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This instrument is manufactured in the United Kingdom.

The company reserves the right to change the specification or design without prior notice.

EP1000 71-028 EN V6 Installation Guide 02 2019

www.megger.com

Megger

Baker EP1000

Dynamic Motor Link

Installation Guide

Contents

Safety and General Operating Information

General Safety Precautions

The general safety information presented here is for operating and service personnel.

NOTICE: If the equipment is used in any manner not specified by Megger the safety protection provided by the equipment may be impaired.

Due to the wide diversity of machine applications, no attempt has been made here to list or review all potentially necessary safety precautions. However, this manual includes special safety precautions applicable to using the EP1000.

WARNING: To prevent serious injury or death, ensure that cabinet source voltage is turned off for installation. Because of the dangerous currents, voltages, and forces encountered safety precautions must be taken for all tests. Follow all corporate guidelines along with those included here.

Use safety equipment required by your organization including eye protection, high-voltage gloves, arc-flash rated masks, hoods and any required personal protective clothing. Prior to opening any Motor Control Cabinet (MCC), ensure that appropriate arc-flash protection clothing is worn.

Ensure that appropriate lockout / tag-out procedures are properly understood and implemented by all personnel. Ensure that the motor's phase connections are not positioned near ground or near each other.

Table 1: *Symbols and labels used on equipment*

Symbol/Label	Description
	Earth (ground) terminal.
	Warning about hazardous voltage and risk of severe electrical shock or death.

Additional Safety Alerts

WARNING: The EP1000 must not be exposed to water or moisture, even with the cabinet securely closed. This instrument is not water resistant with its door either open or closed. Do not allow the instrument to be exposed to water, especially if the cabinet is open. Any water that comes in contact with electronics inside the instrument can harm or destroy the device, and can also result in serious injury and/or death to people working in or around the instrument.

CAUTION: This product conforms to UL/CSA 61010-1 up to a maximum voltage of 600VAC at 50/60Hz with a main line voltage of 100–240VAC with a current draw of less than 2A. This product conforms to IEC/EN 61010-1 up to a maximum voltage of 1000VAC at 50/60Hz with a main line voltage of 100–240VAC with a current draw of less than 2A.

Wherein this manual refers to the maximum input voltage, this maximum is determined by the applicable standards for the environment where the unit is being installed as allowed by the Authority Having Jurisdiction (AHJ) as either 600V or 1000V. Under no circumstances should the voltage sensing circuit be connected to higher voltage levels. This will cause severe damage to the instrument.

CAUTION

The maximum rating of the EXP4000 is 1,000 volts (500 volts for DC operation). 1,000 volts (500 volts DC operation) is the maximum allowable voltage between any two of the four voltages and the ground clip. Under no circumstances connect the voltage sensing circuit to higher voltage levels, this will cause severe damage to instrument.

The maximum voltage rating of the EP1000 current transformers is 600 volts. Under no circumstances connect the current sensors to circuits of any higher voltage, this may cause severe damage to the instrument.

It is necessary that each EP1000 is provided three-phase voltage (not in excess of 1,000 V AC), and a good ground. Some switchgear installations will require this voltage to be wired from the bus cabinet to each cabinet being outfitted with an EP1000. For motors rated at voltages higher than 1,000 V AC, secondary output voltage from the PTs are acceptable provided that all three phases are present as line-to-line voltages, and are lower than 1,000 V AC.

Operational Safety Warnings

Any installer or operator of this equipment must adhere to the following safety precautions:

- Comply with all of your organization's mandated safety practices at all times.
- Ensure that the physical setup of the EP1000 unit does not interfere with site (or facility) power current or adversely impact any site operations.

To avert or avoid dangerous shock hazards:

1. Use all mandated safety equipment required of your organization for performing installations of electrical equipment, including eye protection, high voltage gloves, arc-flash rated masks, hoods and any required personal protective clothing (PPC).
2. Ensure that the site organization's appropriate lockout /tag-out procedures are properly understood and implemented by all personnel involved in this installation.
3. Ensure each rotating system to be monitored IS POWERED DOWN (OFF) and inoperable before installation of this instrument begins. Each and every connection at the motor control center (MCC) must be connected ONLY when the rotating system is powered down/off and inoperable.
4. Ensure that phase connections are made such that they prevent phase-to-phase or phase-to-ground shorting.
5. Install an external disconnect switch for AC power to the EP1000 (this is required). This disconnect switch should be within three feet of the EP1000's permanent mounting position. This is necessary because there is no internal fusing or disconnect for AC power with the EP1000.

Installing the EP1000

Positioning Equipment

Maintain a clearance of 36 inches in front of the EP1000 to allow for opening the door for installation/removal of internal components, and for maintenance and connections. The EP1000 does not require any additional air to keep the unit cool, so airflow at the mounting location is not of concern.

Do not position equipment in such a way that it is difficult to operate the power disconnection device(s).

WARNING: To prevent serious injury or death, ensure that cabinet source voltage is turned off for installation. Read all safety and precautionary information provided in the previous chapter before proceeding.

Verify and Gather Needed Materials and Tools

Verify that all needed materials are included in the package:

- EP1000
- Three current transformers (CTs)
- MCC cable
- Template for EP1000 enclosure mounting

Required Tools

- Small flathead screwdriver
- Pencil or felt-tip pen
- Phillips screwdriver
- Hand drill and set of drill bits
- Greenlee 2-1/2" punch

Required Materials

- Mounting hardware:
  - Four 5/32 4mm aluminum rivets
  - One 8/32 nylon insert nuts
  - Six #8 self-drilling metal screws
- EP1000 drill-hole template
- DB25 Connection MCC wall hole template
- DB25 Connection MCC wall fixture back plate
- Switchboard wire, SIS #14, 1,000 V
- Wire lugs, 14-16 AWG, #8
- Splice sleeves 14-16 AWG
- 7-inch cable ties
- Wire, #14, 1,000 V (green; ground connection)
- Control cable, 3/C #14 AWG, 1,000 V, EPR/CPE
- Tag book, ABC (T&B)
- Fuse block (PT) 1,000 V/2 Amp

Choosing a Suitable Location for the EP1000

- The EP1000 may be mounted in a variety of locations as long as the following criteria are met.
- The EP1000 must be installed in a cabinet or enclosure that is secured with a tool or key lock.
- Voltage and current lines can be easily and safely run to the EP1000 in accordance with applicable electrical codes.
- The MCC cable can reach the cabinet door, and the movement of the door is not restricted.
- The EP1000 does not interfere with or complicate the mechanical operation of the cabinet (i.e. doors opening, terminal blocks covered, slide rack interference).
- The physical location of the EP1000 does not cause an electrical, environmental, or safety hazard.
- An earth ground from the motor cabinet to the EP1000 ground stud is installed.
- The EP1000 may be affixed to the interior of the cabinet by any means deemed appropriate; however, it is recommended that a positive mounting system such as metal screws be utilized.

A mounting template is supplied with the EP1000 for the enclosure, along with self-tapping metal screws.

The actual template (found at the end of this guide) is a 1:1 representation of the EP1000 enclosure. It an be used for location assessment and mounting hole placement.

When the location is decided:

1. Mark the mounting holes from the template to the cabinet.
2. Remove the template.
3. Drill the mounting pilot holes.

The EP1000 enclosure may now be mounted to the cabinet with the screws provided.

