



SYNCHRONISM RELAY

SYNCRO-96

(Code 2 28 913 - 2 28 914 - 2 28 915)

INSTRUCTION MANUAL

(M 981 196 / 99A)

© CIRCUTOR S.A.

Synchronism relay SYNCRO-96

1.- BASIC INSTRUCTIONS

1.1.- Delivery spot check

This manual is issued to help all the SYNCRO-96 users to install and use it in order to get the best from it. After receiving the unit please check the following points:

- (a) Does this device corresponds to your order specifications?
- (b) Check if any damage was done during the shipment process.
- (c) Verify that it includes one instruction manual.



1.2.- Connection procedures

For the safe use of SYNCRO-96 is basic that people who install or handle it follow the normal safety considerations and the diverse advises related in this manual.

Before connecting verify that the **voltage supply of the instrument** (see identificative label) corresponds to the rated phase-phase voltage of the mains where you have to connect it:

<i>Code</i>	<i>Type</i>	<i>Voltage supply (phase to phase)</i>	<i>Frequency</i>
2 28 913	SYNCRO-96 110 V	110 Va.c. ± 20 %	40...70 Hz
2 28 914	SYNCRO-96 230 V	230 Va.c. ± 20 %	40...70 Hz
2 28 915	SYNCRO-96 400 V	400 Va.c. ± 20 %	40...70 Hz

2.- MAIN CHARACTERISTICS



The synchronism relay SYNCRO-96 is an electronic microprocessor based instrument able to measure and control the connection of an auxiliary generator to the electrical mains. To connect an auxiliary supply to the electrical mains it is necessary the meet of the next conditions:

- The generator and the main network must have the same number of phases, the same sequence and the same voltage.
- Same frequency.
- No phase shift between both.

SYNCRO-96 only gives the synchronism order when the above three conditions are achieved.

The main characteristics of the device are:

- Easy visualization of all the synchronism parameters.
- Synchronism relay with the possibility of adjusting the limit phase shift and the delay.
- Two auxiliary generator regulation relays (one to accelerate and another one to break the auxiliary generator). The activating and deactivating time can be adjusted.
- Easy use and installation.
- Little size (96x96 mm).

Before operating the instrument read the **INSTALLATION** and **ADJUST** chapters and choose the properly operation mode.



3.- INSTALLATION AND START-UP

The manual you hold in your hands contains information and warnings that the user should respect in order to guarantee a proper operation of all the instrument functions and keep its safety conditions.

The instrument must not be powered and used until its definitive assembly on the cabinet's door.

If the instrument is not used as manufacturer's specifications, the protection of the instrument can be damaged.

When any protection failure is suspected to exist (for example, it presents external visible damages), the instrument must be immediately powered off. In this case contact a qualified service representative.

3.1.- INSTALLATION

Before applying AC power to the instrument, check following points :

a.- **Voltage supply** (see identificative label):


<i>Code</i>	<i>Type</i>	<i>Voltage supply (phase to phase)</i>	<i>Frequency</i>
2 28 913	SYNCRO-96 110 V	110 Va.c. \pm 20 %	40...70 Hz
2 28 914	SYNCRO-96 230 V	230 Va.c. \pm 20 %	40...70 Hz
2 28 915	SYNCRO-96 400 V	400 Va.c. \pm 20 %	40...70 Hz

- *Connection terminals: Terminals A1-A2 and B1-B2.*
- *Instrument consumption: 7 VA.*

b.- Operation conditions:

- Operation temperature: -20 to +70°C.
- Operation humidity: 25 to 80 % HR.
- Indoor use.

c.- Safety: Designed to meet protection class II as per EN 61010.

Mounting: 

The instrument is to be mounted on a panel. All connections keep inside the cabinet.

Note that with the instrument powered on, the terminals could be dangerous to touching and cover opening actions or elements removal may allow accessing dangerous parts. Therefore, the instrument must not be used until this is completely installed.

The instrument must be connected to a power supply circuit protected with gl type (IEC 269) or M type fuses rated between 0.5 and 2 A. This circuit should be provided with an automatic switch or any equivalent element to disconnect the instrument from the power supply network. The supply and measuring voltage circuits will be both connected through a wire with a minimum cross-section of 1 mm².

