User Manual

1696B Series
Programmable DC Power Supplies

bkprecision.com

B&K PRECISION

Safety Summary

The following safety precautions apply to both operating and maintenance personnel and must be followed during all phases of operation, service, and repair of this instrument.

⚠WARNING

Before applying power to this instrument:

- Read and understand the safety and operational information in this manual.
- Apply all the listed safety precautions.
- Verify that the voltage selector at the line power cord input is set to the correct line voltage. Operating the instrument at an incorrect line voltage will void the warranty.
- Make all connections to the instrument before applying power.
- Do not operate the instrument in ways not specified by this manual or by B&K Precision.

Failure to comply with these precautions or with warnings elsewhere in this manual violates the safety standards of design, manufacture, and intended use of the instrument. B&K Precision assumes no liability for a customer's failure to comply with these requirements.

Category rating

The IEC 61010 standard defines safety category ratings that specify the amount of electrical energy available and the voltage impulses that may occur on electrical conductors associated with these category ratings. The category rating is a Roman numeral of I, II, III, or IV. This rating is also accompanied by a maximum voltage of the circuit to be tested, which defines the voltage impulses expected and required insulation clearances. These categories are:

Category I (CAT I): Measurement instruments whose measurement inputs are not intended to be connected to the mains supply. The voltages in the environment are typically derived from a limited-energy transformer or a battery.

Category II (CAT II): Measurement instruments whose measurement inputs are meant to be connected to the mains supply at a standard wall outlet or similar sources. Example measurement environments are portable tools and household appliances.

Category III (CAT III): Measurement instruments whose measurement inputs are meant to be connected to the mains installation of a building. Examples are measurements inside a building's circuit breaker panel or the wiring of permanently-installed motors.

Category IV (CAT IV): Measurement instruments whose measurement inputs are meant to be connected to the primary power entering a building or other outdoor wiring.

⚠WARNING

Do not use this instrument in an electrical environment with a higher category rating than what is specified in this manual for this instrument.

⚠WARNING

You must ensure that each accessory you use with this instrument has a category rating equal to or higher than the instrument's category rating to maintain the instrument's category rating. Failure to do so will lower the category rating of the measuring system.

Electrical Power

This instrument is intended to be powered from a CATEGORY II mains power environment. The mains power should be 115 V RMS or 230 V RMS. Use only the power cord supplied with the instrument and ensure it is appropriate for your country of use.

Ground the Instrument

⚠WARNING

To minimize shock hazard, the instrument chassis and cabinet must be connected to an electrical safety ground. This instrument is grounded through the ground conductor of the supplied, three-conductor AC line power cable. The power cable must be plugged into an approved three-conductor electrical outlet. The power jack and mating plug of the power cable meet IEC safety standards.

⚠WARNING

Do not alter or defeat the ground connection. Without the safety ground connection, all accessible conductive parts (including control knobs) may provide an electric shock. Failure to use a properly-grounded approved outlet and the recommended three-conductor AC line power cable may result in injury or death.

⚠WARNING

Unless otherwise stated, a ground connection on the instrument's front or rear panel is for a reference of potential only and is not to be used as a safety ground. Do not operate in an explosive or flammable atmosphere.

⚠WARNING

Do not operate the instrument in the presence of flammable gases or vapors, fumes, or finely-divided particulates.

⚠WARNING

The instrument is designed to be used in office-type indoor environments. Do not operate the instrument

- In the presence of noxious, corrosive, or flammable fumes, gases, vapors, chemicals, or finely-divided particulates.
- In relative humidity conditions outside the instrument's specifications.
- In environments where there is a danger of any liquid being spilled on the instrument or where any liquid can condense on the instrument.
- In air temperatures exceeding the specified operating temperatures.
- In atmospheric pressures outside the specified altitude limits or where the surrounding gas is not air.
- In environments with restricted cooling air flow, even if the air temperatures are within specifications.
- In direct sunlight.

This instrument is intended to be used in an indoor pollution degree 2 environment. The operating temperature range is 0°C to 40°C and 20% to 80% relative humidity, with no condensation allowed. Measurements made by this instrument may be outside specifications if the instrument is used in non-office-type environments. Such environments may include rapid temperature or humidity changes, sunlight, vibration and/or mechanical shocks, acoustic noise, electrical noise, strong electric fields, or strong magnetic fields.

Do not operate instrument if damaged

⚠WARNING

If the instrument is damaged, appears to be damaged, or if any liquid, chemical, or other material gets on or inside the instrument, remove the instrument's power cord, remove the instrument from service, label it as not to be operated, and return the instrument to B&K Precision for repair. Notify B&K Precision of the nature of any contamination of the instrument.

Clean the instrument only as instructed

⚠WARNING

Do not clean the instrument, its switches, or its terminals with contact cleaners, abrasives, lubricants, solvents, acids/bases, or other such chemicals. Clean the instrument only with a clean dry lint-free cloth or as instructed in this manual. Not for critical applications

⚠WARNING

This instrument is not authorized for use in contact with the human body or for use as a component in a life-support device or system.

Do not touch live circuits

⚠WARNING

Instrument covers must not be removed by operating personnel. Component replacement and internal adjustments must be made by qualified service-trained maintenance personnel who are aware of the hazards involved when the instrument's covers and shields are removed. Under certain conditions, even with the power cord removed, dangerous voltages may exist when the covers are removed. To avoid injuries, always disconnect the power cord from the instrument, disconnect all other connections (for example, test leads, computer interface cables, etc.), discharge all circuits, and verify there are no hazardous voltages present on any conductors by measurements with a properly-operating voltage-sensing device before touching any internal parts. Verify the voltage-sensing device is working properly before and after making the measurements by testing with known-operating voltage sources and test for both DC and AC voltages. Do not attempt any service or adjustment unless another person capable of rendering first aid and resuscitation is present.
Do not insert any object into an instrument's ventilation openings or other openings.

⚠WARNING

Hazardous voltages may be present in unexpected locations in circuitry being tested when a fault condition in the circuit exists.

⚠WARNING

Fuse replacement must be done by qualified service-trained maintenance personnel who are aware of the instrument's fuse requirements and safe replacement procedures. Disconnect the instrument from the power line before replacing fuses. Replace fuses only with new fuses of the fuse types, voltage ratings, and current ratings specified in this manual or on the back of the instrument. Failure to do so may damage the instrument, lead to a safety hazard, or cause a fire. Failure to use the specified fuses will void the warranty.

Servicing

⚠WARNING

Do not substitute parts that are not approved by B&K Precision or modify this instrument. Return the instrument to B&K Precision for service and repair to ensure that safety and performance features are maintained.

For continued safe use of the instrument

- Do not place heavy objects on the instrument.
- Do not obstruct cooling air flow to the instrument.
- Do not place a hot soldering iron on the instrument.
- Do not pull the instrument with the power cord, connected probe, or connected test lead.
- Do not move the instrument when a probe is connected to a circuit being tested.

