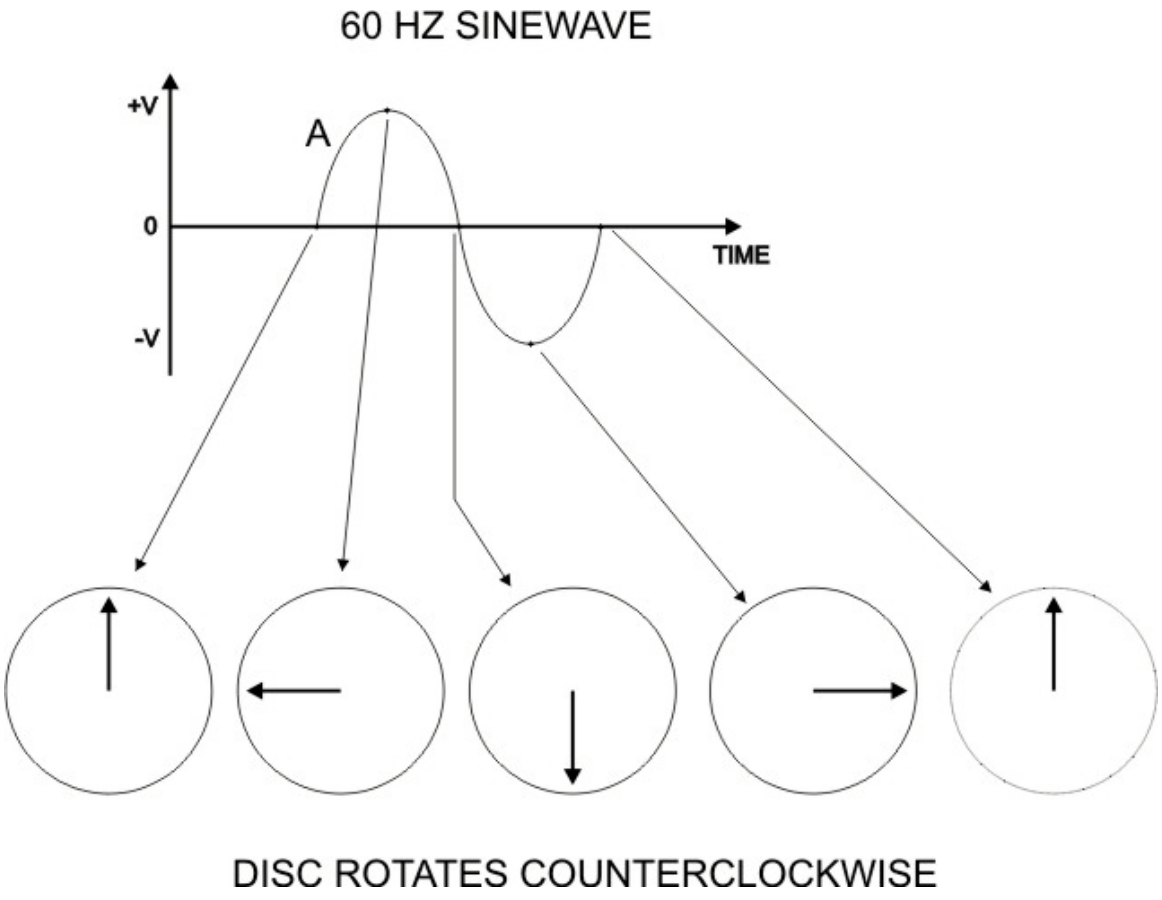
PhaseID System

Principal of Operation

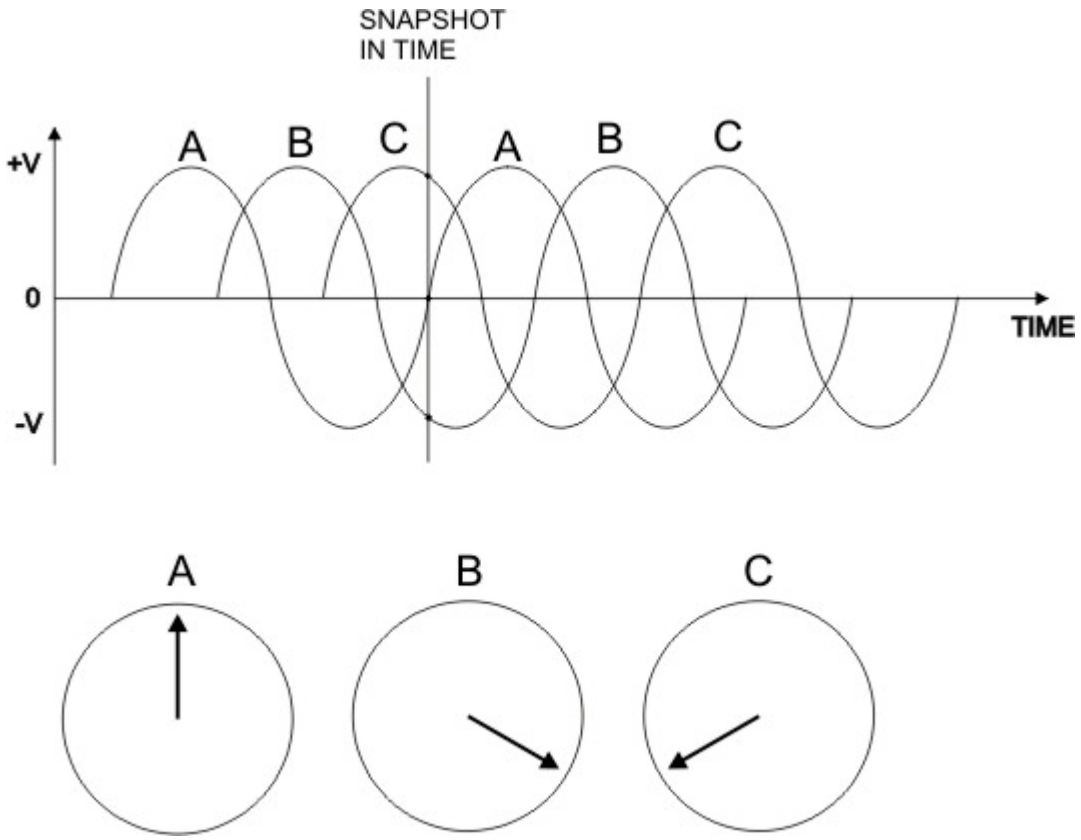
The concept behind the PhaseID System is very simple: A timing signal from the Global Positioning System (GPS) is used to simultaneously measure voltage phase at a reference location and at a field location in a 3-phase power system, and the readings are compared. Since the phase attribute at the reference location is known, the phase attribute at the field location can be determined. Here is how it works.

For illustration purposes, assume you connect a synchronous motor to phase "A" of a 60 Hz power line. A synchronous motor is one that rotates at the power line frequency, in this case, at 60 revolutions per second or 3600 revolutions per minute (RPM).

Connect a disc to the motor shaft and draw an arrow on the disc so that the arrow points up when the voltage changes from negative to positive. For each complete voltage cycle, the disc will rotate through 360 degrees as illustrated below.



Now take two other identical synchronous motors and connect them at the same location to phases “B” and “C”. Use a strobe light or high speed camera to take a snapshot of the orientation of the 3 disc arrows simultaneously as illustrated below. Although the orientation of the phase “A” arrow is completely arbitrary, the orientation of the phase “B” arrow will always be 120 degrees behind the phase “A” arrow. Likewise, the phase “C” arrow will always be 120 degrees behind the phase “B” arrow and 240 degrees behind the phase “A” arrow.

