RTU-1 Configurator

Valquest Systems, Inc.

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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.

- 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:
 - 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 Als)
 - 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.

- 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.
- 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.
- 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

	renell +	Settings Co	ompile Com1 - Chee	c k All Send Verify Real	lime Boot Loader		
EDs							
	IE	D Types		IED Scan Sequence	Connect	ted IEDs	
S	ieg Name	Protocol	Variation Sec	Object Start Stop	Seq IED Name	Addr Port Scan	
-	1 Form 4C	PGE2179		Binary In 0 95	► 0 1 Breaker 1	101 3 1	
_	2 Form 4D	DNP 3.0		Analog In 0 6	1 1 Breaker 2	102 3 1	
_	3 SEL 351R	DNP 3.0	Pulse *		2 1 Breaker 3	103 4 1	
	3 Eaton CL-7	DNP 3.0	Pulse		3 1 Breaker 4	104 4 1	
_	4 SEL 2431	DNP 3.0	Pulse		4 1 Breaker 5	105 5 1	
_	5 SEL 2411	DNP 3.0	Close/Trip				
_	6 L & G Meter	DNP 3.0	Pulse	u-	Server		
_	7 SEL 387E	DNP 3.0	Pulse				
	8 L & G Meter - 2	DNP 3.0	Pulse		Binary In Analog In Analog Out	Counter Control Calculation Physic	al Records
	9 L & G Meter - 3	DNP 3.0	Pulse		77		Hecoras
	10 Form 6	DNP 3.0	Pulse		Counters	9	Renumber 0
1	11 SEL 351A	DNP 3.0	Pulse		DNP Name	IED Point	
	12 SEL 387E - 2	DNP 3.0	Pulse		0 Event Type	0 0	starting with 0
	13 VSI CT3-4D	DNP 3.0	Pulse		1 Date	0 1	
	14 RTAC-1	DNP 3.0	Pulse		2 Hour	0 2	Insert 1
	15 SEL 351R-2	DNP 3.0	Pulse		3 Minute	0 3	before 0
					4 Second	0 4	Delore 0
=		_			5 Current Ground	0 5	
	RTU Management				6 Current 1-2	0 6	Delete 1
-	ni o management				7 Current 3-4		starting with 0
				Terraneous Commenced Commenced		0 7	Staning with U
1	ID Name		DIP Address:Port		8 Current 5-6	0 8	statung with 0
	ID Name		DIP Address:Port 11 10.80.11.43:4001	Add	8 Current 5-6 9 Event Type	0 8	
					8 Current 5-6 9 Event Type 10 Date	0 8 1 0 1 1	Copy 1
	1 Smitherville		11 10.80.11.43:4001	Add	8 Current 5-6 9 Event Type 10 Date 11 Hour	0 8 1 0 1 1 1 2	
	1 Smitherville 2 Laughton MP	,	11 10.80.11.43:4001 3 192.168.173.3:4001		8 Current 5-6 9 Event Type 10 Date 11 Hour 12 Minute	0 8 1 0 1 1 1 2 1 3	Copy 1 starting with 0
	1 Smitherville 2 Laughton MP 3 Benton Healey 4 Foxhall 5 Artexa		11 10.80.11.43:4001 3 192.168.173.3:4001 9 10.80.24.43:4001	Delete	8 Current 5-6 9 Event Type 10 Date 11 Hour 12 Minute 13 Second	0 8 1 0 1 1 1 2 1 3 1 4	Copy 1
	 Smitherville Laughton MP Benton Healey Foxhall Artexa Center Town 	r	11 10.80.11.43:4001 3 192.168.173.3:4001 9 10.80.24.43:4001 6 10.80.15.43:4001		8 Current 5-6 9 Event Type 10 Date 11 Hour 12 Minute 13 Second 14 Current Ground	0 8 1 0 1 1 1 2 1 3 1 4 1 5	Copy 1 starting with 0 to 0
	 Smitherville Laughton MP Benton Healey Foxhall Artexa Center Town Hopwood 	r	11 10.80.11.43.4001 3 192.168.173.3.4001 9 10.80.24.43.4001 6 10.80.15.43.4001 5 10.80.18.43.4001 12 192.168.173.133.4000 7 10.80.30.43.4000	Delete	8 Current 5-6 9 Event Type 10 Date 11 Hour 12 Minute 13 Second 14 Current Ground 15 Current 1-2	0 8 1 0 1 1 1 2 1 3 1 4 1 5 1 6	Copy 1 starting with 0
	 Smitherville Laughton MP Benton Healey Foxhall Artexa Center Town Hopwood Brixton 	r	11 10.80.11.43:4001 3 192.168.173.3:4001 9 10.80.24.43:4001 6 10.80.15.43:4001 5 10.80.18.43:4001 12 192.168.173.13:4000 7 10.80.30.43:4000 2 10.80.14.43:4000	Delete	8 Current 5-6 9 Event Type 10 Date 11 Hour 12 Minute 13 Second 14 Current Ground 15 Current 1-2 16 Current 3-4	0 8 1 0 1 1 1 2 1 3 1 4 1 5 1 6 1 7	Copy 1 starting with 0 to 0
	 1 Smitherville 2 Laughton MP 3 Benton Healey 4 Foxhall 5 Artexa 6 Center Town 7 Hopwood 8 Brixton 9 Welby 	r	11 10.80.11.43.4001 3 192.168.173.3.4001 9 10.80.24.43.4001 6 10.80.15.43.4001 5 10.80.18.43.4001 12 192.168.173.133.4000 7 10.80.30.43.4000 2 10.80.14.43.4000 13 10.80.12.43.4000	Delete	8 Current 5-6 9 Event Type 10 Date 11 Hour 12 Minute 13 Second 14 Current Ground 15 Current 1-2 16 Current 3-4 17 Current 5-6	0 8 1 0 1 1 1 2 1 3 1 4 1 5 1 6 1 7 1 8	Copy 1 starting with 0 to 0 Move 1 starting with 0
	 Smitherville Laughton MP Benton Healey Foxhall Artexa Center Town Hopwood Brixton 		11 10.80.11.43:4001 3 192.168.173.3:4001 9 10.80.24.43:4001 6 10.80.15.43:4001 5 10.80.18.43:4001 12 192.168.173.13:4000 7 10.80.30.43:4000 2 10.80.14.43:4000	Delete	8 Current 5-6 9 Event Type 10 Date 11 Hour 12 Minute 13 Second 14 Current Ground 15 Current 1-2 16 Current 3-4 17 Current 5-6 18 Event Type	0 8 1 0 1 1 1 2 1 3 1 4 1 5 1 6 1 7 1 8 2 0	Copy 1 starting with 0 to 0 Move 1 starting with 0 before 0
	 1 Smitherville 2 Laughton MP 3 Benton Healey 4 Foxhall 5 Artexa 6 Center Town 7 Hopwood 8 Brixton 9 Welby 	r	11 10.80.11.43.4001 3 192.168.173.3.4001 9 10.80.24.43.4001 6 10.80.15.43.4001 5 10.80.18.43.4001 12 192.168.173.133.4000 7 10.80.30.43.4000 2 10.80.14.43.4000 13 10.80.12.43.4000	Delete	8 Current 5-6 9 Event Type 10 Date 11 Hour 12 Minute 13 Second 14 Current Ground 15 Current 1-2 16 Current 3-4 17 Current 5-6 18 Event Type 19 Date	0 8 1 0 1 1 1 2 1 3 1 4 1 5 1 6 1 7 1 8 2 0 2 1	Copy 1 starting with 0 to 0 Move 1 starting with 0 before 0 ✓ Auto Renumb
	 1 Smitherville 2 Laughton MP 3 Benton Healey 4 Foxhall 5 Artexa 6 Center Town 7 Hopwood 8 Brixton 9 Welby 	r	11 10.80.11.43.4001 3 192.168.173.3.4001 9 10.80.24.43.4001 6 10.80.15.43.4001 5 10.80.18.43.4001 12 192.168.173.133.4000 7 10.80.30.43.4000 2 10.80.14.43.4000 13 10.80.12.43.4000	Delete	8 Current 5-6 9 Event Type 10 Date 11 Hour 12 Minute 13 Second 14 Current Ground 15 Current 1-2 16 Current 3-4 17 Current 5-6 18 Event Type 19 Date 20 Hour	0 8 1 0 1 1 1 2 1 3 1 4 1 5 1 6 1 7 1 8 2 0 2 1 2 2	Copy 1 starting with 0 to 0 Move 1 starting with 0 before 0 Undo ✓ Auto Renumb
	 1 Smitherville 2 Laughton MP 3 Benton Healey 4 Foxhall 5 Artexa 6 Center Town 7 Hopwood 8 Brixton 9 Welby 	r	11 10.80.11.43.4001 3 192.168.173.3.4001 9 10.80.24.43.4001 6 10.80.15.43.4001 5 10.80.18.43.4001 12 192.168.173.133.4000 7 10.80.30.43.4000 2 10.80.14.43.4000 13 10.80.12.43.4000	Delete	8 Current 5-6 9 Event Type 10 Date 11 Hour 12 Minute 13 Second 14 Current Ground 15 Current 1-2 16 Current 3-4 17 Current 5-6 18 Event Type 19 Date 20 Hour 21 Minute	0 8 1 0 1 1 1 2 1 3 1 4 1 5 1 6 1 7 1 8 2 0 2 1 2 2 2 3	Copy 1 starting with 0 to 0 Move 1 starting with 0 before 0 ✓ Auto Renumb
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	 1 Smitherville 2 Laughton MP 3 Benton Healey 4 Foxhall 5 Artexa 6 Center Town 7 Hopwood 8 Brixton 9 Welby 	r	11 10.80.11.43.4001 3 192.168.173.3.4001 9 10.80.24.43.4001 6 10.80.15.43.4001 5 10.80.18.43.4001 12 192.168.173.133.4000 7 10.80.30.43.4000 2 10.80.14.43.4000 13 10.80.12.43.4000	Delete	8 Current 5-6 9 Event Type 10 Date 11 Hour 12 Minute 13 Second 14 Current Ground 15 Current 1-2 16 Current 3-4 17 Current 5-6 18 Event Type 19 Date 20 Hour 21 Minute	0 8 1 0 1 1 1 2 1 3 1 4 1 5 1 6 1 7 1 8 2 0 2 1 2 2 2 3	Copy 1 starting with 0 to 0 Move 1 starting with 0 before 0 Undo V Keep Spacing

