

Specmaster: A Simple Spectrum Monitoring Tool

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Introduction

The Specmaster software was developed to implement a straightforward system to conduct remote spectrum measurements. It is a Graphical User Interface (GUI) driven system that enables the user to configure an Agilent 44xx series spectrum analyzer, select from multiple antenna inputs using a low loss RF switch, and autonomously store measurements to disk on a periodic basis. Remote operation has been accomplished using the Remote Desktop feature of Microsoft Windows XP. Specmaster has been successfully deployed at the National Radio Astronomy Observatory in Green Bank, West Virginia, and the LWDA site in New Mexico.

System Components

A typical Specmaster configuration consists of the following elements:

1. The Specmaster software
2. An Agilent E4440A spectrum analyzer
3. An Agilent 87104B low-loss multipoint coaxial RF switch (4-to-1)
4. A National Instruments USB to GPIB interface (GPIB-USB-HS)
5. A Measurement Computing USB to digital I/O interface (PMD-1024HLS)
6. A generic USB 2.0 powered hub
7. A laptop computer running Windows XP

Additional amplification and filtering can be added before the RF switch inputs and then described in a 'configuration comment' to be included within the data files. Compensation factors for external components are not processed by the Specmaster software; only raw data is saved to disk.

Hardware Configuration

The basic hardware configuration for a typical Specmaster installation is provided in Figure 1.

