P F X 2 4 0 0 S E R I E S

CAPACITOR TESTER
PFX2400 Series

Tester for EDLC (Electric Double Layer Capacitor) test
Fully independent channel operations
LAN interface handles setting, operation and data collection
Capable of measuring voltage of reference electrode
Centralized management by dedicated application software
Data sampling at 1 ms or 100 ms

KIKUSUI

Fully supported for testing the large capacity and the low internal resistance devices.

Capacitor Tester
PFX2400 SERIES

The Capacitor Tester PFX2400 Series is dedicated to design charge/discharge testers for electric double layer capacitors. The voltage rating is 5V, targeting single-cell batteries, and a lineup of 4 models is available: 5A/12-ch, 35A/4-ch, 70A/2-ch, and 140A/1-ch.
In recent years, the electric double layer capacitor has been increasing its capacity, and it can be used in electric automobiles as power sources for starting the engine and for assistance during acceleration. Wider use of these capacitors is expected as a new energy source for raising automobile fuel economy and also improving exhaust quality. The Capacitor Tester PFX 2400 Series meets the need for more advanced and specialized tests related to the two key issues facing the wider use of electric double layer capacitors: power storage technologies and power management (energy optimization).

Series line-up

Model	Ch	Voltage / Current / Power	Applications
PFX2411	12 ch	5 A 5 A 5 A 5 A 5 A 5 A 5 A 5 A 5 A 5 A 5 A 5 A 5 V/ 5 A 25 W × 12 ch [300 W]	Electric Double Layer Capacitors
PFX2421	4 ch	35 A 35 A 35 A 35 A 5 V/ 35 A 175 W × 4 ch [700 W]	Electric Double Layer Capacitors
PFX2431	2 ch	70 A 70 A 5 V/ 70 A 350 W × 2 ch [700 W]	The high-capacity Electric Double Layer Capacitors
PFX2441	1 ch	140 A 5 V/ 140 A 700 W × 1 ch [700 W]	The high-capacity Electric Double Layer Capacitors

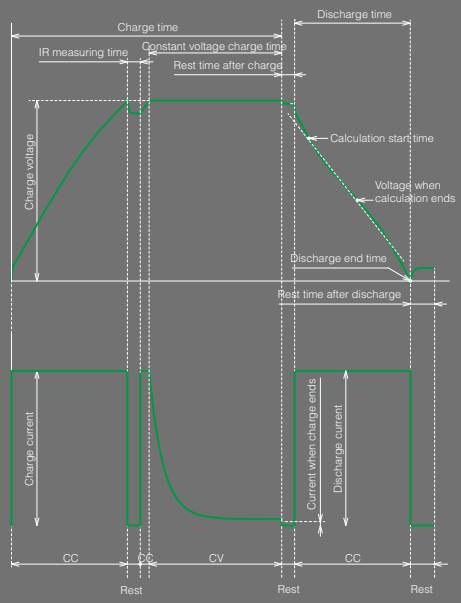
Compliant with IEC 62576(2009) / JIS D1401 !

Electric double layer capacitors for use in hybrid electric vehicles
- Standards for charge/discharge characteristic tests

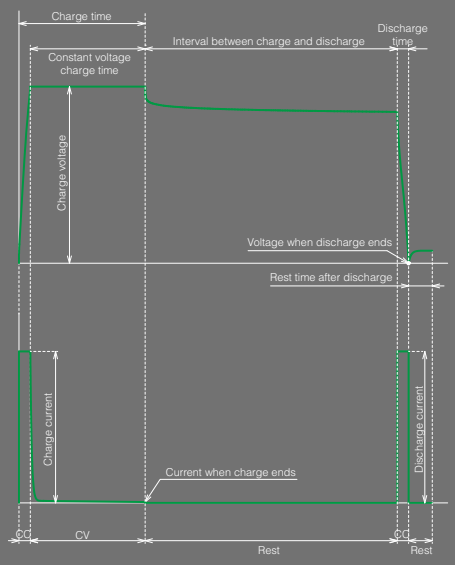
Compliant with IEC 62576(2009) / JIS D1401

The PFX2400 series can perform following tests.