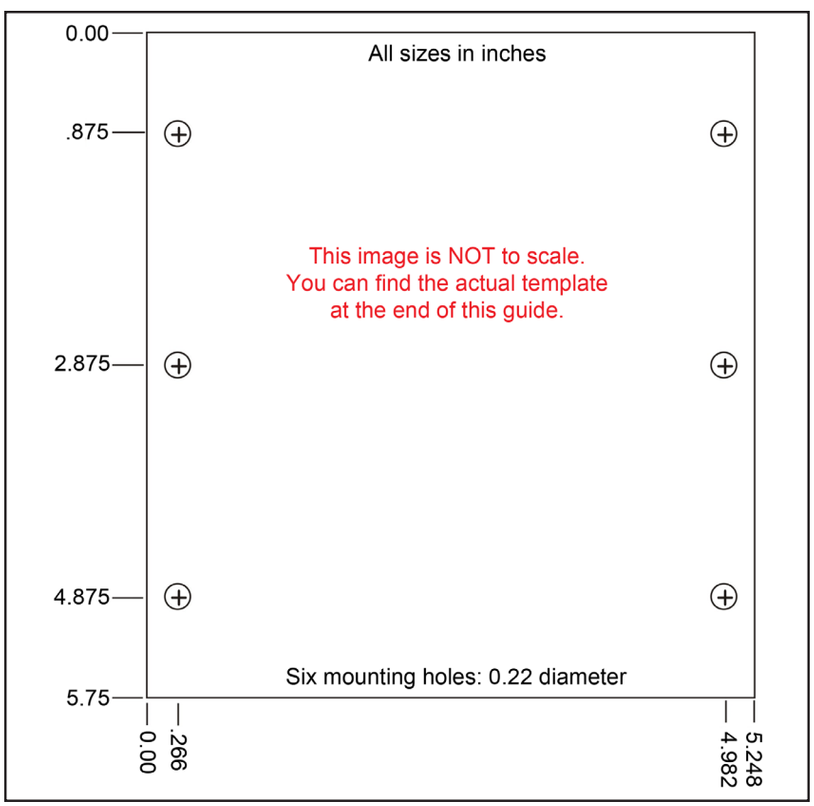

Fig 1: *Representation of EP footprint and mounting dimensions (in inches).*

Mounting the DB25 Panel Plug

Mount the DB25 panel plug on the cabinet door. The location should be easily accessible from the outside of the cabinet, providing the user with an easy and obvious hookup scheme. When the actual location is decided:

1. Mark the center hole to the cabinet.
2. Drill the center hole.
3. Remove the center cutout using appropriate means (for example, a 2.5-inch Greenlee-style punch or hole saw).
4. When the cutout is removed, place the plug over the hole and mark the four mounting holes.
5. Remove the plug, and drill the four outer mounting holes.
6. Mount the plug and the back plate.
7. Provide strain relief for the cabling attached to the panel plug.

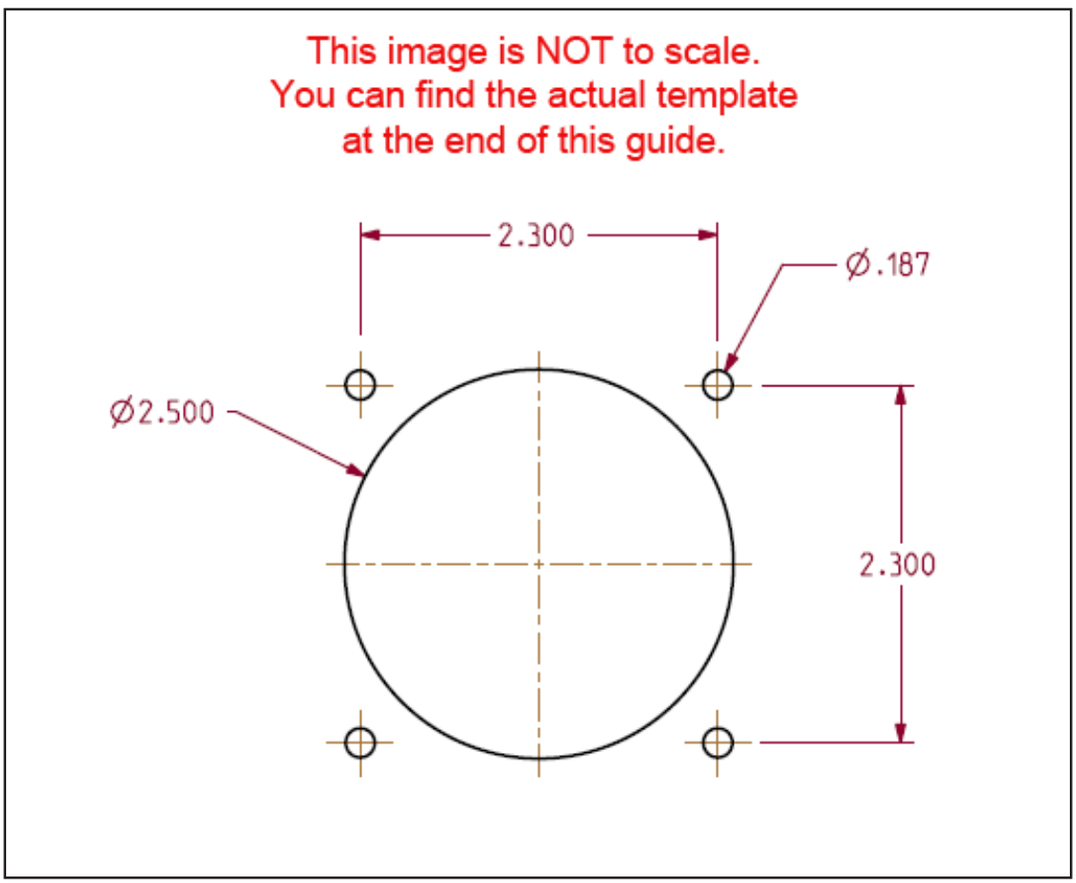

Fig 2: *DB25 connection plate hole dimensions.*

NOTE: In the figure above, all dimensions are specified in inches. A template is provided at the end of this guide.)

The DB25 template provided with this device is for a 2.5-inch diameter hole cut into the MCC wall (as an option to using a Greenlee 2.5-inch punch). This is required to accommodate the through-wall dimensions of a DB25 connector at one end of the cable that connects to the EP1000 inside the cabinet.

Current Transformer (CT) Connections

1. Place the supplied CTs on the three voltage feeds to the motor.
2. Place CTs on the load-side of line protection devices (circuit breakers). Ensure that the dots (or arrows) on the CTs point toward the load (motor). Red is phase A, blue is phase B, and yellow is phase C.
3. CTs should be installed on the output of existing CTs in the system for all motors operated at voltages above 600V. Check that the output of the secondary is less than or equal to the CT's rating.
4. Ensure that there is enough wire length to connect to the EP. If installed CTs are used, be sure to note the ratio because this information will be needed when creating a motor ID.

