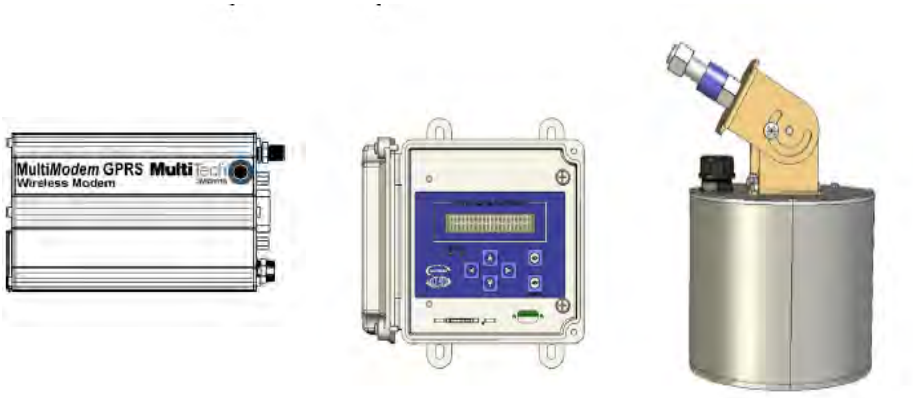
Using the SUTRON RADAR LEVEL CONTROLLER (RLR-0002-1) with a MULTIMODEM GPRS (Wireless Modem MTCBA-G-F4)



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1. PRODUCT OVERVIEW

1.1 SUTRON RADAR LEVEL RECORDER (RLR-0002-1)

The RLR-0002-1 has a front panel that allows a user to setup the operating parameters, monitor performance and perform tests. The RLR-0002-1 is both a sensor and a logger, allowing for stand-alone and integrated applications. The log inside the RLR-0002-1 is capable of holding more than 300 000 readings, and allows the recording of status and stage (stage) data. The RLR-0002-1 has an SDI-12 interface as well as RS232 so it can provide data to data loggers or communications equipment.

The RS232 port supports a simple command line mode compatible with HyperTerminal and other communications programs to display data from the log and perform some essential operating functions. It is possible to connect the radar to a modem or radio.

Features

- Non-contact measurement of stage (water level).
- Low power consumption (<1ma quiescent, <20ma measuring @ 12V) for long battery life.
- High precision featuring 0.001 ft resolution a range of 60ft.
- High accuracy 0.01ft 5- 20ft, 0.05% reading 20-60ft.
- Powerful and configurable processing filters out waves (Averaging and DQAP)
- Automatically saves data in permanent log
- User-settable measurement, logging, and averaging
- Built-in flash log for 300,000 readings safeguards your data even if power is lost
- Stand-alone operation or operation with other loggers/communications via SDI-12 and RS232
- Automatically computes discharge
- Front panel allows full access to setup, status and data
- Provides redundant data storage when connected to a logger

1.2 MULTIMODEM GPRS

The Multi-Tech MultiModem® GPRS is an external data/fax/voice wireless modem. It also supports mobile originated short message service (SMS) and mobile-terminated SMS. It offers standard-based multi-band GPRS Class 10 performance. This ready-to-deploy, standalone modem allows developers to add wireless communication to products with a minimum of development time and expense.

Features

- GPRS Class 10 operation
- Quad-band 850/900/1800/1900
- GSM Class 1 and Class 2 Group 3 FAX
- Desktop or panel mounting

- Short Message Services including text and PDU, point-to-point, cell broadcast
- 14.4K GSM circuit switched data
- SMA antenna connector and SIM socket
- Serial interface supports DTE speeds to 115.2K
- AT command compatible
- MNP2 V.42bis data compression
- Numerous LEDs provide operational status
- ME + SIM phone book management
- Fixed dialing number
- SIM Toolkit Class 2
- SIM, network and service provider locks
- Real time clock
- Alarm management
- UCS2 character set management
- Packet data up to 85K bps
- Embedded TCP/IP stack

NOTE: The purpose of this application note is to focus on the configuration and connection of the modem using the RS232 interface.
To obtain information about **General Specifications** of the previous mentioned equipments access the following web sites.

http://www.sutron.com/products/RadarLevelRecorder.htm

http://www.multitech.com/DOCUMENTS/Collateral/data_sheets/86002084.pdf

2. SETUP AND OPERATION

2.1 Starting the radar level sensor

The radar level sensor starts operating as soon as power is applied. A green blinking LED tells the user that the radar level sensor is operational. The only way to stop the radar is removing power from it.

Setting up the radar level sensor via the front panel is one option for setting Time, Baud Rate, Stage, Enable or Disable Modbus etc. (for more information see RLR-0002-1 User's manual).

2.2 Starting Multimodem

First of all, before we configure the modem, the user will need to activate the modem from a local service provider with a DATA SERVICE PLAN (Circuit Switch Data). A SIM card will be provided to the user by the service provider for each device.
IMPORTANT! **The modem should have Circuit Switched Data (CSD) enabled from the wireless carrier**.

