P F X 2 5 0 0   S E R I E S

PFX2512

PFX2532

Support for Large Current 200 A

Charge/Discharge System Controller
PFX2500 Series

Maximum voltage: 60.0000 V
Maximum current: 50.0000 A (2512) / 200.0000 A (2532)
Capable of seamless charging/discharging (high speed charging/discharging transfer control)
Capable of high-precision measurement of cumulative capacities and amount of power as well as voltage and current
Pattern charging/discharging capabilities by 10000 steps are installed
Supporting temperature measurement and capable of monitoring temperatures during charging/discharging
High speed sampling with maximum 1 ms can be realized
A 6 V range is newly installed and is capable of high-precision measurement
Fully equipped with safety features of the overcharge protection using voltage, electric charge and temperature
Battery deterioration is prevented by turning off the output after detecting wobbling and shock with vibration sensor
LAN as standard equipment

KIKUSUI

Energy Storage Essential to New Energy Application. Fully support Charge and Discharge Measurement from Basic Test to Simulation Test

The test system enables you to carry out easily for the battery simulation of the actual environment. Comprehensive Management from Test Condition Setting, Execution and Test Result Analysis can be conducted by the Exclusive Application Software

PFX2512/2532 Series is a high performance Charge/Discharge system controller that takes measurements in combination with our DC power supply and electronic load in order to evaluate test sample (electric storage elements such as secondary batteries) characteristics.
It is also capable to perform evaluation test with high-performance, large capacity and wide range of rating with the combination of DC power supply and electronic load.
Execution of the test is conducted by the exclusive application software.
The test corresponds to long time continuous test and synchronization test with temperature chambers with the multiplexed protection performance. In addition, easy data editing is also capable with fulfilling graphic performance.

■ Application software
 BPCheccker3000
 [SD007-PFX]

▲ Configuration(example) *PC is provided by users.
Multi Range DC Power Supply PWR1201ML(upper left), DC Electronic load PLZ1205W(lower)

Charge/Discharge System Controller

PFX2512/2532

PFX2512

PFX2532

Examples of Applicataions

Power Tools

Robot

Electric Motorcycle

Electric Vehicle

The Power Conditioners for Stationery Power Storage

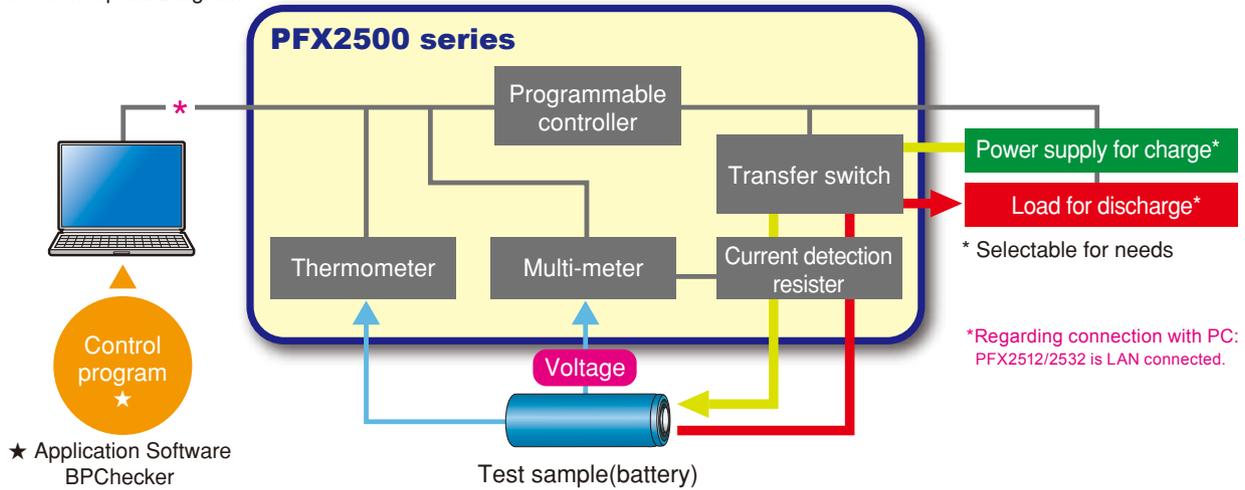| Item	PFX2532	PFX2512
Rating	60 V / 200 A	60 V / 50 A
Application software	BPChecker3000	
Communication interface	LAN	
Monitoring data minimum time interval	0.1 s	
High speed data sampling	Selected from 1 ms/10 ms/100 ms. Maximum 6000 points for every profile.	
Charge/discharge mode	9 modes Charging: CC, CC-CV(Cell CV Voltage)[*1] Discharging: CC, CP, CC-CV(Cell CV Voltage)[*1], CP-CV(Cell CV Voltage)[*1] Others: Pattern(CC, CP, Cell CV Voltage[*2]), I-V, Pause	
Test condition configuration	Individual Profile Setting (unlimited) for Charging/Discharging, etc Conditional branching function from charge/discharge results is available.	
Seamless charge/discharge	Less than 50 ms for transfer time.	
Termination condition	Temperature condition.	

*1 Can be set only when the optional OP02-PFX Volt/Thermometer Unit or OP03-PFX Voltmeter Unit is installed.
*2 Can be set only when the optional OP02-PFX Volt/Thermometer Unit or OP03-PFX Voltmeter Unit is installed. Step time can be used in more than 500 ms.

2

Complicated Systems Integrated into One

PFX2512/2532 Series has integrated systems into one unit where battery evaluation is required. In addition, the series has high degrees of flexibility corresponding to wide range of rating since it is possible to combine our conventional DC power supply (for charging) and our electronic load (for discharging) tailored to needs. Introduction cost is able to be reduced by selecting equipment which meets charge/discharge test condition required.

● System Conceptual Diagram

PFX2500 series

Programmable controller

Transfer switch

Power supply for charge*

Load for discharge*

Thermometer

Multi-meter

Current detection resister

* Selectable for needs

Voltage

Control program ★

★ Application Software BPChecker

Test sample(battery)

*Regarding connection with PC: PFX2512/2532 is LAN connected.

Easy Configuration

It is possible to configure the system by yourself. The DC power supply and electronic load that are applied configuration with PFX2512/2532, can be used for the system. This allows you to have a test system at low cost.
* For details, please refer to system configuration on page 5.

Control of the Constant Current (CC) and Constant Voltage (CV)

The adoption of the digital CC/CV control method minimizes the disparities in the constant current(CC)/ constant voltage(CV) setting accuracy and drift characteristics due to the differences in the system component devices(DC power supplies and electronic loads). This ensures highly accurate tests. There is absolutely no need to make adjustments after system configuration.

Highly accurate measurement

Highly accurate measurement circuits are built in. Battery voltage and charge/discharge current are detected with high accuracy. (Voltage measurement: 100 µV resolution, current measurement: 100 µA resolution, elapsed time measurement: monthly error of 30 s or less (10 ppm or less))
True electric energy and integrated capacity can be measured even for pulse currents that are difficult to be captured.

Protection Functions for Safety Operation

Equipped with protection functions provided by hardware and software against phenomena such as overcharge and overdischarge. The route switch (load switch) is built in the PFX2500 series and it equips with a function to ensure connection between the DUT (batteries) and the DC power supply/ electronic load as well as a high-speed interruption function that promptly disconnects the DC power supply/electronic load in case any abnormal state is detected. In addition, the vibration sensor detects major vibration and shock in case of a disaster or accident during charge and discharge test, then shuts off the output, and it prevents a damage to the connected equipment and the DUT (batteries).

