



P F X 2 7 3 1 S



High-rate Battery Tester **PFX2731S**

Multi-channel battery tester with 6 channels built into a single housing
Supports charge/discharge tests with a maximum rating of 6 V-20 A per channel
Enables high-speed sampling of 10 ms in simultaneous measurement of all channels
A high level of safety is guaranteed by various protection and warning features
T-type thermocouple can be used to monitor temperature during charging and discharging.

The PFX2731S is a 6 V-20 A 6-channel battery tester that supports high-rate charge/discharge tests. It is operated with the application software BPChecker4000, which is exclusive to the PFX2731S. As one PC can operate up to 4 units (24 channels), one can construct a multi-channel charge/discharge system according to the required number of channels. In order to safely conduct long-term continuous testing, it also has 2-system independent protection functions for hardware and software, as well as various protection functions such as a connection confirmation function that detects incorrect wiring and integrated capacity protection.



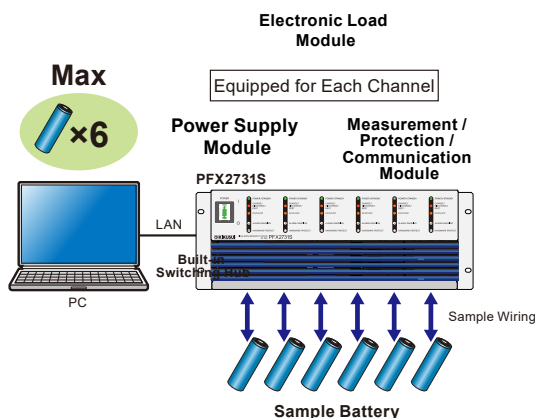
High-rate Battery Tester PFX2731S

Features

- 10 ms continuous measurement (at the fastest setting)
- Supports single-cell evaluation (can be set with C-rate)
- Various charge/discharge modes (9 modes in total)
 - Charge: CC, CC-CV, CP, CP-CV
 - Discharge: CC, CC-CV, CP, CP-CV
 - Pattern charge/discharge (CC(+CV), CP(+CV))
- When an error is found, a built-in path switch immediately terminates the test
- Four constant temperature chambers (produced by Espec) can be operated synchronously
- A T-type thermocouple (optional) can be used to measure temperature
- Simply connecting a LAN cable enables system construction
- Enhanced protection function

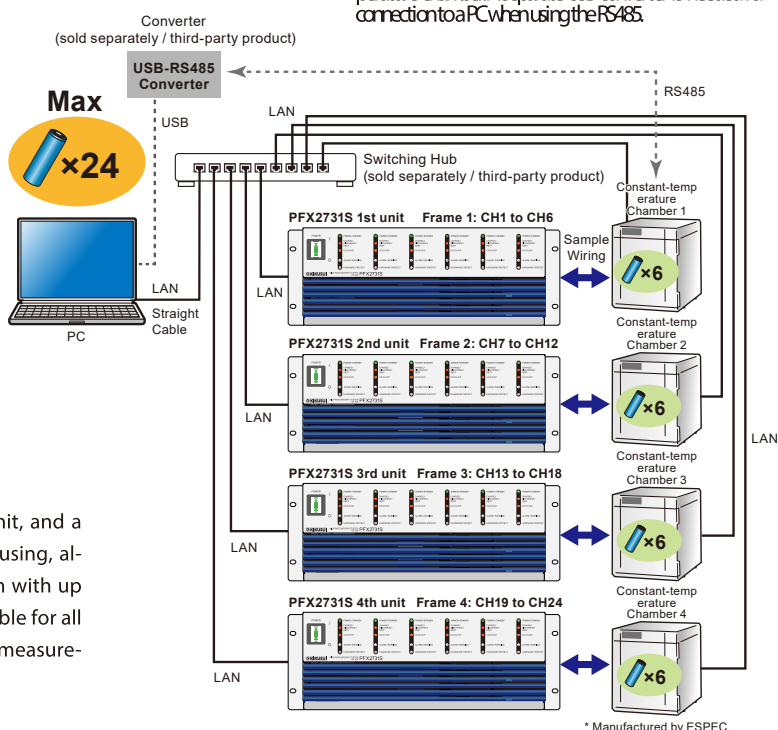
System Configuration

- Example of PFX2731S x 1 unit connected with LAN cable



The PFX2731S combines a control unit, a measurement unit, and a 6-channel 6 V-20 A charge/discharge unit into a single housing, allowing the creation of a compact charge/discharge system with up to 24 channels. Continuous data recording of 10 ms is possible for all channels due to the complete isolation and independent measurement functions of each channel.