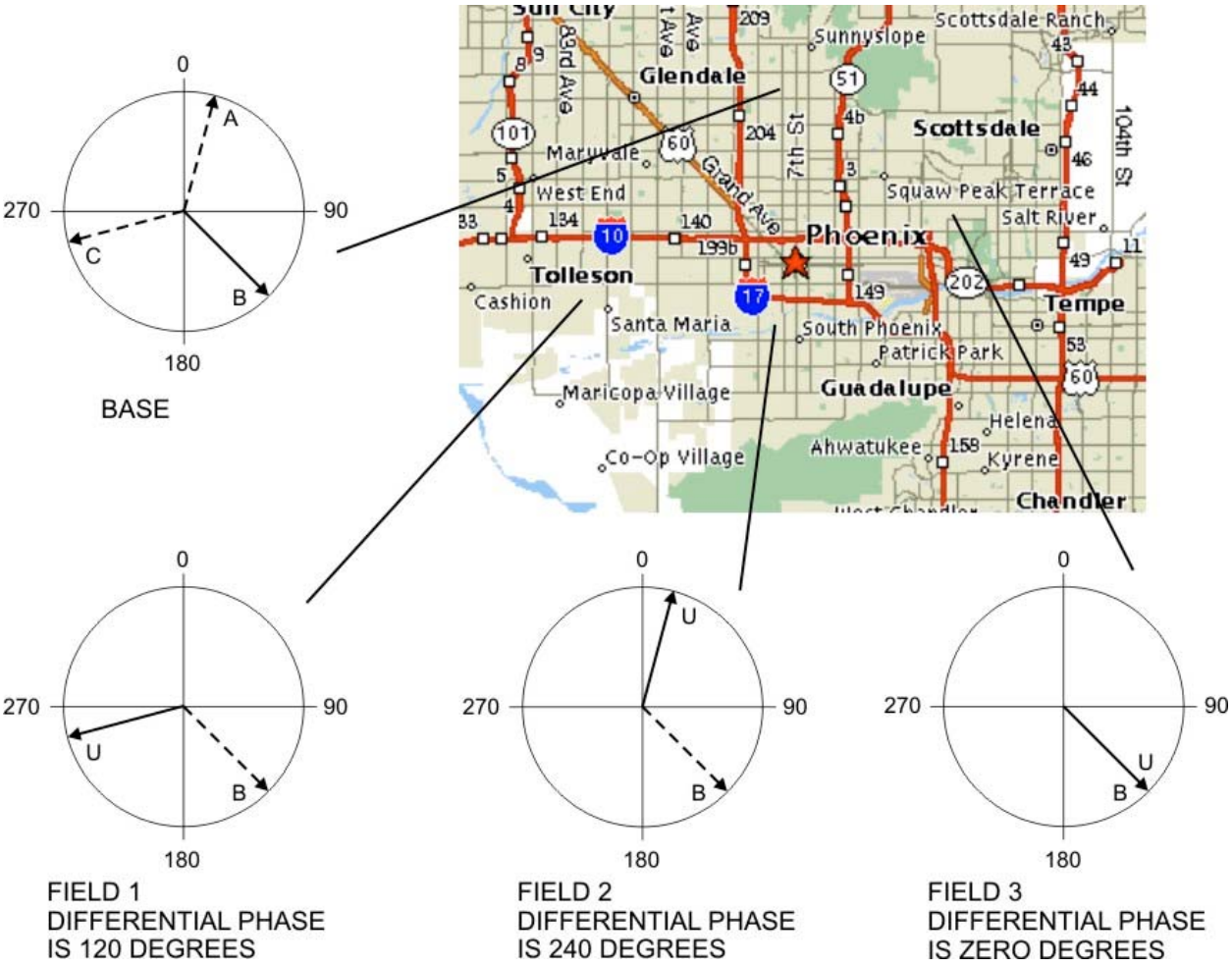


Therefore, if it was known that the reference motor was connected to phase “B”, the phase to which a second similar motor was connected could be determined simply by noting the relative orientations of the second motor arrow with respect to the reference motor arrow.

When the two motors are at different locations, a means of obtaining a snapshot of both arrows at the same instant must be provided. In the PhaseID System, a GPS timing signal is used at both the reference and field locations to take the snapshots. Although GPS is usually used only to determine a user’s location, once the user’s location is known, the GPS can provide a very accurate synchronized timing signal to both users. After the two snapshots are taken at both locations, they only have to be exchanged to determine the unknown phase attribute at the field location.

In the illustration below, the base station (reference motor) is known to be connected to phase “B”. Field motors are connected to unknown phases at 3 different field locations. By taking a snapshot of all 4 disc arrows at the same instant and comparing the field arrow orientations with the base arrow orientation, it is obvious that field 1 is on phase “C”, field 2 is on phase “A”, and field 3 is on phase “B”.

In the PhaseID System, electronic phase measurements are taken instead of actual picture snapshots of arrows on synchronous motor discs. However, the principal of operation is exactly the same.