 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.

	ED Types				IED Scan S	Sequence				Connected I	EDs		
Seq Name	Protocol	Variation		Seq	Object	Start	Stop		Seq	IED Name	Addr	Port	Scan
1 Form 4C	PGE2179	Scan		0	Binary In	32	41		0	2 Ckt-1 FM 8721	1	6	1
2 Form 4D	DNP 3.0	Pulse		1	Analog In	4	26		1	2 Ckt-2 Riverbed	2	6	1
3 SEL 351R	DNP 3.0	Pulse		2	Analog In	83	85	1	2	2 Ckt-3 FM 8711 S	3	6	1
3 Eaton CL-7	DNP 3.0	Pulse		3	Counter16	0	2		3	2 Ckt-4 FM 8711 N	4	6	1
4 SEL 2431	DNP 3.0	Pulse	*						4	2 Ckt-5 One-Off	5	5	1
5 SEL 2411	DNP 3.0	Close/Trip			and the second		11		5	2 Ckt 6 FM 8722	6	6	1
6 L & G Meter	DNP 3.0	Pulse							6	3 CL-7	201	3	0
7 SEL 387E	DNP 3.0	Pulse							7	13 Ckt 1 Faults	901	6	1
8 L & G Meter - 2	DNP 3.0	Pulse						10	8	13 Ckt 2 Faults	902	6	1
9 L & G Meter - 3	DNP 3.0	Pulse							9	13 Ckt 3 Faults	903	6	1
10 Form 6	DNP 3.0	Pulse						10	10	13 Ckt 4 Faults	904	6	1
11 SEL 351A	DNP 3.0	Pulse							11	13 Ckt 5 Faults	905	5	1
12 SEL 387E - 2	DNP 3.0	Pulse						1	12	13 Ckt 6 Faults	906	6	1
13 VSI CT3-4D	DNP 3.0	Pulse						*			1		
14 RTAC-1	DNP 3.0	Pulse									as Au		- 2
15 SEL 351R-2	DNP 3.0	Pulse											
	1	i i											
n.		111 111						_		18		3.5	

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.

