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Champlain, NY 12919
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Operation Manual

Potentiostat/Galvanostat and Power Booster

Potentiostat/Galvanostat Model **N600-HAL3001**
Power Booster Model **N600-HAL3001-B10**

Table of Contents

1. Safety Precautions

1-1 Safety Review

Review this operation manual prior using the instrument. Keep it handy as a reference.

1-2 Indicators

Please review the following symbols to prevent instrument damage or bodily injury.

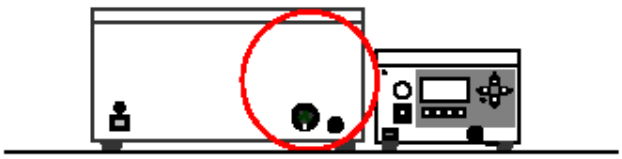
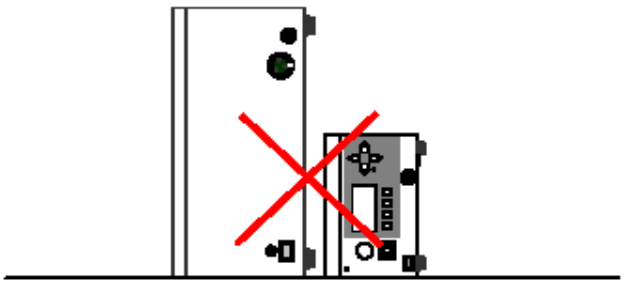
 **Danger**	**Indicates that death or serious bodily injury can occur if handled incorrectly.**
 **Caution**	**Indicates that bodily injury or physical damage can occur if handled incorrectly.**
[Request]	**Indicates that the user needs to take necessary action for proper operation.**

Symbol Definition:

Symbol	Explanation
	**Indicates matters forbidden.**
	**Indicates matters of compulsions.**
	**Indicates danger.**
	**Indicates caution.**

1-3 Installation Precautions

DANGER	
FORBIDDEN	**Do not install or operate the unit near inflammable or volatile gases.**

CAUTION	
FORBIDDEN	Avoid installing the unit in the following places. Otherwise, the unit may malfunction or breakdown. ・ Places where corrosive gases are generated ・ Dusty places ・ Places with vibration and shock ・ Places under direct sunlight or near heating appliances ・ Places where water can be splashed on the unit ・ Places where rapid temperature changes occur ・ Places with high humidity conditions ・ Places close to electric appliances that generate strong electromagnetic fields.
Compulsion	Place the unit on a flat surface (do not stack on another instrument)  

1-4 Handling Precautions

⚠ CAUTION	
Compulsion	Review safety cautions and the operation manual prior to use to thoroughly understand the contents. Otherwise, the user may cause fire, receive an electric shock or injury, or permanently damage the unit.
Compulsion	Immediately turn the power off if you experience one of the abnormalities shown below. Otherwise, you could receive an electric shock, damage the unit, or cause fire. For the safety purposes, contact us with questions or repair: a. When the unit is broken. b. When an abnormal odor or sound occurs. c. When overheated or smoke is generated.
Forbidden	Do not disassemble, modify, or repair the unit. Otherwise, you may cause fire, receive an electric shock, or damage the unit. ▪ Call us for repair instructions.
Forbidden	Do not block the ventilation port. Do not insert fingers or bars. Otherwise, you may cause fire, receive an electric shock, or damage the unit.

1-5 Power and Connection Precautions

⚠ CAUTION	
Compulsion	Connect the ground wire correctly. Otherwise, you may receive an electric shock or damage the unit.
Forbidden	Only use the cord that is supplied with the unit. Do not damage or modify the supplied cord. Otherwise, you may receive an electric shock or damage the unit.
Forbidden	Do not touch the power plug with wet hands. Otherwise, you may receive an electric shock.
Compulsion	Replace the fuse only after disconnecting the power cord from the receptacle. Otherwise, you may receive an electric shock.

1-6 Operating Precautions

⚠ CAUTION	
Forbidden	Do not touch the cell connection cable and do not short circuit the unit during operation. Otherwise, you may receive an electric shock or damage the unit. Before touching the cell cable, make sure that the unit if turned off.
Compulsion	Securely connect the cell cable with a test sample. If the connection is unstable or if rust is built up, it may cause the unit to malfunction. It may also produce a higher voltage than the desired set value. Thoroughly inspect the unit to prevent damage to the unit, unstable measurement, or damage to the sample.

1-7 Additional Information

(1) This apparatus is designed and manufactured for the purpose of use in North America. For after sales service such as repair, maintenance, and technical support, please address your inquiries to:

NADA SCIENTIFIC, LTD.
39 Butternut Street, P.O. Box 1336
Champlain, NY 12919
USA
Phone: 1-800-799-6232
Fax: 518-297-3208
Email: support@nadascientific.com

(2) It is forbidden to copy or to reprint in part or whole contents of this operation manual. The contents of this operation manual may be altered in the future without prior notice.

(3) Please contact us if you notice missing information or clerical mistakes. We appreciate any feedback and questions you may have.

Contents in this Box

When unpacking, please verify that the following items are in the box.

Item	Description	Quantity
1. Main unit	Potentiostat Model N600-HAL3001	1 set
2. Cell cord	Charging clip at end, clip, Length 2m	1 pc
3. Power cord	AC120V, Length 2m	1 pc
4. Ground 15A adapter	for taps without ground connection	1 pc
5. Connection cord between rear panel and booster*	For connection between rear panel and booster Length 50 cm*	1 pc*
6. Connection cord between front panel and booster connection cord*	For connection between front panel and booster Length 50 cm*	1 pc*
7. Ground wire	Length 2m	1 pc
8. Operation manual	English	1 copy

*Only available with the purchase of the Power Booster Model N600-HAL3001-B10.

1. Main unit

2. Cell cord

3. Power cord

4. Ground 15A adapter

5. *Rear Panels connection cord

6. *Front Panels connection cord

7. Ground wire

8. Operation Manual

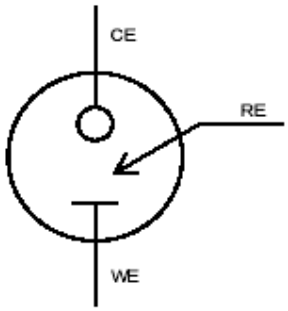
2. Function

Power Booster Model N600-HAL3001-B10 can amplify the maximum output current up to ±10A in combination with the Potentiostat/Galvanostat Model N600-HAL3001. The combination of these two units has following 3 functions:

① Function as Potentiostat
② Function as Galvanostat
③ Function as Potentiometer (electrometer)

2-1 Potentiostat Function

The fundamental function of a potentiostat is to maintain electric potential of sample electrode WE in electrolyte constant or to variable control against reference electrode RE independently from variations of voltammeter, liquid resistance, temperature or any other factors. The electro potential of sample electrode WE is measured against reference electrode RE which is put at the point blank range by means of Luggin tube and is controlled by supplying current to WE and CE (counter electrode) so that the value of WE against RE becomes an optionally designated value.



3 Electrodes system

2-2 Galvanostat function

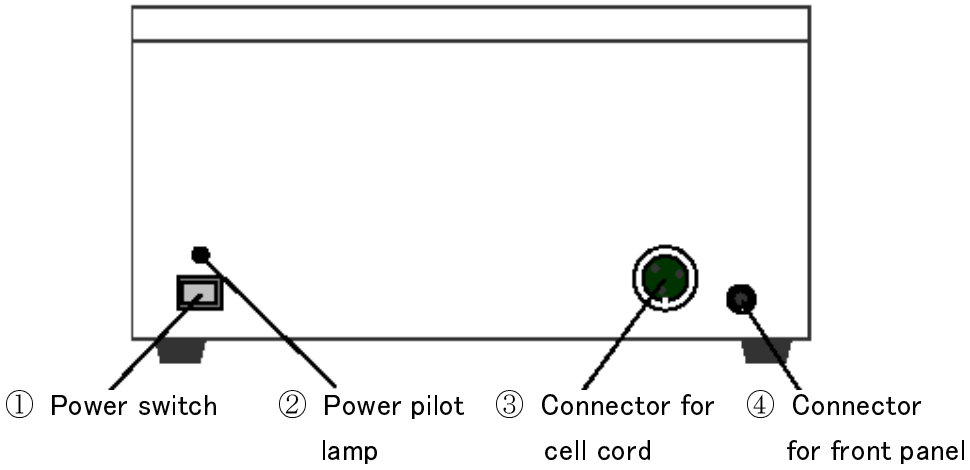
It is possible to supply constant or variable control current between CE and WE irrespective of the variation of electrolyte voltage, liquid resistance, temperature and other factors. Simultaneously, it is possible to monitor electro potential of WE against RE.

2-3 Potentiometer function

This measures and monitors differential potential of the tested sample against the reference electrode. At that time, as the input impedance is as high as $10_{11}\,\Omega$, it is also usable as impedance converter.