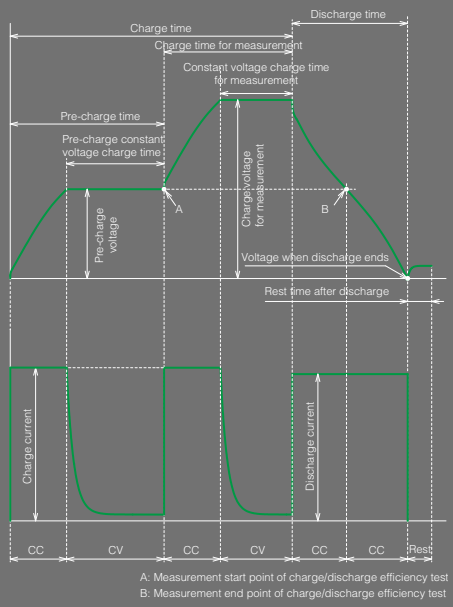
● **Cycle Test**



● **Voltage Hold Test**



● **Charge-Discharge Efficiency Test**



A: Measurement start point of charge/discharge efficiency test
B: Measurement end point of charge/discharge efficiency test

The Charge-Discharge mode for the diverse applications

Charging method (Constant Current - Constant Voltage / Constant Current / Constant Power / Step)
Discharge method (Constant Current - Constant Voltage / Constant Current / Constant Power / Step)

High-speed data sampling

Adopting the LAN communication interface realizes the simultaneous data sampling of the current and voltage.

Fully independent channel operations

The absolute independence of operations on all channels allow you to conduct the combined testing of the different characteristics of EDLC's.
In consideration of synchronization with a thermostatic chamber, a synchronization function has been provided which performs control to extend the rest time.

Energy-saving designs

The PFX2400 controls to keep constant of the internal loss. While in the charging state, and it realizes the low power consumption.

Wide range of the AC input

The PFX2400 can be used at the location from the benchtop to the production line wherever the input power supply of 100 Vac to 240 Vac is provided.

The dedicated software applies to the wide versatility of testings.

Optional application software (SD008-PFX2400) is required to operate the PFX2400 Series.
The test pattern of the "JIS D 1401" and "JIS C 5160" has been provided in the software, so you can easily set and execute the test conditions of the capacitor complied to the JIS standard.
Refer to page 4 for details.

