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INSTRUCTION MANUAL

G L B ELECTRONICS
MODEL 400B
CHANNELIZER

INSTRUCTION MANUAL FOR GLB ELECTRONICS MODEL 400B CHANNELIZER

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INTRODUCTION

The model 400B Channelizer is a true digital frequency synthesizer, using a single crystal to generate 400 (or 800) output frequencies between 144.000 and 147.990 mhz in steps of 10 (or 5) khz. In the transmit mode these frequencies are generated at a subharmonic of the output range, and in the receive mode an offset is provided as well such that the displayed frequency always is the frequency transmitted or received. The offset is generated by means of a second crystal oscillator in which the crystal frequency determines the receiver IF.

A test point is provided containing harmonic frequencies at all of the WWV frequencies for easy zero-beating to align the Channelizer to frequency. Once this adjustment is made, all of the transmit frequencies are automatically placed in correct alignment. The offset oscillator can then be trimmed for proper alignment for all receive channels.

The two sets of frequency control switches are each arranged in decimal form - that is, separate ten-position switches are used for the 10 and 100 khz steps. A four-position switch is used to select mhz steps. Thus the frequencies in use can be read directly from the switch settings. Either set of switches can be used to control either the transmitter or the receiver independently or in the transceive mode via two selector switches.

By means of inserting jumpers on the circuit boards the output frequency ranges of the Channelizer can be changed, permitting great latitude in adapting it to various transceivers. In most cases no changes have to be made to the mating transceiver, and often a direct connection can be made to the crystal sockets. The Channelizer is switched between receive and transmit modes by means of a connection to the push-to-talk circuit of the transceiver.

GLB maintains a file on the necessary steps to adapt a wide variety of transceivers to Channelized operation and provides such information when available. In special cases we will be happy to work with you to develop a procedure for your rig. If our files don't include data on your rig we will need (1) the receiver first IF; (2) frequencies of existing crystals for both the receiver and the transmitter; and (3) a copy of the transceiver schematic.

The Channelizer can be modified in various ways for special requirements. Call or write us concerning such applications.

OPTIONS

Frequency Multiplier

For transceivers requiring signals in the 18, 36, 46 or 72 mhz (nominal) ranges, a frequency multiplier can be provided. [NOTE: all rigs utilizing these frequencies don't need the multiplier. Check with us before ordering.] The multiplier stage mounts inside of the Channelizer cabinet and is a "universal" design -- that is, the same printed circuit board is used for all frequencies.

5 KHZ Step Adaptor

Frequency steps of 5 khz instead of 10 khz can be generated by installing this adaptor circuit. The kit consists of a small circuit board, parts, instructions and a pair of toggle switches for controlling the 5 khz increment on each set of switches. No other parameter of performance in the Channelizer is affected by this change.

SPECIFICATIONS FOR MODEL 400B CHANNELIZER

Frequencies: range 144.000 to 147.990 mhz in steps of 10 khz.
-with adaptor, 144.000 to 147.995 mhz in steps of 5 khz.

Fundamental output frequency range: 24.000 to 24.665 mhz in transmit; lower or higher by 1/6 the IF in receive mode.

Receiver injection: Any IF between 0 and 40 mhz. Standard Channelizer is for low-side injection; can be modified for high-side.

Frequency stability: ± 5 parts per million (.0005%) from -10 to +50 degrees C.

Programmable output divider ratios: 2, 3, or 4

Spurious output levels (non-harmonic): -60 db minimum

Hum and FM noise on carrier: -30 db below 5 khz deviation, minimum at the transmitter output frequency.

Lock time: average, 15 milliseconds; worst-case, 100 ms.

Output power: At least 10 milliwatts into a 50 ohm load.

Dimensions: 5.6 w X 3.1 h X 6.4 deep (inches)

Input power: 11 to 15 volts at 400 ma. Input ripple up to 1.5 v. peak-to-peak tolerable.

External connections: B+ input, push-to-talk, receiver output, transmitter output.

Controls: Two sets of frequency controls, each consisting of:
- Megahertz control
- 100 KHZ control
- 10 KHZ control
- 5 khz control if adaptor is incorporated.

Two selector switches; one to select the receive controls, the other to select the transmitter controls.

CHANNELIZER OPERATION

There are two sets of frequency control switches and two selector switches on the panel of the Channelizer. The two sets of rotary switches control the actual frequency settings while the two-position selector switches determine which of the frequency settings is in actual use. A power on-off switch isn't necessary because the Channelizer is connected to the switched 12 volt line of the transceiver with which it is used.

SELECTOR SWITCHES

These are the two toggle switches located at the right and left sides of the panel. The left-hand switch, labeled "RX" is the receive mode selector. In the "up" position it causes the receiver frequency to be controlled by the top set of frequency control switches. In the "down" position the receiver frequency is determined by the lower frequency control switch settings. Similarly the transmitter can be controlled by either set of switches, depending upon the position of the "TX" switch.

This arrangement provides complete flexibility in the choice of frequencies.

For example, if both the TX and RX switches are up, you are transmitting and receiving on the same frequency, determined by the upper set of switch settings. You can transceive on the bottom set of controls by switching both selectors down. To receive on the top set and transmit on the bottom set, the RX switch is up and the TX switch is down.

For example, if you wish to operate via a repeater having an input frequency of 146.34 mhz and an output of 146.94 mhz you set the top row of controls to 146.34, the transmit selector up, and the bottom set of controls to 146.94 with the receive selector down. If at any time you would like to check the other fellow's unrepeated signal on '34, simply switch the receive selector up and you are listening on your own transmit frequency.

The dual frequency controls are convenient beyond repeater operation, too. Let's say you are in a contact on 146.94 simplex and you wish to change to 146.76. Assuming that you have been using the top row of switches for 146.94 operation, you can set the bottom row to 146.76 while transmitting or receiving. With both selectors up this action has no effect on your QSO. When ready to move, simply flick down the receive selector followed by the transmitter selector and you are there.

FREQUENCY SETTING

The actual setting of a frequency is simply a matter of adding the number of MHZ, hundreds of KHZ and tens of KHZ (plus either 5 khz or 0 khz with the 5 KHZ step adaptor) to 140 MHZ. The 140 MHZ figure is programmed into the Channelizer permanently, so the switch settings are added to it as follows:

EXAMPLE: To set 146.94 mhz. Add "6" on the MHZ switch, "9" on the 100 KHZ switch, and "4" on the 10 KHZ switch. 140 + 6 + .9 + .04 = 146.94.

The top and bottom sets operate independently and identically.

BEFORE TRANSMITTING BE SURE TO CHECK THE POSITION OF THE TX SWITCH TO AVOID ACCIDENTAL INTERFERENCE or OUT-OF-BAND OPERATION!

INSTALLATION OF THE CHANNELIZER

Due to the widely varying requirements of different installations, cables are not supplied with the Channelizer. Output levels are sufficient to drive long coaxial cables to reach trunk-mounted equipment in a mobile installation or remote base station setups with the transceiver in other parts of a building. Cable impedance may be 50, 75 or 91 ohms. Don't use shielded audio cable.

