RTU-1 Configurator

Valquest Systems, Inc.

Contents

RTU Hardware Description

In order to understand the RTU-1 configuration software, it is important to have a working knowledge of the RTU itself. Although there are several mounting styles – rack mount, panel mount, cabinet mount, etc., they all work essentially the same way. The RTU-1 is modular in design and capable or working in the oldest to the newest substations or metering points.

The following is a brief description of the RTU.

1. **Communications** – At its core the RTU-1 processor board has eight (8) communication ports these are:
    a. BDM – Firmware programming port
    b. Serial Port 0 – Maintenance and Local Monitoring
    c. Serial Ports 1–6 – General purpose ports. These can be configured to provide:
        i. One or or two server (slave) ports – in other words the RTU can support two DNP 3.0 masters or one DNP 3.0 master and/or one Valquest protocol master. They can be Ethernet, Serial or Fiber Optic.
        ii. Up to 32 Ethernet client sockets using DNP, Modbus, or PG&E 2179 for IEDs
        iii. Up to 32 Serial client sockets using DNP, Modbus, or PG&E 2179 for IEDs
        iv. Up to 32 Fiber optic client sockets using DNP, Modbus, or PG&E 2179 for IEDs
            1. These can be ST Glass, V-Pin or Plastic fiber.
    d. Serial and Fiber communications are accomplished using communication fan-out boards known as Com-Fans. These boards then connect to modularized back panel Serial and Fiber Pair boards.
        i. Each Com-Fan board can handle up to 15 Serial or Fiber Pair boards
        ii. Up to 2 Com-Fans can be added to the RTU.
    e. TCP/IP and UDP communications are accomplished using Ethernet to Serial boards known as IP-8s.
        i. Each board has 8 Ethernet sockets consisting of
            1. Sockets 0-6 – General purpose sockets which can be configured as
                a. Server – TCP/IP or UDP
                b. Client – TCP/IP
            2. Socket 7 – Maintenance socket for configuration and monitoring.
            3. Each socket can be configured to communicate to the RTU through any of 5 serial ports.
            4. As many of these Ethernet modules as necessary can be added to the RTU.

2. **Analog Inputs** – The RTU accepts Analog Inputs both from IEDs through the communications and from local PTs, CTs and other Analog devices. Capabilities include:
    a. Up to 448 total analog inputs (including local and IED AIs)
    b. Up to 192 local analog inputs
        i. Up to 15 PT inputs
        ii. Up to 96 CT inputs
        iii. Up to 120 DC inputs 0-5 vdc or 4-20 ma
    c. Local Analog Inputs come through analog input boards known as AE-1s.
        i. Each AE-1 can take up to 12 analog inputs.
        ii. Up to 16 of these boards can be added to the RTU.

3. **Binary Inputs** – The RTU accepts Binary Inputs both from IEDs through the communications and from local discreet contacts in devices. Capabilities include:
    a. Up to 512 total binary inputs (including local and IED BIs)
    b. Up to 200 local discreet binary inputs. These are opto-coupled internally for electrical isolation
    c. Local Binary Inputs come through digital input boards known as DI-1s and through the main RTU board.
        i. The RTU board takes 8 discreet binary inputs.
        ii. Each DI-1 can take up to 16 discreet binary inputs.
        iii. Up to 8 of these boards can be added to the RTU.

4. **Analog Outputs** – The RTU accepts and is able to send Analog Output values (usually used for settings) to and from IEDs through the communications. Capabilities include:
    a. Up to 128 analog outputs from IEDs.

5. **Counters** – The RTU accepts Counter values from IEDs through the communications. Capabilities include:
    a. Up to 64 counters from IEDs.

6. **Control Outputs** – The RTU can send Control Outputs both to IEDs and locally through Relay Pairs to local equipment that expose inputs capable of responding to dry contact closures or voltage inputs. Capabilities include:
    a. Up to 512 total control output pairs (including local and IED BOs)
    b. Up to 68 local relay pairs
    c. Local Control Outputs are sent to Relay Panels through control output boards known as DO-1s and through the main RTU board.
        i. The RTU board can operate 4 relay pairs.
        ii. Each DO-1 can operate 8 relay pairs
        iii. Up to 8 of these boards can be added to the RTU

7. **Calculations** – the RTU can make calculations based on inputs that it receives. These include:
    a. RMS Voltage – A, B, C, 3ø – based on signals from PTs
    b. RMS Current – A, B, C, 3ø, Neutral – based on signals from CTs
    c. kW – A, B, C, 3ø – based on signals from PTs and CTs
    d. kVAr – A, B, C, 3ø – based on signals from PTs and CTs
    e. kVA – A, B, C, 3ø – based on signals from PTs and CTs
    f. Power Factor – A, B, C, 3ø – based on signals from PTs and CTs
    g. Phase Angle – A, B, C, 3ø – based on signals from PTs and CTs
    h. Arithmetic functions using Analog Inputs
    i. Arithmetic functions using Counter Inputs
    j. Boolean functions using Binary Inputs

RTU-1 Configurator Overview

The RTU-1 performs many functions. It is:

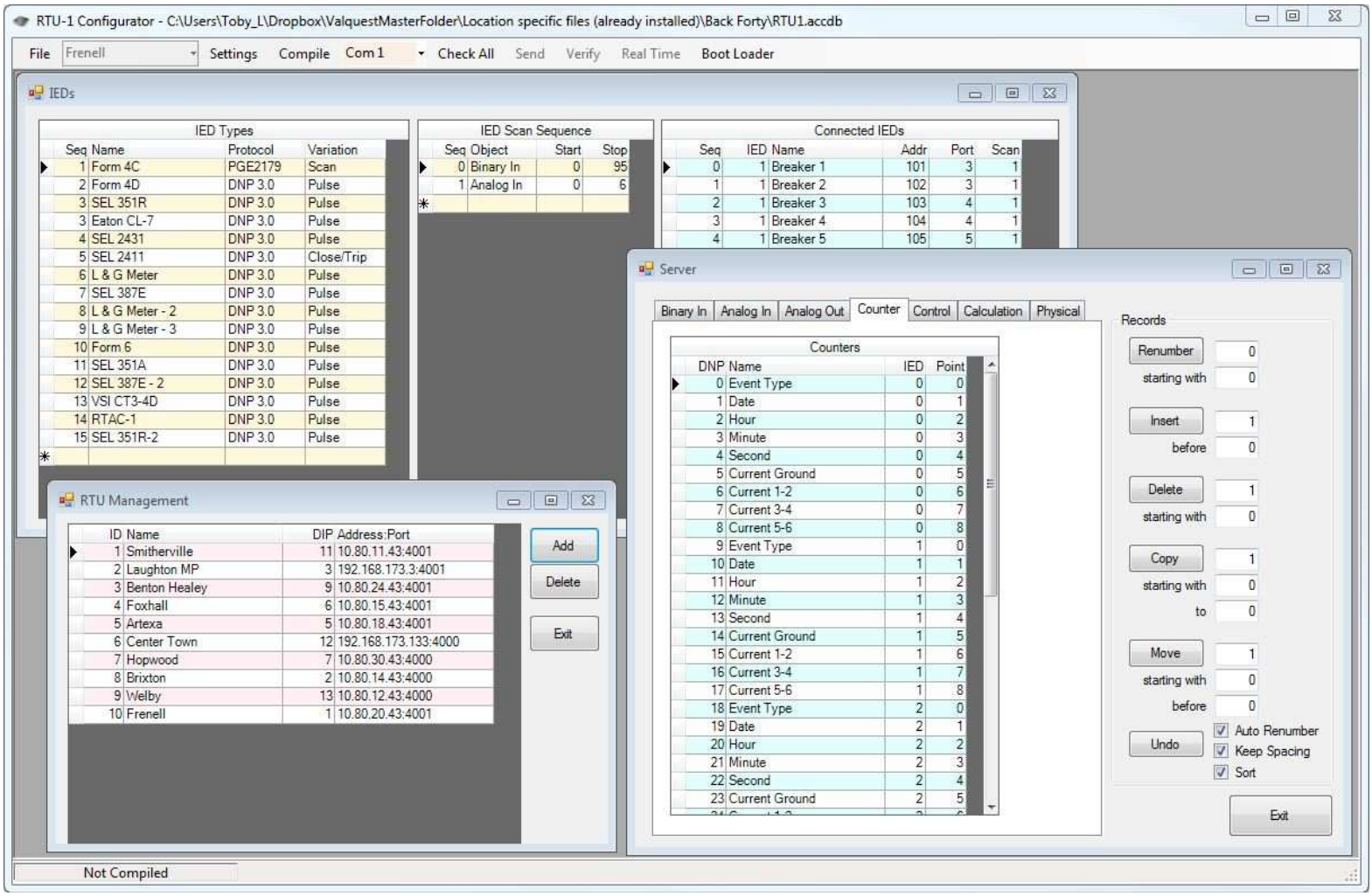
- a server – to the SCADA Master.
- a client – to all of the IEDs.
- a signal conditioner – for all the discreet analog and binary inputs.
- a calculator – for all the electrical parameters and special functions.
- a data concentrator – for streamlining SCADA System communications.

This means that the configuration software must have many functional aspects. The RTU-1 Configurator facilitates populating these in several sections. The following pages give descriptions of each of these sections.

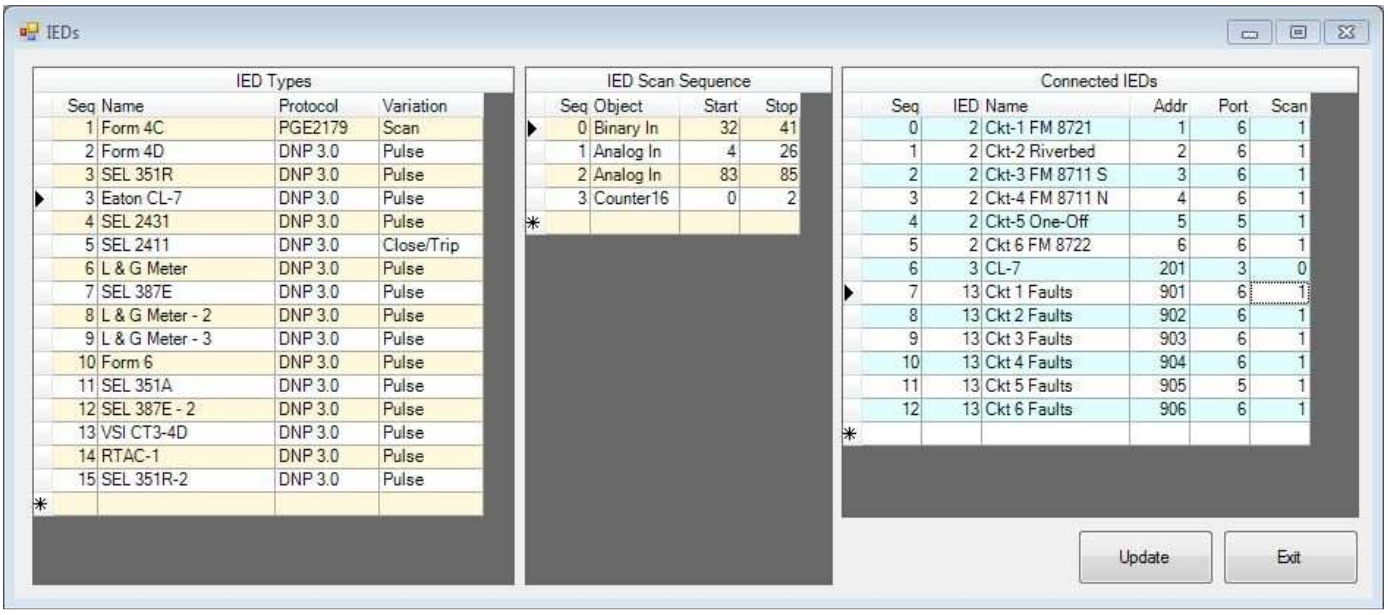
All the data for the RTUs in a SCADA system is contained in a single Microsoft Access database (RTU1.accdb). This program facilitates data entry and data usage for this database. Each of the user interface tables displays data and allows manipulation of one of the Access database tables.

