Appendix D - User's guide for the high resolution monitoring program

1 Objective of this user's guide

This user's guide was designed to provide future users with guidelines for configuration, operation, and upgrading of the monitoring if required for implementation at the PV Training Facility or on other installations. The program was designed and tested for monitoring of environmental data from ADAM modules. However, changes to be made were considered in order to incorporate data from all inverters and advices on upgrading the system are also provided in this guide.

2 Overview of the program

This Program was elaborated as an additional tool to the WebRAPS program to record high resolution data from environmental sensors to be mounted at the Murdoch PV Training Facility and other components to be added to the systems for recording PV array performance. Though the operation of this program is much simpler than the large WebRAPS engine, its operation is less user-friendly and requires a better understanding of Labview language in order to enable changes to be made to the program. It also incorporates less error checking and control of the data obtained. The principle is simple and is highlighted in Figure 1.

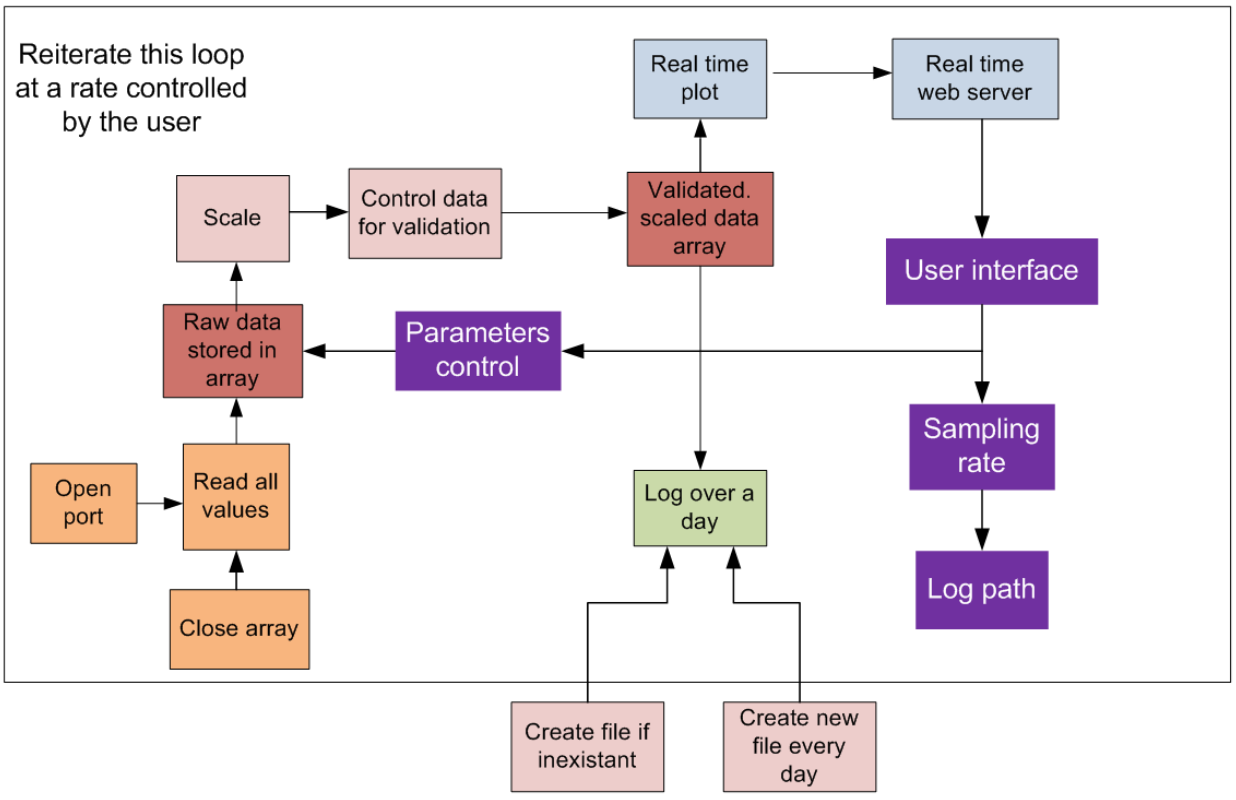

Figure 1: Functions of the Labview monitoring program for the Murdoch University PV Training Facility

