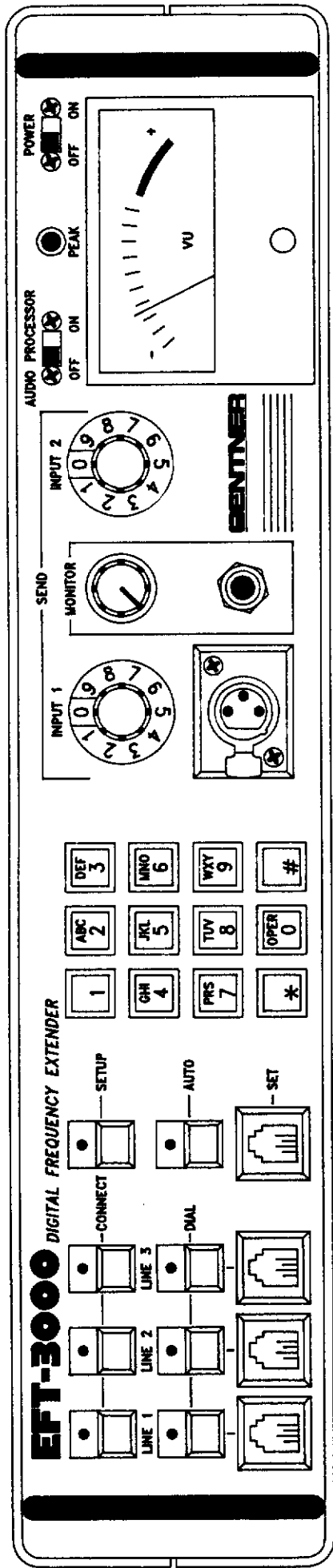
1.4 Physical Specifications

The EFT-3000 is enclosed in a rugged metal case, which may be mounted in a standard 19" equipment rack with the provided rack ears. The actual physical dimensions of the main system are:

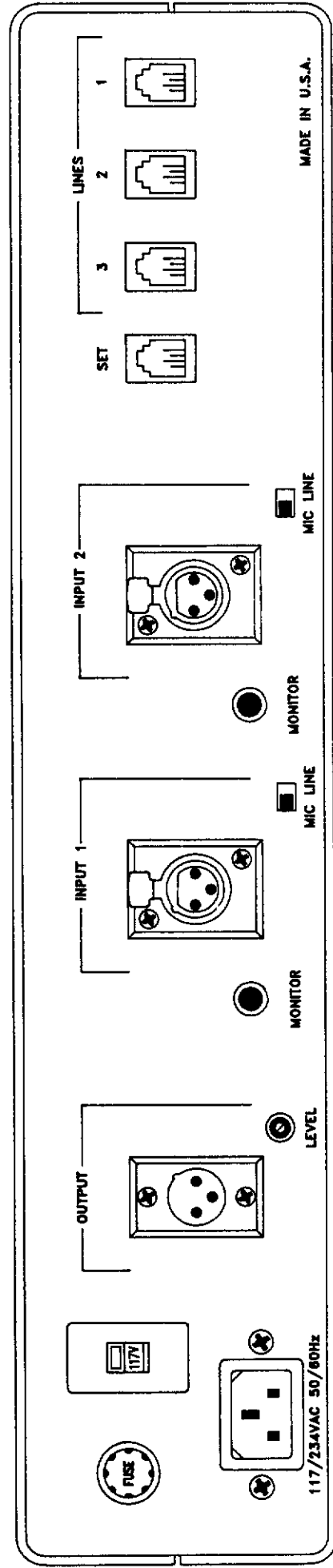
Height: 3.5"/ 8.9 cm
Width: 17.0"/43.2 cm
Depth: 10.0"/25.4 cm

Weight (dry): 10 lbs/4.53 kgs
Shipping weight: 13 lbs/5.9 kgs

The EFT-3000 uses XLR, 1/4" phone, and modular telephone jacks for all connections. Note that some connections are duplicated on the front and rear panel for your convenience.



FRONT PANEL



REAR PANEL

FIGURE 2

1.5 Electrical Specifications

- a. Power Requirements: 117/234 VAC; 60/50 Hz; 15 watts.
- b. Telephone Interface: Three internal hybrid couplers; 600 ohm nominal impedance; Transient voltage protection with intentional path to ground from Tip and Ring at +/- 230 volts; Ringing voltage detection >25 volts RMS, 15 to 90 Hz; Automatic answer (if enabled) after one complete ring; Automatic disconnect on interruption of loop current or reversal of loop current.
- c. Microphone Level Inputs: 1 K ohm nominal input impedance; Transformer balanced input; Two microphone level inputs provided.
- d. Line Level Inputs: >50 K ohm nominal bridging input impedance; Transformer balanced input; Two line level inputs provided.
- e. Audio Output: 600 ohm nominal output impedance; Actively balanced output; Output level user-adjustable from -15 to +10 dbm.
- f. Indicators: Input level indication by standard VU meter on front panel; Peak input level indicated by LED on front panel.
- g. Connectors: Telephone line and set connectors are female modular RJ11C; Inputs 1 and 2 are female XLR; Output connectors are male XLR; Headphone outputs are 1/4" phone jacks.
- h. Switches: Power, audio processor switches are two-position slide; All other switches are ITT Schadow with integral LED indicators.

- i. Processing: All digital signal processing is performed by proprietary architecture using a combination of two Motorola DSP56001 56-bit general purpose digital signal processors.
- j. Temperature Range: Gentner recommends the operation of the EFT-3000 in an environment of between +5 and +35 degrees Celsius.

SECTION TWO -- WARRANTY AND FIRMWARE LICENSE

2.1 EFT-3000 Firmware License

The EFT-3000 is a microprocessor based system. All firmware for the unit was developed by Gentner Electronics Corporation.

By purchasing the EFT-3000, you accept the terms of the Gentner Firmware License Agreement stated below. This License Agreement becomes effective as of the date of purchase of the EFT-3000.

GENTNER FIRMWARE LICENSE AGREEMENT

Gentner Electronics Corporation, (hereinafter referred to as Gentner), is the sole owner of the EFT-3000 firmware. The EFT-3000 firmware is defined as all software stored in the memory device supplied with this license. Gentner grants to the purchaser and/or the end-user of the Gentner EFT-3000 unit a non-exclusive license to use the firmware under the following terms and conditions.

This firmware is:

- a) For use on only the EFT-3000 which has been purchased and properly registered by serial number with Gentner.
- b) Not to be copied or duplicated in any way, and not to be transferred or delivered to any other person or entity without the written consent of Gentner.
- c) Protected by all applicable copyright and patent laws. Any copyrights and patents assigned to Gentner for the EFT-3000 remain the sole property of Gentner.

This license does not assign or transfer ownership of the firmware. Included in this license is all information contained in the instruction manuals, schematic diagrams, and related materials.

This license shall remain in effect for the life of your EFT-3000. You may terminate the license by returning the EFT-3000 to Gentner in its original container. This license is automatically terminated if you violate any of the terms and conditions of this license. Upon such termination, the EFT-3000 must be returned to Gentner.

This license agreement is granted solely to the original purchaser of the EFT-3000. If the EFT-3000, and thus the firmware and this license, is to be passed to another person or entity in any way, the original purchaser must advise Gentner in writing of this transfer. The new holder of the EFT-3000 must acknowledge in writing acceptance of the terms and conditions of this license. The license shall be deemed terminated if such written acceptance is not presented to Gentner.

2.2 Warranty Agreement

The Gentner Warranty Agreement on the following page is effective as of the date of receipt by the purchaser of the EFT-3000. This warranty shall not be effective unless Gentner is notified in writing by the purchaser of the receipt of the unit and the unit's serial number.

You have been supplied with a Gentner Warranty Registration Card. Use this card to notify Gentner of your purchase of the EFT-3000 and the serial number of your unit.

WARRANTY

GENTNER ELECTRONICS CORPORATION (Manufacturer) warrants that this product is free of defects in both materials and workmanship. Should any part of this equipment be defective, Manufacturer agrees, at its option, to:

A. Repair or replace any defective part free of charge (except transportation charges) for a period of 12 months from the date of the original purchase, provided the owner returns the equipment to Manufacturer at the address set forth below. No charge will be paid for parts or labor during this period.

B. Replace or furnish replacement for any defective parts in the equipment for a period of one year from the date of original purchase. Replacement parts shall be furnished without charge except labor and transportation.

This Warranty excludes assembled products not manufactured by Manufacturer whether or not they are incorporated in a Manufacturer product or sold under a Manufacturer part or model number.

THIS WARRANTY IS VOID IF:

A. The equipment has been damaged by negligence, accident, act-of-God or mishandling, or has not been operated in accordance with the procedures described in the operating and technical instructions; or,

B. The equipment has been altered or repaired by other than manufacturer or provided by authorized service representative of Manufacturer; or,

C. Adaptations or accessories other than those manufactured or provided by Manufacturer have been made or attached to the equipment which, in the determination of Manufacturer, shall have affected the performance, safety, or reliability of the equipment; or,

D. The equipment's original serial number has been modified or removed.

NO OTHER WARRANTY EXPRESS OR IMPLIED, INCLUDING WARRANTY OF MERCHANTABILITY OR FITNESS FOR ANY PARTICULAR USE, APPLIES TO THE EQUIPMENT, nor is any person or company authorized to assume any warranty for Manufacturer or any other liability in connection with the sale of Manufacturer products.

Manufacturer does not assume any responsibility for consequential damages, expenses or loss of revenue or property, inconvenience or interruption in operation experienced by the customer due to a malfunction in the purchased equipment. No warranty service performed on any product shall extend the applicable warranty period.

In case of unsatisfactory operation, the purchaser shall promptly notify Manufacturer at the address set forth below, in writing, giving full particulars as to the defects or unsatisfactory operation. Upon receipt of such notice, Manufacturer will give instructions respecting the shipment of the equipment, or such other matters as it elects to honor this warranty as above provided. This warranty does not cover damage to the equipment during shipping and Manufacturer assumes no responsibility for such damage. All shipping costs shall be paid by customer.

This warranty extends only to the original purchaser and is not assignable or transferable.

GENTNER
ELECTRONICS
CORPORATION

P.O. Box 27647
Salt Lake City, UT 84127-0647
(801) 975-7200
Facsimile: (801) 977-0087

2.3 Special Notices

The information contained in this manual is subject to change without notice. Gentner Electronics Corporation makes no warranty of any kind with regard to this material including, but not limited to, the implied warranties of merchantability and fitness for a particular purpose. Gentner Electronics Corporation shall not be liable for errors contained herein or for incidental or consequential damages in connection with the furnishing, performance, or use of this material.

The copyright on this manual is held solely by Gentner Electronics Corporation.

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2.4 EFT Product Line Updates

Gentner Electronics will offer, from time to time, new options and firmware updates for the EFT product line. As a registered owner of an EFT product, you will automatically be notified of updates when they become available.

You must return a completed Warranty Card in order to notified of updates to the EFT product line. (If the card is lost, you may notify us by letter. Your letter must include the following information: EFT-3000 serial number; your name; the name of your organization; your address; date of purchase; the name of the company from whom you purchased your EFT-3000.)

Mail your Warranty Registration Card to:

Gentner Electronics Corporation
P.O. Box 27647
Salt Lake City, Utah 84127-0647

SECTION THREE -- INSTALLATION AND BASIC SET-UP

3.1 Unpacking Your EFT-3000

An EFT-3000 system requires two identical units (one unit at each end of the telephone lines). If you only received one unit (either from a shipping or ordering error), contact your dealer or Gentner for assistance.

Each EFT-3000 unit is packed and shipped in a separate carton, with the items noted in the first section of this manual.

Carefully unpack your shipment and check for any damage. Also be sure that all the parts listed in Section 1.1 of this manual are included in your package.

If you notice any damage to the unit, notify your shipping carrier immediately. Be sure to retain the original boxes and packing material for inspection by the carrier. Gentner is not responsible for shipping damage. You must make claims directly with the carrier.

3.2 Mounting Your EFT-3000

If desired, you can mount the EFT-3000 in a standard 19" equipment rack using the rack ears provided with your unit.

To install the rack ears for the EFT-3000, use the Hex Key provided with the unit to remove the four front chassis hex screws. Install the two rack ears on the side of the EFT-3000 using the four 3/32" X 1/2" Phillips screws included with your unit.

The EFT-3000 does not require an internal cooling fan. As long as the unit receives adequate ventilation, it will operate normally.

Be careful not to block any of the ventilation holes in the unit's chassis. Always be sure that a free flow of air gets to the unit while it is operating.

You can also mount the EFT-3000 in a road case, making it easy to transport and protecting it from the elements and other environmental hazards.

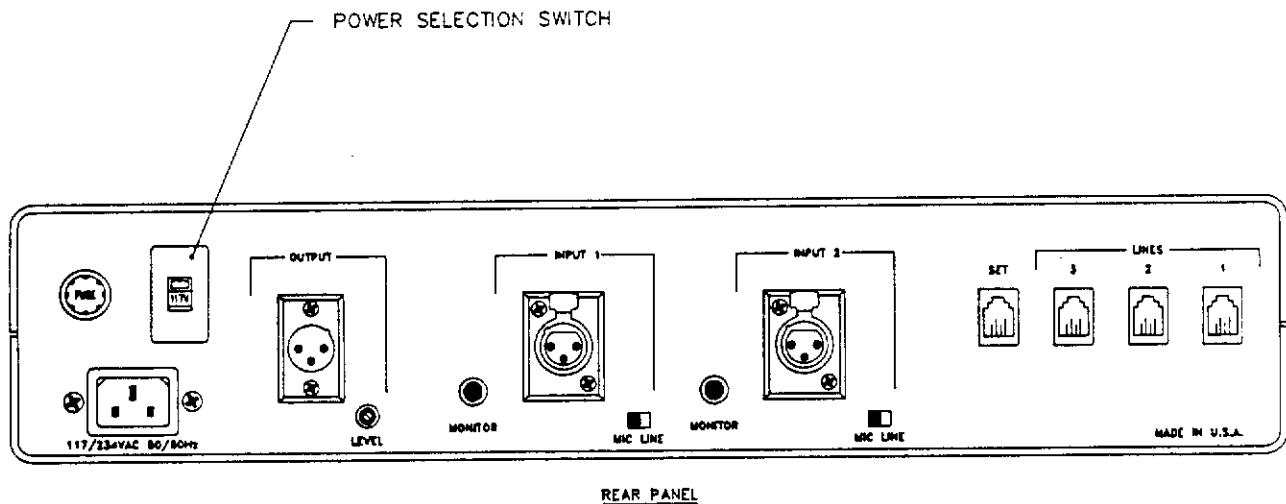
If you install your EFT-3000 in a road case, you should mount a cooling fan in the road case to insure that your EFT-3000 receives adequate ventilation.

3.3 Setting Up the AC Power Input

Your EFT-3000 was shipped to you ready to use with a 117 VAC/60 Hz power source (unless otherwise marked.) You can easily alter the AC power input to accept a 234 VAC/50 Hz power input.

To change the EFT-3000 to 234 VAC/50 Hz operation, push the red slide switch on the rear panel to the 234 V position. This slide switch is located next to the AC power cord receptacle for the unit.

NOTE: Always be sure that the EFT-3000 is configured for the correct power source prior to operation.



3.4 Toggling Between the Transmit and Receive Modes

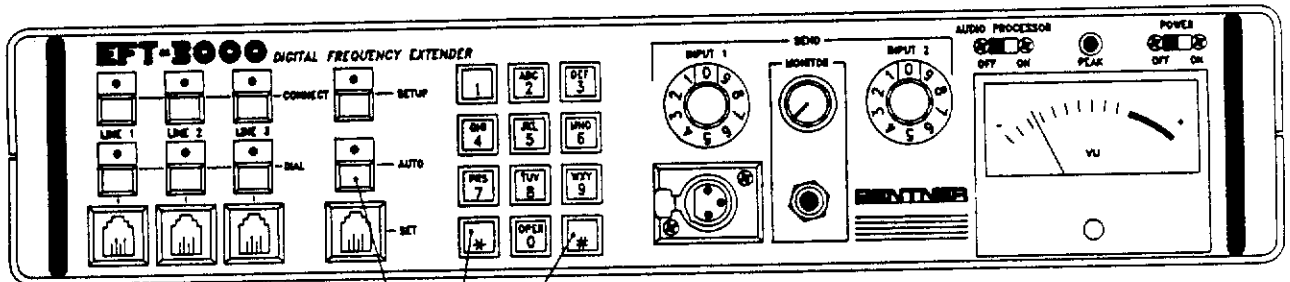
All EFT-3000's are identical, and are capable of operation either as a Transmit or Receive unit.

This feature provides you with great flexibility. For instance, you can use a unit to receive a remote broadcast feed in the morning, and use the same unit to transmit a feed to another site in the afternoon.

To toggle the EFT-3000 between the Transmit and the Receive modes, first make certain the SETUP button's LED is OFF. Then simultaneously depress the * and # keys (on the Touch-Tone pad), and the AUTO button.

When a unit is configured for Transmit, the AUTO button remains lit continuously (when the unit is in the AUTO mode.)

In the Receive mode, the AUTO button flashes rapidly (when the unit is in the AUTO mode.)



FRONT PANEL

PRESS THESE 3 BUTTONS SIMULTANEOUSLY TO TOGGLE BETWEEN TRANSMIT AND RECEIVE MODES.

3.5 Connecting an EFT-3000 to the Telephone Lines

The EFT-3000 is designed to work using three standard dial-up telephone lines (it can also work with dedicated loops and other lines; see Section 3.6 for more information). The EFT-3000 is provided with standard RJ11C modular connectors. Your telephone lines must be available with this standard connector. If your telephone lines are not available with modular connectors, you must purchase an appropriate adapter.

The three telephone lines can be connected to either the front or rear panel modular jacks. The front and rear panel jacks are paralleled to each other. It is recommended that you use either the front panel set of jacks or the rear panel set of jacks, but not a mixture of both. This will help prevent the connection of two telephone lines to the same telephone line input on the EFT-3000.

Note that a fourth modular jack is also provided, both on the rear and front panels. This jack, labeled SET, allows you to connect a telephone set to the EFT-3000. You can use this external telephone instrument to initiate or answer regular telephone calls when the EFT-3000 system is not in use.

You do not normally need to connect an attendant telephone set to the EFT-3000; the unit's built in Touch-Tone pad and monitor can be used instead. However, if your telephone system requires pulse dialing, calls will need to be made with an attendant telephone set. See the Section Four for details on pulse/tone dialing.

3.6 Changing Telephone Line Gain Structure

Your EFT-3000 arrived from the factory configured for a 20dB gain on each of the telephone lines. This is the normal gain structure required to bring a standard dial-up telephone signal to line level.

If you will be using your EFT-3000 with non-standard telephone lines, such as cellular telephones or dedicated loops from the telephone company, the internal gain structure may need to be changed to avoid distortion caused by higher signal levels.

The gain jumpers for all three telephone lines are located on the bottom circuit board (Interface Assembly). It is not necessary to remove the top boards in order to access the jumpers. To change the gain structure, move the jumpers to the desired positions as indicated below:

Gain	LINE 1	LINE 2	LINE 3
0 dB	JP5	JP4	JP1
10 dB	JP7	JP6	JP2
20 dB	JP9*	JP8*	JP3*

* Factory setting

3.7 Using Condenser Microphones With the EFT-3000

The EFT-3000 is capable of providing +30 volts phantom power for condenser microphones. To enable this function, it will be necessary to remove the top circuit boards so that you can access a jumper on the bottom circuit board of the unit.

Phantom power will only be supplied when the MIC/LINE input selector switch is set at MIC level.

The EFT-3000 is delivered from the factory with the phantom power NOT enabled.

Please contact Gentner's Customer Support department at (801) 975-7200 for details on accessing the power jumper.

Further information on this jumper can be found in Section 7.5, Interface Board Theory of Operation.

SECTION FOUR -- BASIC OPERATION

4.1 Manually Establishing a Telephone Connection with the EFT-3000

Before you begin, make certain that the EFT-3000 units at both the Transmit and Receive locations are:

- a) connected to AC power, and
- b) connected to three telephone lines.