Phase Identification Products

There are a number of phase identification products on the market that use GPS timing signals to simultaneously take phase measurement snapshots at a reference and field location. These systems primarily differ in the manner in which they exchange the reference and field location phase measurement data.

Most phase identification systems use real time continuous cell phone modems to send reference location phase to the field location where the reference location phase is compared to the field location phase. The field location phase attribute is determined based on the difference between the reference phase and field phase.

The PhaseID System takes an entirely different approach which eliminates the need for continuous cell phone connectivity to use the equipment.

In manual mode, the PhaseID field probe displays phase measurement data to the user, who can then communicate it to the reference location in any convenient manner and time of their choosing. In automatic mode, a short message is sent to the reference location requesting the reference phase. Continuous connectivity is not required. Here is how it works.

A base station is installed at the reference location and plugged into any 120V wall socket. Each GPS second, an instantaneous reference phase is taken and stored to a file on the base station PC along with the GPS time it was taken.

A probe is carried to the field location. When it contacts the conductor being identified, it takes an instantaneous phase measurement at the next GPS second and encodes this measurement along with the GPS second at which it was taken into a 9-digit sequence.

The 9-digit sequence is communicated to the base station. When it is entered into the base station PC, the sequence is deciphered to determine the instantaneous field probe phase and the GPS second at which it was taken.

The PC retrieves the base station instantaneous reference phase taken at the same GPS second as the field probe phase, compares the instantaneous reference phase to the field probe instantaneous phase, calculates the phase attribute for the field probe, and communicates the field phase attribute to the field probe user.

PhaseID System Data Exchange – Manual and Automatic

The PhaseID System's unique method of phase data exchange between base and field units was chosen because it provides optimum usability of the system. The primary reasons for choosing this data exchange method are listed below.

Manual Mode

The PhaseID System does not require a real time data link to operate. Anyone who uses cell phones knows the frustration of busy signals, dropped calls, poor reception, and no cell coverage when making normal phone calls. When a cell modem data link is added to the phone, these problems just get worse because data communications are much more unforgiving than voice communications. In manual mode,

the PhaseID System does not require a cell phone or any other real time data link to operate so all these communication problems are eliminated by design.

When phase identifying an entire neighborhood or service section, many times there is no reason the field probe operator needs to know phase attributes as they are being measured. With the PhaseID System, the 9-digit sequence can be simply recorded on a measurement form and entered into the base station computer after all measurements are completed. Therefore, no real-time communications are required between the base station and field probe.

When an immediate identification of phase attribute is desired, the PhaseID System allows phase data to be communicated with the base station in many different ways. Typically, this will be by radio or cell phone contact with dispatch. If the phase measurement is being taken at a location where radio or cell phone communications are not available, the user can drive to a different location to call in the 9-digit sequence and receive the unknown phase attribute.

In many outlying farms and small remote towns, radio and cellular coverage may not be available. However, wired phone service is almost always available which can be used to phone in the 9-digit sequence. Using a landline phone may save a long drive back to a radio or cellular coverage area. With a satellite phone, which some utilities already own, a lineman is never out of contact with the base station.

Automatic Mode

The PhaseID Datalogger field probe allows real-time phase attribute determination using short message Internet communications between the field probe and base station which acts as a server for the field probe client. Using short messages, continuous connectivity with the base station is not required. This allows a single base station to support an unlimited number of field probes.

In contrast, current real-time cell phone based phase identification systems require a dedicated phone line and continuous connectivity. As a result, only one field probe user at a time can be supported.

Small, Low Cost and Simple to Use

Placing the phase attribute identification function at the base station allows a smaller, lower cost, and less complicated field probe to be used. The field probe is operated by a single push button.

All the phase identification skill resides in the computer software. At the base station, any data entry person can enter the 9-digit field probe sequence.

The base station can service an unlimited number of low cost field probes so it is affordable to acquire as many probes as necessary to get the work done. The PhaseID System base station can be placed in offices or dispatch locations and used by multiple individuals on multiple computers. It does not have to be placed in isolated substations nor is its use restricted to one user at a time.

Although linemen are required to make primary voltage phase measurements, anyone, including meter readers, can make secondary 120 volt outlet phase measurements.