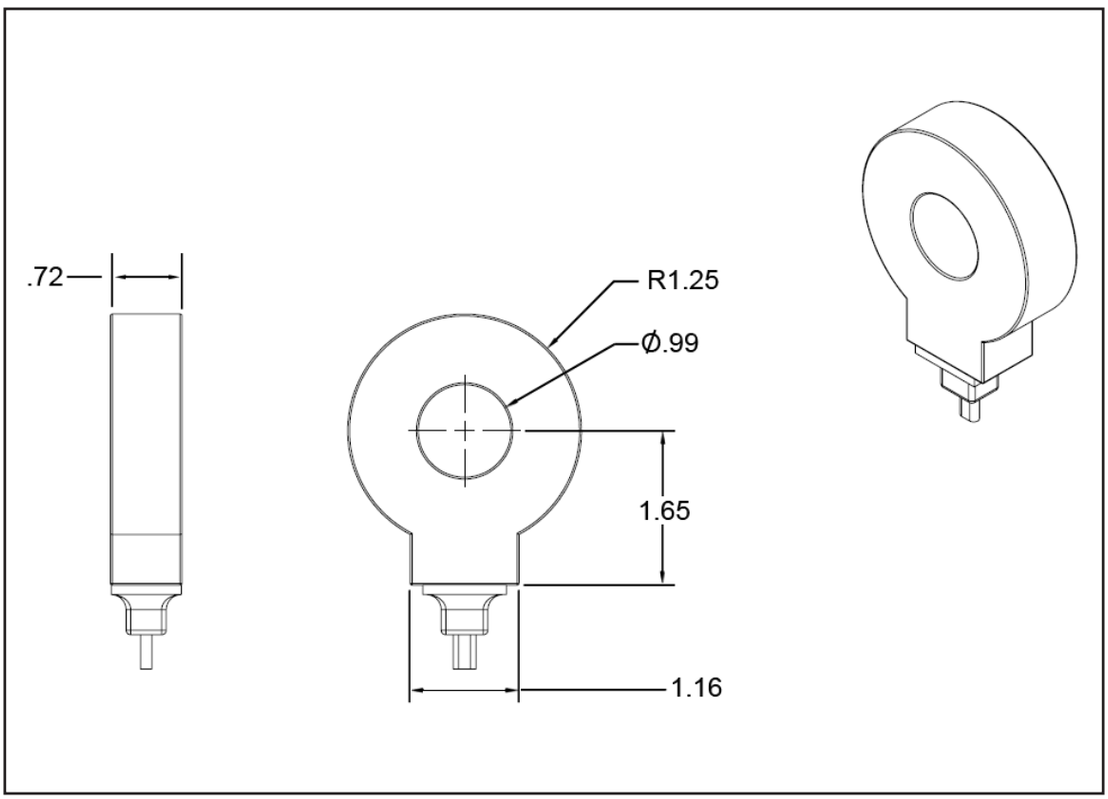

Fig 3: *Current transformer options: 5A, 50A, and 200A (solid core).*

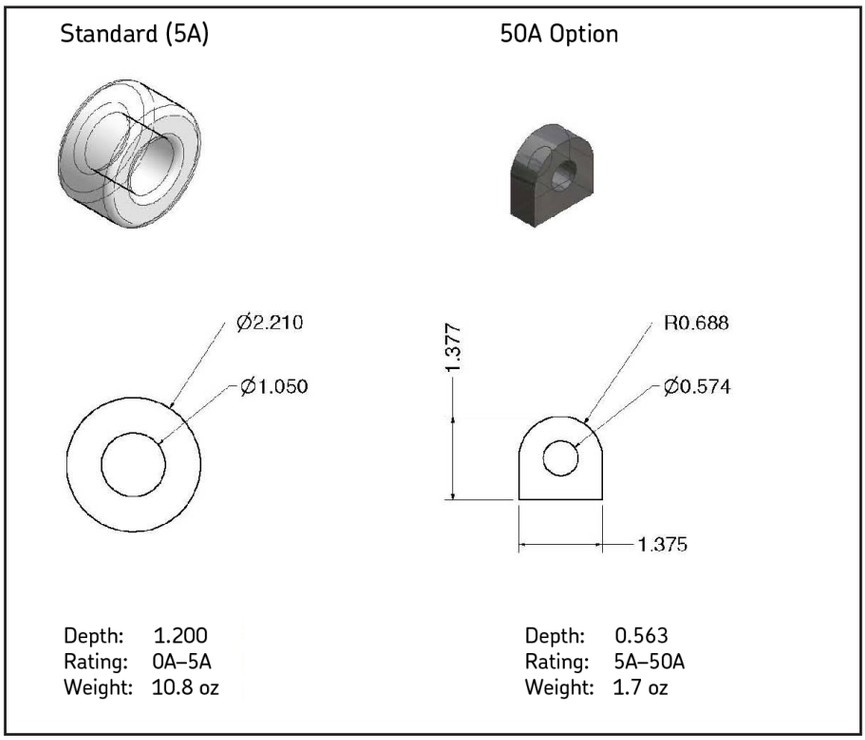

Fig 4: *Current transformer options: 5A (legacy solid core) and 50A (legacy solid core).*

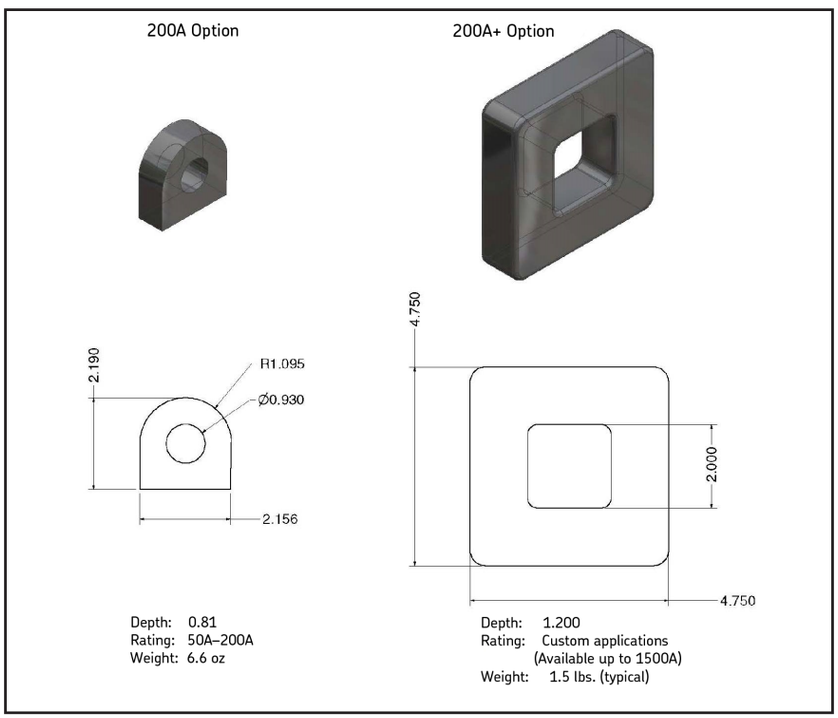

Fig 5: *Current transformer options: 200A (legacy solid core) and 200A+ (current split core products).*

Voltage Bus Connections—Less Than the Maximum Rated Voltage

Connect three-phase voltage to the EP1000 after it has been installed.

Installing a fuse block near the EP, connected in-line between the EP1000 and the voltage source, is recommended.

Ensure that there is enough wire length to connect to the EP1000.

In either of the following connections, connect the EP-to-MCC cable to the DB25 of the EP1000.

Panel mount the other end of the EP-to-MCC cable to the exterior or the MCC.

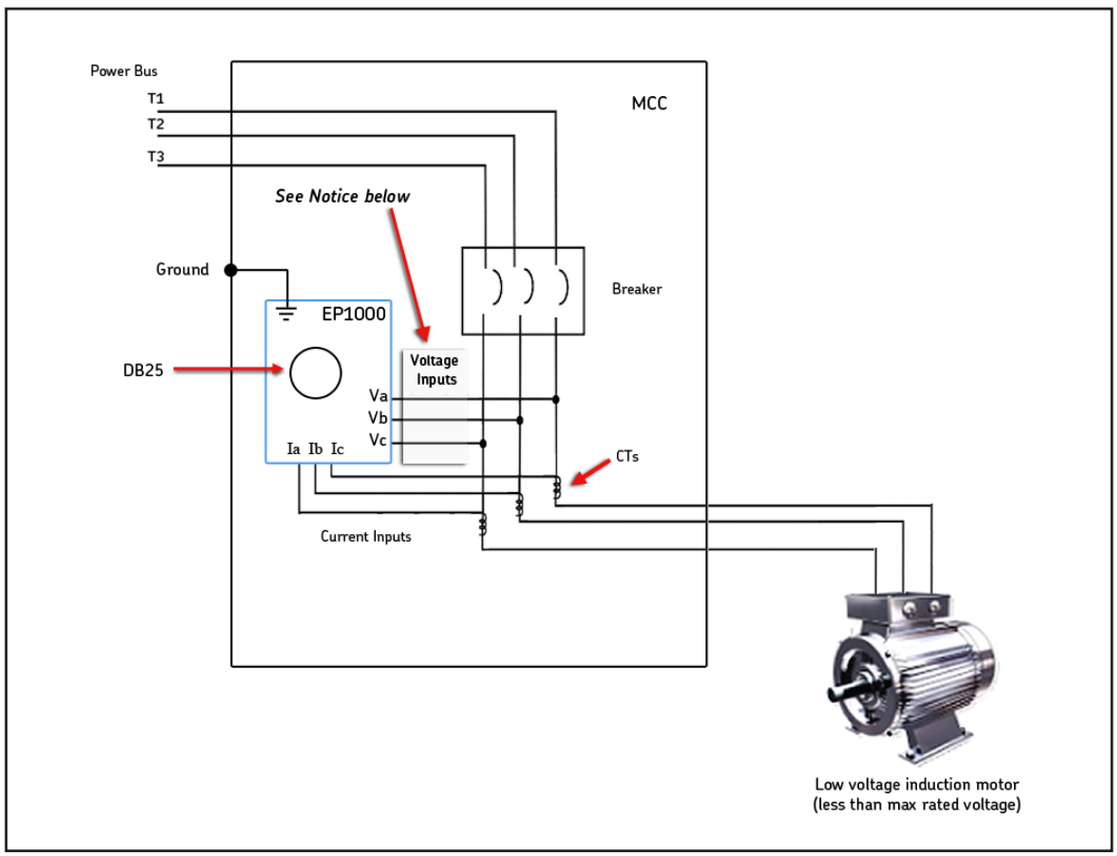

Fig 6: *Voltage bus and CT connections for systems < maximum rated voltage.*

Using this configuration, if you plan to do static testing on your motors (such as using a Baker AWA or DX tester), you must modify the installation. As shown in the diagram above, the EP1000 would be "in circuit" for the HiPOT test. This is problematic because:

- The maximum allowable input voltage for EP1000 is 1000V—this causes a low HiPOT test reading.
- The EP1000 2 MOhm per phase input impedance will make the HiPOT test fail.

