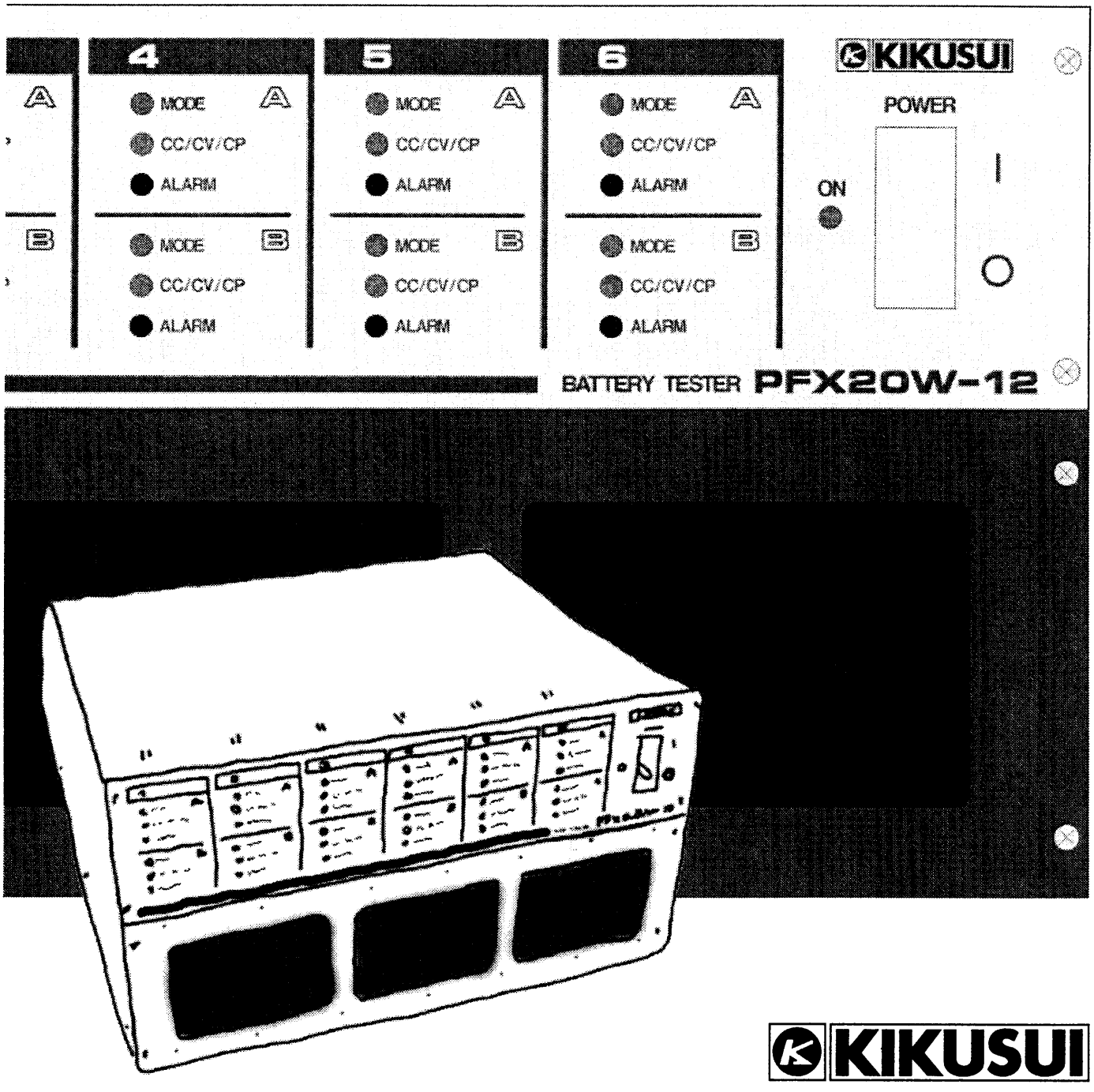
Electronic Test Instruments & Power Supplies

12 CH CHARGE/DISCHARGE TESTER

PFX20W-12

OPERATION MANUAL



KIKUSUI

Use of Operation Manual

Please read through and understand this Operation Manual before operating the product. After reading, always keep the manual nearby so that you may refer to it as needed. When moving the product to another location, be sure to bring the manual as well.

If you find any incorrectly arranged or missing pages in this manual, they will be replaced. If the manual it gets lost or soiled, a new Operation Manual can be purchased. In either case, please contact Kikusui distributor/agent, and provide the "Kikusui Part No." given on this page.

This manual has been prepared with the utmost care; however, if you have any questions, or note any errors or omissions, please contact Kikusui distributor/agent.

Kikusui Part No. Z1-001-682 IB001872

Printed in Japan.

Power Requirements of this Product

Power requirements of this product have been changed and the relevant sections of the Operation Manual should be revised accordingly. (Revision should be applied to items indicated by a check mark ☑.)

☐ Input voltage

The input voltage of this product is _____ VAC,
and the voltage range is _____ to _____ VAC.
Use the product within this range only.

☐ Input fuse

The rating of this product's input fuse is _____ A, _____ VAC, and _____ .

WARNING

- To avoid electrical shock, always disconnect the AC power cable or turn off the switch on the switchboard before attempting to check or replace the fuse.
- Use a fuse element having a shape, rating, and characteristics suitable for this product. The use of a fuse with a different rating or one that short circuits the fuse holder may result in fire, electric shock, or irreparable damage.

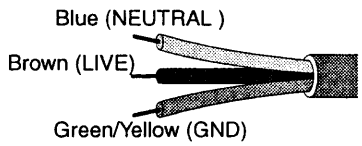
☐ AC power cable

The product is provided with AC power cables described below. If the cable has no power plug, attach a power plug or crimp-style terminals to the cable in accordance with the wire colors specified in the drawing.

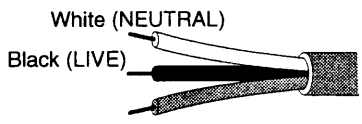
WARNING

- The attachment of a power plug or crimp-style terminals must be carried out by qualified personnel.

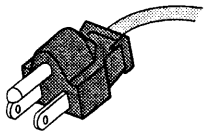
☐ Without a power plug



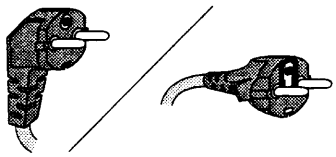
☐ Without a power plug



☐ Plugs for USA



☐ Plugs for Europe



☐ Provided by Kikusui distributor/agent

Kikusui distributor/agent can provide you with suitable AC power cable.
For further information, contact Kikusui distributor/agent.

⚠Safety Precautions

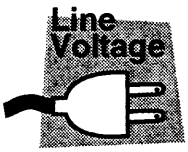
The following safety precautions must be observed to avoid fire hazard, electrical shock, accidents, and other failures. Keep them in mind and make sure that all of them are observed properly. Kikusui assumes no liability against any damages or problems resulting from negligence of the precautions.

Users

- This product must be used only by qualified personnel who understand the contents of this operation manual.
- If it is handled by disqualified personnel, personal injury may result. Be sure to handle it under supervision of qualified personnel (those who have electrical knowledge.)

Purposes of use

- If the product is to be used for purposes not described in this manual, contact Kikusui distributor/agent in advance.

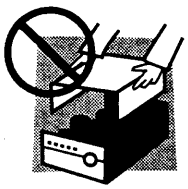


Input power

- Use the product with the specified input power voltage.
- For applying power, use the AC power cable provided. The shape of the plug differs according to the power voltage and areas. Use the cable which is suitable for the line voltage used.

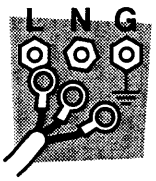
Fuse

- With products with a fuse holder on the exterior surface, the fuse can be replaced with a new one. When replacing a fuse, use the one which has appropriate shape, ratings, and specifications.



Cover

- There are parts inside the product which may cause physical hazards. Do not remove the external cover.



Installation

- When installing products be sure to observe "Precautions for Installation" described in this manual.
- To avoid electrical shock, connect the protective ground terminal to electrical ground (safety ground).
- When applying power to the products from a switchboard, be sure work is per-

formed by a qualified and licensed electrician or is conducted under the direction of such a person.

- Be sure to use the AC power cable provided. Consult Kikusui distributor/agent if other cable than included is to be used for some reason.
- When installing products with casters, be sure to lock the casters.

Relocation

- Turn off the power switch and then disconnect all cables when relocating the product.
- Use two or more persons when relocating the product which weights more than 20 kg. The weight of the products can be found on the rear panel of the product and/or in this operation manual.
- Use extra precautions such as using more people when relocating into or out of present locations including inclines or steps. Also handle carefully when relocating tall products as they can fall over easily.
- Be sure the operation manual be included when the product is relocated.

Operations

- Check that the AC input voltage setting and the fuse rating are satisfied and that there is no abnormality on the surface of the AC power cable. Be sure to unplug the AC power cable or stop applying power before checking.
- If any abnormality or failure is detected in the products, stop using it immediately. Unplug the AC power cable or disconnect the AC power cable from the switchboard. Be careful not to allow the product to be used before it is completely repaired.
- For output wiring or load cables, use connection cables with larger current capacity.
- Do not disassemble or modify the product. If it must be modified, contact Kikusui distributor/agent.

Maintenance and checking

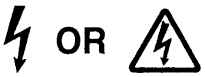
- To avoid electrical shock, be absolutely sure to unplug the AC power cable or stop applying power before performing maintenance or checking.
- Do not remove the cover when performing maintenance or checking.
- To maintain performance and safe operation of the product, it is recommended that periodic maintenance, checking, cleaning, and calibration be performed.

Service

- Internal service is to be done by Kikusui service engineers. If the product must be adjusted or repaired, contact Kikusui distributor/agent.

Safety Symbols

This operation manual and this product use the following safety symbols. Note the meaning of each of the symbols to ensure safe use of the product. (As using symbols depend on the product, all of symbols may not be used.)

	Indicates the presence of 1000 V or higher. Inadvertently touching such a part may cause electrical shock resulting in death. If it is necessary to touch such a part to conduct work, first make sure no voltage is being supplied.
WARNING	Indicates the possibility of personal injury or death. Never fail to follow the operating procedure. Do not proceed beyond a WARNING sign until the noted conditions are fully understood and met.
CAUTION	Indicates the existence of damage to the product or connected equipment. Always follow the operating procedure. Do not proceed beyond a CAUTION sign until the indicted conditions are fully understood and met.
NOTE	Indicates additional information such as operating procedure.
Description	Describes technical terms used in this manual.
	Indicates action prohibited.
	Indicates general warning, caution, risk of danger. When this mark is indicated on the product, refer the relevant section of the Operation Manual.
	Indicates a grounding (earth) terminal.
	Indicates a chassis grounding terminal.

Contents

Contents (continued)

Preface

Introduction to the Product

The PFX20W-12 is a charge/discharge tester with outputs of a maximum of 12 channels. It is capable of performing constant-current charge, constant-current/ constant-voltage charge, constant-current discharge, and constant-power discharge required to perform electrical characteristic tests on a battery. Moreover, it also has a pulse discharging function that quickly switches constant-current settings in turn during discharge.

The PFX20W-12 is equipped with six charge/discharge power supply units, each of which has two 20-W channels, thereby composing 12 channels in total. The two channels (A and B) in each power supply unit can be connected in parallel, and modifying the configuration of those channels enables the tester to work as a charge/ discharge power supply unit at 50 W/channel.

The tester can be controlled by a host computer via GPIB, using the dedicated application software (Battery Performance Checker 12; SD03-PFX).

Features

- The entire tester and each power supply unit are handled by a multi-CPU system that controls the devices using individual CPUs. This enables high-precision control.
- Data collection through GPIB performs a high-speed block transfer in order not to degrade the performance of even a system using multiple PFX20W-12s. For this, the testers allow voltage/current measurements (for all channels) and capacity measurements to be made every 2 seconds.
- The battery voltage detection terminals have high input resistance, achieving very small leakage currents. This enables even minute voltage measurements.
- Adopts MOS FET for switching to charge, discharge, or rest, securing reliability for long continuous operations
- Allows you to specify voltage, time, and other parameters for the charge cutoff and/or discharge cutoff conditions.
- Has a variety of protection functions, including OVP (overcharge protection), UVP (over-discharge protection), OHP (overheat protection), and a watchdog timer (for system monitoring) to improve system reliability.
- For pulse discharging control, the PFX20W-12 is provided with a dedicated CPU to achieve high-precision time axis control and voltage measurement control that is synchronized with pulse current. Thus, it is capable of accurately measuring even slight battery voltage variations caused by pulse currents.

