

**Commissioning Instructions
Novar 315 Capacitor Controller for
Power Factor Correction**

ALSTOM

Commissioning Instructions

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HANDLING OF ELECTRONIC EQUIPMENT

A person's normal movements can easily generate electrostatic potentials of several thousand volts. Discharge of these voltages into semiconductor devices when handling electronic circuits can cause serious damage, which often may not be immediately apparent but the reliability of the circuit will have been reduced.

The electronic circuits of ALSTOM T&D Protection & Control Ltd products are immune to the relevant levels of electrostatic discharge when housed in their cases. Do not expose them to the risk of damage by withdrawing modules unnecessarily.

Each module incorporates the highest practicable protection for its semiconductor devices. However, if it becomes necessary to withdraw a module, the following precautions should be taken to preserve the high reliability and long life for which the equipment has been designed and manufactured.

1. Before removing a module, ensure that you are at the same electrostatic potential as the equipment by touching the case.
2. Handle the module by its front-plate, frame, or edges of the printed circuit board. Avoid touching the electronic components, printed circuit track or connectors.
3. Do not pass the module to any person without first ensuring that you are both at the same electrostatic potential. Shaking hands achieves equipotential.
4. Place the module on an antistatic surface, or on a conducting surface which is at the same potential as yourself.
5. Store or transport the module in a conductive bag.

More information on safe working procedures for oil electronic equipment can be found in BS5783 and IEC 60147-0F.

If you are making measurements on the internal electronic circuitry of an equipment in service, it is preferable that you are earthed to the case with a conductive wrist strap. Wrist straps should have a resistance to ground between 500k - 10M ohms. If a wrist strap is not available, you should maintain regular contact with the case to prevent the build up of static. Instrumentation which may be used for making measurements should be earthed to the case whenever possible.

ALSTOM T&D Protection & Control Ltd strongly recommends that detailed investigations on the electronic circuitry, or modification work, should be carried out in a Special Handling Area such as described in BS5783 or IEC 60147-0F.

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SAFETY SECTION

This Safety Section should be read before commencing any work on the equipment.

Health and safety

The information in the Safety Section of the product documentation is intended to ensure that products are properly installed and handled in order to maintain them in a safe condition. It is assumed that everyone who will be associated with the equipment will be familiar with the contents of the Safety Section.

Explanation of symbols and labels

The meaning of symbols and labels which may be used on the equipment or in the product documentation, is given below.



Caution: refer to product documentation



Caution: risk of electric shock



Protective/safety *earth terminal




Functional *earth terminal.

Note: this symbol may also be used for a protective/safety earth terminal if that terminal is part of a terminal block or sub-assembly eg. power supply.

*Note: The term earth used throughout this manual is the direct equivalent of the North American term ground.

Installing, Commissioning and Servicing

Equipment connections



Personnel undertaking installation, commissioning or servicing work on this equipment should be aware of the correct working procedures to ensure safety. The product documentation should be consulted before installing, commissioning or servicing the equipment.

Terminals exposed during installation, commissioning and maintenance may present a hazardous voltage unless the equipment is electrically isolated.

If there is unlocked access to the rear of the equipment, care should be taken by all personnel to avoid electric shock or energy hazards.

Voltage and current connections should be made using insulated crimp terminations to ensure that terminal block insulation requirements are maintained for safety. To ensure that wires are correctly terminated, the correct crimp terminal and tool for the wire size should be used.

Before energising the equipment it must be earthed using the protective earth terminal, or the appropriate termination of the supply plug in the case of plug connected equipment. Omitting or disconnecting the equipment earth may cause a safety hazard.

The recommended minimum earth wire size is 2.5 mm², unless otherwise stated in the technical data section of the Service Manual.

Before energising the equipment, the following should be checked:

Voltage rating and polarity;

CT circuit rating and integrity of connections;

Protective fuse rating;

Integrity of earth connection (where applicable)

Equipment operating conditions

The equipment should be operated within the specified electrical and environmental limits.



Current transformer circuits

Do not open the secondary circuit of a live CT since the high voltage produced may be lethal to personnel and could damage insulation.