Safety Symbols

Symbol	Description
DANGER	indicates a hazardous situation which, if not avoided, will result in death or serious injury.
WARNING	indicates a hazardous situation which, if not avoided, could result in death or serious injury
CAUTION	indicates a hazardous situation which, if not avoided, will result in minor or moderate injury
	Refer to the text near the symbol.
	Electric Shock hazard
	Alternating current (AC)
	Chassis ground
	Earth ground
	This is the In position of the power switch when instrument is ON.
	This is the Out position of the power switch when instrument is OFF.
NOTICE	is used to address practices not related to physical injury.

Contents

IMPORTANT SAFETY INSTRUCTIONS

1. Do not use this apparatus near water.
2. Clean only with dry cloth.
3. Do not block any ventilation openings.
4. Do not install unit near any heat source or heating emitting devices.
5. Prevent the power cord from being walked on or pinched.
6. Unplug this unit during lightning storms or when unused for long periods of time.

1.1 Precautions

1. The unit must be used within its specified range.
   The rated input voltages can be found on the rating label at the back of the unit. Before plugging into the AC supply, check with the rating label.
2. This unit has a built-in Tracking O.V.P. (Over Voltage Protection) feature. In the event of the output voltage becoming 10% greater than the set value, the O.V.P. will be triggered and the output power will be cut off and >**FAULT**< warning will appear.
   When you get this warning, switch off the unit and remove all loading.
   If you switch the unit back on again it should resume normal operation. In the event that this problem persists contact the manufacturer.
3. This unit has a built-in buzzer, which will sound when Over Temperature/Overload/Over Voltage Protection has been triggered. When you get this warning, switch the unit off and remove all loading.
   Check your load and output voltage setting.

   Allow the unit to cool down for 30 minutes.
   If you switch the unit back on it should resume normal operation.
   In the event this problem persists contact B&K Precision for assistance.
4. Only use the supplied software and optional accessories with this unit.
5. Refer all servicing to manufacturer.

Warning! The maximum output voltage for Model 1698B is up to 60Vdc. It may be hazardous to touch metal part of the terminals.

Product Overview

2.1 Package Contents

- Power Supply (1696B, 1697B or 1698B)
- Power cord
- USB cable

2.2 Power Requirements

Parameter	Value
Voltage	100 - 240 VAC
Frequency	50/60 Hz
Fuse	4A Slow Blow 250V

2.3 Interface and Controls

Item	Description
1	Rotary control knob
2	Up/Down keys
3	Dual function control keys
4	Negative output terminal (black)
5	Chassis ground terminal (green)
6	Positive output terminal (red)

Front Panel Items

Item	Description
1	Power Switch
2	Power Input
3	RS-485 Port
4	USB Port

Rear Panel Items

Figure 2.1 Interface and Controls

Basic Operation

3.1 Setting Voltage and Current by Rotary Knob and Up/Down Keys

1. Press V-set/I-set to switch between setting voltage and current.
2. Rotate control knob  or press ▲ and ▼ to set voltage/current level. Press the control knob to toggle the cursor position.

3.2 Setting Voltage and Current Using Keypad

1. Press V-set/I-set to switch between setting voltage and current.
2. Use the numeric keypad 0 to 9 to input voltage or current value.
3. Press Enter Enter to confirm input values.

Operating Instructions

4.1 Output Enable

1. Press Shift Clear.
2. Press Enter within 3 seconds to ENABLE output Output.

4.2 Output Disable

1. Press Shift Clear.
2. Press Enter within 3 seconds to DISABLE output Output.

4.3 Locking the Keypad and Rotary Knob

1. Press Shift Clear.
2. Press V-set/I-set within 3 seconds to lock keypad and rotary knob.

4.4 Unlocking the Keypad and Rotary Knob

1. Press Shift Clear
2. Press V-set/I-set within 3 seconds to unlock keypad and rotary knob.

4.5 Setting the RS-485 Address

1. Press Shift Clear
2. Press RS-485 Program within 3 seconds to enter into RS-485 address set menu.
3. Use numeric keypad 0 to 9 to input an address from 1 to 255.
4. Press Enter to confirm.

4.6 Setting the Upper Voltage Limit

1. Press Shift Clear.

2. Press 0 on the numeric keypad within 3 seconds to enter upper voltage limit adjustment menu. The first line says "Over" and the second if the voltage limit setting.

3. Use the numeric keypad 0 to 9 to input upper voltage limit.

4. Press Enter to confirm.

4.7 Enable Output at Power Up

This feature limits the upper level setting of output voltage to prevent inadvertent setting of high voltage, which may damage your application. The value of this upper voltage range limit will be retained until further reset.

1. Press Shift Clear.

2. Press the up arrow key within 3 seconds to enable output on power up.

4.8 Disable Output at Power Up

1. Press Shift Clear.

2. Press the down arrow key within 3 seconds to disable output on power up.

4.9 LCD Brightness

1. Press Shift Clear.

2. Press 3 on numeric keypad within 3 seconds to enter brightness menu.

3. Use the rotary knob to raise or lower brightness from 0 to 9.

4. Press Enter to confirm.

4.10 Enable/Disable SCPI

1. Press Shift Clear.
2. Press 4 on numeric keypad within 3 seconds to enter into SCPI enable/disable menu.
3. Use the rotary knob  to toggle between 'Y' to enable SCPI and 'N' to disable SCPI command protocol and use the extended protocol command set instead.
4. Press Enter to confirm.

Using Programming Features

5.1 Preset Program

1. Press **Program** RS-485 Program.
2. Use the numeric keypad 0 thru 9 to select a preset voltage and current value.
3. Use  and V-set/I-set to adjust preset voltage and current values.
4. Press Enter within 3 seconds to confirm or press Shift Clear to exit program setting.

5.2 Setting Timed Program

The unit can be programmed to operate up to 20 timed subprograms (0-19 STEP as shown in the display). Each subprogram is capable of running a preset operation period of 1 second to 99 minutes and 99 seconds with its own preset voltage and current level. The timed subprogram can be set to run in sequence repeatedly from 1 to 9999 cycles or infinity run. You can run the unit through the sequence of subprograms for the input cycles number unless interrupted by pressing the CLEAR key.

1. Press Shift Clear then press 1 on the numeric keypad to enter program setting menu.
2. Use  to select a step to be modified.
3. Use the up ▲ and down ▼ keys to navigate between setting voltage, current, and time
4. Press Enter Enter to confirm and exit.

5.3 Run Timed Programming

1. Press Shift Clear then press 2 to select step program to run
2. Use  to select the number of steps to run (2 to 20) and press Enter.
   Ex. Selecting step 3 means run from step 1 to step 3
3. Input the desired number of cycles from 0000 to 9999 using the numeric keypad or rotary knob, press Enter to confirm and begin timed program. Leave this setting on 0000 for infinite cyclic run. Press Shift Clear to terminate the program.

Maintenance

6.1 Recalibration

The purpose of recalibration is to reduce the difference between the set values and the displayed values on the LCD display. Recalibration is only required when this difference is greater than 0.1 V for voltage or -0.01 A / +0.02 A for current.

