Instruction Manual **IM02607003E** Effective September 2013

AUTOVAR 300
Automatically Switched Capacitor Bank
Installation Operating Maintenance Manual

Contents

Powering Business Worldwide

⚠ WARNING

FAILURE TO INSTALL THE AUTOVAR IN ACCORDANCE WITH THESE INSTRUCTIONS MAY CAUSE DAMAGE TO THE EQUIPMENT AND/OR PERSONAL INJURY.

⚠ WARNING

INCOMING POWER SHOULD BE DISCONNECTED BEFORE MAKING ANY WIRING CONNECTIONS.

⚠ WARNING

AFTER ALL RIGGING, SETTING, AND WIRING HAS BEEN COMPLETED AND BEFORE THE POWER TO THE AUTOVAR IS ENERGIZED, THE INTERIOR OF THE UNIT SHOULD BE CLEARED OF ANY METAL EQUIPMENT, METAL SHAVINGS, TOOLS, AND OTHER DEBRIS.

⚠ WARNING

WHEN THE FRONT DOOR IS OPENED WITH THE MAIN DISCONNECTS CLOSED, THE POWER DISTRIBUTION BLOCKS, CAPACITOR FUSES, CAPACITOR CONTACTOR UPPER TERMINALS, AND CONTROL TRANSFORMER FUSES ARE ENERGIZED AT LINE VOLTAGE. ONLY QUALIFIED PERSONNEL SHOULD HAVE ACCESS TO THE CABINET INTERIOR.

⚠ WARNING

AFTER DE-ENERGIZING THE UNIT, WAIT ONE (1) MINUTE BEFORE OPENING THE FRONT DOOR.

Section 1: Installation Overview

The installation of the Autovar consists of the following steps:

1. Mount the cabinet(s) in place
2. Connecting the assembly to the electrical system
3. Installing the current transformer on the system (checking CT polarity) and terminating secondary in the unit
4. Setting the controller
5. Starting and ensuring proper operation

Current Transformer Installation Instructions

⚠ WARNING

FOLLOW ALL SAFETY PRECAUTIONS AND REGULATIONS FOR WORKING ON ELECTRICAL SYSTEMS RATED UP TO 600V. ALWAYS WEAR APPROPRIATE PERSONAL PROTECTIVE EQUIPMENT (PPE). FOLLOW ALL LOCK OUT TAG OUT PROCEDURES.

⚠ WARNING

FAILURE TO FOLLOW THESE INSTRUCTIONS CAN RESULT IN MALFUNCTION OF THE EQUIPMENT.

- A current transformer (CT) is required for operation of an automatically switched capacitor bank.
  If an order for the CT was placed on Eaton to supply a current transformer with the order, it is included within your unit.
  Unless specified otherwise, Eaton will supply our standard CT which is a multi ratio multi tap split core CT rated from 300A to 3000A with 5A secondary output and is rated for 600V insulation class.
  If supplied the low voltage CTs are 600V insulation class.
- The CT is to be installed on "A-phase" of the main service entrance and wired to the terminal block TB1, terminals 1 and 2 of the capacitor bank. See Figure 2.
- The CT should always be installed upstream of the loads and capacitor bank.
- CT shall not be installed on the feeder feeding the capacitor bank.
- CT polarity must be observed accurately for proper functioning of the capacitor bank. H1 should always face the source (utility) side. See figure A.
- CT rating determined by the mains service entrance rating. If exact rating is not available select the next higher appropriate rating.
- If only transformer rating is known use the following formula to calculate the maximum current.

$$\text{Current for CT rating} = \frac{\text{transformer kVA} \times 1000}{1.732 \times \text{line voltage}}$$

Terminal Connections for Appropriate CT Current Rating

CT Secondary Terminals	CT Amp Rating
X1-x5	3000
X1-x4	2500
X1-x3	2200
X2-x5	2000
X2-x4	1500
X2-x3	1200
X1-x2	1000
X3-x5	800
X4-x5	500
X3-x4	300

The CT secondary rating for all the taps is 5A. To calculate the CT ratio use the CT primary Amp rating and divide by 5 to get the CT ratio.

