

INSTRUCTION MANUAL

AUTOMATIC SYNCHRONIZER

ASY-100

Introduction

Thank you for your purchase of our product.

Read this instruction manual carefully before installation, wiring, and using this product.

Keep this instruction manual handy for reference at any time.

Have a contact with us or sales agent in case that this instruction manual is lost or damaged.

<Caution>

Have a contact with us when you have any questions or are aware of missing article.

Safety precaution

Important contents are mentioned in this instruction manual to prevent any damage/use this product appropriately.

Keep the following safety precaution in mind after understanding each sign.



DANGER

Inappropriate usage leads to the possibility of death/damage



WARNING

Inappropriate usage leads to the possibility of death/damage



ATTENTION

Inappropriate usage leads to the possibility of death/damage

- We are not responsible for the damage caused by following condition(earthquake/fire which is not caused by us, action by third party, other accident, damage caused by our customer, misuse, product usage under abnormal condition).
- We are not responsible for secondary damage caused by product use/product malfunction(loss of profit, halt of business operation). We are also not responsible for damage caused by false operation in combination with connecting equipment which is beyond our control.



DANGER

- Do not disassemble, remodel and repair this product.
Have a contact with us or sales agent when product failure happens to prevent fire/electric shock/injury.
- Do not get this product wet to prevent heat generation/ignition/product failure. When this product gets wet, stop using it.
- Do not connect metal excepting wiring to terminal in order to prevent heat generation/ignition.
- Do not get this product near the inflammables/combustible chemicals/gas to prevent fire.



WARNING

- Connect specified power supply.
Connecting power supply beyond specification causes fire/product failure.
- When dust is on the terminal, wipe it off after power is OFF to prevent fire.
- Follow the below-mentioned procedure when abnormality(fuming/bad odor) happens.
 - (1) Stop using after power and input are OFF.
 - (2) Have a contact with us or sales agent.



ATTENTION

- Do not use this product in a environment of high temperature/high humidity to prevent any damage.
- Do not touch the terminal during operation to prevent electric shock.
- Do not pull/bend connecting cable with force. Cable damage causes heat generation/burn and contact failure leads to equipment damage.
- Do not connect/inspect with wet hands to prevent electric shock.

Other precaution

- Don't mount or store this unit in the following environment.
 - Places where corrosive gas is generated (SO₂ / H₂S / etc.).
 - Places where dust is generated.
 - Places with much vibration and shock.
 - Places with influence of external magnetic field (²).
 Note (1) Corrosive gas = Sulfur dioxide SO₂ / Hydrogen sulfide H₂S / etc.
 (²) Large current bus / saturable reactor / etc.
- Wipe off dirt on the surface with dry cloth softly. Keep in mind that strong rubbing of nameplate leads to character disappearance. Organic solvent is not appropriate for cleaning.
- Mercury component, Nickel-cadmium battery are not used in this product.
- This product is disposed as an industrial waste (Non-inflammable).

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1. Outline

This equipment is automatic synchronizing equipment used in the case of synchronous generation running with the system in parallel. On the occasion of parallel running, there is the need of smooth synchronous closing that suppresses the in-rushing current, alleviates the turbulence of the system and the shock to the generator by coinciding the voltage and frequency of both sides and by closing the circuit breaker precisely at the synchronizing point. This equipment is provided with the following functions for the purpose described above.

(1) Function of voltage balance.

This is the function to send out control pulse to automatic voltage regulator so that the generator voltage becomes consistent with the system voltage.

(2) Function of speed matcher.

This is the function to send out control pulse to governor control equipment so that the generator frequency becomes consistent with the system frequency.

(3) Contact of phase angle difference ($\pm 15^\circ$)⁽³⁾.

When voltage difference (ΔV) and frequency difference (Δf) between the generator side and the system side fall in the permissible range and when phase angle difference becomes within $\pm 15^\circ$ ⁽³⁾, signal of "a" contact is sent out. In the case of automatic synchronizing, this contact is used in series connection with closing command contact signal "25"

(4) Synchronous closing function.

To enable the closing of circuit breaker at the synchronized point, after the voltage difference (ΔV) and frequency difference (Δf) between generator side and system side fall within the permissible range, closing command signal "25" was sent out before the synchronizing point, with the circuit breaker closing time taken into account. In the case of normal synchronizing, this closing command signal "25" becomes "OFF" after 200ms from the synchronizing point, and END indication after 10 seconds, or conducted.

(5) Function to detect unbalance of generator side voltage.

In the case of unbalance of 3 phase voltage of generator side, closing command is stopped.

(6) The advance time setting of circuit breaker.

In the case of two or three circuit breakers provided with different closing time, this setting is conducted (possible up to 3 different setting).

(7) Contact signal for synchronizing failure (alarm).

In case that the phase angle difference arises over $\pm 10^\circ$ between the generator side and the system side after sending out closing command 25 and after passing the synchronizing point, closing command 25 is stopped and alarm contact is made available after 400ms. Whereas, when input signal "START" is continued to be given, control activation of contact within Δf , ΔV and $\pm 15^\circ$ ⁽³⁾ is continued. Alarm is reset by OFF of power supply source.

(8) Function to stop control in case of phase rotation reversed (Generator side).

In case that the connection from generator is mistaken so that the generator phase rotation order is reverse, an alarm contact is made "ON". Whereas, it is necessary to confirm the phase sequence with a phase indicator since the system side does not have the phase sequence detection function.

(9) Setting function of figure keys.

By pushing 10 figure keys, the values respectively of aforementioned (1)~(4) and (6) can be set.

Note⁽³⁾ Specification (Optional) : $\pm 25^\circ$, $\pm 30^\circ$ ($\pm 36^\circ$)

2. Specification and performance

2.1 Specification

2.1.1 Input

- (1) Analogue input : System side input, AC110V, 50/60Hz, 1 ϕ (R, S) 15VA
 Generator side input, AC110V, 50/60Hz, 3 ϕ , Each 1VA
- (2) Power source for test : AC110V (90~120V), 50/60Hz, 15VA
- (3) Contact input
 For setting of advance time of circuit breaker ... (applied voltage, current, DC13V 10mA) ⁽⁴⁾
 3 inputs (Each 1a contact)
- (4) Ten keys input : Respective set signal inputs and setting range.
- 1) Setting of voltage difference (ΔV) (unit = 1%)
 Initial value : 5% ⁽⁵⁾
 Setting range : 1~5% ⁽⁶⁾ Whereas, AC110V = 100%
 - 2) Setting of voltage adjusting pulse width and period.
 - a) Setting of constant pulse width (Unit = 0.1 second)
 Initial value : 0.5 second. ⁽⁵⁾
 Setting range : 0.1~1 second. ⁽⁶⁾
 - b) Setting of pulse period (Unit = 1 second.)
 Initial value : 2 second. ⁽⁵⁾
 Setting range : 1~5 second. ⁽⁶⁾
 - 3) Setting of frequency difference (ΔF) (Unit = 0.1Hz)
 Initial value : 0.1Hz ⁽⁵⁾
 Setting range : 0.1~0.3Hz ⁽⁶⁾
 - 4) Setting of governor control pulse width (unit = 0.1 second.)
 Initial value : 0.5 second. ⁽⁵⁾
 Setting range : 0.1~1 second. ⁽⁶⁾
 - 5) Setting of advance time of circuit breaker (unit = 1ms)
 Initial value : 50ms.
 Setting range : 10~300ms. ⁽⁵⁾
 Setting range ⁽⁷⁾ : For 25-1 : 10~300ms
 For 25-2 : 10~300ms
 For 25-3 : 10~300ms } ⁽⁶⁾

Note⁽⁴⁾ Please use a relay as an input which minimum load fulfills the closing load.