A +12 volt power supply lead is required from the associated transceiver. This connection goes to the switch (and fused) side of the supply line in the transceiver so that they both turn on and off simultaneously. If unusually high levels of ripple or hash are present on the supply line additional filtering may be necessary.

The push-to-talk line on most transceivers is arranged such that it is grounded on transmit and a positive voltage (usually +12) on receive. This arrangement is directly compatible with the Channelizer, requiring a simple direct connection between the push-to-talk lines.

WARNING! Many transceivers operate relay coils with the PTT line. The inductive voltage transient created when relay coil current is broken can have sufficient energy to damage internal parts of the Channelizer. This potential problem can be solved by connecting a diode across the relay coil, as shown in Fig. 1c.

The actual push-to-talk line requirements of the Channelizer are:

Transmit mode - a ground with no more than 1 volt at the PTT terminal.
Receive mode - at least 4 volts or open circuit. Do not exceed 50 volts.

If these requirements can't be met in the transceiver PTT line a transistor inverter or a separate relay can be added to key the Channelizer, as shown in fig. 1.

MATCHING TO TRANSCEIVER

If we have had experience with your transceiver type, specific data is enclosed with the Channelizer for matching the units. If not, the following general information should help you work out the interface.

DRIVING CRYSTAL OSCILLATORS

Coupling the Channelizer into the oscillator circuits of your equipment involves exactly the same techniques you would need to couple in an external VFO. Coupling must be accomplished in such a way as to allow the crystal oscillator to behave as a buffer amplifier and not as an oscillator. Failure to achieve this result can cause spurious frequencies to be generated at the interface.

Many vacuum-tube oscillators are of the Pierce type, where the crystal is connected between the grid and screen. These circuits drive easily, simply by bypassing the screen to ground and coupling the Channelizer into the grid. However, since the Channelizer output impedance is low, a step-up circuit must be used to increase the drive voltage. As shown in fig. 2 there are several ways to accomplish this transformation.

Solid-state oscillators are usually of the Colpitts type as shown in fig. 3. Such an oscillator, when driven directly from a low-impedance source is likely to "squegg", causing spurious outputs in transmit and spurious responses in receive. This problem can be corrected by driving the oscillator thru a series element such as a resistor or inductor. Although the use of a resistor decreases the available drive power, it is possible to overdrive an oscillator with the Channelizer because of its high output power. The drive level can be adjusted by varying the value of the resistor. For maximum drive use a series inductor instead, adjusting its value for maximum output.

Any matching components should be mounted as close as possible to the crystal sockets to prevent RF pickup or radiation. The most reliable installation is achieved with directly soldered connections, but if you prefer a spare crystal holder can be used as a plug-in holder for the matching components. A ground lug, if needed can be mounted under a nearby chassis screw.

RECEIVER CONSIDERATIONS

The only necessary condition for Channelized operation in the receiver is to provide adequate drive at an appropriate frequency. The drive frequency doesn't necessarily have to be at the frequency band of the original crystal. For example, most receivers requiring a 46 mhz crystal work well when driven at 23 mhz, with the crystal oscillator acting as a doubler. In other cases a different multiplication ratio can be used. A Standard 806 requires a 15 mhz receive crystal, which is multiplied by 9 in the receiver. Again, if it is driven with 23 mhz it will just as well multiply by 6. Since the original scheme was to multiply first by 3, then by 3 again, the output of the first tripler was at 45 mhz. Driven by 23 mhz this stage becomes a doubler with the same nominal output frequency to drive the next tripler.

No changes have to be made in the rig because there isn't any tuned circuit at 15 mhz; thus it accepts drive at 23 mhz as well.

Similarly a Motorola 80D utilizes a quintupler after the crystal oscillator. If it is driven at 1/6th the injection frequency it still works, with the quintupler changed to a X6 multiplier. When changing multiplier ratios make sure that there isn't any tuned circuit at the input frequency to be changed. If there is, it will be necessary to pad it down to the new input frequency.

If you need help, be sure to send a copy of the oscillator-multiplier circuit of your particular rig, because some types of equipment have several variations in circuitry.

Channelizer output can be programmed to supply RF drive at 1/6, 1/12, 1/18 or 1/24 of the injection frequency [corresponding to the multiples 6, 12, 18 and 24 on the chart of page 6 .]. Multiples of 8, 4, 3 or 2 can be accommodated by means of the frequency multiplier option. This extra stage mounts within the Channelizer case, providing the required output frequency at the rear jack.

TRANSMITTER CONSIDERATIONS

When properly matched to the Channelizer, the transmitter should operate just as it does with a crystal. Problems sometimes occur, however, and they must be diagnosed correctly in order to correct them.

The most common condition is "bassy" audio quality, sometimes accompanied by hum. These symptoms indicate RF leakage into the Channelizer from the transmitter. The Channelizer is well enough shielded to work in the field of transmitters running a kilowatt, but there are conducting paths that can cause leakage. Two of these possible paths are the PTT and the B+ lines, but these are effectively filtered with coaxial feed-thru capacitors. [Note: if any additional wires are added to the Channelizer for any reason, it is necessary to use feed-thru caps on them. Simple bypassing is not good enough.]

RF can couple in via either the transmitter or receiver output jacks, however. Channelizers with serial numbers above 350 are supplied with low-pass filters for the transmitter line. A low-pass filter passes the RF output of the Channelizer (at relatively low frequency) while rejecting VHF RF. Fig. 4 shows the values and schematic of this filter for various output frequencies of the Channelizer. With some rigs additional filtering is needed. If you need it, place an additional filter section at the transmitter end of the coax from the Channelizer. Use the same values as those in the Channelizer. If you reprogram the Channelizer to a different output at the transmitter jack, change the values in the filter according to fig. 4. When a frequency multiplier is used in the transmitter output the low-pass filter isn't needed.

If the "bassy" syndrome persists, try disconnecting the receiver coax from the Channelizer. If the audio clears up, RF is being coupled into the Channelizer via the receive coax. (The Tempo FMP does this) A low-pass filter in the receiver line is the cure. Again, values for a suitable filter can be picked from fig. 4.

Another factor that increases the "bassy" effect is incidental AM on the transmitter. Incidental AM can be caused by poor transmitter alignment, insufficient drive or weak tubes. AM hum is common on base station equipment. You may have considerable AM hum on your rig without knowing about it, because it is inaudible on an FM receiver. Any RF leakage of the "hummy" carrier into the Channelizer will convert it to an FM hum that is audible! This condition can be corrected by improving the filtering on the transmitter power supplies.

Finally, hum can be produced from the Channelizer itself if the power supply isn't adequately filtered. Power supply ripple should be

held to less than 1.5 volts peak-to-peak at the B+ terminal.
NOTE: Hum can be picked up in the VCO circuits if the covers are left off. Before testing with a transmitter make sure the VCO shield is in place and the cover is securely mounted to the Cabinet with all four screws.

A good test of proper interfacing is to compare the audio quality and RF power output of the transceiver with a crystal to that with the Channelizer (set to the same frequency as the crystal). If there is no change in power output and little or no change in audio level or quality, you are finished! If output power either decreases or increases it could indicate a squegging oscillator and spurious outputs.

