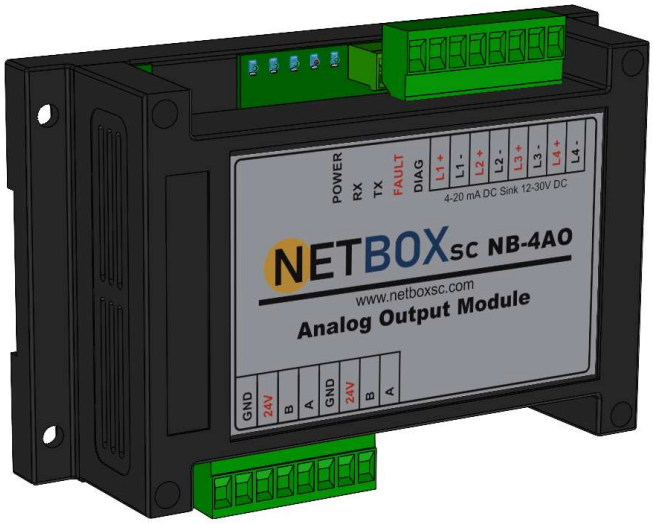
Analog Output Module

USER MANUAL



Rev 1.4

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1: About this Device

The Netbox NB-4AO Analog Output Module is a DIN rail mountable device which allows the user to associate Field Unit outputs — such as process variables, switch input values, and Field Unit status — to 4-20 mA loop output.

Each Field Unit output is received by the Accutech[1] Base Radio and is then routed to the NB-4AO Analog Output Module via a WIM RS-485 connection. This "assigned" variable is then converted to an industry standard 4-20mA signal output within the NB-A4O Analog Output Module and output on a user defined loop.

The NB-4AO Analog Output Module allows the user to select which Field Units and their respective variables are mapped to the device via the Accutech[1] Wireless Instrumentation Manager software.

The purpose of this manual is to help you install and maintain your NetBox Analog Output Module.

1.1 Compatibility

Accutech[1] analog and switch output modules are accessories used with the Accutech[1] base radio module to provide analog 4-20mA and configurable switch output to any PLC using standard 4-20mA and digital inputs.

NOTE

The below figure shows the complete family with both Accutech[1] and NetboxSC Output Modules connected together. The NetboxSC NB-HMI allows for local display of the alarms, values, and battery life of each field unit. In addition, the NB-WIFI module enables WIFI connectivity to allow for a user to access real-time sensor data from their smartphone.

The NetboxSC equivalent modules of the NB-4AO and the NB-8SW will fulfil the same role as the WI-4AO and the WI-8SW respectively; as a one-to-one drop-in replacement for, wired in series with, or independent of existing Accutech[1] modules. With compatible connectors, DIN mounting, and +24VDC input power, the NetboxSC module can be added to any existing WIM RS-485 daisy-chain network connected to a base radio module with no extra considerations for incompatible hardware.

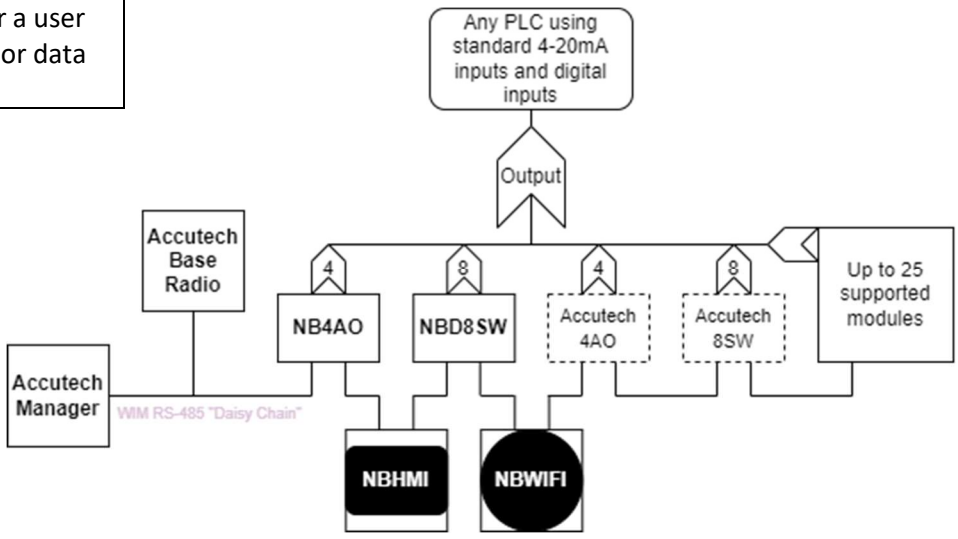

Fig. 1.1 System Block Diagram

[1]Accutech is a trademark of Schneider Electric

2: Quick Start

This section summarizes the steps that should be taken in order to get the device installed, configured, and in operation quickly.