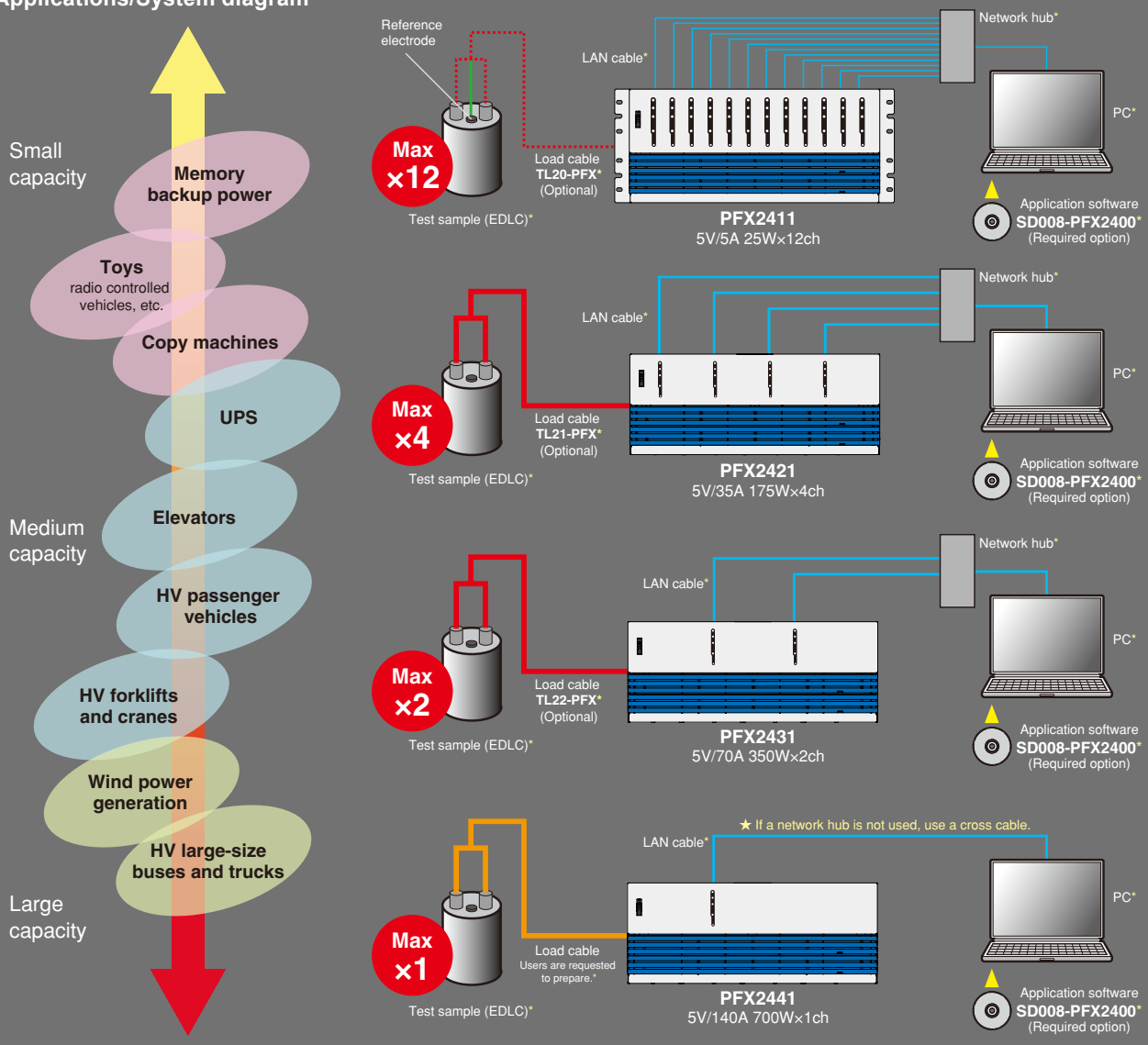
System Configuration

Dedicated application software, SD008-PFX2400 is required to run the PFX2400 series. For configuration of the system, in addition to the PFX2400 series and SD008-PFX2400, you will need a PC, network hub, LAN cable and load cable (optional).

Example : PFX2411

Product	Model
Capacitor tester	PFX2411
Application software	SD008-PFX2400
Load cable	TL20-PFX
PC	*Users are requested to prepare these items
Network hub	
LAN cable	

● Applications/System diagram



*Not included in the PFX2411. They are optional, or users are requested to prepare them separately.

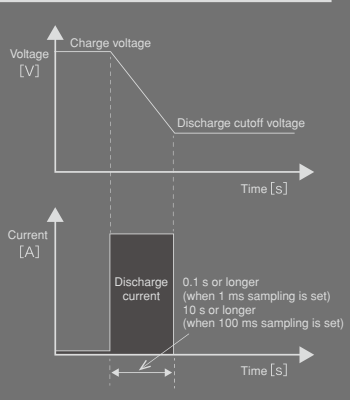
Capacity of test samples (capacitors)

When selecting a PFX2400 Series model, use the table below as a guideline to the capacities of the test capacitors.

Model	PFX2411	PFX2421	PFX2431	PFX2441
Electrostatic capacity	0.1F or higher	0.5F or higher	1F or higher	2F or higher

Setting the test conditions

If the data sampling interval is 1 ms, set the discharge current based on the test sample (capacitor) electrostatic capacity so that the time from starting discharge to cut off is 0.1 s or longer. If the data sampling interval is 100 ms, set the discharge current based on the test sample (capacitor) electrostatic capacity so that the time from starting discharge to cut off is 10 s or longer.