Once the Modem has been activated, it needs to be powered up, hooked up to the antenna, configured and tested.
Requirements:

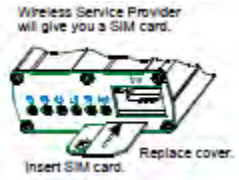
- MTCBA-G –F4 Modem
- SIM card
- RS-232 cable (15 to 9 pin)
- Power supply
- Antenna
- PC running Windows

The GSM modem comes with six LEDs indicators in the front panel. These LEDs indicate the operating status of the GSM modem which makes them very helpful when we are testing the GSM modem.

LED Indicators	
TD	**Transmit Data.** Lit when modem is transmitting data.
RD	**Receive Data.** Lit when modem is receiving data.
CD	**Carrier Detect.** Lit when data connection has been established.
LS	**Line Status.** **Continuous "on" state** indicates that the wireless modem is not registered on the network. **Flashing state** indicates registration on network. **Off state**. Modem is off (not ready) or in download mode.
TR	**Terminal Ready.** Commonly called "Data Terminal Ready." This is a readiness signal from the PC.
PWR	**Power.** Indicates presence of DC power when lit.

2.2.1 Insert SIM card

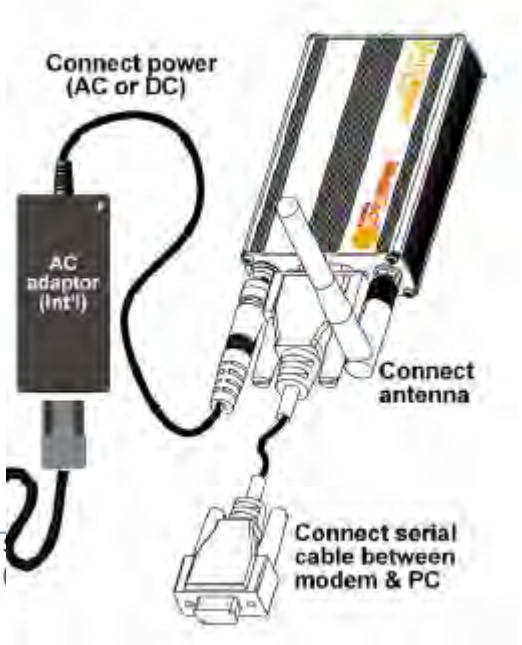
Insert the SIM card into the SIM card slot.



2.2.2

2.2.3 Powering and connecting the modem

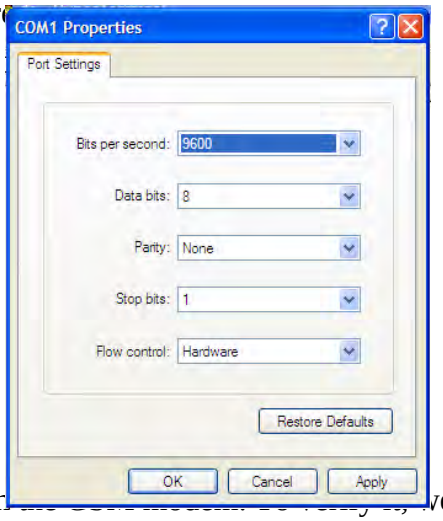
Power: Plug the power supply into the modem (via 2.5mm miniature power jack).
Antenna: Connect a suitable antenna to the SMA connector.
Serial Cable: Connect both sides of the serial and control cable (15-pin Sub D connector on the modem side)



2.2.4 Configuring the GSM Modem

In order to configure the GSM modem, you must use a terminal application such as HyperTerminal in Windows. To open this program, go to: *Start>All programs>Accessories>Communications>Hyper Terminal*.
AT commands can be used to operate, configure and query the GSM modem. A reference guide is included on the Multi-Tech Web site. AT commands used in this application notes will be necessary to configure the GSM modem for our purpose.
After we power up and connect the modem to the COM port in your PC, we should be able to communicate to the modem via Hyper Terminal. The parameters of communication for the Port Settings Tap in the Hyper Terminal configuration ar

- Bits per second: 9600
- Data Bits: 8
- Parity: None
- Stop Bits: 1
- Handshaking: Hardware.



At this point we should be able to communicate with the GSM modem. To verify it, we can type the command "AT&V" (then ENTER), this command will show the current settings of the GSM modem.
The GSM Modem programming depends on the type of interface selected in the setting of the radar level sensor (RLR-0002-1). Two modem interfaces are available to the radar level sensor: Command-line and MODBUS.
In the following sections we will explain the necessary configuration for the GSM modem and the radar level sensor in each interface: Command-line and MODBUS.

2.3 Command Line Interface

This section describes how to configure both the GSM modem and Radar Level Sensor for Command-Line interface. The MODBUS mode must be disabled in the radar level sensor to communicate via Command-line interface. This configuration will allow you to use Hyper Terminal to remote access the data in the radar.

2.3.1 GSM Modem AT commands-Command Line.

The following AT commands are required to program the GSM modem. First, you have to connect the GSM modem to a PC and configure the modem using Hyper Terminal in Windows. You must use a RS 232 serial cable to connect the GSM modem to a PC. This configuration will allow you to access the command line interface in the radar via *Hyper Terminal*. Type a <Enter> after each command.