System Configuration

One frame (one PFX20W-12) consists of six electrically isolated units, and channels that separate the output of each unit into two parts.

Each unit can perform tests individually because they are electrically isolated from each other. Note that charging and discharging tests cannot be conducted on channels A and B of the same unit simultaneously. Tests are restricted to the same test conditions.

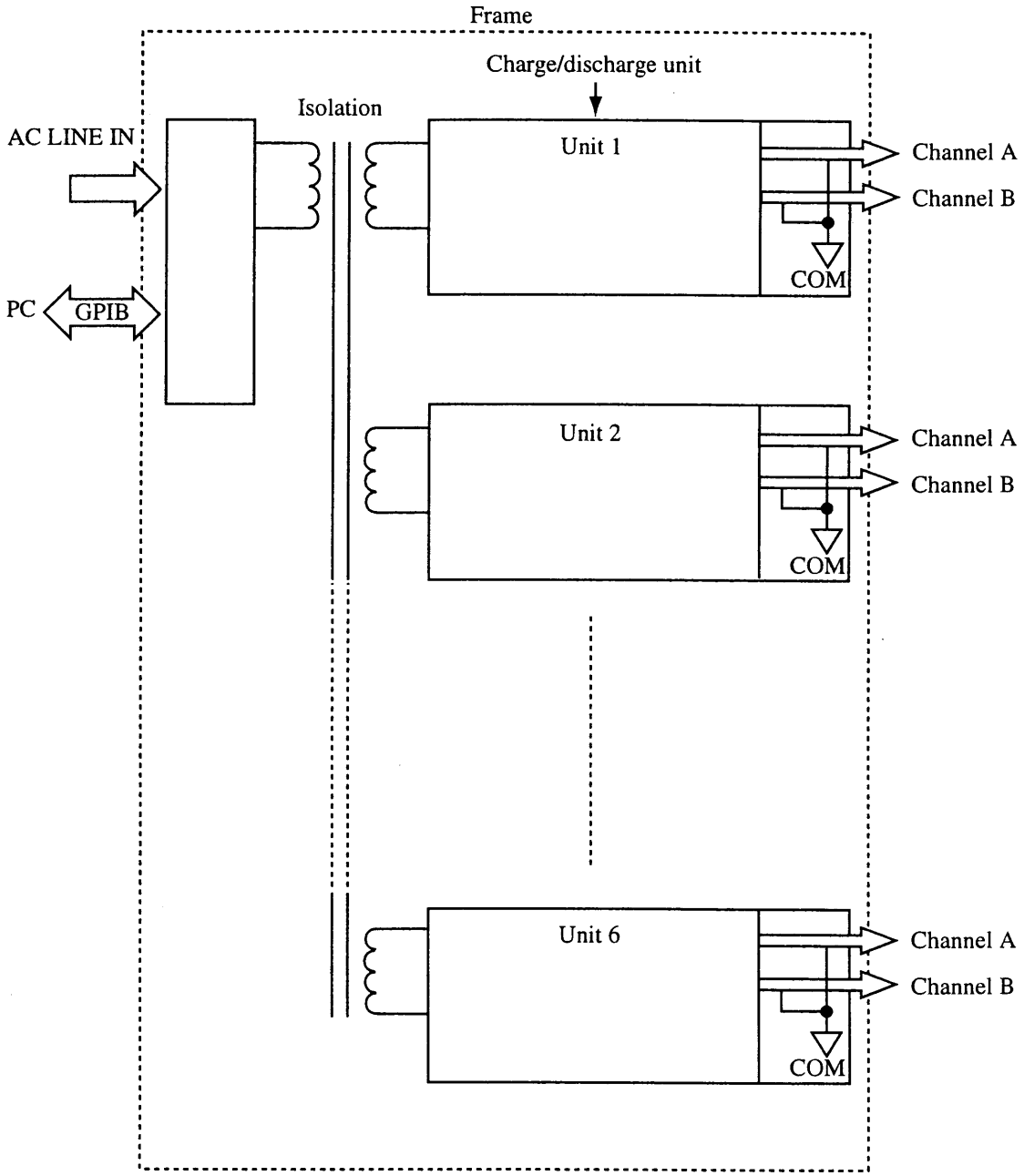


Fig. P-1 Configuration of PFX20W-12

Chapter 1 Setup

This chapter describes the necessary procedures from unpacking and installation to connection to a battery.

1.1 Checks During Unpacking

When you unpack the product, make sure that you have all the parts and that none of them has been damaged in transport.

If any part is damaged or missing, contact Kikusui distributor/agent.

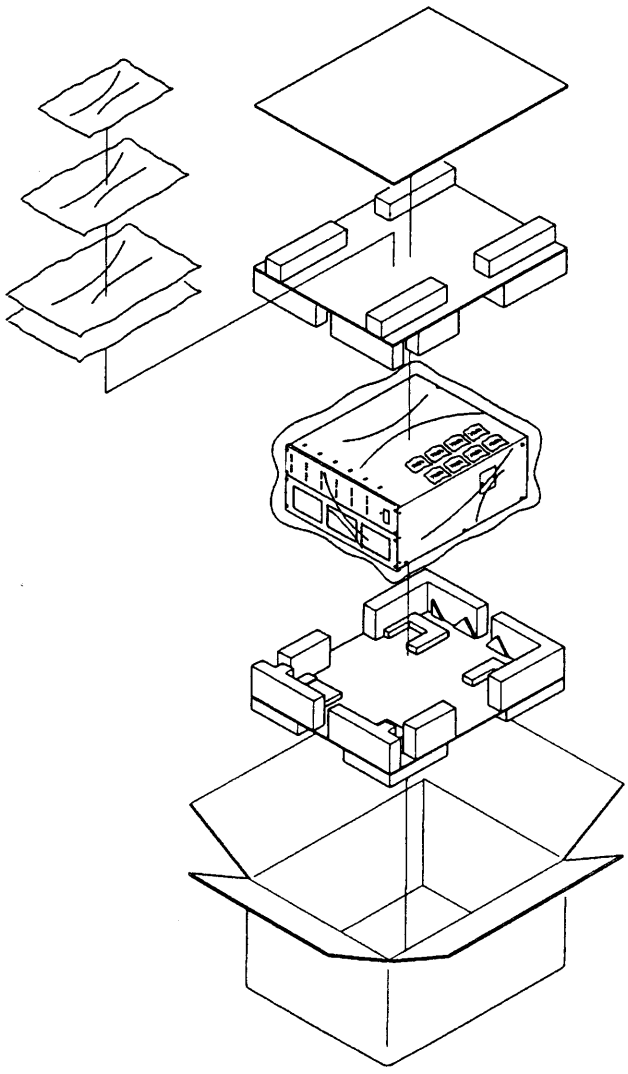
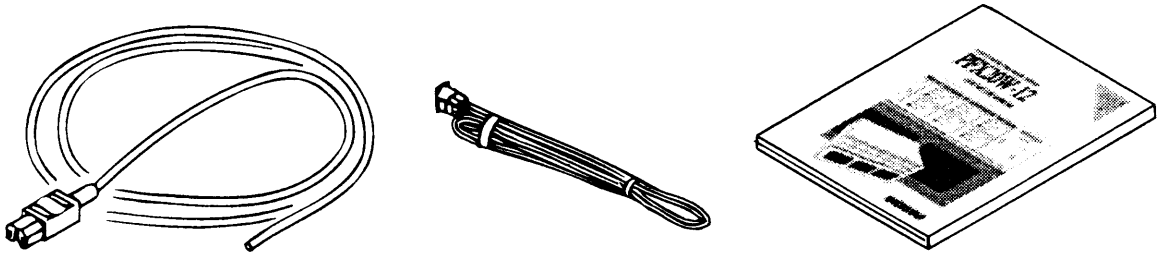


Fig. 1-1 Packing/Unpacking



☐ AC power cable, 1 ☐ Output cables, 12 ☐ Operation Manual, 1

Fig. 1-2 List of Accessories

1.2 Precautions on Moving

When moving the tester, take care of the following:

■ Turn off the POWER switch.

■ Remove all connected wires.

■ Do not carry the tester by one person.

The weight of the PFX20W-12 is 30 kg. To prevent any danger, make sure the tester is carried by two or more persons. When moving the tester to another room, for example, use a wagon to carry it even for short distances.

■ When transporting the product, be sure to use the original packing materials.

If they are missing, contact Kikusui distributor/agent.

1.3 Precautions on Installation

Be sure to observe the following precautions when installing the tester.

■ Do not use the tester in a flammable atmosphere.

To prevent explosion or fire, do not use the tester near alcohol, thinner, or other combustible materials, or in an atmosphere containing such vapors.

■ Avoid locations where the tester is exposed to high temperatures or direct sunlight.

Do not locate the tester near a heater or in areas subject to drastic temperature changes.

Operating temperature range: 0°C to 40°C

Storage temperature range: -10°C to 60°C

■ Avoid humid environments.

Do not locate the tester in a high-humidity environment—near a boiler, humidifier, or water supply.

Operating humidity range: 30% to 80% R.H (no dew condensation is allowed)

Storage humidity range: 20% to 80% R.H (no dew condensation is allowed)

■ Do not place the tester in a corrosive atmosphere.

Do not install the tester in a corrosive atmosphere or one containing sulfuric acid mist or the like. This may cause corrosion of various conductors and imperfect contact with connectors, leading to malfunction and failure, or in the worst case, a fire.

■ Do not locate the tester in a dusty environment.

■ Do not use the tester where ventilation is poor.

The tester employs a forced air cooling system. Air is taken in from intake ports located on the tester's front, and is exhausted from the rear. Provide sufficient space (20 cm or more) around the tester so that the air intake ports and exhaust ports are always completely unobstructed.

■ Do not stack testers on top of one another.

The weight of the tester is 30 kg. To prevent any danger, do not stack testers on top of one another.

■ Do not place the tester on a tilted surface or in a location subject to vibrations.

■ Do not use the tester in locations affected by strong magnetic or electric fields.

1.4 Connecting the AC Power Cable

CAUTION

- The input voltage range of the tester is 200 V AC ± 10%, 50/60 Hz, single phase. Always check the supply voltage and then connect the AC power cable.

The supply side of the AC power cable provided has no power plug. Attach a power plug or crimp terminals to the cable for use, meeting the connector or terminals of the feeder facility in use.

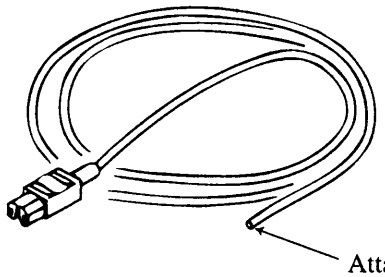


Fig. 1-3 AC Power Cable

WARNING

- The supply side of the AC power cable must be connected by qualified personnel.
- When connecting to a switchboard directly, check that the switch of the switchboard is OFF before performing the connection work.

CAUTION

- Install crimp terminals meeting the terminal screws of the switchboard to which the AC input cable is connected, and connect them securely.

1.5 Grounding

Always ground the PFX20W-12 securely.

Connect the ⏚ terminal on the rear panel of the PFX20W-12 to the dedicated grounding (GND) terminal.

WARNING

- Failure to provide grounding may cause an electric shock.
- Connect the grounding terminal to an electrical ground (safety ground).

CAUTION

- Failure to provide grounding may cause a malfunction resulting from external noise or may cause an increase in noise generated from the tester.

NOTE

- When the GND line (green) of the AC power cable is grounded, grounding of the ⏚ terminal on the rear panel is not required.

1.6 Connecting Output Cables

Connect the tester and a DUT (battery) using the output cables supplied. Connect them securely according to the arrangement of pins on the output connector shown below.