Up to 10000 Steps for Pattern Charge/Discharge

It is capable to set the CC/CP (with V, I limit) step values up to 10000. Complicated charge/discharge test with minimum 100 ms step of time window since high speed charge/discharge transfer control becomes functional. This widely corresponds to the generation of test patterns or simulation patterns for various specification tests.
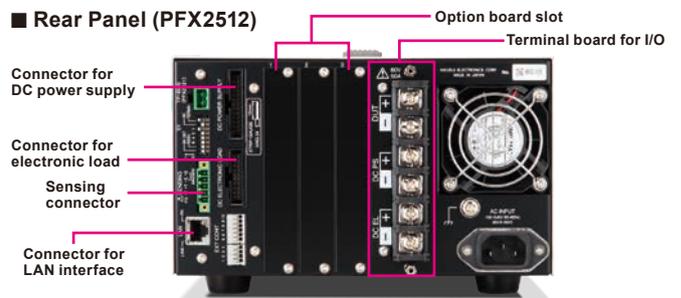
Capable of Expanding Measurement Function

Measurement points, 4 points for voltage and 4 points for temperature, are able to be added by installing optional voltage/temperature Unit, OP02-PFX. Since there are 3 slots for optional board, measurement point addition is capable up to 12 points for voltage and 12 points for temperature as maximum.
By installing an Voltmeter Unit OP03-PFX in an option slot on the SL01-PFX[1], you can increase the number of voltmeter measurement points.
If OP03-PFX units are installed in all option slots of the SL01-PFX[1], voltage measurement points can be expanded to 64 points.
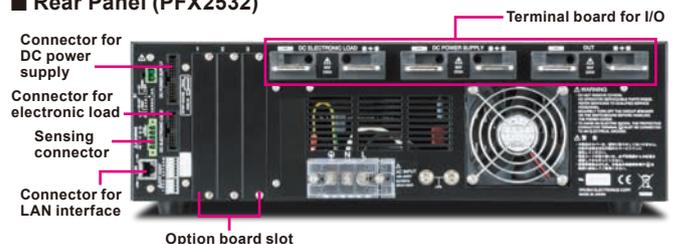
[1] OP02-PFX cannot be installed.
When using the option "SD01-PFX", one of the internal expansion slot of PFX2353/2512 will be used.

■ Rear Panel (PFX2512)

Option board slot

Terminal board for I/O

Connector for DC power supply

Connector for electronic load

Sensing connector

Connector for LAN interface

■ Rear Panel (PFX2532)

Terminal board for I/O

Connector for DC power supply

Connector for electronic load

Sensing connector

Connector for LAN interface

Option board slot

Corresponding to Specification Test Pattern by Realizing Seamless Charge/Discharge

A certain time was required for transferring power supply and electronic load in the past. Seamless charge/discharge transfer has been realized at PFX2512/2532 by the simultaneous control of power supply and electronic load. For this reason, correspondence to characteristic test of recapturing complex applications such as application where charge/discharge repeating without taking breath is performed for electric motorcycle and electric assisted bicycle as well as electric vehicle and hybrid vehicle, and application for UPS for peak shift and to specification test pattern where continuous charge/discharge is performed such as IEC62660 became possible.

● Switching charge/discharge (conventional model)

● Seamless charge/discharge
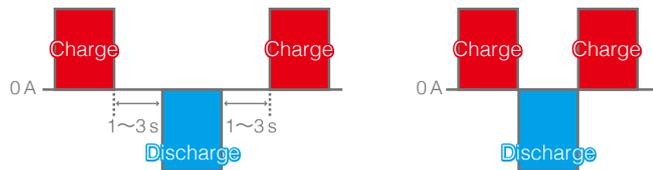
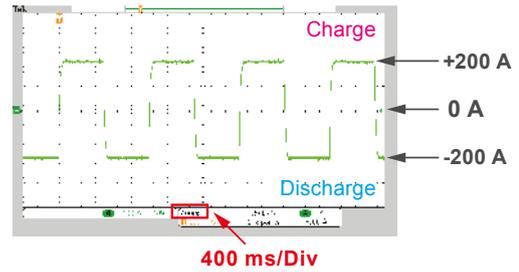● EV/HEV cycle test pattern (example)
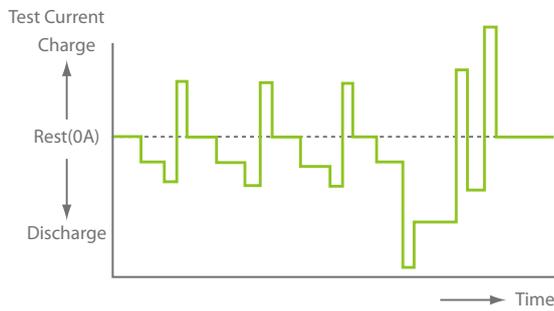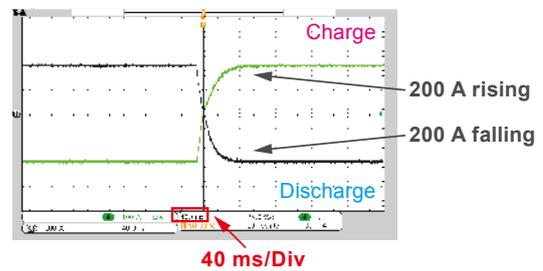
[Pattern Charge/Discharge]

Setting condition

2 values CC pattern charge/discharge	
Step 1	CHG: 200 A 500 ms
Step 2	DISCH: −200 A 500 ms

● Pattern current waveform (example)

Charge
+200 A
0 A
−200 A
Discharge
400 ms/Div

● The rising/falling wave forms of the pattern current (example)

Charge
200 A rising
200 A falling
Discharge
40 ms/Div

Realized Maximum 1 ms High Speed Data Sampling

Minimum 1 ms (maximum 6000 points for every profile) voltage/current measurements are capable by assigned voltage and current steps as trigger. This is most suited to impedance analysis of test and evaluation of life determination since high-precision voltage waveform synchronized to step current can be acquired.

▶Sampling rate: selected from 1 ms/10 ms/100 ms
▶Cell voltage meter: fixed at 100 ms of sampling rate
  (at OP02-PFX installed)
▶4 types of measurement start triggering (just after charge- discharge start/just before charge-discharge completion)
▶6000 sampling storage: 6 s @1 ms/60 s @10 ms/ 600 s @100 ms

● Pattern profile
  Trigger point setting example (case of negative sign delay time)
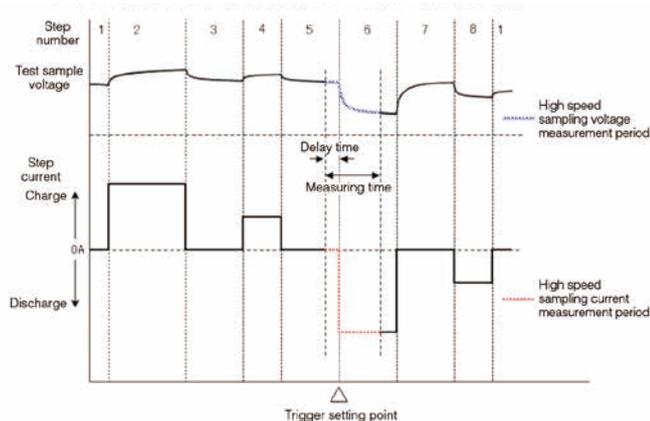
More Accurate Single Cell Evaluation with 6V Range

PFX2512/2532 equips Voltage Range transfer capability between 6 V and 60 V. A 6 V range was newly installed in PFX2512/2532 in order to perform evaluation more accurately even for a single cell. 6 V range accuracy = ±(0.05 % of reading + 0.04 % of rating), 60 V range accuracy = ±(0.05 % of reading + 0.02 % of rating). In addition to the stacked cell assembly, more accurate characteristic test is capable with single cell.

Applied to CAN interface

PFX2512/2532 (BPChecker3000) is able to communicate with exclusive application where communication log, analysis, emulation functions, etc, are added. Herewith, it becomes possible corresponding to various demands such as synchronization between charge/discharge control and log segment, charge/discharge control from exclusive application. For details, please refer to page 6 and 7.

Descriptions of Charge/Discharge Test

With the PFX2512/2532, various electrical characteristic tests are able to be performed regardless battery manufacturer or customers.