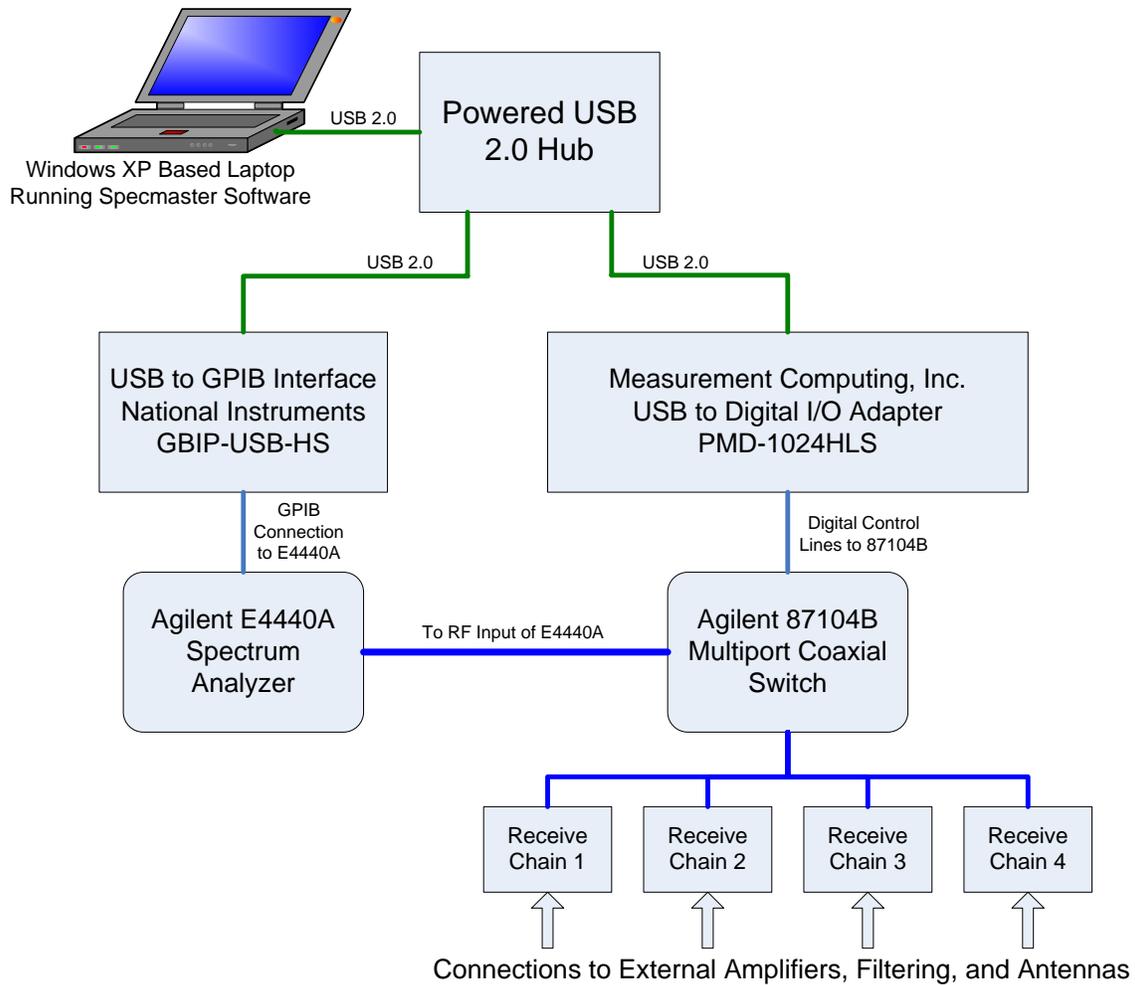


Figure 1 – Specmaster Hardware Configuration

Specmaster Software

Design Philosophy

The Specmaster software was written in ANSI 'C' under the LabWindows/CVI development system. LabWindows provides VISA driver support needed to communicate with the E4440A spectrum analyzer (GPIB) and a GUI generator.

Only a minimum of training and familiarization is required to operate this software. The design philosophy we followed was that all controls and options should be visible at all times on a single display (Figure 2). User selections are validated by the GUI and suggestions are presented if a value is invalid or falls out of range.