Note⁽⁵⁾ The value of "initial value" is set in case of no value to be input.

Note⁽⁶⁾ The values out of "setting range" is inputted, this value is not available and cancelled.

Note⁽⁷⁾ Special specification production range : 10~600ms

2.1.2 Output contact

(Each 1a contact. Switching capacity, DC110V, 2.5W. Relay type : MY-2(OMRON Corporation))

- (1) Voltage increase signal (60R)
- (2) Voltage decrease signal (60L)
- (3) Governor increase signal (15R)
- (4) Governor decrease signal (15L)
- (5) Circuit breaker closing signal (25)
- (6) Signal within $\pm 15^\circ$ of phase angle difference ⁽⁸⁾
- (7) Signal for synchronizing failure (alarm signal) : Reset conducted by OFF of analogue input. (System side)

Note⁽⁸⁾ Specification (Optional) : $\pm 25^\circ$, $\pm 30^\circ$ ($\pm 36^\circ$)

2.1.3 Indication

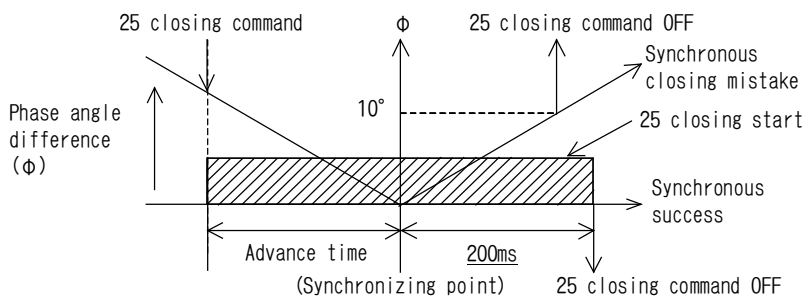
- (1) Indicating lamp (Illumination in red)
 - 1) Power
 - 2) Voltage increase signal = ON
 - 3) Voltage decrease signal = ON
 - 4) Governor increase signal = ON
 - 5) Governor decrease signal = ON
 - 6) Closing command signal of circuit breaker
 - 7) Signal within $\pm 15^\circ$ of phase angle difference ⁽⁹⁾
 - 8) Signal for releasing the lock of frequency difference (Δf)
 - 9) Signal for releasing the lock of voltage difference (ΔV)
 - 10) Alarm signal
- (2) Indication of present values (by pushing figure keys)
 - 1) Phase angle difference
 - 2) Voltage difference
 - 3) Frequency difference
 - 4) Selection of advance time of circuit breaker
- (3) Indication of set values by ten keys.
Indication of all values set by ten keys is possible.

2.1.4 Input contact signal for control (Each 1a contact, switching voltage, current DC13V, 5mA)

- (1) Start signal (START)
 - START terminal short circuit: It starts the control of synchronous closing of Δf , ΔV , and the contact which is within $\pm 15^\circ$ ⁽⁹⁾
 - START terminal open: Control function stop.
 - However, SET function by a short circuit and SET terminal measurement function are possible.
- (2) Ten keys setting input.
 - SET terminal short circuit: By the ten key inputs, setting and display are possible.
 - START terminal open: By the ten key inputs, a display of present value data is possible.

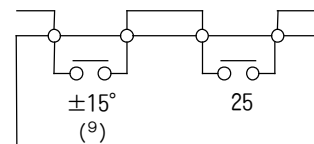
2.1.5 Control signals and content

- (1) Release signal of frequency difference lock.
 - This signal is effective in case that frequency difference continues within Δf set value for over 1 second.
- (2) Release signal of voltage difference lock.
 - This signal is effective in case that voltage difference changes within ΔV set value.
- (3) Signal for synchronization error (Alarm)
 - When phase angle difference exceeds 10° beyond the synchronizing point after sending synchronizing signal, 25 stops and after 400ms, alarm contact becomes ON.
- (4) Closing period of closing command signal "25" (Allowable closing phase angle error: $\pm 5^\circ$)
 - Δf , ΔV cancel a lock, furthermore, a closing in $\pm 15^\circ$ ⁽⁹⁾ inside contact ON becomes as follows.



25 closing command OFF
Depends on establishment of either (1) or (2) described below.

- 1) When phase angle difference after advance time exceeds $\pm 10^\circ$.
- 2) After advance time plus 200ms.

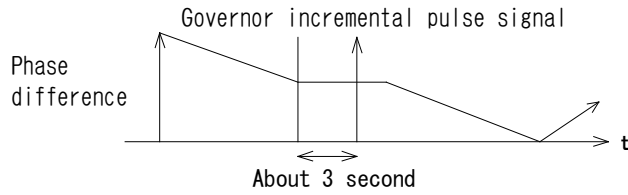


- (5) Contact of phase angle difference within $\pm 15^\circ$ ⁽⁹⁾
 - ① Voltage difference lock cancel.
 - ② Frequency difference lock cancel.
 - ③ All of above are satisfactory and the phase difference is within $\pm 15^\circ$ ⁽⁹⁾.

Remarks. It opens up all the terminals of 25-1~3 when it does a synchronous closing only with a $\pm 15^\circ$ ⁽⁹⁾ signal but not a 25 signal.

Note⁽⁹⁾ Specification (Optional) : $\pm 25^\circ$, $\pm 30^\circ$ ($\pm 36^\circ$)

(6) Automatic governor increase pulse signal



When frequency was the same (0~0.05Hz), and a phase difference became constant on the way, a governor increase pulse signal is outputted automatically.

2.1.6 Control range

This controller is available under following conditions.

- (1) System voltage : 90~120V
- (2) System frequency : 50±3Hz, 60±3Hz
- (3) Generator voltage: Over 80V
- (4) Δf : Within ±4Hz

The control is stopped under conditions other than the above-mentioned, and error is indicated respectively.

2.1.7 Δf setting and settable advance time

Since the synchronizing closing command "25" conducts the check for phase angle difference within ±15° as the closing command condition. By the Δf setting value, the advance time becomes as described below.