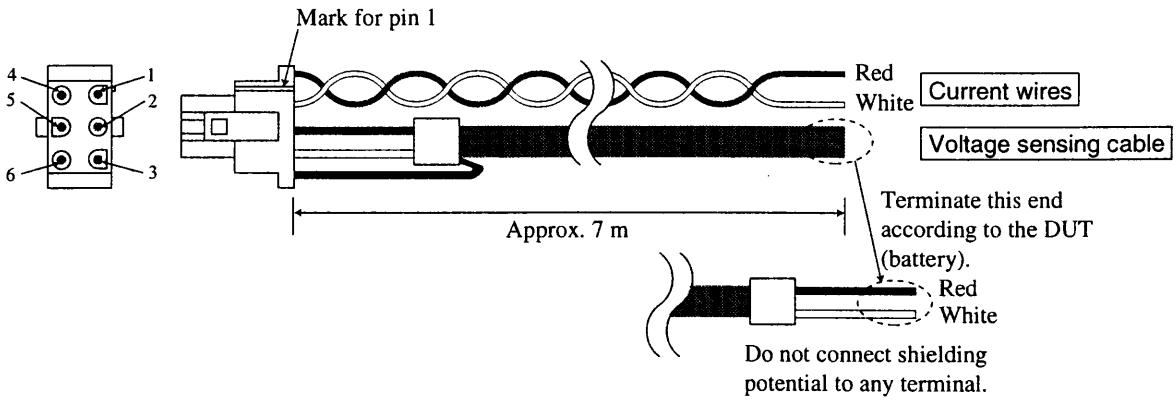


Fig. 1-4 Output Cable

Table 1-1 Wiring for Output Cables

Pin No.	Name	Color	Description
1	+	Red	Positive current terminal. Connect this to the + terminal of the DUT (battery).
2	-	White	Negative current terminal. Connect this to the - terminal of the DUT (battery).
3	+S	Red	Positive voltage terminal. Connect this to the + terminal of the DUT (battery).
4	-S	White	Negative voltage terminal. Connect this to the - terminal of the DUT (battery).
5	Shield	Black	Grounding terminal of shielded wire. This is connected to the chassis of the tester. Do not connect the shielding potential to any part of the DUT (battery).
6	N/A	-	Not available.

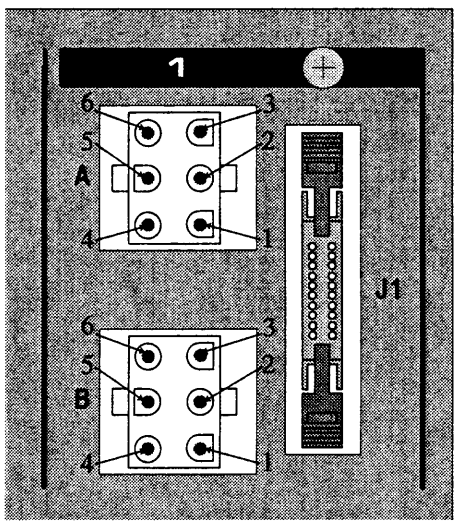


Fig. 1-5 Arrangement of Pins for Output Connector

CAUTION

- Connection to the output connectors must be performed in the standby status (IDLE) or with the POWER switch turned off (0).
- Insert the output connector until it is locked firmly.
- Cut cables to the minimum required length. Tying cables in bundles or allowing excess cable lengths to become entangled may cause unstable tester operations. Always use the output cables of a suitable length or else the tester may operate unstably, especially, in pulse action.
- The length of the output cables must not exceed 7 m. The use of output cables of more than 7 m may cause the tester to operate abnormally or not perform up to its specifications.

NOTE

- Output cables are also available optionally. If necessary, contact Kikusui distributor/agent.

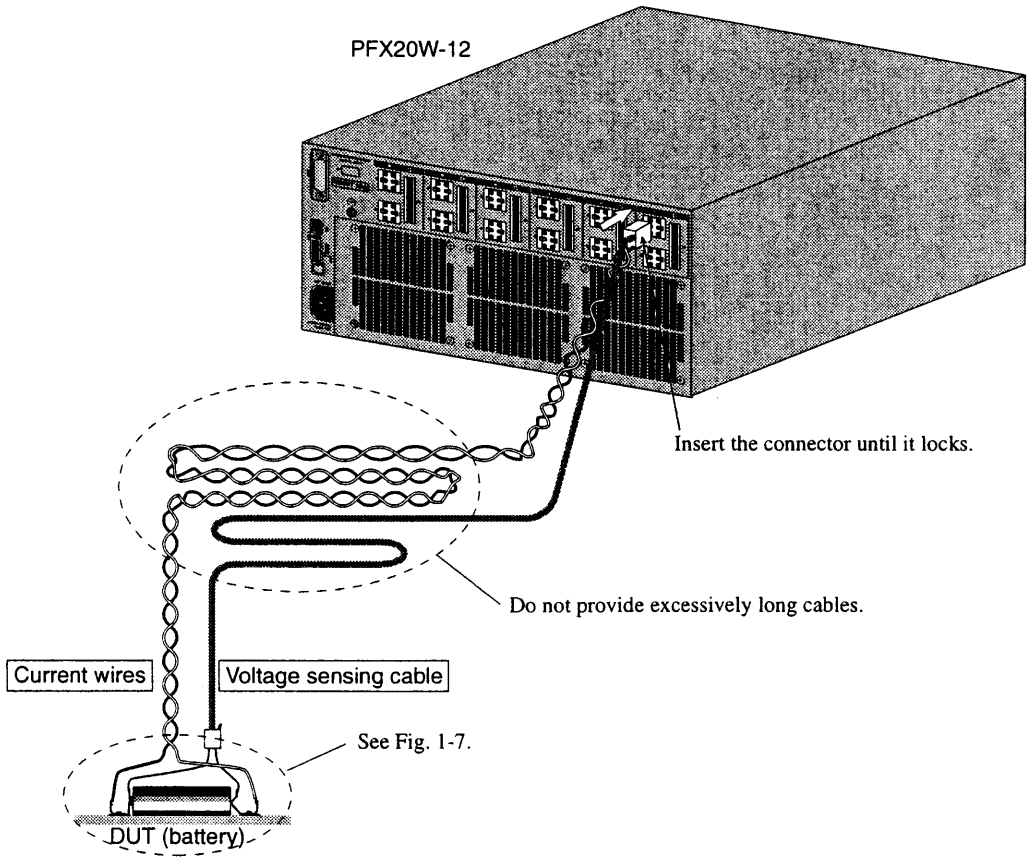


Fig. 1-6 Connecting Output Cables

■ Basic connection for DUT (battery) side

Fig. 1-7 shows the basic connection to a battery.

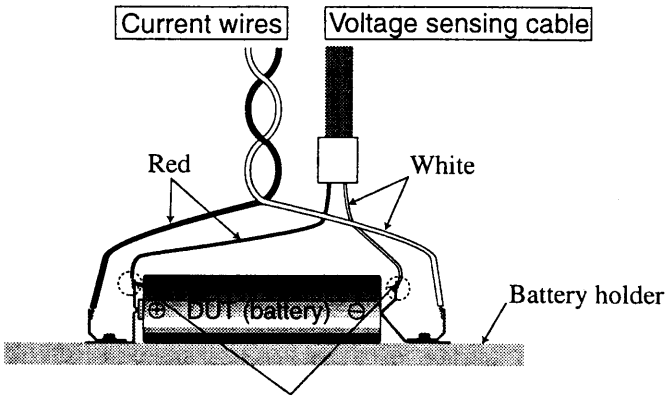


Fig. 1-7 Connecting to a DUT

■ Performing connections for a 6-channel configuration

When the outputs of channels A and B are connected in parallel so that the tester can be used in a 6-channel configuration, connect the output cables as shown in Fig. 1-8.

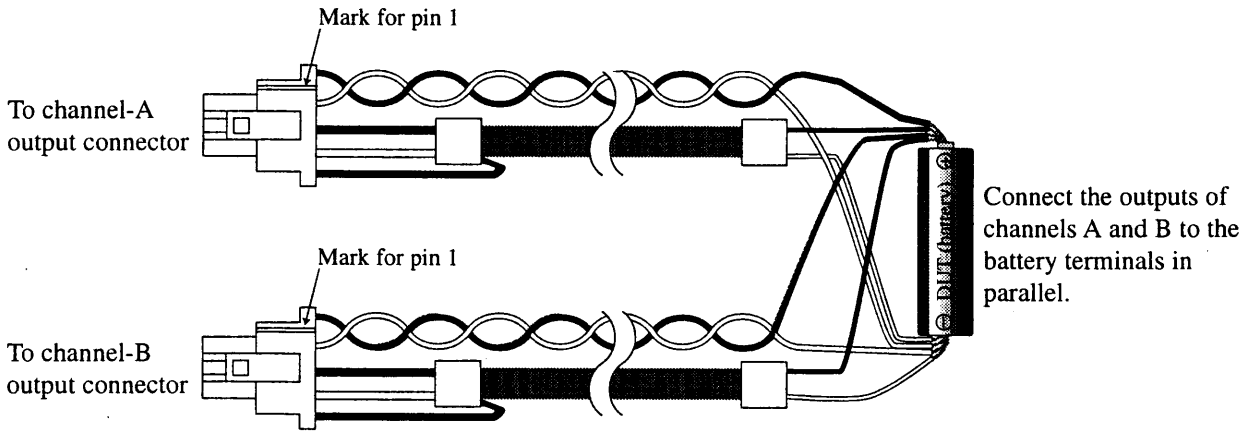


Fig. 1-8 Connecting Output Cables (in 6-Channel Configuration)

1.7 Connecting the Signal Connector

The use of the signal connector (J1) allows the output current and operating status of the tester to be monitored externally.

Table 1-2 shows the wiring used for the signal connector. Check the pin numbers of the required signals.

■ Wires, connectors, and tools required for connection

The following wires, connectors, and tools are required to use the signal connector.

Wire ..... AWG24 (maximum outside wire diameter of 1.3 mm, 7-core configuration)

Connector ..... XG5M-2032N (Omron)

Cover ..... XG5S-2012 (Omron)

Crimping tool ..... XY2B-7006 (Omron)

Connection bands

The following tool is also required to pull out contact pins.

Contact pulling tool ..... XY2E-0001 (Omron)

CAUTION

- Connections to the signal connector (J1) must be performed with the POWER switch turned off (0).

NOTE

- A connector equivalent to the one noted above may also be used.

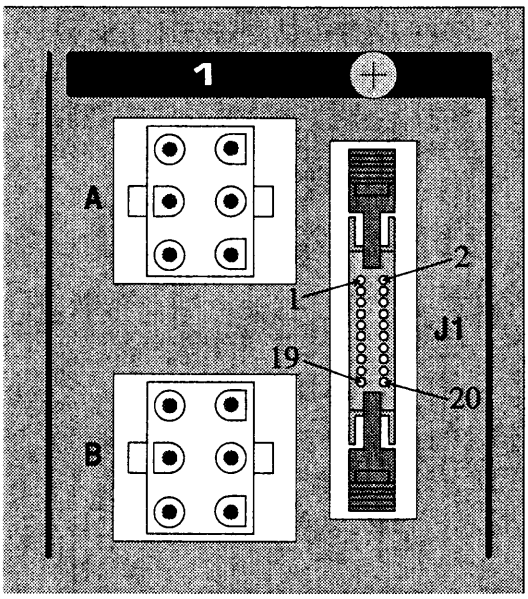


Fig. 1-9 Arrangement of Pins for the Signal Connector

Table 1-2 Wiring for the Signal Connector

Pin No.	Name	Description
1	IMON (1) (Current monitoring signal)	Current monitoring terminal for channel A. This terminal outputs 0 to 5 V for currents of 0 to 5 A at an output impedance of 47 Ω with ACOM used as common.
2	ACOM	Analog common for current monitoring output
3	Not used	Do not use this pin.
4	Not used	Do not use this pin.
5	RESTSTS (1) (Rest status signal)	Signal output indicating that channel A's status is "rest" +5 V CMOS output, active High
6	DISCSTS (1) (Discharging status signal)	Signal output indicating that channel A is discharging +5 V CMOS output, active High
7	CHGSTS (1) (Charging status signal)	Signal output indicating that channel A is charging +5 V CMOS output, active High
8	Not used	Do not use this pin.
9	TRIG OUT (1) (Trigger signal)	An open collector ON signal is output for about 10 ms with DCOM used as common when charge or discharge begins. Active Low, V_{CE} 30 V max., I_C 30 mA max.
10	DCOM	Digital common for each status output including TRIG OUT
11	IMON (2) (Current monitoring signal)	Current monitoring terminal of channel B. This terminal outputs 0 to 4 V for currents of 0 to 4 A at an output impedance of 47 Ω with ACOM used as common.
12	ACOM	Analog common for current monitoring output
13	Not used	Do not use this pin.
14	Not used	Do not use this pin.
15	RESTSTS (2) (Rest status signal)	Signal output indicating that channel B's status is "rest" +5 V CMOS output, active High
16	DISCSTS (2) (Discharging status signal)	Signal output indicating that channel B is discharging +5 V CMOS output, active High
17	CHGSTS (2) (Charging status signal)	Signal output indicating that channel B is charging +5 V CMOS output, active High
18	Not used	Do not use this pin.
19	TRIG OUT (2) (Trigger signal)	An open collector ON signal is output for about 10 ms with DCOM used as common when charge or discharge begins. Active Low, V_{CE} 30 V max., I_C 30 mA max.
20	DCOM	Digital common for each status output including TRIG OUT

NOTE

- When the tester is used in a 6-channel configuration, use channel-A terminals.

1.8 Connecting the Trip Connector

The trip connector allows you to turn off the POWER switch of the tester externally. The POWER switch will be turned off when the + and - terminals of the trip connector are short circuited.