The tables have three different background colors:

- Yellow These are tables that apply to all RTUs.
- Light Blue These tables are specific to the RTU in the pull-down menu just right of *File.*
- Pink The RTU table



1. **IED (RTU as Client) Communications Definitions** – In this section each IED is defined as to how the RTU will communicate with it regarding normal polling. Since the vast majority of IEDs are repeated many times in a SCADA System, it is convenient to create standard communication models type. This greatly reduces the amount of work required to configure each individual one.



The aspects common to all implementations of the different types of IEDs are defined in the *IED Types* and *IED Scan Sequence* tables:

1. Name — User defined device name, ex: SEL 351R
2. Protocol — the protocol to be used
3. Variation — the protocol polling method
4. Object — the various Analog Inputs, Binary Inputs and Counters to be polled.
5. Start, Stop — the indices of these polled inputs

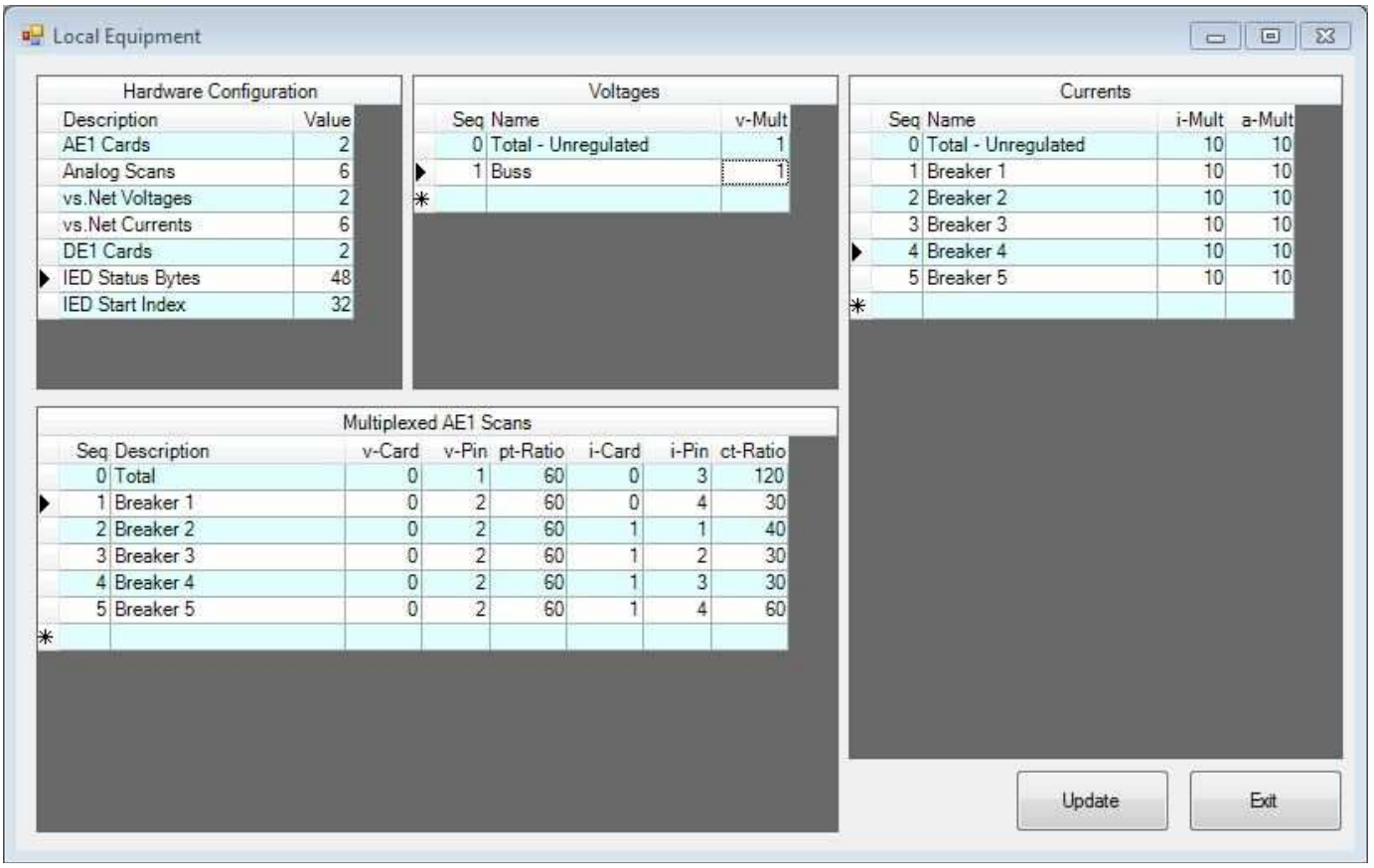
These tables are yellow because they apply to all RTUs.

The individual aspects of the IED are defined in the *Connected IEDs* table:

a. Seq — Polling sequence number
b. IED — Device type – reference the appropriate model from the *IED Types* table
c. Name — User defined name of the particular implementation
d. Addr — Communications protocol address
e. Port — Communications port number
f. Scan — On-line – Off-line status (1 = On-line, 0 = Off line)

This table is light blue because it is specific to the selected RTU.

2. **Local Equipment** – This section is not required if all analog and binary inputs are being polled from IEDs. It is required when using AE-1 boards to get PT and CT inputs for electrical parameter calculations. These tables are all light blue because they are specific to the selected RTU.



It has four sections:

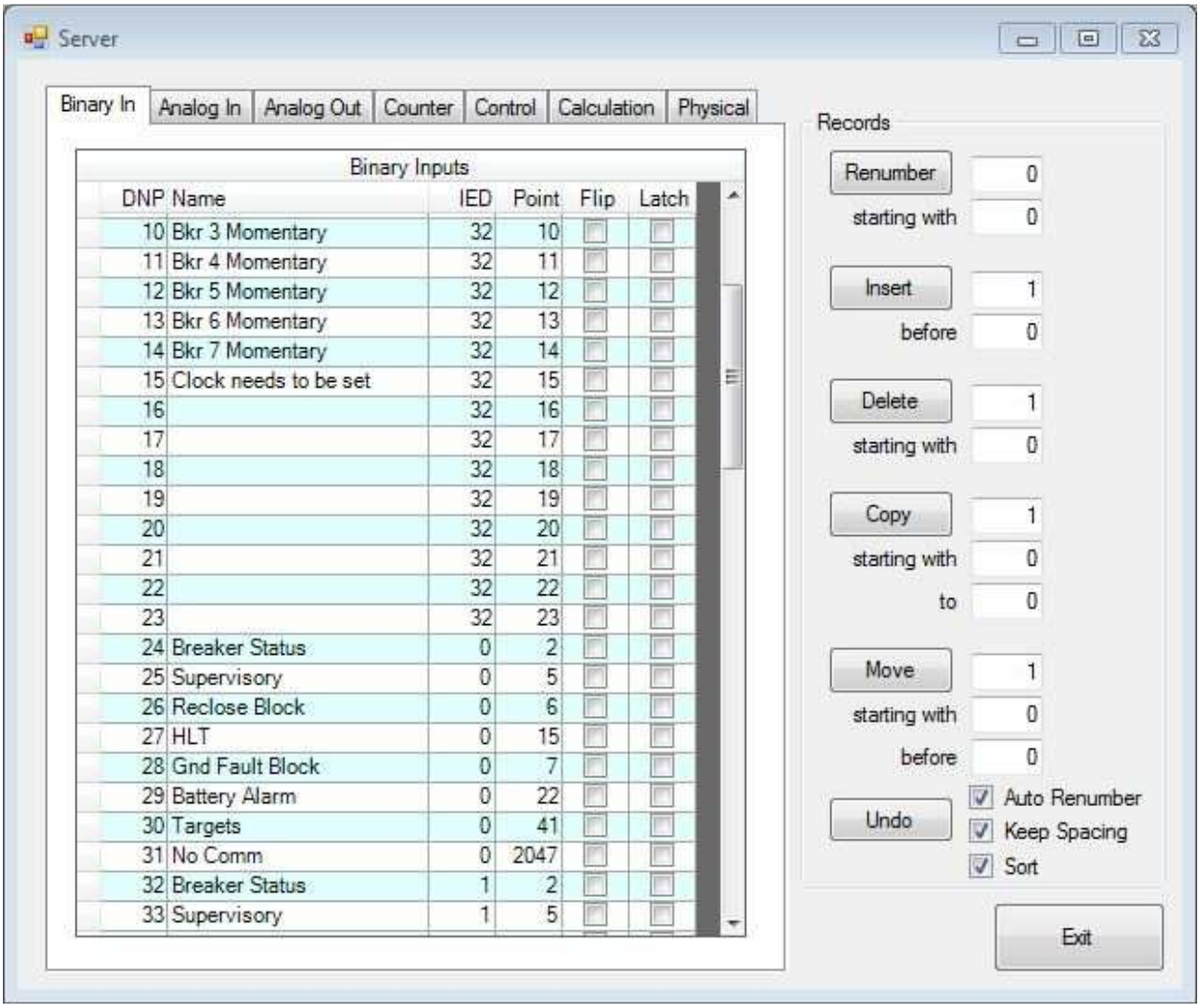
1. *Hardware Configuration*
   - i. AE1 Cards — The number of AE-1 boards being used
   - ii. Analog Scans — The number of AE-1 voltage / current scans
   - iii. vs.Net Voltages — The total number of 3 phase voltages including IEDs
   - iv. vs.Net Currents — The total number of 3 phase currents including IEDs
   - v. DE1 Bytes — The total number of DE-1 bytes (2 per board)
   - vi. IED Bytes — The total number of IED bytes of Binary Inputs
   - vii. IED Start Index — Starting index of IEDs in the Binary Input table

2. *Voltages*
   - i. Seq — Sequence number
   - ii. Name — User defined voltage signal name
   - iii. v-Mult — Multiplier on the voltage data from the IED or RTU