Δf setting	Settable advance time		Special specifications	
	±15°		±25°	±30°
0.1Hz	10~300ms		10~600ms	10~600ms
0.2Hz	10~150ms		10~250ms	10~350ms
0.3Hz	10~80ms		10~150ms	10~210ms

Consult for phase angle difference ±36°

2.1.8 Data hold in an interruption of service

A set value by ten keys holds the value in an interruption of service. (With interruption of service guarantee)

2.1.9 Appearance color

Munsell N1.5 (Black)

2.1.10 Operation temperature and humidity range.

0~50°C, 40~85% RH

2.1.11 Storage temperature range.

-10~+70°C

2.1.12 Mass

Approx. 7kg

2.2 Performance

Item	Performance	
Tolerance	Voltage difference	$\pm 0.5\%$
	Frequency difference	$\pm 0.03\text{Hz}$
	Pulse width	$\pm 10\%$
	Voltage adjustment pulse period	$\pm 10\% + 200\text{ms}$
	Phase angle difference	$\pm 1^\circ \pm 1 \text{ digit}$
Influence of temperature	Within tolerance by $23 \pm 20^\circ\text{C}$.	
Instantaneous overload	2 times of the rated voltage. 10 seconds.	
Insulation resistance	Between the electric circuit as a whole and the case (earth terminal).	Above $30\text{M}\Omega$ at DC500V megger
	Reciprocally between input and output	
Withstand voltage	Between the electric circuit as a whole and the case (earth terminal).	AC2000V (50/60Hz) 1 minute
	Reciprocally between input and output	
Impulse withstand voltage	Between the electric circuit as a whole and the case (earth terminal).	5kV 1.2/50 μs , ± 3 times
Shock	Error : 98m/s ² , Durability : 294m/s ² , X, Y, Z direction, 2 times for each.	
Vibration	Error : 16.7Hz, Double amplitude 1mm, X, Y, Z direction, 10 minute for each.	

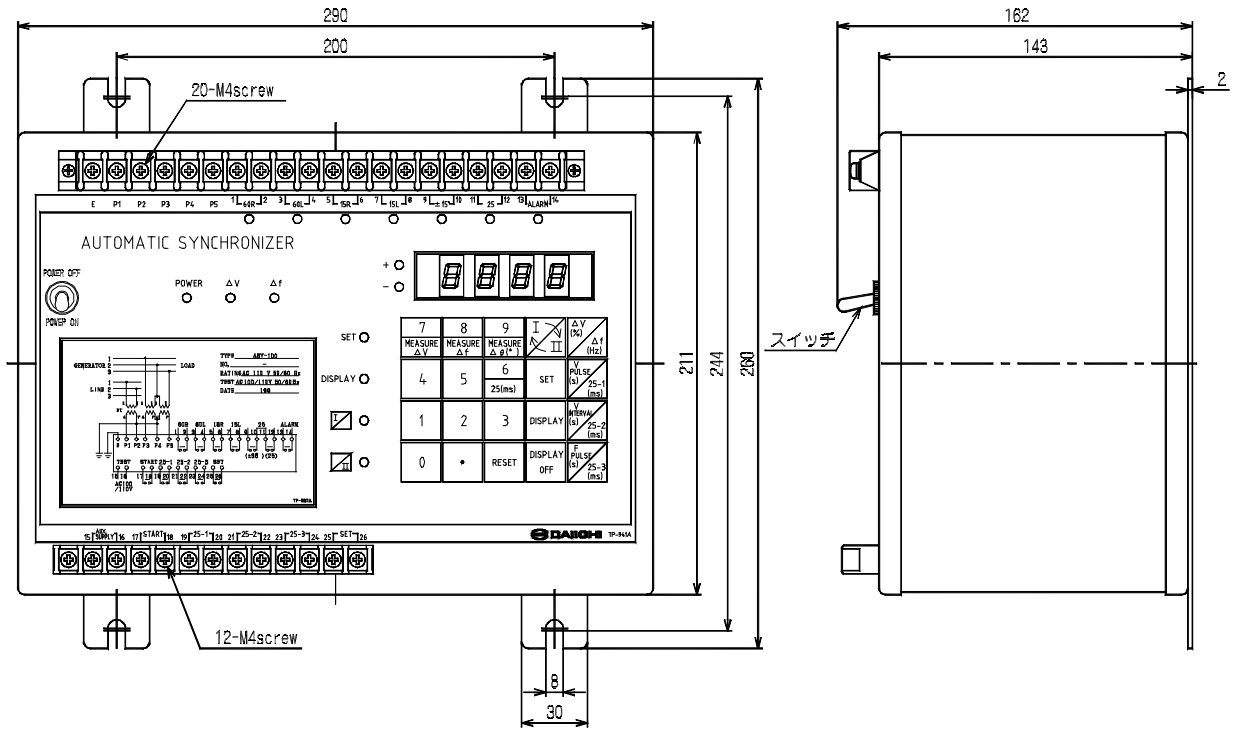
2.3 Other function

Function	Content	Indication
Input measurement	Measurement of Δf , ΔV , ϕ is possible even without "START"	
(10) Error indication	Writing on of set value impossible	Err 2
	Out of the range of set value	Err 3
	Closing command output is not available	Err 4
	Out of the range of system voltage	Err 5
	Out of the range of generator voltage	Err 6
	Unbalance of generator voltage	Err 7
	Out of the range of system frequency	Err 8
	Simultaneous selection of START & SET signals	Err 9
	Combination error of Δf and advance time	Err A
	Out of range of Δf difference control	Err C
	At times of reverse phase order of generator	Err E
End indication	When measuring input for 10 seconds after successful closing.	End
Blackout guarantee	Being left in a condition of no-voltage in the initial setting value.	Setting value storage

Note (10) Clearance of error indication

Err 3 is possible for clear by RESET key. Err 2 is impossible for clear. Err 4 and End is released by OFF of system voltage. Other error indications are of automatic RESET.

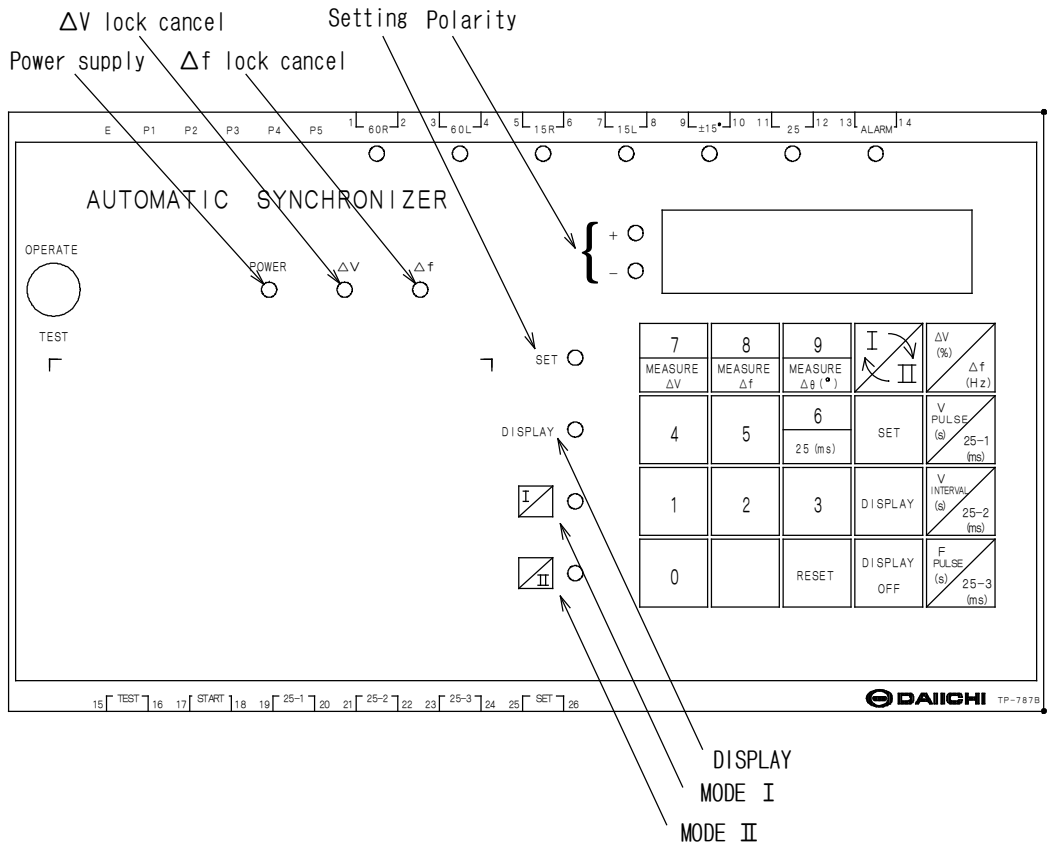
3. Instruction manual
 3.1 Installation
 3.1.1 Dimension diagram



