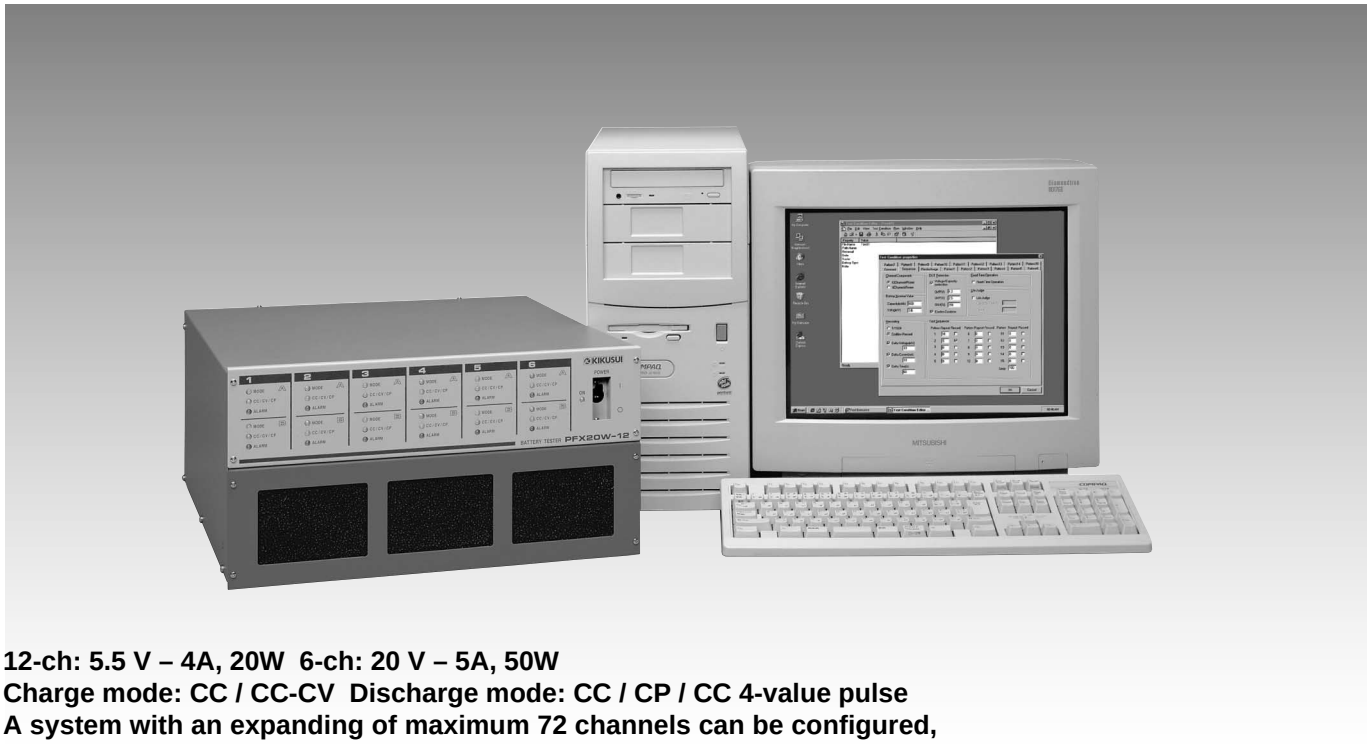
PFX20W-12

12CH BATTERY TESTER



12-ch: 5.5 V – 4A, 20W 6-ch: 20 V – 5A, 50W
Charge mode: CC / CC-CV Discharge mode: CC / CP / CC 4-value pulse
A system with an expanding of maximum 72 channels can be configured, when used with the application software.

Outline

The PFX20W-12 is a charge-discharge tester ready for initial and life tests of high-performance secondary batteries such as lithium-ion batteries. Developed based on KIKUSUI's achievements and experience with custom-made battery evaluation systems, the PFX20W-12 offers the ability to handle complex tests graphically, as well as extendibility and flexibility in system configuration and solid cost performance per channel. In terms of operating performance, the PFX20W-12 employs minimum hardware functions; instead, all settings, control and monitoring functions, and data acquisition features are centrally controlled through a dedicated software, the Battery Performance Checker 12 (model: SD03-PFX).
And finally, PFX20W -12 has been designed to meet increasing demand of multi-channels testing at production line as well as research applications.