Dialing out can be initiated from either the Transmit or Receive unit. Connect a headphone to the MONITOR jack on the EFT-3000 you will use to initiate the telephone calls.

When manually dialing calls, (that is, when you are not using the memory dialer), the AUTO button's LED indicator must be OFF. If the indicator is ON, simply press the AUTO button once to toggle it to the off mode.

To use the EFT-3000's built-in Touch-Tone keypad, press the DIAL button, then the CONNECT button (both are located on the front panel of the unit) for the line you wish to use. You will hear a dial tone in your headset.

Dial the desired number (the telephone number for a line connected to the matching EFT-3000 unit). You will hear the Touch-Tones in the headphones.

If you are using an attendant telephone set for dialing (for example, you need to use pulse dialing), press the DIAL button only. Place the call using the telephone set; once the line starts ringing, press the CONNECT button.

Only one telephone line at a time can be dialed; however, you do not have to wait for the line to be answered to start dialing the next line. As soon as the line starts ringing, you can move to the next desired line for dialing out.

At the other EFT-3000 unit, ringing lines are indicated by flashing LED's in the CONNECT buttons. The ringing lines can be answered by pressing the flashing CONNECT buttons. (If you want the EFT-3000 to automatically answer the lines, place it in the AUTO mode by depressing the AUTO button once.) See Section Five for more details on the AUTO mode.

4.2 Setting Up the EFT-3000 for Extended Audio Transmission and Reception

Once a telephone connection has been established for all three telephone lines, press the SETUP button. This instructs the EFT-3000 units to configure the telephone lines properly and begin sending and receiving frequency extended audio.

The set-up process is automatic, and takes about ten seconds to complete. You can press the SETUP button on either the Transmit or Receive unit to start this process.

During the set-up process, the SETUP button LED indicator will flash rapidly. When the set-up process is complete, this LED will remain lit continuously. The audio output of the EFT-3000 Receive unit will be automatically muted during the set-up process.

Note: Any time the SETUP button is illuminated, the EFT-3000 freezes the number of lines in use. It is not possible to manually disconnect lines, to add lines or to toggle in or out of AUTO mode when the SETUP button's LED is lit.

If the EFT-3000 cannot successfully set up the telephone lines, the SETUP button LED will go OFF. You can try to set up the lines again by re-depressing the SETUP button. However, it may be necessary to re-dial the telephone lines.

If you lose a telephone line while you are using the EFT-3000 system, you can press the SETUP button again and the system will re-configure itself (for operation with a reduced bandwidth) according to the number of remaining telephone lines connected to it.

If you are only using one or two telephone lines, and wish to add another line while you are using the EFT-3000 system, you must press the SETUP button. The SETUP button LED indicator will go OFF. You may now establish a telephone connection for the new line(s) you wish to add. (See Section 4.1.) Once you have established the telephone connections, you must press the SETUP button again to configure the lines.

4.3 Breaking the Connection

If you wish to manually disconnect a telephone line, you must first take the EFT-3000 out of SETUP. This is done by pressing the SETUP button for more than one second. The SETUP indicator should now be off.

To disconnect a telephone line, press the corresponding CONNECT button and hold it down for more than one second. When the connection is broken, the CONNECT button's LED will go OFF.

NOTE: If the other EFT-3000 is operating in the AUTO mode, it will automatically disconnect the corresponding line on sensing the loss or reversal of loop current. If the unit is NOT in the AUTO mode, it will NOT disconnect.

If the EFT-3000 is in the AUTO mode and it detects that a connection has been broken (either by the telephone company or by the user), it will begin the set-up process for the remaining lines automatically. This procedure is identical to the initial set-up procedure described above.

If you are not using the AUTO mode, and you wish to re-configure the system for operation with a reduced bandwidth, BOTH UNITS must be taken out of SETUP. This requires having someone push the SETUP button for more than one second at both locations.

NOTE: You can manually take a remote unit out of SETUP by disconnecting all telephone lines, then starting over. Once both units are unfrozen, SETUP can be re-initiated.

Remember that breaking a single line during operation could have undesirable effects. For example, dropping out the middle line would cause the 2.5 to 5.0 KHz frequency components to drop out of the output from the EFT-3000 Receive unit.

In general, you should not break line connections until after you are finished using the EFT-3000 system.

4.4 What To Do If You Lose a Telephone Line

If you lose a telephone line while you are using the EFT-3000 system, the CONNECT button LED indicator for the line that is lost and the SETUP button LED indicator will go OFF.

If the EFT-3000 is in the AUTO mode and it detects that a connection has been broken (either by the telephone company or by the user), it will begin the set-up process for the remaining lines automatically. This procedure is identical to the initial set-up procedure described in Section 4.2.

If the EFT-3000 is not in the AUTO mode, you must press the SETUP button again (from either location) to initiate the set-up process. When the set-up process is complete, the SETUP button LED indicator lamp will be ON.

4.5 Using the EFT-3000 as a Two Line Frequency Extender

You can use the EFT-3000 system as a two line frequency extender. In the two line mode, the system will provide a frequency response of 50 Hz to 5 kHz.

To use the EFT-3000 system in the two line mode, simply establish only two telephone connections between the EFT-3000 Transmit and Receive units. The EFT-3000 system will automatically configure itself as a two line, 5 kHz system when you press the SETUP button.

NOTE: The EFT-3000 is not compatible with any other telephone frequency extension system when used in the two line mode. You must use an EFT-3000 unit on both ends of your telephone connections.

4.6 Using the EFT-3000 as a Single Line Frequency Extender

You can use the EFT-3000 system as a single line frequency extender. In the single line mode, the system will provide a frequency response of 50 Hz to 2.5 kHz.

To use the EFT-3000 system in the single line mode, simply establish only one telephone connection between the EFT-3000 Transmit and Receive units. The EFT-3000 system will automatically configure itself as a single line, 2.5 kHz system when you press the SETUP button.

NOTE: The EFT-3000 is not compatible with any other frequency extension system when used in the single line mode. You must use an EFT-3000 unit on both ends of your telephone connection.

4.7 Feeding Audio Signals into the EFT-3000

The EFT-3000 contains a two channel mixer with microphone or line level inputs. Mix pots for each channel are located on the front panel of the EFT-3000.

The input channels are labeled INPUT 1 and INPUT 2. Both connectors are XLRs, appearing on the rear panel; the connector for INPUT 1 is duplicated on the front panel of the unit. Be sure to use only one of the connectors for INPUT 1 at a time.

To select an input for microphone or line level, use the small two position slide switch located next to the input connectors on the rear panel of the unit.

Use the VU meter and the INPUT 1 mixer pot on the front panel of the EFT-3000 to adjust the level of your input.

Be sure to not overdrive the EFT-3000 inputs. Watch the VU meters and be sure that the level indicator does not go into the red area of the meter. The LED indicator marked PEAK should only flash occasionally.

NOTE: Inputs to an EFT-3000 which has been programmed as a Transmit unit allow a wideband audio input, with a frequency response of 50 Hz to 7.5 kHz, to be sent to a Receive EFT-3000.

Inputs to an EFT-3000 which has been programmed as a Receive unit provide for a narrow band audio input. This narrow band input may be used as a return cueing channel.

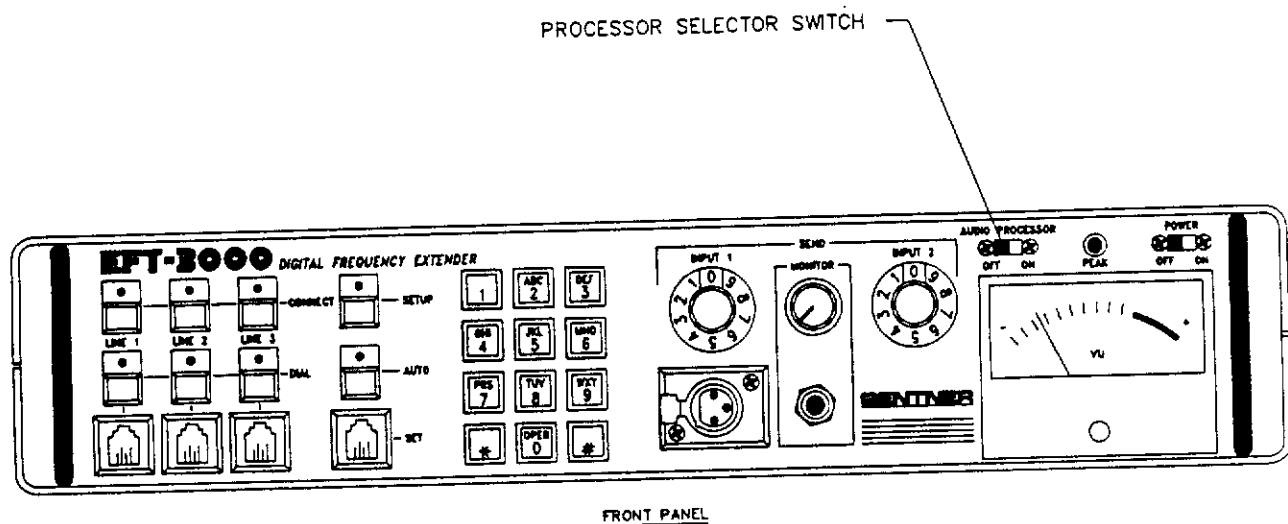
4.8 Using the Built-In Audio Processor

The EFT-3000 has an built-in audio processor (limiter) which will help prevent distortion due to overdriven telephone lines. The audio processor acts on both input channels to the EFT-3000.

To activate the audio processor, move the small slide switch above the VU meter (marked AUDIO PROCESSOR) to the ON position.

In this mode, the function of the PEAK LED indicator changes to show when the limiter is actively compressing audio.

Before activating the audio processor, be sure that you are not overdriving either EFT-3000 input. You should not depend on the limiter to prevent distortion. Your audio feed will always sound better if you feed the EFT-3000 with a clean, strong signal that does not overdrive the inputs. The limiter will help prevent distortion from unexpected audio peaks.



4.9 Taking an Audio Output from the EFT-3000

The EFT-3000 has one audio output connector located on the rear panel of the unit. This XLR connector is labeled OUTPUT.

To take an audio output from the EFT-3000, simply plug a cable from your console or audio amplifier into the OUTPUT jack. You can adjust the output level with the small screwdriver trimmer labeled LEVEL, which is located next to the OUTPUT connector on the rear panel of the unit.

NOTE: The Output for an EFT-3000 which has been programmed as a Receive unit provides a wideband audio output, with a frequency response of 50 Hz to 7.5 kHz.

The Output for an EFT-3000 which has been programmed as a Transmit unit provides a narrow band audio input as a return cueing channel.

4.10 Using Headphones with the EFT-3000

To use a headset with the EFT-3000, plug your headset into one of the jacks marked MONITOR. The EFT-3000 has three MONITOR jacks. Two are located on the rear panel of the unit. One MONITOR jack is located on the front panel of the unit. Headsets can be connected to all three MONITOR jacks at the same time.

Headset level is adjusted the pot labeled MONITOR. This pot is located on the front panel of the EFT-3000.

The MONITOR output for an EFT-3000 which has been programmed as a Receive unit provides a wideband audio signal, with a frequency response of 50 Hz to 7.5 kHz.

The MONITOR output for an EFT-3000 which has been programmed as a Transmit unit provides a narrow band audio signal, with a frequency response of 50 Hz to 2.5 kHz. This signal contains return (cue) audio from the Receive unit.

You can mix a portion of your audio input into the MONITOR output. (This is often referred to as Side Tone.) To increase the level of Side Tone, press the star (*) button on the EFT-3000's Touch-Tone pad until the desired level is reached. To decrease the level of Side Tone, press the pound (#) button on the Touch-Tone pad.

4.11 Sending Cues with the EFT-3000

The EFT-3000 Transmit unit will send specially encoded audio over three standard dial-up telephone lines. The EFT-3000 Receive unit will receive the signals sent over the telephone lines and re-assemble them into a single audio feed with a frequency bandwidth of 50 Hz to 7.5 kHz.

The EFT-3000 system will allow you to send audio cues from the EFT-3000 Receive unit to the EFT-3000 Transmit unit. These cues will be received over the low band of the frequency extended telephone lines, and will therefore have a frequency bandwidth of 50 Hz to 2.5 kHz.

To send audio cues from the Receive unit to the Transmit unit, connect the desired audio source (usually a mix-minus input) to one of the input channels on the Receive unit.

NOTE: Any audio sent from the Receive unit to the Transmit unit will be mixed with your main send audio, since it is sharing a telephone line with the program material. Therefore, cue audio should only be sent during program breaks.

SECTION FIVE -- ADVANCED SET-UP TECHNIQUES

5.1 Programming the Memory Dialer

You can program up to nine telephone numbers in the EFT-3000's built-in Memory Dialer. This will allow you to establish the three telephone lines required for 7.5 kHz operation very quickly.

Each of the Memory Dial numbers can consist of up to 24 digits.

Before entering a telephone number in a Memory Dialer location, make sure that the AUTO button's LED indicator is OFF. If the indicator is ON, press the AUTO button once to turn the LED indicator OFF.

To program a Memory Dial number, do the following:

- a) Press the pound (#) button on the EFT-3000's built-in Touch-Tone pad TWICE, followed by a single digit location number (1 through 9).
- b) Enter the telephone number you want to store.

You can enter a star (*) at any time while you are entering your telephone number. The star (*) entry will cause the EFT-3000 to pause for one second when it dials the telephone number. This is useful for some PBX telephone systems or long distance calling services which require pauses.

- c) Press the pound (#) button again. This ends the programming sequence.

NOTE: If you want to hear the touch-tones as you are programming, press a DIAL button first (do NOT press CONNECT). This will enable you to listen to the tones with a headset.

Repeat this programming procedure for additional Memory Dial numbers.

NOTE: Memory Dial numbers may NOT be entered via an external telephone set plugged into the SET jack. You must use the EFT-3000's built-in Touch-Tone pad.

Memory Dial numbers are stored in a special battery backed-up RAM, which allows the EFT-3000 to store these numbers even when AC power is removed from the unit. The battery in this circuit should last for ten years without replacement.

5.2 Using the Memory Dialer

To use the built-in Memory Dialer, you must first program the desired Memory Dial numbers into the EFT-3000. (See Section 5.1.)

The EFT-3000 must be in the AUTO mode to use Memory Dialing. If the AUTO LED is not lit, press the AUTO button once.

To dial out, do the following:

- a) Press the DIAL button for the desired telephone line. The CONNECT button will light as well.
- b) Press the pound button (#), followed by the location number for the desired telephone number. For example, entering "# 3" will select Memory Dial location 3).

The EFT-3000 will dial the selected telephone number. As soon as the line starts ringing, you can select the next line for dialing. This allows you to set up all three lines for 7.5 kHz operation very quickly.

NOTE: For fully automatic operation, both EFT-3000 units must be in the AUTO mode. See Section 5.3.

5.3 Using the AUTO Mode

The AUTO mode streamlines the operation of the EFT-3000. When enabled, the unit will automatically answer a ringing line, and will automatically disconnect a line when it detects loss or reversal of loop current.

This feature is especially useful for remote broadcasts where the Receive, or Studio, unit might be unattended during set-up of the remote. The operator can simply activate the Receive unit's AUTO button; then when the Transmit unit calls in, the Receive unit will automatically answer the lines.

In addition, the AUTO mode permits the use of the Memory Dialer for fast outbound dialing. See Sections 5.1 and 5.2 for programming and use of the Memory Dialer.

If any of the telephone lines are disconnected while the EFT-3000 system is in the AUTO mode, the system will automatically begin the set-up process again.

SECTION SIX -- TYPICAL APPLICATIONS

6.1 Typical Broadcast Application

The EFT-3000 provides high fidelity audio transmission and reception for any remote broadcast where standard telephone lines are available. It is quick to set up and easy to do great sounding remotes from retail stores, shopping malls, fairs and special events, grand openings, and sports play-by-play. You can even use the EFT-3000 for music remotes.

Simply connect three standard telephone lines for 7.5kHz frequency response or two standard telephone lines for 5kHz. The EFT-3000 can also be used for single line frequency extended remotes. There are two input channels available; just plug your microphone(s) directly into the EFT-3000. If you want to use more than two microphones, connect a multi-channel mixer like the Gentner Combination Remote Mixer.

Set-up and operation are simple. One person can set-up and operate the EFT-3000. Simply dial the telephone numbers, then push the SETUP button. The EFT-3000 takes care of the rest. The Receive unit can be configured to automatically answer and go through the set-up routine with the Transmit unit (by using the AUTO mode.) Refer to Figure 3.

Typical Broadcast Application
Figure 3

6.2 Typical Teleconferencing Application

The EFT-3000 can provide highly intelligible, quality audio for conferencing applications. The EFT-3000 is typically used for one-way audio feeds, such as return audio from a one-way videoconference, or audio fed independently of video to another site.

If full fidelity, duplex audio is required at both sites, two EFT-3000 systems, and six telephone lines, are used. This configuration provides 7.5 kHz of bandwidth response at each site. Participants get the benefit of clear, understandable audio, free of line hiss or hum. Because the strain of listening to unnatural bandwidth limited audio is eliminated, attention spans are increased and listener fatigue is greatly reduced.

Since this system provides a full duplex audio path, the installer of the system must be careful to treat each conference room to avoid acoustic echo (speaker audio being picked up by microphones and re-transmitted on the telephone lines).

6.3 Typical Recording Studio Application.

The EFT-3000 can solve annoying problems caused by trying to interface with distant talent. Since the EFT-3000 lets you send 7.5 kHz audio over standard telephone lines, your talent can work in a studio across town or across the country.

You can cut voice tracks in real time over the telephone, with good quality results.

The EFT-3000 can pay for itself quickly. You will reduce your freight and travel expenses. Most importantly, you will have instant access to a wider variety of talent and will be able to complete your production projects faster.

SECTION SEVEN -- THEORY OF OPERATION

7.1 Digital Signal Processing

The EFT-3000 performs 100% of its signal processing tasks in the digital domain. This process is possible through the use of a special application specific microprocessor called a "Digital Signal Processor" or DSP. The EFT-3000 uses two very powerful DSP's manufactured by Motorola Semiconductor. These two DSP's, along with a Motorola micro-controller, provide an architecture capable of executing 20 million instructions per second (MIPS).

First, wideband (50-7500 Hz) audio applied to the EFT-3000 system for transmission is digitized. Through a binary mathematical process, it is then separated into three bands: low, mid, and high. These bands are frequency shifted to fit the narrow pass bands of three standard dial telephone lines. Lows are shifted up in frequency while the mids and highs are shifted down.

Each telephone line carries approximately 2500 Hz of intelligence in its 300 to 3300 Hz pass band (3000 Hz of response). The full pass band is not utilized because the typical telephone pass band presents its worst envelope delay distortion (group delay) at or near the band edges. Under ideal conditions the frequency response could theoretically be extended to about 9 KHz. On most program sources, this quarter octave of additional response would barely be perceptible, but the audible effects of the increased envelope delay distortion would be very apparent.

At the EFT-3000 Receive unit, the reverse process takes place. Audio on the three incoming lines is digitized, time corrected to compensate for differing telephone company transmission delays, frequency shifted, equalized, and reassembled into the original 50 to 7500 Hz spectrum. This wideband audio is then converted back into an analog signal and made available at an XLR connector on the rear panel.

All digital signal processing and control software is contained in one 27C256 EPROM. This allows the user to take advantage of future software revisions and upgrades when they become available. Software driven products allow for the highest degree of user flexibility.

An EFT-3000 system consists of two identical pieces of hardware. The user, via a few key strokes, programs

the unit to be either a Transmit unit or a Receive unit. This allows a station to receive audio from a remote site in the morning and then transmit an afternoon network news feed using the same piece of equipment.

