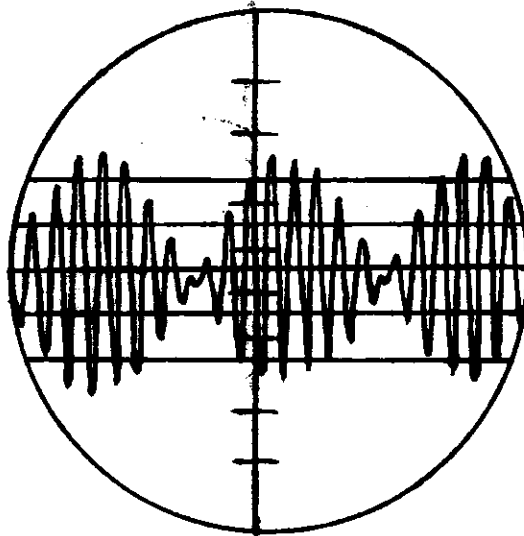


USER'S MANUAL

MODEL CEB EBS ENCODER-DECODER



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I. GENERAL DESCRIPTION

By F.C.C. order, the EBS attention signal after April 15, 1976 is to consist of two superimposed tones at frequencies of 853 and 960 hz. ± 0.5 hz. Minimum percentage modulation for each tone is to be 40%. The tones are to be broadcast for a period of 20-25 sec. Maximum total distortion of each tone is to be 5%.

The model CEB encoder-decoder generates the required tones within F.C.C. specifications. The tones are "activated", that is, connected to the transmitter's modulator in place of program material, for an automatically controlled interval of 20-25 sec. when a front panel ACTIVATE switch is momentarily closed. Activation may be terminated at any time with a front panel ABORT switch. Rear terminals are provided for connection of remote ACTIVATE and ABORT switches.

The EBS tones are available for test purposes at front panel jacks at all times, regardless of whether the encoder is activated. However, the tone amplitude at the jacks will drop about 1 db. upon activation. The encoder is designed to work into a 600 ohm load. Output is transformer coupled and floating, i.e., no connection of the output transformer secondary to either circuit ground or power line ground. The power supply is transformer operated, so that there is no connection between circuit ground and power line ground. However, the chassis is connected to power line ground through the three wire line cord. Circuit ground is accessible at terminal 7 of the rear connector block.

2. BEFORE INSTALLATION

A few minutes at the test bench will suffice for familiarization with the encoder. A VOM, oscilloscope, and optionally, a frequency counter, will be helpful.

Plug the encoder-decoder line cord into a 115 V. 60 hz. source. There is no power switch. (It would be of very limited utility in this equipment.) Lift the mechanical guard adjacent to the ACTIVATE-ABORT switch; move the switch paddle to the right ("activate" side) and release. The ACTIVATE light should go on and pull-in of the encoder relay should be audible. After 20-25 sec., the activate light should go out and the relay should be heard to drop out.

Activate the encoder again and before the automatic activation interval elapses, move the switch paddle to the left ("abort" side). The ACTIVATE light should go out and the relay should be heard to drop out.

The encoder may be activated and aborted remotely. To see how this works, short terminals 5 and 6 of the rear connector block to activate, and terminals 6 and 7 to abort.

With an ohmmeter, it may be observed that the "audio in" terminals are connected to the "audio out" terminals when the encoder is not activated (2 to 4 and 1 to 3). These connections are broken by the encoder relay upon activation and the "audio out" terminals are connected to the EBS tones. This may be observed by connecting an oscilloscope between terminals 3 and 4 and activating the encoder.

Using the double pin plug supplied with the encoder-decoder, connect an oscilloscope to the front panel jacks. The waveform at the jacks should appear as shown in Waveform I, page 4. Move the paddle of the SELECT switch to the left to observe 853 hz. alone, and to the right to observe 960 hz. alone. The ADJUST pots may be used to vary the individual tone amplitudes. Note the appearance of the superimposed tone waveform when the individual tones are unequal in amplitude. Equal tone amplitudes result in a waveform as shown in Waveform I, page 4.

The individual tone frequencies may be measured by connecting a frequency counter to the front panel jacks and using the tone SELECT switch.

CAUTION: DO NOT TIGHTEN OR LOOSEN THE REAR CONNECTOR BLOCK SCREWS UNLESS THE BOARD IS INSTALLED IN THE REAR ENCLOSURE. IF THE BOARD IS NOT INSTALLED, THE CIRCUIT BOARD WILL BE TWISTED AND THE CONDUCTORS MAY BE BROKEN.

3. ADJUSTMENT OF TONES

The F.C.C. requires a minimum of 40% modulation of the transmitter by each of the attention signal tones. The tone SELECT switch and the amplitude ADJUST potentiometers on the front panel of the Model CEB are used for individual adjustment of modulation by each tone. To adjust the modulation:

- A. Connect transmitter to "audio out" terminals, nos. 3 and 4 of rear connector block.
- B. Short terminals 5 and 6 of the rear block with a jumper to maintain continuous activation.
- C. Select 960 hz. only by holding the "tone select" paddle to the right. The switch may be temporarily taped in position.
- D. Adjust 960 hz. modulation with the 960 ADJUST pot.
- E. Repeat for 853 hz.