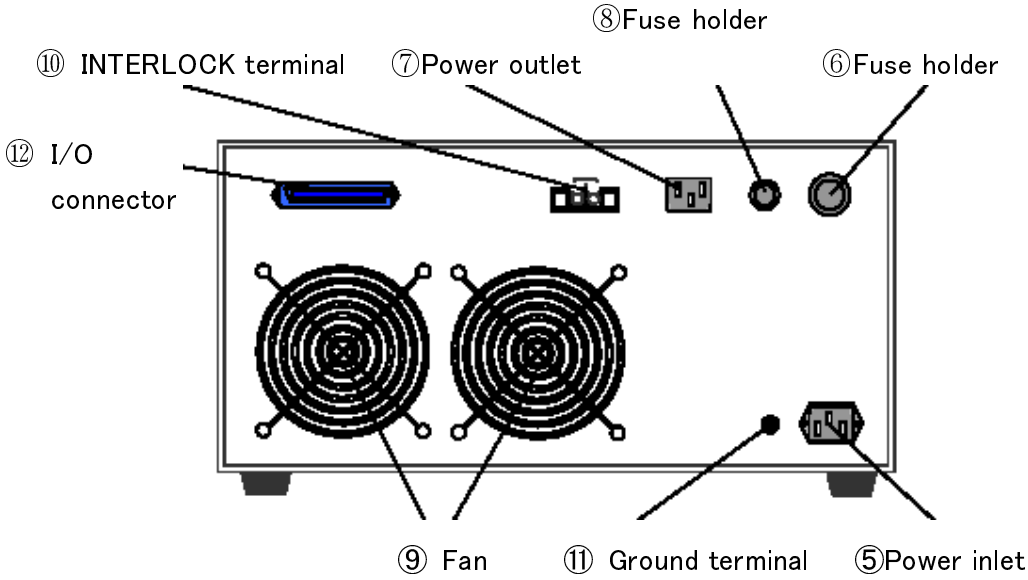
3. Name and function of respective parts

3-1 Power booster Model N600-HAL3001-B10 Front View



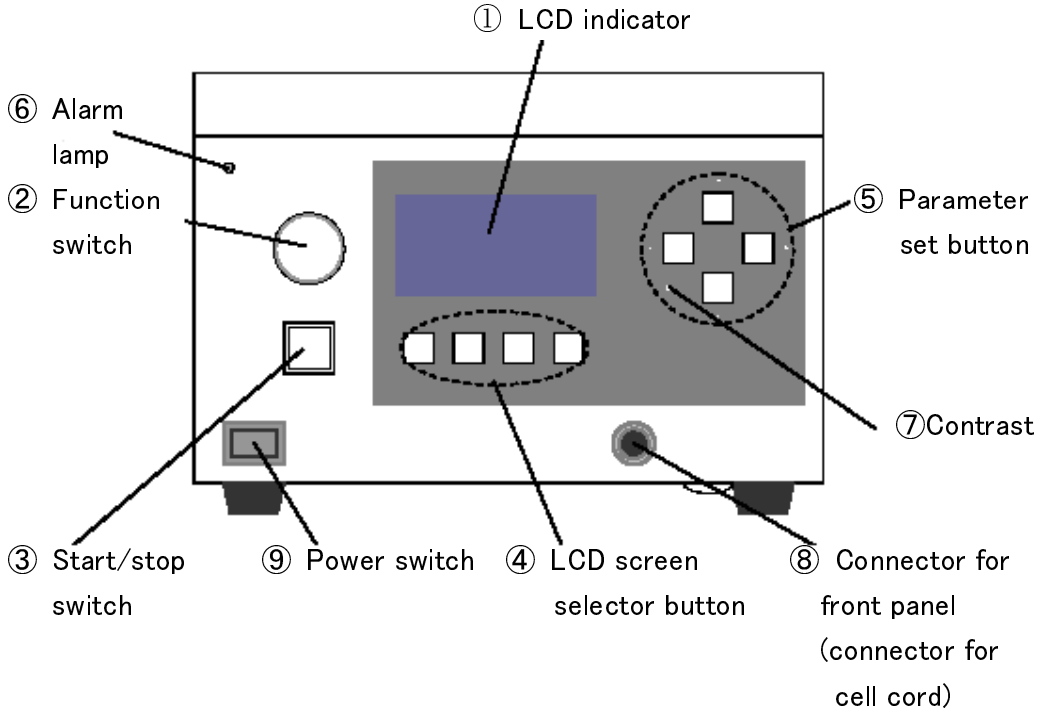
Names	Function
① Power switch	Switch to power on/off
② Power lamp	Lights on when power is on
③ Connector for cell cord	To connect dedicated cell cable
④ Connector for front panel	To connect dedicated cord with TO CELL on front panel of N600-HA3001

3-2 Power Booster Model N600-HAL3001-B10 Rear View



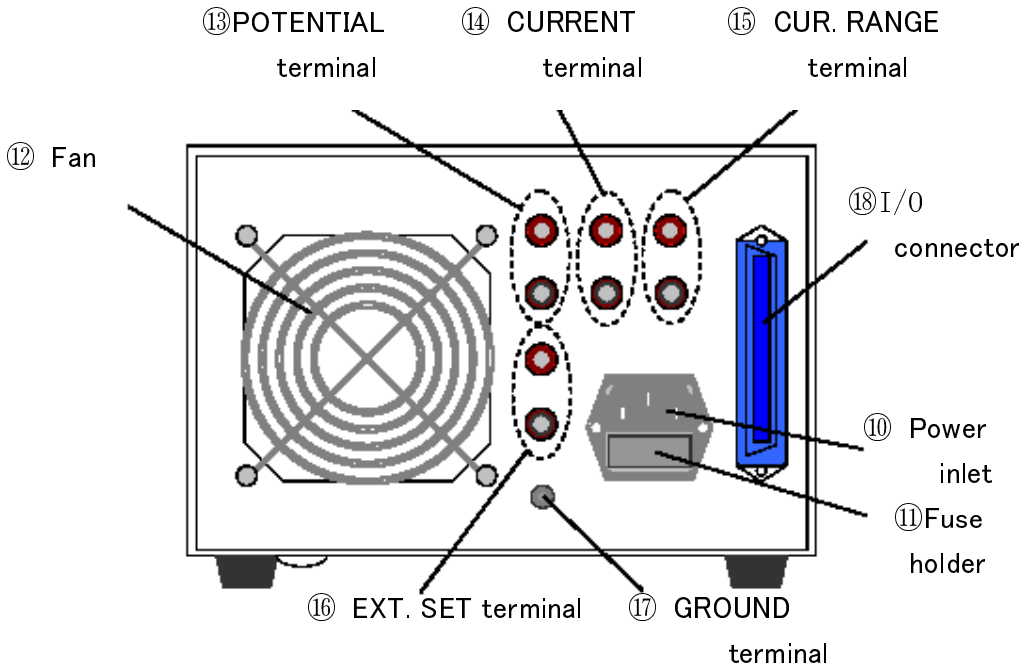
Name	Function
⑤Power inlet	to connect power cord supplied
⑥Fuse holder	Fuse for AC120V Power. Rating 20A
⑦Power outlet	Supplies power to HAL3001. (Do not connect other than this model)
⑧Fuse holder	Fuse for above ⑦ Rating 3A
⑨ Fan	For air cooling inside the unit
⑩ INTERLOCK terminal	for emergency stop by opening
⑪ Ground terminal	Ground terminal
⑫ I/O connector	to connect with I/O connector on rear panel of HAL3001 with dedicated cord.

3-3 Potentiostat/Galvanostat Model N600-HAL3001 Front View



Name	Function
① LCD indicator	Displays measuring data and various settings
② Function switch	Turn this switch to select function
③ Start/stop switch	Press for starting or stopping
④ LCD screen selector switch	Use for selecting LCD screen
⑤ Parameter set button	Executes various settings with this button
⑥ Alarm lamp	Lights on at alarm
⑦ Contrast	Adjusts contrast of the screen
⑧ Connector for front panel (cell cord connection connector)	Connect models HAL3001 to HAL3001-B10 front panel using the dedicated cord (when using separately, connect with cell cable dedicated for HAL3001)
⑨ Power switch	Use for power turning on

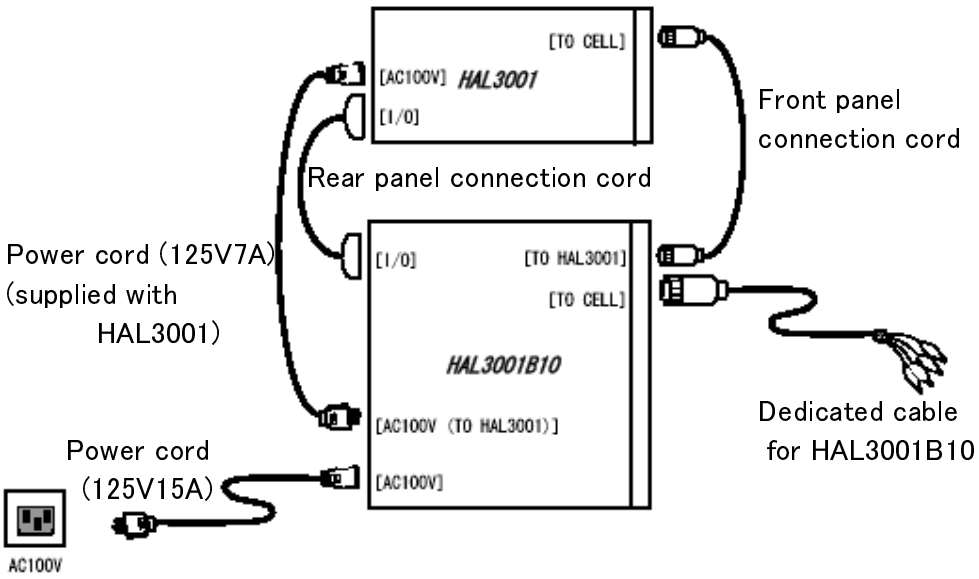
3-4 Potentiostat/Galvanostat Model N600-HAL3001 Rear View



Name	Function
⑩ Power inlet	Connect power cable supplied
⑪ Fuse holder	for AC120V, rating 3A
⑫ Fan	for cooling interior
⑬ POTENTIAL terminal	Output for electro potential recording
⑭ CURRENT terminal	Output for current recording
⑮ CUR. RANGE terminal	Current Range signal
⑯ EXT. SET terminal	Inputs external setting
⑰ GROUND terminal	Terminal for ground wire
⑱ I/O connector	Connect with I/O connector on the rear panel of Power Booster Model HAL3001-B10 using dedicated cord

3-5 Connection between rear panels of Power Booster Model N600-HAL3001-B10 and Potentiostat/Galvanostat Model N600-HAL3001

Connect according to the diagram shown below.