To address these issues, you will need to remove the EP1000 voltage inputs from the circuit for HiPOT testing. This should be accomplished using a disconnect mechanism that best applies to your specific installation.

Voltage Bus Connections—Greater Than the Maximum Rated Voltage

CAUTION

On motors with input voltages higher than the maximum rated voltage, it will be necessary to make the connection after a power transformer (PT) located between the voltage source and the EP1000.

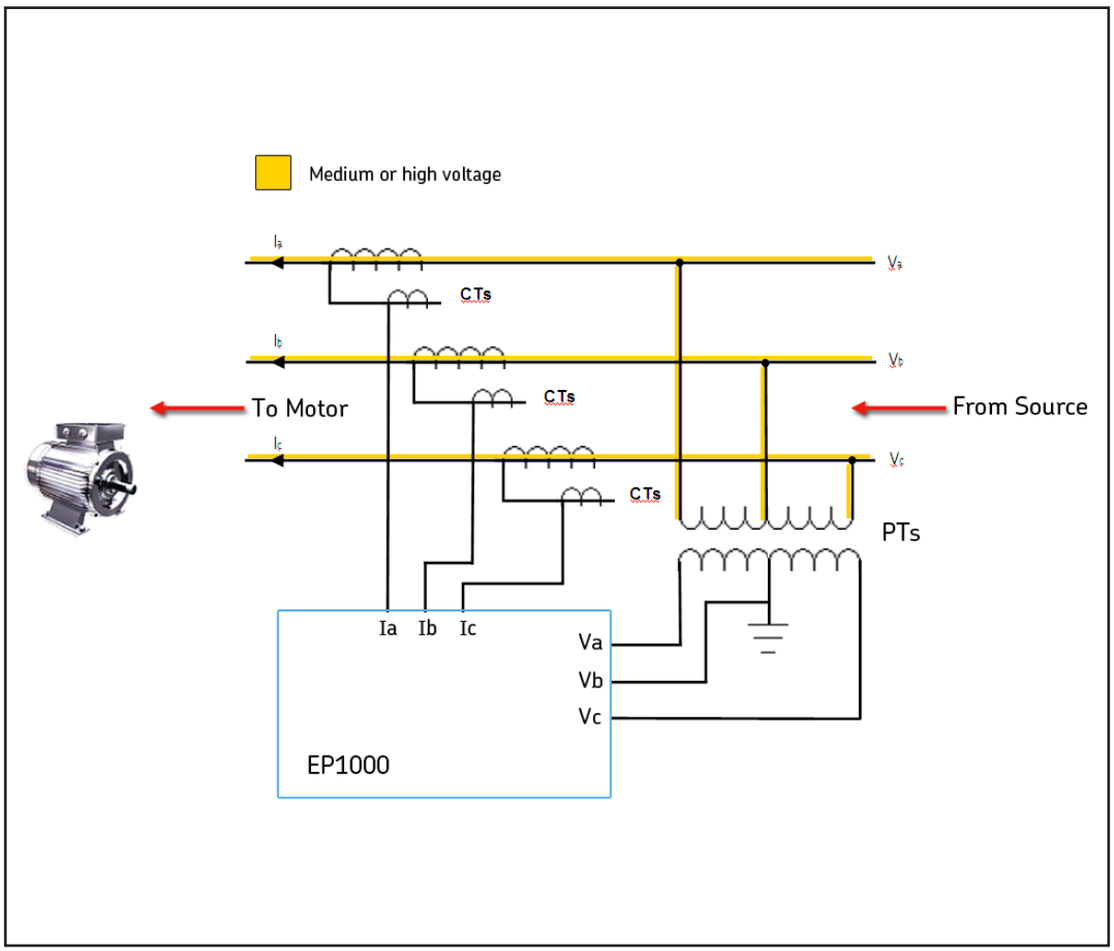

Fig 7: *Voltage bus and CT connections for systems > maximum rated voltage.*

For medium and high-voltage motors, connect voltage inputs to phase transformers (PTs) as shown in the figure above. Connect three phases to the hot secondaries (120 volts typical) and to the ground respectively.

For medium and high-voltage motors or bus voltages greater that 600 volts, use Megger current transformers (CTs) to monitor the secondary of the CTs (5 amps typical) in the MCC.

For monitoring VFD motors, make the electrical connections between the motor and the output of the VFD.

Electrical Connections

WARNING: To prevent serious injury or death cabinet voltage must be de-energized for installation.

After the EP1000 has been mounted, CTs have been installed, and three-phase voltage lower than the maximum rated voltage is made available, you can make the electrical connections.

1. Connect the three CT twisted pairs to the EP1000 current terminal block corresponding to the appropriate phase, marked Ia, Ib, and Ic (from right-to-left); white wire on the right and black wire on the left for each phase. Tightening torque is 0.5 N-m.
2. Using a flat-bladed screwdriver to open the clamp connectors on the terminal block, connect the three voltage leads to the EP1000 voltage terminal block corresponding to the appropriate phase marked Va, Vb, and Vc.
3. Connect a ground to the ground position of the voltage plug.
4. Connect the MCC ground to the ground stud on the EP1000 enclosure.

CAUTION: Make sure that the voltage wiring for each phase is completely captured by its corresponding phase in the EP1000 voltage plug (that is, no wire strands should poke out).

5. Connect the MCC cable (the end opposite the panel plug) to the A/D Bus DB25 receptacle of the EP, and secure in place with the captive screws.
6. Provide strain relief for all current wiring, voltage wiring, and the DB25 cabling at the EP1000 enclosure.

Verifying the Installation

1. Turn power on to the cabinet.
2. Connect an umbilical cable between the EXP4000 and the EP1000 panel plug.
3. Open the EXP4000 software and create a new motor id.
4. Set sensors switch to EP1000 position.
5. Click on the Run Electrical button in the EXP4000 user interface.

Calibrating the EP1000

Connect the EXP4000 to both the portable sensors and to the EP1000 to be calibrated. The EXP4000 calibration wizard is used to complete the process.

1. To launch program, select Calibrate EP then click Next.

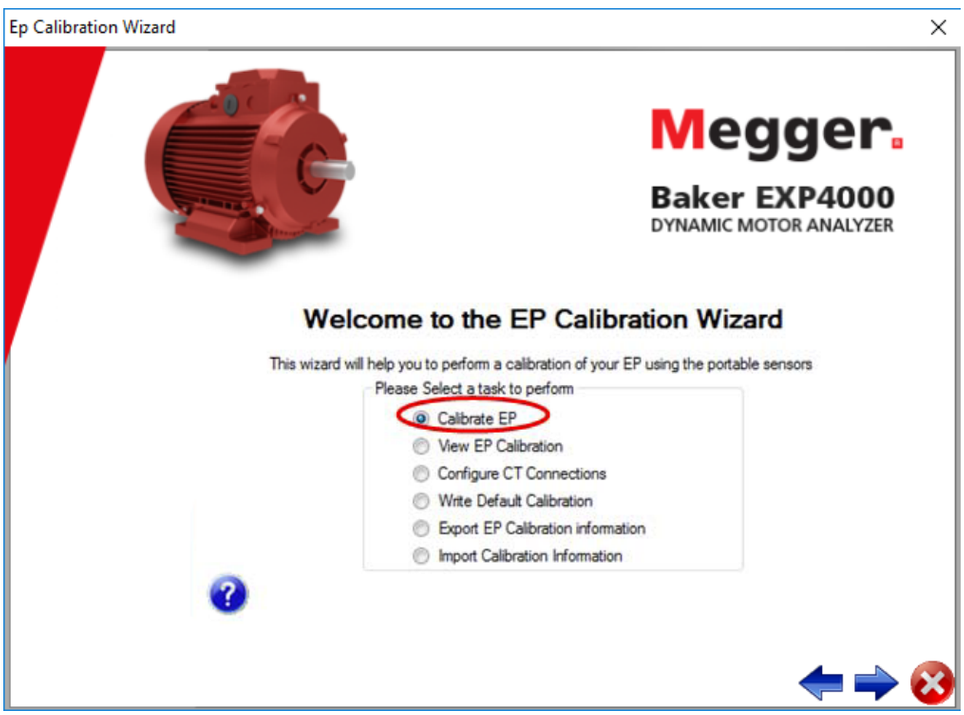

Fig 8: *EP calibration software welcome screen.*

2. Voltage, load, and frequency all must be constant as well. A warning will appear to inform you of this as shown in the example below. If these criteria are met, click OK; otherwise click Cancel.