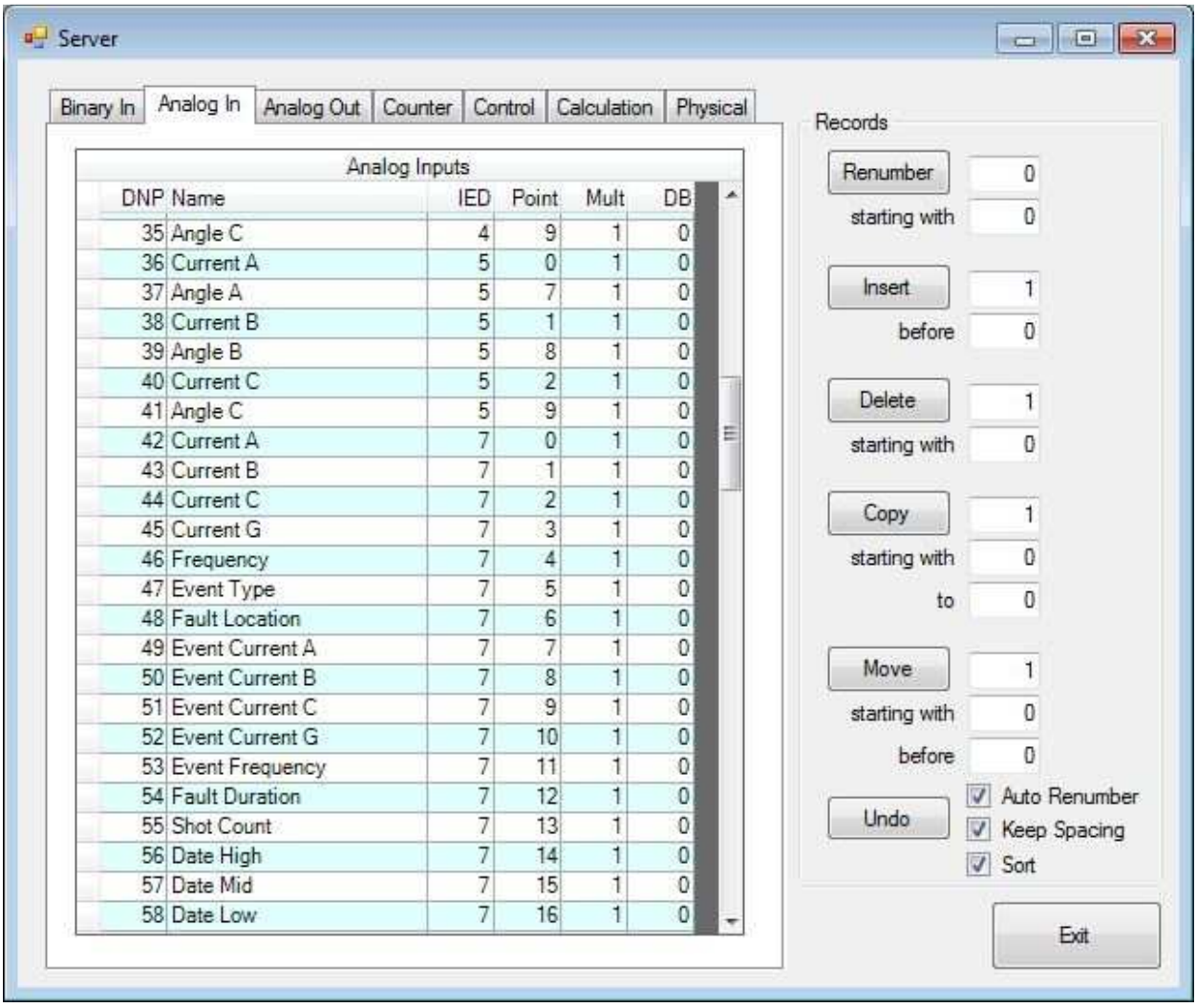
3. *Currents*
   - i. Seq — Sequence number
   - ii. Name — User defined current signal name
   - iii. v-Mult — Multiplier on the current data from the IED or RTU
   - iv. a-Mult — Multiplier on the phase angle data from the IED or RTU

4. *Multiplexed AE1 Scans* – These scans are done once per second. Each scan monitors one set of three phase currents and one set of three phase voltages (the voltages associated with the three currents). Simultaneously the RMS voltages and currents as well as the phase kWs and kVArs are measured for each phase. In order to multiplex the proper PT and CT inputs into the RTU the following table must be populated.
    i. Seq — Sequence number
    ii. Description — User defined description of the scan
    iii. v-Card — Index of the AE-1 board used for this voltage set
    iv. v-Pin — Pin on phase connectors of the AE-1 for this voltage set
    v. pt-Ratio — The PT ratio for this voltage set
    vi. i-Card — Index of the AE-1 board used for this current set
    vii. i-Pin — Pin on phase connectors of the AE-1 for this current set
    viii. ct-Ratio — The CT ratio for this current set

3. **Server (RTU to Master) Communications Definitions** – This section provides the dictionary and translation tables for converting information it receives from the IEDs and the discreet signal conditioning it performs into data to send back to the SCADA master. It also defines the translations for sending control outputs when commanded by the master. All the tables in this section are light blue indicating that they are specific to the selected RTU. This section is divided into seven subsections. They are as follows in the screenshots and descriptions:

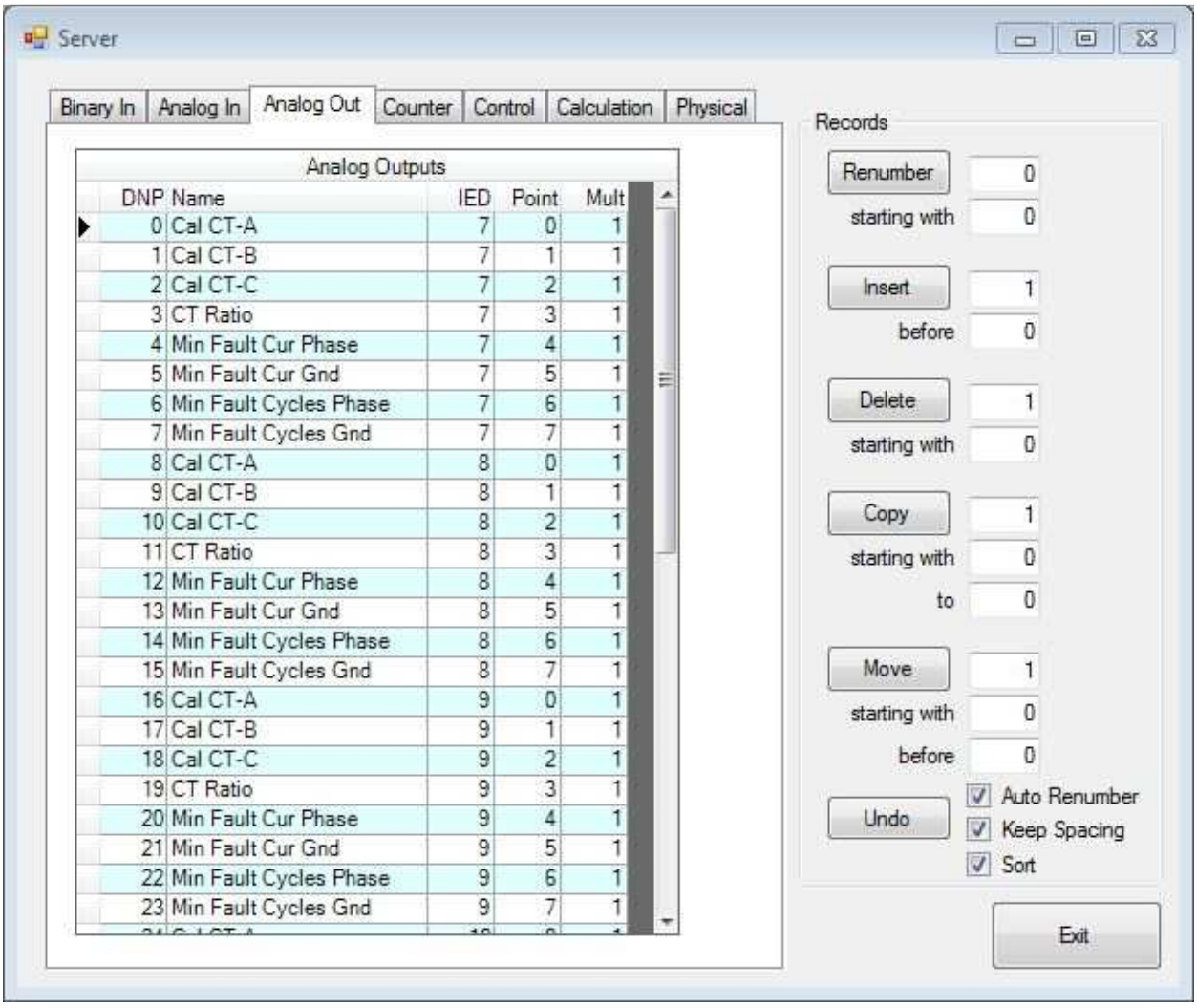


1. *Binary Inputs*
   - i. DNP — Server DNP index (the BI DNP index expected by the master)
   - ii. Name — User defined Binary Input signal name
   - iii. IED — Sequence of the IED as defined in the *Connected IEDs* table (32 = RTU)
   - iv. Point — The IED protocol Binary Input index or RTU status point index
   - v. Flip — Check box indicating that the Binary Input is to be inverted
   - vi. Latch — Check box indicating that the Binary Input will latch when set. The RTU provides a special Reset function for clearing latched bits.

