

**2XP**  
**Two Line Encoder**  
**Product Manual**

**2XP TWO LINE  
FREQUENCY EXTENDER  
ENCODER  
OPERATING & TECHNICAL  
MANUAL**

Comrex Corporation  
65 Nonset Path  
Acton, MA 01720  
Tel: 508 263-1800  
FAX: 508 635-0401  
Twx: 710 347-1049

The Model 2XP Two Line Frequency Extender Encoder is a direct replacement for the Model PTLX Two Line Frequency Extender Encoder. The 2XP may be used with 2XR and RTLX Two Line Decoders. (Note: The 2XP is NOT suitable for use with One Line Decoders.) The most noticeable change in the 2XP is its smaller size (about one half the volume of the PTLX). The 2XP also has updated equalization for dial telephone lines and more streamlined external controls.

### Description of Front Panel Connectors and Controls and Indicators:

**LINE 1 MODULAR JACK** - Accepts modular plug connection to dial telephone circuit. Connections are controlled by telephone selector switches on the front panel.

**LINE 2 MODULAR JACK** - Same as above, but for second line.

**LINE 3 MODULAR JACK** - Same as above, but for third line.

**TEL-SET** - This modular jack accepts the modular plug on a conventional telephone set. The telephone set is connected to either of the three lines by pushing either LINE 1, LINE 2, or LINE 3 switches in the "DIAL" section of the TELEPHONE SELECTOR.

**TEST TONE ON/OFF** - This is used for setting the two program circuits to equal level at the receiving end. When the toggle switch is in the ON position, a 1000 Hz tone is transmitted at equal levels on LINE 1 and LINE 2.

**TELEPHONE SELECTOR** - The telephone selector controls are used to establish circuit connections on dial telephone lines. It is assumed that three lines will be used for most transmissions: two lines for program transmission and one line for supervisory purposes.

The telephone selector permits connecting a telephone set to either of the three lines one at a time for dial up. After the connection has been established, lines one and two should be transferred to the program source. Line three cannot be transferred but may be placed on hold. A release button is provided for releasing any line which has its selector button pushed in. All of these switches are self indicating for visual indication of switch status.

**POWER LED** - Indicates that A/C power is connected to the 2XP.

**OVERLOAD** - This LED should blink about 15% of the time (on program peaks). This will indicate that the proper level is being fed into the 2XP. Note: If the LED does not flash at all, this indicates that the 2XP is being underdriven and maximum benefit will not be gained from the noise reduction system.

### Description of Rear Panel Connectors and Controls

**A/C POWER** - This is a three wire connector.

**INPUT** - XLR-3F connector. Input is transformer balanced, 600 ohms. The desired input level is +4 dBm. Audio is on pins 2 & 3. Pin 1 is case ground.

**2 LINES/1 LINE** - This switch permits the conversion of the 2XP to a single line transmitting frequency extender. It is used if only one line is available or if there is failure of one line.

**NORMAL/REVERSE LINE 1 & 2** - This switch permits reversal of the order of lines. In the event that one line fails, it may be either the line used for low band transmission (normally line 1) or the line used for high band transmission (normally line 2). In the event of line failure, the low band must be transmitted on the surviving line. If line 2 were to fail and the low band is being trans-

mitted on line 1, this switch would remain in the NORMAL position. If line 1 were to fail and the low band is being transmitted on line 1, this switch would be changed to the REVERSE LINE 1 & 2 position. (In both cases, the 2 LINES/1 LINE switch would be placed in the 1 LINE position.)

EQ IN/OUT - EQ IN provides send equalization for use on older loaded telephone circuits. The use of equalization on other circuits is a "judgement call."

115/230 - Selects power supply voltage.

### **2XP SETUP:**

1. Plug the 2XP into A/C Power. If you are operating within the US, set the 115/230 switch to 115. If operating outside the US, set this switch according to the local voltage supplied.

2. Connect your program source to the 2XP input on the rear panel. The output of your console is connected directly to the input connector of the 2XP. This connector is an XLR-3F so you will need a 3 pin male mating plug on your cable. Pin 1 is case ground, Pin 2 is audio low and Pin 3 is audio high.

It is assumed that the program source referred to herein will be some variety of console. The 2XP is designed for a +4 dBm input level. This is a 600 ohm transformer balanced input. You can check that the proper level is being fed to the 2XP by looking at the SEND LEVEL LED on the front panel which should blink approximately 15% on program peaks. If the LED is steadily illuminated, you are overdriving the input level and will probably cause distortion. If the LED is not blinking, you are underdriving the 2XP and will render the noise reduction system useless.

3. Connect the 2XP to the Dial Telephone Circuits. In many cases, the telephone company will terminate its dial telephone lines in modular jacks. In this instance, connection to the 2XP is by means of a cord with modular

plugs at both ends. These are available at various telephone and electronic stores. In some instances, the telephone company will provide only a connector block which has screw terminals. It will be necessary to obtain connecting cords which have spade lugs on one end and a modular plug on the other. The cord with spade lugs will usually have four wires: red, green, black and yellow. The red is RING and the green is TIP. The connector block will either be marked T and R or will have red and green wires appearing at the block. The spade lugs should be connected to the matching color wires.

After the telephone modular jacks have been located, they should be designated as LINE 1, LINE 2, and LINE 3 to avoid confusion later. One of the connecting cords should be inserted into the wall jack marked LINE 1 and the other end should be inserted into the jack marked LINE 1 on the front panel of the 2XP. The same should be done for the remaining two lines. A telephone set with a modular plug cord should be inserted into the jack marked TEL SET on the front panel of the 2XP. This is all of the hookup necessary to connect to dial lines.

4. Check that switches are set as follows:

NORMAL/REVERSE LINE 1&2 to NORMAL

2 LINES/1 LINE to 2 LINES

TEST TONE ON

EQ IN/OUT - The position of this switch will depend on the characteristics of the lines and is a judgement call.

5. Dial the Receive Site as follows:

Push Dial/Line 1 in the Telephone Selector. You should hear dial tone in the telephone handset. Dial the number to which the line 1 receive coupler has been connected. Wait for the station phone to answer. (You may hear a short beep or silence if the phone answers automatically.) When the connection has been established, push the TRANSFER button for LINE 1 to transfer the line from

DIAL to PROGRAM. Repeat the above steps for Line 2.

If a communication line is being used on line 3, dial line 3 as above. This line may be put on hold by pushing the HOLD/LINE 3 button.

#### CAUTION

BE SURE THAT THE DIAL SELECTOR SWITCH IS ON LINE 3 OR RELEASE DURING PROGRAM TRANSMISSION. IF THE DIAL SELECTOR SWITCH IS LEFT ON LINE 1 OR LINE 2 WHILE TRANSMITTING PROGRAM AND THE TELEPHONE HANDSET IS NOT HUNG UP, UNEXTENDED BACKGROUND NOISE WILL BE PICKED UP BY THE MICROPHONE OF THE TELEPHONE INSTRUMENT AND BE FED DOWN THE LINE ALONG WITH THE EXTENDED PROGRAM MATERIAL. IN ADDITION, THE TELEPHONE SET WILL LOAD DOWN THE LINE SO THAT THE SIGNAL LEVEL WILL BE TOO LOW.

6. Allow sufficient time for the receive site to adjust the program lines to equal level based on the TEST TONE from the 2XP. If this is done automatically by means of an LX-L auto leveler at the receive site, leave the TEST TONE on for about 20 seconds. Then turn the TEST TONE off and feed a program test. Check with the receive site to determine whether the EQ in the 2XP should be set IN or OUT.

This completes the setup of the 2XP.

#### Single line operation

In certain cases, it may not be possible to obtain two or three lines from a given site. In this event, the 2XP and 2XR may be converted to single line operation by setting the 2 Lines/1 Line switches on both the 2XP and 2XR to 1 Line and transmitting program down Line One only. The 2XP and 2XR cannot be used with One Line Frequency Extenders, however, because the One Line systems do

not contain the reciprocal noise reduction circuitry.

#### In Case of Line Failure

If a line fails, it will be necessary to convert the two line system into a one line system and to transmit the one line output on the surviving line. When the system is converted to one line, the following happens: The output of the high band compressor is summed with the output of the lowband compressor and results in a wideband feed to the low band upshifter. The transmission will go through the telephone line and emerge as 50 - 2850 Hz. Naturally, it will not be of the same bandwidth as that of the full system, but it will still be quite usable.

If one of the lines fail and one remains, then the survivor line will be used to carry the single line output. One can never be sure which line might fail and so the Comrex two line system has facilities provided for switching the wideband single system to whichever line survives.

On the 2XP rear panel, you will find two switches contained within a rectangular border. These are labeled 2 LINES/1 LINE and NORMAL/REVERSE LINE 1&2. You will find the same pair of switches on the front panel of the 2XR.

To better understand the operation of these switches, assume that you have set up the system as described previously and that it is working properly. Assume that you are in contact with the receiving site by means of the third line. Now assume that line 2 fails. (The presumption is that the telephone line itself has failed.) At the transmitting end, the operator will have no way of knowing that the line has failed, but at the receiving end, the high frequencies will either disappear or an upshifted dial tone will be heard. The receiving site operator will immediately throw his 2 LINES/1 LINE switch to 1 LINE and the dial tone will disappear, but there will be no frequencies above 2400 Hz. The transmitting

site operator, upon notification that line 2 has failed, will then throw his 2 LINES/1 LINE switch from 2 LINES to 1 LINE. This will increase the high frequency response of the system to 2850 Hz. The operators can then reestablish the lost line connection and return to 2 line operation. NOTE: THIS SHOULD BE DONE DURING A PROGRAM BREAK AS IT WILL BE NECESSARY TO RESET THE LINE LEVELS WITH THE TEST TONE.

If line 1 fails, the receiving site operator will hear a loss of low frequencies or a down-shifted dial tone. The two operators can then perform the conversion to one line operation described above and, at the same time, operate the REVERSE LINES 1&2 switch which will place the line 1 audio onto the surviving line (line 2). Again, after the failed circuit is reestablished, the system may be converted to two lines and the lines either switched back to NORMAL or left where they are for the duration of the program.

### Line Equalization

As part of the second generation 2X system, Comrex has included user adjustable EQ circuits on both the send and receive portions of the system. Once set properly, these equalizers should significantly improve your performance when working on poor telephone lines. Both the 2XP and 2XR EQ circuits will lift the response of the high end of the telephone line, where response "droop" is most common.

It is important to understand that any phone line response problem exists between you and your central office, not on the toll network. With few exceptions, all Central Office interconnects are digitized and can be assumed to have a flat response. For this reason, you must keep in mind that you are equalizing ONLY your local loop to your central office.

If you intend to use the 2XP on the same telephone lines at all times (i.e. studio to studio links), you may wish to measure the frequency response of your telephone lines

and fix the equalization on the 2XP if you find that one or both of your lines have a poor high frequency response. (See "How To Measure Your Telephone Lines" at the back of this manual.) With the EQ switch in the "IN" position, the equalizers become active and you can adjust the high end of each line for the flattest response using the pots clearly marked on the bottom of the board.

If you plan on using the 2XP from many different places, we recommend you leave the EQ settings as they are. They are factory adjusted to compensate for the average "poor" telephone line when the EQ switch on the rear panel is in the IN position. If your receive site complains about a "muddy" or "dull" sound, try flipping the EQ IN. Remember that in most cases, however, the EQ switch should be left in the OUT position.

### Basic Trouble Shooting

The Comrex two line frequency extension system is designed to operate for long periods of time without adjustments of any kind. The frequency determining components are crystals and will stay on frequency without need for adjustment almost indefinitely. In the event that trouble does occur, Comrex Corporation stands ready to assist in any way it can.

As a first step, may we suggest a careful inspection of connecting cables and fuses. Most often these are the causes of failures.

Please feel free to call our engineering department at (508) 263-1800. We are usually available between the hours of 0900 & 1800 (US Eastern Time) Monday - Friday of each week. Our FAX number is (508) 635-0401. If, due to time zone problems, you are unable to reach us during the above hours, please notify us by FAX and we will make an engineer available for a call in your time frame or advise you by return FAX.

Our factory service is always available. Express services, able to provide next day service, are available from most parts of the United States and many other parts of the world.

# How to Measure a Telephone Line

If your station puts telephone calls on air in any of your locally produced programming, we urge you to make the time to take a careful look at the actual telephone lines you are using. Comrex Corporation has been involved in telephone interface for over 15 of its 28 years. In the course of our work, we've measured several hundred telephone circuits. (Indeed, we're lucky that our chart recorders don't put in for overtime!) What we have found is that all telephone lines are definitely NOT created equal and to the degree that they fall away from the norm, they can wreak havoc with any telephone interface equipment on that line. Telephone hybrids won't balance properly, frequency extenders produce poor results, noise reduction systems run amok and so on.

In this application note we will discuss how you can measure your phone lines and what you are actually looking at. We'll go on to look at what might be the causes of any deficiencies in your lines and give you some suggestions as to how you might go about dealing with them.

First, we'd like to point out that the only portion of a telephone circuit over which you are likely to have any control is the subscriber loop running from your station to the telephone central office. The subscriber loop consists of a SLIC (Subscriber Line Interface Card) at the central office, a loop usually made up of #24 or #26 gauge twisted wire and a modular or punch block connector at the station end. Unless the phone company reconstructs that line or moves to another location, the characteristics of that loop remain constant.