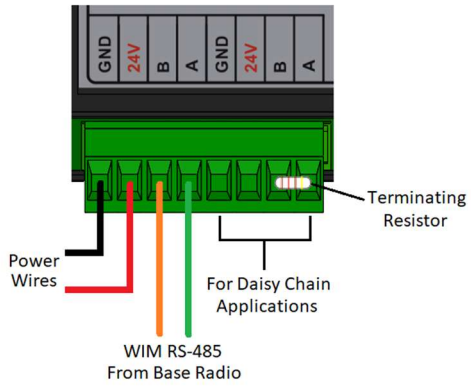

Fig. 2.1 Daisy-Chain Termination

1. Wire 24VDC power to the Output Module (See side Diagram)
2. Wire WIM RS-485 communications to the Module (See side Diagram)
3. Place terminating resistor in terminal only if Module will be used as an End Unit (see side Diagram)
4. With only one Output Module connected to the WIM RS-485 network at a time, configure the WIM RS-485 Address of each Analog Module via the Output Device Utility. (Only assign addresses between 3 and 32).
5. Once each Module has been given a unique address, re-wire the Modules in a daisy-chain with the Base Radio, making sure that the device with the terminating resistor (could be Base Radio) is in the End Unit location. (See Diagram below for daisy-chain wiring diagram).

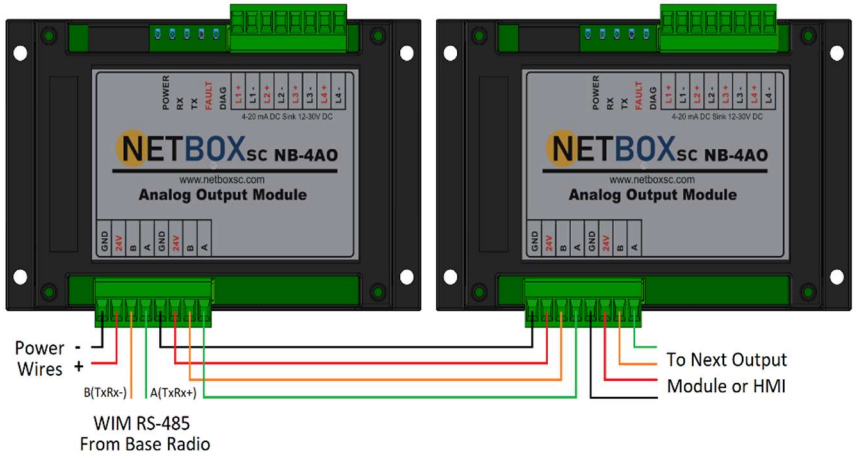

Fig. 2.2 Daisy-Chain Wiring Diagram

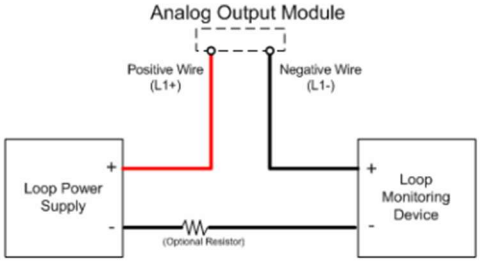

Fig. 2.3 Analog Loop Diagram

6. Wire Analog Loops (L1...L4) (See side Diagram). The input impedance should be >1000 Ohms for 24V Loop Power and >325 Ohms with 12V Loop Power.
7. Use the Accutech Wireless Instrumentation Manager software trim all Analog Output Loops via the Trim Wizard for each Output Module to calibrate the 4mA and 20mA set points.
8. Use the Accutech Wireless Instrumentation Manager software map desired Field Unit Process Values to respective Analog Output Loops via the Base & Output Devices view.

3: Electrical Installation

In this section wiring instructions are discussed for the various setup capabilities of the NB-4AO Analog Output Module. The subsections are as follows:

3.1: Electrical Specifications
3.2: Wiring Power and Communications
3.3: "Daisy-Chaining" Multiple Modules
3.4: Terminating Analog Output Modules
3.5: Wiring Analog Output Loops

3.1: Electrical Specifications

- +24VDC Power Supply with 0.5 Amp minimum output Recommend 22AWG Power Supply wire
- 2 Wire WIM RS-485 Serial Communications Cable Recommend Belden 3105A shielded and protected 22AWG or equivalent
- All output loops are isolated and MUST be externally powered. Two or more channels can be wired to the same Loop Power but the isolation between will be lost.

