# VITEL VX1100 USER'S MANUAL

**Version 2.43**

**December 14, 2000**

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# 1 INTRODUCTION

The VX1100 is a data acquisition device. It has the ability to record data from 20 sensors of various types. It can log this data to internal ram, a front panel display or serial ports. With the correct hardware add-ons, it can send this data to a GOES transmitter, a line-of-site transceiver, a PCMCIA ram card or modem. This unit has the ability to up load and download configurations remotely through serial interface, PCMCIA ram card or through line-of-site transceivers. Flexibility is the design focus of the VX1100. Any sensor number can be assigned to any of the supported 16+ sensor types.

This document is organized in a get-started fashion, followed by a clearly defined menu structure that describes every menu item supported by the VX1100. The Get-Started section describes the bare minimum information to power up the VX1100, set up a sensor and retrieve logged data from that sensor.

# 2 START UP

Set the Power switch to the off position, away from the top edge of the VX1100. Power is applied to the VX1100 through J16, the two-position connector at the top edge of the unit. Figure 1 shows the top edge of the front panel board. The right pin of J16 should be connected to ground and the left pin should be connected to +12 volts. These correspond to '-' and '+' of a 12 volt battery. Turn on unit by setting power switch to the on position, toward the top edge of VX1100.

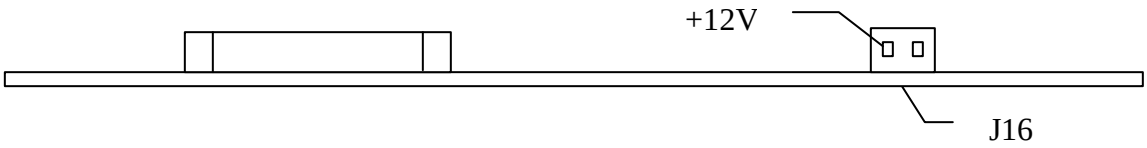



**Figure 1. Power Connection**

The VX1100 is protected against reverse voltage being applied to the two power terminals. If reverse voltage is applied, the re-settable fuse located internally in the VX1100 will trip. It will reset once the fault condition is removed.

The maximum input voltage of 17 volts must not be exceeded, as this will permanently damage the circuitry of the VX1100. Voltage transient conditions of very short duration may be tolerated. The power input is protected by a high power transzorb. This transzorb will conduct with reverse power or with voltages greater than 17 volts. If the current becomes excessive, the re-settable fuse will trip as described previously.

# 3 VX1100 INTERNAL LITHIUM BATTERY

The data logging memory and real-time clock backup battery should be replaced once every two years to ensure battery backup capability.

# 4 VX1100 INTERFACE

The user can interface with the VX1100 by using the keypad and LCD display, or through one of the serial ports.

## 4.1 BUSY

The VX1100 is not truly a multitasking environment; therefore only one user can be logged on a time. A "BUSY XX" message will be displayed when more than one user attempt to log on at a time. XX is a code that describes what port is currently open. The message applies to serial and keypad inputs. The LCD will display:

```
BUSY XX
```

The serial port will display:

```
!<CR><LF>
BUSY XX<CR><LF>
```

This message can only be produced during an idle state in the VX1100 so there may not be an immediate response if the VX1100 is taking a measurement, communicating with a SDI device, or sending a GOES message. If an immediate response is not seen, wait for a short time and verify that the VX1100 finishes its current task.

**Busy Codes are: 81=Aux Comm, 82=Modem, 83=VX0850, 84=RS485, 85=SDI-12, 87=Speech Modem, 88=Terminal, and 90=Key Pad.**

## 4.2 KEYPAD OPERATION

To log on using the keypad, press the 'ON/OFF' button.

```
Enter Password
>
```

appears in the Display. If 'ON/OFF' is pressed again before any other button, the LCD back light will come on. This is useful in low-ambient light conditions and greatly improves the visibility of the LCD.

At any time during input the RIGHT and LEFT arrow buttons may be used to move the cursor right or left in the input field. At the end of an input field, the cursor will remain beneath the final character.

The 'BS' (backspace) button will delete the character to the left of the cursor and drag the following characters left. At column one, 'BS' will delete the current character and drag any other characters left.

Use the following rules when entering numeric data such as the password. To enter a negative number, the negative sign must be selected before any digits are entered. At the '>' prompt, press the '0' button until the display changes to the next character on the button. After the negative symbol is displayed, use the right arrow button to advance to the next digit. The entry will automatically scroll to the next digit unless the first button is '0'. If the first digit is '0' as in 0.005, the right arrow button must be used for the first '0'. When the number is complete, press 'ENTER' button to accept or 'ESC' button to

abandon. To enter the number "-1568" press the buttons '0,'0','0','0','RIGHT','1','5','6','8' and 'ENTER'. To enter 105 press '1','0','5','ENTER'.

When entering an alphanumeric string, such as in "Site ID" or "Sensor Name" the characters are selected by successively striking the button with the desired character until that character appears on the display. This is similar to inputting the negative sign found on the '0' button. When the desired character appears, use the RIGHT arrow button to advance to the next character in the string being entered.

Pressing the 'ON/OFF' button in text entry mode will place the button-pad in ASCII input number mode. The cursor will change to a blinking block. The next three number buttons pressed will be interpreted as an ASCII decimal number. Here is an example of inserting the '&' symbol (ASCII 38) as used by the modem init string. Move the underline-cursor under the space where the symbol should be in the input field using the LEFT or RIGHT arrow buttons. Press the 'ON/OFF' button. The cursor will change to a blinking block character and the current character will be replaced by a 'space'. If the existing character is already a 'space' no change will be noticed. Follow the 'ON/OFF' button with the buttons '0', '3' and '8'. As the first two buttons are pressed, their values will appear at the block cursor. When the third button is pressed, the actual ASCII character will appear and the cursor will advance right one column. If the 'ON/OFF' button is pressed before the third number is pressed, the sequence is restarted.

After the user has logged in, the VX1100 functions become available by the use of menus. The arrow buttons on the button-pad will move forward and reverse through the current menu and wrap at the end of the menu. To enter a submenu press 'ENTER' and the submenu will appear. The arrow buttons may be used again to move through the menu. If the menu item number is known, that number may be pressed on the keypad to go directly to that submenu. To go straight to "Read Sensor" from main menu using the keypad, press '2'.

Press the ESC button to return to a higher level menu or cancel input.

### 4.3 SERIAL PORT OPERATION

The VX1100 supports many serial ports. The Terminal port and the VBUS serial port are located on the VX1100 front panel. The VX1040 card, connected using the VBUS supplies the RS485, Auxiliary and Modem ports. The VX0850 card, connected using the VBUS supplies a serial / RF connection. Any of the Terminal, RS485, Auxiliary or Modem serial ports can be used by a terminal communications software package like Bitcom® or MS Terminal® for serial communications. Set the communications protocol to 9600 baud, 8 data bits, No Parity, 1 stop bit using a DB9-F to DB9-F NULL Modem cable.

### 4.3.1 TERMINAL USE

Make a connection between the VX1100 and a PC (personal computer) using a DB9-F to DB9-F NULL Modem cable. Press any key on the keyboard and the VX1100 will respond with:

```
*<NUL><CR><LF>
Enter Password > _
```

Enter the password including "-" sign if needed then press the <Enter> key. Numeric or character entries may be typed just as they appear. If the correct password is given, the user's permission level will be set and the main menu will be displayed at the connected PC. The default manager password is "1111". Continue by typing the number of the desired menu selection, and then press the <Enter> key.

The <backspace> key deletes one character at a time from the input buffer. Pressing the <ESC> key will return from a submenu or cancel input.

Serial reports to a port that is opened for terminal use will interrupt the flow of inputs. The VX1100 will record all keys that are typed and echoed, but sometimes it is better to escape and start over for a readable entry. If keystrokes are not echoed they will not be recorded in the input buffer. This will happen if the VX1100 has opened another port for data measurements, GOES messaging, or serial reports. During this period the user must wait until those other actions have completed before data entry may continue.

### 4.3.2 0850 PACKET USE

The VX1100 has the ability to communicate with serial devices using the 0850 packet protocol. There are several programs that use this protocol: DataCommand, Operator Terminal Unit (O.T.U.) and FieldCommand. This protocol was written to communicate with the 0850 RTU. The protocol has been modified where necessary to include VX1100 features.

#### 4.3.2.1 SERIAL CONNECTION

Connect the PC running the 0850 packet protocol to the Terminal, Auxiliary, Modem, or RS485 serial port. As commands are given to the PC, the instructions will be converted to packets and sent to the VX1100.

If the VX1100 is in low power sleep mode, it will wake up and send a "NAK Now" message (*<NUL>). If the PC resends the message within 400mS, the incoming packet will be processed. Otherwise, the VX1100 will assume the connection to be terminal communications and respond with "Enter Password >".

If Another port is currently open, the packet will be denied with a "NAK Wait" response: (!<NUL>) followed by the "BUSY XX" message. Each program has a different wait period before packet re-tries. Most programs will retry within 1 second. Some time delays can make the individual programs have timeout-failures. These programs will require adjustments to the timeout parameters to avoid false timeout error messages.

After each message has been sent, accepted and responded to, the VX1100 will return to low power sleep mode.

#### 4.3.2.2 RF CONNECTION, VX0850

The VX0850 provides a way for the VX1100 to be connected to the network by radio. Since the packet protocol was intended to be quick and concise, the VX1100 will process packets received from the VX0850 even if the user is logged in to one of the other serial ports. Assume a user is logged on using a modem connection and is currently changing the "SITE ID". Meanwhile, a packet command is received by the VX0850 with the VX1100 as the destination. Incoming packets will be queued by the VX0850 until the VX1100 reaches an idle state and services the packet queue. The user logged on with the modem will not be notified of the time-sharing and may not know that the packet was processed.

#### 4.3.2.3 SUPPORTED 0850 PACKET COMMANDS

The 0850 packet protocol is very comprehensive. The first versions of the VX1100 firmware support only a small subset of the 0850 packet protocol. Below is a table that describes the currently supported 0850 packet commands.

| 0850 Packet Command | Brief Command Description |
|---|---|
| Get UID | Return the serially connect nodes UID. |
| Interrogate Sensor N | Return measurement from a specific sensor. |
| Interrogate All Sensors | Return measurements from all available sensors. |
| Time Set | Set the time of the VX1100. |
| Time Sync | Set the time of the VX1100 and every node in the path. |
| Time Get | Return the time and battery voltage of the VX1100. |

FieldCommand is run from DataCommand using the menu items: Setup | Program Remotes.

#### 4.3.2.4 GET UID

This command will query the VX1100 for its UID number as specified in the VX1100 under "Main Menu | System Setup | VX0850 Setup | Path Specifiers | Path Spec 1" menu option. The UID number is a 5-digit number ranging from 0 to 65536. Refer to section 7.9.8 for an example of a UID number in a path specifier.

#### 4.3.2.5 INTERROGATE SENSOR N

Send the instantaneous or last logged reading or readings from sensor number N to a requesting station. The valid range for N is from 1 to 20.

#### 4.3.2.6 INTERROGATE ALL SENSORS

Send the instantaneous or last logged reading or readings from all sensors that are defined in the VX1100 to the requesting station. Sensor Number 0 is used for this command.

#### 4.3.2.7 TIME SET

Set the time of the VX1100 using the time from the source station. This command does not effect any nodes in between the source and destination. There is error involved in this command since the time is not updated by any node in between. The error is the end-to-end transmission delay. If the delay time is known, the time delay can be added to the sent time to achieve a more accurate time setting at the VX1100.

#### 4.3.2.8 TIME SYNC

Set the time of the VX1100 using a time packet sent from the source. This is the most accurate way to alter the time of a node. This effects the time of every node in the path. The time is received by each node and updated just before the packet is sent on. This allows for the most current time to be transmitted with only a small error in transmission.

#### 4.3.2.9 TIME GET

The VX1100 supports two versions of the get time command. The first returns the Year, Month, Day, Hour, Minute and Second, the seconds returns a sensor data packet with a system battery voltage that has a time stamp.

## 5 SYSTEM CHECKOUT

After installation, the basic procedure to verify the system will operate correctly is:

- Establish communications with the VX1100 either via the keypad or serial port.
- Check Time and Date.
- Check Location and Site ID.
- Verify Sensor Setups.
- Perform "Read Sensor" on all sensors to verify scaling.
- Re-activate data logging.

A more detailed description of the system checkout follows. Keep in mind that a carriage return on a computer or the ENTER button on the keypad will either select an option or enter a typed value. The Escape key of a computer or the ESC button on the keypad will either cancel a previous selection or back the user out one menu level. When backing out of menus, it is not possible to back out beyond the Main Menu. This can be used as a handy tool for always returning to a known starting location by striking the ESC several times.

### 5.1 ESTABLISH COMMUNICATIONS WITH THE VX1100

- Connect the VX1100 to a portable computer or terminal using terminal cable 181-1085, a DB9-F to DB9-F NULL Modem cable.. The terminal cable will plug into the terminal of the VX1100 jack. If you also have a VX1040 Communications Module in the system, this same terminal cable will also work in the AUX port of the VX1040. Connect the other end of the terminal cable to the Comm port of the PC.
- Run the communications program being used on the PC according to manufacturer's instructions. The default communications is 9600 baud, no parity, 8 data bits and 1 stop bit.

- Depress the <SPACE> key on the keyboard of the PC. This should result in the "*Enter Password >" prompt or "!<NUL><CR><LF>Busy XX<CR><LF>" if another communications port is already in use. NUL is ASCII 0, <CR> is ASCII 13, <LF> is ASCII 10, and XX shows the port number (in hex) that is currently opened.
- Enter a valid Manager Level password to bring up the VX1100 Main Menu. The system default is "1111". Once a user is granted manager privileges, any or all passwords may be changed.

### 5.2 CHECK TIME AND DATE

- Select the "Time" entry of the Main Menu. The time will be displayed at the moment the time was selected from the menu.
- Enter a new 24-hour time if necessary using the format "hh:mm:ss <ENTER>". Refer to section 7.7. Remember that for GOES DCS applications, the time must be set to GMT (Greenwich Mean Time), also known as UTC (Universal Coordinated Time).
- Select the "Date" entry of the Main Menu. The date will be displayed at the moment the date was selected from the menu.
- Enter a new date if necessary using the format "mm/dd/yy <ENTER>". Refer to section 7.8.