External resistors

Where external resistors are fitted to relays, these may present a risk of electric shock or burns, if touched.



Battery replacement

Where internal batteries are fitted they should be replaced with the recommended type and be installed with the correct polarity, to avoid possible damage to the equipment.



Insulation and dielectric strength testing

Insulation testing may leave capacitors charged up to a hazardous voltage. At the end of each part of the test, the voltage should be gradually reduced to zero, to discharge capacitors, before the test leads are disconnected.



Insertion of modules and pcb cards

These must not be inserted into or withdrawn from equipment whilst it is energised, since this may result in damage.




Fibre optic communication


Where fibre optic communication devices are fitted, these should not be viewed directly. Optical power meters should be used to determine the operation or signal level of the device.

Older products


Electrical adjustments

 Equipments which require direct physical adjustments to their operating mechanism to change current or voltage settings, should have the electrical power removed before making the change, to avoid any risk of electric shock.


Mechanical adjustments

 The electrical power to the relay contacts should be removed before checking any mechanical settings, to avoid any risk of electric shock.


Draw out case relays

 Removal of the cover on equipment incorporating electromechanical operating elements, may expose hazardous live parts such as relay contacts.


Insertion and withdrawal of extender cards

 When using an extender card, this should not be inserted or withdrawn from the equipment whilst it is energised. This is to avoid possible shock or damage hazards. Hazardous live voltages may be accessible on the extender card.

Insertion and withdrawal of heavy current test plugs

 When using a heavy current test plug, CT shorting links must be in place before insertion or removal, to avoid potentially lethal voltages.

Decommissioning and Disposal

 **Decommissioning:** The auxiliary supply circuit in the relay may include capacitors across the supply or to earth. To avoid electric shock or energy hazards, after completely isolating the supplies to the relay (both poles of any dc supply), the capacitors should be safely discharged via the external terminals prior to decommissioning.

Disposal: It is recommended that incineration and disposal to water courses is avoided. The product should be disposed of in a safe manner. Any products containing batteries should have them removed before disposal, taking precautions to avoid short circuits. Particular regulations within the country of operation, may apply to the disposal of lithium batteries.

Technical Specifications

Protective fuse rating

The recommended maximum rating of the external protective fuse for this equipment is 6A, unless otherwise stated in the technical data section of the product documentation.

Insulation class:	IEC 601010-1: 1990/A2: 1995 Class I EN 61010-1: 1993/A2: 1995 Class I	This equipment requires a protective (safety) earth connection to ensure user safety.
Installation Category (Overvoltage):	IEC 601010-1: 1990/A2: 1995 Category III EN 61010-1: 1993/A2: 1995 Category III	Distribution level, fixed installation. Equipment in this category is qualification tested at 5kV peak, 1.2/50µs, 500Ω, 0.5J, between all supply circuits and earth and also between independent circuits.
Environment:	IEC 601010-1: 1990/A2: 1995 Pollution degree 2 EN 61010-1: 1993/A2: 1995 Pollution degree 2	Compliance is demonstrated by reference to generic safety standards.
Product safety: CE	73/23/EEC EN 61010-1: 1993/A2: 1995 EN 60950: 1992/A11: 1997	Compliance with the European Commission Low Voltage Directive. Compliance is demonstrated by reference to generic safety standards.

Section 1. INTRODUCTION



There is a warning symbol on the equipment, an exclamation mark within a triangle. This alerts the user to refer **carefully** to these Commissioning Instructions [19-112] before installing, commissioning or operating the equipment.

WARNINGS

1. Installation, commissioning and maintenance should only be carried out by suitably qualified personnel.
2. Terminations exposed during installation, commissioning and maintenance may present a hazard unless the equipment is electrically isolated.
3. The equipment should only be operated as intended, eg. within the specified electrical and environmental limits.
4. Susceptibility to Electrostatic Discharge: 8kV air discharge/4kV contact. This specification applies for direct contact with the terminals and via air discharge. If the device is opened, appropriate ESD precautions must be taken. The human body can generate potentially damaging electrical discharges so care must be taken to earth oneself effectively before removing the Navar from its housing. Use of a wrist strap connected to earth through a 1 M Ω resistor is recommended.
5. If High Voltage capacitors are to be used, set the safety lockout time before applying current to the Navar (refer to Section 5 for the setting procedure).