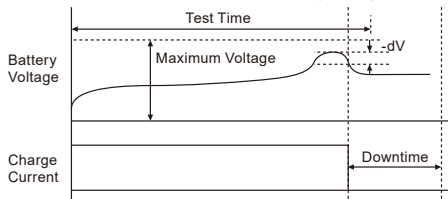
- Example of PFX2731S x 4 units and constant temperature chamber x 4 units connected via LAN cable



* Manufactured by ESPEC

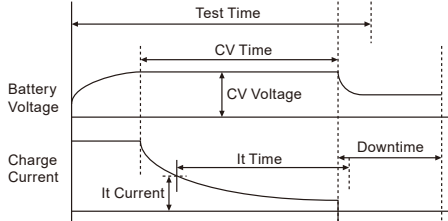
The Charge-Discharge mode for the diverse applications

It is only for constant current charging.
It supports $-dV$ detection, and $-dT/dt$ detection by battery temperature.



Transition of constant current charge → $-dV$ detection → Charge end → Charge rest

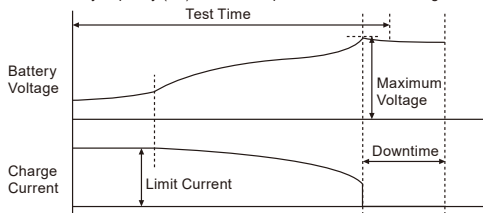
This charge method switches from constant current to constant voltage automatically.
It supports CV time and It current detection.



Transition of Constant current charge → Constant voltage charge → CV time reached → Charge pause (Example of charging terminating at CV time)

New Features

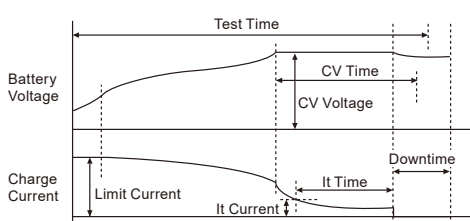
It is only for constant power charging.
The charging current may be limited by the limit current if the voltage is low.
Termination by capacity (Ah) is another option in addition to voltage and battery temperature.



Transition of Limit current (CC) charge → Constant power charge → Maximum voltage detection → Charge end → Charge rest (Example of charge ending at maximum voltage)

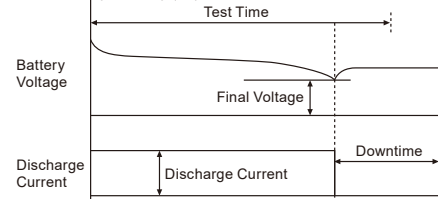
New Features

This charge method switches from constant power to constant voltage automatically.
It supports CV time and It current detection.



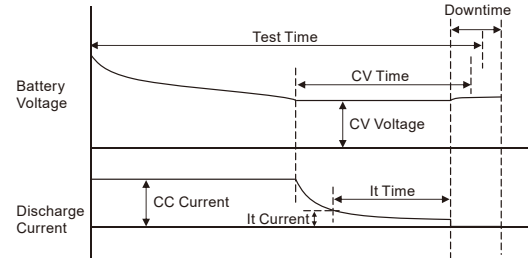
Transition of Limit current (CC) charge → Constant power charge → Constant voltage charge → It time reached → Charge end → Charge rest (Example of charge ending at It time)

It is a general constant current discharge.
Termination by capacity (Ah) is another option in addition to voltage and battery temperature.



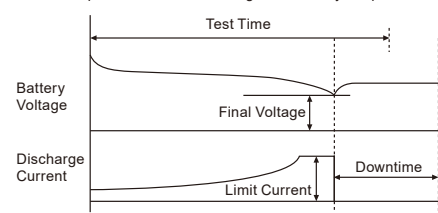
Transition of Constant current discharge → Voltage drop to final voltage → Discharge end → Discharge pause

This discharge method switches from constant current to constant voltage automatically.
It supports CV time and It current detection. Since it is capable of a deeper discharge than the CC discharge profile, it can be used for high-precision discharge capacity measurement.



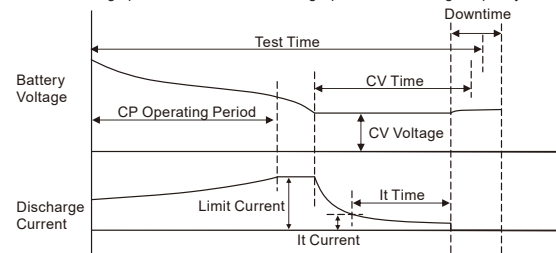
Transition of Constant current discharge → Constant voltage discharge → CV time reached → Charge pause (Example of discharging terminating at It time)

It is only for constant power recharging. The limit current can be used to limit the discharge current if the voltage drops and the discharge current increases. Termination by capacity (Ah) is another option in addition to voltage and battery temperature.