Centralized management by PC is capable of setting the test condition to execution of the test and to analysis of the test data

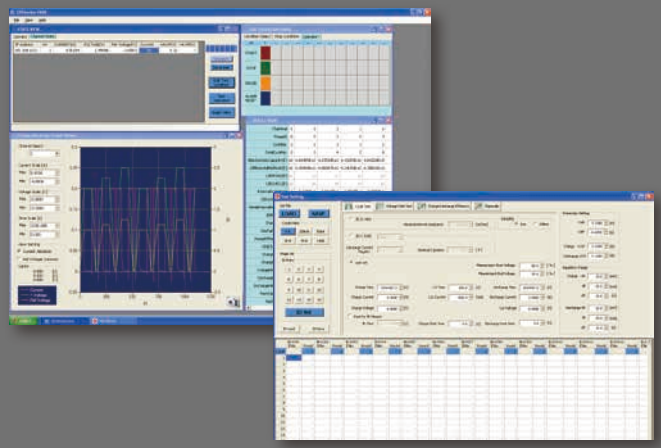
Application software

SD008-PFX2400

The SD008-PFX2400 package contains following three application software.

CPChecker2400

Using the PFX2400 series with this application software, you can create test conditions for the cycle test, voltage hold test and charge/discharge efficiency test and execute the tests.
An operation panel is provided independently for each channel, and individual test per channel can be executed. For setting the test conditions, selections for JIS D 1401 and JIS C 5160 are provided. You can easily set the capacitor test conditions based on the JIS. The test results are saved in text files (CSV format); so it can be used with other spreadsheet software.



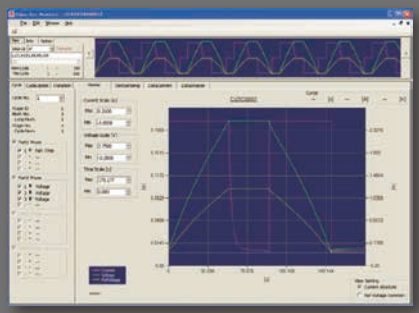
- Multi-channel control *1
- Channel number assignment
- Test condition configuration and saving
- Test start, stop, pause, and alarm reset
- Test result display
- Test result file creation and saving (CSV format)
- Measured value monitoring
  (charge and discharge current, terminal voltage, and reference electrode voltage)
- HOVP/HUVP voltage display
- Rest hold

*1 The number of channels that can be controlled varies depending on the data acquisition interval.For example, if a test cycle is 600 s, up to 96 channels can be controlled under the following conditions.
- ΔV: 0.5 % of the charge-discharge voltage
- ΔI: 0.5 % of the charge-discharge current
- ΔT: 10 s

The maximum number of 12 channels that can be displayed on the screen.

CPChecker2400 Plus

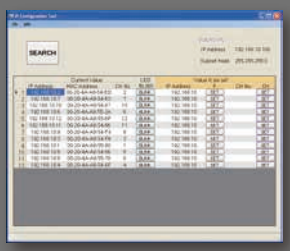
CPChecker 2400 Plus is software that graphs the test data that was created by CPChecker 2400 on the screen or printing. In addition to the test data graphs, it can also display the test data values, electrostatic capacities, and other values calculated from the test data, making a range of data analysis possible.



- Graph display and graph overlay for each test cycle
- Display of test data acquired with CPChecker 2400
- Display and printing of transition graphs for all cycles
- Recalculation of the initial internal resistance and internal resistance following changes to the calculation conditions

IP Configuration Tool *2

The IP Configuration Tool is to set the IP address and channel number of the Capacitor Tester PFX2411. The IP address*3 and channel number can be changed by this software.



►IP address:192.168.0.0 to 192.168.255.254
►Channel number: 0 to 256

*2 When using only 1 unit of the PFX2400 series, IP Configuration Tool is not required.
*3 When IP Configuration Tool is not used, it is necessary to set the IP address and subnet mask of the personal computer with which CPChecker2400 is used according to the range of IP address of the PFX2400 series.

