



POWER FACTOR REGULATOR

Computer-4er

INSTRUCTION MANUAL

(M 981 625 / 00A)

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POWER FACTOR REGULATOR COMPUTER- 4er

1.- POWER FACTOR REGULATORS COMPUTER-4er

Power factor regulator **Computer-4er** series permit the automatic connection and disconnection of capacitors in function of this $\cos \varphi$.

Built with a microprocessor and based on the FCP system (FAST Computerized Program), the power factor regulator becomes an intelligent instrument, able to accurately inform about the power system status, and to take complex decisions that most times require a high quantity of calculations. This series compiles the CIRCUTOR's large experience with power factor regulators, so improving their previous features by the application of latest technology.

Main features:

- **True r.m.s. measurements:** The regulator measure the reactive power in the facility, and will connect or disconnect available capacitors according to setup data.
- Regulator 4 output relays.
- Setting actions from a frontal keyboard (1 Set-up key).
- Instrument is to be mounted on DIN rail mounting device (DIN 43 880).

2.- Connection instructions

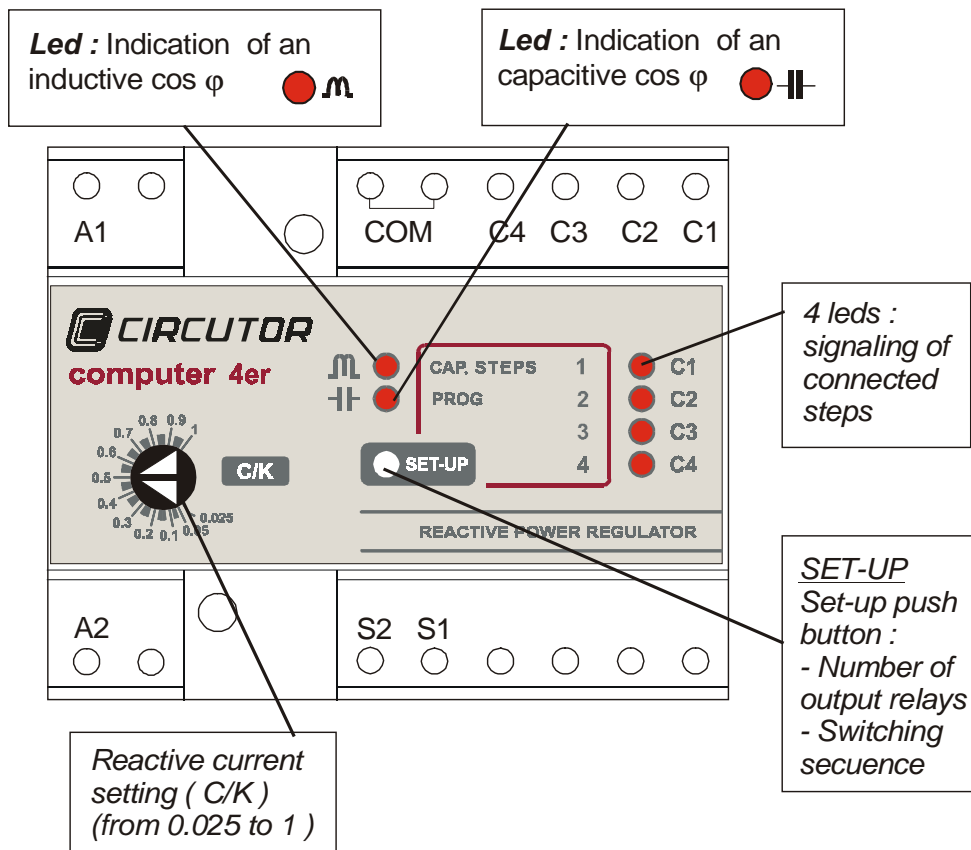


The manual you hold in your hands contains information and warnings about the **Computer 4er** that the user should respect in order to guarantee a proper operation of all the instrument functions and keep its safety conditions.

3.- GENERAL DESCRIPTION

3.1.- VISUALIZATION OF PARAMETERS :

The regulator provides following indications from a frontal panel:



4.- INSTALLATION AND START-UP



The manual you hold in your hands contains information and warnings about the **Computer 4er** that the user should respect in order to guarantee a proper operation of all the instrument functions and keep its safety conditions

The regulator must not be used until its definitive assembly inside the switchgear board.