For example for x1-x5 the CT ratio is 600 (=3000/5)

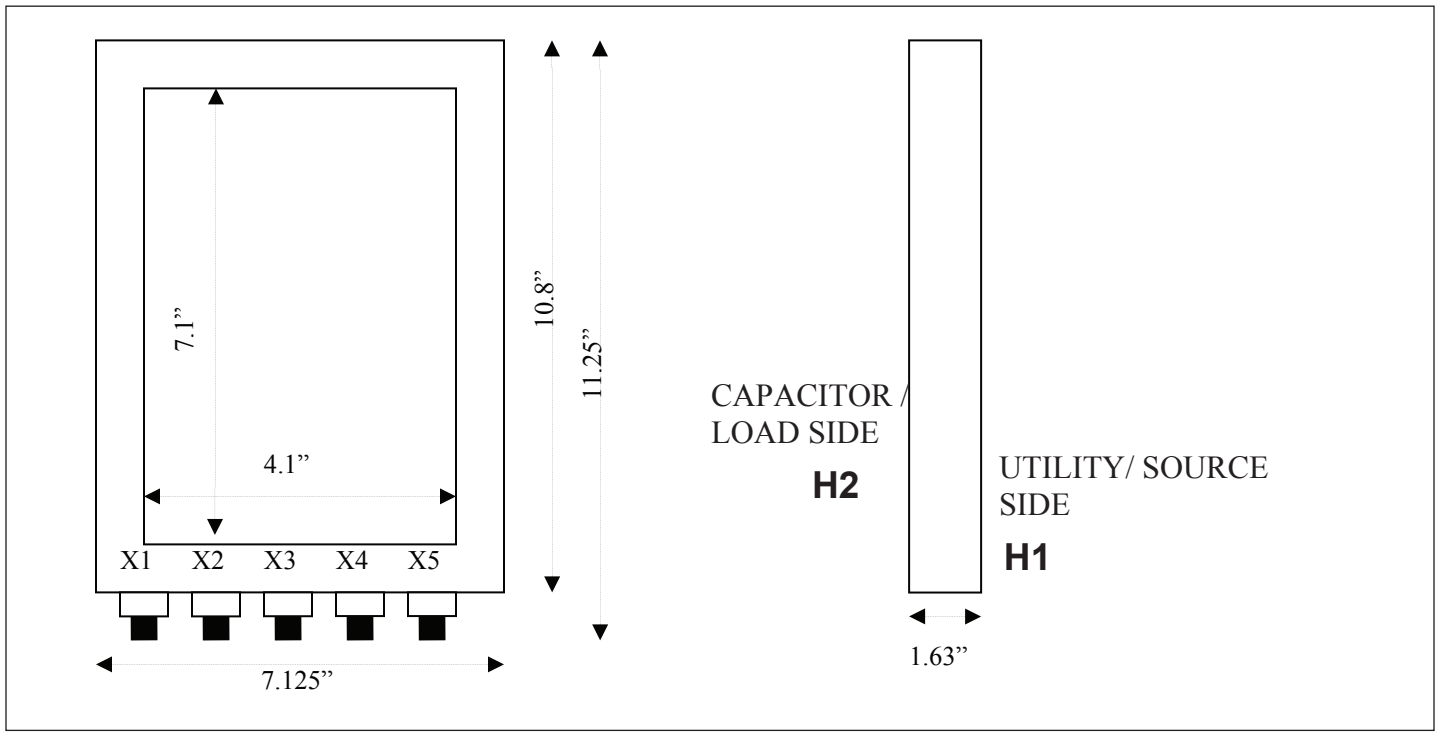

Figure A.

Section 2: Positioning

Position the unit so that:

1. Natural ventilation is not impeded.
2. Ambient temperature does not exceed 104°F (40°C).
3. Spacing complies with the National Electrical Code.