3.2: Wiring Power and Communications

⚠ WARNING ⚠
Remember to turn off all power before hooking up power wires!

Once you have located power and communications terminal blocks shown in Figure 3.2.1, you can wire the Analog Output Module accordingly. The best way to wire the Module is to:

1. Remove the terminal blocks from the jacks on the NB-4AO Output Module
2. Secure the wire into the proper terminal blocks via the small standard screws located on the top of the terminal blocks.
3. Plug the terminal blocks back into the proper jacks on the Output Module.

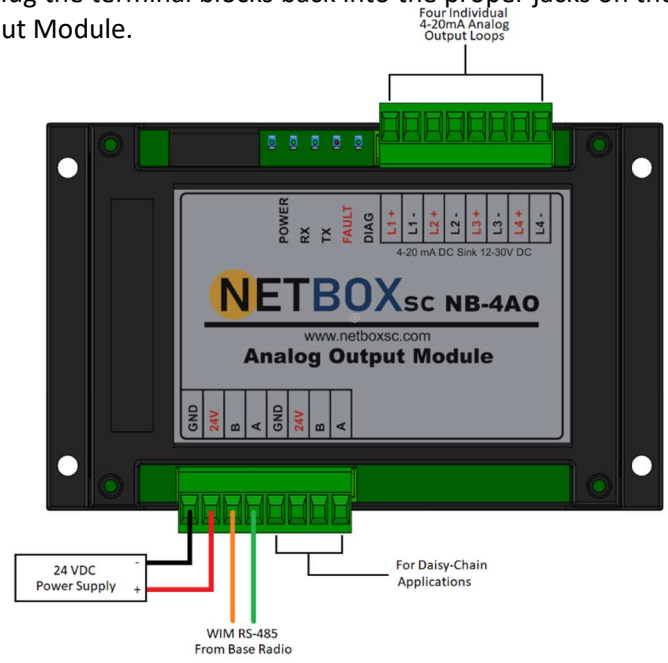

Fig. 3.2.1 Overall Wiring Diagram

3.3: "Daisy-Chaining" Multiple Output Modules

In order to allow the Accutech Base Radio to communicate to an NB-4AO Output Module the user MUST daisy chain the Accutech Base Radio to each NB-4AO Analog Output Module.

⚠ CAUTION ⚠

Make sure only ONE power supply is routed to an Output Module at any time! (Does not apply to Loop Power Supplies)

To do so, bring the WIM RS-485 wires from the Base Radio to the Output Module terminal block labeled "RS-485 from Base Radio" shown in the Figure 3.2.1: Overall Wiring Diagram. Then simply attach the outbound WIM RS-485 communication cable to the A and B terminals of each module. Keep in mind that all A and B connections must be connected to their respective terminals. Failure to do so will result in faulty communications on the WIM RS-485 network.

Power may be supplied in daisy-chain form from a single power supply, but be sure not to power a Module from two separate supplies. Doing so will supply the Analog Output Module with 48VDC and destroy the unit! The two GND and 24V connectors on the Module are connected internally and are used for daisy chaining modules together.

NOTE

All A terminals are connected to other A terminals. All B terminals are connected to other B terminals.

Shown in Figure 3.3.1, is a common daisy-chain network using three optional NetboxSC NB-4AO Analog Output or NB-8SW Digital Modules. In this setup the output from one Output Module is the daisy chained input to the next Output Module.

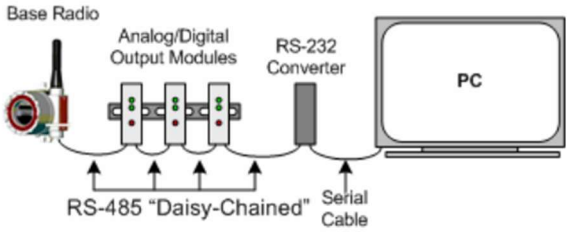

Fig. 3.3.1 Daisy-Chained Network

NOTE

If one of the Output Modules in the daisy-chain application is wired to the NB-BR converter cable, the A (Tx +) and B (Tx-) wires may need to be crossed for correct operation. Please see the converter's user manual for further instructions.

Shown below in Figure 3.3.2, is an example of how to wire the Modules together when using a daisy-chain setup with multiple Analog Output Modules.