Transition of Constant power discharge → Voltage drop to final voltage → Discharge end → Discharge pause

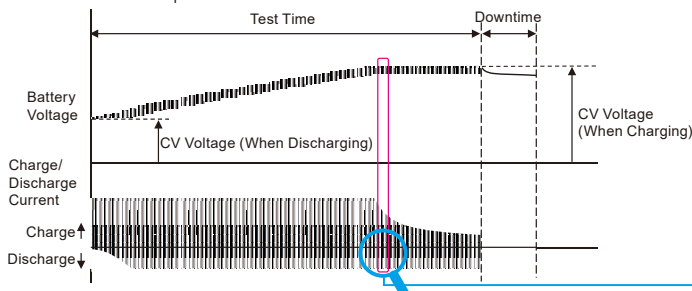
This discharge method switches from constant power to constant voltage automatically.
It supports CV time and It current detection. Since it is capable of a deeper discharge than the CP discharge profile, it can be used for high-precision discharge capacity measurement.



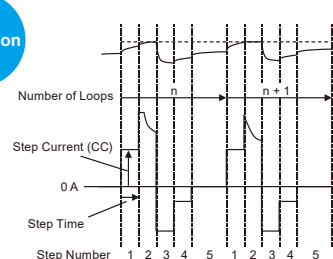
Transition of Constant power discharge → Constant voltage discharge → CV time reached → Charge pause (Example of discharging terminating at It time)

Pattern Charge/Discharge (CC(+CV), CP(+CV)) New Features

A pattern is a series of steps. A maximum of 100,000 steps of CC or CP charge/discharge can be switched at high speed.
More advanced pattern control is supported because the CV voltage can be adjusted for each step.
Even if there are many steps, like in a standard test's pattern charge/discharge and simulation pattern, Excel can be used to input the data.



Expansion



100,000-step pattern charge/discharge function

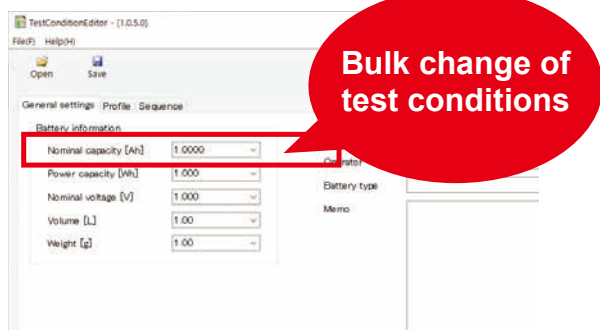
The CC/CP step value can be set up to 100,000 steps. The time width can be set from 100 ms to 999.9 s per step. Furthermore, because the CV voltage can be set for each step, it is possible to handle complex charge/discharge tests with flexibility, including test patterns for a variety of standard tests and simulation patterns.

The C-rate setting function makes changing complex test conditions simple

To accommodate the diversifying requirements of charge/discharge tests, the C-rate setting function has been implemented. The charge/discharge current value of the profile can be set with the C-rate value based on the nominal capacity input value. As a result, the test conditions can be applied to all profiles by simply changing the nominal capacity input value when testing different battery types with the same C-rate conditions and test pattern.

[Test Condition Editor] *Refer to Application Software on P5

Since the C-rate conversion is performed based on the nominal capacitance value, all test conditions can be changed simply by changing the nominal capacitance value.



General project settings screen

High-speed Data Sampling

The measurement of voltage and current is performed using a 24-bit A/D converter. Continuous data collection of 10ms is possible for all channels. (The data recording time can be selected between 10 ms, 100 ms, and 1 s.) Setting the delta voltage and delta current also makes it possible to collect data even when the voltage or current exceeds the set value.

*Specifying a short time setting increases the amount of recorded data. The amount of data will be in the thousands to tens of thousands if the test time is long (several hours or longer). Be sure to set it carefully.

Enables high-precision measurement

Battery voltage and charge/discharge current are accurately detected by a built-in high-precision measurement circuit.

(Voltage measurement: 100 μ V resolution, current measurement: 100 μ A resolution)

(Current measurement: 100 μ A resolution at 20A range, 10 μ A resolution at 2A range)

Enhanced Protection Functions

Protection functions like overcharge and overdischarge are built into the hardware and software. Additionally, the main unit has a built-in path switch and a high-speed shutdown function that instantly terminates the test when an abnormality is detected.