### 5.3 CHECK LOCATION AND SITE ID

- Select "Loc" from the main menu.
- Enter the desired location ID up to 17 alphanumeric characters.
- Select "Site" from the main menu.
- Enter the desired 8-character site identification.

### 5.4 VERIFY SENSOR SETUPS

- Select "Main Menu | System Setup | Sensor Setup". "Pick Sensor #", '1' is displayed. Select sensor #1 by pressing <ENTER>.
- "Sensor Setup, Name:" is displayed. The name can be chosen now or the default can be used for System Sensors.
- Pressing '2' will display "Sensor Types, Sensor Reset". Scroll LEFT until "Main Power" is displayed. Select this type by pressing <ENTER>. "Sensor Setup, Type: Main Power" is now displayed.
- Pressing '4' will enter the Intervals menu where logging intervals are specified. "Intervals, Log Int (mins) :0" is displayed to show that the sensor is not currently logging data. Press <ENTER> to change logging period. Press '6',<ENTER> to change the log interval to six minutes.
- Press <ESC> four times to return to Main Menu.

### 5.5 VERIFY READ SENSORS

- When setting up a unit for the first time, the log RAM should be initialized prior to deployment. This is done last from the "Manager Functions" menu using the "Clear Log RAM" selection.
- Select "Log Off" from the Main Menu.
- The time of the next GOES transmission (if enabled) will be printed to the terminal port.

- VX1100 enters its low power standby state.

## 6 DATA COLLECTION

The VX1100 will store up to 58,000 sensor readings in internal log memory. The VX1100 has an internal lithium battery that maintains the logging memory.

All logging memory is maintained even if the external +12 volts are removed, unless the backup battery is low or disabled or the "Clear Log RAM" selection of the "Manager Functions" menu is selected.

The basic steps involved in retrieving data from the VX1100 are as follows:

- Establish communications with the VX1100.
- Select "Data Download".
- Download Data.
- Re-activate data logging.

### 6.1 ESTABLISH COMMUNICATIONS WITH THE VX1100

Refer to section 5.1

### 6.2 SELECT DATA RETRIEVAL OPTIONS

- Select "3" for Data Download Menu.
- The "Data Download" menu will allow user to select data to be downloaded. A different sensor or different date range may be entered. ASCII downloads echo their file contents to the screen in a format similar to the sample shown below:

```
GRASSY SWAMP PARK, 14, SITE0001, 03-30-97, 14:10:30

Sensor:     WATER LEVEL

Type: Analog Single 5V

98020 15:00 104.43
98020 15:15 105.53
98020 15:30 106.77
Download Complete
```

The first line contains VX1100 information. The location string, the configuration update count, the site id, followed by the date and the time of the printout.

Each Sensor that is logging data will have its own section. The sensor section header will have the word "Sensor: " followed by the sensor name. The next line will have the specific sensor type.

The remaining lines will contain individual measurements. The Julian Date appears first, followed by 24-hour time, and then data in engineering units. Each line is terminated by <CR><LF>. All data is space delimited.

If the XMODEM download format is chosen, the file contents will not be visible to the user as the download proceeds. This binary data requires the program XLATE11.EXE to create an ASCII text file similar to the ASCII download format. XLATE11.EXE is available from Vitel, Inc.

### 6.3 DOWNLOAD DATA

- Select "4" from the Download Menu to obtain data from all sensors, or "5" to download data from only the selected sensor.
- Set up logging file according to instructions for communications package being used.
- Upon striking the <ENTER> key, data download will begin.
- Close logging file according to instructions for communications package being used.

### 6.4 RE-ACTIVATE DATA LOGGING

- Return to Main Menu using <ESC> key.
- Select "Log Off" from the Main Menu. The unit will enter its low power standby state.

## 7 VX1100 MENU DESCRIPTIONS

This section describes the basic menu structure within the VX1100 and how functions are organized.

### 7.1 MAIN MENU OPTIONS

| | |
|---|---|
| Main Menu : NOS 2.29 | Main Menu and firmware version number. |
| 1 Log Off | Returns the VX1100 to low power mode. |
| 2 Read Sensor | Display instantaneous reading of a sensor. |
| 3 Data Download | RS232 data download menu. |
| 4 Loc : VX1100 | Arbitrary 17 character Location Identification. |
| 5 Site: 12345678 | Arbitrary 8 character Site Identification. |
| 6 Time: 11:04:36 | Time displayed when menu was printed. |
| 7 Date: 01-20-95 | Date displayed when menu was printed. |
| 8 System Setup | Sensor, serial data, display, GOES, data card, radio setup menus. |
| 9 Manager Functions | Passwords, session timer, clear log RAM, load default setup. |
| 10 Factory Test | System checkout functions. |

### 7.2 LOG OFF

This places the VX1100 into a low power standby mode. The unit periodically resets hardware ports to avoid permanent communications failure created by static discharge in the area. Resets occur as the unit is preparing for low power standby. The modem init string is re-initialized every few hours. This allows a unit to recover from a lost string within several hours. Otherwise an operator would have to return to the site to re-initialize modem strings manually. "Log Off" is displayed just before entering low power standby unless the display option is enabled (refer to section 7.9.5).

## 7.3 READ SENSOR

Choose this function to display the instantaneous readings from any of the available sensors. The VX1100 will continue to display readings for 30 seconds then return to main menu. This function can be stopped by pressing <ESC>.
*Note: An Aquatrak in operation will not give an instantaneous reading.*

## 7.4 DATA DOWNLOAD

The VX1100 can log data directly to its internal logging RAM and to an SRAM PCMCIA-compliant data card installed in the VX1060 Datacard Module. The Data Download Menu is used to retrieve data from the on-board logging RAM (up to 55,500 readings).

| Download Menu | Description |
|---|---|
| 1 Mode : XMODEM | Select XMODEM or ASCII data download format. |
| 2 Begin : 01/01/80 00:00 | Set beginning date and time for download. |
| 3 End : 01/20/95 11:04 | Set end date and time for download. |
| 4 All Sensors | Start sequential download for all sensors. |
| 5 One Sensor | Select download for only one sensor. |

### 7.4.1 MODE

Mode selects what data format will be used to exchange data between the VX1100 and the PC. Selecting mode will toggle the available choices.

| | |
|---|---|
| XMODEM | Binary data transfer. The VX1100 will try to initiate data transfer 20 times and then time-out. The first 10 attempts will be with CRC, the remaining with Checksum. If the PC gives no response, a 20-second time-out will occur. Pressing <CTRL>X at any point from the PC will abandon transfer. Data must be translated to ASCII using XLATE program available from VITEL. |
| ASCII | ASCII data suitable for import into spreadsheet Space delimited file. |

### 7.4.2 BEGIN

This represents the start time data range for the sensor(s) selected. The default is the time the Log RAM was initialized, but may be set to any time. The valid data range is 1/1/1980 00:00:00 through 12/31/2079 23:59. If the Begin time is after the End time, the End time is set to the Begin time.

### 7.4.3 END

This represents the end time data range for the sensor(s) selected. The default time is the time the menu was entered. If the Begin time is after the End time, the Begin time is set to the End time.

### 7.4.4 ALL SENSORS

This command starts the data download for all sensors that have data logged in the specified data time range using the selected data transfer Mode.

### 7.4.5 ONE SENSOR

This command allows the user to select a single sensor, and download logged data that is in the time range.

## 7.5 SET LOCATION ID

This option allows the unit to have a location named created. The location ID is not necessary for the system to operate correctly, however the ID is included in the Data Download header and provides a means of identifying the data source. The following entry field appears when Loc is selected from the main menu.

| | |
|---|---|
| Loc : VX1100> | Enter up to 17 arbitrary characters. |

## 7.6 SET SITE ID

The site id is used in NOS style GOES messages, ASCII and XMODEM data downloads, Serial Report Headers, and the NWS Tag.

| | |
|---|---|
| ?> | Enter new 8-character site ID. |

## 7.7 SET TIME

The VX1100 uses a 24-hour clock. GOES self-timed message broadcast time will be re-calculated after the time has been altered.

| | |
|---|---|
| Time ( HH:MM:SS ) : | Enter new time in 24-hour format. New time takes effect as soon as CR or ENTER is pressed. |

## 7.8 SET DATE

The VX1100 uses an independent clock that returns a two-digit year. To avoid the year 2000 problem, all dates are assumed to start on 01/01/1980. Years < 80 are assumed to be 2000 through 2079. Years from 80 to 99 are assumed to be from 1980 through 1999.

| | |
|---|---|
| Date ( MM-DD-YY ) : | Enter date in format specified. |

## 7.9 SYSTEM SETUP PARAMETERS

| System Setup | |
|---|---|
| 1 Sensors Setup | Set scaling factors and log intervals. |
| 2 Sensor Display | Show a setup table of all sensors. |
| 3 Alarm Setup | Enable alarm outputs and driving sensors. |
| 4 Serial Setup | Select sensor data to be sent out serial port. |
| 5 Display Setup | Select sensor data to be displayed on LCD. |
| 6 GOES Setup | Select GOES transmission setup. |
| 7 Data Card Setup | Select options for VX1060 logging. |
| 8 VX0850 Setup | Select options for VX0850 radio packets. |
| 9 Timer Controls | Control of OUT1 through OUT4 by time periods. |
| 10 Upload / Download | Transfer setups in/out of VX1100. |

### 7.9.1 SENSOR SETUP

Choosing sensor setup opens a list function that allows the user to choose which sensor number to configure. Depending on the state of the VX1100, more or fewer sensors will be displayed. To choose a sensor not on the list, scroll left or right using the keypad or enter the desired number if using a serial port.

| Pick Sensor # | |
|---|---|
| 1< | THERM 1 |
| 2 | THERM 2 |
| 3 | AQUATRAK |

After choosing a sensor to configure, the VX1100 presents a menu with two rows: Name and Sensor Type. After these are filled in, the menus will vary depending on the type selected. There may be up to twenty sensors defined in the VX1100. Each sensor may have any of the following input types: voltage, counter or serial. In the sensor setup, the user is first prompted for the sensor number. Next to the sensor number is the name programmed by the user corresponding to that sensor. The following is a list of possible sensor types that may be assigned to each sensor.

#### 7.9.1.1 SENSOR TYPES

The following section contains a list of all sensor types supported by the VX1100 and a brief discussion on their use.

Type 10 Analog Single

Single-ended voltage sensors. The 16 possible voltage inputs are A1+, A1-, A2+, A2-… A8+, and A8- all with ground as a reference. The following voltage ranges are supported: 10V, 5V, 2.5V, 250mV, and 25mV.

Type 11 Analog Diff.

Differential-input voltage sensors. The 8 possible voltage inputs are A1+ and A1-, A2+ and A2- … A8+ and A8-. The following voltage ranges are supported: 10V, 5V, 2.5V, 250mV, and 25mV.

Type 20 Accumulator AC
Type 21 Accumulator TTL

Counter sensors (C1, C2, C3 inputs). Inputs 1 & 2 can have a small AC signal applied while all sensors can accept TTL levels.

Type 22 Freq Ctr AC
Type 23 Freq Ctr TTL

Frequency sensors (C1, C2, C3 inputs): Inputs 1 & 2 can have a small AC signal applied while all sensor can accept TTL levels. Note that when a TTL and small AC signal are to be measured, use inputs 1 & 3 to put physical distance between them; otherwise, cross talk can occur on the ribbon cable and effect the small AC signal. Frequency = Counts / Period and is handled independantly of the sample period. If the period is 10 seconds and 25 counts are collected in ten seconds, the frequency is 2.5Hz. With a Period of 5 and 20 counts collected, the frequency is 4Hz. The normal configuration has the sample time and the period the same. A sample interval of 30 and a period of 10 would mean that every thirty seconds, a reading is made of the previous 10 second period.

Type 30 SDI-12

Serial Digital Interface at 1200 baud. The VX1100 can support up to ten different SDI-12 devices. Each SDI-12 device can be assigned to one or more VX1100 sensor numbers. Each VX1100 sensor can have a different set of (M or C) and D commands. If more then one VX1100 sensor has the same SDI-12 address assigned, they both will send M & D commands to the same SDI-12 device. Since SDI-12 devices can only process one M command at a time, care must be taken that the second command is not sent until the data from the first command has been collected or the first command will be aborted. This can be accomplished by using a time offset in the Intervals menu. It is not necessary to use a time offset if the SDI-12 device responds within 2 seconds.

Type 31 Backup Water Level

This sensor was specifically created so that logging occurs with a time stamp of the (log time – first time offset) so that time stamps can occur in the middle of a measurement cycle. Furthermore, GOES logging only occurs at 0 and 30 minutes plus the hour.

Type 40 Wind Data

This sensor type uses the data from two other VX1100 sensors to derive speed, direction, and gust data.

Create a VX1100 sensor assignment for wind speed using whatever sensor type is appropriate( usually Freq Ctr AC ). Assign the desired period and set the correct scaling factors. Refer to section

(7.9.1.3). If a sample period is defined in the Intervals menu of the wind speed sensor, the Wind Data sensor type will compute scalar wind averages, otherwise vectored wind speed averaging is done.

Create a VX1100 sensor assignment for wind direction using whatever sensor type is appropriate ( usually Analog Single ). Set the scaling factors as appropriate.

Make sure that the Speed & Direction sensor numbers are smaller than the Wind Data sensor number. For instance: Speed=3, Direction = 4, Wind Data = 5.

After creating a wind data sensor type, the sensor setup menu will have a reference to Wind Speed and Wind Direction. Assign these to the VX1100 sensors that are defined for wind speed and wind direction. If the wind data log interval is non-zero, the average wind and gust will be computed and reset each time the values are logged. If the serial report interval is non-zero the average wind speed and gust will be calculated since the last reset at each report. If the log interval is zero and the serial report interval is non-zero the average wind speed and gust will be computed and reset.

Type 50 Aquatrak

This is an acoustic sensor used to measure water level. This Aquatrak sensor type takes three readings from an SDI-12 Bartex water level sensor every 6 minutes centered on the hour and combines those measurements with two other VX1100 sensors assigned to thermisters in the calibration and ranging tubes. The time stamp for the Aquatrak is centered in the middle of the cycle. This sensor has two ways to report water level, "finished" and "raw". The "raw" reading is the distance from the Aquatrak sensor head down to the water. This reading is stored in the log ram, sent over GOES, and displayed in ASCII data downloads. The finished water level is defined as: Datum offset – Sensor Offset – "raw" reading. The "finished" water level is sent to serial reports, front panel display, the NWS tag, and 850 packets.

Type 60 Main Power

This is an internal sensor connected to the main power input jack. The scalar values are pre-assigned to produce volts with two decimal places.