The transmitter output of the Channelizer can be programmed to the same multiples previously described under "Receiver considerations".

USE OF CRYSTALS WHILE CHANNELIZER IS CONNECTED

If the Channelizer is wired into one crystal socket while the other crystals are left in the equipment it is not advisable to transmit unless the Channelizer power is disconnected. The presence of RF from the Channelizer at one crystal socket while operating from another crystal position can cause spurious signals due to coupling between switch contacts, wiring, etc. inside the transceiver. Similarly, the receiver might respond to signals it isn't tuned to when it is operated on crystal. Some types of transceivers require interconnections to the Channelizer which preclude operation on crystal at all. It all depends upon the oscillator and crystal-switching circuits used in the transceiver.

BASE STATION POWER SUPPLY

Fig. 6 shows a suggested power supply circuit for operating the Channelizer on AC mains. Any supply may be used with output voltage between 11 and 15 volts under load, with less than 1.5 volts peak-to-peak ripple.

OUTPUT PROGRAMMING CONNECTIONS

Lettered connection points are on the VCO board. Z12 connections are to be made to the pin indicated. E23 and E24 are on the main board and are conveniently connected from the top of the board by soldering the leads to the top of R14 or R58, respectively.

RECEIVER MULTIPLE	TRANSMITTER MULTIPLE	JUMPERS
6	6	A-G, A-B, remove Z12
6	12	A-B, E-G, D-gnd, Z12-9 to E23
6	18	A-B, F-G, D-E, H-E23
6	24	A-B, F-G, H-E23
12	6	A-G, B-F, D-gnd, Z12-9 to E24
12	12	B-E, F-G, D-gnd
12	18	C-B, D-F, E-G, Z12-9 to E23
12	24	C-B, E-G, Z12-9 to E23
18	6	A-G, B-F, D-E, Z12-9 to E24
18	12	B-E, C-G, D-F, Z12-9 to E24
18	18	B-F, D-E, F-G
24	6	A-G, B-F, H-E24
24	12	B-F, C-G, Z12-9 to E24
24	24	B-F, E-G

TABLE 1.
Programming chart.

DIRECT FREQUENCY MODULATION

Very high quality FM can be generated by direct modulation of the Channelizer. Fig. 5 shows how to connect an audio processor into the Channelizer circuit for true FM. The modulation so produced far exceeds the quality attained in a typical PM modulator.

For communications effectiveness the audio processor should include a preemphasis network, a deviation limiter and a low-pass ("splatter") filter. If the audio processor from a transmitter is to be used for this purpose instead of for the original phase modulator it will be necessary to defeat the frequency response correcting network needed with the phase modulator. This network normally consists of an R-C low-pass section of filtering and is designed to attenuate the higher frequencies at the rate of 6 db per octave across the communications audio band (300-3000 hz).

Fig. 5b shows how to carry audio from the processor into the Channelizer without adding feedthru capacitors or increasing the number of interconnecting cables. Audio is fed into the Channelizer on the transmitter RF output cable. If desired the receiver output cable could be used instead.

HIGH-SIDE INJECTION MODIFICATION

The standard Channelizer is equipped for low-side injection. This modification converts it to high-side injection. High-side injection requires a changc in the offset crystal frequency, using the formula:

$$F_{offset} = (150 + \text{RCVR 1st IF})/6, \text{ in MHZ}$$

instead of the original formula.

ALIGNMENT PROCEDURE (NOTE: GLB approval required on wired units in warranty.)

1. VCO Alignment (low-side injection)*

   1. Ground the PTT connection at the rear panel.
   2. Set the upper set of frequency control switches to 147.990 mhz,
   3. Set both selector switches to the "up" position.
   4. Connect a DC voltmeter (VTVM or 20,000 ohms per volt) with the + lead to the top of R6 (main board) and the - lead to ground.
   5. Apply power.
   6. There should be a reading between 1.3 and 5 volts. If outside of these limits there is trouble with the unit.
   7. Tune the slug in L3 with an insulated tuning tool for a reading of 1.75 volts.
   8. Disconnect the PTT ground.
   9. Tune C37 for the same reading obtained in 7.
   10. Ground the PTT terminal again.
   11. If the voltage reading changes more than .05 volts, readjust L3 and repeat steps 8, 9 and 10.

2. VCO Alignment (high-side injection)*

   1. Set the upper set of frequency control switches to 147.990 mhz.
   2. Set both selector switches to the "up" position.
   3. Connect a DC voltmeter (VTVM or 20,000 ohms per volt) with the + lead to the top of R6 (main board) and the - lead to ground.
   4. Apply power.
   5. There should be a reading between 1.3 and 5 volts. If outside of these limits there is trouble with the unit.
   6. Tune L3 for a reading of 1.75 volts.
   7. Ground the PTT connection at the rear panel.
   8. Tune C37 for the same reading as indicated in step 6.
   9. Disconnect the PTT ground.
   10. If the voltage reading changes more than .05 volts, readjust C37 and repeat steps 7-10.

3. Master Oscillator Frequency Adjustment (WWV method)

   1. Connect a clip lead to the top of R10 (main board)
   2. Make sure the clip is clear of other circuits, then turn on power.
   3. On an HF receiver, find a frequency where WWV can be received clearly.
   4. Orient the clip lead as necessary to receive the Channelizer signal at a level that allows a beat note to be heard.
   5. Tune the slug in L1 carefully for zero beat.
   6. Shut off power and disconnect the clip lead.

4. Master Oscillator Frequency Adjustment (Using a frequency counter)

   1. Select from the list below a test point having a frequency just within the frequency capability of your counter.

25 mhz	top of R18
12.5 mhz	Z5 pin 5
6.25 mhz	Z5 pin 8
416.667 khz	Z4 pin 12

   2. Connect the counter to the desired test point.
   3. Apply power.
   4. Adjust L1 carefully for the indicated frequency for that test point.
   5. Shut off power and disconnect frequency counter.

5. Offset Crystal Oscillator Frequency Adjustment.

1. This adjustment should not be made until the master oscillator is accurately adjusted as in procedure 4 or 5.
2. Do not attempt to connect a frequency counter to the offset oscillator directly, because the probe capacitance will disturb the circuit.
3. Connect a frequency counter to the receiver output jack.
4. Calculate the frequency needed for your receiver to receive a selected frequency.
5. Adjust the slug in L2 for the frequency calculated in step 4.

If a frequency counter isn't available:

3. With the Channelizer mated to your transceiver, switch to a channel having a signal known to be on frequency accurately.
4. Connect a suitable meter to the discriminator of the receiver.
5. Adjust the slug in L2 for a zero discriminator reading.

