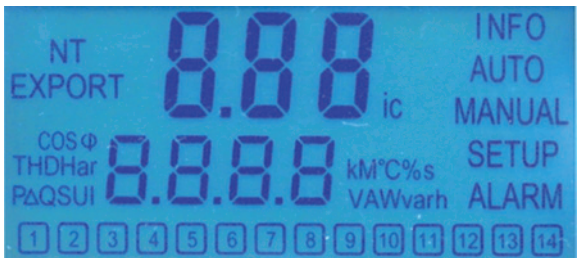
Instruction Leaflet **IL157002EN** Effective July 2019

Eaton BLR-ACX
Quick commissioning guide

Contents

Powering Business Worldwide

Screen legends



INFO	Capacitor database
AUTO	Automatic mode
MANUAL	Manual mode
SETUP	Setup mode
ALARM	Blinking during alarm
NT	Second target-pf is active
EXPORT	Export of active energy
1-14	Capacitor stage number indication

Figure 1. Digital display

Operation

Operation of BLR-ACX is done by 4 keys.

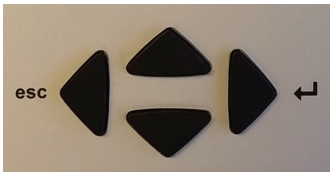


Figure 2. Operational keys

Submenus are scrolled through by pushing the ▲ (up) key or ▼ (down) key.

Pressing ▶ (↵ right / Enter) key allows selection, entering the edit mode or accepts the edited values.

In edit mode, the ◀ (left / esc) key or ▶ (↵ right / Enter) key scroll left and right to allow setting of the appropriate digit.

Outside of edit mode, the ◀ (left / esc) key exits to the next higher level.

Press and hold the ◀ (left / esc) key for approximately 3 seconds to silence any alarms.

Commissioning

Step 1

Upon power on the controller displays the existing power factor value "X.XX i" and enters the Automatic Control mode.

The "i" at the end indicates an inductive power factor and would be appropriate for most installations. A "c" at the end indicates capacitive power factor and suggests reactive power export and may not be appropriate. Refer to the troubleshooting section for resolution steps.

Step 2

Next step is to set up the basic parameters in the controller.

Press the ▼ (down) key to step through the "INFO", "MANUAL" and to "SETUP" mode. Press the ▶ (↵ right /Enter) key to enter the Menu 100 and program and or verify the following values.

Un Nominal voltage (factory programmed, customer may verify)

Ct CT-ratio (Factory set to 600, Customer to program if measurement feature is desired. Refer to Step 3). Note that this ratio is NOT needed for PF correction and is only required for accurate measurement values. Changing the CT ratio will change the capacitor step sizes in 402 and those values will have to be re-programmed.

Pt PT-ratio (factory programmed)

Ai Start of automatic initialization (factory programmed)

PFC PF-control ON/OFF/ HOLD (factory programmed)

CP1 Target-PF (customer to program)

St Switching time delay (factory programmed, customer may verify)

Out Type of each stage (Auto/ Alarm/ Foff/ Fon) (factory programmed, customer may verify)

Once the Menu 100 is programmed, press the ◀ (left / esc) key to return to the main screen that displays the existing PF.

Overview

BLR-ACX is factory preset to the default values shown in **Table 1**.

Customer to program and verify the values set to meet the specific conditions of each installation.

Step 3

The next step is to verify the measured values.

In the main screen press the ▶ (↵ right / Enter) key to enter the Measurement menu. The following parameters are displayed.

To enable measurement values, the CT ratio has to be set.

Otherwise only voltage dependent measurement values are displayed accurately. The shaded fields shown in **Figure 3** are hidden and will only appear if the CT ratio is set in the menu.

Step 4

The final step in commissioning is to verify the working of the capacitor bank. This is done by activating the controller in manual control mode and cycling through all the available steps. **Note that the steps will switch on only after the factory set capacitor stage discharge time has elapsed**.

After each manual operation of the stage, the PF should change in the right direction. (For example 0.70 i >> 0.78 i >> 0.85 i…).

If the PF changes in the right direction, the capacitor bank has been correctly commissioned. If not, please refer to the troubleshooting section.

To switch the controller in manual control mode, press the ▼ (down) key to step through the "INFO" mode to "MANUAL" mode. Press and hold the ▶ (↵ right /Enter) key for approximately 3 seconds until "1" displays indicating the stage number 1 is available for control.

