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## 1. Introduction

The PowerSight\* Frequency Analysis Option (FAO) is a combination of hardware, firmware, and software that allows you to analyze the frequency content of commercial power from 3,000 Hz to 100,000 Hz. These are frequencies above the range of conventional power harmonics. Nevertheless, frequency content in this region can have important impacts on power systems. Since the heating effect of a given current increases with the frequency, very small currents can have large heating effects. For instance, one would expect 1 milliamp of current at 60,000 Hz to have a much greater heating effect than 1 amp does at 60 Hz.

To analyze the high frequency content of power, you will need to plug voltages into the Voltage Conditioning Adapter box and/or a current probe into the Current Probe Adapter Cable that is strapped to the output cable of the Voltage Conditioning Adapter box. The box and adapter are supplied with the FAO.

This exciting option turns your PowerSight meter into a hand-held spectrum analyzer, as well as a power quality analyzer.

## 2. Installing the FAO Option

The FAO (frequency analysis option) is only available for PowerSight models PS4000 & PS4500. The option needs to be installed by Summit Technology at the factory, since special circuitry is added to the meter during installation. Following installation, the PS4000 & PS4500 will look the same, but its capabilities will be greater. PSM version 3.1 or higher software will detect that the option has been installed and will automatically provide the added capabilities. In addition to the internal circuitry, an external Voltage Conditioning Adapter box will be supplied. It is required to do analysis of voltage and the adapter cable that is strapped to its output is required to do analysis of current.

### 3. Connecting to a Power Circuit

#### **To analyze the high frequency content of a voltage:**

First unplug the inputs to the voltage terminals (V1, V2, V3, Vn) and the 12Vdc input of your PowerSight (This will improve the results). Isolating the circuit will improve the accuracy of the frequency analysis.

 **Caution!** Do not connect any input to the Vn input of PowerSight while the Voltage Conditioning Adapter box is plugged into PowerSight. Voltages plugged into the box will appear at the Vn input. Although the current flow is limited, **there can be a danger of shock and injury under certain circumstances.** In addition, the frequency analysis results will be inaccurate while a lead is plugged into the Vn input.

Next, plug the output cable of the Voltage Conditioning Adapter box into the In input (the neutral current input) of the PS4000 or PS4500. Lastly, plug two voltage leads into the V1 and V2 inputs of the Voltage Conditioning Adapter box. Either input can be connected to a “hot” phase or to neutral or to ground.

 **Please Note:** Do not connect the Voltage Conditioning Box to more than 600 Vrms between the two inputs (V1 and V2). Also do not connect to a voltage that is greater than 600 Vrms to ground.



**Please Note:** Do not connect the Voltage Conditioning Box to the output of a variable speed drive until you know the output has been filtered of large high frequency voltage. If the output is sampling a fast switching 10,000 Hz signal that changes its amplitude in order to appear to be a low frequency sine wave, **IT WILL BLOW THE 1/10A 600V FUSE OF THE VOLTAGE CONDITIONING ADAPTER.** If you wish to connect to the output of a variable speed drive, first use the PS4000 or PS4500 to verify that the output is not a rapidly switched signal. If it is, do not use the voltage conditioning adapter. If it is not, you can use the voltage conditioning adapter.

### **To analyze the high frequency content of a current**

First unplug the inputs to the voltage terminals (V1, V2, V3, Vn) and the 12Vdc input of your PowerSight (this will improve the results). Next, locate the current probe adapter cable that is strapped to the output cable of the Voltage Conditioning Box. The current adapter cable is attached to keep it from becoming lost. Plug the male end of the adapter cable into the I1 input of the PS4000 or PS4500. Plug the current probe that you will use, into the female end of the adapter cable. At this time, only the HA1000 current probe is recommended for use with the FAO. Finally, clamp the current probe onto the conductor whose current is to be analyzed. The direction that the current probe is clamped onto the cable has no effect on the results of the test.



**Please Note:** While the current adapter cable is plugged into the I1 input of PowerSight, normal measurement of phase 1 current will be disabled. While the Voltage Conditioning Adapter cable is plugged into the In input, measurement of neutral current will be disabled.