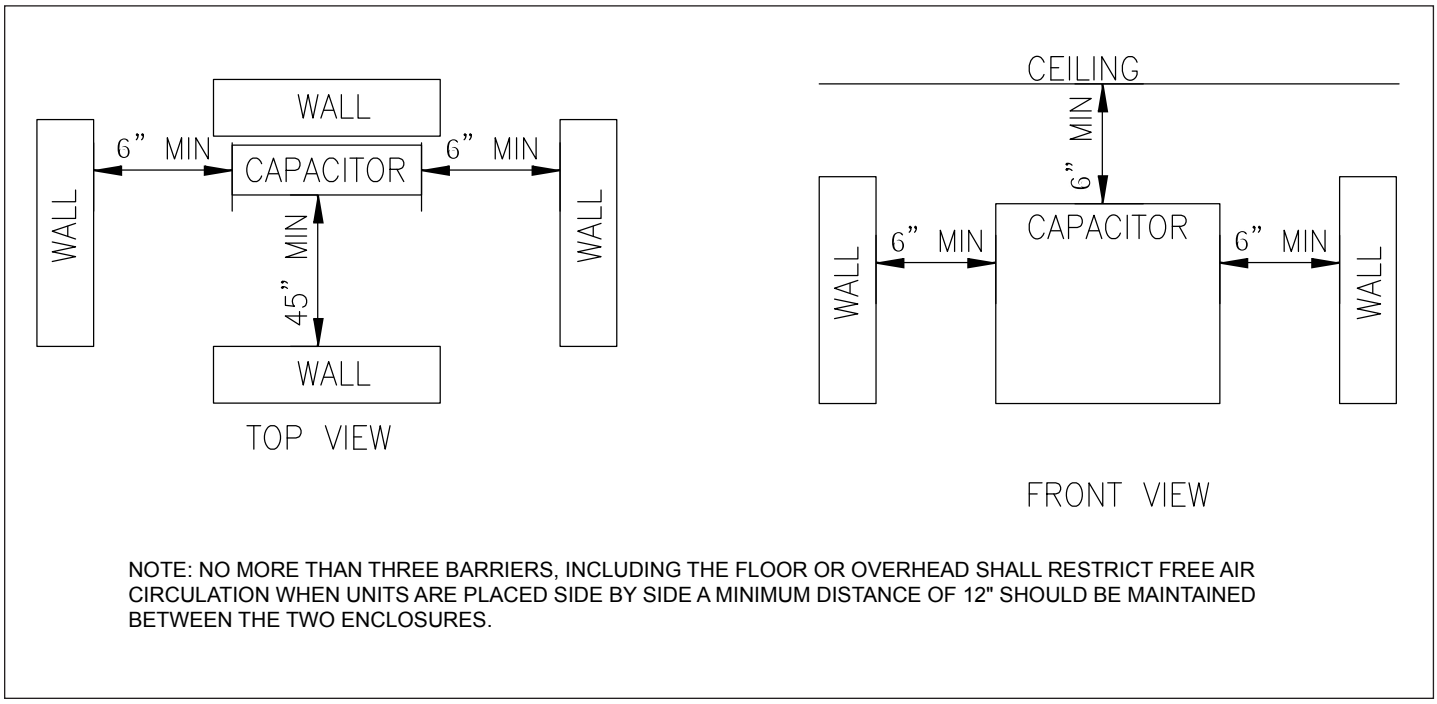

Figure 1 Position of the Unit.

Section 3: Electrical System Connections

When connecting the unit to the power system, the ground lug must be grounded and all applicable National Electrical Codes (NEC) must be followed.

The Autovar must be connected as shown in Figure 2. The lugs which accommodate the incoming conductors are located on the bus bars on the right side of the cabinet. If the unit is supplied with a disconnect, the incoming conductors are connected directly to the disconnect's line lugs. The lugs shall be torqued as indicated on these devices.

Fused Disconnects

Fused disconnects should be sized no less than 165% of the rated capacitor current.

Circuit Breaker

The circuit breaker should be sized no less than 135% of the rated capacitor current.

Note: Rated Capacitor Current = (1000 x kVAr) / (√3 x Voltage) (Amps)

Where: Voltage = line to line voltage

kVAr = 3 phase kVAr rating of capacitor (Nameplate rating)

Example: 500 kVAr capacitor, 480 V system:

Rated Capacitor Current =

(500 x 1000) / (√3 x 480) = 601 Amps

The breaker shall be rated to carry the 601 A x 135% or 811A continuously in its operating environment. In this case therefore a 1000A 100% rated breaker will be required as a minimum.

Conductor Ampacity

NEC Article 460 specifies that the ampacity of capacitor conductors to be rated at 135% of rated capacitor current. Our UL listed units require that only 90 deg C Copper conductors be used at their 75 deg C ampacity rating to supply the units. The ampacity should be derated as necessary for ambient temperature (see NEC).