AT+VGR=1 (Use to tune the receive gain of the speakers)
AT+VGT=255 (Use to tune the transmit gain of the microphone)
AT+CBST=7,0,1 (7 = 9600bps, 0 = only asynchronous modem, 1=Non transparent only)
AT+IPR=9600 (Data rate at which the modem will accept commands)
AT+ICF=3,4 (Character framing modem serial port 3= 8 Data 1 stop, 4= None)
AT+IFC=2,2 (Hardware flow control mode 2= RTS, 2= CTS)
AT+FCLASS=0 (0 = Data operating mode)
AT+CSNS=4 (Select de bearer 4=data)
ATS0=2 (Numbers of rings before automatic answer)
AT&D2 (Upon DTR switch from ON to OFF, the call id release)
AT&C1 (Controls Data Carrier Detect Signal (DCD))
ATQ0 (0 = Modem transmit result codes)
AT&W (Save configuration)

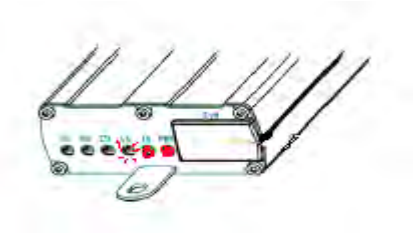
After all programming is done; you can use "AT&V" command to verify the modem configuration. This should show:

AT&V
Q:0 V:1 S0:002 S2:043 S3:013 S4:010 S5:008
+CR:0 +CRC:0 +CMEE:0 +CBST:7,0,1
+SPEAKER:0 +ECHO:0,1 &C:1 &D:2 %C:0
+IPR:9600 +ICF:3,4 +IFC:2,2

2.3.2 LED status.

The LEDs on the GSM modem front panel tell you the status of the modem. The LEDs should be as follow:

PWR Continuous ON
TR Continuous ON
LS Flashing



2.3.3 Disabling Modbus mode in the radar via front panel

Press the down arrow to **Station Setup** then press the right arrow. Press the down arrow to **Modbus Settings** then press the right arrow. Clicking the Set button select Disable.

2.3.4 Changing the baud rate in the radar via front panel

From the factory, the default baud rate setting in the radar level sensor is 115200. The modem baud rate is set to 9600. To change the radar level sensor baud rate, press the down arrow to **Station Setup** then press the right arrow. Press the down arrow to **Other Settings** then press the right arrow. Press the down arrow to **Baud Rate** then select 9600.
Now you are ready to connect the GSM modem to the Radar Level Recorder.

2.4 MODBUS INTERFACE

This section illustrates how to configure the GSM modem and Radar Level Sensor for MODBUS interface and explain how to configure AutoPoll program to support MODBUS.
MODBUS is a standard communication protocol supported by several Sutron loggers (See www.MODBUS.org).
AutoPoll is a program for the PC used to perform scheduled remote data collection from Sutron data loggers. AutoPoll supports multiple protocols, including MODBUS. AutoPoll download data .LOG files from the Radar Level Recorder. This downloaded data is saved in your PC as .CSV file.
(See : http://www.sutron.com/beta/AutoPoll/AutoPoll.htm for more information)

2.4.1 GSM Modem AT commands- MODBUS

The following AT commands are required to program the GSM modem so the modem can communicate properly with the PC via MODBUS interface.
First, you have to connect the GSM modem to a PC and configure the modem using Hyper Terminal in Windows. You must use a RS 232 serial cable to connect the GSM modem to a PC.
Type a <Enter> after each command.

AT+VGR=1	(Use to tune the receive gain of the speakers)
AT+VGT=255	(Use to tune the transmit gain of the microphone)
AT+CBST=0,0,1	(0 = Autobauding, 0 = only asynchronous modem, 1=Non transparent only)
AT+IPR=9600	(Data rate at which the modem will accept commands)
AT+ICF=3,4	(Character framing modem serial port 3= 8 Data 1 stop, 4= None)
AT+IFC=0,0	(Hardware flow control mode 0= none, 0= none)
AT+FCLASS=0	(0 = Data operating mode)
AT+CSNS=4	(Select de bearer 4=data)
ATS0=1	(Numbers of rings before automatic answer)
AT&D2	(Upon DTR switch from ON to OFF, the call id release)
AT&C1	(Controls Data Carrier Detect Signal (DCD))
ATQ1	(1 = Result codes suppressed, no transmitted)
AT&W	(Save configuration)

The modem is now configured for use with the Radar Level Recorder and Autopoll using MODBUS over the GSM modem. To verify this configuration use “AT&V” command. This should show:
AT&V
Q:1 V:1 S0:001 S2:043 S3:013 S4:010 S5:008

+CR:0 +CRC:0 +CMEE:0 +CBST:0,0,1
+SPEAKER:0 +ECHO:0,1 &C:1 &D:2 %C:0
+IPR:9600 +ICF:3,4 +IFC:0,0.