● Main items and setting ranges of protection settings

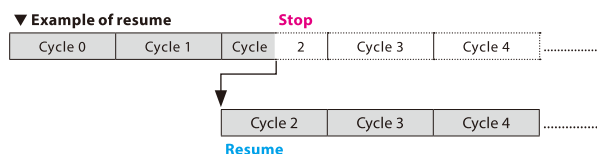
Hardware	
Hardware Overvoltage Protection (HOVP)	0.000 V to 6.300 V
Hardware Undervoltage Protection (HUVVP)	-1.100 V to 5.700 V
Hardware Overcurrent Protection (HOCP_Low Range)	0.000 A to 2.100 A
Hardware Overcurrent Protection (HOCP_High Range)	0.000 A to 21.000 A
Software	
Software Overvoltage Protection (SOVP)	0.000 V to 6.300 V
Software Undervoltage Protection (SUVP)	-1.100 V to 5.700 V
Software Overcharge Ampere Protection (SOAH)	1.0000 Ah to 2000.0000 Ah
Software Overtemperature Protection (SOTP)	-100 °C to 400 °C
Charge Overcurrent Protection (Charge OCP_Low Range)	0.000 A to 2.100 A
Charge Overcurrent Protection (Charge OCP_High Range)	0.000 A to 21.000 A
Discharge Overcurrent Protection (Discharge OCP_Low Range)	-2.100 A to 0.000 A
Discharge Overcurrent Protection (Discharge OCP_High Range)	-21.000 A to 0.000 A
Over SOC Charge Rate (Over SOC)	0.00 % to 150.00 %
Under SOC Charge Rate (Under SOC)	0.00 % to 10.00 %

Resuming a test from any point

It is possible to resume the test from any point if it is interrupted due to a power outage, an alarm going off, or user action.

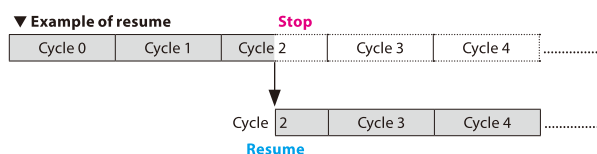
● Profile specification

The test can be started by specifying the "start cycle" and "start step".



● Start from the stop position

The time that has passed since the PFX2731S was stopped is remembered. The test can be restarted from the stopped state.



Fully Independent Operation for All Channels

Since each channel is fully independent, it can be controlled using various timings and test conditions.

Conditions for Various Charge/Discharge Cutoffs

*See the List of Charge/Discharge Cutoff Conditions on P6

In addition to voltage, time and temperature, It current value and SOC can also be used to set the charge termination condition and discharge termination condition.

Easy Firmware Update

Downloading the firmware updater from our website will allow the PFX2731S's firmware to be updated to the most recent version.

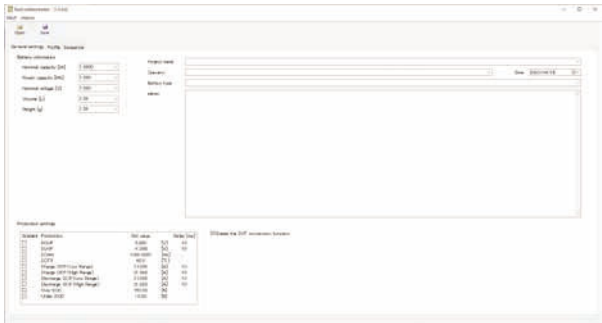
Application Software SD035-PFX BPChecker4000

The BPChecker4000 allows the conditions for battery charge/discharge characteristic tests to be set, tests to be carried out, and the test results to be stored. BPChecker4000 consists of two programs, the Test Condition Editor and the Test Executive, which create and run tests respectively.