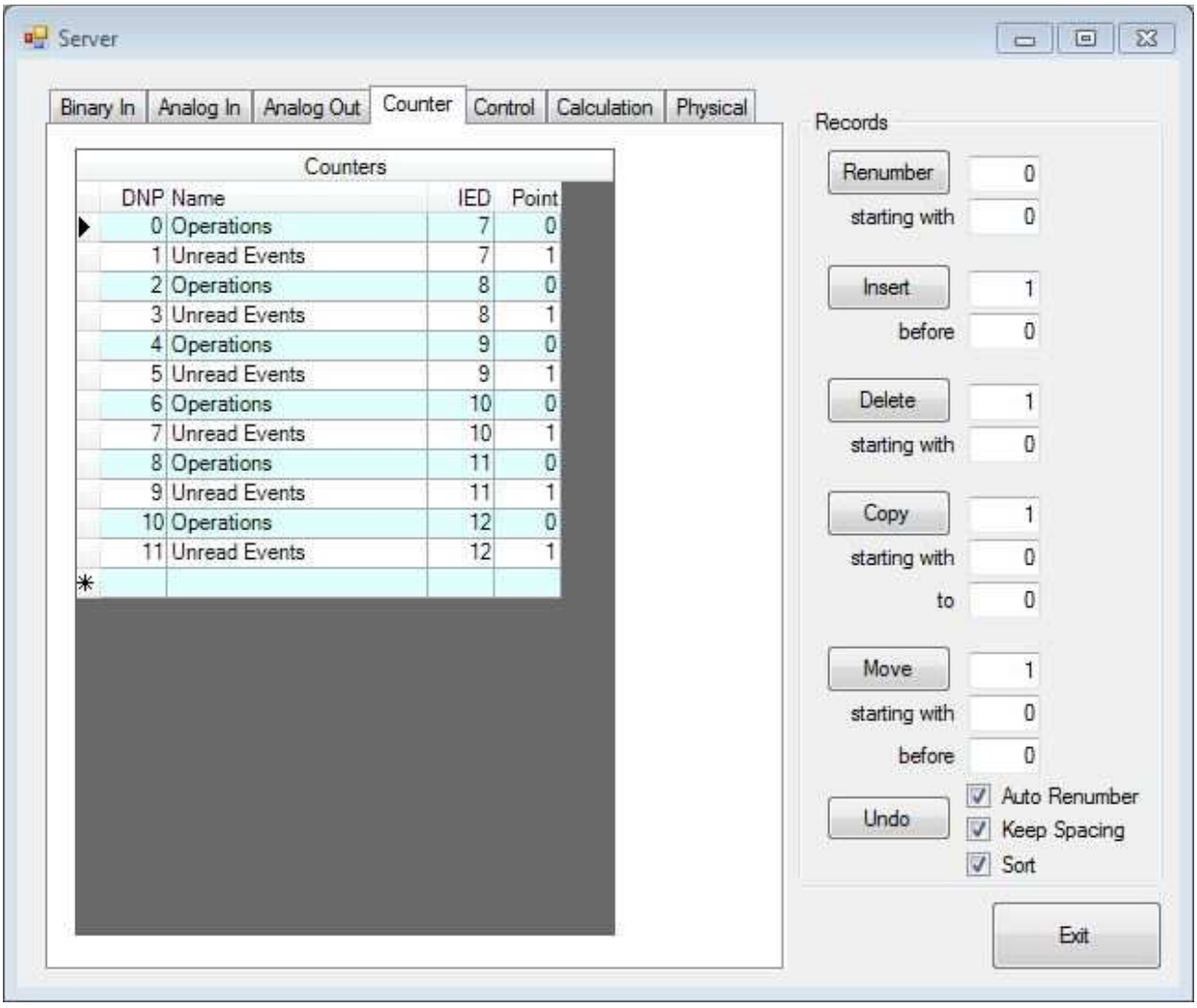


2. Analog Inputs

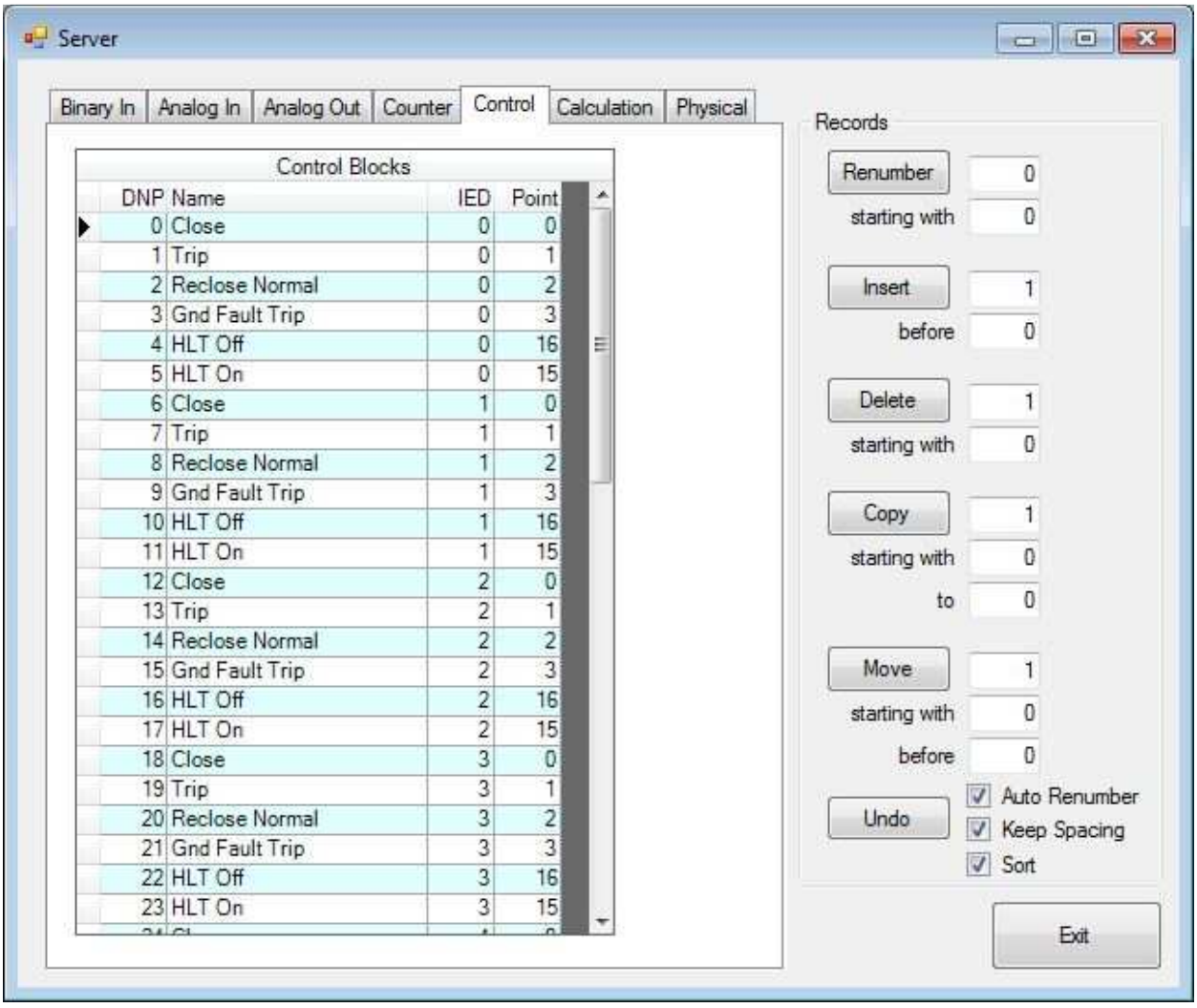
i. DNP Server DNP index (the AI DNP index expected by the master)
ii. Name User defined Analog Input signal name
iii. IED Sequence of the IED as defined in the *Connected IEDs* table (32 = RTU)
iv. Point The IED protocol Analog Input index or RTU electrical parameter index.
v. Mult A multiplier for monitoring purposes (does not affect data sent to master)
vi. DB Deadband value for poll by exception from RTU to master (0 = off)



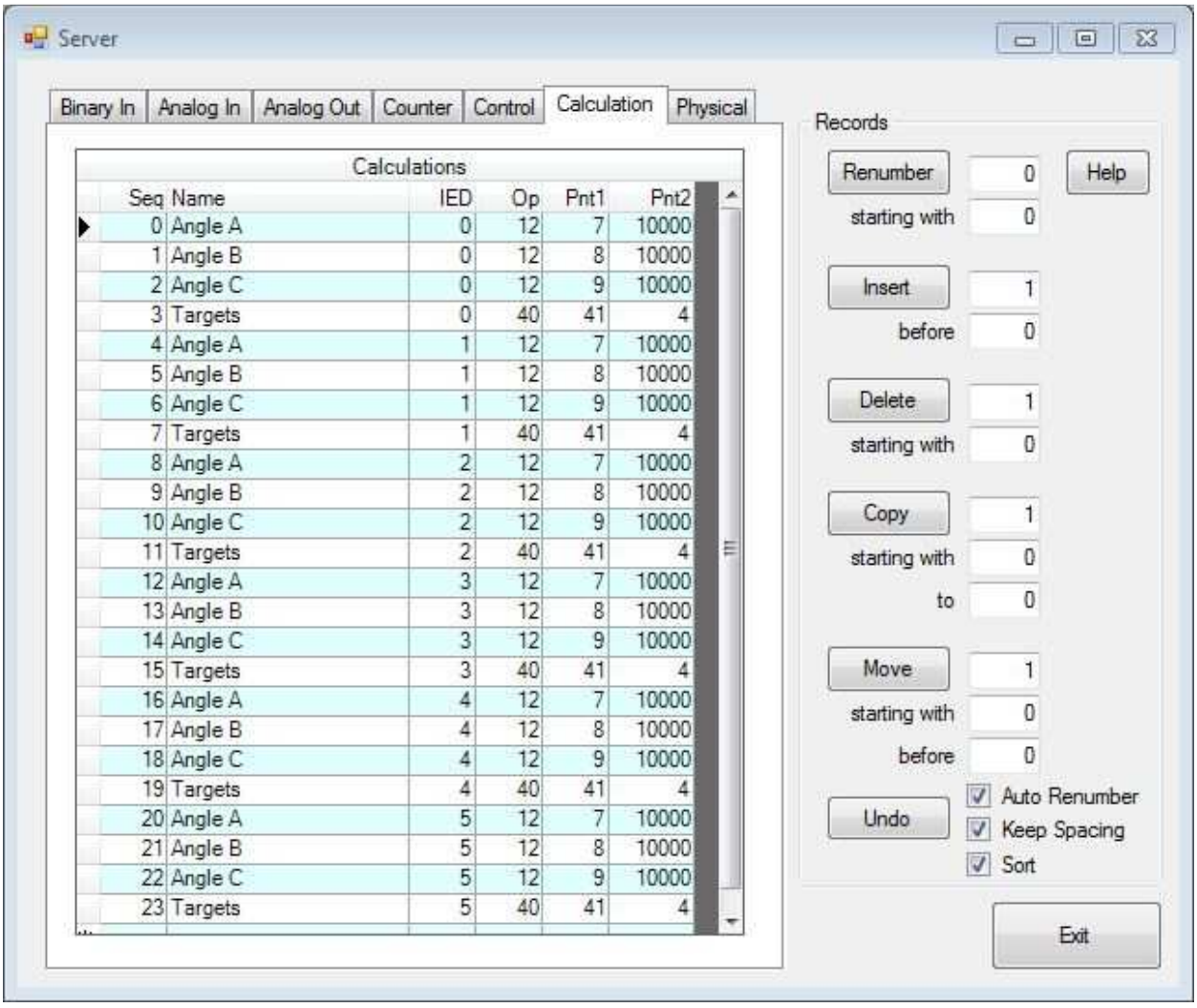
3. *Analog Outputs*
   i. DNP Server DNP index (the AO DNP index expected by the master)
   ii. Name User defined Analog Output signal name
   iii. IED Sequence of the IED as defined in the *Connected IEDs* table
   iv. Point The IED protocol Analog Input index
   v. Mult A multiplier for monitoring purposes (does not affect data sent to master)



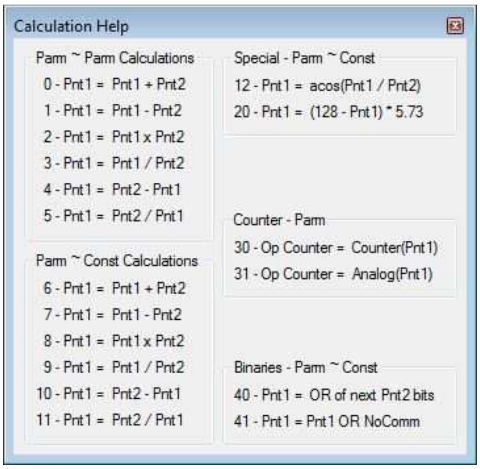
4. *Counters*
    i. DNP Server DNP index (the Counter index expected by the master)
    ii. Name User defined Counter name
    iii. IED Sequence of the IED as defined in the *Connected IEDs* table
    iv. Point The IED protocol Counter index

