SEA·BIRD SCIENTIFIC

SATLANTIC

Operation Manual
HyperOCR

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SATLANTIC

Operation Manual For: HyperOCR
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A - OVERVIEW

Figure A-1: The HyperOCR. Irradiance (left) and Radiance (right).

Purpose

The HyperOCR is the latest addition to Satlantic's line of hyperspectral radiometer instruments. It has a fully digital optical sensor package, providing up to 255 channels of optical data with wavelengths ranging from 300 to 1200 nm.

See Figure A-1: The HyperOCR

Background

The HyperOCR is a complete stand-alone instrument capable of providing spectral records of light collected in an ocean environment. The on-board spectrometer uses a 16-bit A/D converter with a 25 bit dynamic resolution. The instrument can integrate incoming light over a wide range of predefined time intervals, providing sensor capabilities spanning a wide range of light levels. Two standard serial interfaces are provided. The RS-232 interface provides isolated half-duplex transmit and receive capabilities. The RS-422 telemetry interface is isolated transmit-only for instrument telemetry output. An isolated RS-485 network interface is also provided for combining several Satlantic networked devices on a single telemetry interface. Instrument telemetry, which is transmitted from the instrument during normal operation, is a fixed frame format compliant with the *Satlantic Data Format Standard*[1].

Features

- Compact size
- Light weight
- Low power consumption
- Minimal amount of support equipment required
- Fully isolated interface
- Networking capabilities
- Corrosion proof housing
- Easy to use

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[1] For more information in this data format, refer to the *Instrument File Standard* document available from Satlantic.

HyperOCR Configurations

Figure A-2 – HyperOCR-I (in air) - Irradiance Configuration

The HyperOCR has three basic physical configurations, two for irradiance measurements and one for radiance. The labels on each HyperOCR specify the configuration and serial number of that particular instrument. Irradiance instruments are labeled as follows:

```
HyperOCR-I
```

For radiance instruments, the label would read as follows:

```
HyperOCR-R
```

In addition, a yellow label will indicate whether the instrument is for use in air or water. The following diagram illustrates the connector pin configuration of the HyperOCR instrument:
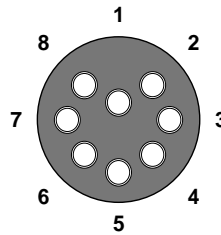
Figure A-3 - Impulse® MCBH8M Male Face View

These pins are designated as follows:

Pin	Identification	Description
1	V+	DC Power Supply (9-18 Volts or 18-72 Volts)
2	V-/SG	Power Supply Return / Signal Ground
3	TA	RS-422 Telemetry Interface (Transmit A). Balanced differential serial data from instrument to computer.
4	TB	RS-422 Telemetry Interface (Transmit B). Balanced differential serial data from instrument to computer.
5	Tx	RS-232 Telemetry Interface. Serial data from instrument to computer.
6	Rx	RS-232 Telemetry Interface. Serial data from computer to instrument.
7	NA	RS-485 Network Interface (A)
8	NB	RS-485 Network Interface (B)

Specifications for HyperOCR-I (in water) - Nominal Characteristics

Spatial Characteristics:

- Field of view: cosine response - within 3% 0° - 60°; within 10% 60° - 85° (350 - 750 nm)
- Detectors: 256 channel silicon photodiode array
- Entrance slit: 70 x 2500 μm
- Pixel size 25 x 2500 μm

Spectral Characteristics:

- Bandwidth range: 300-1200 nm (350-800 nm standard)
- Spectral sampling: 3.3 nm/pixel
- Spectral accuracy: 0.3 nm
- Spectral resolution: 10 nm
- Stray light: $<1 \times 10^{-3}$

Electrical Characteristics:

- Acquisition module: 16 bit ADC
- Digital resolution: 16 bits (variable)
- Integration time: 8 - 2048 ms (adaptive gain feature) (higher integration times are available)
- Frame rate: 3 Hz (at 128 ms integration time)
- Data rate: 9600 to 115200 bps (user selectable)
- Telemetry interface: RS-422 / RS-232 (isolated)
- Network interface: RS-485 (isolated)
- Power requirements: 18 - 72 V or 9 – 18 V DC (2.25 Watts nominal, 3.1 Watts shutter active)

Physical Characteristics:

- Housing: Black Acetron
- Size: 358 mm long (not including connector) 60 mm / 70 mm diameter
- Weight: 1.2 kg
- Depth rating: 250 m
- Operating temperature: -10 to +50 °C

Specifications for HyperOCR-I (in air) - Nominal Characteristics

Spatial Characteristics:

- Field of view: cosine response - within 3% 0° - 60°; within 10% 60° - 85° (300 - 800 nm)
- Detectors: 256 channel silicon photodiode array
- Entrance slit: 70 x 2500 μm
- Pixel size: 25 x 2500 μm

Spectral Characteristics:

- Bandwidth range: 300-1200 nm (350-800 nm standard)
- Spectral sampling: 3.3 nm/pixel
- Spectral accuracy: 0.3 nm
- Spectral resolution: 10 nm
- Stray light: $<1x10^{-3}$

Electrical Characteristics:

- Acquisition module: 16 bit ADC
- Digital resolution: 16 bits (variable)
- Integration time: 8 - 2048 ms (adaptive gain feature) (higher integration times are available)
- Frame rate: 3 Hz (at 128 ms integration time)
- Data rate: 9600 to 115200 bps (user selectable)
- Telemetry interface: RS-422 / RS-232 (isolated)
- Network interface: RS-485 (isolated)
- Power requirements: 18 - 72 V or 9 – 18 V DC (2.25 Watts nominal, 3.1 Watts shutter active)

Physical Characteristics:

- Housing: Black Acetron
- Size: 358 mm long (not including connector) 60 mm diameter
- Weight: 1.2 kg
- Depth rating: 250 m
- Operating temperature: -10 to +50 °C

Specifications for HyperOCR-R - Nominal Characteristics

Spatial Characteristics:

- Field of view: 11.5° half-angle, half-radiance, in air
  8.5° half-angle, half-radiance, in water
- Detectors: 256 channel silicon photodiode array
- Entrance slit: 70 x 2500 μm
- Pixel size: 25 x 2500 μm

Spectral Characteristics:

- Bandwidth range: 300-1200 nm (350-800 nm standard)
- Spectral sampling: 3.3 nm/pixel
- Spectral accuracy: 0.3 nm
- Spectral resolution: 10 nm
- Stray light: $<1x10^{-3}$

Electrical Characteristics:

- Acquisition module: 16 bit ADC
- Digital resolution: 16 bits (variable)
- Integration time: 8 - 2048 ms (adaptive gain feature)
  (higher integration times are available)
- Frame rate: 3 Hz (at 128 ms integration time)
- Data rate: 9600 to 115200 bps (user selectable)
- Telemetry interface: RS-422 / RS-232 (isolated)
- Network interface: RS-485 (isolated)
- Power requirements: 18 - 72 V or 9 – 18 V DC
  (2.25 Watts nominal, 3.1 Watts shutter active)

Physical Characteristics:

- Housing: Black Acetron
- Size: 319 mm long (not including connector)
  60 mm diameter
- Weight: 1.2 kg
- Depth rating: 250 m
- Operating temperature: -10 to +50 °C

B - SAFETY & HAZARDS

Personal Safety

- The operators should always remain aware of the cable. Any cable or line released from a ship can be dangerous. Keep a safe distance from the cable coil on deck when the instruments are being used.

Instruments

- Do not leave an in-water instrument unattended. Boat drift can entangle the cable and cause damage or instrument loss.

Cable

- To prevent damage to the conductors within the Kevlar™ strength member, ensure the power/telemetry cable is not pinched or bent to a radius less than 18 cm.

Connections

- Handle electrical terminations carefully, as they are not designed to withstand strain. Disconnect the cables from the components by pulling on the connector heads and not the cables. Do not twist the connector while pulling, as this will damage the connector pins.

- Do not use petroleum-based lubricants on Impulse® connectors. Connectors should be free of dirt and lightly lubricated before mating. Satlantic recommends using DC-111 silicone grease (made by Dow-Corning) on the male pins prior to connection.

Troubleshooting

- While checking voltages with a multimeter, extreme care should be used to not short the probe leads. A shorted power supply or battery can output many amperes of current, potentially harming the user, starting fires, or damaging equipment.

Recovery

- Remember never to grab the electrical portion of the instrument cable during recovery. This can cause damage to the power/telemetry bulkhead and the underwater splice.

- Lens caps should always be replaced as soon as the instrument comes back on board. This will help protect the heads from direct damage.

- Be sure to rinse seawater from the instrument with fresh water prior to storage. Corrosion resulting from failure to do so is not covered under warranty.

C - START UP

Assembly Procedure

PREPARATION

Your HyperOCR radiometer is a simple instrument to setup and operate. You will need the following items:

- DC power source. Refer to the specifications in section **A - OVERVIEW** for the power requirements of your instrument's configuration.

- Computer with a free serial communications port for telemetry acquisition.

- Power/Telemetry interface cables (may be provided).

- Data acquisition and processing software compliant with the *Satlantic Data Format Standard*[1]. (may be provided).

- The instrument's *calibration file*[2] (provided).

If you are not using your instrument in an embedded system, or you do not have your own data acquisition software, you may use the software provided by Satlantic. Two applications, *SatView*[3] and *SatCon*[3], are available to you for any PC running Microsoft Windows®. Both applications are compliant with the *Satlantic Data Format Standard*[1]. *SatView* is a data acquisition and real-time display application. *SatCon* is a post processing application for telemetry logged with *SatView*.

Note that it is not necessary to use the software mentioned above to log the instrument telemetry. Any properly configured terminal emulator can serve this purpose. However, you will need the proper software to interpret any of the data.

In any case, there are a few standard communications settings needed for any computer application communicating with the instrument. All serial transmissions use 1 start bit, 8 data bits, 1 stop bit, and no parity. No flow control of any kind is used. Make sure that your software is configured with the baud rate specified for your instrument (normally 57600 bps). These settings apply to both the RS-232 and RS-422 telemetry interfaces.

> **IMPORTANT! Both the RS-232 and RS-422 telemetry interfaces transmit the same information. The RS-232 interface provides bi-directional communication while the RS-422 is transmit-only. Normally, the RS-232 interface is used for configuring and testing your instrument. The RS-422 interface would normally be used for telemetry acquisition in the field using longer cables. Most computer serial interfaces are RS-232. Therefore, if you are using the RS-422 interface on the instrument, a converter will be required to convert the output from the instrument to levels compatible with your computer. Normally, only one of these telemetry interfaces is provided on a cable.**

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[2] For more information on calibration files, refer to the *Instrument File Standard* document available from Satlantic
[3] For more information on these applications, refer to the user's manuals distributed with the software.