Type 61 Backup Power

No longer supported.

Type 62 System Power

No longer supported.

Type 63 System Temp

This is an internal sensor that monitors the VX1100 system temperature. The scalar values are pre-assigned to produce degrees C with two decimal places.

Type 70 Quadrature

This sensor type allows the VX1100 to be connected to a sensor that produces quadrature signals.

Type 71 Virtual

The virtual sensor type derives its input values from another sensor. The alternate sensor number is specified using the virtual sensor's "Input Number". 1 or 3 parameters can be read into the virtual sensor. Set the virtual sensor's "Param #" to 0 to choose the first three previously collected parameters of the alternate sensor; otherwise, set it to the desired parameter number (1, 2, or 3).

Type 72 Smart Sensor

This is used to poll sensors via the AUX port on the VX1040 communications card. The VX1100 will send a <CR> to the AUX port using the baud rate specified in the serial port setup menu. Within one second the sensor must respond with data in the following format: "+xx.xxx –xx.xxx<CR><LF>". Up to ten readings can be returned. The '+' sign may be omitted. Precision should match the decimal places specified by the sensor setup | scaling menu.

7.9.1.2 VOLTAGE SENSOR SETUP

| Sensor Setup | |
|---|---|
| 1 Name : WIND DIR | User programmed name. |
| 2 Type : Analog Single 5V | Sensor type as described above. |
| 3 Read Sensor | Perform instantaneous readings continually. |
| 4 Intervals | Set the time periods for Sampling & Logging. |
| 5 GOES Flag : 0 | Enter flag for GOES TX or 0 to exclude from GOES TX. |
| 6 Alarm | Alarm threshold menu . |
| 7 Scaling | Scaling factors for engineering units. |
| 8 Input Number : +5 | VX1100 Termination board Analog input number.<br>Single Ended input. (range: +8 to +1, -1 to –8).<br>Differential input. (range: 8 to 1). |

Sensors that normally return single instantaneous readings may be configured to log their data in one of two ways:

Instantaneous Data Logging: The Log Interval should be set to the desired number of minutes in between readings, and the Sample Interval should be "0". The Log Interval can vary between 1 and 1440 minutes inclusive. As soon as it is collected, the reading is logged in on-board RAM and reported to the desired output port(s). Refer to section 7.9.4.3 for more information on displaying sensor readings in serial reports.

Averaged Data Logging: Most sensor inputs may also be configured to log an average of samples over the specified log interval by specifying a non-zero Sample Interval. Samples may be taken as frequently as once per second, and may be averaged over the entire range of log intervals if desired. The maximum sample interval is 32760 seconds. Sample rates specified that are less than a sensor's measurement cycle will not occur regularly but will still produce accurate averaged readings. If a SDI-12 device takes 3 seconds to complete a reading and a sample period is specified at 1 second, then 15 samples per minute would be taken. The one-second interval plus the 3-second process time divided into 60 seconds. At the log interval, the average reading, maximum reading, and minimum reading for the log interval just completed will be stored in on-board RAM.

Averaged data logging is applicable only to sensors that return a single, instantaneous reading to the VX1100. Because SDI-12 sensors may return more than one value depending on the command issued, averaging can not be performed on these sensors. Likewise, since the Aquatrak sensor type performs its own average internally, its Sample Interval should always be "0". All other types of sensors may be configured with averaged readings.

GOES flag: The goes flag is valid only for NOS versions of software. The goes flag is an ASCII number between 33, 0x21, " ! " and 62, 0x3E " > ".

GOES TX: Standard VITEL versions will only allow an ON or OFF flag.

#### 7.9.1.2.1 INTERVALS

This menu allows the user to set time periods for various functions.

| | | |
|---|---|---|
| 1 Log Int (mins) | :0 | Interval on which readings are logged in minutes. Averaged readings are reset as the data is logged so a new average can be computed. |
| 2 1st Log (mins) | :0 | Logging time offset from midnight. |
| 3 Samp Int (secs) | :0 | Sample interval in 1 second increments on which averaged readings are taken. Averaged data is summed until the data is logged. |
| 4 Report (mins) | :1 | Interval on which instantaneous readings are sent to serial ports. If the data is not logged, a serial report will reset the cumulative average. |
| 5. VX0850 | :On | On / Off. Gives the user a way to enable only desired sensors to produce self-timed 0850 data packets. |

#### 7.9.1.2.2 ALARM

This menu allows the user to establish thresholds for alarm conditions created by a sensor. Refer to section 7.9.3 for a description on the alarm system.

| Alarm | | |
|---|---|---|
| 1 High Limit | :32767 | High threshold for alarm activation. |
| 2 Low Limit | :-32767 | Low threshold for alarm activation. |
| 3 Hysteresis | :0 | Change below/above threshold for deactivation. |
| 4 Change | :65353 | Change in reading for alarm activation. |

#### 7.9.1.2.3 SCALING

Engineering measurements can be created from raw counts by using these scaling factors applied as ((raw * multiplier) / divisor) + offset. The decimal point is only applied to reports and is not stored with the data.

| Scaling | | |
|---|---|---|
| 1 Mult | :1 | Range: -32767 to 32767 |
| 2 Div | :1 | Range: 1 to 32767 |
| 3 Offset | :0 | Range: -32767 to 32767 |
| 4 Decimal Pt | :0 | Range: 0 to 5 |

7.9.1.3 FREQUENCY SENSOR SETUP

| Sensor Setup | |
|---|---|
| 1 Name :WIND SPEED | User programmed name. |
| 2 Type :Freq Ctr AC | Sensor type as described above. |
| 3 Read Sensor | Perform instantaneous readings continually. |
| 4 Intervals | Set the time periods for Sampling & Logging. |
| 5 GOES Flag :0 | Enter flag for GOES TX or 0 to exclude from GOES TX. |
| 6 Alarm | Alarm threshold menu. |
| 7 Scaling | Scaling factors for engineering units. |
| 8 Input Number :0 | VX1100 Termination board Counter input number. (range: 0 to 3). The valid counters are C1, C2 and C3. The correct counter must be selected before operation can begin. If zero is chosen, no counter action will be performed. |
| 9 Period (secs) : 1 | Range: 1 to 255 seconds. The frequency for a sensor is defined as (number of counts) / (period in seconds). The longer the period, the more accurate the reading. This number is separate from sample period, which defines how often the VX1100 takes a reading. If the sample period is less than the frequency period, the same reading will be averaged multiple times. |

7.9.1.4 COUNTER SENSOR SETUP

| Sensor Setup | |
|---|---|
| 1 Name : Tipping Bucket | User programmed name. |
| 2 Type : Accumulator AC | Sensor type as described above. |
| 3 Read Sensor | Perform instantaneous readings continually. |
| 4 Intervals | Set the time periods for Sampling & Logging. |
| 5 GOES flag :0 | Enter flag for GOES TX or 0 to exclude from GOES TX. |
| 6 Alarm | Alarm threshold menu. |
| 7 Scaling | Scaling factors for engineering units. |
| 8 Input Number : 0 | VX1100 Termination board Counter input number. (range: 0 to 3). The valid counters are C1, C2 and C3. The correct counter must be selected before operation can begin. If zero is chosen, no counter action will be performed. |
| 9 Reset Accumulator | Reset counter contents to zero. In some instances, it may be desired to reset the accumulator manually. This may be done by selecting "Reset Accumulator". |

7.9.1.5 CALCULATED WIND SENSOR SETUP

| Sensor Setup | |
|---|---|
| 1 Name : PROC WIND | User programmed name. |
| 2 Type : Wind Data | Sensor type as described above. |
| 3 Read Sensor | Perform instantaneous readings continually. |
| 4 Intervals | Set the time periods for Sampling & Logging. |
| 5 GOES Flag :0 | Enter flag for GOES TX or 0 to exclude from GOES TX. |
| 6 Alarm | Alarm threshold and activation menu. |
| 7 Speed Sensor Num :1 | Sensor number of wind speed sensor. |
| 8 Dir Sensor Num :2 | Sensor number of wind direction sensor. |

7.9.1.6 SDI-12 SENSOR SETUP

| Sensor Setup | |
|---|---|
| 1 Name: SDI-12 | User-programmed name. |
| 2 Type: SDI-12 | Sensor type as described above. |
| 3 Read Sensor | Performs a measurement cycle using the M- and D- commands specified below for that sensor. |
| 4 Intervals | Set the time periods for Sampling & Logging. |
| 5 GOES Flag : 0 | Enter flag for GOES TX or 0 to exclude from GOES TX. |
| 6 Alarm | Alarm threshold and activation menu. |
| 7 Address: 0 | Should match the address in the sensor. (range 0-9). |
| 8 M or C -Command: | Blank for 'M!', 1-9 otherwise, depends on sensor. |
| 9 D-Command: 0 | 0-9 for data retrieval, depends on sensor, may have several. |
| 10 Transparent Mode | The user can type commands directly to the sensor. |

| | |
|---|---|
| 11 Scaling | Scaling factors for engineering units. |

Notes on SDI-12 sensor setup:

#### 7.9.1.6.1 SDI-12 ADDRESS

Each SDI-12 sensor on the SDI-12 serial bus must be preprogrammed with its own unique address from 0 to 9. Failure to maintain individual addresses will lead to measurement errors since multiple sensors will try to respond to measurement requests. The sensor address may be reprogrammed using the VX1100 Transparent Mode. An extended command for the desired sensor type must be provided by manufacturer of sensor; however, version 1.2 of the SDI-12 specification states: aAb! will be used for changing an address.

'a', address currently used by sensor.
'A', used to specify the change address command.
'b', the new address between '0' and '9'.

#### 7.9.1.6.2 M-COMMAND OR C-COMMAND

This is used to specify what measurement command will be sent to a SDI-12 device to start a measurement cycle or concurrent-measurement. Measurement commands are between '0' and '9'. If more than one VX1100 sensor is allocated for a single SDI-12 device, each measurement cycle must be exclusive. This can be done by setting the 1st Log (offset) of the second sensor to take place after the first sensor's first measurement cycle has completed.

Example 1:

VX1100 Sensors 13 and 14 are setup to access the same SDI-12 device using address 4 and take measurements every 6 minutes with a 1st Log offset of 0 (so they both occur at the same time of day, one sensor after the other). Sensor 13 has an M-Command of '0' and D-Command list of '0', '1', '2'. Sensor 14 has an M-Command of '1' and a D-Command list of '1', '4'. The following sequence occurs:

| Actual Data | Sensor Number | Command Sent | Response |
|---|---|---|---|
| 0M!00015<CR><LF> | 13 | 0M! | 5 readings in 1 second. |
| 0D0!0+12.5<CR><LF> | 13 | 0D0! | +12.5 |
| 0D1!0+17<CR><LF> | 13 | 0D1! | +17 |
| 0D2!0+4<CR><LF> | 13 | 0D2! | +4 |
| Proceed with sensor 14 since 13 is now finished. | | | |
| 0M1!00015<CR><LF> | 14 | 0M1! | 5 readings ready in 1 second. |
| 0D1!0+17<CR><LF> | 14 | 0D1! | +17 |
| 0D4!0+.0012 | 14 | 0D4! | +.0012 |

Example 2:

VX1100 Sensors 15 and 16 are setup to access the SDI-12 device using address 5 and take measurements every 6 minutes. Sensor 16 must specify a 1st Log offset of 1 minute (so that the measurement cycle of sensor 15 can complete). Sensor 15 has an M-Command of '0' and a D-Command list of '0'. Sensor 16 has an M-Command of '7' and a D-Command list of '3', '4'. The following sequence occurs:

| Actual Data | Sensor Number | Command Sent | Response |
|---|---|---|---|
| 4M!40035<CR><LF> | 15 | 4M! | 5 readings in 3 seconds. |
| 4D0!0+12.5<CR><LF> | 15 | 4D0! | +12.5 |
| Proceed with sensor 16 one minute after the Sensor 15 measurement cycle began. | | | |
| 4M7!40035<CR><LF> | 16 | 4M7! | 1 reading ready in 1 second. |
| 4D3!4+3.4<CR><LF> | 16 | 4D3! | +3.4 |
| 4D4!4+100<CR><LF> | 16 | 4D4! | +100 |

Since this SDI-12 device requires more than two seconds to process data, the measurements would be queued within the VX1100 and the next sensor would start. This would cause the first measurement cycle, started by sensor 15, to be abandoned and the second cycle to start. The 1st Log offset should be set to one minute for every multiple of 60 seconds of the previous sensor's data ready response time.

| Data Ready Response Time | Following Sensor's 1st Log Offset |
|---|---|
| 0 to 2 seconds | 0 minutes |
| 3 to 59 seconds | 1 minute |
| 60 to 119 seconds | 2 minutes |
| 120 to 179 seconds | 3 minutes |

#### 7.9.1.6.3 D-COMMAND LIST

The data command list is specified as a number of '0' through '9' characters. Each D-Command is sent and responded to before the next D-Command is sent. The VX1100 deviates from SDI-12 specification 1.2 in that the user can specify the exact data commands that are sent to the sensor. This allows for faster and more exact retrieval of data. The user must enter each D-Command in the range of '0' through '9' followed by <ESC> if not all 10 commands are used. If the desired data retrieval commands are "D0!", "D1!", and "D2!", then the D-Command list would be entered as: <0><ENTER> <1><ENTER> <2><ENTER><ESC>. Then the VX1100 would display "D-Command : 012". Each sensor comes with its own factory-programmed set of SDI-12 commands to which it will respond. Many sensors have a variety of measurement commands and data commands. The user must determine which of these the VX1100 will ask for in a measurement cycle. The VX1100 can recognize and log up to 10 data values. The measurement and data commands should be adjusted accordingly.

