



AUTOMATIC POWER FACTOR CONTROLLER

MODEL VAR-6A VAR-12A

User's Manual



- Before use, you should read this user's manual carefully to properly operate this device.

Be sure to forward the manual to the end user.

Introduction

Thank you for purchasing Automatic Power Factor Controller.




This instruction manual explains how to install and use Automatic Power Factor Controller VAR series (hereinafter referred to as “device”).




Before use, you should read this user’s manual carefully to properly operate this device.

We recommend that you keep this manual in a safe place for future reference and read it whenever necessary.

Be sure to forward the manual to the end user.

The following marks are used in this manual.


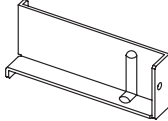

Mark	Explanation
 WARNING	This symbol indicates matters that may lead to death or serious injury if ignored or incorrectly handled.
 CAUTION	This symbol indicates matters that may lead to injury or physical damage if ignored or incorrectly handled.
 NOTE	This symbol indicates precautions to avoid any device failure or to operate this device properly.

Even items described under [WARNING], [CAUTION], or [NOTE] may cause serious results.

In any case, important information that must be observed is explained.

Check on your delivery

Besides the main unit, the following accessories are packaged.

Parts name	Quantity	Specifications
User’s Manual (this document)	1	 A5 size (148 mm × 210 mm)
Embedded Mounting Fittings	2	
Embedded Fixing Screw	2	 (M3 mm × 14 mm)

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Safety Precautions

■ Working Environment and Working Condition

Avoid using this device in the following places. Use in the following places will negatively affect the device lifetime and operations.

Do not;

- Place where the ambient temperature exceeds the temperature range (-5 °C to +50 °C).
- Place where the daily average temperature exceeds 35 °C.
- Place where the ambient humidity exceeds the humidity range (30 % to 85 %).
- Place with a lot of dust, corrosive gas, salt or oily smoke.
- Place with a lot of vibrations or impacts.
- Place where the device may be exposed to rain or drops of water.
- Place exposed to the sun.
- Place where metal pieces and inductive substances are laying around.
- Place with strong electromagnetic field or much outside noise.
- Place higher than 1000 m above sea level.
- If you consider using this device for a special purpose, such as nuclear power plants, electric power aerospace, medical care, passenger vehicles, or systems, consult with our sales representative.

■ Cautionary Instructions for Installation and Connection

Read this User's Manual before using.

CAUTION

- To secure safety, the connecting work should be done by a person qualified in performing electric wiring work.
- Do not perform hot line work. It can cause electrification, device failure or fire.
- At the time of tightening screws and wiring, be careful about the invasions of parings or the electric wire into the device.
- Perform connection after you fully check with the connection diagram. Inappropriate connection can cause electrification, device failure or fire.
- Use electric wires which can comply with the rated current. Using inappropriate wire can cause fire due to heat generation.
- At the time of the resisting pressure examination of the high voltage apparatus, carry out grounding to avoid any negative influence. The device can break down if more than 2000 V is impressed for 1 minute.
- Always earth the ⊕ terminal to the protective earth conductor. Earth the terminal with less than 100 ohm of earth resistance. Otherwise there will be a false operation.

⚠ CAUTION

- Use solderless terminal that comply with the size of the electric wire. (Refer to page 44) Using inappropriate terminals can cause malfunction, device failure / burnout or fire.
- After tightening all the screws, be sure to confirm that all the screws are tightened enough. Leaving any screws loose can cause malfunction, fire or electrification.
- Tighten the screws to the appropriate torque. Tightening to the excessive torque can cause terminal damage. (Refer to page 44)
- In order to prevent the invasion of noise, do not place power line and high voltage line near the input and output signal line or put them together. Make the following distance showed below when power line and high voltage line are parallel to the input signal line.

Condition	Distance
The power line is less than 600 V	More than 300 mm
Other power lines	More than 600 mm

- Do not drop this device from high places.
When the device is dropped, and a LCD is cracked, do not touch and drink the liquid. If you touch the liquid, wash it away with soapy water promptly.
- Do not strongly pull the wire.
If terminal wire is pulled strongly, there is a possibility that an input-and-output terminal can break away.

■ Cautionary Instructions before Use

- Follow the environment and an operating condition in setting place.
- Make settings before use of this device. Read the User's Manual in order to set it correctly.
Inappropriate settings can cause incorrect operation.
- After checking the power supply rating of this device, impress appropriate voltage. (Refer to page 49)

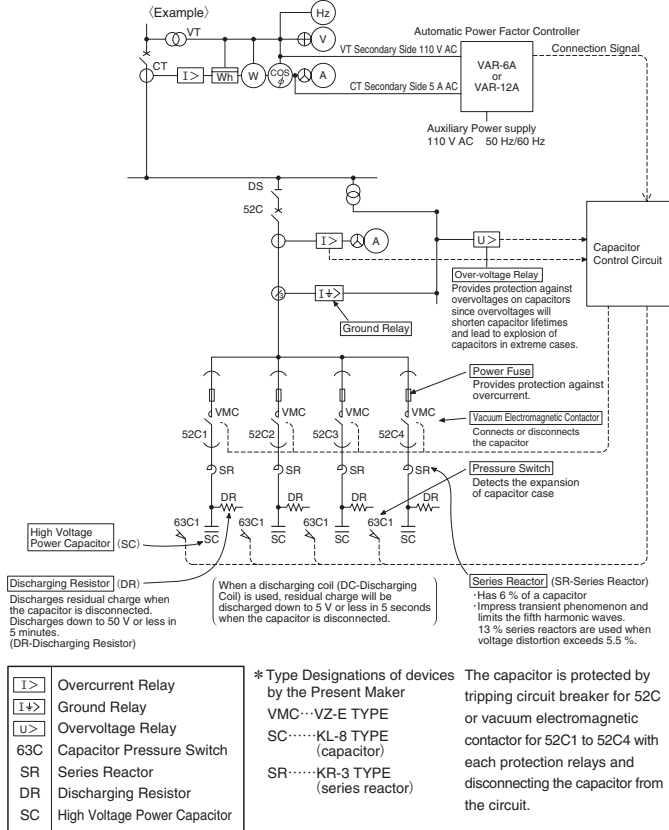
■ Cautionary Instructions for Using

- We cannot take responsibility for the loss, lost profits, and the damage caused in special circumstances. Moreover, we will not take responsibility to the second damage, accident compensation, and the damage to any places other than our product.
- When blackout occurs during setting, it will not be set correctly. After the return of electricity, set it again.

Safety Precautions

Safety Precaution

- Since this device is not equipped with protective functions against overcurrent, overvoltage, ground faults, temperature, or pressure on capacitor, protected circuits must be prepared separately.



CAUTION

- Install series reactor to the capacitor, which is to be automatically controlled by this device.
- This device has a constant excitation system that outputs no voltage 1a contact that continuously keeps on when capacitor control signal is closed, while the contact becomes off when capacitor control signal is opened for each bank. One side of the output signal of from C1 to C6 is COM1 and the other side of the output signal of from C7 to C12 is COM2. When connecting with the vacuum electromagnetic contactor for disconnection and connection of capacitor, be sure to use auxiliary relay such as DC operated type (Model : SRD-T5) or AC operated type (Model : SR-T5) manufactured by Mitsubishi Electric.
- The maximum current must be under 1.5 A on a common terminals.
- In case of using by balanced load, connect at the diagram.
- Circuits set as "Manual ON" or "Manual OFF" will not connect/disconnect capacitor.
- When electric discharge coil is instituted, set Delay Time for 5 minutes.

 **WARNING**

- Set up the applicable delay time to the discharge device of the capacitor (Discharge resistance: over 5 minutes, Discharge coil: over 1 minute), when the connection/disconnection test with the high voltage circuit is carried out. Carry out the test with the delay time set to be shorter than it should can cause capacitor failure accidents.

 **CAUTION**

- Do not dismantle or remodel this device.
It can cause malfunction, electrification or fire.

Safety Precautions

■ Cautionary Instructions for Maintenance and Inspection

- Wipe off surface with a soft cloth.
- Do not allow chemical cloth to contact for a long time or wipe with benzene, thinner or alcohol.
- For correct use of the device, perform the following inspection.
Enforce ④ as a periodic inspection (every half year to 1 year), and ① to ③ as an everyday inspection.

Check to see:

- ① Any damage in the device?
- ② Any Error in the LCD?
- ③ Any unusual sound or smell or fever?
- ④ Any looseness in the installation or terminal block connection?
(Be sure to perform the inspection with the power off.)

■ Storage Precautions

When storing the device, turn off auxiliary power and the power supply of input circuit, remove wiring, and store it in a plastic bag etc. (Please take care of the removed wirings to prevent any accidents.)

Do not store the device for long time in places mentioned below. There is a risk of failure or deterioration in service life.

Do not;

- Place where the ambient temperature exceeds the temperature range (-20 °C to +60 °C).
- Place where the daily average temperature exceeds 35 °C.
- Place where the ambient humidity exceeds the humidity range (30 % to 85 %).
- Place with a lot of dust, corrosive gas, salt or oily smoke.
- Place with a lot of vibrations or impacts.
- Place where the device may be exposed to rain or drops of water.
- Place exposed to the sun.
- Place where metal pieces and inductive substances are laying around.

■ Disposal

- Dispose of this device according to “The law about abandonment and cleaning”.
- Batteries are not used in this device.

■ About the Packing material and the User's Manual

For environmental load reduction,

- Corrugated paper is used on packing material.
- Regenerated paper is used on User's Manual.

■ Term of Guarantee

The period of guarantee is for one year from the purchase date.

Repair is onerous in case you break the device intentionally or by mistake even if it is during the guaranteed period.

■ Recommended renewal time

Exchange cycle will depend on status of use, however update should be carried out in every 10 years.

Operation

1. Features

This device controls input of capacitor automatically with primary voltage and measured primary current.

■ List of Model

Model	Output Function	Input Function
	Capacitor Control Signal	Forced Disconnection Signal
VAR-6A	6 circuits	1 circuit
VAR-12A	12 circuits	1 circuit

2. Functions in each mode

There are following modes in this device.

Operation Mode

Measurement value is indicated with digital number.

The measurement values and capacity (of capacitors) are displayed on this Mode.

Measure Set-up Mode

Set-up of phase/wire type, primary voltage, and primary current are possible.

Set necessary items for operation.

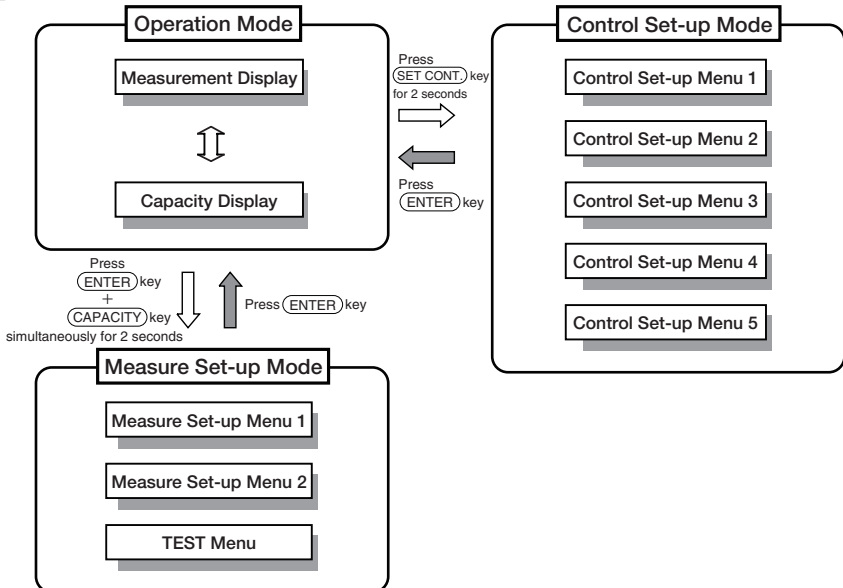
In addition, it can carry out operation tests for connecting/disconnecting.

Control Set-up Mode

Set-up of target power factor, control method, and capacity are possible.

Set necessary items for operation.

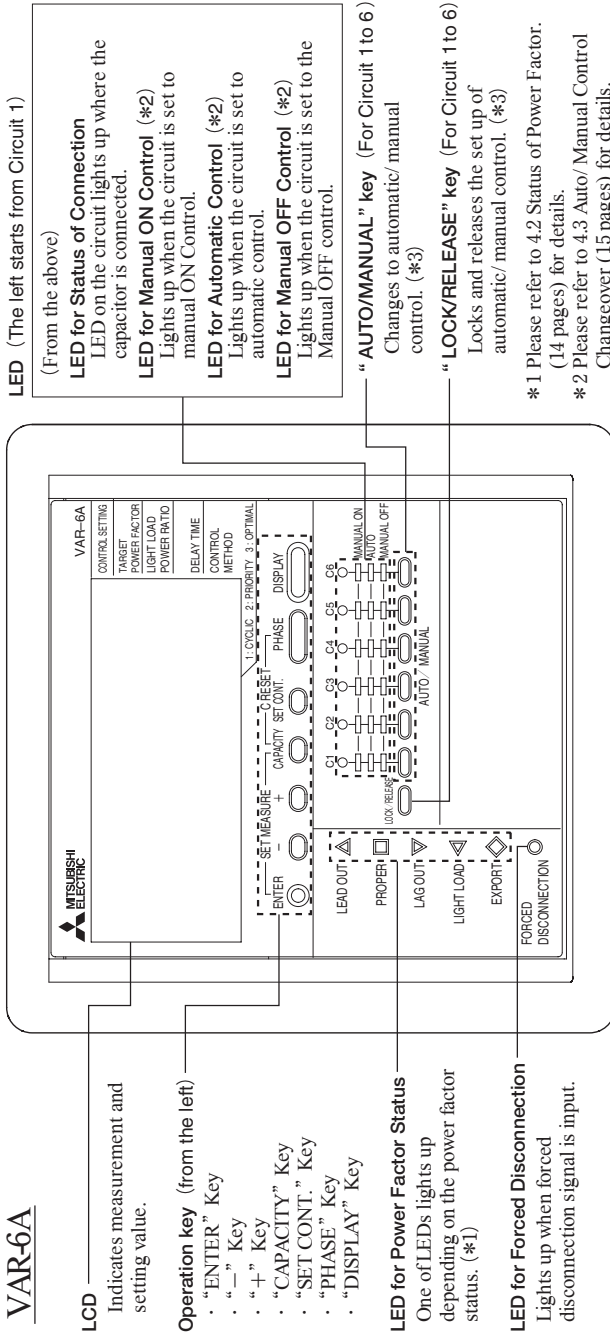
■ Flow of each mode



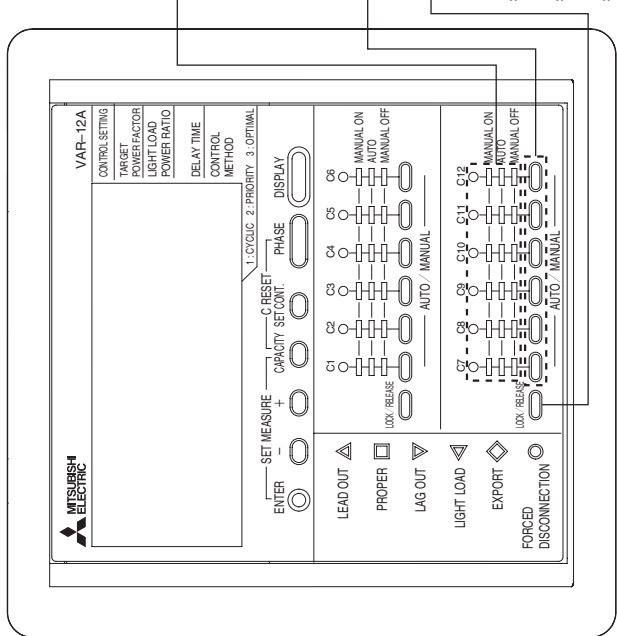
3. Names and Function of Each Part

■ Name and Function of LCD / LED / Operation Key

LCD



VAR-12A



LED (The left starts from Circuit 7)
(From the above)
LED for Status of Connection
LED on the circuit lights up where the capacitor is connected.
LED for Manual ON Control (*1)
Lights up when the circuit is set to manual ON Control.
LED for Automatic Control (*1)
Lights up when the circuit is set to automatic control.
LED for Manual OFF Control (*1)
Lights up when the circuit is set to Manual OFF control.