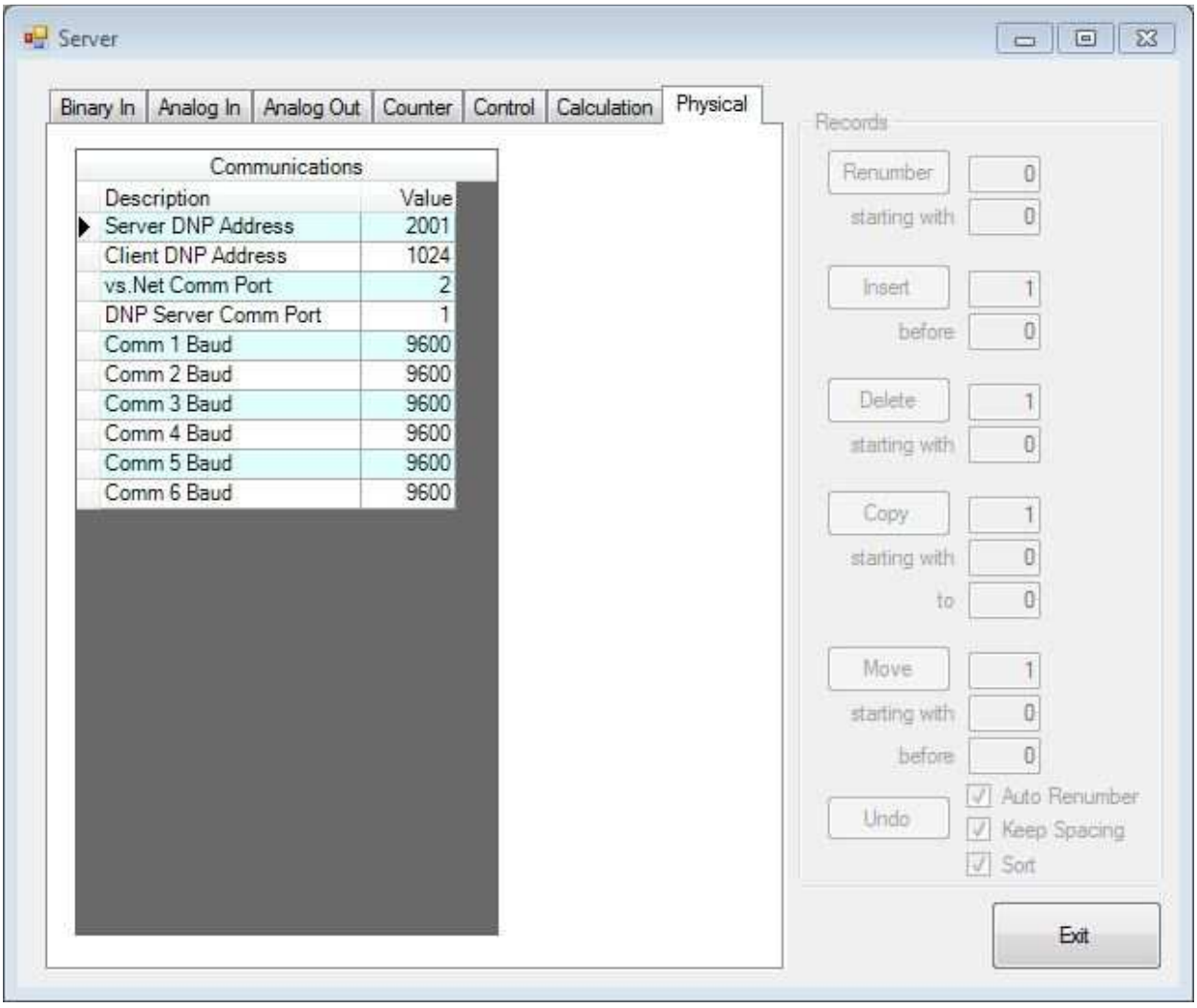


5. *Controls*
   - i. DNP Server DNP index (the Control Output index expected by the master)
   - ii. Name User defined Control Output name
   - iii. IED Sequence of the IED as defined in the *Connected IEDs* table
   - iv. Point The IED protocol Control Output index



6. *Calculations* – A help screen is available in this subsection
   i. Seq Sequence number of the calculation
   ii. Name User defined Calculation name
   iii. IED Sequence of the IED as defined in the *Connected IEDs* table
   iv. Op A number indicating the function to be done (see descriptions below)
   v. Pnt1 Point 1 of the function
   vi. Pnt2 Point 2 of the function





7. *Physical*
   - i. Server DNP address — Primary DNP Server address to Master
   - ii. Client DNP Address — DNP Client address to IEDs
   - iii. Vs.Net Comm Port — Secondary DNP or Valquest Server port
   - iv. DNP Server Comm Port — Primary DNP Server Port
   - v. Comm 1 Baud — Baud rate of communicates Port 1
   - vi. Comm 2 Baud — Baud rate of communicates Port 2
   - vii. Comm 3 Baud — Baud rate of communicates Port 3
   - viii. Comm 4 Baud — Baud rate of communicates Port 4
   - ix. Comm 5 Baud — Baud rate of communicates Port 5
   - x. Comm 6 Baud — Baud rate of communicates Port 6

8. Editing Tools – Each of the subsections with the exception of Physical has Record editing tools which facilitate modification of the subsection tables. These are in the form of buttons with some field entry boxes:
   - i. Insert — Inserts blank rows above a given DNP index
   - ii. Delete — Deletes rows starting at a given DNP index
   - iii. Copy — Copies rows starting at a given DNP index to another DNP index
   - iv. Move — Moves rows starting at a given DNP index to another DNP index
   - v. Renumber — Renumbers DNP indices starting at a given DNP index
   - vi. Undo — Undoes the last operation

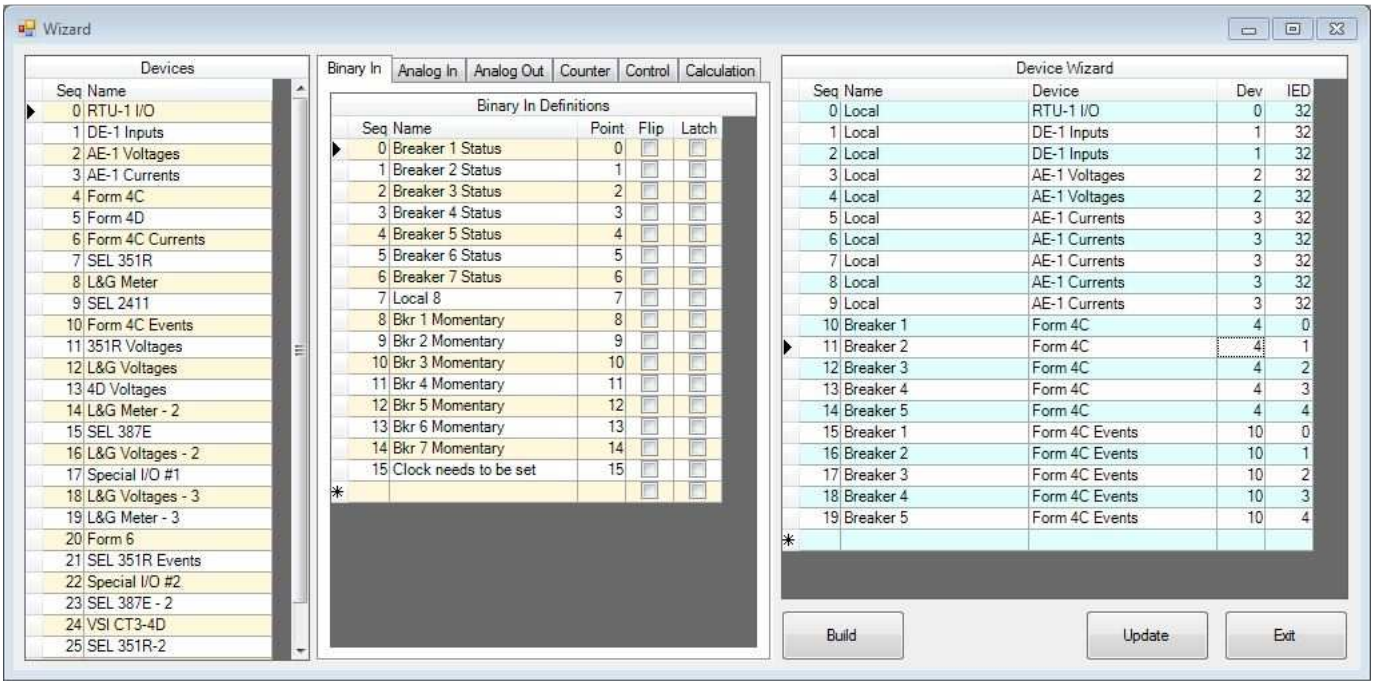
4. **Wizard** – As with the IEDs, the amount of typing necessary to fill the Server tables would be daunting without a Wizard. The Wizard allows the creation of an unlimited number of device templates. These templates contain all the same categories of information that was detailed in Server subsection descriptions a – f excepting the IED field. Naturally, the IED number cannot be part of the template. Any template may have as many as six or as few as one subsection populated.

   The *Devices* table contains the list of device templates. The associated tabbed table to the right of the *Devices* table contains the details for the selected template. Both these tables are yellow because they are common to all RTUs

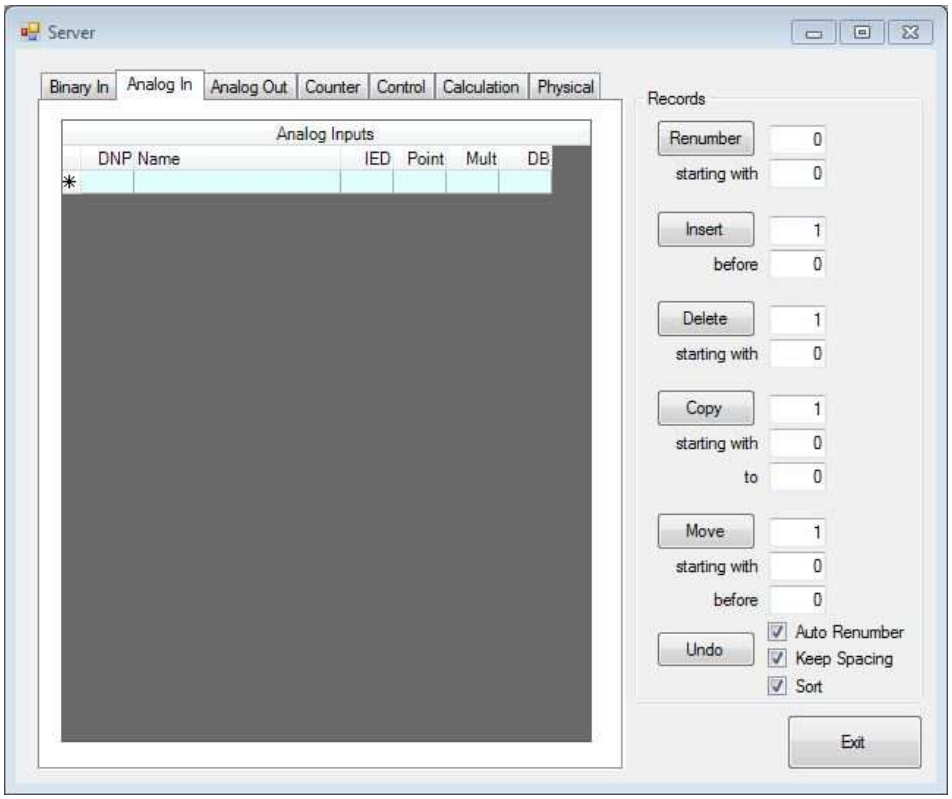
   The *Device Wizard* table is then populated to build the Server portion of the RTU. The user first enters sequence numbers in the *Seq* column (this is the sort field). Then, as Device numbers are entered in the *Dev* column, the *Device* column is auto-populated with the device name from the *Devices* table. As IED numbers are entered in the *IED* column, the *Name* column is auto-populated with the IED name from the *Connected IEDs* table in the IED Communications Definitions screen. If the number 32 is entered in the *IED* column, the Name column is auto-populated with the word "Local" representing that this is a template for RTU I/O rather than an IED.