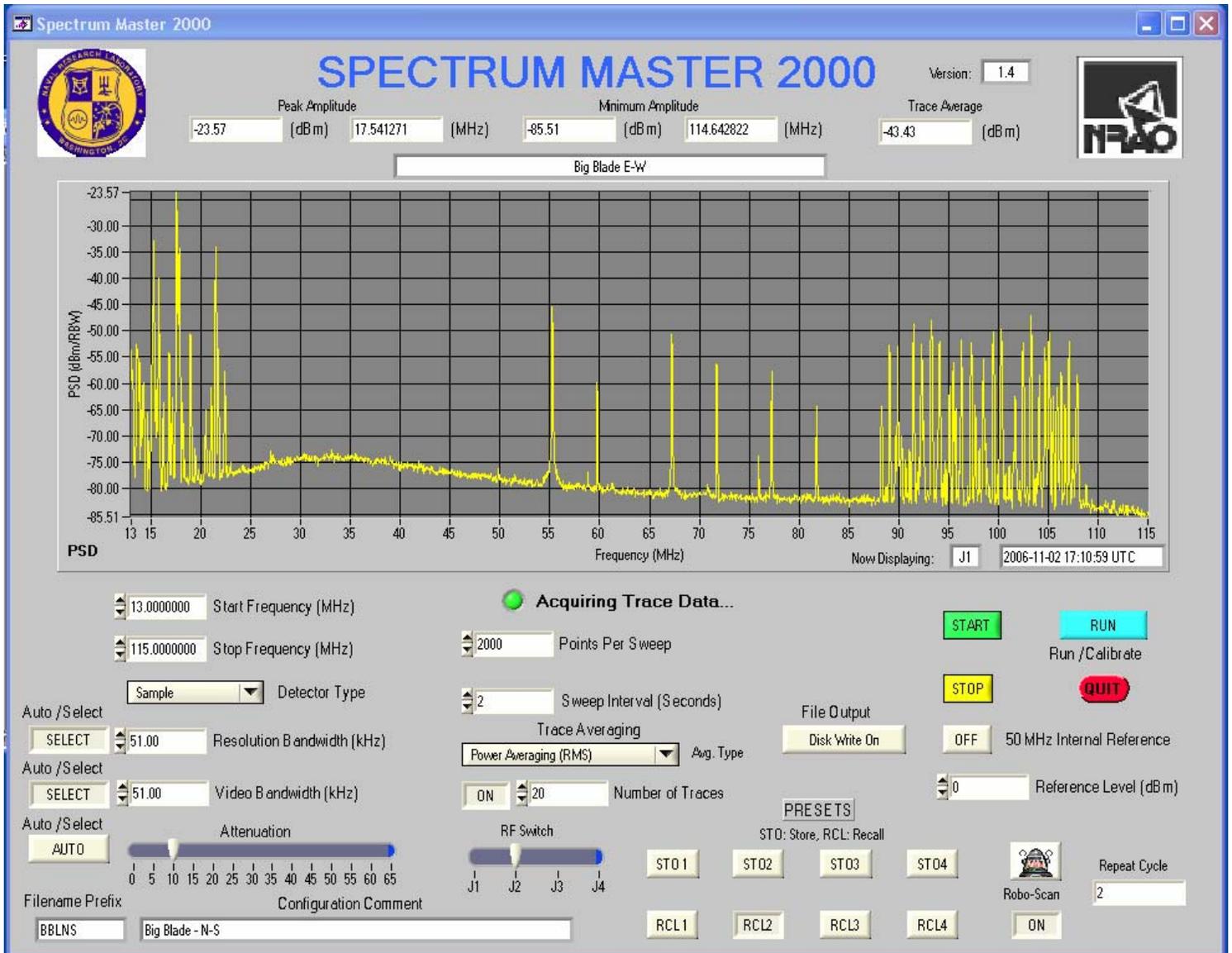


Figure 2 – Specmaster software GUI

Presets

It is possible to store and recall four measurement setups as ‘presets’. Preset configurations consist of all of the settings visible on the screen. We modeled this functionality after scientific calculators; pressing ‘STO1’ will store a configuration in the first preset slot, pressing ‘RCL1’ will recall that preset. Presets are persistent and stored as ASCII format files.

Automation

Easy automation of complex measurement campaigns is facilitated through the use of the Robo-Scan mode and presets. When ‘Robo-Scan’ is activated Specmaster will cycle

through presets up to the preset number indicated in the 'Repeat Cycle' field and then return to the first preset after that scan. In the configuration shown in Figure 2, Specmaster would alternate between Preset 1 and Preset 2. The 'Sweep Interval' setting provides for a delay between scans in this mode. Because the RF switch position is included in the presets, Specmaster is able to cycle automatically through multiple antennas and provide specific spectrum analyzer settings for each one.

Data File Format

The present version of Specmaster stores data files in an ASCII format. Each file consists of a preamble describing the measurement parameters followed by the data. A portion of a typical data file is shown below:

```
Specmaster Data File version 2
Start Time: 2006-10-22 6:51:11 UTC
File Name: 2006-10-22\DATA_20061022_065111.txt
Configuration Comment: Configuration One - 10 to 100 MHz
#
Start Frequency (MHz): 10.000000
Stop Frequency (MHz): 100.000000
Resolution Bandwidth (kHz;AUTO): 1000.00
Video Bandwidth (kHz;AUTO): 1000.00
Attenuation (dB;AUTO): 10
Traces Averaged: None
Averaging Type: None
RF Switch Position: J1
SENS:DET:NORM
Points Per Sweep: 401
#
# -----      Basic Trace Statistics      -----
# Peak Amplitude: -19.90 (dBm) @ 50.049999 (MHz)
# Minimum Amplitude: -68.13 (dBm) @ 41.950001 (MHz)
# Average Level: -28.18 (dBm)
#
#-----  Trace Data Follows  -----
BEGIN DATA
-64.92
-64.43
-64.80
-64.77
-65.28
-66.47
```

Files are stored in directories named after the date (e.g. 'C:\2006-10-22'), and filenames are automatically assigned that contain both the date and time (UTC). The main data directory is always located within the Specmaster application folder.

Present Applications

Specmaster is presently being used to provide on-site measurements of RFI levels as seen by the baseline LWA antenna - the 'Large Blade'. We have used Specmaster to produce drift scans for both the LWDA (small blade) and 'Large Blade' antennas (Figure 3). Daily dynamic spectra are available at the Specmaster Data Page (<http://lwa.nrl.navy.mil/rduffin/>). Links are also provided at this site to Specmaster observations of data during special events such as solar bursts (Figure 4).