3.1.2 Conditions of fitting environment

At the time of installation, please select an installation place with less mechanical vibration, dust and corrosive gas, a place without an impact of strong electro-magnetic field nearby due to a large current bus or a saturable reactor. There is no particular restriction for the installation posture.

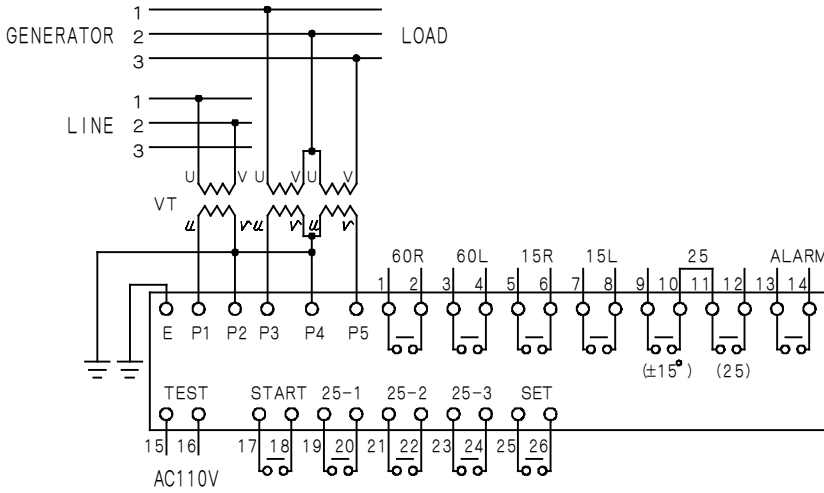
3.2 Surface sheet



3.3 Connection

3.3.1 Connection diagram

Using phase rotation detector, check and confirm that the line side and generator sides indicate the correct phase rotation.



- 60R : Signal for voltage increase
- 60L : Signal for voltage decrease
- 15R : Signal for governor increase
- 15L : Signal for governor decrease
- 25 : Synchronous closing signal
- ALARM : Synchronous mistake signal
- START : Control START signal
- 25-1 : Selection of different
- 25-2 : advance time of short circuit
- 25-3 :
- SET : This is used when setting by ten keys
- TEST : It is an apply with AC110V in setting.

3.4 Instruction manual

3.4.1 Target of a synchronous closing

There is the need to minimize voltage difference, frequency difference and phase angle difference in order to reduce the system turbulence and shock to the generator by suppressing in-rushing current. The following Fig.1 and Fig.2 show the magnitude of in-rushing current due to voltage difference, frequency difference and phase angle difference.

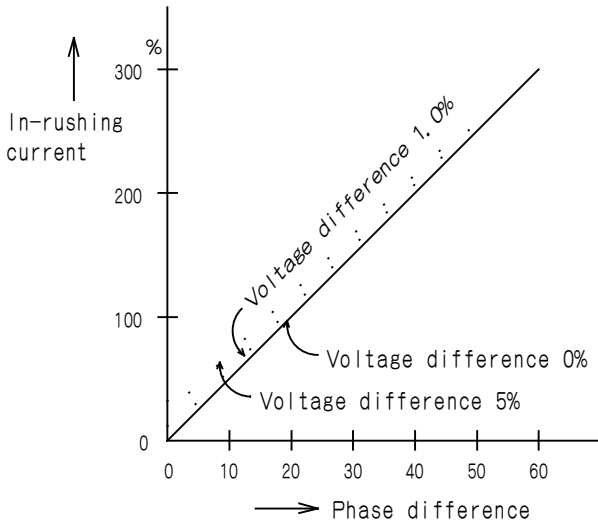


Fig. 1

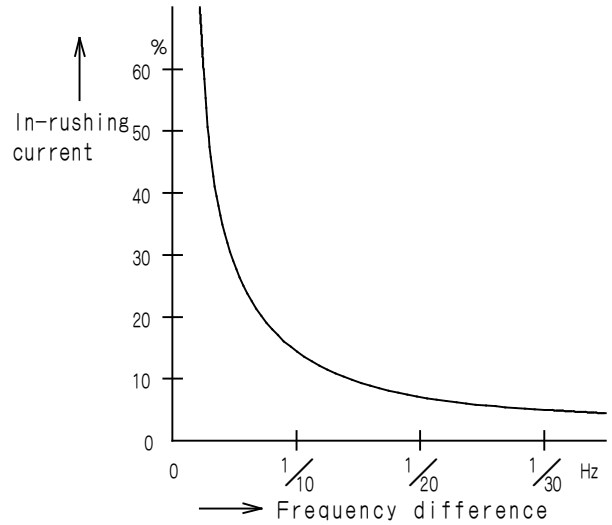


Fig. 2

For the target of synchronizing closing, in-rushing current should be decreased below 50%. For this purpose, by setting voltage difference below 5%, phase angle difference within 5° and frequency difference within 0.1Hz or 0.2Hz, the synchronizing closing satisfied can be conducted.

3.4.2 Switch

- 1) OPERATE side
With START signal being, it starts the control.
- 2) TEST side
Without START signal being, with SET signal being, it starts setting.

< Caution > When the system side voltage and generator side voltage are applied under the condition of with START signal being and without SET signal being, a 25 closing order is placed if all of Δf , ΔV and synchronization are matching.

3.4.3 Setting

Setting condition

- ① Terminal for "SET" should be short-circuited Setting stop can be released.
- ② LED "SET" should be illuminated by pushing SET ten key Setting becomes possible.

