Micro Specialties, Inc.
CR1000 Data Collection Program
Version 1040
Document Revised June 27, 2013

Station Type	Update Rate	Data Groups	Sensor Fields	Xmit Rate
SNOTEL SnowDepth, AirTemp (1040.33)	60 seconds*	One	6	6 hours
SNOTEL SnDepth, AirT, Soils (1040.53)	60 seconds*	One	21 or 22	6 hours

*see sensor configuration table below for individual sensor sample rate

Current Revisions: 1040.33, 1040.53

CR1000 data collection program version 1040 is a *Global Modem* telemetry program for the CR1000 data logger. This program has a normal sensor update rate of 60 seconds, and produces a data report every 6 hours via Global Modem and logging storage. The telemetry values are sent using the FP2 short floating point numeric system. Each value occupies 16 data bits.

This program utilizes three Hydra 2 soil probes. The program expects to find 3 probes connected to C1. These probes must have probe IDs of 1, 2 and 3. Any probe connected that has an ID other than 1,2 or 3 will be ignored.

Upon program initialization the program configures probe ID 1 through probe ID 3 to provide the hydra2 measurement set ABCDF as the default measurement.

Revision History

Revision 1040.0
Initial release of 12/6/2011

Revision 1040.01 (12/13/2011)
- Fixes the issue where the midnight report contained all zero values.
- Correctly disables fastUpdate at midnight.
- Correctly saves setup parameters

Revision 1040.20 (12/23/2011)
- Report interval changed to 6 hours
- SixHour Table added

Revision 1040.23 (2/23/2012)
- Move C8 pulse sampler out of the fastUpdate loop, so that a report can be triggered even if fastUpdate is disabled.

Revision 1040.30 (6/6/2012)
- Removes Judd air temperature measurement and Judd type selection, since the time-to-sample for depth is always the same.
- Adds a YSI 44211 thermistor as on SE9, VX1
  - airTemp_mv is the raw 0 to 5000mv voltage sample of the YSI.
  - airTemp_C is the current air temperature in deg C, derived from the YSI
- Sensors reported via GlobalModem at 6 hour interval:
  1. BattVolt - volts
  2. AirTemp_mv - millivolts
  3. MaxAirTemp - millivolts
  4. MinAirTemp - millivolts
  5. AvgAirTemp - millivolts
  6. snowDepth - inches

Revision 1040.31 (6/10/2012)
- Samples Snow Depth sensor hourly unless fastUpdate is > 0 in which case it is sampled every 10 seconds for testing purposes.

Revision 1040.32 (6/20/2012)
- Sets sample rate for air temperature to 60 minutes.

Revision 1040.33 (8/20/2012)
- Sets sample rate for air temperature to 60 seconds.
- Adds two new Public variables to keep track of report performance:
  - rptAttempts – Number of reports attempted.
  - rptFailures – Number of reports which were not delivered (failed).

Revision 1040.50 (8/21/2012)
- Adds three Hydra 2 soil probes, which are appended to the end of the record.

Revision 1040.51 (8/21/2012)
- Adds a 100" PMP317 Druck storage precipitation sensor. This sensor is disabled by default, but may be enabled by setting the Public variable "hasPrecip" to 1.0. If hasPrecip is greater than zero, the sensor is sampled along with the other sensors, and the precip value is added to the telemetry report in the second position (after the battery voltage).

Revision 1040.52 (8/30/2012)
- Uses the hydra2 soil probe's default measurement set to return V1 through V4 and SoilTemp in degrees C in response to the M! command.
- Upon program initialization the program now configures probe ID 1 through probe ID 3 to provide the hydra2 measurement set ABCDF as the default measurement.

Revision 1040.53 (10/3/2012)
- Changes the order of values in the telemetry data report soils section from
  h1v1,h1v2,h1v3,h1v4,h1degC…
    to
  h1v1,h1v2,h1v3,h1v4,h2v1…h3v4,h1degC,h2degC,h3degC

- This groups all of the soil voltages together, followed by all of the soil temps.