One of the functions of the SLIC is to convert your "two wire" subscriber loop to "four wire." The send and receive ports of the hybrid are then connected to digital encoder/decoders for transmission to other central offices through other CODECs and SLICs to other subscriber loops and callers. Once your call has been digitized, you have no further "metallic" connection to the outside world and therefore it is impossible for you to control the impedance characteristics of the circuit beyond the SLIC.

When Comrex moved to a new facility, we made frequency response measurements of all our subscriber loops by sending a frequency sweep of 50 Hz to 5000 Hz out one line and back into another line, measuring at the point the line entered the building and not downstream of our in house PABX. We repeated this, choosing different lines until we found a fairly flat response from 300 Hz to 3000 Hz on a pair of lines (see Chart 1). We then knew that both Lines A and B were reasonably good and we established Line A as our reference against the rest of the lines to our building. When we looked at Line A through Line C, we found that there was a marked difference in the high frequency response between 2000 and 3000 Hz. (See chart 2) The A to B circuit was down 2 dB at 2 KHz and 6 dB at 3 KHz while the A to C circuit was down 8 dB at 2 KHz and 12 dB at 3 KHz. While Line C might be acceptable for normal telephone use, it would be very difficult to obtain an adequate hybrid balance for on air use. Similarly, any companding or processing system on that line will accentuate the high end droop. The likely cause of the high frequency rolloff of line C is a bridged tap on the subscriber loop.

Comrex Corporation  
65 Nonset Path  
Acton, MA 01720  
(508) 263-1800

**COMREX**

Telephone companies usually follow major arteries and their cross streets when installing cables. Whenever these cables cross, a junction box is provided. If new service is requested, a connection is made at the nearest junction box and later if that service is stopped, the service on that line is denied by a digital command to the SLIC at the central office. If another new service request comes for a site a couple of blocks down, the telephone company may use the same line on the main artery and simply connect to the junction box two blocks down. If they don't remember to disconnect the first cross street cable, the new line will consist of a cable between the central office and the new site PLUS an open ended piece of cable going down the first cross street.

This is called a bridged tap and it is quite possible to have more than one on a line. Because it is open ended and not terminated, it is simply a large capacitor connected across your line. It's a great source of noise and its capacitance is more sensitive to the environment than a discrete capacitor would be. Also, its presence will make hybrid balance difficult.

Bridge taps are a fairly common problem. Other hazards include loading coils which are often used by the phone company to improve the high end response of subscriber loops over 6000'. These can produce widely varying impedances across the 300 to 3000 Hz band and provide complications for any telephone hybrid on that loop.

If you have identified certain lines as "problem lines," what can you do about them? In the case of the bridge tap, armed with your frequency response measurements, you can call the telephone company and ask them to remove it. We know of some broadcasters who have actually been able plead their case and get results. If you can't get the line fixed, you might try asking for a special "data conditioned" line. In this instance, the phone company installs a "conditioning box" at your SLIC which equalizes the loop to some extent. This is typically used for high speed modem applications. The line has all the characteristics of a normal dial business line but costs somewhat more (about \$15/mo).

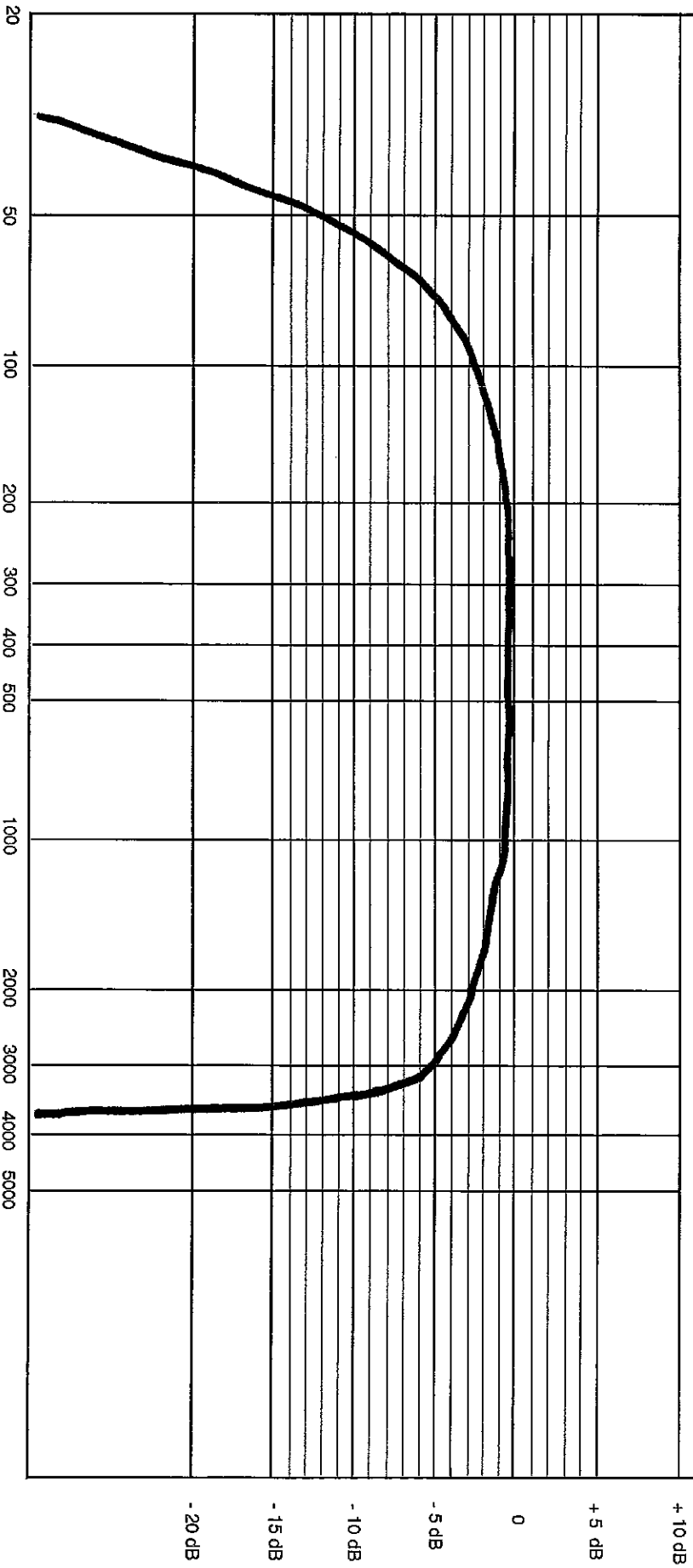
Another approach would be to put an equalizer on the line at the station. This would not help a hybrid since it won't equalize both ways, but it would take care of one-way feed applications. Perhaps the simplest approach would be to mark all the lines you do not want to use on air and give them to the business office. They're fine for run of the mill conversation and you can save the good ones for your programs.

Comrex Corporation  
65 Nonset Path  
Acton, MA 01720  
(508) 263-1800

**COMREX**



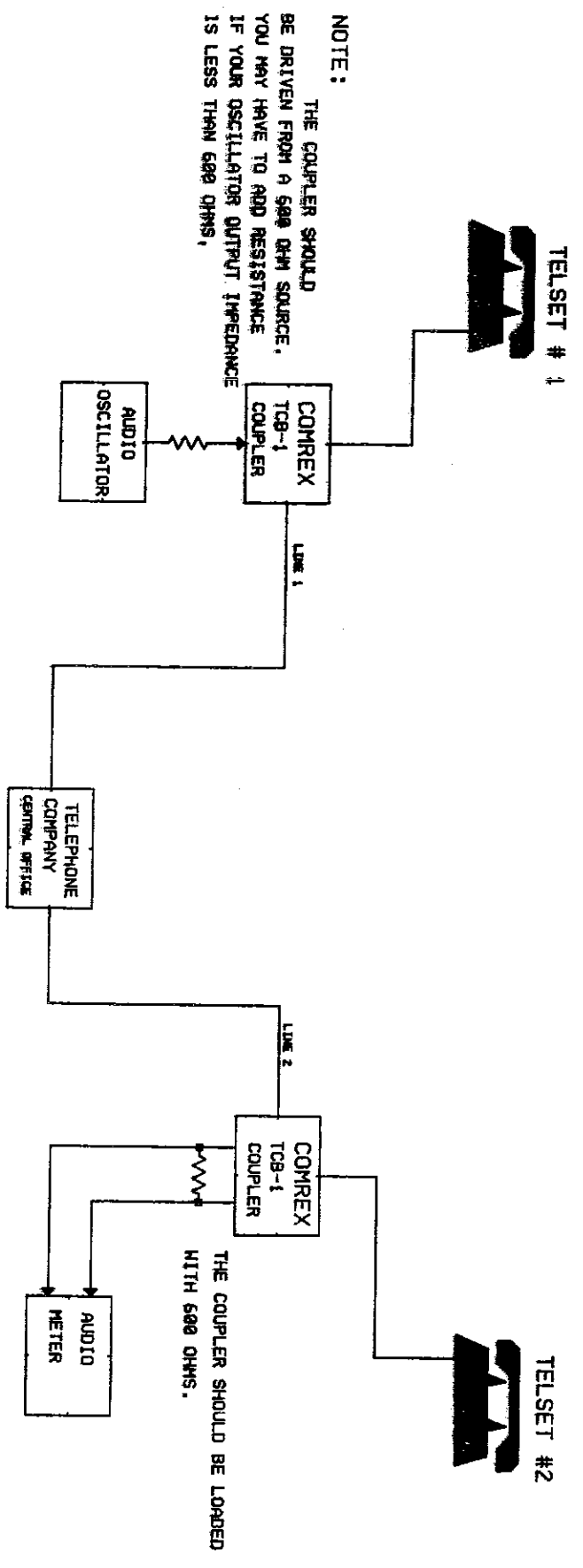
Frequency Response Line A to Line B



*These are good lines.  
This shows what the  
telephone company can do.*

FREQUENCY IN CYCLES PER SECOND

# HOW TO MEASURE THE FREQUENCY RESPONSE OF YOUR TELEPHONE LINES.



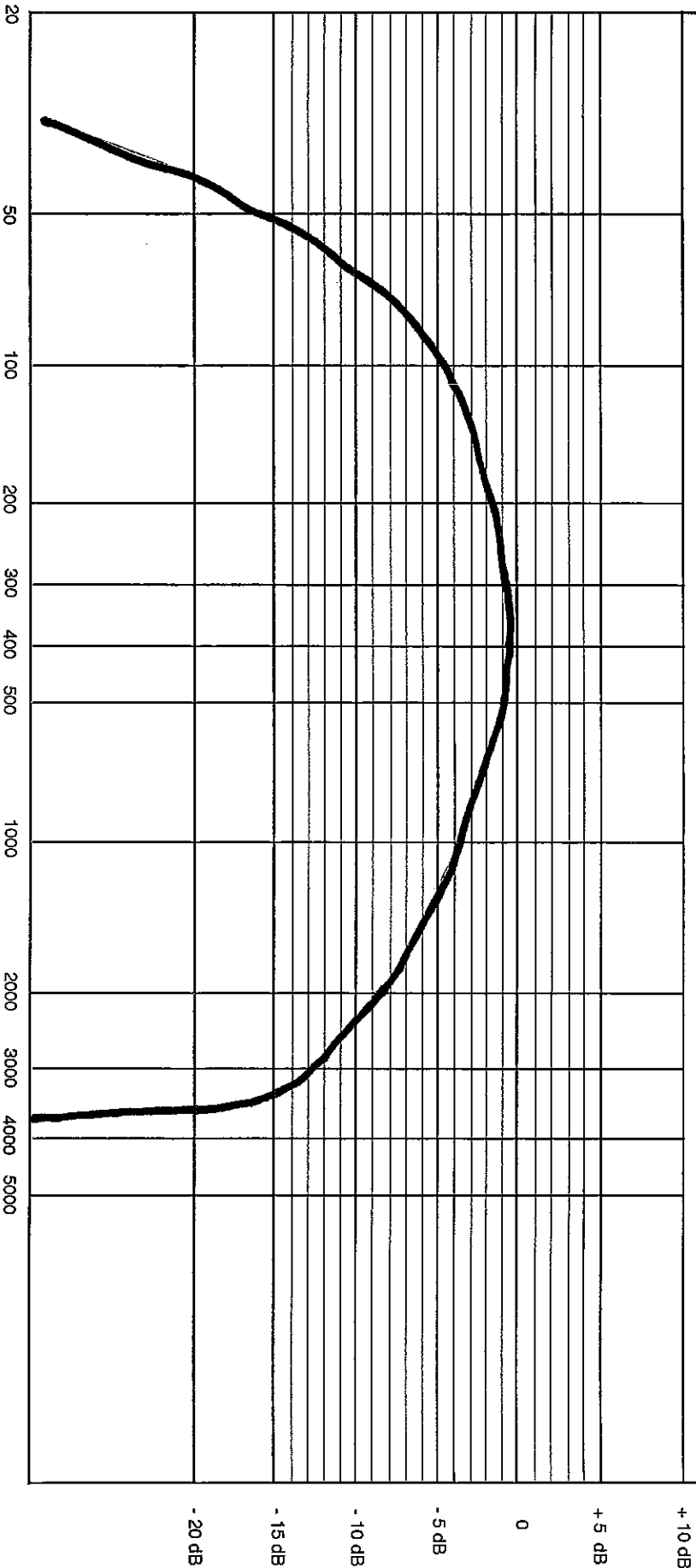
**NOTE:**  
 THE COUPLER SHOULD BE DRIVEN FROM A 500 OHM SOURCE. YOU MAY HAVE TO ADD RESISTANCE IF YOUR OSCILLATOR OUTPUT IMPEDANCE IS LESS THAN 600 OHMS.