2.4.2

2.4.3 Configuring the Radar – MODBUS

The radar (RLR-0002-1) can be configured from the front panel. The following configuration is necessary to use MODBUS interface over GSM modem.

2.4.3.1 Enabling MODBUS

Press the down arrow to **Station Setup** then press the right arrow. Press the down arrow to **Modbus Settings** then press the right arrow. Clicking the Set button select Enable.

2.4.3.2 Set Modbus Device ID

Press the down arrow to **Station Setup** then press the right arrow. Press the down arrow to **Modbus Settings** then press the right arrow. Press down arrow to **Modbus Device ID.** Clicking the Set button select the ID number (This ID number must be the same that will select in Autopoll configuration)

2.4.3.3 Set Modbus Protocol

Press the down arrow to **Station Setup** then press the right arrow. Press the down arrow to **Modbus Settings** then press the right arrow. Press down arrow to **Modbus Protocol.** Clicking the Set button select RTU

2.4.3.4 Set Modbus Parity

Press the down arrow to **Station Setup** then press the right arrow. Press the down arrow to **Modbus Settings** then press the right arrow. Press down arrow to **Modbus Parity.** Clicking the Set button select None

2.4.3.5 Set Delay Before Tx

Press the down arrow to **Station Setup** then press the right arrow. Press the down arrow to **Modbus Settings** then press the right arrow. Press down arrow to **Delay Before Tx.** Clicking the Set button select 10 ms

2.4.3.6 Set Delay After Tx

Press the down arrow to **Station Setup** then press the right arrow. Press the down arrow to **Modbus Settings** then press the right arrow. Press down arrow to **Delay After Tx.** Clicking the Set button select 10 ms

2.4.3.7 Set Modbus BaudRate

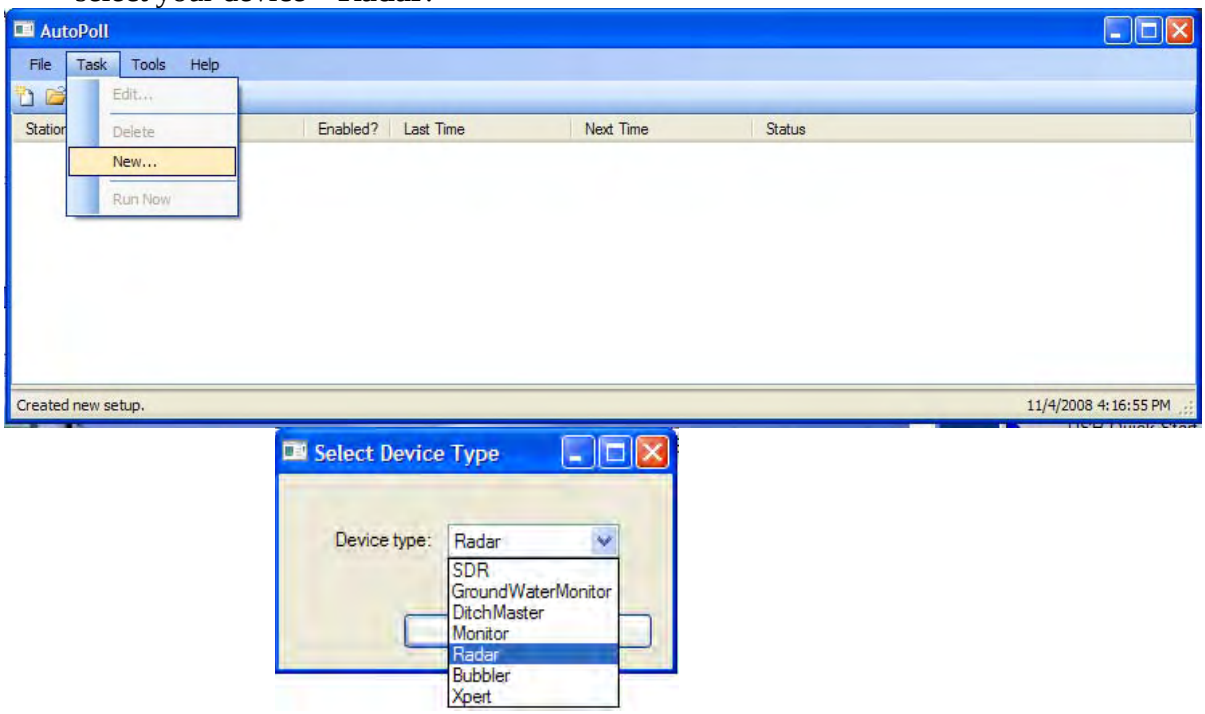
Press the down arrow to **Station Setup** then press the right arrow. Press the down arrow to **Modbus Settings** then press the right arrow. Press down arrow to **Modbus BaudRate.** Clicking the Set button select 9600.

2.4.4 Configuring AutoPoll

This section explains how to set up AutoPoll to support MODBUS interface. You have to install AutoPoll program in your PC. The AutoPoll installation package and manuals may be obtained from http://www.sutron.com/.

