INSTRUCTION MANUAL

AUTO GENERATOR CONTROLLER

AGC-300-0□

DAIICHI ELECTRONICS CO., LTD.

Introduction

Thank you for your purchase of our product.
Please read this instruction manual carefully before installation, wiring, and using this product.
Please keep you in custody at hand to be found any time after it was read.

Safety precaution

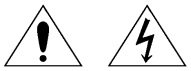
1. Operating/storage environment

Do not install or store this product under below-mentioned environment. Damage caused by the product usage beyond specified environment leads to repair (not free of charge) even under warranty period.

① Ambient temperature: below -10 or over +55℃. Humidity: over 90% RH.
② Places where corrosive gas is generated (SO_2 / H_2S / etc.)
③ Places where dust is generated.
④ Places with much vibration and shock.
⑤ Places with noise from the outside.

2. Installation, electrical wiring

Only technical expert can install or perform electrical wiring work following below-mentioned safety precaution along with referring to instruction manual.

 Danger Electric shock	① Perform connection with connection diagram. Inappropriate connection causes product damage, burnout, fire (Example: High voltage generation on the secondary side of CT). ② Hot-line job is prohibited to prevent electrical shock, product damage, burnout, fire and gas explosion. ③ Never fail to install terminal cover after work for electrical shock prevention.

④ Install this product to panel by tightening screw of installation tool using plus screwdriver(Tightening torque 0.2 to 0.29N･m). If torque wrench is not kept handy, rotate this product approximately 360 degree after contacting both screws to panel, then make sure that this product is fixed firmly.

3. Setting

This product is set up by next initial value at factory shipment.
Please make a setting change, if it does different usage from an initial setting value. (5. section, 13 page to 19 page)
In addition, about a rated frequency, it is shipped by the designated set value.

4. Use

① Please use input within rated range. Use outside rated range has caused failure of a device.
② Please shut a switch cover other than the case of operation.

 Danger	③ Please keep in mind that it will receive an electric shock if a terminal is touched into an energization. ④ Please keep in mind that it separates from the object of a guarantee if this product is disassembled and converted without notice. And, since failure of a device, a fire, etc. occur by reconstruction etc., it is dangerous. Please inform our company of specification change etc.

5. Maintenance, inspection

① Wipe off the surface of the unit with a dry soft cloth. If the display name plate stuck on the body is rubbed strongly, a character may disappear. Please do not use solvent, cleaner, alcohol, chemical for cleaning.
② Please check the next item.
- Isn't there any damage in the appearance of a product?
- Does indication correspond to the input?
- Isn't there any slack in the connection of mounting and a terminal stand? (Please carry out in the state of blackout.)

If an unknown thing occurs, please check to our company.

6. Transportation

Please pack up with shock absorbing material. In order to heighten a buffer effect, please stuff shock absorbing material into all crevices firmly. Failure by the shock in transportation should not occur.

7. The other

① This product does not use a mercury part and a nickel-cadmium battery.
② The discarded product. If the burns up this product, it gives bad influence to environment.

Content

1. Product explanatory

1.1 Use

Arrangement for controlling electric generator (AGC-300-0□) is the arrangement for controlling electric generator of multifunctional set type which carried each function etc.
(Function : Synchronous closing, Load distribution, Operation quantity control, Loaded condition monitor)
It is the high product of flexibility which can correspond to all needs. This equipment should use continuous power generating system and emergency generator system and cogeneration system.

1.2 Features

- Maximum of 8 system configurations is freely possible for an operation quantity. And, an operation quantity can extend a maximum of 8 sets easily.
- Efficient operation of a generator is possible. (Heavy burden operation mode)
- The change of a control value is possible by daytime / night, or a weekday/holiday.
- Setting change is easy. Stable operation put together with the system is realized.
- For the purpose of laborsaving, it can correspond to all needs broadly.
- It contributes to reduction of system total cost.
- Ac input is withstand voltage AC2000V design.

1.3 Function

- Synchronous closing control
  - ① Speed matcher function.
  - ② Voltage balance function.
  - ③ Synchronous closing function.
  - ④ Synchronous detection display function.
  - ⑤ Check relay output (Phase difference ±15°) function.
  - ⑥ Phase difference delay detection function.
  - ⑦ Synchronous closing direction change function. (FAST/FREE/SLOW)
  - ⑧ Frequency range outside detection function.
  - ⑨ Voltage range outside detection.

- Power control and operation quantity control
  - ① Starting detection function.
  - ② Separation detection function.
  - ③ Operation mode (heavy burden operation or power receiving constant operation) designation function.
  - ④ Power receiving constant control value change function.
  - ⑤ Receiving power average control function.
  - ⑥ Generator starting and separation control value change function.
  - ⑦ Interruption starting function.
  - ⑧ Forced separation function.
  - ⑨ Governor system abnormality detection function.
  - ⑩ Frequency range outside detection function.

- Generator power factor constant control.
  - ① Power factor control dead band change function.
  - ② Power factor control cut function at light-load.
  - ③ AVR system abnormality detection function.
  - ④ Voltage range outside detection function.

- Rated frequency control.

- Rated voltage control.

2. Specification

2.1 Type and specification code

AGC-300-0(1)

Type　　Specification code

(1) Auxiliary power supply

Symbol	Auxiliary power supply
0	AC100/110V 50/60Hz DC100/110V
1	DC24V

2.2 Input, output, display

No.	Item	Description	Specification
1	Operation method	Parallel operation of power receiving and generator	Receiving power constant + Generator power proportional distribution + Quantity control / Generator power-factor constant control
		Only a generator operation.	Generator power proportional distribution + Rated frequency control + Quantity control / Generator reactive power proportional distribution + Rated voltage control
2	Bus single-phase input	For voltage, frequency, phase measurement	AC110V, 50/60Hz, 0.5VA
3	Generator 3-phase input	For voltage, power, reactive power, frequency, power factor measurement	AC110V, AC5A, 3Φ, 50/60Hz, Each 0.5VA
4	DC input	Receiving power measurement (With external transducer)	DC4～20mA (About 50Ω) /0～200W (AC110V, 5A, 50/60Hz)
5	Input for control (8 circuits)	Control start	(1) Voltage input DC24V (Operation current 10mA)
		Power receiving start	
		Synchronous start	
		Distribution start	
		Offering start	
		Forced separation	
		Lead generator designation	
		Control change	
6	Output for control (10 circuits)	Start command	1a contact photo MOS relay output . (There is polarity, minus common) MAX. DC24V, 90mA
		Separation command	
		Light trouble	
		90R (AVR increase signal)	
		90L (AVR decrease signal)	
		65R (Governor increase signal)	
		65L (Governor decrease signal)	
		25 Closing command	(2) 1a contact photo MOS relay output MAX. DC24V, 100mA or DC110V, 50mA
		Synchronous check	
		Alarm	
7	Communication	Communication to other controller	RS-485
8	Auxiliary power supply	Auxiliary power supply of AGC-300	AC100/110V (85～127V) 50/60Hz Below 10VA, and DC100/110V (80～143V) Below 9W, for both AC and DC uses. Or DC24V (20～28V) Below 9W. Can be specified.
9	Switch	Address	Digital switch
		Set value input / measurement display	Push switch
		Set value registration	
		Digit shift	
		Set value increase	
		Display change	
		Function change (ALS/APFR/ALS＋APFR)	Slide switch
		Generator heavy burden (ON/OFF)	
		Power receiving control change (MODE1/MODE2)	
		Generator control change (MODE1/MODE2)	
		Closing direction change (FAST/FREE/SLOW)	
		Set change (ON/OFF)	
10	Display	ITEM CODE	2 digit 7 segment LED (Orange)
		MEAS･SET DATA	4 digit 7 segment LED (Orange), LED×2 (Orange)
		Phase difference display	LED×24 (Yellow), LED×1 (Green)
		Status display	LED×10 (Green), LED×1 (Yellow), LED×2 (Red)

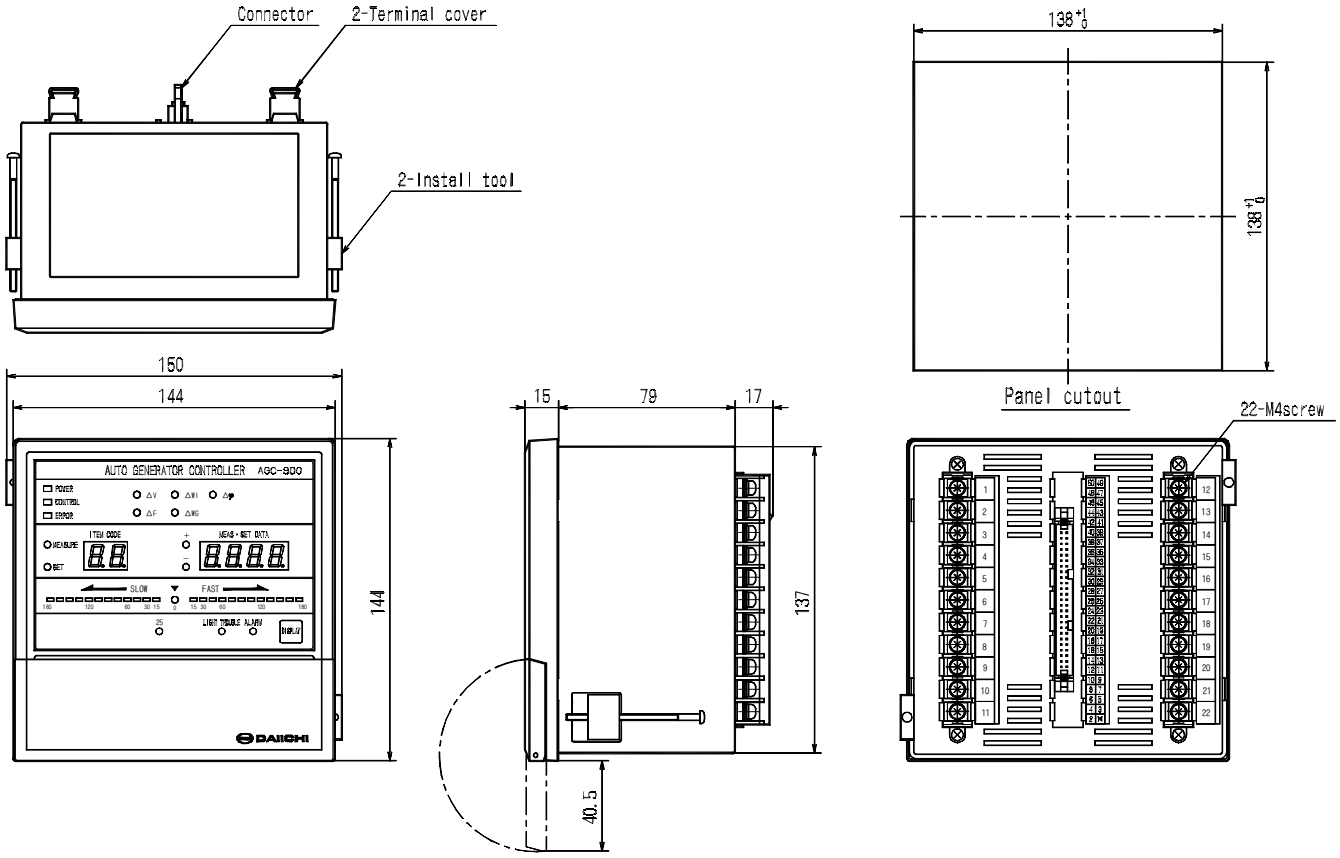
Note(1) An external relay should use the relay for very small signals which satisfies the designated voltage and current.
Note(2) The external relay for 25 closing command and a synchronizing check output should use the relay with a surge absorber.

2.3 Performance

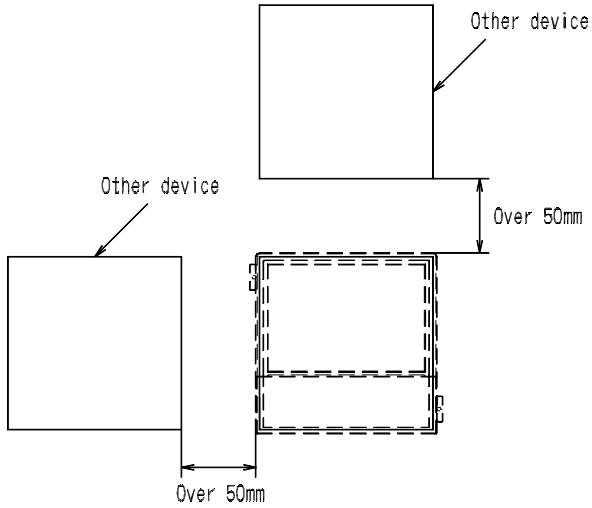
Item			Specification	
Accuracy	Synchronous closing	Voltage difference	±0.5%　% for rated voltage	
		Frequency difference	±0.03Hz	
		Closing phase difference	±5°	
	Distribution control	Receiving power detection accuracy	±1.0%　% for maximum power (Maximum power setting. 1/2 of transducer full scale ～ full scale.)	
		Power detection accuracy	±1.0%　% for rated power	
		Reactive power detection accuracy	±1.0%　% for rated reactive power	
		Power-factor detection accuracy	±3°　(Load current：more than 10%, Power-factor：LEAD 0.5～1～LAG 0.5)	
		Current detection accuracy	±1.0%　% for retad current	
		Frequency detection accuracy	±0.1%　% for rated frequency	
		Voltage detection accuracy	±1.0%　% for rated voltage	
	Common	Pulse width	±10% ±0.1s　% for set value	
		Control delay time	±10% ±0.1s　% for set value	
Charac-teristic	Influence of temperature		In accuracy at 23±20℃.	
	Influence of frequency		In accuracy at 45～65Hz.	
	Influence of voltage		In accuracy at bus voltage and generator voltage AC85V～126V.	
	Influence of power supply voltage		In accuracy at AC100/110V(AC85～127V), DC100/110V(DC80～143V), DC24V(DC20～28V).	
	Other		Conformity to JIS C 1111：1989	
Strength	Over-voltage strength	AC input	2 times 10 seconds, 1.2 times continuation of rated voltage.	
		AC100/110V power supply	1.5 times 10 seconds, 1.2 times continuation of rated voltage.	
		DC100/110V power supply	1.5 times 10 seconds of rated voltage.　DC143V continuation.	
	Over-current strength	AC input	40 times 1 second, 1.2 times continuation of rated current.	
		DC input	2 times 10 seconds, 1.2 times continuation of rated current. (Output signal of transducer)	
	Insulation resistance		Between electric circuit and case (earth).	Above 30MΩ at DC500V megger
			Bus voltage input, generator voltage input, generator current input, power supply input, DC input, input for control, governor control output, AVR control output, other control outputs, communication, each mutual interval.	
	Withstand voltage		Between electric circuit and case (earth).	AC2000V 50/60Hz 1 minute
			Bus voltage input, generator voltage input, generator current input, power supply input, DC input, input for control, output for control, communication, each mutual interval.	
			Governor control output, AVR control output, other control outputs, each mutual interval.	AC500V 50/60Hz 1 minute
	Impulse withstand voltage		Between electric circuit and case (earth).	5kV 1.2/50μs Positive and negative polarity, for each 3 times
	Shock		294m/s², X, Y, Z direction for each 3 times.	
	Vibration		16.7Hz Double amplitude 1mm, X, Y, Z direction for each 2 hours.	
Operating temperature and humidity range			-10～+55℃ , 30～85% RH (Non condensing)	
Storage temperature range			-25～+70℃	
Color of case			Black (Munsell N1.5)	
Mass			Approx. 1.3kg	
Installation			Panel side installation	

3. Handling

3.1 Outline drawing



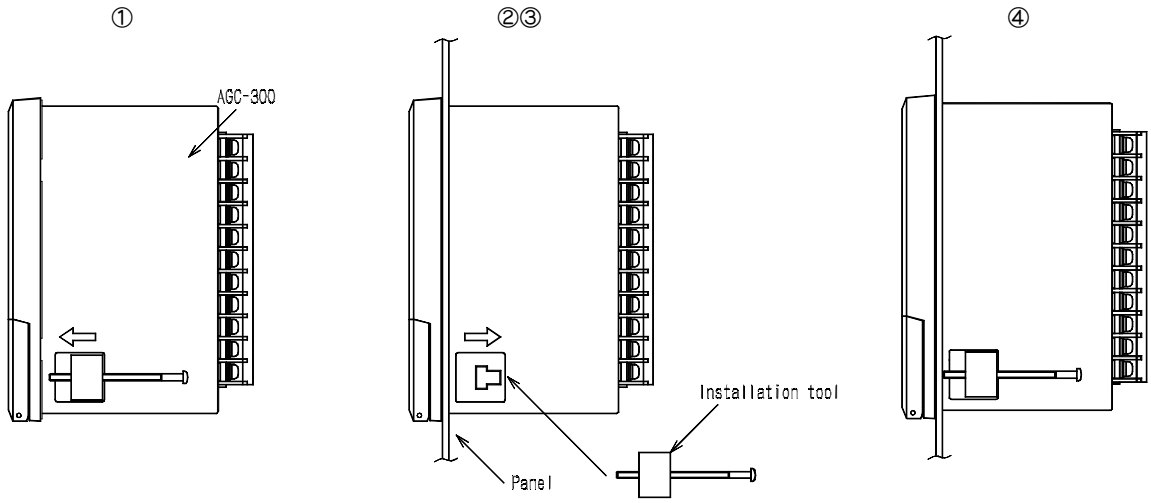
(Dimension of continuous installation)



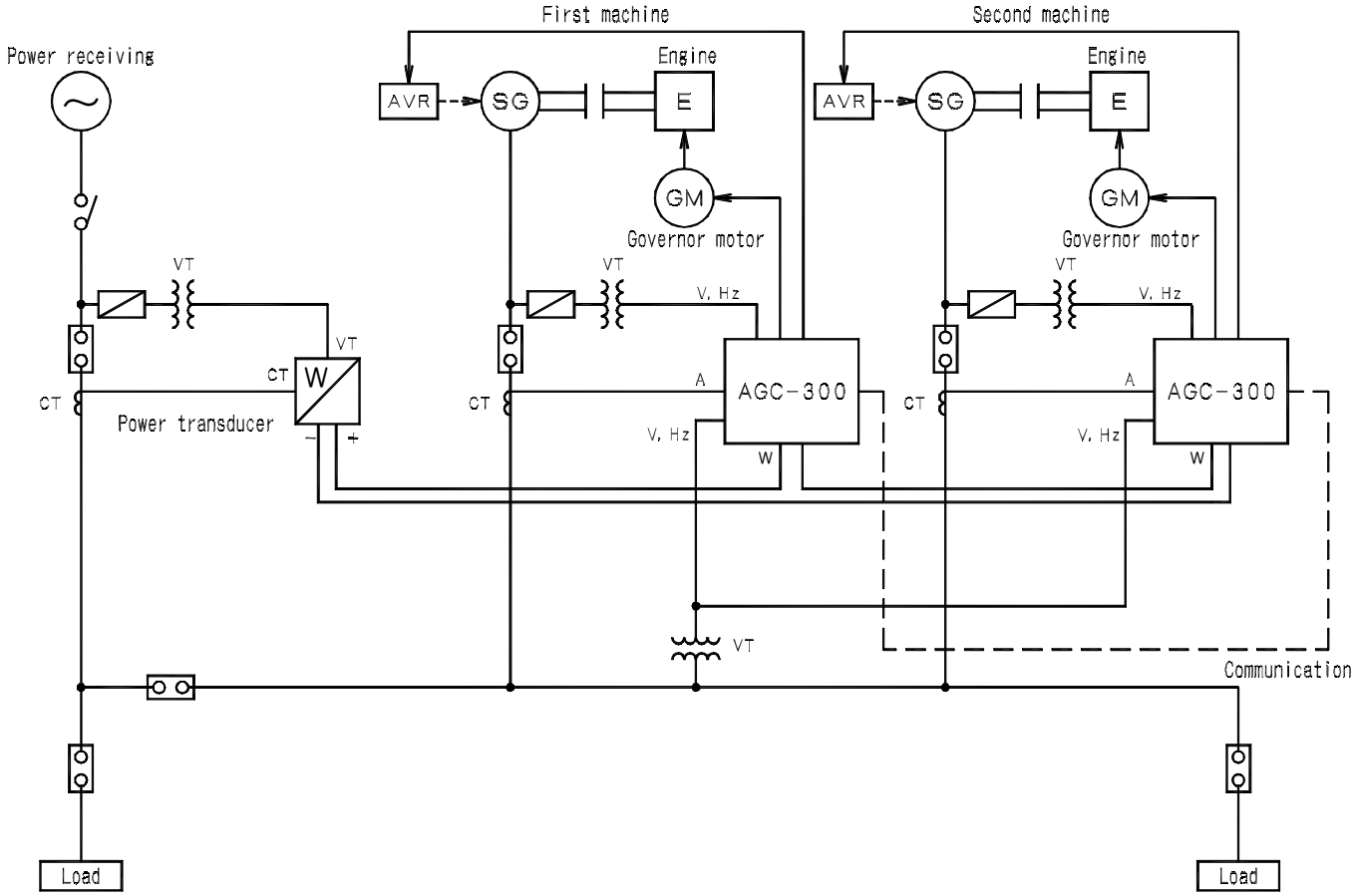
Please establish other devices and space distance over 50mm in consideration of radiation by the natural convection of air. And, please secure a space over 50mm with each field in the board (upper, under, side).