* The dedicated software, Battery Performance Checker 12 for PFX20W-12 (model: SD03-PFX), is available as an option.
* PFX20W-12 units are not accompanies by a PC.

Features

■ Ready for actual-load simulations of single-cell batteries or pack batteries

Using an internal configuration of six charge-discharge units with two channels, A and B, you can switch to divided or parallel connection of each channel, selecting either [5.5 V – 4 A, 20W] × 12 channels or [20 V – 5 A, 50W] × 6 channels. You can also set the test conditions for the units individually. In terms of testing modes, the PFX20W-12 offers both constant power discharge, which is essential for actual-load simulations of batteries for mobile equipment, and pulse discharge, which enables setting of a minimum pulse time width of 500 µs, in addition to constant current charge, constant current – constant voltage charge, and constant current discharge. These features allow the PFX units to test different batteries under individual testing conditions simultaneously, regardless of whether single-cell or pack batteries are being used.

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Features

■ Achieving high-precision control through multi-CPU and high reliability by provision of a variety of protection features

The PFX20W-12 uses a multi-CPU system in which the entire frame and individual units are managed by different CPUs to achieve high-precision control. It also employs MOSFET technology for switching between charge, discharge, and rest functions, to ensure reliability over continuous, long-term operation. Moreover, all units are fully equipped with a variety of protective functions including OVP (overvoltage protection), UVP (undervoltage protection), OHP (overheat protection), OAH (overcharge capacity protection), and sample-connection failure detection. A watchdog timer (for system monitoring functions) is used to improve total reliability.

Main protective functions

(for other features, see the "List of Functions Provided" on page 4-4)

Overvoltage protection (OVP)	Tripped if sample (battery) voltage exceeds an OVP voltage value during a test.
Undervoltage protection (UVP)	Tripped if sample (battery) voltage falls below a UVP voltage value during a test.
Overheat protection (OHP)	Detects overheating of the control unit.
Overcharge capacity protection (OAH)	Tripped if totalized capacity exceeds an OAH capacity value during a charge test.
Sample (battery) connection failure detection	Detects a sample (battery) connection failure.
Watchdog timer	When tripped, cuts off the output, stopping a test. Initialized when the power is turned on.

■ Allows a system with a maximum of 72 channels to be built!

Synchronization control with a temperature chamber is also possible.

The Battery Performance Checker 12 (model: SD03-PFX) software unit supports centralized control of a maximum of six PFX20W-12s (and a maximum of 72 channels). It can also control a temperature chamber* prepared for the protocol converters of Tabai Espec corp. to perform tests including temperature control. Moreover, the unit's high-speed block transfer system for data acquisition allows voltage and current measurements (for all channels) and capacity measurements to be made every 2 seconds.

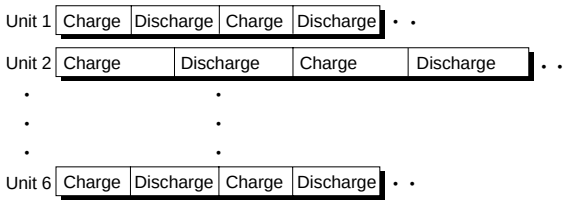
* PMS-CA or PMS-CG. The Battery Performance Checker 12 can control one temperature chamber at a time.

Remarks: Channel configuration

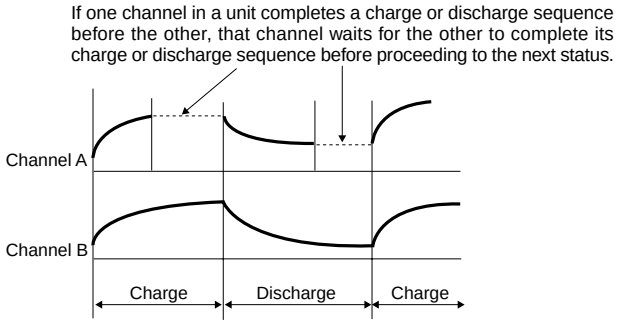
A PFX20W-12 can be used either in 6-channel configuration (20V-5A, 50W × 6 channels) or 12-channel configuration (5.5V-4A, 20W × 12 channels.) when each power unit is divided into 2 channels.However when a PFX20W-12 is used in a 12-channel configuration, the two channel (A and B) in the power unit must perform charge-discharge tests under the same testing conditions

PFX20W-12					
Unit 1A Unit 1B	Unit 2A Unit 2B	Unit 3A Unit 3B	Unit 4A Unit 4B	Unit 5A Unit 5B	Unit 6A Unit 6B

◆ Image of operations between the units in a 6-channel configuration



◆ Test Image in a 12-channel configuration



The 12-channel configuration differs from the 6-channel configuration in test operations. If one channel for a unit has already begun testing, the channel that has not started testing may not be started at a subsequent time.