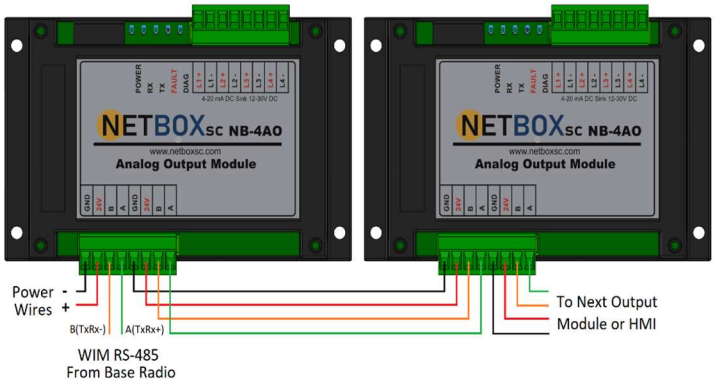

Fig. 3.3.2 Daisy-Chain Wiring Diagram

3.4: Terminating Analog Output Modules

RS-485 is capable of maintaining communications over a maximum distance of approximately 3000 to 4000 feet. In most (and we recommend all) situations the unit that comprises an “end” of an RS-485 network should be terminated by a resistor wired across the A and B communication wires.

In the case of a daisy-chained application the end unit should be terminated. The end unit is the unit that is at the end of series of units. Note: a PC is also an end unit, but the termination for this end unit is done within the converter. In a multiple unit daisy-chain application the end unit is the RS-485 unit located farthest from the PC, as shown in Figure 3.4.1 below:

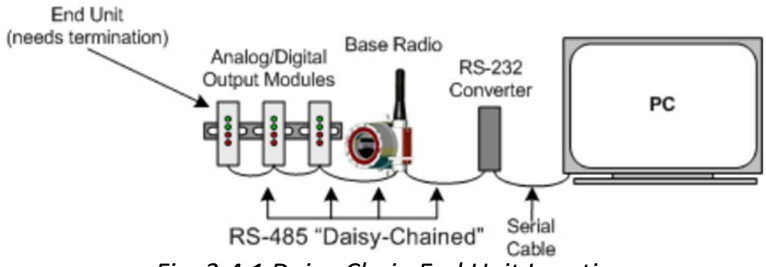

Fig. 3.4.1 Daisy-Chain End Unit Location

Termination of an end unit is done by placing a resistor across the A and B wires of the RS-485 cable. The value of this resistor should match the characteristic impedance (Zo) of the RS-485 cable. The characteristic impedance (Zo) is published by the manufacturer of the RS-485 cable you are using. The nominal value for the terminating resistor is 120Ω @ ¼ Watt.

To terminate an Output Module simply place one end of the resistor in the open terminal block’s B slot and place the other end of the resistor in the open terminal block’s A slot. Doing so will place the resistor across the A and B wires as needed. An example of this is shown below:

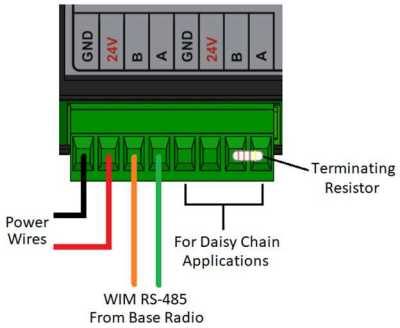

Fig. 3.4.2 Daisy-Chain Termination

3.5: Wiring Analog Output Loops

Because the Analog Module does not supply the loop power for each of its four output loops (L1…L4); this must be supplied by an external power supply and an optional current limiting resistor in series with the monitoring device. The input impedance of the Loop Monitoring Device should be >1000 Ohms for 24V Loop Power and >325 Ohms with 12V Loop Power. The wiring of this configuration is shown in the figure below:

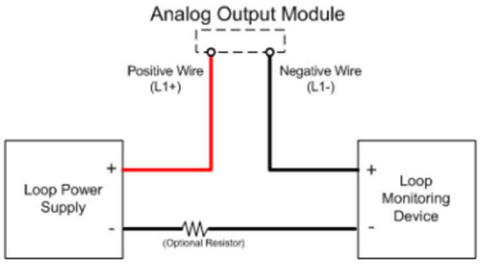

Fig. 3.5.1 Analog Loop Diagram

4: Configuring the RS-485 Address

Each Output Module has a WIM RS-485 address. These addresses must be set before the Output Modules can be used in service. Only one Output Module can be connected to the WIM RS-485 network at a time when doing address configuration.