3.2 Installation

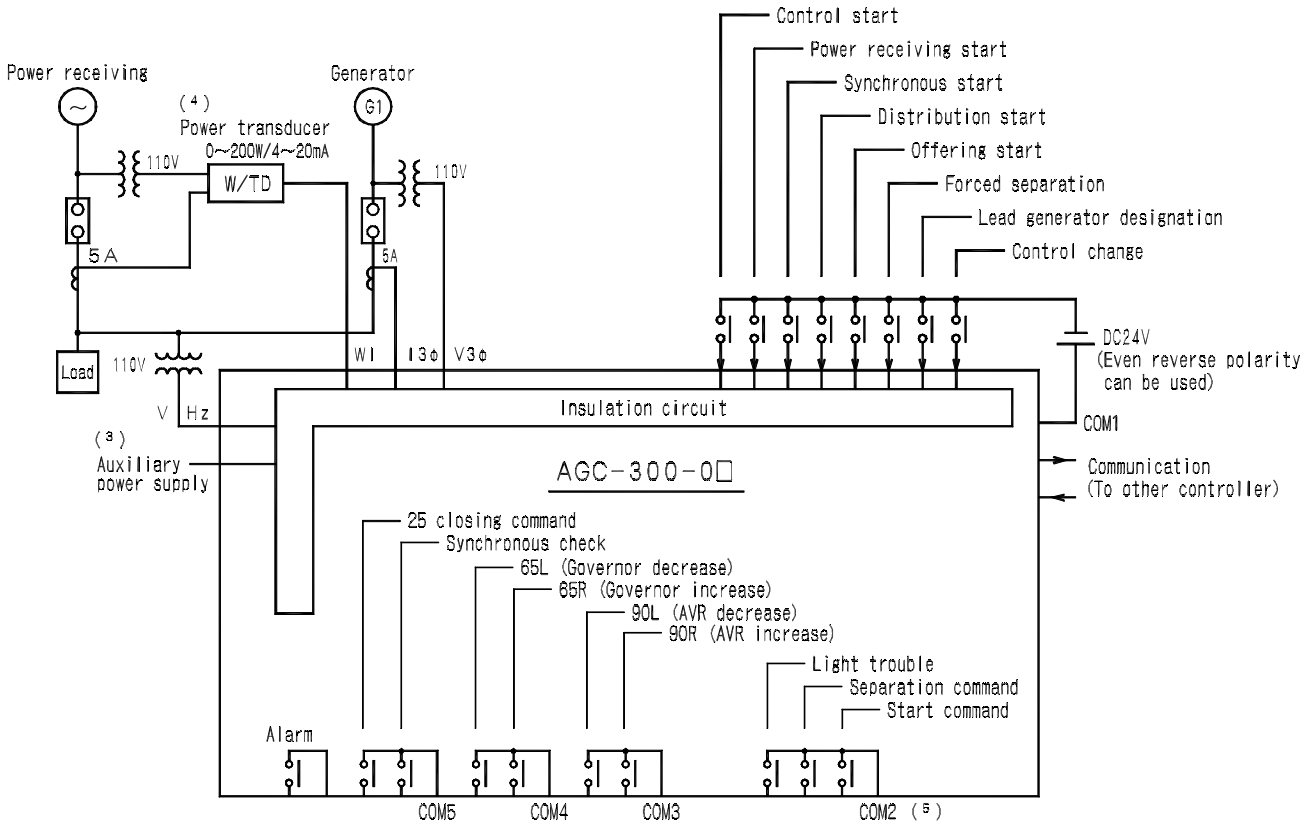
① Slide installation tool to front direction and remove installation tool from AGC-300.
② Install AGC-300 to installation hole of panel.
③ Install the installation tool to protrusion part of both sides of AGC-300 case and slide toward terminal.
④ Tighten the screw of installation tool with plus screwdriver.
Tightening torque.: 0.20～0.29N･m
If torque wrench is not kept handy, rotate this product approximately 360 degree after contacting both screws to panel, then make sure that this product is fixed firmly.



3.3 Control wiring reference drawing of power receiving and plural generators

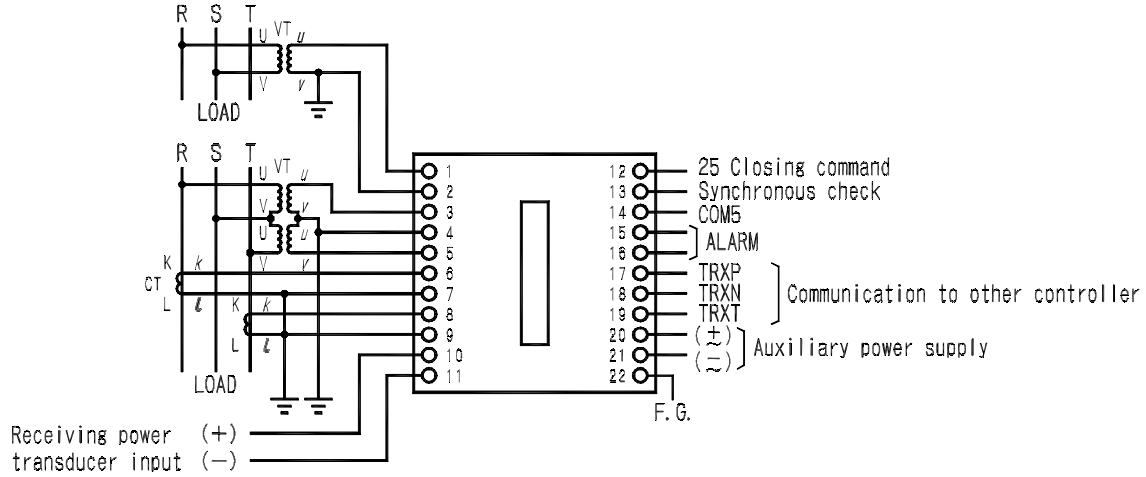


3.4 Block diagram of input and output



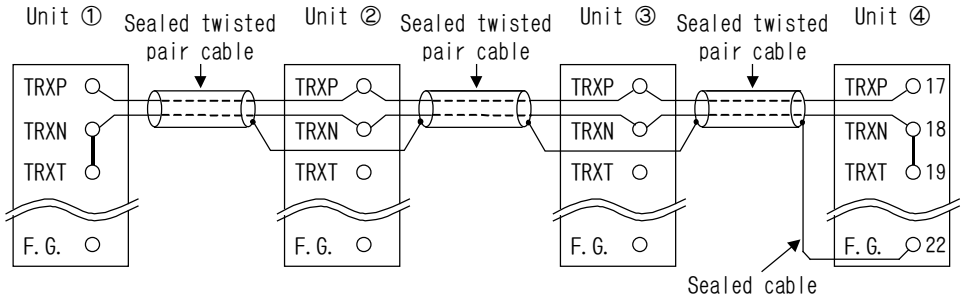
Note(3) It can correspond to the auxiliary power supply DC100/110V, AC100/110V(50/60Hz), or DC24V.
Note(4) The input sensitivity of the transducer for power receiving measurement is a standard (0~200W).
By measurement and the control range, if there is the want of extending a measuring range, please use 0~500W (or 0~1kW).
Note(5) COM2, COM3, COM4 are minus common.

3.5 Connection diagram



〈Caution〉 The relay for 25 closing command and a synchronizing check output should use the relay with a surge absorber.

■ The connection method between controls is shown the following. (4 sets of examples)



(1) The communication TRXP between each controller and TRXN(s) are connected in twisted pair wire with a shield, as shown in the above figure.

(2) One shielding wire of twisted pair wire with a shield is connected to the frame ground (F. G.) of controllers. (The above figure ④)

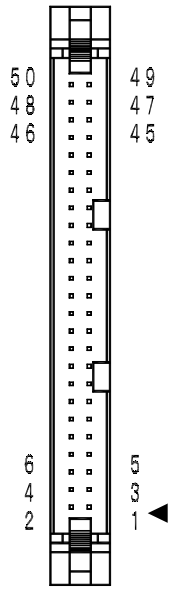
(3) The controllers (at the above figure, they are ① and ④) of both ends should connect TRXN and TRXT.

(4) The order of a controller and the address number of the above figure are not related.

■ Connector arrangement drawing

Conformity connector { HIF3BA-50D-2.54C (For crimp contact) / HIF3BA-50D-2.54R (For ribbon cable)

DI/DO Terminal name	No.		No.	DI/DO Terminal name	
NC	50		49	NC	DI
Control start	48		47	Control start	
Power receiving start	46		45	Power receiving start	
Synchronous start	44		43	Synchronous start	
Distribution start	42		41	Distribution start	
Offering start	40		39	Offering start	
Forced separation	38		37	Forced separation	
Lead generator designation	36		35	Lead generator designation	
Control change	34		33	Control change	
COM1	32		31	COM1	
NC	30		29	NC	
NC	28		27	NC	
NC	26		25	NC	
NC	24		23	NC	
Start command	22		21	Start command	DO
Separation command	20		19	Separation command	
Light trouble	18		17	Light trouble	
COM2	16		15	COM2	
90R	14		13	90R	
90L	12		11	90L	
COM3	10		9	COM3	
65R	8		7	65R	
65L	6		5	65L	
COM4	4		3	COM4	
NC	2		1	NC	



HIF3BA-50PA-2.54DS
(HIROSE ELECTRIC CO., LTD.)

The terminal of a same name is connected inside. Even if it does not wire both of terminals, a problem does not have (good only at single-sided wiring).

3.6 Cautions on connections

● Please install a terminal cover, after connection is completed.

● This equipment has sufficient noise-capacity. However, if a large noise can be thought of, please separate wiring of each input and output (AC input, auxiliary power supply input, DC input, input for control, output for control). It becomes the effective malfunction preventive measures to exogenous noise.

● In order to advance the shield effect, please earthing frame grand terminal (F.G.). And, please give the grounding resistance between a frame grand terminal (F.G.) and the ground as less than 100Ω.

3.7 Cautions on operation

(1) Caution at the case of an operation start.

・Please apply auxiliary power supply after establishing voltage. If power-supply voltage goes up gradually, a malfunction may be done in power supply unstable area.

・The address of a controller is read and decided at the case of auxiliary power supply apply. Therefore, please check the address of controller before auxiliary power supplies apply. If the address is changed after a auxiliary power supply apply (in operation) : Auxiliary power supply is turned off after change. → Again, auxiliary power supply is applied. → It is re-set up.

(2) Caution in operation.

・The controller contained in an operation quantity should apply auxiliary power supply constantly.

・If it does not change set value, the setting switch is OFF. If it is used with the setting switch ON, set value mistaken writing (control is abnormal) may occur.

(3) Caution about input, output signal.

・The input for control is DC24V (input resistance 2.4kΩ). The operating current at the case of rated voltage input is about 10mA. If it uses a relay for the input for control, please use the relay for very small current.

・If it operates an external relay by the control output, please use the relay with a surge killer (in order to mitigate the influence of noise). In addition, the common mode noise-capacity of the contact output of controller is 1μs square wave noise ±1000V.

4. Display

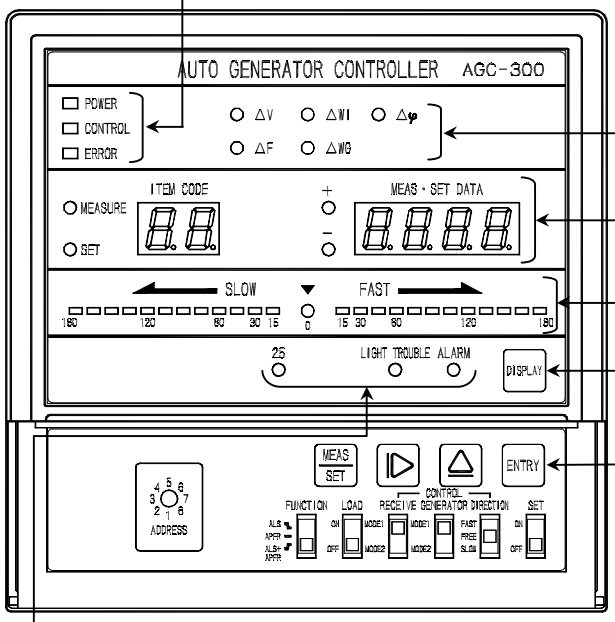
4.1 The name and function of each part

① Status display of controller

POWER : The light is put on at the case of auxiliary power supply apply.

CONTROL : The light is put on at the case of control start input or synchronous start input.

ERROR : The light is put on at the case of input range error occurrence.



② Control status display

ΔV : At the case of synchronous control : A voltage difference turn on a light within a closing allowance voltage difference. At the case of distribution control : The light is put on within a dead band to rated voltage.

ΔF : At the case of synchronous control : A frequency difference turn on a light within a closing allowance frequency difference. At the case of distribution control : The light is put on within a dead band to rated freqency.

ΔWI : The light is put on within a receiving power dead band.

ΔWG : The light is put on within dead band of generator power distribution

Δφ : At the case of synchronous control : The light is put on within (synchronizing check) 15° of phase difference. At the case of power-factor control : The light is put on within a dead band.

③ MEAS・SET DATA display.

The [MEAS SET] key changes measurement mode and setting mode. Item code No. and data are displayed in each mode.

④ Synchronous detection (Phase difference) display.

▼ of center is 0° of phase difference. To center, left side is SLOW and right side is FAST. LED is turn on a light at intervals of 15° of phase difference.

⑤ Output status display

25 : The light is put on at the case of 25 closing signal output.

LIGHT TROUBLE : The light is put on at the case of light trouble occurrence (A/D error, Set value error, Communication error, Input designation mistake, etc.).

ALARM : The light is put on at the case of alarm occurrence (Memory error, Synchronous closing mistake, etc.).

⑥ Switching and change of measurement data / setting data

It is the key switch of a display change and set value change. (Display change of measurement data, display change of setting data, set value change of setting data) 5 key switches are operated and performed.

4.2 Measurement value display

(1) Change of display item by [DISPLAY] key.

If the [DISPLAY] key is pressed from synchronous or distribution control, the display of a measurement value is possible.

Whenever indicated value presses the [DISPLAY] key, rotation of it is done to the following order. The contents of a display are distinguished by the code.

● Display item at synchronous control.

Code	Display description	Unit
01	Bus voltage	V
02	Bus frequency	Hz
04	Generator voltage	V
09	Generator frequency	Hz
10	Voltage difference	%
11	Frequency difference	Hz
13	Device address	—

The above contents of a display are displayed in order of codes 01～13 (rotation).

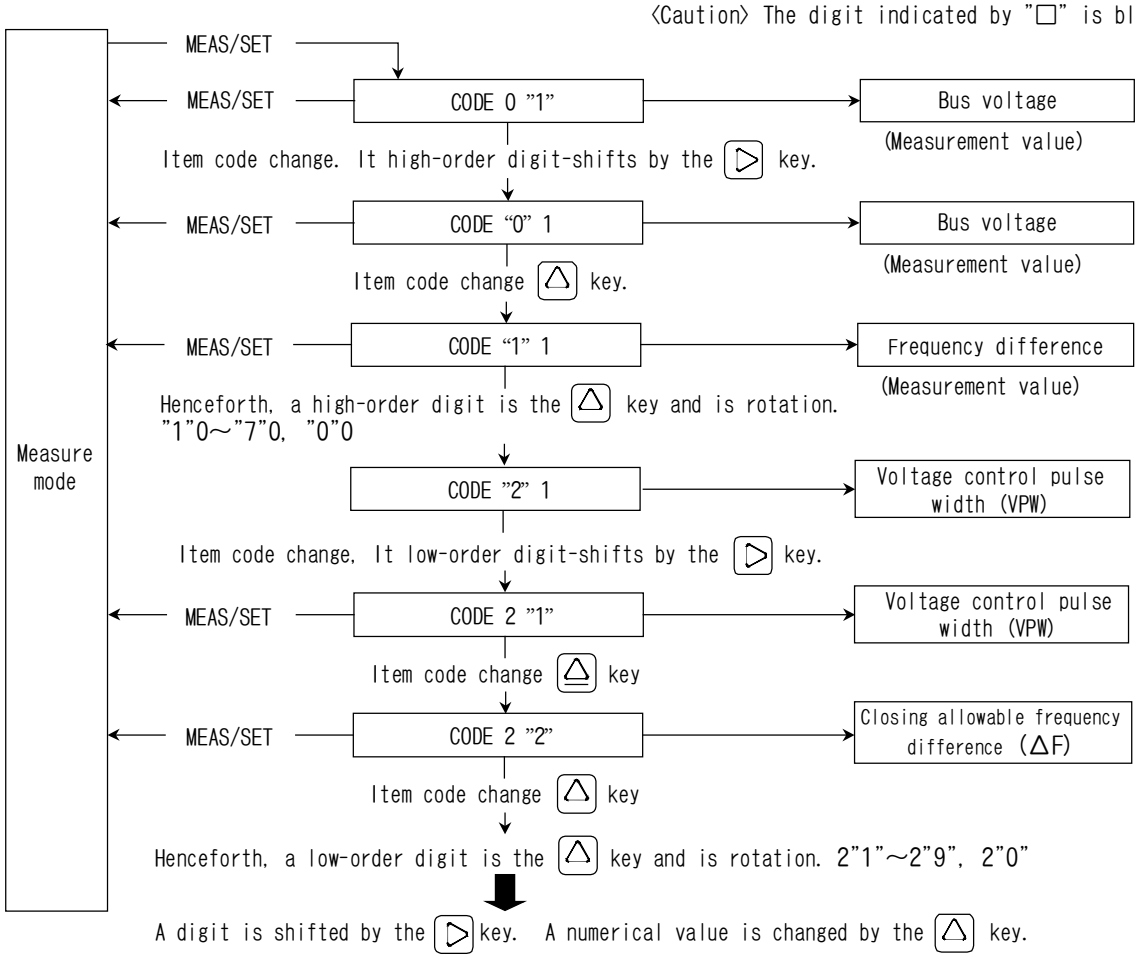
● Display item at distribution control.

Code	Display description	Unit
03	Receiving power	kW
04	Generator voltage	V
05	Generator current	A
06	Generator power	kW
07	Generator reactive power	kvar
08	Generator power factor	%
09	Generator frequency	Hz
12	Power receiving average power	kW
13	Device address	—

The above contents of a display are displayed in order of codes 03, to13 (rotation).

(2) Caution about a measurement value display
By the relation which gives priority to control processing, there is an item which stops measurement by the control state. Please keep in mind that the applicable item holds the value at the time that control changes.
At synchronous control ····· Item 05 Generator current, Item 06 Generator power,
Item 07 Generator reactive power, Item 08 Generator power-factor
At distribution control (Other than the synchronous control)····· Item 10 Voltage difference,
Item 11 Frequency difference

(3) Change of display item by change of item code. (Set change switch : OFF)
By changing an item code from synchronous or distribution control, the display of a measurement value and set value is possible. The display of the item code 0～79 is possible.

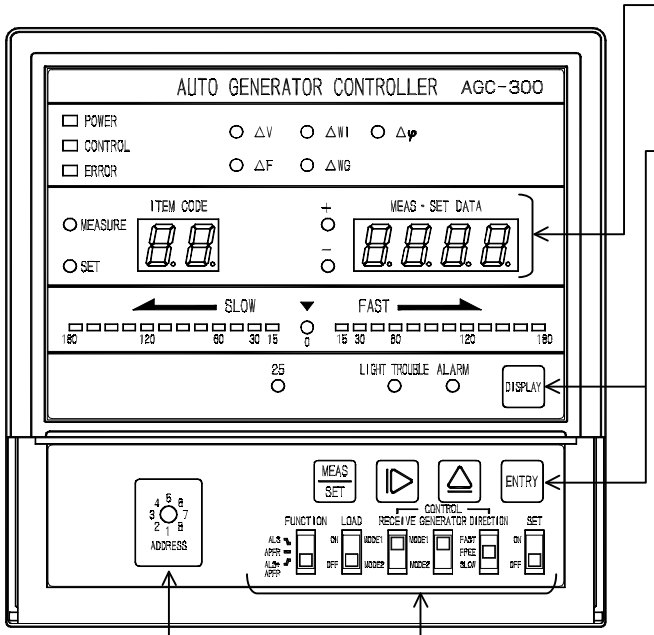


4.3 Turn off the light of display
(1) Turn off the light of display by key grabbing.
The DISPLAY key is turn off the light by pushing for about 3 seconds.

(2) Automatic displays turn off the light.
A display is turn off the light if there is no key operation within a time which was set up.
Set value is based on the set value of the display lights-out of the item code 79.

5. Operation / setting

5.1 The name and function of each part



① Measurement data / Set data display 【MEAS･SET DATA】

Measurement mode / setting mode is changed by MEAS SET key.

Item code No. and data are displayed in each mode.

② Switching and change of measurement data / setting data

It is the key switch of a display change and set value change. (Display change of measurement data, display change of setting data, set value change of setting data)

5 key switches are operated and performed.