If an alarm is issued in one of the channels, the other channel ceases output. To resume testing, you must clear the alarm from the channel affected.

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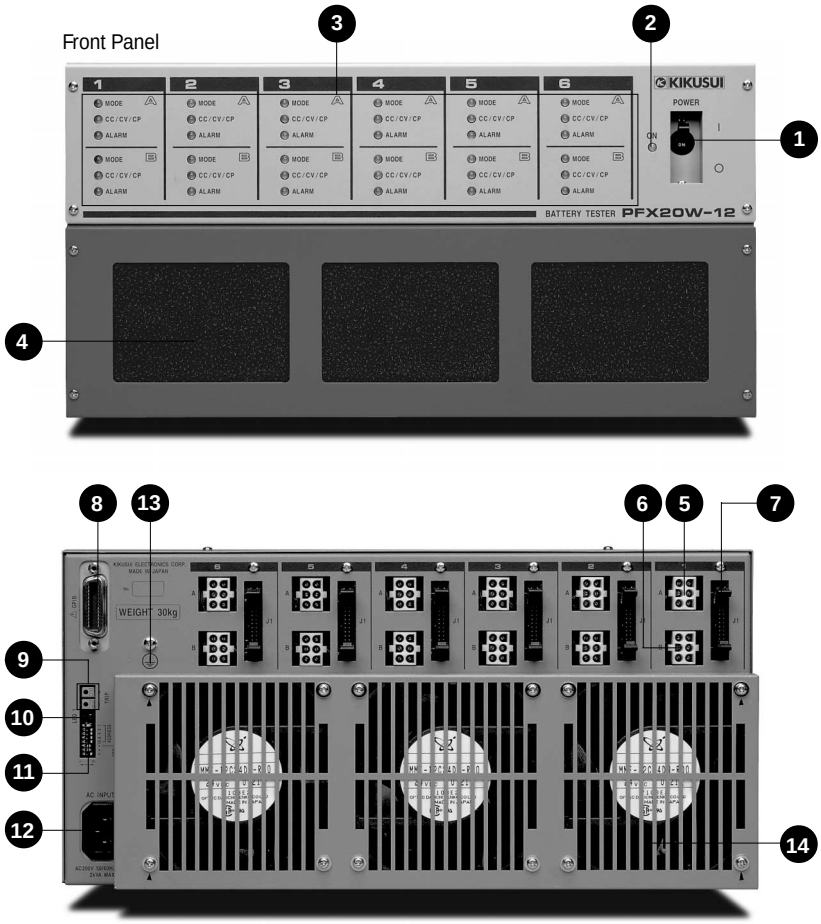
Panel



1. **POWER**
   The Power switch
2. **ON lamp**
   Lit green when the power supply of the tester is on.
3. **Status indicator lamps**
   Indicate the operating status of the tester.
   MODE
   Charge (lit red) / discharge (lit green) / rest (lit orange)
   CC / CV / CP
   Constant current (CC) or pulse action (lit red)
   Constant voltage (CV) action (lit in green)
   Constant power (lit orange)
   ALARM
   Lit red if any of the tester's protection functions such as OVP (overvoltage protection), UVP (undervoltage protection), or OHP (overheat protection) are activated.
4. **Air intake port (dust filter)**
5. **A**
   The channel-A output connector.
6. **B**
   The channel-B output connector.
7. **J1**
   The signal output connector for channels A and B.
8. **GPIB**
   The GPIB connector.
9. **TRIP**
   When the terminals (+ and -) of this connector are short-circuited, the POWER switch of the tester will be shut down. This function can be used as an external interlock.
10. **LED1**
    This indicates the operation status of the main CPU in the tester. This LED blinks under normal conditions but lights up or goes off if any anomaly occurs in CPU operations.
11. **ADDRESS/SRQ**
    DIP switches 1 to 5 are used to set a GPIB address. DIP switch 6 is used to enable the SRQ (service request) function.
12. **AC INLET**
13. **Ground terminal**
14. **Exhaust port**
    It uses a cooling fan to exhaust heated air from inside.