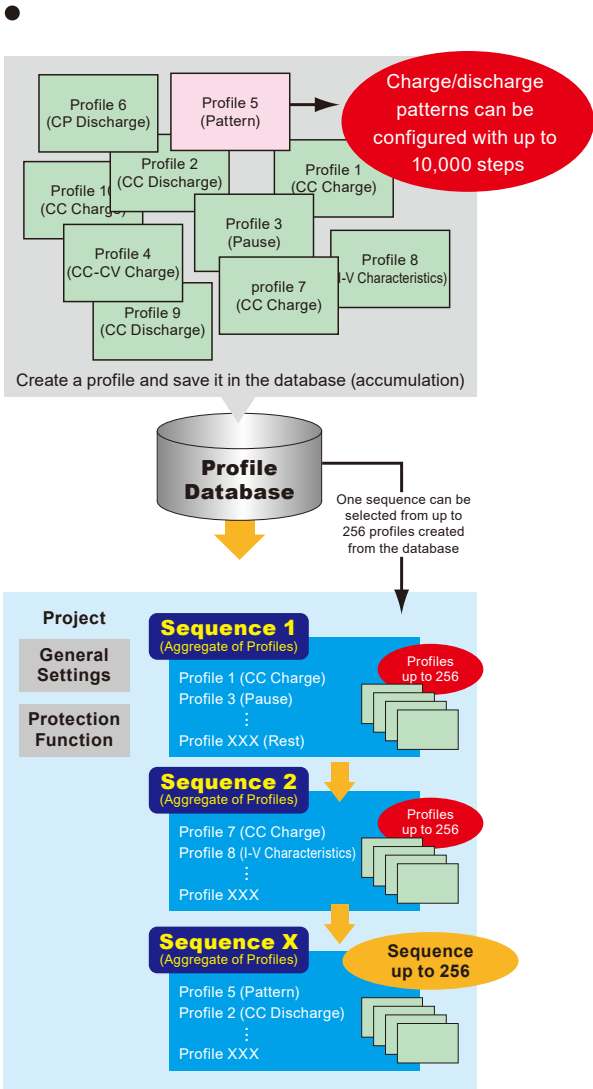
Test Condition Editor

All test conditions for charging and discharging are created and edited using this program. After creating a profile, a project is created by setting the sequence, general settings, etc. The test is run for each project by BPChecker4000.

[General project setting screen]



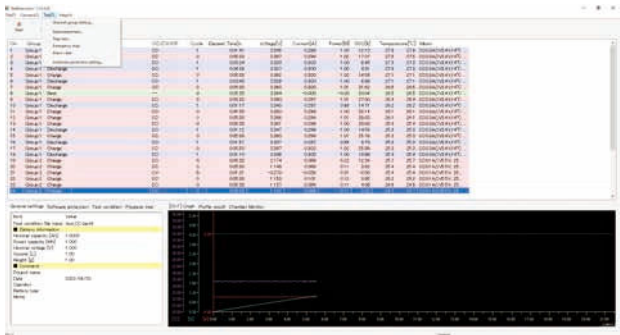
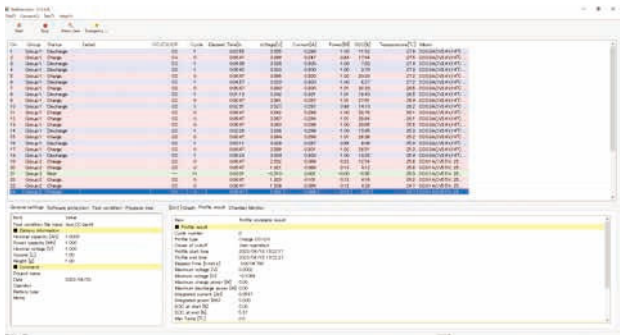
[Software conceptual diagram]



- The battery temperature's rest end conditions (Rest Temp) can be set. The rest time can be set to a specified time (fixed time) after charging ends, or a rest end condition based on the battery temperature can be set.
- Equipped with pause function. The pause function is one of the profile type options. The test can be paused by using this feature.

Test Executive

The Test Condition Editor is used to create projects (test conditions), which are then assigned to each channel of the PFX2731S and put through charge/discharge tests by the program called Test Executive.



Operating environment of BPChecker4000

- OS: Windows 11, Windows 10 Pro (64 bit)
- Processor: Core i5 or higher
- Memory: 8 GB or higher
- Storage: 2-drive configuration is recommended. Drive1 SSD, Free space: 150 GB or more (System Drive). Drive2 HDD, Free space: 540 GB or more (Data Drive).
- Display: Resolution of 1280 x 1024 or higher, 19 inches or larger
- Communication: Wired LAN (100Base-TX)
- CD-ROM drive
- KI-VISA

Specifications

Unless specified otherwise, the specifications are for the following settings and conditions.

- The product is warmed up for at least 30 minutes.

The used terminology is as follows:

- TYP: These are typical values that are representative of situations where the product operates in an environment with an ambient temperature of 23 °C (73.4 °F). These values do not guarantee the performance of this product.
- setting: Indicates a set value.
- reading: Indicates a readout value.
- rating: Indicates a rated value.
- Static: General term to indicate CC charge, CC - CV charge, CC discharge, CC - CV discharge, CP discharge, and CP - CV discharge.
- Pattern: General term to indicate pattern charge/discharge.

C-rate entry is supported.

- Individual CC values, pattern charge/discharge step current, limit current, current capacity of end condition/lt cutoff current can be set using a C-rate.

- C-rate calculation specifications

The nominal capacity setting value is assumed to be 1C.

C-rate setting range: 0.001 to 99.999 (the range is common.)

The conversion result from a C-rate to a current/capacity value is rounded to the nearest control resolution.