 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.

Description Value AE1 Cards Seq Name v-Mult Seq Name i-Mult a-Mu AF1 Cards 2 0 Total - Unregulated 1 0 Total - Unregulated 10 1 Analog Scans 6 1 1 Buss 11 Breaker 1 10 1 vs. Net Voltages 2 vs. Net Currents 6 10 1 3 Breaker 2 10 1 IED Status Bytes 48 IED Statu Index 32 10 1 4 Breaker 3 10 1 Multiplexed AE1 Scans Multiplexed AE1 Scans Seq Description v-Card v-Pin pt-Ratio i-Card i-Pin ct-Ratio i # i			Hardware Config	uration			Voltages	s				Currents	£	
vs.Net Voltages 2 vs.Net Currents 6 DE1 Cards 2 IED Status Bytes 48 IED Status Bytes		Descr	ription						v-Mult				i-Mult	a-Mu
vs.Net Voltages 2 vs.Net Currents 6 DE1 Cards 2 iED Status Bytes 48 iBreaker 1 0 2 iED Status Bytes	1000	AE1 C	Cards	2	0	Total - Uni	regulated				0	Total - Unregulated		
vs.Net Currents 6 DE1 Cards 2 IED Status Bytes 48	-	Analo	g Scans	6	1	Buss	10		1		1	Breaker 1	10	
IED Status Bytes 48 IED Start Index 5 Breaker 5 10 1 Multiplexed AE1 Scans Multiplexed AE1 Scans Seg Description v-Card v-Pin pt-Ratio i-Card i-Pin ct-Ratio 0 Total 0 1 60 0 3 120 1 Breaker 1 0 2 60 1 1 40 2 Breaker 2 0 2 60 1 2 30 4 Breaker 3 0 2 60 1 3 30 5 Breaker 5 0 2 60 1 4 60	- 2	vs.Ne	t Voltages	2 *							2	Breaker 2	10	1
IED Status Bytes 48 IED Start Index 32 Multiplexed AE1 Scans * Seg Description v-Card v-Pin pt-Ratio i-Card 0 Total 0 1 60 0 1 Breaker 1 0 2 1 1 3 1 3 1 4 1 3 1 3 1 3 1 3 1 3 1 3 1 3 1 3 1 3 1 3 1 4 1 3 1 4 1 4 1 5 1 5 1 5 1 4 1 5 1 1 1 <td></td> <td>vs.Ne</td> <td>t Currents</td> <td>6</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>3</td> <td>Breaker 3</td> <td>10</td> <td>1</td>		vs.Ne	t Currents	6							3	Breaker 3	10	1
IED Start Index 32 Multiplexed AE1 Scans Seg Description v-Card v-Pin pt-Ratio i-Card i-Pin ct-Ratio 0 Total 0 1 60 0 3 120 1 Breaker 1 0 2 60 0 4 30 2 Breaker 2 0 2 60 1 1 40 3 Breaker 3 0 2 60 1 2 30 4 Breaker 4 0 2 60 1 3 30 5 Breaker 5 0 2 60 1 4 60	1	DE1 C	Cards	2									10	
Multiplexed AE1 Scans Seg Description v-Card v-Pin pt-Ratio i-Card i-Pin ct-Ratio 0 Total 0 1 60 0 3 120 1 Breaker 1 0 2 60 0 4 30 2 Breaker 2 0 2 60 1 1 40 3 Breaker 3 0 2 60 1 2 30 4 Breaker 4 0 2 60 1 3 30 5 Breaker 5 0 2 60 1 4 60		IED S	tatus Bytes	48							5	Breaker 5	10	1
Seq Description v-Card v-Pin pt-Ratio i-Card i-Pin ct-Ratio 0 Total 0 1 60 0 3 120 1 Breaker 1 0 2 60 0 4 30 2 Breaker 2 0 2 60 1 1 40 3 Breaker 3 0 2 60 1 2 30 4 Breaker 4 0 2 60 1 3 30 5 Breaker 5 0 2 60 1 4 60	Ĩ	IED S	tart Index	32						*				
4 Breaker 4 0 2 60 1 3 30 5 Breaker 5 0 2 60 1 4 60		0	Total	v-Card 0	v-Pin 1	pt-Ratio 60	0	3	120					
4 Breaker 4 0 2 60 1 3 30 5 Breaker 5 0 2 60 1 4 60	2	0	Total Breaker 1	v-Card 0 0	v-Pin 1 2	pt-Ratio 60 60	0	3 4	120 30					
5 Breaker 5 0 2 60 1 4 60		0 1 2	Total Breaker 1 Breaker 2	v-Card 0 0 0	v-Pin 1 2 2	pt-Ratio 60 60 60	0 0 1	3 4 1	120 30 40					
		0 1 2 3	Total Breaker 1 Breaker 2 Breaker 3	v-Card 0 0 0 0	v-Pin 1 2 2 2	pt-Ratio 60 60 60	0 0 1	3 4 1 2	120 30 40 30					
		0 1 2 3 4	Total Breaker 1 Breaker 2 Breaker 3 Breaker 4	v-Card 0 0 0 0 0 0	v-Pin 1 2 2 2 2	pt-Ratio 60 60 60 60 60	0 0 1 1	3 4 1 2 3	120 30 40 30 30					
		0 1 2 3 4	Total Breaker 1 Breaker 2 Breaker 3 Breaker 4	v-Card 0 0 0 0 0 0	v-Pin 1 2 2 2 2	pt-Ratio 60 60 60 60 60	0 0 1 1	3 4 1 2 3	120 30 40 30 30					
	*	0 1 2 3 4	Total Breaker 1 Breaker 2 Breaker 3 Breaker 4	v-Card 0 0 0 0 0 0	v-Pin 1 2 2 2 2	pt-Ratio 60 60 60 60 60	0 0 1 1	3 4 1 2 3	120 30 40 30 30					
	*	0 1 2 3 4	Total Breaker 1 Breaker 2 Breaker 3 Breaker 4	v-Card 0 0 0 0 0 0	v-Pin 1 2 2 2 2	pt-Ratio 60 60 60 60 60	0 0 1 1	3 4 1 2 3	120 30 40 30 30					
	•	0 1 2 3 4	Total Breaker 1 Breaker 2 Breaker 3 Breaker 4	v-Card 0 0 0 0 0 0	v-Pin 1 2 2 2 2	pt-Ratio 60 60 60 60 60	0 0 1 1	3 4 1 2 3	120 30 40 30 30					
	•	0 1 2 3 4	Total Breaker 1 Breaker 2 Breaker 3 Breaker 4	v-Card 0 0 0 0 0 0	v-Pin 1 2 2 2 2	pt-Ratio 60 60 60 60 60	0 0 1 1	3 4 1 2 3	120 30 40 30 30					