Special Feature Notes

This program has several special features which will allow it to be used in multiple data sites without revision. These features, however, require some attention and manipulation by the installation and service technicians.

1. **Temporary Rapid Sensor Update** - A special Public variable, **fastUpdate**, will increase the sensor update rate to 10 seconds, when its value is 1. At power up, fastUpdate is always set to 1, enabling rapid sensor update for test purposes. At midnight, fastUpdate is automatically reset to 0, reducing the sensor update rate to 1 minute. This variable may be edited to increase the sensor update rate at any time, but its value will always return to 0 at midnight to fix the update rate to 60 minutes.

2. **Site ID** - A numeric value may be entered which will serve as a site identifier such as the site's SNOTEL ID. This will help to ensure that data records are never transposed among the various sites. Edit the Public variable, **siteID** with LoggerNet to set the site identifier. The siteID is logged in all data tables, but is never transmitted via telemetry.

Site and sensor variables are initialized to default values when the program is sent to the CR1000. The technician should always verify that the variables are acceptable before leaving the site. **Figure One** (page 3) shows an example of **Public Variables**, which may be modified by right clicking, then editing each variable on a NUMERIC DISPLAY within LoggerNet. The sixHour table always contains the column named stoPrecip even if hasPrecip is zero.

Sensor Configuration

SENSOR	INPUT	EXITATION	XTROL	VARIABLE	SAMPLE RATE	SENSOR MODEL
Site Battery	Internal			Batt_volt	60 seconds	
Air Temperature	SE9	VX1		airTemp_C	60 seconds	YSI 44211 thermistor
Snow Depth	DIFF7	12V	C3	snowDepth	60 minutes	Judd Snow Depth sensor
Soil Parameters	C1	SW12V or 12V		h1V1 to h3V5	60 minutes	Hydra 2 (SDI-12)

Control Port Assignments

CONTROL	FUNCTION
C1	SDI12 interface for Hydra2 probes
C2	None
C3	Judd Snow Depth control
C4	Global Modem power enable
C5	Serial data out to Global Modem
C6	Serial data from Global Modemt
C7	None
C8	Force a Global Modem data message

Special <u>Setup</u> Variables
Important: These variables are saved frequently to the Setup table so that the values are retained in the event of power failure. These variables are reset to default values whenever the program is loaded, or reloaded into the CR1000.

Label	Functionality (Public Table)
SiteID	Numeric ID to identify the particular site. Not included in telemetry report
hasPrecip	Set to 1 to enable the precip sensor and include precip in the telemetry reports

Current Sensor Value Locations (Public Table)

These are **public** variables, which contain the current sensor readings. Version 1040.53

Label	Functionality
Batt_Volt	Site Battery Voltage. Requires a battery voltage divider connected to the site battery.
stoPrecip	Storage Precipitation in inches. (only valid if hasPrecip > 0)
airTemp_C	Air Temp deg C
snowDepth	inches to soil or snow * -1
h1V1*	Soil probe ID 1 voltage 1 * Program Rev 1040.53 and above only
h1V2*	
h1V3*	
h1V4*	
h2V1*	
h2V2*	
h2V3*	
h2V4*	
h3V1*	
h3V2*	
h3V4*	
h1degC*	Soil probe ID 1 temperature in degrees C
h2degC*	
h3degC*	

Daily Sensor Value Locations (Daily Table)

These are public variables, which contain daily values processed by the program.

Label	Functionality
siteID	This site's SNOTEL ID as entered at program load
Batt_Volt	Midnight battery voltage sample
MaxAirTemp	Daily Maximum Air Temperature
MinAirTemp	Daily Minimum Air Temperature
AvgAirTemp	Daily Average Air Temperature
snowDepth	Midnight Sample

sixHour Sensor Value Locations (sixHour Table)

These are public variables, which contain six hour interval values processed by the program.