[System requirements]

■CPChecker2400 and CPChecker2400 Plus
- PC running Microsoft Windows XP Service Pack 3 or later, Windows Vista, Windows 7, or Windows 8
- Microsoft Windows Installer 3.1 (may need to be installed on Windows XP; included on the CD)
- Microsoft .NET Framework 3.5 SP1 (included on the CD)
- Microsoft Chart Controls for Microsoft .NET Framework 3.5 (included on the CD)
- 2 GB or more of memory
- Monitor with a resolution of 1280 x 1024 dots or higher
- 100 MB 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
- Mouse or other pointing device
- 10BASE-T or 100BASE-TX LAN port

*1 If you only need to use one channel without a switching hub, you can connect the PFX2400 Series directly to a PC using a crossover LAN cable.

■IP Configuration Tool
- PC running Microsoft Windows XP Service Pack 3 or later, Windows Vista, Windows 7, or Windows 8
- Microsoft Windows Installer 3.1 (may need to be installed on Windows XP; included on the CD)
- Microsoft .NET Framework 3.5 SP1 (included on the CD)
- 256 MB or more of memory
- Monitor with a resolution of 1024 x 768 dots or higher
- CD-ROM drive
- Mouse or other pointing device
- 10BASE-T or 100BASE-TX LAN port

■Others
- LAN cables (the number of straight cables required is the number of PFX2400 channels that you want to use and one straight cable for the PC) *1
- Switching hub (the minimum number of ports required is the number of PFX2400 channels that you want to use and one port for the PC)
- PFX2400 Series
- Adobe Reader 6 or later (required to view the PDF version of the operation guide)