List of functions provided

Charging function	Charging method	Constant current, constant current – constant voltage
	Cutoff conditions	Specified current, voltage, time, or -ΔV after constant voltage action
	Rest	Time
	Others	Output is turned off when the set current is 0 A.
Discharging function	Discharging method	Constant current, constant power, and pulse current
	Cutoff conditions	Voltage or time
	Rest	Time
	Others	Output is turned off when the set current is 0 A.
Measuring function	Battery voltage	To be measured every 2 seconds
	Charging and discharging currents	To be measured every 2 seconds
	Capacity	To be measured every 2 seconds
	Time	Totalized time, or time elapsed from the start of a measurement pattern.
	Cycle count	(2000 times maximum. The maximum number of counts depends on the application.)
Protective functions	Overvoltage protection (OVP)	Tripped if sample (battery) voltage exceeds an OVP voltage value during a test.
	Undervoltage protection (UVP)	Tripped if sample (battery) voltage falls below a UVP voltage value during a test.
	Overcharge capacity protection (OAH)	Tripped if totalized capacity exceeds an OAH capacity value during a charge test.
	Sample (battery) connection failure detection (Connection Error)	Detects a sample (battery) connection failure.
	CPU communication error detection (CPU Error)	Detects a communication error inside the tester.
	AC power line abnormality detection (AC Line)	Detects an abnormality in the AC power line, such as instantaneous power failure.
	GPIB communication error detection (Communication Error)	Detects an abnormality in GPIB communication between the PFX20W-12 and a PC.
	PS board abnormality detection (PS/B)	Detects overheating or overvoltage of the tester's power supply unit.
	CD board abnormality detection (CD/B)	Detects abnormal circuit condition in the tester's control unit due to incorrect connection of a sample (battery).
	CD board overheat detection (OHP)	Detects overheating of the tester's control unit.
	Watchdog timer	When tripped, it turns off the output, stopping a test. Initialized during the power-on sequence.
	External interlock	Occurs when a no-fuse breaker in the AC input block is tripped in response to an external make-contact signal.
Status monitoring		Includes charge, discharge, pulse discharge, rest, and other functions
Alarm monitoring		OVP,UVP,OAH,Connection Error,CPU Error,AC Line,Communication Error,PS/B,CD/B,OHP

Constant current /constant voltage charge (CC-CV)

Fig.1

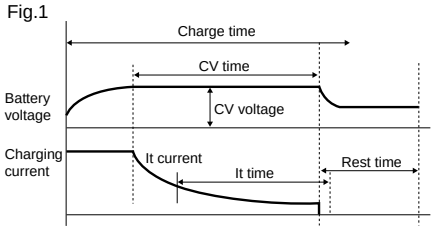


Fig.1 illustrates the transition of Constant current charge → Constant voltage charge → CV time → Rest time.

■ Charge time
Indicates the maximum time for a charge period. Charging stops after this time elapses, if it has not already been ended by another factor.

■ CV time
CV time refers to the period between two instantaneous events: when the battery voltage rises to shift the sample to constant voltage action and when charging ends.

■ It current and It time
"It current" is the current value for detecting charging current, which may be arbitrarily set by the user when performing a constant voltage charge. After this current is detected, charging ends once the set "It time" has elapsed.

Constant current charge (CC)

Fig.2

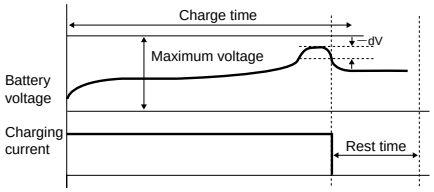


Fig.2 illustrates the transition of Constant current charge → - dV detection → Charge ended → Rest time.

■ Maximum voltage
When the battery voltage reaches this voltage during a charge period, charging ends. This item is set only in CC charge.

■ -dV voltage
Charging ends when the battery voltage rises to a peak during a charge period, and a subsequent voltage drop of -dV is detected. This detection may be disabled for the time set by the -dV mask time, or for a shorter period.