6.2 Troubleshooting

Keypad and Dial do not work

Check key lock symbol for lock state, unlock unit by pressing Shift Clear then V-set/I-set key, otherwise switch the unit off and then back on to see if the problem persists.

No output power

Check the output for on/off symbol on the display. Press Shift Clear then Enter.

Cannot get a high voltage setting within the rated maximum

Check the upper voltage limit setting by pressing Shift Clear then 0. Adjust the maximum voltage limit with the ▲ and ▼ keys.

"OUT OF RANGE" keeps appearing

Check if the setting is within the rated range. If this occurs during voltage setting, refer to troubleshooting solution to the previous problem.

When keying in operations the unit keeps exiting and does not save inputs

Only 10 seconds are allowed for inputting and 3 seconds for operation mode settings.

PC Software Control and Installation

The PC software provides remote communication, data logging, front panel emulation, and timed programming capabilities using the USB or RS-485 interfaces. The software supports Windows 7, 8, 8.1, 10.

Note: Do not connect both USB and RS-485 simultaneously.

7.1 USB Driver Installation

Figure 7.1 Download Link

1. Click "CP210X_USB_Driver.zip" to begin the download
2. Whem complete, right click on the .zip folder and click "Extract All..."
3. Depending on your system right-click and run the 32-bit or 64-bit installer as administrator to begin installation, see **Figure 7.2**.

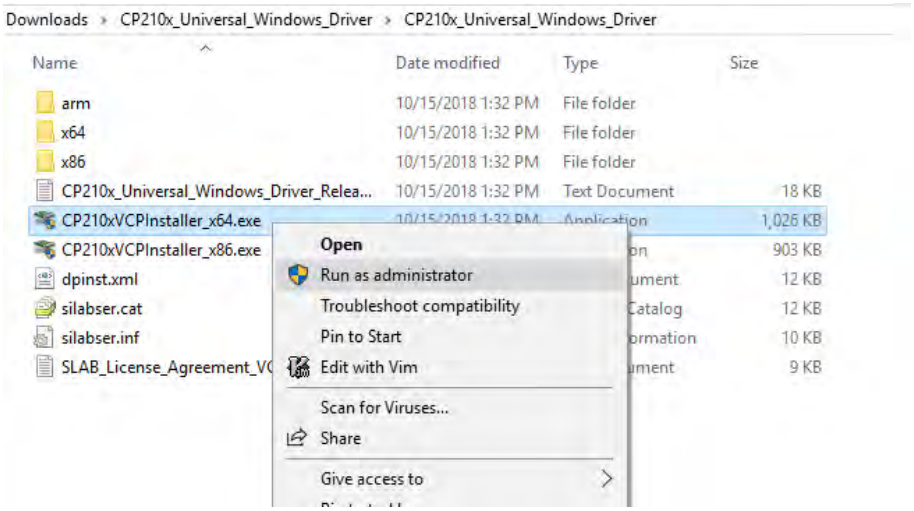

Figure 7.2 Install as the Administrator

7.2 Software Installation

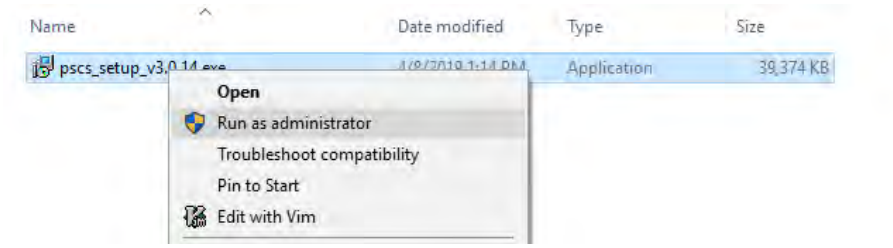

Figure 7.3

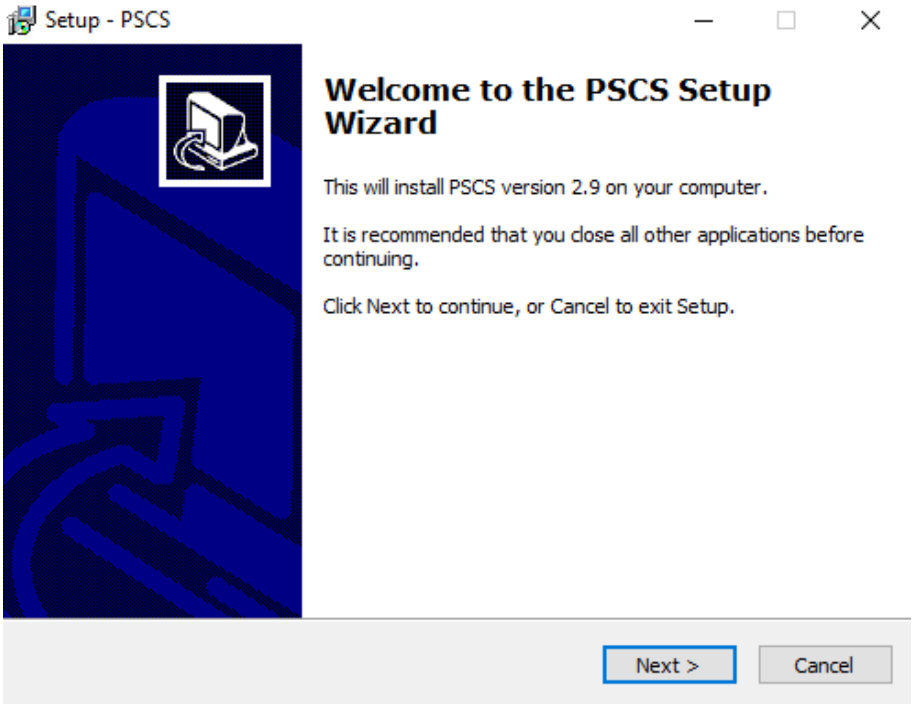

Figure 7.4

4. Click "Next" to continue. **Figure 7.4**
5. Select a destination location for the software. **Figure 7.5**
6. Select a location for the software shortcut. **Figure 7.6**
7. Check the box if you would like to create a desktop shortcut and click "Next" to continue. **Figure 7.7**
8. Click "Install" to begin installation. **Figure 7.8**

7.3 Multi-Unit Control

7.3.1 Connect Multiple Power Supplies to PC with RS-485

Use the RS-485 interface at the back of the power supply to daisy-chain up to 31 power supplies, see **Figure 7.9**. The USB to RS-485 adapter shown in **Figure 7.10** below is required.

7.4 Software Setup and Configuration

Connect the instrument to the PC with the supplied USB cable and power on the instrument. Ensure the drivers are installed and the device is connected. To install the drivers, refer to **Section 7.1** above for driver installation instructions.