   Once the *Device Wizard* table is complete, clicking the Build button will erase the first six Server tables and then re-populate them based on the information in the Wizard tables. In the case of Local inputs and outputs, when multiple entries of the same type are encountered the *Point* numbers are automatically increased as needed to reflect the proper sequence in the RTU.

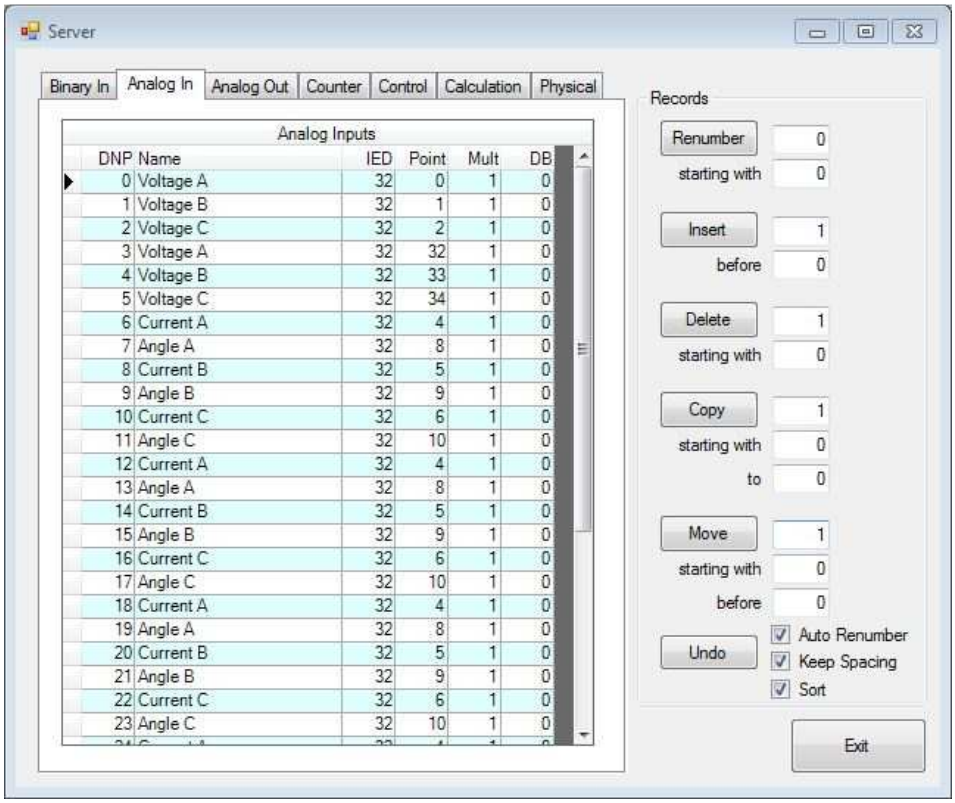
   The Wizard table is light blue because it is specific to the selected RTU.



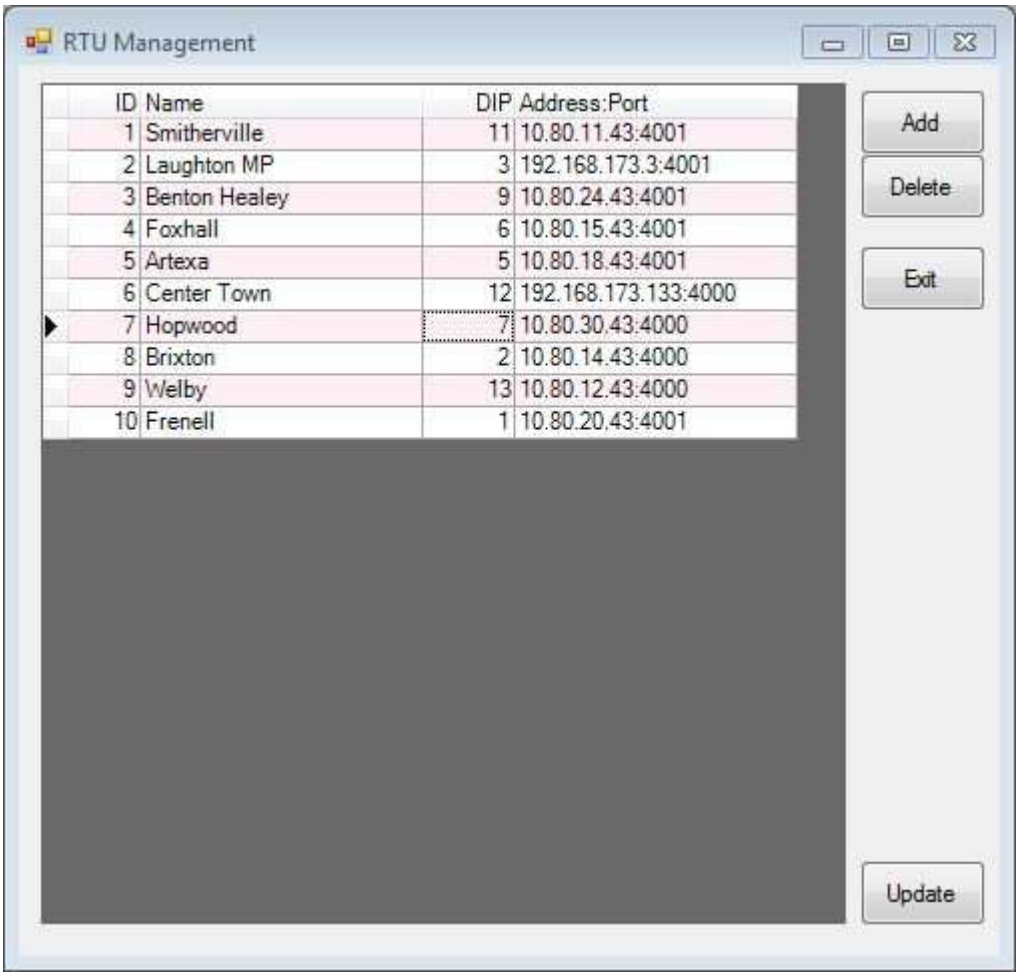
Before Wizard



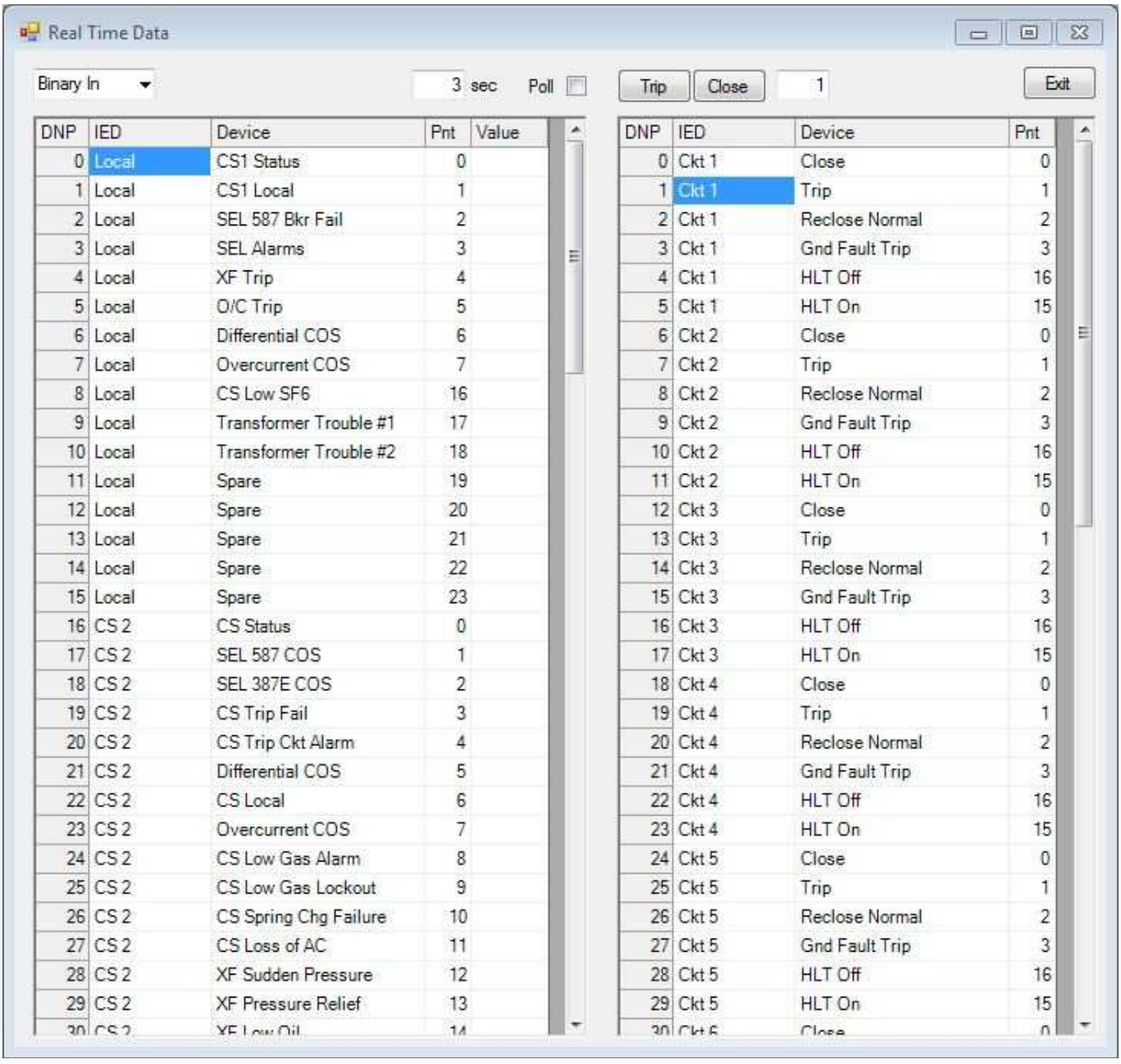
After Wizard



5. **RTUs** – The RTU Management table contains the list of RTUs configured in the database along with their IP addresses and TCP port numbers. Also included is the DIP switch setting for the DNP or vs.Net protocol address of the Secondary Server. The *Name* column in this table will populate the pulldown menu to the right of *File* in the menu bar of the MDI screen.