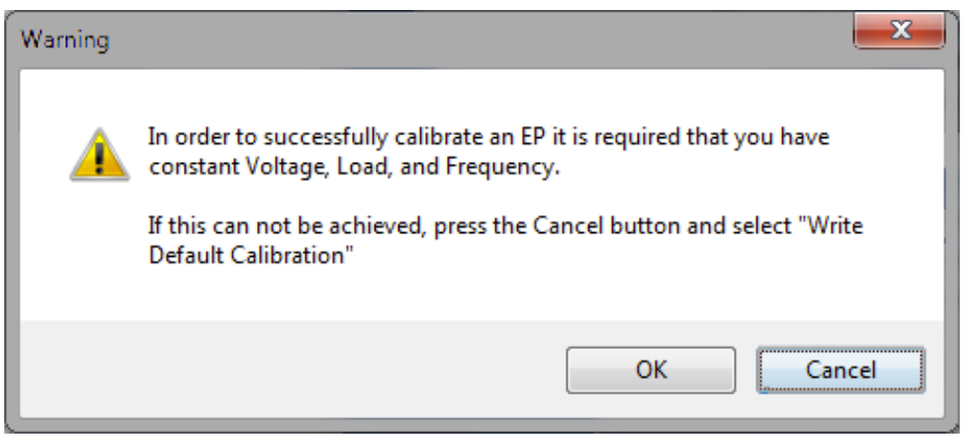

Fig 9: *Voltage, load, frequency warning.*

3. Use the drop-down menu to select the specific CTs being used to calibrate the EP then click Next.

Note: Default tolerances applied to the EP during calibration can be changed, but this is not recommended except in rare cases.

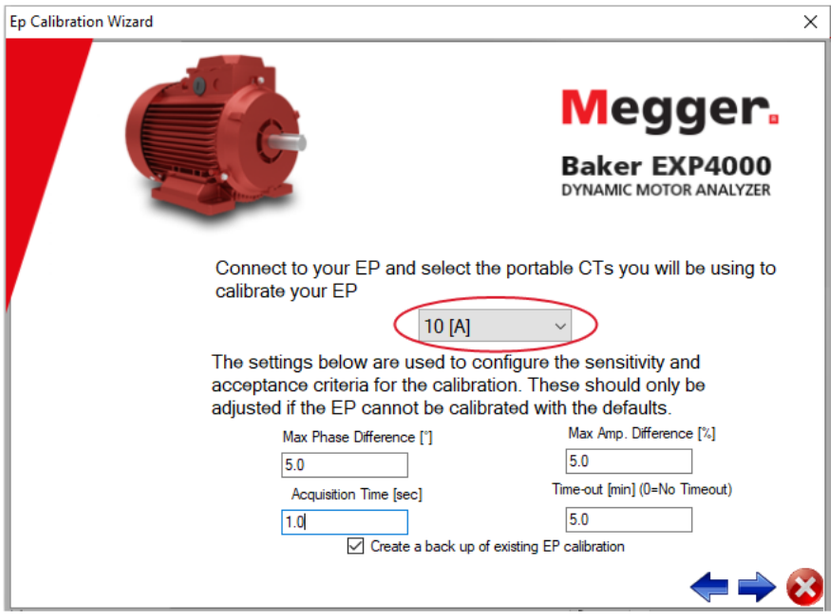

Fig 10: *Calibration settings.*

Voltage Connection Issues

The portable voltages have to be connected in the same sequence as they are to the EP. The red (portable voltage sensors) and blue (EP voltage sensors) phasors must be aligned. If they are not aligned (as shown in the example below) the angle of the offending phase will be red.

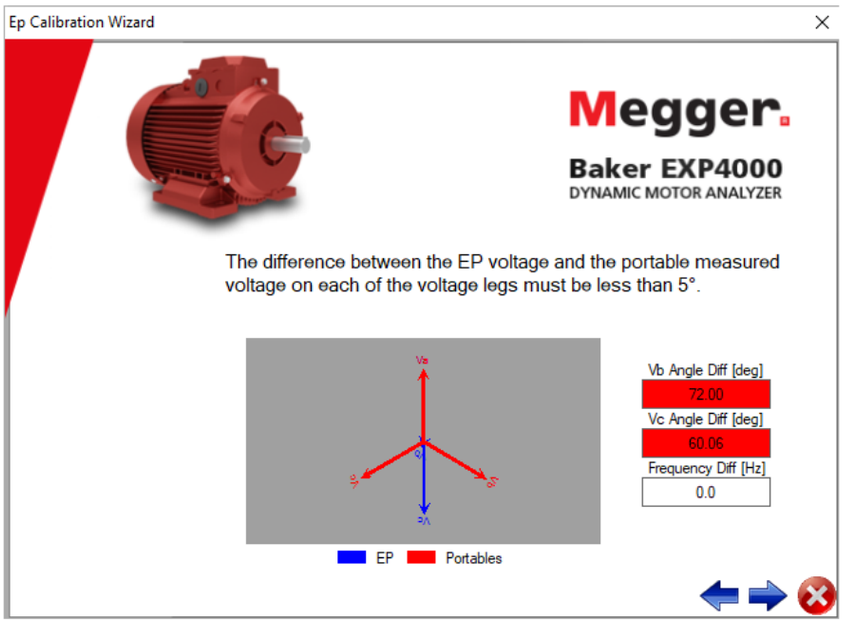

Fig 11: *Voltages not connected properly.*

When all the voltages are connected properly, the Next button will be enabled as shown below.

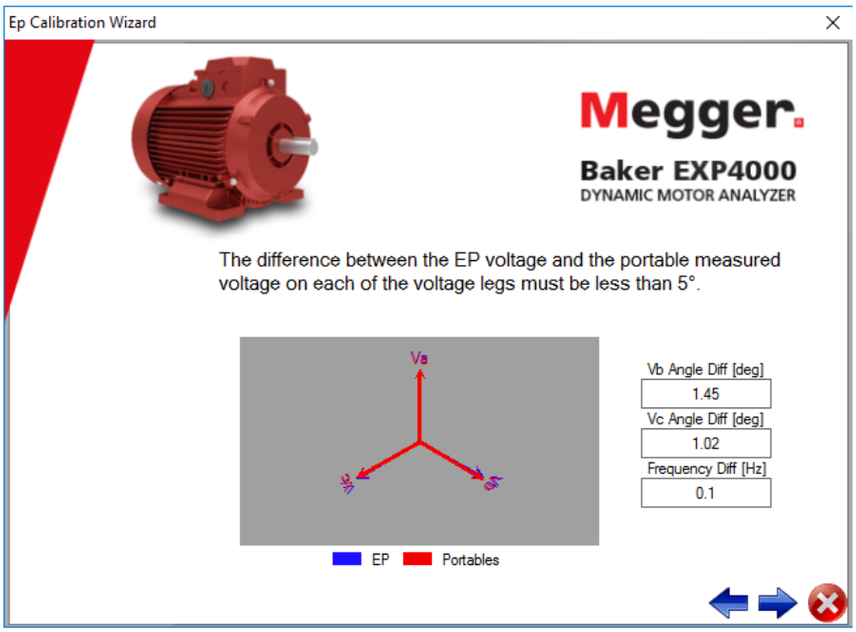

Fig 12: *Voltages connected properly.*

Current Connections

CTs must be connected in the same phase and direction as the EP CTs. If the EP CTs are not properly connected, you may not receive a standard phasor diagram (as shown below).

