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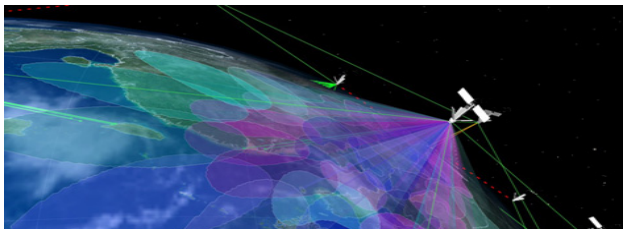
REMOTE DAM SAFETY MONITORING SYSTEMS

SAUNDERS GAUGING STATIONS UPGRADE

APPLICATION NOTE

ONTARIO POWER GENERATION

SUTRON



Client: ***Ontario Power Generation Dam Safety***

Project: ***Saunders Gauging Stations Upgrade***

For Sales & Service Contact:
Hoskin Scientific Ltd.
Edmonton Ph. (780) 434-2645
Vancouver Ph. 1-800-663-3023

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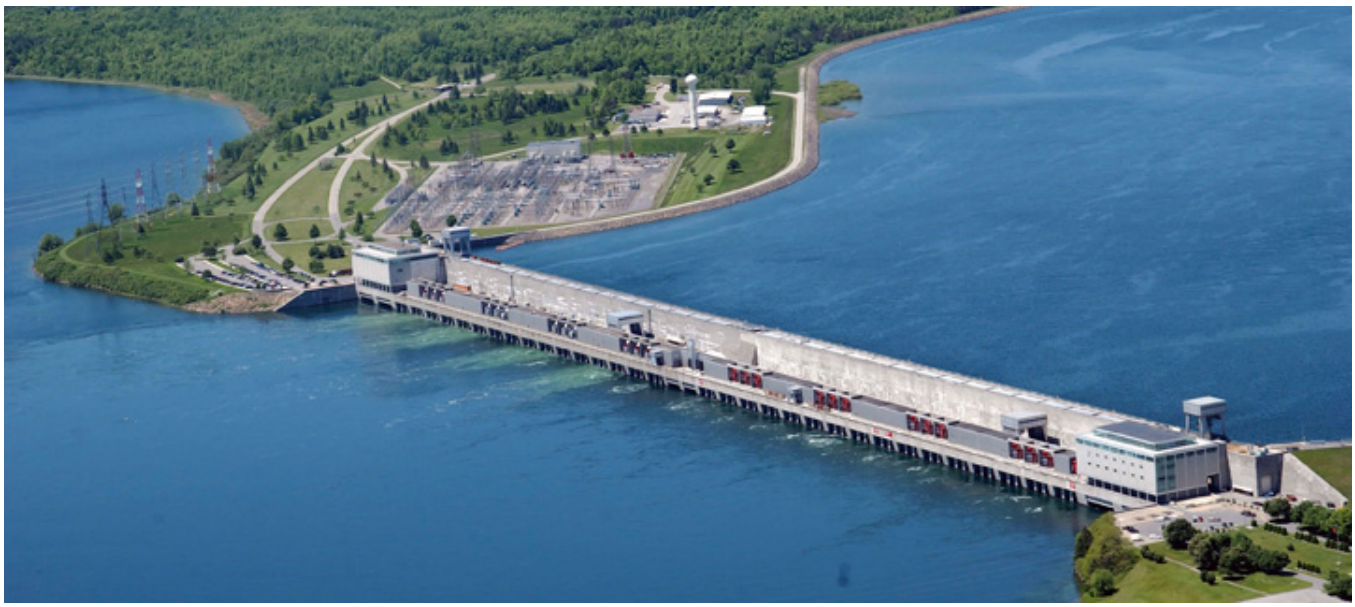
System Overview:

The Saunders Gauging Station Upgrade Project for Ontario Power Generation is a complete retrofit of nine stations with Sutron dataloggers, sensors and telemetry for real time water level monitoring. The network has a combination of GOES satellite, LTE cellular, radio telemetry with Modbus communications.

From a Master SMP Gateway located at the Saunders Generating station, the data from the remote sites are polled and collected in near real time .

Hoskin Scientific Ltd. has supplied all of the station hardware components and system integration services and testing.

This document outlines the network Saunders network architecture, hardware configuration and programming used in this project.



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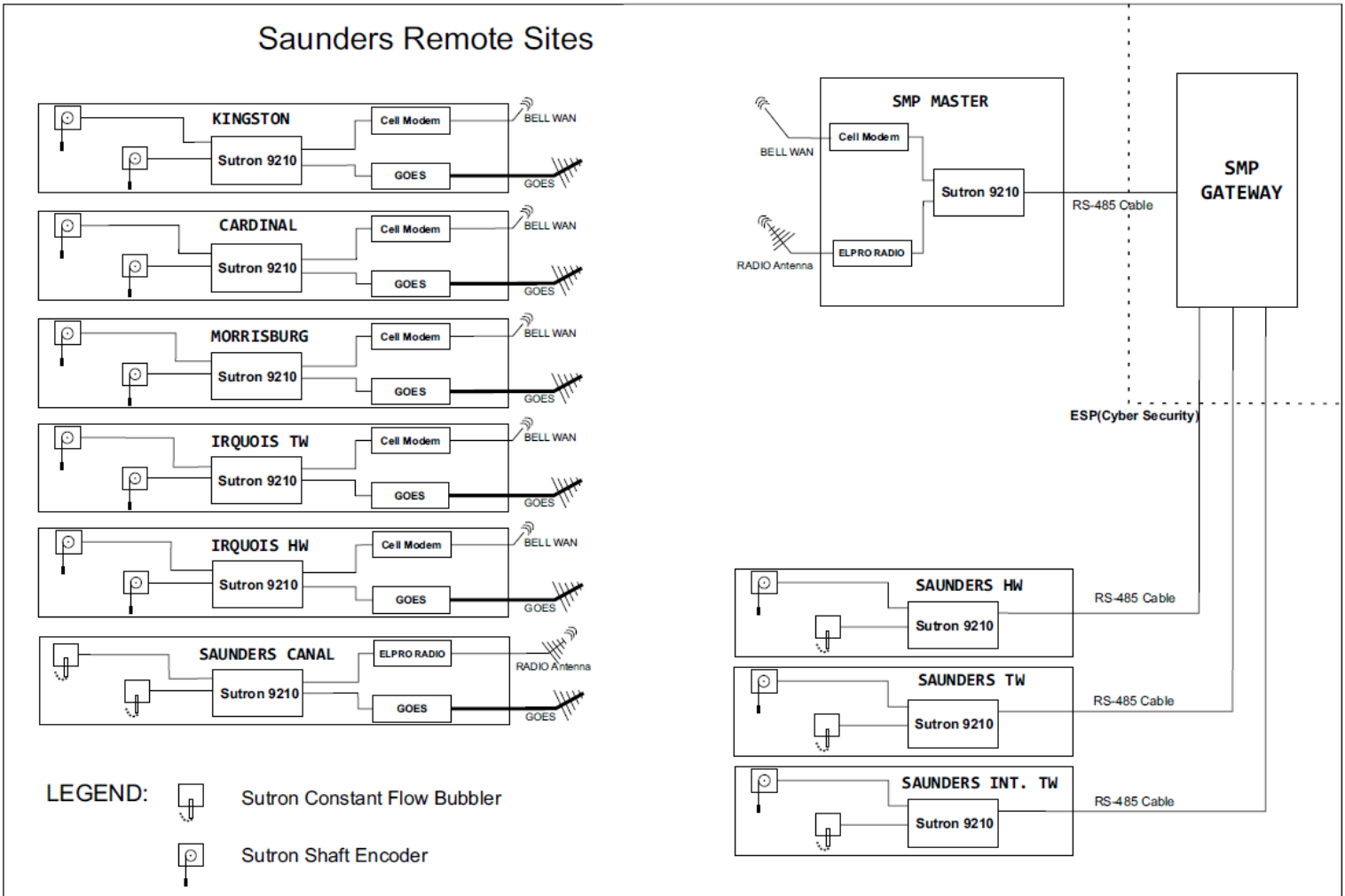
Ontario Power Generation Telemetry System Architecture



Date	December 28, 2016	Hoskin Scientific Systems Integration	Title:	Network Diagram
Rev.	1	OPG Saunders	Drawn By:	Chintan Patel

Synopsis:

The upgrade for the Saunders network has the following configuration:

1) Located at the Saunders generating station is a SMP Gateway which is used for polling the data from nine remote Gauging stations. A Master 9210 datalogger with a RV50 cellular modem is connected to the SMP Gateway. Using Modbus TCP protocol over the cellular network the Master 9210 datalogger polls five Saunders remote sites which are programmed to update the Modbus registers once per minute. The SMP Gateway also has a wireless Ethernet radio modem for polling a sixth site and a RS-485 port for direct Modbus polling of three additional gauging stations. The SMP Gateway polls the SMP 9210 datalogger using Modbus RTU over a RS-485 communication cable.

2) Five remote gauging stations; Kingston, Cardinal, Morrisburg, Iroquois TW, Iroquois HW have dual shaft encoders as water level sensors. The shaft encoders are connected to a Sutron 9210 datalogger using SDI-12 protocol. Connected to the Ethernet port of the 9210 datalogger is a Sierra Wireless RV50 LTE cellular modem. The cellular modems have SIM cards activated on the Bell network and within the OPG VPN. Therefore only other communications devices within the OPG VPN can communicate with the remote sites for security reasons. The 9210 datalogger and RV50 cellular modem at the SMP Gateway poll these remote sites once per minute.

3) The Saunders Canal station is the sixth gauging station and has a dual bubbler system, 9210 datalogger and a Elpro 245U-E wireless Ethernet radio modem for communications with the SMP Gateway. The 9210 datalogger and radio modem at the SMP Gateway poll this site once per minute.

4) Gauging stations at Saunders HW, Saunders TW and Saunder International TW have a shaft encoder and a bubbler and direction Modbus RTU RS-485 communications to the SMP Gateway.

5) All of the stations are installed indoors and are powered off 121 Ahr. AGM batteries with an AC battery charging system. For time synchronization the remote sites have Garmin GPS antenna's connected. The system also has provisions for communication failure monitoring and two way communication which allows for remote programming changes and redundant data downloading.

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Section 1

Ontario Power Generation

Master SMP Gateway Station Documentation

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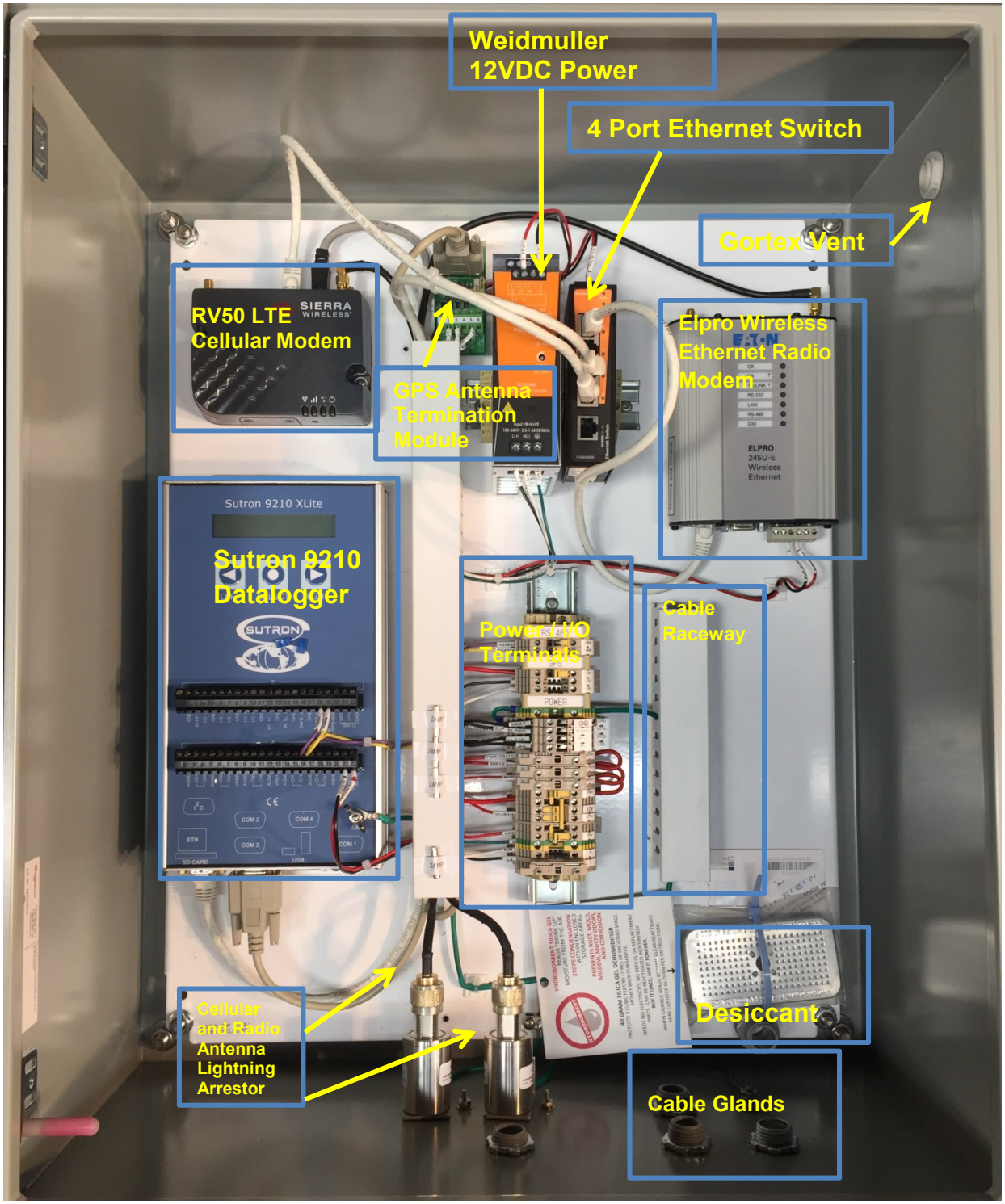
Ontario Power Generation Master SMP Gateway Station Configuration



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SMP Gateway Elpro 245U-E Wireless Ethernet Radio Modem
Wireless communications with Saunders Canal.

SMP Weidmuller Power 12VDC Power Supply & SMP Gateway Ethernet Switch

Ethernet Switch provides connections for 9210, RV50 Cell Modem, Elpro 245U-E Radio Modem and PC.

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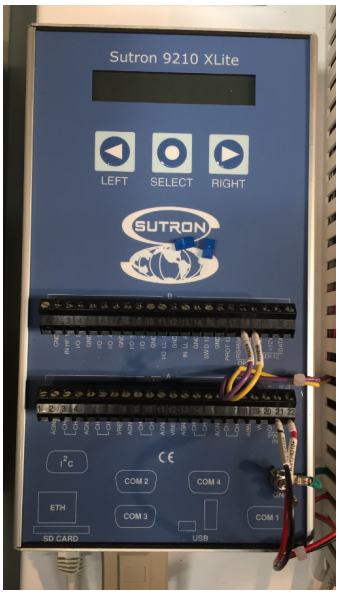
SMP RV50

LTE Radio Modem for Polling Saunders Remote Sites

Showing Ethernet, Power and SMA Antenna Connection.

SMP Sutron 9210 Xlite Datalogger

RS-485 and Power Connections Connections



SMP RV50 LTE Modem and 245U-E Radio Modem Antenna Lightning Arrestors

N Male Antenna Cable Connections and Bulkhead Mount with Earth Ground

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SMP Gateway Enclosure
Gable Glands, Coaxial, Earth Ground and Liquid Tight Connectors

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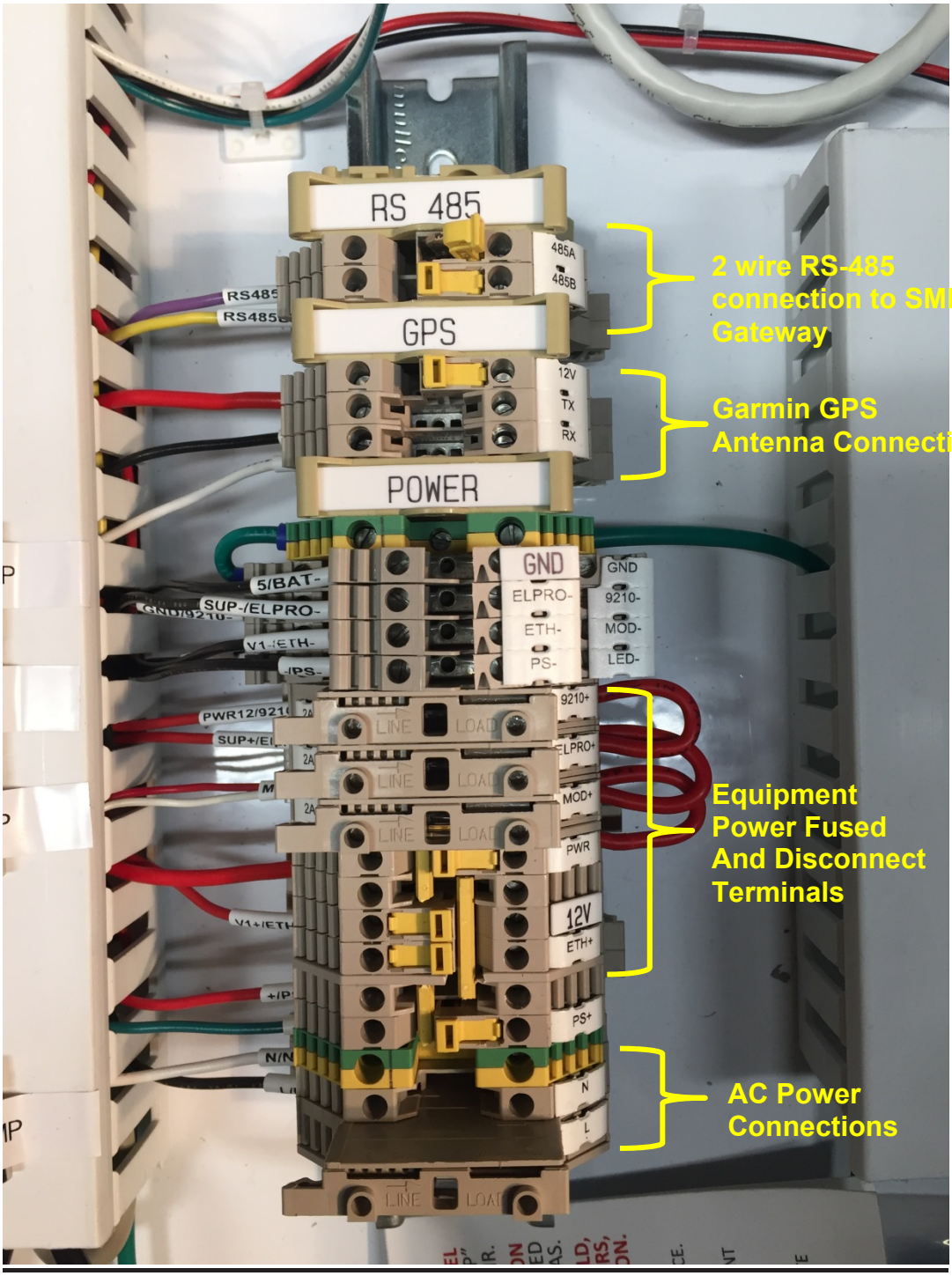
SMP Gateway Panel Weidmuller Terminals for Power and I/O Connections



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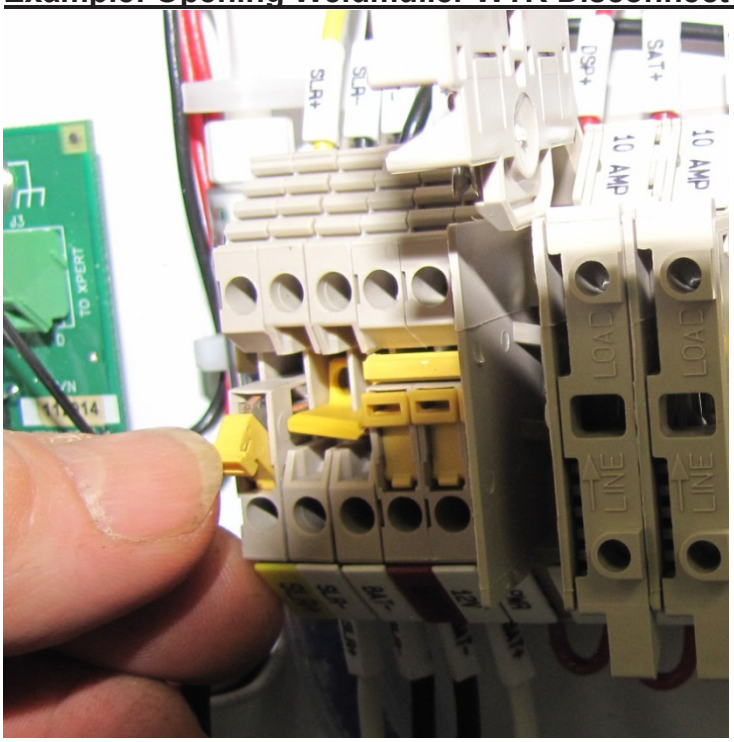
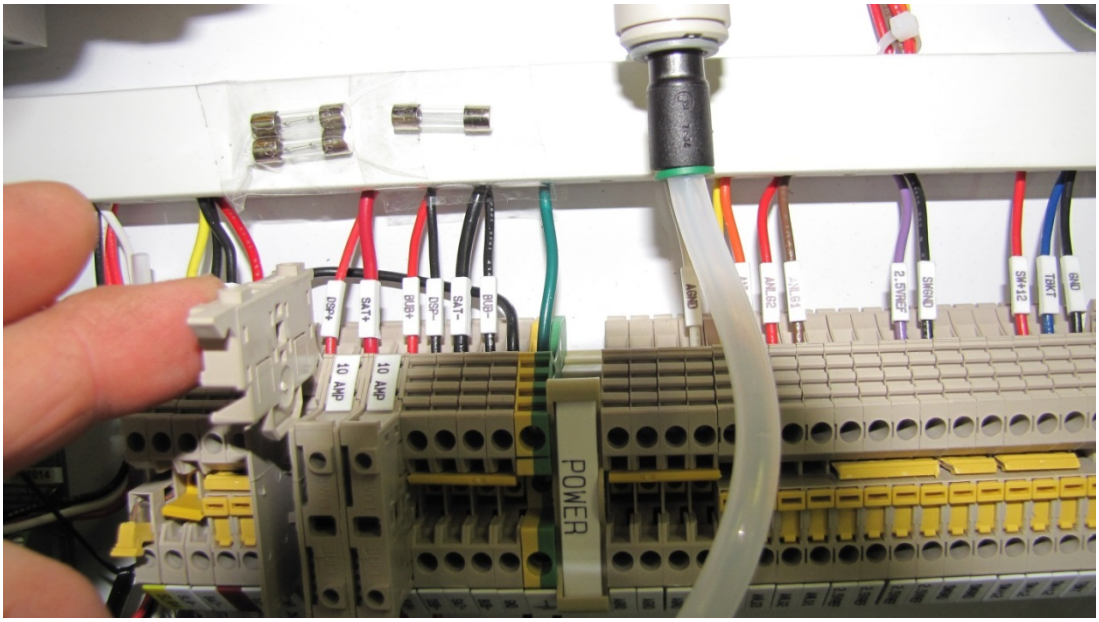
Example: Opening Weidmuller WTR Disconnect Terminal



Example: Opening Weidmuller WSI Fused Terminals



Garmin GPS Sensor for 9210 Datalogger Clock Synchronization

The SMP 9210 datalogger clock is synchronized using a Garmin GPS sensor. This sensor has a RS-232/RS-422 output and is connected to COM 2 of the 9210 datalogger. The 9210 has a Basic program scheduled to run twice a day where the clock is automatically adjusted to GPS time. A local time offset is configured within the Basic file.

garmingps_with_LTO.bas

GARMIN

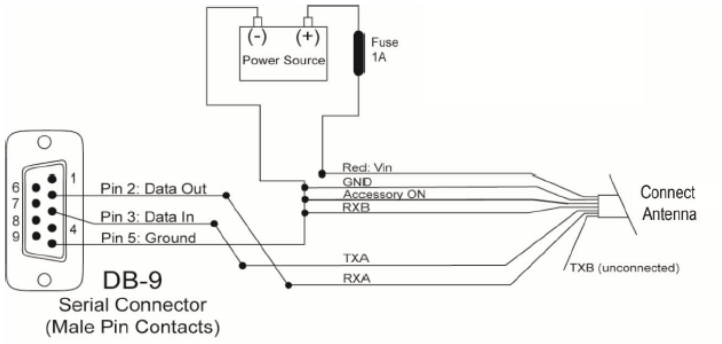
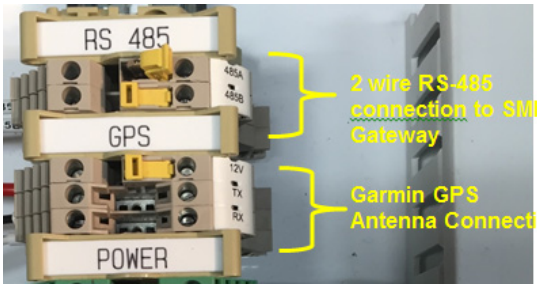


Figure 2. PDA Serial Port Interconnection

9210 Garmin Basic File (note Baud Rate , 38400, 8N1, Local Time Offset -5 Hours

```
' This subroutine can be scheduled to run
' periodically (e.g. every hour) to read the GPS
' and set the Xpert/9210 clock.
' The routine expects the GPS to be connected to COM2 and that the
' power pin is on DIO module 1, channel 4
' If those need changed, change in USER SET Constants
' Make sure to set the port power to +12Volts
' The routine expects the data in
' NEMA $GPGGA format (default for GRAMIN)
' For troubleshooting, statusmsg may be uncommented
'------- USER SET CONSTANTS -----
CONST GPSPort = "COM2:"
CONST GPSPwrMod = 1 ' DIO module
CONST GPSPwrCH = 4  ' DIO Channel
LTOhr = -5 'Local Time Offset hours
LTOMin = 0 'Local Time Offset minutes
'------- GARMIN Constants -------
Const BAUD = 38400
Const NOPARITY = 0
Const NOHANDSHAKE = 0
Const GPSTimeout = 900 'Timeout in seconds to get a valid GPS signal
'--------------------------------
```



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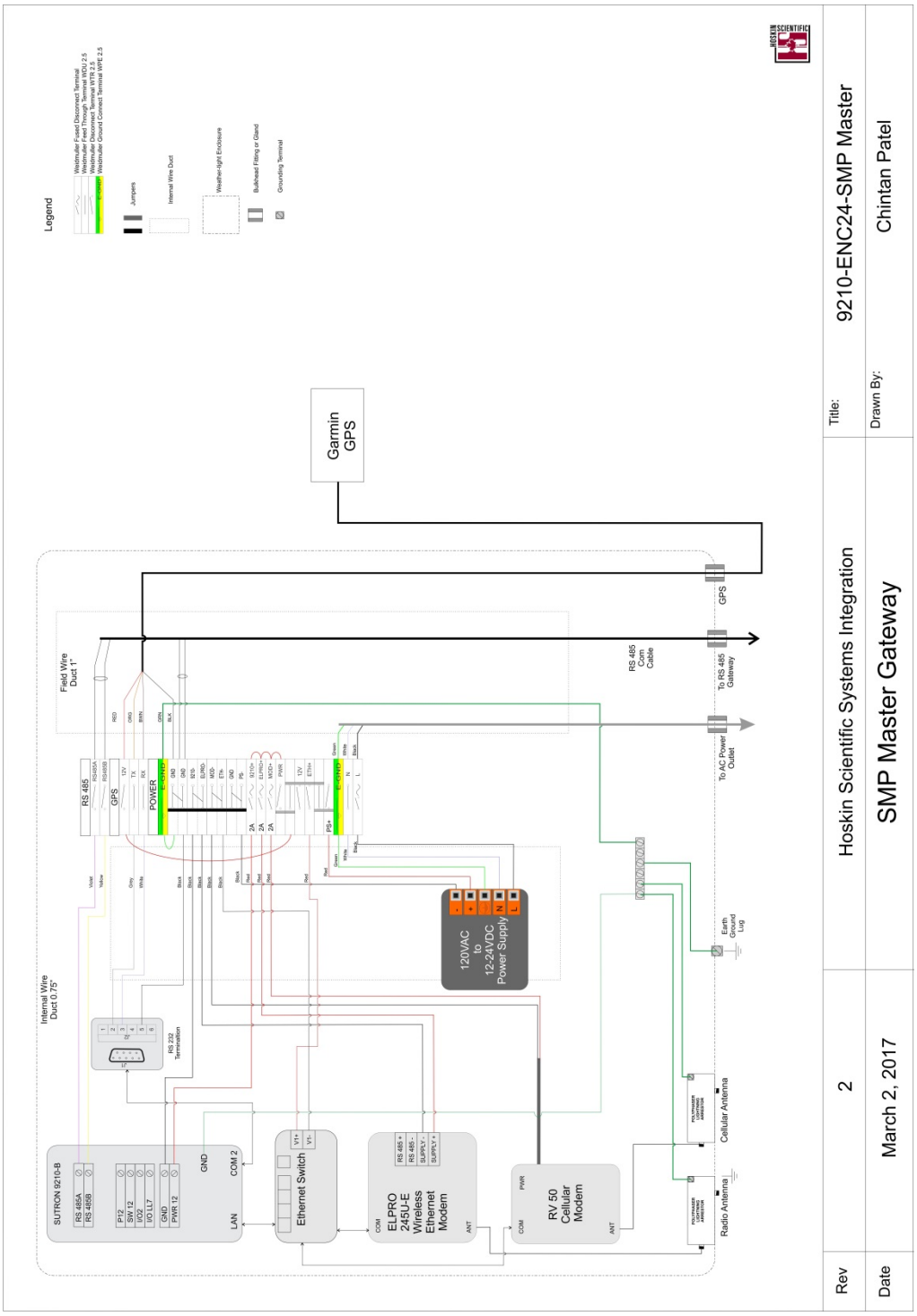
SMP Gateway Panel Schematic



SMP Gateway Master Modbus Table for Remote Sites

SMP Gateway 9210 Modbus Port Settings

Modbus Address	**1**
9210 COM Port	**4 (RS-485 to SMP)**
Baud Rate /Data Format	**9600,8N1**

Station Name: Kingston

SMP Modbus Register Map (32 bit Floating Point)	Sensor	Units	Sampling Interval	Sampling Time	Static IP Address
1-2	Shaft Encoder1	M	00:01:00	00:00:12	
3-4	Shaft Encoder2	M	00:01:00	00:00:12	
5-6	Battery Voltage	V	00:01:00	00:00:12	
7-8	Logger Temperature	C	00:01:00	00:00:12	
9-10	Watchdog Counter	cnts	00:01:00	00:00:12	

Station Name: Morrisburg

SMP Modbus Register Map (32 bit Floating Point)	Sensor	Units	Sampling Interval	Sampling Time	Static IP Address
11-12	Shaft Encoder1	M	00:01:00	00:00:12	
13-14	Shaft Encoder2	M	00:01:00	00:00:12	
15-16	Battery Voltage	V	00:01:00	00:00:12	
17-18	Logger Temperature	C	00:01:00	00:00:12	
19-20	Watchdog Counter	cnts	00:01:00	00:00:12	

Station Name: Iroquois HW

SMP Modbus Register Map (32 bit Floating Point)	Sensor	Units	Sampling Interval	Sampling Time	Static IP Address
21-22	Shaft Encoder1	M	00:01:00	00:00:12	
23-24	Shaft Encoder2	M	00:01:00	00:00:12	
25-26	Battery Voltage	V	00:01:00	00:00:12	
27-28	Logger Temperature	C	00:01:00	00:00:12	
29-30	Watchdog Counter	cnts	00:01:00	00:00:12	

