1. Introduction

This document will outline the function and intent of the fast full spectrum feature of the si255, including the theory of operation, the require resources for using the feature, and a brief analysis of the performance of the feature.

1.1. Theory of Operation

The si255 Hyperion optical interrogator uses a series of high-speed analog to digital converters to capture full optical spectrum on multiple, parallel detection channels. Typically, this high-speed full spectrum is either simplified in real time to peak/valley detected data for user delivery at 1kHz, or it is average and integrated to yield high repeatability, low noise full spectrum data for user delivery at 10 Hz.

However, there are applications that can benefit from full optical spectrum signals at rates higher than 10Hz. Though the data is present within the si255 Hyperion FPGA at kHz rates, data transfer and delivery limitations to computer buses and communication protocols limit the rates at which data can be realistically transferred.

The Fast Full Spectrum feature of the si255 Hyperion offers an avenue for the user to gain access to very high resolution optical spectrum over wide wavelength ranges and multiple, parallel channels at heretofore unattainable rates. Specifically, the Fast Full Spectrum can support over 200Hz data rates over 160nm with 8 pm resolution on four channel units. The feature, when applied to a 16 channel capable unit, can capture data at rates of over 80Hz for 16 parallel channels of 160nm spectrum with the same high 8 pm resolution.

The manner in which the feature performs this features is by sreaming the full optical spectrum from the on-board FPGA to an on-board solid state drive. While the instrument is in this Stream to Storage mode, all other acquisitions are suspended. When the prescribed duration of Full Spectrum data streaming has completed, the instrument will revert to its previous settings and resume all other data transfers.

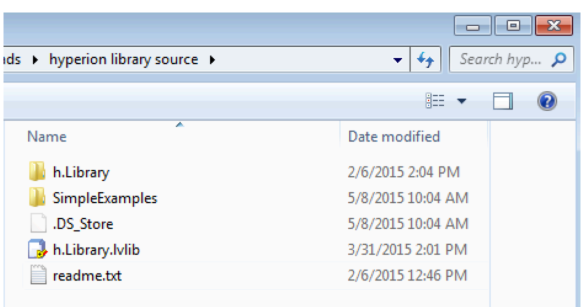
1.2. Required Resources

1.2.1. Version 9.0 Firmware and FPGA Upgrade

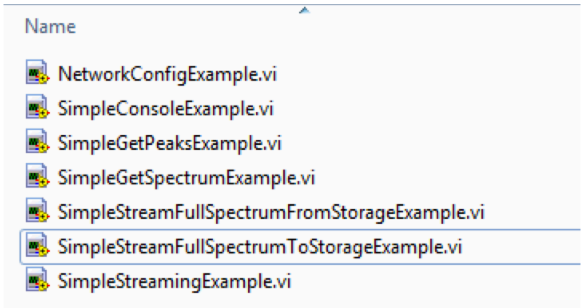
Use of this feature requires that the si255 Hyperion Instrument be running v9.0 FW or greater. If the target instrument is running firmware less than version 9.0, please contact Micron Optics for an upgrade utility.

1.2.2. LabVIEW API

The Fast Full Spectrum feature is presently supported only through the LabVIEW API. The LabVIEW API can be download at http://micronoptics.com/support_downloads/ under the si255 Hyperion subheading.



Once downloaded, extract the API file to a known location and open the SimpleExamples folder.