Whether the instrument is not used as manufacturer's specifications, the protection of the instrument may result 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.

4.2.- CONNECTIONS



Instrument is to be mounted on DIN rail mounting device with low dimensions. All connections keep inside the cabinet .



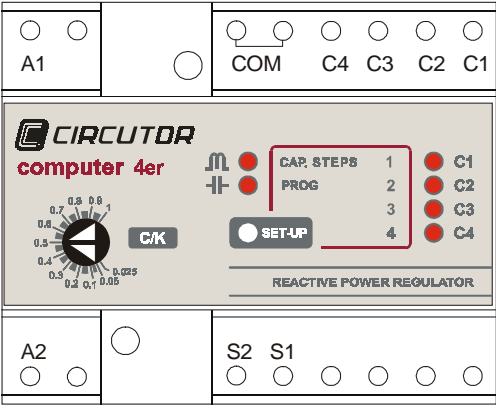
All connections keep inside the cabinet .

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 regulator must be powered from a power source protected with gI type (IEC 269) or M type fuses (IEC 127) rated between 0.5 and 2 A. This circuit should be provided with an automatic switch (I/O) or any equivalent element to connect (ON) or disconnect (OFF) the instrument from the power supply network. Power supply circuit as well as connections to different relays will be wired with cables of a minimum cross-section of 2.5 mm². The circuit from de current transformer secondary will be also wired with a cable with a have a minimum cross-section of 2,5 mm².

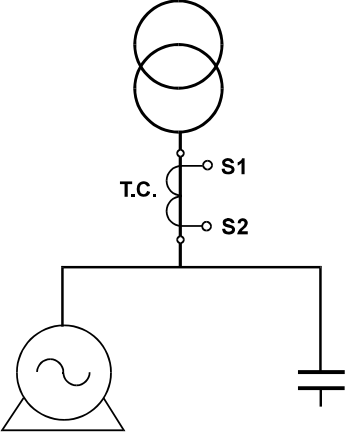
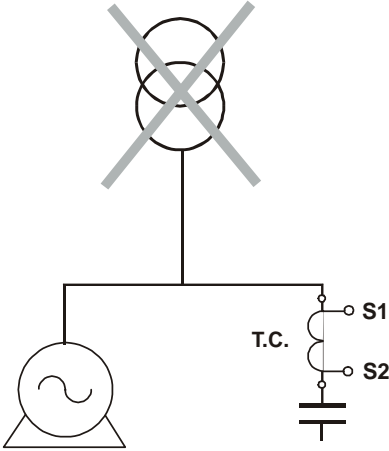
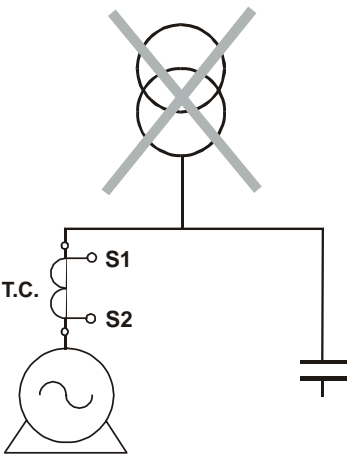
COMPUTER-4er CONNECTION TERMINALS

| | Terminal N° | Terminal description |
|---|---|---|
|  | <p>S1 S2 A1 A2 C4 C3 C2 C1 COM</p> | <p>Current input S1 Current input S2 Voltage input V a.c. Voltage input V a.c. Output relay 4 Output relay 3 Output relay 2 Output relay 1 Relay common C1 to C4</p> |