- I-V Characteristics Test
- Cycle Characteristics Test
- Charge/Discharge Rate Test
- Temperature Characteristics Test
- Charge/Discharge Efficiency Test

- Capacitance Measurement Test
- Storage Characteristics Test
- Capacitance Change Test
- Actual Load Simulation Test
- BMS Validation Test

System Configuration

[2532 System Configuration example]
(model ID : 7358)

Text API script message

Application software **BPChecker3000**

CAN analytical / Log Application software **Vehicle Spy3 (outsidegoods)**

Digital Interface

Regulated DC power supply **PAT40-200T**

Control cable for PAT-T series (Standard accessory for PFX2532)

LAN

LAN

Router

LAN

OP03-PFX Cell voltage

TL11-PFX

CAN

EX01-PFX (Standard accessory for SL01-PFX)

OP02-PFX Cell voltage Cell temperature

TL09-PFX

TL10-PFX Load cable

SL01-PFX

Sensing cable

I/F cable for PLZ-5W series **SC05-PFX**

Charge/discharge system controller **PFX2532**

DC electronic load **PLZ1205W(M range) +PLZ2405WB×4**

BMS equipped DUT (Test sample)

Thermostatic chamber manufactured by Espec Corp.

- Regulated DC power supply PAT40-200T
- DC electronic load PLZ1205W
- Electronic load booster PLZ2405WB
- Charge/discharge system controller PFX2532
- 8Slot unit SL01-PFX
- Voltmeter unit OP03-PFX
- Application software BPChecker3000
- Voltage/thermometer unit OP02-PFX
- Sensing cable(for OP02-PFX)................... TL09-PFX
- Load cable(20 A, 3 m)............................... TL10-PFX
- Sensing cable(for OP03-PFX) TL11-PFX
- I/F cable(for PLZ-5W series) SC05-PFX

- Personal computer...........Windows 7 or Windows 8. Display resolution: 1280 × 1024 or more Equipped with 10 Base T(or higher model) LAN interface
- Thermostatic chamber....Supports synchronized operation with temperature chambers. To perform synchronized operation, temperature chambers equipped with a communication function, manufactured by ESPEC and the associated components are required. For details, please consult with us.

[2512 System Configuration example]
(model ID : 7155)

Text API script message

Application software **BPChecker3000**

CAN analytical / Log Application software **Vehicle Spy3 (outsidegoods)**

Digital Interface

Multi range DC power supply **PWR801L**

I/F cable for PWR-01 series **SC07-PFX**

USB

Converter

CAN

LAN

OP02-PFX Cell voltage Cell temperature

TL09-PFX

I/F cable for PLZ-5W series **SC05-PFX**

Sensing cable

Charge/discharge system controller **PFX2512**

TL08-PFX Load cable

DC electronic load **PLZ1205W**

BMS equipped DUT (Test sample)

Thermostatic chamber manufactured by Espec Corp.

- Multi range DC power supply PWR801L
- DC electronic load PLZ1205W
- Charge/discharge system controller PFX2512
- Application software BPChecker3000
- Voltage/thermometer unit OP02-PFX
- Sensing cable(for OP02-PFX)................... TL09-PFX
- Load cable(50 A, 5 m)............................... TL08-PFX
- I/F cable(for PLZ-5W series) SC05-PFX
- I/F cable(for PWR-01 series).................... SC07-PFX

- Personal computer...........Windows 7 or Windows 8. Display resolution: 1280 × 1024 or more Equipped with 10 Base T(or higher model) LAN interface
- Thermostatic chamber....Supports synchronized operation with temperature chambers. To perform synchronized operation, temperature chambers equipped with a communication function, manufactured by ESPEC and the associated components are required. For details, please consult with us.

Comprehensive management from test condition setting to execution and data analysis on test results by PFX2512/2532 exclusive application software, BPChecker3000

▲ Program structure
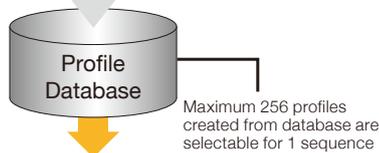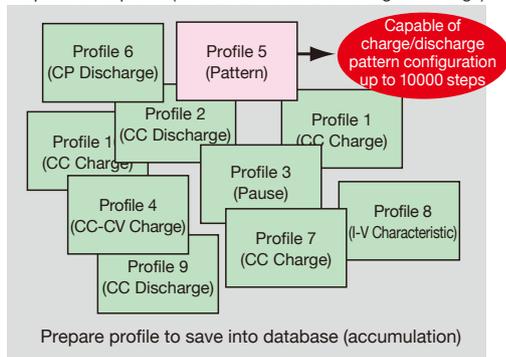This software consists of four programs.

The application software, BPChecker3000 (SD007-PFX), equips with the new features of PFX2512/2532 where test condition and graphical drawing function are emphasized on existing BPChecker2000, and it realizes [Seamless Charge/Discharge] and [High Speed Data Sampling]. At the test condition setting, the test condition (project) is created from database compiled charge/discharge condition (profile).
The test execution shows that graphical display function is emphasized in its extraction and overwriting functions for larger data integration. In addition, synchronized operation with a temperature chambers is capable and the charge/discharge test is comprehensively controlled including temperature control under test environment. Further more, it can be applied to the operation with [CAN Bus] for which demand will be increased accompanied by the technical development of battery management in future.

[Caution] BPChecker3000 is essential for PFX2512/2532 performance. PFX2512/2532 does not work with BPChecker2000.

● Program Structure

Test Condition Editor

This program is used to create and edit all of test conditions related to charge/discharge testing. After profile creation, sequence and total settings, etc, are performed to create a project. BPChecker3000 executes the test by the project.

Preparation of profile (detailed conditions for charge/discharge)

Profile 6 (CP Discharge)
Profile 5 (Pattern) → Capable of charge/discharge pattern configuration up to 10000 steps
Profile 2 (CC Discharge)
Profile 1 (CC Charge)
Profile 1 (CC Charge)
Profile 4 (CC-CV Charge)
Profile 3 (Pause)
Profile 8 (I-V Characteristic)
Profile 7 (CC Charge)
Profile 9 (CC Discharge)

Prepare profile to save into database (accumulation)

Profile Database

Maximum 256 profiles created from database are selectable for 1 sequence

Preparation of project (test condition)

Project
- Overall setting
- Battery protection and voltage/thermometer unit
- Link and jump setting

Capable of reflecting test results onto the succeeding test condition to be executed (link) or dividing sequence with termination factor (jump).

Sequence-1 (Aggregate of profile) — Profile up to 256
Sequence-2 (Aggregate of profile)
Sequence-3 (Aggregate of profile) — Sequence up to 256

● **Capable of setting battery temperature termination conditions (rest temp)**
For stop time setting, it is capable to set termination conditions by battery temperature in addition to time setting (fixed time) determined after charge.