7.2 System Architecture

The EFT-3000 assembly consists of seven printed circuit boards. Four of these boards simply provide connection for front panel controls and switches, the majority of the circuitry being found on the three largest boards. These three boards are as follows:

- a) Processor board. This contains all of the digital signal processing, controller circuitry and memory. DSP's process the digital audio and the controller handles all operating logic functions, including auto answer, auto disconnect, auto and manual dialing, and other functions.
- b) Telephone Coupler and Filter Board. This board contains the coupling circuitry and relays necessary for connection to standard dial telephone lines. It provides for the detection of ringing voltage and line supervisory current. This board also contains two eight pole anti-alias filters for the wideband analog audio.
- c) Interface Board. The analog microphone mixer, audio processor, and headset amplifier circuitry are on this board along with four analog to digital (A/D) and four digital to analog (D/A) converters and their associated switch capacitor anti-alias filters. This board also contains the power supply voltage regulators and circuitry that provides the following voltages: +5 CPU, +5 Interface Logic, +/- 15V analog, +/- 5V analog, and +30 volts provided as phantom power for use with condenser microphones.

In addition to the above boards, chassis wiring provides connection to a toroidal power transformer. Toroidal power transformers provide a high power to size ratio and they radiate far less hum that could be coupled into the internal microphone transformers. The transformer has dual primaries providing for 117 or 234 Volt, 50 - 60 Hz operation, switch selectable on the rear panel.

7.3 Processor Board Theory of Operation

Please refer to the Processor Board Schematic found in Section 8.4 for the following discussion.

J1 (on Sheet 1) connects the processor board to 5 volt power from the regulator circuit on the interface board. Diode D1 protects the processor board from reverse polarity that would damage several hundreds of dollars worth of I.C.'s.

All processor clock and timing signals are derived from Y1, a 20.48 Mhz crystal. The crystal is connected to the oscillator circuit in the DSP at U11. The oscillator is buffered by a series of nand gates at U22. U22 pin 8 feeds the 20.48 Mhz clock to DSP 2, while U22 pin 6 applies clock to the synchronous divider chain comprised of U23 and U21. The 20.48 Mhz clock signal is divided by two, several consecutive times, to produce several different clock signals for the processor and digital conversion circuitry. A 5.12 Mhz clock from U23 pin 1 provides the master clock for the A/D converters. The 2.56 Mhz clock at pin 2 provides the master clock for the MC146805 micro-controller.

Several of the repetitively divided clocks are applied to U20, a Programmable Logic Device (PLD). This I.C. has been programmed at the factory and takes the place of several individual logic gates and flip-flops. PLD-1 (U20) is used to generate several special timing waveforms required by the 16 Bit A/D converters on the Interface Board. These signals are connected to the Interface Board via J2. A combined serial data stream from all four A/D converters is present at J2 pin 2. This data stream is applied to both DSP's (U11 and U15) at pins J12.

Pins on the right hand side of U11 implement a 16 bit address bus (1A(0) through 1A(15)), a 24 bit data bus (1D(0) through 1D(23)), and five bits of control (/1DS, /1RD, /1WR, 1X/Y, and /1PS). U15 on Sheet 2 is connected in a similar manner, but with separate address and data buses (designated 2A(0) etc.).

PLD-2 at U24 has been factory programmed to generate a series of waveforms from the divided clock signals that provide for the proper timing and operation of 4 D/A converters on the Interface Board. These signals are connected to the Interface Board via J2.

PLD 3 and PLD 4 (U1 and U5 respectively) have been factory programmed to properly decode the address buses of both DSP's and provide the correct chip enable signals to the series of RAM I.C.'s.

Sheet 3 shows a special RAM circuit that allows the two DSP's to communicate with each other. This circuit is implemented with Dual Port RAM chips. Note that the left hand side of the three I.C.'s connect to DSP 1 address and data buses, while the right hand sides connect to DSP 2. This RAM consists of 2048 locations that have access from either side. This circuit would be analogous to the old system of sorting mail. One person would sort the mail into pigeon holes from one side while a postman standing on the other side would stack his route. This system provides for very fast transfers of large blocks of data between the two DSP's. Each chip handles an 8 bit byte for a total of a 24 bit word per location transfer.

24 bit data processing RAM is shown on Sheet 4. Three chips make up 24 bit words in an X and Y format for each DSP. U2, U3, and U4 connect to DSP 1. U18, U6, and U16 tie to DSP2.

Sheet 5 shows six additional RAM chips. These devices have been arranged differently than Sheet 4, providing three banks of 16 bit time buffering RAM. All six devices are connected to DSP 2, which provide the time equalizing algorithm.

A Motorola MC146805 micro-controller at U29 (Sheet 6) provides all of the simple sequential logic functions such as auto dialing, telephone line control, etc. U31, a factory programmed PLD, decodes the address bus of the controller and provides chip select signals to the controller's peripherals. U30 provides an 8 bit parallel port for controller communications with the two DSP's. Reset and watchdog functions are derived from U28. J3 pins 1 through 12, 19, and 20, allow for the connection of the front panel touch tone pad to the controller.

Sheet 7 shows the connections to U26, a general purpose parallel interface. J4 pins 1 through 8 provide connection for the front panel DIAL, CONNECT, SETUP, and AUTO buttons. Pins 9 through 16 provide output for the LED indicators in these buttons. U27 is a buffer that can provide the proper sinking current for the LED indicators.

Telephone loop current and ringing sense signals for the three telephone lines and the local Set jack are scanned by the controller at J2 pins 24 through 27. Control of the telephone line switching relays is provided by U25 through J2 pins 28 to 35.

U33 is a 2K battery backed up RAM chip. This RAM chip allows the controller to remember its pre-programmed speed dial numbers after the power has been turned off. This memory also allows the unit to recover from a brief power interruption without dropping the connected telephone line or forgetting the configuration that it was in prior to the failure. This adds an added factor of reliability to remote broadcasting. The memory, battery, and its switching circuit are all sealed in one package by the manufacturer and has a battery life of 10 years.

The firmware program for the EFT-3000 is contained in the 27C256 EPROM at U32. This device has been mounted in a high quality gold machined pin socket for reliability and serviceability. As new product ideas or features are implemented at the factory, older units already in the field can be upgraded to the new features by simply changing U32. Please take the time to send in your warranty card so that we can keep you informed of new features when they become available.

7.4 Telephone Coupler and Filter Board

Refer to the four page schematic of the Telephone Coupler and Filter Board found in Section 8.4 for the following discussion.

The EFT-3000 Telephone Coupler and Filter Board contains three identical telephone line coupling circuits. Because of this redundancy, only one circuit will be described. Telephone line number one is connected to the rear panel of the unit via connector J1 pins 3 and 4. These connections are wired in parallel with J5 pins 2 and 3. The connections at J5 are routed via internal cabling to the modular connector for line one on the front panel. This redundancy in jacks allows for flexibility in connecting to the phone lines.

Telephone line TIP is connected to R1, RING to R2. R1, R2, R7, and R9 are series fusing resistors. When they are used in conjunction with shunt elements GT1, GT2, TZ1, and TZ2, they form a surge suppression network that provides an intentional path to protective ground at plus or minus 220 volts. This circuit is to protect the internal components from damage resulting from a lightning strike or large voltage surge on the telephone line. After the suppression network, TIP and RING are applied to switching relays K3 and K7.

All relays used in the Telephone Coupler circuit are dual coil, magnetic latching. When the SET coil is energized momentarily, the relay closes. When the Reset coil is momentarily energized, the relay opens. This configuration allows for momentary power interruptions without disconnection from the telephone line. A micro-controller driver matrix on the Interface Board, along with steering diodes CR5, CR6, CR7, and CR8 determine which relay coils will be activated.

The coils of relays K2 and K7 have been wired in parallel. When the micro-controller activates the SET coils, the telephone line is connected through K7 to the primary of Hybrid Transformer T1. K2 closes, providing a short between pins 2 and 5 of both the front and rear panel line one modular connectors. This closure provides for supervision of the A-LEAD used on some Key Service and PABX systems. The bridge rectifier at DB2 corrects the line polarity if needed and then directs a portion of the telephone loop current through clamp diodes CR9, CR10, CR11, and CR12, and to an LED inside of U1. U1 optically isolates the micro-controller from the relatively hazardous voltages on the telephone line. When this LED is lit, pin 4 of U1 will be at a logic 0 or low. This signal indicates to the micro-controller, through J15 pin 11, that an active line has been seized. When the unit is placed in the auto disconnect mode, the micro-controller monitors this line. If the phone company drops or reverses the telephone loop current, the LED will extinguish momentarily. The micro-controller, sensing a high level at U1 pin 4, will then command K2 and K7 to disconnect by pulsing their RESET coils.

When the unit is disconnected from the line, a small amount of ringing current is leaked around the open contacts of K7 via R8 and C1. This A.C. ringing current will pulse the LED in U1, indicating to the controller that the line is ringing. If the unit is in the auto mode, the controller will then command the relays to seize the line.

Relay K3, also associated with the line one circuit, provides routing of line one to the front and rear SET jack (J4) when the unit is in the manual dial mode. This allows the line connected to the unit to be tone or pulse dialed by an attending instrument.

Resistor R20 on the secondary windings of T1 provides a terminating resistor that allows T1 to partially separate (null) the send audio being applied for transmission from the receive audio. FB1, C8, L1, and C9, provide an RFI filter on the send of the hybrid transformer. FB2, C10, L2 and C11, provide filtering on the receive side of T1. These filters keep a high RF field on the telephone line from becoming demodulated in the active circuitry and causing distortion to the audio.

The couplers for lines two and three work in a similar manner and are shown on Sheet 1 and Sheet 2. A fourth loop current detector circuit is connected in series with the SET jack and is constructed of DB1, CR25, CR26, R19, and U4. This circuit is used to detect the presence of the attending telephone instrument, if used.

Sheet 3 of the schematic shows four bi-quadratic filter sections connected together to form an 8 pole elliptical low pass filter. Audio to be filtered is applied at J16 pins 1 and 2. The filter's low-pass output is on J16 pins 4 and 5. This filter was designed via computer to provide a very accurate amplitude and phase response. The resistors in the circuit are all one percent tolerance. An identical filter is shown on Sheet 4.

These two filters are flat to 7.5 Khz and then roll off very sharply, applying 50 dB of attenuation at 10 Khz. These filters are used to anti-alias the wideband audio from the digital sampling at 20 Khz employed in the unit.

7.5 EFT-3000 Interface Board Theory

Please refer to the Interface Board Schematic, found in Section 8.4 of this manual, for the following discussion.

The Interface Board of the EFT-3000 contains a processor to telco relay interface, two microphone / line level selectable pre-amps, a two channel mixer, audio processor (limiter), level detector and LED driver, VU metering amplifier, headset power amplifier, active balanced output amplifier, four 16 bit A/D converters, four 16 bit D/A converters, six switched capacitor low-pass filters, RFI protection filters and a power supply section consisting of rectifiers, filters, and seven voltage regulators.

The board has a wide collection of circuits that simply interface the processor board to the analog world.

Sheet 1 of the schematic shows the processor relay interface consisting of U13, a high current driver, Q1, Q2, and their associated components. This circuit drives a matrix of latching relay coils on the Telco / Filter board. The connection to the Telco / Filter board is provided at P15. The connection of the circuit to the Processor board is provided at J14.

The MIC / LINE level pre-amps and mixer circuit are shown on Sheet 2. Audio from the rear panel INPUT 1 XLR connector reaches the interface board at J7. A parallel connection is made to the front panel XLR at J13. Audio from either XLR is filtered to remove RFI by FB8, C122, L5, and C123. A similar filter circuit exists on the other two XLR connections. R82, R83, and R84, form a 55 dB pad when selected by SW1. This provides for the selection of microphone or line level input audio. The audio is then applied at the primary of T2. T2 provides conversion from 150 ohm input impedance to 15K ohms at the secondary.

Through this process 20 dB of passive voltage gain is achieved. A center-tap connection on the primary of T2 allows for the application of +30 volts D.C. to phantom power condenser microphones. This phantom power option can be selected by moving the small plastic shorting jumper from JP12 to JP13. Phantom power will only be supplied when the input level switch is in the MIC position.

Audio from the transformer secondary is amplified 25 dB by one section of U18. The output of the operational amplifier is then applied to the front panel pot for level adjustment. This pot is followed with an additional 25 dB of gain provided by the second op-amp in the U18 package. An identical circuit for INPUT 2 is shown on the bottom of the page using U17. The outputs of U18 and U17 are mixed together in U24. The output of U24 is then applied to the audio limiter circuit.

The audio limiter is shown on Sheet 3. Audio is connected to two circuits, a voltage controlled amplifier (VCA) at U21, and an RMS detector at U22. The RMS detector generates a logarithmic output voltage based on the amplitude of the input signal. This varying voltage is then stored in C146. U19 and R110 determine how fast C146 will charge, R112 determines discharge. This control voltage is then buffered and level shifted through R108 and R107. Constant current supplied by CR1, U19, and Q3 allows for a D.C. level conversion without losing the rate of change information. The control voltage is then connected to a threshold detector comprised U19 and CR3. R107 was set at the factory to produce a limiter threshold 8 dB below VCA clipping.

U20 and R127 comprise a control voltage buffer. If the front panel AUDIO PROCESSOR switch is in the OFF position, FET Q4 will be turned on and the input to the buffer at U20 will be held at 0 volts (VCA at unity gain). If the processor is turned on, Q4 will be off and the control voltage will be allowed to pass through the buffer to U21 pin 3 and vary the gain of the VCA. The output of U21 is a current that must be converted to a voltage swing. This is accomplished by U20 and R19. The audio output of the limiter is sent to the 8 pole anti-alias filter on the Telco / Filter Board via P16 pins 1 and 2.

The final circuit on this sheet is the LED display circuit. Audio from the VCA output is coupled to a voltage divider at R142 and R147. This divided audio is fed to a comparator at U20 pin 6. A reference voltage is derived and applied to U20 pin 5. When the audio exceeds the reference, clipping is detected. Pin 7 of U20 will go low which causes pin 3 of U23 to go high, charging C164. When C164 is charged, U23 pin 6 will go low and light the front panel LED, indicating the threshold of clipping. U23 pin 2 is fed from an additional comparator that senses when the VCA is being told to limit its amplitude. U23 OR's these signals together to both light the LED. C164 and R141 act as a one shot circuit to make sure that the LED is turned on long enough to be visible.

When the front panel Audio Processor switch is OFF the LED indicates clipping; when the switch is ON, the LED indicates the limiting threshold.

Sheet 4 shows the monitor and output amplifiers. Digital to analog converted audio is present at P16 pins 13 and 14. This audio is fed to one section of U26 which acts as a buffer. Audio is then adjusted by the front panel monitor pot and then amplified in the second section of U26. U26 has an external current booster circuit comprised of Q5 and Q6, so that it can drive the headphone with adequate volume. The output of the headphone amp is then isolated through sets of 100 ohm resistors and applied to the three 1/4 inch headphone jacks.

Converted output audio is also applied to an additional buffer at U24. A shielded jumper connects the buffer to a level control trimmer through J16 and J17. Audio from the pot is then active balanced at U25 and fed to the output XLR via J15.

The process of analog to digital conversion is accomplished on Sheet 5 and Sheet 6. Wide band, limited, and anti-aliased audio is present at P16 pins 5 and 6. This audio is applied directly to U8, a 16 bit oversampling A/D converter. The digital output of the converter I.C. is connected to the Processor Board via J14.

Audio from telephone line one is amplified by U16. The gain applied to the telephone receive audio is determined by the selection of one of three shorting jumpers. JP5 selects 0 dB gain, JP 7 selects 10 dB gain, and JP 9 selects 20 dB of gain. The units are shipped from the factory in the 20 dB gain configuration. The jumpers are provided to provide flexibility when connecting the unit to a cellular phone system or dedicated high level loops from the phone company.

Audio from the U16 amplifier is low pass filtered to prevent alias problems in the digital conversion process. This filtering is provided at U12. U12 is a monolithic switch capacitor low-pass filter. The 3.58 Mhz crystal at Y1 provides the timing for U12 and then is daisy-chained to the other filter chips. Audio from the filter is connected to U9 where it is digitized and sent to the processor board. An identical amplifier, filter and A/D circuit is employed for telephone line two at the bottom of Sheet 5 and for line three on Sheet 6.

Sheet 7 and Sheet 8 contain the digital to analog conversion circuits. Digital audio from the processor board is connected to U4 via J14. U4 is a dual 16 bit D/A converter. The output of the converter is a current that gets converted to a voltage by U1 and R3. This output contains the wide band receive audio output. This audio is sent to an 8 pole low pass filter on the Telco / Filter board to have its digital alias and images removed.

The output at U1 pin 7 contains audio to be transmitted on line one. Sheet 8 shows identical converter circuits for lines two and three.

Sheet 9 shows three identical switched capacitor low pass filter circuits. These filters remove alias and images from the digitally converted audio signals before they are applied to the three telephone lines for transmission.

Sheet 10 contains the schematic of the power supply circuits, including the transformer chassis wiring. The power supply makes use of seven monolithic regulators to derive eight supply voltages. U29 provides +5 volts for the Processor Board. This power is made available at J10 for connection to the Processor circuit board. U30 and U27 yield plus and minus 5 volts to be used in the analog sections of the switched capacitor filters, A/D, and D/A circuits.

All of the digital logic circuits on the Interface Board are powered by U33. U32 and U28 derive plus and minus 15 volts for all of the operation amplifier I.C.'s. A voltage doubler circuit made up of C199, C200, CR14, and CR15, along with the regulator U31 provide the +30 volts phantom power supply option for condenser microphones.

Two additional schematics are shown in Section 8.4 for the front panel control switches and touch tone pad.

7.6 The Set-Up Process

The set-up process is the method the EFT-3000 Transmit unit uses to send a set of standard signals to the EFT-3000 Receive unit. With these signals the EFT-3000 Receive unit evaluates the differential time delay between the each telephone line in use, and evaluates the transfer function (gain and phase as a function of frequency) of each telephone line in use.

All delay, gain, and phase compensation is done by the EFT-3000 Receive unit.

The EFT-3000 has 24K by 16 bits of Random Access Memory (RAM) available for differential time delay compensation. Since only two of the telephone lines must be delayed (in the three line configuration), this provides up to 12K RAM per line for delay compensation functions.

No single standard signal will transfer enough information to determine the delay and transfer functions simultaneously. Therefore, the set-up process consists of a sequence of three standard signals.

The set-up calibration signals are called the Differential Delay Compensation (DDC) signal, the Line Quality Evaluation (LQE) signal, and the Line Identifier (LID) signal.

The DDC signal is the first signal emitted from the EFT-3000 Transmit unit. It consists of five cycles of a 1 kHz sine wave, sent in pulses every 0.5 seconds. The DDC signal continues until the EFT-3000 Transmit unit receives a confirmation signal back from the EFT-3000 Receive unit, or until a time-out period of ten seconds is reached.

The confirm signal from the EFT-3000 Receive unit is a pure 1 kHz tone sent on all telephone lines for one second.

During the DDC procedure, the EFT-3000 Receive unit adjusts the pointers in the delay RAM to compensate for the differential delay between telephone lines. The EFT-3000 system preserves these pointer offsets to enable line synchronization. These pointers are not reset until the set-up process is initiated again. These pointers are preserved in a power down condition.

After the DDC procedure is completed, the EFT-3000 system enters the LQE mode. The EFT-3000 Transmit unit sends one second of silence, followed by five seconds of a linear superposition of zero phase sine waves with frequencies of 200, 600, 1000, 1400, 1800, 2200, 2600, and 3000 Hz.

The EFT-3000 Receive unit stores these tones and evaluates each tone for amplitude and phase response. The EFT-3000 Receive unit then internally interpolates the amplitude and phase response for all intermediate frequencies. This procedure results in a transfer function which yields the equalization function for each telephone line.

After the LQE procedure is completed, the EFT-3000 Transmit unit sends one second of silence, followed by the LID tones. The LID tones identify which of the telephone lines will be used for the Low Band, the Mid Band, and the High Band audio signals. The LID tone for the Low Band is 1000 Hz. The LID tone for the Mid Band is 1500 Hz. The LID tone for the High Band is 2000 Hz.

The EFT-3000 does not require that all lines be present. The system will operate with any combination of lines.

The LID procedure continues until the EFT-3000 Transmit unit receives a 1000 Hz confirm tone from the EFT-3000 Receive unit, or until a time-out period of ten seconds is reached.

The entire set-up process takes approximately ten seconds to complete, depending on line conditions.

The set-up procedure is controlled by an exclusive code set running on one Motorola DSP56000.

The EFT-3000 system transmits no standard audio information until the set-up process is complete.