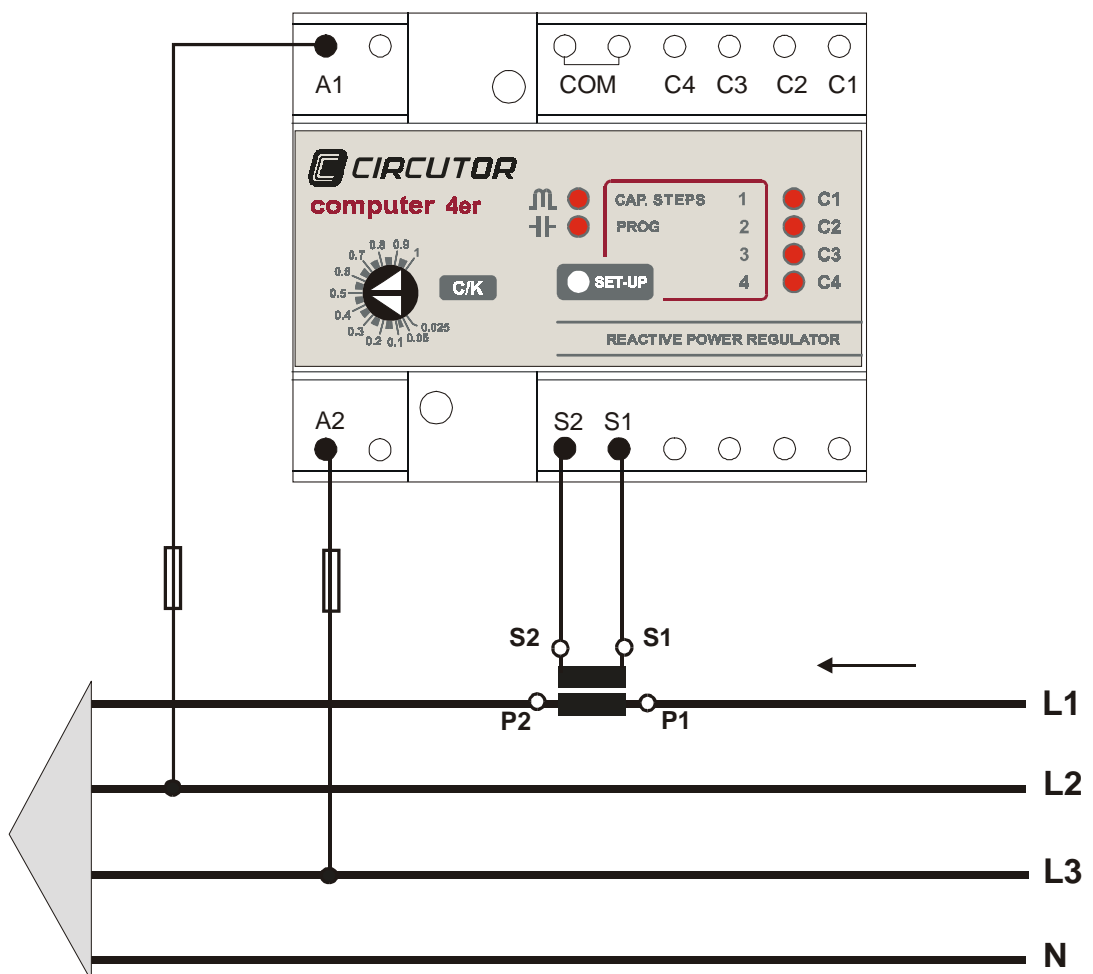
Connect the regulator according to the connection drawing attached at the rear part of the regulator. Take following points into account:

- To start-up the regulator it is necessary to install a current transformer (normally **In / 5 A**) suitable for **the whole current of loads in the facility**. The circuit from the C.T. secondary will be wired with a cable of a cross-section adequate to the distance between the C.T. and the regulator.
- The regulator is powered between **two phases** (except for a single-phase model). **The phase in the power system where the C.T. is placed can or not coincide with any of the phases the regulator is powered from.**

- The C.T. must be placed at any point of the power system entrance where the whole current of the facility, even the own current of capacitors, can be measured.

| RIGHT | WRONG | |
|--|---|---|
|  <p data-bbox="177 1794 568 1895">- The C.T. must be obligatory placed before the capacitor bank and loads (motors, etc).</p> |  <p data-bbox="603 1742 1007 1939">- No capacitor is connected as the C.T. does not provide any signal - Check that the C.T. is not at short-circuit or placed out from load circuit.</p> |  <p data-bbox="1026 1742 1437 1939">- All capacitors of the bank are connected, but none will be disconnected when the load falls. The power system may be over-compensated when no load exists.</p> |

Connection diagram of the Computer-4er



- Connect the C.T. secondary (S1-S2) to the terminals marked as S1-S2. If the leds "ind" or "cap" blinks , means that the phase rotation is not respected : inverted the voltage phase connections (or S1-S2 of the current transformer have to be inverted) .