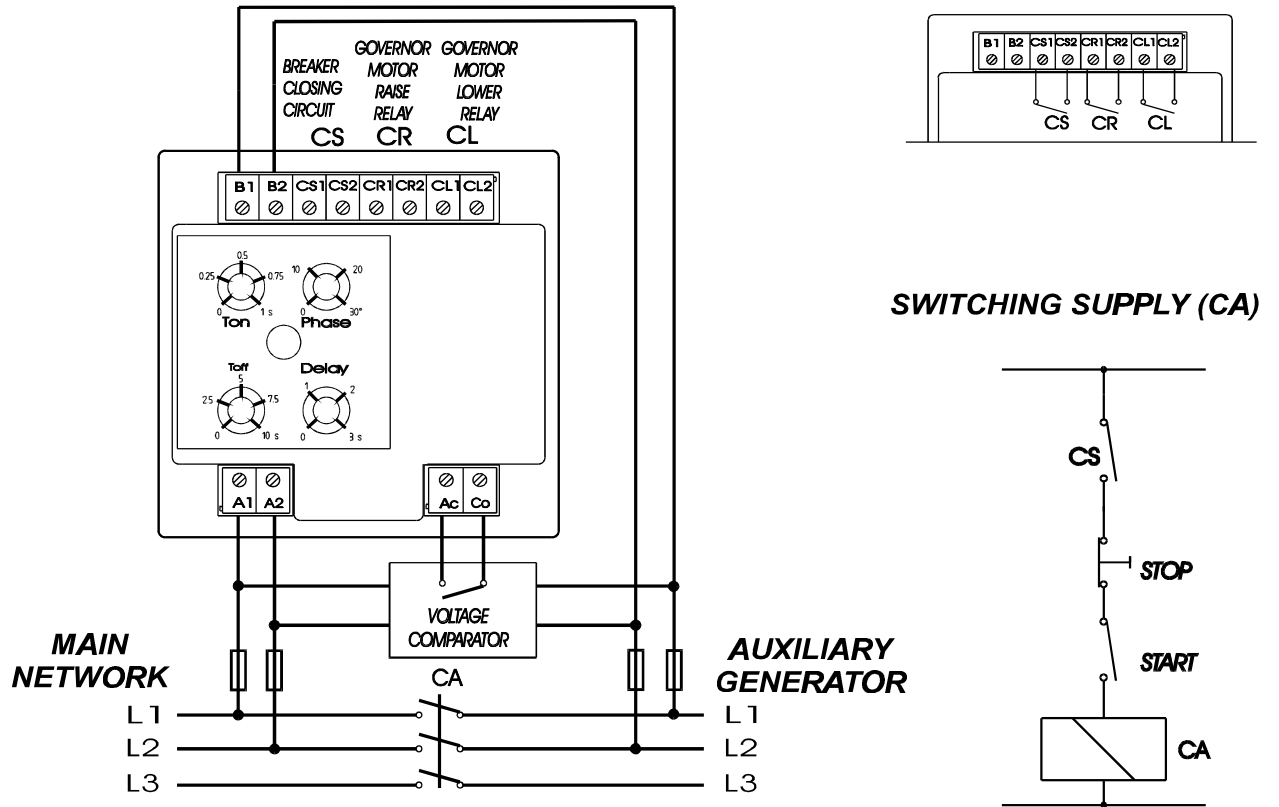
3.2.- SYNCRO-96 CONNECTION

3.2.1.- Connection terminals

<i>Name</i>	<i>Concept</i>
A1 - A2	Connection to the main network Auxiliary supply of the device (voltage supply depending on the model)
B1 - B2	Connection to the auxiliary generator Auxiliary supply of the device (voltage supply depending on the model)
Ac - Co	Voltage comparator input
CS1 - CS2	Synchronism relay (NO) output
CR1 - CR2	Output of the relay for increasing the frequency of the auxiliary generator (NO relay)
CL1 - CL2	Output of the relay for reducing the frequency of the auxiliary generator (NO relay)