SECTION EIGHT -- MAINTENANCE

8.1 EFT-3000 Maintenance

Your EFT-3000 system is a highly reliable device. It has been thoroughly tested at the factory before being shipped to you.

To protect your EFT-3000 system from damage, do not operate it in an excessively hot or cold environment. Do not drop the system or any of its components.

If you leave your EFT-3000 permanently connected to telephone lines, it is strongly recommended that you provide external surge protection for each of the three telephone lines plus the AC power input. Gentner can provide highly reliable surge protection devices for both the telephone lines and the AC power input. Call the Gentner sales office for more information.

The EFT-3000 does not contain any user serviceable parts. Should your unit not operate satisfactorily, call Gentner and ask for Customer Support.

WARNING: THE EFT-3000 CONTAINS CMOS INTEGRATED CIRCUITS. ALL SERVICE TO THE UNIT MUST BE PERFORMED IN A STATIC FREE ENVIRONMENT.

8.2 Resetting the CPU

The EFT-3000 is a microprocessor based device. If the unit starts behaving erratically, reset the CPU in the following manner:

- a) Turn off power to the unit by moving the POWER slide switch to the OFF position.
- b) Simultaneously depress the star (*) and pound (#) buttons on the built-in Touch-Tone pad.
- c) While holding these buttons down, turn the POWER switch back on.

The CPU does NOT reset on simple power down. You must follow the above procedure to reset the unit.

8.3 Troubleshooting

This section is intended as a guide to solving common problems experienced when operating the EFT-3000. If you need further assistance, call Gentner Customer Support.

Problem: Memory Dialer doesn't work.

Probable causes of trouble:

- a) AUTO mode is not active. Press AUTO button.
- b) Numbers have not been programmed into Memory Dial locations. Follow procedure in Section 5.1 of this manual to program Memory Dialer.

Problem: Can't manually dial telephone lines.

Probable cause of trouble: AUTO button is still active. Turn this button OFF to manually dial out.

Problem: I'm in an area that doesn't have Touch-Tone service. How do I place telephone calls?

You must take along an attendant telephone set that provides pulse dialing. To use, press DIAL button, dial number, wait for pulses to complete, then press CONNECT. Your EFT-3000 must NOT be in the AUTO mode.

Problem: The Receive EFT-3000 won't answer the telephone lines.

Probable cause of trouble: The AUTO mode is not activated in the Receive unit. Call someone and have them push the AUTO button, or manually answer the lines.

Problem: Talent can't hear themselves in headsets.

Probable cause of trouble: Side Tone level is not high enough. Press the star (*) button on the EFT-3000's Touch Tone pad until the level increases.

Problem: Audio going into the console from the Receive unit is too low.

Probable cause of trouble: Audio output level needs to be increased. Use a small screwdriver to adjust the output trimmer pot located on the rear panel.

Problem: Receive audio is distorted.

Probable cause of trouble: Input audio level at the Transmit site is too high. Tell talent to reduce send level. If send level is ok, check output level of Receive unit to make sure it is not too high.

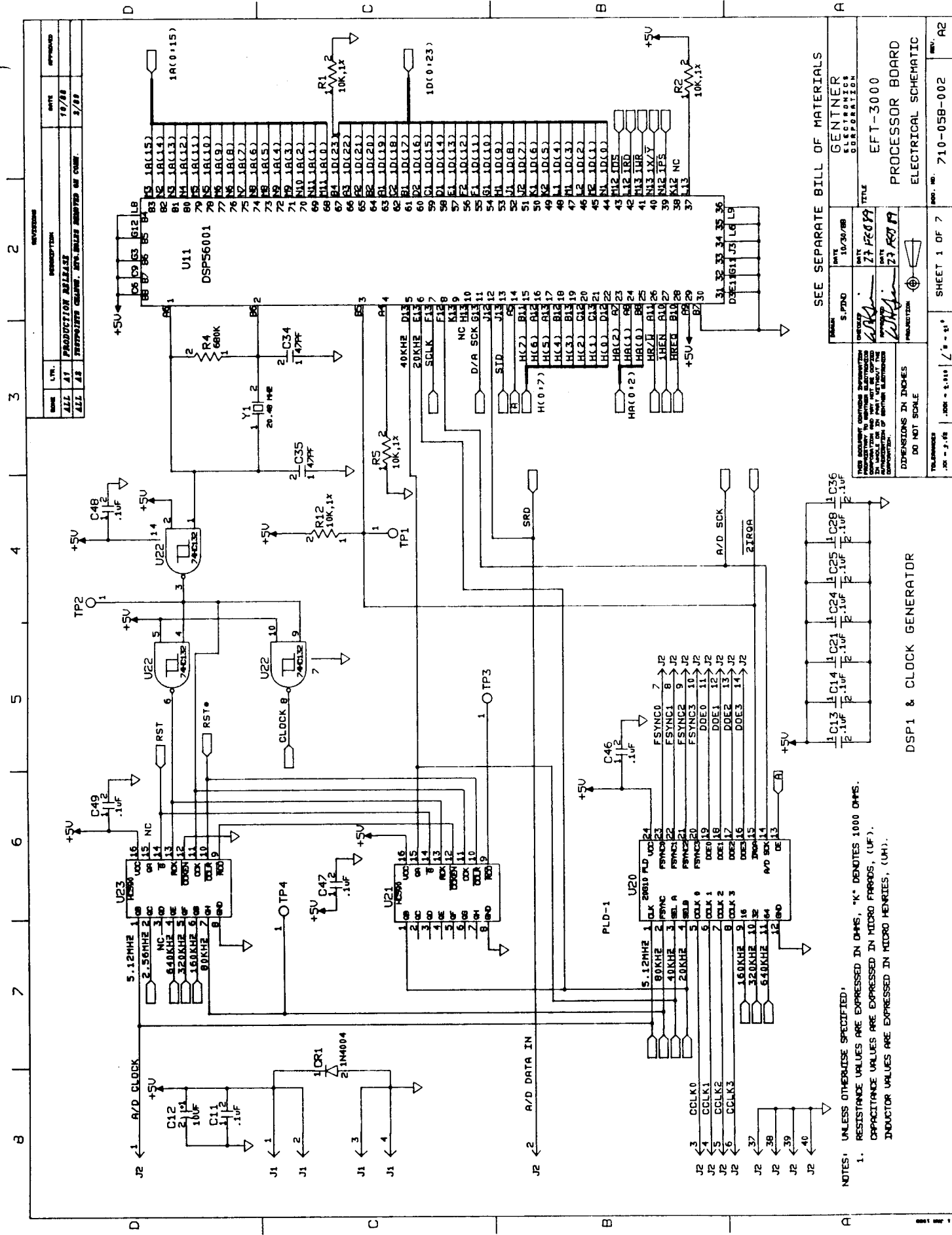
NOTE: if you are using the EFT-3000 with non-standard telephone lines (such as dedicated loops), the internal gain structure of the unit may be set too high. See Section 3.6 of this manual to reset the gain structure.

Problem: The EFT-3000's don't reconfigure when a line is lost.

Probable cause of trouble: The units will reconfigure only when in the AUTO mode. For manual reconfiguration, both units must be taken out of SETUP (by pressing the button), then the SETUP button must be pressed again.

8.4 Schematics

A complete set of schematic diagrams for the EFT-3000 unit are presented on the following pages.



REV	DATE	DESCRIPTION
1	10/88	PRODUCTION RELEASE
2	3/89	REVISIONS

DATE	BY	DESCRIPTION
ALL	AT	PRODUCTION RELEASE
ALL	AT	REVISIONS

SEE SEPARATE BILL OF MATERIALS

DATE	REV	DESCRIPTION
10/30/88	S.P.D	GENTNER ELECTRONIC CORPORATION
27 FEB 89	DATE	U11
27 FEB 89	DATE	U20
27 FEB 89	DATE	U21
27 FEB 89	DATE	U22
27 FEB 89	DATE	U23
27 FEB 89	DATE	U24

PROCESSOR BOARD
EFT-3000
ELECTRICAL SCHEMATIC

SHEET 1 OF 7
REV. NO. 710-058-002

USE ASSUME ELECTRICAL CHARACTERISTICS UNLESS OTHERWISE SPECIFIED IN THIS SCHEMATIC. DIMENSIONS IN INCHES UNLESS OTHERWISE SPECIFIED.

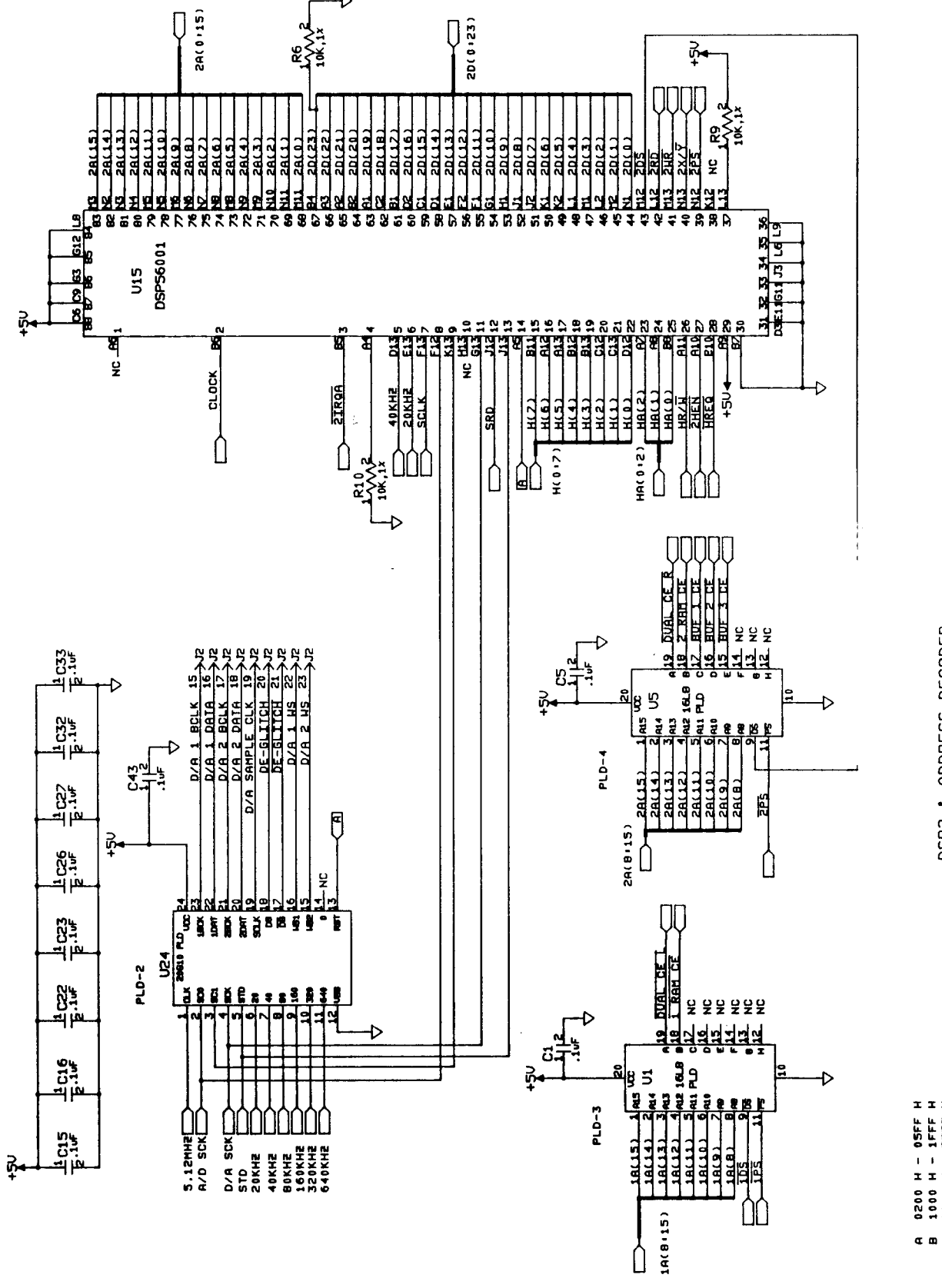
DIMENSIONS IN INCHES
DO NOT SCALE

TELEPHONE NO. 710-5110 / 710-5111

NOTES:

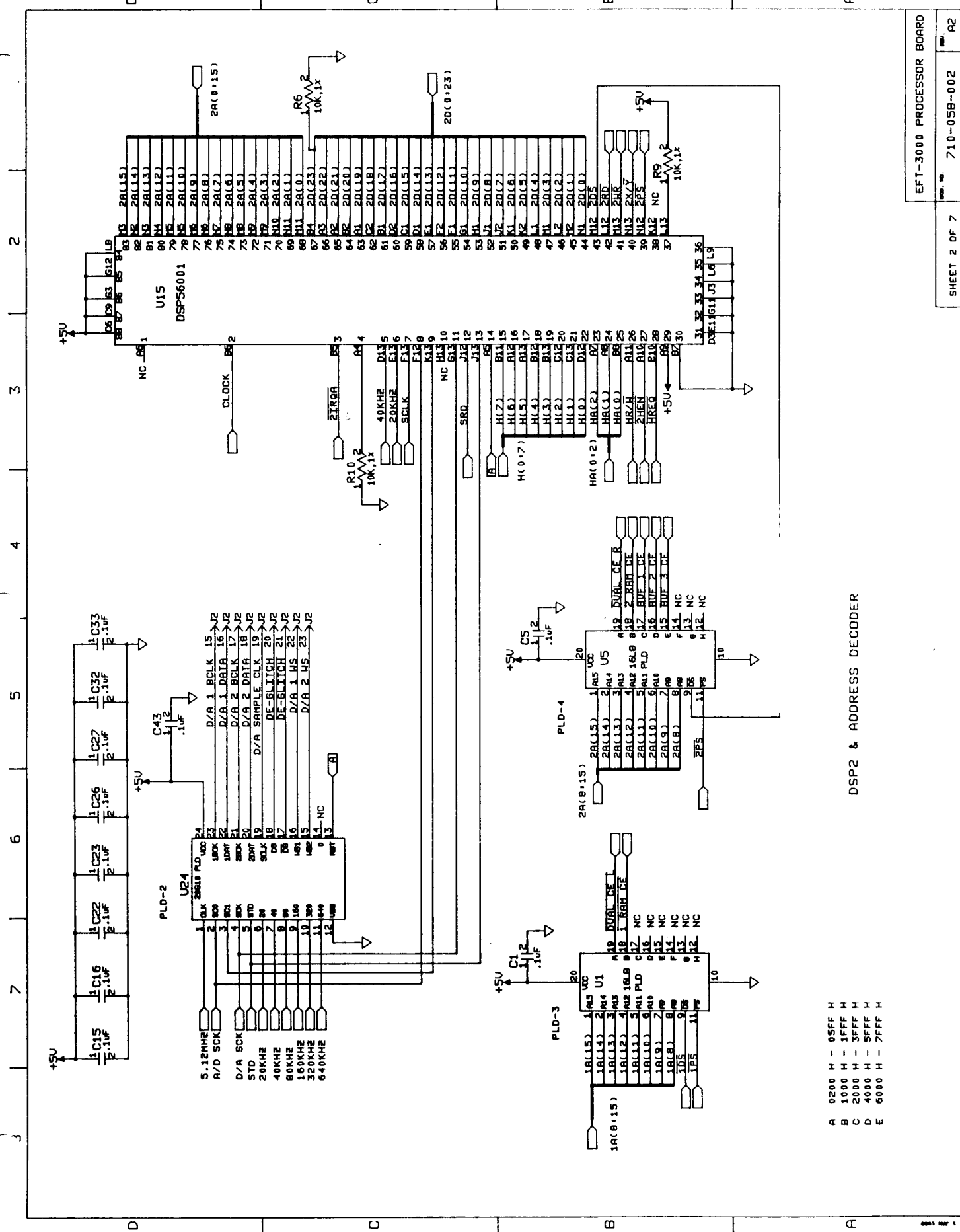
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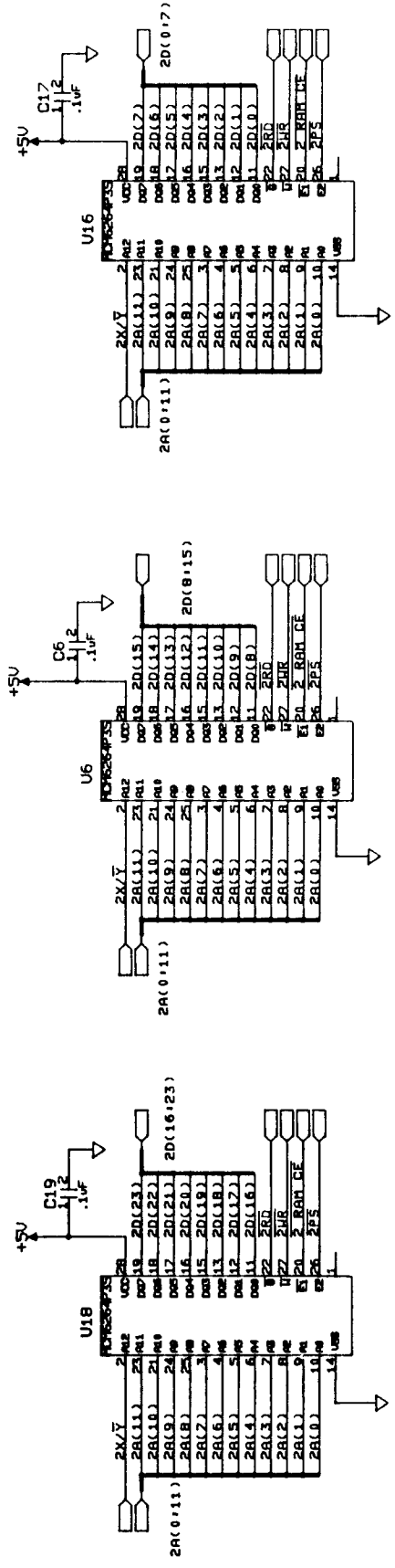
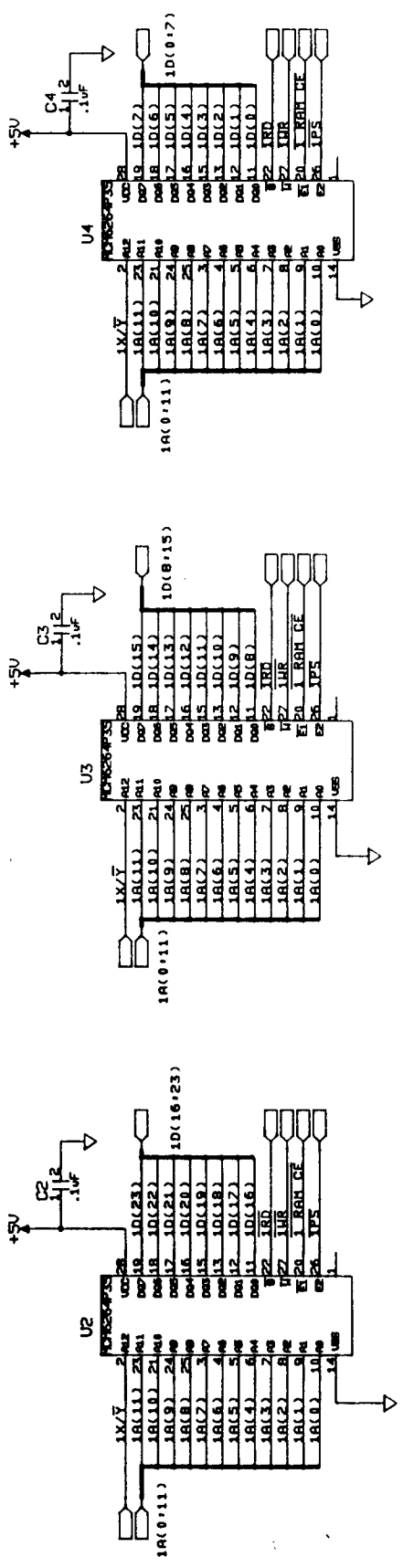
DSP1 & CLOCK GENERATOR