CONNECTING THE COMPONENTS

When making connections, proper alignment on the connector pins is critical to avoid damage. Visually ensure that the pins on the male connectors are properly aligned with (and partially seated into) the sockets on their female counterparts before pushing them together for final connection. Finally, ensure that the locking sleeve or locking strap is securely fastened after connection.

The following is a generic step-by-step procedure for setting up your HyperOCR Hyperspectral Radiometer. You may use this procedure with any Satlantic approved interface cable:

1. Ensure that, initially, the instrument is completely disconnected from the power supply.

2. Ensure that the power supply is setup for the proper voltage.

3. If possible, turn off the power supply.

4. Mount the instrument in the desired position.

5. Connect the instrument side of the interface cable to the bulkhead on the instrument.

6. Connect the telemetry-output side of the interface cable to the serial interface of the computer. Use an appropriate level converter if needed.

7. Configure any software for use with the instrument.

8. Remove the protective cover from the end of the HyperOCR.

9. Connect the power-input side of the interface cable to the power supply.

10. Apply power to the instrument (turn on the power supply).

Once your HyperOCR has been properly connected and power has been applied, an initialization sequence will begin automatically to ready the device for normal operation. This sequence takes approximately 4 seconds to complete. Once finished, the instrument should begin normal operation. See the ***Conduct a Telemetry Test*** section below to make sure that your instrument is working properly. If this does not happen, remove power from the instrument and repeat the connection sequence. If you are still experiencing problems, contact a Satlantic customer service representative for assistance.

See section **D - OPERATION** for more information on operating your instrument.

See section **F – RECOVERY** for information on recovering and disconnecting your instrument after use.

NETWORK ASSEMBLY

Your HyperOCR is capable of functioning as a stand-alone instrument or as one node in a network of other SatNet network capable instruments. Networking the instruments effectively allows one instrument (the *Network Master*) to share its telemetry interface with all instruments in the network. In this way, only one serial connection is needed for an array of instruments. Alternatively, if these instruments were all operating independently, each one would need a dedicated serial port for telemetry.

The HyperOCR uses a proprietary Satlantic networking protocol known as SatNet. To create a SatNet network, all devices must be compliant with the protocols and at least one (such as the HyperOCR) must be Network Master capable. One and only one instrument may behave as the Network Master at a time. This instrument, during normal operation, will be the only one with a useable telemetry interface.

If you are using your HyperOCR in a networked environment, the assembly procedure is a little more complex than the steps stated above. There are many possible physical configurations for networked instruments, so exact assembly procedures cannot be defined. However, some basic tenants still hold true. Use the procedures stated in the previous section for mounting your instrument and connecting/disconnecting power. In most cases, Satlantic will provide you with the necessary cables and assembly instructions for connecting your networked instruments. The cables must ensure that the NA and NB pins of all networked devices are connected to each other. See section **D - OPERATION** for more information on operating your instrument in a network.

Conduct a Telemetry Test

Before using any instrument in the field, a simple telemetry test should be conducted to ensure that the instrument is functioning properly. This is also a good way to familiarize yourself with the software used with the instrument. The best way to conduct this test is to use *SatView*[3] with the calibration file[2] provided with your instrument. If you are using more than one instrument in a network, you will need the calibration files for each instrument. However, it is a good idea to test your instrument on its own before testing it in a network. Setup *SatView* as described in the manual or on-line help. Next, complete the ***Assembly Procedure*** described above and ensure that *SatView* is receiving telemetry.

For a more comprehensive test, you will need to check the instrument status more thoroughly to ensure the telemetry received by *SatView*[3] is correct. Below are a few guidelines to help you with the test:

- Enable *SatView's Frame Counter* and *Check Sum* error checking to confirm that the data integrity is stable.

- Look at the spectral output to make sure there are no glaring errors in the data, i.e. unexpected peaks and valleys in the spectrum.

- Look at the spectral output under varying light conditions to make sure the spectrum is adjusting accordingly.

- Log a few minutes of telemetry and process the log file with *SatCon*[3]. Check for errors in the data and consistency in the optical sensor values.

Once you are satisfied that the instrument(s) are working correctly, the next step is to deploy it for fieldwork. Otherwise, if you are experiencing any problems receiving telemetry, see section **G - MAINTENANCE** for information on troubleshooting your instrument. If you are still experiencing problems, contact a Satlantic customer service representative for assistance.

D - OPERATION

The HyperOCR can operate in one of three primary operating modes – Autonomous, Network, or Network Master Operation. These operating modes are collectively called *normal operation* and are described in detail below. The instruments configuration and physical environment determine which mode the instrument will operate in. Instrument configuration is done during the initialization sequence, which begins immediately after power is applied to the instrument. Once the initialization sequence completes, normal operation begins. This will continue until power is removed or the instrument is reset.

> **IMPORTANT! This section goes into detail about the SatNet aspect of the HyperOCR, and is intended for advanced users only. Most users will not require any knowledge of this system, as the instrument is essentially a "plug and play" device when used with SatView. Changing any parameters will affect system operation – please discuss any changes with a Satlantic representative before modifying these settings.**

Initialization Sequence

Once power is applied to the HyperOCR, the instrument begins a four-second window of operation called the initialization sequence. During this time, the on-board electronics are powered up, checked, and readied for operation. If the *silent mode configuration parameter*[4] is disabled, a start-up banner will be output on the telemetry interface, similar to the one shown below:

```
HyperOCR - Hyperspectral Ocean Colour Radiometer
Copyright (C) 2004, Satlantic Inc. All rights reserved.
Firmware version: 1.2B(P), 1.0A(S) - SatNet Type A
Instrument: SATHSE
S/N: 0146

Reset Source: Power
Press <Ctrl+C> for command console.
Initializing system. Please wait...
```

This banner is a simple text message that can be viewed in a terminal emulator. See section **E - CONFIGURATION** for more information on setting up a terminal emulator to monitor output from the telemetry interface.

The first section of the banner identifies the instrument. Specifically, the first line identifies the instrument type. The firmware (or microcontroller software) version is identified on the third line. This line also defines the SatNet compliance used by the instrument. *Type A* compliance uses a dual processor control system capable of operating as a Network Master. *Type B* compliance is a smaller, single processor system without Network Master capabilities. The next two lines define the instrument type identifier and serial number used at the beginning of a

---

[4] Configuration parameters are discussed in detail in section *E - CONFIGURATION*.

telemetry frame. See the ***Telemetry Format*** section below for more information on the instruments telemetry frames.

The next section of the banner gives additional information related to the initialization sequence. The first line identifies the mode in which the system was initialized. *Power* indicates that the instrument began operation after power was applied. *Software* indicates that a *reset* command was issued to the instrument to reboot itself. *External* may mean that a brown out (or brief interruption in power input) occurred and the processor reset itself.

The next line of the banner gives instructions on how to access the ***Command Console***. In most cases, the command console would be accessed during normal operation. If this is done during the initialization sequence, the instrument will be forced into autonomous operation before the console is displayed. This gives the ability to break into the command console even if the instrument is configured to run in a network. Note that the command console is not displayed until the initialization sequence completes. See section **E - CONFIGURATION** for more information on accessing and using the command console.

Once the initialization sequence has finished, normal operation begins. If silent mode is disabled, one of the following messages will be output, depending on which operating mode is enabled.

```
Autonomous operation enabled.
```

> or

```
Network operation enabled.
```

> or

```
Network Master operation enabled.
```

Autonomous Operation

Autonomous, or stand-alone, operation for the HyperOCR is defined as the continuous operation of the instrument outside the scope of a network. Autonomous operation uses only the telemetry interface for communication and telemetry output. The network interface is disabled.

During autonomous operation, the default behavior of the instrument is to continually sample its sensors and output telemetry on the RS-232 and RS-422 telemetry interfaces. When the instrument is used in the field, this telemetry would be collected and saved to a storage medium. Generally, a data acquisition application like SatView would be used. If you are using your HyperOCR in an embedded system, another mode of telemetry acquisition may be more appropriate. When telemetry output is free-running, as described above, no user input is required to operate the instrument.

However, telemetry output can also be controlled with simple commands sent to the instrument through the telemetry interface. As this involves two-way communication, only the RS-232 telemetry interface can be used. These commands are simple one-byte transmissions. In an embedded or larger scale system, the data acquisition software could use this feature to finely control telemetry output and instrument operation. These commands can also be sent

directly by the user with a terminal emulation program, as discussed in section **E - CONFIGURATION**.

The following table defines these command bytes and their effect on the instrument. All commands, which are standard with all SatNet compliant instruments, are ASCII control characters. They are not echoed back so if you are using a terminal emulator to send these commands, you will not see any command values on the screen. For example, in a terminal emulation program, you would use the <Ctrl+C> command to access the command console. To do this, press and hold the Ctrl key followed by the C key. This is the same as sending the hexadecimal equivalent byte "03" to the instrument over the telemetry interface. This number is also indicated in the table.

Command	Hex	Description
<Ctrl+C>	03	This command interrupts normal operation of the instrument and invokes the **Command Console**. See section **0 Error! Not a valid result for table.** For more information.
<Ctrl+S>	13	This command stops *free-running* telemetry output, enabling *polled* telemetry output.
<Enter> or <SPACE>	0D or 20	If the instrument is running with *polled* telemetry output, either of these commands will force the instrument to sample its sensors and return a telemetry frame.
<Ctrl+A>	01	This command stops *polled* telemetry output, enabling *free-running* telemetry output.
<Ctrl+P>	10	This command powers down the operational components of the instrument. This may reduce the instruments total power consumption, as any electronics associated with sensor operation will be turned off, if possible. The instrument is otherwise fully operational, so communication is still possible. When operational components are powered down, telemetry output is disabled, regardless of the telemetry output mode.
<Ctrl+U>	15	This command returns power to the operational components of the instrument if they were previously powered down. Telemetry output will resume based on the current telemetry output mode.
<Ctrl+R>	12	This command forces the instrument to reset itself. After a few seconds, the instrument will reboot and the initialization sequence will begin again.

With the exception of the <ENTER> and <SPACE> commands, repeatedly sending a command will have no effect. For example, you cannot power down operational components more than once.