Other points to take into account:

- Whether no enough current signal is provided to the regulator, this cannot measure the $\cos \varphi$. In case that loads are in operation, check the circuit coming from the C.T. secondary (this could be open or in short-circuit at any point).
- Whether no measuring signal is received by the regulator and some capacitor stages are energized, these will be automatically switched off for safety purposes. Check the circuit coming from the C.T. secondary (this could be open or in short-circuit at any point).
- In case that the regulator measures **GENERATED** active power, and this situation is confirmed during 6 s, the led "ind" or "cap" will start blinking and all active capacitor stages will be automatically switched off.
- For a voltage signal loss longer than 30 ms, the regulator will automatically switch off all active capacitor stages and will perform an internal reset.

5.- SETUP MODE**- FIXED PARAMETERS**

- 1.- The Cos φ setting : 1.00
 2.- Connection time Tr / Safety time Ts : 10 s / 50 s (fixed)

- USER-PROGRAMMABLE PARAMETERS

- 1.- C/K setting (reactive current ratio) : from 0.025 to 1 (Directly by means of knobs on the frontal cover).
 2.- Switching sequence : 4 sequences
 3.- Number of output relays : 1.....4

5.2.- REACTIVE CURRENT (C/K SETTING)

To obtain a right performance from the regulator, the user must set the relationship between the rated current of the first capacitor stage and the current transformer that supply the current signal to the regulator. This operation is done by the frontal placed knob marked as **C/K**.

This control can be set by calculation with the following formula :

$$\text{Transformer ratio } \frac{I_t}{5} = K$$

$$\text{Reactive current adjustment } C / K = \frac{I_c}{K}$$

with : I_t = Primary current of C.T. transformer.
 I_c = Current of the first capacitor stage.

Example:

Transformer ratio : $\frac{500}{5} = K = 100$

First capacitor stage: 60 kvar at 400 V $\equiv 86.7$ A

Setting of the C/K current control $C/K = \frac{I_c}{K} = \frac{86.7}{100} = 0.867$



IMPORTANT :

- If the adjustment of the C/K is too low: the regulator can repeatedly switch on/off a capacitor stage at low time intervals.
- If the adjustment of the C/K is too high : No dienergized capacitor stage could be switched on although the preset target $\cos \varphi$ has not been reached.

OTHER SETUP PARAMETERS (see Section 5.5.- SETUP computer-4er)**5.3.-SELECTION OF SWITCHING SEQUENCE (OPERATION PROGRAM)**

The switching sequence of the regulator will depend on the power (kvar) of different capacitor stages that compose the capacitor bank.

| <i>Switching sequence</i> | <i>Description</i> | <i>Example: Capacitor bank arrangement (kvar)</i> |
|---------------------------|--|---|
| 1.1.1.1.1 | All capacitor stages have the same power value | 20 + 20 + 20 + 20 |
| 1.2.2.2.2 | All capacitor stages from the second one have a power value that doubles the first capacitor one | 20 + 40 + 40 + 40 |
| 1.2.4.4.4 | The power value of the second stage doubles the first capacitor one, and the power value of additional stages from the third one is 4 times the first capacitor one. | 20 + 40 + 80 + 80 |
| 1.1.2.2.2 | All capacitor stages from the third one have a power value that doubles the first and second capacitor one. | 20 + 20 + 40 + 40 |

Any of above listed switching sequences can be set (**see Section 5.5.- SETUP computer-4er**). The regulator is set by default at the 1.1.1 switching sequence.

5.4.- SWITCHING DELAY TIME

Delay time (T_r) for switching on/off operations between capacitor stages is by default set at **10 s**, and the safety (reconnection) time at **50 s**.

| | |
|---|---|
| T_r = Switching delay time between two capacitor stages | T_s = Safety time delay between successive switching on/off operation of the same capacitor stage (s). The safety time is 5 times higher than switching delay time between two capacitor stages ($T_s = 5 T_r$) |
|---|---|

When the regulator is powered up, it will wait the safety time (T_s) before switching on the first capacitor stage.