3 Requirements for use of the program

The program was developed on Labview version 11.0, so a similar platform should be used for future applications of the program. The program is using built-in functions from the Advantech ADAM' library for Labview to communicate with the ADAM modules. This library should be installed on the required computer to be able to use those functions, and can be found on the CD obtained with the ADAM modules, or on the Advantech website (Advantech 2012). In particular, the file "Advantech.common.dll"will be searched upon opening of the program and should be located within the path "C:\Program Files (x86)\Advantech\Adam.NET Utility\Program" if the installation was successful. The required sub-vis to run the program along with a description are listed below:

- HighResolutionMonitor-E&ERooftop.vi

  This Vi is the Top-level structure that calls every sub-vis. It also contains all the required controls to run and configure the channels and logging functions.
- OpenComPort.vi

  Opens and configures the selected communication port from controls. Defaults is GPIB for power analyser and Serial ComPort7 for Adam modules. The VI also configures communication with instruments.
- HarmonicPowerMeterConfiguration.vi

  This VI is called by OpenComPort.vi. Configure power meter communication in harmonic mode by turning ON all required parameters and generating a row of headers to initialise log file.
- NormalPowerMeterConfiguration.vi

  This VI is called by OpenComPort.vi. Configure power meter communication in normal mode by turning ON all required parameters and generating a row of headers to initialise log file.
- TestThinDataLogFilePath.vi &TestAvgDataLogFilePath.vi

  If "Define Log Path" is selected, then this sub-vi tests whether the file path specified in the control exists, and if not it sends the specified path to Log file initialization sub-vis.

  If "Define Log Path" is unselected, then it tests whether a log file exists under the current date, otherwise sends to the log file initialization sub-vis. This is also used to create a new file every day for the logged data. (only if "Define Log Path" is selected) or test whether the daily
- InitializeThinDataLogFile.vi & InitializeAvgDataLogFile.vi

  These sub-vi are used to initialize the files where the data is logged, including a creation of row of headers including names of each parameter. They only operate if logging is enabled and if the required files for logging the data do not exist.
- LowLevelRead

  This Vi is called by the top-level program after opening and configuring the communication port to send commands and collect data from the data acquisitions devices in a stacked sequence structure. The responses are acquired in string format, each response containing all channel

measurements. The received strings are then separated into individual parameters and store in a single array.

- ComErrorCheck.vi

  This VI check whether the instruments which are required to send data send anything to the port and if not produce an error message on the main control pannel.

- ScaleRawData.vi

  Uses parameters' scaling coefficients from "parameter's configuration" table on main program's control panel to scale raw data to useful units. Also separate data for average and high resolution logging and also for real time display.

- SeparateData.vi

  According to the user's selection of "parameter's control" logging mode on main program's control panel, create two Booleans arrays, one having true values for parameters that need to be logged instantaneously, and another one having true values for parameters that need to be logged as average values.

- CallAvgData.vi

  Test whether the current minute has changed to an integer multiple of the logging interval and send the accumulated data to GetStatisticalData.vi for calculation of average and statistical parameters.

- GetStatisticalData.vi

  Calculate mean, standard deviation, maximum and minimum values, for the averaged data before it is sent to the LogAvgData.vi.

- LogThinData.vi & LogAvgData.vi

  Log data on two separate logging modes only if logging is enabled. It also logs only required values from the "parameters' configuration" control.

- GetDateTime.vi

  Obtains current system time to use for the log files and real time plots

- RealTimePlots.vi

  This vi produce real time plots of the different parameters. It is also output its front panel to the web serving tool to enable live remote monitoring of the facility.

- PlotParameters.vi

  Produce an array of parameters which can be plotted in real time, so that search can be made in the data arrays to find the required elements.

