

Knopp PHASE SEQUENCE INDICATORS



- ROTARY TYPE
- NO LAMPS
- RELIABLE
- RUGGED
- VERSATILE
- TIME SAVING

POSITIVE, STRAIGHTFORWARD SEQUENCE INDICATION IS PROVIDED over a wide variety of voltage and frequency by direction of rotor rotation. No need for range switching or terminal changing. Also indicates an open phase.

MODEL K-3: 60-600 volts, 25-60 Hertz

MODEL K-6: 24-480 volts, 400 Hertz

*See next page for application on other frequencies.

Use of the Knopp Indicator saves man-hours and protects valuable equipment against damage. It pays for itself in a short time.

FEATURES

The following salient features are reasons for this instrument's proven reliability and long life, for its convenience, simplicity, and safety in use and for its durability in rigorous service.

1. Specially designed induction motor unmistakably indicates the phase sequence by direction of rotation of rotor disc.
2. The Lead Set is permanently connected to the instrument to save testing time and prevents errors in connecting.
3. For ease and certainty in identifying connections, the test clips are permanently marked with letters A, B, and C and the corresponding flexible leads and clip insulators are coded red, white, and blue.
4. The patented circuit and switch arrangement makes for instrument protection and personnel safety. Because of the switch, the Indicator clips can be left connected to the circuit-under-test between "before" and "after" readings of the phase sequence--timesaving and error preventing. Between these tests the instrument can be left hanging from the clips.
5. There are **no exposed metal parts**. The instrument housing is made of laminated phenolic, and is cylindrically shaped, an exceptionally rugged service-proven construction. The three window panes are small and deeply recessed for protection from impacts.
6. Good visibility of the rotor movement is assured. The black area on the aluminum rotor blacks out windows in phase sequence.
7. Only 21 oz. in weight, the Indicator is small and easily carried.

APPLICATIONS

The primary function of the Phase Sequence Indicator is to indicate the order of succession in time of the different voltage peaks of a multiphase supply. In addition the Knopp Sequence Indicator enables one to make continuity tests. It is a valuable instrument in diverse fields involving polyphase power apparatus, being employed by line and installation crews for public utility systems and industrial-plant electrical departments. It is, furthermore, helpful in the testing departments of public utility systems for laboratory and field testing.

The Knopp Phase Sequence Indicator is used in connection with the making of three-phase circuit installations or alterations, and replacement installations of motors and generators, also for making continuity tests of circuits of polyphase systems. Moreover, it is valuable in making connections of power-factor meters, voltampere meters, watt and watthour meters, and relays. Some of these applications are discussed in the following paragraphs.

Phasing-In Power Circuits After Alterations

The most frequent application for the Knopp Phase Sequence Indicator is for phasing-in a power line which has supplied power to motors and plants, and where line alterations are made in the circuit feeding this line. It is necessary to determine the phase sequence before alteration is made so that the **same sequence** can be reestablished for the consumer by the line crew after alteration has been made. This will avoid any possibility of damage incident to reversing the consumers' motors and machinery.

APPLICATIONS (Continued)

Connecting Motors and Generators

Use of the Knopp Sequence Indicator protects apparatus and enhances service efficiency. By indicating which terminals of a newly installed polyphase power circuit are to be connected to the sequence-identified motor terminals, it eliminates the trial-and-error method and thus prevents damage and saves time.

Obviously the trial-and-error method is not permissible for direct-connected electric motors which, because of the nature of the machines they drive, cannot be operated in reverse. Furthermore, reversal of a generator's phase rotation when being paralleled would result in a short circuit.

Suppose a three-phase motor load is to be connected to a new set of three-phase conductors. Before a change is made, the original power sequence to the load is determined by attaching the Sequence Indicator to the line side of the motor switch. After temporary new connections are made, the line is again energized and the phase sequence checked. If the original sequence is reversed, two of the new conductors can be interchanged to give the original sequence. Since only minute power is required to operate the Knopp Sequence Indicator, there is no need for making tight connections until the correct order has been established.