Section 2. COMMISSIONING

The Navar 315 should be connected to the system according to the wiring diagram on the rear of the case. Ensure that the current and voltage connections are made to the correct terminals and have the required phase relationship. Capacitors must be connected on the load side of the CT.

Fuses (0.5A rated) should be connected in the voltage inputs as shown on the wiring diagram.

The following settings need to be made:

Sequence, Safety lockout time, Stage limit, c/k, Target cos ϕ , Harmonic alarm (optional), Type of switching (rotational or linear), Type of stepping (double or single) and System Phase.

All the necessary adjustments are accessible via the controller fascia (see Figure 1).

2.1 Navar power up

Apply voltage and current to the Navar 315

The Navar 315 should display "315" for a few seconds during its self test.

It will then enter AUTO mode and display the power factor value.

If not, see sections 2.2 and 2.3

2.2 Connection error

If the voltage or current connections have been made to the wrong phase, the Novar 315 will display the phase angle by which the current leads the voltage to assist with connection fault-finding.

For example: At unity power factor with a reversed CT, the display will indicate 270°.

2.3 Current beyond operational limits

If the current is below 10% of nominal rating, the Novar 315 will display " _ _ _ "; it will however, function correctly as a capacitor controller. If the current is higher than 120% of nominal rating "AHI" will be displayed and relay switching will stop. Switching will recommence once the current has fallen below 120% of nominal rating.

Section 3. AUTO MODE

The Novar will be in AUTO mode after switching on, otherwise press and hold **[Fn]**.

Capacitors will be connected to the system automatically as required to correct the load.

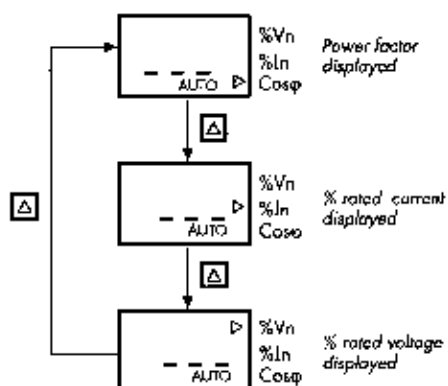
In AUTO mode the Novar 315 will display $\cos\phi$, % system voltage, V_n , and % system current, I_n .

The nominal V_n and I_n values are printed on the label.

The power factor is displayed as a number when lagging. An additional c denotes a leading power factor.

If the input lagging vars exceed the c/k setting, IND will be displayed to the right of the AUTO and capacitors will be connected. If the input leading vars exceed the c/k setting, CAP will be displayed to the left of the AUTO and capacitors will be disconnected.

Rotate through the displays by repeatedly pressing **[Δ]**.



Section 4. MANUAL MODE

Enter MANUAL mode from AUTO mode by pressing the **[Fn]** button once.

The capacitor switching is controlled with **[▽]** or **[△]** as follows

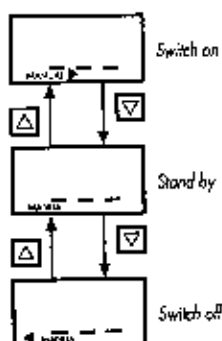
Press **[△]** once. The Novar will switch on the capacitors up to the set limit one after the other after the safety lockout time elapses. Once the limit is reached, the alarm output, if fitted, is switched on.

Press **[▽]** once, as soon as the number of capacitors required are connected. Switching of the capacitor stages is now stopped and the alarm is switched off.

Press **[▽]** once more. The Novar will then switch off the capacitors in sequence.

d) Press and hold **[Fn]** to return to the "AUTO" mode.

display:



WARNING

THE MANUAL FACILITY SHOULD NOT BE USED TO DISABLE CAPACITORS FOR MAINTENANCE PURPOSES.