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Station Name: Iroquois TW

SMP Modbus Register Map (32 bit Floating Point)	Sensor	Units	Sampling Interval	Sampling Time	Static IP Address
31-32	Shaft Encoder1	M	00:01:00	00:00:12	
33-34	Shaft Encoder2	M	00:01:00	00:00:12	
35-36	Battery Voltage	V	00:01:00	00:00:12	
37-38	Logger Temperature	C	00:01:00	00:00:12	
39-40	Watchdog Counter	cnts	00:01:00	00:00:12	

Station Name: Cardinal

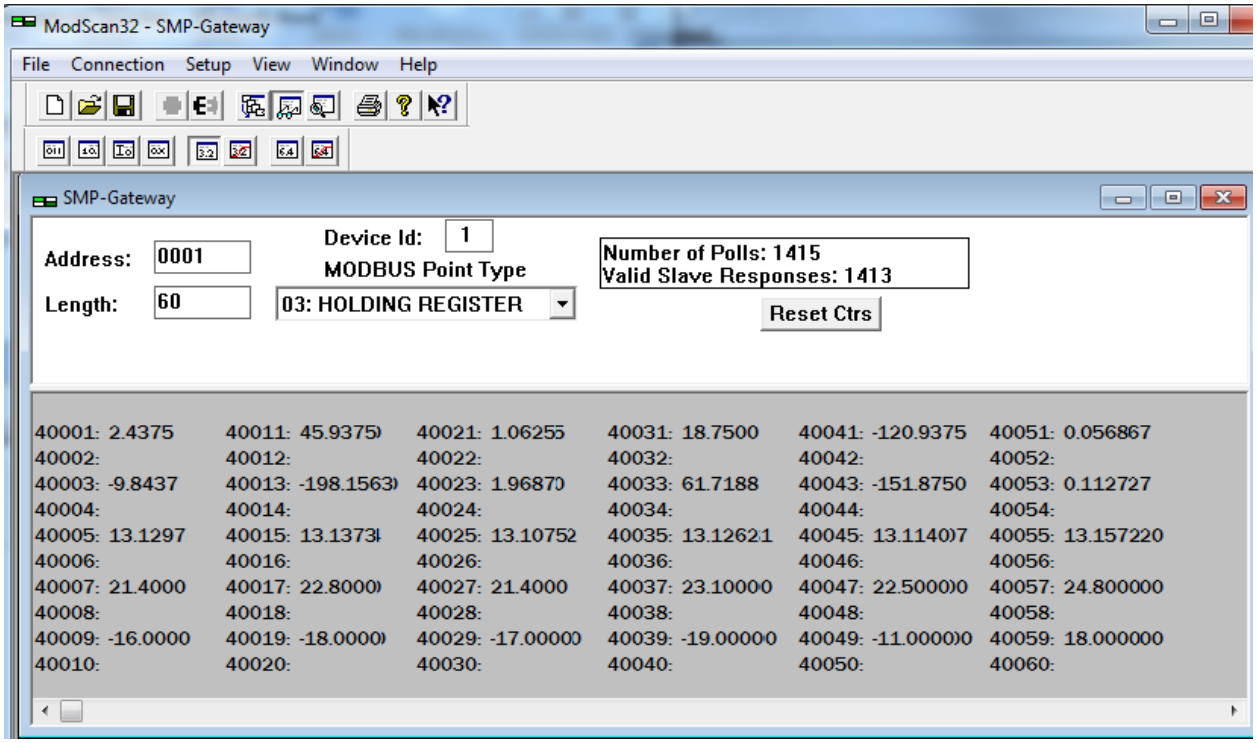
SMP Modbus Register Map (32 bit Floating Point)	Sensor	Units	Sampling Interval	Sampling Time	Static IP Address
41-42	Shaft Encoder1	M	00:01:00	00:00:12	
43-44	Shaft Encoder2	M	00:01:00	00:00:12	
45-46	Battery Voltage	V	00:01:00	00:00:12	
47-48	Logger Temperature	C	00:01:00	00:00:12	
49-50	Watchdog Counter	cnts	00:01:00	00:00:12	

Station Name: Saunders Canal

SMP Modbus Register Map (32 bit Floating Point)	Sensor	Units	Sampling Interval	Sampling Time	Static IP Address
51-52	Bubbler 1	M	00:01:00	00:00:12	
43-54	Bubbler 2	M	00:01:00	00:00:12	
55-56	Battery Voltage	V	00:01:00	00:00:12	
57-58	Logger Temperature	C	00:01:00	00:00:12	
59-60	Watchdog Counter	cnts	00:01:00	00:00:12	

SMP Gateway Modscan Modbus Simulator Screen

Showing Saunders Remote Site data as per previous tables



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Saunders Direct RS-485 Communication Sites

Station Name: Saunders HW

Saunders HW 9210 Modbus Port Settings

Modbus Address	**1**
9210 COM Port	**3 (RS-232)**
Baud Rate /Data Format	**9600,8N1**

SMP Modbus Register Map (32 bit Floating Point)	**Sensor**	**Units**	**Sampling Interval**	**Sampling Time**	**Modbus Port**
1-2	Shaft Encoder1	M	00:01:00	00:00:12	**COM 3 9600,8N1**
3-4	Shaft Encoder2	M	00:01:00	00:00:12	
5-6	Battery Voltage	V	00:01:00	00:00:12	
7-8	Logger Temperature	C	00:01:00	00:00:12	
9-10	Watchdog Counter	cnts	00:01:00	00:00:12	

Station Name: Saunders TW

Saunders TW 9210 Modbus Port Settings

Modbus Address	**2**
9210 COM Port	**3 (RS-232)**
Baud Rate /Data Format	**9600,8N1**

SMP Modbus Register Map (32 bit Floating Point)	**Sensor**	**Units**	**Sampling Interval**	**Sampling Time**	**Modbus Port**
1-2	Shaft Encoder1	M	00:01:00	00:00:12	**COM 3 9600,8N1**
3-4	Shaft Encoder2	M	00:01:00	00:00:12	
5-6	Battery Voltage	V	00:01:00	00:00:12	
7-8	Logger Temperature	C	00:01:00	00:00:12	
9-10	Watchdog Counter	cnts	00:01:00	00:00:12	

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Station Name: Saunders International TW

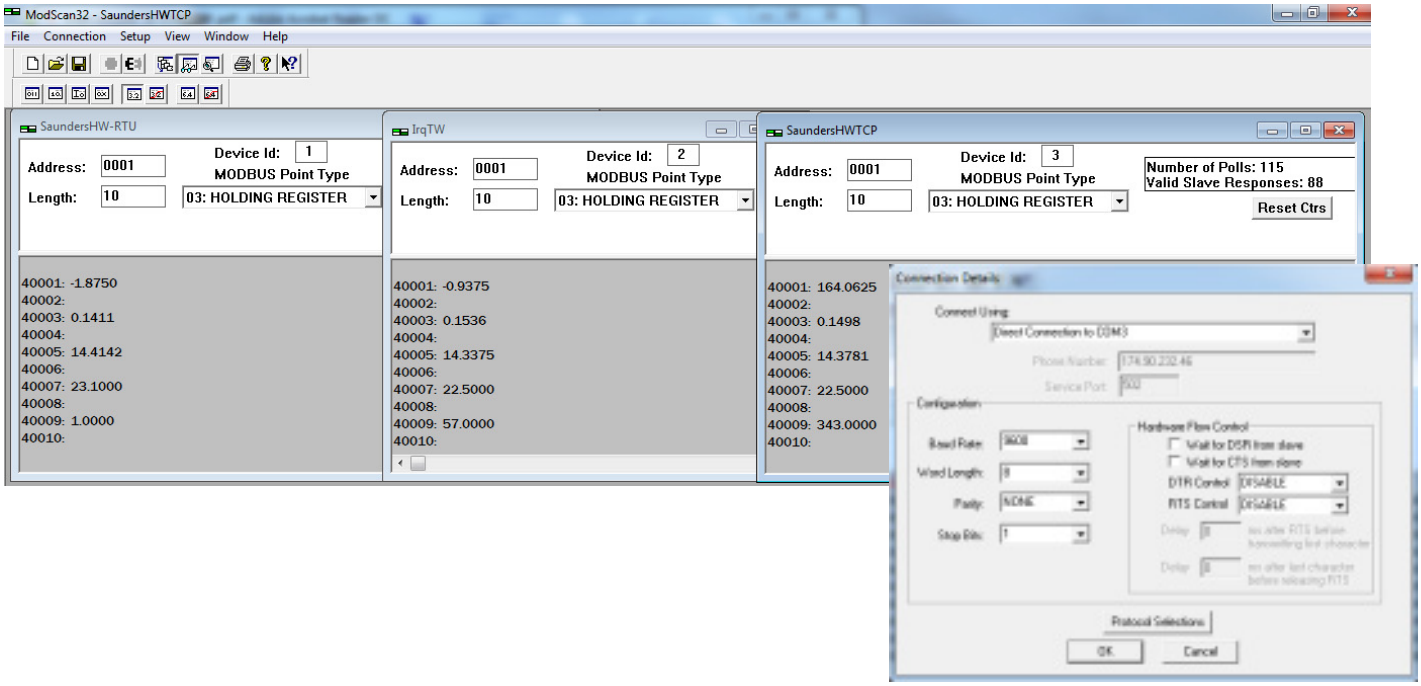
Saunders HW 9210 Modbus Port Settings

Modbus Address	**3**
9210 COM Port	**3 (RS-232)**
Baud Rate /Data Format	**9600,8N1**

SMP Modbus Register Map (32 bit Floating Point)	**Sensor**	**Units**	**Sampling Interval**	**Sampling Time**	**Modbus Port**
1-2	Shaft Encoder1	M	00:01:00	00:00:12	**COM 3 9600,8N1**
3-4	Shaft Encoder2	M	00:01:00	00:00:12	
5-6	Battery Voltage	V	00:01:00	00:00:12	
7-8	Logger Temperature	C	00:01:00	00:00:12	
9-10	Watchdog Counter	cnts	00:01:00	00:00:12	

SMP Gateway Modscan Modbus Simulator Screen

(Showing Saunders RS-485 Communications Site data as per previous tables)



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SMP Gateway Sutron Panel Commissioning Guide

Connect AC Power Line

- Open Fuse Terminals L(120VAC), MOD+, ELPRO+ and 9210+
- Open Disconnect terminals ETH+ and PWR
- Connect 120VAC power as per wiring chart (Licensed Electrician reruired)
- Close terminal L(120VAC)
- Wait for the Green LED on the power supply to come on.

Connect Cellular and Elpro Radio Antenna and GPS Antenna

- Connect ELPRO radio Yagi antenna & connect to enclosure bulkhead connector.
- Connect Cellular omni antenna & connect to enclosure bulkhead connector.
- Connect GPS Antenna to enclosure terminals as per wiring chart

Start Datalogger and Sensors

- Close disconnect terminal PWR to enable 12V power to panel .
- Close Fuse terminal 9210+ & datalogger powers ON
- Close Fuse terminal ELPRO+ & Elpro radio modem powers ON
- Close Fuse terminal MOD+ & Cellular Modem powers ON
- Close disconnect terminal ETH+ and Ethernet switch powers ON

Confirm System Operation

- Open Xterm software and connect serial cable to 9210 datalogger
- Confirm operation of logger and sensors
- Verify sensor readings
- Verify that logs in datalogger. Ensure data match remote stations
- Confirm modbus output data to DCS System

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SMP Gateway Sensor and Power Connections

AC Input Power

Wire Color	Description	Terminal
White	AC N	N
Black	AC L	L
Green	GND	Earth Ground Terminal

GARMIN GPS 19X Connection

Wire Color	Description	Terminal
Red	12V	12V
Grey	Tx	TX
White	Rx	RX
Black+Orange+White/Orange	GND	GND

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Section 2

Ontario Power Generation

Saunders Remote Sites:

Kingston
Cardinal
Morrisburg
Iroquois TW
Iroquois HW

Station Documentation

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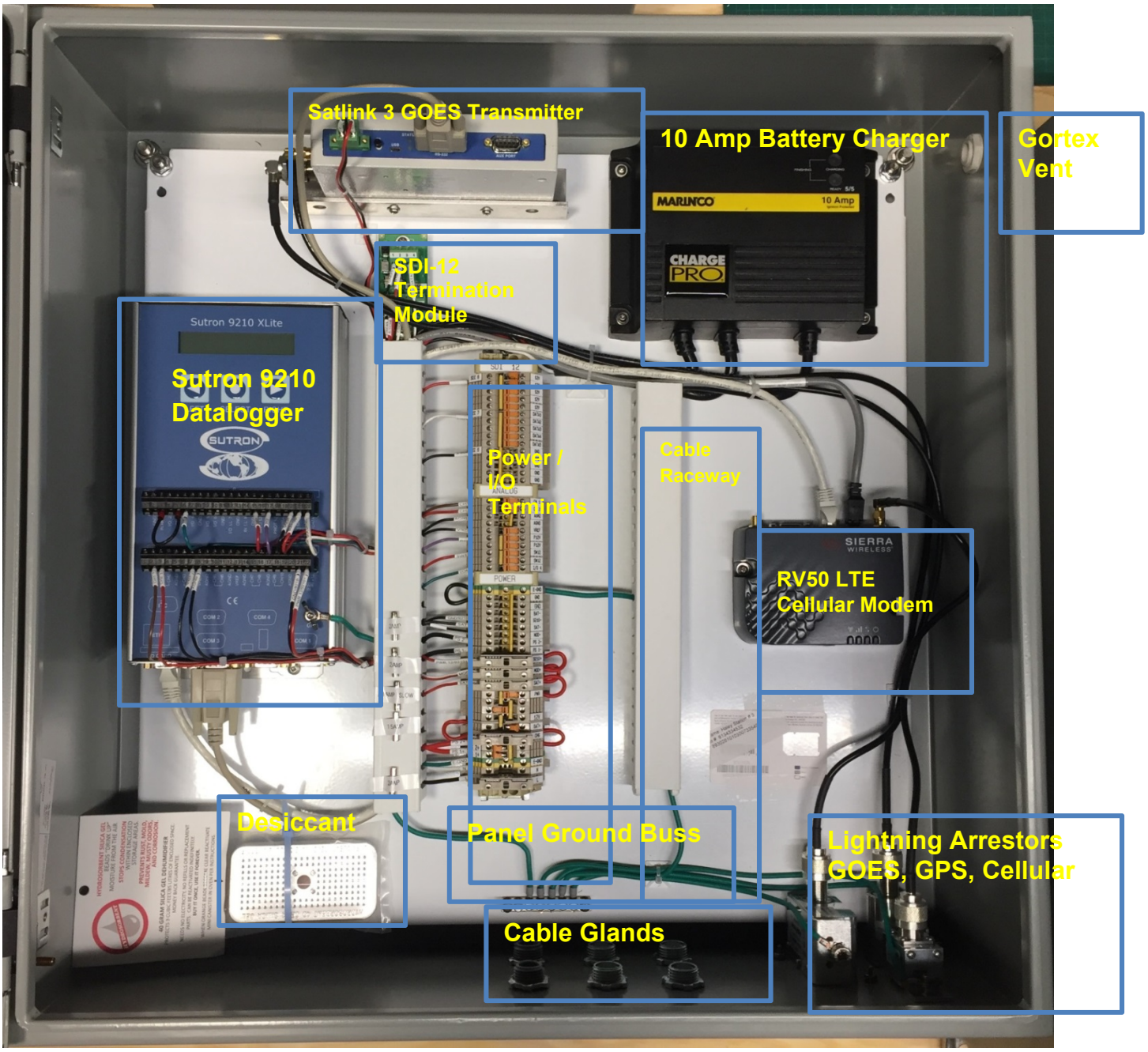
Ontario Power Generation Saunders Remote Station Configuration

Kington, Cardinal, Morrisburg, Iroquois TW, Iroquois HW



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Saunders Remote Sites

Marinco 10 Amp Battery Charger for 120 Ahr. AGM Batteries

Battery Charger is CSA approved and -40C Operating Temperature

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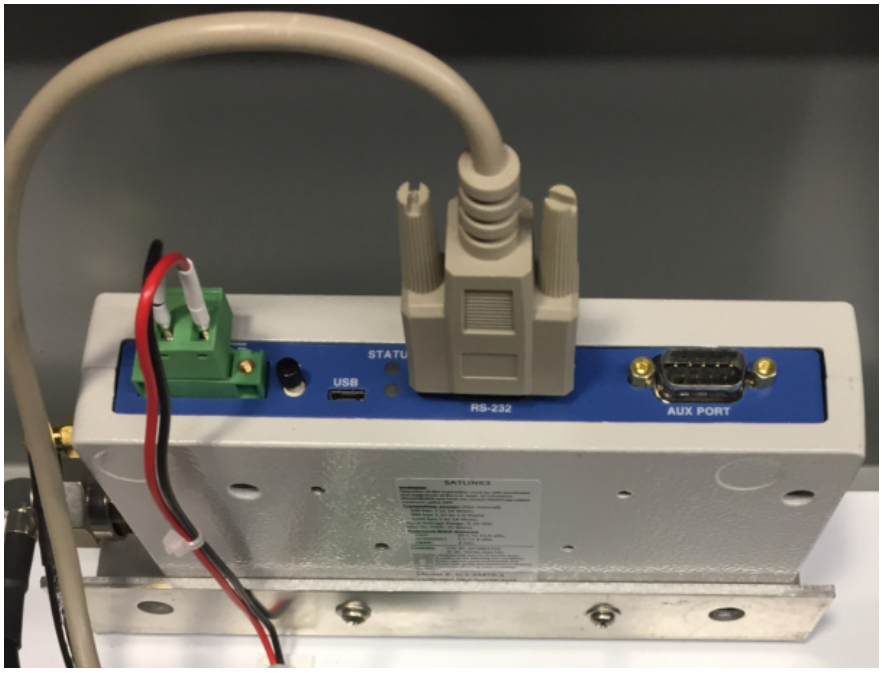
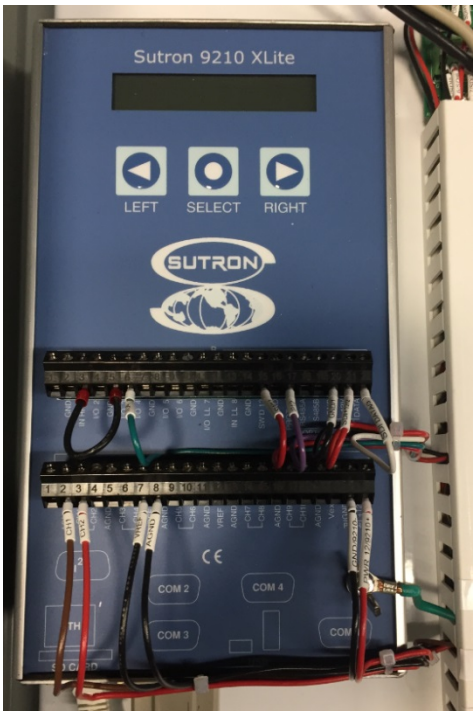
Saunders Remote Sites Sutron GOES Satlink 3 Transmitter

Note serial cable from COM 2 on 9210 datalogger



Sutron Xlite 9210 Datalogger with Panel Wiring for Power and I/O



Sierra Wireless RV50 LTE Cellular Modem

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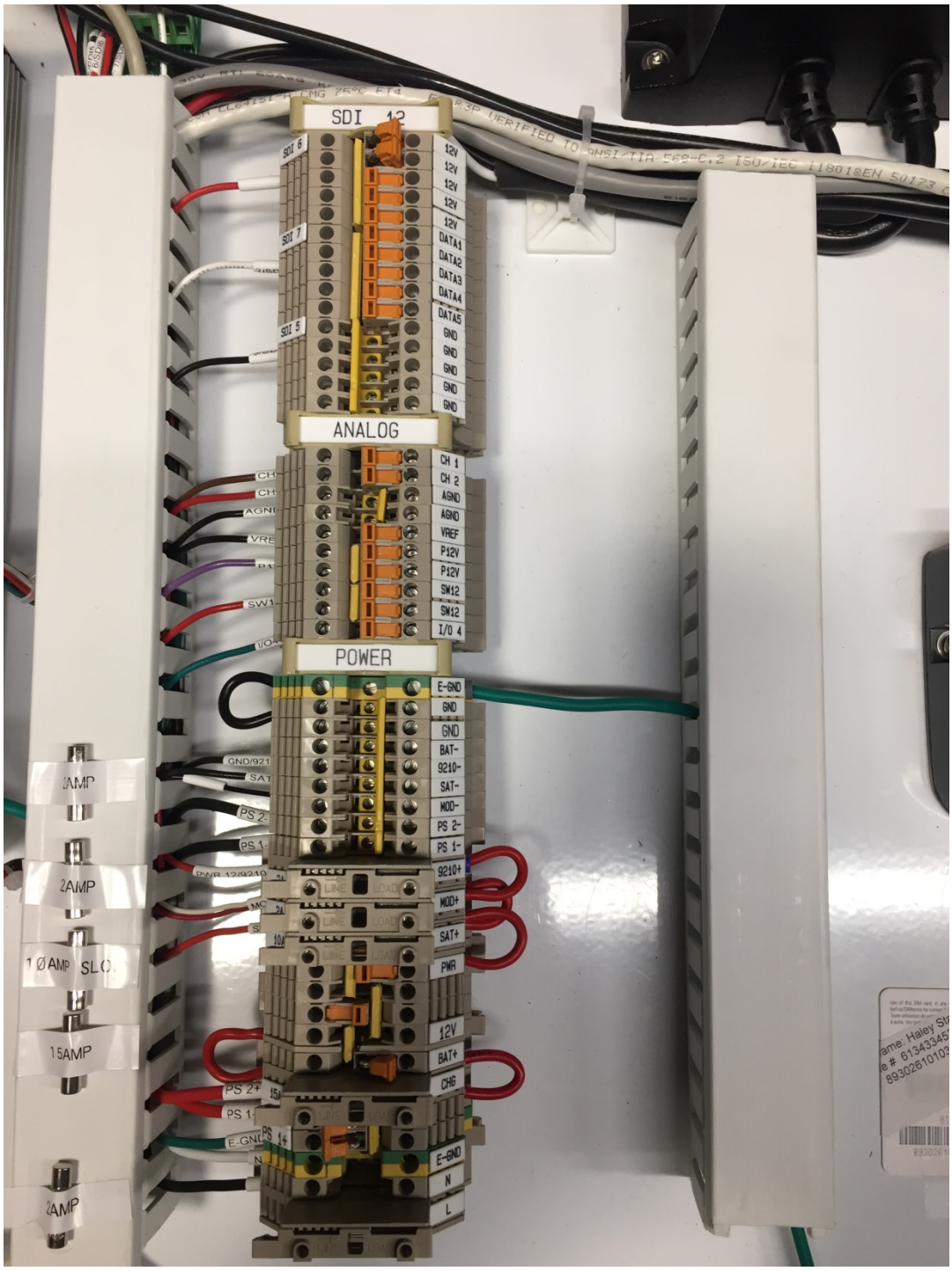
Saunders Remote Sites Weidmuller Power and I/O Terminals



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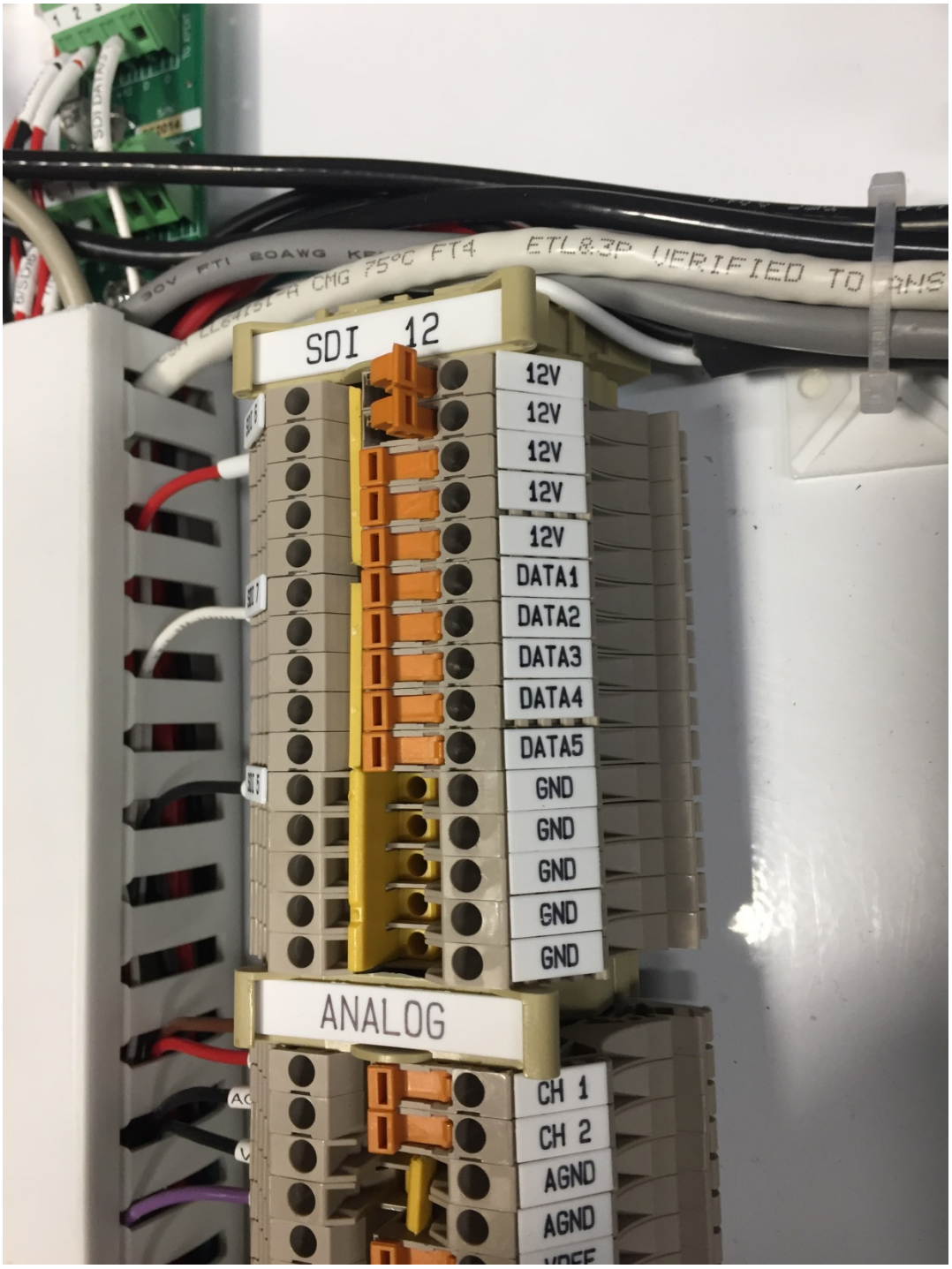
Saunders Remote Sites SDI-12 Terminal Connections



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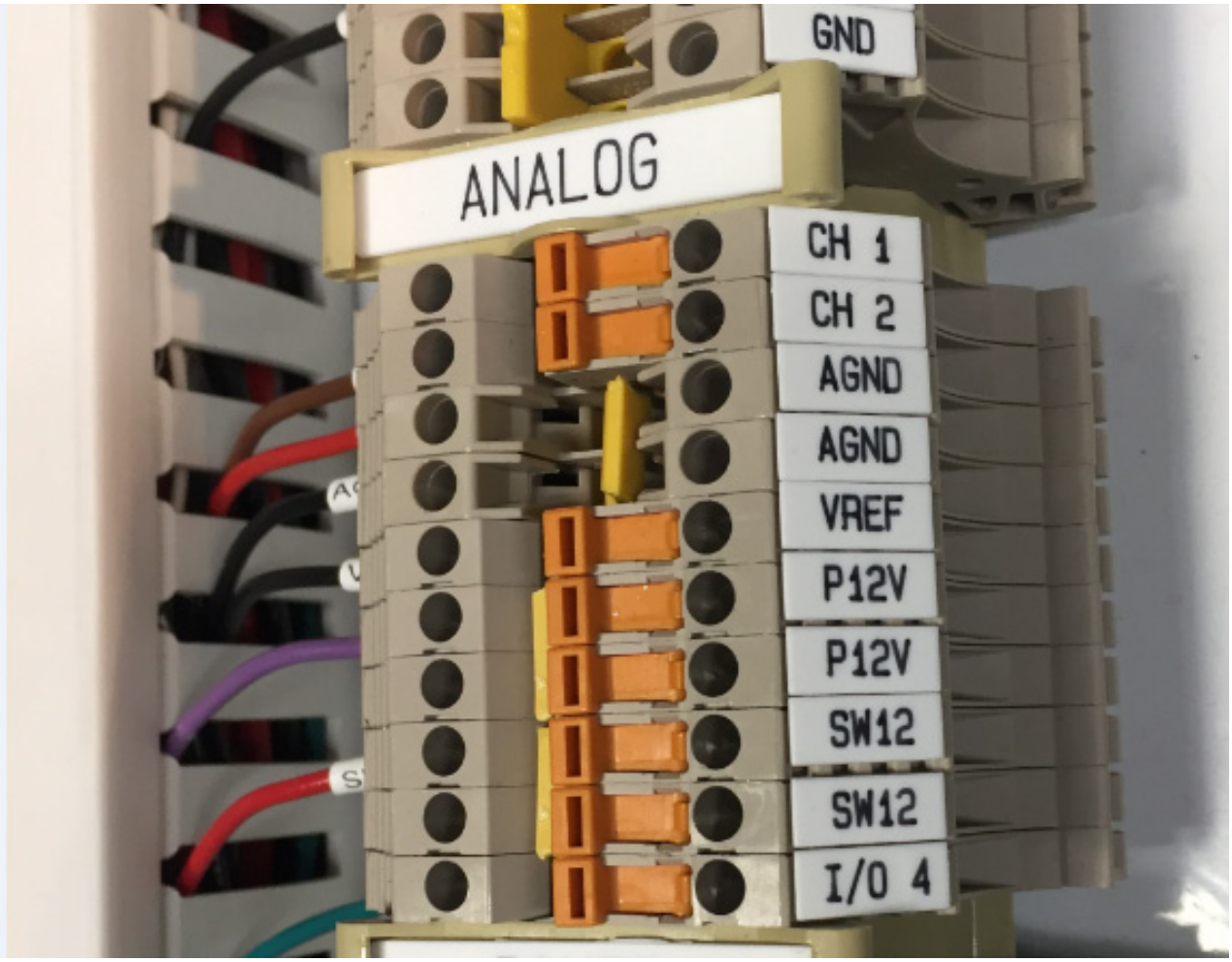
Saunders Remote Sites Analog and Sensor Power Terminal Connections