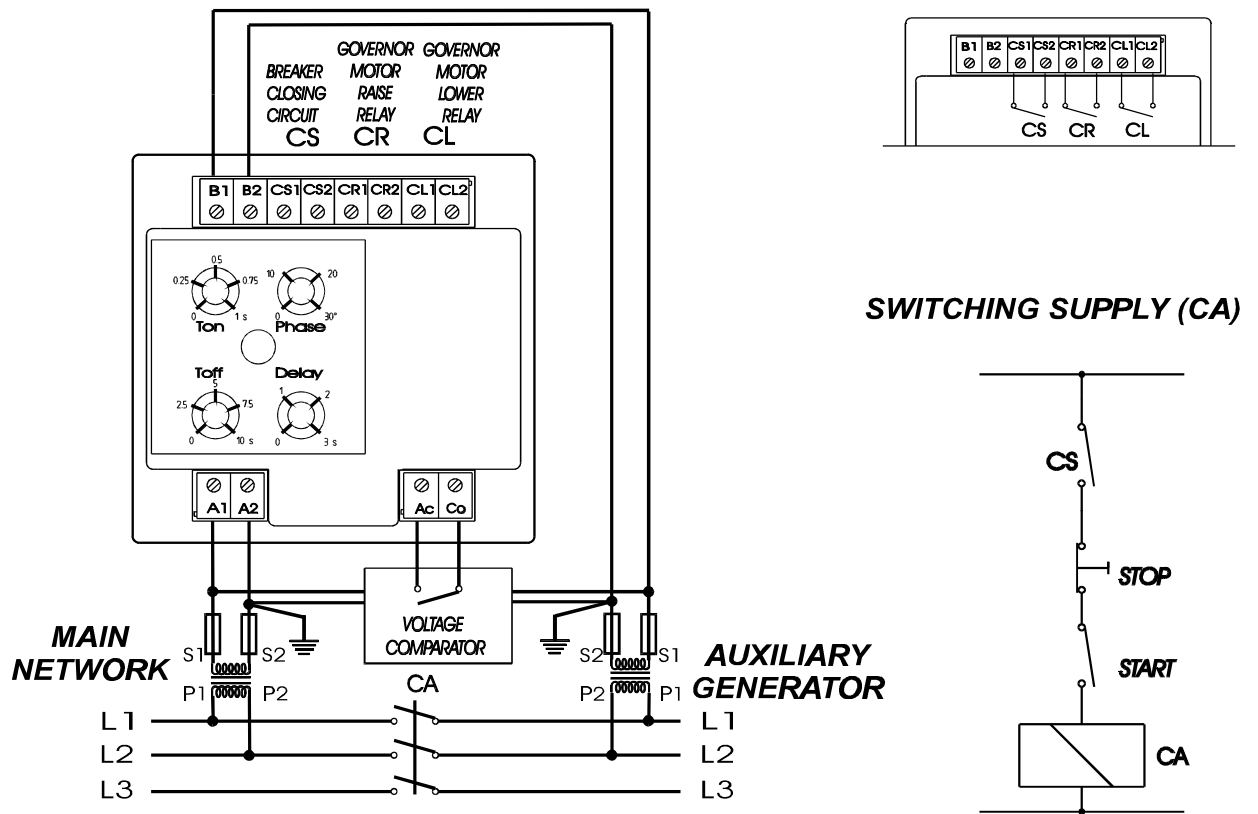
3.2.2- Wiring diagrams

a) Wiring diagram for a 3-phase low voltage network:



* LINK Ac AND Co TERMINALS IF VOLTAGE COMPARATOR IS NOT REQUIRED

b) Wiring diagram for a 3-phase low or medium voltage network through voltage transformers:



* LINK Ac AND Co TERMINALS IF VOLTAGE COMPARATOR IS NOT REQUIRED



IMPORTANT REMARKS:

- *Connect A1-A2 and B1-B2 inputs with the polarity shown in the picture (if you use voltage transformers, also take care of their polarity). A polarity change would cause a 180° error in the SYNCRO-96 phase shift measurement. The instrument would give the synchronism order just when the voltages are 180° shift (!).*
- *In a three-phase network is important to know the phase sequence, since the instrument measures between two phases. The phase connected to the A1 terminal input has to be the same that the one connected to the B1 terminal input and the phase connected to the A2 terminal input has to be the same that the one connected to the B2 terminal input.*
- *In case of using voltage transformers, take into account the possible phase shift that might affect over the measurement.*