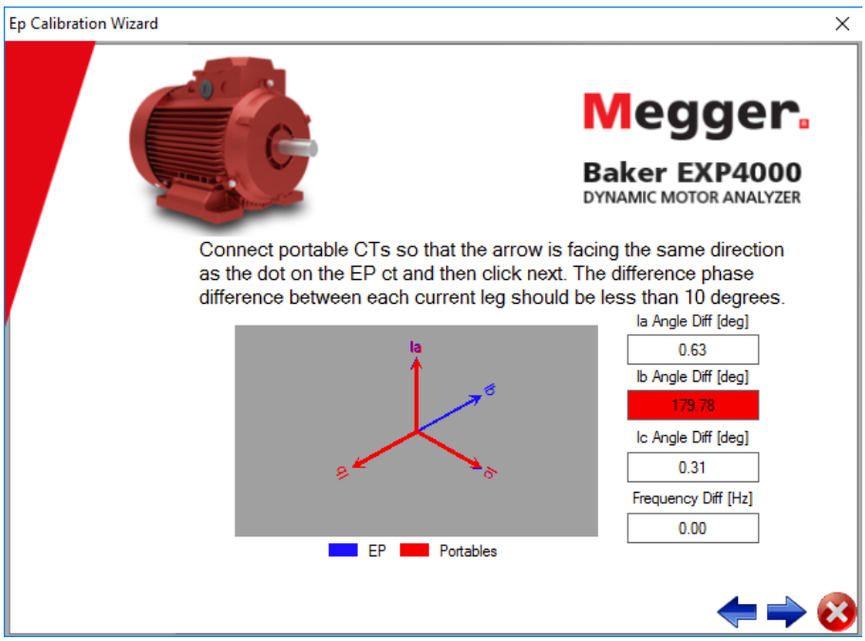

Fig 13: *Improper CT connection.*

In this case, the portable current phasors must be aligned with the EP current phasors, as shown in the following example.

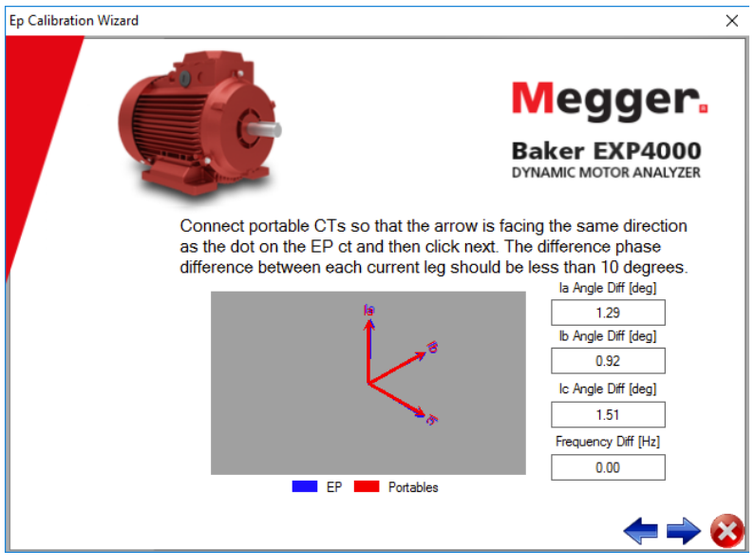

Fig 14: *Proper CT connections (Phase B is inverted).*

Automatic Calibration

When the voltages and currents are aligned, the EP can be calibrated. This requires that the voltage, load, and frequency remain constant. The values of the portable sensors will be compared to the values read from the EP, and new calibration constants will be calculated.

The error resulting from the next comparison will be compared to the settings configured earlier. If these values are out of range, a red X indicating that the calibration was unsuccessful will appear as shown in this example.

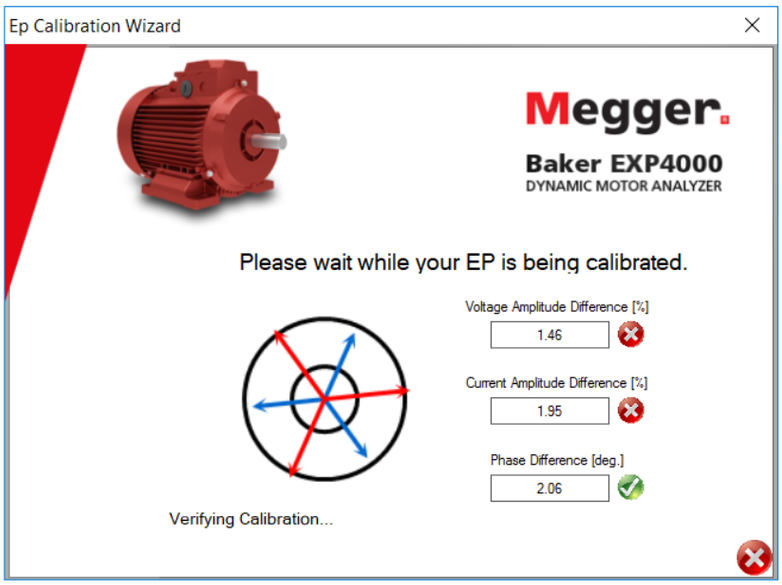

Fig 15: *Calibration being calculated; red Xs indicate issues.*

The calibration is iteratively calculated so it may take some time to converge. When the calibration is successful, green check boxes will appear next to each of the values. The software will then automatically continue to the next stage.

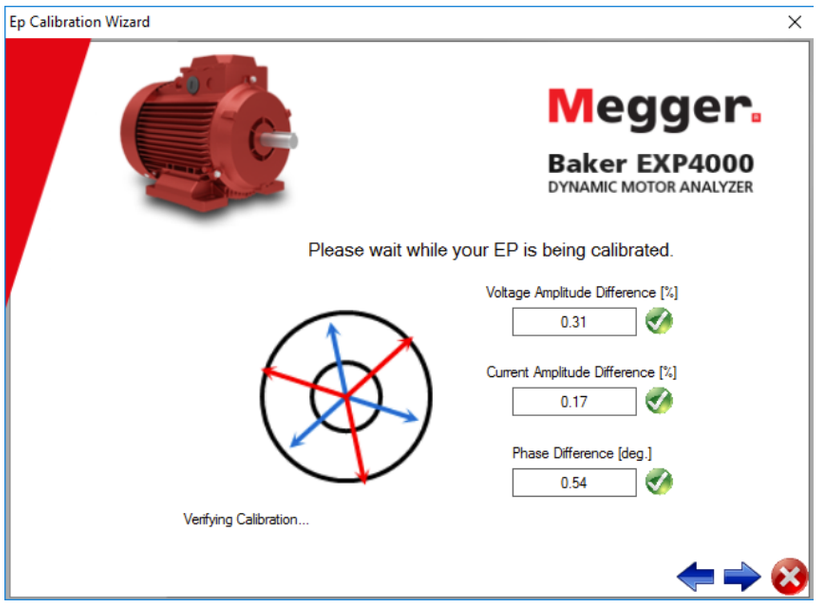

Fig 16: *Calibration is successful, and being verified.*

CT Mapping

When the calibration constants have been successfully calculated and applied, the software can be used to virtually re-map the EP CT connections. Mapping of a channel to anther CT input has the same effect as physically disconnecting a CT and moving it to another phase. Inversion of a channel has the same effect as physically turning a CT over.

Take the opportunity to verify that the EP is reading expected values, but keep in mind if there are sensor ratios, they are not applied in this screen. The following two figures provide an example of using the software to correct a CT that was placed backwards.

NOTE: This mapping will only apply in Explorer software versions 3.0.18 and greater. If using a version older than this, connections must be readjusted at acquisition time.