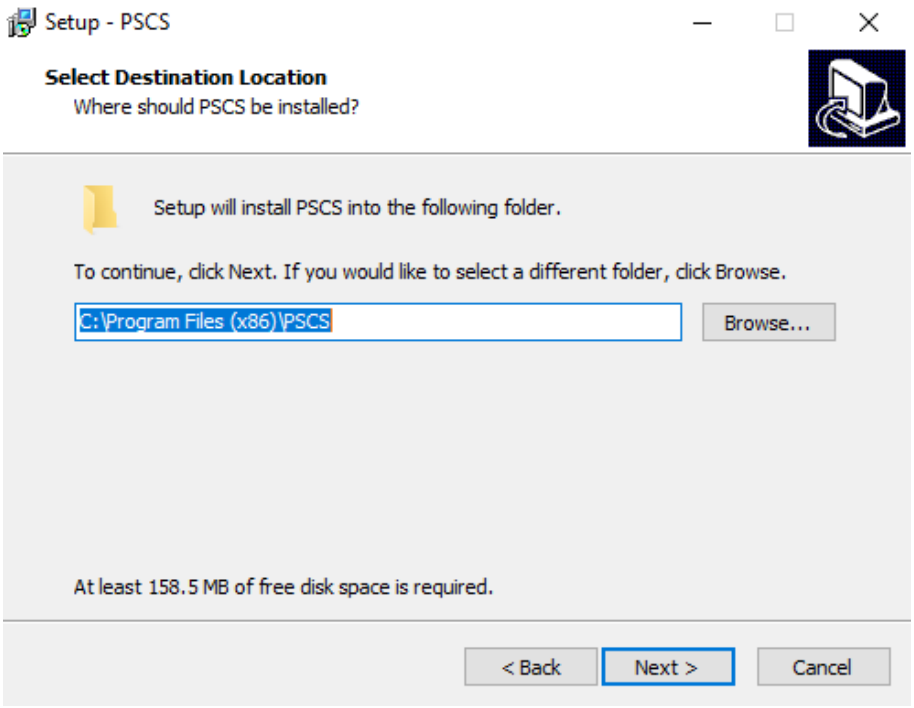

Figure 7.5

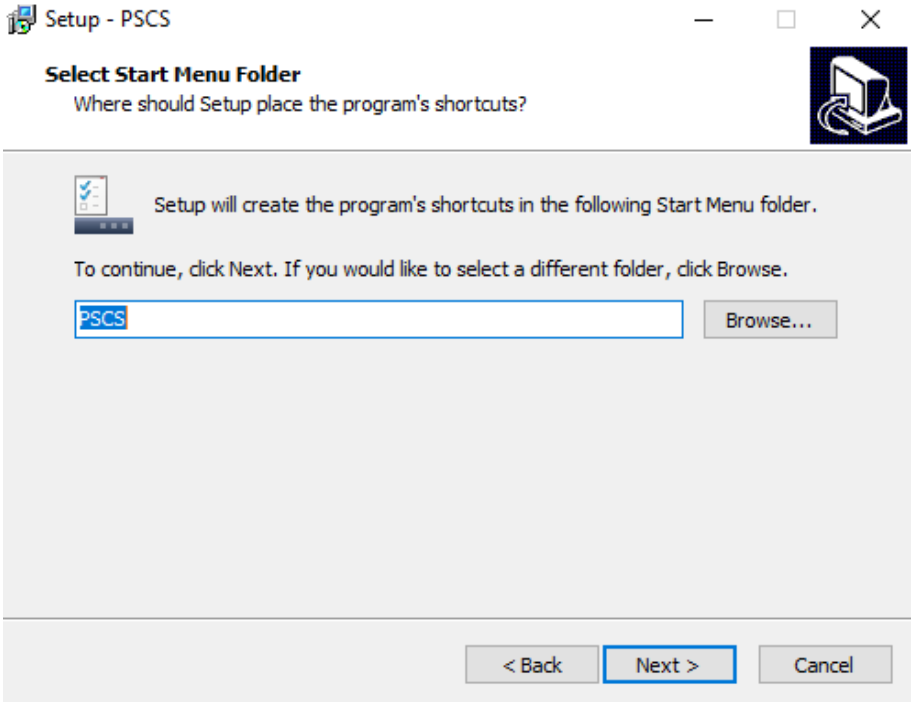

Figure 7.6

Also, the software uses the "SCPI" protocol, this must be enabled, see **Section 7.4.2**. With the instrument connected, open the PC software. **Figure 7.11** shows the screen to expect when the software starts. If there is already a saved connection the software will automatically connect to the instrument.