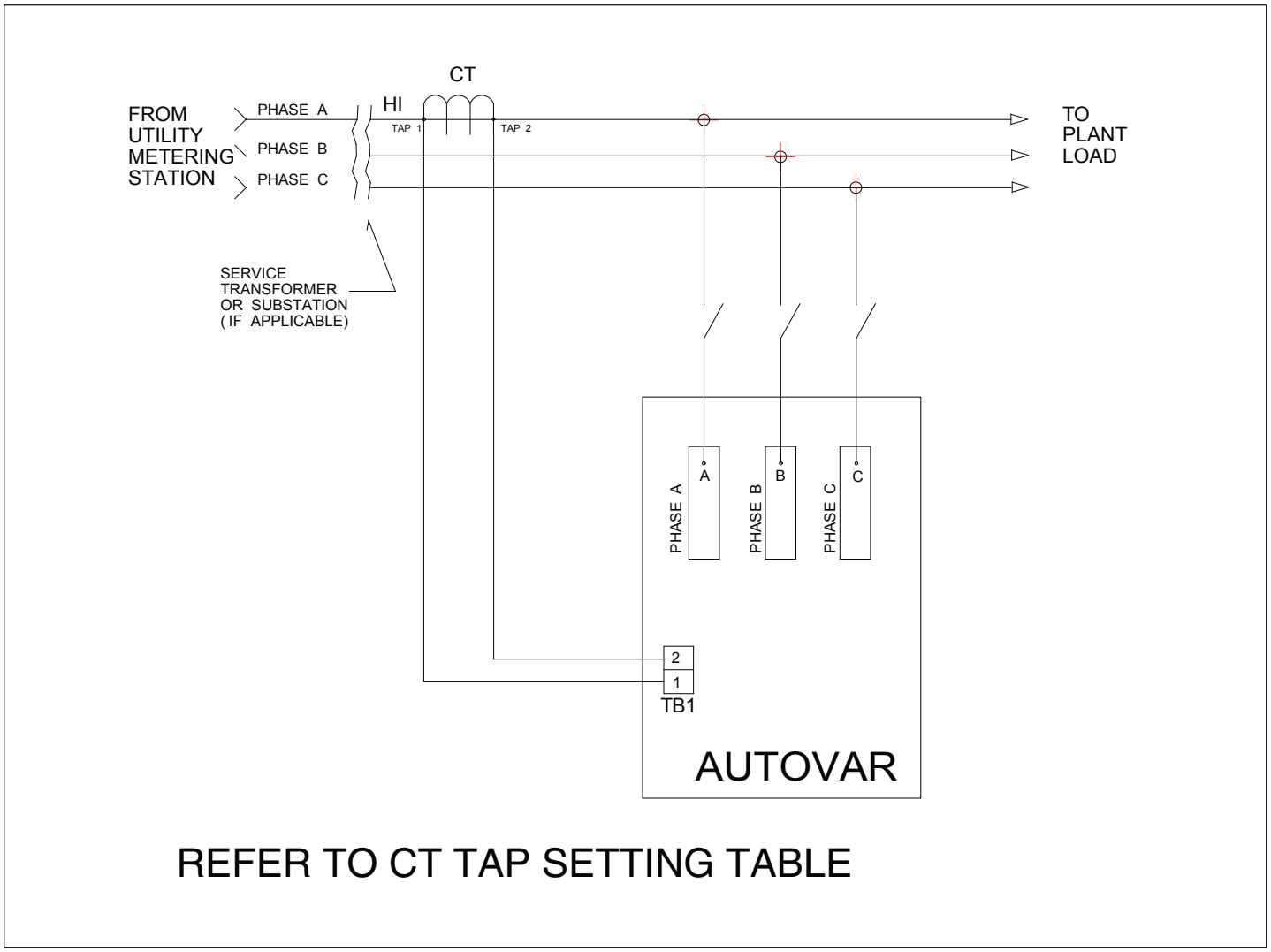

Figure 2. Connection Schematic

Section 4: Controller Set Up Procedure

Current Transformer Placement and Connection

⚠ WARNING

THE CT TERMINALS MUST ALWAYS BE SHORT CIRCUITED DURING INSTALLATION, REMOVAL, OR AT ANY OTHER TIME WHEN THE CT MAY BECOME OPEN CIRCUITED. THE CT IS SHORTED BY `JUMPERING' ANY TWO "X" TAPS OF THE CT TOGETHER. A CT SHORTING TERMINAL BLOCK (CAN BE PROVIDED AS OPTIONAL) MUST BE INSTALLED NEAR THE LOCATION OF THE CT.
A CT JUMPER MUST BE USED WITH ANY FUTURE ADJUSTMENTS TO THE CT OR ANY REMOVAL OF THE CT CONNECTIONS AT THE CONTROLLER

CT Tap Setting

The CT is the current sensor required by the controller and is installed around the Service Entrance. The CT tap settings (CT ratio) therefore are to be selected so that it can handle the maximum load current that it will see. The easiest way to size the CT is to size it to the same ampacity as the service entrance rating.

If the maximum load current (MLC) of the plant is not known but the transformer kVA rating is known then use the following formula:

Maximum load current = (kVA x 1000)/(√3 x V) (Amps)
= (kVA X 577)/(V) (Amps)

Where: kVA = kVA of service transformer
V = line to line voltage

Example: 480v, 1000kVA entrance XFMR
MLC = (1000 X 577)/480 = 1200A

Once the maximum load current is known, the CT tap setting is determined by comparing the actual MLC to the values in the third column of the table following. The taps corresponding to the closest higher value should be used

Table 1. CT Tap Setting Table

3000:5 MULTI RATIO CT (039010-0006V)			
Tap1	**Tap2**	**MLC Amps: 5 Amps (CT Ratio)**	
X1	X5	3000	:5
X1	X4	2500	:5
X1	X3	2200	:5
X2	X5	2000	:5
X2	X4	1500	:5
X2	X3	1200	:5
X1	X2	1000	:5
X3	X5	800	:5
X4	X5	500	:5
X3	X4	300	:5

CT Placement

The placement of the CT is critical to the proper operation of the Autovar. **Improper location and phasing of the current transformer (CT) causes more start up problems than any other error.**

As shown in Figure 2, the CT must be placed upstream of the Autovar power connections preferably on phase A of the main incoming bus. In other words, place the CT so that it 'sees' the *entire* plant load, including the Autovar and any other capacitors. The high side of the CT (marked "H1") must face the utility source.