- A 0200 H - 05FF H
- B 1000 H - 1FFF H
- C 2000 H - 3FFF H
- D 4000 H - 5FFF H
- E 6000 H - 7FFF H

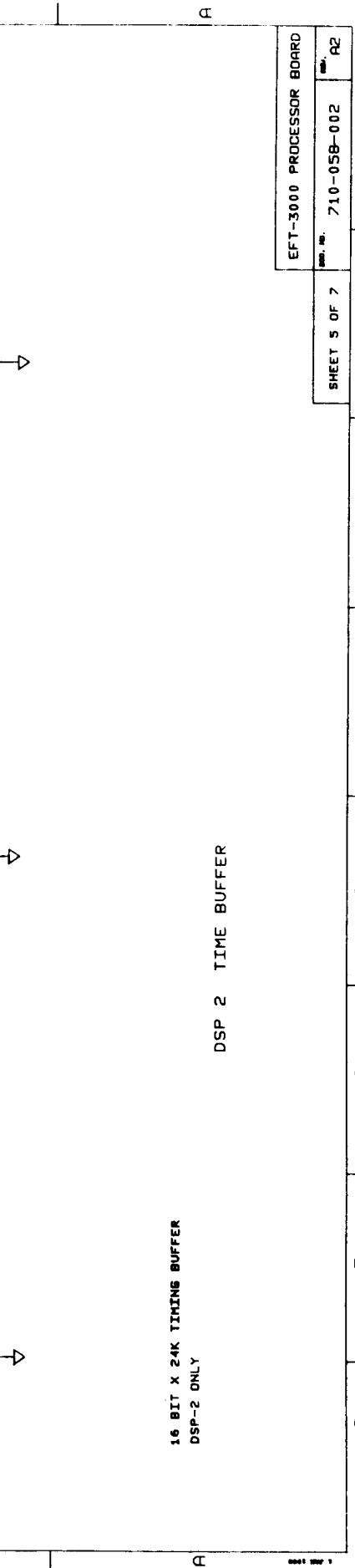
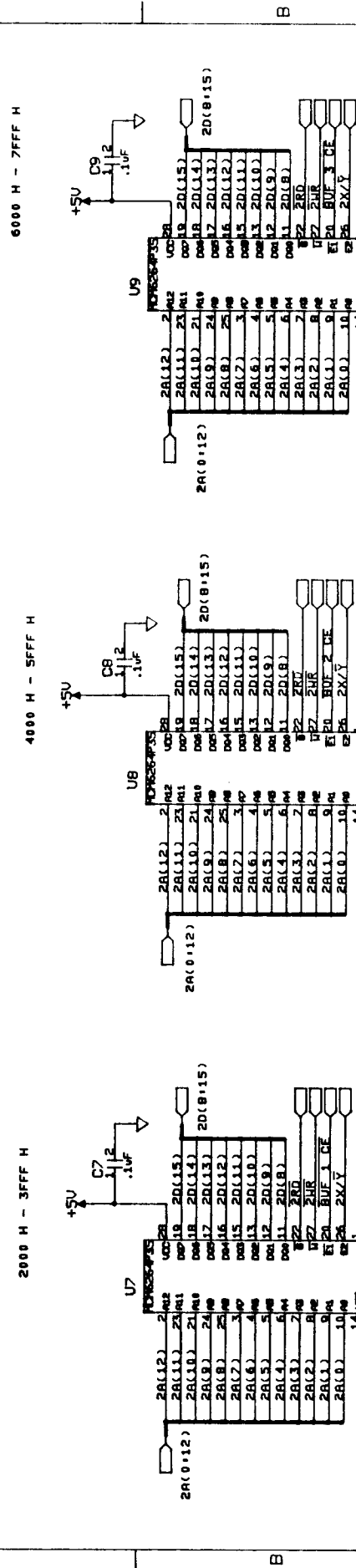
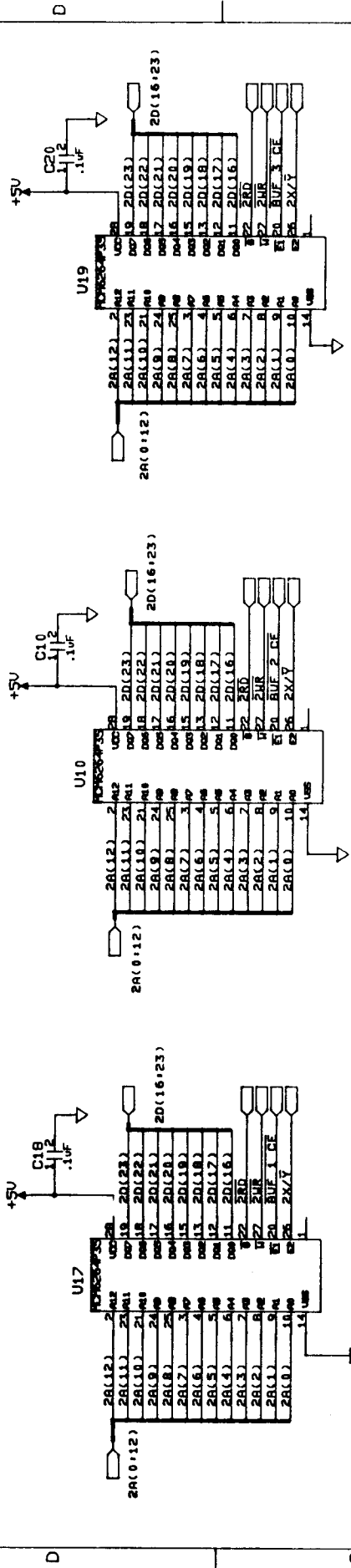
DSP2 & ADDRESS DECODER





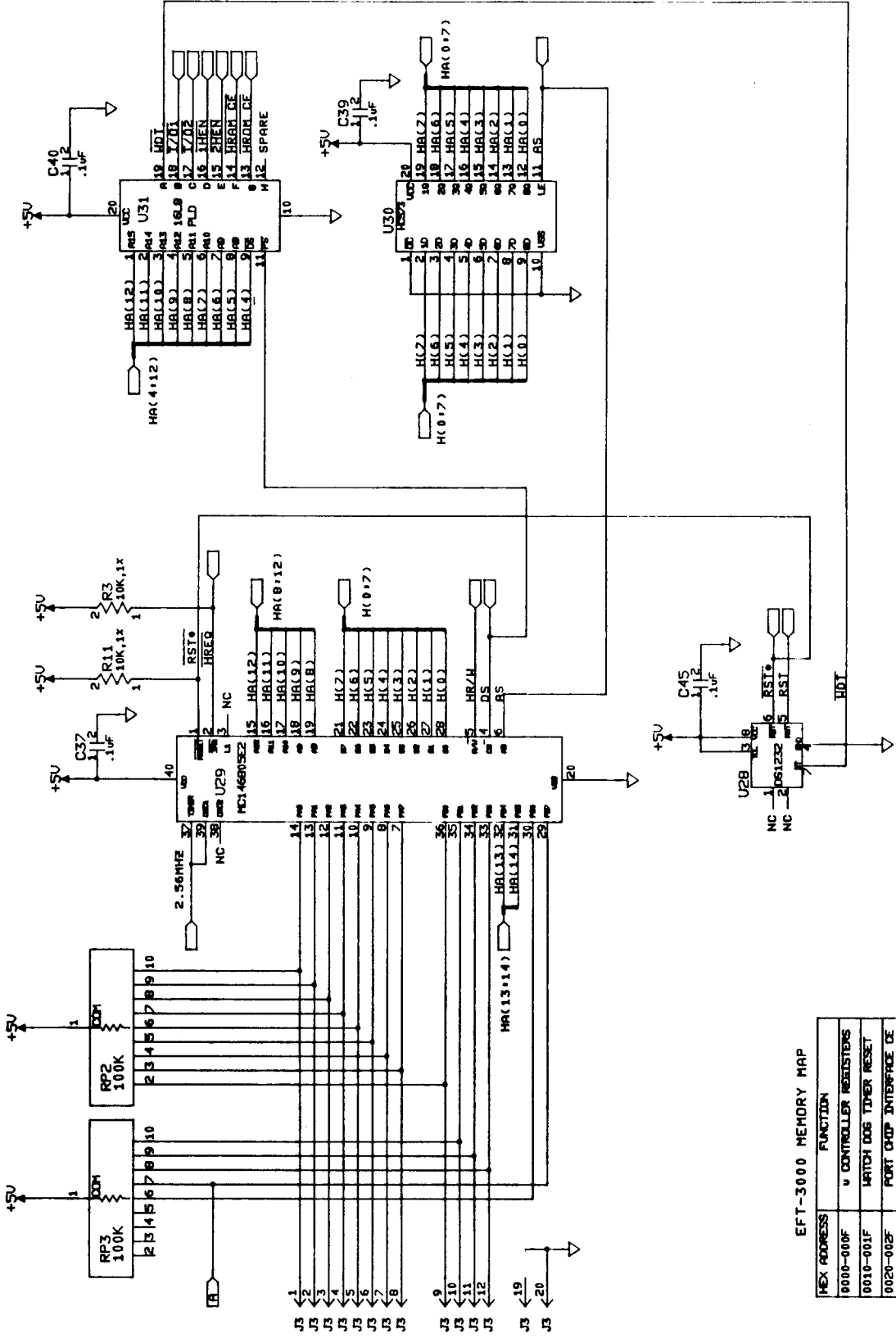
X/Y FORMAT 1000 H - 1FFF H

DSP 1 & 2 X/Y RAM



16 BIT X 24K TIMING BUFFER
DSP-2 ONLY

DSP 2 TIME BUFFER

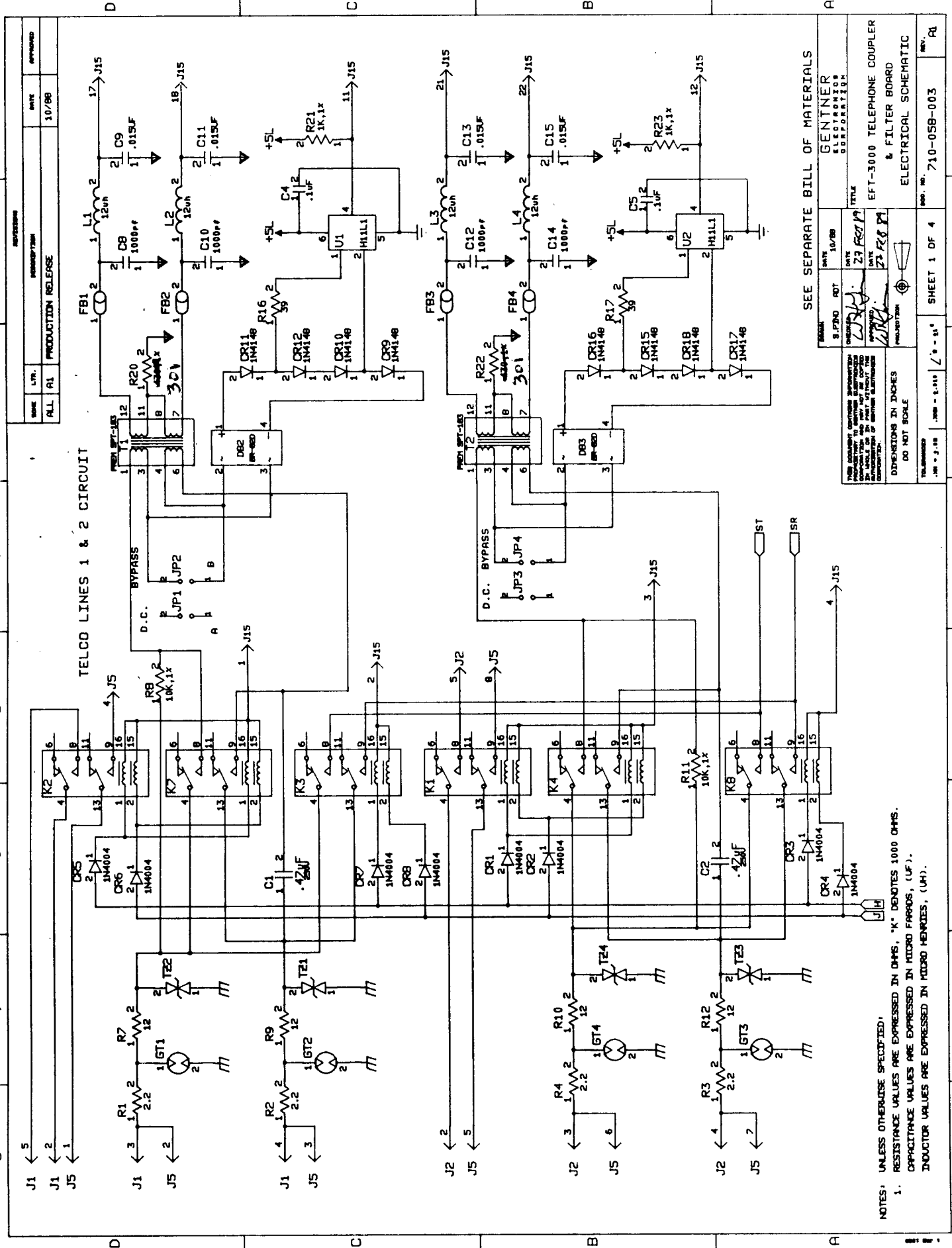


EFT-3000 MEMORY MAP

HEX ADDRESS	FUNCTION
0000-000F	CONTROLLER REGISTERS
0010-001F	WATCH DOG TIMER RESET
0020-002F	PORT CHIP INTERFACE CE
0030-003F	LINE RELAY INTERFACE CE
0040-004F	DSP-1 HOST INTERFACE
0050-005F	DSP-2 HOST INTERFACE
0060-006F	HOST RAM CE
0800-1FFF	HOST ROM CE

HOST MICROCONTROLLER

TELCO LINES 1 & 2 CIRCUIT

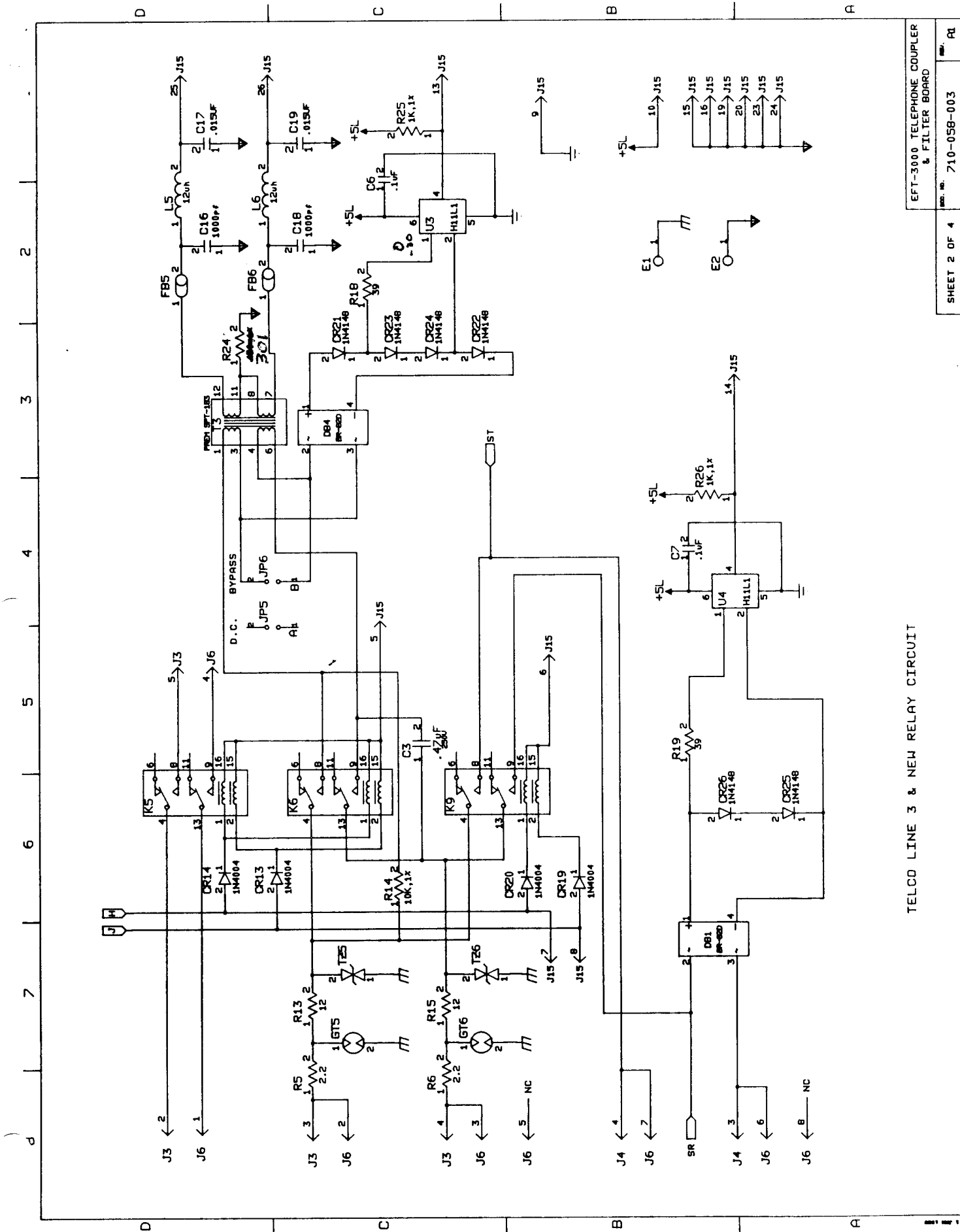


DATE	DESCRIPTION	DATE	APPROVED
10/88	PRODUCTION RELEASE		

SEE SEPARATE BILL OF MATERIALS

GENTNER CORPORATION		EFT-3000 TELEPHONE COUPLER & FILTER BOARD ELECTRICAL SCHEMATIC	
DATE	10/88	DATE	27 FEB 89
DESIGNED BY	[Signature]	DATE	29 FEB 89
APPROVED BY	[Signature]	DATE	
DO NOT SCALE			
DIMENSIONS IN INCHES			
TOLERANCES: .100 - .300 .000 - 0.010 / .9 - .010			
SHEET 1 OF 4			REV. A1

- NOTES: UNLESS OTHERWISE SPECIFIED:
- RESISTANCE VALUES ARE EXPRESSED IN OHMS, "K" DENOTES 1000 OHMS.
 - CAPACITANCE VALUES ARE EXPRESSED IN MICRO FARADS, (UF).
 - INDUCTOR VALUES ARE EXPRESSED IN MICRO HENRIES, (UH).