Constant current discharge (CC)

Fig.3

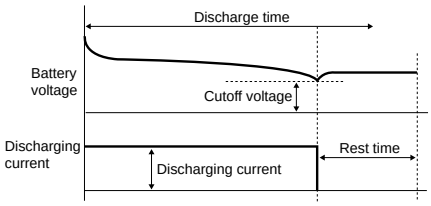


Fig.3 illustrates the transition of Constant current discharge → drop in battery voltage to cutoff voltage → discharge ended , → Rest time.

■ Discharge time
Indicates the maximum time for a discharge period. If not already finished due to another factor, discharging halts after this time has elapsed.

■ Discharging current
Constant current value in constant current discharge

■ Cutoff voltage
This is the battery voltage value at which discharging terminates. When battery voltage drops to this level, discharging ends.

Constant power discharge (CP)

Fig.4

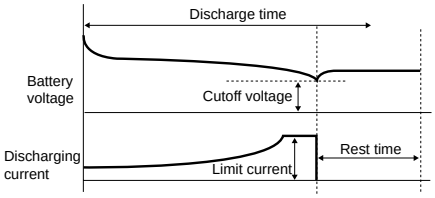


Fig.4 illustrates the transition of Constant power discharge → A drop in battery voltage to cutoff voltage → Discharge ended, → Rest time.

■ Discharge time
Indicates the maximum time of a discharge period. If not yet finished due to another factor, discharging halts after this time has elapsed.

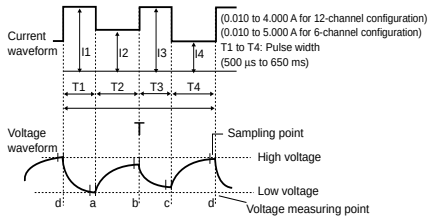
■ Discharging current
Discharging current changes with battery voltage to maintain the constant power value.

■ Limit current
In constant power discharge, the discharging current increases as the battery voltage drops. The limit current value is the upper limit value for the discharging current.

■ Cutoff voltage
This is the battery voltage value at which discharging terminates. When the battery voltage drops to this voltage, discharging ends.

Pulse discharge (pulse)

Fig.5



Discharge is achieved by the pulse currents shown in Fig.5. (Fig.5 illustrates the waveform for discharge.)

■ Current setting
As shown in Fig. 5, up to four current values (I1 to I4) may be set within one cycle.

* Current values may be set starting at 0.01 A only for pulse discharge.

■ Time setting
As shown in Fig. 5, you may set an "On time" (T1 to T4) for each current value.

■ Voltage measurement function
In pulse discharge, the voltage measurement function measures battery voltage at points "a" to "d" (voltage measurement points) in a single cycle (T), as shown in Fig.5, then acquires a High voltage (Upper peak) and Low voltage (Lower peak) from among the values measured. Note that more than one cycle may be required to acquire High and Low voltages, depending on the setting for the pulse time width.

Fig.6

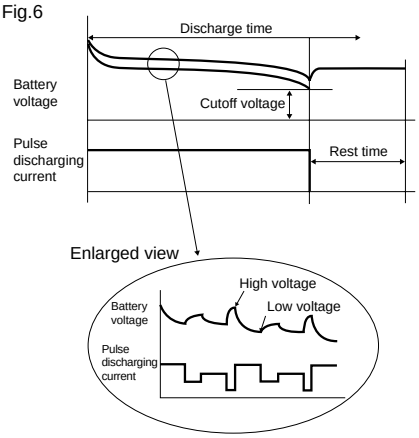


Fig.6 illustrates the transition of Pulse: Pulse discharge → A drop in battery voltage to cutoff voltage → pulse discharge ended → Rest time

■ Cut off voltage
This is a battery voltage value at which discharging terminates.
For pulse discharge, discharging ends if the Low voltage in Fig. 6 (Enlarged view) drops to the cutoff voltage.

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Application software (Battery Performance Checker 12, model:SD03-PFX)

The Battery Performance Checker 12 for the PFX20W-12 (hereafter, the "BP Checker") is an application software unit for configuring a battery characteristics testing system. Designed to perform charge-discharge characteristics tests on batteries by controlling PFX20W-12 via a PC, the BP Checker also stores all test results. Using a BP Checker, up to six PFX20W-12s can be connected, thus allowing battery characteristics tests for a maximum of 72 channels to be centrally controlled by a single PC; and further allowing all test results to be preserved.