- It has four sections:
 - 1. Hardware Configuration
 - i. AE1 Cards
 - ii. Analog Scans
 - iii. vs.Net Voltages
 - iv. vs.Net Currents
 - v. DE1 Bytes
 - vi. IED Bytes
 - vii. IED Start Index
 - 2. Voltages
 - i. Seq
 - ii. Name
 - iii. v-Mult
 - 3. Currents
 - i. Seq
 - ii. Name
 - iii. v-Mult
 - iv. a-Mult

The number of AE-1 boards being used

The number of AE-1 voltage / current scans The total number of 3 phase voltages including IEDs The total number of 3 phase currents including IEDs

The total number of DE-1 bytes (2 per board) The total number of IED bytes of Binary Inputs Starting index of IEDs in the Binary Input table

Sequence number User defined voltage signal name Multiplier on the voltage data from the IED or RTU

Sequence number

User defined current signal name Multiplier on the current data from the IED or RTU 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 User defined description of the scan
 - ii. Description
 - iii. v-Card
 - iv. v-Pin
 - v. pt-Ratio
 - vi. i-Card
 - vii. i-Pin
 - viii. ct-Ratio
- Index of the AE-1 board used for this voltage set Pin on phase connectors of the AE-1 for this voltage set
- The PT ratio for this voltage set
 - Index of the AE-1 board used for this current set
 - Pin on phase connectors of the AE-1 for this current set 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:

Binary In	Analog In	Analog Out	Counter	Cont	rol	Calcula	tion	Physica	al	Records	
		Bir	nary Input	s						Renumber	0
DN	IP Name		11	ED	Point	Flip	Late	h 🔺	2		
	10 Bkr 3 Mo	omentary		32	10					starting with	0
1 6	11 Bkr 4 Mo	omentary		32	11	100					
	12 Bkr 5 Mo	omentary		32	12				1	Insert	1
1 6	13 Bkr 6 Mo	omentary		32	13	m				before	0
	14 Bkr 7 Mo	omentary		32	14					Derore	U
11 8	15 Clock ne	eeds to be set		32	15		0	E			
-	16			32	16					Delete	1
11 2	17			32	17	m				starting with	0
-	18			32	18	3			1		
11 - 5	19			32	19	m				Com	1
2	20			32	20	i hanned				Сору	1
	21			32	21					starting with	0
2	22			32	22					to	0
1 2	23		i.	32	23	1 been				10	U.
2	24 Breaker	Status		0	2					1	
	25 Supervis		i.	0	5	1				Move	1
2	26 Reclose	Block		0	6	-				starting with	0
1 2	27 HLT		Ĩ.	0	15	C. Linned				5000000 0 0000000	
2	28 Gnd Fau	It Block		0	7					before	0
	29 Battery A	Alarm		0	22	1 million 1					🔽 Auto Renumber
	30 Targets			0	41					Undo	V Keep Spacing
1 4	31 No Com	m		12.	2047	m					Sort
	32 Breaker	Status		1	2						IT SAL
10	33 Supervis	SOLA		1	5	100	100				

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.

Binary In	Analog In	Analog Out	Counter	Contr	ol	Calculation	Phys	ical	Records	
		An	alog Input	s					Renumber	0
DNI	P Name			IED F	oint	Mult	DB	-		
3	5 Angle C			4	9	1	0		starting with	0
3	6 Current A	1		5	0	1	0			
3	7 Angle A			5	7	1	0		Insert	1
3	8 Current B	3		5	1	1	0		before	0
3	9 Angle B			5	8	1	0		001010	Y I
4	0 Current 0	3		5	2	1	0	- (1)		
4	1 Angle C			5	9	1	0		Delete	1
4	2 Current A	1		7	0	1	0	E	starting with	0
4	3 Current E	3		7	1	1	0			
4	4 Current (2		7	2	1	0		Сору	1
4	5 Current (3		7	3		0			-
4	6 Frequence	су		7	4	1	0		starting with	0
4	47 Event Type			7	5	1	0		to	0
4	8 Fault Loc	ation		7	6	1	0			U.
4	9 Event Cu	irrent A		7	7	1	0			
5	0 Event Cu	irrent B		7	8	1	0		Move	1
5	1 Event Cu	rrent C		7	9	1	0		starting with	0
5	2 Event Cu	irrent G		7	10		0			
5	3 Event Fre	equency		7	11		0		before	0
5	4 Fault Du	ration		7	12	1	0		(Auto Renumbe
5	5 Shot Cou	ant		7	13	1	0		Undo	V Keep Spacing
5	6 Date Hig	h		7	14	100	0			Sort
5	7 Date Mid			7	15	1	0			LEL Son
5	8 Date Low	É		7	16	1	0			