After the CT has been placed on the main incoming bus, the interconnects from the CT secondary should be terminated on the terminal strip (TB) pins #1 and #2 (located on the inside left panel of the capacitor cabinet). The CT shorting strap may then be removed.

CT Cabling and Connections

CT wires should be minimum #12AWG up to 100' of wire length and #10 AWG up to 150'. CT wires will be routed separately than the power conductors and if not routed in a metal conduit will be of shielded type cable. The length and gauge of wire is applicable for up to ANSI C57 B-0.5 burden. CT lead resistance will be kept to a minimum and calculated at expected overload capacity of up to 120%.

If CT signal is shared with other equipment ensure that the VA burden does not exceed the CT accuracy requirement and CT leads first land on the PFC controller.

If the CT ratio does not accurately match the expected full load current please contact the factory.

The Autovar electrical connections are now complete.

Section 5: Startup And Commissioning

On/Off Switch

Ensure the "on/off" switch located on the door is in the "off" position. The upstream or (optional integral) disconnect or circuit breaker can now be closed to energize the unit. Once energized turn the ON/OFF switch to the ON position and the unit is ready to begin operation as indicated by the illuminated light within the ON/OFF switch.

Blown Fuse Indicator Lights

The indication lights on the door are blown fuse indicator lights. These lights come on when a power fuse inside the unit clears.

Manual Operation

Refer to the controller operation section (Section 6) for energizing the capacitor bank in manual mode

You are now ready to set the controller.

Section 6: Controller

Instructions henceforth are only applicable for the factory standard (default) controller. For Option C controller please refer to the separately included controller user's guide and follow the startup and testing procedures indicated therein.

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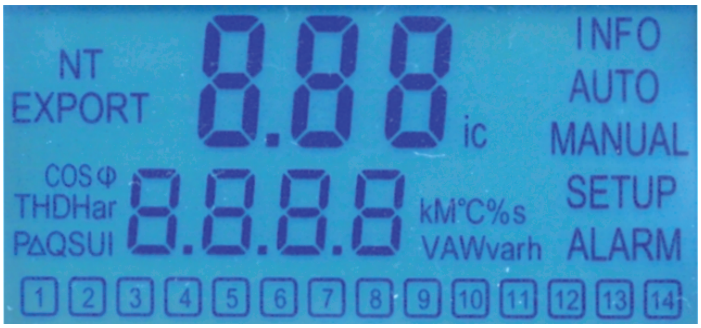
EATON BLR-ACX
Quick Commissioning Guide

Contents

Powering Business Worldwide

Screen Legends:



INFO	Capacitor database
AUTO	Automatic mode
MANUAL	Manual mode
SETUP	Setup mode
ALARM	Blinking during alarm
NT	2nd target-pf is active
EXPORT	Export of active energy
1-14	Capacitor stage number indication

Figure 3. Digital Display

Operation

Operation of BLR-ACX is done by 4 keys.

Figure 4. Operational Keys

Sub Menus 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 silences 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 setup 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 the 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 below are hidden and will only appear if the CT ratio is set in the menu.

1.00 i	▶	1.00 i U 480 V	Voltage L - L	1.00 i Cos φ 0.999	Displacement Pf Cos φ
▼		▼		▼	
1.00 i INFO		1.00 i U 277 V	Voltage L - N	PF 0.888	True Pf kW/kVA
▼		▼		▼	
1.00 i MANUAL		1.00 i I 40.45 A	current (CT phase)	APF 1.000	Average Power factor
▼		▼		▼	
1.00 i SETUP		1.00 i P 30.37 kW	Active power (kW) 3 phase	F 60	Frequency
		▼		▼	
		1.00 i Q 82.89Var	Reactive power (kVAr) 3 phase	t 58 °C	Temperature (only with RTD input)
		▼		▼	
		1.00 i ▲Q 80.08 Var	kVAr lacking to reach target PF	thi 88 °C	Highest Temperature (only if RTD input)
		▼		▼	
		1.00 i S 30.68 kVar	Apparent power (kVA) 3 phase	OPH 188.9 h	Counter operation hours
		▼			
		1.00 i THD U 1.41 %	Total Voltage distortion		
		▼			
		3 Har U 0.40 %	Harmonic Order % distortion		
		▼			

Press the ◄ (left / esc) key to return to the main screen that displays the existing PF.

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 trouble-shooting section.

