

Tagging Reference Phase

Introduction

Before the Origo PhaseID System can be used, the tagging reference phase must be set up in the base station software.

This white paper describes what tagging reference phase is and gives detailed step-by-step instructions on how to set it up in the base station.

Tagging Reference Phase – What it is

Tagging reference phase is simply the selection of which phase in your system you wish to designate as phase A.

For example, Origo periodically assists customers in the western grid in converting their field probe readings to phase attributes using Origo's Phoenix base station. However, before this is possible, Origo must know what the tagging reference phase attribute is for at least one of the customer's field probe readings.

Once this reference phase is obtained, the Origo base station plugged into a wall socket in Phoenix can be used to identify field probe phase attribute readings even 1500 miles away in Seattle because both locations are on the same power grid. That is, except for a phase offset, both the Phoenix and Seattle 60 Hz voltages are synchronized.

In a like manner, before you can determine the phase attribute for measurements in your utility, you have to relate the reference phase from your base station wall socket to the tagging reference phase you wish to designate as phase A. You do this by setting up a tagging reference phase configuration file in the base station software.

Setting up a tagging reference phase configuration file is a very simple procedure that only has to be done once for a particular region and class of voltage. It requires 3 simple steps and only takes a couple of minutes to do after the field measurement is obtained.

Base Station Setup

Step 1 – Gather the field probe reading.

- 1 Go to a location and take a field probe reading on the phase you wish to call phase A. In most cases, this will be the substation distribution voltage that is designated as phase A.
- 2 If possible, use a grounded field probe primary connection. That is, use the ground wire and set the display to HI. This is an example of one of the few times you will ever use the HI setting. The HI setting is only selected when **the ground cable is used** and **the voltage is over 1000 volts**.

- 3 If no ground reference is available, then use a capacitive connection. That is, the ground wire is not used and the display is set to LO. The LO setting is used for all field probe measurements except for the single above mentioned condition.
- 4 For transmission voltages (voltages over 20 KV to ground), the ground wire must not be used so all those measurements are capacitive connections.
- 5 For transmission voltages over 40 KV to ground, do not use the ground wire or touch the conductor with the field probe. Instead, simply hold the field probe close enough to the conductor to obtain a yellow light.
- 6 In a like manner, take a reading for phases B and C. You will need these measurements to determine if the phase rotation in your utility is (A, B, C) or (A, C, B).

It is a good idea to take two readings on each of the three phases. The second set of readings serve as a backup in case any problems occur with the first set of readings. This can save you another trip to the substation if you intend to decode the readings at a later time.

Step 2 – Decode the field probe reading.

- 1 Open the base station “Setup” page and set the “Phase Attribute” to A.
- 2 Set the “Primary Offset” to 0 and set the “Capacitive Offset” to 90.
- 3 If the field probe reading was taken using the ground wire and touching the probe to the conductor (primary connection), set the “Secondary Offset” to 0. Otherwise, set it to 90 (capacitive connection).
- 4 Close the “Setup” page and enter the field probe reading as a “Secondary” connection.
- 5 Click on “Confirm Readback” and read the phase attribute in the large white text box (not the small red outlined black box). If the attribute is “**in phase with...**”, then the attribute is **positive (+)**. If the attribute is “**out of phase with...**”, then the attribute is **negative (-)**.
- 6 Open the base station “Help” page and select “Help topics”. Select the “Origo PhaseID System Base Station Program Manual” and display the “Base Station Attribute and Rotation” page.
- 7 In the table, search for the attribute you just decoded under the “Attribute obtained” column heading. **Be sure you select the correct positive or negative sign.** Across from that attribute, determine the base station setup attribute required under the “Set base to” column heading.
- 8 For example, if you decoded “Secondary - out of phase with delta across B & C”, then you will read across from -BC to get BC. That is, the base station attribute is to be set to BC.

The reason for selecting the “Secondary” connection is because the base station wall socket can have any of the 12 possible secondary attributes (A, -A, B, -B, C, -C, AB, -AB, BC, -BC, CA, or -CA). In contrast, “Primary” and “Capacitive” connections can only have one of 3 possible attributes (A, B, or C). Entering the reading as a “Secondary” connection allows any of the 12 secondary wall socket attributes to be identified.

Since the readings are entered as “Secondary”, the “Secondary Offset” must be changed from 0 to 90 when a capacitive connection is used to account for the 90 degree phase shift of capacitive connections. Once the base station tagging reference phase has been set up, the “Secondary Offset” is changed back to 0 because normal “Secondary” readings never use capacitive connections .

Step 3 – Set the base station to the new attribute.