#### 7.9.1.7 AQUATRAK SDI-12 SENSOR SETUP

| Sensor Setup | |
|---|---|
| 1 Name: SDI-12 | User-programmed name. |
| 2 Type: SDI-12 | Sensor type as described above. |
| 3 Read Sensor | Performs a measurement cycle using the M- and D- commands specified below for that sensor. |
| 4 Intervals | Set the time periods for Sampling & Logging. |
| 5 GOES Flag : 0 | Enter flag for GOES TX or 0 to exclude from GOES TX. |
| 6 Alarm | Alarm threshold menu. |
| 7 Address: 0 | Should match the address in the sensor (0-9). |
| 8 M-Command: | Blank for 'M!', 1-9 otherwise, depends on sensor. |
| 9 D-Command: 0 | 0-9 for data retrieval, depends on sensor, may have several. |
| 10 Transparent Mode | The user can type commands directly to the sensor. |
| 11 Sensor Offset: 1mm | User entered data for sensor zero-offset from collar. Data is included with GOES TX and Data Download, but is not applied to the raw data by the VX1100. |
| 12 Datum Offset: 1mm | User entered data for sensor datum offset from collar. Data is included with GOES TX and Data Download, but is not applied to the raw data by the VX1100. |
| 13 Temp Input 1: 1 | Sensor number for upper ranging tube air temperature sensor. |
| 14 Temp Input 2: 2 | Sensor number for lower ranging tube air temperature sensor. |

### 7.9.2 SENSOR DISPLAY

This screen dump was added as a simple way to see the setup for all sensors. The following line is a typical example of the first two lines:

```
SN Tp  Log  Off Samp Ser GS RP  Mult   Div Offset . I# Other
01 11    0    0    0   1  0  0 -1471 32767   +958 1 +8
```

| | |
|---|---|
| SN | Sensor number. |
| Tp | Decimal number representing a sensor type. 60 would be Main Power. |
| Log | Log interval in minutes. |
| Off | Log offset in minutes. |
| Samp | Sample interval in seconds rounded to the nearest ten. |
| Ser | Serial report interval in minutes. |
| GS | Goes Flag as a decimal number. |
| RP | Radio Packet data enabled. |
| Mult | Multiplier scaling factor. |
| Div | Divisor scaling factor. |
| Offset | Offset scaling factor. |
| . | The decimal place factor. |

| | |
|---|---|
| I# | The associated input number. |
| Other | *P=xxx is the period for frequency sensors.<br>*D=xxx is the data command list for sdi12 devices. |

On the following line is data that refers to GOES transmissions. The line may look like this:

**Goes ID:x0101F3DC FTX:00:00:00 CH151/1:STX=23:59:50@1440 CH151/0:RTX=00:00:00@18**

| | |
|---|---|
| Goes ID | See section 7.9.6, GOES Setup. |
| FTX:00:00:00 | First Transmission time for self timed messages. |
| CHxxx | Channel number. |
| /1 or /0 | /1 is Enabled, /0 is disabled. |
| :STX or :RTX | Self-timed or Random transmission. |
| =23:59:50 | The time for the next transmission. |
| @1440 | The time interval. Random time intervals are +/- 20%. |

### 7.9.3 ALARM SETUP

This system allows the VX1100 to control OUT1 through OUT4 on the termination board based on the reading of one or more sensors. Alarm active status is defined as High, Low, Change or Normal (refer to section 7.9.1.2.2). When a sensor produces a reading that exceeds one of the alarm limits, an alarm status byte is set. If one or more sensors is in an alarm list have their status bytes set, then the configure byte will be applied to OUT1 through OUT4.

| Alarm Setup | |
|---|---|
| 1 Alarm Number : 1 | Alarm Number. (range: 0 to 3) |
| 2 Sensor List | Sensors to drive alarm event. |
| 3 Config : 0x04 | Used to control Out1 through Out4 on the termination board. |
| 5 Set | Set the alarm event flag. |
| 6 Clear | Clear the alarm event flag. |
| 7 Status | Show what alarm events are currently set. |

#### 7.9.3.1 SENSOR LIST

Any sensor placed in an alarm list will drive an alarm event. Therefore it is possible to have one sensor in multiple alarm lists, and many sensors driving one alarm. The GOES RTX is also treated as an alarm event but is defined in the GOES RTX setup menu ( refer to 7.9.6 ).

##### 7.9.3.1.1 DISPLAY LIST

This will show all sensors that are in a list. Press <Enter> to return to the menu.

##### 7.9.3.1.2 ADD SENSOR

Choosing this will display a list of sensors that are defined. Select one of these sensors to add it to a list.

#### 7.9.3.1.3 DELETE SENSOR

This will display a list of sensors that are currently in the list. By entering the sensor list number that precedes the sensor number, a single sensor can be removed from a list.

#### 7.9.3.1.4 CLEAR ALL

To remove all sensors from a list, choose this item.

### 7.9.3.2 CONFIG

This byte is used by Analog Outputs and Timed Alarm and to determine which Outputs are controlled and their active state.

To control one or more OUTPUTS with a single alarm list, OR the following numbers together for each OUT to be controlled: OUT1 = 0x01, OUT2 = 0x02, OUT3 = 0x40 & OUT4 = 0x80.
For each out that is controlled, add the following numbers for each OUT that is active HIGH: OUT1 = 0x10, OUT2 = 0x20, OUT3 = 0x40, OUT4 = 0x80.

To control OUT1, OUT2 & OUT4, add together 1+2+4 = 0x07.
To make OUT1 & OUT3 active HIGH and leave OUT2 active LOW, add 0x10 + 0x40 = 0x50.
0x50 + 0x7 = 0x57. Since the input pad does not accept hexadecimal numbers, we set Config to 87.
The display shows that our Config byte = 0x57.

The following table tries to demonstrate how three sensors are used to control all four outputs.

- If sensor 1 is H L or C then OUT1 and OUT3 will be driven. This did not require two alarms, it could have been performed by a single alarm with a Config of 0x55.
- If sensor 2 is H, L or C then OUT3 will be driven.
- If sensor 3 is N then OUT4 will be driven.
- If sensor 4 if H, L or C then OUT1 & OUT2 will be driven and OUT3 & OUT4 will be cleared.

| Sensor # | Status | Alarm #0 | Alarm #1 | Alarm #2 | Alarm #3 |
|---|---|---|---|---|---|
| | | Config = 0x11 | Config = 0x3F | Config = 0x44 | Config = 0x08 |
| 1 | H | X | | X | |
| 2 | L | | | X | |
| 3 | N | | | | X |
| 4 | H | | X | | |
| | | Sensor Lists | | | |

### 7.9.4 SERIAL SETUP

This menu covers the configuration for these 5 serial devices: Terminal port (on VX1100), Auxiliary, RS485, and Modem (on VX1040) and Speech Modem (VX1045).

| Serial Setup | |
|---|---|
| 1 Port : RS232 Terminal | Current port to be configured. |
| 2 Speed : 9600 | Baud rate. |
| 3 Reports : Off | Enable or disable serial reports. |
| 4 Sensor List | Sensors included in this serial report. |
| 5 Send Init String : Off | Enable or disable init string. |
| 6 CMD: | The serial port initialization string. |
| 7 Command Mode | Enter serial port command mode. |
| 8 NWS tag | NWS serial report control fields. |

#### 7.9.4.1 PORT

Port allows the user to select one of the available serial ports.

#### 7.9.4.2 SPEED

This controls the transmission baud rate. Available options are 300, 1200, 2400, 4800, 9600 and 19200. The default is 9600.

#### 7.9.4.3 REPORTS

Selecting this menu item will toggle the serial reports option between On & Off. With reports on, any sensor that is in the sensor list will display up to its first three readings at a period determined by serial report interval in the sensor setup menu.

#### 7.9.4.4 SENSOR LIST

This is a list option used by a few services of the VX1100. Each port has its own list and any sensor can be in any, all or no lists. If a sensor is in a list and that function is enabled, the function will perform the appropriate action starting with the lowest sensor number and working sequentially until all sensors have been processed.

##### 7.9.4.4.1 DISPLAY LIST

This will show all sensors that are in a list. Press <Enter> to return to the menu.

##### 7.9.4.4.2 ADD SENSOR

Choosing this will display a list of sensors that are defined. Select one of these sensors to add it to a list.

##### 7.9.4.4.3 DELETE SENSOR

This will display a list of sensors that are currently in the list. By entering the sensor list number that precedes the sensor number, a single sensor can be removed from a list.

#### 7.9.4.4.4 CLEAR ALL

To remove all sensors from a list, choose this item.

### 7.9.4.5 SEND INIT STRING : ON

When a serial port is connected to a modem or other device that requires a setup string, this flag enables and disables the command (CMD) string. When enabled, the command string is sent on power up and again two – three minutes after the first power down. Thereafter it is sent every 255 minutes. This allows the VX1100 to regain control of the modem after power outages and improper disconnects.

### 7.9.4.6 CMD

This displays the 29 character, modem initialization string. The default for the VX1040 modem is: "ATE0S0=1S24=5Q1&D2&C1".

- E0, echo off. The user cannot turn echo on since this results in the VX1100 and Modem constantly echoing each other. E1 is prevented from happening in software.
- S0=1, # of rings before auto-answer.
- S24=5, Sleep mode inactivity timer (seconds).
- Q1, No responses from modem.
- &D2, Modem disconnects if the host revokes DTR.
- &C1, DCD indicates a valid carrier signal has been detected.

In Addition, the AUX port can be used to send a special report to the Vorne 2100 serial display. The CMD string for the AUX port must be set to: DISPLAY. The Sensor Name and first parameter of each sensors listed in the NWS sensor list is printed on the Vorne Display in the following sequence:

| Date & Time | SN10 | SN11 | SN12 |
|---|---|---|---|
| | SN7 | SN8 | SN9 |
| | SN4 | SN5 | SN6 |
| | SN1 | SN2 | SN3 |

The first line will scroll across the screen to accommodate messages that are greater than 20 characters. For each sensor to be displayed, set the sensor number in the NWS sensor list. To skip a sensor, set the NWS sensor number to 00. The NWS Sensor List would look like: "010203040506070809101112" to achieve the above readouts.

### 7.9.4.7 COMMAND MODE

Allows the user to enter AT commands directly to the modem. Typing "AT<Enter>" should produce a modem response of "ok". If there is no response from modem, "***" will be displayed. This will occur if Q1 is in the CMD string. Enable command responses with "ATQ0". "ok" should be the response.

The VX1100 can also be used to talk to a smart sensor connected to the RS232-AUX port of the VX1040 card. Each command sent to the AUX port must begin with and exclamation (!) in order to prevent the VX1100 from using the AT command interface and provide an unmodified data exchange. The following symbols can be sent by prefixing them with a backslash (\). A carriage return = \R. A tab = \T. A linefeed = \N. A NUL symbol ( ASCII 0 ) = \0. A backslash = \\.

An example would be: "!OOOR\R" to send three O's and an R followed by a carriage return.

#### 7.9.4.8 NWS TAG

This gives the user access to a menu that controls the setup for the NWS Tag.

| NWS tag | |
|---|---|
| 1 NWS:031311060705… | NWS sensor list. |
| 2 PWL offline : 0 | 1 or 0 in status line of report. |
| 3 Test | This causes a print of the NWS list followed by a print of the NWS formatted serial report. |

##### 7.9.4.8.1 NWS SENSOR LIST

The NWS setup string is 32 characters that define the order for the sensors in the NWS serial report. Each pair are assigned to one sensor in the NWS report. The first two characters should be used to identify the first sensor in the report. For instance: Sensor 3 is a primary water sensor. The first two characters in the NWS field should be "03". If "00" or " " is found in the string, no sensor will be associated with that reading in the report and six '9's will be displayed. The 31st and 32nd characters in the field define the 16th sensor in the report. The sensor list should follow this order: Primary water level[03]; Backup water level[13]; Wind data[11]; Air temp[06]; Water temp[07]; Barometer[05]; Conductivity( high )[16]; Current( N/A )[00]; Relative humidity[12]; Rainfall[08]; Solar Radiation[00]; Analog voltage #1[04]; Analog voltage #2[00]; Upper Paros[00]; Lower Paros[00]; and Frequency[00].

Precision in the NWS report is specified by each sensor using the decimal point parameter found in the scaling menu of each sensor. Conductivity is an exception in that there will always be 3 decimal places. The format for conductivity is: XX.XX0. The smallest digit will always be zero.

The second use for this setup string is to control what readings are sent to the AUX comm port when a VORNE display is connected. Refer to 7.9.4.6 to see how the sensor numbers from this list will show up on the 4 line display.

##### 7.9.4.8.2 PWL OFFLINE

The leading number on the status line of the NWS report is controlled by this field. It reflects the manual override status of the primary water level. If a "0" is desired on the status line, the PWL offline field should be zero. Selecting this menu item toggles between 1 & 0.

### 7.9.5 DISPLAY SETUP

The display menu controls how the display is used when in low power standby mode. If the mode is ON, the display will update regularly with sensor data from the sensor selected by 3 Name.

| Display | |
|---|---|
| 1 Mode : Off | Activate/deactivate data display on LCD. |

| | |
|---|---|
| 2 Backlight : Off | Activate/deactivate LCD backlight. Note that the backlight increases the system current draw by 90 milliamps. |
| 3 Name | Select Sensor to be displayed on LCD. Data from the selected sensor will be displayed on the LCD and is updated with every reading of the sensor. |

7.9.6 GOES SETUP

| GOES Setup | |
|---|---|
| 1 GOES ID 0101F3DC | Enter BCH ID number. |
| 2 Preamble Short | Select long or short preamble. |
| 3 Power Check 151 | Channel 151 is selected. TX Duration and Retry is software limited to avoid tripping the GOES fail-safe. |
| 4 GOES Self Timed | Opens the Self-timed menu. |
| 5 GOES Random | Open the Random menu. |
| 6 Debug Msg On | Display GOES formatted message or not at terminal port. |
| 8 ARGOS | Open the ARGOS setup menu. |

7.9.6.1 GOES SELF TIMED

| GOES Self Timed | | |
|---|---|---|
| 1 GOES On/Off | :On | Enable or disable self timed GOES. Default is on. |
| 2 Channel | :151 | Enter self-timed GOES channel. |
| 3 Test STX | | Send a self timed GOES message. |
| 4 Format Msg | | Format and print a GOES STX message without sending. |
| 5 First TX | :00:00:05 | Enter first transmit offset time. |
| 6 Interval | :240 | Enter interval between transmissions in minutes. |
| 7 GOES Duration | :6.40 | Length of transmission in seconds. This number is calculated only when the menu is entered and is based upon the log interval and number of sensors with GOES flags assigned in the sensor setup menus. |
| 8 PWL Hours | 3 | Primary water level data for NOS format GOES TX. |
| 9 RWL Hours | 3 | Redundant water level data for NOS format GOES TX. |