Note that in manual mode, the controller freezes the stages in their existing state (ON, OFF or HOLD). Therefore it is important to ensure that at the end of this step 4, the controller is returned back to the automatic control mode by pressing the ◀ (left / esc) key to return to the main screen that displays the existing PF.

After activating all available steps, one should make note of the displayed PF value as that reading should be greater than or equal to the target PF desired. If the displayed PF with all steps energized is less than the target PF, then the selected capacitor bank is not sized adequately to raise the PF to the desired value. The customer should either upgrade the capacity of the capacitor bank or the target PF value should be decreased to prevent "PF alarms".

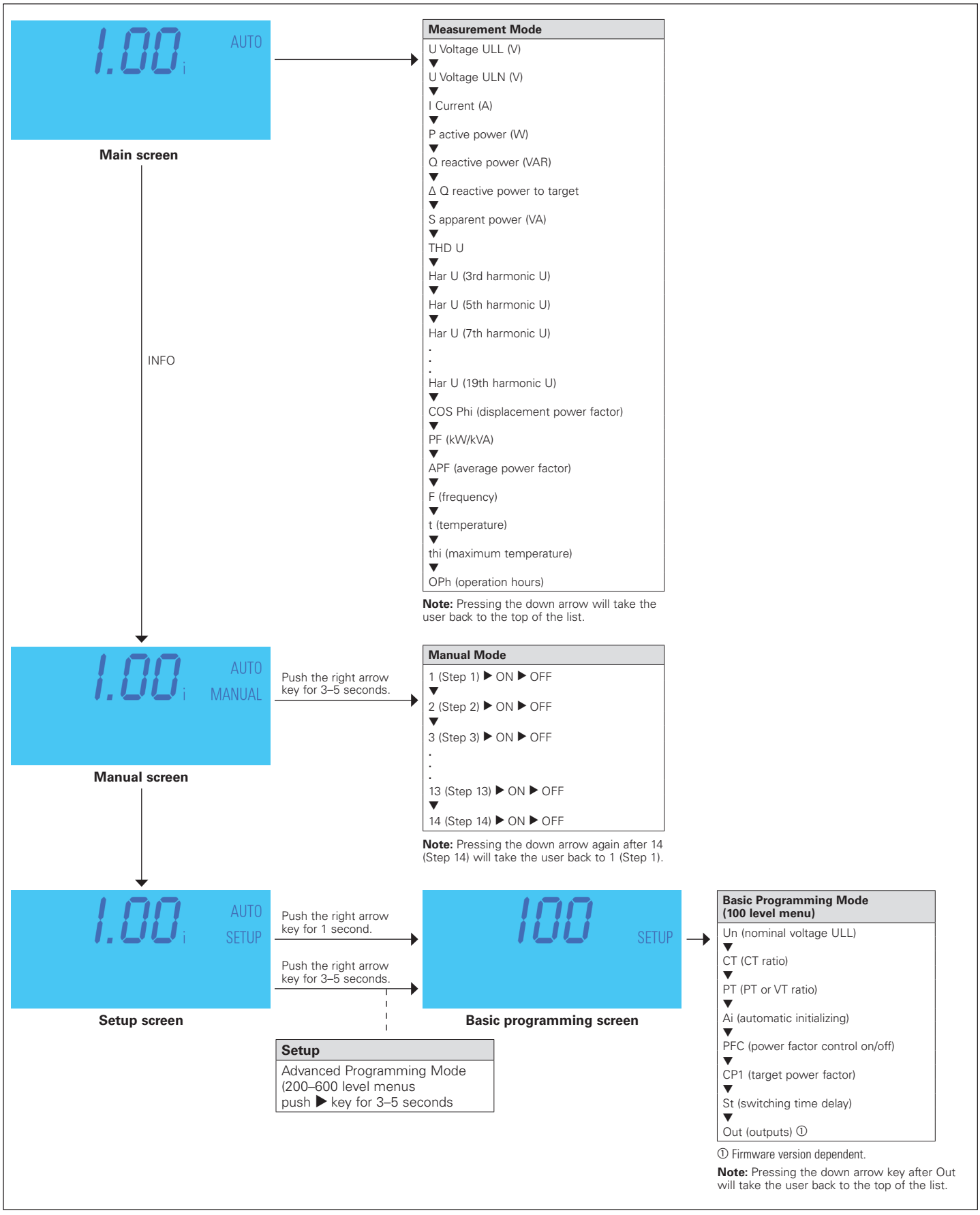


Figure 3. Menu map

Menu structure

The following table provides an overview about the basic and advanced programming parameters of BLR-ACX.