If the transmitter is equally modulated by both tones, the demodulated transmitter signal should be similar to Waveform 1, page 4.

4. REMOTE ACTIVATE AND ABORT

Connect a push button normally open switch between terminals 5 and 6 for remote activate. The F.C.C. requires that such a switch be guarded to prevent unintentional activation. For remote abort, connect a push button normally open switch between terminals 6 and 7 of the rear block.

5. DESCRIPTION OF ENCODER CIRCUIT

The 853 and 960 hz. tones are generated by counting down the 3.931463 mhz. output of a quartz crystal oscillator by factors of 4608 and 4096 respectively. The tone frequencies actually generated are 853.18 and 959.83 hz., which are within F.C.C. tolerances.

The 3.931463 mhz. crystal is excited by feedback amplifiers built into IC1. IC1 also counts down the crystal oscillator output by factors of 4096 and 512, giving square wave outputs at 960 hz. and 7677 hz. IC2 counts down the 7677 hz. output of IC1 by an additional factor of 9 to produce an 853 output.

The 853 hz. output of IC2 and the 960 hz. output of IC1 drive amplitude control pots used for adjustment of transmitter modulation. The two outputs can also be shorted by the tone selector switch. In the center position of the tone selector switch, neither of the outputs is shorted. Thus, either or both of the attention signal tones may be selected. The amplitude control outputs are added and filtered by a three stage RC filter. The filter output is amplified by IC3, which is used with negative feedback to control its gain. Capacitance in the feedback loop of IC3 further reduces harmonic distortion.

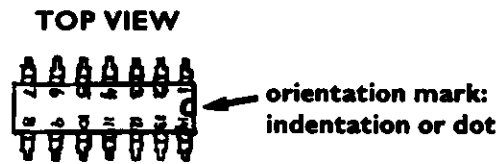
The output of IC3 is capacitance coupled to the primary of the output transformer, the secondary of which is connected to the normally open contacts of a DPDT relay. When the relay is energized, the EBS tones are connected to the "audio out" terminals of the rear panel connector block. If the relay is not energized, the "audio out" terminals are connected to the "audio in" terminals. The relay and an LED which indicates activation are turned on by IC4 when the input voltage to PIN 3 exceeds the 2.9 VDC reference level applied to the inverting input by more than a few millivolts required to drive IC4 to saturation. When the "activate" switch is closed, a 47 mf. capacitor connected to the non-inverting input of IC4 charges to 6.0 volts and turns on the relay and LED. The capacitor discharges through a 1 megohm pot used to control the activation interval, and after 20-25 sec. reaches the 2.9 V. trigger level, after which the relay and LED are de-energized.

6. MAINTENANCE

- A. To remove the covers, remove four screws securing the top and bottom covers to the rear enclosure.
- B. To remove the front panel, remove the reset switch nut and the four screws fastening the front panel to the rear enclosure and carefully work LEDs out of their front panel holes.

CAUTION: SHOCK HAZARD. 115 V., 60 HZ. IS EXPOSED ON THE POWER TRANSFORMER OF THE CIRCUIT BOARD.

C. IC pin numbering:



pin sequence is the same for 16 pin ICs

- D. If the encoder fails, check for tones of correct amplitude and frequency at the front panel test jacks. If tones are not found at the jacks, observe the waveforms at each of the test points corresponding to the figures shown on page 4. The waveforms on page 4 are in sequence working from the output toward the crystal oscillator. If some but not all are observed, the trouble will be localized to a particular IC. If none of the waveforms are present, the trouble may be the crystal or the power supply.

Normal power supply voltages are:

- (1) 17 VDC at input of voltage regulator 78L12
 - a. 15 VDC with encoder activated
- (2) 12 VDC at output of 78L12

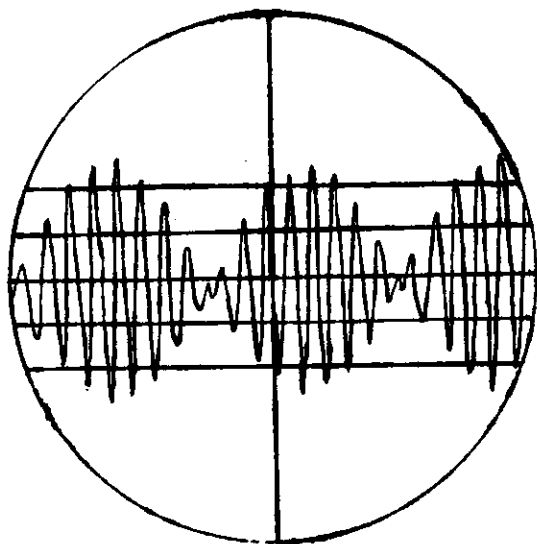
If correct output is found at the front jacks but not at the "audio out" terminals, the fault is in the relay or the activate circuit. Note whether the front panel ACTIVATE light comes on when encoder is activated. If it does, the trouble is in the relay. If it does not, the fault probably lies in the trigger amplifier IC4.