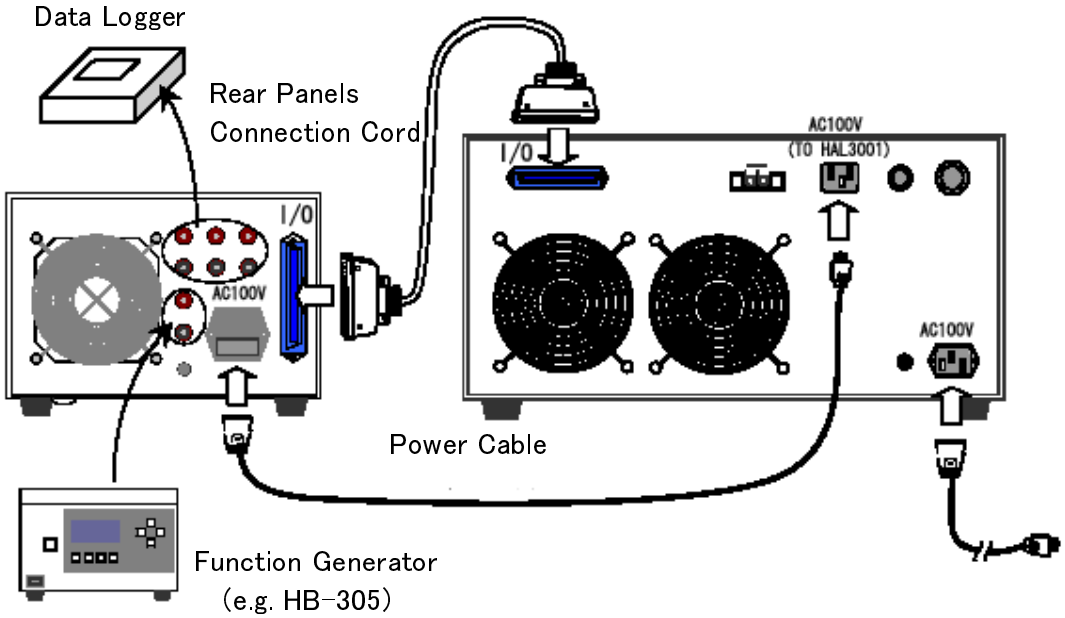


Compulsion

Connect after turning the power switch off.

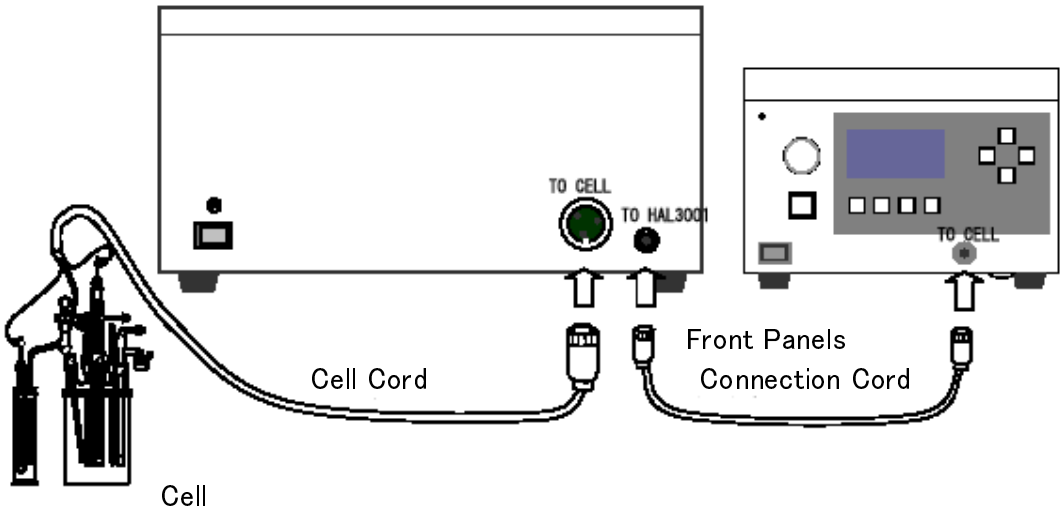
3-6 Connection between rear panels of Power Booster Model N600-HAL3001-B10 and Potentiostat/Galvanostat Model N600-HAL3001

Power to Potentiostat/Galvanostat Model N600-HAL3301 is supplied from Power Booster Model N600-HAL3001-B10.
By connecting connection cord between rear panels, information exchange, such as control command value, detected values, status values are executed.
Potentiostat/Galvanostat Model N600-HAL3001 automatically acknowledges that Power Booster Model N600-HAL3001-B10 is connected.



3-7 Connection Between front panels of Power Booster Model N600-HAL3001-B10 and Potentiostat/Galvanostat Model N600-HAL3001

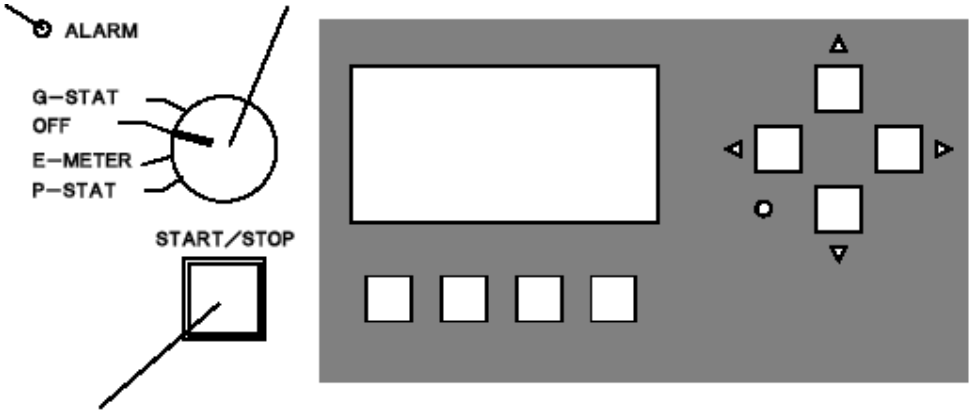
By connecting a connection cord between front panels, analog signal standards on both sides meet. Further, when Potentiostat/Galvanostat Model N600-HAL3001 recognizes that the 10A Power Booster is connected, START becomes possible.



3-8 Operation Panel

Alarm lamp　　Function switch

Lights on alarm status　　Switches over commanded function



START/STOP switch

Momentary action. Lights on/off in green color.

<table>
<tr><th>Name</th><th>Function</th></tr>
<tr><td>Function switch</td><td>① Function switches as per indication by this switch.
There are 3 kinds of measuring function and check action.
<table>
<tr><th>Indication</th><th>Function</th></tr>
<tr><td>G-STAT</td><td>Galvanostat function</td></tr>
<tr><td>OFF
(CHECK)</td><td>Check action
(Works as potentiostat against internal pure resistance 1 kΩ of internal)</td></tr>
<tr><td>E-METER</td><td>Electrometer function</td></tr>
<tr><td>P-STAT</td><td>Potentiostat function</td></tr>
</table></td></tr>
<tr><td></td><td>②Turn this knob during operation. Unit stops measurement.
When START/STOP switch lights on, unit executes measurement.
By turning this switch during measurement, unit stops measurement and START/STOP switch lights off.
There is a spot where measurement is carried on.
During measurement on P-STAT function, turn it to E-METER.
The unit continues measurement.
From Potentiostat function to Electrometer function, measurement continues.</td></tr>
<tr><td></td><td>③By turning this switch, display on the screen changes.
When OFF is selected, the initial screen is OFF screen.
The initial screens of G-STAT, E-METER and P-STAT are monitor screen.</td></tr>
<tr><td></td><td>④By turning this knob, ALARM is cancelled.
When unit stops and ALARM lamp gets lit on during measurement, cancel ALARM.
But, when ALARM status continues, ALARM lamp gets lit again.</td></tr>
</table>

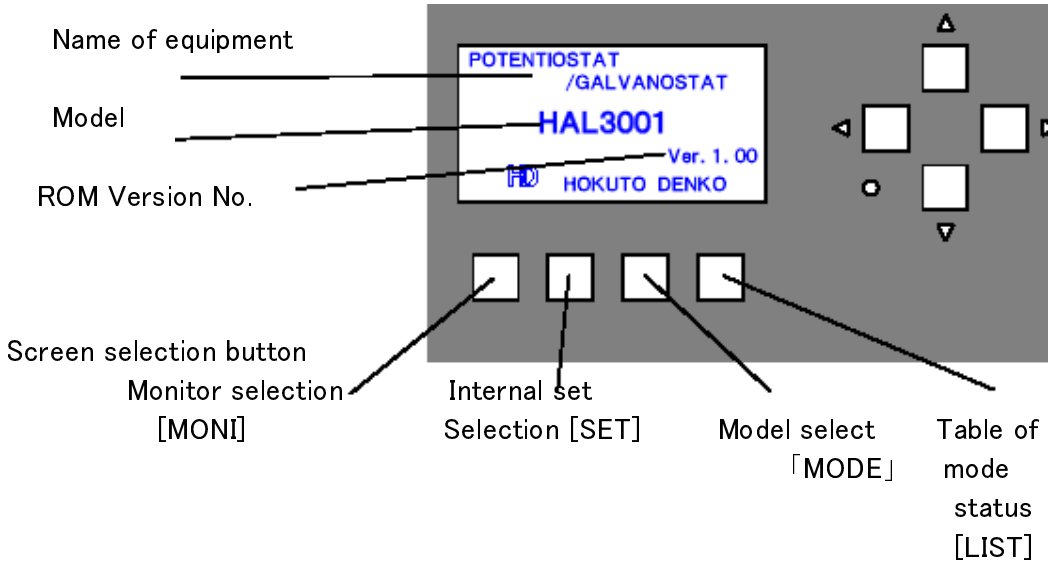
<table>
<tr><th>Name</th><th>Function</th></tr>
<tr><td>START/STOP switch</td><td>When this lamp lights on, unit is shut off.
By pressing this button, the unit starts measurement.
At that time, this switch gets lit on.

When this switch lights on, unit works.
By pressing this button, the unit stops measurement.
At that time, this switch gets lif off.