③ Function change switch 【FUNCTION】

The function of distribution control is set up.

ALS ･･･････ Power distribution control is performed.

APFR ･･･････ Generator power-factor control is performed.

ALS＋APFR ･･･ Power distribution and generator power-factor control are performed.

④ Heavy burden change switch. 【LOAD】

ON/OFF of generator heavy burden control is set up.

⑤ Control change switch (3 points). 【CONTROL】

The controls at the case of control change input apply is set up.

・ Power receiving mode change switch. 【RECEIVE】

The mode 1 has not switching with set value ①.

The mode 2 performs switching control to set value ①→②.

・ Generator mode change switch. 【GENERATOR】

The mode 1 has not switching with set value ①.

The mode 2 performs switching control to set value ①→②.

・ Closing direction change switch. 【DIRECTION】

The direction of synchronous closing is changed.

FAST in RANDOM closing → It changes to FAST closing.

FREE in FAST closing → It changes to SLOW closing.

SLOW in RANDOM closing → It changes to SLOW closing.

⑥ Set change switch. 【SET】

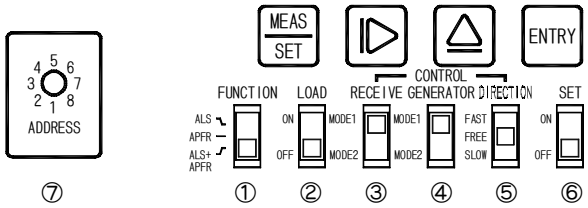
Setting change is possible (ON) or setting change is impossible (OFF), it changes.

⑦ Address change switch. 【ADDRESS】

The address of a controller is set up.

5.2 Setting

5.2.1 Setting of slide-switch

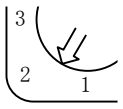


(Shipment set value)

① Function change switch	ALS＋APFR
② Heavy burden change switch	OFF
③ Power receiving mode change switch	MODE 1
④ Generator mode change switch.	MODE 1
⑤ Direction change switch	SLOW
⑥ Set change switch	OFF
⑦ Address change switch	1

CAUTION

The closing direction circuit-changing switch can be changed in the synchronous start input OFF.
The address circuit-changing switch can be changed in the power-supply input OFF.
It is not set in case it performs to other timing.
Please do not make an address switch into a middle position.
It becomes the cause of switch failure.
Please stop doing between 1 and 2, as shown in a figure.
Please set the slide-switch as the right position of the both ends or the center.
If a switch is stopped in an intermediate position, this product may malfunction (or failure).



① Function change switch.
The function of distribution control is set up.
ALS ····· Power distribution control is performed.
APFR ····· Generator power-factor control is performed.
ALS＋APFR ····· Power distribution and generator power-factor control are performed.

② Heavy burden change switch.
ON/OFF of generator heavy burden control is set up.

・Control change switch. (3 points ③～⑤)
Switching is performed by ON/OFF of control change input.

③ Power receiving mode change switch.
The mode 1 has not switching with set value ①.
The mode 2 performs set value ①→② switching control at the case of control change input ON.

④ Generator mode change switch.
The mode 1 has not switching with set value ①.
The mode 2 performs set value ①→② switching control at the case of control change input ON.

⑤ Closing direction change switch.
In the combination of the closing direction changeover switch and control change input, as shown in the following table, the closing direction at the case of synchronous control can be designated.

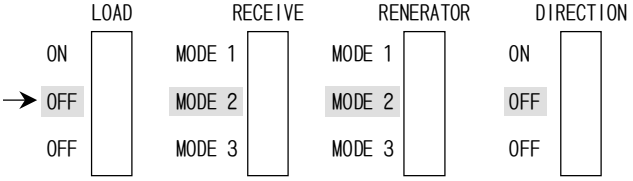
Closing direction change switch (Slide switch)	Control change input (DI)	
	OFF	ON
FAST	Random	FAST
FREE	FAST	SLOW
SLOW	Random	SLOW

〈Caution〉 Control change input serves as ③～⑤ common use. Therefore, a distribution control value also changes by ON/OFF of the closing direction switching.
Set value may consider as start command OFF. Please prepare holding circuit externally.

⑥ Set change switch.
Setting change is possible (ON) or setting change is impossible (OFF), it changes.

⑦ Address change switch.
The address of controller is set up.

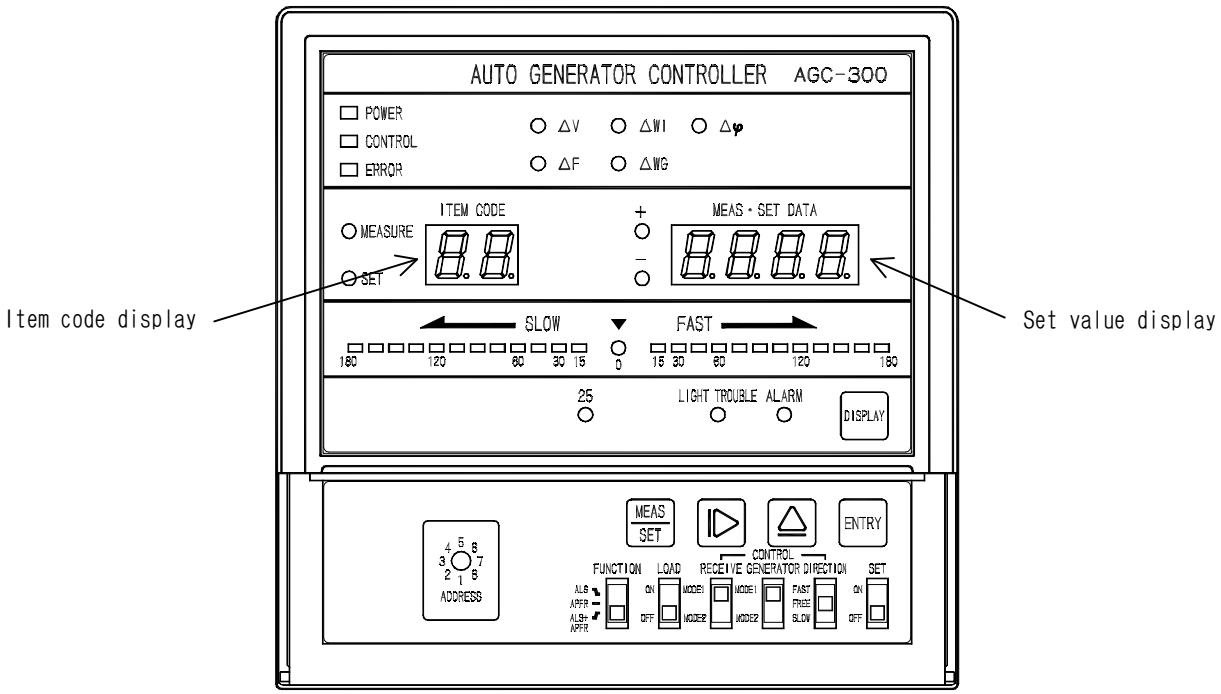
〈Caution〉 About switch middle position.
The switch middle position of ②, ③, ④, ⑥ is as follows.



5.2.2 Change of the set value by the key switch

After switching ON of setting changeover switch, it is possible of change of set value by pressing the MEAS SET key. Display and set value change of the item codes 20～79 are possible.

(Layout plan)



(An example) Item code 33. The power receiving maximum power WRI is changed into initial value 600→800.

(1) A setting changeover switch (slide switch) is set to ON. → Set permission.

(2) Push MEAS SET key. (Turn on the light of SET LED, turn off the light of MEASURE LED)
The 1 digit of an item code is blinking.

(3) Selection of item code
▷| key : Digit shift, △ key : Numerical setting. The item code 33 is selected.

(4) Next, push DISPLAY key. The 4th digit of a set value display is blinking.

(5) Setting of set value. (It changes into 600→800)
Push ▷| key (digit shift). It shifts blinking to the 3 digits.
Push △ key (Numerical setting) two times. It changes into 800.

(6) The ENTRY key is pushed if setting change is an end. If set value is a range error, it returns to the value before setting change. Please set up again after checking the range.

(7) Other setting changeing. : Flashing is shifted to an item code by the DISPLAY key. (3) section or subsequent ones is repeated.

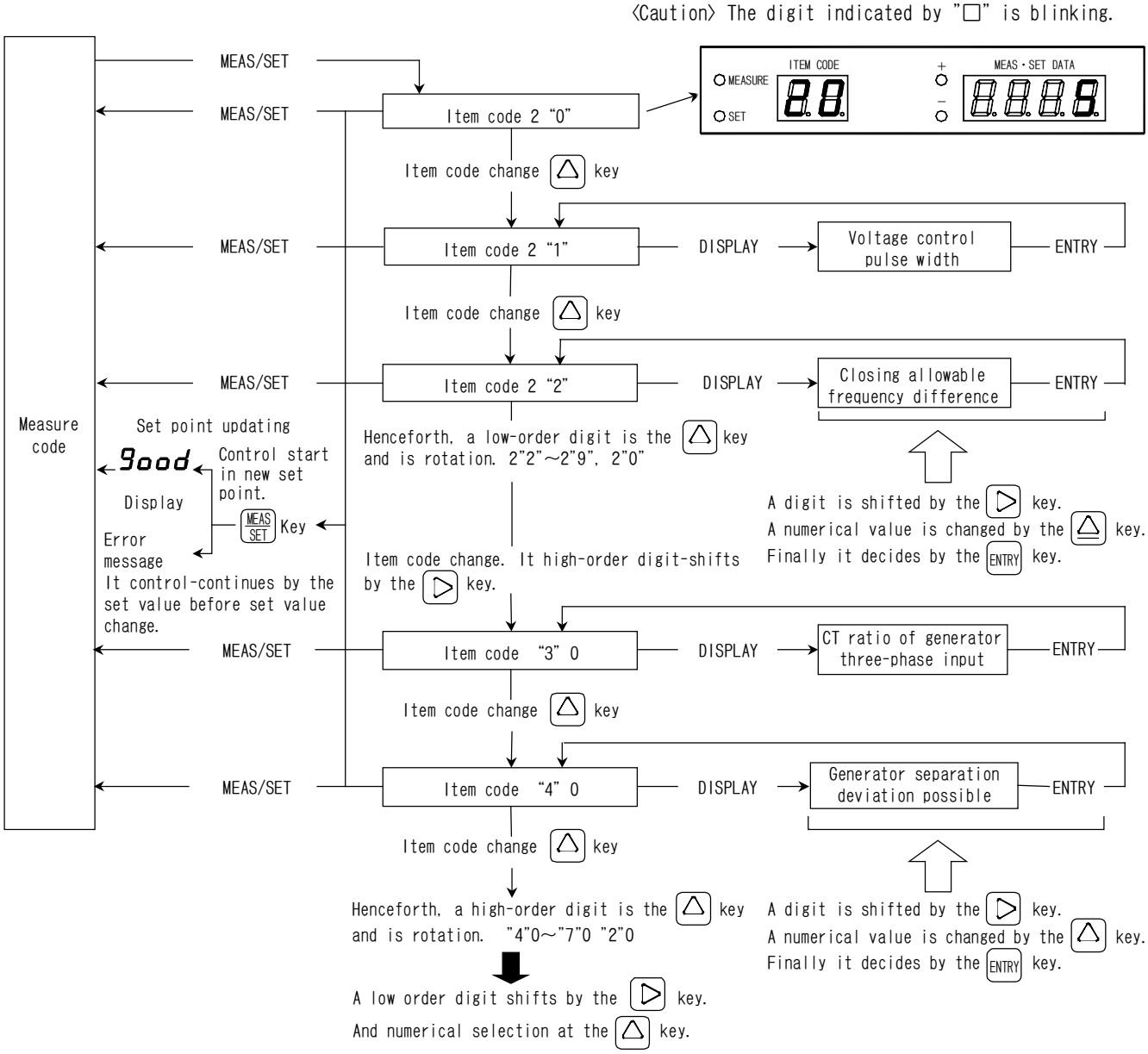
(8) All setting is completed. The MEAS SET key is pushed and the update of data is done.
If updated normally, "Good" during about 2 seconds is displayed on the set value display.

(9) An error is displayed if there is an error by the conformity check of setting data. Please check the contents of the error, because it is indicated by the text (8.1 section, 43～46 pages).

(10) In error occurrence, the MEAS SET key is pushed again. Please check and correct the set value shown by the error code. Please perform from the above (8) after a correction end.

(11) After setting finishing. Please setting changeover switch is OFF.

■ The setting operation method (A setting changeover switch is possible for setting at ON.)



5.3 Caution on setting

- After setting is finished, please return to OFF by setting changeover switch.
- The planned control is unrealizable if there is a setting mistake. Please perform setting change carefully after checking set value.
- Before the update of setting data, if a setting changeover switch is OFF, the set value in change becomes invalid. Control is continued by the set value before setting change.
- Setting change cannot be performed from synchronous closing control.
- It is designed for the generator of more than 100kW of rated powers. Please consult with our company, if each rated (WRG, QRG, WFSI, WRI) setting is under 100kW (100kvar).

5.4 Setting item list

No.	Set description		Mark	Initial value	Possible range set	Synchronous control	Power receiving parallel	Generator individual	Note
							Power distribution control + generator power-factor control	Power distribution control + frequency, voltage control	
20	Synchr-onous closing control	Closing allowable voltage difference	△V	5%	1～10%	○	×	×	It is the set value of synchronous control. It can set up at the case of the synchronizing start input OFF.
21		Voltage control pulse width	VPW	0.5s	0.1～1.0s	○	×	×	
22		Closing allowable frequency difference	△F	0.1Hz	0.1, 0.15, 0.20, 0.25, 0.30Hz	○	×	×	
23		Governor control pulse width	FPW	0.5s	0.1～1.0s	○	×	×	
24		Voltage pulse output period	PI1	2s	1～5s	○	×	×	
25		Circuit breaker progressive time	25	50ms	10～310ms (6)	○	×	×	
26		Closing output continuation number of times	25N	1 time	0: No limiting 1: 1 time 2: 2 times 3: 3 times	○	×	×	
27	Receiving power transducer full scale		WFSI	1200kW	100～9999kW	×	○	×	Set value of the transducer input sensitivity of power receiving. Only power receiving parallel needs to be set up.
28	Receiving power measurement average time (7)		TAI	2s	0～120s	×	○	×	It sets up if needed.
29	VT ratio of generator 3-phase input		VT	60	1～9999	○	○	○	It is setting of VT and CT of a generator.
30	CT ratio of generator 3-phase input		CT	50	1～9999	×	○	○	
31	Bus rated voltage (VT secondary)		V	110V	90～120V	○	○	○	The rated voltage of bus, and setting of rated frequency.
32	Bus rated frequency		F	50.0Hz	49.0～51.0Hz 59.0～61.0Hz	○	○	○	
33	Power receiving maximum power		WRI	600kW	100～WFSI	×	○	×	(10) It is setting item about receiving power constant control. There is a limit of WHI-△M-△WI≧WMI ≧WLI+△WI other than the following and the range which can be set up. Set value is % to WRI.
34	Generator starting power		WHI①	90%	20～95%	×	○	×	
35			WHI②						
36	Power receiving constant control power		WMI①	50%	10～87%	×	○	×	
37			WMI②						
38	Power receiving minimum power		WLI①	20%	1～50%	×	○	×	
39			WLI②						
40	Generator separation possible deviation		△M①	10%	5～70%	×	○	×	
41			△M②						
42	Receiving power dead band		△WI①	10%	3～30%	×	○	×	
43			△WI②						
44	Power control maximum pulse time		THW	3.0s	0.5～5.0s	×	○	○	Control speed is set up.
45	Power control minimum pulse time (8)		TLW	0.3s	0.1～1.0s	×	○	○	
46	Frequency control dead band		△FC	1.0%	0.2～5.0%	×	×	○	It is the setting item of frequency control at the case of operation of only a generator.
47	Frequency control maximum pulse time		THF	3.0s	0.5～5.0s	×	×	○	

No.	Set description	Mark	Initial value	Possible range set	Synchronous control	Power receiving parallel Power distribution control + generator power-factor control	Generator individual Power distribution control + frequency, voltage control	Note
48 49	Generator rated power (Generator maximum operation power)	WRG① WRG②	1500kW	100～(VT×CT) kW MAX. 9999kW	×	○	○	(11) It is a setting item about next machine starting power and separation possible power. There is a limit of WHG-5%≧WMG other than the following and the range which can be set up. Set value is % to WRG.
50 51	Next number machine starting power	WHG① WHG②	100%	70～100%	×	○	○	
52 53	Generator separation possible power	WMG① WMG②	80%	50～95%	×	○	○	
54	Generator minimum power	WLG	10%	1～40%	×	○	○	
55	Next machine starting deviation and separation possible deviation. (Only a generator is at the ream system case.)	△H	20%	1～40%	×	×	○	
56 57	(9) Generator power dead band	△WG① △WG②	2%	1～30%	×	○	○	
58	Reactive power control maximum pulse time	THQ	3.0s	0.5～5.0s	×	○	○	Control speed is set up.
59	Reactive power control minimum pulse time	TLQ	0.3s	0.1～1.0s	×	○	○	
60	Voltage control dead band	△VC	2.0%	0.5～5.0%	×	×	○	Only generator is setting item of voltage control at operation.
61	Voltage control maximum pulse time	THV	3.0s	0.5～5.0s	×	×	○	
62	Generator rated reactive power	QRG	750kvar	100～ (VT×CT) kvar MAX. 9999kvar	×	○	○	It is the set value of the rated reactive power of a generator.
63	Generator constant control power factor value	cosΦ	LAG90 %	LEAD(-)95～100 ～LAG(+)70%	×	○	×	It is a setting item at the case of power-factor control of a generator.
64	Power factor control dead band	△Φ	3°	2～10°	×	○	×	
65	Power factor control dead band change current value	CHA	30%	10～60%	×	○	×	
66	Power factor control cut current value	CTA	10%	1～10%	×	○	×	
67	Generator starting detection timer	TS	60s	0～120s	×	○	×	It is timer setting.
68	Generator separation possible detection timer	TB	30s	0～60s	×	○	○	
69	Governor control delay time	TGDL	2s	0～20s	×	○	○	Control speed is set up.
70	AVR control delay time	TADL	2s	0～20s	×	○	○	
71	Power receiving maximum pulse power deviation	△WTHI	50%	50% fix value	-	-	-	
72	Generator all conduction pulse power deviation	△WTRG	50%	10～70%	×	○	○	
73	Generator maximum pulse power deviation	△WTHG	30%	10～50%	×	○	○	
74	Maximum pulse frequency deviation	△FTH	10%	10% fix value	—	—	—	
75	Maximum pulse power factor deviation	△ΦTH	60°	60° fix value	—	—	—	
76	Maximum pulse voltage deviation	△VTH	10%	10% fix value	—	—	—	

No.	Set description	Mark	Initial value	Possible range set	Synchronous control	Power receiving parallel	Generator individual	Note
						Power distribution control + generator power-factor control	Power distribution control + frequency, voltage control	
77	Governor system abnormality detection	GAV	1	1:ON 2:OFF	○	○	○	It is existence or nonexistence setting of governor system abnormality detection.
78	Generator parallel operation number	Paral-lel number	1	1～8	○	○	○	It is setting of the operation quantity of generator.
79	Display turn off the light time	-	10 min.	0:Continuation 1～10 minutes	○	○	○	The 7 segment LED is turn off the light.

Note(6) Relationship of possible progressive time 25 closing allowable frequency difference setting (△F) and set.

ΔF set	Setting possible progressive time.
0.1 Hz	10～310ms
0.15Hz	10～210ms
0.2 Hz	10～150ms
0.25Hz	10～100ms
0.3 Hz	10～ 80ms

Note(7) Regardless of TAI (second), detection control of the power receiving reverse power detection is done by instantaneous value.

Note(8) The frequency control minimum pulse time is the power control minimum pulse time (TLW) and common use.

Note(9) They are a generator reactive power dead band and common use. However, it becomes % to QRG.

Note(10) Power receiving setting conditions. ① WFSI≧WRI ② WHI－ΔM－ΔWI≧WMI≧WLI＋ΔWI

Note(11) Generator setting conditions. ① VT×CT≧WRG

6. Control function

6.1 Synchronous closing control

(1) Control range

Bus voltage	80～132V
Generator voltage	More than 80V
Bus frequency	Rated frequency ±3Hz
Frequency difference ΔF	Less than 4Hz

(2) Speed matcher function

The frequency difference of a bus and a closing generator controls the frequency of a closing generator to come in tolerance (ΔF or ΔF＋0.1Hz).

About tolerance

・At the case of power receiving and parallel operation (power receiving start ON) : ΔF

・At the case of the parallel operation (power receiving start OFF) of only generator : ΔF＋0.1Hz

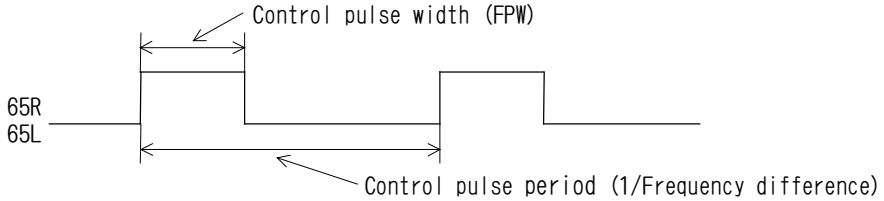
However, in case of ΔF＝0.3Hz setting. Tolerance is 0.3Hz.

in case of ΔF＝0.25Hz setting. Tolerance is 0.3Hz.