●Rated output

Item		Specifications
Number of outputs		6 ch (per frame)
Isolation		Between channels, Ch-chassis
Charge current range	2 A range	0.0000 A to 2.0000 A
	20 A range	0.000 A to 20.000 A
Charge voltage range		-1.000 V to 6.000 V
Discharge current range	2 A range	0.0000 A to 2.0000 A
	20 A range	0.000 A to 20.000 A
Discharge voltage range		-1.000 V to 6.000 V

*DUT cable: 5.5 mm² in diameter, 5 min length

●Setting accuracy

Item		Specifications	
Static			
Constant current charge/discharge	2 A range	Range	0.0000 A to 2.0000 A
		Accuracy *1	±(0.15 % of setting + 1.0 mA)
		Resolution	0.1 mA
	20 A range	Range	0.000 A to 20.000 A
		Accuracy *1	±(0.15 % of setting + 10.0 mA)
Constant voltage charge/discharge		Resolution	1 mA
		Range	-1.000 V to 6.000 V
		Accuracy *1	±(0.05 % of setting + 1.2 mV)
		Resolution	1 mV
Constant power charge/discharge *2	2 A range	Range	-0.100 W to 12.000 W
		Accuracy *1, *3	±(0.5 % of setting + 0.01 W)
		Resolution	1 mW
	20 A range	Range	0.10 W to 120.00 W
		Accuracy *1, *3	±(0.5 % of setting + 0.1 W)
		Resolution	10 mW
Pattern			
Constant current pattern	2 A range	Range	-2.0000 A to 2.0000 A (negative values are discharge currents)
		Accuracy *1	±(0.15 % of setting + 1.0 mA)
		Resolution	0.1 mA
	20 A range	Range	-20.000 A to 20.000 A
		Accuracy *1	±(0.15 % of setting + 10.0 mA)
		Resolution	1 mA
	Number of settings		100000 step (maximum number of steps)
	Range		100 ms to 999.9 s (the time width per step)
	Resolution		100 ms
Switching time *4		100 ms max.	
Constant power pattern *2	2 A range	Range	-12.000 W to 12.000 W (negative values are discharge power)
		Accuracy *1, *3	±(0.5 % of setting + 0.01 W)
		Resolution	1 mW
	20 A range	Range	-120.00 W to 120.00 W
		Accuracy *1, *3	±(0.5 % of setting + 0.1 W)
		Resolution	10 mW
	Number of settings		100000 step (maximum number of steps)
	Range		100 ms to 999.9 s (the time width per step)
	Resolution		100 ms
Switching time *4		100 ms max.	

*1 Ambient temperature range: 18 °C to 28 °C

*2 The battery voltage is measured, and the control current (constant current control) is calculated from the set power value through software calculation.

*3 Battery voltage range: 1 V to 6 V or higher

*4 Maximum time required for switching: charge -> discharge, discharge -> charge

●Measurement accuracy

Item		Specifications
Static/ Pattern		
Charge/discharge Current measurement	Range	2 A range 20 A range
		-2.00000 A to 2.00000 A -20.0000 A to 20.0000 A
	Accuracy *1	2 A range 20 A range
		±(0.15 % of reading + 1.0 mA) ±(0.15 % of reading + 10.0 mA)
	Resolution	2 A range 20 A range
		0.01 mA 0.1 mA
Voltage measurement	Range	
	Accuracy *1	
	Resolution	
	Input resistance	
Power measurement	Range	2 A range 20 A range
		-12.000 W to 12.000 W -120.00 W to 120.00 W
	Accuracy	
	Resolution	
	2 A range 20 A range	
	1 mW 10 mW	
Capacity measurement	Range *2	
	Accuracy	
	Resolution *2	
Time *3	Accuracy *1, *4	
	±10 ppm (TYP)	

*1 At an ambient temperature between 18 °C and 28 °C.

*2 The same for the 2 A range and 20 A range.

*3 Accuracy of signal source used for elapsed time in charge/discharge

*4 Monthly error: approximately 30 seconds

●Temperature measurement

The temperature scale conforms to JIS C 1602-1995 (ITS-90: International temperature scale).

Thermocouple voltage (temperature) measurement block	Specifications
Number of measured terminals	Per channel
Thermocouple type	Type T
Range	-100.0 °C to 400.0 °C *1
Accuracy *2, *3	±1.5 °C (TYP)
Reference junction compensation *2, *4	±0.7 °C (TYP)
Resolution	0.1 °C
Measurement interval	2 s

*1 The accuracy of the thermocouple is not guaranteed when it is used outside the operating range. The range depends on the thermocouple specifications (thermocouple class, wire diameter, and insulation).

*2 At an ambient temperature between 18 °C and 28 °C.

*3 When the voltage that the thermocouple calibrator produces is measured (the thermocouple tolerance is not included).

*4 Indicates the performance of a thermometer at a reference junction (cold junction).