NOTE

All Output Modules are given an RS-485 Address of 3 at the factory. If you have purchased more than one module, readdressing must be done. Failure to do so will prevent the Wireless Instrumentation Manager from properly communicating with these devices.

To set the WIM RS-485 address for the Output Module, follow the instructions below. The factory default for all Modules is Address 3:

1. Make sure Accutech Wireless Instrumentation Manager Software is installed on the PC.
2. Wire and connect an individual NB-4AO Output Module to the PC via the NB-BR converter cable.
3. Run the Output Device Utility. You should see the following screen after performing these steps:

NOTE

Connect only the 24v power supply and communications connections A and B for address configuration

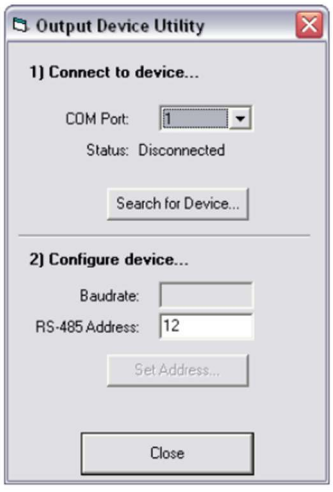

Fig. 4.1 Output Device Utility

Configuring the RS-485 Address cont.

NOTE

Programming the address only changes the module address and does not change any of the output trim or output configurations. If the user desires to change these settings, then it should be done through the Accutech Wireless Instrumentation Manager Software by using the trim and/or configuration functions or through a factory reset as described in section 6.

Once the Output Device Utility is open (Fig. 4.1), perform the following steps:

1. Select the COM Port that the WIM RS-485 converter is connected to
2. Then click Search for Device
3. Once the device is found, its current Baud Rate and RS-485 Address will be displayed. Enter a new address from 3 to 32. (NOTE: Output Modules CANNOT share the same address if they reside on the same daisy-chain WIM RS485 network)
4. Click Set Address. The module address has been set and is ready for operation.
5. Repeat all steps for subsequent devices but only installing one module at a time to this programming setup.

5: Configuring the Analog Output Loops

In this section software configuration instructions are discussed for the various setup capabilities of the Analog Output Module. The subsections are as follows:

5.1: Getting Started
5.2: Trimming the 4-20mA Loop Outputs
5.3: Mapping Field Units to Analog Outputs

NOTE

All loops must be externally powered as the Output Module does not supply the loop power. See section 3.5 for more wiring details.

There are four possible 4-20mA output loops available on each NB-4AO Analog Output Module. Each individual loop is configurable to a Field Unit RF ID number

For example: If Loop 1 on the NB-4AO Analog Output Module has been mapped to RFID #1 and Input #1, then the Field Unit that has been set to RFID #1 will have its process variable from Input #1 output on that 4- 20mA loop

The Module also has five indication lights:

- POWER — Indicates +24VDC power is being supplied.
- RX — Flashes every time the Output Module receives a WIM RS485 message from the Base Radio.
- TX — Flashes every time the NB-4AO Output Module transmits a WIM RS485 message to the Base Radio.
- FAULT — Indicates loss of communication or sensor error with one of the four mapped inputs when lit.
- DIAG — Blinks error code patterns for diagnostics

5.1: Getting Started

Once you have properly wired up the Base Radio and the Analog Output Module(s), turn on the Field Units, Base Radio and Output Module. Make sure that the Field Unit(s) and Base Radio are communicating properly (see respective User Guides for more details). Then run the Accutech Wireless Instrumentation Manager (WIM) software.

Once you are connected to the WIM software, click on the Base & Output Devices icon in the left-hand VIEWS pane. The top half of the view will contain all the Base Radios on your network. The bottom half of the view will contain all the Analog Output Modules that are on the network. Each Module that is in the WIM RS485 network should appear on the screen. This will include their address and type. If it does not there, there is an error in the setup that needs to be corrected.

If you have connected the NB-4AO Analog Module but do not see it being displayed, you may have to tell the software to look for new devices. The software performs a new device search upon start-up of the RF Server, however if devices are added after the RF Server is already running, they may not be detected. To manually perform a new device search click Discover Devices, which is found under the File menu. The software will inform the user when it is finished searching for devices via the Events Log.