(1) Setting of voltage balance

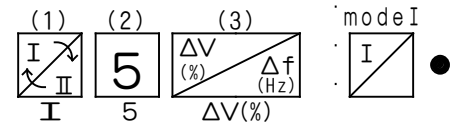
1) Setting of voltage difference (1% unit)

Initial value : 5%

Setting range : 1~5% (Not accepted except values within this range)

Whereas, AC110V = 100%

Example : 5% (integer) setting



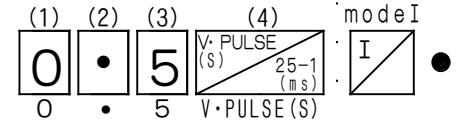
2) Setting of pulse width (0.1 second. unit)

Initial value : 0.5 second.

Setting range : 0.1~1 second.

(Not accepted except values within this range)

Example : 0.5 second. setting



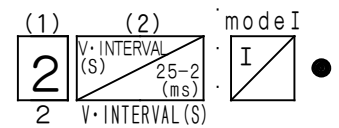
3) Setting of pulse period (1 second. unit)

Initial value : 2 second.

Setting range : 1~5 second.

(Not accepted except values within this range)

Example : 2 second. setting



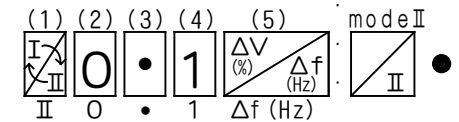
(2) Setting of Δf frequency difference (0.1Hz unit)

Initial value : 0.1Hz

Setting range : 0.1~0.3Hz

(Not accepted except values within this range)

Example : 0.1Hz setting



(3) Setting of speed matcher

Pulse width setting (0.1 second. unit)

Initial value : 0.5 second.

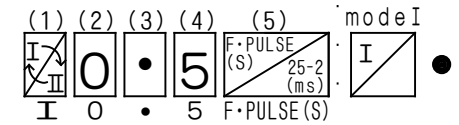
Setting range : 0.1~1 second.

(Not accepted except values within this range)

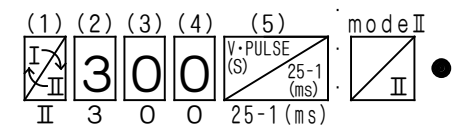
Pulse width comes out in inverse proportion to frequency difference.

$$\text{Pulse period (S)} = \frac{1}{\text{Frequency difference (Hz)}}$$

Example : 0.5 second. Setting



Example, 25-1 : 300ms setting



(4) Advance time of circuit breaker (1ms. unit)

Initial value : 50ms

Setting range : 10~300ms ⁽¹⁾

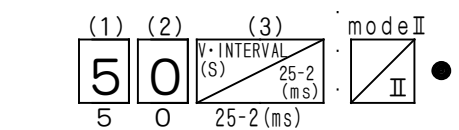
(Not accepted except values within this range)

25-1 : 10~300ms

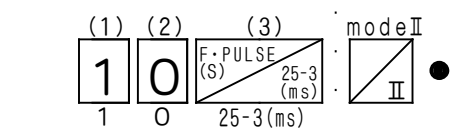
25-2 : 10~300ms

25-3 : 10~300ms

Example, 25-2 : 50ms setting



Example, 25-3 : 10ms setting



< Caution > Δf setting and settable advance time.

Δf setting	Settable advance time		
	±15°	±25°	±30°
0.1Hz	10~300ms	10~600ms	10~600ms
0.2Hz	10~150ms	10~250ms	10~350ms
0.3Hz	10~80ms	10~150ms	10~210ms

(5) Confirmation of set value.

After setting, confirm for sure that the set values are correct as per the items of indication described below.

After confirmation, are sure to open terminals (SET) for setting.

Note ⁽¹⁾ 10~600ms is possible by special specification.

3.4.4 Indication

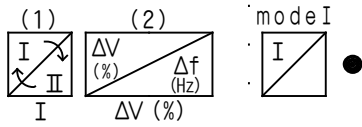
• Condition of indication

By pushing "DISPLAY" key LED DISPLAY should be lit up (indication possible)

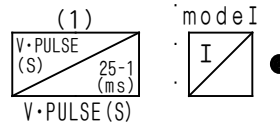
(By putting off the light of LED SET, DISPLAY mode should be obtained. Even if leaving the SET terminals short-circuited as it is, Display mode is obtained likewise.)

(1) Indication of voltage balance setting

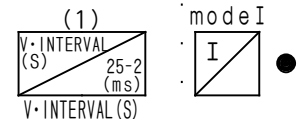
1) Indication of set value of voltage difference (ΔV)



2) Indication of set value of pulse width

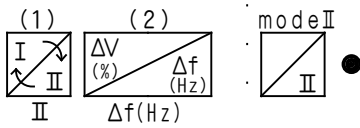


3) Indication of pulse interval

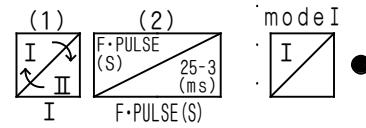


(2) Indication of speed matcher setting

1) Indication of set value of frequency difference (Δf)

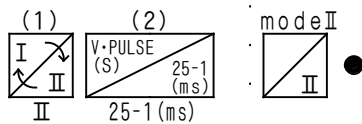


2) Indication of set value of pulse width

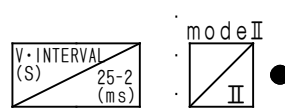


(3) Advance time of circuit breaker

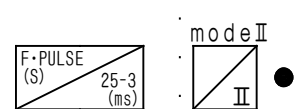
1) Indication of 25-1 set value



2) Indication of 25-2 set value

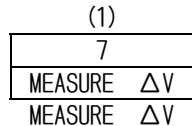


3) Indication of 25-3 set value

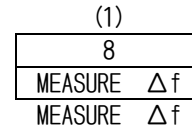


(4) Indication of present value (LED DISPLAY is lit up by pushing "DISPLAY" key)

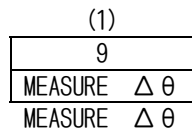
1) Indication of present value of voltage difference (ΔV)



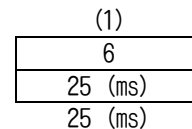
2) Indication of present value of frequency difference (Δf)



3) Indication of present value of phase angle difference.



4) Selection of advance time of circuit breaker



Polarity indication

① Phase angle ($\Delta \phi$)

- + Indication: The case that phase of generator side is delayed compared to line side.
- Indication: The case that phase of generator side is advanced compared to line side.

② Voltage difference (ΔV)

- + Indication: The case that voltage of generator side is high compared to line side.
- Indication: The case that voltage of generator side is low compared to line side

③ Frequency difference (Δf)

- + Indication: The case that frequency of generator side is high compared to line side.
- Indication: The case that frequency of generator side is low compared to line side.