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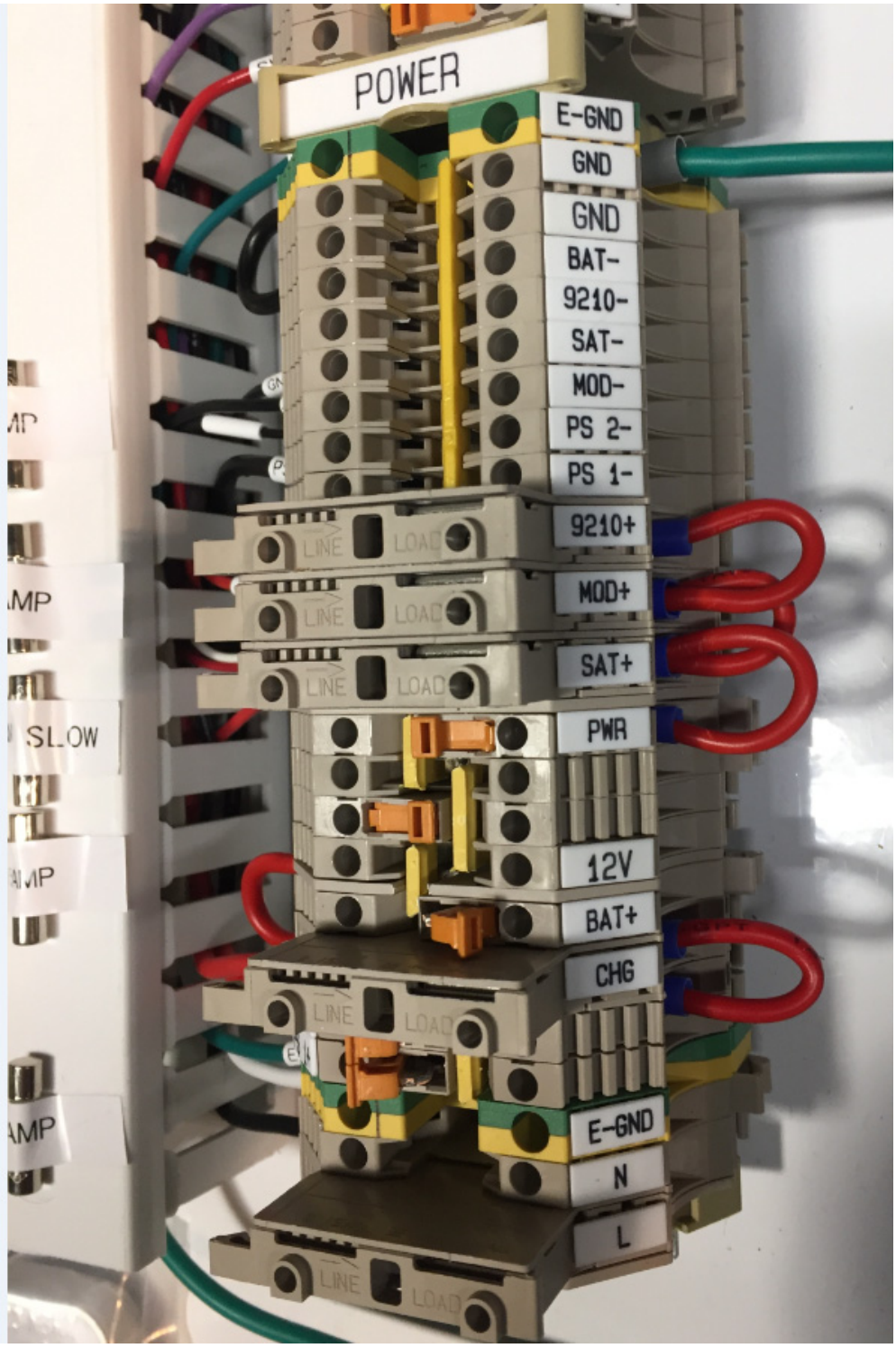
Saunders Remote Sites Power Terminal Connections

Battery, AC power, battery charger, power switches for modems and datalogger, spare fuses



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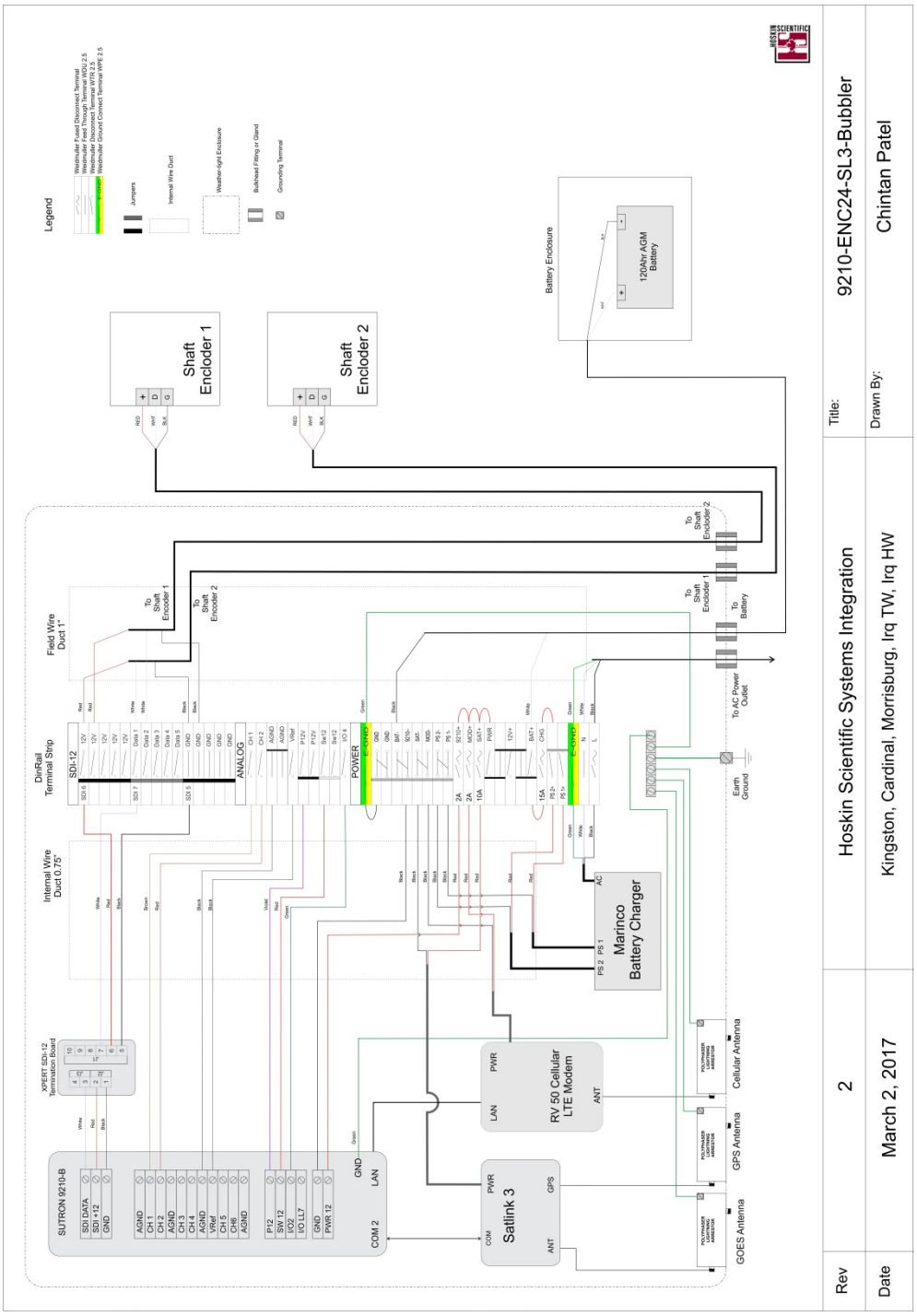
Saunders Remote Sites Enclosure Outside View

Spare plugs, Liquid tight conduit connectors, antenna coaxial connectors and earth ground

Saunders Remote Sites Panel Schematic



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Saunders Remote Datalogging Parameters

Station Name: Kingston

Sensor	Parameters	SDI Address/ parameters	Right Digits	Units	Sampling Interval	Sampling Time	Modbus Registers	GOES ID	GOES Transmits Time/ Interval	Static IP Address
Shaft Encoder1	SE1	0/C4	4	M	00:01:00	00:00:12	1-2			
Shaft Encoder2	SE2	1/C4	4	M	00:01:00	00:00:12	3-4			
Battery Voltage	BatVolt	-	2	V	00:01:00	00:00:12	5-6			
Logger Temperature	LT	-	2	C	00:01:00	00:00:12	7-8			
Watchdog Counter	Counter	-	0	cnts	00:01:00	00:00:12	9-10			

Station Name: Cardinal

Sensor	Parameters	SDI Address/ parameters	Right Digits	Units	Sampling Interval	Sampling Time	Modbus Registers	GOES ID	GOES Transmits Time/ Interval	Static IP Address
Shaft Encoder1	SE1	0/C4	4	M	00:01:00	00:00:12	1-2			
Shaft Encoder2	SE2	1/C4	4	M	00:01:00	00:00:12	3-4			
Battery Voltage	BatVolt	-	2	V	00:01:00	00:00:12	5-6			
Logger Temperature	LT	-	2	C	00:01:00	00:00:12	7-8			
Watchdog Counter	Counter	-	0	cnts	00:01:00	00:00:12	9-10			

Station Name: Morrisburg

Sensor	Parameters	SDI Address/ parameters	Right Digits	Units	Sampling Interval	Sampling Time	Modbus Registers	GOES ID	GOES Transmits Time/ Interval	Static IP Address
Shaft Encoder1	SE1	0/C4	4	M	00:01:00	00:00:12	1-2			
Shaft Encoder2	SE2	1/C4	4	M	00:01:00	00:00:12	3-4			
Battery Voltage	BatVolt	-	2	V	00:01:00	00:00:12	5-6			
Logger Temperature	LT	-	2	C	00:01:00	00:00:12	7-8			
Watchdog Counter	Counter	-	0	cnts	00:01:00	00:00:12	9-10			

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Station Name: Iroquois TW

Sensor	Parameters	SDI Address/ parameters	Right Digits	Units	Sampling Interval	Sampling Time	Modbus Registers	GOES ID	GOES Transmits Time/ Interval	Static IP Address
Shaft Encoder1	SE1	0/C4	4	M	00:01:00	00:00:12	1-2			
Shaft Encoder2	SE2	1/C4	4	M	00:01:00	00:00:12	3-4			
Battery Voltage	BatVolt	-	2	V	00:01:00	00:00:12	5-6			
Logger Temperature	LT	-	2	C	00:01:00	00:00:12	7-8			
Watchdog Counter	Counter	-	0	cnts	00:01:00	00:00:12	9-10			

Station Name: Iroquois HW

Sensor	Parameters	SDI Address/ parameters	Right Digits	Units	Sampling Interval	Sampling Time	Modbus Registers	GOES ID	GOES Transmits Time/ Interval	Static IP Address
Shaft Encoder1	SE1	0/C4	4	M	00:01:00	00:00:12	1-2			
Shaft Encoder2	SE2	1/C4	4	M	00:01:00	00:00:12	3-4			
Battery Voltage	BatVolt	-	2	V	00:01:00	00:00:12	5-6			
Logger Temperature	LT	-	2	C	00:01:00	00:00:12	7-8			
Watchdog Counter	Counter	-	0	cnts	00:01:00	00:00:12	9-10			

Station Name: Saunders Canal

Sensor	Parameters	SDI Address/ parameters	Right Digits	Units	Sampling Interval	Sampling Time	Modbus Registers	GOES ID	GOES Transmits Time/ Interval	Static IP Address
Bubbler 1	BUB1	0/C4	4	M	00:01:00	00:00:12	1-2			
Bubbler 2	BUB2	1/C4	4	M	00:01:00	00:00:12	3-4			
Battery Voltage	BatVolt	-	2	V	00:01:00	00:00:12	5-6			
Logger Temperature	LT	-	2	C	00:01:00	00:00:12	7-8			
Watchdog Counter	Counter	-	0	cnts	00:01:00	00:00:12	9-10			

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Kingston, Cardinal, Morrisburg, Irq TW, Irq HW Station Commissioning Guide

Connect AC Power Line

- Open Fuse Terminals L(120VAC), CHG, SAT+, MOD+ and 9210+
- Open Disconnect terminals BAT+ and PWR
- Connect 120VAC power as per wiring chart (Licensed Electrician reruired)
- Close terminal L(120VAC)
- Wait for the Green LED on the power supply to come on.

Connect Battery and Start Charging system

- Make sure battery terminal BAT+ open.
- Connect Battery+ ---->BAT+
- Connect Battery- ---->BAT-
- Close terminal switch BAT+
- Measure Battery voltage between BAT+ & BAT- Battery Volt.....V
- Battery should be 12V to 14V.
- Now close fuse terminal CHG to enable charging system
- Wait for the Red LED on charger to come on which indicates battery is charging
- Measure Battery Voltage again it should be increasing slowly increasing.

Connect Cellular, GOES Antenna and GPS Antenna

- Connect Cellular Omni antenna and connect to enclosure bulkhead connector as per tag.
- Connect GOES YAGI antenna and connect to enclosure bukhead connector as per tag.
- Connect GPS Bullet antenna and connect to enclosure bukhead connector as per tag.
- Wrap antenna connection with electrical tape.

Connect Shaft Encloders

- Connect encoder to enclosure terminals as per wiring chart and sensor wire tags.
- Make sure cable glands are secure and tight. LTC gland should be secure with conduit putty.

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Start Datalogger, Cellular Modem and Satlink

- Close disconnect terminal PWR to enable 12V power to panel .
- Close Fuse terminal 9210+ & datalogger powers ON.
- Close Fuse terminal MOD+ & Modem powers ON.
- Close Fuse terminal SAT+ & Satlink power ON.

Confirm Datalogger Operation

- Open Xterm software and connect serial cable to 9210 datalgoger
- Confirm operation of logger and sensors
- Confirm GOES setting E.g. Satellite ID, TX time and Interval
- Verify sensor readings
- Verify that logs in datalogger. Ensure data matches with Master Station.
- Confirm GOES data on GOES decoder.

HOSKIN SCIENTIFIC

Section 3

Ontario Power Generation

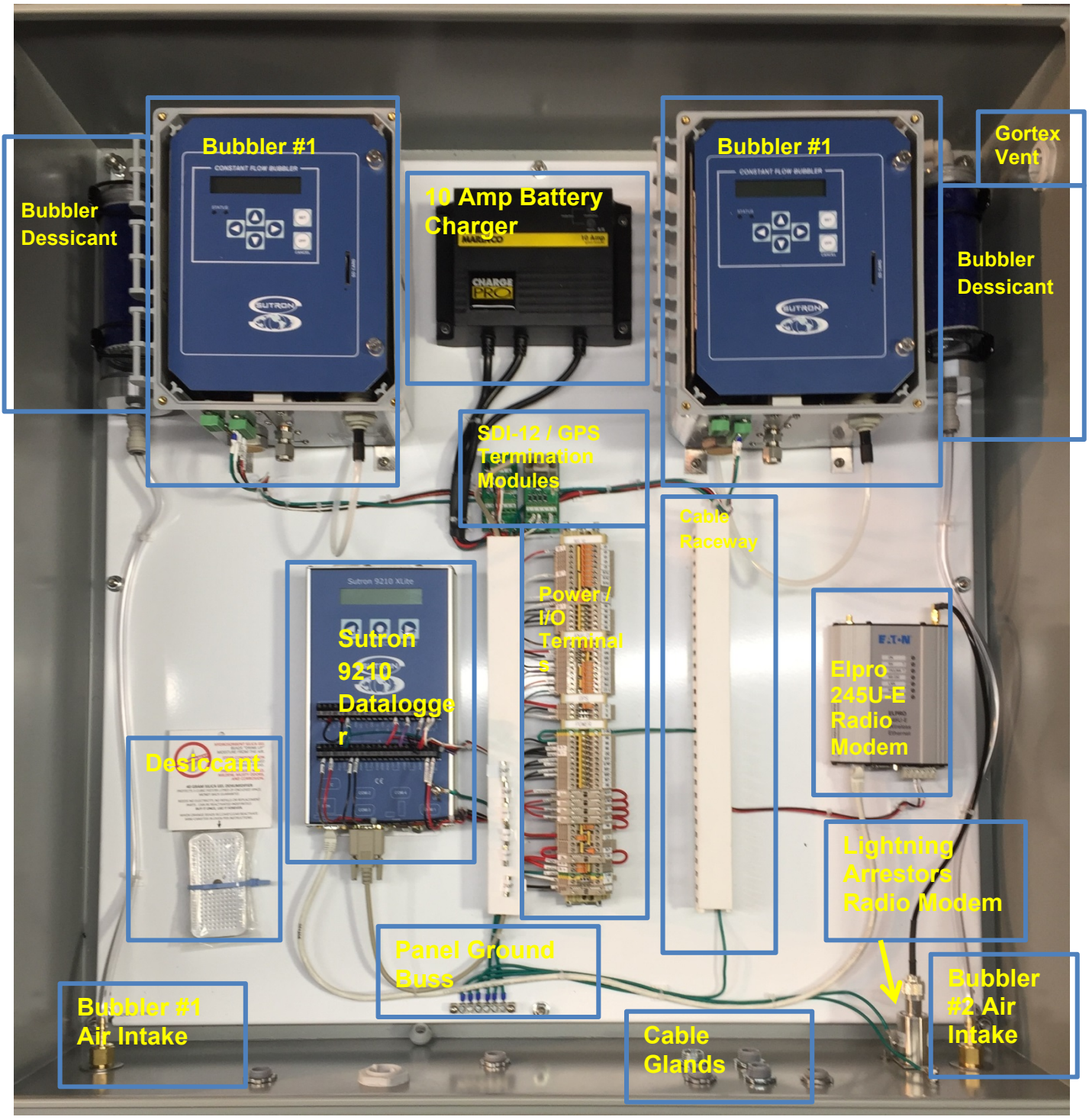
Saunders Remote Site:

Saunders Canal

Station Documentation

HOSKIN SCIENTIFIC

Saunders Canal Dual Bubbler Enclosure Outside View

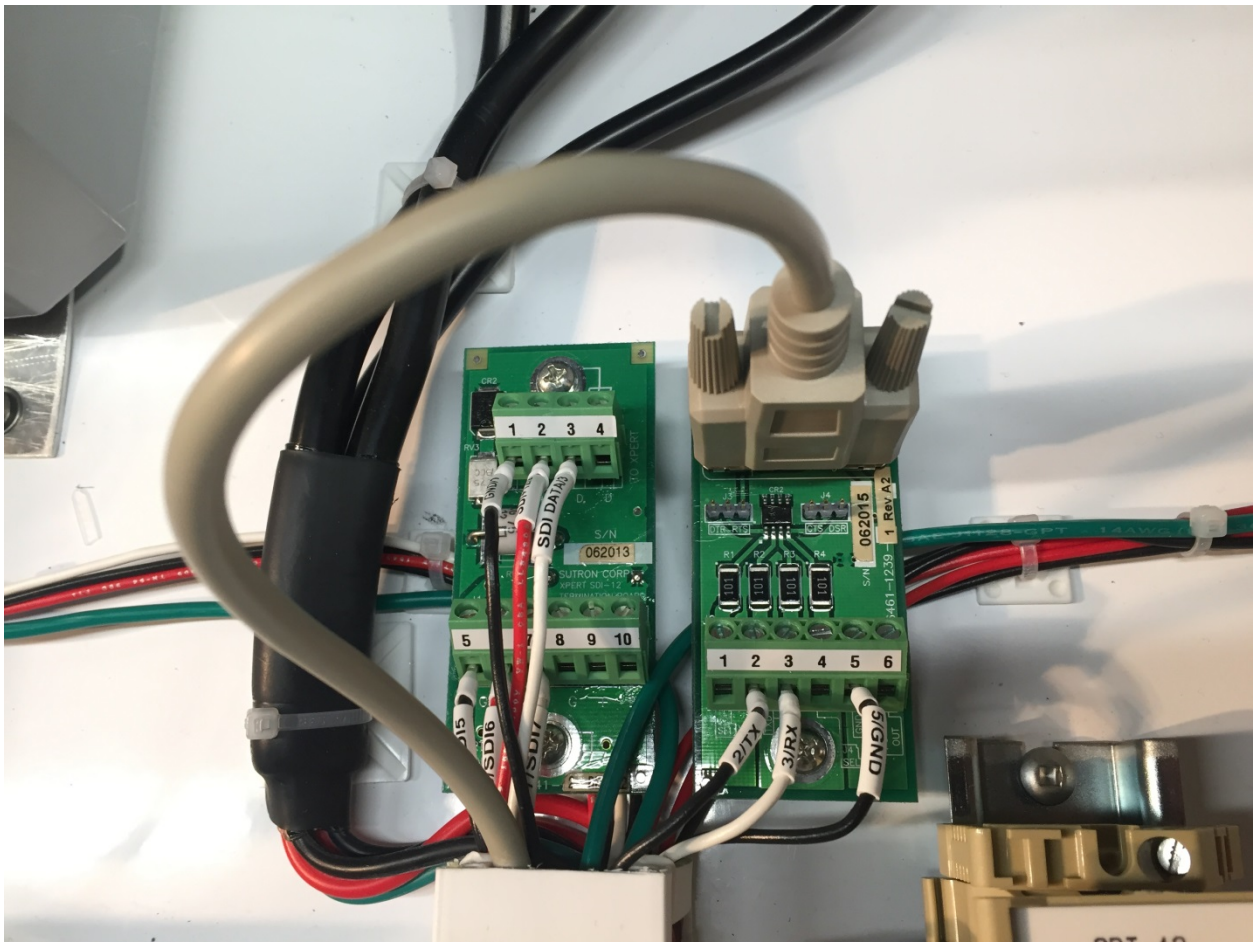


HOSKIN SCIENTIFIC

Saunders Canal Bubbler Showing Power Connections and Desiccant

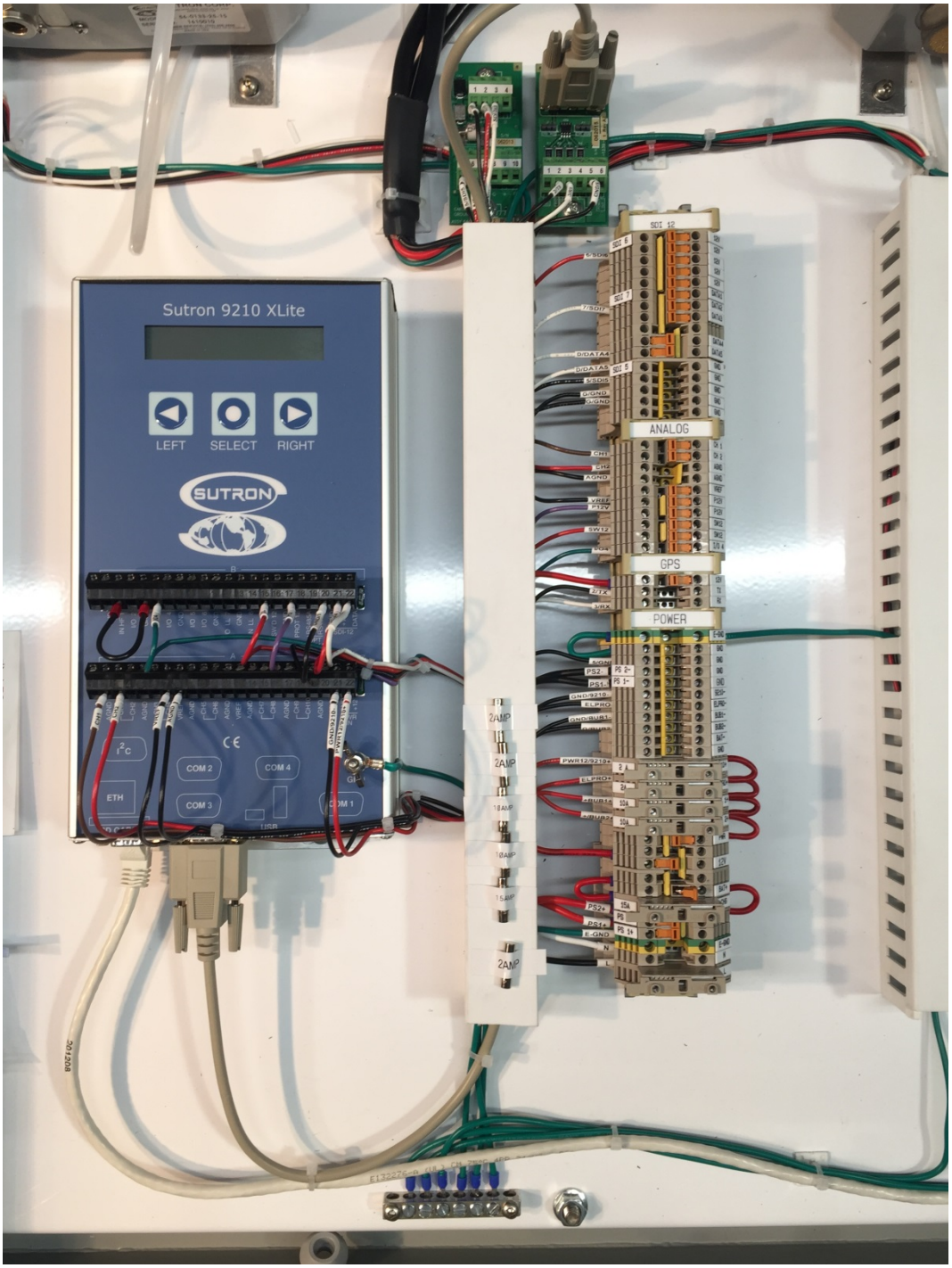
HOSKIN SCIENTIFIC

Saunders Canal SDI-12 (sensors) and GPS RS-232 Termination Modules



HOSKIN SCIENTIFIC

Saunders Canal Sutron 9210 Datalogger with Weidmuller Power and I/O Terminals



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Saunders Canal SDI-12 and Analog Panel Terminals

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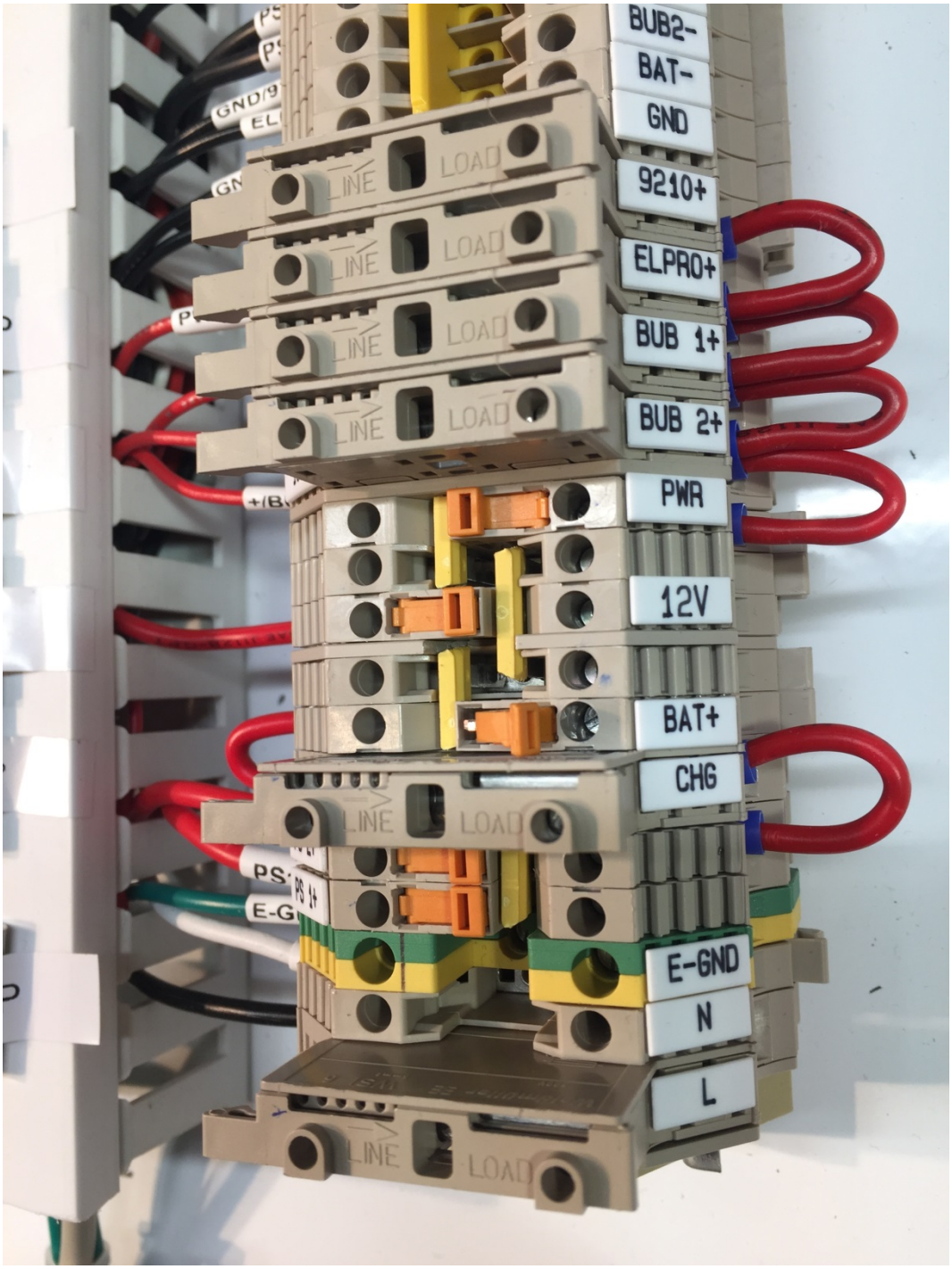
SCIENTIFIC

Saunders Canal Power and Dual Bubbler Fused Terminals



Saunders Canal Enclosure Bottom View

(showing bubbler venting, power, antenna and ground connections)

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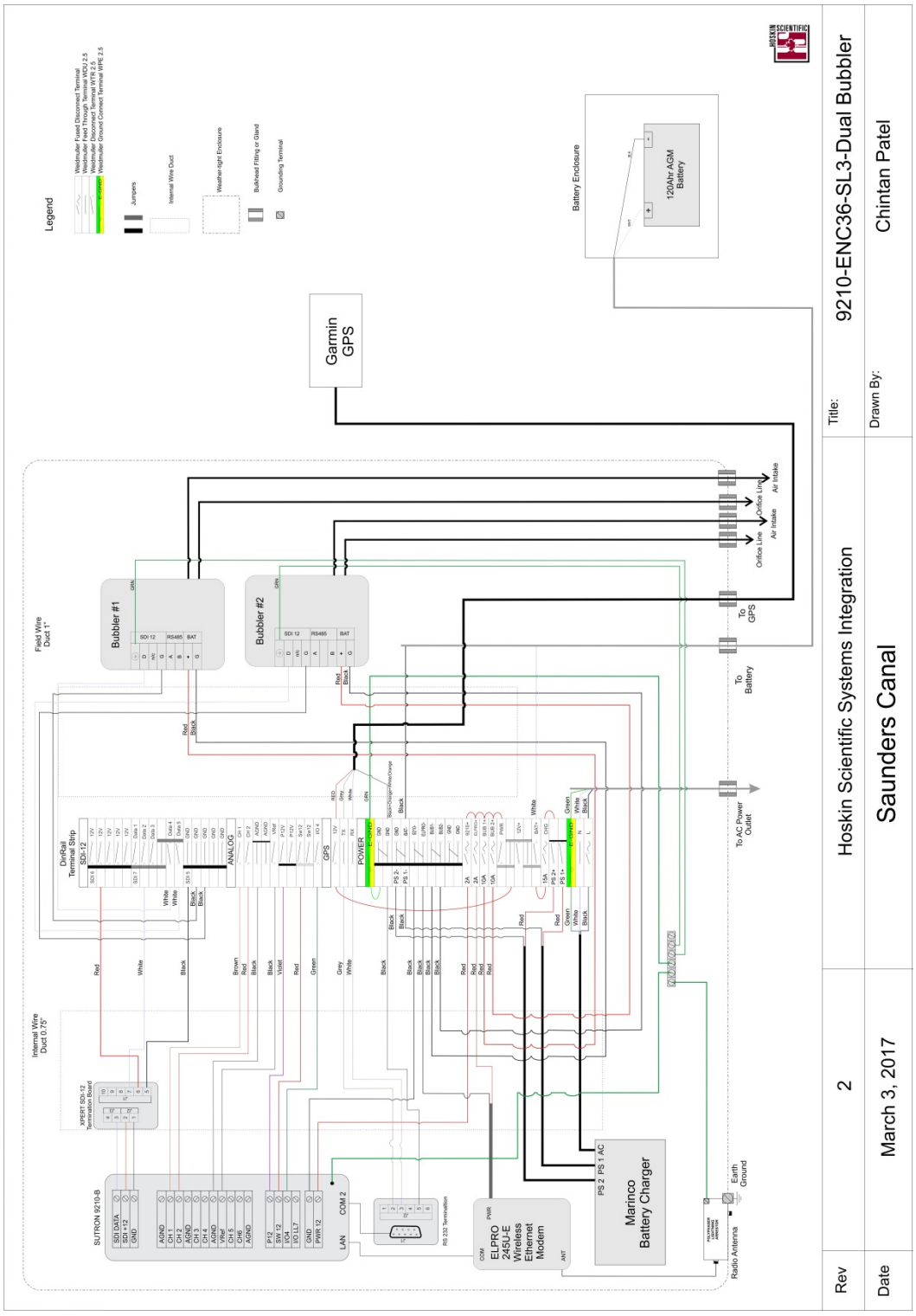
Saunders Canal Panel Schematic



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Saunders Canal Dual Bubbler System Commissioning Guide

Start Datalogger and Sensors

- Close disconnect terminal PWR to enable 12V power to panel .
- Close Fuse terminal 9210+ & datalogger powers ON

Connect Battery and Start Charging system

- Make sure battery terminal BAT+ open.
- Connect Battery+ ---->BAT+
- Connect Battery- ---->BAT-
- Close terminal switch BAT+
- Measure Battery voltage between BAT+ & BAT- Battery Volt.....V
- Battery should be 12V to 14V.
- Now close fuse terminal CHG to enable charging system
- Wait for the Red LED on charger to come on which indicates battery is charging
- Measure Battery Voltage again it should be increasing slowly increasing.