THEORY OF OPERATION

Fig. 8 shows a block diagram of the Model 400B. A signal is generated in the 20 to 25 mhz frequency range by a voltage-controlled oscillator (VCO). Its output is amplified and fed to a mixer. In the transmit mode the mixer also receives a 25 mhz signal from the master oscillator. The resulting mixer output frequency is equal to the difference between the VCO frequency and the 25 mhz reference signal. For operation in the 144 to 148 mhz range the VCO operates at 1/6 of the output frequency of the transceiver or 24 to 24.6667 mhz. The resulting IF output from the mixer is in the range of 1.000 to 0.3333 mhz. This IF signal is low-pass filtered to eliminate the undesired mixer output products, amplified and fed to a programmable frequency divider.

A digital programmable frequency divider consists of a series of flip-flops suitably interconnected, that can be programmed by combinations of voltages on its control lines to divide by any desired number. In the Model 400B the programmable divider can be set to divide by any number between 1 and 1000. Ten control lines are used to program it to numbers between 201 and 600, the range of ratios actually used to cover the 2 - meter band.

The purpose of this divider is to divide the IF down to a reference frequency of 1 2/3 khz. If, for example, it is set to divide by 300, the output would be 1 2/3 khz only for an IF input of 300 X 1 2/3 = 500 khz. Working back to the mixer, this IF could occur only if the VCO was on a frequency of 25 - 0.5 = 24.5 mhz. This VCO frequency corresponds to an output frequency at the transmitter of 6 X 24.5 = 147.00 mhz.

The foregoing assumes that the VCO was originally on the right frequency to make the programmable divider output equal to 1 2/3 mhz. However, if the VCO starts out on some other frequency, the output of the programmable divider will also be wrong. A frequency comparator circuit is employed o to correct this error.

The frequency comparator compares the frequency of the programmable divider output against a 1 2/3 khz reference frequency and responds to their relationship by adjusting the DC tuning voltage of the VCO. If the two frequencies are identical the tuning voltage is held steady. If the output of the programmable divider is higher or lower than the 1 2/3 khz reference frequency, the frequency comparator responds by adjusting the tuning voltage up or down, in such a way as to correct the error. The end result is always to equalize the frequency of the programmable divider to the 1 2/3 khz reference signal, because once this goal is achieved the VCO will have been automatically adjusted to the dialed frequency (divided by 6, of course).

The two reference frequencies needed in the process are both derived from the same source; the 25 mhz master crystal oscillator. In order to obtain 1 2/3 khz, the 25 mhz frequency is divided by 15,000 in a chain of flip-flops permanently programmed to this ratio.

With both reference frequencies derived from the same source, the final output frequency is only dependent upon the accuracy of that source and the settings of the switches, which determine the ratio of the programmable divider.

Thus, the loop is completed. If the VCO frequency doesn't correspond to the frequency dictated by the switch settings, the output of the programmable divider can't be at 1 2/3 khz. This error is detected by the frequency comparator, which responds by retuning the VCO frequency.

Actually, the comparator has two modes of operation; that of a frequency discriminator when a large frequency difference occurs and that of a phase detector when the signals it sees are nearly identical. Since the final frequency correction is based upon phase information the frequency error goes to zero. In fact, the type of phase comparator used actually reduces the phase error to zero! Thus the synthesizer output frequency is related by an exact mathematical expression to the reference crystal oscillator frequency:

VCO output freq. = 25 - N/600 [N is the programmable divider ratio]

and:

Transceiver output frequency is six times the VCO frequency, or:

F_{trans}=150-N/100, in MHZ.

When N changes in integer steps, the output therefore changes in steps of 1/100 mhz, which is 10 khz. Thus the position of the frequency control switches (which determine N) determines the output frequency of the transmitter and can be calibrated in terms of frequency output.

For operation in the receive mode the only difference is that a different frequency is injected into the mixer in place of the 25 mhz reference frequency used on transmit. Assuming that a 24 mhz reference is substituted;

VCO freq = 24 - N/600

and:

$F_{inject.}$ = 6(VCO freq) = 144 - N/100

If N=300, the transmit output would be 150-300/100 = 150 - 3 = 147 mhz. For the same switch settings, but the receive mode the local oscillator injection frequency is:

$F_{inject.}$ = 144 - 300/100 = 144 - 3 = 141 mhz.

This frequency is 6 mhz lower than the corresponding transmitter output frequency, so that if a receiver having a 6 mhz first IF were being used it would receive the same frequency as was being transmitted. It turns out that the relation for determining the frequency of the offset crystal is:

$$F_{offset} = (150\text{-RCVR 1st IF})/6, \text{ in MHZ.}$$

These examples were for the case where both the receiver and transmitter multiply the input frequency by 6. Other multiples are accommodated by dividing the VCO output frequency by 2,3 or 4. Choice of this divide ratio is made by wiring the jumpers according to Table 2. As long as the net multiple from the VCO to the final output frequency is 6, frequency step spacing doesn't change. For example, consider a transmitter with frequency multiplication from the crystal frequency to the output frequency of 24 (using 6 mhz crystals). For this type of equipment the Channelizer is wired to divide the VCO output by 4 to obtain 6 mhz, which is then multiplied by 24 in the transmitter. 24/4=6, which is the desired ratio.

WARRANTY

GLB ELECTRONICS warrants that for a period of 90 days from the date of shipment, all GLB-supplied parts shall be free from defects in materials or workmanship. Defective parts or assemblies shall be replaced or repaired only upon the return of such parts or assemblies without further damage to GLB Electronics. This warranty applies only to the original purchaser and is and shall be in lieu of all other warranties, whether expressed or implied and in no case will GLB Electronics be liable for any anticipated profits, consequential damages, loss of time, or other losses incurred by the purchaser in connection with the purchase or operation of GLB products or components thereof. Parts damaged in handling or assembly by the purchaser shall not be replaced.

The foregoing warranty does not apply to any kits or assemblies, and repairs, replacement or service will not be made on kits or assemblies in which acid-core solder or paste fluxes have been used. It also does not apply to factory-wired-and-tested units which have been tampered with or modified by the purchaser.

Information supplied by GLB Electronics on the adaptation of other equipment to GLB kits or assemblies is believed to be true and accurate, but GLB assumes no responsibility for its use or damages incurred in such use.

FACTORY SERVICE

All replacements or repairs require prepaid shipment to GLB Electronics. In-warranty repairs to factory-built units will be made free of charge, providing the terms of the warranty are not violated. In-warranty repairs to kits will be made free of charge when in the opinion of GLB Electronics the fault lies with the design or is due to defective parts supplied by GLB and where such defect interferes with the normal intended use and operation of the equipment. In other cases a charge will be made for labor and any customer-damaged parts. If the service costs are a substantial portion of the original cost of such equipment, the customer will be notified before such service is performed.

RETURNS

It is advisable to keep the original shipping carton in case shipment to GLB is necessary. Make sure that the unit is well padded and protected against damage in shipment and insure it. Make sure all parts are included. Ship prepaid to:

GLB ELECTRONICS
SALES DIVISION
404 CAYUGA CREEK RD.
SO. CHEEKTOWAGA, N.Y. 14227

Tel. 716-897-3766

In order to avoid unnecessary delay or charges, be sure to complete all steps in the assembly instructions before returning for service. Include instructions describing the services you wish to have performed. Return shipments will be sent collect.