2.4.4.1 Configure a New Task in AutoPoll

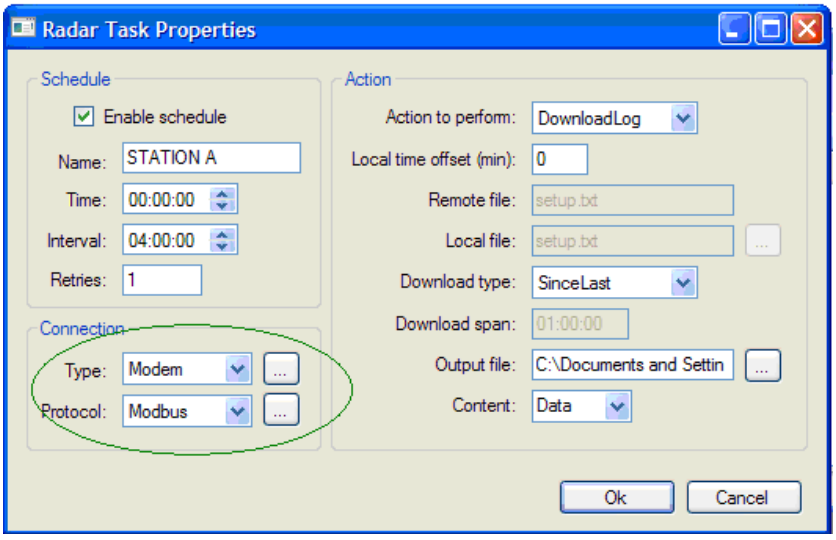
A New Task in AutoPoll must be created to configure the PC modem, Serial port and the Modbus properties in Autopoll. Select AutoPoll>Task>New from the main menu. Next select your device – **Radar**.



Setting up the radar task properties

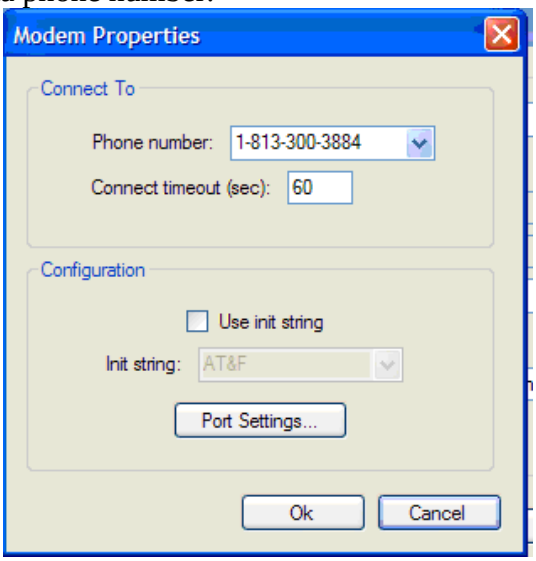
The Task properties window will appear after selecting your device. In the Connection group box, select:

- Type= Modem
- Protocol=Modbus



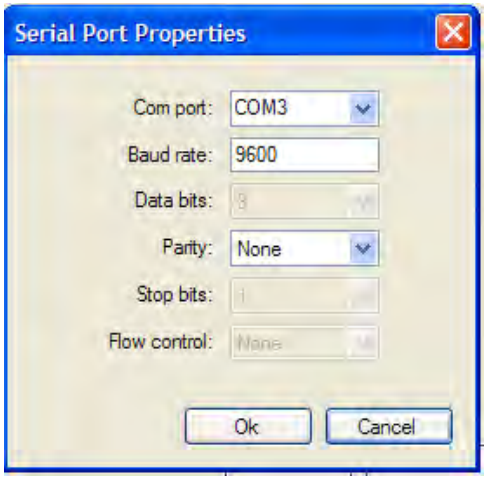
Modem Properties.

Clicking the (…) button next to the Type field opens the PC modem properties window. Enter your GSM data phone number.



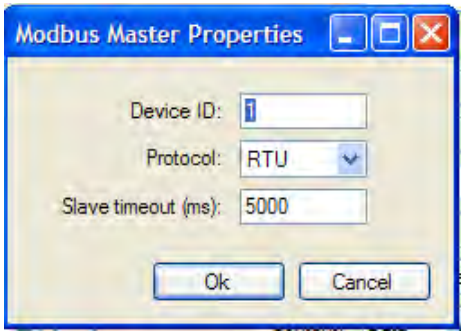
Click Port Settings button. Enter the settings below. Click OK when finished to return to the Task Properties window.

- Com port: Com port where the PC modem is connected
- Baud Rate: 9600
- Data Bits: 8
- Parity: None
- Stop bits: 1
- Flow control: None



2.4.4.2 Modbus Master Properties

In the Radar Task Properties window, click the (…) button next to the Protocol. The Modbus Master Properties window.