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)

Binaŋ	/ In /	Analog In	Analog Out	Counter	Con	trol	Calculat	ion	Physical	Records	
			Analog	Outputs						Renumber	0
	DNP	Name			ED	Point	Mult				
	0	Cal CT-A	۱		7	0	1			starting with	0
	1	Cal CT-E	3		7	1					
	2	Cal CT-C	2		7	2				Insert	1
	3	CT Ratio			7	3				before	0
	4	Min Faul	t Cur Phase		7	4				Derore	Ų
	5	Min Faul	t Cur Gnd		7	5			E		
		the second second second second	t Cycles Pha	242222	7	6				Delete	1
	7	Min Faul	t Cycles Gnd		7	7	1	2		starting with	0
	8	Cal CT-A	۱		8	0				oranning mint	
	9	Cal CT-E	3		8	1					
111	10	Cal CT-0			8	2	1			Сору	1
	11	CT Ratio		2	8	3	C 100 100 100 100 100 100 100 100 100 10			starting with	0
	12	Min Faul	t Cur Phase		8	4	- · · · ·				-
111			t Cur Gnd	2	8	5				to	0
	14	Min Faul	t Cycles Pha	se	8	6					
10	15	Min Faul	t Cycles Gnd		8	7		8		Move	1
	16	Cal CT-A	N		9	0				starting with	0
	1.1.1.1	Cal CT-E			9	1					
	18	Cal CT-0			9	2				before	0
	19	CT Ratio			9	3				1	Auto Renumbe
	20	Min Faul	t Cur Phase		9	4				Undo	V Keep Spacing
	21	Min Faul	t Cur Gnd		9	5		2		1	Sort
	22	Min Faul	t Cycles Pha	se	9	6	1. · · · · · · · · · · · · · · · · · · ·				V SOR
	23	Min Faul	t Cycles Gnd		9	7	1	9			-

3. Analog Outputs

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

Binary Ir	A	nalog In	Analog Out	Counter	Con	ntrol	Calculation	Physica	Rec	ords		
			Counter						F	lenumber	0	
C		Name		1 (IED	Poin				starting with	0	
	20.0	Operatio	1633201		7	0				stating with	U	
10	104	Unread E			7						121	
		Operatio			8	(Insert	1	
	190	Unread B			8		1			before	0	
		Operatio Unread E			9 9	(
	- 623	Operatio			10	(Delete	1	
		Unread E	1627211		10						A	
		Operatio	2000016036		11	(starting with	0	
		Unread E			11	03			-			
		Operatio			12	(Сору	1	
1	1.1	Unread B	16222.01		12		1			starting with	0	
*		1								1000		
										to	0	
										Move	1	
										starting with	0	
										before	0	
I							L			Undo	12.1	Renumbe Spacing

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

Binary In	Analog In	Analog Out	Counter	Cor	ntrol	Calculation	n Phy	/sical	Records		
		Control Blo	ocks						Renumber	0	
DN	IP Name			IED	Poin	t 🖌				-	
	0 Close			0	0				starting with	0	
	1 Trip			0	1						
	2 Reclose			0	2 0	2			Insert	1	
	3 Gnd Fau	ult Trip		0					before	0	
	4 HLT Off	÷		0	16				Delote	U	
100	5 HLT On			0	15					-	
	6 Close			1	()			Delete	1	
1	7 Trip			1	1				starting with	0	
	8 Reclose			1	2 0	2			1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 -		
	9 Gnd Fau	101110-0227		1					Com		
	10 HLT Off	1		1	16				Сору	1	
	11 HLT On			1	15				starting with	0	
	12 Close			2	0				to	0	
	13 Trip			2	1				10	U.	
	14 Reclose	CALC 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2		2	2 23					_	
	15 Gnd Fau			2					Move	1	
	16 HLT Off	1		2	16				starting with	0	
	17 HLT On	3		2	2 15						
	18 Close			3	0				before	0	
	19 Trip			3	1					Auto	Renumber
	20 Reclose			3	2 23				Undo	Keep	Spacing
	21 Gnd Fau	140101-076270		3					100	Sort	en Manari (Te
20	22 HLT Off	N		3	16					a Soir	
	23 HLT On			3	15	÷.				-	

5. Controls

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

Binary I	n A	Analog In	Analog Out	Counter	Control	Calcula	ation	Physica	al	Records		
			Ca	alculations	1					Renumber	0	Help
	Seq	Name		IEI	D Op	Pnt1	Pn		2			
		Angle A			0 12	7	100	2012		starting with	0	
10		Angle B			0 12	8	100					
i f	2	Angle C		1	0 12	9	100	00		Insert	1	
11	3	Targets			0 40	41		4		before	0	
111	4	Angle A			1 12	7	100			before	U	
10	5	Angle B			1 12	8	100	00				
	6	Angle C			1 12	9	100	00		Delete	1	
11	7	Targets			1 40	41		4		starting with	0	
i f	8	Angle A			2 12	7	100	00		starting min		
10	9	Angle B		12.4	2 12	8	100	A				
1 C	10	Angle C			2 12	9	100	00		Сору	1	
10	11	Targets		1 3	2 40	41		4 ■ =		starting with	0	
1	12	Angle A			3 12	7	100	00				
10	13	Angle B			3 12	8	100	00		to	0	
	14	Angle C			3 12	9	100	00			_	
10	15	Targets			3 40	41		4		Move	1	
	16	Angle A		1 25	4 12	7	100	00		starting with	0	
10	17	Angle B		1	4 12	8	100	00		2000 C C C C C C C C C C C C C C C C C C		
	18	Angle C			4 12	9	100	00		before	0	
	19	Targets			4 40	41		4			Auto	Renumbe
	20	Angle A			5 12	7	100	A.57		Undo	V Kee	o Spacing
	21	Angle B			5 12	8	100	00		1		
	22	Angle C		1	5 12	9	100	00			Sort	
	23	Targets		1 1	5 40	41		4			-	