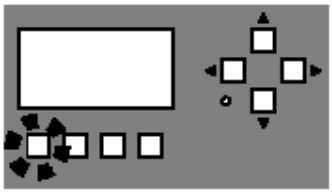
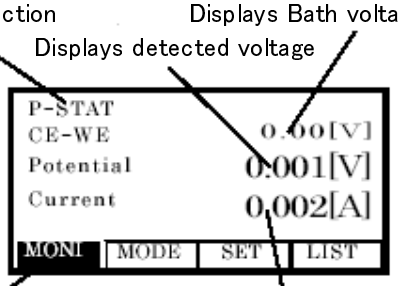
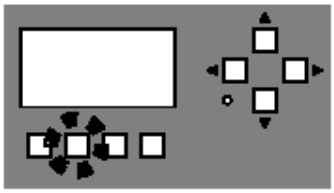
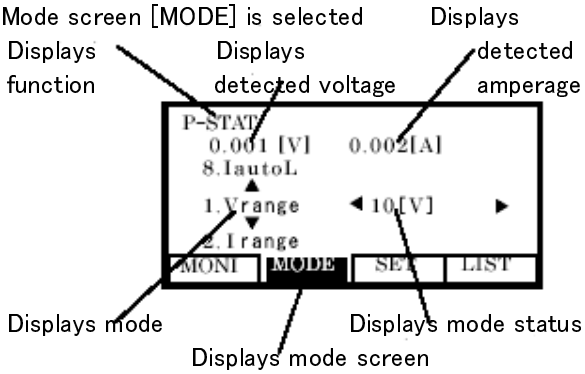
Each time the button is pressed, it repeats start and stop. However, when the function is off and the off screen is selected, it does not start by pressing this switch.
<table>
<tr><td>Status</td><td>START/STOP switch lamp</td></tr>
<tr><td>Measuring</td><td>Lights on</td></tr>
<tr><td>Stop</td><td>Lights off</td></tr>
</table></td></tr>
<tr><td>ALARM lamp</td><td>It gets lit on when ALARM signal is received.
<table>
<tr><td>ALARM lamp</td><td>Contents</td></tr>
<tr><td>Excess current</td><td>Gets lit on at over 110% of each range</td></tr>
<tr><td>Excess voltage</td><td>Gets lit on at over 110% at each range</td></tr>
<tr><td>Excess bath voltage</td><td>Gets lit on at over 33V</td></tr>
<tr><td>Thermostat</td><td>Gets lit on when power protection fuse in radiator melt down.</td></tr>
<tr><td>Fuse cut</td><td>Gets lit on when power protection fuse in radiator melt down.</td></tr>
<tr><td>Interlock</td><td>Gets lit on when contact point signal on the rear panel of the power booster becomes open.</td></tr>
</table></td></tr>
</table>

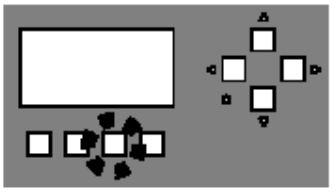
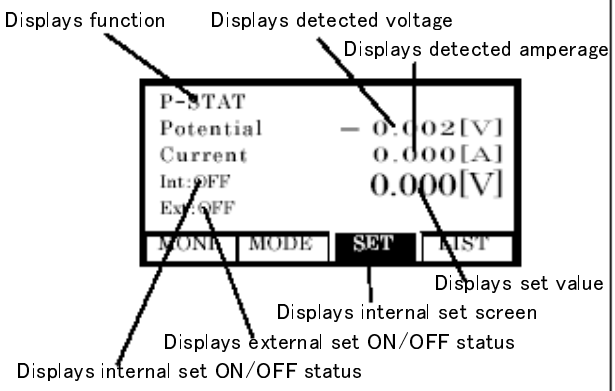
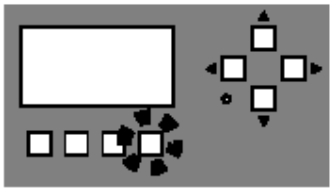
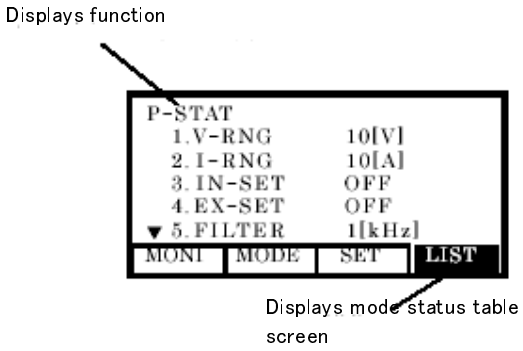
3-9 Screen Selection Button

This is the initial screen when power is supplied.



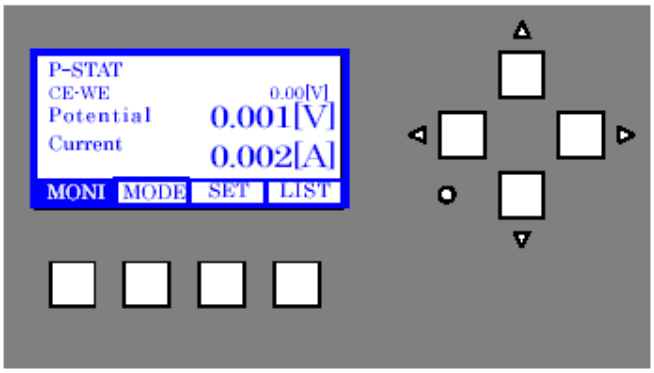
Common to G-STAT, E-METER and P-STAT

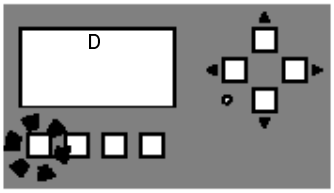
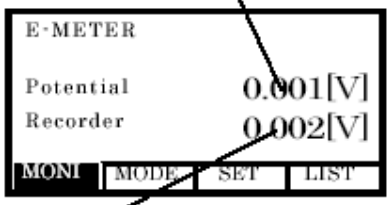
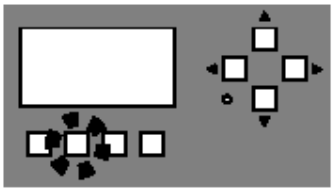
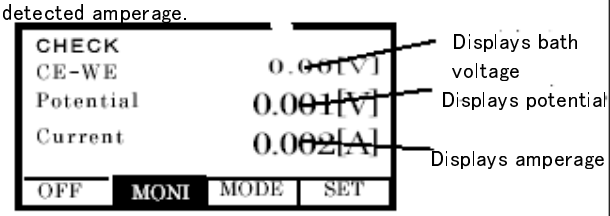
Operation	Operation
Press Monitor selection button.  Select G-STAT, E-METER or P-STAT by turning function switch, monitor screen is displayed first.	Monitor screen [MONI] is selected.  Values are displayed as "-" when STOP.
Press Mode Select [MODE] button. 	Mode screen [MODE] is selected 

Operation	Function
Press Internal Set Selection [SET] button. 	Internal set selection screen is selected. 
Press Table of mode status [LIST]. 	Table of mode status [LIST] is selected.  Displays 5 modes among 8.

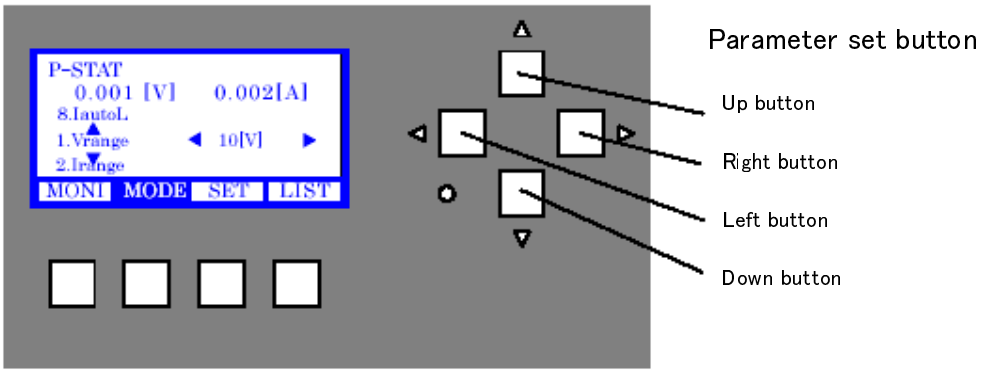
The selection of screen is common to G-STAT, E-METER and P-STAT.
When it is turned off, they are selection buttons of OFF screen, MONI screen, (CHECK), Mode screen (CHECK), SET screen (CHECK) from left to right in turn, respectively.

3-10 MONI Screen Detected Values Display

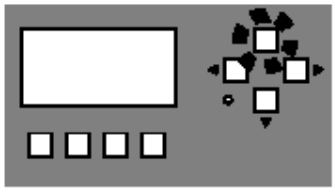
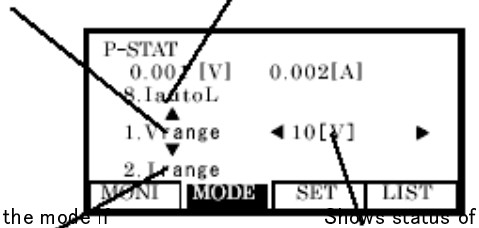
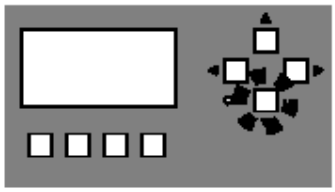
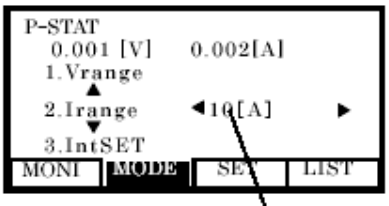


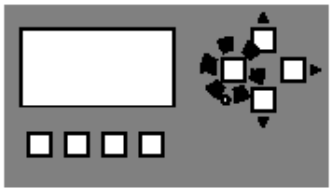
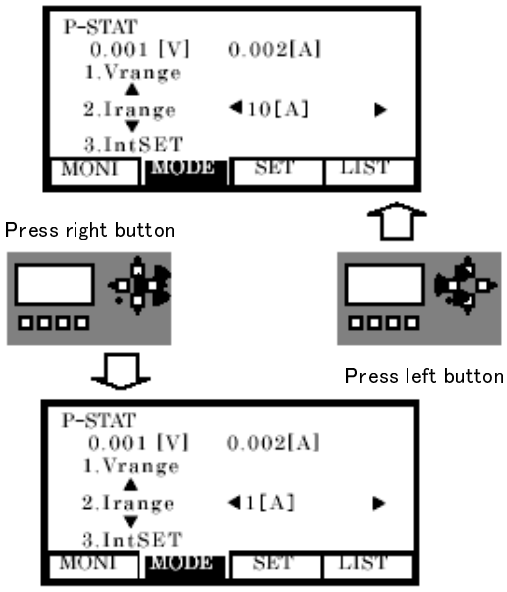
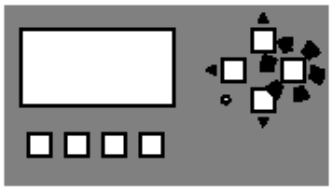
Operation	Function
The initial screen when G-STAT, E-METER or P-STAT is selected is monitor screen. 	G-STAT and P-STAT display bath voltage, detected potential, E-METER displays detected potential and record output value. 
Pressing next button at G-STAT, E-METER or P-STAT, it goes to Monitor screen 	Displays potential value. Displays potential between RE-WE  Displays potential value. When denial voltage is ON, this displays reflecting that value.
For monitor screen of CHECK, select OFF by function switch and press next button. 	CHECK displays bath voltage, detected potential and detected amperage. 

