

# INSTRUCTION BOOK

FOR

## MODEL 411 EXTENDED RANGE AUDIO OSCILLATOR

MANUFACTURED BY

THE CLOUGH-BREngle CO.

CHICAGO, ILL.

### Specifications

Frequency Range: 20 cycles to 1000 KC in five ranges; 20-240 cycles, 200-2400 cycles, 2-24 KC, 20-240 KC and 200-1000 KC.

Frequency Accuracy: P/M (2% plus 1 cycle) from 20 cycles to 200 KC; P/M 3% from 200 KC to 1000 KC.

Output: 10 volts open circuit. Internal impedance is approximately 100 ohms. At maximum output level the load impedance should be 2000 ohms or greater. A continuously variable output control and a switch to reduce output approximately 50 times are provided.

Output Curve: P/M .5 db from 20 cycles to 100 KC; P/M 2 db from 100 KC to 1000 KC.

Distortion: Less than 1% with 2000 ohm load from 100 cycles to 100 KC. Below 100 cycles and above 100 KC the distortion may rise a small amount. Distortion is reduced when the load impedance is very high or when the OUTPUT switch is in the LO position.

Output Hum: Less than 5 millivolts of maximum output. Less than .1 millivolt with OUTPUT switch in the LO position.

Power Supply: 115 volts, 50-60 cycles. Power Consumption 35 watts.

Tubes: (Supplied) One type 6AG5, two type 12BY7, and one type 6X5GT.

Size and finish: 6" wide by 8 $\frac{1}{2}$ " high by 8 $\frac{1}{2}$ " deep. Engraved panel and etched dial. Panel and case are gray wrinkle finish.

Weight 13 $\frac{1}{2}$  pounds.

#### WRITE DIRECTLY TO THE FACTORY FOR INFORMATION

Customers within the United States are urged to write directly to the factory for all information. To best serve you we sell direct. It is suggested that customers outside of the United States write for the name of the authorized representative in their territory.

#### ORDERS FOR PARTS

Should state both the Model number and the serial number of the instrument for which they are intended. Power transformer orders should state the line voltage and frequency. For very old instruments, the return of the worn or damaged part will assure a perfect replacement.

We endeavor to supply parts and repairs at the lowest possible cost at all times. It will be appreciated though, that as a design becomes older or is discontinued from the line, prices on its parts must necessarily advance to cover fabrication and testing of components in small or even single lots.

Due to their nature, repair parts are sold on a cash or net 10 days basis and are not returnable for any reason.

#### WARRANTY

We warrant each new instrument manufactured and/or sold by us to be and remain free from defect due to faulty material (tubes excluded) and/or workmanship for ONE YEAR from date of shipment from our factory.

Our obligation under this warranty is expressly limited to repairing or replacing, at our plant, any part (except tubes) which is proven by our examination to be defective, provided the instrument is returned by the owner, transportation prepaid.

If the instrument is incomplete, abused, or tampered with or the serial number effaced, this warranty shall be deemed null and void.

#### REPAIRS AND SERVICE

We have a special department conducted as a service bureau for C-B instrument users and place each instrument in as nearly new condition as possible. Final tests are made with the same fixtures and equipment used in the original production.

For ordinary repairs and reconditioning to original specification no authorization for return of the instrument is necessary. Simply wrap the instrument securely in tough paper and pack in a carton with at least 3" of excelsior on all sides, mark the package "Att: Service Dept." and ship with transportation prepaid.

A letter referring to the instrument by Model and Serial number will permit us to notify you in case of non-delivery. Also, relate in as much detail as possible the nature of the difficulty encountered and the services desired. This will frequently save time in getting at the source of the trouble and effect a corresponding saving in the cost of repairs.

Unless advised to the contrary, worn and damaged parts will be replaced and the instrument put in as nearly new condition as possible. This complete service is suggested unless the instrument is so old that the expense is unwarranted.

We are always happy to supply an estimate of the repair costs before proceeding with the work, if requested. It is not possible to estimate repair and recalibration charges without examination of the particular instrument involved.

Please do not ask us to add features to or modernize old instruments to new specifications unless previous correspondence has indicated that we are in a position to do so.

Like repair parts, all repair service is sold on a cash or net 10 days basis; No discount allowed.

## Section I. Description

### 1. General

The Model 411 Extended Range Audio Oscillator is a high grade instrument suitable for making measurements or tests requiring a sine wave signal over the range from low audio frequencies to well into radio frequencies.

This instrument employs a resistance capacity tuned oscillator circuit. Basically the oscillator portion consists of a broad band amplifier stage, a cathode follower, a regenerative feedback path and a degenerative feedback path. The response of the regenerative feedback path is uniform to all frequencies involved. The degenerative feedback path is through a bridged T network which is the tuned element of the instrument. A second cathode follower is used as the output stage. The necessary operating potentials are supplied internally by a transformer, rectifier and filter circuit.