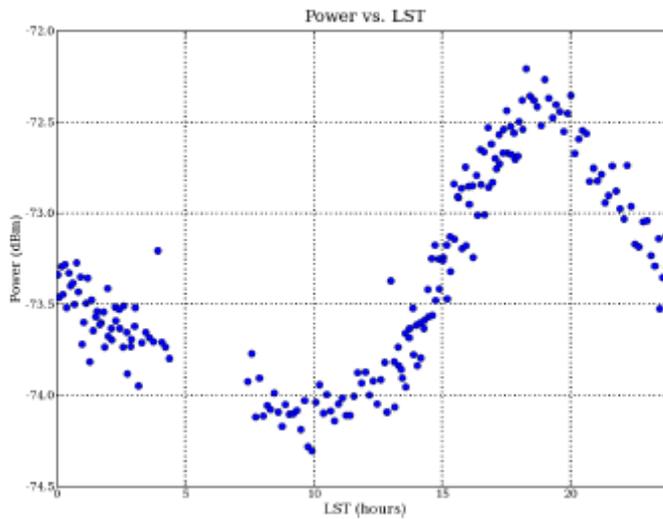


Figure 3 – Power in the 74 MHz band as a function of local sidereal time.

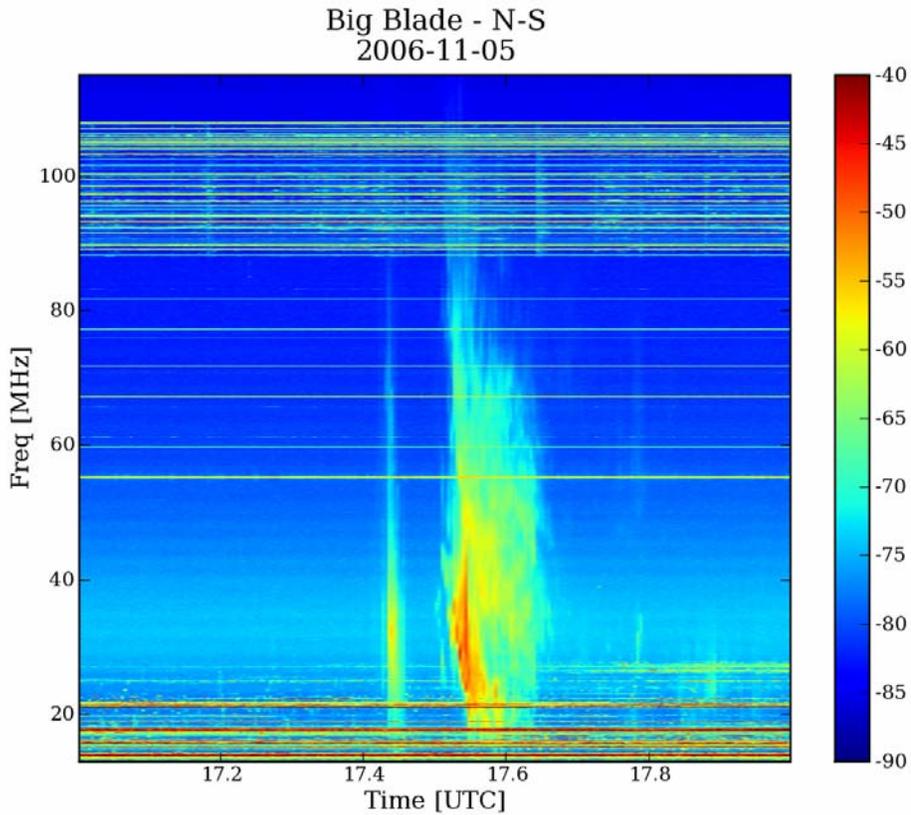


Figure 4 – Specmaster observation of Type III solar burst

Future Plans

Present plans include the addition of multiple file format support. The existing ASCII format has proved suitable for RFI measurements and drift curves, but is too voluminous for solar applications.

It is anticipated that a format resembling FITS will be added which will feature an ASCII preamble followed by binary data. Support for accumulating a single day in a single file will also be added soon.

Acknowledgements

The Specmaster software evolved out of a similar program that Steve Ellingson provided to get us started. We are appreciative of his support.