4.- OPERATION MODE

The device has two voltage inputs: one for the main network and another one for the auxiliary generator. The instrument measures the frequency difference and the phase shift between both signals. These parameters allows SYNCRO'96 to decide about the connection of the generator to the mains. The voltage difference between both voltages is a less critical parameter for the connection of the generator, so an acceptance signal can be given to the instrument just making a contact between the terminals Ac and Co

The instrument only works if the generator and mains voltages are between the values specified in point 3.1. If one of the voltages falls SYNCRO-96 will stop. When the voltages return to the specified level the instrument will automatically start-up.

4.1.- SYNCHRONICITY

If the connection of a generator to a main network has to be done without any kind of disturbance (overcurrents or mechanical stress on the generator), the following conditions have to be met:

- a. The generator and the main network must have the same number of phases, the same sequence and the same voltage.
- b. No phase shift between both voltages.
- c. Same frequency.

In the SYNCRO-96, these conditions turn to these ones:

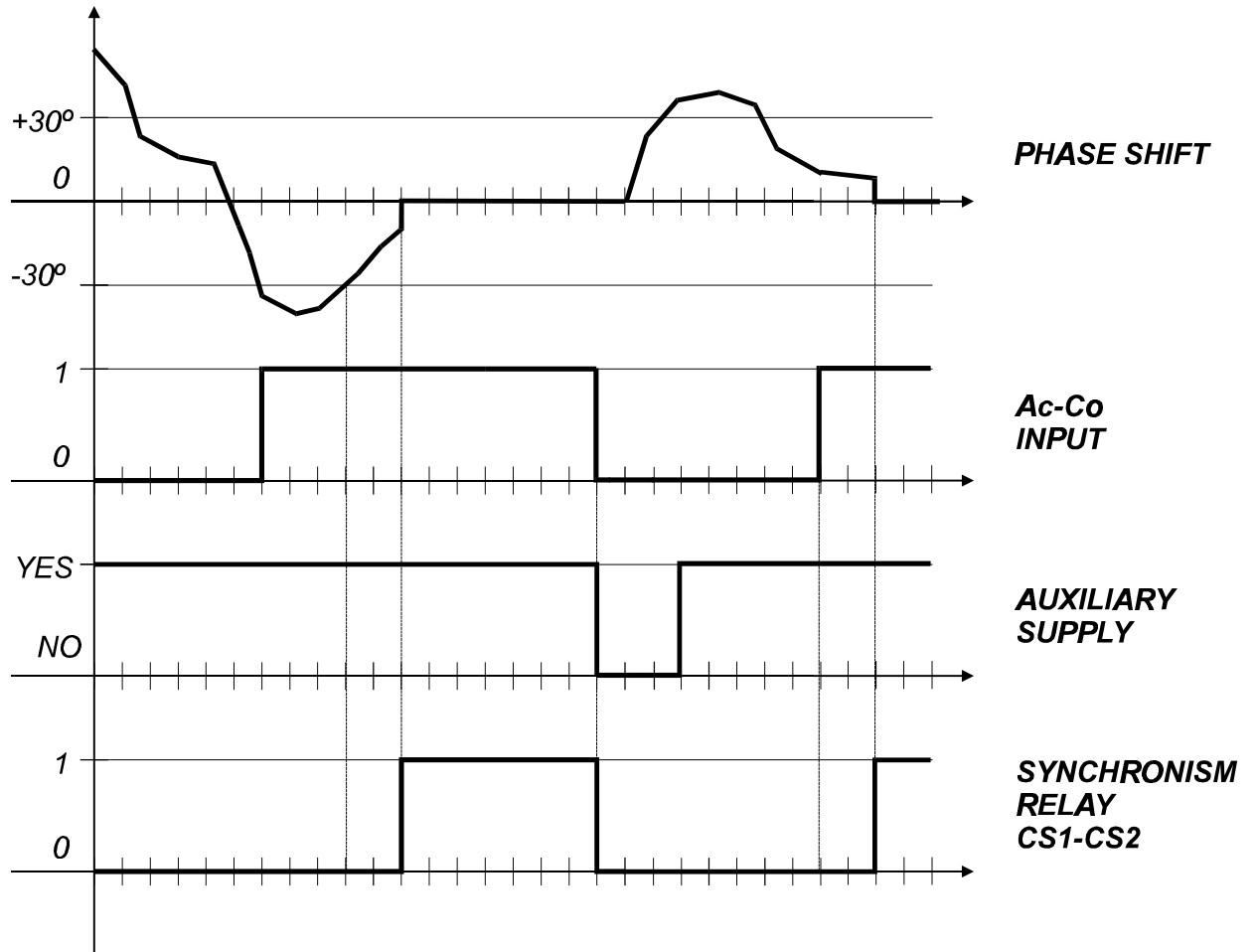
- a. **Ac and Co terminals have to be linked (this means that voltages has the same value). It is given as a fact that systems have the same number of phases and the same sequence (it has been verified).**
- b. **Phase shift has to be lower than the adjusted value in PHASE knob.**
- c. **Phase shift has to be lower than the adjusted value in PHASE knob for a**
time higher than the adjusted value in the DELAY knob.