Connect Elpro Radio Antenna and GPS Antenna

- Connect ELPRO radio Yagi antenna & connect to enclosure bulkhead connector.
- Connect GPS Antenna to enclosure terminals as per wiring chart

Install Orifice Line

- Install Orifice line through the enclosure gland and connect to bubbler
- Make sure fitting is tight

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Start Datalogger and Sensors

- Close disconnect terminal PWR to enable 12V power to panel .
- Close Fuse terminal 9210+ & datalogger powers ON
- Close Fuse terminal ELPRO+ & Elpro radio modem powers ON
- Close Fuse terminal BUB1+ & Bubbler 1 powers ON
- Close Fuse terminal BUB2+ & Bubbler 2 powers ON

Confirm System Operation

- Open Xterm software and connect serial cable to 9210 datalgoger
- Confirm operation of logger and sensors
- Verify sensor readings
- Verify that logs in datalogger. match the data on master station.

Sensor and Power Connection

AC Input Power

Wire Color	Description	Terminal
White	AC N	N
Black	AC L	L
Green	GND	Earth Ground Terminal

Battery Connections

Enclosure Terminals	Wire Color	Battery Terminal
BAT(+)	White	POS(+)
BAT(-)	Black	NEG (-)

GARMIN GPS 19X Connection

Wire Color	Description	Terminal
Red	12V	12V
Grey	Tx	TX
White	Rx	RX
Black+Orange+White/Orange	GND	GND

Section 4

Ontario Power Generation

Saunders Remote Sites:

Saunders HW
Saunders TW
Saunders International TW

Station Documentation

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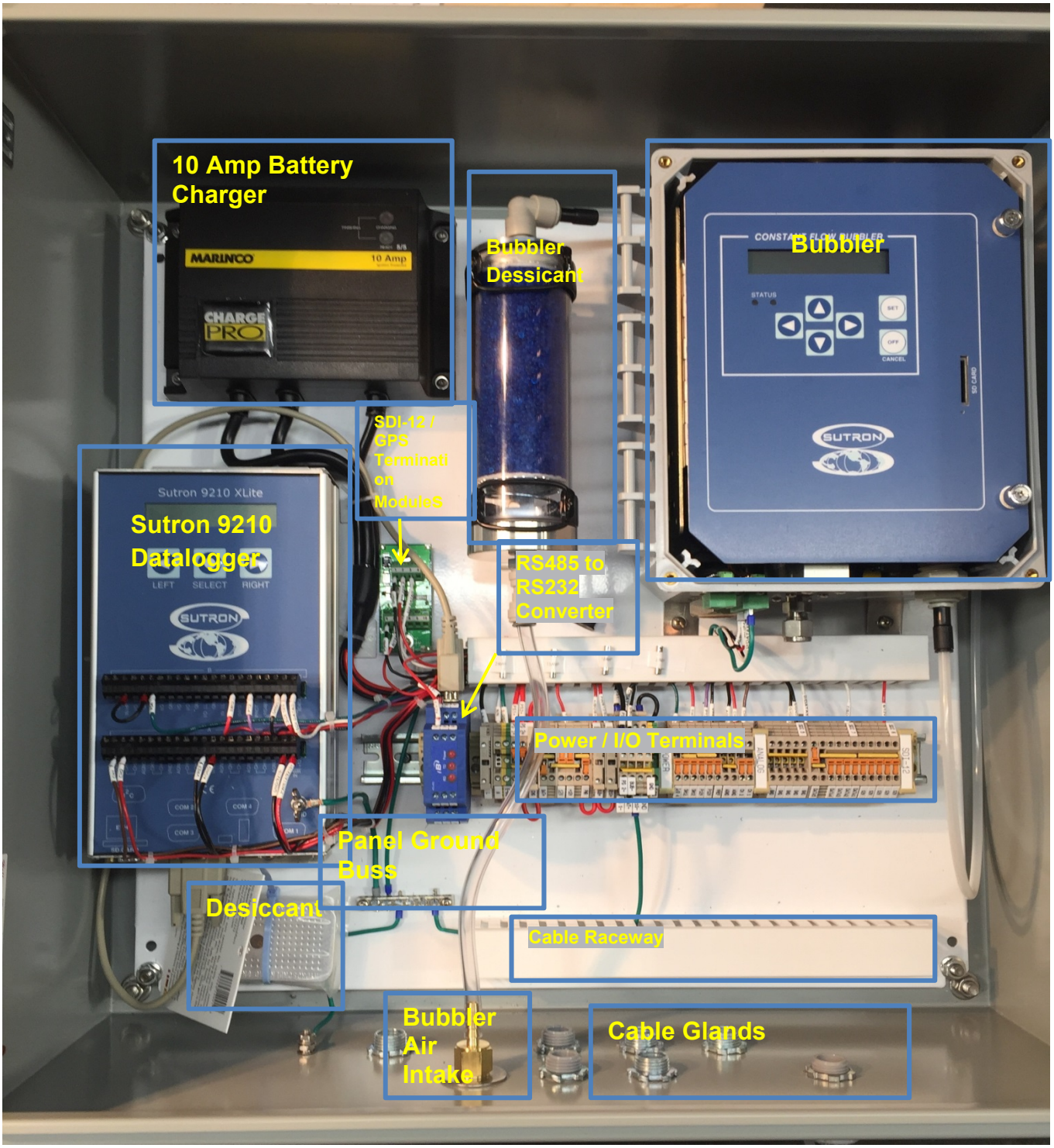
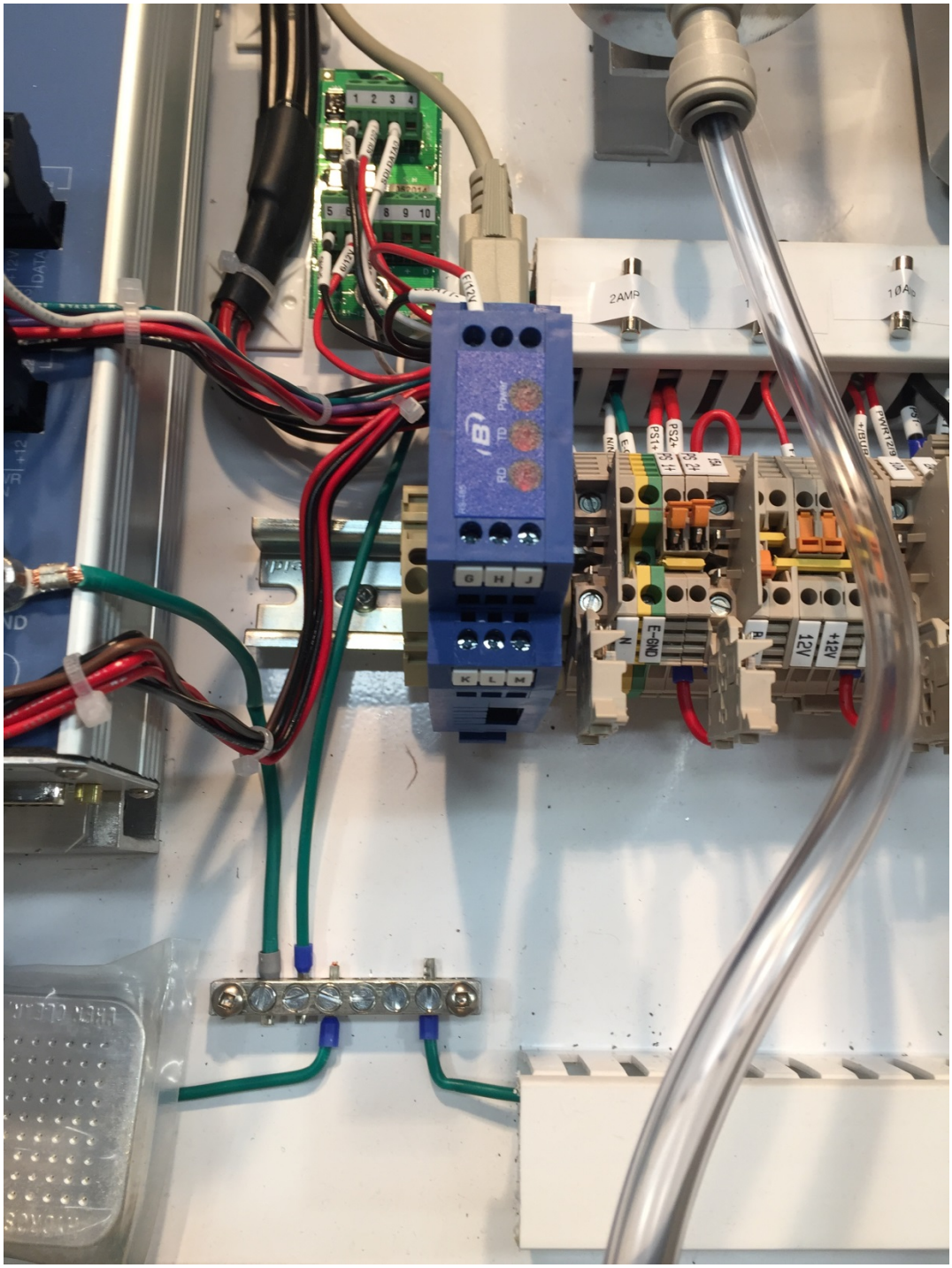
Saunders Remote Sites with Direct RS-485 Communications to SMP Gateway

Sites: Saunders HW, Saunders TW, Saunders International TW



HOSKIN SCIENTIFIC

Saunders Remote Sites with RS-485 / RS232 / RS422 Optically Isolated Converter



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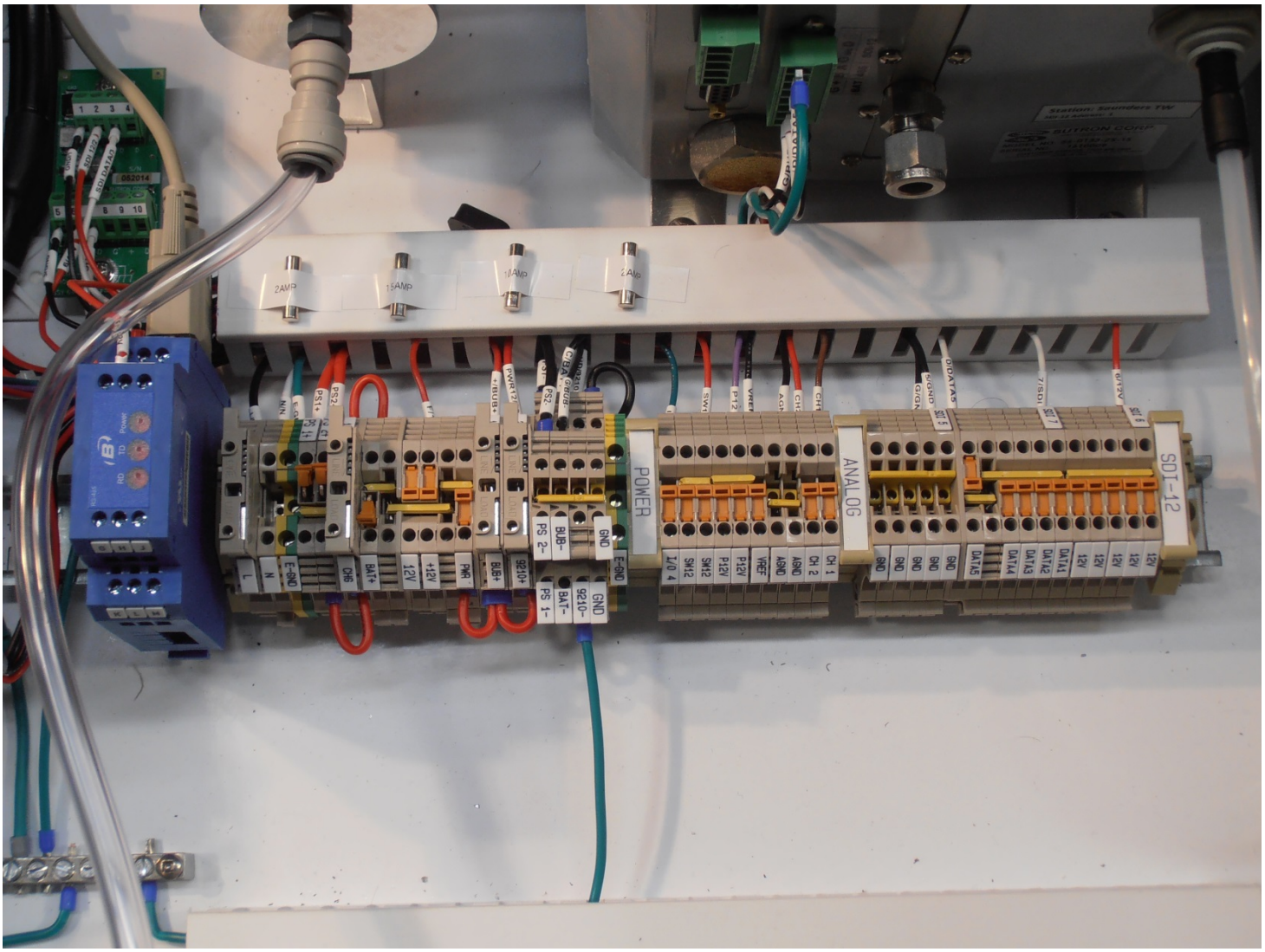
Saunders Remote Sites with Direct RS-485 Communication Panel Terminals



Garmin GPS Sensor for Saunders HW, TW, INT TW

The SMP 9210 datalogger clock is synchronized using a Garmin GPs sensor. This sensor has a RS-232/RS-422 output and is connected to COM 2 of the 9210 datalogger. The 9210 has a Basic program scheduled to run twice a day where the clock is automatically adjusted to GPS time. The local time offset is configured in the Basic file

garmingps_with_LTO.bas

GARMIN

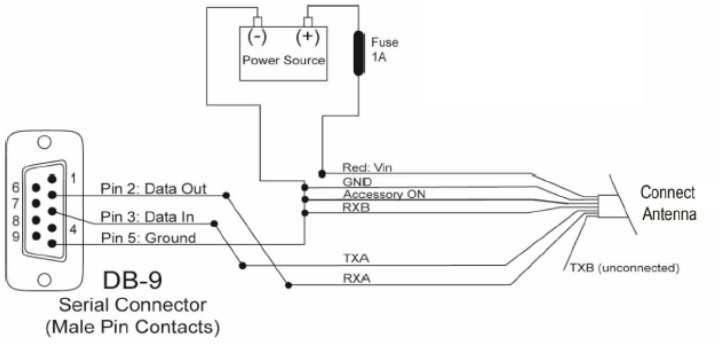
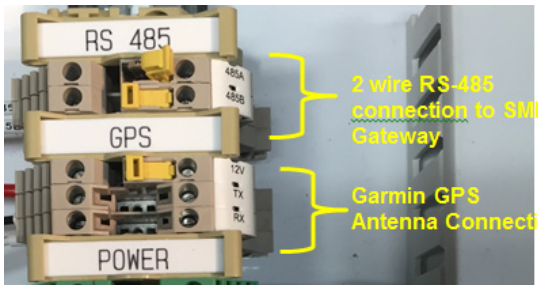


Figure 2. PDA Serial Port Interconnection

9210 Garmin Basic File (note Baud Rate , 38400, 8N1, Local Time Offset -5 Hours

```
' This subroutine can be scheduled to run
' periodically (e.g. every hour) to read the GPS
' and set the Xpert/9210 clock.
' The routine expects the GPS to be connected to COM2 and that the
' power pin is on DIO module 1, channel 4
' If those need changed, change in USER SET Constants
' Make sure to set the port power to +12Volts
' The routine expects the data in
' NEMA $GPGGA format (default for GRAMIN)
' For troubleshooting, statusmsg may be uncommented
'------- USER SET CONSTANTS -----
CONST GPSPort = "COM2:"
CONST GPSPwrMod = 1 ' DIO module
CONST GPSPwrCH = 4   ' DIO channel
LTOhr = -5 'Local Time Offset hours
LTOMin = 0 'Local Time Offset minutes
'------- GARMIN Constants -------
Const BAUD = 38400
Const NOPARITY = 0
Const NOHANDSHAKE = 0
Const GPSTimeout = 900 'Timeout in seconds to get a valid GPS signal
'--------------------------------
```



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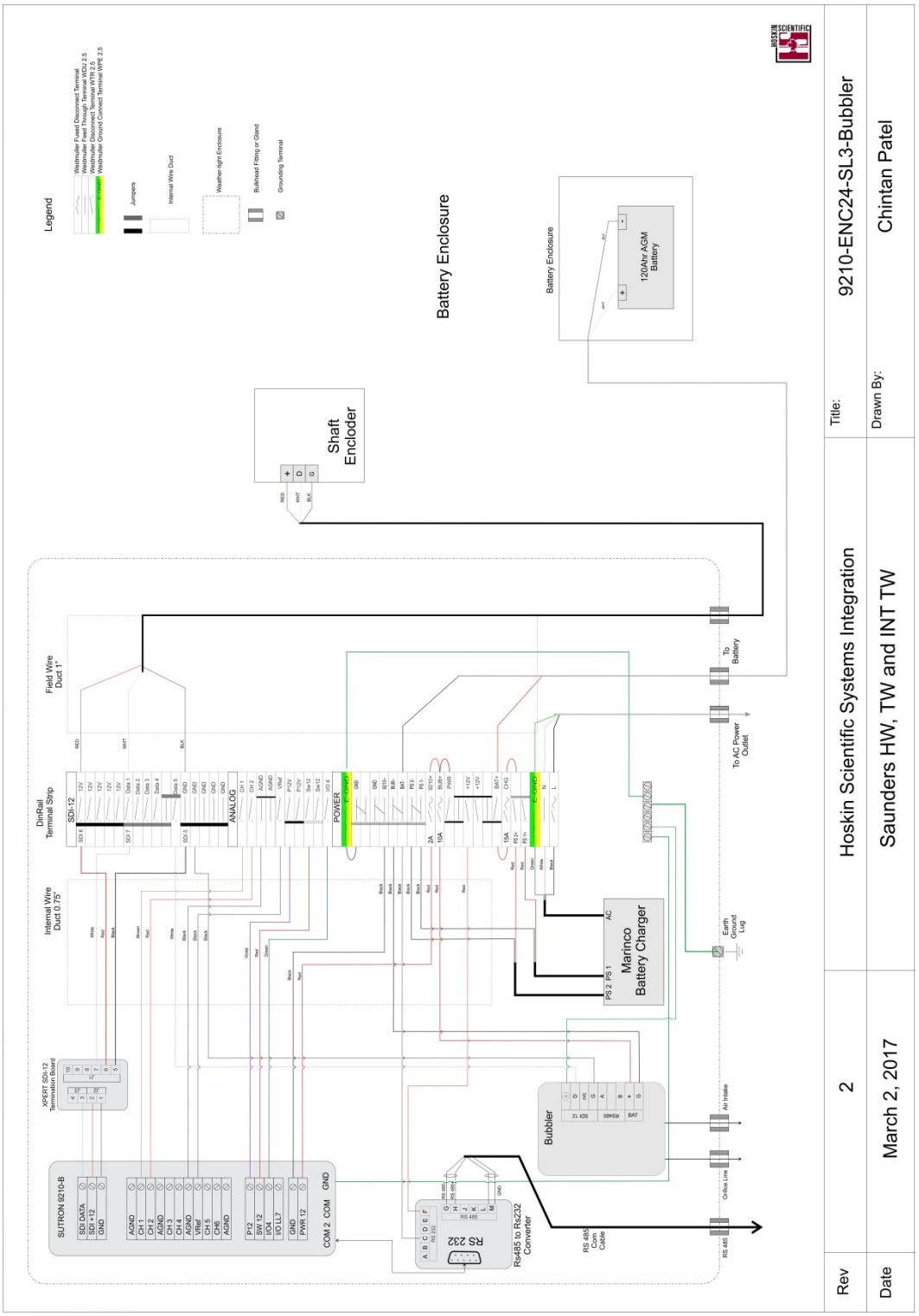
Schematic for Saunders HW, TW, INT, TW



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Saunders HW, TW and Int TW Station Commissioning Guide

Connect AC Power Line

- Open Fuse Terminals L(120VAC), CHG, BUB+ and 9210+
- Open Disconnect terminals BAT+ and PWR
- Connect 120VAC power as per wiring chart (Licensed Electrician reruired)
- Close terminal L(120VAC)
- Wait for the Green LED on the power supply to come on.

Connect Battery and Start Charging system

- Make sure battery terminal BAT+ open.
- Connect Battery+ ---->BAT+
- Connect Battery- ---->BAT-
- Close terminal switch BAT+
- Measure Battery voltage between BAT+ & BAT- Battery Volt.....V
- Battery should be 12V to 14V.
- Now close fuse terminal CHG to enable charging system
- Wait for the Red LED on charger to come on which indicates battery is charging
- Measure Battery Voltage again it should be increasing slowly increasing.

Connect Shaft Encloder and RS485 Cable

- Connect encoder to enclosure terminals as per wiring chart and sensor wire tags.
- Connect RS485 data cable to RS485 to RS232 Converter as per wiring chart.
- Make sure cable glands are secure and tight. LTC gland should be secure with conduit putty.

Install Orifice Line

- Install Orifice line through the enclosure gland and connect to bubbler
- Make sure fitting is tight and secure.

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Start Datalogger and Sensors

- Close disconnect terminal PWR to enable 12V power to panel.
- Close Fuse terminal 9210+ & datalogger powers ON
- Close Fuse terminal BUB+ & Bubbler powers ON

Confirm System Operation

- Open Xterm software and connect serial cable to 9210 datalgoger
- Confirm operation of logger and sensors
- Verify sensor readings
- Verify that logs in datalogger. match the data on master station.

Saunders HW, TW, INT TW Sensor and Power Connection

AC Input Power

Wire Color	Description	Terminal
White	AC N	N
Black	AC L	L
Green	GND	Earth Ground Terminal

Battery Connections

Enclosure Terminals	Wire Color	Battery Terminal
BAT(+)	White	POS(+)
BAT(-)	Black	NEG (-)

Shaft Encoder Connection

Enclosure Terminals	Description	Wire Tag
12V	SDI Power	12V
DATA1	SDI Data	DATA
GND	SDI Gnd	GND

RS485 Wiring

RS485 Module Terminals	Description
G	RS485-
H	RS485+
M	GND

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Section 5

Datalogger Software Documentation

Saunders Remote Sites:

Cellular Modem Communications

Kingston
Cardinal
Morrisburg
Iroquois TW
Iroquois HW

Radio Modem Communications

Saunders Canal

RS-485 Communications

Saunders HW
Saunders TW
Saunders Internation TW

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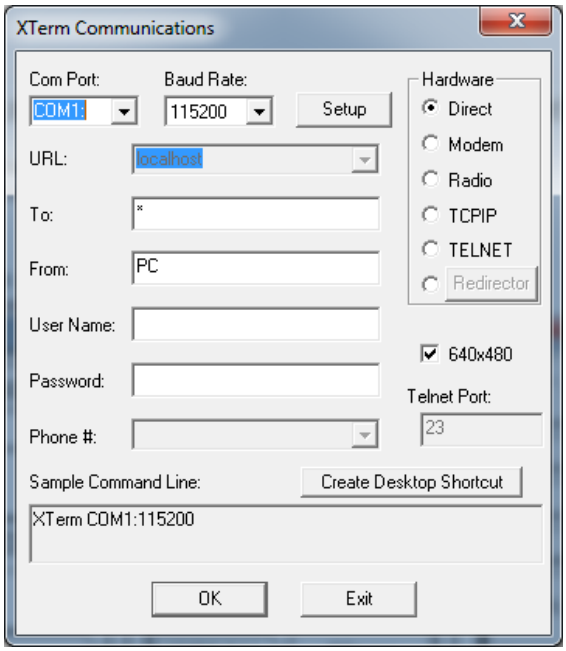
Sutron 9210 Xterm Datalogger Software

Overview

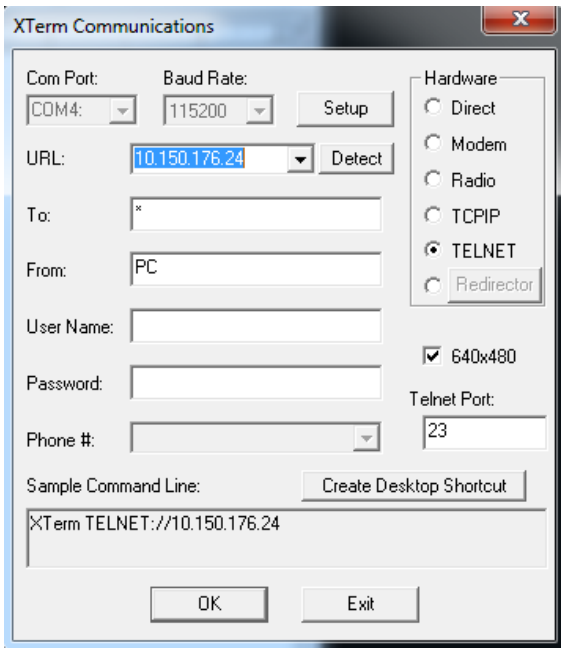
Sutron Xterm is a Windows software program which performs control and interface functions for the Sutron Xlite 9210 datalogger. A Windows PC can communicate to the 9210 datalogger using the computers serial or Ethernet ports.
www.sutron.com/documents/xterm-for-pc.exe (Software Download link).

Connecting Xterm through Direct Serial & LAN connections

Serial RS-232



Using DHCP or Static IP

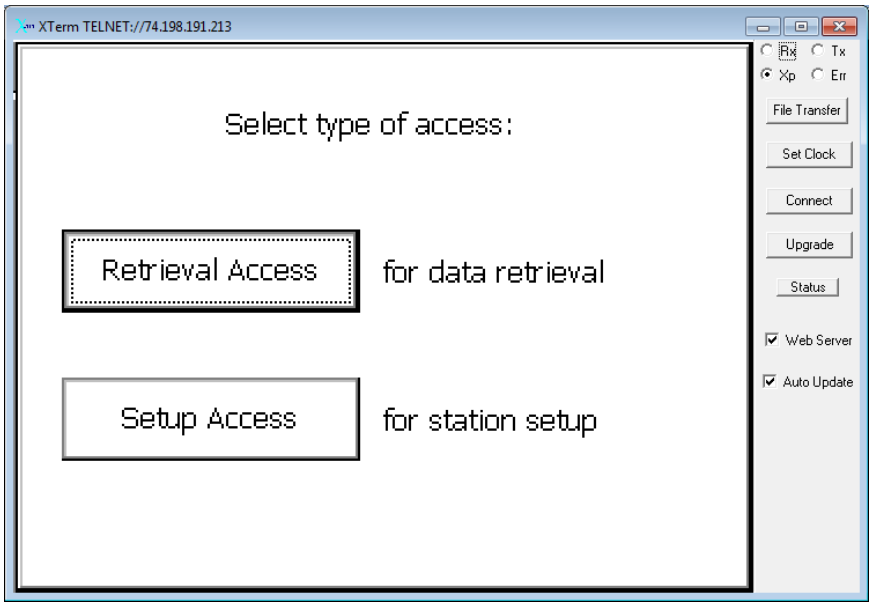


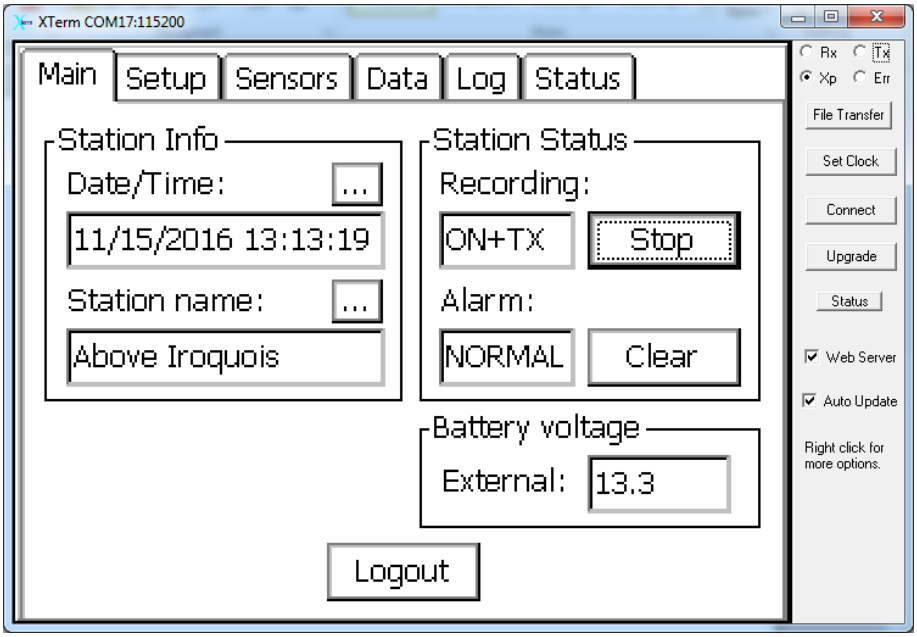
In the COM Port settings enter the computers active COM port and connect a straight through DB-9 Male to DB-9 female cable. If using Ethernet first enable the LAN connection in the 9210. If connecting the 9210 directly to the PC Ethernet port put a Static IP address in the 9210. If the 9210 is connected to a LAN then select DHCP in the LAN settings. Select detect in Xterm to determine the IP address. Enter the IP address and Telnet Port 23. If communicating with a cellular modem then enter the Static IP address of the Modem

Sutron 9210 Xlite Data Logger Software Configuration

A successful log on with Xterm takes you to the access page of the logger. Setup Access opens all available tabs. The following screen captures show the custom setup for OPG Saunders.

The Main tab lets to set up time and station information and status.