**⚠ For best results:** The PS4000 or PS4500 should run off its battery power and nothing should be plugged into the V1, V2, V3, and Vn inputs while the test is in progress. This is one of the reasons why we recommend that you disconnect the cable from the DC input to the PS4000 or PS4500 and remove the voltage test leads while doing the test. **In addition, it removes a risk of shock if a lead is plugged into the Vn input.**

## 4. Setting Up the Data Setup (PS4500 only)

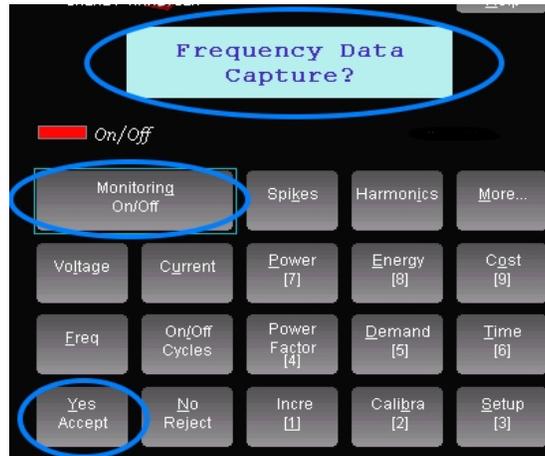
With the PS4500, the FAO analysis needs to be setup in the meter’s data setup before it will allow you to take a test. To do this, connect to PSM (3.4 series or higher) and press the Data Setup button. Check the

box that says “Spectrum Waveforms”, choose how many test you want to allocate to the meter’s memory, then press “Save to PowerSight”. The amount of tests you can allocate to the meter may vary depending on what memory option you have.

(Note: The SD card has no effect on the number of test you can allocate. It does, however, expand the number that can be taken and stored to the card by wrapping the data in the meter, but incrementing the test on the card).

## 5. Capturing High Frequency Data

After connecting to the power circuit as described in the previous section, you are ready to gather frequency data. The test can be initiated by pressing keys on your PowerSight meter. The test



will always be done simultaneously on both the voltage and current inputs whether or not both are attached.

To perform the test, press the “Monitoring On/Off” key two or three times until the display shows “Frequency Data Capture?” Press the “Yes” key and the test will begin. It will take 10 to 20 seconds.

Performing the test will write over the data of the previous test, (If on a PS4500 so be sure you no longer need that data. Also, since you should be running the test with the PowerSight meter running off its internal battery, be sure that the battery is adequately charged before beginning the test.

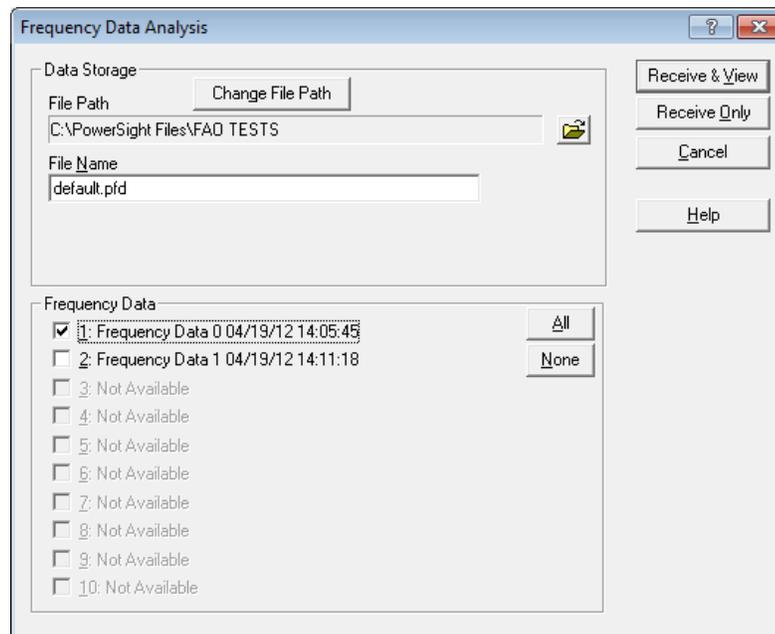
## Recommendations for better results:

1. Prior to doing a frequency analysis, store a waveform set or take a waveform snapshot so there is a record of the lower frequency information of the waveforms that are being analyzed.
2. When receiving frequency data, assign a unique file name before clicking on the “Receive and View” or “Receive Only” buttons. This will prevent you from writing over a previously stored frequency data file using the default name.
3. Prior to performing frequency analysis, do a test with the probes plugged into I1 and/or In but having them not connected to power signals. Store this “baseline” frequency response with a unique file name for later reference. This may reveal frequencies that are in the environment, but are not actually part of the voltage and current to be measured.