The free-running and polled telemetry output modes described above are sub-modes of normal operation. When the instrument is free-running, telemetry frames are output from the instrument according to the *maximum frame rate* configuration parameter.

Network Operation

Network operation for the HyperOCR is defined as continuous operation of the instrument within the scope of a SatNet network. Furthermore, standard network operation means that the instrument is **not** operating as a Network Master device. While operating in this mode, only the network interface is used for communication. The telemetry interface is disabled.

To enable network operation, a number of criteria must be met; otherwise operation will default to running autonomously. First, the *network mode* configuration parameter must be enabled. Secondly, the network interface pins, NA and NB, must be physically connected to another SatNet instrument operating as a Network Master device. These first two conditions will ensure that network operation is invoked. However, to ensure proper operation of the network, additional criteria must be adhered to. Namely, the *network baud rate* configuration parameter must be set to the same baud rate as the Network Master. Finally, the *network address* configuration parameter must be unique to all other instruments in the network.

During network operation, the HyperOCR is completely controlled by the Network Master. All communication is relayed through the network between the Network Master and the other instruments running in network operation mode. Instead of sending a telemetry frame through the telemetry interface, as is done in autonomous operation, each instrument sends its telemetry through the network interface to the Network Master. The Network Master then channels the telemetry through its telemetry interface where it can be collected by a data acquisition system.

The only way to gain access to an instrument running in network operation mode is through the telemetry interface of the Network Master. A Network Master has a set of commands for controlling telemetry similar to that of an instrument running autonomously. These commands can also control other instruments in the network. For more information on the Network Master and its operational command structure, refer to the operating manual of your Network Master device.

Network Master Operation

Network Master operation for the HyperOCR is defined as the continuous operation of the instrument within the scope of a SatNet network, acting as the Network Master. When operating in this mode, the instrument uses the network interface to obtain data from the slave devices and outputs the information, together with its own data, on the telemetry interface.

To enable Network Master operation, a number of criteria must be met. First, the *network mode* configuration parameter must be enabled. Secondly, the network interface pins, NA and NB, must be physically connected to other SatNet instruments operating as a Network Slave devices – there can be only one Network Master in a SatNet configuration. In addition, the *network master mode* parameter must be enabled. Finally, the *master network* bias parameter must be enabled. These conditions will ensure that network master operation is invoked. However, to ensure proper operation of the network, additional criteria must be adhered to. Namely, the *network baud rate* configuration parameter must be set to the same baud rate as the rest of the network instruments. Also, the *network address* configuration parameter must be unique to all other instruments in the network.

During network master operation, the HyperOCR completely controls the Network Slave devices. All communication is relayed through the network between the Network Master and the other instruments running in network operation mode. Instead of sending a telemetry frame through the telemetry interface, as is done in autonomous operation, each instrument sends its telemetry through the network interface to the Network Master. The Network Master then channels the telemetry through its telemetry interface where it can be collected by a data acquisition system (such as SatView).

As in autonomous mode, telemetry output can be controlled with simple commands sent to the instrument through the telemetry interface. As this involves two-way communication, only the RS-232 telemetry interface can be used. These commands are simple one-byte transmissions. In an embedded or larger scale system, the data acquisition software could use this feature to finely control telemetry output and instrument operation. These commands can also be sent directly by the user with a terminal emulation program, as discussed in section **E - CONFIGURATION**.

The following table defines these command bytes and their effect on the instrument. All commands, which are standard with all SatNet compliant instruments, are ASCII control characters. They are not echoed back so if you are using a terminal emulator to send these commands, you will not see any command values on the screen. For example, in a terminal emulation program, you would use the <Ctrl+C> command to access the command console. To do this, press and hold the Ctrl key followed by the C key. This is the same as sending the hexadecimal equivalent byte "03" to the instrument over the telemetry interface. This number is also indicated in the table.

Command	Hex	Description
<Ctrl+C>	03	This command interrupts normal operation of the instrument and invokes the **Command Console**. See section **0 Error! Not a valid result for table.** For more information.
<Ctrl+S>	13	This command stops *free-running* telemetry output, enabling *polled* telemetry output.

Command	Code	Description
<Enter> or <SPACE>	0D or 20	If the instrument is running with *polled* telemetry output, either of these commands will force the instrument to sample its sensors and return a telemetry frame.
<Ctrl+A>	01	This command stops *polled* telemetry output, enabling *free-running* telemetry output.
<Ctrl+P>	10	This command powers down the operational components of the instrument. This may reduce the instruments total power consumption, as any electronics associated with sensor operation will be turned off, if possible. The instrument is otherwise fully operational, so communication is still possible. When operational components are powered down, telemetry output is disabled, regardless of the telemetry output mode.
<Ctrl+U>	15	This command returns power to the operational components of the instrument if they were previously powered down. Telemetry output will resume based on the current telemetry output mode.
<Ctrl+R>	12	This command forces the instrument to reset itself. After a few seconds, the instrument will reboot and the initialization sequence will begin again.
<Ctrl+N>	0E	This command is only available to the network master. After enabling polled telemetry, issuing this command followed by a valid network address allows the user to poll the slave device at that address. Press <Ctrl+N> to return to the master device.

With the exception of the <ENTER> and <SPACE> commands, repeatedly sending a command will have no effect. For example, you cannot power down operational components more than once.

The free-running and polled telemetry output modes described above are sub-modes of normal operation. When the instrument is free-running, telemetry frames are output from the instrument according to the *maximum frame rate* configuration parameter

Telemetry Format

The telemetry format for the HyperOCR, as with all Satlantic instrumentation, follows the *Satlantic Data Format Standard*[1]. This standard defines how Satlantic telemetry can be generated and interpreted. For every sample taken of the

spectrometer, the instrument will compose and transmit one frame of telemetry containing all the necessary sensor information for that sample. The specific format of this frame, including the center wavelengths represented by the spectrometer channels, is defined by the instrument's *calibration file*[2]. The format is the same for autonomous and network operation. Internally, the HyperOCR generates a frame of telemetry with the following components:

Field Name	Field Size (bytes)	Description
INSTRUMENT	6	A six character AS formatted string denoting the start of a frame of telemetry. The sequence normally starts with "SAT" for a Satlantic instrument. The next three characters would identify the type of instrument (or telemetry).
SN	4	A four character AI formatted string denoting the serial number of the instrument. This field combined with the INSTRUMENT field uniquely identifies the instrument. This combination is known as the frame header or synchronization string.
INTTIME	2	This field contains a BU formatted value representing the current integration time used for the spectrometer sample. The value is in milliseconds. See the Maximum Integration Time section for more information.
Sample Delay	2	A BS formatted value representing the number of milliseconds to offset the Timer value to give an accurate indication of when the frame's sensors were sampled.
Channel (λ_1)	2	A BU formatted value representing the sampled A/D counts of the start channel from the spectrometer.
...	...	...
Channel (λ_n)	2	A BU formatted value representing the sampled A/D counts of the end channel from the spectrometer.
DARK_SAMP	1	A BU formatted value representing the number of dark channels used for the dark approximation of the DARK_AVE field.

DARK_AVE	2	A BU formatted value representing the average of the dark channel values used for the dark approximation. Dark channels are spectrometer sensors with low sensitivity that may be used for baseline measurements.
SPECTEMP	6	An AF formatted value indicating the temperature of the spectrometer photodiode array. The format is ±CC.CC, in degrees Celsius. Used for temperature-dependent corrections.
FRAME COUNTER	1	A BU formatted data integrity sensor that maintains a count of each frame transmitted. The count increments by one for each frame transmitted from 0 to 255, at which point it rolls back to zero again.
TIMER	10	The field is an AF formatted string indicating the number of seconds that have passed since the end of the initialization sequence. This field is left padded with zeros and is precise to two digits after the decimal.
CHECK SUM	1	This is a BU formatted data integrity sensor which implements a check sum on the telemetry frame.
TERMINATOR	2	This field indicates the end of the frame. The frame is terminated by a carriage return/line feed pair ($0D_{hex}$ and $0A_{hex}$).

The HyperOCR is capable of closing an on-board shutter over the spectrometer before sensor sampling and telemetry output. The instrument can be configured to do this periodically for better baseline dark measurements. To distinguish between *Light* and *Dark* frames in the telemetry output, the instrument uses different frame headers. This allows any telemetry acquisition system to distinguish between sensor readings taken with the shutter opened and closed. See **Shutter Frame Output** in section **E - CONFIGURATION** for more information.

Temperature Corrections

The response of a photodiode array is temperature dependent, causing errors when the temperature at the time of measurement differs from the temperature during calibration. Although the overall effect on the measurement is relatively small, temperature corrections can be applied during post-processing of the data to compensate. To facilitate these corrections, the telemetry frame provides the array temperature (refer to the SPECTEMP field). Please contact Satlantic for details on applying the temperature corrections.

E - CONFIGURATION

Your HyperOCR has been pre-configured by Satlantic with standard configuration parameters. These parameters control many aspects of the instruments operation to account for the wide variety of applications in which HyperOCR instruments are used. In addition to the operating modes described in section **D - OPERATION**, a configuration mode is also available to modify configuration parameters and test various systems of the instrument. This configuration mode is implemented by the instruments **Command Console**.

In most cases, the command console would be accessed using a terminal emulation program. Terminal emulators are used in many applications involving serial communications, internet mail and news services, telnet and ftp services, etc. For communication with your HyperOCR, you will need to make a direct connection to the serial port hosting the instrument. Connect the instrument using the RS-232 telemetry interface. You cannot use the RS-422 interface, as it is transmit-only. For communications software, use your favorite terminal emulator (Windows® comes with one called HyperTerminal®[5]). Ensure that the serial connection to the instrument is at the *telemetry baud rate*. Use any ANSI or ANSI-compliant (i.e. VT-xxx) emulation. While operating in this mode, your HyperOCR uses simple character I/O with no control character interpretation. Therefore, most terminal emulators will do.

The command console can be accessed at any point during the instruments operation. You can even access the command console of a remote or networked instrument through the Network Master. Methods for accessing the console are described in section **D - OPERATION**.