7.9.6.2 GOES RANDOM

| GOES Random | | |
|---|---|---|
| 1 GOES On/Off | :On | Enable or disable self timed GOES. Default is on. |
| 2 Channel | :151 | Enter random GOES channel. |
| 3 Test RTX | | Send a random GOES message. |
| 4 Format Msg | | Format and print a GOES RTX message without sending. |
| 5 Interval | :18 | This specifies the frequency +/- 20% for each message. |
| 6 Data Sets | :6 | Specifies how many times that data sets will be sent after an alarm has occurred. |
| 7 Flywheel Count | :10 | This controls the number of times that storm surge messages will be sent after an alarm level has been activated for one of the sensors in the sensor list. If set to 1, only 1 random GOES message will be sent with data from each sensor in the sensor list. |
| 8 Sensor List | | All sensors in this list will be included in a random message if ANY of these sensors is in an alarm state. |

7.9.6.3 ARGOS SETUP

ARGOS is implemented using the Telonix ST-13 Platform Transmitter. The VX1100 is programmed to send data every 200 seconds +/- 6 seconds that causes the ST-13 to transmit. The power and communications are supplied through the serial cable supplied by Vitel. The VX1100 sends sixteen 16-bit signed data readings through the ARGOS system. This is accomplished by adding a sensor to the ARGOS sensor list. Only the first parameter of any sampled sensor is added to the ARGOS transmission; therefore, a sensor type like "Wind Data" will only send wind speed. If the second or third parameter needs to be sent, assign a virtual sensor type to the correct parameter and add the virtual sensor to the ARGOS sensor list. The following menu describes the features that the VX1100 supports.

| Argos Setup | |
|---|---|
| 1 Mode : On | This is used to turn the ARGOS transmitter On or Off. A message will be sent each time the ARGOS transmitter is turned On. |
| 2 Sensor List | Any sensor placed in this list will have its first sampled sensor parameter added to the ARGOS transmission. |
| 3 Next : 01-01-01 08:53:12 | This shows the next time an ARGOS transmission is scheduled to take place. Selecting this will cause the ST-13 to send out a dummy message. The message is sixteen hex numbers in the sequence: x0102, x0304, x0506 and ending with x3132 |
| 4 Checkup | This sends a brief command to the ARGOS transmitter to verify that it is functioning. An error code of zero should be reported. |

7.9.7 DATA CARD SETUP

If a VX1060 Data Card Module is installed with the VX1100, sensor data will automatically be logged to a data card inserted in the VX1060. The data card must be a static RAM card with battery backup,

with or without attribute memory. The size of the installed data card is auto-detected when the menu below is entered as long as the Write Protect tab is disabled.

| Data Card Setup | |
|---|---|
| 1 Card 1024Kb | SRAM Data Cards up to 16 MB are supported. |
| 2 Init Logged Data | Clears data on Data Card and downloads configuration to card. |
| 3 Card Size Type : 9 | 0 = Turn off card use.<br>1 = 128Kb<br>2 = 256Kb<br>3 = 512Kb<br>4 = 1Mb<br>5 = 2Mb<br>6 = 4Mb<br>7 = 8Mb<br>8 = 16Mb<br>9 = Automatically select ram card size. |

The data card must be formatted with the VX1100 site setup information before logging can begin. When the "Init Data Card" option is chosen, the first 8192 bytes of the data card will be loaded with the VX1100 nonvolatile memory contents. The rest of the card will be formatted with data pages that organize the logged data by sensor. This saves room on the card by allowing a single timestamp and sensor scaling entry per page of sensor readings. Logging to the data card will then begin with the next scheduled measurement.

In order to save the VX1100 setup parameters, the user must use the Upload/Down load menu (see Section 7.9.10) and manually save the configuration to the VX1060 PCMCIA RAM card.

A new Data Card may be installed and formatted without the operator gaining access to the setup menus. This is performed by inserting the new Data Card, then pressing the pushbutton on the VX1060. The LCD display will then prompt the operator for card format confirmation. If the operator then presses the 'ENTER' button, the card will be formatted and logging will begin. The user can manually specify a card size by pressing a number on the pad that represents the desire card size instead of pressing 'ENTER'.

To calculate how long a data card can log before losing its oldest readings, use the following formula:

Cs = Card size in bytes:
1Mb = 1024 * 1024 = 1048576
256Kb = 256 * 1024 = 262144
Pn = Number of pages of data on card can be calculated as:
(Cs – 2150) / (508 + 2)
128Kb card, ((128*1024) - 2150) / (508 + 2) = 252.788 = 252
16Mb card, ((16*1024*1024) - 2150) / (508 + 2) = 32892.286 = 32892
Rt = The total number of readings per hour from all sensors:
SN3 (Aquatrak), 5 readings every 6 minutes = 50 / hr
SN4 (Battery), 1 reading every 60 minutes = 1 / hr

SN11(Wind Data), 3 readings every 15 minutes = 12 / hr
Total = 63 readings / hr

Ht = total hours of data logging capacity = (250 * Pn) / Rt

### 7.9.8 VX0850 SETUP

| VX0850 Setup | | |
|---|---|---|
| 1 VX0850 flag | ON | Setting this flag to ON enables self-timed data transmissions. |
| 2 Path Length | 0 | The number of nodes in the path specifier. Range: 0 to 10. |
| 3 Path Specifiers | | Create path for self timed data. |
| 4 Sensor List | | All sensors in this list will transmit their readings to the destination node each log interval. |
| 4 VX0850 Test | | Send canned message to destination. |
| 5 Get UID | 65535 | Poll a node in the path for its UID. |
| 7 Set UID | | Send a UID number to some node in the path. |
| 8 Packet Limit | 5 | This limits the number of packets that a VX1100 will create in response to a DataCommand interrogation. |

#### 7.9.8.1 VX0850 FLAG

This is used to control the generation of self-timed data packets. Any sensor that is in the sensor list will create a data packet if the flag is set to ON.

#### 7.9.8.2 PATH LENGTH

The Path length can be from 0 to 10. In order to specify a UID for the VX1100 without actually having a destination path, specify a path length of 1. And enter the path data as normal.

#### 7.9.8.3 PATH SPECIFIER

The format for each Path Spec N is: <UID>:<In-Port>/<Out-Port>". The UID is a unique number from 0 to 65534 that is assigned to a node in the system. 65535 is used by the system to mean ANY. The first path specified is used to specify the VX1100 UID number. In-Port and Out-Port are defined as: "0" for source or destination, "4" for serial link and "1" for RF link. Example: "00001:0/4". VX1100 UID of 1, "0" indicates source of message, "4" indicates that the packet will leave by serial connection.

#### 7.9.8.4 VX0850 TEST

This function allows the user to test the path by sending a "canned" message to the specified destination.

#### 7.9.8.5 GET UID

Each node in the path is specified by a node number starting with zero for the source. To poll the VX0850, use node 1.

#### 7.9.8.6 SET UID

Each node in the path is specified by a node number starting with zero for the source. To set the VX0850 UID, enter the desired UID number from 0 to 65534 and the node number ( 1 ).

#### 7.9.8.7 PACKET LIMIT

The limit was created to give the VX1100 control over time spent servicing 0850 interrogation packets. A packet limit of 0 implies no limit. VX1100 measurement cycles will be ignored while packets are being sent; therefore it is good to keep this limit low if measurement cycles are less than one minute apart.

### 7.9.9 TIMER CONTROL

Timed Analog Outputs will allow the VX1100 to control Out1 through Out4 by time. The control is specified by Offset, On Period, and Off Period. All these are specified in seconds and range from 0 to 65636. In most cases, the On Period + Off Period should be evenly divisible into 86400 (the number of seconds per day). Otherwise, the On/Off period will not be very predictable and the Offset will be useless.

| Timer Control | | |
|---|---|---|
| 1 Timer | :Off | Each time that timer is enabled, a calculation is made from the present day's midnight plus Offset to the current time. Each on and off period is added and the timers state is calculated to be active or inactive. In an active state, the Port Control Byte is applied to OUT1 through OUT4 similar to the alarm controls ( refer to section 7.9.3.2 ). |
| 2 Set Offset | :0 | #seconds from midnight to offset the first active period. |
| 3 On Period | :0 | #seconds for each on period. |
| 4 Off Period | :0 | #seconds for each off period. |
| 5 Port Control | :00 | Refer to section 7.9.3.2 |

### 7.9.10 UPLOAD / DOWNLOAD

The VX1100 has the capability of storing and retrieving its system setup parameters by ram card or serial transfer using XMODEM. The following menu describes the setup transfer menu:

| | |
|---|---|
| 1 VX1100 to Data Card | Upload system setup to VX1060 ram card. |
| 2 VX1100 from Data Card | Download system setup from VX1060 ram card. |
| 3 VX1100 to Computer | Download VX1100 configuration to PC. |
| 4 VX1100 from Computer | Upload VX1100 configuration from PC. |

### 7.9.11 SETUP TO PC

Using XMODEM protocol, the VX1100 will store the entire system configuration to a binary file on the PC.

### 7.9.12 SETUP FROM PC

The VX1100 will restore a previously saved system configuration using the XMODEM protocol. Caution must be used to avoid loading a setup that was stored by a VX1100 with a different software version.

## 7.10 MANAGER SETUP

| Manager Functions | | |
|---|---|---|
| 1 Manager Passwd | :1111 | Access to all system functions. |
| 2 Operator Passwd | :2222 | Access to setup and data download. |
| 3 Visitor Passwd | :3333 | Access to Sensor read and data download. |
| 4 Session Timeout | :60 | User menu timeout in minutes. Operator logged into system will be automatically logged out after the Session timer expires. |
| 5 Hard Resets | :00,00 | Number occurrences of hardware and stack overflow resets. |
| 6 Config changes | :8 | Number of times that the configuration has been changed. |
| 6 Load Default Setup | | Initialize setup parameters to factory default. |
| 7 Clear Log RAM | | Clear data logging memory. |

## 7.11 FACTORY TEST MENU

The functions contained in the factory test Menu are meant for factory checkout only and should not be used except in a depot level repair.

# 8 SENSOR WIRING

When equipped with a termination board, the VX1100 has the following provisions for sensor connections:

| | |
|---|---|
| 16 | Single-ended --or-- |
| 8 | Differential analog inputs with 2.5V, 5V, or 10V reference. |
| 2 | Frequency/Counter inputs with programmable thresholds. |
| 1 | SDI-12 sensor bus. |
| 1 | V-BUS interface for expansion modules. |
| 1 | Switched Power output (switched battery voltage). |
| 8 | +5 volt excitation outputs. |
| 3 | Analog ground connections. |
| 4 | Open Drain control outputs. |

The analog ground pins should not be used for high-current ground-return lines. The following describes the connection of general sensor types.

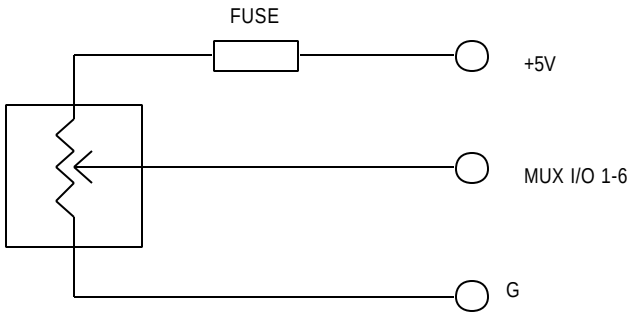
To allow checkout of sensors and connections, the VX1100 has provision for direct reading of sensor inputs without having to go through a measurement cycle. See the "Sensor" selections of both the "Serial Port Menus" section and the "Front Panel Operation Menus".

The number that is displayed on the screen is the reading after the scaling and offset factors have been applied to the direct reading.

## 8.1 RATIOMETRIC POTENTIOMETER SENSORS

An example of a ratiometric sensor is a wind direction indicator. The sensor excitation for the potentiometer comes from the +5V excitation output and the ground should be connected to the analog ground pin. The sensor output then gets connected to the desired analog input terminal.

**Figure 3.**
**Ratiometric Sensor Wiring**

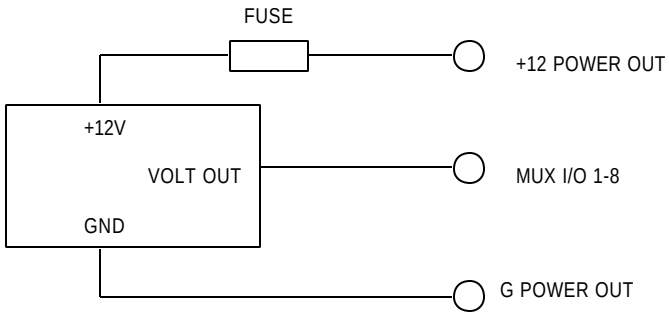



The zero output of the sensor will be read as zero counts and the full scale (2.5V, 5V, or 10V) output will be read as 32767 counts. A multiplier, divisor, and offset may be applied to these numbers. See "Sensor Scaling Factors" for more detail.

## 8.2 BATTERY POWERED VOLTAGE OUTPUT SENSORS

Some sensors may be powered off the battery voltage and give a voltage output which is proportional to the parameter the sensor is measuring. The power and ground leads from the sensor should be connected to the SW12 terminals of the VX1100 termination board. The SW12 is switched on at the programmed measurement time and is switched off at the end of the measurement. The sensor output signal should then be connected to an analog input terminal.

**Figure 4.**
**Battery Powered Sensor Connections with Voltage Output**



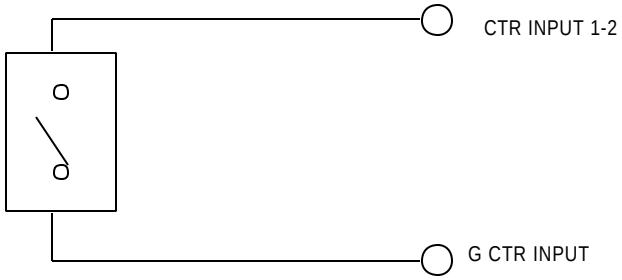

The SW12 terminal will supply up to 800 milliamps. The SW12 current does not go through the VX1100 panel mount fuse so any sensor using this should be separately fused. To prevent damage to the VX1100, an internal automatically resetting current limiter protects the SW12 terminal.

A zero voltage input signal corresponds to zero counts and a full scale ( 2.5V, 5V or 10V) input signal corresponds to 32767 counts. A multiplier, divisor, and offset may be applied to these numbers. See "Sensor Calibration" for more detail.

## 8.3 SWITCH CLOSURE SENSORS

A common example of a switch closure sensor is a tipping bucket precipitation gauge. The switch closure completes a circuit between the two sensor leads. The counter inputs can be used to measure this type of sensor output in one of two modes. The frequency of the tipping over a one-second-measurement period may be measured or the total number of switch closures that have occurred may be counted. The desired mode is selected from the Sensor Counter setup menu. Connection to the VX1100 is to a ground pin and the desired counter input terminal.