Specifications

Item/Model		PFX2411	PFX2421	PFX2431	PFX2441
Charge function					
Charge method	CC	Constant current charge			
	CC-CV	Constant current charge until the specified voltage is reached, followed by constant voltage charge			
	CP	Constant power charge			
	Step	Charging is performed in steps that are combinations of the CC, CC-CV, and CP modes			
Cutoff condition	CV time	In CC-CV mode, charging stops when the CV time elapses after charging switches to CV mode			
	Voltage	In CC mode, charging stops when the specified voltage is reached			
	Current	In CC-CV mode, charging stops when the specified current is reached after charging switches to CV mode			
	Charge time	Charging stops when the specified time elapses after charging has been started			
Rest end condition	Rest time	Charging stops when the specified time elapses after charging has been paused			
	Synchronization	The pause extension feature is used to synchronize the stopping of charging			
Discharge function					
Discharge method	CC	Constant current discharge			
	CC-CV	Constant current discharge until the specified voltage is reached, followed by constant voltage discharge			
	CP	Constant power discharge			
	Step	Discharging is performed in steps that are combinations of the CC, CC-CV, and CP modes			
Cutoff condition	CV time	In CC-CV mode, discharging stops when the CV time elapses after discharging switches to CV mode			
	Voltage	In CC mode, discharging stops when the specified voltage is reached			
	Current	In CC-CV mode, discharging stops when the specified current is reached after discharging switches to CV mode			
	Charge time	Discharging stops when the specified time elapses after discharging has been started			
Rest end condition	Rest time	Discharging stops when the specified time elapses after discharging has been paused			
	Sync commands during extended idling	The pause extension feature is used to synchronize the stopping of discharging			
Measurement function					
Voltage	Measuring interval	1 ms or 100 ms			
Current	Measuring interval	1 ms or 100 ms			
Reference electrode voltage	Measuring interval	1 ms or 100 ms	—	—	—
Time		Elapsed time from the start of test			
Cycle count		Counts the total number of cycles			
Protection function					
Overvoltage (overcharge) protection	Software OVP	Cleared when the corresponding channel's output is turned off and when a reset command is received			
	Hardware OVP				
Overcurrent protection	Software OCP	Cleared when the corresponding channel's output is turned off and when a reset command is received			
Overheat protection (OHP)		Activated when the heatsink temperature is at 90 °C ± 5 °C. Cleared when the corresponding channel's output is turned off and when a reset command is received			
Undervoltage(Overdischarge) protection	Software UVP	Cleared when the corresponding channel's output is turned off and when a reset command is received			
	Hardware UVP	—	Cleared when the corresponding channel's output is turned off and when a reset command is received		
External alarm input		Testing stops at the HI level (2 V to 12 V)			
Display function (status monitoring)					
Power status	POWER	A test is in progress or the PFX2400 series is ready for a test to be executed. The POWER/STANDBY LED lights in green.			
	STANDBY	The PFX2400 series is in standby mode or the system is ready to be stopped. The POWER/STANDBY LED lights in orange.			
Charge and discharge status	CHARGE	Charging. The CHARGE/DISCHARGE/REST LED lights in red.			
	DISCHARGE	Discharging. The CHARGE/DISCHARGE/REST LED lights in green.			
	REST	Resting. The CHARGE/DISCHARGE/REST LED lights in orange.			
Control status	CC	Constant current mode. The CC/CV/CP LED lights in red.			
	CV	Constant voltage mode. The CC/CV/CP LED lights in green.			
	CP	Constant power mode. The CC/CV/CP LED lights in orange.			
Alarm	ALARM	Alarm detected. Protection function activated. The ALARM/WARNING LED lights in red.			
	WARNING	Alarm detection warning. A warning to indicate that a protection function will be activated if a test is executed. The ALARM/WARNING LED lights in orange.			
Rated output					
Number of outputs		12 ch	4 ch	2 ch	1 ch
Charge current range		0.0000 A to 5.0000 A	0.000 A to 35.000 A	0.00 A to 70.00 A	0.00 A to 140.00 A
Charge voltage range		0.0000 V to 5.0000 V			
Charge power range		0.1 W to 25.00 W	0.1 W to 175.0 W	1 W to 350 W	1 W to 700 W
Discharge current range		0.0000 A to 5.0000 A	0.000 A to 35.000 A	0.00 A to 70.00 A	0.00 A to 140.00 A
Discharge voltage range		-0.5000 V to 5.0000 V		0.0000 V to 5.0000 V	
Discharge power range		0.01 W to 25.00 W	0.1 W to 175.0 W	1 W to 350 W	1 W to 700 W
Maximum charge and discharge power		25.0 W	175.0 W	350 W	700 W
Setting accuracy					
Current setting	Range	0.0000 A to 5.0000 A	0.000 A to 35.000 A	0.00 A to 70.00 A	0.00 A to 140.00 A
	Accuracy	±(0.07 % of set +1 mA)	±(0.15 % of set +15 mA)	±(0.15 % of set +30 mA)	±(0.15 % of set +60 mA)
	Resolution	100 µA	1 mA	10 mA	10 mA
	Ripple *1	1.5 mArms or less	20 mArms or less	40 mArms or less	60 mArms or less
Voltage setting	Range	0.0000 V to 5.0000 V			
	Accuracy *2	±(0.07 % of set + 1.5 mV)			
	Resolution	100 µA			
	Ripple *1	3 mVrms or less			
Power setting	Range	0.01 W to 25.00 W	0.1 W to 175.0 W	1 W to 350 W	1 W to 700 W
	Accuracy *3	±(0.1 % of set + 10 mW)	±(0.1 % of set +100 mW)	±(0.1 % of set + 1 W)	±(0.1 % of set + 1 W)
	Resolution	10 mW	100 mW	1 W	1 W

*1. 10 Hz to 500 kHz band *2. During charging *3. At a capacitor voltage of 0.5 V or higher