> **IMPORTANT! This section goes into great detail about the SatNet aspect of the HyperOCR, and is intended for advanced users only. Most users will not require any knowledge of this system, as the instrument is essentially a "plug and play" device when used with SatView. Changing any parameters will affect system operation – please discuss any changes with a Satlantic representative before modifying these settings.**

Command Console

The HyperOCR command console was designed to resemble an MS-DOS® or UNIX® command prompt[6]. Although the actual functionality of the console is quite removed from these systems (it is actually far simpler), the basic design lends a certain degree of familiarity. When the console is first invoked, you will see a prompt on your terminal emulator screen similar to the one shown below:

```
HyperOCR Command Console
Type 'help' for a list of available commands.

[Master:001]$
```

---

[5] See APPENDIX A for more information on using HyperTerminal. HyperTerminal is a registered trademark of Microsoft Corporation.
[6] MS-DOS and UNIX are registered trademarks of Microsoft Corporation and The Open Group respectively.

The first two lines are the command prompt header. They are not repeated unless you reset the console. The first line indicates the type of instrument for which the console is being used. The next line helps new users to get acquainted with the system.

The actual command prompt ends with the "$" character. The characters between the [ ] brackets provide information on the operating mode of the instrument. In the example above, "Master" indicates that the instrument is running in Network Master mode. The numbers following the ":" character is the three-digit network address for the HyperOCR. If the instrument is running in network mode, which means the command console was accessed through the Network Master, the command prompt will look something like this:

```
[Remote:050]$
```

The "Remote" keyword indicates that the command prompt is for a remote or networked instrument. The numbers following the ":" character is the three-digit network address of the remote instrument. This gives the user the ability to quickly differentiate one remote instrument from another. In Autonomous mode, the prompt would simply show "[Auto]$".

Using the command prompt is quite simple. Type in a command at the prompt followed by the <Enter> key. This will execute the command, displaying the results to the screen, if any. You can easily edit commands if you make a mistake. Use the <Backspace> key to delete characters in your command before you execute them. You can even recall the last executed command by pressing the <Esc> key on a clear command prompt. This is handy if you are repeatedly executing the same or similar commands.

The command console interprets all commands as case sensitive. This means that the command "exit" is different from "EXIT". Most commands require small case letters.

If this is your first time using the command console, a good starting point is the "help" command. As you probably noticed, the command prompt header suggests this command for novice users. Executing this command will display the following text:

```
The following console commands are available for this
instrument:

reset    Resets the command console.
id       Displays the instrument identification banner.
power    Turns operational power on and off.
set      Sets the instrument's configuration parameters.
show     Shows the instrument's configuration
         parameters.
save     Saves the instrument's configuration
         parameters.
query    Queries the spectrometer version.
sample   Tests spectrometer sample operation.
shutter  Tests shutter operation.
config    Automatically configures spectrometer.
```

```
spectemp  Measures spectrometer temperature.
exit      Exits the command console.
exit!     Exits the command console and resets
          the instrument.

For more information on individual commands, type '-?'
after the command.
```

All commands available to the instrument are listed on the left, with descriptions on the right. For the most part, these descriptions adequately define the purpose of each command. However, some commands are more complex and require a little more than a simple one-word entry. As indicated above, you can type a "-?" after a command to display additional help information. Make sure there is a space between the command and the "-?" parameter. If there is additional help available for the command, the text will be displayed. Otherwise, a message indicating, "No more help is available." will be displayed.

Some commands require additional command line parameters. Executing one of these commands with missing or incorrect parameters will display a "Usage:" message. This is helpful in determining what parameters are acceptable for a particular command and how they should be formatted. For example, if you executed the "power" command without any parameters, the following message would be displayed:

```
Usage: power [operational power (on|off|?)]
```

This command requires one parameter, as indicated by the contents of the [ ] brackets. If the command required more than one parameter, additional sets of [ ] brackets with their parameter descriptions would be displayed. Parameters must always be separated by a space. Within the [ ] brackets is a description of the parameter followed by the list of acceptable parameter values, contained in the ( ) brackets. The values listed here are always separated by the "|" character. In this case, there are three accepted forms of this command; "power on", "power off", and "power ?".

Generally, the usage of the command console is self-explanatory. It should only take you a few moments to get a working knowledge of the system. Although the on-line help is fairly extensive, some commands need more detailed explanations that would be too cumbersome to include in the instrument itself. The following sections describe each command in more detail.

RESET COMMAND

The "reset" command resets the console, redisplaying the command prompt header described above. Any configuration parameters modified during the console session that were not saved will revert back to their previous values. This command requires no additional command line parameters.

ID COMMAND

The "id" command displays the identification banner for the instrument, as shown is the following example:

```
HyperOCR - Hyperspectral Ocean Colour Radiometer
Copyright (C) 2004, Satlantic Inc. All rights reserved.
Firmware version: 1.2B(P), 1.1.1(S) - SatNet Type A
Instrument: SATHPL
S/N: 0000
```

The identification banner is also part of the start-up banner, which is displayed during the initialization sequence described in section **D - OPERATION**. This command requires no additional command line parameters.

POWER COMMAND

The "power" command may be used to turn operational power on and off during a command console session. Operational power supplies electronic components in the instrument responsible for sensor data acquisition. Powering down these components will reduce the instruments total power consumption, but you will no longer be able to obtain optical data. The instrument is otherwise fully operational, so communication is still possible. When operational components are powered down, sensor data acquisition is disabled.

This command requires one command line parameter. To turn on operational power, use the "power on" command. To turn off operational power, use the "power off" command. To query the operational power status, use the "power ?" command. This will display a message similar to the one below:

```
Operational Power: on
```

IMPORTANT! Operational power will remain in the state set by this command once the command console exits and normal operation resumes.

SET COMMAND

The "set" command modifies configuration parameters for the instrument. These parameters affect various aspects of the instruments operation and can be modified by the user to customize the instrument. For a HyperOCR, if you enter a "set -?" command, the following will be displayed:

```
Usage: set [parameter] [value]

set telbaud [telemetry baud rate (bps)]
set maxrate [maximum frame rate (Hz)]
set initsm [initialize silent mode (on|off)]
set initpd [initialize power down (on|off)]
set initat [initialize auto telemetry (on|off)]
set netmode [network mode (on|off)]
```

```
set netadd [network address (1-255)]
set netbaud [network baud rate (bps)]
set master [network master (on|off)]
set mct [master controlled telemetry (on|off)]
set bias [master network bias (on|off)]
set netdelay [network reset delay (1-3600)]

set minint [min. integration time (ms)]
set maxint [max. integration time (ms)]
set startint [start integration time (ms)]
set ifactor [multiplier (1.0-100.0)]
set dfactor [multiplier (0.01-1.0)]
set adgain [adaptive gain (on|off)]
set uthresh [upper threshold (16-bit cts.)]
set lthresh [lower threshold (16-bit cts.)]
set dframes [dark frames (0-255)]
```

This command requires two command line parameters. The first parameter specifies the configuration parameter to modify. The second specifies the new value to assign to the parameter. A list of all available configuration parameters is shown above.

> **IMPORTANT! Be careful using this feature. Changes made to the HyperOCR configuration parameters affect the way the instrument operates. Before you modify any of configuration parameters, make sure you understand the consequences of the change.**

For more information on these parameters and their effect on your instruments operation, see section **E – Configuration -** *HyperOCR Configuration Parameters*.

SHOW COMMAND

The "show" command displays configuration parameters for the instrument. These parameters are modified by the "set" command explained above. If you enter "show -?" at the command prompt, the following message will be displayed:

```
Usage: show [parameter|all]

See help for the 'set' command for a list of
available parameters.
```

This command requires only one command line parameter, which is the same as the first parameter of the "set" command. Using the "show" command in this way displays the current value of the configuration parameter, even if it has not yet been saved. You may also use "all" as the command line parameter to show a complete list of all configuration parameters and their current values. For example, using the "show all" command on your HyperOCR would display something like this:

```
Telemetry Baud Rate: 57600 bps
Maximum Frame Rate: AUTO
Initialize Silent Mode: off
Initialize Power Down: off
Initialize Automatic Telemetry: on
Network Mode: on
Network Address: 100
Network Baud Rate: 38400 bps
Network Master Mode: off
Master Controlled Telemetry: off
Master Network Bias: off
Network Reset Delay: 5

Minimum Integration Time: 8 ms
Maximum Integration Time: 2048 ms
Starting Integration Time: 256 ms
Increase Factor: 2.000000
Decrease Factor: 0.500000
Adaptive Gain: on
Upper Threshold: 42000
Lower Threshold: 10000
Dark Frames: 5
```

For more information on these parameters and their effect on your instruments operation, see section *HyperOCR Configuration Parameters* below.

SAVE COMMAND

Modifying configuration parameters with the "set" command does not necessarily mean that those parameters will be retained for use in the next session with the instrument. When the "save" command is issued, all configuration parameters are placed in persistent storage inside the instrument. If these parameters are not saved once they are modified, all changes will be lost when the command console exits or power is removed from the instrument.

The "save" command requires no additional command line parameters. Once the command is issued, it cannot be undone.

IMPORTANT! Once the instruments configuration parameters have been saved, the instrument must be reset before normal operation can resume.

PING COMMAND

The "ping" command is only available to network master instruments. It can be used to test the presence of slave devices on the network, and to determine their network addresses.

If you enter "ping -?" at the command prompt, the following message will be displayed:

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```
Usage: ping [network address (1-255|all)]

Use this command to ping a network address.  If an instrument
is present, it's identification will be displayed.
```

This command requires only one command line parameter, either a known network slave address (1-255) or "`all`". For example, if you wish to ping the instrument at address 101, you would enter "`ping 101`" and receive a response similar to the following:

```
101> Instrument: SATHSL – S/N: 0045
```

if an instrument is present at that address. If not, you will receive a "`No response`" message.

Using "`all`" as the command line parameter will send a global ping command to all slaves on the network. For example, issuing a "`ping all`" command from the HyperOCR command console would give a response similar to the following:

```
100> Instrument: SATHSE – S/N: 0044
101> Instrument: SATHSL – S/N: 0045
```

The exact response will of course depend on your instrument configuration.

Note: occasionally, slave sensors may not respond to the "ping all" command properly; you may have to issue the command several times to determine all the slaves on the network.

REMOTE COMMAND

The "`remote`" command is only available to network master instruments. It can be used connect directly to a remote network slave's command console through the network. In order to connect to the remote slave, its network address must be known – this can be determined using the "`ping all`" command explained above. Note that the term "remote" does not imply a distantly located instrument, only that it is a instrument other than the network master.

If you enter "`remote -?`" at the command prompt, the following message will be displayed:

```
Usage: remote [network address (1-255)]

Use this command to engage the command console of a networked
instrument.  The command prompt will indicate the address of
the remote (or networked) instrument.
```

This command requires only one command line parameter – a known remote instrument address. For example, to connect to an instrument at remote address 100, enter "`remote 100`". Assuming that address is in use and it is an HyperOCR, the following message would be displayed:

```
HyperOCR Command Console
Type 'help' for a list of available commands.