Menu 100 is the Basic Menu. Menu 200 through 600 is for advanced users only and requires a PIN access (242). The settings in these submenus should only be accessed and changed after consulting with Eaton

Table 1. Programming mode detailed menu map

Menu	Function	Default	Customer settings
100	**Quick start setup**		
Un	Nominal voltage (phase-phase)	208 V / 240 V / 480 V / 600 V	
Ct	CT-ratio	600 (corresponds to 3000:5 CT ratio)	
Pt	VT-ratio	1.7 (240 V unit) 3.7 (480 V unit) 4.7 (600 V unit)	
Ai	Start automatic initializing	N	
PFC	Start/Stop/Hold PF-control	On	
CP1	Target-PF 1	0.95i	
St	Switching time delay	60 s	
Out	Type of each step (1,2...14)	Auto (for each step installed in unit), Fixed Off (for unused controller outputs)	
200	**Setup measuring system**		
201	Nominal voltage (phase-phase)	208 V / 240 V / 480 V / 600 V	
202	CT-ratio	600 (corresponds to 3000:5 CT ratio)	
203	VT-ratio	1.7 (240 V unit) 3.7 (480 V unit) 4.7 (600 V unit)	
204	Tolerance nominal voltage	20%	
205	Voltage measuring	Y = L–L	
206	Phase-offset	90	
207	Start automatic initializing	N	
208	Activate Ai by every start of BLR-ACX-V	N	
209	Synchronization to frequency	60 (60 Hz unit)	
210	Temperature offset	0 °C	
300	**Setup control system**		
301	Switching threshold 55%		
302	Target-PF 1	0.95i	
303	Target-PF 2	0.95i	
304	Target-PF 2 at KW-export	N	
305	Switching time delay	60 s	
306	Switching time delay for fine control	10 s	
307	Fine control active	N (for units with equal stage sizes), Y (for units with multiple stage sizes)	
308	Stop automatic capacitor size detection	Y	
309	Blocking of defective capacitors	N	
310	Start/Stop/Hold PF-control	On	
311	Control algorithm	1	
312	Reactive-power offset	0	
313	Asymmetrical switching time delay	1	
314	Switch-off capacitors in leading condition	N	

Menu	Function	Default	Customer settings
400	**Setup capacitor database**		
401	Discharging time	60 s	
402	Capacitor size: step 1...max. 14	Varies (see equipment drawings for step size, typically 25, 50, or 100 kvar capacitive)	
403	Type of exit: step 1...max. 14 ,	Auto (for each step installed in unit), Fixed Off (for unused controller outputs)	
404	Switching operations: step 1...max. 14	0	
500	**Setup alarm system**		
501	Disable automatic alarm reset	N	
502	THD alarm	Y	
503	Threshold THD	6%	
504	Disconnect capacitors when THD >	N	
505	Delay time THD Alarm / Temp. threshold 2	120 s	
506	Freeze exits when I = 0	N	
507	Service alarm	N	
508	Max. operations per step	262 k	
509	Max. operation hours of BLR-ACX-V	65.5 k	
510	Use temp. sensor as digital input	N	
511	Digital input active at high signal	N	
512	Temperature alarm active	Y	
513	Temp. threshold level 1 (fan control, type of exit: AL)	40 °C	
514	Temp. threshold level 2, disconnect capacitors	55 °C	
515	Control alarm (target cannot be reached)	Y	
516	Defective steps alarm	Y	
517	Loss of capacitor reactive power alarm	Y	
600	**Reset**		
601	Reset to default values		
602	Reset capacitor database to default		
603	Reset operation hours		
604	Reset average PF		
605	Reset max. temperature		
606	Reset alarm		
607	Display software version		

Troubleshooting

⚠ CAUTION

WHILE ATTEMPTING ANY TROUBLESHOOTING STEPS THAT REQUIRE ACCESS INTO THE CAPACITOR BANK, ALWAYS FOLLOW ALL SAFETY PRECAUTIONS AND REGULATIONS FOR WORKING ON ELECTRICAL SYSTEMS. ALWAYS WEAR PROPER PPE AND FOLLOW APPROPRIATE LOCK OUT AND TAG OUT PROCEDURES.