7.4.1 Setup a new instrument

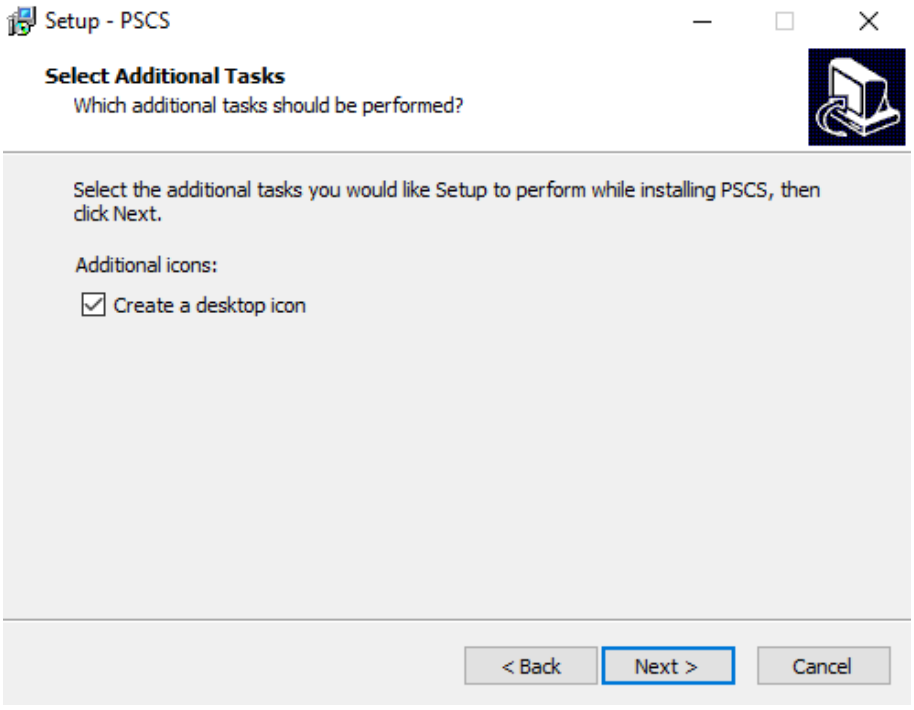

Figure 7.7

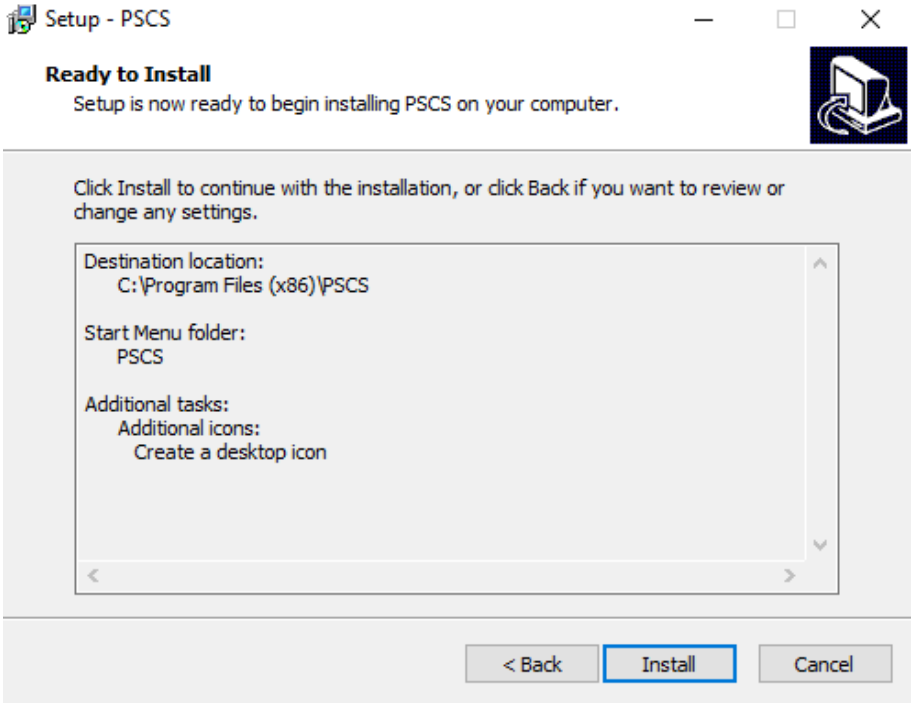

Figure 7.8

- Select the "Setting" tab. See **Figure 7.12**
- Click on "Edit" to access the connection settings. See **Figure 7.13**

Note: When using USB: Only connection name, connection type, and COMM port are required. See **Figure 7.14**

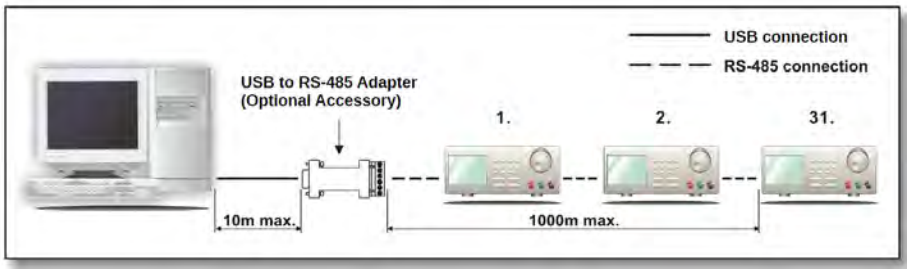

Figure 7.9 Connection diagram for multiple power supply control

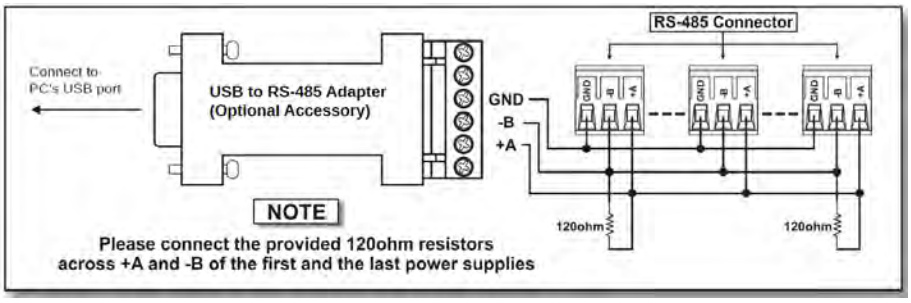

Figure 7.10 Connection diagram between USB adapter and RS-485 connectors

- Type in a connection name, select USB from the drop down, and select the correct COMM port assigned by your PC. Check the windows the device manager to determine the correct COMM port. In this case Windows has assigned COM port 12. Click "Save" and the black display will light up to indicate a successful connection. See **Figure 7.15**
- If using RS-485, enter the three digit ID displayed on the RS-485 setting on the instrument.
  - To set the RS-485 ID on the instrument press Shift Clear then RS-485 Program and use the ▲ and ▲ or numeric keypad entry to edit ID. Press Enter to save and exit.

If everything has gone well and the power supply is connected the software should look similar to **Figure 7.16**.
Display Panel

7.4.2 Enable SCPI protocol

Press Shift Clear then 4 to enter SCPI setting. Use to move the selector down next to the "n" and press Enter to save and exit. See **Figure 7.17**

7.4.3 Internal Timed Program

Configure up to 20 user defined voltage, current, and duration steps save to the instruments internal memory, or read parameters already stored in the internal memory for edit.

1. Click on the "Internal Timed Program" tab
2. Double-click on the desired cell and use the slider to set voltage and current values.
3. Set the number of cycles from 1 to 9999 and click Run to start, or click Save To PS to save the program into the instruments internal memory for future recall.

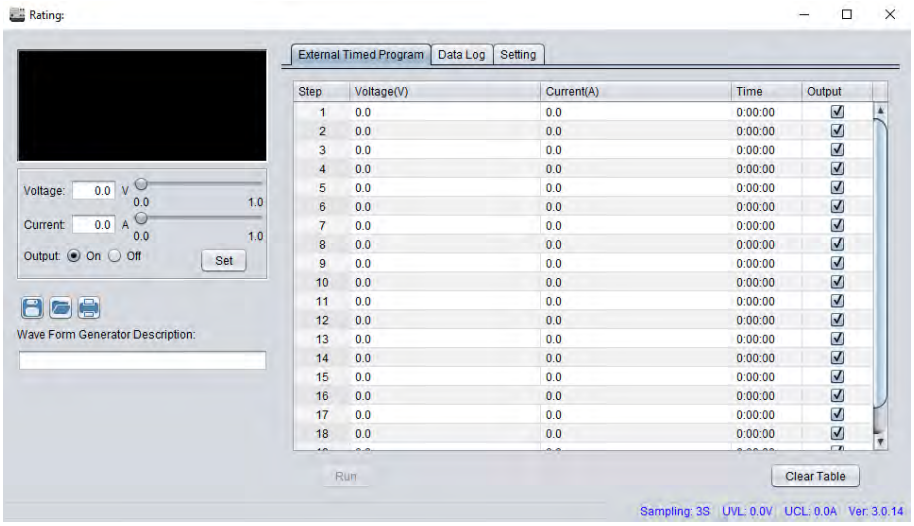

Figure 7.11

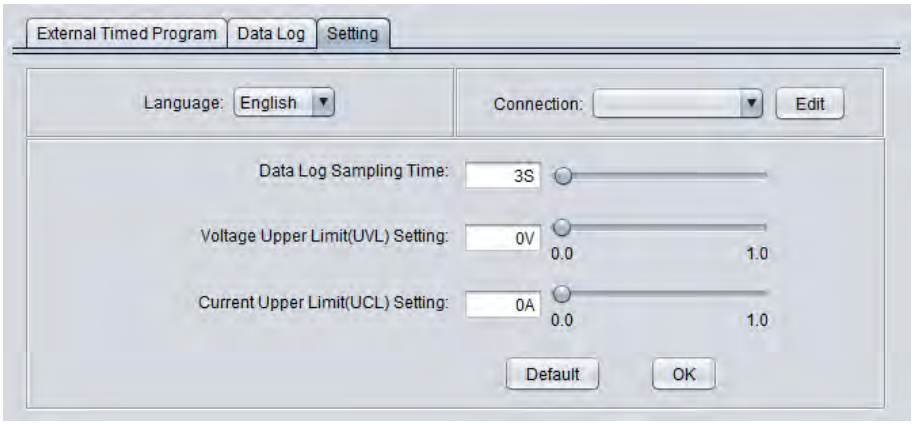

Figure 7.12

7.4.4 External Timed Program

External Timed Program is completely controlled by the PC. The PC counts the step time and changes the specific voltage and current levels of the power supply. Configure up to 20 user defined voltage, current, and duration steps.

