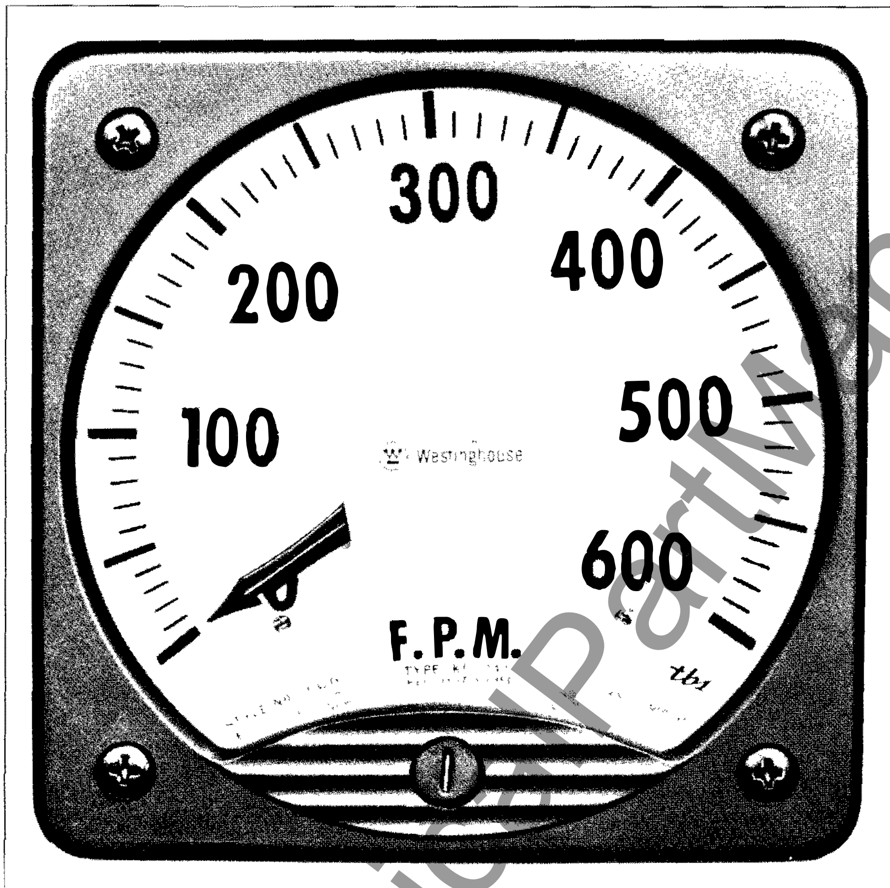
Westinghouse

Pulse Transducer

Type VR-842
For Speed and Frequency Measurement



I. The Pulse Transducer – What It Is

This transducer accepts electrical impulses into the device and with its transistorized pulse sensitive network, provides a voltage output which is directly proportional to the input pulse rate. The input may be a variable ac frequency or a series of pulses generated by a notched magnetic material wheel in conjunction with a variable reluctance pick-up device.

The output may be used to energize a standard permanent magnet-moving coil type of indicating instrument, or as the input to potentiometric recorders, telemetering circuits, or any indicating or controlling circuitry which bases its operation on a "voltage per unit of measure" basis.

The type VR-842 pulse transducer offers several advantages:

A Will measure pulse rates of from 0 to 10,000 pulses per second with but 3 ratings.
0 to 400
0 to 5,000
0 to 10,000

B Output is essentially a linear voltage function of the input pulse rate.

C Very simple calibration adjustments.

D Wide choice of indicating instrument or other display device.

E Available either as a complete transducer and type K-241 switchboard mounted instrument (type KR-241) or as a separate transducer (type VR-842) for use with separately mounted indicator, recorder, etc.