TROUBLE-SHOOTING HELP

If you wish to call or write us concerning a problem, send complete information regarding the symptoms. Go over the voltage chart and report any variations from the chart to help us locate the trouble. **The tests on page 14 are the most important ones.**

TROUBLESHOOTING - VOLTAGE READINGS for 400B

Readings are taken with a 20,000 ohms-per-volt meter, negative probe grounded unless otherwise indicated. Supply voltage = 12, both selector switches in up position, top set of controls set to 147.990 mhz.

TEST POINT	RECEIVE	TRANSMIT	NOTES
R1	6.3	6.3	
R3	12	12	varies with supply voltage
R4, 5, 6	1.75	1.75	depends upon accuracy of VCO alignment
R7, 8, 9, 10	3.2	3.2	
R12	4.2	0.75	
R13	1.55	0.3	
R14	0.9	4.0	
R15	2.4	1.55	end toward Q14
R16	1.5	0.8	
R17	1.6	1.6	
R18	1.9	1.9	
R19	1.6	1.6	
R20	5.2	5.2	
R21	0.6	0.6	
R22	2	2	end toward C16
R23	1.4	1.4	
R25	3	3	
R26	2.8	2.6	0.8/0.8 with 10 khz sw at "8"
R27 rear	0.8	0.8	2.7/2.5 with 10 khz sw at "7"
R28	0.8	0.8	2.7/2.5 with 10 khz sw at "7"
R29 rear	2.8	2.6	0.8/0.8 with 10 khz sw at "7"
R30	2.7	2.5	0.8/0.8 with .1 mhz sw at "7"
R31 rear	0.8	0.8	2.7/2.5 with .1 mhz sw at "7"
R32	0.8	0.8	2.6/2.4 with .1 mhz sw at "7"
R33 rear	2.7	2.5	0.8/0.8 with .1 mhz sw at "7"
R34	2.6	2.4	0.8/0.8 with mhz sw at "6"
R35 front	2.7	2.5	0.8/0.8 with mhz sw at "5"
R 60	0.3	0.3	
R37	6	6	
R38	5	5	end away from VCO cover
R39,41,42,43	1.75	1.75	R43 end toward R40
R40,52	0	0	
R44	10.5	10.5	varies with supply voltage - end away from VCO can
R45	1.65	1.65	
R46,55,56	0.6	0.6	
R47	4.7	4.7	end toward Q9
R48	1.75	1.75	loop may break lock when probed
R49	0.8	0.8	
R50	0.9	3.8	
R51	3	3	end toward R53
R53	0.35	0.7	panel end
R54	0.85	0.85	bottom end
R58	5	0.1	

Power supply, with negative probe to Q2 heat sink; 2.6/2.8 volts

Troubleshooting voltage readings, continued.

REFERENCE GENERATOR TESTS

TEST POINT	Voltage (same on receive & transmit)
Z5 pin 8	2.2
Z4 pin 12	2.1
Z3 pin 12	2
Z2 pin 12	2 [check for same voltage at Z1 pin 3]

IF and PROGRAMMABLE DIVIDER CHECKS

TEST POINT	Voltage (same on receive & transmit)
Z10 pin 8	2.7
Z9 pin 12	0.85
Z8 pin 12	0.95
Z7 pin 12	3.8 [changes when mhz switch changed in position]
Z1 pin 1	same as above

PHASE DETECTOR TEST **(valid only when inputs exist on both pins 1 and 3)**

Connect meter positive to R6, negative to ground. Observe 5 volts when R23 is grounded temporarily, 1.3 volts when R18 is grounded temporarily.

FREQUENCY READINGS

NOTE: The waveforms vary widely, causing some counters to give erratic readings. If you can't get a steady count, check waveform on an oscilloscope before concluding that the waveform is erratic. Counter gate time = 1 second

TEST POINT	FREQUENCY (mhz)
R18	25.000
Z5 pin 5, 13	12.500
Z5 pin 8	6.2500
Z4 pin 8	same
Z4 pin 5,6	3.33333
Z4 pin 12	0.41667
Z3 pin 5, 6	0.208333
Z3 pin 12	26.667 khz
Z2 pin 5,6	13.334 khz
Z2 pin 12	1.667 khz
The following readings are meaningful only if loop is in lock:	
R23	335.000 khz
Z9 pin 8	same
Z9 pin 5, 6	168.333 khz
Z9 pin 12	35.000 khz
Z8 pin 5, 6	18.333 khz
Z8 pin 12	3.333 khz
Z7 pin 5, 6	1.667 khz
Z7 pin 12	1.667 khz
Z1 pin 1	1.667 khz

Fig. 1 (a) Circuit for converting positive-going push-to-talk circuits to Channelizer PTT. (b) Use of a relay permits any circuit to be used, as long as the relay can be operated. (c) Showing a "de-spiking" diode across the normal changeover relay in transceiver, when Channelizer PTT line is directly connected.

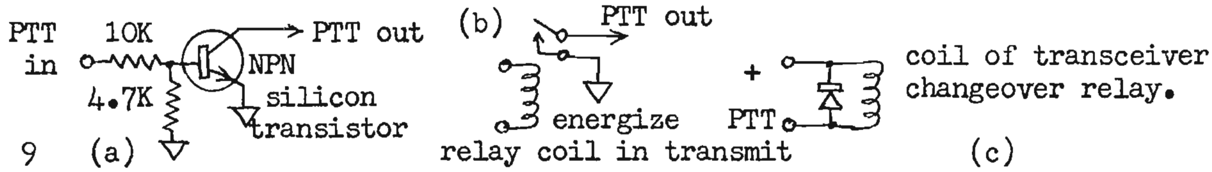


Fig. 2. Impedance step-up circuits for vacuum-tube equipment. (a) tapped tuned circuit, (b) link-coupled tuned circuit, (c) L-network. In each case C represents the internal capacitance of the transmitter oscillator circuit. The inductance value is adjusted to resonate with the circuit capacitance at the Channelizer output frequency, and addition of capacitance is not recommended.

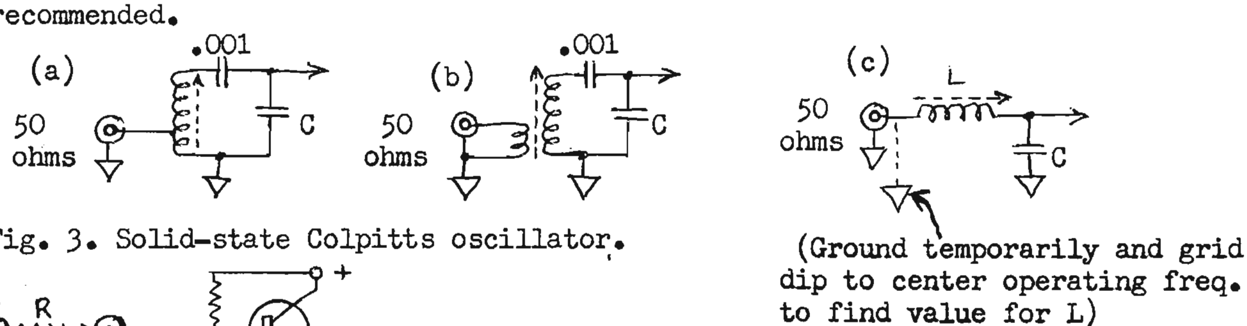


Fig. 3. Solid-state Colpitts oscillator.