### 2. Panel Controls

a. Frequency dial. This is the circular dial just above the center of the panel on which all frequencies are read. The outer ring of markings is used for frequencies up to 240 KC and the inner ring for the 200-1000 KC range. A friction drive having a ratio of approximately 5 to 1 actuates this dial.

b. RANGE Switch. The frequencies generated by this instrument are covered in five ranges. The RANGE switch selects the desired range. The first four positions (for frequencies up to 240 KC) are marked in multiplying factors of the markings on the frequency dial. The fifth position is marked with the frequency range covered (200-1000 KC).

c. OUTPUT Control. This is a linear control for the adjustment of the amplitude of the frequency generated by the instrument.

d. LO-HI Switch. This switch selects the output voltage range which is covered by the OUTPUT Control. The open circuit output voltage is 0-.2 in the LO position and 0-10 volts in the HI position.

e. ON-OFF Switch. This switch controls the application of line power to the instrument.

## Section II. Operation

### 1. Connections

a. To power line. The line cord plug should be inserted in an AC power source. Make certain that the source of power is consistent with the data on the nameplate before making this connection. The power switch should be turned to the ON position. The jewel in the upper right hand corner of the panel will light when the power is on. The line cord should be wound on the metal strips on the rear of the case when not in use or when the full length is not required.

b. Output. The binding posts on the panel of the Model 411 should be connected to the input of the device under test. The black binding post should be connected to the low potential side. The load impedance should be 2000 ohms or greater if the rated distortion is not to be exceeded when the OUTPUT switch is in the HI position. If the load has an impedance less than 2000

ohms, a resistor should be placed in series with it before connecting to the Model 411 so that the total value will be 2000 ohms. If it is not convenient to add a series resistor to build out the load to 2000 ohms, the load may be connected directly to the Model 411 binding posts provided that it is operated at reduced output voltage. In most cases, if the AC current in the load does not exceed 5 MA, the distortion will not be objectionable. Minimum distortion will be obtained when the load impedance is very high (10,000 ohms or greater).

### 2. Setting the frequency.

The frequency dial and the RANGE switch are set to indicate the desired frequency. The range 200-1000 KC is read on the inner ring of markings on the dial; all other frequencies are read on the outer ring of markings on the dial, the RANGE switch supplying the appropriate multiplying factor. Overlap of the ranges is provided by the 200 to 240 markings on the outer ring of the dial. Frequencies in this range may also be obtained at the low frequency end of the next higher range.

Frequency generation in the Model 411 begins in about 15 seconds after the line power switch is turned to ON. There will be a small frequency drift as the instrument warms up. This drift is due mainly to the temperature coefficient of the resistors in the frequency determining network. In general this drift does not exceed .5% and is essentially complete in two hours after the instrument is turned on. The stated frequency tolerance in the specification includes this drift.

### 3. Setting the Output Voltage.

The OUTPUT switch is turned to the HI position when voltage greater than .2 volts are needed. With the switch in this position, the open circuit output may be varied from 0 to 10 volts by rotating the OUTPUT control. The output voltage under load will be a small amount less than the open circuit value due to the drop in the 100 ohm internal impedance of the instrument. When small voltages are required such as for checking high gain amplifiers the OUTPUT switch should be turned to the LO position, the OUTPUT control will then have a range of 0 to approximately .2 volts. The internal impedance under this condition is still approximately 100 ohms. The hum output will be considerably less than when the HI output condition is used and the distortion regardless of load impedance, will be the same as obtained on open circuit in the HI position.

## Section III. Precaution in Operation.

The output coupling capacitor in the Model 411 is an electrolytic capacitor. This type is necessary because of the large value required to pass the low frequencies without attenuation when low impedance loads are used. Because of the nature of electrolytic capacitors, there may be some DC leakage thru it. If this leakage should be objectionable, such as when connection is made directly to the grid of an amplifier tube, an external paper capacitor should be connected in series with the output. Under such circumstances, the load impedance being high, a .5 MFD capacitor will usually pass all frequencies involved without attenuation.

1. General Replacements.

Replacement of the variable capacitors and the resistors on the RANGE switch should not be attempted since they affect the frequency calibration. All the other components may be replaced in the field without impairment of operation. Except for the power transformer and filter choke, they may be replaced with an equivalent value and size component of any reputable manufacturer. Some selection of the 6AG5 and 12BY7 tubes may be necessary to keep the distortion very low.

2. Replacement of fuse.

The fuse may be removed by unscrewing the black cap marked FUSE which protrudes thru a hole in the rear of the case. The correct fuse replacement is a type 3AG, 1 ampere. If a fuse blows immediately after replacement, the cause should be found and corrected.

3. Removal from case.

The panel and chassis assembly may be removed from the case by first removing the two screws on the rear and the one on the bottom of the instrument, then sliding the panel and chassis assembly out. When replacing the panel and chassis assembly in the case be careful not to strike the 6AG5 tube shield on the side of the case.

4. Adjustment of output voltage.

If the output voltage of the Model 411 changes due to aging of the tubes or replacement of some component, it may be reset to 10 volts by adjusting the control marked R1 which is adjacent to the 6AG5 tube on the chassis. A high impedance voltmeter should be used in checking the output voltage.