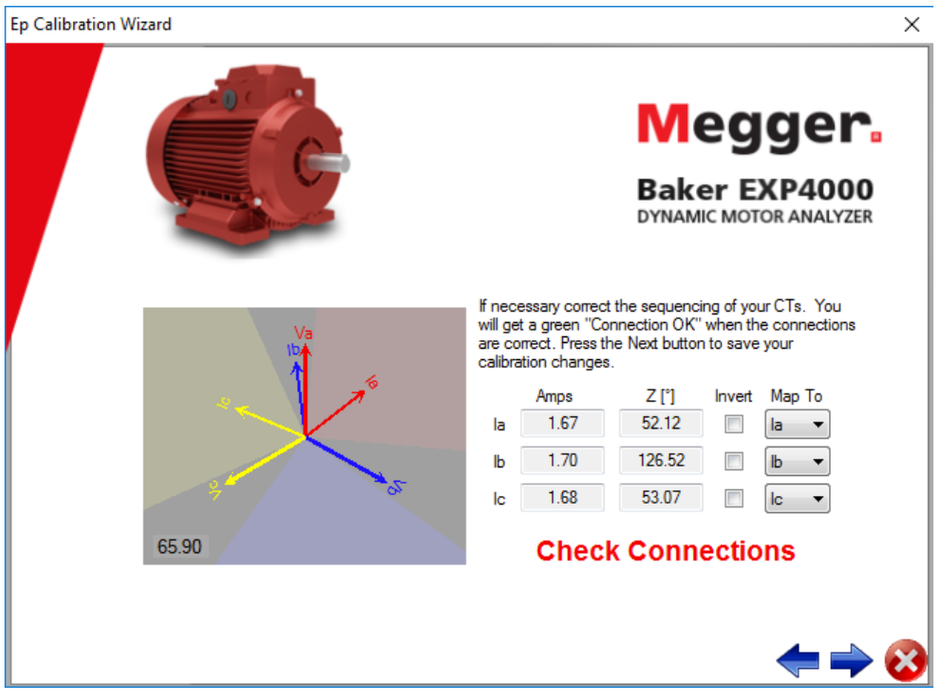

Fig 17: *EP connected with B phase inverted.*

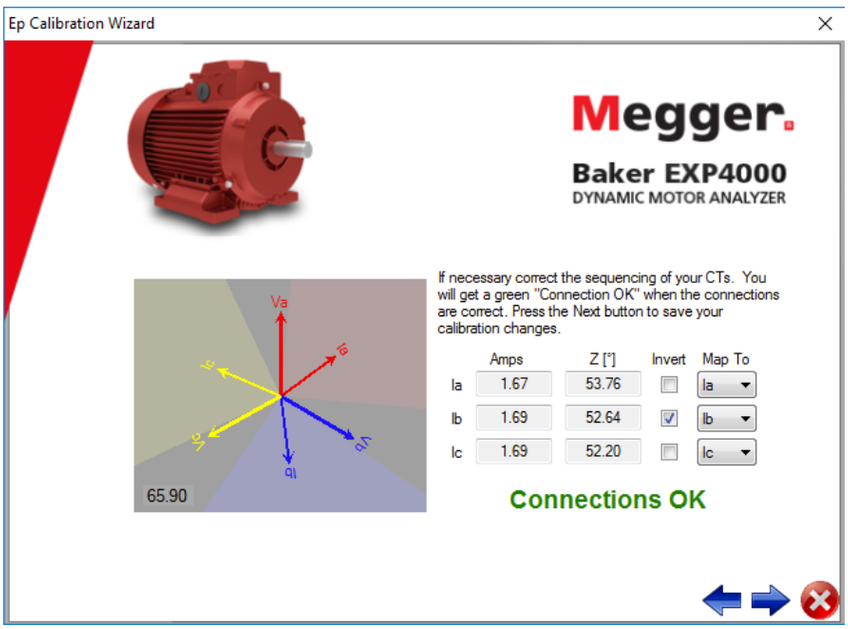

Fig 18: *EP B phase corrected by inverting.*

Save EP Calibration

When the calibration constants have been successfully calculated and the CT connections have been properly configured, the software will begin writing the calibration information to the EP. This can take several minutes to complete.

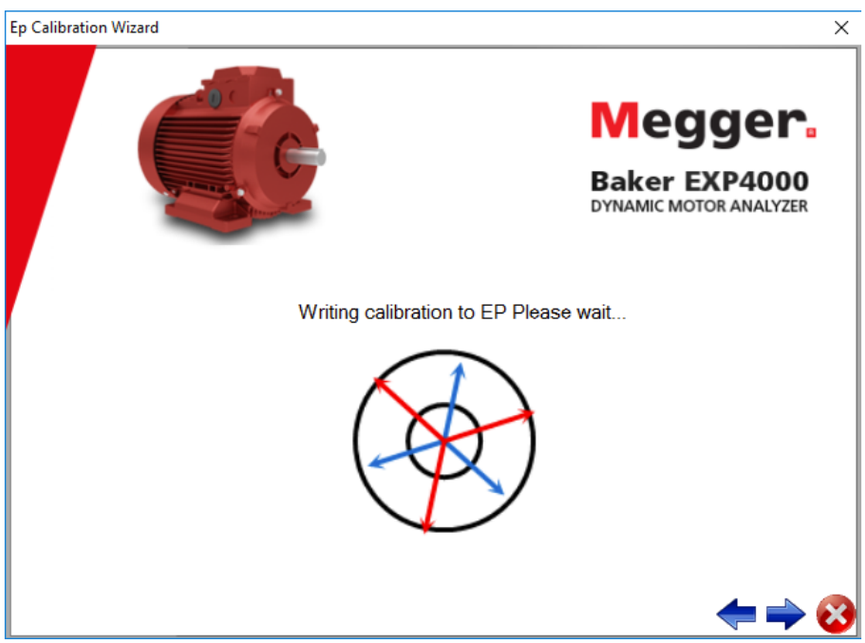

Fig 19: *EP calibration save-in-progress screen.*

EP Calibration Complete

When the calibration constants are successfully written to the EP, the calibration process is complete. A confirmation message should appear as shown in the example below.

Fig 20: *EP calibration successful.*

Press the View EP Calibration button to see the calibration information that has been saved to your EP.

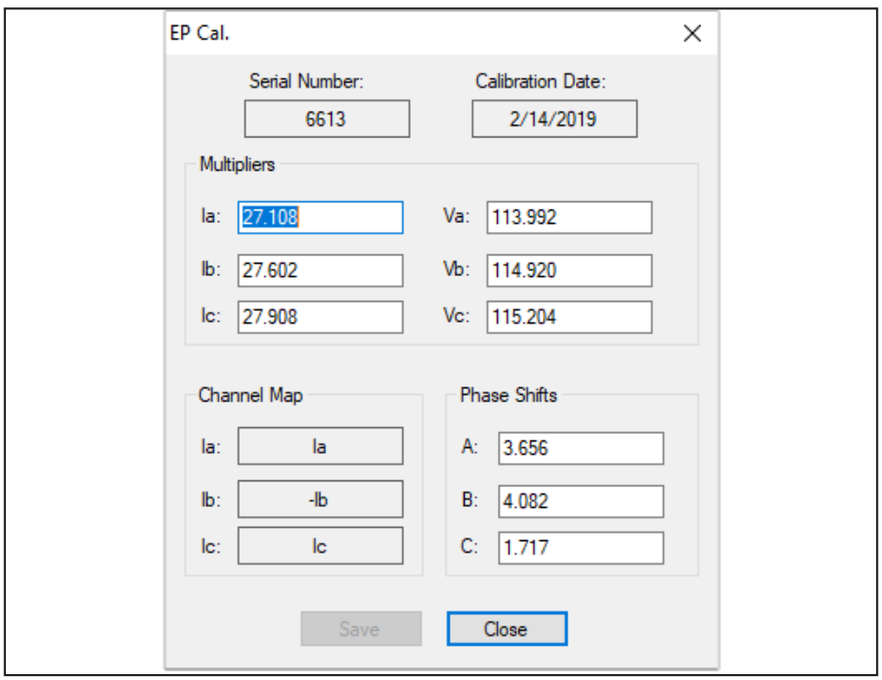

Fig 21: *Figure 14: EP calibration constants.*

Troubleshooting and Specifications

Table 2: *Common issues and solutions.*

Issue Description	Potential Solution
MCC sensor error.	Verify all connections between EP1000 and EXP4000.
Autophasing not successful; or V-sequence does not match I-sequence.	Verify correct voltage and current hookup. Verify arrows/dots on CTs point toward load.
EP1000 not associated with a Motor ID.	Follow procedure in EXP4000 manual to associate an EP1000 with a Motor ID.
Voltages and/or currents are too small.	Check correct sensor ratios.

EP1000 Ratings

CAUTION

This product conforms to UL/CSA 61010-1 up to a maximum voltage of 600VAC at 50/60Hz with a main line voltage of 100–240VAC with a current draw of less than 2A.

This product conforms to IEC/EN 61010-1 up to a maximum voltage of 1000VAC at 50/60Hz with a main line voltage of 100–240VAC with a current draw of less than 2A.

Wherein this manual refers to the maximum input voltage, this maximum is determined by the applicable standards for the environment where the unit is being installed as allowed by the Authority Having Jurisdiction (AHJ) as either 600V or 1000V.

Under no circumstances should the voltage sensing circuit be connected to higher voltage levels. This will cause severe damage to the instrument.

Current terminal: use specified Megger current transformers

A/D bus connector: use specified umbilical cable

Input power: 5VDC 105mA (provided by EXP4000)

Connect only to EXP4000 or similar

CT dimensions: see drawings in "Installing the EP1000" chapter.