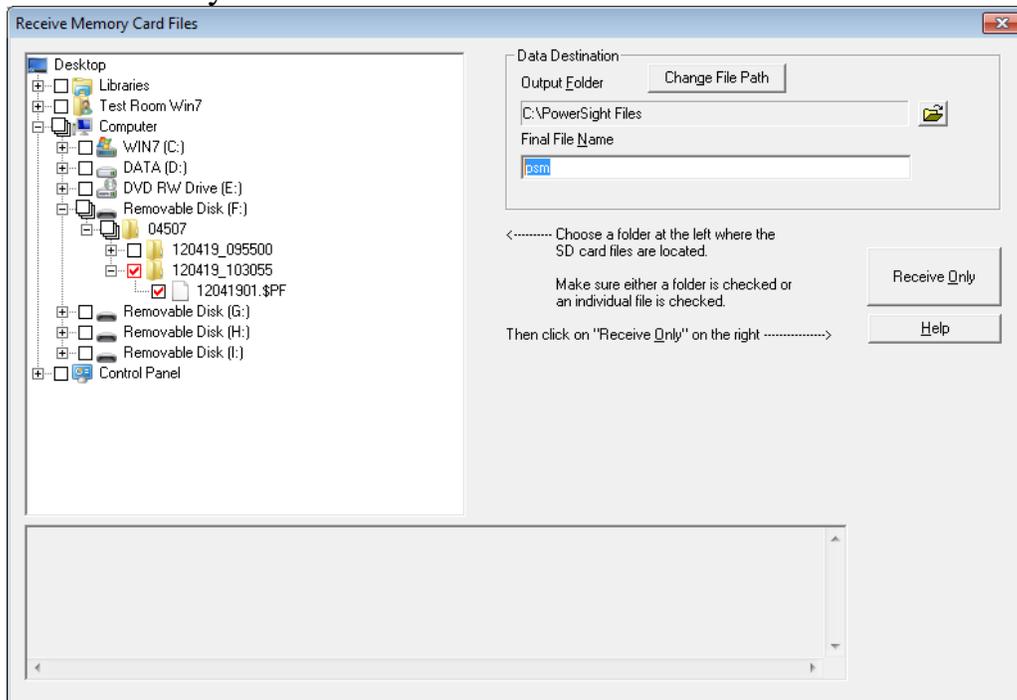
## 6. Getting the Frequency Analysis Data out of PowerSight

When the test was performed using PowerSight’s keypad, the data is already stored in PowerSight. To get this stored data via serial/Bluetooth communication, connect PSM to PowerSight as described in the previous section, then click on either the icon or the command

sequence to “Receive Frequency Data via Serial Comm”. Check the test(s) you want to download, then click on either “Receive Only” or “Receive and View”. The Stored data will be stored under the file name that was shown.



To receive the FAO test from the SD card, insert the card into your computer's SD card slot, then press the "Receive via Memory Card" button. Navigate to your SD card directory, then navigate to the folder in which your FAO test is stored (should be the one with a file called xxxx.\$PF). Check the box, give the file a name, then click on "Receive Only".