5.2: Trimming the 4-20mA Loop Outputs

In order to make the 4-20mA loop read accurately, you may need to trim it to match the device that is reading it. To trim one of the four analog loops on the device, go to the Base & Device Outputs view in the Accutech WIM software. Right-click on the Output Module you wish to trim. Then select the Trim Wizard selection from the menu. Doing this will bring up the trim wizard as shown below:

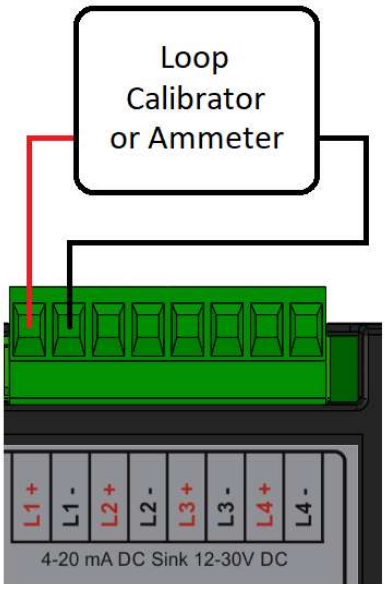

Fig. 5.2.1 Output Loop Terminals

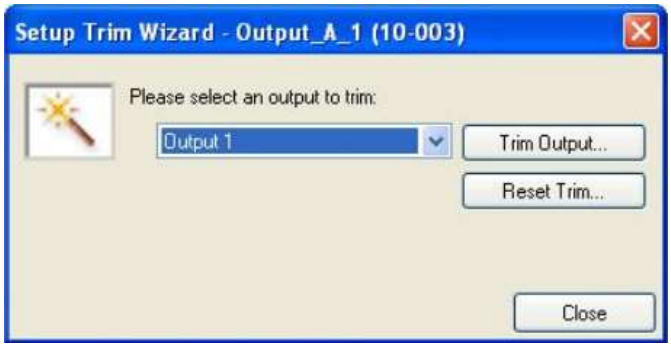

Fig. 5.2.2 WIM Loop Trim

As shown above, select the output loop you wish to trim from the drop-down box. These outputs correspond to loops L1, L2, L3, and L4.

Trimming the 4-20mA Loop Outputs cont.

Once you have selected the output you wish to trim, click the Output Trim button. This will take you through a set of steps that will trim that particular output of the unit. Please note that you must have a way to read the output of the unit as this is required when performing the trim functions. This is done thru the use of an mA meter or loop calibrator. See Fig 5.2.1.

5.3: Mapping Field Units to Analog Outputs

Any Field Unit input may be mapped to an available output loop on the Analog Output Module. This is done by navigating to the Base & Output Devices view as shown below:

NOTE

Field Units are often referenced throughout the software by two numbers, such as 9-001 in Figure 5.3.2. The first number refers to the Base Radio ID and the second number refers to the Field Unit RFID