● **Pause function installed**
There is the pause function among profile types. Test is able to be paused by using this function.
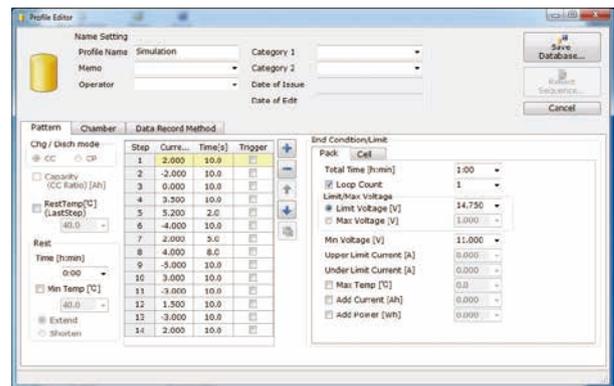
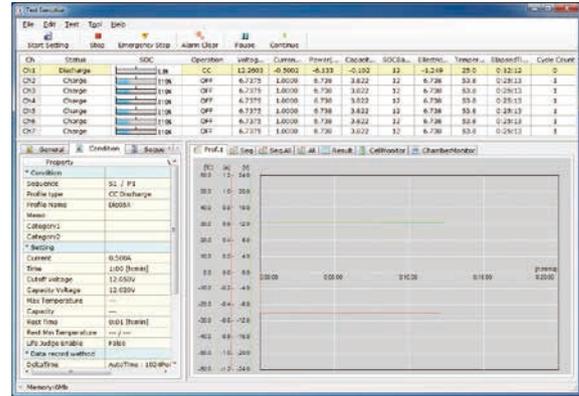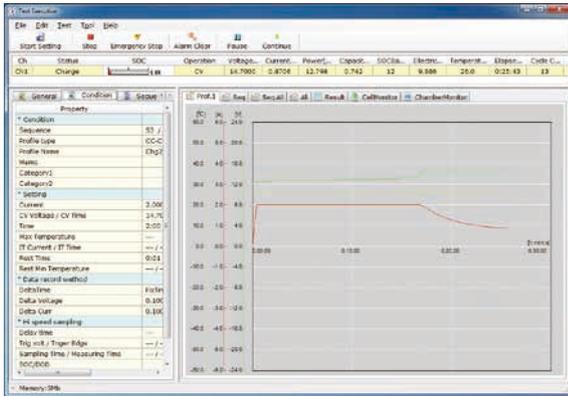
▲ Preparation of profile
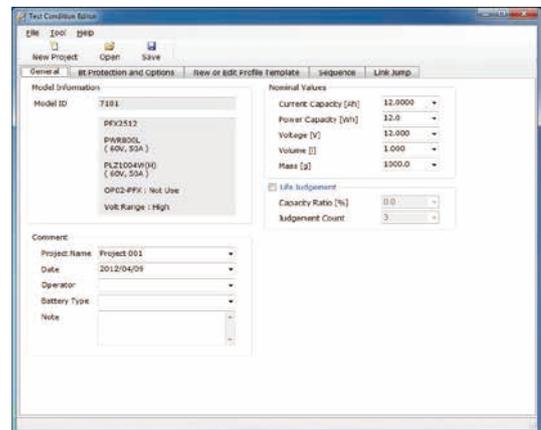
▲ Setting total project
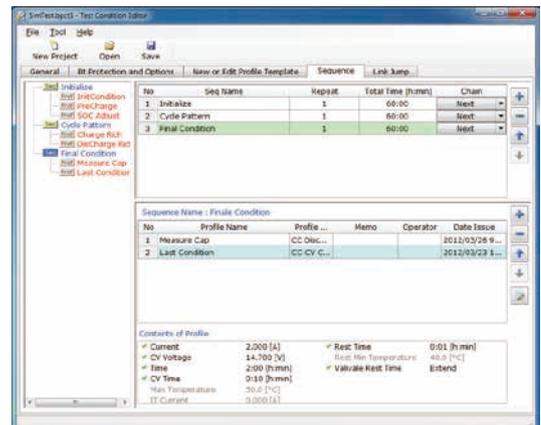
▲ Sequence setting

Test Executive

This program executes charge/discharge tests according to the test condition file created using the Test Condition Editor.

Graph Viewer

This program is used to display the graph of test data on the screen and print the graph. When the Graph Viewer is used, overall analysis is capable to display the calculated value acquired from the test data, and from test data for energy, etc, test conditions in addition to test data graph. The Graph Viewer also able to display overlapped graphs where multiple numbers of graphs are on the screen into one.
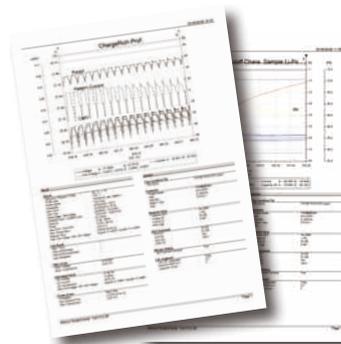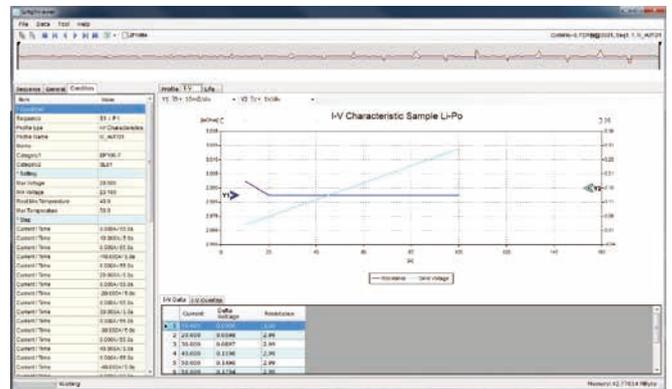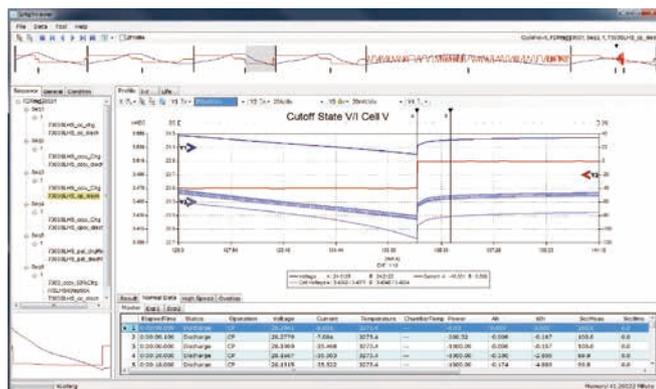
[Recommended operating environment]
■ OS: Windows 7, Windows8.2
■ Memory: 4 GB or more
■ HD drive: 1 GB or more of free hard disk space (the amount of additional space that is needed depends on the type of data you need to save)
■ CD-ROM drive: Required for installing the applications
■ Mouse or other pointing device
■ Display resolution: 1280 × 1024 (17 inch) or more
■ Equipped with 10 Base T (or higher model) LAN interface
■ Printer: Compatible with windows
■ The thermostatic chambers that can be controlled via Espec Corp.'s protocol converter/USB-RS485 converter
■ VISA library: NI-VISA 3.3 or later, Agilent I/O Libraries Suite 15.0 or later, or KI-VISA 3.1.3 or later

Specifications

Unless specified otherwise, the specifications are for the following settings and conditions.
- The warm-up time is 30 minutes.
- TYP (typical) values do not guarantee the performance.
- reading: Indicates the readout value.
- set: Indicates the setting value.
- rating: Indicates the rated.
- 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 and I - V characteristics charge / discharge

■ Rated Output

		PFX2512	PFX2532
Number of output		1 ch	1 ch
Charge current range *1		0.000 A to 50.000 A	0.000 A to 200.000 A
Charge voltage range *1	60 V range	0.000 V to 60.000 V	0.000 V to 60.000 V
	6 V range	0.000 V to 6.000 V	0.000 V to 6.000 V
Discharge current range *1		0.000 A to 50.000 A	0.000 A to 200.000 A
Discharge voltage range *1 *2	60 V range	0.000 V to 60.000 V	0.000 V to 60.000 V
	6 V range	0.000 V to 6.000 V	0.000 V to 6.000 V

*1 The range varies depending on factors such as the connected DC power supplies and electronic loads, the wiring configuration of the system, and the charge/discharge operation.
*2 The minimum voltage that can be discharged varies depending on factors such as the connected electronic load models and the wiring configuration.

■ Setting Accuracy

			PFX2512	PFX2532
Static				
Constant current charge/discharge	Range *1		0.000 A to 50.000 A	0.000 A to 200.000 A
	Accuracy *2		*3	*3
	Resolution		1 mA	1 mA
Constant voltage charge/discharge	Range *1	60 V range	0.000 V to 60.000 V	0.000 V to 60.000 V
		6 V range	0.000 V to 6.000 V	0.000 V to 6.000 V
	Accuracy *2		*3	*3
	Resolution		1 mV	1 mV
Constant cell voltage charge/discharge *4	Range *1		0.000 A to 20.000 V	0.000 A to 20.000 V
	Accuracy *2		*3	*3
	Resolution		1 mV	1 mV
Constant power discharge	Range *1		0.1 W to 3000.0 W	1 W to 12000 W
	Accuracy *2		±(0.5 % of set + 1 W) *5	±(0.5 % of set + 10 W) *5
	Resolution		10 mW	1 W
Pattern *6				
Pattern constant current	Range *1		-50.000 A to 50.000 A	-200.000 A to 200.000 A
	Accuracy *2		*3	*3
	Resolution		1 mA	1 mA
	Number of settings		10000 values (Maximum number of steps)	10000 values (Maximum number of steps)
	Time width	Range	0.1 s to 9999.9 s (Time width for 1 step)	0.1 s to 9999.9 s (Time width for 1 step)
		Accuracy *2	±(0.05 % of set + 10 ms)	±(0.05 % of set + 10 ms)
		Resolution	100 ms	100 ms
Pattern constant power	Range *1		-3000.00 W to 3000.00 W	-12000 W to 12000 W
	Accuracy *2 *7		±(0.5 % of set + 1 W) *5	±(0.5 % of set + 10 W) *5
	Resolution		10 mW	1 W
	Number of settings		10000 values (Maximum number of steps)	10000 values (Maximum number of steps)
	Time width	Range	0.1 s to 9999.9 s	0.1 s to 9999.9 s
		Accuracy *2	±(0.05 % of set + 10 ms)	±(0.05 % of set + 10 ms)
		Resolution	100 ms	100 ms