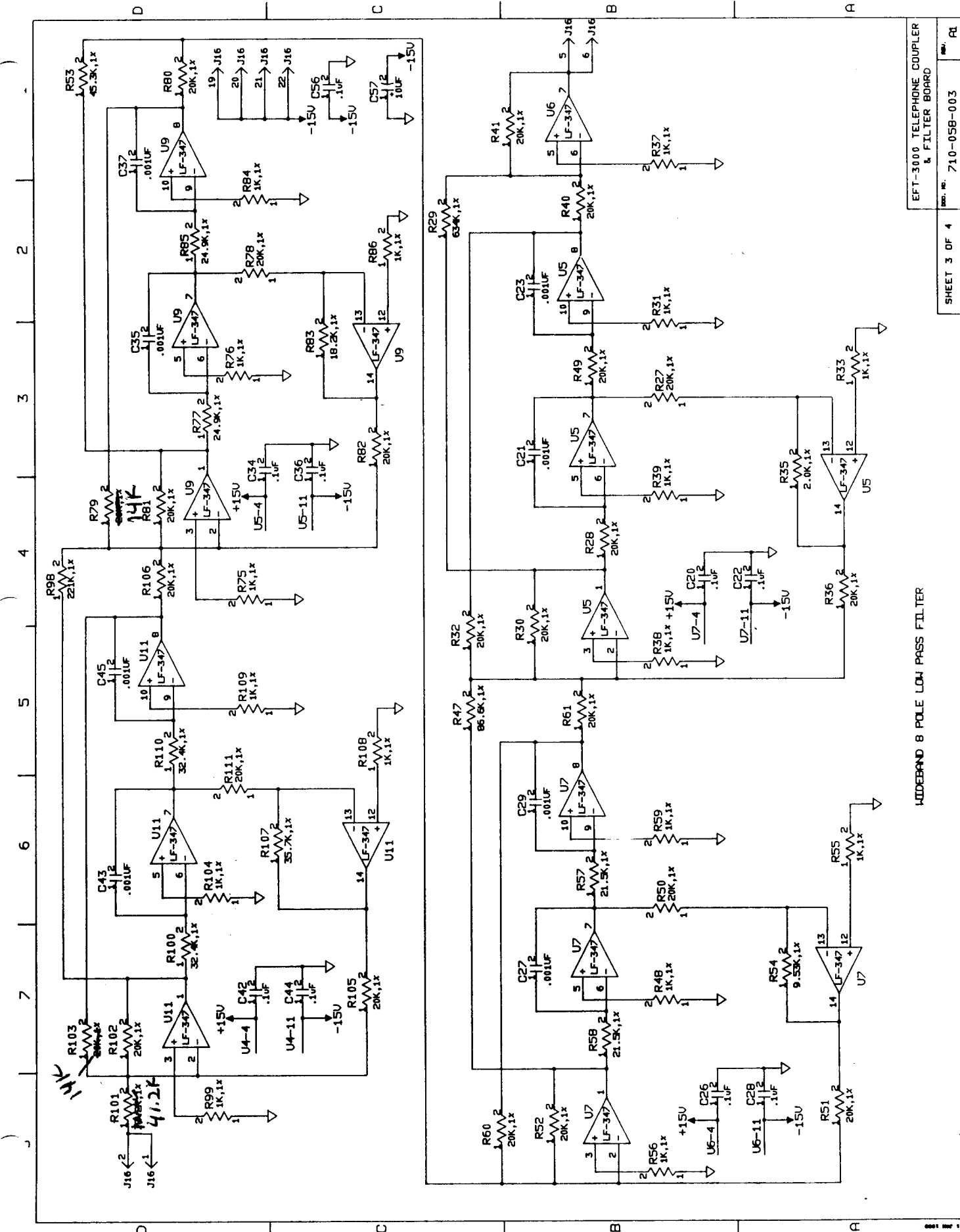


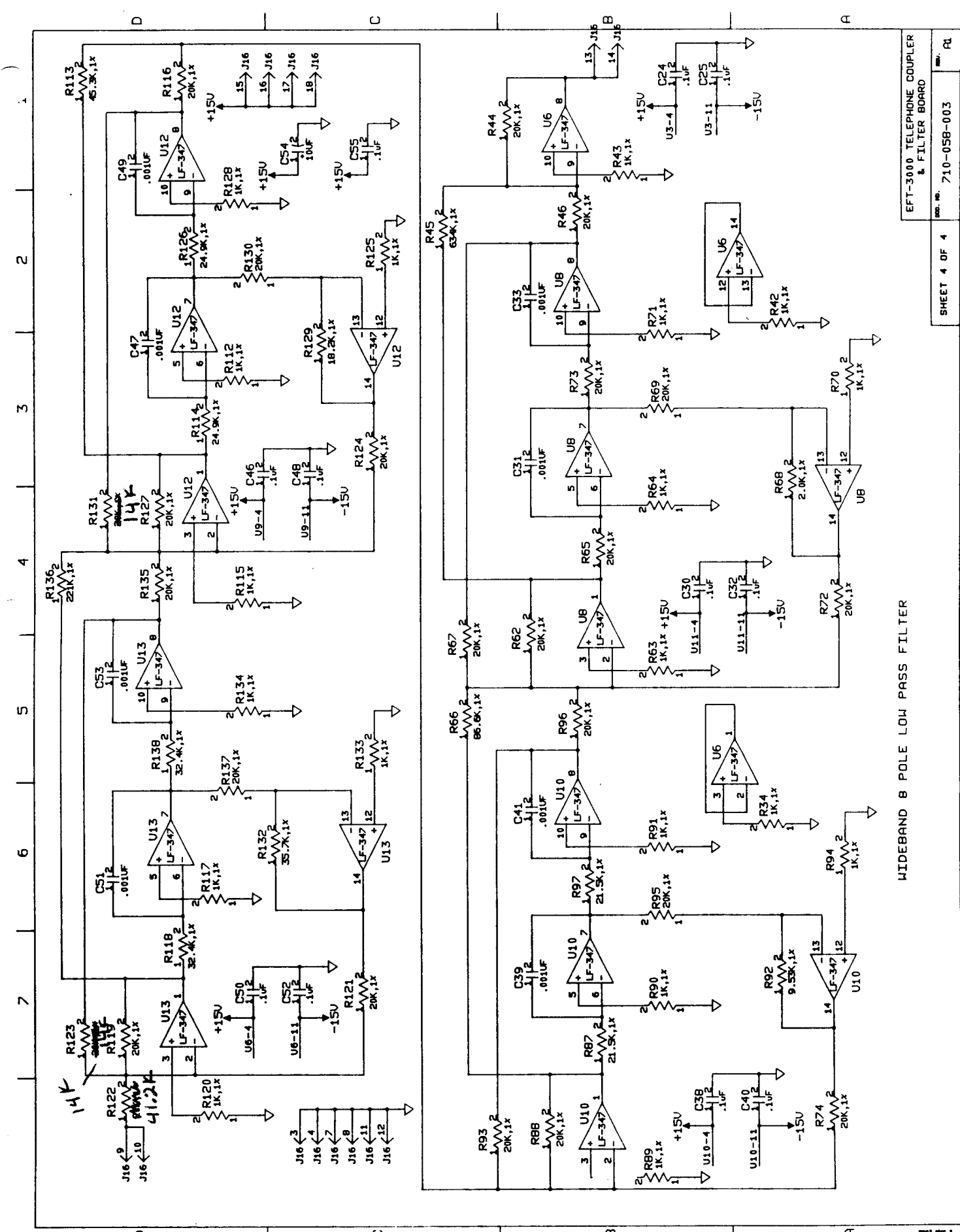
TELCO LINE 3 & NEW RELAY CIRCUIT

EFT-3000 TELEPHONE COUPLER
& FILTER BOARD

SHEET 2 OF 4
REV. NO. 710-058-003
REV. PL

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





WIDEBAND 8 POLE LOW PASS FILTER

EFT-3000 TELEPHONE COUPLER
& FILTER BOARD

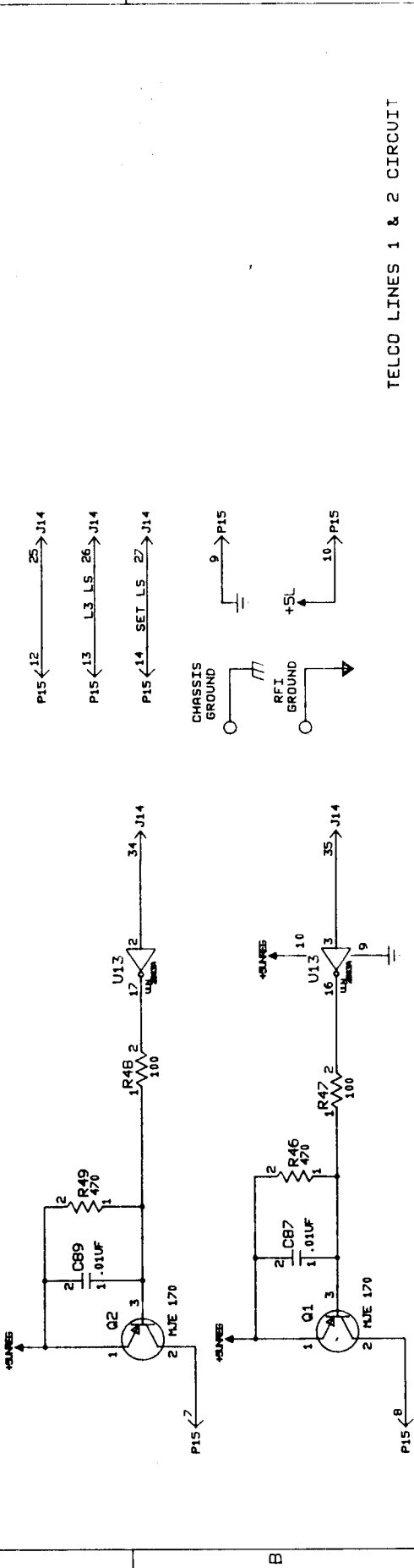
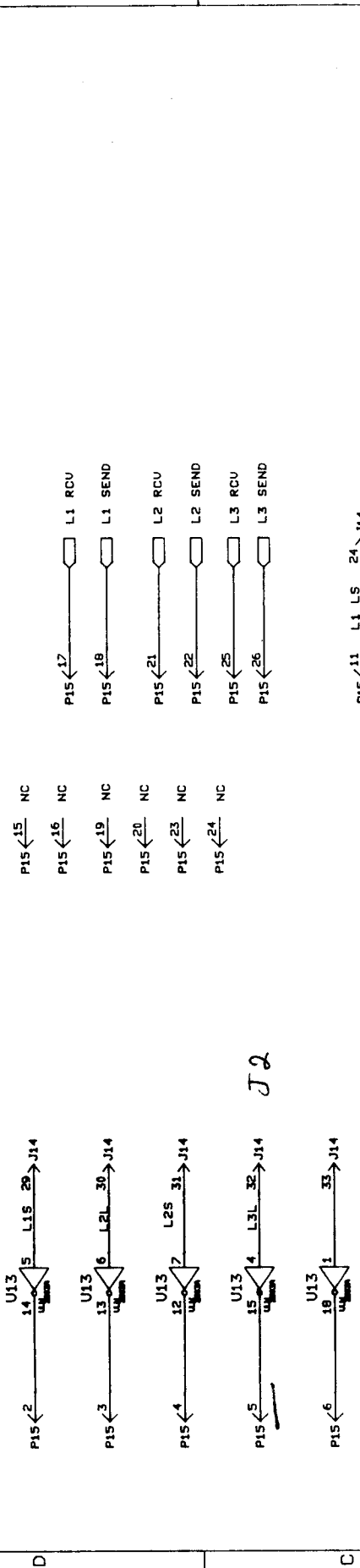
SHEET 4 OF 4

710-058-003

REV. 1

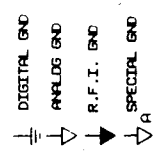
1 2 3 4 5 6 7 8

REV. NO.	DESCRIPTION	DATE	BY	APPROVED
ALL AS	PREPARED FOR PRODUCTION BUILD	12/88	JEP	
ALL AS	IMP. VALUE CHANGE, 710 ORIENTATION AND REMOTE	3/89		



TELCO LINES 1 & 2 CIRCUIT

2. STANDARD GROUND SYMBOLS:

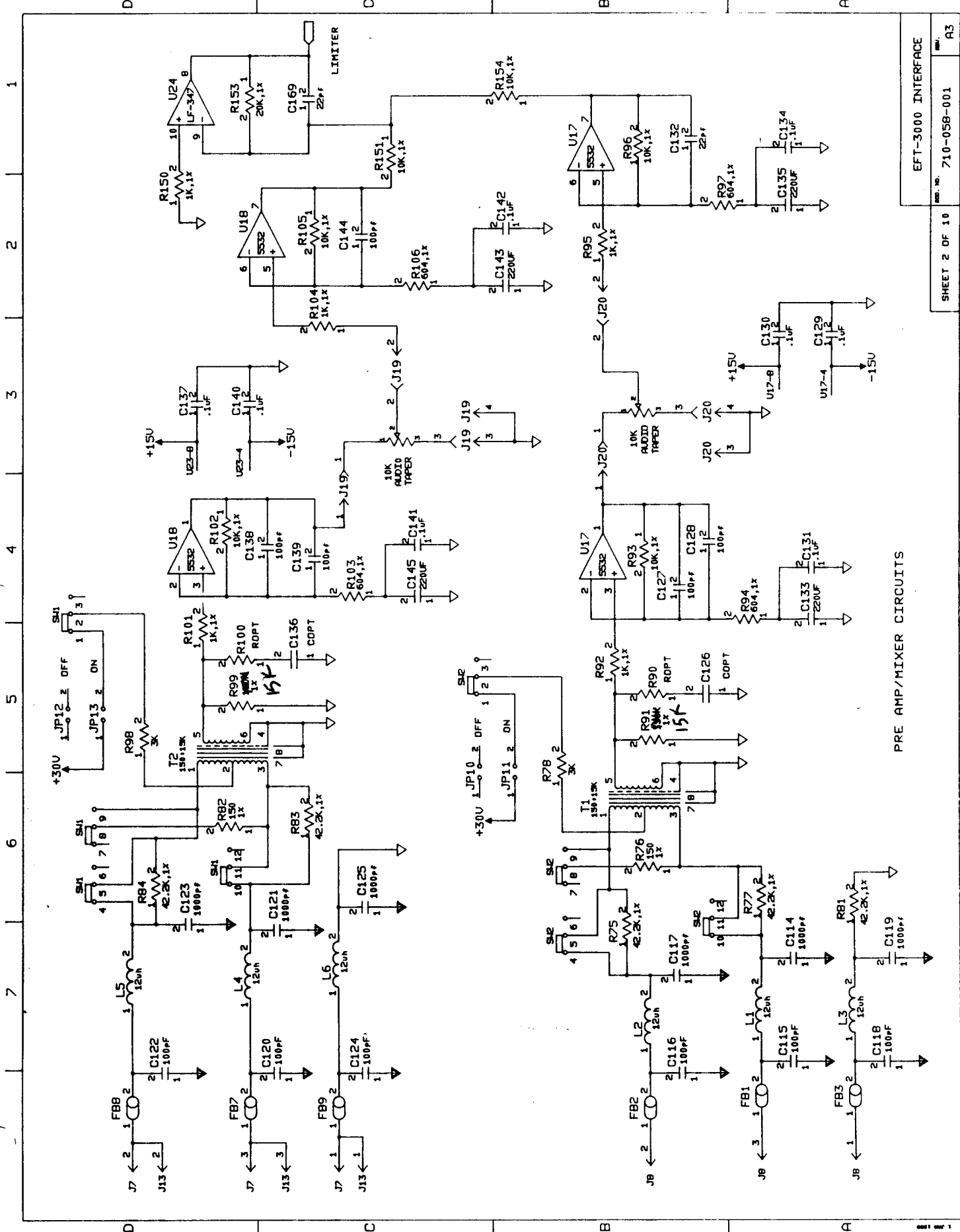


- NOTES: UNLESS OTHERWISE SPECIFIED:
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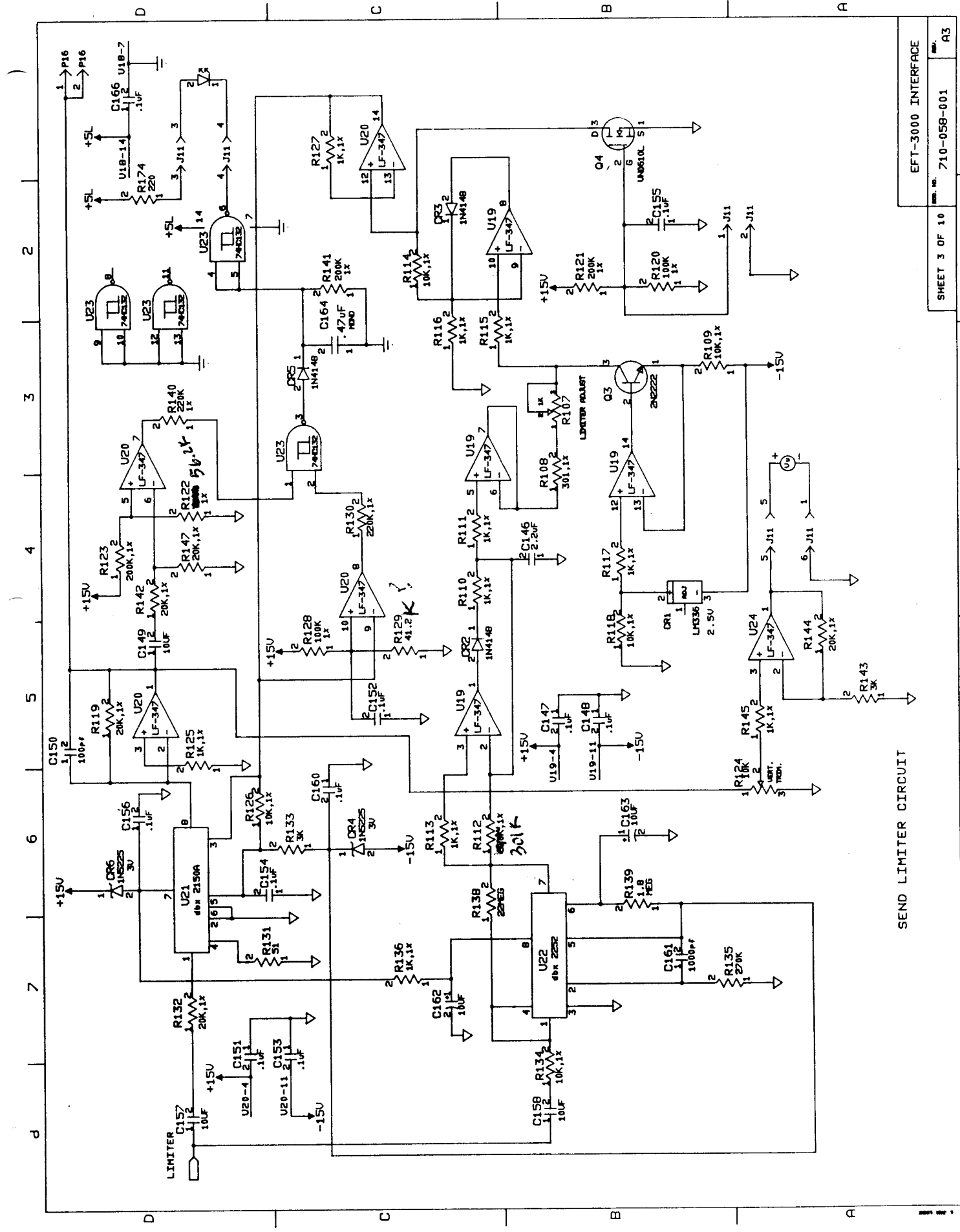
SEE SEPARATE BILL OF MATERIALS

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2	2/78	JEP	
3	3/89	JEP	

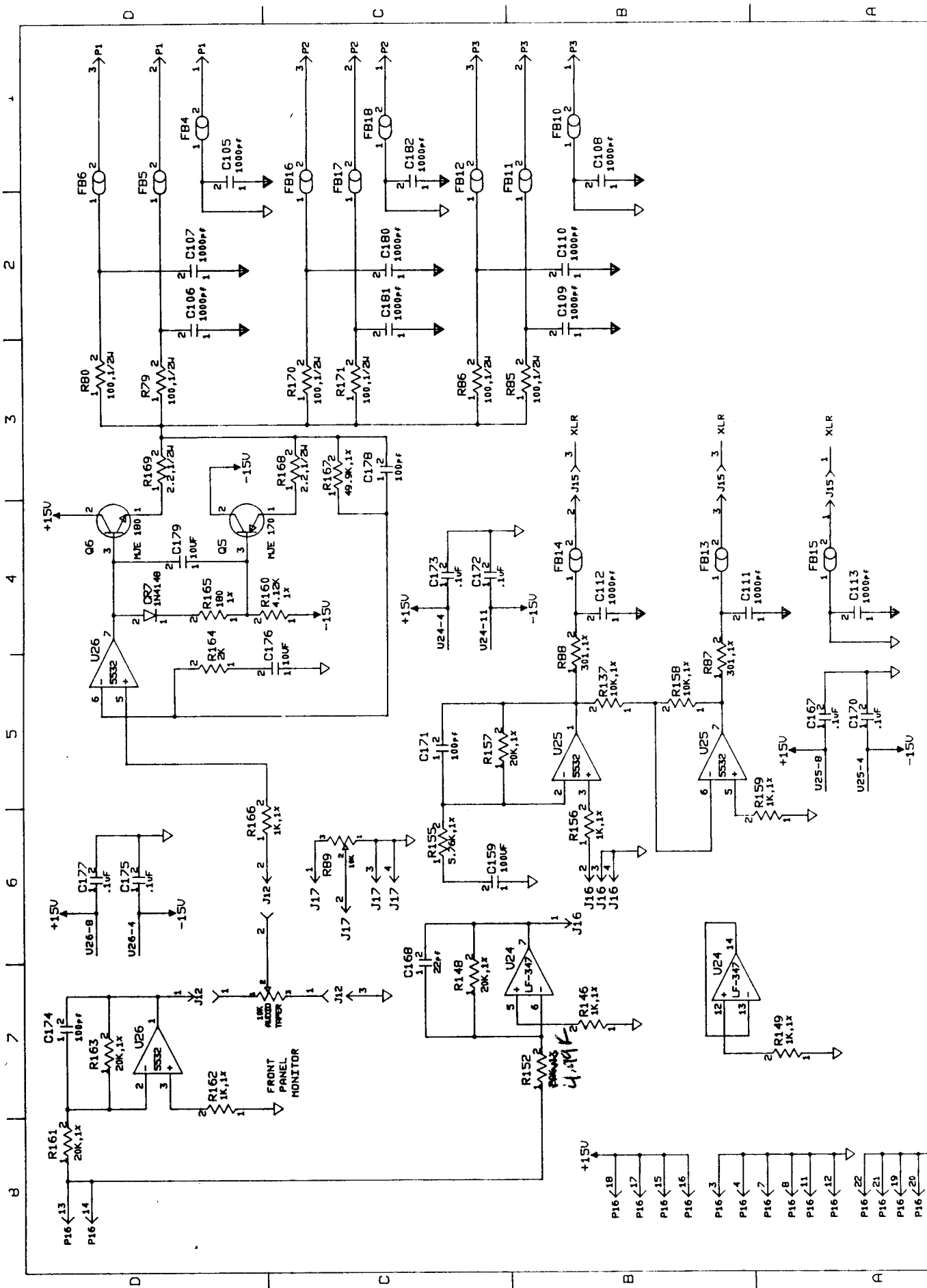
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 PROJECT: ELECTRICAL SCHEMATIC
 SHEET 1 OF 10
 PROJ. NO. 710-058-001
 REV. A3