4 Configuration of the program

The program has been designed to communicate with five ADAM modules, and display and log as much as thirty parameters (number of inputs available from the five ADAM modules all together). It also displays and logs parameters from the power analyser Yokogawa WT2030.The Adam modules' parameters can be entered in the control panel of the main program "HighResolutionMonitor-E&ERooftop.vi" together with their scaling coefficients. The com port that is used to communicate with the instruments and the sample rate can also directly be set in the same control pane shown in Figure 2. The parameters required in each logging file (high resolution or average data) can be selected by entering 1 in the appropriate cells for column "High Resolution" or "average".

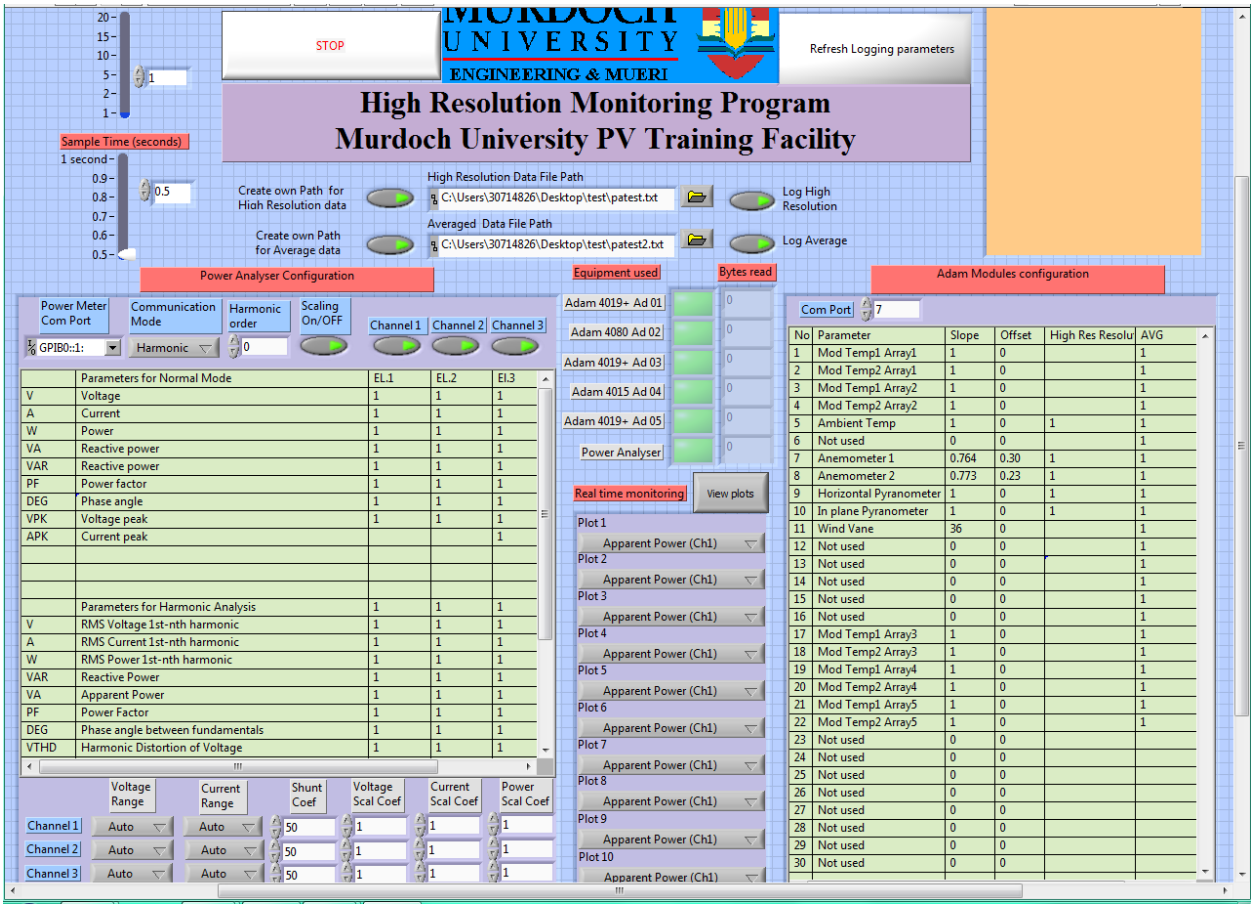

Figure 2: HighResolutionMonitor - E&E rooftop.vi control panel

1. Choose the path where the log file has to be located both for high resolution and average data monitoring. This can be done by clicking the icon next to the path input box. Note that if these controls are made during monitoring the "refresh logging parameters" control needs to be executed in order for the change to take effect. If Create own path for high resolution/average data is unselected, then the program will automatically create a file on "E:\HighResolution\" with a file named after the current date. If the files are to be located on a different location then this can be changed in the string constant of "TestAvgDataLogFilePath.vi" and TestThinDataLogFilePath.vi".

2. Logging interval and sample time can be set on the top left corner of the control panel. These parameters are checked continuously during monitoring so refreshing is not required after changing logging or sample rate.
3. Select if logging is required for both high resolution and average data through the " Log High Resolution" and "Log Average" control. Logging can be turned ON and OFF during monitoring and change does not require refreshing.
4. Power analyser configuration enables inputting power analyser parameters. The com port should be selected. By default it is GPIBO::1: if GPIB/USB converter is used, and address 1 is set on power analyser.
5. Communication mode is to be selected and can be either Normal or Harmonic, the available parameters for both modes are shown in the table.
6. Scaling coefficients can be entered, and the scaling ON/Off control should be applied for those coefficients to be used.
7. Voltage and Current Range, as well as shunt coefficients if use can be entered.
8. The user can choose as much as 10 real time plots to be displayed. The "view plots" button is used to view the generated plots (see figure 3).