3-11 Parameter Setting Button MODE Screen Mode Set



Common to G-STAT, E-METER and P-STAT. Also operation of CHECK is the same.

Operatio	Function
 At mode screen, press Up button. Mode shifts up	Select desired mode by up button and down button. Shows the mode if Up button is pressed. Status can be altered on this mode.  Shows the mode if Down button is pressed. Shows status of mode Press Down button 
 At mode screen, press down button. Mode shifts down.	 Current range can be set

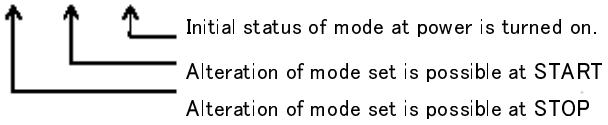
Operation	Function
 At mode screen, press left button. Mode status shifts to the left.	
 At mode screen, press right button. Mode status shifts to the right.	

Shows following mode contents.

Mode	Contents
1. Vrange	This selects voltage range 10V range and 2V range are selectable. At G-STAT and E-meter, AUTO range is selectable
2. Irange	This selects current range. 10 A range, 1A range, 100 mA range, 10 mA range and 1 mA range are selectable. At p-stat, auto RANGE CAN BE SELECTECD.
3. IntSET	This selects ON/OFF of internal set.
4. ExtSET	This selects ON/OFF of external set.
5. FILTER	This selects filter of record output. 1 kHz, DIRECT and 10 Hz are selected.
6. RESP	This selects response speed. At G-STAT, SLOW and MEDIUM can be selected. At P-STAT. SLOW and MEDIUM can be selected.
7. CeOVER	When bath voltage exceeds ±33V, this selects coninue measurement : CONT1 or stop measurement STOP.
8. IautoL	At the current range is AUTO, this displays the minimum current range to transit. When this power booster is connected, it is fixed at 1 mA.

Table below shows selectable mode status at each function.

Function	Mode	STOP	START	Initial Status	Selection of Status				
G-STAT	1. Vrange	○	○	10V	2V	AUTO			
	2. Irange	○		10A	1A	100mA	10mA	1mA	
	3. IntSET	○	○	OFF	ON				
	4. ExtSET	○	○	OFF	ON				
	5. FILTER	○	○	1kHz	DIRECT	10Hz			
	6. RESP	○		SLOW	MEDIUM				
	7. GeOVER	○	○	CONTI	STOP				
	8. IautoL			—					
CHECK	1. Vrange	○		10V	2V				
	2. Irange	○	○	10A	1A	100mA	10mA	1mA	AUTO
	3. IntSET	○	○	OFF	ON				
	4. ExtSET	○	○	OFF	ON				
	5. FILTER	○	○	1kHz	DIRECT	10Hz			
	6. RESP			SLOW					
	7. GeOVER			CONTI					
	8. IautoL			1mA					
E-METER	1. Vrange	○	○	10V	2V	AUTO			
	2. Irange			—					
	3. IntSET	○	○	OFF	ON				
	4. ExtSET	○	○	OFF	ON				
	5. FILTER	○	○	1kHz	DIRECT	10Hz			
	6. RESP			—					
	7. GeOVER			—					
	8. IautoL			—					
P-STAT	1. Vrange	○		10V	2V				
	2. Irange	○	○	10A	1A	100mA	10mA	1mA	AUTO
	3. IntSET	○	○	OFF	ON				
	4. ExtSET	○	○	OFF	ON				
	5. FILTER	○	○	1kHz	DIRECT	10Hz			
	6. RESP	○		SLOW	MEDIUM				
	7. GeOVER	○	○	CONTI	STOP				
	8. IautoL			1mA					

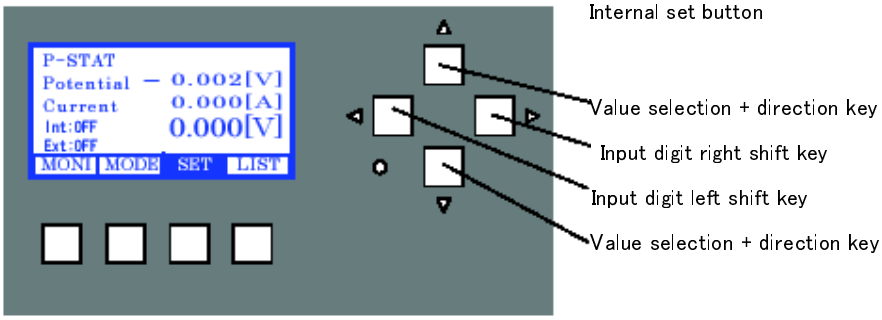


Initial status of mode at power is turned on.

Alteration of mode set is possible at START

Alteration of mode set is possible at STOP

3-12 Parameter Set Button　SET screen　Internal set



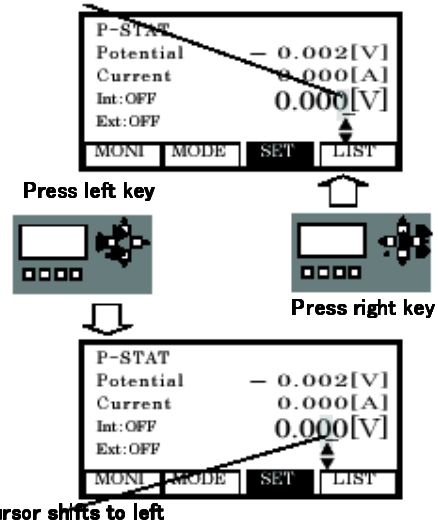
Execute ON/OFF of internal set on mode screen.

Value input can be done irrespective with internal set ON/OFF and unit's START/STOP.

It is possible to set value preliminary or to modify at the middle.

Set values at each range are 0 cleared when the range is changed.

(0 cleared range G-STAT : 2.Irange CHECK : 1.Vrange E-METER : 1.Vrange P-STAT : 1.Vrange)

Operation	Function
 Cursor goes to the left Selects digit to set	Executes internal set. Move the cursor to the desired digit. Move the cursor by left and right arrow key to the desired digit. **Cursor and digit flicker** 
 Cursor goes to the right Selects digit to set	

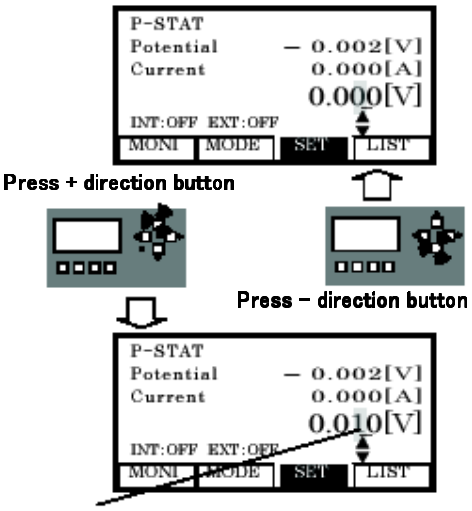
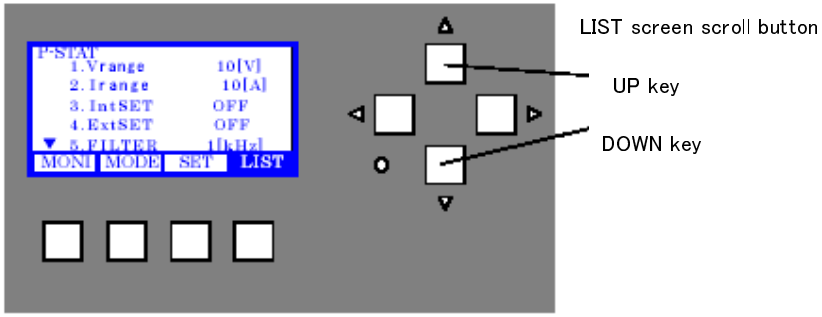
Operation	Function
 Value is counted up Input set value	After moving cursor to the desired digit, input numerical values by + or − direction buttons. 
 Value is counted down Input set value	

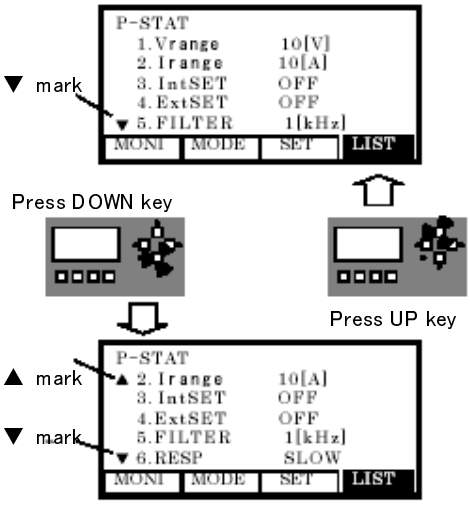
Table of set range, measurable range and minimum gradation

Function	Max. Measurable value	Set range	Internal set Min. Div.
G-STAT	10A	±10.00 A	0.001 A
	1A	±1.000 A	0.0001 A
	100 mA	±100.00 mA	0.01 mAa
	10 mA	±10.000 mA	0.001 mA,
	1 mA	±1.0000 mA	0.0001 mA
CHECK	2V	±2.0000 V	0.5 mV
	10V	±10.000 V	1 mV
E-METER Denial voltage	2 V	±2.0000 V	0.5 mV
	10 V	±10.000 V	1 mV
P-STAT	2 V	±2.0000 V	0.5 mV
	10 V	±10.000 V	1 mV

3-13 Parameter Set Button　LIST screen　Screen scroll



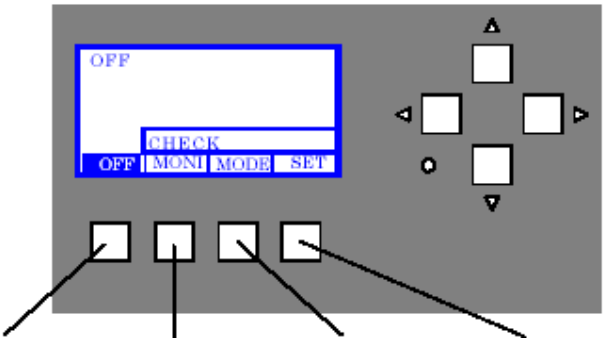
This displays table of mode status on LIST screen at G-STAT, E-METER, P-STAT
This displays 5 modes among 8. Hidden modes can be confirmed by scrolling screen by UP and DOWN keys.