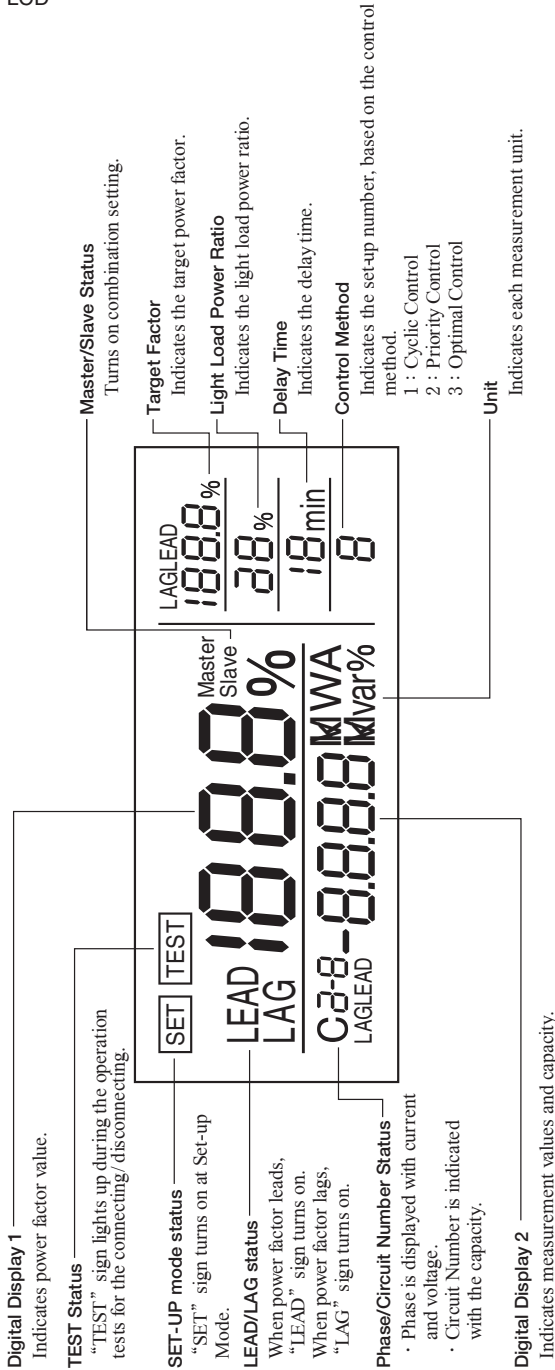
“AUTO/MANUAL” key (For Circuit 7 to 12)
Changes to automatic/ manual control. (*2)

“LOCK/RELEASE” key (For Circuit 7 to 12)
Locks and releases the set up of automatic/ manual control. (*2)

*1 Please refer to 4.3 Auto/ Manual Control Changeover (15 pages) for details.
*2 Please refer to 5.11 Set-up of Auto/ Manual Control (37 pages) for details.
*3 Other parts are the same as VAR-6A.

3. Names and Function of Each Part

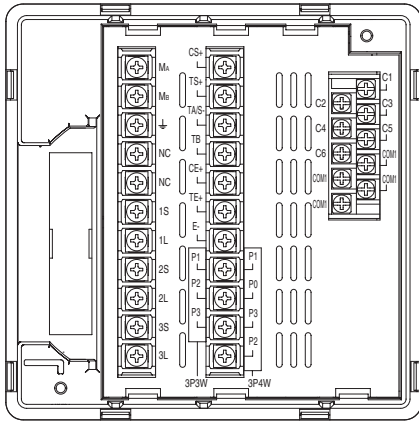
■ Functions of LCD



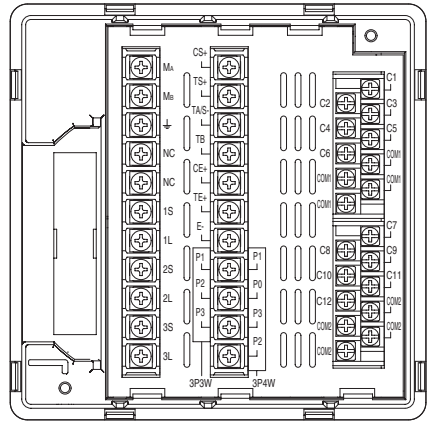
*Since this LCD display is only for the explanation here, the actual displays are different from the above.

■ A Name and the Work of Terminal.

VAR-6A



VAR-12A

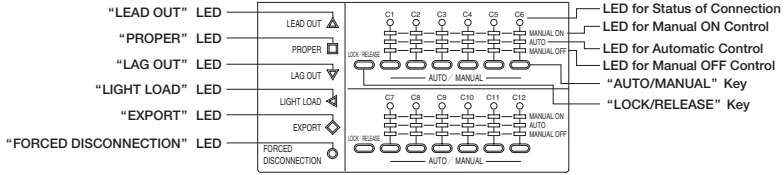


Terminal Name	Terminal Number	Detailed Explanation
Auxiliary Power Terminal	MA, MB	Terminals for inputting auxiliary power for this device.
Earthing Terminal	\perp	Terminal for earthing.
Non-connection Terminal	NC	They are not in use. Please do not connect.
Current Input Terminal	1S, 1L, 2S, 2L, 3S, 3L	Terminals for inputting the current (CT secondary signal) to the measurement circuit.
Connection Disable / Disconnection Disable Input Terminal	CS+, TS+, TA/S-	Connection disable input terminal: CS+ Disconnection disable input terminal: TS+ Disable signal: TA/S- Terminals for inputting the connection disable signal to disable the connection operation. Terminals for disconnection disable signal to disable the disconnection operation.
Forced Disconnection Signal Input Terminal	TA/S-, TB	Terminals for inputting the signal for forced disconnection of capacitor circuits that are closed by automatic control.
Connecting Completion / Disconnecting Completion Output Terminal	CE+, TE+, E-	Connecting completion output terminal: CE+ Disconnecting completion output terminal: TE+ Completion signal common: E- Terminals for outputting connecting completion signal when all the capacitors are connected and disconnecting completion signal when all the capacitors are disconnected.
Voltage Input Terminal	P0, P1, P2, P3	Terminals for inputting the voltage (VT secondary signal) to the measurement circuit. Direct connections can be made in the case of 220 V and 110 V circuit. In 3 ϕ 3W, do not connect to P2 terminal for 3 ϕ 4W.
Control Signal Output Terminal	C1 to C6, COM1 C7 to C12, COM2	Terminals for connecting the signal circuit for capacitor Connection/Disconnection.

4. Explanation of Control and Movement

4.1 Details of Display of Power Factor Status and Auto/Manual Control Changeover

Details of Display of Power Factor Status and Auto/Manual Control Changeover is shown below.



4.2 Status of Power Factor

■ Status Indication of Power Factor

LEAD OUT \triangle : This LED will light up on when Power Factor enters a Lead Out Area.

PROPER \square : This LED will light up on when Power Factor enters a Proper Area.

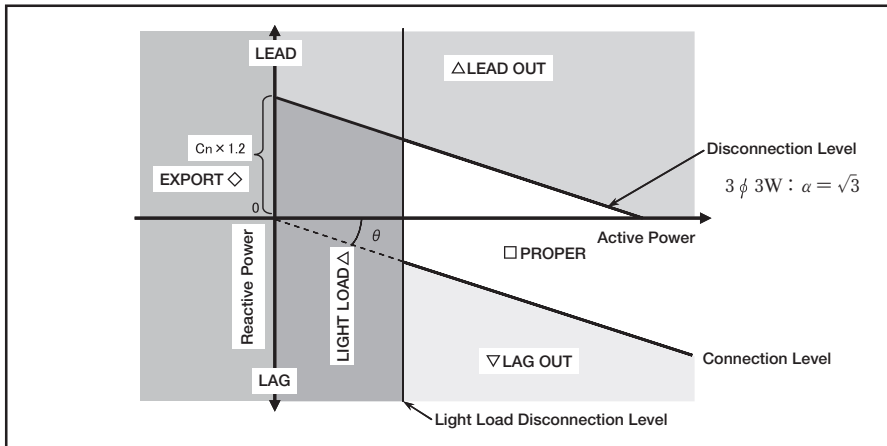
LAG OUT ∇ : This LED will light up on when Power Factor enters a Lag Out Area (Power Factor is less than Target Power Factor).

LIGHT LOAD \lessgtr : This LED will light up on when Power Factor enters a Light Load Disconnection Area.

EXPORT \diamond : This LED will light up on when Power Factor enters a EXPORT Area (power transmission).

FORCED DISCONNECTION \circ :

This LED will light up on when the forced disconnection signal is inputted.



* The display changes based on the moving average deviations within 16 seconds.

· The Connection Level is the target power factor value.

· The Disconnection Level is defined as:

$$(\text{Connection Level}) - (\text{capacity to be disconnected}) \times 1.2$$

· The light load disconnection level is a value calculated as:

$$\alpha \times (\text{primary voltage setting value}) \times (\text{primary current setting value}) \times (\text{Light Load Power Ratio})$$

$$3\phi 3W: \alpha = \sqrt{3}$$

$$3\phi 4W: \alpha = 3$$

4.3 Auto / Manual Control Changeover

A control set-up is possible among “Manual ON”, “Manual OFF”, and “Auto” on each capacitor bank.

Refer to “5.11 Set-up of Auto/Manual Control” (page 37) for the setting method.

(a) “Manual ON” set-up

“Manual ON” set-up (LED for “Manual ON” control lights up) is done by pressing “AUTO / MANUAL” Key, and the control signal for each capacitor will close after the Delay Time passes, regardless of the input conditions.

(b) “AUTO” set-up

“AUTO” set-up (LED for “AUTO” control lights up) is done by pressing “AUTO / MANUAL” Key, and automatic control will start.

If reactive power increases, “LAG OUT” LED lights up, and the control signal of capacitor will close after the Delay Time passes.

If reactive power decreases, “LEAD OUT” LED lights up, and the control signal of capacitor will open after the Delay Time passes.

(c) “Manual OFF” set-up

“Manual OFF” set-up (LED for “Manual OFF” control lights up) is done by pressing “AUTO / MANUAL” Key, and the control signal of capacitor will close for each capacitor immediately, regardless of the input conditions.

- * 1. The Auto / Manual changeover is effective from the instant it is operated; There is no necessary for restarting the device after setting.
- * 2. The “Manual ON” and “Manual OFF” operation is effective even if the connection disable signal or the disconnection disable signal is inputted.
- * 3. After changing the setting from “Manual OFF” to “Auto”, the generation of the capacitor connection signal will not begin until the Delay Time passes.
- * 4. Please set to “Manual OFF” for banks that are not connected to capacitors.

4. Explanation of Control and Movement

4.4 Features of each Control

The features of each control is shown below.

Control name	Feature
Cyclic control	The cyclic control is suitable for controlling capacitors with equivalent capacity. Since the number of the switching operation of the vacuum electromagnetic contactors are made equally, long lifetime can be expected. It is necessary to replace all the contactors at the same time.
Priority control	The priority control is suitable for controlling the different - capacity capacitor group in stable load circuit which use the large - capacity capacitor on base and adjusts changes of reactive power on the small - capacity capacitors. But since the switching of certain vacuum electromagnetic contactors will become more frequent than those of others, maintenance and inspections must be made frequently and each contactor must be replaced at the end of their respective lifetime.
Optimal control	The optimal control is suitable for controlling the different - capacity capacitor groups in the circuit where load fluctuation is frequent. But since the switching of vacuum electromagnetic contactors become frequent and not equal, the maintenance and inspections must be performed frequently and each contactor must be replaced at the end of their respective lifetime.

4.5 Cyclic Control Operation

- In the cyclic control, the number of the switching operation of each capacitor circuit are made equally.
- At the time of turning on the power supply, the connection begins with C1 and proceeds as follows:

→ C1→C2→C3→C4→C5→C6

It operates as follows in the case of 12 circuits.

→ C1→C2→.....→C11→C12

- The disconnection also begins with C1 at the time of turning on the power supply and proceeds in the same manner as the connection:

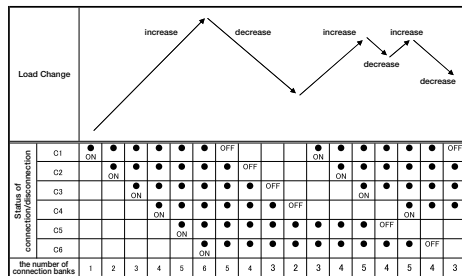
→ C1→C2→C3→C4→C5→C6

It operates as follows at the time of 12 circuits.

→ C1→C2→.....→C11→C12

- The cyclic control is suitable for controlling capacitors with equivalent capacity. Since the switching operation of the vacuum electromagnetic contactors are made equally, long lifetime can be expected. It is necessary to replace all the contactors at the same time.
- When “Combination ON/OFF” set-up is “ON”, a control method serves as only cyclic control.

Cyclic Control Operation



4.6 Priority Control Operation

■ In the priority control method, priorities are attached to the connection and disconnection of each capacitor.

■ Upon turning on the power supply, the connection sequence begins with C1 and proceeds as follows:

C1→C2→C3→C4→C5→C6

It operates as follows at the time of 12 circuits.

C1→C2→.....→C11→C12

■ In the disconnection sequence, disconnection proceeds sequentially, starting from the last capacitor circuit that was closed. In other words, it proceeds in the reverse order of the connection sequence.

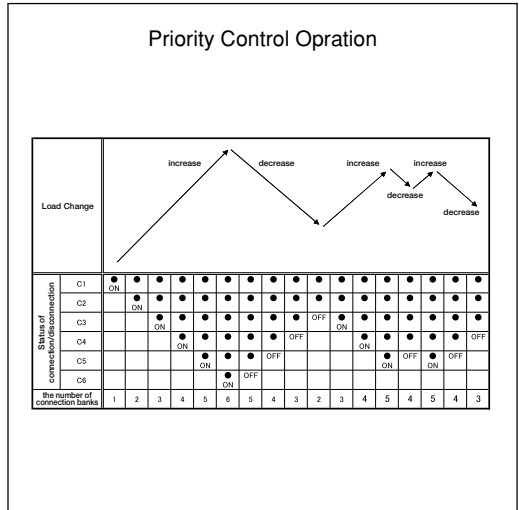
C1←C2←C3←C4←C5←C6

It operates as follows at the time of 12 circuits.