Note that the loggers Station name must match the setup file name in the logger's flash directory.

+TX indicates Satlink transmissions are enabled.

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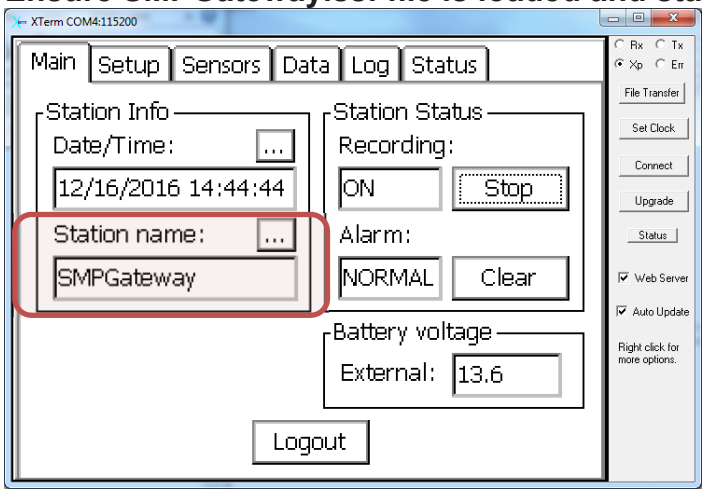
SMP Gateway 9210 Datalogger Configuration in Xterm

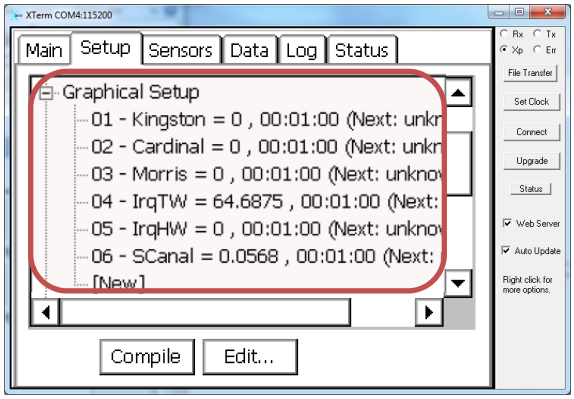
The following are Xterm screen captures for the SMP Gateway, 9210 datalogger. The SMP Gateway 9210 will poll sites: Kingston, Cardinal, Morrisburg, Iroquois TW, Iroquois HW, Saunders Canal. The Kingston configuration shown below is used as an example for all of the sites that have a RV50 cellular modem and Satlink.

Ensure SMPGateway.ssf file is loaded and station name is SMPGateway

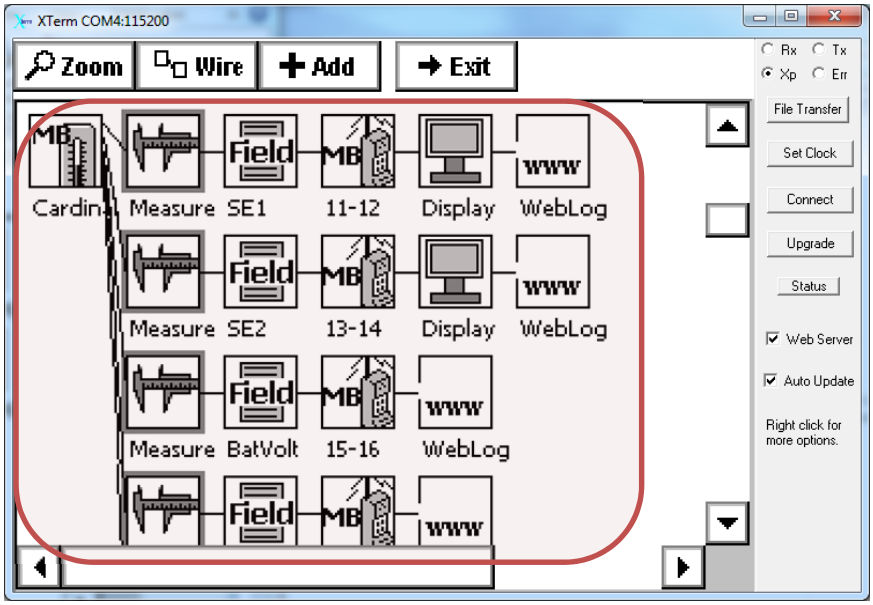


SMP 9210 Xterm Graphical Setup for Kingston: The graphical setup starts with a Modbus MB Block. This block has the IP address of the cellular modem that is connected to the Kingston 9210. Then on the schedule listed in the Measure Block the MB Modbus Master block will send a Modbus TCP Poll request to Kingston Modbus Slave. The Modbus registers will be associated with the sensors SE1 (Shaft Encoder 1), SE2 (Shaft Encoder 2), BatVolt(Battery Voltage), LogTemp(logger temperature), Counter. These values be logged to the 9210 memory using the LogField block then associated with a Modbus Tag in the SMP 9210. The SMP 9210 is a Modbus RTU Slave for the SMP Gateway.

SMP 9210 Graphical Setup Showing Remote Sites



Cardinal Graphical Setup in SMP 9210



Xterm Block	
MB Cardinal	Modbus TCP block with the Modem Static IP address used for polling Cardinal 9210 Modbus Slave at 1 Minute Intervals
Measure	Measure block sets the Modbus TCP Polling Interval of 1 Minute
Field SE1	LogField for Shaft Encoder #1 defines the 9210 datalog and data string
MB Tag 11-12	Modbus RTU Slave Block defines the Modbus register for Shaft Encoder #1. In this case Shaft Encoder #1 will be a floating point value registers 11-12. The SMP Gateway will then poll COM4 of the SMP 9210 to get these values
Display	Enables the SMP 9210 Display to display the SE1 values
WebLog	Puts the updated logged values into the 9210 web page for quick display

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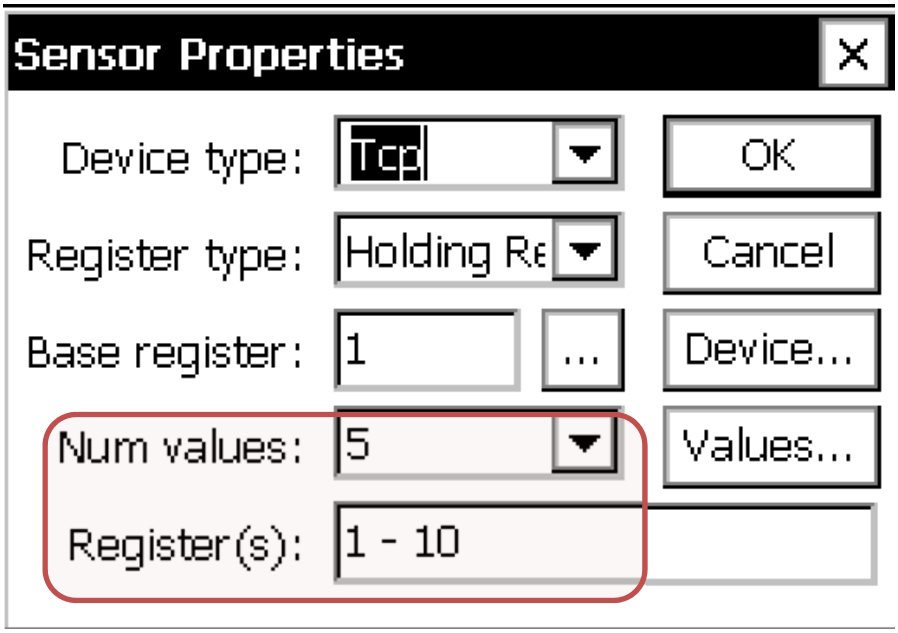
MB Block Properties

Note: 9210 will poll Qty 5 32 bit floating point values, registers 1-10

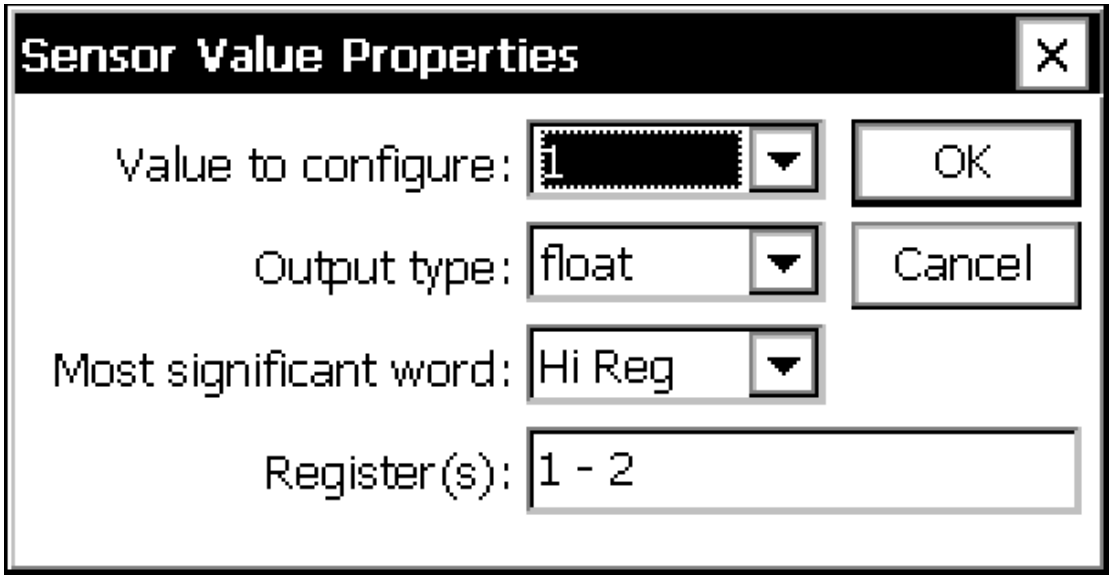


MB Block with Modem Static IP Address of Kingston and Modbus Port

Note: retries are set to 0 to reduce communication delays that could affect the other sites polling intervals

MB Tag Block Defines the Modbus RTU Register for Sensor SE1.

The SMP 9210 will be a Modbus Slave for the SMP Gateway. The SMP Gateway will poll Modbus Address 1 Register 1-2 for Shaft Encoder #1



SMP Gateway 9210 Modbus Port Settings

Modbus Address	**1**
9210 COM Port	**4 (RS-485)**
Baud Rate /Data Format	**9600,8N1**

Station Name: Kingston

SMP Modbus Register Map (32 bit Floating Point)	**Sensor**	**Units**	**Sampling Interval**	**Sampling Time**	**Static IP Address**
1-2	Shaft Encoder1	M	00:01:00	00:00:12	
3-4	Shaft Encoder2	M	00:01:00	00:00:12	
5-6	Battery Voltage	V	00:01:00	00:00:12	
7-8	Logger Temperature	C	00:01:00	00:00:12	
9-10	Watchdog Counter	cnts	00:01:00	00:00:12	

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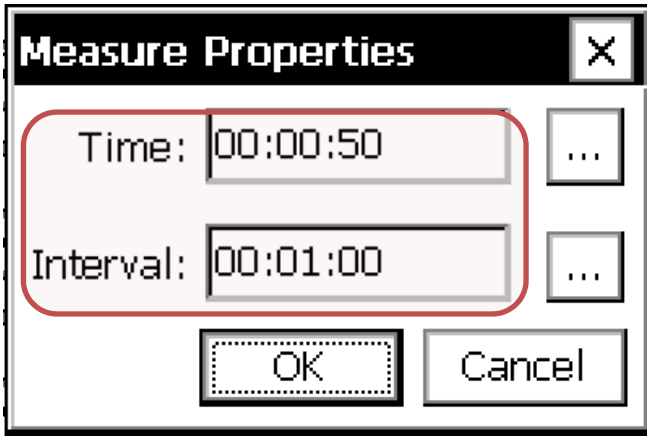
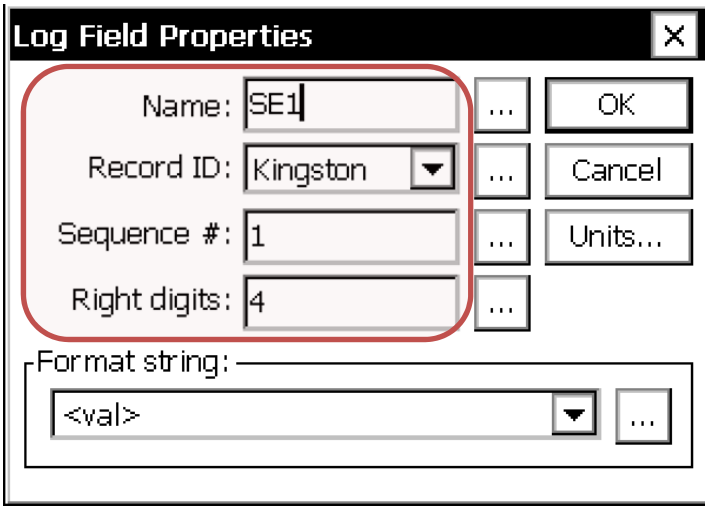
Measure Block Defines the Modbus TCP Polling and 9210 logging intervals

The shaft encoders at the remote sites measure once a minute and start the measurement sampling at 12 seconds after the top of the minute. The shaft encoders are programmed with a 30 second average. Once the measurement is started it will be ccomplete at 00:00:45 seconds as the measurement takes a total of 32 seconds. The SMP 9210 then wait an additional 5 seconds and at 00:00:50 it will send a Modbus poll request to the remote station. The SMP Gateway will then poll the SMP 9210 at the top of the minute to ensure that the latest data is being monitored.



Shaft Encoder #1 Log Field Block for Kingston

Ensures that Shaft encoder 1 is put into the 9210 log and the time stamp is tagged as Kingston. The Sequence of 1 defines that SE1 will be the first measurement in the Kingston data string



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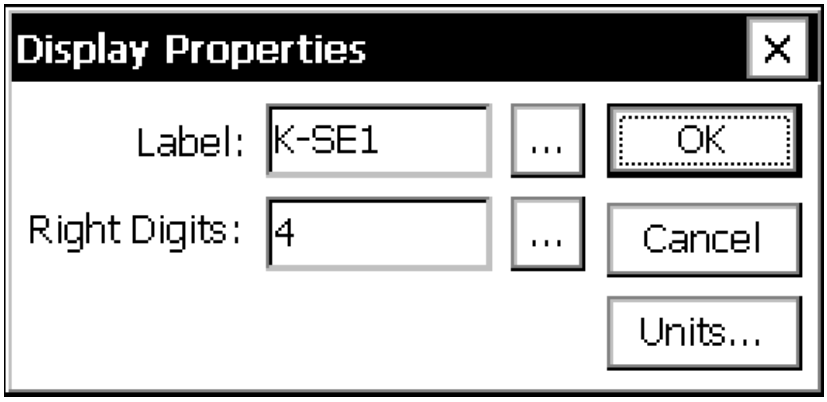
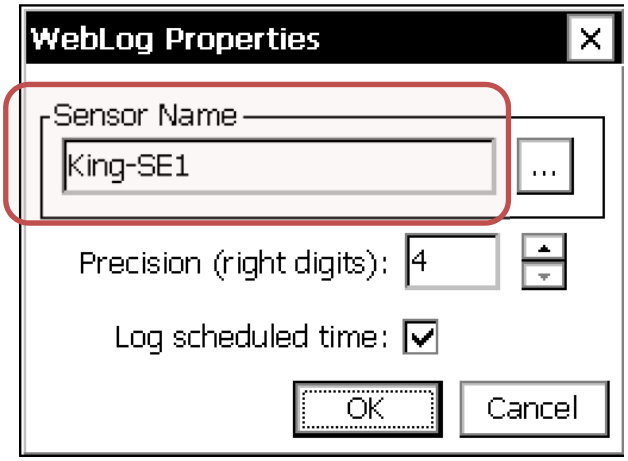
Display Block Properties for Kingston Shaft Encoder #1

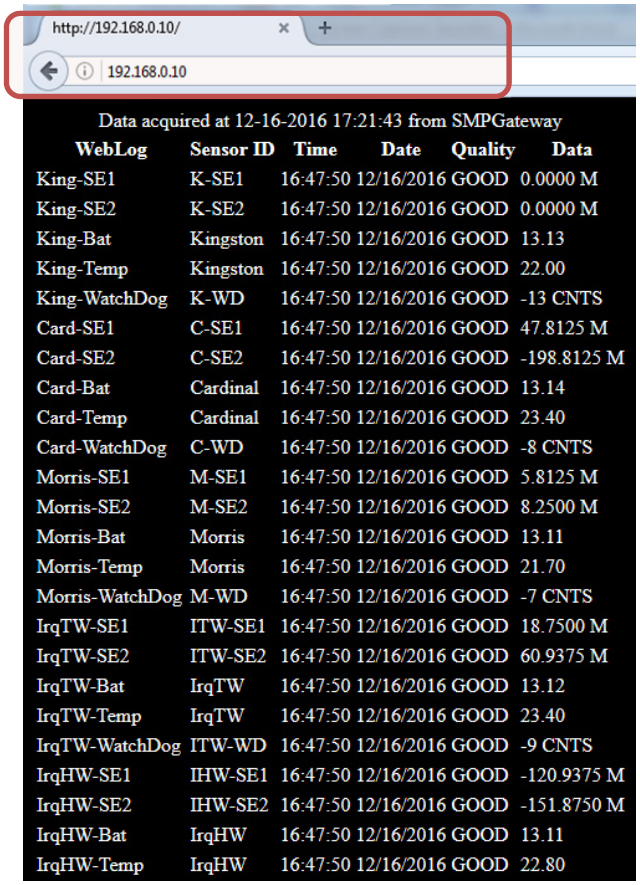
Defines how the sensors are displayed when the SMP 9210 center button on the display is pressed. In this example K-SEI is Kingston Shaft Encoder #1



Web Log block Properties

(Defines how the sensors are displayed on the 9210 web page. To view the web page just enter the static IP address of the SMP 9210 in the computers browser 192.168.0.10)





Data acquired at 12-16-2016 17:21:43 from SMPGateway

WebLog	Sensor ID	Time	Date	Quality	Data
King-SE1	K-SE1	16:47:50	12/16/2016	GOOD	0.0000 M
King-SE2	K-SE2	16:47:50	12/16/2016	GOOD	0.0000 M
King-Bat	Kingston	16:47:50	12/16/2016	GOOD	13.13
King-Temp	Kingston	16:47:50	12/16/2016	GOOD	22.00
King-WatchDog	K-WD	16:47:50	12/16/2016	GOOD	-13 CNTS
Card-SE1	C-SE1	16:47:50	12/16/2016	GOOD	47.8125 M
Card-SE2	C-SE2	16:47:50	12/16/2016	GOOD	-198.8125 M
Card-Bat	Cardinal	16:47:50	12/16/2016	GOOD	13.14
Card-Temp	Cardinal	16:47:50	12/16/2016	GOOD	23.40
Card-WatchDog	C-WD	16:47:50	12/16/2016	GOOD	-8 CNTS
Morris-SE1	M-SE1	16:47:50	12/16/2016	GOOD	5.8125 M
Morris-SE2	M-SE2	16:47:50	12/16/2016	GOOD	8.2500 M
Morris-Bat	Morris	16:47:50	12/16/2016	GOOD	13.11
Morris-Temp	Morris	16:47:50	12/16/2016	GOOD	21.70
Morris-WatchDog	M-WD	16:47:50	12/16/2016	GOOD	-7 CNTS
IrqTW-SE1	ITW-SE1	16:47:50	12/16/2016	GOOD	18.7500 M
IrqTW-SE2	ITW-SE2	16:47:50	12/16/2016	GOOD	60.9375 M
IrqTW-Bat	IrqTW	16:47:50	12/16/2016	GOOD	13.12
IrqTW-Temp	IrqTW	16:47:50	12/16/2016	GOOD	23.40
IrqTW-WatchDog	ITW-WD	16:47:50	12/16/2016	GOOD	-9 CNTS
IrqHW-SE1	IHW-SE1	16:47:50	12/16/2016	GOOD	-120.9375 M
IrqHW-SE2	IHW-SE2	16:47:50	12/16/2016	GOOD	-151.8750 M
IrqHW-Bat	IrqHW	16:47:50	12/16/2016	GOOD	13.11
IrqHW-Temp	IrqHW	16:47:50	12/16/2016	GOOD	22.80

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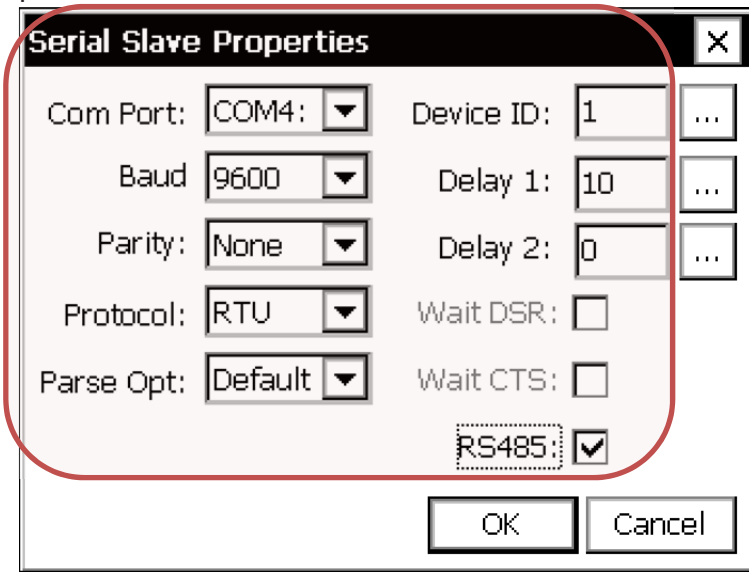
Saunders 9210 LAN Properties

LAN settings in the 9210 loggers have been programmed with a Static IP address. The cellular modems have been programmed with port forwarding to this IP on Telnet port 23 which allows the remote user to log into the 9210 using Xterm software

Saunders SMP 9210 Modbus RTU Settings

The SMP 9210 has been configured as a Modbus Slave on COM 4 which is a RS-485 Port. The SMP Gateway will then poll the SMP 9210 on this port as a Modbus Slave. Note serial port parameters and Device ID - Modbus Address 1.



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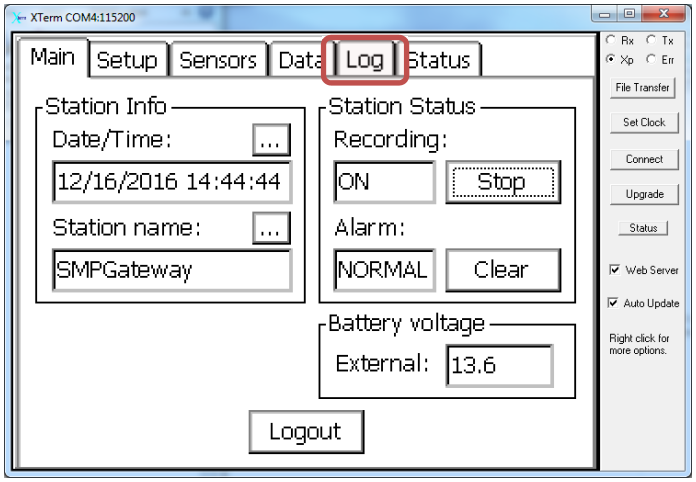
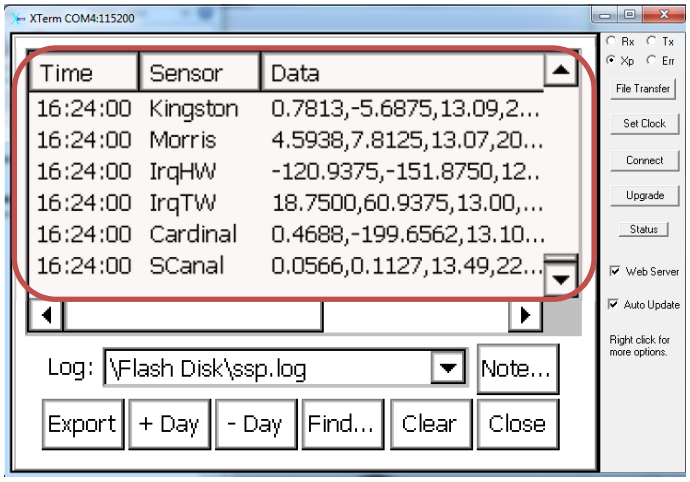
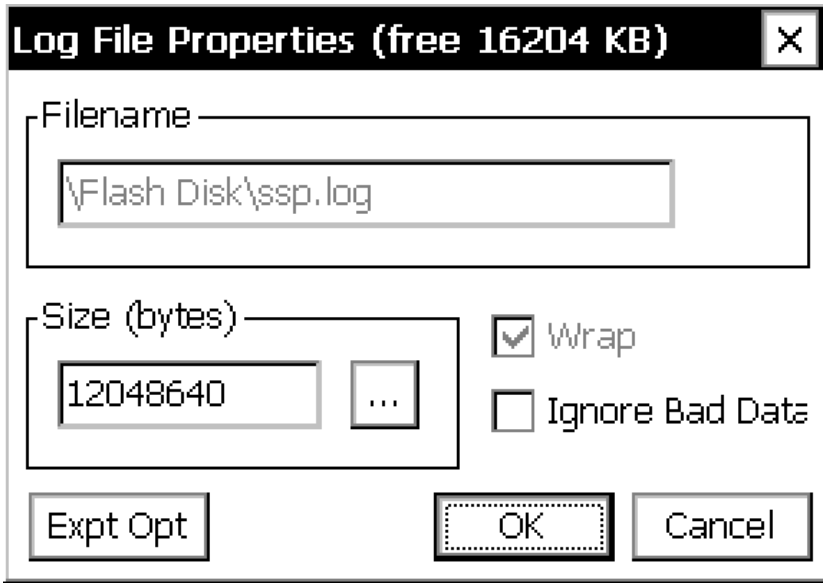
SMP 9210 Xterm Log Tab

Go to the Log Tab in Xterm to get a quick view of the 9210 log. The time stamp and data strings will appear for each site. The latest data will be appended as each measurement takes place)





9210 SSP Log Size (the 9210 SSP Log have been sized to 12 MB



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Saunders Remote Sites Xterm Software Configuration

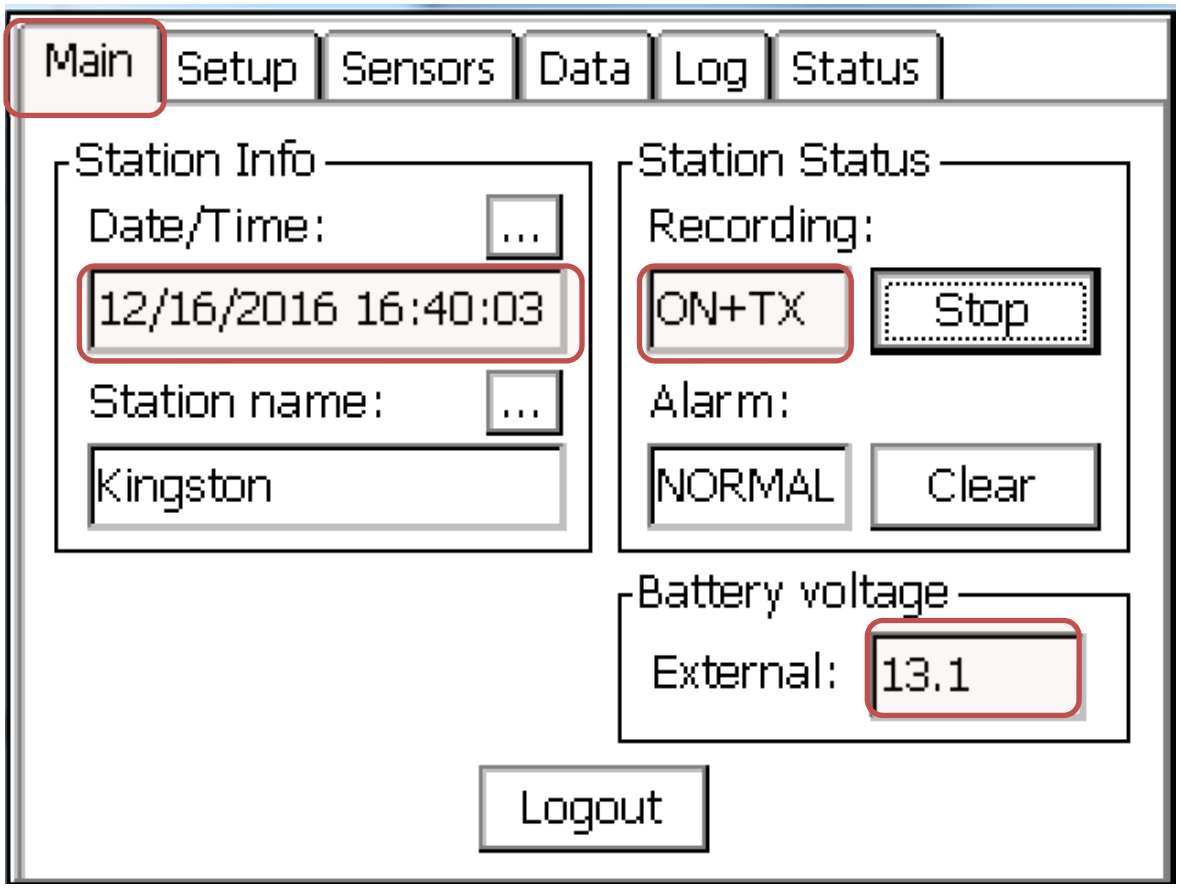
To remotely log into the Saunders sites using the cellular modem, plug the computer into the SMP 9210 panels Ethernet switch or have a computer with a cell modem and OPG Bell SIM card. From Xterm in the URL put in the remote site static IP address with Telnet Port 23 selected.