●Charge/discharge end condition list

Charge/discharge mode	Maximum voltage	Minimum voltage	Specified time after charge/discharge start	Specified time after starting constant voltage operation	Specified current after starting constant voltage operation
Constant current charge (CC)	✓	✓	✓	✓	
Constant current-constant voltage charge (CC-CV)			✓	✓	✓
Constant power charge (CP)	✓	✓	✓	✓	
Constant power-constant voltage charge (CP-CV)			✓	✓	✓
Constant current discharge (CC)		✓	✓	✓	
Constant current-constant voltage discharge (CC-CV)			✓	✓	✓
Constant power discharge (CP)		✓	✓	✓	
Constant power-constant voltage discharge (CP-CV)			✓	✓	✓
Pattern constant current charge/discharge (Pattern)	✓	✓	✓	✓	

Specifications

●Protection function

Item	Specifications			
Overvoltage (overcharge) protection				
Software OVP	Setting range	0.000 V to 6.300 V		
	Resolution	1 mV		
	Setting accuracy *1	Depends on the voltmeter accuracy		
	Operating time	50 ms max.		
Hardware OVP *2	Setting range	0.0 V to 6.6 V		
	Resolution	100 mV		
	Setting error *1	± 0.5 % of rating		
	Operating time	10 ms (TYP) From overvoltage detection to output shutoff.		
Undervoltage (overdischarge) protection				
Software UVP	Setting range	-1.100 V to 5.700 V		
	Resolution	1 mV		
	Setting accuracy *1	Depends on the voltmeter accuracy		
	Operating time	50 ms max.		
Hardware UVP *2	Setting range	-1.1 V to 6.0 V		
	Resolution	100 mV		
	Setting error *1	± 0.5 % of rating		
	Operating time	10 ms(TYP) From undervoltage detection to output shutoff.		
Overcurrent protection				
Software OCP	Setting range	Charge	2 A range	0.000 A to 2.100 A
			20 A range	0.000 A to 21.000 A
	Discharge	2 A range	0.000 A to 2.100 A	
		20 A range	0.000 A to 21.000 A	
	Resolution *3	1 mA		
	Setting accuracy *1	Depends on the ammeter accuracy		
Operating time	50 ms max.			
Delay time	0 ms min. Detection delay timer setting			
Hardware OCP *2	Setting range	Charge/ discharge	2 A range	0.0 A to 2.2 A
			20 A range	0.0 A to 22.0 A
	Resolution *3	100 mA		
	Setting error *1	± 0.5 % of rating		
	Operating time	10 ms(TYP) From overcurrent detection to output off.		
Overcharge/overdischarge capacity protection				
Software OAH *4	Setting range	1.0000 Ah to 2000.0000 Ah		
	Setting accuracy *1	Depends on the ammeter accuracy and the main CPU clock accuracy		
	Resolution	0.1 mAh		
Temperature (overheat) protection				
Software OTP	Setting range	-100 °C to 400 °C		
	Setting accuracy *1	Depends on the temperature measurement accuracy		
	Resolution	1 °C		

*1 At an ambient temperature between 18 °C and 28 °C.

*2 Set values are retained in the charging/discharging unit. The system always protects the DUT even when BPC4000 is executing no test.

*3 The same for the 2 A range and 20 A range.

*4 The application software calculates the value by multiplying the nominal capacity by the preset percentage and sets the capacity.

End condition

Specified time after current falls below It Current	-dV (mask time can be set)	dT/dt (°C/min)	Integrated current (Ah)	Integrated power (Wh)	Maximum SOC	Minimum SOC	Time since pattern charge/discharge start	Number of loops	Battery temperature
✓	✓	✓	✓	✓	✓				✓
✓	✓		✓	✓	✓	✓			✓
			✓	✓	✓				✓
✓	✓		✓	✓	✓	✓			✓
			✓	✓		✓			✓
✓	✓		✓	✓	✓	✓			✓
			✓	✓		✓			✓
✓	✓		✓	✓	✓	✓			✓
			✓	✓	✓				✓
✓	✓		✓	✓	✓	✓	✓	✓	✓

