Appendix B - User’s guide for the ADAM Series Remote I/O modules

1 Overview
This User’s guide is designed to provide the reader with guidelines to set up the data acquisition system for the PV Training Facility in the Engineering & Energy Building, and install a RS 485 network between the data acquisition modules and a computer.

2 Connection to the RS485 network

2.1 Adam I/O modules connection
Although the ADAM modules are able to operate in temperatures from 0 to 70 °C, and humidity from 0 to 95%, they should be placed in industrial enclosures as suggested by the manufacturer (Advantech 2005). A suggestion of the location for the ADAM modules is presented in Figure 1. Connections of the analog inputs to each module are shown in drawings 2 to 5.

Figure 1: Suggested location of the ADAM data acquisition modules on the roof of the E&E Building.
2.2 Computer requirements and connection

The computer for which the Labview program has been tested is part of the project room in the Engineering and Energy building. This computer possesses the Advantech library in Labview to enable built-in functions to be used in Labview. Options are to use that computer for the monitoring system, or to bring another one and install the Advantech library again.

The computer has to have the following requirements for communication with remote I/O modules:

- A host computer, such as an IBM PC/AT compatible, that can output ASCII characters through serial communication
- ADAM Series Utility software (for configuration of the Adam modules
- A RS-485 port (PCI serial card)

Because of the impossibility to communicate with inverters, only communication with ADAM modules was tested, and one single serial port was required. However, for the connection of the complete monitoring network shown in Drawing 1, a serial card with multiple serial ports is required to be installed on the computer.

The communication through the RS 485 port is made through half-duplex RS485 communication, since only one pair of wires is required to communicate with the ADAM modules. This is done by connecting the positive transmitting and receiving pins (TXD+ and RXD+) of the master to the positive data pins (DATA+) of the modules, and connecting the negative transmitting and receiving pins (TXD- and RXD-) of the master to the negative data pins (DATA-) of the modules. This is illustrated in Table 1 and Figure 2.

Table 1: Pin layout for a DB-9 male connector

<table>
<thead>
<tr>
<th>Pin</th>
<th>422/485</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>GND</td>
</tr>
<tr>
<td>2</td>
<td>CTS+   (HSI+)</td>
</tr>
<tr>
<td>3</td>
<td>RTS+   (HSO+)</td>
</tr>
<tr>
<td>4</td>
<td>RXD+</td>
</tr>
<tr>
<td>5</td>
<td>RXD-</td>
</tr>
<tr>
<td>6</td>
<td>CTS-   (HSI-)</td>
</tr>
<tr>
<td>7</td>
<td>RTS-   (HSO-)</td>
</tr>
<tr>
<td>8</td>
<td>TXD+</td>
</tr>
<tr>
<td>9</td>
<td>TXD-</td>
</tr>
</tbody>
</table>

(National Instruments 2007b)

Figure 2: Connection of ADAM modules to RS485 DB-9 connector
3 **Adam I/O modules configuration**

The ADAM modules must be configured before being added to the network. Configuration can be made using the ADAM utility software (Advantech 2008). The search function can be performed on the different ports to detect any ADAM module connected to it. Parameters can be then entered individually by clicking on the desired module.

Default settings:

- Baud rate: 9600 But/sec
- Address: 01 (hexadecimal)
- Protocol: Advantech ASCII

Maximum baud rate allowed for ADAM-4080 is 38400 bps. Therefore, this is the maximum allowed baud rate for all the modules in the RS485 network, as baud rates must be the same for all modules connected in series.

The protocol can be changed to Modbus, except for the ADAM-4080 modules that cannot support Modbus. The procedure required to change the protocol to modbus is outlined in appendix H of the ADAM 4000 Series user’s manual (Advantech 2008).

The ADAM modules have already been configured using the utility software, and also by issuing commands to set the modules to the required parameters. Their configuration settings are displayed in Table 2.