- PROCEDURE:**
1. CONNECT THE COUPLERS TO THE DIAL TELEPHONE LINES.
  2. MAKE CERTAIN THAT THE COUPLERS ARE NOT IN "SEIZE".
  3. FROM TELSET #1 DIAL TELSET #2.
  4. WHEN TELSET #2 RINGS PICKUP TELSET #2 OR PLACE COUPLER IN "SEIZE".
  5. PLACE BOTH COUPLERS IN "SEIZE" AND HANG UP THE TELEPHONE SETS.
  6. SET THE OSCILLATOR FOR 250 MILLIVOLTS OUTPUT AT 1 KHZ. YOU SHOULD SEE A READING ON THE AUDIO METER. ADJUST EITHER THE OSCILLATOR OUTPUT OR THE METER SENSITIVITY TO OBTAIN A CONVENIENT READING.
  7. VARY THE OSC. FREQ. OVER THE RANGE 50HZ TO 5KHZ.
  8. RECORD THE READINGS AND PLOT THE RESPONSE CURVE.

XXXXX ALL CIRCUIT DESIGNS COPYRIGHT © BY COMEX CORPORATION-ACTION, WA 81728-1968

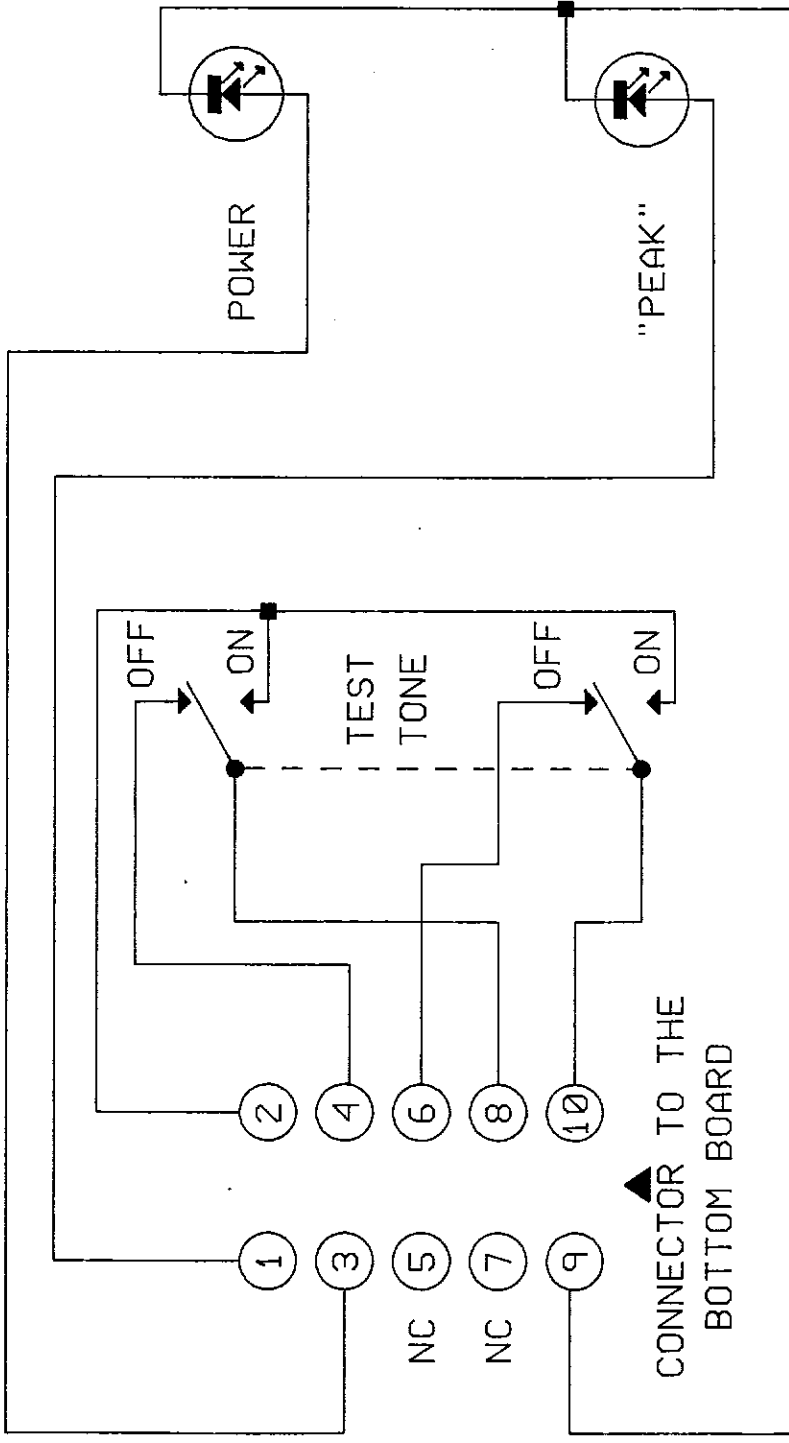
<b>COMEX CORP.</b>	
ACTION, WA 81728 U.S.A.	
TITLE TELEPHONE LINE	
DATE FREQUENCY RESPONSE MEASUREMENT	
27 SEPT 64	DRG. NO.

Frequency Response Line A to Line C

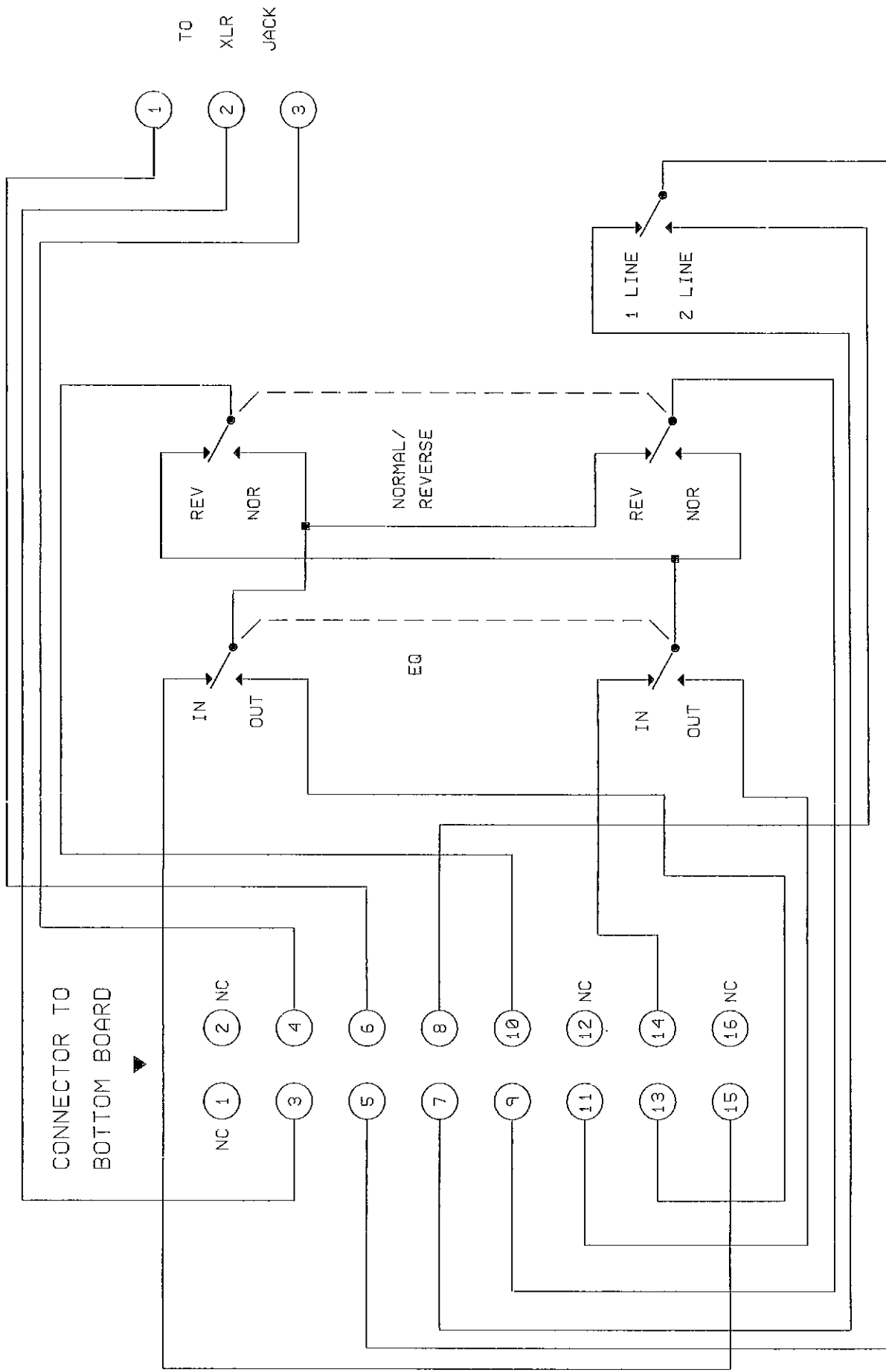


*Note the high end rolloff. Since we know that Line A has a flat response, we can conclude that Line C is the one with bridged tap.*