Label	Functionality
siteID	This site's SNOTEL ID as entered at program load
Batt_Volt	Current Battery voltage sample
stoPrecip	Current Storage Precipitation sensor sample *Program rev 1040.51 only if hasPrecip > 0
AirTemp_mv	Current Air Temperature in millivolts
snowDepth	Current Snow Depth in inches
*h1V1	Current Hydra 2 soil probe 1 voltage 1 *Program Rev 1040.50 and above
*h1V2	Current Hydra 2 soil probe 1 voltage 2
*h1V3	Current Hydra 2 soil probe 1 voltage 3
*h1V4	Current Hydra 2 soil probe 1 voltage 4
*h1degC	Current Hydra 2 soil probe 1 Soil Temp in degC
*h2V1	
*h2V2	
*h2V3	
*h2degC	
*h2V5	
*h3V1	
*h3V2	
*h3V4	
*h3degC	

Telemetry Data Reports

Important: **Hourly reports are sent to the Global Modem and are also logged to the CR1000 Data Tables. All Global Modem values are sent in FP2 format, 16 bits per value.**

Six Hour report - group 1

Position	Sensor Value	
1.	Site Battery Sample	
2.	StoPrecip Sample	Program Rev 1040.52 only and if hasPrecip > 0
3.	AirTemp Sample	
4.	AirTemp Daily Maximum	
5.	AirTemp Daily Minimum	
6.	AirTemp Daily Average	
7.	SnowDepth Sample	
8.	Hydra2 Probe1 V1	Program Rev 1040.52and above
9.	Hydra2 Probe1 V2	Program Rev 1040.52and above
10.	Hydra2 Probe1 V3	Program Rev 1040.52and above
11.	Hydra2 Probe1 V4	Program Rev 1040.52and above
12.	Hydra2 Probe1 degC	Program Rev 1040.52and above
13.	Hydra2 Probe2 V1	Program Rev 1040.52and above
14.	Hydra2 Probe2 V2	Program Rev 1040.52and above
15.	Hydra2 Probe2 V3	Program Rev 1040.52and above
16.	Hydra2 Probe2 V4	Program Rev 1040.52and above
17.	Hydra2 Probe2 degC	Program Rev 1040.52and above
18.	Hydra2 Probe3 V1	Program Rev 1040.52and above
19.	Hydra2 Probe3 V2	Program Rev 1040.52and above
20.	Hydra2 Probe3 V3	Program Rev 1040.52and above
21.	Hydra2 Probe3 V4	Program Rev 1040.52and above
22.	Hydra2 Probe3 degC	Program Rev 1040.52and above

Setting the Site ID Variable

This program saves a variable named **SiteID** in the data summaries to help eliminate the possibility of confusing data records among the various data sites. To adjust the SiteID, simply **right click** then edit the location on the Numeric Display. The new SiteID will then be included in all subsequent data table summaries, but is never included in telemetry reports.

Forcing a Data Message

This program normally generates one or two data messages at the end of each hour. These data message are sent to the *Global Modem* data modem. Usually it is highly inconvenient to wait for the end of the hour when one wishes to observe a data message being delivered to the *Global Modem* data modem. By temporarily connecting **5V** to **C8** on the CR1000 wiring panel, the technician can force the CR1000 to immediately send its hourly data messages to the *Global Modem* data modem.

Use the following procedure to force a new data message, and observe it at the *Global Modem* operator's console.
1. After completing sensor validation with LoggerNet, make sure the CR1000 public variable **msgSent** is visible in LoggerNet's Numeric Display.
2. On the CR1000 Wiring Panel, momentarily connect a jumper wire between **5V** and **C8**. This will initiate a new data message from the CR1000 within 10 seconds.
3. Observe the three lights in the *Global Modem* front panel window. Two lights should light within 10 seconds of step 2, above. This indicates that power has been applied to the *Global Modem* circuit board and the satellite RF unit.
4. After a few seconds, the third *Global Modem* light should illuminate, indicating that the modem can see the Iridium satellite constellation.
5. In a few seconds, all three lights should go out. This indicates that the modem has delivered the data message to the Iridium network for delivery to AMBCS.