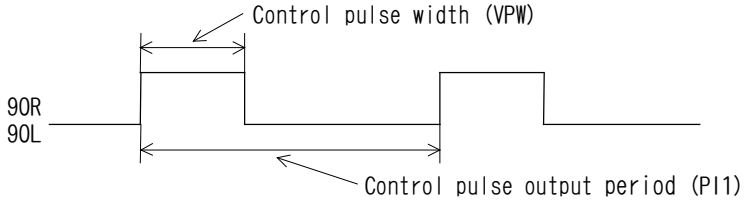
・Pulse output wave form

Control pulse width (FPW) : Constant pulse width (Setting to 0.1～1.0s is possible.)

Control pulse output cycle : 1 / frequency difference (In phase difference 1 turn of 1 pulse output)



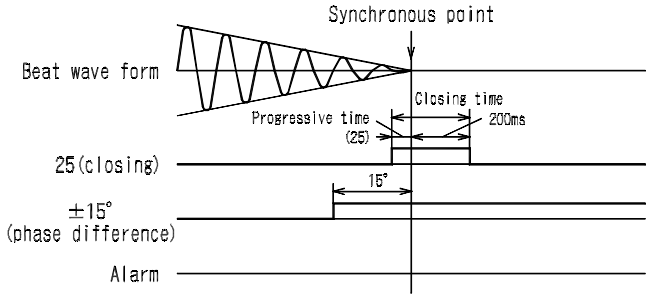
(3) Voltage balance function
The voltage difference of a bus and a closing generator controls the voltage of a closing generator to come in tolerance (△V).
・Pulse output wave form
Control pulse width (VPW) : Constant pulse width (Setting to 0.1～1.0s is possible.)
Control pulse output cycle (PI1) : Constant pulse period (Setting to 1～5s is possible.)



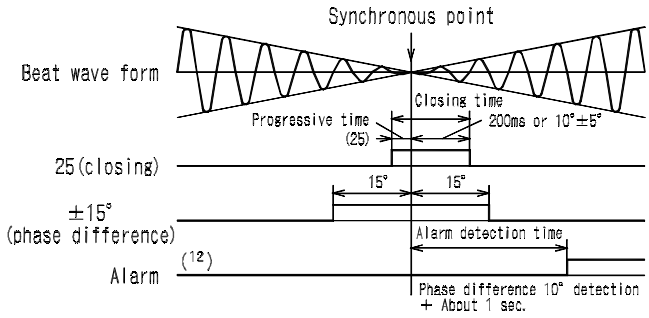
(4) Synchronous closing function ····· In case of ΔF, ΔV.
In order to detect the phase point of agreement of a bus and a closing generator and to do the closed circuit of the circuit breaker by the synchronous point, the progressive time of a circuit breaker is forecasted and a closing command is outputted before a synchronous point.
A circuit breaker progressive time can be set as 10～310ms.

(5) Phase difference 15° within detection function ····· In case of ΔF, ΔV.
The phase difference of bus and closing generator is within 15°, a synchronous check relay signal is outputted.
・Synchronous closing output

Synchronous closing success example.



Synchronous closing error example.



Note(12) An alarm is outputted if a synchronous closing mistake occurs after 25N(1～3) of counts of closing output continuation. It is not outputted if unconditional in a closing output continuation count setting.
Reset of an alarm output is performed by synchronous start input OFF.

(6) Phase difference delay detection function
In order to speed up synchronous closing control in the next case, a governor control output is done after 3 seconds. (If the frequency difference (less than 0.05Hz) of a bus and a closing generator was small and the phase difference becomes constant)
25 closing command is not outputted from phase difference delay detection.
・65L is outputted at the case of SLOW closing designation.
・FAST or random closing designation outputs 65R.

6.2 Power control

(1) Control conditions

Receiving power constant control :

In parallel operation with power receiving. And at the case of ALS control designation. (Control start ON, Power receiving start ON, Distribution start ON, Function change switch : ALS or ALS+APFR)

Power proportional distribution control :

Only a generator is into operation. And at the case of ALS control designation. (Control start ON, Power receiving start OFF, Distribution start ON, Function change switch : ALS or ALS+APFR)

(2) Control range

Bus voltage : AC80～132V

Bus frequency : Rated frequency F±7Hz

Receiving power constant control or power proportional distribution control is performed in control range.

If a bus voltage input is other than the control range. : ERROR LED turn on the light and light trouble are outputted, and power control is stopped.

(3) Receiving power constant control. (At the case of parallel operation with power receiving.)

In order that receiving power may serve as power receiving constant control value (WMI±ΔWI), proportional distribution control of the remaining power excluding the burden share (WMI) of power receiving from all power (receiving power + generator total power) is done between each generator.

Thereby, receiving power is controlled by WMI constant.

$$\text{Each generator control object (\% for WRG)} = \frac{\text{(Receiving power + Generator total power) − Power receiving constant control value WMI}}{\text{Summation of generator rated power WRG}} \times 100\%$$

The above calculation formula.

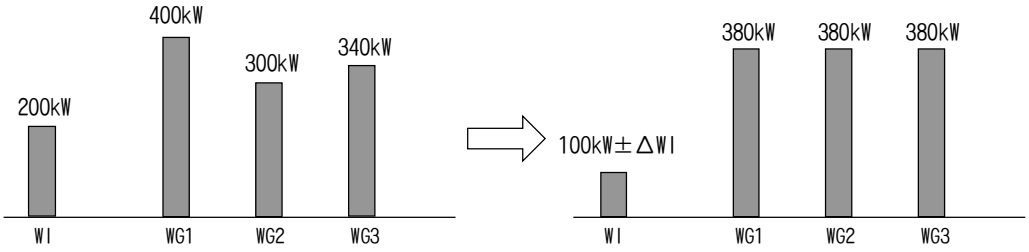
To the computed generator control object, in order that each generator may become in a generator control object ±ΔWG dead band, governor control is done. If the receiving power has not come in the power receiving constant control value (WMI±ΔWI) dead band (Even if all generators come in a generator control object ±ΔWG dead band), the minimum pulse is outputted in each generator. And, in order that receiving power may become in deltaWI dead band, it adjusts.

〈Caution〉 There is a limiter of bounds in a generator control object at the case of power receiving parallel. If the computed generator control object exceeds 100%, it sets to 100% of upper limit. And, if it becomes a minus object, it sets up to 0% and control is continued.

Example 1) Power receiving + 3 generators (WMI=100kW , WRG1～3=500kW)

$$\text{Generator object} = \frac{(WI+WG1+WG2+WG3)-WMI}{\text{Summation of generator rated power WRG}} \times 100\% = \frac{(200kW+400kW+300kW+340kW)-100kW}{1500kW} \times 100\% = 76\% \text{ (\% for WRG)}$$

Generator object power, 380kW



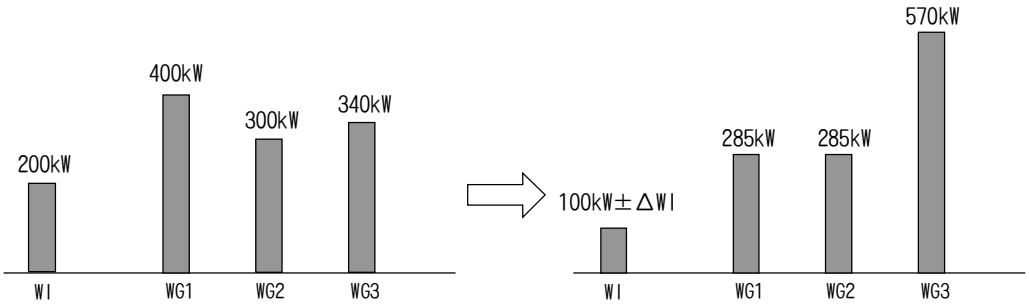
Example 2) Power receiving + 3 generators (WMI=100kW , WRG1～2=500kW , WRG3=1000kW)
If the rated powers of a generator are different

$$\text{Generator object} = \frac{(\text{WI}+\text{WG1}+\text{WG2}+\text{WG3})-\text{WMI}}{\text{Summation of generator rated power WRG}} \times 100\%$$

$$= \frac{(200\text{kW}+400\text{kW}+300\text{kW}+340\text{kW})-100\text{kW}}{2000\text{kW}} \times 100\%$$

= 57% (% for WRG)

Generator object power, G1, G2=285kW
G3=570kW



〈Caution〉 It becomes a power proportional distribution control to a rated power WRG.

(4) Power proportional distribution control (at the case of isolated operation of generator only.)
Proportional distribution control of all the power (generator total power) is done between each generator.

$$\text{Each generator control object (\% for WRG)} = \frac{\text{Generator total power}}{\text{Summation of generator rated power WRG}} \times 100\%$$

The above calculation formula.
To the computed generator control object, in order that each generator may become in a generator control object ±ΔWG dead band, governor control is done. All generators become in ΔWG dead band, and a power proportional distribution control is completed. After that, bus voltage is supervised to all machine coincidence, and rated frequency control is performed.

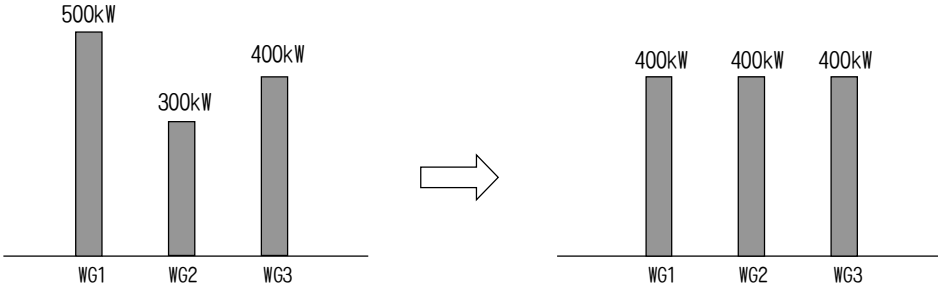
Example) 3 generator (WRG1～3=500kW)

$$\text{Generator object} = \frac{(\text{WG1}+\text{WG2}+\text{WG3})}{\text{Summation of generator rated power WRG}} \times 100\%$$

$$= \frac{(500\text{kW}+300\text{kW}+400\text{kW})}{1500\text{kW}} \times 100\%$$

= 80% (% for WRG)

Generator object power, 400kW

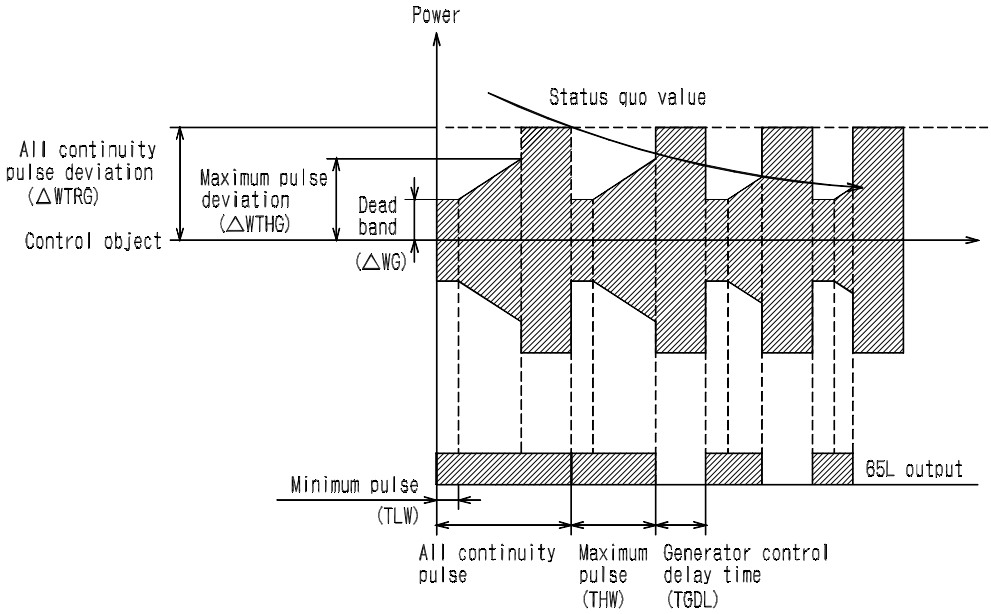


(5) Governor pulse output waveform

A governor pulse output is controlled so that generator output becomes in generator control object ±△WG dead band. As for governor pulse output, pulse width changes with the deviation (control object − generator output of present) to control object.

In case of deviation is more than all conduction pulse power deviation (△WTRG), it becomes a continuous pulse without governor control delay time (TGDL). And, in case of deviation is more than all conduction pulse power deviation (△WTRG) ～ maximum pulse power deviation (△WTHG), the pulse of the power maximum pulse time (THW) is outputted.

In case of deviation for maximum pulse power deviation (△WTHG)～ power dead band (△WG), it is the pulse width at the case of power maximum pulse time (THW)～ power minimum pulse time (TLW). The pulse of short pulse width is outputted as a control object is approached.



(a) Governor pulse width in power control

The deviation and the following set value to a control object determine pulse width.

Item No. 44 Power control maximum pulse time (THW)
Item No. 45 Power control minimum pulse time (TLW)
Item No. 56, 57 Generator power dead band (△WG①, △WG②)
Item No. 72 All generator conduction pulse power deviation (△WTRG)
Item No. 73 Generator maximum pulse power deviation (△WTHG)

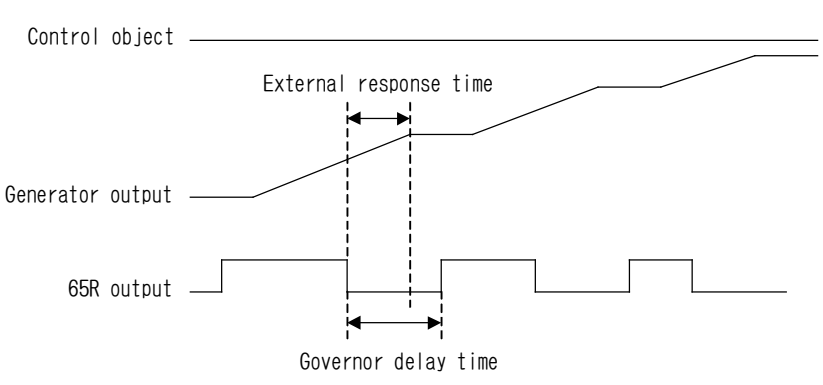
$$\text{Pulse width} = TLW + \frac{(THW - TLW)}{(\triangle WTHG - \triangle WG)} \times (\text{Deviation to control object} - \triangle WG)\ (s)$$

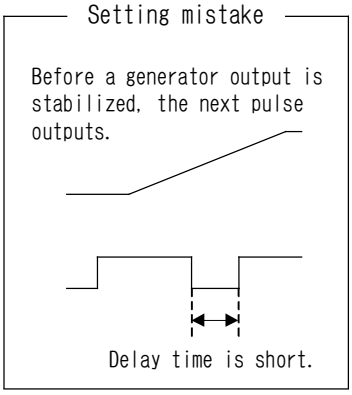
(b) Governor control delay time

Please set up setting of governor control delay time in consideration of the response time of the external equipment containing governor equipment etc.

To the response time, if setting of delay time is short, it becomes the cause of overshoot of a generator output, or undershoot.

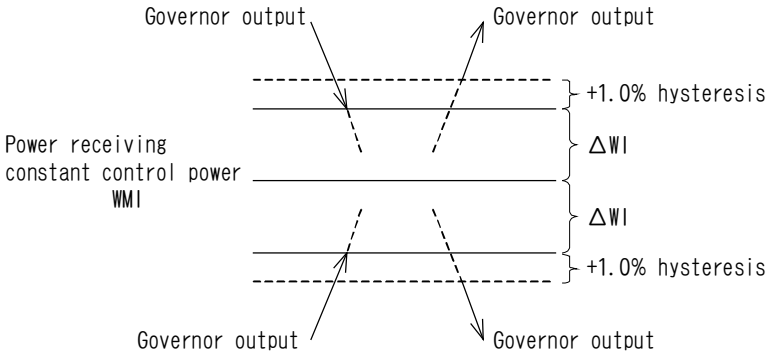
Governor delay time set value ≧ Response time of external device





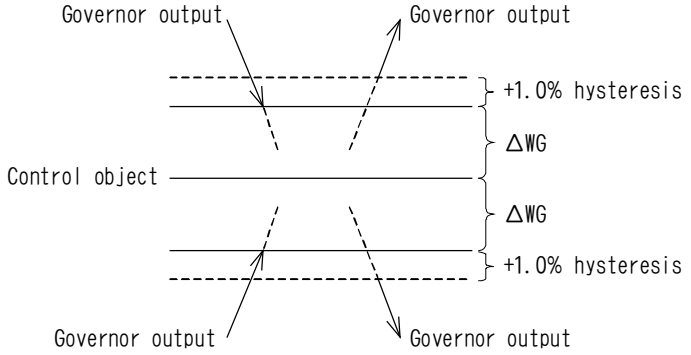
(6) Setting of receiving power dead band
In actual control, as for the control dead band, +1.0% of hysteresis is prepared in the outside of set value ΔWI.
Please set up dead band ΔWI after taking this hysteresis into consideration.

The point that separates from a dead band and starts a governor pulse output again serves as a dead band set value ΔWI+1.0% hysteresis.



(7) Setting of generator power dead band
In actual control, as for the control dead band, +1.0% of hysteresis is prepared in the outside of set value ΔWG.
Please set up dead band ΔWG after taking this hysteresis into consideration.

The point that separates from a dead band and starts a governor pulse output again serves as a dead band set value ΔWG+1.0% hysteresis.



(8) Average value measurement control
It is possible to perform distribution control of receiving power by average value by setting up receiving power measurement average time TAI second. CR filter processing with the time constant of the set-up value is performed by software.

(9) Over load detection
If generator power exceeds 110% of the rated power WRG, over load detection and a light trouble are outputted.
However, control is continued.

(10) Generator power maximum operation power
The maximum operation power value of the generator at the case of power receiving and generator parallel operation is a rated power WRG. If this is exceeded, receiving power constant control is stopped. And, it becomes the generator maximum operation constant control of WRG±ΔWG.

(11) Receiving power transducer input breaking detection
If receiving power transducer input (receiving power average value) continues for 5 seconds in the status within 0mA ±0.8mA, input breaking error detection and light trouble are outputted. And, control stops.

(12) Power receiving reverse power prevention control
In order to prevent the reverse power of power receiving, if receiving power (instantaneous value) constitutes below power receiving minimum power (WLI), distribution control is interrupted temporarily.
And, if the status of power receiving reverse power (less than 0kW) continues more than 10 seconds, power receiving reverse power error detection and a light trouble are outputted.
However, power receiving reverse power control is continued.

〈Caution〉 In order to prevent the motor ring of a generator, if generator power becomes below 0kW+ΔWG, the governor decrease maximum pulse is stopped. And, if it becomes below 0 kW+ΔWG also in the usual control, a governor decrease signal is not outputted.

(13) Governor system abnormality detection
If a generator does not reach an object even if it outputs a governor signal (65R, 65L) in the same direction 60 times continuation, a governor system abnormality detection and a light trouble are outputted.
Governor system abnormality detection machine continues control. Other normal machines perform a quantity control and receiving power constant control except for an abnormal machine. And, effective/no effect setting is possible for governor system abnormality detection function by the setting item. Governor system abnormality detection is detected also in the case of all conduction pulse output.

〈Caution〉 All conduction pulse output, "maximum pulse time + delay time" is counted as output for one pulse.

(14) Generator number control

Heavy burden OFF : Power receiving constant control priority mode.
Heavy burden ON : Generator heavy burden operation priority mode.

Power receiving + Generator	Generator only
● Start command output Common : As for starting of the first generator, power receiving load becomes more than WHI. It outputs, if it continues during TS sec. Heavy burden OFF : If total load reaches more than "WMI＋WHG× number of generator in operation", a starting (with no timer) command will be outputted to the machine of the next order of operation. Heavy burden ON : If total load reaches more than "WHI＋WHG× number of generator in operation", if it continues TS second, a start command will be outputted to the machine of the next order of operation. 〈Caution〉 According to power conditions, multiple start commands may be outputted simultaneously.	● Start command output (Heavy burden ON／OFF common) If total load reaches more than "(WHG－ΔH)× number of generator in operation", a starting (with no timer) command will be outputted to the machine of the next order of operation. 〈Caution〉 According to power conditions, multiple start commands may be outputted simultaneously.
● Separation control Heavy burden OFF : The total load after the separation becomes below "WMI＋WMG× generator number of remnant", if it continues TB sec the machine of the last order of operation will start separation control. Heavy burden ON : The total load after the separation becomes below "(WHI－ΔM)＋WHG× generator number of remnant", if it continues TB sec the machine of the last order of operation will start separation control. Common : The separation of the last generator starts separation control, if total load becomes below WHI－ΔM and continues TB sec.	● Separation control (Heavy burden ON／OFF common) The total load after the separation becomes below "(WMG－ΔH)× generator number of remnant", if it continues TB sec the machine of the last order of operation will start separation control.