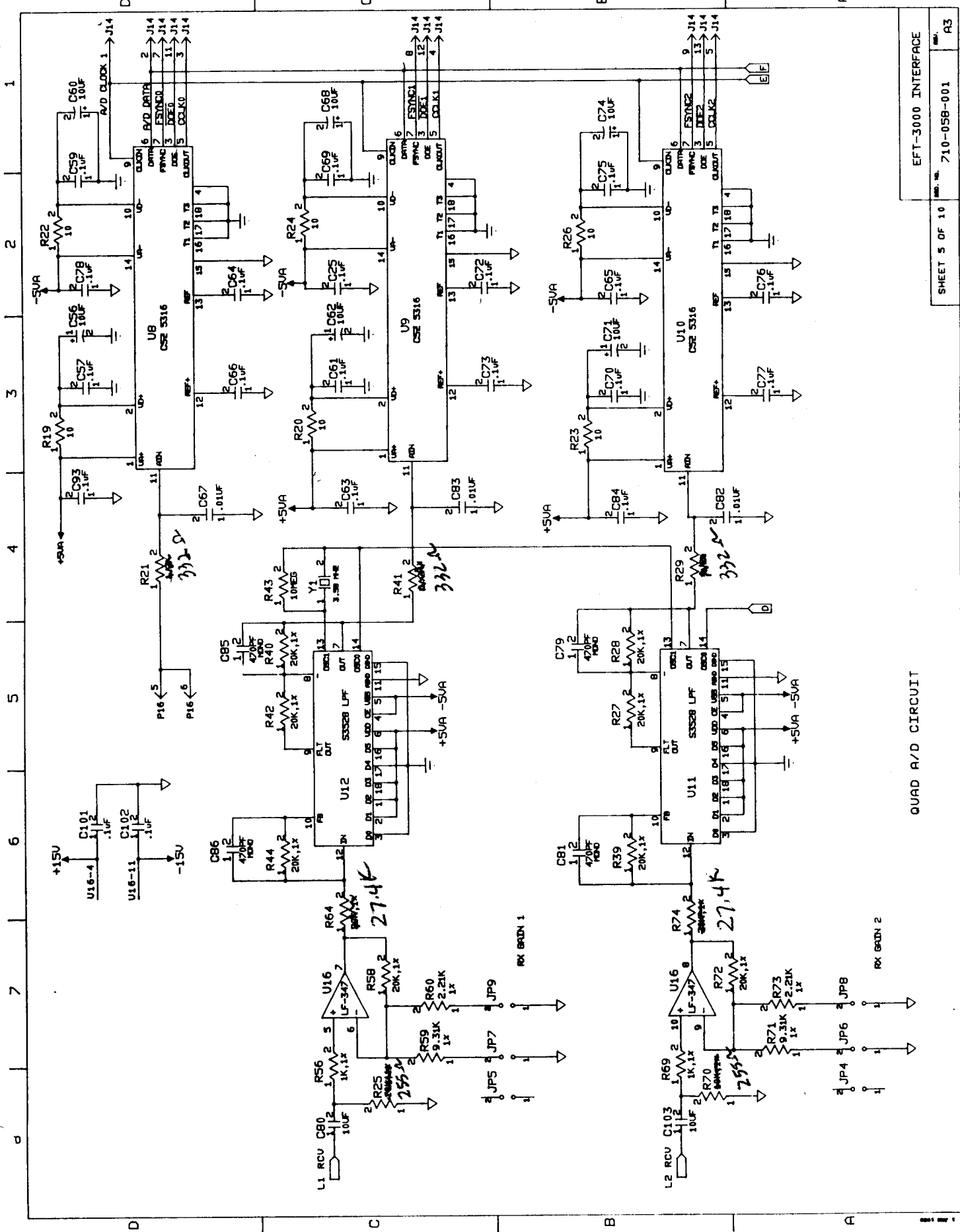
PRE AMP/MIXER CIRCUITS



SEND LIMITER CIRCUIT



MONITOR & OUTPUT AMPLIFIER



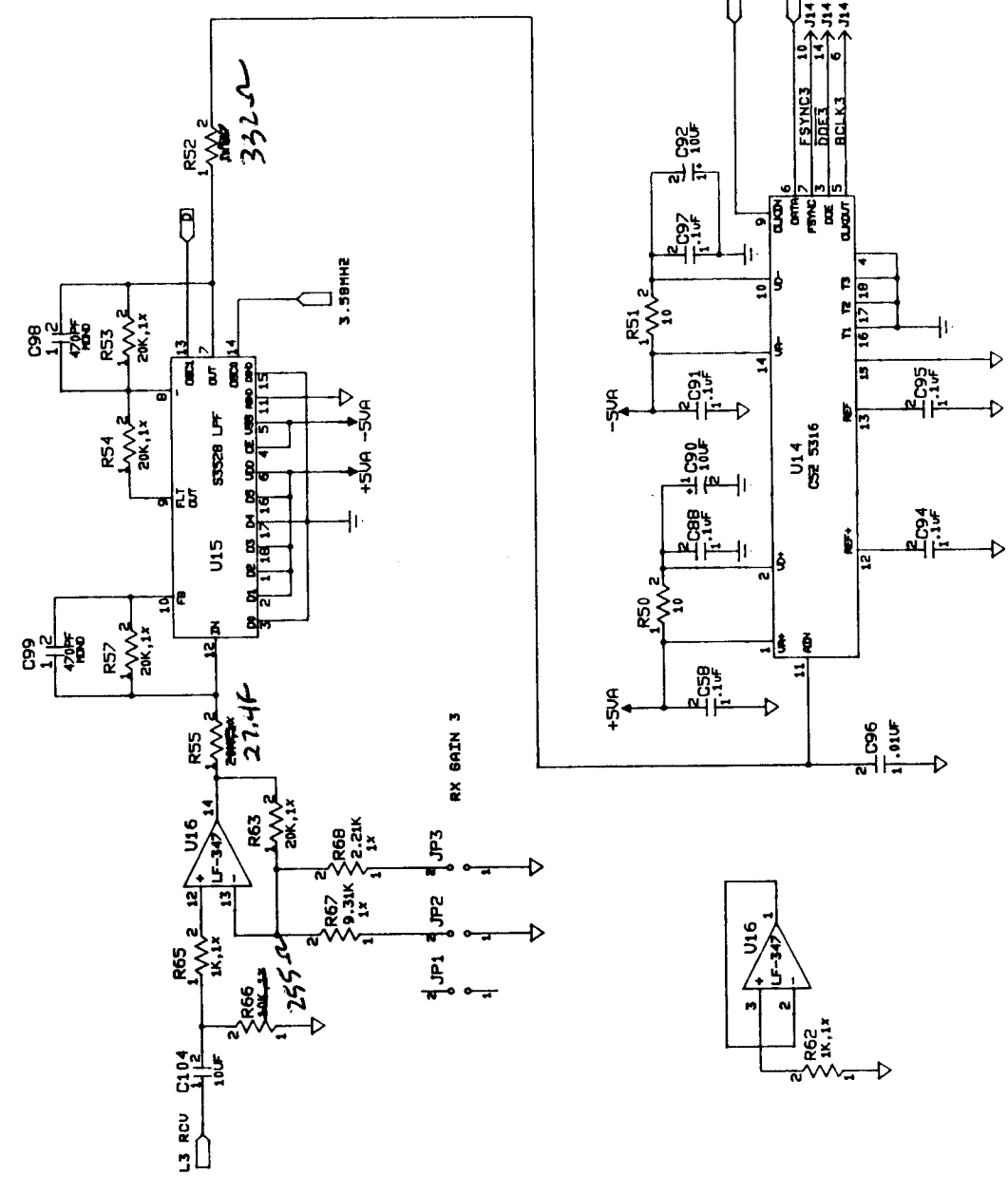
QUAD A/D CIRCUIT

EFT-3000 INTERFACE

D C B A

2 3 4 5 6 7 8

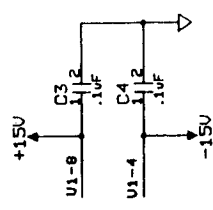
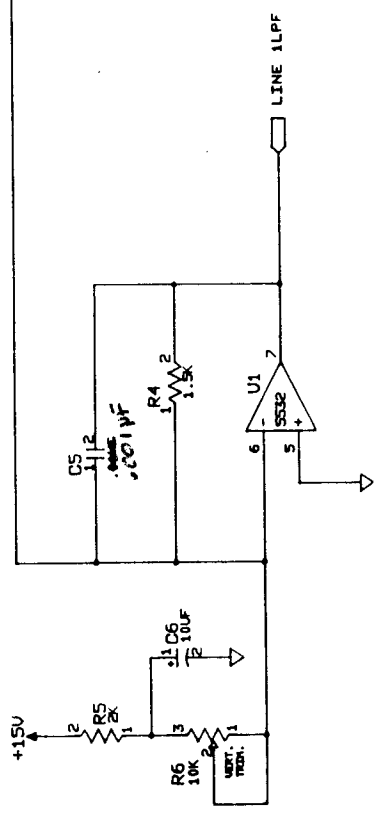
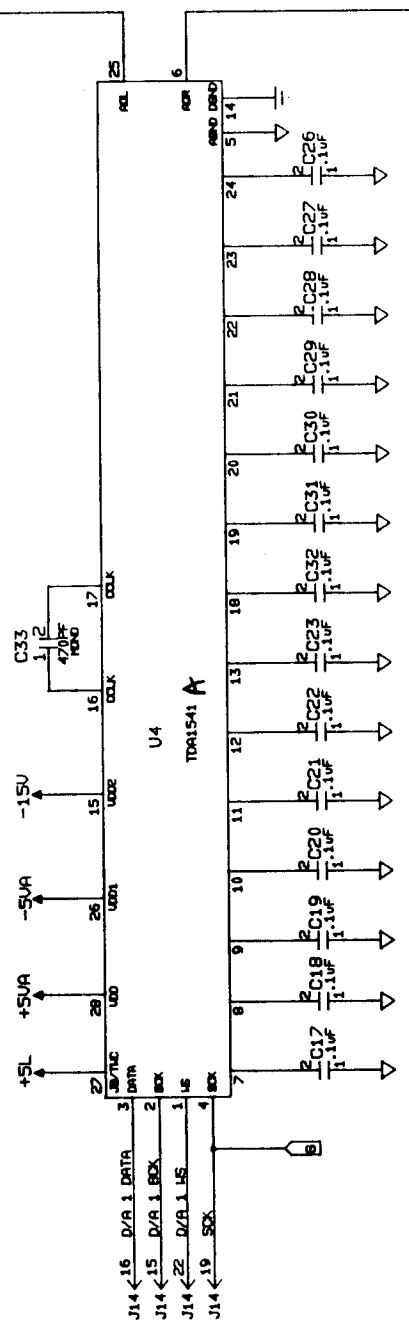
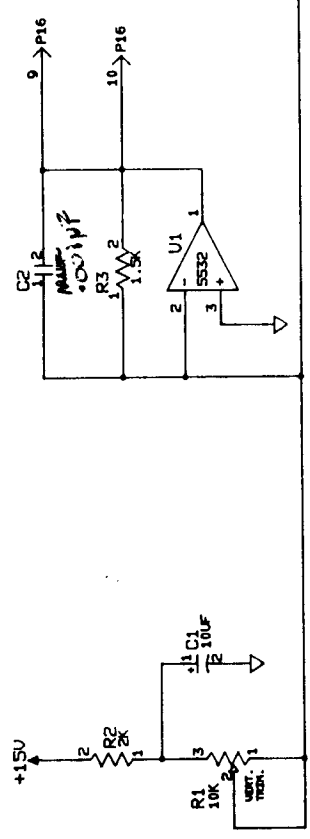
D C B A



QUAD A/D CIRCUIT

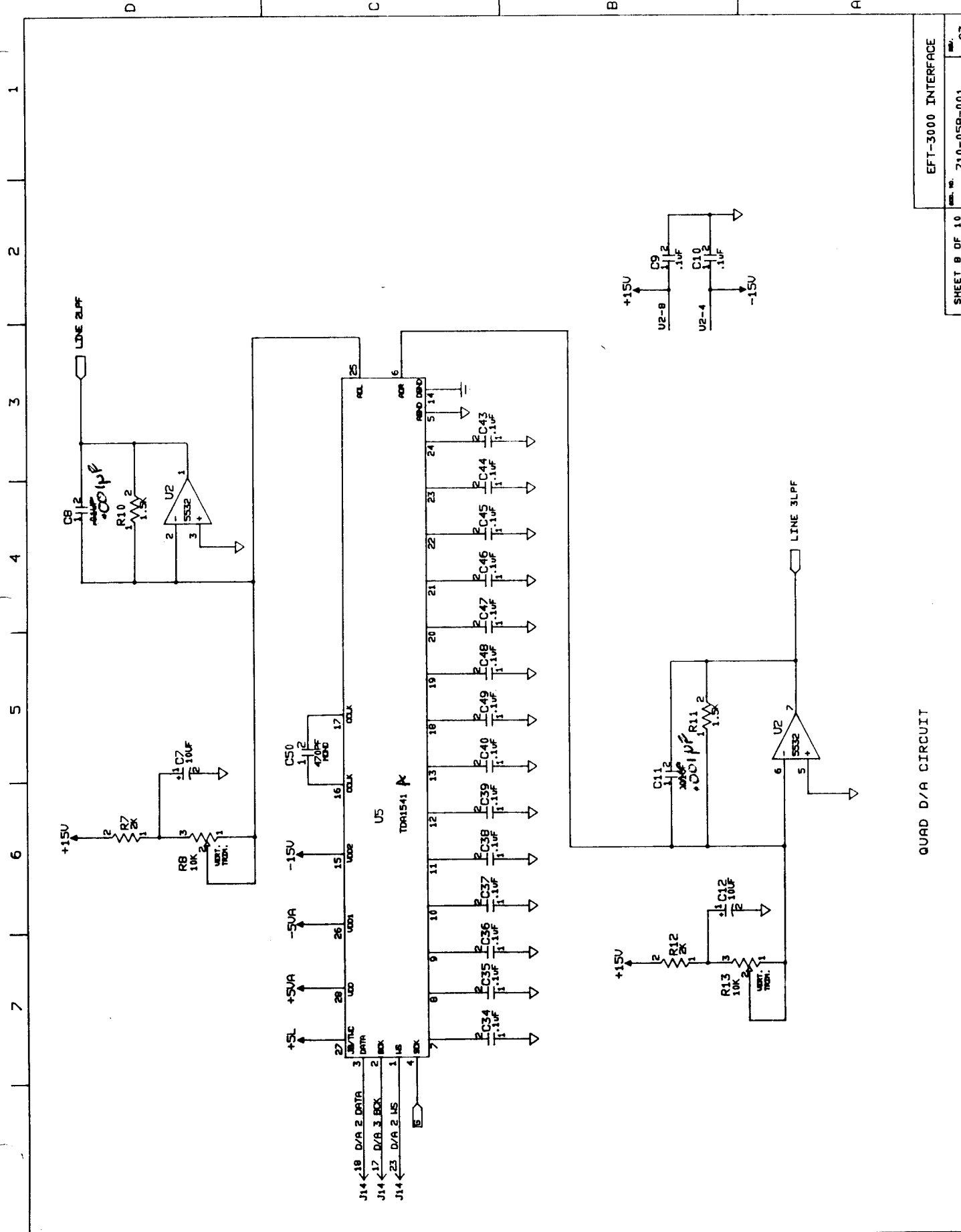
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1 2 3 4 5 6 7