■ Wires required for connection

One of the following wires is required to use the trip connector.

Solid wire ..... AWG26 to 18 (diameter of 0.4 to 1.0 mm)

Stranded wire..... AWG22 to 20 (0.3 mm to 0.75 mm O.D., strand diameter of 0.18 mm or more)

■ Electrical specifications

The electrical specifications of TRIP input are as follows. Use a floated contact signal or open collector output that meets these specifications.

When open: 24 V DC

When short circuited: 200 mA

Trip level: 6 V or less

CAUTION

- Connections to the trip connector must be performed with the POWER switch turned off (0).
- Ensure that any exposed parts of the wire do not contact the chassis or other wires on adjacent connectors.
- After connection, gently pull out the wire to see that it is not removed.

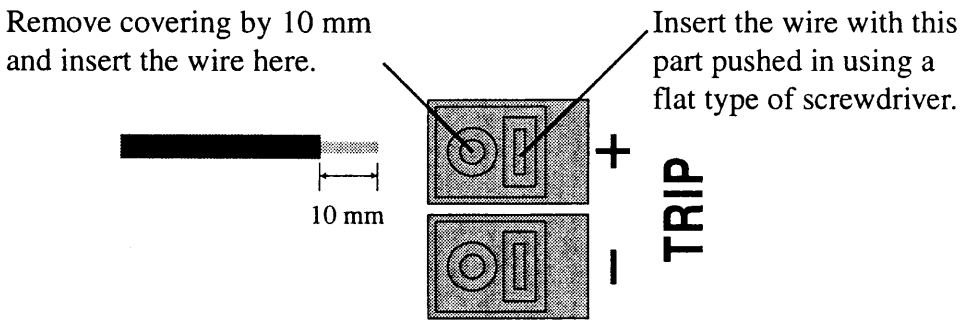


Fig. 1-10 Trip Connector (on the Rear Panel of the PFX20W-12)

1.9 Connecting the GPIB Connector

This connector is used to connect the tester and the host computer using a GPIB cable.

■ Cable required for connection

GPIB cable..... Compliant with IEEE-STD-488

CAUTION

- Before connecting a GPIB cable, check that the POWER switches of the tester and computer are OFF (0).

Chapter 2 Operation Method

The PFX20W-12 tester is entirely operated from a host computer via GPIB, using the dedicated application software. For more information about how to operate the tester, see the documents provided with the application software. This chapter describes only what is related to the hardware.

2.1 Setting the GPIB Address

The GPIB address should be set using the ADDRESS switch on the rear panel. The address value is determined by setting the five switches indicated as "1" to "16" to the left (1). The GPIB address can be set in a range of 0 to 30.

For example, to set the address to 6 (= 2 + 4), set the ADDRESS switches marked "2" and "4" to the left.

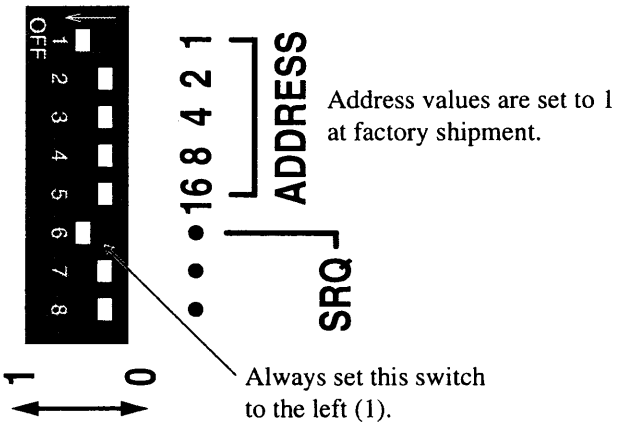


Fig. 2-1 GPIB Address Switches

NOTE

- Always set the DIP switch 6, or SRQ (service request), to the left (1). If it is set to the right (0), the application software (SD03-PFX) cannot control the tester.
- Keep DIP switches 7 and 8 to the right (0) even though their settings have little bearing on the operation of the tester.
- The address value set will not apply until the POWER switch of the tester is turned on again.

2.2 Turn ON the Power

Power ON procedure:

1. – Check that the AC power cable of the tester has been correctly connected.
2. – Turn ON the POWER switch.
3. – The tester enters an initialization routine for about 30 seconds, during which time the LEDs on the front panel will blink.

CAUTION

- During this initialization period, do not make an access to GPIB.

4. – After checking the initialization, all LEDs, except the POWER ON lamp, go off.

This allows the tester to enter the IDLE status, waiting for a command from the host computer.

Chapter 3 Part Names and Their Functions

This chapter describes the names and functions of switches, connectors, and other items on the front and rear panels.

3.1 Front Panel

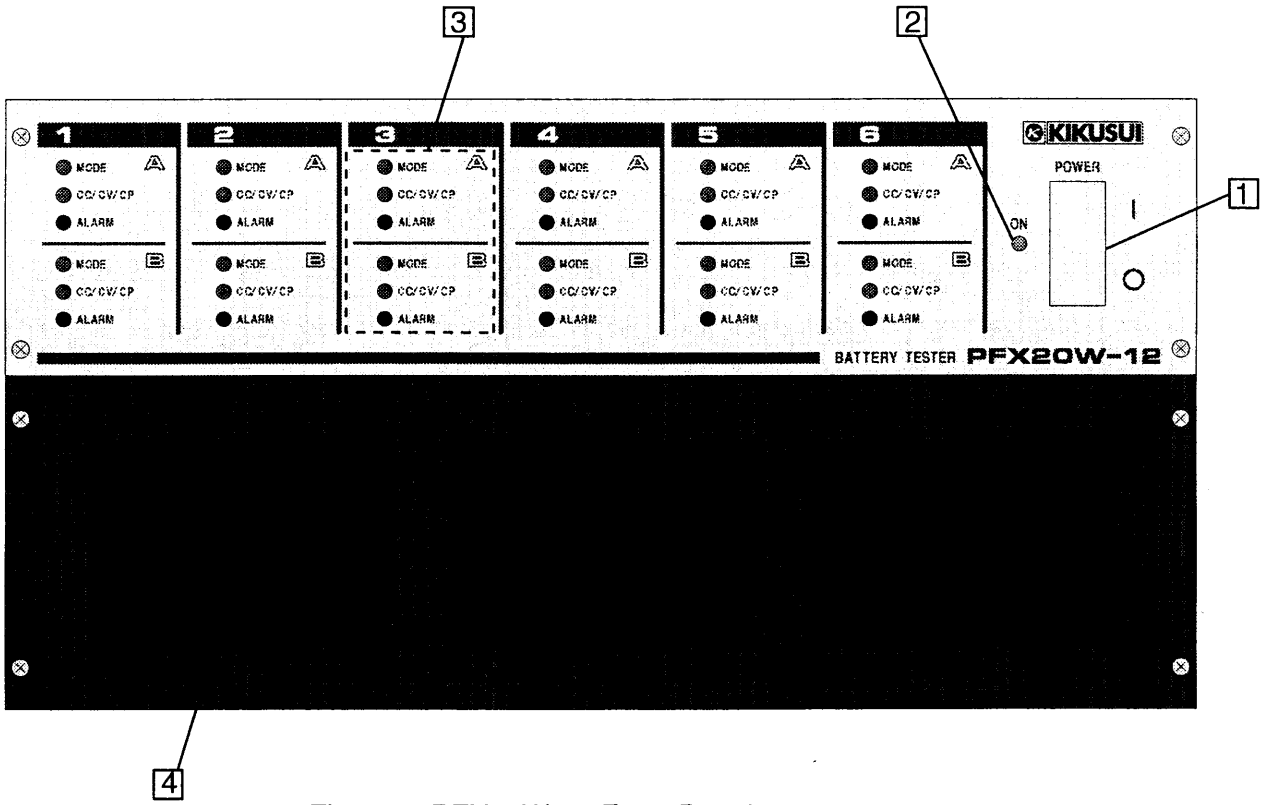


Fig. 3-1 PFX20W-12 Front Panel

1 POWER

Turns the power to the tester ON and OFF. Flip up the lever to turn the power ON (1), and flip it down to turn the power OFF (0).

2 ON lamp

Lights up (green) when the tester power is ON.

3 Status lamps

Indicate the operation status of the tester.

MODE

When illuminated in red	Charging
When illuminated in green	Discharging
When illuminated in orange	Resting

CC/CV/CP

When illuminated in red	In constant current (CC) or pulse action
When illuminated in green	In constant voltage (CV) action
When illuminated in orange	In constant power (CP) action

ALARM

Lights up (red) when a protection function of the tester, such as OVP (overcharge protection), UVP (over-discharge protection), and OHP (overheat protection), is activated. For more information, see Appendix 3, Protection Functions, and Appendix 4, Description of Alarms and Remedies.

4 Air intake ports (dust filters)

Clean dust filters periodically. For information on cleaning the dust filters, see 4.1, Cleaning.

3.2 Rear Panel

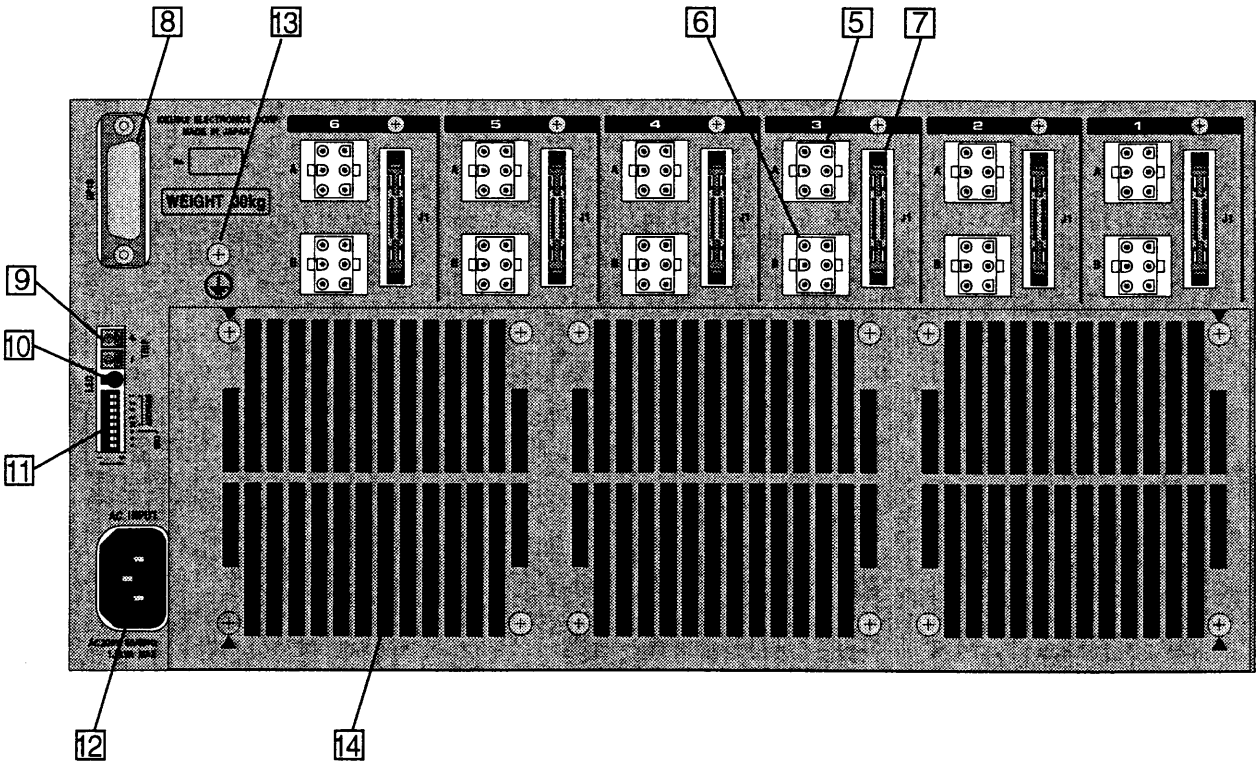


Fig. 3-2 PFX20W-12 Rear Panel

5 A
Channel-A output connector

6 B
Channel-B output connector

7 J1
Signal output connector for channels A and B

8 GPIB
Connector for connecting a GPIB cable

9 TRIP
When terminals (+, -) are short circuited, the POWER switch of the tester will be turned off. TRIP can be used as an external interlock.

10 LED1
Indicates the operation status of the main CPU in the tester. Normally, it blinks. If the CPU malfunctions, it lights up or goes off.