WebLog

To view the latest data from the remote sites from Internet Explorer put the remote site IP address in the browser URL and the 9210 web page shown below will be displayed

Xterm Main Screen

The Saunders remote sites have a Satlink connected to the 9210 datalogger so when the stations are started they will show ON+TX. Verify the station name, Date and Time and battery voltage. Stations that have Satlinks and GPS will have the time automatically set from in GMT time. One can have the time set to local time by setting a local time offset in the Satlink settings



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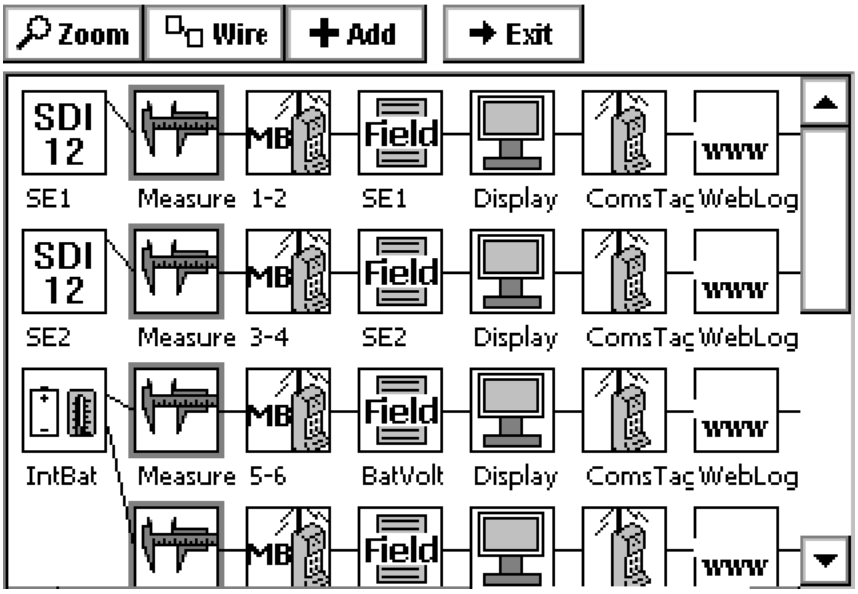
Saunders Remote Sites Graphical Setup

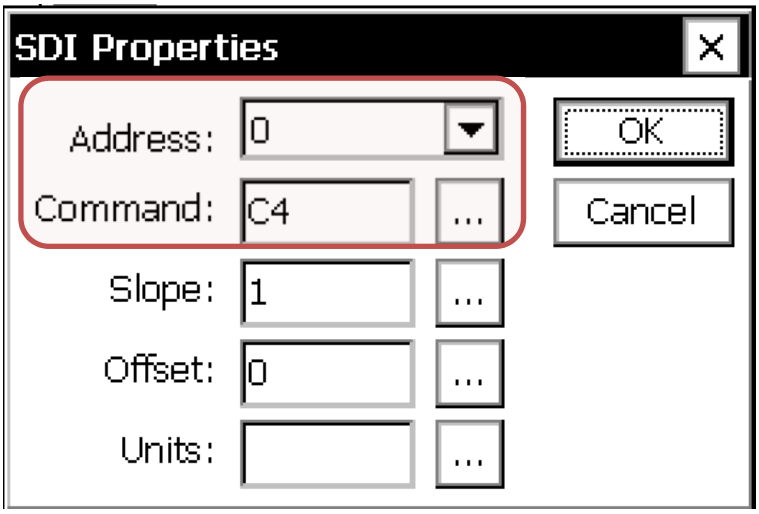


Xterm Block	
SDI-12	SDI-12 Block defines the sensor type as SDI-12 and the SDI-12 address , command and parameter #
Measure	Measure block defines the logging interval and measurement time
MB Tag 1-2	Modbus RTU Slave Block defines the Modbus register for Shaft Encoder #1. In this case Shaft Encoder #1 will be a floating point value registers 1-2. The SMP Gateway will then poll these registers using Modbus TCP
Field SE1	LogField for Shaft Encoder #1 defines the 9210 datalog and data string
Display	Enables the 9210 Display to display the SE1 values
Coms Tag	Outputs the latest data into the DataTab in Xterm for Easy viewing
WebLog	Puts the updated logged values into the 9210 web page for quick display
Watchdog Counter	Counter that is incremented each measurement. Used by SMP Gateway SCADA to ensure that communications are still active

Saunders Remote Sensor Configuration in Xterm

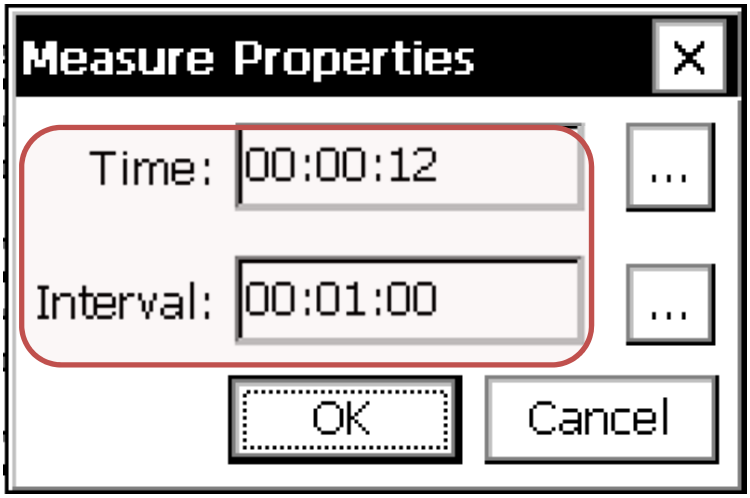
SDI-12 Block for SE1 Shaft Encoder #1

Note: SDI-12 Address and Command C4 triggers the encoder to do a 30 second average. C command triggers a concurrent measurement in the encoder which allows multiple SDI-12 sensors to start their measurements at the same time)



Measure Block for SE1

The shaft encoders have an internal 30 second average interval. The shaft encoders at the remote sites measure once a minute and start the measurement sampling at 12 seconds after the top of the minute. This ensures that the measurement is complete at 00:00:45 seconds, since the complete measurement takes 32 seconds.



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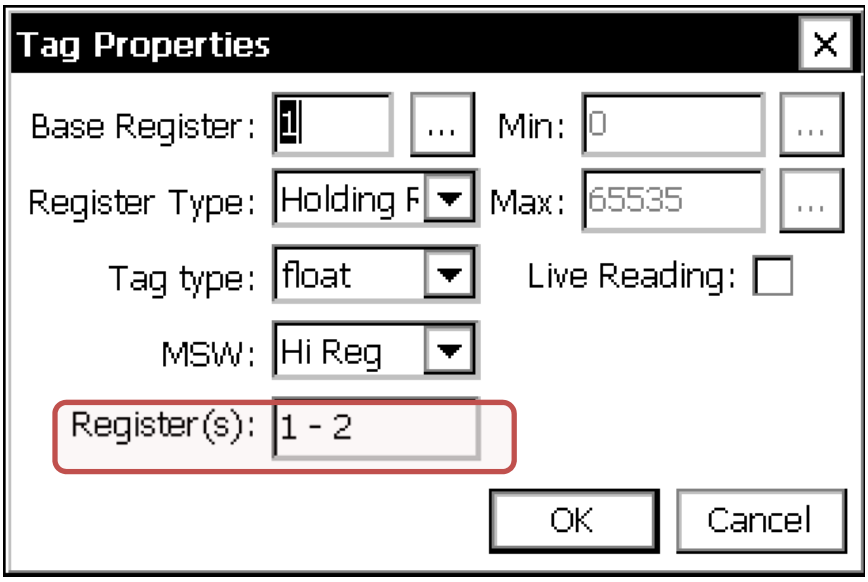
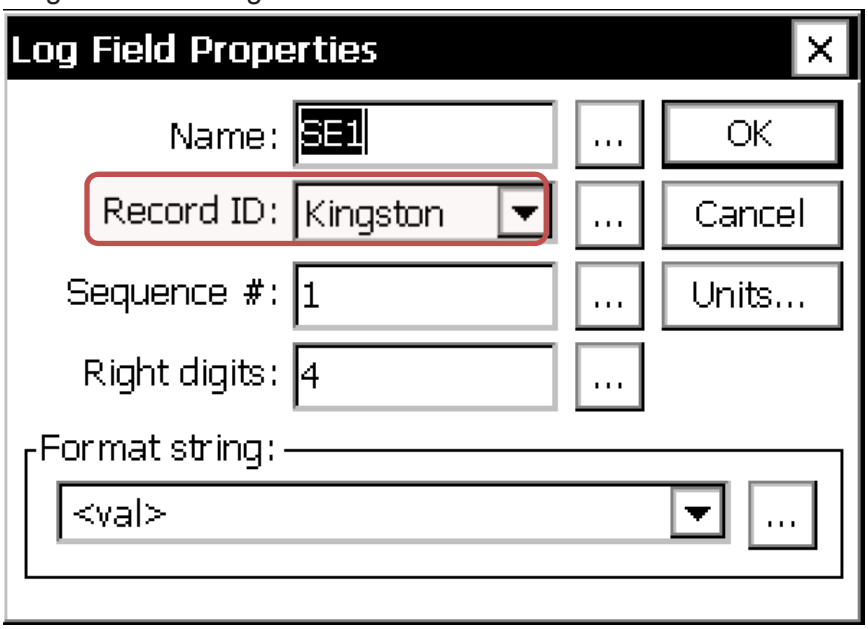
MB Tag Block for SE1 Shaft encoder #1

Defines how the SE1 data is formatted in 32 bit floating point in registers 1-2 Holding Registers (40001-40002

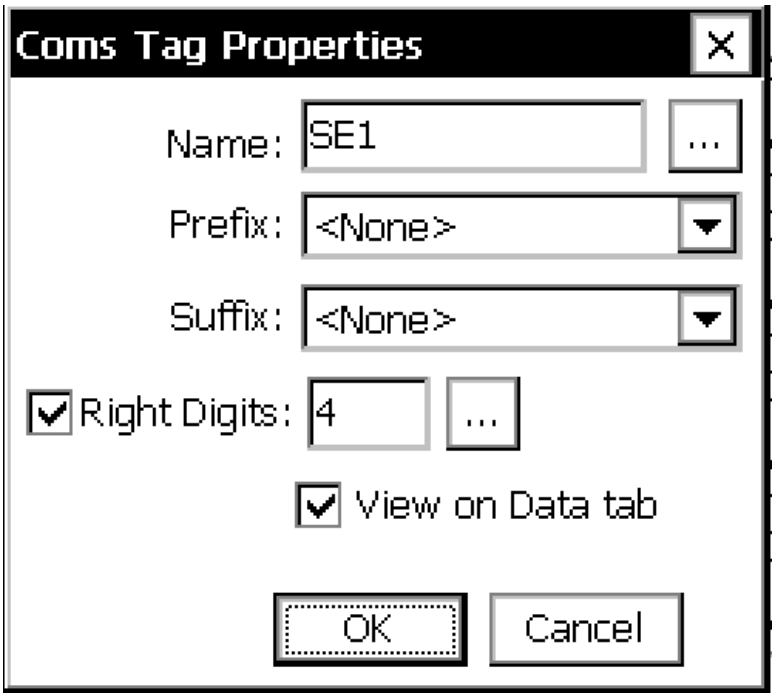


Shaft Encoder #1 Log Field Block for Kingston

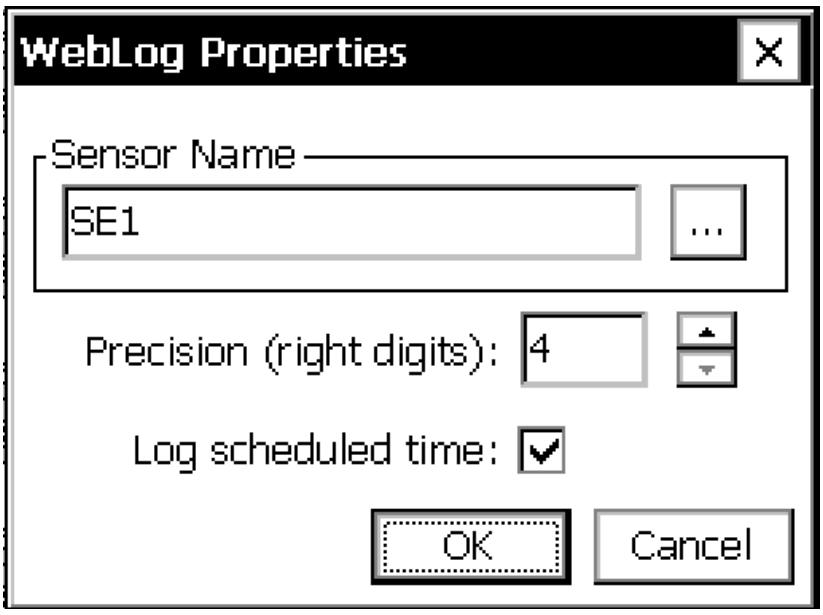
Ensures that the data for Shaft Encoder 1 is placed into the 9210 log and the time stamp is tagged as Kingston. Sequence of 1 defines that SE1 will be the first measurement in the Kingston data string



SE1 COMS Tag Properties for Data Tab

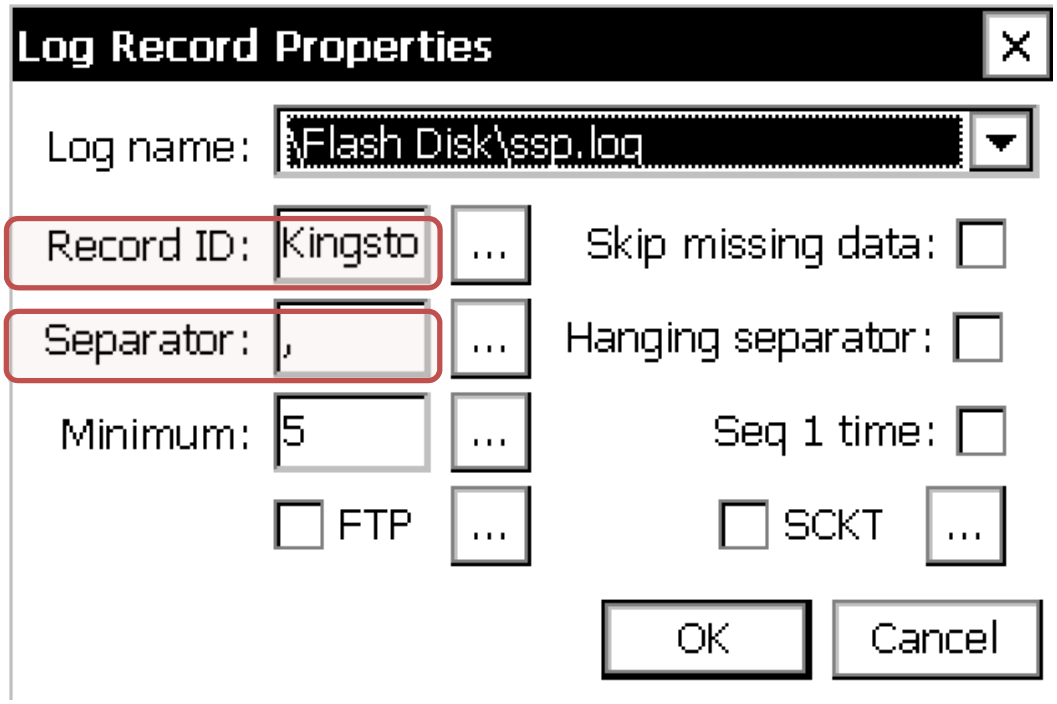


SE 1 Web Log Properties for 9210 Web Page



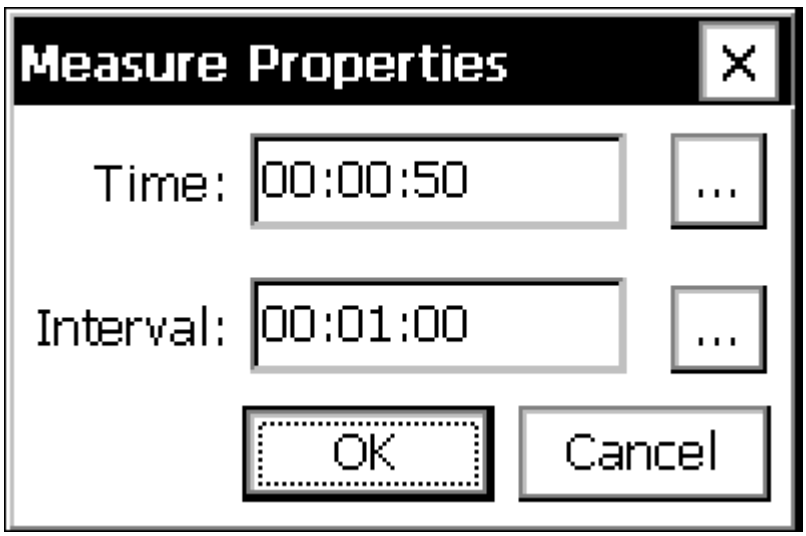
Log Record Block Sets the Log Record ID such as Kingston

Data is formatted in Comma Seperated Format



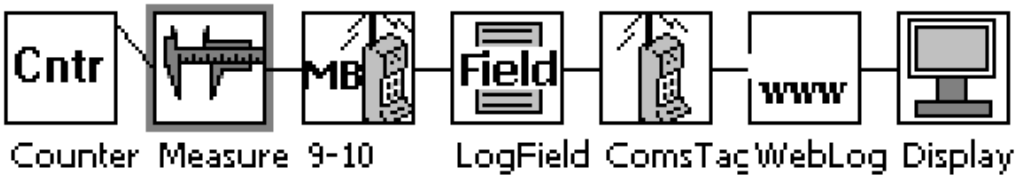
Measure Block Associated with the Log Record Block Sets the Data's Time Stamp

Time Stamps will be at 00:00:50, 01:00:50 etc.

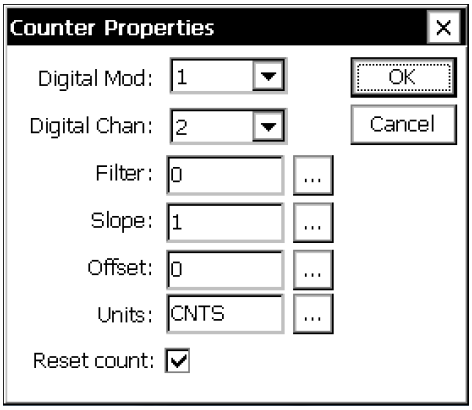


Counter Block for WatchDog

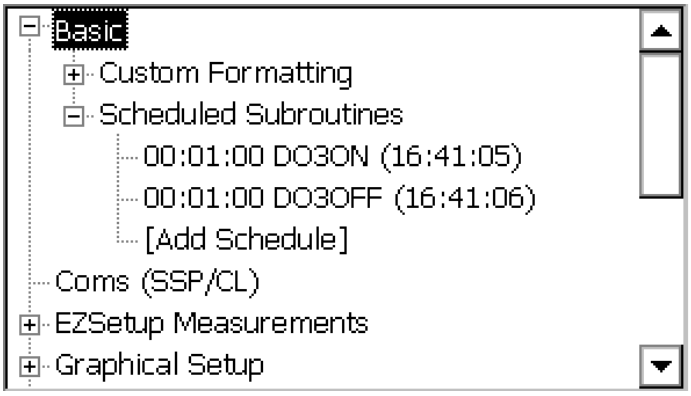
The 9210 loggers are all programmed with a Basic Program that increments DO2 Counter every time it takes a reading. The counter is used to verify that the remote site communications is working properly. For example if the remote site communications failed the sensors values logged by the SMP Gateway could remain in frozen state and not change. Monitoring the counter values from the remote sites the SCADA would detect this because the count did not change.



Counter Block for DI/02

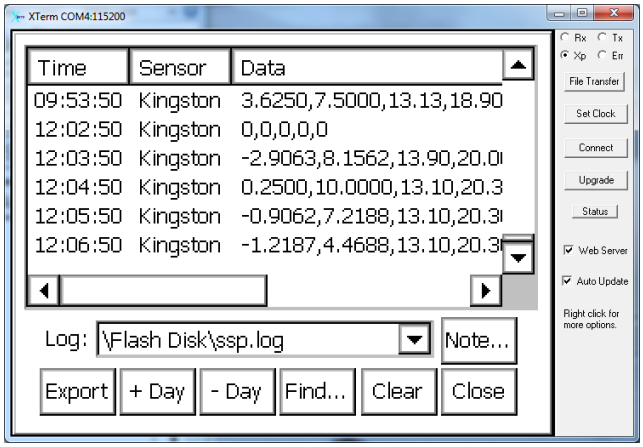


Basic Program Schedule to Increment Counter



Saunders Remote Sites Xterm Log Tab

This example shows the Log Tab in Xterm with time stamped data strings from Kingston. The SMP 9210 logged data for Kingston should be a mirror image of this data.



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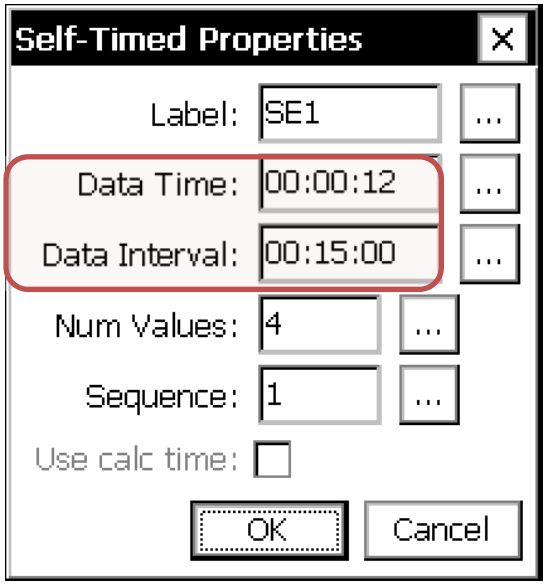
Saunders Remote Sites GOES Satellite Configuration in Xterm

Xterm Self Timed Logging Properties

Defines what logged values are transmitted by GOES each interval. The sensors are logged in the 9210 once a minute but the GOES data in the Satlink will transmit the data logged at 15 minute intervals. So in this case the GOES data will be at 00:15:12, 00:30:12, 00:45:12, 00:00:12



GOES Satlink Properties in Xterm

Shows the GOES ID, local time offset to get Eastern Time and antenna type. COM2 is where the 9210 serial port where the Satlink is connected

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GOES Transmission Parameters in Xterm

Note Interval, Channel and Time Window for Tx data. Data will be transmitted in ASCII Column format

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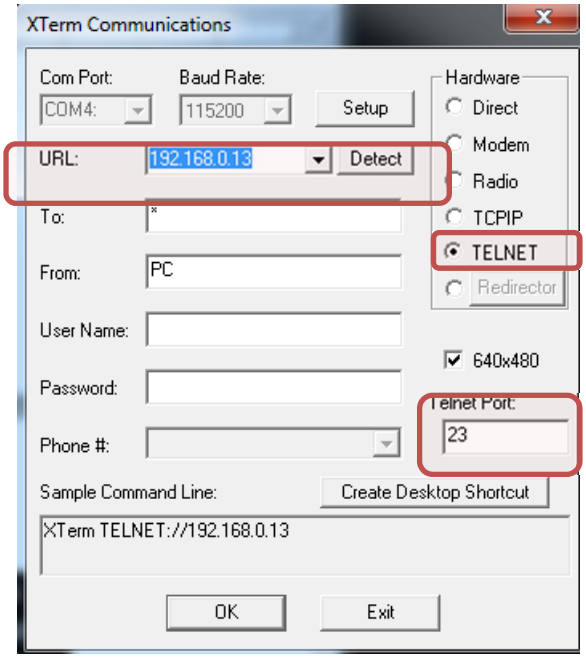
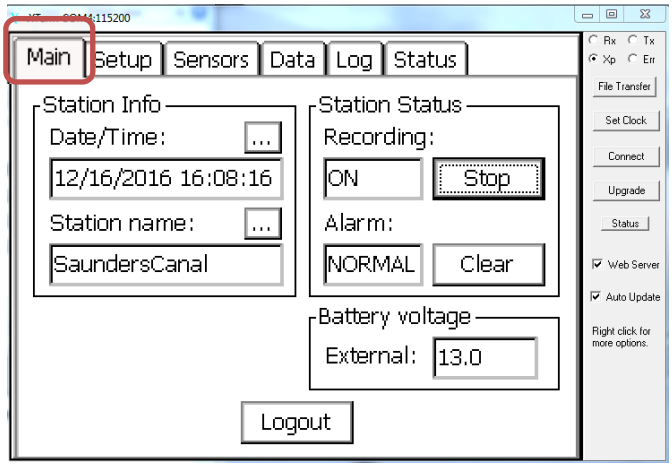
Saunders Canal Xterm Configuration

The Saunders Canal Station has a dual bubbler system and a Elpro wireless Ethernet radio modem for communication with the SMP 9210. Otherwise the mode of 9210 communications and logging is the same as the other Saunders remote sites.

Xterm Communication Screen



Saunders Canal Main Xterm Tab



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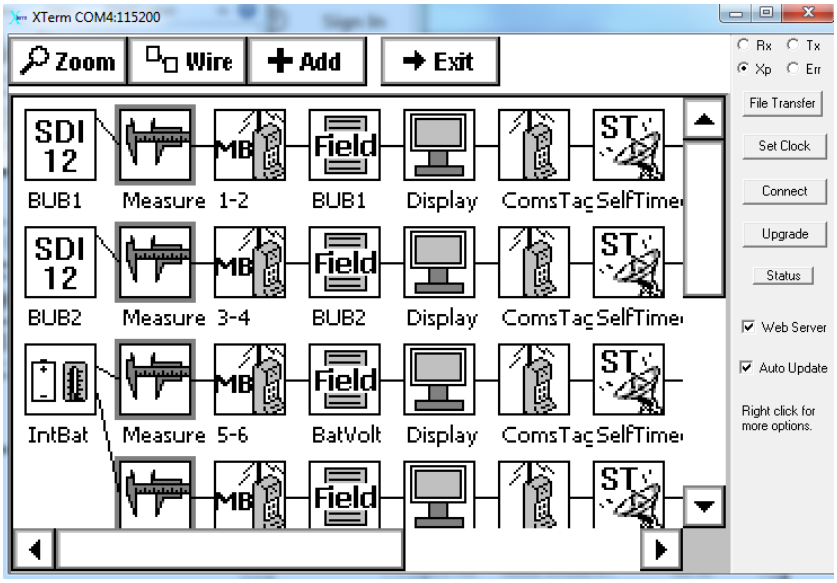
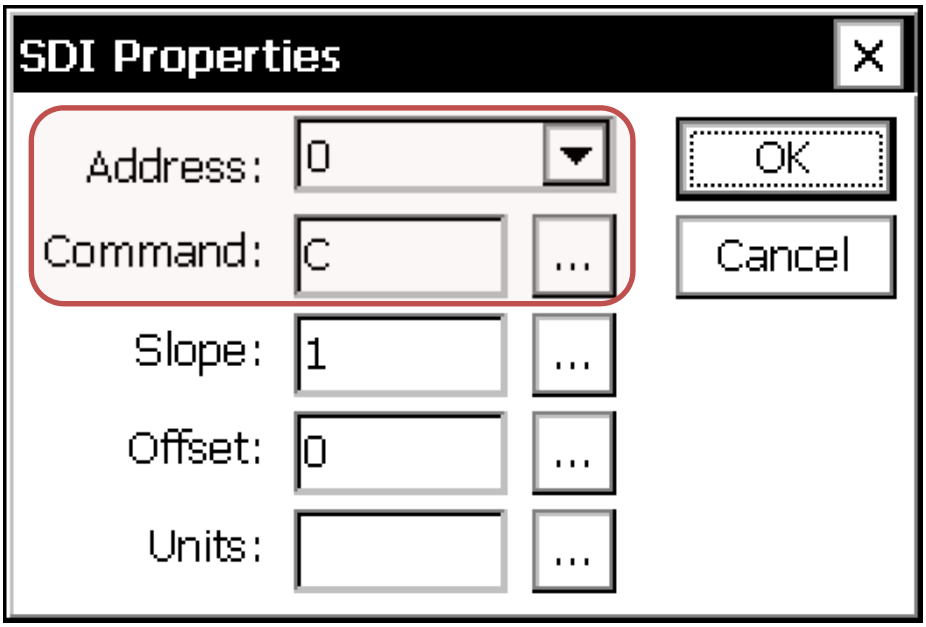
Saunders Canal Graphical Setup Screen in Xterm (with 2 bubblers)



SDI-12 Block for Bubbler #1



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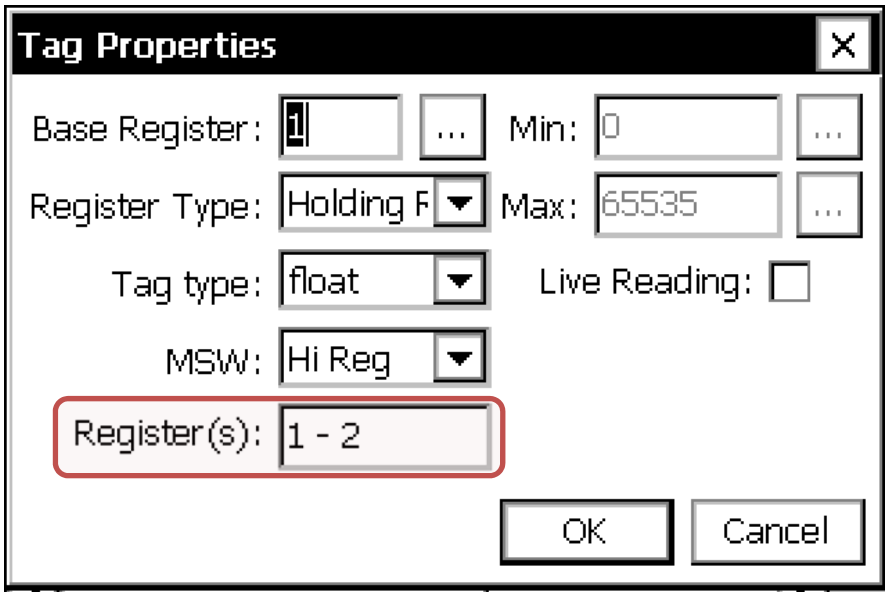
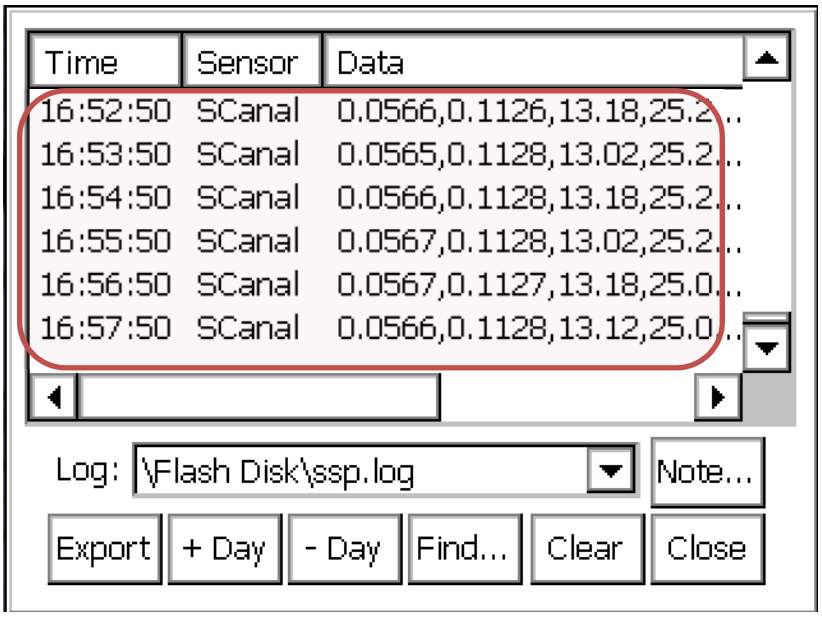
Modbus Tag for Bubbler #1



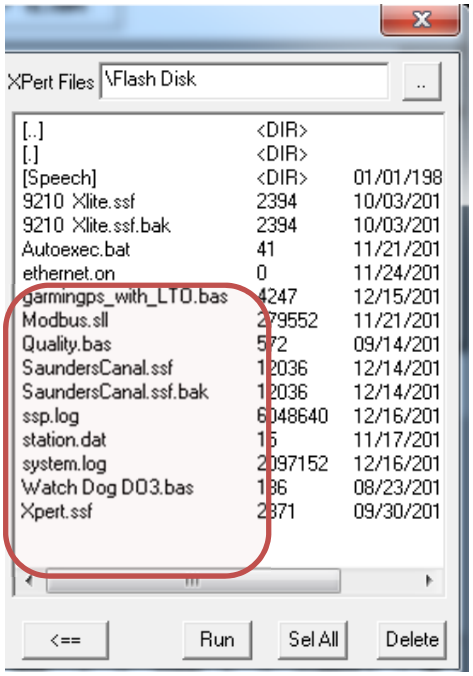
Saunders Canal LAN Settings with Static IP Address