*1 The range varies depending on factors such as the connected DC power supplies and electronic loads and the wiring configuration of the system.
*2 Ambient temperature at 18 °C to 28 °C
*3 The external devices are controlled through software so that the measured values are equal to the settings. The accuracy of the settings is the same as the measurement accuracy. Because this is dependent on the control cycle, correct control may not be possible for a DUT (battery) with high impedance or a DUT whose circuit is open. Control cycle for constant current / constant voltage control is 1 ms and for constant cell voltage control is 100 ms.
*4 Can be set only when the optional Volt / Thermometer Unit OP02-PFX or OP03-PFX Voltmeter Unit is installed.
*5 The battery voltage is measured, and the control current (constant current control) is calculated from the set power value through software calculation. The time required to process one calculation (from the voltage measurement to the output setting) is approximately 1 ms.
*6 The operating voltage range is 1 V or more (when the TL10-PFX is being used; regardless of whether a bias DC power supply is being used).
*7 With battery voltage of 2 V or more.

■ Measurement Accuracy

			PFX2512	PFX2532
Static				
Charge / discharge current measurement	Range *1		0.0000 A to 50.0000 A	0.000 A to 200.000 A
	Accuracy *2		± (0.15 % of reading + 0.02 % of rating)	± (0.2 % of reading + 0.1 % of rating)
	Resolution		0.1 mA	1 mA
Voltage measurement	Range	60 V range	-6.0000 V to 60.0000 V *3	-6.0000 V to 60.0000 V *3
		6 V range	-1.0000 V to 6.0000 V *4	-1.0000 V to 6.0000 V *4
	Accuracy *2 *5	60 V range	± (0.05 % of reading + 0.02 % of rating)	± (0.05 % of reading + 0.02 % of rating)
		6 V range	± (0.05 % of reading + 0.04 % of rating)	± (0.05 % of reading + 0.04 % of rating)
	Resolution *5		0.1 mV	0.1 mV
Power measurement	Range		0.000 W to 3000.000 W	0.0 W to 12000.0 W
	Accuracy		Software calculation (voltage measurement × current measurement)	Software calculation (voltage measurement × current measurement)
	Resolution		1 mW	100 mW
Current capacity calculation	Range		0.000 Ah to 2000.000 Ah	0.000 Ah to 2000.000 Ah
	Accuracy *2		Depends on the current measurement accuracy and the time accuracy	
	Resolution		1 mAh	1 mAh
Power capacity calculation	Range		0.000 Wh to 120000.000 Wh	0.000 Wh to 120000.000 Wh
	Accuracy *2		Depends on the voltage measurement accuracy, current measurement accuracy and the time accuracy	
	Resolution		1 mWh	1 mWh
Time *7	Accuracy *2 *7		±10 ppm (TYP values)	±10 ppm (TYP values)
Pattern				
Charge / discharge current measurement	Range *1		-50.0000 A to 50.0000 A	-200.000 A to 200.000 A
	Accuracy *2		± (0.2 % of reading + 0.03 % of rating)	± (0.2 % of reading + 0.1 % of rating)
	Resolution		0.1 mA	1 mA
	Measured value		Average current, Update a data per period of 1 s	Average current, Update a data per period of 1 s
Voltage measurement	Range	60 V range	-6.0000 V to 60.0000 V *3	-6.0000 V to 60.0000 V *3
		6 V range	-1.0000 V to 6.0000 V *4	-1.0000 V to 6.0000 V *4
	Accuracy *2	60 V range	± (0.05 % of reading + 0.02 % of rating)	± (0.05 % of reading + 0.02 % of rating)
		6 V range	± (0.05 % of reading + 0.04 % of rating)	± (0.05 % of reading + 0.04 % of rating)
	Resolution *5		0.1 mV	0.1 mV
Power measurement	Range		-3000.000 W to 3000.000 W	-12000.00 W to 12000.00 W
	Accuracy *2		Software calculation (voltage measurement × current measurement)	Software calculation (voltage measurement × current measurement)
	Resolution		1 mW	10 mW
Current capacity calculation	Range		-2000.000 Ah to 2000.000 Ah	-2000.000 Ah to 2000.000 Ah
	Accuracy *2		Depends on the current measurement accuracy and the time accuracy	
	Resolution		1 mAh	1 mAh
Power capacity calculation	Range		-120000.000 Wh to 120000.000 Wh	-120000.000 Wh to 120000.000 Wh
	Accuracy *2		Depends on the voltage measurement accuracy, current measurement accuracy and the time accuracy	
	Resolution		1 mWh	1 mWh
Time *7	Accuracy *2 *7		±10 ppm (TYP values)	±10 ppm (TYP values)

*1 Measurable range: -210.000 A to 210.000 A (TYP). However, the accuracy is not guaranteed for values outside of the range listed in the table.
*2 Ambient temperature at 18 °C to 28 °C.
*3 Measurable range: -6.500 V to 65.000 V (TYP). However, the accuracy is not guaranteed for values outside of the range listed in the table.
*4 Measurable range: -6.500 V to 6.500 V (TYP). However, the accuracy is not guaranteed for values outside of the range listed in the table.
*5 The same for the 6 V range and 60 V range.
*6 Accuracy of the elapsed time (Cutoff condition) when charging / discharging or resting.
*7 Monthly error: approximately 30 seconds.

■ Measurement Accuracy

			PFX2512	PFX2532
High speed sampling				
Current measurement	Range *1		-50.0000 A to 50.0000 A	-200.000 A to 200.000 A
	Accuracy *1 *2 *3	1 ms sampling	± (0.2 % of reading + 0.5 % of rating)	± (0.4 % of reading + 0.5 % of rating)
		10 ms sampling	± (0.15 % of reading + 0.05 % of rating)	± (0.3 % of reading + 0.1 % of rating)
		100 ms sampling	± (0.15 % of reading + 0.02 % of rating)	± (0.2 % of reading + 0.1 % of rating)
	Resolution		1 mA. The same for all sampling settings.	1 mA. The same for all sampling settings.
Voltage measurement	Range *1	60 V range *4	-6.0000 V to 60.0000 V	-6.0000 V to 60.0000 V
		6 V range *5	-1.0000 V to 6.0000 V	-1.0000 V to 6.0000 V
	Accuracy *1 *2 *3	1 ms sampling *6	± (0.1 % of reading + 0.1 % of rating)	± (0.1 % of reading + 0.1 % of rating)
		10 ms sampling *6	± (0.1 % of reading + 0.05 % of rating)	± (0.1 % of reading + 0.05 % of rating)
		100 ms sampling	60 V range: ± (0.05 % of reading + 0.02 % of rating)	60 V range: ± (0.05 % of reading + 0.02 % of rating)
			6 V range: ± (0.05 % of reading + 0.04 % of rating)	6 V range: ± (0.05 % of reading + 0.04 % of rating)
	Resolution		0.1 mV. The same for all sampling settings.	0.1 mV. The same for all sampling settings.

*1 The accuracy is not guaranteed for values outside of the rated output range.
*2 Ambient temperature at 18 °C to 28 °C.
*3 The wavering caused by the ripple noise and AC line noise (50 Hz/ 60 Hz) of the DC power supply that you are using is not included.
*4 Measurable range: -6.500 V to 65.000 V (TYP). However, the accuracy is not guaranteed for values outside of the range listed in the table.
*5 Measurable range: -6.500 V to 6.500 V (TYP). However, the accuracy is not guaranteed for values outside of the range listed in the table.
*6 The same for the 6 V range and 60 V range.