Section 5. CHANGE SETTINGS MODE

Notes:

- Even with no current, the settings may be changed.
- Just before the change settings mode is reached, all capacitor stages will be switched off automatically. A safety lockout time will be imposed to allow the capacitors to discharge before any further switching.
- When in the change setting mode, if no settings have been changed for five minutes, the Novar will automatically reset and return to normal operation including all the new settings.
- A setting is changed when the **[Fn]** button is pressed.

Before starting the setting procedure, press and hold the **[Fn]** button until the Novar is in the AUTO mode with **cosp** displayed.

5.1 Setting procedure

[See diagram in 5.2]

Press the **[Fn]** button twice so that the selected sequence is displayed.

Press **[▽]** once and then change the displayed number to equal the security code (located on the rear label) using the **[▽]** or **[△]** buttons. The code is accepted when **[Fn]** is pressed.

The alarm indicator "▲" flashes when the setting mode is entered.

The settings can now be displayed by repeatedly pressing and releasing $\boxed{\text{Fn}}$ to loop through them.

Adjust each setting, as required, using $\boxed{\nabla}$ or $\boxed{\Delta}$.

Press and hold $\boxed{\text{Fn}}$ until "End" is displayed and press $\boxed{\nabla}$ to return to normal operation.

a) Sequence:

Set the Sequence required from 000 to 007. Further details and explanation about these sequences are provided in Section 6, SEQUENCES.

display:

$\boxed{5 _ _ _}$

b) Safety Lockout time:

Set the safety lockout time to suit the installation. The available times are from 10 to 600 seconds in 10 second increments.

$\boxed{E _ _ _}$

c) Stage limit:

Set this (from 1 to 6) to the number of capacitor stages to be controlled.

$\boxed{L _ _ _}$

d) c/k:

Setting range = 0.03 to 1

$\boxed{E _ _ _}$

$$c/k = \frac{\text{smallest capacitor step size (in vars)} \times 5}{\sqrt{3} V I}$$

where V = nominal primary system voltage.

I = primary rating of the current transformer.

Example:

Smallest capacitor step size = 100 kvar

CT primary rating = 500A

Primary system voltage = 3300V

$$c/k = \frac{100000 \times 5}{3 \times 3300 \times 500} = 0.17$$

The Novar should be rated at the nominal secondary voltage of any VT used.

e) Target cosφ:

Setting range: 0.80 lagging

to 0.95 leading (additional c displayed)

$\boxed{C _ _ _}$

f) Harmonic alarm: OPTIONAL

The harmonic resonance detection level is from 1% to 5% in increments of 1%. It can be disabled by selecting the final position (above the 5% setting) designated "hOFF".

$\boxed{h _ _ _}$

g) Switching type:

Rotational → "On" / Linear → "OFF"

$\boxed{r _ _ _}$

h) Stepping type:

Single → "OFF" / Double → "On"