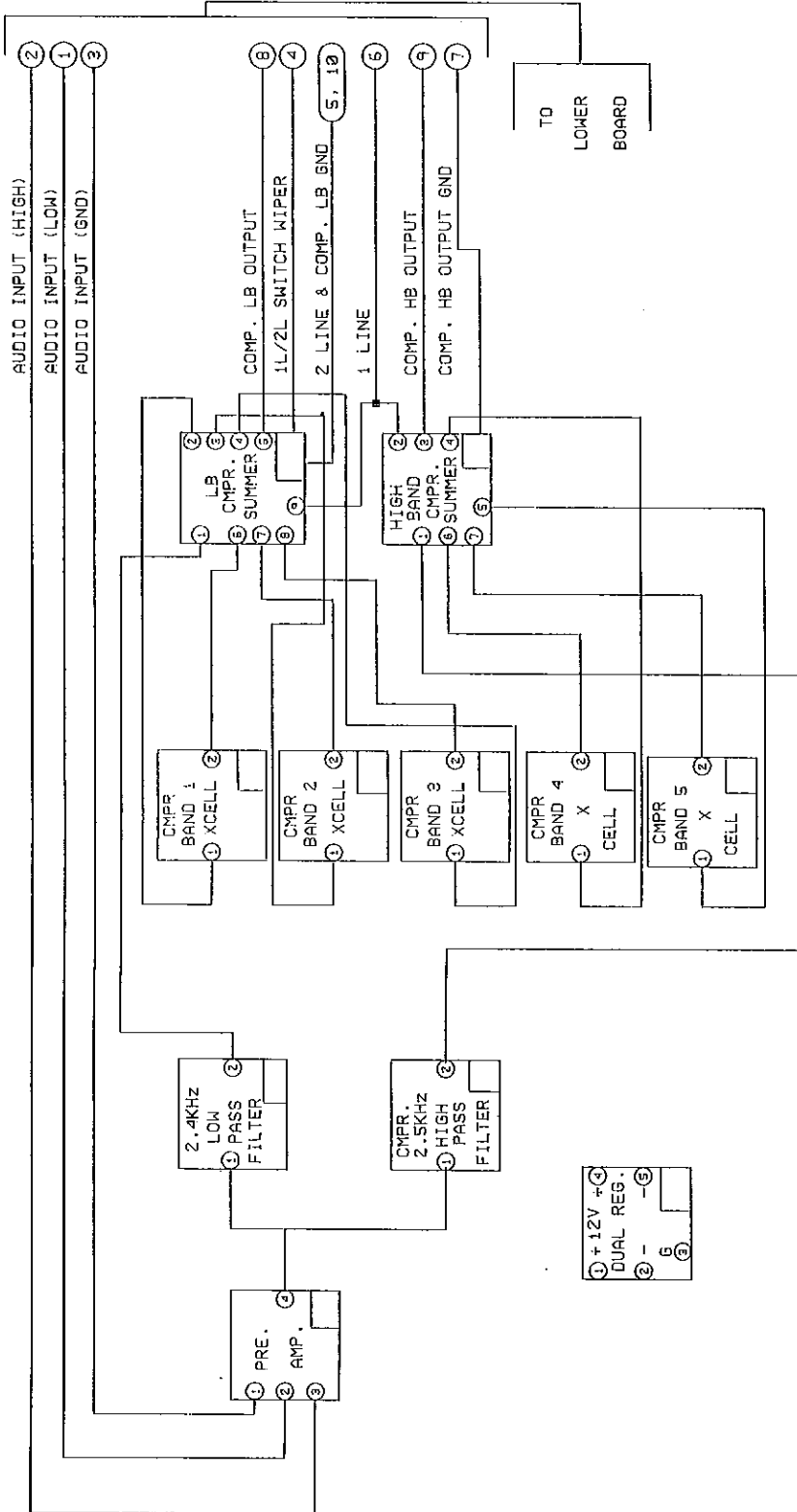
FREQUENCY IN CYCLES PER SECOND



# ZXP FRONT PANEL BOARD



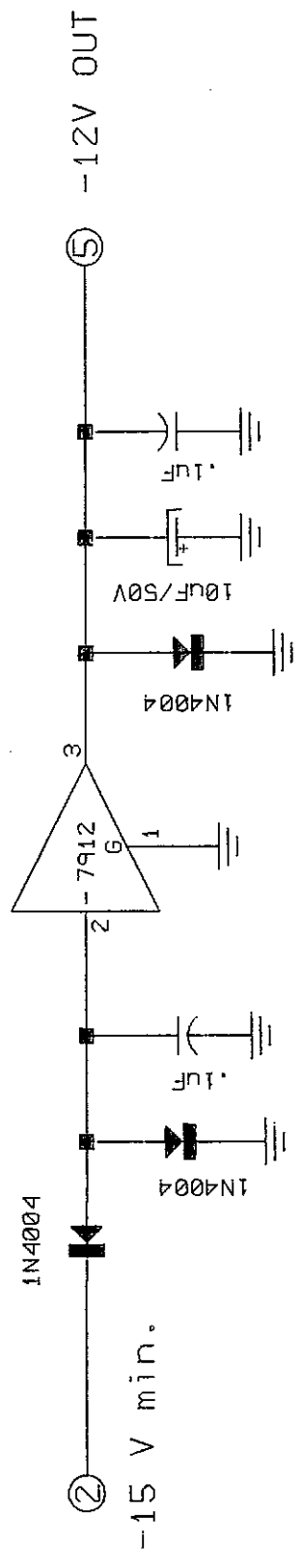
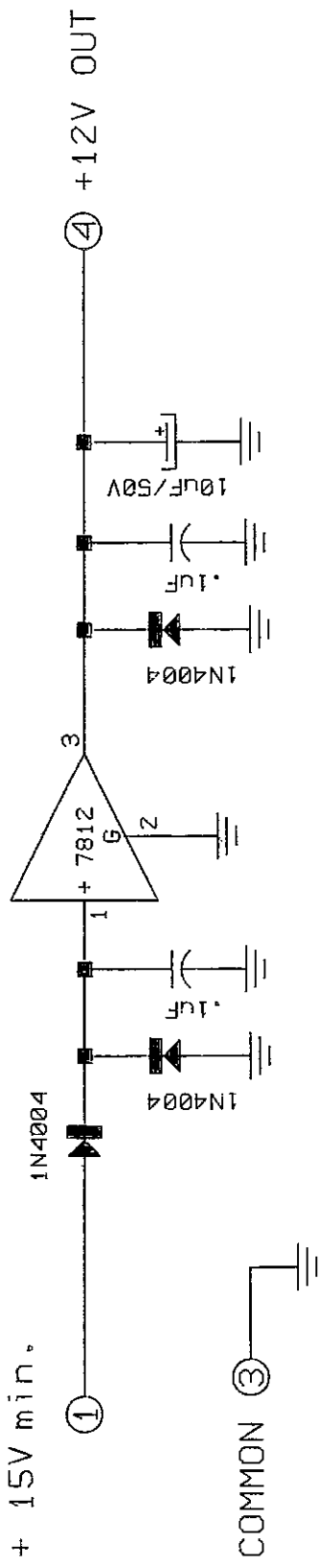
ZXP REAR PANEL BOARD



# ZXP UPPER BOARD

COMREX Corp.  
 ACTON, MA 01720 U.S.A. (617) 253-1988

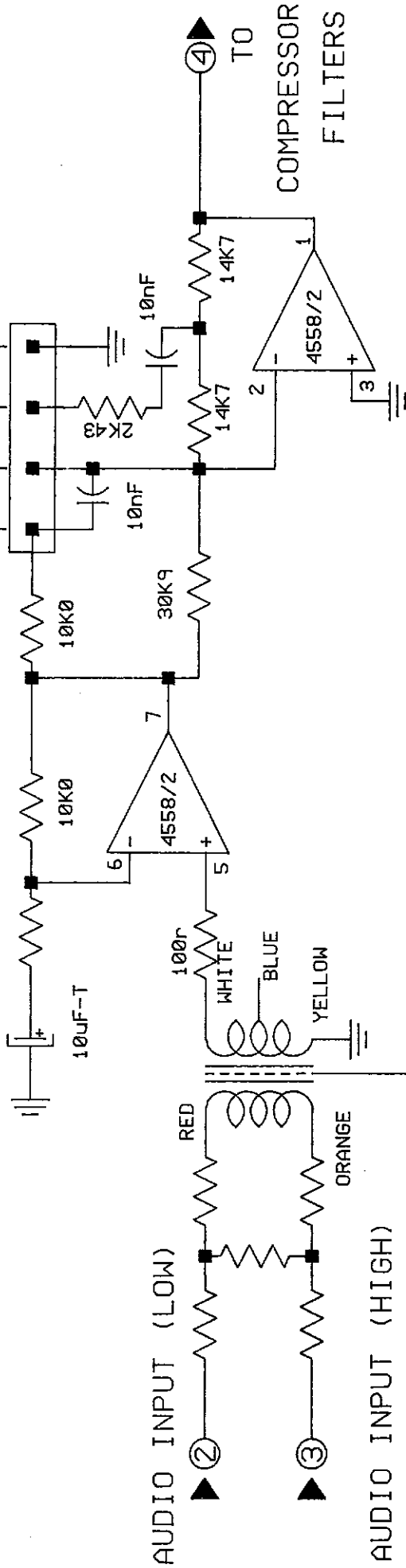
TITLE \_\_\_\_\_  
 DATE \_\_\_\_\_ DWG. NO. \_\_\_\_\_



# 12 V. DUAL REGULATOR

PRE-EMPHASIS

"OFF" "ON"



AUDIO INPUT (LOW)

AUDIO INPUT (HIGH)

AUDIO INPUT (GND)

BLACK

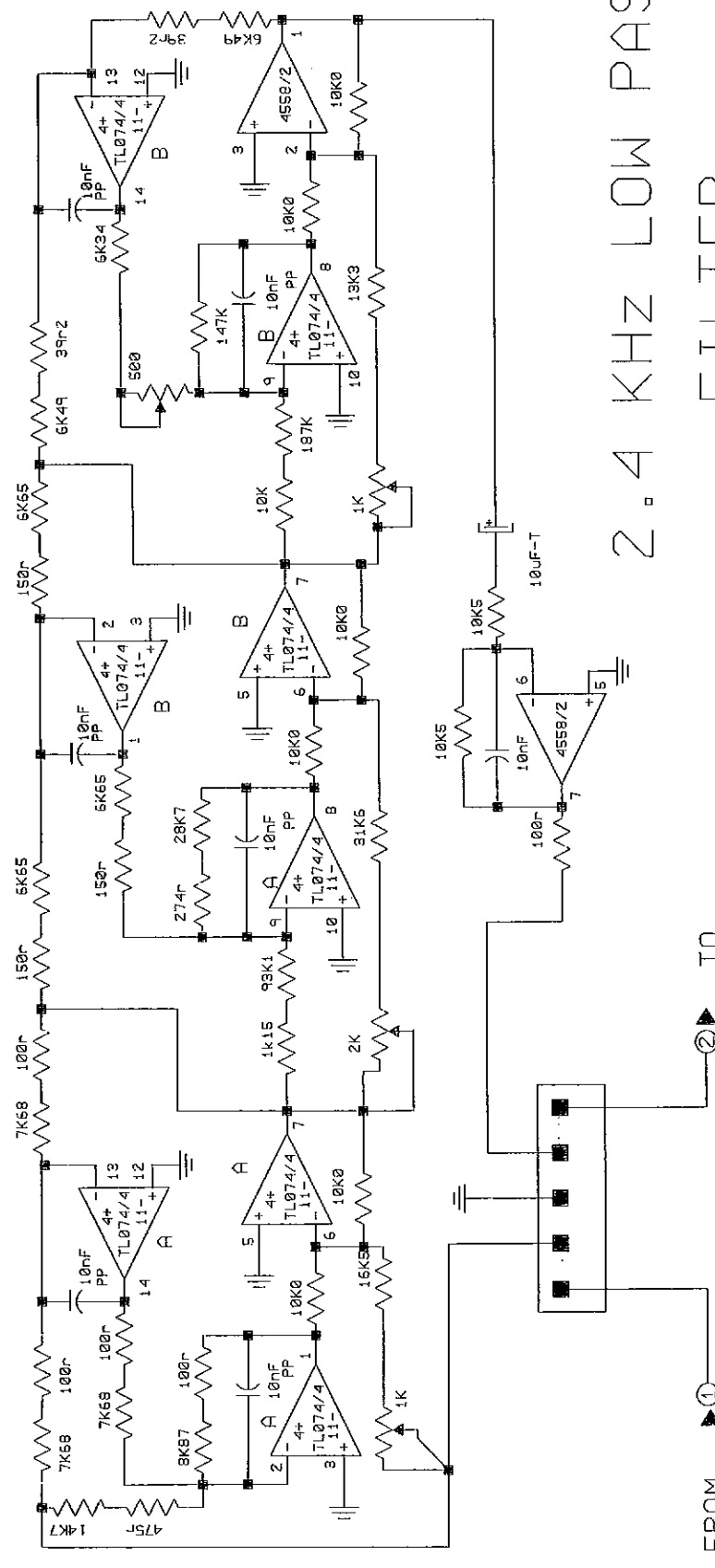
TRANSMIT PRE-AMPLIFIER

AUDIO INPUT (GND)