Environmental Specifications

Specification	Detail
General use	The EP1000 is designed strictly for indoor use. This instrument is NOT waterproof or sealed against water entry with the cabinet door open OR closed. This system NOT approved for use in explosive environments. Do not use or install this instrument in explosive environments. This instrument is NOT approved for use in any flammable or hazardous environments.
Operating temperature range and humidity	Only operate the tester in temperatures ranging from 0 to 48° C (32 to 120° F). This unit is for use at a maximum relative humidity of 80% for temperatures up to 31 °C (88 °F), decreasing linearly to 50% relative humidity at 40° C (104° F).
Maximum altitude	The unit has been tested for use up to 2,000 m (6,500 ft.).
Pollution degree II	This unit is intended for Installation Category II in a Pollution Degree II environment. (From IEC 61010-1 3.6.6.2) Only non-conductive pollution occurs. However, temporary conductivity caused by condensation is expected.

Cleaning and Decontamination

Keep the EP1000 clean and in a dry environment. To clean the unit, power it down (off) and de-energize all voltage bus connections, including the AC power to the unit. Gently wipe the surface with a clean cloth slightly dampened with water (dampen and wring to near dry; no dripping water). Do not submerge in water or other cleaners or solvents.

Mounting Hole Template

Tear or cut page to use template for installation. If copying, ensure that page is not resized. Double-check dimeensions on copies before marking and drilling holes.

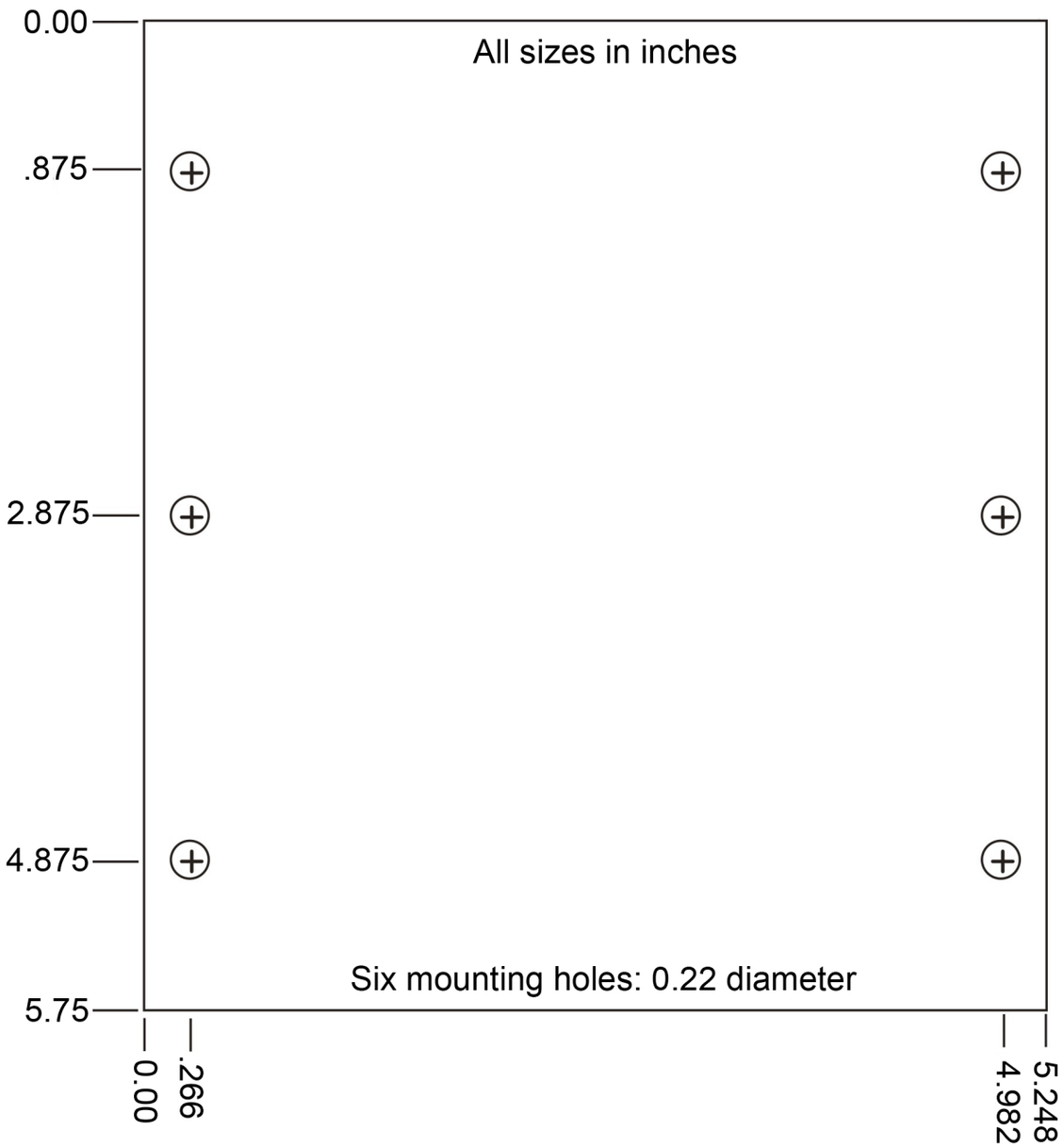

Fig 22: *Mounting hole template.*

Mounting Hole Template

DB25 Plate Hole Template

Tear or cut page to use template for installation. If copying, ensure that page is not resized. Double-check dimeensions on copies before marking and drilling holes.

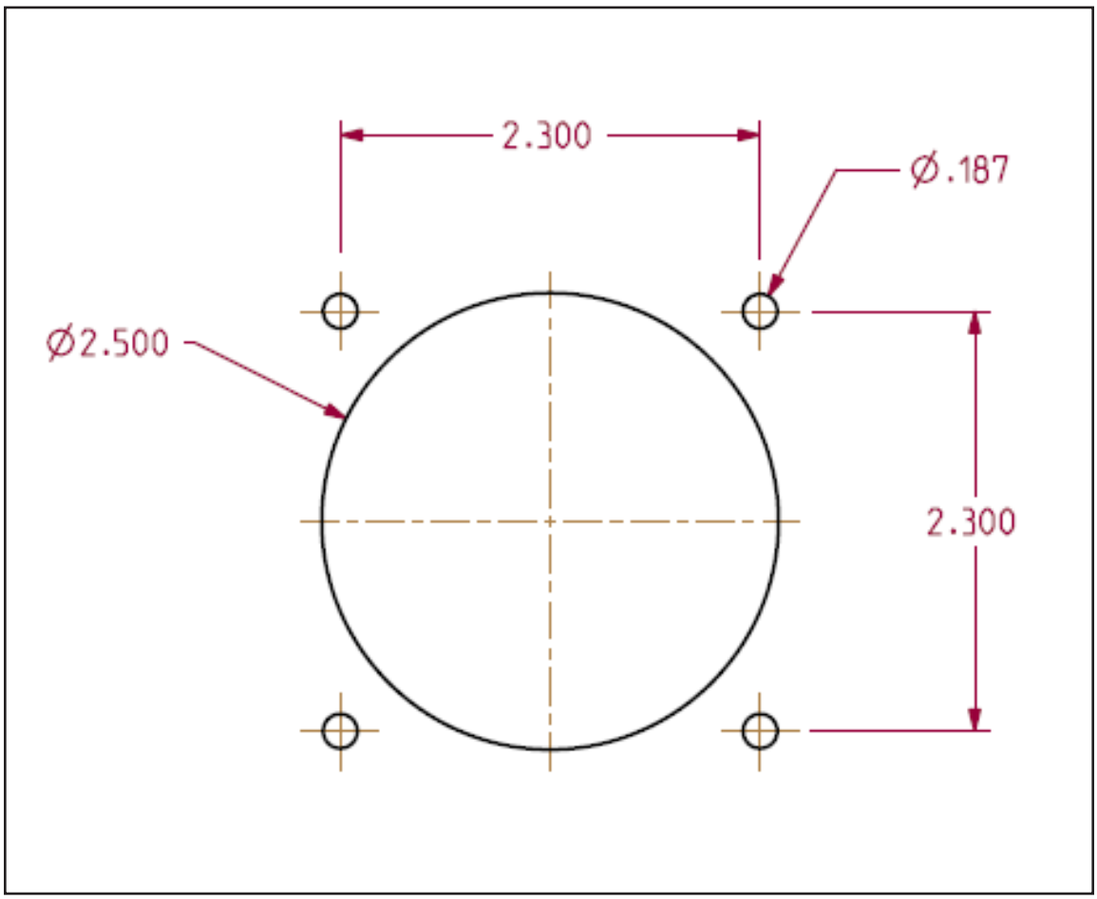

Fig 23: *DB25 connection plate hole template.*