**Figure 5.**
**Switch Closure Sensor Connections**

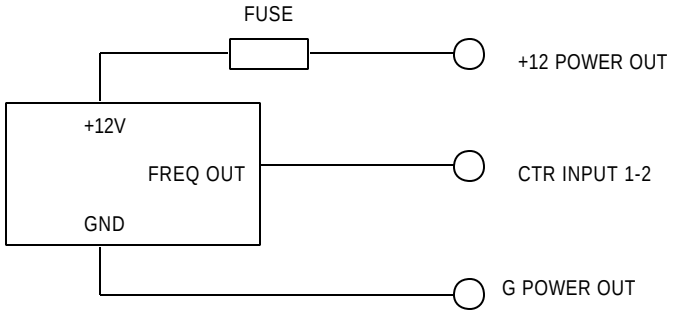



For a switch closure sensor, the input must be configured for TTL levels. An external pull-up resistor is not required. When the TTL input level is selected, an internal 470K pull-up resistor is energized. If the particular sensor requires a smaller pull-up resistor, one may be wired from the counter input terminal to battery voltage, switched power, or +5V excitation output. The one used is dependent upon whether it must be on all the time or not.

## 8.4 BATTERY POWERED 0-5 VOLT FREQUENCY OUTPUT SENSORS

Some sensors may be powered off the battery voltage and give a frequency output which is proportional to the parameter the sensor is measuring. The power and ground leads from the sensor should be connected to the SW12 terminals of the VX1100. The SW12 is switched on at the programmed measurement time and is switched off at the end of the measurement. The sensor output signal should then be connected to a CTR INPUT terminal.

**Figure 6.**
**Battery Powered Sensor Connections with Frequency Output**



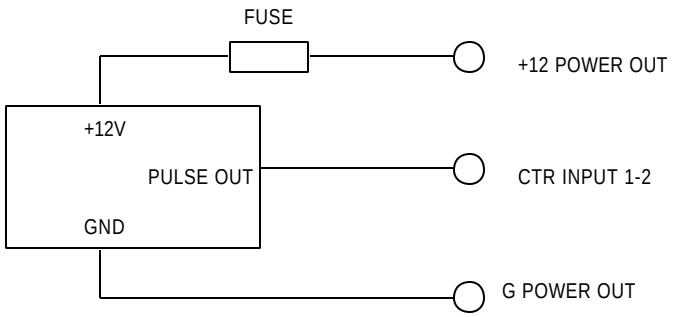

The SW12 terminal will supply up to 800 milliamps. The SW12 current does not go through the VX1100 panel mount fuse so any sensor using this should be separately fused. To prevent damage to the VX1100, an internal automatically resetting current limiter protects the SW12 terminal.

The frequency is measured over a one-second period. A zero frequency-input signal corresponds to zero counts. Even though the counter input will accept a signal up to 500 kHz, the counter will only count up to a maximum of 65,536 counts before it wraps back to zero and starts counting up again. If the expected frequency is known, this can be compensated for. If not, the maximum frequency at the input is 32,767 hertz. A slope and offset may be applied to these numbers. See "Sensor Scaling Factors" for more detail.

## 8.5 BATTERY POWERED 0-5 VOLT EVENT OUTPUT SENSORS

Some sensors may be powered off the battery voltage and give a digital output signal whenever a particular event occurs. The counter inputs may be used to count the number of events that have occurred during a given time frame. The power and ground leads from the sensor should be connected to power input plus and minus terminals of the VX1100 or other convenient battery connection.

**Figure 7.**
**Battery Powered Sensor Connections with A Digital Event Output**

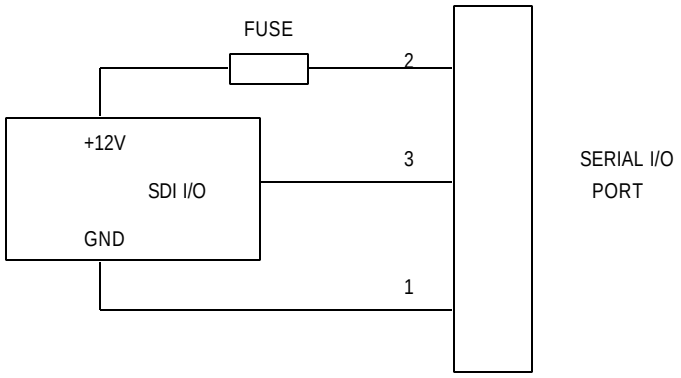



The internal counters will continue to count events at the input and are only reset by the user through the proper menu. At each log time, the current counter contents are logged. Thus the number of event from one log time to the next is the difference between the two readings. A slope and offset may be applied to these numbers. See "Sensor Scaling Factors" for more detail.

**SDI-12 SENSOR BUS**

Sensors equipped with SDI-12 compatibility require power, ground, and a serial data line, all of which are available at the Serial Output Connector on the VX1100 Termination Board. The pin-out of the Serial Output Connector is shown below.

**Figure 8.**
**Battery Powered Sensor Connections with SDI-12 Output**




Up to ten SDI-12 sensors may be chained in parallel to this bus, provided that the combined current draw of the sensors does not surpass 800 milliamps. All sensors should be separately fused.

# 9 PROGRAMMING THE VX1100 FOR OPERATION

The various parameters required by the VX1100 may be set either through the RS-232 port or by using the front panel LCD and buttons. The procedure is the same in either case. For correct operation, the following must be set:

- Sensor enable and scaling.
- Sensor logging and averaging intervals.
- GOES ID, Transmit enable and TX interval.
- Time and date.

All of these parameters are retained in non-volatile EEPROM memory and thus will not be lost even if the unit is powered down and the backup battery turned off.

Most of the programming is self-explanatory through the menus. All of the setup information may be programmed in the VX1100 ahead of installation time.

**IMPORTANT: Any time the VX1100 is started for the first time where the backup battery was not enabled, the "Clear Log RAM" option should be executed from the Manager Functions menu. If the unit has already been operating with the backup battery enabled, this is not necessary.**

## 9.1 SENSOR SCALING FACTORS

Each sensor setup includes unique scaling factors allowing the raw data readings to be transformed to other engineering units. The raw data from an analog voltage measurement (one of the analog inputs) is 0 to 32767 counts which is equivalent to 0 to 2.5 volts, 5 volts or 10 volts, depending upon the range selected. The raw data from a frequency measurement over a one-second sample (one of the CTR inputs) is from 0 to 32767 counts per second. If the counter exceeds 32767 counts in one second, the counter will wrap and display negative values. The Multiplier, Divisor, and Offset parameters are applied to the raw data according to the following equation:

$$\text{Logged Measurement} = [(\text{Multiplier} \times \text{Raw Data}) / \text{Divisor}] + \text{Offset}$$

The (Multiplier / Divisor) is considered as the slope of the reading. The Decimal Point entry allows the user to specify the number of digits to the right of the decimal point. The number with decimal point is the value that gets downloaded during a data retrieval process. The decimal point is also displayed during a sensor check. The data transmitted does not have this decimal point.

Sensors previously used with the VX1100 already have had the scaling factors predetermined. Please consult the factory.

These steps may be used to determine the scaling factors for any sensor.

Step 1. Determine Multiplier and Divisor (slope)

> The slope relating the reading to counts is determined by dividing the sensor output by the corresponding VX1100 input range.

The slope is then:

$$\frac{\text{Sensor output range}}{\text{VX1100 input range}} = \frac{\text{Multiplier}}{\text{Divisor}}$$

Example: A barometer having a 600 to 1100 millibar range with a corresponding output range of 1 to 5 volts has a multiplier of 500 m per 4 volts. Thus, the multiplier would be 500 and the divisor would be 4/5 times 32767 resulting in a divisor of 26214.

For this example, the Multiplier = 500 and the Divisor = 26214.

If one decimal of precision is desired, the above computation would have to be repeated in tenths of millibars. Therefore:

Example: A barometer having a 600 to 1100 millibar range with a corresponding output range of 1 to 5 volts has a range of 5000 tenths of millibars and thus a multiplier of 5000 per 4 volts. The divisor would still be 4/5 times 32767 resulting in a divisor of 26214.

In this instance, the Decimal Points number in the VX1100 sensor setup would now be one, not zero as in the previous example.

Step 2. Determine the Offset

If the sensor output is zero for a zero measurement, then the offset is zero. Otherwise the offset factor must be computed. To compute the offset, the output relative to a given input must be known. Then:

$$\text{Reading} = (\text{mult/div})\ (\text{VX1100 reading}) + \text{Offset}$$

or:

$$\text{Offset} = \text{Reading} - ((\text{mult/div}) \times (\text{VX1100 reading}))$$

In the last example:

mult = 5000 (tenths of millibars)

Div = 26214

Dec Pt = 1 the reading of 1100 millibars = 32767 (full scale input). Therefore:

Offset = 6000 tenths mB - (5000/26214) x (6553) = 4750

## 10 SYSTEM STARTUP

Once the VX1100 is installed and properly programmed for operation, the following should be checked:

1) Verify that the backup battery is enabled for data storage.
2) Check Time and Date.
3) Perform Read Sensor on each sensor used to confirm proper sensor setup.

Once logging is activated, it is possible to monitor operation by watching the LCD display. If Serial Reports are enabled, all activity will be printed to the serial port.

## 11 GOES TRANSMITTER FAIL-SAFE

The GOES Transmitter fail-safe will permanently disable GOES transmissions until the fail-safe circuit is manually reset. The fail-safe circuit is tripped when the transmission exceeds 110 seconds or the time between two successive transmissions is less than 80 seconds. In the GOES setup menu, the rough transmission time is calculated and displayed to the user.

The fail-safe does not inhibit operation of the VX1100, but prevents any power to the transmit antenna. Thus, from monitoring operation of the VX1100 it is not evident that the GOES transmissions are being inhibited. Forcing a transmission into a dummy load through a wattmeter may check the fail-safe status. If there is no power output, but the VX1100 went through a transmission cycle, the fail-safe may be tripped and must be reset.

To reset the fail-safe, refer to Figure 9 and perform the following steps:

1. Remove the lid of the Power Amplifier.
2. Check the voltage level on Test Point 4. If it is 0.4VDC or greater, the fail-safe has been tripped.
3. To reset the fail-safe, a 10uF 16V tantalum capacitor (C17) must be shorted to ground (Test Point 5). This capacitor is located in the lower left side of the Power Amplifier enclosure, just to the right of a mounting screw.
4. Recheck the voltage at TP4 and make sure that it is 0.0VDC.
5. Generate a test transmission from the Factory Test Menu, using a dummy load and a wattmeter to verify power output.
6. Verify that the voltage on TP4 is now 0.0VDC.

## 12 GOES TRANSMIT POWER ADJUSTMENT

The transmit power of the VX1004PA Power Amplifier may be adjusted by using a small non-metallic flat-blade screwdriver to adjust the power adjustment potentiometer. The location of this potentiometer may be seen from Figure 9. To adjust the power output, the RF output of the power amplifier should be connected to a wattmeter. The wattmeter should have a 25-watt element in the 402 MHz range with a 25-watt dummy load. Adjust the power output during a transmission until the desired power is attained.

The maximum received EIRP must not be exceeded. Nominally, the power output with a VITEL V2TH antenna should be set to 12.5 watts. Factors such as antenna cable length, antenna cable type, and antenna orientation will affect the power received by the satellite.

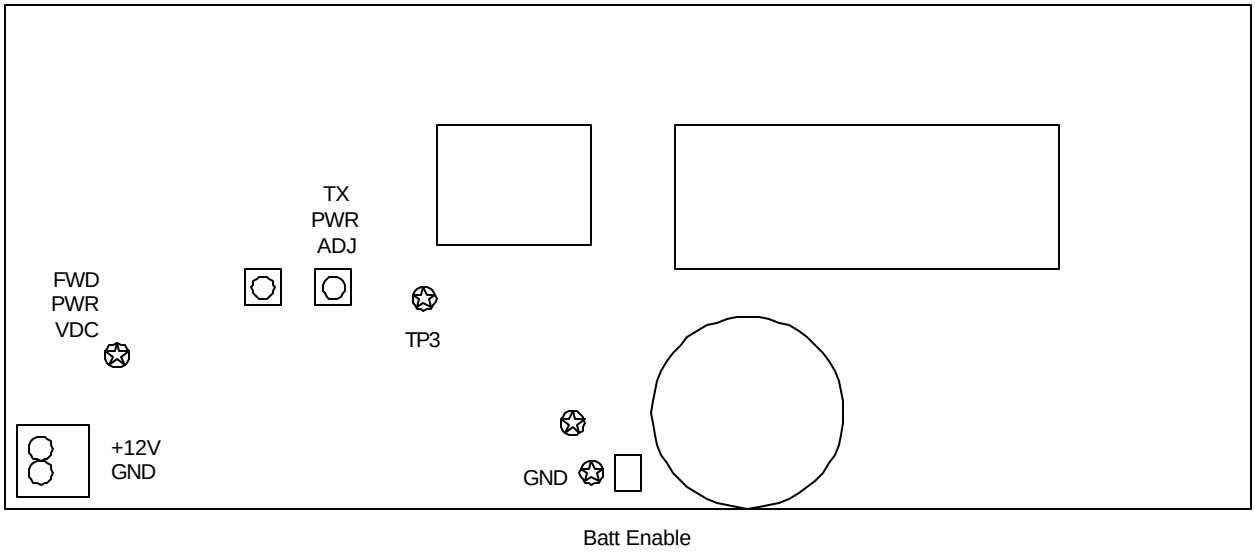



**Figure 9. External GOES Amplifier.**

## 13 TROUBLESHOOTING

The following is a list of possible problems that may be encountered with a VX1100 installation. The following possible causes should be investigated before the unit is assumed to be malfunctioning.

| Problem | Possible Cause |
|---|---|
| No menu sent to terminal upon power up. | Improper power connection.<br>Blown fuse.<br>Bad or improper serial cable to computer.<br>Communications software not running.<br>Baud rates not compatible. |
| Incorrect sensor readings. | Improper sensor wiring.<br>Wrong scaling factors applied.<br>Too many decimal places specified.<br>Sensor malfunction. |
| Data lost upon power down. | Backup battery switch not turned on.<br>Backup battery needs to be replaced. |
| No GOES transmissions. | Time and GOES enable not set.<br>RF cable from VX1100 to RF amplifier bad or not connected.<br>RF cable from RF amplifier to antenna bad or not connected.<br>Antenna not properly oriented.<br>Low battery.<br>Power amplifier output not correctly adjusted.<br>Wrong GOES channel.<br>Wrong GOES ID.<br>Fail-safe tripped. |
| No sensor data with GOES transmissions. | Sensors not enabled for GOES transmission.<br>Log interval not set. |
| No Data From Data Download. | Data logging RAM not initialized prior to system operation.<br>Log interval not set. |

## 14 EPROM INSTALLATION

At times it may be necessary to update the firmware contained in the EPROM installed in the VX1100. This may be done by returning the VX1100 to the factory. The customer may exchange the EPROM without voiding the factory warranty. The procedure is as follows:

WARNING: The VITEL VX1100 contains CMOS circuitry sensitive to damage from electrostatic discharge. Employ ESD precautions such as grounding straps and work on an ESD protected workstation.