COMPRESSOR  
FILTERS

T0





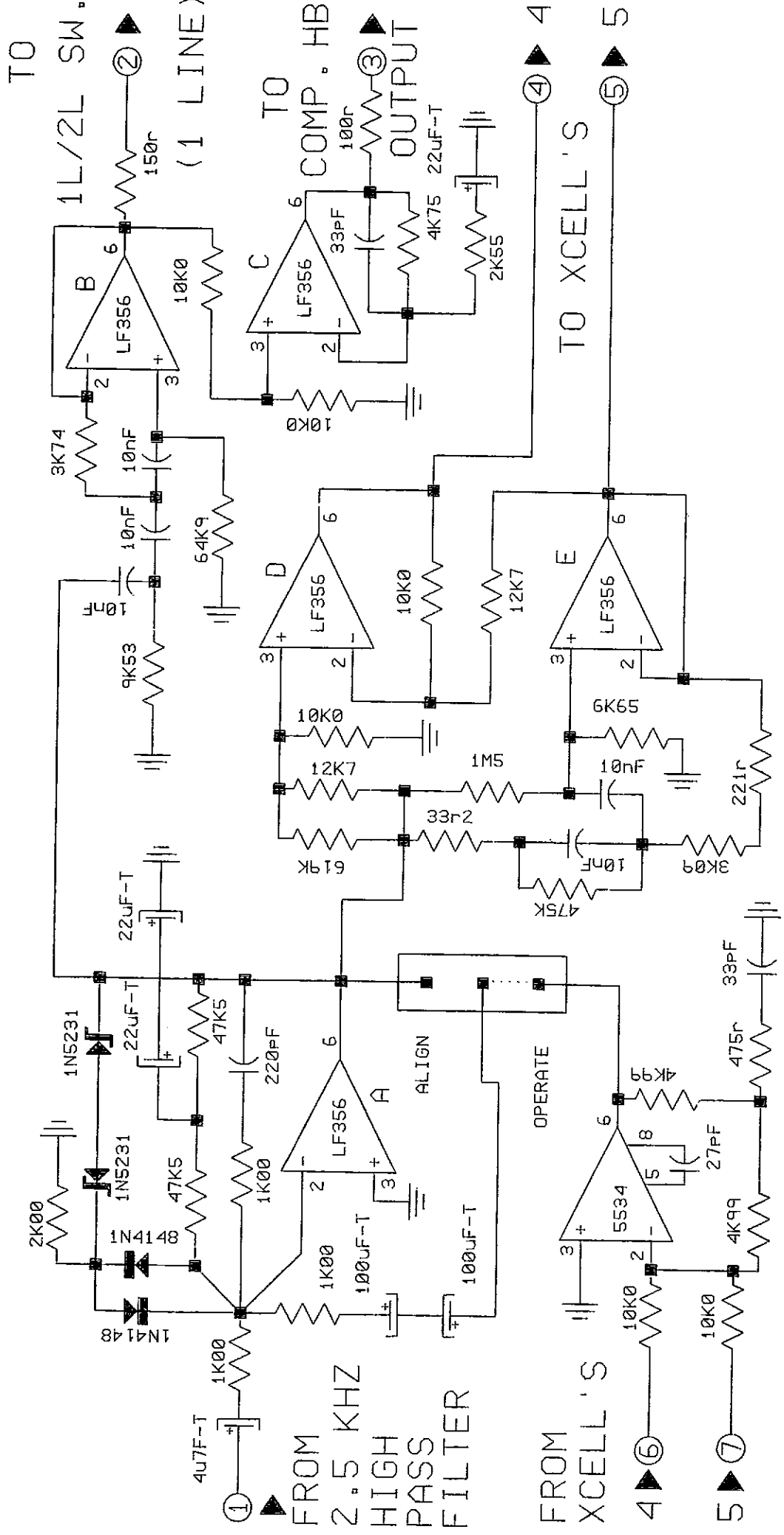
# 2.4 KHZ LOW PASS FILTER

FROM PREAMP TO LOW BAND COMPRESSOR SUMMER

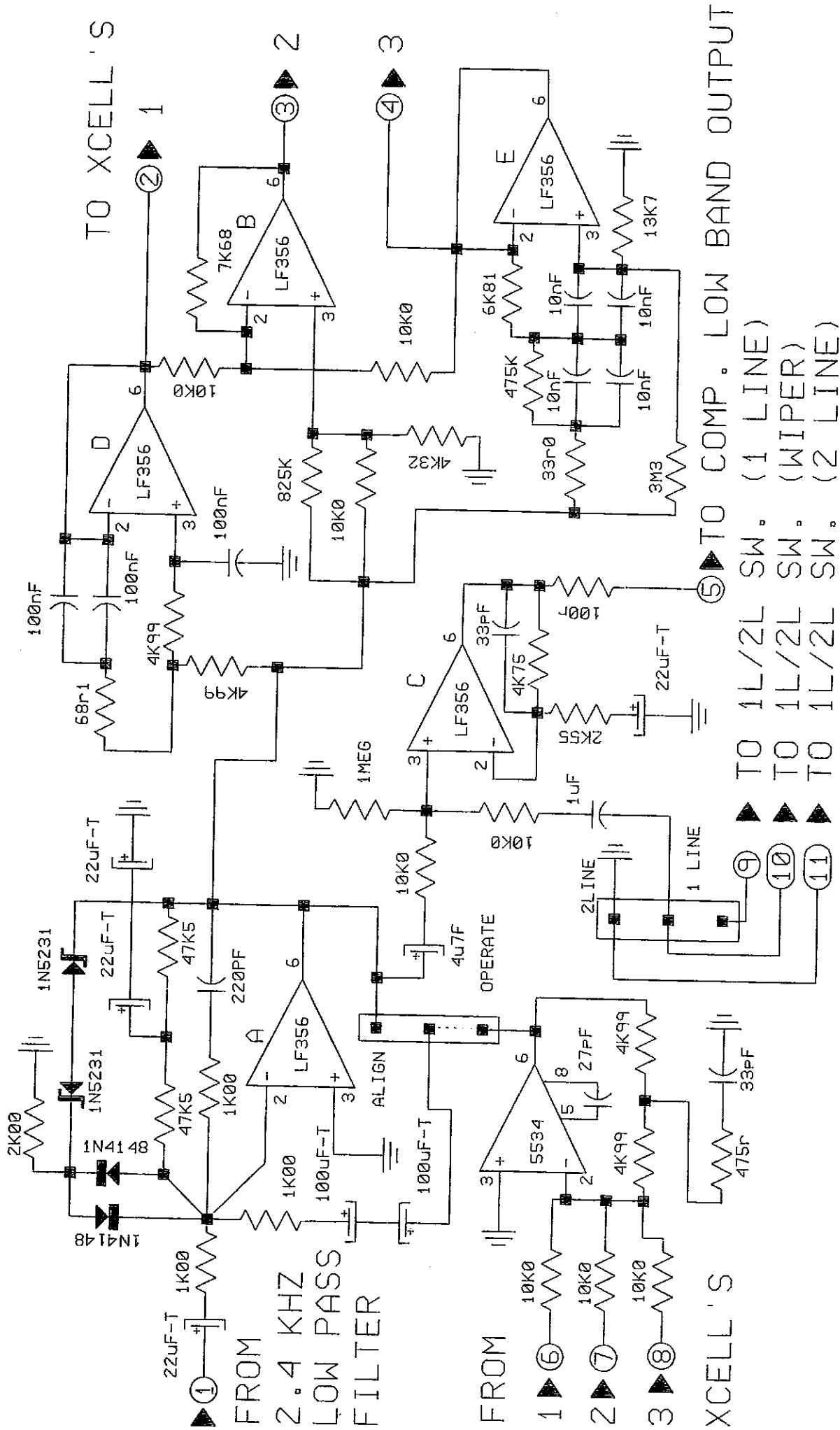
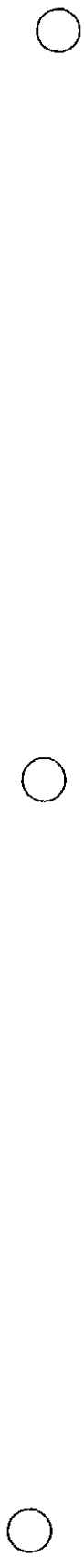




TO  
1L/2L SW.  
(1 LINE)



# HIGH BAND COMPRESSOR SUMMER



TO XCELL'S

FROM  
2.4 KHZ  
LOW PASS  
FILTER

FROM

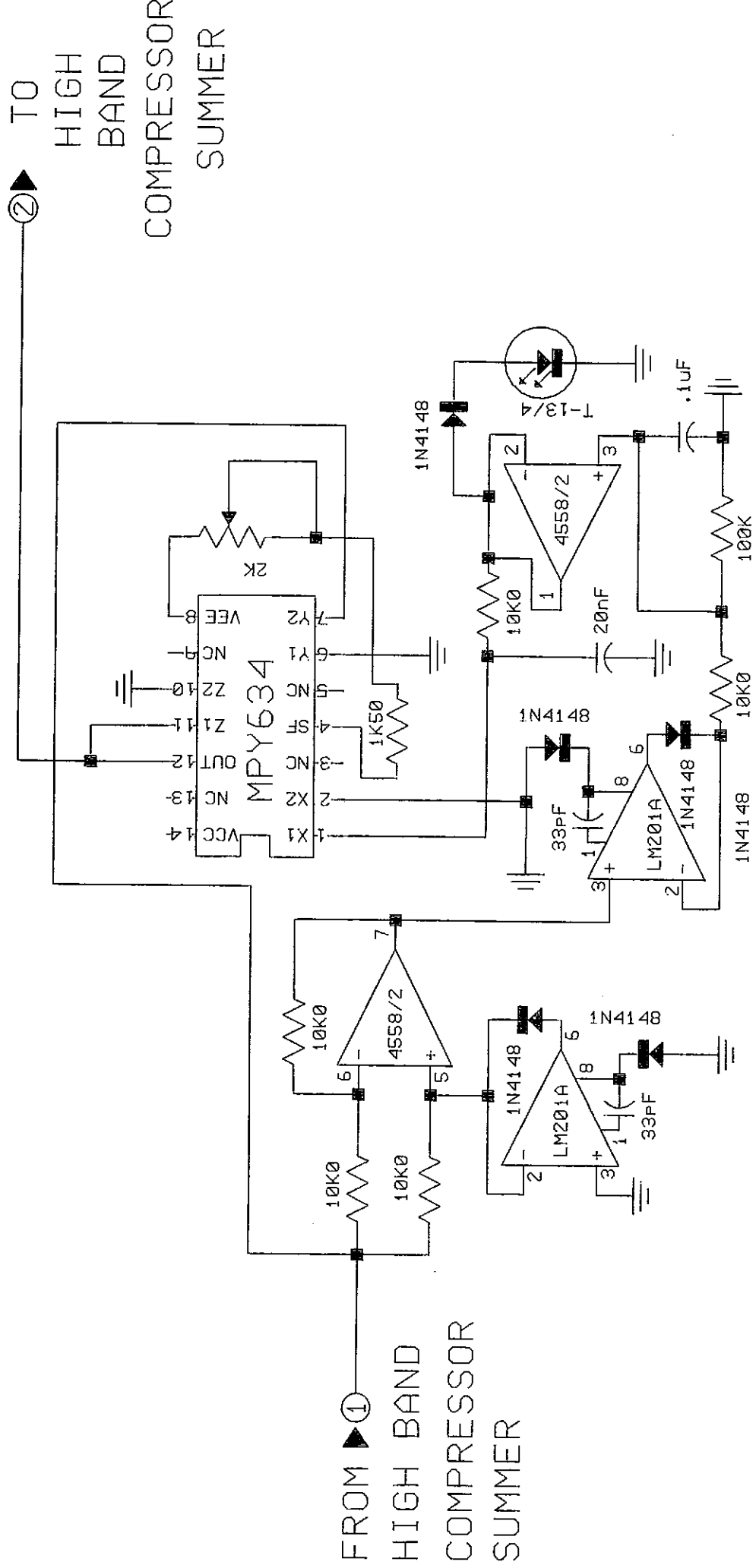
XCELL'S

TO COMP. LOW BAND OUTPUT

▲ TO 1L/2L SW. (1 LINE)  
▲ TO 1L/2L SW. (WIPER)  
▲ TO 1L/2L SW. (2 LINE)