Charge-discharge tests are performed by creating patterns (i.e., data clusters involving detailed settings for voltage, current, time, and other charge-discharge characteristics) using the Test Condition Editor, then running Test Executive. Up to 15 such patterns may be set for a single test, and up to 2,000 repetitions may be run, thus giving the BP Checker the capacity to handle both initial-characteristics and battery-life tests.

Moreover, when used in conjunction with a Tabai Espec's protocol converter and temperature chamber, the BP Checker allows tests to be carried out in sync with the temperature chamber.

Pattern-based charge-discharge data and life capacity data for the entire cycle are saved as files during testing. These test data files are then converted into graphs by CD Data Graph or Life Data Graph to provide a waveform numeric-data display, test result display, and other useful display formats.

The BP Checker also includes a function that allows test data in text format to be copied and pasted to the clipboard for manipulation in spreadsheet applications. The BP Checker is made up of the following four programs, with the following functions:

1. Test Condition Editor

The Test Condition Editor is a software program used to create and edit all test conditions concerning the charge-discharge tests carried out by the frames. Test conditions can be entered for individual power supply units, with key testing data such as test titles and charge-discharge patterns (i.e., data clusters involving detailed settings for voltage, current, time, and other charge-discharge characteristics) set by the user. The Test Executive (see below) may be run directly from the Test Condition Editor, allowing tests to be performed instantly under the test conditions currently being edited.

2. Test Executive

The Test Executive sends and receives data for the test conditions prepared using Test Condition Editor to and from frames via the GPIB interface and conducts charge-discharge tests.

During a test, the Test Executive monitors voltage, current, capacity, time, and other parameters for each frame, displaying detailed test conditions and real-time data graphs. It saves pattern-based charge-discharge data and life capacity data for the entire cycle as data files. It also allows you to select whether files are saved in binary or text format.

Moreover, as a disk management function, Test Executive also has a recovery function that provides protection against interruptions such as power failure occurring in the middle of cycle tests.

3. CD Data Graph

The CD Data Graph handles charge-discharge data file processing such as, converting data for pre-discharge, charge, and discharge characteristics into graphs and displaying waveform numeric data, test results, and other information. It provides several helpful user functions, including search function for file-reads. Another function allows test data in text format to be copied and pasted to the clipboard for manipulation in spreadsheet applications.

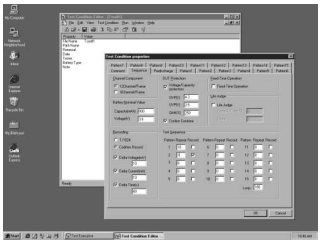
4. Life Data Graph

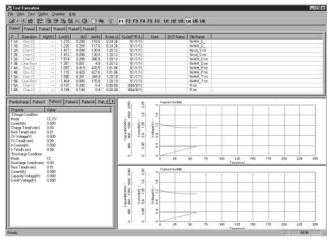
The Life Data Graph handles life-data file processing such as, converting charge-discharge capacity data into graphs, switching graph displays (the capacity axis may be switched between 1.0, 100%, and measured capacity values; the cycle axis, between linear and logarithmic scales) and displaying waveform numeric data, test results, and other information. It also offers a search function for file-reads as well as a paste function allowing life data in text format to be transferred to spreadsheet applications.

■Recommended system requirements:

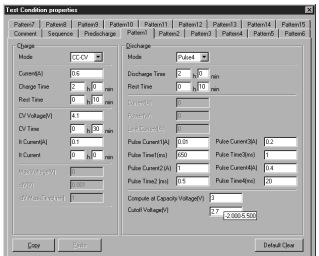
- IBM PC/AT or compatible with a Pentium 100MHz or higher processor; Windows 95/98 or Windows NT Workstation 4.0
- Memory: 32 MB or greater
- Display adapter of SVGA or better
- 17-inch or 20-inch display monitor
- GPIB card and 32-bit GPIB driver with National Instruments NI-488.2 specifications
- Printer: OS-compatible printer

Note: Windows NT workstation and Windows 98SE are highly recommended in case the test will take more than 49 days from power up of PC until the end of testing.