Operation at the case of communication malfunction detection

Starting output : The start command output by the offering start is possible. Moreover, in power receiving parallel, a start command is outputted on the starting conditions of the first generator of power receiving + generator. (Power receiving load ≧ WHI, TS sec continuation)

Separation control : In power receiving parallel, the separation control by the forced separation is possible. Moreover, separation control is performed on the separation conditions of the last generator of power receiving + generator. (Power receiving load + self-machine load ≦ WHI-ΔM, TB second continuation)

(15) Separation of generator

If the generator in separation control reaches separation power (WLG＋ΔWG), separation command will be outputted. If it is status as continued, constant control of separation power (WLG) ±ΔWG is performed.

(16) Offering start

Regardless of the loaded condition and starting order of generator, start command is outputted by the Offering start input. Separation control of all generators is stopped from a starting output (until distribution start is inputted). If the offering start input is applied to the generator in parallel operation, the generator separates from the object of automatic separation control. (The order of separation can be flown)

If closing of large capacity load is forecasted, generator can be held before application of load by applying a offering start input to all the generators of the required number with low loaded condition.

(17) Forced separation

It is possible to do the separation of the generators arbitrary irrespective of separation command by the forced separation input, and if there is a standby generator, after starting a standby generator, separation control is started. If there is no standby generator, separation control is started only at the case of power receiving and parallel. It is effective in the case of failure of a generator or check. If the forced separation input is applied to the generator in stop, it is excepted from the object of automatic starting. And, although a few set input is possible for a forced separation, it performs one separation control every.

Other forced separation standby machines do not output governor increase (65R) signal. The timer for about 10 seconds is contained until it starts forced separation.

(18) Lead generator designation

The order of operation of a generator is determined. Please designate one set from the generator in a system (that to which the control start input is applied). (If not designated, an error is detected and a light trouble output is done)

From the generator which had the advantage generator designated, it starts in order of the address.

The separation is done to an address inverse order from the generator put into operation at the end.

An advantage generator can be designated arbitrarily. An operation machine is changed if an advantage generator is changed from operation (it becomes the designated order of operation).

(Example) The order of operation.

Advantage machine designation

↓

┌→1→2 3→4→5→6→7→8 ┐

(Example) The order of separation.

Advantage machine designation

↓

┌ 1←2 3←4←5←6←7←8 ←┘

〈Caution〉 The machine of the control start OFF or the machine more than operation quantity flies and controls. If a lead generator designation machine has a generator in load distribution (offering start machine is excluded.) in others, it will output a start command regardless of power conditions.

(19) Control change

It is at a control change input and it is possible to change the power control value of power receiving and a generator from ① to ②. It is combination with a control changeover switch, and switching of the following (No.① to ④) pattern is possible. It is effective in the change control by the daytime/night, summer / winter, weekday / holiday, etc.

No.	Control change input	Control change switch.		Power control value		Description
		Power receiving mode	Generator mode.	Power receiving	Generator	
1	ON	MODE 1	MODE 1	WHI WMI WLI △M △WI } ①	WRG WHG WMG △WG } ①	With no switching of a power control value.
	OFF					
2	OFF	MODE 1	MODE 2	WHI WMI WLI △M △WI } ①	WRG WHG WMG △WG } ①	With no switching of a power control value.
	ON			WHI WMI WLI △M △WI } ①	WRG WHG WMG △WG } ②	Only the power control value of a generator is changed to ①→②.
3	OFF	MODE 2	MODE 1	WHI WMI WLI △M △WI } ①	WRG WHG WMG △WG } ①	With no switching of a power control value.
	ON			WHI WMI WLI △M △WI } ②	WRG WHG WMG △WG } ①	Only the power control value of power receiving is changed to ①→②.
4	OFF	MODE 2	MODE 2	WHI WMI WLI △M △WI } ①	WRG WHG WMG △WG } ①	With no switching of a power control value.
	ON			WHI WMI WLI △M △WI } ②	WRG WHG WMG △WG } ②	The power control value of both power receiving and generator is changed to ①→②.

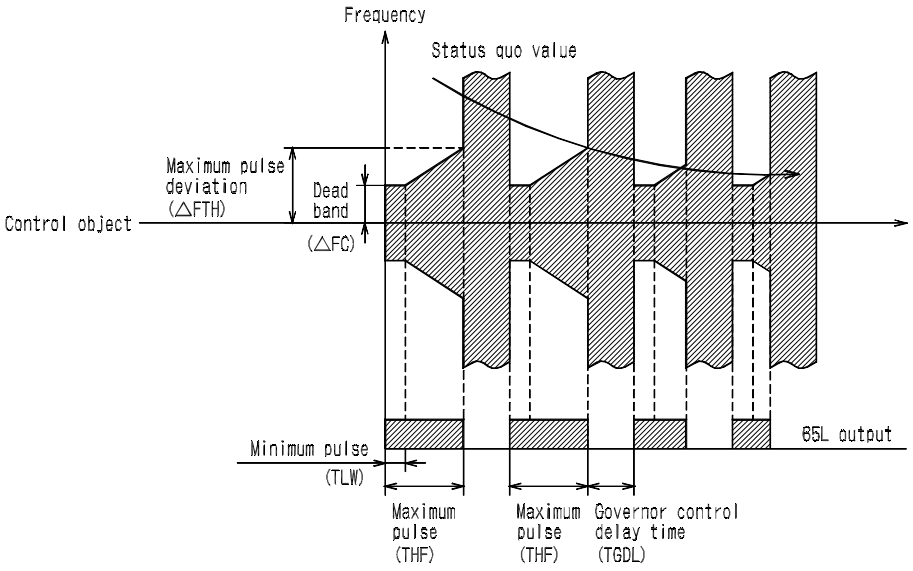
6.3 Rated frequency control

(1) Rated frequency control

In operation of only a generator, all generators become in ΔWG dead band. All machines supervise bus voltage simultaneously after completing a power proportional distribution control. And, rated frequency control is performed.

(2) Governor pulse output waveform

In each generator, in order that it may become bus rated frequency F±ΔFC to which generator frequency was set, governor control is done. As for a governor pulse output, pulse width changes with the deviation (control object − generator output of present) to a control object. Deviation is at the case more than the maximum pulse deviation (ΔFTH), the pulse of the maximum pulse time THF is outputted. Deviation (between ΔFTH～ΔFC) outputs the pulse of short pulse width as it approaches a control object by the pulse width between THF～TLW.



(a) Governor pulse width in frequency control.

The deviation and the following set value to a control object determine pulse width.

Item No. 47 Frequency control maximum pulse time (THF)
Item No. 45 Power control minimum pulse time (TLW)
Item No. 46 Frequency control dead band (ΔFC)
Item No. 74 Maximum pulse frequency deviation (ΔFTH)

$$\text{Pulse width} = TLW + \frac{(THF - TLW)}{(\Delta FTH - \Delta FC)} \times (\text{Deviation to control object} - \Delta FC) \quad (s)$$

(b) Governor control delay time

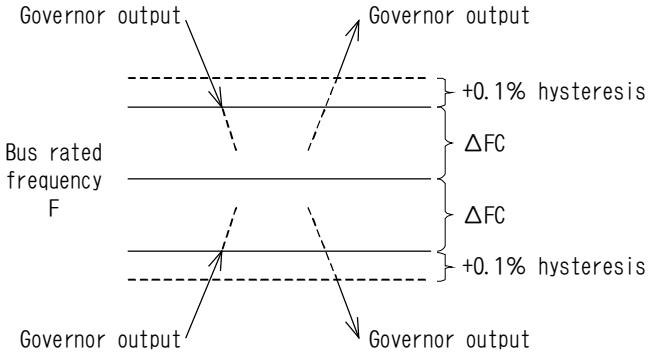
Please set up setting of governor control delay time in consideration of the response time of the external device containing a governor device etc. To the response time, if setting of delay time is short, it becomes the cause of overshoot or undershoot of a generator output.

(3) Setting of frequency dead band

In actual control, as for the control dead band, +0.1% of hysteresis is prepared in the outside of set value ΔFC.

Please set up dead band ΔFC after taking this hysteresis into consideration.

The point which separates from a dead band and starts a governor pulse output again constitutes a dead band set value ΔFC+0.1% hysteresis.



(4) Governor system abnormality detection

If a generator does not reach an object even if it outputs a governor signal (65R, 65L) in the same direction 60 continuation, it detects the abnormality of governor system. And, a light trouble is outputted.

Governor system abnormality detection machine continues control. However, other normal machines perform rated frequency control except for an abnormal machine. And, effective/no effect setting is possible for governor system abnormality detection function by the setting item.

6.4 Generator power factor constant control (Parallel operation of power receiving and a generator)

(1) Control conditions

It APFR control designates in parallel operation with power receiving.
(Control start ON, Power receiving start ON, Distribution start ON, Function switching : APFR or ALS+APFR)

(2) Control range

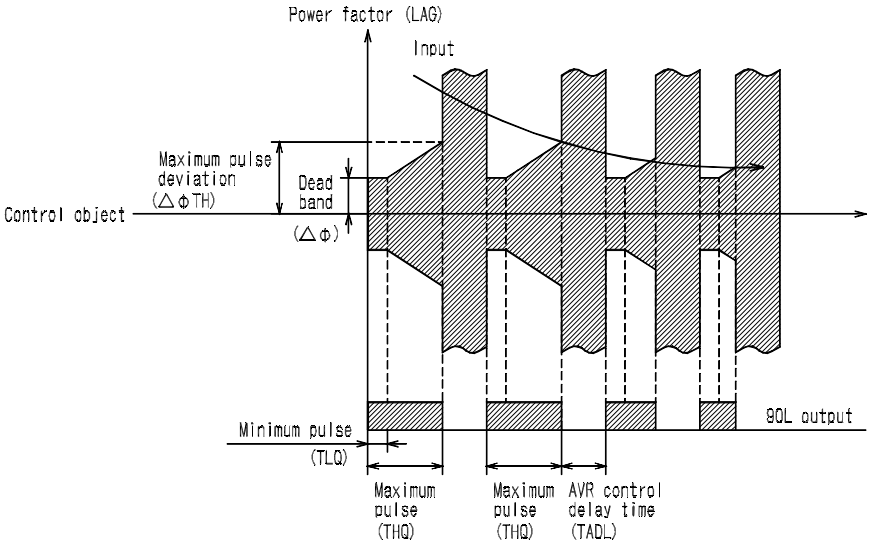
Bus voltage : 80～132V
Bus frequency : Rated frequency F±7Hz
Generator power-factor constant control is performed to above control range.
At the case outside the control range of bus voltage input, ERROR LED is turn on the light. And, a light trouble is outputted. Furthermore, generator power-factor constant control is stopped.

(3) Generator power-factor constant control

In each generator, in order that it may become the modulus value of generator constant controlling force cosΦ±ΔΦ to which the generator power-factor was set, AVR control is performed.

(4) AVR pulse output waveform

As for an AVR pulse output, pulse width changes with the deviation (control object − generator output of present) to a control object. Deviation is at the case more than the maximum pulse deviation (ΔTH), the pulse of the maximum pulse time THQ is outputted. Deviation (between ΔΦTH～ΔΦ) outputs the pulse of short pulse width as it approaches a control object by the pulse width between THQ～TLQ.



(a) AVR pulse width in power-factor control

The deviation and the following set value to a control object determine pulse width.

Item No. 58 Reactive power control maximum pulse time (THQ)
Item No. 59 Reactive power control minimum pulse time (TLQ)
Item No. 64 Power-factor control dead band (ΔΦ)
Item No. 75 Maximum pulse power-factor deviation (ΔΦTH)

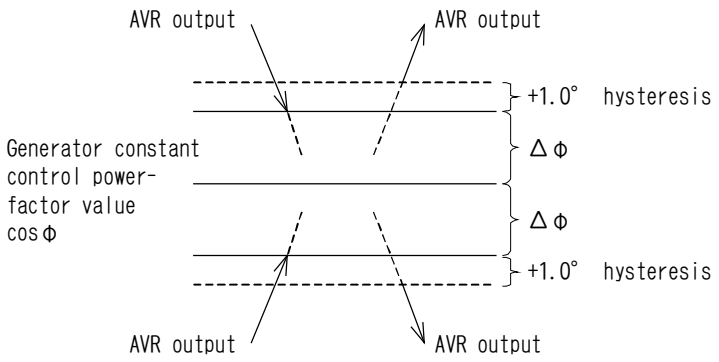
$$\text{Pulse width} = TLQ + \frac{(THQ - TLQ)}{(\Delta\Phi TH - \Delta\Phi)} \times (\text{Deviation to control object} - \Delta\Phi) \quad (s)$$

(b) AVR control delay time

Please set up setting of AVR control delay time in consideration of the response time of the external device containing an AVR device etc. To the response time, if setting of delay time is short, it becomes the cause of overshoot or undershoot of generator output.

(5) Setting of power-factor dead band
In actual control, as for the control dead band, +1.0° of hysteresis is prepared in the outside of set value Δφ.
Please set up dead band Δφ after taking this hysteresis into consideration.

The point which separates from a dead band and starts a AVR pulse output again constitutes a dead band set value Δφ+1.0° hysteresis.



(6) Power-factor dead band change current value
Power-factor dead band change current value (CHA) ≦ Load current : A power-factor dead band is Δφ.
Power-factor dead band change current value (CHA) ＞ Load current : A power-factor dead band is Δφ×2.
As mentioned above, generator power-factor constant control is performed.

(7) Power-factor control cut current value
Power-factor control cut current value (CTA) ＞ Load current : Generator power-factor constant control is stopped.

(8) Over load detection
An over load is detected if generator reactive power exceeds LAG110% or LEAD55% of the rated reactive power QRG. And, a light trouble is outputted. However, control is continued.

(9) Generator reactive power maximum operation limiter control
If the reactive power maximum operation value (more than the LAG side limiter value QRG, and more than the LEAD side limiter value QRG/2) of a generator is exceeded, generator power-factor constant control is stopped. And, it becomes the maximum operation limiter control.

(10) AVR system abnormality detection
If a generator does not reach an object even if it outputs an AVR signal (90R, 90L) in the same direction 60 continuation, it detects the abnormality of AVR system. And, a light trouble is outputted.
However, generator power-factor constant control is continued.

6.5. Reactive power proportional distribution control (Parallel operation of only a generator)
(1) Control conditions
When only a generator designates APFR control from operation.
(Control start ON, Power receiving start OFF, Distribution start ON, Function switching : APFR or ALS+APFR)

(2) Control range
Bus voltage : 80～132V
Bus frequency : Rated frequency F±7Hz
Reactive power proportional distribution control is performed to above control range.
At the case outside the control range of bus voltage input, ERROR LED is turn on the light. And, a light trouble is outputted. Furthermore, reactive power proportional distribution control is stopped.

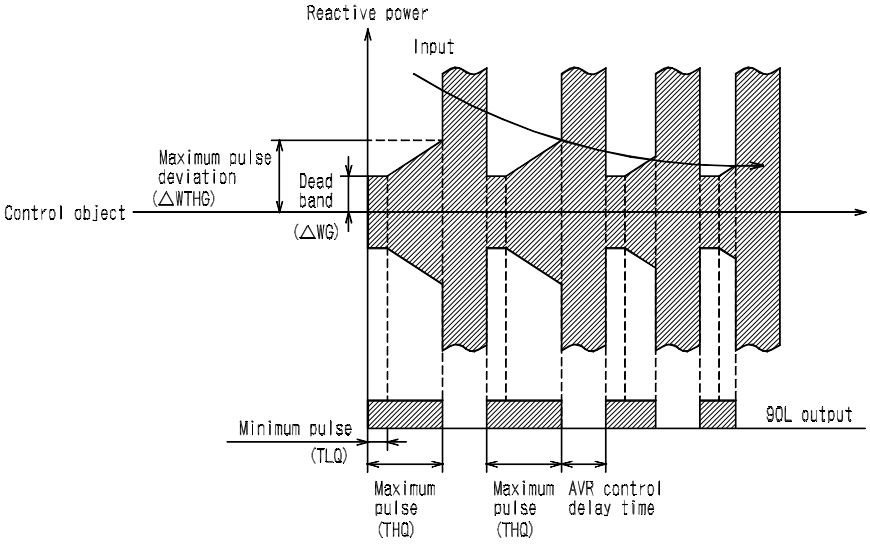
(3) Reactive power proportional distribution control
Proportional distribution control of all the reactive power is done between each generator.

$$\text{Each generator control object (\% for QRG)} = \frac{\text{Generator total reactive power}}{\text{The summation of the generator rated reactive power QRG}} \times 100\%$$

To the generator control object computed from the upper type, in order that each generator may constitute generator control object ±ΔWG (inside of ΔQG dead band), AVR control is done. All generators become in ΔQG dead band, after completing reactive power proportional distribution control, bus voltage is supervised to all machine coincidence, and rated voltage control is performed to them.

(4) AVR pulse output waveform

AVR pulse output is controlled so that generator output constitutes generator control object ±ΔWG (inside of ΔQG dead band). As for an AVR pulse output, pulse width changes with the deviation (control object − generator output of present) to control object. When deviation is more than the maximum pulse deviation (ΔWTHG), the pulse of the maximum pulse time THQ is outputted. Deviation (between ΔWTHG～ΔWG) outputs the pulse of short pulse width as it approaches a control object by the pulse width between THQ～TLQ.



(a) AVR pulse width in reactive power control

The deviation and the following set value to a control object determine pulse width.

Item No. 58 Reactive power control maximum pulse time (THQ)
Item No. 59 Reactive power control minimum pulse time (TLQ)
Item No. 56, 57 Generator power dead band (ΔWG)
Item No. 73 Generator maximum pulse power deviation (ΔWTHG)

$$\text{Pulse width} = TLQ + \frac{(THQ - TLQ)}{(\Delta WTHG - \Delta WG)} \times (\text{Deviation to control object} - \Delta WG) \ (s)$$

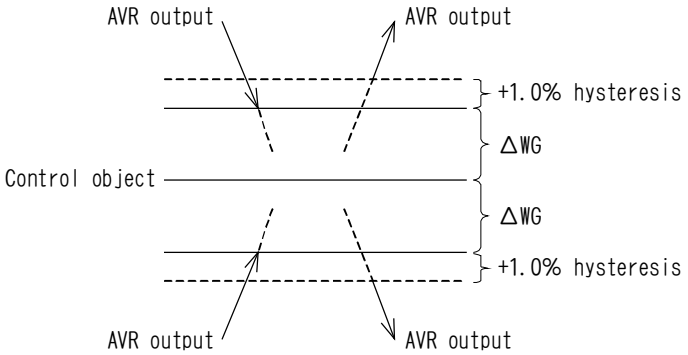
(b) AVR control delay time

Please set up setting of AVR control delay time in consideration of the response time of the external device containing an AVR device etc. To the response time, if setting of delay time is short, it becomes the cause of overshoot or undershoot of generator output.

(5) Setting of dead band

In actual control, as for the control dead band, +1.0% of hysteresis is prepared in the outside of set value ΔWG.
Please set up dead band ΔWG after taking this hysteresis into consideration.

The point which separates from a dead band and starts a AVR pulse output again constitutes a dead band set value ΔWG+1.0% hysteresis.



(6) Over load detection

An over load is detected if generator reactive power exceeds LAG110% or LEAD55% of the rated reactive power QRG. And, a light trouble is outputted. However, control is continued.

(7) AVR system abnormality detection

If a generator does not reach an object even if it outputs an AVR signal (90R, 90L) in the same direction 60 continuation, it detects the abnormality of AVR system. And, a light trouble is outputted.
AVR system abnormality detection machine continues control. However, other normal machines perform reactive power proportional distribution control except for an abnormal machine.

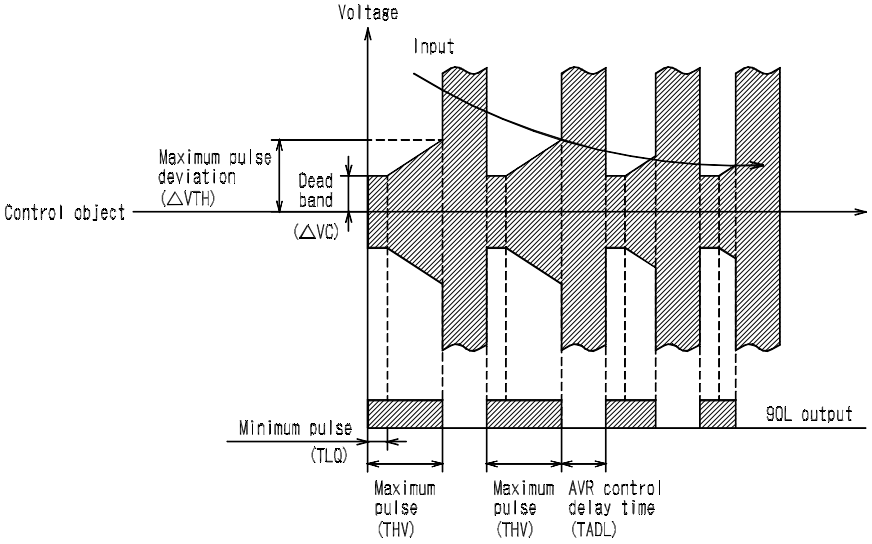
6.6 Rated voltage control

(1) Rated voltage control

In operation of only a generator, all generators become in ΔQG dead band. All machines supervise bus voltage simultaneously after completing a reactive power proportional distribution control. And, rated voltage control is performed.