# LOW BAND COMPRESSOR SUMMER

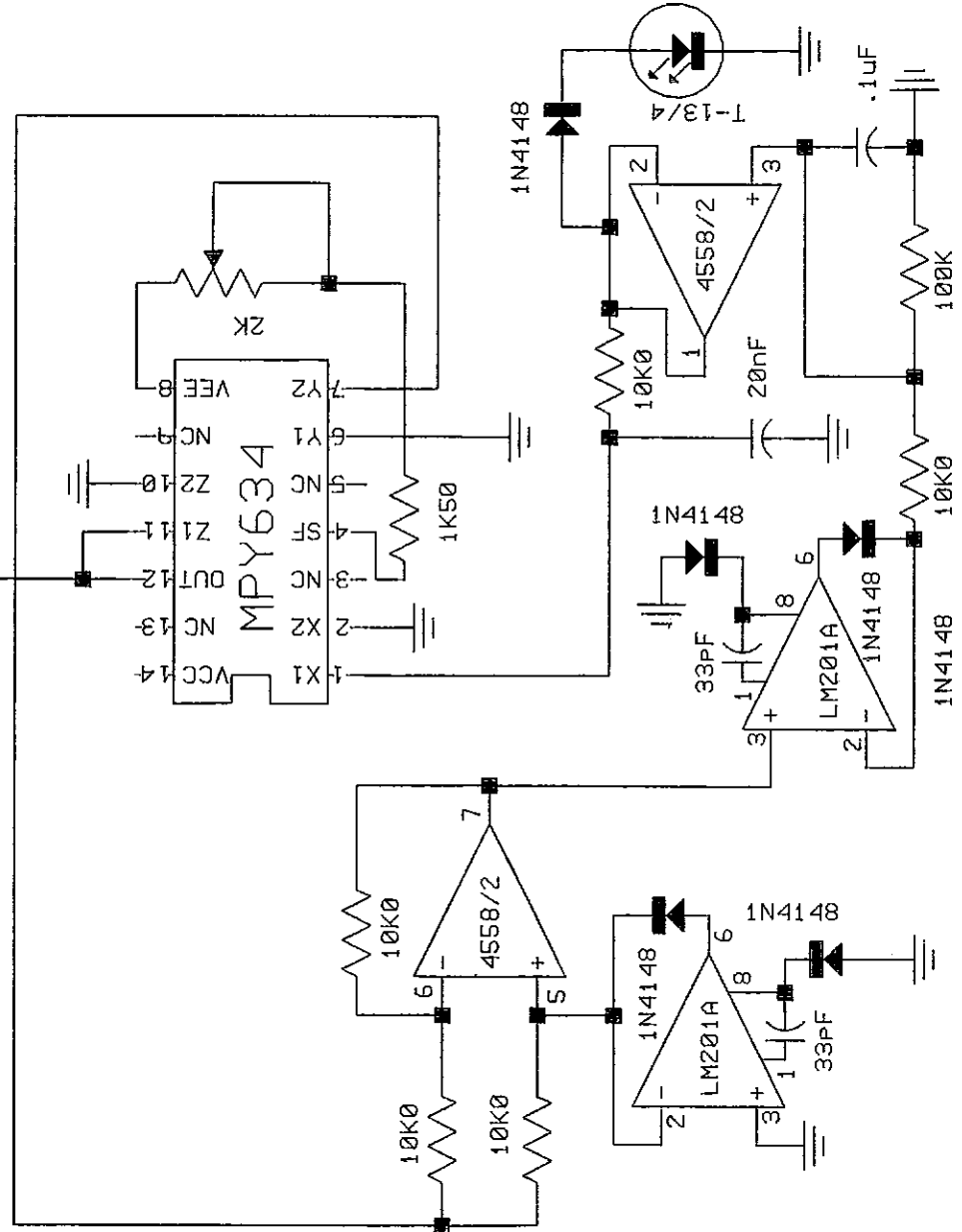




COMPRESSOR BAND 4 X CELL



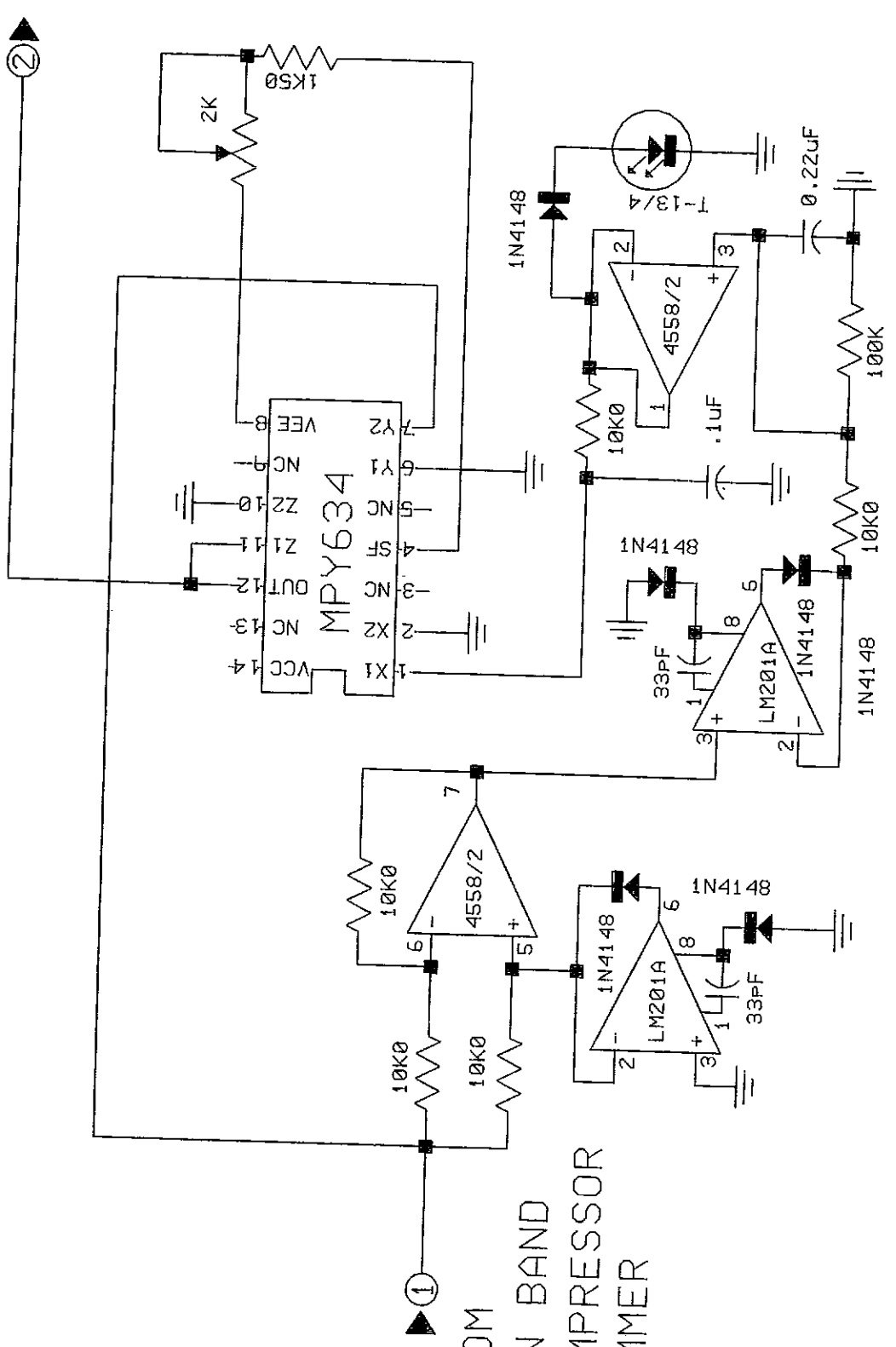
② TO LOW  
BAND  
COMPRESSOR  
SUMMER



FROM ①  
LOW BAND  
COMPRESSOR  
SUMMER

COMPRESSOR BAND 3 X CELL

TO LOW BAND  
COMPRESSOR  
SUMMER

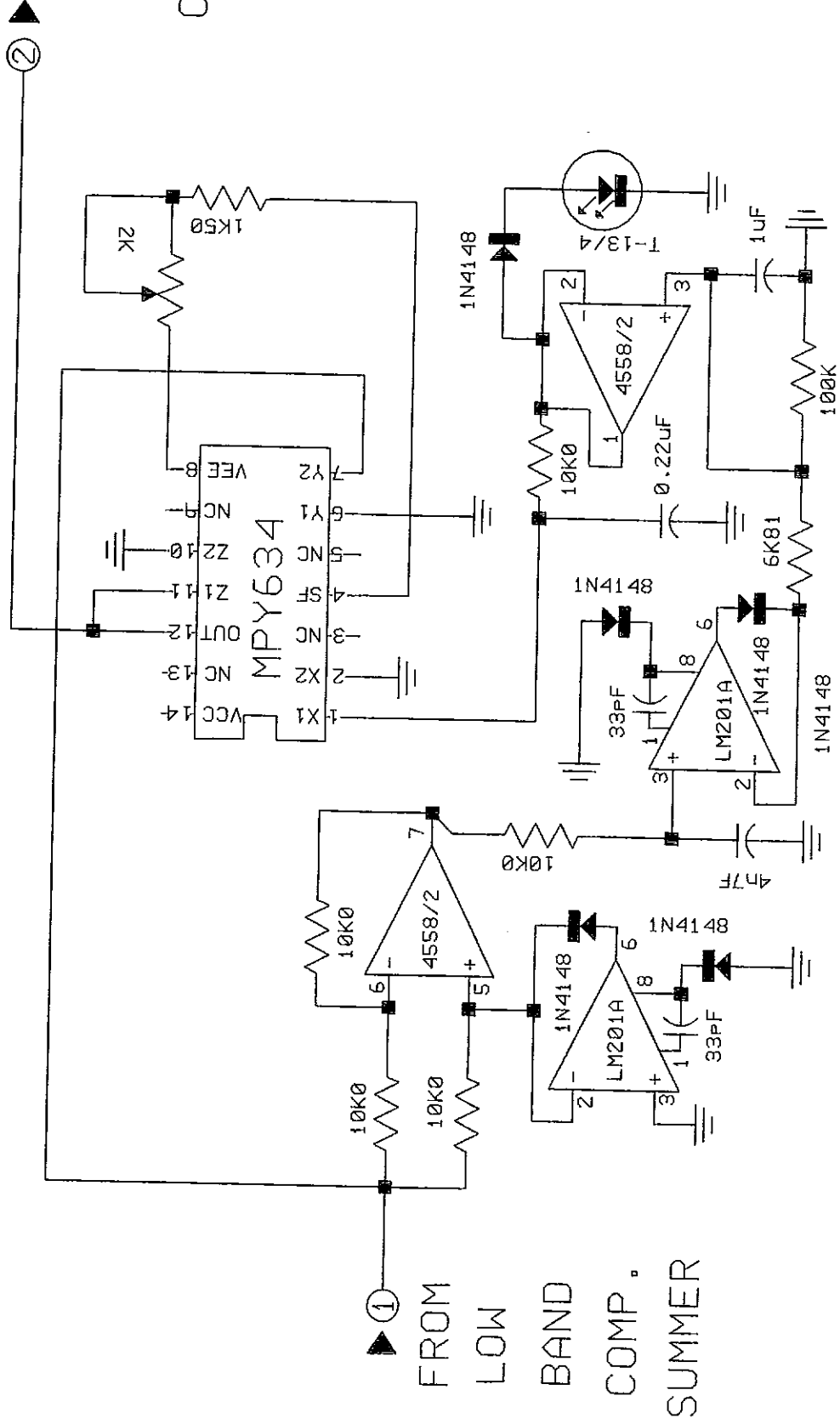


FROM  
LOW BAND  
COMPRESSOR  
SUMMER

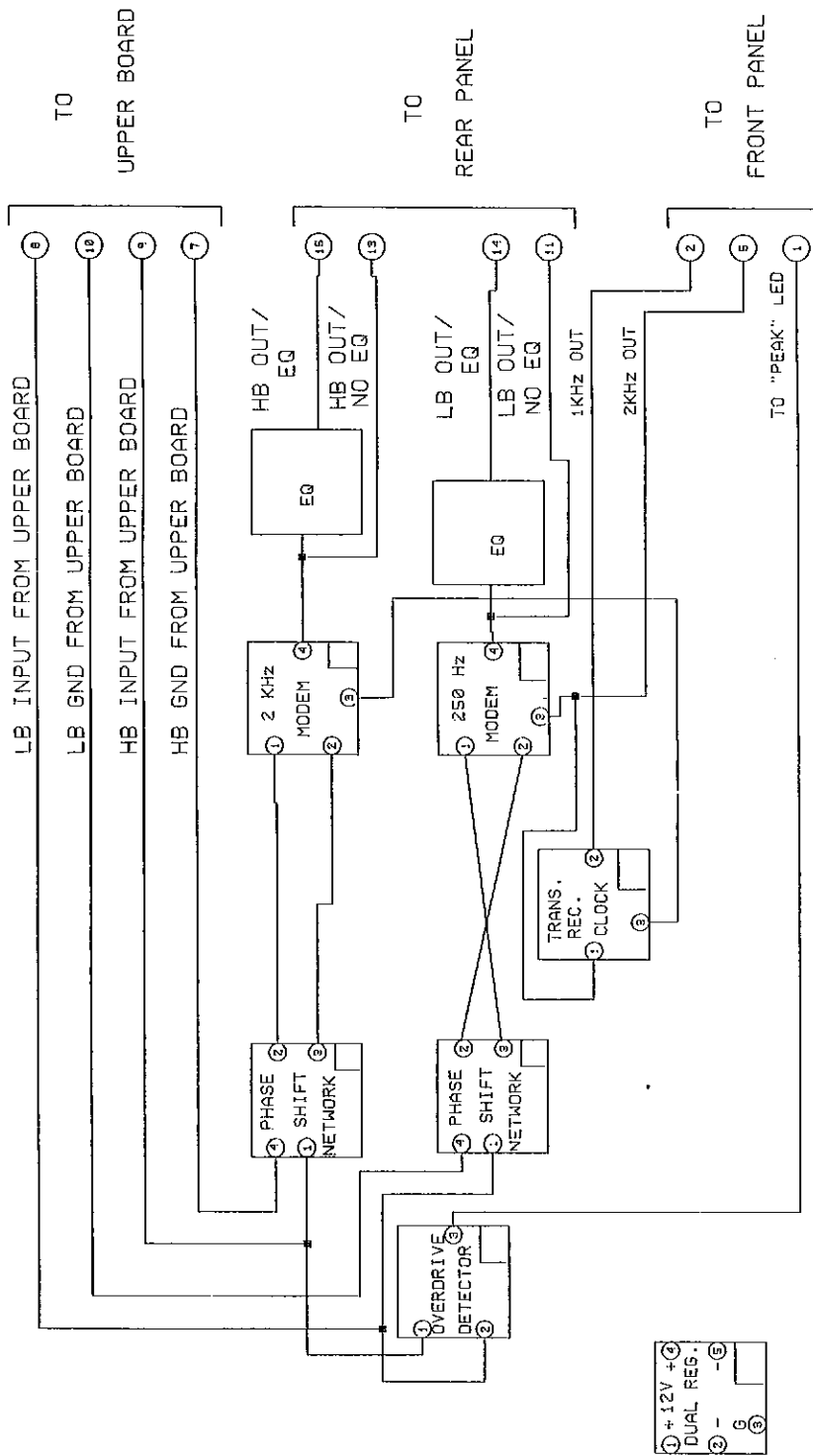
COMPRESSOR BAND 2 X CELL



TO  
LOW  
BAND  
COMPRESSOR  
SUMMER



COMPRESSOR BAND 1 X CELL



# ZXP LOWER BOARD

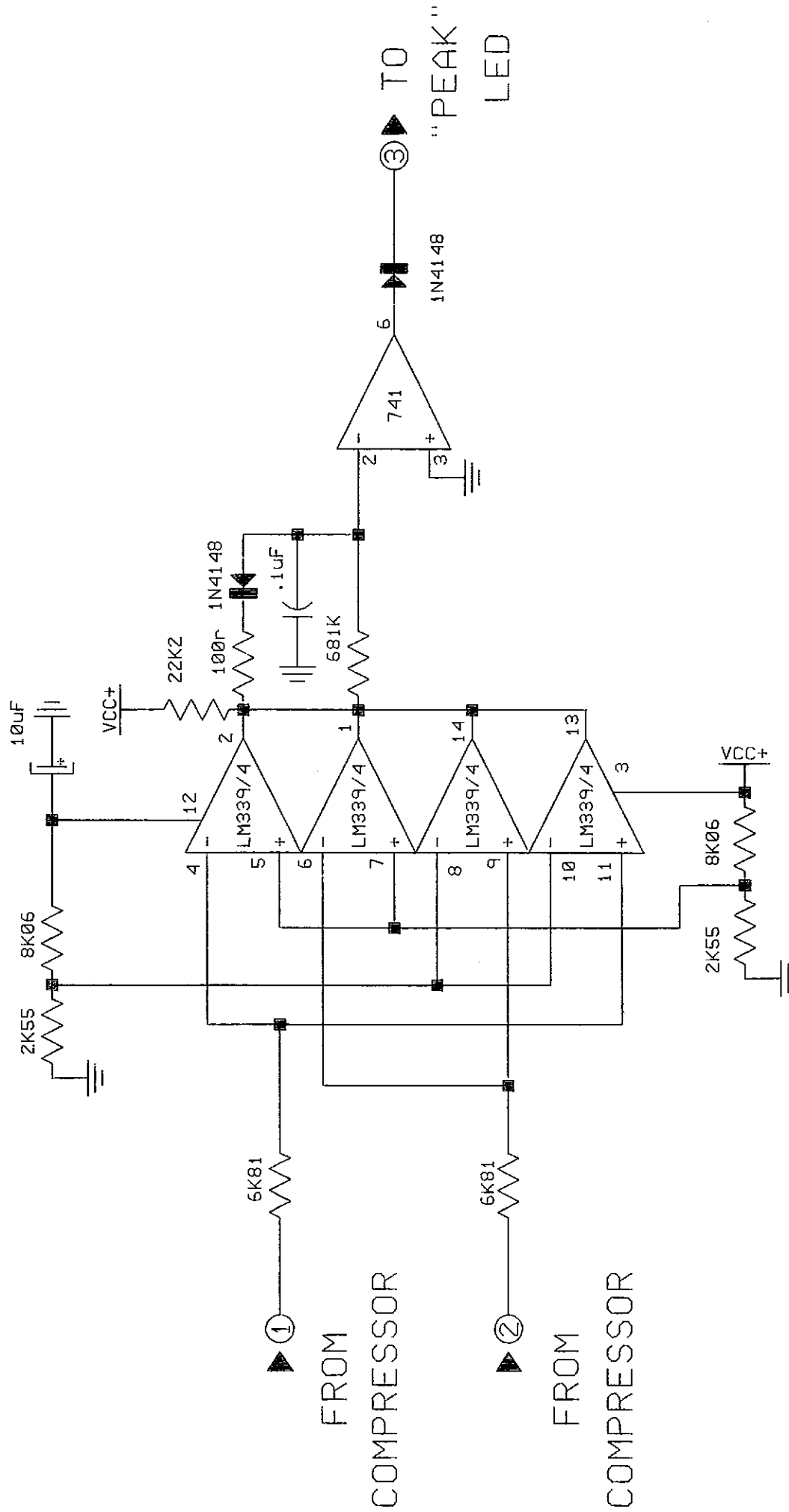
COMREX Corp.  
 ACTON, MA 01720 U.S.A. (617)259-1988