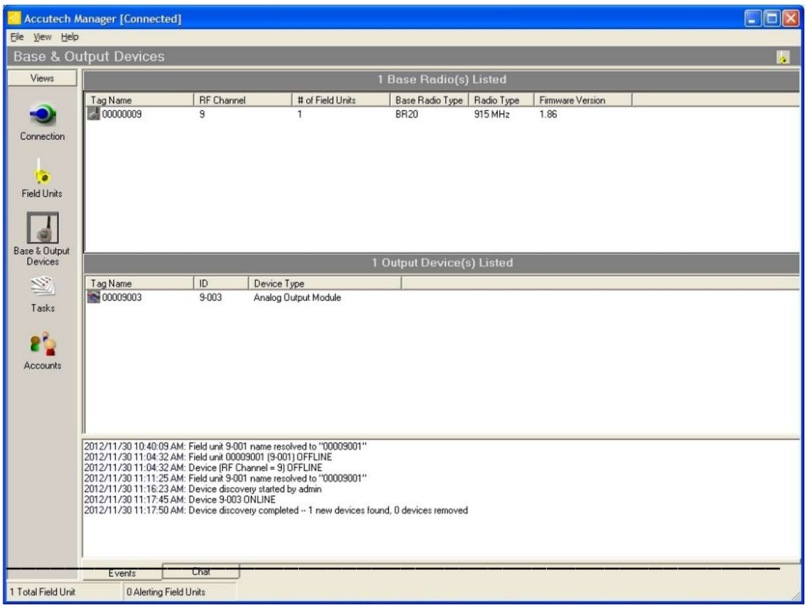

Fig. 5.3.1 WIM Base & Output Devices View

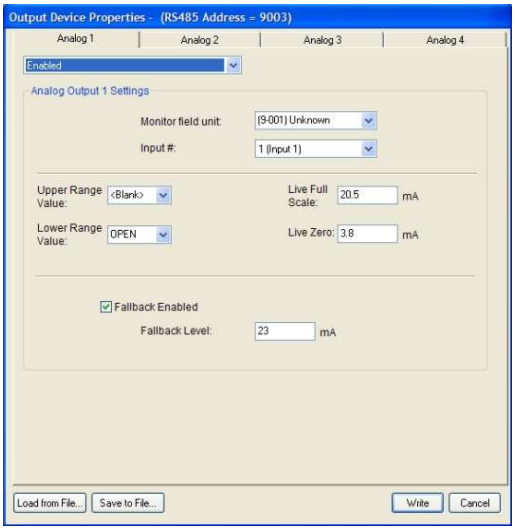

Fig. 5.3.2: WIM Output Device Properties

To map a Field Unit input to a particular output loop, right-click on the Output Module you want to map. Select "Properties" from the drop-down menu. This opens the Output Device Properties dialog as shown to the left.

First, select the appropriate Analog tab and set it to "Enabled." Select the desired field unit to be mapped from the Monitor field unit drop-down list. The first number in the field unit designator corresponds to the Base Radio ID and the second refers to the Field Unit RFID

Once the Field Unit is selected, select the Input Number. This refers to the available inputs on the selected Field Unit. Please note that a Field Unit may only have one input.

Set the Upper Range Value (URV) and Lower Range Value (LRV) in the Input Unit Values section of the dialog. Enter corresponding mA loop output values in the Live Full Scale and Live Zero text boxes. The Live Full Scale (LiveFS) and Live Zero (LiveZero) settings

Mapping Field Units to Analog Outputs cont.

NOTE

When an NB-4AO Output Module is configured, the configuration data is downloaded into the unit via the WIM RS-485 connection. This means that the software and PC can be completely separated from the device and it will continue to operate in the way it was last configured.

If the Accutech Wireless Instrumentation Manager software is being run in Configuration Mode, the software will ask the Analog/Digital Output Module how it is currently configured and display this to the user.

If the Accutech Wireless Instrumentation Manager software is being run in Management Mode, the software will store the Analog/Digital Output Module configuration data and display this stored data to the user

indicate the maximum and minimum mA level that the device outputs, excluding the Fallback Level.

In an example of a RTD field unit reading temperature in degrees C, the upper and lower ranges are set between 0 and 100C. These values would be entered into the Lower Range Value and Upper Range Values respectively. This means the 4 to 20 mA output will represent 0 to 100C with 4.00mA being 0C and 20.00mA being 100C with all temperatures between 0 and 100C being represented by values between 4.00 and 20.00 mA. In the above figure, the LiveFS is set to 20.5 mA which means that if the level passes 100 degrees C (the URV) the device continues to output until it reads 103.25 degrees C which corresponds to 20.5 mA output. If the value goes beyond 103.25 degrees C, the device continues to only output 20.5 mA. The output between the Lower Range Value (LRV, which is 4 mA) and the Upper Range Value (URV, which is 20 mA) is linear.

In recapping the example, the input of field unit ID 001 is selected and mapped to Output Loop 1. Then, 100 degrees C is set as the URV and this causes an output of 20.00 mA on the output loop. The selection of 0 degrees C causes an output of 4.00 mA on the output loop. This means that if the field unit read 50 degrees C, the output is 12.00 mA (or midway between 4 and 20 mA).

Check or uncheck the Fallback Enabled check box to enable or disable a fallback output for the analog loop. When the Fallback Enabled check box is checked, the fallback output is enabled. This means that if a fallback condition occurs, the output loop no longer outputs the field unit value, but instead outputs the mA source specified in the Fallback Level text box. Reasons for a fallback condition are:

- Loss of RF communication between the Base Radio and Field Unit.
- Loss of RS-485 communication between the Base Radio and Output Module.
- Field Unit Sensor Failure or System Failure.
- Field Unit mapped input is disabled by user.

If the Fallback check box is not checked the NB-4AO will output different mA values indicating different error conditions. An error condition is indicated by the Red Fault indicator also being on. The follow table is a list of the mA values that are output during different error conditions.

Mapping Field Units to Analog Outputs cont.

mA Output	Fault Condition
2.40mA	Loss of WIM RS-485 Comm
2.50mA	Unit not Online
2.60mA	Sensor Alert Condition
2.70mA	Sensor Level Alert
2.80mA	System Alert
2.90mA	Conversion Value Out of Range
3.00mA	Unit not Online
3.35mA	Internal Hardware error

The above table has a tolerance of +/-0.04mA after calibration has been performed.