11 ADDRESS/SRQ
DIP switches 1 to 5 are used to set the GPIB address. DIP switch 6 enables the SRQ (service request) function. Always set this switch to the left (1). The setting of DIP switches 7 and 8 has little bearing on the operations of the tester. For information on setting the DIP switches, see 2.1, Setting the GPIB Address.

12 AC INLET
Connector of the AC power cable for feeding power to the tester. Insert the plug of the AC power cable supplied with the product here.

13 ⏚
This is the ground terminal.

WARNING

- Always provide grounding. For more information, see 1.5, Grounding.

14 Exhaust ports
These ports use cooling fans to exhaust heated air from inside.

Chapter 4 Maintenance and Calibration

This chapter describes the maintenance and calibration procedures for the tester. To maintain the tester's original performance as long as possible, conduct periodic maintenance, checks, and calibration.

4.1 Cleaning

WARNING

- Before carrying out cleaning, always turn off the POWER switch and unplug the AC power cable or turn off the switches on the switchboard.

■ Dirt on the panel surface

If the panel surface becomes soiled, wet a piece of soft cloth with a water-diluted neutral detergent, and wipe it gently.

CAUTION

- Do not use volatile solvents such as thinner or benzine. They may discolor the tester surface coating or erase printed characters.

■ Dust filters

Remove dust filters from the air intake ports of the front panel. Remove dust and dirt from the filters using a vacuum cleaner. If they are heavily soiled, clean with neutral detergent and rinse and dry them sufficiently.

CAUTION

- If a dust filter contains water, the humidity inside the tester will increase, possibly resulting in a tester malfunction.

4.2 Inspection

AC power cable:

Check that there is no damage on the insulation coating, and that the plug is attached securely and free from cracks.

WARNING

- Breaks in the insulation coating may cause electric shock. If a break is found, immediately stop using the tester.

To purchase accessories, contact Kikusui distributor/agent.

4.3 Calibration

The PFX20W-12 tester has been properly calibrated at factory shipment. However, it requires re-calibration due to secular changes in a long time use.

For re-calibration, consult with Kikusui distributor/agent.

Chapter 5 Specifications

5.1 Functional Specifications

Item		Description
Charging function		
	Charging method	Constant current/constant voltage
	Cutoff conditions	Specified current, voltage, time, or -ΔV after constant voltage operation
	Rest	Time
	Others	Output is off when current setting is 0 A.
Discharging function		
	Discharging method	Constant current, constant power, and pulse current
	Cutoff conditions	Voltage or time
	Rest	Time
	Others	Output is off when current setting is 0 A.
Measuring function		
	Battery voltage	To be measured every 2 seconds
	Charging and discharging current	To be measured every 2 seconds
	Capacity	To be measured every 2 seconds
	Time	Totalized time, or elapsed time from the start of specified charge/discharge pattern in measurement
	Cycle count	(2000 times maximum. The maximum number of counts depends on the application.)
Protection functions*1		
	Overcharge protection (OVP)	Tripped if DUT (battery) voltage exceeds the OVP voltage value during a test.
	Over-discharge protection (UVP)	Tripped if DUT (battery) voltage falls below the UVP voltage value during a test.
	Overcharge capacity protection (OAH)	Tripped if totalized capacity exceeds the OAH capacity value during a charging test.
	DUT (battery) connection error (Connection Error)	Detects erroneous connection of a DUT (battery).
	CPU communication error (CPU Error)	Detects a communication error inside the tester.
	AC power line abnormality (AC Line)	Detects an abnormality in the AC power line such as an instantaneous power failure.
	GPIB communication error (Communication Error)	Detects an abnormality in GPIB communication between the PFX20W-12 and PC.
	PS board abnormality (PS/B)	Detects overheating or overvoltages in the power supply unit of the tester.
	CD board abnormality (CD/B)	Detects abnormal circuit conditions in the control unit in the tester due to improper connection of the DUT (battery).
	CD board overheat (OHP)	Detects overheating of the control unit in the tester.
	Watchdog timer	When the timer trips, output is turned off and the test is canceled. Initialize the unit at power ON.
	External interlock	Trips a fuseless breaker in the AC input block by to an external make-contact signal.
Status monitoring		Charge, discharge, pulse discharge, rest, and others
Alarm monitoring		OVP, UVP, OAH, Connection Error, CPU Error, AC Line, Communication Error, PS/B, CD/B, OHP

*1 For more information, see "Appendix 3, Protection Functions", and "Appendix 4, Description of Alarms and Remedies".

5.2 Electrical Specifications

Item			Description	
			12-channel configuration	6-channel configuration
Rated output				
	Number of outputs		12 channels	6 channels*2
	Charging current range		0.001 A to 4.000 A	0.001 A to 5.000 A
	Charging voltage range		0.000 V to 5.500 V	0.000 V to 20.000 V
	Discharging current range		0.001 A to 4.000 A	0.001 A to 5.000 A
	Discharging voltage range		-2.000 V to 5.500 V	-2.000 V to 20.000 V
	Maximum charging/discharging power		20 W	50 W
Output setting functions*3				
	Constant current setting	Range	0.001 A to 4.000 A	0.001 A to 5.000 A
		Accuracy	± (0.3% of setting + 2 mA)	
		Resolution	1mA	
		Ripple	Within 3 mA rms for DC to 500 kHz	
	Constant voltage setting	Range	0.000 V to 5.500 V	0.000 V to 20.000 V
		Accuracy	± (0.2% of setting + 5 mV)	
		Resolution	1 mV	
		Ripple	Within 10 mV rms for DC to 500 kHz	
	Constant-power discharging setting	Range	0.01 W to 20.00 W	0.01 W to 50.00 W
		Accuracy	± (1% of setting + 10 mW) at a battery voltage of 2 V or more	
		Resolution	10 mW	
	Pulse discharging current setting*4	Range	0.010 A to 4.000 A	0.010 A to 5.000 A
		Resolution	1 mA	
		Accuracy	± (0.5% of setting + 5 mA)	
		Number of settings	Four values	
		Response*5	100 µs, short-circuited at the end of a 7 m load cable	
	Pulse time width	Range	0.50 ms to 650 ms	
		Resolution	10 µs	
		Accuracy*6	± (0.1% of setting + 20 µs)	
		Number of settings	Four values	
Measuring function*3				
	Current measurement	Range	0.000 A to 4.000 A	0.000 A to 5.000 A
		Accuracy	± (0.3% of reading + 2 mA)	± (0.3% of reading + 2.5 mA)
	Voltage measurement	Range	-2.000 V to 20.000 V	
		Accuracy	± (0.2% of reading + 5 mV)	
	Battery voltage during pulse discharging	Measured value	High/low voltage	
		Range	0.000 V to 20.000 V*7	
		Accuracy	± (0.5% of reading + 7digit)	
	Battery current during pulse discharging	Measured value	Returns a theoretical value.*8	
		Range	0.000 A to 4.000 A	0.000 A to 5.000 A
		Accuracy	———	

Item			Description	
			12-channel configuration	6-channel configuration
Current monitoring*3				
	Channel A	Range	0.000 A to 4.000 A	0.000 A to 5.000 A
		Magnification	1 A/V	
		Accuracy*9	± (0.3% of reading +10 mV)	
	Channel B	Range	0.000 A to 4.000 A	None
		Magnification	1 A/V	
		Accuracy*9	± (0.3% of reading +10 mV)	None
Status indication				
	Operation mode	Charging	Illuminated in red	
		Discharging	Illuminated in green	
		Resting	Illuminated in orange	
	Charging and discharging action mode	CC	Illuminated in red	
		CV	Illuminated in green	
		CP	Illuminated in orange	
		Pulse	Illuminated in red	
	Power supply abnormality (ALARM)		Illuminated in red	
	Power ON		Illuminated in green	
Protection functions				
	Overcharge protection (OVP)	Setting range	0.000 V to 21.000 V	
		Setting resolution	1 mV	
		Setting accuracy	Same precision as that of the voltage measurement	
		Time to trip*10	150 ms maximum	
	Over-discharge protection (UVP)	Setting range	-2.100 V to 20.000 V	
		Setting resolution	1 mV	
		Setting accuracy	Same precision as that of the voltage measurement	
		Time to trip*10	150 ms maximum	
	Overcurrent protection		Depends on the fuse (7 A) at output end.	
	Overheat protection (OHP)		Tripped if the temperature of the internal heat sink exceeds 100℃.	
	AC input overcurrent protection		Depends on the fuse in the AC input block.	
Signal connector (J1)				
	IMON (Current monitoring signal)	Channel A	Outputs 0 to 5 V for currents of 0 to 5 A at an output impedance of 47 Ω.	
		Channel B	Outputs 0 to 4 V for currents of 0 to 4 A at output impedance of 47 Ω.	None
	RESTSTS (Rest status signal)	Channel A	+5 V CMOS output, active High	
		Channel B	+5V CMOS output, actve High	None
	DISCSTS (Discharging status signal)	Channel A	+5 V CMOS output, active High	
		Channel B	+5 V CMOS output, active High	None
	CHGSTS (Charging status signal)	Channel A	+5 V CMOS output, active High	
		Channel B	+5 V CMOS output, active High	None
	TRIG OUT (Trigger signal)	Channel A	Outputs a signal for about 10 ms at the start of charge or discharge. Active Low V_{CE} 30 V max, I_C 30 mA max, open collector output	
		Channel B	Outputs a signal for about 10 ms at the start of charge or discharge. Active Low V_{CE} 30 V max, I_C 30 mA max, open collector output	None

*2 In parallel operation

*3 At ambient temperatures of 23°C ± 5°C

*4 Voltage operation range for constant-power discharge; 1 to 20 V

*5 Response is the time required by the output value to reach 90% of the final value (set value) when starting from 10% of that value when the output current value is varied stepwise.

*6 The (setting) accuracy of the pulse time width indicates the accuracy of the time width of a reference signal generated by the internal D-A converter. (This value does not include the delay element (response) of the power supply circuit. Pulse time width is measured by a half-pulse value.)

*7 The measurement precision of negative voltage is not guaranteed.

*8 The theoretical current value is average current theoretically calculated from the pulse current value set and the value of the pulse time width. Thus, this value is also used for calculating battery capacity.

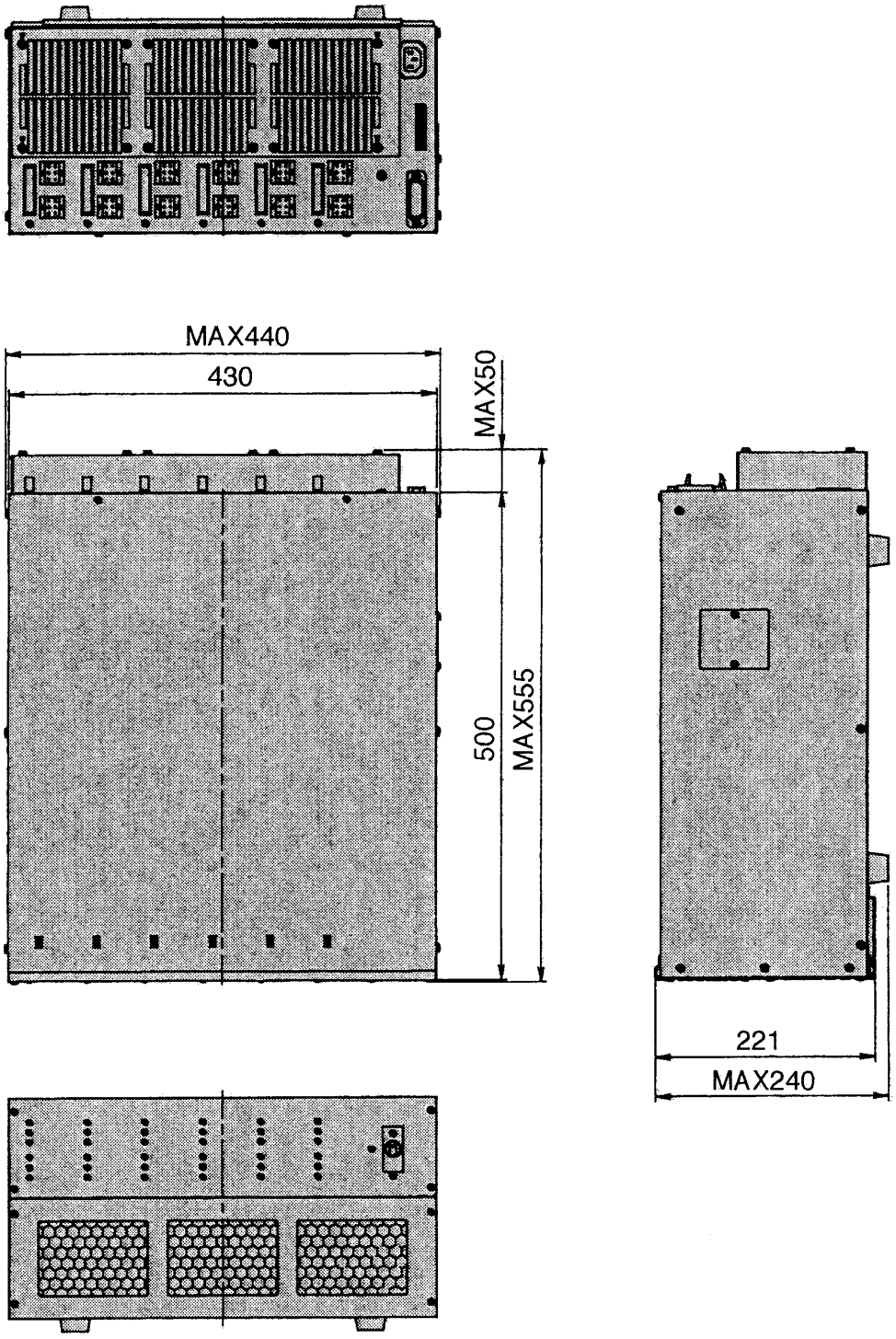
*9 For a pulse charge operation, the accuracy of current monitoring output is not guaranteed.