(2) AVR pulse output waveform

In each generator, in order that it may be set to bus rated voltage V±ΔVC to which generator voltage was set, AVR control is done. As for a AVR pulse output, pulse width changes with the deviation (control object − generator output of present) to a control object. Deviation is at the case more than the maximum pulse deviation (ΔVTH), the pulse of the maximum pulse time THV is outputted. Deviation (between ΔVTH～ΔVC) outputs the pulse of short pulse width as it approaches a control object by the pulse width between THV～TLQ.



(a) AVR pulse width in voltage control.

The deviation and the following set value to a control object determine pulse width.

Item No. 61 Voltage control maximum pulse time (THV)
Item No. 59 Reactive power control minimum pulse time (TLQ)
Item No. 60 Voltage control dead band (ΔVC)
Item No. 76 Maximum pulse voltage deviation (ΔVTH)

$$\text{Pulse width} = TLQ + \frac{(THV - TLQ)}{(\Delta VTH - \Delta VC)} \times (\text{Deviation to control object} - \Delta VC) \quad (s)$$

(b) AVR control delay time

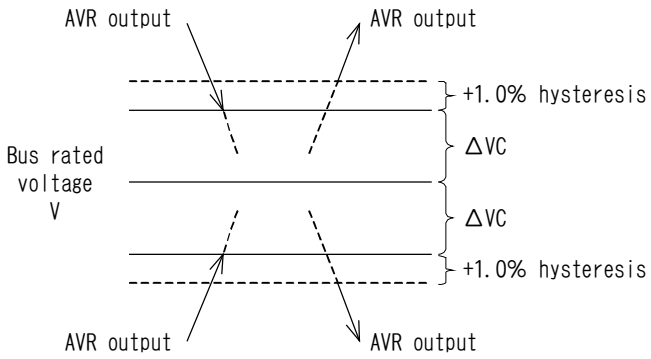
Please set up setting of AVR control delay time in consideration of the response time of the external device containing an AVR device etc. To the response time, if setting of delay time is short, it becomes the cause of overshoot or undershoot of generator output.

(3) Setting of voltage dead band

In actual control, as for the control dead band, +1.0% of hysteresis is prepared in the outside of set value ΔVC.

Please set up dead band ΔVC after taking this hysteresis into consideration.

The point which separates from a dead band and starts a AVR pulse output again constitutes a dead band set value ΔVC+1.0% hysteresis.



(4) AVR system abnormality detection

If a generator does not reach an object even if it outputs an AVR signal (90R, 90L) in the same direction 60 continuation, it detects the abnormality of AVR system. And, a light trouble is outputted.

AVR system abnormality detection machine continues control. However, other normal machines perform rated voltage control except for an abnormal machine.

7. Operation outline

7.1 Before control start

① The controller contained in an operation quantity applies a power supply constantly. In order to perform communications processing, if it does not contain the number of control (if a control start is OFF by check or repair of generator etc.), should also apply a power supply.

〈Caution〉 A communication error is displayed if a power supply apply is not done.
Control is continued except for an error machine.

② The address determines the operation order of a generator, and the order of communication between controllers.
The address is set up in order that there may be no empty number to 1 ～ operation quantity.
If an empty number occurs, an empty number is designated as a communication error machine. And, control is performed in the number few one set.
If the address overlaps and is set up, it is designated as a communication data error machine.
Control is continued except for an error machine.

③ Change of set value
Address modification in operation is not received. Address modification is performed with the auxiliary power supply OFF. Change of an operation quantity is performed immediately. If it changes simultaneously with the address, address modification is performed previously. All machine invocations of the change of an operation quantity are done at each generator each. A setting change is not made from synchronous closing control.

7.2 Synchronous closing control

① The voltage and frequency of a generator are established. After that, a synchronous control start is done in a synchronizing start input.

② It controls in voltage ±ΔV and frequency ±ΔF. After that, 25 closing commands are outputted before a progressive time from a synchronous point. Contact ON time is made into of progressive times +200ms.

③ Detection of a synchronous closing mistake. In spite of having outputted 25 closing commands, after the case (synchronous closing mistake) where a synchronous point is passed occurs by the count of closing output continuation, it detects after phase difference 10° + about 1 sec efflux, and alarm is outputted.
If unconditional setting of the count of closing output continuation is done, an alarm will not be outputted but will repeat a synchronous closing. Reset of an alarm is performed by OFF of a synchronizing start signal.

④ The synchronous control re-start of closing mistake detection ③. It sets to ON again after the synchronizing start OFF.

⑤ The generator in parallel operation is control as follows, if the generator which started synchronous control in the system is detected.
At the case of parallel operation with power receiving
···· Governor control and AVR control are continued.
At the case of generator individual operation.
···· Governor control and AVR control are interrupted temporarily (2 minutes). Control is resumed after that.

⑥ If more than two synchronizing starts are inputted simultaneously, ΔF and ΔV control is performed simultaneously. And, a closing order is as follows.
At the case of parallel operation with power receiving
···· It supplies from the generator included in closing conditions. More than one may be supplied simultaneously.
At the case of generator individual operation.
···· For 2 minutes after a synchronizing start input, it supplies according to the order of operation.
It supplies from the generator included in closing conditions after 2-minute efflux.

⑦ A synchronizing start sets to OFF after closing finishing.

⑧ If the setting switch constitutes ON, a synchronizing start becomes no effect and synchronous control is not started. And, setting change in synchronous control cannot be performed, either.

⑨ Synchronous control at the case of power failure recovery.
The distribution control between all generators is stop (Distribution start OFF). Please perform a bus input change externally. After that, it is made the synchronizing start ON.
In order to perform stable control, please form the timer for 0.5 seconds or more between the distribution start OFF (+ bus input switching) and the synchronizing start ON.

7.3 Distribution control

Power distribution control, rated frequency control, generator power-factor control, and rated voltage control are selected by each start input.

(1) Power distribution (at the case of switch ON of distribution start input and ALS or ALS＋APFR)

Power receiving ＋ Generator	① Power receiving constant value ＝ WMI ② Reverse power of power receiving. Generator over load check. ③ Power distribution (Proportional distribution) Each generator burden ＝ $\frac{\text{Total load} - \text{Power receiving constant value}}{\text{Generator rated summation}}$
Generator only	① Over load check of generator ② Power distribution (Proportional distribution) Each generator burden ＝ $\frac{\text{Total load}}{\text{Generator rated summation}}$

(2) Rated frequency constant (at the case of switch ON of distribution start input and ALS or ALS＋APFR)

Power receiving ＋ Generator	―
Generator only	After power distribution end, rated frequency control is performed to all machine coincidence.

(3) Power-factor constant (at the case of switch ON of distribution start input and APFR or ALS＋APFR)

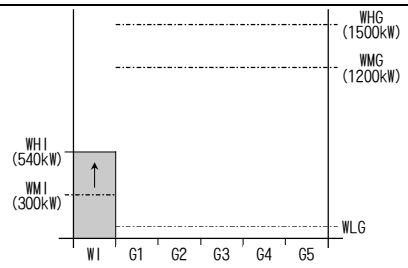
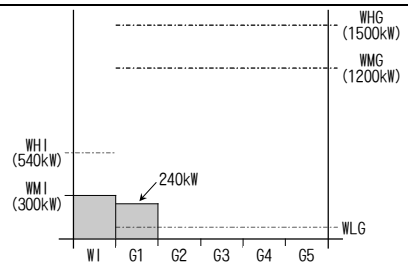
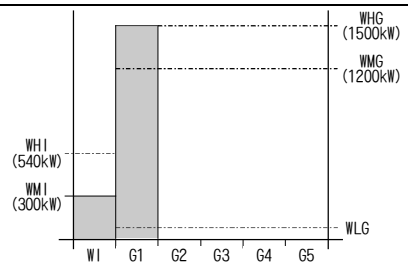
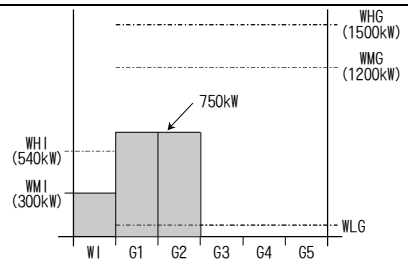
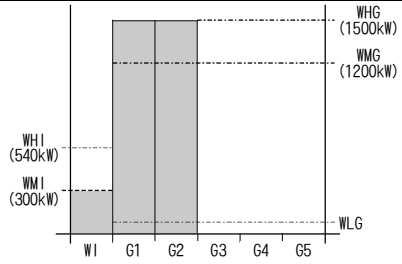
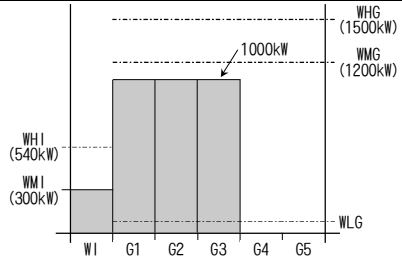
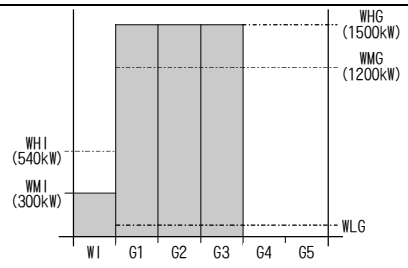
Power receiving ＋ Generator	① Generator power-factor constant value ＝ cosΦ ② Generator reactive power over load check. ③ Generator power-factor is control to constant value.
Generator only	① Reactive power over load check of generator ② Reactive power distribution (Proportional distribution) Each generator reactive power burden ＝ $\frac{\text{Total reactive power}}{\text{Generator rated reactive power summation}}$

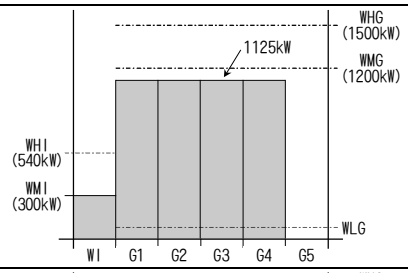
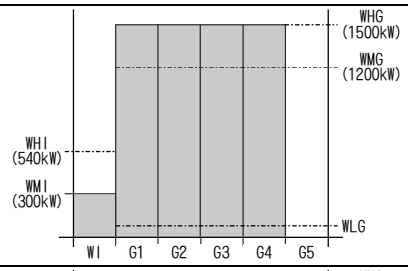
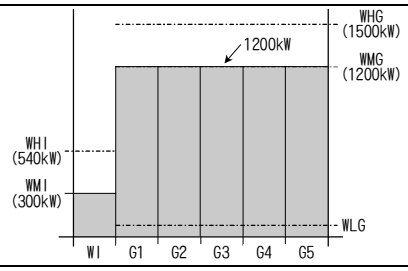
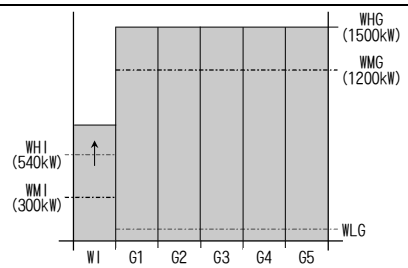
(4) Rated voltage constant (at the case of switch ON of distribution start input and APFR or ALS＋APFR)

Power receiving ＋ Generator	―
Generator only	After reactive power distribution end, rated voltage control is performed to all machine coincidence.

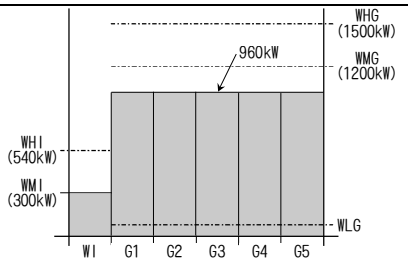
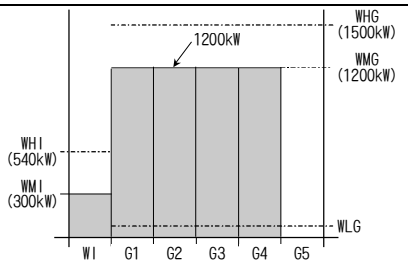
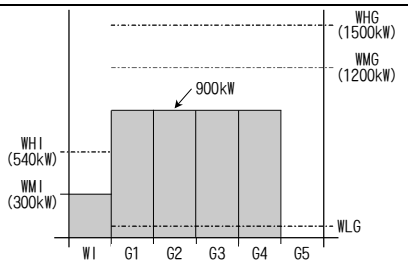
7.4 Control example of operation quantity (In case of 5 generator parallel)

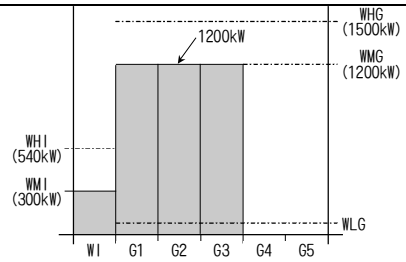
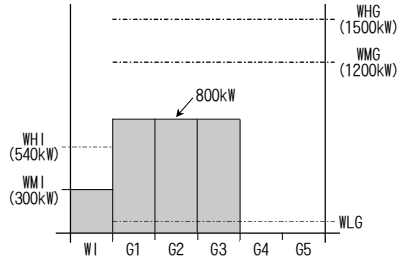
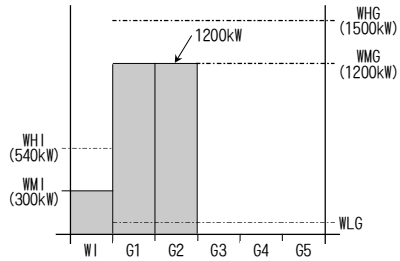
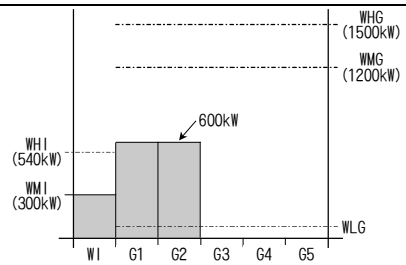
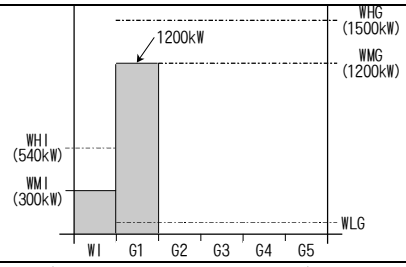
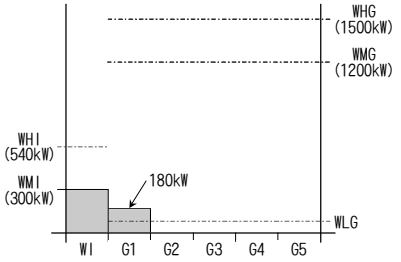
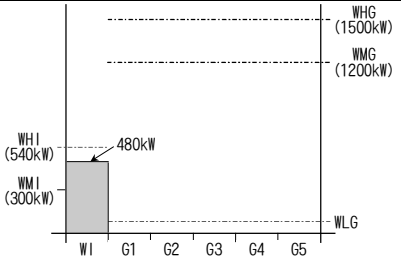
● Starting and distribution control. (Power receiving constant control mode)

Operation quantity	Load distribution state	Control value
(1) Power receiving only		① When load power increases and only power receiving amounts to 540kW in operation, a generator start command is outputted after TS second. Cancel is 420kW $\left(\frac{WHI+WMI}{2}\right)$
(2) Power receiving and one generator.		② The load assignment after linkage of power receiving and one generator. Receiving power : WMI(300kW) Constant control Generator No.1 power : Remaining power (240kW)
(3) Power receiving and one generator.		③ Total load increases by linkage operation of power receiving and one generator. If WMI(300kW)＋WHG(1500kW)＝1800kW is exceeded, A next number machine start command outputs. Cancel is 1650kW $\left(WMI+\frac{WHG+WMG}{2}\right)$
(4) Power receiving and two generators.		④ The load assignment after linkage of power receiving and two generators. Receiving power : WMI(300kW) Constant control Generator No.1 power : 750kW Generator No.2 power : 750kW proportional distribution
(5) Power receiving and two generators.		⑤ Total load increases by linkage operation of power receiving and two generators. If WMI(300kW)＋WHG(1500kW)×2(set)＝3300kW is exceeded, A next number machine start command outputs. Cancel is 3000kW $\left(WMI+\frac{WHG+WMG}{2}\times 2\right)$
(6) Power receiving and three generators.		④ The load assignment after linkage of power receiving and three generators. Receiving power : WMI(300kW) Constant control Generator No.1 power : 1000kW Generator No.2 power : 1000kW Generator No.3 power : 1000kW proportional distribution
(7) Power receiving and three generators.		⑦ Total load increases by linkage operation of power receiving and three generators. If WMI(300kW)＋WHG(1500kW)×3(set)＝4800kW is exceeded, A next number machine start command outputs. Cancel is 4350kW $\left(WMI+\frac{WHG+WMG}{2}\times 3\right)$

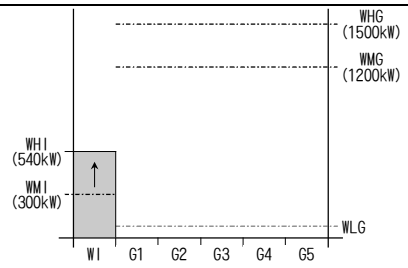
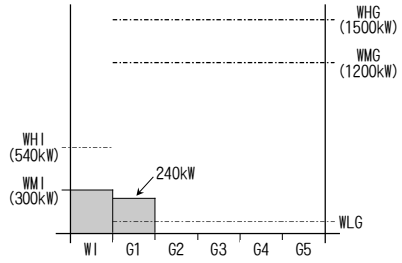
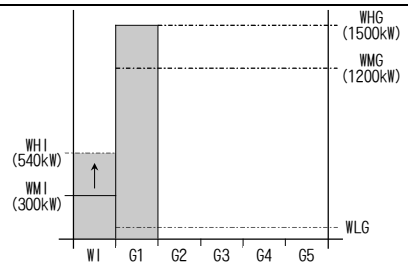
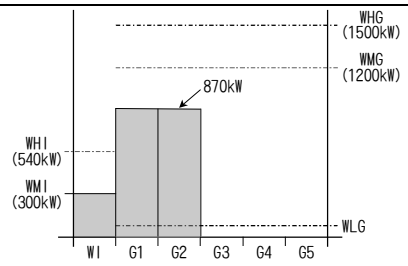
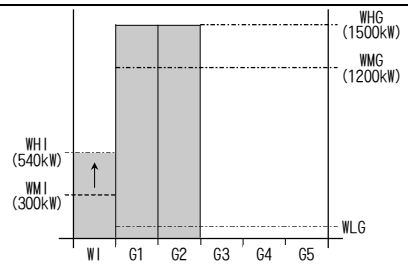
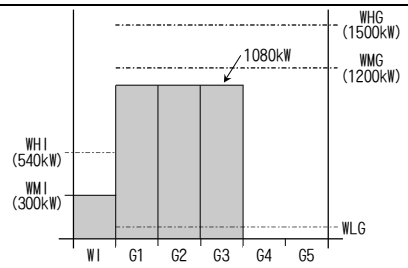
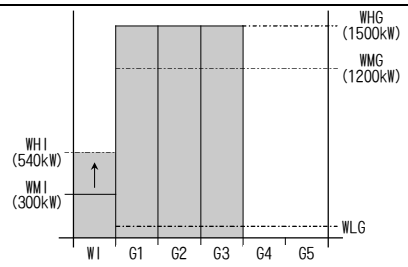
Operation quantity	Load distribution state	Control value
(8) Power receiving and four generators.		⑧ The load assignment after linkage of power receiving and four generators. Receiving power : WMI(300kW) Constant control Generator No.1 power : 1125kW Generator No.2 power : 1125kW Generator No.3 power : 1125kW Generator No.4 power : 1125kW proportional distribution
(9) Power receiving and four generators.		⑨ Total load increases by linkage operation of power receiving and four generators. If WMI(300kW)＋WHG(1500kW)×4(set)＝6300kW is exceeded, A next number machine start command outputs. Cancel is 5700kW $\left(\mathrm{WMI}+\frac{\mathrm{WHG}+\mathrm{WMG}}{2}\times 4\right)$
(10) Power receiving and five generators.		⑩ The load assignment after linkage of power receiving and five generators. Receiving power : WMI(300kW) Constant control Generator No.1 power : 1200kW Generator No.2 power : 1200kW Generator No.3 power : 1200kW Generator No.4 power : 1200kW Generator No.5 power : 1200kW proportional distribution
(11) Power receiving and five generators.		⑪ Total load increases by linkage operation of power receiving and five generators. If WMI(300kW)＋WHG(1500kW)×5(set)＝7800kW is exceeded. A generator does WRG constant control. Power receiving shares the remaining load. 〈Caution〉 The above is the case where it is set as WRG＝WHG. In case of WRG＞WHG, it becomes WRG constant control.