Saunders Canal Log Tab showing Data Strings



Saunders Canal Flash Disk

Shows Setup file, Basic files and Modbus SLL



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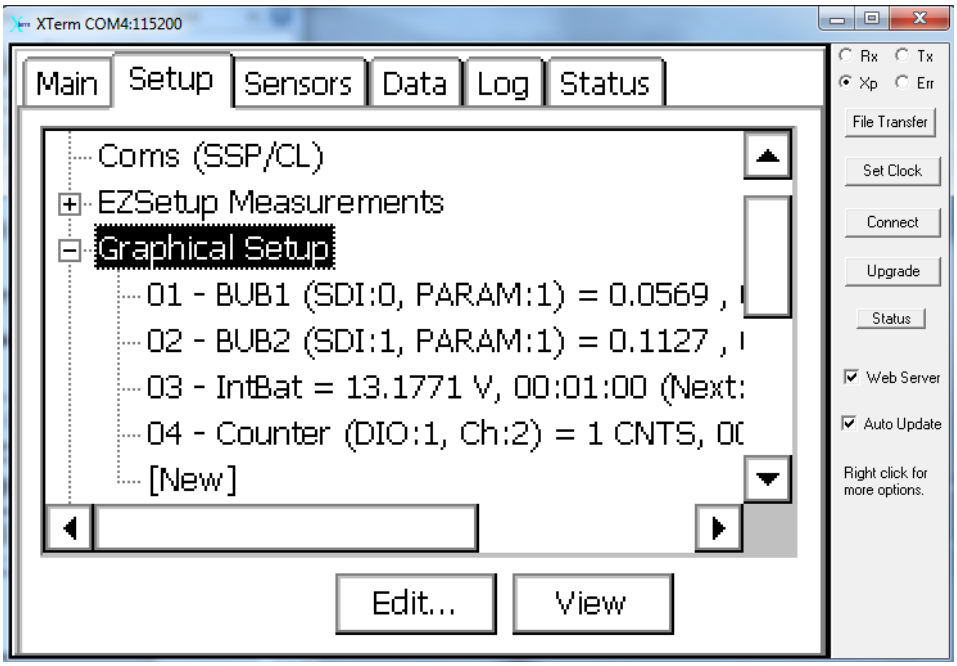
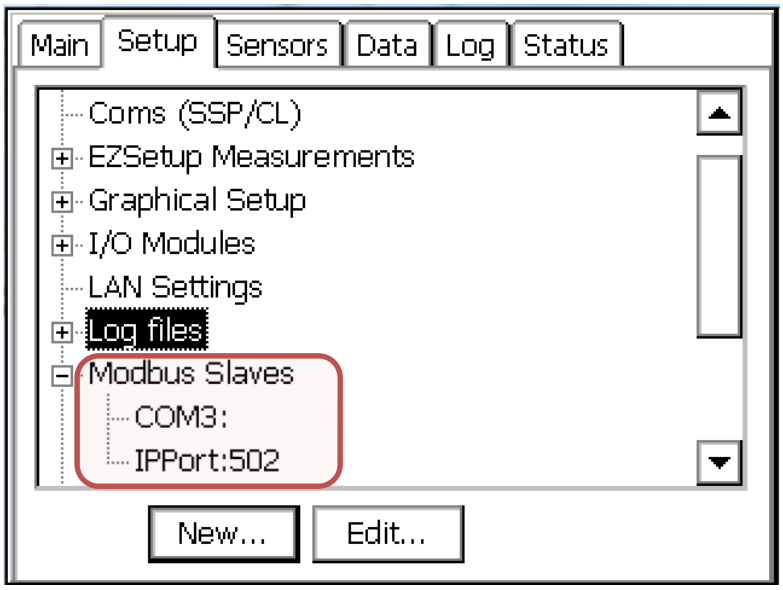
Saunders Canal Graphical Setup



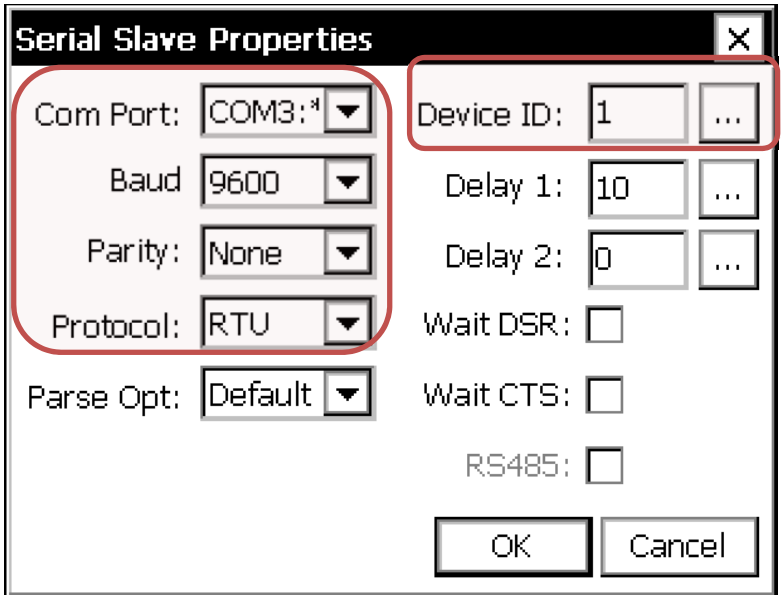
Saunders Sites with RS-485 Communications to SMP Gateway

Sites: Saunders HW, Saunders TW, Saunders INT TW

Saunders RS-485 Modbus Slave Settings



Saunders HW Modbus Settings Modbus Address 1



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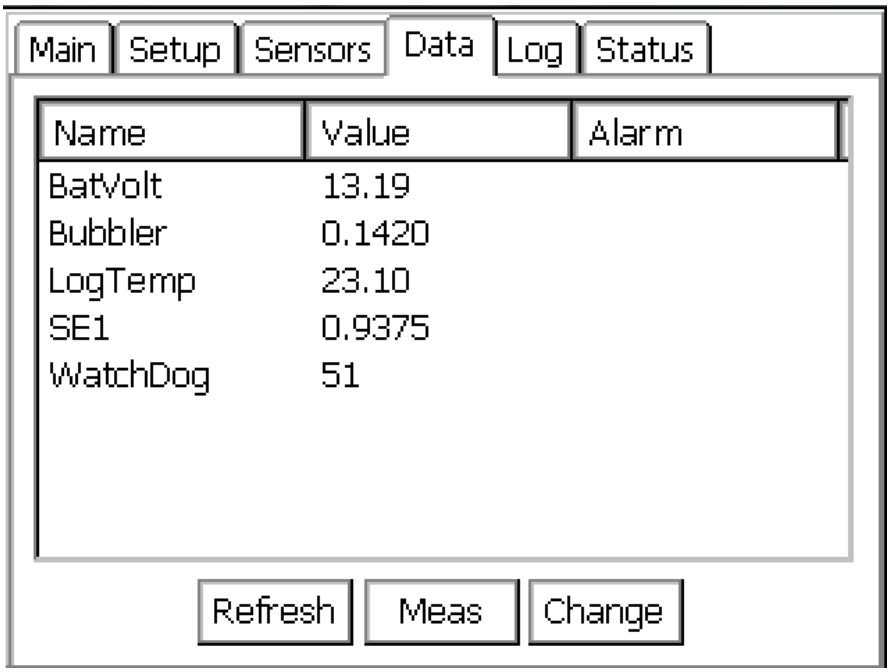
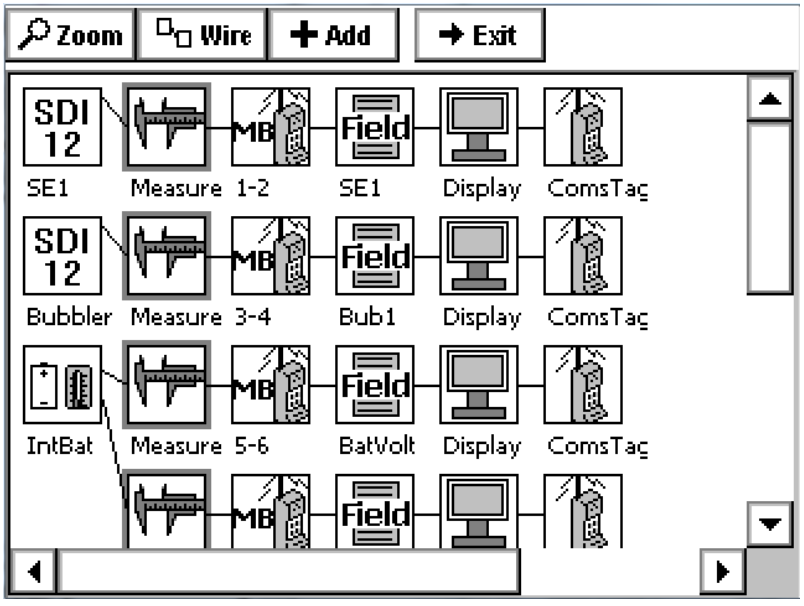
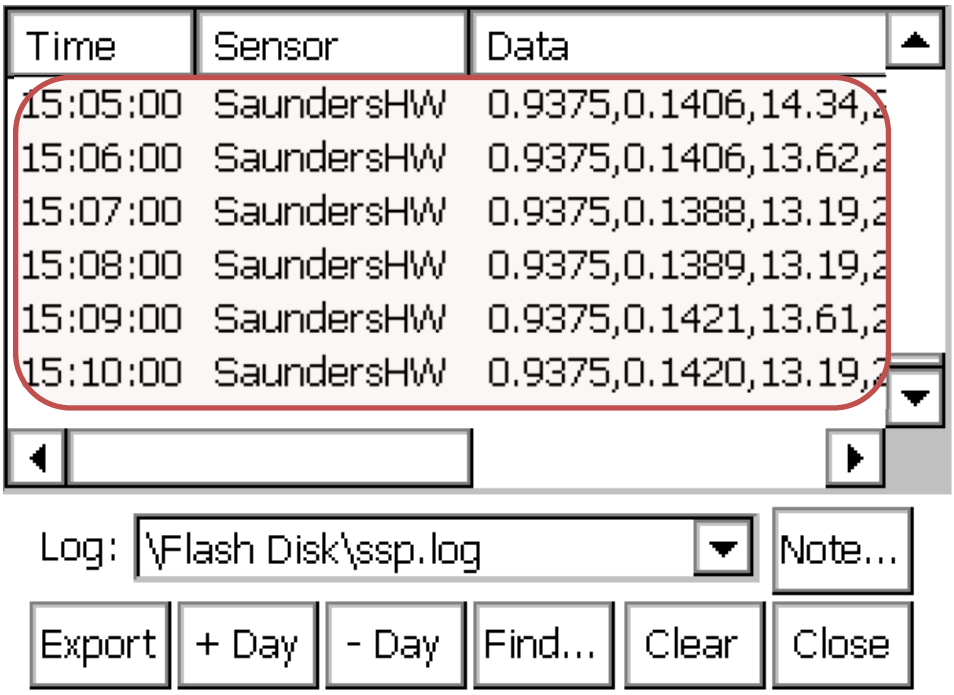
Saunders HW Data Tab Showing Latest Data



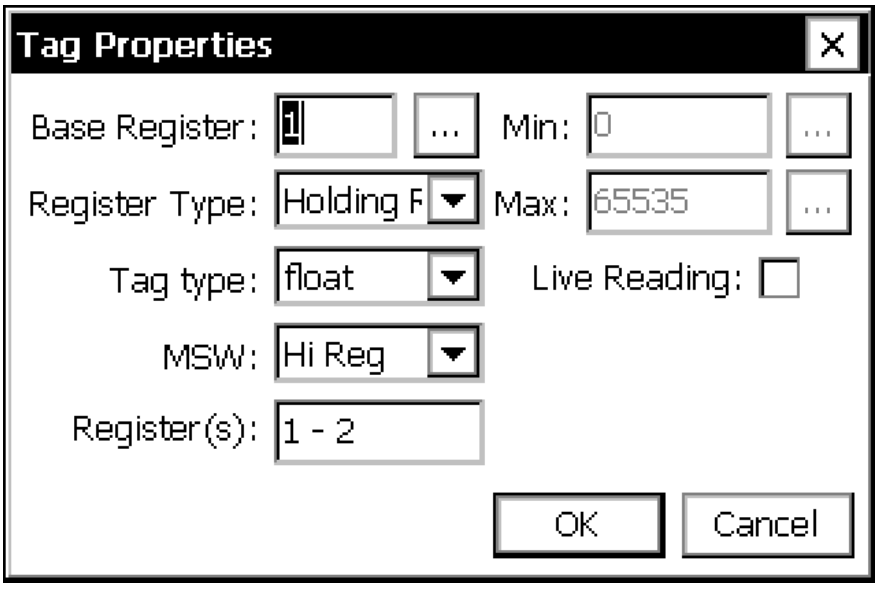
Saunders HW Graphical Setup (each site has a Shaft Encoder and a Bubbler)



Saunders HW Log Tab Showing Data Strings



Modbus Tag Properties for Shaft Encoder



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Station Name: Saunders HW

Saunders HW 9210 Modbus Port Settings

Modbus Address	**1**
9210 COM Port	**3 (RS-232)**
Baud Rate /Data Format	**9600,8N1**

SMP Modbus Register Map (32 bit Floating Point)	**Sensor**	**Units**	**Sampling Interval**	**Sampling Time**	**Modbus Port**
1-2	Shaft Encoder1	M	00:01:00	00:00:12	**COM 3 9600,8N1**
3-4	Shaft Encoder2	M	00:01:00	00:00:12	
5-6	Battery Voltage	V	00:01:00	00:00:12	
7-8	Logger Temperature	C	00:01:00	00:00:12	
9-10	Watchdog Counter	cnts	00:01:00	00:00:12	

Station Name: Saunders TW

Saunders TW 9210 Modbus Port Settings

Modbus Address	**2**
9210 COM Port	**3 (RS-232)**
Baud Rate /Data Format	**9600,8N1**

SMP Modbus Register Map (32 bit Floating Point)	**Sensor**	**Units**	**Sampling Interval**	**Sampling Time**	**Modbus Port**
1-2	Shaft Encoder1	M	00:01:00	00:00:12	**COM 3 9600,8N1**
3-4	Shaft Encoder2	M	00:01:00	00:00:12	
5-6	Battery Voltage	V	00:01:00	00:00:12	
7-8	Logger Temperature	C	00:01:00	00:00:12	
9-10	Watchdog Counter	cnts	00:01:00	00:00:12	

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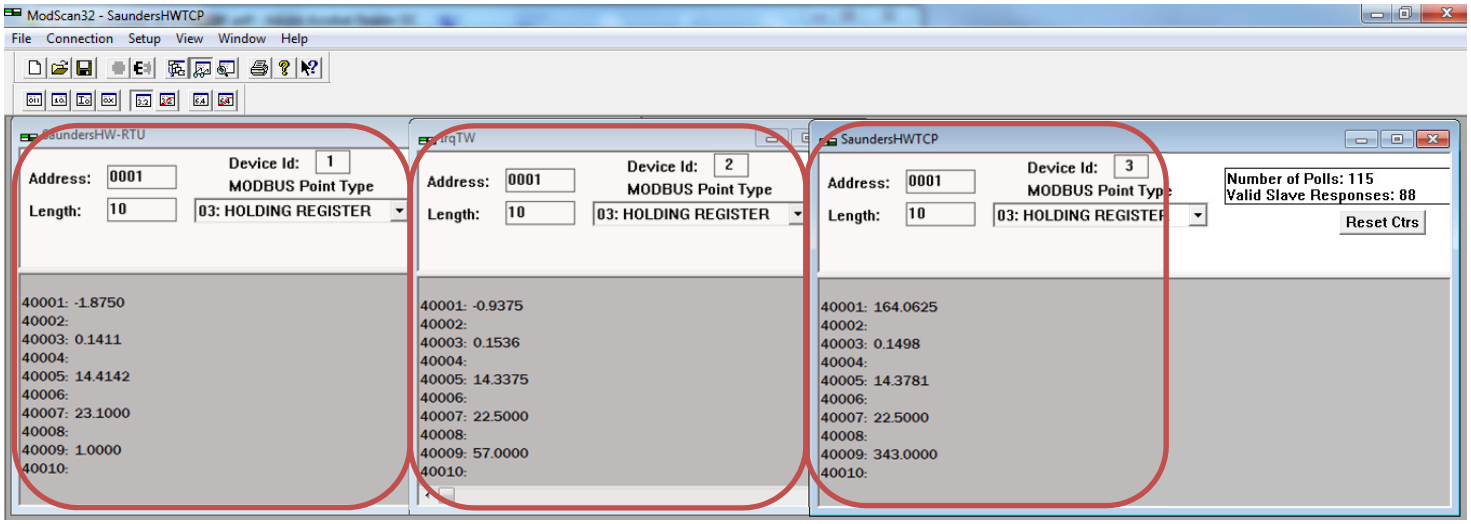
Station Name: Saunders International TW

Saunders HW 9210 Modbus Port Settings

Modbus Address	**3**
9210 COM Port	**3 (RS-232)**
Baud Rate /Data Format	**9600,8N1**

SMP Modbus Register Map (32 bit Floating Point)	**Sensor**	**Units**	**Sampling Interval**	**Sampling Time**	**Modbus Port**
1-2	Shaft Encoder1	M	00:01:00	00:00:12	**COM 3 9600,8N1**
3-4	Shaft Encoder2	M	00:01:00	00:00:12	
5-6	Battery Voltage	V	00:01:00	00:00:12	
7-8	Logger Temperature	C	00:01:00	00:00:12	
9-10	Watchdog Counter	cnts	00:01:00	00:00:12	

Modscan Diagnostic Software Showing Live Modbus Polling of Saunders HW, Saunders TW and Saunders INT TW



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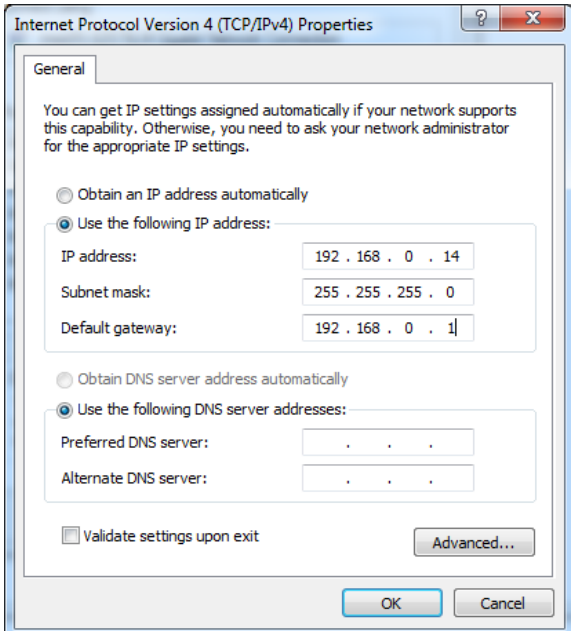
Section 7

Ontario Power Generation

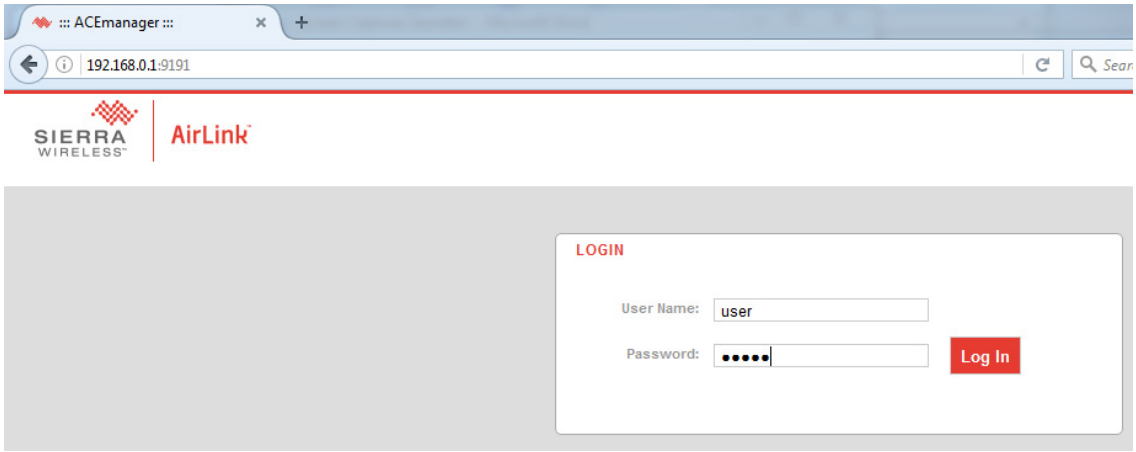
Sierra Wireless RV50 LTE Cellular Modem Documentation

Sierra Wireless RV50 Cellular Modem Configuration for Saunders

The Saunders RV50 modems Ethernet settings for HTTP access have been changed to 192.168.0.1. To access the modems web page first change the computers network settings as follows:



From the Computers Browser enter 192.168.0.1 in the URL and put the user name as User and the password as 12345



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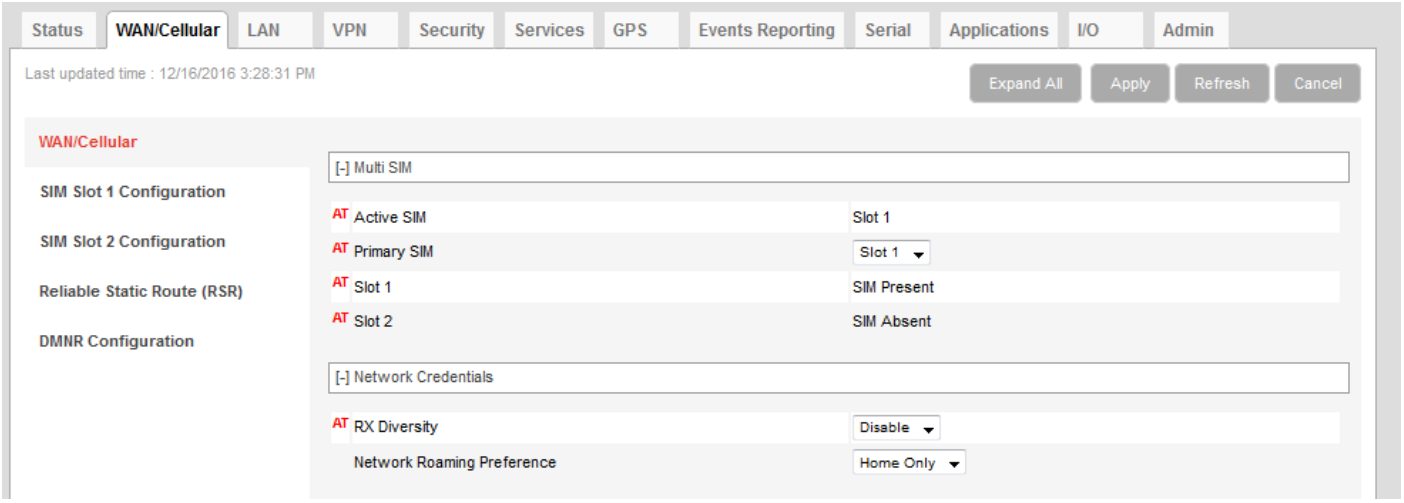
Check the modem Status page to ensure that the modem has the proper IP address and the signal strength is better than -95 db

The SIM card is installed in SIM Card slot #1



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Enable remote HTTP and HTTPs Access in the Services Tab for Remote Modem Access

Section 8

Ontario Power Generation

Elpro 245U-E Radio Modem Documentation

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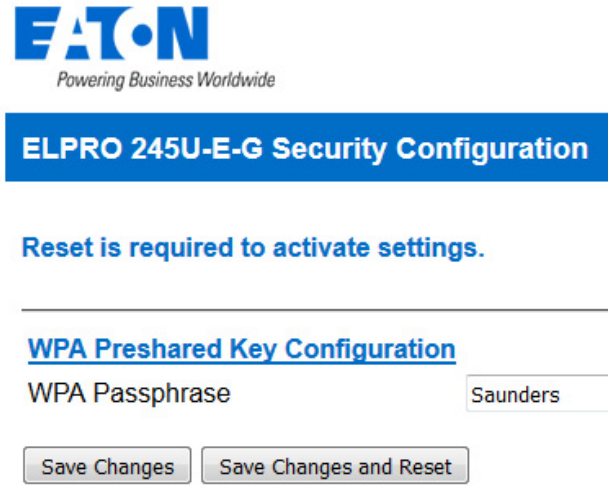
Elpro 245U-E Wireless Ethernet Radio Modem for Saunders Canal and SMP Gateway

The Elpro 245U-E radio modem is connected to the 9210 and dual bubbler at the Saunders Canal station. Another 245U-E is connected to the 9210 in the SMP Gateway station. The remote 245U-E is programmed as an Access Point with a SSID of SaundersCanal and has a IP address of 192.168.0.11. The 245U-E at the SMP Gateway is a Client and has a IP address of 192.168.0.12. The SMP 9210 will poll the Saunders Canal 9210 the same way as the cellular stations using the Static IP address and Modbus TCP.

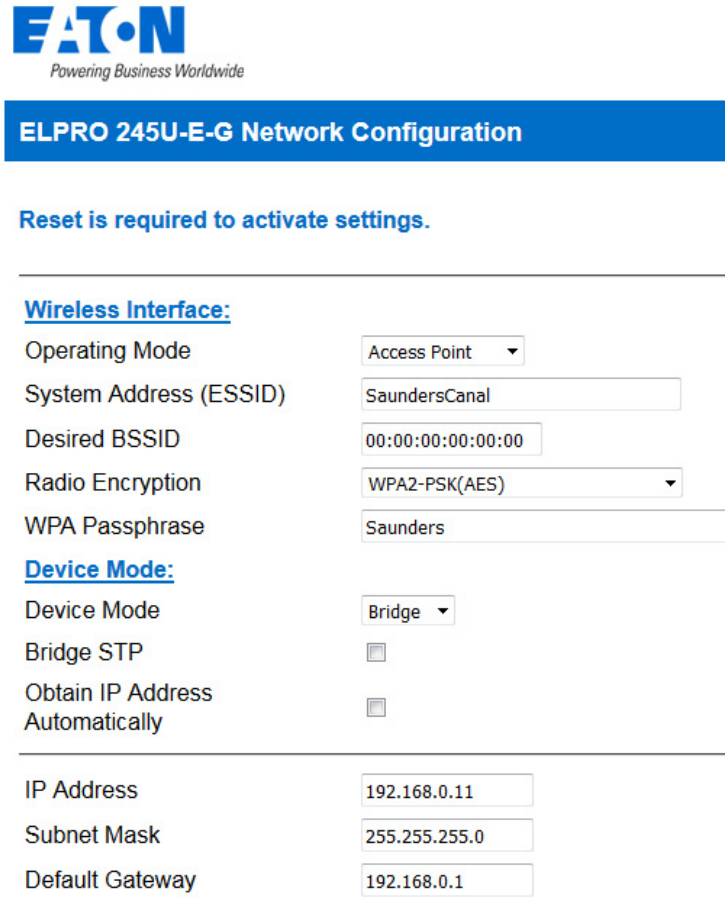
245U-E Radio Modem Web Page Configuration

From the computers Browser enter the IP address for Remote site and for the SMP Gateway. Select the user name as User and the Password as User.

Elpro SMP Gateway Configuration (WPA Passphrase Saunders)



Saunders Canal Remote Site Access Point (ESSID SaundersCanal)



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SMP Gateway Elpro 245U-E Client Configuration at SMP Gateway

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Section 9

Ontario Power Generation

Sutron 56-0540 Shaft Encoder Sensor Documentation

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Sutron SDI-12 Shaft Encoder 56-0540 Configuration

- Input Voltage — 7 to 16 VDC over voltage and reverse voltage protected
- Power Consumption
- Starting Torque — < 0.25 inch-ounce
- Shaft Diameter — 5/16 inch with both threads and a flat
- Rotation Resolution — 400 count per revolution
- Counter Resolution — 32 bit
- Reported Resolution — User selectable Range 7 decimal digits (examples: ±99999.99 or ±9999.999)
- Display — 2 line, 8 character per line with backlight Backup Battery AA size, 1.5V or 3.6V accepted
- Bearing Supports — Double bearing arrangement supports up to 10 lb. shaft load
- Supported Wheels — User specifies wheel size – no required circumference
- Support Units — User specified
- Rotation Speed — User specified – factory default 2.5 rev/s
- Maximum Rotation Speed — 5 rev/s
- Temperature Range — -40ºC to +60ºC (Display viewable -20ºC to +60ºC)

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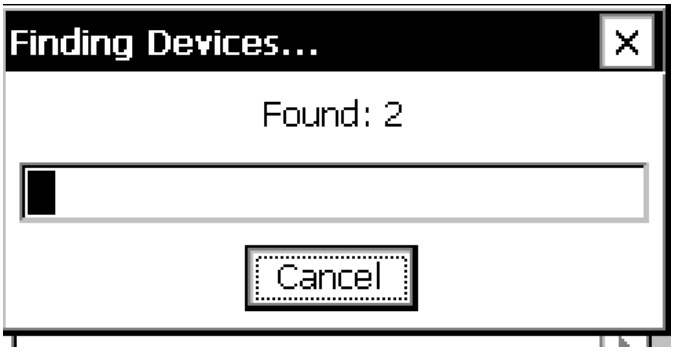
Shaft Encoder Settings:

The Sutron Shaft encoders have been preconfigured by Hoskin Scientific Ltd. for 375mm pulley wheels, 4 right digits and with a 30 second averaging interval.

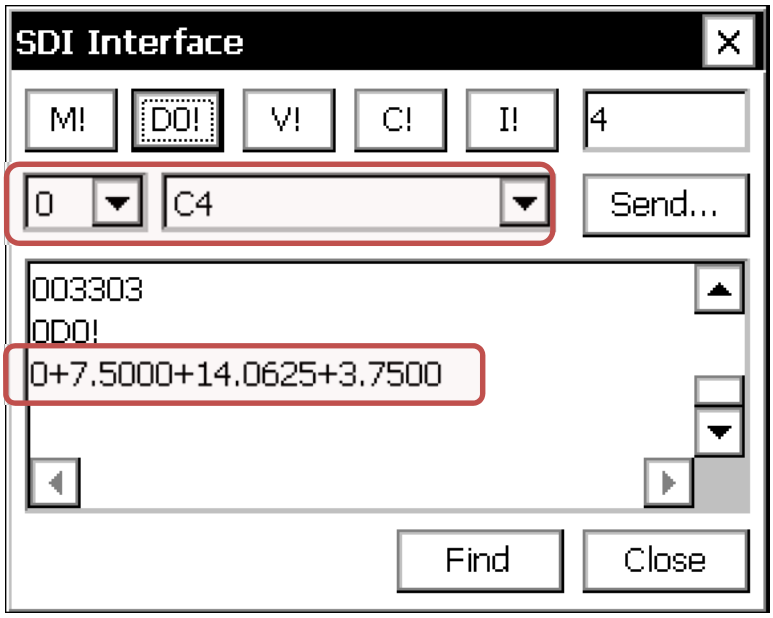
SDI-12 Configuration using Xterm

From the sensors tab select the SDI Button and the dialog box below will be displayed. Connect the SDI-12 sensors and then select the Find button. A message saying found 2 for the 2 sensors should be displayed.