- 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

arm ~ Parm Calculations	Special - Parm ~ Const
0 - Pnt1 = Pnt1 + Pnt2	12 - Pnt1 = acos(Pnt1 / Pnt2)
1 - Pnt1 = Pnt1 - Pnt2	20 - Pnt1 = (128 - Pnt1) * 5.73
2 - Pnt1 = Pnt1 x Pnt2	
3 - Pnt1 = Pnt1 / Pnt2	
4 - Pnt1 = Pnt2 - Pnt1	
5 - Pnt1 = Pnt2 / Pnt1	Counter - Parm
arm ~ Const Calculations	30 - Op Counter = Counter(Pnt1)
6 - Pnt1 = Pnt1 + Pnt2	31 - Op Counter = Analog(Pnt1)
7 - Pnt1 = Pnt1 - Pnt2	
8 - Pnt1 = Pnt1 x Pnt2	
9 - Pnt1 = Pnt1 / Pnt2	Binaries - Parm ~ Const
0 - Pnt1 = Pnt2 - Pnt1	40 - Pnt1 = OR of next Pnt2 bits
1 - Pnt1 = Pnt2 / Pnt1	41 - Pnt1 = Pnt1 OR NoComm

Binary In	Analog In	Analog Out	Counter	Control	Calculation	Physical	- Records		
	Com	munications					Renumber	0	
	cription		Value						
1.	ver DNP Add	200-0-1-1-1-1-1-1-1-1-1-1-1-1-1-1-1-1-1-	2001				starting with	0	
And the second s	nt DNP Addr	7722.07.0	1024				1 million 1 mill		
100000	let Comm Po	51/2551	2				insert	1	
10000000	Server Cor	nm Port	1				before.	0	
2.2.2.2.1	nm 1 Baud nm 2 Baud		9600 9600						
2000 U	nm 2 Baud nm 3 Baud		9600				Delete	1	
2.0.000	nm 3 Baud		9600						
2008-00	nm 5 Baud		9600				starting with	0	
201210	nm 6 Baud		9600				1		
							Сору	1	
							starting with	0	
							to	0	
							Move	1	
							starting with	0	
							before	0	
				L			Undo	🕖 Keep	Renumbe Spacing
							E	/ Sort	

- 7. Physical
 - i. Server DNP address
 - ii. Client DNP Address
 - iii. Vs.Net Comm Port
 - iv. DNP Server Comm Port
 - v. Comm 1 Baud
 - vi. Comm 2 Baud
 - vii. Comm 3 Baud
 - viii. Comm 4 Baud
 - ix. Comm 5 Baud
 - x. Comm 6 Baud

Primary DNP Server address to Master DNP Client address to IEDs Secondary DNP or Valquest Server port Primary DNP Server Port Baud rate of communicates Port 1

- Baud rate of communicates Port 2
- Baud rate of communicates Port 3
- Baud rate of communicates Port 4
- Baud rate of communicates Port 5
- 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:
 - Inserts blank rows above a given DNP index i. Insert
 - ii. Delete Deletes rows starting at a given DNP index
 - Copies rows starting at a given DNP index to another DNP index iii. Copy
 - Moves rows starting at a given DNP index to another DNP index iv. Move
 - 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 tabled 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.

Devices	Bina	ry In Analog In Analog O	ut Counter	Control	Calculati	on			Device Wizard		
Seq Name	· ·	1	-			-11	Seq	Name	Device	Dev	IED
0 RTU-1 I/O			1 Definitions				0	Local	RTU-1 I/O	0	32
1 DE-1 Inputs	2	Seq Name		Flip	Latch		1	Local	DE-1 Inputs	1	32
2 AE-1 Voltages		0 Breaker 1 Status	0				2	Local	DE-1 Inputs	1	32
3 AE-1 Currents		1 Breaker 2 Status	1				3	Local	AE-1 Voltages	2	32
4 Form 4C		2 Breaker 3 Status	2				4	Local	AE-1 Voltages	2	32
5 Form 4D	2	3 Breaker 4 Status	3				5	Local	AE-1 Currents	3	32
6 Form 4C Currents		4 Breaker 5 Status	4				6	Local	AE-1 Currents	3	32
7 SEL 351R	2	5 Breaker 6 Status	5	the second se			7	Local	AE-1 Currents	3	32
8 L&G Meter		6 Breaker 7 Status	6				8	Local	AE-1 Currents	3	32
9 SEL 2411	2	7 Local 8	7				9	Local	AE-1 Currents	3	32
10 Form 4C Events		8 Bkr 1 Momentary	8	the state of the s			10	Breaker 1	Form 4C	4	0
11 351R Voltages		9 Bkr 2 Momentary	9				11	Breaker 2	Form 4C	4	1
12 L&G Voltages		10 Bkr 3 Momentary	10				12	Breaker 3	Form 4C	4	2
13 4D Voltages	2	11 Bkr 4 Momentary	11	the second se			13	Breaker 4	Form 4C	4	3
14 L&G Meter - 2		12 Bkr 5 Momentary	12				14	Breaker 5	Form 4C	4	4
15 SEL 387E	2	13 Bkr 6 Momentary	13				15	Breaker 1	Form 4C Events	10	0
16 L&G Voltages - 2		14 Bkr 7 Momentary	14				16	Breaker 2	Form 4C Events	10	1
17 Special I/O #1	0	15 Clock needs to be se	t 15				17	Breaker 3	Form 4C Events	10	2
18 L&G Voltages - 3	*						18	Breaker 4	Form 4C Events	10	3
19 L&G Meter - 3	2						19	Breaker 5	Form 4C Events	10	4
20 Form 6	12						*				1
21 SEL 351R Events	2									and the second s	
22 Special I/O #2	6										
23 SEL 387E - 2										2.2	
24 VSI CT3-4D	12							uild	Update		Exit