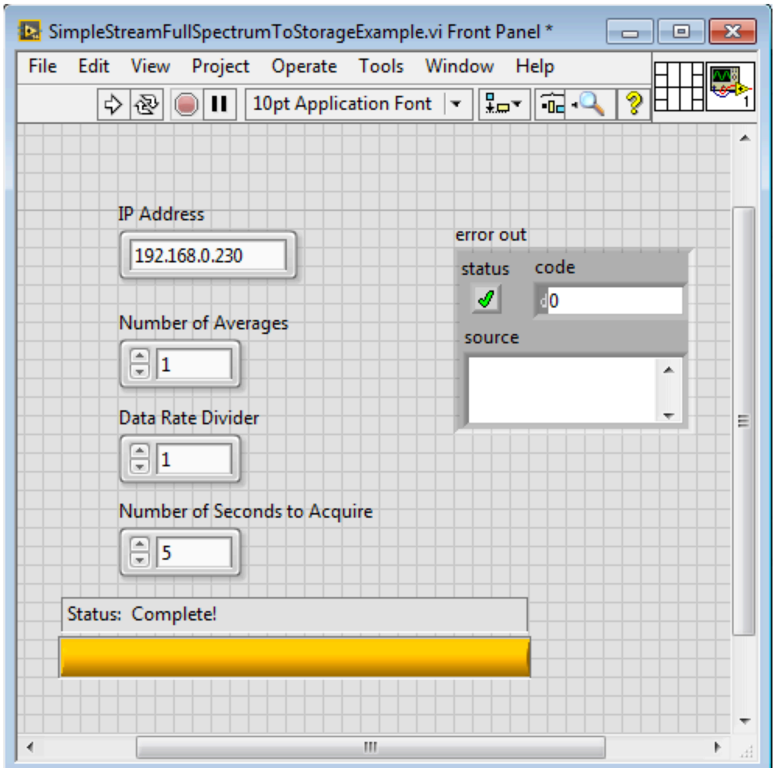


The two vi's that will be used in this process are SimpleStreamFullSpectrumToStorageExample.vi and SimpleStreamFullSpectrumFromStorageExample.vi.

2. Using the FFS Feature

2.1.1. Stream Full Spectrum to Storage

To capture Fast Full Spectrum and stream the data to onboard storage, the user will run the SimpleStreamFullSpectrumToStorageExample.vi



Here the user will set the target instrument IP address, the number of full spectrum Averages, and the Data Rate Divider for the data acquisition. For the fastest results, these values shoule both be left at a value of 1.

The user will also select the Number of Seconds to Acquire, which determines the duration over which full spectrum data is streamed directly from the FPGA to the onboard solid state drive.

NOTE: there is no hard limit to the duration, though durations longer than 5 seconds increase the probability of larger interruptions or delays in the data transfer.

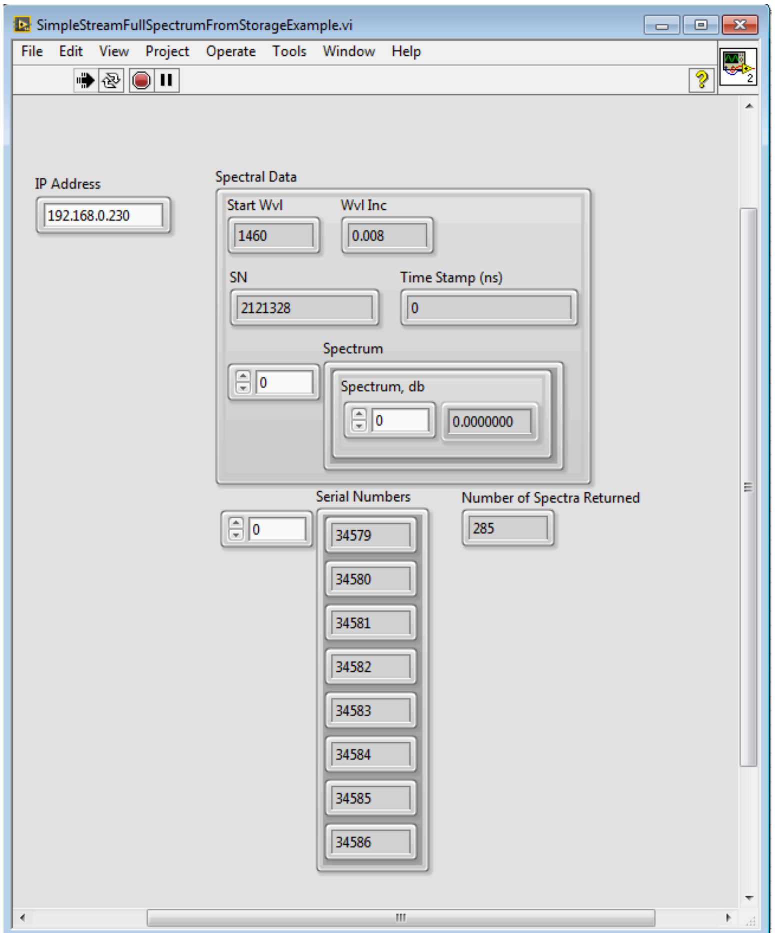
Once the settings are complete, the user will click on the run arrow and the program will update the status/progress bar to reflect the passage of time up through the Number of Seconds to Acquire. When the acquisition to disk is complete, the Status will show as above.