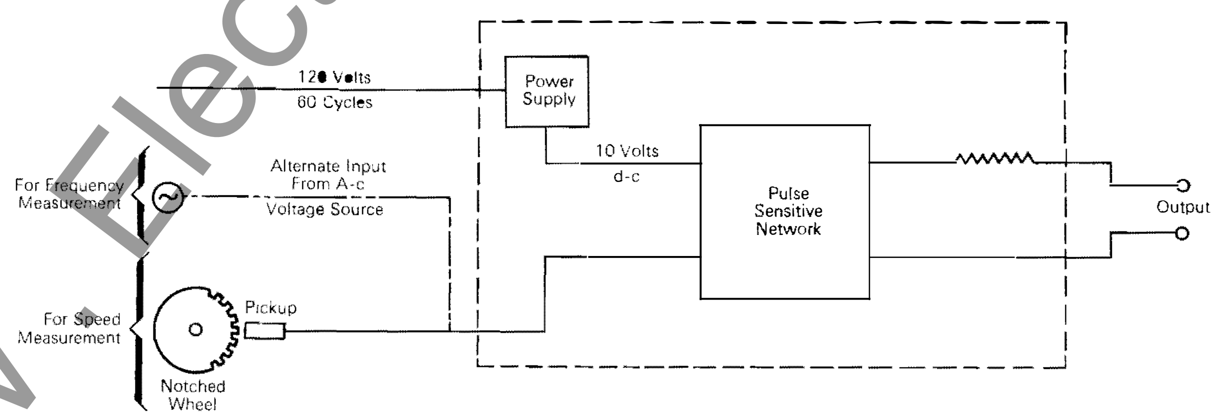


Figure 1: Simplified block diagram of VC-842 speed and frequency measurement applications.

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II. Application

One of the most common uses of the pulse transducer is for speed measurement in conjunction with a notched wheel-reluctance pickup tachometer generator.

In this application a notched wheel of magnetic material is mounted on or coupled to a rotating shaft whose speed is to be measured. Mounted in close proximity to the notched wheel, is a reluctance type pickup device. As the notched wheel rotates, the notches generate electrical impulses in the pickup. The higher the speed, the more pulses are generated, hence the pulses are directly proportional to the speed of the shaft. The VR-842 transducer translates these impulses into a dc output which is directly proportional to the rate of impulses fed into the transducer. This dc output therefore, is directly proportional to the speed of the shaft being measured. The dc output is used to energize an indicating or recording instrument which has its dial (or chart) calibrated in revolutions per minute. This dc output can also be used to operate telemetering transmitters and various types of control circuitry.

Above about 100 pulses per second, the shape of the teeth on the notched wheel is not critical, as any form of notches or projections of magnetic material on the rotating shaft will give an accurate measurement provided the pickup device can be mounted close enough for the projections or notches to generate a reasonable impulse in the pickup coil. The minimum pulse input to the transducer should be 0.1 volt or above.

On applications where the proportional speed of two rotating shafts is to be measured, the transducers may be connected in such a way as to furnish an output to the display device which is directly proportional to the difference in speed between the two rotating shafts.

Speed measurements of feet per minute of material passing a point in the process machine is another common application of the VR-842 transducer. A wire or strip passing over a roller is an example of such an application. The basic concept is the same as a measurement of r.p.m. except the diameter of the roller enters the calculation in determining the impulse rate. A typical application problem is given below.

Another application of the type VR-842 (or KR-241) is for the measurement of a widely variable ac frequency which varies outside the limits of the type VR-841 tuned circuit type of frequency transducer. The variable frequency input is applied to the type VR-842 transducer input in the same manner as the magnetic pickup source described above.

A simplified block diagram showing the speed, or variable ac frequency, application is covered in Figure 1.

Typical Application Problem

The problem: to indicate the speed of a strip in a rolling mill in feet per minute, on a switchboard mounted indicator remote from the machine. The strip passes over a 24" diameter roller, which is driven by a motor running at 1750 r.p.m. through a gear reduction of 5:1. The pinion on the motor has 20 teeth and the gear on the roller shaft has 100 teeth.

Investigation reveals that the reluctance type pickup device can be mounted in close proximity to the teeth on the 100 tooth steel gear (magnetic material).

With the motor running at full load speed of 1750 r.p.m. the feet per minute of the strip can be determined by:

$$\frac{1750}{5} \times \frac{24}{12} \times \pi = 220 \text{ f.p.m.}$$

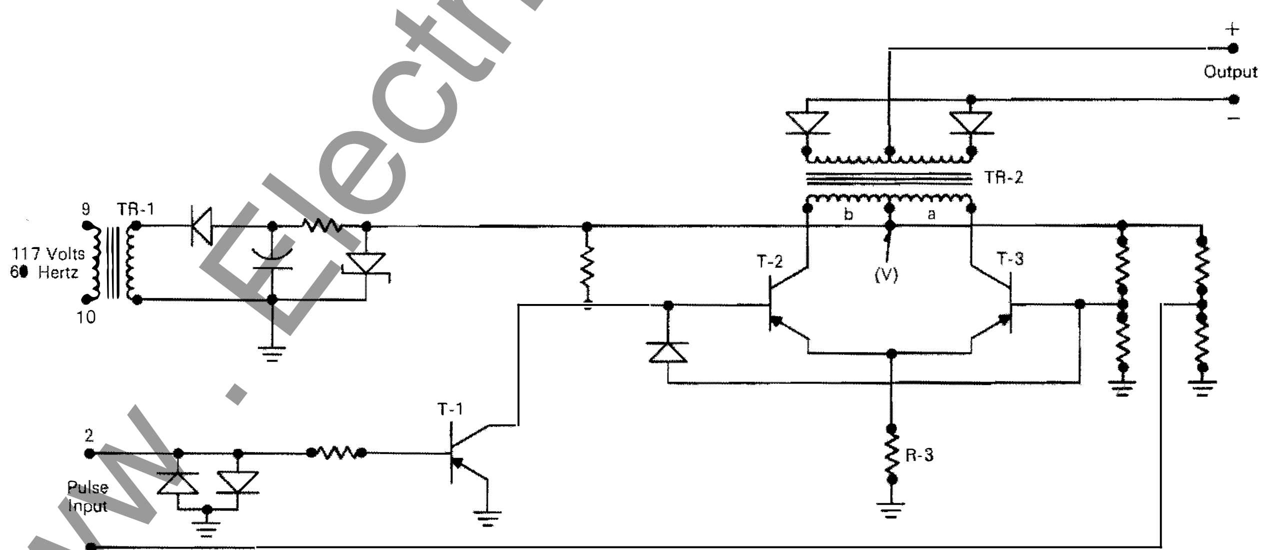
Impulses per second would be:

$$\frac{100 \times 350}{60} = 583.3 \text{ i.p.s.}$$

As the standard calibration is 1 milliampere for full scale deflection of the indicating instrument, the full scale rating would be 1 milliampere at .636 volts, based on the following:

$$583 \times \frac{2400}{2200} = 636 \text{ i.p.s. at 2400 f.p.m. for full scale.}$$

Using the transducer rated at 401-5000 i.p.s., the voltage output of this unit is 1.0 volts/1000 i.p.s. Therefore, the voltage delivered to the indicator at 636 i.p.s. (full scale) would be $\frac{1.0 \times 636}{1000} = .636$ volts.



Note: ⏚ Is Common Connection—Not Ground

Figure 2: Schematic wiring diagram.

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III. Operation

Referring to Figure 2, pulses or frequency to be measured is applied to terminals 1 and 2. A power supply of 120 volts 60 Hertz is fed into terminals 9 and 10.

The 120 volt 60 Hertz power is passed through the voltage reducing transformer TR-1, thence through a rectifier and filter. At this point a zener diode is used to regulate the dc voltage. The constant dc voltage is applied to point "V" of transformer TR-2.

With the pulse input terminals connected to a source, and with no pulse voltage applied transistor T-1 and T-3 are "on", and a current will flow from point "V" through the "a" section of TR-2 through T-3 and R-3 to the common connection.

A positive signal applied to terminal 1 and thence to the base of T-1 will block T-1 and T-3, this automatically unblocks T-2 and it will conduct. Current now flows from point "V" through the "b" section of TR-2, through T-2 and R-3 to common. Thus with each pulse or cycle applied to terminals 1 and 2 the flux in the transformer TR-2 reverses.

The transformer TR-2 is constructed with square looped transformer iron. Current from point "V" through either coil "a" or "b" completely saturates the transformer core. With reversal of the current in these coils as explained above the flux in the iron reverses and saturates in the opposite direction. Thus the voltage developed at the transducer output for each pulse input is constant and of the same duration. It is independent of the input pulse amplitude or duration. This characteristic is shown graphically in Figure 3.

As shown at A in Figure 3, the flux reversal is practically instantaneous from "steady state" minus, to "steady state" plus, for each incoming pulse, producing an essentially square wave output. In B above the solid line pulses show one rate, and the solid plus the dotted lines show twice the impulse rate. Thus the output is a series of square wave pulses of equal amplitude and duration and of a frequency matching the input frequency.