6. You can verify that the data message was delivered by observing the following CR1000 variables:
   - **commState** – holds the text value "msgSent" if the current message has been delivered across the network, or "Msg Failed" if repeated attempts to send the message has failed to deliver the message across the network.. Any other text value may indicate communication in progress.
   - **tries** – This variable indicates how many times (0-5) the program has attempted to deliver the data without delivery confirmation having been received from the network. Each "try" consists of powering the modem up, and attempting to connect with the Iridium global network, verifying network availability, sending the message to the network and awaiting delivery confirmation.
   - **sendLoop** – This variable indicates how many times (0-10) the program has looped in attempt to deliver the data message. The program will loop 10 times in attempt to "try" to deliver a message, waiting 20 seconds between attempts.
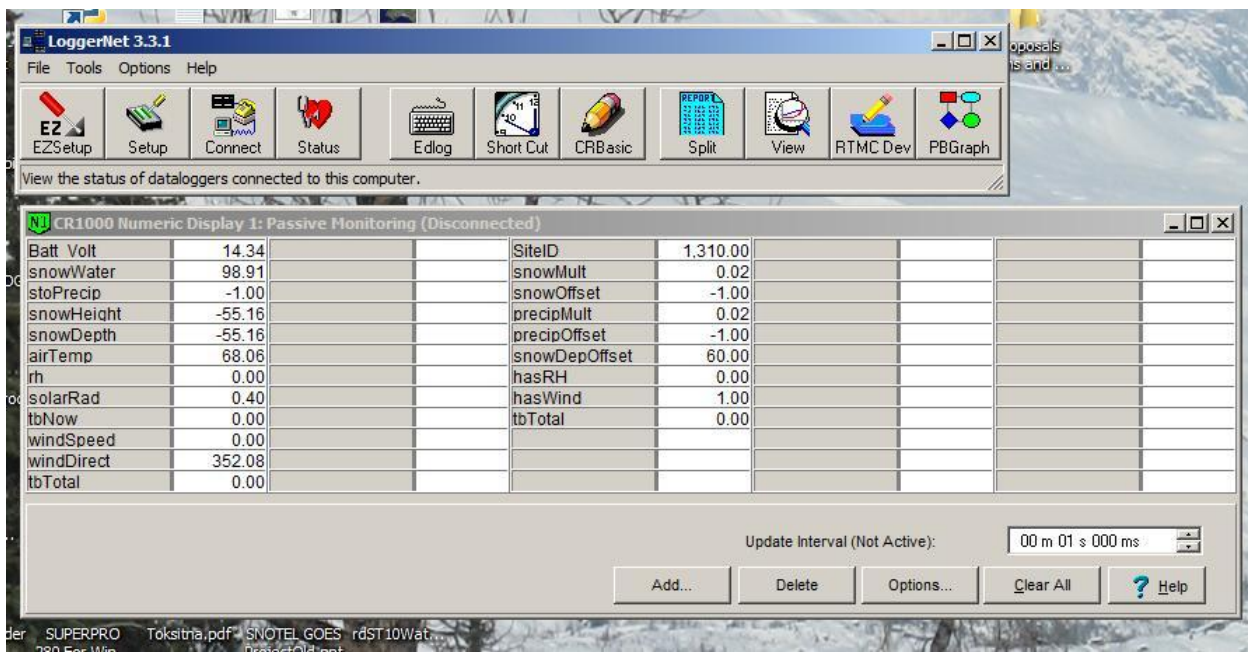   - **msgSent** - This variable is 0 if the data message has not been delivered, and is 1 when the message has been delivered.

Figure One – Typical LoggerNet Numeric Display with Variables