1. Download existing data if desired.
2. Remove power to the VX1100.
3. Work on a grounded work pad and use a body-grounding strap.
4. Locate the EPROM on the microprocessor PC board assembly. The EPROM will have a paper label identifying the VX1100, software version, and date.
5. Gently remove the EPROM from its socket using a flat bladed tool, noting the orientation of the EPROM.
6. Install the new EPROM in the socket, paying careful attention to the orientation notch. Pin 1 of EPROM should be aligned with notch in socket.
7. Power up VX1100 with a terminal connected to serial port at 9600 baud. A first time power up may take several seconds.
8. Strike a key to wake the VX1100.
9. Enter a valid Manager level password.
10. Select "Manager Functions".
11. Select "Load Default Setup".
12. Type "Y" <return> to confirm.
13. Select "Clear Log RAM".
14. Type "Y" <return> to confirm.
15. Type ESC to return to the Main Menu, and set the time, the date, and the desired setup parameters.

# 15 HELPFUL HINTS FOR SYSTEM OPERATION

## 15.1 HARD RESETS

In the "Manager Functions" Menu, there is a selection for "Hard Resets". This selection displays a counter that is incremented every time the system resets due to low power (less than 8 volts) or watchdog-timer reset. A high number of Hard Resets can indicate a weak battery. For instance, each time a GOES transmission occurs, there is a high current draw that can pull a seemingly good battery down below the 8-volt threshold.

## 15.2 CLEAR LOG RAM

When first deploying a VX1100, it is a good idea to "Clear Log RAM" using this selection in the "Manager Functions" menu. Keep in mind that executing this selection will delete any data logged in the VX1100. This will get rid of any possibly meaningless lab test data in system memory. It is absolutely necessary to execute "Clear Log RAM" if the internal lithium coin cell is ever replaced or DIP switch #1 is ever switched off and on again. If this is not done, the logging memory data pointers will not be initialized properly.

## 15.3 COMPLETE SYSTEM REBOOT

On rare occasions, it may be necessary to perform a system reboot from scratch. Prior to performing these procedures, make absolutely certain that the problem is not due to another cause such as faulty power supply, faulty communications cable, or faulty communications software/hardware.

If terminal port does not respond with password prompt, you may wish to first attempt to reset the communications data rate. It may be possible that the baud rate was changed unknowingly:

1) Press ON/OFF on keypad.
2) Press 5553 followed by pressing the ENTER button.
3) Arrow down to System Setup.
4) Arrow down to "Serial Report".
5) Arrow down to "Baud".
6) Press ENTER.
7) Arrow down to "9600".
8) Press ENTER.
9) Press ESC several times until you are at the "Main Menu".
10) Arrow down to "Log Off".
11) Press ENTER.

At this point you are ready to communicate via the terminal port. If you are not able to successfully download any data, you should reset the system from the "Manager Functions" Menu. Do this by first performing "Load Default Setup" and then "Clear Log RAM".

## A. LIMITED WARRANTY FOR VITEL, INC. PRODUCTS

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This warranty gives the customer specific rights, and the customer may also have other rights which may vary from state to state.

## B. DATA HANDLING

The 16-bit analog to digital (A/D) converter in the VX1100 provides a measurement between -32767 and +32767 counts. The counters inside the VX1100 provide a count between 0 and 65,535 for frequencies or running count measurements (such as a tipping bucket). Frequencies are measured over a 1 to 255 second period.

The output from these circuits may be converted to engineering units using the Multiplier, Divisor, and Offset in the sensor setup table. Different multipliers, divisors, and offsets may be applied to each sensor input. After applying these scaling factors to the raw measurement, you are left with an integer between -32,767 and +32,767. This integer value is what is transmitted over the satellite and stored in the data logging RAM.

When the data is printed out to the display or downloaded to a computer, a decimal point may be added to each value to make it more readable. The user specifies the number of digits that he would like to see to the right of the decimal point in the sensor-scaling table. If a value of 2 were entered in the sensor setup table, it would cause the value 2162 to be printed as 21.62. This decimal point selection has no effect on the data that is transmitted over the satellite. The receive-site computer must add any decimal points. For the example given above, the integer value 2162 is transmitted to the satellite.

## C. BUREAU OF RECLAMATION GOES FORMAT

The VX1100 transmits all data in the pseudo ASCII format recommended by NESDIS; this allows the maximum amount of data to be transmitted within the assigned time slot. All messages conform to the specified format of Carrier, Clock, 15-Bit Frame Sync Word, 31-bit User Address, the user data field, and an EOT character. The VX1100 may be programmed to transmit either the long preamble (5 seconds carrier, 2.5 seconds clock) or the short preamble (0.5 seconds carrier, 0.48 seconds clock).

The basic format of the user data field for VX1100 transmissions is shown below as four sections.

<Message Header> <Sensor Data> <Battery Voltage> <EOT>

Message Header

For self-timed messages, the header consists of 7 bytes as defined below:

| | | | |
|---|---|---|---|
| Byte 1 | X | Header Byte | 'X' is ASCII 88. Indicates that message came from a VX1100 unit. |
| Byte 2 | t | Message Type | Currently:<br>* for self-timed messages;<br># for regular random message or;<br>! for alarm random. |
| Byte 3 | v | Software Version | This is the EPROM software version. |
| Byte 4 | r | Reset Counter | Range 0 to 63, circular. Increments each time unit is reset. Set to zero when logging ram is initialized. |
| Byte 5 | b | Low Battery event Counter | Range 0 to 63, circular. Incremented each time a transmission is aborted due to low battery voltage. |
| Byte 6 | s | Session Counter | Range 0 to 63, circular. Incremented each time configuration is changed. |
| Byte 7 | e | Error Status | 'e' is error status byte. Not yet defined. |

Sensor Data

The message may contain from 0 to 20 sensor data fields, depending on how many sensors are enabled for GOES transmissions. The sensor data field is defined below:

<Space><Sensor Number><Time Byte><data><data>...<data>

An ASCII space character precedes all sensor data fields. The sensor number is transmitted as an ASCII character between A and Z. The number is calculated by subtracting 40 hex (64 decimal) from the transmitted character. For example, sensor number 1 is transmitted as the ASCII character A, which is 41 Hex. 41 hex - 40 hex = 1.

The time byte is a one byte ASCII character that represents a number between 0 and 63. This number represents the number of minutes from when the data was logged to when it was transmitted. The time byte is followed immediately by sensor data.

The data is transmitted with the most recent data first. Each data value, which may vary from +/- 32767, is transmitted as a 3-byte pseudo-ASCII value. Each 16-bit integer data value is encoded to three pseudo-ASCII bytes, with six data bits in each byte, in the following manner:

| **Bit Position** | **7** | **6** | **5** | **4** | **3** | **2** | **1** | **0** |
|---|---|---|---|---|---|---|---|---|
| **First Byte:** | P | 1 | X | x | 15 | 14 | 13 | 12 |
| **Second Byte:** | P | 1 | 11 | 10 | 9 | 8 | 7 | 6 |
| **Third Byte:** | P | 1 | 5 | 4 | 3 | 2 | 1 | 0 |

Where 15 through 0 in the bit field represent bit positions from the integer.

As before, the P is the parity bit and bit 6 is always a '1'. The xx shown in the first byte are "don't care" bits and are set to 00 for zero or positive values, and to 11 for negative values. An example of how to encode the integer value 21429 follows:

Integer Value: 21429
Hex Value: 0x53B5
Binary Value: 0101 0011 1011 0101

Encoded Bytes:
First byte: P1 00 0101
Second byte: P1 0011 10
Third byte: P1 11 0101

Some values may be encoded to bytes that result in P111 1111 (Hex 7F), which is the non-printable ASCII DELETE character. In this specific case, that byte will be changed to P011 1111 (Hex 3F), the ASCII question mark (a printable character).

Battery Voltage

The battery voltage, measured during the Carrier portion of the transmission, is included as the last sensor data field. The battery voltage field consists of an ASCII space character, the ASCII zero character '0', and a one byte pseudo-ASCII character which represents the battery voltage. The one byte provides six bits for data, which accommodates the values from 0 to 63. The battery voltage is then calculated from the following equation:

Battery Voltage = 9.5 + (value)(0.10) Volts,

where "value" is a number from 0 to 63.

Example GOES Transmission -- The transmission shown below was downloaded from Wallops DAPS on 02 May 1995. The actual transmission contains no linefeed or carriage returns. They are added here for clarity.

Raw Message:
344DC57295122141113G46-4NN042WFF00115X*0F@a@
BK@dC@d@@cy@cy@cx@cu@ct@cw CK@?S@~[ DK@?Y@~\ EK@@U@@U
FK@Ce@CW GK@Cx@Cy@Co@C{@Cl@CU@Cl@C] HK@@q@@k 0W

Decoded:
Wallops Added Header:
344DC572 95 122 14:11:13 G 46-4NN 042W FF 00115

User Data:

| | |
|---|---|
| X*0F@a@ | Message Header |
| BK @dC @d@ @cy @cy @cx @cu @ct @cw | Sensor 2 Data |
| CK @?S @~[ | Sensor 3 Data |
| DK @?Y @~\ | Sensor 4 Data |
| EK @@U @@U | Sensor 5 Data |
| FK @Ce @CW | Sensor 6 Data |
| GK @Cx @Cy @Co @C{ @Cl @CU @Cl @C] | Sensor 7 Data |
| HK @@q @@k | Sensor 8 Data |
| 0W | Battery Voltage |

## D. NOS GOES FORMAT

This explains the preparation for GOES NOS style messages sent by the VITEL VX1100. The first section is a list of all currently defined GOES flags. GOES self-timed messages are second. The final section describes the Storm Surge format.

GOES Sensor Flag Descriptions:

| GOES Flag | ASCII | Byte Code* | Meaning | GOES Flag | ASCII | Byte Code* | Meaning |
|---|---|---|---|---|---|---|---|
| 33 | ! | -3 | Shaft Angle Encoder | 48 | 0 | -2<br>+1 | NOS Date Code,<br>Time |
| 34 | " | -3 | Backup Water Level | 49 | 1 | +2<br>+2<br>+1<br>–2<br>–2 | Primary Water Level,<br>Std Deviation,<br>Outliers,<br>Range Tube Temp,<br>Cal Tube Temp |
| 35 | # | -3 | Reserved | 50 | 2 | -3 | Backup Water Level (Discontinued) |
| 36 | $ | -3 | Reserved | 51 | 3 | +2<br>+2<br>+2 | Wind Speed,<br>Direction,<br>Gust |
| 37 | % | -3 | Paros Scientific #1 | 52 | 4 | -2 | Air Temp |
| 38 | & | -3 | Paros Scientific #2 | 53 | 5 | -2 | Water Temp |
| 39 | ' | -3 | Redundant Paros Scientific #1 | 54 | 6 | +2 | Barometer |
| 40 | ( | -3 | Reserved | 55 | 7 | -2 | Conductivity |
| 41 | ) | -3 | Reserved | 56 | 8 | +2<br>+2 | Water Current Speed<br>Direction |
| 42 | * | -3 | Paros Scientific (Old) | 57 | 9 | -2 | Dew Point |
| 43 | + | +2 | Frequency #1 | 58 | : | +2 | Rain Fall |
| 44 | , | -3 | Unspecified | 59 | ; | +2 | Solar Radiation |
| 45 | - | -3 | Unspecified | 60 | < | +2 | Analog #1 |
| 46 | . | -3 | Redundant Shaft Angle | 61 | = | +2 | Analog #2 |
| 47 | / | -3 | Unspecified | 62 | > | -3 | Redundant Water Level |

*Note: Byte Code describes how many bytes are used to convey bits of data. +1 = 6 bits of unsigned data for a decimal range of 0 to 63. +2 = 12 bits of unsigned data for a decimal range of 0 to 4095. –2 = 12 bits of signed data for a decimal range of –2048 to 2047. –3 = 16 bits of signed data for a range of -32768 to 32767. A full descrption of the Byte Code is presented below.