1. Click on the "External Timed Program" tab. See **Figure 7.20**
2. Double-click on the desired cell and use the slider to set voltage and current values. **Figure 7.21**
3. Set step duration with the up/down buttons. The time can be set from 0 up to 9 hours 59 minutes and 59 seconds. If time set left at 0 the step will be skipped. See **Figure 7.22**
4. Set the number of cycles from 0-999. Leave this setting at 0 for continuous loop.
5. Click Run to start running the cycle.

7.4.5 Internal Preset Memory

Preset up to 9 voltage and current combinations into memory for quick output. Set voltage and current with the slider bar and click Set to confirm. See **Figure 7.23**

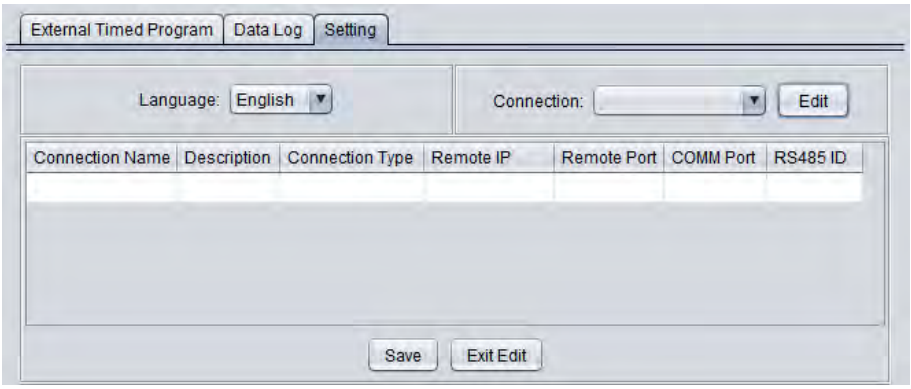

Figure 7.13

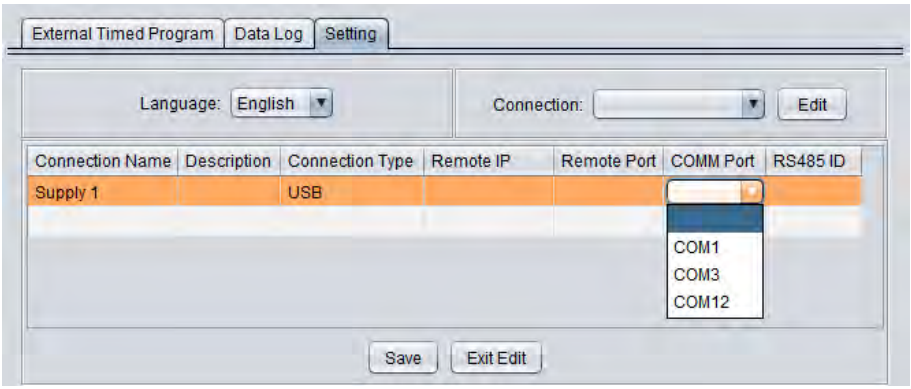

Figure 7.14

7.4.6 Data Logging

Data Log allows can be used to view present or stored output data, see **Figure 7.24**. Data can be saved and exported as .CSV spreadsheet file or sent to a printer.

7.4.7 Data Log Sampling Time and Voltage Upper Limit (UVL) Setting

Under the "Setting" tab:

- Adjust the data log sampling time. 1S means the voltage, current, and power reading will be recorded every 1 second.
- Set the Voltage Upper Limit (UVL) and general output setting and timed programming setting will not exceed this limit. See **Figure 7.25**
- Click OK to save.