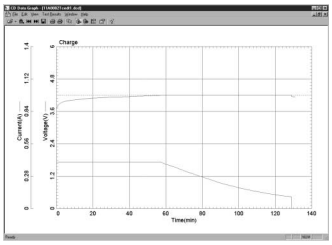




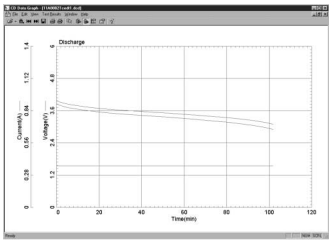
▲Screen of a test under process (Test Executive)



▲Creating a test condition file (Test Condition Editor)



▲An example display of test results ▼(CD Data Graph)



Specifications

■ Rated output

Number of outputs	12 ch(12-channel configuration) 6 ch(6-channel configuration)*1
Charging current range	0.001 A to 4.000 A (12-ch) 0.001 A to 5.000 A (6-ch)
Charging voltage range	0.000 V to 5.500 V (12-ch) 0.000 V to 20.000 V (6-ch)
Discharging current range	0.001 A to 4.000 A (12-ch) 0.001 A to 5.000 A (6-ch)
Discharging voltage range	-2.000 V to 5.500 V (12-ch) -2.000 V to 20.000 V (6-ch)
Maximum charging/discharging power	20 W (12-ch) 50 W (6-ch)

■ Output setting functions*2

Constant current setting	
Range	0.001 A to 4.000 A (12-ch) 0.001 A to 5.000 A (6-ch)
Accuracy	± (0.3% of setting + 2 mA)
Resolution	1 mA
Ripple	Within 3 mA rms for DC to 500 kHz
Constant voltage setting	
Range	0.000 V to 5.500 V (12-ch) 0.000 V to 20.000 V (6-ch)
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 (12-ch) 0.01 W to 50.00 W (6-ch)
Accuracy	± (1% of setting + 10 mW) at a battery voltage of 2 V or more
Resolution	10 mW
Pulse discharging current setting*3	
Range	0.010 A to 4.000 A (12-ch) 0.010 A to 5.000 A (6-ch)
Resolution	1 mA
Accuracy	± (0.5% of setting + 5 mA)
Number of settings	Four values
Response*4	100 µs, short-circuited at the end of a 7m load cable
Pulse width	
Range	0.50 ms to 650 ms
Resolution	10 µs
Accuracy*5	± (0.1% of setting + 20 µs)
Number of settings	Four values

■ Measuring functions*2

Current measurement	
Range	0.000 A to 4.000 A (12-ch) 0.000 A to 5.000 A (6-ch)
Accuracy	± (0.3% of reading + 2 mA) (12-ch) ± (0.3% of reading + 2.5 mA) (6-ch)
Voltage measurement	
Range	-2.000 V to 20.000 V
Accuracy	± (0.2% of reading + 5 mV)
Battery voltage during pulse discharge	
Measured value	High/low voltage
Range	0.000 V to 20.000 V*6
Accuracy	± (0.5% of reading + 7 digits)
Battery current during pulse discharging	
Measured value	Returned a theoretical value.*7
Range	0.000 A to 4.000 A (12-ch) 0.000 A to 5.000 A (6-ch)

■ Current monitoring*2

Channel A	
Range	0.000 A to 4.000 A (12-ch) 0.000 A to 5.000 A (6-ch)
Magnification	1 A/V
Accuracy*8	± (0.3% of reading + 10 mV)
Channel B	
Range	0.000 A to 4.000 A(12-ch)
Magnification	1 A/V
Precision*8	± (0.3% of reading + 10 mV) (12-ch)

■ 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*9	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*9	150 ms maximum
Overcurrent protection	Output fuse (7A)
Overheat protection (OHP)	Tripped if the temperature of the internal heat sink exceeds 100°C.
AC input overcurrent protection	AC input fuse

■ Temperature range

Operation temperature range	0°C to +40°C
Storage temperature range	-10°C to +60°C

■ 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 V AC ±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 × 221 H × 500 D mm
Approx. 440 W × 240 H × 555 D mm max

■ Weight Approx. 30 kg

*1 In parallel operation
*2 At ambient temperatures of 23°C ± 5°C
*3 Voltage operation range for constant-power discharge; 1 to 20 V
*4 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.
*5 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.)
*6 The measurement precision of negative voltage is not guaranteed.
*7 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.
*8 For a pulse charge operation, the accuracy of current monitoring output is not guaranteed.
*9 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.