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

Before Wizard

	Analog In	Analog Out C	Counter C	ontrol C	alculation	Physical	Records		
	A10.000	Anale	og Inputs				Renumber	0	
DN *	P Name		IED	Point	Mult	DB	starting with	0	
							Insert	1	
							before	0	
							Delete	1	
							starting with	0	
							Сору	1	
							starting with	0	
							to	0	
							Move	1	
							starting with	0	
							before	0	
							Undo	1000	Renumbe Spacing
								Sort	501911111111 1 0

After Wizard

Bina	ry In	Analog In	Analog Out	Counter	Contro	I Calc	ulation	Phys	sical	Records	
			An	alog Input						Renumber	0
	DN	IP Name		1.1	A CONTRACT OF A PARTY OF	oint M	fult	DB	<u>^</u>	1	
		0 Voltage /			32	0	1	0		starting with	0
		1 Voltage B			32	1	1	0			
		2 Voltage (32	2	1	0		Insert	1
		3 Voltage A			32	32	1	0		before	0
		4 Voltage B			32	33	1	0		Derore	U
		5 Voltage (32	34	1	0			
		6 Current A	Į.		32	4	1	0		Delete	1
		7 Angle A			32	8	1	0	=	starting with	0
		8 Current B	3		32	5	1	0			
		9 Angle B			32	9	1	0		Сору	1
		10 Current (÷.		32	6	1	0		copy	L
		11 Angle C			32	10	1	0		starting with	0
		12 Current A	7		32	4	1	0		to	0
		13 Angle A			32	8	1	0		10	0
		14 Current B	3		32	5	1	0]	- (
		15 Angle B			32	9	1	0		Move	1
		16 Current (32	6	1	0		starting with	0
		17 Angle C			32	10	1	0			0
		18 Current A	4		32	4	1	0		before	U
		19 Angle A			32	8	1	0		1	🔽 Auto Renumbe
	37	20 Current E	3		32	5	1	0		Undo	V Keep Spacing
		21 Angle B			32	9	1	0			Sort
	37	22 Current (-		32	6	1	0			Tel our
	2	23 Angle C			32	10	1	0			

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.

	ID	Name	DIP	Address:Port	
	1	Smitherville	11	10.80.11.43:4001	Add
1	2	Laughton MP	3	192.168.173.3:4001	
1	3	Benton Healey	9	10.80.24.43:4001	Delete
1	4	Foxhall	6	10.80.15.43:4001	
1	5	Artexa	5	10.80.18.43:4001	6.0
- í	6	Center Town	12	192.168.173.133:4000	Exit
ŝ	7	Hopwood	7	10.80.30.43:4000	
1	8	Brixton	2	10.80.14.43:4000	
1	9	Welby	13	10.80.12.43:4000	
1	10	Frenell	1	10.80.20.43:4001	
					L

- 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:

 - Binary Inputs
 Analog Inputs
 - 3. Analog Outputs
 - 4. Counters

Binary I	In 🔻		3	sec Po	oll 📃	Trip	Close		Б	cit
DNP	IED	Device	Pnt	Value	^	DNP	IED	Device	Pnt	
0	Local	CS1 Status	0			0	Ckt 1	Close	0	1
1	Local	CS1 Local	1			1	Ckt 1	Trip	1	
2	Local	SEL 587 Bkr Fail	2			2	Ckt 1	Reclose Normal	2	
3	Local	SEL Alarms	3		E	3	Ckt 1	Gnd Fault Trip	3	
4	Local	XF Trip	4		1	4	Ckt 1	HLT Off	16	
5	Local	O/C Trip	5			5	Ckt 1	HLT On	15	
6	Local	Differential COS	6			6	Ckt 2	Close	0	
7	Local	Overcurrent COS	7			7	Ckt 2	Trip	1	
8	Local	CS Low SF6	16			8	Ckt 2	Reclose Normal	2	
9	Local	Transformer Trouble #1	17			9	Ckt 2	Gnd Fault Trip	3	
10	Local	Transformer Trouble #2	18			10	Ckt 2	HLT Off	16	
11	Local	Spare	19			11	Ckt 2	HLT On	15	
12	Local	Spare	20			12	Ckt 3	Close	0	
13	Local	Spare	21			13	Ckt 3	Trip	1	
14	Local	Spare	22			14	Ckt 3	Reclose Normal	2	
15	Local	Spare	23			15	Ckt 3	Gnd Fault Trip	3	
16	CS 2	CS Status	0			16	Ckt 3	HLT Off	16	
17	CS 2	SEL 587 COS	1			17	Ckt 3	HLT On	15	
18	CS 2	SEL 387E COS	2			18	Ckt 4	Close	0	
19	CS 2	CS Trip Fail	3			19	Ckt 4	Trip	1	
20	CS 2	CS Trip Ckt Alarm	4			20	Ckt 4	Reclose Normal	2	
21	CS 2	Differential COS	5			21	Ckt 4	Gnd Fault Trip	3	
22	CS 2	CS Local	6			22	Ckt 4	HLT Off	16	
23	CS 2	Overcurrent COS	7			23	Ckt 4	HLT On	15	
24	CS 2	CS Low Gas Alarm	8			24	Ckt 5	Close	0	
25	CS 2	CS Low Gas Lockout	9			25	Ckt 5	Trip	1	
26	CS 2	CS Spring Chg Failure	10			26	Ckt 5	Reclose Normal	2	
27	CS 2	CS Loss of AC	11			27	Ckt 5	Gnd Fault Trip	3	
28	CS 2	XF Sudden Pressure	12			28	Ckt 5	HLT Off	16	
29	CS 2	XF Pressure Relief	13			29	Ckt 5	HLT On	15	