■ Temperature measurement

*The thermistor 103AT-2 (SEMITEC Corporation) is used for temperature detecting element.

	PFX2512	PFX2532
Resistor (temperature) measuring section *1		
Measurement range	-40.0 °C to 100.0 °C	
Measurement resolution	0.1 °C	
Measurement accuracy *2 *3	± 0.5 °C (measurement temperature at 0 °C to 40.0 °C)	
	± 1 °C (measurement temperature at -20 °C to 80 °C)	
Reference (thermistor 103AT)		
Model	103AT-2 by SEMITEC Corporation	
R25	Nominal zero-load resistance at 10.0 kΩ, 25 °C	
Operating temperature range	-50.0 °C to 110.0 °C	
Temperature accuracy *3	± 0.5 °C (measurement temperature at 0 °C to 40.0 °C)	
Tolerance	± 1 %	
Constant-B	3435 K ± 1 % (measurement temperature at 25 °C)	

*1 The temperature measurement does not trace the absolute temperature. Temperature converted from resistance.
*2 Excludes temperature detector errors.
*3 Ambient temperature at 18 °C to 28 °C

■ Protection Functions

	PFX2512	PFX2532
Overvoltage (overcharge) protection	Software OVP, Hardware OVP	
Undervoltage (overdischarge) protection	Software UVP, Hardware UVP	
Overcurrent protection	Software OCP *1, Hardware OCP Load shorting protection	
Capacity (overcharge/overdischarge) protection	Software OAH *2	
Overtemperature (DUT) protection	Software OTP	
Vibration alarm		

*1 For the software OCP, the application software automatically sets a value obtained by adding 5 A to the preset current.
*2 The application software calculates the value by multiplying the nominal capacity by the preset percentage and sets the capacity.

■ General Specifications

|		PFX2512	PFX2532
Nominal input rating		100 Vac to 240 Vac, 50 Hz/60 Hz	
Input voltage range		90 Vac to 250 Vac	
Power consumption		60 VAmax (when three OP02-PFXs are installed: 80 VAmax)	
Operating temperature/ humidity range		0 °C to 40 °C (32 °F to 104 °F), 20 %rh to 85 %rh (no condensation)	
Storage temperature/humidity range		-10 °C to 60 °C (14 °F to 140 °F), 0 %rh to 90 %rh (no condensation)	
Operating environment		Indoors, Overvoltage category II	
Altitude		Up to 2000 m	
Isolation voltage	Across the I/O terminals and chassis	±60 Vmax	
Insulation resistance	Primary and chassis	500 Vdc, 30 MΩ or greater, 70 %rh humidity or less	
	Primary and across the I/O terminals		
Withstand voltage	Primary and chassis	No abnormalities at 1500 Vac for 1 minute	
	Primary and across the I/O terminals		
Safety *1		Complies with the requirements of the following directive and standard. Low Voltage Directive 2014/35/EU *2 EN61010-1 (Class I *3, Pollution degree 2 *4)	Complies with the requirements of the following directive and standards. Low Voltage Directive 2014/35/EU *2 EN 61010-1 (Class I *3, Pollution degree 2 *4)
Electromagnetic compatibility(EMC) *1		Complies with the requirements of the following directive and standard. EMC Directive 2014/30/EU EN61326-1 (Class A *5) EN55011 (Class A *5, Group 1 *6) EN61000-3-2, EN61000-3-3 Applicable under the following conditions. The maximum length of all cabling and wiring connected to the PFX2512 is less than 5 m.	Complies with the requirements of the following directive and standards. EMC Directive 2014/30/EU EN61326-1 (Class A *5) EN55011 (Class A *5, Group 1 *6) EN61000-3-2, EN61000-3-3 Applicable under the following conditions. The maximum length of all cabling and wiring connected to the PFX2532 is less than 3 m.
External dimensions		See the outline drawing.	
Weight		Approx. 7 kg (15.43 lb)	Approx. 17 kg (37.48 lb)
Accessories	Power cord *7	1 pc	1 pc. with no plug
	Cable with Solderless terminal	4 pcs (Red: 2 pcs, White: 2 pcs) 45 cm each (17.72 inch)	–
	I/O terminal cover set	–	Three terminal covers, six cable ties for locking
	I/O terminal M8 screw set	–	6 sets
	Load input terminal cover set	–	Cover, four auxiliary bands
	26-core flat cable	1 pc. DC power supply connection I/F cable	1 pc. DC power supply connection I/F cable (for PWR)
	Ferrite core for 26-core flat cables	1 pc	1 pc
	20-core flat cable	1 pc. Electronic load connection I/F cable	1 pc. Electronic load connection I/F cable
	Ferrite core for 20-core flat cables	1 pc	1 pc
	26-core cable (with ferrite core)	–	1 pc. DC power supply connection I/F cable (for PAT-T)
	Sensing connector	1 pc	1 pc
	Sensing connector cover set	–	One cover set, one cable tie for locking
	Thermistor	1 pc	1 pc
	Lock lever	2 pcs	2 pcs
	LAN cable	1 pc. Straight type	1 pc. Straight type
	Operation manual	1 copy	1 copy

*1 Does not apply to specially ordered or modified PFX2512s and PFX2532s.
*2 Limited to products that have the CE/UKCA mark on their panels. When the optional OP03-PFX Voltmeter Unit is used, compliance is achieve by using the optional TL12-PFX sensing cable (length: approx. 3 m, connector area: with cover, with core).
*3 This is a Class I equipment. Be sure to ground the PFX2512's and PFX2532's protective conductor terminal. The safety of this product is only guaranteed when the product is properly grounded.
*4 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.
*5 This is a Class A equipment. The PFX2512 and PFX2532 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.
*6 This is a Group 1 equipment. The PFX2512 and PFX2532 does not generate and/or use intentionally radio-frequency energy, in the from of electromagnetic radiation, inductive and/or capacitive coupling, for the treatment of material or inspection/analysis purpose.
*7 Because the power cord does not comply with CE/UKCA, it may not be included depending on the shipment destination.

Voltage/thermometer unit [OP02-PFX]

PFX 2512 **PFX 2532**

When monitoring the status of each cell of the battery pack is required, install the optional voltage/thermometer unit OP02-PFX. By installing OP02-PFX on PFX2512/2532, voltages/temperatures for four cells are able to be monitored/logged with one sheet, respectively. (Up to 3 boards can be installed.) For a battery pack connected in series, monitoring of balance among cells is important. With OP02-PFX, the charge and discharge control can be stopped according to the status of each cell.In addition, it is equipped with a function to stop charge and discharge when the balance beteen the cells in the battery pack becomes large (maximum voltage - minimum voltage). Furthermore, at the time of pulse discharge, voltage can be measured at the same time as the synchronization of all cells for load fluctuations.
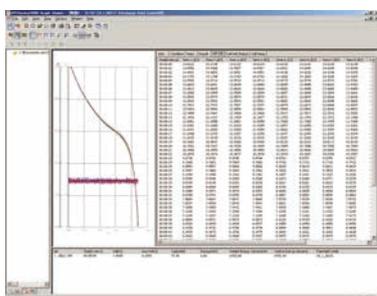
■ Expanded features
Monitor data: Cell voltage, cell temperature.
Charge stop conditions: Cell voltage, cell temperature and potential difference among cells
Discharge stop conditions: Cell voltage and potential difference among cells, cell temperature
Charge/discharge conditions: Cell voltage, cell temperature, Cell unbalance
Protective functions: Cell voltage, cell temperature and potential difference among cells

■ Restricted functions
The maximum number of channels that 1 unit of personal computer can control is 5 ch.

