Westinghouse

Frequency Transducer

Type VC-841

I. Why the Frequency Transducer?

The frequency transducer was designed to permit frequency measurements with a conventional d-c permanent magnet moving coil instrument mechanism. Prior to its design, a complex crossed-coil dynamometer mechanism was required to make this measurement.

The frequency transducer has several advantages. It permits:

1. Narrower frequency ranges, 59-61 Hertz is readily available with a standard mechanism.
2. A nearly linearal scale distribution. (See Figure 1).
3. The use of any size or shape instrument.

In addition to its use with indicating and recording instruments, the frequency transducer is suited for computer and control applications, since its output varies almost linearly with a change in frequency over the specific range (see Specifications).

Note: Because the output is not isolated from the input it is recommended that a potential transformer be used ahead of the transducer for computer or control use.

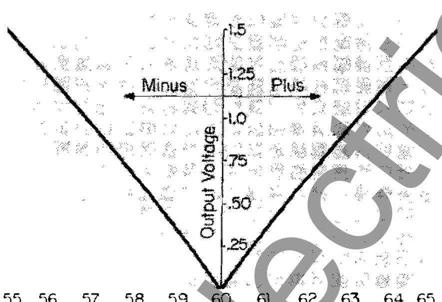

Figure 1: Linearity of Output with Frequency Change

II. Principle of Operation

The operation of the VC-841 frequency transducer depends on two series resonant circuits tuned to different frequencies. In Figure 2, these circuits are represented by L_1C_1 and L_2C_2. One circuit is tuned above, and one below, the nominal frequency (for example, 60 Hertz).

Since the resonant circuits are turned to different frequencies, they present a different impedance to the voltage across them, and a different a-c current flows in each.

The four rectifiers are connected to provide a dc potential across the output X_1-X_2, which is dependent only on the frequency input to the transducer. A Zener in the input circuit provides voltage regulation for a ±15% input voltage variation.

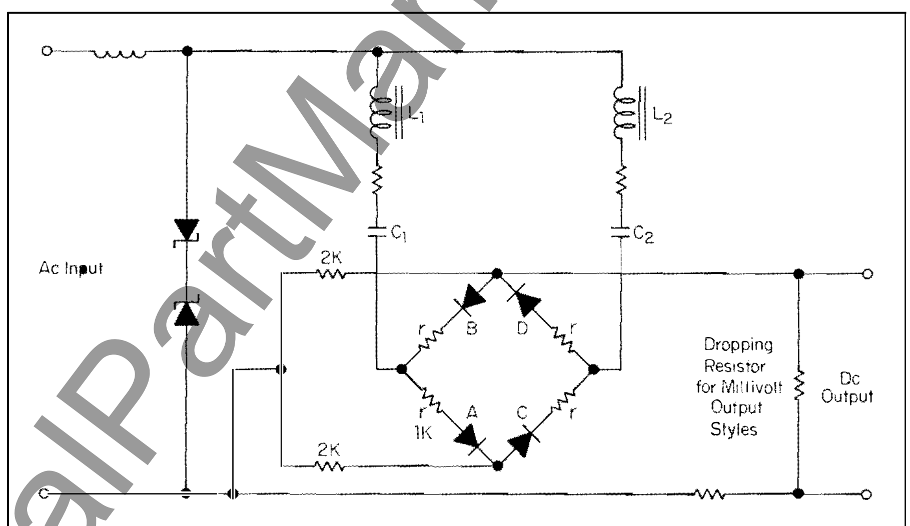

Figure 2: Internal Schematic Wiring Diagram

III. Transducer Output

A. The Balance Point

As explained in Section II, one of the transducer resonant circuits is tuned above and one below the nominal frequency. Consequently, the dc voltage output of the transducer is zero when the resonant circuits are carrying equal currents. This is called the balance point, and is at or near the nominal frequency. The polarity of the dc output depends on whether the input frequency is above or below the balance point.

B. Waveform

Since there is no inherent filtering in the transducer, the output waveform is not a constant value. The rectifiers in the transducer cause this waveform to approximate a sawtooth, as indicated in Figures 3, 4 and 5. Its frequency is double the input frequency.

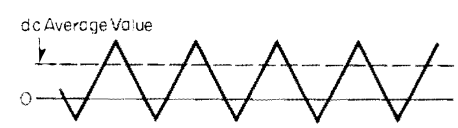

Figure 3: Output Waveform, Frequency above Balance Point

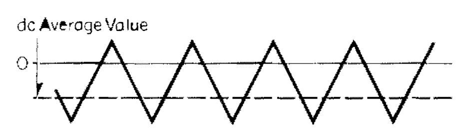

Figure 4: Output Waveform, Frequency below Balance Point

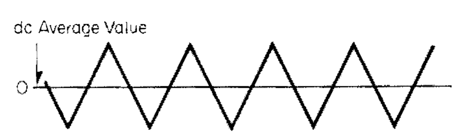

Figure 5: Output Waveform, Frequency at Balance Point

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E. D. C/2043/DB

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C. Magnitude

1. Transducer used with direct-acting instrument:

In this application the transducer must supply a small amount of power to operate the display device. The 60 Hertz transducer is designed to provide an output of 0.3 volts/cycle at a load resistance providing 0.5 mA and scale current. For example, if such a transducer is used to measure 55-65 Hertz, its output over this range would be approximately 1.5-0-1.5 volts, into a 3000 ohm load.