T**o 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.**

1.00 i					
▼					
1.00 i INFO		Choose step with ▼▲ Switch on / off with ►		At each switching of a stage the new PF value is shown	
▼				1.00 i MANUAL 1	
1.00 i MANUAL	►	0,95 i MANUAL 1	►	1	
▼		▼		1.00 i MANUAL 2	
1.00 i SETUP		0,95 i MANUAL 2	►	2	

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 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".

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 3.

MENU	FUNCTION	DEFAULT	CUSTOMER SETTINGS
100	**QUICK START SETUP**		
Un	Nominal voltage (phase-phase)	240V / 480V / 600V	
Ct	CT-ratio	600	
Pt	VT-ratio	1.7/3.7/4.7	
Ai	Start automatic initializing	N	
PFC	Start/Stop/Hold PF-control	On	
CP1	Target-PF 1	I 0.95	
St	Switching time delay	60s	
Out	Type of each step (1,2...14)	Auto/Fon/Foff/AL	
200	**SETUP MEASURING SYSTEM**		
201	Nominal voltage (phase-phase)	240V / 480V / 600V	
202	CT-ratio	600	
203	VT-ratio	1.7/3.7/4.7	
204	Tolerance nominal voltage	20%	
205	Voltage measuring Ph-N	Y	
206	Phase-offset	90	
207	Start automatic initializing	N	
208	Activate Ai by every start of BLR-ACX-V	N	
209	Synchronisation to frequency	Auto	
210	Temperature offset	0°C	
300	**SETUP CONTROL SYSTEM**		
301	Switching threshold	55%	
302	Target-PF 1	I 0.95	
303	Target-PF 2	I 0.95	
304	Target-PF 2 at KW-export	N	
305	Switching time delay	60s	
306	Switching time delay for fine control	10s	
307	Fine control active	Y	
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	60s	
402	Capacitor size: step 1...max. 14	Varies	
403	Type of exit: step 1...max. 14	Auto	
404	Switching operations: step 1...max. 14	0	
500	**SETUP ALARM SYSTEM**		
501	Alarm storage	N	
502	THD alarm	Y	
503	Threshold THD	6%	
504	Disconnect capacitors when THD >	N	
505	Delay time THD Alarm / Temp. threshold 2	120 sec	
506	Freeze exits when I = 0	N	
507	Service alarm	N	
508	Max. operations per step	262k	
509	Max. operation hours of BLR-ACX-V	65,5k	
510	Use temp. sensor as digital input	N	
511	digital input active at high signal	N	
512	Temperature alarm active	N	
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 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	1.08		

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 s less then 15mA,
- voltage is out of range or
- 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:

U ALARM	Measuring voltage is out of tolerance
I Lo ALARM	Measuring current is less 15mA (please check CT signal)
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 /1 1 ALARM	One or more steps have less than 70% of original size. Number of step and alarm text are blinking alternately.
tHo ALARM	Over temperature alarm. The steps will be switched-off step by step.
OPH ALARM	Max. allowed operating hours are reached.
OPC ALARM /1 1 ALARM	Max. allowed number of switch cycles of one or more steps is reached.
A, Abort	Abort of automatic initialization due to not suitable load conditions

Current and Voltage Monitoring

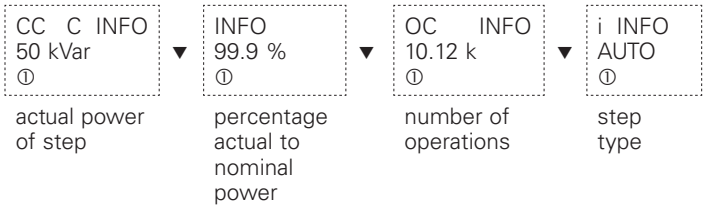
The controller is equipped with current and voltage monitoring to ensure it is within its operating parameters. The controller will show "I LO" alarm if there is no measured current or the magnitude sensed is less than 15mA. If the current is > 6A the controller will show "I Hi alarm".

If either of these alarms are displayed, check the CT current path, verifying that the correct CT ratio is selected, that the CT is in the correct position, that 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 sub menu 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 is shown.



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

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 50kVAr).

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.

For 1 and 2: Short the two terminals 1 and 2 on TB1 on the side where CT field wiring is terminated and interchange the two wires on the factory wiring side. DO NOT OPEN CIRCUIT THE CT CIRCUIT.

For 3: enter the advanced menu (PIN 242) and change the setting in 206 to 330 (if CT is on B phase) or 210 (if CT is on C phase).

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 CT and PT ratios are programmed correctly in Menu 100.
2. Check 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 60kVAr!). The controller will not bring on any step to prevent overcompensation.