When these three conditions are met, SYNCRO-96 activates the synchronism relay (CS1-CS2).

The CS1-CS2 relay keeps activated while the conditions are met. If the auxiliary supply falls, the CS1-CS2 relay will switch to open position (NO relay).

Following, an example of the operation mode is attached:

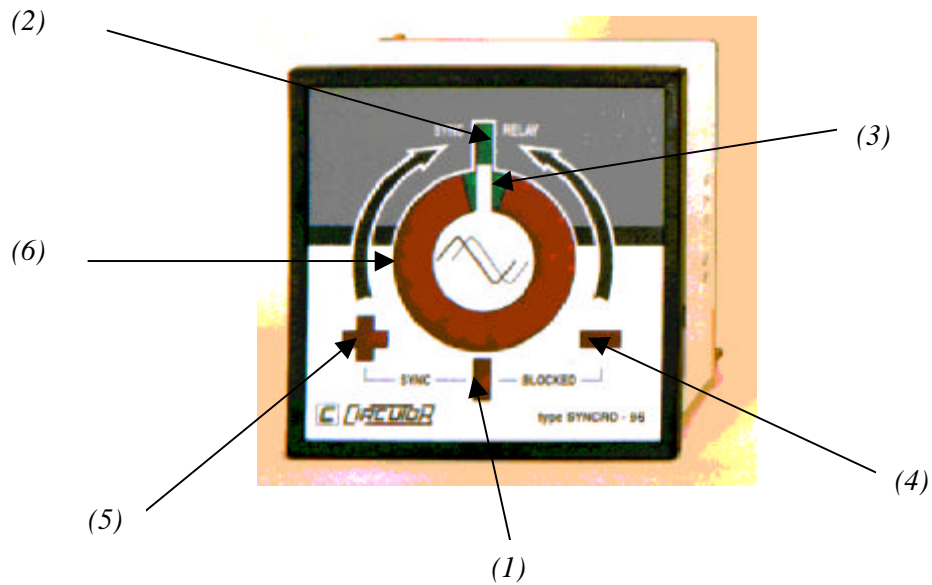
- DELAY knob adjusted to 2 s
- PHASE knob adjusted to 30°



4.2.- REGULATION INDICATORS AND RELAYS

The user is informed about all the synchronism parameters by means of:

- A circular visualization consisting of 10 LEDs, that gives information about the phase shift and the frequency difference between the two voltage (6).
- Several leds that indicate:
 - If voltages are equal (1).
 - Pre-synchronism and synchronism orders (2).
 - Status of the regulation relays (4 and 5).