TITLE \_\_\_\_\_

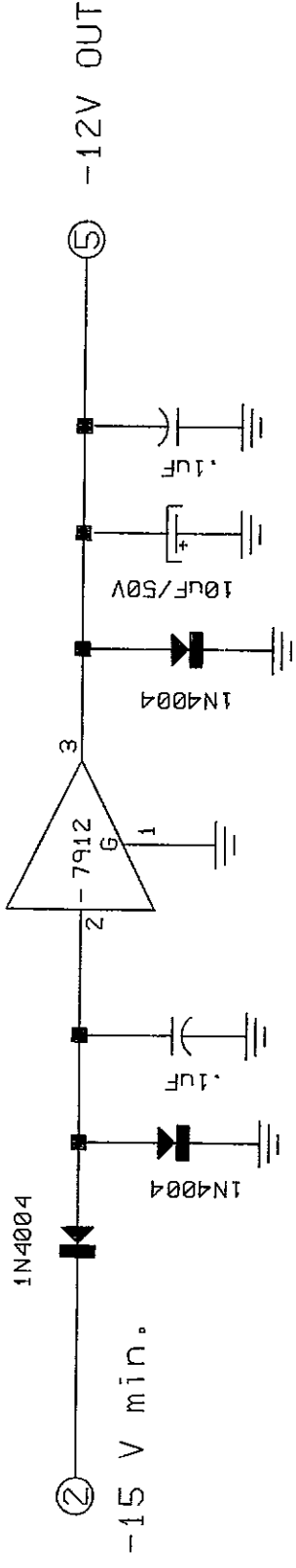
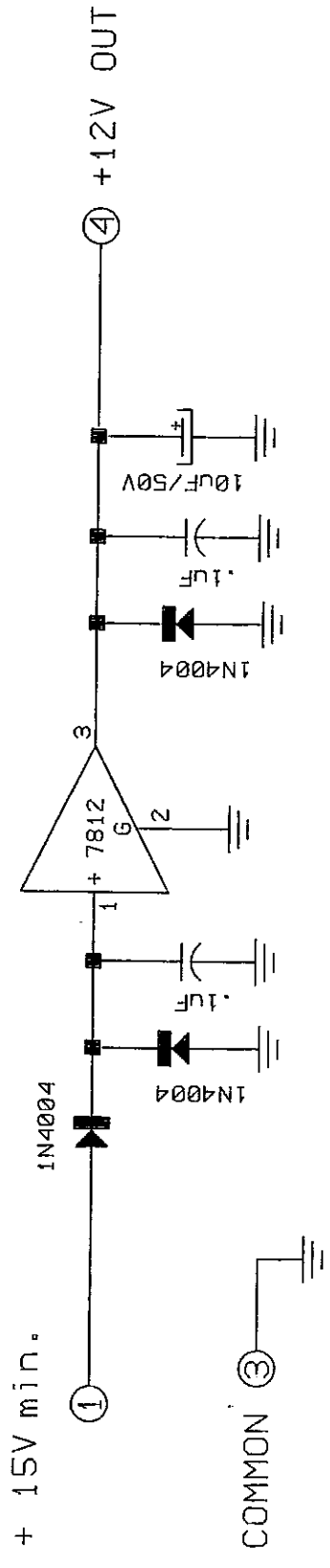
DATE \_\_\_\_\_