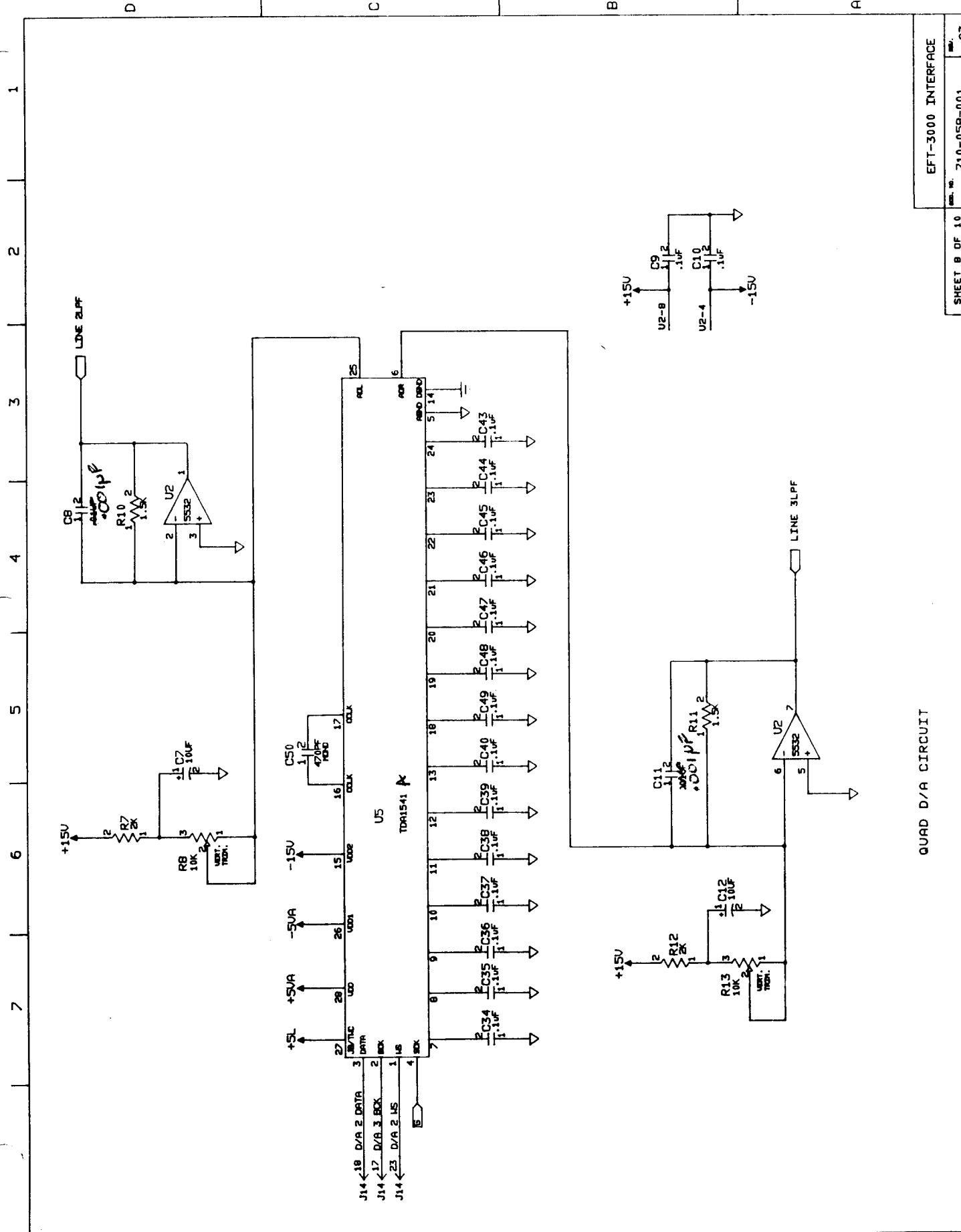


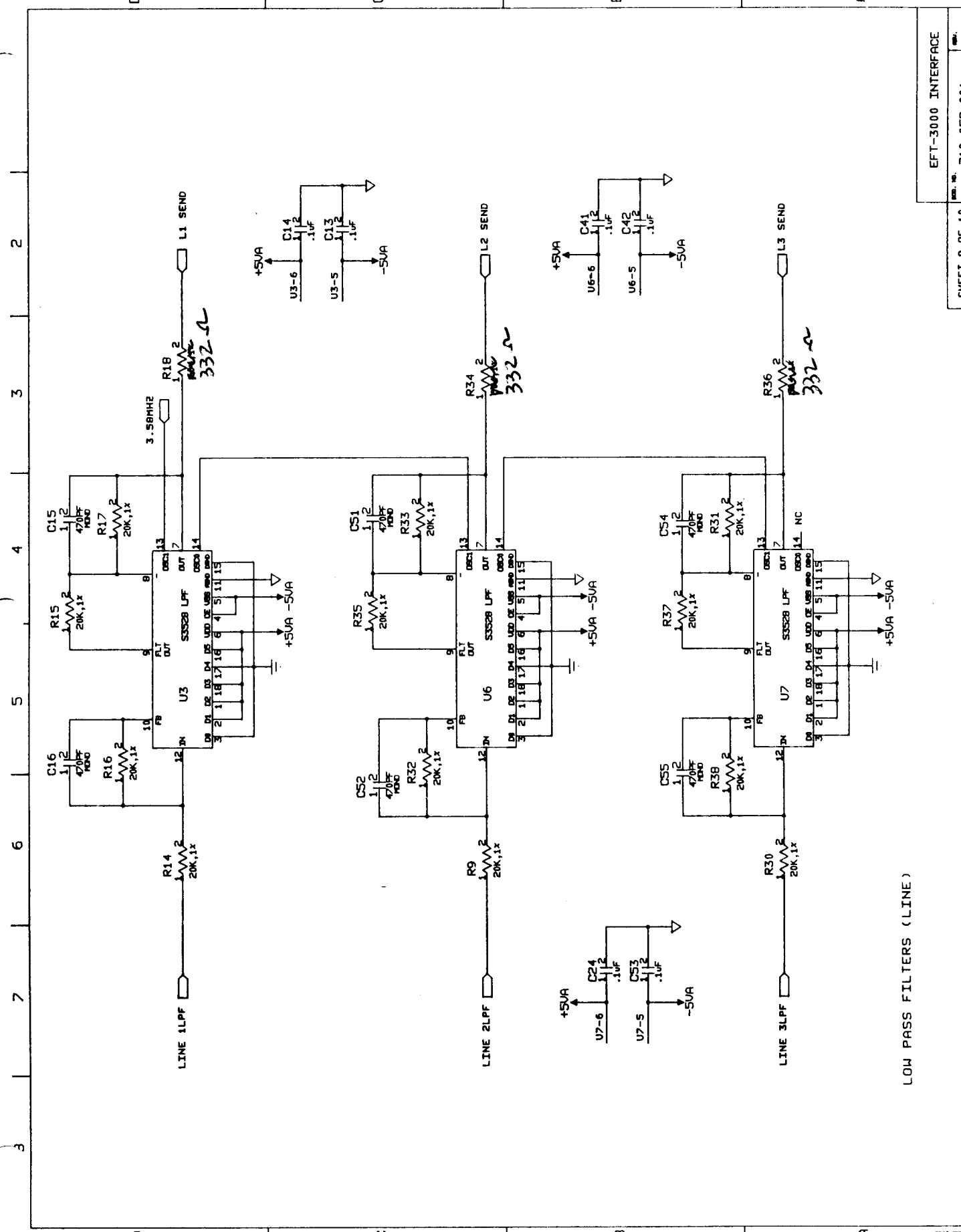
QUAD D/A CIRCUIT

1 2 3 4 5 6 7



QUAD D/A CIRCUIT



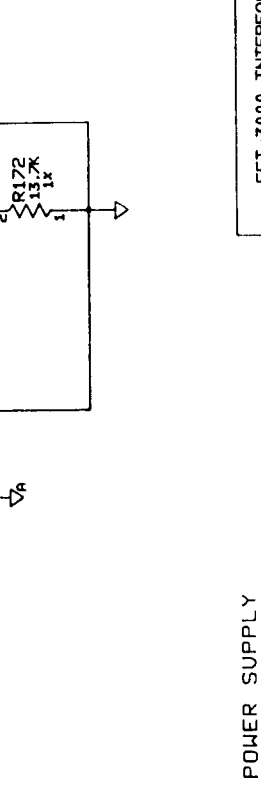
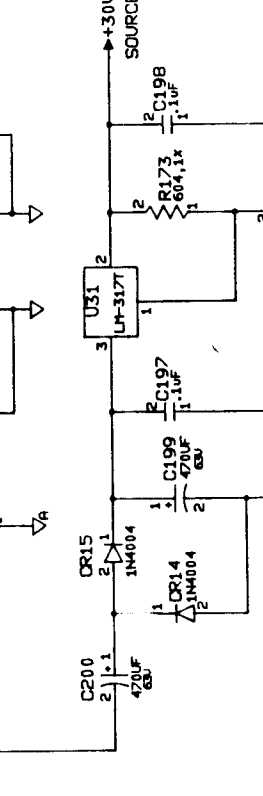
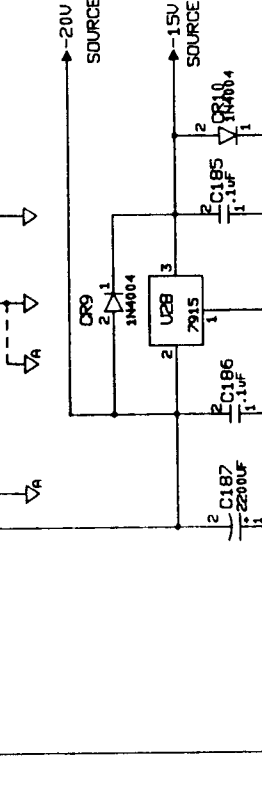
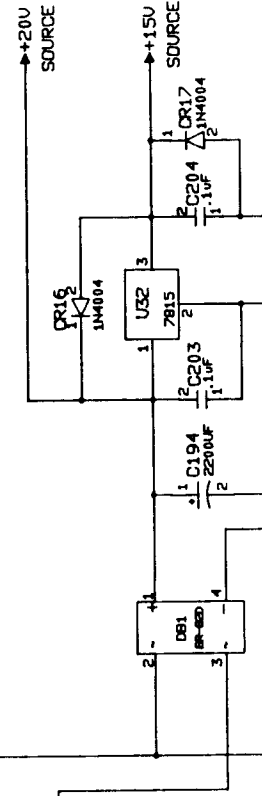
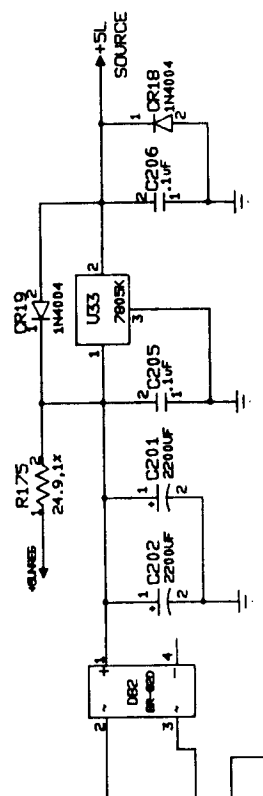
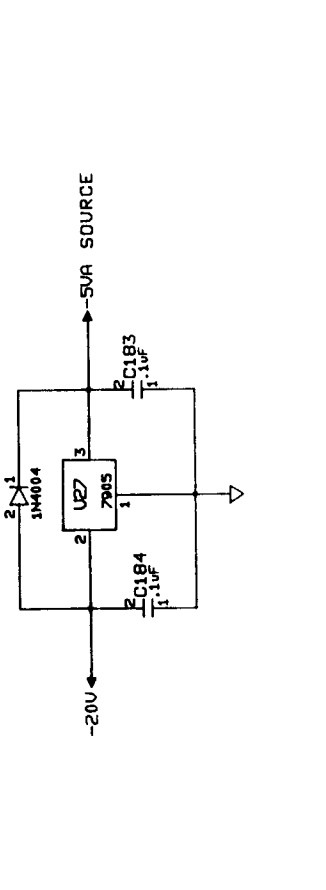
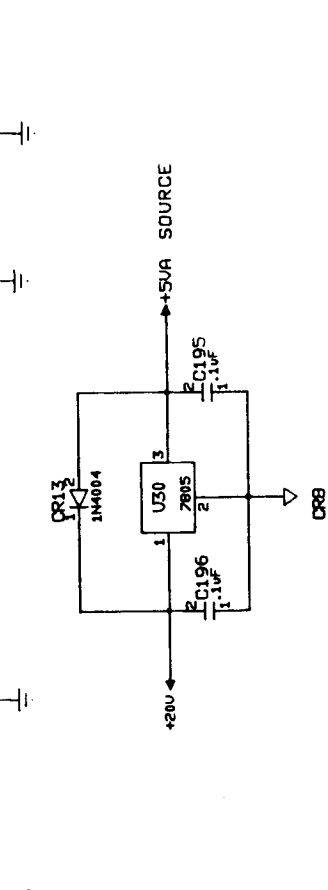
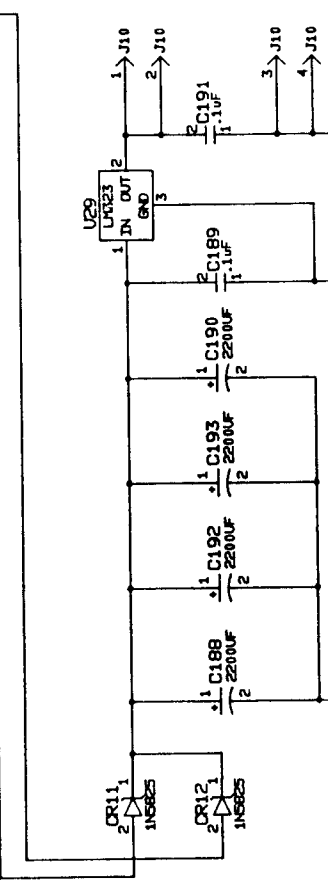
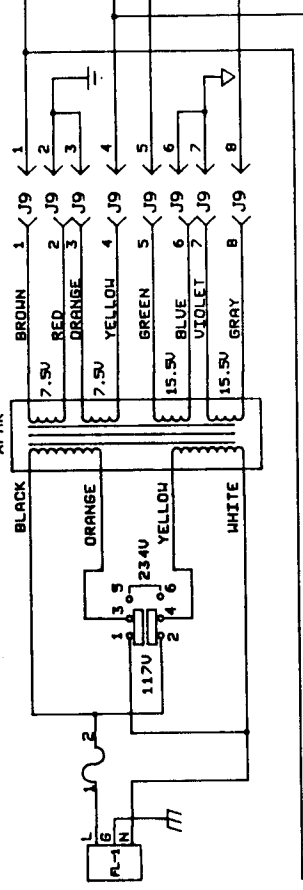


LOW PASS FILTERS (LINE)

3 4 5 6 7 8

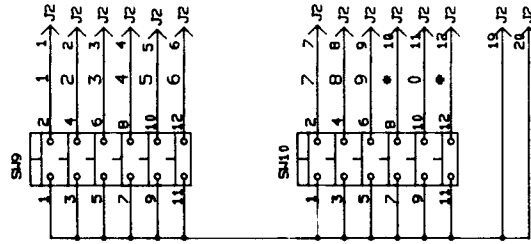
1 2 3 4 5 6 7 8

TOROID PHR
XFMR



POWER SUPPLY

DATE	LTH.	DESCRIPTION	DATE	APPROVED
ALL AT		PRODUCTION RELEASE	10/88	



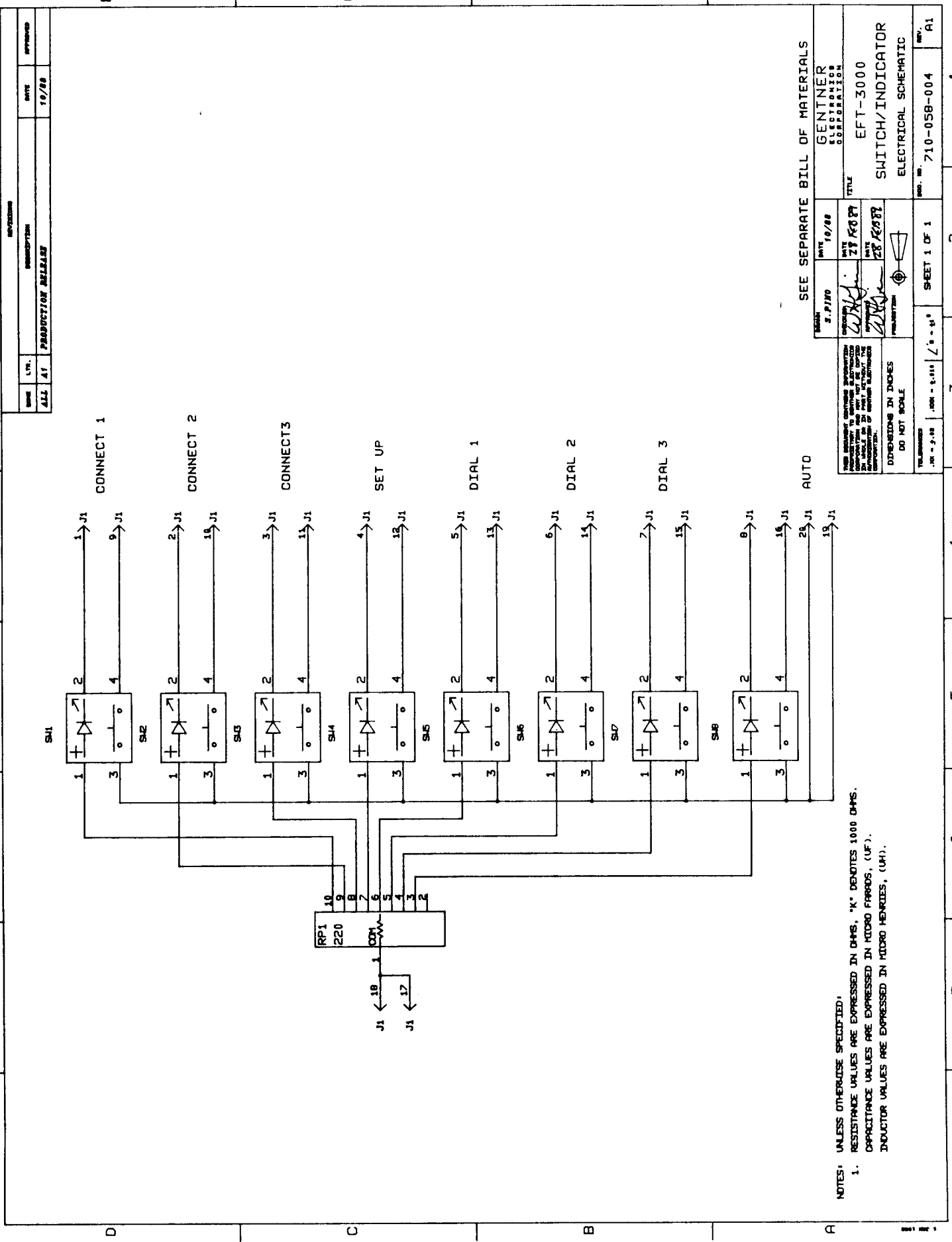
NOTES: UNLESS OTHERWISE SPECIFIED:

1. RESISTANCE VALUES ARE EXPRESSED IN OHMS, "K" DENOTES 1000 OHMS. CAPACITANCE VALUES ARE EXPRESSED IN MICRO FARADS, (UF). INDUCTOR VALUES ARE EXPRESSED IN MICRO HENRIES, (UH).

SEE SEPARATE BILL OF MATERIALS

THIS DRAWING IS UNLESS OTHERWISE SPECIFIED TO BE IN THE DIMENSIONS AND TOLERANCES SHOWN THEREON AND SHALL BE CONSIDERED AS SUCH UNLESS OTHERWISE SPECIFIED. DIMENSIONS IN INCHES DO NOT SCALE	DRAWN <i>S. PIANO</i>	DATE 10/88	GENTNER CORPORATION
	CHECKED <i>[Signature]</i>	DATE 28 FEB 89	TITLE EFT-3000 TOUCH-TONE PAD ELECTRICAL SCHEMATIC
	PRODUCED <i>[Signature]</i>	DATE 28 FEB 89	PROJ. NO. 710-058-005

TOLERANCES: .10 - .30 / .5 - .11 SHEET 1 OF 1 REV. A1



REV.	DATE	DESCRIPTION	BY	APP'D
ALL A1	10/88	PRODUCTION RELEASE		

REV.	DATE	DESCRIPTION	BY	APP'D
ALL A1	10/88	PRODUCTION RELEASE		

SEE SEPARATE BILL OF MATERIALS

GENTNER CORPORATION
EFT-3000
SWITCH/INDICATOR
ELECTRICAL SCHEMATIC

DATE: 10/88
DATE: 27 FEB 89
DATE: 28 FEB 89

PRODUCTION

DO NOT SCALE

TOLERANCES: .10" - .250" / .001" - .005"

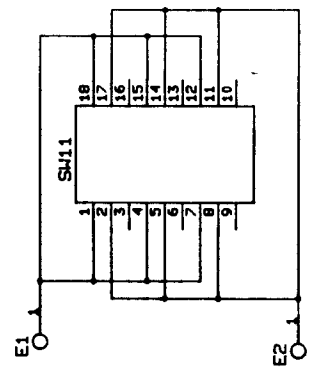
SHEET 1 OF 1

REV. A1

- NOTES:
- UNLESS OTHERWISE SPECIFIED:
1. RESISTANCE VALUES ARE EXPRESSED IN OHMS, "K" DENOTES 1000 OHMS.
CAPACITANCE VALUES ARE EXPRESSED IN MICRO FARADS, (UF).
INDUCTOR VALUES ARE EXPRESSED IN MICRO HENRIES, (UH).

1 2 3 4 5 6 7

REVIZIONS		DATE	APPROVED
NO.	DATE	DESCRIPTION	
ALL	41	PRODUCTION RELEASE	



NOTES: UNLESS OTHERWISE SPECIFIED:
 1. RESISTANCE VALUES ARE EXPRESSED IN OHMS, "K" DENOTES 1000 OHMS.
 CAPACITANCE VALUES ARE EXPRESSED IN MICRO FARADS, (UF).
 INDUCTOR VALUES ARE EXPRESSED IN MICRO HENRIES, (UH).

SEE SEPARATE BILL OF MATERIALS	
DESIGNED BY <i>[Signature]</i>	DATE 10/68
CHECKED BY <i>[Signature]</i>	DATE 28 FEB 69
APPROVED BY <i>[Signature]</i>	DATE 28 FEB 69
TITLE EFT-3000 SWITCH BOARD AUDIO PROCESSOR ELECTRICAL SCHEMATIC	
DRAWING NO. 710-058-006	
SHEET 1 OF 1	
SCALE: DO NOT SCALE	
DIMENSIONS IN INCHES	
TOLERANCES: .005 - .010	

D C B A