If configuration parameters of the modules have been changed or there is confusion between modules, it is possible to communicate with the modules using factory settings by setting the module to initial mode using the switch located on the side of the module. In initial mode, the modules will have the default configuration settings presented above. New configuration parameters can be addressed to the module by using default address and baud rate to communicate with the module. Each module should be connected and configured individually with the utility software to avoid any cohesion (modules would have same address of 00 if set to initial mode). It must be noted that baud rate and checksum parameters can only be altered in initial mode.
<table>
<thead>
<tr>
<th>Remote I/O Module</th>
<th>Module Ref</th>
<th>Address</th>
<th>Baud rate</th>
<th>Protocol</th>
<th>Data Format / mode (code)</th>
<th>Freq gate time</th>
<th>Checksum status</th>
<th>Channel</th>
<th>Input sensor</th>
<th>Input range type</th>
<th>Input range code</th>
<th>Non-isolated high Trigger Level</th>
<th>Non-isolated low Trigger Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADAM-4015</td>
<td>IAA7422008</td>
<td>04</td>
<td>9600</td>
<td>ADAM ASCII</td>
<td>Engineering units (00)</td>
<td></td>
<td>Disabled</td>
<td>Ch 0</td>
<td>module temp</td>
<td>Pt100(IEC)</td>
<td>-50 - 150°C</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Ch 1</td>
<td>module temp</td>
<td>Pt100(IEC)</td>
<td>-50 - 150°C</td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td>Ch 2</td>
<td>module temp</td>
<td>Pt100(IEC)</td>
<td>-50 - 150°C</td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>Ch 3</td>
<td>module temp</td>
<td>Pt100(IEC)</td>
<td>-50 - 150°C</td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>Ch 4</td>
<td>module temp</td>
<td>Pt100(IEC)</td>
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<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Ch 5</td>
<td>Not used</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ADAM-4015+</td>
<td>IAA7373084</td>
<td>05</td>
<td>9600</td>
<td>ADAM ASCII</td>
<td>Engineering units (00)</td>
<td></td>
<td>Disabled</td>
<td>Ch 0</td>
<td>Not used</td>
<td>± 5V</td>
<td>08</td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Ch 1</td>
<td>Not used</td>
<td>± 5V</td>
<td>08</td>
<td></td>
<td></td>
</tr>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Ch 2</td>
<td>Not used</td>
<td>± 5V</td>
<td>08</td>
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<td>Ch 3</td>
<td>Not used</td>
<td>± 5V</td>
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<td></td>
<td>Ch 5</td>
<td>Not used</td>
<td>± 5V</td>
<td>08</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Table 2**: Current configuration of the Adam series modules
4 Testing of Adam modules’ communication:

The Adam Modules can be tested for communication through the “Adam.NET Utility” software. This software is installed on the computer used in the projected room.

Procedure:

Enter the Adam.NET Utility software.

Click “Refresh COM and LAN Node” under Setup tab to see communication ports 4 to 7 which corresponds to serial com card (See Figure 3).

Make sure settings of the communication port are appropriate. The devices are set to a baud rate of 9600 Bps and would not be detected if com port baud rate is different. Also, default settings are shown in Figure 3.

Right click on com port to which Adam Module are connected to (In current configuration Adam modules are connected to Com port 7), and select search. Then press start.

It should detect devices very quickly as they are set to address 01 to 05. After all 5 devices are detected (or 4 devices depending on Adam modules’ configuration), press cancel to stop search.

Figure 3: Refreshing communication ports on Utility Software
Basic commands can be made to devices to check communication operation through the emulation program by selecting the required com port and clicking (See Figure 4).

For example, command $\text{AA2}$ can be addressed to query current module settings, where AA corresponds to the hexadecimal address of modules.

On figure above, command $\text{022}$ was made to query configuration settings of module 2 (ADAM 4080 frequency/counter module).

Response: !02510604

“!“ means no error in command (otherwise “?”)

02 means address 02

51 means frequency mode (50 for counter mode)

06 means baud rate of 9600 bds

04 represents the data format and indicates gate time setting of 1.0 second
The previous settings are expected for frequency counter Adam 4080. However, for analog counter 4019+ and RTD 4015, following responses are expected:

**Adam 4019+:**

Address 03  Baud rate of 9600 bds

!03FF0600

Input Range code (Set to default FF, however channel ranges are set individually in module setting)

Data format (Engineering units, checksum disabled, integration time of 50Hz)

**Adam 4015:**

Address 04  Baud rate of 9600 bds

!04000600

Input Range code (Default for ADAM 4015 is 00)

Data format (Engineering units, checksum disabled, integration time of 50Hz)
In this configuration, we connect the Adam 4019+ at address 05 on a separate network, which can be used to monitor solar radiation from a spare solar radiation sensor.

We require two logging computers to operate both high time resolution monitoring and long term average data monitoring (WebRAPS).
If only one RS 485 Network is used, then there is no need to add the Adam 4019+ module at address 05.

This is if we only use one monitoring program at a time. (High Resolution Monitoring program or WebRAPS)

These programs cannot be run at the same time on the same computer and operating one will require stopping the operation of the other.