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

Communi	ications			Response Timir	ngs			Boot Loader						
IP	10.80.24.4	3		Normal Timeou	t	3000		Class 0	Erase	Holding	Progr	am	Verify	
Port	4001			Erase Timeout		10000		Clear Flags	Send	Firmware	Send	d Confi	guration	٦
Master RTU	1024 9	Timeout	3000 t	Program Timeout 7000 Send Block Timeout 5000			Not Erased	Program I		Continue 🕅				
01	2 3 4	5 6 7	8 9 A	BCDE	F -CR	(C- 0	1	2 3 4	567	8 9 A	вс	DE	F -C	

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

Exits the program

- Save As Brings up a dialog box to save current database to a new file
- o Compilation
- o Database Flat
- o Sniffer Template
- 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
 - Database
 Builds and encrypts a database hat hie to Combines the two previous menu items
 - Coning an
 Poot Pood
- Boot Read

RTU Pull Down

o Exit

A pull down menu allowing RTU selection

Reads a database flat file from the RTU

Builds a file with the configuration data that will go to the RTU

Builds a template for use with the Valguest DNP SniffSet

Builds a flat file representing the entire database

- 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
 Watch

 Brings up the Real Time Monitor
 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

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 0 - 7 RTU-1 4 8 9 10 11 12 13 14 15 Binary Input 6 - 16 17 18 19 20 21 22 23 Binary Input 16 - 31 DI-1 1 10 40 41 42 43 44 45 46 47 Binary Input 48 - 55 DI-1 2 6 48 49 50 51 52 53 54 55 Binary Input 64 - 71 DI-1 3 1 72 73 74 75 <td< th=""><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th>Pin</th><th>with D</th><th>NP Ind</th><th>ices</th><th></th><th></th></td<>										Pin	with D	NP Ind	ices		
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Binary Input 8 - 15 DI-1 0 6 16 17 18 19 20 21 22 23 Binary Input 16 - 23 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 1 56 57 58 59 60 61 62 63 Binary Input 64 - 71 DI-1 3 1 72 73 74 75 76 77 78 79 Binary Input 80 - 95 DI-1 5 6 96 97 98 90 100 100 100 100 100 100 100 100	Momentary														
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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 64 - 71 Di-1 3 1 72 73 74 75 76 77 78 79 Binary Input 80 - 87 Di-1 4 1 88 89 90 91 92 93 94 95 Binary Input 86 - 101 5 1 104 105 106 107 108 109 101 101 101 101 101 101 101 101 101 101 101 101 101 101 101 101	Binary Input	8	-	15	DI-1	0	6	16	17		19	20		22	23
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 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 80 - 87 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 6 112 113 114 115 116 <td< td=""><td>Binary Input</td><td>16</td><td>-</td><td>23</td><td>DI-1</td><td>0</td><td>1</td><td>24</td><td>25</td><td>26</td><td>27</td><td>28</td><td>29</td><td>30</td><td>31</td></td<>	Binary Input	16	-	23	DI-1	0	1	24	25	26	27	28	29	30	31
Binary Input 40 - 47 DI-1 2 6 48 49 50 51 52 53 54 55 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 80 - 87 DI-1 4 1 88 89 90 91 92 93 94 95 Binary Input 88 - 95 DI-1 5 1 104 105 106 107 108 109 110 110 110 110 110 101 101 101 101 101 111 111 111 111 111 111 111 111 111 111 111	Binary Input	24	-	31	DI-1	1	6	32	33	34	35	36	37	38	39
Binary Input 48 - 55 DI-1 2 1 56 57 58 59 60 61 62 63 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 104 111 DI-1 6 112 113 114 115 116 117 118 119 Binary Input 120 - 127 DI-1 7 6 128 129 130 131 132 133	Binary Input	32	-	39	DI-1	1	1	40	41	42	43	44	45	46	47
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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 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	Binary Input	112	-	119	DI-1	6	1	120	121	122	123	124	125	126	127
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Binary Input224-231DI-1131232233234235236237238239Binary Input232-239DI-1146240241242243244245246247Binary Input240-247DI-1141248249250251252253254255Binary Input248-255DI-1156256257258259260261262263Binary Input256-263DI-1151264265266267268269270271Binary Input264-271DI-1166272273274275276277278279	Binary Input	208	-	215	DI-1	12	1	216	217	218	219	220	221	222	223
Binary Input232-239DI-1146240241242243244245246247Binary Input240-247DI-1141248249250251252253254255Binary Input248-255DI-1156256257258259260261262263Binary Input256-263DI-1151264265266267268269270271Binary Input264-271DI-1166272273274275276277278279	Binary Input	216	-	223	DI-1	13	6	224	225	226	227	228	229	230	231
Binary Input240-247DI-1141248249250251252253254255Binary Input248-255DI-1156256257258259260261262263Binary Input256-263DI-1151264265266267268269270271Binary Input264-271DI-1166272273274275276277278279	Binary Input	224	-	231	DI-1	13	1	232	233	234	235	236	237	238	239
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	232	-	239	DI-1	14	6	240	241	242	243	244	245	246	247
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	240	-	247	DI-1	14	1	248	249	250	251	252	253	254	255
Binary Input 264 - 271 DI-1 16 6 272 273 274 275 276 277 278 279	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 272 - 279 DI-1 16 1 280 281 282 283 284 285 286 287	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

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

Electrical Configuration Sequence with DNP Indices

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 + Al-1 Card * 12	3	3	266	278	290	302	314	326	338	350	
DC Value	11 + Al-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