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 main power bus bars, 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.

TABLE OF CONTENTS

SECTION 1 - Installation Overview

The installation of the Autovar consists of the following steps:

1) Setting the cabinet(s) in place

2) Connecting the assembly to the electrical system

3) Installing the current transformer on the system and terminating secondary in the unit

4) Setting the controller

5) Starting and ensuring proper operation

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

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 3.1. 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) / ($\sqrt{3}$ 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 =

(1000 x 500) / ($\sqrt{3}$ x 480) = 601 Amps

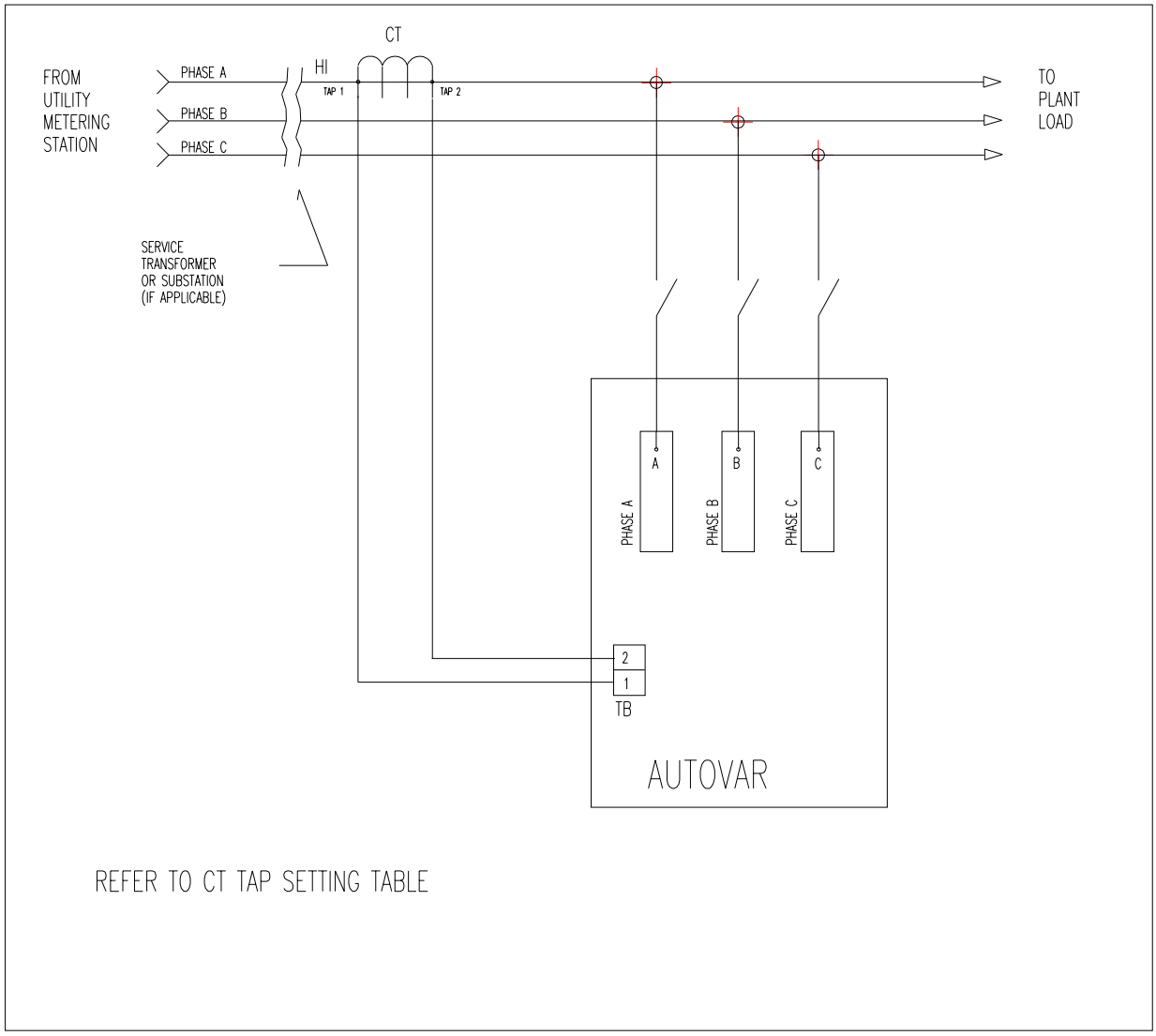


Fig. 3.1 Connection Schematic

SECTION 3 - Electrical System Connections (cont.)