Operation	Function
When LIST screen is selected  LIST screen is scrolled up	When ▼ mark is displayed on the LIST screen, UP key is effective and when ▲ mark is displayed on the LIST screen, DOWN key is effected. 
When LIST screen is selected  LIST screen is scrolled down	

Prior to measurement, confirm mode set contents on this LIST screen

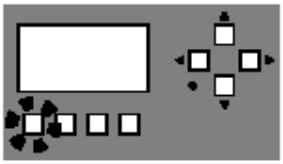
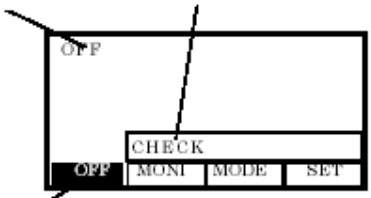
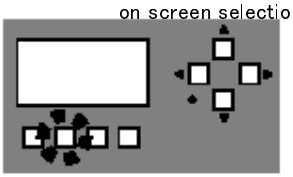
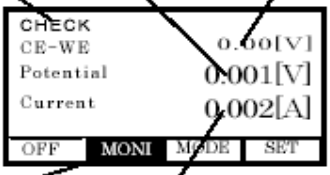
3-14 Screen Selection Keys at CHECK (OFF)

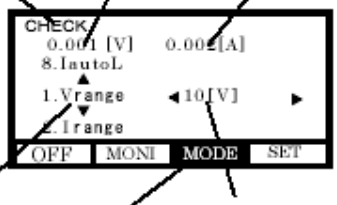
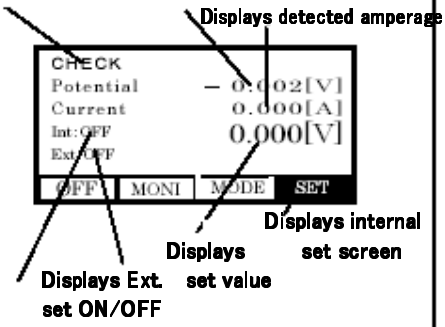
Screen selection keys
(OFF, CHECK)



OFF selection key [OFF]
Monitor selection key [MONI]
Mode selection key [MODE]
Internal set selection key [SET]

When function switch is set to OFF and OFF screen is selected, this unit is shut off.

Operation	Function
Press OFF selection key [OFF]  By selecting OFF by function switch, OFF screen is displayed at the first.	OFF screen is selected. **OFF is displayed** 3 tabs are for CHECK action  **Displays OFF screen** At this time, the unit is Shut off status.
Press Monitor selection key [MONI] on screen selection key 	Monitor screen is selected. **Displays CHECK** **Displays bath voltage** **Displays detected voltage**  **Displays monitor screen** **Displays detected amperage**

Operation	Function
Press model selection key [MODE] 	MODE selection screen is displayed. **Displays CHECK** **Displays detected amperage** **Displays detected voltage**  **Displays mode** **Displays mode status** **Displays mode screen** Possible to select mode and modify mode status.
Press internal set selection key [SET] 	SET screen is displayed. **Displays CHECK** **Displays detected voltage** **Displays detected amperage**  **Displays internal set screen** **Displays set value** **Displays Ext. set ON/OFF** Displays internal set status

CHECK outputs P-STAT against pure resistance 1kΩ built-in the unit.

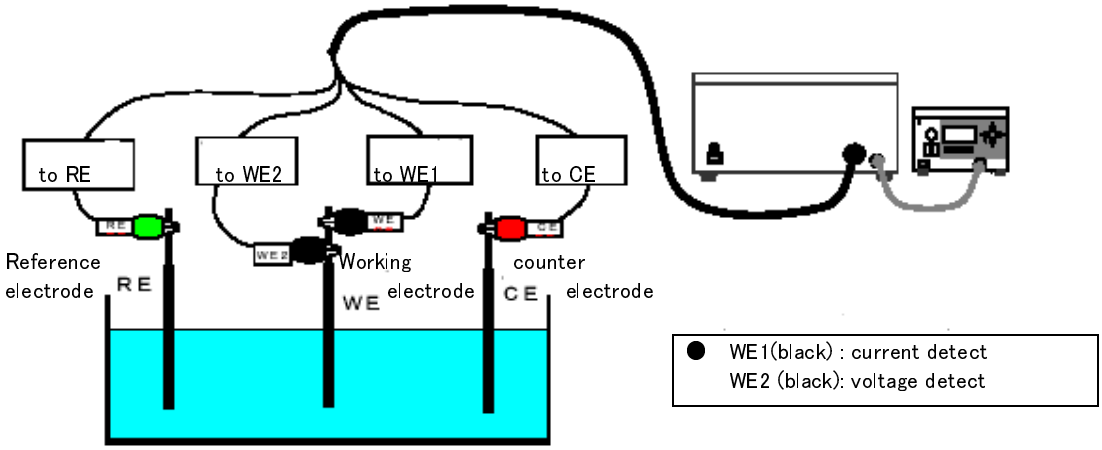
4. Connections

4-1 Connection of test sample

Provide dedicate connection cord for connecting with load.
Connect a clip marked “CE” (red) of sample connecting cable with counter electrode, a clip marked “RE”(green) to counter electrode, a clip marked “WE2” (black) to working electrode (voltage detection) and a clip marked “WE1”(black) to working electrode (current detection), respectively.

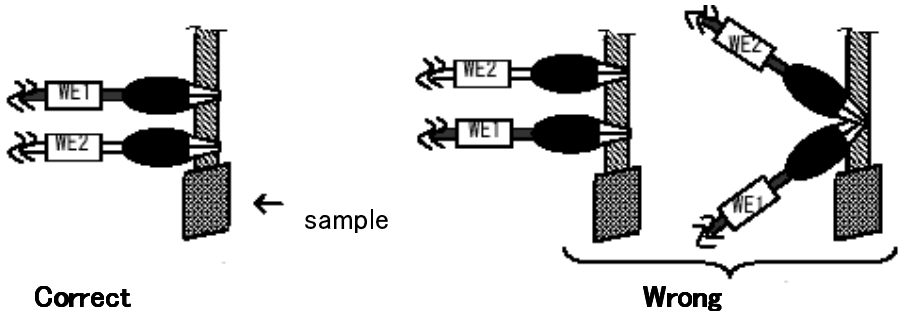
WE1	clip (black)
WE2	clip (black)
RE	clip (green)
CE	clip (red)

In the event you put the sample into a sealed box in order to eliminate noise, connect the sealed box with Ground terminal.



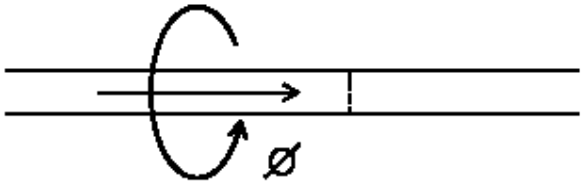
4-2 General Caution Prior to Operation

When connecting WE1 and WE2 with load, pay attention on followings.
WE2 is added for detecting potential of sample electrode and almost no current flows through.
WE1 current flows actually as the electrode to receive electrolytic current from the counter electrode.
To avoid lowering the voltage of sample or lead wire, fit WE2 clip as near as possible from the sample. Do not contact clips WE1 and WE2 each other.



4-3 Shield of Cell

When the electricity supplied into the cable, line of magnetic force is generated magnetic around it, as explained by the Fleming's rule. When the variation of current Is large, line of magnetic force also becomes stronger. It is understood that the magnetic noise from



When experimenting using the potentiostat, the following noises can become apparent:

(1) Static electricity noise generated by the electric capacitance on all material

(2) Magnetic noise having 50/60 Hz frequency

Static electricity noise can be decreased by the doing the following:

(a) Cover the electrolyte bath with iron place and connect sealed case with the ground terminal of the case.

(b) Apply sealed coat on the reference electrode and connect the ground terminal of the case.

(c) Wrap salt bridge of the reference electrode with aluminum foil and connect it with sealed coat.

As for the magnetic noise, do the same with static electricity noise. Use a magnetic absorbing material such as iron or permalloy, which are better than aluminum, to decreases noise.

4-4 Confirmation of Lead Wire and Connecting Clip

Connection cord from the unit to electrolyte bath may be deteriorated in time due to corrosion. Continued usage will permit unobstructed conductivity.

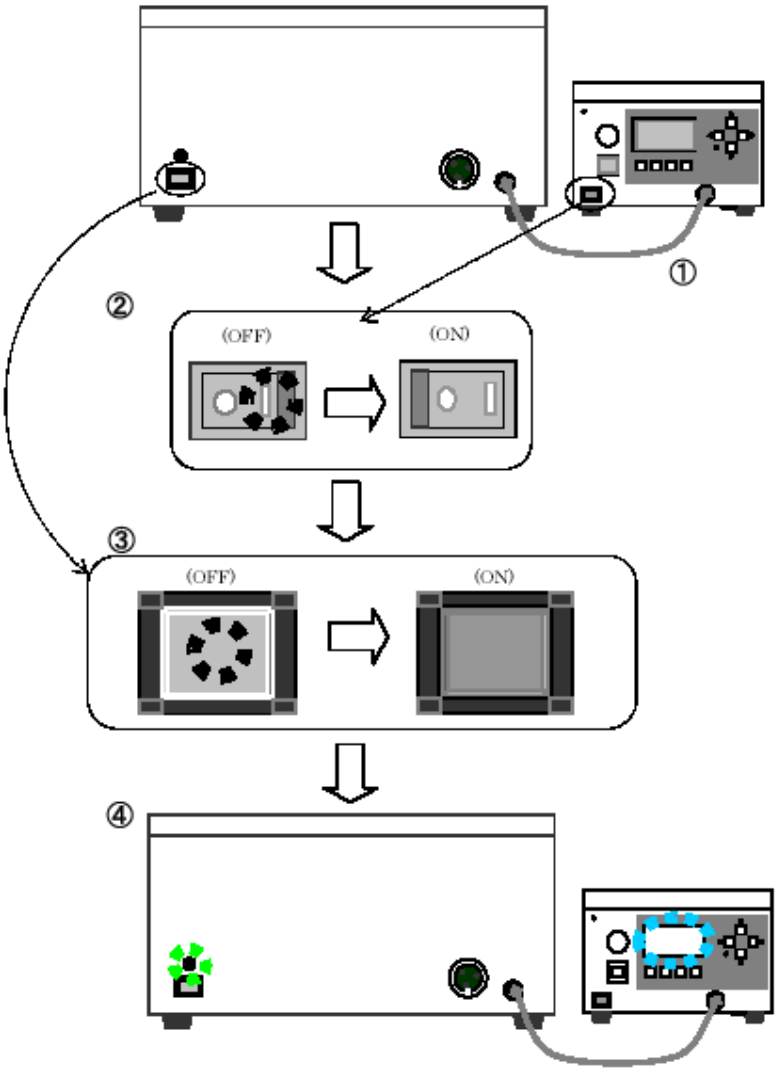
4-5 Confirmation of Cell

Confirm conductivity of solution in the cell, the area ratio of the sample and counter electrode (1:4), conductivity of salt bridge, air contamination or blockage on the glass filter of counter electrode, whether surface of electrode is covered with bubble or not. At this time, it becomes uncontrollable as the electricity is not supplied to the sample or reference electrode.