If you can localize the fault to a particular component, write or phone and a replacement will be promptly shipped. There will be no charge if the unit is in warranty.

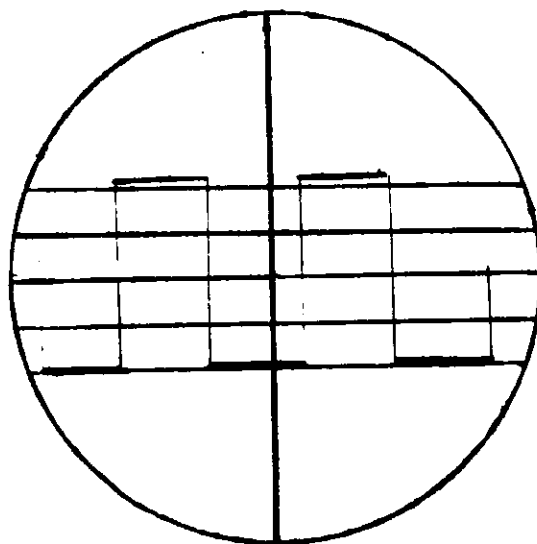
WARRANTY

For a period of one year from date of shipment, Gorman-Redlich Mfg. Co. will repair or replace, at its option, any Model CEB or Model CE that fails in normal use, with no charge for replacement components and a flat labor and shipping fee of \$25.00, prepaid by purchaser. Units will only be accepted for adjustment under warranty after written or telephone notice. If the purchaser establishes that failure of the unit was caused by a particular component or components, and wishes to make his own repair, replacement components will be shipped promptly at no charge upon written or telephone notification, with the understanding that faulty components will be promptly returned to Gorman-Redlich Mfg. Co. Units showing evidence of abuse or modification, in the judgement of Gorman-Redlich Mfg. Co. cannot be accepted for adjustment under warranty, but, if the purchaser so desires, will be repaired for a reasonable fee. The purchaser will be notified of the amount of this fee before any repairs are made, and repairs will only be made with the purchaser's consent.

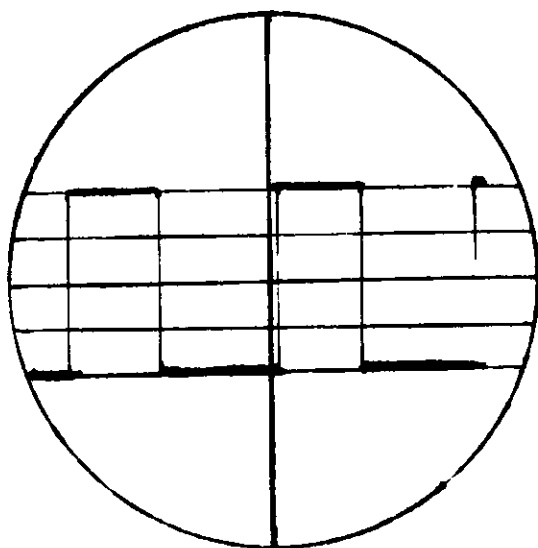
ENCODER WAVEFORMS



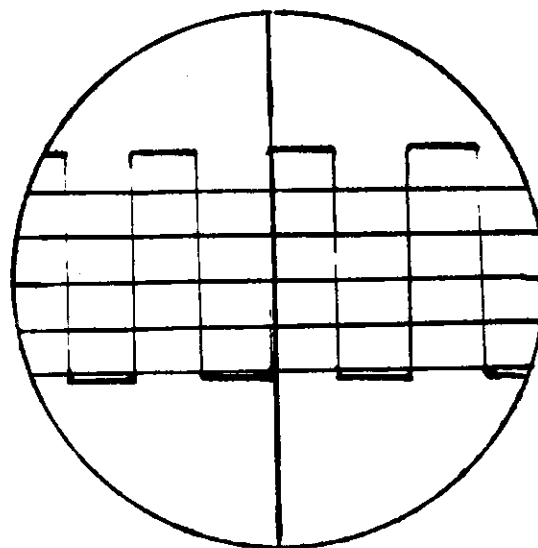
1. TEST SIGNAL AT FRONT PANEL
600 OHM LOAD
H = 2000 Microsec./cm.
V = 2 V./cm.



2. 960 HZ., PIN 1 OF IC1
H = 250 Microsec./cm.
V = 2 V./cm.



3. 853 HZ., PIN 4 OF IC2
(NOTE ASYMMETRY)
H = 250 Microsec./cm.
V = 2 V./cm.



4. 7.678 KHZ., PIN 13 OF IC1, PIN 14
OF IC2
H = 40 Microsec./cm.
V = 2 V./cm.

MODEL CEB DECODER SECTION

I. GENERAL DESCRIPTION

The decoder section of the Model CEB is used to detect the transmission of the new two frequency EBS attention signal by the station being monitored, and to provide an audible alert by demuting the monitor receiver, and/or an additional audible or visible alert. Signal for the decoder is taken from the output transformer of the monitor receiver. When the EBS attention signal is received, a relay in the Model CEB will close after a delay of 8-16 seconds. Both of the attention signal tones, 853 and 960 hz., must be received continuously for the entire 8-16 seconds in order for the relay to close. Two sets of normally open contacts on the relay are used to demute the receiver and/or actuate an auxiliary alarm. Another set of normally closed contacts is used to connect a dummy speaker load across the output transformer when the receiver is muted. After the relay has closed, it will remain closed until a front panel RESET button is pressed. The receiver may be demuted at any time by pressing the RESET button.