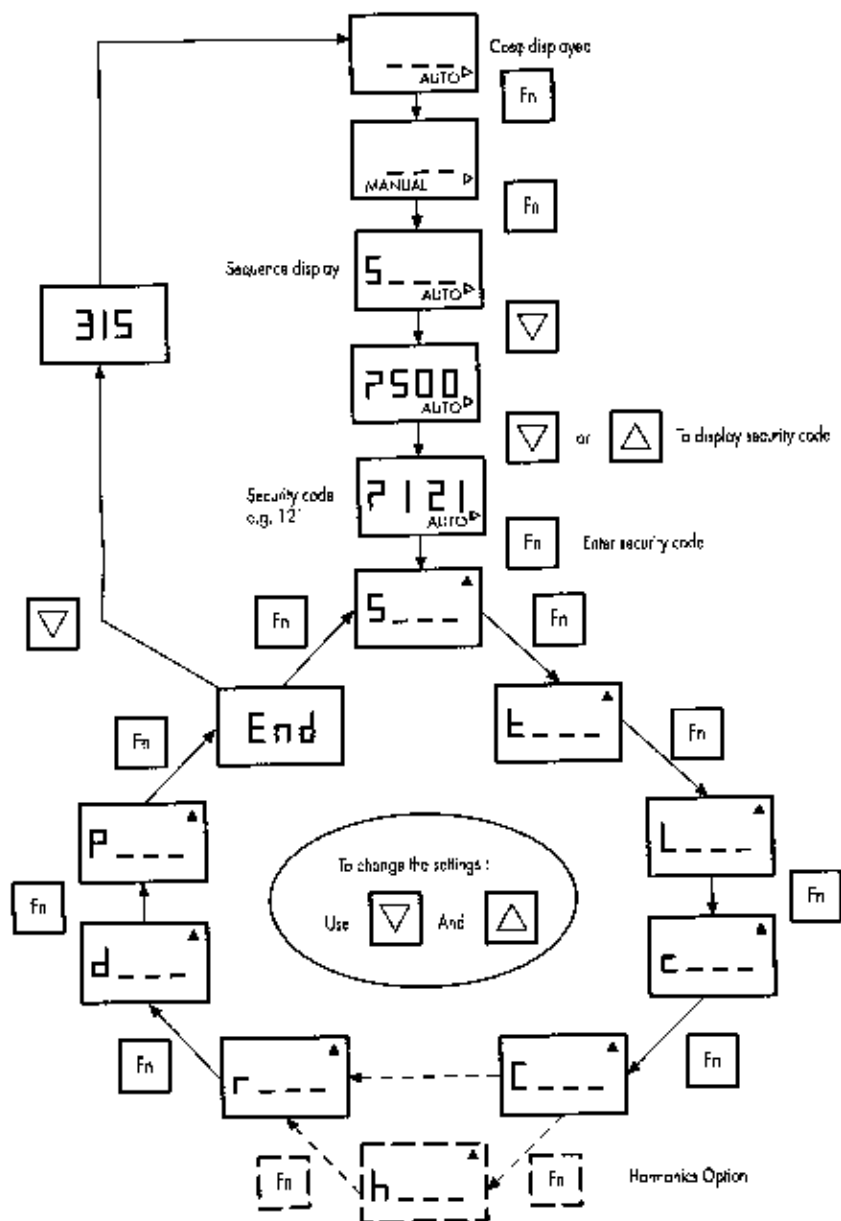
d _ _ _

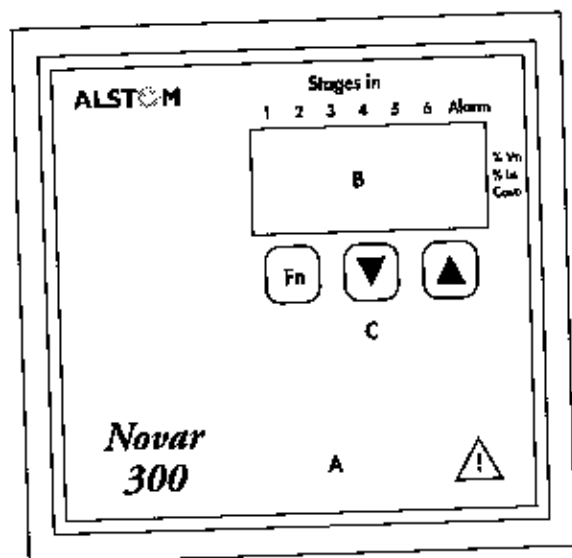
i) Phase:

Three phase connection (P3) or single phase (P1) can be selected.

P _ _ _

5.2 Change settings mode diagram for adjusting settings





Fascia key:

A = Novar front case classified IP52

B = High definition liquid crystal display

C = Function keys

Figure 1: Novar 315

Section 6. SEQUENCES

Sequence number	Sequence	Maximum no. steps per controller for		
		1 stage	3 stage	6 stage
S 000	1:1:1:1:1:1	1	3	6
S 001	1:1:2:2:2:2	1	4	10
S 002	1:2:2:2:2:2	1	5	11
S 003	1:2:3:3:3:3	1	6	15
S 004	1:2:3:4:4:4	1	6	18
S 005	1:2:4:4:4:4	1	7	19
S 006	1:2:3:6:6:6	1	6	24
S 007	1:2:4:8:8:8	1	7	31

When each capacitor stage has the same value, e.g. 50, 50, 50, 50 kvar, sequence S 000 should be selected.