The maximum impulse rate is limited by the characteristics of the iron core of TR-2. When the pulse rate exceeds the rate at which the TR-2 core can reverse flux polarity the pulses overlap and the unit then does not produce an output proportional to the input pulse rate. By changing the proportions of the TR-2 core and coils the range of pulse rates can be varied. Hence three ranges are listed:

0- 25 to 0- 400 pps
0- 401 to 0- 5,000 pps
0-5001 to 0-10,000 pps

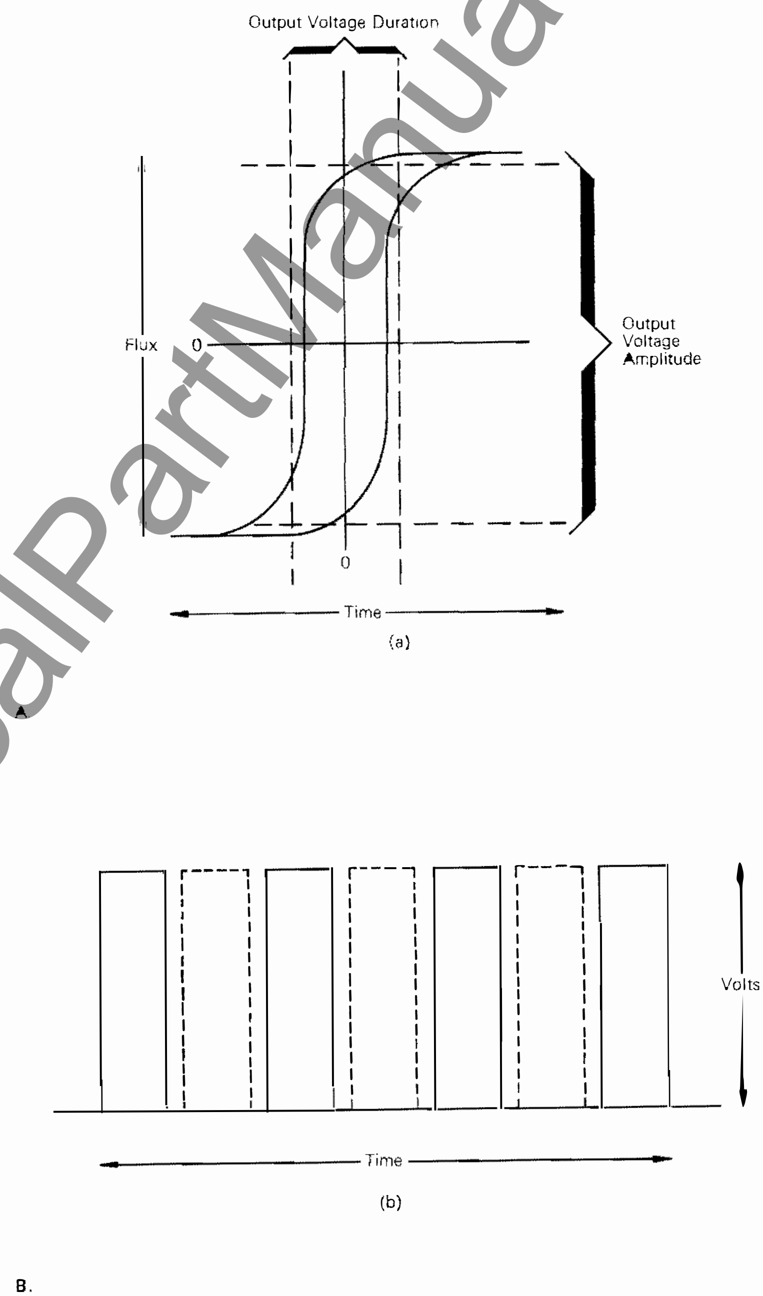

Figure 3:

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IV. Specifications

Range: minimum – 0-25 pulses per second, maximum – 0 10,000 pulses per second.

Accuracy (transducer only): ±½% for 100-130 volt supply, 25° – 60° ambient.

Power consumption and supply: 1.3 volt-amperes from 120 volt, 60 Hertz source.

Pulse input: 0.1 to 2 volts

Frequency input: When used to measure frequency, dropping resistors are included in the transducer input circuit for input voltages between 20 and 150 volts ac.

Output: Proportional to pulse input. If an output proportional to speed difference is desired, negotiate with nearest Westinghouse representative.

Standard calibration provides one milliampere output for full scale instrument deflection.

Voltage output for full scale deflection corresponding to one milliampere is:

Range: Pulses Per Second	Volts/1000 Pulses Per Second
0-25 to 0-400	15.0
0-401 to 0-5000	1.0
0-5001 to 0-10000	0.5

Gap spacing: 0.01 ±0.005 inches.

Lead resistance between pickup and transducer: 100 ohms maximum.

Response time (transducer only): 0.01 seconds.

Insulation test: 2600 volts terminals to case.

Weights

Type	Net	Shipping
VR-842	2	4
KR-241	5	7

Further Information

List prices and ordering information: Price List 43-800
Description: Descriptive Bulletin 43-842

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