The decoder is designed so that it will not be triggered by a power outage. Upon resumption of power, the receiver will return to the muted state. Loss of carrier by the station being monitored will not trigger the decoder.

2. BEFORE INSTALLATION

A few bench tests before the installation will familiarize the user with operation of the decoder. Plug the Model CEB into a suitable 60 hz. source. The front panel READY light should go on. Press the RESET button a few times; the READY light should alternate between on and off. Connect an ohmmeter between terminals 8 and 9 of the rear connector block and press the reset button a few times. The ohmmeter should show an open circuit when the READY light is on (this is the muted state) and a short circuit when the READY light is out (demuted state). An ohmmeter between the auxiliary alarm terminals will show the same indications.

SELF-TEST: The decoder may be self-tested by using a simulated EBS signal taken from the encoder. Using the two-pin plug supplied with the Model CEB, make up a two wire lead to connect the front panel TEST jacks to terminals 8 and 10 of the rear connector block. **THE READY LIGHT MUST BE ON AND THE MONITOR RECEIVER MUST BE DISCONNECTED FOR SELF-TEST**, to avoid loading the encoder output with the speaker that is connected between terminals 8 and 10 in the muted state. 8 to 16 seconds after the front panel jacks are connected to terminals 8 and 10, the READY light should go out.

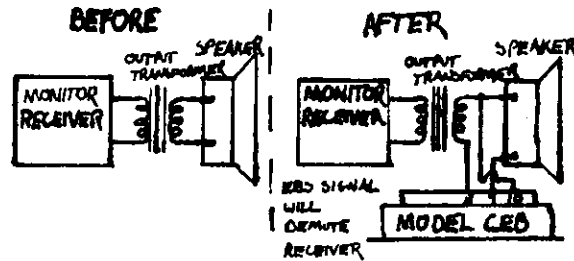
BEFORE CONNECTING THE MONITOR RECEIVER TO THE DECODER, CHECK THE RESISTANCE OF THE MONITOR RECEIVER'S SPEAKER VOICE COIL. WHEN THE RECEIVER IS MUTED THE SPEAKER IS DISCONNECTED AND A DUMMY SPEAKER LOAD MUST BE CONNECTED ACROSS THE OUTPUT TRANSFORMER TO AVOID AUDIO DISTORTION. IN THE MODEL CEB, A 6 OHM RESISTOR IS AUTOMATICALLY CONNECTED ACROSS THE OUTPUT TRANSFORMER WHEN THE RECEIVER IS MUTED. THIS IS A SATISFACTORY LOAD FOR COMMON SPEAKER RESISTANCES OF 4-8 OHMS. IF YOUR SPEAKER HAS A HIGHER RESISTANCE, PROCEED AS FOLLOWS:

- A. **SPEAKER RESISTANCE 9-16 OHMS:** Remove the covers according to instructions in Part 6 of the Encoder Section. Locate the two 12 ohm resistors which, in parallel, make up the dummy speaker load. They are on the rear of the circuit board next to the decoder relay (refer to parts layout diagram if necessary). Cut one lead of one of the 12 ohm resistors, leaving a dummy speaker load of 12 ohms.
- B. **SPEAKER RESISTANCE GREATER THAN 16 OHMS:** Remove the covers according to instructions in Part 6 of the Encoder Section. Locate the two 12 ohm resistors which, in parallel, make up the dummy speaker load. They are on the rear of the circuit board next to the decoder relay (refer to parts layout diagram if necessary). Cut the leads to (or completely remove) both 12 ohm resistors. Obtain a resistor within a few ohms of your speaker resistance, with wattage rating appropriate to the audio power output of your receiver, and install it in place of the two 12 ohm resistors, either by soldering it underneath the circuit board, or by using the holes vacated by the 12 ohm resistors.

3. CONNECTING THE MONITORING RECEIVER TO THE DECODER

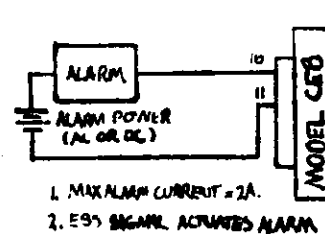
CAUTION: DO NOT TIGHTEN OR LOOSEN REAR CONNCTOR BLOCK SCREWS UNLESS THE BOARD IS INSTALLED IN THE REAR ENCLOSURE. IF THE BOARD IS NOT INSTALLED THE CIRCUIT BOARD WILL BE TWISTED AND CONDUCTORS MAY BE BROKEN.