The word "approximately" is used here because the transducer balance point is usually not set exactly at the nominal frequency (i.e., 60 Hertz) when used with direct acting display devices. This is a "fail safe" feature. Transducer output at the balance point is zero, so if this does not supply any signal to the instrument, the instrument will indicate its mechanical zero position. If this is set right on the nominal (60 Hertz) position, transducer output failure will cause the instrument to read 60 Hertz and it may appear that "all is well".

To prevent this, an off-center balance point is chosen. Figure 6 shows a typical example. Here the balance point 60.8 Hertz (and a green line is marked on the dial at that frequency). The voltage calibration of the instrument must be 1.74-0-1.26 volts and not 1.5-0-1.5. The terminal resistance remains at 3000 ohms/volt.

In the case of the 400 Hertz transducer, the voltage output is 0.045 volts per cycle, also at a load resistance providing 0.5 mA and scale current.

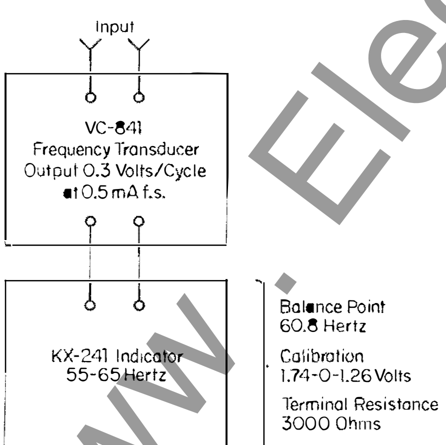

Figure 6 Transducer Used with Direct-Acting Instrument

The unfiltered output waveform is normally not a problem in this type of application, since the end device (such as a direct-acting indicating or recording instrument) normally has inherent damping of filtering. The KX-241 instrument shown in Figure 6, for example, will not respond to the double-frequency component of the output voltage, but only to the dc average value.

2. Transducers used with high input-impedance load:

In addition to its use with direct-acting instruments, the VC-841 transducer is also frequently used with high-input impedance devices, such as potentiometric recorders, telemetering transmitters and electronic computers. In such applications, virtually no current is drawn from the transducer, and its function is to provide a suitable millivolt output. Since most high-input impedance devices will operate satisfactorily with 100 millivolt inputs, the standard operating range of the transducer is 100-0-100 millivolts over the frequency range required. Any voltage may be supplied up to the maximum rated output. This standard "millivolt" transducer will normally have its balance point identical to the nominal, or center frequency. However, they can be supplied with the balance point "off center" if desired.

The output resistance of the 100-0-100 millivolt transducer is 200 ohms, regardless of the input frequency range. Therefore, any external load having an input impedance of 100,000 ohms or more will have a negligible effect on the transducer output. The percent error introduced by the load resistor can be expressed by the formula . . .

$$100\left[1-\left(\frac{R_L\times 200}{R_L+200}\div 200\right)\right]$$

As pointed out in III B, the transducer output is unfiltered. The unfiltered output will normally have an adverse affect on high input impedance devices, so a VF-876, VF2-876 filter should be used to reduce the ripple voltage to 0.5% of the sawtooth wave amplitude.

Caution: See note on Page 1 regarding input-output isolation

Characteristics (Style Number 187A493 series only)

Linearity . . . . 1.5% of span①
Voltage Range:
120V. . . . . 100-140V.
240V. . . . . 200-280V.

Frequency Range: Hertz	Load Resistance: Ohms	Dc Output
45-55	3000	1.5-0-1.5V
48-52	1200	0.6-0-0.6V
55-65	3000	1.5-0-1.5V
58-62	1200	0.6-0-0.6V
59-61	600	0.3-0-0.3V
350-450	4500	2.25-0-2.25V
380-420	1800	0.9-0-0.9V
390-410	900	0.45-0-0.45V

Temperature Range . . . . . 0°-65°C.
(0.5% deviation for 10°C change)
Voltage Influence②
120V. Unit . . . . 110-130V., ±1% of span
100-140V., ±2% of span
240V. Unit . . . . 220-260V., ±0.5% of span
200-280V., ±1% of span
Insulation Ground Test . . 2600V.
Loss: 120V. Unit . . . . 3.6 Va
240V. Unit . . . . 6.0 Va
Net Weight . . . . 13 lbs.
Shipping Weight . . . . 18 lbs.

① ±2% on 50-70 Hertz range only.
② Zener regulated.

Further Information

Dimensions: Descriptive Bulletin 43-841
List Prices and Ordering Information:
Price List 43-840

Westinghouse Electric Corporation
Relay-Instrument Division, Newark, N. J. 07101
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