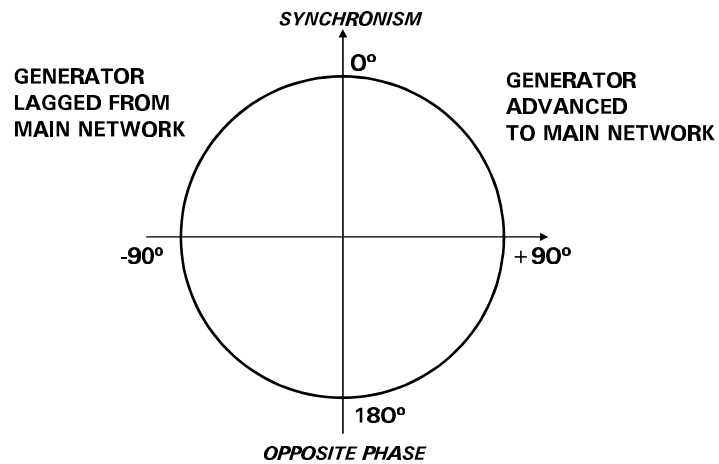
4.2.1.- Circular display

When the display indication is turning in the opposite way that a clock pointer the auxiliary generator frequency is lower than the mains frequency.

When the display indication is turning as a clock pointer the auxiliary generator frequency is higher than the mains frequency.

The speed of the movement is proportional to the frequency difference.

In case that frequencies are equal, one LED will keep lit on indicating the approximate phase shift:



Actually, when the phase shift between generator voltage and mains voltage is close to 0, the zone (3) is lit on.

4.2.2.- Equality voltage indicator

The indicator (1) is lit on when the Ac and Co input terminals are linked and it is lit off when they are not linked.

4.2.3.- Pre-synchronism and synchronism indicators

When the following conditions are met:

- phase shift lower than the set at the PHASE knob
 - Ac and Co input terminals linked, in other words, equality of voltages
- indicator (2) begins to blink (*pre-synchronism indication*).

If the two above conditions keep for a time higher than the adjusted in the DELAY knob, indicator (2) keeps permanently lit on and the CS1-CS2 synchronism relay is activated (*synchronism indication*).

However, if in the pre-synchronism state SYNCRO'96 is not under anyone of two above conditions, the indicator (2) turns off. This indicator will lit on again when the two conditions are met.

4.2.4.- Regulating relays operation

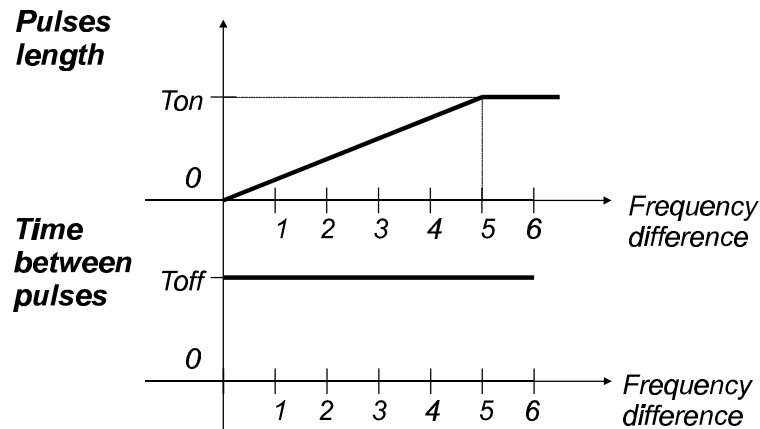
The regulating relays give pulses proportionally to the frequency difference between the generator and the mains. These pulses allows the generator regulator to accelerate or break the generator in order to achieve the synchronism conditions.

The instrument has two free of voltage output relays:

- CR1-CR2. This relay operates when the generator frequency is lower than the mains frequency.
- CL1-CL2. This relay operates when the generator frequency is higher than the mains frequency.

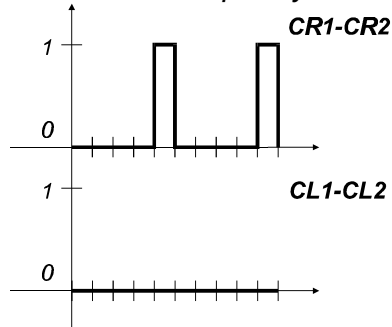
The activation and non-activation times of the relay pulses can be adjusted by means of the T_{on} and T_{off} knobs (on rear side):

- T_{off} is the relay non-activation time (time between pulses). This time will keep constant during all the synchronicity process.
- T_{on} is the relay activation time. When the frequency difference is equal or higher than 5 Hz, the activation time keeps equal to the knob set value. When the frequency difference is lower than 5 Hz the activation time is proportional to this difference.