For receiver demuting by the EBS signal, connect as in the following diagram:



After connecting the monitor receiver according to the diagram, turn the receiver on, plug in the Model CEB, demute the receiver with the RESET button, and tune to the station being monitored. Adjust the audio volume as required. It is advisable at this point to observe the audio signal between terminals 8 and 10 (or directly at the output transformer terminals) with an oscilloscope, with the receiver in both the muted and demuted states. If the dummy speaker load is correct, there should be little change in peak amplitude or distortion when the receiver is muted. This test is important because the output transformer signal is the input to the decoder. Peak to peak audio amplitude should be between 500 MV. and 20 V. for proper decoder operation.

An auxiliary alarm may be connected according to the following diagram:



4. DESCRIPTION OF DECODER CIRCUIT

The decoder is based on the superheterodyne principle. It has two channels, one fixed tuned to 853 hz., the other fixed tuned to 960 hz. The intermediate frequency for both channels is 107 hz. "Local Oscillator" signals are taken from the encoder and are thus crystal controlled. The 853 hz. component of the EBS signal is mixed with 960 hz. signal from the encoder to produce a 107 hz. intermediate frequency. Similarly, the 960 hz. component of the EBS signal is mixed with an 853 hz. signal from the encoder to produce a second 107 hz. intermediate frequency. The intermediate frequency signals are peak detected and the two peak detected outputs are applied to an "AND" circuit, which responds only if BOTH inputs are above a preset trigger level and remain so continuously for a period of 8-16 seconds. When the AND circuit triggers, it pulses a latch which changes state and remains in its new state until the reset button is pressed. A relay and a light emitting diode are connected to the latch. When the relay is closed, thus demuting the monitoring receiver and/or actuating an auxiliary alarm, the LED is out and vice-versa. Thus, when the relay is deenergized, the LED, which is the READY light on the front panel, is on, indicating that the decoder is ready to receive the EBS signal.

The incoming EBS signal, taken from the output transformer of the monitor receiver, is first roughly filtered by a resistance-capacitance filter with 3 db point at approximately 900 hz. and falling off at 20 db/decade below that frequency. The RC filter output is applied to each of two active filters (two halves of IC5) having center frequencies of 853 and 960 hz. and 3 db bandwidths of ± 25 hz. The active filters consist of operational amplifiers with negative feedback through precision filters made up of highly stable 1% resistors and capacitors.

The outputs of the 853 hz. and 960 hz. active filters drive amplifier mixers (two halves of IC6).

The 853 hz. and 960 hz. signals are mixed with "local oscillator" signals obtained from the encoder portion of the Model CEB. The mixer output is a train of pulses, width modulated at 107 hz. The width modulated pulse train has a Fourier component at 107 hz. whose amplitude is independent of the EBS signal input amplitude (when EBS signals exceed the

minimum recommended signal of 100 MV. RMS per tone) and which is fixed at a precise level that is determined almost entirely by the regulated 12.0 VDC supply.

Each of the width modulated pulse trains at the outputs of the two mixers drives an active filter with a center frequency of 107 hz. and a 3 db. bandwidth of ± 3.5 hz. The active filters are identical. Each is composed of an operational amplifier (one-half of IC7) with negative feedback through a twin-tee filter made up of highly stable 1% precision resistors and capacitors. The 107 hz. component of the input signal to each active filter appears at the filter output at a level of 8.0 to 8.5 V P-P.

The outputs of the 107 hz. active filters are peak detected by diodes D1 and D2 and their associated RC filters. Diodes D3 and D4 connect the detected DC voltages to a 47 mf. capacitor, which charges through a 390 K resistor to the lower of the detector voltages. The charging time constant is 8-16 seconds. The capacitor voltage is applied to the inverting input of an operational amplifier (IC8). The non-inverting input is connected to + 6.0 VDC. The operational amplifier under these conditions acts as a trigger; its output voltage going from 12 VDC to 2 VDC when the voltage at PIN 2 IC8 changes from a few millivolts below + 6.0 volts to a few millivolts above.

IC8 therefore triggers if, and only if, both of the 107 hz. detector outputs exceed 6.0 volts continuously for 8-16 seconds. It therefore functions as an AND circuit with a time constant of 8-16 seconds. If either of the two detector voltages drops below 6.0 V., the 47 mf. capacitor quickly discharges to the new lower level, with a time constant of about 1 second.

When IC8 triggers, a negative pulse is applied to the other half of IC8 (operating as a latch) through a diode. Positive pulses are blocked by D5. The latch changes state upon application of a negative pulse to its input. Its output is connected to the front panel READY light and to the coil of a 2 PDT relay. When the ready light is on, the relay is open. If both tones of an EBS signal are received continuously for a period of 8-16 seconds, IC8 triggers, the ready light goes out and the relay closes, thus demuting a receiver and/or actuating an alarm.

The front panel RESET switch, when closed momentarily, applies a pulse input voltage to IC8, causing it to trigger and PIN 7 to change state. The reset switch can be used to demute the monitoring receiver or to reset the decoder to the READY state when necessary.