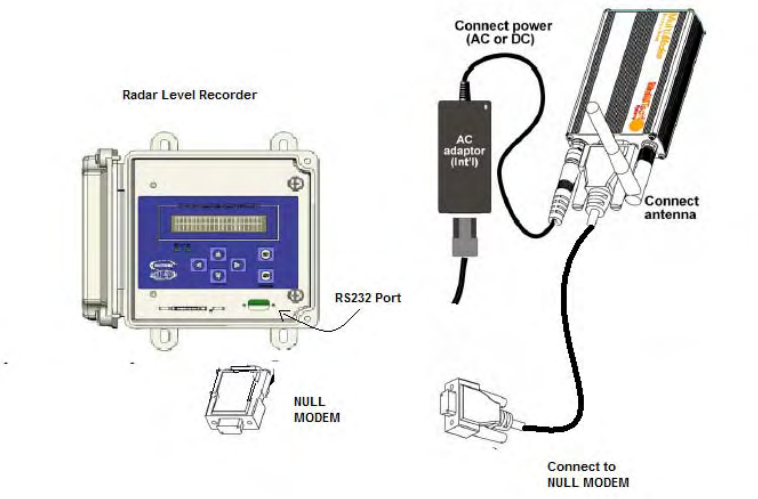
Enter the settings below:

- Device ID: Should be the same device ID that we select in the radar configuration.
- Protocol: RTU
- Slave timeout: 5000

2.5

2.6 CONNECTING GSM MODEM TO THE RADAR

After the radar sensor and GSM modem have been configured, we use the RS-232 interface to connect the radar to the wireless modem using a NULL MODEM CONNECTOR.



2.7

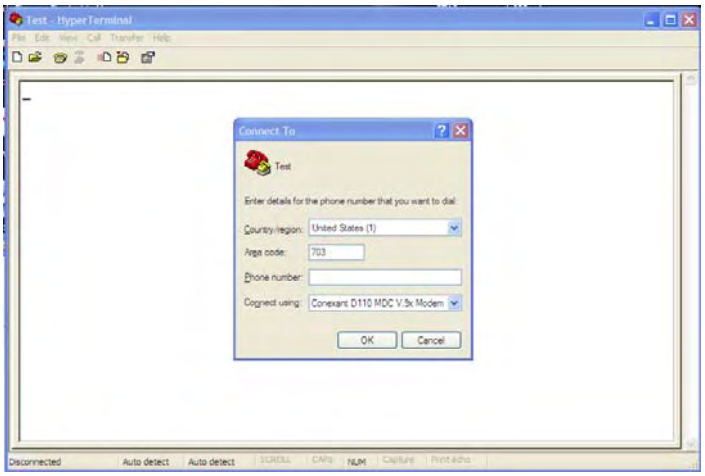
2.8 TESTING MODEM WITH RADAR LEVEL SENSOR

2.8.1 COMMAND-LINE INTERFACE

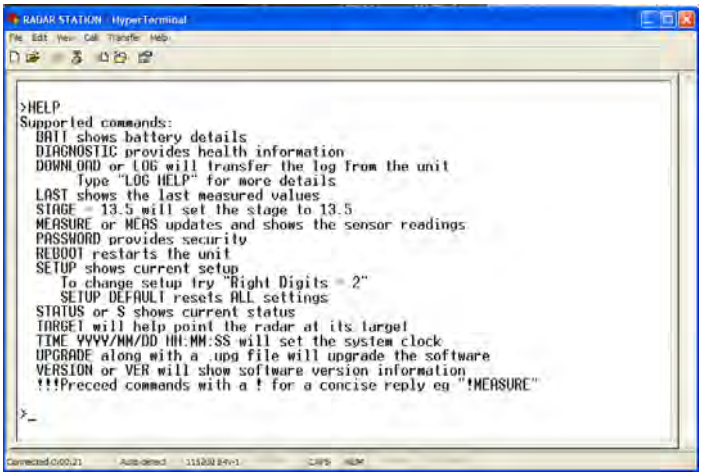
This example will show you how to test GSM modem with the Radar Level Sensor (RLR-0002-1). We use a HyperTerminal session in Windows to communicate with the GSM modem connected to the RLR-0002-1 sensor.

In one side you should have the RLR-0002-1 sensor connected to the GSM modem (See configuration in COMMAND LINE INTERFACE section, page 7) and in the other side your PC connected to a phone line.

First you have to start a Hyper Terminal session on Windows as follows: Start > Programs > Accessories > Communication > Hyper Terminal. This will show this window.



Then, in the **Connect To** window enter the data GSM modem phone number and click OK. After this, click Dial and you will connected and ready to retrieve data from the RLR-0002-1 sensor. The command prompt symbol (>) will appear in the HyperTerminal window. This shows that you are connected with the GSM modem. In this example we type the HELP command for illustration.