5.5.- SETUP computer-4er

It has been equipped with a configuration system by means of the **set-up** key :



Accessing the setup mode:

- a) To access the **SETUP** mode, the regulator must be powered off, and then, holding pressed key (**set-up**) powered back on. In case of a correct operation, the led "**ind**" will start blinking and then the following options are enabled :

| | |
|-----------------|---|
| C1 ...C4 | setting of the number of output relays |
| 1....4 | Switching sequence setting |

Once one option is accessed, repeatedly pressing the key (**setup**), it is possible to modify the value at the desired one. To pass to the next option just maintain press the key **setup**.

- b) The leds C1..... C4 are on, indicating the **number of output relays** used in the regulator. Use the **set-up** key to modify the number of outputs relays setting: repeatedly pressing the setup key , the number of relays change along C1...C4 , and related leds are on.
- c) To pass to the next option holding pressed key (**set-up**). In case of a correct operation, the led "**cap**" will start blinking and then one led (1, 2, 3 or 4) is on , indicating the setup number of **switching sequence**. Use the **set-up** key to modify the **switching sequence** : repeatedly pressing the setup key , the number of **switching sequence** change along 1 to 4 , and related led are on.

Switching sequence : Any of above listed switching sequences can be set:

| N° of switching sequence | switching sequence |
|--------------------------|--------------------|
| 1 | 1.1.1.1 |
| 2 | 1.2.2.2 |
| 3 | 1.2.4.4 |
| 4 | 1.1.2.2 |



The setup mode can be exited by three means:

- By holding pressed again the key (**setup**) the setup mode is exited and modifications are kept in the regulator internal memory.
- If no key is pressed during more than 50 s, the regulator will perform an automatic reset and no modification will be kept in memory.
- If the regulator is powered off no modification will be kept in memory.

6.- INTERNAL PERFORMANCE OF THE FCP SYSTEM

With data received from the external circuit (voltage and current), the regulator calculates the phase angle and the capacitor value necessary to reach the pre-set target $\cos \phi$. In case that, for instance, the switching sequence is 1.2.2, the regulator will decide, according to the reactive demand, whether the most convenient decision is to connect the first step or directly to switch on a double-power one (this system avoid unnecessary switching operations of the first step) thus increasing the life span of the whole power factor correction unit. Besides, in order to get a uniform wear of the automatic bank, the FCP system keeps in memory the time each capacitor remains switched off, so that when a capacitor is required to be connected, this capacitor will be the one switched off for the longest time.

Example : Required switching operations for a 100 % demand from zero for a regulator set at 4 steps.

FCP SYSTEM

| Steps | 1 | 2 | 2 | 2 |
|----------------|----------|----------|----------|----------|
| 1 ^o | | X | | |
| 2 ^o | | X | X | |
| 3 ^o | | X | X | X |
| 4 ^o | X | X | X | X |


Total number of operations = 4

STANDARD SYSTEM

| Steps | 1 | 2 | 2 | 2 |
|----------------|----------|----------|----------|----------|
| 1 ^o | X | | | |
| 2 ^o | | X | | |
| 3 ^o | X | X | | |
| 4 ^o | | X | X | |
| 5 ^o | X | X | X | |
| 6 ^o | | X | X | X |
| 7 ^o | X | X | X | X |