1. Check the sensed and programmed capacitor step sizes are set and match the actual value.
2. Check the setting in 314 is set to N
3. Check the amount of shortfall kVAr ( ) 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.

Technical Data

Measuring- and supply voltage:	90 – 550V AC, single phase, 45-65HZ, 5VA, max. fuse 6A VT-ratio from 1,0 – 350,0
Current measuring:	15mA – 6A, single phase, burden 20mOhm, ct-ratio from 1-9600
Control Exits:	Up to 14 relays, n/o, with common point, max. fuse 6A breaking capacity: 250V AC / 5A
Temperature measuring:	By NTC
Alarm contact:	Relay, volt free, life contact, max. fuse 6A, breaking capacity: 250V AC / 5A
Fan control:	By using one switching exit defined as “Alarm”
Interface:	TTL, rear
Ambient temperature:	Operation: -20°C – 70°C, storage: -40°C – 85°C
Humidity:	0% - 95%, without moisture condensation
Voltage class:	II, dirt class 3 (DIN VDE 0110, part 1 / IEC60664-1)
Conformity and listing:	CE, c UL us, GL
Connection	Pluggable terminal block, screw type max. 4qmm
Case:	Front: instrument case PC/ABS (UL94-V0), Rear: metal
Protection class:	Front: IP50, (IP54 by using a gasket), Rear: IP20

Retrofit Installations

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 2 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.

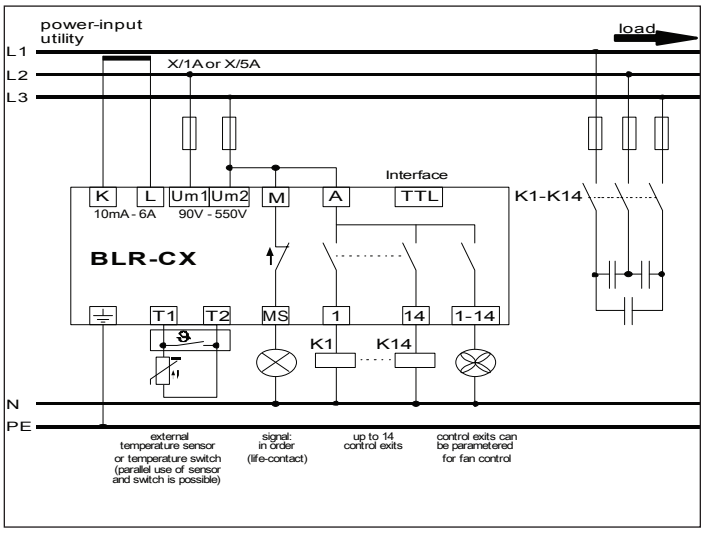


Figure 5. Wiring Diagram

Section 7: 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 pf 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 name plate voltage.
Displayed power factor does not change as stages engage.	- Review 'Current Transformer Placement and Connection'.
Controller Troubleshooting	- Refer to Section 6.

Fuse (Clearing)

Capacitor fuses may clear for many reasons. An occasional cleared fuse may be the result of a switching 'spike', lightning strike, or other electrical disturbance. However, frequent fuse clearing may be a sign of a more serious problem. Please contact your Eaton representative or Eaton's Technical Resources Center at 1-800-809-2772 Opt 4, Sub-Opt 2 for assistance if frequent fuse clearing occurs.

Temperature Control

The controller is fitted factory default with an ambient temperature alarm and trip option. The controller is also fitted with a non reversing temperature sticker that helps monitor the highest reached temperature inside the cabinet.

The alarm and trip options are field adjustable and are set at the values shown in the controller set point table- Table 1.

When the cabinet temperature exceeds the trip set point the controller will stage wise shutdown all the stages until the cabinet temperature falls below the trip set point, at point which the controller will resume the control of the stages.

If the PFC unit appears not to bring on any stages or is otherwise inoperable check the temperature indicator on the back of the controller and verify that the temperature is within the specified limits of the unit.

Section 8: Options

Remote Alarm Relay (Option Code A)

Remote alarm relay provides a single Normally Open volt free 250V / 5A contact wired to a terminal block for customers use.

Communications Controller (Option code C)

Selecting option code C provides the user with our advanced controller that is equipped with modbus over RS485 communications capability and additional advanced features.

HOA Switches (Option code H)

The HOA switches provide external control of the capacitor stages. The following switch positions are available.

- Hand - turns stage on.
- Off - turns stage off.
- Auto - controller activated stages.

Circuit Breaker (Option code M)

The trip settings on the circuit breakers shall be set in accordance with the National Electric Code and coordination requirements within the facility.

IQ Meter (Option code Q)

The IQ 250 provides an electronic panel meter to those who wish to monitor various electrical parameters of the capacitor bank. IQ meter cannot display the system parameters and thus should not be used for displaying the system parameters such as power factor, power, voltage, current etc. For operation of the IQ meter please refer to the IQ manual.