[Remote:100]$
```

You are now indirectly connected to the remote instrument's command console at the specified network instrument. Any command normally accessible from the slave's telemetry interface is now accessible through the network master. This capability is very useful for troubleshooting and for changing operational parameters for the slave, as a direct connection to the slave is not required. Be careful what settings you change on the remote instrument!

To return to the network master's command console, simply enter the 'exit' command.

QUERY COMMAND

The "query" command allows you to directly query the on-board spectrometer for device information. This provides information on the main attributes specific to the particular spectrometer in the instrument, as shown in the example below:

```
Spectrometer Configuration:

# of pixels:   256
Resolution:    16  bits
Frequency:     16  MHz
```

Operational Baud Rate: 57600 bps

SAMPLE COMMAND

The "sample" command can be used to test the operation of the spectrometer. This may be helpful in diagnosing problems if some kind of abnormality occurs. Before using this command, make sure operational power has been applied.

This command requires one additional command line parameter to indicate the desired sample integration time, in milliseconds. Using the "sample" command with no argument will display the following:

```
Usage: sample [integration time (ms)]
```

The integration times used by the HyperOCR spectrometer must be between 5-8192 milliseconds.

For example, if you type "sample 16" at the command prompt, a result similar to the following will be displayed:

```
Integration time: 16 ms


  5:  1061
 10:  1044
```

```
 15:  1032
 20:  1057
 25:  1036
 30:  1032
 35:  1046
 40:  1030
 45:  1044
 50:  1052
 55:  1026
 60:  1039
 65:  1042
 70:  1029
 75:  1036
 80:  1045
 85:  1041
 90:  1040
 95:  1040
100:  1058
105:  1038
110:  1040
115:  1065
120:  1038
125:  1045
130:  1060
135:  1030
140:  1047
145:  1054
150:  1026
155:  1037
160:  1042
165:  1024
170:  1045
175:  1044
180:  1032
185:  1043
190:  1041
195:  1044
200:  1039
205:  1037
210:  1068
215:  1048
220:  1046
225:  1057
230:  1041
235:  1032
240:  1058
245:  1018
250:  1035
255:  1094
```

As this is a test function, only every fifth spectrometer channel is displayed.

SHUTTER COMMAND

This command allows you to test operation of the on-board shutter. This would only be used as a test to confirm that the shutter is operating correctly. Typing the "shutter" command with no parameters displays the following:

```
Usage: shutter [on|off|*|?]
```

As you can see, the shutter command takes one command line parameter. If the parameter is "on", the shutter will close; if the parameter is "off", the shutter will open. Entering a "*" parameter simply toggles the state of the shutter, while entering "?" as the parameter returns the current state of the shutter.

SPECTEMP COMMAND

This command allows you to test operation of the spectrometer temperature sensor. No parameters are required. Typing the "spectemp" command will result in a display similar to the following:

```
DS18S20 found
DS18S20 Registers:
2D
0
4B
46
FF
FF
2
10
19
Spectrometer Temperature:        +22.625 degrees C
```

If the temperature sensor has failed or is not present, a "DS18S20 not found" message will be displayed.

EXIT AND EXIT! COMMANDS

The "exit" and "exit!" commands end the current command console session. Once the console exits, normal operation will resume in most cases. Otherwise, the instrument will reset itself before normal operation can begin. The only difference between the two versions of this command is that the "exit!" command forces a reset of the instrument, even if it isn't necessary.

There are two conditions that will cause the instrument to reset itself. One or both conditions must exist for this to occur. These conditions are:

1. The command console was invoked during the initialization sequence.

2. Configuration parameters have been modified and saved.

If you attempt to exit the console with modified configuration parameters that have not been saved, the following dialog will be presented:

```
The configuration parameters have been modified.
```

```
Save changes [y/n]?
```

Choose "y" for yes or "n" for no to answer this question. If you choose yes, the configuration parameters will be saved and the instrument will reset itself. Otherwise, any modifications to the configuration parameters will be lost. See the **Save Command** section above for more information on saving configuration parameters.

HyperOCR Configuration Parameters

This section describes, in detail, the function of each configuration parameter used by the HyperOCR. The title of each section identifies the name of the parameter, as displayed by the "show" command. Also clearly identified in each section is the command line parameter keyword used in both the "set" and "show" commands.

See the descriptions of the "set" and "show" commands described in the **Command Console** section above for more information.

TELEMETRY BAUD RATE

Command Line Parameter: telbaud

The telemetry baud rate defines the speed at which data is transferred on the telemetry interface. This should not be confused with the frame rate. Baud rates are specified in units of *bits per second* (bps). Any data acquisition or terminal emulation software must be configured to communicate with the instrument at this baud rate. Only certain standard parameter values are accepted, as shown in the table below:

Baud Rate (bps)
9600
19200
38400
57600
115200

When modifying this parameter with the "set" command, you must enter at least the first two digits of one of these baud rates as the value parameter.

Ideally, you would want the telemetry interface to run at the fastest baud rate available. However, certain restrictions, like cable quality or excessively long transmission mediums, may require a reduction in the telemetry baud rate. The data acquisition computer and/or software may also impose restrictions.

The factory default baud rate is 57600 bps.

MAXIMUM FRAME RATE

Command Line Parameter: `maxrate`

This parameter allows you to define the maximum frame rate that the instrument will use during normal operation with free-running telemetry output. The frame rate defines how often a frame of telemetry is composed and transmitted. If the instrument is running autonomously (autonomous operation), frames are transmitted through the telemetry interface. If the instrument is operating in network mode (network operation), these frames are transmitted through the network interface. However, the Network Master can be configured to override the frame rates of all other instruments using the *master controlled telemetry* (*mct*) option.

Frame rates are specified in units of *frames per second* or *Hertz* (Hz). There are several factors involved in determining how quickly the instrument can transmit frames. On-board electronics, such as the spectrometer, may limit how fast a telemetry frame can be composed. Configuration parameters like the telemetry and/or network baud rates are important in determining how quickly one frame can be transmitted before the next. While in network operation, saturation of the Network Master's telemetry interface, caused by too many networked instruments broadcasting their telemetry at the same time, may slow down the frame rate of some or all instruments in the system. Therefore, the actual frame rate realized during normal operation cannot be any faster than the limitations imposed by these conditions. Some of these factors may vary during normal operation, making the determination of a constant frame rate impossible. Providing a maximum frame rate slower than what the instrument is capable of providing will help pace the output of each frame evenly. For the HyperOCR, the frame rate is largely determined by the spectrometer's integration time.

Only certain standard frame rates are accepted by this parameter, as shown in the table below:

Frame Rate (Hz)
0.125
0.25
0.5
1
2
4
8
10

| 12 |
| 0 (AUTO) |

When modifying this parameter with the "set" command, you must enter one of these numbers as the value parameter. Any numerical values that are in between the values in the table will be rounded up to the nearest standard frame rate. To specify an automatic (AUTO) frame rate, input "0" as the value parameter. This will cause the instrument to output frames as fast as possible.

Specifying a frame rate faster than is practically possible will not force the actual frame rate to that level. The instrument will only transmit as fast as possible for the given operating parameters. This is essentially the same as specifying an AUTO frame rate. In addition, frames are always transmitted as a whole as much as possible. Once a frame starts transmitting, it is transmitted continuously until the frame is completely output. Specifying a frame rate of, for example, 0.5 Hz does not mean that half a frame is transmitted every second. It means that every two seconds, a frame will begin transmitting.

INITIALIZE SILENT MODE

Command Line Parameter: initsm

Normally, just after the instrument is powered up or reset, a start-up banner will be output on the telemetry interface during the initialization sequence. The messages in this banner, among other things, identify the instrument and provide a copyright notification. If silent mode is enabled, this banner will not be displayed. This ensures that no data will be transmitted on the telemetry interface until, if running autonomously, normal operation begins and telemetry output is available. Enabling silent mode does not mean that the telemetry interface is disabled during initialization. The command console can still be engaged. See section **D - OPERATION** for more information on the start-up banner and the initialization sequence.

When modifying this parameter with the "set" command, you must enter either "on" or "off" as the value parameter to enable or disable silent mode.

INITIALIZE POWER DOWN

Command Line Parameter: initpd

Near the end of the initialization sequence, operational power is normally applied. However, the instrument can be configured to boot into a power savings mode. With the initialize power down parameter enabled, operational power will not be applied during initialization. This means that telemetry output will be disabled when normal operation begins. See section **D - OPERATION** for more information on the initialization sequence.

When modifying this parameter with the "set" command, you must enter either "on" or "off" as the value parameter to enable or disable the power savings mode.

INITIALIZE AUTOMATIC TELEMETRY

Command Line Parameter: `initat`

For instruments running in <u>autonomous operation only</u>, the telemetry output mode can be configured to start as free-running or polled once normal operation begins. This means that once normal operation has begun and this parameter is disabled (polled operation), telemetry output will not occur unless the instrument is polled with the <Enter> or <Space> key commands. Otherwise, telemetry output will be free-running in accordance with the maximum frame rate configuration parameter. Of course, if operational power is not applied, telemetry output is disabled altogether regardless of this parameter. See **Network Operation** in section **D - OPERATION** for more information on telemetry output modes.

When modifying this parameter with the "`set`" command, you must enter either "`on`" or "`off`" as the value parameter to enable or disable automatic telemetry.

NETWORK MODE

Command Line Parameter: `netmode`

This parameter enables or disables network operation for the instrument. Although disabling this parameter will force the instrument to run autonomously, enabling it does not necessarily mean network operation will be invoked. The instruments operating mode is determined during the initialization sequence. See **Network Operation** in section **D - OPERATION** for more information.

When modifying this parameter with the "`set`" command, you must enter either "`on`" or "`off`" as the value parameter to enable or disable network operation.

NETWORK ADDRESS

Command Line Parameter: `netadd`

The network address uniquely identifies an instrument on a network. All network transmissions use this parameter to identify the sender and receiver of the message. It is not important what value is assigned to the network address, as long as it is unique from other instruments in the network.

> **IMPORTANT! Make sure that each device on the network, including the Network Master, has a unique network address. If two or more devices have the same address, contentions may result and data could be lost.**

When modifying this parameter with the "`set`" command, you must enter an integer from 1 to 255 inclusive as the value parameter.

NETWORK BAUD RATE

Command Line Parameter: `netbaud`

The network baud rate defines the speed at which data is transferred on the network interface. Baud rates are specified in units of *bits per second* (bps). Only certain standard parameter values are accepted, as shown in the table below:

Baud Rate (bps)
9600
14400
19200
28800
38400
57600
76800

When modifying this parameter with the "set" command, you must enter at least the first two digits of one of these baud rates as the value parameter.

> **IMPORTANT! Make sure that each device on the network, including the Network Master, is operating with the same network baud rate. Any devices in the network running at a baud rate different from the Network Master will be ignored.**

Ideally, you would want to run the network at the fastest baud rate available. However, certain restrictions, like cable quality or excessively long transmission mediums, may require a reduction in the network baud rate.

NETWORK MASTER MODE

Command line parameter: master

The network master mode setting determines whether or not the instrument will act as a network master.

When modifying this parameter with the "set" command, you must enter either "on" or "off" as the parameter value to enable or disable network master mode.

MASTER CONTROLLED TELEMETRY

Command line parameter: mct

The master controlled telemetry setting determines whether or not the master controls the frame rate of the slave instruments. In a typical SatNet environment, slaves are allowed to "free-run", outputting telemetry when it is available. However, the master device can force its frame rate onto the slave devices by enabling this parameter.

> **IMPORTANT! Slave devices may not be able to update their frames as fast as the network master. In this instance the mct parameter will have no effect.**

When modifying this parameter with the "set" command, you must enter either "on" or "off" as the parameter value to enable or disable master controlled telemetry.

MASTER NETWORK BIAS

Command line parameter: bias

The master network bias setting determines whether or not the instrument enables its network biasing circuitry.

> **IMPORTANT!   The network bias circuitry must be enabled for normal network operation.**

The basic rule of thumb is that if a device is configured as a Network Master, its bias circuit must be enabled. If the device is configured as a slave, the bias circuit must be disabled.

When modifying this parameter with the "set" command, you must enter either "on" or "off" as the parameter value to enable or disable the bias circuitry.

NETWORK RESET DELAY

Command line parameter: netdelay

The network reset delay setting is used by the network master to ensure proper network operation.

If, after receiving a telemetry frame from a slave device, the network master does not receive a second frame before the netdelay time expires, the network master will reset the network.

MINIMUM INTEGRATION TIME

Command line parameter: minint

The integration time used by the HyperOCR indicates how long the spectrometer is to collect light for a sample. The integration time helps normalize the resultant spectrometer values in varying light conditions. In bright light, a short integration time would be used to keep the sensors from saturating. In low light levels, a longer integration time would be needed to get enough light exposure for a good reading. Integration times are specified in units of milliseconds (ms). The minimum integration time can be set to any value above 5ms with a 1ms