C1←C2←.....←C11←C12

■ The priority control is suitable for controlling the different - capacity capacitor group in stable load circuit which use the large - capacity capacitor on base and adjusts changes of reactive power on the small - capacity capacitors. But since the switching of certain vacuum electromagnetic contactors will become more frequent than those of others, maintenance and inspections must be made frequently and each contactor must be replaced at the end of their respective lifetime.

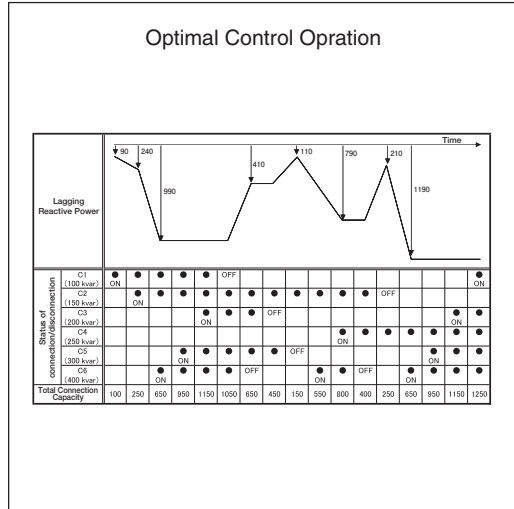
■ Priority control cannot be performed when “Combination ON/OFF” set-up is “ON.” Control method serves as only cyclic control.



4. Explanation of Control and Movement

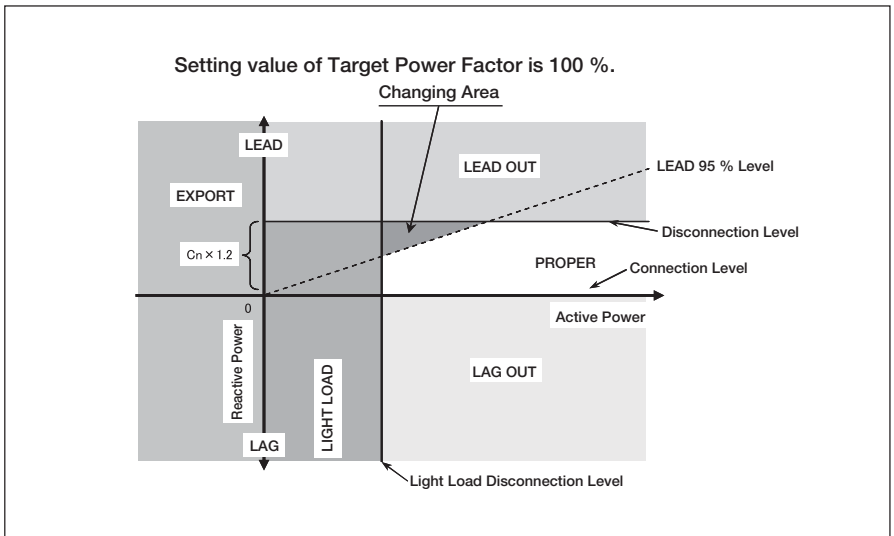
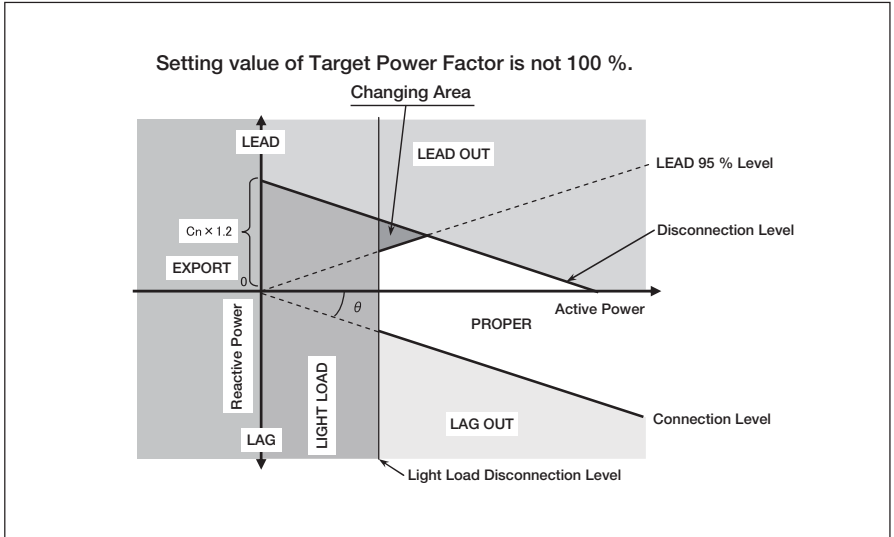
4.7 Optimal Control Operation

- In the optimal control, connection and disconnection is selectively performed for one capacitor circuit with the most appropriate capacity that will keep the lagging reactive power within the target power factor.
- In the connection, capacitors are cut off sequentially in order to decrease capacity until the power factor becomes the closest to the target power factor and the lag is minimized at the same time.
- Capacitors are cut off sequentially in order to decrease capacity until the power factor becomes the closest to the target power factor but it is never below the target power factor.
- The optimal control is suitable for controlling the different - capacity capacitor groups in the circuit where load fluctuation is frequent. But since the switching of vacuum electromagnetic contactors become frequent and not equal, the maintenance and inspections must be performed frequently and each contactor must be replaced at the end of their respective lifetime.
- At the time of turning on the power supply, the device first operates in the cyclic control mode until all capacitors C1 to C6 (It is C1 to C12 at the time of 12 circuits.) are closed. The device then begins the optimal control operations.
- When “Capacity Auto/ Hold” set-up is on “Hold” set-up and each capacity is the same, it becomes cyclic operation.
- The optimal control is not possible when the “Combination ON/ OFF” set-up is “ON.” Control method serves as only cyclic control.



4.8 Capacitor Changing Control at Optimal Control Operation

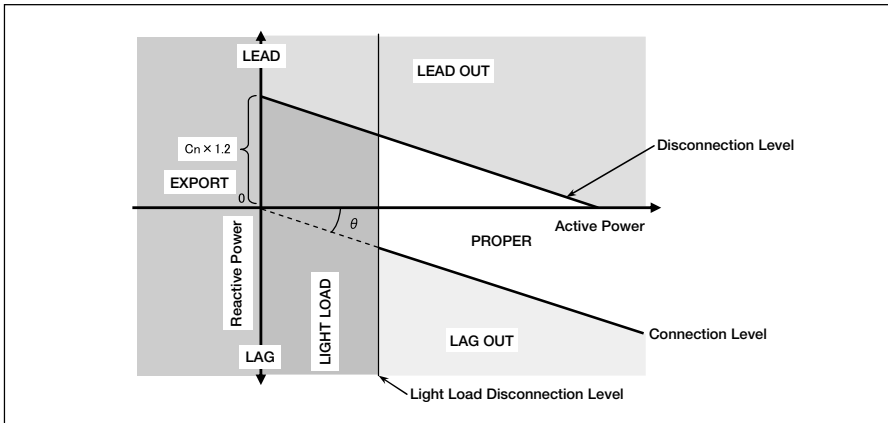
- Optimal control is suitable for circuits with sharp load fluctuation. However, in case the load decreases gradually when multiple capacitors are closed, capacitors will open from the smallest capacity, and the capacitor with the largest capacity will remain last.
- In the area where light load disconnection is not made, the disconnection level is determined by the capacity. Thus this last capacitor will not be cut off.
- When the power factor leads out further than 95 % (Changing Area) in this status, changing control takes place where large capacity capacitor opens and small capacity capacitor closes.



4. Explanation of Control and Movement

4.9 Light Load Disconnection Operation

- In order to prevent overloading under light load conditions, the closed capacitors are sequentially cut off when the load falls below the power value determined from the low load power ratio setting value. (Please refer to page 32 about the calculation formula of the light load power ratio.)
- When the active power decreases and the “LIGHT LOAD” LED lights up and this condition continues for the Delay Time, one capacitor circuit is cut off. Thereafter, one capacitor circuit is cut off each time the Delay Time passes as long as the “LIGHT LOAD” LED lights up.
- When “EXPORT” LED lights up, the same operation as the case when “LIGHT LOAD” LED lights up is carried out.
- The order of disconnecting capacitor is as follow:
 - ① In cyclic control, capacitor circuits are turned OFF. This starts from the first capacitor circuit where the connection signal is outputted. (Disconnection proceeds in the same order as connection.)
 - ② In priority control, capacitor circuits are turned OFF. This starts from the last capacitor circuit where the connection signal is outputted. (Disconnection proceeds in the reverse order of connection.)
 - ③ In optimal control, capacitor circuits are turned OFF in order of the output terminal number. This starts from the lowest terminal number.

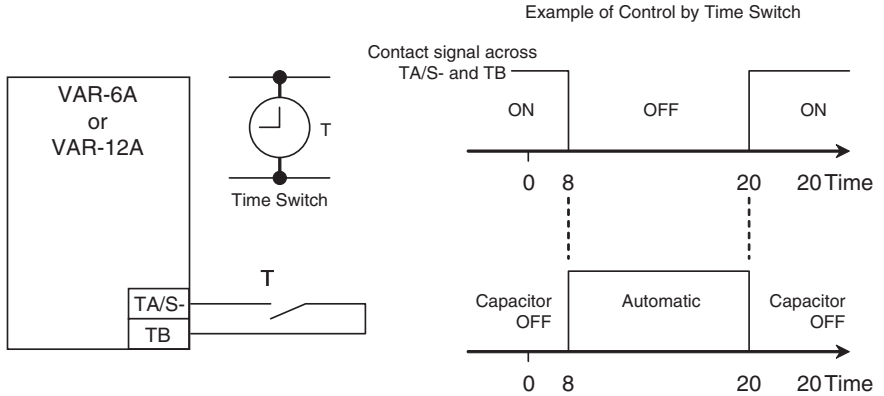


4.10 Forced Disconnection Operation

- Forced disconnect operation is used to open the capacitor circuits when the influence of harmonic interferences is expected, and during nighttime operations.
- Forced disconnection input terminals, “TA/S-” and “TB”, are provided to disconnect the capacitor circuits closed by automatic control.

When these input terminals are cut, all capacitors are cut offsimultaneously.

- When the signal across the input terminals becomes OFF, the control begins.
Please use the applicable for the switching of 5 V, 25 mA DC for shorting.



5. Set-up

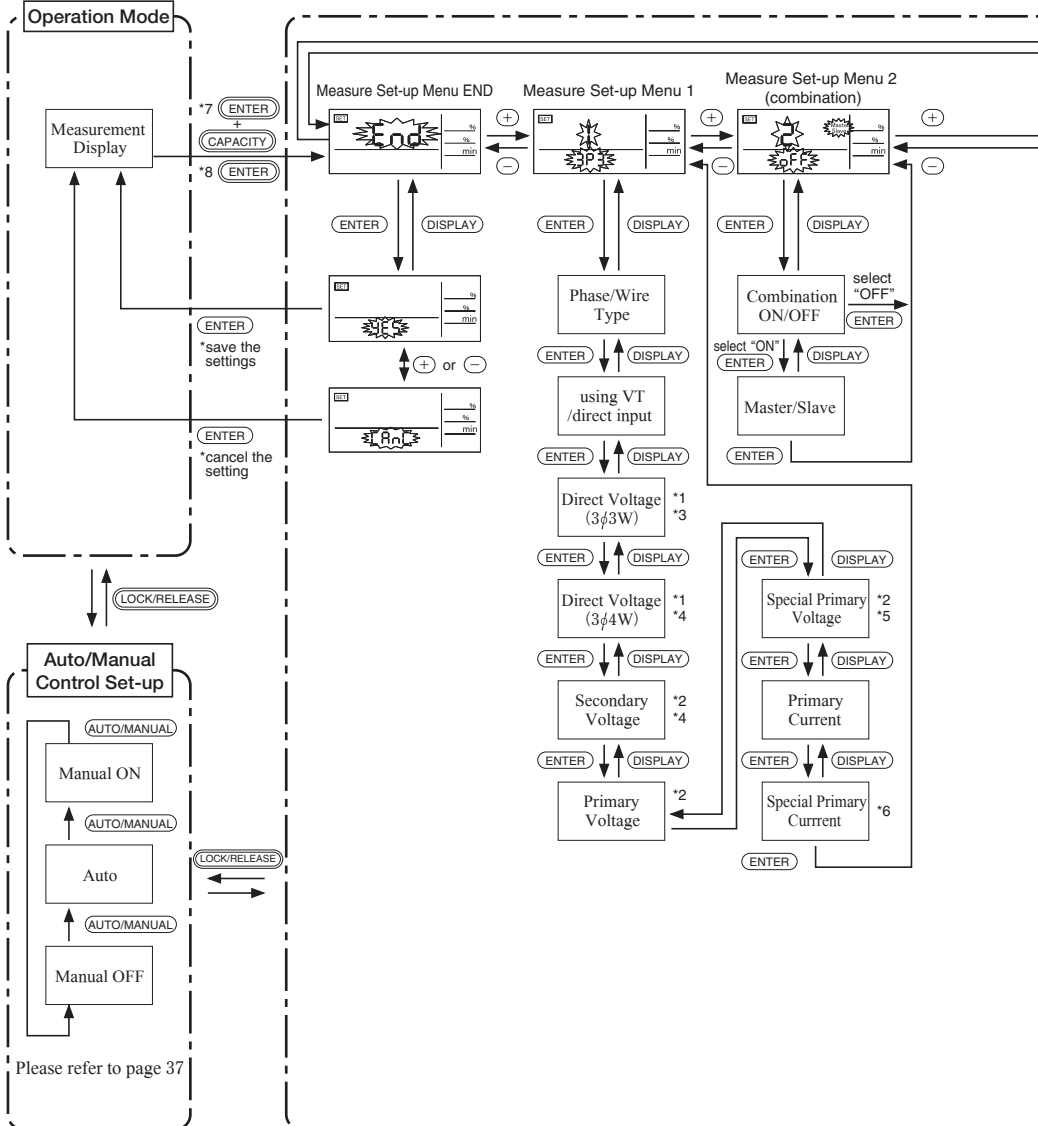
5.1 Flow of Set-up (Measure Set-up Mode)

In order to perform control and measurement, it is necessary to set-up Phase/Wire Type, Primary Voltage, Primary Current, etc. in Measure Set-up Mode.

It changes from Operation Mode to Measure Set-up Mode, and required items are set-up.

The items you do not set up become the initial contents. (Please refer to page 50 for the initial contents.) Please refer to after page 26 for the detailed setting.

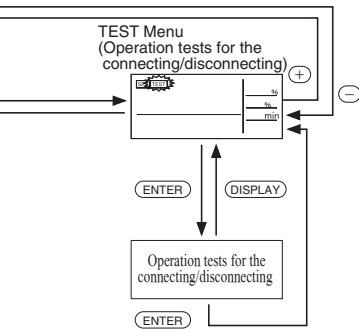
If (ENTER) Key is pressed over 2 seconds, it changes from Operation Mode to The Set Value Confirmation Mode. A setting value cannot be changed in The Set Value Confirmation Mode.



● The setting method

- ① It changes to Measure Set-up Mode by pressing (ENTER) Key and (CAPACITY) Key for 2 seconds simultaneously.
- ② It changes to each set-up menu by pressing (+) Key or (-) Key.
- ③ Set-up in each menu. (Please refer to page 26 to page 29)
- ④ Press (+) Key or (-) Key to set-up each setting value and complete set-up by pressing (ENTER) Key.
- ⑤ Press (ENTER) Key after selecting “Measure Set-up Menu END”, after all the set-ups are completed.
- ⑥ Press (ENTER) Key after changes “yES” Display.