Custom Options (Option Code S)

Non standard options including remote shut down command, external interlock etc.

Weatherproof Option Code W

Allows the enclosure ingress protection rating to be NEMA 3R.

Section 9: Maintenance

The Autovar requires very little maintenance to operate reliably. However, please follow the Start-up and Maintenance Schedule included.

De-energize unit before opening cabinet doors to access dust filter.

NOTICE

IF ANY LARGE NONLINEAR LOADS (ADJUSTABLE SPEED DRIVES, VFDS, DC DRIVES, BATTERY CHARGERS, ETC.) ARE INSTALLED IN THE PLANT AFTER INSTALLATION, PLEASE CONTACT YOUR EATON SALES REPRESENTATIVE TO ENSURE THAT THE CAPACITOR WILL NOT BE ADVERSELY AFFECTED.

Dust Filters– Strata density Panel Air 600 UL class 2 - 1" x 28" x 8"

The dust filter is located inside the door at the bottom.

Dust filters should be replaced at least quarterly as suggested in our preventive maintenance guidelines and more often should the unit be located in a polluted environment.

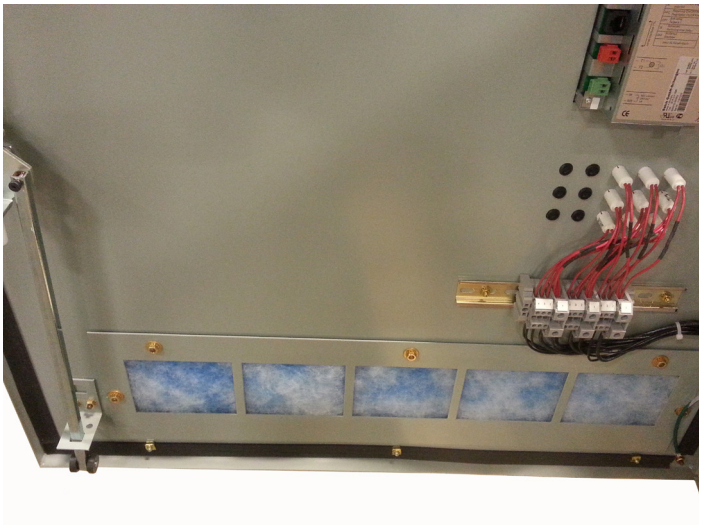


Figure 6. Dust Filter Location.

Table 2. LOW VOLTAGE CAPACITOR BANK START-UP INSPECTION AND MAINTENANCE SCHEDULE

CUSTOMER:	
UNIT SERIAL NUMBER:	

Qtr: Every 3 months Semi: Every 6 months Ann: Every 12 months	C	Clean	P	Touch-up Paint
	F	Check for Open/Damage Fuse	R	Replace parts or component
	I	Inspection of Component/Equipment	S	Apply Silicone Caulk (Outdoor Unit)
	L	Lubricate	T	Test component
	O	Torque Connections	V	Verify Operation

	Routine							**Service Schedule Years From Installation Date**															
Component	**Start-up**		**Quarterly**		**Semi-Annually**		**Annually**		**2.5**		**5**		**7.5**		**10**		**12.5**		**15**		**17.5**		**20**	
Date of Service:																								
Service Performed By:																								
Air Filters		I		R																				
Alarm Indication		V						V																
Bus Connections		O								O		O		O		O		O		O		O		O
Bushings		I						I, C																
Cable Terminations		O						I		O		O		O		O		O		O		O		O
Capacitor		I						I				T				T				T				T, R
Control & Timing Relays		V										T				T				T				T, R
Controller		V						V				T				T				T				T, R
Corrosion / Condensation		I						I, P																
CT Circuit		V						V								T								
Enclosure		I, S, P						I, P								S								S
Fans		V				I		I, V								T								R
Fuses		T						F																R
Insect Screens		I, C								C		C		C		C		C		C		C		C
Insulators and Supports		I, C						I, C																
Power & Control Cables		I						I								T								T
Reactor		I						I, C								T								T
Contactors		V						V								T								T, R
Test CT Polarity (optional)		T																						

Table 2. LOW VOLTAGE CAPACITOR BANK START-UP INSPECTION AND MAINTENANCE SCHEDULE

Section 10: Drawings, Major Components and Spare Parts List

Instruction Manual IM02607003

Effective September 2013

AUTOVAR 300
Automatically Switched Capacitor Bank
Installation Operating Maintenance Manual

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Eaton
Electrical Sector
1000 Eaton Boulevard
Cleveland, OH 44122
United States
877-ETN-CARE (877-386-2273)
Eaton.com

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