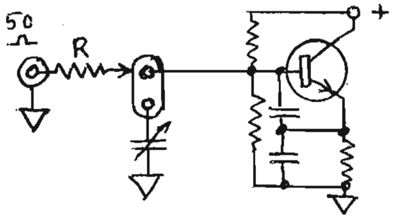
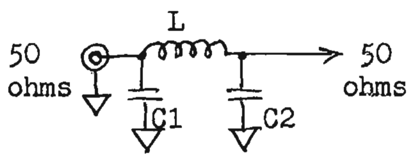


Fig. 4. Low-pass filter circuit.



Values

Frequency	L, uh	C1=C2, pf.
6 mhz	3.9	220
8 mhz	3.3	180
12 mhz	2.0	100
24 mhz	1.0	47
48 mhz	0.47	22
72 mhz	0.33	15

Fig. 5 Direct FM connections.(a) The audio processor consists of pre-emphasis clipping and filtering. A deviation pot is included at its output. (b) Simple connections to feed audio into Channelizer via output cable.

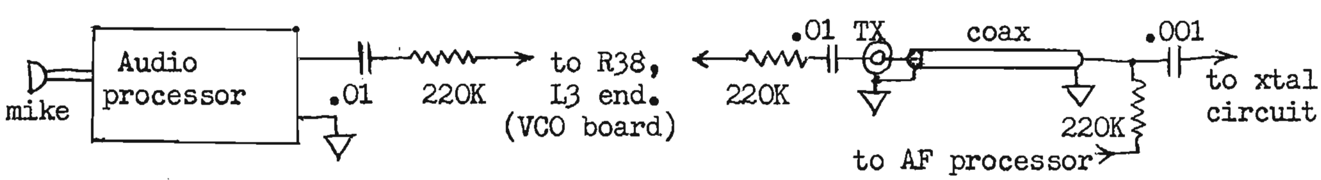
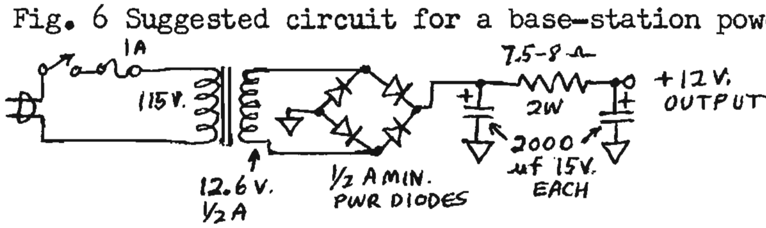


Fig. 6 Suggested circuit for a base-station power supply for the Channelizer.