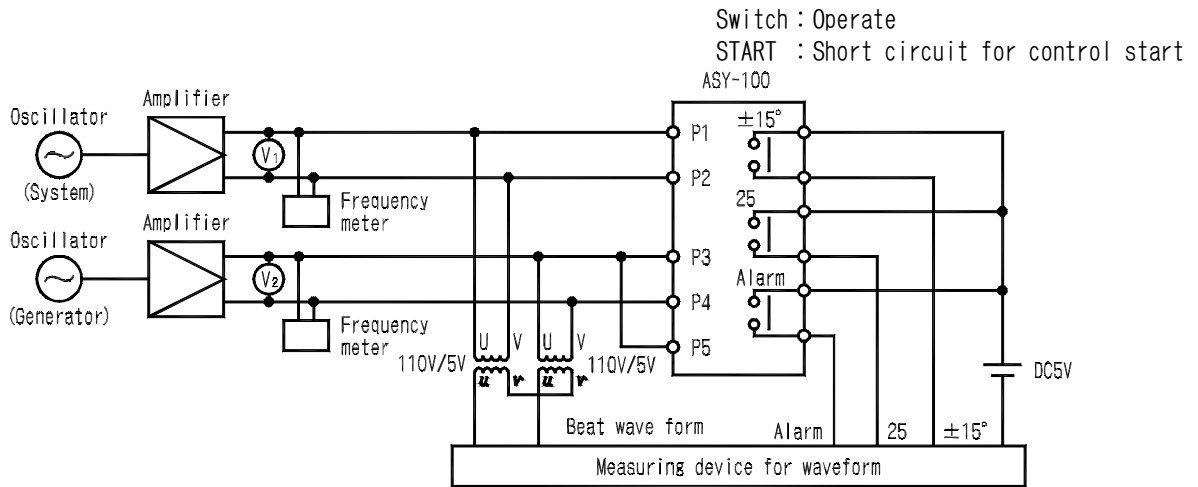
3.4.5 Contact input

Applied closing voltage current : DC13V 10mA. Please use a relay as an input which minimum load fulfills the closing load.

3.4.6 Test

Though the quality of this product is secure enough, to prevent an accident of emergency beforehand, carry out the 3-phase operation test by all means before implementing the closing. If the 3-phase operation test can not be carried out unavoidably, implement the single-phase type operation test according to the instruction below.

(1) Single-phase type operation test.



Example of set values

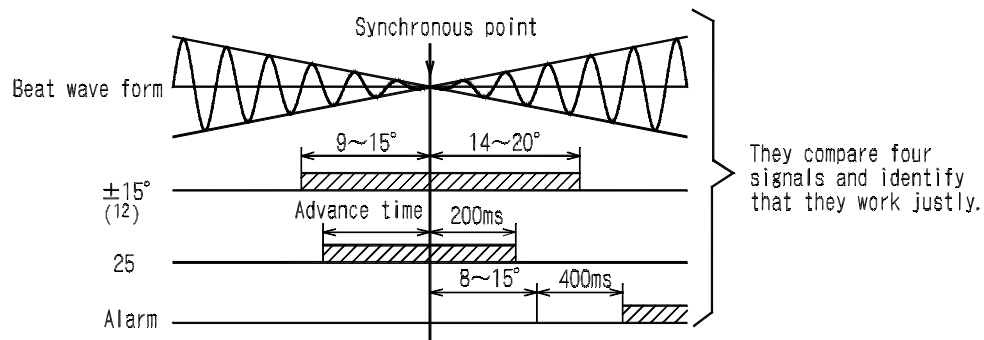
Voltage difference : 5%

Frequency difference : 0.1Hz

25-1 : 100ms

Voltage increase / decrease pulse width : 0.5s

Voltage increase / decrease pulse period : 2s

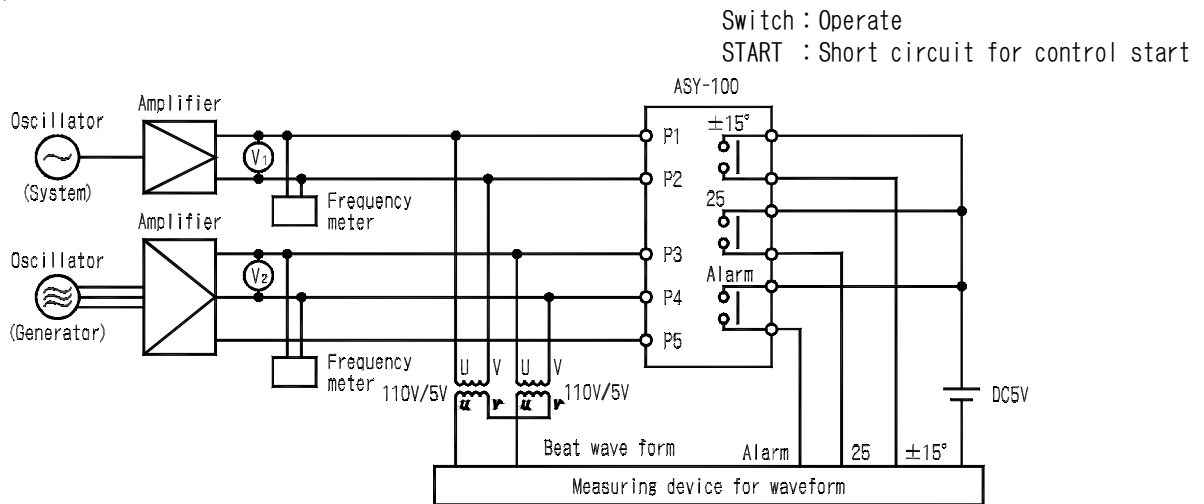


- ① When a voltage is applied to terminal P1-P2 (VB) and terminal P3-P4 (VG), and the voltage difference and the frequency difference are less than the set value (Δf LED ON, ΔV LED ON), if the phase difference of either became small, a $\pm 15^\circ$ ⁽¹²⁾ signal turns ON first, and a 25 order signal turns ON successively.
- ② A voltage difference is a $V_G \geq V_B + \text{setting value}$: it lowers the voltage, and a signal (60L) turns ON. A voltage difference is a $V_G \leq V_B - \text{setting value}$: it raises the voltage, and a signal (60R) turns ON.
- ③ Control is within $90V \leq V_B \leq 120V$, control stops besides $80V \leq V_G$.
- ④ Because of single-phase system, governor increase / decrease pulse signal cannot be output. Whereas, in the case of $\Delta f = 0 \sim 0.05\text{Hz}$, 15R is outputted at 3 seconds interval.
- ⑤ Once a 25 order signal is placed, the control stops by an END indication five or six seconds later. Reset is implemented with system voltage OFF.

Note⁽¹²⁾ Special specifications (optional) : $\pm 25^\circ$, $\pm 30^\circ$ ($\pm 36^\circ$)

(2) 3-phase type operation test.

Using phase rotation detector, check and confirm that the line side and generator sides indicate the correct phase rotation.