*10 Time to trip is the time required between the instant when output voltage exceeding the setting range is detected and the instant when the output is actually cut off. It varies with the setting of the pulse width during the pulse charge operation. For instance, time to trip is 40 ms to 670 ms when the set pulse width is 20 ms or more.

5.3 General Specifications

Item			Description
Temperature range	Operation temperature range		0 to +40
	Storage temperature range		-10 to +60
Humidity range	Operation humidity range		30% to 80% R.H with no dew condensation
	Storage humidity range		20% to 80% R.H with no dew condensation
Insulation resistance	Between input and chassis		30 MΩ or more at 500 V DC
	Between unit output and chassis		20 MΩ or more at 50 V DC
Withstanding voltage	Between AC input and chassis		1500 V AC for 1 minute
	Between AC input and DC output		1500 V AC for 1 minute
AC input	Input power		200 VAC ± 10%, 50/60 Hz, 1φ
	Power consumption	At rated output	Approx. 1800 VA (during charging when all channels output at their specified ratings)
		At no-load	Approx. 400 VA (at no-load on all channels)
GPIB interface			IEEE488-1978
	Interface function		SH1, AH1, T6, L4, SR1, RL0, PP0, DC1, DT0, C0, E1
	Address		0 to 30, set using DIP switches on the rear panel
Dimensions			Approx. 430 W x 221 H x 500 D mm Approx. 440 W x 240 H x 555 D mm max
Weight			Approx. 30 kg
Accessories			AC power cable 1 Output cables 12 Operation Manual 1

5.4 Dimensions



Unit: mm

Fig. 5-1 Dimensions of the PFX20W-12 Tester

Appendix

To encourage safe use of the tester, this Appendix gives examples of connections and remedies to be taken in the event of problems.

Appendix 1 Connections for a Battery Pack

NOTE

- The circuits shown below are just a few of many possible examples. Before connecting the tester to a battery pack, thoroughly understand the internal circuitry of the pack to be used.

Nickel-Cadmium (Ni-cd) and Nickel-Metal Hydride (Ni-MH) Battery Packs

Fig. A-1 shows the general internal circuitry of a Nickel-Cadmium (hereafter, Ni-cd) or nickel-metal hydride (hereafter, Ni-MH) battery pack.

These battery packs must be connected to the tester as shown in the figure.

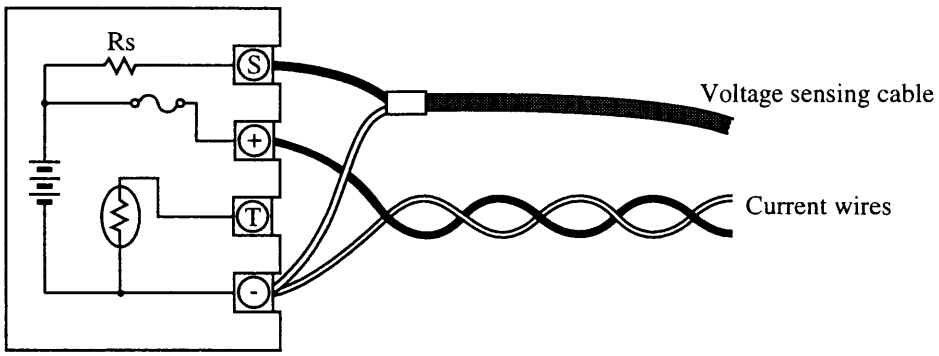


Fig. A-1 Connection of a Ni-cd or Ni-MH Battery Pack

Ni-cd and Ni-MH Battery Packs Incorporating a Diode

Battery packs that have connection terminals for both a charger and another device generally incorporate a diode between the charger connection terminals and battery, as shown in Fig. A-2. Connecting the charger connection terminals of this type of battery pack to the tester may prevent the tester from discharging or measuring battery voltage properly. For battery packs of this type, connect the device connection terminals of the battery pack to the tester.

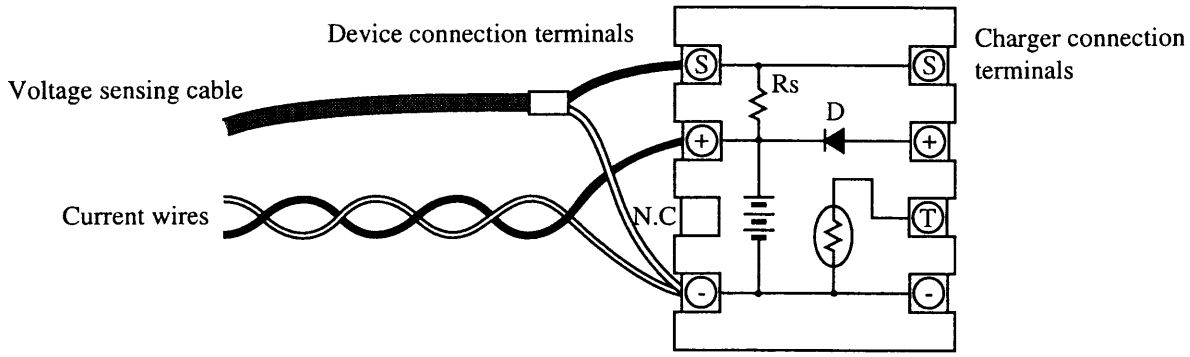


Fig. A-2 Connections for a Ni-cd or Ni-MH Battery Pack Incorporating a Diode

Lithium-Ion Battery Packs

Lithium-ion battery packs incorporate a protection circuit. Unless you understand the operation of this circuit, charge tests cannot be performed properly. The following describes how to connect a lithium-ion battery to the tester and perform other operations, taking a typical lithium-ion battery as an example.

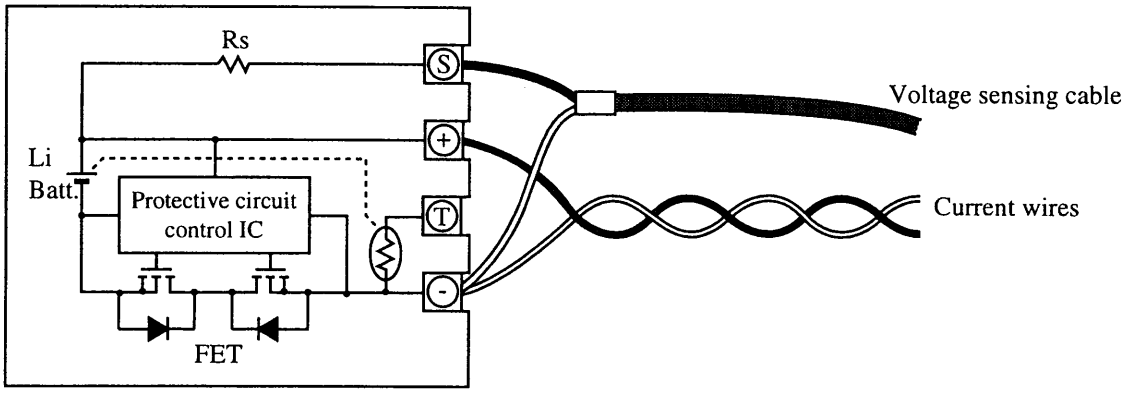


Fig. A-3 Connections for a Lithium-Ion Battery Pack

■ Connection

A lithium-ion battery pack is connected the same way as an Ni-cd or Ni-MH battery pack. Note that for lithium-ion battery packs with charger connection terminals, do not connect those terminals to the tester. Otherwise, you cannot perform discharge operations.

■ Operation

If an external overvoltage is applied, a discharge occurs due to the overcurrent, or a voltage drop is caused by the excess discharge, the protection circuit of the lithium-ion battery pack cuts off FET to protect the battery. If this protection is activated during a charge or discharge operation, no current flows in the battery, disabling the test. In the event of over-discharge protection, in particular, the protection circuit often continues to cut off FET until the next charge is made. Thus, precautions should be paid in setting discharge conditions (such as cutoff voltage) to the tester.

When a test is begun from a pre-discharge, if a CD/B (CD board abnormality) or Connection Error (DUT connection error) occurs immediately after that, the protection circuit of the battery pack is likely to have been tripped. To avoid this, check that the protection circuit of the battery pack has not been tripped before starting the test.

Appendix 2 Checking the Precision of Pulse Voltage Measurements

The pulse voltage measuring function accurately captures minute variations in battery voltage (variations synchronized with the pulse current) that are caused when a battery is discharged by pulse currents, to measure the maximum voltage (High voltage) and minimum voltage (Low voltage) at that time. This function measures battery voltage in synchronization with the pulse current. Thus, even if you input an external pulse waveform to the tester when you wish to check measuring accuracy in a functional check, the pulse voltage measurement function will not work properly.

This section describes how to check this pulse voltage measuring accuracy easily.

■ Mechanism of measurement

The measuring circuit consists of a standard resistor of 0.1 Ω and a power supply unit (see Fig. A-4). The power supply unit always keeps the voltage (Vps) at a constant level to ensure constant voltage generation. In contrast, the voltage (Vr) synchronized with the pulse current is produced across the resistor. Thus, the voltage between the voltage sensing wires (Vsens) of the tester is as shown below.

$Vr = Idis \times R$ Idis: pulse discharging current
R: resistance value of standard resistor

$Vsens = Vps + (-Vr)$

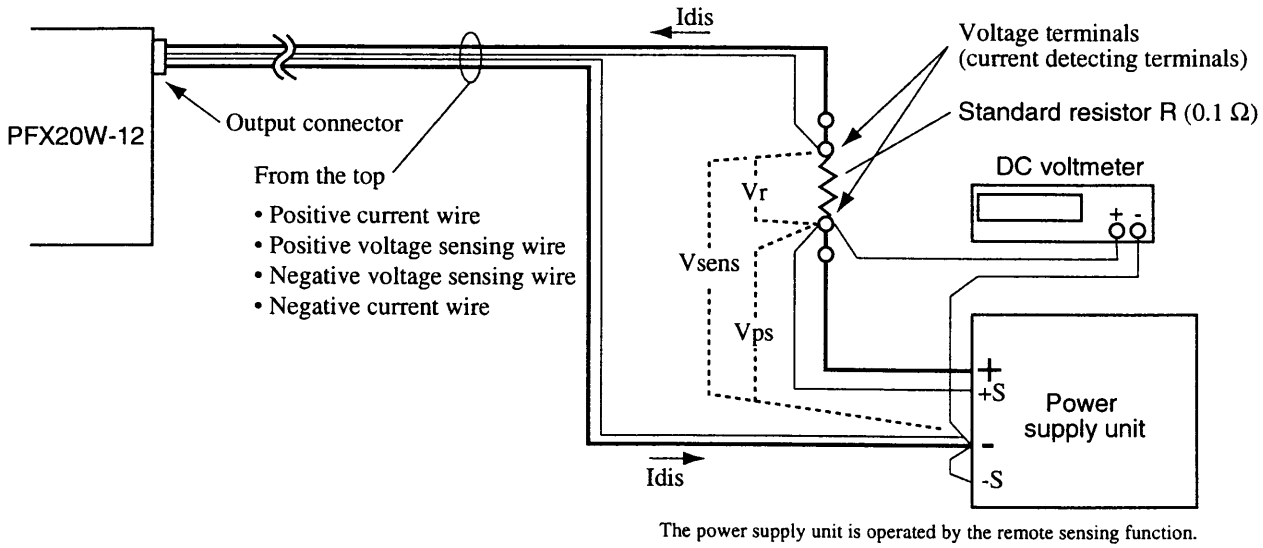


Fig. A-4 Measuring Circuit for Accurate Pulse Voltage Measurement

■ Preparations for measurement

1. Measuring instruments and connection

Prepare the measuring instruments listed in Table A-1 or equivalent devices and connect them as shown in Fig. A-4.