5 Power Source

5.-1 Turn Power On

This unit has a power switch on the front. By turning the power switch on, the unit starts. After the monitor screen is displayed on the LCD display, the unit gets ready.



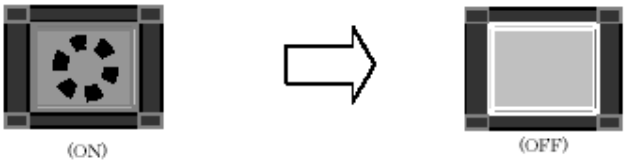
① Prior to turning the power on, confirm whether Power Booster Model N600-HAL3001-B10 with Potentiostat/Galvanostat Model N600-HAL3001 is properly connected.
② Turn power switch of Potentiostat/Galvanostat on preliminary.
③ Turn power switch on.
④ Power Booster Model N600-HAL3001-B10 and Potentiostat/Galvanostat Model N600-HAL3001 start simultaneously.

When power does not correctly turned on, it is assumed that the fuse is burnt.
Extract fuse from the box at the rear and check the fuse.

5-2 Turn Power Off

When the measurement is shut off, turn power switch at the front off to shut off the unit.

Current action parameter and measuring conditions which have been set are cancelled. Set data such as action parameters are not saved.



When using Potentiostat/Galvanostat Model N600-HAL3001 separately from Power Booster N600-HAL3001-B10, confirm that the power of Potentiostat/Galvanostat Model N600-HAL3001 is off.

5. Operation Method

6-1 E-METER (natural potential) Action

(a) Without using denial

Function switch	E-METER	
Mode screen	Potential range	10V, 2V, AUTO
	Internal set (denial voltage)	OFF

Impedance converted output at the terminal for potential recording

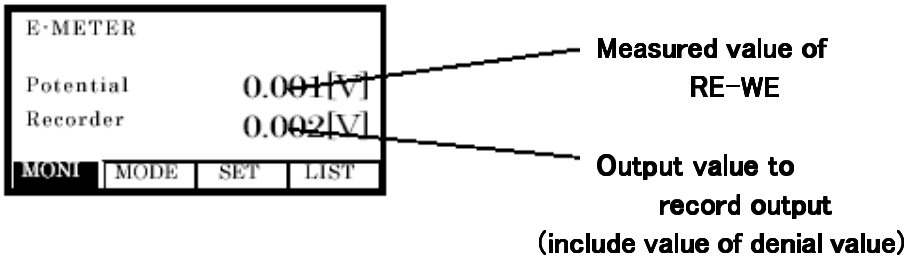
(b) When using denial

Function switch	E-METER	
Mode screen	Potential range	10V, 2V, AUTO
	Internal set (denial voltage)	OFF
Internal set screen	Internal set value	Optional value

Adjust denial voltage value so that detected value indicates "0".
At that time, read out value of denial voltage equals to natural potential.

(c) MONI screen at E-METER

At this time, current value is not displayed.
The value of potential displays detected potential of RE-WE.
The value of recorder displays the value of record output , <Potential> of rear panel of HAL3001.
When denial voltage works, the values of potential and recorder may be different from each other.



6-2 P-STAT (Potentiostat) Action

(a) When using internal set.

Function switch	P-STAT	
Mode screen	Potential range	10V, 2V
	Current range	10A, 1A, 100mA, 10mA, 1mA, AUTO
	Internal set	ON
	External set	OFF
	Filter	DIRECT, 1kHz, 10Hz
	Response	SLOW, MEDIUM
	Bath voltage	Continue, shut off
	Lower limit of AUTO current range	1 mA
Internal set screen	Internal set value	Optional value

(b) When using external set.

Function switch	P-STAT	
Mode screen	Potential range	10V, 2V
	Current range	10A, 1A, 100mA, 10mA, 1mA, AUTO
	Internal set	OFF
	External set	ON
	Filter	DIRECT, 1kHz, 10Hz
	Response	SLOW, MEDIUM
	Bath voltage	Continue, shut off
	Lower limit of AUTO current range	1 mA
Rear panel EXT. SET terminal	Between terminals	Apply optional voltage value at 10V range Max. external set ±10V at 2V range, max. external set ±2V

(c) When drawing polarization curve.

Connect terminal for voltage recording to X axis of XY recorder and terminal for current recording to Y axis of XY recorder, respectively.

Internal set and external set can be turned on simultaneously.
Pay attention so that the total amount of the internal set and external set does not exceed the voltage range value.

6-3 G-STAT (GALVANOSTAT) Action

(a) When using internal set.

Function switch	G-STAT	
Mode screen	Potential range	10V, 2V auto
	Current range	10a, 1a, 100Ma, 10Ma, 1Ma
	Internal set	ON
	External set	OFF
	Filter	DIRECT, 1kHz, 10Hz
	Response	SLOW, MEDIUM
	Bath voltage	Continue, shut off
Internal set screen	Internal set value	Optional value

(b) When using external set.

Function switch	G-STAT	
Mode screen	Potential range	10V, 2V auto
	Current range	10a, 1a, 100Ma, 10Ma, 1Ma
	Internal set	ON
	External set	OFF
	Filter	DIRECT, 1kHz, 10Hz
	Response	SLOW, MEDIUM
	Bath voltage	Continue, shut off
Rear Panel EXT. SET terminal	Between terminals	applies optional voltage value Outputs max. value of each current range at ±1V

Internal set and external set can be turned on simultaneously.
Pay attention so that the total amount of internal set and external set does not exceed the voltage range value.

6-4 CHECK (check) Action

This equipment is incorporated with CHECK mode for the purpose of checking normal action of the unit.
As for the simulation of the cell, pure resistance 1 kΩ is built-in.
This executes potentiostat action against its pure resistance of 1 kΩ.

function switch	OFF	
Mode screen	Potential range	10V, 2V
	Current range	10A, 1A, 100mA, 10mA, 1mA, AUTO
	Internal set	ON
	External set	OFF
	Filter	DIRECT, 1kHz, 10 Hz
	Response	SLOW
	Bath voltage	Continue
	Lower limit of AUTO current range	1 mA
Internal set screen	External set value	Optional value (effective at INT.ON)

Potential ±10V
Current ±10 mA

When displayed at internal set ±10V, the control action of the unit is normal.
At the set of other optional values, it displays in accordance with Ohm's law.

6-5 AUTO Range

When auto range is selected at Voltage measurement range and current measurement range, it executes the upper limit and lower limit of range modification detection and switches measuring range.

When the action signals auto range, there are various restrictions:

(1) At auto range action, when it is used at the environment where the noise is very great, range selection is not stabilized as it is influenced at the low range side.

(2) Rising wave form measuring of step response shall be executed on fixed range. Auto range action cannot follow up the variation of input value of high speed.

(3) In accordance with the connected test sample conditions, it may happen that an oscillation phenomenon takes place at auto range action. In such a case, select fixed range to execute measurement.

When the current range of AUTO at P-STAT is selected, minimum transition current range is fixed at 1 mA.

Current range transition range:

Function P-STAT selected Mode 2.Irange-AUTO

Model selection	Current range
2. Irange → AUTO	10A 1A 100mA 10mA 1mA
8. IautoL → 1 [mA]	:

6-6 Control Response and Measurement Filter

① Control response

Designate speed response speed when potentiostat/galvanostat controls set potential and current.

On Potentiostat, either MEDIUM (control time constant 1ms) or SLOW (control time constant 5 ms) is selected.

On Galvanostat, either MEDIUM (control time constant 0.5 ms) or SLOW (control time constant medium 5 ms) is selected.

High speed response speed is ideal but overshooting can easily occur. According to test sample, it may occur that correct measurement cannot be done due to oscillation. In such a case, **lower response speed** is recommended. On the other hand, in measurements of CV of high potential sweep and step mode, high response speed is required. Set higher speed until it oscillates.

② Measurement Filter

Designate noise elimination Low Pass filter for voltage and current measurement. Shut off frequency of filter can be selected among "DIRECT" (without filter), "1 kHz"(high shut off frequency) and "10 Hz" (Low shut off frequency).

Measuring filter does not affect control response speed of Potentiostat/ Galvanostat. **Generally, by the use of low shut off frequency filter, stable measuring results are obtained.**

But in the case where the measuring quick signal changes, signal factor is also eliminated together with noise and incorrect measured values are obtained. In the case of CV measurement of high speed potential sweep and step mode, select high frequency filter or without filter according to the noise level.

② Selection of control response and measuring filter

The selection quide is as follows:

Measurements		Control response	Filter
CV. LS hi-speed sweep	10 V/S. 1V/S	MEDIUM	1 kHz
CV, LS lo-speed sweep	100 mV/s～1 mV/min	**SLOW**	**10 Hz**
Step action mode	Measures excess status, mainly	MEDIUM	DIRECT
	Measures steady state status, mainly	MEDIUM/SLOW	1 kHz/10 Hz

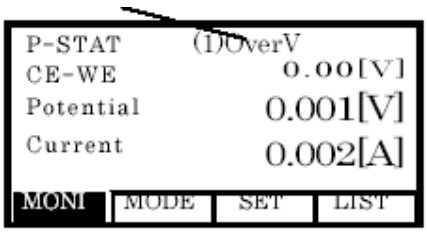
In general, it is possible to eliminate unnecessary oscillation phenomena or affection of noise by using lo-speed response and low frequency filter. When measuring excess step action, etc., it is necessary to execute measurement without filter in order to influence and achieve high speed response.