Specifications

Item/Model		PFX2411	PFX2421	PFX2431	PFX2441
Measurement accuracy					
Current measurement	Range	0.00000 A to 5.00000 A	0.000 A to 35.000 A	0.000 A to 70.000 A	0.000 A to 140.000 A
	Accuracy *1 *2	±(0.07 % of rdng + 1 mA)	±(0.15 % of rdng + 15 mA)	±(0.15 % of rdng + 30 mA)	±(0.15 % of rdng + 60 mA)
	Resolution	10 µA	100 µA	1 mA	1 mA
	Sampling time	1 ms or 100 ms			
Voltage measurement	Range	-0.50000 V to 5.00000 V			
	Accuracy *1 *2	±(0.07 % of rdng + 1.5 mV)			
	Resolution	10 µV			
	Sampling time	1 ms or 100 ms			
Reference electrode voltage measurement	Range	-0.50000 V to 5.00000 V	—	—	—
	Accuracy *1 *2	±(0.07 % of rdng +1.5 mV)	—	—	—
	Resolution	10 µV	—	—	—
	Sampling time	1 ms or 100 ms	—	—	—
Protection function					
Overvoltage (Overcharge) protection *3					
Hardware OVP	Setting range	0.10 V to 6.00 V			
	Resolution	10 mV			
	Setting accuracy	±300 mV			
	Operating time	100 ms or less			
Software OVP	Setting range	-0.6000 V to 5.1000 V			
	Resolution	100 µV			
	Setting accuracy	±(0.07 % of set + 1.5 mV)			
	Operating time	100 ms or less			
Undervoltage (Overdischarge) protection *3					
Hardware UVP	Setting range	—	-1.80 V to 4.00 V		
	Resolution	—	10 mV		
	Setting accuracy	—	±300 mV		
	Operating time	—	100 ms or less		
Software UVP	Setting range	-0.6000 V to 5.1000 V			
	Resolution	100 µV			
	Setting accuracy	±(0.07 % of set + 1.5 mV)			
	Operating time	100 ms or less			
Overcurrent protection					
Software OCP	Setting range	0.0000 A to 5.1000 A	0.000 A to 35.700 A	0.00 A to 71.40 A	0.00 A to 142.80 A
	Resolution	100 µA	1 mA	10 mA	10 mA
	Setting accuracy	±(0.07 % of set +1 mA)	±(0.15 % of set +15 mA)	±(0.15 % of set +30 mA)	±(0.15 % of set +60 mA)
	Operating time	100 ms or less			
Built-in fuse		7 A	40 A	40 A×2	40 A×4
Overheat protection (inside the equipment)					
OHP	Operating temperature	Activated when the built-in heatsink temperature is at 90 °C ± 5 °C			
AC input overcurrent protection		Through the power switch (breaker) or the AC input fuse			
External alarm input					
Allowable input voltage		+12 V			
Input level		HI level : 2 V to 12 V / LOW level : OPEN or 0 V to 1 V			
Minimum pulse width		50 ms			
Interface					
Ethernet(LAN)		Automatic 10BASE-T/100BASE-TX selection			
Connector		RJ45			
General specifications					
Nominal input rating / Input voltage range		100 Vac to 240 Vac, 50 Hz to 60 Hz / 90 Vac to 250 Vac			
Power consumption		Per channel:Approx. 100 VA (when charged at 5 V, 5 A)	Per channel:Approx. 500 VA (when charged at 5 V, 35 A)	Per channel:Approx. 1000 VA (when charged at 5 V, 70 A)	2000 VAmax (when charged at 5 V, 140 A)
		For all 12 channels:2000 VAmax (when all channels are charged at 5 V, 5 A)	For all 4 channels:2000 VAmax (when all channels are charged at 5 V, 35 A)	For all 2 channels:2000 VAmax (when all channels are charged at 5 V, 70 A)	
Operating temperature and humidity range		0 °C to +40 °C, 20 %rh to 85 %rh (no condensation)			
Storage temperature and humidity range		-20 °C to +60 °C, Within 90 %rh (no condensation)			
Operating environment		Indoor. Overvoltage category II			
Elevation		Up to 2000m			
Isolation voltage	Across the I/O terminals and chassis	±50 Vmax			
Insulation resistance	Across the AC input and chassis	100 MΩ or more			
	Across the DC output and chassis	20 MΩ or more			
Withstand voltage	Across the AC input and chassis	No malfunction at 1500 Vac for 1 minute			
Leakage current		3.5 mA or less			
Voltage dip tolerance		Approx.50 ms	10 ms or more (when the output current is 50 %)		
Safety *4		Complies with the requirements of the following standards. Low Voltage Directive 2006/95/EC, EN 61010-1 (Class I, Pollution degree 2)			
Dimensions		Refer to the dimensions on page 8.			
Weight		Approx.23 kg (50.71 lbs)	Approx.27 kg (60 lbs)	Approx.26 kg (57.32 lbs)	Approx.26 kg (57.32 lbs)
Accessories	Power code	1 pc.			
	OUTPUT terminal cover	—	4 sets	2 sets	1 set
	M8 output terminal screw	—	8 sets	4 sets	2 sets
	M4 output terminal screw	—	8 pcs.	4 pcs.	2 pcs.
	Sensing connector	—	—	2 pcs.	1 pc.
	OUTPUT connector	12 pcs.	—	—	—
	Operation manual	1 pc.			