Measure Set-up Mode/The Set Value Confirmation Mode



- *1: This set-up is skipped when a "Using VT/direct input" set-up is "yES".
- *2: This set-up is skipped when a "Using VT/direct input" set-up is "no".
- *3: This set-up is skipped when a "Phase/Wire Type" set-up is "3φ4W".
- *4: This set-up is skipped when a "Phase/Wire Type" set-up is "3φ3W".
- *5: This set-up is skipped when a "Primary Voltage" set-up is except "SP".
- *6: This set-up is skipped when a "Primary Current" set-up is except "SP".
- *7: It changes to Measure Set-up Mode.
- *8: It changes to The Set Value Confirmation Mode.

- Note 1. : Press Key
 : Press Key for 2 seconds

	Motion	Key operation		
Measure Set-up/The Set Value Confirmation	Measure Set-up Menu / Measure Set-up	It changes to the following item after deciding a set-up item.	(ENTER)	press
		Menu change. Setting value moving down.	(-)	press
		Menu change. Setting value moving up.	(+)	press
		It changes to a front item after deciding a setting value.	(DISPLAY)	press
		Setting value moving down. (fast forward)	(-)	Press for 1 second
		Setting value moving up. (fast forward)	(+)	Press for 1 second
		Setting value moving down. (fast forward)	(-)	Press for 3 seconds
		Setting value moving up (fast forward)	(+)	Press for 3 seconds
		It locks or releases an automatic /manual change.	(LOCK/RELEASE)	Press for 2 seconds
		Control ("Manual ON" / "AUTO" / "Manual OFF") of each capacitor circuit is changed.	(AUTO/MANUAL)	press
Measure Set-up Menu END	Measure Set-up Menu END	"YES" Display: It changes to Operation Mode after memorizing the contents of a setting. "CANCEL" Display: It changes to Operation Mode after canceling the contents of a setting.	(ENTER)	press
		A "YES" display and a "CANCEL" displays are switched.	(+)	press
		A "YES" display and a "CANCEL" displays are switched.	(-)	press
		The restart of device. This Key is effective only on a "CANCEL" Display.	(PHASE) + (DISPLAY)	Press simultaneously for 1 second
		It locks or releases an automatic /manual change.	(LOCK/RELEASE)	Press for 2 seconds
Control ("Manual ON" / "AUTO" / "Manual OFF") of each capacitor circuit is changed.	(AUTO/MANUAL)	press		

Note 2. The example of Display of "Measure Set-up Mode" and "The Set Value Confirmation Mode"



(Measure Set-up Mode) (The Set Value Confirmation Mode)

[SET] flickers in "The Set Value Confirmation Mode".

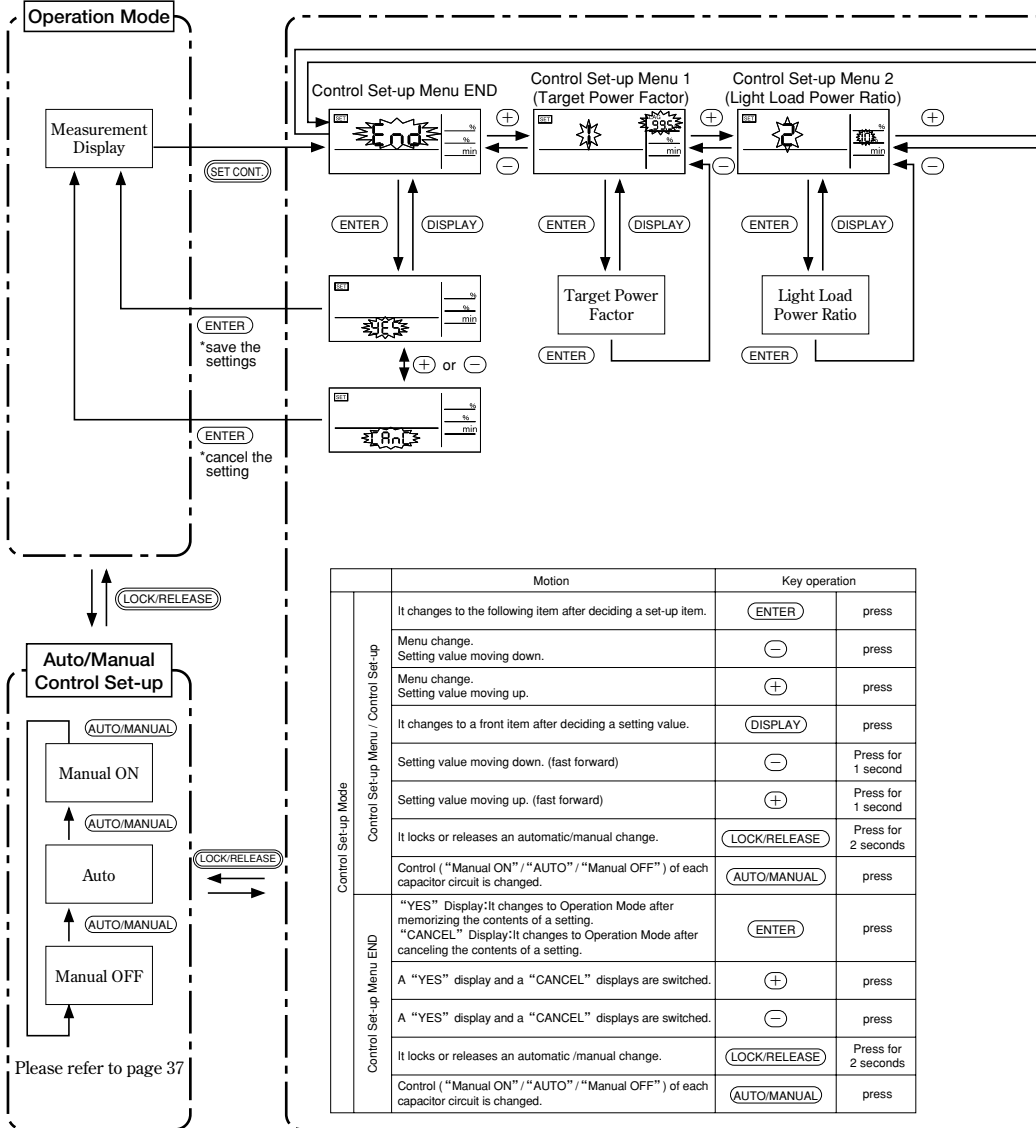
CAUTION

- Please set up "Measure Set-up Menu 1", or check the contents of setting. If the set-up is wrong, the measurement is not appropriately carried out.
- Set-up other items if needed. When it is not set-up, it operates at the initial contents. (please refer to page 50)
- Restart of device will stop measurement (a measurement display and a control output) for several seconds.

5. Set-up

5.2 Flow of Set-up (Control Set-up Mode)

In order to perform the detailed control set-up, it is necessary to set-up Target Power Factor, Delay Time, Capacity, etc. in Control Set-up Mode. It changes from Operation Mode to Control Set-up Mode, and a required item has to be set-up. The items you do not set up are the initial contents. (Please refer to the page 50 for the initial contents.) Please refer to after page 30 for the setting details.



		Motion	Key operation	
Control Set-up Mode	Control Set-up Menu / Control Set-up	It changes to the following item after deciding a set-up item.	ENTER	press
		Menu change. Setting value moving down.	-	press
		Menu change. Setting value moving up.	+	press
		It changes to a front item after deciding a setting value.	DISPLAY	press
		Setting value moving down. (fast forward)	-	Press for 1 second
	Control Set-up Menu END	Setting value moving up. (fast forward)	+	Press for 1 second
		It locks or releases an automatic/manual change.	LOCK/RELEASE	Press for 2 seconds
		Control ("Manual ON"/"AUTO"/"Manual OFF") of each capacitor circuit is changed.	AUTO/MANUAL	press
		"YES" Display: It changes to Operation Mode after memorizing the contents of a setting. "CANCEL" Display: It changes to Operation Mode after canceling the contents of a setting.	ENTER	press
		A "YES" display and a "CANCEL" displays are switched.	+	press
A "YES" display and a "CANCEL" displays are switched.	-	press		
It locks or releases an automatic /manual change.	LOCK/RELEASE	Press for 2 seconds		
Control ("Manual ON"/"AUTO"/"Manual OFF") of each capacitor circuit is changed.	AUTO/MANUAL	press		

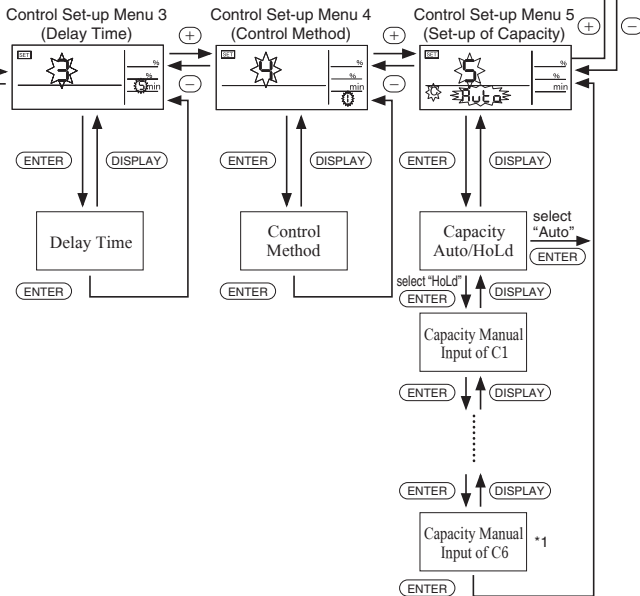
Please refer to page 37

Set-up

● The setting method

- ① It changes to Control Set-up Mode by pressing **(SET CONT.)** Key for 2 seconds.
- ② It changes to each set-up menu by pressing **(+)** Key or **(-)** Key.
- ③ Set-up in each menu. (Please refer to page 30 to page 35)
- ④ Press **(+)** Key or **(-)** Key to set-up each setting value and complete set-up by pressing **(ENTER)** Key.
- ⑤ Press **(ENTER)** Key after selecting “Control Set-up Menu END”, after all the set-ups are completed.
- ⑥ Press **(ENTER)** Key after changing to “yES” Display.

Control Set-up Mode



*1: In VAR-6A, it is C6. In VAR-12A, it is C12.

- Note 1. : Press Key
 : Press Key for over 2 seconds.

CAUTION

- When “Combination ON/OFF” set-up is “ON”, control method becomes cyclic control.
- Set-up other items if needed.

5. Set-up

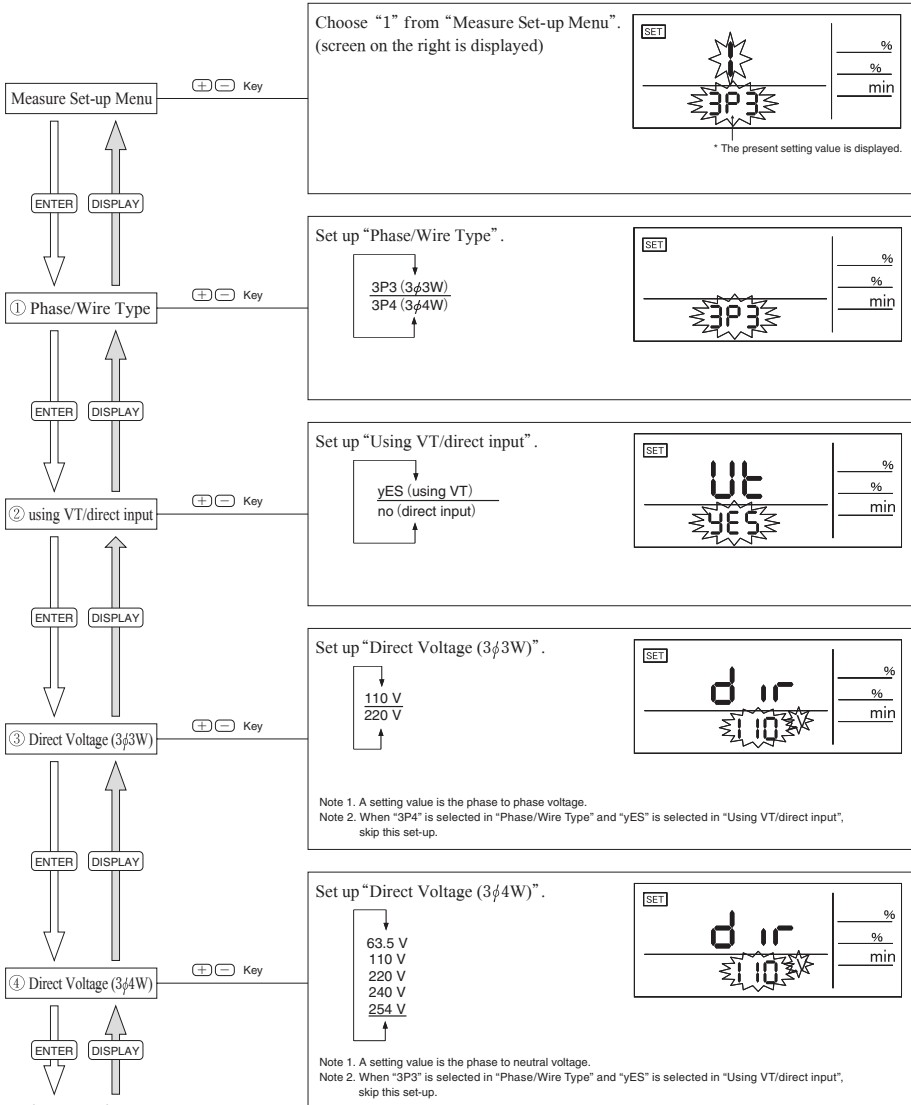
5.3 Measure Set-up Menu 1 (Set-up of Phase/Wire Type · Using VT/direct input · Primary Voltage · Primary Current)

How to set up measurement.

“Measure Set-up Menu END” is displayed by pressing (ENTER) Key and (CAPACITY) Key for 2 seconds simultaneously in Operation Mode.

Furthermore, “Measure Set-up Menu 1” is selected by pressing (+) Key or (-) Key.

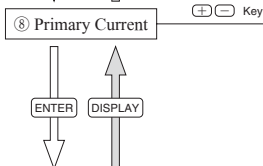
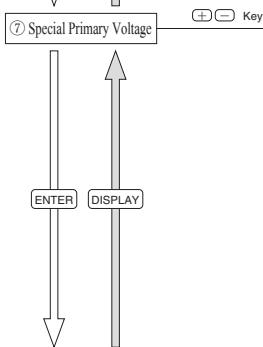
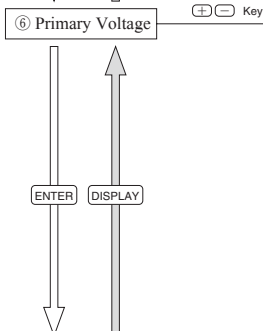
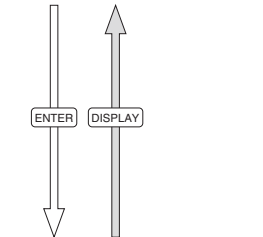
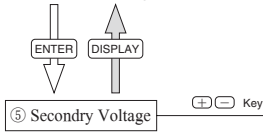
Then, the following set-ups are possible.



continues onto the next pages.