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 `jumping' any two "X" taps of the CT together.

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 tap setting (CT ratio) shall be selected so that it can handle the maximum load current that it will see.

If the maximum load current (MLC) of the plant is not known, use the following formula:

Maximum load current = (KVA x 1000)/(√3 x V) (Amps)

= (577 x KVA)/(V) (Amps)

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

Example: 480v, 1000KVA entrance XFMR
MLC = (577 x 1000)/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.

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 Tap Setting Table

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 3.1, the CT must be placed on phase A of the main incoming bus on the line side of the connection to the unit. 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.

The Autovar electrical connections are now complete.

The "on/off" switch located on the door should now be placed in the "off" position, and the disconnect or circuit breaker can be closed to energize the unit's busbars.

Blown Fuse Indicator Lights

The three lights on the door are blown fuse indicator lights. These lights come on when a power fuse inside the unit clears. If the door of the unit is opened (with unit still energized), the blown fuse can be identified by the red light(s) that are illuminated (a light is located next to each fuse).

SECTION 4 - Controller Set Up Procedure

The following items have been factory set:

1) target power factor (set at .95)
2) time dial setting
3) step limiting program (if required)

The following items must be set by the customer:

1) target power factor (if different than .95)

Setting COS φ (Power Factor Setting)

The COS φ adjustment can be set in the range of 0.70 lagging to 0.90 leading.

1) Select position 1 on the function switch (located behind controller nameplate)
2) Select target pf on the digital display using the +/- buttons
3) Return function switch to position 3

Time Delay Dial

The time delay dial setting corresponds to the minimum time which must elapse after a stage has been de-activated before it may be re-activated. The time delay is factory set to prevent a stage from re-energizing unit it has been de-energized for 60 seconds. If a stage has been off for greater than 30 seconds, it will energize after a 3 second delay.

SECTION 5 - Start Up and Commissioning

NOTE: A common problem during start up results from an insufficient amount of load current being drawn to activate the controller. The controller requires at least a 1 Ampere input from the CT in order to operate reliably. The load current drawn by the plant must therefore be such that the controller will see at least 1 Ampere.

For example:

For a CT ratio of 1000:5 (a ratio of **200:**1),

the load current must be at least **200** Amps to produce **1** Amp of input current to the controller

Turn the ON-OFF switch to 'ON'

When turned on, the controller will display the power factor of the plant. It should display an inductive power factor between 0.60 and 1.00 in most cases. An 'i' or 'c' will be displayed to the left of the power factor value, indicating inductive (lagging) or capacitive (leading) power factor, respectively.

It is recommended that all contactors for each capacitor stage be checked for proper operation.

Manual stepping in stages

1) Select position 4 on the function switch (loaded behind the controller nameplate)
2) Depress + button ONCE
3) After a time delay, the stages engage, accompanied by the LED lights on the front of the controller
4) Repeat steps 2 and 3 for each stage until all stages are on
5) As the stages engage, the power factor should increase, and contact sounds should be audible
6) After all stages have engaged, proceed to disengage them by depressing the – button once for each stage
7) After all stages have been de-energized, place the function switch to position 3. The staged should engage to achieve the target power factor.

The unit can now be left to operate automatically

Note: If it is desired to disconnect or turn the unit off, all stages should be disengaged using manual mode. This will decrease the severity of the switching transient within the factory and decrease the likelihood of blown control fuses within the unit.

Fault Signaling Device

The letter ‘AL’ will appear on the digital display if the target power factor cannot be reached. This usually results when all of the automatic stages are activated but are not sufficient to achieve the target power factor. This will alarm after a time delay of 75 times step switching time. Dip-switch 2 must be in the up (on) position for this device to operate.

+/- LEDs

The + and – indications below the digital display indicate the status of the controller as follows:

'+' LED	-	Next stage will be engaged following time delay
'-' LED	-	Stage will be disengaged following time delay

SECTION 6 - 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 - Check GFCI located on control panel inside cabinet
Displayed power factor is obviously wrong or decreases as stages engage	- CT secondary current is too low (check CT tap setting and plant load) - See 'phase rotation' on following page
Stages do not engage and target pf has not been reached	- Check C/k setting - Confirm that an inductive power factor is being displayed (i.e. 'i.73', not 'c.73'). If not, see 'phase rotation'
Blown fuse lights on front of cabinet are lit (w/no blown fuses)	- Check 3 primary control fuses (on control panel)
Displayed power factor does not change as stages engage	- Review 'Current Transformer Placement and Connection'

Fuse blowing

Capacitor fuses may blow for many reasons. An occasional blown fuse may be the result of a switching 'spike', lightning strike, or other electrical disturbance. However, frequent fuse blowing may be a sign of a more serious problem. Please contact your representative for assistance if frequent fuse blowing occurs.