■ Voltage/thermometer unit OP02-PFX Specifications

	OP02-PFX
Cell measurement function	
Static	
Cell voltage	Average voltage of the every 100 ms
Cell temperature	Temperature measurement function to make thermocouple as temperature detecting element, updated every second
Cell voltage measurement	
Static	
Number of measurement terminals	4
Measurable range *1	-2.0000 V to 20.0000 V
Accuracy *2	±(0.05 % of reading + 0.02 % of rating)
Measurement resolution	0.1 mV
Measurement value	Average voltage of the every 100 ms
Measurement Interval	100 ms
Cell temperature measurement *3	
Number of measurement terminals	4
Thermocouple type	K type
Measurable range *4	-100.0 °C to 400.0 °C
Accuracy *2 *5	± 1.5 °C (TYP values)
Reference junction accuracy *2 *6	± 0.5 °C (TYP values)
Resolution	0.1 °C
Measurement interval	1 s

*1 You can apply a voltage from -20 V to 22 V.
*2 Ambient temperature at 18 °C to 28 °C.
*3 The temperature scale conforms to JIS C 1602-1995 (ITS-90). (ITS-90 is an international temperature scale.)
*4 Depending on your thermocouple's specifications (thermocouple class, wire diameter and insulation), the usable temperature range will vary.
*5 When the voltage that the thermocouple calibrator produces is measured.
*6 This shows the internal sensor performance. This indicates the temperature measurement accuracy of the thermocouple connector.
Thermometer accuracy = Measurement accuracy + reference junction compensation + thermocouple tolerance

Voltmeter Unit [OP03-PFX]

PFX 2512 **PFX 2532**

By installing an Voltmeter Unit OP03-PFX in an option slot on the SL01-PFX, you can increase the number of voltmeter measurement points. If OP03-PFX units are installed in all option slots of the SL01-PFX, voltage measurement points can be expanded to 64 points.

■ Voltmeter Unit OP03-PFX Specifications

	OP03-PFX
Cell voltage measurement	
Number of measured terminals	8
Measurement range *1	-2.0000 V to 20.0000 V
Measurement accuracy *2	±(0.05 % of reading + 0.02 % of rating)
Resolution	0.1 mV
Measured value	Average voltage every 100 ms
Measurement interval	100 ms

*1 You can apply a voltage from -20 V to 22 V.
*2 Ambient temperature at 18°C to 28°C.

8Slot Unit [SL01-PFX]

PFX 2512 **PFX 2532**
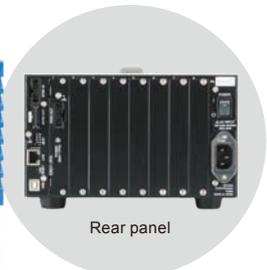
Rear panel

The 8Slot Unit SL01-PFX is connected to the PFX2512/2532 Charge/Discharge System Controller to expand the voltage measurement points. For this connection, an EX01-PFX connection board is installed into the PFX2512/2532. It enables highly accurate evaluation of cell voltage disparity measurements, which is indispensable for evaluation testing of large capacity battery modules. If Voltmeter Units OP03-PFX are installed in all SL01-PFX slots, voltage measurement points can be expanded to 64 points. Further, by installing Volt/Thermometer Units OP02-PFX in the PFX2512/2532, you can increase the number of measurement points to 72.

■ 8Slot Unit SL01-PFX Specifications

	SL01-PFX
Number of slots	8
Compatible boards *1	Voltmeter Unit OP03-PFX
Interface	LAN(Ethernet) (PC connection)
	Sync connector (EX01-PFX connection)
Input voltage range	90 Vac to 250 Vac, 50 Hz/60 Hz
Power consumption	60 VAmax (when 8 OP03-PFXs are installed: 80 VAmax)
Operating temperature and humidity range	0 °C to 40 °C (32 °F to 104 °F), 20 %rh to 85 %rh (no condensation)
Dimensions	214.5 (8.44) W × 155 (6.10) H × 410 (16.14) Dmm (inch)
Weight	Approx. 5 kg (11.02 lb)
Accessories	Power cord/100 V System (1 pc.)
	Power cord/200 V System (1 pc.)
	EX01-PFX (1 pc.)*2 extension board (for installing in a PFX2532 slot)
	LAN cable (1 pc.) 2m Straight type
	14-core flat cable (1 pc.)
	Ferrite core for 14-core flat cable (1 pc.)
	Lock lever (2 pcs.)
	Handling of the product (1 copy)

*1 OP02-PFX cannot be installed.   *2 Installed in the SL01-PFX by factory default.

Load cable set [TL08-PFX]

PFX 2512

Load cable(with voltage current, and temperatur sensing cable.)
■ Rating: 50 A ■ Length: Approx. 5 m ■ Thermistor installed
■ Maximum operating temperature: 105 °C

Sensing cable set [TL09-PFX]

PFX 2512 **PFX 2532**

Lead wire for voltage/thermometer unit
■ K type thermocouple for 4 cells ■ Length: Approx. 5 m

Cable set [TL10-PFX]

PFX 2532

This is a cable set for connecting the PFX2532 to configure a charge/discharge system.
■ Rated current: 200 A ■ DUT cable: Approx. 3 m
■ DC power supply connection cable: Approx. 60 cm
■ Electronic load connecion cable: Approx. 60 cm
■ Voltage sensing cable with the thermistor
■ CE/UKCA compliant product
■ Maximum operating temperature: 75 °C (Connection cable/ DUT cable)

Cell voltage sensing cable set [TL11-PFX]

PFX 2512 **PFX 2532**

Sensing cable set (for OP03-PFX)
■ This product supports eight voltage measurement points.
■ Length: Approx. 5 m
■ Maximum operating temperature: 105 °C
■ No-finished end on the side of test materials

Cell voltage sensing cable set [TL12-PFX]

PFX 2512 **PFX 2532**

Sensing cable set (for OP03-PFX)
■ This product supports eight voltage measurement points.
■ Length: Approx. 3 m ■ Maximum operating temperature: 105 °C
■ No-finished end on the side of test materials
■ CE/UKCA compliant product

I/F cable [SC05-PFX]

PFX 2512 **PFX 2532**

This is a dedicated load cable for connecting the Electronic load PLZ-5W. Connectors are attached to these cables, so connection is easy.

I/F cable [SC07-PFX]

PFX 2512 **PFX 2532**

This is a dedicated load cable for connecting the DC power supply PWR-01. Connectors are attached to these cables, so connection is easy.

Rack mount frame

PFX 2512

■ KRA3 (Inch rack EIA Standard)
■ KRA150 (Milli rack JIS Standard)

Rack mount bracket

PFX 2532

■ KRB3-TOS (Inch rack EIA Standard)
■ KRB150-TOS (Milli rack JIS Standard)

Rack mount system

PFX 2512 **PFX 2532**

We also provide a rack mounting service.
■ System rack: KRC363L
* The picture shown below is an example of the rack mount system

Coordination between BPChecker3000 and Vehicle Spy3

PFX2512/2532 system is able to be connected to battery pack where BMS (Battery Management System) is equipped. Charge/discharge test is able to be conducted while communicating with BMS by combining exclusive application software [BPChecker3000], and vehicle-installed network analysis tool [Vehicle Spy3].