Set-up

From the previous page.



continues onto the next pages.

Set up "Secondary Voltage of VT".

- 63.5 V
- 100 V
- 110 V
- 115 V
- 120 V



Note 1. A setting value is phase to neutral voltage.
 Note 2. When "3P3" is selected in "Phase/Wire Type" and "no" is selected in "Using VT/direct input", skip this set-up.
 Note 3. Secondary voltage on 3φ3W is fixed at 110 V (phase to phase voltage).

Set up "Primary Voltage of VT".

- | | | | |
|--------|---------|--------|--------|
| 220 V | 11 kV | 33 kV | 220 kV |
| 440 V | 13.2 kV | 66 kV | 275 kV |
| 690 V | 13.8 kV | 77 kV | 380 kV |
| 1100 V | 15 kV | 110 kV | 500 kV |
| 2.2 kV | 16.5 kV | 132 kV | 550 kV |
| 3.3 kV | 22 kV | 154 kV | 750 kV |
| 6.6 kV | 24 kV | 187 kV | SP. |



Note 1. In the case of 3φ3W, a setting value shows phase to phase voltage and, in the case of 3φ4W, a setting value shows phase to neutral voltage.
 Note 2. When "no" is selected in "Using VT/direct input", skip this set-up.

Set up "Primary Voltage of VT (special)".

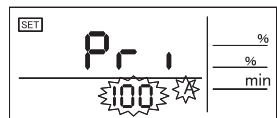
- 220.0 V
- ⋮
- ⋮
- ⋮
- 6.59 kV
- 6.60 kV
- 6.61 kV
- ⋮
- ⋮
- 750 kV



Note 1. When "no" is selected in "Using VT/direct input" or other settings except for "SP" are selected in "Primary Voltage", skip this set-up.
 Note 2. Skipping Set-up will have the third digit to one variable.
 Note 3. In the case of 3φ3W, a setting value expresses phase to phase voltage and, in the case of 3φ4W, a setting value expresses phase to neutral voltage.

Set up "Primary Current of CT".

- | | | | |
|-------|-------|--------|--------|
| 5 A | 50 A | 500 A | 4 kA |
| 6 A | 60 A | 600 A | 5 kA |
| 7.5 A | 75 A | 750 A | 6 kA |
| 8 A | 80 A | 800 A | 7.5 kA |
| 10 A | 100 A | 1000 A | 8 kA |
| 12 A | 120 A | 1200 A | 10 kA |
| 15 A | 150 A | 1500 A | 12 kA |
| 20 A | 200 A | 1600 A | 20 kA |
| 25 A | 250 A | 2000 A | 25 kA |
| 30 A | 300 A | 2.5 kA | 30 kA |
| 40 A | 400 A | 3 kA | SP. |

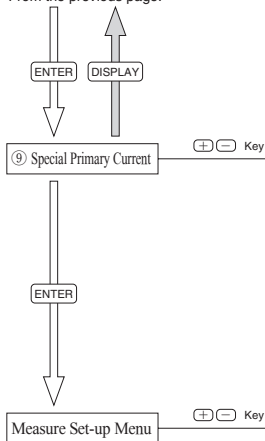


Set-up

5. Set-up

Continuation of Measure Set-up Menu 1

From the previous page.



Set up "Primary Current of CT (special)".

5.00 A
·
·
·
·
·
·
·
99.0 A
100.0 A
110.0 A
·
·
·
·
·
·
30.00 kA



Note 1. When other settings except for "SP" are selected in, skip this set-up.
Note 2. Skipping Set-up will have the two digit to one variable.

Choose whether to complete the set-up refer to page 22 and 23 about how to finish the set-up or to continue other set-up.



* A changed setting value is displayed.

✓ NOTE

When the "Measure Set-up" is changed, all the capacitors which is connecting are cut off and the control starts again.

5.4 Measure Set-up Menu 2 (Setup of Combination)

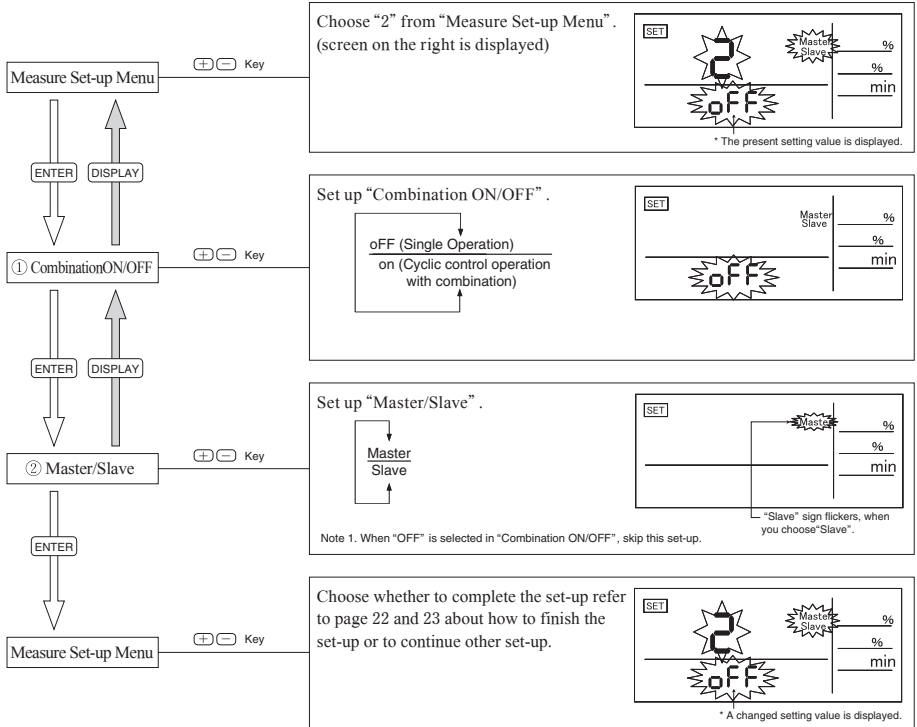
How to set up combination. (When the cyclic control with combination is not used, no this setting change is required.)

Combination setting is used to increase the number of controllable capacitor circuits by using two units of this device with the cyclic control. For details, refer to page 48.

“Measure Set-up Menu END” is displayed by pressing (ENTER) Key and (CAPACITY) Key for 2 seconds simultaneously in Operation Mode.

Furthermore, “Measure Set-up Menu 2” is selected by pressing (+) Key or (-) Key.

Then, the following set-ups are possible.



✓ NOTE

- When “Combination ON/OFF” set-up is “ON”, control method serves as only cyclic control.
- When this Set-up is changed, all the connecting capacitors are cut off and the control starts again.

5. Set-up

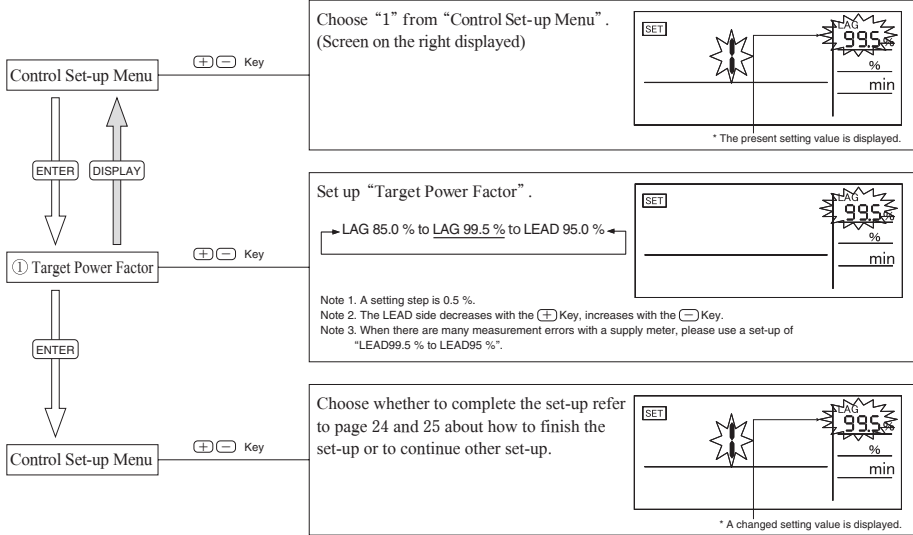
5.5 Control Set-up Menu 1 (set-up of Target Power Factor)

How to set up target power factor.

“Control Set-up Menu End” is displayed by pressing (SET CONT.) Key for 2 seconds in Operation Mode.

Furthermore, “Control Set-up Menu 1” is selected by pressing (+) Key or (-) Key.

Then, the following set-ups are possible.



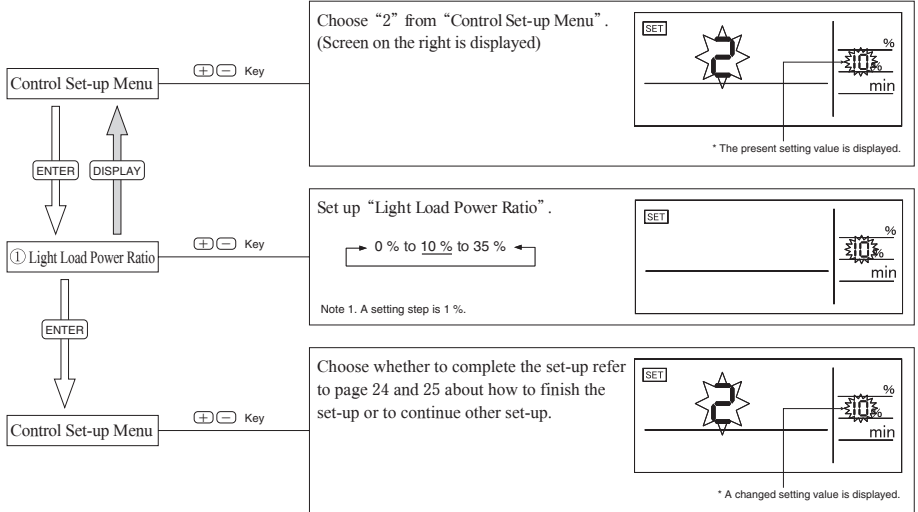
5.6 Control Set-up Menu 2 (Set-up of Light Load Power Ratio)

How to set up light load power ratio.

“Control Set-up Menu END” is displayed by pressing (SET CONT.) Key for 2 seconds in Operation Mode.

Furthermore, “Control Set-up Menu 2” is selected by pressing (+) Key or (-) Key.

Then, the following set-ups are possible.



* Please refer to the following page for the determination method of the setting value of “Light Load Power Ratio”.

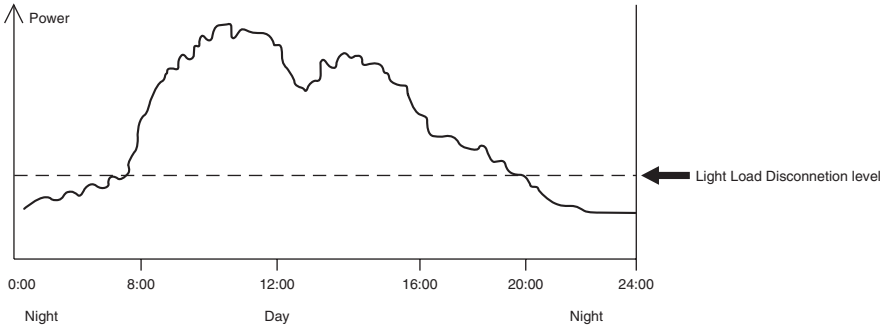
5. Set-up

Continuation of Control Set-up Menu 2

“Light Load Power Ratio” is a setting value for “Light Load Disconnection” of a capacitor.

“Light Load Disconnection” is a function that forces the disconnection of all capacitors when the light load active power falls below the power required by the light load power ratio to prevent power factor from leading out too much.

Please decide the setting value of “Light Load Power Ratio” from power at nighttime based on the daily load curve.



- (a) Calculate “Light Load Disconnection Level” based on the daily load curve.

“Light Load Disconnection Level” is a value about 20 % to 40 % higher than the power at nighttime. Please decide the margin, taking into account load change during night time.

- (b) Calculate “Light Load Power Ratio” .

Calculate the following formula based on primary voltage and primary current.

$$\text{Light Load Power Ratio} = \frac{\text{Light Load Disconnection level}}{\alpha \times \text{Primary Voltage} \times \text{Primary Current}} \times 100(\%) \quad \begin{array}{l} 3 \phi 3W : \alpha = \sqrt{3} \\ 3 \phi 4W : \alpha = 3 \end{array}$$

Example

When “Phase/Wire Type” is 3 ϕ 3W and primary voltage is 6600 V and “Primary Current” is 100 A and Light Load Disconnection Level is 115 kW, “Light Load Power Ratio” becomes as follows.

$$\text{Light Load Power Ratio} = \frac{115 \text{ kW}}{\sqrt{3} \times 6.6 \text{ kV} \times 100 \text{ A}} \times 100 \% = 10 \%$$

Therefore “Light Load Power Ratio” is set at 10 %.

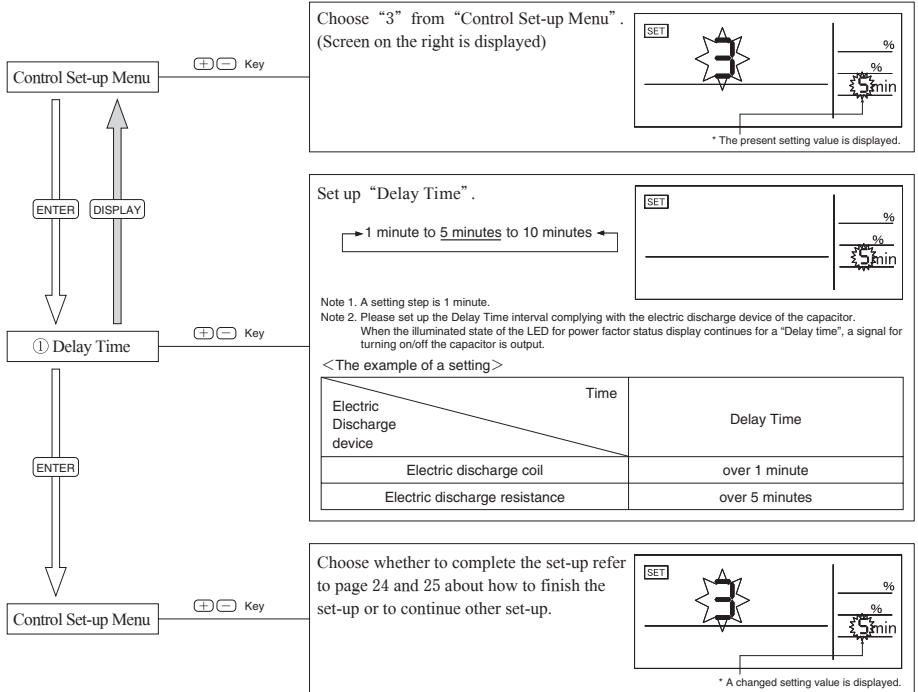
5.7 Control Set-up Menu 3 (Set-up of Delay Time)

How to set up delay time.

“Control Set-up Menu END” is displayed by pressing (SET CONT.) Key for 2 seconds in Operation Mode.

Furthermore, “Control Set-up Menu 3” is selected by pressing (+) Key or (-) Key.