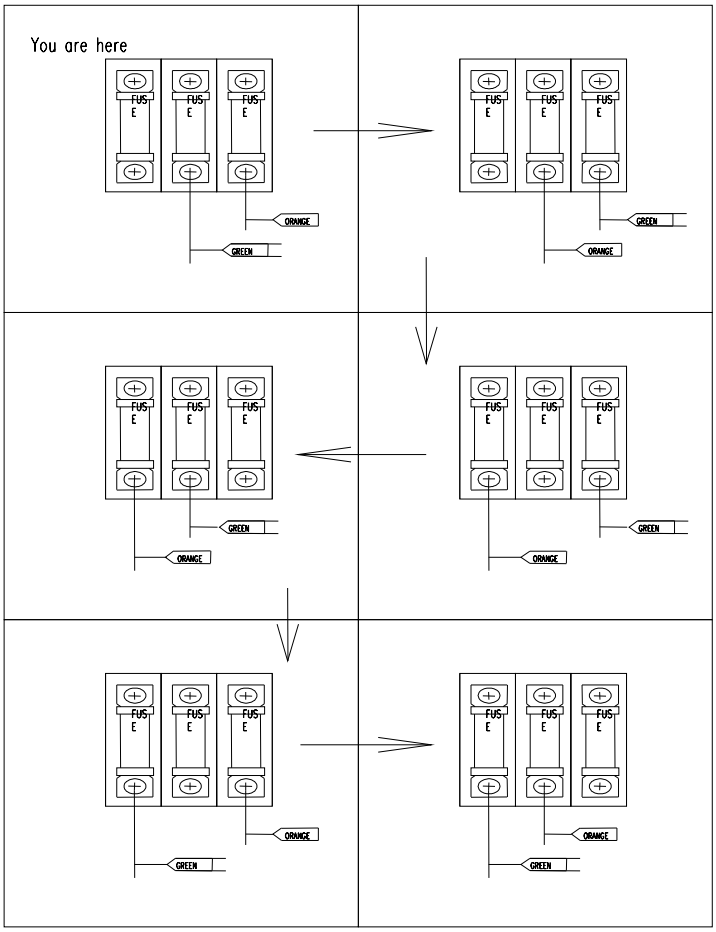
Phase Rotation Procedure

If the CT and control power connections are made improperly, the controller will not function properly. This can be corrected by manipulating the two tagged, black wires connected to the small fuse block in the reactor cabinet.

The diagram below illustrates the six possible phase relationships -- only one of these is the correct one. The upper left configuration shows the tagged wires in their original position (as shipped). To correct a phase rotation problem, reconnect the two wires to the fuses as shown in the next configuration as indicated by the arrows. After the phases are rewired, close the cabinet door and turn on the controller. If the problem persists, repeat the procedure using **the next** of the **remaining** phase combinations (as illustrated below) until the problem is corrected.

!!!!!!!! Open Disconnecting Means Before Manipulating Control Wires !!!!!!!

Phase Rotation Chart



SECTION 7 - Specifications

SECTION 8 - Options

HOA Switches

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

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

SECTION 9 - Maintenance

The Autovar requires very little maintenance to operate reliably. However, the following items will help ensure that the maximum benefits are derived from the unit.

- Check regularly for blown fuses (once/week) and replace blown fuses immediately with identical or equivalent parts. If fuse blowing persists, see 'Troubleshooting Guide'.

- Check regularly for proper operation of cooling fans. There are two cooling fans per unit, located behind the louvers at the top front of the units.

- Clean the dust filters located in the bottom of the cabinets four times a year so that airflow is not impeded. If the unit is located in a dirty or dusty environment, clean the filters at least once a month.

De-energize unit before opening cabinet doors to access dust filters

!! Notice !!

If any large nonlinear loads (adjustable speed drives, VFDs, DC drives, battery chargers, etc.) are installed in the plant after installation of the filter, contact your CSCI sales representative to ensure that the capacitor will not be adversely affected.

SECTION 10 - Drawings