●General specifications

Item	Specifications	
Nominal input rating	200 Vac to 240 Vac, 50 Hz / 60 Hz, single phase	
Input voltage range	180 Vac to 250 Vac	
Maximum power consumption	1870 VAmx. in 1 frame (6 ch) at rated charge	
Environmental conditions	Operating temperature	0 °C to 40 °C
	Humidity range	20 %rh to 85 %rh (no condensation)
	Storage temperature	-10 °C to 60 °C
	Humidity range	0 %rh to 90 %rh (no condensation)
	Operating environment	Indoors, overvoltage category II
Isolation voltage	Altitude	Up to 2000 m
	Between I/O terminals and chassis	Maximum ±50 V
Insulation resistance	Between primary and chassis	500 Vdc, 30 MΩ or greater, 70 %rh humidity or less
	Between I/O terminals and chassis *1	500 Vdc, 30 MΩ or greater, 70 %rh humidity or less
Withstand voltage	Between primary and chassis	No abnormalities at 1500 Vac for 1 minute.
	Between primary and I/O terminals *1	No abnormalities at 1500 Vac for 1 minute.
Outline drawing	430(16.93)(MAX 440(17.32))W×173(6.81)H×620(24.41)MAX 695(27.36)D mm(inch)	
Weight	Approx. 34 kg (75 lbs)	
Accessories	Power cord × 1, Rear panel cover set × 1, Temperature measurement boxes × 6, Temperature measurement cables × 6,  Temperature measurement boxes TRIP connector × 1, Signal I/O connector × 1, LAN cable × 1, Heavy object warning label × 1, Operation Manual (Japanese and English, one each) × 1, Safety Information × 1, China RoHS sheet × 1 *Cable set is not included. Please purchase the optional cable set together with the main unit.	
Electromagnetic compatibility *2, *3	Complies with the requirements of the following directive and standards. EMC Directive 2014/30/EU EN 61326-1 (Class A *4) EN 55011 (Class A *4, Group 1 *5) EN 61000-3-2 EN 61000-3-3 Applicable under the following conditions: The maximum length of all cabling and wiring connected to this product is less than 5 m.	
Safety *2	Complies with the requirements of the following directive and standards. Low Voltage Directive 2014/35/EU *3 EN 61010-1 (Class I *6, Pollution Degree 2 *7) EN IEC 61010-2-030	

*1 The input/output terminals refer to charging and discharging terminals connected to the DUT, voltage sensing terminal, and external signal input/output.

*2 Does not apply to specially ordered or modified products.

*3 Only for products with CE marking / UKCA marking on their body.

*4 This is a Class A instrument. This product is intended for use in an industrial environment. This product may cause interference if used in residential areas. Such use must be avoided unless the user takes special measures to reduce electromagnetic emissions to prevent interference to the reception of radio and television broadcasts.

*5 This product belongs to Group 1 products. This product does not generate and/or use intentionally radio-frequency energy, in the form of electromagnetic radiation, inductive and/or capacitive coupling, for the treatment of material or inspection/analysis purpose.

*6 This is a Class I instrument. Be sure to ground this product's protective conductor terminal. The safety of this product is guaranteed only when the product is properly grounded.

*7 Pollution is addition of foreign matter (solid, liquid or gaseous) that may produce a reduction of dielectric strength or surface resistivity. Pollution Degree 2 assumes that only non-conductive pollution will occur except for an occasional temporary conductivity caused by condensation.

Ordering Information

● 6ch charge/discharge test system configuration example

number of channels	Model	Part	quantity
6	PFX2731S	High rate battery tester	1
	TL13-PFX	Cable set	6
	SD035-PFX BPChecker4000	Application software	1

*Please prepare a PC separately.

● 24ch charge/discharge test system configuration example

number of channels	Model	Part	quantity
24	PFX2731S	High rate battery tester	4
	TL14-PFX	Cable set	24
	SD035-PFX BPChecker4000	Application software	1
	KRC273L	19 inch rack	1

*Please prepare a PC and a switching hub for LAN separately.

*We can prepare a customized rack-mounted system, including PC and software. (Additional fees apply)

Options

● Output cable set



TL13-PFX

TL13-PFX

- Output cable (with connector): AWG10(equivalent to 5.5 mm²), cable length: approx. 2 m
- Voltage sensing cable (with connector): AWG24, cable length: approx. 2 m
- Thermocouple: AWG24, T type, Teflon, wire diameter: 0.32 mm², cable length: approx. 3 m
- Cable ties: 4 pcs.

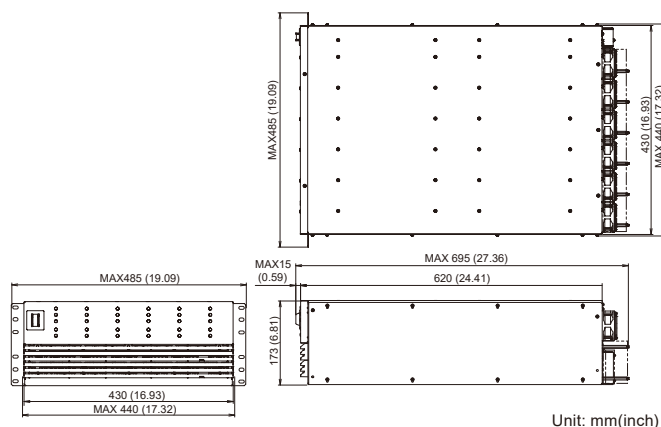
TL14-PFX

- Output cable (with connector): AWG10(equivalent to 5.5 mm²), cable length: approx. 5 m
- Voltage sensing cable (with connector): AWG24, cable length: approx. 5 m
- Thermocouple: AWG24, T type, Teflon, wire diameter: 0.32 mm², cable length: approx. 5 m
- Cable ties: 10 pcs.

Rear Panel



Outline Drawing



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