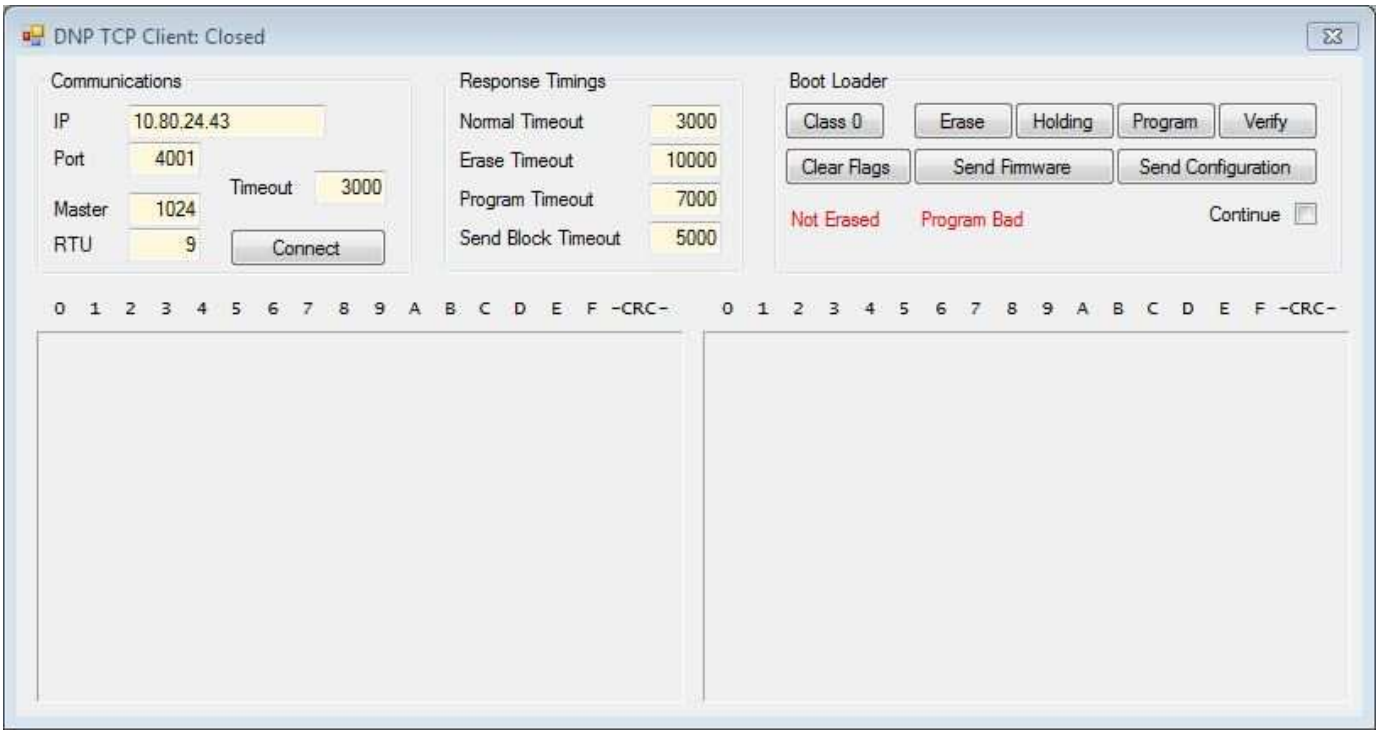
6. **Real Time Monitor** – The Configurator has a real time monitor which can display all server data as well as send control functions to the RTU. It is a convenient tool for verifying proper RTU functionality locally. It can monitor:
    1. Binary Inputs
    2. Analog Inputs
    3. Analog Outputs
    4. Counters



DNP	IED	Device	Pnt	Value
0	Local	CS1 Status	0	
1	Local	CS1 Local	1	
2	Local	SEL 587 Bkr Fail	2	
3	Local	SEL Alarms	3	
4	Local	XF Trip	4	
5	Local	O/C Trip	5	
6	Local	Differential COS	6	
7	Local	Overcurrent COS	7	
8	Local	CS Low SF6	16	
9	Local	Transformer Trouble #1	17	
10	Local	Transformer Trouble #2	18	
11	Local	Spare	19	
12	Local	Spare	20	
13	Local	Spare	21	
14	Local	Spare	22	
15	Local	Spare	23	
16	CS 2	CS Status	0	
17	CS 2	SEL 587 COS	1	
18	CS 2	SEL 387E COS	2	
19	CS 2	CS Trip Fail	3	
20	CS 2	CS Trip Ckt Alarm	4	
21	CS 2	Differential COS	5	
22	CS 2	CS Local	6	
23	CS 2	Overcurrent COS	7	
24	CS 2	CS Low Gas Alarm	8	
25	CS 2	CS Low Gas Lockout	9	
26	CS 2	CS Spring Chg Failure	10	
27	CS 2	CS Loss of AC	11	
28	CS 2	XF Sudden Pressure	12	
29	CS 2	XF Pressure Relief	13	
30	CS 2	XF Low Oil	14	

DNP	IED	Device	Pnt
0	Ckt 1	Close	0
1	Ckt 1	Trip	1
2	Ckt 1	Reclose Normal	2
3	Ckt 1	Gnd Fault Trip	3
4	Ckt 1	HLT Off	16
5	Ckt 1	HLT On	15
6	Ckt 2	Close	0
7	Ckt 2	Trip	1
8	Ckt 2	Reclose Normal	2
9	Ckt 2	Gnd Fault Trip	3
10	Ckt 2	HLT Off	16
11	Ckt 2	HLT On	15
12	Ckt 3	Close	0
13	Ckt 3	Trip	1
14	Ckt 3	Reclose Normal	2
15	Ckt 3	Gnd Fault Trip	3
16	Ckt 3	HLT Off	16
17	Ckt 3	HLT On	15
18	Ckt 4	Close	0
19	Ckt 4	Trip	1
20	Ckt 4	Reclose Normal	2
21	Ckt 4	Gnd Fault Trip	3
22	Ckt 4	HLT Off	16
23	Ckt 4	HLT On	15
24	Ckt 5	Close	0
25	Ckt 5	Trip	1
26	Ckt 5	Reclose Normal	2
27	Ckt 5	Gnd Fault Trip	3
28	Ckt 5	HLT Off	16
29	Ckt 5	HLT On	15
30	Ckt 6	Close	0

7. **Boot Loader** – The Boot Load allows programming the RTU remotely. It can upload a new configuration to the RTU or update the firmware.



Steps for Sending Configuration from a Remote Client.

1. Make sure the configuration is correct and click *Compile* from the Main Menu
2. Using the Main Menu click *File -> Boot Send -> Database*. This creates the file that will be sent to the RTU.
3. In the Boot Loader click the *Connect* button to make a TCP/IP connection on the DNP port.
4. Verify connection and communication using the *Class 0* button. Request and Response data will be displayed in the left and right panels respectively.
5. Click the Erase button. After a time (about 7 seconds) the *Not Erased* message will change to *Erased.*
6. Click the *Send Configuration* button. Requests and Responses will pass through the left and right panels as the file is sent.
7. When the transmission is finished the Program Bad message will change to *Program OK*.
8. Click the *Program* button. After a time (about 4 seconds) a message box will appear saying Programming is complete.

A firmware upgrade is very similar but using *File -> Boot Send -> Firmware.* Then using *the Send Firmware* button in Step 6.

The Menu System

The main menu appears across the top section of the multiple document interface (MDI). A description of each menu item

- File
  - Open — Brings up a dialog box to open a new database
  - Save As — Brings up a dialog box to save current database to a new file
  - Compilation — Builds a file with the configuration data that will go to the RTU
  - Database Flat — Builds a flat file representing the entire database
  - Sniffer Template — Builds a template for use with the Valquest DNP SniffSet
  - Boot Send
    - Firmware — Encrypts a saved firmware file for transmission to the RTU
    - Configuration — Builds and encrypts a configuration file to be sent to the RTU
    - Database — Builds and encrypts a database flat file to be sent to the RTU
    - Config and DB — Combines the two previous menu items
  - Boot Read — Reads a database flat file from the RTU
  - Exit — Exits the program
- RTU Pull Down — A pull down menu allowing RTU selection
- Settings
  - IEDs — Brings up the IEDs window
  - Server — Brings up the Server window
  - Local — Brings up the Local Equipment window
  - Wizard — Brings up the Wizard window
  - RTUs — Brings up the RTU Management window
- Compile — Compiles data for the selected RTU for transmission to the RTU
- Com Port Pull Down — A pull down menu allowing Serial Com Port selection
- Send — Sends the compiled data to the RTU via the selected serial port
- Verify — Verifies the compiled data in the RTU via the selected serial port
- Real Time
  - SCADA — Brings up the Real Time Monitor
  - Watch — Brings up a display of configuration data being sent to the RTU
- Boot Loader — Brings up the Boot Loader window

DNP Indices

The following pages show the DNP indices for various data available directly from the RTU (not from IEDs):

Binary Inputs

RTU-1
Binary Inputs
DNP Indices

						Pin with DNP Indices							
Parameter	Sequence	Board	Card	J	8	7	6	5	4	3	2	1
Binary Input	0 - 7	RTU-1		4	0	1	2	3	4	5	6	7
Momentary Input	0 - 7	RTU-1		4	8	9	10	11	12	13	14	15
Binary Input	8 - 15	DI-1	0	6	16	17	18	19	20	21	22	23
Binary Input	16 - 23	DI-1	0	1	24	25	26	27	28	29	30	31
Binary Input	24 - 31	DI-1	1	6	32	33	34	35	36	37	38	39
Binary Input	32 - 39	DI-1	1	1	40	41	42	43	44	45	46	47
Binary Input	40 - 47	DI-1	2	6	48	49	50	51	52	53	54	55
Binary Input	48 - 55	DI-1	2	1	56	57	58	59	60	61	62	63
Binary Input	56 - 63	DI-1	3	6	64	65	66	67	68	69	70	71
Binary Input	64 - 71	DI-1	3	1	72	73	74	75	76	77	78	79
Binary Input	72 - 79	DI-1	4	6	80	81	82	83	84	85	86	87
Binary Input	80 - 87	DI-1	4	1	88	89	90	91	92	93	94	95
Binary Input	88 - 95	DI-1	5	6	96	97	98	99	100	101	102	103
Binary Input	96 - 103	DI-1	5	1	104	105	106	107	108	109	110	111
Binary Input	104 - 111	DI-1	6	6	112	113	114	115	116	117	118	119
Binary Input	112 - 119	DI-1	6	1	120	121	122	123	124	125	126	127
Binary Input	120 - 127	DI-1	7	6	128	129	130	131	132	133	134	135
Binary Input	128 - 135	DI-1	7	1	136	137	138	139	140	141	142	143
Binary Input	136 - 143	DI-1	8	6	144	145	146	147	148	149	150	151
Binary Input	144 - 151	DI-1	8	1	152	153	154	155	156	157	158	159
Binary Input	152 - 159	DI-1	9	6	160	161	162	163	164	165	166	167
Binary Input	160 - 167	DI-1	9	1	168	169	170	171	172	173	174	175
Binary Input	168 - 175	DI-1	10	6	176	177	178	179	180	181	182	183
Binary Input	176 - 183	DI-1	10	1	184	185	186	187	188	189	190	191
Binary Input	184 - 191	DI-1	11	6	192	193	194	195	196	197	198	199
Binary Input	192 - 199	DI-1	11	1	200	201	202	203	204	205	206	207
Binary Input	200 - 207	DI-1	12	6	208	209	210	211	212	213	214	215
Binary Input	208 - 215	DI-1	12	1	216	217	218	219	220	221	222	223
Binary Input	216 - 223	DI-1	13	6	224	225	226	227	228	229	230	231
Binary Input	224 - 231	DI-1	13	1	232	233	234	235	236	237	238	239
Binary Input	232 - 239	DI-1	14	6	240	241	242	243	244	245	246	247
Binary Input	240 - 247	DI-1	14	1	248	249	250	251	252	253	254	255
Binary Input	248 - 255	DI-1	15	6	256	257	258	259	260	261	262	263
Binary Input	256 - 263	DI-1	15	1	264	265	266	267	268	269	270	271
Binary Input	264 - 271	DI-1	16	6	272	273	274	275	276	277	278	279
Binary Input	272 - 279	DI-1	16	1	280	281	282	283	284	285	286	287