Then, the following set-ups are possible.



5. Set-up

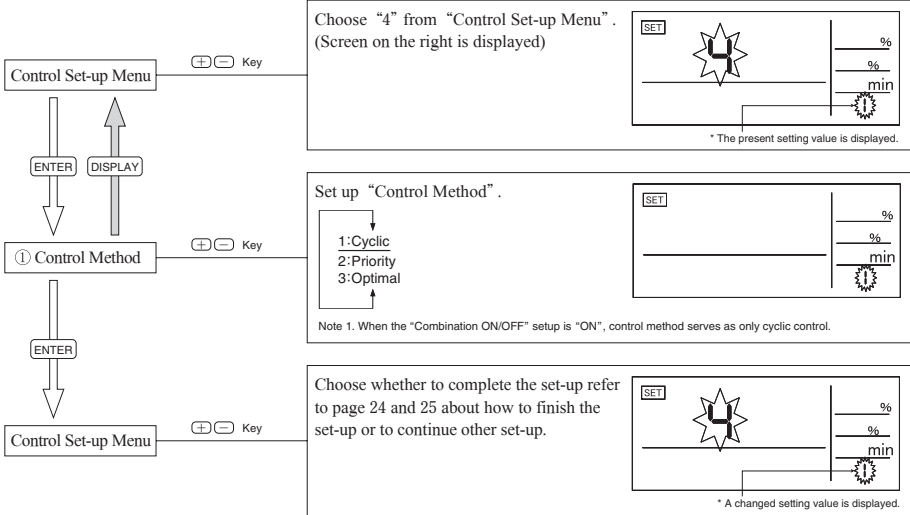
5.8 Control Set-up Menu 4 (Set-up of Control Method)

How to set up control method.

“Control Set-up Menu END” is displayed by pressing (SET CONT.) Key for 2 seconds in Operation Mode.

Furthermore, “Control Set-up Menu 4” is selected by pressing (+) Key or (-) Key.

Then, the following set-ups are possible.



✓ NOTE

- When this Set-up is changed, all the connecting capacitor are cut off and control starts again.
- Please refer to pages 16 to 19 about the operations of each control.

5.9 Control Set-up Menu 5 (Set-up of Capacity)

How to set up Capacity.

A set-up for automatic recognition and manual input of capacity are possible by this set-up.

After the automatic recognition, by setting “HoLd”, automatic recognition is stopped and the capacity recognized automatically is fixed. You can also manually input.

“Control Set-up Menu END” is displayed by pressing (SET CONT.) Key for 2 seconds in Operation Mode.

Furthermore, “Control Set-up Menu 5” is selected by pressing (+) Key or (-) Key.

Then, the following set-ups are possible.

Control Set-up Menu

(+) (-) Key

ENTER

↓

↑

DISPLAY

① Capacity Auto/HoLd

(+) (-) Key

ENTER

↓

↑

DISPLAY

② Capacity (Manual Input)

(+) (-) Key

ENTER

↓

Control Set-up Menu

(+) (-) Key

Choose “5” from “Control Set-up Menu”.
(Screen on the right is displayed)

SET

____ %

____ %

____ min

* The present setting value is displayed.

Set up automatic recognition of capacity or manual setting of capacity.

System	setting method	Hold period
Auto (automatic recognition)	automatic recognition every capacitor connection	Until the next capacitor connection.
HoLd (manual setting)	manual setting in this set-up	Until the next set-up.

Note 1. This device recognizes capacity automatically by the following method.
At the time the capacitor is connected, the changed portion in the reactive power, before and after capacitor connecting, is stored as Capacity. (Can be turned on either automatically or manually.)

SET

____ %

____ %

____ min

Set up capacity for every circuit.

SET

____ %

____ %

____ min

ENTER

↓

↑

DISPLAY

(+) (-)

0

|

9

ENTER

↓

↑

DISPLAY

(+) (-)

0

|

9

Note 1. This set-up is skipped when “Auto” is selected in “Capacity Auto/HoLd”.
Note 2. VAR-6A is the circuit 1 to 6, and VAR-12A is the circuit 1 to 12.
Note 3. The flickering digit can be changed.

Choose whether to complete the set-up refer to page 24 and 25 about how to finish the set-up or to continue other set-up.

SET

____ %

____ %

____ min

* A changed setting value is displayed.

NOTE

The capacity is stored in non-volatile memory and will not be cleared even in the event of power failure.

5. Set-up

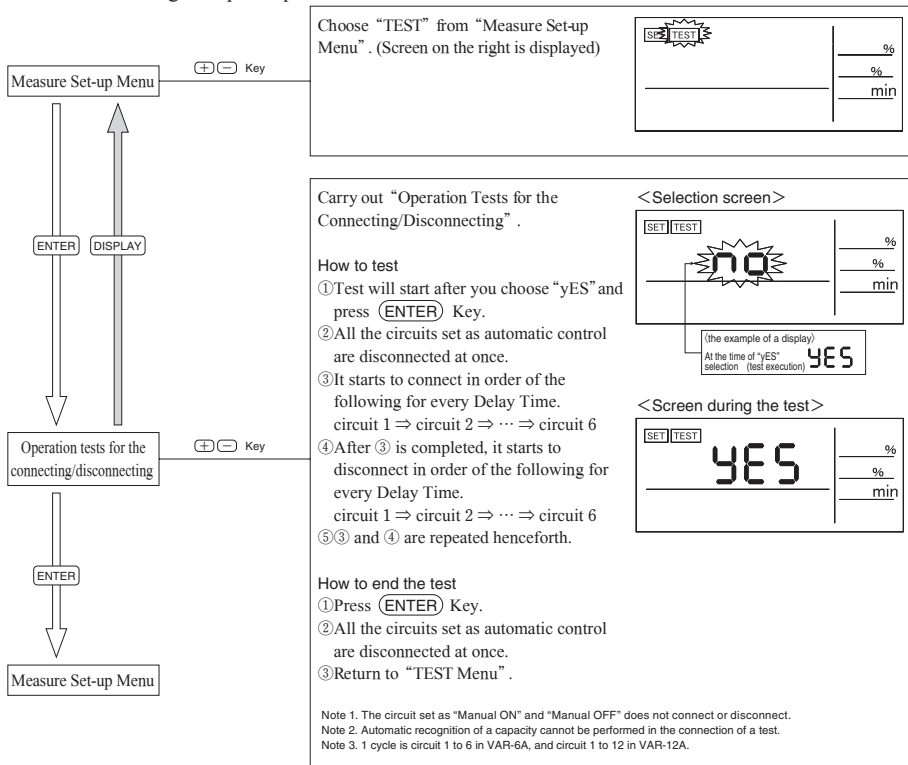
5.10 TEST Menu (Operation Tests for the Connecting/Disconnecting)

How to set up operation tests for the connecting/disconnecting.

“Measure Set-up Menu END” is displayed by pressing (ENTER) Key, and (CAPACITY) Key for 2 seconds simultaneously in Operation Mode.

Furthermore, “TEST Menu” is selected by pressing (+) Key or (-) Key.

Then, the following set-ups are possible.



WARNING

• During “Operation Tests for the Connection/ Disconnection” with the high voltage circuit live, set the “Delay Time” conforming to the capacitor discharge device.

Carrying out the test with “Delay Time” set to be shorter than it should be may cause capacitor breakage accidents.

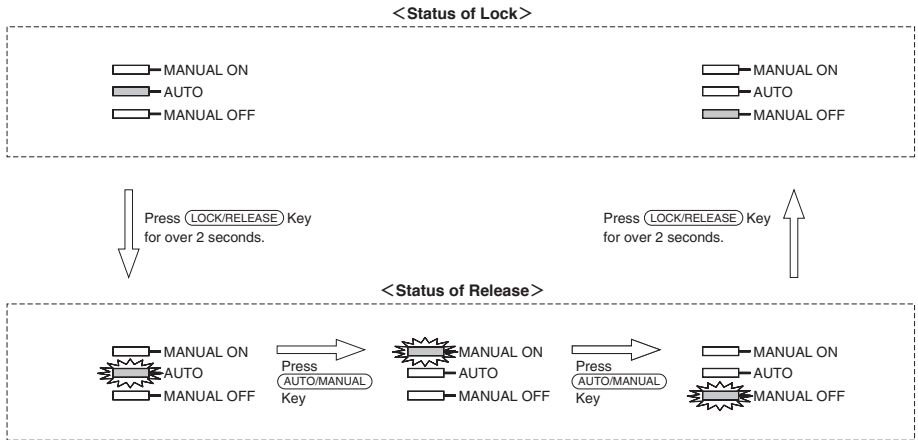
5.11 Set-up of Auto/Manual Control

Change of “MANUAL ON” / “AUTO” / “MANUAL OFF” is performed by pressing the (AUTO/MANUAL) Key of the applicable circuits after status of lock is released.

A status of lock is released by pressing (LOCK/RELEASE) Key for 2 seconds. (LED flickers)

A status of release is locked by pressing (LOCK/RELEASE) Key for 2 seconds again. (LED lights up)

The contents of change are reflected by changing into the Lock status.



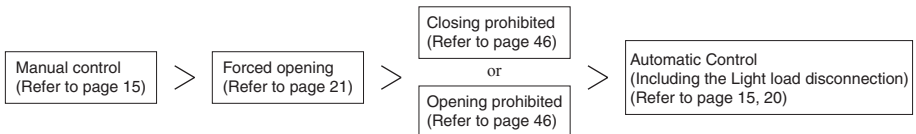
Note 1. A status of release continues, unless a status of Lock is changed.

Note 2. In a status of release, the device is controlling by the previous setting.

Note 3. The (LOCK/RELEASE) Key lock and release circuit 1 to 6 or circuit 7 to 12 by package.

5.12 Priority Order of Control

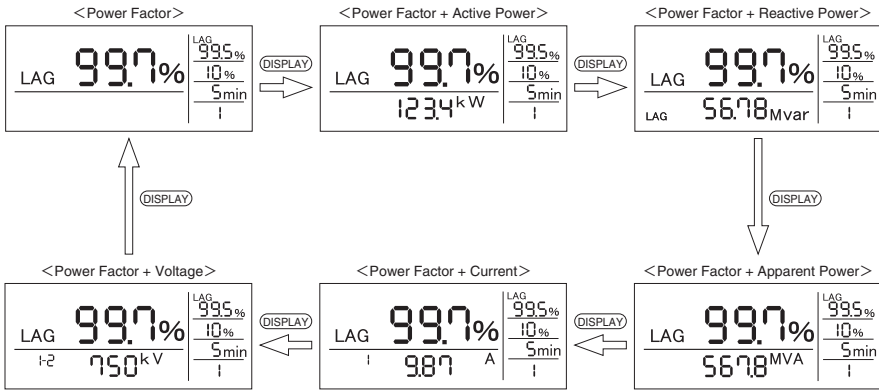
The priority order of control is as follows.



6. Operation

6.1 Changing of the Display

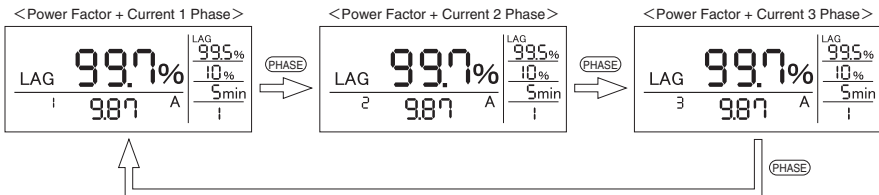
The display element switches by pressing (DISPLAY) Key.



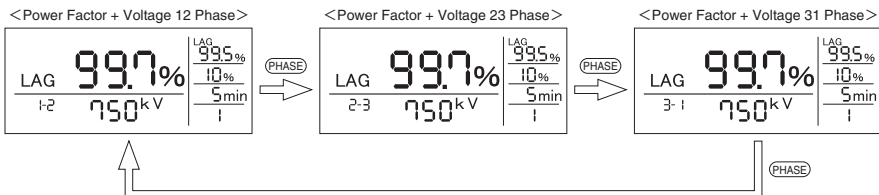
6.2 Changing of the Phase

The display element of current phase or voltage phase switches by pressing (PHASE) Key.

<Example of display change (current)>



<Example of display change (voltage)>



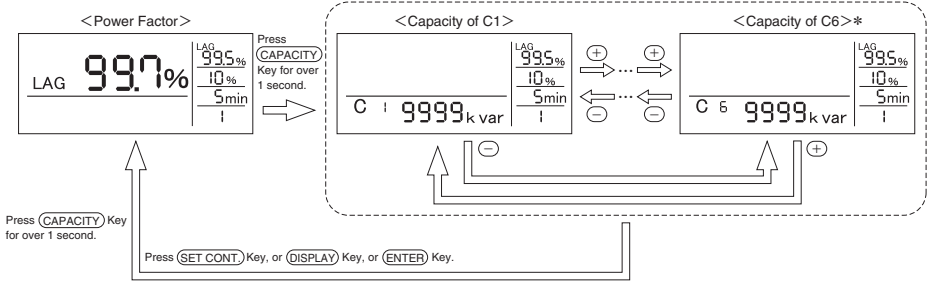
*1. In 3φ4W, display of phase is "1-n" or "2-n" or "3-n".

✓ NOTE

- A display of voltage changes by "Phase/Wire Type".
 - { 3φ 3W : phase to phase voltage
 - { 3φ 4W : phase to neutral voltage

6.3 Display of Capacity

In the Measurement display, the memorized capacity is displayed by pressing **(CAPACITY)** Key for 1 second. Furthermore, The capacity display of each circuit is displayed by pressing **(+)** Key or **(-)** Key. Then, the following set-ups are possible.



*VAR-6A is the circuit 1 to 6, and VAR-12A is the circuit 1 to 12.

6.4 Reset of Capacity

When “Capacity Auto/HoLd” set-up is “Auto”, capacity set as “Auto” can be reset by pressing **(CAPACITY)** Key and **(PHASE)** Key for 2 seconds simultaneously in Display of Capacity. However, capacitor circuits set as “Manual ON” or “Manual OFF” can not be reset. In addition, when “Capacity Auto/ HoLd” set-up is “HoLd”, capacity set as “Auto” can not be reset.

7. Others

7.1 Operation

■ Operation of device other than “Operation Mode”

Status	Measurement	Display		The output point of contact for capacitor control
		Measurement (LCD)	Power Factor Status (LED)	
For several seconds after the auxiliary power supply injection	A measurement is not possible.	No display.		All the circuits are “open” .
Set-up Mode	A measurement is possible	No display.	The same operation as Operation Mode	The same operation as Operation Mode
During a blackout	A measurement is not possible.	No display.		All the circuits are “open” .
Second blackouts more than 3 cycles	A measurement is not possible.	No display.		All the circuits are “open” .

When a blackout occurs, the operation of this device will stop, and all displays on this device will disappear, all the output point of contact for capacitor control become “open”. When the power supply revives, the new start of the capacitor control action is carried out from C1.

■ Device operation by the input power supply status

Measurement display		
Power Factor	The display of power factor becomes 100 %, when the display of voltage is “0 V” , or when the display of current is “0 A” .	—
Current	The display of current becomes “0 A”, when Input current is less than 0.4 % of rated current.	More than 9999 shows 9999.
Voltage	The display of voltage becomes “0 V”, when input voltage” is less than “6 V” .	
Active Power	The display of active power becomes “0 W”, when the display of voltage is “0 V” , or when the display of current is “0 A” .	
Reactive Power	The display of reactive power becomes “0 var” , when the display of voltage is “0 V” , or when the display of current is “0 A” .	
Apparent Power	The display of apparent power becomes “0 VA” , when the display of voltage is “0 V” , or when the display of current is “0 A” .	