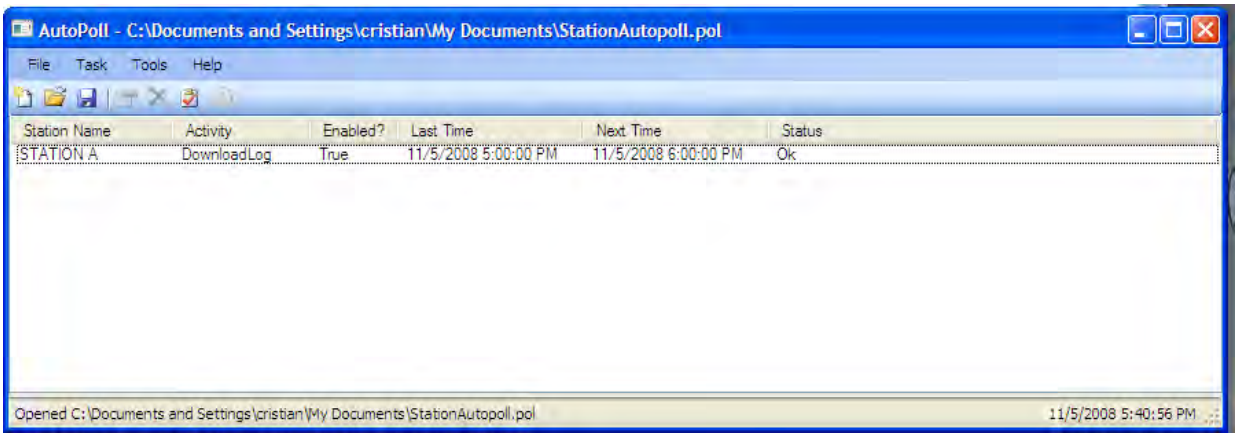
A list of command-Line commands is provided in the APPENDIX A at the end of this application note.

2.8.2 MODBUS INTERFACE

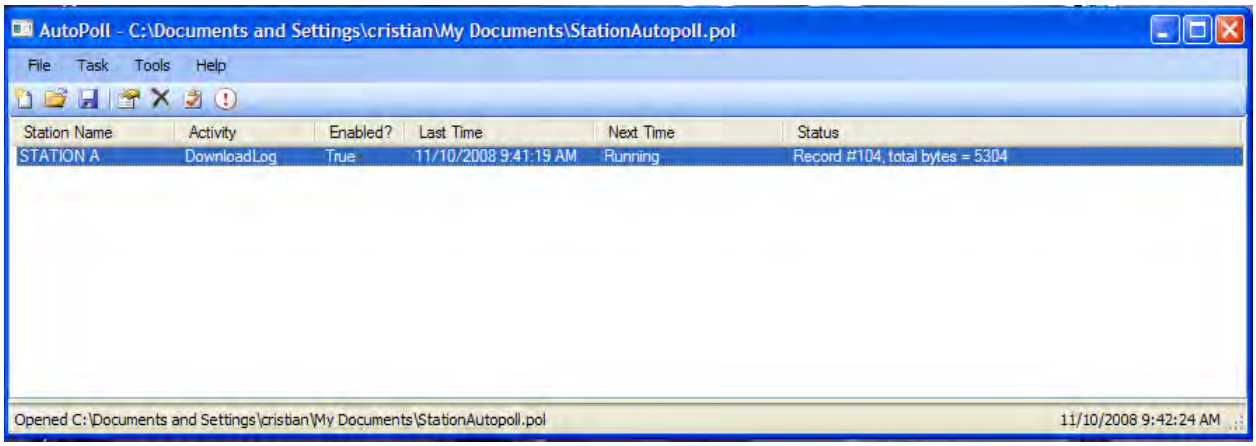
We are going to use an example to test the GSM modem with the radar level sensor. In this example we use AutoPoll program to retrieve log data from the radar level sensor connected to a GSM modem. The configuration for the equipment is in MODBUS INTERFACE section (page. 8).

At this point, in one side the radar level recorder sensor should be connected to the GSM modem and in the other side AutoPoll running in your PC (You must connect a phone line to the PC modem).

AutoPoll in your PC will show as follow



This indicated that your connection with the GSM modem is OK. Then, you can click over this task and then right click to select **Run Now**. AutoPoll will star to retrieve data (.LOG file) from the Radar Level Recorder sensor.



The status field in the AutoPoll window will show you the record number and the total bytes that are downloading. If you want to see the retrieved data, browse for the .CSV file (the default path is My Documents / Radar.csv)

3. APPENDIX A : COMMAND LINE INTERFACE:

3.1 List of commands

BATT +

Shows the current battery reading.

DIAG + 0

Shows system diagnostics, including system resets. If followed by 0, it will clear system resets.

DOWNLOAD

See LOG

EXIT

Quits command line.

HELP

Brings up the end user help (lists commands).

HI

System replies with “Hello”

LAST +

Shows the last auto measured reading.