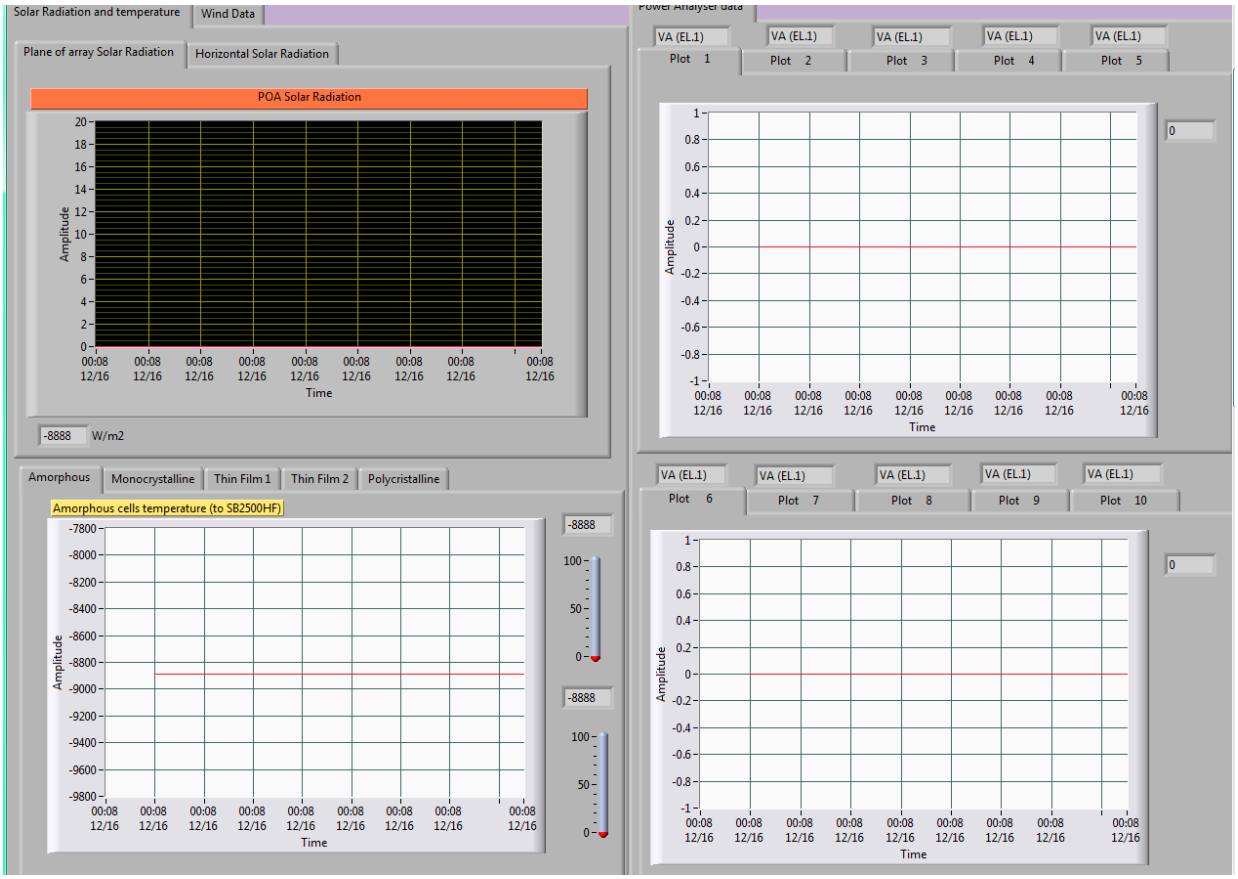

Figure 3: RealTimePlots.vi control pane

5 Upgrade to incorporate more data

If the program needs to monitor more than thirty parameters, then changes should be made in the "GetAdamSeriesData" sub-vi. This sub-vi is used to read data by sending commands in a stacked sequence structure to the communication port. Each sequence is related to a command that need to be addressed to get data from one device. Since there are unused channels on the ADAM Series I/O modules, spare locations are available within the data array which is used to extract data in the Labview program. It is recommended to use these locations as much as possible so only this subvi is required to be modified. Required modifications are adding sequences to the structure, programming commands to send to the port, and relink spare elements of the array to the required parameters. The data acquisition is made in a string format as seen in Figure 4, and converted to a number that is stored in an array.

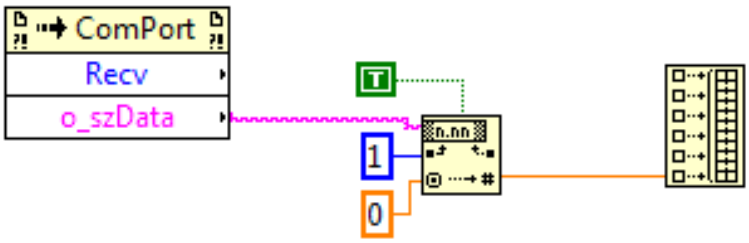

Figure 4: Conversion of environmental data in GetAdamSeriesData.vi

Another option is to increase array size and connect other elements, then further modifications are required in the Vis below, using similar functions to the ones used in those vis.

- InitializeThinDataLogFile.vi → Modifications are required to add parameters to the header raw for the logging file.
- InitializeAvgDataLogFile.vi → Modifications are required to add parameters to the header raw for the logging file.
- LogThinData.vi and LogAvgData.vi and LogAvgData.vi → Modifications are required to log additional array elements
- ScaleRawData.vi → Modifications are required to incorporate scaling of new elements
- RealTimePlots.vi → Modifications are required to plots new elements
- GetAvgData.vi → Modifications are required to calculate statistical parameters from new elements

5.1 “LowLevelRead.vi”

This program already allows for maximum use of the thirty parameters that can be inputted to the ADAM modules. If communication with new devices is made, the data acquisitions steps should be made in parallel using different communication ports. The port would be open, initialized, and close in the “user interface.vi”. The port reference number would be sent to the “low level ADAM read.vi”, for acquisition of data from the port. This would be done by having additional sequences to the stacked sequence structure on that vi, and append the data to the same raw data array as for the ADAM modules’ data.