5. MAINTENANCE

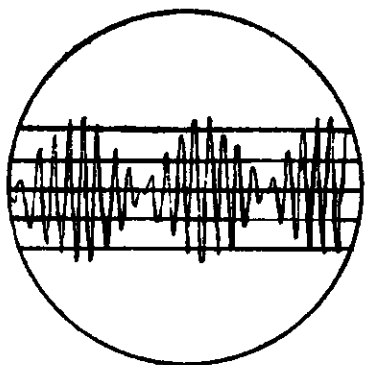
- A. See Section 6 of Encoder Instructions for disassembly.
- B. If the decoder fails and seems completely inoperative (READY light does not go on, RESET switch does not function), check the fuse and the power supply. Normal power supply voltages are shown in Encoder Instructions, section 6D.

Check for proper operation of the RESET switch. If it operates normally and the decoder relay audibly pulls in and drops out, IC8 and the power supply are OK.

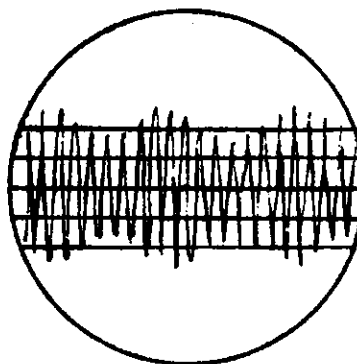
Connect the decoder for self-test as described in Part 2 of this manual. Note that the monitor receiver must be disconnected for this test. With an oscilloscope, observe the waveforms shown on page 8 of this manual. Anomalies in the observed waveforms should localize the fault to: the encoder, if no signal is observed at the TEST jacks; IC5, if the 853 or 960 hz. filter outputs are faulty, IC6 if either of the mixer outputs is faulty, IC7 if either of the 107 hz. IF outputs is faulty.

If you are able to localize the fault to a particular component, write or phone and a replacement will be promptly shipped with no charge, if the unit is in warranty.

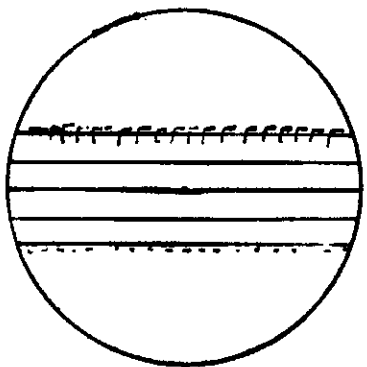
DECODER WAVEFORMS



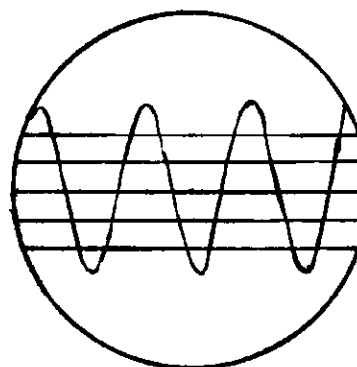
1. SELF TEST SIGNAL AT FRONT PANEL JACKS. THIS WAVEFORM SHOWS APPEARANCE OF SUPERIMPOSED, EQUAL, 853 & 960 HZ.
H=2000 Microsec./cm.
V=2 V./cm.



2. 853 HZ. PREFILTER OUTPUT, PIN 1; IC5 (960 PREFILTER OUTPUT, PIN 7, IC5, IS SIMILAR). INPUT IS SELF-TEST SIGNAL.
H=2200 Microsec./cm.
V=1 V./cm.