Automatic control mode

The controller should display status "Auto," which indicates that the controller is working in automatic mode. This is the desired mode of operation. If "Auto" is not displayed, then the power factor control is not working. Reasons for this are:

- Manual mode is active
- Control mode has been switched off
- Temperature is too high (if temperature input is provided)
- Current from the CT is less than 15 mA
- Voltage is out of range
- Harmonic level of voltage is too high

Alarms and description

The controller has an extended alarm system. When an alarm is active, the sign ALARM in the display blinks and an error code is shown on the screen. Possible error codes are shown in the table below.

Alarm				Description
U	ALARM			Measuring voltage is out of tolerance.
I LO	ALARM			Measuring current is less than 15 mA (please check CT signal and verify that CT shorting pin has been removed).
I HI	ALARM			Measuring current is too high.
PFC	ALARM			Target cannot be reached.
HAR	ALARM			THD U alarm (harmonic alarm).
STEP	ALARM	FLTY	ALARM	One or more steps are defective. The defective steps are blinking together with the ALARM sign.
SPL	ALARM	/11	ALARM	One or more steps have less than 70% of original size. Number of step and alarm text are blinking alternately.
THI	ALARM			Over temperature alarm. Threshold level 2 exceeded. The steps will be switched-off step by step.
OPH	ALARM			Maximum allowed operating hours are reached.
OPC	ALARM	/11	ALARM	Maximum allowed number of switch cycles of one or more steps is reached.
AI/ABRT				Abort of automatic initialization due to unsuitable load conditions.

Current and voltage monitoring

The controller is equipped with current and voltage monitoring to ensure it is within its operating parameters. The controller will show "I LO" alarm if there is no measured current or the magnitude sensed is less than 15 mA. If the current is greater than 6 A, the controller will show "I Hi alarm".

If either of these alarms are displayed, check the CT current path, verifying that the correct CT ratio is selected, the CT is in the correct position, and the current input and shorting jumpers at the terminal block are removed.

The allowed range of voltage depends on nominal voltage. When nominal voltage is out of range, "U Alarm" is shown. If this alarm is seen, then the setting of nominal voltage has to be adjusted. Nominal Voltage is measured and entered phase to phase.

Capacitor stage database

A step fault ("STEP / FLTY") or step low ("SPL") alarm indicates problems with the sensed capacitor size. To check the capacitor stages, switch the controller into the INFO mode by pressing the ▼ (down) key. In the INFO submenu, by pressing the ▲ (up) or ▼ (down) key, the steps can be chosen and once the steps are indicated in the display, pressing the ▶ (↵) (right/enter) key displays the information for the selected steps.

CC C INFO 50 kvar ①	▼	INFO 99.9% ①	▼	OC INFO 10.12 k ①	▼	i INFO AUTO ①
actual power of step		percentage actual to nominal power		number of operations		step type

It's possible to have capacitive steps as well as inductive steps. Ensure the steps show capacitive ("C") kvar).

High temperature alarm

1. Replace dust filters (Catalog Number AUTOVAR6FX8).
2. Verify proper operation of fans.
3. Verify that measured ambient temperature does not exceed 40 °C (104 °F).
4. Check for external sources of heat such as direct sunlight.

PFC alarm

Possible reasons could be:

1. Insufficient capacitance available or target PF set too high.
2. Capacitor stages deteriorated.
3. Capacitor stages sensed or set incorrectly (both in terms of type (inductive or capacitive) and value (100 kvar instead of 50 kvar).

PF value incorrect, decreases as steps are added or shows X.XX"c"

1. CT polarity is incorrect.
2. CT leads are swapped.
3. CT is not mounted on A phase.

Adjust the Phase-Offset menu parameter according to the following chart.

CT installed phase (with respect to incoming AutoVAR bus)	CT polarity	Controller phase-offset
A	Straight	90
A	Reverse	270
B	Straight	330
B	Reverse	150
C	Straight	210
C	Reverse	30

PF value shows unity or does not change even after steps are engaged

1. Location of CT is incorrect. Ensure that the CT is connected electrically ahead of the capacitor bank (at the service entrance panel or switchgear) and is not connected on the feeder that supplies power to the capacitor bank.
2. Steps have failed.

Incorrect measurement values

1. Check that CT and PT ratios are programmed correctly in Menu 100.
2. Check that Nominal voltage is programmed correctly in Menu 100.

Controller not switching on additional steps and does not reach target PF

This usually happens when the amount of capacitance available does not match the amount of kvar required. This can happen especially in low load situations when the amount of kvar required is very low compared to the smallest available step size (for example, total kvar required is 12 kvar and the smallest step size available is 60 kvar). The controller will not bring on any step to prevent overcompensation.