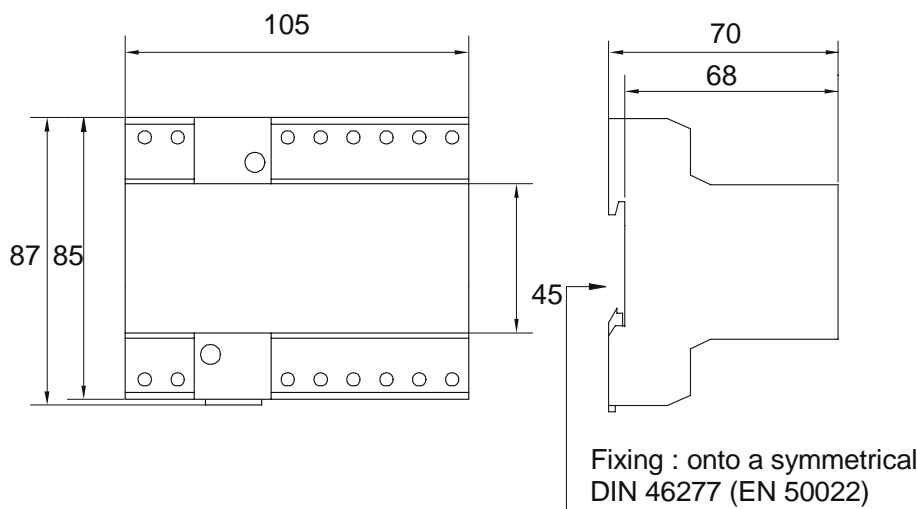
Total number of operations = 7

7.- TECHNICAL FEATURES

| | |
|--|---|
| Supply voltage : | standard : 230 V (computer 4er 230 V) or 400 V a.c. (computer 4er 400 V)  other voltages on request |
| Voltage circuit : Tolerance Burden Frequency | + 15 % / - 15 % 4 VA 45 ... 65 Hz |
| Current circuit : Rated current Permanent overload Short-time overload Burden | Isolated In / 5 A a.c. 2 x In 5 x In during 10 s 0,5 VA |
| Control system | FCP |
| Cos φ setting | 1.00 (fixed) |
| Cos φ indication | 2 leds : ind or cap |
| Switching sequences | 1:1:1:1 / 1:2:2:2 / 1:2:4:4 / 1:1:2:2 |
| Output relays | 4 relays |
| Connection time Tr | 10 s (fixed) |
| Safety time Ts | 50 s (fixed) |

| | |
|---|--|
| <p>Output relay : Maximum voltage U_i Thermal current I_{th} AC11 I_e / U_e DC11 I_e / U_e Max. switching Power Mechanic endurance Electric endurance</p> | <p>277 V c.a. / 30 V c.c. 5 A 2 A / 250 V c.a. 2 A / 30 V c.c. 1385 VA - 150 W 2 x 10⁶ operations 1 x 10⁵ operations (full load)</p> |
| <p>Safety</p> | <p>Installation class III, as per EN 61010. Protection against electric shock by double isolation system (class II equipment)</p> |
| <p>Environmental conditions Working temperature Maximum relative humidity</p> | <p>-10° to +50 °C 95 % no-condensation</p> |
| <p>Standards :</p> | <p>EN 61010, EN 61000-3-2, EN 61000-3-3, EN 50081-2, EN 50082-1, EN 50082-2, EN 61000-4-2, EN 61000-4-4, EN 61000-4-8, EN 61000-4-5, EN 61000-4-11 , UL 94,</p> |

| | |
|-----------------------------------|--|
| Mechanic characteristics : | |
| Connection | Metallic terminals with "posidraft" screws |
| Case material | Self-extinguishing, V0, plastic (UL-94) |
| Protection class | Built-in relay : IP 41 Terminals : IP 20 |
| External dimensions | 105 x 85 x 70 mm. 6 modules relay as per DIN 43 880. (fixing : onto a symmetrical DIN 46 277) |
| Net weight | 0.360 kg |
| Codes : | code 1 11 250 computer 4er 230 V code 1 11 251 computer 4er 400 V |



8.- SAFETY WARNINGS



The user should take into account all installation instructions referred in sections related with INSTALLATION AND STARTUP, CONNECTION INSTRUCTIONS and TECHNICAL FEATURES of the regulator.

Note that with the instrument powered on, the terminals could be dangerous to touching, and cover opening or elements removal actions may allow accessing dangerous parts. The regulator is factory-shipped in proper conditions.

9.- MAINTENANCE

The **Computer 4er** does not require any special maintenance. No adjustment, maintenance or repairing actions should be done over the instrument open and, should those 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 own instrument design permits a quick replacement in case of damage.

10.- TECHNICAL SERVICE

For any inquiry about the instrument operation mode or in case of malfunction, you can contact CIRCUTOR S.A.'s technical service.

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