The self-timed NOS GOES message has four parts: the Header, the primary water level and ancillary data, redundant water level, and battery voltage during transmission. At the reception time, the number of hours of PWL data and RWL data may be unknown. It is not a problem decoding since all data following the reception of the RWL char '>' are considered redundant data. The basic format for a goes message is:

<Header>
<PWL data><BWL data><Ancillary Sensors> (x PWL hours)
<RWL data><Redundant BWL data> (x RWL hours)
<Battery Voltage>

| Explanation of the 18-byte Self Timed Header: | |
|---|---|
| 'M' | Self-timed data indicator, fixed. |
| 'SITE0001' | 8 character site id. |
| '@@@' | -32768, 32767. PWL (Primary Water Level) Datum Offset. |
| '@@' | -2048, 2047. PWL Sensor Offset. |
| '@@' | 0, 4095. System Status. |
| '@' | 0, 63. Reset counter. |
| 'V' | Version character, fixed. |
| '@' | 0, 63. Goes Version |

The data encoding is explained in C as follows:

```
// Format Primary water level and Ancillary sensor data.
// pwl_hours range: 0 to 4.
for(int hour = pwl_hours; hour > 0; hour--){
    // Time of data:
    '0'    // Time character (zero), fixed.
    '@@'   // 0, 4095. *NOS Date Code described below.
    '@'    // 0, 63. Hour of day of first reading in set.

    // PWL Data Format:
    '1'    // Aquatrak Primary water level character, fixed.
    '@'    // 0, 63. Water level offset x 0.250 meters.
           // raw reading = water level offset x 0.250m + average water level.

    for(x=0; x<10; x++){
    '@@'   // 0, 4095. AQT average water level - water level offset.
    '@@'   // 0, 4095. AQT sigma.
    '@'    // 0, 63. AQT number of outliers.
    '@@'   // -2048, 2047. AQT temp 1 in tenths of degrees C.
    '@@'   // -2048, 2047. AQT temp 2 in tenths of degrees C.
    }

    // BWL (Backup Water Level) Data Format:
    '"'    // Double Quotes, Backup water level indicator.
    '@@@'  // -32768, 32767. First water level measurement at xx:00.
    '@@@'  // -32768, 32767. Second water level measurement at xx:30.


    // Ancillary Sensors Data Format:
    // Ancillary data separated only by goes flags
    //    and repeated for each sensor.
    '@'    // Goes Flag for appropriate sensor type, described above.
    '@@'   // Data varies in size and signed as per GOES flags.
    '@@@'  //
           // Time stamp interval = 60 minutes / number of readings.
           // 60 minutes / 6 readings = 10 minutes apart.
           // 60 minutes / 4 readings = 15 minutes apart.
    '@@'
    '@@@'  // ... (Up to 60 readings, one per minute)
}

// Format Redundant Water level and Redundant Backup Water level.
// rwl_hours range: 0 to 4.
for(int hour = rwl_hours; hour > 0; hour--){
    // Time of data:
    '0'    // Time character (zero), fixed.
    '@@'   // -2048, 2047. Day description below.
    '@'    // 0, 63. Hour of day of first reading in set.

    // RWL Data Format:
    '>'    // Aquatrak Redundant water level character, fixed.
    '@'    // 0, 63. Water level offset x 0.250 meters.
```

```
            // raw reading = water level offset x 0.250m + average water level.

    for( x=0; x<10; x++ ){
    '@@'   // 0, 4095. AQT average water level - water level offset.
    }

    // BWL (Backup Water Level) Data Format:
    '"'    , Double Quotes, Backup water level indicator.
    '@@@'  // -32768, 32767. First water level measurement at xx:00.
    '@@@'  // -32768, 32767. Second water level measurement at xx:30.
}

// Battery Voltage Format:
' '    // SPACE to identify battery voltage next.
'@'    // 0, 63. (BV) Battery voltage in tenths of a volt - 9.5 volts.
       // Battery voltage during transmission is ( 9.5 + BV/10 )volts.
```

*The NOS Date code wraps approximately every eleven years or 4096 days and is specified as:
(0xFFF & (((The number of seconds since 0:00 1-1-1980) - 157852800) / 86400) + 1)

The NOS Storm surge GOES message has three parts: the header; the primary water level and ancillary data; and, battery voltage during transmission. The basic format for a goes message is:

<Header>
<6 x PWL Data>
<Wind Data> and/or <Barometer Data>
<Battery Voltage>

| Explanation of the 4-byte Random Header: | |
|---|---|
| 'S' | Random transmission indicator, fixed. |
| '@' | 0, 23. Time of first AQT reading in hours. |
| '@' | 0, 59. Time of first AQT reading in minutes. |
| '@' | 0, 63. Water level offset x 0.250 meters. |
| | raw reading = water level offset x 0.250m + average water level. |

```
// PWL Data Format:
for(int sets=0; sets<6; sets++){
'@@'    // 0, 4095. AQT average water level - water level offset.
}

// Wind Data Format:
       // This is the value of the last logged wind data.
'3'    // NOS Wind Data, fixed.
'@@'   // -2048, 2047. Average Wind Speed in tenths of meters per second.
'@@'   // -2048, 2048. Wind Direction.
'@@'   // -2048, 2047. Wind Gust in tenths of meters per second.

// Barometer Data Format:
       // This is the value of the last logged barometer reading.
'6'    // NOS Barometer type, fixed.
'@@'   // barometer reading in tenths of millibars – 8000.


// Battery Voltage Format:
' '    // SPACE to identify battery voltage next.
'@'    // 0, 63. (BV) Battery voltage in tenths of a volt - 9.5 volts.
       // Battery voltage during transmission is ( 9.5 + BV/10 )volts.
```

The use of the @, @@ and @@@ are functions that convert integer numbers into one, two or three byte pseudo ASCII characters (PAC). Bit6 is always set to 1, therefore with 1 byte the range is 0 to 63 (6 bits of data). With 2 bytes the range is 0 to 4095 (12 bits of data). With 3 bytes there are 16 bits of data. The function odd parity takes each byte and sets bit7 to 1 if the number of high bits are even, 0 otherwise. Furthermore, 0x7F if replaced by 0x3F = '?'. Bytes are expressed as MSB ... LSB and B2, B1, B0.

```
/* A C-Function that converts an unsigned char into a Psuedo ASCII character with Bit-6 set and Bit-7
set for Odd Parity. */
unsigned char odd_parity( unsigned char cCheck){
        int nParityCount = 1; // because bit6 is always 1
        unsigned char nFixed = cCheck;
        for( int loop = 0; loop<6; loop++){
                if( cCheck &0x01 )
                        nParityCount++;
                cCheck = cCheck >> 1;
        }

        if( nParityCount % 2 == 0) // even parity
                nFixed |= 0x80;
        if( nFixed == 0x7F )
                nFixed = 0x3F;
        nFixed |= 0x40;
        return nFixed;
}

        One byte PAC:
        B0 = odd_parity( int );

        ex: Convert decimal 12 (0x0C) into a one-byte PAC.
        'L' = odd_parity( 0x0C );

        Two byte PAC:
        B0 (lsb) = odd_parity( int );
        B1 (msb) = odd_parity( int >> 6 );

        ex: Convert decimal 4093 (0x0FFD ) into a two-byte PAC.
        '}' = odd_parity( 0x0ffd );
        '?' = odd_parity( 0x0ffd >> 6 );
        '?}' = 4093

        Three byte PAC:
        if ( int < 0 ){
           int = -int;
           B2 (msb) = odd_parity(((int >> 12) & 0x0f) | 0x70);

        } else {
           B2 (msb) = odd_parity(((int >> 12) & 0x0f) | 0x40);
        }
        B1 = odd_parity(((int >> 6) & 0x3f) | 0x40);
```

```
B0 = odd_parity((int & 0x3f) | 0x40);
```

## E. VITEL VS100-05 -15 SUBMERSIBLE PRESSURE TRANSDUCER

INTERCONNECTIONS USING DC-DC CONVERTER

| VS100 | Signal | VX1100 | 141-1148 -15VDC |
|---|---|---|---|
| Red | DC Supply | | Terminal 5, +15 VDC |
| Black | 4-20 mA Return | #2, A1- | |
| | | 125 ohm or 250 ohm Resistor from #2 to #1 | |
| | | #51, SW 12 | Terminal 2, PWR |
| | | #50, GND | Terminal 1, GND |
| | | | Terminal 1 and 3 Jumpered for common ground |

Note 1:141-1148 DC-DC converter PCBA is modified for +15VDC output on both pins 4 and 5 contrary to what the silkscreen on the PCBA states.

INTERCONNECTIONS USING BATTERY +12VDC

| VS100 | Signal | VX1100 |
|---|---|---|
| Red | DC Supply | #51, SW 12 |
| Black | 4-20 mA Return | #2, A1- |
| | | 125 ohm or 250 ohm Resistor from #2 to #1 |

VX1100 SCALING FACTORS USING 250 OHM RESISTOR

| Model | Range | Type | Mult | Div | Offset | Dec. Pt. |
|---|---|---|---|---|---|---|
| VS100-05 | 0 to 11.535 ft | Analog Single 5V | 1154 | 26214 | -288 | 2 |
| VS100-05 | 0 to 3.516 meters | Analog Single 5V | 3516 | 26214 | -879 | 3 |
| VS100-15 | 0 to 34.605 ft | Analog Single 5V | 3460 | 26214 | -865 | 2 |
| VS100-15 | 0 to 10.547 meters | Analog Single 5V | 10547 | 26214 | -2637 | 3 |

VX1100 SCALING FACTORS USING 125 OHM RESISTOR

| Model | Range | Type | Mult | Div | Offset | Dec. Pt. |
|---|---|---|---|---|---|---|
| VS100-05 | 0 to 11.535 ft | Analog Single 2.5V | 1154 | 26214 | -288 | 2 |
| VS100-05 | 0 to 3.516 meters | Analog Single 2.5V | 3516 | 26214 | -879 | 3 |
| VS100-15 | 0 to 34.605 ft | Analog Single 2.5V | 3460 | 26214 | -865 | 2 |
| VS100-15 | 0 to 10.547 meters | Analog Single 2.5V | 10547 | 26214 | -2637 | 3 |

## F. VITEL AIR TEMPERATURE PROBE

PCBA 141-1112 Rev B

THERMISTOR ASSEMBLY COMPONENT VALUES

| Range | YSI Resistor Set | R1 Value | R2 Value | 44018 T1 | 44018 T2 |
|---|---|---|---|---|---|
| -30 to +50 °C | 44303 | 18.7K | 35.25K | 6K | 30K |
| -5 to +45 °C | 44302 | 5.7K | 12.0K | 6K | 30K |

-30 TO +50 °C VOLTAGE OUTPUT VERSUS TEMPERATURE

$V_{out} = V_{in} [ (-0.0067966) T + 0.65107 ]$ where T = degrees Celsius
$V_{in}$ = 5 volts

-5 TO +45 °C VOLTAGE OUTPUT VERSUS TEMPERATURE

$V_{out} = V_{in} [ (-0.0056846) T + 0.805858 ]$ where T = degrees Celsius
$V_{in}$ = 5 volts

VX1100 SCALING FACTORS

| **Signal** | Range | Type | Mult. | Div. | Offset | Dec. Pt |
|---|---|---|---|---|---|---|
| Air Temp | -30 to +50 °C | 11, Single 0-5V | -1471 | 32767 | 958 | 1 |
| Air Temp | -22 to 122 °F | 11, Single 0-5V | -2648 | 32767 | 2044 | 1 |
| Water Temp | -5 to +45 °C | 11, Single 0-5V | -500 | 9313 | 1417 | 1 |
| Water Temp | 23 to 113 °F | 11, Single 0-5V | -900 | 9313 | 2871 | 1 |

*Note 1: Range shipped is -30C to +50C.*
*Note 2: PCBA is shaved on one side thus cutting off trace labeled 'GROUND'.*
*Note 3: Ground conductor is run through R3/R4 traces. R3/R4 not installed.*

## G. RM YOUNG 05103 WIND SENSOR

MODEL 05103 TO VX1100 CONNECTIONS

| RM Young 05103 | Signal | Color Code | Termination Number | Termination Signal |
|---|---|---|---|---|
| Earth | Earth | Bare | Ring lug to side rail | Earth Ground |
| WS REF | Ground | Black | 1* | GND |
| WD SIG | Direction Signal | White | 3* | A1+ |
| WD EXC | Direction Excitation | Red | 4* | +5V |
| WS SIG | Speed Signal | Green | 34 | CTR 1 |

*Note: *1, 3 & 4 are example terminal input numbers for analog input number one. Other inputs may be used and must agree with input specified in VX1100 sensor setup.*

VX1100 WIND DIRECTION SCALING FACTORS

| Signal | Range | Type | Mult. | Div. | Offset | Dec. Pt |
|---|---|---|---|---|---|---|
| Direction | 0 to 359 Degrees | 11, Single 0-5V | 359 | 32767 | 0 | 0 |
| Speed (mpS.) | | 22, AC Freq | 980 | 1000 | 0 | 1 |
| Speed (Knots) | | 22, AC Freq | 1904 | 1000 | 0 | 1 |
| Speed (Mph.) | | 22, AC Freq | 2192 | 1000 | 0 | 1 |
| Speed (Kph.) | | 22, AC Freq | 3528 | 1000 | 0 | 1 |

## H. SETRA BAROMETER MODEL 270

w/ option 623 (12VDC supply)

SETRA MODEL 270 VX1100 INTERCONNECTIONS

| SETRA 270 | Signal | Color Code | Termination Number | Termination Signal |
|---|---|---|---|---|
| | Ground | Black | 1* | GND |
| | Power | Red | 47 | SW 12 |
| | Neg Output | White | 2* | A1- |
| | Pos Output | Green | 3* | A1+ |

*Note: *1, 2 & 3 are example terminal input numbers for analog input number one. Other inputs may be used and must agree with input specified in VX1100 sensor setup.*

VX1100 SCALING FACTORS

| Signal | Range | Type | Mult | Div | Offset | Dec. Pt. |
|---|---|---|---|---|---|---|
| Pressure | 800 to 1100 MB | 14, Diff 0-5V | 3000 | 32767 | 8000 | 1 |

## I. VITEL CONDUCTIVITY PROBE MODEL VEC-200

VEC-200 SENSOR CONNECTIONS

| VEC-200 | SIGNAL | VX1004 | VX1100 |
|---|---|---|---|
| Black | Ground | G, #22 | GND, #50 |
| Red | +12VDC Supply | PWR OUT, #23 | SW+12V, #51 |
| White | Temp Output, 4-20 mA | MUX I/O | *An+ or An- |
| Blue | EC Output, 4-20 mA | MUX I/O | *Am+ or Am- |
| Green | Ground | G, #22 or n/c | GND #50 or n/c |

VX1100 SCALING FACTORS

| **Signal** | **Range** | **Type** | **Mult** | **Div** | **Offset** | **Dec. Pt.** |
|---|---|---|---|---|---|---|
| Temperature | 0 to50C | 11, Single 0-5V | 625 | 32767 | -125 | 1 |
| Conductivity | 0 to 60 mS/cm | 11, Single 0-5V | 750 | 32767 | -150 | 1 |
| Conductivity High Salinity alternate | 0 to 60 mS/cm | 12, Single 0-10V | 1500 | 32767 | -150 | 1 |
| Conductivity | 0 to 70 mS/cm | 11, Single 0-5V | 875 | 32767 | -175 | 1 |
| Conductivity High Salinity alternate | 0 to 70 mS/cm | 12, Single 0-10V | 1750 | 32767 | -175 | 1 |
| Conductivity | 0 to 80 mS/cm | 11, Single 0-5V | 1000 | 32767 | -200 | 1 |

**Note:* Any available single ended analog input with a *250.0 ohm scaling resistor connected from terminal block to Analog or MUX I/O Ground Terminal.*

## J. KIPP & ZONEN PYRANOMETER, MODEL CM11

| Signal | Range | Type | Mult | Div | Offset | Dec. Pt. |
|---|---|---|---|---|---|---|
| Langlies | 0 to 5.22mV | Differential<br>0 to 25mV | 297 | 2032 | 0 | 2 |

LAST PAGE

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