Table A-1 List of Measuring Instruments

	Model	Measuring instrument	Manufacturer
Power supply*	PBX40-10	High-speed bipolar power supply	KIKUSUI
Standard resistor	2792 0.1 Ω	High-precision standard resistor	Yokogawa Electric
DC voltmeter	8842A	5 1/2 Digit DVM	FLUKE

* The power supply should be operated under constant voltage. If large voltage variations are caused with respect to pulse-wise current load, the power supply is unsuitable for performing this measurement. Moreover, to achieve more precise measurements, use a power supply with an external remote sensing feature. From these conditions, we recommend that our "PBX Series" power supply be used.

2. Setting of the PFX20W-12

Set up the tester for pulse discharge as follows. Just as for normal test setting, use the application software for this setup.

- 12-channel configuration
- Mode Pulse 2
- Pulse current 1 1.000 A
- Pulse time 1 0.5 ms
- Pulse current 2 4.000 A
- Pulse time 2 0.5 ms

■ Measurement

1. – Set the power supply to output 0.500 V. (Set the output at precisely 0.500 V by using a DC voltmeter.)
2. – Operate the tester in the pulse discharge set as in the previous section.
3. – Check the High and Low voltages on the monitoring screen in the application software.
4. – Table A-2 shows the theoretical values for pulse voltage measurement. Compare them with the measured values to see if they meet the specifications.
5. – In the same manner, change the output voltage of the power supply to 3.000 V and then to 5.000 V. Compare the measured pulse voltage values obtained at that time with the theoretical values in Table A-2 to see if the measured values meet the specifications.

Table A-2 Theoretical Values for Pulse Voltage Measurement

Output voltage of power supply	Theoretical measurement value	
	High voltage	Low voltage
0.500 V	0.400 V	0.100 V
3.000 V	2.900 V	2.600 V
5.000 V	4.900 V	4.600 V

■ From the results of measurement

If a measured pulse voltage value is out of the theoretical value and does not meet the specifications, consider the following possible causes:

- A change in the calibrated values of the current setting function and/or pulse voltage measuring function; or
- A circuit-related problem with those functions

For calibration and repair, contact Kikusui distributor/agent.

Appendix 3 Protection Functions

This section describes the typical protection functions of the tester.

■ OVP (overcharge protection) and UVP (over-discharge protection)

OVP and UVP prevent overcharge or over-discharge of a DUT by monitoring the voltage of the DUT. If the DUT voltage exceeds the OVP voltage value or falls below the UVP voltage value during a test, the channel connected to that DUT enter an alarm status. Moreover, the other channel of the same unit enters an idle status.

Once a channel enters an alarm status, the test cannot be resumed unless that alarm is cleared by the application software. The relevant unit enters an idle status when the alarm status is canceled.

The values (voltage) of OVP and UVP are set on a unit-by-unit basis using the application software. For information on how to set OVP and UVP and how to clear an alarm status, see the documentation that comes with the application software (SD03-PFX).

■ OAH (overcharge capacity protection)

OAH prevents a DUT from overcharging by monitoring the current capacity (Ah) of the DUT. OAH is set as a ratio (100% to 1000%) relative to the nominal battery capacity value (separately set) of the DUT.

If the charge capacity value exceeds the current capacity value set by OAH during a test, that channel automatically enters an alarm status, and the other channel of the same unit enters an idle status. (However, this does not cause the alarm lamp to light up.)

Once a channel enters an alarm status, the test cannot be resumed unless the alarm is canceled by the application software. The relevant unit enters an idle status when the alarm status is canceled.

The set value of OAH (%) is input on a unit-by-unit basis through the application software. For instructions on how to set OAH and how to clear an alarm status, see the documentation that comes with the application software (SD03-PFX).

■ OHP (overheat protection)

OHP prevents thermal runaway of the tester's power supply unit and control unit. If the internal heat sink temperature exceeds a specified temperature, that unit enters an alarm status and then automatically moves to an idle status. If an alarm status is caused by OHP, the unit automatically recovers when the unit temperature falls below the specified temperature. (Until recovery, the status of that unit remains idle.) You cannot recover a unit using the application software.

For more information on the protection functions noted above and other protection functions, see Appendix 4, Description of Alarms and Remedies.

Appendix 4 Description of Alarms and Remedies

The tables below describes the alarms issued by the PFX20W-12-dedicated application software (SD03-PFX), and offers remedies to take in each case.

Table A-3 Alarms Relating to DUT (Battery) Protection Functions

Symbol	Name	ALRM lamp status	Description	How to clear
OVP	Overcharge protection	On	DUT (battery) voltage has exceeded the OVP voltage value during a test.	Cancellation by alarm reset
UVP	Over-discharge protection	On	DUT (battery) voltage has fallen below the UVP voltage value during a test.	Cancellation by alarm reset
OAH	Overcharge capacity protection	Off	A totalized capacity has exceeded the OAH capacity value during a charge test.	Cancellation by alarm reset
Connection Error	DUT (battery) connection error	On	DUT (battery) has not been connected to the tester correctly. The DUT is connected incorrectly or there is a broken wire or other fault in the connection. Check the wire connections.	Cancellation by alarm reset

Table A-4 Alarms Relating to the System or Hardware

Symbol	Name	ALRM lamp status	Description	How to clear
CPU error	CPU communication error	Off	A communication error occurred in the tester. The LEDs on the front panel of the PFX20W-12 must be blinking in the same way as when the unit is first powered on.	Turn on the power again. (*1)
AC Line	AC power line abnormality	Off	An instantaneous power failure has occurred. The LEDs on the front panel of the PFX20W-12 must be blinking in the same way as when the unit is first powered on.	Turn on the power again. (*2)
Communication Error	GPIB communication error	Off	An error occurred in GPIB communication between the PFX20W-12 and the PC. An abnormality occurred in the PFX20W-12.	Restart the tester, then carry out frame connection.
PS/B	PS board abnormality	On	Overheat protection has been triggered in the tester's power supply unit. Check for problems in mishandling of the tester, the set values, and abnormalities in the filters or fans.	The power unit will recover automatically when the temperature falls below the specified value.
			Overvoltage protection has been triggered in the tester's power supply unit.	Turn on the power again. (*2)
CD/B	CD board abnormality	On	Control circuit protection has been triggered due to a problem of load wiring in the control unit of the tester. Check the connection conditions of the current wires, battery holder, and connectors.	Cancellation by alarm reset (*2)
OHP	Overheated CD board	On	Overheat protection has been triggered in the control unit. Check for problems in mishandling of the tester, the set values, and abnormalities in filters or fans.	The power unit will recover automatically when the temperature falls below the specified value.

*1 If the alarm is triggered frequently, the tester may be faulty. Contact Kikusui distributor/agent.

*2 If the alarm persists even after following the above procedure, the tester may be faulty. Contact Kikusui distributor/agent.

Appendix 5 Connection Checking Function

The connection checking function automatically monitors the wiring conditions between the tester and DUT. This function is automatically started at the start of a test or at specified intervals during the test. If any abnormality is found in the connections, an alarm is triggered and the test will be canceled.

■ Principles of connection checking

As shown in Fig. A-5, switches SW1 and SW2 provided at the input section of the voltage sensing amplifier are generally set to side "b." DUT voltages measured under these conditions are treated as V1.

Before starting charge or discharge, SW1 and SW2 are switched to side "a" temporarily to measure DUT voltage via the current wire route. DUT voltages measured under these conditions are treated as V2.

The connection checking function compares V2 and V1. If V2 = V1, there are no abnormalities in the connection of the voltage sensing cable, and the test begins. If V2 ≠ V1, there may be a broken wire or connection failure in the voltage sensing cable, and the test is canceled.

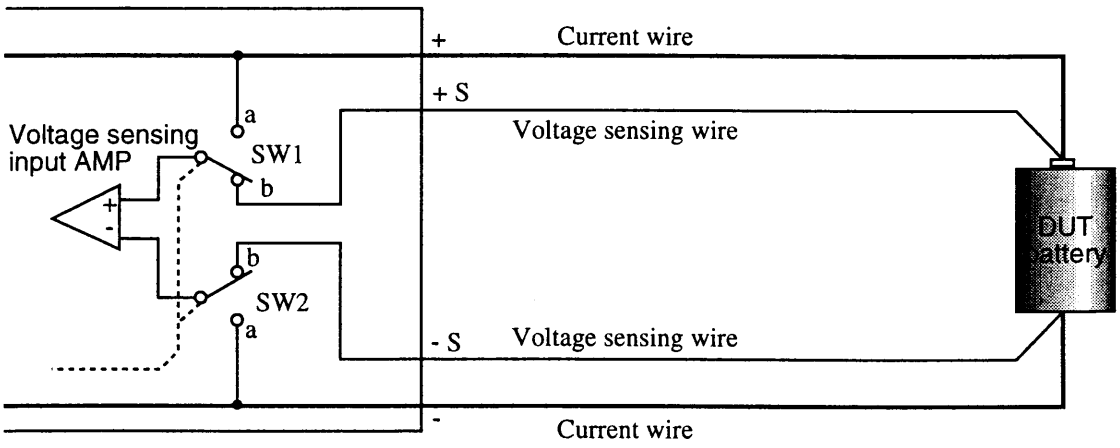


Fig. A-5 Principles of Connection Checking

The connection checking function is triggered at the following times.

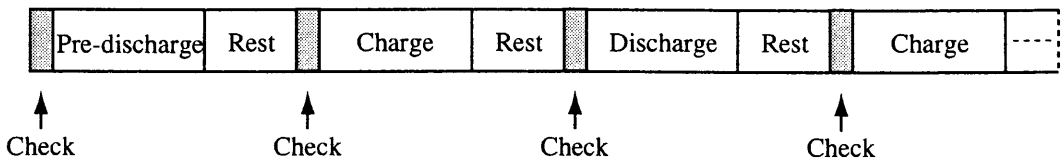


Fig. A-6 Timing of Connection Checking (General Pattern)

■ Precautions in using the connection checking function

For lithium-ion batteries and other batteries with a protection circuit, the protection circuit may be tripped at the start of the test. If connection checking is performed under these conditions, the tester may conclude that the connection is faulty and cancel the test. In this case, carry out the test with the connection checking function set to off.

For instructions on how to turn off the connection checking function, see the documentation that comes with the application software (SD03-PFX).

■ Cases where the connection checking function is disabled:

The connection checking function cannot detect an abnormality under the following conditions.

- When the current wires and voltage sensing cable are collected at a terminal board or the like, and there is a broken wire between that terminal board and the DUT's terminals.
- Although the current wires and voltage sensing cable are not connected to the same DUT (for example, they are connected to different DUT), the voltages are identical.

Appendix 6 Example of Operations Resulting from Erroneous Connection

This section describes examples of resulting operations if tests are conducted with the output cables connected incorrectly. Any of the cases given below may result in a very hazardous situation depending on the set values in the test starting and ending conditions (such as OVP, UVP, time, and others). Take great care in connecting the tester to a DUT.