Motor and Generator Terminal Markings

It will be obvious that the Knopp Sequence Indicator may be used to correlate definitely the motor and generator conductor markings with the phase sequence of applied or generated voltage.

Connections of Polyphase Power-Factor Meters

Where instrument transformers are employed for power factor metering, mistakes are easily made in the connections. The phase sequence of the input current for the current coils should be checked for the correct order of attachment, as indicated by the manufacturer's diagrams. The phase sequence of the voltage coils is determined by the Sequence Indicator.

Reactive-Volt-Ampere Connections

When varmeters are being connected in polyphase circuits, it is necessary to use the correct phase order so as to assure the correct meter indications. The Knopp Indicator furnishes direct and positive means of determining the proper sequence.

Two-Phase, 3-Wire Operation

The Knopp Sequence Indicator (catalog number 44030, 3-phase, 3-wire type) will operate satisfactorily on 2-phase, 3-wire systems. However, it should be noted that on such systems the voltage between the outers is 1.4 times the phase voltage. This factor should be taken into consideration when using the Indicator on higher voltage circuits, bearing in mind the voltage rating of the instrument.

Open-Phase Indication

The presence of an open circuit in at least one phase of a three-phase supply is indicated by the failure of the Sequence Indicator to rotate when connected to the circuit.

Six-Phase Sequence

The Indicator can be used to determine the phase order of six-phase circuits by arranging the six terminals into two groups of three, each group having equal voltage between all pairs of terminals and both groups having the same sequence. The two 3-phase triangles should form a hexagon with equal voltage sides.

Polarity Identification of Wires of the Same Polyphase System

If more than three conductors are involved and it is desired to determine which are identified with the same three-phase system, the conductors may be successively attached to the Sequence Indicator. Rotation indicates that the conductors are all of one system.

If six conductors are involved, all of which are of the same three-phase system, select three conductors which give a phase sequence indication. Leaving two clips connected, remove the third and attach it to the remaining three conductors successively until the same phase rotation is obtained. The conductor which produces the same phase rotation when connected to the third clip is of the same polarity as the conductor from which the clip was originally removed. Another clip is now manipulated in the same manner in order to determine which of the remaining conductors gives the same phase sequence.

Active and Reactive Power Measurements

When connecting polyphase watt-hour meters for combination active and reactive power measurements, the correct order of phase rotation is essential. The Knopp Phase Sequence Indicator is of great value in seeing that the right connections are made.

DESCRIPTION

The Knopp Phase Sequence Indicator includes a three-phase induction motor having an aluminum-disc rotor mounted for free rotation on a cushioned glass-hard bearing and having field windings placed at 120 geometrical-degree intervals about the rotor axis. One terminal of each winding is extended beyond the case to a distinctly colored conductor and to a lettered test clip for attachment to one conductor of the tested system; and the second terminal of each winding is connected to one of three contacts of the insulated protector-switch. The protector-switch must be held closed to energize the windings and is so arranged that accidental or even continuous closure of the switch is unlikely.

The flexible cable withstands severe handling and is intended for suspending the instrument from the line wires or terminals with the test clips. The free ends of the conductors are shorter than the sheathed portion so that, when the instrument is suspended, a detached clip cannot contact the operator while the switch is closed. Since the cable is anchored in the sealed housing, clockwise rotation of the rotor always means that the phase order of the tested terminals is that of the marks A, B, C, on the clips attached thereto.

CATALOG NUMBER	MODEL	TYPE	FREQUENCY	VOLTAGE	LEAD LENGTH	DIMENSIONS		APPROX. WEIGHT	
						Diameter	Height	Net	Shipping
44030	K-3	3-phase 3-wire	25-60*	60-600	36"	3/4"	1 1/8"	21 oz	24 oz
44035	K-6	3-phase 3-wire	400	24-480	36"	3/4"	1 1/8"	21 oz	24 oz
44050	Cordura Carrying Case. (Should be ordered as separate item.)								

*Suitable for use on frequencies above 60 Hz, provided the circuit voltages are equal to, or exceed, the following: 150 volts for 133 Hz; 200 volts for 180 Hz; 250 volts for 360 Hz; 300 volts for 400 Hz.



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