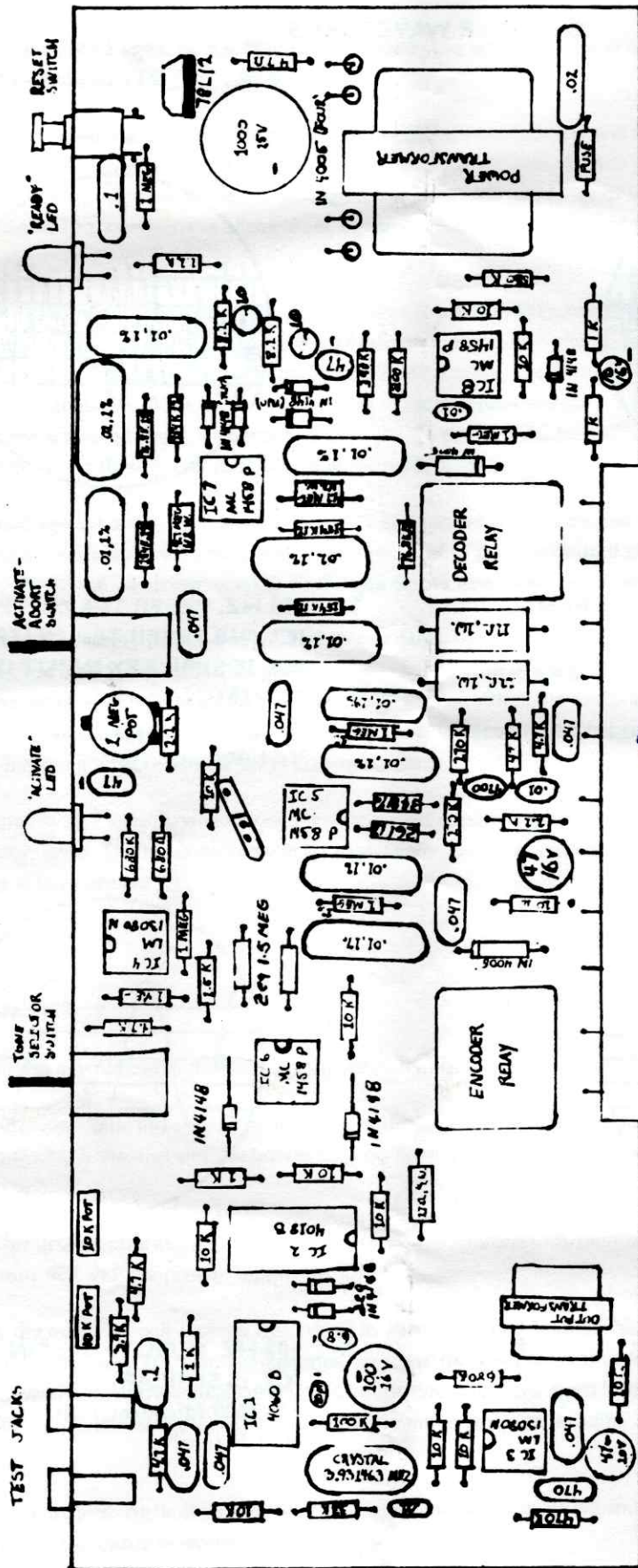


3. MIXER OUTPUT; PIN 1, IC6 (PIN 7, IC6 IS SIMILAR).
H=2000 Microsec./cm.
V=2 V./cm.



4. 107 HZ. IF OUTPUT; PIN 1, IC7 (PIN 7, IC7, IS SIMILAR).
H=2000 Microsec./cm.
V=1 V./cm.

COMPONENT LAYOUT MOD CEB ENCODER-DECODER

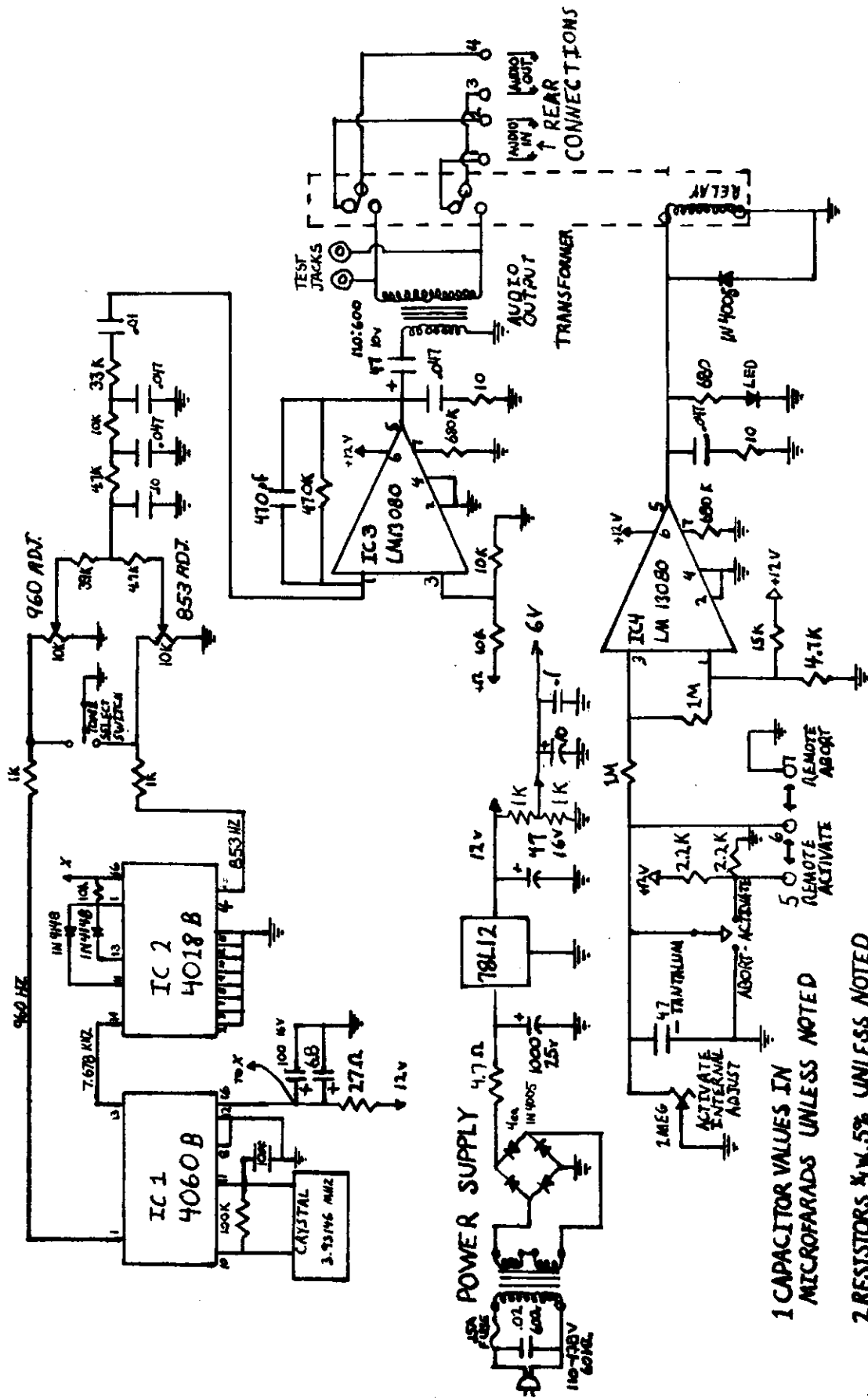


RESISTORS 1/4 W., 5% UNLESS NOTED.
CAPACITANCE VALUES IN MICROFARAD
UNLESS NOTED.