■ Notes in case of combination

- (1) In the following case, please set “Combination ON/ OFF” to “OFF” by the side of a master.
 - ① When the slave side breaks down, or the auxiliary power supply by the side of a slave is OFF.
 - ② When the capacitor control by the side of a slave is set as all the circuit manual operation.
- (2) When forced disconnection signal is used, please connect with both a master and a slave.

7.2 Troubleshooting

If unusual sound, smell, emitting smoke, or fever occur from the device, turn off the power immediately. If there is a problem, confirm the following points before taking out to repair.

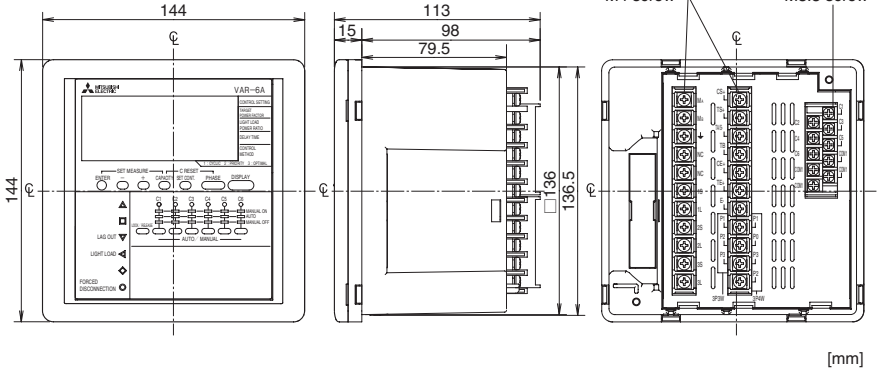
	Phenomenon	Possible causes	Countermeasure
Operation	Setting value in Measure Set-up can not be changed.	Mode is "The Set Value Confirmation Mode".	Please return to Operation Mode and change the setting value on Measure Set-up Mode.
	Capacity cannot be cleared.	"AUTO/MANUAL" set-up is "Manual ON" or "Manual OFF".	Reset capacity after setting "AUTO/MANUAL" to "Auto".
		"Capacity Auto/HoLd" set-up is "HoLd".	Reset capacity after setting "Capacity Auto/HoLd" to "HoLd".
Display	Display does not light up.	Auxiliary power is not impressed between MA and MB.	Impress auxiliary power between MA and MB.
		Inside power supply is out of order.	It cannot be repaired by the customer. Contact to the service network.
	Display does not light up immediately.	It is normal. Initialization of an internal circuit is performed after the auxiliary power supply injection.	Keep using.
	LCD display becomes black.	It may become black under the influence of static electricity.	After a while, it will disappear.
	"END" display is kept on the display.	Setting has not been completed.	Press the ENTER Key.
Output point of contact	"E**" is kept on the display. (** is 01 to 05.)	An error is occurring in this device.	Turn on the auxiliary power again. If the display is not changed even after reinjection, contact to the service network.
	Capacitor Connection Signal is output, although load becomes leading power.	1. The polarity of VT connection is wrong. 2. The polarity of CT connection is wrong. 3. The wrong phase is inserted to the detection VT. 4. The wrong phase is inserted to the detection CT.	Check the wiring.
	Capacitor Disconnection Signal is output, although load becomes leading power.		
	Capacitor is not disconnected although "LEAD OUT" LED lights up.	The terminals for the disconnection disable signal (TS+ and S-) are shorted.	Check the wiring.
	Capacitor is not connected although "LAG OUT" LED lights up.	1. Connection disable signal (CS+ and S-) are shorted. 2. Forced disconnection signal (TA/S- and TB) are shorted.	
	"LAG OUT" LED does not light up and capacitor is not connected, although power factor lags target power factor.	Light Load Disconnection Area	Check "Light Load Power Ratio".
		Export Area	Check the wiring.
Capacitor repeats connection and disconnection.	"Capacity Auto / HoLd" is "HoLd" and The setting value of all the capacity manual input become "0 kvar". Or the wrong value is set-up.	Check the set-up.	

■ After-sale service

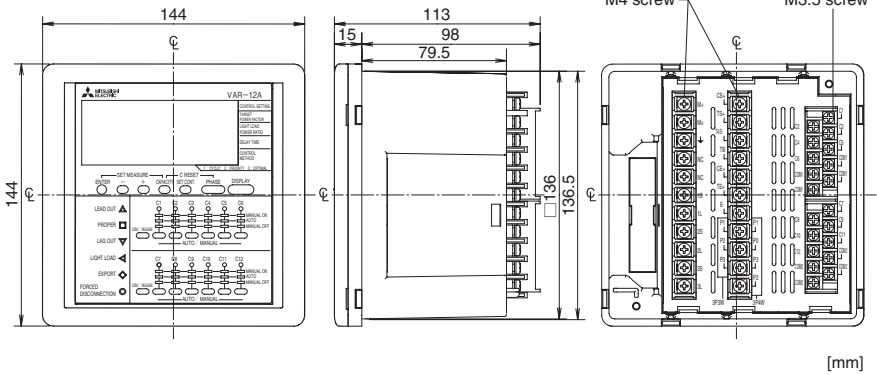
When there is an unclear point or when the device breaks down, please contact to the service network. (See the back cover of this User's Manual.)

Installation 1. Dimensions

VAR-6A



VAR-12A

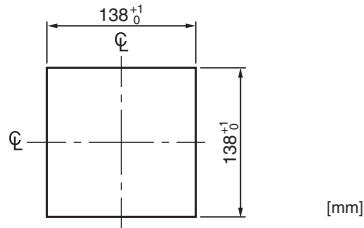


Installation 2. Attachment

1 Panel Cutout

Cut out the panel like the below.

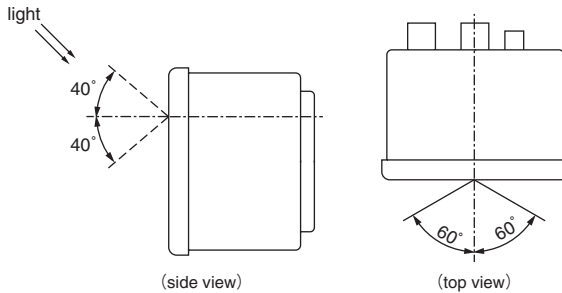
Panel Cutout (It is possible to attach the device on a board from 1.6 mm to 4 mm.)



2 Attachment Location

Contrast of LCD changes if looked at different angles.

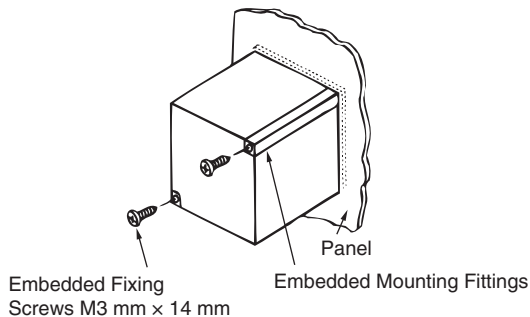
The optimal angle is as follows. Attach the device to the panel with the optimal angle.



3 Attachment Method

Put the device onto the panel surface from the front side and fix it by using embedded mounting fittings and fixing screws (2 places)

Tighten the fitting screw to the torque from 0.61 to 0.82 N·m.



NOTE

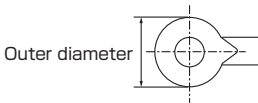
At the time of attaching this device at the edge of the board, decide attachment location in consideration for the wiring space.

Installation 3. Wiring

1 Solderless Terminal

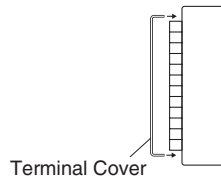
Use solderless terminal that comply with the size of the electric line.

	Connecting Completion Output terminal Disconnecting Completion Output terminal Connection Disable Input terminal Disconnection Disable Input terminal Forced Disconnection Signal terminal Current Input terminal Voltage Input terminal Auxiliary Power terminal	Control Signal Output terminal
Screw Specification	M4 screw	M3.5 screw
Solderless Terminal	For M4 screw of outer diameter below 8.5	For M3.5 screw of outer diameter below 7.1
Tighting Torque	0.98 N·m to 1.47 N·m	0.61 N·m to 0.82 N·m



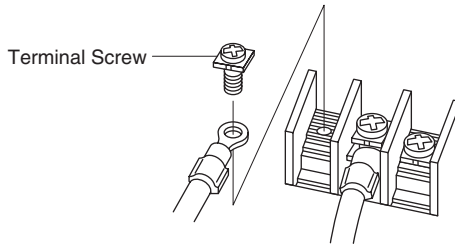
2 Terminal Cover

- ① Insert the terminal cover for power supply into the terminal stand as shown in the right figure.
- ② Since the terminal cover for input and output has structure to open, close it.



3 Wire connections

Tighten a terminal screw on the terminal stand.



⚠ CAUTION


Do not connect three or more electric wires to one terminal. It can generate heat and cause a fire.

4 Checking


Check that there is no mistake in wire connections after completing wire connection.

5 Terminal cover attachment

After checking, close the terminal cover till it makes clicking sound.

 CAUTION	<p>Do not perform hot-line jobs.</p>
	<p>Do not perform hot-line work. It can cause on electrification electric burn, fire and damage by fire on apparatus. Installation of protection fuse etc. is recommended to VT and auxiliary power.</p>
	<p>Do not open the secondary side of CT circuit.</p>
	<p>Correctly connect the secondary side signal of CT to the CT connection terminal. Incorrect connection of CT or disconnection of the secondary side of CT induces high voltage on the secondary side. It can cause insulation breakdown of the secondary winding which can result in burnout accidents.</p>
	<p>Do not short circuit the secondary side of VT.</p>
	<p>Correctly connect secondary side signal of VT to the VT connection terminal. Incorrect connection of VT or short circuiting in the secondary side of VT causes excessive current to pass in the VT secondary side. It can cause burnout of the secondary winding which can result in insulation breakdown of the primary winding and inter phase short-circuiting in the end.</p>
	<p>Connect electric wire certainly to a terminal.</p>
	<p>If the connection to a terminal is not as tight as it should be and result in a measurement mistake.</p>
	<p>Do not forget wiring of “1L”, “2L” and “3L” for pass.</p>
	<p>When the L side of CT circuit is common wire in “3ϕ4W”, it is necessary to short-circuit “1L”, “2L” and “3L” terminal of this device. In the case of 3ϕ3W, “1L” and “3L” should be short circuited.</p>
<p>Do not use unsuitable electric wire.</p>	
<p>Electric wire size should be suitable for rated current and rated voltage. Use of unsuitable electric wire can cause a fire.</p>	
<p>Do not strongly pull the wire.</p>	
<p>If terminal wire is pulled strongly, there is a possibility that an input-and-output terminal can break away. Tensile load is less than 39.2 N.</p>	
<p>Attach a terminal cover.</p>	
<p>Attach a terminal cover. If it is not attached, it can cause electrification.</p>	
<p>Do not impress unusual voltage.</p>	
<p>At the time of the resisting pressure examination of the high voltage apparatus, carry out grounding to avoid any negative influence. The device can break down if more than 2000 V is impressed for 1 minute .</p>	
<p>Do not connect to Non-connection terminal.</p>	
<p>Do not connect to Non-connection terminal for the purpose of relay etc.</p>	

Auxiliary Power

 CAUTION	<p>Impress the appropriate voltage to auxiliary power.</p>
	<p>Impress the right voltage to auxiliary power. If inappropriate voltage is impressed, it can cause a fire or breakdown of the device.</p>

Installation 4. Wiring Diagram



To secure safety, the connecting work should be done by a qualified person in electric wiring work. (electrician)

1 Connection with vacuum electromagnetic contactor for capacitor switching.

This device has a constant excitation system that outputs no-voltage 1a contact at each bank that keeps continuously ON at connection and continuously OFF at disconnection as a capacitor control signal.

Upon connecting with the vacuum electromagnetic contactor for capacitor switching, be sure to use auxiliary relay. (Refer to the connection with auxiliary relay C1 to C6 in page 47.)

Use the counter electromotive force absorption diode built-in relay as the auxiliary relay for DC (100 V DC).

2 Reversed Phase

This device operates on reversed phase without changing the wire connections.

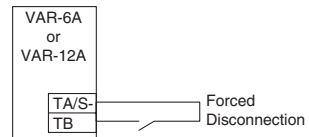
3 Forced Disconnection Signal

- When ON signal is input on the forced disconnection signal terminal TB and terminal TA/S, all the connecting capacitors in automatic control are disconnected.
- When OFF signal is input on terminal TB and TA/S, the control operation restarts.
- Use input contacts suited for the switching of 5 V, 25 mA DC.

*This signal can be used for the following applications.

- ① To disconnect the capacitor by an external time switch for purpose of avoiding leading-out of power factor during night time.

Our recommended type:
 skip-day-type TSE-2SB Series
 weekly-type TSE-2WB Series

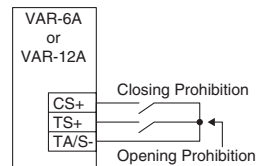


- ② To disconnect the capacitor for purpose of protecting the capacitor and the reactor, when content rate of harmonics is rising by use of a harmonic meter, etc.

Our recommended type:
 ME110SSR-HAH

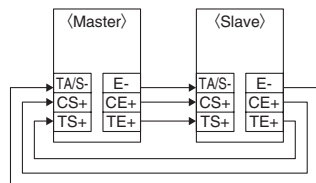
4 Closing Prohibition Signal · Opening Prohibition Signal

- When an ON signal is inputted across the closing prohibition signal terminal CS+ and terminal TA/S-, the closing control of capacitors is stopped. Also, when an ON signal is inputted across the opening prohibition signal terminal TS+ and terminal TA/S-, the opening control of capacitors is stopped. Control operations are restarted when the input signal becomes OFF. Please use input contacts adapted for the switching of 5 V, 15 mA DC.

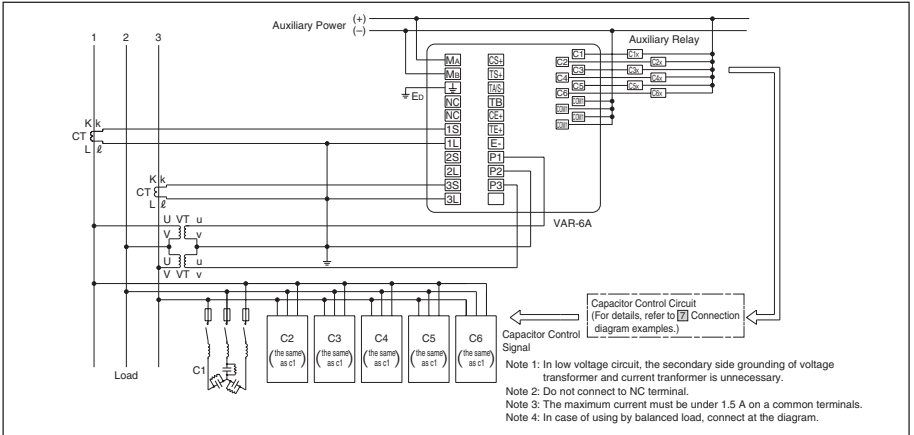


5 Combination

- At the time of 2 set combination use, do use connecting completion terminal (CE+), disconnecting completion terminal (TE+), completion terminal (E-), connection disable terminal (CS+) and disconnection disable terminal (TS+).
- When “Combination ON/OFF” set-up is “ON”, the cyclic control operates.