6-7 Counter Measure at Error and Abnormality

Abnormality at measurement

When an error takes place it is displayed on the screen.

Error contents are displayed



(1) OverV

When the detected voltage value exceeds each range, error is displayed and measurement stops. Select the correct range again. For cancelling an error, turn the function switch.

(2)OverI

In case the detected current value exceeds each range, error is displayed. Select the correct range again. It continues measurement while keeping the alarm output on.

(3) OverCE

In case the output voltage of Potentiostat/Galvanostat (CE-WE) exceeds maximum output value, error is displayed. Causes include that the **load resistance becomes higher to exceed driving capacity**, **removal of cell connection cord** or **oscillation of control system**, etc. It is possible to select whether to continue measurement when error alarm is output or not on mode screen.
If shut off is selected, and when cancellation is required, turn the function key.

Continuation of measurement under range over and CE over status may damage the unit. Always execute measurements without the error alarm.

(4) TH

When it detects overheating of heat sink, error is warned and measurement stops. To clear this error, turn the function switch. (But in case the thermostat detects approximately 100° again, the alarm continues.)

(6)PBTH

When it detects overheating of heat sink of power booster, the error message is displayed and measurement stops. To clear this error, turn the function switch. (But in case the thermostat detects approximately 100° again, the alarm continues.)

(7)PBEM

When it detects the interlock signal, the error message is displayed and measurement stops. Open the INTERLOCK contact signal on the rear panel of the power booster and the unit turns off. To clear this error, turn the function switch. (But in case interlock signal is detected again, the alarm continues.)

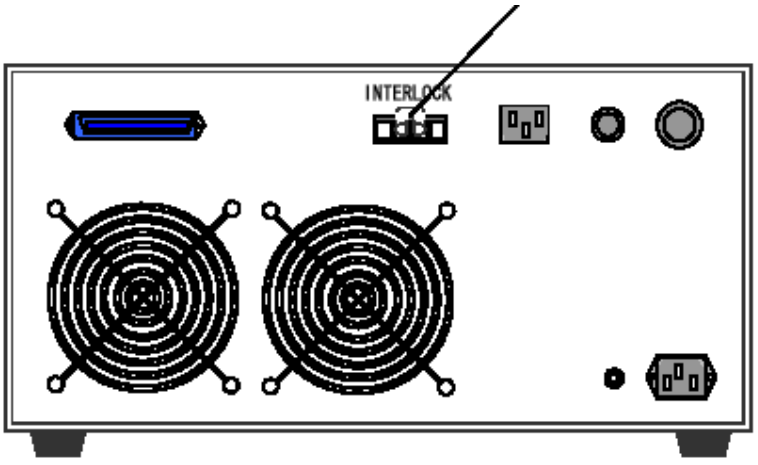
(8)PBFUSE

When it detects a burnt protection fuse in the power booster, an error message is given and measurement stops. Replacing the fuse is necessary at this point.

Table of Alarm

Item	Display	Contents	Status
Rated voltage over	(1)OverV	Alarm at ±110% of voltage range Unit stops	Stops
Current range over	(2)OverI	Alarm at ±110% of current range	Continues
Bath voltage over	(3)OverCE	Alarm at exceeding ±33V At that time Continue/Stop is selectable.	Continue/stop
Heat sink overheat	(4)TH	Observes heat sink. When detects approx. 100℃, it alarms. Unit stops	stop
Heat sink of power booster overheat	(6)PBTH	Observes heat sink of power booster and when detects approx. 100℃, it alarms. Unit stops	stop
interlock	(7)PBEM	Observes interlock signal of power booster. When contact signal opens, it alarms. Unit stops	Stop
fuse cut	(8)PBFUSE	Observes protective fuse. When detects burnt down, it alarms. Unit stops	Stop
current range limit		Clamps at 120% of each current range	Continue

Remove the short bar to access between the terminals. It stops the emergency signal.



7. Specifications

7-1 POTENTIOSTAT (HAL3001B10 + HAL3001)

ITEM		CONTENTS	
Max. output voltage (CE-WE)		±30V	
Max. output current		±10A	
Set voltage (WE-RE)	Range	±2V	2V range
		±10V	10V range
	Resolution	0.06 mV	2V range
		0.32 mV	10V range
	Control accuracy	±0.2% Full scale ±1mV	
	Rising time	<1 ms	
		conditions (no load, shunt resistance 10A/100mV, 10A range, response : MEDIUM))	
	Control response switching	SLOW, MEDIUM	

7-2 GALVANOSTAT (HAL3001B10 + HAL3001)

ITEM		CONTENTS
Max. output voltage		±10A
Max. output current(CE-WE)		±30V
Set voltage (WE-RE)	Range	±10A
	Control accuracy	±0.3% Full scale
	Rising time	<1 ms
		conditions (no load, shunt resistance 10A/100mV, 10A range, response : MEDIUM))
	Control response switching	SLOW, MEDIUM

7-3 CURRENT DETECTING (HAL3001B10 + HAL3001)

ITEM	CONTENTS
Detecting current range	10A
	1A
	100mA
	10mA
	1mA
	AUTO
Detected current accuracy	±0.3% full scale of current range

7-4 ELECTROMETER (HAL3001B10 + HAL3001)

ITEM	CONTENTS
Input Impedance	$>10^{11}\,\Omega$
Reference electrode bias dark current	$<5 \times 10^{-11}$ A
Max. input voltage (WE-RE)	±10V,
Detected voltage range	±10V, ±2V, AUTO
Detected voltage accuracy	±0.2% Full scale ±1mV
Temperature drift	10μV/℃

7-5 RECORD OUTPUT (HAL3001 REAR PANEL)

ITEM		CONTENTS	
POTENTIAL OUTPUT	Terminal	4mmφ chip jack corresponding terminal	
	Output Impedance	510Ω	
	Exchange rate	1.1(Max. ±10V, independent from voltage range)	
	Accuracy	±0.2% Full scale ±1mV	
	Filter (low pass filter)	10Hz, 1kHz, DIRECT	
CURRENT OUTPUT	Terminal	4mmφ chip jack corresponding terminal	
	Output Impedance	510Ω	
	Exchange rate	1V/each current range full scale	
	Accuracy	±0.2% full scale ±1mV	
	Filter (low pass filter)	10Hz, 1kHz, DIRECT	
CURRENT RANGE OUTPUT (CUR RANGE)	Terminal	4mmφ chip jack corresponding terminal	
	Output Impedance	510Ω	
	Analog signal voltage	Current range	Voltage (min. 100V)
		1mA	400mV
		10mA	500mV
		100mA	600mV
		1A	700mV
		10A	800mV

7-6 EXTERNAL INPUT (HAL3001 REAR PANEL)

ITEM	CONTENTS
Terminal	4mmφ chip jack corresponding terminal
Impedance	1MΩ or more
Potentiostat voltage exchange rate	1:1(Max. ±10V)
Control accuracy	±0.2% Full scale ±1mV
Galvanostat current exchange rate	1V/each current range full scale
Control accuracy (Galvanostat)	±0.3% full scale

7-7 PROTECTION・ALARM (HAL3001B10 + HAL3001)

ITEM	CONTENTS
Bath voltage over	Alarm when exceeding ±33V
Rated voltage over	Alarm at ±110% of voltage range. Unit stops
Current range over	Alarm at ±110% of current range.
Overheat of heat sink	Observes heat sink's overheat. Alarm when detecting approx. 100℃. Unit stops.
Fuse cut	Alarm when protective fuse in power booster is melt down. Unit stops.
Interlock	Alarm when interlock contact signal on rear panel of power booster opens. Unit stops.
Current range limit	Clamps at 120% of each current range

7-8 LCD DISPLAY 8HAL3001 FRONT PANEL)

ITEM	CONTENTS
Dot structure	128W x 64H dot 2.5"
Effective view field range	66.8W x 35.5H mm
LCD type	STN/Full mode/Transparent type
Illumination	LED illumination/Luminescent color

7-9 SIZE, WEIGHT, POWER SOURCE

ITEM		CONTENTS
Main unit HAL3001B10 only)	External size (WHD)	W430xD420xH225(mm) Excluding connector, including rubber feet
	Weight	approx. 33 kg
Power source (HAL3001B10 +HAL3001)	Voltage	AC100V ±10% 50/60Hz
	Power consumption	1200VA or less
HAL3001 alone	External size	W200 x D420 x H145 mm, excl. connector, incl rubber feet
	Weight	approx. 8 kg
HAL 3001 alone	Voltage	AC120V, 60Hz
	Power consumption	150VA or less

7-10 ENVIRONMENT (HAL3001B10 + HAL3001)

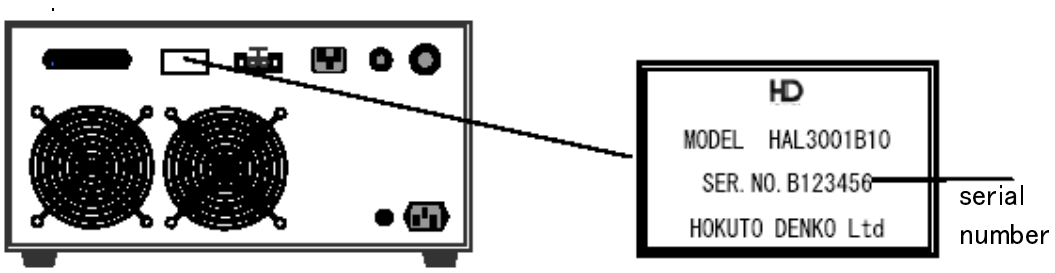
ITEM		CONTENTS
ENVIRONMENT	Working temp.	5℃～40℃
	Working humidity	10%～90%(without dew)
	Storage temp.	-10℃～40℃
	Storage humidity	5%～95％ without dew
	Accuracy guarantee temp.	23℃±5℃

8 .WARRANTY

This unit went through a thorough inspection prior to shipment. However,
should you experience any issues caused by workmanship or accident during transportation, call us immediately at 1-800-799-6232. The warranty period is 1 year after receipt of this instrument.

8. MAINTENANCE AND SERVICE

For prompt service and return to the customer, please provide detailed information regarding the issues you have experienced using this unit. In addition, please return in the original box or equivalent. Please include all instrument attachments that originally came with your instrument. Finally, please provide the serial number of the instrument. It is located at the rear of the unit.



Ex: N600-HAL3001-B10 REAR PANEL