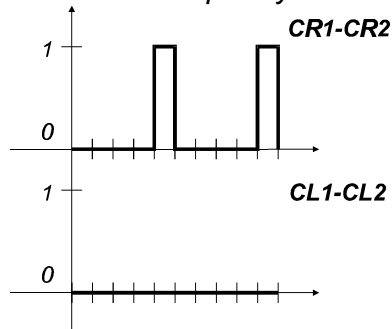


Examples: Adjusted times: $T_{off} = 4\text{ s}$ and $T_{on} = 1\text{ s}$

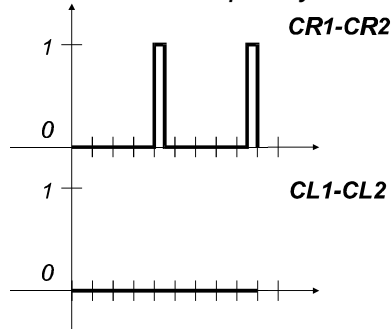
Ex. 1. Generator frequency= 42.5 Hz / Mains frequency= 50 Hz



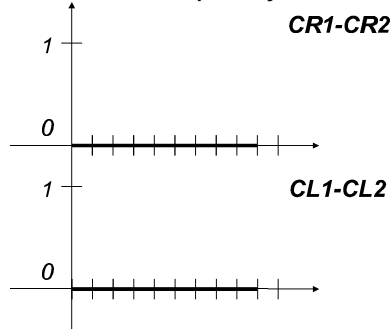
Ex. 2. Generator frequency= 45 Hz / Mains frequency = 50 Hz



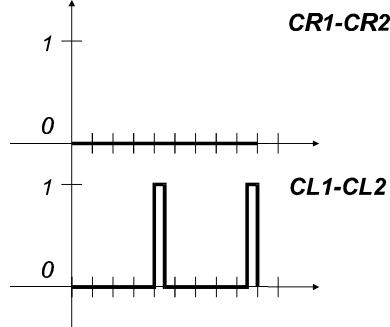
Ex. 3. Generator frequency= 47.5 Hz / Mains frequency= 50 Hz



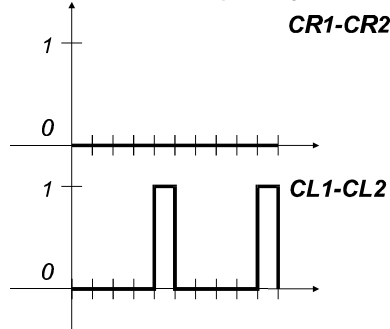
Ex. 4. Generator frequency= 50 Hz / Mains frequency= 50 Hz



Ex. 5. Generator frequency= 52.5 Hz / Mains frequency= 50 Hz



Ex. 6. Generator frequency= 57.5 Hz / Mains frequency= 50 Hz



Different generators will need different adjusting times (T_{on} and T_{off}) with the purpose of getting the more accurate connection.

4.2.5.- Regulating relay operation indicators

When the network frequency is higher than the generator one, the indicator – (4) is lit on. CR1-CR2 relay operates and CL1-CL2 relay keeps open. Each time that the CR1-CR2 relay is activated the indicator + (5) is lit on.

When the generator frequency is higher than the network one, the indicator + (5) is lit on. CL1-CL2 relay operates and CR1-CR2 relay keeps open. Each time CL1-CL2 relay is activated the indicator – (4) is lit on.

When there is almost no difference between frequencies, indicators – & + lit on alternatively.

5.- TECHNICAL CHARACTERISTICS

Auxiliary supply

From the measuring circuit (A1-A2 and B1-B2 connection terminals).

Measuring circuit

Frequency range: from 40 to 70 Hz.

Rated voltage: 110 V, 230 V or 400 Vac, depending on the type (see label).