Incorrect connection of channels

The symbols in the tables below represent the degree of danger

- ▲: Possibility of overcharge
- ▼: Possibility of over-discharge
- ◆: Other danger
- ◇: No damage to DUT

Table A-5a Cases Where the Connection Checking Function is Enabled (Abnormalities Detectable by the Connection Checking Function)

No.	Status of incorrect connection			Mode	Degree of danger	Situation that results if the alarm given by connection checking function is ignored and the test is continued:	Stop or start/end conditions
1	The current wires are connected to the terminals of the reverse polarity. Voltage sensing cable is connected normally.			Charge	▼	DUT itself is discharged; DUT voltage does not reach the CV level or maximum voltage.	UVP, charging time, or -ΔV
				Dis-charge	▲	DUT itself is charged; DUT voltage does not reach the cutoff voltage.	OVP or discharging time
2	Wires of the voltage sensing cable are connected to the terminals of the reverse polarity. The current wires are connected normally (battery voltage is 2 V or less).	UVP setting	Battery voltage or above	Charge	◇	The detected voltage is indicated as a negative value, and the tester stops immediately.	UVP, -ΔV
			Battery voltage or below		▲	The detected voltage is indicated as a negative value and does not reach the CV level or maximum voltage.	Charging time
		UVP and cutoff voltage settings	Battery voltage or above	Dis-charge	◇	The detected voltage is indicated as a negative value, and the tester stops immediately.	UVP or terminating voltage
			Battery voltage or below		▼	The detected voltage is indicated as a negative value and does not reach the cutoff voltage.	Discharging time
3	The wires of the voltage sensing cable are connected to the terminals of the reverse polarity. The current wires are connected normally (battery voltage is 2 V or more).			Common	▲ ▼ ◆	If greater than 2 V, the battery voltage exceeds the voltage measurement limit (-2 V); normal operation cannot be assured.	OVP, UVP, charging time, discharging time
4	A current wire has been short circuited at the - (or +) terminal of the DUT. Voltage sensing cable is connected normally.			Charge	◇	No current flows in the DUT, and the battery voltage does not reach the CV level or maximum voltage.	Charging time
				Dis-charge	◇	No current flows in the DUT, and the battery voltage does not reach the cutoff voltage.	Discharging time

Table A-5b Cases Where the Connection Checking Function is Enabled (Continued)

No.	Status of incorrect connection			Mode	Degree of danger	Situation that results if the alarm given by connection checking function is ignored and the test is continued:	Stop or start/end conditions
5	A wire in the voltage sensing cable has been short circuited at the - (or +) terminal of DUT. The current wires are connected normally.	UVP setting: 0 V or above		Charge	◇	Because the voltage sensing cable has been short circuited, the DUT voltage cannot be measured (0 V is indicated). The tester stops immediately, issuing an alarm.	UVP
		UVP setting: 0 V or below			▲	The DUT keeps on charging until the charging time is reached.	Charging time
		UVP setting: 0 V or above		Dis-charge	◇	Because the voltage sensing cable has been short circuited, the DUT voltage cannot be measured. The tester stops immediately, issuing an alarm.	UVP
		UVP setting: 0 V or below, Cutoff voltage: 0 V or above			◇	The tester immediately enters the idle status.	Cutoff voltage
		UVP setting: 0 V or below, Cutoff voltage: 0 V or below			▼	The DUT keeps on discharging until discharging time is reached.	Discharging time
6	One or both current wires have been disconnected. The voltage sensing cable is connected normally.			Common	◇ ◆	The tester stops, issuing a CD/B alarm. It is very dangerous if a current wire contacts a metal part.	CD/B (CD board abnormality)
7	One or both wires of the voltage sensing cable have been disconnected. The current wires are connected normally.	OVP and maxi-mum voltage settings	Measured voltage value or below	Charge	◇	The battery voltage cannot be measured, and an abnormal value is returned. The tester stops immediately.	OVP or maximum voltage
			Measured voltage value or above		▲	The battery voltage cannot be measured and does not reach the CV level or maximum voltage.	Charging time
		OVP setting	Measured voltage value or below	Dis-charge	◇	The battery voltage cannot be measured, and an abnormal value is returned. The tester stops immediately.	OVP
			Measured voltage value or above		▼	The battery voltage cannot be measured and does not reach the cutoff voltage.	Discharging time
8	An output connector has been open.			Common	◇	The tester stops immediately, issuing an alarm.	OVP, UVP, CD/B

Table A-6 Cases Where the Connection Checking Function is Disabled (Abnormalities not Detected by the Connection Checking Function)

No.	Status of incorrect connection			Mode	Degree of danger	Situation occurring if the test is continued:	Stop or start/end conditions
1	Both the current wires and voltage sensing cable are connected to terminals of the reverse polarity. This is the same as the case where the DUT is connected in reverse. (Battery voltage: 2 V or less)	UVP setting	Battery voltage or above	Charge	◇	The detected voltage is indicated as a negative value, and the tester stops immediately.	UVP, -ΔV
			Battery voltage or below		▼	The battery itself is discharged, and the battery voltage does not reach the maximum voltage.	Charging time
		UVP and cutoff voltage settings	Battery voltage or above	Dis-charge	◇	The detected voltage is indicated as a negative value, and the tester stops immediately.	UVP, cutoff voltage, discharging time
			Battery voltage or below		▲	The battery itself is charged, and the battery voltage does not reach the cutoff voltage.	Discharging time
2	Both the current wires and voltage sensing cable are connected to terminals of the reverse polarity. This is the same as the case where the DUT is connected in reverse. (Battery voltage: 2 V or more)			Common	▲ ▼ ◆	If greater than 2 V, the battery voltage exceeds the voltage measurement limit (-2 V); normal operation cannot be assured.	OVP, UVP, charging time, discharging time
3	The current wires and voltage sensing cable are connected, but they are open at their ends (no DUT).			Common	◇	The tester stops immediately, issuing an alarm.	OVP, UVP, CD/B

Improper Channel Connections

The symbols in the tables below represent the degree of danger

▲: Possibility of overcharge
▼: Possibility of over-discharge
◆: Other danger
◇: No damage to DUT

Table A-7 Cases Where the Connection Checking Function is Enabled (Abnormalities Detectable by the Connection Checking Function)

No.	Status of incorrect connection	Mode	Degree of danger	Situation that results if the alarm given by connection checking function is ignored and the test is continued:	Stop or start/end conditions
1	Only channel A is connected, and a test is conducted for a 6-channel configuration.	Common	▲ ▼ ◆	All set currents flow in channel A only. If a setting exceeds 20 W or 4 A, the internal circuits of the tester may be damaged.	
2	Only channel B is connected, and a test is conducted for a 6-channel configuration.	Common	◇	No current flows in channel B.	OVP, UVP, CD/B
3	Connections are made in a 6-channel configuration using different units, and a test is conducted for a 6-channel configuration for the unit whose channel A is connected to a DUT (channel B is open).	Common	◇	The tester stops, issuing a CD/B (CD board abnormality) alarm.	CD/B
4	Connections are made in a 6-channel configuration using different units, and a test is conducted for a 6-channel configuration on the unit whose channel B is connected to a DUT (channel A is open).	Common	◇	The tester stops, issuing a CD/B (CD board abnormality) alarm.	CD/B

Table A-8 Cases Where the Connection Checking Function is Disabled
(Abnormalities not Detected by the Connection Checking Function)

No.	Status of incorrect connection	Mode	Degree of danger	Situation occurring if the test is continued:	Stop or start/end conditions
1	A test is conducted for a 6-channel configuration on a unit connected in a 12-channel configuration.	Common	▲ ▼ ◆	All set currents flow in channel A only. If a setting exceeds 20 W or 4 A, the internal circuits of the tester may be damaged.	
2	A test is conducted for 12-channel configuration on a unit connected in a 6-channel configuration.	Common	▲ ▼ ◆	Not only the total currents of channels A and B flow in the DUT, but also the electronic load circuits of the tester may go out of balance, resulting in a total current of more than 4 A for channels A and B. In such a case, the internal parts of the tester may be damaged.	
3	Connections are made in a 6-channel configuration using different units, and a test is conducted for a 6-channel configuration on the unit whose channel A is connected to a DUT (channel B is connected to another DUT).	Common	▲ ▼ ◆	All set currents flow in channel A only. If a setting exceeds 20 W or 4 A, the internal circuits of the tester may be damaged.	
4	Connections are made in a 6-channel configuration using different units, and a test is conducted for a 6-channel configuration on the unit whose channel B is connected to a DUT (channel A is connected to another DUT).	Common	▲ ▼ ◆	All set currents flow in channel A only. If a setting exceeds 20 W or 4 A, the internal circuits of the tester may be damaged.	
5	Connections are made in a 6-channel configuration using different units, and a test is conducted for a 6-channel-configuration on both units concerned.	Common	▲ ▼ ◆	All set currents flow in channel A only. If a setting exceeds 20 W or 4 A, the internal circuits of the tester may be damaged.	
6	Connections are made in a 6-channel configuration using different units, and a test is conducted for a 12-channel-configuration.	Common	▲ ▼ ◆	Not only the total currents of channels A and B flow in the DUT, but also the electronic load circuits of the tester may go out of balance, resulting in a total current of more than 4 A for channels A and B. In such a case, the internal parts of the tester may be damaged.	

Appendix 7 Synchronized Operations with an External Charger

This section describes an example of battery charging where an external charger is used and the tester is used to conduct a capacity test and a life test. Except for the settings of the charging current for charge and the calculation of capacity, the functions of the tester can be used as is.

NOTE

- If an external charger does not have a function to automatically cut off the connection to a battery when charging is complete, a relay must be added, as shown in Fig. A-7.

Setting the charge on the tester

- Set the charging current to 0 A. (If 0 A is set, the output will be off.)
- Set the charging time to charging time of the external charger + rest time.

■ Example of use

In this example, a circuit is configured using CHGSTS (1) (charging status signal of channel A) at pin No. 7 of signal connector J1.

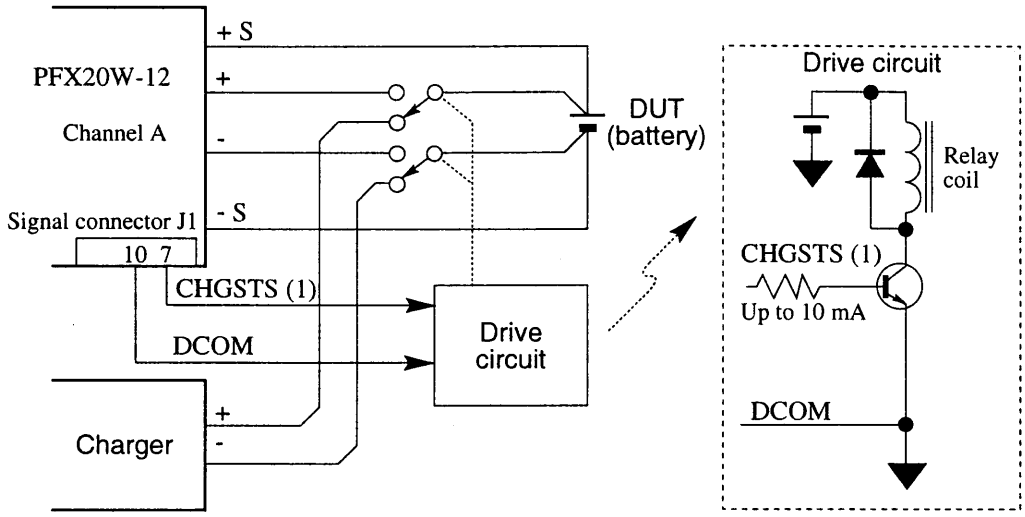


Fig. A-7 Connection for Synchronized Operations with an External Charger

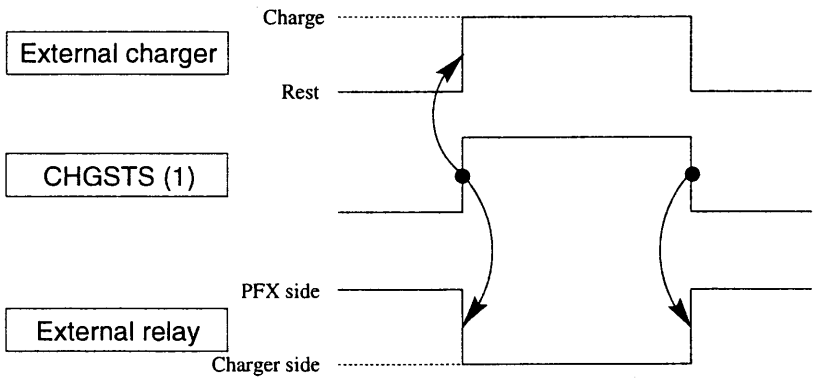


Fig. A-8 Timing Chart of Operations Synchronized with the External Charger

Appendix 8 Color Indications and Operation Status of Status Indicator Lamps

Fig. A-9 shows the color indications and operation status of the status indicator lamps on the front panel. Copy this figure for use as necessary.

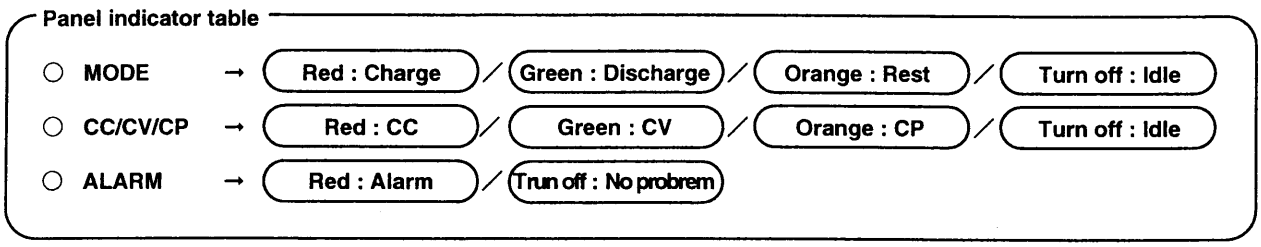


Fig. A-9 Color Indications and Operation Status of Status Indicator Lamps

12 CH CHARGE/DISCHARGE TESTER PFX20W-12 OPERATION MANUAL

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