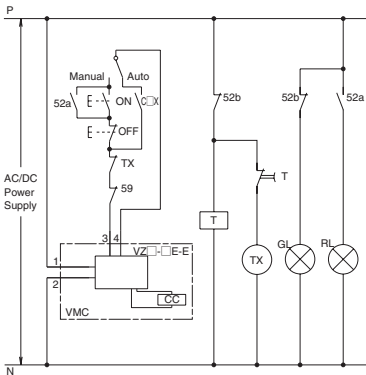
6 Exemplary Overall Connections Diagram



7 Connection diagram examples for the capacitor control circuit

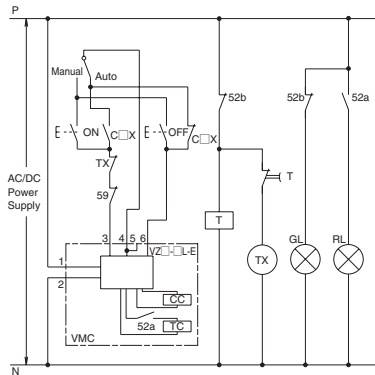
(The following diagrams are for reference only, and consider according to customer's use.)

Example of a latching type vacuum electromagnetic contactor



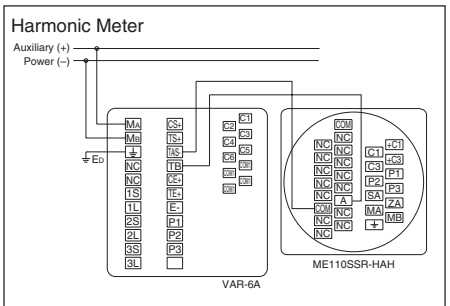
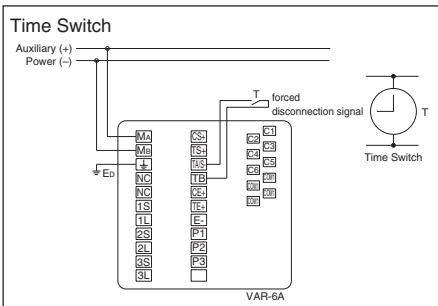
Note1. In VAR-6A, C□X in the figure shows C1X to C6X.
Note2. In VAR-12A, C□X in the figure shows C1X to C12X.
Note3. This diagrams are schematic diagrams. Prepare protected circuits, etc. if needed.

Example of a non-latching type vacuum electromagnetic contactor



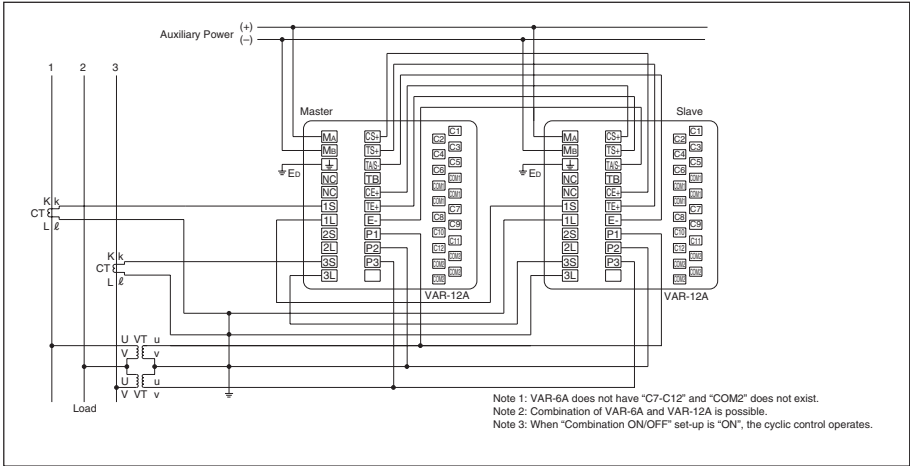
Note1. In VAR-6A, C□X in the figure shows C1X to C6X.
Note2. In VAR-12A, C□X in the figure shows C1X to C12X.
Note3. This diagrams are schematic diagrams. Prepare protected circuits, etc. if needed.

8 Connections for Performing Forced Disconnection

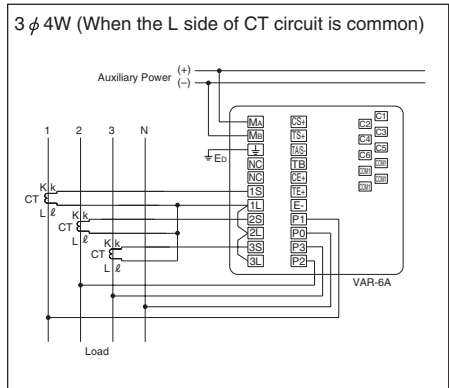
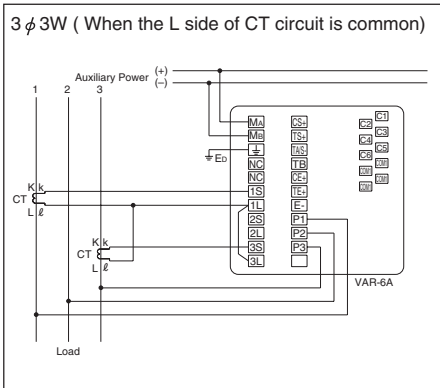
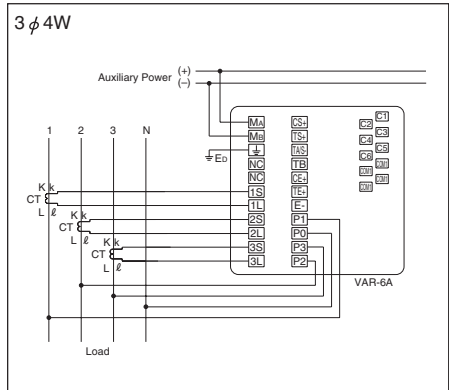
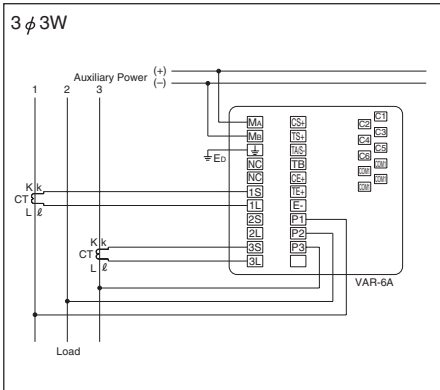


Installation 4. Wiring Diagram

9 Combination



10 Without VT



Note: In case of using by balanced load also, connect at the upper diagram.

Specifications

Specifications

Type		VAR-6A, VAR-12A	
Measurement Element	Power Factor	±2.0 %	
	Current	±1.0 %	
	Voltage	*1. In case of 3φ 3W and 3φ 4W, current on neutral phase is not measured. *2. 3φ 3W measures phase to phase voltage, while 3φ 4W measures phase to neutral voltage.	
	Active Power		
	Reactive Power	±1.0 %	
	Apparent Power		
Response Time		2 seconds (Note1)	
Automatic Power Factor Control Method		Reactive power detection method	
Input Rating	Voltage	3φ 3W:110 V/220 V AC / 3φ 4W:Max.254 V AC	
	Current	5 A AC	
	Frequency	50 Hz/60 Hz	
Phase Sequence		3φ 3W / 3φ 4W	
Set-up Items	Measure Set-up	Phase/Wire Type (3φ 3W,3φ 4W), Using VT/direct input (YES,NO), Direct Voltage (3φ 3W-Phase to Phase Voltage/110 V/220 V, 3φ 4W:Phase to Neutral Voltage 63.5 V to 254 V), Secondary Voltage (Phase to Neutral Voltage 63.5 V to 120 V), Primary Voltage (220 V to 750 kV), Primary Current (5 A to 30 kA), Combination, Master/Slave	
	Control Set-up	Target Power Factor (LAG85 % to 100 % to LEAD95 %), Delay Time (1 to 10 minutes), Light Load Power Ratio (0 to 35 %), Control method (1:Cyclic 2:Priority 3:Optimal), Capacity Auto/HoLd, Capacity Manual Input (0 to 9999 kvar)	
Display	Display for Indication	LCD, LED	
	Maximum Number of Display Digits	Digital display 4 figures	
	Capacity	Digital display 4 figures	
	Power Factor Status	LEAD OUT, PROPER, LAG OUT, LIGHT LOAD, EXPORT, FORCED DISCONNECTION	
	Conditions of Connection / Disconnection for Capacitor	VAR-6A: output conditions of connecting/disconnecting signals for capacitor C1 to C6. VAR-12A: output conditions of connecting/disconnecting signals for capacitor C1 to C12.	
	Conditions of Auto / Manual Control for Capacitor	VAR-6A: conditions of auto/manual for capacitor C1 to C6. VAR-12A: conditions of auto/manual for capacitor C1 to C12.	
	Updating Cycle	1 second	
Control Method	Automatic	Cyclic / Priority / Optimal	
	Manual	Manual ON / Manual OFF	
Capacitor Control Output	Circuit Total Number	VAR-6A: 6 circuit VAR-12A: 12 circuit	
	Output Contact	Latching output form a	
	Contact Capacity	250 V 1 A AC, 110 V 0.1 A DC	
Connection Conditions		"LAG OUT" LED stays lit past Delay Time.	
Disconnection Conditions		"LEAD OUT" LED stays lit past Delay Time.	
Operation Completion Output	Connecting Completion	OFF across terminals CE+ and E-	
	Disconnecting Completion	OFF across terminals TE+ and E-	
	Output Contact	Form A, contact capacity: 24 V, 0.1 A DC	
Operation Disable Input	Connection Disable	ON across terminals CS+ and TA/S-	
	Disconnection Disable	ON across terminals TS+ and TA/S-	
	Forced Disconnection	ON across terminals TB and TA/S-	
	Input Contact	Connection Disable · Disconnection Disable : Form A, contact capacity : 5 V, 15 mA DC Forced Disconnection : Form A, contact capacity : 5 V, 25 mA DC	
Power Failure Compensation		Non-volatile memory (Items: setting value, Capacity)	
Apparent Power Consumption	Voltage Circuit	Each Phase 0.1 VA (110 V), 0.2 VA (220 V)	
	Current Circuit	Each Phase 0.1 VA	
	Auxiliary Power Circuit	VAR-6A	11 VA (110 V AC) 13 VA (220 V AC) 6 W (110 V DC) VAR-12A 15 VA (110 V AC) 19 VA (220 V AC) 9 W (110 V DC)
Auxiliary Power Supply		100 V to 240 V AC (-15 %, +10 %) 50 Hz/60 Hz 100 V DC (-25 %, +40 %)	
Dielectric Strength	Across electric circuit group and frame earthing terminal		2000 V AC (50 Hz/60 Hz) 1 minute
	Across current circuit / voltage circuit group and auxiliary power		
	Across current circuit / voltage circuit group and capacitor control output circuit / completion output / disable input circuit group		2000 V AC (50 Hz/60 Hz) 1 minute
	Auxiliary power / capacitor control output circuit and completion output / disable input circuit group		
	Across voltage circuit group and current circuit group		2000 V AC (50 Hz/60 Hz) 1 minute
Combination of two circuit (capacitor control output circuit, completion output, disable input circuit)		2000 V AC (50 Hz/60 Hz) 1 minute	
Insulation Resistance		Across electrical circuit and case: 10 MΩ at 500 V DC	
Ambient Temperature		-5 °C to +50 °C (day average usage temperature: 35 °C or below)	
Ambient Humidity		30 % to 85 % RH or below; without condensation	
Weight		0.9 kg	
Dimension		144 mm (H)×144 mm (W)×98 mm (D)	
Attachment Method		Embedding attachment	

Note 1: Response time is time until it reaches ±1 % of the last directions value.

Specifications

Set-up Table

Set-up Menu No.	Set-up Item	Initial Content	VAR-6A	VAR-12A	Notes		
1	1.1	1.1.1 Phase/Wire Type	3P3 (3 ϕ 3W)	<input type="radio"/>	<input type="radio"/>		
		1.1.2 Using VT/direct input	YES (Using VT)	<input type="radio"/>	<input type="radio"/>		
		1.1.3 Direct Voltage(3 ϕ 3W)	110 V	<input type="radio"/>	<input type="radio"/>		
		1.1.4 Direct Voltage(3 ϕ 4W)	254 V	<input type="radio"/>	<input type="radio"/>		
		1.1.5 Secondary Voltage	63.5 V	<input type="radio"/>	<input type="radio"/>		
		1.1.6 Primary Voltage	6.6 kV	<input type="radio"/>	<input type="radio"/>		
		1.1.7 Special Primary Voltage	6.60 kV	<input type="radio"/>	<input type="radio"/>		
		1.1.8 Primary Current	100 A	<input type="radio"/>	<input type="radio"/>		
		1.1.9 Special Primary Current	100.0 A	<input type="radio"/>	<input type="radio"/>		
		1.2	1.2.1 Combination ON/OFF	OFF (single operation)	<input type="radio"/>	<input type="radio"/>	
			1.2.2 Master/Slave	Master	<input type="radio"/>	<input type="radio"/>	
		1.3	1.3.1 Operation Tests for the Connecting/Disconnecting	No (Test non-execution)	<input type="radio"/>	<input type="radio"/>	
2	2.1	2.1.1 Target Power Factor	LAG99.5 %	<input type="radio"/>	<input type="radio"/>		
	2.2	2.2.1 Light Load Power Ratio	10 %	<input type="radio"/>	<input type="radio"/>		
	2.3	2.3.1 Delay Time	5 min	<input type="radio"/>	<input type="radio"/>		
	2.4	2.4.1 Control Method	1 (Cyclic)	<input type="radio"/>	<input type="radio"/>		
	2.5	2.5.1 Capacity Auto/HoLd	Auto (automatic recognition)	<input type="radio"/>	<input type="radio"/>		
		2.5.2 Capacity Manual Input of C1	0	<input type="radio"/>	<input type="radio"/>		
		2.5.3 Capacity Manual Input of C2	0	<input type="radio"/>	<input type="radio"/>		
		2.5.4 Capacity Manual Input of C3	0	<input type="radio"/>	<input type="radio"/>		
		2.5.5 Capacity Manual Input of C4	0	<input type="radio"/>	<input type="radio"/>		
		2.5.6 Capacity Manual Input of C5	0	<input type="radio"/>	<input type="radio"/>		
		2.5.7 Capacity Manual Input of C6	0	<input type="radio"/>	<input type="radio"/>		
		2.5.8 Capacity Manual Input of C7	0	<input type="radio"/>	<input type="radio"/>		
		2.5.9 Capacity Manual Input of C8	0	<input type="radio"/>	<input type="radio"/>		
	2.5.10 Capacity Manual Input of C9	0	<input type="radio"/>	<input type="radio"/>			
	2.5.11 Capacity Manual Input of C10	0	<input type="radio"/>	<input type="radio"/>			
	2.5.12 Capacity Manual Input of C11	0	<input type="radio"/>	<input type="radio"/>			
	2.5.13 Capacity Manual Input of C12	0	<input type="radio"/>	<input type="radio"/>			

MEMO