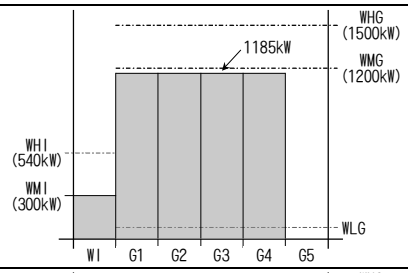
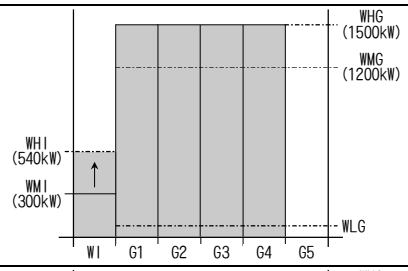
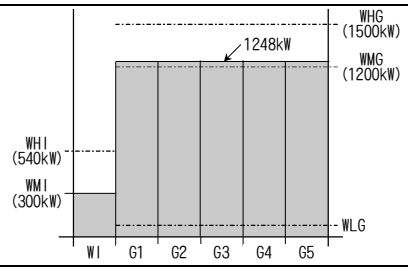
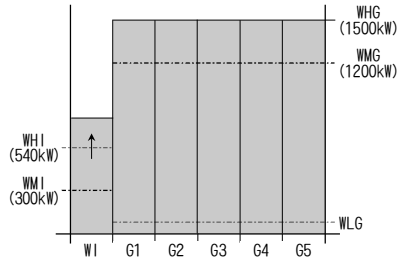
● Separation and distribution control (Power receiving constant control mode)

Operation quantity	Load distribution state	Control value
(12) Power receiving and five generators.		⑫ Total load decreases by linkage operation of power receiving and five generators. If below WMI(300kW)＋WMG(1200kW)×4(set)＝5100kW. An operation order is the last generator (with generator in operation), separation control is started after TB second. Cancel is 5700kW $\left(\mathrm{WMI}+\frac{\mathrm{WHG}+\mathrm{WMG}}{2}\times 4\right)$
(13) Power receiving and four generators.		⑬ The load assignment after one generator separation. Receiving power : WMI(300kW) Constant control Generator No.1 power : 1200kW Generator No.2 power : 1200kW Generator No.3 power : 1200kW Generator No.4 power : 1200kW proportional distribution
(14) Power receiving and four generators.		⑭ Total load decreases by linkage operation of power receiving and four generators. If below WMI(300kW)＋WMG(1200kW)×3(set)＝3900kW. An operation order is the last generator (with generator in operation), separation control is started after TB second. Cancel is 4350kW $\left(\mathrm{WMI}+\frac{\mathrm{WHG}+\mathrm{WMG}}{2}\times 3\right)$

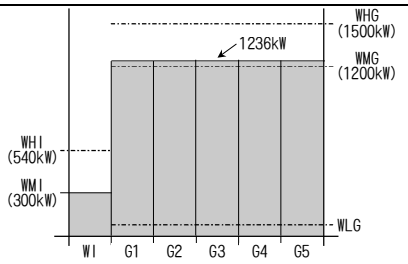
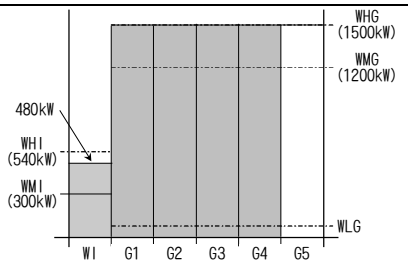
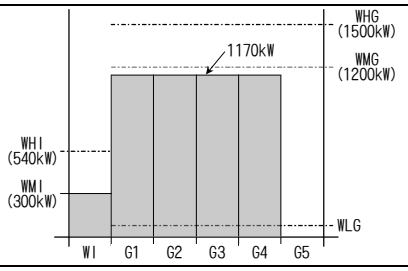
Operation quantity	Load distribution state	Control value
(15) Power receiving and three generators.		⑮ The load assignment after one generator separation. Receiving power : WMI(300kW) Constant control Generator No.1 power : 1200kW Generator No.2 power : 1200kW Generator No.3 power : 1200kW proportional distribution
(16) Power receiving and three generators.		⑯ Total load decreases by linkage operation of power receiving and three generators. If below WMI(300kW)＋WMG(1200kW)×2(set)＝2700kW. An operation order is the last generator (with generator in operation), separation control is started after TB second. Cancel is 3000kW $\left(\text{WMI} + \frac{\text{WHG}+\text{WMG}}{2} \times 2 \right)$
(17) Power receiving and two generators.		⑰ The load assignment after one generator separation. Receiving power : WMI(300kW) Constant control Generator No.1 power : 1200kW Generator No.2 power : 1200kW proportional distribution
(18) Power receiving and two generators.		⑱ Total load decreases by linkage operation of power receiving and two generators. If below WMI(300kW)＋WMG(1200kW)×1(set)＝1500kW. An operation order is the last generator (with generator in operation), separation control is started after TB second. Cancel is 1650kW $\left(\text{WMI} + \frac{\text{WHG}+\text{WMG}}{2} \times 1 \right)$
(19) Power receiving and one generator.		⑲ The load assignment after one generator separation. Receiving power : WMI(300kW) Constant control Generator No.1 power : 1200kW proportional distribution
(20) Power receiving and one generator.		⑳ Total load decreases by linkage operation of power receiving and one generator. If below WHI(540kW)－ΔM(60kW)＝480kW. Separation control of the last generator is started after TB second. Cancel is 510kW $\left(\text{WHI} - \frac{\Delta M}{2} \right)$
(21) Power receiving only		㉑ Load after a generator separation. Receiving power : 480kW

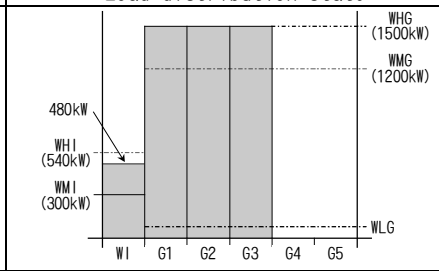
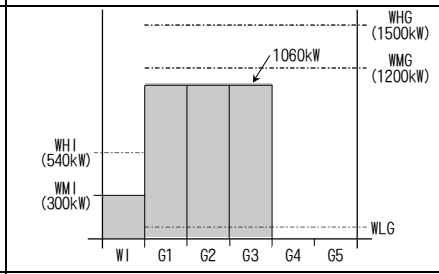
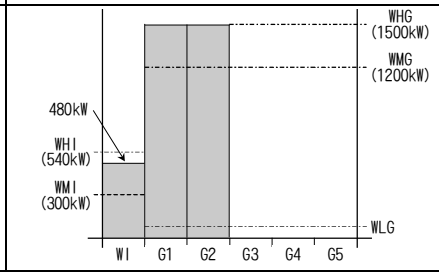
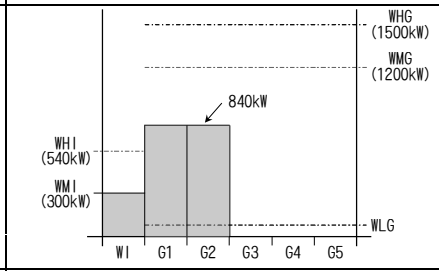
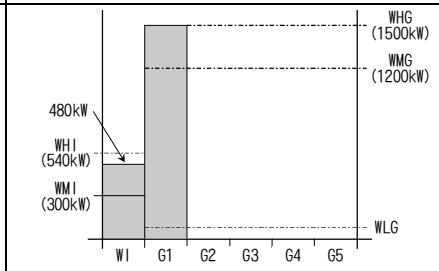
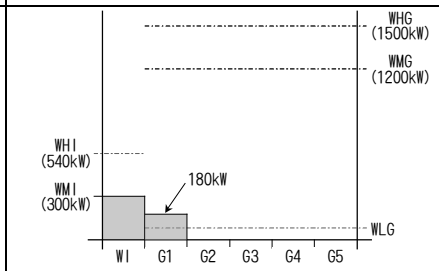
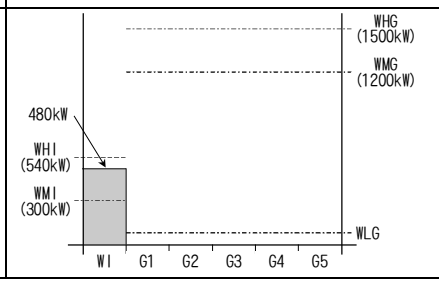
● Starting and distribution control (Generator heavy burden operation mode)

Operation quantity	Load distribution state	Control value
(1) Power receiving only		① When load power increases and only power receiving amounts to 540kW in operation, a generator start command is outputted after TS second. Cancel is 420kW $\left(\frac{WHI+WMI}{2}\right)$
(2) Power receiving and one generator.		② The load assignment after linkage of power receiving and one generator. Receiving power : WMI(300kW) Constant control Generator No.1 power : Remaining power (240kW)
(3) Power receiving and one generator.		③ Total load increases by linkage operation of power receiving and one generator. If WHI(540kW)＋WHG(1500kW)＝2040kW is exceeded, A next number machine start command outputs after TS second. Cancel is 1920kW $\left(\frac{WHI+WMI}{2}+WHG\right)$
(4) Power receiving and two generators.		④ The load assignment after linkage of power receiving and two generators. Receiving power : WMI(300kW) Constant control Generator No.1 power : 870kW Generator No.2 power : 870kW proportional distribution
(5) Power receiving and two generators.		⑤ Total load increases by linkage operation of power receiving and two generators. If WHI(540kW)＋WHG(1500kW)×2(set)＝3540kW is exceeded, A next number machine start command outputs after TS second. Cancel is 3420kW $\left(\frac{WHI+WMI}{2}+WHG\times2\right)$
(6) Power receiving and three generators.		⑥ The load assignment after linkage of power receiving and three generators. Receiving power : WMI(300kW) Constant control Generator No.1 power : 1080kW Generator No.2 power : 1080kW Generator No.3 power : 1080kW proportional distribution
(7) Power receiving and three generators.		⑦ Total load increases by linkage operation of power receiving and three generators. If WHI(540kW)＋WHG(1500kW)×3(set)＝5040kW is exceeded, A next number machine start command outputs after TS second. Cancel is 4920kW $\left(\frac{WHI+WMI}{2}+WHG\times3\right)$

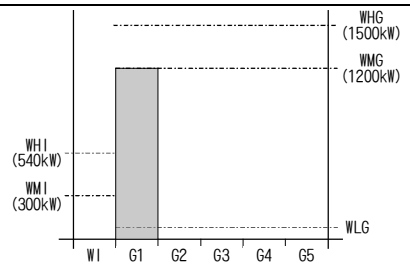
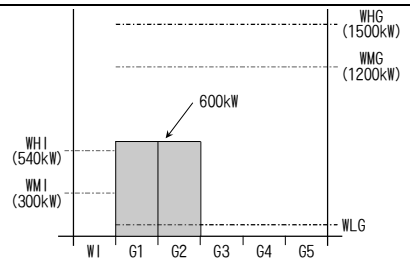
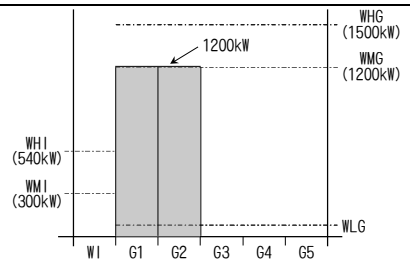
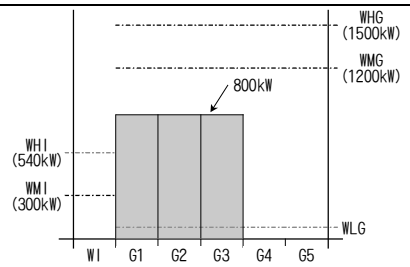
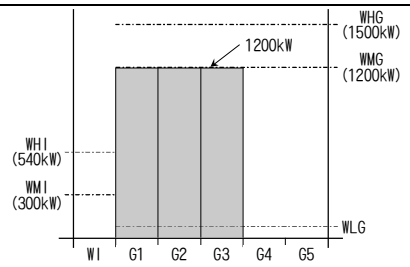
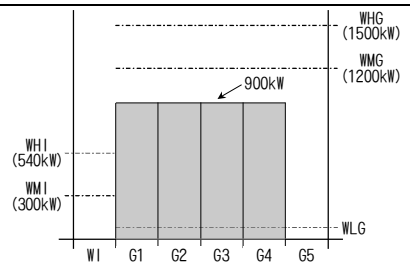
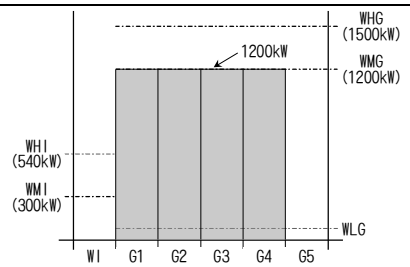
Operation quantity	Load distribution state	Control value
(8) Power receiving and four generators.		⑧ The load assignment after linkage of power receiving and four generators. Receiving power : WMI(300kW) Constant control Generator No.1 power : 1185kW Generator No.2 power : 1185kW Generator No.3 power : 1185kW Generator No.4 power : 1185kW proportional distribution
(9) Power receiving and four generators.		⑨ Total load increases by linkage operation of power receiving and four generators. If WHI(540kW)＋WHG(1500kW)×4(set)＝6540kW is exceeded, A next number machine start command outputs after TS second. Cancel is 6420kW $\left(\frac{\text{WHI}+\text{WMI}}{2}+\text{WHG}\times 4\right)$
(10) Power receiving and five generators.		⑩ The load assignment after linkage of power receiving and five generators. Receiving power : WMI(300kW) Constant control Generator No.1 power : 1248kW Generator No.2 power : 1248kW Generator No.3 power : 1248kW Generator No.4 power : 1248kW Generator No.5 power : 1248kW proportional distribution
(11) Power receiving and five generators.		⑪ Total load increases by linkage operation of power receiving and five generators. If WHI(540kW)＋WRG(1500kW)×5(set)＝8040kW is exceeded. A generator does WRG constant control. Power receiving shares the remaining load. 〈Caution〉 The above is the case where it is set as WRG＝WHG. In case of WRG＞WHG, it becomes WRG constant control.

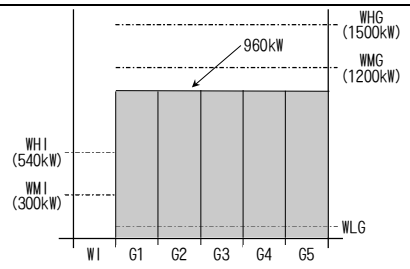
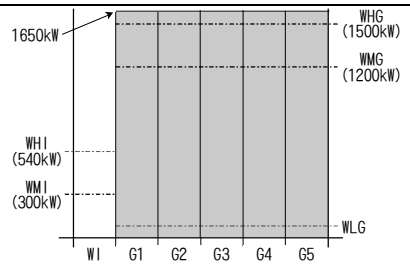
● Separation and distribution control (Generator heavy burden operation mode)

Operation quantity	Load distribution state	Control value
(12) Power receiving and five generators.		⑫ Total load decreases by linkage operation of power receiving and five generators. If below WHI(540kW)－ΔM(60kW)＋WHG(1500kW)×4(set)＝6480kW. An operation order is the last generator (with generator in operation), separation control is started after TB second. Cancel is 6510kW $\left(\text{WHI}-\frac{\Delta\text{M}}{2}+\text{WHG}\times 4\right)$
(13) Power receiving and four generators.		⑬ The load assignment after one generator separation. Receiving power : 480kW Generator No.1 power : 1500kW Generator No.2 power : 1500kW Generator No.3 power : 1500kW Generator No.4 power : 1500kW proportional distribution
(14) Power receiving and four generators.		⑭ Total load decreases by linkage operation of power receiving and four generators. If below WHI(540kW)－ΔM(60kW)＋WHG(1500kW)×3(set)＝4980kW. An operation order is the last generator (with generator in operation), separation control is started after TB second. Cancel is 5010kW $\left(\text{WHI}-\frac{\Delta\text{M}}{2}+\text{WHG}\times 3\right)$

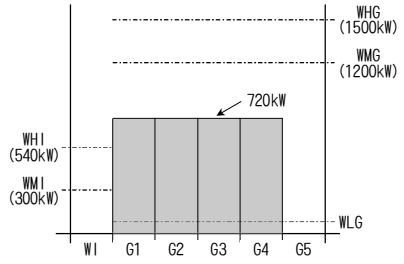
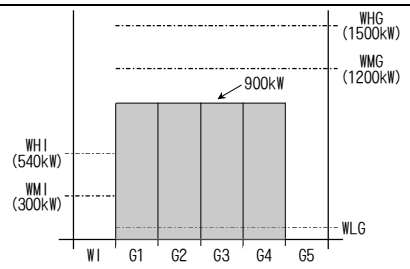
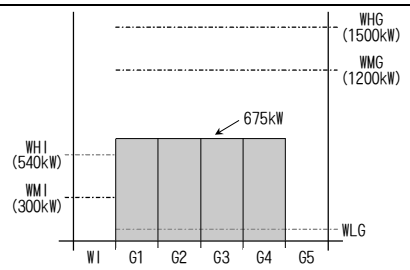
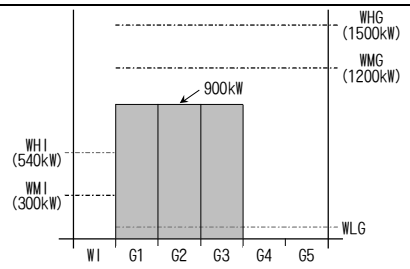
Operation quantity	Load distribution state	Control value
(15) Power receiving and four generators.		⑮ The load assignment after one generator separation. Receiving power : 480kW Generator No.1 power : 1500kW Generator No.2 power : 1500kW Generator No.3 power : 1500kW proportional distribution
(16) Power receiving and three generators.		⑯ Total load decreases by linkage operation of power receiving and three generators. If below WHI(540kW)－ΔM(60kW)＋WHG(1500kW)×2(set)＝3480kW. An operation order is the last generator (with generator in operation), separation control is started after TB second. Cancel is 3510kW $\left(\mathrm{WHI}-\frac{\Delta M}{2}+\mathrm{WHG}\times 2\right)$
(17) Power receiving and two generators.		⑰ The load assignment after one generator separation. Receiving power : 480kW Generator No.1 power : 1500kW Generator No.2 power : 1500kW proportional distribution
(18) Power receiving and two generators.		⑱ Total load decreases by linkage operation of power receiving and two generators. If below WHI(540kW)－ΔM(60kW)＋WHG(1500kW)×1(set)＝1980kW. An operation order is the last generator (with generator in operation), separation control is started after TB second. Cancel is 2010kW $\left(\mathrm{WHI}-\frac{\Delta M}{2}+\mathrm{WHG}\times 1\right)$
(19) Power receiving and one generators.		⑲ The load assignment after one generator separation. Receiving power : 480kW Generator No.1 power : 1500kW proportional distribution
(20) Power receiving and one generators.		⑳ Total load decreases by linkage operation of power receiving and one generator. If below WHI(540kW)－ΔM(60kW)＝480kW. Separation control of the last generator is started after TB second. Cancel is 510kW $\left(\mathrm{WHI}-\frac{\Delta M}{2}\right)$
(21) Power receiving only		㉑ Load after a generator separation. Receiving power : 480kW

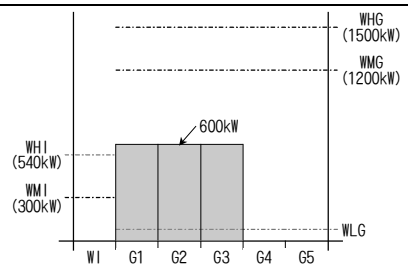
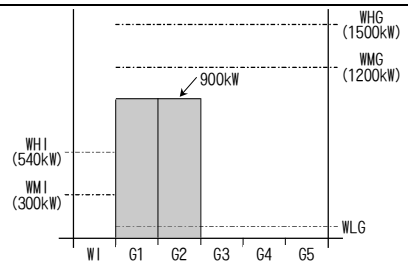
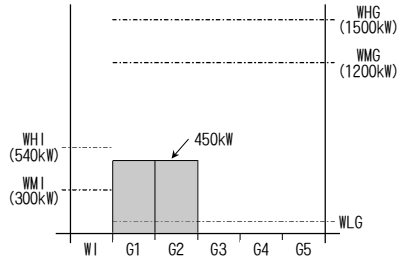
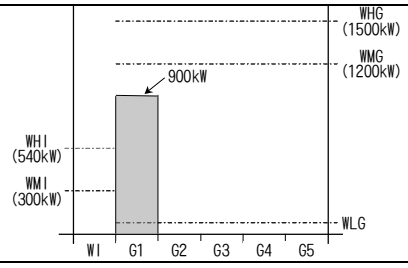
● Starting and distribution control (Individual operation mode)

Operation quantity	Load distribution state	Control value
(1) One generator		① Generator load increases by operation of one generator. If next machine starting power "WHG(1500kW) − deviation ΔH(300kW) = 1200kW" is exceeded. Start command outputs to next machine. Cancel is 1050kW $\left(\frac{WHG+WMG}{2}-\Delta H\right)$
(2) Two generators		② The load assignment after linkage of two generators. Generator No.1 power : 600kW Generator No.2 power : 600kW proportional distribution
(3) Two generators		③ Total load increases by linkage operation of two generators. If next machine starting power "WHG(1500kW) − deviation ΔH(300kW) × 2(set) = 2400kW" is exceeded. Start command outputs to next machine. Cancel is 2100kW $\left(\left(\frac{WHG+WMG}{2}-\Delta H\right)\times 2\right)$
(4) Three generators		④ The load assignment after linkage of three generators. Generator No.1 power : 800kW Generator No.2 power : 800kW Generator No.3 power : 800kW proportional distribution
(5) Three generators		⑤ Total load increases by linkage operation of three generators. If next machine starting power "WHG(1500kW) − deviation ΔH(300kW) × 3(set) = 3600kW" is exceeded. Start command outputs to next machine. Cancel is 3150kW $\left(\left(\frac{WHG+WMG}{2}-\Delta H\right)\times 3\right)$
(6) Four generators		⑥ The load assignment after linkage of four generators. Generator No.1 power : 900kW Generator No.2 power : 900kW Generator No.3 power : 900kW Generator No.4 power : 900kW proportional distribution
(7) Four generators		⑦ Total load increases by linkage operation of four generators. If next machine starting power "WHG(1500kW) − deviation ΔH(300kW) × 4(set) = 4800kW" is exceeded. Start command outputs to next machine. Cancel is 4200kW $\left(\left(\frac{WHG+WMG}{2}-\Delta H\right)\times 4\right)$

Operation quantity	Load distribution state	Control value
(8) Five generators		⑧ The load assignment after linkage of five generators. Generator No.1 power : 960kW Generator No.2 power : 960kW Generator No.3 power : 960kW Generator No.4 power : 960kW Generator No.5 power : 960kW proportional distribution
(9) Five generators		⑨ Total load increases by linkage operation of five generators. If 110% of the generator power WRG(1500kW) is exceeded, a generator over load is detected and light trouble output is done.