DWG. NO. \_\_\_\_\_

XXXXX ALL CIRCUIT DESIGNS COPYRIGHT © BY COMREX CORPORATION-ACTON, MA 01720-1988

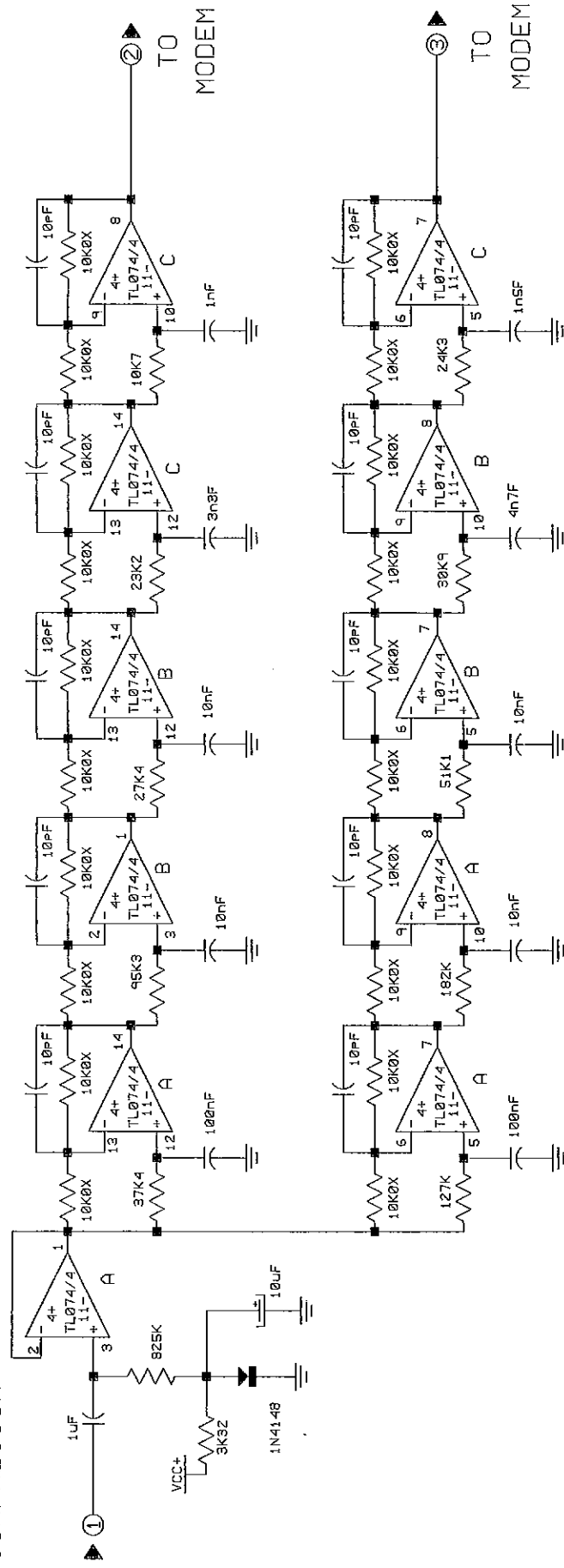


# OVERDRIVE DETECTOR

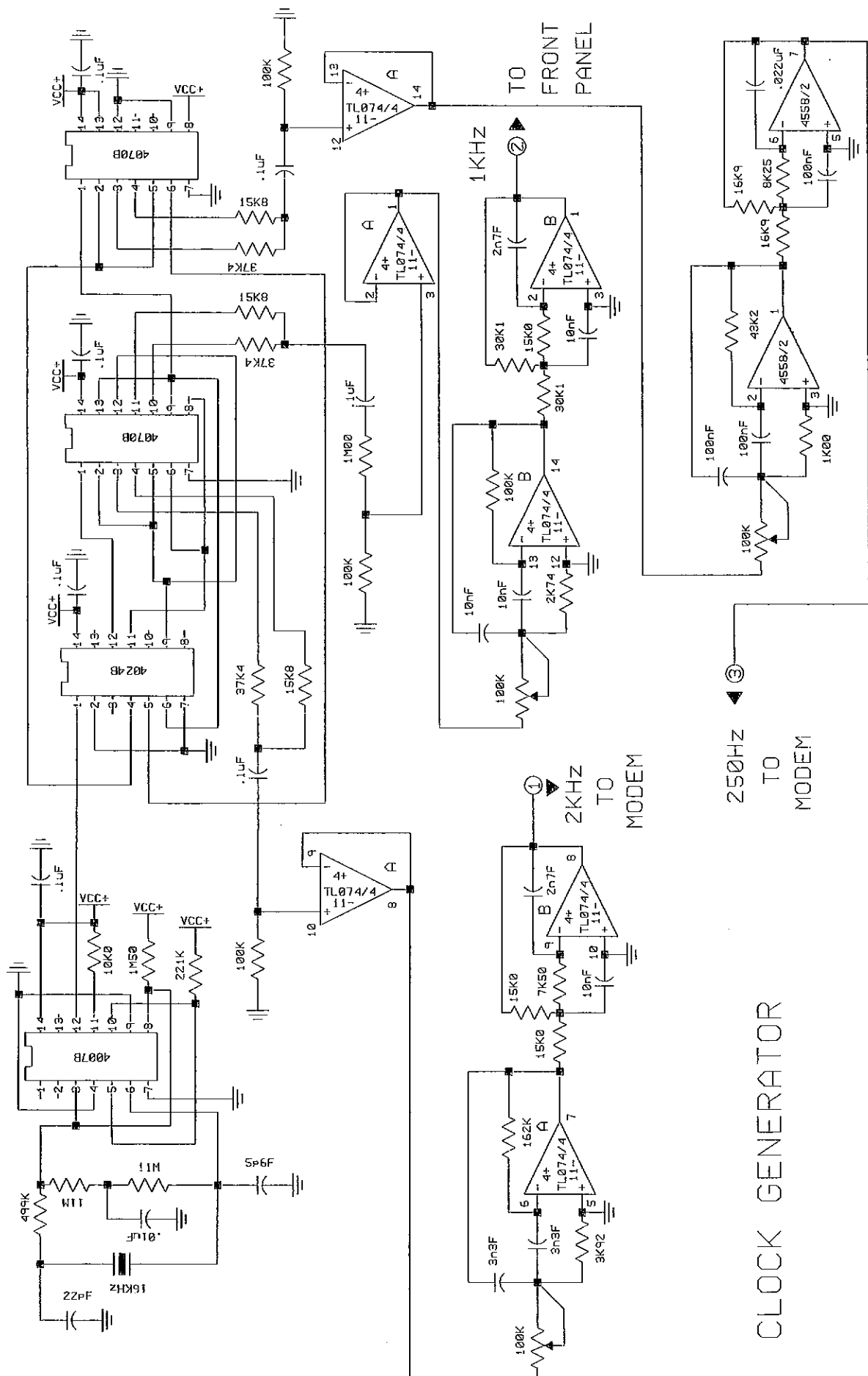


# 12 V. DUAL REGULATORY

INPUT  
FROM  
COMPRESSOR

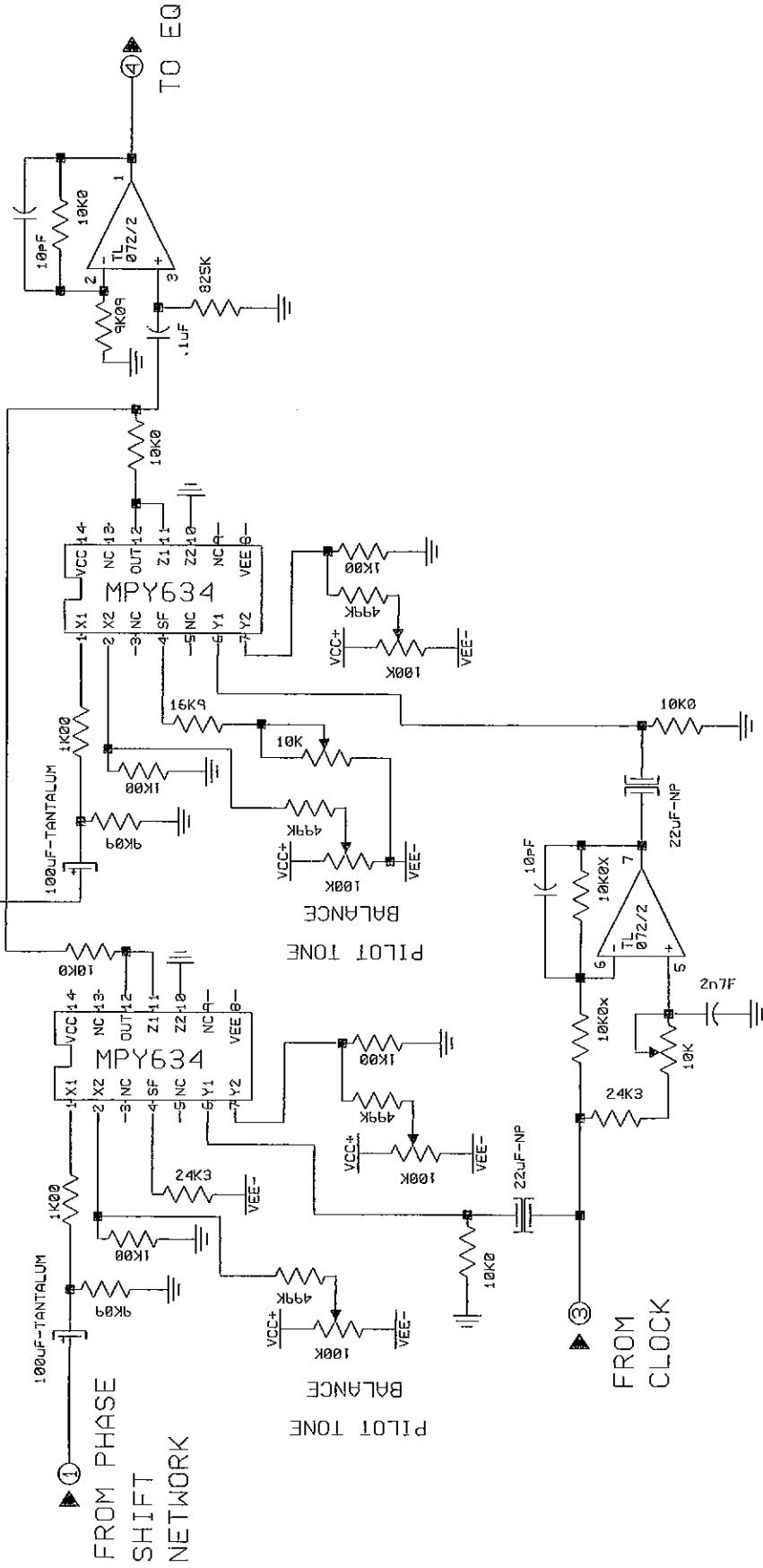


PHASE SHIFT NETWORK



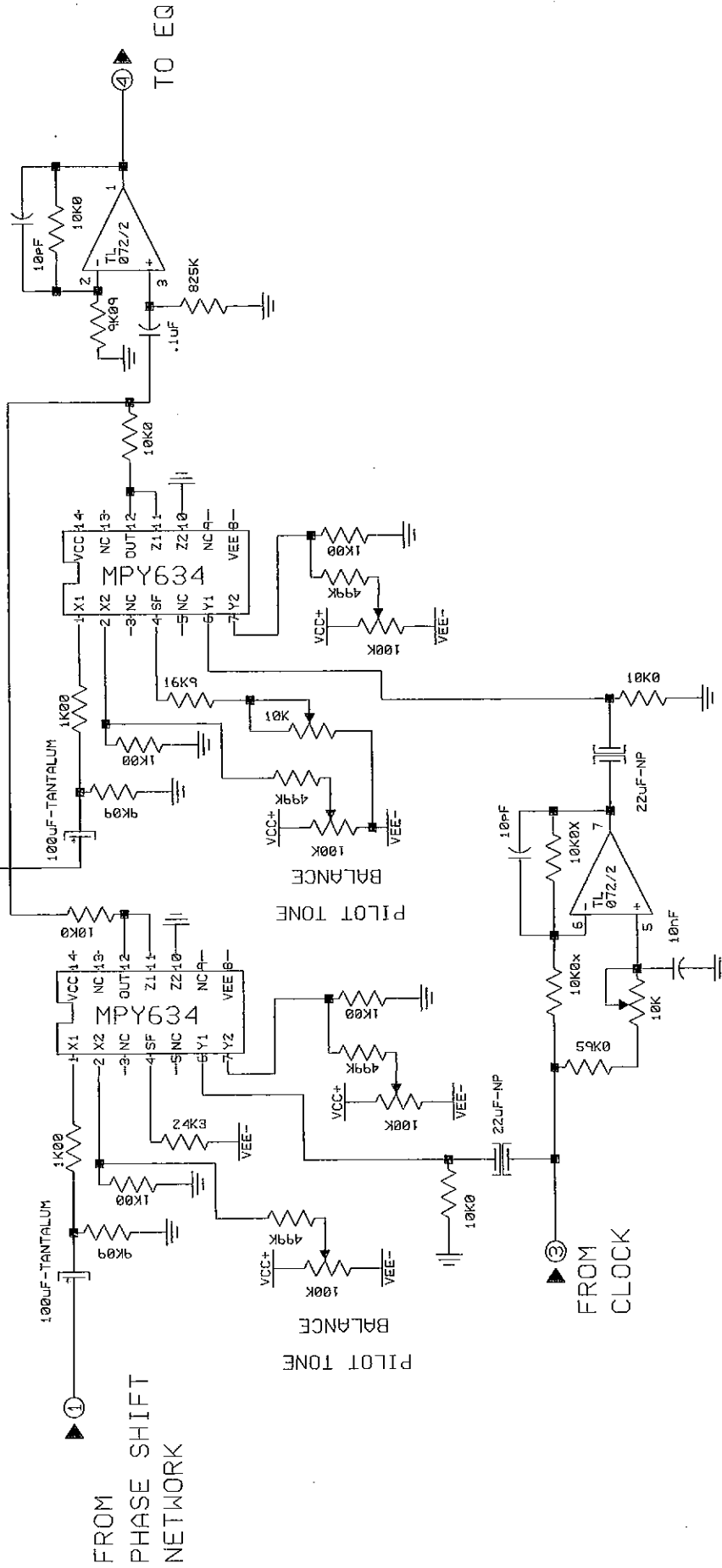
CLOCK GENERATOR

FROM PHASE SHIFT NETWORK



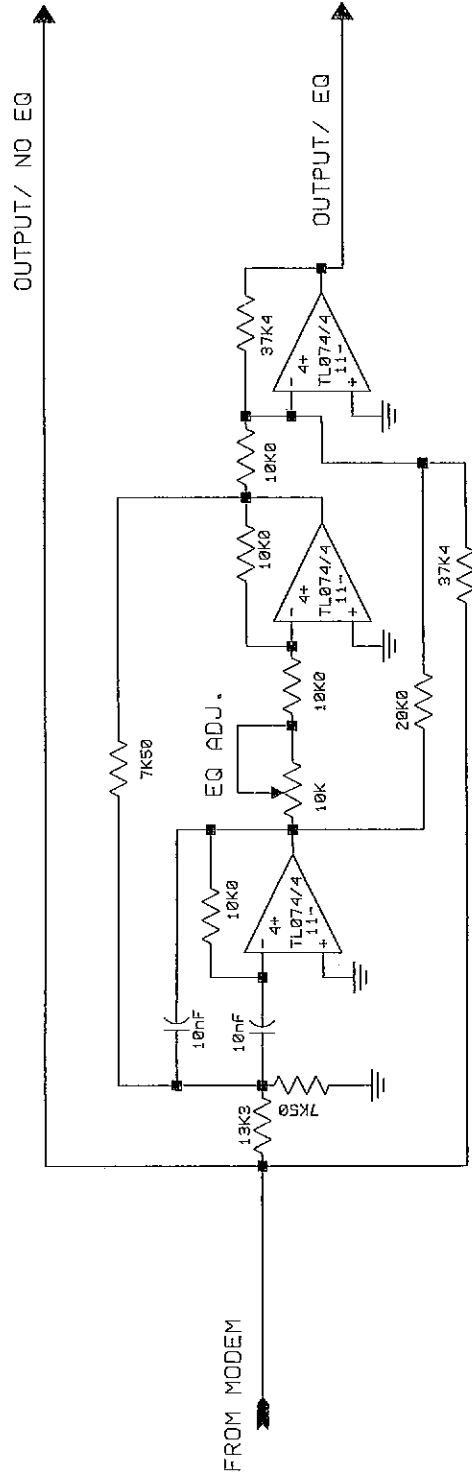
2 KHZ MODEM

FROM PHASE SHIFT NETWORK



250 HZ MODEM





2XP EQ





## 7. Shutting down the 2XP:

When your program is over, release all self indicating buttons so that no colors are showing. Remove the modular plugs from the 2XP and from the TELCO jacks. Disconnect the program source from the 2XP and unplug the 2XP from the A/C.

If you lose a line:

You can operate with 1 line. If you lose Line 2, all you need to do is set the 1 line/2 line switch on the back of the 2XP to 1 LINE. The receive site will also have to set the decoder switch to 1 LINE.

If you lose Line 1, you must reverse the lines by setting the reverse lines switch on the back of the 2XP to REVERSE. This must also be done at the receive site. This will lower the frequencies of the program onto the surviving line. Be sure that both ends are set to 1 LINE operation to improve the high frequency response in this mode.

When you establish the second line at a program break, be sure to resend the TEST TONE so that both program lines can be reset to equal level.

**Note:** The 2XP is a direct replacement for the Model PTLX Two Line Encoder. It will operate with the 2XR & RTLX Two Line decoders. The 2XP is NOT compatible with the one line systems. Please refer to 2XP operating manual for further instructions.



Comrex Corporation

65 Nonset Path Acton, MA 01720

(508) 263-1800 / FAX: (508) 635-0401

e-mail: [info@comrex.com](mailto:info@comrex.com)

## 2XP SETUP:

Equipment Checklist:

- 1 telephone set with a modular cord and plug
- 2 or 3 TELCO dial lines terminated with modular jacks
- 2 or 3 connecting cords with modular plugs on each end
- A/C power cord for the 2XP
- Mixer console with +4 dBm output

1. Plug the 2XP into A/C Power. If you are operating within the US, set the 115/230 switch to 115. If operating outside the US, set this switch according to the local voltage supplied.

2. Connect your program source to the 2XP input on the rear panel. The output of your console is connected directly to the input connector of the 2XP. This connector is an XLR-3F so you will need a 3 pin male mating plug on your cable. Pin 1 is case ground, Pin 2 is audio low and Pin 3 is audio high.

It is assumed that the program source will be some variety of console. The 2XP is designed for a +4 dBm input level. This is a 600 ohm transformer balanced input. You can check that the proper level is being fed to the 2XP by looking at the SEND LEVEL LED on the front panel which should blink approximately 15% on program peaks. If the LED is steadily illuminated, you are overdriving the input level and will probably cause distortion. If the LED is not blinking you are underdriving the 2XP and will render the noise reduction system useless.

3. Connect the 2XP to the Dial Telephone Circuits. In many cases the telephone company will terminate its dial telephone lines in modular jacks. In this instance, connection to the 2XP is by means of a cord with modular plugs at both ends. These are available at various telephone and electronics stores. In some instances, the telephone company will provide only a connector block which has screw terminals. It will be necessary to obtain connecting cords which have spade lugs on one end and modular plug on the other. The cord with spade lugs will usually have four wires: red, green, black, yellow. The red is RING and the green is TIP. The connector block will either be marked T and R or will have red and green wires appearing at the block. The spade lugs should be connected to the matching color wires.

After the telephone modular jacks have been located, they should be designated as Line 1, Line 2, and Line 3 to avoid confusion later. One of the connecting cords should be inserted into the wall jack marked Line 1 and the other end should be inserted into the jack marked Line 1 on the front panel of the 2XP. The same should be done for the remaining two lines. A telephone set with a modular plug cord should be inserted into the jack marked TEL SET on the front panel of the 2XP. This is all the hookup necessary to connect to dial lines.

4. Check that switches are set as follows:

- NORMAL/REVERSE LINE 1&2 to NORMAL
- 2 LINES/1 LINE to 2 LINES
- TEST TONE ON
- EQ IN/OUT - The position of this switch will

depend on the characteristics of the lines and is a judgement call.

5. Dial the Receive Site as follows:

Push Dial/Line 1 in the Telephone Selector. You should hear dial tone in the telephone handset. Dial the number to which the line 1 receive coupler has been connected. Wait for the station phone to answer. (You may here a short beep or silence if the phone answers automatically.) When the connection has been established, push the TRANSFER button for LINE 1 to transfer the line from DIAL to PROGRAM. Repeat the above steps fro Line 2.

If a communication line is being used on line 3, dial line 3 as above. This line may be put on hold by pushing the HOLD/LINE 3 button.

#### CAUTION

BE SURE THAT THE DIAL SELECTOR SWITCH IS ON LINE 3 OR RELEASE DURING PROGRAM TRANSMISSION. IF THE DIAL SELECTOR SWITCH IS LEFT ON LINE 1 OR LINE 2 WHILE TRANSMITTING PROGRAM AND THE TELEPHONE HANDSET IS NOT HUNG UP, UNEXTENDED BACKGROUND NOISE WILL BE PICKED UP BY THE MICROPHONE OF THE TELEPHONE INSTRUMENT AND BE FED DOWN THE LINE ALONG WITH THE EXTENDED PROGRAM MATERIAL. IN ADDITION, THE TELEPHONE SET WILL LOAD DOWN THE LINE SO THAT THE SIGNAL LEVEL WILL BE TOO LOW.

6. Allow sufficient time for the receive site to adjust the program lines to equal level based on the TEST TONE from the 2XP. If this is done automatically by means of an 2XL auto leveler at the receive site, leave the TEST TONE on for about 20 seconds. Then turn the TEST TONE off and feed a program test. Check with the receive site to determine whether the EQ in the 2XP should be set IN or OUT.