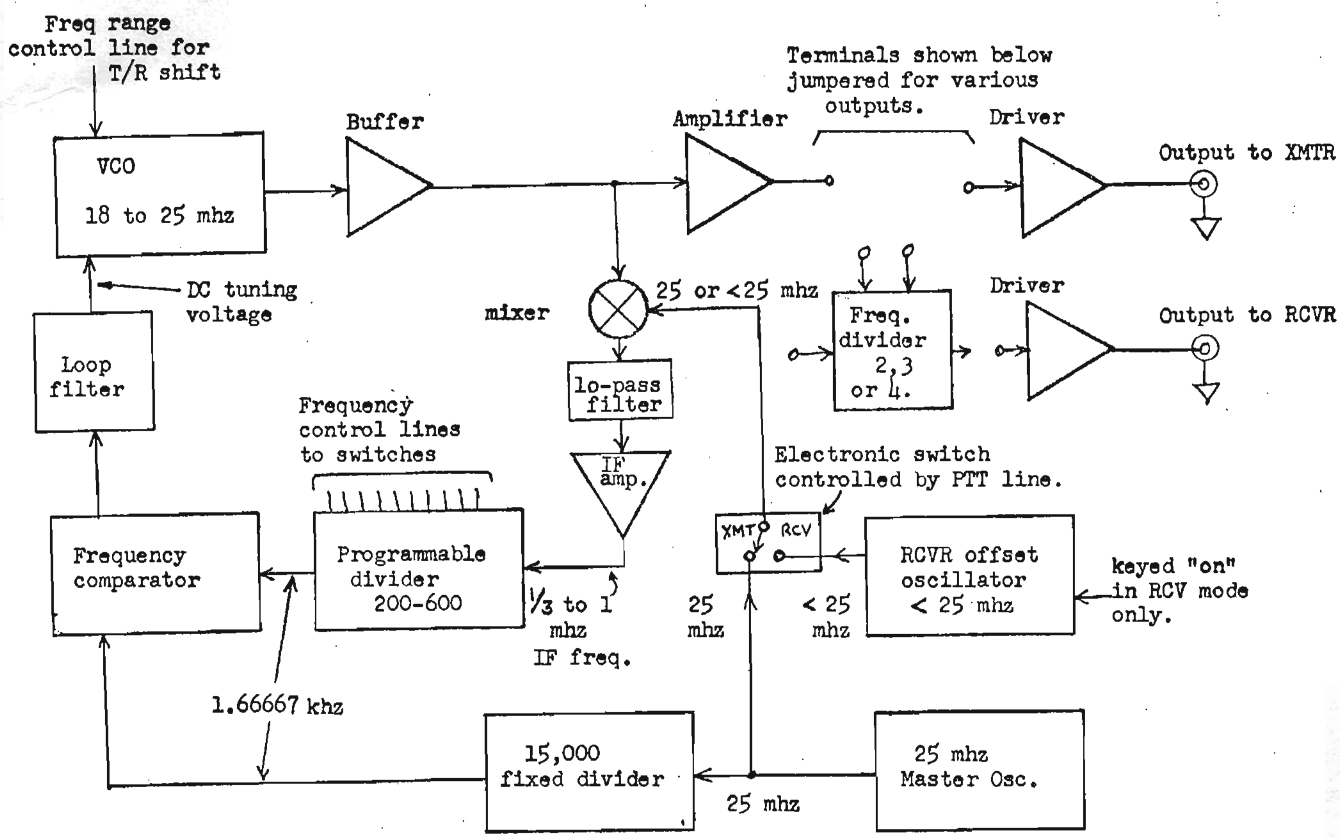
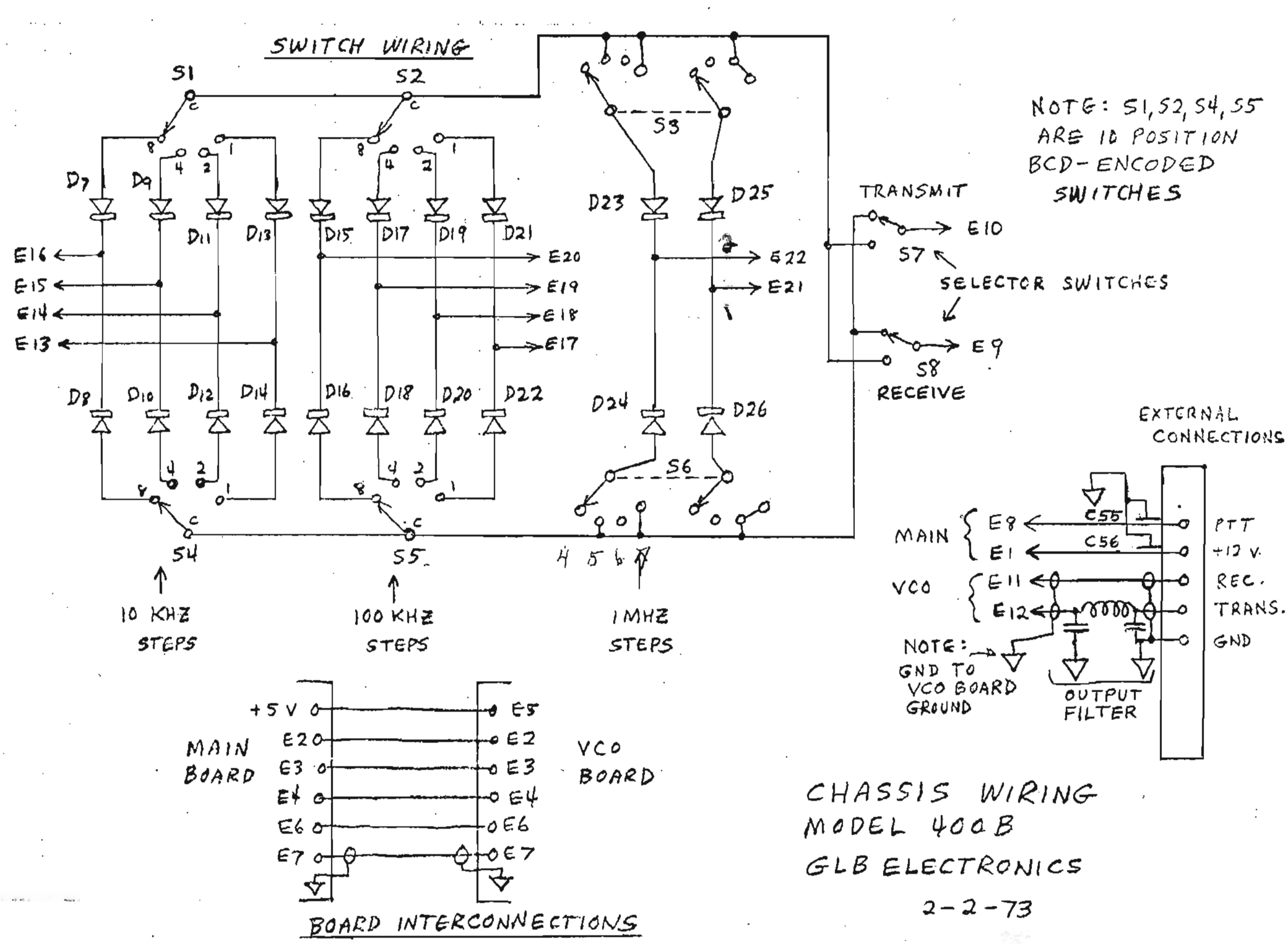
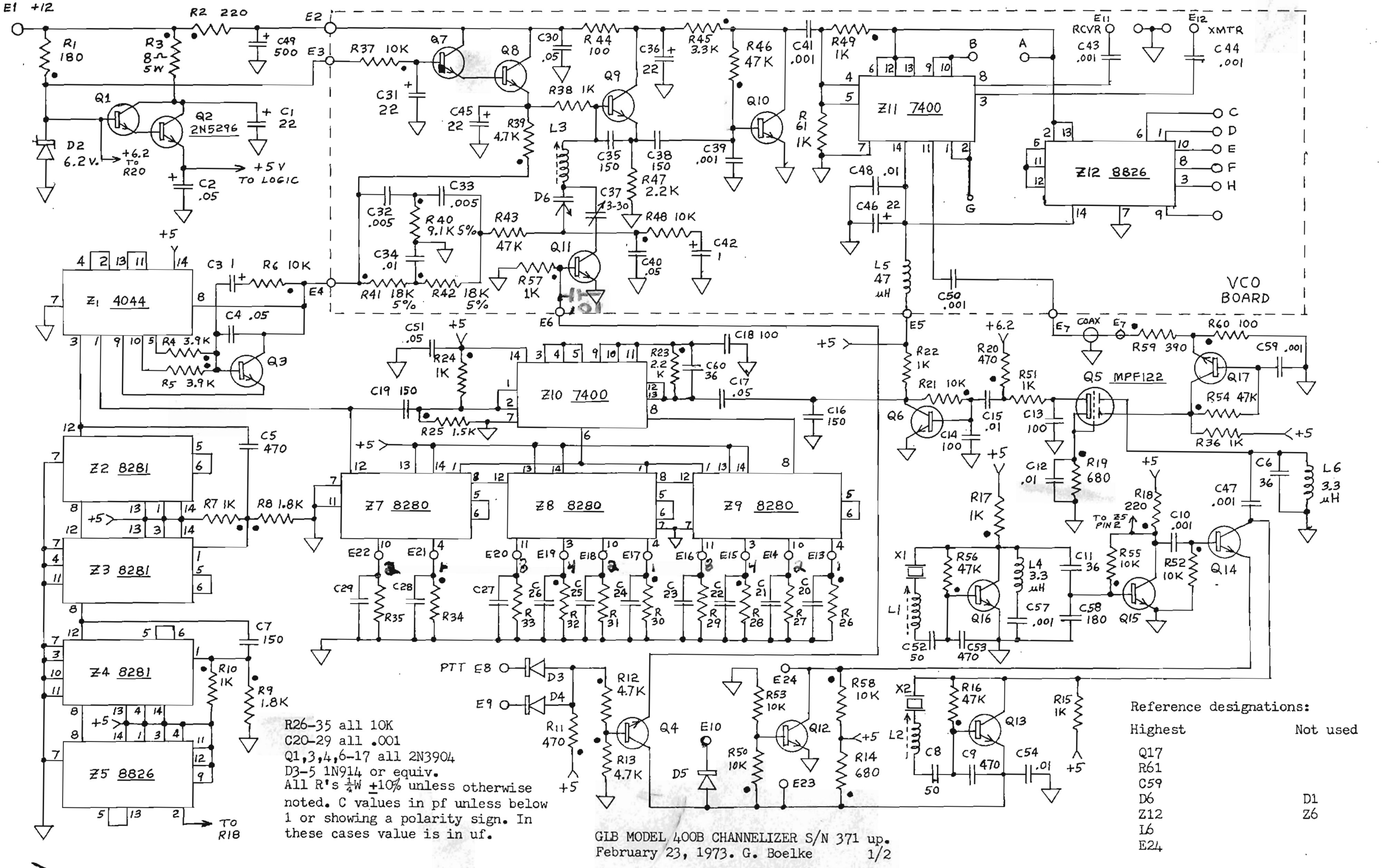


Figure 8. Functional block diagram of Model 400B Channelizer.