For systems with different step ratios, choose the appropriate sequence.

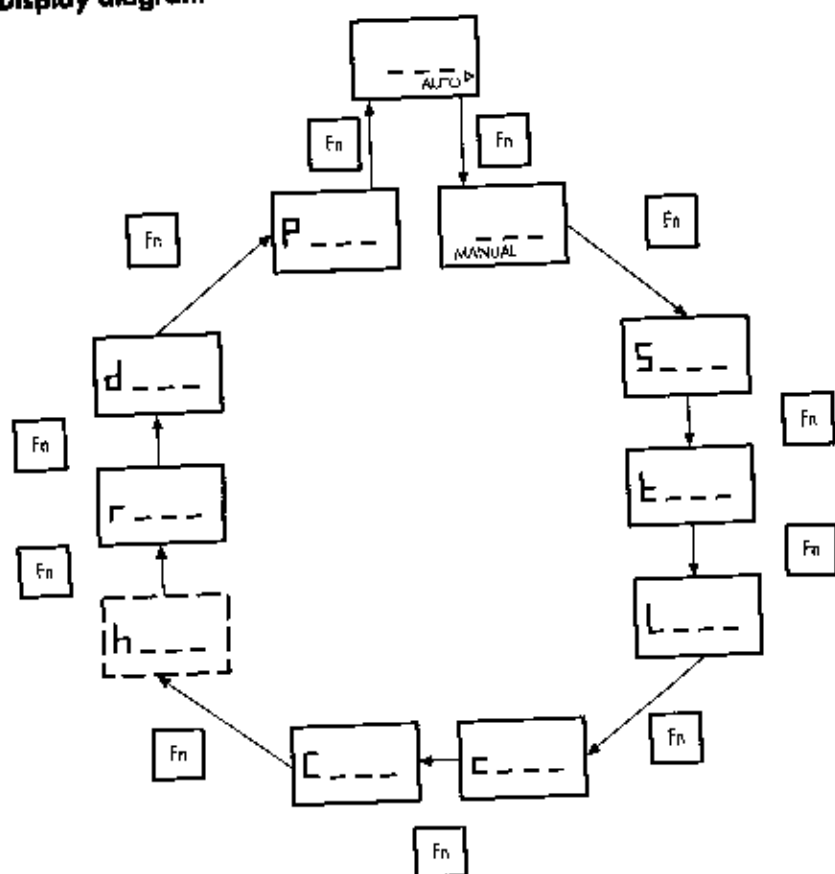
For example, for 50, 100, 100, 100 kvar, choose sequence S 002.

Section 7. DISPLAY MODE

(For displaying the settings)

Repeatedly press and release the **[Fn]** button to loop through and display the settings. Novar 315 continues to operate in the AUTO mode during this procedure. Press and hold the **[Fn]** button to return to AUTO and the cosp display.

7.1 Display diagram



DANGER!

OPEN CIRCUIT CURRENT TRANSFORMERS ARE DANGEROUS.
THE CURRENT TRANSFORMER SECONDARY SHOULD BE SHORT-CIRCUITED
BEFORE THE CONTROLLER INPUTS ARE DISCONNECTED.

Electromagnetic Compatibility Directive 89/336/EEC

Emissions standard EN50081-2 1994 Industrial environment

Immunity standard EN50082-2 1995 Industrial environment
(IEC 60801 parts 2, 3 and 4)

Susceptibility to
Electrostatic Discharge 8kV air discharge/4kV contact.

Warning: This specification applies when the front cover is fitted. If the front cover is removed to gain access to the adjustment potentiometers then appropriate ESD protection must be taken.

Low Voltage Directive 72/23/EEC

Designed to EN61010-1 1993 safety requirements.



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Our policy is one of continuous product development and the right is reserved to supply equipment which may vary from that described.

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