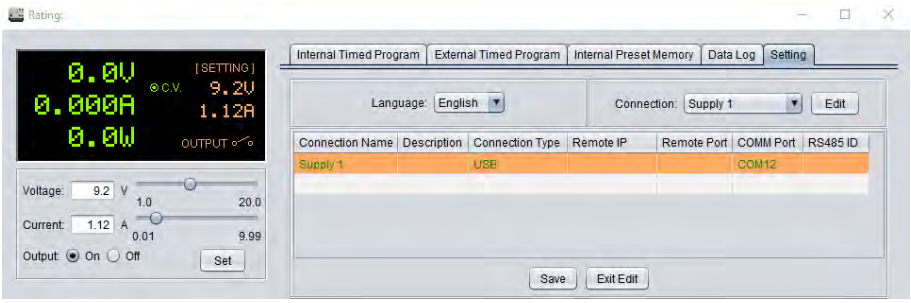

Figure 7.15

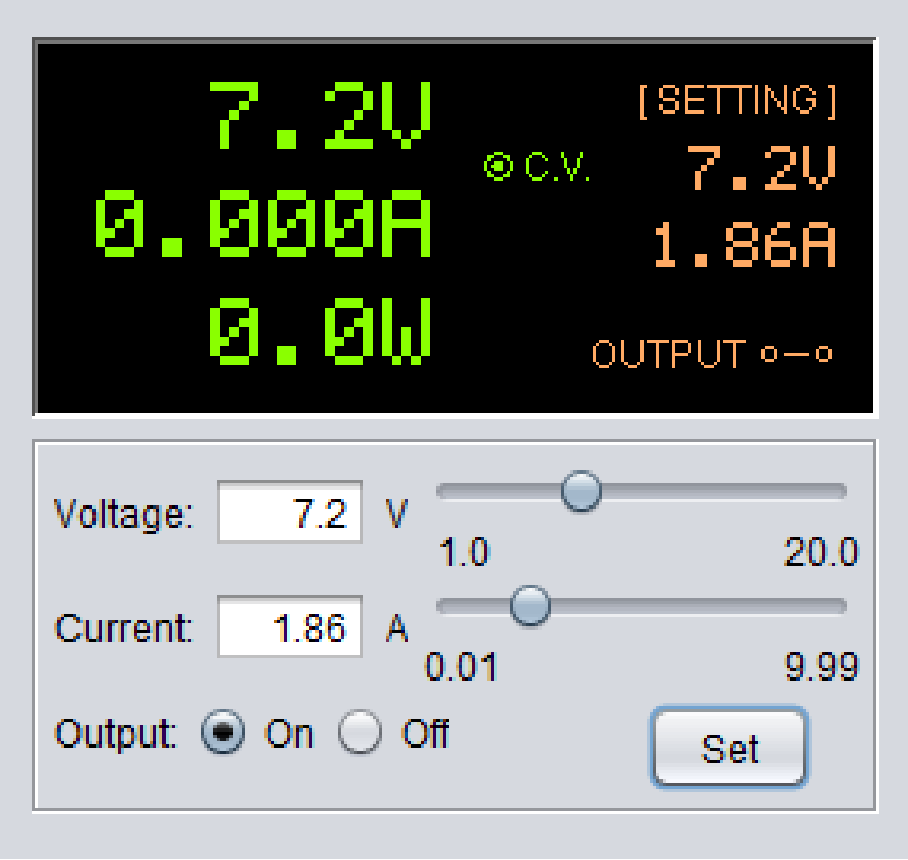

Figure 7.16

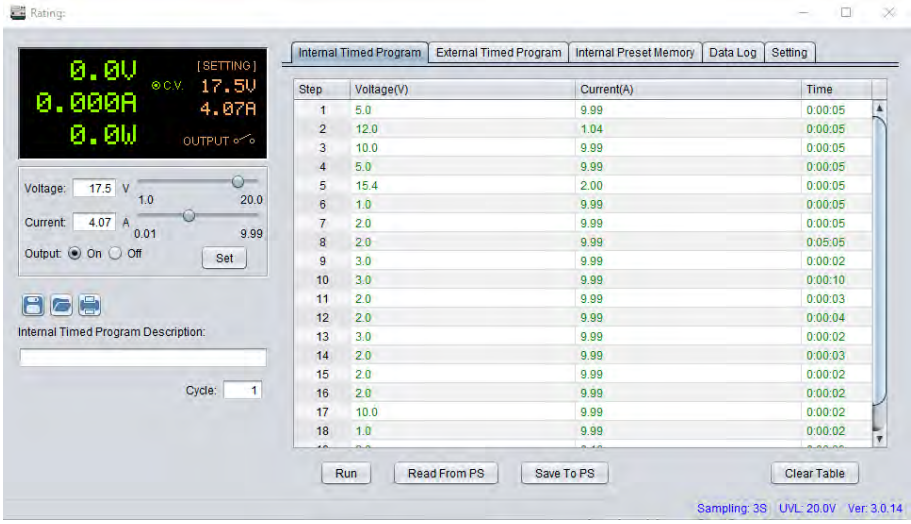

Figure 7.18

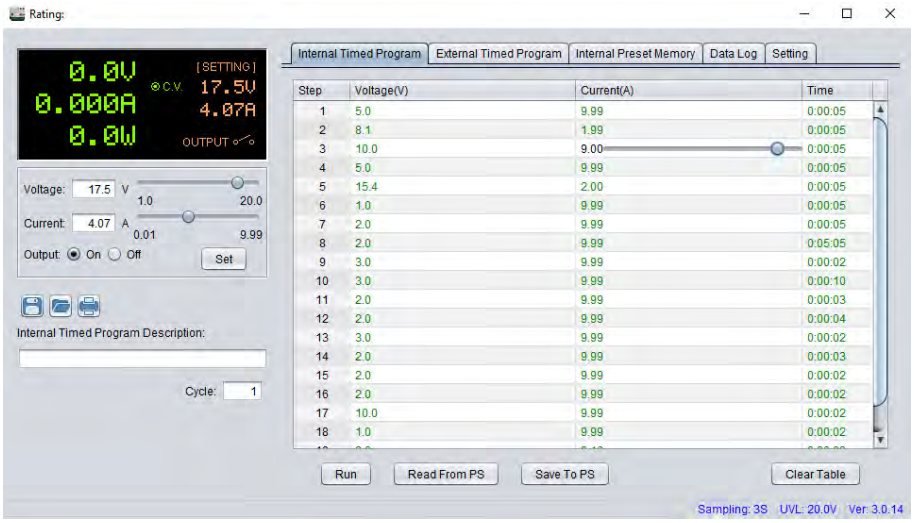

Figure 7.19

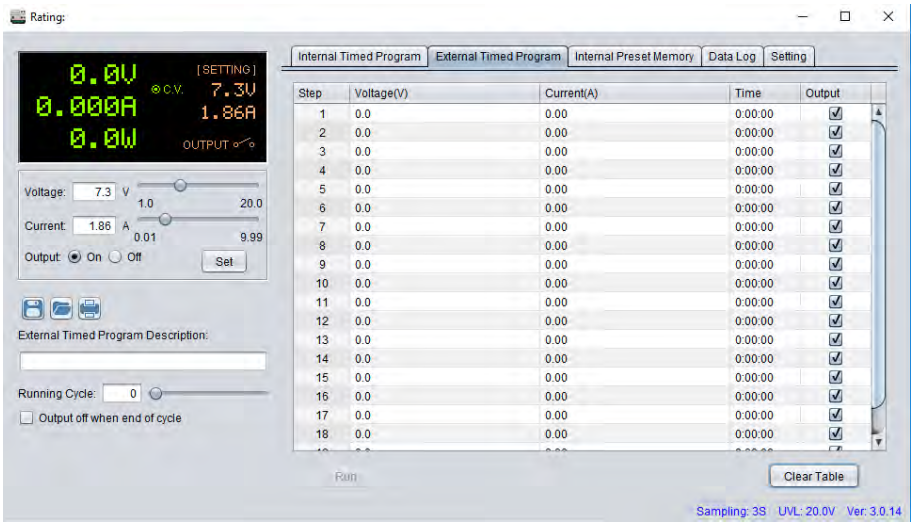

Figure 7.20

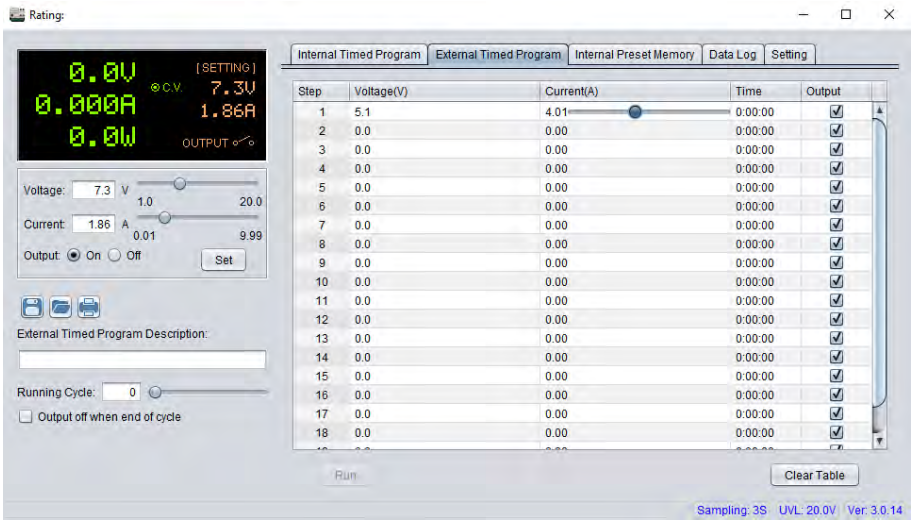

Figure 7.21

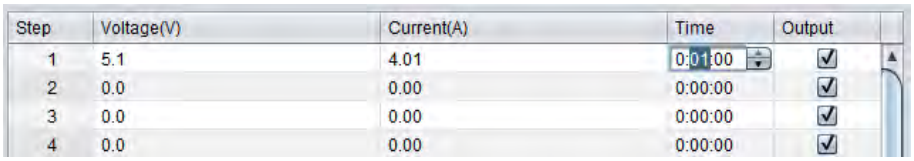

Figure 7.22

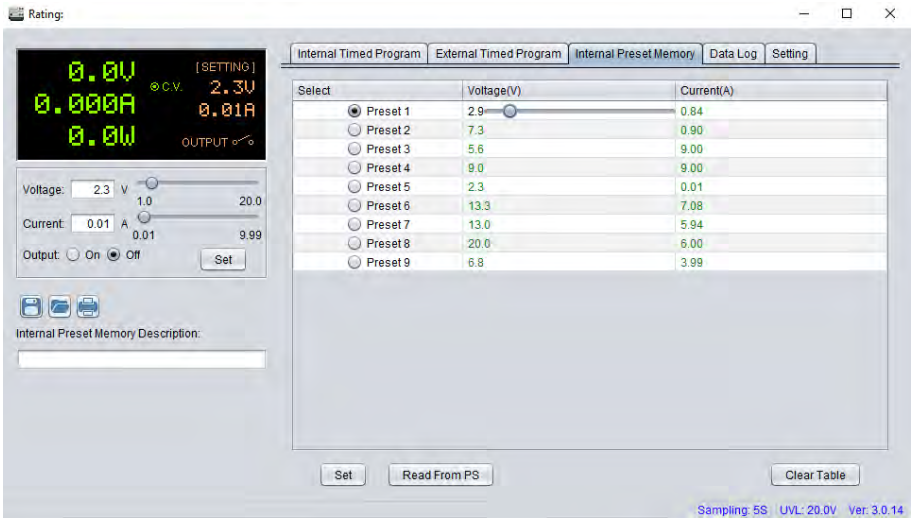

Figure 7.23

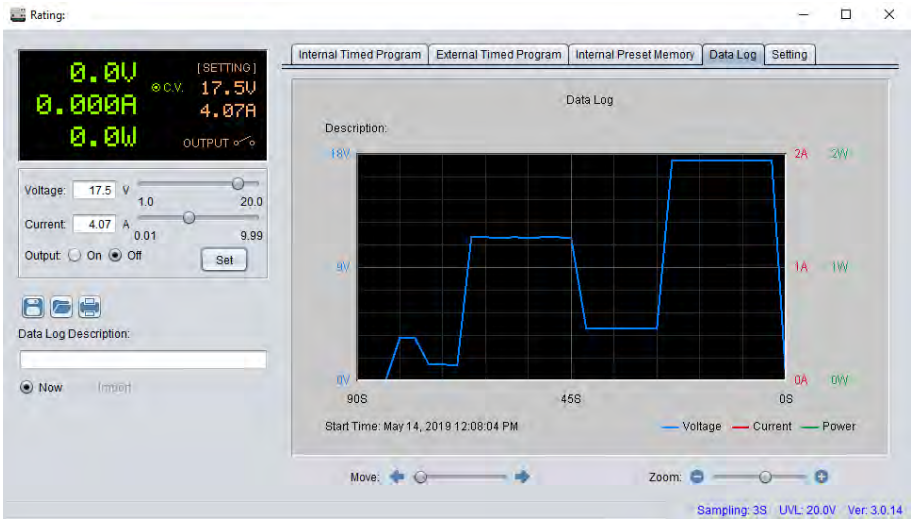

Figure 7.24

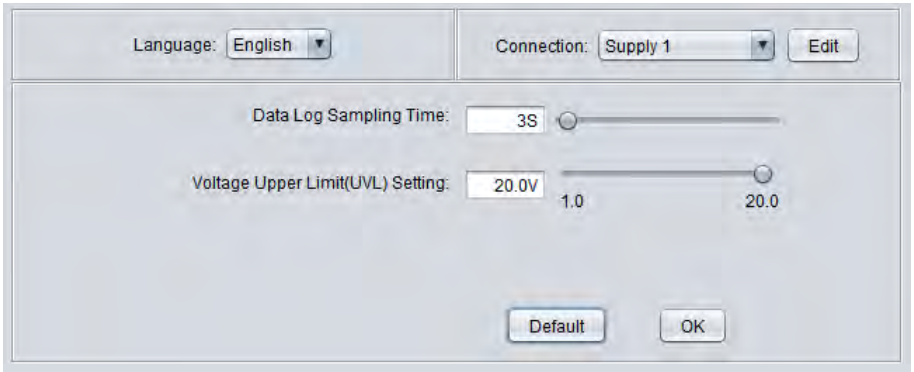

Figure 7.25

Specifications

Note: All specifications apply to the unit after:

1. A temperature stabilization time of 15 minutes over an ambient temperature range of 23 °C ± 5 °C.
2. Short correction operation performed before making measurement.

Specifications are subject to change without notice.

Specifications

Note: All specifications apply to the unit after a temperature stabilization time of 30 minutes over an ambient temperature range of 23 °C ± 5 °C.

Model	1696B	1697B	1698B
Output Rating			