Tolerance: $\pm 20\%$.

Consumption: 7 VA.

Synchronism mark

By means of the CS relay (CS1-CS2 connection terminals).

Delay in the synchronism mark: adjustable from 0 to 3 s by means of a rear knob (DELAY).

Maximum phase shift allowed: adjustable from 0 to 30° by means of a rear knob (PHASE).

Accuracy at synchronism mark: $\pm 0,5\%$ at 50 Hz.

Voltage comparator input

Ac-Co terminals: working contact (NPN).

Auxiliary generator regulation

By means of 2 relays (CR1 CR2: frequency increasing and CL1 CL2: frequency reducing).

T_{on} (relay activation time): adjustable from 0 to 1 s by means of a rear knob.

T_{off} (relay non-activation time): adjustable from 0 to 10 s by means of a rear knob.

Output relays

Relays: CS1-CS2, CL1-CL2, CR1-CR2.

Type: mechanical, 2 contacts (open/closed), free of voltage, NO.

Use: AC11 250 V/2 A

DC11 24 V/6 A

Isolating system

Between A1-A2 and B1-B2 inputs: 3 kV a 50 Hz during 1 min.

Between inputs and output relays: 3 kV a 50 Hz during 1 min.

Working conditions

Working temperature: -20 / +70°C.

Use: indoor.

Constructive characteristics

Case material: ABS self-extinguishing (as per UL 94 V1) and high resistance against impacts.

Protection degree: Box: IP 52 / Connection terminals: IP 20

Screwed transparent cover for the adjustment knobs.

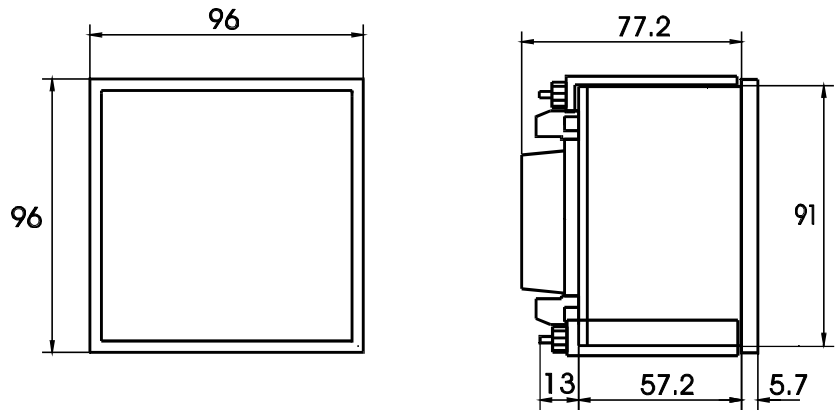
Security

Category II , EN-61010.

Standards

IEC 51-1, IEC 255-5, IEC 1010-1, EN 61010-1.

Dimensions:



Panel hole: $92 \text{ mm}^{+0.8} \times 92 \text{ mm}^{+0.8}$



7.- SAFETY CONSIDERATIONS

All installation specification described at the previous chapters named INSTALLATION AND STARTUP and SPECIFICATIONS.

Note that with the instrument powered on, the terminals could be dangerous to touching and cover opening actions or elements removal may allow accessing dangerous parts. This instrument is factory-shipped at proper operation condition.

8.- MAINTENANCE

The SYNCRO-96 does not require any special maintenance. No adjustment, maintenance or repairing action should be done over the instrument open and powered and, should those actions are essential, high-qualified operators must perform them.

Before any adjustment, replacement, maintenance or repairing operation is carried out, the instrument must be disconnected from any power supply source.

When any protection failure is suspected to exist, the instrument must be immediately put out of service. The instrument's design allow a quick replacement in case of any failure.

9.- TECHNICAL SERVICE

For any inquiry about the instrument performance or whether any failure happens, contact to CIRCUTOR's technical service.

CIRCUTOR S.A. – Aftersales Service
c / Lepanto , 49
08223 - TERRASSA (Barcelona) - SPAIN
Telf. 34 - 93 - 745 29 00
Fax. 34 - 93 - 745 29 14
e-mail : central@circutor.es