Once all of your channels on this Output Module are set, click the "Write" button to save the settings to the device. This will close the Output Device Properties window.

If all of the outputs are configured and working properly the red fault light will be off indicating everything is in working order.

6: Factory Reset and Diagnostics

The NB-4AO has two built in features for preforming a factory reset and internal diagnostics. There are two jumpers or DIP Switches located on the printed circuit board of the NB-4AO. To access these jumpers or switches the top cover of the module must be removed. This is done by removing the four screws located in each corner of the module. Once the cover is removed, locate the JP jumpers or the DIP switches located in the upper lefthand side of the board. JP1 or DIP switch 1 is used to perform a factory reset. JP2 is used to test each of the 4-20mA outputs.

6.1: Factory Reset

To perform a factory reset, install a jumper or turn on DIP switch 1. Remove all output connections to the NB-4AO. This is to prevent unwanted signals from appearing on the receiving 4-20mA input device such as a PLC. Apply power to the NB-4AO module. Press the Reset button located in the upper lefthand side of the NB-4AO module. The green power light should be on and the green diagnostic light should flash one time. Doing this operation will reset the address of the module to 3, clear all output trim values to a factory setting and disable all configurations. Remove power from the NB-4AO module and remover the JP1 jumper or turn DIP switch 1 off. After this operation has been performed, the user should do the following:

1. Set the module address to the desired value (see section 4).
2. Trim each output using the Accutech Wireless Instrumentation Manager software. (section 5.2)

Factory Reset cont.

3. Set the Mapping of each Field Unit to an Analog Output of each channel using the Accutech Wireless Instrumentation Manager software. (section 5.3)

⚠ CAUTION ⚠

ALL previous values and setting are lost.

This operation should only be done if a complete reset of the NB-4AO module is desired.

6.2: Diagnostic Output

The NB-4AO has a diagnostic 4-20mA output mode. In this mode the NB-4AO will output 4-20mA signals that can be used to check it for proper operation. In this mode, each output is sequenced from 4.00mA to 20mA in increments of 4.00mAs. Using the same connection method as in trimming an output (section 5.2), a loop calibrator or mAmp meter can be used to verify the output of each channel. If the output fails to read the desired values, it may be an indication of a bad output or recalibration. An error reading of over 1mA or no output is usually an indication of board failure and the unit should be replaced. An error reading of less than 1mA usually indicates recalibration is required.

To place the NB-4AO outputs in this diagnostic mode, install jumper JP2 or turn on DIP switch 2. Remove the output connections to the NB-4AO so that loop output measurements can be made. Refer to the output trimming section 5.2 for connection configuration. This also prevents unwanted signals 4-20mA output signals from appearing on the input device such as a PLC. Apply power to the NB-4AO module. Press the Reset button located in the upper lefthand side of the NB-4A) module. The green power light should be on as well as the red fault LED. This is followed by the alternating green diagnostic LED then the red fault LED approximately 2 seconds apart. This indicates the module is in diagnostic mode. Each output will now change with each change of the LEDs. This pattern will continue until the power is removed and the JP2 jumper removed or the DIP switch 2 is set to off. Putting the module in diagnostic mode does not change any of the previous setting made by the user. Once the use of this mode is completed, restore the module and wiring to its original condition for normal operation.

7: Technical Specifications

Operating Characteristics:

- 10-30 VDC
- 0°F to 175 °F (-17 °C to 79 °C)

Analog Output Characteristics:

- 4-20mA outputs require 12-30 VDC loop power
- 4-20 mA is Opto-isolated
- Isolation voltage = 800 V
- 4 uA resolution

Accuracy:

- Accuracy of 10 µA at 25°C (reference conditions)
- Ambient Temperature effect ±0.1% of reading per 18°F (10°C)
- Supply rejection less than 2 µA from 12-30 V

Physical Characteristics:

- DIN Rail mounted
- 3.6” high X 5.7” wide X 1.2” deep

Fault (Fail-Safe) Condition:

- Each output goes into fail safe in the event of a sensor failure, missing sensor, NO RF condition, RS-485 link down, field unit powered down
- The Analog Output Module displays a fault indication if any enabled output goes into a fail-safe condition

User Programmable Options:

- Range (lower value range and upper value range) each output using Accutech Wireless Instrumentation Manager (WIM)
- Trim each output using WIM
- Enable or disable failsafe for each output
- Failsafe output user selectable to 3.6mA, 23mA, or user specified value
- Select WIM RS-485 address with the Configuration Utility Program