Example of set values

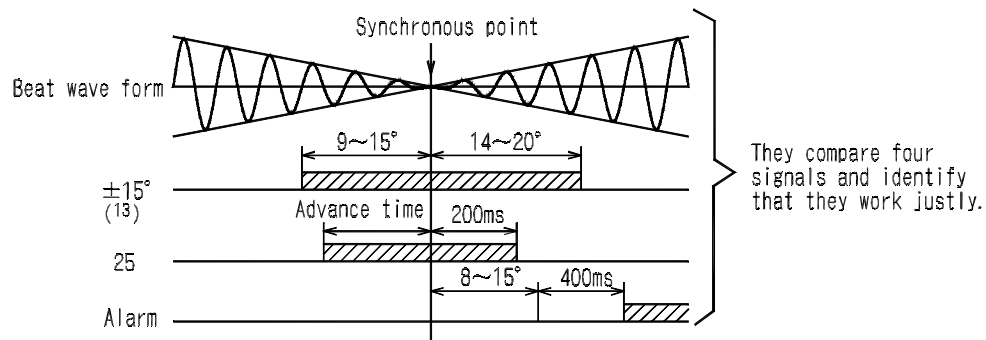
Voltage difference : 5%

Frequency difference : 0.1Hz

25-1 : 100ms

Voltage increase / decrease, pulse width : 0.5s

Voltage increase / decrease, pulse period : 2s



① Signals of governor increase (15R) and governor decrease (15L).

Depending on the frequency difference between generator side frequency (f_G) and grid side frequency (f_B), when its difference is large, output pulse period is short and when its difference is small, output pulse period becomes long.

In case of $f_G < f_B$, 15R activates.

In case of $f_G > f_B$, 15L activates.

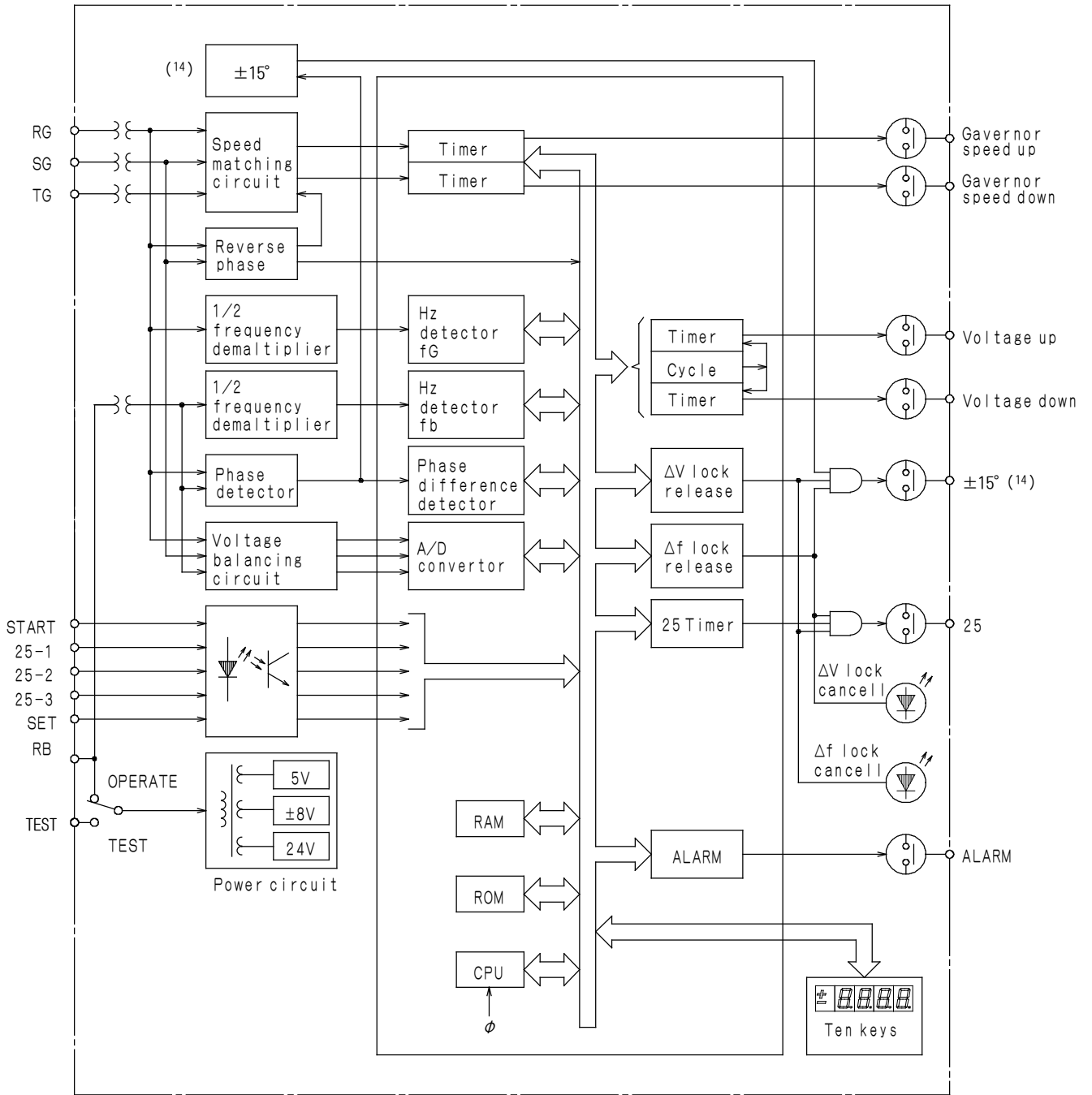
② 60R, 60L control range does an action the same as test of single-phase type.

③ In case that phase rotation of generator side is reverse, this device stops. ErrE indication.

Notes⁽¹³⁾ Special specifications (optional) : $\pm 25^\circ$, $\pm 30^\circ$ ($\pm 36^\circ$)

4. Operation principle

4.1 Circuit composition (ASY-100 Block diagram)

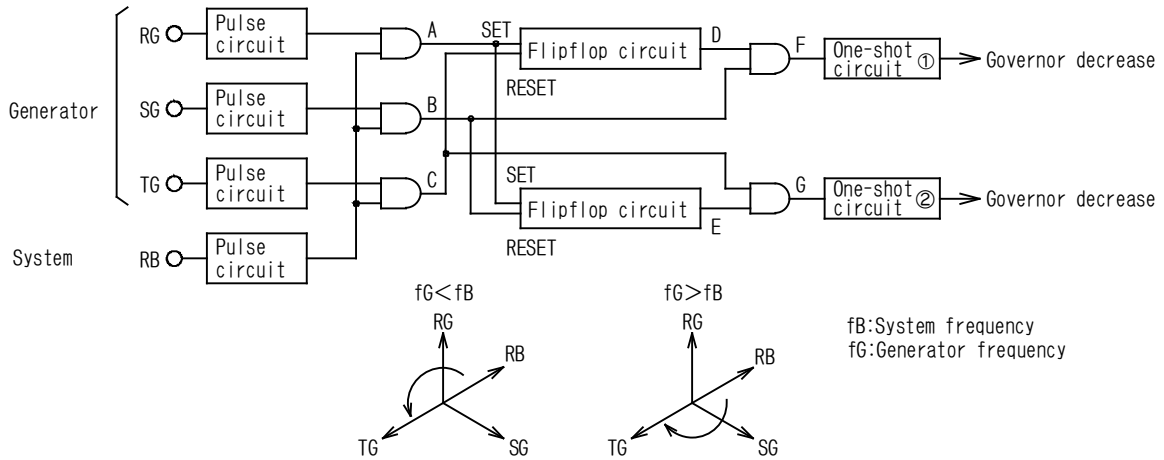


Note⁽¹⁴⁾ Special specifications (optional) : $\pm 25^\circ$, $\pm 30^\circ$ ($\pm 36^\circ$)

4.2 Explanation of activation

(1) Speed matching circuit

This circuit detects the frequency difference between the line side and generator side and a pulse is sent out to keep the frequency difference below a constant value.