NOTE: this features stores exactly one Full Spectrum Dataset in onboard storage. That dataset will remain in storage, available to read as many times as the user desires until another write event (running again the SimpleStreamFullSpectrumToStorageExample.vi)

2.1.2. Stream Full Spectrum From from Storage

Once data has been streamed to storage, it can be read (streamed from storage) using the StreamFullSpectrumFromStorageExample.vi

NOTE: while the streaming to storage process is near real-time, streaming from disk involves then transferring data across Ethernet and onto the client computer. Fast Full Spectrum involves a very large volume of data, this process may take some time depending on computer and network speeds.



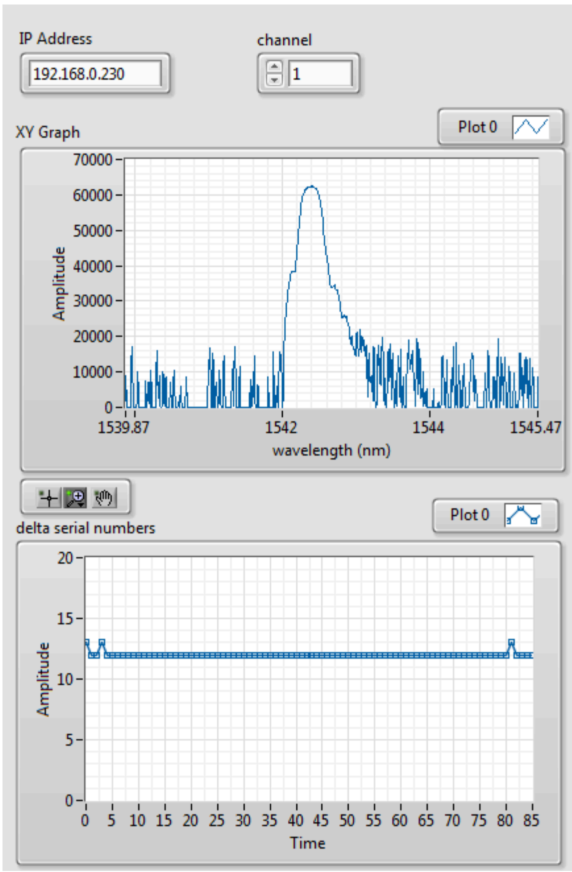
2.2. 2. Evaluating results (modified reader to show plots, don't try to build a big array and hold it in labview)

NOTE: the volume of data generated by FFS requires careful consideration of how memory is used. In order to generate these plots, small modification were made within a copy of the StreamFullSpectrumFromStorageExample.vi to facilitate data playback and timestamp evaluation.

The fast full spectrum feature streams the full spectrum to disk as rapidly as the system will allow.

2.2.1. 16 channel module, set to run at 1 kHz:

For a 16 channel unit, the datasets can be transferred to disk approximately every 12 to 13 acquisitions, yielding an aggregate FS data rate of ~80Hz for 16 channels, all with 160nm range and 8 pm resolution.



2.2.2. 4 channel modules 1kHz,

For a 4 channel unit, the datasets can be transferred to disk approximately every 4 to 5 acquisitions, yielding an aggregate FS data rate of 200 to 250 Hz for 4 channels, all with 160nm range and 8 pm resolution.

The results below show playback of a 5 second dataset taken on a 4 channel unit with averaging and interleaving set to 1. Four channels of 160nm data are recorded with 94% of all dataset serial number spacing at 4ms (250Hz) and the remaining 6% of serial number spacings at 5 ms (200Hz).