LOG

This command is used to download the log. It can be followed by optional parameters indicating what part of the log to download.
LOG with no parameters will download since last.
“LOG ALL” gets whole log.
“LOG X” gets X last days ("LOG 3" gets last 3 days worth of data)
“LOG timeStart” gets data since provided date
“LOG timeStart timeEnd” gets data between provided dates
time can be YYYY/MM/DD HH:MM:SS or YYYY/MM/DD or HH:MM:SS
e.g. "LOG 12:00:00 13:00:00"
e.g. "LOG 2006/01/20 12:00:00 2006/01/21 12:00:00"
The file name for the downloaded log has the format

Stationname_log_YYYYMMDD.csv where YYYYMMDD is the date of the first data in the log file

The data in the log file consists of some header lines to document important station information followed by data. The following are examples of the header lines :

Station Name, WDID, model and version, Measuring Point, Operating Mode, Avg Time, DQAP, Sample Form Period
Sutron Radar, 20003, RDR ver. 1.11, 48.24659 feet, Normal, 10.000 sec, Disabled, 1.0 sec
PWM Slope, Factory Offset, SigStrCal
0.75743, -2.216, 3.195
Discharge, Equation, Parshall Flume Width, Weir Coefficient W, Coefficient A, Coefficient B, Gauge Height Shift
Enabled, Generic: A*(Stage^B), 12 inches, 1, 1, 1.5, 0.1

The header lines are followed by data in the following format:
Name, Date, Time, Value, Units, Quality
The following are examples of the logged data:

Display On, 8/9/2007, 17:20:37
Display Off, 8/9/2007, 17:25:52
Stage, 8/9/2007, 17:30:00, -23.2459, feet
Setup Change, 8/9/2007, 17:30:40
Before Cal, 8/9/2007, 17:30:40, -23.2466
After Cal, 8/9/2007, 17:30:40, 25
Stage, 8/9/2007, 17:45:00, 24.9958, feet
Stage, 8/9/2007, 18:00:00, 24.9963, feet
Stage, 8/9/2007, 18:15:00, 24.9994, feet
Stage, 8/9/2007, 18:30:00, 25.006, feet
Stage, 8/9/2007, 18:45:00, 24.9952, feet
Stage, 8/9/2007, 19:00:00, 25.0002, feet

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LOG HELP
Shows details on how to use the download command.

STAGE = 14.5
Changes the current stage to 14.5 (of whatever units are currently chosen). User can choose any number, not just 14.5. Please see the section Setting Stage on page 13.

MEAS +
Initiates, waits for, and shows the results of sensor measurements.

REBOOT
Does a software resets of the system.

RESETS + 0
Shows system diagnostics, including system resets. If followed by 0, it will clear system diagnostic status.

SETUP
If provided without any other parameters, it lists all setup details. That includes each setup variable and its current value.
Can be followed by a setup variable name and a new value for that variable.
E.g. "CHANGE STATION NAME = SUTRON"
If SETUP DEFAULT is issued, it will reset the entire setup to defaults.

STATUS 0
Shows system status including time, boot time, battery readings, last Radar measurements, current onboard sensor readings, and any hardware errors that may exist. If followed by 0, it clears the hardware errors.

TIME
Shows the current system date and time. If followed by a new time, it changes the system time.

UPG +
Initiates a system software upgrade. It needs to be followed by the YModem transfer of an .upg file specific to the product. Both the main application and the bootloader are upgraded this way (but each needs its own .upg file).

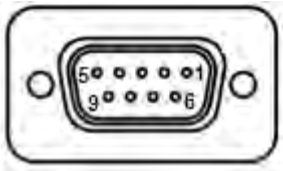
VER +
Shows the current software version, including build date and time and the bootloader version.

4. APPENDIX B : CABLING

4.1 RLR-0002-1 (DB9 Connector)

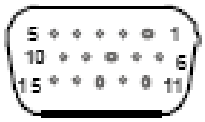
The radar level sensor comes with a DB9F connector for connection to RS-232 devices. The DB9F can be connected to the serial port on most PCs using a straight cable. A null modem adapter is needed to connect to most PDAs and modems. This connector allows for access to the command line interface using a terminal program. Some modems and radios can be connected to this port. A logger can be programmed to use this port. The following table shows the pin assignments of the DB9F connector.

DB9F Pin	Name	Notes
1	N/C	No Connection
2	RXD	Data from Radar
3	TXD	Data to the radar
4	DTR	Signal to the radar
5	Ground	
6	N/C	No Connection
7	RTS	Request to Send, signal to the radar
8	CTS	Clear to Send, signal from the radar
9	*VOUT*	*Jumper selectable for 5V or VBAT (100ma max)*



4.2 MTCBA-G-F4 (RS-232 15-Pin Connector Pinout)

The Wireless Modem has a DE15-serial connector incorporated which includes a RS-232 interface link, audio link, Boot and reset. This connector allows for access to the command line interface using a terminal program such as HyperTerminal of Windows. The following table shows the pin assignment.



	PIN	EIA	CCIT	Designation
RS-232	1	DCD	109	Data Carrier Direct
	6	RX	104	Receive Data (out)
	2	TX	103	Transmit Data
	8	DTR	108.2	Data Terminal Ready
	9	GND		Signal Ground
	7	DSR	107	Data set ready
	12	RTS	105	Request to Send
	11	CTS	106	Clear to Send
	13	RI	125	Ring Indicator
Audio	4	MIC (+)		
	5	MIC(-)		
	10	SPEAKER(+)		
	15	SPEAKER(-)		
Boot	3	BOOT		For factory use only
Reset	14	RESET		To reset, connect toGND momentarily (Typical: 2mSec). Open for normal operation.