- 1 Open the base station “Setup” page and set the “Phase Attribute” to the base station attribute determined in step 2 (BC in this example).
- 2 Reset the “Secondary Offset” back to 0 if it was changed to 90 in step 2 for a capacitive connection field probe reading.
- 3 Close the “Setup” page and enter the field probe reading as a “Primary” reading if the ground wire was used or as a “Capacitive” reading if the ground wire was not used.
- 4 Click on “Confirm Readback”. This time you should obtain a phase A attribute. Note the “PhaseError1” and “PhaseError 2” in the large white text box. They should be within a few degrees of each other. Note if the error is positive or negative.
- 5 Open the base station “Setup” page and change the “Primary Offset”, “Secondary Offset”, and “Capacitive Offset” by the nearest integer average of the two phase errors that were displayed in the large white text box.
- 6 For example, if “PhaseError1” was -4 and “PhaseError2” was -5 , then change all three offsets by -4 . Since the “Primary Offset” and “Secondary Offset” are zero, set them to -4 . Since the “Capacitive Offset” is 90, set it to 86.
- 7 Close the “Setup” page and enter the field probe reading again as a “Primary” reading if the ground wire was used or as a “Capacitive” reading if the ground wire was not used.
- 8 Click on “Confirm Readback”. This time you should obtain a phase A attribute with a phase error very close to zero. This confirms that the base station is now set to the desired tagging reference phase.
- 9 Enter the reading for phase B and click “Confirm Readback”. If the attribute is phase C, open the base station “Setup” page and click on the “Phase Sequence ACB Rotation” check box.
- 10 Close the “Setup” page, enter the reading for phase C, and click “Confirm Readback”. The attribute should be phase C.
- 11 If you gathered a second set of readings, enter them now to verify that the setup is correct.

The purpose of the offsets is to ensure that the average error over many different readings is close to zero. As you enter readings over time, note the error readings and make slight adjustments to the offsets if needed.

For example, suppose that the phase error over the last 50 primary readings tended to range from 8 to 16 degrees. If you adjust the “Primary Offset” by adding 12 to its current value, the next 50 primary phase error readings would tend to range from -4 to $+4$.

However, since it requires a primary phase error outside the -60 to $+60$ degree range to make an attribute error, you could safely just ignore the original 8 to 16 degree primary phase error.

For “Secondary” readings, a phase error outside the -15 to $+15$ degree range will make a secondary attribute error. Therefore, try to keep the secondary phase errors to a minimum.

Do not “chase” the phase error by adjusting it on every reading. The phase error can alert you when a particular reading is suspect. If the average primary phase error is near zero, but the phase error for a particular reading is 35, you should make sure you are using the right tagging reference phase configuration file. Alternatively, the reading could be bad, recorded incorrectly, or entered incorrectly. You may wish to recheck this measurement.

Save Your Tagging Reference Phase Configuration File

Be sure to save your new tagging reference phase setup to a new configuration file. Click on “File” and select “Save As”. Give it a unique name and save it to either the default base station software directory or to another directory of your choice.

For example, if the tagging reference phase is for a 12.5 KV distribution voltage at substation Tango, you might name the configuration file “Tango_12KV”. If the tagging reference phase is for the 138 KV voltage that feeds your entire utility, you might call it “Grid_138KV”.

A tagging reference phase only has to be set up once. To use it in the future, simply load that configuration file to decode any field probe readings that are based on that tagging reference phase.

To load a configuration file, simply click on “File”, select “Open”, and select the proper configuration file. For example, if all 12.5 KV distribution voltages in a particular region of your system use the same tagging reference phase as substation Tango, then select the “Tango_12KV” configuration file.

Keeping it Simple

Tagging reference phase configuration files are one of the most powerful features of the PhaseID System. Once you have done a few, you will find they only take a couple of minutes to set up.

Configuration files make keeping track of which phase reference to use on each voltage class in various parts of your system much simpler. For example, suppose a utility has a 12 KV wye distribution system on the east side of town and a 12 KV delta system on the west side, each section has its own tagging reference “A” phase, and they are separated from each other by 30 degrees.

Suppose the 12 KV substations are fed by 69 KV which have their own tagging reference phase, some of which may be rotated 30 degrees from the 12 KV distribution voltages. Suppose the utility also has 115 KV and 345 KV transmission voltages, each of which have their own tagging reference phases.

So now, a field operator is tasked with obtaining a phase attribute at some location in the utility. How does the field operator know what the tagging reference phase is at that location and its offset from the base station reference phase? Chances are they don’t.

By using configuration files, no one has to remember the reference phase. The base station operator simply opens the “West_12KV.pid” configuration file for measurements taken in the west region or the



“East_12KV.pid” file for measurements taken in the east region. Likewise for the various 69 KV, 138 KV, and 345 KV measurements.

Additional information on base station setup and tagging reference phase can be found in the document “Base Station Operation – Local & Remote” at www.origoCorp.com under “White Papers”.