*1. Ambient temperature: 18 °C to 28 °C *2. Measurable range: Within the ranges indicated above *3. The capacitance of the connected DUT (capacitor) must be 0.1 F or more for the PFX2411, 0.5 F or more for the PFX2421, 1 F or more for the PFX2431, or 2 F or more for the PFX2441. When data sampling is performed at 1 ms intervals, the discharge current must be such that the time between when discharging starts and when it finishes is 0.1 s or more. When data sampling is performed at 100 ms intervals, the discharge current must be such that the time between when discharging starts and when it finishes is 10 s or more. *4. Does not apply to specially ordered or modified products.

Ordering information

● **Main part**

Model	Part	Remarks
PFX2411	Capacitor Tester	5 V/5 A 25 W × 12 ch
PFX2421	Capacitor Tester	5 V/35 A 175 W × 4 ch
PFX2431	Capacitor Tester	5 V/70 A 350 W × 2 ch
PFX2441	Capacitor Tester	5 V/140 A 700 W × 1 ch

TL20-PFX

● **Option**

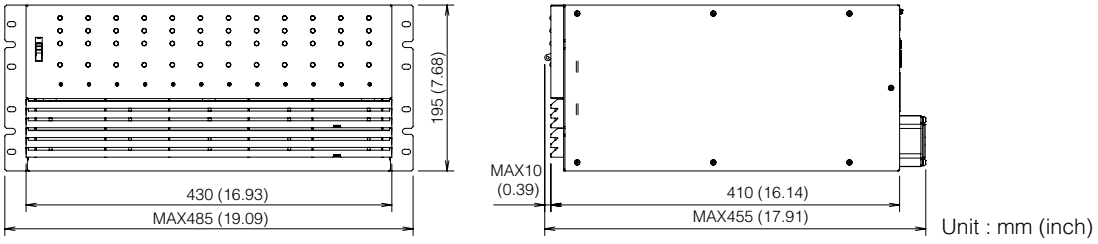
Model	Part	Remarks
SD008-PFX2400	Application software	Required to operate the PFX2400 Series
TL20-PFX	Output cable for PFX2411	10 Vdc/6 A AWG16 About 7 m in length
TL21-PFX	Output cable for PFX2421	10 Vdc/80 A AWG4 About 5 m in length
TL22-PFX	Output cable for PFX2431	10 Vdc/80 A AWG4 About 5 m in length
KRB4	Rack mount brackets	For inch-type rack (EIA)
KRB200	Rack mount brackets	For metric type rack (JIS)

TL21-PFX

[Caution] Application software (SD008-PFX2400) is required in order to operate the PFX2400 Series.
Also, the system is not provided with an output cable for connecting the sample (capacitor). Prepare an output cable that is suitable for the sample (capacitor).
A separate load cable is required for each channel that is used.

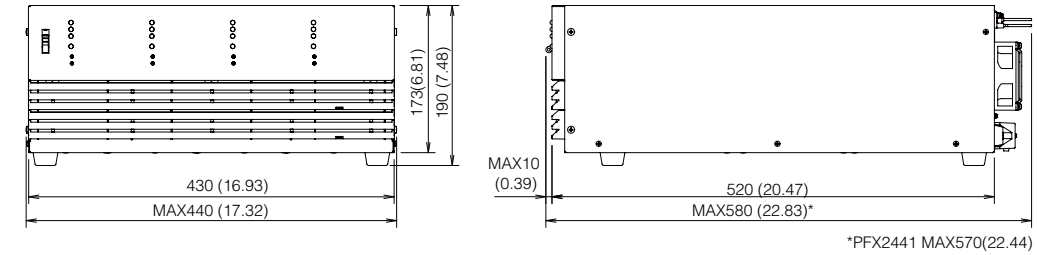
Dimensions

PFX2411



Unit : mm (inch)

PFX2421/2431/2441



*PFX2441 MAX570(22.44)

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