1. Check that the sensed and programmed capacitor step sizes are set and match the actual value.
2. Check that the setting in 314 is set to N.
3. Check the amount of shortfall kvar (▲Q) in the measurement menu and program this value in menu 312.
4. If all above fails, one may need to install smaller kvar size steps to allow the controller to switch them during low demand.

BLR-ACX controller technical data

Description	Specification
Measuring and supply voltage	90–550 Vac, single-phase, 45–65 Hz, 5 VA, max. fuse 6 A VT-ratio from 1.0 to 350.0
Current measuring	15 mA – 6 A, single-phase, burden 20 mohm, ct-ratio from 1 to 9600
Control exits	Up to 14 relays, n/o, with common point, max. fuse 6 A breaking capacity: 250 Vac / 5 A
Temperature measuring	By NTC
Alarm contact	Relay, volt free, life contact, max. fuse 6 A, breaking capacity: 250 Vac / 5 A
Interface	TTL, rear
Ambient temperature	Operation: –20 °C to 70 °C, storage: –40 °C to 85 °C
Humidity	0–95%, without moisture condensation
Voltage class	II, dirt class 3 (DIN VDE 0110, part 1 / IEC 60664-1)
Conformity and listing	
Connection	Pluggable terminal block, screw type max. 4 qmm
Case	Front: instrument case PC/ABS (UL94-V0), Rear: metal
Protection class	Front: IP50, (IP54 by using a gasket), Rear: IP20

Retrofit installations with BLR-ACX controller

Please retain and follow all instructions and safety precautions during and after installation.

1. Compare voltage and current ratings of BLR-ACX with data of mains and installation.
2. Mount the relay in the control panel with the two mounting clips.
3. Connect protection GROUND to PE connection of metal case.
4. BLR-ACX is to be connected according to the wiring diagram.
5. Ensure that the short-link for CT input signal is removed.
6. Typical wiring diagram of the controller is shown below. This may not match the existing installation. Please consult Eaton for retrofitting this into existing Eaton capacitor banks.

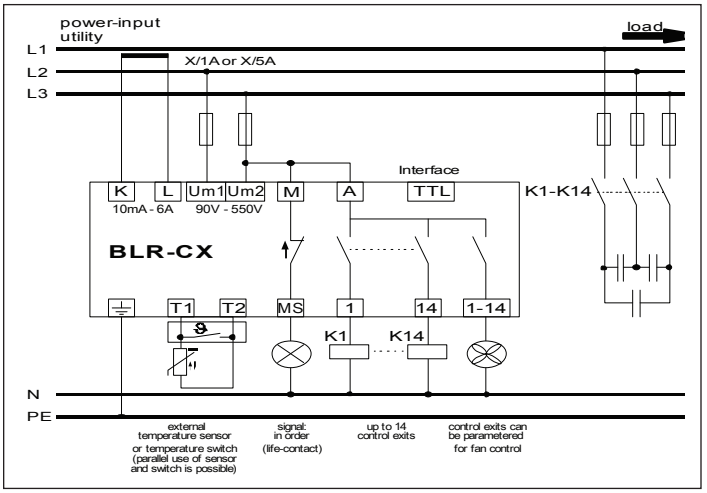


Figure 4. Wiring diagram

Troubleshooting

Symptom	Correction
No control power	Check primary control fuses (three fuses located in fuse holder) and secondary fuse located on control transformer.
	Check disconnect or circuit breaker is ON.
	Check GFCI located on control panel inside cabinet.
	Check the reactor thermal switches status (open if operated, closed if healthy).
Displayed power factor is obviously wrong or decreases as stages engage	CT secondary current is too low (check CT tap setting and plant load).
	CT polarity is incorrect or leads are reversed.
Stages do not engage and target power factor has not been reached	Confirm that an inductive power factor is being displayed (i.e., 'i.73', not 'c.73').
	Confirm that the required reactive power is at least 60% of the smallest step size available for switching.
	Confirm availability of capacitor stages and there is no stage alarm.
	Confirm "AUTO" is being displayed on the controller.
Blown fuse lights on front cabinet are lit (w/no blown fuses)	Check 3 primary control fuses (on control panel) if check system voltage matches the nameplate voltage.
Displayed power factor does not change as stages engage	Review 'Current transformer placement and connection'
Controller troubleshooting	Refer to "Controller setup procedure" section.

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