- DENOTES CATHODE OF DIODES
(BANDS END) OR NEGATIVE
TERMINAL OF ELECTROLYTE
CAPACITORS.

GORMAN-REDLICH
MANUFACTURING CO.
ATHENS, OHIO

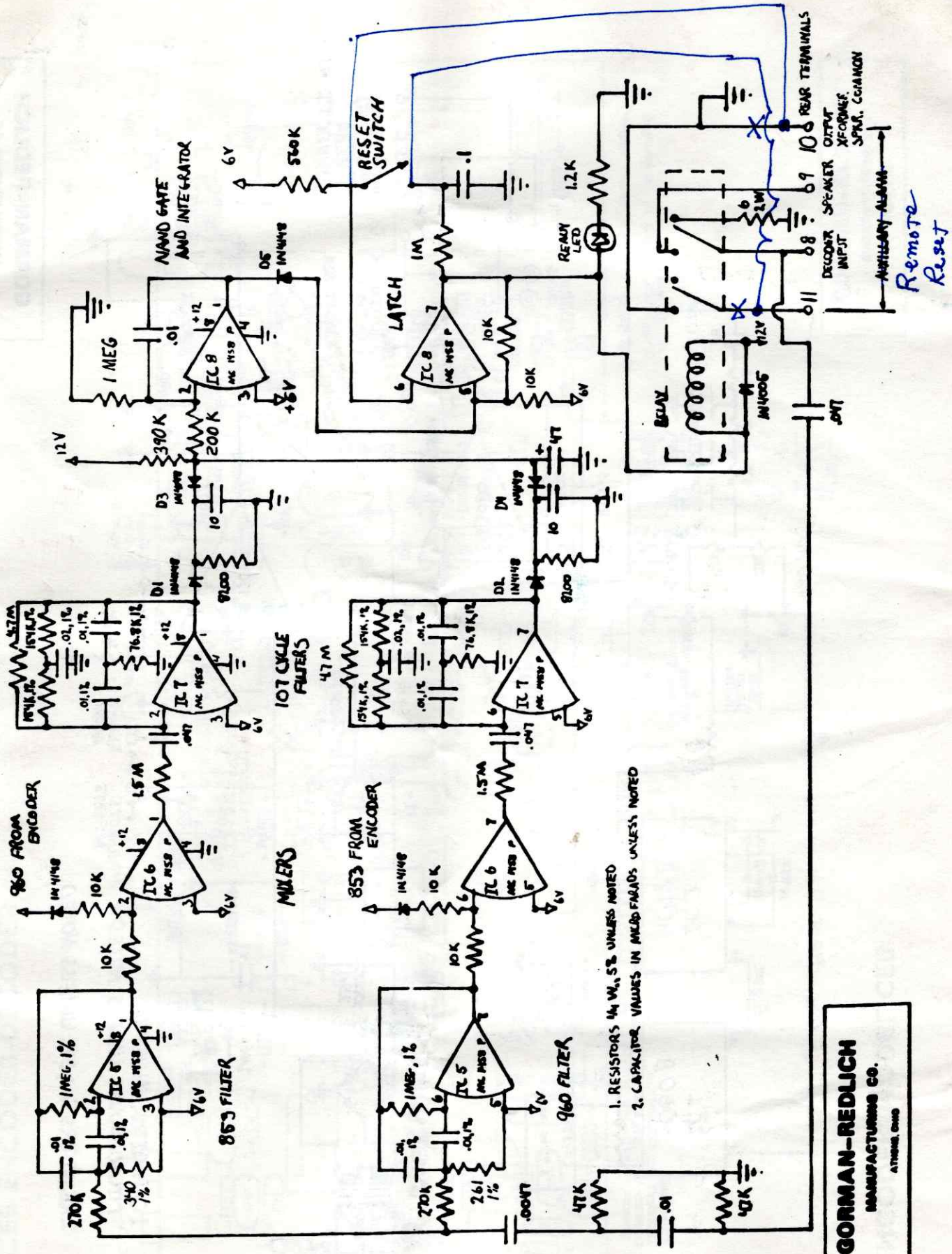
EBS ENCODER, MODEL CEB



1 CAPACITOR VALUES IN MICROFARADS UNLESS NOTED
 2 RESISTORS $\frac{1}{4}$ W, 5% UNLESS NOTED

GORMAN-REDLICH
 MANUFACTURING CO.
 ATHENS, OHIO

EBS DECODER, MODEL CEB



GORMAN-REDLICH
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 A THOMAS GROUP