R26-35 all 10K
C20-29 all .001
Q1,3,4,6-17 all 2N3904
D3-5 1N914 or equiv.
All R's ¼W ±10% unless otherwise noted. C values in pf unless below 1 or showing a polarity sign. In these cases value is in uf.

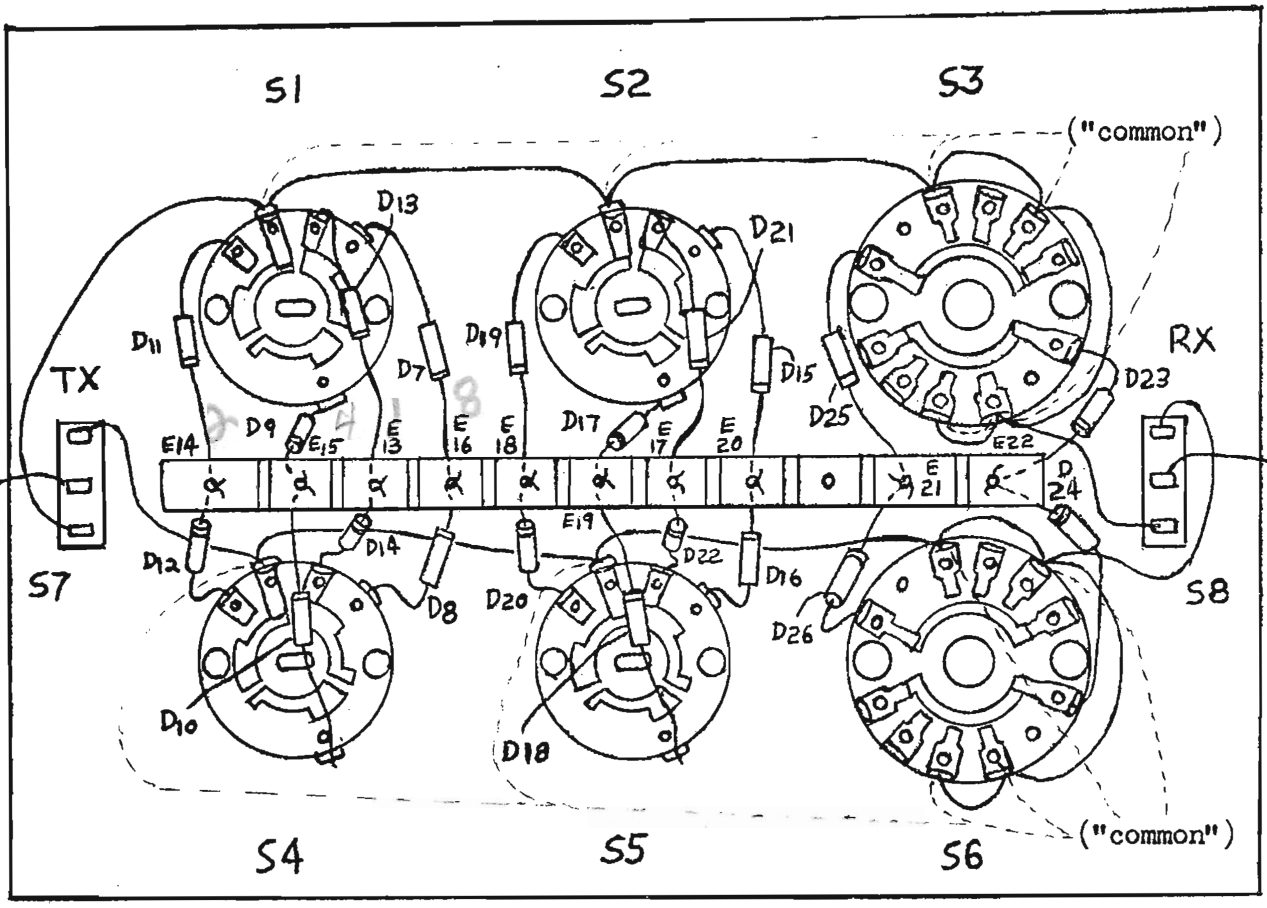
GLB MODEL 400B CHANNELIZER S/N 371 up.
February 23, 1973. G. Boelke 1/2

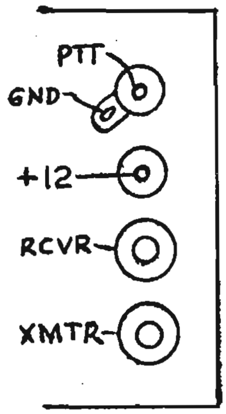
Reference designations:

Highest	Not used
Q17	
R61	
C59	
D6	D1
Z12	Z6
L6	
E24	

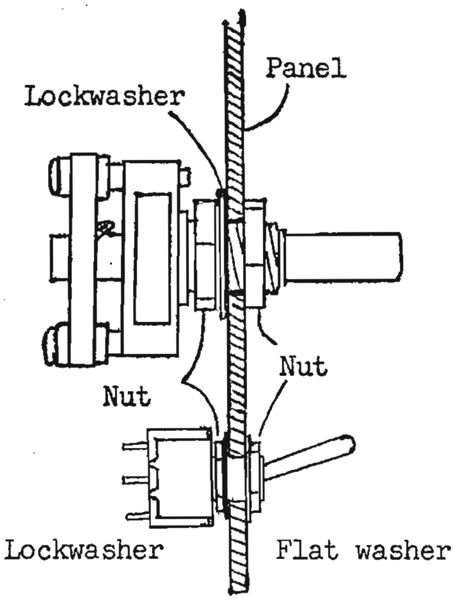
GIB MODEL 400B CHANNELIZER

Switch Assembly Pictorial

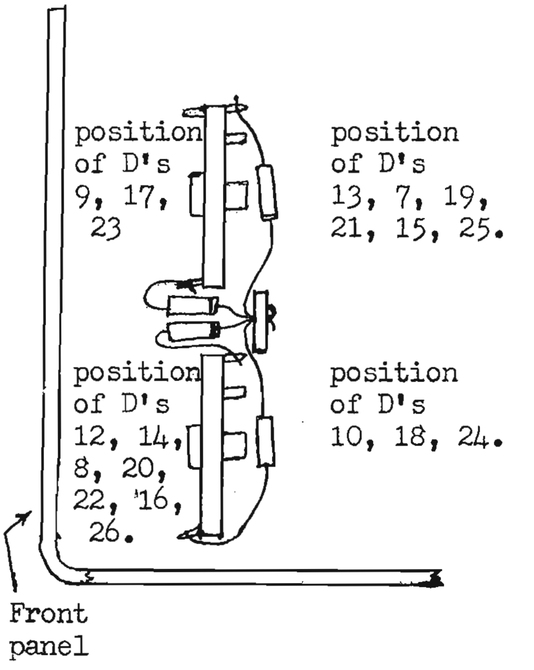




Rear Panel Connections



Switch Mounting Details



Side view showing diode positions on switches.