■ Function example
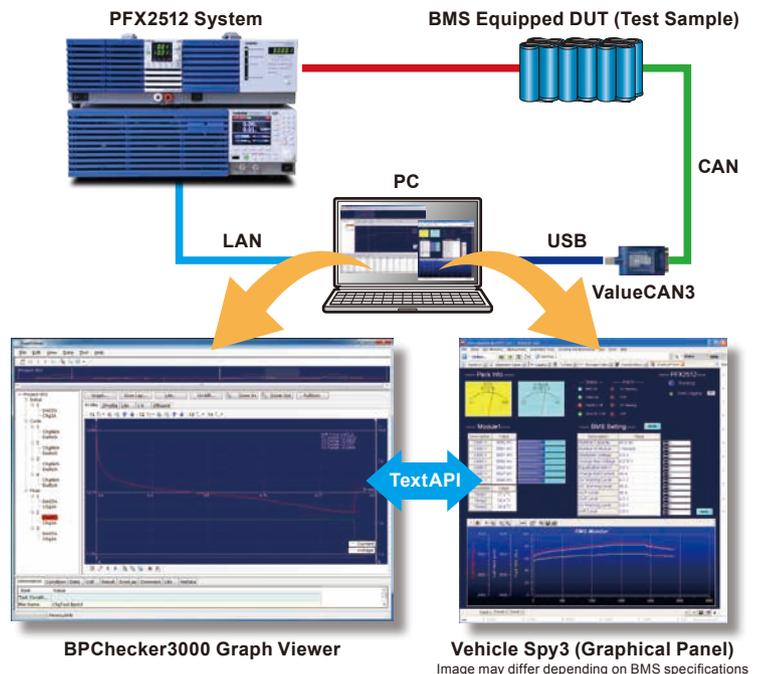**(May not be realized depending on BMS specifications*)**
● Record data BMS data during charge/discharge test (save text file)
● BPChecker3000 receives alarm generated by BMS and stops charge/discharge test
● Parameters assigned to BMS at charge/discharge starting time are automatically sent out
● Readout/writing BMS setting parameters

*Our company will perform Vehicle Spy3 customization upon accepting the presentation of BMS specifications by customers. Please consult us separately since BMS specifications are different by every customer. In addition, please contact the following for inquiry related to Application Software, [Vehicle Spy3].

Embedded Car Unit (ECU) Developing Tool;
Intrepid Control Systems Japan, K.K.
HonCyo Amber Building 7F 6-52 Hon-Cyo, Naka-ku, Yokohama-shi, Kanagawa-ken, 231-0005 Japan
Phone: +81 45-263-9294 www.intrepidcs.com

■ **System Outline Drawing**

PFX2512 System

BMS Equipped DUT (Test Sample)

PC

CAN

LAN

USB

ValueCAN3

TextAPI

BPChecker3000 Graph Viewer

Vehicle Spy3 (Graphical Panel)
Image may differ depending on BMS specifications

The System with PFX2500 Series

● Applied configuration (model ID) [As of the end of March 2022]

Model ID is used for combination of the selected power supply and electronic load if you wish to have a combination that is not on the available model ID list, please consult with us.
More model IDs will be added in future. The latest information for the system configuration is available on our website.

Model ID PFX2512	Power supply for charge	Electronic load for discharge
7103	PWR1600L	PLZ1004W (2 units in parallel)*2
7105 *4	PAT60-67T	PLZ1004W+2000WB *1
7106	PWR1600L	PLZ1004W *2
7107	PAS10-70	PLZ1004W *2
7110	PAS40-27	PLZ1004W *2
7112	PAS10-35	PLZ334W *2
7119	PWR1600L	PLZ1004W+2004WB *1
7122	PAS60-12	PLZ664WA *2
7124	PAS40-9	PLZ1004W *2
7125	PWR1600L	PLZ664WA *2
7126	PWR801L	PLZ1004W *2
7127	PWR801ML	PLZ1004W *2
7128	PWR1201ML	PLZ1004W *2
7151	PWR401L	PLZ205W *2
7152	PWR401ML	PLZ205W *2
7153	PWR401L	PLZ405W *2
7154	PWR401ML	PLZ405W *2
7155	PWR801L	PLZ1205W *2
7156	PWR801ML	PLZ1205W *2
7157	PWR1201L	PLZ1205W *2
7158	PWR1201ML	PLZ1205W *2
7159	PWR1201ML	PLZ1205W (2 units in parallel)*2
7160	PWR1201ML	PLZ1205W+2405WB *1

Model ID PFX2532	Power supply for charge	Electronic load for discharge
7301	PWR1600L(2 units in parallel)	PLZ1004W*2 + 2004WB
7302	PAT60-133T	PLZ1004W*2 + 2004WB x 2 (2 units in parallel)*3
7303	PAT40-200T	PLZ1004W*2 + 2004WB x 2 (2 units in parallel)*3
7304	PAT40-200T	PLZ1004W*2 + 2004WB
7305	PWR1600L	PLZ1004W*2
7306	PAT40-200T	PLZ1004W*2
7307	PWR1601L	PLZ1004W*2 x 2 (2 units in parallel)
7351	PWR1201L	PLZ1205W*2
7352	PWR1201L	PLZ1205W*2 x 2
7353	PAT60-133T	PLZ1205W*2 + 2405WB x 2
7354	PAT40-200T	PLZ1205W*2
7355	PAT40-200T	PLZ1205W*2 + 2405WB
7356	PAT40-200T	PLZ1205W*2 + 2405WB x 2
7357	PAT40-200T	PLZ1205W*2 + 2405WB x 3
7358	PAT40-200T	PLZ1205W*1 + 2405WB x 4
7359	PAT80-100T	PLZ1205W*1 + 2405WB x 4

*1. M range *2. H range
*3. Can be replaced with the Kikusui SR Large Capacity Electronic Load Smart Rack System PLZ5004W.
*4. A separate cable is required. For details, contact your Kikusui agent or distributor.

*A SC07-PFX (optional) is necessary to connect the PWR-01 series with the PFX2500 series.
*A SC05-PFX (optional) is necessary to connect the PLZ-5W series with the PFX2500 series.

● Note on selecting power supply for charge (route loss)

Application of the charge current causes a voltage drop in the DUT cable, connecting cables, the current pass route of the PFX2500 series, etc. The power loss at charging caused by this voltage drop is the route loss. The maximum power that can be used for charging is the value from which the route loss is subtracted.
[Maximum charge power = Maximum rated power of DC power supply - Route loss]

● Note on selecting electronic load for discharge (minimum operating voltage for discharge)

The electronic load has minimum operating voltage (1.5 V in PLZ1004W), and it does not operate at the voltage below the specified level. The result of an addition of this level and the route loss (voltage drop) is the minimum operating voltage for discharge.
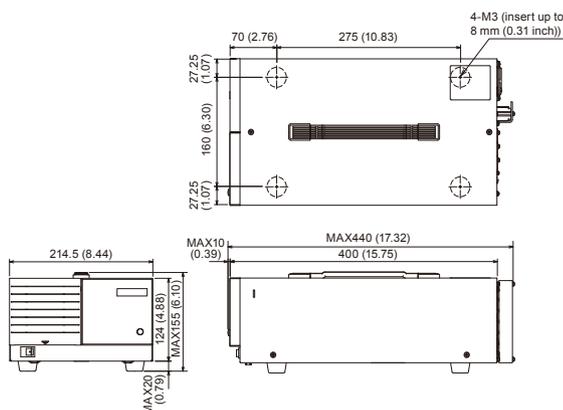[Minimum operating voltage for discharge = Minimum operating voltage of electronic load + Voltage drop caused by route loss]
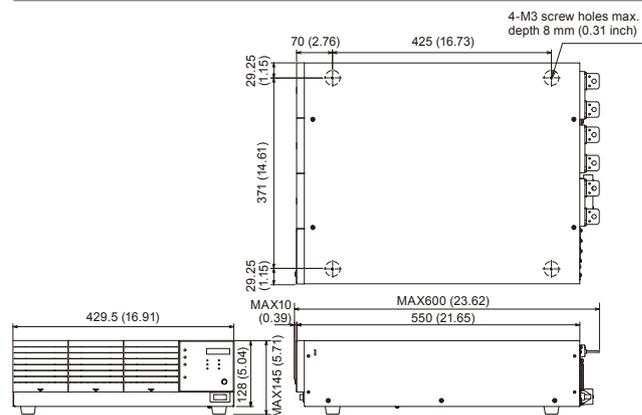
[Conceptual diagram of route loss]
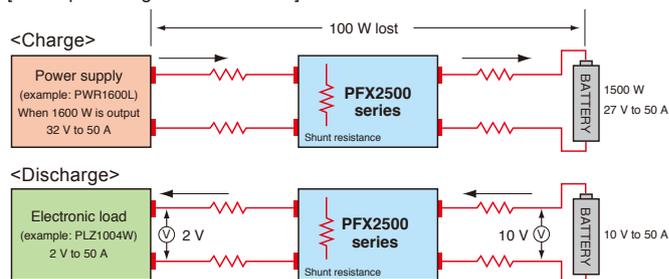
Outline Drawing

Unit mm (inches)

[PFX2512]

[PFX2532]

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