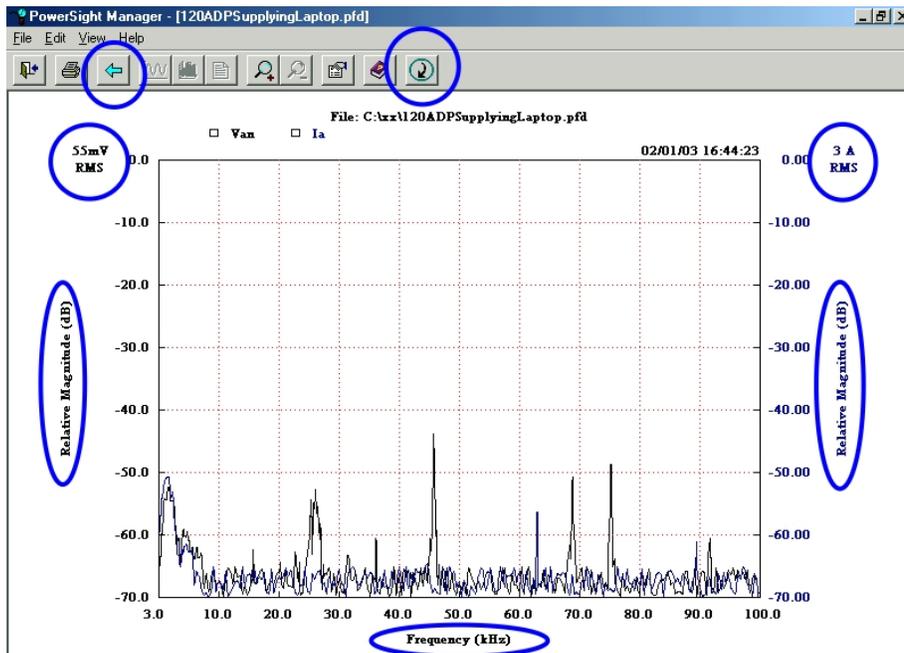
If you took multiple tests with the SD card plugged into your computer, all the tests will be combined into one PFD file, then separated after downloading via the Receive via Memory Card procedure.

## 7. Viewing the Frequency Analysis Data

There are two ways to view the frequency data. First, if it is received and the "Receive and View" option is selected, the data will be automatically displayed after it has been stored to disk. Data that is already stored can be viewed later by either clicking on the "View Frequency Data" button on the main menu and then selecting the file you wish to examine or by clicking "Frequency Data" at the top of the

main menu and then clicking on “View Frequency Data” and then selecting the file you wish to examine.

When the frequency data is displayed, you will notice that it appears as a frequency spectrum. The horizontal axis is frequency in Hertz, from 3,000 Hz to 100,000 Hz. Resolution is in 100 Hz increments. The vertical axis is in dB, decibels, a logarithmic scale. The top of the scale is typically 55 mV for voltage and 3A for currents (using the HA1000 probe). The definition of dB is  $\text{dB} = 20 \cdot \log(V/V_r)$ , where  $V_r$  is the reference voltage (or current) and  $V$  is the measured voltage (or current). Log is the base 10 log function. The log of  $X$  is the power of 10 that equals  $X$ . For instance if  $X = 1/10$ , then  $\log(X) = -1$ , because 10 to the  $-1$  power equals  $1/10$ . In this way,  $-20$  dB down from full scale is  $1/10$  of the full scale value and  $-40$  dB down is  $1/100$  of the full scale value. Therefore, if looking at voltage and full scale voltage is 55 mV, then a frequency spike that reaches  $-40$  dB has a magnitude of  $0.55\text{mV}$ .



To view only voltage, only current, or both voltage and current, click on the “back” arrow and then select the signal you wish to see graphed. To print what you see, click on either the “print” icon or click on “File” and then “Print”.

For a more effective presentation, you may wish to change the scale of the presentation first by clicking “View” and then “Set Scale” and then adjusting the scale for best effect.

To analyze frequencies below 3,000 Hz, view a regular waveset capture and perform a harmonic analysis on it to view the harmonic content.

### 8. Specifications \*

Frequency range:	3,000 to 100,000 Hz
Voltage input:	0 to 600 Vrms (Va to Vb) 600 Vrms (maximum, Va or Vb to ground)
Current input:	HA1000 current probe
Voltage input protection:	Double fault.
Voltage display range:	110 mV full scale down to -65 dB or 1.10 Vrms full scale down to -65 dB
Current display range:	3 A full scale down to -65 dB (HA1000) or 30 A full scale down to -65 dB (HA1000)
Output:	PC display Color printer Windows bitmap (BMP file)

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\*Specifications are subject to change without notice.

\*PowerSight is a registered trademark of Summit Technology Inc.