resolution. The minimum integration time value must be less then the maximum integration time value. The maximum and minimum integration times define the range over which the adaptive gain feature of the HyperOCR can set the current integration time. The table below shows the preferred minimum integration times. Note that 8ms is the preferred minimum integration time.

Integration Time (ms)
8
16
32
64
128
256
512
1024
2048
4096
8192

To select a minimum integration time, input a numerical value above 5ms as the parameter value.

The exact usage of the minimum integration time varies slightly depending on whether adaptive gain has been enabled. If adaptive gain is not being used, the minimum integration time has no effect. Otherwise, this setting determines the lower limit of the integration times used during normal operation.

MAXIMUM INTEGRATION TIME

Command line parameter: `maxint`

The integration time used by the HyperOCR indicates how long the spectrometer is to collect light for a sample. The integration time helps normalize the resultant spectrometer values in varying light conditions. In bright light, a short integration time would be used to keep the sensors from saturating. In low light levels, a longer integration time would be needed to get enough light exposure for a good reading. Integration times are specified in units of milliseconds (ms). The maximum integration time can be set to any value above 5ms with a 1ms resolution. The maximum and minimum integration times define the range over

which the adaptive gain feature of the HyperOCR can set the current integration time. The table below shows some of the most commonly used maximum integration times. Note that 2048ms is the standard maximum integration time setting.

Integration Time (ms)
8
16
32
64
128
256
512
1024
2048
4096
8192

To select a maximum integration time, input a numerical value above 5ms as the parameter value.

The exact usage of the maximum integration time varies slightly depending on whether adaptive gain has been enabled. If adaptive gain is not being used, the maximum integration time has no effect. Otherwise, this setting determines the upper limit of the integration time used during normal operation.

START INTEGRATION TIME

Command line parameter: `startint`

The start integration time setting defines the starting integration time of the spectrometer.

If adaptive gain is turned off the integration time remains constant at the starting integration time. With adaptive gain 'on' the integration time of the spectrometer starts out at the start integration time but the HyperOCR is able to alter the integration time when needed. See the Adaptive Gain section for more information. The default setting for the start integration time is 128ms.

ADAPTIVE GAIN

Command line parameter: `adgain`

The adaptive gain feature of the HyperOCR enables the instrument to control the integration time used by the spectrometer during normal operation based on incoming light levels and a set of threshold values. See the sections on **Maximum** and **Minimum Integration Time** for more information.

The adaptive gain feature works on a simple principle. If the incoming light level of the previous spectrometer sample is outside a user defined threshold range, the integration time for the next sample will be adjusted accordingly. The HyperOCR does this by keeping track of the highest spectrometer value output in the telemetry for each sample taken. If the highest value is greater than the upper threshold, the integration time for the next sample is reduced by the decreasing integration time multiplier. If the highest value is less than the lower threshold, the integration time for the next sample is increased by the increasing integration time multiplier. However, integration times cannot be reduced below 5ms or increased above the maximum integration time. When normal operation first begins, the starting integration time is used for the first sample. See the *Upper Threshold* and *Lower Threshold* sections for more information.

Only *Light* frames are used with the adaptive gain feature. *Dark* frames will not be considered for the threshold check. See section for more information.

When modifying this parameter with the "`set`" command, you must enter either "`on`" or "`off`" as the parameter value to enable or disable the bias circuitry.

UPPER THRESHOLD

Command line parameter: `uthresh`

The upper threshold specifies the upper limit of the threshold range used with the adaptive gain feature. This value is defined in spectrometer A/D counts. When modifying this parameter with the "`set`" command, you must enter an integer greater than the lower threshold and less than or equal to 65535.

LOWER THRESHOLD

Command line parameter: `lthresh`

The lower threshold specifies the lower limit of the threshold range used with the adaptive gain feature. This value is defined in spectrometer A/D counts. When modifying this parameter with the "`set`" command, you must enter an integer greater than or equal to 0 and less than the upper threshold.

INCREASE INTEGRATION TIME MULTIPLIER

Command line parameter: `ifactor`

The increase integration time multiplier defines the factor by which the integration time will increase if the incoming light level of the previous spectrometer sample is above the user defined upper threshold range. This setting is only used if the

adaptive gain setting is 'on'. The default value for the increase integration time multiplier is 2.

DECREASE INTEGRATION TIME MULTIPLIER

Command line parameter: `dfactor`

The decrease integration time multiplier defines the factor by which the integration time will decrease if the incoming light level of the previous spectrometer sample is below the user defined lower threshold range. This setting is only used if the adaptive gain setting is 'on'. The default value for the decrease integration time multiplier is 0.5.

SHUTTER FRAME OUTPUT

Command line parameter: `dframes`

The shutter frame feature of the HyperOCR enables the instrument to periodically send out a frame of telemetry consisting of spectrometer data sampled with the on-board shutter closed. This gives a complete run-time measurement of all output spectrometer channels with no light exposure. This setting specifies how often a shutter frame, or *Dark* frame, is output during normal operation. If the setting is 0, only *Light* frames will be output, i.e. the shutter will never be closed. If the setting is 1, every other frame will be a Dark frame. If the setting is 2, 2 Light frames will output for every Dark one, and so on. When modifying this parameter with the "`set`" command, you must enter an integer greater than or equal to 0 and less than or equal to 255.

F - RECOVERY

To recover the HyperOCR when it is used in water, terminate data acquisition and pull the instrument back in using the cable. You may then power down the instrument and disconnect all the cables from their corresponding components. When disconnecting a cable from the instrument or any supporting apparatus, like the power supply, grasp firmly on the connector head and pull off the cable. DO NOT TWIST THE CABLE OR PULL ON THE CABLE DIRECTLY AS THIS MAY DAMAGE THE CONNECTORS OR THE CABLE ITSELF. ALWAYS DISCONNECT THE POWER SUPPLY FIRST. Replace the dummy plugs to the connectors and the vinyl end cap to the instrument for protection during storage.

Always be sure to rinse the instrument with fresh water prior to storage in order to prevent corrosion. If there is any seawater in contact with the instrument for a prolonged period of time, particularly around bolts and other contacts of dissimilar materials, corrosion may occur. Not properly rinsing the instrument before storage is considered misuse and warranty claims cannot be made under such circumstances.

G - MAINTENANCE

Preventative Maintenance

The HyperOCR requires virtually no maintenance. The life of the instrument will be prolonged by protecting it from impacts, rinsing it with fresh water after each use and properly storing the instrument with the dummy connector plug and vinyl end cap on when not in use.

Troubleshooting with a Terminal Emulator

If you are experiencing problems receiving data with your data acquisition software, there may be a problem with the instrument, its configuration, or its physical setup. You can check to see if your HyperOCR is transmitting telemetry with a terminal emulator.

To do this, first complete the **Assembly Procedure** described in section **C.** Connect the instrument using the RS-232 interface. You may also do this with the RS-422 interface, but if at a later point you want to gain access to the instrument's control menus, you will have to change over to RS-232. For communications software, use your favorite terminal emulator (Windows® comes with one called HyperTerminal[7]). Ensure that the serial connection to the instrument is at the telemetry baud rate. Use any ANSI or ANSI-compliant (i.e. VT-xxx) emulation.

Once the instrument is powered up and is in normal operation, you should see what looks like random characters being periodically output to the display. This is normal. The instrument telemetry contains a lot of binary data, which is not normally processed by a dumb terminal. However, you should be able to periodically pick out the instrument's frame header or synchronization string. This series of characters appears at the beginning of every frame of telemetry, as defined in your instruments calibration file. If you do not see the frame header, but you do see random characters, check that the baud rate of the terminal emulator is the same as for the instrument. If you so not see anything at all, make sure that no other application is using the serial port of the computer. If this checks out, there may be a hardware problem.

Troubleshooting for Hardware Problems

If a telemetry check using a terminal emulator failed to show any telemetry, you should check the physical connections of your instrument and supporting equipment.

> **WARNING! While checking voltages, extreme care should be used so as not to short the probe leads. A shorted power supply or battery can output many amperes of current, potentially harming the user, starting fires, or damaging equipment.**

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[7] See APPENDIX A for more information on using HyperTerminal.

CHECK CONNECTIONS

The cable connections of the system should be checked for continuity and correctness. Make sure that all Impulse® connectors are free of dirt and lightly lubricated before mating. Do not use petroleum-based lubricants. Satlantic recommends using DC-111 silicone grease (made by Dow Corning®) on the male pins prior to connection. Also, ensure that the connections are complete and, if applicable, the locking sleeves are secure.

- Check that the power cable is properly connected to the power supply and the instrument

- Check that the RS-232 or RS-422 cable is connected to the correct PC communications port.

CHECK THE SUPPLY VOLTAGE TO THE HYPEROCR

Voltages above the maximum input voltage may damage the instrument and voltages below the minimum operating voltage may cause the device to drop out of regulation. Thus, you must ensure the voltage input to the instrument is within the allowed range, specified in the *Assembly Procedure* of section **C - START UP**.

To check voltages, a multimeter with DC voltage measurement, resistance measurement, and continuity check capability is required.

Procedure:

1. Set the multimeter to measure a DC voltage.

2. If using a battery as the power source, measure the voltage directly at the battery terminals with the multimeter. If the voltage is low then recharge or replace the battery. If using a DC power supply, set the output voltage to within the proper range and check the voltage with the multimeter.