By the frequency difference between f_G and f_B , the phase rotating direction of voltage vector changes.

In case of $f_G < f_B$

Flip flop ① ② are set and outputted at point D and E, by the consistent pulse of RG and RB (point A). Next since RB and TG become consistent, point G becomes on, one shot circuit ② start and governor increase signal is outputted. Simultaneously flip flop ① is reset and governor decrease signal is continued to be off condition. There after since RB and SG become consistent, flip flop ② is reset.

In case of $f_G > f_B$

Flip flop ① ② are set and outputted at point D and E, by the consistent pulse of RG and RB (point A). Next since RB and RG become consistent, point F becomes on, one shot circuit ① start and governor decrease signal is outputted. Simultaneously flip flop ② is reset and governor increase signal is continued to be off condition. There after since FB and to become consistent, flip flop ① is reset.

- Signal interval of governor increase or governor decrease changes in inverse proportion to frequency difference.
- In case of 0.1Hz : 10 seconds interval.
- In case of 1Hz : 1 second interval. Above intervals are obtained.
- In case that frequency difference is within the set value, Δf lock release signal is outputted from CPU and signals of governor increase / decrease are cut off.

(2) Voltage balance circuit

This circuit detects the difference between generator voltage and line voltage as well as the unbalance of control range and generator voltage. A/D converter is conducted for all 3 inputs and processing is conducted as described below by CPU.

① The case providing voltage difference.

$V_G > V_B (+ \text{ set value})$: Voltage increase signal is sent out.

$V_G < V_B (- \text{ set value})$: Voltage decrease signal is sent out.

Whereas, V_G : Generator voltage

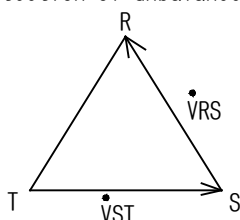
V_B : System voltage

$V_B (+ \text{ set value}) > V_G > V_B (- \text{ set value})$: ΔV lock release LED is illuminated.

② Control range

$V_G \geq 80V, 90 \leq V_B \leq 120V$: Out of the range described in the left becomes control stop.

③ Detection of unbalance of generator voltage



$$|\dot{V}_{RS} \times 1.2| \geq |\dot{V}_{ST}| \geq |\dot{V}_{RS} \times 0.8|$$

Control stop is conducted excluding above range.

$$|\dot{V}_{RS} \times 1.1| \geq |\dot{V}_{ST}| \geq |\dot{V}_{RS} \times 0.9|$$

OK for closing command is offered in the range mentioned above.

(3) Reverse phase detection (Generator side)

In case that generator side phase is reverse rotation, speed matching circuit is reset and control stop is instructed to CPU.

(4) Signal within $\pm 15^\circ$ ⁽¹⁵⁾

The signal within $\pm 15^\circ$ for the phase difference between VRS of generator side and VRS of system side is constituted in the digital IC circuit. The $\pm 15^\circ$ contact signal is outputted under AND condition with Δf and ΔV lock cancel signal outputted from CPU which calculated the Δf and ΔV .

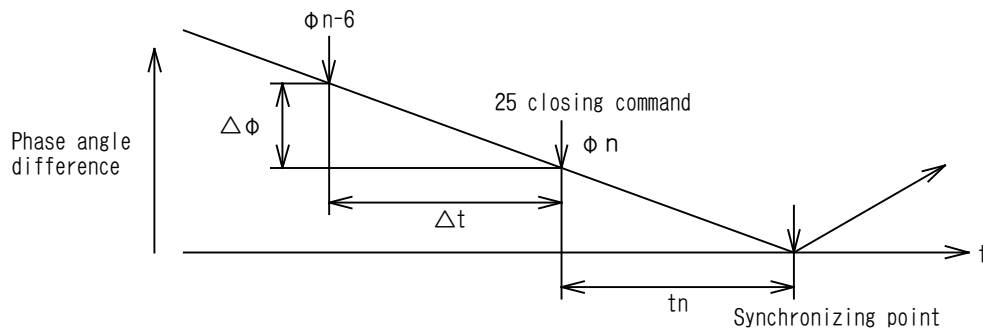
(5) CPU circuit

① By the frequency of line side and by the phase angle difference between system side and generator side, synchronizing point and frequency difference is calculated. Thereby Δf lock cancel signal, ΔV lock cancel signal and "25" closing command are outputted.

② The timer writes in circuit, set values inputted with ten keys.

(6) 25 closing command.

Detection is conducted to it that voltage difference and frequency difference between the line side and generator side is within the allowable difference. And taking advance time (closing time of circuit breaker) into account, closing command is sent out just before the synchronizing point.



$$t_n = \frac{\phi_n}{\Delta\phi} \cdot \Delta t \text{ is calculated.}$$

When t_n agrees in an advance time of a breaker, a 25 closing order goes.

Note⁽¹⁵⁾ Special specifications (optional) : $\pm 25^\circ$, $\pm 30^\circ$ ($\pm 36^\circ$)

5. Maintenance and check

5.1 Maintenance and check

Pay attention to following precautions before using this product.

- If dust stuck to this product, please clean it away.
- Please check looseness of wiring, looseness of an installation screw.
- Please check whether an exchange maintenance period of a relay is valid.

Exchange maintenance period of relay.

- Relay type and maker.
MY-2 (DC24V) OMRON corporation
For socket installation. No polarity
- Use condition and life
Load MM4X (DC100/110V)
Life times : 2 million times

< Caution >

Use a relay has no polarity.
In case a polarity type with a built-in diode is used, there is the case that inside circuit may be damaged.

5.2 About life

The life duration of ASY-100 changes with the ambient temperature.

(For aluminum electrolytic capacitor being used)

Average temperature of installation environment. 30°C : Guaranteed life 10.7 years, Ability life 15 years.
40°C : Guaranteed life 5.3 years, Ability life 14.5 years.

Be careful that when the ambient temperature rises, the life shortens.

5.3 Measures against trouble

The repair of product is only possible by acceptance of the product in principle.

Contact us or the sales agent if you think the product is broken, or a modification to the specification.

Any malfunctions caused by unauthorized disassembly or modification or misuse are excluded from warranty even if the warranty is still valid. Please be careful to the handling the product.

 **DAIICHI ELECTRONICS CO., LTD.**

Head Office : 11-13 Hitotsuya 1-chome, Adachi-ku, Tokyo, 121-8639 Japan.
Phone : 03-3885-2411 , Fax : 03-3858-3966

Kyoto Office : 1-19 Ichinobe-Nishikawahara, Jyoyou-shi, Kyoto, 610-0114 Japan.
Phone : 0774-55-1391 , Fax : 0774-54-1353

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