AC Analog Inputs

RTU-1

AC Analog Inputs

DNP

Indices

			Electrical Configuration Sequence with DNP Indices							
Parameter	Ph	Mult	0	1	2	3	4	5	6	7
Voltage	A	1	0	32	64	96	128	160	192	224
Voltage	B	1	1	33	65	97	129	161	193	225
Voltage	C	1	2	34	66	98	130	162	194	226
Voltage	3	1	3	35	67	99	131	163	195	227
Current	A	10	4	36	68	100	132	164	196	228
Current	B	10	5	37	69	101	133	165	197	229
Current	C	10	6	38	70	102	134	166	198	230
Current	3	10	7	39	71	103	135	167	199	231
Angle	A	10	8	40	72	104	136	168	200	232
Angle	B	10	9	41	73	105	137	169	201	233
Angle	C	10	10	42	74	106	138	170	202	234
Angle	3	10	11	43	75	107	139	171	203	235
PF %	A	10	12	44	76	108	140	172	204	236
PF %	B	10	13	45	77	109	141	173	205	237
PF %	C	10	14	46	78	110	142	174	206	238
PF %	3	10	15	47	79	111	143	175	207	239
kW	A	1	16	48	80	112	144	176	208	240
kW	B	1	17	49	81	113	145	177	209	241
kW	C	1	18	50	82	114	146	178	210	242
kW	3	1	19	51	83	115	147	179	211	243
kVAr	A	1	20	52	84	116	148	180	212	244
kVAr	B	1	21	53	85	117	149	181	213	245
kVAr	C	1	22	54	86	118	150	182	214	246
kVAr	3	1	23	55	87	119	151	183	215	247
kVA	A	1	24	56	88	120	152	184	216	248
kVA	B	1	25	57	89	121	153	185	217	249
kVA	C	1	26	58	90	122	154	186	218	250
kVA	3	1	27	59	91	123	155	187	219	251
Current	N	10	28	60	92	124	156	188	220	252
kWH	3	1	29	61	93	125	157	189	221	253
kVArH	3	1	30	62	94	126	158	190	222	254
Rotation	3	N/A	31	63	95	127				
Frequency	A	100					159			
Temp		1						191		
Firmware		N/A							223	

DC Analog Inputs

RTU-1

DC Analog Inputs

DNP Indices

				AI-1 Card with DNP Indices							
Parameter	Sequence	J	Pin	0	1	2	3	4	5	6	7
DC Value	0 + AI-1 Card * 12	1	1	256	268	280	292	304	316	328	340
DC Value	1 + AI-1 Card * 12	1	2	257	269	281	293	305	317	329	341
DC Value	2 + AI-1 Card * 12	1	3	258	270	282	294	306	318	330	342
DC Value	3 + AI-1 Card * 12	1	4	259	271	283	295	307	319	331	343
DC Value	4 + AI-1 Card * 12	2	1	260	272	284	296	308	320	332	344
DC Value	5 + AI-1 Card * 12	2	2	261	273	285	297	309	321	333	345
DC Value	6 + AI-1 Card * 12	2	3	262	274	286	298	310	322	334	346
DC Value	7 + AI-1 Card * 12	2	4	263	275	287	299	311	323	335	347
DC Value	8 + AI-1 Card * 12	3	1	264	276	288	300	312	324	336	348
DC Value	9 + AI-1 Card * 12	3	2	265	277	289	301	313	325	337	349
DC Value	10 + AI-1 Card * 12	3	3	266	278	290	302	314	326	338	350
DC Value	11 + AI-1 Card * 12	3	4	267	279	291	303	315	327	339	351

Control Outputs

RTU-1

Control Outputs

DNP Indices

Pair	DNP Index	Relay	Board	Card	J	Pin	Ref	Action
0	0	Close	RTU-1		1	8	0	Pulse On
0	1	Trip	RTU-1		1	7	0	Pulse On
1	2	Close	RTU-1		1	6	1	Pulse On
1	3	Trip	RTU-1		1	5	1	Pulse On
2	4	Close	RTU-1		1	4	2	Pulse On
2	5	Trip	RTU-1		1	3	2	Pulse On
3	6	Close	RTU-1		1	2	3	Pulse On
3	7	Trip	RTU-1		1	1	3	Pulse On
0	8	Pair	RTU-1		1	7/8	0	Pulse On / Off
1	9	Pair	RTU-1		1	5/6	1	Pulse On / Off
2	10	Pair	RTU-1		1	3/4	2	Pulse On / Off
3	11	Pair	RTU-1		1	1/2	3	Pulse On / Off
4	16	Pair	DO-1	0	1	7/8	0	Pulse On / Off
5	17	Pair	DO-1	0	1	5/6	1	Pulse On / Off
6	18	Pair	DO-1	0	1	3/4	2	Pulse On / Off
7	19	Pair	DO-1	0	1	1/2	3	Pulse On / Off
8	20	Pair	DO-1	0	4	7/8	4	Pulse On / Off
9	21	Pair	DO-1	0	4	5/6	5	Pulse On / Off
10	22	Pair	DO-1	0	4	3/4	6	Pulse On / Off
11	23	Pair	DO-1	0	4	1/2	7	Pulse On / Off
12	24	Pair	DO-1	1	1	7/8	0	Pulse On / Off
13	25	Pair	DO-1	1	1	5/6	1	Pulse On / Off
14	26	Pair	DO-1	1	1	3/4	2	Pulse On / Off
15	27	Pair	DO-1	1	1	1/2	3	Pulse On / Off
16	28	Pair	DO-1	1	4	7/8	4	Pulse On / Off
17	29	Pair	DO-1	1	4	5/6	5	Pulse On / Off
18	30	Pair	DO-1	1	4	3/4	6	Pulse On / Off
19	31	Pair	DO-1	1	4	1/2	7	Pulse On / Off
20	32	Pair	DO-1	2	1	7/8	0	Pulse On / Off
21	33	Pair	DO-1	2	1	5/6	1	Pulse On / Off
22	34	Pair	DO-1	2	1	3/4	2	Pulse On / Off
23	35	Pair	DO-1	2	1	1/2	3	Pulse On / Off
24	36	Pair	DO-1	2	4	7/8	4	Pulse On / Off
25	37	Pair	DO-1	2	4	5/6	5	Pulse On / Off
26	38	Pair	DO-1	2	4	3/4	6	Pulse On / Off
27	39	Pair	DO-1	2	4	1/2	7	Pulse On / Off

Pair	DNP Index	Relay	Board	Card	J	Pin	Ref	Action
28	40	Pair	DO-1	3	1	7/8	0	Pulse On / Off
29	41	Pair	DO-1	3	1	5/6	1	Pulse On / Off
30	42	Pair	DO-1	3	1	3/4	2	Pulse On / Off
31	43	Pair	DO-1	3	1	1/2	3	Pulse On / Off
32	44	Pair	DO-1	3	4	7/8	4	Pulse On / Off
33	45	Pair	DO-1	3	4	5/6	5	Pulse On / Off
34	46	Pair	DO-1	3	4	3/4	6	Pulse On / Off
35	47	Pair	DO-1	3	4	1/2	7	Pulse On / Off
36	48	Pair	DO-1	4	1	7/8	0	Pulse On / Off
37	49	Pair	DO-1	4	1	5/6	1	Pulse On / Off
38	50	Pair	DO-1	4	1	3/4	2	Pulse On / Off
39	51	Pair	DO-1	4	1	1/2	3	Pulse On / Off
40	52	Pair	DO-1	4	4	7/8	4	Pulse On / Off
41	53	Pair	DO-1	4	4	5/6	5	Pulse On / Off
42	54	Pair	DO-1	4	4	3/4	6	Pulse On / Off
43	55	Pair	DO-1	4	4	1/2	7	Pulse On / Off
44	56	Pair	DO-1	5	1	7/8	0	Pulse On / Off
45	57	Pair	DO-1	5	1	5/6	1	Pulse On / Off
46	58	Pair	DO-1	5	1	3/4	2	Pulse On / Off
47	59	Pair	DO-1	5	1	1/2	3	Pulse On / Off
48	60	Pair	DO-1	5	4	7/8	4	Pulse On / Off
49	61	Pair	DO-1	5	4	5/6	5	Pulse On / Off
50	62	Pair	DO-1	5	4	3/4	6	Pulse On / Off
51	63	Pair	DO-1	5	4	1/2	7	Pulse On / Off
52	64	Pair	DO-1	6	1	7/8	0	Pulse On / Off
53	65	Pair	DO-1	6	1	5/6	1	Pulse On / Off
54	66	Pair	DO-1	6	1	3/4	2	Pulse On / Off
55	67	Pair	DO-1	6	1	1/2	3	Pulse On / Off
56	68	Pair	DO-1	6	4	7/8	4	Pulse On / Off
57	69	Pair	DO-1	6	4	5/6	5	Pulse On / Off
58	70	Pair	DO-1	6	4	3/4	6	Pulse On / Off
59	71	Pair	DO-1	6	4	1/2	7	Pulse On / Off
60	72	Pair	DO-1	7	1	7/8	0	Pulse On / Off
61	73	Pair	DO-1	7	1	5/6	1	Pulse On / Off
62	74	Pair	DO-1	7	1	3/4	2	Pulse On / Off
63	75	Pair	DO-1	7	1	1/2	3	Pulse On / Off
64	76	Pair	DO-1	7	4	7/8	4	Pulse On / Off
65	77	Pair	DO-1	7	4	5/6	5	Pulse On / Off
66	78	Pair	DO-1	7	4	3/4	6	Pulse On / Off
67	79	Pair	DO-1	7	4	1/2	7	Pulse On / Off