3. Connect the power supply cable to the power source.

4. Being extremely careful not to short the probe leads, measure the voltage between the pins on the supply cable. It should read approximately the same as the measurement taken in step 2. If the voltages are not the same, recheck the power supply cable connections. If the voltages are still not the same, the cable is likely broken and will need repair. A wire break can be confirmed with a *continuity check*, as outlined in the next section.

5. If the voltage is within tolerance, connect the power supply cable to the instrument.

6. Again, measure the voltage at the power supply terminals. The voltage should remain approximately the same as before, although there may be a small voltage drop when using a battery (battery voltage drops under load). If there is a significant voltage drop, disconnect the power immediately and check for shorts in the cable.

CHECK CABLE CONTINUITY

Often, system problems can be traced to cable breaks or shorts. Usually, these cable failures are a result of improper handling or storage. Cable continuity can be checked as outlined below. MAKE SURE ALL CABLES ARE COMPLETELY DISCONNECTED BEFORE PERFORMING THIS TEST.

Procedure:

1. Set the multimeter to measure continuity. The resistance measurement setting can also be used.

2. Check for continuity by measuring from pin 1 on one end of the cable to pin 1 on the other end. The meter should confirm that the connection is continuous by either giving an audible signal or measuring a low resistance. If there is not continuity, there is a break in the cable, which will require repair.

3. Repeat step 2 for all pins in the cable.

4. Check for shorts from pin 1 to all other pins by keeping one probe lead on pin 1 and touching the other probe lead to each of the other pins in the same connector in turn. Repeat this for all pins on the cable to make sure that all the pins are isolated from each other. The meter should read this as open or measure a very high resistance. If any of the pins are not isolated, there is a short in the cable, which will require repair.

H - WARRANTY

Warranty Period

All Satlantic equipment is covered under a one-year parts and labor warranty from date of purchase.

Restrictions

Warranty does not apply to products that are deemed by Satlantic to be damaged by misuse, abuse, accident, or modifications by the customer. The warranty is considered void if any optical or mechanical housing is opened. In addition, the warranty is void if the warranty seal is removed, broken or otherwise damaged.

Provisions

During the one year from date of purchase warranty period, Satlantic will replace or repair, as deemed necessary, components that are defective, except as noted above, without charge to the customer. This warranty does not include shipping charges to and from Satlantic.

Returns

To return products to Satlantic, whether under warranty or not, contact the Satlantic Customer Support Department and request a Returned Material Authorization (RMA) number and provide shipping details. All claims under warranty must be made promptly after occurrence of circumstances giving rise thereto and must be received by Satlantic within the applicable warranty period. Such claims should state clearly the product serial number, date of purchase (and proof thereof) and a full description of the circumstances giving rise to the claim. All replacement parts and/or products covered under the warranty period become the property of Satlantic LP.

Liability

IF SATLANTIC EQUIPMENT SHOULD BE DEFECTIVE OR FAIL TO BE IN GOOD WORKING ORDER THE CUSTOMER'S SOLE REMEDY SHALL BE REPAIR OR REPLACEMENT AS STATED ABOVE. IN NO EVENT WILL SATLANTIC LP. BE LIABLE FOR ANY DAMAGES, INCLUDING LOSS OF PROFITS, LOSS OF SAVINGS OR OTHER INCIDENTAL OR CONSEQUENTIAL DAMAGES ARISING FROM THE USE OR INABILITY TO USE THE EQUIPMENT OR COMPONENTS THEREOF.

I - CONTACT INFORMATION

If you have any problems, questions, suggestions or comments about the instrument or manual, please contact us.

Location

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Business Hours

Satlantic is normally open for business between the hours of 9 AM and 5 PM Atlantic Time. Atlantic Time is one hour ahead of Eastern Time. Daylight saving time is in effect from 2:00 a.m. on the second Sunday in March through 2:00 a.m. on the first Sunday in November. Atlantic Standard Time (AST) is UTC-4. Atlantic Daylight Saving Time (ADT) is UTC-3.

Satlantic is not open for business during Canada's statutory holidays, which are as follows:

New Year's Day	January 1st
Heritage Day	The third Monday in February
Good Friday	The Friday before Easter Sunday (Easter Sunday is the first Sunday after the full moon on or following March 21st, or one week later if the full moon falls on Sunday)
Victoria Day	The first Monday before May 25th
Canada Day	July 1st
Halifax Natal Day	The first Monday in August
Labor Day	The first Monday in September
Thanksgiving Day	The second Monday in October
Remembrance Day	November 11th
Christmas Day	December 25th

J - DECLARATION OF CONFORMITY

Barclay-Phelps

CE MARKING SPECIALISTS
Hoi Yuen Road, Kwun Tong, Kowloon, Hong Kong

DECLARATION OF CONFORMITY

Company contact details:
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Satlantic LP declares that their:
1) PAR Sensor - Photosynthetically Active Radiation Sensor
2) OCR-500 - Ocean Color Radiometer
3) HyperOCR - Hyperspectral Ocean Color Radiometer
4) SAT-THS - Tilt Heading Sensor.
5) Bioshutter
6) Profiler II
7) ISUS - In Situ Ultraviolet Spectrophotometer
8) STOR-X
9) Alkaline Battery Pack

are classified within the following EU Directive:
Electromagnetic Compatibility Directive 2004/108/EC

and further conform with the following EU Harmonized Standard:
EN 61326-1:2006

Dated: 12 October 2012
Position of signatory: President
Name of Signatory: Marlon Lewis
Signed below:
on behalf of Satlantic LP

K - MANUAL REVISIONS

Date	Author	Rev.	Comments
2004-07-31	SKF	A	Initial release.
2007-05-01	KMB	B	Warranty statement.
2008-09-30	SKF	C	Telemetry format update for v1.1.x firmware. Temperature corrections paragraph added. Description of `spectemp` command added.
2011-12-31	SKF	D	Changed company name to Satlantic LP.
2012-12-10	KMB	E	Declaration of Conformity.
2015-10-21	RVD	F	Clarified radiance field of view. Updated holiday list. Updated opening HOCR figure.

L - APPENDIX A

Using Windows® HyperTerminal

Most Satlantic instrumentation uses serial communications for interfacing with the outside world. This type of interface is simple to operate and convenient for applications such as these. Although the instrument's telemetry interface is used mainly for broadcasting telemetry, it can also be used to establish a human user interface so you may configure and test the instrument's systems. To use this interface, or to monitor instrument telemetry directly, you will need a terminal emulation program. These programs have many common uses such as communicating with bulletin board services, remotely logging on to other computers on a network, or communicating directly with your modem. You can also use it for direct communications with a serial port, which is ideal for communicating with Satlantic instruments.

There are many types of terminal emulation programs. Most of these are suitable for this application, so you are free to use whatever terminal emulator you are comfortable with. If you are unfamiliar with terminal emulators, this tutorial will help you get started with the emulator program that is distributed with Windows® called *HyperTerminal*.

The first step in using HyperTerminal is to make sure you have it installed. One way of starting the application is to use the **Start** button on your desktop. Select "**Run…**" and type "hypertrm" in the space provided. If the program cannot be found, it has probably not been installed. You can also check for a HyperTerminal installation by selecting **Start -> Programs -> Accessories**. If a **HyperTerminal** folder is visible in the **Accessories** folder, HyperTerminal is already installed.

If HyperTerminal is not installed, it is an easy matter to install it now. In Windows 95/98, open the Control Panel by selecting **Start -> Control Panel**. Open the **Add/Remove Programs** control. When you have setup these dialog boxes as shown below, press the OK button in each one. Windows will now install HyperTerminal on your computer. You may need your Windows Setup Disks/CD for this to complete. Just follow the on-screen instructions.
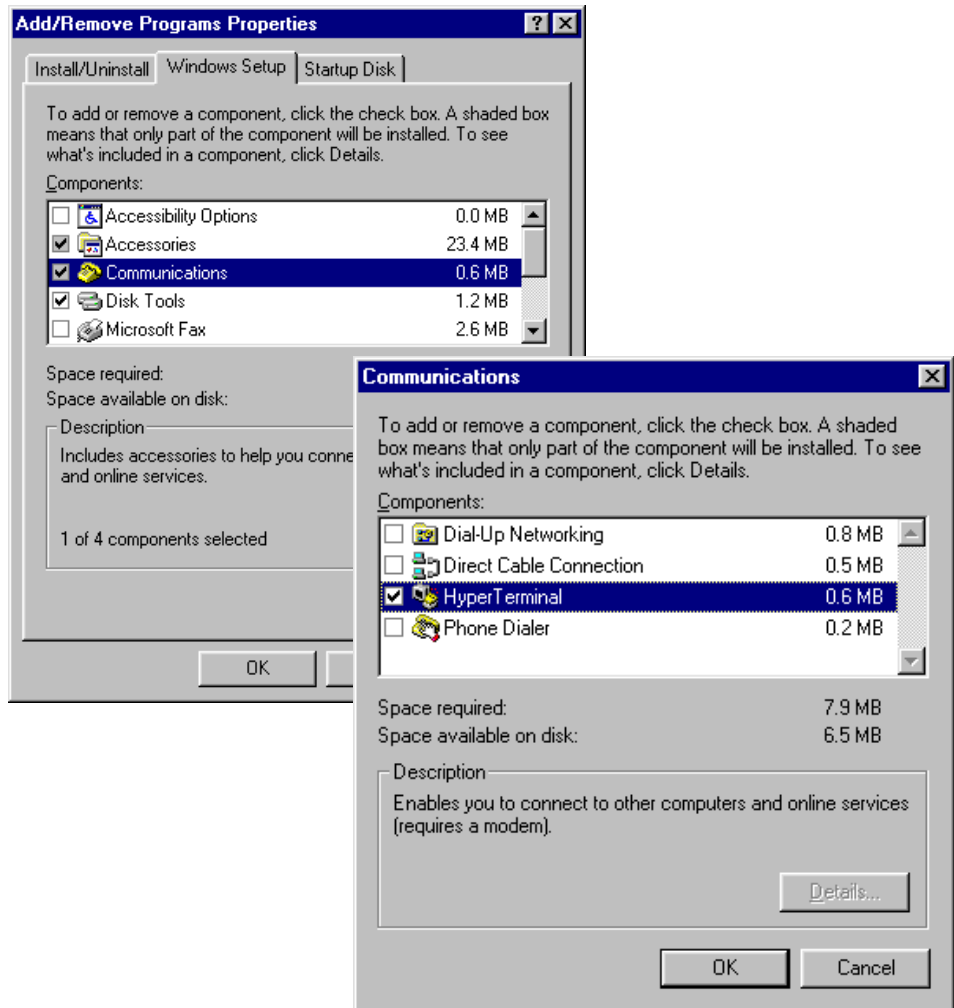
Figure L-1 - Add/Remove Programs

When you run HyperTerminal with a new connection, the program will ask you for connection information so it can be saved for your next session. You should see the following dialog box.
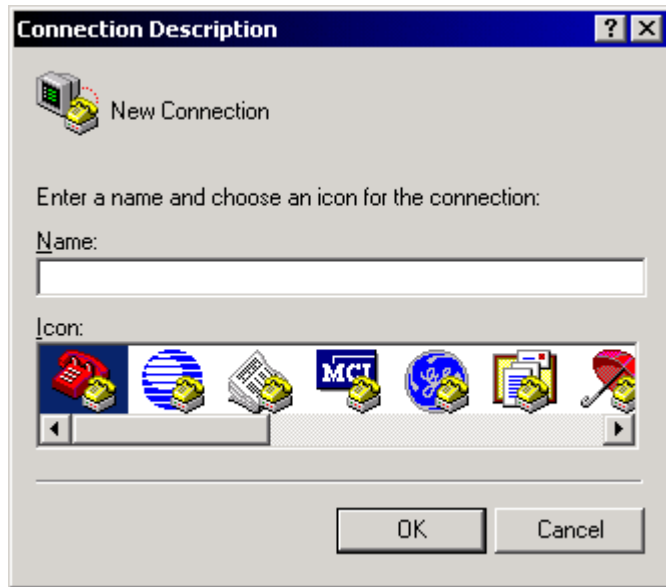
Figure L-2 - HyperTerminal Connection Description

Enter a name for your new connection in the space provided. The name should reflect the nature of the connections use. In this case, a good name would be "COM1 Direct" or "COM2 Direct", depending on which serial port you are using on your computer. The word "Direct" indicates that you are making a direct connection to the port. You do not need a modem for a direct connection. When you have selected your connection name, press the OK button. This should invoke the "Connect To" dialog box, as shown below.

Figure L-3 - HyperTerminal Connect To dialog box

As your connection does not involve a modem, only the "Connect using:" dropdown box is needed. Select a direct connection to your desired serial port as shown. After you make your selection, press the OK button. Finally, HyperTerminal will open a communications properties dialog box for the serial port you selected. An example dialog box, for COM1, is shown below.
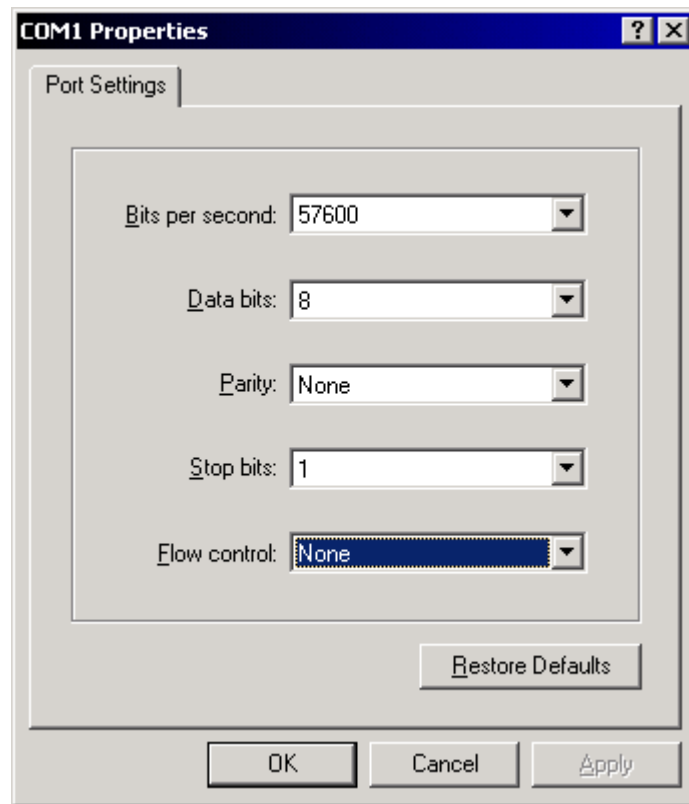

Figure L-4 – Serial Port Properties dialog box

The parameters of this dialog box should be set the specifications of your instrument's telemetry interface. In most cases, this is 8 data bits, no parity, one stop bit, and no flow control. The "Bits per second:" dropdown box should be set to the baud rate of the telemetry interface. Keep in mind that you may change the properties of your connection at any time after your initial setup. Once you have chosen your settings, press the OK button. HyperTerminal will then connect to the serial port, which should be connected to your instrument, and display the main window.

You must now configure HyperTerminal's emulation options for use with your instrument. Before you do so, you will have to disconnect HyperTerminal from the serial port. You can reconnect later when you are finished. Under the **Call** menu, select **Disconnect**. You can reconnect later with the **Call** menu item. To complete HyperTerminal's configuration, under the **File** menu, select **Properties** to open the connection's Properties dialog box. Select the "Settings" tab as shown below.
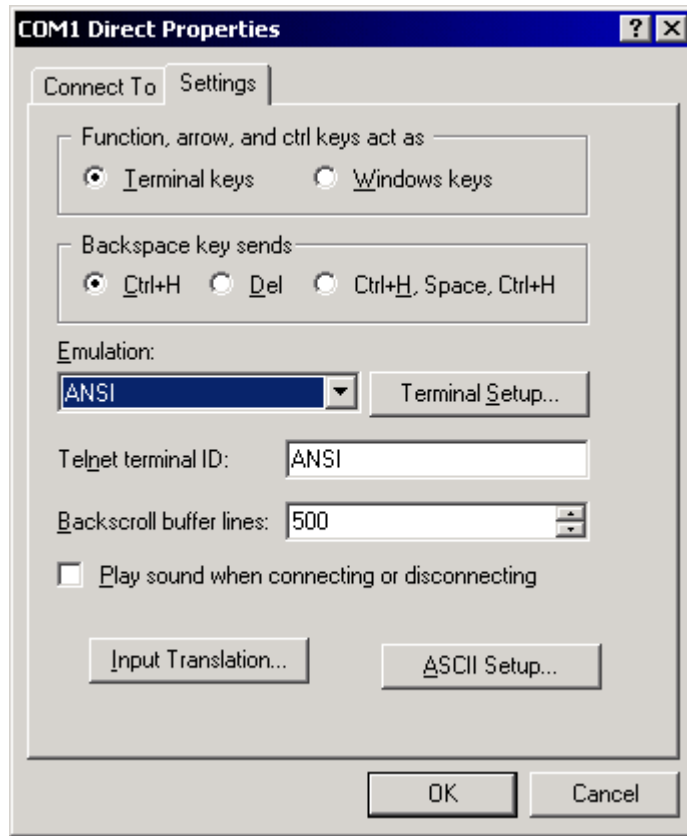
Figure L-5 – Connection Properties dialog box

In the "Emulation:" dropdown box, select ANSI as the connection's terminal emulation mode. The other settings of the dialog box should be set as shown. When you have completed setting these parameters, press the "ASCII Setup" button to open the ASCII Setup dialog box, as shown below.
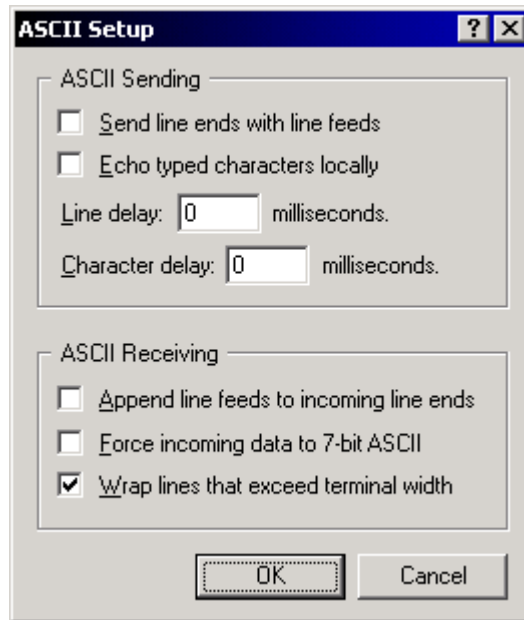
Figure L-6 – ASCII Setup dialog box

Make sure this dialog box is setup as shown. These settings are important in maintaining proper character I/O with your instrument. You are now ready to use HyperTerminal to establish instrument communications.

You should only have to go through this setup process once. HyperTerminal will save all your connection information in a HyperTerminal file (*.ht) in the application's directory. To reestablish your connection, simply open this file. HyperTerminal will open and automatically connect to the serial port with the saved settings.