● Separation and distribution control (Individual operation mode)

Operation quantity	Load distribution state	Control value
(10) Five generators		⑩ Total load decreases by linkage operation of five generators. If below " Generator separation possible power WMG(1200kW) − Deviation ΔH(300kW)×4(set)＝3600kW". An operation order is the last generator (with generator in operation), separation control is started after TB second. Cancel is 4200kW $\left(\left(\frac{WHG+WMG}{2}-\Delta H\right)\times 4\right)$
(11) Four generators		⑪ The load assignment after one generator separation. Generator No.1 power : 900kW Generator No.2 power : 900kW Generator No.3 power : 900kW Generator No.4 power : 900kW proportional distribution
(12) Four generators		⑫ Total load decreases by linkage operation of four generators. If below " Generator separation possible power WMG(1200kW) − Deviation ΔH(300kW)×3(set)＝2700kW". An operation order is the last generator (with generator in operation), separation control is started after TB second. Cancel is 3150kW $\left(\left(\frac{WHG+WMG}{2}-\Delta H\right)\times 3\right)$
(13) Three generators		⑬ The load assignment after one generator separation. Generator No.1 power : 900kW Generator No.2 power : 900kW Generator No.3 power : 900kW proportional distribution

Operation quantity	Load distribution state	Control value
(14) Three generators		⑭ Total load decreases by linkage operation of three generators. If below " Generator separation possible power WMG(1200kW) − Deviation ΔH(300kW)×2(set)＝1800kW". An operation order is the last generator (with generator in operation), separation control is started after TB second. Cancel is 2100kW $\left(\left(\frac{WHG+WMG}{2}-\Delta H\right)\times 2\right)$
(15) Two generators		⑮ The load assignment after one generator separation. Generator No.1 power：900kW Generator No.2 power：900kW proportional distribution
(16) Two generators		⑯ Total load decreases by linkage operation of two generators. If below " Generator separation possible power WMG(1200kW) − Deviation ΔH(300kW)×1(set)＝900kW". An operation order is the last generator (with generator in operation), separation control is started after TB second. Cancel is 1050kW $\left(\left(\frac{WHG+WMG}{2}-\Delta H\right)\times 1\right)$
(17) One generators		⑰ The load assignment after one generator separation. Generator No.1 power：900kW

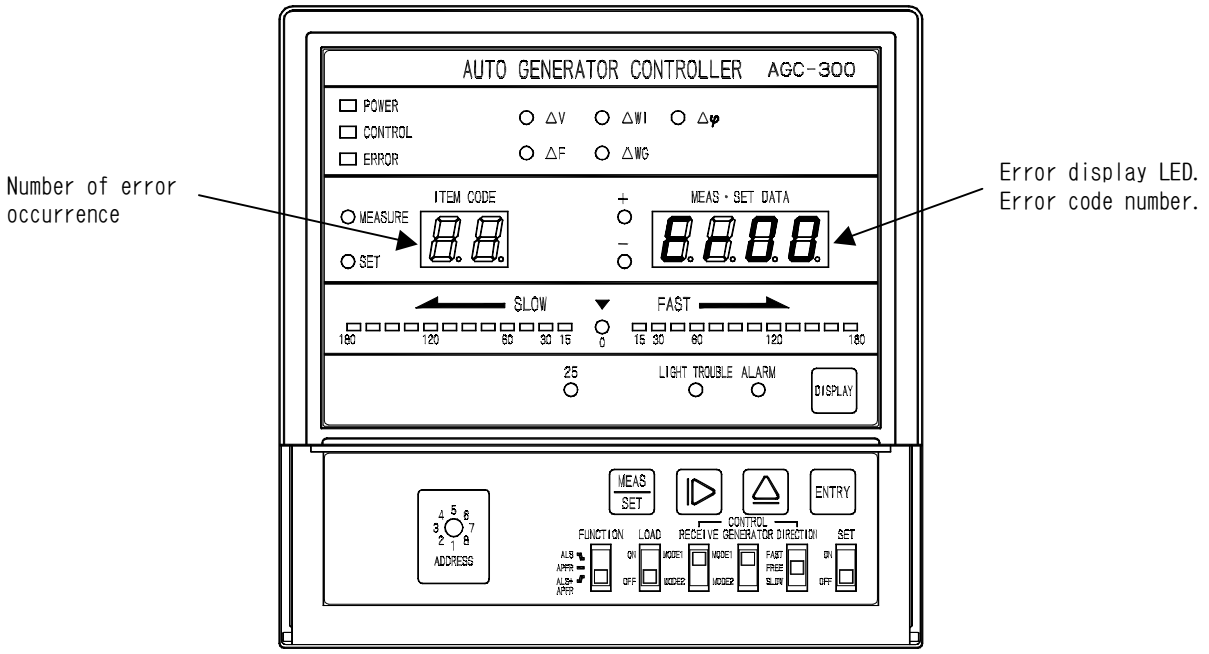
8. Maintenance

8.1 Error message

When displaying an error from error occurrence. The key and the key are simultaneously pushed 3 seconds or more in the state of display lighting. An error is not displayed if the error has not occurred.

Switching of an error display is possible by pushing the DISPLAY key.

The error display of a maximum of ten items is displayed. (If the number of error occurrence is ten or less, it returns to No.01 after displaying the number of occurrence.)



● Error of equipment (Er00～Er29)

No.	Error description	Control state	Trouble output	Error return condition	Note
Er00	ROM memory abnormality	Stop	Alarm	Not clear	Check enforcement at auxiliary power supply apply.
Er01	RAM memory abnormality	Stop	Alarm	Not clear	Check enforcement at auxiliary power supply apply.
Er02	A/D conversion abnormality	Stop	Light trouble	Auto reset	
Er03	Control set value abnormality (Set range combination error)	Stop	Light trouble	Data-corrects in key switch.	
Er04	Save set point abnormality (Set range combination error)	Stop	Alarm	Not clear	Check enforcement at auxiliary power supply apply.
Er05	Measurement reference value abnormality (Parity error)	Stop	Alarm	Not clear	Check enforcement at auxiliary power supply apply.
Er06					
Er07					
Er08					
Er09			(12)		
Er10	First machine communication data error.	Continuation	Light trouble	Auto reset	Error of continuation occurrence
Er11	Second machine communication data error.	Continuation	Light trouble	Auto reset	Error of continuation occurrence
Er12	Third machine communication data error.	Continuation	Light trouble	Auto reset	Error of continuation occurrence
Er13	Fourth machine communication data error.	Continuation	Light trouble	Auto reset	Error of continuation occurrence
Er14	Fifth machine communication data error.	Continuation	Light trouble	Auto reset	Error of continuation occurrence
Er15	Sixth machine communication data error.	Continuation	Light trouble	Auto reset	Error of continuation occurrence
Er16	Seventh machine communication data error	Continuation	Light trouble	Auto reset	Error of continuation occurrence
Er17	Eighth machine communication data error	Continuation	Light trouble	Auto reset	Error of continuation occurrence
Er18	First machine communication line error.	Continuation	Light trouble	Auto reset	Error of continuation occurrence
Er19	Second machine communication line error	Continuation	Light trouble	Auto reset	Error of continuation occurrence
Er20	Third machine communication line error	Continuation	Light trouble	Auto reset	Error of continuation occurrence
Er21	Fourth machine communication line error.	Continuation	Light trouble	Auto reset	Error of continuation occurrence
Er22	Fifth machine communication line error	Continuation	Light trouble	Auto reset	Error of continuation occurrence
Er23	Sixth machine communication line error	Continuation	Light trouble	Auto reset	Error of continuation occurrence
Er24	Seventh machine communication line error	Continuation	Light trouble	Auto reset	Error of continuation occurrence
Er25	Eighth machine communication line error	Continuation	Light trouble	Auto reset	Error of continuation occurrence
Er26					
Er27					
Er28					
Er29					

Note(12) Er10～Er25 The error of those other than a self-machine is only a display.

● Operation error of equipment (Er40～Er65)

No.	Error description	Control state	Trouble output	Error return condition	Note
Er40	Set combination error. ΔF and 25	Continuation	—	Error display is clear in SET SW.	Data are not received but are control-continued by the old data.
Er41	Set combination error. WFSI≧WRI	Continuation	—	Error display is clear in SET SW.	Data are not received but are control-continued by the old data.
Er42	Set combination error. WHI①－ΔM①－ΔWI①≧WMI①≧WLI①＋ΔWI①	Continuation	—	Error display is clear in SET SW.	Data are not received but are control-continued by the old data.
Er43	Set combination error. WHI②－ΔM②－ΔWI②≧WMI②≧WLI②＋ΔWI②	Continuation	—	Error display is clear in SET SW.	Data are not received but are control-continued by the old data.
Er44	Set combination error. VT×CT≦9999	Continuation	—	Error display is clear in SET SW.	Data are not received but are control-continued by the old data.
Er45	Set combination error. VT×CT≧WRG①	Continuation	—	Error display is clear in SET SW.	Data are not received but are control-continued by the old data.
Er46	Set combination error. VT×CT≧WRG②	Continuation	—	Error display is clear in SET SW.	Data are not received but are control-continued by the old data.
Er47	Set combination error. WHG①-5%≧WMG①	Continuation	—	Error display is clear in SET SW.	Data are not received but are control-continued by the old data.
Er48	Set combination error. WHG②-5%≧WMG②	Continuation	—	Error display is clear in SET SW.	Data are not received but are control-continued by the old data.
Er49	Set combination error. THW≧TLW	Continuation	—	Error display is clear in SET SW.	Data are not received but are control-continued by the old data.
Er50	Set combination error. THF≧TLW	Continuation	—	Error display is clear in SET SW.	Data are not received but are control-continued by the old data.
Er51	Set combination error. ΔWTRG≧ΔWTHG≧ΔWG①	Continuation	—	Error display is clear in SET SW.	Data are not received but are control-continued by the old data.
Er52	Set combination error. ΔWTRG≧ΔWTHG≧ΔWG②	Continuation	—	Error display is clear in SET SW.	Data are not received but are control-continued by the old data.
Er53	Set combination error. THQ≧ΔTLQ	Continuation	—	Error display is clear in SET SW.	Data are not received but are control-continued by the old data.
Er54					
Er55					
Er56					
Er57					
Er58					
Er59					
Er60	Address set mistake.	Stop	Light trouble	Power supply reset after correction	Machine interval set mistake.
Er61	Start input mistake.	Stop	Light trouble	Auto reset	
Er62	Lead generator designation mistake.	Continuation	Light trouble	Auto reset	Address 1 priority to nothing.
Er63	Power receiving constant control value designation mistake	Continuation	Light trouble	Auto reset	Control by lead machine data. (Only in lead machine and self-machine distribution)
Er64	Address change mistake.	Continuation	Light trouble	Auto reset	Change address for power-up.
Er65					

● Error of generator circumference and generator (Er70～Er95)

No.	Error description	Control state	Trouble output	Error return condition	Note
Er70	Bus voltage control range outside	Stop	Light trouble	Auto reset	Error LED turn on the light.
Er71	Generator voltage range outside	Stop	Light trouble	Auto reset	Error LED turn on the light.
Er72	Bus frequency range outside	Stop	Light trouble	Auto reset	Error LED turn on the light.
Er73	Generator frequency range outside	Stop	Light trouble	Auto reset	Error LED turn on the light.
Er74	Frequency difference control range outside	Stop	Light trouble	Auto reset	Error LED turn on the light.
Er75					
Er76					
Er77	Synchronous closing mistake	Closing output stop	Alarm	Possible at the auto synchronous start OFF. Return, Restart.	ΔV, ΔF control. Synchronous check output continuation.
Er78	Governor system abnormality	Continuation	Light trouble	Auto reset	They are possible by set detection cancellation.
Er79	AVR system abnormality	Continuation	Light trouble	Auto reset	
Er80	Power receiving transducer input disconnection	Stop	Light trouble	Auto reset	W transducer input OmA 5 seconds
Er81	Power receiving reverse power	Continuation	Light trouble	Auto reset	Less than OkW 10 seconds
Er82	Generator over load	Continuation	Light trouble	Auto reset	With no detection timer
Er83					
Er84					
Er85					
Er86					
Er87					
Er88					
Er89					
Er90					
Er91					
Er92					
Er93					
Er94					
Er95					

8.2 Trouble shooting

No.	Abnormal phenomenon	Probable cause		Measures
1	POWER LED does not turn on the light.	Power supply is not applied.		Check of power supply.
		Equipment trouble.		Equipment replacement.
2	Error is displayed. (Er00～Er82)	Er00	ROM memory abnormality	Equipment error. Equipment replacement.
		Er01	RAM memory abnormality	
		Er02	A/D conversion abnormality	
		Er03	Control set value abnormality (Set range combination error)	Control data abnormality, Re-setting.
		Er04	Save set point abnormality (Set range combination error)	Equipment error. Equipment replacement.
		Er05	Measurement reference value abnormality (Parity error)	
		Er10 ～ Er17	Each machine communication data error.	Abnormal check of communication circuit.
		Er18 ～ Er25	Each machine communication line error.	Abnormal check of communication circuit. Check of parallel operation number set mistake, or address set mistake.
		Er40	Set combination error. ΔF and 25	Set data abnormality, Re-setting.
		Er41	Set combination error. WFSI≧WRI	
		Er42	Set combination error. WHI①－ΔM①－ΔWI①≧WMI①≧WLI①＋ΔWI①	
		Er43	Set combination error. WHI②－ΔM②－ΔWI②≧WMI②≧WLI②＋ΔWI②	
		Er44	Set combination error. VT×CT≦9999	
		Er45	Set combination error. VT×CT≧WRG①	
		Er46	Set combination error. VT×CT≧WRG②	
		Er47	Set combination error. WHG①－5%≧WMG①	
		Er48	Set combination error. WHG②－5%≧WMG②	
		Er49	Set combination error. THW≧TLW	
		Er50	Set combination error. THF≧TLW	
		Er51	Set combination error. ΔWTRG≧WTHG≧ΔWG①	
		Er52	Set combination error. ΔWTRG≧WTHG≧ΔWG②	
		Er53	Set combination error. THQ≧TLQ	
		Er60	Address set mistake.	Address overlap. Re-setting.
		Er61	Start input mistake.	Synchronous and distribution simultaneous input. Offering start and forced separation simultaneous input. Setting switch ON and synchronous simultaneous input. Delete of one side.
		Er62	Lead generator designation mistake.	Designated overlap (3 or more sets) With no designation. Re-setting.
		Er63	Power receiving constant control value designation mistake	It is a set value disagreement between machines from distribution control. All machine uniformity value re-setting
		Er70	Bus voltage control range outside	Check of voltage input value.
		Er71	Generator voltage control range outside.	
		Er72	Bus frequency control range outside.	Check of input frequency.
		Er73	Generator frequency control range outside.	
		Er74	Frequency difference control range outside.	
		Er77	Synchronous closing mistake.	25 output. Check of circumference of circuit breaker
		Er78	Governor system abnormality.	Check of governor system.
		Er79	AVR control system abnormality.	Check of AVR control system.
		Er80	Power receiving transducer input disconnection	Check of power transducer and wiring.
		Er81	Power receiving reverse power	Loaded condition check. Quality judging of power receiving set value.
		Er82	Generator over load. (Power, Reactive power)	Loaded condition check. Quality judging of generator set value.

No.	Abnormal phenomenon	Probable cause	Measures
3	No control begins. (However, automatic synchronous closing control is excluded)	Control start input is not applied.	Check of control starts input.
		Equipment trouble.	Equipment replacement.
4	Automatic synchronous closing does not begin.	Synchronous start input is not applied.	Check of synchronous starts input.
		Equipment trouble.	Equipment replacement.
5	Control of power receiving does not begin.	Power receiving start is not inputted.	Check of power receiving start input.
		Equipment trouble.	Equipment replacement.
6	Distribution control does not begin.	Control start, distribution start is not inputted.	Check of control start input, distribution start input.
		Setting of function change switch (ALS, APFR, ALS+APFR) is not right.	Check of function change switch (ALS or ALS+APFR select)
		Equipment trouble.	Equipment replacement.
7	Power-factor control does not begin.	Power receiving start and distribution start is not inputted.	Check of control start input, distribution start input.
		Setting of function change switch (ALS, APFR, ALS +APFR) is not right.	Check of function change switch (APFR or ALS+APFR select)
		Equipment trouble.	Equipment replacement.
8	Order of operation is not right. (Start command does not output)	Order of operation is not right. (Omission, overlap)	Re-setting of operation order.
9	Voltage does not balance. (ΔV LED does not turn on the light.)	If 90R and 90L output. Fault of AVR system.	Check of AVR system.
		If 90R and 90L don't output. Eequipment trouble.	Equipment replacement.
10	Frequency does not balance. (ΔF LED does not turn on the light.)	If 65R and 65L output. Failure of governor system.	Check of governor system.
		If 65R and 65L don't output. Equipment trouble.	Equipment replacement.
11	Closing signal does not output. (25 LED does not turn on the light)	Closing conditions are not met.	Check of closing condition. (Check of ΔV, ΔF)
		It is equipment trouble if closing conditions are met.	Equipment replacement.
12	Synchronous check signal does not output.	ΔV and ΔF have not come in the regulation value.	Check of ΔV, ΔF.
		Equipment trouble.	Equipment replacement.
13	Alarm is outputted.	Synchronous closing mistake. (Er77)	Check of circuit breaker system.
		Set point abnormality. (Er04)	Equipment replacement.
14	Light trouble is outputted.	Error occurrence	Check of error code. Individual correspondence.
15	Setting by the key switch cannot be performed.	The setting permission switch does not constitute ON.	Setting permission switch is set to ON.
		Synchronous start is ON	The setting synchronously controlling is impossible.
		Equipment trouble.	Equipment replacement.

8.3 Maintenance

(1) About the life of an aluminium electrolytic condenser.

If par temperature of the installation environment of AGC-300 is made into 40℃, the life of an aluminium electrolytic condenser becomes about 11 years by the shortest.

Replacement repair is needed if the usable years of this product exceed 11 years.

(2) Check

Please check the next item periodically.

① Does power supply LED light?

② ERROR LED, ALARM LED (alarm output), LIGHT TROUBLE LED. Does not LED light?

③ Have not other light emitting diodes or Numbers light emitting diode given the abnormal display?

④ Aren't there slack of wiring and slack of a captive screw?

⑤ Has not dust adhered to the case or the terminal? Please remove, if it has adhered.

8.4 Measures at trouble

As our principle, we recall product in question and repair it. If judged as product failure, have a contact with us or sales agent for repairing work (Also have a contact with us or sales agent for specification change).

Product failure which we are not responsible for (When responsibility in manufacturing process is not recognized, when product is disassembled/remodeled, in case of false operation by customer, etc.) is beyond our warranty.

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