Voltage	1 to 20 V	1 to 40 V	1 to 60 V
Current	0 to 10 A	0 to 5 A	0 to 3.3 A
Max Output Power	200 W		
Load Regulation			
Voltage	≤ 200 mV	≤ 200 mV	≤ 100 mV
Current	≤ 25 mA	≤ 15 mA	≤ 10 mA
Line Regulation			
Voltage	≤ 10 mV		
Programming/Readback Resolution			
Voltage	10 mV		
Current	1 mA		
Power	1 mW		
Meter Accuracy			
Voltage Meter	± (1% + 2 counts for V > 5 V)		
Current Meter	± (1% + 2 counts for I > 0.5 A)		
Ripple & Noise			
Voltage	≤ 30 mVp-p / ≤ 6 mVrms		
Current	≤ 10 mArms		
General			
Efficiency	≥ 70%		
AC Input	100 to 240 VAC ±10%, 50/60 Hz		
Display Meter	4-digit voltage, current and power meter		
I/O Interface	USB (type B), RS485		
Operating Temperature	32 °F to 104 °F (0 °C to 40 °C), ≤ 80% R.H		
Safety	LVD: EN61010-1:2010		
Electromagnetic Compatibility	EN55011, EN61000-3-2, EN61000-3-3, EN61000-6-1		
Dimensions	7.6" x 3.85" x 8.46" (193 mm x 98 mm x 215 mm)		
Weight	6.6 lbs. (3 kg)		
Warranty	2 years		
Included Accessories	PC software, RS485 adapter, USB cable, and test report		
Optional Accessories	RS232 to RS485 adapter (ATR-2485)		