Send a SDI-12 Read Command C4 and after 30 seconds, send a D0 command to read the data. The encoder data string will be displayed

0(SDI-12 Address) + 7.5000 (encoder value) + 14.0625 (Max Value) + 3.75 (Min Value)



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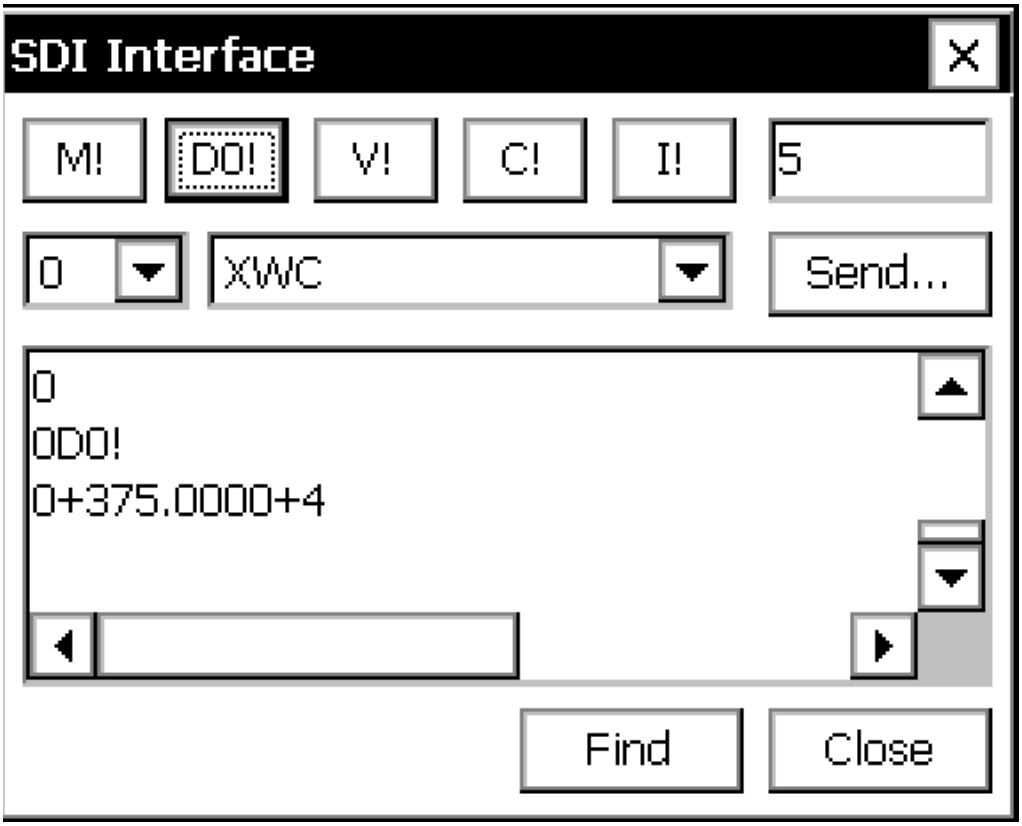
Set the Encoder Wheel Circumference and Right Digits using SDI Command XWC

Setting the Wheel Circumference

The wheel circumference and number of decimal places to report the result are set together. The form of this command is:

aXWC+n+d!	Where a is the address character, XWC is the extended command to set the wheel circumference, n is the wheel circumference in desired units, d is the number of decimal places to report the result.



aM4! aC4! aMC4! aCC4!	Measure Average, Maximum and Minimum level. Returns three values: Average, Maximum and Minimum level over n seconds set by aXT+n! Command.

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Set the Encoder Averaging Time to 30 Seconds

Setting the Averaging Time

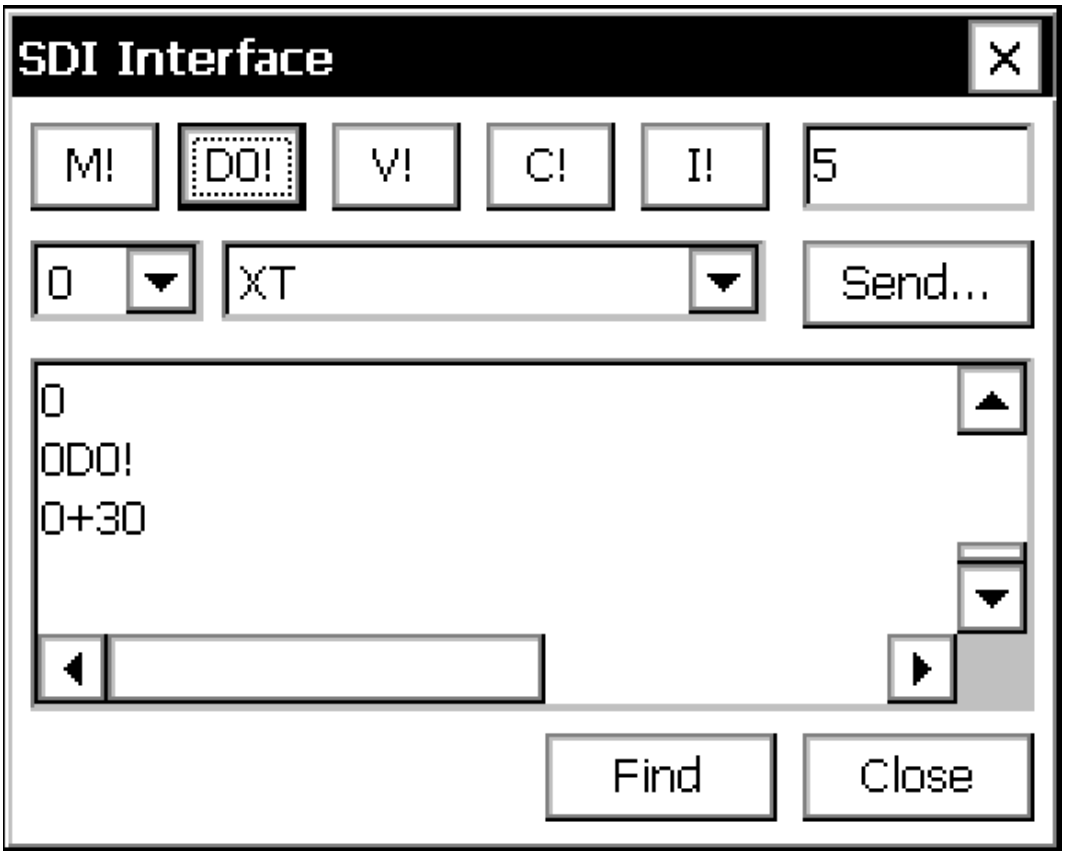
You can get Average, Maximum and Minimum level over the certain number of seconds called here as Averaging time. This Averaging time is user selectable (minimum 1 second and maximum 254 seconds). The factory default is 10 seconds. The form of this command is:

aXT+n!	Where a is the address character, XT is the extended command to set averaging time, n is the number of 1 second samples to average.

A subsequent aD0! Command will display the averaging time set. For Example,

0XT+20!

Will set the averaging time to 20 seconds for a shaft encoder at address 0. After this, whenever a aM4, aC4, aMC4 or aCC4 command is issued, the shaft encoder will take 20 readings of level at 1 second interval and will return the average, maximum and minimum level over these 20 seconds.



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Section 10

Ontario Power Generation

Sutron Compact Constant Flow Bubbler Sensor Documentation

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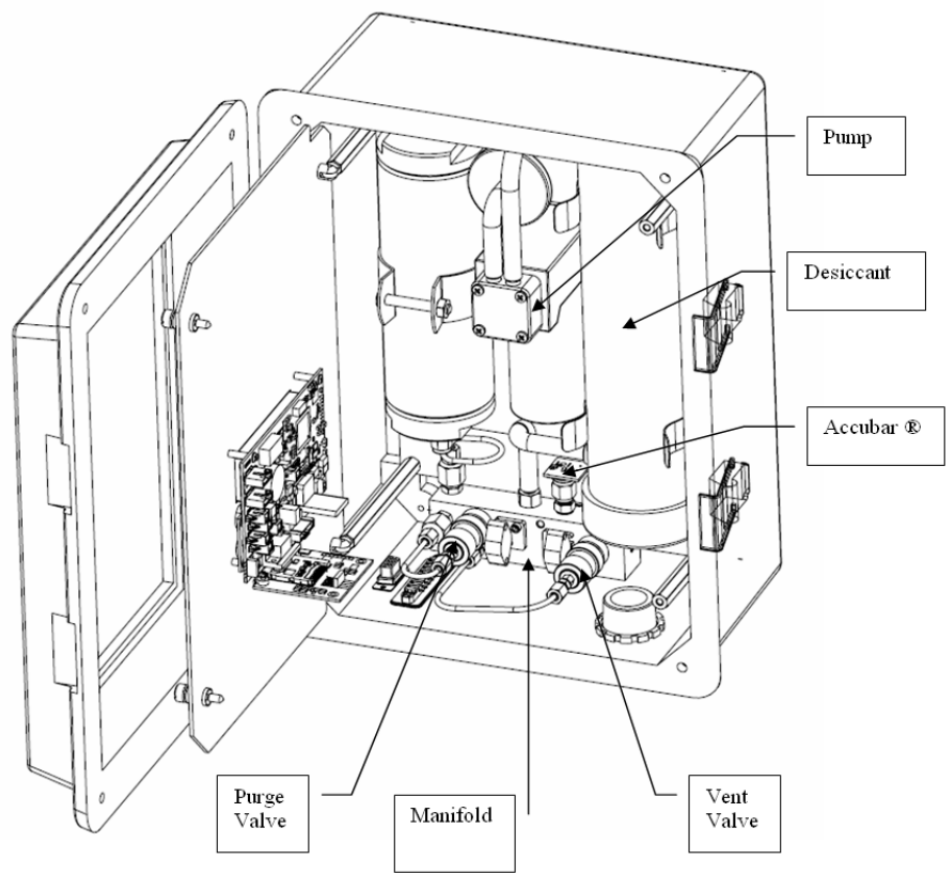
Sutron Bubbler System Components and Programming

Sutron Accubar Compact Constant Flow Bubbler

Layout: the diagram shows the sub-systems within the bubbler. It has its own controller and is capable of semi-autonomous operation.

Air is drawn through the desiccant from the space within enclosure. Pre-drying the air assures there is no moisture of frost buildup that might adversely affect operation of the device. The blue indicator dye in the desiccant will turn pink as it saturates. Replace the desiccant before the color changes completely.

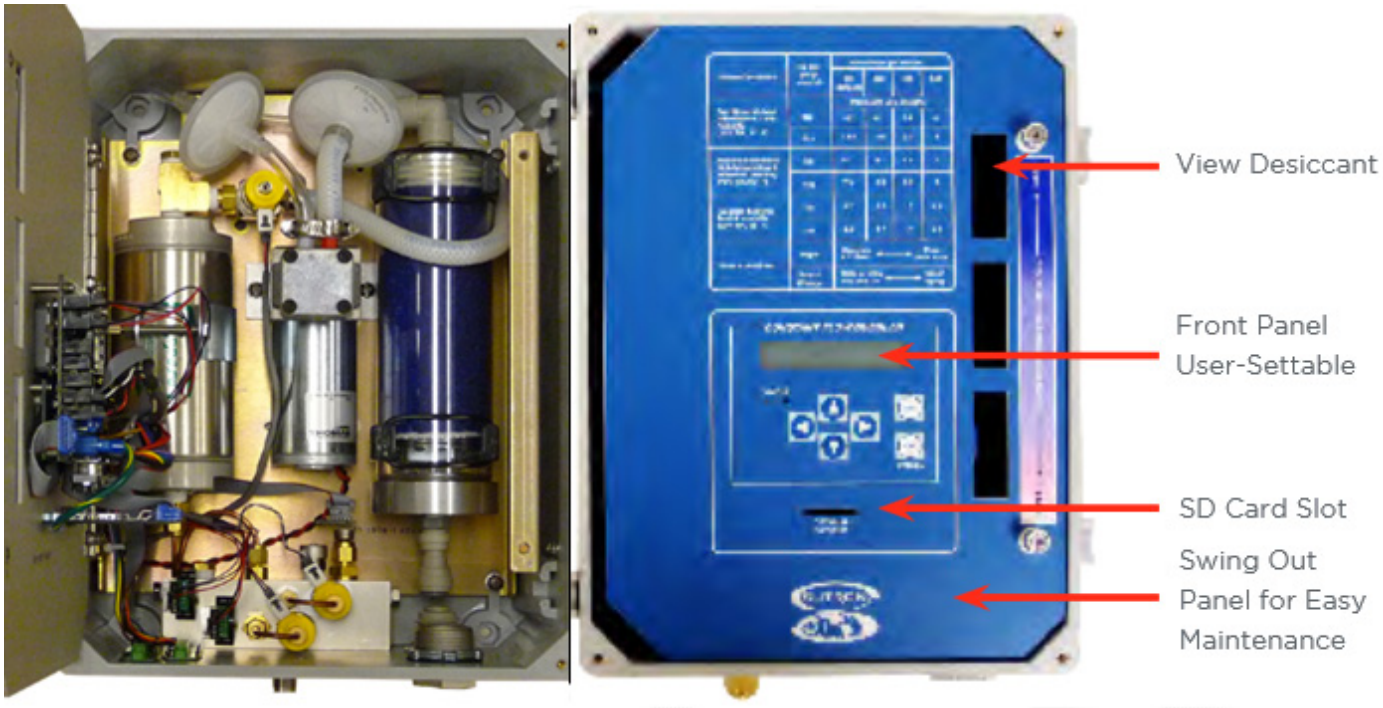
A sensor on the output side of the pump measures the back-pressure required for air to exit from the bottom of the orifice tube. Measurements require only a brief burst of air. Periodic long bursts for purging obstructions from the orifice outlet can be scheduled by frequency and duration



Sutron Single Orifice Constant Flow Bubbler

Layout (cont.): the photo shows details of the front panel and internal components. Note the electronics mounted of the back of the swing out panel. All mechanical and pneumatic parts are mounted within the space of the enclosure.

Refer to the full manual for more complete information concerning operation and maintenance schedules.



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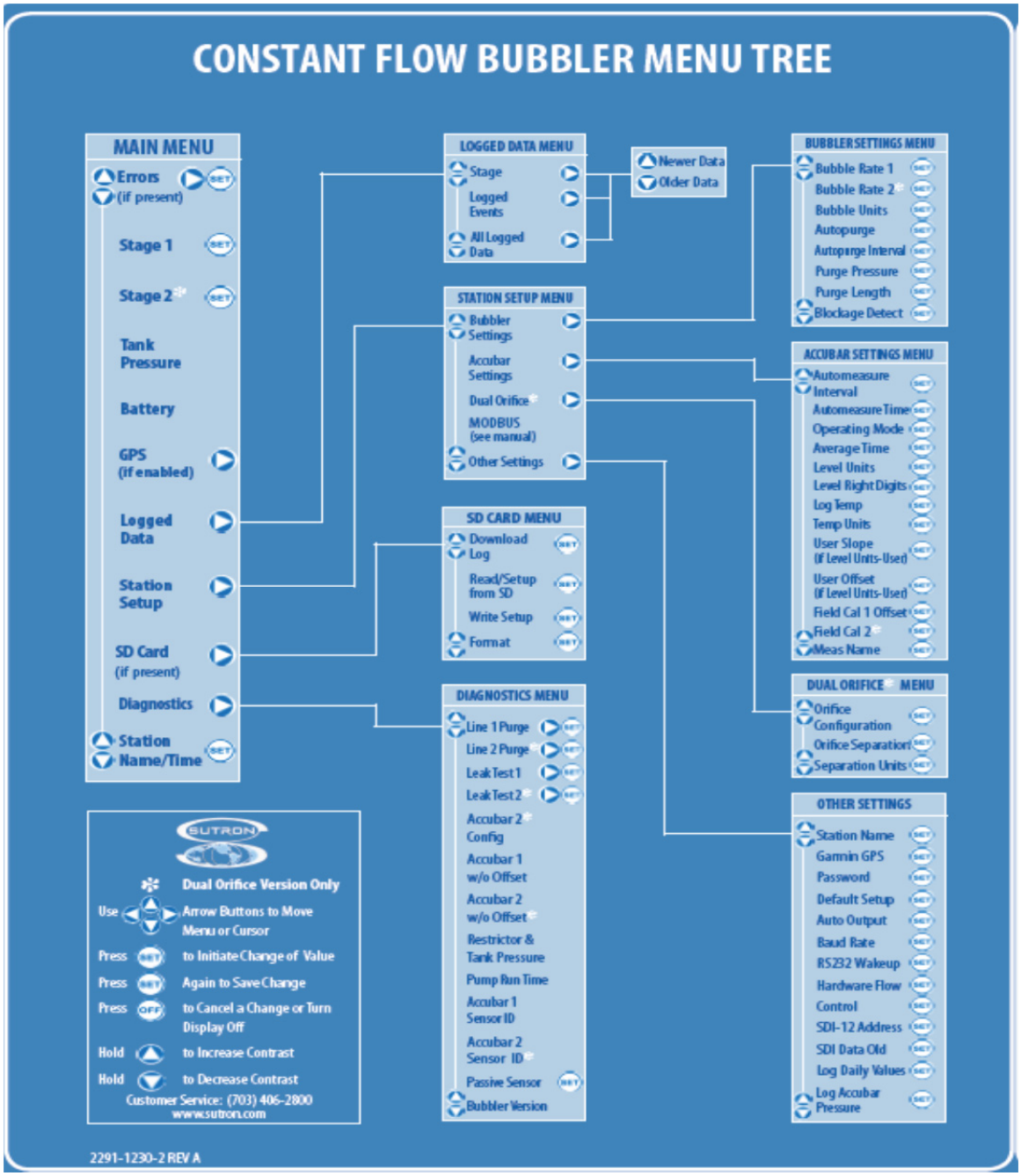
Sutron Single Orifice Constant Flow Bubbler Menu Tree

Setup Menu: This is the set up menu map to be followed for keyboard input of bubbler operating parameters: Hoskin Scientific Ltd. System Integration Division sets the unit according the scope of work before shipment to the client.



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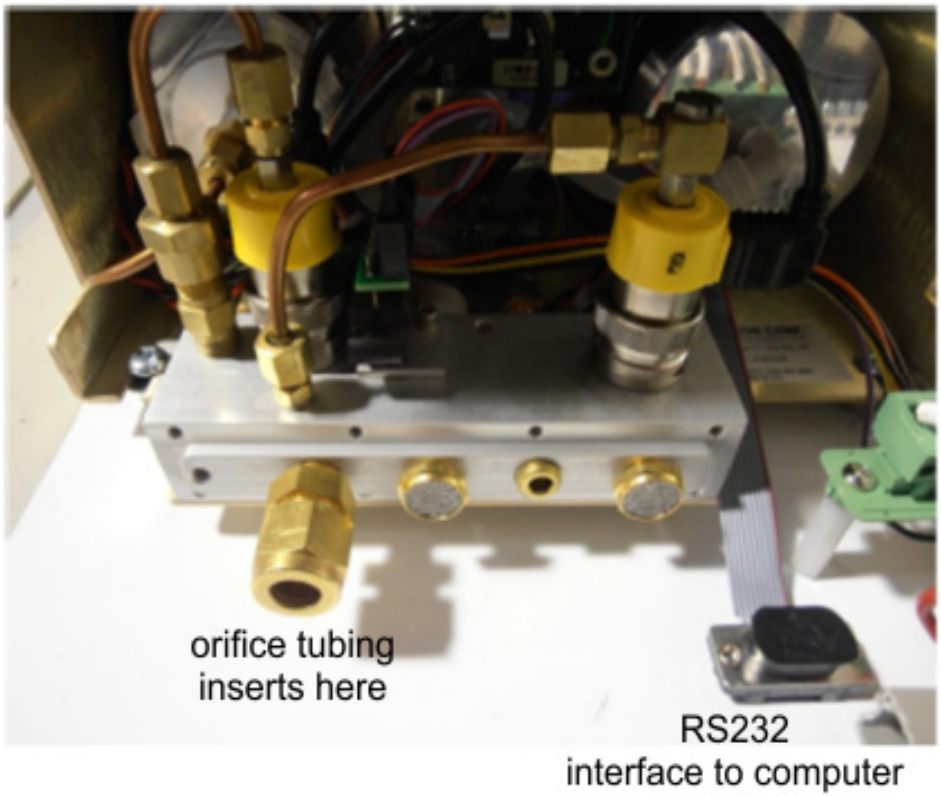
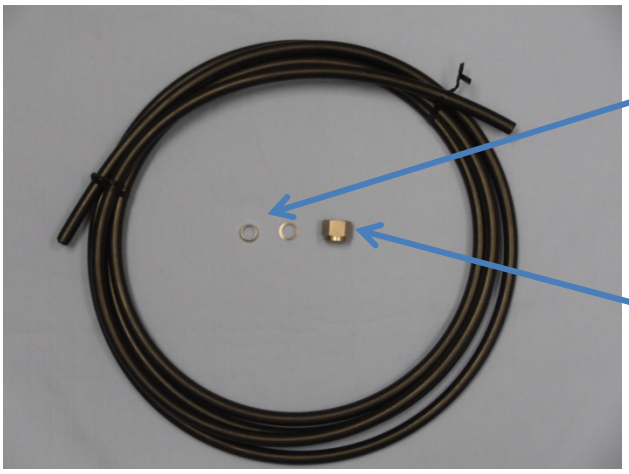
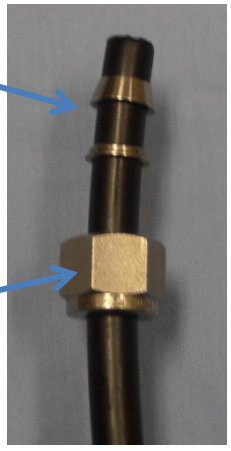
Bubbler Orifice Connector and Air Intake Valve



The Orifice Line connects as shown in picture to the left. Pass the orifice line through enclosure strain relief gland.





Insert compression fitting and compression nut as shown in picture above and tighten the nut on bubbler orifice tubing fitting.

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Sutron Single Orifice Constant Flow Bubbler Log

The Bubbler datalog is capable of holding more than 300,000 readings, and allows the recording of status and water level data. The Bubbler has an SDI-12 interface as well as RS232/RS485 so it can provide data to data loggers or other communication equipment.

Starting the Bubbler

The Bubbler starts operating as soon as power is applied. The display will turn on. If an Accubar is installed, the measurement will commence and the front panel will be updated with a water level reading. While the bubbler is operating, the status LED will flash occasionally to let you know that the bubbler is operational.

Green LED flashes every five seconds to indicate the Bubbler is operating normally
Red LED flashes if the Bubbler has encountered a problem

Check for Leaks

Leaks inside the Bubbler can be a source of inaccuracy and/or excessive pumping and use of desiccant. To check for leaks, you must cap the outlet or orifice and run the built-in leak test routine. Leak test cap comes with each unit that can be used to cap the outlet for the leak test. When the leak test completes, the system will display a status indicating whether the unit has passed or failed the leak test along with a score.

Bubbler Rate

The Bubble rate is the measure of the amount of air going down the orifice line per unit of time. Bubbler supports two units for bubble rate: Bubbles per minute (BPM) and Standard Cubic Centimeters per minute (SCCM).

The Correct bubble rate is station dependent
Sites measuring a deeper water level will require a higher bubble rate.
Sites with rapidly changing water levels will require a higher bubble rate.

Auto-Purge

The Purpose of the purge is to clear the orifice line of any obstructions, such as dirt and silt. Purging turns on the pump and builds to *purge pressure* (default 50 PSI for 25PSI units/ 70PSI for 50PSI units) and then opens the restrictor bypass valve to force the pressurized air to the outlet.

The purge may be done automatically by the bubbler. It can be done periodically, whenever the Bubbler detects a blockage, and whenever initiated by the user.
The system is preconfigured with Auto purge once a day. Blockage Detection Is also enabled.

SD Card Interface

The Bubbler supports SD card usage for downloading logged data and setup changes. An SD card is a portable media storage that is widely available on the commercial market. MMC cards may also be used with the Bubbler**.**

SD Card Log Download (2GB Max. SDHC is not supported)

To download the log using an SD card, simply plug the card in.

- If the front panel is off when the card is plugged in, an automatic log download will start in 10 seconds. The automatic download will download since last download.
- If the display is on when the card is plugged in, the download log menu will appear. Navigate the menus and choose the appropriate log download type.

There is a red LED that will light up while the SD card is in use. Please do not remove the card when it is in use.

Automatic Log Backup

If an SD card is left plugged in, the unit will perform an automatic backup of the log to the SD card. All the user needs to do is leave the SD card plugged in, and the Bubbler will periodically download the log and save it to a file on the SD card.

With an SD card left plugged in, four hours after the user stops using the display, and every four hours afterwards, the unit will download the logged data and append it to a file. Once the file exceeds about 2MB, a new file will be started. The backup will work until the SD card gets full, at which point it stops downloading.

When visiting the station for maintenance to retrieve the log, it is only necessary to remove the card that was left plugged in.

RS-232 Command Line Interface

The RS232 interface provides a simple way to connect the unit to PCs, modems and other communications devices. Microsoft Windows usually comes with a program called HyperTerminal. It can be found by going to the Windows start menu, Programs, Accessories, and Communications.

By default the RS232 interface operates at 115200 Baud, no parity, 8 data bits, 1 stop bit. Changing the baud rate can be done via the front panel: Station Setup > Other Settings, or via the command line by typing “BAUD RATE”.

If connecting to a PC, use a standard DB9 serial cable. To start command line mode, send carriage return or line feed (or both). If using HyperTerminal or a similar program, simply press ENTER. The unit will respond with a prompt >
Once in command line mode, type “HELP” to get a list of supported commands.
Please check Bubbler manual for full list of instruction

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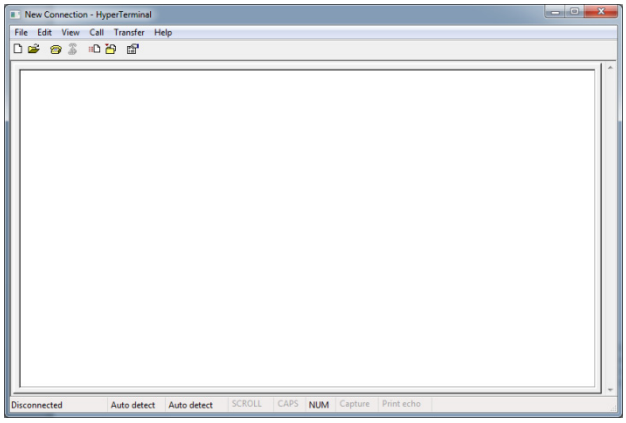
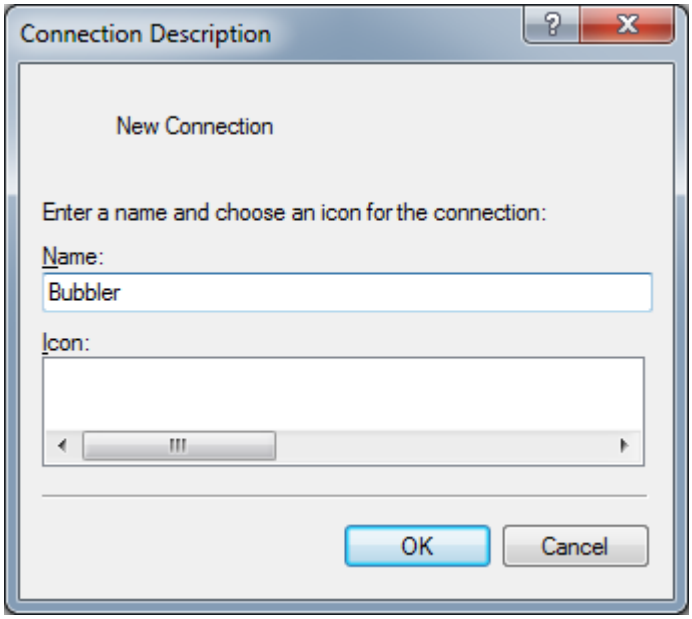
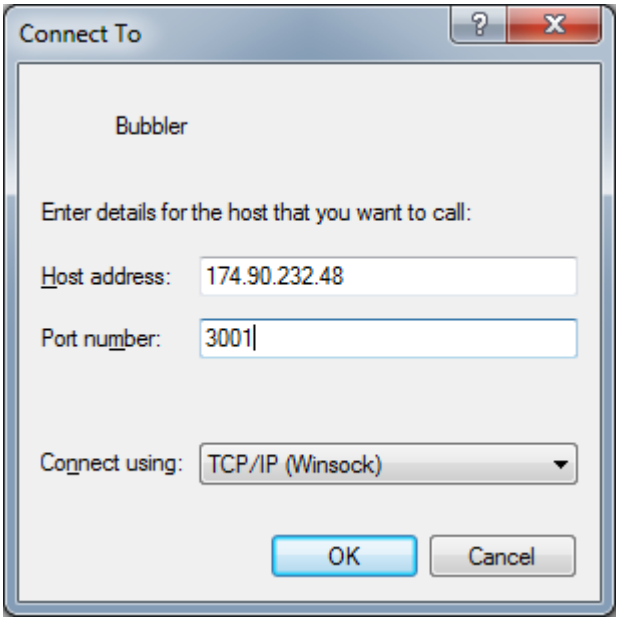
Bubbler Configuration using HyperTerminal through Cell modem or Serial Connection

To connect bubbler open HyperTerminal

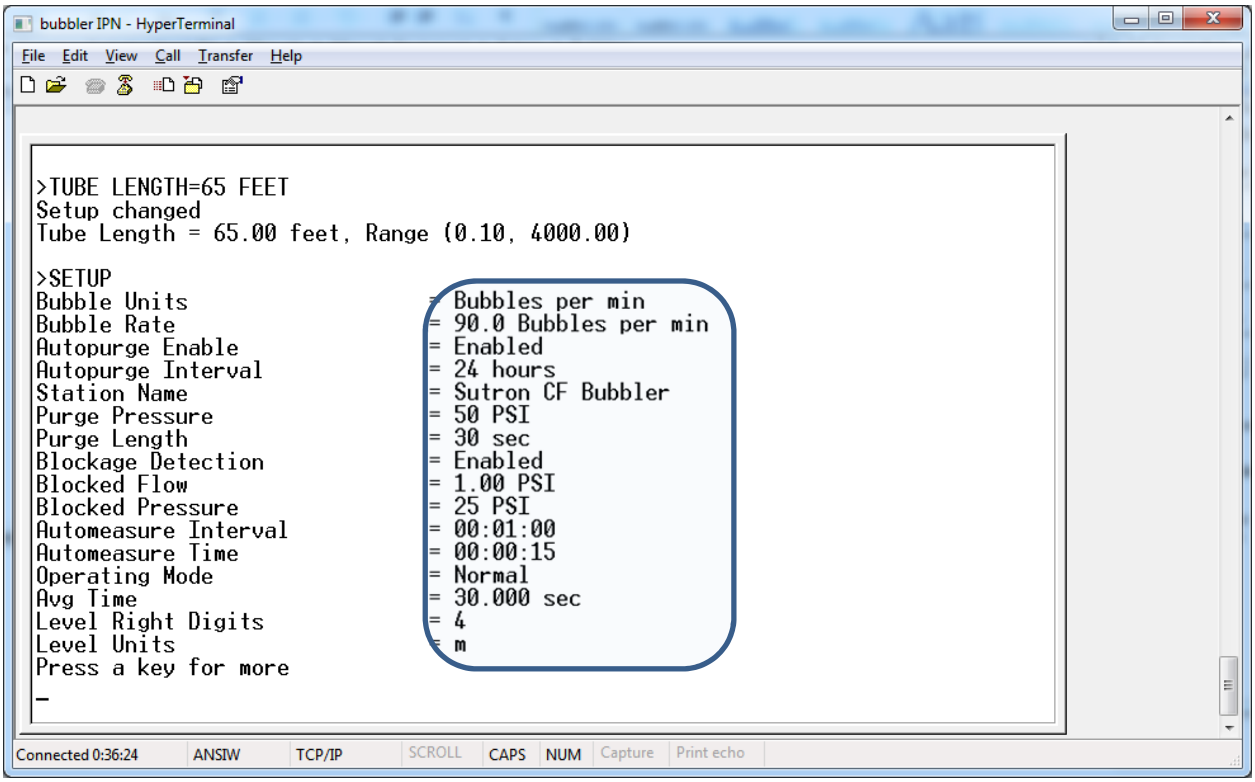


Enter COM Port or if using cellular modem enter the static IP address of your station and port number 3001. To Connect with serial cable select com port and baud rate





a successful connection will bring up the bubbler menu . Note the averaging interval of 30 seconds and automeasure interval along with the station name.



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